Least cost model

The least cost model is a module available in most GIS software packages to calculate the areas within the landscape associated with the least cost to specific issues. In the case of vegetation, the model will determine where in the landscape a proposed development will have the least cost to vegetation. In principal if the model works correctly, it would guide the proposed development/ activity away from the most sensitive areas for a specific parameter to the least sensitive areas for that specific parameter. In terms of vegetation, it would guide the proposed development to transformed areas such as roads, cultivated land, built-up areas). Obviously the model is only as good as the information on which it is based. For this study, the input data ranged in scale from 1: 250 000 (small scale) to 1: 50 000 (large scale), at a 100 m pixel resolution, thus each pixel representing one hectare (1 ha). **Therefore in terms of the landscape, the model can be described as being broad scaled and fine grained** (Barbour, Burk & Pitts 1980, De Frey 1999, Forman Sperling et al 2003, Hilty, Lidicker Jr & Merenlender 2006, Kent & Coker 1992, Lindenmayer & Fischer 2006, Mucina & Rutherford 2006, Turner, Gardner & O'Neill 2001, Van Andel & Aronson 2006, Van Wyk & Smith 2001, Wiens, Moss, Turner & Mladenoff 2006).

4.2 Local Context

This component consisted of two tasks, namely fieldwork involving the collection of species information and vegetation characteristics and the evaluation of the final alternative alignments based on the results from the scoping component.

4.2.1 Fieldwork

Twenty – four (24) plots were surveyed during February/ March 2012. The distribution of the 24 plots was based on the combination of the following datasets, which represent drivers of vegetation variation at a small scale, namely geology, landform and land cover. The plots were placed within those modelled habitat units, which occurred across all three proposed route alignment corridors, with the potential to compare plots underneath the existing power line with those from the proposed route alignments. Only those plots were surveyed which occurred within actual natural vegetation at a local scale.

At each plot, a species list was obtained using the Braun-Blanquet approach; the soil was classified and digital photos taken along the alignment.

4.2.2 Evaluation

On completion of the fieldwork, the collected vegetation data was analysed using MS Access and Juice. A Two Species Indicator Analysis (TWINSPAN) was done to evaluate whether plots from underneath the existing power line differ from those in the areas of the proposed route alignments. The other data collected was used to identify those species, which should be prioritised during rehabilitation or plant rescue exercises.

The final three route alignments were also evaluated again using the small-scale models created during the scoping component.

5 RESULTS

The National Environmental Management Biodiversity Act (No 10 of 2004) aims to manage and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998; the protection of species and ecosystems that warrant national protection, the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.

5.1 Regional Context

Therefore this section aims to provide an overview of the ecosystems and species of concern (Red Data flora, protected, medicinal) present within the study area on a regional scale.

5.1.1 Ecosystem diversity

Vegetation reflects the influence of the physical environment on the distribution and dominance of plant species, which in certain combinations present habitat to a variety of animals.

Continental scale

On a global level/ continental scale, three WWF ecoregions[1] intersects the study area (Figure 3):

1. Drakensberg montane grasslands, woodlands and forests: "The Drakensberg Montane Grassland, Woodland, and Forest ecoregion is the center of southern Africa's Afromontane region, and is famous for playing a vital role in the restoration of the southern white rhino and black wildebeest. This ecoregion spans the medium altitude areas of the Drakensberg Mountains in South Africa and Swaziland, and the lower slopes of the high altitude Lesotho Plateau. Its vegetation is mainly grassland, but it also contains some of the few stands of conifer forest in Africa. There are also a few patches of grassland occurring in the Stormsberg Mountains, Mount Andersson, and further north in the isolated Soutpansberg and Blouberg Mountains. In all these locations there are high rates of endemism in the flora, and in the fauna, particularly among the reptiles. However, much of the ecoregion has been degraded by farming, afforestation, logging, overgrazing, and burning activities. STATUS – Critical/ Endangered."
2. Highveld grasslands: "Grasslands all over the world have experienced dramatic habitat destruction as a result of anthropogenic changes. The Highveld Grassland is no exception, with agriculture severely fragmenting this once-expansive region. This ecoregion now provides the last remaining stronghold of several grassland species that have suffered major reductions in abundance in the grassland biome, and which are consequently threatened with extinction (e.g. the blue crane (*Anthropoides paradisea*)). The ecoregion draws its name from the high interior plateau known as the Highveld, and the expansive cover of species-rich communities of grasses. The ecoregion is bordered by the Drakensberg in the east, the arid Karoo and Kalahari in the west, and the low-lying bushveld to the north. The Highveld Plateau is fairly flat with elevations varying from 1,400 m to 1,800 m. The flat topography means that the landscape is traversed by many meandering rivers, with the grassland community historically playing an important role in natural water purification of the westward flowing rivers that originate on the Drakensberg escarpment (Davies and Day 1998). The functioning of this ecosystem has been disrupted in many areas by water transfer projects that have been built to supply greater Johannesburg with water (Davies and Day 1998). The Highveld Grassland has suffered extensive degradation. Because it is one of the best areas for farming in South Africa, large tracts of land have already been converted to agriculture, mainly for corn production. Urban expansion, fire, and overgrazing have led to increased fragmentation, as has coal mining and afforestation for stands of exotic trees, especially by species of *Eucalyptus* (Low and Rebelo, 1998; Cowling et al. 1997). Over several hundred years, particularly around towns, planted wattle (*Acacia mearnsii*) has become invasive, and is prone to rapid expansion up river watersheds. In the future, expanded surface

