



Netherlands Commission for  
Environmental Assessment

# Advisory Review on ESIA for Coal Transportation and Dredging of Zambezi River

NCEA OS25 – 092

## Zambezi Delta – Mozambique



# 1. Introduction

## 1.1 Initiative

The initiative concerns coal transportation by barge convoys on the Zambezi river from Benga mine to a yet to be created offload point offshore of Chinde. This transportation requires dredging of the Zambezi river to make it navigable and the construction of several facilities.

## 1.2 Involvement of the NCEA

The Netherlands Commission for Environmental Assessment (NCEA) has been asked by MICOA's National Directorate for EIA (MICOA/DNAIA)<sup>1</sup> to review the quality of the ESIA.

The NCEA and MICOA agreed to follow a shortened procedure for this review due to the limited time available. The NCEA will not perform the usual site visit, nor will there be a consultation with stakeholders. The NCEA will review only the ESIA report and its annexes, rather than a full literature review of relevant sources. As a consequence this review does not have the status of a 'full' NCEA review, but is to be regarded as a technical desk review. The main implication is that there will be more uncertainty in the conclusions of the NCEA.

The aim of the review is to verify whether the ESIA contains sufficient information to enable the full integration in decision making of environmental considerations, and their linkage to socio-economic issues. In the case of serious shortcomings, the consequences for decision making will be assessed and recommendations will be given for supplementary information.

There has been no involvement of the NCEA in the scoping phase. For this project, the reference framework for review is the Mozambican ESIA regulation, in combination with professional good practice.

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<sup>1</sup> Appendix 1: letter of invitation

## 2. Main review findings

### 2.1 General observations

The NCEA is of the opinion that the ESIA report is well written. A great deal of information has been collected and analysed. It is clear, however, that many data are not available, resulting in many uncertainties. These shortcomings are especially found in the chosen reference water level and the uncertainties in the dredging amounts, as well as the lack of a detailed monitoring programme.

The ESIA does not discuss alternative transport modalities to river transport such as railway, pipeline (outside or in the river bed) or road transport. The NCEA does not consider this an omission in the ESIA, since this is a responsibility of the Mozambican government rather than Riversdale's. Alternatives should, however, be considered in strategic government multi-sector planning, in particular in the currently planned SEA for the Lower Zambezi Basin Multi-Sector plan.<sup>2</sup>

The NCEA is of the opinion that the ESIA falls short on three issues:

- The ESIA lacks a justification of the chosen reference water surface elevation during the low flow season, and the reference discharge associated with this water level; as well as an analysis of the possible environmental consequences of choosing a certain water level.
- There is no sensitivity analysis of the assessed impacts in light of the uncertainties in the amounts of material that need to be dredged.
- In the ESIA there is no detailed description of the monitoring programme needed to deal with these uncertainties during implementation of the project.

Chapter 3 discusses these issues in more detail. The NCEA recommends to remedy these shortcomings by providing additional information in a supplement to the ESIA report before the start of the licensing process. This information is a necessary condition.

Furthermore, the NCEA is of the opinion that the following issues – although not essential for decision making at this stage – are not yet sufficiently dealt with in the ESIA:

- site selection for deposition of dredged material;
- periods of the year during which dredging should not take place;
- possible barging optimisation;
- consequences of possible varying coal quality on expected impacts;
- impacts of underwater noise related with the construction of facilities;
- induced development of the intended developments near Chinde;
- role of local fishermen in the participation process of the ESIA;
- possible mitigation measures.

Chapter 4 discusses these issues in more detail. The Commission recommends to remedy these shortcomings by providing additional information in a supplement to the ESIA report. This could be done either before the start of, or during the licensing process.

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<sup>2</sup> See also NCEA Advice on Scoping for an integrated Multi-Sector Plan and SEA for the Lower Zambezi Basin.

### 3. Essential shortcomings to remedy

In this chapter, the NCEA gives recommendations to provide additional information on a number of relevant issues to remedy, in a supplement to the ESIA report before the start of the licensing process.

