

## **[APPENDICES]**

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## 1 . Member List of the Study Team

### (1) Field Survey Team

Name	Job Title	Occupation
Mr. Hiroyuki Hayashi	Team Leader	Senior Project Administration Officer Transportation and Electric Power Team Project Management Group I Grant Aid Management Department, JICA
Mr. Toshinori Toda	Chief Consultant / Road Transport Planner	Katahira & Engineers International
Mr. Soemu Oshita	Road Designer I	Katahira & Engineers International
Mr. Tetsuro Izawa	Road Designer II	Japan Engineering Consultants Co., Ltd.
Mr. Shuichi Yashiro	Road Designer III / Coordinator	Katahira & Engineers International
Mr. Kou Kuwata	Natural Condition Surveyor	Japan Engineering Consultants Co., Ltd.
Mr. Tadashi Sato	Construction Planner / Cost Estimator	Katahira & Engineers International

### (2) Draft Final Report Explanation Team

Name	Job Title	Occupation
Mr. Eiji Inui	Team Leader	Resident Representative, JICA Zambia Office
Mr. Toshinori Toda	Chief Consultant / Road Transport Planner	Katahira & Engineers International
Mr. Soemu Oshita	Road Designer I	Katahira & Engineers International

## 2. Study Schedule

### (1) Field Survey (February 18~March 28, 2007)

Month	Date	Hiroyuki Hayashi	Toshinori Toda	Soemu Oshita	Tetsuro Izawa	Shuichi Yashiro	Kou Kuwata	Tadashi Sato	
		Official Member	Consultants Members						
		Team Leader	Chief Consultant	Road Designer I	Road Designer II	Road Designer III	Surveyor	Const. Planner & Cost Estimator	
2	18	NRT→HKG→JNB				-Ditto-			
	19	→LSK / Meeting at JICA / EOJ							
	20	MLGH Meeting				MLGH Meeting			
	21	NCC Meeting				NCC Meeting			
	22	NCC / RDA Meeting				NCC / RDA Meeting			
	23	KCC Meeting				KCC Meeting			
	24	KTW→LSK	Site Survey		KTW→LSK	Site Survey			
	25	Meeting	Site Survey		Site Survey	Site Survey			
	26	Signing of M/D, EOJ		Site Survey		Site Survey	Site Survey		
	27	LSK→JNB	Meeting	Site Survey		Site Survey	Site Survey		
	28		Site Survey	Site Survey		Site Survey	Site Survey	NRT→HKG→	
3	1		Site Survey	Site Survey		Site Survey	Site Survey	→JNB→LSK	
	2		LSK→KTW	Site Survey		LSK→KTW	Site Survey	LSK→KTW	
	3		Site Survey		NRT→HKG	Site Survey			
	4		Site Survey		JNB→LSK	Site Survey			
	5		Site Survey						
	6		Site Survey						
	7		Site Survey						
	8		Site Survey						
	9		Site Survey						
	10		Site Survey						
	11		Site Survey						
	12		Site Survey						
	13		Site Survey						
	14		Site Survey						
	15		Site Survey						
	16		Site Survey						
	17		Site Survey						
	18		Site Survey						
	19		Site Survey						
	20		Site Survey						
	21		Site Survey						
	22		KTW→LSK	Site Survey			KTW→LSK		
	23		MLGH, EOJ	Site Survey			Site Survey		
	24		Site Survey	Site Survey			Site Survey		
	25		Site Survey	KTW→LSK			Site Survey		
	26		Report to JICA Zambia Office						
	27		LSK→JNB→						
	28		→HNG→NRT						

LEGEND: NRT(Narita), HNG(Hong Kong), JNB(Johannesburg), LSK(Lusaka), KTW(Kitwe), EOJ(Embassy of Japan), MLGH( Ministry of Local Government and Housing)

(2) Draft Final Report Explanation (August 31 ~ September 9, 2007)

Month	Date	Eiji Inui	Toshinori Toda	Soemu Oshita
		Official Member	Consultants Members	
		Team Leader	Chief Consultant	Road Designer I
8	31		NRT→HKG→JNB	
9	1		JNB→LSK	
		JICA Meeting		
9	2		LSK→KTW	
9	3	EOJ / MLGH Meeting		KCC Meeting
9	4		LSK→KTW	NCC Meeting
		NCC Meeting		
9	5		KCC Meeting	
9	6		KTW→LSK	
		MLGH Meeting		
9	7	Signing on M/D with MLGH, Report to EOJ and JICA		
9	8		LSK→JNB→HK	
9	9		HK→NRT	

LEGEND: NRT(Narita), HNG(Hong Kong), JNB(Johannesburg), LSK(Lusaka), KTW(Kitwe), EOJ(Embassy of Japan), MLGH( Ministry of Local Government and Housing)

### 3. List of Parties Concerned in the Republic of Zambia

Ministry of Local Government and Housing (MLGH)	
Mr. Maswabi M. Maimbolwa	Permanent Secretary
Mr. Peter Lubambo	Director
Mr. Davies C. Zulu	Assistant Director
Mr. Richard Kangwa	Senior Engineer
Mr. Nkumbu Siame	Senior Engineer
Road Development Agency ( RDA)	
Mr. Watson Ng'ambi	Director & CEO
Mr. Muliya Mushimbei	Environmentalist
Mr. Charles Mushota	Head Procurement
Mr. Erasmus M. Chilundika,	Manager Planning & Design
Mr. Jan Tore Odd	Technical Advisor
Mr. Sean Canavan	Technical Assistant (Consultant)
Mr. Misheck Lungu	Copperbelt Regional Engineer
Mr. Phillimon Goma	Executive Engineer, Copperbelt Regional Office
Mr. Richard Kasongo,	Sr. Road Engineer, Copperbelt Regional Office
Ndola City Council (NCC)	
Ms. Charity Nanda Mpande	Town Clerk
Mr. Evervisto Makungo	Director of Housing
Mr. Gilvert Sendama,	Director of Engineering Service
Mr. Joseph Zulu	Assistant Director, Engineering
Ms. Katai Kambogi,	Sr. Road Engineer
Kitwe City Council (KCC)	
Mr. Ali D. Simwinga	Town Clerk
Mr. Ireen T. Mundia,	Director of Legal Service
Mr. John Kaliminwa	Director of Engineering Service
Mr. John Ngwata	Deputy Director of Engineering Service
Mr. Webster Musukwa	Assistant Director, Engineering Service
Mr. Mr. Reynolds Muluka	Civil Engineer
National Road Fund Agency	
Mr. Raphael Mabenga	Director
Mr. Stephen N. Mwale	Account-Road Fund
National Council for Construction (NCC)	
Dr. M.S. Mashamba	Executive Director
Ndola Police	
Mr. Simfukwe,	Assist. Superintendent
Mr. Syinjelesyo	Inspector
Kitwe Ploice	
Mr. Simmohza	Chief Inspector, Department of Traffic

#### 4. Minutes of Discussions

Field Survey (February 26, 2007)

**Minutes of Discussions  
on the Basic Design Study  
on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads  
in the Republic of Zambia**

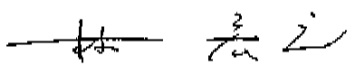
In response to a request from the Government of the Republic of Zambia (hereinafter referred to as "GRZ"), the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

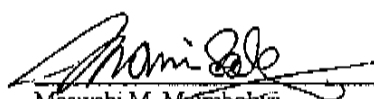
JICA sent to Zambia the Basic Design Study Team (hereinafter referred to as "the Team"), headed by Mr. Hayashi Hiroyuki, Senior Project Administration Officer, Transportation and Electric Power Team, Project Management Group I of the Grant Management Department, JICA, and is scheduled to stay in the country from February 19 to March 27, 2007.

The Team held discussions with the officials concerned of GRZ and conducted a field survey at the study area.

In the course of discussions and field survey, both sides confirmed the main items described in the attached sheets.

Lusaka, February 26, 2007

  
\_\_\_\_\_  
Hayashi Hiroyuki  
Leader  
Basic Design Study Team  
Japan International Cooperation Agency

  
\_\_\_\_\_  
Maswabi M. Maimbetwa  
Permanent Secretary  
Ministry of Local Government and Housing  
The Republic of Zambia

## ATTACHMENT

### 1. Objective of the Project

The objective of the Project is to rehabilitate and maintain the roads and related structures in the cities of Ndola and Kitwe.

### 2. Project Sites

The sites of the Project are located in the cities of Ndola and Kitwe, as shown in Annex-1.

### 3. Responsible and Implementing Organization

3-1. The responsible Ministry is the Ministry of Local Government and Housing (MLGH).

The organization chart of the MLGH is shown in Annex-2-1.

3-2. The implementing organizations are the Ndola City Council (NCC) and the Kitwe City Council (KCC).

The organization charts of the both City Councils are shown in Annex-2-2 and Annex-2-3.

### 4. Items Requested by the GRZ

After discussions with the Team, the items described in Annex-3 were confirmed and requested by the Zambian side. JICA will assess the appropriateness of the request and will report the findings to the Government of Japan.

### 5. Japan's Grant Aid Scheme

5-1. The Zambian side understands Japan's Grant Aid Scheme for General Project explained by the Team, as described in Annex-4, which was attached as Annex-4 of the Minutes of Discussions signed on August 2, 2006 (hereinafter referred to as "the previous M/D").

5-2. The Zambian side will take the necessary measures, as described in Annex-5, which was attached as Annex-6 of the previous M/D, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

### 6. Schedule of the Study

6-1. The Team will proceed with the study in Zambia until March 27, 2007.

6-2. JICA will prepare the draft report in English and dispatch a team to Zambia in order to explain its contents around the beginning of September 2007.

6-3. When the contents of the draft report are accepted in principle by GRZ, JICA will complete the final report and send it to GRZ around October 2007.

### 7. Other Relevant Issues

7-1. The Team explained to the Zambian side that the Project will be divided into two (2) phases, and the tentative implementation schedule is shown as below;

1) Phase-1 will be commenced in Japanese Fiscal Year (JFY) 2007, subjected to obtaining the Japanese Cabinet's approval and signing of the Exchange of Notes (E/N) by the Government of Japan and Zambia.

2) Phase-2 will be commenced in JFY 2008, subjected to obtaining the Japanese Cabinet's approval and signing of the E/N by the Government of Japan and Zambia.

The Team will inform the Zambian side of the tentative implementation plan for each phase by the end of May, 2007.

The Team will inform the Zambian side of the tentative implementation plan for each phase by the end of May, 2007.

7-2. The Zambian side should conduct the public information campaign and the stakeholder meetings for effective public participation with the Project Affected Persons (PAPs) including illegal occupant(s) (squatters), local communities, related NGOs, etc., to inform them about the outline of the Project including positive and negative impacts as agreed in the previous M/D by end of August, 2007.

7-3. The Zambian side should obtain the approval and/or confirmation in writing regarding the environmental and social considerations necessary for the Project from the Environmental Council of Zambia by the end of middle of September, 2007.

7-4. The Zambian side should obtain agreements from the PAPs for conditions and contents of the land acquisitions and/or involuntary resettlements (if any) for the Project by the end of August, 2007 for Phase-1 and by the end of December, 2007 for Phase-2. The Team will provide the drawings and data necessary for identifying the affected area by the end of May, 2007. The Zambian side should complete all procedures regarding land acquisitions and/or involuntary resettlements before the commencement of each construction.

7-5. The Zambian side should relocate the public utilities, such as electricity & telecommunication lines, water and sewerage pipes, within the Right of Way (ROW) and/or Corridor of Impact (COI) of the roads before the commencement of the Project. The Team will provide the drawings and data necessary for identifying ROW and/or COI by the end of May, 2007.

7-6. The Zambian side should provide necessary number(s) of counterpart personnel to the Team during the period of the studies in Zambia.

7-7. The Zambian side should submit answers in English to the Questionnaire with relevant documents, which the Team handed to the Zambian side, by March 15, 2007.

7-8. The Zambian side requested the Team to carry out the training in Japan to the staff of NCC and/or KCC on advanced road maintenance technique as technical cooperation by JICA. The Zambian side should submit the official request regarding training with concrete contents of training through the Embassy of Japan/JICA Zambia Office.

7-9. The Team explained to the Zambian side that the "Japan's Grant Aid Scheme for Community Empowerment" might be applied to 3 roads (total length: about 5.1 km) and 3 markets and other related equipment and facilities in the both cities. The Ministry of Foreign Affairs of Japan continues to examine/assess the feasibility to proceed the above-mentioned new scheme.

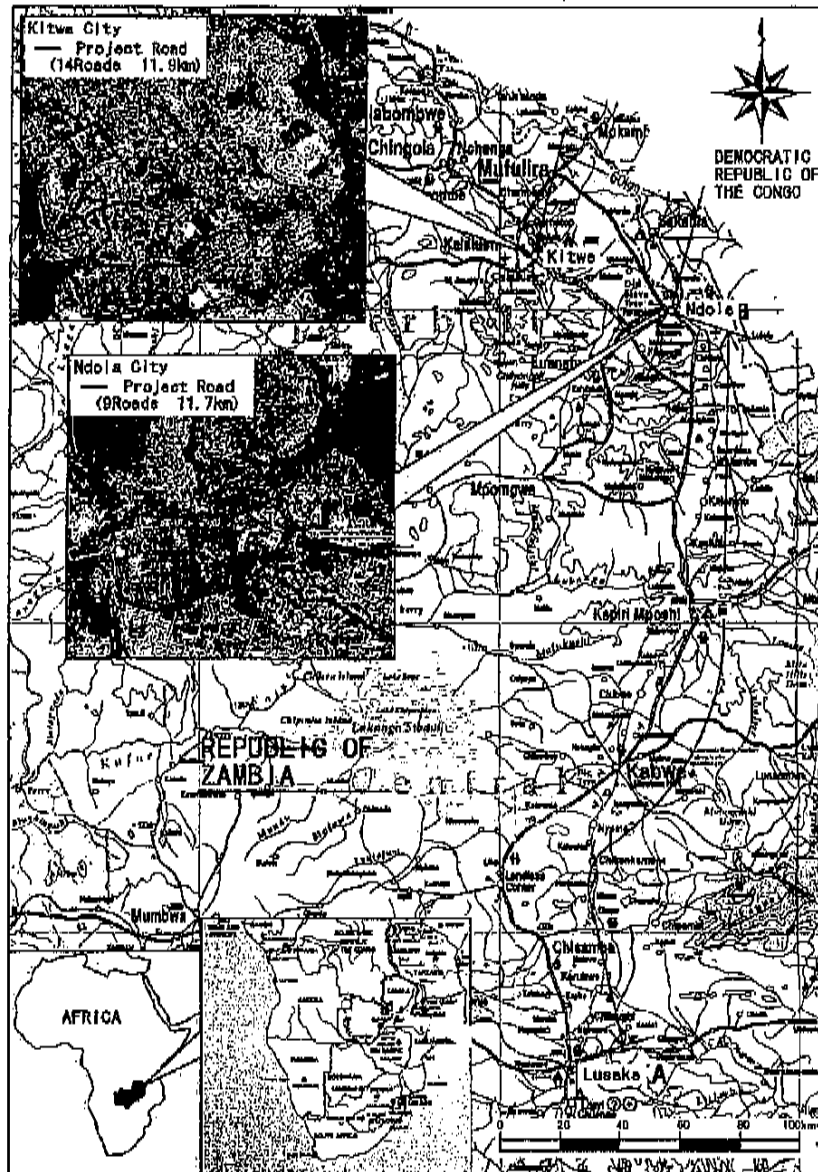
7-10. Both sides agreed that the Zambian side provides office space for the Team during study period.

7-11. Both NCC and KCC re-requested the Team to include provision of street lights for traffic safety measure and provision of crane mounted truck, tower wagon truck and other equipment shown in the Technical Notes signed on August 5, 2006 between the Preliminary Study Team (the P/S Team) and NCC, and signed on August 14, 2006 between the P/S Team and KCC for proper maintenance of roads and street lights.

APP

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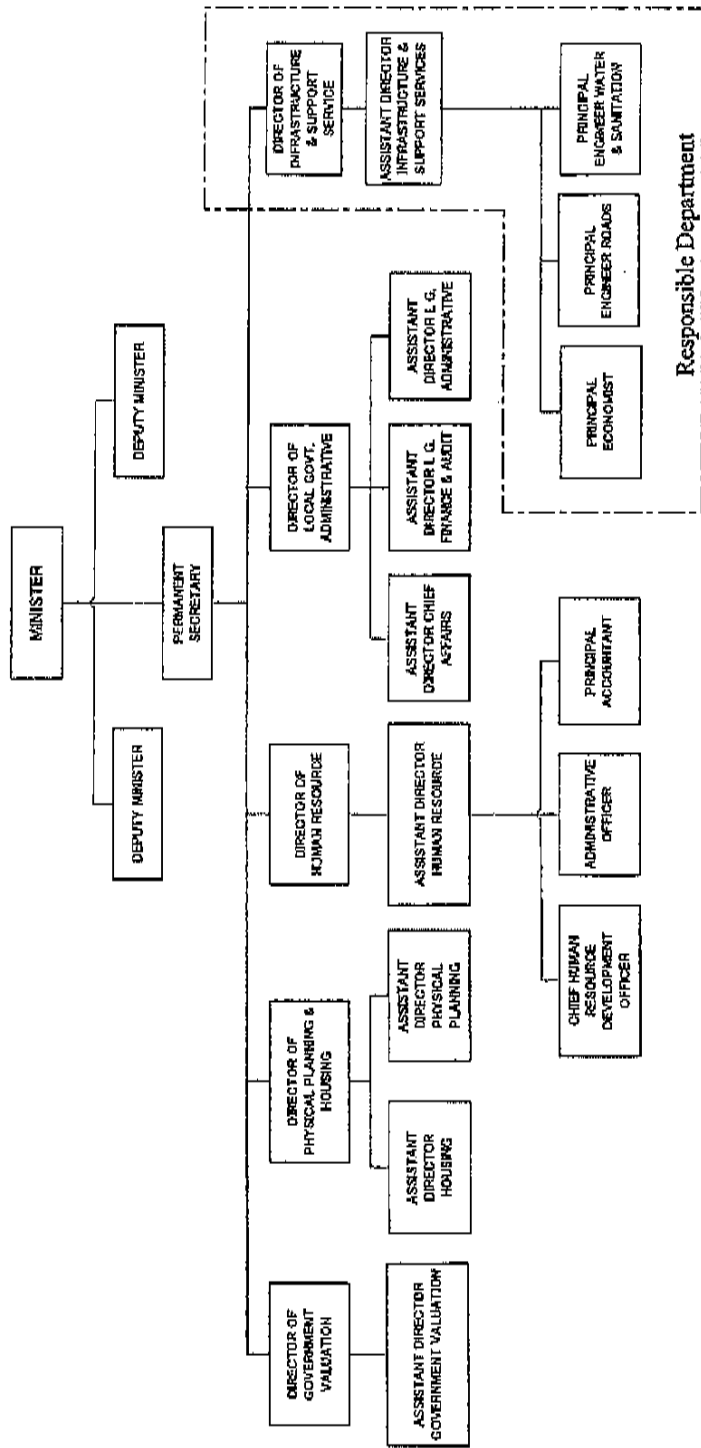




LOCATION MAP

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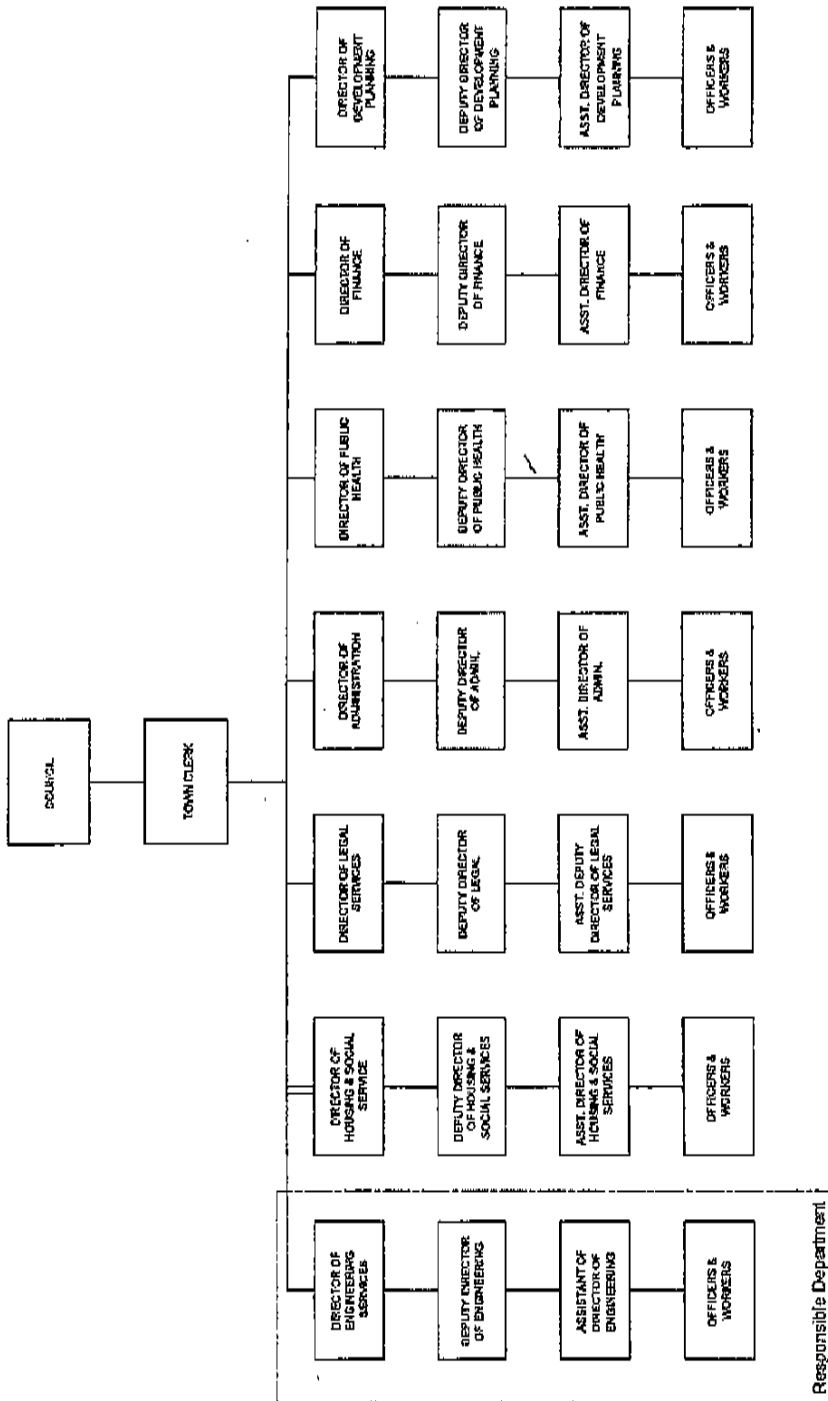
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MINISTRY OF LOCAL GOVERNMENT AND HOUSING

