MINISTRY OF LOCAL GOVERNMENT AND HOUSING
THE REPUBLIC OF ZAMBIA
NDOLA CITY COUNCIL
KITWE CITY COUNCIL

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA

October 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL
JAPAN ENGINEERING CONSULTANTS CO.,LTD

PREFACE

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a basic design study on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zambia a study team from February 18 to March 28, 2007.

The team held discussions with the officials concerned of the Government of Zambia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Zambia in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zambia for their close cooperation extended to the teams.

October, 2007

Masahumi Kuroki
Voice-President
Japan International Cooperation Agency

October, 2007

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads in the Republic of Zambia.

This study was conducted by the Consortium of Katahira & Engineers International and Japan Engineering Consultants Co., LTD., under a contract to JICA, during the period from February 2007 to October 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Zambia and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Toshinori Toda
Project manager,
Basic design study team on the Project for Improvement and Maintenance of Ndola and Kitwe City Roads in the Republic of Zambia
The consortium of Katahira & Engineers International and Japan Engineering Consultants Co., LTD.

Summary

1. Outline of the Country

The Republic of Zambia is located in Southern Africa and a land-lock country having an area of 72.56 thousand km^2 and population of 10.5 million with an annual growth rate of 1.4%. Eighty percent of the people are Christians and there are 73 tribes. The official language is English. The country is in step climate and tropical savanna. Temperature ranges 15 - 30℃ and annual rainfall is 500 - 1,250mm. Geology is old and formed two billion years ago. Geological features bases were composed of sedimentary rocks and metamorphic rocks covered by latelite which were created by weathering the base rocks.

The project sites of Ndola and Kitwe cities belong to Copperbelt Province, which are located 300km north of Lusaka City, the Capital City, and bordering the southern part of the Democratic Republic of Congo. Ndola City and Kitwe City, adjoining each other, have an area of 938km^2 and 777km^2, respectively, and approximately 400 thousand populations each with annual growth rate of 0.8～1.0%. Topographic features are hilly and approximately 1,200m height above the sea level. There are three seasons; hot rainy season (September - November), rainy season (November - March), and cold dry season（April - August）.

Main industries in Zambia are agriculture (maize, tobacco, etc.), mine (copper, cobalt, etc.) and tourism (game park). GNI per capita in 2004 was 450US$. Annual economic growth is 4.6% and inflation is 19.9%, and unemployment rate is 12.4%. Copper occupied around 60% of exports and thus Zambia economy has been depending on copper products since colonial era and characterized by monopoly. The Government of Zambia intends to diversify economy by promoting agriculture and tourism. GDP in 2004 was 5.4 billion US$ and split by sector shares as 20.9 % of primary, 37.1% of secondary and 42.0% of tertiary sector.

2. Background of the Project

The Government of the Republic of Zambia (GRZ) has launched the 5th National Five-Year Development Plan (2006-2010) having national socio-economic objectives aiming at sustainable development, employment generation, and poverty reduction. Under the Plan, the transport sector has to support and enhance economic restoration, environmental sustainability, and social service accessibility through efficient management of national resources by maintenance of the existing infrastructure and construction of new infrastructure. In this context, the road sub-sector plays an important role to enhance international and national freight and passenger transport and thus contributes as a base of economic development.

In 1997, GRZ established a “Committee of Ministers on Road Management” consisting of MWS,

MLGH and other relevant authorities and prepared a Road Sector Investment Program (ROADSIP) for overall road network rehabilitation. The first ROADSIP was implemented from 1998 to 2002 and the second ROADSIP was prepared as a ten-year plan commencing in 2004 and will be ended in 2013. The second ROADSIP has put the priority on urban road development for economic vitalization of growth pole cities and towns and support local economic activities and social services. Among these cities and towns, Ndola and Kitwe cities in the Copperbelt Province have been selected as the strategic cities, where the most important mineral resources are concentrated on and relevant industries are developed. The urban road development of Ndola and Kitwe cities are therefore urgent issues.

