DEBSWANA DIAMOND MINING COMPANY
MORUPULE COLLIERY LIMITED

DESIGN AND BUILD OF A RAW WATER PUMPING SYSTEM FROM THE NORTH-SOUTH CARRIER TO MORUPULE COLLIERY

FINAL ENVIRONMENTAL IMPACT STATEMENT

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February 2008
EXECUTIVE SUMMARY

This report is the Environmental Impact Statement of the proposed construction of a 22km long of pipeline from the North South Carrier to the Morupule Colliery in Palapye, a pump station and three reservoirs. The objective of the project is to transport raw water to the mine for its coal washing plant and future expansion plans. The pipeline has been aligned within the railway reserve from the colliery to the connection point close to the NSC. The project is being designed by Bothakga Burrow Botswana (Pty) Ltd.

In undertaking the EIA exercise the procedures as highlighted in the EIA Act, 2005 were followed. A Preliminary EIA was prepared and submitted to the Department of Environmental Affairs to determine the need for detailed EIA for the project. Following the recommendation of the need for a detailed EIA an advert was placed in Mmegi (a circulating newspaper) to publicize the project for public consultation. All relevant stakeholders and interested and affected parties were consulted by use of questionnaires which were administered through the face to face method. These included the Tribal Administration, Serowe-Palapye Sub district Council, Water utilities Corporation and households in close proximity to the pipeline route. The objective was to identify the pertinent environmental issues pertaining to the proposed project from the perspective of households and the relevant institutions. In addition, a detailed fieldwork was undertaken by the environmental team to familiarize themselves with the biophysical and social environment of the project site. The above activities culminated with a review of literature and professional experience dovetailed into the drawing of the projects Terms of Reference which were then approved by the Department of Environmental Affairs. Through this exercise the anticipated impacts presented below were identified and assessed using Guideline No.5 from Roads Department.
Biophysical Environmental Themes

Negative Impacts
1. Vegetation removal
2. Soil erosion and sedimentation
3. Air pollution
4. Increase in ambient noise levels
5. Trenching
6. Geological Impacts and Land transformation
7. Waste generation

Socio Economic Environment Themes

Positive Impacts
8. Short term employment to locals

Negative Impacts
9. Health and Safety Issues (Workers and households)
10. Traffic hazard to vehicle operators and pedestrians

Operation Phase

Socio Economic Environment Themes

Positive Impacts
11. Safe transportation of raw water to the colliery
12. Improved quality of coal for a cleaner environment.

The EIA exercise indicates that there is no major adverse impact militating against the proposed project that is not mitigable. Most of the impacts listed above are of temporary nature and of a local scale. An archaeological assessment of the proposed pipeline route and the locations of the reservoir and pump station also undertaken did not reveal any adverse impact. It is therefore recommended that the project be allowed to proceed.

The implementation of the project should however heed to the following recommendations.

1. The areas where trenches would be dug should be rehabilitated to at least the original conditions.
2. Surplus Soil and rock materials shall be disposed off promptly in order to minimise the time of storage at the construction site and the risk of erosion and sediment discharge. The availability of the spoils could be advertised for community members to utilise them or they disposed off appropriately according to the recommendations of the land board.

3. No more than 50m of open trenches should be left overnight.

4. Crossing structures should be provided across major footpaths to enable pedestrians to cross between the northern and southern parts of the railway line.

5. All utilities laid underground within the areas where the pipeline is to be installed should be identified to avoid accidental damage and curtailment of services.

6. Micro Tunnelling is recommended for use across the 10 roads to be crossed by the pipeline.

7. Filling, Compaction and levelling up of trenches should be properly done to avoid the pooling of water along the route. This should be monitored.

8. Workers should be supplied with protective clothing and it should be ensured that they are used at all times on site.

9. No camp sites should be set for this project.

10. In view of the anticipated power supply shortages in the country, it is recommended that a generator be provided at the pumping station. The location of the generator should be bunded to capture any spill of fuel/lubricants. Waste oil should be collected in trough and disposed off to waste oil companies for treatment and disposal.

11. The Environmental Management Plan and Code of Conduct should strictly be adhered to.
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<th>Abbreviation</th>
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<tbody>
<tr>
<td>AIA</td>
<td>Archaeological Impact Assessment</td>
</tr>
<tr>
<td>BPC</td>
<td>Botswana Power Corporation</td>
</tr>
<tr>
<td>BTC</td>
<td>Botswana Telecommunication Corporation</td>
</tr>
<tr>
<td>CCT</td>
<td>Clean Coal Technology</td>
</tr>
<tr>
<td>CDDP</td>
<td>Central District Development Plan</td>
</tr>
<tr>
<td>CFC</td>
<td>Carbon Flouro Chloride</td>
</tr>
<tr>
<td>CSO</td>
<td>Central Statistics Office</td>
</tr>
<tr>
<td>DTRP</td>
<td>Department of Town and Regional Planning</td>
</tr>
<tr>
<td>DWA</td>
<td>Department of Water Affairs</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>GHG</td>
<td>Green House Gas</td>
</tr>
<tr>
<td>NACA</td>
<td>National Aids Coordinating Agency</td>
</tr>
<tr>
<td>NEPA</td>
<td>National Environmental Protection Agency (in USA)</td>
</tr>
<tr>
<td>NSC</td>
<td>North-South Carrier</td>
</tr>
<tr>
<td>PPADP</td>
<td>Palapye Planning Area Development Plan</td>
</tr>
<tr>
<td>uPVC</td>
<td>Unplastisiced Poly Vinyl Chloride</td>
</tr>
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1 BACKGROUND INFORMATION

1.1 Introduction
Morupule Colliery Limited managed by Debswana Diamond Mining Company intends to construct a 22km long pipeline from the North-South Carrier pipeline to the colliery in Palapye (see Map 1.1). The purpose is to enable it to transport water to the mine for its coal washing plant and future expansion plans.

The Supply Chain Management, Debswana Diamond Company (Pty) Ltd commissioned Bothakga Burrow Botswana as engineering consultants to carry out the design and construction supervision of the raw water pumping system. Earthtec Consultancy was then commissioned by Bothakga Burrow Botswana to undertake the EIA component of the works in compliance with the Environmental Impact Assessment Act, 2005.

This Draft Environmental Impact Statement has been prepared and issued in this direction. The purpose of the report is to guide the implementation of the project to minimise social and physical adverse impacts and to enhance the positive ones. The archeological impact assessment of the pipeline route has been attached to this report.

1.2 Project Profile
This section presents a description of the proposed activities to be undertaken.

1.2.1 Project Title:
Design and Build of a Raw Water Pumping System from the North-South Carrier (NSC) to Morupule Colliery Contract No: CDC/RDS/08/2007

1.2.2 Project Duration:
Design: Planned to be completed by 30th October 2007
Project Commencement: After design and all approvals have been given by competent authorities.
Map 1.1 Palapye in National Context
1.3 **Description of the Project**

The project as already indicated entails the construction of a 22km pipeline which is to be routed within the railway reserve from the Morupule Colliery to the NCS. The route of the pipeline is parallel to the existing sewage line and would pass through the built up environment of Palapye to the eastern side of the Francistown-Gaborone Road and the undeveloped area western of the road.

The raw water will be transported through proposed 300mm diameter uPVC pipes of 30m lengths. Trenches 2m deep will be dug where the pipes would be laid. The pipes are of 6m length and would be joined by spigot or connecting sockets with gel lubricants. It is estimated that the pipes will be operating at a pressure of 16 bars. It will also involve the construction of manholes. Bedding materials for the pipes may also be borrowed where existing conditions are rocky and unstable.

Four 750m³ reservoir tanks and a booster pump station would also be constructed. The reservoir tanks would be built of reinforced concrete materials. One of the storage tanks is to be located to the western side of the NSC just outside its servitude (Figure 1.1 and Map 1.2) and the other three reservoirs are to be constructed at the colliery.

1.4 **Proponents and Engineers Details**

<table>
<thead>
<tr>
<th>Proponents</th>
<th>Design Engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Applicant:</strong> Debswana Diamond Company</td>
<td>Team Leader: <strong>Mr. A. Siwawa</strong></td>
</tr>
<tr>
<td><strong>Contact Person:</strong> Mr. M. Majaha</td>
<td>Bothakga Burrow Botswana</td>
</tr>
<tr>
<td>Telephone Number: 3615224</td>
<td>Telephone Number: 3951891</td>
</tr>
<tr>
<td>Fax Number: 3615295</td>
<td>Fax Number: <a href="mailto:arthur@bbbl.co.bw">arthur@bbbl.co.bw</a></td>
</tr>
</tbody>
</table>
Map 1.2 Aerial view of proposed water pipeline route.
1.5 Objectives of the study
The objectives of the study are to undertake an environmental impact study of the proposed pipeline and pump station from the NSC to the Morupule Colliery.

Specific Objectives of the EIA are:

a. To undertake environmental and social studies to sufficiently address the prevailing impacts.

b. To identify and evaluate the social, environmental and archaeological impacts, which will be caused by the construction of the pipeline and its operations.

c. To identify and describe procedures and activities that will mitigate adverse impacts and enhance beneficial effects.

d. To liaise with relevant stakeholders all organizations that represent interest groups in order to seek their views on issues related to the pipeline project.

1.6 Methodology
Several methods were employed in carrying out the environmental impact assessment exercise in compliance with the procedures of the EIA Act, 2005. These dovetailed in preparing this statement. These were field surveys, review of literature and consultations of interested and affected parties.

Reconnaissance site visits of the proposed pipeline route and location of the booster station and reservoirs were undertaken. This involved walking and driving the entire stretch of the proposed pipeline alignment. This started from the connecting point from the NSC, to the proposed location of the reservoirs in the colliery. The EIA team was guided by two officials from the Water Utilities Corporation in Palapye (Plate 1.1).

In addition documents concerning all communications and consultations held by the engineering consultants with important stakeholders in connection with the proposed project were reviewed. These have been attached as Appendix 1.1. The review indicated that consultations have been held with Botswana Railways Corporation, Water Utilities Corporation, Roads Department and the Central District Council (Serowe-Palapye Sub District). It has been recorded that approval for the pipeline route to use the servitude of the railway line has been granted by the Botswana Railway Corporation.
This was followed by the preparation and submission of Preliminary EIA to the Department of Environmental Affairs. Following the submission of the Preliminary EIA and upon the recommendation of the Department of Environmental Affairs to undertake the scoping and public participation exercise and then develop the TOR (Appendix 1.2), an advert of intent to consult the beneficiary communities was placed in the Mmegi (Newspaper) in compliance with Section 7 (2) of the EIA Act, 2005 (Appendix 1.3).

Several Institutions were issued with questionnaires to gather their views on the construction of the pipeline; public consultation exercise in the form of a socio-economic survey was carried out in the village. This targeted the households directly to be affected by the construction of the water pipeline. A total of 30 households were consulted. The report on the scoping exercise has been attached to the report. Following the consultations, the project’s Terms of Reference was drawn in combination with professional judgment (field observation and experience with similar projects) and existing sources of information for the pipeline project. This was presented to the Department of Environmental Affairs and was approved. The Terms of Reference provided direction for the EIA exercise.

![Plate 1.1 Officials from Water Utilities Corporation in Palapye showing the environmental team the proposed connecting point of the pipeline to the North South Carrier (NSC).](image)

Literature was reviewed on the biophysical and social environment of the general project area and general impacts of the installation of pipelines and pump stations and reservoirs. These provided pointers for identification of potential impacts. The Roads Department Guideline No. 5 was used to assess the impacts (see Chapter 4) following which mitigation measures were recommended. An EMP was prepared based on the arching issues which need to be monitored during the
construction and operation of the pipeline. A Code of Conduct to regulate the activities of the contractor to implement the project has also been prepared.

1.7 Study Team

The table below presents the environmental team at this stage.

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Profession</th>
</tr>
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<tbody>
<tr>
<td>Dr Ebenezer Archer</td>
<td>Environmental Specialist- Team Leader</td>
</tr>
<tr>
<td>Miss Sephiwe Phillimon</td>
<td>Archaeologist</td>
</tr>
<tr>
<td>Miss Laone Botite</td>
<td>Sociologist</td>
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</tbody>
</table>
2 ENVIRONMENTAL ISSUES

2.1 Biophysical Environment

2.1.1 Climate
Palapye lies within the Central District, which, like the rest of Botswana experiences semi-arid climate with summer (October-March) rainfall and largely dry winter periods (May-July). During the winter months a cell of high pressure over the eastern Transvaal brings fine dry weather to the region, although moist air from the Mozambique Channel may occasionally penetrate inland bringing clouds and drizzle (Central District Council, 2003).

2.1.2 Rainfall
During the summer months, the region is affected by a number of synoptic conditions, chief among the Westerly troughs which affect the region in the early part of the rainy season (October –December) as well as in March and April. The southward migration of the Inter-tropical Convergence Zone (ITCZ) brings moisture on the latter part of the season. The Zaire Air Boundary (ZAB) and the high intensity storms on the south eastern part o of the sub-continent, also influence the region.

Drought conditions, defined as less than 40 per cent annual rainfall, occur on average one year in seven. Evapo-transpiration is very high, and precipitation exceeds Evapo-transpiration for only a few days in December/January (PPADP1996). The mean annual precipitation is about 460 mm.

2.1.3 Temperature
Temperatures exhibit high annual and diurnal ranges. Summer temperatures are uniformly high in the district with peaks coincident with dry spells. The average maximum temperatures in summer months are about 32 degrees Celsius. In winter months the average temperature is about 13 degrees Celsius, with ground and air frost possible in the early mornings between June and August. The mean annual temperature is around 21 degrees Celsius.
2.1.4 Wind speed and wind direction

Wind is dominantly from the east and north east, although a southeasterly component is present in the summer months associated with thunderstorms. In winter, southeasterly winds accompany cold fronts. Calm conditions prevail approximately 30 per cent of the time.

Wind speeds are highest in October and lowest in May and July. Mean annual wind speeds are between 2.5 and 3.5 meters per second although wind speeds of up to 25 meters per second can be recorded during thunderstorms.

2.1.5 Topography

The Palapye Planning Area lies astride the Lotsane River, with approximately three quarters of the area lying to the north of this river. The general amplitude of the planning area is about 9340 meters above sea level with the general landform rising from the banks of the Lotsane-Dikabeya confluence at 899 meters above sea level to the peak of Khurumela hill at 961 meters above sea level. Some rock outcrops interspace the landscape reflecting an intrusion of a different geological material. These form the hills dotting the landscape such as Majwaane-Matshwane hill to the south west of the village and Tswapong Hills east of the village.

2.1.6 Hydrology

The Planning area falls in the Limpopo Drainage System with rivers drain into the Limpopo River which forms the border with the Republic of South Africa. The drainage density is very low, with drainage channels more than 5km on the northern banks of the Lotsane and at least three kilometers on the southern banks of the Lotsane. The Lotsane River is the main drainage component in the area

Surface hydrology does not provide much alternative for the supply of water for Palapye Village. Only Lotsane River, which is an ephemeral river, runs through the planning area. Both the Dibokwe and Dikabeya Rivers which form the north eastern and eastern boundary of the planning area are also seasonal as well as the Morupule River which forms the western boundary. The only other river entering the Planning area from the south east is the Leupane River which has a dam just outside the boundary. A livestock dam also exists on Dikabeya River.
However, the Department of Water Affairs is considering the construction of a dam on Lotsane River at Maunatlala village, outside the Planning area. There are no significant hydrological features along the pipeline route.

2.1.7 Geology
This geological brief is based on the Geology of Palapye by Ermanovics and Skinner 1979; Quarter Degree Sheet 2227C and Geological Survey of Botswana. The area of Palapye is in general underlain by rocks of the Palapye Groups. These rocks lie unconformably upon rocks of the basement complex which comprises Limpopo tectono-metamorphic complex. Rocks of the basement complex are poorly exposed except in the ridges south east and northeast of Makoro Hills (marble and calc-silicate), at Rasesele Hill (calc-silicate), and north of Maope village (quartzite) where exposure is good.

