ENVIRONMENTAL IMPACT ASSESSMENT FOR THE CONSTRUCTION AND UPGRADING OF THE PROPOSED BRAAMHOEK ACCESS ROADS

FINAL EXTENDED SCOPING REPORT

February 2006

PREPARED FOR
ESKOM Holdings Limited
Generation

PREPARED BY
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FINAL EXTENDED SCOPING REPORT FOR THE PROPOSED CONSTRUCTION AND UPGRADING OF INTERNAL AND EXTERNAL ACCESS ROADS FOR THE BRAAMHOEK PUMPED STORAGE SCHEME

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I ABBREVIATIONS

BCJV	Braamhoek Consultants Joint Venture
BH1 – BH14	Braamhoek Heritage Assessment site designations
BPEO	Best Practicable Environmental Option
DEAT	Department of Environmental Affairs and Forestry
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FS DTEEA	Free State Department of Tourism, Environment and Economic Affairs
I&AP's	Interested and Affected Parties
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
KZN DAEA	KwaZulu Natal Department of Agriculture and Environmental Affairs
PPP	Public Participation Process
SAHRA	South African Heritage Resources Agency
PSS	Pumped Storage Scheme
RoD	Record of Decision
WESSA	Wildlife and Environment Society of South Africa

II TERMS AND DEFINITIONS

Best Practicable Environmental Option: BPEO is the outcome of a systematic consultative and decision-making procedure that emphasizes the protection of the environment across land, air and water. It establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole at an acceptable cost in the long term and as well as the short term.

Environment: Associated cultural, social, soil, biotic, atmospheric, surface and groundwater aspects impacted on (or which could potentially be impacted on) by the proposed road projects.

Environmental Impact Assessment: A process of assessing the potential impact of a proposed activity on the environment and the surrounding community. The process involves the assessment of both biophysical and social impacts to propose mitigation and make final recommendations.

Environmental Management Plan: A document that contains recommendations for the control or management of the potential significant impacts of operations on the environment and recommendations to contain or mitigate actual impacts.

Feasible: Acceptable, capable of being used or implemented successfully, without unacceptably damaging the environment.

Interested and/or Affected Parties: Any member of the public, non-government organisation or local community with an interest in the project, or which may be impacted on by the proposed project.

Public Participation Process: A process of facilitating the participation of the general public in the EIA process. The process includes publishing of notices, public meetings and local community involvement in order to inform the public regarding projects which may impact on them or their environment, to identify problems and to receive input from interested and affected parties regarding projects and activities.

Risk: The scientific judgement of probability of harm.

Significant: Factors or considerations are termed significant when they are important, because they are of consequence. For example, they will have a detectable influence on a process, the environment, or the end result.

1 INTRODUCTION

1.1 Project Background

Eskom Holdings Limited (Eskom) is undertaking the construction of the Braamhoek Pumped Storage Scheme (PSS) in order to meet expected future electricity demand. The scheme comprises upper and lower storage reservoirs, connected by enclosed tunnel systems in which pump-turbine units will be located.

The environmental impact assessment (EIA) for the PSS was compiled and submitted by Poltech in 1999, and subsequently approved by the Department of Environmental Affairs and Tourism (DEAT) on 13 December 2002. A condition of the Record of Decision (RoD) issued by the Minister of Environmental Affairs and Tourism indicated that:-

> "*The construction of ancillary instruction such as roads and power lines are not included in (this) authorisation and a formal application must be lodged for such activities.*"

This EIA therefore only covers the proposed upgrading of existing provincial roads and construction of new roads required to access the upper and lower reservoir sites during the construction and operational phases of the PSS project.

1.2 Site Location

1.2.1 Regional Setting

The study area is located within the Drakensberg escarpment, approximately 23 km north east of Van Reenen. The study area straddles the Free State and KwaZulu-Natal provinces (**Figure 1-1)**, falling within the Maluti a Phufong and Phumelela Local Municipalities to the north west and the Emnambithi/Ladysmith Local Municipality to the south east.

1.2.2 Detailed Site Layout

The external access roads requiring upgrading will connect to major transport routes via the N3 at Swinburne and the R103 between Ladysmith and Van Reenen. Although three alternatives were carried forward for detailed alternatives assessment, alternative 2 – De Beers pass – was selected as the preferred option following a detailed alternatives assessment based on several criteria including environmental sensitivity, heritage resources, land use and tourism potential. A detailed description of the proposed alignment is presented in Section 4 below.

Figure 1-1: Locality Plan

1.2.3 Pavement Design

New paved roads

Materials for paved roads will be obtained from cut, borrow and fill operations. Preparation will be required for in-situ materials and allowance made for construction hard material. The proposed pavement layers will be constructed as follows (from top to bottom):-

• Asphalt wearing course	30 mm	AC
• Crushed stone base	150 mm	G2
• Stabilised sub base	150 mm	C3
• Upper selected sub grades (USSG)	150 mm	G7
• Lower selected sub grades (LSSG)	150 mm	G9

Upgrade Paved Road

Some of the existing provincial gravel access roads will be upgraded to a paved road standard. Mass earthworks are limited, although some alignment modifications may be required to improve the geometric design standards.

Preparation will be required on in-situ materials. Upgraded paved roads will not, however, require the LSSG as the existing wearing courses are of adequate quality. The pavement layers will be constructed (from top to bottom) as follows:-

• Asphalt wearing course	30 mm	AC
• Crushed stone base	150 mm	G2
• Stabilised sub base	150 mm	C3
• Upper selected sub grades (USSG)	150 mm	G7

Maintenance of Existing Gravel Roads

Eskom will be required to maintain existing provincial gravel roads during the construction phase. Maintenance will typically require blading, shaping and re-gravelling of wearing course. Allowance has been made for the partial upgrade of sections of gravel road for which routine maintenance will not be sufficient.

Design Pavement Loading

All pavement layer works have been designed for Category B (90% design reliability) designation, experiencing traffic volumes of between 600 and 2 000 vehicles per day. The proposed base pavement layer will be sufficient to carry one to three million E80's (equivalent 80 kN single axis loads). The design lifespan incorporates a five year construction lifespan and fifteen year operational lifespan.

1.3 Project Brief

Africon has been retained by Eskom to conduct an EIA for the proposed construction and upgrading of roads which will be utilised to access the Braamhoek PSS. The EIA focuses on issues identified by various specialists as well as comments, issues and concerns raised by various stakeholders during a comprehensive Public Participation process conducted by Acer Africa, and continued by Afrosearch.

In addition to this, a detailed assessment of three alternatives identified during the Public Participation and Scoping process has been conducted based on the potential environmental and social impacts of existing and proposed roads.

1.4 Statutory and Institutional Procedure Requirements

1.4.1 National Environmental Management Act, Act 107 of 1998

Section 2(3) of NEMA requires that the proposed development must be socially, environmentally and economically sustainable, and that the following must be considered:-

"4(a) (i) ….disturbance of ecosystems and loss of biological diversity be avoided, or …. are minimised or remedied;
4(a) (ii) that pollution and degradation of the environment be avoided;
4(a) (vii) that a risk averse and cautious approach is applied.…; and
4(a) (viii) that negative impacts on the environment.…be anticipated and prevented, or.…minimised and remedied."

In addition to this, Section 2(4) (b) requires that the environmental management approach be integrated, such that all interrelated elements of the environment are considered, evaluated and incorporated through use of the Best Practicable Environmental Option (BPEO). The principles of Integrated Environmental Management (IEM - Section 23), require amongst others, the investigation of project design and technological alternatives; identification, prediction and evaluation of real or potential environmental impacts; and the implementation of mitigation measures to reduce these impacts to within acceptable environmental levels.

1.4.2 Environment Conservation Act (Act 73 of 1989)

The following activity is identified in Government Notice R1182 (promulgated in terms of Sections 21 and 22 of the Act) as an activity which may have a substantial detrimental impact on the environment and therefore requires an impact assessment:-

"1(d) the construction or upgrading of roads, railways, airfields and associated structures."

The process and format to be followed for the assessment of the impacts of such projects are defined in terms of Government Notice R1183, promulgated in terms of Section 26 of the Act.

1.4.3 National Heritage Resources Act (Act 25 of 2002)

Application and enforcement of the Act is overseen by the South African Heritage Resources Agency (SAHRA). Management of heritage resources is considered in Section 38 of the act, and requires that SAHRA be consulted where the following activities will be conducted:-

"*38(1) (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.*"

Typically, SAHRA requires, as a minimum, that a phase 1 Heritage Impact Assessment (HIA) be conducted to identify and describe heritage resources within a development area, and that the HIA provide mitigation to prevent potential impacts on heritage resources. In addition to this, the provincial authority of SAHRA, Amafa aKwaZulu-Natali requires that the suitably qualified person undertaking the HIA be registered with the authority.

1.4.4 Mineral and Petroleum Resources Development Act (Act 28 of 2002)

The quarrying of material for road construction layers requires the submission of Mining Right application in terms of Section 22 (for borrow pits larger than 1.5 ha) or Mining Permit application in terms of Section 27 (for borrow smaller than 1.5 ha). Since mining activities are specifically excluded from the provisions of Section 21 of ECA, the borrow pits are not addressed within this EIA or EMP.

Once suitable material was identified for road construction, the necessary applications were lodged with the Department of Minerals and Energy (DME). Applications lodged with the DME require the submission of a detailed EMP and Rehabilitation programme for approval, thus mitigation of environmental impacts associated with Borrow Pit activities have been.

1.5 Project Process

The process to date is summarised below:-

September 2004	○ The project is registered with the DEAT. The Plan of Study for Scoping (PoSfS) is submitted by the BCJV.
November 2004	○ The Public Participation process, undertaken by Acer Africa on behalf of BCJV, commences:- • BID, flyers and comment sheets distributed 25 November • EIA process advertised 26 November in six local/regional and two national newspapers • Public open days are held in the region from 29 November to 01 December 2004 • Key stakeholder workshop held 30 Nov in Ladysmith
December 2004	○ The PoSfS is approved by DEAT
February 2005	○ Focus group meetings held 18 February at Ladysmith / Harrismith
April / May 2005	○ Draft scoping report made available for public comment
May 2005	○ Public meetings and workshops are held to obtain comment on draft Scoping report:- • Public open day held 6 May, Ladysmith • Focus group meetings held 5 May and 6 May in Ladysmith
August 2005	○ After consultation with DEAT, Eskom identifies possible independence risk of the EIA consultant. Africon environment and sustainability is appointed to complete the EIA process
September 2005	○ Specialist assessments, undertaken by Africon, commence
October 2005	○ Consultation meeting held 14 October with DEAT and telephonic consultation held 21 October with FS DTEEA/KZN DAEA regarding the change of EIA consultants and submission of the scoping report. National and provincial departments support the submission of an Extended Scoping Report (ESR).
November 2005	○ Focus group meetings held 7 November by Afrosearch, on behalf of Africon, in Ladysmith/Swinburne to notify stakeholders of change in consultant and process
December 2005	○ EIA process Status quo document distributed to stakeholders 5 December. Minutes from draft Scoping Report (DSR) open days and focus group meetings held May 2005 distributed with status quo document ○ Draft Extended Scoping Report submitted for stakeholder comment

	12 December 2005 to 23 January 2006
January 2006	○ EIA feedback open day and public meeting held 17 January 2006 at the Harrismith Public Library. Focus group meetings held with Swinburne Farmers Association and Maluti a Phufong Municipality at same venue. ○ EIA feedback open day and public meeting held 18 January 2006 at the Emnambithi / Ladysmith Municipality Town Hall. ○ Period for comment on the Draft Extended Scoping report closes 23 January 2006 ○ Final community meetings held at the Hammilberg School and Hlomisa Schools on 26 January 2006. ○ The Final Extended Scoping Report (this document) is submitted to the DEAT, FS DTEEA and KZN DAEA on 13 February 2006 for approval. Copies of the Final Extended Scoping Report also made available at the Harrismith Municipality offices and Public Library, as well as the Emnambithi / Ladysmith Municipality offices and Public Library.

1.6 Project Objectives

The scoping process is considered to be the environmental base upon which the development layout is finalised. The extended scoping assessment should thus inform planning, rather than justify it. The objectives of this Scoping process include:-

- Identification and sourcing of status quo environmental information which will provide a solid base for an informed decision by the relevant national and provincial departments;
- Identification of environmental parameters which will be impacted upon by the development activity;
- Determination of the significance of the impacts; and
- Mitigation of the identified issues through management actions to prevent any long-term adverse impacts.

2 BASELINE ENVIRONMENTAL DESCRIPTION

The following section provides a description of the baseline or status quo environment as well as the social-economic parameters which characterise the study area.

2.1 Physical Environment

2.1.1 Climate

Mean monthly temperatures (**Figure 2-1**) and A-Pan evaporation (**Figure 2-2**) have been extrapolated from the Poltech survey (1999) for the Braamhoek PSS. Data was recorded on the farm Bedford (upper reservoir, Free State Province) and the farm Bramhoek (lower reservoir, KwaZulu Natal Province). Mean Annual Precipitation data has been obtained from the South African Weather Services for the Van Reenen (upper) and Moorside (Lower) weather station.

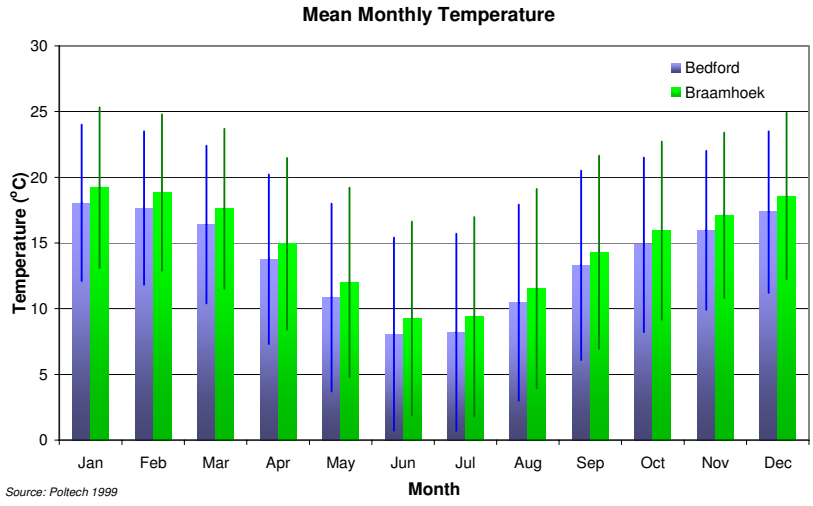


Figure 2-1: Mean Monthly recorded during the Poltech survey. Error bars indicate mean maxima and minima are indicated

Mean monthly temperatures are on average 1.2°C warmer than those recorded on the KwaZulu Natal side of the study area. Mean monthly temperatures peak during summer (December and January) at 18.1°C and 19.2°C (Bedford and Bramhoek respectively) and dip during winter (June and July) to 8.1°C and 9.3°C respectively.

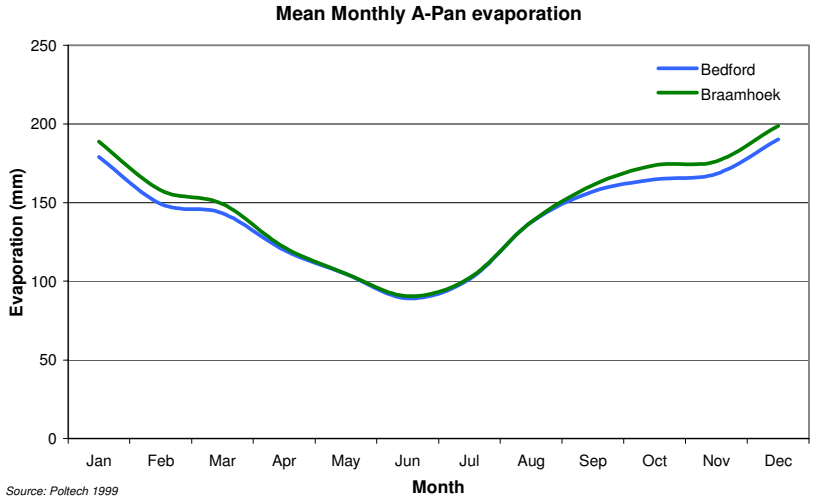


Figure 2-2: Mean monthly A-pan evaporation recorded during the Poltech Survey

Mean monthly A-pan evaporation recorded at the Bramhoek (KwaZulu Natal) site is marginally higher, particularly during the summer period from October to March. Mean annual evaporation is 1705 mm and 1763 mm for the Bedford and Bramhoek sites respectively. Mean annual precipitation for the area is significantly lower, with rainfall above the scarp of 1 004 mm per annum and 847 mm per annum below the scarp, resulting in a net negative water balance for the study area.

2.1.2 Geomorphology and soil

The study area is split by the Great Escarpment, separating the elevated interior plateau from a coastal hinterland at lower altitude (Poltech, 1999). The Great Escarpment was initially located along the coastline at the time of the break-up of the Gondwanaland super-continent between 160 and 120 million years ago. Erosion has driven it inland to its present position since that time. As it receded, vast erosion surfaces were formed simultaneously above and below the escarpment. Remnants of the oldest of these, the African surface, form the lower interfluves at elevations of around 1750 - 1800 m above mean sea level (mamsl) in the vicinity of the Upper Reservoir site. In this watershed area, African plantation has been relatively recent. Despite this, substantial thick weathered and residual material has developed on dolerites and sandstones close to the edge of the escarpment.

The access roads to the Lower Reservoir site lie within the upper part of the Ladysmith Basin, formed by ongoing erosion along headwater tributaries of the Tugela River. In this area all vestiges of the African surface have been removed by erosion, and the landscape is dissected and characterised by frequent dolerite koppies and relatively thin soil mantles, except in the high rainfall zone in proximity to the escarpment. The

influence of active down-cutting within streams emerging from the base of the escarpment, such as the Braamhoekspruit, can be seen in over-steepening of parts of the scarp front, which has led to large slope failures in some areas, for example, to the east of the PSS site (Poltech, 1999).

