CHAPTER 19 IMPLEMENTATION PROGRAMME

19.1 Project Outline

19.1.1 Project Location

- Project Location (Bridge):
  Existing ferry line which is connects Zambia with Botswana across the Zambezi river at Kazungula.
- Project Location (Border Control Facility):
  Near the existing border control facility.

19.1.2 Project Length of Bridge and Road

- Project Length of Bridge and Road : 3,700 m

19.1.3 Bridge Feature

- Total Bridge Length : 720.0 m
- Main bridge length : 465.0 m
- Approach span bridge (Zambia side) : 127.5 m (3@42.5 m)
- Approach span bridge (Botswana side) : 127.5 m (3@42.5 m)
- Bridge width (2 – lane carriageway) : 9.0 m (4.5 m + 4.5 m)
- (2 – side walk) : 1.0 m each side

(1) Main Span Bridge

- Superstructure Type : PC – Extradozed Girder (220 m)
- Foundation Type : ϕ3.0 m Cast in place RC pile

(2) Approach Span Bridge

- Approach span bridge (Zambia side)

  Superstructure Type : PC – Box Girder (127.5 = 3@42.5 m)
  Foundation Type : ϕ1.0 m Cast in place RC pile

- Approach span bridge (Botswana side)

  Superstructure Type : PC – Box Girder (127.5 = 3@42.5 m)
  Foundation Type : ϕ1.0 m Cast in place RC pile

19.1.4 Approach Roads

- Zambia side : 1,383.0 m
- Botswana side : 1,597.0 m

- Total Length : 2,980.0 m

19.1.5 Passing Road (Zimbabwe side)

- Passing Road length : 600.0 m

19.1.6 Border Control Facility Area

- Zambia : 15.8 ha
- Botswana : 17.1 ha
- Zimbabwe : 12.7 ha

19.1.7 Construction Period

- Construction Period (Package - 1) : 39 months
- Construction Period (Package - 2) : 30 months

19.1.8 Project Packaging

Project package on this project will be divided into two packages as described in Chapter 17.7. Package-1 consists of bridge which include main bridge and approach span bridges, and approach roads (Zambia, Botswana side). Package-2 consists of three border control facilities (Zambia, Botswana and Zimbabwe). The project packages are shown as below:

Package-1 : Bridge and Approach Roads

- Approach Road (Zambia side)
- Main Bridge and Approach Span Bridges
- Approach Road (Botswana side)
- Replacement of Ferry Facility

Package-2 : Border Control Facility

- Border Control Facility (Zambia)
- Border Control Facility (Botswana)
- Border Control Facility (Zimbabwe)

19.2 Total Project Cost and Breakdown

19.2.1 Bridge and Approach roads (Package - 1)

Summary of total project cost and breakdown for Bridge and Approach roads (Package-1) is shown in Table 19.2.1.

Table 19.2.1 Total Project Cost for Package-1

Unit: 1,000US$

Total Project Cost (Package-1)		Amount	
1)	Construction cost	47,668	(FC 80%)
	- Bridge	*45,339*	
	- Approach roads	*2,271*	
	- Ferry facility	*58*	
2)	Engineering cost	4,766	(FC 100%)
	- Details design	*2,383*	
	- Construction supervision	*2,383*	
	- Environmental monitoring	*46*	
3)	Administration cost	2,860	
	- Administration cost	*486*	
	- Maintenance cost (25year)	*2,383*	
4)	Land acquisition (Re-vegetation) and compensation cost	6	
5)	Price escalation (10%)	4,766	
6)	Physical contingency (10%)	4,766	
7)	Interest during construction	715	
8)	Duty tax (VAT) (10%)	4,766	
	Total	70,317	(FC 71.8%)

Note: FC is foreign currency portion

19.2.2 Border Control Facilities (Package-2)

Summary of total project cost and breakdown for Border Control Facilities (Package-2) is shown in Table 19.2.2.

Table 19.2.2 Total Project Cost for Package-2

Unit: 1,000US$

Total Project Cost (Package-2)		Amount	
1)	Construction cost	15,437	(FC 7%)
	- Border control facility	*15,437*	
2)	Engineering cost	2,315	
	- Details design	*1,157*	
	- Construction supervision	*1,157*	
	- Environmental monitoring	*5*	
3)	Administration cost	7,873	(FC 100%)
	- Administration cost	*154*	
	- Operation and Maintenance cost (25year)	*7,718*	
4)	Land acquisition (Re-vegetation) and compensation cost	60	
5)	Price escalation (10%)	1,543	
6)	Physical contingency (10%)	1,543	
7)	Interest during construction	231	
8)	Duty tax (VAT) (10%)	1,543	
	Project Cost Total	30,549	(FC 11.8%)

Note: FC is foreign currency portion

19.3 Project Operation and Maintenance

Prior to completion of construction bridge, a Bridge Management Committee for operation and maintenance will be organized in both Zambia and Botswana. After completion, the operation and maintenance of the bridge will be carried out effectively under each country's committee. Each country will be also responsible for its approach roads, border facilities, immigration, customs, etc.

19.4 Project Implementation Schedule

The implementation schedule of the Kazungula Bridge Project takes into consideration the period of detailed design, pre-qualification, tendering, and construction. The construction schedule of the bridge and roads should consider the local condition of the bridge site, especially, flood season from February to June (5-month) for the foundation works in the river and rainy season from October to March and dry season from April to September for concrete works. The implementation schedule was prepared tentatively based on mobilisation and preparatory works starting at the end part of flood season and the works in the river starting the during the low water season.

(1) Tentative Project Implementation Schedule

-	Detailed Design, including Tender Documents	:	12 months
-	Prequalification	:	4 months
-	Pre-construction (Tendering)	:	6 months
-	Construction of Bridge and Approach Roads	:	39 months
-	Border Control Facilities	:	30 months

(2) Tentative Construction Schedule

a) Bridge and Approach Roads

-	Mobilization	:	6 months
-	Foundation & Substructure	:	7 months
-	Superstructure	:	13 months
-	Approach Roads	:	6 months

b) Border Control Facilities

-	Roads/Parking Space	:	6 months
-	Buildings	:	18 months
-	Facilities	:	6 months

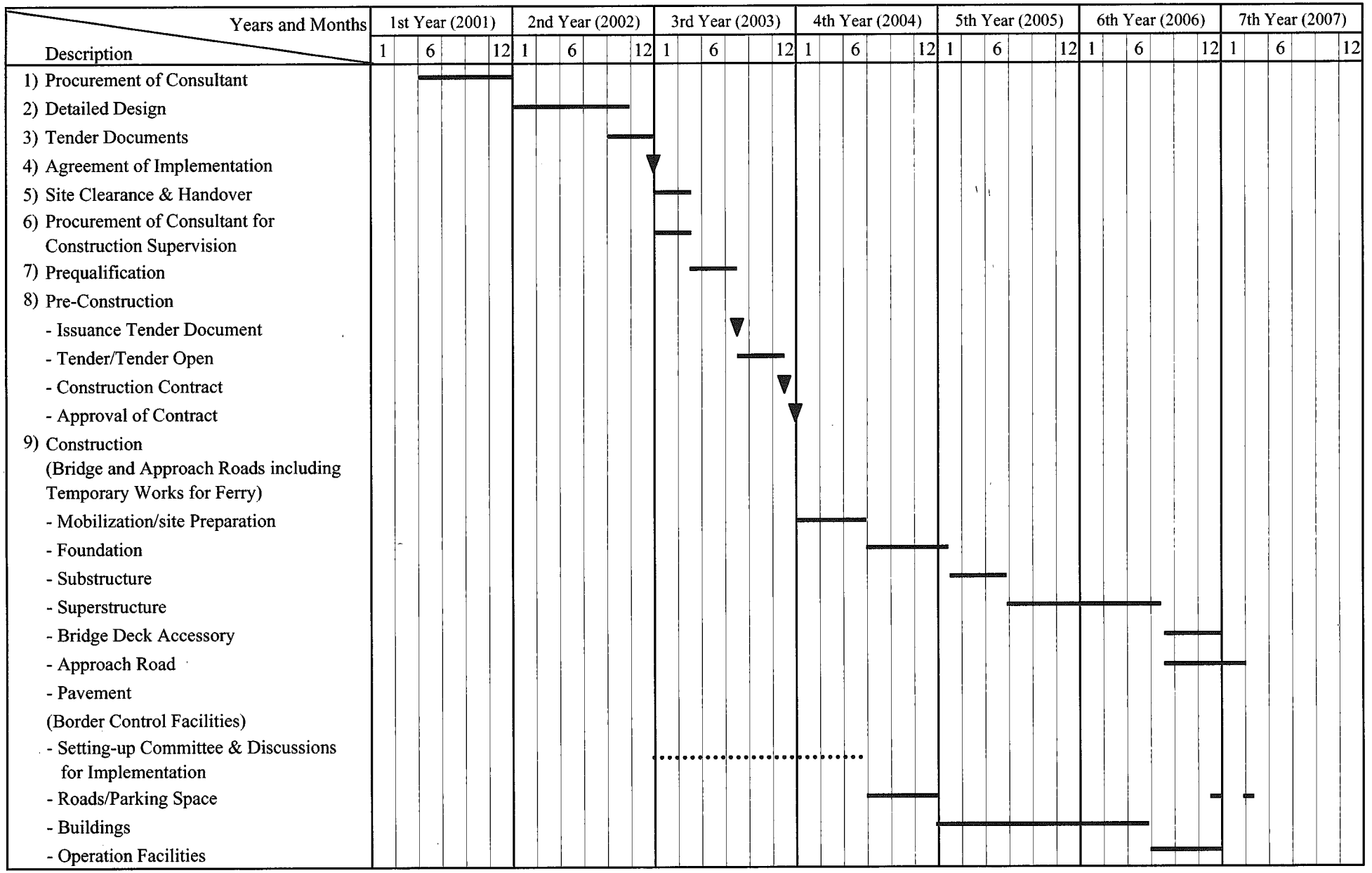

Figure 19.5.1 Tentative Project Implementation Schedule

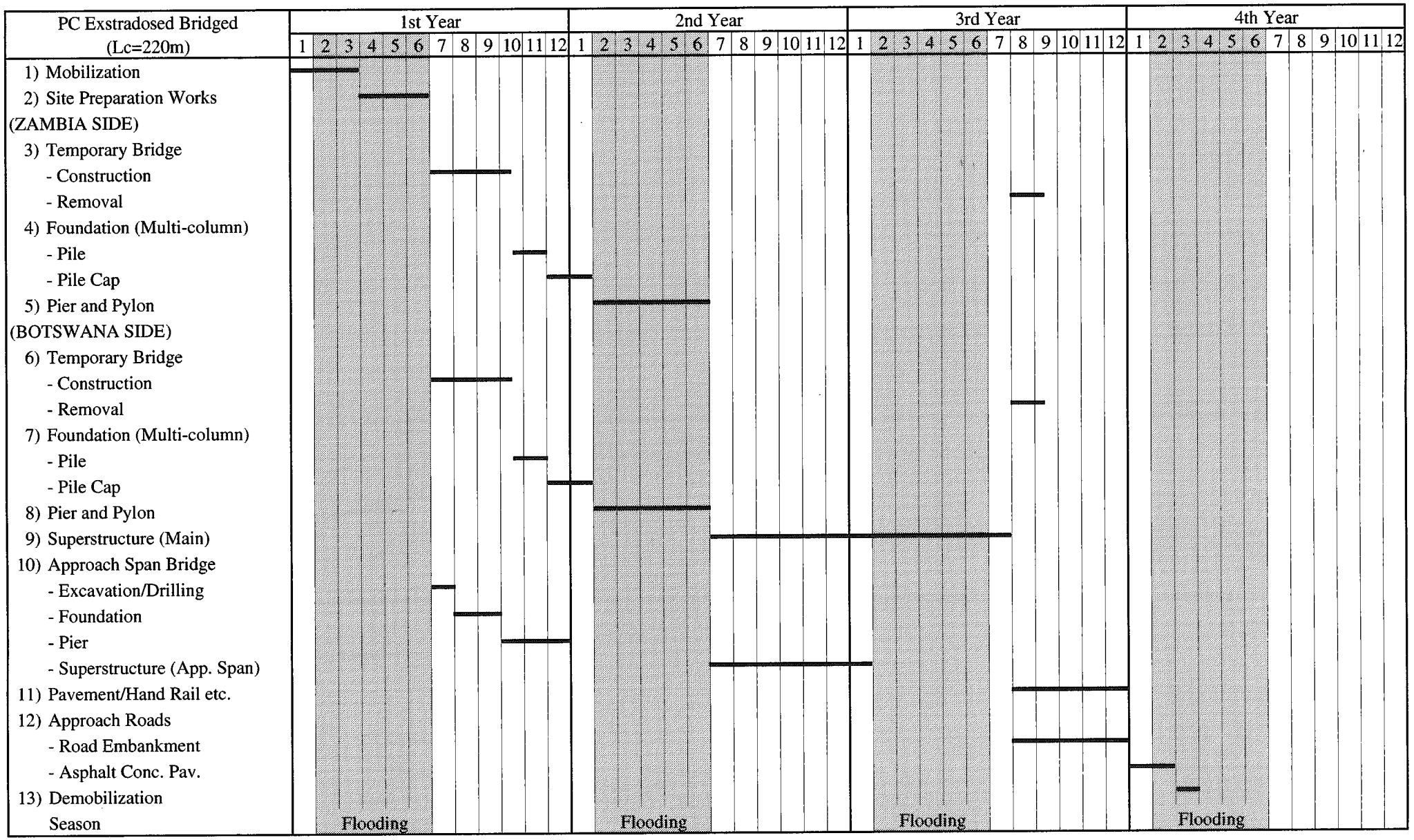

Figure 19.5.2 Tentative Construction Schedule of Bridge and Approach Roads

19.5 Flood Records to be considered for the Schedule

The Figure 19.6.1 shows the monthly water flows at the Kazungula Bridge site, based on the records of the Victoria Falls (Zambian side). The duration from February to June is flood season, and the preparation of false work such as the temporary bridge to be built in the river should consider these flood water levels when the deck level of the temporary bridge is determined.

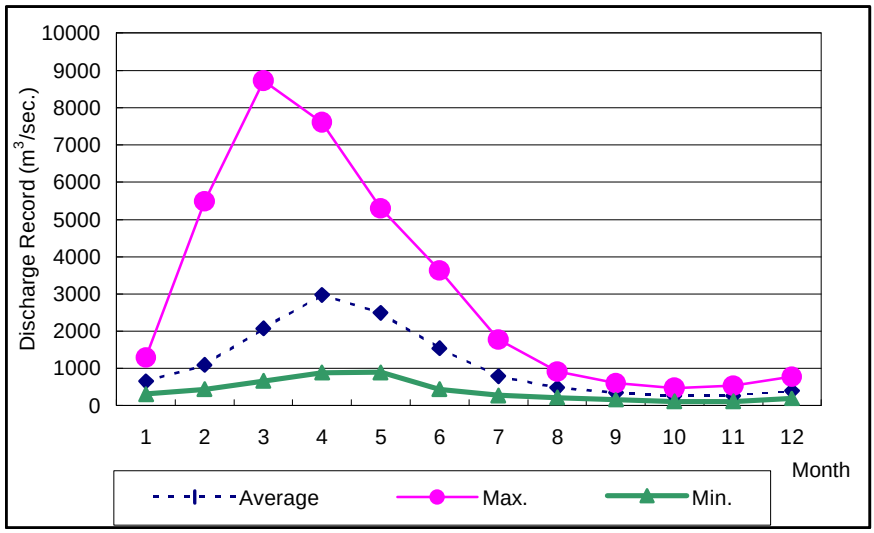

Figure 19.6.1 Monthly Water Flows at Kazungula

CHAPTER 20 ECONOMIC ANALYSIS

20.1 Introduction

20.1.1 Purpose and Content of Economic Evaluation

(1) Economic viability of the development schemes proposed in this study which consist of Bridge Construction at Kazungula, One-Stop Border Post and Improvement of Ferry Operation, have been evaluated in terms of investment efficiency in the national economies.

(2) To evaluate of the economic viability, indicators such as Internal Rate of Return (IRR), Net Present Value (NPV) and Benefit Cost Ratio (B/C) were calculated. All the economic costs and major tangible benefits that accrue to each project, necessary for the above calculations, were estimated.

(3) In addition to the above, socio-economic impacts including intangible benefits from the projects were analysed.

20.1.2 Preposition of Evaluation

For the evaluation of the viability of the projects following prepositions have been introduced in this Study:

(1) Construction Works

Bridge: 4 years after the preceding engineering studies
One-Stop Border Post: 4 years after the preceding engineering and administrative studies
Ferry Facilities: Facility improvement works shall begin in 2001.

(2) Project life: 30 years after the completion of initial construction works.

(3) Monetary Unit for the Evaluation

US$ is adopted taking international nature of the projects into consideration, where the following exchange rates (as of November 1 2000) are adopted:

US$1=5.5 Botswana Pula
US$1=3600.0 Zambia Kwacha
US$1=55.0 Zambia $
US$1=110.0 Japanese Yen

(4) Standard Conversion Factor

Standard conversion factor of 0.85 for the conversion of financial cost into economic was applied in consideration of the tax rates and duties in Botswana and Zambia.

(5) Discount Rate

A 12% discount rate, for the calculation of B/C and NPV, was applied taking the opportunity costs of Botswana and Zambia into consideration. In addition, the calculation of the above indicators under a 10% of discount rate was also done for reference.

(6) Future Traffic Levels

Two of the future traffic growth scenarios presented in Ch.8: high growth and low growth were adopted as the basis of evaluation. Annual traffic growth rates applied throughout the evaluation period by individual project are as follows:

Evaluation of the Bridge and the One-Stop Border Post
High Growth Scenario: 8.56%
Low Growth Scenario: 6.36%

Evaluation of the Improved Ferry
High Growth Scenario: 7.11%
Low Growth Scenario: 4.70%

(7) Vehicle Mode

Throughout the economic evaluation, following vehicle classification was adopted:

Mode1: Car
Mode2: Bus, Medium Truck
Mode3: Heavy Truck

(8) Traffic Classification

Throughout the evaluation, two traffic classifications, i.e. (i) normal traffic (ii) developed traffic were handled separately. Definitions of these traffic are as follows.

- Normal traffic

  Traffic due to natural increase of economic activities, includes those traffic which may divert from the other routes,

- Developed traffic

  Traffic due to development effects of the project, includes induced traffic by the project.

(9) Cases for Evaluation

Cases for evaluation were introduced as follows:

Case B-1: Case for evaluation of bridge that assumes that improved ferry service shall be replaced by bridge in future in accordance with bridge implementation schedule proposed in Chapter 15. This case mentions timing of bridge construction in relation to the ferry improvement plan.

Case B-2: Case for evaluation of bridge that assumes that existing ferry service shall be replaced by bridge in future in accordance with bridge implementation schedule proposed in Chapter 15. This case mentions timing of bridge construction in relation to the existing ferry capacity.

Case BP-1: Case for evaluation of one-stop border post which assumes that existing border posts shall be improved in future in accordance with one-stop border improvement plan proposed in Chapter 9.

Case F-1: Case of evaluation of ferry improvement which assumes that existing ferry shall be improved annually in accordance with ferry operation plan proposed in Chapter 10.