The Palapye Group is subdivided into four conformable formations which essentially show a two–fold succession of coarse to fine grained clastic rocks. The base of the Seleka Formations around Ramokgonami contains pebble conglomerate beds 3 to 5 metres thick that are intercalated with cross-bedded, red to purple feldspathic and quartzitic sandstones. The basal unit at the Tswapong Hills is coarser and contains thicker beds. The lavas are poorly exposed; and are found only around Ramokgonami. Their presence is marked primarily by scree. The top of the formation becomes finer grained with impersistent conglomerate beds. Ferruginous and manganiferous sediments near the top include a Manganese Member 29.2 metres thick which in turn is overlain by red quartzites interlayered with siltstones.

The succession of the Tswapong formation can only be distinguished from that of the underlying Seleka formation with difficulty. The beds are less red; fewer conglomerate and gritty partings occur, and the manganiferous and lava horizons are absent. Despite these differences the beds are of sufficient lithological similarity to be confused if the succession cannot be established, or if the shales of the intervening Moeng formation are absent. Generally, the succession comprises red to buff coloured sandstone and quartzite with minor conglomerate and gritty horizons throughout. Pisolitic ironstone is developed near the base. Basal boulder beds are developed westward where the formation oversteps younger formations onto basement rocks.
The Lotsane formation comprises variegated fine grained, micaceous, arenaceous and argillaceous shales, with minor siltstone and quartzite. Contacts are gradational. Exposure is confined within the Lotsane River.

Karoo strata overlie the Palapye Group conformably. The strata are poorly exposed and their distribution is based primarily on data obtained from boreholes. The rocks define the eastern edge of a local Karoo basin where a succession of conglomerate, shale, and sandstone, 280 metres thick was deposited prior to the development of coaliferous beds.

2.1.8 Soils
The CDDP, 2003 describe soils found in the Palapye area (eastern part of the Central District), as belonging to the Limpopo Unit. These are soils of mixed texture and depth and their agricultural potential is reasonable good. The CDD6 further explains that the best soils are located along the Limpopo River between the Tswapong and Shoshong Hills.

2.1.9 Vegetation
Palapye Planning Area lies in the hardveld region of eastern Botswana where soils are more fertile and more structured than in the sandveld region in central and western parts of the country. The vegetation of the area is considered to be of Mophane mixed tree and shrubland. The vegetation is floristically diverse ranging from combinations of Mophane with Acacia and other species to pure stands of Mophane trees. The common overstory species include Mophane (Colophospermum mopane), Mohudiri (Combretum apiculatum), Motswere (Combretum imberbe) and Acacia species. Other tree species include Motisiara (Terminaria prunoides) and Mokomoto (Commiphora edulis) species.

The understory layer comprises the shorter forms of the above tree species, herbs and grasses. Herbs are seasonal and die off during the dry season lasting May to August every year. The major grass species that occur in Palapye and the surrounding areas include; Rathathe (Eragrostis rigidior), Moseka (Digitaria milanjiana), Seloka (Aristida congesta), Lepheto (Pogonathria squrosa), Chloris virgata and Parotis patens. Other grass species include Lenapa (Rhyncelytrium repens), Anthephora pubescens, Motiskiri (Eragrostis pallens), Tshikitsane (Stipagrostis uniplumis) and Mfahfa (Panicum maximum) (Aganga and Omphile, 2000: Field, 1976). Most of these grasses occur in the shaded and or protected
sites. Majority of these grasses provide forage to the livestock, while some are harvested for thatching purposes including Motsikiri and Tshikitsane species.

2.1.10 Wildlife

The major wildlife species that occur in the communal lands around Palapye and surrounding villages may include dicker, eland, Impala, Kudu, Ostrich, Steenbok and wild beast. Other wildlife species that may occur in low abundance may include baboons, and jackals. According to the Central District Council (2003: 6), wildlife population in the communal lands are low due to the combined effects of livestock displacement, impeded migration by cordon fences, drought and hunting pressures. Hence there are very low wildlife densities and the distribution is less extensive with declines of most species being reported (Bonifica, 1992: Central District Council). However, wildlife population increase in the communal areas towards Tuli block farms as there are relatively higher wildlife densities in the farms.

The area around Palapye is also significantly disturbed by anthropogenic activities and as such most of the wildlife would have moved to seek sanctuary elsewhere with fewer disturbances. However, it would not be completely rare to occasionally encounter such species as steenbok and scrub hare.

Other wildlife species include gecko, lizards, snakes and other types of invertebrate whose population is not well established and distribution is not clear. But none of the protected wildlife species in Botswana are known to occur in the area. Some of the protected species include: Wild dog (Lycaon pictus), Black rhinoceros (Diceros bicornis), Brown hyaena (Hyaena brunnea) and the Cheetah (Acinonyx jubatus).

Botswana has a wide variety of bird species with 496 species represented by 285 non-passerine and 211 passerine species from 47 and 25 families respectively (Penry, 1994). Although none of these birds are endemic to Botswana, 20 per cent of the avifauna is composed of migrants from the Palaearctic and other African countries. In addition approximately 65 species of rarely observed birds in Botswana have been identified.

There are 21 protected species of birds in Botswana, six of which are considered globally threatened (Kalikawe, 2004). The birds that are globally threatened and have been observed in Botswana include Wattled Crane (Grus carunculata), Cape Vulture (Gyps coprotheres), Peregrine Falcon (Falco peregrinus), Black-
cheeked Lovebird (*Agapomis nigrogenis*), Slaty Egret (*Egretta vinaceigula*) and Lesser Kestrel (*Falco naumanni*). The avifauna community in the ornithological zone where Palapye village is located includes the following common bird species (from one area rather than being threatened by physical developments. Birds for example have been observed to expand their previous ranges and population due to agricultural activities and provision of water as their habitats increase (Penry, 1994).

According to Penry (1994) and Senyatso (2005) the birds that occur in the generally built up areas such as towns, cities and other build up areas are shown in the Table 2.1. The most abundant ones in the Palapye village and the surrounding areas include kites, dove, mouse birds and hoopoe among others. These birds mainly occur in association with natural plants that occur in parks and gardens. In build up areas, the birds occur especially if there are large trees or shrubs for nesting sites. More and more birds are adapting to town lifestyle and can be encouraged even by planting suitable plants (Penry, 1994; Senyatso, 2005).

<table>
<thead>
<tr>
<th>Common / Setswana name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kites / Segodi</td>
<td><em>Milvus migrans parasitus</em></td>
</tr>
<tr>
<td>Doves / Segodi, Mhiri</td>
<td><em>Streptopelia semitorquata</em>, <em>S. Capicola</em>, <em>S. Senegalensis</em></td>
</tr>
<tr>
<td>Mouse Bird / Marungwane, Letsiababa</td>
<td><em>Colius colius</em>, <em>Urocolius indicus</em></td>
</tr>
<tr>
<td>Hoopoe / Mmadilepe</td>
<td><em>Upupa africana</em></td>
</tr>
</tbody>
</table>

Source Penry, 1994: Senyatso, 2005

### 2.2 Social Environment

#### 2.2.1 Land Tenure and Land use

All land in the Palapye Planning Area is tribal land and falls under the jurisdiction of the Ngwato Land Board. However all the land issues in the planning area are the responsibilities of the Serowe-Palapye Sub-Land Board located in Palapye. All land applications are processed by the Sub-Land Board. The Sub-Land Board is also responsible for resolving all land disputes and the control of the use of land within the Planning Area.

Palapye is a planning area and therefore land use planning of the village is under the jurisdiction of the Department of Town and Regional Planning. The
implementation of the plan is undertaken by the Palapye Sub-Land Board and planning permission and control is undertaken by the Physical Planning Department of the Serowe-Palapye Sub District Council. The development plan of Palapye is currently under review.

2.2.2 Population

The 2001 census showed that the population of Palapye was 26,293 people, made up of 12,087 males and 14,206 females.

The distribution of population in the planning area shows a heavy concentration in the Palapye village area. The PPADP explains the large growth in the Palapye area in terms of:

- Migration from both the rural areas, other towns and villages in search of employment especially after the opening of the Morupule Colliery and Power Station as well as the designation of Palapye as a Sub-District headquarters.
- The recurring drought that has gripped the country from the mid 80’s that drove people from the rural areas in search of employment and other forms of livelihood.
- The growth in industrial and commercial activity in Palapye which attracted more business and created more employment opportunities.

In the same period, most of the localities around Palapye recorded negative population growth, reflecting perhaps, that part of their population could have moved to Palapye Village. The population growth rate for Palapye in the last 20 years is presented in Table 2.2. Based on the annual Growth of 4.2 per cent the 2007 population is expected to be 33,655.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Population change</th>
<th>Average annual growth %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>5218</td>
<td>4376</td>
<td>6.1</td>
</tr>
<tr>
<td>1981</td>
<td>9594</td>
<td>7768</td>
<td>5.9</td>
</tr>
<tr>
<td>1991</td>
<td>17362</td>
<td>8931</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Source: CSO, 1981 and 2001
It is significant to note that the combined population of Palapye and surrounding localities including Lecheng and Malaka is about 34,000 people. When the university opens and is operating at full capacity it will be having a population of about 11,000 people. Given that a significant number of the academic staff and students will be coming from outside Palapye, the opening of the university will represent a significant increase in population for Palapye by more than 30 per cent. This obviously, has to be met with commensurate increase in the provision of goods and services in Palapye. CSO, (2005) has also projected the population of Palapye as shown in Figure 2.1. It is estimated that Palapye had a population of 26,792 and it is projected to have a population of 28,155 by 2011. It is pessimistic about this population figure as it is a surety that this population would be exceeded as a result of the proposed university in the village.

![Figure 1.2 Population Projection for Palapye](source: Data from CSO, 2005)

Over 65 per cent of the population of Palapye is less than 30 years of age. This presents a formidable pool of labour for the project (see Table 2.3).
### Table 2.3: Distribution of population for Palapye Village by Age and Sex 2001

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>1,475</td>
<td>5.6</td>
<td>1,573</td>
<td>6.0</td>
</tr>
<tr>
<td>5-9</td>
<td>1,566</td>
<td>6.0</td>
<td>1,597</td>
<td>6.1</td>
</tr>
<tr>
<td>10-14</td>
<td>1,404</td>
<td>5.3</td>
<td>1,629</td>
<td>6.2</td>
</tr>
<tr>
<td>15-19</td>
<td>1,490</td>
<td>5.7</td>
<td>1,855</td>
<td>7.1</td>
</tr>
<tr>
<td>20-24</td>
<td>1,249</td>
<td>4.8</td>
<td>1,628</td>
<td>6.2</td>
</tr>
<tr>
<td>25-29</td>
<td>1,092</td>
<td>4.2</td>
<td>1,359</td>
<td>5.2</td>
</tr>
<tr>
<td>30-34</td>
<td>824</td>
<td>3.1</td>
<td>1,032</td>
<td>3.9</td>
</tr>
<tr>
<td>35-39</td>
<td>705</td>
<td>2.7</td>
<td>899</td>
<td>3.4</td>
</tr>
<tr>
<td>40-44</td>
<td>612</td>
<td>2.3</td>
<td>651</td>
<td>2.5</td>
</tr>
<tr>
<td>45-49</td>
<td>568</td>
<td>2.2</td>
<td>581</td>
<td>2.2</td>
</tr>
<tr>
<td>50-54</td>
<td>317</td>
<td>1.2</td>
<td>359</td>
<td>1.4</td>
</tr>
<tr>
<td>55-59</td>
<td>199</td>
<td>0.8</td>
<td>228</td>
<td>0.9</td>
</tr>
<tr>
<td>60-64</td>
<td>148</td>
<td>0.6</td>
<td>206</td>
<td>0.8</td>
</tr>
<tr>
<td>65-69</td>
<td>123</td>
<td>0.5</td>
<td>186</td>
<td>0.7</td>
</tr>
<tr>
<td>70-74</td>
<td>91</td>
<td>0.3</td>
<td>151</td>
<td>0.6</td>
</tr>
<tr>
<td>75+</td>
<td>151</td>
<td>0.6</td>
<td>264</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,089</strong></td>
<td><strong>45.7</strong></td>
<td><strong>14,204</strong></td>
<td><strong>26,293</strong></td>
</tr>
</tbody>
</table>

Source: CSO, 2001

Economically active population refers to all those people recorded as either working or seeking work in the ages of 12 years and over. Thus the economically active population for Palapye in 2001 was 9,662 representing 36.8 per cent of the population. It is significant to note that men outnumber women 52 per cent to 48 per cent in this category. However, more women (54.5 per cent) are seeking employment as compared to men (45.5 per cent) (see Table 2.4).

### Table 2.4: Economically Active Population, 12 years and Over

<table>
<thead>
<tr>
<th>Activity category</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economically Active</td>
<td>5,026</td>
<td>52</td>
<td>4,636</td>
<td>48</td>
<td>9,662</td>
<td>100</td>
</tr>
<tr>
<td>Employed</td>
<td>3,399</td>
<td>55,4</td>
<td>2,734</td>
<td>44,6</td>
<td>6,133</td>
<td>100</td>
</tr>
<tr>
<td>Self Employed</td>
<td>543</td>
<td>46,7</td>
<td>620</td>
<td>53,3</td>
<td>1,163</td>
<td>100</td>
</tr>
<tr>
<td>Family Business</td>
<td>14</td>
<td>53,9</td>
<td>12</td>
<td>46,1</td>
<td>26</td>
<td>100</td>
</tr>
<tr>
<td>Work on lands, Farms and Cattle Post</td>
<td>18</td>
<td>64,3</td>
<td>10</td>
<td>35,7</td>
<td>28</td>
<td>100</td>
</tr>
<tr>
<td>Actively seeking work</td>
<td>1,052</td>
<td>45,5</td>
<td>1,260</td>
<td>54,5</td>
<td>2,312</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: CSO, 2001
**Active and Inactive population**

Economically inactive population refers to those engaged in housework, the students, retired and the sick who are 12 years of age or over. Women dominate all the categories in this section including those involved in housework and also the student category. This can partly be explained by the distribution of population in Palapye which shows a preponderance of women over men. The opening of the university will further increase the segment of economically inactive people specifically in the student category thereby raising the dependency ratio although most of the young people will be coming from outside Palapye (see Table 2.5).

<table>
<thead>
<tr>
<th>Activity/Category</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housework</td>
<td>953</td>
<td>24.1</td>
<td>2,994</td>
<td>75.9</td>
<td>3,947</td>
<td>100</td>
</tr>
<tr>
<td>Student</td>
<td>2,107</td>
<td>46.6</td>
<td>2,414</td>
<td>53.4</td>
<td>4,521</td>
<td>100</td>
</tr>
<tr>
<td>Retired</td>
<td>134</td>
<td>55.6</td>
<td>107</td>
<td>44.4</td>
<td>241</td>
<td>100</td>
</tr>
<tr>
<td>other</td>
<td>216</td>
<td>45.5</td>
<td>259</td>
<td>54.5</td>
<td>475</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: CSO, 2001

**2.3 Description of Proposed Pipeline Route**

This section presents a brief description of the proposed pipeline route. It also shows some photos which have been presented from Plates 2.1 through to 2.20.

The proposed pipeline route traverses from the eastern side of Palapye to the western boundary of the village. The pipes are to be laid to the southern side of the railway line (see Map 1.2 and 2.1a and b). The site where the reservoir and booster pump station are to be built is covered with acacia trees and shrubs. This is located southern of the sanitation lift station. The proposed pipeline will then be laid beside the existing sewer line along an earth road to the western side of the village.

The pipeline will cross ten roads at various railway level crossings along the 22km stretch. Four of these are major roads, tarred and within the built up environment. One of such level crossings is the Francistown-Gaborone Road which is a primary road. This road has been used to divide the pipeline route into the eastern and western side.
The eastern side of the road is built up with residential areas and mixed land uses (commercial, residential and industrial) to the north and south of the railway line (Map 2.1a and 2.1b). An industrial site also abuts the railway line to the northern side. A number of footpaths were also observed crossing the railway line from the north to the south. A playing field also lies within the area where the proposed pipeline will be constructed. Certain sections of the proposed route were unkempt with rubbish and rubbles. Cattle were also found grazing along the proposed route at locations where there were grass and acacia shrubs.
Plate 2.5 Some acacia trees to be removed

Plate 2.6 Children Playing close to the railway line

Plate 2.7 Footpath across the railway line and abutting the playing field

Plate 2.8 Pedestrian crossing the railway line

Plate 2.9 Rubbish dumped within the railway reserve.

Plate 2.10 Level crossing at the Francistown-Gaborone Road.
Plate 2.11 Cow grazing within railway reserve.