[1] http://worldwildlife.org/ecoregions/

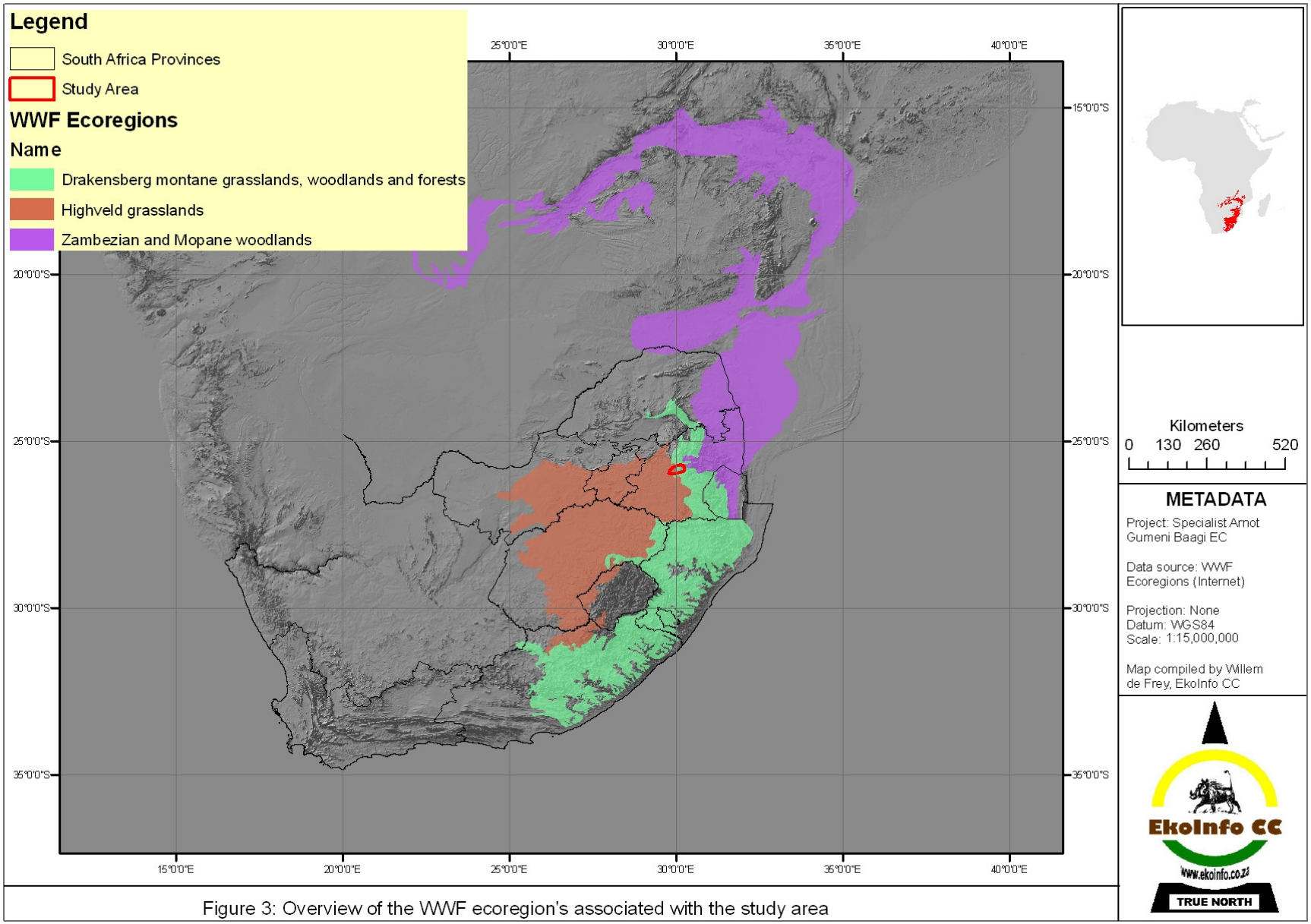

Figure 3: Overview of the WWF ecoregion's associated with the study area

activity associated with mining below the grassland may become a greater concern as companies develop new technology to make deep mining of coal more profitable (Mallett 1999).

a. The Highveld plays an important role in natural water purification, as the peat formed here has been shown to filter out 90 percent of the harmful chemicals in herbicides. Peat is also useful in absorbing various other pollutants, as a source of fuel, in horticulture, and for medicinal purposes. In South Africa, where clean water resources are already particularly valuable, this natural filter is being extracted from the Highveld at an unprecedented rate. Approximately 60 percent of locally extracted peat is used to grow mushrooms, while the remaining 40 percent comprises "environmentally friendly" potting soil and compost. Peat has an extremely slow regeneration rate, increasing between 0.7 mm to 1.2 mm per year depending on environmental conditions (Dada 1999). Given its slow formation process, it is unlikely this resource will recover from the damage caused by its rapid removal. Hence, the Highveld's role as a natural filtration element for scarce water resources could be in danger. The preservation of this resource is imperative, and could be fulfilled by moderating or halting the use of peat for gardening purposes. STATUS – Critical/ Endangered."

3. Zambezian and Mopane woodlands: "Zambezian and Mopane Woodlands are dispersed throughout southern Africa, bounded by the Luangwa River in the north and the Pongola River in the south. Mopane tree (*Colophospermum mopane*) woodlands mix with Zambezian woodlands in lower-elevation areas, often along major river valleys. Although the ecoregion, particularly the mopane communities, is considered to be poor in endemics, it supports some of the largest and most significant wildlife populations in Africa, particularly