2. OVERVIEW OF SOCIAL, ECONOMIC AND TRANSPORT DEVELOPMENT

2.1 Current National Conditions

2.1.1 Social and Economic Conditions

Uganda's population in 2008 is estimated at 29.2 million at an annual average growth rate of 3.2% per annum from 2002 to 2008.

The annual GDP growth rate is 7.7% on average from 2000 to 2007 at 2002 constant price. Per capita income in 2007 is estimated at Ushs. 801,515 (about US$415 based on an exchange rate in January 2009).

2.1.2 Road Network and Traffic

Table 2.1 shows the Ugandan road network classifications.

Table 2.1 Road Classification

Category	Length (km)	Of which paved (km)	Jurisdiction
National roads	10,953	2,700	UNRA
District roads	27,500	-	District (local government)
Urban roads	4,300	-	Urban councils (local government)
Community access roads	30,000	-	Village(local government)

Source: National Transport Sector Master Plan

Figure 2.1 also shows the trunk road network. As can be seen, the routes of major roads are radial in pattern connecting the district centres in the country.

The traffic volume between Njeru and Jinja is around 7,300, while Jinja and Kakira are around 11,800 vehicles in total in 2003, including motorcycles.

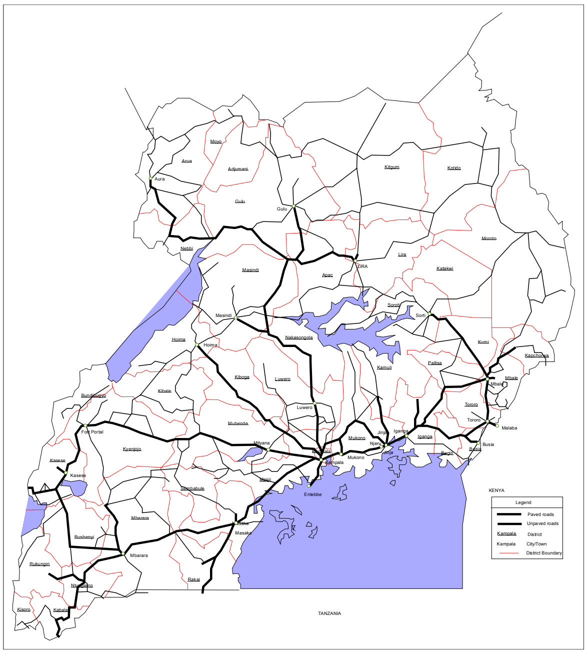


Figure 2.1 Trunk Road Network

2.1.3 Budget for MOWT and UNRA

Table 2.2 shows the budget allocated for the Ministry of Works and Transport in 2007/08 which accounted for some 15.7% of the national budget.

Table 2.2 Budget of MOWT in 2007/08

Unit: Ushs. Billion

Recurrent		Development		GoU Total*2	Grand Total*2
Wage	Non-wage	GoU	Donor*1		
3.656	205.042	113.554	335.684	322.252	657.936

Source: Annual Budget Performance Report FY 2007/08
Note:*1 Donor release and expenditure data unavailable
*2 Does not include allocations and expenditures from Non Tax Revenues retained and spent by vote.

UNRA is responsible for national road management and the budget is categorized into recurrent and development. Table 2.3 shows the annual budget allocated for UNRA in 2007/08 which accounted for around 78% of the budget of MOWT.

Table 2.3 Budget for UNRA in 2007/08

Unit: Ushs. Billion

Recurrent		Development		GoU Total*2	Grand Total*2
Wage	Non-wage	GoU	Donor*1		
2.321	145.827	65.354	298.316	213.503	511.819

Source: Annual Budget Performance Report FY 2007/08
Note:*1 Donor release and expenditure data unavailable
*2 Does not include allocations and expenditures from Non Tax Revenues retained and spent by vote.

The establishment of Uganda National Road Authority (UNRA) in July 2008 as an exclusive road maintenance agency in Uganda, remarkably increased the budget allocation for road maintenance from Ushs 511,819 million for 2007/2008 to Ushs 948,630 million for 2008/2009 as shown in Table 2.4 hereunder.

Table 2.4 Budget Allocated for UNRA in 2008/09

(Unit: Ushs Million)

No.	Category	Budget		Growth (%)
		2007/08	2008/09*1	
01	Administration	12,326	7,258	59%
02	National Road Maintenance	158,587	165,939	105%
03	National Road Construction	340.906	775,433	227%
Total		511,819	948,630	185%

Source: Annual Budget Performance Report FY 2007/08
Note: *1 Draft estimates

2.2 National Development Plans and Strategies

2.2.1 National Development Plans

A Five-year Development Plan for Uganda is currently under compilation and Poverty Eradication Action Plan (PEAP) is given priority as a national development goal.

The transportation development plan and strategy in Uganda under the National Transport Sector Master Plan (NTSMP), was issued in March 2005.

Roads

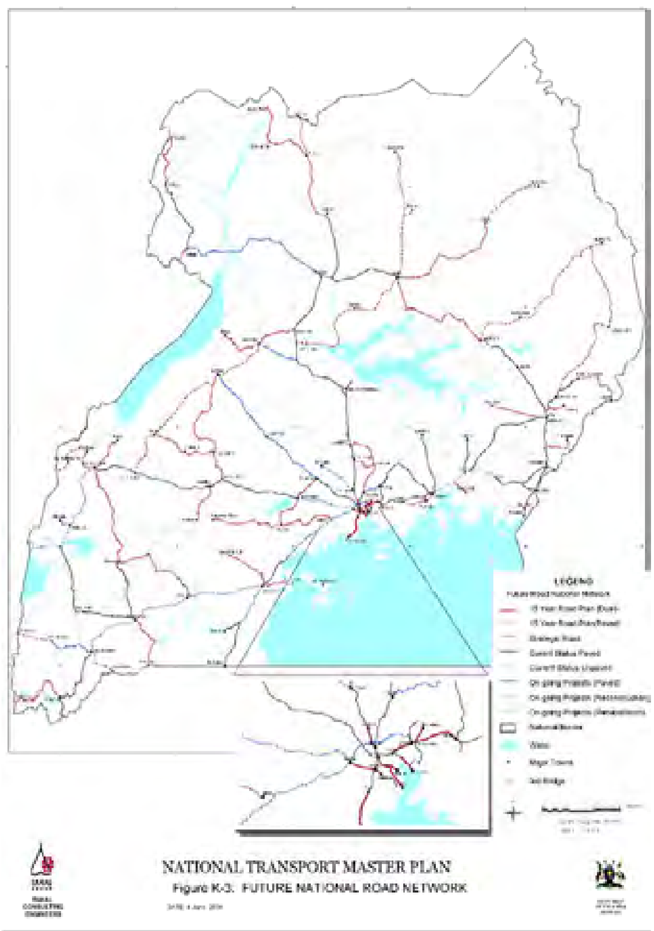
Figure 2.2 shows the 15-Year Plan covering the period 2003 to 2018. As shown, the plan specifically covered two major topics relative to the Feasibility Study.

- Replacement of the bridge Crossing the River Nile to avoid any disruptions caused by the strict impositions of traffic controls(either by legal or reduced vehicle load limits or interruptions of traffic flows due to structural repairs that may be needed.
- The development of a new ferry system about 50 km from Jinja at both sides of the River Nile to cater for Nabuganyi and Mbulamuti cargo and passenger traffic.

Railway

In 2005, the Government of Uganda was expediting a joint concession for URC and KRC for the smooth operation of the railway under a privatization scheme.

EAC, has other option to introduce a cape standard railway for all the railways in EAC to increase its transporting capacity but the primary problem that has been identified is the source of funding necessary for the huge initial investment needed to realize the concept.



Source: National Transport Sector Master Plan

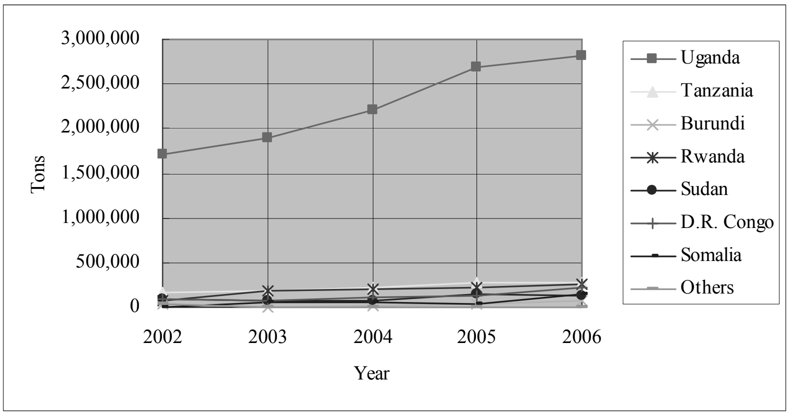
Figure 2.2 Long Term Road Development Plan

2.2.2 Development Strategy of the Northern Corridor

Port Characteristics of Transit Cargo

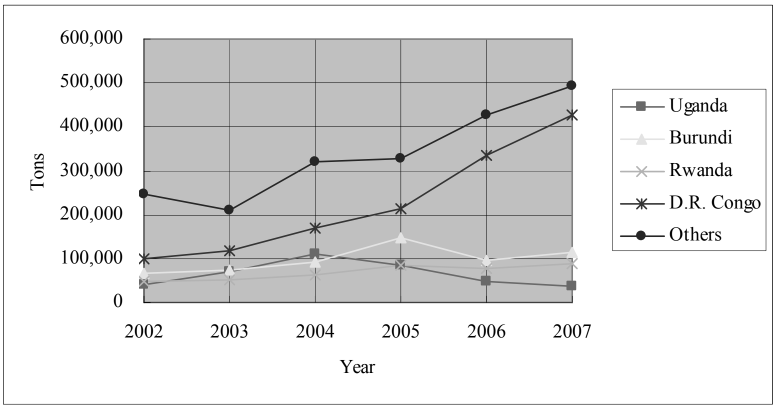
Figures 2.3 and 2.4 show the cargo transit volume of Mombasa Port for landlocked countries. The transit cargo for Uganda shows a dominant volume of around 2.8 million tons while in Dar es Salaam Port, the cargotransit is as low as 37 thousand tons.

Cargo transit traffic in Mombasa Port registered a remarkable growth rate of 10.2%, from 4.4 million tons in 2007 to 4.87 million tons in 2008. Individual transit countries have also increased but Uganda maintained her lead at 75.9% of the traffic market share with the port handling some 3.7 million tons of Ugandan cargo in 2008, from the 3.4 million tons handled in 2007, or representing a growth rate of 8.9%.