In the first ROADSIP, a total of 40,311km are registered as Core Road Network including Trunk Road (3,088km), Main Road (3,691km), District Road (13,707km), Urban Road (5,294km), and Primary Feeder Road (14,333). Total 3,075km (approximately 7%) was improved by 2002. Priority sections of the urban road network totaling 125km were selected and improved in the major cities i.e. Lusaka (55km), Ndola (35km), and Kitwe (35km). This was followed by improvement of 49km in Lusaka and 45km in other five towns in the Copperbelt Province. For Ndola City and Kitwe City, only 6.6% and 6.0% of total roads, which are 530km for Ndola City and 582km for Kitwe City, were improved. Thus the present urban road improvement program is still inadequate. The delay of improvement hampered smooth and stable urban transport and efficient economic activities of mineral and other industries, commercial and social services of the citizens. To solve these problems, GRZ has launched Urban Road Support Program in ROADSIP II to develop urban roads of 775km in total with 76.6 million US$ for all nine provincial capitals including Ndola City and 15 major cities including Kitwe City. Improvement of the Ndola and Kitwe City Roads is selected as priority in this program.

Ndola City intends to develop the efficient arterial road network to connect with the administrative, the commercial, the industrial and the residential zones. In particular, low-cost housing for low and middle income groups is being developed in the southern residential zone, and the improvement of the commuting roads connecting the residence zone and the central administrative and commercial zones becomes an urgent issue. In addition, improvement of collector road networks in each zone, such as the northern residential zone, Central Business District (CBD), the industrial zone, and the southern residential zone also become the city's high priority projects. Most pavements of these roads have been deteriorated and in bad condition due to lack of drainage system and maintenance and then vehicles including public buses barely passable at slow speed. This road condition is a major problem for the people to do their daily activities such as commuting to offices, factories, schools, hospitals and shopping.

Kitwe City is the center of the copper mining and other related industries. The development of the minor arterial and collector roads network in industrial zone, commercial zone and residential zone was given high priority since these roads have been deteriorated and damaged severely due

to the increase of heavy vehicles and then vehicles barely passable at slow speed. Such road condition is a problem in transportation and daily activity of the people.

The urban road development of Ndola and Kitwe Cities is therefore urgent matters. Hence GRZ requested the Government of Japan (GOJ) for Grant Aid, particularly the Project for Improvement and Maintenance of Ndola and Kitwe City Roads (The Project). The Project aims to facilitate the smooth and stable urban transportation and thus to vitalize the local socio-economic activities by improving the roads with high priorities.

3. Outlines of the Survey Results and Contents of the Project

In response to the request of GRZ, GOJ decided to conduct a basic design on the above project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent the Basic Study Team to Zambia to discuss with GRZ and conduct a field survey from February 18 to March 28, 2007. After returning to Japan, the team prepared the basic design taking the field survey results, project conditions and suitable contents into consideration and then summarized it in a Draft Basic Design report (DBD). JICA then sent a mission to explain and confirm DBD with GRZ from August 31 to September 9, 2007. Following results of the discussion, a Basic Design report was finalized in October 2007.

The project is to improve the following roads which were classified into minor arterial and collector road and the contents of the project are presented below.

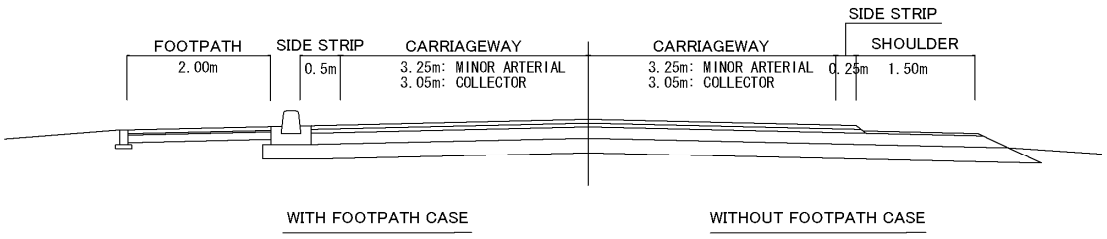
In the first phase, five project roads will be implemented; Chambeshi Road (L=4.674km) in Ndola City and Dr. Aggrey Avenue (L=0.993km), Zomba Road (L=0.370km), Blantyre Road (L=0.449km), Kantanta Street (L=2.371km) in Kitwe City. In the second phase, 18 project roads will be implemented; eight roads with 8.056km in Ndola and 10 roads with 7.447km in Kitwe City.