Plate 2.12 Residential houses southern of the railway line.
Map 2.1A: Detailed Perspective of Proposed Water Pipeline Route
Map 2.1B: Detailed Perspective of Proposed Water Pipeline Route
The western side of the road along the railway line is unkempt. The area has been zoned as industrial site but not yet developed. This side of the pipeline route is fenced parallel to the Francistown-Gaborone Road.

A track already exists along the entire railway line which is used for servicing the rails. In addition to the ten railway crossings, another crossing was observed being constructed at this section of the route.

About 100m from the Francistown-Gaborone road, it was observed that piles of sand have been tipped close to the proposed pipeline route. Empty beverage cans were also observed been dumped within the area.
Plate 2.17 Empty cans close to proposed pipeline route
Plate 2.18 Rubbles within railway reserves
Plate 2.19 New access road across the railway line being constructed.
Plate 2.20 Heap of sand along proposed pipeline route
3 ANTICIPATED IMPACTS, THEIR ASSESSMENT, ENHANCEMENT AND/OR MITIGATION

3.1 Introduction
This chapter presents the significant potential impacts and mitigation measures directly associated with the pipeline, reservoirs and pump stations. It presents the positive and negative impacts on the biophysical and socio-economic environs within the pipeline corridor. The impacts anticipated were identified through the various field surveys, public consultations held and from experience and professional judgement.

3.2 Description of Project Options
In undertaking the project assessment two options were considered. These are the 'no project / do nothing option / alternative zero' and the project or the 'do something option'. Both options however generally impacts have and have broadly been looked into as below.

3.2.1 The ‘No Project’ or Alternative 0 option
This option implies maintaining the status quo of not constructing the pipeline to supply water to the colliery. This implies keeping the existing railway reserve intact, with no disturbance to the vegetation along the proposed alignment, no disruption or disturbance to public footpaths and movement across the railway line, no traffic hazards, no disturbance to playing fields and nuisance of noise due to construction which would affect the residents along the pipeline route in the built up environment of Palapye. These impacts are however temporary and would be experienced only during construction as the pipes are to be buried to a depth of 2m.

The “do nothing” option will also act against the provision of raw water to the colliery to enable the washing of coal which will intend reduce the adverse environmental impact from raw coal. The “no project” or “do nothing” option will however maintain the stability of the social fabric and biophysical conditions of the project area (unless otherwise detected by nature)
From the above, it is evident that the ‘no project’ or “do nothing” option would not be beneficial particularly to the country and the especially users of coal. With the energy crises in the country, the use of coal to generate power would be paramount. The use of clean or washed coal is therefore appropriate for reduction of green house gases hence promoting environmental sustainability.

3.2.2 The Project Option
From the foregoing, it is clear that the proposed project will not only be in the best interest of the Morupule Colliery but also the entire country. The anticipated impacts associated with this option are presented in Section 3.3.

3.3 Anticipated (Predicted) Impacts of the Proposed Pipeline Construction
Following the review of literature, field survey, the scoping exercise and professional experience, the below listed biophysical and socio-economic impacts have been identified as likely to occur at various stages of the provision of the pipeline, pump station and reservoirs.

Construction Phase
The construction phase will involve activities such as the removal of vegetation, trenching to lay pipes, creation of tunnels along existing roads, undertaking concrete works, filling up of trenches and rehabilitation of disturbed areas. The impacts associated with the above activities are presented as below:

Biophysical Environmental Themes

Negative Impacts
8. Vegetation removal
9. Soil erosion and sedimentation
10. Air pollution
11. Increase in ambient noise levels and vibrations
12. Trenching
13. Geological Impacts and Land transformation
14. Waste generation
**Socio Economic Environment Themes**

**Positive Impacts**
8. Short term employment to locals

**Negative Impacts**
9. Health and Safety Issues (Workers and households)
10. Traffic hazard to vehicle operators and pedestrians

**Operation Phase**
The operation phase involves the use of the pipeline, reservoir and pump station. This phase includes the routine and periodic maintenance of the pipeline and pump station. The impacts associated with this phase or stage is anticipated as follows.

**Socio Economic Environment Themes**

**Positive Impacts**
11. Safe transportation of raw water to the colliery
12. Improved quality of coal for a cleaner environment.

### 3.4 Assessment Method of Impacts

The Department of Roads Guideline No.5 has been used to assess the value, magnitude and significance of the impacts identified above.

\[
\text{Value} + \text{Magnitude} \downarrow \text{Significance of Impacts}
\]

Value according to the Guideline No.5 refers to the use of the land area proposed for the drainage development. The value must be seen in relation to national and international strategies for conservation and development (Roads Department, 2001). The value of impacts has been ranked and provided by the Guideline as Large, Medium and Small/low value. These are explained in Table 3.1.
Table 3.1 Rank of Values

<table>
<thead>
<tr>
<th>Value Rank</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Value: -</td>
<td>Areas protected by law or zoning e.g. Habitats of engendered species, areas or assets of national or great local importance such as national parks or Kgolaa and areas of high vulnerability</td>
</tr>
<tr>
<td>Medium Value</td>
<td>Regionally important areas or areas which are considered to be important locally and of medium vulnerability</td>
</tr>
<tr>
<td>Small / Low value</td>
<td>Locally important areas and areas of low Vulnerability</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001

Magnitude explains the degree /extent/ severity of the impact to the physical and /or socio-economic environment. Where possible it has been quantified. The scale for measuring the magnitude as provided in the Guideline and used in the assessment is provided in Table 3.2.

Table 3.2 Rank of Magnitude

<table>
<thead>
<tr>
<th>Magnitude Scale</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Positive</td>
<td>Substantial Positive Effects</td>
</tr>
<tr>
<td>Medium</td>
<td>Condition noticeably improved</td>
</tr>
<tr>
<td>Small /None</td>
<td>Little or no change</td>
</tr>
<tr>
<td>Medium negative</td>
<td>Condition noticeably worsened</td>
</tr>
<tr>
<td>Large Negative</td>
<td>Substantial adverse effects</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001

The significance of an impact is the combination of the value and magnitude and done by judgmental value of the environmentalist. As indicated in the guideline the scale for assessing the significance is shown in Table 3.3.

Table 3.3 Rank of Significance

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>+++++</td>
<td>Very Large Positive Significance</td>
</tr>
<tr>
<td>+++</td>
<td>Large Positive Significance</td>
</tr>
<tr>
<td>++</td>
<td>Fairly Positive Significance</td>
</tr>
<tr>
<td>+</td>
<td>Small Positive Significance</td>
</tr>
<tr>
<td>0</td>
<td>Small /no Significance</td>
</tr>
<tr>
<td>-</td>
<td>Small Negative Significance</td>
</tr>
<tr>
<td>--</td>
<td>Fairly Negative Significance</td>
</tr>
<tr>
<td>---</td>
<td>Large Negative Significance</td>
</tr>
<tr>
<td>----</td>
<td>Very Large Negative Significance</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001
3.5 Assessment of Identified Impacts, their Mitigation and Enhancement

This section presents an assessment of the impacts identified in Section 3.3.

**Construction Phase**

**Biophysical Environment Themes**

**Negative Impacts**

**Impact 1: Vegetation Removal**

The proposed pipeline route as indicated would be within the railway reserve. Most section of the route is cleared off vegetation. However the servitude of the pipeline and areas required for working would be cleared off vegetation. In addition the location of the pump station and reservoirs will require the vegetation on the site to be cleared.

The vegetation likely to be affected includes common Mophane (Colophospermum mopane), Mohudiri (Combretum apiculatum), Motswere (Combretum imberbe) and Acacia species. The major grass species to be affected include Rathathe (Eragrotis rigidior), Moseka (Digitara milanjiana), Seloka (Aristida congesta), Lepheto (Pogonathria squroso), Chloris virgata and Parotis patens.

**Assessment of impact**

Value = low  
Magnitude = small negative

**Significance of impact**

None of the vegetation identified along the proposed pipeline route and at the sites for the reservoirs and pump stations are protected. Vegetation is already heavily impacted upon by anthropogenic uses both within the built-up environment of Palapye and along the existing railway reserve. More than 15km of the route is already without vegetation.

The significance of this impact is therefore small or no significance. However excess areas should not be cleared for use as working areas.
Mitigation

1. Working areas of not more than 30m should be cleared. These should be intermittently located along the route. This should be demarcated on the ground to guide the operator of the excavators to be used for trenching.

2. The top soil of the area to be excavated should be used after filling up to initiate vegetation re-growth of disturbed areas.
**Impact 2: Soil Erosion / Destabilization**

The removal of vegetation and the general sloppy nature of some sections of the pipeline may exacerbate the destabilization of soils which may lead to gully, sheet and rill erosion. The agents of soil erosion are water and wind, each could contribute a significant amount of soil loss.

**Erosion by Water**

The rate and magnitude of soil erosion by water is controlled by the following factors:

**Rainfall Intensity and Runoff**

Both rainfall and runoff factors must be considered in assessing a water erosion problem. The impact of raindrops on the soil surface can break down soil aggregates and disperse the aggregate material. Lighter aggregate materials such as very fine sand, silt, clay and organic matter can be easily removed by the raindrop splash and runoff water; greater raindrop energy or runoff amounts might be required to move the larger sand and gravel particles.

Soil movement by rainfall (raindrop splash) is usually greatest and most noticeable during short-duration, high-intensity thunderstorms. Although the erosion caused by long-lasting and less-intense storms is not as spectacular or noticeable as that produced during thunderstorms, the amount of soil loss can be significant, especially when compounded over time. Runoff can occur whenever there is excess water on a slope that cannot be absorbed into the soil or trapped on the surface which is typical of the area. The amount of runoff can be increased if infiltration is reduced due to soil compaction and crusting.

**Off-Site Effects**: Off-site impacts of soil erosion are not always as apparent as the on-site effects. Sediment can be deposited on down slope properties and can contribute to road damage. Sediment which reaches streams or watercourses can accelerate bank erosion, clog drainage ditches and stream channels, silt in reservoirs, and reduce downstream water quality.

**Erosion by Wind**

The rate and magnitude of soil erosion by wind is controlled by the following factors:

**Erodibility of Soil**

Very fine particles can be suspended by the wind and then transported great distances. Fine and medium size particles can be lifted and deposited, while coarse particles can be blown along the surface (commonly known as the siltation
The abrasion that results can reduce soil particle size and further increase the soil erodability.

**Soil Surface Roughness**

Soil surfaces that are not rough or ridged offer little resistance to the wind. However, over time, ridges can be filled in and the roughness broken down by abrasion to produce a smoother surface susceptible to the wind. Excess tillage can contribute to soil structure breakdown and increased erosion.

**Climate**

The speed and duration of the wind have direct relationship to the extent of soil erosion. Soil moisture levels can be very low at the surface of excessively drained soils or during periods of drought, thus releasing the particles for transport by wind. This effect also occurs in freeze drying of the surface during winter months.

**Unsheltered Distance**

The lack of windbreaks (trees, shrubs, residue, etc.) allows the wind to put soil particles into motion for greater distances thus increasing the abrasion and soil erosion. Knolls are usually exposed and suffer the most.

**Vegetative Cover**

The lack of permanent vegetation cover in certain locations has resulted in extensive erosion by wind. Loose, dry, bare soil is the most susceptible; however, crops that produce low levels of residue also may not provide enough resistance. As well, crops that produce a lot of residue also may not protect the soil in severe cases.

Continual drifting of an area gradually causes a textural change in the soil. Loss of fine sand, silt, clay and organic particles from sandy soils serves to lower the moisture holding capacity of the soil. This, in turn, increases the erodability of the soil and compounds the problem.

The above literature on soil erosion has been used to assess the situation pertaining to the construction site.

**Assessment of impact**

Value = medium

Magnitude = medium negative

**Significance of impact**

Soil erosion could lead to the washing out of the pipeline route if filling up of trenches; compaction and leveling are not properly done. The significance of this impact is fairly negative as the project area as indicated earlier in Chapter 2 is susceptible to both wind and water erosion.
This impact is indirect and reversible. It could be a temporary problem if adequate engineering solution is provided and implemented on time. This is of local importance.

**Mitigation**

1. Undertake vegetation clearing in a manner that minimizes the exposure of bare soil. The retention of grass and vegetation debris will assist with protection of the soil from erosion caused by rain and runoff. This is particularly important on steep slopes.

2. Excavate and stockpile topsoil separately and when filling up ensure topsoil are replaced to encourage re-vegetation.

3. Undertake routine monitoring of the effectiveness of soil erosion measures for at least three months after construction or until construction sites are stabilized.

4. Protect the health of workers by providing and encouraging the use of protective clothing including nose masks.

5. There should be proper compaction and leveling up of slopes to the near original state as much as possible.
**Impact 3: Air pollution.**

The main air quality impact that is likely to arise from the construction activities would be related to an increase in ambient dust levels. The presence of construction and other vehicles could lead to an increase in air pollution through the emission of diesel fumes from diesel-powered equipment in addition to the dust from excavation and transportation of pipes and other materials including sand for bedding. Fugitive dust could also be generated as trucks travel on temporary, unpaved hauls roads and from the handling of aggregate and other materials. The air could also be polluted from the use of fuel and other chemicals during construction.

Dust and particulate emissions associated with construction activities impact on amenity and human health. Health or amenity impacts depend on particulate size with particles of between 10µm and 2.5 µm having important health impacts due to their ability to penetrate the respiratory system.

Wind in Palapye is dominantly from the east and north east, although a southeasterly component is present in the summer months. Wind speeds are highest in October and lowest in May and July. Mean annual wind speeds are between 2.5 and 3.5 meters per second although wind speeds of up to 25 meters per second can be recorded during thunderstorms. The impacts of the air or dust pollution on amenity can include soiling of surfaces, the creation of deposits in water and on cars, and other such unwanted effects.

Construction activities identified as specific potential source of dust generation include:
- Vegetation clearance
- Earthmoving activities and excavation
- Movement of vehicles and construction machinery
- Transport of construction materials, fill, rubble and waste
- Stock piling of materials

**Assessment of impact**

Value = Small scale
Magnitude = medium scale
**Significance of impact**

The significance of this impact would be considered fairly negative as most the documented wind direction and strength could have effect on amenities especially households located to the southern part of the pipeline. The residential areas are located between 30 to 100m from the edge of the railway reserve.

The impact is direct, of temporary nature and of local extent (site only). This may affect the activities and health of construction workers and staff on site. The dust generated during construction may have significant health impacts in terms of respiratory problems and the irritation of eyes which could result in a permanent damage.

**Mitigation**

1. Workers should be provided with adequate protective clothing including nose masks during construction activities to prevent contracting dust/emission related diseases.

2. All plants and construction equipment should be maintained to the appropriate standards to ensure that exhaust emissions are minimised. They should comply with the Vehicle Emission Standards.

3. All stockpiled sand or spoils should not be kept for long periods otherwise they should be covered with tarpaulin to prevent it from being blown away by wind.

4. Hauling trucks containing earth materials, loose construction materials, or other fine particles should be covered to prevent dust pollution along the roads during the transportation.

5. Speed limits of 40 km/hr should be adhered to by construction vehicles within the built up environment along the railway reserve to reduce dust pollution.

6. Dust suppression measures by using water should be done as frequently as needed along the pipeline route in the built-up environment.
Impact 4: Increase in ambient noise levels and vibrations

Certain levels of noise are unavoidable in the vicinity of construction sites and some elevation of background levels is normally acceptable for limited periods. Excessive noise, particularly when experienced continuously outside normal working hours and on rest days can be a nuisance to both workers and the public. In extreme cases it may become a health hazard. Typical noise for plant and equipment likely to be deployed for the construction are shown in Table 3.4 below together with typical international standards on noise limit.

Table 3.4 Noise Levels generated by construction machinery under normal wind conditions

<table>
<thead>
<tr>
<th>Type of Plant</th>
<th>Distance between Plant and Observer</th>
<th>Typical International Standard</th>
<th>NEPA Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5m</td>
<td>20m</td>
<td>50m</td>
</tr>
<tr>
<td>Loader</td>
<td>90</td>
<td>78</td>
<td>70</td>
</tr>
<tr>
<td>Bulldozer (excavator)</td>
<td>86</td>
<td>74</td>
<td>66</td>
</tr>
<tr>
<td>Pneumatic Hammer</td>
<td>86</td>
<td>84</td>
<td>78</td>
</tr>
<tr>
<td>Concrete Mixer</td>
<td>91</td>
<td>79</td>
<td>71</td>
</tr>
<tr>
<td>Concrete Pump</td>
<td>85</td>
<td>70</td>
<td>62</td>
</tr>
</tbody>
</table>

Sound levels experienced in day-to-day life typically range from around 30dBA in a bedroom (very quiet) to 80dBA on a busy street (loud) to 110 dBA near an activity such as steel grinding. The noise levels during construction will be highly dependent on the type of construction activities undertaken, their duration and location. The most significance source will be mechanical plant operations or the excavator.