(10) Assumption of "without" or "do nothing" cases as the Base of Benefit Calculation

The cases of "without" or "do nothing" as the base of benefit estimation are assumed as follows:

Evaluation of Bridge:	Case B-1:	Improved ferry
	Case B-2:	Existing ferry
Evaluation of One-Stop Border Post:	Case BP-1	Existing border posts
Evaluation of Ferry Improvement:	Case F-1	Existing ferry

(11) Residual Values

Residual value of bridge was reckoned at the end year of evaluation period, where the residual value was calculated by following formula:

Residual Value = Bridge Construction Cost X (Remaining Years in Use/ Duration period of Bridge (50 years))

20.2 Evaluation Procedures

20.2.1 Economic Project Cost and Cost Disbursement Schedule

(1) Economic Project Cost

The project costs expressed in financial prices were converted into economic prices applying the standard conversion factor of 0.85 as below:

a) Bridge

	Financial		Economic
Engineering Cost	US$4.7668 millions	⇒	US$4.0906 millions
Construction Cost	US$47.6680 millions	⇒	US$40.4687 millions
Maintenance Cost	US$4.0828 millions	⇒	US$3.4704 millions
Total Cost	US$56.5176 millions	⇒	US$48.0297 millions

b) One-Stop-Border Post

	Financial		Economic
Engineering Cost	US$2.3150 millions	⇒	US$1.9440 millions
Construction Cost	US$15.4370 millions	⇒	US$12.9610 millions
O&M Cost	US$13.2323 millions	⇒	US$11.2474 millions
Total Cost	US$30.9843 millions	⇒	US$26.1524 millions

c) Ferry Improvement

<u>High Growth</u>

	Financial		Economic
Improvement Cost	US$7.4468 millions	⇒	US$6.3298 millions
Operation Cost	US$33.2154 millions	⇒	US$28.2331 millions
Total Cost	US$40.6622 millions	⇒	US$34.5629 millions

Low Growth

	Financial		Economic
Improvement Cost	US$5.7899 millions	⇒	US$4.9214 millions
Operation Cost	US$29.9611 millions	⇒	US$25.4699millions
Total Cost	US$35.7545 millions	⇒	US$30.3913 millions

(2) Composition of Construction Cost

a) Bridge: Foreign & Local portion in terms of economic cost

Unit: mil. US$

	Foreign Cost	Local Cost	Total
Bridge	32.3723	6.1662	38.5385
Approach Road	1.4863	0.4439	1.9302
Total	33.8586	6.6101	40.4687

b) Border Facility/Ferry Improvement: Share to be borne by each nation in terms of economic cost

Unit: mil. US$

	Zambia	Botswana	Zimbabwe	Total
Border Facility	8.3688	12.8147	4.9690	26.1524
Ferry Improvement, low case	22.4659	12.0970	-	34.5629
Ferry Improvement, high case	19.7543	10.6370	-	30.3913

(3) Cost Disbursement Schedule

The annual cost disbursement of the above items was prepared according to the implementation schedule.

20.2.2 Method of Benefit Calculation

(1) Methodology

As mentioned in 20.1 (9), benefits were calculated as the balance of traffic costs obtained in traffic simulation on “without project case” and on “with the project case”. In this context benefit calculation was directly related to traffic demand forecast explained in Chapter 7 of this report. Details of methodology for benefit calculation by each project component are as follows:

a) Bridge

The benefits of the project were obtained as the difference between the traffic costs obtained for the two traffic simulations, “without bridge

case" and "with bridge case". In the "without bridge case", these were two variations: CaseB-1 which assumed improved ferry operation and CaseB-2 which assumed existing ferry operation. Each was examined as explained in 20.1.2. With this background, traffic costs throughout the evaluation period had to be simulated in relation to ferry capacity and actual traffic volume to be transported in each year. The surplus traffic, above ferry capacity, was defined as having detoured to other river crossings across the Zambezi. For this reason, two types of traffic costs were calculated; one is traffic cost on improved ferry, and another is traffic cost for detoured traffic. The concept of benefit calculation by each case of evaluation is illustrated in Figure 20.1.1 (1) and (2).

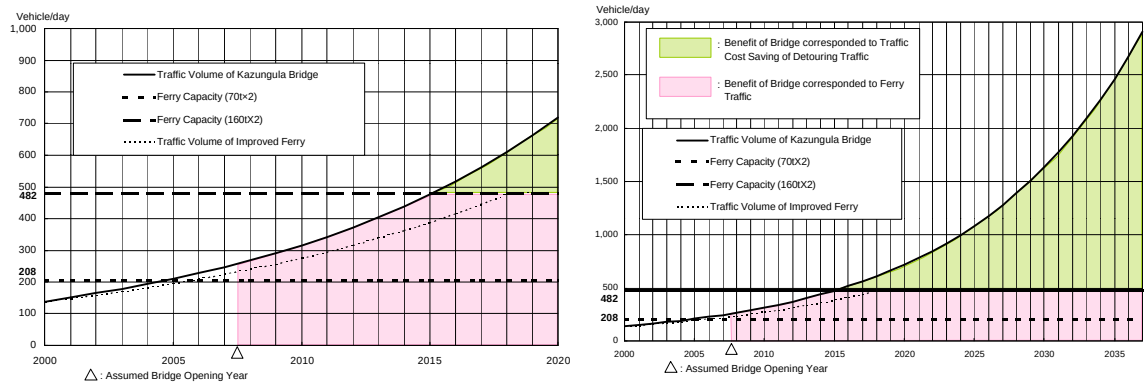

Figure 20.1.1 (1) Concept of Benefit Calculation (Case B-1)

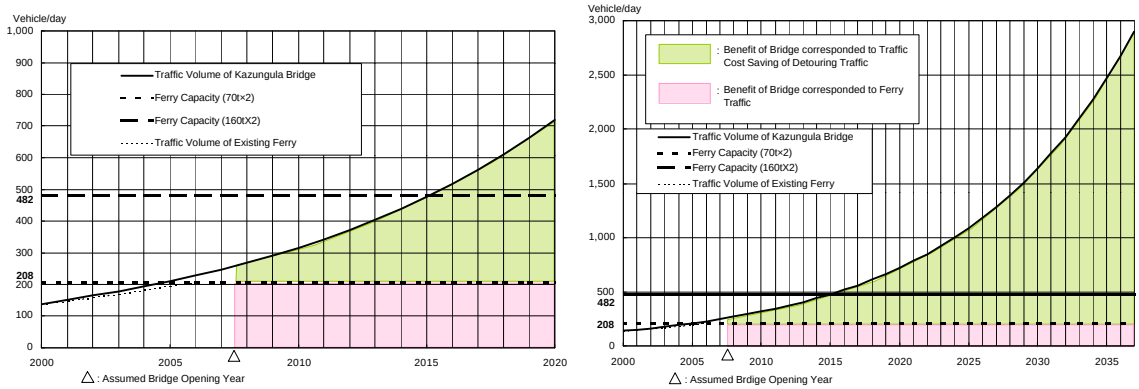

Figure 20.1.1 (2) Concept of Benefit Calculation (Case B-2)

b) One-Stop-Border Post

Usage of existing border posts is assumed in "without project case" and traffic costs in " with project case" were calculated on the condition that the bridge is available. For the calculation of the above, capacity of existing border posts is set at 282 vehicles a day, whilst that of one-stop border was set at 1,852 vehicles a day. The surplus traffic is assumed as

pass traffic due to the extension of office hours for case B-1 and case B-2. The concept of benefit calculation for one-stop border is illustrated in Fig.20.1.2.

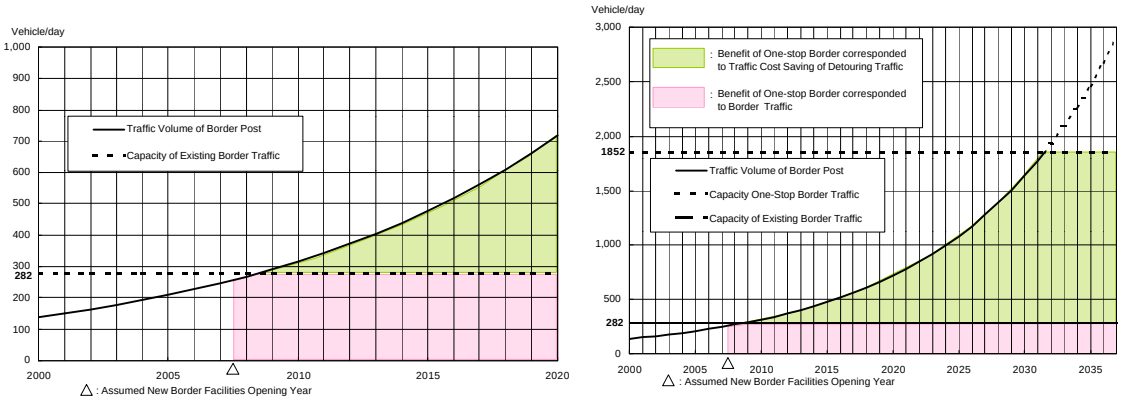

Figure 20.1.2 Concept of Benefit Calculation (Case BP-1)

c) Ferry Improvement

River crossing by existing ferry is assumed in “without project case”, and traffic above the existing ferry capacity is deemed as detoured traffic to other river crossings across the Zambezi, whilst the traffic above the capacity of the improved ferry is defined as suppressed traffic and its traffic cost was not reckoned. The capacity of existing ferry is set at 208 vehicles a day, whilst that of improved ferry is set at 482 vehicles a day. The concept of benefit calculation for improved ferry is illustrated in Fig.20.1.3.

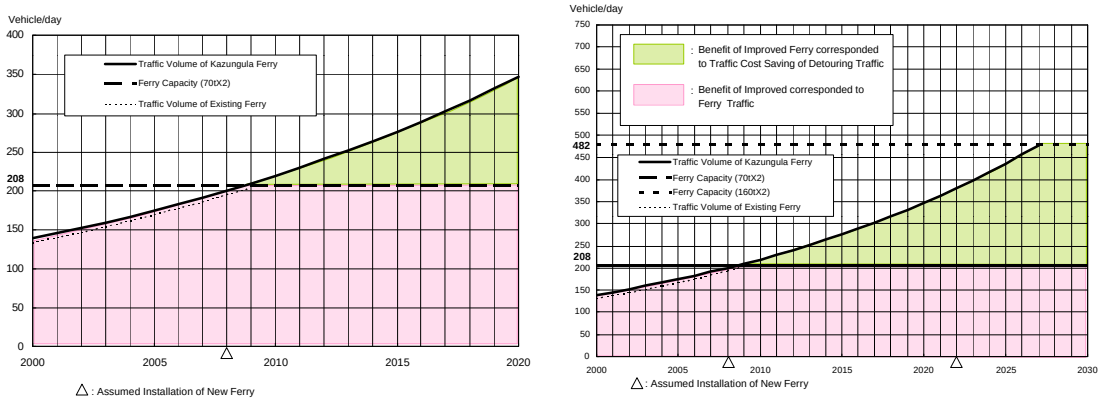

Figure 20.1.3 Concept of Benefit Calculation (Case F-1)

(2) Items of Benefit

The following items of benefit that accrue to the proposed projects have been estimated in terms of economic price:

a) Bridge

River Crossing
- Ferry Waiting Time and River Crossing Time Saving Benefit
- Pedestrian River Crossing Time Value Saving Benefit
- Freight Time Value Saving Benefit
- Vehicle Stop/Start Cost Saving Benefit

Detouring
- Vehicle Travel Time Saving Benefit
- Vehicle Operation Cost Saving Benefit

b) One-Stop Border

Border Clearance
- Border Clearance Time Saving Benefit
- Freight Time Value Saving Benefit
- Vehicle Stop/Start Cost Saving Benefit

Detouring
- Vehicle Travel Time Saving Benefit
- Vehicle Operation Cost Saving Benefit

(3) Estimation of Unit Traffic Cost

a) Value of Time

Time values for each nation in SADC region have been estimated on the basis of wage data and of the relation between wage rates and time values available at other parts of the world.

Figure 20.2.1 shows average wages and values of time for four cities, two in Europe and the other two in developing Asia. The ratio of value of time to average wage is remarkably constant, with a range of 0.0026 to 0.0030, and an average of 0.0028.

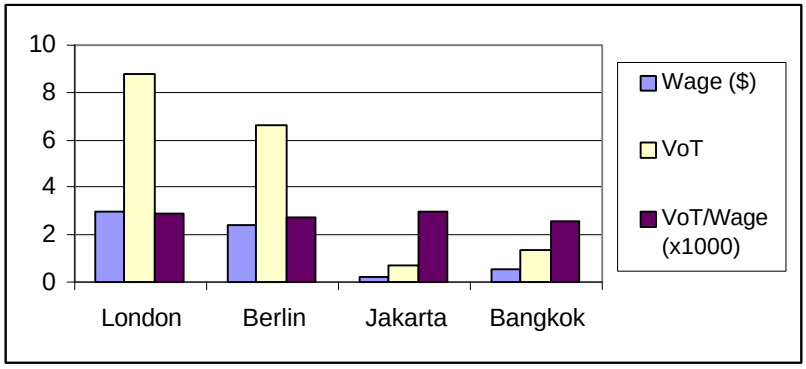

Figure 20.2.1 Relation between Wages and Time Values

The value of time for Zambia has been estimated to be US$0.24/hour giving the average wage of K280,000 in Zambia. The values of time for other southern African countries have been estimated as shown in Table 20.2.1.

Table 20.2.1 Estimated Values of Time for Southern African Countries

Country	Value of Time (US$ per hour)
Congo	0.08
Mozambique	0.11
Tanzania	0.14
Malawi	0.16
Zambia	0.24
Angola	0.41
Zimbabwe	0.48
Namibia	1.25
South Africa	1.97
Botswana	2.05

Values of time are personal and travel with the individual and the results of traffic survey revealed that most of the vehicles crossing at Kazungula were registered in either Zambia or South Africa. For calculating time savings in monetary values it is assumed that 50% of traffic has Zambian values of time, and 50% South African values of time, consequently US$1.10 dollar/h per person has been adopted for the study. Values of time by vehicle type have been estimated as shown in Table20.2.2.

Table20.2.2 Estimation of Value of Time by Vehicle Type

Vehicle Type	Unit VOT (personal) (US$/h)	Average No. of Passengers	% of Economic Actives	VOT by Vehicle Type (US$/h)
Mode1	1.1	4.13	0.5	2.2715
Mode2	1.1	5.11	0.5	2.8105
Mode3	1.1	3.43	0.5	1.8865

(b) Estimation of Freight Time Values

Freight time values per ton and hour by freight type were estimated adopting the following formula:

Freight Time Value = Value of Freight per ton
X (Short Time Interest Rate/365days X 24hours)

Where the values of freight per ton are estimated as shown in Table 20.2.3.

Table 20.2.3 Values of Freight

Unit: US$/ton

Freight Type	Commodity	Value
Agricultural Product	-Vegetable/Fruit	237
Fishery Product	-Fish	813
Forestry Product	-Pulp and Paper	771
Minerals	-Mineral Product	83
Livestock Product	-Live Animals	791
	-Hides and Skins	1367
	Average	1079
Food and Drinks	-Prepared Food Staff	734
Machinery Equipment	-Machinery/Electric Equipment	5057
	-Transport Equipment	1924
	Average	3491
Construction Material	-Stone/Plaster Product	820
	-Base Metal	743
	Average	782
Fuel or Chemicals	-Chemical Product	1181
	-Plastic	2848
	Average	2015
Miscellaneous/ Manufactures		10930

Freight time values per ton and hour were estimated using the above formula and values of freight per ton as shown below where interest rate of 12 % was applied taking present Zambian short-term interest rate into consideration:

Agricultural Product	:	US$ 0.0032
Fishery Product	:	US$ 0.0111
Forestry Product	:	US$ 0.0105
Minerals	:	US$ 0.0011
Livestock Product	:	US$ 0.0148
Food & Drinks	:	US$ 0.1000
Machinery Equipment	:	US$ 0.0475
Construction material	:	US$ 0.0106
Fuel or Chemicals	:	US$ 0.0274

Others : US$ 0.1485

(c) Estimation of Unit Vehicle Stop/Start Cost

Newly introduced bridge and one-stop border post are expected to reduce the number of stop/start times. To estimate the benefit from this, first of all, unit vehicle stop/start costs were estimated on the basis of a similar study conducted in USA as shown in Table 20.2.4.

Table 20.2.4 Fuel Consumption Affected by Number of Stop/Start of Vehicle
- Case Study in USA -

Average Distance per Litre (km)	Number of Gear Change					Speed Level
	0	1	2	3	4	
Mode1	9.21	8.40	7.73	7.15	6.66	30km/h
Mode2	4.30	3.92	3.61	3.34	3.11	30km/h
Mode3	3.42	3.12	2.87	2.66	2.47	30km/h

Source：Economic Analysis for Highway, R. Winfrey

Unit stop/start costs were obtained applying the above information, under the assumption that 4 times of stop/start shall be reduced with the introduction of the bridge and 2 times of stop/start at one-stop border post, where fuel price is assumed to be US$ 0.9 per litre.

(d) Estimation of Unit Vehicle Operation Cost

Unit vehicle operation costs were estimated based on physical features of vehicles and unit prices of the components of operating costs by item in Zambia as shown in Table 20.2.5.

Table 20.2.5 (1) Unit Vehicle Operation Cost

Physical Quantities per 1000km Drive

Item	Unit	Car	Utility	Medium Truck	Heavy Truck	Trailer
Fuel Consumption	Litres	91.96	178.69	219.78	307.87	699.81
Lubricants	Litres	2.03	2.03	3.55	3.55	5.83
Tyre	%of equivalent tyres	0.07	0.07	0.15	0.15	0.40
Maintenance Labour	Hours	2.78	2.78	9.74	9.74	35.00
Maintenance Parts	%of new vehicle price	0.23	0.23	0.20	0.20	0.36
Depreciation	%of new vehicle price	0.70	0.69	0.24	0.25	0.14
Interest	%of new vehicle price	0.33	0.33	0.11	0.12	0.07

Table 20.2.5 (2) Vehicle Operating Costs in US$ per 1000km Drive

Item	Car	Utility	Medium Truck	Heavy Truck	Trailer
Fuel Consumption	83.4	162.0	189.6	265.6	603.6

Lubricants	2.5	2.5	4.4	4.4	7.3
Tyre	15.3	15.3	42.2	42.2	112.5
Maintenance Labour	9.2	9.2	32.1	32.1	115.5
Maintenance Parts	14.4	14.4	98.0	98.0	176.4
Depreciation	43.8	43.1	117.6	122.5	68.6
Interest	20.6	20.6	53.9	58.8	34.3
Total	189.2	267.1	537.8	623.6	1118.2

Corresponding values from the above classification of vehicle type and the mode adopted in this Study is as follows:

Mode1: Consisting of 44% of cars and 36% of utilities
Mode2: Consisting of Medium Trucks
Mode3: Consisting of 10% of Large Trucks and 90% of Trailers

It is noteworthy that the crew cost is excluded from the total vehicle operation cost to prevent duplication with the time cost.

(4) Future Traffic Volume by Facility for Each Project Component

a) Bridge Traffic

Bridge traffic volumes throughout the evaluation period were forecast under low growth scenario and high growth scenario respectively in “with project case” of bridge evaluation.

