Seismological Bulletin

for the

Malawian Seismic Network

April to December

1989

by the

Seismology Section

At

Department of Geological Survey
Zomba
Malawi

April-December 1989

STATION	LATITUDE	LONGITUDE	HEIGHT(m)	NAME	
AAE	9.029N	38.766E	2442	ADDIS ABABA ,	ETHIOPIA
ALE	9.430N	42,040E	2133	ALEMAYA	--------
WNDE	7.040N	38.370E	2420	WENDOGENET	--------
NAI	1.274S	36.837E	1692	NAIROBI,	KENYA
TDM	9.296S	32.771E	1590	TUNDUMA,	TANZANIA
ITB	9.429S	33.186E	1270	ITUMBA,	TANZANIA
ITK	8.873S	32.783E	1590	ITAKA,	TANZANIA
MBA	8.874S	33.453E	1780	MBEYA,	TANZANIA
PDH	8.983S	33.242E	1340	PANDA HILL,	TANZANIA
MTD	16.780S	31.585E	967	MOUNT DARW,	ZIMBABWE
KRI	16.830S	29.615E	1343	KAROI,	ZIMBABWE
CIR	21.013S	31.580E	430	CHIREDZI,	ZIMBABWE
BUL	20.143S	28.613E	1341	BULAWAYO,	ZIMBABWE
DOT	6.208S	35.756E	1204	DODOMA,	TANZANIA
ART	3.440S	36.640E		ARUSHA,	TANZANIA
ENT	0.055N	32.470E	1175	ENTEBBE,	UGANDA
HOI	1.417N	31.342E	1097	HOIMA,	UGANDA
KIL	0.200N	30.000E	1372	KILEMBE,	UGANDA
LSZ	15.277S	28.188E	1184	LUSAKA,	ZAMBIA
KMZ	13.456S	25.834E	1224	KASEMPA,	ZAMBIA
MZZ	11.142S	28.876E	1256	MANSA,	ZAMBIA
IKZ	10.171S	32.646E	1350	ISOKA,	ZAMBIA
PTZ	14.249S	31.339E	1027	PETAUKE,	ZAMBIA
ZOM	15.373S	35.331E	0970	ZOMBA,	MALÀWI
LLN	14.184S	33.775E	1106	LILONGWE,	MALAWI
MZM	11.434S	34.035E	1258	MZUZU,	MALAWI
LLO	13.912S	33.790E	1106	LILONGWE,	MALAWI
MZU	11.425S	34.010E	1256	MZUZU,	MALAWI

The model used is;

P-wave velocity (km)	Depth to interface(km)
6.2	0.0
6.6	13.0
8.0	38.0
8.1	50.0
8.2	80.0
8.4	300.0

Vp/Vs velocity ratio: 1.74
Lg velocity : 3.5 km/sec

Coda magnitude scale Mc = -1.2 + 1.9 log(coda) + 0.0004 * dist
where coda is coda length in secs and distance is epicentral distance.

Information Page

Abreviations:

TIME:	Origin time in GMT (hour, minute and second)
LAT:	Latitude of epicenter
LON:	Longitude of epicenter
DEPTH:	Focal depth in kilometer (Trailing F indicates fixed depth)
AGENCY:	Hypocenter reporting agency
MAGNITUDES:	Up to 3 different magnitudes are given followed by type and reporting agency
RMS:	Root mean square value of travel time residuals
STAT:	Station code
CO:	Component
DIST:	Distance (km)
AZI:	Azimuth from source to station
PHAS:	Phase; The first letter characterizes onset E(mergent) or I(mpulsive)
P:	Polarity
HR:	Hour, a * in front of of HR means that S - P time has been used
MN:	Minute
SECON:	Seconds
TRES:	Residual (seconds)
CODA:	Signal duration in seconds
AMPL:	Ground Amplitude (0.5*pp, nm) at period PERI
PERI:	Period of phase where amplitude is measured
BAZ:	Back azimuth (station to event)
ARES:	Back azimuth residual
VELO:	Apparent velocity of phase
WT:	Weight of phase in the location

April 8 1989 Hour: 9: 9 23.0 Agency: EAF Local

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			EP		0909	23.0		154						

April 9 1989 Hour: 2:35 22.0 Agency: EAF Local

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			EP		0235	22.0		68						
CLK	SZ			ISN		0235	49.0								

April 11 1989 Hour: 4:15 35.0 Agency: EAF Local

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			IP	D	0415	35.0		293						
CLK	SZ			ISN		0417	25.0								

April 17 1989 Hour: 4:21 23.3 Lat: 14.73S Lon: 33.98E Depth: 15 Agency: EAF Local
Magnitudes: 3.1MC EAF Rms: 1.2 secs

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ	150	134	EP		0421	52.0	5.0	178						.3
CLK	SZ	150	134	ISN		0422	01.0	-3.7							.3
PTZ	SZ	290	281	IPN		0422	05.0	.4							1.0
PTZ	SZ	290	281	IPG		0422	12.7	.1							1.0
PTZ	SZ	290	281	ISN		0422	41.2	6.0							.0
PTZ	SZ	290	281	ISG		0422	53.0	4.0							.0
LSZ	SZ	626	265	IPN		0422	48.0	1.3							.9
LSZ	SZ	626	265	ISN		0423	45.3	-3.0							.2
LSZ	SZ	626	265	ISG		0424	32.0	3.9							.0
KMZ	SZ	891	280	IPN		0423	16.4	-3.4							.4
KMZ	SZ	891	280	ISN		0424	40.0	-6.0							.0
KMZ	SZ	891	280	ISG		0425	36.0	-10.2							.0

April 19 1989 Hour: 14:33 22.0 Agency: EAF Local

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			EP		1433	22.0		106						
CLK	SZ			ISN		1433	35.0								

April 20 1989 Hour: 11:41 25.0 Agency: EAF Local

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			IP	C	1141	25.0		140						
CLK	SZ			ISN		1141	28.0								

April 20 1989 Hour: 18:18 18.2 Lat: 13.54S Lon: 34.37E Depth: 0 Agency: EAF Local
Magnitudes: 3.8MC EAF Rms: .6 secs

STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ	245	164	IP	D	1818	54.5	-1.4	398						.5
CLK	SZ	245	164	ISN		1819	24.0	.1							1.0
PTZ	SZ	337	257	IPN		1819	08.0	.6							1.0
PTZ	SZ	337	257	ISN		1819	46.0	2.2							.5
LSZ	SZ	694	255	IPN		1819	52.0	.0							.8
LSZ	SZ	694	255	ISN		1821	02.0	.5							.8
LSZ	SZ	694	255	ISG		1821	42.0	-.7							.8
KMZ	SZ	924	272	IPN		1820	20.3	-.5							.8
KMZ	SZ	924	272	ISN		1821	51.0	-.6							.8

April 27 1989 Hour: 7:57 42.0 Agency: EAF Local

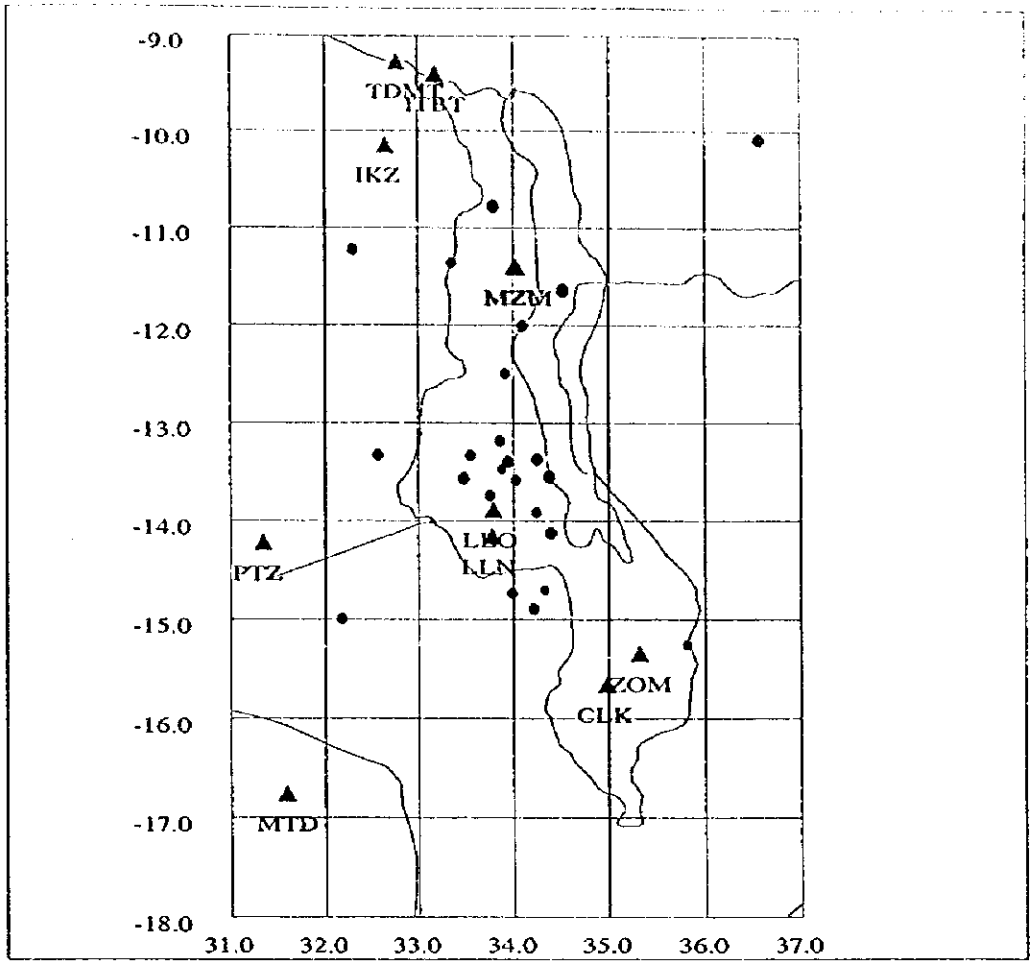
STAT	CO	DIST	AZI	PHAS	P	HRMN	SECON	TRES	CODA	AMPL	PERI	BAZ	ARES	VELO	WT
CLK	SZ			EP		0757	42.0		72						