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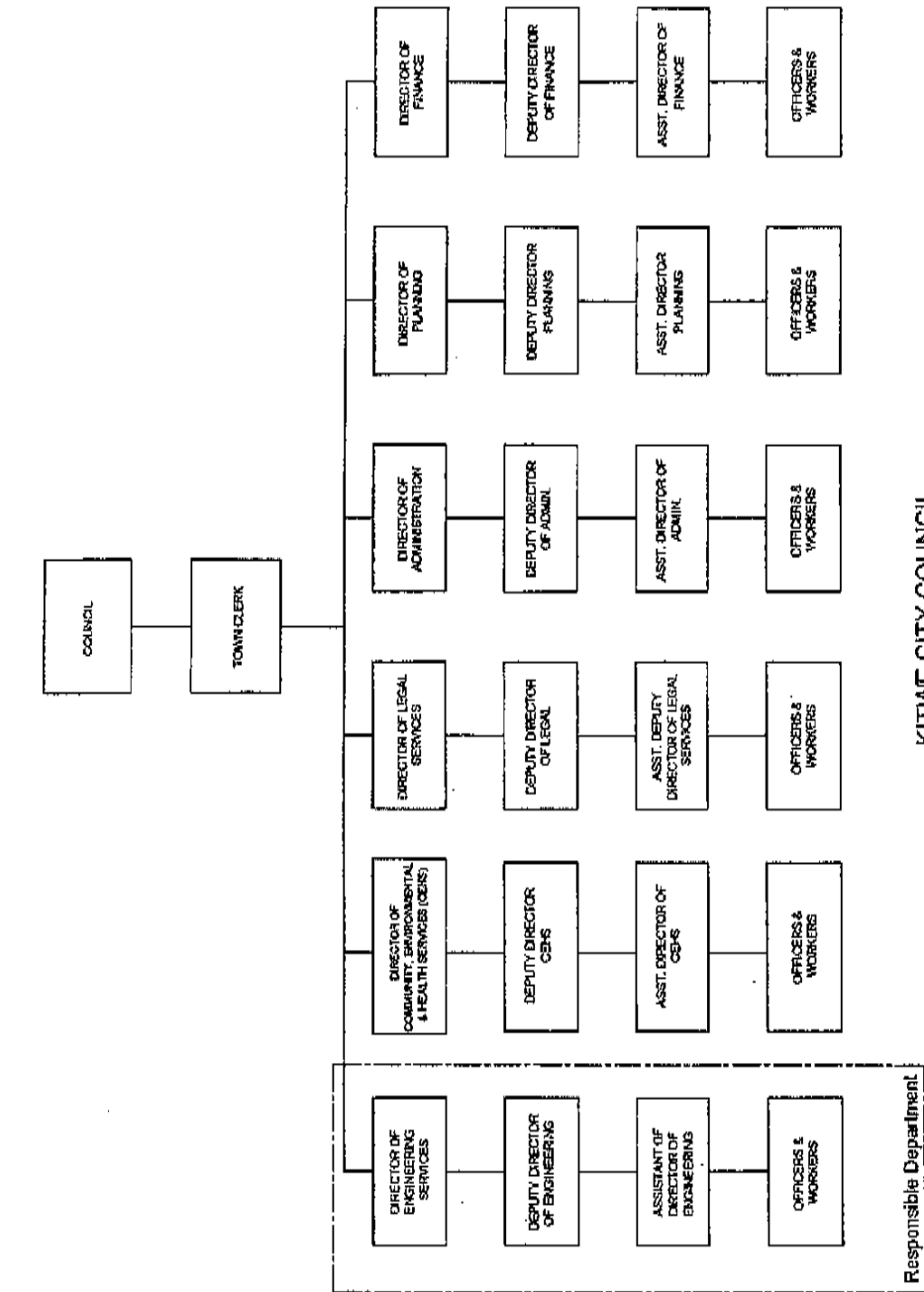
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NDOLA CITY COUNCIL

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KITWE CITY COUNCIL

AS

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## Items Requested by GRZ

Ndola City			Kitwe City		
No.	Road Name	Length (Km)	No.	Road Name	Length (Km)
1.	Vitanda Street	0.8	1.	Dr. Aggrey Avenue (South)	1.0
2.	Kaunda Drive	0.3	2.	Euclid Road	0.6
3.	Makoli Avenue	0.9	3.	Zomba Road	0.4
4.	Independence Way	1.7	4.	Blantyre Road	0.6
5.	Zambia Road	2.1	5.	Eshowe Road	0.4
6.	Matelo Road	0.4	6.	Matuka Avenue	0.4
7.	Lukasu Road (Including Siemens Road)	1.2	7.	Kantanta Street	2.4
8.	Chambeshi Road (Including Lubuto Avenue)	3.9	8.	Natwange Road	0.9
9.	Livingstone Road	0.4	9.	Mutentemuko Road	1.1
			10.	Miseshi Street	0.9
			11.	Kanongesba Road	0.7
			12.	Mulilakwenda Road	0.8
			13.	Lilogwe Road	0.6
			14.	Independence Service Lane	1.1
		11.7			11.9
	Total			Total	23.6

### Japan's Grant Aid Scheme for General Project

The Grant Aid scheme provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

#### 1. Grant Aid Procedures

Japan's Grant Aid Scheme is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using Japanese consulting firms.

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the recipient country.

Finally, for the smooth implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

#### 2. Basic Design Study

##### 1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICA on a requested project (hereinafter referred to as "the Project"), is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view;
- Confirmation of items agreed upon by both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.
- Estimation of cost of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project.

Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses registered consulting firms. JICA selects firms based on proposals submitted by interested firms. The firms selected carry out a Basic Design Study and write a report, based upon terms of reference set by JICA.

The consulting firms used for the Study are recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

1) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

2) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed.

However, in case of delays in delivery, installation or construction due to unforeseen factors such as natural disaster, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

3) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability of Japanese taxpayers.

5) Undertakings required to the Government of the recipient country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

- a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the Project,
- b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,
- c) To secure buildings prior to the procurement in case the installation of the equipment,

## Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Party
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the site	( ● )	( ● )
4	To construct roads		
	1) Within the site	●	
	2) Outside the site when needed	N/A	N/A
5	To bear the following commission to the Japanese bank for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
6	To ensure prompt unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
7	To accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the verified contract, such facilities as may be necessary for their entry into Zambia and stay therein for the performance of their works		●
8	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Zambia with respect to the supply of the products and services under the verified contracts		●
9	To maintain and use properly and effectively the facilities constructed and equipment provided under the Japan's Grant		●
10	To bear all the expenses, other than those to be borne by the Japan's Grant, necessary for construction of the facilities		●

(B/A: Banking Arrangement, A/P: Authorization to Pay)



- d) To ensure all the expense and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,
- e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts,
- f) To accord Japanese nationals, whose services may be required in connection with supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

6) "Proper Use"

The recipient country is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

7) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

8) Banking Arrangement (B/A)

- a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.
- b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of recipient country or its designated authority.

9) Authorization to pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.



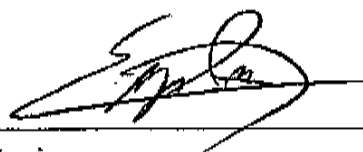
**Minutes of Discussions  
on the Basic Design Study  
on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads  
in the Republic of Zambia  
(Explanation on Draft Report)**

In February 2007, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads (hereinafter referred to as "the Project") to the Republic of Zambia (hereinafter referred to as "Zambia"), and through discussions, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

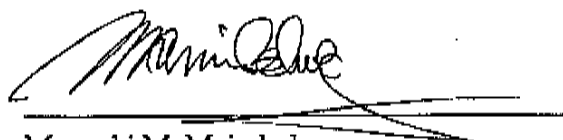
In order to explain and to consult with officials concerned of the Government of Zambia on the components of the draft report, JICA sent to Zambia the Draft Report Explanation Team (hereinafter referred to as "the Team"), which was headed by Mr. Eiji Inui, Resident Representative, JICA Zambia Office, from September 1 to September 8, 2007.

As a result of discussions, both sides confirmed the main items described on the attached sheets.

Lusaka, September 7, 2007



Eiji Inui  
Leader  
Draft Report Explanation Team  
Japan International Cooperation Agency



Maswabi M. Maimbolwa  
Permanent Secretary  
Ministry of Local Government and Housing  
The Republic of Zambia

## ATTACHMENT

### 1. Components of the Draft Report

The Government of Zambia agreed and accepted in principle the components of the draft final report explained by the Team. The main components are shown in Annex-1.

### 2. Schedule of the Study

JICA will complete the final report and send it to the Government of Zambia in October 2007.

### 3. Other Relevant Issues

3-1. The Team explained to the Zambian side that the Project will be divided into two (2) phases as shown in the draft report.

3-2. Both the Ndola City Council (NCC) and the Kitwe City Council (KCC) agreed and accepted that their additional requests, such as installation of street lights, procurement of road maintenance equipment, etc. are excluded from the Project.

3-3. The Zambian side submitted a letter of committal regarding environmental and social considerations necessary for the Project from the Environmental Council of Zambia (ECZ) as per Annex-2. The Zambian side should submit the approval in writing regarding environmental and social considerations necessary for the Project from the Environmental Council of Zambia (ECZ) as soon as possible by the end of September 2007. The Team indicated that in case the submission of the approval was delayed, the appraisal by the Government of Japan would be delayed consequently and not be able to proceed the further step.

3-4. The Zambian side shall relocate the public utilities, such as electricity & telecommunication lines, water and sewerage pipes, necessary for the Project based on the contents of the draft report. The tentative schedule for these activities is shown in Annex-3.

3-5. The Zambian side agreed to secure and allocate the necessary budget for undertakings to be done in a timely manner, based on the provisional amount shown in the draft report in fiscal year 2008 to 2010.

3-6. Both sides confirmed that it is necessary to control over-loaded vehicles in order to sustain the investment and accordingly both sides reconfirmed that the Zambian side should establish suitable measures for traffic safety and control, especially overloading traffic, which are essential for appropriate operation and maintenance of the roads improved by the Project.

3-7. Both sides agreed that the Project Cost estimate, as attached in Annex-4, should never be duplicated or released to any outside parties before the award and signing of all Contracts for the Project.

3-8. The Zambian side requested the Team to arrange counterpart training in Japan on Road Management and Maintenance under technical cooperation by JICA. The Zambian side understands that an official request for the counterpart training is necessary to be submitted to the Japanese side through the Embassy of Japan/JICA Zambia Office.



## Components of the Project

Ndola City			Kitwe City		
No.	Road Name	Length (Km)	No.	Road Name	Length (Km)
1.	Vitanda Street	0.859	1.	Dr. Aggrey Avenue (South)	0.993
2.	Kaunda Drive	0.295	2.	Euclid Road	0.587
3.	Makoli Avenue	0.881	3.	Zomba Road	0.370
4.	Independence Way	1.726	4.	Blantyre Road	0.449
5.	Zambia Road	2.537	5.	Eshowe Road	0.485
6.	Matelo Road	0.383	6.	Matuka Avenue	0.363
7.	Lukasu Road (Including Siemens Road)	1.000	7.	Kantanta Street	2.371
8.	Chambeshi Road (Including Lubuto Avenue)	4.674	8.	Natwange Road	0.904
9.	Livingstone Road	0.375	9.	Mutentemuko Road	1.075
			10.	Miseshi Street	0.913
			11.	Kanongesha Road	0.724
			12.	Mulilakwenda Road	0.705
			13.	Lilogwe Road	0.623
			14.	Independence Service Lane	1.068
		12.73			11.63
	Total			24.36	

DISS/02/16/C

24 July 2007

The Director  
Environmental Council of Zambia  
LUSAKA

Dear Sir,

**ENVIRONMENTAL PROJECT BRIEF FOR THE PROJECT FOR THE  
REHABILITATION AND MAINTENANCE OF NDOLA CITY AND KITWE  
CITY ROADS**

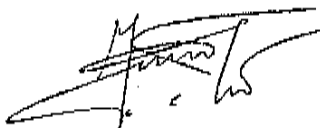
Please be informed that the Japanese Government through the Japan International Cooperation Agency has continued to give support to the Government of Zambia in the improvement of Lusaka City Roads.

The civil works for the project are expected to commence towards the end of 2007. This will cover 11.7 km of urban roads in Ndola and 11.9 km of urban roads in Kitwe.

In view of the above, we would like to submit six (6) copies each of the Environmental Project Brief for the Project of the Rehabilitation and Improvement of Ndola City and Kitwe City Roads for your consideration.

Your usual cooperation will be highly appreciated.

Yours Faithfully,



Davies C. Zulu  
Acting Director – DISS  
For/Permanent Secretary

**MINISTRY OF LOCAL GOVERNMENT AND HOUSING**

- c.c. The Town Clerk – Ndola City Council
- c.c. The Town Clerk – Kitwe City Council



MLGH/101/34/14

7<sup>th</sup> September 2007

The Chairman  
Environmental Council of Zambia  
**LUSAKA**

Dear Sir

**RE: ENVIRONMENTAL PROJECT BRIEF FOR THE PROJECT FOR  
IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE  
CITY ROADS**

---

The Government of Zambia has received a grant from the Government of Japan to rehabilitate selected urban roads in Ndola and Kitwe.

On the 27<sup>th</sup> July 2007, my Ministry submitted the Project Brief to the Environmental Council. It is one of the conditionalities of the project that the project is approved by the Council to ensure compliance with the Environmental Protection and Pollution Control Act of the Laws of Zambia.

It has now come to my attention that the Government of Japan will be considering the Zambian Projects on 25<sup>th</sup> September, 2007 and that we stand to lose out if the necessary approvals are not presented together with the design documents.

I therefore, wish to appeal to ECZ to urgently consider the Ministry's application, preferably before the 15<sup>th</sup> September so that we may communicate the approval to the Japanese Government in time.

I need not emphasise the importance of this project to the Government and the people of Zambia.



I have also resubmitted six (6) copies of the Environmental Project Brief for Kitwe City and Ndola City Councils.

Your usual cooperation will be appreciated.

Yours faithfully



Maswabi M. Maimbolwa  
PERMANENT SECRETARY  
**MINISTRY OF LOCAL GOVERNMENT AND HOUSING**





# ENVIRONMENTAL COUNCIL OF ZAMBIA

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Chirundu, Zambia  
Tel/Fax: 260-1-515261

ECZ/101/4/1

September 7, 2007

*In reply please quote*

The Permanent Secretary  
Ministry of Local Government and Housing  
P.O. Box 50027  
Lusaka

No.....

**Attention: Mr. P Lubambo**

Dear Sir,

**RE: ENVIRONMENTAL PROJECT BRIEF FOR THE PROJECT FOR THE IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS**

We make reference to the above captioned subject and your letter dated September 7<sup>th</sup> 2007 in which you submitted to the Environmental of Zambia 2 x 6 copies of the Environmental Project Briefs (EPBs) for road improvement and maintenance for Ndola and Kitwe City roads respectively.

We have taken note of the importance of the projects submitted. To this end, we would like to inform you that we have in accordance with the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations Statutory Instrument No. 28 of 1997 commenced the EIA approval process for the said EPBs.

We would like to assure you that we shall work on the documents and shall subsequently notify you of the outcome of the approval process by the end of September.

We thank you in anticipation of your usual cooperation.

Yours faithfully,

Chibesa Chibesakunda  
Acting Director

**ENVIRONMENTAL COUNCIL OF ZAMBIA**





**Project Cost Estimate**

The total project cost necessary to implement this Project is estimated at 2,210 Million Yen. The costs to be borne by both Governments, Japan and the Republic of Zambia based on the scope of works for both Governments as described in the draft report of the Basic Design Study and respective details are estimated as follows on the conditions shown in (3) below. However, this cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

**(1) Cost borne by the Government of Japan**

Total Cost : approximately 2,175 Million Yen

Improvement of urban roads of approximately 24.3km in total consisting of 12.7km (9 Roads) in Ndola City and 11.6km (14 Roads) in Kitwe City.

Item			Roughly Estimate Cost (Million Yen)
Facility	Road	Pavement Drainage Culvert	2,048
Detailed Design/ Construction & Supervision			127

**(2) Cost borne by the Government of the Republic of Zambia**

Total Cost:           Approximately 1,187 Million Kwacha (35 Million Yen)

- |   |                      |                                      |
|---|----------------------|--------------------------------------|
| ① | Advising Commission  | 76 Mil.Kwacha (app. 2 Mil. Yen)      |
| ② | Payment Commission   | 90 Mil. Kwacha (app. 3 Mil. Yen)     |
| ③ | Relocation Cost etc. | 1,021 Mil. Kwacha (app. 30 Mil. Yen) |

**(3) Conditions in Cost Estimate**

- ① Time of Cost Estimate: February 2007
- ② Exchange Rate : 1US Dollar=119.59Yen, 1Kwacha=0.029Yen
- ③ Construction Period: As shown in Draft BD report
- ④ Cost estimate is implemented in accordance with the guideline of Japan's Grant Aid.



5. ECZ Environmental Approval



# ENVIRONMENTAL COUNCIL OF ZAMBIA

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Chirundu, Zambia  
Tel/Fax: 260-1-515261

September 24<sup>th</sup>, 2007

**ECZ/INS/101/4/1**  
*In reply please quote*

No.....

The Director,  
Department of Infrastructure and Support Services  
Ministry of Local Government and Housing  
P.O. Box 50027  
Lusaka

Dear Sir

**RE: Proposed Rehabilitation of Nine Roads in Ndola by Ndola City Council**

Reference is made to the above captioned project submitted to the Environmental Council of Zambia (ECZ) on **11<sup>th</sup> September, 2007** for consideration in accordance with the requirements of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, Statutory Instrument No. 28 of 1997.

The ECZ has since reviewed your Environmental Project Brief (EPB) and based on the information provided in the EPB, comments submitted by interested and affected parties and our site verification inspection findings, ECZ has **approved** your project proposal.

Attached to this Decision Letter are conditions of approval.

Yours faithfully,

  
Edward Zulu  
Director

**ENVIRONMENTAL COUNCIL OF ZAMBIA**

cc: The Town Clerk – Ndola City Council  
The Director – Road Development Agency





## ENVIRONMENTAL COUNCIL OF ZAMBIA (ECZ)

### DECISION LETTER

#### **1.0 PROJECT BACKGROUND**

##### **1.1 PROJECT TITLE**

Proposed Rehabilitation of Nine Roads in Ndola by Ndola City Council

##### **1.2 PROJECT PROPONENT**

Ministry of Local Government and Housing

##### **Contact Person:**

Town Clerk  
Ndola City Council  
P.O. Box 70197  
**Ndola**

##### **1.3 PROJECT LOCATION**

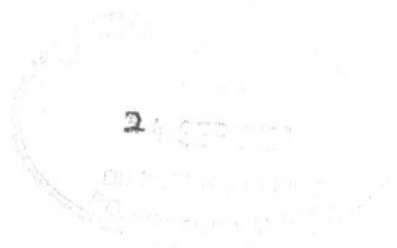
The project sites are in the heavy industrial area for 4 roads, namely, Lusaka, Chambeshi, Zambia and Livingstone. The rest are located in Ndolas' Central Business District.

##### **1.4 DATE OF SUBMISSION BY PROPONENT**

11<sup>th</sup> September, 2007.

##### **1.5 DATE OF CONSIDERATION BY COUNCIL**

24<sup>th</sup> September, 2007.





## 2.0 DETAILS OF THE PROJECT

This project will be fully financed by a Grant Aid by the Government of Japan through JICA to the Government of the Republic of Zambia through the Ministry of Local Government and Housing. The project will involve rehabilitation and maintenance of nine selected roads in Ndola. The following are the roads with their respective lengths selected for maintenance and rehabilitation:

Vitanda Street – 0.8 Km; Kaunda Drive – 0.3 Km; Makoli Avenue – 0.09 Km; Independence Way – 1.7 Km; Zambia Road – 2.1 Km; Matelo Road – 0.4 Km; Lusaka Road – 1.2 Km; Chambeshi Road – 3.9 Km; Livingstone Road – 0.4 Km

## 3.0 DECISION BY COUNCIL

3.1 The project is **approved** subject to the following conditions:

- 3.1.1 Ndola City Council shall implement the project as stated in the Environmental Project Brief (EPB).
- 3.1.2 Quarrying of gravel at Twapia and Mushili Borrow Pits shall be done systematically.
- 3.1.3 Ndola City Council shall submit a plan to the Environmental Council of Zambia for the final rehabilitation of the borrow pits within month of approval of the project.
- 3.1.4 Kitwe City Council shall comply in full with the following regulations throughout the project cycle:
  - a) Waste Management Regulations, SI No.71 of 1993;
  - b) Water Pollution Control Regulations, SI. No. 72 of 1993;
  - c) The Air Pollution Control Regulations of 1996.



- 3.1.5 Dust suppression techniques shall be employed during construction phase.
- 3.1.6 Noise levels throughout project cycle shall be maintained within acceptable levels.
- 3.1.7 Culverts should be installed at all stream crossing and the road should be fitted with effective drainage facilities that will also act as silt traps.

3.2 The Council **advises** Ndola City Council to:

- 3.2.1 Obtain any other relevant authorizations such as but not limited to the following:
  - a) The Town and Country Planning Act;
  - b) The Local Government Act;
  - c) The Water Act.
  - d) The Road Traffic Act
- 3.2.2 To give priority to local people when employing the workforce for the project.
- 3.2.3 Make available information on malaria control and HIV/AIDS to employees.
- 3.2.4 To provided all workers with personal protective equipment.

3.3 Ndola City Council should consider complying with environmental standards and/or specific limits of particular pollutants as its responsibility. Thus, compliance with ECZ recommended measures does not absolve Ndola City Council from its responsibility if such measures do not achieve compliance with environmental control standards.

3.4 Ndola City Council shall implement the project within **three years** from the date of approval. Failure to implement the project within the said period shall render this approval invalid and the developer shall resubmit the EPB.



3.5 The Council may suspend or cancel this Decision Letter **without notice** should Ndola City Council fail to comply with any of the given conditions.

.....  
Date

.....  
Edward Zulu  
Director

**Environmental Council of Zambia**



# ENVIRONMENTAL COUNCIL OF ZAMBIA

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Tel/Fax: 260-1-515261

24<sup>th</sup> September 2007

*In reply please quote*  
**ECZ/INS/101/4/1**

No.....