Table 20.2.6 Future Bridge Traffic (AADT)

Year	High Growth Scenario			Low Growth Scenario		
	Normal Traffic	Developed Traffic	Total Bridge Traffic	Normal Traffic	Developed. Traffic	Total Bridge Traffic
2007	246	41	287	213	41	254
2008	267	44	311	227	44	270
2009	290	47	337	241	47	288
2010	315	50	365	256	50	306
2011	342	53	395	273	53	326
2012	371	57	428	290	57	347
2013	403	61	464	309	61	370
2014	438	65	503	328	65	394
2015	475	70	545	349	70	419
2016	516	75	591	371	75	446
2017	560	80	640	395	80	475
2018	608	86	693	420	86	506
2019	660	92	751	447	92	538
2020	716	98	814	475	98	573
2021	778	105	882	505	105	610
2022	844	112	956	537	112	649
2023	916	120	1036	572	120	691
2024	995	128	1123	608	128	736
2025	1080	137	1217	647	137	784
2026	1172	147	1319	688	147	834
2027	1273	157	1430	731	157	888
2028	1382	168	1550	778	168	946
2029	1500	180	1679	827	180	1007
2030	1628	192	1820	880	192	1072
2031	1768	205	1973	936	205	1141
2032	1919	220	2139	996	220	1215
2033	2083	235	2318	1059	235	1294
2034	2262	251	2513	1126	251	1378
2035	2455	269	2724	1198	269	1467
2036	2665	288	2953	1274	288	1562
2037	2894	308	3201	1355	308	1663

b) Ferry Traffic

Ferry traffic volumes were forecast for “without project case” for bridge evaluation and both for “with project case” and “without project case” of ferry improvement evaluation. The estimations were carried out in

relation to the ferry capacity expansion program prepared in Chapter 10 as shown in Table 20.2.7.

Table 20.2.7 Future Ferry Traffic (AADT)

Year	High Growth Scenario		Low Growth Scenario	
	Improved Ferry	Existing Ferry	Improved Ferry	Existing Ferry
2001	149	149	145	145
2002	159	159	152	152
2003	171	171	159	159
2004	183	183	166	166
2005	196	196	174	174
2006	209	209	182	182
2007	224	209	191	191
2008	240	209	200	200
2009	257	209	210	209
2010	276	209	220	209
2011	295	209	230	209
2012	316	209	241	209
2013	338	209	252	209
2014	363	209	264	209
2015	388	209	276	209
2016	416	209	289	209
2017	446	209	302	209
2018	477	209	317	209
2019	487	209	331	209
2020	487	209	347	209
2021	487	209	363	209
2022	487	209	380	209
2023	487	209	398	209
2024	487	209	417	209
2025	487	209	436	209
2026	487	209	456	209
2027	487	209	478	209
2028	487	209	487	209
2029	487	209	487	209
2030	487	209	487	209
2031	487	209	487	209
2032	487	209	487	209
2033	487	209	487	209
2034	487	209	487	209
2035	487	209	487	209
2036	487	209	487	209
2037	487	209	487	209

c) Border Traffic

Border traffic has been obtained on the basis of forecasted future traffic volume and capacities of border facilities.

Table 20.2.8 Future Border Traffic (AADT)

Year	High Growth Scenario		Low Growth Scenario	
	Improved Border Traffic	Existing Border Traffic(A)	Improved Border Traffic	Existing Border Traffic(A)
2001		150		147
2002		163		157
2003		177		167
2004		192		177
2005		209		188
2006		227		200
2007	287	246	254	213
2008	311	267	270	227
2009	337	280	288	280
2010	365	280	306	280
2011	395	280	326	280
2012	428	280	347	280
2013	464	280	370	280
2014	503	280	394	280
2015	545	280	419	280
2016	591	280	446	280
2017	640	280	475	280
2018	693	280	506	280
2019	751	280	538	280
2020	814	280	573	280
2021	882	280	610	280
2022	956	280	649	280
2023	1036	280	691	280
2024	1123	280	736	280
2025	1217	280	784	280
2026	1319	280	834	280
2027	1430	280	888	280
2028	1550	280	946	280
2029	1679	280	1007	280
2030	1820	280	1072	280
2031	1852	280	1141	280
2032	1852	280	1215	280
2033	1852	280	1294	280
2034	1852	280	1378	280
2035	1852	280	1467	280
2036	1852	280	1562	280
2037	1852	280	1663	280

(5) Detoured Traffic

Detoured traffic for each case of evaluation was estimated by route of river crossing on the basis of simulated traffic in the year 2015.

Table 20.2.9 (1) Future Detoured Traffic (AADT) – for Bridge Evaluation
(Assumed "without case": Improved Ferry: Case B-1)

Year	High Growth Scenario				Low Growth Scenario			
	Detoured Traffic			Total Detoured Traffic	Detoured Traffic			Total Detoured Traffic
	Chirundu	Katima Mulilo	Victoria Falls		Chirundu	Katima Mulilo	Victoria Falls	
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0
2016	50	41	13	104	0	0	0	0
2017	74	60	19	153	0	0	0	0
2018	99	81	26	206	0	0	0	0
2019	127	104	32	264	0	0	0	0
2020	158	129	39	327	0	0	0	0
2021	191	157	47	395	56	46	21	123
2022	228	186	55	469	74	60	28	162
2023	267	218	64	549	93	76	35	204
2024	310	254	73	636	113	93	43	249
2025	356	291	82	730	135	110	52	297
2026	407	333	92	832	157	129	61	347
2027	462	378	104	943	182	149	71	401
2028	522	427	115	1063	199	163	78	439
2029	585	479	128	1192	235	192	93	520
2030	655	536	141	1333	264	216	105	584
2031	732	599	155	1486	295	241	118	654
2032	815	667	170	1652	328	268	132	728
2033	905	741	185	1831	363	297	147	807
2034	1003	821	203	2026	401	328	162	891
2035	1109	907	221	2237	440	360	179	980
2036	1225	1002	239	2466	482	395	198	1075
2037	1349	1104	261	2714	527	431	218	1176

Table 20.2.9 (2) Future Detoured Traffic (AADT) - Without Bridge Case
(Assumed “without case”: Existing Ferry: Case B-2)

Year	High Growth Scenario				Low Growth Scenario			
	Detoured Traffic			Total Detoured Traffic	Detoured Traffic			Total Detoured Traffic
	Chirundu	Katima Mulilo	Victoria Falls		Chirundu	Katima Mulilo	Victoria Falls	
2007	37	30	11	78	0	0	0	0
2008	48	39	14	102	28	23	10	61
2009	61	50	18	128	36	30	13	79
2010	74	61	21	156	45	37	16	97
2011	88	72	25	186	54	44	19	117
2012	104	85	29	219	63	52	23	138
2013	122	100	34	255	74	60	27	161
2014	141	115	38	294	85	69	31	185
2015	161	132	43	336	96	79	35	210
2016	183	150	49	382	108	89	40	237
2017	207	170	54	431	122	99	45	266
2018	233	191	60	484	136	111	50	297
2019	262	214	66	542	150	123	56	329
2020	293	240	73	605	166	136	62	364
2021	326	267	80	673	183	149	69	401
2022	363	297	87	747	200	164	76	440
2023	402	329	96	827	219	179	83	482
2024	445	364	104	914	239	196	92	527
2025	492	402	114	1008	261	213	101	575
2026	543	444	123	1110	283	232	110	625
2027	598	489	134	1221	307	251	120	679
2028	658	538	145	1341	334	273	130	737
2029	722	591	157	1470	361	295	142	798
2030	792	648	171	1611	390	319	154	863
2031	869	711	183	1764	420	344	168	932
2032	952	779	199	1930	453	371	182	1006
2033	1043	853	213	2109	488	399	197	1085
2034	1140	933	230	2304	526	430	213	1169
2035	1246	1020	249	2515	565	463	230	1258
2036	1363	1115	266	2744	607	497	249	1353
2037	1488	1217	287	2992	652	533	269	1454

Table 20.2.10 Detoured Traffic (AADT) – Case F- **1** (for Ferry Evaluation)

Year	High Growth Scenario				Low Growth Scenario			
	Detoured Traffic			Total Detoured Traffic	Detoured Traffic			Total Detoured Traffic
	Chirundu	Katima Mulilo	Victoria Falls		Chirundu	Katima Mulilo	Victoria Falls	
2001	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0
2007	6	5	5	15	0	0	0	0
2008	11	9	10	31	0	0	0	0
2009	18	14	16	48	0	0	0	1
2010	25	20	22	67	4	3	4	11
2011	32	26	29	86	8	6	7	21
2012	39	32	36	107	12	9	11	32
2013	47	39	43	129	16	13	14	43
2014	56	46	51	154	20	16	18	55
2015	66	54	60	179	25	20	22	67
2016	76	62	69	207	29	24	27	80
2017	87	71	79	237	34	28	31	93
2018	98	80	89	268	39	32	36	108
2019	102	83	93	278	45	37	41	122
2020	102	83	93	278	51	41	46	138
2021	102	83	93	278	57	46	51	154
2022	102	83	93	278	63	51	57	171
2023	102	83	93	278	69	57	63	189
2024	102	83	93	278	76	62	69	208
2025	102	83	93	278	83	68	76	227
2026	102	83	93	278	91	74	82	247
2027	102	83	93	278	99	81	90	269
2028	102	83	93	278	102	83	93	278
2029	102	83	93	278	102	83	93	278
2030	102	83	93	278	102	83	93	278
2031	102	83	93	278	102	83	93	278
2032	102	83	93	278	102	83	93	278
2033	102	83	93	278	102	83	93	278
2034	102	83	93	278	102	83	93	278
2035	102	83	93	278	102	83	93	278
2036	102	83	93	278	102	83	93	278
2037	102	83	93	278	102	83	93	278

Table 20.2.11 Detoured Traffic (AADT) – Case BP-1 (for One-Stop Border Evaluation)

Year	High Growth Scenario				Low Growth Scenario			
	Detoured Traffic			Detoured Traffic	Detoured Traffic			Detoured Traffic
	Chirundu	Katima Mulilo	Victoria Falls		Chirundu	Katima Mulilo	Victoria Falls	
2007	3	2	1	6	0	0	0	0
2008	14	12	4	30	0	0	0	0
2009	27	22	8	56	0	0	0	0
2010	40	33	12	84	0	0	0	0
2011	55	45	16	115	0	0	0	0
2012	71	58	20	148	5	4	2	10
2013	88	72	24	184	13	11	5	29
2014	107	87	29	223	22	18	8	48
2015	127	104	34	265	32	26	12	69
2016	149	122	39	311	42	34	15	91
2017	173	142	45	360	52	43	19	115
2018	200	163	51	414	64	52	24	140
2019	228	187	58	472	76	62	28	167
2020	259	212	64	536	89	73	33	195
2021	293	240	72	604	103	84	39	225
2022	329	269	79	678	117	96	44	257
2023	369	302	88	759	133	108	51	292
2024	412	337	96	846	149	122	57	328
2025	459	376	106	941	166	136	64	367
2026	511	418	116	1044	185	151	72	408
2027	566	463	126	1155	204	167	80	451
2028	626	512	138	1276	225	184	88	498
2029	691	566	150	1407	247	202	98	547
2030	659	539	159	1357	271	222	107	600
2031	769	629	174	1572	296	242	118	656
2032	762	623	186	1572	322	264	129	716
2033	755	618	199	1572	351	287	141	779
2034	747	611	213	1572	380	311	154	846
2035	739	605	228	1572	412	337	168	918
2036	730	598	244	1572	446	365	183	994
2037	721	590	261	1572	482	394	199	1075

(5) Conditions for Benefit Estimation

A stream of future benefit was estimated on the basis of above obtained unit traffic cost and future traffic volume, where the following assumptions were introduced relative to ferry waiting time and driving conditions of detouring routes:

a) Ferry Waiting Time

Future ferry waiting time was determined so that future waiting time may be contained at the level of present waiting time i.e. ferry: 5.8 hours existing border: 9.6 hours.

b) Driving Condition

Driving conditions of competitive routes were determined in terms of driving distance and travel time as shown in Table 20.2.12.

Table 20.2.12 (1) Driving Condition (Chirundu or Kazungula) - 2015

Chirundu Route

Route	Distance (km)	Speed (km/h)	Driving Time(h)	Procedure Time(h)	Total Time (h)
Lusaka					
	130	60	2.167		2.167
Chirundu					
	177	40	4.425		4.425
Chirundu Border Post					
	0			5	5.000
Chirundu Border Post					
	177	40	4.425		4.425
Harare					
	574	40	14.350		14.350
Beit Border Post					
	0			5	5.000
Beit Border Post					
	471	60	7.850		7.850
Pretoria					
	628	80	7.850		7.850
Durban					
Total	2133		41.067		51.067

Note: The procedure times in Chirundu and Beit Border Post will be decreased from over 20 hours in 2000 to 5 hours by 2015, because of Improvement border procedures (one stop border control) in accordance with the SADC protocol.

Kazungula Route

Route	Distance (km)	Speed (km/h)	Driving Time (h)	Procedure Time (h)	Total Time (h)
Lusaka					
	543	60	9.050		9.050
Kazungula					
	2	60	0.033		0.033
Kazungula Border Post					
	0			5	5.000
Kazungula Border Post					
	2	60	0.033		0.033
Kasane					
	486	80	6.075		6.075
Francistown					
	414	80	5.175		5.175
Gaborone					
	177	80	2.213		2.213
Botswana/S.A. Border Post					
	0			1	1.000
Botswana/S.A. Border Post					
	177	80	2.213		2.213
Pretoria					
	628	80	7.850		7.850
Durban					
Total	2429		32.642		38.642

Table 20.2.12 (2) Driving Condition (Katima Mulilo or Kazungula) - 2015

Katima Mulilo Route

Route	Distance (km)	Speed (km/h)	Driving Time (h)	Procedure Time (h)	Total Time (h)
Livingstone					
	190	60	3.167		3.167
Sesheke					
	39	40	0.975		0.975
Zam.-Nam. Border Post					
	0			5	5.000
Zam.-Nam. Border Post					
	20	40	0.500		0.500
Nam.-Bots.Border Post					
	0			5	5.000
Nam,-Bots Border Post					
	20	40	0.500	1	1.500
Ngoma					
	120	60	2.000		2.000
Kasane					
Total	389		7.142	11	18.142

Kazungula Route

Route	Distance (km)	Speed (km/h)	Driving Time (h)	Procedure Time (h)	Total Time (h)
Livingstone					
	70	60	1.167		1.167
Kazungula					
	2	60	0.033		0.033
Zam.-Bots. Border Post					
	0			5	5.000
Zam.-Bots. Border Post					
	2	60	0.033		0.033
Kasane					
Total	74		1.233	5	6.233

Table 20.2.12 (3) Driving Condition (Victoria Falls or Kazungula) - 2015

Victoria Falls Route

Route	Distance (km)	Speed (km/h)	Driving Time (h)	Procedure Time (h)	Total Time (h)
Livingstone					
	2	40	0.050		0.050
Zam.-Zim.Border Post					
	0			5	5.000
Zam.-Zim.Border Post					
	2	40	0.050		0.050
Victoria Falls					
	70	60	1.167		1.167
Zim.-Bots.Border Post					
	0			5	5.000
Zim.-Bots.Border Post					
	2	60	0.033		0.033
Kasane					
Total	76		1.300	10	11.300

Kazungula Route

Route	Distance (km)	Speed (km/h)	Driving Time (h)	Procedure Time (h)	Total Time (h)
Livingstone					
	70	60	1.167		1.167
Kazungula					
	2	60	0.033		0.033
Zam.-Bots. Border Post					
	0			5	5.000
Zam.-Bots. Border Post					
	2	60	0.033		0.033
Kasane					
Total	74		1.233	5	6.233

(4) Estimated Benefit

Benefits of the Project were estimated on the basis of unit time cost calculated above, unit traffic cost and traffic volumes by each component of Project, where items of the benefit to be considered were defined as below:

Bridge Evaluation

- Ferry Waiting Time Saving Benefit (FWTS)
- Pedestrian River Crossing Time Saving Benefit (PRCTS)
- Freight Time Value Saving Benefit (FTVS)
- Vehicle Stop/Start Cost Saving Benefit (VSSCS)
- Vehicle Operation Cost Saving (VOCS) – for detoured traffic
- Vehicle Travel Time Cost Saving (VTTC) – for detoured traffic

One-Stop Border Post Evaluation

- Border Clearance Time Saving Benefit (BCTS)
- Freight Time Value Saving Benefit (FTVS)
- Vehicle Stop/Start Cost saving Benefit (VSSCS)
- Vehicle Operation Cost Saving (VOCS) – for detoured traffic
- Vehicle Travel Time Cost Saving (VTTC) – for detoured traffic

Improvement of ferry Evaluation

- Vehicle Operation Cost Saving (VOCS) – for detoured traffic
- Vehicle Travel Time Cost Saving (VTTC) – for detoured traffic

Estimated benefits throughout the period of evaluation are listed in Table 20.2.13~20.2.15.

