PRELIMINARY INVESTIGATION REPORT
PONGOLA RIVER BRIDGE No.3513 AT MBOZA

VEHICULAR BRIDGE OPTION PROPOSALS

JULY 2015

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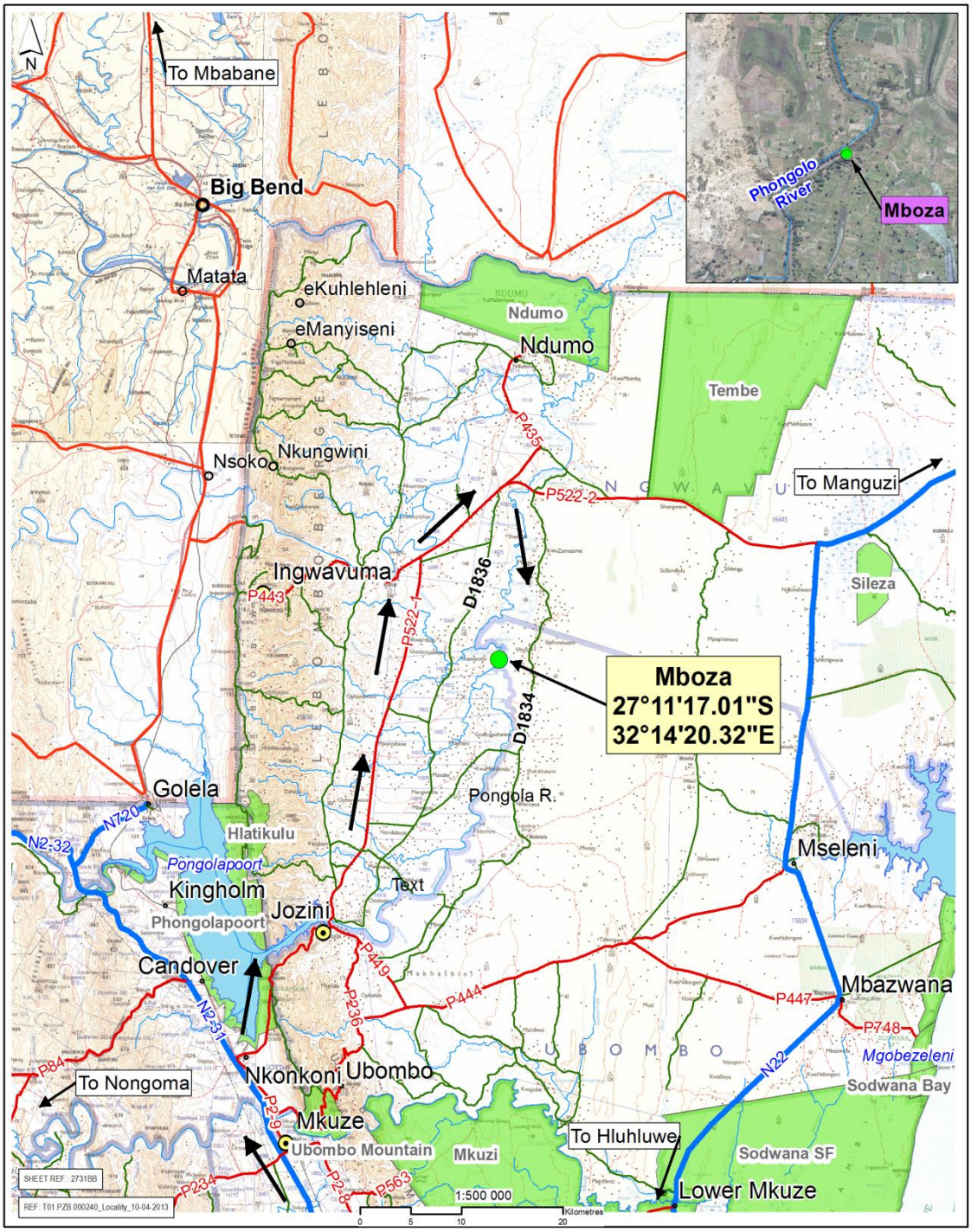
PRELIMINARY INVESTIGATION OF MBOZA RIVER BRIDGE IN PONGOLA

Page No

ANNEXURES

Locality Plan



Royal HaskoningDHV
Enhancing Society Together

Jozini & uMhlabuyalingana Local Municipalies
Mboza Bridge

PRELIMINARY INVESTIGATION OF MBOZA RIVER BRIDGE IN PONGOLA

1. INTRODUCTION

1.1 Bridge Need

The site in located on the Pongola River about 3,5km to the west of Mboza Clinic off District Road D1834. At the site the main channel is 55m and 3m deep and is always inundated with high water. Scholars and locals use a boat to cross the river. The nearest bridge is 12km south of this crossing point. The affected social facilities are Mboza school and clinic, Esipondweni Hospital, Manaba Primary School and Mzinyeni Primary School to the West.