EVENTS FOR 1989

Total events: 104
Selected events: 25

Magnitudes:

M = 0 +
M = 1 .
M = 2 •
M = 3 ●
M = 4 ●

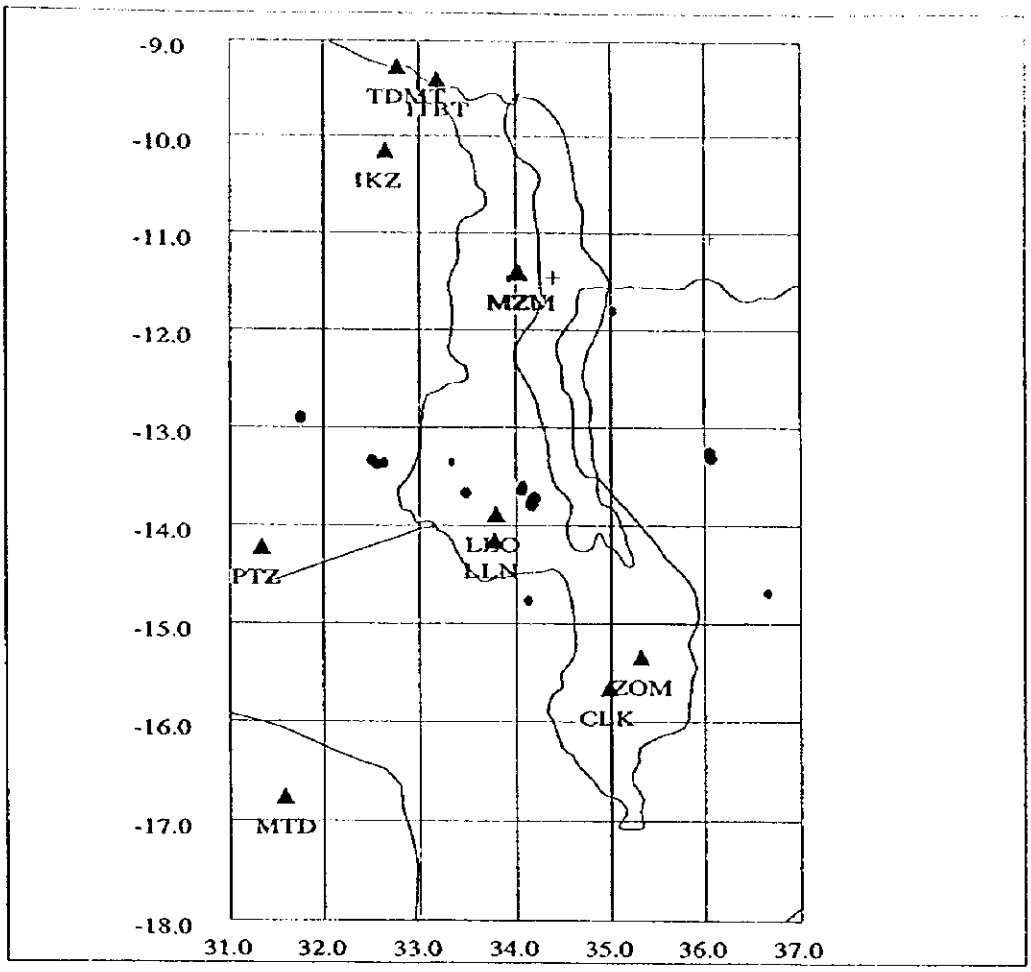


EVENTS FOR 1990

Total events: 139
Selected events: 18

Magnitudes:

M = 0 +
M = 1 .
M = 2 •
M = 3 ●

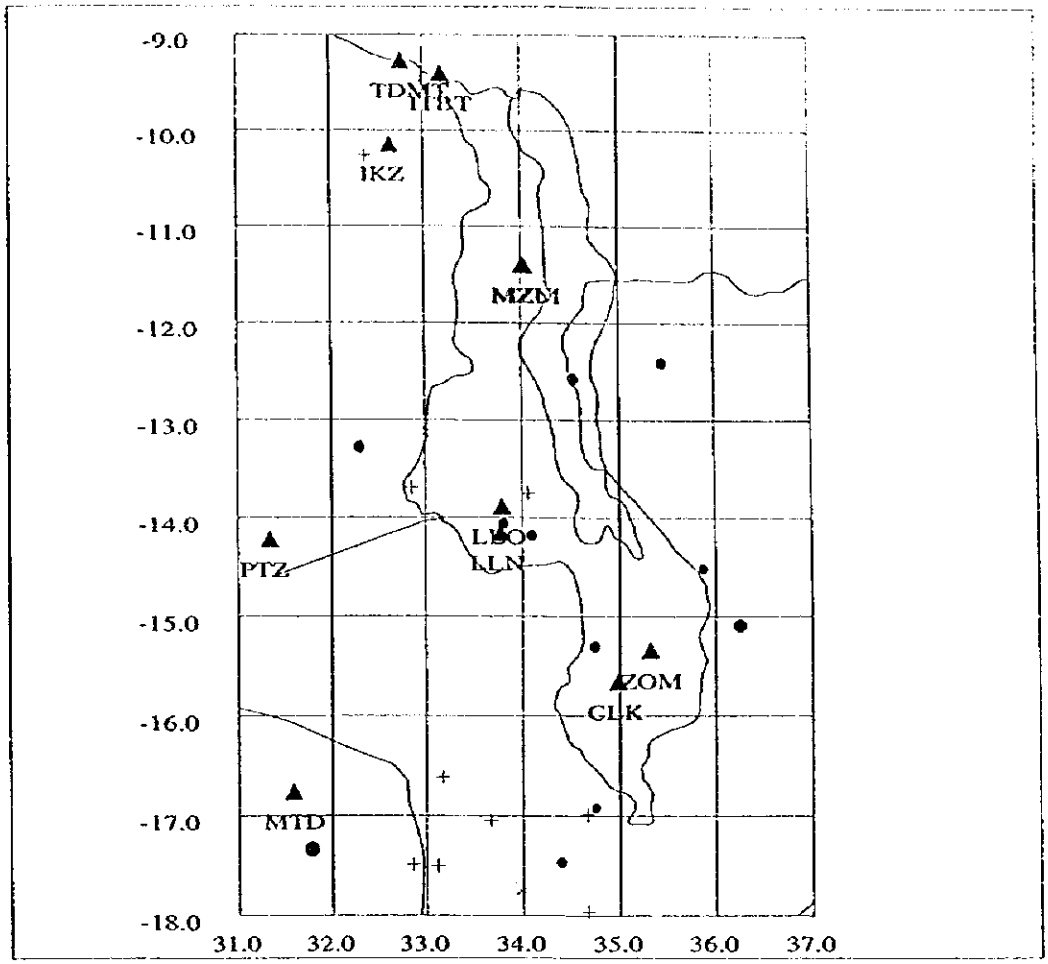


EVENTS FOR 1991

Total events: 155
Selected events: 20

Magnitudes:

M = 0 +
M = 1 .
M = 2 •
M = 3 ●
M = 4 ●

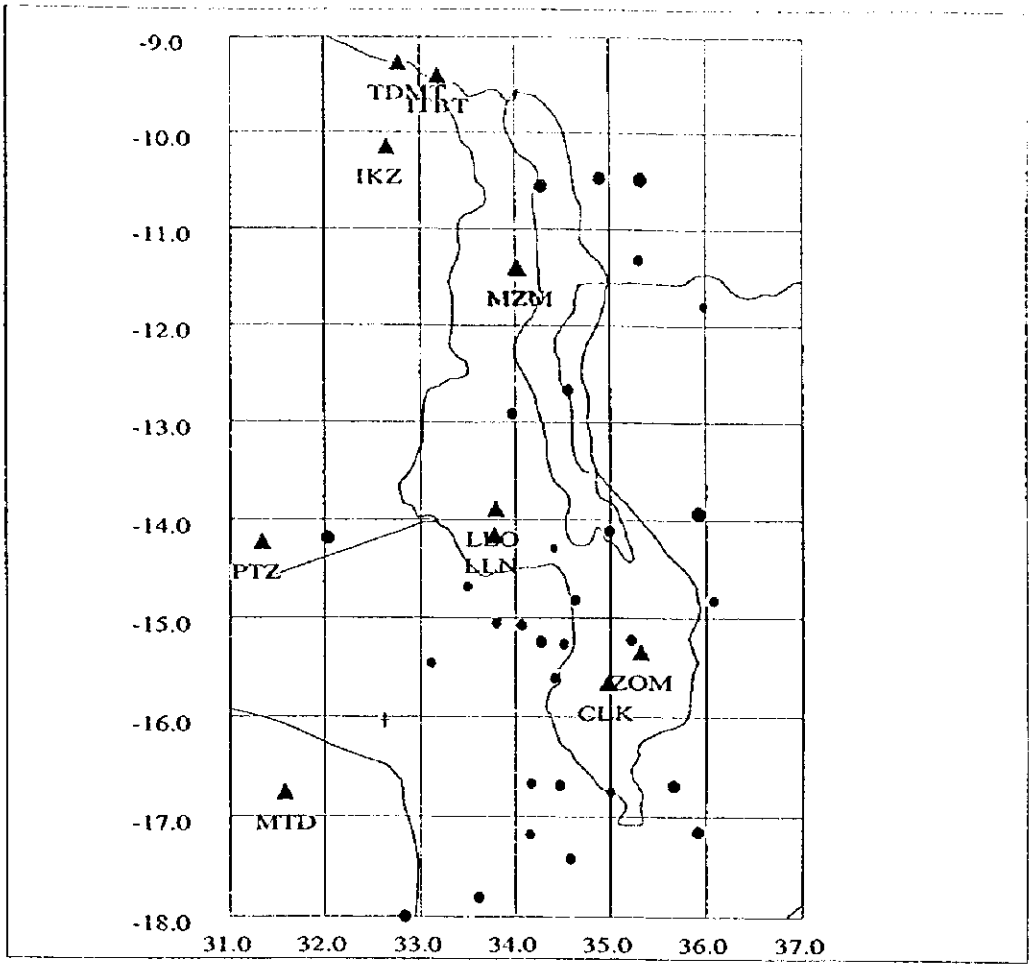


EVENTS FOR 1992

Total events: 181
Selected events: 31

Magnitudes:

M = 0 +
M = 1 .
M = 2 •
M = 3 ●
M = 4 ●



APPENDIX 7

ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Water Quality Test for the Shire River Water.