It is anticipated that during the construction phase of the project, noise levels would increase due to the use of heavy equipment. This equipment includes bulldozers, backhoes and jackhammers. The noise directly attributable to the construction activities should not exceed 75dBA during the day time.

Sub surface pipes and cables can also be destroyed due to vibrations and damage to buildings from traffic vibrations is difficult to quantify. The primary impacts of vibration on human environment relate to structural damage and the effects on human comfort. Vibration is measured in mm/s. Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. Vibration of 0.15 mm/s is at the threshold of human perception, while that of 14mm/s would be very strongly noticeable. Any impacts
associated with vibration are expected only to occur during the construction phase of the project with blasting identified as the major potential source.

**Assessment**

Value = Small scale  
Magnitude = Small /None

**Significance of impact**

This impact is considered to be of low significance and of temporary nature. The distance from the residential houses to locations of the pipeline are well over 20m and well below the international standard acceptable noise level of 75 dBA during the day.

**Mitigation**

1. To avoid impacting surrounding land uses, construction hours should be limited to 8 am to 5 pm, Monday to Friday and 8am to 1 pm Saturday, wherever possible.

2. The contractor should ensure that all equipment used on site is fitted with efficient silencers or mufflers, which should be routinely maintained to minimize noise.

3. Construction activities should be planned to avoid prolonged noise generating activities. All machines and plants that will be used intermittently should be shut down (or throttled down) during periods of inactivity.

4. Workers should be provided with ear mufflers/ear plugs to minimise the noise impact from operation of machinery.

5. Truck drivers should continuously be advised to respect speed limits along the road this would reduce noise from the operation of the trucks.

6. As some sections of the construction would be undertaken in the built up environment, photographic records of structures within 200m radius of the pipeline should be undertaken if blasting of rocks is to be undertaken when required.

7. All pump station buildings should be acoustically rated to prevent excessive noise impacts to surrounding land uses. Design should include reinforced concrete walls and roof, lined with insulation with acoustical absorption properties.
**Impact 5: Trenching/Micro Tunneling**

Trenches are to be dug to a depth of 2m and will disrupt access along the numerous footpaths that cross the railway line. The footpaths provide access to the industrial area located north of the Morupule railway line.

The pipeline would also traverse 10 roads one of which is the primary Palapye-Francistown Road, the remaining include collector roads in Palapye and access roads to the colliery and Botswana Power Corporation. It would also disturb the steel fencing along the Palapye-Francistown Road.

The trenching by use of an excavator could introduce exotic weeds in the project area and may also spill hydrocarbons at the sites.

**Assessment**

Value = Large scale  
Magnitude = Large negative

**Significance of impact**

Trenching is of great concern to the residents along the pipeline route. The household survey reported the dissatisfaction of the residents along the pipeline route with the trenches opened for the installations of the sewer lines during construction. They indicated the trenches were opened for long periods and no provision was made for crossing over them. Lessons are to be learnt from the previous experience.

**Mitigation**

1. Good work practice should be inculcated in all workers employed.

2. It is desired that all trenches by the end of the day are closed. However if this is not achieved at worse no more than 50m of trenches should be left uncovered at the close of the day.

3. Crossing structures should be provided over the trenches along major footpaths.
4. Tunnelling should be used when crossing roads to avoid disruption of traffic flow and hazards.

5. Reinstall the fences along the Palapye-Francistown Road after installation of water pipes.
**Impact 6: Geology and Land Transformation**

The geology of the project area indicates that rocks could be exposed at 2 or more meters deep. If rocks are encountered there would be a need for blasting and their removal. In turn there would be a need to provide bedding materials to provide stability of the pipes against damage. This may necessitate the acquisition of sand which is normally used as a bedding material. Such bedding materials could be obtained either from commercial sources or by borrowing. Another anticipated problem would be the stock piling of these rocks and boulders and their disposal.

Trenching would transform the land surface in the project area if compaction is not properly done. The construction of the pump station and reservoirs would also change the surrounding environment.

**Assessment**

*Value = Small scale*

*Magnitude = Small / None*

**Significance of Impact**

This impact is of small significance as relatively small area would be impacted upon.

**Impact Mitigation**

1. The project should limit itself to the land allocated for its construction.
2. Where feasible existing materials along the pipeline route should be recycled.
3. Proper compaction and leveling up of the pipeline route should be undertaken to allow infiltration and movement.
4. Plans should be made for bedding materials incase rocks are encountered during excavation.

Contingency Plans should be made to dispose off rock boulders in case they are encountered in overwhelming quantities. This is to avoid unpleasant aesthetics and to cause nuisance to the residents.
**Impact 7: Waste generation**

At the construction stage, it is likely that the following waste would be generated:
- Cleared vegetation
- Spoils from trenching (and possibly blasting of rocks).
- Domestic waste from construction workers and staff,
- Oil spillage and contamination

**Assessment of impact**

Value = Small scale  
Magnitude = medium negative

**Significance**

This impact is considered to be fairly negative. The risk of oil and fuel spillage occurring could impact negatively on the water, soil and vegetation in the vicinity of the project area. The extent of the damage will depend on the extent of spillage and could lead not only to contaminating the soils but also ground and surface water.

The vegetation to be cleared could also be a source of nuisance and waste to be handled.

**Impact Mitigation**

1. Appropriate materials to be used for construction should be used based on the following hierarchy of waste management
   - Avoid waste through good construction practice
   - Reduce waste through construction methods and purchasing specifications
   - Reduce waste actively by seeking out operations that can recycle the waste generated
   - Reuse waste by actively seeking out operations that can reuse the waste generated
   - Dispose off waste appropriately

2. Provide receptacles (skips and bins) or chambers for waste collection.

3. Cleared vegetation should not be burnt. Villagers should be allowed to harvest the resource
4. Waste or cleanup facilities/containers should be provided on site for use as oil containment measures.

5. Machine and equipment operators should be cautioned about the need to handle potential contaminants with care on site.

6. Equipment maintenance and repairs should be conducted off site where possible. Where this is not achievable, then works should be carried out within a designated bunded area which should be provided on site. Maintenance of equipment should be undertaken with care.

7. Disposal of the contents of the receptacles should be done at an approved designated site.

8. Provide potable sanitary conveniences for the construction workers for control of sewage waste.
**Socio Economic Environment Themes**

**Positive Impacts**

**Impact 8: Short term employment to locals**

It is anticipated that the construction of the pipeline would lead directly to the creation of short-term employment opportunities for about 20 people in Palapye. Indirectly, if labour is employed from the village, the short-term increase in the spending power of the workers will impact positively on the community through the following:

- Some workers might invest their incomes into other sectors
- Enhanced market of various goods and services
- Small-scale informal business could spring up at the construction site where food and other merchandise would be sold.

These could lead to poverty reduction by reducing the unemployment rate. Skills may also be transferred to previously unskilled labour.

**Enhancement**

1. As much as possible, labour should be sourced from Palapye village. This could obviate the need to set up labour-camp.

2. Consideration should be given to gender balance during the recruitment exercise.

3. Local contractors’ and suppliers where possible should be contracted. This will induce or lead to a boost in the local economy.

4. During health education sessions financial management lessons should also be given to enable the workers invest wisely the little money they would be making.
Negative Impacts

Impact 9: Health and Safety Issues

Health and safety issues are important and as such should be seriously considered during project planning and particularly at the construction stage. Health and Safety issues are to be looked at from two perspectives; that emanating directly from the construction activities or physical impact and that from social interactions or relationships.

- Construction

From the physical perspective the following activities have implications for health and safety:

- Dust Pollution (particulates) may be toxic or may carry toxic and carcinogenic organic and inorganic substances. May also penetrate deep into the respiratory system irritating lung tissue. Episodes of high atmospheric concentration often correlate with deaths from respiratory illness.
- Construction Noise
- Possible work related-accidents during hauling and delivery of materials including pipes, injuries, road accidents.

- Social Interactions

The interactions amongst the workers and other community members might lead to the establishment of relationships or partnership. These relationship or partnership might lead to the spread of STDS and HIV/AIDS.

Assessment

Value = Large scale
Magnitude = Large Negative

Significance of Impact:

This is of high significance and could be life threatening.

Impact Mitigation:

1. Protective clothing including overalls, helmets, boots, hand gloves, ear mufflers and nose mask should be provided to all staff working on site. It should be ensured that they are used. A mechanism should be put in place to reward workers who use their protective clothing at all times. The reverse of the above is also
applicable.
2. HIV/AIDS education should be provided to all workers on the project.

3. To empower the locals against falling victims to workers employed on the project whose incomes would have been increased, they should be given priority in recruiting especially women.

4. Well equipped first aid box should be readily available on site.

5. A health and safety committee should be formed. This should comprise of the contractor, supervising engineer, representatives of the workers and the environmentalist or clerk of work. A lead person should be appointed and identified to be responsible for emergencies on site.

6. Training and continuous education of truck drivers and vehicle operators.

7. There should be regular servicing of hauling vehicles and cranes.

8. There should be education on the safety measures for handling construction materials.
**Impact 10: Traffic hazard**
The construction exercise will involve the transportation of materials equipment and materials on a daily basis. This may impact on traffic flow along the internal roads in Palapye Village. This will pose traffic hazard during implementation to all road users and may slow down traffic at areas where works are been undertaken.

**Assessment**
Value = Small scale
Magnitude = Small /None

**Significance of impact**
This impact is of low significance as tunneling would be used to pass the pipes under roads and railway lines. Disturbance could be caused to road users and residents due to the increase in number of construction and staff vehicles

**Mitigation**
1. Adequate and appropriate warning road signs indicating the movement of hauling construction vehicles and activities should be placed about 100m away from both approaches of roads to be disturbed. This is to alert motorists and road users to slow down and be cautious.

2. The operators of all vehicles associated with the project should be educated on the need to obey road regulations and speed limits. The drivers are to be conscientised on a regularly basis to be extra cautious when driving.

3. Tunneling should be undertaken during off peak traffic hours.
**Operation Phase**

**Socio Economic Environment Themes**

**Positive Impacts**

**Impact 11: Safe transportation of raw water.**
The construction of the pipeline, water reservoirs and pump station will provide a sustainable means of transporting water to the colliery other than other methods such as bowsings.

**Impact 12: Improved Coal Quality for Cleaner Environment.**
Indirectly the construction of the pipeline would contribute significantly to the supply of water to wash the coal form the colliery for a cleaner environment during operation. Coal contains organic and inorganic compounds. Kernot (2000) provides an ultimate analysis of the details of the content of individual elements within the coal, which have environmental consequences. The organic materials are carbon, hydrogen, oxygen, nitrogen and sulphur. Partially burned coal produces carbon monoxide, a poisonous by-product. Carbon monoxide is deadly in quantities as little as 1 per cent. Other dangerous gases locked inside coal deposits include hydrogen sulphide, a poisonous gas.

Sulphates and sulphides are reduced during coal washing process, where as organic sulphur is retained within the coal. Sulphur content is not only a problem with respect to acid rain; it can adversely affect the performance of a boiler, leading to enhanced corrosive effects and to the fouling or clogging of boiler tubes. Sulphur content may range from as little as 0.1 per cent to levels above 8 per cent. On combustion the sulphur within the coal oxidises to form sulphur dioxide and on emission into the air the sulphur dioxide (SO₂) combines with water and oxygen to form sulphuric acid, which can cause acidification of rivers and destruction of forests. The nitrogen content of coal may also lead to atmospheric pollution in view of the various oxides that can be produced during combustion. Chlorine may also be present in coals and causes similar problems as sulphur - potential acid rain together with fouling and corrosion of boilers.

Coal also contains inorganic components known as Ash. Ash lowers the fixed carbon content of coal decreasing its heating value. Methane is also often trapped in coal deposits. High-grade coals which are typically buried deeper than lower grade coals often contain more methane.
At the 1990 Kyoto summit on world climate change it was indicated that carbon dioxide (CO₂) contributes 55 per cent to the depletion of the ozone layer, methane (CH₄) contributes 15 per cent, nitrous oxide (NOx) contributes 6 per cent and carbon flouro chlorides (CFCs) contribute about 24 per cent.

In view of the effects of elevated levels of GHG to the atmosphere several conventions and protocols have been passed to control and prevent the excess production of these gases. Botswana has ratified several of these conventions and protocols. These include the Vienna Convention on the protection of Ozone Layer (ratified in 1991), Montreal Protocol on substances that deplete Ozone layer (ratified in 1991), London Amendment to Montreal Protocol (ratified in 1997), and the United Nations Framework on Convention on Climate Change (ratified in 1994).

The objective of the United Nations Framework Convention on Climate Change (UNFCCC), which has been the main guiding convention and adopted in 1992 is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Globally, coal combustion accounts for more than half of the SO₂ and some 30 per cent of the NOₓ released into the atmosphere by human endeavors.

If the world is to ensure that increasing energy demand does not lead to excessive CO₂ (Carbon dioxide) generation and the potential global warming concerns that this arouses, then much of the projected increase in coal fired electricity generation will have to be developed using clean coal technologies (CCT) of which this project intends to do by supplying water to the Morupule Colliery for the washing of the coal that it mines.
4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 Introduction
This chapter outlines the Environmental Management Plan (EMP) that has been formulated based on the potential environmental impacts and mitigation measures identified in the EIA studies and the design.

This EMP provides guidelines to be followed in ensuring that environmental issues are taken into consideration in the project’s implementation. Prior to the plan a presentation is made of the legislation guiding or protecting the environment, which has implications for the development.

4.2 Statutory Requirements for Environmental Management of the proposed pipeline.
The proposed infrastructure development is to be undertaken and managed under the purview of the laws of the country. A list of the main issues and a synopsis of the relevant existing legal and policy framework is presented in Table 4.1 below.

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Legislation / Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality</td>
<td>Atmospheric Pollution Act (1971)</td>
</tr>
<tr>
<td></td>
<td>Public Health Act (1981)</td>
</tr>
<tr>
<td>Archaeology</td>
<td>Monuments and Relics Act (2001)</td>
</tr>
<tr>
<td></td>
<td>National Policy on Natural Resources Conservation and Development (1990)</td>
</tr>
<tr>
<td></td>
<td>Atmospheric Pollution Act (1971)</td>
</tr>
<tr>
<td></td>
<td>Factories Act (1979)</td>
</tr>
<tr>
<td>Impact Monitoring</td>
<td>EIA Act (2005)</td>
</tr>
<tr>
<td>Fires</td>
<td>Herbage Preservation Act (1978)</td>
</tr>
<tr>
<td>Water</td>
<td>Water Act (1967)</td>
</tr>
</tbody>
</table>
### Environmental Issue | Legislation / Policy
--- | ---
Public Health Act (1981) | Road safety
Road Traffic Act (1993) | Borrow pits
Explosive Act (1962)

#### 4.2.1 Water Act (1967)

This Act defines the ownership of any right to the use of water and also provides for the grant of water rights and servitude.\(^2\)

The Act establishes a Water Apportionment Board, which may grant water rights to any person. Such rights may be to divert, dam, store, abstract, use or discharge any effluent, into public water\(^3\) from such source, in such quantity and for such period definite or indefinite as it may deem fit.

Anyone wishing to discharge into public water would need to do so with permission from the Water Registrar. In addition, it introduces the issuing of water rights for use of public water other than for watering stock; drinking, washing and cooking; or use in a vehicle. The grant of the right may be subject to such terms and conditions, as the Board may deem necessary.\(^4\) Owners or occupiers of land may, without a water right, sink or deepen any well, borehole, abstract and use water on their land for domestic purposes not exceeding such amount per day as may be prescribed for the area by the Minister after consultation with an advisory board. Furthermore, such owners or occupiers may construct any work on their land for the conservation of public water and abstract, and use public water conserved for domestic purposes.\(^5\)

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\(^2\) Servitude is defined as a right to enter on the land of another for the purposes of constructing or maintaining works thereon, or storing the water thereon, or carrying water under, through, or over such land, or for all or any of such purposes.