Contents of the Project Road

	Ndola City Roads (L=12.730km)	Kitwe City Roads (L=11.630km)
Minor Arterial	N3: Makoli Avenu (L=0.881km) N9: Livingstone Road (L=0.375Km)	K1: Dr. Aggrey Avenue (L=0.993km)
Collector Road	N1: Vitanda Street (L=0.859km) N2: Kaunda Drive (L=0.295km) N4: Independence Way (L=1.765km) N5: Zambia Road (L=2.537km) N6: Matelo Road (L=0.383km) N7: Lukasu Road (L=1.000km) N8: Chambeshi Road (L=4.674km)	K2: Euclid Road (L=0.587km) K3: Zomba Road (L=0.370km) K4: Blantyre Road (L=0.449km) K5: Eshowe Road (L=0.485km) K6: Matuka Avenue (L=0.363km) K7: Kantanta Street (L=2.371km) K8: Natwange Road (L-0.904km) K9: Mutentemuko Road (L=1.075km) K10: Miseshi Street (L=0.913km) K11: Kanongesha Road (L=0.724km) K12: Mulilakwenda Road (L-0,705km) K13: Lilogwe Road (L=0.623km) K14: Independence Service Lane (L=1.068km)

Road width component is as follows:

- Carriageway Minor Arterial 3.25m
  Collector Road 3.05m
- Footpath 2.0m
  (Only for roads having high pedestrian traffic volume)
- Design Speed Minor Arterial 50km/hour
  Collector Road 40km/hour



Road Width Component

The components of the Japanese assistance are as follows:

Components of Japanese Assistance

Component	Specification	Quantity
Road Length	Ndola City (12.73 km)、Kitwe City (11.63 km)	24.36 km
Pavement Work	Asphalt Concrete Surface Course (T=50mm, Ave. Width= 7.9m)	192,012 ㎡
	Asphalt Concrete Binder Course (T=50mm, Ave. Width= 7.9m)	60,355 ㎡
	Granular Base Course (T=100mm～200mm, Ave. Width=9.9m)	239,536 ㎡
	Crushed Stone Subbase Course (T=100mm～300mm, Ave. Width=9.9m)	205,538 ㎡
Road Shoulder Surfacing	Asphalt Concrete Surface Course (T=30mm, Ave. Width=1.25m)	45,211 ㎡
Footpath Surfacing	Precast Tile (50cm x 50cm) Surfacing (Width=2.0m))	6,907 ㎡
	Crushed Stone Subbase Course (T=100mm～150mm, Width=2.0m)	7,196 ㎡
Access Way Surfacing	Asphalt Concrete Surface Course (T=30mm) + Subbase Course (T=150mm)	467 Spot
	Crushed Stone Surfacing (T=100mm)	467 Spot
Drainage Structures	Stone Masonry Ditch (Bottom Width=500～1200mm)	21,688 m
	U-Shape Concrete Ditch (Bottom Width=500～1200mm)	10,990 m
	L-Shape / Rolled Gutter Ditch	3,881 m
	Cross Pipe (Diameter=600～1200mm)	1167 m
Box Culvert	3-Barrel Box (Width=10m (3+4+3) x Height=3.5m x Width=13.1m)	1 Site
Kerbs	Concrete Kerb (Barrier Type)	4,152 m
	Edge Block	3,602 m
Sign Boards		179 Each
Lane Marking	Centerline, Edge Line	68.36 km
Road Marking	Crosswalk, Stop Line, Left/Right Turn Arrows	217 Spot
Hump		6 Spot

4. Project Period and Rough Cost Estimate

In case the Project is implemented, the detailed design will take 6.0 months and the construction will take 24.3 months. The Project will be implemented in accordance with the Japan's Grant Aid scheme and the cost will be determined before concluding the Exchange of Notes (E/N) for the Project.

5. Project Evaluation

The direct beneficiaries of the Project are the population of approximately 783,000 (394,000 in Ndola City and 389,000 in Kitwe City), whereas the indirect beneficiaries are the population of approximately 1,658,000 in Copperbelt Province.

(1) Direct Effects

(i) The travel speed will be increased from 18.7km/h to 40.0km/h.

(ii) The traffic accidents will be reduced by repairing of pot holes which cause sudden stops and turnings of vehicles, installation of traffic safety facilities (sign boards, crosswalks, humps, etc.) and provision of footpaths.

(2) Indirect Effects

(i) Products of mining and manufacturing industries are expected to be more competitive, and the local economy will be vitalized.