(1) Water quality test.

The water quality test of the Shire River water is carried out in order to obtain the baseline data for of Mangochi Bridge reconstruction project. Six water sampling points are chosen in the vicinity of the existing Mangochi Bridge (Figure 7.1). The water quality test is carried out with respect to following 12 parameters such as pH, conductivity, TDS, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), phosphate, nitrate, turbidity, permanganate value, suspended solid (SS), and E-Coli.

Traditional methods for the analysis/analytical examination of water samples were used according to "Standard Methods for the examination of water, 13-th edition". A filtration and incubation method was used for the microbiological examination of water (i.e., E-Coli quantification). Results of all parameters tested are summarized in Table 7.1.

(2) Discussions.

The water quality with respect to each parameter will be discussed, separately. Compared with water quality data, measured by Talling et al. [Main Report Table 5.1], no big difference between results obtained through this study and Talling's one is recognized, so it can be said that the water quality sampling work conducted within this study is valid and its results is meaningful and useful as the baseline data of current Shire River water at rain season. Impact of the bridge construction activity on the local water quality will be summarized, briefly.

1. pH The high pH ranging between 8.0 - 8.3 indicates that the biological photosynthetic activity in the water, that produce a lot of CO_2 is dominant the water body around the existing Mangochi Bridge. CO_2 may also be produced in water through the biological oxidation of organic matter, in particular in polluted water (World Health Organization Guideline values range between 6.5 – 8.5).

2. Electrical conductivity Measurement of this parameter is made on site immediately since this value change with time. The conductivity of the Shire River water is almost same at all six points (ranging between 298 – 301 $MSCM^{-1}$). This indicates that the same ions are distributed and hence the same water chemistry in this stretch of the river. This range is normal for the surface water of this nature. EC value will be increased during the construction since more ions will come into solutions due to the re-suspension of deposited sediments from the river bottom.

3. Total dissolved Solids (TDS) TDS values range between 146 – 150 mg/*l*, i.e., the river water is in almost same river water chemistry. This range is normal for the natural water bodies (World Health Organization Guideline value is 1000 mg/*l*).

4. Dissolved oxygen (DO) DO values range between 5.1 – 6.3 mg/*l*, and this range is far below the saturation concentration (10.0 mg/*l*). The oxygen level concentration should be expected to become lower when river bottom sediments will be re-suspended due to the scouring or the construction activities. These will increase the oxygen demand and hence would reduce the oxygen level of the water body.

5. Biological oxygen demand (BOD) BOD values range between 0.2 – 1.6 mg/*l*, indicating that the river water is relatively clean. The BOD is mostly natural organic matter which forms the detritus/organic sink in the aquatic system. There is a possibility that BOD value might be increased when the bridge construction that would provide a river bottom disturbance locally and cause re-suspension of river bottom sediments will commence.

6. Chemical oxygen demand (COD) COD values range between 18.0 – 25.9 mg/*l*, indicating that complex organic compounds, e.g., microplants and glucose are both oxidized completely. However, that range is still in the low level, so it can be said that the Shire River water is relatively clean.

7. Phosphate Phosphate levels range between 0.019 – 0.032 mg/*l*, indicating that the phosphorous of the Shire River water is not limiting. This explains the proliferation of several aquatic plants in the water.

8. Turbidity Generally low with values normally less than 5 NTU.

9. Nitrate Nitrate levels range between 0.90 – 1.0 mg/*l*, which is quite normal for the surface water bodies of this nature (World Health Organization Guideline value is 10mg/*l*). The nitrate concentration should have resulted from the nitrification process and contributions from inorganic fertilizers washed away from upland agricultural fields. Some of the nitrate is also released from the decomposition process of organic matter, dead algae and other detritus materials. The low nitrate level suggests that the Shire River is clean and has not been affected by any big-scale wastewater discharge and agricultural run-off with high level nitrate concentration.

Construction of the bridge will increase the amount of the nitrates released upon the re-suspension of the deposited sediments.

10. Permanganate Values are generally above the 0.1mg/*l* (World Health Organization Guideline value, this is a value based on the aesthetic quality, not constitute a health risk).

11. Suspended solids SS values range between 1.8 - 8.7 mg/*l*. These are quite low values, indicating that the river around the Mangochi Bridge is relatively clean. This might be explained by the fact that the water body around this area does not receive any domestic/or industrial effluents.

12. E-Coli E-Coli values range between 440 – 740, suggesting a healthy river system with a sound microbiological base.

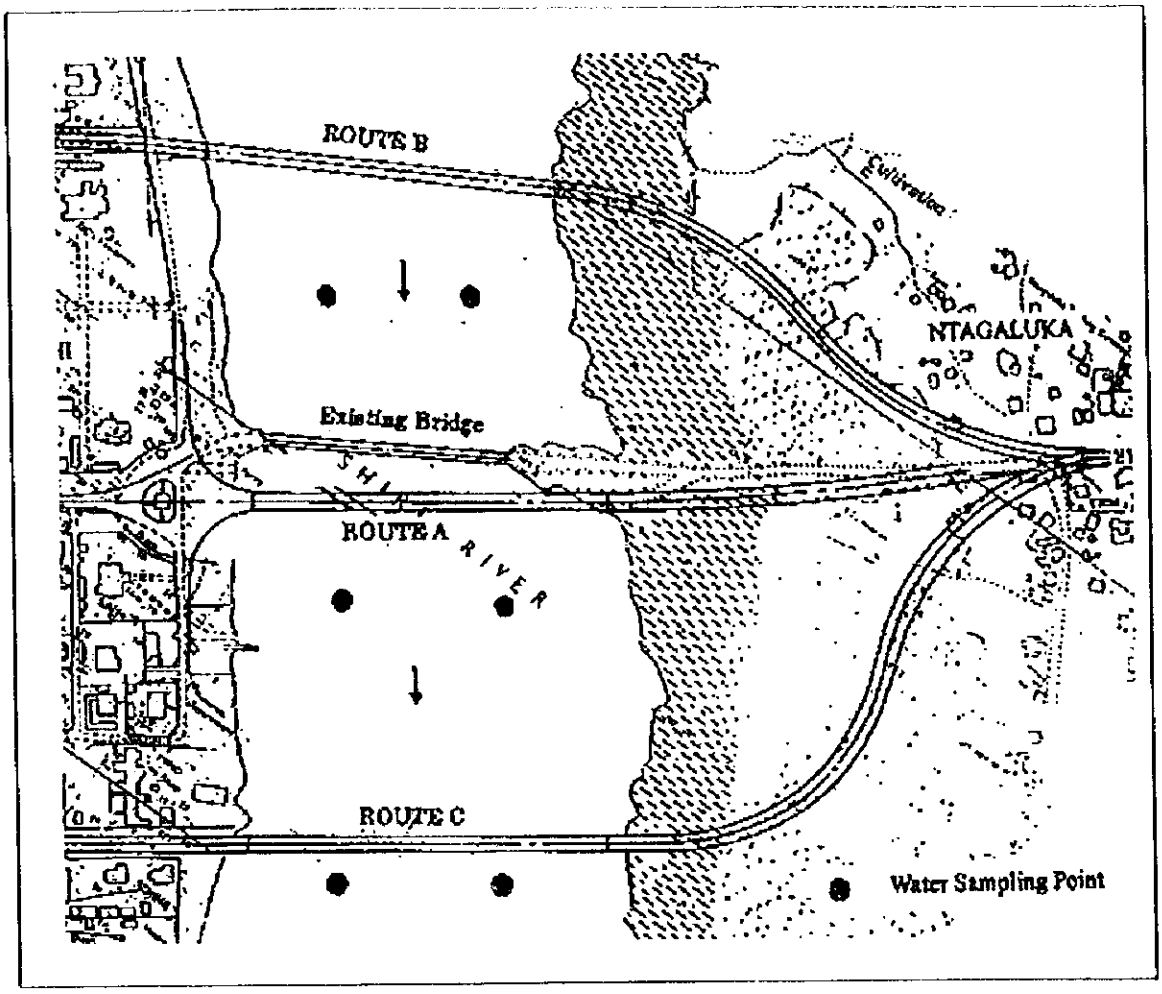


Figure 7.1 Water Quality sampling Point (March, 1998)

Table 7.1 Water quality test results.

	pH	EC	TDS	DO	BOD	COD	P	TBD	N	PMG	SS	E-Coli
		μs/m	mg/l	Mg/l	mg/l	mg/l	mg/l	NTU	mg/l	Mg/l	mg/l	count/100 ml
1	8.2	298	146	5.2	1.60	25.9	0.024	4.2	1.00	12.0	6.0	540
2	8.0	300	149	5.4	0.20	18.0	0.030	4.4	1.00	10.2	8.3	480
3	8.2	299	150	5.1	0.60	18.8	0.030	5.0	0.98	10.1	8.7	510
4	8.2	300	149	6.3	0.20	18.3	0.028	4.3	0.98	9.8	6.0	740
5	8.3	300	148	6.2	1.40	22.7	0.019	3.0	0.90	9.6	3.4	560
6	8.2	301	150	5.5	1.00	21.8	0.032	1.3	1.00	11.8	1.8	440

Note 1. Sampling date March/21/98

Six sampling points in the vicinity of existing Mangochi Bridge.

Note 2. EC : Electrical conductivity @ 25 °C

TDS : Total dissolved solids

DO : Dissolved oxygen

BOD : Biological oxygen demand

COD : Chemical oxygen demand

P : Phosphate

TBD : Turbidity

N : Nitrate

PMG : 4 hours permanganate value @ 27 °C

SS : Suspended solids

7.2 Project Brief

The Republic of Malawi

Ministry of Works and Supplies

THE FEASIBILITY STUDY

ON

THE RECONSTRUCTION OF MANGOCHI ROAD BRIDGE

IN

THE REPUBLIC OF MALAWI

ENVIRONMETAL IMPACT ASSESSMENT

PROJECT BRIEF

Submitted by

JAPAN INTERNATIONAL CO-OPERATION AGENCY
NIPPON KOEI CO., LTD
CHODAI CO., LTD

MARCH 1997

1. INTRODUCTION

The transportation of export and import of Malawi has depended upon northern corridor via Port Dar es Salaam in Tanzania and southern corridor via Port Durban in South Africa since the transportation from Port Nacala deteriorated due the political turmoil and following inner war in Mozambique. Recently, because of recent termination of inner war in Mozambique, the Government of Malawi has placed high priority on the Nacala corridor improvement within its country. The existing Mangochi Bridge across the Shire River, a bridge facility on this Nacala corridor between Malawi and Mozambique, becomes fatigued because it has been 30 years since its operation started.