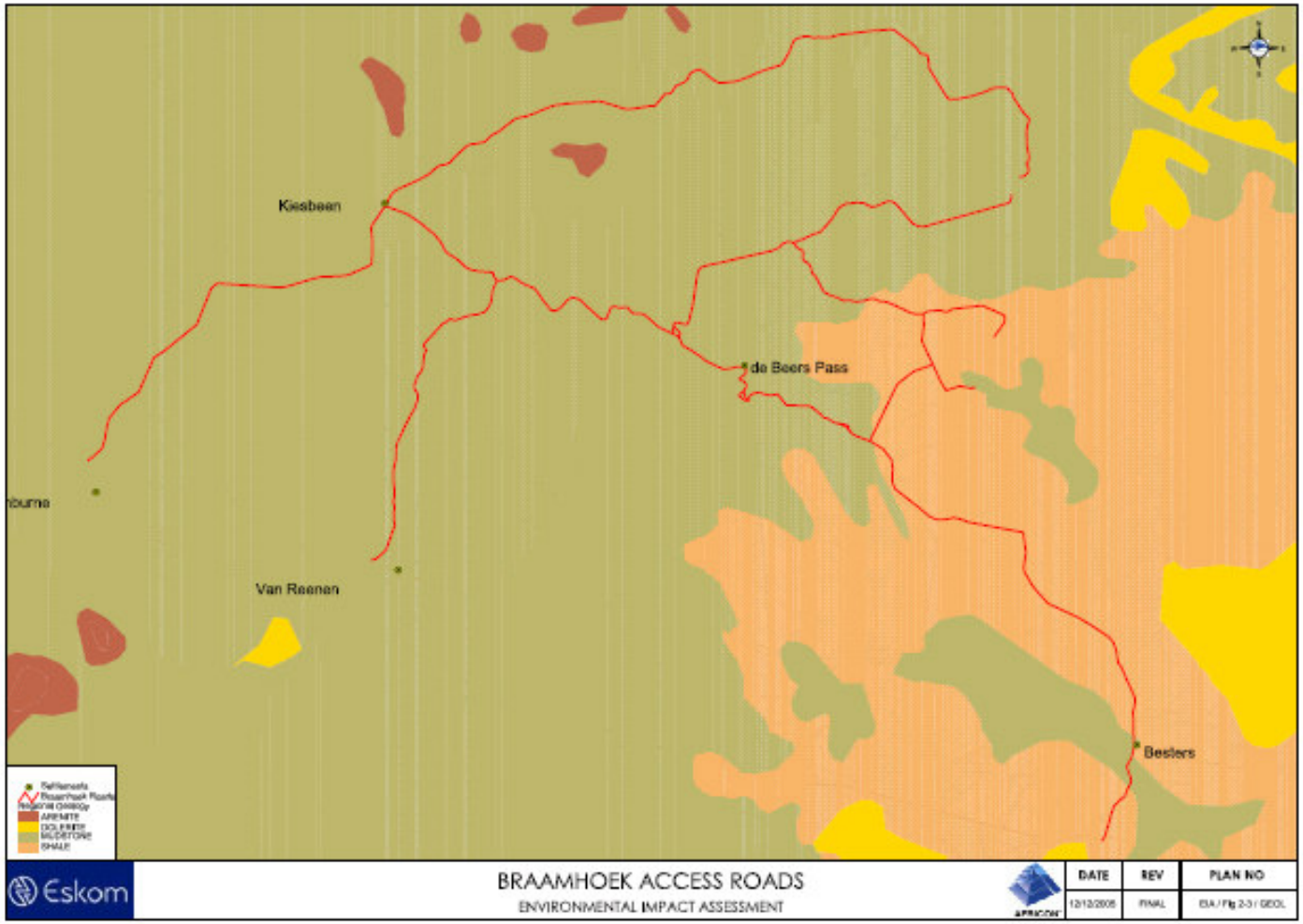
In the area of the access roads to the Upper Reservoir site, local relief is of the order of 100 m. Low, flat topped koppies and spurs characterise the landscape and have resulted from the strong structural influence of flat-lying strata of the Karoo Supergroup, particularly the Rooinek Sandstone, which outcrops extensively in the area. Locally, streams have incised through the sandstone to depths of up to 50 m, forming small waterfalls and narrow valleys, one of which is a headwater of the Wilge River and contains the Upper Reservoir site.

The study area is underlain by sedimentary rocks of the Karoo Supergroup (**Figure 2-3**), more specifically of the Ecca and Beaufort Groups, which have been intruded by dolerites of the Karoo Dolerite Suite. The sedimentary units are of Middle to Upper Permian age (260 - 250 million years), while the dolerites belong to the Lower Jurassic age (183 million years). The Ecca Group is represented at the base of the succession by the Volksrust Formation, which comprises a monotonous series of dark greyish-blue silty mudstones and claystones, which were deposited in a sheltered, near shore, marine environment (Poltech, 1999). Although these rocks do not appear to have undergone deep weathering (3 – 5 m of pale yellowish or greyish clayey, residual soil was observed in a deep erosion donga in the foothill zone), they are typical of many Karoo mudrocks in experiencing rapid disintegration on the exposure of fresh surfaces to the air.

The Beaufort Group comprises the bulk of the geological column, with almost the entire face of the escarpment being cut in these rocks. The basal unit of the succession is the Frankfort Member, which is some 130 m thick, including some thin dolerite sills. Previously known as the Estcourt Formation, this unit consists of a succession of inter-bedded greyish white to greyish blue siltstone and sandstone layers, which often contain abundant mica along bedding planes. The sandstones are usually dirty when fine textured, classifying as greywackes, becoming cleaner as they coarsen upwards to become sublitharenites.

Above the Frankfort Member is a series of strata dominated by dark greyish mudrocks. Some 280 m in thickness, this unit contains numerous two to five metre thick horizons of greyish white sandstone. In the upper part of the succession two thicker sandstone bands outcrop conspicuously in the escarpment face. The mudrocks of this unit are fairly typical of other Karoo mudrocks in their propensity to disintegrate in exposure to the air.

Figure 2-3: Regional geology of the study area



The upper edge of the escarpment is formed by a prominent sandstone known as the Rooinek Member. In reality, this unit consists of a series of sandstone bands, separated by thin mudstone horizons, but, as a whole, it forms a resistant stratum about 50 m in thickness, which also outcrops very widely in the plateau area behind the escarpment (**Plate 1** and **2**).

Plate 1: Sandstone outcrops behind escarpment

Plate 2: Sandstone outcrops behind escarpment

With regards to soil, distributions are complex, and, in order to define units suitable for environmental management purposes, individual soil profile types have been grouped into associations (**Figure 2-4**). Comprehensive laboratory testing was carried out on a representative suite of soil samples to confirm the soil classifications and to define the range of physical and chemical soil properties typical of the area.

Many of the soils, especially in the high rainfall area close to the escarpment, are highly leached and strongly acidic (Partridge, 2005). The presence of light textured, silty subsoils underlain by slaking mudrock renders many of these soils very susceptible to erosion. This characteristic is confirmed by the presence of numerous dongas.

Soils of the gully and wetland areas are also highly susceptible to disturbance, especially by developments that would impact upon their hydrology and the accelerated ingress of sediments from their catchments (Poltech, 1999).

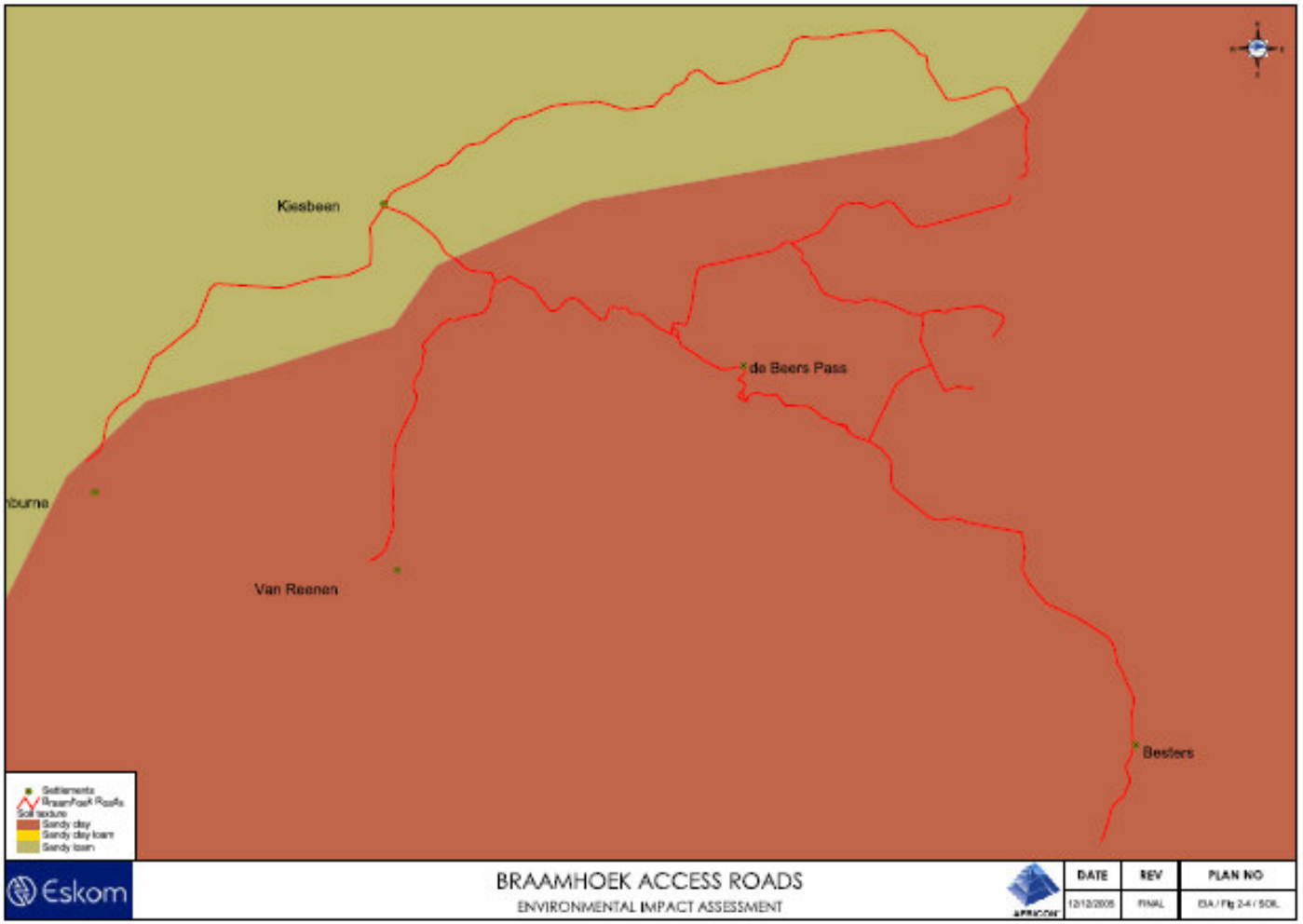
2.1.2.1 Soil Erosion Potential

Susceptibility to erosion is determined as a function of topography, vegetation cover, soil chemical and physical characteristic and climate.

Soil Physics: Sandier soils, such as those which cover the study area, are typically more prone to erosion

Topography: Soils overlying steep slopes tend to erode easily, particularly during high rainfall periods. The topography associated with the study area is particularly conducive to erosion.

Figure 2-4: Regional soil types study area



Vegetation cover: Soils underlying well established vegetation are generally protected from erosion, reducing run-off velocities during high rainfall periods. Removal of vegetation will, therefore, increase susceptibility to erosion.

Climate: Increase surface water runoff and high wind speeds will tend to increase erosion.

Based on these criteria, susceptibility to erosion over the study area will be **Moderate** to **High**, with susceptibility increasing as vegetation cover is compromised. Erosion is particularly problematic above the escarpment, as evidenced during the various field surveys (**Plates 3** and **4**), and particularly within and along drainage channels and features (**Plates 5** and **6**).

Plate 3: Erosion rills formed by loss of vegetation cover

Plate 4: Erosion rills formed by loss of vegetation cover

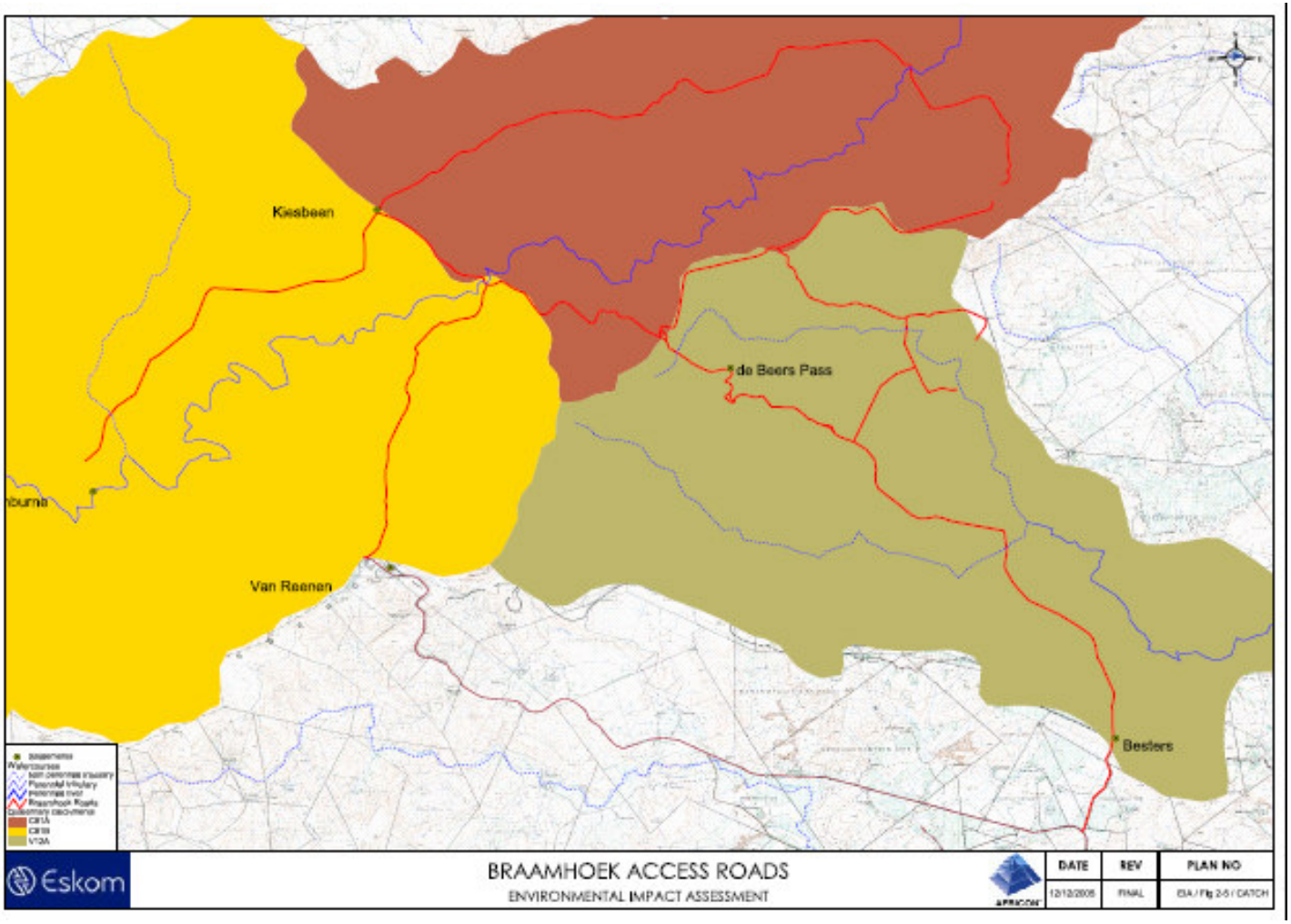
Plate 5: Erosion gullies associated with poor stormwater management

Plate 6: Erosion gullies associated with poor stormwater management

2.1.3 Hydrology

The study area straddles several catchments (**Figure 2-5**), due to the position within the landscape on the Drakensberg escarpment. The north eastern section subtends the C81B and C81A quaternary catchments (Vaal River primary catchment) within the Free State province. The south eastern sections subtend the V12A quaternary catchment (Tugela primary catchment).

Figure 2-5: Quaternary catchments subtended by the various road alternatives



Due to the undulating, folded topography, numerous perennial and non-perennial tributaries flow through the study area. Watercourses within the study area comprise shallow to deeply incised channels with associated flood plains. This is particular evident with drainage features located above the scarp, where wide flood plains ranging from 50 m to 500 m wide were noted. In some cases, the geological and pedological patterns have result in the formation of ox-bow lakes, such as those associated with the lower reaches of the Wilge River.

Various impoundments have been constructed along most of the smaller tributaries, which are utilised for livestock watering. In general, hydrological functioning in many of the watercourses is significantly reduced due to poor stormwater management associated with road crossings (**Plates 7** and **8**), movement and grazing of livestock, siltation caused by erosion within the catchments and poor veld management techniques such burning and aforrestation.

Plate 7: Inadequate storm water management structures

Plate 8: Inadequate storm water management structures

2.1.4 Topography

The topography of the proposed site is typical of the Drakensberg escarpment (**Figure 2-6**). The Upper Reservoir site (Bedford farm) is situated at an altitude of 1700 mamsl and consists of rolling grassland, with incised drainage lines (**Plate 9**).

Figure 2-6: Study Area Elevation

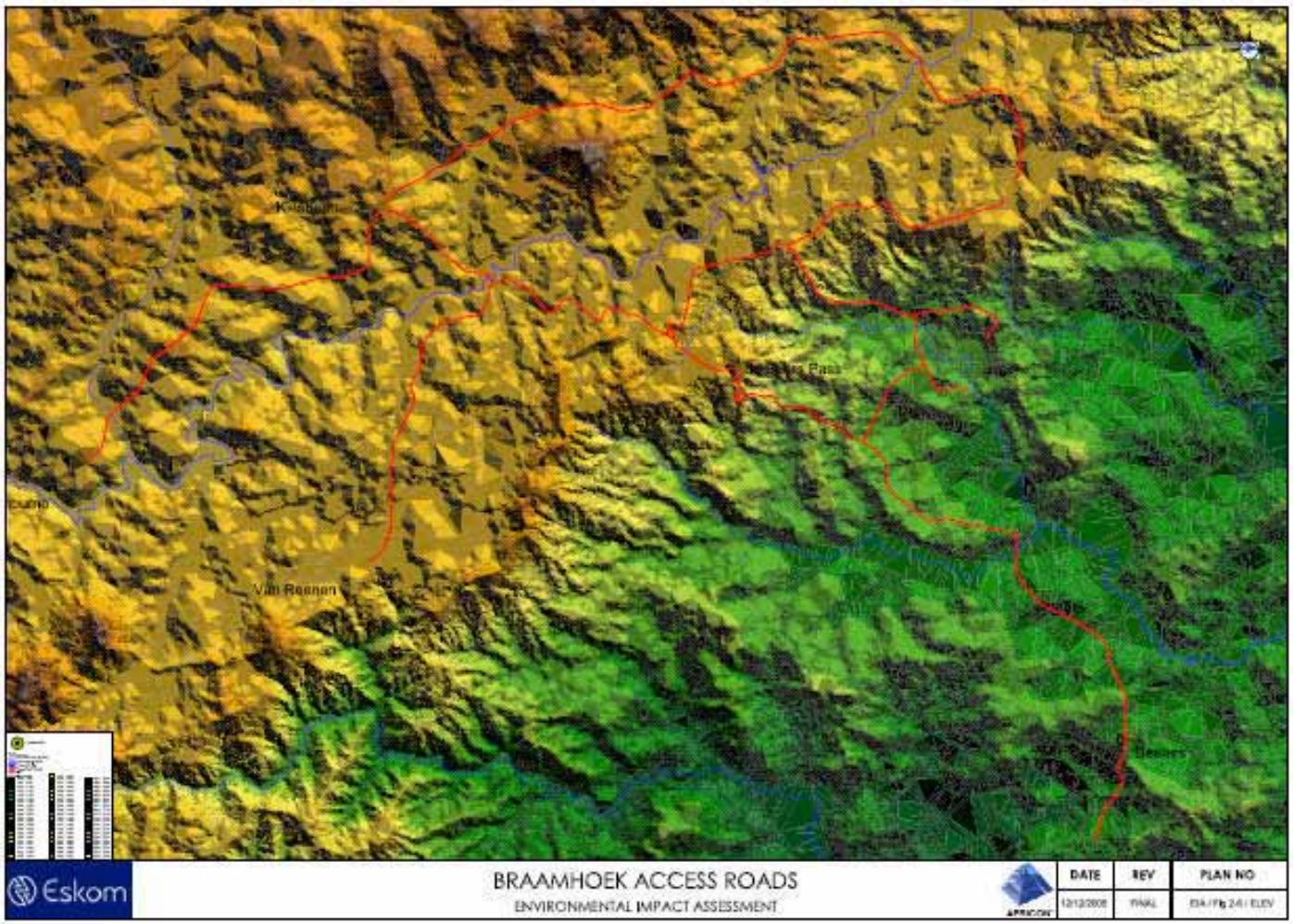


Plate 9: General topography associated with upper reservoir area

Plate 10: General topography associated with lower reservoir area

The Lower Reservoir (Bramhoek farm) is situated in the foothills of the Drakensberg escarpment at an altitude of 1220 mamsl, in typical grassland with rolling hills, small streams, erosion gullies and a few farm dams (**Plate 10**).