#### **Water level / discharge flow**

In the ESIA, impacts have been assessed given a certain reference situation. This reference water level has been set at 2.80 m as read on a gauging plate in the Zambezi River near Tete, equivalent to 123.90 m above mean sea level.<sup>3</sup> The Environmental Flow specialist study of the ESIA associated this water level with a discharge of 2,006 m<sup>3</sup>/s.<sup>4</sup> The ESIA does not provide a justification of the chosen reference water surface elevation and the reference discharge associated with it.

In a personal note, Riversdale has commented that the reference water level of 2.8 m near Tete has a chance of exceedance of 80%. This means that during 20% of the time the water level will be lower. The ESIA however does not clarify this figure.

The Environmental Flow Assessment specialist study in the annex of the ESIA seems to suggest that the chance of exceedance of a discharge of 2,006 m<sup>3</sup>/s (associated with the water level of 2.8 m near Tete) may only be approximately 55%.<sup>5</sup> This could imply that the water level in the river would be lower than the reference water level as frequently as 45% of the time. If this is true, this could have major consequences for the feasibility of the intended barging operation. The NCEA therefore recommends to clarify the used reference water level.

Furthermore, the consequences of the chosen reference water level on the initiative and its impacts are not discussed in the ESIA. For example, a possible lower water level or discharge flow would have an impact on the initiative and could lead to intensified dredging activities, application of boats and barges with less draught, reduced fuel load, absence of transportation in certain periods of the year. These aspect in turn could lead to additional demands on releases from upstream reservoirs and extra safety measures when barging at water levels below the reference level, which, could have an impact on the feasibility of the barging operation.

Also, the following two “reasonably foreseeable” activities are not analysed in the ESIA on their possible consequences for the project and their impacts:

- A possible change of the operating rules of the large dams upstream (e.g. Kariba and Cahora Bassa) to synchronise operations within (inter)national agreements and to establish a more natural flow regime. This could involve creating ‘modest annual floods coupled with better protection from large floods through early wet season releases’<sup>6</sup>, and as a result no additional discharge in the dry season. This could possibly constrain the barging operations (and might also reduce electricity production) during certain months of the dry season.

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<sup>3</sup> ESIA page 47

<sup>4</sup> Environmental Flow Assessment volume 2, page 80

<sup>5</sup> Environmental Flow Assessment volume 1, figure 7.2, page 31

<sup>6</sup> Dr Beilfuss comment on the Environmental Flow Assessment, 12-11-2010

- Large-scale irrigation development in the Lower Zambezi (90,000 ha additional irrigation has been mentioned in certain official reports) that may result in large water diversions from the main river which may reduce discharges and water levels downstream of those diversions. These impacts are likely to be minor by themselves (decrease in flow in the order of 100 m<sup>3</sup>/s or more), but may come on top of other developments.

The NCEA recommends that, before the start of the licensing process, the following has been done:

- clarify the chosen reference water surface elevation during the low flow season, and the reference discharge associated with this water level;
- confirm the calculated dredging volumes;
- indicate the possible environmental impact of this reference water level and dry season flow;
- consider mitigating measures when water levels are lower than the reference.

### **Dealing with uncertainty**

Regardless of the chosen scenario for environmental flow, the river system is dynamic to the extent that there is a considerable uncertainty regarding the amounts to be dredged and, as a consequence, the impacts of dredging and depositing. The ESIA does not include a sensitivity analysis on what this could mean for the initiative.

In the Environmental Flow assessment report,<sup>7</sup> it is mentioned that the Zambezi river system is a highly dynamic system. This is caused by the continuously changing discharge and suspended bed load sediment transport of the river. As a result, the sedimentation and erosion pattern of the riverbed also continuously changes. Among other things this is demonstrated by the moving islands and sand bars in the Zambezi river.

Because of the dynamics of the Zambezi river, it is difficult to predict the initial and maintenance dredging quantities that are needed to be dredged to create and maintain the channel in the Zambezi river needed for coal transport. In the ESIA, these uncertainties are mentioned. However, their implications for environmental impacts are not discussed. The NCEA strongly recommends to consider a range of dredging amounts and their effects on the operational activities (dredging, depositing), and to assess the environmental impacts of these.

The NCEA recommends to include a sensitivity analysis of the dredging amounts and the environmental effects in the ESIA before the decision on the licence granting.