(ii) Improving convenience for the people to do their daily activities by improving mobility due to provision of fast, comfortable and reliable public transportation and improving accessibility of the low and middle income groups to the hospitals and schools.

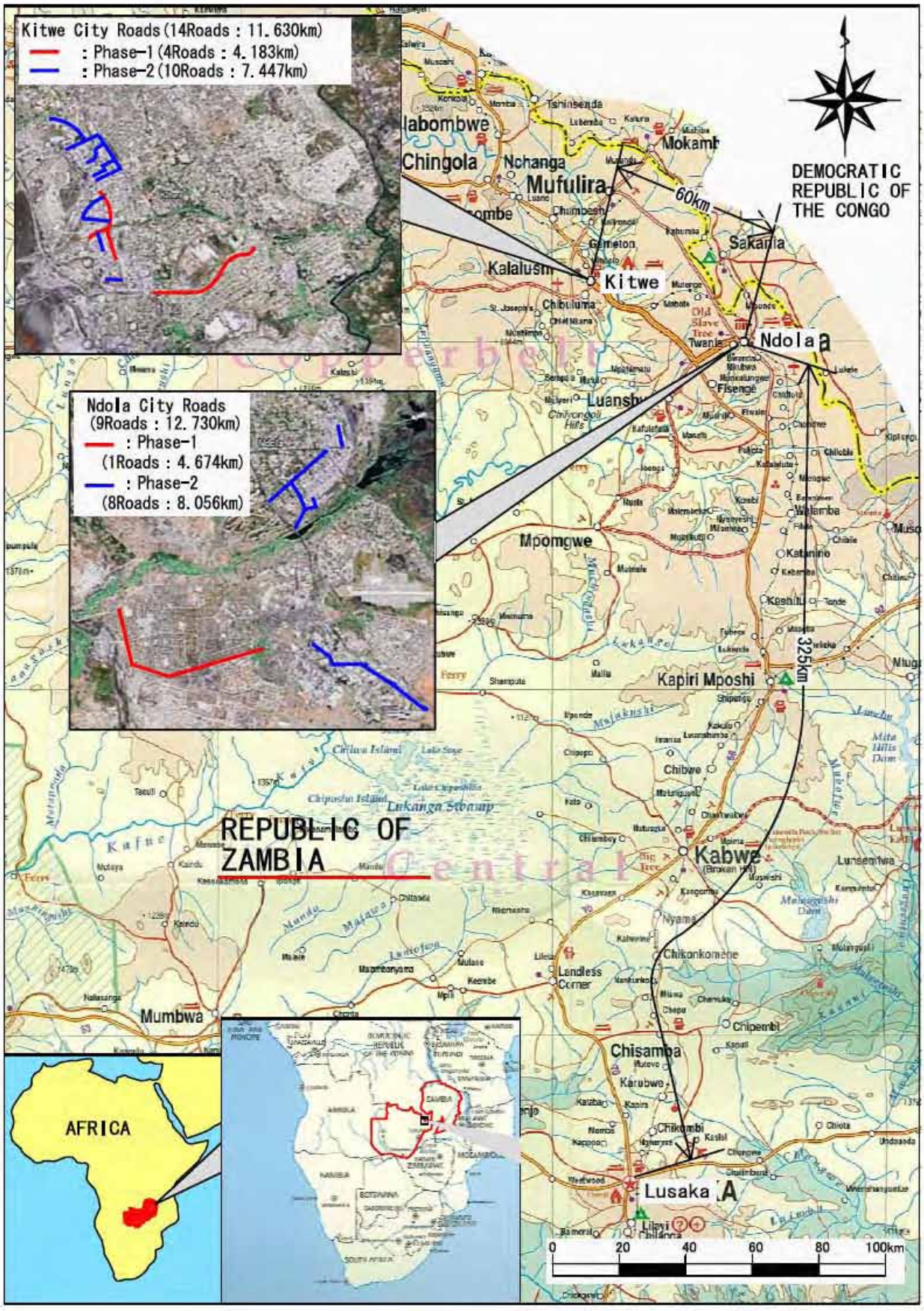
6. Recommendations

The following recommendations are intended for the Zambian side to maximize the Project effects:

