

# BOTSWANA

## Morupule B Generation and Transmission Project

### Environmental Impact Assessment for Botswana Transmission Lines

#### Executive Summary



**ENVIRONMENTAL IMPACT STATEMENT**  
**BOTSWANA TRANSMISSION LINES FOR THE MMAMABULA ENERGY**  
**PROJECT**

**BOTSWANA POWER CORPORATION**

**MARCH 2007**

**DRAFT FOR COMMENT BY STAKEHOLDERS AND AUTHORITIES**

**VOLUME 1 OF 3: TRANSMISSION LINE EIS**

**VOLUME 2 OF 3: APPENDIX A – APPENDIX K**

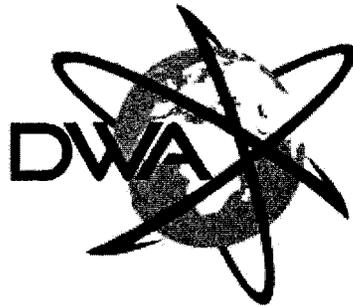
**VOLUME 3 OF 3: APPENDIX L**



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## *Executive Summary*

Digby Wells & Associates (DWA) has been appointed by CIC Energy Corp (CIC) as independent environmental consultants to investigate the environmental and social aspects of a proposed transmission line project in Botswana.

Meepong Resources (Pty) Ltd (Meepong Resources) and Meepong Energy (Pty) Ltd (Meepong Energy) are Botswana based companies wholly owned by CIC Energy Corp (CIC). Meepong Resources has the rights to explore for coal resources in the Mmamabula coal field, situated in the Central District of Botswana, adjacent in the vicinity of the villages of Mmaphashalala and Dovedale. Meepong Energy is the Environmental Impact Statement (EIS) applicant for the power plant while Meepong Resources will be applying for the coal mine. This proposed combined project is called the Mmamabula Energy Project (MEP) and, if approved, would include the development of coal mines; the construction of a power plant and the development of transmission lines to carry power to various areas of Botswana and South Africa. Although the funding for the transmission lines will be included in the MEP, ownership will ultimately rest with the Botswana Power Corporation (BPC). BPC is thus the EIS applicant for the proposed transmission lines.

This report is an EIS, which will identify the positive and negative environmental impacts and feasible alternatives. In addition, it will provide management plans to mitigate predicted adverse impacts, manage residual effects as well as deal with relocation and compensation frameworks. These plans will be implemented during construction, project operation and closure.

### Legal Requirements

Botswana has seen significant changes to the environmental legislative and administrative frameworks within the last few years culminating in the promulgation of the Environmental Impact Assessment Act, Act 6 of 2005, and the creation of the Ministry of Environment, Wildlife and Tourism (MEWT) with a mandate to coordinate environmental conservation and protection. The Department of Environmental Affairs (DEA) is mandated to implement the Environmental Impact Assessment Act which requires that an Environmental Impact Assessment (EIA) be completed for the project area and an Environmental Impact Statement (EIS) subsequently approved. In addition to the DEA, several additional permits and licenses will be required from several Botswana Government Departments for the successful implementation of the MEP.



### Project Description

A separate EIS will be submitted for the proposed Mmamabula mine and power plant as well as for the MEP ancillary activities such as the potential wellfield project. This EIS has been compiled for the proposed transmission line project only.

The proposed transmission line project includes:

- A 400kV line running north past Mahalapye to the proposed Morupule B power station outside Palapye. From there it will go on to the Phokoje substation, outside Selebi Phikwe.
- In addition there will be four 400kV lines running east, from the Mmamabula power plant to the Limpopo River and the South African border.
- Although this report only covers the lines within Botswana, these lines will continue in South Africa to the proposed Delta substation.
- A corridor for a 400kV line to the proposed Mosaditshweni substation, north of Mochudi was also included in the assessment, although the development of this line will not form a component of the MEP.
- The EIA also evaluated a proposed 66kV line from Phokoje to the mine and power plant area, which will be used to supply power for construction and commissioning.

### Project Alternatives

Project alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include process or technology alternatives, location or site alternatives, activity alternatives, temporal alternatives or the no-go alternative.

In order to transmit power from the proposed Mmamabula Power Plant, transmission lines are the only available technology and, in this regard, there are no alternatives.