Table 20.2.13 (1) Calculated Benefit - Bridge - High growth (Assumed “without case”: Improved Ferry: CaseB-1)

Year	Ferry traffic					Detoured Traffic									Grand Total
	FWTS	PRCTS	FTVS	VSSCS	Sub-total	VOCS (US$ mil.)				VTTS (US$ mil.)				Sub-total	
	US$ mil	US$ mil	US$ mil	US$ mil	US$ mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	(US$ mil,)	
2007	2.0575	0.0059	0.1442	0.0232	2.2308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.2308
2008	2.2044	0.0129	0.1545	0.0249	2.3967	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.3967
2009	2.3606	0.0140	0.1655	0.0266	2.5666	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.5666
2010	2.5351	0.0152	0.1777	0.0286	2.7566	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.7566
2011	2.7096	0.0165	0.1899	0.0306	2.9466	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.9466
2012	2.9025	0.0179	0.2034	0.0327	3.1566	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.1566
2013	3.1045	0.0194	0.2176	0.0350	3.3766	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.3766
2014	3.3342	0.0211	0.2337	0.0376	3.6266	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.6266
2015	3.5638	0.0229	0.2498	0.0402	3.8767	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.8767
2016	3.8210	0.0249	0.2678	0.0431	4.1568	-1.4098	2.2085	0.0043	0.8030	0.4254	0.3336	0.0459	0.8049	1.6079	5.7647
2017	4.0965	0.0270	0.2871	0.0462	4.4569	-2.0788	3.2566	0.0062	1.1840	0.6273	0.4919	0.0664	1.1857	2.3696	6.8265
2018	4.3813	0.0293	0.3071	0.0494	4.7671	-2.8021	4.3897	0.0083	1.5958	0.8456	0.6631	0.0887	1.5974	3.1932	7.9603
2019	4.4731	0.0318	0.3135	0.0505	4.8689	-3.5993	5.6384	0.0105	2.0496	1.0861	0.8517	0.1119	2.0497	4.0993	8.9683
2020	4.4731	0.0345	0.3135	0.0505	4.8717	-4.4683	6.9999	0.0128	2.5443	1.3484	1.0574	0.1363	2.5420	5.0863	9.9580
2021	4.4731	0.0375	0.3135	0.0505	4.8746	-5.4037	8.4651	0.0153	3.0767	1.6306	1.2787	0.1633	3.0726	6.1493	11.0239
2022	4.4731	0.0407	0.3135	0.0505	4.8778	-6.4306	10.0738	0.0178	3.6611	1.9405	1.5217	0.1906	3.6528	7.3139	12.1917
2023	4.4731	0.0442	0.3135	0.0505	4.8813	-7.5360	11.8055	0.0207	4.2902	2.2740	1.7833	0.2212	4.2786	8.5688	13.4501
2024	4.4731	0.0480	0.3135	0.0505	4.8851	-8.7500	13.7073	0.0236	4.9809	2.6404	2.0705	0.2519	4.9628	9.9437	14.8287
2025	4.4731	0.0521	0.3135	0.0505	4.8892	-10.0545	15.7509	0.0268	5.7232	3.0340	2.3793	0.2866	5.6999	11.4231	16.3123
2026	4.4731	0.0565	0.3135	0.0505	4.8936	-11.4853	17.9922	0.0300	6.5370	3.4658	2.7178	0.3208	6.5044	13.0414	17.9350
2027	4.4731	0.0614	0.3135	0.0505	4.8985	-13.0322	20.4156	0.0337	7.4171	3.9326	3.0839	0.3604	7.3768	14.7939	19.6924
2028	4.4731	0.0666	0.3135	0.0505	4.9037	-14.7236	23.0652	0.0373	8.3789	4.4430	3.4841	0.3988	8.3259	16.7049	21.6086
2029	4.4731	0.0723	0.3135	0.0505	4.9094	-16.5289	25.8933	0.0415	9.4059	4.9877	3.9113	0.4431	9.3421	18.7480	23.6574
2030	4.4731	0.0785	0.3135	0.0505	4.9156	-18.5048	28.9886	0.0459	10.5298	5.5840	4.3789	0.4909	10.4537	20.9835	25.8991
2031	4.4731	0.0852	0.3135	0.0505	4.9223	-20.6749	32.3882	0.0502	11.7635	6.2388	4.8924	0.5369	11.6681	23.4317	28.3540
2032	4.4731	0.0925	0.3135	0.0505	4.9296	-23.0101	36.0464	0.0553	13.0916	6.9435	5.4450	0.5912	12.9796	26.0713	31.0009
2033	4.4731	0.1004	0.3135	0.0505	4.9376	-25.5602	40.0412	0.0601	14.5412	7.7130	6.0484	0.6425	14.4039	28.9451	33.8826
2034	4.4731	0.1090	0.3135	0.0505	4.9462	-28.3138	44.3549	0.0659	16.1070	8.5439	6.7000	0.7039	15.9478	32.0548	37.0009
2035	4.4731	0.1184	0.3135	0.0505	4.9555	-31.2973	49.0287	0.0720	17.8034	9.4442	7.4060	0.7694	17.6196	35.4230	40.3785
2036	4.4731	0.1285	0.3135	0.0505	4.9656	-34.5777	54.1677	0.0778	19.6677	10.4341	8.1823	0.8310	19.4474	39.1152	44.0808
2037	4.4731	0.0697	0.3135	0.0505	4.9069	-38.0973	59.6812	0.0847	21.6687	11.4962	9.0151	0.9052	21.4165	43.0851	47.9920

Table 20.2.13 (2) Calculated Benefit - Bridge - Low growth (Assumed “without case”; Improved Ferry: CaseB-1)

Year	Ferry traffic					Detoured Traffic									Grand Total
	FWTS	PRCTS	FTVS	VSSCS	Sub-total	VOCS (US$ mil.)				VTTS (US$ mil.)				Sub-total	
	US$ mil	US$ mil	US$ mil	US$ mil	US$ mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	(US$ mil,)	
2007	1.4312	0.0109	0.1066	0.0223	1.5710	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.5710
2008	1.4908	0.0219	0.1111	0.0232	1.6470	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.6470
2009	1.5653	0.0220	0.1166	0.0244	1.7284	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.7284
2010	1.6399	0.0222	0.1222	0.0255	1.8098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.8098
2011	1.7144	0.0223	0.1278	0.0267	1.8912	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.8912
2012	1.7964	0.0225	0.1339	0.0280	1.9807	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.9807
2013	1.8784	0.0226	0.1400	0.0293	2.0702	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0702
2014	1.9679	0.0228	0.1466	0.0307	2.1679	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.1679
2015	2.0573	0.0229	0.1533	0.0320	2.2655	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.2655
2016	2.1542	0.0244	0.1605	0.0336	2.3726	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.3726
2017	2.2511	0.0259	0.1677	0.0351	2.4798	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.4798
2018	2.3629	0.0276	0.1761	0.0368	2.6033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.6033
2019	2.4673	0.0293	0.1838	0.0384	2.7189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.7189
2020	2.5865	0.0312	0.1927	0.0403	2.8507	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.8507
2021	2.7058	0.0332	0.2016	0.0421	2.9827	-1.5814	2.5544	0.0069	0.9798	0.4772	0.3742	0.0735	0.9249	1.9048	4.8875
2022	2.8325	0.0353	0.2111	0.0441	3.1230	-2.0803	3.3602	0.0091	1.2890	0.6278	0.4923	0.0974	1.2174	2.5064	5.6294
2023	2.9667	0.0375	0.2211	0.0462	3.2715	-2.6197	4.2314	0.0115	1.6232	0.7905	0.6199	0.1226	1.5330	3.1562	6.4277
2024	3.1083	0.0399	0.2316	0.0484	3.4282	-3.1937	5.1586	0.0141	1.9789	0.9637	0.7557	0.1505	1.8700	3.8489	7.2772
2025	3.2499	0.0424	0.2422	0.0506	3.5852	-3.8048	6.1455	0.0169	2.3577	1.1481	0.9003	0.1806	2.2290	4.5867	8.1719
2026	3.3990	0.0451	0.2533	0.0529	3.7504	-4.4399	7.1714	0.0199	2.7514	1.3398	1.0506	0.2122	2.6026	5.3540	9.1043
2027	3.5630	0.0480	0.2655	0.0555	3.9320	-5.1246	8.2774	0.0231	3.1759	1.5464	1.2127	0.2466	3.0056	6.1815	10.1135
2028	3.6301	0.0510	0.2705	0.0565	4.0082	-5.6102	9.0618	0.0253	3.4768	1.6929	1.3276	0.2700	3.2905	6.7673	10.7755
2029	3.6301	0.0543	0.2705	0.0565	4.0114	-6.6373	10.7207	0.0301	4.1135	2.0029	1.5706	0.3216	3.8950	8.0086	12.0200
2030	3.6301	0.0577	0.2705	0.0565	4.0149	-7.4451	12.0256	0.0340	4.6144	2.2466	1.7618	0.3632	4.3716	8.9860	13.0009
2031	3.6301	0.0614	0.2705	0.0565	4.0185	-8.3274	13.4506	0.0383	5.1615	2.5129	1.9705	0.4090	4.8924	10.0539	14.0724
2032	3.6301	0.0653	0.2705	0.0565	4.0225	-9.2583	14.9542	0.0428	5.7388	2.7938	2.1908	0.4578	5.4424	11.1812	15.2036
2033	3.6301	0.0695	0.2705	0.0565	4.0266	-10.2504	16.5568	0.0478	6.3541	3.0932	2.4256	0.5103	6.0290	12.3831	16.4097
2034	3.6301	0.0739	0.2705	0.0565	4.0310	-11.3174	18.2802	0.0527	7.0155	3.4151	2.6781	0.5634	6.6566	13.6721	17.7031
2035	3.6301	0.0786	0.2705	0.0565	4.0357	-12.4327	20.0816	0.0583	7.7072	3.7517	2.9420	0.6231	7.3167	15.0239	19.0596
2036	3.6301	0.0836	0.2705	0.0565	4.0407	-13.6212	22.0013	0.0643	8.4444	4.1103	3.2232	0.6872	8.0207	16.4651	20.5059
2037	3.6301	0.0889	0.2705	0.0565	4.0460	-14.8827	24.0389	0.0707	9.2269	4.4910	3.5218	0.7558	8.7686	17.9955	22.0415

Table 20.2.13 (3) Calculated Benefit - Bridge - High growth (Assumed “without case”: Existing Ferry: Case B-2)

Year	Ferry traffic					Detoured Traffic									Grand Total
						VOCS($US mil.)				VTTS ($US mil.)				Sub-total	
	FWTS $US mil	PRCTS $US mil	FTVS $US mil	VSSCS $US mil	Sub-total $US mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	($US mil,)	
2007	3.5638	0.0059	0.2498	0.0402	3.8597	-0.9781	1.5322	0.0034	0.5575	0.2951	0.2314	0.0362	0.5628	1.1203	4.9801
2008	3.5638	0.0129	0.2498	0.0402	3.8667	-1.2805	2.0060	0.0044	0.7299	0.3864	0.3030	0.0470	0.7364	1.4663	5.3330
2009	3.5638	0.0140	0.2498	0.0402	3.8678	-1.6106	2.5232	0.0054	0.9180	0.4860	0.3811	0.0582	0.9253	1.8433	5.7111
2010	3.5638	0.0152	0.2498	0.0402	3.8690	-1.9675	3.0822	0.0065	1.1212	0.5937	0.4656	0.0699	1.1292	2.2504	6.1194
2011	3.5638	0.0165	0.2498	0.0402	3.8703	-2.3513	3.6835	0.0077	1.3398	0.7095	0.5564	0.0821	1.3481	2.6879	6.5582
2012	3.5638	0.0179	0.2498	0.0402	3.8717	-2.7717	4.3420	0.0090	1.5793	0.8364	0.6559	0.0960	1.5882	3.1675	7.0392
2013	3.5638	0.0194	0.2498	0.0402	3.8732	-3.2348	5.0675	0.0103	1.8430	0.9761	0.7655	0.1101	1.8517	3.6946	7.5679
2014	3.5638	0.0211	0.2498	0.0402	3.8749	-3.7381	5.8559	0.0117	2.1295	1.1280	0.8846	0.1250	2.1375	4.2671	8.1420
2015	3.5638	0.0229	0.2498	0.0402	3.8767	-4.2820	6.7079	0.0132	2.4391	1.2921	1.0133	0.1406	2.4460	4.8851	8.7618
2016	3.5638	0.0249	0.2498	0.0402	3.8787	-4.8738	7.6350	0.0148	2.7761	1.4707	1.1533	0.1586	2.7826	5.5587	9.4374
2017	3.5638	0.0270	0.2498	0.0402	3.8808	-5.5115	8.6341	0.0165	3.1390	1.6631	1.3042	0.1762	3.1435	6.2826	10.1634
2018	3.5638	0.0293	0.2498	0.0402	3.8831	-6.1964	9.7069	0.0184	3.5289	1.8698	1.4663	0.1962	3.5323	7.0612	10.9443
2019	3.5638	0.0318	0.2498	0.0402	3.8856	-6.9547	10.8949	0.0202	3.9604	2.0986	1.6457	0.2162	3.9606	7.9210	11.8066
2020	3.5638	0.0345	0.2498	0.0402	3.8883	-7.7808	12.1890	0.0222	4.4304	2.3479	1.8412	0.2374	4.4265	8.8569	12.7453
2021	3.5638	0.0375	0.2498	0.0402	3.8913	-8.6652	13.5744	0.0245	4.9337	2.6148	2.0505	0.2619	4.9271	9.8609	13.7522
2022	3.5638	0.0407	0.2498	0.0402	3.8945	-9.6398	15.1012	0.0267	5.4882	2.9089	2.2811	0.2858	5.4758	10.9639	14.8584
2023	3.5638	0.0442	0.2498	0.0402	3.8980	-10.6843	16.7374	0.0294	6.0825	3.2241	2.5283	0.3137	6.0660	12.1485	16.0465
2024	3.5638	0.0480	0.2498	0.0402	3.9018	-11.8350	18.5400	0.0319	6.7370	3.5713	2.8006	0.3407	6.7126	13.4495	17.3513
2025	3.5638	0.0521	0.2498	0.0402	3.9059	-13.0669	20.4699	0.0349	7.4379	3.9430	3.0921	0.3724	7.4075	14.8454	18.7513
2026	3.5638	0.0565	0.2498	0.0402	3.9103	-14.4215	22.5920	0.0377	8.2082	4.3518	3.4126	0.4029	8.1673	16.3755	20.2858
2027	3.5638	0.0614	0.2498	0.0402	3.9152	-15.8815	24.8792	0.0411	9.0388	4.7924	3.7581	0.4392	8.9897	18.0284	21.9436
2028	3.5638	0.0666	0.2498	0.0402	3.9204	-17.4816	27.3857	0.0443	9.9485	5.2752	4.1367	0.4736	9.8855	19.8340	23.7544
2029	3.5638	0.0723	0.2498	0.0402	3.9261	-19.1847	30.0538	0.0481	10.9172	5.7892	4.5398	0.5143	10.8432	21.7604	25.6865
2030	3.5638	0.0785	0.2498	0.0402	3.9323	-21.0484	32.9734	0.0523	11.9772	6.3515	4.9808	0.5584	11.8907	23.8679	27.8002
2031	3.5638	0.0852	0.2498	0.0402	3.9390	-23.0990	36.1857	0.0561	13.1428	6.9703	5.4660	0.5999	13.0362	26.1790	30.1181
2032	3.5638	0.0925	0.2498	0.0402	3.9463	-25.3009	39.6351	0.0608	14.3950	7.6348	5.9871	0.6500	14.2718	28.6669	32.6132
2033	3.5638	0.1004	0.2498	0.0402	3.9542	-27.7092	43.4077	0.0652	15.7637	8.3615	6.5569	0.6965	15.6149	31.3786	35.3329
2034	3.5638	0.1090	0.2498	0.0402	3.9628	-30.3048	47.4740	0.0705	17.2396	9.1447	7.1712	0.7534	17.0693	34.3089	38.2717
2035	3.5638	0.1184	0.2498	0.0402	3.9722	-33.1169	51.8792	0.0762	18.8385	9.9933	7.8366	0.8141	18.6440	37.4825	41.4547
2036	3.5638	0.1285	0.2498	0.0402	3.9823	-36.2125	56.7286	0.0815	20.5976	10.9274	8.5691	0.8703	20.3669	40.9645	44.9468
2037	3.5638	0.0697	0.2498	0.0402	3.9236	-39.5291	61.9242	0.0879	22.4830	11.9282	9.3539	0.9392	22.2214	44.7044	48.6279

Table 20.2.13 (4) Calculated Benefit - Bridge - Low growth (Assumed “without case”: Existing Ferry: Case B-2)

	Ferry traffic					Detoured Traffic									
	FWTS	PRCTS	FTVS	VSSCS	Sub-total	VOCS($US mil.)				VTTS ($US mil.)				Sub-total	Grand Total
Year	$US mil	$US mil	$US mil	$US mil	$US mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	($US mil,)	
2007	1.8801	0.0109	0.1401	0.0293	2.0604	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0604
2008	2.0573	0.0219	0.1533	0.0320	2.2646	-0.7471	1.2067	0.0030	0.4626	0.2254	0.1768	0.0323	0.4345	0.8972	3.1617
2009	2.0573	0.0220	0.1533	0.0320	2.2647	-0.9675	1.5628	0.0039	0.5992	0.2920	0.2289	0.0418	0.5628	1.1619	3.4266
2010	2.0573	0.0222	0.1533	0.0320	2.2648	-1.1865	1.9165	0.0048	0.7348	0.3580	0.2808	0.0517	0.6905	1.4254	3.6902
2011	2.0573	0.0223	0.1533	0.0320	2.2650	-1.4295	2.3089	0.0059	0.8853	0.4314	0.3383	0.0627	0.8324	1.7177	3.9827
2012	2.0573	0.0225	0.1533	0.0320	2.2651	-1.6840	2.7201	0.0070	1.0430	0.5082	0.3985	0.0745	0.9811	2.0242	4.2893
2013	2.0573	0.0226	0.1533	0.0320	2.2653	-1.9624	3.1697	0.0082	1.2155	0.5922	0.4644	0.0874	1.1439	2.3594	4.6246
2014	2.0573	0.0228	0.1533	0.0320	2.2654	-2.2549	3.6422	0.0094	1.3967	0.6804	0.5336	0.1004	1.3144	2.7111	4.9765
2015	2.0573	0.0229	0.1533	0.0320	2.2655	-2.5565	4.1294	0.0107	1.5836	0.7715	0.6050	0.1147	1.4911	3.0747	5.3402
2016	2.0573	0.0244	0.1533	0.0320	2.2670	-2.8818	4.6547	0.0122	1.7851	0.8696	0.6819	0.1302	1.6817	3.4668	5.7338
2017	2.0573	0.0259	0.1533	0.0320	2.2686	-3.2305	5.2180	0.0138	2.0012	0.9748	0.7644	0.1470	1.8863	3.8875	6.1561
2018	2.0573	0.0276	0.1533	0.0320	2.2702	-3.6070	5.8261	0.0154	2.2345	1.0884	0.8535	0.1641	2.1061	4.3406	6.6108
2019	2.0573	0.0293	0.1533	0.0320	2.2720	-3.9908	6.4461	0.0171	2.4724	1.2043	0.9444	0.1829	2.3315	4.8039	7.0758
2020	2.0573	0.0312	0.1533	0.0320	2.2738	-4.4100	7.1232	0.0190	2.7322	1.3308	1.0436	0.2035	2.5779	5.3101	7.5839
2021	2.0573	0.0332	0.1533	0.0320	2.2758	-4.8525	7.8378	0.0211	3.0065	1.4643	1.1483	0.2255	2.8381	5.8445	8.1203
2022	2.0573	0.0353	0.1533	0.0320	2.2779	-5.3180	8.5897	0.0233	3.2950	1.6047	1.2584	0.2489	3.1120	6.4071	8.6850
2023	2.0573	0.0375	0.1533	0.0320	2.2801	-5.8256	9.4096	0.0255	3.6096	1.7579	1.3785	0.2727	3.4091	7.0187	9.2988
2024	2.0573	0.0399	0.1533	0.0320	2.2825	-6.3618	10.2757	0.0281	3.9420	1.9197	1.5054	0.2998	3.7250	7.6669	9.9495
2025	2.0573	0.0424	0.1533	0.0320	2.2851	-6.9328	11.1980	0.0308	4.2960	2.0920	1.6405	0.3290	4.0616	8.3576	10.6427
2026	2.0573	0.0451	0.1533	0.0320	2.2878	-7.5265	12.1570	0.0337	4.6642	2.2712	1.7810	0.3597	4.4119	9.0761	11.3638
2027	2.0573	0.0480	0.1533	0.0320	2.2906	-8.1669	13.1914	0.0368	5.0613	2.4644	1.9326	0.3930	4.7900	9.8512	12.1419
2028	2.0573	0.0510	0.1533	0.0320	2.2937	-8.8645	14.3182	0.0399	5.4936	2.6749	2.0976	0.4265	5.1991	10.6927	12.9864
2029	2.0573	0.0543	0.1533	0.0320	2.2969	-9.5865	15.4844	0.0435	5.9414	2.8928	2.2685	0.4645	5.6258	11.5671	13.8641
2030	2.0573	0.0577	0.1533	0.0320	2.3004	-10.3548	16.7253	0.0473	6.4178	3.1246	2.4503	0.5051	6.0800	12.4978	14.7982
2031	2.0573	0.0614	0.1533	0.0320	2.3041	-11.1691	18.0406	0.0513	6.9228	3.3704	2.6430	0.5485	6.5619	13.4847	15.7888
2032	2.0573	0.0653	0.1533	0.0320	2.3080	-12.0412	19.4492	0.0557	7.4638	3.6335	2.8494	0.5954	7.0783	14.5420	16.8500
2033	2.0573	0.0695	0.1533	0.0320	2.3121	-12.9709	20.9509	0.0604	8.0405	3.9141	3.0694	0.6457	7.6291	15.6696	17.9817
2034	2.0573	0.0739	0.1533	0.0320	2.3165	-13.9751	22.5729	0.0651	8.6629	4.2171	3.3070	0.6957	8.2198	16.8827	19.1993
2035	2.0573	0.0786	0.1533	0.0320	2.3212	-15.0207	24.2618	0.0704	9.3116	4.5326	3.5544	0.7528	8.8398	18.1513	20.4726
2036	2.0573	0.0836	0.1533	0.0320	2.3262	-16.1352	26.0620	0.0762	10.0030	4.8689	3.8181	0.8140	9.5011	19.5041	21.8303
2037	2.0573	0.0889	0.1533	0.0320	2.3316	-17.3184	27.9732	0.0823	10.7371	5.2260	4.0981	0.8795	10.2037	20.9407	23.2723