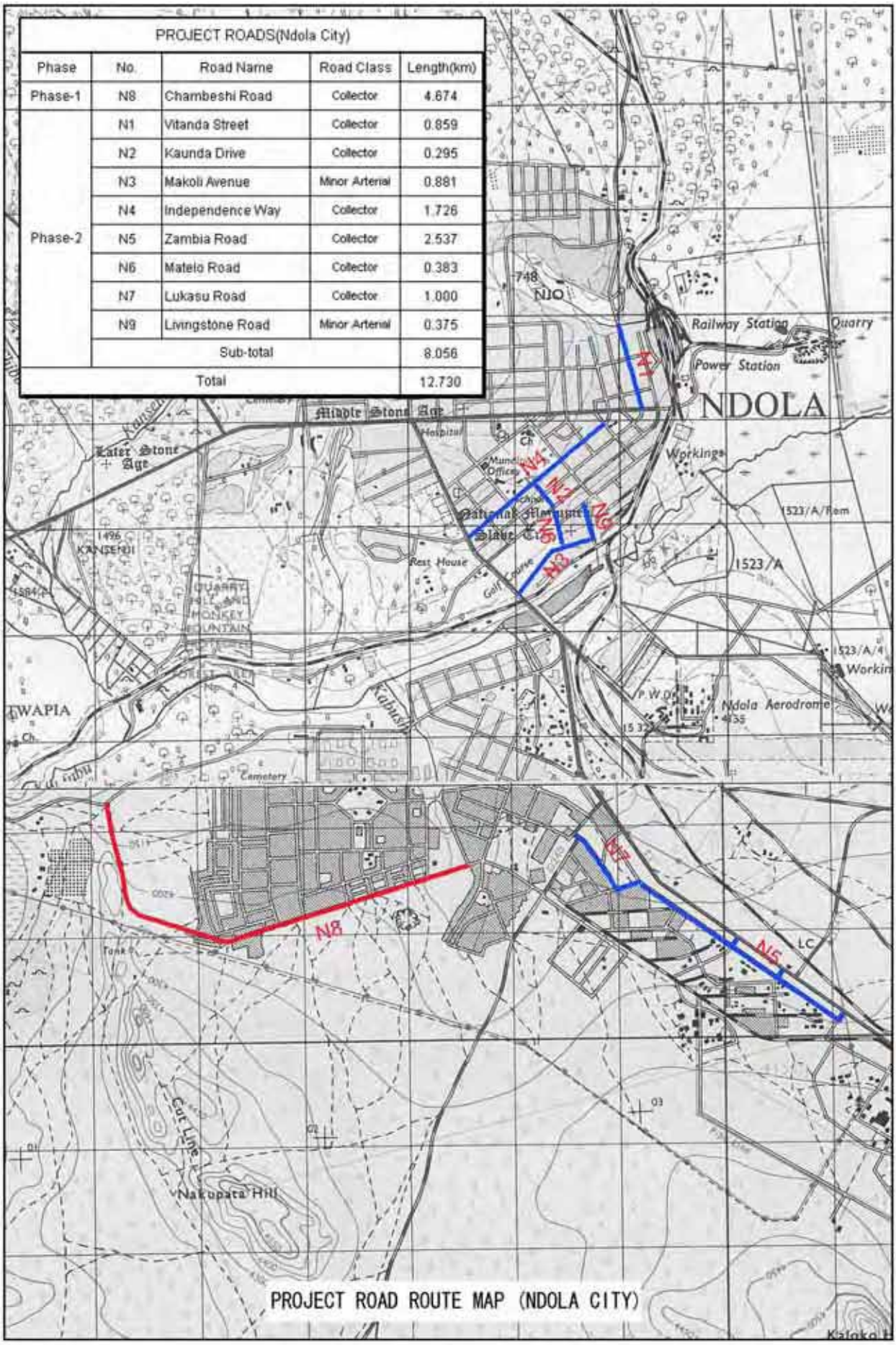
- To continue human resource development of engineers and technicians in order to enhance road maintenance and management,
- To provide the budgets for road maintenance and management in accordance with the long-term road maintenance program,
- To regulate and reinforce the ban on overloading of heavy vehicles in order to optimize the pavement durability.