Source: KPA

Figure 2.3 Transit Cargo of MBS by Country



Source: TPA

Figure 2.4 Transit Cargo of DSM by County

2.3 Current Conditions of the Study Area

2.3.1 Current Population and Land Use

Jinja's current population is around 71,000 in 2002 while the population in Njeru is around 51,000 in 2002.

The land use pattern in Njeru Town differs from Jinja. Spontaneous development of commercial and residential areas along the primary roads characterizes the land use pattern in Njeru Town, while planned area development is being implemented in Jinja Municipality as shown in Figure 2.5.

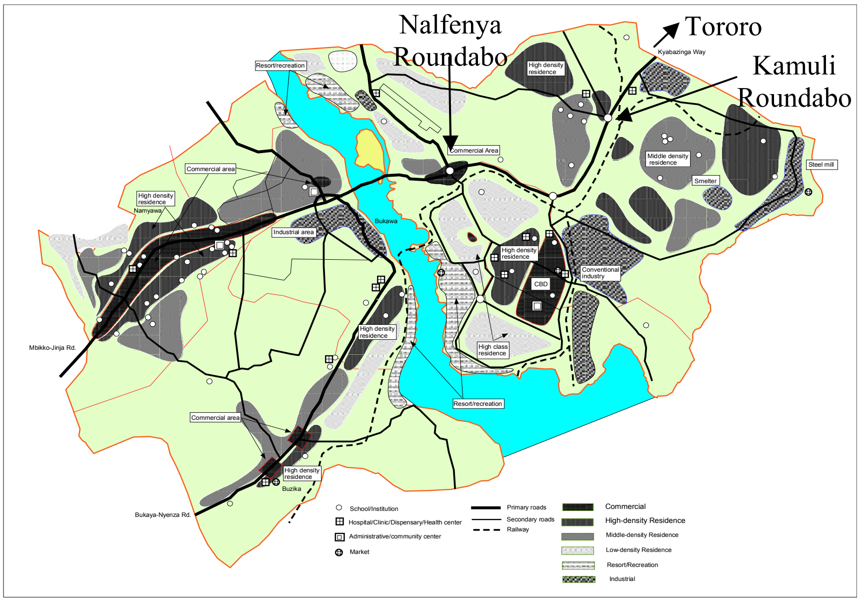


Figure 2.5 Current Land Use in the Study Area

2.3.2 Existing Road Network and Traffic in the Study Area

The existing road network in the study area is bounded by the Kampala-Jinja road and Jinja-Bugiri road which is an axis traversing the routes from east to west and is connecting the trunk roads running in the north–south direction as shown in Figure 2.6.

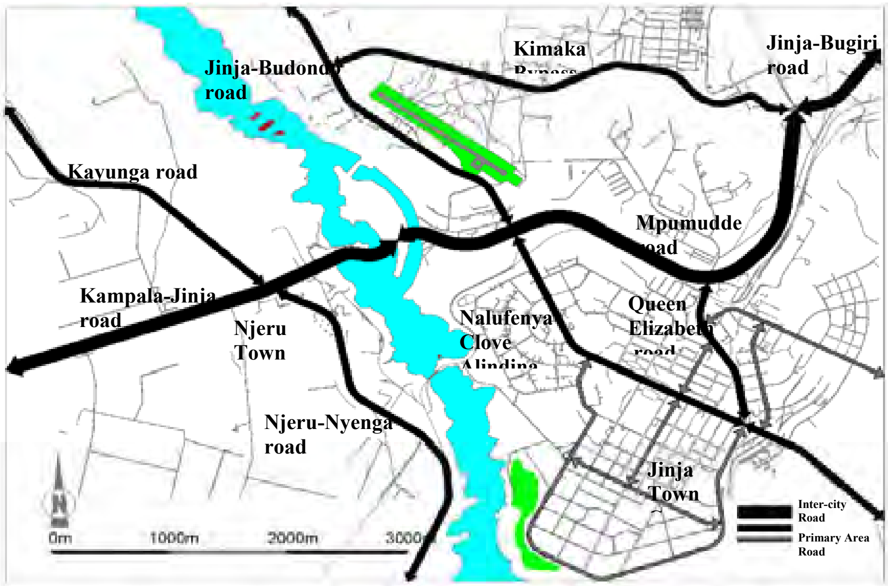


Figure 2.6 Existing Road Network in the Study Area

Based on traffic count survey for Nalubaale Dam bridge in December 2008, the average daily traffic (ADT) was estimated at 9,412 vehicles/day (excluding motorcycles) or 11,124 vehicles/day (including motorcycles). (See section 4.1 for more details.)

3. SELECTION OF OPTIMUM SOLUTION TO CROSS RIVER NILE AT JINJA

3.1 Base Alignment Alternatives of the Project

In order to identify possible alignment alternatives, reference has been made to previous studies made including the "Pre-investment Study for Nile Bridge at Jinja Uganda" by the World Bank (WB) and the "Study on Jinja Bridge Construction" by Japan International Development Institute (IDI). The WB Study compared two alignment alternatives (A and B) and eventually recommended Alignment A. The IDI Study identified Alignment (C) as the most appropriate which is located at the downstream of the Nalubaale Dam Bridge. These three alignment alternatives are the basis in formulating the comparative analysis for selecting the optimum solution as outlined in Table 3.1 and Figure 3.1 hereunder.

Table 3.1 Outline of Base Alignment and Bridge Location Alternatives

Name of Alignment	Name of Bridge Location	Description of Bridge Location
Alignment A	Bridge Location A	500 m upstream of Nalubaale Dam with river width of 300 m;
Alignment B	Bridge Location B	1,200 m upstream of Nalubaale Dam, very close to Nile Bridge, with river width of 170 m;
Alignment C	Bridge Location C	1800 m downstream of Nalubaale Dam with river width of 250 m.

Source: JICA Study Team

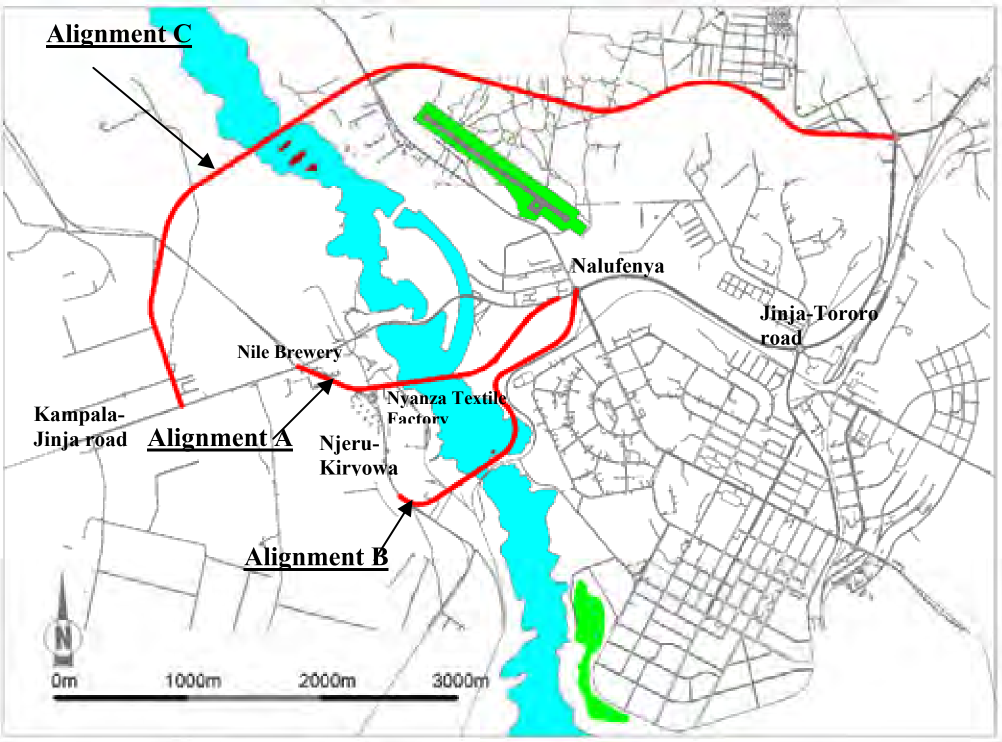


Figure 3.1 Base Alignment Alternatives

3.2 Definition of Key Terms

To avoid possible confusion in discussing further the selection of alternatives, several key terms are defined as follows:

- **[Route]** : This term delineates a general location of the bridge and the approach road as the combined stretch and is drawn with some margin to allow possible adjustments of alignments within the space allocated for the route.
- **[Bridge Location]** : This term refers to a place where the bridge crosses the River Nile.
- **[Alignment]** : This term shows the centreline of the approach road drawn on the basis of the adopted design standard, existing land use, environmental conditions along the route, connecting the point of the bridge location.
- **[Bridge Type]** : This term is used for the discussion of the structural types of the bridge to be adopted for the bridge location.