Normal water levels at Mboza

Boat currently used to cross at Mboza

1.2 Pedestrian Bridge Activities

The site was visited by Mr Paul Dantuma and approved for a pedestrian bridge No.3513. A 110m long suspension pedestrian bridge was designed and drawings approved, plotted on plastic and signed in June 2014.

The first revision of the draft tender document was submitted on 17 July 2013. This document was not approved by BSC on 17 August 2013 due to funding. The second revision was submitted on 17 July 2014 this draft document was not approved due to cost and KZNDOT decided that a road bridge could cost more but would provide a better level service for the community.

1.3Vehicle Bridge Community Consultations

Two separate meetings were held by the Empangeni Region management and local communities and it was decided that a road bridge was to be designed and be located at the crossing point which had been earmarked for the pedestrian bridge.

Present: Representative from Nyawo Tribal Authority - Mr. Mpontshane
Ward Councillor (Ward 10- Jozini)
Jozini RRTF members-Mr N Mngomezulu (Chairperson) and Mr Mavundla
Ezinhlabeni area community members
DoT officials-Hluhluwe CC Manager, and Technicians from Jozini Area office

The community aired their need for a vehicular bridge and indicated that the site which had been earmarked for the pedestrian bridge be retained for the vehicle bridge and that the approach road be improved.

Typical state of approach road during the wet months.

Pongola flood plain on the Mboza approaches during wet months

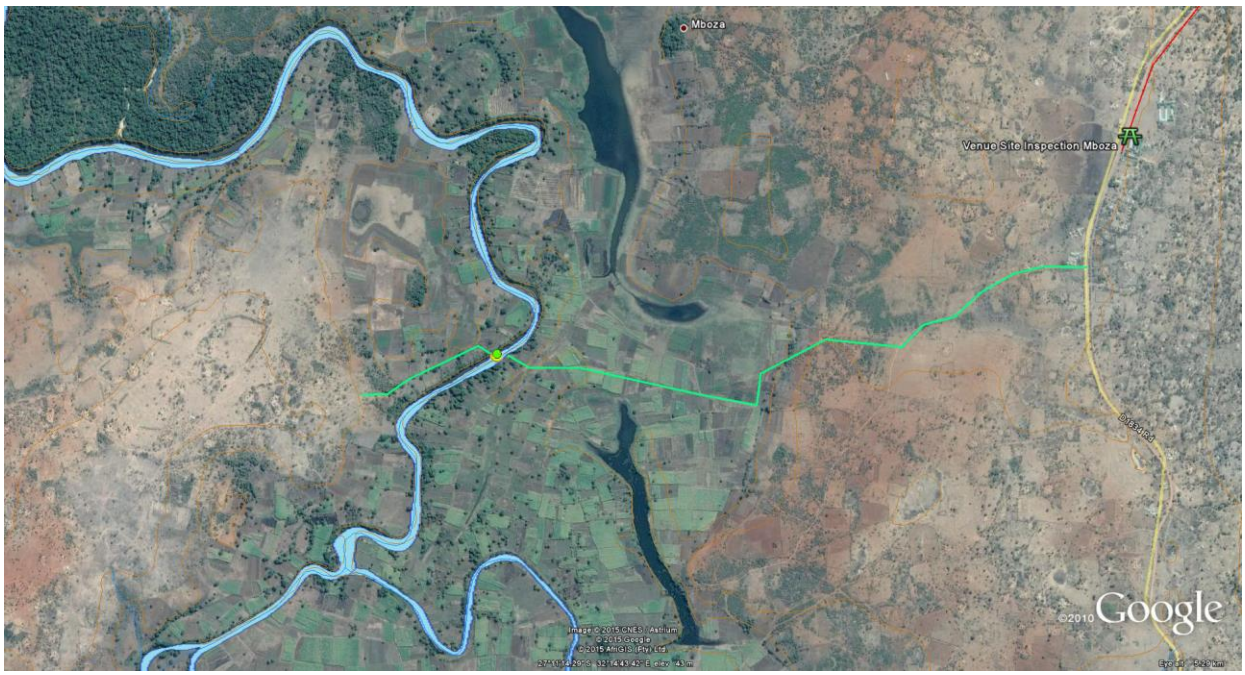
It was established that the new design was to have 3.5km of road works from the east side (D1834 and Mboza side) and 1km from the west side (D1836 side) of the Pongola river.