A number of route alternatives were, however, considered in this study. Two alternatives were provided for the lines between the proposed Mmamabula Power Plant and the proposed Morupule B as well as between the proposed Mmamabula Power Plant and the proposed Mosaditshweni substation. As the 66kV lines will share corridors with the 400kV lines, similar route alternatives



will apply. Four alternative corridors, with an additional fifth Limpopo River crossing point, for the lines to South Africa were assessed.

Fewer impacts are anticipated for the route alternative running adjacent to the existing 220kV lines between Gaborone and Selebi Phikwe and this is recommended as the preferred route alignment for this section of the transmission lines. As the environmental impact assessment (EIA) for the South African section of the transmission lines is in an early stage, the final route alignment for these lines has not been identified. Although a number of aspects will have to be taken into account in deciding on the preferred alternative, there is no fatal flaw for any of the alternatives within Botswana and all the options will remain a possibility until the South African EIA is complete.

Alternative line voltages are also another variation that was considered for the project but increasing the line voltage will not affect the number of lines as this has been determined by risk of failure rather than carrying capacity.

Alternative land uses for the project area have been identified as housing, livestock grazing, various crops and tourism. Although the aesthetics of the area will be affected by the transmission lines, which may impact on tourism, all these land uses can continue relatively undisturbed once the lines have been strung.

The no project option would mean the Mmamabula Power Plant would not be constructed and therefore this alternative can only be considered in conjunction with the MEP no project alternative. If this occurred there would be none of the negative impacts associated with the project but there would also be no benefit to the Botswana economy, which would be substantial.

#### Project Benefits & Motivation

Although a separate EIS has been compiled for the transmission line component of the MEP, these lines have a direct co-dependence with the development of the Mmamabula Power Plant and the motivation for them cannot, therefore, be considered in isolation.

Energy plays a pivotal role in economic growth and improving livelihood of people. In the near future it is expected that there will be more electricity needed by people living in Southern Africa than can be supplied by existing power plants. The development of the MEP would therefore provide a new and important source of power supply for Botswana and South Africa.

The MEP will benefit the local, regional and national Botswana economy in terms of job creation, economic growth, social development, skills development and the provision of infrastructure and services. The MEP and associated activities will provide a boost to the district economy through



the establishment of a range of businesses, services, public transport and improved access. Employment opportunities will be created with an additional benefit of community upliftment. The resulting economic multiplier effect will ensure that new businesses are created and the wage economy in the area is substantially enhanced.

Additionally, the MEP will contribute towards skills development and technology transfer, while the project would greatly benefit the Southern African Development Community (SADC) through addressing some of the region's power needs. The energy demand in the Southern Africa region is expected to exceed the available supply by 2007.

#### Public Participation Process

A Public Participation Process (PPP) has been followed for the MEP. The process has been incorporated into a Public Consultation and Disclosure Plan (PCDP) which includes the findings of the authorities and public participatory meetings held at the national and district levels as well as meetings in the villages along the proposed transmission line routes.

The PPP is not aimed at avoiding conflict but rather at facilitating a process in which people feel heard and included in decision-making and project design and where satisfactory outcomes are identified. Although this process has been initiated during the EIA phase of the project, it will continue through construction and operation.

#### Environmental Status

The baseline environmental aspects that were studied included climate, topography, soil, surface and groundwater, air quality, noise, visual assessment, fauna and flora, archaeology, social aspects and economics.

##### *Climate*

The climate of the region, through which the proposed transmission line will pass, is semi-arid. Though it is hot and dry for much of the year, there is a rainy season, which runs through the summer months. Rainfall tends to be erratic, unpredictable and highly regional. Showers are often followed by strong sunshine so that large volumes of rainfall do not penetrate the ground but are lost to evaporation and transpiration. The prevailing wind direction of the region is northeast. On average, the temperature ranges between 2.65°C in winter and up to 41.35°C in summer. Rainfall occurs between the months of October and March, with the dry season commencing in mid April continuing until September. The annual average rainfall recorded for the study area is 445 mm. The annual total evaporation is observed to be in the region of ~2 520 mm.