3.3 Methodology Flow for Selecting the Optimum Solution

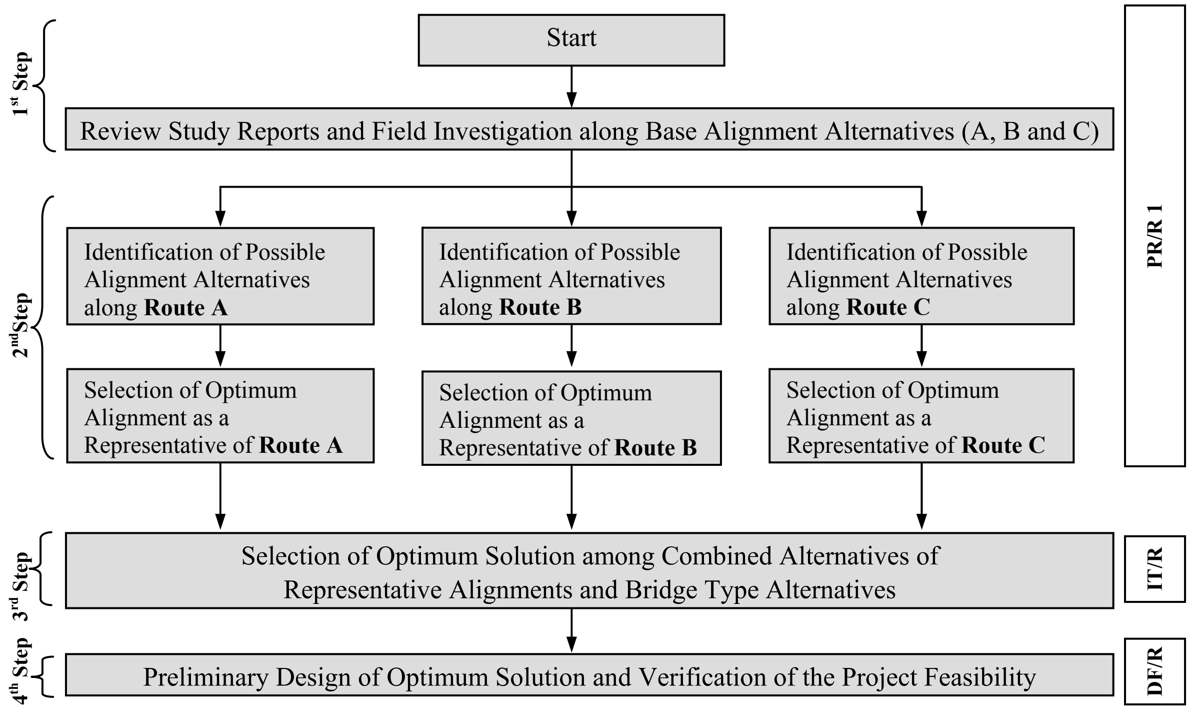
The four (4) major steps taken to achieve the selection of the optimum solution for the Project are described as follows:

First Step: Three (3) base alignments were reviewed, identified/confirmed at site and assessed by field investigation.

Second Step: Additional possible route alignments (combination of bridge locations and approach road alignments) are identified, based on field survey and engineering studies. Consequently, Route A comprised three (3) alignment alternatives, Route B has one and Route C has two alignment alternatives. Alignment alternatives for the respective routes were compared and ultimately three representative alignments were considered.

Third Step: The representative alignment alternatives for the respective routes are then combined with possible bridge type options. Each representative alignment had more than two structural type options. Eventually, ten alternatives were compared to select the optimum solution to cross the River Nile at Jinja.

Fourth Step: After the optimum solution was selected, preliminary design was pursued and supplemented by estimated total project cost and to determine the feasibility of the project. Methodology flow of the alternative study is presented in Figure 3.2.



Note: PR/R 1 (Progress Report 1), IT/R (Interim Report), DF/R (Draft Final Report)

Figure 3.2 Methodology Flow for Selecting Optimum Solution

3.4 Selection of Alignment Alternatives and Evaluation Method

3.4.1 Alignment Alternatives for Respective Routes

Taking into account the current land use conditions on both of the left and right banks of the river and the bridge planning (bridge length and span layout), possible alignment alternatives are selected. Consequently, Route A comprises three (3) alignment alternatives (A1, A2 & A3), Route B has only one alternative (B) and Route C has two alignment alternatives (C1 & C2) as exhibited in Figures 3.3, 3.4 and 3.5 below.

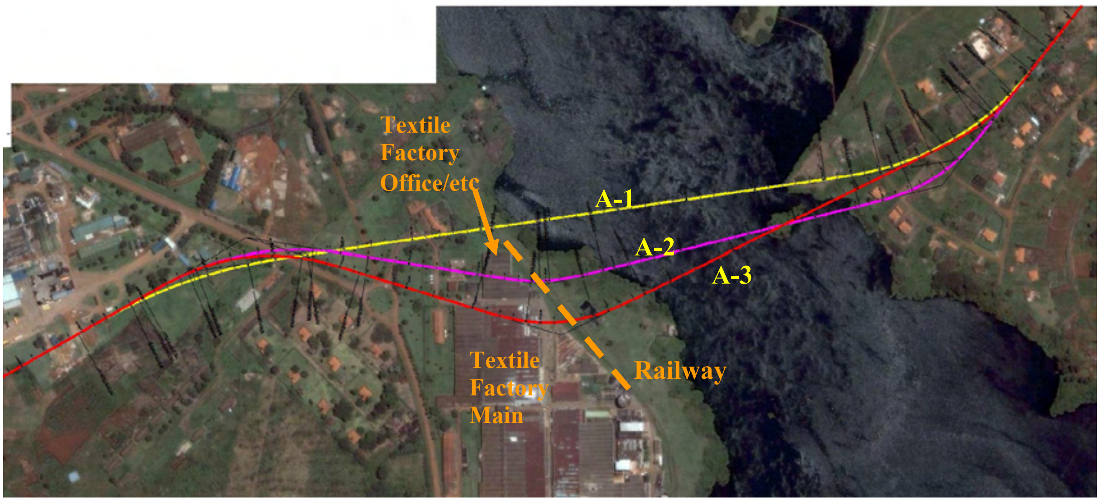


Figure 3.3 Alignment and Bridge Location Alternatives A-1, A-2 and A-3

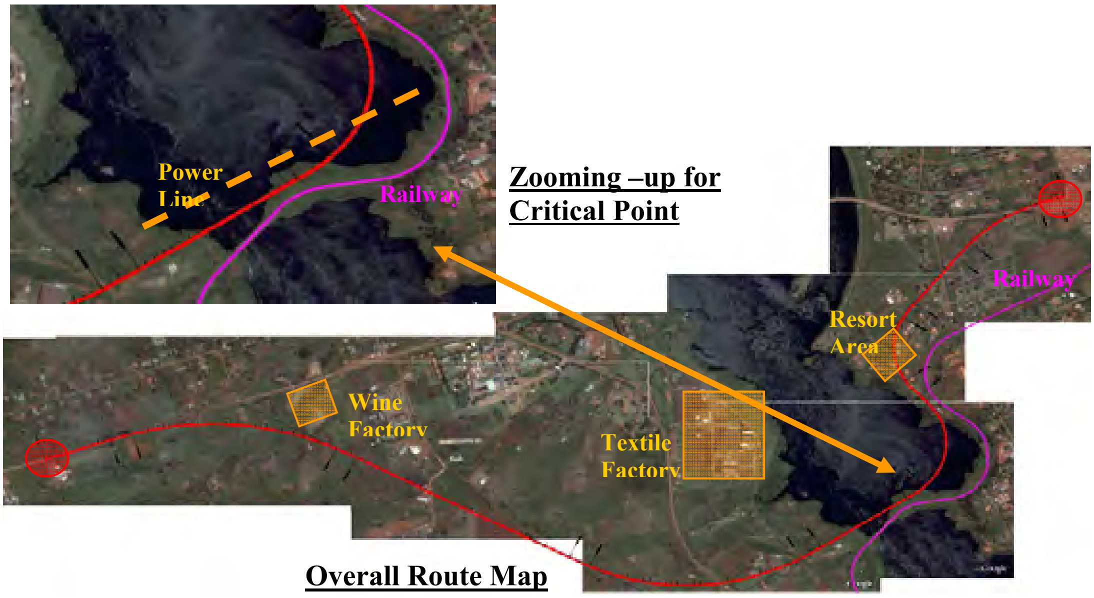


Figure 3.4 Alignment and Bridge Location Alternative B

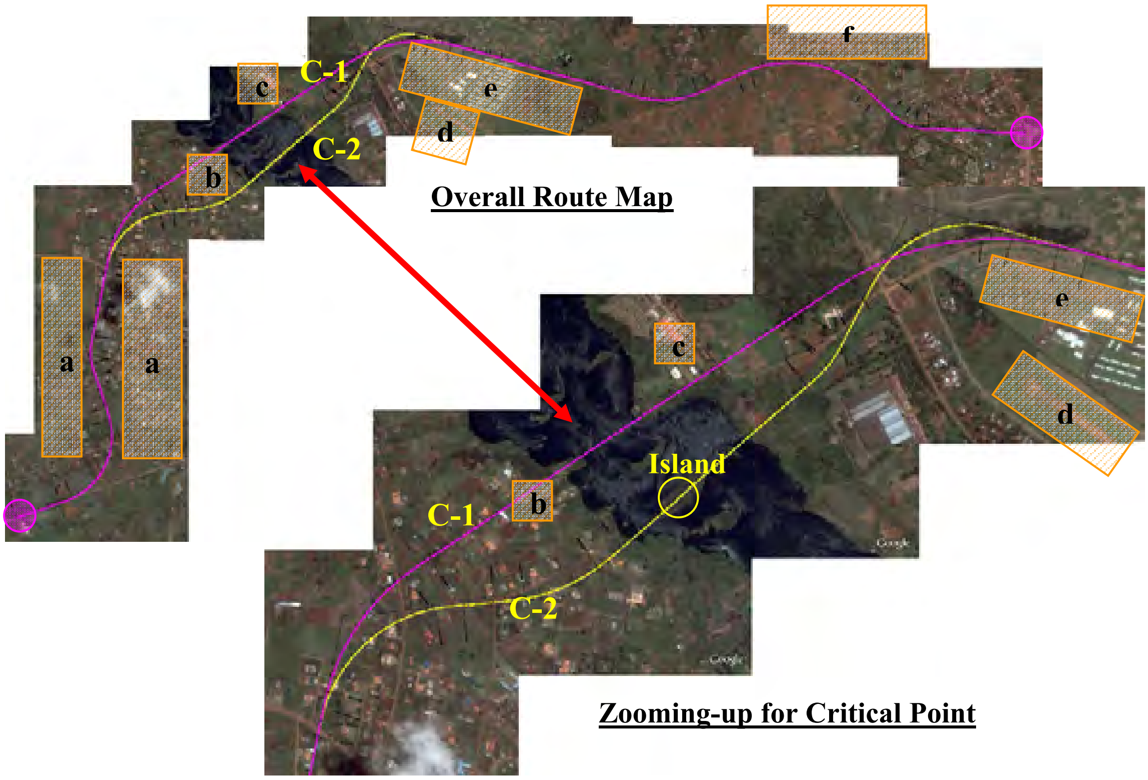


Figure 3.5 Alignment and Bridge Location of Alternatives C-1 and C-2

3.4.2 Evaluation Criteria and Method

The comparative analysis adopted three criteria, i.e., "Criteria I: Engineering", "Criteria II: Social and Natural Environmental Considerations" and "Criteria III: Financial" with corresponding weight of 20%, 40% and 40% respectively considering the varying importance of the project feasibility. Each criteria was provided with items for assessing its merits and demerits (sub-criteria) and evaluated by index (+++, ++, + i.e. Good, Moderate, Poor). The evaluation results by the index method were summarized for each criteria level, and the result was adjusted accordingly by weights and re-summarized for the final selection result.