Within the Nacala corridor in Mozambique, the Government of Japan is implementing rehabilitation of three bridges with the grant aid, and the World Bank has the urgent road rehabilitation plan. Within the section of this corridor in Malawi, the feasibility study and detail design between the Mangochi Bridge and Chiponde has been completed by the aid of Kuwait Fund. Under these circumstances, the rehabilitation of the Mangochi Bridge becomes urgent matter in order to enhance the international transportation flow through the Nacala corridor.

2. PROJECT BRIEF

Reference is made to Appendix C of the Administrative Guidelines for Environmental Impact Assessments which sets out requirements for an acceptable **Project Brief**, including **Draft Terms of Reference** for the study and the approval prior to the implementation of the main body of the work (See Appendix 1).

C.1.1 The nature of the project

The main purpose of this project is to carry out the feasibility study on the reconstruction of Mangochi Bridge targeting year 2005. The area of concern covers the existing Mangochi Bridge across the Shire River and the area around related candidate bridge routes (three alternative bridge routes and five alternative structure designs, that will be described later, are to be considered).

C.1.2 Activities to be undertaken

The new bridge will make the access (market, work, school, cultural event and so on) to/and from each side of the river easier. In addition, it will enhance the transportation of Nacala corridor after the entire road rehabilitation project of this corridor is completed.

C.1.3 The possible products and by-products anticipated

This new bridge project will provide a new landmark at the waterfront of Upper Shire River around Mangochi town.

C.1.4 The number of people the project will employ

Precise number of people to be employed in this project depends on the type of bridge to be chosen, that is currently investigated through this feasibility study. So, it is difficult to provide exact information about this issue at this moment. However, roughly 40 through 50 workers will be hired temporally during the bridge construction period. After its construction, the maintenance and the operation of the new bridge will be transferred to the local government.

C.1.5 The area of land, air or water that may be affected.

During the construction period, the temporal water quality degradation at the downstream side of the Shire River might occur due to the bridge pier construction. Also, minor bank cut or embankment due to the access road construction at both ends of new bridge will take place. Minor resettlement or relocation of the facility close to the new bridge route might be required (depending on the new bridge route to be selected). Erosion or sedimentation around the pier of the new bridge might occur due to the change of the river cross-section.

C.1.6 Any other matters

C.1.6.1 Basic Description

There are three (3) alternative plans for bridge route and five (5) for bridge-design type, respectively. The best bridge plan will be selected among those alternatives, reflecting several evaluation factors such as (1) approximate construction and maintenance cost, (2) construction period, (3) structural characteristic, (4) availability of local materials, (5) technique transfer, (6) social and environmental impact, (7) land acquisition and compensations, and (8) conformity with existing facilities.

C.1.6.2 The stage in the project cycle

This investigation is at the feasibility study level, so it is very difficult to provide more detailed information about the new bridge construction schedule at this stage.

APPENDIX 1. Draft Terms of Reference for the Environmental Impact Assessment Study of the Feasibility Study on the Reconstruction of Mangochi Road Bridge in the Republic of Malawi.

Followings are major tasks to be studied in this EIA study after the route and the structure design type of the new bridge is finalized.

1. To summarize current water use practice and the water quality of the Shire River, in consultation with the Ministry of Water Development, and describe the importance of the Shire River as water resources to the local community around the project site.

2. To describe the scale of temporal water quality degradation caused by the bridge construction (pier, embankment or cut) during the construction period.

3. To describe the likelihood of the sedimentation or erosion caused by the bridge construction, and evaluate those effects on the local flow pattern around the project site.

4. To describe the effect of the bridge construction on the floatation of the Water Hyacinth and Sudd islands around the project site.

5. To describe the status of the fish and wildlife such as crocodile and hippopotamus around the project site (type of species, their behavioral pattern and value to the local populace).

6. To describe the vegetation at both river banks around the project site and evaluate the impact of the bridge construction and its approach road.

7. To summarize the current activity of the local fishery operating around the project site, and to describe the effect of the bridge construction on their livelihood (e.g., new employment opportunities).

8. To describe the socio-cultural and economic activities of the community including their small local fishery around the project site.

9. To describe the current land use practice in the vicinity of the project sites, and evaluate the impact of the bridge construction and its approach road on surrounding residential area, business activities, historical monuments, traffic movement and pedestrian and cyclist' safety.

Cable Address: Premium, Lilongwe
Telephone: 782 411
Telex No: 45311 [illegible]
Telefax: 783 379

Our Reference No. EAD/99/7/5
Your Reference No. ....

Communications should be addressed to:
Director of Environmental Affairs

ENVIRONMENTAL AFFAIRS DEPARTMENT
PRIVATE BAG 394
LILONGWE 3
MALAWI

2nd April, 1998

Mr. Takanori Hayashida
Chodai Co. Ltd.
c/o Wendel's Guest House
P.O. Box 31037
Lilongwe 3.

Dear Mr. Hayashida,

RE: OUTCOME OF REVIEW OF THE PROJECT BRIEF FOR THE MANGOCHI BRIDGE RECONSTRUCTION PROJECT

We have now completed our review of the above-noted project brief which you submitted on behalf of your client, the Ministry of Works and Supplies, Government of Malawi.

We have attached the comments that we have received from our technical reviewers on the project brief for your reference.

Based on the above-noted review comments, and on the review of the project brief conducted by this office, we conclude that an environmental impact assessment (EIA) of this project will be required. Furthermore, we advise that the following changes be made to the draft terms of reference for the EIA that you submitted.

First, to make the best informed decision about the alternative bridge designs and locations, one has to evaluate them based on technical criteria and public preference. In other words, EIA must be conducted of each of

the alternatives being considered, not just of the alternative selected, as the first sentence in your draft ToRs implies.

Second, for each of the ToRs where you are proposing to describe an environmental situation and evaluate the project's environmental effects, you must also recommend how those effects will be mitigated and by whom.

Third, the following specific revisions to your draft ToRs should be made:

- ToR #1 should be re-written to read: "To summarise current water use practice and the water quality of the Shire River, *in consultation with the Ministry of Water Development*, and describe...."

- The words: ".....currently generated by the eutrophication of Lake Malawi and the Upper Shire River...." from ToR #4 should be deleted.

- ToR #9 should be expanded to read: ".....on surrounding residential areas, *business activities, historical monuments, traffic movement and pedestrian and cyclists' safety.*"

Fourth, the following new terms of reference should be added to the list of things that the EIA of the Mangochi Bridge Reconstruction Project will consider:

<= from Derk

- To study the relationships, in consultation with Malawi Railways, between improving the Nacala road corridor and improving the Nacala railway corridor;

- To design the final bridge structure to allow the best possible boat navigability on the Shire River and the best possible movement of vehicles, bicycles and pedestrians on the bridge;

- To minimise the relocation of people and the costs and administrative difficulties associated with human relocation;

- To study the future plans for the development of Mangochi Boma and the Mangochi Lakeshore so that the bridge design and location are consistent with these plans;

- To study the environmental effects of the temporary aspects of the bridge construction (e.g. workers' camp, quarry stone mining) and to recommend measures by which these effects will be minimised;

- To study the implications, if any, of the Shire River Flow Augmentation Project at Samama on the bridge project; and

- To involve the local communities in deciding on what the best bridge design and location would be.

We trust that the above provides you with clear guidance on what the EIA of the Mangochi Bridge Reconstruction should consider. In terms of the structure of the EIA report that you need to submit, Appendix C of the Malawi EIA Guidelines provides details on this issue.

Should you have any questions on may of the foregoing, please do not hesitate to contact us.

Yours sincerely,

Peter W, Somers
for: Director of Environmental Affairs

Att'd.

c.c. Dr. John Wilson, Chair, TCE (Southern Region)
Mrs. J. Theu, National Economic Council
Mr. D.M. Chirwa, Ministry of Local Government and Sports
Mr. S.A. Mapila, Department of Fisheries
Mr. M.D. Mulebe, Department of Transport
Mr. F.C.S. Zambezi, Department of Physical Planning
Mr. E. Mukwawa, Ministry of Works
Mr. O.N. Shera, Ministry of Water
Mrs. E.R. M'mangisa, UNDP
Mr. L.M. Chiona, Mangochi Environmental District Officer

7.3 Questionnaire Form for Socio-Cultural Community Survey

Socio-Cultural Community Survey

No.

MANGOCHI BRIDGE ACTIVITY SURVEY

A. BACKGROUND INFORMATION

Survey Date

Occupation Age Sex M / F

Education

No. of years staying at Mangochi yrs

Staying at East / West side of the Shire River

How far from your house to Mangochi Bridge?

