

# AN ASSESSMENT OF ECOLOGICAL SENSITIVITY OF PROPOSED SERVICE ROADS TO THE FARMS BEDFORD 389 FREE STATE AND BRAAMHOEK 1220, KWAZULU-NATAL.

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## INTRODUCTION

At the request of T. van Viegen of the firm AFRICON, an assessment of the sensitivity of three proposed access routes and construction sites comprising the Braamhoek Pumped Storage Scheme was undertaken over the period 26-30 September 2005. The current proposal was that provincial roads would be upgraded, and new roads constructed. All access roads would have a 30 m wide servitude. These roads would mostly be surfaced with gravel with small sections paved, to accommodate construction vehicles and equipment.

The area lies above and below the Drakensberg Escarpment with dams to be constructed on the farms Braamhoek in KwaZulu-Natal and Bedford in the northeastern 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 Braamhoek 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 a shallow topsoil with a highly erodible 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 Option 1 and Option 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 Option 2 and Option 3 is likely an observation artifact 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 Option 2 is likely to be substantially greater than that of Option 3, despite the latter being a longer route.

## **ACCESS ROADS TO THE FARMS BRAAMHOEK, THE DAM CONSTRUCTION CAMP SITE AND TO THE FARM BEDFORD AND CONSTRUCTION SITE.**

### **OPTION 1**

De Beers Pass road to Zaaifontein (JKN)

This section of the proposed road originates at Point J from the De Beers Pass road and consists of a track on the farm Braamhoek 1220. This track runs north-easterly for approximately two kilometers 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 NNE in a shallow arc through *H. hirta* dominated grassland for approximately 2,5 km before linking up with an existing north-south track about one kilometer south of Point K. 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 (Table 1). A seep and drainage line within the former burnt area may lie along the proposed route.

From the junction of this proposed section to K and on to N an existing track runs through a wetland for approximately three kilometers. 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.

### **Braamhoek to Chatsworth (KP)**

An existing track branches off the JK track and extends northwards to a former farmhouse in northwestern Braamhoek, situated in a stand of *Syringa* *Melia azerdarach* and Wattle *Acacia* spp. The proposed new road extends northeast from K to P crossing an 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<sup>0</sup> 17' 15,3" S; 29<sup>0</sup> 33' 16,2" E 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* 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, from P 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 (Table 1).

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* 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.

## **OPTION 2**

Track from De Beers Pass road over the farms Strathmorn, Blomhoek, Chatsworth, Oulston to Bedford (TPS)

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* grew at the junction of the track with that of Option 1 at P.

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 (Table 1). 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.

A list of the flora recorded mostly between Points P and S are incorporated in Table 1.

### **OPTION 3**

A provincial road from the Farm Kiesbeen to Bedford (RB)

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<sup>0</sup> 13' 58,8" S; 29<sup>0</sup> 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. Dencutting 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.

### **SWINBOURNE TO KIESBEEN (AR)**

The gravel road from the N3 at Swinbourne (A) to the farm Kiesbeen 426 is also 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 previous section 'natural' grassland still occurs along the fencelines, 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.

## **DE BEERS PASS ROAD (RE)**

The provincial road from the farm Kiesbeen (R) to Bester (E) over De Beers Pass is similar in construction to that of the previous provincial roads, with a similar width. It is initially quite rough becoming less stony from point T onwards to E. 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*, *Salix 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.

## **BESTER TO N3**

The road from Bester to the N3 is a tarmac road with a road servitude width of 20 m. Like that of the other provincial roads the road reserve is comprised primarily of *Hyparrhenia hirta* grassland. Stream and wetland crossings have been in some cases reinforced with gabions, especially at a bridge across a deep donga, the latter originating some distance upstream.

## **BRAAMHOEK CONSTRUCTION 'VILLAGE'**

The proposed siting of the Braamhoek Construction Village within a large clump of alien trees, including Poplars *Populus deltoideus*, Wattle *Acacia mearnsii* and *A. dealbata* as well as many other alien species and large numbers of fruit trees situated around an old homestead, will have limited impact on the environment at this site. The area appears to have previously been a relatively prosperous farmhouse with numerous outbuildings with an extensive garden. Little in the way of indigenous species is still present on the site none of which are rare or threatened. To the contrary, the site is extensively degraded as a result of the former development and subsequent neglect with weeds and ruderals commonplace.