3.5 Selected Optimum Alignment by Route

Tables 3.3 and 3.4 show the comparison of alternative bridge locations for the respective routes. Based on the result of the evaluations, the Study Team recommended A2 for Route A, B for Route B and C1 for Route C as the optimum alignment and the results are summarized in Table 3.2 hereunder. Relative thereto, the 2nd Steering Committee Meeting held at UNRA on February 18, 2009 agreed with the Study Team's recommendation.

Table 3.2 Optimum Alignments for Each Route

	Route A	Route B	Route C
Optimum Alignment	A2	B	C1

Since A2, B and C1 are somewhat confusing as terminologies for discussions in bridge type alternatives, Alignment A (or Bridge Location A), Alignment B (or Bridge Location B) and Alignment C (or Bridge Location C) are used hereafter in lieu of A2, B, and C1 respectively.

After the Steering Committee in February, Focus Group Discussion was held in Jinja in March 2009, for which the investment plan estimated at about USD 29 million) for Nile Brewery Plant was disclosed. As such, Alignment A was eventually modified, as shown in Figure 3.6 which was accepted by the 3rd Steering Committee on April 1, 2009.

Figure 3.6 Final Alignment Alternatives for Route A, B and C

Table 3.3 Evaluation of Bridge Location for Alignment A

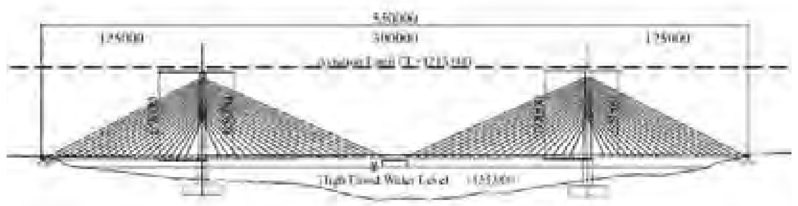
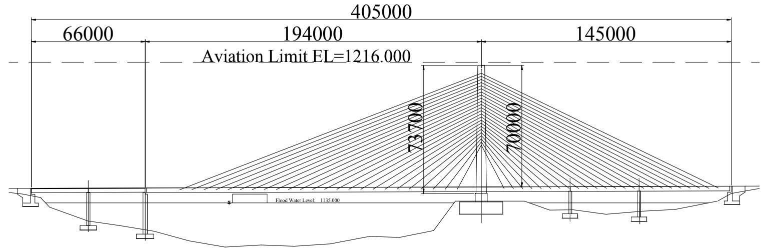
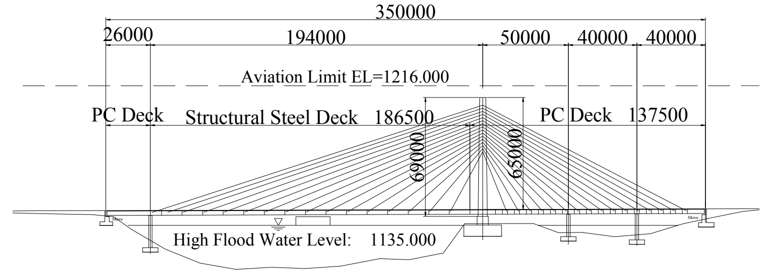
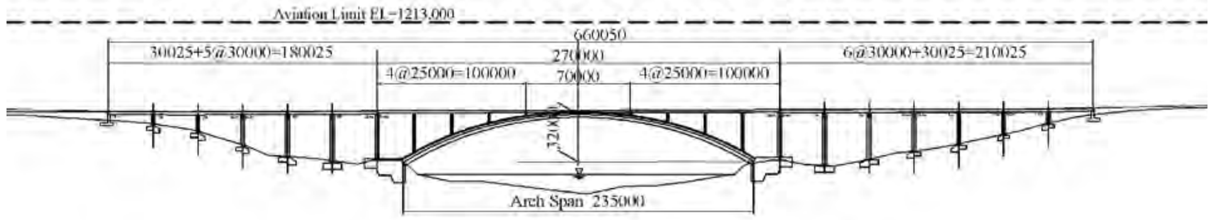
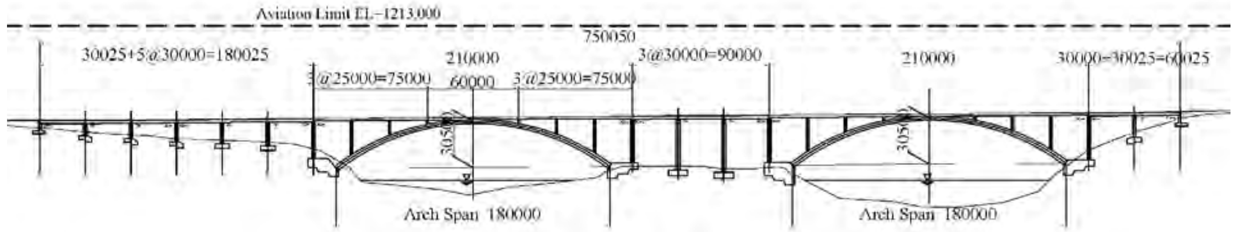
Bridge Location	**Bridge Location A-1**	**Bridge Location A-2**	**Bridge Location A-3**
Probable Bridge Type	3 Span Cable Stay Bridge with Prestressed Concrete Deck	***4 Span Hybrid Cable Stay Bridge with Structural Steel & Prestressed Concrete Deck***	***4 Span Hybrid Cable Stay Bridge with Structural Steel & Prestressed Concrete Deck***
Bridge Length	550 m	***405 m***	***350 m***
Span Arrangement	125 m + 300 m + 125 m	***260 m + 65 m + 2 x 40 m***	***220 m + 50 m + 2 x 40 m***
Bridge Profile			
Outline	• Road alignment is established in order to give minimum impact on the Textile factory, total length of the Alignment is 3,974 m. • Probable cost-effective bridge is 3-span cable stay bridge with prestressed concrete deck and reinforced concrete pylons, • Number of piers in the river is minimal considering the costly foundations, temporary cofferdam and jetty works, • One pylon will be constructed in the shallow depths near the left and right banks, • Foundations of the pylons may be of caissons laid on flat base rock., Abutment foundation will be the spread foundation type laid on rock.	• Road Alignment is established in order to give medium impact on the Textile factory, the total length of the Alignment is 4,015m • Probable cost-effective bridge is 4-span cable stay bridge with prestressed concrete deck and reinforced concrete pylon, • Number of piers in the river is minimal considering the costly foundations, temporary cofferdam and jetty works, • The pylon will be constructed on the island in the river, • Intermediate piers are required to resist the uplift forces in a short span, • Foundations of the pylons and intermediate piers may be the caisson type laid on flat base rock. Foundations of abutments will be the spread foundation type laid on rock.	• Road alignment and bridge location are established in order to obtain the shortest possible bridge length, total length of the Alignment is 4,032m • Probable cost-effective bridge is 4-span cable stay bridge with prestressed concrete deck on reinforced concrete pylon, • Number of piers in the river is minimal considering the costly foundations, temporary cofferdam and jetty works, • The pylon will be constructed on the island in the river, • Intermediate piers are required to resist the uplift forces in a short span, • Foundations of pylons and intermediate piers may be caisson type laid flat base rock. Foundations of the abutments will be the spread foundation type laid on rock.
I. Engineering (20)			
Constructability Issue	• Dynamite and/or non-explosives demolition agent may be required for rock excavation, • Concrete pylon would use jumpform techniques with cable stay anchorages castinto defined locations. • Two pylon foundations should be constructed in the deep mater.	• Dynamite and/or non-explosives demolition agent may be required for rock excavation. • Concrete pylon would use jumpform techniques with cable stay anchorages cast into defined locations. • Four pier foundation should be constructed in the river.	• Dynamite and/or non-explosives demolition agent may be required for rock excavation. • Concrete pylon would use jumpform techniques with cable stay anchorages cast into defined locations. • Three pier foundations should be constructed in the river.
	++	++	++
Construction Risk	• This bridge type of huge dimensions have never been constructed in Uganda. To ensure good quality and construction schedule, local contractors & workers needs training otherwise reputable international contractors may have to be engaged, • Future maintenance work might be required on stay cables and anchorages.	• This bridge type of huge dimensions have never been constructed in Uganda. To ensure good quality and construction schedule, local contractors & workers needs training otherwise reputable international contractors may have to be engaged. • Future maintenance work might be required on stay cables and anchorages.	• This bridge type of huge dimensions have never been constructed in Uganda. To ensure good quality and construction schedule, local contractors & workers needs training otherwise reputable international contractors may have to be engaged. • Future maintenance work might be required on stay cables and anchorages.
	++		++
Road Alignment	• Total length of the Alignment is 3,974 m which is shortest among three alternatives • Relatively small size curves (R=400, 420) are applied at approach to the Bridge which is acceptable horizontal alignment design for the design speed 80 km/hr.	• Total length of the Alignment is 4,015 m which is 2nd shortest among three alternatives • The alignment of approach to the bridge forms abrupt reverse curve (R=240,400m) which is absolute horizontal alignment design for the design speed 80km/hr	• Total length of the Alignment is 4,032 m which is longest among three alternatives • The alignment of approach to the bridge forms abrupt reverse curve (R=240,300m) which is absolute horizontal alignment design for the design speed 80km/hr
	+++	++	+
Maintenance	• Periodical inspection work is required for stay cables and anchorages. • Maintenance work might be required on stay cables and anchorages if any defects such as corrosion and cable cut are found.	• Periodical inspection work is required for the structural steel deck, stay cables and anchorages. • Maintenance work might be required on stay cables and anchorages if any defects such as corrosion and cable cut are found.	• Periodical inspection work is required for the structural steel deck, stay cables and anchorages. • Maintenance work might be required on stay cables and anchorages if any defects such as corrosion and cable cut are found.
	++	++	++
Sub-Total	**9**	**8**	**7**
Modified Sub Total	**9/12x20=15.0**	**8/12x20=13.3**	**7/12x20=11.7**
II. Social Environment (40)			
Land-use Issues	• Minor facility of the Textile factory is affected	• Attached facility (Office building, Store) of the Textile factory is affected	• Main facility of the Textile factory is affected
(Textile Factory)	+++	++	+
Nos. of Facility to be Affected	• 11 facilities are affected.	• 11 facilities are affected.	• 13 facilities are affected.
	+++	+++	+
Sub-Total	**6**	**5**	**2**
Modified Sub Total	**6/6x40=40**	**5/6x40=33.3**	**2/6x40=13.3**
III. Cost Effectiveness (40)	• Highest cost is estimated because of longest bridge length.	• Highest cost is estimated because of longest bridge length.	• Moderate cost is estimated because of 2nd longest bridge length.
	+	++	+++
Sub Total	**1**	**2**	**3**
Modified Sub Total	**1/3x40=13.3**	**2/3x40=26.7**	**3/3x40=40**
Total Score	**68.3**	**73.3**	**65.0**