This report presents the programme activities and presents the bridge design options so as to enable the detailed design of the vehicle bridge to proceed.

2. PRELIMINARY INVESTIGATIONS

2.1 Site Surveys

The road approach on the east passes through the site of a track in the gardens. Two kilometres of this section gets inundated annually. And the remaining 1,5km is through village tribal land. On the west one km is through a track passing in between cultivated gardens and fruit trees. The available site survey used for the design of the pedestrian bridge is adequate for the design of the new bridge main structure but is not adequate for the design of the road approaches. An extra survey is required to link to the current survey. The extent of the required survey is indicated in the google map below.



Extend of the road survey required

Royal HaskoningDHV propose to do the survey inhouse, the preparatory work will take one week, the field work one week and the data processing one week, a total maximum of one month of the surveyor's time including data processing and liaison with KZNDoT survey section.

2.2 Environmental Authorization Application

Environmental Authorization No. DC/27/0009/2013 which was issued on 27 November 2013 was for a 1.2m pedestrian bridge with no piers in the main channel. A new EA process is required as this new structure has piers in the main channel, is now a vehicle bridge and includes 4.5km of roadwork's in a Greenfield area. The new application requires water use licence (WULA) application and may require specialist studies in the wetlands.

The planned period for this authorization is 12 months from July 2015 to July 2016.

2.3 Geotechnical Report

The field investigations for geotechnical investigations for the pedestrian bridge comprised the drilling of five (5No.) boreholes to minimum 21m depths the holes were located at abutment positions and at the positions of the main towers. No holes were drilled in the main channels. The core samples were logged and borehole profiles prepared. The boreholes indicate that alluvial materials underlie the Site for the entire depth of the boreholes, which largely have been terminated in sub rounded to rounded pebbles and cobbles at depths ranging between 21.4m and 22.51m below EGL. It is inferred that the latter form a basal horizon that overlies the bedrock. The alluvial sediments comprise predominantly CLAYS, SILTY CLAYS, fine grained sandy SILTS and SILTY SANDS, which are interlayered and laterally discontinuous. The SPT 'Nf' values indicate that the clays are predominantly firm to stiff (Nf <15) to between 7m and 11m depth below EGL on the western abutment (Mboza Clinic) and to between 11m and 14m below EGL on the eastern abutment (Munyu Primary School). Thereafter, the clays become stiff to very stiff and interlayered sands medium dense down to the basal "boulder" layer at depths greater than 21m below EGL.

The borehole logs indicate that the geology of the site is uniform and a similar geological profile is expected in the main channel.

It is proposed that for the design of the vehicle bridge the geotechnical report used in the design of the pedestrian bridge be adopted and that Augured piles (or similar) be used for supporting the vehicle bridge. To mitigate any undue risk additional geotechnical investigations shall be carried out during the bridge construction and these shall be logged and analysed and any necessary mitigation to the design carried out accordingly.

2.4 Hydrology and Hydraulics

The fully catchment of the Pongola River at the Mboza Site is 8903km2 with a longest collector of 376 km. However the flow at the site is controlled by flood gates. The flow at this site comprises of water released from the Pongola Dam and the flow from the catchment downstream of the dam. The floods released from the dam were provided by the Department of water affairs. The releasing is done annually in September / October and released floods are measured accurately. The catchment downstream of the dam is 1114km2 with the longest collection being 53km, using the SDF the flows at the site catchment were added to the flows from the flood gates to provide the design floods. The road is a minor rural road connector class 5 (Fig 8.2) hence designed for Q10 (10 year flood return period). The minimum freeboard required is 0.3m from fig. 8.3 of SANRAL Drainage Manual. The Q2T level for the 20 year flood return period is satisfied for all the options presented in this report.

3. PRELIMINARY PROPOSALS FOR STRUCTURES

3.1 Design Parameters

3.1.1 Bridge width

The road is a minor rural road connector class 5. The cross-section required for this class of road is a one lane with refuge side walk for safety.