### **Monitoring programme**

As stated in the EIA report, the existing uncertainties make a monitoring programme essential, including a clear outline of the approach, assignment of responsibilities and a budget. Such a monitoring programme is not part of the ESIA. Annex D of the ESIA provides a first

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<sup>7</sup> Environmental Flow assessment volume 1: main report, Southern waters ecological research and consulting cc, February 2011.

draft of a framework of the different elements that should be included in the monitoring programme.

The monitoring programme should also include: the dynamics of the Zambezi River and the effects it has on dredging and disposal, the effects of disposal on ecology and on operation of transport (convoy design, safety measures etc.).

The monitoring and assessment programme should become an integral part of the proposed development. The NCEA recommends an adaptive programme that comprises a cyclical and adaptive process, allowing the continued assessment and management of possible project impacts throughout the programme. The adaptive approach can adjust the execution of work during construction, operation and closing in order to reach environmental and socio-economic goals. The adjustments should be based on the monitoring of effects. Furthermore, a complete cycle of planning, execution of monitoring and evaluation of results is necessary to facilitate the adjustment.

The NCEA recommends to establish an adaptive monitoring and assessment programme before the decision on the licence granting.

## 4. Other recommendations

In this chapter, the NCEA gives recommendations to provide supplementary information on a number of issues either before the start of or during the licensing process.

### 4.1 Dredging

#### **Site selection for deposition of dredged material**

The ESIA proposes to dispose the dredged river material in lees of islands and at sand bars about 300 – 700 m from the dredge sites where possible. However, the ESIA does not clarify whether it is possible in terms of available space to dispose nearly 19 million m<sup>3</sup> of spoil this way. If this would not be possible, the ESIA suggests that the dredged material will be disposed alongside the dredged channel. The sites to do this are not described in the ESIA. This is important since the different ecological studies mention that dredged material should not be disposed in or near the entrances of distributaries, floodplains and important fish habitats such as wetlands, backwaters and vegetated areas.<sup>8</sup>

No spoil deposition is recommended in or near entrances of distributaries, to avoid cutting these off from the main stream. The NCEA would like to emphasize that, due to natural movements in the river basin, a deposit might end up in or near a distributary. This risk and its impacts are not analysed in the ESIA. The NCEA recommends to carry out this analysis and, based on the findings, include a detailed map of go or no-go depositing areas in the ESIA. This also applies for floodplains and important fish habitats such as wetlands, backwaters and vegetated areas. It is also possible to set up a monitoring program that monitors

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<sup>8</sup> Riversdale Zambezi river coal barging project specialist study on the potential effects on fish and fisheries, Jorge M. Mafuca, January 2011

whether distributaries, floodplains and important fish habitats are directly and/or indirectly affected by spoil deposition.

The ESIA suggests to deposit dredged material from the offshore bank (capital and maintenance) in an active shallow near-shore coastal system near the shore of the Chinde River. It is not clear yet if this could have an impact on the river mouth, the beach and/or the estuary development (shape, erosion, accretion). The NCEA recommends to analyse this.

### **Dredging periods**

Dredging is expected to continue year-round. The free movement of aquatic biota through the basin may be potentially impacted by year-round dredging, as migration and resettlement on new deposits and other ecological connectivity issues might be hampered. For example, in the annex<sup>9</sup> it is recommended in order to prevent that fish being trapped in the dredger in breeding areas, that dredging should not continue during the breeding season. For the majority of fish species, the breeding season is during the rainy season. It is also recommended that dredging should not continue for up to three months after the breeding season, in order to allow juveniles to grow. These recommendations are not further discussed in the ESIA. For instance, it is only mentioned that *where possible* dredging activities will be planned outside the breeding seasons and possibly three months after to allow for the juveniles to grow. The criteria used to concretise 'where possible' are not further clarified. An alternative to dredge more intensively (use more dredging equipment) outside the breeding season is not considered in the ESIA. The NCEA recommends to specify whether these mitigation measures will be integrated into the plan and to what extent.

## **4.2 Barging optimisation**

From the ESIA it is not clear why the chosen convoy design has been selected (ESIA page 67) . This is important because the chosen barge system or design influences the need for dredging, transportation frequencies or safety issues. For instance, convoys of 4 x 2 barges may be difficult to control when travelling down stream (uncontrolled drifting). The ESIA suggests to use a trial and error-method for the first period of the project, combined with monitoring. The NCEA supports this suggestion and recommends to also use this period to gain more insight in the river systems dynamics, create a navigation map and set up a system of navigation guidance, particularly at night and during bad weather.