The Director,  
Department of Infrastructure and Support Services  
Ministry of Local Government and Housing  
P.O. Box 50027  
Lusaka

Dear Sir

**RE: Proposed Rehabilitation of Fourteen Roads in Kitwe by Kitwe City Council**

We make reference to the above captioned project submitted to the Environmental Council of Zambia (ECZ) on **11<sup>th</sup> September, 2007** for consideration in accordance with the requirements of the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997.

The ECZ has since reviewed your Environmental Project Brief (EPB) and based on the information provided in the EPB, verbal and written comments submitted by interested and affected parties and our site verification inspection findings, ECZ has **approved** your project proposal.

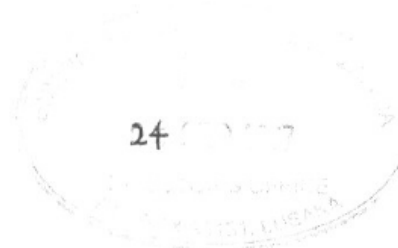
Attached to this Decision Letter are conditions of approval.

Yours faithfully,

Edward Zulu  
Director

**ENVIRONMENTAL COUNCIL OF ZAMBIA**

cc: The Town Clerk – Kitwe City Council  
The Director – Road Development Agency







## ENVIRONMENTAL COUNCIL OF ZAMBIA (ECZ)

### DECISION LETTER

#### **1.0 PROJECT BACKGROUND**

#### **1.1 PROJECT TITLE**

Proposed Rehabilitation of Fourteen Roads in Kitwe by Kitwe City Council

#### **1.2 PROJECT PROPONENTS**

Ministry of Local Government and Housing

#### **Contact Person:**

The Town Clerk  
Kitwe City Council  
P.O. Box 70197  
**KITWE**

#### **1.3 PROJECT LOCATION**

The project sites are in the heavy industrial area for 12 roads, namely, Dr. Aggrey, Zomba, Blantyre, Eshowe, Euclid, Lilongwe, Kanongesha, Independence Service Lane, Mutentemuko, Misesi, Mulilakwenda and Natwange roads. Matuka and Kantanta are located in Kitwe's Central Business District.

#### **1.4 DATE OF SUBMISSION BY PROPONENT**

11<sup>th</sup> September, 2007.

#### **1.5 DATE OF CONSIDERATION BY COUNCIL**

24<sup>th</sup> September, 2007



## 2.0 DETAILS OF THE PROJECT:

This project will be financed by the Japanese Grant Aid through JICA to the Government of the Republic of Zambia and will involve rehabilitation and maintenance of the following fourteen selected roads in Kitwe:

Dr. Aggrey Avenue (South) – 0.993 Km; Euclid Road – 0.587 Km; Zomba Road – 0.370; Blantyre Road – 0.449 Km; Eshowe Road – 0.485Km; Matuka Avenue – 0.363 Km; Kantanta Street – 2.29 Km; Natwange Road – 0.904 Km; Mutentemuko Road – 1.075 Km; Miseshi Road – 0.913 Km; Kanongesha Road – 0.724 Km; Mulilakwenda Road – 0.705 Km; Lilongwe Road – 0.623 Km; Independence Service Lane – 1.068 Km

## 2.0 DECISION BY COUNCIL

2.1 The project is **approved** subject to the following conditions:

- 2.1.1 Kitwe City Council shall implement the project as stated in the Environmental Project Brief (EPB).
- 2.1.2 Quarrying of gravel at Mindolo Borrow Pits shall be done systematically.
- 2.1.3 Kitwe City Council shall submit a plan to the Environmental Council of Zambia for the final rehabilitation of the borrow pits within one month of approval of the project.
- 2.1.4 Kitwe City Council shall comply in full with the following regulations throughout the project cycle:
  - a) Waste Management Regulations, SI No.71 of 1993;
  - b) Water Pollution Control Regulations, SI. No. 72 of 1993;
  - c) The Air Pollution Control Regulations of 1996.
- 2.1.5 Dust suppression techniques shall be employed the during construction phase.
- 2.1.6 Noise levels throughout project cycle shall be maintained within acceptable levels.

## 6. References

No.	Title	Style	Issued by	Year
1	Terms of Reference for a Road Authority (including Power and Duties)	Report	RDA	Nov. 2006
2	Economic Review, October 2004 - April 2005	Report	Barclays Bank	2005
3	Zambia 1990 Census of Population, Housing and Agriculture, Demographic Projections 1990-2015	Report	Central Statistical Office	Nov. 1995
4	Natural condition of Ndola and Kitwe	Report	MLGH	—
5	A Secondary geography of Zamabia, 3rd Edition	Report	Longman	1995
6	Vision 2030	Report		Dec. 2006
7	Fifth National Development Plan 2006-2016 Summary	Report	Ministry of Finance and National Planning	Dec. 2006
8	Road Sector Investment Programme (ROADSIP 1997-2007), June, 1997	Report	MCT	Jun. 1996
9	Road Sector Investment Programme (ROADSIP), Draft bankable Document, 29 October 1999	Report	National Task Force for Roadsip II	Nov. 2006
10	Road Sector Investment Programme (ROADSIP), Draft Annual Review, 1999	Report	National Road Board	1999
11	Road Sector Investment Programme (ROADSIP), Quarterly Progress Report (July to September 2006), 20 Nov 2006	Report	National Road Fund Agency (JICA Zambia Office: JZO)	Nov. 2006
12	Agenda for the Committee of Permanent Secretaries on Road Maintenance Initiative (RMI) on 31 January 2007	Report	WB (JZO)	Jan. 2007
13	Agenda for Cooperating Partners Meeting, Road Transport, 12 Sept 2006	Report	Cooperating Meeting (JZO)	Sep. 2006
14	Road Rehabilitation and Maintenance Project, Mid-Term Review Mission Aide Memoire, June 26-July 14, 2006	Report	EU(JZO)	Jul. 2006
15	NDF Credit no.428, Terms of Reference on the Study of Road User and its Implementation, March 2007	Report	NRFA(JZO)	Mar. 2007
16	NRFA Notice of Disbursement Schedule, 2006, February 28, 2007	Report	Times of Zambia, NRFA	Feb. 2007
17	City of Ndola Strategic Development Plan (2006-2010)	Report	Ndola City Stakeholders, Development Cooperation Ireland,	2005
18	City of Ndola, District Situation Analysis (Draft for Final Discussion at DDCC), November 2006	Report	NCC	Nov. 2006
19	KCC Budget Estimates 2007	Report	KCC	2006
20	Construction News	News Letter	National Council for Construction	Nov. 2006
21	Ndola City Council, Annual Work Plan 2007 (Draft), March 2007 (5 pages)	Report	NCC	Mar. 2007
22	Ndola City Council, Budget Summary, Engineering Services Department, 2006, (1 pages)	Report	NCC	2006
23	Environmental Management Unit, Road Department, MOWS, Initial Environmental Impact Assessment Report for the Proposed Rehabilitation of the Chingola-Kasumbaleasa Road, Copperbelt Province Zambia, March 2003 (54 pages)	Report	RDA	Mar. 2003
24	ZCCM-IH, Preparation of Phase 2 of a Consolidated Environmental Management Plan, Project Summary Report, December 2005	Report	SGAB, SWECO, THOMRO, UNZA	Dec. 2005
25	Standard Specifications for Roads and Bridges, December 1973	Report	Road Department	Dec. 1973
26	Rehabilitation of Ndola Urban Roads, Funded by World Bank, Traffic Survey and economic Report, Revised Report, September 1998	Report	ASCO, NCC	Sep. 1998

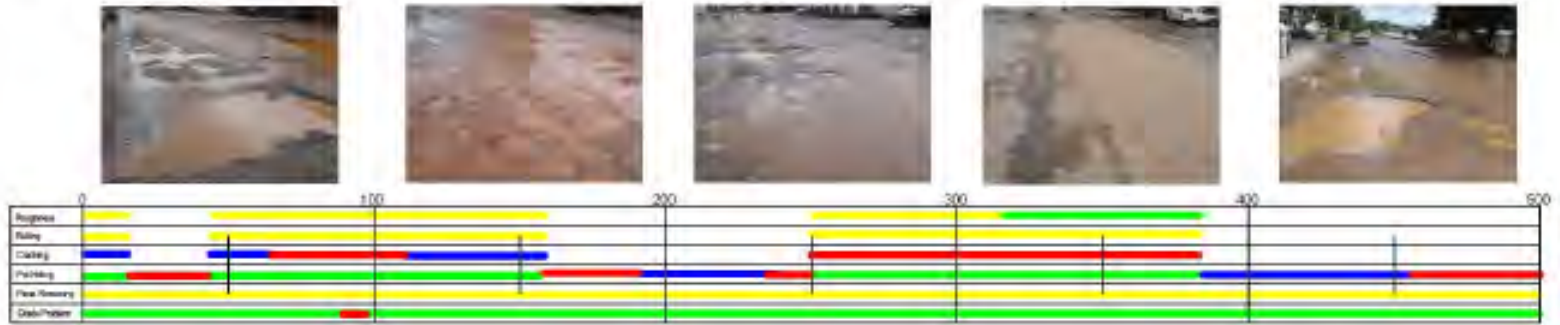
No.	Title	Style	Issued by	Year
27	Road Sector Investment Program, Rehabilitation of 40.19km of Priority Roads in Kitwe, Technical Report, Phase I (Results of Field Survey & Investigation)	Report	Burrow Binnie Zambia for MCT	Aug./Dec. 1998
28	Report on Traffic Survey, Axle Load Survey, Vehicular Speed Survey, Roughness Survey, Drainage and Land Use Survey Environmental Project Brief for the proposed Borrow Pit Sites Along the Chingola/Kasum	Report	JICA/ Zulu Borrow	2004
29	Environmental Project Brief for the proposed Borrow Pit Sites Along the Chingola/Kasum	Report	RDA, Environmental Management Unit	Jun. 2006
30	Economic Evaluation Report, Rehabilitation of 40.19km of Priority Roads in Kitwe, ROADSIP, August 1998	Report	Zulu Borrow	-
31	Ndola City Council, Bus Route Map	Map	NCC	Mar. 2007
32	Kiwe City Council, Bus Route Map	Map	KCC	Mar. 2007
33	Urban Roads in Kitwe, Lot 2,3 and 4, Final Tender Evaluation Report, November 2004	Report	Zulu Borrow	Nov. 2004
34	Contract Document & Agreement for the Accelerated Urban Roads Rehabilitation Programme (226/2007), Rehabilitation of Urban Roads in Kitwe, October 2006	Report	Roads and Paving Zambia, BICON Zambia Limited	Oct. 2006
35	Contract for the Rehabilitation of the Lunda via KTTC-MINDOLO to Chingola Road, National Roads Programme 2004. Urban Roads Maintenance - Kitwe Copperbelt Province, October 2003	Report	Turner Construction LTD	Oct. 2003
36	Contract, Lot2, Kitwe City Council, Urban Roads Maintenance, Copperbelt Province, AEP2001, Lot 2 Kitwe City Council, National Roads Programme 2000-2001, October 2002	Report	Zulu Borrow	Oct. 2002
37	Contract Document Volume 3, Drawings, Rehabilitation of 40.19KM of Priority Roads in Kitwe,	Report	Zulu Borrow	
38	Progress Report No.2 Contract Document Volume 3, Drawings, Rehabilitation of 40.19KM of Priority Roads in Kitwe, August 1999	Report	Zulu Borrow	Aug. 1999
39	Progress Report No.8 Contract Document Volume 3, Drawings, Rehabilitation of 40.19KM of Priority Roads in Kitwe, February 2000	Report	Zulu Borrow	Feb. 2000
40	Ndola Lime Company LTD, Local Price List (1 page), March 2007	Report	Ndola Lime Company Ltd	Mar. 2007
41	Phenix Materials, Kitwe Crusher (1 page), March 2007	Report	Phenix Materials, Kitwe Crusher	Mar. 2007
42	Zulu Borrow, Final Report, Rehabilitation of 34KM of Priority Roads in Kitwe, September 2002	Report	MLGH	Sep. 2002
43	ASCO, Progress Report No.12 June 2000	Report	MLGH	Jun. 2000
44	Joint Response of the Cooperating Partners to the zero draft FNDP on chapter 8 and its respective sector financing tables, June 2006 (10 pages)	Report	JICA	Jun. 2006
45	News Paper, "District now road authority" (1 page)	Report	JICA	Mar. 2007
46	Mopani Copper Mines PLC, Nkana Division, Rainfall Season 2006-2007 (1 page)	Report	KCC	2007
47	RDA Awards Council Jobs, February 24, 2007	News Paper	Times of Zambia	Feb. 2007
48	RDA Awards Council Jobs, February 24, 2007	News Paper	Times of Zambia	Feb. 2007
49	Report for the Establishment of the Kitwe Road Fund, Executive Summary (17 pages)	Report	KCC	-
50	Core Road Network, Draft Work Programme, ROADSIP August 1997	Report	National Road Board	Aug. 1997

## **7. Design Data**

- (1) Existing Pavement Condition Survey Result
- (2) Traffic Survey Result
- (3) 18-Kip Equivalent Single Axle Load (ESAL) per Vehicle
- (4) 18-kip Equivalent Single Axle Load (ESAL) for Design Period
- (5) Existing Pavement Structure
- (6) Subgrade CBR Test Result and Design CBR
- (7) Calculation of Pavement Thickness
- (8) Rainfall Data
- (9) Project Road Drainage System Map
- (10) Calculation of Discharge
- (11) Calculation of Velocity and Depth

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (1/32)

Road No. N1 Road Name: Vitanda Street



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

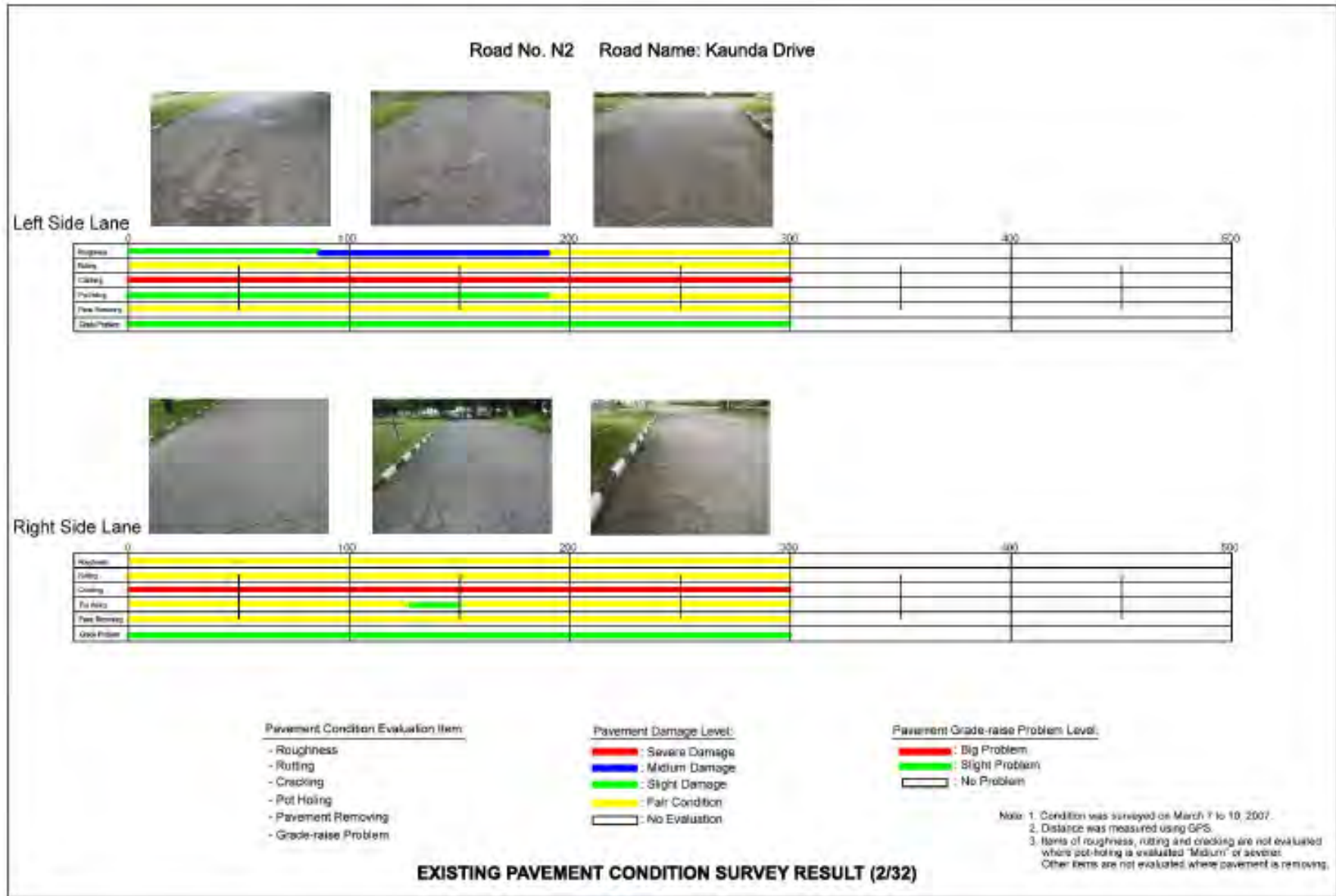
Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

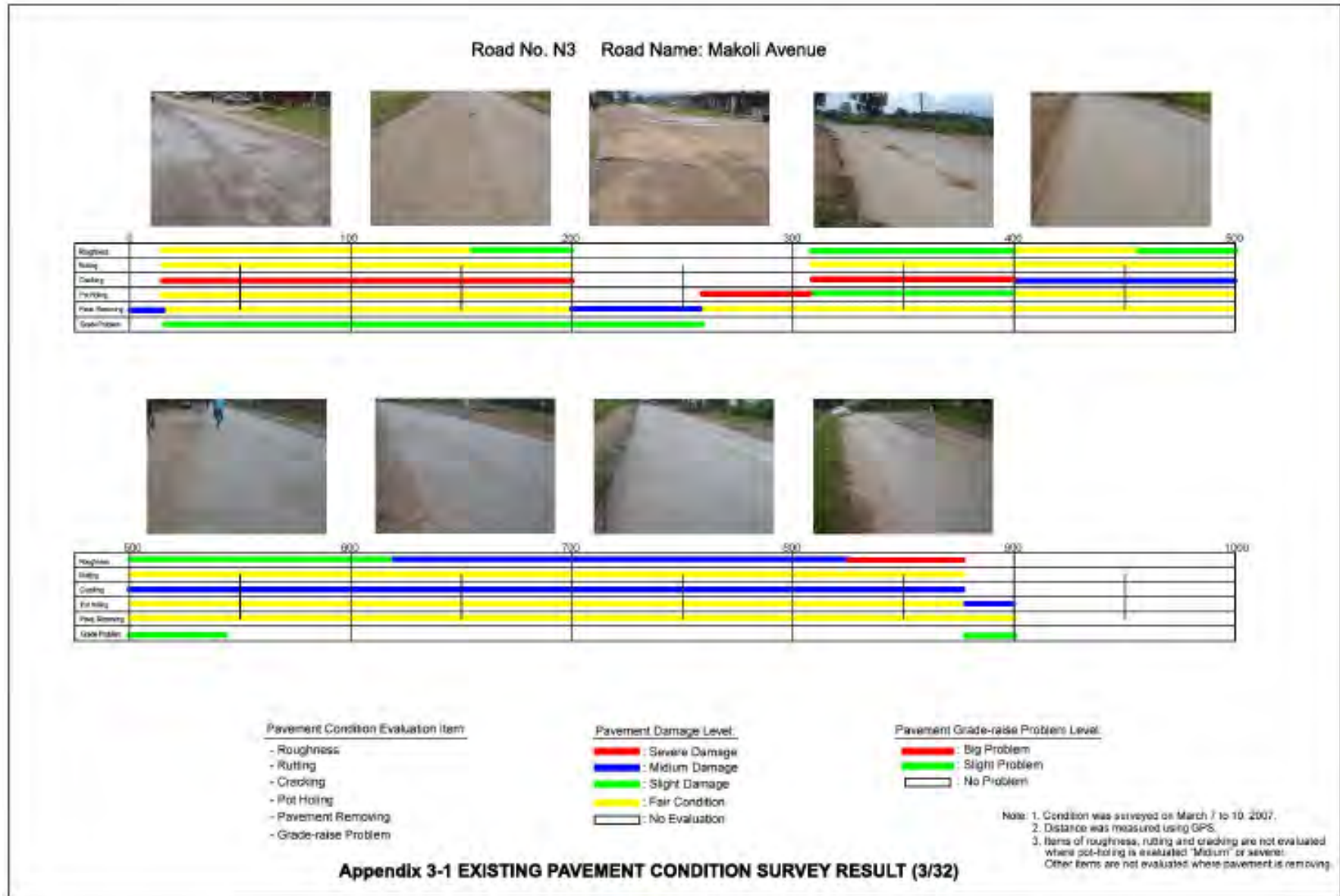
Note: 1. Condition was surveyed on March 7 to 10 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (1/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (2/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (3/32)





(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (4/32)