The Upper and Lower Reservoir sites are separated by the Great Escarpment, which is a giant horseshoe-shaped feature peculiar to southern Africa, where it separates an elevated interior plateau from a coastal hinterland at lower altitude (Poltech, 1999). The Great Escarpment was initially located along the coastline at the time of the break-up of the Gondwanaland super-continent between 160 and 120 million years ago. Erosion has driven it inland to its present position since that time. As it receded, vast erosion surfaces were formed simultaneously above and below the escarpment. Remnants of the oldest of these, the African surface, form the lower interfluves at elevations of around 1 750 – 1 800 mamsl in the vicinity of the Upper Reservoir site (**Plate 11**). In this watershed area, African planation has been relatively recent. Despite this, substantial thick weathered and residual material has developed on dolerites and sandstones close to the edge of the escarpment.

The access roads to the Lower Reservoir site lie within the upper part of the Ladysmith Basin, formed by ongoing erosion along headwater tributaries of the Tugela River. In this area all vestiges of the African surface have been removed by erosion, and the landscape is dissected and characterised by frequent dolerite koppies and relatively thin soil mantles, except in the high rainfall zone in proximity to the escarpment. The influence of active down-cutting within streams emerging from the base of the escarpment, such as the Braamhoekspruit, can be seen in over-steepening of parts of the scarp front, which has led to large slope failures in some areas, for example, to the east of the pumped storage scheme site (Poltech, 1999).

In the area of the access roads to the Upper Reservoir site, local relief is of the order of 100 m. Low, flat topped koppies and spurs characterise the landscape and have resulted from the strong structural influence of flat-lying strata of the Karoo Supergroup, particularly the Rooinek Sandstone, which outcrops extensively in the area. Locally, streams have incised through the sandstone to depths of up to 50 m, forming small

waterfalls and narrow valleys, one of which is a headwater of the Wilge River and contains the Upper Reservoir site (**Plate 12**).

Plate 11: Lower fluves around the upper reservoir area

Plate 12: Head waters to the Wilge River

2.2 Biophysical Environment

2.2.1 Flora

The area lies above and below the Drakensberg Escarpment with dams to be constructed on the farms Bramhoek in KwaZulu-Natal and Bedford in the north eastern Free State. The area falls within Veld Type 57 North-eastern Sandy Highveld on top of the Drakensberg to a transition with 65, Southern Tall Grassland (Acocks 1975) on the farm Bramhoek 1220, or according to Bredenkamp *et al* 1996 Veld Types 41, Wet Cold Highveld Grassland and 43 North-eastern Mountain Grassland of which the former appears to be the most applicable.

Erosion seemed to be extensive in the area with dongas evident along drainage lines and hillsides, being prevalent along steeper slopes. According to Acocks (1975) the Southern Tall Grasslands typically have shallow topsoil with highly erodable subsoil which accounts for the extensive erosion to be seen in the area.

The proposed roads were traversed by vehicle and on foot and species observed were recorded, as well as the condition and sensitivity of the terrain. Along the current provincial roads this was mostly limited to drainage line crossings or when specific plants were seen along the route. The sensitivity of a road was evaluated on the basis of biodiversity, type, sensitivity and diversity of habitats such as wetlands, rocky outcrops, exposed bedrock, and susceptibility of the soils to erosion.

It seems that it is a general farming practice in the area to burn the veld at this time of the year, in order to provide palatable grazing for the livestock. At the time of the assessment most of the area had been burnt or was in the process of burning as veld fires were seen in the area on a daily basis. Most of the grassland was in various stages of recovery according to the length of time since the burn. It was therefore not

possible to fully assess the species richness of the grasslands which the proposed roads would traverse. Over most of the area the grasses had not recovered to flowering stage while forbs were also at varying levels of recovery. As a consequence it was difficult to identify many taxa which were just sprouting. It may therefore seem that some areas exhibited a greater biodiversity than others along the route. However the great difference between Alternative 1 and Alternative 2 appears in part to be real although survey effort of the latter was perhaps not as detailed as that of the former. The small difference between Alternative 2 and Alternative 3 is likely an observation artefact as a result of the burnt grassland in the case of the former and does not represent the situation on the ground as the flora of Alternative 2 is likely to be substantially greater than that of Alternative 3, despite the latter being a longer route.

2.2.2 Swinburne to Kiesbeen (All Alternatives)

The gravel road (S790) from Swinburne to farm Kiesbeen 426 is a provincial road, poorly constructed, largely comprising cobble-like gravel. The road servitude is at least 20 m wide and like that of the previous road with which it links up has had a substantial impact on the former vegetation cover. Due to construction activities most of the vegetation along the route is comprised of the grass *Hyparrhenia hirta*. Like that of the proceeding sections, 'natural' grassland still occurs along the fence lines, where some biodiversity is found. Some trees, mostly Willows *Salix fragilis* grow along the larger tributaries of the Wilge River. Stream and wetland crossings have mostly been poorly constructed and maintained with the result that they exhibit various levels of disturbance.

2.2.3 De Beers Pass Road (All Alternatives)

The provincial road (S61 and D48) from the farm Kiesbeen to Bester over De Beers Pass is similar in construction to that of the previous provincial road, with a similar width. It is initially quite rough becoming less stony. River and wetland crossings suffer the same fate as that along the other provincial roads and are to some extent degraded. The road reserve is dominated by Thatch grass *H. hirta* with stands of *H. tamba* along De Beers Pass.

Species richness along this road is similar to that described for the other provincial roads due to the extent of disturbance during road construction activities. Alien woody vegetation such as Willows *Salix fragilis* and Wattle *Acacia mearnsii* occur at some of the bridges and culverts. Plants recorded at and under the bridge across the Wilge River included *Senecio polyodon, Salis fragilis, Artemisia afra, Cyperus fastigiatus, Asparagus laricinus, A. cooperi, Oenothera rosea, Persicaria* sp. and *Rhus gerrardii*.

Bridges and culverts need to be cleaned out to ensure adequate water flow. Erosion control is required along this route as along the other provincial roads.

2.2.4 De Beers Pass road to farm Bramhoek (All Alternatives)

This section of the proposed road originates at the De Beers Pass road and consists of a track on the farm Bramhoek 1220. This track runs north-easterly for approximately 2 km before angling more to the east. For the most part the existing track runs through disturbed grassland dominated by the grass *Hyparrhenia hirta* with few forbs evident. At this point the proposed road does not continue on the existing track but continues north north east in a shallow arc through *H. hirta* dominated grassland for approximately 2,5 km before linking up with an existing north-south track about 1 km south of the intersection. A portion of this has been burnt and many forbs especially *Hypoxis* spp. and the Eland Bean *Elephantorrhiza elephantina*, a suffrutex, were emerging and beginning to flower in the burnt area, as well as, but less apparent in the unburnt grassland. Several grasses and forbs were noted. A seep and drainage line within the former burnt area may lie along the proposed route.

From the junction of this proposed section an existing track runs through a wetland for approximately 3 km. Part of this road has been raised as a result of the seasonal marshy conditions, several streams crossing the track. Much of this wetland has been modified by past farming practices and most of this south of the track will be flooded by the proposed Braamhoek dam.

2.2.5 Braamhoek Pass (Alternative 1)

An existing track branches off the track and extends northwards to a former farmhouse in north-western Bramhoek, situated in a stand of Syringa *Melia azerdarach* and Wattle *Acacia* spp. The proposed new road extends northeast, crossing extensive seasonal and permanent wetlands lying between the arms of streams originating from springs along and at the foot of the escarpment. A permanent spring at 28° 17' 15,3" S; 29° 33' 16,2" E (**Plate 13**) is situated at the foot of a rocky ridge between the arms of two streams feeds the wetlands as well. What appears to be *Dierama* sp. cf *nixonianum* (**Plate 14**) grew in the seasonal wetland below the spring. After crossing this wetland the proposed road extends across a floristically rich grassland including scattered populations of *Hoffmannseggia sandersonii* and large numbers of *Watsonia* sp. cf *confusa / lepida* clumps, continuing upslope past the former farmhouse referred to above. It crosses a marshy stream to ascend a narrow spur in order to link up with a track extending downhill along the boundary between the farms Cotswold 10382 and Oulston 8510, at the top of the escarpment. Most of this area had been burnt prior to this assessment and many grasses were only sprouting and many could not be identified. Many forbs were also sprouting and the species richness along the wetland and intervening area was impressive.

Plate 13: Spring below dolerite outcrop. Yellow-green plants in foreground are Swamp Fern *Thelypteris confluens*

Plate 14: A hairbell *Dierama sp. cf D. nixonianum*, a rare KwaZulu-Natal endemic, on the farm Braamhoek

The spur was relatively narrow with steep slopes and patches of scarp forest in the valleys on either side exhibiting abrupt margins as a result of the frequent grass fires. A few *Protea roupelliae* and clumps of coppicing *Protea* sp. cf *simplex* grew along the upper section of the spur.

Lower down, on a dolerite knoll on the spur, a population of *Aloe dominella* (**Plate 15**) at 28° 16' 58,7" S; 29° 31' 52,1" E was found together with an unidentified *Tristachya* sp.

Species richness and abundance was less along the spur but included several other species which in many instances did not occur lower down. Erosion was everywhere in evidence, including along the track leading down from the top.

Plate 15: *Aloe dominella*, a highly localized and sparsely distributed aloe endemic to KwaZulu-Natal

2.2.6 New Scarp road from De Beers Pass road (S61) over the farms Strathmorn, Blomhoek, Chatsworth, Oulston to Bedford (Alternative 2)

The proposed road follows an existing farm track along the edge of the escarpment starting from the De Beers Pass Road it extends NNE along the boundary between the farms Ward 1638 and Strathmorn 9878, swinging northeast along the boundaries between Cotswold and Blomhoek 227, Chatsworth 388 and Oulston, and Bedford 2 1845 and Braambosch 14497. The terrain is undulating grassland, with wetlands flowing north or south according to the watershed. Stands of wattle *Acacia* spp. and eucalypts *Eucalyptus* spp. occur on the farms Chatsworth and Blomhoek. Several clumps of a hairbell *Dierama* sp. cf *robustum* (**Plate 16**) grew at the junction of the track with that of Alternative 1.

Most of the grassland on these farms had been burnt, some sections more recently than others. This resulted in a short but mixed grass sward, species being difficult to identify due to lack of flowering material. However *Rendlia altera* seemed to be one of the dominant species. Forbs were common on the farms Ward and Braambosch. For the most part the proposed road followed existing tracks deviating only on the farm Oulston. Areas of exposed bedrock were present along the track on this farm, on Braambosch and on Bedford. Typical bedrock plants included *Crassula dependens* and *Psammotropha myriantha*.

Despite the farm management practices in the area the grass sward was still good. However extensive areas of erosion were seen along the track, most associated with wetlands along the escarpment margin.

Plate 16: Small tussocks of another hairbell, probably *Dierama sp. cf robustum* growing in grassland on the farm Chatsworth

2.2.7 Provincial road S922 from the Farm Kiesbeen to Bedford (Alternative 3)

The road from the farm Kiesbeen 426 to the farm Bedford follows an existing provincial road, which is relatively poorly maintained. The road servitude is approximately 20 m

wide but due to road construction most of the route exhibits disturbed conditions, and a vegetation cover dominated by the grass *Hyparrhenia hirta*. Remnants of the former grassland including scattered clumps of *Watsonia* sp. cf *lepida*/ *confusa* still occur along the fence lines fringing the road reserve, and where construction activities have not extended as far as the fence on either side of the road. Several clumps and individuals of a hairbell *Dierama dracomontanum* grew within the road reserve on the farm Langspruit 448 at 28° 13' 58,8" S; 29° 24' 04,4" E. Some Ouhout *Leucosidea sericea* grew along the streams which the road crossed.

On the farms Maggie's Deel 1565 and Klein Drakensberg 256 the farm track fringes rocky outcrops and exposed bedrock with similar plant communities to that seen on Oulston and Bedford.

All of the stream and wetland crossings have been impacted as a result of construction and subsequent neglect. Most of the culverts were blocked by large quantities of dead wood brought down under high flow and flood conditions and have subsequently not been cleared away, backing up the water and creating new channels. Down cutting of channels by streams as a result of the sudden influx of water is evident, especially along the Wilge River which exhibits what appears to be a very impoverished system. It seems that the active channel has incised so deep that it is only likely to overtop its banks under high flow conditions.

A detailed vegetation survey from which the above description has been extracted is appended (**Appendix A**). A detailed species list is provided within this report.

2.2.8 Fauna

With the exception of livestock and Blesbok (*Damaliscus dorcs phillipsi*), no large mammals were recorded during the field surveys, although Scrub hare (*Lepus saxatilits*), Meerkat (S*uricata suricatta*) and Springhare (*Pedetes capensis*) were recorded during field surveys and evidence of Mole rats (*Cryptomys hottentotus*) Aardvark (*Orycteropus afer*) and Porcupine (*Hystrix africaeaustralis*) was noted.

Avian species diversity was much higher in the study area, particularly within indigenous forest pockets associated with fluves in the escarpment. Although no detailed lists were generated area, the following rare or endangered species were observed in the upper reservoir areas:-

Crowned Crane - *Balearica regulorum*
Blue Crane - *Anthropoides paradiseus*
Wattled Crane - *Grus carunculata*

Crowned and blue cranes were noted hunting in grassland areas adjacent to existing roads. A single pair of Wattled cranes were recorded on a farm dam above the scarp located approximately 200 m from the proposed Scarp alignment (Alternative 2).

In addition to these, White winged flufftail (*Sarothrura ayresi*) had been previously recorded in the upper reservoir area (Poltech, 1999). During the ecology survey, however, it was determined that no suitable habitat for the flufftail occurs along the proposed scarp road alignment.

Similarly, herpetofaunal sensitivity can be expected to be high, since several rare or endangered taxa have been recorded in the Drakensberg area (Poltech 1999). These include the Spiny Crag Lizard (*Pseudocordylus spinosus*), Striped Harlequin Snake (*Homoroselaps dorsalis*) and Beyer's Longtail Seps (*Tetradactylus breyeri*). While none of these species were recorded during the field surveys, suitable habitat does occur along the proposed scarp road alignment.

2.3 Environmental Sensitivity

Environmental sensitivity mapping was conducted utilising the following available resources:-

- 1:50 000 Topocadastral maps
- Aerial photographs
- Flora and Fauna field survey
- Field and survey verification

All identified sensitive environments are indicated in **Figure 2-7**.

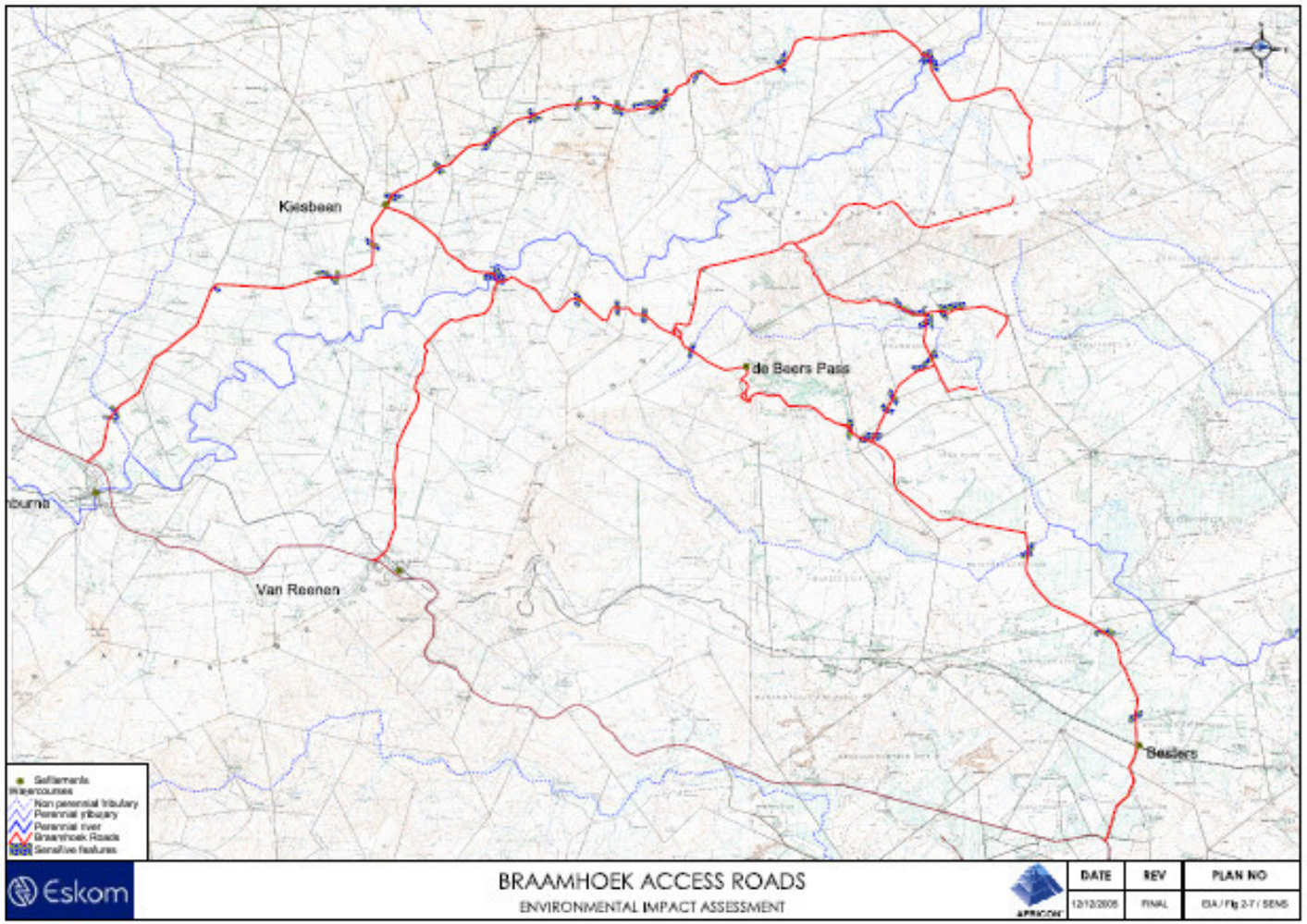
Based on the available resources, several large permanent and seasonal wetlands were recorded along the various alignments, and are considered sensitive. Pockets of indigenous montane forest, although not directly impacted on by the proposed route alignments, are considered sensitive and must be taken into consideration during the construction and operational phases of the project.