Table 3.4 Evaluation of Bridge Location in Alignment C

Bridge Location	**Bridge Location C-1**	**Bridge Location C-2**
Probable Bridge Type	Reinforced Concrete Arch Bridge + Prestressed Concrete Precast Girders	Reinforced Concrete Arch Bridge + Prestressed Concrete Precast Girders
Bridge Length	660.05 m	750.05 m
Span Arrangement	30.025 m + 5 x 30 m + 270 m + 6 x 30 m + 30.025 m	30.025 m + 5 x 30 m +210 m + 3 x 30 m + 210 m + 30 m + 30.025 m
Bridge Profile		
Outline	• Road alignment is set in order to obtain optimum bridge location and alignment for river crossing, total length of the Alignment is 8,005 m. • Probable cost-effective bridge is of reinforced concrete arch bridge over the river and prestressed concrete precast girders for approach. • No pier/foundation is constructed in the river. • All structural elements are above the flood water level at time of dam failure (estimated 4.5m increase in water level).	• Road alignment is set in order to minimize impact on resort facilities, total length of the Alignment is 8,079 m. • Probable cost-effective bridge is of reinforced concrete arch bridge over the river and prestressed concrete precast girders for approach. • No pier/foundation is constructed in the river. • All structural elements are above the flood water level at time of dam failure (estimated 4.5m increase in water level).
I. Engineering (20)		
Constructability Issue	• Dynamite and/or non-explosive demolition agent may be required for rock excavation, • Arch member is cast with cantilever method that the arch is supported by temporary stay cables anchored to the pylon temporary installed at arch abutment. • Subsequently, vertical members and concrete deck are constructed on arch member.	• Dynamite and/or non-explosive demolition agent may be required for rock excavation, • Arch member is cast with cantilever method that the arch is supported by temporary stay cables anchored to the pylon temporary installed at arch abutment. • Subsequently, vertical members and concrete deck are constructed on arch member.
	+++	+++
Construction Risk	• This bridge type and dimensions have never been constructed in Uganda. To ensure good quality and construction schedule, local contractors & workers need training or international contractors may be selected. • It is basically maintenance free except in the special cases such as dam failure.	• This bridge type and dimensions have never been constructed in Uganda. To ensure good quality and construction schedule, local contractors & workers need training or international contractors may be selected. • It is basically maintenance free except in the special cases such as dam failure.
	+++	+++
Road Alignment	• Total length of the road is 8,005 m which is shorter than Alignment C-2. • Medium size curves (R=600) are applied at approach to the bridge which is moderate horizontal alignment design for the design speed 80 km/hr.	• Total length of the road is 8,079 m which is longer than Alignment C-1 • The alignment of approach to the bridge forms abrupt reverse curve which makes drivers uncomfortable, hence some safety measures (lower speed limit) might be required. • Minimum curve size (R=240) is applied at approach to the bridge, some safety measurement (lower speed limit) might be required.
	+++	+
Maintenance	• Periodical inspection work is required to ensure design life period.	• Periodical inspection work is required to ensure design life period.
	+++	+++
Sub-Total	**12**	**10**
Modified Sub Total	**12/12x20=20**	**10/12x20=16.7**
II. Social Environment (40)		
Land-use Issues	• There is a huge impact on the resort facility (Muto Muyoni)	• No impact on the resort facilities
(Textile Factory)	+	+++
Nos. of Facility to be Affected	• 45 facilities are affected.	• 56 facilities are affected.
	+++	++
Sub-Total	**4**	**5**
Modified Sub Total	**4/6x40=26.7**	**5/6x40=33.3**
III. Cost Effectiveness (40)		
	+++	++
Sub Total	**3**	**2**
Modified Sub Total	**3/3x40=40**	**2/3x40=26.7**
Total Score	**86.7**	**76.7**

3.6 Selection of Bridge Type

The optimum bridge design concepts were discussed and the optimum bridge types were chosen based on the selection flow as shown in Figure 3.7. Technical issues regarding the bridge construction and costs were compared among the alternative bridge types for selection of the optimum types for Alignments A, B and C respectively.

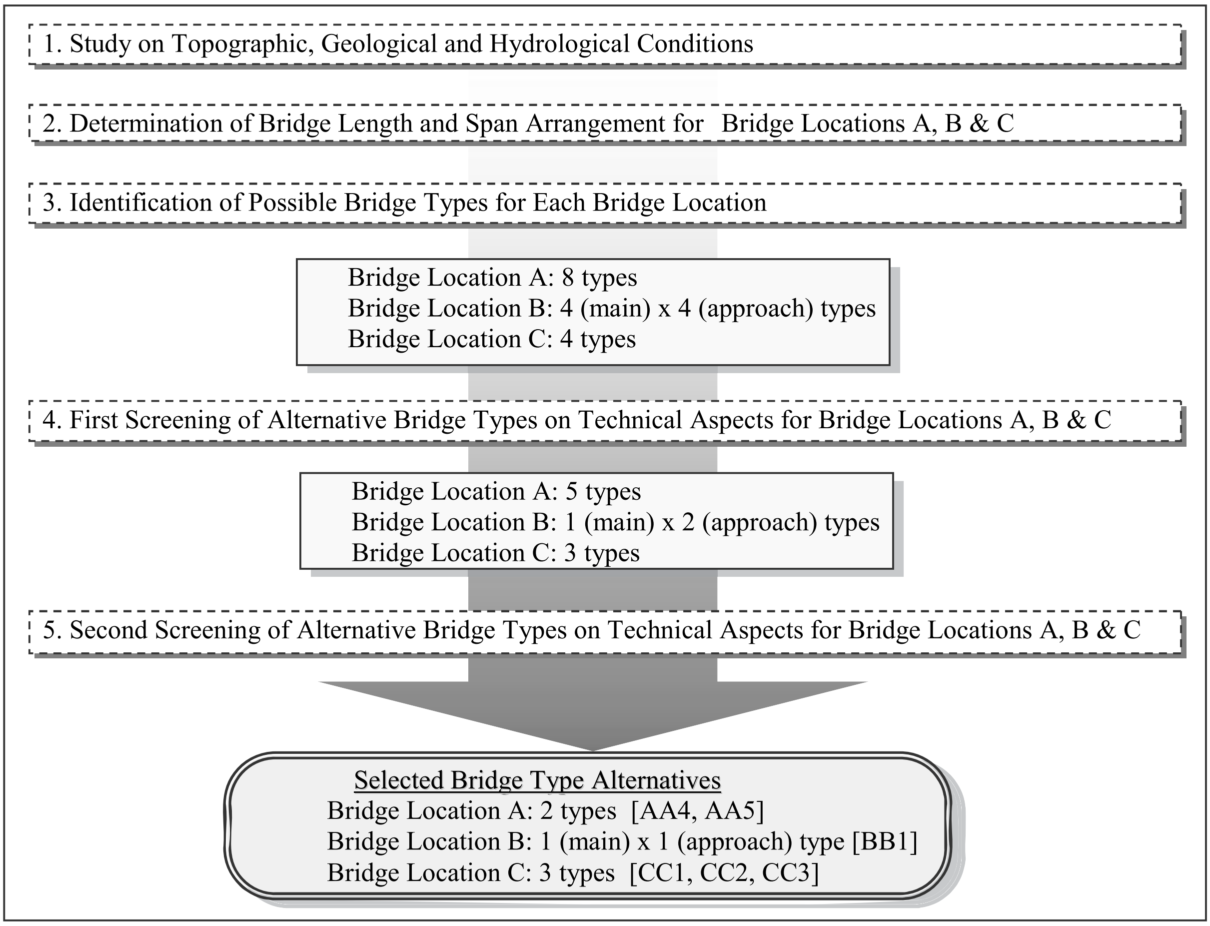


Figure 3.7 Flow Chart for Selecting Optimum Bridge Types for Bridge Locations A, B & C

Alternative bridge types for alternative Bridge Locations A, B and C was compared based on the foregoing evaluation viewpoints, particularly on the following: 1) Structural Properties, 2) Constructability, 3) Construction Period, 4) Construction Cost, 5) Maintenance, and 5) Bridge Aesthetics. Based on the comparative analysis, the following bridge type alternatives were chosen as shown in Tables 3.5, 3.6 and Figure 3.8 for further comprehensive evaluation for selection of the optimum type to cross the River Nile at Jinja.

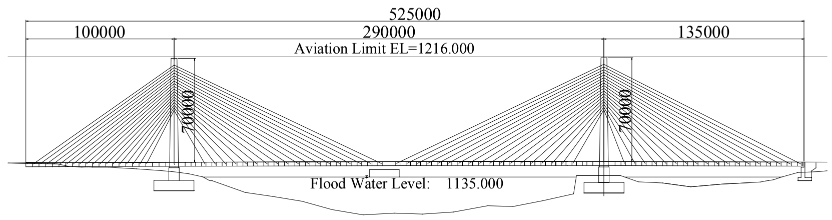
Table 3.5 Definitive Bridge Type Alternatives

Bridge Type		Reason
AA4	3-Span PC cable-stayed	A plan to avoid the risk of setting the foundations on the river bed of hard rock in deep water and to satisfy aviation limit Most recommendable.
AA5	4-Span Hybrid Cable-stayed	A plan to avoid the risk of setting the foundations on the river bed of hard rock in deep water In case aviation limit is relaxed, this option is also recommendable.
BB1	RC Arch with 3-Span Balanced Cantilever PC Box Girder and PC I-Girders	Recommendable. Only BB1 was selected as BB2 has higher risk for construction of foundations bearing on hard rock in deep water.
CC1	RC Arch with PC I-Girders	While the cost is high there is no risk for construction of foundations, CC1 is selected for further comparison.
CC2	3-Span Extra-dosed PC Girder with PC I-Girders	Since the cost difference is not much when compared with CC1, CC2 this option is selected for further comparison.
CC3	7-Span Balanced Cantilever PC Box Girders	Since there is low risk for the construction of the foundations and considering that the cost is the lowest, CC3 is also recommendable.