B. BRIDGE RELATIONSHIP

1. What kind of changes will take place if the bridge is improved?
2. Any ethnic groups/ indigenous people likely to be affected by the bridge?
   a. If yes, how?
   b. No
3. Any rare animals (game, bird, fish, amphibian, others) around the bridge?
4. Any cultural / historical / archeological / conservation / religious places near the existing bridge?
   a. If yes, Which place & Where?
   b. No
5. Any opinions if the new bridge construction would temporally affect any cultural / historical / archeological / conservation / religious places you mentioned in question 4?
6. Any opinions if any cultural / historical / archeological / conservation / religious places you mentioned in question 4 will be relocated due to the new bridge construction?
7. Any opinions about the bridge attracting new settlers? If you have, please answer following questions.
   a. Likely origins/ ethnicity of new settlers?
   b. How many?
   c. Their kind of work?
8. Any opinions or possibility that a new bridge may lead to:
   a. Environmental degradation (specify)
   b. More market access
   c. Availability of more services
   d. More educational opportunities
   e. More employment opportunities

f. More spread of diseases

g. Fish losses

h. Other impacts (specify)

9. Any thoughts on the potential national/ international significance of the bridge?

C. CURRENT EXISTING BRDIGE USE ACITIVITY

		No. of Times/week	Travel Mode
1. Go to	a. Work.		
	b. Visit Relatives, Friends		
	c. Church/or Mosque		
	d. School		
	e. Clinic		
	f. Store, Market		
	g. Post office, Bank		
	h. Government office		
	i. Home		
	j. Others (specify)		
2. Attend	a. Community Meeting		
	b. Sports, Party, Event		
	c. Others (specify)		

D. WATER RESOURCES

1. Source of drinking water from:

a. Shire River without treatment

b. Well

c. Town water supply system

d. Others (specify)

2. Quality of the water

a. Pure

b. Little salty

c. Others (specify)

3. Water for other uses:

	Sources	Daily amount	Quality
a. Irrigation			
b. Livestock			
c. Cleaning			
d. Others (specify)			

4. How has source of water changed over the years?

5. Do you go to the banks of the Shire River to do laundry?

a. If Yes, how often (No./day)?

b. No

E. BIOTA AND ENVIRONMENT

1. What are the current main local environmental concerns or issues?
2. If the new bridge is built, what will be the main local environmental concerns or issues?

F. FISHERY

1. Do you catch any fish at the Shire River for your Eating/ or Selling?

a. If yes, How often (No./ week), quantity, and the type of fish?

b. No, but I used to, How often (No./ week), quantity, and the type of fish?

c. No.

2. What are the current main local fishery concerns or issues?
3. If the new bridge is built, what will be the main local fishery concerns or issues?
4. Any opinions about the sustainable local fishery industry?

G. MISCELLANEOUS

1. If the community should desire to undertake this new bridge construction project, what should be the priorities?

2. Beside this new bridge project, what kind of infrastructure improvement project would be necessary for the community?

THANK YOU FOR YOUR CO-OPERATION !!

ZIKOMO! !

Appendix D Results of Socio-cultural survey

Survey Date	March/1998
Survey Place	Mangochi Township, Malawi
Total number of interviewee	150 (90 male & 60 female).
	60 live @ West bank while 90 from East.

A. Background Information.

(1) AGE

ATTRIBUTE	Results
Below 20	20
20 – 30	59
30 – 40	31
40 – 50	23
50 – 60	7
Above 60	3
Unknown	7
Total	150

(2) Occupation

ATTRIBUTE	Results
Student	13
House wife	26
Farmer	25
Unemployed	11
Business	35
Fishermen	4
Welder	6
Government Clerk	5
Others	25
Total	150

(3) Distance between your house and the bridge.

ATTRIBUTE	Results
Less than 100 m	8
100 - 500 m	24
500 m – 1 km	14
1 – 2 km	16
2 – 5 km	35
More than 5 km	45
Unknown	10
Total	150

(4) Years of Living at Mangochi

ATTRIBUTE	Results
Less than 1 yr	9
1 – 2 yrs	6
2 – 5	17
5 – 10	15
10 – 20	26
More than 20 yrs	46
Unknown	31
Total	150

(5) EDUCATION

ATTRIBUTE	Results
None	46
Primary (8 yrs)	75
Secondary (4 yrs)	28
College	1
Total	150

B BRIDGE RELATIONSHIP

(1) B-1 What kind of changes will take place if the bridge is improved?

ATTRIBUTE	Results
Accident Reduction	98
Easy Transport	72
More Development	6
No change	3
Others	6

(2) B-2 Any ethnic groups/ indigenous people likely to be affected by the bridge?

ATTRIBUTE	Results
Any group	87
Yao	53
Chewa	11
UDF	1
Europeans	2
None	4

(3) B-3 Any rare animals (game, bird, fish, amphibian, others) around the bridge?

ATTRIBUTE	Results
Crocodile	120
Hippopotamus	114
Snake	20
Bird	53
Cow, Goats	10
Tortoise	1
Frog	11
Fish	147
Others	1
None	4

(4) B-4 Any cultural/historical/archeological/conservation/religious places near the existing bridge?

ATTRIBUTE	Results
Mosque	4
Memorial pillar	71
Church	2
Bridge	19
Stone	24
Gun	43
House	4
Ferry /or Boat	20
Museum	13
River	9
Tree	1

(5) B-5 Any opinions if the new bridge construction would temporally affect any cultural/ historical/ archeological/ conservation/ religious places you mentioned in question 4?

B-6 Any opinions if any cultural/ historical/ archeological/ conservation/ religious places you mentioned in question 4 will be relocated due to the new bridge construction?

ATTRIBUTE	Results
None	81
Relocate to any appropriate place (e.g., museum)	53
Can be relocated temporally, but moved back to original place	7
Don't touch	5
Can be destroyed if bridge comes.	3
Others	1
Total	150

(6) B-7 Any opinions about the bridge attracting new settler? If you have, please answer following questions.

(a) Likely origins/ethnicity of new settlers?

ATTRIBUTE	Results
Lomwe	27
Yao	36
Chewa	29
Ngoni	15
Tumbuka	9
Indian	7
Europeans/White	15
Tonga	6
Zambian	3
Others	9
None	12

(b) How many?

ATTRIBUTE	Results
Less than 500	21
500 – 1000	33
1000 – 2000	7
2000 – 5000	12
More than 5000	7

(c) Their kind of work?

ATTRIBUTE	Results
Fishermen	28
Businessmen	104
Tourist	10
Farmer	7
Civil servant	2
Builder	1

(7) B-8 Any opinion or possibility that a new bridge may lead to:

ATTRIBUTE	Yes	No
Environmental	39	111
More Market Access	139	11
More Services	141	9
Educational Opportunity	142	8
Employment	137	13
Spread of Disease	48	102
Fish Loss	40	110
Others	U	U

(8) B-9 Any thoughts on the potential national/ international significance of the bridge?

ATTRIBUTE	Results
Attract more tourists	43
Enhance international transportation (Mozambique-Malawi-Zimbabwe)	72
More development	5
Better Life	4
None	26
Total	150

C-1 Current Existing Bridge Use Activity

(1) Go to Work

ATTRIBUTE	Results
None	102
1	7
2	4
3	3
5	6
6	4
7	11
10	7
14	1
15	3
20	1
30	1
Total	150

(2) Visit Relative, Friends

ATTRIBUTE	Results
None	45
1	34
2	27
3	23
4	2
5	2
6	2
7	7
10	2
14	2
20	2
21	1
28	1
Total	150

(3) Church/or Mosque

ATTRIBUTE	Results
None	54
1	35
2	15
3	6
5	10
7	3
9	1
14	1
35	24
Total	150

(4) School

ATTRIBUTE	Results
None	115
1	18
2	2
5	14
10	1
Total	150

(5) Clinic

ATTRIBUTE	Results
None	78
1	47
2	15
3	5
4	2
5	2
7	1
Total	150

(6) Store, Market

ATTRIBUTE	Results
None	61
1	20
2	14
3	6
4	2
5	2
6	1
7	35
10	3
14	4
15	2
Total	150

(7) Post Office, Bank

ATTRIBUTE	Results
None	84
1	40
2	17
3	5
4	1
5	2
7	1
10	1
Total	150

(8) Government Office

ATTRIBUTE	Results
None	113
1	22
2	7
3	1
5	3
6	1
7	2
20	1
Total	150

(9) Home

ATTRIBUTE	Results
None	103
1	14
2	7
3	2
4	3
5	9
6	1
7	5
10	5
15	1
Total	150

C-2 Objective

ATTRIBUTE	Results
Attend a community meeting	64
Sport, party, events	107
Islamic meeting	1
Funeral	1

D. Water Resources

(1) D -- 1 Source of drinking water from:

ATTRIBUTE	Results
Shire River without	27
Well	28
Town water supply	94
Others	1
Total	150

(2) D-2 Quality of water

ATTRIBUTE	Results
Pure	109
Little Salty	28
Others	13
Total	150

(3) D-3 Water for other uses:

	Sources	Daily amount (pail)	Results
Irrigation	Town Water	1	1
		3	1
		5	2
		6	2
		15	1
		20	1
	River	Unknown	22
		4	1
		5	1
		6	4
		7	1
		10	1
	Well	1	1
		2	1
		3	1
		5	2
		6	1
	Dambo	Unknown	1
		3	1
Livestock	Town Water	Unknown	1
		1	3
		2	6
		3	1
		6	1

	River	Unknown	49
		1/2	1
		1	2
		2	2
		5	1
	Well	1/2	2
		2	3
		3	1
		4	1
		6	2
	Mwasa	Unknown	1
Cleaning	Town Water	Unknown	7
		1	17
		2	4
		3	12
		4	9
		5	3
		6	3
		8	1
		10	1
	River	Unknown	51
		1	8
		2	1
		3	3
		4	3
		5	4
	Well	Unknown	2
		1	1
		2	6
		4	2
	Dambo	Unknown	2
Unknown	4		
None	4		

(4) D-4 How has source of water changed over the years?

ATTRIBUTE	Results
No change	69
Volume increased	22
Volume decreased	23
Unknown	25
Getting better	11
Total	150

(4) D-5 Do you go to the bank of the Shire River for the laundry?

ATTRIBUTE		Results
Yes	1	49
	2	31
	3	11
	4	2
	5	2
	6	0
	7	13
No		42
Total		150

E. Biota and Environment.

(1) E-1 What are the current main local environmental concerns or issues?

ATTRIBUTE	Results
Hunger	3
Fish conservation	38
Water Resources	9
Deforestation	55
Wildlife conservation	6
Over population	9
Vegetation	3
Transportation improvement	1
None	34

(2) E-2 If the new bridge is built, what will be the main local environmental concerns or issues?

ATTRIBUTE	Results
Hunger	4
Deforestation	32
Fish conservation	24
Water resources	12
Transportation improvement	3
Wildlife conservation	4
Vegetation	2
Settlement	2
Air pollution	1
None	67

F. Fishery

(1) F-1 Do you catch any fish at the Shire River for your Eating/or Selling?