2.4 Social-Economic Environment

2.4.1 Land Use

The regional land use is agricultural in nature. The local land use is all agricultural and rural livelihoods. Livestock and grazing (**Plate 16**) are the primary economic

Figure 2-7: Sensitive environments associated with the proposed route alignments



categories, with extensive cattle husbandry, sheep and goat herds. Planted crops are limited in the upper reservoir region. There is a marked increase in planted crops in the lower reservoir region (**Plate 17**), especially the section directly below De Beers Pass where the topography flattens out considerably from the escarpment.

Plate 17: Cattle husbandry in the upper reservoir region

Plate 18: Extensive Planted Crop in the lower reservoir region

2.4.2 Sites of Cultural or Archaeological interest

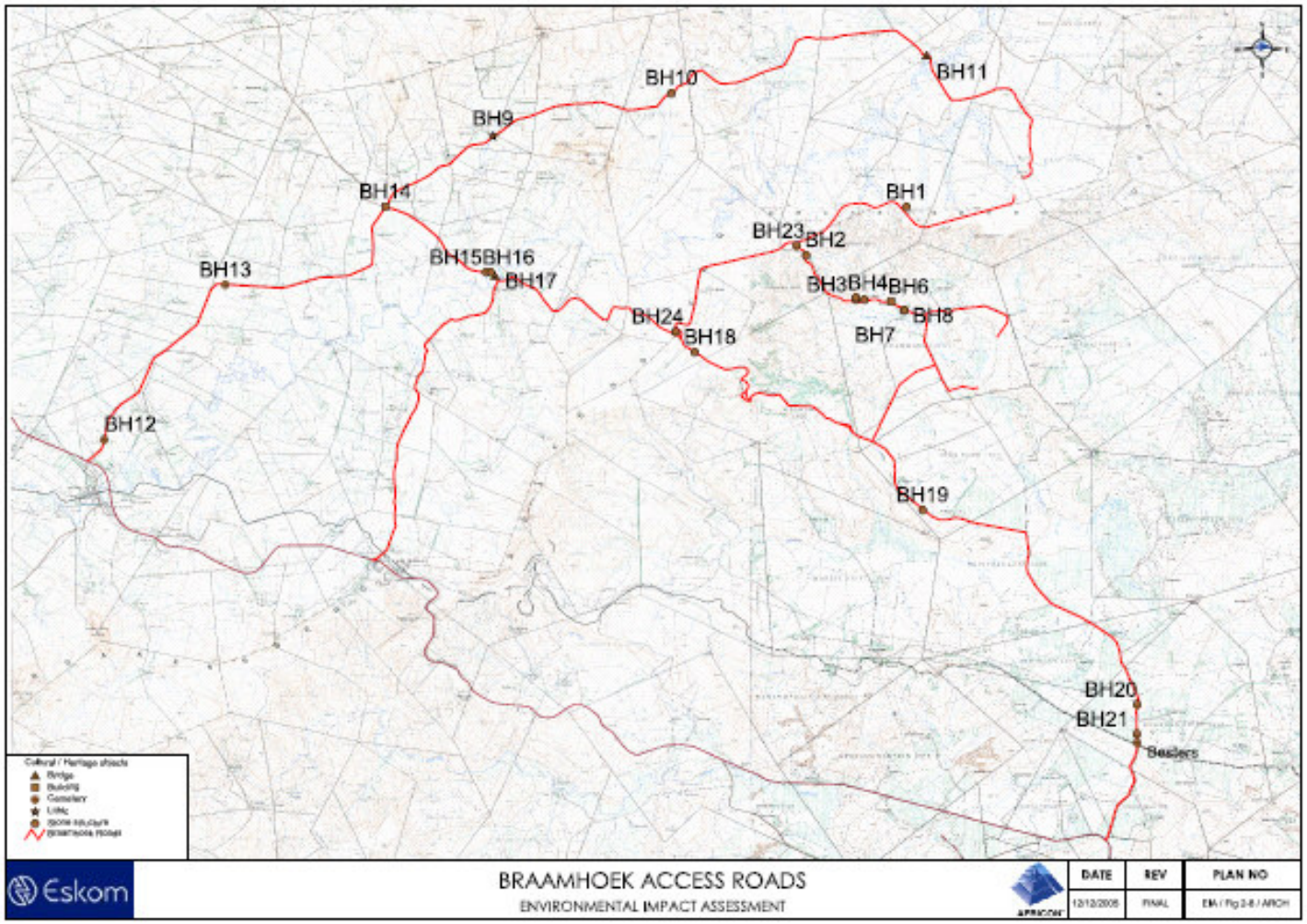
A description of significant sites (indicated in **Figure 2-8**) of cultural or archaeological interest recorded during the field surveys is provided below. Note that none of the sites occur within any proposed alignment. A detailed Heritage Impact Assessment is appended (**Appendix B**).

2.4.2.1 BH1 (28.25109 S, 29.55276 E)

Unidentifiable stone structure situated on top of the Drakensburg (**Plate 19**). The structure, which is orientated along the north-south axis, is not associated with any other cultural material or features. The structure is situated some distance away from the road, and no negative impact is expected. Furthermore, the structure does not form part of a formal settlement. As a result, **BH1** is of **Low Significance**.

Plate 19: The stone structure from site BH1 can be seen

Figure 2-8: Sites of cultural / heritage interest recorded during the field survey



2.4.2.2 BH2 (28.26735 S, 29.51878 E)

The site consists of stonewall which was packed in a straight line. The feature is approximately 20 m in length. The wall is double-packed, and is located on the mountain's scarp (**Plate 20**). From the 2829BC BESTERS map it is evident that **BH2** is located close to the western boundary of the farm Oulsten 8510. The feature can therefore be described as an old farm boundary. The existing road of the Braamhoek Pass passes over the site. The stonewall is already impacted upon by the Braamhoek Pass road and although it might be older than 60 years, it is not a unique feature in the landscape. As a result, **BH2** is of **Low Significance**.

Plate 20: General view of the long stone wall

2.4.2.3 BH3 (28.28267 S, 29.53553 E)

The site is comprised of a number of features located in the same general vicinity. Undecorated potsherds, iron objects and possible ash deposits were also observed in the area. The features include the following:-

- A stone-lined structure orientated along the east-west axis which may be a grave (**Plate 21**).
- One terrace wall.
- Two rectangular foundation structures.

The dwelling foundations are associated with farm labourer housing. These foundations are not significant. However, a worst case scenario, wherein the stone-

lined structure is indeed a grave, was used to assess the site significance. As a result the site is given a **High Significance** rating.

Plate 21: Stone-lined structure which may be a grave

2.4.2.4 BH4 (28.28205 S, 29.53561 E)

This site is associated with **Site BH3**, and consists of a rectangular stone cattle kraal (**Plate 22**). Two enclosures were added to the outer wall of the kraal and are interpreted as keeps for small livestock. The site is situated close to a small stream. Associated material culture consists of a broken lower grinder. This rectangular stone structure interpreted as a cattle kraal dates from the relative recent past and is not a unique feature. Therefore, **BH4** is of **Low Significance**.

Plate 22: A portion of the stone kraal is visible in this photograph

2.4.2.5 BH5 (28.28234 S, 29.53847 E)

This is the location of a highly disturbed stonewall foundation. A number of undecorated potsherds were observed in the surrounding area. The general area is characterised by sheet erosion.

The possibility exists that this stone foundation formed part of a Late Iron Age/Historic settlement. The walling was most probably robbed to construct the more recent structures from Site BH3 and Site BH4. Due to the disturbed nature of the site, BH5 is of **Low Significance**.

Plate 23: The disturbed stonewall at Site BH5 is barely visible

2.4.2.6 BH6

The site consists of the old Bramhoek farmstead (**Plate 24**). The farmstead comprises the following structures:-

- Rectangular foundation structure that appears to have been the dwelling. Mud bricks as well as more conventional bricks were observed here, indicating that the original dwelling may have been quite old (**Plate 25**).
- Small rectangular wagon shed and stables comprising a stone and mortar foundation structure with a mud brick extension on top (**Plate 26** and **27**). The mud brick sections of the inner and outer walling were plastered. The structure's doorframes and supporting cross-beams are all made of wood, while the roof is missing.

The farmstead is associated with planted vegetation such as poplars. If the road alignment is changed so that the line of the planned road moves closer to the farmstead, suitable mitigation measures must be undertaken. The site is of **Moderate Significance**.

Plate 24: General view of the site. The foundation is indicated

Plate 25: Remains of the farm dwelling. Note the mud bricks as well as the more conventional bricks (with cement)

Plate 26: The remains of what used to be the farmstead's wagon shed and stables

Plate 27: The remains of what used to be the farmstead's wagon shed and stables

2.4.2.7 BH7 (28.28608 S, 29.55188 E)

The site consists of two stone concentrations, which could possibly be graves (**Plate 28**). These concentrations are also roughly orientated along the east-west axis, and are associated with the circular enclosures at site BH8. A worst case scenario, wherein the two stone concentrations are indeed graves, was used to assess the site significance. As a result the site is given a **High Significance** ranking.

Plate 28: One of the stone concentrations from BH7

2.4.2.8 BH8 (28.28637 S, 29.55203 E)

This site consists of two Late Iron Age settlement units, referred to as Settlement Unit A and Settlement Unit B. These units are located approximately 80 meters apart and are situated near the foothills of the Drakensberg range. Each unit consists of more than one stone-walled circular enclosure of which some are linked (**Plate 29)**. These enclosures have an average diameter of approximately five meters in diameter. A single stone concentration which could potentially be a grave was also observed in the vicinity of the circular enclosures (**Plate 30**). A worst case scenario, wherein the

possible grave is indeed a grave, was used to assess the site significance. As a result the site is given a **High Significance** ranking.

Plate 29: This photograph depicts a section of one of the circular stone enclosures.

Plate 30: Stone concentration at BH7

2.4.2.9 BH9 (28.22662 S, 29.41266 E)

A single Middle Stone Age lithic (**Plate 31**) was observed on the side of the road (**Plate 32**). No other Stone Age artefacts could be observed in the direct vicinity, and as such the site must be viewed as a findspot. **BH9** is of **No Significance**.

Plate 31: Close-up view of the artefact

Plate 32: The approximate spot where the lithic was observed is indicated

2.4.2.10 BH10 (28.21216 S, 29.47314 E)

A number of stone foundation structures are located on a west-facing slope overlooking a non-perennial stream (**Plate 33**). These structures are located directly adjacent to the northern fence of the road.

The oldest available map on which the site is shown is the 2829AB GROOTHOEK Topographical Sheet that was printed in 1965. This map furthermore made use of aerial photography undertaken in 1955. The Harrismith sheet of the 1:125 000 series undertaken of the Orange Free State, and which was surveyed in 1908, reveals that the site did not exist as early as that (National Archives, Maps, 3/671). The topographical sheet shows the site to have been a school. An archival file located in the Free State Archives mentions the existence of the so-called Fullerton Native Farm School, also known as the Nelsonskop Berlin Mission School (VAB, 1/1/111, N25/4/3). As this file contains documents and reports of the school for the period 1930 to 1961, it is safe to say that the school was probably established in 1930. The site is therefore older than 60 years. **Site BH10** is of **Low** to **Moderate Significance**.

Plate 33: One of the rectangular foundation structures can be seen in the foreground.

2.4.2.11 BH11 (28.19933 S, 29.55948 E)

The site consists of a reinforced concrete bridge over the Wilge River (**Plate 34** and **35**). The bridge was located on the road between Collins Pass and Harrismith, on what used to be Chatsworth 388 (the section on which the bridge is located is today known as Wilgerivier 319). Comparing the map that was surveyed in 1908 (National Archives, Maps, 3/671) with the topographical map that was surveyed in 1964, it becomes evident that the bridge was not constructed over the original drift, but slightly west of it. During 1908 the drift was described as being "much used".

During the mid-1920s a number of bridges were constructed in the Orange Free State by the Union of South Africa's Public Works Department, who were based at the Union Buildings in Pretoria. The bridge at **Site BH11** is one of these constructions. The construction of the bridge commenced on 17 May 1926, and was completed before 10 September 1927. This means that the bridge is older than 60 years, and as a result protected by the legislation. The bridge can therefore not be altered, disturbed or demolished without a permit issued by the heritage authority. Although the bridge is older than 60 years, and represents an infrastructural element of the area's transport development history, a number of such bridges were constructed during the 1920s. As a result the bridge can not be seen as unique.

The site is given a **Low** to **Moderate significance** rating.

Plate 34: General view of the bridge

Plate 35: One of the bollards found at both ends of the bridge can be seen

2.4.2.12 BH12 (28.33022 S, 29.28086 E)

Cemetery containing approximately 15 graves (**Plate 36**). The graves are all orientated along the east-west axis, while the dressings are predominantly oval-shaped and stone-packed. The cemetery is situated approximately 25 meters to the west of the existing fencing along the road. **BH12** is of **High Significance**.

Plate 36: General view of cemetery

2.4.2.13 BH13 (28.27766 S, 29.32194 E)

Cemetery containing approximately 12 graves. The dressings for approximately ten of these graves consist of stone-packed features without any formal headstones (**Plate**

37). The remaining two graves possess cement headstones. All the graves from this cemetery are orientated along the east-west axis. **BH13** is of **High Significance**.

Plate 37: A number of graves from BH12 can be seen

2.4.2.14 BH14 (28.25089 S, 29.37613 E)

The site consists of a building that may be older than 60 years, since it appears the building has been constructed between 1908 and 1965. The building is constructed of bricks and has a corrugated iron roof (**Plate 38**). The condition of the structure is poor, with all windows and doors having been removed. **BH14** is of **Low** to **Moderate Significance**.

Plate 38: The building from BH14

2.4.2.15 BH15 (28.27342 S, 29.41033 E)

The site consists of an upright boulder associated with a headstone-shaped stone (**Plate 39**) on which the following inscription was made: “MJ 1985” (**Plate 40**). The upright boulder itself bears another inscription, and although it is quite weathered seems to read “15-12-85”. The site located approximately 12 meters from the road fence. The inscriptions and stones seem to indicate the presence of a grave or memorial to a deceased. A possibility may be that the feature acts as a memorial to a person who had died in a car accident on the road.

Depending on whether the site represents a grave or simply a memorial, the significance can vary considerably. For the moment a worst case scenario will be assumed, namely that the site represents a grave. **BH15** is of **High Significance**.

Plate 39: The upright stone with a number of loose stones packed at its base

Plate 40: Headstone-shaped stone with inscription

2.4.2.16 BH16 (28.27338 S, 29.41188 E)

A single rectangular foundation structure was observed here (**Plate 41**). The structure is situated to the east of the road, and directly adjacent to the fence. **BH16** is of **No Significance**.

Plate 41: The position of the foundation structure is indicated with an arrow

2.4.2.17 BH17 (28.27435 S, 29.41327 E)

The site consists of a reinforced concrete bridge over the Wilge River at a place known as Schaapdrift (**Plate 42**). The bridge is located on what used to be the road between Ladysmith and Harrismith. Comparing the map that was surveyed in 1908 (National Archives, Maps, 3/671) with the topographical map dating from 1965, it becomes evident that the bridge was not constructed over the original drift, but a short distance south of it. The 1908 map also indicates that the drift over which the road crossed at the time, was "much used."

The construction of the bridge during the mid-1920s means that the bridge is older than 60 years, and as a result protected by the legislation. The bridge can therefore not be altered, disturbed or demolished without a permit issued by the heritage authority. The bridge is more unique than the one from Site BH11. This is because it is a larger, more imposing structure consisting of two supports and three spans. Furthermore, the association of the bridge with C. Van Riet Lowe also supports a higher significance. The site is given a **Moderate** to **High Significance** rating.

Plate 42: Bridge over the Wilge Spruit.

2.4.2.18 BH18 (28.30046 S, 29.48100 E)

A single oval-shaped stone feature was observed here (**Plate 43**). The feature is approximately three meters in diameter, and some 11 meters from the road fence. **BH18** is of **No Significance**.

Plate 43: Small oval-shaped feature

2.4.2.19 BH19 (28.35426 S, 29.55823 E)

The site consists of numerous circular Iron Age stone enclosures (**Plate 44**) located in a valley. The existing gravel road transects the site and these enclosures were observed on both sides of the road. Although an inspection of the gravel road and its sides were undertaken for a large portion of the site, no ash middens or exposed cultural material could be identified. **BH19** is of **Moderate Significance**.

Plate 44: General view of the site from the road. Note the many enclosures that are visible.

2.4.2.20 BH20 (28.42071 S, 29.63094 E)

The site consists of rough stonewall foundations situated along the western slope of a ridge. **BH20** is of **No Significance**.

2.4.2.21 BH21 (28.43073 S, 29.63080 E)

Two stone structures are located here (**Plate 45**). One of the structures is rectangular, the other one circular. The site appears to be the remains of a recent-historic farm worker dwelling. The site is located close to the road fence. **BH21** is of **Low Significance**.

Plate 45: The two stone structures can be seen

2.4.2.22 BH22 (28.43361 S, 29.63091 E)

A cemetery containing five stone-packed graves are located approximately 15 meters from the road fence (**Plate 46**). The cemetery is associated with buildings that appear to be a school. **BH22** is of **High Significance**

Plate 46: The arrow indicates the position of the five stone-packed graves.

2.4.2.23 BH23 (28.26431 S, 29.51550 E)

The site consists of two stone foundation structures located at the north-eastern foot of a small rise (**Plate 47**). The structures appear to be historic-recent worker housing. At present the age of the structure are unknown. The possibility exists for them to be older than 60 years. No cultural material was observed in the surrounding area.

A worst case scenario was used to evaluate the site's significance. In this scenario it was assumed that the structures are older than 60 years, thereby providing the site with a **Low** to **Moderate Significance** rating. Should the structures not be older than 60 years, the site will have no heritage significance.

Plate 47: The rectangular structure is visible in the foreground, while the arrow indicates the circular structure.

2.4.2.24 BH24 (28.29354 S, 29.47449 E)

The site consists of a small circular stone structure located on the dyke (**Plate 48**). No cultural material was observed in the surrounding area. At present the age of the structure is unknown. The possibility exists for the structure to be older than 60 years, and possibly even older than 100 years.

The structure is located in a strategic location just before the start of the De Beers Pass. The desktop study has shown the De Beers Pass to have already existed in 1847. The strategic importance of the De Beers Pass, as well as its location on what had been for a long time the boundary between the Boer Republic of the Orange Free State and the British Colony of Natal, has led various military and police posts to be established in the vicinity. Furthermore, during the Anglo Boer War of 1899-1902, the passes over the Drakensberg were manned by both Boer and British forces during various stages of the conflict.

A worst case scenario was used to evaluate the site's significance. In this scenario it was assumed that the structure is older than 60 years, thereby providing the site with a **Low** to **Moderate Significance** rating.

Plate 48: The small stone circle is visible adjacent to the dolerite dyke

2.4.3 Economic Activity

Socio-economic data has been obtained from Statistics SA (http://www.statssa.gov.za), based on Census 2001 data. For comparative purposes, data is presented for the Maluti a Phufong Local Municipality, Phumelela Local Municipality and the Emnambithi/Ladysmith Local Municipality.

2.4.3.1 Population size and density

Population size and density is presented in **Figures 2-9** and **2-10** respectively. Population size within the three municipal areas is approximately 36 200, evenly distributed between the three local municipality (LM) areas.