An access road to the Construction Village is planned from Point K north across the wetland to this Site for ease of access from the actual dam wall construction site. The former farm access road to the homestead actually starts close to the Braamhoekspruit and extends diagonally NW across the wetland to the homestead. Due to the burnt nature of the grassland few plant species could be identified along this stretch. Which of these two tracks would have the greatest impact is difficult to say as few plants were flowering. The shortest and most

direct route is the proposed new road, which runs more or less parallel to the drainage systems whereas the former track extends diagonally across a portion of the wetland.

## **TUNNEL CONSTRUCTION SITE**

An access road and tunnel construction activity has impacted on the natural grassland formerly occurring on the site. Many clumps of *Watsonia* sp. cf *lepida/ confusa* were still growing adjacent to the tunnel trench some even along the edge. The grassland appeared to have a similar plant community to others in the vicinity. A stream flowed between the tunnel area and the construction camp with a stand of Blue squill *Scilla natalensis* growing along the left hand bank.

### **Red Data Species**

During the site visit five Red Data Book species namely *Eucomis autumnalis* ssp *clavata*, *Dierama* sp. cf *nixonianum* and *Scilla natalensis* listed as Vulnerable, and *Hoffmannseggia sandersonii* and *Aloe dominella*, both listed as Lower Risk –least concern. (Hilton-Taylor 1996, Scott-Shaw 1999), were observed. The first two species were growing respectively at and down slope from the spring along a dolerite outcrop along the Option 1 route. *Scilla natalensis* was observed along the stream adjacent to the tunnel construction site on the farm Zaaifontein 1074. Both *H. sandersonii* and *A. dominella* occurred along the proposed route of Option 1 between K and P.

### **Fauna**

The fauna of the area is impoverished with no signs of any large ungulate, the largest mammal recorded being Aardvark *Orycteropus afer*. Burrows of this species were widespread and observed along both Options 1 and 2 and it is probable that the animals regularly cross Option 3. However it is likely that densities are low. Other species seen or deduced as being present include Porcupine *Hystrix africae-australis*, Scrub hare *Lepus saxatilis*, and the Common Mole Rat *Cryptomys hottentotus* which were widespread. It is possible that some burrows were of the Hottentot Golden Mole *Amblysomus hottentotus* while a Highveld gerbil *Tatera brantsi* colony was recorded in shallow soils around bedrock outcrops on the farm Oulston 8510. None of these species are considered rare or threatened.

The avifauna was typical of Highveld grasslands with Orange-throated Longclaws *Macronyx capensis*, Grassveld Pipits *Anthus cinnamomeus* and Long-tailed Widow *Euplectes progne*, common. Jackal Buzzards *Buteo rufofuscus* were frequently seen and a solitary Bald Ibis *Geronticus calvus* listed as Vulnerable in the Red Data Book (Barnes 2000) was seen along Option 2 on the farm Bedford. Two Crowned Cranes *Balearica regulorum*, a threatened species (Barnes 2000) were seen at wetlands on the farm Bedford. Due to extensive veld burning little cover remains for specialized birds such as the

Critically Endangered White-winged Flufftail *Sarothrura ayresi* which has been recorded from the farms Chatsworth and Bedford (Barnes 2000).

Due to the extensive grass fires and dry conditions few reptiles and no amphibians were seen. Only Delalande's Sandveld Lizard *Nucras lalandei*, the Variable Skink *Trachylepis varia* and Drakensberg Crag Lizard *Pseudocordylus melanotus* were recorded, none of which are rare or threatened.

## **DISCUSSION**

According to the Site Manager F. Loubscher, Option 1 was the preferred route as it was the shortest distance between the upper and lower reservoirs, with the emphasis on quick access in the event of a problem occurring at the upper site. Failing that then Option 2 was the next best and lastly Option 3, the latter route being substantially longer and therefore taking much longer to reach the upper site.

For the sake of convenience it is best to discuss each option on its own merit as follows:

### **Option 1**

The upgrading of the 'established' track across the wetland between N, K and J will have limited impact due to the existence of the current track and flooding of the wetland by the proposed dam on the southern side. The area had been burnt and in some parts was still blackened from the fire. Few plants could be identified along this section. The seep and associated drainage line in the burnt grassland between J and K should be avoided as this is a sensitive area which could destroy one of the wetland feeding into the dam basin.

The section of road between Points K and P is considered to be the most sensitive route of the three options proposed. Not only will it extend across wetlands including a spring and a high floral diversity, including several Red Data Book species, it proceeds up a spur which along the upper section is relatively narrow with steep sides and therefore unsuited for the type of access road envisaged. Already substantial erosion has taken place along the spur and adjacent valleys. There is a risk of severe damage to the scarp zone and associated forest patches should the road be constructed here. The high plant species richness recorded (Table 1) is a consequence of the range of habitats occurring along this route as result of topography, altitude and climate. Many other species not recorded at this time are also likely to occur.