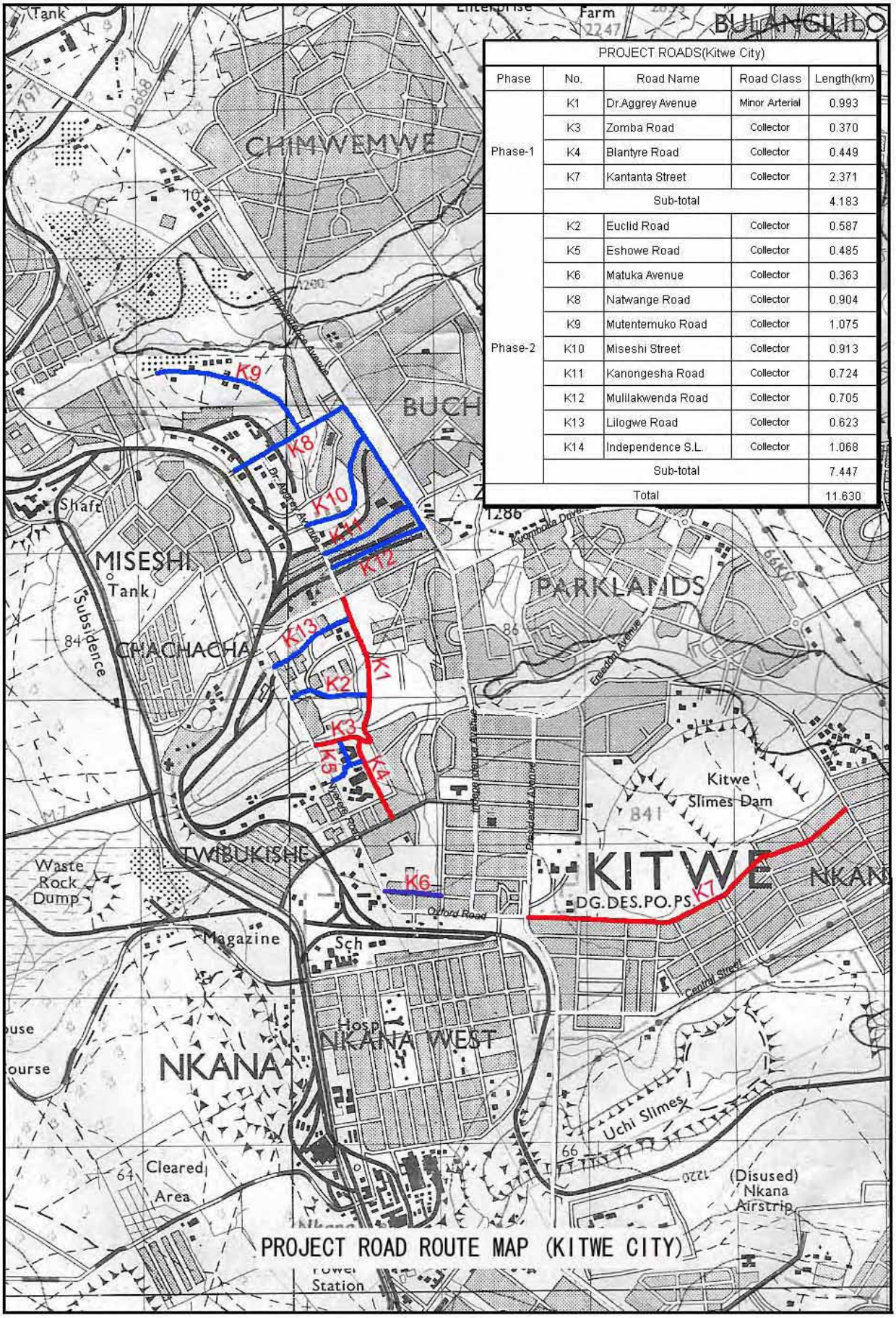
Table of Contents

［Appendices］



Location Map


PROJECT ROADS(Ndola City)
Phase | No. | Road Name | Road Class | Length(km)
Phase-1 | N8 | Chambeshi Road | Collector | 4.674
Phase-2 | N1 | Vitanda Street | Collector | 0.859
N2 | Kaunda Drive | Collector | 0.295
N3 | Makoli Avenue | Minor Arterial | 0.881
N4 | Independence Way | Collector | 1.726
N5 | Zambia Road | Collector | 2.537
N6 | Matelo Road | Collector | 0.383
N7 | Lukasu Road | Collector | 1.000
N9 | Livingstone Road | Minor Arterial | 0.375
Sub-total | 8.056
Total | 12.730
N1
N2
N3
N4
N5
N6
N7
N8
N9
NDOLA
Railway Station
Quarry
Power Station
Workings
Middle Stone Age
Later Stone Age
Rest House
Golf Course
Cemetery
Ndola Aerodrome
1523/A
1523/A/Rem
KANSENJI
TWAPIA
Nakupata Hill
Cut Line
PROJECT ROAD ROUTE MAP (NDOLA CITY)