Table 20.2.14 (1) Calculated Benefit - One Stop Border - High growth (Assumed “without case”: Existing Border Posts: Case BP-1)

Year	Border Traffic				Detoured Traffic									Grand Total
	BCTS	FTVS	VSSCS	Sub-total	VOCS(US$ mil.)				VTTS (US$ mil.)				Sub-total	
	US$ mil	US$ mil	US$ mil	US$ mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	(US$ mil,)	
2007	1.0322	0.2361	0.0257	1.2940	-0.0799	0.1290	0.0003	0.0494	0.0283	0.0222	0.0035	0.0541	0.1035	1.3974
2008	1.1236	0.2570	0.0280	1.4086	-0.4002	0.6464	0.0014	0.2476	0.1421	0.1114	0.0173	0.2708	0.5183	1.9269
2009	1.1243	0.2573	0.0283	1.4099	-0.7486	1.2091	0.0025	0.4631	0.2658	0.2084	0.0318	0.5060	0.9691	2.3790
2010	0.9915	0.2273	0.0259	1.2447	-1.1252	1.8174	0.0038	0.6960	0.3994	0.3132	0.0472	0.7599	1.4558	2.7005
2011	0.8476	0.1948	0.0233	1.0657	-1.5439	2.4938	0.0051	0.9549	0.5481	0.4298	0.0636	1.0416	1.9965	3.0622
2012	0.6916	0.1596	0.0204	0.8716	-1.9910	3.2159	0.0064	1.2313	0.7068	0.5543	0.0809	1.3419	2.5733	3.4449
2013	0.5226	0.1214	0.0173	0.6613	-2.4804	4.0064	0.0079	1.5339	0.8806	0.6905	0.0992	1.6703	3.2041	3.8655
2014	0.3394	0.0800	0.0140	0.4334	-3.0122	4.8654	0.0094	1.8626	1.0694	0.8386	0.1186	2.0265	3.8892	4.3226
2015	0.1409	0.0352	0.0103	0.1864	-3.5864	5.7928	0.0111	2.2175	1.2732	0.9984	0.1391	2.4108	4.6283	4.8147
2016	-0.0743	-0.0134	0.0064	-0.0814	-4.2174	6.8121	0.0128	2.6075	1.4972	1.1741	0.1610	2.8324	5.4398	5.3585
2017	-0.3076	-0.0661	0.0021	-0.3716	-4.8906	7.8994	0.0146	3.0235	1.7362	1.3615	0.1841	3.2818	6.3053	5.9337
2018	-0.5604	-0.1232	-0.0025	-0.6861	-5.6351	9.1020	0.0166	3.4835	2.0005	1.5688	0.2089	3.7782	7.2617	6.5756
2019	-0.8345	-0.1851	-0.0075	-1.0271	-6.4363	10.3960	0.0187	3.9785	2.2849	1.7918	0.2350	4.3118	8.2903	7.2632
2020	-1.1315	-0.2522	-0.0129	-1.3967	-7.3235	11.8291	0.0209	4.5265	2.5999	2.0388	0.2631	4.9018	9.4283	8.0317
2021	-1.4535	-0.3249	-0.0188	-1.7973	-8.2669	13.3528	0.0233	5.1093	2.9348	2.3014	0.2927	5.5290	10.6382	8.8410
2022	-1.8026	-0.4037	-0.0252	-2.2315	-9.2959	15.0150	0.0258	5.7449	3.3002	2.5879	0.3243	6.2124	11.9573	9.7257
2023	-2.1810	-0.4892	-0.0322	-2.7023	-10.4255	16.8396	0.0285	6.4425	3.7012	2.9024	0.3580	6.9616	13.4041	10.7018
2024	-2.5911	-0.5818	-0.0397	-3.2126	-11.6403	18.8018	0.0313	7.1928	4.1324	3.2406	0.3939	7.7669	14.9597	11.7470
2025	-3.0358	-0.6822	-0.0478	-3.7658	-12.9701	20.9497	0.0344	8.0139	4.6045	3.6108	0.4321	8.6475	16.6614	12.8956
2026	-3.5178	-0.7911	-0.0566	-4.3656	-14.4146	23.2828	0.0376	8.9059	5.1173	4.0129	0.4729	9.6032	18.5090	14.1435
2027	-4.0404	-0.9091	-0.0662	-5.0157	-15.9733	25.8005	0.0411	9.8683	5.6707	4.4469	0.5163	10.6339	20.5021	15.4864
2028	-4.6070	-1.0371	-0.0766	-5.7206	-17.6761	28.5509	0.0448	10.9196	6.2752	4.9209	0.5627	11.7588	22.6783	16.9577
2029	-5.2212	-1.1758	-0.0878	-6.4848	-19.5225	31.5333	0.0487	12.0595	6.9307	5.4349	0.6121	12.9777	25.0372	18.5524
2030	-5.8871	-1.3262	-0.1000	-7.3133	-18.5994	30.0423	0.0518	11.4946	6.6030	5.1780	0.6507	12.4316	23.9262	16.6130
2031	-6.0366	-1.3599	-0.1027	-7.4992	-21.7025	35.0545	0.0567	13.4087	7.7046	6.0418	0.7127	14.4591	27.8678	20.3686
2032	-6.0366	-1.3599	-0.1027	-7.4992	-21.5141	34.7501	0.0606	13.2967	7.6377	5.9894	0.7623	14.3894	27.6860	20.1868
2033	-6.0366	-1.3599	-0.1027	-7.4992	-21.3125	34.4246	0.0649	13.1769	7.5662	5.9333	0.8153	14.3147	27.4916	19.9924
2034	-6.0366	-1.3599	-0.1027	-7.4992	-21.0970	34.0763	0.0694	13.0488	7.4896	5.8733	0.8721	14.2349	27.2837	19.7845
2035	-6.0366	-1.3599	-0.1027	-7.4992	-20.8664	33.7039	0.0742	12.9117	7.4078	5.8091	0.9328	14.1496	27.0613	19.5621
2036	-6.0366	-1.3599	-0.1027	-7.4992	-20.6197	33.3055	0.0794	12.7652	7.3202	5.7404	0.9977	14.0583	26.8234	19.3242
2037	-6.0366	-1.3599	-0.1027	-7.4992	-20.3559	32.8794	0.0849	12.6084	7.2265	5.6670	1.0671	13.9606	26.5690	19.0698

Table 20.2.14 (2) Calculated Benefit - One Stop Border - Low growth (Assumed “without case”: Existing Border Posts: Case BP-1)

Year	Border Traffic				Detoured Traffic									Grand Total
					VOCS (US$ mil.)				**VTTS (US$ mil.)**				Sub-total	
	FWTS US$ mil	FTVS US$ mil	VSSCS US$ mil	Sub-total US$ mil	Chirundu	Katima Mulilo	Victoria Falls	Total($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	(US$ mil,)	
2007	0.6481	0.1472	0.0136	0.8090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8090
2008	0.6885	0.1564	0.0145	0.8594	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8594
2009	1.0145	0.2304	0.0214	1.2663	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.2663
2010	0.9485	0.2154	0.0200	1.1839	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.1839
2011	0.8782	0.1995	0.0185	1.0961	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0961
2012	0.8034	0.1825	0.0169	1.0027	-0.1305	0.2108	0.0005	0.0808	0.0463	0.0363	0.0068	0.0894	0.1703	1.1730
2013	0.7237	0.1644	0.0152	0.9033	-0.3694	0.5967	0.0015	0.2288	0.1312	0.1028	0.0193	0.2533	0.4821	1.3854
2014	0.6389	0.1451	0.0134	0.7974	-0.6231	1.0064	0.0026	0.3859	0.2212	0.1735	0.0327	0.4274	0.8133	1.6108
2015	0.5486	0.1246	0.0115	0.6847	-0.8924	1.4415	0.0037	0.5528	0.3168	0.2484	0.0471	0.6124	1.1652	1.8499
2016	0.4525	0.1028	0.0095	0.5647	-1.1784	1.9034	0.0050	0.7300	0.4183	0.3281	0.0626	0.8090	1.5389	2.1037
2017	0.3501	0.0796	0.0073	0.4370	-1.4821	2.3939	0.0063	0.9181	0.5261	0.4126	0.0791	1.0179	1.9360	2.3729
2018	0.2411	0.0548	0.0050	0.3009	-1.8045	2.9147	0.0077	1.1179	0.6406	0.5024	0.0969	1.2399	2.3577	2.6587
2019	0.1251	0.0285	0.0025	0.1561	-2.1469	3.4677	0.0092	1.3300	0.7622	0.5977	0.1159	1.4758	2.8058	2.9619
2020	0.0015	0.0004	-0.0001	0.0019	-2.5105	4.0550	0.0108	1.5553	0.8912	0.6989	0.1363	1.7265	3.2818	3.2837
2021	-0.1300	-0.0294	-0.0029	-0.1623	-2.8966	4.6786	0.0126	1.7946	1.0283	0.8064	0.1582	1.9929	3.7875	3.6252
2022	-0.2700	-0.0612	-0.0059	-0.3371	-3.3066	5.3409	0.0144	2.0487	1.1739	0.9205	0.1816	2.2760	4.3247	3.9877
2023	-0.4191	-0.0951	-0.0090	-0.5232	-3.7420	6.0442	0.0164	2.3186	1.3285	1.0418	0.2067	2.5769	4.8955	4.3723
2024	-0.5779	-0.1311	-0.0124	-0.7213	-4.2045	6.7912	0.0186	2.6053	1.4926	1.1705	0.2335	2.8966	5.5019	4.7806
2025	-0.7469	-0.1695	-0.0160	-0.9323	-4.6956	7.5845	0.0209	2.9097	1.6670	1.3072	0.2622	3.2365	6.1462	5.2139
2026	-0.9269	-0.2103	-0.0198	-1.1570	-5.2172	8.4270	0.0233	3.2331	1.8522	1.4524	0.2930	3.5976	6.8307	5.6738
2027	-1.1185	-0.2538	-0.0238	-1.3961	-5.7712	9.3218	0.0259	3.5765	2.0488	1.6067	0.3260	3.9815	7.5580	6.1619
2028	-1.3225	-0.3001	-0.0282	-1.6508	-6.3596	10.2722	0.0287	3.9413	2.2577	1.7705	0.3612	4.3894	8.3308	6.6800
2029	-1.5397	-0.3495	-0.0328	-1.9219	-6.9845	11.2816	0.0317	4.3288	2.4796	1.9444	0.3990	4.8230	9.1518	7.2298
2030	-1.7710	-0.4020	-0.0377	-2.2106	-7.6483	12.3537	0.0349	4.7404	2.7152	2.1292	0.4393	5.2838	10.0241	7.8135
2031	-2.0173	-0.4579	-0.0429	-2.5180	-8.3532	13.4924	0.0384	5.1775	2.9655	2.3255	0.4825	5.7735	10.9510	8.4330
2032	-2.2795	-0.5174	-0.0484	-2.8453	-9.1020	14.7018	0.0421	5.6419	3.2313	2.5339	0.5288	6.2940	11.9359	9.0905
2033	-2.5587	-0.5808	-0.0544	-3.1938	-9.8973	15.9865	0.0460	6.1351	3.5137	2.7554	0.5782	6.8472	12.9823	9.7885
2034	-2.8560	-0.6483	-0.0607	-3.5649	-10.7421	17.3509	0.0502	6.6590	3.8136	2.9905	0.6311	7.4352	14.0942	10.5293
2035	-3.1725	-0.7201	-0.0674	-3.9600	-11.6394	18.8002	0.0547	7.2156	4.1321	3.2403	0.6877	8.0601	15.2757	11.3157
2036	-3.5095	-0.7967	-0.0745	-4.3807	-12.5925	20.3397	0.0595	7.8067	4.4704	3.5057	0.7482	8.7243	16.5310	12.1503
2037	-3.8684	-0.8781	-0.0821	-4.8286	-13.6048	21.9748	0.0647	8.4347	4.8298	3.7875	0.8129	9.4302	17.8649	13.0363

Table 20.2.15 (1) Calculated Benefit - Ferry Improvement - High growth

(Assumed" without case": Existing Ferry: Case F-1)

Year	VOCS (US$ mil.)				VTIS (US$ mil.)				Grand Total
	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	
2001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2007	-0.1554	0.2509	0.0016	0.0972	0.0032	0.0107	-0.0079	0.0060	0.1032
2008	-0.3211	0.5186	0.0034	0.2009	0.0066	0.0222	-0.0163	0.0124	0.2133
2009	-0.4971	0.8030	0.0052	0.3111	0.0101	0.0343	-0.0253	0.0192	0.3302
2010	-0.6939	1.1209	0.0073	0.4342	0.0142	0.0479	-0.0353	0.0268	0.4610
2011	-0.8907	1.4387	0.0093	0.5573	0.0182	0.0615	-0.0453	0.0344	0.5917
2012	-1.1082	1.7900	0.0116	0.6934	0.0226	0.0765	-0.0564	0.0428	0.7361
2013	-1.3361	2.1581	0.0140	0.8360	0.0273	0.0922	-0.0679	0.0515	0.8875
2014	-1.5950	2.5763	0.0167	0.9980	0.0325	0.1101	-0.0811	0.0615	1.0595
2015	-1.8539	2.9945	0.0194	1.1600	0.0378	0.1280	-0.0943	0.0715	1.2315
2016	-2.1439	3.4629	0.0224	1.3414	0.0437	0.1480	-0.1090	0.0827	1.4241
2017	-2.4547	3.9648	0.0257	1.5358	0.0501	0.1694	-0.1248	0.0947	1.6305
2018	-2.7757	4.4834	0.0290	1.7367	0.0566	0.1916	-0.1411	0.1071	1.8438
2019	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2020	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2021	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2022	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2023	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2024	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2025	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2026	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2027	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2028	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2029	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2030	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2031	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2032	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2033	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2034	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2035	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126

Table 20.2.15 (2) Calculated Benefit - Ferry Improvement - Low growth

(Assumed "without case": Existing Ferry: Case F-1)

Year	VOCS (US$ mil.)				VTIS (US$ mil.)				Grand Total
	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	Chirundu	Katima Mulilo	Victoria Falls	Total ($mil)	
2001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2009	-0.0079	0.0127	0.0001	0.0049	0.0002	0.0005	-0.0004	0.0003	0.0052
2010	-0.1096	0.1770	0.0011	0.0686	0.0022	0.0076	-0.0056	0.0042	0.0728
2011	-0.2160	0.3489	0.0023	0.1351	0.0044	0.0149	-0.0110	0.0083	0.1435
2012	-0.3274	0.5288	0.0034	0.2049	0.0067	0.0226	-0.0166	0.0126	0.2175
2013	-0.4440	0.7172	0.0046	0.2778	0.0091	0.0307	-0.0226	0.0171	0.2950
2014	-0.5661	0.9144	0.0059	0.3542	0.0115	0.0391	-0.0288	0.0218	0.3761
2015	-0.6939	1.1209	0.0073	0.4342	0.0142	0.0479	-0.0353	0.0268	0.4610
2016	-0.8277	1.3369	0.0087	0.5179	0.0169	0.0571	-0.0421	0.0319	0.5498
2017	-0.9678	1.5631	0.0101	0.6055	0.0197	0.0668	-0.0492	0.0373	0.6428
2018	-1.1144	1.7999	0.0116	0.6972	0.0227	0.0769	-0.0567	0.0430	0.7402
2019	-1.2678	2.0478	0.0133	0.7932	0.0259	0.0875	-0.0645	0.0489	0.8422
2020	-1.4284	2.3073	0.0149	0.8938	0.0291	0.0986	-0.0726	0.0551	0.9489
2021	-1.5966	2.5789	0.0167	0.9990	0.0326	0.1102	-0.0812	0.0616	1.0606
2022	-1.7726	2.8632	0.0185	1.1091	0.0362	0.1224	-0.0901	0.0684	1.1775
2023	-1.9569	3.1608	0.0205	1.2244	0.0399	0.1351	-0.0995	0.0755	1.2999
2024	-2.1498	3.4724	0.0225	1.3451	0.0439	0.1484	-0.1093	0.0829	1.4280
2025	-2.3517	3.7985	0.0246	1.4714	0.0480	0.1623	-0.1196	0.0907	1.5621
2026	-2.5631	4.1399	0.0268	1.6037	0.0523	0.1769	-0.1303	0.0989	1.7025
2027	-2.7843	4.4973	0.0291	1.7421	0.0568	0.1922	-0.1416	0.1074	1.8495
2028	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2029	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2030	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2031	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2032	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2033	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2034	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126
2035	-2.8793	4.6507	0.0301	1.8015	0.0587	0.1988	-0.1464	0.1111	1.9126

20.3 Result of Economic Evaluation

20.3.1 Results of Evaluation Indicators

The results of evaluation indicators calculated are shown in Table 20.3.1.

Table 20.3.1 Results of Calculated Evaluating Indicators

	Project	Case	IRR	B/C		NPV (US$ mil.)	
				Discount rate: 10%	Discount rate: 12%	Discount rate: 10%	Discount rate: 12%
Bridge	Bridge (CaseB-1) (without case: Improved Ferry)	High Growth	0.1370	1.8931	1.3193	23.0674	7.9723
		Low Growth	0.0943	0.8990	0.6371	-2.6583	-9.1780
	Bridge (CaseB-2) (without case: Existing Ferry)	High Growth	0.1569	2.0095	1.5349	31.4575	15.4818
		Low Growth	0.1106	1.1541	0.8862	4.8040	-3.2941
One stop Border Post	One Stop Border Post (Case BP-1)	High Growth	0.1846	2.7258	2.0894	22.0636	12.7053
		Low growth	0.1144	1.1730	0.8909	2.1814	-1.2566
Ferry	Ferry Improvement (Case F-1)	High Growth	0.2483	3.2372	2.7388	4.1557	2.7624
		Low growth	0.1542	2.2306	1.7763	1.7526	0.9427

(1) Evaluation of Bridge Construction Project

It can be concluded from the above results that the bridge construction project is economically feasible in the case of high traffic growth scenario, as the IRRs obtained were 13.70% for Case B-1 (assumed without case: improved ferry) and 15.69% for Case B-2 (assumed without case: existing ferry), respectively. These IRRs are higher than 12%, the official discount rate being adopted in Botswana and Zambia for the evaluation of infrastructure development projects in these countries. The reason why the IRR of case B-2 (assumed “without case”: improved ferry) is higher than that of case B-1 (assumed “without case”: existing ferry) is the greater amount of detoured traffic caused by ferry capacity constraint in the case of high traffic growth scenario. The calculated indicators for the low traffic growth scenario suggest that the project is not feasible in the case of such high discount rate or opportunity cost of 12%. In this case opening of the bridge in later period of time is recommended.