\(^3\) Public water is defined as all water flowing over the surface of the ground or contained in or flowing from any river, spring or stream or natural lake or pan or swamp or in or beneath a watercourse and all underground water made available by means of works. The term does not include any water, which is used solely for the purposes of extracting mineral substances there from, or water, which has been lawfully appropriated for use.

\(^4\) See s. 15 of the Act.

\(^5\) See s. 6 of the Act.
The Act makes it an offence, for example, to pollute public water, with penalties of a fine of P1,000 or a term of imprisonment for one year or both. This makes it necessary that waste materials are not disposed off at vulnerable areas within Palapye.

4.2.2 Waste Management Act (1998)

The objective of this Act is to promote the standards of waste management in Botswana in order to prevent harm to human, animal and plant life, to minimise environmental pollution and to conserve natural resources.

The Department of Waste Management and Pollution Control is charged with the responsibility of regulating, co-ordinating and promoting co-operation on waste management among public and private bodies.

Local authorities such as the Selebi Phikwe Town Council is empowered to collect and dispose all household waste in their area except waste which is situated at a place which in the opinion of the local authority is isolated, inaccessible or which is produced in such small quantities that the cost of collecting it would be high, or the person who controls the waste is capable of collecting it. The waste collection and disposal system should be environmentally sound and be able to utilise the valuable resources, which may be recovered from the waste.

The Act also prohibits littering in any public place and imposes a duty on local authorities to clean public places. In order to make the Act effective; enforcement powers are provided, for example, to the Director of the Department of Waste Management and Pollution Control, to obtain any information from anybody in order to carry out his functions under the Act. Any authorised officer of the Department may enter any premises for the purpose of conducting a search and may seize any item during the course of an investigation in connection with the keeping, treating and disposal of waste. A general penalty of a fine of P14 000 or a term of imprisonment not exceeding 10 years or both may be imposed on a person who is found guilty of depositing waste on land which gives rise to the pollution of the environment or harm to human, animal or plant life.

This point is important and should be considered during the plan implementation as the construction activities may generate waste materials such as grass and tree
cutting, uPVC materials, and human waste from the workers on site. These would be required to be managed and disposed of at appropriate sites or areas.

4.2.3 Monuments and Relics Act (2001)

The Monuments and Relics Act, Act No.12 of 2001, provides for two major issues:

1. The preservation and conservation of areas and items of historical, architectural, archaeological and Palaeontological value.

   The Monuments and Relics Act, 2001 defines Monuments as ‘any area of land which is of archaeological or historical interest or contains objects of such interest, any area of land which has distinctive or beautiful scenery or a distinctive geological formation, any cave, rock shelter, grove or trees, tree, old structure or other object or article (whether natural, or constructed by man) other than a relic, of aesthetic, archaeological or historical or scientific values or interest’.

2. The undertaking of an Environmental Impact Assessment (EIA)

   This Act, under section 19 (1) and (2) makes it mandatory for any prospective developer to undertake both an archaeological pre-development impact assessment study and an environmental impact assessment study (EIA) and submit a written report which is to be submitted to the Commissioner of Monuments and Relics, after which written consent is given. This Act requires that Archaeological and Environmental Impact Assessment are undertaken for all major development projects and that a Development Permit is obtained from the National Museum before any construction can take place. No development is therefore permitted to go ahead without the written consent of the Commissioner.

   This Act has been complied with. An archaeological study has been conducted and the clearance letter attached to this report.

4.2.4 Development Control Code (1995)

The Ministry of Lands and Housing through Department of Town and Regional Planning, has transferred authority in this case to Palapye since it is a declared planning area, to administer this development code. The Development Code is a set of planning regulations (which are legally binding) aimed at controlling land use activities.
Development regulations cover the following land use areas:
- Residential land use
- Commercial land use
- Industrial land use
- Open Spaces
- Civic and community land use
- Mixed land use
- Advertisement

As part of the guiding principles for the land use areas, environmental protection objectives are stated. In summary some of the key objectives include:
- Reduction in dependence on non-renewable and scarce resources,
- Prevention of airborne emissions and water borne discharges i.e. the control of pollution at source
- Conservation of energy and resources
- Aesthetic considerations and sensitivity of building characteristics to the natural environment
- Consideration for neighbours
- Provision of suitable space for the storage and collection of refuse
- Landscaping and management of open space
- Appropriate sanitation provision
- Control of site boundary set backs

These are to be considered in the construction of the water pipeline especially in the disposal of waste materials.

4.2.4 Public Health Act (1981)
This Act relates to the well being of the country’s citizens by making provisions for public health. Essentially it makes notification of certain diseases compulsory and seeks to prevent and control the spread and introduction of communicable diseases within and into the country. It also seeks to regulate sanitation. In addition it provides for the protection of water supplies.

Part IX Section 57 of the Act makes it mandatory for public health officers to take all practicable and lawful measures to ensure the purity of any public water supply which has the right to be used for drinking or other domestic purposes and to take action against any persons found polluting any such supply or streams. This Act compels that clean and hygienic environment is created at the work site and
workers educated on clean behavior at home and work place to avoid or minimize the possibility of falling sick and to spread communicable diseases.

This Act obligates the contractor to seek the proper health of the workers and residents close to the construction site.

4.2.5 National Policy on Natural Resources Conservation and Development (1990)

This is Government Paper No.1 and approved in 1990. The primary goal of the policy is to increase the effectiveness with which natural resources are used and managed so that beneficial interactions are optimized and harmful environmental side effects are minimized. The policy identifies five key areas of environmental concern, which requires solutions. These are:

- Growing pressure on water resources from increased population, urbanization, and development
- Pollution of air, water, soil and vegetation resources.

The solutions provided by the policy for the identified problems above include the following:

- Improved planning and administrative measures in the interest of both protecting water resources against pollution and improving multi-purpose use.
- Recycling of treated effluent
- Incentives to encourage recycling

4.2.6 Atmospheric Pollution (Prevention) Act (1971)

This Act is intended for the prevention of the pollution of the atmosphere by carrying out industrial processes. The Act seeks to control the emission of ‘objectionable matter’, which is defined in Section 2 as “smoke, gases including noxious or offensive gases, vapours, fumes, grit, dust or other matter capable of being dispersed or suspended in the atmosphere which is produced or is likely to be produced by any industrial process”.

The Act requires that Air Pollution Control Officers should be satisfied that proposed industrial activities do not conflict with locational land uses within the project environs. During the construction phase of the project, dust would be generated through trench digging. The movement of vehicles and machinery to and around the site and excavation of construction materials will also have the same effect. The dust problem will not be significant as the roads leading to the pipeline route are mostly tarred.
The flexibility or dynamism of the Act in terms of regulations is provided for in Section 15. In view of this the Department of Waste Management and Pollution Control has developed standards for air quality indicating allowable maximum measurement of major indicators of pollution such as sulphur, particulate matter etc, this is shown in Table 4.2.

The fine of P500 for first offence and P1000 for subsequent conviction set in 1971 in contravention of the Act is outdated and is no longer adequately sufficient to act as a deterrent.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Standard Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Particulate Matter (PM)</strong></td>
<td></td>
</tr>
<tr>
<td>Annual average</td>
<td>100 µg/m³</td>
</tr>
<tr>
<td>Monthly average</td>
<td>200 µg/m³</td>
</tr>
<tr>
<td><strong>Sulphur Dioxide (SO₂)</strong></td>
<td></td>
</tr>
<tr>
<td>Annual average</td>
<td>80 µg/m³</td>
</tr>
<tr>
<td>Monthly average</td>
<td>160 µg/m³</td>
</tr>
<tr>
<td>24 hour average</td>
<td>90 per cent of hourly observation to be less than 300 µg/m³</td>
</tr>
<tr>
<td><strong>Carbon Monoxide (CO)</strong></td>
<td></td>
</tr>
<tr>
<td>8 hours average</td>
<td>10 000 µg/m³</td>
</tr>
<tr>
<td>1 hour average</td>
<td>40 000 µg/m³</td>
</tr>
<tr>
<td><strong>Nitrogen Dioxide (NO₂)</strong></td>
<td></td>
</tr>
<tr>
<td>Annual average</td>
<td>100 µg/m³</td>
</tr>
<tr>
<td>Monthly average</td>
<td>200 µg/m³</td>
</tr>
<tr>
<td>1 hour average</td>
<td>400 µg/m³</td>
</tr>
<tr>
<td><strong>Ozone (O₃)</strong></td>
<td></td>
</tr>
<tr>
<td>8 hours average</td>
<td>157 µg/m³</td>
</tr>
<tr>
<td>1 hour average</td>
<td>235 µg/m³</td>
</tr>
</tbody>
</table>

Source: National Environmental Laboratory, 2004

4.2.7 Environmental Impact Assessment Act (2005)
This Act makes provision for environmental impact assessment to be used to assess the potential effects of planned developmental activities; to determine and to provide mitigation measures for effects of such activities as they may have a significant adverse impact on the environment; to put in place a monitoring process and evaluation of the environmental impacts of implemented activities; and to provide for matters incidental to the foregoing.
The Act provides for the establishment and strengthening of environmental impact assessment in the decision making process to ensure that the environmental implications of policies, programmers or development projects are evaluated before approval. The Act makes it obligatory for relevant technical department or local authority to monitor development activities that are undertaken to ensure that they comply with the agreed mitigation measures provided.

It also requires the developer to submit an evaluation report to the relevant technical department or local authority at such time that the authority shall determine.

The Act in Part V Section 20 clearly indicates the need for monitoring the implementation of mitigation measures to ensure the compliance of agreed mitigation measures during and after project implementation. The Act imposes a fine not exceeding P100 000 or a term of imprisonment not exceeding five years or both to any person who contravenes the provisions of the Act.

It is for this EIA Act that this EMP has been prepared in compliance.

### 4.2.8 Road Traffic Act - Road Traffic (Amendment) Act 1993 and 2001

This Act provides for the regulation of traffic in the country to ensure road safety. Part VIII of the Act presents driving and other offences relating to the use of vehicles on roads and their penalties.

The Act also presents the following
1. Road Traffic (Signs) Regulation, which deals with road signs (regulatory, warning and informative), road markings, signals
2. Road Traffic (Speed Limits for specified vehicles) Regulations.

This Act regulates the behaviour of drivers involved with the development, thus the hauling of pipeline materials and spoils/waste materials for the proposed development. The Road traffic regulations are to be adhered to although the pipeline is to be constructed out of the built up environment at some sections.
4.2.9 **Factories Act (1979)**

This Act among others emphasise on the health, safety and welfare of individuals operating in an industry.

Part IV, Section 36 of the Act states that where grinding, sieving or any such process gives rise to dust, gas or vapour steps should be taken to prevent the accumulation of dust, vapour or gas.

Part VII of the Act, Sections 53 and 54 present the need for protective clothing. The Act states that where employees are exposed to wet conditions or any such environment liable to cause injuries, they should be provided with necessary suitable gloves, footwear, goggles, head or face coverings. Where electric welding is done, workers should be provided with safety spectacles to avoid exposure of the individual’s eyes to the electric arch flash.

Protective clothing is to be supplied to the workers and they should be encouraged to use them at all times at the work site.

4.2.10 **Mines and Minerals Act (1999)**

This provides for the management of mineral resources of the country. Under this Act a ‘mineral’ means any substance, whether in solid, liquid or gaseous form, occurring naturally in or on earth, formed by or subject to a geological process, but excluding petroleum. Soils, which are formed as a result of weathering of rock material, are therefore a mineral under this classification. This Act is important as construction materials such as sand may be required to be used as a bedding material for lying of the pipes. Some of the provisions written in the Act which apply to the issuance of such licenses and subsequent operations of mining areas include:

- Holders of the licenses should conduct their operations in such a manner as to preserve as far as possible the natural environment, minimise and control waste or undue loss or damage to natural and biological resources. They also have to prevent pollution of the environment, and when such pollution happens, promptly treat and clean up the polluted area.

- Holders of mineral concessions shall ensure that their concession area is rehabilitated from time to time and ultimately reclaimed in so far as is practicable in a manner acceptable to the Director of Mines.
• During and at the end of operations in any mine, excavation, waste dump or pond, the holder of mineral concession shall take such measures as are required from time to time to maintain and restore the top soil of affected areas and otherwise to restore the land substantially to the condition in which it was prior to commencement of operations.

If bedding materials are to be mined it is prudent that the contractor obtains a license from the Department of Mines or buys from licensed commercial outlet to comply with this Act.

4.2.11 Explosive Act (1962)

This Act provides for the control of the manufacture, importation, sale, storage, use and disposal of explosives. The Act provides for the safe firing of explosives by providing safe distances in relation to the weight of the explosives. This is shown in Regulation 62, Third Schedule as scanned and presented in Box 4.2.

The above should be considered if it becomes necessary that some minor blasting at some sections along the pipeline route is to be undertaken. This is necessary as the railway line and the proposed route alignment of the pipeline are within close proximity. These land uses therefore fall in Category B as shown in Box 4.2. Should the need for blasting arise then the weight of the explosives to be used should be considered with due cognizant of the safe distance of other land uses.
## Box 4.2 Safe Distances

<table>
<thead>
<tr>
<th>Quantity Explosives in kilograms</th>
<th>Distance in Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 250</td>
<td>At the discretion of an inspector</td>
</tr>
<tr>
<td>251 – 500</td>
<td>15  30  60</td>
</tr>
<tr>
<td>501 – 1,000</td>
<td>20  50  100</td>
</tr>
<tr>
<td>1,001 – 1,500</td>
<td>25  80  160</td>
</tr>
<tr>
<td>1,501 – 2,000</td>
<td>28  100 200</td>
</tr>
<tr>
<td>2,001 – 2,500</td>
<td>30  115 230</td>
</tr>
<tr>
<td>2,501 – 3,000</td>
<td>33  130 260</td>
</tr>
<tr>
<td>3,001 – 3,500</td>
<td>35  145 290</td>
</tr>
<tr>
<td>3,501 – 4,000</td>
<td>37  155 310</td>
</tr>
<tr>
<td>4,001 – 4,500</td>
<td>38  165 330</td>
</tr>
<tr>
<td>4,501 – 5,000</td>
<td>40  175 350</td>
</tr>
<tr>
<td>5,001 – 7,500</td>
<td>42  190 380</td>
</tr>
<tr>
<td>7,501 – 10,900</td>
<td>47  215 430</td>
</tr>
<tr>
<td>10,901 – 12,500</td>
<td>52  240 480</td>
</tr>
<tr>
<td>12,501 – 15,000</td>
<td>55  255 510</td>
</tr>
<tr>
<td>15,001 – 20,000</td>
<td>60  275 550</td>
</tr>
<tr>
<td>20,001 – 25,000</td>
<td>65  305 610</td>
</tr>
<tr>
<td>25,001 – 30,000</td>
<td>70  330 655</td>
</tr>
<tr>
<td>30,001 – 35,000</td>
<td>74  350 695</td>
</tr>
<tr>
<td>35,001 – 40,000</td>
<td>78  365 730</td>
</tr>
<tr>
<td>40,001 – 45,000</td>
<td>82  380 765</td>
</tr>
<tr>
<td>45,001 – 50,000</td>
<td>84  390 780</td>
</tr>
<tr>
<td>50,001 – 75,000</td>
<td>90  415 830</td>
</tr>
<tr>
<td>75,501 – 100,000</td>
<td>105 475 950</td>
</tr>
<tr>
<td>100,001 – 125,000</td>
<td>115 520 1,030</td>
</tr>
<tr>
<td>125,001 – 150,000</td>
<td>125 545 1,060</td>
</tr>
<tr>
<td>150,001 – 200,000</td>
<td>135 555 1,100</td>
</tr>
<tr>
<td>200,001 – 300,000</td>
<td>155 625 1,240</td>
</tr>
<tr>
<td>over 300,000</td>
<td>170 700 1,400</td>
</tr>
</tbody>
</table>

Source: Republic Of Botswana Explosives Act.
4.2.12 Policy on HIV/AIDS

HIV/AIDS is a national scourge of which everyone has a role to play to eradicate the pandemic. Policies have been formulated to combat this pandemic and also to protect the rights of individuals who are HIV positive at home and at the work place.