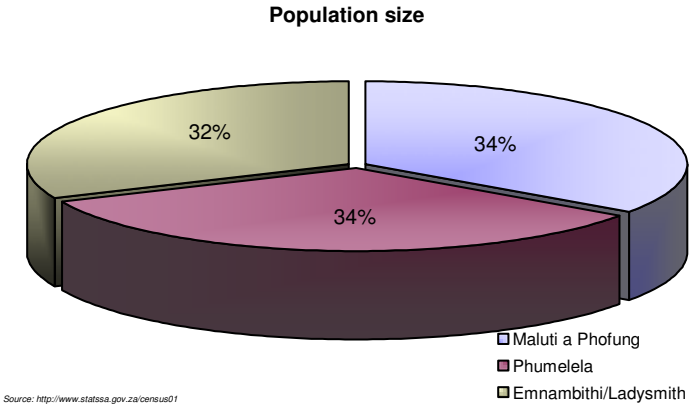


Figure 2-9: Population size per local municipal area

More people, however, reside per square kilometre (4.6 people / km^2) within the Emnambithi/Ladysmith Local Municipality than within the Maluti a Phufong and Phumelela Local Municipalities (3.9 people / km^2 and 2.8 people / km^2 respectively – **Figure 2-10**).

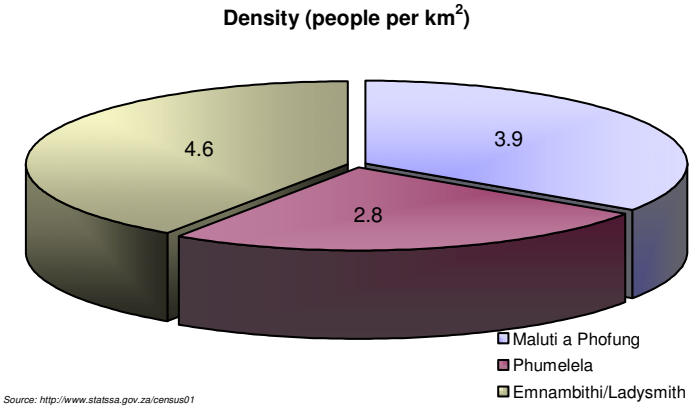


Figure 2-10: Population density per square kilometre

2.4.3.2 Employment Figures and Sectors

Unemployment within the three local municipalities is significantly higher than the national unemployment rate. Employment within Maluti a Phufong and Phumulela

Local Municipalities is marginally higher at 46 % and 53 % respectively (**Figure 2-11** and **2-12)**. Less than 32% of residents within the Emnambithi/Ladysmith Local Municipality are employed and more than 40 % are economically inactive (**Figure 2-13**).

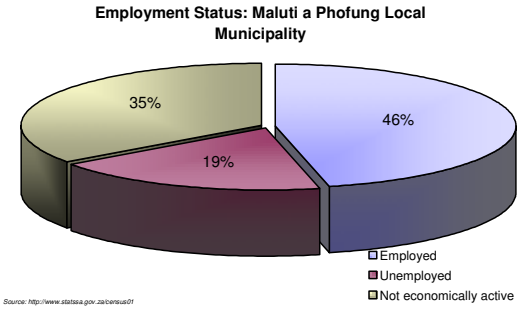


Figure 2-11: Employment Status within Maluti a Phufong Local Municipality

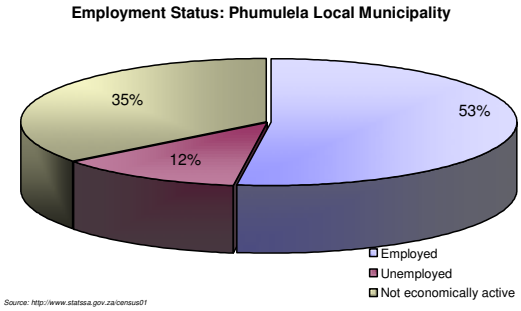


Figure 2-12: Employment status within the Phumelela Local Municipality

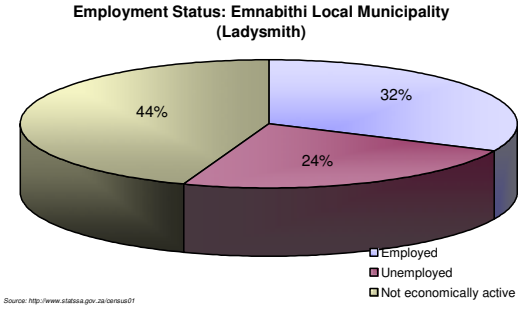


Figure 2-13: Employment Status within Emnambithi Local Municipality

Employment sectors within the three local municipalities are indicated in **Figure 2-14** below. The predominant source of employment within all municipal areas is within the agricultural, forestry, hunting and fishing industries, followed by employment as domestics or gardeners.

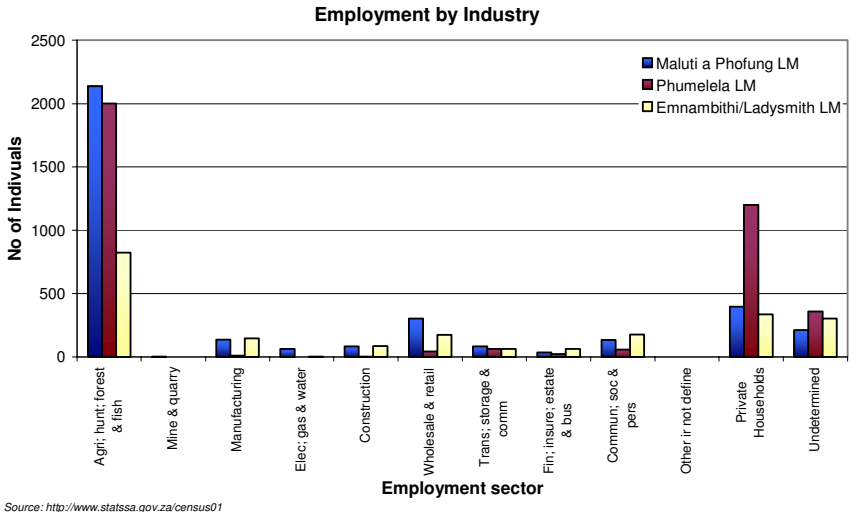


Figure 2-14: Employment by Sector within the Local Municipalities

Skill levels within local residents are typically moderately skilled to skilled, with the majority of labourers employed as skilled agricultural labourers or plant and machine operators (**Figure 2-15**).

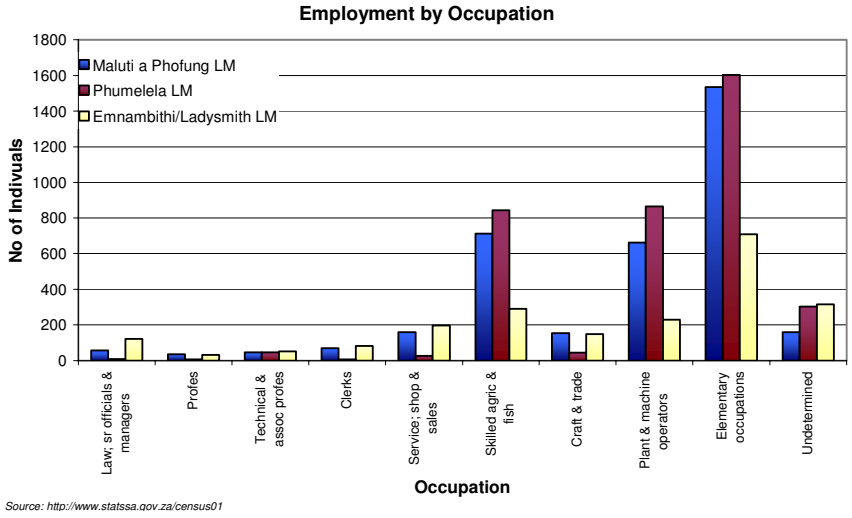


Figure 2-15: Employment by occupation within the Local Municipal areas

A large proportion of residents have no access to formal / public transport, and therefore travel predominantly by foot (**Figure 2-16**). This would indicate that the transport system within all municipal areas requires upgrading and/or transformation.

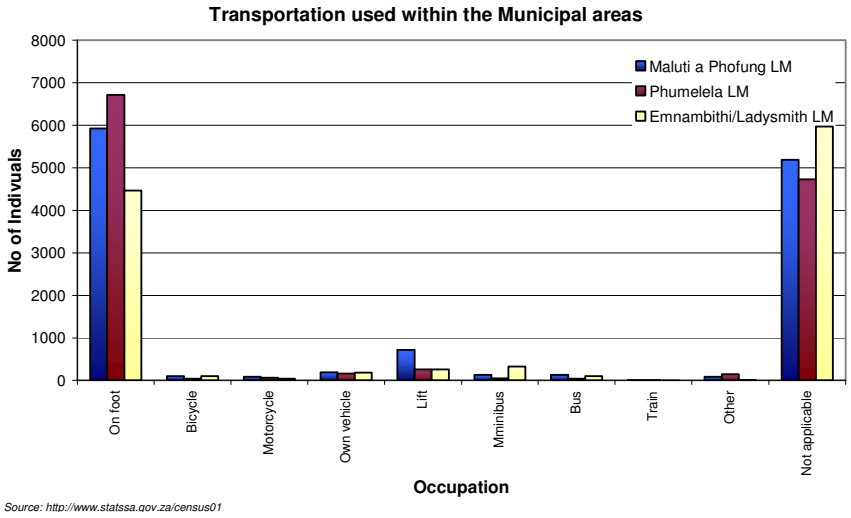


Figure 2-16: Transportation utilised within the Local Municipal areas

2.4.3.3 Household and Individual Income

Monthly individual income is presented below in **Figure 2-17**. It is evident that that the majority of residents within all three municipal areas earn below R 800 per month.

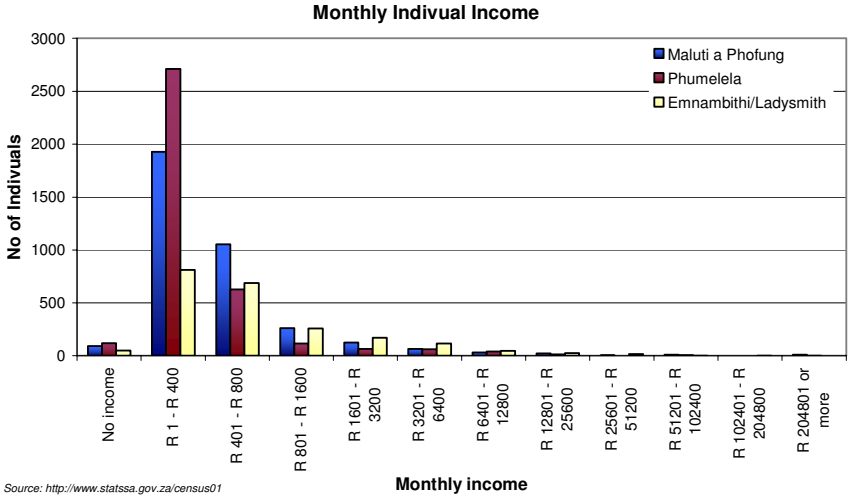


Figure 2-17: Monthly individual incomes per Local Municipal area

Annual Household income (**Figure 2-18**), when considering average household size per municipal area, is below R 20 000 per annum.

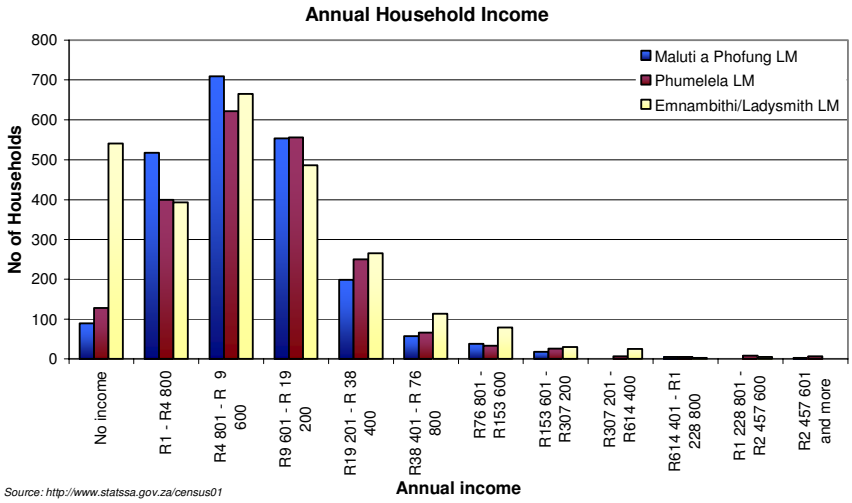


Figure 2-18: Annual Household income per Local Municipal Area

2.4.4 Visual Character

A detailed landscape and visual assessment is appended (**Appendix C**). The study area and surrounding region is prominent in topographical identity – the Drakensberg. Against this dramatic backdrop is a region which displays a picturesque, tranquil, rural farming characteristic. The combination of dramatic and contrasting topography, appealing monotone vegetation and farming / rural land use establishes a strongly defined 'sense of place' and characteristic.

A rural farming character placed within a region with well defined 'sense of place' provides the region and study area with very high visual and landscape character. The seemingly unspoilt and remoteness of certain sections of the access roads further adds to the quality of the character of the area. The experiential quality of the distinct character is further enhanced by the occurrence of rare and endangered mega-species occurring in the area, such as Blue and Crowned Cranes. The region is similarly sparsely populated which also further emphasises the seemingly remoteness and isolation experienced.

2.4.4.1 Visual Absorption Capacity (VAC)

In considering VAC of the roads it must be understood that the activity already exists in most of the alternatives, with only minimal Greenfield sites proposed. The activity is generally well absorbed into the environment due to the small scale and 'low key' quality of the current status.

The landscape does not have the ability to absorb substantial impact types. The vegetation cover is very low, the topography although relatively scenic and diverse is predominantly rolling in nature. The land use is limited, restricted to natural and rural farming, with little to no clutter or diversity.

Similarly the very specific character of the receiving environment will not be able to support large scale development without compromising the landscape and visual quality, irrespective of the level of ecological quality.

2.4.4.2 Landscape Receptors

Landscape receptors within the study area are indicated in **Table 2-2** below.

Table 2-1: Landscape receptors within the study area

LANDSCAPE ASPECT	LANDSCAPE RECEPTOR
Landscape Elements & Features	• Natural low grasslands, pastures and fields • Extensive wetland systems and streams • Rolling, undulating hills and plains, resulting in more prominent view receptors to the site. • Dramatic escarpment landscape • Wilge River
Landscape characteristics (tangible and intangible)	• Picturesque, tranquil, rural farming characteristic • Dramatic and contrasting topography, appealing monotone vegetation and farming / rural land use establishes a strongly defined 'sense of place' and characteristic • Very high scenic quality • Strongly defined sense of place
Landscape Character	• Well established mature rural farming community, with dramatic natural escarpment and mountainous backdrop.

3 PUBLIC PARTICIPATION

Public participation commenced in November 2004, and has been conducted in accordance with the principles and objectives of NEMA, and ECA. Best practice principles, such as the core values held by the International Association for Public Participation have also applied. Prior to August 2005, Acer Africa conducted the Public Participation process on behalf of BCJV. Subsequently, Afrosearch has undertaken to complete the Public Participation process on behalf of Africon.

3.1 Public participation to date

The description of the Public Participation process conducted by Acer Africa prior to August 2005 is extracted from the BCJV Scoping Report, August 2005. Drawing from the principles contained in legislation and from best practice, the following standards guided the Public Participation process conducted by Acer Africa:-

- Consultation has occurred with all sectors of society, affording the broadest possible range of stakeholders the opportunity to provide comment and input into the scoping phase of the project;
- A variety of non-technical media was employed to advertise the project, over an extended timeframe;
- Uncomplicated feedback mechanisms to providing information to stakeholders, including (and particularly) historically disadvantaged communities;
- Allowing sufficient comment period for stakeholders; and
- Enabling stakeholders to provide comment by various reciprocal media.

The Public Participation process for the proposed construction and upgrade of access roads for the Braamhoek PSS was structured as follows:-

- Preparation;
- Scoping and impact assessment; and
- Announcement of the Record of Decision (RoD).

Only the first two phases (preparation and scoping) have been conducted to date. The Public Participation process to date is summarised below in **Figure 3-1**.

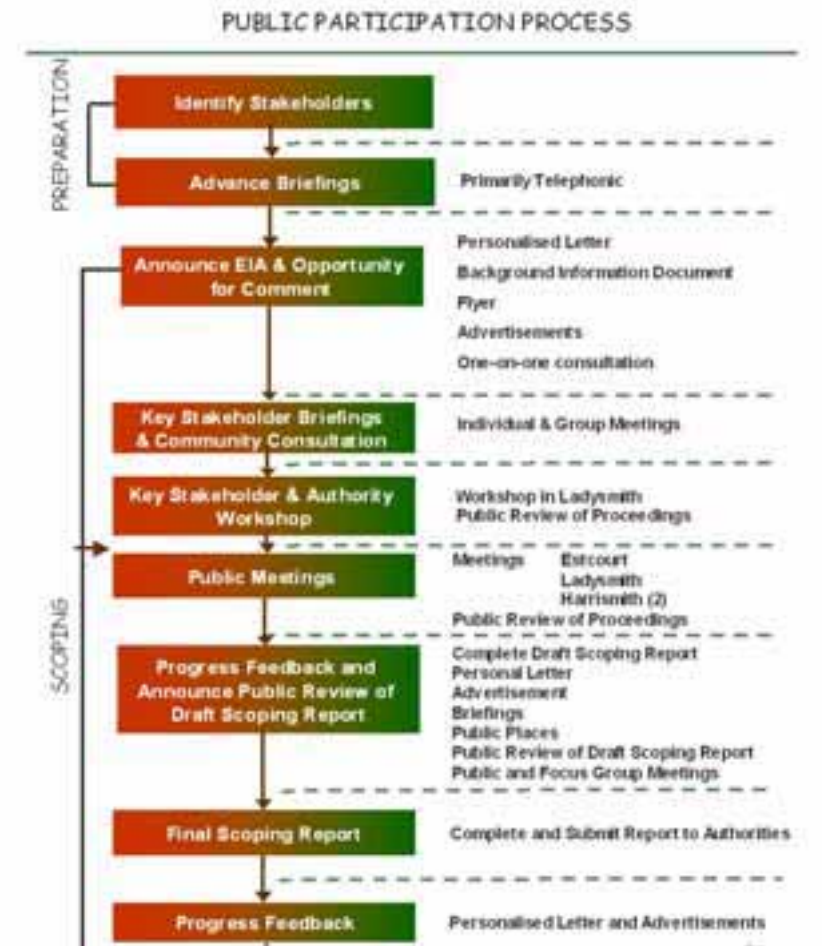


Figure 3-1: Public Participation Process conducted to date by Acer Africa (Source: BCJV Final Scoping Report, August 2005)

3.1.1 Preparation Phase

Stakeholders were identified and a comprehensive stakeholder database was created (see **Appendix D**). This process is, however, ongoing and was updated by Afrosearch throughout the life of the EIA process. The following broad stakeholders groups have been identified.

- National and Provincial Government (Transport, Environmental Affairs, Tourism, Agriculture, Education, etc.);
- Local Government (District and Local Municipalities);
- Conservation authorities, notably, Ezemvelo KwaZulu Natal Wildlife, and environmental groups, for example, the Wildlife and Environment Society of Southern Africa (WESSA) and Birdlife Africa;
- Farmers Unions and Associations;

- Tourism Associations;
- Traditional Authorities and local communities;
- Non-Government and Community-Based Organisations;
- Landowners;
- Learners;
- Media; and
- Academics and consultants.