Road No. N4 Road Name: Independence Way



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

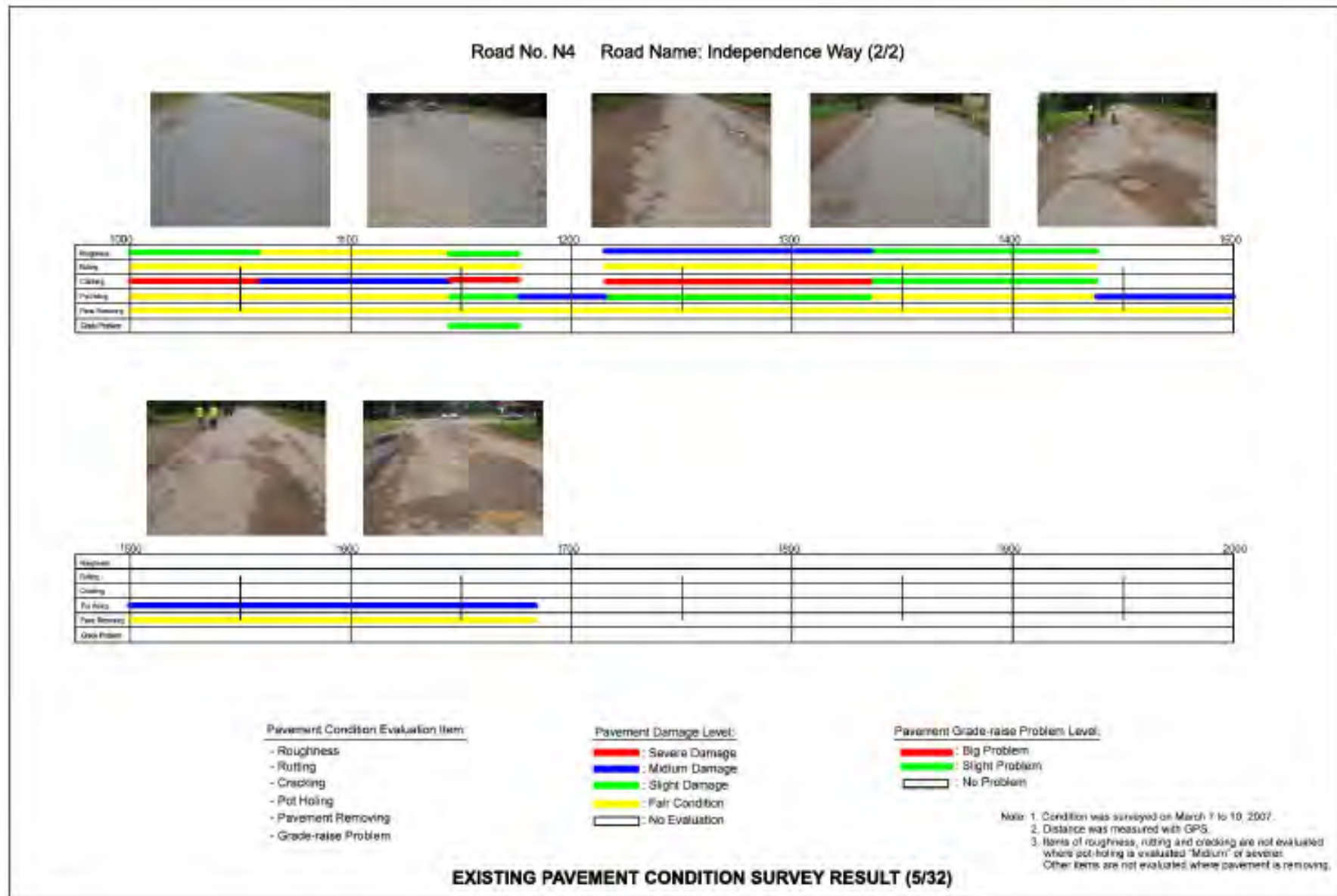
Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

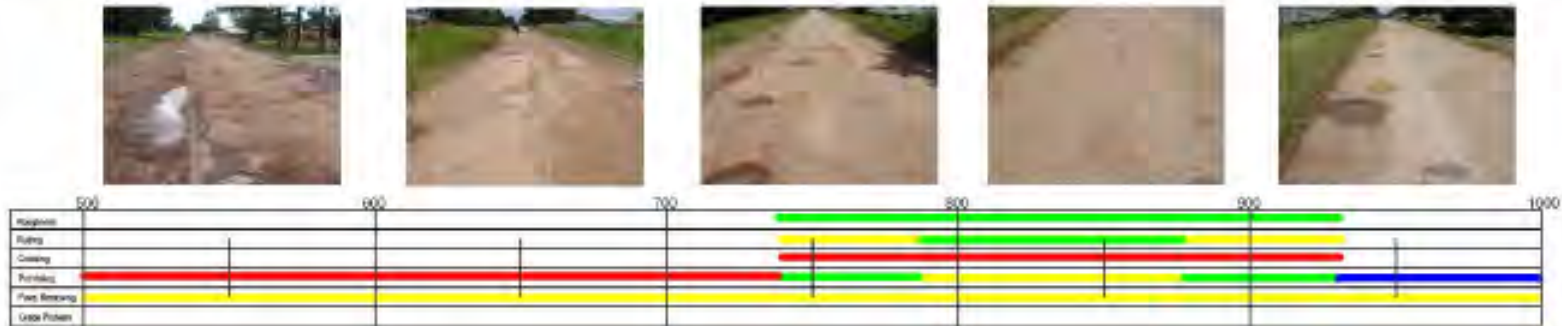
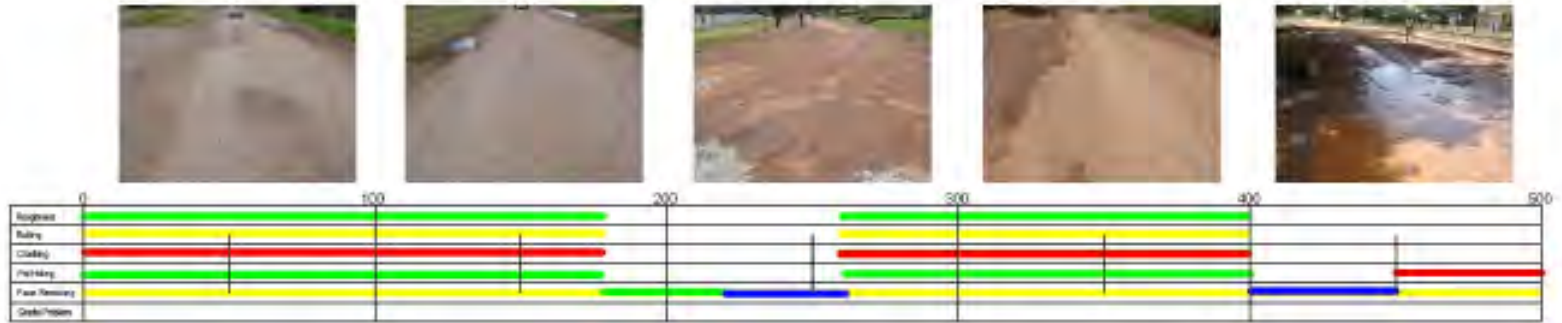
EXISTING PAVEMENT CONDITION SURVEY RESULT (4/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (5/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (6/32)

Road No. N5 Road Name: Zambia Road



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Severe Damage (Red)
- Medium Damage (Blue)
- Slight Damage (Green)
- Fair Condition (Yellow)
- No Evaluation (White)

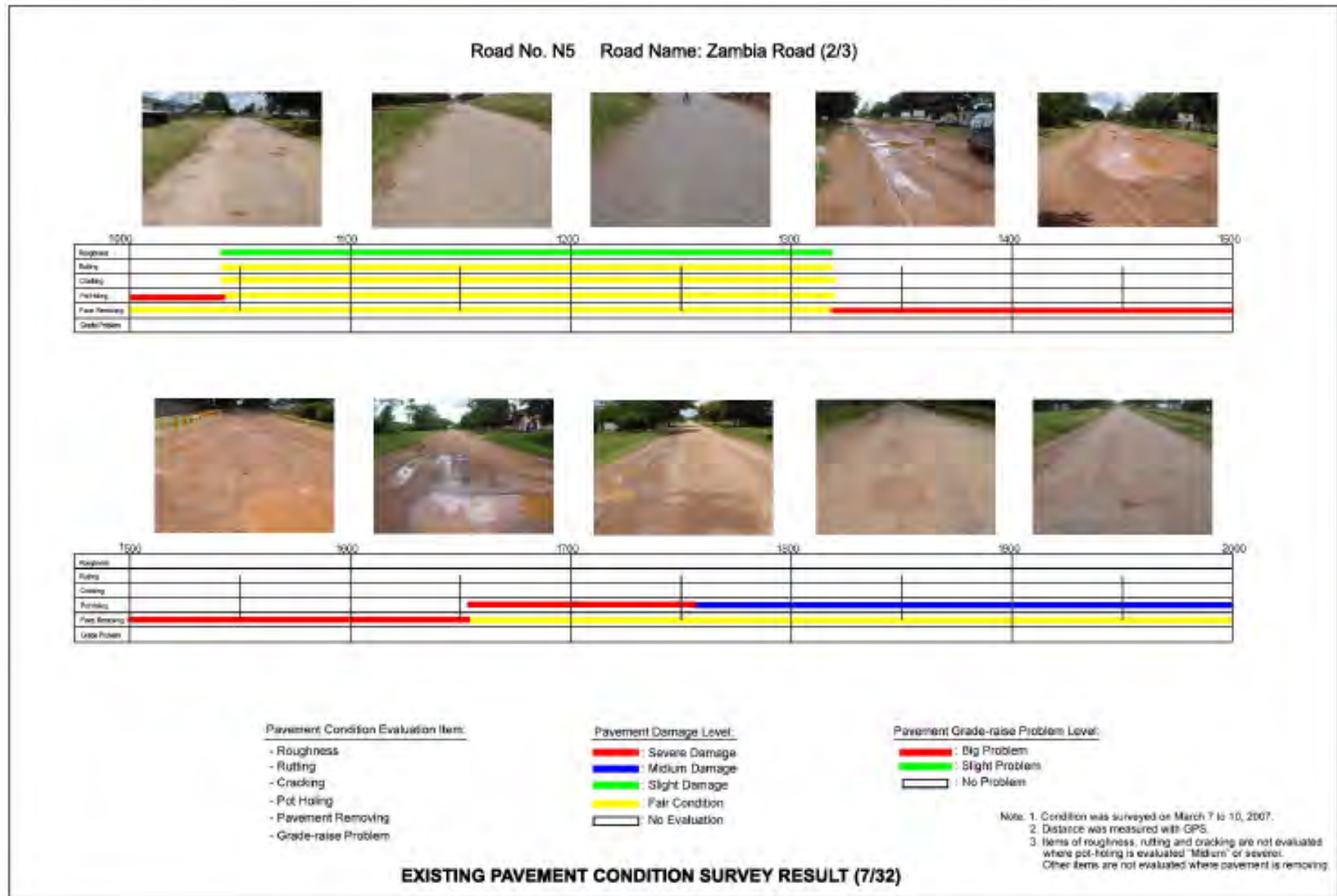
Pavement Grade-raise Problem Level:

- Big Problem (Red)
- Slight Problem (Green)
- No Problem (White)

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

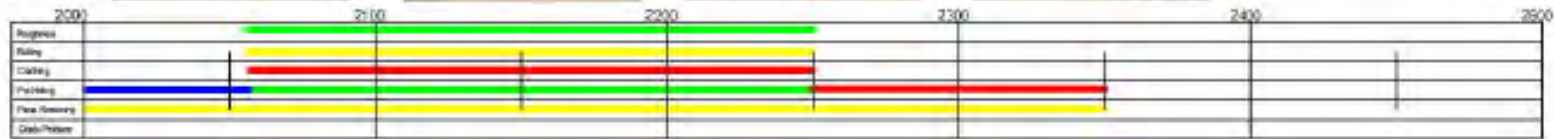
EXISTING PAVEMENT CONDITION SURVEY RESULT (6/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (7/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (8/32)

Road No. K5 Road Name: Zambia Road (3/3)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- [Red] : Severe Damage
- [Blue] : Medium Damage
- [Green] : Slight Damage
- [Yellow] : Fair Condition
- [White] : No Evaluation

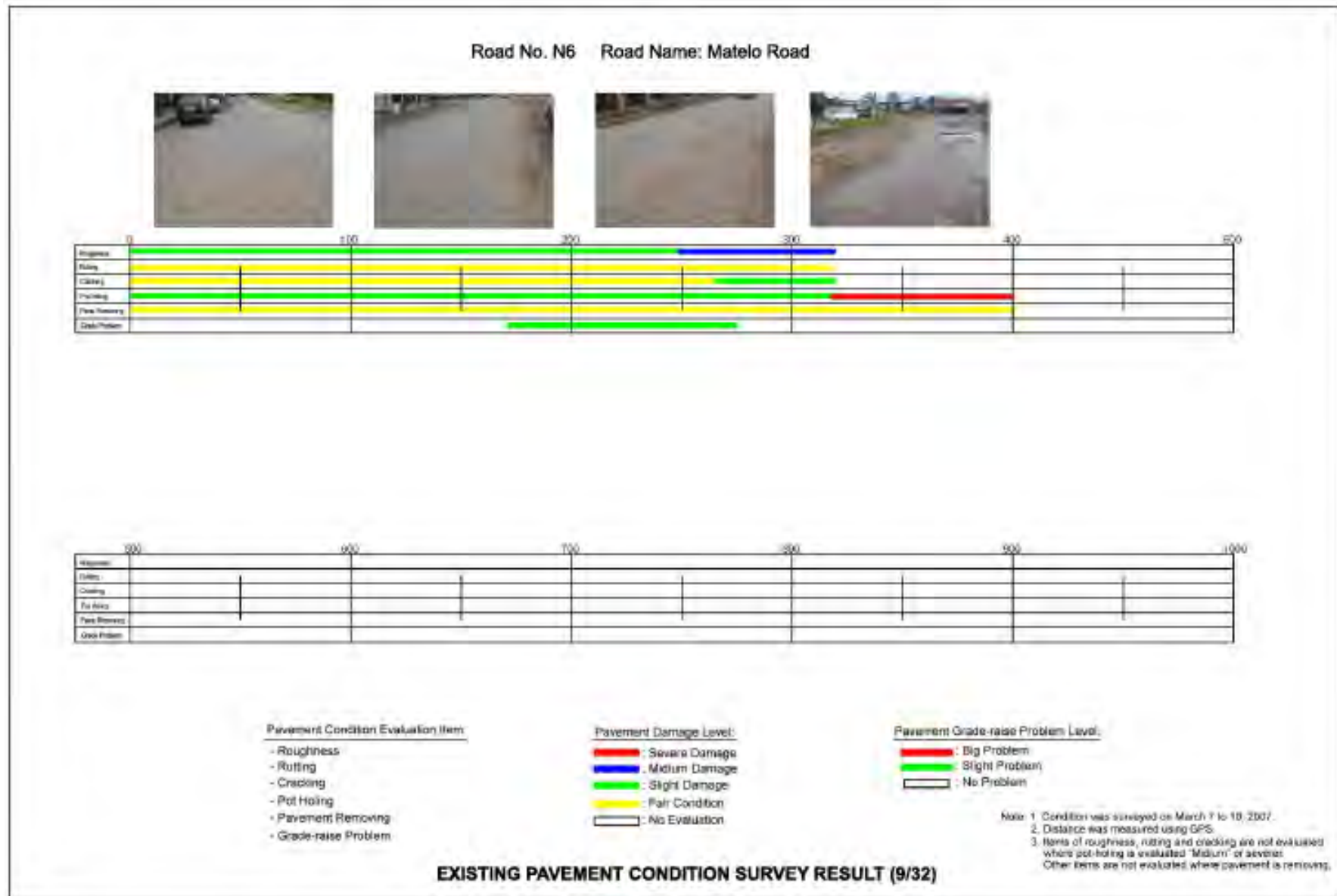
Pavement Grade-raise Problem Level:

- [Red] : Big Problem
- [Blue] : Slight Problem
- [Green] : No Problem

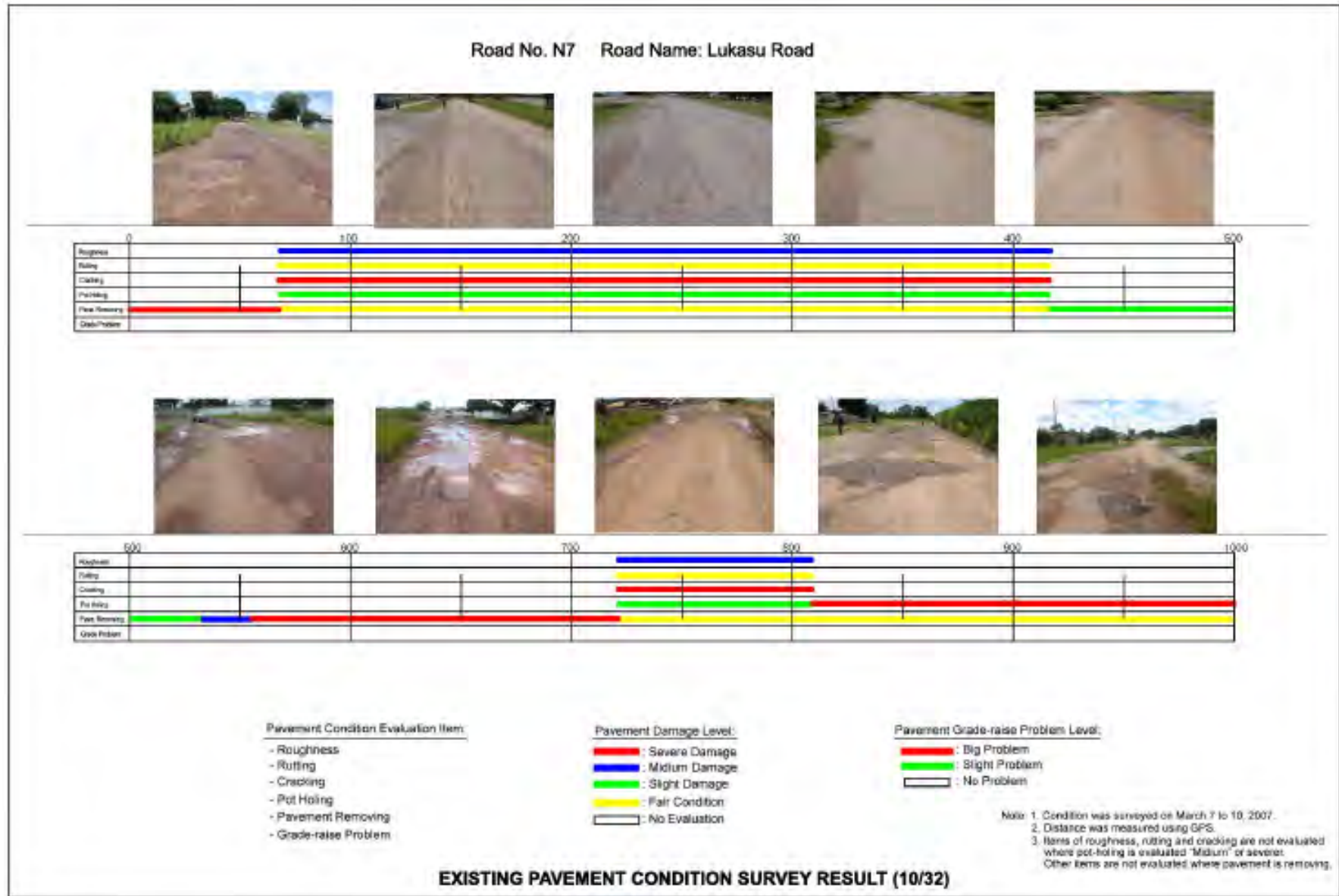
Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (8/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (9/32)

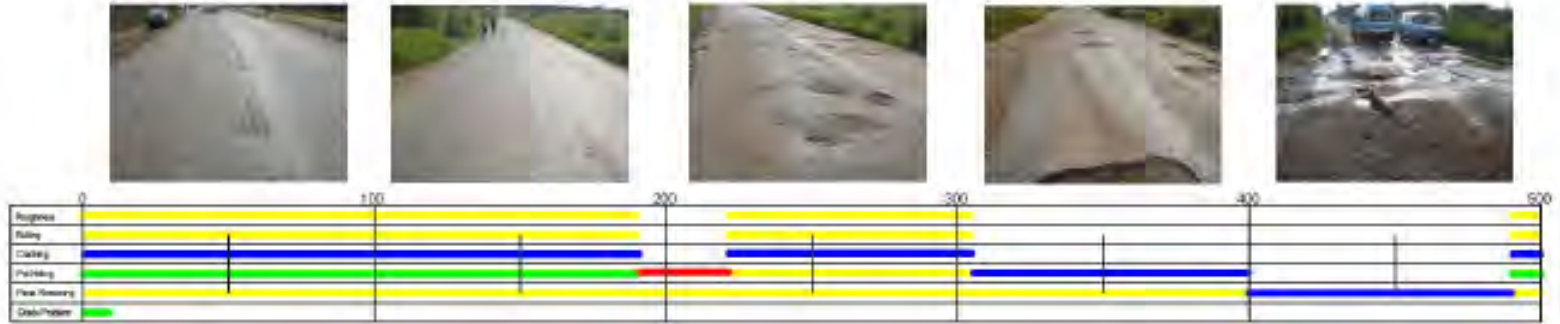


(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (10/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (11/32)

Road No. N8 Road Name: Chambeshi Road (1/4)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

- █ : Big Problem
- █ : Slight Problem
- : No Problem

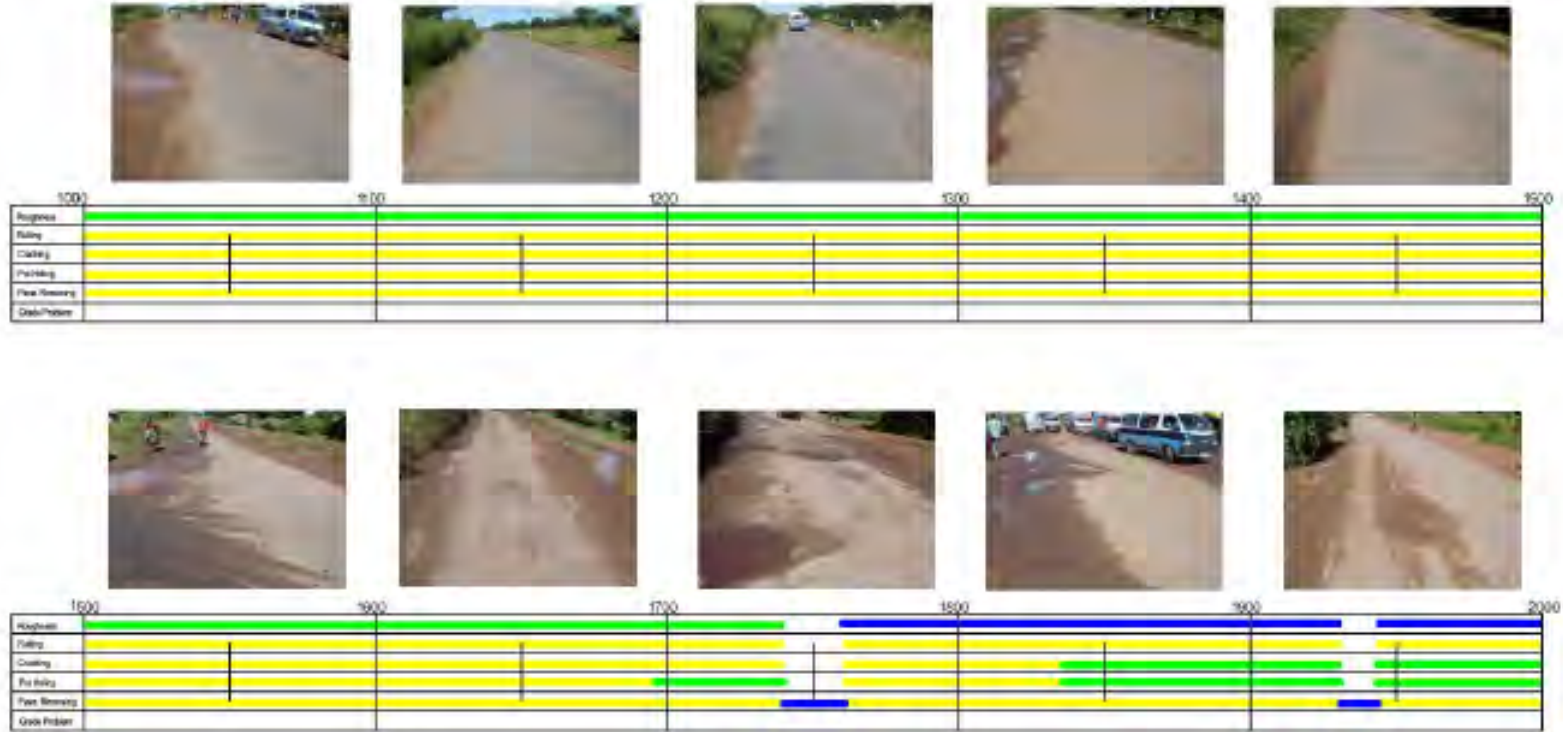
Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (11/32)**