### *Topography*

Apart from the Tswapong and Maifala Hills, the study area is dominated by a low relief plain and featureless veld. There are a number of perennial rivers draining the area that will have to be spanned by the transmission lines. These are the Bonwapitse, Limpopo, Ramatanka, Mhalatswe, Thangwane, Mahunwane, Dikabeya and Mmaitsokwane Rivers.

### *Soil*

The major soil groups that will be crossed by the proposed transmission routes are mostly Arenosols and Luvisols, with small areas of Lixisols. They are mostly found on fine-grained and coarse-grained sedimentary rocks e.g. sandstone. Luvisols have an accumulation of clay (15-25%) and a higher fertility, while Arenosols are coarse, sandy soils with weak structure and low fertility. In general the soils are sandy with a low clay content (<10%); this results in high water infiltration rates, low water holding capacity and fairly poor fertility. Lixisols are highly weathered and strongly leached soils and also have a zone of clay accumulation which may occur at some depth below the soil surface.

### *Land Capability and Land Use*

Soils are mostly sandy, with poor structure and are extremely low in all essential nutrients especially phosphate. These soils are thus seldom farmed on a large scale, mainly due to the high cost of fertilization and low rainfall. The entire study area is classified as being veld or grazing land for purposes of its "pre-project" land capability. The land in the study area is used for grazing cattle, goats and sheep, with small areas of subsistence agriculture practised along the proposed routes. There is also a growing amount of focus on tourism within the Tuli block over which the proposed lines will cross.

### *Surface Water*

There are eight rivers that will have to be spanned by the transmission lines. These all experience a zero flow during dry weather conditions and most only flow temporarily after large storms. Flood lines and volumes have been calculated and are presented in the report. A unique feature of this project is its transboundary nature i.e. it involves crossing the Limpopo River, which is the national border between Botswana and South Africa. The Limpopo River catchment is of interest to various government departments in the countries that border the river, namely Botswana, South Africa, Mozambique and Zimbabwe.

The surface water quality in the area is unaffected by industrial activity and care must be taken to control all dirty surface water runoff generated by the proposed project and minimise the impact



on surface water quality. Samples taken in standing pools showed the surface water to be slightly saline but, due to low rainfall during the 2006/2007 wet season, no samples could be taken in the rivers under flow conditions.

#### *Groundwater*

The sand layer associated with most of the study area has a high infiltration rate and a low storage capacity but can be considered an aquifer with sufficient water supply throughout the year. Hand dug wells along the riverbeds indicate that this aquifer is a good source of water supply for the local cattle farmers. The aquifer potential of the basalts in the study area has been described by Cheney (1981) and it was concluded that the basalts give a consistent yield of potable water within the fractured zone. The sandstones along the proposed routes are porous, but secondary permeability is required to produce high yielding boreholes. Cheney (1981) found hydrological continuity between the basalts and the underlying Ntane (termed cave sandstone) in the Dibete area. The block faulting of the sandstones allow the transmission of water across them where the Ntane sandstones are juxtaposed against one another, otherwise they act as boundaries to groundwater flow (Geotechnical Consultants, 1999).

This contact between the dolerite dyke and the Lower Karoo formation being intruded is also a source of groundwater, depending on the age of the dolerite and the amount of weathering that has taken place. The faults are another source of groundwater as these structures open spaces between the formation to allow water to be collected and stored. One such fault that is considered to have a very high yield in the area of interest is the Zoetfontein Fault.

#### *Air Quality*

Existing sources of emissions include industrial sources and power generation; mining operations in the region; vehicle tailpipe emissions; household fuel combustion; agricultural activities; biomass burning and fugitive dust sources. Emissions arising from two operational coal-fired power stations fall within the region of concern, one located near Lephalale in South Africa (~100 km to the east) and one near Palapye in Botswana (~ 111 km north-northeast).

Biomass burning; crop-residue burning and general wild fires represent significant sources of combustion related emissions associated with agricultural areas. Fugitive dust emissions may occur as a result of vehicle entrained dust from local paved and unpaved roads, and wind erosion from open areas.



*Noise*

The topography of the area of the proposed development is very flat, i.e. there is little screening against the propagation of noise from the source to the receiver. The vegetation is, however that of densely grown bush and trees and the ground conditions are to a large degree very sandy. These conditions provide excess attenuation of noise sources as sound is absorbed as the noise propagates across the ground.