Those I&AP's considered to be key stakeholders were personally briefed about the project, by telephone, through Key Stakeholder Workshops and via the Background Information Documents (BID's).

3.1.2 Scoping Phase

The announcement of the project commenced in November 2004 and was achieved by a variety of methods:-

Personalised Letters
Personalised letters in English, Afrikaans and Zulu were sent on 25 November 2004 to approximately 800 people, predominantly in the study area but also from further afield, informing them of the proposed project and inviting them to participate in the environmental assessment process (**Appendix E**).

Background Information Documents, Flyers and Comment Sheets
BID's, flyers and Comment Sheets were available in English, Afrikaans and Zulu (**Appendix F**). They were sent to approximately 800 stakeholders with the personalised letters on 25 November 2004, and were also made available at the following public places in the study area:-

- Ladysmith/ Emnambithi Municipal Offices;
- Ladysmith Public Library;
- Estcourt/ Umtshezi Municipal Public Library;
- Hlomisa School, Harrismith District; and
- Hamilberg School, Harrismith District.

Statutory Advertisements
Table 3-1 provides a list of newspapers in which the EIA announcements were placed, as required by the EIA Regulations. Advertisements were in English, Afrikaans and Zulu.

Table 3-1: Print media in which EIA process was advertised

PUBLICATION	DISTRIBUTION	LANGUAGE	PUBLICATION DATE
Natal Witness	Regional	English	26 November 2004
Ilanga	Regional	Zulu	25 November 2004

Harrismith Chronicle	Community	English	26 November 2004
Harrismith Chronicle	Community	Afrikaans	26 November 2004
Estcourt and Midlands News	Local	English	26 November 2004
Rapport	National	Afrikaans	28 November 2004
Sunday Times	National	English	28 November 2004
Ladysmith Gazette	Local	English	26 November 2004

An article was published in the Agri-SA Magazine in the February/March 2005 issue (**Appendix G**).

A project web site (www.eskom.co.za/eia) was published to host all documentation. Public Participation process documents currently loaded onto the web site include advertisements, the BID and the comment sheet. The project web site is updated on a regular basis.

Key Stakeholder and Authority Workshop
A Key Stakeholder Workshop was held on 30 November 2004 at the Ladysmith Royal Hotel. The purpose of this workshop was to enable key stakeholders, the proponent and the Authorities to interact directly with each other, and to identify issues of concern. The consultants and the proponent, Eskom, gave presentations on the EIA process and the project, after which key stakeholders were given the opportunity to raise their issues and concerns.

Key Stakeholder Workshop documents can be viewed in **Appendix H** and issues that were raised during the workshop have been captured in a Comment and Response Report, which is included as **Appendix I** of this document.

Public Open Days
Four Public Open Days were convened as follows:-

- 29 November 2004, Estcourt/Umtshezi Municipal Public Library, 13h00 to 18h00.
- 30 November 2004, Ladysmith Royal Hotel, 13h00 to 18h00.
- 1 December 2004, Hamilberg School (Harrismith District), 10h00 to 12h00.
- 1 December 2004, Hlomisa School (Harrismith District), 14h00 to 17h00.

The purpose of the Public Open Days was to enable I&AP's, the proponent and the project team to interact directly with each other, and to identify issues of concern. There were presentations by the consultants and the proponent, Eskom, after which I&APs were given the opportunity to raise their issues and concerns (translations were provided, where necessary). Posters were presented on a mobile display with detailed project information and maps. Project information was available in English, Afrikaans and Zulu.

Public Open Day documents can be viewed in **Appendix J** and issues that were raised during the meetings have been captured in the Comments and Response Report, which is included as **Appendix I** of this document.

Focus Group Meetings
Focus Group Meetings were held at the request of stakeholders. Two focus group meetings were convened as follows:

- 18 February 2005, Ladysmith/ Emnambithi Local Municipality, 08h00 to 10h00.
- 18 February 2005, Various Harrismith District Farmers Associations and local residents, 18h00 to 21h00.

The purpose of the Focus Group Meetings was to enable I&AP's and the project team to interact directly with each other, and to identify issues of concern.

Focus Group Meeting documents can be viewed in **Appendix K** and issues that were raised during the meetings have been captured in an Issues and Response Report, which is included as **Appendix I** of this document.

Interaction through the Public Participation Office
The public and registered I&APs were provided with the contact details (telephone, facsimile, postal address and e-mail address) of the Public Participation Office in order for them to interact directly with the PPP team, either with queries or to submit comment. All interactions were recorded on the database and the issues captured in the Comment and Response Report, which is included as **Appendix I** of this document.

Landowner Identification
The process of landowner identification is a lengthy and difficult process as there is no single database that records all the property names, associated landowner names and contact details. To date, Acer Africa has identified as many potentially affected landowners as possible and briefed them about the project. This is an on-going exercise that will continue for the duration of the project until all landowners have been identified and consulted. Please refer to **Appendix D**.

Public review of Draft Scoping Report (DSR)
The following PPP activities comprise the public review process of the DSR:-

- The DSR was made available in the public domain for review and comment before being finalised and submitted to the National Department of Environmental Affairs and Tourism (DEAT), Free State Department of Tourism, Environmental and Economic Affairs (FS DTEEA) and KwaZulu Natal Department of Agriculture and Environmental Affairs (KZN DAEA). The

duration of the comment period was four weeks (25 April 2005 – 25 May 2005);

- The DSR was available at the following venues during this period:-
  - Ladysmith Public Library.
  - Harrismith Public Library.
  - Green Lantern Inn, Van Reenen.
- A letter was sent to all registered I&APs informing them of the availability of the report and Comments Period;
- Key stakeholders were contacted telephonically;
- The following key stakeholders received copies of the DSR:-
  - Department of Environmental Affairs and Tourism.
  - KwaZulu-Natal Department of Agriculture and Environmental Affairs.
  - Free State Department of Tourism, Environmental and Economic Affairs.
  - Free State Department of Agriculture.
  - Free State Conservation Department.
  - Ezemvelo KZN Wildlife.
  - Thabo Mofutsanyane District Municipality.
  - Uthukela District Municipality.
  - Emnambithi/Ladysmith Local Municipality.
  - Maluti a Phofung Local Municipality.
  - Besters Farmers Association.
  - Harrismith District Farmers Union.
  - South African Heritage Resources Agency.
  - Institute for Cultural Resources Management.
  - Wildlife and Environment Society of SA.
  - Middelpunt Wetland Trust.
  - South African National Roads Agency.
  - N3 Toll Concession.
  - Free State Department of Roads.
- Print media advertisements were placed in national, regional and local newspapers in English, Afrikaans and Zulu as follows:-

Table 3-2: Print media in which availability of the Draft Scoping report was advertised

PUBLICATION	DISTRIBUTION	LANGUAGE	PUBLICATION DATE
Natal Witness	Regional	English	4 April 2005
Ilanga	Regional	Zulu	4 April 2005
Harrismith Chronicle	Community	English	4 April 2005
Harrismith Chronicle	Community	Afrikaans	4 April 2005
Estcourt and Midlands News	Local	English	4 April 2005
Rapport	National	Afrikaans	4 April 2005
Sunday Times	National	English	10 April 2005
Ladysmith Gazette	Local	English	4 April 2005

Draft Scoping Report Public Meeting

A DSR Public Meeting was held on 6 May 2005, 09h30 to 12h00 at the Ladysmith Royal Hotel. The purpose of this meeting was to enable key stakeholders, the proponent and the Authorities to discuss and comment on the findings of the DSR. The consultants gave presentations, after which key stakeholders were given the opportunity to raise their issues and concerns.

The DSR Public Meeting documents can be viewed in **Appendix J** and issues that were raised during the meeting have been captured in Comment and Response Report 2, which is included as **Appendix I** of this document.

DSR Focus Group Meetings
Focus Group Meetings were held at the request of stakeholders. Two focus group meetings were convened as follows:-

- 5 May 2005: various Farmers Association and local residents, 18h00 to 20h30.
- 6 May 2005: Ladysmith/Emnambithi Local Municipality, 13h00 to 14h30.

The purpose of the Focus Group Meetings was to enable I&AP's with a common interest to discuss and comment on the findings of the DSR, and to identify further issues of concern.

Focus Group Meeting documents can be viewed in **Appendix K** and issues that were raised during the meetings have been captured in the Comment and Response journal (**Appendix I**).

3.2 Current process

Since a comprehensive Public Participation process has been run to date, it was agreed with DEAT and the provincial authorities that Afrosearch, on behalf of Africon, would continue with the existing process rather than commence with a new, separate process. As such, all issues raised during the public participation process, including during the comment period on the DSR, were addressed within the Draft Extended Scoping Report. These issues include:-

- Ecological including fauna and flora;
- Surface water;
- Air quality;
- Land-use;
- Geology, soils and erosion;
- Visual and aesthetics;
- Noise;
- Socio-economic;

- Tourism potential; and
- Heritage resources.

A status quo document (**Appendix F**), outlining the change in process and way forward, was distributed to all stakeholders listed within the Stakeholder Database. The following additional activities have been conducted to complete the Public Participation process.

Stakeholder meetings
Focus Group meetings were held with the Emnambithi/Ladysmith Municipality as well as the Swinburne Farmers Association on 7 November 2005. The purpose of these meetings was to inform key stakeholders about the change in consultants as well as the change in process which will result in the submission of an Extended Scoping Report. Minutes of these meetings are provided in **Appendix H**.

Review of Extended Scoping report
The draft extended scoping report was made available from 12 December 2005 to 23 January 2006. This comment period was to provide stakeholders with an opportunity to ensure that their concerns and issues had been addressed. Copies of the report were provided at the following venues:-

- Ladysmith Public Library
- Ladysmith Local Municipality
- Harrismith Public Library
- Harrismith Local Municipality
- Green Lantern Inn, Van Reenen

The following stakeholders also received copies for comment:-

- Department of Environmental Affairs and Tourism.
- KwaZulu-Natal Department of Agriculture and Environmental Affairs.
- Free State Department of Tourism, Environmental and Economic Affairs.
- Free State Department of Agriculture.
- Free State Conservation Department.
- Ezemvelo KZN Wildlife.
- Thabo Mofutsunyane District Municipality.
- Uthukela District Municipality.
- Emnambithi/Ladysmith Local Municipality.
- Maluti a Phofung Local Municipality.
- Besters Farmers Association.
- Harrismith District Farmers Union.
- South African Heritage Resources Agency.
- Institute for Cultural Resources Management.

- Wildlife and Environment Society of SA.
- Middelpunt Wetland Trust.
- South African National Roads Agency.
- N3 Toll Concession.
- Free State Department of Roads.
- Kwazulu Natal Department of Roads and Transport

Stakeholders were advised as to the availability of the document in the status quo document, as well as advertisements placed within national and regional newspapers (**Appendix L**).

Public open days and meetings
Additional public open days and meetings were held 17 and 18 January 2006 at the Harrismith Public Library and Emnambithi / Ladysmith Municipality Town Hall respectively. Stakeholders were informed of these meetings by personal invitation (**Appendix E**), within the status quo document and press advertisements. All stakeholders were afforded the opportunity to interact with the EIA project team members and Eskom and provide comment or queries. Minutes from the public meetings are appended (**Appendix J**).

Focus Group meetings
Focus group meetings were held on the 17 January 2006 at the Harrismith Public Library with both Swinburne Farmers Association and representatives of the Maluti a Phufong Municipality. Minutes of these meetings are presented in the **Appendix K**. Although a similar meeting was requested with representatives from the Emnambithi / Ladysmith Municipality (**Appendix M**), the municipality indicated that they did not require additional feedback from the EIA process (**Appendix M**).

All comments received during this period have been incorporated into the Comments journal, and addressed (where applicable) in the Final Extended Scoping report (this document) for submission to the Department of Environmental Affairs and Tourism for approval.

4 ALTERNATIVES TO THE PROJECT

The alternatives assessment has been drafted based on guidelines and methodologies outlined in "*EIA Regulations: Implementation of Sections 21, 22 and 26 of the Environment Conservation Act*" published by Department of Environmental Affairs and Tourism (April 1998). In accordance with these guidelines, layout, land use and development density alternatives were investigated. Note that 'No Go' option was not considered, since the access roads are required for the authorised Braamhoek PSS project.

4.1 Alternative 1 – Braamhoek Pass

The proposed alternative 1 route follows the Drakensberg Escarpment using the existing track, Braamhoek Pass. The new section of road will link with the existing road network (at D48) to the south of the Lower Reservoir, where the Provincial Road 275 (D275) will be upgraded to link to the R103 near Besters and part of the D48 will be upgraded. The S61 from the Drakensberg Escarpment to Kiesbeen, the S790 between Kiesbeen and Swinburne and the remaining section of the D48 would be maintained by Eskom during the construction period. This alternative will require the construction of 27 km of new road, and will result in a total road distance of ***19 km*** between the Lower and Upper Reservoirs (**Figure 4-1**).

This alternative will have a significant impact on ecology (biodiversity) as well as heritage resources. Several tributaries of the Braamhoekspruit will be traversed by the proposed road, including close proximity to a natural spring. In addition, positioning of the road will result in a significant negative impact on visual aesthetics of the area. The proposed route alignment will also have a significant detrimental impact on land use and tenure. However, this route will result in the shortest travel time between the upper and lower reservoir – approximately 20 minuts – as well as the lowest construction costs.

4.2 Alternative 2 – De Beers Pass

As in Alternative 1, the D48 and D275 will be upgraded to link to the R103 near Besters. The S61 from the Drakensberg Escarpment to Kiesbeen and the S790 between Kiesbeen and Swinburne would be maintained by Eskom during the construction period. A new link road along the escarpment will provide a link to the Upper Reservoir site. A new link road will link D48 to the Lower Reservoir site. This alternative will require the construction of 23 km of new road, and will result in a total road distance of 30 km (a travel time of approximately 30 minutes) between the Lower and Upper Reservoirs (**Figure 4-2**).

Figure 4-1: Proposed route alignment, Alternative 1

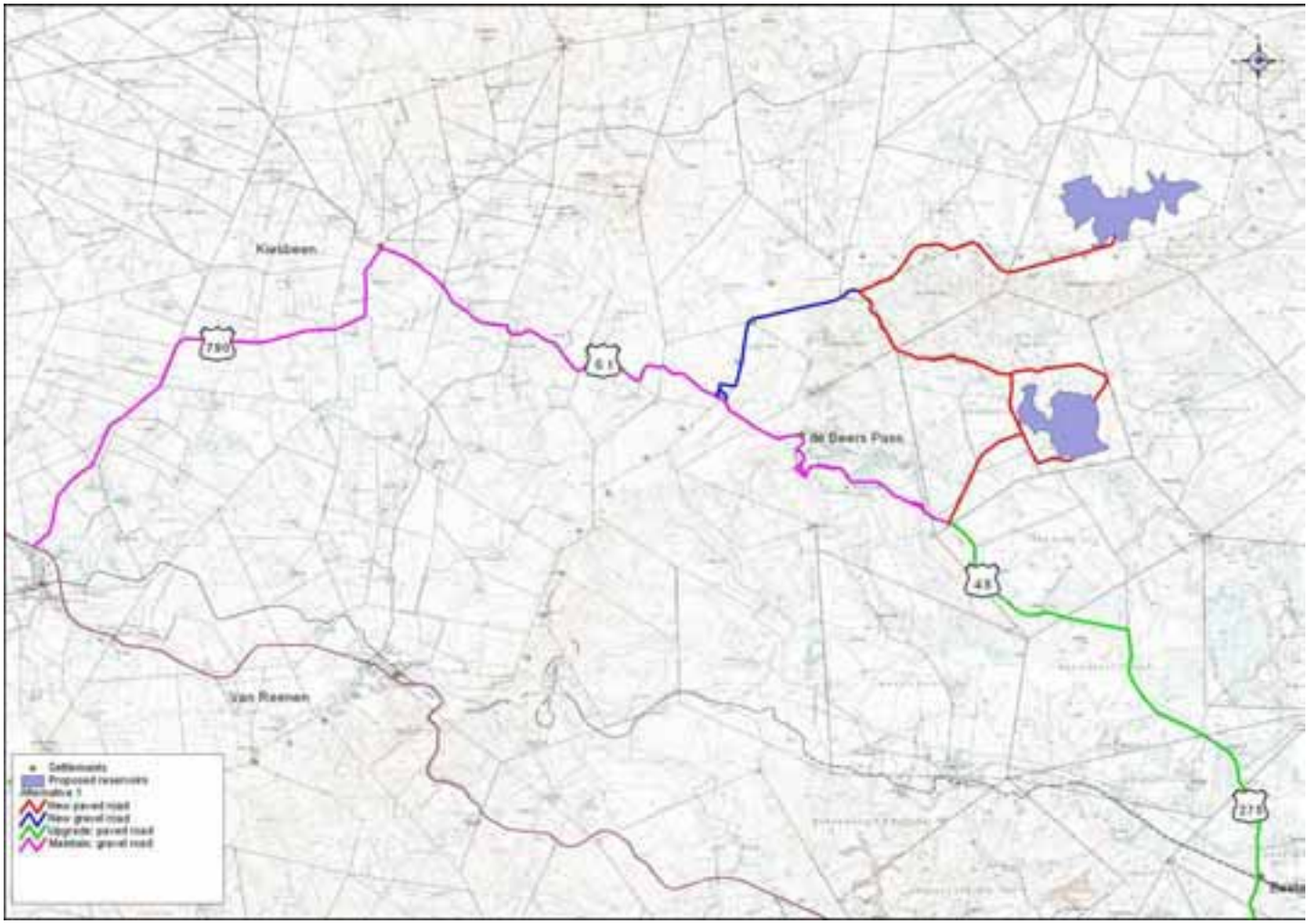
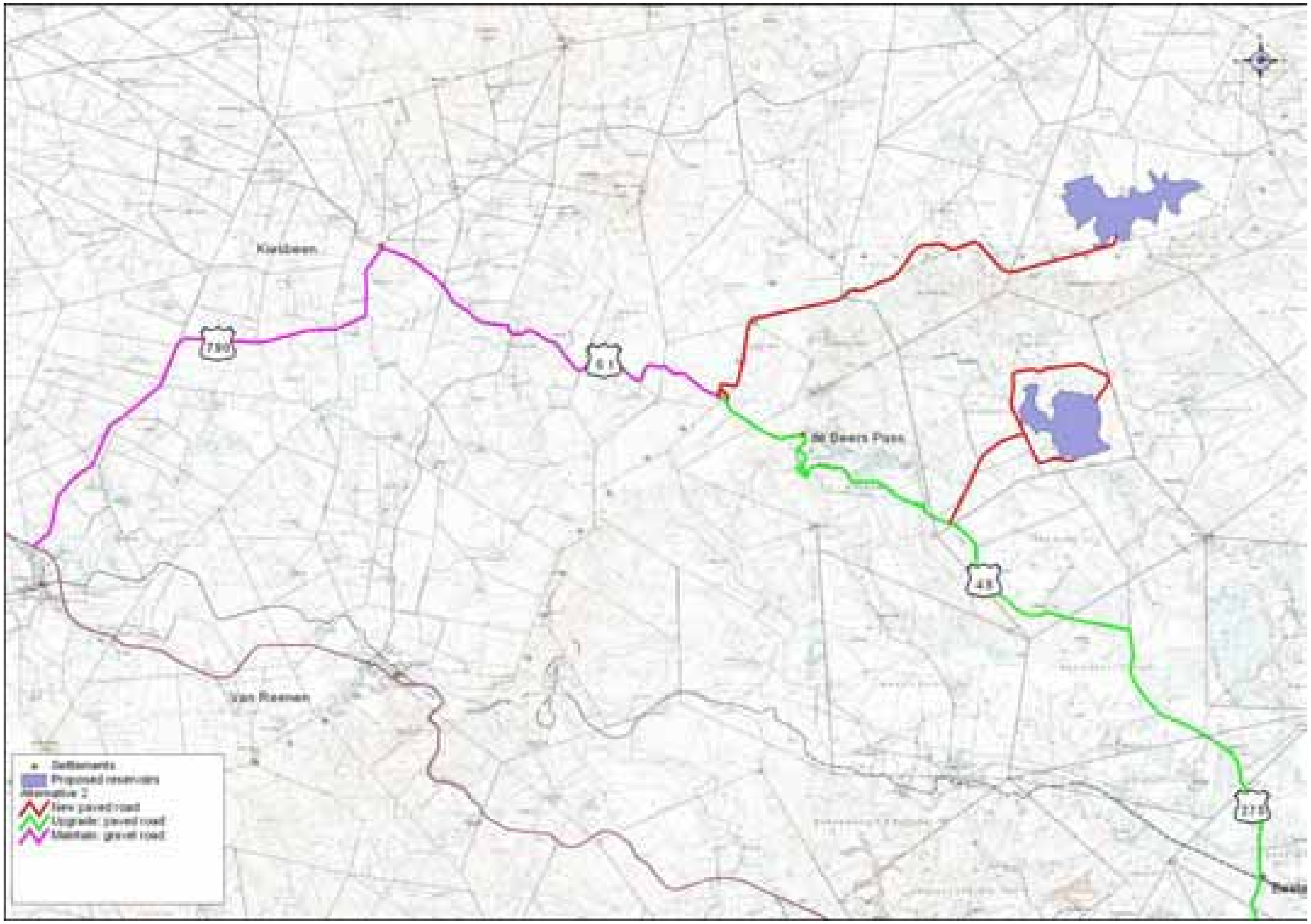


Figure 4-2: Proposed route alignment, Alternative 2



Running along the edge of the scarp, the proposed alignment can be expected to have significant negative impact on biodiversity within a sensitive environment. Design intervention can result in the construction of the road along the watershed, thus negating the potential impact on surface water hydrology. While land use will be reduced by the proposed scarp road, loss of land tenure will be minimised since the proposed route passes predominantly over an existing access road running over the farms Strathmorn 9878 and Bloemhoek 227. Similarly, the road will not be visible from any major transport route or residences within the area.