those of the endangered elephant (*Loxodonta africana*) and critically endangered black rhino (*Diceros bicorn*is). Important populations of predators are also found in the Zambezian and Mopane Woodlands. The abundance of wildlife can be largely attributed to the high level of protection in the ecoregion, in which more than 45 percent of the habitat is devoted to various forms of state and private conservation. Two cross-border conservation efforts are set to further increase the extent of protected lands in the near future. STATUS - Relatively Stable/Intact."

Of the three ecoregions, the Drakensberg montane grasslands, woodlands and forest covers the largest portion of the study area at 50.6% (Table 1), followed by the Highveld grasslands (41.8%) with the Zambezian and Mopane woodlands covering only 7.6%. Therefore it is evident that the proposed power lines will affect mainly the grassland areas.

Regional vegetation units

Four regional vegetation units intersects the study area (Figure 4), they are:

3. Aquatic ecosystem/ Azonal vegetation
    a. Eastern Temperate Freshwater Wetlands
4. Terrestrial ecosystem/ zonal vegetation
    a. Eastern Highveld Grassland
    b. KaNgwane Montane Grassland
    c. Lydenburg Montane Grassland

Table 2 provides an overview of the four regional vegetation units, extracted from VEGMAP (Rutherford & Mucina 2006). The vulnerable Eastern Highveld Grassland covers the largest extent of the study area at 65%. No biogeographically important taxa or endemic taxa are listed for this regional vegetation unit.

Overall the number of regional vegetation units within the study area reflects the influence of the geology, climate, topography and soils within the landscape at a regional scale. On a local scale, the presence of various soil forms, soil depth, soil texture, rockiness, changes in altitude and human influences will define various vegetation communities. This distribution and extent of these vegetation communities are beyond the scope of this document.