(2) Evaluation of One-stop Border Post

One-stop border post construction project is proved to be feasible for the high traffic growth scenario with high IRR of 18.46%. It is not feasible for the low traffic growth scenario with a calculated IRR of 11.44%, although this is only lower rate than official discount rate of Botswana and Zambia.

(3) Evaluation of Improved Ferry

The ferry improvement project is proved to be feasible both in high growth and low growth scenarios with IRR of 24.83% for the high growth scenario and 15.42% for low growth. The high values of IRR in the ferry improvement project result from the following facts.

- Investment cost of ferry improvement is US$6.3 million, which is equivalent to about 15% of bridge construction cost of US$40.47 million in terms of economic price. This small investment cost is major reason of high economic returns obtained.
- As the capacity of existing ferry is as small as 209 vehicles/day, detouring of traffic at early stage of time tends to produce great amounts of traffic cost saving benefit.
- Because of relatively low capacity of improved ferry which is 478 vehicles/day, NPVs are small (high growth scenario: US$2.76 millions, low growth scenario: US$0.94 millions) as against that of the bridge.

From the results, all the development projects at Kazungula crossing, by and large, are feasible if these results are interpreted in the combined manner of two different traffic growth scenarios in general.

20.3.2 Sensitivity Test

(1) Sensitivity Tests for Variations of Costs and Benefits

A sensitivity test was conducted on the IRR of the bridge construction project to confirm the robustness of the evaluation system in the case of variations of original cost and benefit. These variations may be caused, in most cases, by unexpected changes in implementation schedule, cost escalation and difference between forecasted traffic and actual traffic. The test was conducted on the assumed cases of ±20% of original amounts of benefit and cost. The reasons behind these set up of criteria are as follows:

- Accuracy of feasibility study, in terms of calculation of cost and benefit, is within the level of ±20% as maximum.

- Maximum of cost escalation in such cases as prolongment of construction term is to be limited to the level of 20% increase of original cost.

The results are as shown in Table 20.3.2.

Table 20.3.2 Result of Sensitivity Analysis of the Bridge Construction Project

1) High Growth Scenario: Case B-1 (=Assumed without case: Improved Ferry)

	Benefit 20% down	Benefit Constant	Benefit 20% up
Cost 20% down	0.1370	0.1520	0.1652
Cost Constant	0.1232	0.1370	0.1492
Cost 20% up	0.1126	0.1257	0.1370

2) High Growth Scenario: Case B-2 (= Assumed without case: Existing Ferry)

	Benefit 20% down	Benefit Constant	Benefit 20% up
Cost 20% down	0.1569	0.1793	0.1996
Cost Constant	0.1368	0.1569	0.1750
Cost 20% up	0.1218	0.1403	0.1569

3) Low Growth Scenario: Case B-1 (=Assumed without case: Improved Ferry)

	Benefit 20% down	Benefit Constant	Benefit 20% up
Cost 20% down	0.0943	0.1065	0.1172
Cost Constant	0.0829	0.0943	0.1042
Cost 20% up	0.0742	0.0849	0.0943

4) Low Growth Scenario: Case B-2 (= Assumed without case: Existing Ferry)

	Benefit 20% down	Benefit Constant	Benefit 20% up
Cost 20% down	0.1106	0.0832	0.1441
Cost Constant	0.0943	0.1106	0.1250
Cost 20% up	0.0820	0.0972	0.1106

From the above, the following can be concluded:

- The highest IRRs can be obtained in the case of 20 % lower costs and 20% increase of benefits as shown in the north east corner of the Tables.
- In the low growth scenario, IRRs in 20% of benefit increase with 20% of cost down of original level in the case B-2 come up with values that are higher than discount rate of 12%. This fact suggests the project is apt to be feasible even in the low growth scenario if these conditions are met.
- The results suggest that IRRs are insensitive to the variation of cost and benefit, as the test results do not change drastically with the variation of cost and benefit.

(2) Case Study of the Opening Year of the Bridge

For the purpose of finding out the optimal year to open the bridge, a case study that assumes different opening years has been conducted as shown below, where evaluation indicators, including IRR, were calculated under two different benefit estimation scenarios as described below:

a) High Growth Scenario

Assumption 1: Opening year of the bridge: 2013

This case assumes opening year of bridge is delayed by 5 years, in which two of the benefits as shown below need to consider the effect of improved ferry.

B-1: Assumed without case: Improved ferry

Assumption 2: Opening year of the bridge: 2018

This case assumes opening year of bridge is delayed by 10 years, which coincides saturation year of improved ferry in high growth scenario.

B-1: Assumed without case: Improved ferry

b) Low Growth Scenario

Assumption 1: Opening year of the bridge: 2013

This case assumes opening year of bridge is delayed by 5 years, in which two of the benefits as shown below need to consider the effect of improved ferry.

B-1: Assumed without case: Improved ferry
B-2: Assumed without case: Existing ferry

Assumption 2: Opening year of the bridge: 2018

This case assumes opening year of bridge is delayed by 10 years, at that time the existing ferry is already saturated.

B-1: Assumed without case: Improved ferry

Assumption 3: Opening year of the bridge: 2027

This case assumes opening year of bridge is delayed until 2027, which coincides with the saturation year of the improved ferry in low traffic scenario.

B-1: Assumed without case: Improved ferry

Concepts of benefit calculation for the above are illustrated in Figure 20.3.1 ~ 20.3.4.

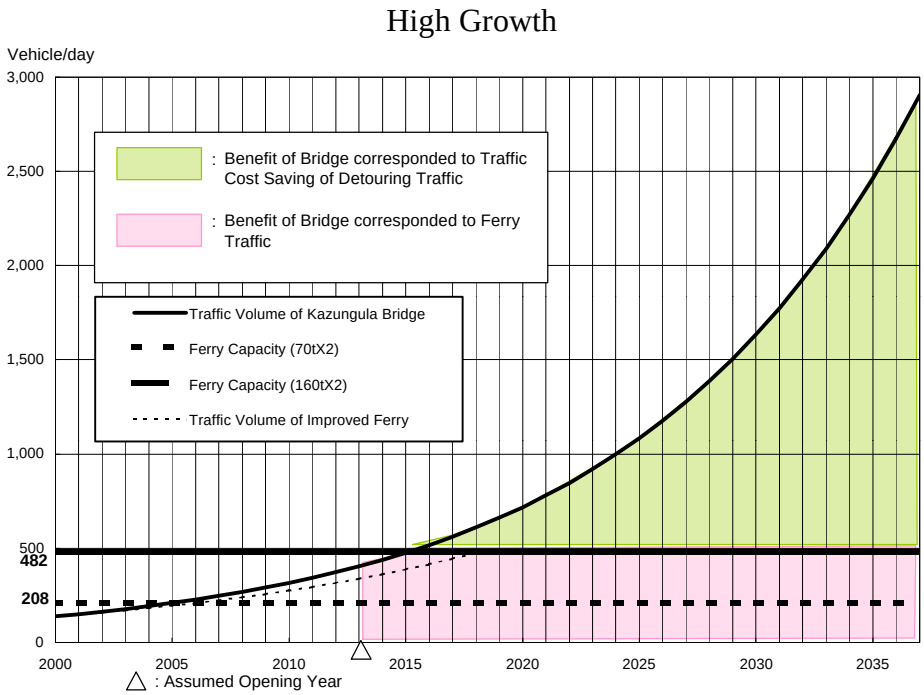

Figure 20.3.1 Concept of Benefit Calculation (Case B-1)

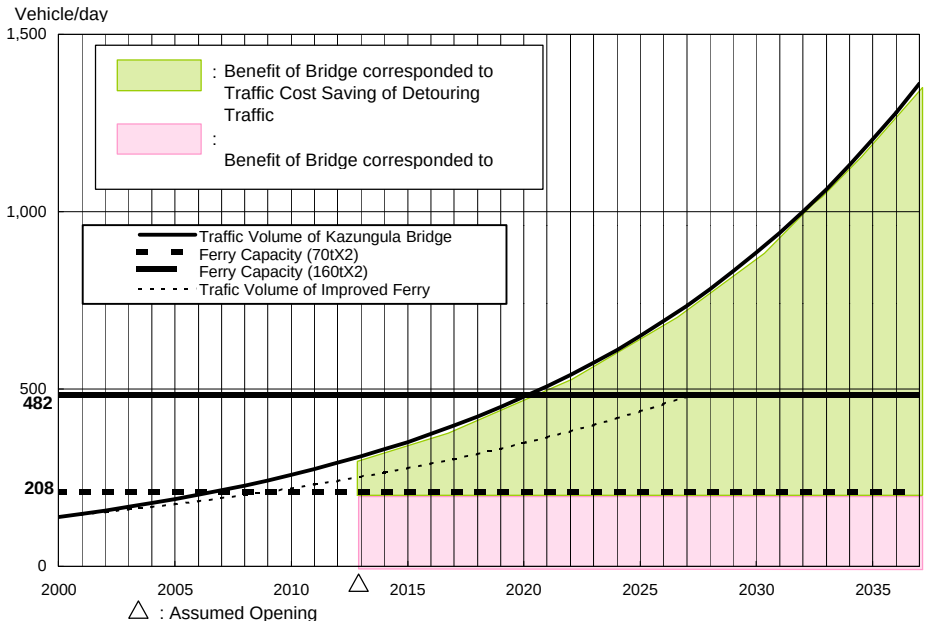

Figure 20.3.2 (1) Concept of Benefit Calculation (Case B-1)

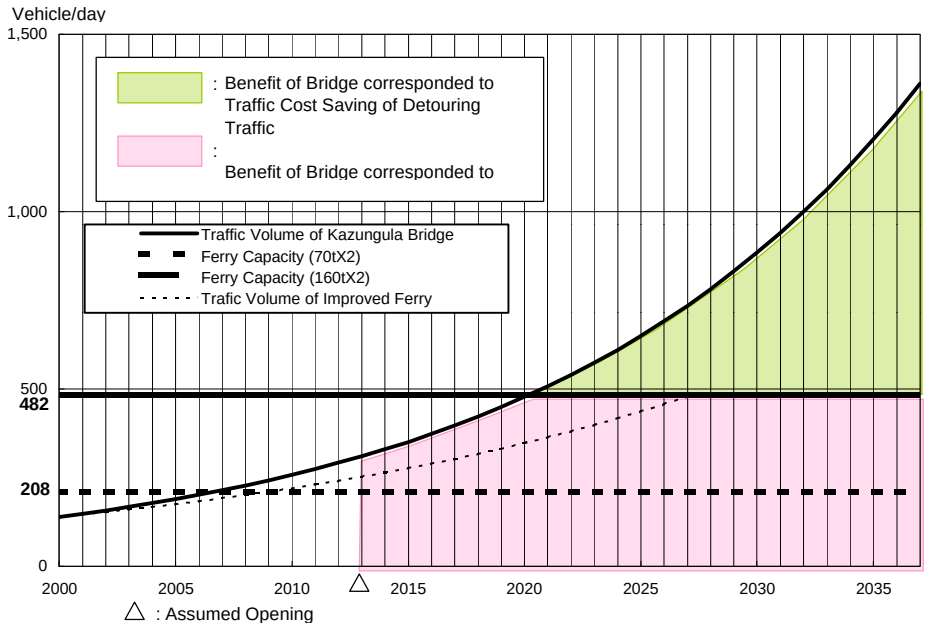

Figure 20.3.2 (2) Concept of Benefit Calculation (Case B-2)

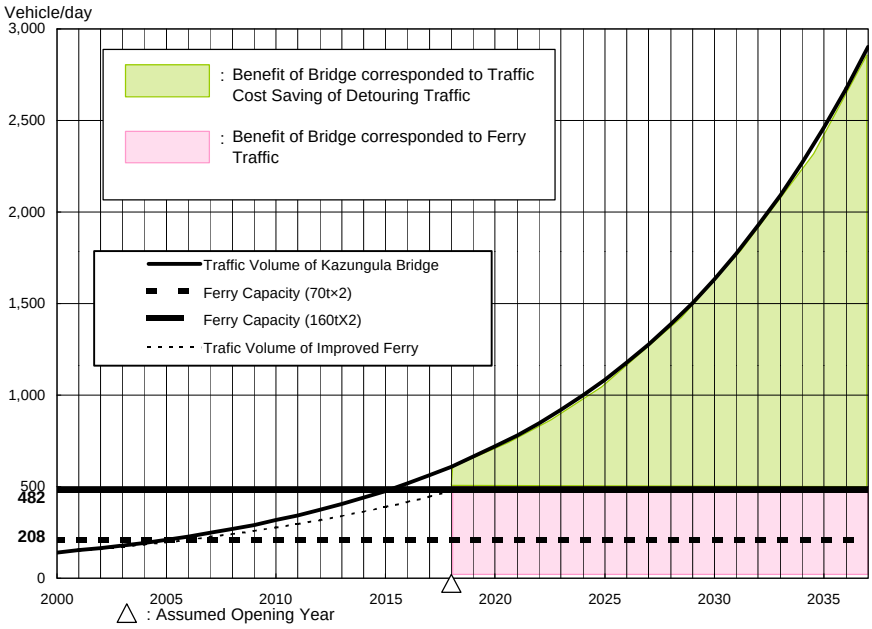

Figure 20.3.3 (1) Concept of Benefit Calculation (Case B-1)

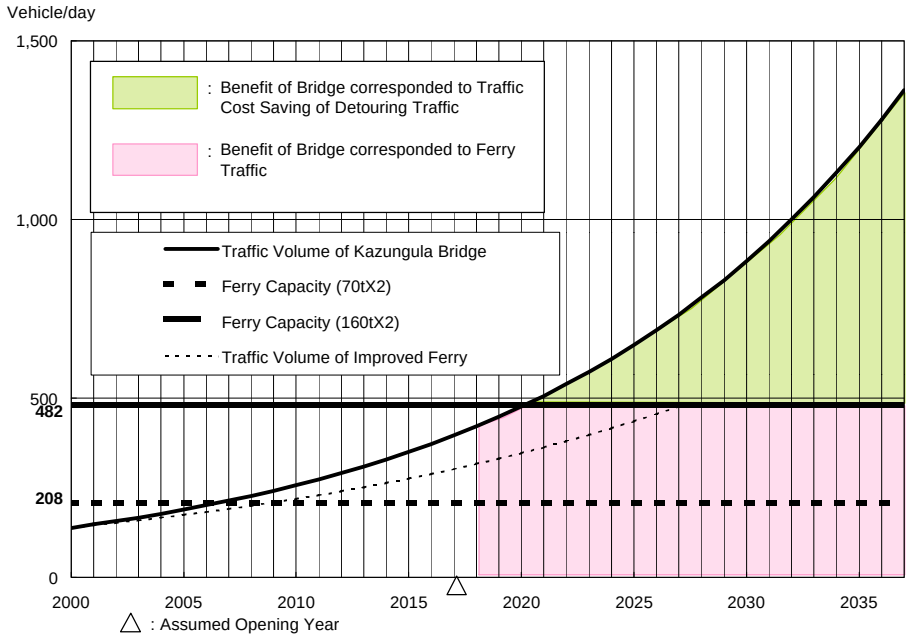

Figure 20.3.3 (2) Concept of Benefit Calculation (Case B-2)

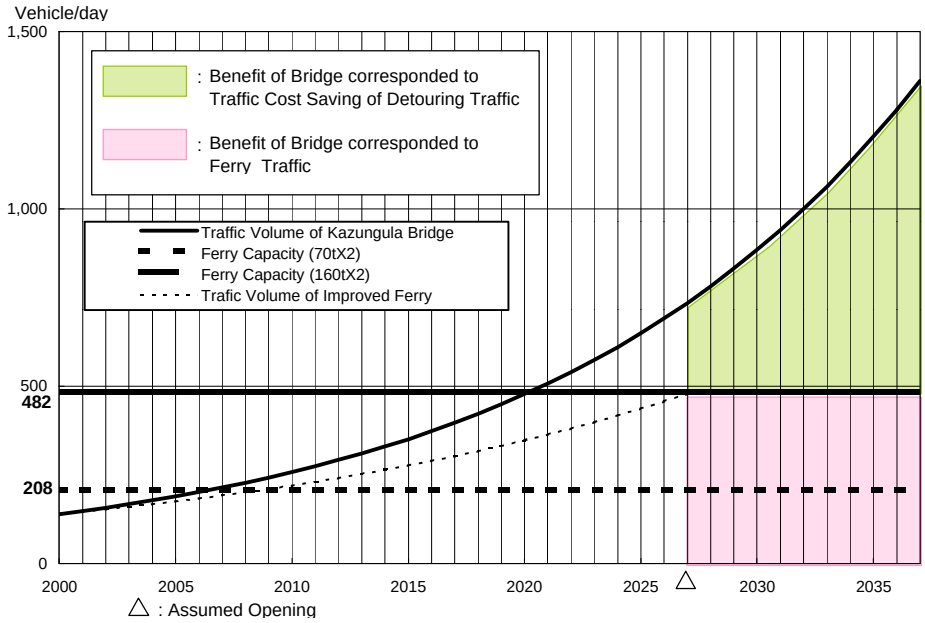

Figure 20.3.4 Concept of Benefit Calculation (Case B-2)

The results of the above calculation are shown in Table 20.3.3, and from which the following can be suggested:

- As far as IRRs for high growth scenario are concerned, the later the opening year, the higher the values of IRR that is obtained as described below.

Opening year	IRR (Case B-1)	NPV
2007 (B-2)	15.48%	US$15.48
2013 (B-2)	18.56%	US$15.78
2018 (B-1)	22.67%	US$14.91

This growing tendency of IRRs is natural as it is caused mainly by relatively greater traffic volume assumed in the later period of evaluation period than that of earlier period.

- NPVs (under 12 % of official discount rate) in high growth scenario also tend to increase with the postponement of the opening year of the bridge as described below: But maximum NPVs, in the Case B-2, where benefits are calculated under existing ferry capacity and ferry operation costs are not reckoned as residual value, appears around year 2013, that is 5 years of postponement from original schedule. This fact suggests that opening of the bridge in 2013 is more feasible in terms of national economics than that in 2007.