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (12/32)

Road No. N8 Road Name: Chambeshi Road (2/4)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holes is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (12/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (13/32)

Road No. K8 Road Name: Cambeshi Road (3/4)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

- Red: Big Problem
- Blue: Slight Problem
- Green: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (13/29)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (14/32)

Road No. N8 Road Name: Chambeshi Road (4/4)



	3500	3600	3700	3800	3900
Roughness					
Rutting					
Cracking					
Potholing					
Pavement Removing	Unpaved Road				
Grade/Problem	Unpaved Road				



	3500	3600	3700	3800	3900	4000
Roughness						
Rutting						
Cracking						
Potholing						
Pavement Removing	Unpaved Road					
Grade/Problem	Unpaved Road					

Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holing
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ Severe Damage
- █ Medium Damage
- █ Slight Damage
- █ Fair Condition
- No Evaluation

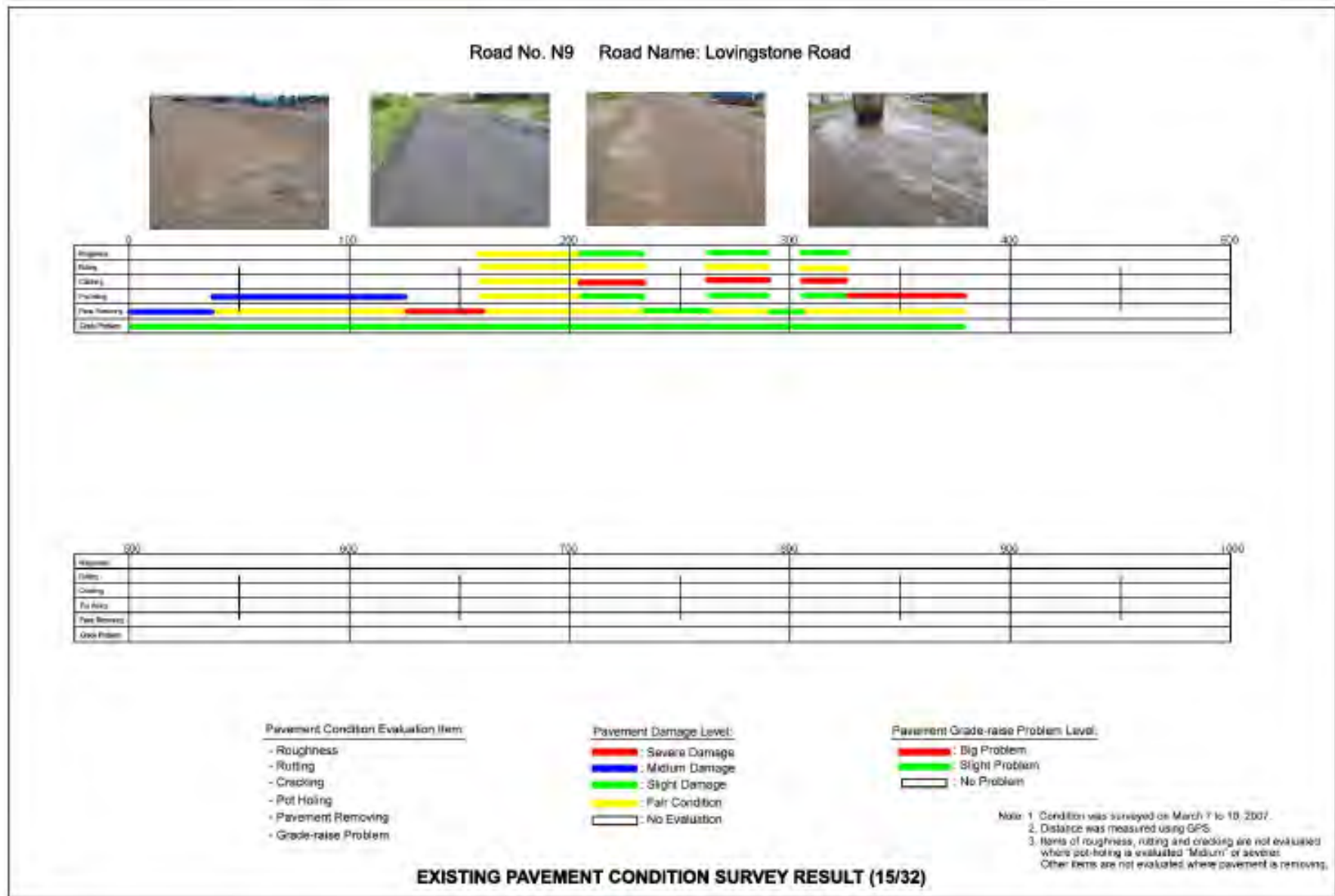
Pavement Grade-raise Problem Level:

- █ Big Problem
- █ Slight Problem
- No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

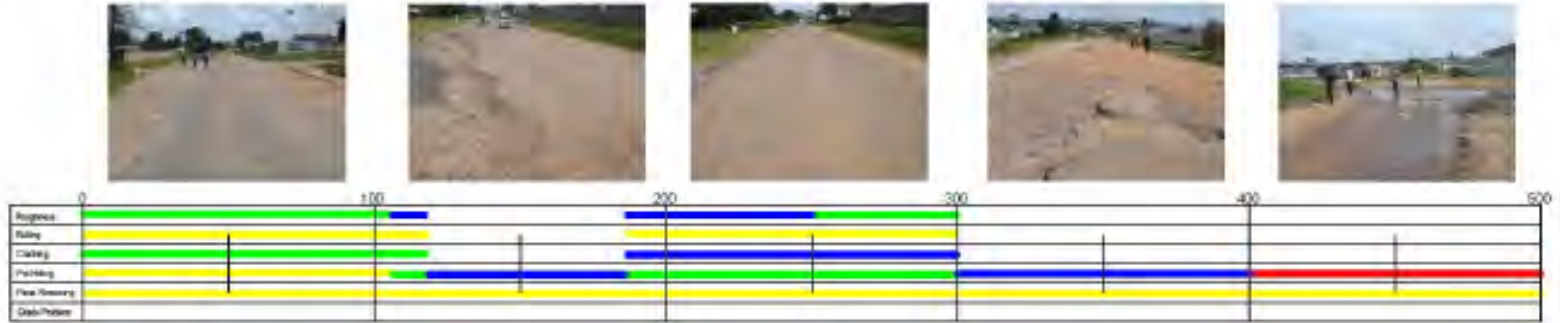
**EXISTING PAVEMENT CONDITION SURVEY RESULT (14/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (15/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (16/32)

Road No. K1 Road Name: Dr. Aggrey Avenue



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

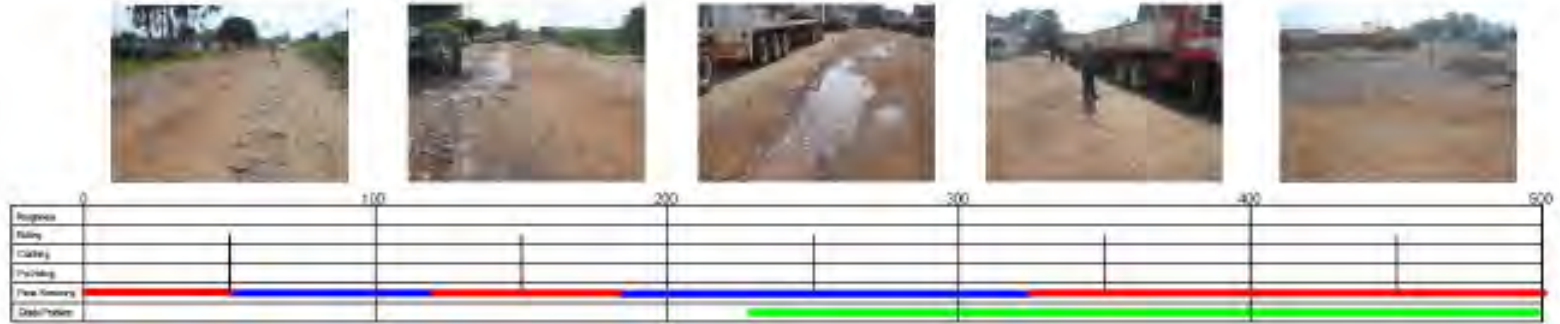
- █ : Big Problem
- █ : Slight Problem
- : No Problem

Note:  
 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (16/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (17/32)

Road No. K2 Road Name: Euclid Road



Pavement Condition Evaluation Item

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

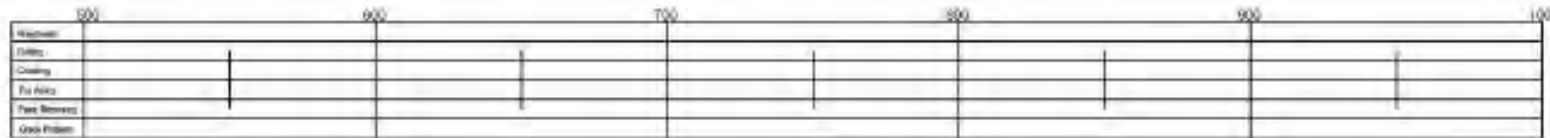
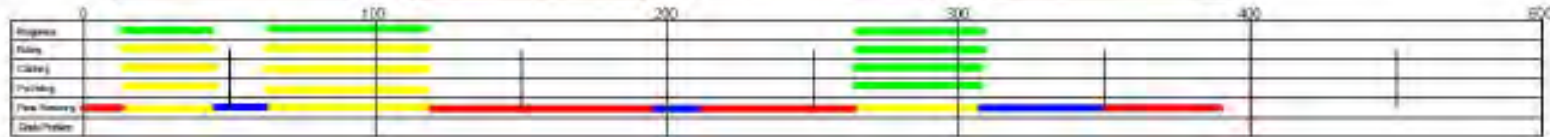
- █ : Big Problem
- █ : Slight Problem
- : No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (17/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (18/32)

Road No. K3 Road Name: Zomba Road



Pavement Condition Evaluation Item

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

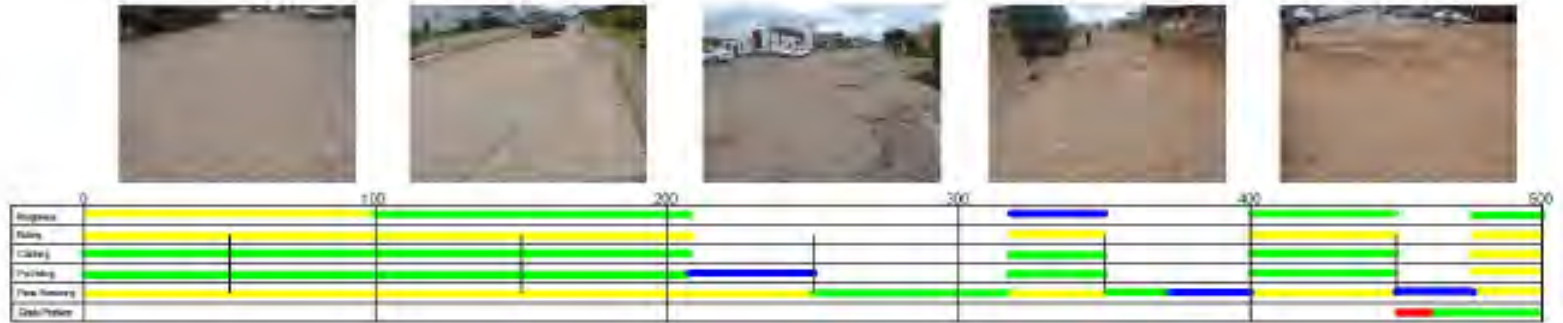
- █ : Big Problem
- █ : Slight Problem
- : No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (18/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (19/32)

Road No. K4 Road Name: Brantyre Road



Pavement Condition Evaluation Item

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

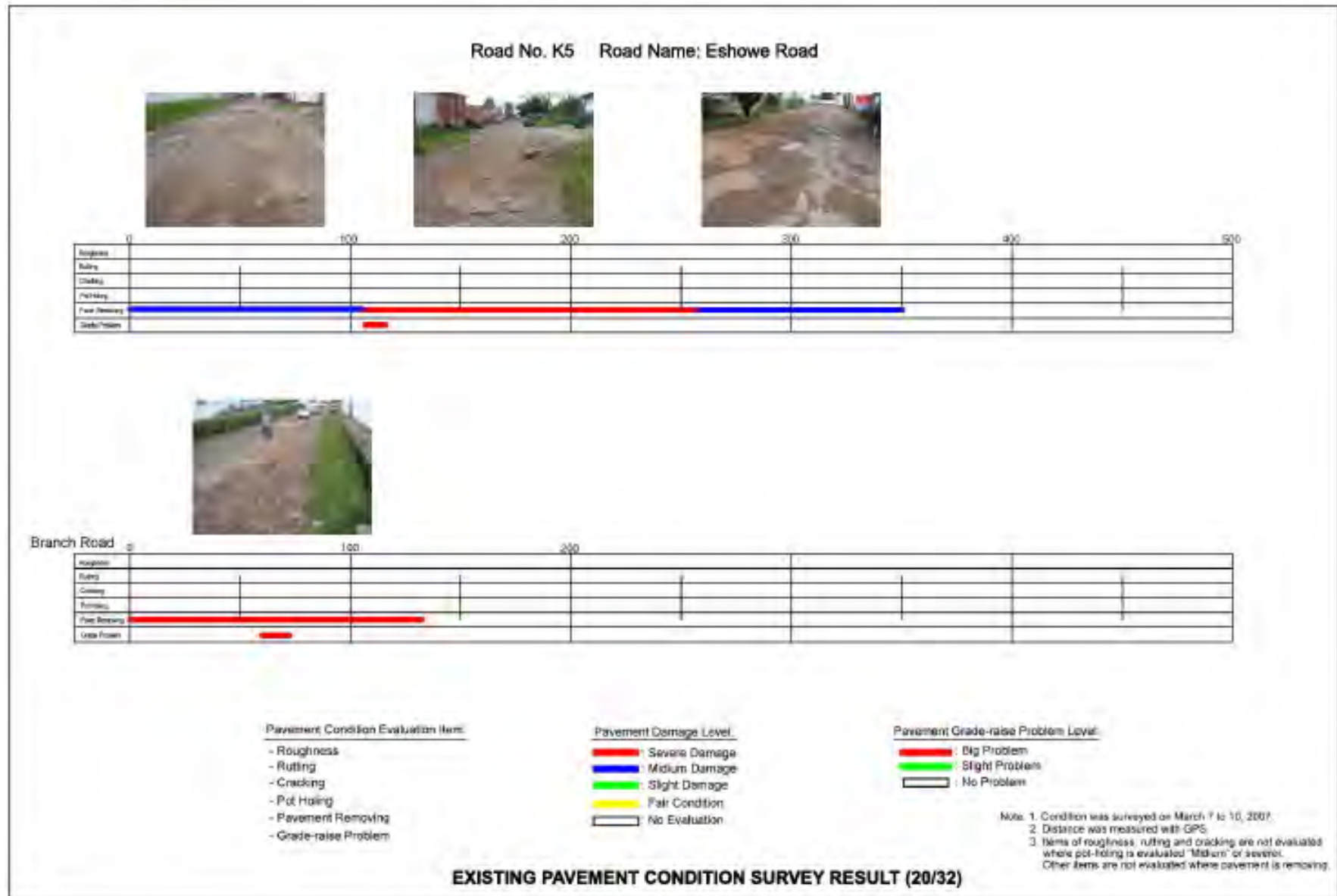
- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe. Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (19/32)

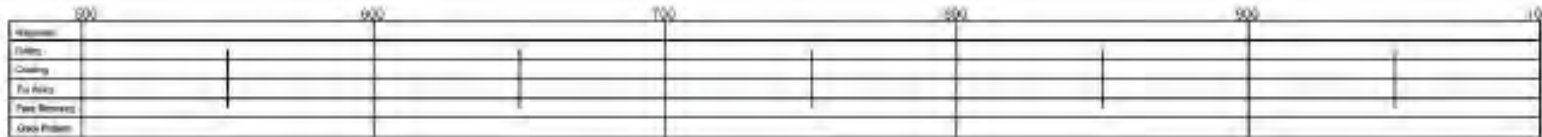
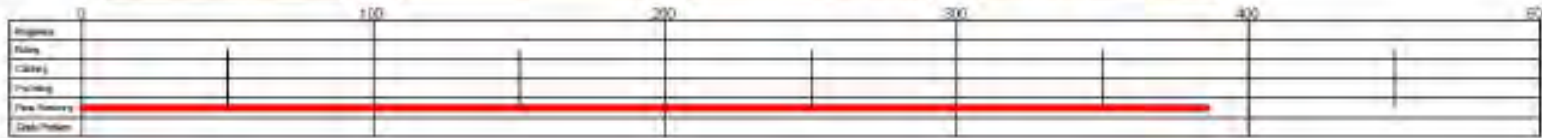


(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (20/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (21/32)

Road No. K6 Road Name: Matuka Street



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (21/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (22/32)

Road No. K7 Road Name: Kantanta Street (1/3)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

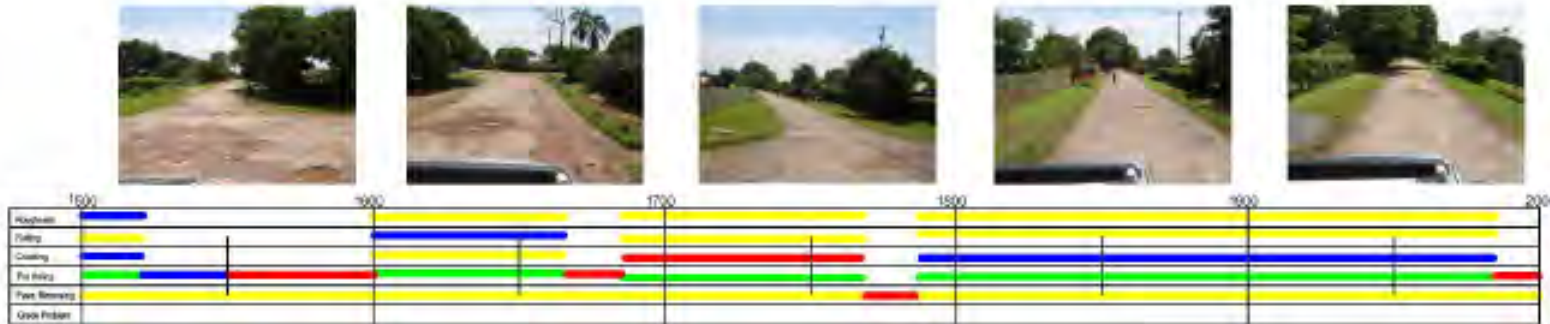
- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holes is evaluated "Medium" or severe. Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (22/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (23/32)

Road No. K7 Road Name: Kantanta Street (2/3)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Severe Damage
- Medium Damage
- Slight Damage
- Fair Condition
- No Evaluation

Pavement Grade-raise Problem Level:

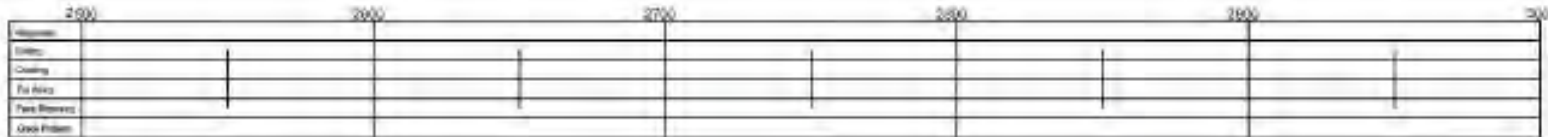
- Big Problem
- Slight Problem
- No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (23/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (24/32)

Road No. K7 Road Name: Kantanta Street (3/3)



Pavement Condition Evaluation Item

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

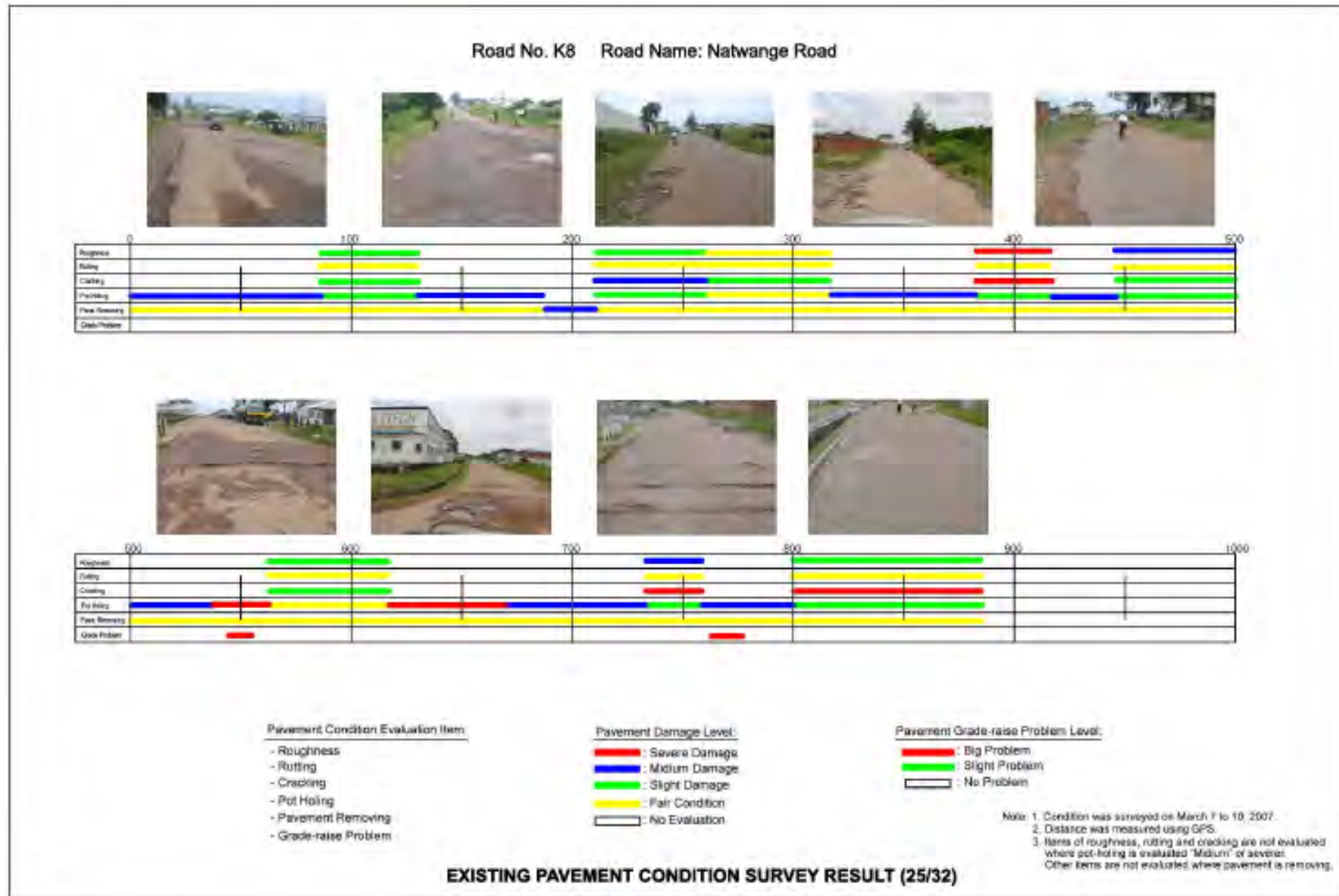
Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severer. Other items are not evaluated where pavement is removing.

