

DREDGING FOR DEVELOPMENT ON THE LOWER RIVER NIGER BETWEEN BARO AND WARRI, NIGERIA

ABSTRACT

The Federal Republic of Nigeria is desirous to develop her inland waterways through the agency the National Inland Waterways Authority (NIWA), which operates on behalf of the Federal Ministry of Transportation. By a Presidential directive the development of a Master Plan together with a Bankable Feasibility Program was started early 2006. The overall project scope for the project was to prepare a Comprehensive Master Plan for the development of the inland waterways in Nigeria; carry out a feasibility study on the socio-economic, financial, technical and environmental viability of such a project justifying required investments; develop a Marketing Plan to promote inland waterway transport as an important and attractive mode of transport; and execute the actual construction works. The long-term advantage of the project is that the increased transport of goods over the water will have a positive effect on the welfare of the population living along the river.

INTRODUCTION

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agency the National Inland Waterways Authority (NIWA), which operates on behalf of the Federal Ministry of Transportation. By a Presidential directive the development of a Master Plan together with a Bankable Feasibility Program was started early 2006. The overall project scope for the project included the following aspects:

- Prepare a Comprehensive Master Plan for the development of the inland waterways in Nigeria
- Carry out a feasibility study on the socio-economic, financial, technical and environmental viability of such a project justifying required investments
- Develop a Marketing Plan to promote inland waterway transport as an important and attractive mode of transport.
- Execute the construction works itself.

The River Niger measures a total length of 4,200 kilometres and is one of the longest rivers in Africa. Navigation on the River Niger is not new. Already in 1832 the steam vessel *Alburkah* sailed up the river and managed to reach Lokoja which lies 500 km inland from

the Atlantic Ocean. The total length of the Lower River Niger to be dredged between Baro and Warri measures approximately 575 km.

The river has a strong meandering character and has no regulating measures to guide the flow (Figure 1). Another significant characteristic of the river is its water level which varies up to 9 metres between the dry season and the rainy season. To maintain water depths during the dry season would require so-called River Training Works.



Figure 1. Location map of River Niger traversing through several countries. The river's meandering character is visible.

Above: Dredging and River Training works on the River Niger, one of the longest rivers in Africa, will have positive economic and social impacts for those who live and work along the riverbanks.

CHALLENGES: EXTREME DEPTH CHANGES

The execution of a large-scale project as the River Niger project has many challenges. During the rainy season (June till September) the output of the river increases from 1,800 m³/sec to more than 20,000 m³/sec. This has a major impact on the current, which can peak to more than 3 m/sec.

During the dry season the river becomes so shallow that, in addition to the construction of a navigation channel, measures are going to be taken to guide the water in such a way that the minimum water depth can be guaranteed. These so-called River Training Works include the construction of cross dams which block branches of the river and provide guidance of the main stream and protection of the river banks by the construction of groynes.

THE PROJECT

The total length of the Lower River Niger to be dredged between Baro and Warri measures approximately 575 km and has been divided into 5 sections. Van Oord has been awarded sections 3 and 4 with a total length of approximately 250 km. These two sections stretch from the Jamata Bridge north of Lokoja to the Niger Bridge at Onitsha and also include the River Training Works, which are unique to this section and not included in the other sections.

DESIGN AND SOLUTIONS

The tender design was drafted by Royal Haskoning in 2002 and describes a navigation channel alignment and the locations of the cross dams and groynes. As the actual project execution only started in 2009 the design needed to be verified to check if its parameters were still valid. This formed part of the scope of work for the contractors.

For this reason a survey team started early 2009 with a so-called "Thalweg Survey" to verify if the original channel alignment was still located along the deepest points in the river. The main goal of this Thalweg survey was to ensure that the Navigation Channel Alignment was following the deepest part of the river to minimise maintenance activities in the future. On completion of the capital dredging this Thalweg Survey proved to be an accurate basis for the channel alignment.



Figure 2. The cutter suction dredger *Eendracht* on the Niger.

To ensure safe navigation of the vessels the alignment also has to meet with some other design parameters:

- Channel shall be minimum 60 metres wide with a minimum depth of 2.5 metres
- Curve radiuses are to measure a minimum of 600 metres
- Each kilometre of the alignment shall only include one change in direction
- The angle between the channel alignment and the main stream of the river shall not exceed 30°
- Operators shall have a line of sight of minimum 5 ship lengths

Clearly, a compromise between all the parameters had to be found, keeping in mind that the volume of material to be dredged was to be kept to a minimum.