The Hluhluwe cost center also confirmed that provision for pedestrians must be included as school children need to cross this river safely, hence the total bridge width is 6m comprising of 3.0m of road lane with two 0,5m wide shoulders plus a raised 1,1m wide raised of pedestrian walk-way with pedestrian handrails on either side.

3.1.2 Codes and Standards

The design of this bridge will comply with:

- The agreement between KZN DoT and Royal HaskoningDHV for this project.
- TMH7 Parts 1, 2 and 3 (as amended 1989), the traffic loading will be NA and NB24.
- SANRAL's Drainage Manual

3.2 Mboza River bridge proposals

3.2.1 Case Studies

To come up with conceptual proposals for the vehicle bridge at Mboza we hereby discuss drainage structures upstream and downstream of the Mboza site, these were inspected by Royal HaskoningDHV in the 2012 Principal Bridge Inspections. The Pongola River Bridge

located 12km downstream of Mboza, STC3781 on District Road D2375 comprises a five span overtopped reinforced concrete slab bridge. Next to this bridge is a series of culverts STC3780.

			
	Pongola Bridge STC3781 Elevation	Bridge STC3781 erosion behind abutment	
			
	STC3780 series of culverts near Pongola Bridge STC3781	Pongola series of culverts ZPC3675 paved road	

The abutments of bridge STC3781 are both are scoured (in front of the breast walls, not shown in the photos). The wearing course gravel on the bridge approaches were eroded, probably this happens every year. Debris and logs were trapped on the bridge deck bollards. The series of culverts in the vicinity of this bridge were all heavily scoured and it appears after every September/October of water discharge from the Jozini dam this area becomes impassable and requires repairs on an annual basis. This is because of a conceptual design fault.

On the other hand on District Road D1861, downstream of Mboza (near Shemula lodge) there is an unmarked pedestrian bridge on the Pongola River. This pedestrian bridge has a soffit above the normal flood levels. In the flood plain west of this pedestrian bridge is a series of Armco pipe culverts ZPC3765. These culverts showed that water constantly over tops them. There are no erosions or scour damage to these culverts or the pedestrian bridge abutments on this site.

Lessons learnt:

- The bridge at Mboza must be raised above the annual flows (above the top banks of the main channel) to reduce trapping of debris and logs in the main channel.
- The abutments must be out of the main banks to prevent them from being scoured
- A concrete paving with cut off walls must be provided on the road approaches as for ZPC3675 (this will allow water to flow over the road without damaging the road).

3.2.2 Option 1:

A simply supported six span bridge (spans 6x13m total 78m) has been proposed in order to provide sufficient waterway opening for the design flood with the required freeboard.

The deck for this Option comprises of a 900mm deep reinforced concrete slab deck.

The reinforced concrete abutments are box type to minimize the risk of scouring taking place on the road embankments immediately behind the abutments.

The piers to comprise two columns with a top cross beam serving as a beam seating for the deck. The piles will act as the columns.

Option 1 is not recommended because it requires a lot of staging in the main channel of a very aggressive river.

The preliminary proposal for this option is included in Annexure A.

3.2.3 Option 2:

This proposal offers a simply supported five span deck (5x15m total 75m) comprising precast reinforced concrete modified M3 beams in composite with an in-situ reinforced concrete slab. This option reduces staging in the river but requires a large crane on site for launching the beams each beam weighs approximately 12 tonnes. Over and above the large crane, this option requires an access ramp for the crane. This access ramp to be located in the main channel of a very aggressive river.

The piers and abutments are similar to those used in Options 1 and 3.

Option 2 is not recommended because of access for launching heavy concrete beams.

The preliminary proposal for this bridge is included in Annexure A.

3.2.4 Option 3:

This proposal offers a simply supported 6 span composite steel deck (6x 13.0m total 78m (un-propped)) comprising of standard steel girder beams, in composite with a 200mm deck slab which gives the same waterway opening as for Options 1 and 2. This option provides a much more buildable solution as it does not require temporary works as required in Option 1 and it therefore reduces the amount of risk to the construction from working in 2m (deep) of water. The steel beams weigh only about 1,5tonnes. The I-beams erection could be done by an excavator or TLB or a small crane and jacks. The deck slab erection will not require scaffolding in the main channel.