	Type of Fish	How often ? (No./week)	Results
Yes	Chambo	1	1
		7	7
	Kambuzi	1	1
		7	9
	Mbamba	6	1
		7	3
	Makumba	2	1
		7	1
	Bamba	7	1
	Sandika	7	1
	Matemba	2	1
		7	1
	Utaka	1	2
	Idozen	1	1
	Dowadowa	7	1
	Milamba	1	1
	Mcheni	7	1
	Ntchira	7	1
No, but I used to.	Chambo	7	4
	Kambuzi	7	1
	Sawasawa	7	1
	Sungwa	7	1
	Mbana	7	1
	Mchenzi	7	1
	Crates	7	1
	Utaka	7	1
	Usipa	7	1
	Makumba	7	1
	Dondolo	7	1
	Kampango	1	1
	Tsungwa	1	1
No	111		

(2) F-2 What are the main local fishery concerns or issues?

ATTRIBUTE	Results
None	69
Fishing ban	2
Fish resources depletion (over fishing)	73
Threatened by crocodile.	5
Too many fishermen	1
High fish price	1
Loan for fishermen	1

(3) F-3 If the new bridge is built, what will be the main local fishery concerns or issues?

ATTRIBUTE	Results
None	83
Fishing ban	4
Fish resources depletion	40
Threatened by crocodile.	2
Navigation clearance for fishing boat	1
Flood control	1
More fish transport	11
More employment	2
Fish price hike	2
Fish price down	4
More accessibility to fish port	2

(4) F-4 Any opinions about the sustainable local fishery industry?

ATTRIBUTE	Results
None	59
New fish regulation	63
Monopolization of local fish industry by MADECO	1
Civic education to fishermen	21
New job training for fishermen (with loan)	3
Local land use near the river	1
Recent water quality degradation	1

G. Miscellaneous

(1) G-1 If the community should desire to undertake this new bridge construction project, what should be the first priority?

ATTRIBUTE	Results
Bridge structure design (2 lanes, enough space for pedestrians & enough cycle track, paved surface and so on.....like Liwonde barrage).	128
Should be 1-way	2
Same to existing bridge	1
Resettlement	10
Temporally access	12
Environmental conservation	2
None	6

(2) G-2 Beside this new bridge project, what kind of infrastructure improvement project would be necessary for the community?

ATTRIBUTE	Results
Modern market	36
School & hospital	49
Road improvement	47
More employment	11
Housing	6
Water supply	8
Post office	5
Transportation	3
Reopen airport	2
Community Hall	2
Public Toilet	2
Police station	2
Others	5
None	9

Appendix E Guidelines on Maximum Sound Levels

Location	Measurement Position	Recommended Maximum Sound Level
Village adjacent to work sites	1 m from the nearest building	Rating level 7 dB (A) above residual sound level.
Villages adjacent to access roads	1 m from the nearest building	Rating level of 60 dB (A) and maximum sound pressure level of 70 dB (A).
Schools	Inside classroom with partially opened windows	Rating level of 40 dB (A)
Health Clinics/ Hospital	Inside building with partially opened windows	Rating level of 45 dB (A)

Appendix CONTACTS (EIA)

Mr. Kara Dand	Director, Ministry of Works and Supplies (MOWS)
Mr. E. L. K. Mhakhama	Deputy Director, Same
Mr. B. Kapoteza	Same, counterpart
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	Blantyre, Malawi

(WSM, formerly known as National Fauna Preservation Society)

APPENDIX 8

COST ESTIMATE

8.1 Unit Price of Equipment

Unit Price of Equipments (Incl. Transportation)

	ITEM	UNIT	MOWS	KIER RSA	SBC Local	C.C.C Local	Ave.	Adopted Price
			MK	MK	MK	MK	MK	MK
1	Backhoe 1.0m³	hr		2,290	2,550	2,450	2,430	2,400
2	Backhoe 0.7m³	hr		1,700	1,900	1,820	1,807	1,800
3	Backhoe 0.4m³	hr		1,520	(900)	-	1,520	1,500
4	Breaker(1.3t) with backhoe	hr		2,030	2,000	2,250	2,093	2,100
5	Bulldozer 32T/w, Ripper	hr		3,620	4,100	3,900	3,873	3,900
6	Bulldozer 21T/w, Ripper	hr		2,750	3,000	2,950	2,900	2,900
7	Bulldozer 15T/w, Ripper	hr		1,460	1,600	1,575	1,545	1,500
8	Bulldozer 11T/w, Ripper	hr		-	-	1,200	1,200	1,200
9	Dump Truck 11T	hr		910	1,000	970	960	960
10	Dump Truck 8T	hr		780	850	850	827	830
11	Dump Truck 4T	hr		640	750	-	695	700
12	Flat Bed Truck 10T	hr		650	750	690	697	700
13	Flat Bed Truck 8T	hr		420	450	-	435	440
14	Flat Bed Truck 4T	hr		330	350	-	340	340
15	Cargo Truck 8T/w crame	hr		1,120	1,260	1,250	1,210	1,210
16	Cargo Truck 4T/w crame	hr		750	-	-	-	750
17	Truck Mixer 4.5m³	hr		1,260	1,260	1,200	1,240	1,240
18	Truck Mixer 1.6m³	hr		750	-	-	-	750
19	Truck Crane 45T	hr		3,720	4,150	3,980	3,950	4,000
20	Truck Crane 25T	hr		2,030	2,250	2,000	2,093	2,100
21	Truck Crane 15T	hr		1,510	1,650	1,500	1,553	1,550
22	Crawler Crane 80T	hr		6,300	-	-	-	6,300
23	Crawler Crane 50T	hr		4,000	4,500	4,250	4,250	4,300
24	Crawler Crane 35T	hr		3,460	4,000	3,700	3,720	3,700
25	Trailer 45T	hr		790	800	750	780	780
26	Trailer 30T	hr		660	750	500	637	640
27	Trailer 20T	hr		340	350	400	363	360
28	Generator 250KVA	day	(970)	2,210	2,510	2,400	2,383	2,400
29	Generator 200KVA	day	(970)	1,660	1,800	1,700	1,720	1,700
30	Generator 60KVA	day	(520)	920	980	950	950	950
31	Generator 20KVA	day	(370)	760	850	750	787	790
32	Crawler Drill 150kg	day		1,490	-	1,600	1,545	1,550
33	Vibration Roller 10~12T	day		1,290	1,400	1,350	1,347	1,350
34	Tyre Roller 8~20T	day		740	825	750	772	770
35	Macadam Roller 10~12T	day		510	565	550	542	540
36	Tamper 60~100kg	day	(677)	250	280	250	260	260
37	Vibration Roller 0.5~0.6T	hr		140	155	150	148	150
38	Air Compressor 5m³/min	day		1,250	1,400	1,350	1,333	1,330
39	Air Compressor 17m³/min	day		2,320	2,500	2,400	2,407	2,400
40	Dozer Shovel 1.2m³	hr		1,590	1,750	1,700	1,680	1,700
41	Dozer Shovel 1.8m³	hr		2,060	2,300	2,200	2,187	2,200
42	Tyre Shovel 1.2m³	hr		1,590	1,750	1,700	1,680	1,700

Unit Price of Equipments (Incl. Transportation)

	ITEM	UNIT	MOWS	KIER RSA	SBC Local	C.C.C Local	Ave.	Adopted Price
			MK	MK	MK	MK	MK	MK
43	Tyre Shovel 1.8m³	hr		1,860	1,900	2,000	1,920	1,900
44	Motor Grader 3.1m	hr		1,570	1,650	1,700	1,640	1,600
45	Submersible Pump 4m	day		240	350	250	280	280
46	Submersible Pump 3m	day		170	220	200	197	200
47	Submersible Pump 2m	day		100	120	150	123	120
48	Water Lorry 6000L	hr		1,290	1,450	1,500	1,413	1,410
49	Concrete Pump 50m3/hr	hr		1,000	1,200	1,600	1,267	1,270
50	Concrete Mixer 0.5m³	hr		460	520	500	493	490
51	Concrete Balcher Plant30m³/hr	hr		2,990	3,500	3,300	3,263	3,300
52	Mortar Plant	day		1,000	1,100	1,000	1,033	1,000
53	Concrete Vibrator	month		7,480	8,200	8,000	7,893	7,900
54	Concrete Bucket 1.0m³	month		5,610	6,250	6,000	5,953	6,000
55	Vibro Hammer 90kw	hr		2,050	2,000	2,200	2,083	2,100
56	Diesel Pile Hammer 4.5T	hr		4,480	5,000	4,800	4,760	4,800
57	Diesel Pile Hammer 3.5T	hr		4,340	5,000	4,500	4,613	4,600
58	Diesel Pile Hammer 2.5T	hr		3,140	-	3,500	3,320	3,300
59	Transformer 100KVA	month		18,700	22,000	20,000	20,233	20,200
60	Transformer 300KVA	month		35,800	44,000	40,000	39,933	39,900
61	Leg Drill 30kg	day		2,080	2,000	-	2,040	2,000
62	Hand Breaker 30kg	day		1,040	1,000	-	1,020	1,000
63	Pick Hammer 8kg	day	(75)	415	500	-	458	460
64	Grout Pump 2.2kw	day	(350)	3,330	3,500	-	3,415	3,400
65	Grout Mixer 1.5kw	day	(300)	2,490	2,750	-	2,620	2,600
66	Asphalt Sprayer 200L	day		670	650	750	690	690
67	Asphalt Distributor 6m³	day		1,840	1,750	1,950	1,847	1,800
68	Line Maker 80~120kg	day		1,000	-	-	-	1,000
69	Fuel Lorry 6000L	hr		1,100	1,000	1,200	1,100	1,100
70	Fuel Lorry 2000L	hr		830	-	-	-	830
71	Earth Auger φ1000 D20m	hr		6,200	-	-	-	6,200
72	Pontoon(10m×30m)	day		16,500	-	20,000	18,250	18,000
73	Tag Boat 250Hp	day		-	-	20,000	-	20,000
74	Tag Boat 720Hp	day		31,200	-	-	-	31,200