Table 1: Overview of the percentage of WWF Ecoregions present within the study area

WWF Ecoregion			Study Area	
Name	**Ecoregion code**	**Area (km2)**	**Hectares**	**% Cover**
Drakensberg montane grasslands, woodlands and forests	AT1004	201962	49714	51%
Highveld grasslands	AT1009	185863	41096	42%
Zambezian and Mopane woodlands	AT0725	471874	7511	8%
TOTALS			98321	100%

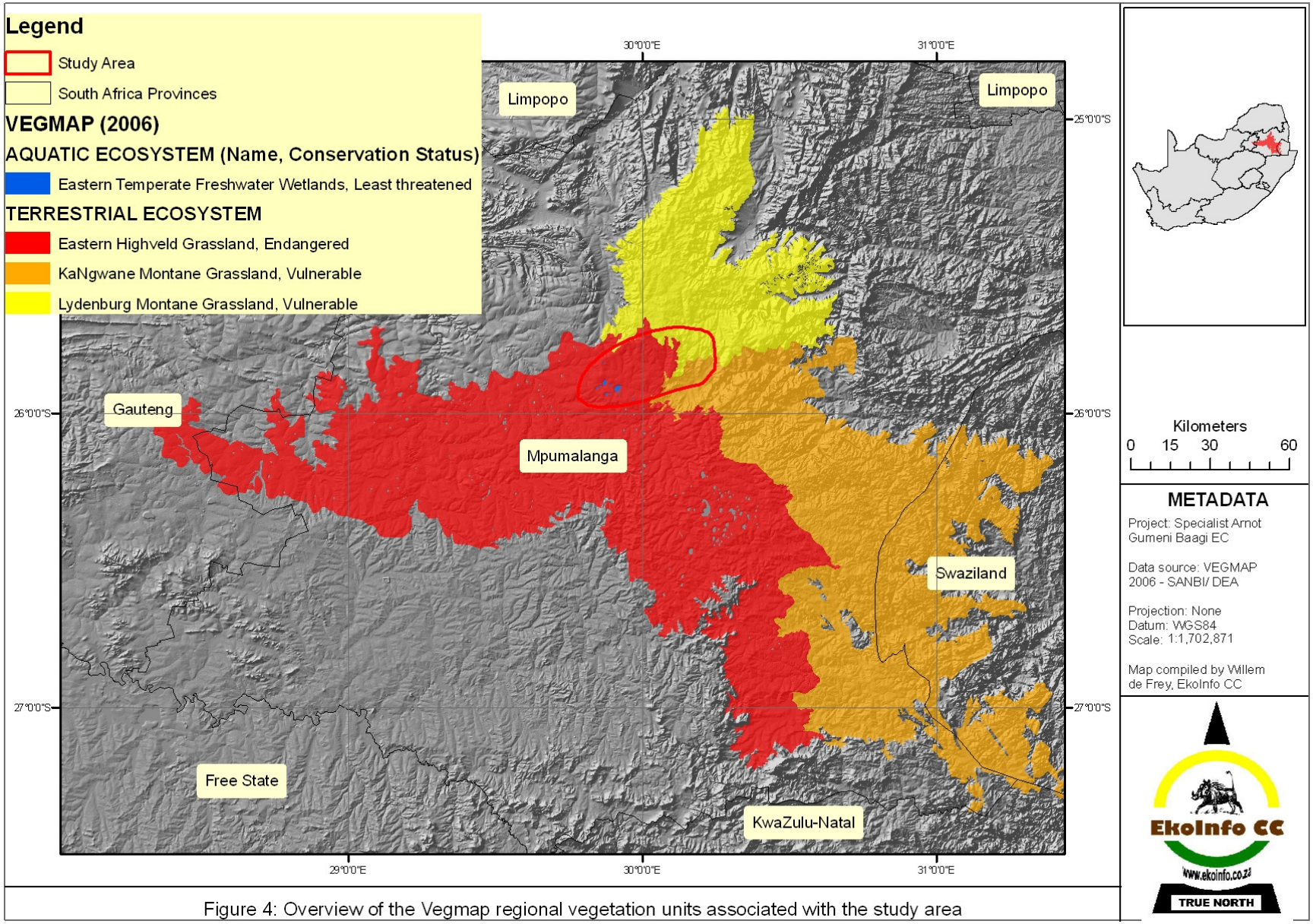

Figure 4: Overview of the Vegmap regional vegetation units associated with the study area

Table 2: Extracts of the four regional vegetation units present within the study area from Vegmap (Rutherford & Mucina 2006)