Much of the catchment of the proposed Braamhoek dam may be affected by this proposal, with a reduction in water flowing into the dam as well as a probable increase in siltation, as a result of this road.

## Option 2

The proposed road along the escarpment is as sensitive as Option 1 as it runs along the edge of the escarpment mostly along the watershed but on occasions flanking drainage lines flowing south down the escarpment. Many of these drainage lines have been impacted by poor farming practices, with severe donga erosion in parts. This could be exacerbated by the road development. As currently planned the road follows an existing farm track linking farms together. It is only on the farm Oulston at Point P that the road veers around a sensitive wetland while a diversion on the same farm further east may actually cross the upper portion of the wetland.

Although fewer plant species were recorded than that along Option 1 (Table 1), this is not comparable as most of the area had been recently burnt and few plants were emerging, fewer being in flower, especially the grasses. In addition the topography along this route is undulating and presents poorer habitat diversity than is present along Option 1. However there may be rare and threatened plant species along this route which were not observed due to the current condition of the grassland.

Bird species such as the White-winged Flufftail, a critically endangered species has been recorded from farms along this route. Such birds are dependent on wetland habitat including well vegetated seeps and vleis, some of which occur along the route. Where possible the route should avoid traversing such areas.

## Option 3

This provincial road is the least sensitive of the three options. Not only is there an existing gravel road within a 20 m wide servitude but most of the area within the road reserve has been impacted on during road construction, hence the dominance of the vegetation by the grass *Hyparrhenia hirta*. Most of the original vegetation cover has been removed and has not returned due to the condition of the road verge. In some instances a narrow zone of the former vegetation cover exists along the farm fence and more rarely within the Road reserve, where construction activities have not been as extensive. Plant species richness is therefore low with few species being recorded (Table 1).

Stream and wetland crossings along the road also show signs of erosion such as incised channels, mostly downstream of the these structures as a result of the road bridges and drifts as well as current farming practices,. This has been exacerbated by flood or high flow debris piling up against these bridges, blocking the culverts and forcing the water to flow along other paths of least resistance, frequently resulting in erosion. Some of the crossings have been bolstered by gabions to prevent such erosion but if the culverts are blocked the flood waters must find an alternative route. Alien wattles occur within the road servitude along some of the streams.

## Provincial gravel roads

The remaining Provincial gravel roads including the road from Swinbourne to Kiesbeen and from Kiesbeen to Bester over De Beers Pass are similar in condition to that of Option 3, with at least a 20 m servitude. Comments are similar to that expressed under Option 3. Thatch grass *Hyparrhenia hirta* dominates the road reserve along the length of the road with few exceptions such as parts of De Beers Pass where *Hyparrhenia tamba* appears to dominate over small sections, mostly more moist than elsewhere.

Alien trees such as *Salix fragilis*, Wattle *Acacia mearnsii* and occasionally Weeping Willow *S. babylonica* occur along some of the streams. Ouhout *Leucosidea sericea* also occurs along streams, but most areas around bridges have been substantially disturbed.

On the farm Berriesvale 1656 the road runs above a horseshoe bend in the river which could be especially vulnerable to disturbance by major roadworks.

The tarmac road from Bester to the railway crossing is similar in width to that previously described and with a similar vegetation cover. The sides of a donga along this stretch of road have been bolstered by gabions to prevent further erosion under the bridge.

Due to the degree of disturbance and poor biodiversity these roads have a low sensitivity value.

In this area erosion is very prevalent on most if not all of the farms along the route. Causative factors differ but are mostly linked to the timing and frequency of veld burning, the grazing of livestock and the layout and maintenance of farm tracks. With regard to the first, veld burning takes place mostly during spring with the result that the slopes are bare of vegetation permitting the rapid runoff of water into drainage lines. This rapid influx of water erodes the stream banks resulting in incised channels. This is exacerbated by the grazing of livestock following the sprouting of grasses which have been stimulated to grow by the heat and smoke of the fire. As a consequence the grass sward remains short for lengthy periods at a time when thunder storms and driving rain are a common feature of the climate. This permits excessive runoff and the flushing of streams and drainage lines. In addition cattle are creatures of habit and tend to move along known routes to and from areas resulting in footpaths. Water is funneled along such paths and along slopes increase in speed and eroding ability, cutting down as a result, forming a donga which eats its way uphill.