8.2 Unit Price of Materials

Unit Price of Materials 1/2

	ITEM	UNIT	MOWS	KIER RSA	SBC Local	C.C.C Local	Ave.	Adopted Price
			MK	MK	MK	MK	MK	MK
1	Ordinary Portland Cement	T	6,100	5,100	6,000	5,150	5,588	5,600
	Tax Free	T						4,400
2	Coase Aggregate	m^3	(350)	710	800	600	703	700
3	Fine Aggregate	m^3	(75)	440	500	(100)	470	470
4	Crushed Gravel	m^3	(300)	610	700	550	620	620
5	Riprap Stone	m^3	-	430	500	450	460	460
6	Crushed Stone (For Road)	m^3	-	745	850	600	732	730
7	Backfilling Sand	m^3	-	440	500	(100)	470	470
8	Timber (Form Work)	m^3	(900)	4,160	4,650	(1780)	4,405	4,400
9	Timber (Hard Wood)	m^3	-	-	7,500	6,400	6,950	7,000
10	Plywood t=19mm	m^2	-	470	550	-	510	510
11	Gasoline	L						13.00
	Tax Free	L						8.67
12	Kerosene	L						7.00
	Tax Free	L						4.98
13	Diesel	L						11.00
	Tax Free	L						7.61
14	Lubricant	L						76.00
	Tax Free	L						46.70
15	Acetylene	kg	-	424	-	416	420	420
16	Oxygen	kg	-	141	-	139	140	140
17	LPG	kg	-	33		33	33	33

Unit Price of Materials 2/2

	ITEM	UNIT	MOWS	KIER RSA	SBC Local	C.C.C Local	Ave.	Adopted Price
			US$	US$	US$	US$	US$	US$
18	Rapid hardening Portland Cement	T	200	210			205	210
	Tax Free							170
19	Water Reducing Agent	kg	-	3.4	3.9	2.7	3.3	3.1
20	Reinforcing Bar (Deformed)	T	(556)	735	857	672	755	755
	Tax Free							556
21	Structure Steel	T	1,460	1,710	-	-	1,585	1,600
	Tax Free							1,220
22	Nail	kg	-	2.7	3.1	(1.7)	2.9	2.9
23	Mesh Reinforcement	m^2	-	3.44	3.90	-	3.67	3.70
24	Straight Asphalt 80/100	kg		0.67	-	0.55	0.61	0.60
25	Asphalt Emulision Mc3000	kg		0.67		0.57	0.62	0.60
26	PVC Water Step 200mm	m	3.47	5.37	6.04	4.29	4.79	4.80
27	Electric Detonator	Pc	-	1.35	-	-	-	1.40
28	Explosive Dynamite	kg	-	4.18	-	-	-	4.20
29	Ammonitum Nitrate	kg	-	1.62	-	-	-	1.60
30	Hume Pipe φ200mm L=2m	Pc	-	36.40	-	-	-	36.00
31	Hume Pipe φ300mm L=2m	Pc		60.70	-	-	-	60.00
32	PVC Pipe φ50mm	m	5.69	5.67	6.62	-	5.99	6.00
33	PVC Pipe φ75mm	m	7.17	7.29	8.18	-	7.55	7.50
34	PVC Pipe φ100mm	m	(12.64)	8.10	8.96	-	8.53	8.50
35	Steel Pipe φ50mm	m	-	25.1	28.1	28.1	27.1	27.1
36	Sreel Pipe φ75mm	m	-	38.5	42.9	44.9	42.1	42.1
37	Steel Pipe φ100mm	m	-	51.8	58.4	56.1	55.4	55.4
38	U-Type Concrete Gutter 150×200×600	Pc	-	32.4	35.1	-	33.8	33.8
39	U-Type Concrete Gutter 200×250×600	Pc	-	42.2	50.6	-	46.4	46.4
40	U-Type Concrete Gutter 250×250×600	Pc	-	56.7	62.3	-	59.5	59.5
41	Steel Pipe Pile φ500～φ1,200	T	-	1,161	1,286	-	1,224	1,220
42	Prestressing Cable	T	-	1,350	-	-	-	1,350

8.3 Unit Price of Labor

Unit Price of Labor

	ITEM	UNIT	MOWS	KIER RSA	SBC Local	C.C.C Local	Ave.	Adopted Price
			MK	MK	MK	MK	MK	MK
1	Skilled Laborer	day	(43)	71	75	75	74	75
2	Common Loborer	day	(31)	66	70	65	67	65
3	Blaster	day	-	71	75	75	74	75
4	Driller	day	98	98	105	100	100	100
5	Civil Foreman	day	(104)	203	215	210	209	210
6	Mechanic Foreman	day	(104)	203	200	205	203	200
7	Electric Foreman	day	(104)	203	200	205	203	200
8	Electrician	day	(95)	146	160	150	152	150
9	Mechanician	day	(95)	179	190	190	186	190
10	Operater(Heavy Machine)	day	(85)	177	190	185	184	185
11	Ass Operator	day	(74)	94	90	100	95	95
12	Crane Operator	day	(104)	295	305	300	300	300
13	Plant Operator	day	(85)	94	100	105	100	100
14	Dump Truck Driver	day	-	109	115	120	115	115
15	Common Driver	day	(36)	89	115	90	98	100
16	Re-Bar Fixer	day	-	159	172	170	167	165
17	Steel Erector	day	-	160	175	170	168	170
18	Carpentor	day	(85)	(139)	180	170	175	175
19	Concrete Worker	day	-	98	105	110	104	105
20	Plasterer	day	-	159	170	165	165	165
21	Welder	day	(85)	146	155	150	150	150
22	Painter	day	(85)	139	152	150	147	145
23	Gardener	day	-	71	80	75	75	75
24	Civil Engineer	M/M	(3,200)	13,200	14,000	13,500	13,567	13,600
25	Building Engineer	M/M	(3,200)	13,200	14,000	12,000	13,067	13,100
26	Mechanic Engineer	M/M	(3,200)	13,200	14,000	13,300	13,500	13,500
27	Electric Engineer	M/M	(3,200)	13,200	15,000	13,500	13,900	13,900
28	Ass Engineer	M/M	(2,890)	8,300	8,500	8,000	8,267	8,300
29	Blasting Technician	M/M	(1,920)	8,300	8,000	7,000	7,767	7,800
30	Draftman	M/M	(2,160)	6,800	7,200	7,000	7,000	7,000
31	Surveyer	M/M	(1,920)	8,300	8,000	7,000	7,767	7,800
32	General Foreman	M/M	(1,920)	11,100	11,500	11,000	11,200	11,200
33	Accountant	M/M	(3,160)	16,600	17,000	15,000	16,200	16,200
34	Clerk	M/M	(1,920)	10,700	11,000	9,000	10,233	10,200
35	Typist	M/M	(1,500)	10,000	10,000	9,000	9,667	9,700
36	Driver	M/M	(900)	2,400	2,600	2,500	2,500	2,500
37	Watchman	M/M	(900)	1,730	1,750	2,000	1,827	1,800

8.4 Quantity

No.

Summary of Work Quantitiy for Superstructure

Item		Detail		Unit	Quantity	Remarks
Concrete	Curb/Handrail			m^3	207.8	σck=240kgf/cm²
	Main Girder Form	Cantilever		m^3	1,492.8	σck=350kgf/cm²
		Pier Head		m^3	460.0	
		Supporting Works		m^3	216.6	
		Closing		m^3	31.6	
		Total		m^3	2,201.0	
Form Works	Curb/Handrail			m^2	1,387.9	
	Main Girder Form Works	Cantilever	Outer Form	m^2	1,842.5	
			Form	m^2	416.0	
			Inner Form	m^2	1,947.6	
			Subtotal	m^2	4,206.1	
		Pier Head	Outer Form	m^2	358.0	
			Form	m^2	51.6	
			Inner Form	m^2	371.2	
			Subtotal	m^2	780.8	
		Supporting Works	Outer Form	m^2	221.1	
			Form	m^2	142.2	
			Bottom Form	m^2	32.4	
			Inner Form	m^2	212.0	
			Subtotal	m^2	607.8	
		Closing	Outer Form	m^2	37.3	
			Bottom Form	m^2	24.0	
			Inner Form	m^2	64.1	
			Subtotal	m^2	125.4	
		Total		m^2	5,720.1	
	Total			m^2	7,108.0	
Re-Bar	SD345	Curb/Handra	D12	t	22.86	
			D16~D25	t	8.31	
			Subtotal	t	31.17	
		Prestressing Superstructure	D12	t	132.06	
			D16~D25	t	220.10	
			Subtotal	t	352.16	
		Total		t	383.33	
PC Tendon	Strand Cable 12S15.2B Both Side	Cable Works	Weight	kg	102,660	Vertical Prestressing SWPR7B
			Nos.	nos.	260	
		Jacking Works		nos.	520	
		Anchor Works		nos.	-	
	Strand Cable 1S21.8 One side	Cable Works	Weight	kg	17,859	Transverse Prestressing SWPR19
			Nos.	nos.	710	
		Jacking Works		nos.	710	
		Anchor Works		nos.	710	
Bearing	Rubber Bearing	Abutment	R=400t	nos.	4	
		Pier	R=1,800t	nos.	4	
Expansion joint	Steel Finger Joint	Length		m	21.0	
		Weight		kg	9,450	
Drainage	Catch Basin			nos.	24	
	Drain Pipe			m	110.4	

No.