PROJECT EXECUTION

Two cutter suction dredgers, CSD *Eendracht* and CSD *Calabar River* (Figure 2), are operating on the Lower River Niger Project. In addition, a large spread of auxiliary equipment is on site to allow the dredgers to work independently (Figure 3). The equipment includes two house boats, two multicasts, three tugboats, a workshop barge, 5 storage pontoons, 5 crew tenders and various dry earth moving equipment. All the equipment arrived on site during August 2009. The dredging activities commenced on September 17, 2009 after the official flag-off ceremony in the presence of the President of Nigeria, His Excellence Yar'Adua. The dredged soil, mainly sand, is deposited along the riverbanks and in special depots along the river. Purpose of these depots is to sell the sand and use the income for the development of villages and



Figure 3. Various auxiliary equipment on the river project.



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Figure 4. Dredged material is deposited onto an island along the riverbanks and will later be recycled by the local population.

roads along the river (Figure 4). To date Van Oord has completed the capital dredging of the Navigation Channel covering the full length of 250 km between Jamata Bridge north of Lokoja and the Niger Bridge at Onitsha. Also a total of 300 navigation buoys have been supplied and placed to mark the alignment of the navigation channel to its users. In addition to the capital dredging activities the contract also include maintenance dredging for a period of two years which has also been allocated for the construction of the afore-mentioned River Training Works.

RIVER TRAINING WORKS

At various locations the river is so shallow that even with maintenance dredging the water depth of 2.5 metres cannot be guaranteed. To solve this problem a total of 18 cross dams are to be

constructed. The main purpose of a cross dam is to block a secondary branch of the river to guide the water towards the navigation channel alignment. This will increase the velocity of the water and therefore the erosion of sediment on the bottom to ensure the required water depth. The cross dams are to be constructed using sand dredged from the Navigation Channel and are protected by a layer of rock materials contained in gabions. In addition to the cross dams, the contract also provides for the construction of 14 groyne. The main purpose of these groyne is not the guidance of the river flow but to protect some of the outer bends of the river to stop erosion.

LOGISTICS AND THE SITE

From logistic aspects the contract stipulates that dredging is to be executed from upstream

to downstream. As facilities along the river are limited, Van Oord also mobilised two large house boats to house the crew and staff for the execution of the works. This results in a transient site character whereby all equipment is moving in one spread down the river. Besides accommodations, the house boats also provide catering and medical facilities.

Before mobilising to site all equipment was prepared at the Van Oord main yard in Port Harcourt situated in the Niger Delta. Given the shallow areas in the River Niger the equipment could only be mobilised to site during the high water period in 2009. The voyage whereby all equipment was travelling in a convoy escorted by security units of the army took exactly four weeks (Figure 5).



Figure 5. Overview and close up of the convoy of house boats being pulled. House boats provide accommodations, catering and medical facilities.



Figure 6. Life on the river is impacted by the project, so liaison officers spend significant time communicating with the local communities.

Working in Nigeria also means that the project team must liaise with the communities along the project site. This can be challenging. For this reason separate community liaison officers have been employed and trained where required. The main task for the liaison officers is to communicate with the various communities affected by the work and diffuse any potential situations. Where possible, requests are honoured. Compensation, if applicable, is agreed upon after consultation with the client (Figure 6).

SOCIAL RESPONSIBILITY

Working in an environment such as the River Niger project also means that the project team comes in contact with the true way of life of the local population along the river. The role of social responsibility is taken very seriously and many local community projects have been organised. These projects involve the construction of boreholes for the supply of water, construction of school blocks, support to orphanage houses, and so on. The local population welcomes these community projects as they have a positive effect on both the project execution as well as the general living standards along the river (Figure 7).

Figure 7. Community projects are welcomed by the local population, as they have a positive effect on both the project execution as well as general living standards along the river.

CONCLUSIONS

The River Niger Project is a multidiscipline project which offers numerous challenges. Scale, social and economic importance as well as the cultural and engineering challenges make it a unique project. To date the project is fully on track, various milestones have been achieved and the Capital Works have been completed.

For the coming two years the channel will need to be maintained and this includes the

construction of the River Training Works. Participating in a project of this type gives a sense of fulfilment: It will increase the transport of goods over the water and will thus make a long-term contribution to the welfare of the population living along the river. The satisfaction of the client – the Nigerian Inland Water Authority – will hopefully lead to continuing activities even after the project has been completed.