Table 20.3.3 (1) Sensitivity Test for Different Opening Year of Bridge-High Growth Scenario

			B/C	NPV (mil. US$)
Assumption	Alternative	IRR	12%	12%
Base Case	CaseB-1	0.1370	1.3193	7.9723
(2007 open)	CaseB-2	0.1569	1.5349	15.4818
Assumption1	CaseB-1	0.1723	2.0121	13.8263
(2013 open)	CaseB-2	0.1856	1.9624	15.7839
Assumption 2(2018 open)	CaseB-1	0.2267	2.8945	14.9167

Table 20.3.3 (2) Sensitivity Test for Different Opening Year of Bridge-Low Growth Scenario

			B/C	NPV (mil. US$)
Assumption	Alternative	IRR	12%	12%
Base Case	CaseB-1	0.0946	0.6371	-9.1780
(2007 open)	CaseB-2	0.1106	0.8862	-3.2941
Assumption1	CaseB-1	0.1122	0.8872	-1.6062
(2013 open)	CaseB-2	0.1310	1.1310	2.1480
Assumption 2 (2018)	CaseB-1	0.1419	1.3103	2.4605
(2027 open)	CaseB-1	0.1022	-2.0538	-2.0538

- NPVs (under 12 % of discount rate) in low growth scenario also tend to increase if the opening year of the bridge is postponed to 2013 and 2018 as described below. And the case of assumed opening year in 2018

produces a very good result that suggests the project is feasible under these circumstances. But NPV, along with IRR and B/C, in the case of assumed opening year of 2027 tends to decrease drastically. This fact comes from very short evaluation period of 2027-2037 in this case set-up. From the above, it could be judged that the optimal opening year in low growth scenario may lie somewhere around the year 2018.

Opening year	IRR	B/C	NPV
2007	0.0943	0.6371	US$-9.18
2013	0.1121	0.8872	US$-1.61
2018	0.1419	1.3103	US$2.46
2027	0.1022	0.7410	US$-2.05

20.4 Indirect Benefit from the Project

In addition to the direct benefits that have been incorporated in the evaluation indicators, it is expected that the project shall produce indirect benefits or intangible benefits. These benefits from the project, among other things, are itemised as follows:

- Strengthening of regional integrity,
- Promotion of local industries,
- Enhancement of farm gate prices of agricultural production,
- Inducement of community area development,
- Contribution to enhancement of Basic Human Needs,
- Contribution to Women in Development (WID),
- Strengthening of smuggling control and security,
- Enhancement traffic safety levels, and
- Contribution to mitigation of water contamination.

CHAPTER 21 FINANCIAL ANALYSIS

21.1 Introduction

This Chapter presents a financial analysis of the project for which possibilities of a toll system for the bridge and methods of procurement of financing were studied.

The project consists of three components: a bridge across the Zambezi River, one stop border post at crisscrossing area of Zambia, Botswana and Zimbabwe borders, and ferry operation improvement across the Zambezi. The probable methods of financing the project have been studied taking the international nature of this project into consideration.

21.2 Possibilities of Toll System

21.2.1 Basic Concept

As the bridge is an alternative measure of river crossing substituting for the existing ferry service that is charged, it is reasonable that bridge would be operated under toll system.

The revenue from the toll bridge shall be appropriated for refunding the loan in case of international and private financing and/or to the subsidies the maintenance cost of the bridge itself.

At present, the ferry is serviced by a Zambian para-statal company and ferry fee is being charged for the river crossing. As most of the users of the bridge are expected to be those users from the existing ferry service, toll bridge system shall be easily accepted by the users.

21.2.2 Optimal Toll Rate

In general, in the determination of optimal toll rate there are two different approaches: “Willing to Pay Principle” and “Redemption Principle” as explained below:

(1) Willing to Pay Principle

The concept behind the principle is that toll rate shall be determined at a certain level, within the level of the benefit that users may receive from project. Benefits in this case are cost of time (COT) saving, vehicle operation cost (VOC) saving and so on, and should the toll rate be higher than level of total benefit, such cases as diversion to other routes and/or abstention of trip shall occur.

(2) Redemption Principle

This is the principle that addresses that toll rate shall be set at a level that can recover project cost at the end of redemption period.

This principle stands on the side of project administrators or financiers, and is apt to result in over-charge of toll fee.

(3) Existing Ferry Fee

At present, existing ferry is serviced by Zambian Engineering Service Corporation Limited (ESCO) and discriminative fee system, different fee level to be charged by nationality of registered vehicle, is being adopted. Ongoing ferry fees by vehicle type are shown in Table 21.2.1.

Table 21.2.1 Ongoing Ferry Fee at Kazungula (Revised in April 2000)

	Vehicle Registered in Zambia		Vehicle Registered in Other Countries		
	(Kwacha)	(US$ Equivalent)	US$	Rand	Pula
Passenger Car	11,000	3.06	20	70	40
Taxi	16,000	4.44	20	70	40
Mini Bus (Private)	20,000	5.56	30	106	70
Mini Bus (Public)	23,000	6.39	30	106	70
Bus	39,000	10.83	35	140	105
Medium Truck	50,000	13.89	55	215	135
Truck (3axle)	53,000	14.72	65	235	190
Truck (4axle and over)	67,000	18.61	70	260	195
Trailer	53,000	14.72	-	-	-
Tractor with Trailer	21,500	5.97	-	-	-
Tractor	17,500	4.86	-	-	-
Bike	8,000	2.22	-	-	-
Jeep	16,000	4.44	-	-	-

US$1 = 3,600 Kwacha（November 2000）

In the traffic simulation, toll rates of the bridge are set at average ferry fee charged on Zambia and non-Zambia registered vehicle, and it is known that considerable amount of traffic uses the toll bridge with this high charge.

(4) Optimal Toll Rate

Taking the stance of “willing to pay principle”, it is reasonable to determine the toll rates at the level of benefit that users may receive from the project. With this consideration, an optimal toll rate has been determined on the basis of ferry waiting time in 2000 as shown in Table 21.2.2.

Table 21.2.2 Optimal Toll Rate by Vehicle Type

2000	Unit Vehicle Time Value (US$)	Time Saved (hour)*	Time Value Saved (US$)	PCU Factor	PCU Modified Time Value Saved (US$)	Toll Rate (Full Charge) (US$)	Optimal Toll Rate (US$)
Mode1	2.27	5.8	13.17	1	13.17	15	10
Mode2	2.81	5.8	16.30	2	32.60	35	20
Mode3	1.89	5.8	10.94	4	43.76	45	30

* Ferry waiting time in 2000

Where,

Mode1: Car,

Mode2: Bus, Medium Trucks

Mode3: Heavy Truck

In the above calculation, optimal toll rates have been set at one half of total time value saved, as it is empirically known that one half is a kind of a benchmark to determine the rate.

21.2.3 Calculation of Financial Internal Rate of Return (FIRR)

(1) Cases for FIRR Calculation

Cases for FIRR calculation were prepared as below:

Base Case:

Toll rate corresponding to existing ferry charge (Mode1: US$20, Mode2: US$55, Mode3: US$70)

Alternative of Base Case:

Toll rate corresponding to about 30% lower than existing ferry charge (Mode1: US$15, Mode2: US$40, Mode3: US$50)

Optimal Toll Rate:

Optimal toll rate as discussed in the preceding section (Mode 1: US$10, Mode2: US$20, Mode3: US$30)

(2) Assumption

FIRR has been calculated in order to examine financial viability of the toll bridge, where the following assumptions are introduced:

- Operation period of 30 years is assumed,
- Price level is set at 2000 level, where no cost escalation and no rate hike is assumed, and

- Traffic is assumed to increase according to two traffic increasing scenarios; low growth and high growth.

(3) Relation between Toll Rate and Traffic Volume

The relation between toll rate and traffic volume was established by the following model :

Traffic share of Kazungula

= 1/(1-5.0992EXP(0.0063 X)

where

X= Traffic cost by way of Kazungula VS Average Traffic cost by other Zambezi crossings

In the above, traffic cost by each crossing was determined, taking Zambia-South Africa traffic as the representative traffic, in which the total traffic Cost consists of VOC, TC and Toll Charge by each route.

The result for traffic volume in 2015 corresponding to each toll rate was estimated as below:

Unit: Vehicles/day

		High growth	Low Growth
Base case	:	464	341
Alternative of Base Case	:	474	348
Optimal Toll Rate	:	483	355

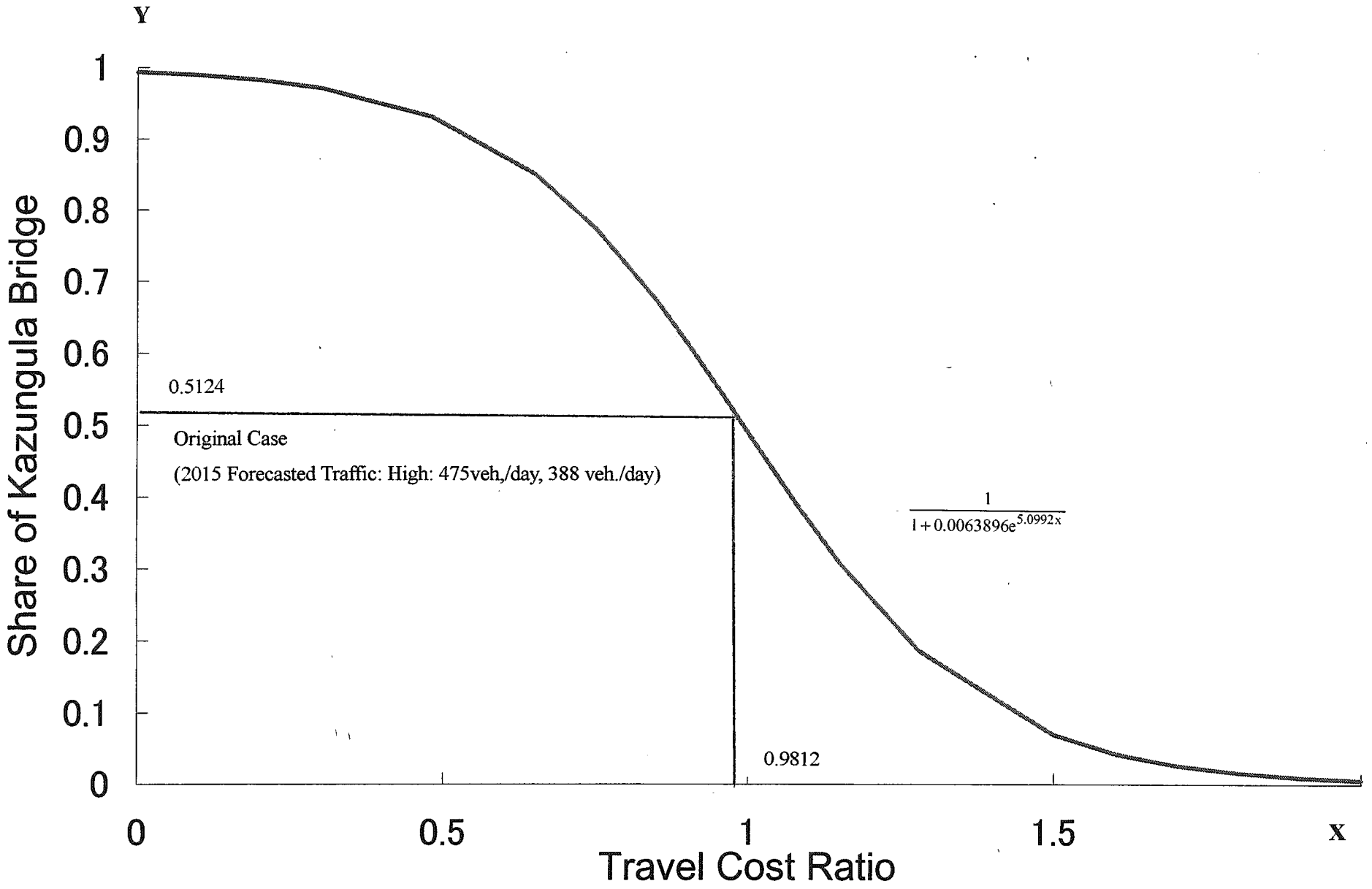

Fig. 21.2.1 Relation between Traffic Cost and Traffic Share

(4) Cost/Revenue Flow

Cost/Revenue flows, as the basis of financial analysis, have been prepared in accordance with project cost disbursement schedule expressed in financial price and calculated annual toll revenue under the toll rates as shown in Table 21.2.3 ~ 21.2.5.

Table21.2.3 (1) Cost-Revenue Flow –Base Case

(High Growth Scenario) US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	2.3496	1.0814
2008			0.1361	0.1361	5.0968	4.9607
2009			0.1361	0.1361	5.5379	5.3918
2010			0.1361	0.1361	5.9957	5.8596
2011			0.1361	0.1361	6.5031	6.3670
2012			0.1361	0.1361	7.0535	6.9174
2013			0.1361	0.1361	7.6506	7.5145
2014			0.1361	0.1361	8.2983	8.1623
2015			0.1361	0.1361	9.0010	8.8649
2016			0.1361	0.1361	9.7633	9.6277
2017			0.1361	0.1361	10.5903	10.4542
2018			0.1361	0.1361	11.4875	11.3514
2019			0.1361	0.1361	12.4608	12.3247
2020			0.1361	0.1361	13.5168	13.3807
2021			0.1361	0.1361	14.6624	14.5263
2022			0.1361	0.1361	15.9052	15.7691
2023			0.1361	0.1361	17.2536	17.1175
2024			0.1361	0.1361	18.7165	18.6804
2025			0.1361	0.1361	20.3037	20.1676
2026			0.1361	0.1361	22.0256	21.8895
2027			0.1361	0.1361	23.8939	23.7578
2028			0.1361	0.1361	25.9209	25.7848
2029			0.1361	0.1361	28.1201	27.9840
2030			0.1361	0.1361	30.5062	30.3701
2031			0.1361	0.1361	33.0951	32.9590
2032			0.1361	0.1361	35.9041	35.7680
2033			0.1361	0.1361	38.9518	38.8157
2034			0.1361	0.1361	42.2586	42.1225
2035			0.1361	0.1361	45.8466	45.7105
2036			0.1361	0.1361	49.7396	49.6035
2037			0.0681	0.0681	26.9819	26.9138

Table21.2.3 (2) Cost-Revenue Flow- Base Case

(Low Growth Scenario) US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	2.0541	0.7859
2008			0.1361	0.1361	4.3713	4.2352
2009			0.1361	0.1361	4.6512	4.5151
2010			0.1361	0.1361	4.9491	4.1830
2011			0.1361	0.1361	5.2661	5.1300
2012			0.1361	0.1361	5.6035	5.4672
2013			0.1361	0.1361	5.9622	5.8261
2014			0.1361	0.1361	6.3441	6.2080
2015			0.1361	0.1361	6.7504	6.6143
2016			0.1361	0.1361	7.1828	7.0467
2017			0.1361	0.1361	7.6429	7.5068
2018			0.1361	0.1361	8.1325	7.9964
2019			0.1361	0.1361	8.6535	8.5174
2020			0.1361	0.1361	9.2079	9.0718
2021			0.1361	0.1361	9.7978	9.6617
2022			0.1361	0.1361	10.4255	10.2894
2023			0.1361	0.1361	11.0935	10.9574
2024			0.1361	0.1361	11.8043	11.6682
2025			0.1361	0.1361	12.5607	12.4246
2026			0.1361	0.1361	13.3655	13.2294
2027			0.1361	0.1361	14.2220	14.0859
2028			0.1361	0.1361	15.1334	14.9973
2029			0.1361	0.1361	16.1033	15.9672
2030			0.1361	0.1361	17.1353	16.9992
2031			0.1361	0.1361	18.2335	18.0974
2032			0.1361	0.1361	19.4021	19.2660
2033			0.1361	0.1361	20.6547	20.5096
2034			0.1361	0.1361	21.9691	21.8330
2035			0.1361	0.1361	23.3774	23.2413
2036			0.1361	0.1361	24.8759	24.7398
2037			0.0681	0.0681	13.2353	13.1673

Table 21.2.4 (1) Cost-Revenue Flow
(Alternative of Base Case: About 30% down of Base Case)

(High Growth Scenario) US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	1.7351	0.4669
2008			0.1361	0.1361	3.7637	3.6276
2009			0.1361	0.1361	4.0821	3.9460
2010			0.1361	0.1361	4.4274	4.2913
2011			0.1361	0.1361	4.8020	4.6659
2012			0.1361	0.1361	5.2084	5.0723
2013			0.1361	0.1361	5.6492	5.5131
2014			0.1361	0.1361	6.1274	5.9913
2015			0.1361	0.1361	6.6462	6.5101
2016			0.1361	0.1361	7.2090	7.0729
2017			0.1361	0.1361	7.8195	7.6834
2018			0.1361	0.1361	8.4819	8.3458
2019			0.1361	0.1361	9.2004	9.0643
2020			0.1361	0.1361	9.9799	9.8438
2021			0.1361	0.1361	10.8256	10.6895
2022			0.1361	0.1361	11.7431	11.6070
2023			0.1361	0.1361	12.7385	12.6024
2024			0.1361	0.1361	13.8184	13.6823
2025			0.1361	0.1361	14.9901	14.8540
2026			0.1361	0.1361	16.2612	16.1251
2027			0.1361	0.1361	17.6403	17.5042
2028			0.1361	0.1361	19.1365	19.0004
2029			0.1361	0.1361	20.7599	20.6238
2030			0.1361	0.1361	22.5213	22.3852
2031			0.1361	0.1361	24.4322	24.2961
2032			0.1361	0.1361	26.5057	26.3696
2033			0.1361	0.1361	28.7533	28.6192
2034			0.1361	0.1361	31.1962	31.0601
2035			0.1361	0.1361	33.8445	33.7084
2036			0.1361	0.1361	36.7181	36.5824
2037			0.0681	0.0681	19.9180	19.8499

Table21.2.4(1) Cost-Revenue Flow
(Alternative of Base Case: About 30% down of Base Case)

(Low Growth Scenario) US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	1.5157	0.2475
2008			0.1361	0.1361	3.2256	3.0895
2009			0.1361	0.1361	3.4322	3.2961
2010			0.1361	0.1361	3.6520	3.5159
2011			0.1361	0.1361	3.8859	3.7498
2012			0.1361	0.1361	4.1348	3.9987
2013			0.1361	0.1361	4.3997	4.2636
2014			0.1361	0.1361	4.6815	4.5454
2015			0.1361	0.1361	4.9814	4.8453
2016			0.1361	0.1361	5.3005	5.1644
2017			0.1361	0.1361	5.6401	5.5044
2018			0.1361	0.1361	6.0014	5.8633
2019			0.1361	0.1361	6.3859	6.2498
2020			0.1361	0.1361	6.7951	6.6590
2021			0.1361	0.1361	7.2304	7.0943
2022			0.1361	0.1361	7.6937	7.5576
2023			0.1361	0.1361	8.1867	8.0506
2024			0.1361	0.1361	8.7114	8.5753
2025			0.1361	0.1361	9.2696	9.1335
2026			0.1361	0.1361	9.8637	9.7276
2027			0.1361	0.1361	10.4968	10.3597
2028			0.1361	0.1361	11.1685	11.0324
2029			0.1361	0.1361	11.8843	11.7482
2030			0.1361	0.1361	12.6461	12.5100
2031			0.1361	0.1361	13.4567	13.3206
2032			0.1361	0.1361	14.3193	14.1832
2033			0.1361	0.1361	15.2372	15.1011
2034			0.1361	0.1361	16.2140	16.0779
2035			0.1361	0.1361	17.2535	17.1174
2036			0.1361	0.1361	18.3596	18.2235
2037			0.0681	0.0681	9.7684	9.7003

Table 21.2.5 (1) Cost/Revenue Flow- Optimal Toll Rate

(High Growth Scenario) Unit: US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	1.0428	-0.2254
2008			0.1361	0.1361	2.2618	2.1267
2009			0.1361	0.1361	2.4528	2.3167
2010			0.1361	0.1361	2.6601	2.5240
2011			0.1361	0.1361	2.8848	2.7487
2012			0.1361	0.1361	3.1287	2.9926
2013			0.1361	0.1361	3.3931	3.2570
2014			0.1361	0.1361	3.6800	3.5439
2015			0.1361	0.1361	3.9912	3.8551
2016			0.1361	0.1361	4.3287	4.1926
2017			0.1361	0.1361	4.6949	4.5588
2018			0.1361	0.1361	5.0921	4.9560
2019			0.1361	0.1361	5.5230	5.3869
2020			0.1361	0.1361	5.9904	5.8543
2021			0.1361	0.1361	6.4975	6.3614
2022			0.1361	0.1361	7.0475	6.9114
2023			0.1361	0.1361	7.6443	7.5082
2024			0.1361	0.1361	8.2916	8.1555
2025			0.1361	0.1361	8.9939	8.8578
2026			0.1361	0.1361	9.7558	9.6197
2027			0.1361	0.1361	10.5823	10.4462
2028			0.1361	0.1361	11.4790	11.3429
2029			0.1361	0.1361	12.4518	12.3157
2030			0.1361	0.1361	13.5071	13.3710
2031			0.1361	0.1361	14.6521	14.5160
2032			0.1361	0.1361	15.8944	15.7583
2033			0.1361	0.1361	17.2421	17.1060
2034			0.1361	0.1361	18.7043	18.5682
2035			0.1361	0.1361	20.2907	20.1546
2036			0.1361	0.1361	22.0119	21.8758
2037			0.0681	0.0681	11.9396	11.8716

Table 21.2.5 (2) Cost/Revenue Flow- Optimal Toll Rate

(Low Growth Scenario) Unit: US$ Mil.