Summary of Work Quantitiy for Superstructure

Item		Detail	Unit	Quantity	Remarks
Pavement Works	Road Pavement	Asphalt Pavement	m^2	1,603.8	
	Sidewalk Pavement	Filling Concrete Pavement	m^3	90.1	σck = 180 kgf/cm^2
	Curbstone Works	Concrete Curbstone	m	439.4	
	Rain Mark Works	Division Line	m	219.7	
Bridge Name/Record Books of Bridge			nos.	1	
Lighting Works	Lighting Post	TYPE-A	nos.	4	
		TYPE-B	nos.	6	
	Instelling Light		nos.	10	
	CV Cable		m	460.0	
	Distributing Board		nos.	1	
Temporary Fix Works	Concrete	Pedestal/	m^3	6.6	σck=350kgf/cm^2
	Form Works	Temporary Key Concrete	m^2	25.2	
	High Strength Steelbar	ϕ32	kg	5,136	SBPR930/1180
	H-steel	H-350*350*12*19	kg	2,592	SS400
Supporting Works	Cantilever		m^3	5,952	Cantilever Floor Slab + Inside Box-Girder
	Pier Head		m^3	1,188	
	Side Span		m^3	600	
	Closing		m^3	109	
	Total		m^3	7,849	
Suspended Supporting Works	Side Span	SS400	kgf	58,140	
	Closing	SS400	kgf	6,120	
	Total		kgf	64,260	
Erection Works	Wagen Assembly/Demolition		time	4	use 2 Wagens
	Wagen Removal/Setting		time	48	
	Wagen Climbing		time	4	
	Wagen Replace		m	152.0	

Summary of Work Quantity for P1 Pier

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Wall	Concrete	σck=240		m3	368.5	
	Form Works		Curved Surface H<4m	m2	278.5	
	Re-Bar Works		below D13	t	0.000	
			above D16	t	36.849	
			Subtotal	t	36.849	
	Prefabricated Scaffold			m2	444.0	
Foundation Works	Caisson Excavation	on Land		m3	723.2	
		under Water		m3	1,442.2	Excavation Length L=26.5m
		Total		m3	2,165.4	
	Concrete	σck=240	Side Wall	m3	456.2	
			Top Slab	m3	190.9	
			Watertight Wall	m3	191.0	
			Subtotal	m3	838.0	
		σck=180	Floor Slab	m3	171.9	σ28=225kg/cm2
	Form Works	Side Wall	H<4m	m2	0.0	
			Curved Surface H<4m	m2	728.8	
			Subtotal	m2	728.8	
		Top Slab	Bottom	m2	38.5	
		Watertight Wall	H<4m	m2	0.0	
			Curved Surface H<4m	m2	792.3	
			Subtotal	m2	792.3	
	Re-Bar Works	Side Wall	below D13	t	0.228	
			above D16	t	45.387	
			Subtotal	t	45.615	
		Top Slab	below D13	t	0.000	
			above D16	t	19.085	
			Subtotal	t	19.085	

Summary of Work Quantity for P1 Pier

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Foundation Works	Re-Bar Works	Watertight Wall	below D13	t	3.824	
			above D16	t	9.547	
			Subtotal	t	13.371	
		Total		t	78.071	
	Sand Filled	Soil		m3	288.6	
	Reinforcing Steel Plate	SS400		t	7.5	
	Prefabricated Scaffold			m2	1,347.1	
	Jack Down			t	600.0	150tf×4

Summary of Work Quantity for A1 Abutment

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Permanent Works	Structure Excavation	Common Soil	Embankment	m3	967.7	
			Dumping	m3	377.3	
			Subtotal	m3	1,345.0	
	Filling Works			m3	66.2	the front of Footing
	Backfilling Works			m3	1,087.8	
	Foundation Crushed Stone			m3	16.4	
	Concrete	σck=240	Handrail	m3	7.2	
			Wall	m3	263.2	
			Footing	m3	175.4	
			Subtotal	m3	445.8	
		σck=180	Leveling Concrete	m3	8.2	
	Form Works	Handrail	H<4m	m2	45.1	
		Wall	4m<H	m2	265.8	
			H<4m	m2	160.8	
		Footing	H<4m	m2	75.6	
		Total		m2	547.3	
		Leveling Concrete		m2	3.9	
	Re-Bar Works	Handrail	below D13	t	0.866	
			above D16	t	0.578	
			Subtotal	t	1.444	
		Wall	below D13	t	0.248	
			above D16	t	23.675	
			Subtotal	t	23.923	
		Footing	below D13	t	0.000	
			above D16	t	10.523	
			Subtotal	t	10.523	
		Total		t	35.890	
	Prefabricated Scaffold			m2	522.0	

Summary of Work Quantity for A1 Abutment

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Approach Slab	Concrete	σck=240		m3	12.8	
	Form Works			m2	6.1	
	Re-Bar Works	below D13		t	0.102	
		above D16		t	1.942	
		Subtotal		t	2.044	
Foundation Works	Cast-in-Place Pile φ1.2m L=16.0m n= 9 each	Design Length		m	180.0	
		Excavation Length	N<30	m	25.5	per a Pile
			30≦N	m	1.7	
			Subtotal	m	27.2	
		Concrete	σck=240	m3	20.6	(σ28=300kg/cm2)
		Re-Bar	below D13	t	0.045	
			above D16	t	2.217	
			Subtotal	t	2.262	

Summary of Work Quantity for P2 Pier

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Wall	Concrete	σck=240		m3	368.5	
	Form Works		Curved Surface H<4m	m2	278.5	
	Re-Bar Works		below D13	t	0.000	
			above D16	t	36.849	
			Subtotal	t	36.849	
	Prefabricated Scaffold Works			m2	444.0	
Foundation Works	Caisson Excavation	on Land		m3	583.4	
		under Water		m3	1,418.5	Excavation Length L=26.5m
		Total		m3	2,002.0	
	Concrete	σck=240	Side Wall	m3	376.0	
			Top Slab	m3	190.9	
			Watertight Wall	m3	191.0	
			Subtotal	m3	757.9	
		σck=180	Floor Slab	m3	171.9	σ28=225kg/cm2
	Form Works	Side Wall	H<4m	m2	0.0	
			Curved Surface H<4m	m2	622.0	
			Subtotal	m2	622.0	
		Top Slab	Bottom	m2	38.5	
		Watertight Wall	H<4m	m2	0.0	
			Curved Surface H<4m	m2	792.3	
			Subtotal	m2	792.3	
	Re-Bar Works	Side Wall	below D13	t	0.188	
			above D16	t	37.416	
			Subtotal	t	37.604	
		Top Slab	below D13	t	0.000	
			above D16	t	19.085	
			Subtotal	t	19.085	

Summary of Work Quantity for P2 Pier

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Foundation Works	Re-Bar Works	Watertight Wall	below D13	t	3.824	
			above D16	t	9.547	
			Subtotal	t	13.371	
		Total		t	70.060	
	Sand Filled	Soil		m3	211.7	
	Reinforcing Steel Plate of	SS400		t	7.5	
	Prefabricated Scaffold			m2	1,347.1	
	Jack Down			t	600.0	150tf×4

Summary of Work Quantity for A2 Abutment

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Permanent Works	Structure Excavation	Common Soil	Embankment	m3	0.0	
			Dumping	m3	1,252.8	
			Subtotal	m3	1,252.8	
	Filling Works			m3	66.2	the front of Footing
	Backfilling Works			m3	722.4	
	Foundation Crushed Stone			m3	16.4	
	Concrete	σck=240	Handrail	m3	7.0	
			Wall	m3	254.5	
			Footing	m3	175.4	
			Subtotal	m3	436.9	
		σck=180	Leveling Concrete	m3	8.2	
	Form Works	Handrail	H<4m	m2	43.5	
		Wall	Ordinary 4m<H	m2	246.3	
			H<4m	m2	160.8	
		Footing	H<4m	m2	75.6	
		Total		m2	526.2	
		Leveling Concrete		m2	3.9	
	Re-Bar Works	Handrail	below D13	t	0.835	
			above D16	t	0.557	
			Subtotal	t	1.392	
		Wall	below D13	t	0.229	
			above D16	t	22.736	
			Subtotal	t	22.965	
		Footing	below D13	t	0.000	
			above D16	t	10.523	
			Subtotal	t	10.523	
		Total		t	34.880	
	Prefabricated Scaffold Works			m2	510.0	

Summary of Work Quantity for A2 Abutment

Division	Item	Detail	Classification	Unit	Quantity	Remarks
Approach Slab	Concrete	σck=240		m3	12.8	
	Form Works			m2	6.1	
	Re-Bar Works	below D13		t	0.102	
		above D16		t	1.942	
		Subtotal		t	2.044	
Foundation Works	Cast-in-Place Pile φ1.2m L=16.0m n= 9 nos.	Design Length		m	144.0	
		Excavation Length	N<30	m	20.8	per a Pile
			30≦N	m	1.9	
			Subtotal	m	22.7	
		Concrete	σck=240	m3	18.1	
		Re-Bar	below D13	t	0.036	
			above D16	t	1.773	
			Subtotal	t	1.809	

8.5 Direct Project Cost

Construction Cost

No.	Work Item	Item	Qty.	Unit	Amount US$
1	Substructure	A1 Abutment	1	Ls	232,345
		A1 Abutment Cofferdam	1	Ls	226,930
		A2 Abutment	1	Ls	213,997
		A2 Abutment Cofferdam	1	Ls	103,288
		P1 Pier	1	Ls	70,050
		P1 Pier Open Caisson	1	Ls	328,725
		P1 Pier Cofferdam	1	Ls	327,925
		P2 Pier	1	Ls	70,024
		P2 Pier Open Caisson	1	Ls	308,790
		P2 Pier Cofferdam	1	Ls	265,373
		Subtotal			2,147,447
2	Superstructure	Girder Work - Cantilever Erection	1	Ls	208,717
		Girder Work - Pier Column	1	Ls	233,424
		Girder Work - Cantilever	1	Ls	468,911
		Girder Work - Center Connection	1	Ls	53,246
		Girder Work - Sidespan	1	Ls	77,463
		Girder Work - PC Tensioning	1	Ls	894,947
		Bearing,Expansion Joint	1	Ls	82,346
		Surface Work - Kerb,Railing	1	Ls	47,817
		Surface Work - Pavement	1	Ls	24,139
		Surface Work - Newel Post,Bridge Record Plate	1	Ls	41,564
		Surface Work - Drainage	1	Ls	7,121
		Subtotal			2,139,694
3	Approach Road	Mongochi Side (A1)	1	Ls	211,883
		Ntagaluka Side (A2)	1	Ls	230,362
		Drainage	1	Ls	21,796
		Ancillary Works	1	Ls	4,041
		Subtotal			468,082
4	Bank Protection		1	Ls	229,024
5	Repair of Existing Bride	(for Construction Road)	1	Ls	103,240
6	Depreciation Value		1	Ls	523,124
7	Direct Temporary Work		1	Ls	340,404
8	Indirect Temporary Work		1	Ls	742,129
9	Site Expense		1	Ls	1,162,246
10	Specialist		1	Ls	285,866
11	Mobilization		1	Ls	543,901
12	General Overhead		1	Ls	623,683
		Total			9,308,839