NACA et al. (2003 and 2004) indicates that HIV/AIDS prevalence in the Selebi Phikwe area is quite high compared to other areas in the country although it is seen to have declined from 52.2 per cent in 2003 to 23.3 per cent in 2004 as presented in Chapter 2.

Strategies put in place at the national level include ensuring behavioural change, providing care, treatment, and support for People Living with HIV/AIDS, promotion of use of male and female condoms, promotion of HIV/AIDS programmes in the work place and empowering People Living with HIV/AIDS with livelihood skills.

The Ministry of Health is also tirelessly combating the pandemic to achieve an HIV/AIDS free generation by the year 2016 and to mitigate the negative socio-economic impacts of the pandemic. The objectives set by the ministry are being achieved by stimulating businesses and other relevant stakeholders involved in enhancing the national response through:

- Regular dialogue
- Assisting businesses and other relevant stakeholders in policies, strategies and programmes aimed at achieving the national vision for HIV/AIDS-free society by 2016,
- Strengthening education and publicity campaigns,

The social aspect of the implementation of the project has direct relationship to the above. It is therefore imperative that such concerns are brought to bear in the construction of the water pipeline.

4.3 Environmental Management Plan (EMP) Issues

The issues considered in the EMP for the proposed development are presented in Table 4.3. The ensuing table presents the management plan under key areas of EMP issues, management objective, EMP actions or key performance indicators for monitoring purposes, the implementing agency, monitoring agency, the relevant Act governing the EMP activity and proposed time frame for action.
<table>
<thead>
<tr>
<th>Table 3.3 MANAGEMENT PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
4.4 Monitoring and Auditing

An effective EMP has to be dynamic, capable of receiving and reacting to feedback from actions previously taken. For this reason it is important that the project is monitored throughout the lifespan of its operation.

Monitoring is the activity undertaken to provide specific information on the characteristics and functioning of environmental and social variables in space and time. This involves monitoring the achievement of targets or the performance of certain management actions concerned with the project. Key performance indicators are essential for the monitoring of the environmental actions. These indicators have been presented in the tables above (Table 4.3). The tables have also suggested some agencies responsible for monitoring the environmental actions.

It is essential that environmental auditing be undertaken periodically. Auditing is the processes of comparing the impacts predicted in an EIA with those, which actually occur after implementation in order to assess whether the impacts prediction process conforms or do not conform to those predicted. It is essential that periodic audits are performed to confirm whether the purpose or benefits anticipated or which gave rise to the upgrading of the water pipes are being realized, if they are not, then corrective measures have to be put in place. The EIA Act, 2005 in Section 21 indicates that the Department of Environmental Affairs is charged with the responsibility of carrying out environmental audits for approval and operational purposes and may require a developer to implement specific mitigation measures to ensure compliance with predictions made in the environmental statements or to implement mitigation measures to address environmental impacts not anticipated at the time of the authorization.
<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Category</th>
<th>Purpose</th>
<th>Indicators</th>
<th>Method</th>
<th>Duration</th>
<th>Frequency</th>
<th>Responsibility</th>
<th>Expertise Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Site Inspections</td>
<td>To ensure compliance with EMP including Health and safety</td>
<td>Site Clearance</td>
<td>Visual and Descriptive against a check list</td>
<td>For the duration of site clearance</td>
<td>Daily</td>
<td>Supervising Engineer and Contractor</td>
<td>Environmental Specialists</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Disruption to traffic, access and utility services,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Materials storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Traffic Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Open trenches with warning signage.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Health Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Opening and closure of Borrow Pits (if undertaken)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMP Compliance</td>
<td>To ensure Contractor comply with Standards and EMP requirements</td>
<td>To ensure compliance with EMP requirements</td>
<td>Site inspection and interrogation of site records</td>
<td>Throughout the period of construction.</td>
<td>Every month</td>
<td>Supervising Engineer</td>
<td>Environmental Specialists /Experienced site supervision staff with adequate knowledge of the EMP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4.3 Monitoring During Construction**
5 CODE OF CONDUCT

5.1 Introduction

This chapter sets out to present the general environmental practice expected of the contractor and his subcontractors to ensure the integrity of the environment. This code of conduct should be adhered to and made known to all workers. It should be included in the contractor’s tender documents. The Code of Conduct has been presented in the form of a brief point form set of instructions and shall be adhered to by the contractor.

5.2 Environmental Legislation

The contractor and his Subcontractors must familiarize themselves with the Acts, which relate to environmental issues and concern presented in Chapter 4.

5.2.1 Environmental Control Officer

The Contractor shall appoint an Environmental Control Officer (ECO) either as an independent employee or as part of his initial staff intake. The role of the ECO will be to:
- Implement environmental controls and measures
- Conduct environmental awareness courses for all of the Contractor and Subcontractor’s employees
- Inform all workers of their environmental responsibilities
- Be accountable for the disregard of environmental controls
- Report all environmental concerns to the general site manager for onwards transmission to the Engineer or his Representative
- Respond to all public enquiries and complaints
- Manage environmental monitoring procedures
- Attend and report on environmental issues at monthly site meetings and
- Submit monthly environmental monitoring reports to the Engineer and Employer.
5.2.2 Compliance
All persons employed by the Contractor or his Subcontractor shall comply with the requirements of the environmental code.

No staff or employee of the Contractor or his Subcontractor shall be directed to undertake any activities that contravene the requirements of the environmental code.

Staff employees of the Contractor or his Subcontractor if found in breach of the foregoing shall have their employment terminated forthwith. They shall also be required to leave the construction site as soon as possible.

5.2.3 Environmental Monitoring and Audits
Compliance with the environmental code shall be regularly monitored through audits and reviews. The employer or a nominated representative and the Engineer shall conduct these audits unannounced at intervals of no more than two (2) months.

The Contractor must make available all necessary documentation for effective review and auditing of his environmental compliance programme.

The Contractor responsible for an area/system to be audited shall assist the audit team in the execution of the audit. The Contractor shall also be responsible for timely corrective actions based on the findings of the audit. The Contractor shall sign the audit findings report sheet to indicate acceptance and commitment to the required corrective action.

5.3.4 Other Concerns
Local authorities and the representatives of the people shall be informed in good time of works or other aspects of the design and construction, which may affect their activities or daily lives.

All work for the design and construction of the water treatment plant shall be carried out with due care and respect for the human, social, cultural, historical/Archaeological and biophysical environment in which the work is being done.

All Contractors and Subcontractors must adhere to both the specific requirements and the spirit of this code in accordance with the undertaking submitted with their tender.
Wherever possible the economic spin-offs from the construction work shall be made accessible to the people in the vicinity of the planned works.

5.3 **Construction (Methods and Application)**

5.3.1 **Consultation and liaison**

The Contractor must consult and liaise with authorities, local people and their representatives on all matters that affect the activities or daily lives of the resident community. Liaison and consultations must be well in advance of the proposed activity to allow for required corrective actions to be taken by either the Contractor or concerned individuals.

Consultations and liaison must occur whenever new activities in new areas are initiated. Among the activities that require consultations are the following:

- Reporting to the local authorities on arrival in community area
- Obtaining permission to set-up camp to storage of materials from the relevant authorities and liaising with community leaders and leadership structures
- Liaising with concerned individuals and relevant authorities before destroying or tampering with private property in the areas of project development
- Maintaining continuous contact with the community through the local leadership structures, to allow for appropriate communication on matters that affect the community, such that advice, complaints, feedback and corrective actions can be taken well in advance of the situation and relationships deteriorating.
- Using natural resources from the area in the construction process
- Employment practices, which must be done in transparent manner, must not disadvantage the local community or exhibit gender bias. The Contractor shall make concerted effort to maximize the utilization of local; resources, services, skills and labour
- Establishing new working fronts, new haulage routes, opening borrow pits and water abstraction points
- The Contractor should liaise and consult with the relevant authorities when construction activities or other situations, occurrences or activities are likely to be of nuisance or pose danger to health, welfare and safety of public; and
- Employment practices, must be done in a transparent manner, must not disadvantage the local community or exhibit gender bias.
5.3.2 **Commercial/Economic Aspects**

The Contractor shall encourage his employees and Subcontractors to support the local economy by utilizing goods and services from the area as much as possible. The following activities among others must be encouraged:

- Purchase of goods and services from the local community or local industry
- Employment of local community where skills, qualifications and experiences are locally available
- Hiring accommodation from the villages in the area for those employees and staff not housed at Contractor’s camp: and
- Employment of the local community in all activities that do not require specialized skills, qualifications and experience

5.3.3 **Social Disorder and Squatting**

The Contractor shall minimize disruption of the social order of the communities by facilitating and/or encouraging the following:

- Sensitizing his employees and those of his Subcontractors about the importance of observing local norms and behavior and avoiding contravention of the social set up, protocol and respect for tribal authorities, etc, etc
- The Contractor’s employees and those of his Subcontractors shall refrain from being public nuisance. The Contractor shall facilitate the course of justice for those who become a nuisance and terminate employment of those who regularly do so
- The Contractor’s employees and those of his Subcontractor shall avoid activities that facilitate the creation of squatter camps or squatting in the vicinity of labour camps or construction sites
- The Contractor’s employees and those of his Subcontractors shall be discouraged from patronizing squatter camps and
- The Contractor and his Subcontractor shall hire only at designated established settlements (villages) sites to discourage squatting by those seeking employment. Under no circumstances shall hiring occur at the construction site.
5.3.4 **Private Property Affected**

The Contractor and his Subcontractor shall minimize disruption of the day to day activities of the owners of private property, which may be affected by construction activities. This can be achieved through, among others, the following:
- Early consultation and liaison with the affected property owner
- Adoption of measures that address concerns of the owner, for instance, ensuring that there is a relocated secure temporary fence for the farmer’s field or homestead
- Allowing the property owner opportunities to salvage re-useable parts of the property destroyed
- Replacing damaged property with new material or items of equal or better quality and condition, than existing
- Getting documented and witnessed confirmation for settlements/agreements made on replacements to damaged properties
- Involving the village leadership/authorities throughout the above process.

5.3.5 **Construction Process and Construction Spoils**

The Contractor and his Subcontractors must ensure that during the construction process, open trenches and excavated areas are minimized and left open only for limited periods. These shall be properly protected to eliminate the danger they may pose to the general public, livestock, etc. Active construction sites shall be appropriately sign posted.

The Contractor and his Subcontractors must ensure that construction process by-products, spoils, rejects, etc that are of value to the community are disposed off in a manner that is transparent, and allows for equitable acquisition by the majority of the community. This refers particularly to items such as timber and firewood generated during bush clearing, containers, etc. The ECO must ensure that this is effected without fail through active participation of the community.

5.4 **Archaeological Aspects**

All of the Contractor’s supervisory personnel and those of his Subcontractors shall be given basic training in the identification of the Archaeological artefacts by the Project Archaeologist.
At least 3 days before commencing any new excavation operation at the Site, the Contractor shall inform the Engineer in writing of his intentions, in order that the Project Archaeologist may inspect the area to be excavated prior to commencement of work. If Archaeologist material is found, the Project Archaeologist shall be given time to perform a test Archaeological excavation.

Should the Contractor expose any Archaeological artefacts, excavation work shall cease immediately and the Engineer shall be notified as soon as possible. No Archaeological artefacts shall be removed from Archaeological sites without authorization.

Upon receipt of such notification, the Engineer will arrange for the excavation to be examined by the Project Archaeologist as soon as practicable, and so that work is not held up. Acting upon advice from the Archaeologist, the Engineer will advise the Contractor of necessary actions to be taken. The Engineer will take all necessary actions to ensure that delays are minimized.

Under no circumstances shall Archaeological artefacts be removed, destroyed or interfered with by the Contractor, his employees, his Subcontractor or his Subcontractor’s employees.

The Contractor shall ensure that none of his employees or Subcontractor’s gains access to any Archaeological areas, whether fenced or unfenced, except when authorized to do so as directed by the Engineer.

Staff and employees of the Contractor or his Subcontractors found in breach of the foregoing shall have their employment terminated forthwith. They shall also be required to leave the construction site as soon as possible.

5.5 Protection of Vegetation

The Contractor, his employees and Subcontractors must ensure that there is limitation of the environmental imprint in all activities associated with the project execution.

Only areas that are required for effective project execution should be cleared, grubbed and excavated.
All works must be undertaken in a way that facilitates sustainable, cost effective and timely rehabilitation of the affected areas.

Haulage routes shall avoid areas designated as environmentally sensitive and should otherwise be as short as possible. All articulated vehicles should turn at designated turning areas.

### 5.6 Flora and Fauna

The Contractor and his Subcontractors shall ensure that all works are undertaken in a manner which minimizes the impacts on the local fauna and flora and shall apply the following:

- Under no circumstances shall any animals be handled, removed, killed or interfered with by the Contractor, his employees, or his Subcontractors
- The Contractor, his Subcontractors or their employees shall not bring any domesticated animals onto site.
- The Contractor shall ensure that the work site is kept clean and tidy and free from rubbish, which may attract animal pest species
- There should be no feeding of indigenous animal pest species
- No flora is to be removed.

### 5.7 Natural Resources

The Contractor and his Subcontractors shall ensure that relevant permits are obtained for the extraction of natural resources required in the execution of the project. The Contractor and his Subcontractors must liaise with the relevant authorities and affected parties in the extraction of these resources to avoid conflict. Extraction must be achieved in a sustainable and environmentally sensitive manner.

The following are some aspects relating to water resources:

- Runoff entering and leaving construction areas must be strictly controlled to prevent erosion, pollution, and siltation of water sources
- All construction areas must be kept clear of refuse, and spillages of chemicals within the site must be cleaned up, approved dumping sites are to be established.
Water abstraction for construction purposes must not be to the detriment of local water requirements and existing water supplies locally and in downstream areas.

No polluted water shall be discharged into natural watercourses: such polluted waters should be disposed in an appropriate environmentally sensitive manner, and

Excavations for any construction shall be carried out in such a way as to minimize disturbance to the soil and to allow rehabilitation of the works area as soon as construction work is completed.

5.8 **Air Quality**

The Contractor and his Subcontractors must ensure that they observe the requirements of the Atmospheric Pollution (Prevention) Act, Cap. 65:03. The Contractor and his Subcontractors must ensure that vehicles, plant, equipment, etc utilized in the construction project do not pollute the environment by exuding noxious fumes.

Additionally the following must be done:

- In the vicinity of habitation, unsurfaced roads must be sprayed with water during construction, as a dust inhibitor. If water is not available, unsurfaced roads must be chemically treated with dust suppressants. Haulage distance on these roads must be limited where possible to avoid dust generation.

- Stockpiles must be placed in such a way that they are not subject to erosion by wind, particularly when they are situated near to settlements. If stockpiles are left for a month or more, they must be treated with a biodegradable chemical binding agent. All long-term stockpiles (greater than 1 year) must be shaped and re-vegetated.

- Complaints about dust by affected parties must be recorded in detail and mitigated immediately by the ECO or the environmentalist and reported to the monthly site meetings.

5.9 **Noise and Vibration**

- When construction activity takes place near homesteads and settlements, no work will be undertaken on Sundays or at night.
- All buildings within the blast hazard zone (200m radius) must be inspected both prior to and after blasting. The inspection will take place in the presence of the owner/resident 48hrs before the blast and again 48hrs after the blast.
- Blasting induced damage to buildings within the blasting hazard zone will be compensated accordingly.
- Complaints about noise and vibration by affected parties must be recorded in detail by the environmentalist and reported to monthly site meetings. However corrective actions must be undertaken immediately.

5.10 Construction Rubble

The Contractor and his Subcontractors must ensure that all forms of construction waste and rubble and surplus spoil are removed from the site at the earliest possible opportunity to avoid creating a nuisance and an eyesore. The waste must be disposed off approximately at designated sites.

5.11 Public Health

- The Contractor and his Subcontractors must sensitize their staff and employees on issues of public health and hygienic practices. The Contractor and his Subcontractors must sensitize their staff and employees about diseases such as malaria, bilharzia (schistomiasis) and STDs, HIV/AIDS, etc.
- The Contractor shall assist the relevant authorities in monitoring changes in the spread of STDs and other communicable diseases.
- The Contractor and his Subcontractors must sensitize their staff and employees about the risk of infection from the above diseases as well as ways of preventing or avoiding them.
- The Contractor must ensure that proper and adequate sanitation facilities are provided and appropriate sanitation practices observed.
- The Contractor and his Subcontractors shall minimize the generation of dust especially in the vicinity of settlements.