Year	Eng. Cost	Con. Cost	Maint. Cost	Total Cost	Toll Revenue	Net Revenue
2001	1.0712			1.0712		-1.0712
2002	1.0712			1.0712		-1.0712
2003	0.2381			0.2381		-0.2381
2004	0.7296	8.6631		9.3927		-9.3927
2005	0.7296	22.2795		23.0091		-23.0091
2006	0.7296	15.7107		16.4403		-16.4403
2007	0.2432	0.9570	0.0681	1.2683	0.9129	-0.3554
2008			0.1361	0.1361	1.9427	1.8066
2009			0.1361	0.1361	2.0673	1.9312
2010			0.1361	0.1361	2.1998	2.0637
2011			0.1361	0.1361	2.3408	2.2047
2012			0.1361	0.1361	2.4908	2.3547
2013			0.1361	0.1361	2.6505	2.5144
2014			0.1361	0.1361	2.8204	2.6843
2015			0.1361	0.1361	3.0012	2.8651
2016			0.1361	0.1361	3.1936	3.0575
2017			0.1361	0.1361	3.3984	3.2623
2018			0.1361	0.1361	3.6162	3.4801
2019			0.1361	0.1361	3.8481	3.7120
2020			0.1361	0.1361	4.0949	3.9588
2021			0.1361	0.1361	4.3574	4.2213
2022			0.1361	0.1361	4.6369	4.5008
2023			0.1361	0.1361	4.9342	4.7981
2024			0.1361	0.1361	5.2507	5.1146
2025			0.1361	0.1361	5.5874	5.4513
2026			0.1361	0.1361	5.9458	5.8097
2027			0.1361	0.1361	6.3272	6.1911
2028			0.1361	0.1361	6.7330	6.5969
2029			0.1361	0.1361	7.1649	7.0288
2030			0.1361	0.1361	7.6245	7.4884
2031			0.1361	0.1361	8.1136	7.9775
2032			0.1361	0.1361	8.6342	8.4981
2033			0.1361	0.1361	9.1881	9.0520
2034			0.1361	0.1361	9.7776	9.6415
2035			0.1361	0.1361	10.4050	10.2689
2036			0.1361	0.1361	11.0726	10.9365
2037			0.0681	0.0681	5.8916	5.8235

(5) FIRR

From the above Cost/Revenue Flows, FIRR of 0.1444 for high growth scenario and 0.1145 for low growth scenario were obtained for the respective base cases, as shown in Table 21.2.6.

Table 21.2.6 Results of Sensitivity Test

	Base Case	Alternative of Base Case	Optimal Toll Rate
High Growth Scenario	0.1444	0.1196	0.0839
Low Growth Scenario	0.1145	0.0910	0.0571

21.2.4 Some Results of Financial Analysis about the Proposed Toll Bridge

From the above analysis following the conclusions can be obtained:

- Total revenue from the toll bridge throughout the project life is estimated to be about US$605 million for high growth scenario and US$360 million for low growth scenario in the base case, which is 10.7 and 6.4 times of total project cost of the bridge in financial prices, respectively.
- The revenue is large enough to cater to annual and periodic maintenance cost of the project.
- The IRR for optimal toll rate is 0.0839 in the high growth scenario, that is fairly good value when it is considered that the toll rates in this case are at very low level as against the existing ferry charge (Mode1: US$20, Mode2: US$55, Mode3: US$70).
- Should a toll rate hike be introduced in future, a higher FIRR would be obtained which would justify financial viability of the toll bridge.

21.3 Procurement of Finance

21.3.1 Project Cost

The financial project costs by component of the project are as follows:

Bridge and Access Road

- Engineering Cost: US$ 4.81 million
- Construction Cost: US$47.61 million (of which maximum disbursement per annum is US$ 23.01 million in 2005)
- Maintenance Cost: US$4.08 million
- Total Cost: US $ 56.51 million

One-Stop Border post

- Engineering Cost: US$ 2.29 million
- Construction Cost: US$15.25 million (of which maximum disbursement per annum is US$ 8.53 million in 2004)
- Maintenance Cost: US$13.23 million
- Total Cost: US$30.76 million

Ferry Improvement

(High Growth Scenario)

- Facility Improvement Cost: US$ 7.45 million
- Operation Cost: US$33.21 million
- Total Cost: US$40.66 million

(Low Growth Scenario)

- Facility Improvement Cost: US$ 5.79 million
- Operation Cost: US$29.96 million
- Total Cost US$35.75 million

21.3.2 Financing Methods

Apart from the availability, there are the following conceivable methods of financing:

Method 1: Domestic Financing by Botswana and Zambia

This is a method of financing the project by the individual governments, with agreement on the share of cost to be borne by each government. However, this method is unrealistic in light of the relatively small budgets of both governments, especially that of Zambia as shown in Table 21.3.1

Table 21.3.1 (1) Budget of Implementation Agencies (Zambian MOWS)

Unit: Mil. Kwacha

	1994/5	1995/6	1996/7	1998/9
Total Government	964,569	1,266,026	1,625,562	1,818,339
MOWS	56,755	64,114	81,193	119,845
Road Department	57,714	70,461	112,919	221,407
Maintenance	50,173	58,579	71,071	113,455

US$1=3,600 Kwacha (Nov, 2000)

Table 21.3.1 (2) Budget of Implementation Agencies (Botswana MWTC)

Unit: Mil.Pula (97price)

		1996/7	1998/9	1999/2000
Development Budget of MWTC	Development Budget	386.7	349.9	279.3
	Road/Bridge	204.8	212.2	151.1
Recurrent Budget of MWTC	Recurrent Budget	459.8	483.7	508.9
	Road/Bridge	108.9	111.7	114.6
Total MWTC Budget	MWTC Budget	846.5	833.6	788.2
	Road/Bridge	313.7	323.9	265.7

US$1=5.5 pula (Nov, 2000)

Method2: Private Financing

The results of relatively high FIRR obtained in the financial analysis suggests that there is some potential of project financing by the private sector under such method of BOT and so on.

Method3: International Financing

Recognising the huge project cost and international nature of the Project, it is most realistic to finance it under international financing schemes either loan or grant basis by international donors available.

In the case of International Financing, there are following two distinctly different methods:

- ODA: Official Development Assistance from international financiers such as World Bank, AFDB and/or foreign governments
- Non-ODA: Such official project financing method as OOF(Other Official Flow)

21.3.3 Implementation Method

As far as economic evaluation is concerned, the project proposed in the study is mainly feasible. Furthermore, the simple cost/revenue analysis suggests that the revenues from the toll bridge can cover a great portion of project cost. Under these conditions, implementation of the project is a matter to be discussed among the concerned parties in line with the probable financing method to be adopted.

Furthermore, the international nature of the project entails many international arrangements to be conducted before the initiation of the plan, that are closely related to financial arrangement of the project.

With regard to the international financing of this bilateral project, either of the

following methods is probable:

Method 1: Separate finance to Botswana and Zambia

After the arrangement of legal matters such as (e.g. property ownership, international boundary, responsibility of maintenance, and toll levying right) the type and conditions of international financing, including the term of repayment, interest rate and so on, shall be discussed between the recipient governments and probable international financiers, independently.

Method 2: Finance to one of the governments that is a representative of the project implementation body

After the same discussion between Botswana and Zambia and agreement attained, method of international financing shall be discussed between the representative government selected and probable international financiers. The arrangement between Botswana and Zambia is subject to the two governments.

In either case, it is recommended that the governments of Botswana and Zambia should establish a joint committee for the project preparation at an early stage.

CHAPTER 22 COMPREHENSIVE CONCLUSIONS AND RECOMMENDATIONS

22.1 Engineering Conclusions and Recommendations

(1) Environment

According to the initial environmental evaluation on the Kazungula Bridge construction, the adverse impacts on the natural and socio-economic environment are rather small. However, mitigation programme in collaboration with the authorities to the adverse impacts such as revegetation, resettlement, and monitoring services during the construction are needed. An Environmental Management Plan (EMP) was proposed to address the management of the environmental issues associated with the Project. The Plan consists of the three main components: implementing specific mitigation measures, establishing an institutional framework for the EMP, and implementing monitoring the EMP.

(2) Border Control Facilities

The issues of the existing border control facilities are: inadequate office space to conduct proper formality, inadequate parking areas to accommodate current traffic, inadequate number of office facilities, lack of inspection facilities, manual formality recording, and lack of appropriate protection against wildlife attack. The clearance time of the procedures for immigration and customs clearance is directly being affected by these issues. Therefore, the improvement of the existing operation and facilities corresponding to increasing vehicle traffic volume is needed.

Since the existing two-stop border control system needs two clearance procedures at each departure and arrival border, it causes tremendous time loss and stagnation of economic growth of the Southern African region. In order to solve the issues for attaining efficient and smooth cross border process, adoption of the one-stop border system which needs only one time stop for departure and arrival clearance is inevitable, and has been agreed and committed by the relevant governments.

The separated type of border control post, which proposes one facility in each country, was recommended for its smaller occupied area, simple road alignment, user’s convenience in clearance process, convenient administration from legal and economic aspects, and shorter construction time.

(3) Alternative Route and Bridge Type

The alternative Route C was selected and concluded for technical and economical reasons in terms of shorter alignment and less hydraulic issues involved. As to bridge type, Prestressed Concrete Extra-dosed bridge type was recommended from the reasons for superiority in low construction cost, vertical gradient, concrete works and symbolic appearance.

(4) Construction Duration

The whole period of construction of bridge and approach roads will be 3 years and 3 months. The timing of the starting of temporary bridge and foundation works in the river, during the flooding period from February to June, would be especially taken into consideration.

(5) Maintenance

To create the effective implementation of all maintenance activities for the new facilities (bridge and roads, and border control facilities), the administration system for maintenance should be organised within the existing organisations.

(6) Project Outline

The Project package will be divided into two packages with different characteristics in administration and technical aspects. Package-1 consists of bridge and approach roads. Package-2 consists of the three border control facilities. The project outlines are:

Package-1

-	Total project length of Bridge and Approach Roads	:	3,700 m
-	Total Bridge Length	:	720 m
-	Main Bridge Length	:	465 m
-	Approach Road (Zambia side)	:	1,383 m
-	Approach Road (Botswana side)	:	1,597 m
-	Total Approach Roads Length	:	2,980 m

Package-2

-	Border Control Facility (Zambia)	:	15.8 ha
-	Border Control Facility (Botswana)	:	17.1 ha
-	Border Control Facility (Zimbabwe)	:	12.1 ha
-	Passing Road (Zimbabwe)	:	600 m

(7) Project Cost

The project cost and its breakdown are (unit: thousand USD) described as below:

-	Construction Cost	:	47,668
-	Engineering Cost	:	4,766
-	Administration Cost	:	2,860
-	Land Acquisition and Compensation	:	6
-	Price Escalation & Physical Contingency, etc.	:	9,532
-	Duty Tax (VAT)	:	4,766
	Total Project Cost	:	70,317

22.2 Socio-economic Framework and Traffic Demand Forecast

(1) General

Preparation of future socio-economic framework and succeeding traffic demand forecast have been conducted from the following view points:

- The project is positioned as one of the components of improving the overall transportation network is SADC region. Therefore, the project is expected to conduct unobstructed traffic flow in the region and to induce regional development such as promotion of local industries.

- Recognising that the Zambezi Crossings have been a constraint to free traffic movement in SADC region, the role of Kazungula Bridge, in conjunction with other crossings such as Chirundu Bridge, Victoria Falls Bridge and proposed Katima Mulilo Bridge.

In the above context, results of the analysis obtained in the study are described as follows:

(2) Socio-economic Framework

Present Condition

As far as the economic development of SADC countries concerns, the polarisation of regional economies is occurring: One group consists of countries such as Botswana and Namibia where steady development of national economies are being attained. On the other hand are such countries as Zambia and Malawi which showed negative economic growth in the same period. The economy in the total SADC was stagnated with annual GDP growth rate during the period at 1.4%.

Prospect of Future Economy

In spite of this unfavourable achievement of economies in SADC in the last decade, there are some good prospects for development which allow prediction future economies of SADC countries.

These are:

- SADC region is endowed with untapped natural resources of mineral, fuel and vast agricultural lands for the great leaps in future,

- With the ceasefire of internal turmoil in Angola and Congo, the target of national development is plausible to be turned to economic development of the nations.

- It is expected that structural adjustment efforts and deregulation policies undertaken by governments in the last decade may function as the catalysis of future economic development.

- The steady implementation of transportation development undertaken in the last decade may induce regional development with the provision of easy accessibility among SADC countries.

In this context, SATCC, the transportation development committee of SADC in its recent study report of "Transport and Communications Integration - The Catalyst for economic development in South Africa" has set forth rather ambitious prospect of future development.

The framework of this study has been prepared adopting the viewpoints of the above SATCC study report, and set force the prospect of economic growth at 3.4% per annum in high growth scenario and 3.0% in low growth scenario respectively.

In addition to the above, standing on the viewpoint that the proposed development plans in Botswana and Livingstone are spurred by the project, all the envisioned projects such as tourism development in Okavango Delta and Chobe National Park in Botswana and Livingstone District are included in the framework.

(3) Traffic Demand Forecast

Traffic demand forecast has been conducted on the basis of above future socio-economic framework and prospects of the future transportation development proposed by SATCC. Especially, the traffic volume at proposed Katima Mulilo Bridge is carefully examined in conjunction with the traffic volume at the Kazungula bridge.

The normal traffic volume at Kazungula in 2015 is forecast to be 475 vehicles a day in high growth scenario and 350 vehicles a day in low growth scenario.

22.3 Evaluation Results

Results of Economics/Financial Evaluations.

Economic Evaluation

Three of the project components; the bridge at Kazungula, one-stop border post and ferry improvement were individually evaluated. As a result, it was found that the bridge and the one-stop border are both economically feasible for the high traffic growth scenario with calculated Internal Rate of Return (IRR) of more than 12%, which is the official discount rate for both Botswana and Zambia. The ferry improvement plan was proved feasible with calculated IRRs of more than 12% for both high and low growth scenarios.

The results of a case study on different opening years suggest that a bridge opening in 2013 produces higher economic returns in high growth scenario, whilst an opening in 2018 produces higher economic returns for the Low growth scenario.

Financial Evaluation

It was found that the toll bridge system shall bring high revenue. This fact suggests that project implementation under private financing is viable as is ODA by international financiers.

According to the budget analysis of implementing agencies of Botswanan MWTC and Zambian MOWS, it could be concluded that both government agencies are not capable of carrying the total project cost, but could support annual maintenance costs of the project after completion.

It is reasonable to propose that the project be financed by international financing, should the details of implementation method and responsibilities of each counties and so on be clearly determined in the negotiation among concerned governments.

There are essentially only two possible international financing measures for the project as described below:

- Separate financing to Botswana and Zambia from international financiers
- Financing to one representative government which could be either Botswana or Zambia. The details of financial conditions, owner ship of property, and conditions for redemption of fund, and so on have to be discussed by the two nations.

Kinds and types of financing are a matter to be discussed among concerned parties.

22.4 Recommendations towards Materialisation of the Project

On the basis of the study conclusions, the recommendations toward the materialisation of the Project are as follows:

Settlement of International Borders in the River: The international boundaries on shore in and around the bridge crossing site are clearly identified by several concrete stakes, but it is difficult to identify the off shore boundaries one map due to missing written documents related to the boundaries. Prior to the commencement of the further stage, the international borders in the Zambezi River shall therefore be settled by a joint committee composed of Representatives from the Governments of Zambia, Botswana, Zimbabwe and Namibia.

Formulation of Project Management Joint Committee: For smooth project implementation in the succeeding stage, it is requisite to formulate a project management joint committee (provisionally called) composing of high level Government officials from Zambia and Botswana, and also attended by Representatives from the Governments of Zimbabwe and Namibia as an observer. This Committee is mainly responsible for tasks such as seeking project financial source(s), determination of ownership of the bridge, project implementation and procurement method, formulation of regulations of usage and maintenance, and setting up of management policy and bridge maintenance strategy and other key issues related to the project implementation.

After completion of the Project, this committee will be re-organised to function as **Kazungula Bridge Authority (KBA)** that will be responsible for operation and maintenance of the Bridge.

Special Attention for Construction of Bridge Across the Border: Each country has its own legal system, regulations, guidelines, and different customs and culture. Consequently, some conflicts and misunderstandings are likely to arise, especially concerning construction of a bridge across the border. A successful example with similar features to the Project in the SADC region is the New Chirundu Bridge Construction Project between Zambia and Zimbabwe, which is being implemented with Japan's Grant Aid Scheme. Some of the lessons from implementing the Chirundu Project will be applicable to the Kazungula Bridge Construction Project, but some other possible issues derived from differences in site conditions and socio-economic situations between the two projects shall be taken into consideration. The issues from the Chirundu Project applicable to the Kazungula Bridge Construction Project are as follows:

- Distinguished construction area as an neutral zone
- Issuance of border pass for free passage of the Project staff and vehicles

- Assignment of joint security force for unity
- Application of standardised wage rates for labour and technicians in the Project

The Study Team concludes that the construction of the Kazungula Bridge, by and large, is technically and economically feasible. Thus, it is recommended that the implementation of the Project be made in future.