The chance of collisions seems small given the intensity of shipping. However, especially at night and in bad weather there is an increased risk of collision with bridges and of stranding. This is relevant for designing the necessary fenders near the bridges Dona Ana and Caia. The NCEA recommends to include these aspects in the navigation safety investigation, mentioned on pg 66 of the ESIA report.

At Dona Ana Bridge it is suggested in the ESIA to first disassemble the convoys into smaller convoys, which will pass the bridge. On the other side the assembly of 8-barge convoys will take place. Another option that might be considered is the passage of a 4-barge convoy with a combination of a push boat *and* a pull boat. The last option does not require a mooring place. Of course, this also depends on the outcome of the navigation safety investigation.

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<sup>9</sup> Freshwater micro invertebrates, Rob Palmer, December 2010

### 4.3 Coal quality

The annex<sup>10</sup> concludes that the type and chemical composition of the transported coal will not result in a major environmental impact. This conclusion is based on data from Riversdale (not shown in report) that confirm that the sulphur content in Benga coal is low (< 1%). Because of the low sulphur concentrations, it is concluded that the metal concentrations in the coal will also be low since metals are bound to sulphur. It is also concluded that the amount of metals that will dissolve will be low because the solubility of metals is low at neutral and weakly basic solutions. The low metal concentrations found in the river mouth sediment are used to support these arguments.

The NCEA recommends that these conclusions are confirmed by measurements of sulphur and metals in the to be transported Benga coal. The annex mentions that measurements of metal concentrations in coals are underway. Furthermore, NCEA recommends to take into account the oxidation of sulphur and the consequent release of metals. The release of metals following sulphur oxidation (e.g. from coal spill in the river, or seepage from coal storage on shore) could impact river ecology

### 4.4 Underwater noise related to the construction of facilities

At several sites (Chinde, Dona Ana Bridge and Benga) facilities related to the coal transportation will be constructed. Sinking piles will be part of the construction. This can have a large effect on water life. High underwater noise levels may not only affect biota with swimbladders (impact on fish is described in ESIA) but may potentially (directly or indirectly) affect invertebrates as well (e.g. statocyst damage). Pile driving in a flowing and shallow mangrove area as an important nursery and refuge area could disturb larger animals and directly impact juveniles, eggs, plankton and other fragile organisms and life stages.

The NCEA recommends to specify which techniques will be used (e.g. percussion or vibration) including a list of noise-reducing measures.

### 4.5 Induced development near Chinde

The estimated direct potential loss of mangroves through access routes (3,5 ha) and Dolphin berths (7 ha disturbed) on a total of 180 ha on the northern Chinde shores would lead to a maximum of 6% loss of mangrove coverage. However, the impact and significance of two more potential problems should be considered as well:

- The immigration of people (drawing from adjacent mangrove system: firewood, material for house construction) is expected when opening up the area to planned facilities at Northern Chinde. The NCEA recommends to specify possible mitigation measures for this, e.g. limit access to routes to planned buildings.

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<sup>10</sup> Potential trophic transfer of contaminants associated with coal. Appendix 1 of 'Freshwater micro invertebrates'.



- In shallow water areas there is a relation between boat traffic, sediment resuspension, turbidity levels and/or total suspended solids. This applies to boat speed and to frequency. Increased prop wash may potentially lead to:
  - increased resuspension of finer sediment in lower Zambezi,
  - affected mangrove species composition and distribution
  - or, when prolonged, may negatively impact mangroves, its ecological functions and adjacent salt marshes habitats and marsh sods.

The NCEA recommends to investigate possible mitigation including turbidity control, monitoring and maintaining integrity of the fine sediment bed.

## 4.6 Participation

In annex b the participation process is described. The NCEA has the impression that although there have been numerous important discussions, the participation of local fishermen and the application of their local fisheries knowledge has not fully been taken into consideration. Please note that this argument is based on Annex B and the ESIA only. The NCEA did not have access to Appendix 1 (Record of Meetings), to which is referred in Annex B. In a personal note, Riversdale mentions that the majority of the local fisher communities have been consulted during the public participation process (PPP). However, these sessions are not clearly mentioned in the PPP, as well as the issues raised and the measures undertaken to take these issues into account. The NCEA recommends to clarify the participation of local fishermen, their contribution and what consequences this has for the plan.