5.12 Waste Management

The Contractor must ensure that waste generated during the works and by his employees at the camp is disposed off without harm to the environment in general, with particular attention paid to minimizing the risk of ground water and surface water pollution. Waste management should among other things include:
- Separation of waste (e.g. solids from liquids or hazardous substances from non-hazardous ones) and its subsequent disposal using trained personnel and appropriate equipment.
- Hazardous waste and petroleum fluids can be safely put in special storage containers for subsequent reuse and disposal. If transported to suitable waste disposal facilities, appropriate measures should be taken to ensure that spillages are avoided.
- Appropriate facilities and equipment should be availed for storage of non-toxic waste on site and their subsequent transportation and disposals to designated sites.
- If noxious liquids and solvents are split (including oil) contaminated soil must be buried at least 1m below the surface.
- Skips and dustbins must be provided at construction camps for the temporary disposal of domestic waste. Regular, permanent disposal of such waste at a permitted waste site shall be undertaken. Domestic waste will not be burned.
- Appropriate collection and disposal standards must be adhered to for the disposal of waste and litter at all construction areas.
- Sufficient portable chemical toilets must be supplied at camps and construction areas.
- Disposal of excavated material, which is not required for back filling and rehabilitation, shall be done outside the designated works areas at sites specially set aside for that purpose. The Engineer shall designate these sites in consultation with relevant authorities (land Board and community leaders).

### 5.13 Safety and Blasting Operations

The Contractor and his Subcontractors must ensure that the construction process does not in any way pose a threat to the safety and welfare of the general public and those engaged to undertake the works.

There should be effective information dissemination to all role players. For it to be effective, appropriate sign and warning should be adopted to ensure safety.

People in the vicinity of the blasting zone must be warned, by siren, one hour before the blast, and again 5 minutes before blasting. People in the vicinity of the blast area must have been informed 3 weeks before it is due to take place. They must be
supplied with information as to the location, date and time of the blast and a description of the warning siren.

5.14 Maintenance and Monitoring

- All structures and their foundation must be destroyed and removed on closure of the burrow pits, construction camps and any other areas disturbed by construction.
- Noise and dust nuisance will be monitored through recording the public complaint and taking appropriate corrective action immediately.
- Water quality sampling must be undertaken on a weekly basis at all water courses in areas where construction has taken place and where it is active.
- Rehabilitated areas must be monitored on a weekly basis until plants have been successfully established.
- Areas where re-vegetation and/or re-planted plants have not established successfully must be replanted and watered.

5.15 Aesthetic and Scenic Quality

The Contractor and his Subcontractors must ensure that they minimize activities, which reduce the aesthetic appeal of the project area.

The Contractor and his Subcontractors must avoid activities not essential to the project execution that deface and degrade natural features in the project area. For instance, marking for survey purposes shall only be done with pegs and beacons.

The Contractor and his Subcontractors must avoid activities that degrade or destroy cultural archaeological/historical artefacts or site.

All cuttings, fillings and rehabilitated sites should be rounded and smoothened to blend with the surrounding landforms. Slopes that allow for vegetation foothold should be maintained at all times.

5.16 Rehabilitation

The Contractor will be required to rehabilitate, among others, the following:
- Borrow pits if they were created
- Storage/ stockpile sites
- Old roads and haulage roads: and embankments and cuttings
- Areas required for temporary purpose during construction
- Private property outside the railway reserve required during construction
- Fences and gates, arable agricultural land, a farm, homesteads etc
- Buildings and/or structures affected by the construction process.

The following rehabilitation measures have been designated for the pipeline contracts:

<table>
<thead>
<tr>
<th>Action</th>
<th>Feature</th>
<th>Rehabilitation Measures</th>
</tr>
</thead>
</table>
| 1. Clearing vegetation          | construction camps, old haulage roads, embankments, cutting, storage/stockpile, borrow pits | - Large well established trees must be left insitu. If their removal is unavoidable, these plants must be carefully uprooted using specialized tree removing apparatus and replanted in a similar environment elsewhere, on instruction from the Engineer.  
- All of the above applies, but vegetation has been removed must be stockpiled and used for compost during re-vegetation. |
| 2. Top soil stock piling        | All areas to be disturbed by construction activities | - All topsoil must be removed and stockpiled close to the site.  
- Top soil must not be stockpiled in natural drainage channels or in areas where it will be exposed to wind or water erosion, especially when soil is stockpiled close to settlements  
- Stockpiles should not be higher than 20m to avoid compaction  
- Single handling is recommended  
- Stockpiles that remain undisturbed for a month or more must be treated with dust suppression substances (bio-degradable chemical binding agent)  
- Stock piles that remain undisturbed for 2 months or more must be re-vegetated |
| 3. Back filling and contouring  | Borrow pits embankment cuttings Construction camps | - The surface must be ripped  
- Back fill may require contouring to ensure that it blends in with the surrounding environment  
- Slopes must be graded to at least 1:3 but a gradient of 1:5 is more acceptable  
- Slopes will then be capped with topsoil. This requires a minimum layer of 200mm in most areas, but a layer of 500mm thick is required to restore agricultural land.  
- All structures and their foundations must be completely removed before any topsoil or substrate treatment is applied  
- Compacted surfaces must be ripped and disked to a depth of 100mm before any topsoil or substrate treatment is applied |
| 4. Preparation of the substrate for planting | All areas to be disturbed Construction activities | - apply fertilizer @200 kg/ha  
- fertilizers must be applied in advance of planting and watering and 6 months later |
| 5. The seed mix                  | All areas to be disturbed Construction activities | - the seed mix should be of seeds from existing grasses in the area which must be harvested wherever possible |
| 6. The planting method           | All areas to be disturbed Construction activities | Manual option for slopes steeper than 1:3  
-grass runners must be planted into trenches on the slopes to stabilize the slopes. Trenches must be 100mm deep along the slope contours, and must be 300 mm |

85
<table>
<thead>
<tr>
<th>Action</th>
<th>Feature</th>
<th>Rehabilitation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>apart. Mulch, made from grass preferably in the area must be applied and dug into the surface at a rate of 2 tons per hectare. - In areas where the slopes are steeper than 1:2 mulch and young plants must be protected by a biodegradable geonetting. <strong>Mechanical option for slopes steeper than 1:3</strong> - These slopes must be hydro seeded - The hydro seeding mix slurry must contain seeds, fertilizer and a mulch of grass species in the area - A biodegradable adhesive should be included in the slurry to ensure that the seeds and mulch are not blown or washed away. <strong>manual option for slopes more gentle than 1:3</strong> - The slopes must be hand sown using a manual seed spreader - Trenches must be dug to a depth of 100mm and must be approximately 300mm apart - Seed must be placed by hand and the soil must be gently drawn over the trenches <strong>Mechanical option for slopes more gentle than 1:3</strong> - These slopes must be mechanical sown using agricultural equipment - Fertilizer must be applied and ploughed into the soil - The surface must then be harrowed to prepare the seed bed - After the seed is sown it must be rolled using an agricultural roller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Maintenance All areas to be disturbed Construction activities - Watering must take place on a bi-weekly basis until vegetation cover is sufficient to control erosion - A micro-spray hose attached to a waste cart is a recommended system of watering - All rehabilitated areas must be monitored until vegetation is well established - Vegetation must be immediately replaced in areas where plants have failed to establish themselves - Strict records for monitoring exercises must be kept and details of species composition, basal cover, plant vigor and soil fertility must be noted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. Reinstatement /replacement and rehabilitation Areas required for temporary purposes, Private property outside the road reserve, Fences and gates, Buildings and/or structures - These shall be rehabilitated to a quality and condition equal or better than the original quality and condition. The Engineer shall have the final say on the adequacy of corrective measures.</td>
</tr>
</tbody>
</table>
6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Morupule Colliery intends to construct a 22km long pipeline from the North-South Carrier to the colliery and also to construct three reservoir tanks and a pumping station. The purpose is to enable it to transport raw water to the mine for its coal washing plant and future expansion plans. The water pipeline has been designed to lie within the servitude of the railway line to the south. Permission from the Botswana Railways Corporation has been granted for the pipes to be laid within its railway servitude.

The environmental issues pertaining to the proposed construction of the pipeline pump station and reservoirs have been outlined and assessed in the preceding chapters. It must be emphasized that all the relevant institutions, individuals and households have been informed and consulted on the project. Their concerns or views expressed in relation to the project have duly been incorporated into the report. Mitigation measures have been proposed to minimise adverse impacts that are associated with the project. An EMP and a Code of Conduct has also been prepared to manage the salient processes that give rise to the frontline impacts.

The conclusion from the findings of the EIA exercise is that the benefits of the proposed project far outweigh the disbenefits. Most of the impacts identified are mitigable and their severity can be minimized through the proposed mitigation measures in the report. The locations of the reservoirs and pump station and pipeline route do not also affect any area of archaeological importance (Archaeological Report Attached). In view of the above it is requested that the proposed project be allowed to proceed. The following recommendations however have been made:
6.2 **Recommendations**

In addition to the numerous actions recommended in the EMP and Code of Conduct the following are emphasized:

1. The areas where trenches would be dug should be rehabilitated to at least the original conditions.

2. Surplus Soil and rock materials shall be disposed of promptly in order to minimise the time of storage at the construction site and the risk of erosion and sediment discharge. The availability of the spoils could be advertised for community members to utilise them or they disposed off appropriately according to the recommendations of the land board.

3. Warning tapes should be used around trenches being worked on.

4. No more than 50m of open trenches should be left overnight.

5. Crossing structures should be provided across major footpaths to enable pedestrians to cross between the northern and southern parts of the railway line.

6. The pump station to be constructed should be fenced.

7. All utilities laid underground within the areas where the pipeline is to installed should be identified to avoid accidental damage and curtailment of services.

8. Emergency response Team for breakage of pipes or underground utilities should be created.

9. Micro Tunnelling is recommended for use across the 10 roads to be crossed by the pipeline.

10. Filling, Compaction and levelling up of trenches should be properly done to avoid the pooling of water along the route. This should be monitored.

11. Road Signs indicating the construction of the pipeline and reservoirs should be placed at strategic locations to warn and inform vehicle operators and community member. This should be both in English and Setswana.
12. It should be ensured that workers use their protective clothings at all times.

13. Care should be taken during delivery of materials and ensured that materials are off loaded safely and stored. Machinery especially cranes should be ensured that they are in good working order.

14. In view of the anticipated power supply shortages in the country, it is recommended that a generator be provided at the pumping station. The location of the generator should be bunded to capture any spill of fuel/lubricants. Waste oil should be collected in trough and disposed off to waste oil companies for treatment and disposal.

15. No camp sites should be set for this project.
7 UNDERTAKINGS OF ENVIRONMENTAL CONSULTANTS

I, the undersigned, on behalf of the members of the Environmental Team certify that the information provided is to the best of our knowledge true and correct as at the time of reporting.

Dr. E.K. Archer  
25/01/08

Name                                      Signature                                      Date

Environmental Team

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Qualification</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebenezer K. Archer</td>
<td>PhD</td>
<td>Environmental Specialist-Infrastructure</td>
</tr>
<tr>
<td>Philimon Sephiwe</td>
<td>BA</td>
<td>Archaeologist</td>
</tr>
<tr>
<td>Laone Botite</td>
<td>BA</td>
<td>Sociologist</td>
</tr>
</tbody>
</table>

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E-Mail Address: earthtec@bbi.co.bw


APPENDIX 1.1 MINUTES OF MEETING AND CORRESPONDENCES
APPENDIX 1.2 LETTER TO CARRY OUT SCOPING AND PUBLICATION PARTICIPATION FROM DEPARTMENT OF ENVIRONMENTAL AFFAIRS
APPENDIX 1.3 ADVERT PLACED IN MASS MEDIA
ATTACHMENTS
Introduction
The outcome of the various consultations held with households and governmental institutions are presented below.

Households
The household survey that was conducted was aimed at establishing the main issues of concern with regard to the proposed developments in the certain parts of the village, which are to be affected by the proposed project, and to find out what problems they have encountered with the construction of the existing sewer line, what impacts do they foresee from the pipeline and how they think the adverse impacts can be mitigated. The survey was carried out on the households along the proposed project’s pipeline. This was to correct such mistakes and to avoid the problems experienced.

A total of 30 households were consulted, out of which 23 were female respondents and 7 were male respondents. Out of the total, 27 people reported that they have lived in the area for more than 2 years and only 3 have lived for 1 year, these constitutes 90 per cent and 10 per cent respectively.

In order to anticipate impacts from the households on the proposed water pipeline, their experience with the laying of the sewer line was explored. This was to draw inferences and provide appropriate mitigation measures for the adverse problems that they encountered. From the 30 respondents, 13 reported that they experienced problems with the construction of the sewer line and 17 had no problems. This figure represents 43 per cent of the total respondents who had experienced problems and 57 per cent reported that they never had any problems.
Problems encountered with the construction of the sewer lines are shown in Figure 1.

Of those who experienced problems with the sewer lines, nine reported the problem they had and only four did not. The respondents who had experienced problems reported the matter to construction officials, project inspectors and their Member of Parliament, on the other hand those who did not report gave reasons that they did not know who to report to and were not staying in the household at the time of construction.

The respondents anticipated several negative impacts in regard to the trenching and construction of the water pipe line. These are as follows:

- disturbance of the soil natural structure
- soil left without being compacted
- burrowing of river sand
- disruption in water supply and availability
- trenches left open
- blocking of households gates
- accidents as children will play and fall into the trenches
- trenches dug close to power lines
- removal of some household’s fences
- heavy machinery will cause cracking of houses
To mitigate the above problems, respondents suggested that the following be done with the construction of the water pipeline in the village:

- compensation of those affected should be done well in time
- the work should not drag on for a long time
- consider the existing water pipeline
- mark the work site with red tape to alert people
- if possible the pipeline should be some distance from households
- clear heaps of soil left behind as they become hiding places for criminals
- cover trenches as they cause accidents to both people and animals
- write signs in English and Setswana to warn people of ongoing construction
- consult with the community on construction plan and dates
- the work should be monitored and inspected regularly
- the landscape should be restored

Minutes of the meeting with Palapye Sub Land Board on the 16th of November 2007

Miss Sephiwe Phillimon consulted with Mr. K. M Butale who is the Land Board Clerk. Concerning the issues that should be taken into account during the construction of the pipeline, Mr. Butale said that the EIA should cover everything that is likely to impact negatively on the environment and people’s lives (socio economic issues), archeological sites of any kind and fragile ecosystems like rivers and other wetlands.

Minutes of the meeting with Botswana Railways on the 19th of November 2007

Miss Sephiwe Phillimon consulted with Miss L. Nkonkwena, the Station Master at Botswana Railways Palapye, concerning the issues that should be taken into account during the construction of the pipeline. Miss Nkonkwena pointed out that the EIA should take into consideration the health hazards the pipeline may pose to the public and public safety should be considered during the construction of the pipeline.

Minutes of the meeting with the Village Development Committee (VDC) member on the 19th of November 2007

Miss Sephiwe Phillimon conducted an interview with Miss Goitsemang Mmelesi who is a member of the VDC for Palapye, (Boikago Ward). Miss Mmelesi stated that children use the road and rail crossings when going to school therefore road signs should be erected to cater for their safety. She also added that the elderly also use the crossings to go to land board offices and other areas and hence temporary
crossings should be provided. Miss Mmelesi finally said that people in the village still own livestock so a proper crossing should be provided so that they won’t fall into open trenches.

**Serowe-Palapye Sub District Roads Department**

The Roads Department Senior Technical Officer Mr. F. T Batshu responded to the questionnaire about the construction of the water pipeline in Palapye. He pointed out that safety measures should be put in place during the time of construction and that the land surface should be compacted after completion to avoid soil erosion and water stagnation. He also recommended provision of diversion roads and rehabilitation of those roads that are to be affected.

**Botswana Power Corporation (Morupule Power Station)**

Miss E. Sephatla the Environmental Officer for BPC Morupule Power Station responded to the questionnaire. She stated the following issues as the ones that should be taken into account during preparation of the EIA:

- **Wildlife Resources**
  Disturbance of wild animals within the project area either by noise or displacement of habitat

- **Ground Water Resources**
  Wells located within the pipeline corridor may be affected by pipeline construction (blasting may affect the yield of wells located close to the blasting area).