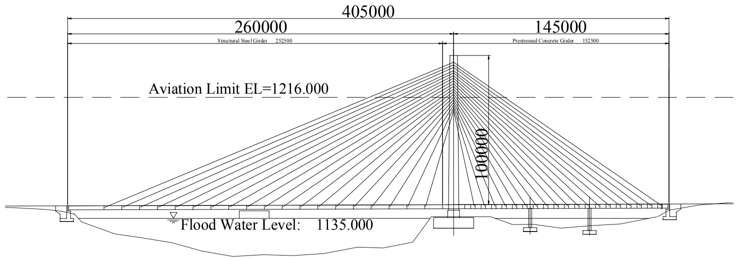
Table 3.6 Selected Features of the Bridge Type Alternatives

Elements of Bridge Type		A		B	C		
	Unit	AA4	AA5	BB1	CC1	CC2	CC3
Alignment Length (4 lanes)	**-**	**2.4 km**	**2.4 km**	**5.1 km**	**8.1 km**	**8.1 km**	**8.1 km**
Construction Cost	**million**	**$70.0**	**$68.9**	**$92.7**	**$87.3**	**$89.5**	**$81.2**
Bridge	million	$57.1	$56.0	$78.3	$56.1	$58.3	$50.0
Approach Road	million	$10.6	$10.6	$11.7	$26.9	$26.9	$26.9
Land Acq. & Compensation	million	$2.3	$2.3	$2.7	$4.3	$4.3	$4.3
Maintenance Cost (100yrs)							
Present Value	thousand	$55.0	$289.0	$18.5	$23.0	$22.0	$7.0
Undiscounted Value	thousand	$3,372.0	$10,907.0	$971.0	$1,129.0	$1,450.0	$327.0
Construction Period	**-**	**3.5 yrs**	**3.3 yrs**	**3.5 yrs**	**3.4 yrs**	**3.0 yrs**	**3.0 yrs**

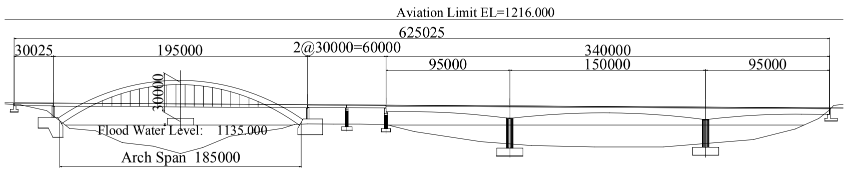
Bridge Type AA4
3-Span PC Cable-stayed



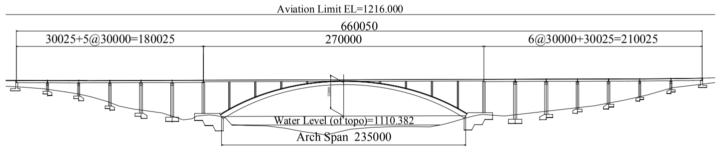
Bridge Type AA5
4-Span Hybrid Cable-stayed



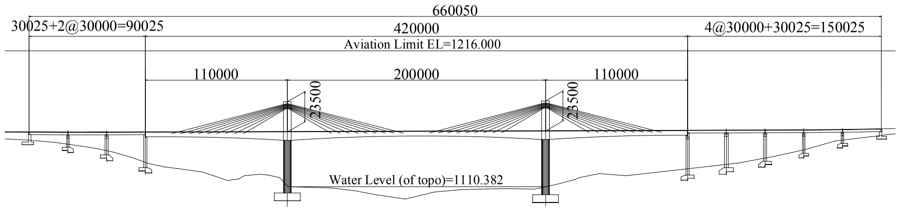
Bridge Type BB1
RC Arch Bridge with 3-SpanBalanced Cantilever PC Box Girder + PC I-Girders



Bridge Type CC1
RC Arch Bridge with PC I-Girders



Bridge Type CC2
3-Span Extra-dosed PC Girder with PC I-Girders



Bridge Type CC3
7-Span Balanced Cantilever PC Box Girder

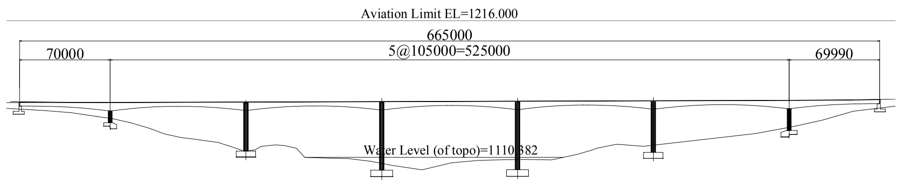


Figure 3.8 Profiles of Proposed Bridges

3.7 Comprehensive Evaluation

3.7.1 Evaluation Method

(1) Evaluation Step

The six (6) alternatives, which are presented in the previous section, were initially evaluated by the Study Team based on selected evaluation items by scoring 1 to 5 and which were then weighted by factors derived from a questionnaire survey presented during the stakeholders Focus Group Discussion.

However, the evaluation of Alternative AA5 is only feasible if the current aviation limit is relaxed. Otherwise, AA5 could not be selected as an optimum solution.

(2) Evaluation Items

Various evaluation items were selected for the discussion of the optimum solution. The selected evaluation items are classified into five (5) major categories and ten (10) sub-items as shown in Table 3.7 below.

Table 3.7 Major Evaluation Items

Major Category		Sub-item
1	Local Development	1.1 Contribution to Local Development
2	Social Environment	2.1 Social Environmental Impact
3	Natural Environment	3.1 Natural Environmental Impact
4	Engineering Aspect	4.1 Impact of Airfield Expansion Plan
		4.2 Construction Cost
		4.3 Risk of Construction Works
		4.4 Maintenance Works
		4.5 Aesthetics of Bridge Type
5	Economic Benefit	5.1 Transit Traffic and Through Traffic
		5.2 Accessibility to Kampala Road from Jinja

3.7.2 Characteristics of Alternatives

The characteristics of the alternatives are summarized in Table 3.8.

Table 3.8 Characteristics of Alternatives

<table>
<tr><th>No.</th><th>Item</th><th colspan="2">Alignment A</th><th>Alignment B</th><th colspan="3">Alignment C</th></tr>
<tr><td rowspan="2">1</td><td colspan="7">Local Development</td></tr>
<tr><td>1.1 Contribution to Local Development</td><td colspan="2">Considering future local development in integration of Jinja conurbation, the development in the east side of Njeru will be expected.</td><td>Since the route passes through south east of Njeru, local development is not expected.</td><td colspan="3">Although vast empty land exists, the land is owned by the military. Large urban development is not expected.</td></tr>
<tr><td rowspan="2">2</td><td colspan="7">Social Environment</td></tr>
<tr><td>2.1 Social Environmental Impact</td><td colspan="2">Large-scale involuntary resettlement is not required. Note that warehouse of textile factory and relevant facilities are affected as well as the water intake. There is expansion plan for the beer factory.</td><td>Large-scale involuntary resettlement is not required. Note that the impacts to the existing infrastructures such as transmission line exist.</td><td colspan="3">Large-scale involuntary resettlement including private retreat centre is required. Note that the impact to water usages is minimal as compared to Alignment A and B.</td></tr>
<tr><td rowspan="2">3</td><td colspan="7">Natural Environment</td></tr>
<tr><td>3.1 Natural Environmental Impact</td><td colspan="2">Temporary water quality degradation. Worsened roadside noise and air quality during/after construction phase. Temporary minor impact on flora/fauna of the River Nile.</td><td>Temporary water quality degradation. Worsened roadside noise and air quality during/after construction phase. Temporary minor impact on flora/fauna of River Nile.
Much negative impact on water quality since many bridge piers are to be constructed inside the River Nile.</td><td colspan="3">Temporary water quality degradation. Worsened roadside noise and air quality during/after construction phase. Temporary minor impact on flora/fauna of the River Nile.
Largest impacts on regional drainage. Largest amount of construction wastes due to construction of longest approach roads.
Enhanced river bank erosion during construction
Potential risk of dam failure.</td></tr>
<tr><td rowspan="7">4</td><td colspan="7">Engineering Aspects</td></tr>
<tr><td></td><td>AA4</td><td>AA5</td><td>BB1</td><td>CC1</td><td>CC2</td><td>CC3</td></tr>
<tr><td>4.1 Impact to the Airfield Expansion Plan</td><td colspan="2">No influence</td><td>No influence</td><td colspan="3">The expansion plan will delay the decision of approach road alignment.</td></tr>
<tr><td>4.2 Construction Cost</td><td>Lower than C</td><td>Lower than C</td><td>Higher than C</td><td>Moderate</td><td>Moderate</td><td>Moderate</td></tr>
<tr><td>4.3 Risk of Construction Works</td><td>Moderate(one foundation in shallow water)</td><td>A little higher (three foundations in shallow water)</td><td>High (two foundations in deep water)</td><td colspan="2">Very low (no foundations in the water)</td><td>Low (two foundations in shallow water)</td></tr>
<tr><td>4.4 Maintenance Works</td><td>Little higher than B & C (for cable)</td><td>Very high (for cable and steel girder)</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>Very little</td></tr>
<tr><td>4.5 Aesthetics of Bridge Type</td><td colspan="2">Symbolic landmark</td><td>Old type and slightly poor in bridge combination</td><td colspan="2">Harmonization to environment and symbolic landmark</td><td>Simple and Balanced</td></tr>
<tr><td rowspan="3">5</td><td colspan="7">Economic Benefits</td></tr>
<tr><td>5.1 Transit Traffic & Through Traffic</td><td colspan="2">Travelling distance is almost similar to the existing bridge.</td><td>Travelling distance is slightly longer than the existing bridge.</td><td colspan="3">Travelling distance is slightly longer than the existing bridge.</td></tr>
<tr><td>5.2 Accessibility to Kampala Rd. from Jinja</td><td colspan="2">Travelling time and distance is similar to the existing bridge.</td><td>Travelling time and distance will increase by around 20% compared to Alignment A.</td><td colspan="3">Travelling time and distance will increase by around 60% compared to Alignment A.</td></tr>
</table>

Note: In terms of detailed characteristics of the alternatives, please refer to respective chapter or section.

3.8 Evaluation and Conclusion

3.8.1 Evaluation Procedure

Evaluation of individual sub-items is scored accordingly, described hereafter as follows: 1 (inferior to other alternatives), 3 (moderate) to 5 (superior to other alternatives). The scoring were then weighted by factors derived from stakeholders' remarks as shown in Table 3.9.