The general description of the ambient noise climate, in the area, that will be affected by the proposed transmission lines is rural. Ambient levels in this rural environment are therefore low, and ranged from LAeq values of between 40.1 dB(A) and 51.4 dB(A) in the day to between 28.8 dB(A) and 42.9 dB(A) at night. The more urban areas along the route will have higher ambient noise levels, above which the noise from the transmission lines will have little impact.

*Flora and Fauna*

The typical vegetation in this region is savanna, containing a tree and shrub layer as well as a grass layer. Due to the extensive grazing by livestock in some areas along the proposed routes, the relationship between these two layers has been unbalanced, resulting in the tree and shrub layer becoming dominant over the grass layer. This then allows the tree and shrub layer to continually out-compete the grass layer, resulting in a dense tree and shrub layer and limited grass cover. The vegetation is in differing stages of succession, and this is reflected by the species that were found. The herbaceous component of the sampled area consisted mostly of pioneer or sub-climax species. These were mostly increaser 2 species, which are grasses that are typically associated with overgrazed veld. The tree component encountered, varied between different degrees of bush encroachment to proper Savanna, depending on the proximity to human settlements. *Acacia tortillas*, *Dichrostachys cinerea*, *Grewia flava*, were the most common species found.

Areas of potential significance are those where the transmission lines cross the rivers and streams. All the rivers and streams in this region are non-perennial. The vegetation supported by riparian environments differs from the surrounding vegetation. This is due to the increased availability of a water supply and different soil forms. Larger trees tend to be found in these zones. These zones are important as they provide habitat for animal species and generally support abundant bird life.

Due to anthropogenic pressure, there is very little wildlife occurring along most of the proposed routes. The exceptions to this are the relatively healthy birdlife as well as the higher game counts in the privately owned Tuli block area, where smaller mammals as well as species such as impala, wildebeest, kudu, zebra and warthog are abundant.



*Archaeological and Cultural*

There are a number of archaeological sites located along the various transmission line routes. The located sites are representative of all the broad archaeological periods, namely the Stone Age, Iron Age and Historical period. The first Iron Age communities arrived in the central Limpopo valley during the Early Iron Age, around 500AD. These communities were predecessors of larger Iron Age farming communities who settled in the Limpopo River valley between AD 800 and AD 1400 (Mitchell 2002). At approximately 700 AD, a group of communities often associated with gold mining, new settlement layouts and cattle ranching established settlements in east central Botswana. Their ceramic tradition has since been named the Toutswe tradition (Denbow 1984).

The majority of documented archaeological and cultural sites are concentrated towards the north eastern border of Botswana, where the country shares rich archaeological legacies with South Africa and Zimbabwe in the region of the World Heritage Site, Mapungubwe. This stage was succeeded by the rise of centralized kingdoms, as exemplified by the Zimbabwe and successor states in the north and the Tswana *merafhe* essentially in the south. The proto and historic period sees the penetration of Europeans into the interior. Although the Project area is not located in close proximity to the Mapungubwe and K2 sites or Great Zimbabwe, the definite cultural association of the proposed development area with the renaissance of southern African civilization confirms the importance of the development area in furthering our understanding of this complex period of our past.

*Socio-Economic*

With a GDP of P48.6 billion in 2005 (about US\$ 7.6 billion), Botswana's economy is viewed as one of the strongest in Africa, bolstered mainly by revenues from mining, particularly diamond mining. Income per head has reached US\$8,700 on a purchasing power parity basis, making the country a middle income nation and one of the wealthiest in per capita terms in Africa (GDP on a purchasing power parity basis is over four times the sub-Saharan Africa average). Over the past three decades, Botswana's economy has recorded impressive growth rates. The economy grew at an annual average growth rate of 8.8% over this time, culminating in a real growth rate of 8.3% from 2003/04 to 2004/05. The investment in the MEP is likely to contribute to the sustained growth of the economy in future

The study area is predominantly rural so most of the residents are engaged in both arable and livestock agriculture. Most arable operations are at subsistence level, while cattle are farmed on a more commercial basis. In addition to agriculture there are commercial operations such as butcheries, shops, bars, bottle stores, wholesalers (existing in major villages), as well as hawkers and vendors. The idea of community based wildlife management areas has also gained momentum. Currently, the Nata Sanctuary and the Khama Rhino Sanctuary are in operation. Research is being conducted to establish viability of similar activities along the Tswapong Hills.