4.3 Alternative 3 – Kiesbeen to Skeurklip

This alternative will utilise the full length of the S61 and the D48, requiring full upgrading of these roads. The S922 will be upgraded to provide a link to the Upper Reservoir site. The D48 and D275 will be upgraded to link to the R103 near Besters. The S790 between Swinburne and Kiesbeen would be maintained by Eskom during the construction period. This alternative will result in a total road distance of **58 km** between the Lower and Upper Reservoirs, a travel time of approximately 1 hour (**Figure 4-3**).

This alternative is expected to have a minimal impact on biodiversity, land use and visual aesthetic. However, the road can be expected to have a negative impact on surface water resources since the existing route alignment traverses numerous watercourses and wetlands – most noticeably the Wilge River and associated flood plains – and would thus require significant design intervention in order to prevent and mitigate impacts on hydrological patterns. In addition, this route constitutes the longest travel time between upper and lower reservoir as well as the highest construction cost.

4.4 Comparative Assessment: Summary

The comparative assessment for each alternative is present below in **Table 4-4**. Each alternative is evaluated in terms of identified environmental and social criteria. The potential impact of the alternative on the criterion is assessed in terms of negative impact (-1), no impact (0) and positive impact (+1). In addition to these, the overall value of the alternative as well as travel time between reservoirs is assessed.

Figure 4-3: Proposed route alignment, Alternative 3

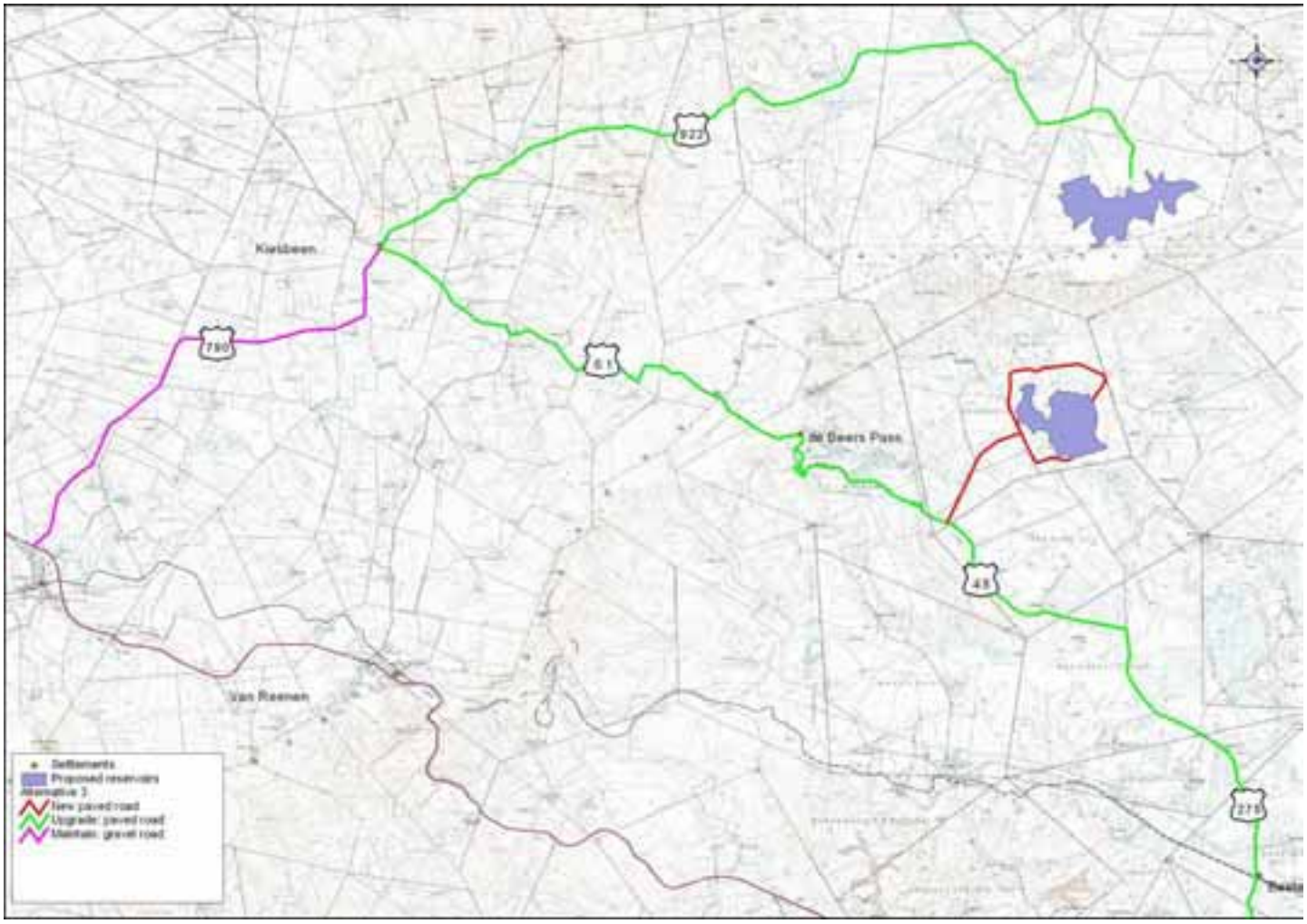


Table 4-1: Comparative alternative analysis

CRITERION	ALT 1	ALT 2	ALT 3
Ecological including fauna and flora	-1	-1	0
Surface water	-1	0	-1
Air quality	-1	-1	-1
Land-use	-1	-1	0
Geology, soils and erosion	-1	-1	-1
Visual and aesthetics	-1	0	0
Noise	-1	-1	-1
Socio-economic:			
Job creation	1	1	1
Land tenure (compensation)	-1	0	0
Tourism potential	1	1	1
Heritage resources	-1	0	0
Cost of Construction	1	0	-1
Travel Time	1	0	-1
TOTAL	**-5**	**-3**	**-4**

Several environmental and social criteria are impacted on equally by each alternative. Erosion potential, for instance, is high along all routes along drainage lines and watercourses, and will require significant design intervention such as armouring or cladding. Upgrading of gravel surfaces to paved surfaces or maintenance of existing gravel routes will automatically result in increased noise levels due to increased travel speeds along all routes.

It was determined that tourism potential may increase through the maintenance and upgrading of the S790, S61 and D48 over the De Beers Pass – as is the case with all three alternatives. The upgrading or maintenance of the S922 to the upper reservoir site can only be expected to increase tourism potential along the existing road up to the Braamhoek PSS and proposed conservancy area. This potential also exists through the construction of the proposed Scarp road, which will also provide access to the Conservancy area provided the road is accessible to the public. A detailed tourism potential assessment is appended (**Appendix N**).

It should be remembered that the ultimate purpose of the access roads is to provide the fastest possible travel time between the upper and lower reservoir in the event of an emergency, which therefore has community and personnel safety considerations. Thus, while alternative 3 may have relatively less impact from an environmental perspective, it is proposed that alternative 2 be utilised since any potential impacts can be minimised or negated through the implementation of a site specific EMP and various design interventions.

5 EIA METHODOLOGY AND APPROACH

5.1 Introduction

One of the objectives of this study is to identify and quantify the potential positive and negative impacts which the proposed roads will have on the receiving biophysical and socio-economic environment. Similarly, it will be required to consider alternatives in cases where the proposed alignment will have a greater social and environmental cost than is acceptable or can be mitigated for. The negative impacts will be mitigated to minimise their significance and the positive impacts will be enhanced as far as possible.

For sections of the road which traverse and are aligned through open spaces the focus is on preventing impacts, while for existing or upgrade projects the focus is on rehabilitation and mitigation of further impacts. Road impacts differ significantly from rural to urban settings. Activities in urban settings typically impact mostly in social or cultural function, such as disruption of existing travel routes and times, damage to residences or businesses and even compensation for the requisition of land along the alignment.

Key impacts in rural settings, however, revolve around the opening up of previously inaccessible (or marginally accessible) territory, in-migration as a result of job opportunities and large-scale resource harvesting. Introduction of new sources of noise pollution is often an issue in rural areas, where ambient noise levels are typically low. Furthermore, rural life and livelihoods are closely integrated with the biophysical aspects of the environment; issues such as water quality and biodiversity conservation deserve special attention.

This section of the report addresses the impact findings based on the initial evaluation and field survey. The detailed analysis followed for each of the specific road sections is described below. Impacts on specific environmental elements per kilometre distance are presented in Section 6. The summary of these impacts, divided into impact categories, form the basis of the assessment in Sections 6.2, 6.3 and 6.4. These impacts have been generated and identified by field investigation, specialist studies and evaluation. Input from the public and various authorities consulted during this process are also incorporated.

5.1.1 Impact Evaluation and Assessment Approach

Numerous assessment methodologies and approaches exist within the international sphere for assessing potential impacts of development activities on the environment.

When a particular method for environmental impact analysis is selected or used, certain general principles must be kept in mind to avoid the mystique and pseudo-science, which cloud many planning procedures. In general terms, an environmental assessment evaluation comprises four main tasks:-

- Collection of data;
- Analysis and interpretation of this data;
- Identification of significant environmental impacts; and
- Communication of the findings.

In addition to these, mitigation measures must be proposed and management options for the identified impacts must be provided. The selected impact evaluation method must enable these four tasks. Impact methodologies provide an organised approach for predicting and assessing these impacts. Any one methodology and approach will have opportunities and constraints, as well as resource and skill demands, and no one method is appropriate for all South African circumstances. The selected methodologies proposed by this document are appropriate for South African situations, taking the above criteria into account.

The selected Impact assessment methodology is compliant with the following criteria:-

1. *Comprehensiveness:* The environment consists of intricate systems of biotic and abiotic factors, bound together by complex relationships. The methodology must consider the impact on these factors.
2. *Flexibility:* Flexibility must be contained in the methodology, as projects of different size and scale result in different types of impacts.
3. *Detect true impact:* The actual impact that institutes environmental change, as opposed to natural existing conditional changes. Long-term and short-term changes should be quantified.
4. *Objectivity:* The methodology must be objective and unbiased, without interference from external decision-making.
5. *Ensure input of required expertise:* Sound, professional judgement must be assured by a methodology.
6. *Utilize the state of the art:* Draw upon the best available analytical techniques.
7. *Employ explicitly defined criteria:* Evaluation criteria used to assess the magnitude of environmental impacts should not be arbitrarily assigned. The methodology should provide explicitly defined criteria and explicitly stated procedures regarding the use of these criteria, including the documented rational.
8. *Assess actual magnitude of impacts:* A method must be provided for an assessment based on specific levels of impact for each environmental concern.
9. *Provide for overall assessment of total impact:* Aggregation of multiple individual impacts is necessary to provide an evaluation of overall total environmental impact.
10. *Pinpoint critical impacts:* The methodology must identify and emphasize particularly hazardous impacts.

Methods for identification of environmental impacts can assist in specifying the range of impacts that may occur, including their spatial dimensions and time period. Identification methods answer questions concerning the components of the project and what elements of the environment may be affected by these components.

FUNCTION	METHODOLOGY
Identification	• Description of the existing environmental system • Determination of the components of the project • Definition of the environment modified by the project
Prediction	• Identification of environmental modifications that may be significant • Forecasting of the quantity and/or spatial dimensions of change in the identified environment • Estimation of the probability that the impact (environmental change) will occur (time period)
Evaluation	• Determination of the incidence of costs and benefits to user groups and populations affected by the project • Specification and comparison of the trade offs (costs or effects being balanced) between various alternatives

In order to achieve this goal, the study was structured according to the following tasks:-

1. Identify sensitive social or environmental features along the alignments
2. Predict the significance of the impact on the features
3. Evaluate the impact in terms of social, environmental and financial cost
4. Determine the feasibility of the project and evaluate against the need for the project

5.1.2 Evaluation Methods

While the use of multiple evaluation methods may seem excessively demanding, it is usually obtaining the inputs to evaluation methods that is demanding. Once these inputs are available, application of the methods themselves is often relatively straightforward. A particular evaluation obviously should not be seen as equivalent to a decision; rather evaluation methods are designed as decision *aids* for decision makers. They do not replace the need for decisions to be made, particularly where issues such as fairness and distribution of costs and benefits are involved. Ultimately evaluation methods should serve as convenient means of connecting assumptions to consequences so that decision-makers can explore and more fully appreciate different alternatives and value sets to ultimately make better decisions.

5.1.2.1 Formal Procedure

An evaluation method is a formal, explicit, and thorough way of organising and describing choices. The amount and complexity of data characteristic of evaluations of large projects means that the iterative assessment process requires a method too comprehensive to be applied casually or intuitively. Methods are intended to be applied repeatedly, each time with deliberate changes in assumptions or data that produce changes in preferences. This evaluation process gradually shows how differences in environmental preferences result in different ratings among alternatives.

Where interests conflict, evaluation methods are used to assist in reconciling differences as far as possible.

5.1.2.2 Methodology Types

More than 50 impact analysis methodologies have been developed internationally. Of those considered, the two primary methods and variations on them selected in this instance are checklists and matrices, since these are mostly applicable.

Checklists can be divided into simple, descriptive, scaling, and scaling-weighting checklists. **Matrices** are subdivided into simple and stepped matrices. The key point with regard to all environmental impact analysis methodologies is that there are useful tools for examining relative environmental impacts of alternatives. They represent a tool that must be applied with professional judgement, and their results must also be interpreted using professional judgement.

Checklists contain environmental factors that need to be addressed relative to the impact of alternatives. The simplest approach is a checklist of potential impacts, which should be considered. The main disadvantage of checklists is that they must be exhaustive if no serious impact is to be overlooked. An exhaustive checklist is likely to be unwieldy and may stifle initiative during assessment. Checklists can contain categories and sub-categories as the classification and categorisation is refined. Due to the inherent limitations the most useful feature of checklists is as a basis for the construction of cause-effect matrices.

Matrices are particularly useful for EIA as they reflect the fact that impacts result from the interaction of development activities and the receiving environment. The matrix format is ideally suited for impact identification, although the ability of the Leopold matrix to identify indirect impacts has been questioned. This method is basically an extension of the checklist approach in the sense that it combines the checklist of project elements with the checklist of impacts. The Leopold matrix is also used to present the results of an appraisal.

5.1.3 Implementation Methodology

The technical analysis and evaluation of the envisaged projects were preceded by an extensive data collection effort. The entire project team visited the study area to ascertain themselves of local conditions, have discussions with knowledgeable people in the respective technical fields and acquire as much relevant legislative and technical documentation from previous projects as possible. After the information acquisition period, the project team interactively proceeded with the different technical, environmental, legislative and financial evaluations to assess the viability of envisaged projects.

The collection of information as required for this EIA spanned eight weeks, and comprised the following two phases:

Data Collection: Various specialists were incorporated into the project team, in order to determine the impacts on environmental and socio-economic factors identified during the Public Participation process. All specialists were mobilised during September 2005, providing approximately two months to conduct desktop assessments and literature reviews of the study area.

Field Surveys: The Environmental field assessment was conducted over a period of four weeks between October and November 2005. Additional field surveys were conducted where alignment changes had occurred.

Checklists were established for a) Environmental characteristics and b) Human development activities. These lists are comprehensive and feature all the necessary items on which to base an informed decision. The checklists are further categorised by single assessment sheets for each individual activity impacting on specific environmental parameters.

These are evaluated in terms of the following:-

- Nature and Extent

DESIGNATION	DESCRIPTION
Immediate	The impact restricted to the activity site
Local	The impact does extends beyond the area/boundary into the surrounds
Regional	The impact may extend over municipal boundaries
National	The impact may extend over provincial or international boundaries

- Duration

DESIGNATION	DESCRIPTION
Transient	The impact is predominantly linked to climatic events such as high winds/high rainfall etc.
Short	The impact only arises and persists through the construction phase
Medium	The impact persists through the construction and operational phases,

DESIGNATION	DESCRIPTION
	but cease after rehabilitation/decommissioning
Long	The impact persists after the rehabilitation/decommissioning phase but will cease as a result of the re-establishment of natural ecosystem processes
Permanent	The impact is permanent

- Status and intensity

DESIGNATION	DESCRIPTION
Low	Cultural and Ecosystem processes are not affected, or can be maintained at a high level of functionality through implementation of adequate mitigation measures. Impacts are reversible
Medium	Cultural and Ecosystem processes are impacted on, but can be functionally maintained through the implementation of adequate mitigation measures. Impacts, while severe, can be reversed
High	Cultural and Ecosystem processes are irreversibly impacted on, and may cease completely. Mitigation must be implemented to reduce these to within acceptable limits

- Probability

DESIGNATION	DESCRIPTION
Improbable	It is unlikely that the impact will arise
Probable	There is a 30% likelihood of the impact arising
Highly probable	There is a 75% likelihood of the impact arising
Definite	The impact will occur

The overall Significance of the impact is then determined, based on the above four criteria, and designated as described below.