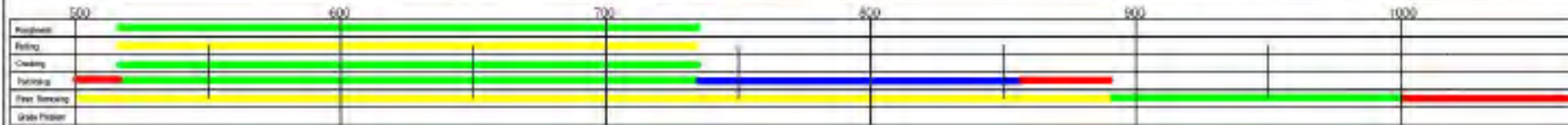
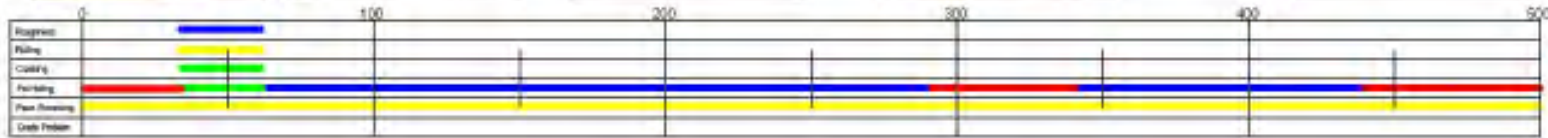
EXISTING PAVEMENT CONDITION SURVEY RESULT (24/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (25/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (26/32)

Road No. K9 Road Name: Mutentemuko Road



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated 'Medium' or severe.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (26/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (27/32)

Road No. K10 Road Name: Miseshi Street



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red : Severe Damage
- Blue : Medium Damage
- Green : Slight Damage
- Yellow : Fair Condition
- White : No Evaluation

Pavement Grade-raise Problem Level:

- Red : Big Problem
- Green : Slight Problem
- White : No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holes is evaluated 'Medium' or 'severe'.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (27/32)**



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (28/32)



(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (29/32)

Road No. K12 Road Name: Mullakwenda Road



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Severe Damage (Red)
- Medium Damage (Blue)
- Slight Damage (Green)
- Fair Condition (Yellow)
- No Evaluation (White)

Pavement Grade-raise Problem Level:

- Big Problem (Red)
- Slight Problem (Green)
- No Problem (White)

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (29/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (30/32)

Road No. K13 Road Name: Lilogwe Road



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- Red: Severe Damage
- Blue: Medium Damage
- Green: Slight Damage
- Yellow: Fair Condition
- White: No Evaluation

Pavement Grade-raise Problem Level:

- Red: Big Problem
- Green: Slight Problem
- White: No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or "severe".  
 Other items are not evaluated where pavement is removing.

EXISTING PAVEMENT CONDITION SURVEY RESULT (30/32)

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (31/32)

Road No. K14 Road Name: Independence Service Lane (1/2)



Pavement Condition Evaluation Item:

- Roughness
- Rutting
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

- █ : Big Problem
- █ : Slight Problem
- : No Problem

Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured using GPS.  
 3. Items of roughness, rutting and cracking are not evaluated where pot-holing is evaluated "Medium" or severe.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (31/32)**

(1) EXISTING PAVEMENT CONDITION SURVEY RESULT (32/32)

Road No. K14 Road Name: Independence Service Lane (2/2)



Pavement Condition Evaluation Item

- Roughness
- Rolling
- Cracking
- Pot Holes
- Pavement Removing
- Grade-raise Problem

Pavement Damage Level:

- █ : Severe Damage
- █ : Medium Damage
- █ : Slight Damage
- █ : Fair Condition
- : No Evaluation

Pavement Grade-raise Problem Level:

- █ : Big Problem
- █ : Slight Problem
- : No Problem

- Note: 1. Condition was surveyed on March 7 to 10, 2007.  
 2. Distance was measured with GPS.  
 3. Items of roughness, rilling and cracking are not evaluated where pot-holing is evaluated "Medium" or severer.  
 Other items are not evaluated where pavement is removing.

**EXISTING PAVEMENT CONDITION SURVEY RESULT (32/32)**

(2) TRAFFIC SURVEY RESULT

Survey Date: March 2007 Unit:Vehicle

City	No.	Road Name	Vehicle Type											(④~⑪)
			①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	
			Pedestrian	Bycycle	Motorbike	Car / Pick-up	Mini-Bus	Mid-Bus	Large Bus	Truck (2-Axle)	Truck (3-Axle)	Truck / Trailer (4/5-Axle)	Truck / Trailer (6/More Ax)	
Ndola City	N1	Vitanda Street	2,542	342	37	4,638	332	257	58	254	106	56	59	5,760
	N2	Kaunda Drive	2,018	422	24	2,716	435	329	36	240	94	26	18	3,894
	N3	Makoli Avenue	2,511	897	48	2,931	2,835	1,497	18	246	55	34	31	7,647
	N4	Independence Way	1,602	327	21	1,963	176	125	19	169	48	16	15	2,531
	N5	Zambia Road	2,131	504	12	2,225	345	50	48	425	122	139	374	3,728
	N6	Matelo Road	2,450	758	14	3,103	1,978	915	10	327	53	10	27	6,423
	N7	Lukasu Road	1,644	421	8	1,399	73	49	45	146	123	226	381	2,442
	N8	Chambeshi Road	2,174	470	4	2,242	1,625	885	69	281	30	8	8	5,148
	N9	Livingstone Road	1,946	587	38	1,619	1,584	1,060	40	181	81	40	22	4,627
Kitwe City	K1	Dr. Aggrey Avenue	8,665	909	50	1,485	141	87	17	234	134	59	72	2,229
	K2	Euclid Road	4,860	645	25	773	77	7	3	85	135	25	22	1,127
	K3	Zomba Road	1,817	216	33	1,401	131	47	9	195	60	9	11	1,863
	K4	Blantyre Road	2,776	265	100	778	121	61	7	95	101	20	9	1,192
	K5	Eshowe Road	2,376	205	56	709	69	47	2	99	49	14	8	997
	K6	Matuka Avenue	1,592	17	0	318	1,486	1,383	22	3	3	0	0	3,215
	K7	Kantanta Street	6,024	719	102	3,264	132	49	10	262	44	17	17	3,795
	K8	Natwange Road	2,885	406	139	1,873	177	65	28	408	409	82	94	3,136
	K9	Mutentemuko Road	2,754	286	163	1,476	137	50	36	355	180	81	79	2,394
	K10	Miseshi Street	2,451	1,358	339	1,957	175	83	59	402	211	131	210	3,228
	K11	Kanongesha Road	3,668	182	0	728	152	24	66	199	19	8	0	1,196
	K12	Mulilakwenda Road	1,060	163	21	269	3	2	0	21	12	12	19	338
	K13	Lilogwe Road	1,456	392	23	852	79	59	4	124	74	46	29	1,267
	K14	Independence Service	2,372	553	89	1,013	97	30	49	169	87	43	70	1,558



**(4) 18-kip EQUIVALENT SINGLE AXLE LOAD (ESAL) FOR DESING PERIOD**

	Road	2010 ADT (Vehicle/day)							Total ESAL per day	ESAL (x10 <sup>6</sup> ) 2010 - 2020
		①Mini-bus	②Mid-Bus	③Large Bus	④2-Ax Truck	⑤3-Ax Truck	⑥4-Ax Truck	⑦Trailer		
N1	Vitanda St.	363	281	63	278	116	61	64	679	1.42
N2	Kaunda Dr.	475	360	39	262	103	0	0	253	0.53
N3	Makoli Av	3,098	1,636	20	269	60	37	34	486	1.02
N4	Independence Wy.	192	137	21	185	52	0	0	149	0.31
N5	Zambia Rd.	377	55	52	464	133	152	409	2,190	4.58
N6	Metro Rd.	2,161	1,000	11	357	58	11	30	397	0.83
N7	Lusaka Rd.	80	54	49	160	134	247	416	2,364	4.95
N8	Chambesi Rd.	1,776	967	75	307	33	9	9	302	0.63
N9	Livingstone Rd.	1,731	1,158	44	198	89	44	24	459	0.96
K1	Dr. Aggrey Av.	331	241	91	435	214	122	328	1,924	4.03
K2	Euclid Rd.	84	8	3	93	148	27	24	352	0.74
K3	Zomba Rd.	143	51	10	213	66	10	12	236	0.49
K4	Blantyre Rd.	132	67	8	104	110	22	10	261	0.55
K5	Eshowe Rd.	75	51	2	108	54	15	9	179	0.38
K6	Matuka Av.	1,624	1,511	24	3	3	0	0	84	0.18
K7	Kantanta St.	144	54	11	286	48	19	19	299	0.63
K8	Natwange Rd.	193	71	31	446	447	90	103	1,273	2.66
K9	Mutentemuko Rd.	150	55	39	388	197	89	86	942	1.97
K10	Miseshi St.	191	91	64	439	231	143	229	1,655	3.46
K11	Kanogsha Rd.	166	26	72	217	21	9	0	177	0.37
K12	Mulilakwenda Rd.	7	5	0	50	29	29	46	291	0.61
K13	Lilogwe Rd.	86	64	4	135	81	50	32	402	0.84
K14	Independence Svwy.	106	33	54	185	95	47	76	599	1.25
ESAL per Vehicle		0.0003	0.045	0.46	0.44	1.00	2.98	3.36	Both Direction	Per Lane

Traffic Growth Rate(%)= 3.0

Heavy vehicle restriction is considered for N2 and N5.



**(5) EXISTING PAVEMENT STRUCTURE**

Road No.	Road Name	Station	Surface Course		Base Course		Subbase		Subgrade
N1	Vitanda Street	100m	DBST	50mm	CSB	210mm	—	—	Laterite
		600m	DBST	50mm	CSB	150mm	Crushed Stone	70mm	Silt
N2	Kaunda Drive	150m	DBST	40mm	Crushed Stone	100mm	Laterite	160mm	Silt
N3	Makoli Avenue	450m	DBST	40mm	Crushed Stone	60mm	Laterite	170mm	Silt
		800m	DBST	100mm	CSB	190mm	—	—	Laterite
N4	Independence	620m	DBST	60mm	CSB	200mm	Laterite	200mm	Silt
		1200m	DBST	40mm	CSB	100mm	Laterite	150mm	Silt
N5	Zambia Road	400m	DBST	40mm	CSB	—	—	—	Laterite
		700m	DBST	35mm	CSB	260mm	—	—	Laterite
		1500m	DBST	35mm	CSB	—	—	—	Laterite
		2100m	DBST	40mm	CSB	220mm	—	—	Laterite
N6	Matelo Avenue	200m	DBST	50mm	CSB	100mm	Laterite	200mm	Silt
N7	Lukasu Road	150m	DBST	70mm	CSB	130mm	Laterite	210mm	Silt
		500m	DBST	30mm	CSB	170mm	—	—	Laterite
		900m	DBST	20mm	CSB	300mm	—	—	Laterite
N8	Chambeshi Road	700m	DBST	50mm	CSB	220mm	—	—	Silt
		1400m	DBST	60mm	CSB	190mm	—	—	Silt
		2100m	DBST	50mm	CSB	220mm	—	—	Silt
		3200m	—	—	—	—	—	—	Laterite
N9	Livingstone Road	200m	DBST	30mm	CSB	180mm	Laterite	210mm	Silt
K1	Dr. Aggrey Ave	500m	DBST	25mm	CSB	80mm	Crushed Stone	70mm	Silty Sand
		1000m	DBST	20mm	Crushed Stone	240mm	—	—	Laterite
K2	Euclid Road	500m	—	—	—	—	Sandy Gravel	250mm	Silt
K3	Zomba Road	300m	DBST	30mm	CSB	130mm	Crushed Stone	150mm	Silt
K4	Blantyre Road	200m	DBST	20mm	CSB	100mm	Crushed Stone	200mm	Laterite
		400m	DBST	30mm	CSB	100mm	Crushed Stone	200mm	Laterite
K5	Eshowe Road	200m	DBST	20mm	CSB	100mm	Crushed Stone	200mm	Silt
K6	Matuka Ave	132m	—	—	CSB	280mm	—	—	Silt
K7	Kantanta Ave	500m	DBST	45mm	CSB	60mm	Crushed Stone	100mm	Silt
		1000m	DBST	30mm	CSB	180mm	Crushed Stone	280mm	Silt
		1500m	DBST	30mm	CSB	60mm	Crushed Stone	60mm	Silt
		2000m	DBST	30mm	CSB	70mm	Laterite	120mm	Laterite
K8	Natwange Road	500m	DBST	30mm	CSB	140mm	Crushed Stone	200mm	Silt
K9	Mutentemko Road	500m	DBST	30mm	CSB	120mm	Crushed Stone	120mm	Laterite
K10	Miseshi Street	500m	DBST	30mm	CSB	100mm	Crushed Stone	175mm	Silt
			DBST	35mm	CSB	100mm	Crushed Stone	300mm	Laterite
K11	Kanongesha Road	500m	DBST	35mm	CSB	220mm	—	—	Laterite
		670m	DBST	35mm	Crushed Stone	240mm	—	—	Laterite
K12	Mulilaquenda Road	500m	DBST	35mm	CSB	70mm	Crushed Stone	110mm	Laterite
		790m	DBST	30mm	CSB	80mm	Crushed Stone	200mm	Silt
K13	Lilongwe Rd	300m	DBST	20mm	Laterite	100mm	Crushed Stone	140mm	
K14	Independence	500m	DBST	35mm	CSB	100mm	Crushed Stone	150mm	Silt
		1000m	DBST	30mm	CSB	70mm	Crushed Stone	75mm	Silt

DBST: Double Bituminous Surface Treatment

CSB: Cement Stabilized Base Course

**(6) SUBGRADE CBR TEST RESULTS AND DESIGN CBR (NDOLA CITY) (1/2)**

Road Name	Sampling Station	Site CBR
		Spot CBR
Vitanda, N1	Chainage: 0+000 LHS	4
	Chainage: 0+200 RHS	12
	Chainage: 0+400 LHS	5
	Chainage: 0+800 RHS	20
Kaunda Drive, N2	Chainage: 0+100 RHS	4
	Chainage: 0+200 LHS	3
Makoli Avenue, N3	Chainage: 0+010 RHS	6
	Chainage: 0+200 LHS	2
	Chainage: 0+400 RHS	6
	Chainage: 0+600 LHS	3
Independence Way N4	Chainage: 0+200 LHS	4
	Chainage: 0+400 RHS	2
	Chainage: 0+600 LHS	13
	Chainage: 0+800 RHS	4
	Chainage: 1+000 LHS	4
	Chainage: 1+200 RHS	5
	Chainage: 1+400 LHS	4
	Chainage: 1+600 RHS	11
Matelo Rd., N6	Chainage: 0+100 LHS	6
	Chainage: 0+300 RHS	3
Livingstone Rd., N9	Chainage: 0+100 LHS	2
	Chainage: 0+300 RHS	9

Laboratory CBR		Remarks
Spot CBR	Section CBR	
15	11.6	Section Average CBR
4	6.0	Standard Deviation
18	5.6	Ave. CBR—S.D.
	<b>5</b>	Design CBR
16		
7		
12		
7		
5		
20		

Road Name	Sampling Station	Site CBR
		Spot CBR
Chambeshi, N8	Chainage: 0+020 RHS	9
	Chainage: 0+250 LHS	8
	Chainage: 0+500 RHS	7
	Chainage: 0+750 LHS	6
	Chainage: 1+000 RHS	4
	Chainage: 1+250 LHS	6
	Chainage: 1+500 RHS	3
	Chainage: 1+750 LHS	20
	Chainage: 2+000 RHS	2
	Chainage: 2+250 LHS	1
	Chainage: 2+500 RHS	8
	Chainage: 2+750 LHS	2
	Chainage: 3+000 RHS	4
	Chainage: 3+250 LHS	3
	Chainage: 3+500 RHS	2
	Chainage: 3+750 LHS	2
	Chainage: 3+920 LHS	6
	Chainage: 4+100 RHS	7
Chainage: 4+600 LHS	1	

Laboratory CBR		Remarks
Spot CBR	Section CBR	
	13.8	Section Average CBR
2 *	5.1	Standard Deviation
	8.7	Ave. CBR—S.D.
12	<b>8</b>	Design CBR
8		
20		
15		

\*: Excluded

Road Name	Sampling Station	Site CBR
		Spot CBR
Zambia Road, N5	Chainage: 0+100 RHS	4
	Chainage: 0+300 LHS	3
	Chainage: 0+500 RHS	20
	Chainage: 0+700 LHS	4
	Chainage: 0+900 RHS	4
	Chainage: 1+100 LHS	5
	Chainage: 1+300 RHS	2
	Chainage: 1+500 LHS	18
	Chainage: 1+700 RHS	3
	Chainage: 1+900 LHS	5
	Chainage: 2+000 RHS	2
Lukasu Rd., N7	Chainage: 0+100 LHS	20
	Chainage: 0+300 RHS	3
	Chainage: 0+500 LHS	2
	Chainage: 0+700 RHS	5
	Chainage: 0+900 LHS	6

Laboratory CBR		Remarks
Spot CBR	Section CBR	
16	23.7	Section Average CBR
	10.9	Standard Deviation
16	12.8	Ave. CBR—S.D.
19	<b>12</b>	Design CBR
41		
18		
18		
38		

**(6) SUBGRADE CBR TEST RESULTS AND DESIGN CBR (NDOLA CITY) (2/2)**

Road Name	Sampling Station	Site CBR
		Spot CBR
Dr. Aggrey, K1	Chainage: 0+250R	36
	Chainage: 0+500 LHS	6
	Chainage: 0+750 RHS	27
	Chainage: 0+986 LHS	5
Euclid, K2	Chainage: 0+200 RHS	7
	Chainage: 0+400 LHS	20
	Chainage: 0+587 RHS	5
Zomba Road, K3	Chainage: 0+100 LHS	8
	Chainage: 0+200 RHS	20
	Chainage: 0+300 LHS	14
Blantyre Road, K4	Chainage: 0+200 RHS	20
	Chainage: 0+400 RHS	11
	Chainage: 0+590 LHS	9
Eshowe Road, K5	Chainage: 0+100 LHS	20
	Chainage: 0+200 RHS	11
	Chainage: 0+300 LHS	12
Lilongwe, K13	Chainage: 0+200 RHS	20
	Chainage: 0+400 LHS	4
	Chainage: 0+584 RHS	4

Laboratory CBR		Remarks
Spot CBR	Section CBR	
20.0	28.8	Section Average CBR
8.0	6.5	Standard Deviation
20.0	22.2	Ave. CBR—S.D.
18.0	<b>20</b>	Design CBR
20.0		
10.0		
3.0		
16.0		

Road Name	Sampling Station	Site CBR
		Spot CBR
Matuka, K6	Chainage: 0+015 LHS	9
	Chainage: 0+200 RHS	5

Laboratory CBR		Remarks
Spot CBR	Section CBR	
5.0	<b>5.0</b>	Design CBR

Road Name	Sampling Station	Site CBR
		Spot CBR
Kantanta, K7	Chainage: 0+026 LHS	20
	Chainage: 0+250 LHS	3
	Chainage: 0+500 RHS	3
	Chainage: 0+750 LHS	3
	Chainage: 1+000 RHS	6
	Chainage: 1+250 LHS	2
	Chainage: 1+500 RHS	2
	Chainage: 1+750 LHS	2
	Chainage: 2+000 LHS	4
	Chainage: 2+250 RHS	2

Laboratory CBR		Remarks
Spot CBR	Section CBR	
	12.5	Section Average CBR
11.0	6.0	Standard Deviation
15.0	6.5	Ave. CBR—S.D.
19.0	<b>6</b>	Design CBR
5.0		

Road Name	Sampling Station	Site CBR
		Spot CBR
Natwange, K8	Chainage: 0+013 LHS	24
	Chainage: 0+200 RHS	6
	Chainage: 0+600 LHS	3
	Chainage: 0+800 RHS	3
Mutentemuko, K9	Chainage: 0+200 LHS	4
	Chainage: 0+400 RHS	26
	Chainage: 0+600 LHS	2
	Chainage: 0+800 RHS	3
	Chainage: 1+000 LHS	2

Laboratory CBR		Remarks
Spot CBR	Section CBR	
	20.0	Section Average CBR
20.0	0.0	Standard Deviation
20.0	20.0	Ave. CBR—S.D.
20.0	20	Design CBR
20.0		