Table 3.9 Definitive Scoring on the Alternatives

No.	Sub-item	A		B	C			Weight	
		AA4	AA5	BB1	CC1	CC2	CC3	Weight of Sub-items by Stakeholders	Weight of Categories by Stakeholders in ratio
Alignment Length (km)		2.4		5.1	8.1				
Construction Cost (US$ M)		67.7	66.0	90.0	83.0	85.2	76.9		
	Bridge	57.1	56.0	78.3	56.1	58.3	50.0		
	Road	10.6		11.7	26.9				
	Maintenance Cost (Present value US$1,000)	5.6	289.0	19.0	23.0	22.0	7.0		
	Construction Period (Year)	3.5	3.3	3.5	3.4	3.0	3.0		
1	1.1 Contribution to local development	5	5	4	3	3	3	4.17	0.21
2	2.1 Social environmental impact	4	3	4	2	2	2	3.39	0.17
3	3.1 Natural environmental impact	4	4	3	2	2	2	3.82	0.20
4	Engineering Aspects								
	4.1 Impact by airfield expansion plan	5	5	5	2	2	2	4.37	
	4.2 Construction cost	5	5	1	2	2	3	4.37	
	4.3 Risk of construction works	3	2	1	5	5	4	4.37	
	4.4 Maintenance	3	1	4	4	4	5	4.37	
	4.5 Bridge aesthetics	4	4	2	5	5	4	3.40	
	Composite score	4.00	3.37	2.63	3.53	3.53	3.58	4.18	0.21
5	Economic Benefits								
	5.1 Transit traffic & Through traffic	5	5	4	4	4	4	3.80	
	5.2 Accessibility to Kampala Road to/from Jinja	5	5	4	1	1	1	4.06	
	Composite Score	5.00	5.00	4.00	2.45	2.45	2.45	3.93	0.20
Overall Evaluation		**4.25**	4.11	3.51	2.64	2.64	2.64	19.49	1.00

3.8.2 Sensitivity Analysis

The scoring method is widely known in integrating the different scores into one value. However, there is no fixed and definite method in the evaluation of the different items. Therefore a sensitivity analysis was conducted to determine whether or not the evaluation results would change under certain range by altering the scores.

Based on the result of the sensitivity analysis, the scores of individual sub-items for Alternatives BB1, CC1, CC2, and CC3 were intentionally increased within its rationale range compared to Alternative AA4. The analysis result ensured that Alignment A with Bridge Type AA4 was the most optimum solution to be adopted for the crossing of the River Nile at Jinja.

3.8.3 Consensus

Based on the comparative evaluation of the six alternatives, Alignment A with Bridge Type AA4 (3-Span PC Cable-Stayed Bridge) scored the highest point among the alternatives and this was also confirmed by sensitivity analysis.

Since it is officially acknowledged that the aviation limit of Jinja Airfield was not relaxed, Bridge Type AA5 was not considered as an optimum solution.

Based on the above evaluation, the 3rd Steering Committee held on 1 April, 2009 accepted the recommendation of the Study Team, and also that of the stakeholders, during the 2nd Public Consultation held in Kampala on 3 April 2009, agreed with the Team's recommendation, for the adoption of, Alignment A with Bridge Type AA4 as the optimum solution to cross the River Nile at Jinja.

4. TRAFFIC DEMAND FORECAST

4.1 Traffic Survey

The Study Team carried out traffic surveys (Traffic Count Survey, Roadside OD Interview Survey, Cargo Truck Survey and Stated Preference (SP) Survey) in December 2008 to gather primary traffic data for the analysis of the current traffic characteristics to provide a basis for the forecast of traffic demand of the project.

Tables 4.1 and 4.2 show the summary of estimated Average Daily Traffic volumes (ADT) in both directions. ADT for the existing bridge is estimated at 9,412 (excluding motorcycle) vehicles per day or 11,124 vehicles (including motorcycle) per day in December 2008.

Table 4.1 Traffic Flow at Nalubaale Dam Bridge in December 2008

ADT	Sedan	Station Wagon	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck	Semi Trailer	Truck Trailer	Others	Total
W/B	980	923	1,344	72	88	355	262	85	385	11	4,505
%	22%	20%	30%	2%	2%	8%	6%	2%	9%	0%	100%
E/B	863	1,104	1,543	72	194	324	285	93	422	7	4,907
%	18%	22%	31%	1%	4%	7%	6%	2%	9%	0%	100%
Total	1,843	2,027	2,887	144	282	679	547	178	807	18	**9,412**
W:E	0.53:0.47	0.46:0.54	0.47:0.53	0.50:0.50	0.31:0.69	0.52:0.48	0.48:0.52	0.48:0.52	0.48:0.52	0.61:0.39	0.48:0.52

Source: JICA Study Team
Note: W/B means "Direction to Kampala", and E/B means "Direction to Jinja"

Table 4.2 Motorcycle and Non-Motorized Traffic Flow in December 2008

	Motorcycle	Bicycle	Pedestrian	Total
W/B	893	914	488	2,296
E/B	819	777	181	1,777
Total	1,712	1,691	669	4,072

Source: JICA Study Team

4.2 Future Socio-economic Framework

(1) Future Population

Uganda Bureau of Statistics has forecasted the Ugandan population from 2003 to 2017. Based on the 2015 Uganda population projections, the Study Team estimated the population growth up to 2025 on the assumption that the growth rate from 2015 to 2017 will continue to rise to year 2025 as shown in Table 4.3 hereunder.

Table 4.3 Future Uganda Population

Year	Uganda Population (thousand)	Annual Average Growth Rate
2008	29,593	-
2015	37,907	3.5% (2008 to 2015)
2025	53,289	3.5% (2015 to 2025)

Source: Uganda Bureau of Statistics
Note: 2025 population was estimated by JTS

(2) GDP (Gross Domestic Product) and GDP per Capita

The current study adopted the GDP growth rate derived from interviews by economists of the Macroeconomic Policy Department, Ministry of Finance (MOF), for which three GDP Growth scenarios (High, Middle and Low growth) were prepared for the traffic demand forecast as shown in Table 4.4.

Table 4.4 Future Uganda GDP Growth Ratio by Scenario

Year	Low Growth	Middle Growth	High Growth
2009 to 2015	6.0%	7.0%	8.0%
2016 to 2025	5.0%	6.0%	7.0%

Source: JICA Study Team

4.3 Traffic Demand Forecast

Regression analysis was made using traffic and socio-economic data (Uganda Population and GDP) to forecast future traffic demand. Additionally, the demand forecast considered international traffics through Uganda (trips between foreign countries) and the Influence of Oil Transport by an Oil Pipeline (Low Traffic Case). It seems that Influence of the Railway and Ferry would be very small and limited. Therefore, it was assumed that there would be no diversion from road traffic to the railway or the ferry in the future. The future traffic volumes on the project bridge were estimated as shown in Table 4.5 hereunder.

Table 4.5 Future Average Daily Traffic for Middle Growth Scinario

<Vehicle Base>

	Motorcycle	Sedan, SW	Mini Bus	Large Bus	Truck	Trailer	Total
2008*	1,712	3,868	2,886	146	1,510	986	11,108
2015	3,686	5,858	3,826	236	2,596	1,754	17,956
2025	6,356	8,578	4,934	358	4,870	2,848	27,944

Source: JICA Study Team
Note: * based on JST's survey data in 2008
Unit: Vehicle/Day

<PCU Base>

	Motorcycle	Sedan, SW	Mini Bus	Large Bus	Truck	Trailer	Total
2008*	856	3,868	3,175	292	3,020	2,859	14,070
2015	1,842	5,858	4,209	472	5,192	5,087	22,660
2025	3,178	8,577	5,427	717	9,740	8,259	35,898

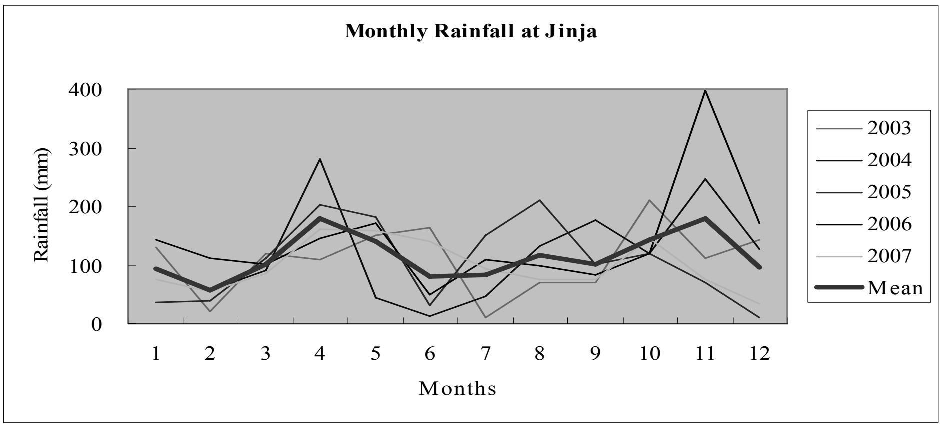
Source: JICA Study Team
Note: *) based on JST's survey data in 2008
Unit: PCU/Day

5. ENGINEERING STUDY

5.1 Meteorological Condition

Rainfall

Figure 5.1 shows the monthly rainfall intensity in Jinja between 2003 to 2007. Total annual rainfall intensity is around 1,300mm, and high rainfall intensity is observed during the rainy season in April and November.



Source: JICA Study Team

Figure 5.1 Monthly Rainfall Intensity at Jinja

Wind Velocity

Hourly wind speed data in Entebbe are collected and analyzed for the determination of the design wind velocity to be adopted for the New Nile Bridge Project, because the wind data records in Jinja are taken twice on a daily basis at 9:00 and 15:00 hours which is considered insufficient. . Table 5.1 shows the 10-minutes average wind velocity of 29.3m/sec transformed from the instantaneous wind velocity with a return period of 120 years based on Entebbe data.