Below are photographs of the deck construction of kwaKweme River Bridge on D1820, the method proposed for this option. The steel beams to be designed to take wet concrete with acceptable deflection.


Timber planks supporting timber shutter boards


Scaffolding supports for deck shuttering not required

The reinforced concrete abutments and piers are substantially identical to those used in Options 1 and 2.

The preliminary proposal for this bridge is included in Annexure A.

This is the recommended Option based on build ability.

3.2.5 Pier Design proposal

The Pongola River is an aggressive working environment with regard to access and drainage. To reduce working in the 2m deep water which is always in the Pongola River at this site it is proposed to use piles as columns and only provide a cross beam to support the decking in all three options. The proposed pile is an auger pile or driven cast in situe pile, with a permanent casing. The depth of the piles will be about 18m as per the geotechnical report.

4. COST COMPARISONS

4.1 Estimate assumptions

Estimates have been prepared for the three options and they are tabled below. These estimates are based on preliminary component quantities and recently tendered rates for works of a similar character and magnitude in KwaZulu Natal. The estimates are inclusive of Ps and Gs, escalation and VAT.

4.2 Summary of Costs

COST COMPARISONS OF MBOZA VEHICLE BRIDGE OPTIONS SUMMARY OF SECTIONS				
SECTION	**DESCRIPTION**	**OPTION 1**	**OPTION 2**	**OPTION 3**
1200	GENERAL REQUIREMENTS AND PROVISIONS	55,000.00	55,000.00	55,000.00
1300	CONTRACTOR'S ESTABLISHMENT ON SITE AND GENERAL OBLIGATIONS	4,144,500.00	4,144,500.00	4,144,500.00
1400	HOUSING, OFFICES AND LABORATORY FOR THE ENGINEER SITE PERSONNEL	538,430.00	538,430.00	538,430.00
1500	ACCOMMODATION OF TRAFFIC	73,045.00	73,045.00	73,045.00
1600	OVERHAUL	50,000.00	50,000.00	50,000.00
3300	MASS EARTHWORKS	0.00	0.00	0.00
3400	PAVEMENT LAYERS OF GRAVEL MATERIAL	0.00	0.00	0.00
8100	TESTING MATERIAL AND WORKMANSHIP	30,675.00	30,675.00	30,675.00
8200	QUALITY CONTROL	0.00	0.00	0.00
6100	FOUNDATIONS FOR STRUCTURES	10,407,215.00	9,664,250.00	9,207,215.00
6200	FALSEWORK, FORMWORK AND CONCRETE FINISH	1,189,000.00	752,200.00	453,500.00
6300	STEEL REINFORCEMENT FOR STRUCTURES	1,525,500.00	1,147,500.00	1,012,500.00
6400	CONCRETE FOR STRUCTURES	1,637,500.00	3,237,500.00	912,500.00
6600	NO-FINES CONCRETE, JOINTS, BEARINGS, BOLT GROUPS FOR ELECTRIFICATION, PARAPETS AND DRAINAGE FOR STRUCTURES	1,271,185.00	1,271,185.00	1,271,185.00
6700	STRUCTURAL STEEL	0.00	0.00	849,500.00
D1000	DAYWORKS	54,140.00	54,140.00	54,140.00
G1000	EPWP-NYS	236,750.00	236,750.00	236,750.00
	SUBTOTAL 1	**21,212,940.00**	**21,255,175.00**	**18,888,940.00**
	Add: Contingencies (10% of SUBTOTAL 1)	2,121,294.00	2,125,517.50	1,888,894.00
	SUBTOTAL 2	**23,334,234.00**	**23,380,692.50**	**20,777,834.00**
	Add: Contract Price Adjustment (12% of SUBTOTAL 2)	2,800,108.08	2,805,683.10	2,493,340.08
	SUBTOTAL 3	**26,134,342.08**	**26,186,375.60**	**23,271,174.08**
	Add: VAT (14% of SUBTOTAL 3)	3,658,807.89	3,666,092.58	3,257,964.37
	TOTAL ESTIMATE OPTION 3	**29,793,149.97**	**29,852,468.18**	**26,529,138.45**
	ROUNDED TOTALS	**30,000,000**	**30,000,000**	**27,000,000**

5. SUMMARY AND RECOMMENDATIONS

The three alternative designs have been carefully considered and in conclusion, on the basis of cost, inherent robustness and future low maintenance. The 6x13m spans Option 3 steel beam and slab is the recommended option based on cost and constructability.