Road Name	Sampling Station	Site CBR
		Spot CBR
Miseshi, K10	Chainage: 0+000 RHS	14
	Chainage: 0+200 LHS	8
	Chainage: 0+400 RHS	5
	Chainage: 0+600 LHS	4
	Chainage: 0+800 RHS	11
Kanongesha, K11	Chainage: 0+012 LHS	3
	Chainage: 0+200 RHS	4
	Chainage: 0+400 LHS	4
	Chainage: 0+600 RHS	4
Mulilakwenda, K12	Chainage: 0+200 LHS	12
	Chainage: 0+400 RHS	20
	Chainage: 600 LHS	6
	Chainage: 0+787 RHS	20
Independence, K14 Servic Lane	Chainage: 0+200 LHS	22
	Chainage: 0+400 RHS	5
	Chainage: 0+600 LHS	9
	Chainage: 0+800 RHS	20

Laboratory CBR		Remarks
Spot CBR	Section CBR	
	15.0	Section Average CBR
15.0	4.4	Standard Deviation
20.0	10.6	Ave. CBR—S.D.
13.0	<b>10</b>	Design CBR
8.0		
21.0		
15.0		
13.0		

**(7) CALCULATION OF PAVEMENT THICKNESS**

Road No.		N1	N2	N3	N4	N5	N6	N7	N8	N9	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14
18-kip ESAL	W18	1,420,000	530,000	1,020,000	310,000	4,580,000	830,000	4,950,000	630,000	960,000	4,030,000	740,000	490,000	550,000	380,000	180,000	630,000	2,660,000	1,970,000	3,460,000	370,000	610,000	840,000	1,250,000
Reliability	R (%)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Standard Deviate	ZR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Combined Standard Error	S0	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Initial Serviceability Index	P0	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Terminal Serviceability Index	PI	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
(PO-P1)	ΔPSI	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Subgrade CBR (%)	CBR	5	5	5	5	12	5	12	8	5	20	20	20	20	20	5	6	20	20	10	10	10	20	10
Resilient Modulus	MR	7,500	7,500	7,500	7,500	18,000	7,500	18,000	12,000	7,500	30,000	30,000	30,000	30,000	30,000	7,500	9,000	30,000	30,000	15,000	15,000	15,000	30,000	15,000
Structural Number	SN	2.866	2.460	2.724	2.259	2.509	2.638	2.540	2.125	2.698	2.034	1.523	1.413	1.443	1.348	2.070	2.365	1.900	1.805	2.565	1.786	1.942	1.558	2.184

Where,  $\log_{10}(W_{18}) = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \{ \log_{10} [ \frac{\Delta PSI}{(4.2-1.5)} ] / [0.40 + 1094 / (SN+1)^{0.19}] + 2.32 \times \log_{10}(M_R) - 8.07$

Left: $\log_{10}(W_{18}) =$	6.152	5.724	6.009	5.491	6.661	5.919	6.695	5.799	5.982	6.605	5.869	5.690	5.740	5.580	5.255	5.799	6.425	6.294	6.539	5.568	5.785	5.924	6.097
Right =	6.152	5.724	6.009	5.491	6.661	5.919	6.695	5.799	5.982	6.605	5.869	5.690	5.740	5.580	5.255	5.800	6.426	6.294	6.539	5.568	5.785	5.925	6.098

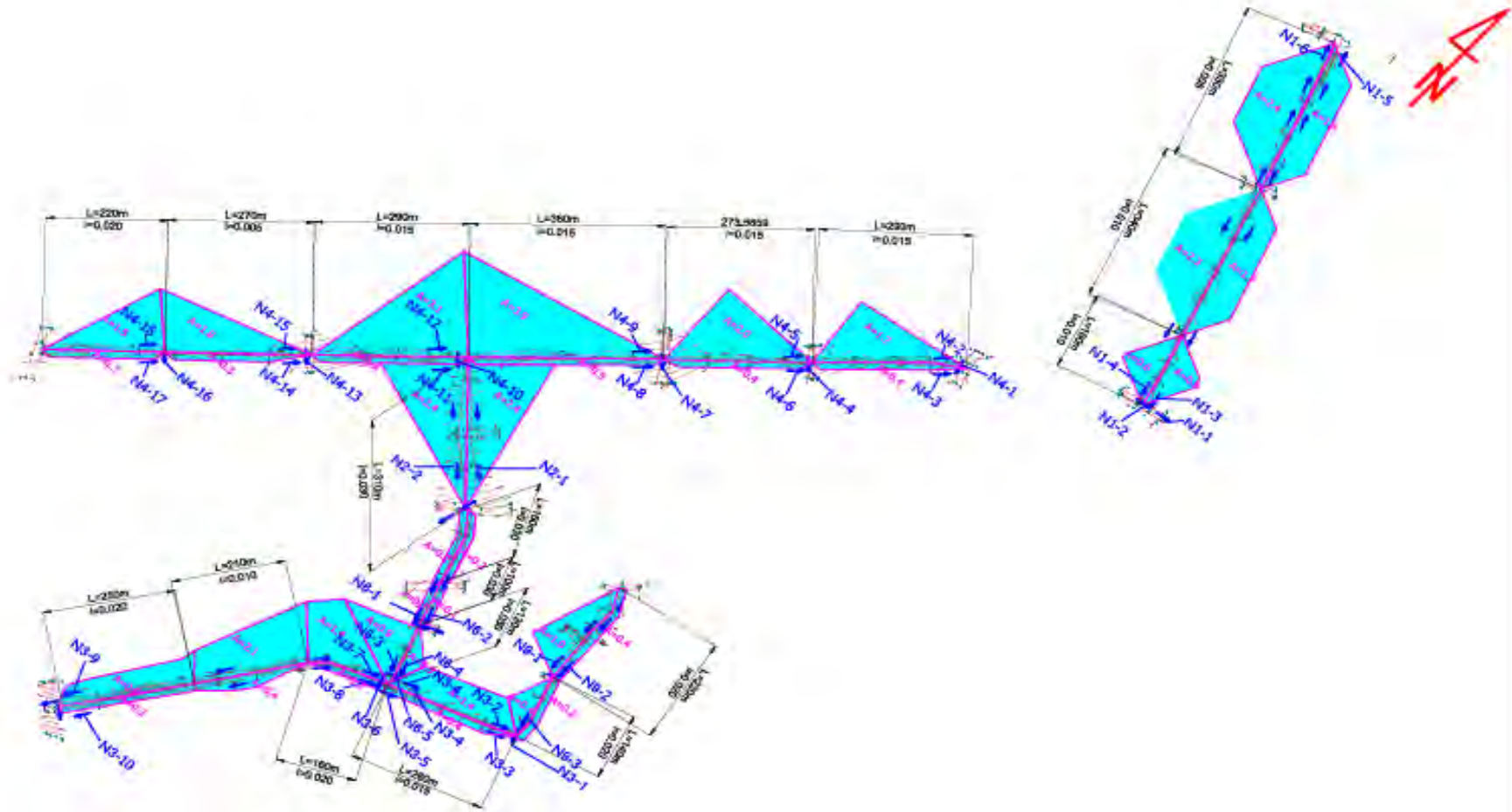
Pavement Layer	Drainage C.	Layer Co. (a)	Pavement Thickness (cm) and Structural Number (SN) in case Pavement Reconstruction																							
Road No.			N1	N2	N3	N4	N5	N6	N7	N8	N9	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	
AC Surface Course	-	0.350	10.0	10.0	10.0	5.0	10.0	10.0	10.0	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	5.0	5.0	5.0	5.0	
Granular Base Course	0.9	0.130	15.0	15.0	15.0	15.0	10.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0	10.0	10.0	15.0	20.0	15.0	15.0	15.0	15.0	15.0	10.0	15.0	
Crushed Stone Subbase	0.8	0.110	25.0	15.0	20.0	30.0	20.0	20.0	20.0	25.0	20.0	20.0	15.0	15.0	10.0	15.0	20.0	25.0	20.0	20.0	15.0	15.0	20.0	15.0	25.0	
Structural Number (SN) of Proposed Pave.			2.94	2.59	2.76	2.42	2.53	2.76	2.76	2.25	2.76	2.07	1.67	1.67	1.50	1.67	2.07	2.48	2.07	2.07	2.59	1.90	2.07	1.67	2.25	

Where,  $SN = a_1 * D_1 + a_2 * m_2 * D_2 + a_3 * m_3 * D_3$

Pavement Layer	Drainage C.	Layer Co. (a)	Pavement Thickness (cm) and Structural Number (SN) in case Overlay (Utilizing Existing Pavement as Subbase Course)																							
Road No.			N1	N2	N3	N4	N5	N6	N7	N8	N9	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	
AC Surface Course	-	0.350			10.0	5.0	10.0		10.0	5.0					5.0			5.0	5.0	5.0						
Granular Base Course	0.9	0.130			10.0	15.0	10.0		15.0	15.0					10.0			20.0	15.0	15.0						
Subbase (Exist. Pave.)	0.8	-			36.0	29.0	26.0		41.0	27.0					25.0			26.0	37.0	27.0						
Subbase Layer Coeff.					0.10	0.10	0.10		0.10	0.10					0.10			0.10	0.10	0.10						
Structural Number (SN) of Proposed Pave.					2.97	2.29	2.66		3.36	2.23					1.94			2.43	2.55	2.23						



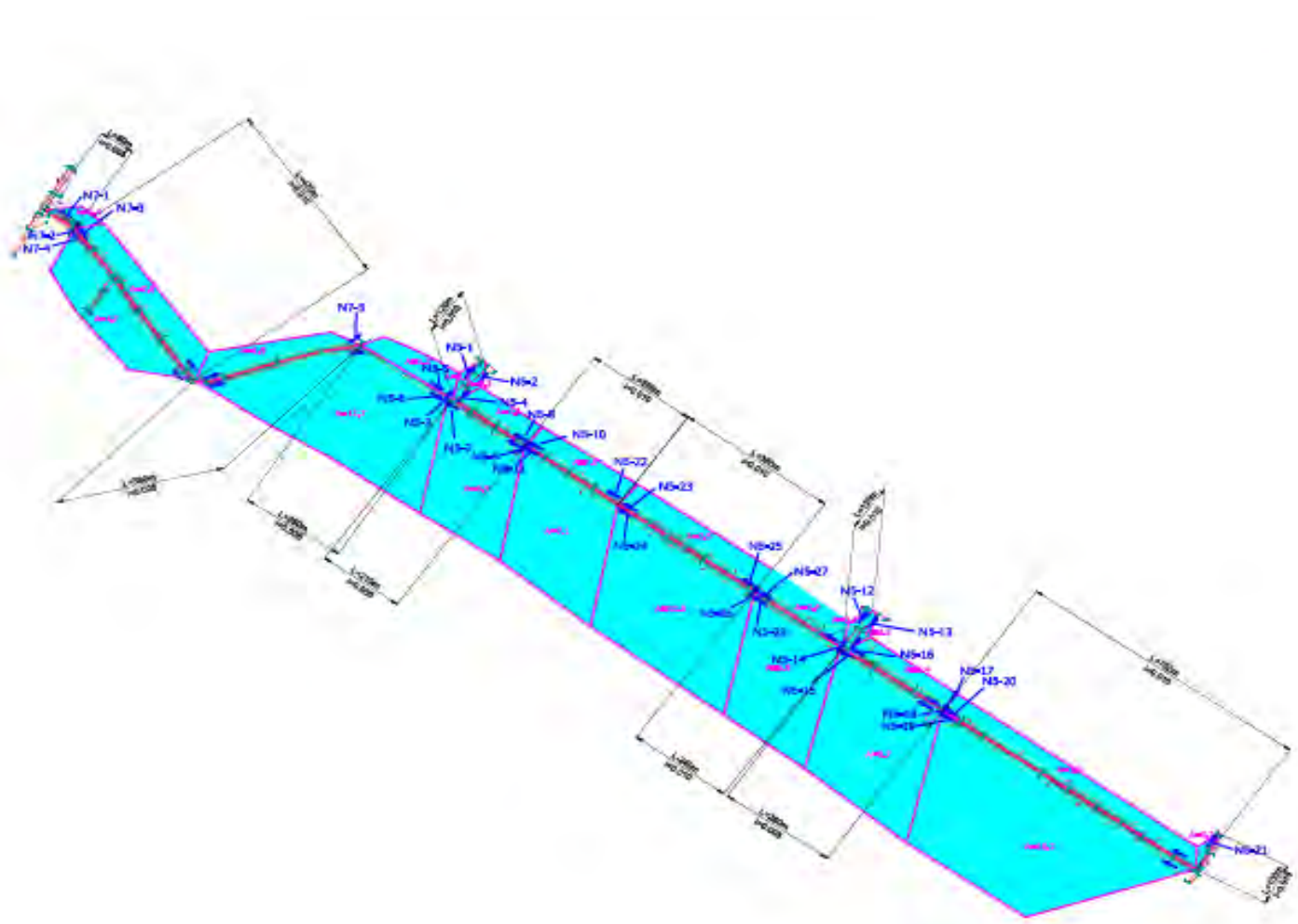
(9) PROJECT ROAD DRAINAGE SYSTEM MAP (1/8)



A7-42

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS OF THE REPUBLIC OF ZAMBIA	KATHENA ENGINEERING INTERNATIONAL (P) LTD. In association with JAPAN ENGINEERING CONSULTANTS CO., LTD.	Catchment Area Maps	SCALE	DRAWN BY: JOKA CHECKED BY: JOKA APPROVED BY: JOKA	APPROVED	WORKS SUPERVISOR	PROJECT CHECKED	DATE	SHEET NO
			Msala City Roads (1)	1:7,500 In A3 paper		DATE	NAME	NAME		

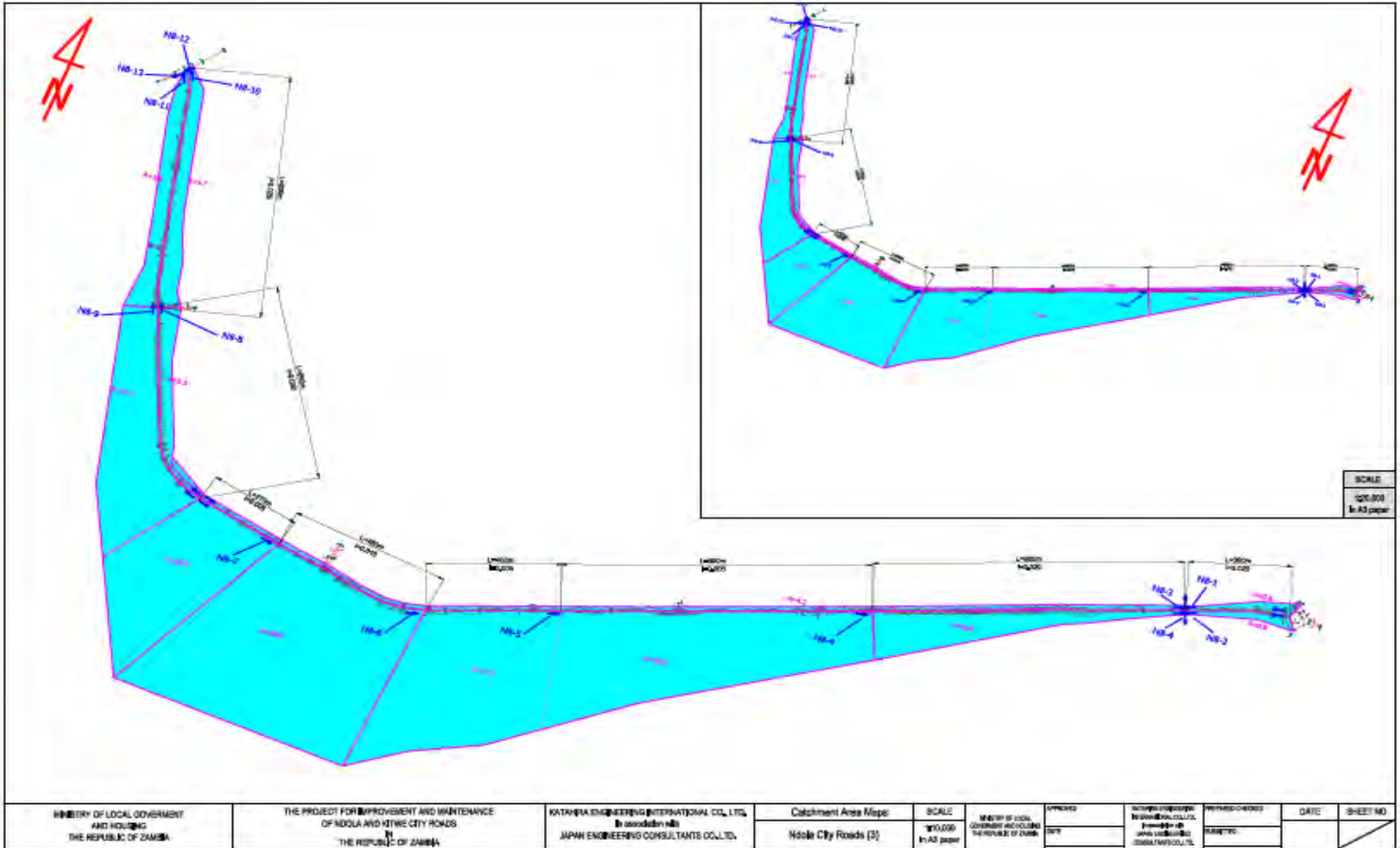
(9) PROJECT ROAD DRAINAGE SYSTEM MAP (2/8)



A7-43

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOGA AND NITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	KATAMBA ENGINEERING INTERNATIONAL LTD. LTD. In association with APWA ENGINEERING CONSULTANTS CO. LTD.	Catchment Area Maps Ndoqa City Roads (2)	SCALE 1:10,000 In A3 paper	APPROVED BY DATE	DRAWN BY DATE	CHECKED BY DATE	DATE	SHEET NO.
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(9) PROJECT ROAD DRAINAGE SYSTEM MAP (3/8)

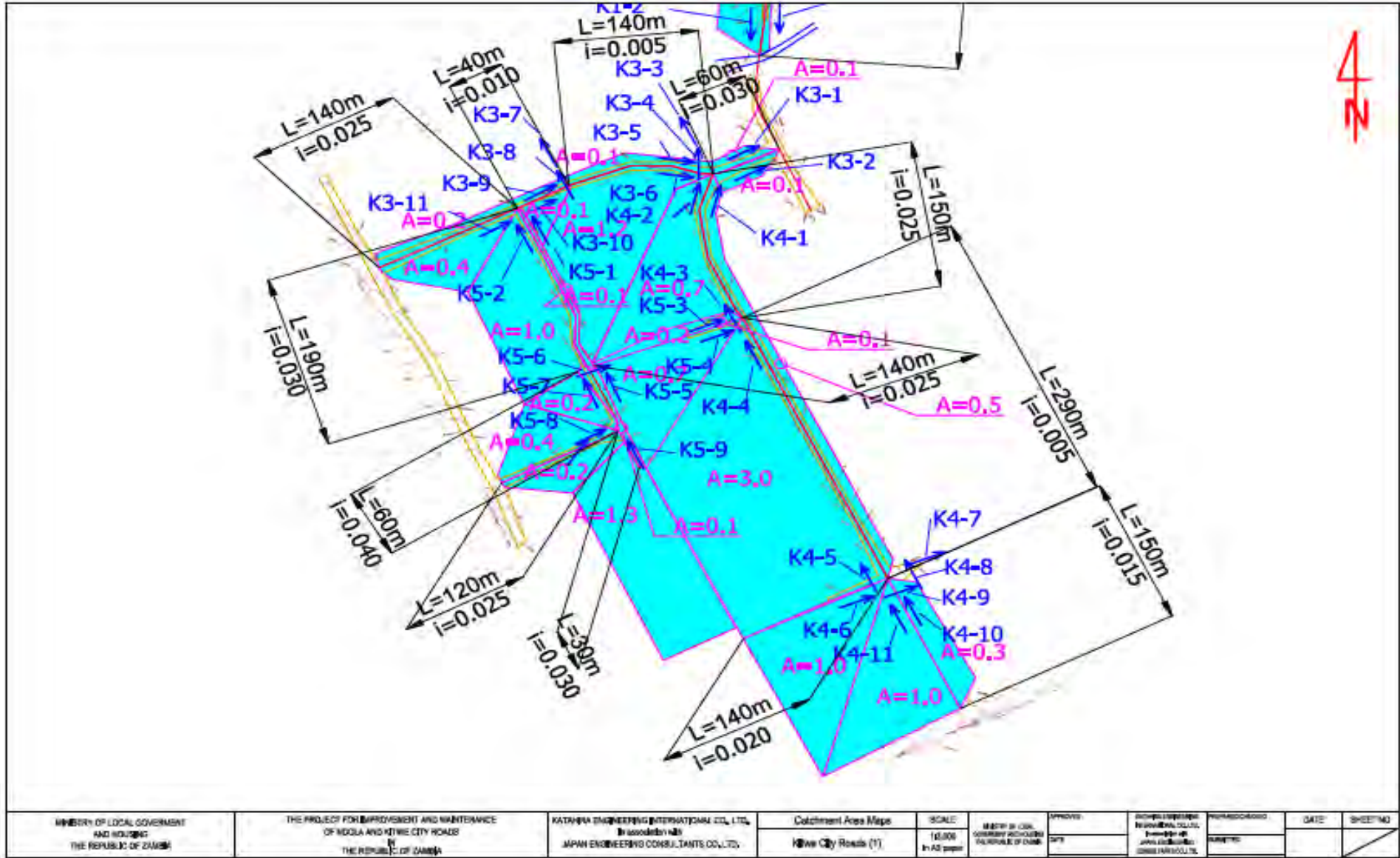


A7-44

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND NIWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	KATAHIRA ENGINEERING INTERNATIONAL CO., LTD. In association with JAPAN ENGINEERING CONSULTANTS CO., LTD.	Catchment Area Maps	SCALE	MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	APPROVED	KATAHIRA ENGINEERING INTERNATIONAL CO., LTD. In association with JAPAN ENGINEERING CONSULTANTS CO., LTD.	PREPARED BY	DATE	SHEET NO.
			Niwe City Roads (3)	1:20,000 In A3 paper		DATE		SUBMITTED		