- **Accidental release of contaminants**
  Oil, petrol and diesel spillages, if not managed can seep into the ground and contaminate soil and under ground water.

- **Palapye Village Residents**
  Residents may be relocated for pipeline construction to go through their households; they must be consulted about the project.

**Serowe-Palapye Sub District; Physical Planning Department**

Mr. Basinyi Siviya the Physical Planner for Serowe Sub District highlighted the following points that he thinks should be taken into consideration for the construction of the
pipeline:
- The number and proximity of infrastructure services already in the servitude in relation to the existing residential plots and any future expansion of the railway service
- Relate the usage of the servitude and the buffer to the revision of Palapye Development Plan.
- Part of the servitude serve as a buffer between the railway and the residential, therefore cutting of vegetation in this area should be minimized.

The significant concerns expressed above have been incorporated into the Terms of Reference which is presented in the next chapter.
The Terms of Reference for the EIA for the Construction of the raw water pumping system from the North-South carrier to Morupule Colliery has been developed from the original terms of reference from the scoping exercise, various consultations held, desk study and from professional judgment.

The objective of the Environmental Impact Assessment study is:

- To undertake extensive environmental and archaeological impact assessment of the proposed raw water pipeline construction and make recommendations on mitigation measures to be undertaken.

Specific Objectives of the EIA are:

a) To undertake environmental and social studies to sufficiently address the prevailing impacts.
b) To identify and evaluate the social, environmental and archaeological impacts, which will be caused by the construction and operation of the drains.
c) To identify and describe procedures and activities that will mitigate adverse impacts and enhance beneficial effects.
d) To liaise with the Department of Environmental Affairs, District Officers (Planners, Engineers and Land Boards), Village Development Committees and all other organizations that represent interest groups in order to seek their views on issues related to the construction of the pipeline.
e) To prepare an Environmental Management Plan and Code of Conduct for the project, which is to be included in the contractor’s tender document.
f) To prepare a summary list of issues (mitigation measures) to be included in the bill of quantities for construction.
Items / Scope of Work

Below is a list of the scope of work to be undertaken by the environmental team.

A. The EIA Consultant to review the Development Plans pertaining to the project area together with other relevant documents relating to the bio-physical environment (geology, topography, soils, climate, surface and ground water, hydrology and hydrogeology, vegetation, rare or endangered species, rivers, etc) and human environment (population, economic activities, social activities, land uses etc).

B. The EIA Consultant to also review all relevant policies, programmes, legislative, and statutory documents that would have an effect on the project. These should include the following:

- Waste Management Act 1998
- Monuments and Relics Act, 2001
- Development Control Code, 1995
- Town and Country Planning Act
- Herbage Preservation (Prevention of Fires) Act
- Tribal Land Act, 1968
- Atmospheric Pollution (Prevention) Act
- EIA Act, 2005
- Road Traffic Act
- Mines and Minerals Act

C. The EIA Consultant shall make local inquiries and liaise with the National Museum, Monuments and Arts Gallery to determine whether there are any sites of religious, cultural or archaeological significance within the study area. The EIA Consultant should therefore undertake an archaeological impact assessment study, the objective of which shall be to survey, identify, record and collect necessary archaeological features, structures, artifacts and material within the project area. The EIA Consultant should apply and obtain a research permit from the National Museum, Monuments and Art Gallery.

D. The EIA Consultant to undertake detailed studies of the following impacts of the project activities particularly on the following:
- Potential spread of HIV/AIIDS
- Noise and Air Pollution
- Open trenches;
- Safety of road/track users and workers
- Interruption of access to houses, social and economic facilities
- Employment creation
- Compensation issues where properties are to be affected
- Avoidance of destruction of electric cables, telephone lines and water lines
- Waste Generation and management (including spoils from trenching)

E. The EIA Consultant to assess the significance of the impacts under (D) and describe clearly the methods used for the assessment of these impacts.

The Department of Roads Guideline No.5 is to be used to assess the value, magnitude and significance of the impacts to be identified.

<table>
<thead>
<tr>
<th>Value + Magnitude</th>
<th>Significance of Impacts</th>
</tr>
</thead>
</table>

Value according to the Guideline No.5 refers to the use of the land area proposed for the development. The value must be seen in relation to national and international strategies for conservation and development (Roads Department, 2001). The value of impacts has been ranked and provided by the Guideline as Large, Medium and Small/low value. These are explained in Table 1.

**Table 1: Rank of Values**

<table>
<thead>
<tr>
<th>Value Rank</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Value: -</td>
<td>Areas protected by law or zoning e.g. Habitats of endangered species, areas or assets of national or great local importance such as national parks or Kgotla and areas of high vulnerability</td>
</tr>
<tr>
<td>Medium Value</td>
<td>Regionally important areas or areas which are considered to be important locally and of medium vulnerability</td>
</tr>
<tr>
<td>Small / Low value</td>
<td>Locally important areas and areas of low Vulnerability</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001
Magnitude explains the degree /extent/ severity of the impact to the physical and/or socio-economic environment. Where possible it will be quantified. The scale for measuring the magnitude as provided in the guideline and used in the assessment is provided in Table 2.

<table>
<thead>
<tr>
<th>Magnitude Scale</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Positive</td>
<td>Substantial Positive Effects</td>
</tr>
<tr>
<td>Medium</td>
<td>Condition noticeably improved</td>
</tr>
<tr>
<td>Small /None</td>
<td>Little or no change</td>
</tr>
<tr>
<td>Medium negative</td>
<td>Condition noticeably worsened</td>
</tr>
<tr>
<td>Large Negative</td>
<td>Substantial adverse effects</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001

The significance of an impact is the combination of the value and magnitude and will be done by judgmental value of the environmental team. As indicated in the guideline the scale for assessing the significance is shown in Table 3.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>++++</td>
<td>Very Large Positive Significance</td>
</tr>
<tr>
<td>+++</td>
<td>Large Positive Significance</td>
</tr>
<tr>
<td>++</td>
<td>Fairly Positive Significance</td>
</tr>
<tr>
<td>+</td>
<td>Small Positive Significance</td>
</tr>
<tr>
<td>0</td>
<td>Small /no Significance</td>
</tr>
<tr>
<td>-</td>
<td>Small Negative Significance</td>
</tr>
<tr>
<td>--</td>
<td>Fairly Negative Significance</td>
</tr>
<tr>
<td>---</td>
<td>Large Negative Significance</td>
</tr>
<tr>
<td>----</td>
<td>Very Large Negative Significance</td>
</tr>
</tbody>
</table>

Source: Roads Department 2001

The identified and assessed impacts should further be explained by the following:

- Direct or indirect impact
- Permanent or reversible impact
- Temporal or long term impact
- Spatial or local extent

Archaeological sites or impacts will be ranked according to the grading system of the National Art Gallery Monuments and Museum. Impacts associated with each of the following project stages will be identified: pre-construction, construction, operation and decommissioning.
As far as the impact assessment is concerned, the Roads Department Guideline No. 5 – Planning and Environmental Impact Assessment of Road Infrastructure (2001) will be used.

F. The EIA Consultant to propose mitigation measures for the identified adverse impacts.

G. The EIA Consultant following the environmental impact statement, prepare an environmental management plan, which will include a framework for monitoring the implementation of mitigation measures identified during the construction, operation, decommissioning and post decommissioning stages.

H. The EIA Consultant to further develop guidelines to be followed during the different stages of construction of the project.

I. The EIA consultant where properties have been affected to liaise accordingly with Serowe/Palapye Land Board.

J. The EIA consultant should monitor the implementation of the EMP during construction of the pipeline.

**Reporting**

**EIA and AIA Reports**
Draft Environmental and Archaeological Impact Assessment Report should be prepared after subjecting the proposed pipeline route to an impact assessment. At each stage of reporting copies should be sent to the client, two copies to the Department of Environmental Affairs and a copy to the National Museum.
3 ARCHAEOLOGICAL IMPACT ASSESSMENT REPORT AND CLEARANCE LETTER
ARCHAEOLOGICAL IMPACT ASSESSMENT REPORT

FOR

A
BOOSTER PUMP STATION

AND

COLLECTOR RESERVOIR

MORUPULE COLLIERY

Commissioned by: EARTHTEC CONSULTANCY (PTY) LTD
P O Box 81082
Gaborone
Tel: 3923604

Prepared by: Sephiwe Phillimon
P O Box 524
Palapye
Tel/Fax: 4921879

November 2007
1.0 BACKGROUND INFORMATION

1.1 Introduction

Debswana Diamond Company Morupule Colliery is intending to build a pump station, reservoir collector and construct a pipe line from North South Carrier Pipe line to Morupule Colliery. The project will start at about 4km east of a rail crossing at the old industrial site of Palapye at the existing North South Carrier Pipe Line. The proposed developments are a part of Morupule Colliery expansion project.

The proposed route for the pipe line project was visited/ surveyed between the 28th September and 5th October 2007.

1.2 Objectives of the study

The aim of the study was to:
- Locate and record archaeological sites in the proposed pipe line route.
- Propose mitigation strategies where necessary in the proposed area.
- Depending on the type of sites, come up with monitoring methods for the intended developments as a way of curbing destruction and disturbance of archaeological resources.

1.3 Legislative Framework

The Monument and Relics Act as amended protects all Archaeological/cultural resources in Botswana. The cultural/archaeological resources include some defined below:

- National Monument: means a recent monument, recent artifact or relic which has been declared a national monument under section 10.
- National Value: means value to the cultural or natural heritage of Botswana.
- Ancient Monument: means any building ruin, remaining portion of a building or ruin, ancient working, stone cycle, grave, cave, rock shelter, midden, shell mound, archaeological site or other site or thing of a similar kind, which is known or believed to have been erected, constructed or used in Botswana before 1st June, 1902.
Historic building: means any building of national value, which was erected, constructed or used in Botswana after the 1st of June 1902, which has been declared a historic building under section 11.

Recent artifact: means any drawing, painting, carving, ornament, implement, stone tool, bone, pottery or any other artifact, of national value, that were made or used in Botswana after 1st of June 1902.

Recent Historic monument means any structure, of value, which was erected, constructed, or used in Botswana after the 1st of June 1902, which has been declared a historic building.

The law automatically protects all relics predating 1902 and it also forbids any authorized person from altering, destroying or damaging any archaeological remains or removing materials from the site of discovery or deposition, whether they are registered with the National Museum or have not yet been discovered. (Roads Department-Planning and Environmental Impact Assessment of Road Infrastructure, September 2001).

1.4 Archaeological and Historical Background

A number of archaeological impact assessments have been conducted in Palapye and the locality. Some of them include:

- Environmental and Archaeological Impact Assessment for the proposed borrow pit at Majwanaaaphiri.
- Clearance letter for the expansion of Morupule Colliery
- Archaeological Impact Assessment for Palapye, Serule, Road Rehabilitation.
- Archaeological Impact Assessment for the proposed University of Science and Technology.
- Archaeological Impact Assessment for the Airport.
- Archaeological Impact Assessment of a proposed borrow pit for Palapye Internal roads.

Apart from the studies mentioned above, there are other researches conducted in the locality of Palapye. In addition there are some historic/cultural sites in the locality of the proposed site. These include some of the following:
- **Toutswemogala**
  Toutswemogala is about 30km northwest of Palapye near Topisi. The site has had a lot of cultural materials and excavations done. Toutswemogala is one of the large settlements which were built on hilltops in Botswana. The Toutswe tradition is associated with the domination of livestock and evidence of large cattle herds has been found from the faunal remains. The site is said to have had over 200 inhabitants and controlled an area greater than 100km across. A cultural has been proposed at this site. (Lane 1998).

- **Old Palapye**
  The ruins of London Missionary Society church in Old Palapye. The site is about 35km from Palapye. Old Palapye was the capital of Bangwato between 1889 and 1902, and it was therefore occupied at the end of the ninetieth century. It is said that settlement pattern that occurred at this site have shown division between the African and Europeans. Research in this area was done by a lot of scholars who collected artifacts and discussed settlement patterns, for instance, Mathibidi demonstrated that settlement around the main area of the town was clustered, forming into ward structures. (Mathibidi1996; Lane1998).

- **Moremi Gorge**
  Moremi Gorge Conservation Area is about 32km east of Palapye, along the northern edge of Tswapong Hills. The people who live in Moremi are the Bapedi, and according to Oral history, they arrived in the Tswapong area shortly before the Matebele incursions of the late 1830’s. They are said to be the fist Bapedi to settle in the area. (White 2001). The Manonnye Gorge is believed to be the resting place of the spirit ancestors. This is very important to the people of Goo-Moremi.

The sites mentioned above are not the only sites in the vicinity of the project area. Some of them are listed below

- **Majojo**
- **Royal Cemetery in Serowe**
- **Khama Memorial Museum**
- Lotsane River Ruins
- Malaka Waterfalls

As already mentioned, The Toutswe tradition influenced to areas about 100km, it is possible that the project area was among these areas. As such, there is a probability of archaeological sites being found.

1.5 Project and archaeology

The proposed developments are not in the exact location of the sites mentioned/discussed above; therefore, the proposed developments do not pose threat to the known archaeological sites of the area. The major concern is the archaeological materials that may be buried in the earth surface and those that could not be visible to the naked eye.

The proposed pipe line is basically a ground disturbing project as such there is a possibility of burials being found. This is so, because in the past people were buried under the trees, in the kraals, houses etc. Accidental discoveries of burial sites and other archaeological materials can occur.

2.0 METHODOLOGY

The following research methods were used to study the proposed pump station project.

- Desktop Study
- Foot survey
- Design details
- Photography

2.1 Desktop Study

A research of existing literary materials was studied prior and after site visit. A major research on handbooks, academic papers, environmental and archaeological materials was done. All these were studied as way of familiarizing one with the project area.
2.2 Foot survey

A foot survey of the proposed site was done from North South Carrier Pipeline near old industrial Palapye. The proposed pipe line from North South Carrier Pipe Line will be along Morupule railway line and it is within the railway line reserve.

The starting point was North South Carrier Pipeline existing chamber. Near the starting point, there is an existing sewer pump house for Palapye Sanitation and a field adjacent the pump house. The pipe line will be along the road, until it crosses the Botswana Railway line (Francistown-Gaborone) in Palapye.

A proposed booster pump station will be built behind the Sewer pump station. At this proposed location, there is an access road to Majwanaadiphiri borrow pit and the borrow pit has been rehabilitated and used partly.

A distance of 20m within the railway line reserve was surveyed on both sides in straight lines. This was meant to cover the area intensively, especially outside the village.

Survey Results

No archaeological materials were found in the proposed project area. The proposed site has been disturbed by:
- Maintenance road for the power line
- Building of the railway line
- Squatter settlement towards Morupule Colliery
- Damping of litter/building rumble in the village as well as outside the village
- Play grounds/football pitch
- Access road to the borrow pit
- Sewer line to Palapye
- Water line from North South Carrier.

2.3 Design Details for the proposed project

A detailed design of the proposed project was used to mark the exact route of the pipe line. This was helpful since the exact starting point of the pipeline was marked and it was easy to follow the proposed route using the design.
2.4 Photography

The proposed site was photographed during survey. The photographs will be used in report writing as well as in future for other research.

3.0 RECOMMENDATIONS

The proposed site is graded (5), using the grading system for archaeological sites below.

1- Preserve at all costs
2- Preserve if possible, otherwise extensive salvage work
3- Test excavation to determine whether further work is necessary
4- Systematic representative sampling sufficient
5- No further archaeological work required

Even though there were no archaeological materials, it is recommended that, watching briefs be done especially during excavations of pipe line route. This will be a monitoring tool that will be meant to salvage archaeological materials in case they are found.

The developer can be allowed to do proposed developments since a foot survey of the proposed site did not yield any archaeological finds.
Figure 1: North South Carrier Pipe Line Site

Figure 2: Proposed site along the railway line reserve
Figure 3: Proposed site along the power line maintenance road

Figure 4: Squatter camp near the proposed site
Figure 5: Proposed site in Palapye

Figure 6: Proposed site in Palapye- rubbish in the location
REFERENCES


Mason, R.1993. Archaeological Investigation of the North South Carrier Pipeline. Commissioned by the Department of Water Affairs.


Monuments and Site Register.

Segadika, P.2000, Archaeological Impact Assessment of Borrow Pits for Palapye-Serule Road Rehabilitation, Commissioned by EHES.

Clearance Letter