DESIGNATION	DESCRIPTION
Negligible	The impact is not contrary to environmental legislation or objectives. No mitigation is necessary
Low	The impact, while not conforming to environmental legislation or objectives, can be reduced to within acceptable levels through the implementation of minimal mitigation measures
Medium	The impact does not conform to environmental legislation or objectives, and will require extensive mitigation to reduce the impact to within acceptable levels
High	The impact is contrary to environmental legislation or objectives. Extensive mitigation is required to reduce the impact to within acceptable levels. Alternatives to site placement or methodologies may be required.
Positive	The impact enhances environmental or cultural processes.

Together with the above, integrated in the evaluation checklist sheet, provision is made for:-

- Description of the impact: Nature, what causes the effect and how is it affected.

- Intervention specifications: Design, precautionary, management, rehabilitation and documentation.

- Monitoring specifications: What, how, frequency, deviation, detection and reporting.

Once the above assessment has been completed, an objective evaluation of the potential impact of the activity can be assured. The activity impact is then offset against the list of environmental characteristics in the cause-effect interaction matrix, which will be the evaluated significance. Affected environmental components will be categorised as primary effect and secondary or peripheral effect.

6 IMPACT DESCRIPTION

6.1 Introduction

The Impact assessment conducted below pertains specifically to all potential impacts – both positive and negative – which may arise at any phase of the development of the proposed Alternative 2 alignments. Two phases have been identified in which significant impacts may arise:

- Construction phase
- Operational phase

A description of the Macro and Micro impacts which can be expected to arise as a result of construction and operation phase activities associated with the road construction and upgrade project is presented below. Mitigation measures are presented in the assessment tables below.

The Planning and Development phase, as well as the closure phase, have been discarded since no impacts will arise during these phases due to the nature of the project.

6.2 Macro Impacts Associated with the Construction Phase

6.2.1 Air Quality

Environmental Description		
Dust generation and Air quality: Negative Impact		
Impact Descriptions		
Construction activities such as clearing and grubbing, topsoil removal, trenching and storage as well as the movement of construction vehicles generate dust. The dust will influence the air quality in the immediate vicinity of the construction activity.		
	Description	**Summary**
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The Impact will only persist during the construction phase	Short
Probability	Distinct possibility that impact will occur	Probable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Medium, and requires mitigation	Medium
Mitigation		
• Dust suppression to be conducted • Construction activities to occur only along alignment or within construction camp		

- Natural vegetation to be left as erosion protection
- Construction workers to follow prescribed precautions when working in dusty conditions

6.2.2 Environmental Aesthetic

Environmental Description		
Construction Camp and Site offices: Negative impact		
Impact Descriptions		
The construction camp and site offices could have an impact on the environment if the placement or design is poorly situated. Domestic waste as well as construction waste generated at the construction camp could also impact on the fauna and flora in the area as well as the human health of construction workers and the community if it is not removed to a landfill site. The management of construction camps throughout the project construction phase has to be managed effectively. Construction camps will have a significant impact on surrounding communities for the duration of the construction activity.		
	Description	**Summary**
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The Impact will only persist during the construction phase	Short
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Low	Low
Mitigation		
• The placement of the construction camps must be negotiated with the local land owners and community leaders • The construction camps must be placed on a disturbed piece of land • Indigenous vegetation must not be disturbed if at all possible • The contractor must supply the workers with firewood or preferably gas cooking appliances, to ensure that wood is not harvested from the surrounding vegetation		

6.2.3 Ecological: Flora and Fauna

Environmental Description
Removal of vegetation during road construction: Negative impact
Impact Descriptions
Road construction activities will have result in loss of vegetation along new routes. The loss of biodiversity, while not encouraged, must be mitigated through proactive and reactive mechanisms.

	Description	Summary
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Medium, and requires mitigation	Medium

Mitigation

- Movement of machinery must be restricted to demarcated areas only
- Indigenous vegetation must not be disturbed outside of the surveyed alignment
- No movement of machinery will be allowed outside of demarcated areas
- Fines to be imposed for the infractions relating to habitat conservation

6.2.4 Erosion

Environmental Description

Erosion: Negative impacts

Impact Descriptions

Construction activities such as clearing and grubbing, topsoil removal, trenching and storage of materials could cause erosion during rainstorms or flooding. Erosion of the soil or run-off from construction materials could cause siltation of the water bodies in the surrounding area. As indicated, the soils occurring within the study area are highly erodable.

	Description	Summary
Nature and Extent	The impact is likely to extend across provincial or national boundaries	National
Duration	The impact is permanent	Permanent
Probability	The impact will definitely occur	Definite
Intensity	Natural, Cultural and Social function is irrevocably altered, and may temporarily or permanently cease.	High
Significance	The significance is High. Extensive mitigation or design intervention is required	High

Mitigation

- The location of topsoil and other construction material stockpiles must be carefully considered to minimise siltation / pollution of water sources
- These stockpiles must be clearly demarcated and stabilised to ensure minimum erosion during rainstorms
- Construction activities to disturb as small an area as possible – natural vegetation to be left as erosion protection
- Construction vehicles must be maintained regularly and services conducted in clearly demarcated service areas designed to contain fuel and oil spillages

6.2.5 Disturbance of Surface Flow

Environmental Description		
Soil, surface and groundwater pollution: Negative impacts		
Impact Descriptions		
Erosion of the soil or run-off from construction materials could cause siltation of the water bodies in the surrounding area. Hydrocarbon spills from poorly maintained construction vehicles could pollute the soil and water. The location of the construction camp and construction materials should be considered carefully to minimise potential impacts on soil and water bodies. The proposed scarp road will be constructed along major watersheds. Incorrect alignment may impact on surface water flows within either catchment.		
	Description	**Summary**
Nature and Extent	The impact restricted to within municipal boundaries	Regional
Duration	The Impact will only persist during the construction phase	Short
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural and Social function is irrevocably altered, and may temporarily or permanently cease.	High
Significance	The significance is High. Extensive mitigation or design intervention is required	High
Mitigation		
• The location of topsoil and other construction material stockpiles must be carefully considered to minimise siltation / pollution of water sources • Route alignments to be designed to minimise impact on natural runoff patterns • These stockpiles must be clearly demarcated and stabilised to ensure minimum erosion during rainstorms • Construction activities to disturb as small an area as possible – natural vegetation to be left as erosion protection • Construction vehicles must be maintained regularly and services conducted in clearly demarcated service areas designed to contain fuel and oil spillages		

6.2.6 Noise Pollution

Environmental Description
Noise generation: Negative impact
Impact Descriptions
Noise is generated by construction activities such as clearing and grubbing, layer works, trenching and cement / asphalt batching. Construction vehicles generate noise.

	Description	Summary
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The Impact will only persist during the construction phase	Short
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural or Social functions are unaffected by the impact	Low
Significance	The significance is Low	Low

Mitigation

- Construction workers to adhere to health and safety standards as prescribed in the EMP
- Working hours should be restricted to reduce impacts on the neighbouring residences at night
- All machinery and plant to conform to national noise reduction standards
- All plant to be well maintained and fitted with effective mufflers

6.2.7 Socio-Cultural Environment

Environmental Description

Health implications: Negative social impact

Impact Descriptions

Easier access into once relatively remote areas has the probability of increasing the influx of more people. Rural communities, whose lifestyles consisted to a large extent on a traditional lifestyle, will be more susceptible to influences from the urban areas. Diseases such as HIV/AIDS are a reality and can significantly impact on rural communities. Similarly the influx of skilled and unskilled work force on the construction of the project will also impact negatively on local communities, if not managed effectively. Aspects such as the placement of the construction camps to limit contact with the local community will be further explored in the mitigation phase of the project.

	Description	Summary
Nature and Extent	The impact is likely to extend across provincial or national boundaries	National
Duration	The Impact will only persist during the construction phase	Short
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural and Social function is irrevocably altered, and may temporarily or permanently cease.	High
Significance	The significance is High. Extensive mitigation or design intervention is required	High

Mitigation

- Construction camps should be placed in locations where construction workers from areas outside the community have limited access to the community.
- Education programs should be implemented to educate construction workers as well as the surrounding communities on potential diseases associated with the influx of people from other regions.

Environmental Description		
Creation of employment opportunities: Positive impact		
Impact Descriptions		
A significant impact is the short-term wealth expectation created by any development project. Unskilled labour should be used during the construction process, and if possible labour intensive construction methods should be employed where possible. This facilitates adequate transfer of skills. Based on current employment and skill levels within the local communities, a significant number of skilled positions, such as machinery operators, can be filled from within local communities.		
	Description	**Summary**
Nature and Extent	The impact restricted to within municipal boundaries	Regional
Duration	The Impact will only persist during the construction phase	Short
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural or Social functions are unaffected by the impact	Low
Significance	The impact is Positive	Positive
Sustainability Actions		
• Local unskilled or semi-skilled labour (including women) should be used as far as possible during the construction of the road through a local labour recruitment plan • Mechanisms and structures to ensure the appropriate development and transfer of skills to the local community should be established • Labour intensive construction methods should be employed where possible • An overall development / land use plan for the surrounding area should be implemented to ensure that potential future conflicts are identified and mitigated		

6.3 Macro Impacts Associated with the Operational Phase

6.3.1 Air Quality

Environmental Description
Dust generation and Air quality: Negative Impact
Impact Descriptions
Potential road users could generate dust if the road surface or shoulders are not maintained. With the upgrade of the road infrastructure, it can be expected that the vehicle emissions level will decrease, due to more efficient vehicle operation and reduced stop-start traffic.

	Description	Summary
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The impact will persist into operational phase	Medium
Probability	Possibility of impact arising is very low due to design/historic experience	Improbable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Medium, and requires mitigation	Medium

Mitigation

- The road surface and shoulders to be maintained regularly to eliminate potholes and reduce dust entrainment

6.3.2 Noise Pollution

Environmental Description

Noise generation: Negative impact

Impact Descriptions

Noise will typically be an impact associated with the road as long as it is in operation. It is not envisaged that the daily traffic flow will increase to such an extent that the noise levels will present a problem. An improvement in the quality of the road will probably result in a decrease of noise, however faster speeds do increase the level of noise pollution. Speed restriction should decrease noise in these areas.

	Description	Summary
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural or Social functions are unaffected by the impact	Low
Significance	The significance is Medium, and requires mitigation	Medium

Mitigation

- Regular maintenance of the road to ensure road safety and to reduce noise as a result of potholes and vehicles reducing speed to avoid them
- Noise in significantly sensitive cultural and social areas can be mitigated by berms and planting of vegetation screens where and if required
- Speed limiting interventions, such as speed humps or speed restrictions, to be implemented along roads

6.3.3 Disturbance of Surface Flow

Environmental Description

Soil, surface and groundwater pollution: Negative impacts

Impact Descriptions		
Daily natural water resources play a very significant part in the biophysical and human environment. The most significant impact will be a change in the water velocity (run-off), flow quantities and water quality due to construction of impervious surfaces. All water resources must be protected, including all hydrological and aquatic systems. Pollution of the water sources could impact on the health of the neighbouring community, construction and facility workers.		
	Description	**Summary**
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural and Social function is irrevocably altered, and may temporarily or permanently cease.	High
Significance	The significance is High. Extensive mitigation or design intervention is required	High
Mitigation		
• The road surface should be maintained regularly to minimise accidents which result in spillage of hazardous materials • Water user licences (if applicable) will be obtained from Department of Water Affairs and Forestry for water required during the maintenance use • A suitable hazmat response programme to be initiated during the maintenance phase, to reduce the probability of the accidental hazardous material spills from entering the natural environment		

6.3.4 Socio-Cultural Environment

Environmental Description		
Increased accessibility: Positive and negative impact		
Impact Descriptions		
Maintenance and repair of the S790, S61 and D48 will improve access of local communities to health, education and market/business facilities as well as improve access to tourism-related industries (**Appendix N**) in the area. Easier and efficient access to these facilities will greatly improve the quality of life of communities along the alignments. On the other hand, improvement of infrastructure may lead to increased crime within the area.		
	Description	**Summary**
Nature and Extent	The impact restricted to within municipal boundaries	Regional
Duration	The impact will persist into operational phase	Medium
Probability	Distinct possibility that impact will occur	Probable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Medium, and requires mitigation	Medium
Mitigation		

- Eskom to Liaise with local law enforcement agencies to ensure effective policing within region
- Eskom to ensure labourers are aware of consequences of fostering illegal activities
- Eskom to assist in the establishment of policing forums within the construction areas

Environmental Description		
Reduced travel times and operating cost: Positive impact		
Impact Descriptions		
One of the most significant benefits of improved transport infrastructure is reduced travel times. This will constitute tremendous cost savings and production turn-around times, which can in turn stimulate local and regional economies. Vehicle operating costs in terms of maintenance and energy inputs will be decreased through the upgrade, once again contributing to stimulating efficiency and cost savings.		
	Description	**Summary**
Nature and Extent	The impact restricted to within municipal boundaries	Regional
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural or Social functions are unaffected by the impact	Low
Significance	The impact is Positive	Positive
Sustainability Actions		
• Pavement layers and bridge structures must be regularly maintained • Ensure that erosion is minimal during the wet season to improve road safety • Areas where the road passes through social or cultural gathering places should be clearly marked with road signage and sufficient road crossings should be introduced		

Environmental Description		
Upgrading of current infrastructure: Positive impact		
Impact Descriptions		
The project will upgrade the existing poor infrastructure to an acceptable level through upgrading of existing routes and the construction of new routes. Erosion control measures will be implemented where required and rehabilitation measures instituted. Existing stormwater management structures can be rehabilitated to improve storm water management.		
	Description	**Summary**
Nature and Extent	The impact restricted to within municipal boundaries	Regional
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Natural, Cultural or Social functions are unaffected by the impact	Low
Significance	The impact is Positive	Positive
Sustainability Action		
• Erosion control measures must be implemented where required and rehabilitation measures instituted		

- Effective storm water management systems and structures must be put in place and existing structures to be retained must be rehabilitated
- Stormwater must be managed to minimise erosion and siltation of aquatic systems

Environmental Description		
Safety along the alignment: Negative and Positive social implication		
Impact Descriptions		
Poorly maintained and un-surfaced roads impact significantly on the safety of vehicle users, especially of pedestrians and private vehicles as are found in the study area. Upgrading of the route alignment and surface will invariably increase the design speed of the road, and vehicle travel speeds can be expected to increase dramatically. Conversely, increased vehicle speeds will impact negatively on current pedestrian road users or hawkers on the roads.		
	Description	**Summary**
Nature and Extent	The impact does not extend further than the project boundary	Local
Duration	The impact will persist into operational phase	Medium
Probability	It is highly likely that the impacts will occur	Highly Probable
Intensity	Although altered, Natural, Cultural and Social function can be maintained	Medium
Significance	The significance is Medium, and requires mitigation	Medium
Mitigation		
• The road must be maintained regularly and traffic calming measures implemented in areas of high risk with increased community members in the surrounding area of the road. • Areas where the road passes through important social or cultural gathering points should be clearly marked with road signage, and sufficient road crossings and traffic calming measures should be introduced.		

6.4 Environmental Impact Checklists

Micro impacts, which may impact on specific environmental features (indicated in **Figure 6-1**) along the route alignments, are provided below in **Table 6-1**. A photographic summary of the impacts at specific points along the alignments are provided in **Figures 6.2a** to **6.2i**.

Table 6-1: Micro Impacts associated with the proposed Alternative 2 alignment

REFERENCE	PHOTO NO	LOCALITY (KM)	FEATURE / ACTIVITY DESCRIPTION	ENVIRONMENTAL FACTOR																																		
				AIR		WATER		LAND			FAUNA AND FLORA			HUMAN USE								QUALITY OF LIFE						IMPACT					COST WITHOUT MITIGATION	
				Dust level	Emissions	Surface water flows	Surface water quality	Erosion/deposition	Drainage patterns	Slope stability	Sensitive habitats	Terrestrial flora/fauna	Aquatic flora/fauna	Infrastructure	Public facilities	Agriculture	Livestock	Forestry	Economic	Industry / commerce	Residential	Social structure	Public health and safety	Family finances	Noise level	cultural heritage	Landscape quality	Duration	Extent	Probability	Intensity	SIGNIFICANCE	Community	Project cost
1	1	1.1	S790 Maintain: heritage resource																							X		P	I	L	M	**L**		
2	2	2.3	S790 Maintain: stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
3	3	5.9	S790 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
4	4	8.4	S790 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
5	5	8.7	S790 Maintain: heritage resource																							X		P	I	L	M	**L**		
6	6	10.0	S790 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
7	7	12.5	S790 Maintain: stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
8	8	14.5	S790 Maintain: stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
9	9	16.0	S790 Maintain: heritage resource																							X		P	I	L	M	**L**		
10	10	17.0	S61 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
11	11	18.7	S61 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
12	12	20.4	S61 Maintain: heritage resources																							X		P	I	L	M	**L**		
13	13	20.6	S61 Maintain: heritage resources																							X		P	I	L	M	**L**		
14	14	20.8	S61 Maintain: Stream crossing	X	X	X	X	X				X	X				X									X		P	I	H	H	**H**		X
15	15	22.3	S61 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
16	16	23.5	S61 Maintain: Stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
17	17	26.6	S61 Maintain: Stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
18	18	27.7	S61 Maintain: Stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
19		29.1	S61 Maintain: heritage resources																							X		P	I	L	M	**L**		
20	20	29.2	S61 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
21	21	29.9	S61 Maintain: Stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
22	22	30.1	S61 Maintain: heritage resources																							X		P	I	L	M	**L**		
23	23	32.1	S61 Maintain: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
24	24	34.2	D48 Upgrade: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
25	25	37.2	D48 Upgrade: Stream crossing	X	X	X	X	X				X	X				X											P	I	H	H	**H**		X
26	26	37.9	Braamhoek access road: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
27	27	38.7	D48 Upgrade: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
28	28	40.2	D48 Upgrade: road habitus	X	X			X				X					X											P	I	H	L	**L**		X
29	29	41.7	D48 Upgrade: heritage resources																							X		P	I	L	M	**L**		
30	30	45.3	D48 Upgrade: road habitus	X	X			X				X					X											P	I	H	L	**L**		X

REFERENCE	PHOTO NO	LOCALITY (KM)	FEATURE / ACTIVITY DESCRIPTION	ENVIRONMENTAL FACTOR																																		
				AIR		WATER		LAND			FAUNA AND FLORA			HUMAN USE								QUALITY OF LIFE						IMPACT					COST WITHOUT MITIGATION	
				Dust level	Emissions	Surface water flows	Surface water quality	Erosion/deposition	Drainage patterns	Slope stability	Sensitive habitats	Terrestrial flora/fauna	Aquatic flora/fauna	Infrastructure	Public facilities	Agriculture	Livestock	Forestry	Economic	Industry / commerce	Residential	Social structure	Public health and safety	Family finances	Noise level	cultural heritage	Landscape quality	Duration	Extent	Probability	Intensity	SIGNIFICANCE	Community	Project cost
31	31	45.8	D275 Upgrade: road habitus	X	X			X				X					X										P	I	H	L	**L**		X