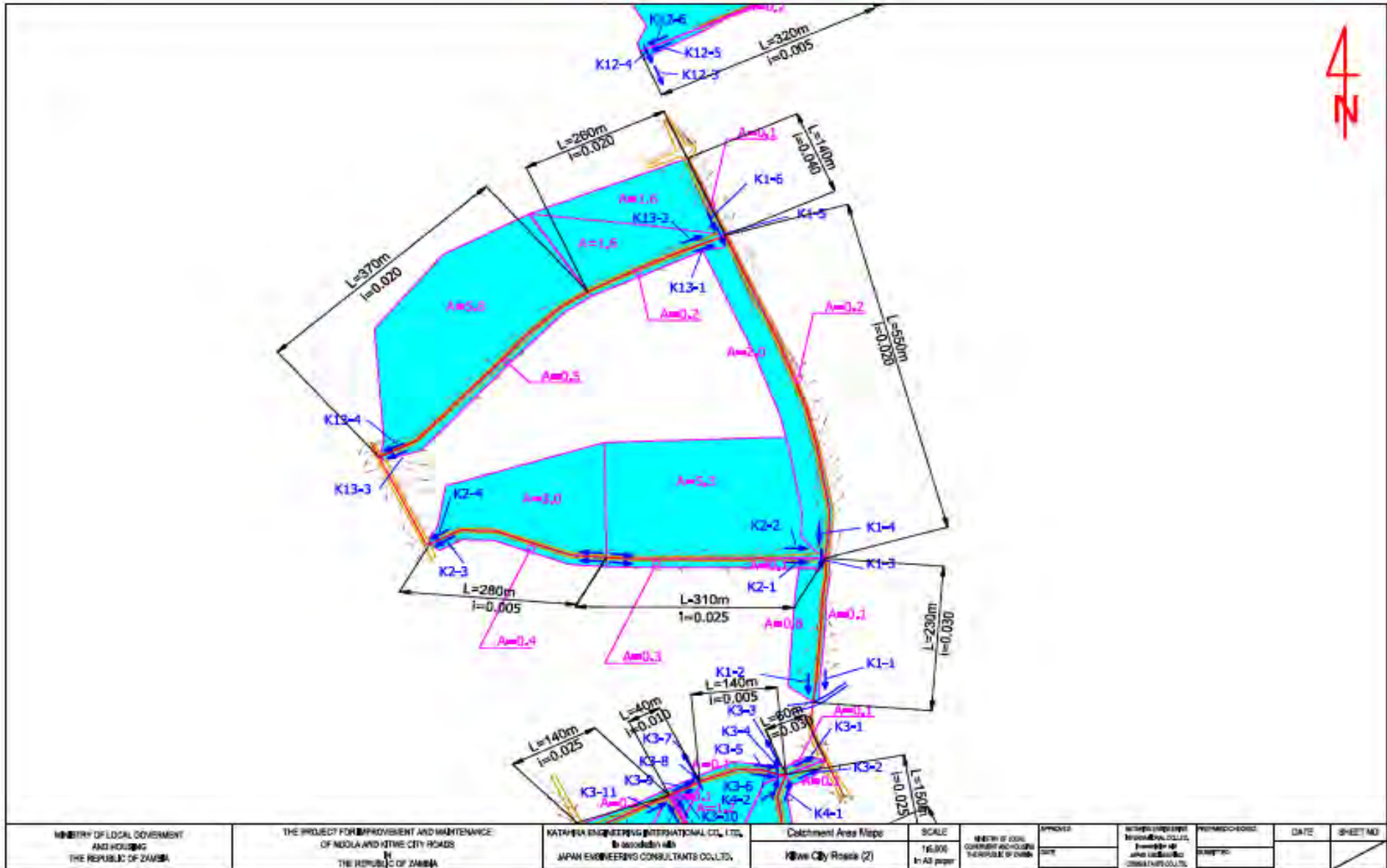


(9) PROJECT ROAD DRAINAGE SYSTEM MAP (4/8)



A7-45

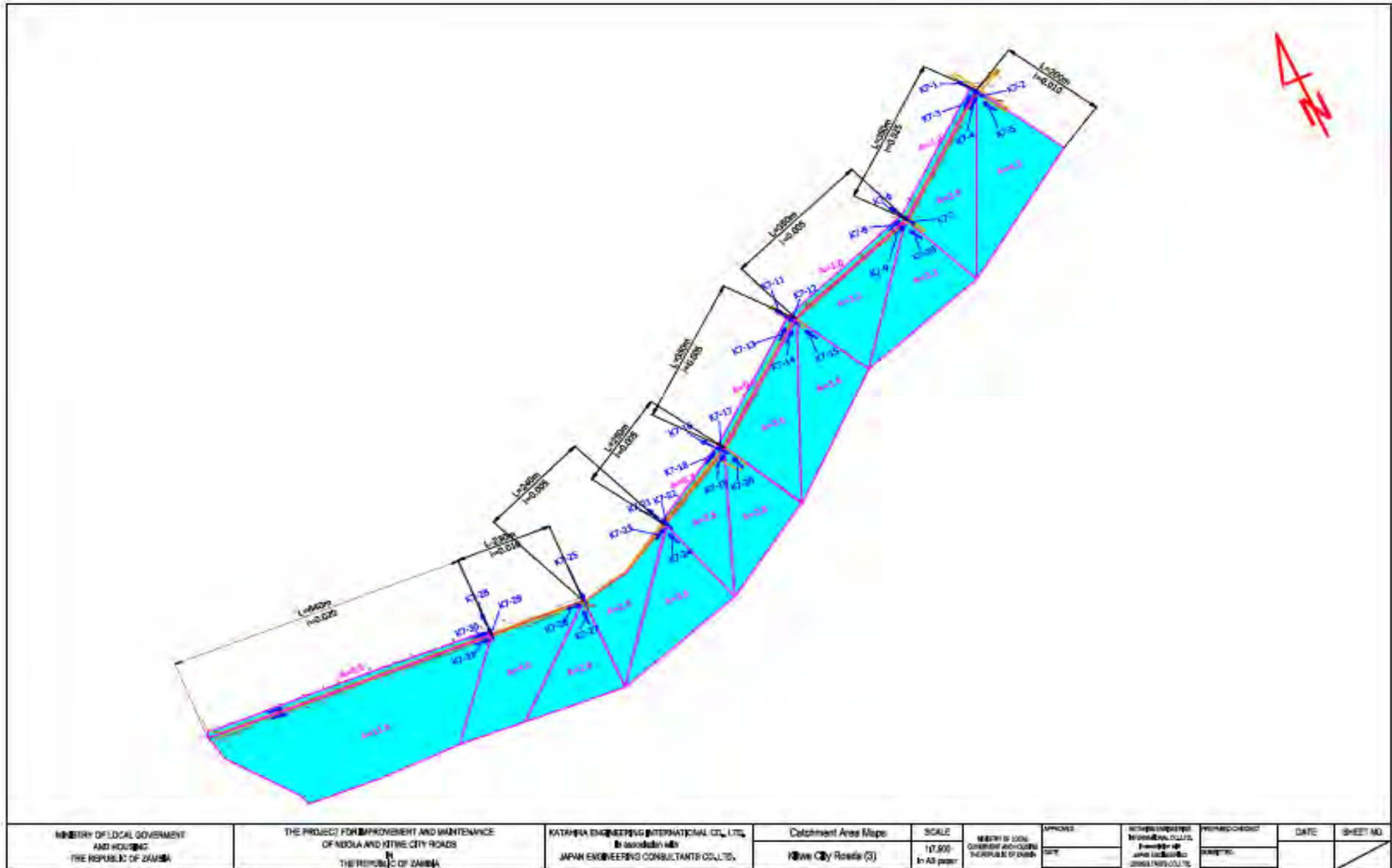
(9) PROJECT ROAD DRAINAGE SYSTEM MAP (5/8)



A7-46

(9) PROJECT ROAD DRAINAGE SYSTEM MAP (6/8)

A7-47



MINISTRY OF LOCAL GOVERNMENT  
AND HOUSING  
THE REPUBLIC OF DROMA

THE PROJECT FOR IMPROVEMENT AND MAINTENANCE  
OF NIOBA AND KOTWE CITY ROADS  
IN  
THE REPUBLIC OF DROMA

KATAMURA ENGINEERING INTERNATIONAL CO., LTD.  
In association with  
JAPAN ENGINEERING CONSULTANTS CO., LTD.

Catchment Area Maps  
Niova City Roads (5)

SCALE  
1:7,500  
In A3 paper

REPUBLIC OF DROMA  
GOVERNMENT AND HOUSING  
THE REPUBLIC OF DROMA

APPROVED  
SITE

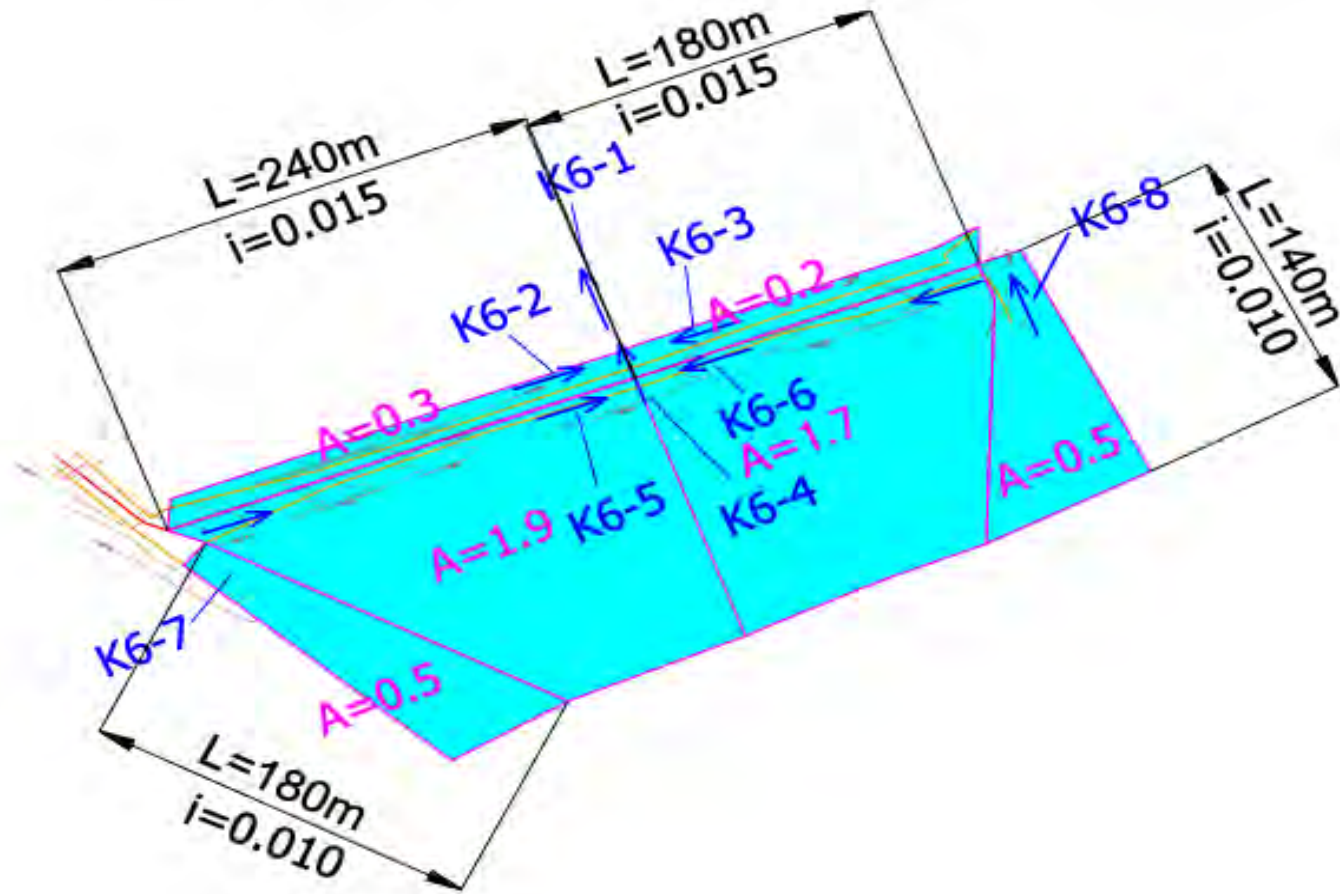
MINISTER OF LOCAL GOVERNMENT  
AND HOUSING  
JAPAN ENGINEERING CONSULTANTS CO., LTD.

PREPARED BY  
ENGINEER

DATE

SHEET NO.

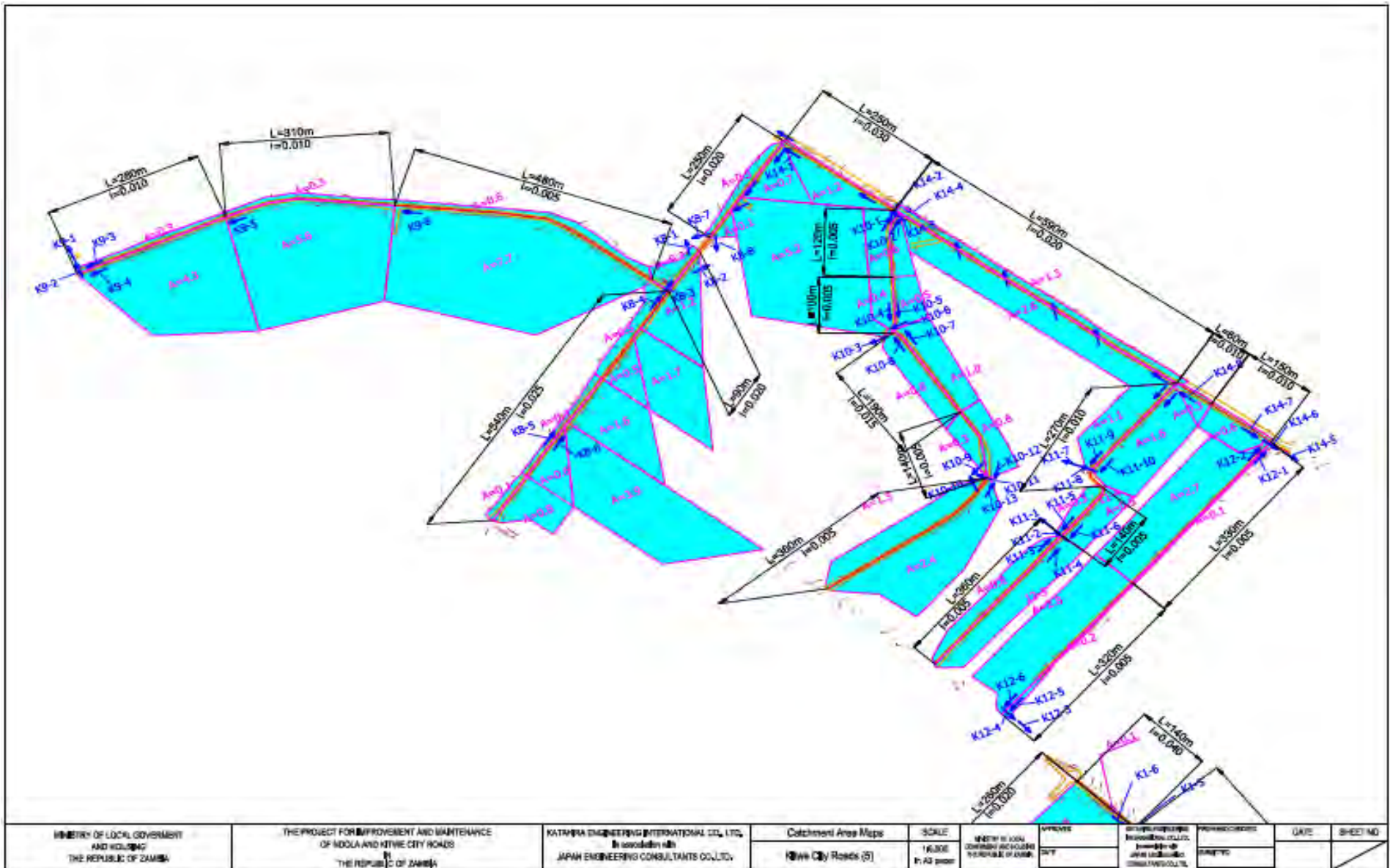
(9) PROJECT ROAD DRAINAGE SYSTEM MAP (7/8)



A7-48

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	KATAMPA ENGINEERING INTERNATIONAL CO. LTD. In association with JAPAN ENGINEERING CONSULTANTS CO. LTD.	Catchment Area Maps	SCALE	MINISTRY OF LOCAL GOVERNMENT AND HOUSING RESPONSIBLE OFFICER	APPROVE DATE	DRAWN BY CHECKED BY DATE	PROJECT NO. SHEET NO.	DATE	SHEET NO.
			Hive City Roads (4)	1:6,000 In A3 paper						

(9) PROJECT ROAD DRAINAGE SYSTEM MAP (8/8)



A7-49









**(11) CALCULATION OF VELOCITY AND DEPTH (Cross Culvert) (3/3)**

No.	Pipe Dia. φ(m)	Roughness n	Discharge Q(m <sup>3</sup> /sec)	Gradient i(%/100)	Velocity V(m/sec)	W. Depth (m)	Sec. Area (m <sup>2</sup> )	R (m)	L (m)	t(min)			Spec.	Remarks
										t1(min)	t2(min)	t1+t2		
N1-2	0.718	0.013	0.417	0.005	1.806	0.399	0.231	0.191	500	5.0	4.6	9.6	DP-750	
N3-1	0.596	0.013	0.324	0.005	1.681	0.388	0.192	0.172	390	5.0	3.9	8.9	DP-600	
N3-6	0.596	0.013	0.151	0.005	1.398	0.245	0.108	0.130	160	5.0	1.9	6.9	DP-600	
N4-1	0.596	0.013	0.183	0.005	1.471	0.273	0.125	0.141	290	5.0	3.3	8.3	DP-750	
N4-4	0.596	0.013	0.216	0.005	1.533	0.300	0.141	0.150	270	5.0	2.9	7.9	DP-750	
N4-7	0.718	0.013	0.421	0.005	1.809	0.401	0.232	0.192	360	5.0	3.3	8.3	DP-750	
N4-10	0.596	0.013	0.334	0.005	1.692	0.397	0.198	0.174	290	5.0	2.9	7.9	DP-750	
N4-13	0.596	0.013	0.194	0.005	1.493	0.282	0.130	0.144	270	5.0	3.0	8.0	-	*Existing
N4-16	0.596	0.013	0.162	0.005	1.423	0.254	0.114	0.134	220	5.0	2.6	7.6	DP-750	
N6-5	0.596	0.013	0.129	0.005	1.340	0.225	0.097	0.122	130	5.0	1.6	6.6	DP-600	
N7-2	0.718	0.013	0.453	0.005	1.840	0.420	0.246	0.197	550	5.0	5.0	10.0	-	*Existing
N8-12	0.854	0.013	0.647	0.005	2.016	0.468	0.321	0.226	2200	5.0	18.2	23.2	-	
	0.596	0.013	0.369	0.005	1.721	0.428	0.214	0.178	2200	5.0	21.3	26.3	DP-750	
K1-3	1.100	0.013	1.154	0.005	2.331	0.568	0.495	0.281	1260	5.0	9.0	14.0	-	
	0.854	0.013	0.922	0.005	2.172	0.593	0.425	0.252	1260	5.0	9.7	14.7	-	*Existing
K1-5	0.596	0.013	0.345	0.005	1.702	0.407	0.203	0.175	400	5.0	3.9	8.9	-	*Existing
K3-3	0.718	0.013	0.891	0.010	2.770	0.532	0.322	0.216	640	5.0	3.9	8.9	DP-750	
K3-4	0.718	0.013	0.877	0.010	2.764	0.525	0.317	0.215	150	5.0	0.9	5.9	DP-750	
K3-7	0.596	0.013	0.259	0.005	1.602	0.335	0.162	0.160	250	5.0	2.6	7.6	DP-750	
K3-8	0.596	0.013	0.230	0.005	1.558	0.312	0.148	0.153	250	5.0	2.7	7.7	DP-750	
K4-3	0.718	0.013	0.575	0.005	1.932	0.495	0.298	0.212	580	5.0	5.0	10.0	-	*Existing
K4-5	0.596	0.013	0.144	0.005	1.379	0.238	0.104	0.128	290	5.0	3.5	8.5	-	*Existing
K5-6	0.596	0.013	0.029	0.005	0.871	0.105	0.033	0.064	210	5.0	4.0	9.0	-	*Existing
K6-1	0.718	0.013	0.442	0.005	1.830	0.414	0.242	0.195	740	5.0	6.7	11.7	-	
	0.718	0.013	0.398	0.005	1.785	0.387	0.223	0.188	740	5.0	6.9	11.9	DP-750	
K6-4	0.718	0.013	0.518	0.005	1.894	0.459	0.273	0.205	740	5.0	6.5	11.5	-	
	0.718	0.013	0.471	0.005	1.856	0.431	0.254	0.199	740	5.0	6.6	11.6	DP-750	
K7-2	0.718	0.013	0.701	0.005	1.973	0.589	0.355	0.218	550	5.0	4.6	9.6	DP-750	
K7-7	0.718	0.013	0.584	0.005	1.937	0.501	0.302	0.212	550	5.0	4.7	9.7	DP-750	
K7-12	0.718	0.013	0.629	0.005	1.958	0.531	0.321	0.216	550	5.0	4.7	9.7	DP-750	
K7-17	0.718	0.013	0.476	0.005	1.861	0.434	0.256	0.200	450	5.0	4.0	9.0	DP-750	
K7-22	0.718	0.013	0.548	0.005	1.915	0.478	0.286	0.209	440	5.0	3.8	8.8	DP-750	
K7-25	0.718	0.013	0.593	0.005	1.942	0.507	0.305	0.213	430	5.0	3.7	8.7	DP-750	
K8-3	0.596	0.013	0.097	0.005	1.238	0.193	0.078	0.109	540	5.0	7.3	12.3	DP600	
K10-6	0.718	0.013	0.162	0.005	1.408	0.235	0.115	0.132	290	5.0	3.4	8.4	DP-600	
K10-11	0.718	0.013	0.324	0.005	1.701	0.345	0.192	0.175	500	5.0	4.9	9.9	DP-750	
K11-2	0.718	0.013	0.183	0.005	1.455	0.250	0.125	0.138	450	5.0	5.2	10.2	DP-750	
K11-8	0.596	0.013	0.173	0.005	1.448	0.264	0.119	0.137	270	5.0	3.1	8.1	DP-600	
K12-3	0.718	0.013	0.431	0.005	1.820	0.407	0.237	0.194	320	5.0	2.9	7.9	DP-750	
K12-4	0.718	0.013	0.403	0.005	1.791	0.390	0.225	0.189	290	5.0	2.7	7.7	DP-750	
K14-2	0.596	0.013	0.086	0.005	1.197	0.182	0.072	0.103	690	5.0	9.6	14.6	DP-750	
K14-3	0.596	0.013	0.029	0.005	0.871	0.105	0.033	0.064	690	5.0	13.2	18.2	DP-750	
K14-6	0.596	0.013	0.489	0.010	2.412	0.410	0.205	0.176	480	5.0	3.3	8.3	DP-600	