Ecosystem	Aquatic	Terrestrial		
Regional vegetation unit	Eastern Temperate Freshwater Wetlands	Eastern Highveld Grassland	KaNgwane Montane Grassland	Lydenburg Montane Grassland
General description	Flat landscape or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands	Slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya etc)* with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra, Celtis africana, Diospyros lycioides* subsp *lycioides, Parinari capensis, Protea caffra, P. welwitschii and Rhus magalismontanum*)	Largely comprised of undulating hills and plains that occur on the eastern edge of the Escarpment. This unit is transitional between the Highveld and Escarpment and contains elements of both. The vegetation structure is comprised of a short closed grassland layer with many forbs, and a few scattered shrubs on the rocky outcrops.	High-altitude plateaus, undulating plains, mountain peaks and slopes, hills and deep valleys of the Northern Escarpment region, supporting predominantly very low grasslands on the high-lying areas. Height of the grass sward increases on the lower slopes. The grassland is very rich in forb species.
Biogeographically Important Taxa	1		6	24
Endemic Taxa	4		4	25
Threats	Some 15% has been transformed to cultivated land, urban areas or plantations. In places intensive grazing and use of lakes and freshwater pans as drinking pools for cattle or sheep cause major damage to the wetland vegetation.	Some 44% transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact. No serious alien invasions are reported, but *Acacia mearnsii* can become dominant in disturbed areas.	It is well suited for afforestation and 30% has already been converted to plantations of alien trees. A further 6% is under cultivation.	The level of transformation is relatively high at 23%, with mostly alien plantations (20%) and cultivated lands (2%).
Conservation status	Least threatened	Endangered	Vulnerable	Vulnerable

Table 3: Overview of the percentage of Vegmap regional vegetation units present within the study area

Regional Vegetation Unit	Conservation Status	Surface area (ha)	% Cover
Eastern Highveld Grassland	Endangered	64060	65%
Lydenburg Montane Grassland	Vulnerable	20168	21%
KaNgwane Montane Grassland	Vulnerable	13065	13%
Eastern Temperate Freshwater Wetlands	Least threatened	1027	1%
TOTALS		98321	100%

Land use

Sixteen (16) land cover categories had been recorded within the study area (Figure 5), associated with various land uses (Table 4). Natural areas mainly associated with livestock farming, whether domestic or game and disturbance; cover 75% of the study area. Thus only 25% of the study area is transformed, which implies that it is well connected in terms of biodiversity (Forman Sperling et al 2003, Hilty, Lidicker Jr & Merenlender 2006, Lindenmayer & Fischer 2006, Turner, Gardner & O'Neill 2001, Van Andel & Aronson 2006, Wiens, Moss, Turner & Mladenoff 2006).

Overall it is concluded that the study area represents a rural landscape where agricultural activities are the main source of income and the main driver of land cover change.

Areas of conservation importance

The main source of areas of concern on a provincial level is the Mpumalanga Parks Board Conservation Plan[2] (Figure 6). This data source highlights the distribution and extent of nature reserves and irreplaceable areas in terms of biodiversity and reaching conservation targets. Approximately 37% of the study area is considered to be of high conservation significance (Table 5) on a provincial scale.

[2] Lötter, M.C. & Ferrar, A.A. 2006. Mpumalanga Biodiversity Conservation Plan Map. Mpumalanga Parks Board, Nelspruit