## 4.7 Mitigation measures

There is a discrepancy between the mitigation measures mentioned in the annex and those in the ESIA. Some of the mitigation measures mentioned in the annex might be worth considering, some of these are also mentioned in the sections above:

- avoid deposition of spoils near, in, or blocking the entrances of, distributaries, flood plains and important fish habitats;
- no dredging in breeding or compiling areas in the breeding season;
- avoid lowered connectivity between habitats and related biota due to dredging/pilling.
- prepare detailed risk map of 'go and no-go' areas for deposits that consider river dynamics and ecological cycles of biota in time (reproduction, migration, recruitment).

The NCEA recommends to specify whether these mitigation measures will be integrated into the plan and to what extent.

## APPENDIX 1

Letter of MICOA of 5 October 2011.



REPÚBLICA DE MOÇAMBIQUE

MINISTÉRIO PARA A COORDENAÇÃO DA ACÇÃO AMBIENTAL  
DIRECÇÃO NACIONAL DE AVALIAÇÃO DO IMPACTO AMBIENTAL  
DNAIA

À:

NCEA  
Att: Sr. Post

Holanda

*Att: Sr. Tom Dorsey*

N/Ref.º N.º *1239* GDN/DNAIA/MICOA/11

Data: 05/10/2011

Assunto: **Pedido de parecer sobre o Projecto de Transporte de Carvão no Rio Zambeze.**

Exmo Senhor,

No âmbito do Memorando de Entendimento entre o MICOA e a NCEA, a DNAIA serve-se desta para enviar à V.Excia, o Estudo de Impacto Ambiental (EIA) do projecto "**Transporte de Carvão no Rio Zambeze**", para análise e emissão de parecer.

Com vista a harmonizarmos os pareceres técnicos do projecto e análise da sua viabilidade ambiental, para a tomada de decisão, gostaríamos que o parecer da NCEA nos fosse enviado até ao dia 01/11/2011.

Com os melhores cumprimentos

Atenciosamente,  
  
Rosa Cesaltina Benedito  
Directora Nacional



## APPENDIX 2

### Project information and composition of the Commission's working group

**Proposed activity:** Coal transportation by barge convoys on the Zambezi river from Benga mine to a yet to be created offload point offshore of Chinde. This transportation requires dredging of Zambezi river to make it navigable and the constructing of several facilities.

**Project specific information:**

The NCEA has been asked to review the Environmental and Social Impact Assessment (ESIA) by MICOA National Directorate for EIA (MICOA/DNAIA) concerning the proposed activity.

The NCEA and MICOA agreed to follow a shortened procedure for this review due to the limited time available. The NCEA will not perform the usual site visit, nor will there be a consultation with stakeholders. The NCEA will review only the ESIA report and its annexes, rather than a full literature review of relevant sources. As a consequence this review does not have the status of a 'full' NCEA review, but is to be regarded as a technical desk review. The main implication is that there will be more uncertainty in the conclusions of the NCEA.

The aim of the review is to verify whether the ESIA contains sufficient information to enable the full integration of environmental considerations in decision making, and their linkage to socio-economic issues. In the case of serious shortcomings, the consequences for decision making will be assessed and recommendations will be given for supplementary information.

**Categories:** DAC/CRS: 41010 Environmental policy and administrative management; 21040 Water transport; 14040 Water sector policy and administrative management; 14015 Water resources conservation (including data collection); 14040 River basins' development; 14050 Waste management/disposal; 31310 Fishing policy and administrative management.

**Project number:** Netherlands Commission for EA (NCEA): 092

**Procedural information:**

Receipt request for Advice	: 5 October 2011
Submission of Final Draft Advisory ToR	: 23 November 2011

**Composition of the working group of the Commission for EA:**

Mr Jappe de Best  
Mr Victor Langenberg  
Mr Pieter van der Zaag  
Mr Rudy Rabbinge (chair)

**Technical secretary**

Ms Corrie Smit (technical secretary)