Such paths often extend into wetlands, where a nick point may develop where the soil is weakest resulting in erosion and the dehydration of the wetland. Wetlands are sensitive to disturbances especially where roads and paths cross seepage areas as they compact the soil, diminish wetland functioning and impede flow down the slope. Cattle are frequently allowed to trample springs and seeps to the detriment of the latter and associated plant communities.

Similarly farm roads ascend slopes with little provision for erosion control. In time the vegetation cover is killed or reduced resulting in erosion, which increases in severity along slopes with speed of runoff, eventually forming dongas, which tend to branch out laterally along lines of least resistance.

### **Braamhoek Construction Village**

From an environmental perspective the site is ideal for siting the construction village with the exception of the access road from K. Such a road will have to be large and carry heavy machinery and equipment which will impact negatively on the seasonal wetlands along the section between the Braamhoekspruit and K, further fragmenting it although the proposed road is parallel to the direction of drainage here.

### **Fauna**

Few threatened species of fauna occur in the area, most of these being birds such as the White-winged Flufftail, Southern Crowned Crane and Bald Ibis. The two former species require wetlands while the latter forages in open grassland, nesting on cliffs. Both Option 1 and Option 2 roads affect wetlands although in the case of the latter the proposed road will mostly run along the watershed except on the farms Chatsworth and Oulston. Here care should be taken to avoid impacting on wetlands and route the proposed road around such sites.

However construction activities along these roads with associated dust and noise will affect areas close by and cause such species to flee. In addition the larger the road and the better the surface, the greater the speed of vehicles, which will result in road kills for many species of fauna.

### **CONCLUSIONS**

In conclusion the upgrading of existing provincial roads is unlikely to have a greater deleterious impact than is currently the case. It would seem that the current road reserves may be adequate for this purpose. Bridges and stream crossings need to be rebuilt to reduce erosion and lessen any environmental impact such as accelerated erosion downstream or by impeding the flow of water under the road.

Of the three access route options between the upper and lower reservoirs, part of Option 1 between Points K and P, appears to be the most sensitive and therefore least desirable. Option 2 as a construction road is undesirable due to the sensitivity of the terrain and to a lesser extent of the flora and fauna although this was not adequately assessed due to the state of the vegetation at the time of the survey. Although wetlands occur along this route most were small and probably marginal for such species as the White-winged Flufftail. However the route does not lend itself to a large construction road despite the presence of an existing farm track along the greater part of the route. Instead this makes provision for a

smaller paved and gravel quick access route between the two reservoirs. This should however be planned and executed with the least possible impact on the wetlands, escarpment and watershed.

Option 3 is the least sensitive of the three options due to the existence of the provincial road including a wide road reserve along which most of the former plant cover has been replaced, with a poor biodiversity. Most wetland crossings require upgrading and amending of existing structures to reduce erosion and the down-cutting of stream channels. This results in incised channels reducing the ability of streams to overtop their banks under conditions of moderate to high flow ending in the dehydration of off channel wetlands.

The Construction Village site has a low environmental sensitivity rating with the exception of the access road which will negatively impact on the wetland.

A Vulnerable Red Data plant species occurs along a stream between the Tunnel construction site and the camp. Some impact on the stream is already evident and this should be given some consideration and remediation.

The upgrading of existing provincial roads is unlikely to have a significant impact providing adequate erosion control measures are incorporated during construction.

The impact of access and construction roads on the fauna will increase with increased width, condition and time of day or night resulting in road kills. It is therefore imperative that cognizance of this be taken during and following the construction phase.

## **RECOMMENDATIONS**

The following recommendations are made regarding the three access options:

### **Option 1.**

The section from J to K does not appear to be very sensitive with the exception of the seepage area which the proposed road should avoid and the drainage line crossings which require adequate erosion prevention measures.

In the section from the Braamhoekspruit and an unnamed stream around the corner south of K, where the proposed road traverses across a wetland, sufficient underpasses should be inserted under the road for water draining into the wetland and proposed reservoir from the north and west.

The section between K and the top of the pass at P is a highly sensitive route as it lies within the catchment of the Braamhoek dam, with wetlands, including springs, a high plant biodiversity including Red Data Book species and steep slopes with scarp forest which are highly susceptible to erosion. Accordingly it is therefore recommended that this option be abandoned.

## Option 2

This route is equally sensitive but lies across undulating terrain and is therefore less susceptible to erosion provided that the road flanks around seeps and drainage lines and keeps to the watershed. Where possible rocky outcrops and bedrock sheets should also be avoided as they tend to contain specific plant and animal communities and act as refuges for animals during the annual grass fires which appear to be part of veld management techniques in the area. The sensitivity of the terrain including the route and sense of place of the proposed road does not lend itself to a 30 m wide construction road. The area is too sensitive for such a road which carries with it an element of risk from accidents and irresponsible behaviour, particularly during construction activities.