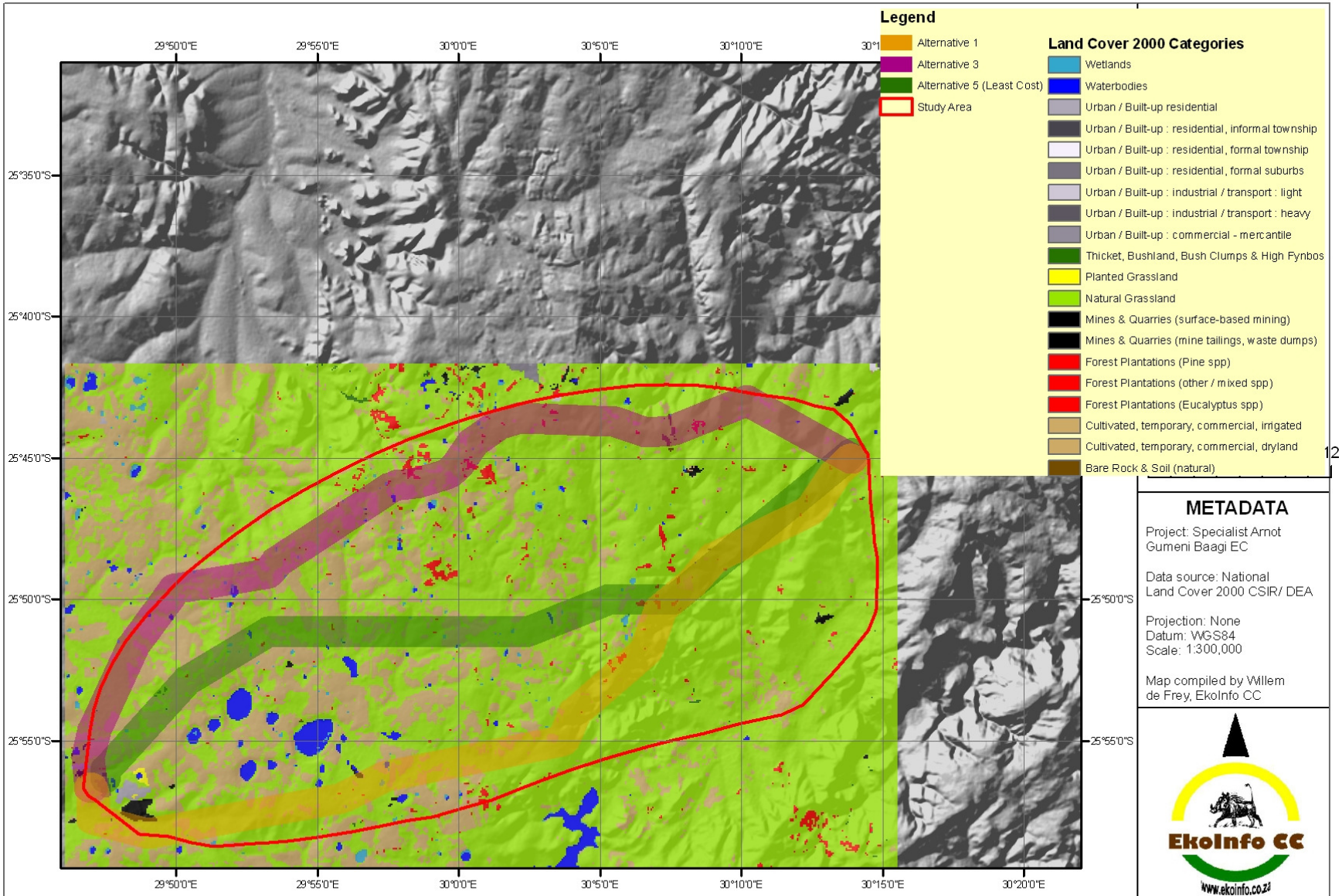

Figure 5: Overview of the 2000 land cover categories associated with the study area

Table 4: Overview of the 2000 land cover categories, percentage cover and associated drivers of change within the study area

Land Cover Categories	Hectares	% Cover	Derived Ecological Status		Drivers of land cover change			
					Agriculture		Industry	Urbanisation
			Natural	Transformed	Grazing	Cultivation/ Forestry		
Thicket, Bushland, Bush Clumps & High Fynbos	48	0%	48		48			
Natural Grassland	72070	73%	72070		72070			
Planted Grassland	53	0%		53	53			
Forest Plantations (Eucalyptus spp)	997	1%		997		997		
Forest Plantations (Pine spp)	5	0%		5		5		
Forest Plantations (other / mixed spp)	52	0%		52		52		
Waterbodies	1384	1%	1384		1384			
Wetlands	408	0%	408		408			
Bare Rock & Soil (natural)	50	0%	50		50			
Cultivated, temporary, commercial, irrigated	825	1%		825		825		
Cultivated, temporary, commercial, dryland	21908	22%		21908		21908		
Urban / Built-up residential	184	0%		184				184
Urban / Built-up : industrial / transport : heavy	80	0%		80				80
Urban / Built-up : industrial / transport : light	14	0%		14				14
Mines & Quarries (surface-based mining)	147	0%		147			147	
Mines & Quarries (mine tailings, waste dumps)	218	0%		218			218	
TOTALS	98445	100%	73960	24484	74014	23788	365	278
			75%	25%	75%	24%	0%	0%