Table 5.1 Probability of Wind Speed

Return Period	Instantaneous Wind Speed knots	Instantaneous Wind Speed m/sec	10 minutes Average Wind Speed knots	10 minutes Average Wind Speed m/sec
1/2	34.6	17.8	23.1	11.9
1/3	40.8	21.0	27.2	14.0
1/10	56.3	29.0	37.5	19.3
1/13	59.5	30.6	39.7	20.4
1/14	60.3	31.0	40.2	20.7
1/15	61.2	31.5	40.8	21.0
1/20	64.6	33.2	43.1	22.2
1/25	67.2	34.6	44.8	23.0
1/50	75.1	38.7	50.2	25.8
1/100	83.3	42.9	55.5	28.6
1/110	84.4	43.4	56.3	28.9
1/120	85.4	43.9	56.9	29.3
1/130	86.4	44.4	57.6	29.6
1/140	87.2	44.9	58.1	29.9
1/150	88.0	45.3	58.7	30.2
1/200	91.3	47.0	60.9	31.3

Notes: Records Period: 1955 — 2008
No. of Records: 38
Instantaneous wind speed
= 10 minutes average wind speed of 1.5 times

5.2 River Condition

Figure 5.2 shows the longitudinal profile of River Nile including Nalubaale Dam. The selected bridge location (Route A) crosses the river about 500m upstream the dam. Hence, the water level (flood level: 1,135m) at the bridge location is administered and controlled in accordance with the dam operating rules.

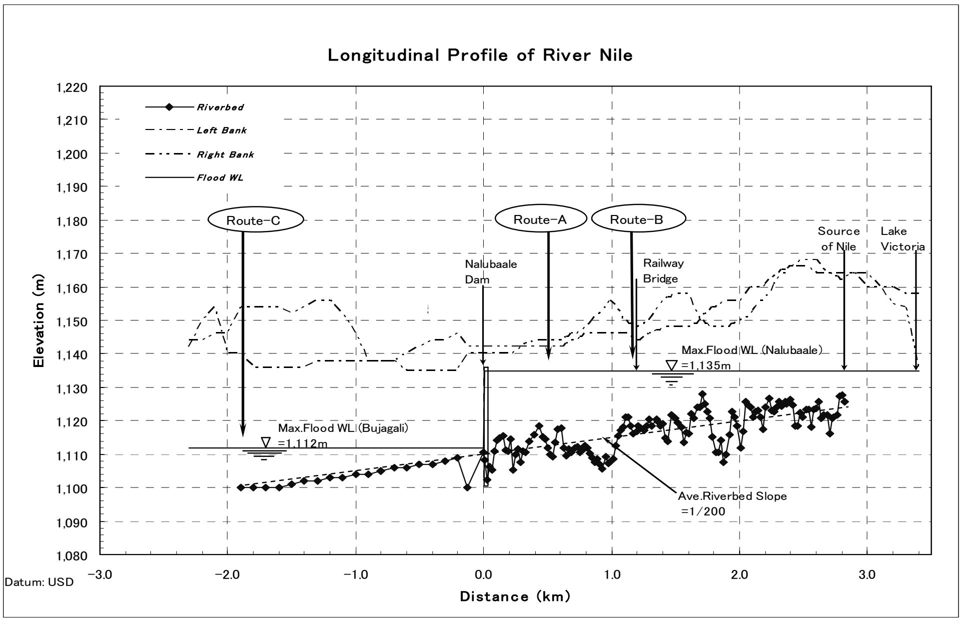


Figure 5.2 Longitudinal Profile

5.3 Geological and Geotechnical Condition

The investigations that have been conducted are shown in Table 5.2 and Figure 5.3. Figures 5.4 ~ 5.6 show the assumed geological profiles for each route, and Table 5.3 summarises the stratification of the strata. Subject to the design requirements, Weathered Rock is assumed to be a probable bearing layer for each route.

Table 5.2 Realized Investigations

Object	Item
Investigations for Bridge Design	Drilling Standard Penetration Test Trial Pit on the Island Lab Test
Investigations for Existing Conditions	Trial Pit Dynanmic Cone Penetration Test Lab Test (CBR etc.)
Investigations for Quarry	Site Exploration Lab Test
Investigations for Borrow Pit	Site Exploration Trial Pit Lab Test

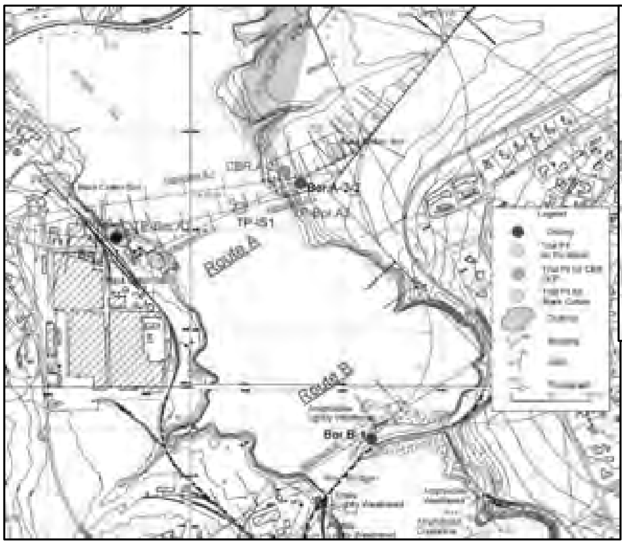
Source: JICA Study Team

Table 5.3 Geological Stratification of Each Route

Route	Type	Symbols	Rock (Soil) Type	
Route A	Deposit	GCS	Gravel (Boulder Cobble) with Sandy Clay	
Route A	Base Rock	WR/Amp, WR/Amp&Gns	Weathered	Amphibolite, Amphibolite with Gneiss (Partially)
Route A	Base Rock	FR/Amp	Fragile	Amphibolite, Amphibolite with Gneiss (Partially)
Route A	Base Rock	SR/Amp, SR/Amp&Gns	Sound Rock	Amphibolite, Amphibolite with Gneiss (Partially)
Route B	Former Filling Material	CS	Sandy Clay	
Route B	Residual Soil	Lat	Lateritic Soil	
Route B	Base Rock	HWR/Amp	Highly Weathered	Amphibolite
Route B	Base Rock	WR/Amp	Weathered	Amphibolite
Route B	Base Rock	SR/Amp	Sound Rock	Amphibolite

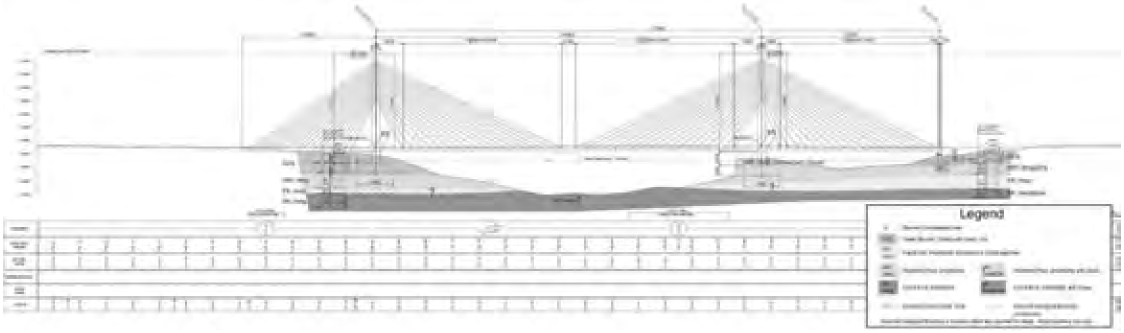
Route	Type	Symbols	Rock (Soil) Type	
Route C	Talus Deposit	Td	Sandy Clay with Gravel	
Route C	Residual Soil	Lat	Lateritic Soil	
Route C	Residual Soil	Lat/Sap	Lateritic Soil with Sapprolitic Layer	
Route C	Residual Soil	Sap	Sapprolitic Layer	
Route C	Base Rock	HWR/Amp	Highly Weathered	Amphibolite
Route C	Base Rock	WR/Amp	Weathered	Amphibolite
Route C	Base Rock	SR/Amp	Sound Rock	Amphibolite

Source: JICA Study Team



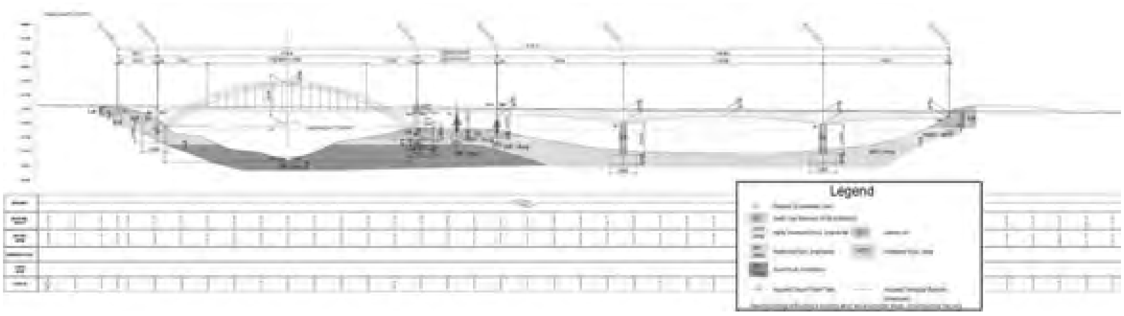
Source: JICA Study Team

Figure 5.3 Map of the Studied Site



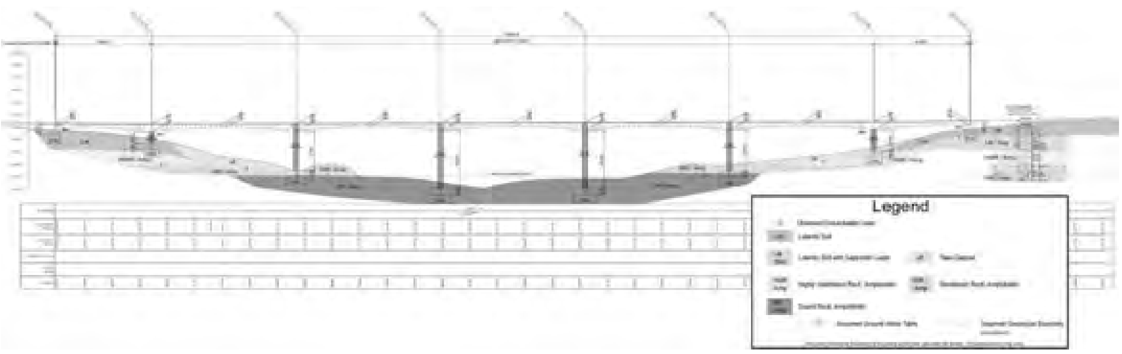
Source: JICA Study Team

Figure 5.4 Assumed Geological Profile (Route A)



Source: JICA Study Team

Figure 5.5 Assumed Geological Profile (Route B)



Source: JICA Study Team

Figure 5.6 Assumed Geological Profile (Route C)