A survey was undertaken by ERM and BIDPA in November 2006, focussing on businesses along the transmission lines. The survey included Mahalapye, Palapye, Serowe, Selebi-Phikwe and Mookane in the Central District, as well as Gaborone. The survey found that most businesses are small-scale and not well established. There is an extremely limited industrial and business base in the Central District. Almost 60 percent of businesses surveyed are in the wholesale and retail sector, with the majority of products and services sourced from South Africa or other countries and distributed within Botswana. Only a third of the businesses surveyed have any experience in dealing with mining, engineering or energy companies.

In terms of weaknesses and constraints, competition from larger companies (41%) and availability of finance (23%) are cited as the major constraints of doing business in the Central District according to surveyed companies. Although goods and services produced by these businesses are mainly for domestic use and not for export, the bulk of the raw materials are imported from South Africa. These businesses are faced with high transaction costs for importing inputs, which limit their profitability and their capacity to meet the demand that would be generated by the transmission line project.

#### Environmental Impacts & Issues

It is anticipated that the majority of the environmental impacts associated with the transmission lines will occur during the construction phase. These will include vegetation clearing and cutting, movement of vehicles, increased presence and activity of construction personnel as well as the establishment of servitudes and access roads. Associated with the increase in vehicle and people activity there will also potentially be an impact of dust as well as pressure on the fauna, both domestic and wild, along the proposed corridors. Although some of these impacts will be significant, they will all be short term or temporary and are relatively straightforward to manage and mitigate during or after construction.

There should be fewer impacts resulting from the operation of the lines, however, due to the long term nature of such a development, the significance of these impacts will potentially be greater. Although only affecting a small section of the total distance covered by the transmission lines, one of the major impacts will be the visual impact on the tourism potential of the area. Following farm boundaries, rather than dissecting farms is recommended as a means to lessen this impact as well as mitigate the effect of dividing farms. Concern from both communal and private pastoralists is the loss of grazing land, however, apart from a relatively narrow servitude, there should be no permanent loss of grazing or browsing and this impact is not, therefore, considered significant. One of the more significant impacts recorded on existing transmission lines is bird fatalities. The large clearance on 400kV lines means that electrocution is not an issue in this regard. Collisions are, however, responsible for a large number of avifauna fatalities. A fair amount of research has been conducted on reducing this impact and several mitigatory mechanisms have been developed. These are detailed in the respective specialist report and will



need to be implemented on areas of high bird movement such as near rivers, wetlands, roosting sites and open lands. Another concern often raised in relation to transmission lines is the health impact of electromagnetic fields (EMF). No experimental evidence exists to substantiate this impact, although anecdotal evidence may suggest otherwise. In order to err on the side of caution, safety limits for both occupational and environmental exposure have been established by the International Commission for Non-Ionising Radiation Protection (ICNIRP) and will be adhered to.

#### Environmental Management Plans

There are a number of management and policy responses that may be implemented to help mitigate negative impacts and maximise benefits, thus minimising negative impacts on the economy and stakeholders, maximising positive impacts, decreasing risks to the transmission line project and maximising opportunities for the MEP to add to their triple bottom line (ERM & DWA, 2006).

The EMP serves as a framework for implementing the mitigation measures during each phase of the project. A number of plans have been developed for the EMP. These plans will serve as a legally binding management plan for the project and each plan will be further developed and detailed prior to the project commencing.

As the majority of impacts will be associated with the construction phase a management plan for this phase has been outlined in the EIS, however, a final design profile will only be available once the necessary environmental approvals have been obtained. When this information becomes available, a profile specific EMP will be required before construction commences. This should be to a level of detail that identifies and provides management recommendations for specific sensitive sites such as graves, river crossings habitats and for red data species.

#### Project Timing and Implementation

Construction of the transmission lines should begin in 2008, with the final MEP commissioning anticipated for mid 2011. Construction will begin on the 66kV lines as these will be required for construction of the mine and power plant as well as commissioning. The 400kV lines will, however, have to be complete in order to transmit power generated by the Mmamabula Power Plant.

Although the planned life of the coal mine is 50 years, the transmission lines may well remain in use as a component of the regional power grid after closure of the mine.