Faunistically this road is the more sensitive as three threatened bird species have been recorded on the farms through which it passes, which again emphasizes the need for a smaller less frequently used road, which bypasses wetlands and other sensitive habitats.

In the light of the necessity of providing quick access to the upper reservoir it is recommended that a smaller road be considered to facilitate this and that the existing provincial road from Kiesbeen to Bedford be adopted as a construction road.

Adequate anti erosion measures are vital along the former road and should be incorporated during construction planning. Construction activities should be limited to the smallest footprint possible and subject to stringent control.

In the event of the construction of this road then plants of the hairbell *Dierama* sp. cf *robustum* which occur at Point P, 28° 15' 48,3" S; 29° 30' 44,1" E, should be avoided or plants translocated nearby but away from any construction activities.

## Option 3

This route is the preferred option of access to the upper reservoir because of its current state and limited additional impact on the environment. This road should be considered as a construction access road. With upgrading it provides direct access from the N3 to the upper reservoir site. Should upgrading commence it is imperative that plants of the hairbell *Dierama dracomontanum* in the road reserve on the farm Langspruit 448, at locus 28° 13' 57,8" S; 29° 24' 05,4" E, be relocated inside the farm fence where others occur. At least six tussocks are involved.

## Tunnel Construction Site

With regard to the occurrence of *Scilla natalensis* along the stream between the Construction Camp and the Tunnel construction area, it is recommended that care is taken not to further degrade the stream and immediate environs creating

a buffer zone of at least 50 m on either side. The plants should be counted and flagged, and workers instructed not to remove them as they are desired 'muthi' plants, which accounts for their Vulnerable status.

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*Watsonia* sp. cf. *lepida*/ *confusa* commonly growing in small clumps on the farm Braamhoek, along the Option 2 route and along parts of the other provincial roads, forming large colonies under optimum conditions. The plants seen here appear intermediate between *W. lepida* which is described as being mostly a solitary species and *W. confusa* which occurs solitary or in small clumps (Goldblatt 1989, Pooley 1998).

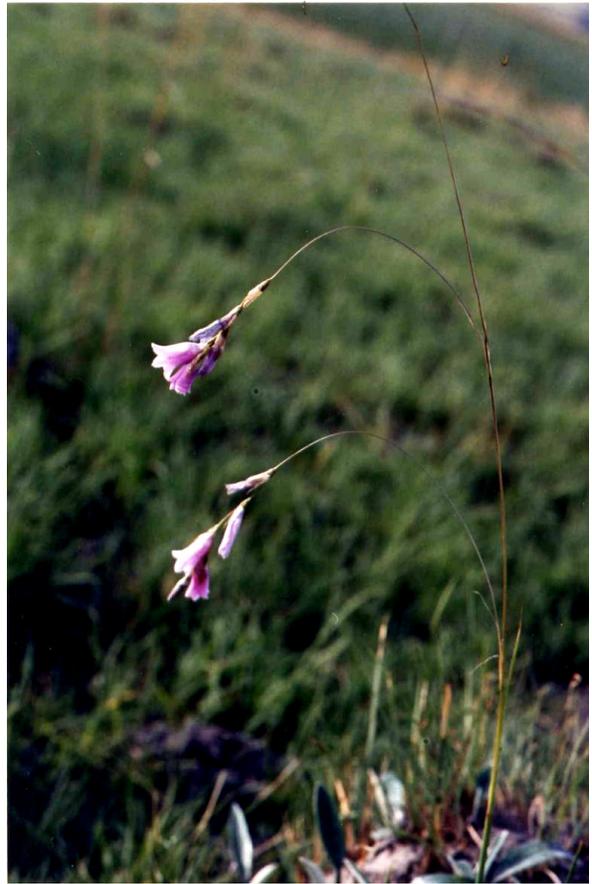


*Aloe dominella* growing along a dolerite outcrop along the Option 1 between K and P. A highly localized and sparsely distributed aloe endemic to KwaZulu-Natal.



A spring emerging from a dolerite outcrop, probably the result of a sill, forcing water to overtop the barrier, emerge, and flow downhill to the proposed reservoir on Braamhoek. The paler yellow green plants are the fronds of a Swamp Fern *Thelypteris confluens*.

A hairbell *Dierama* sp. cf. *D. nixonianum*, a rare KwaZulu-Natal endemic, on the farm Braamhoek, mostly recorded from further east and at slightly lower altitudes.



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