PROJECT ROADS(Kitwe City)
Phase | No. | Road Name | Road Class | Length(km)
Phase-1 | K1 | Dr.Aggrey Avenue | Minor Arterial | 0.993
Phase-1 | K3 | Zomba Road | Collector | 0.370
Phase-1 | K4 | Blantyre Road | Collector | 0.449
Phase-1 | K7 | Kantanta Street | Collector | 2.371
Sub-total | | | | 4.183
Phase-2 | K2 | Euclid Road | Collector | 0.587
Phase-2 | K5 | Eshowe Road | Collector | 0.485
Phase-2 | K6 | Matuka Avenue | Collector | 0.363
Phase-2 | K8 | Natwange Road | Collector | 0.904
Phase-2 | K9 | Mutentemuko Road | Collector | 1.075
Phase-2 | K10 | Miseshi Street | Collector | 0.913
Phase-2 | K11 | Kanongesha Road | Collector | 0.724
Phase-2 | K12 | Mulilakwenda Road | Collector | 0.705
Phase-2 | K13 | Lilogwe Road | Collector | 0.623
Phase-2 | K14 | Independence S.L. | Collector | 1.068
Sub-total | | | | 7.447
Total | | | | 11.630
CHIMWEMWE
BUCH
MISESHI
CHACHACHA
PARKLANDS
TWIBUKISHI
KITWE
DG.DES.PO.PS
NKANA
NKANA WEST
Kitwe Slimes Dam
Uchi Slimes
Waste Rock Dump
Magazine
Sch
Hosp
Cleared Area
(Disused) Nkana Airstrip
Power Station
Tank
Shaft
Subsidence
Farm
Kuampala Drive
Freedom Avenue
Independence Avenue
Oxford Road
Central Street
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
K12
K13
PROJECT ROAD ROUTE MAP (KITWE CITY)

Perspective (N4 : Independence way): Ndola City

Perspective (K7 : Kantanta Street): Kitwe City

List of Figure & Table

Abbreviation

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concreate
AWP	Annual Worl Plan
BADEA	Arab Bank for Economic Development in Africa
COI	Corridor of Impact
CBD	Central Business District
CBR	California Bearing Ratio
COMESA	Common Market for Eastern and Southern Africa
DANIDA	Danish International Development Assistance
DBST	Double Bituminous Surface Treatment
DCP	Dual-Mass Dynamic Cone Penetrometer
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EMU	Environmental Management Unit
ESAL	Equivalent Single Axe Load
EU	European Union
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GRZ	Government of the Republic of Zambia
HDM	Highway Development & Manegment System
IDA	International Development Association
IEE	Initial Environmental Examination
IRI	International Roughness Index
JICA	Japan International Cooperation Agency
KCC	Kitwe City Council
KFAED	Kuwait Fund for Arab Economic Development
KFW	Kreditanstalt für Wiederaufbau
MCT	Ministry of Communication and Transport
MLGH	Ministry of Local Government and Housing
M/D	Minutes of Discussion
MTENR	Ministry of Tourism: Environment and Natural Resources
MWS	Ministry of Works and Supply
NAPA	National Asphalt Pavement Association
NCC	Ndola City Council
NORAD	Norwegian Agency for Development Cooperation
NRB	National Road Board
NRFA	Natioanl Road Fund Agency

OPEC	Organization of the Petroleum Exporting Countries
PRSP	Poverty Reduction Strategy Papers
RDA	Roads Development Agency
ROADSIP	Road Sector Investment Programme
ROW	Right of Way
RTSA	Road Transport and Safety Agency
SADCC	Southern African Development Coordination Conference
SATCC	Southern Africa Transport and Communications Commission
SOX	Sulfur Oxide
TOR	Terms of Reference
WB	World Bank
ZESCO	Zambian Electricity Supply Corporation
ZAMTEL	Zambia Telecommunications Limited
ZMK	Zambian Kwacha

CHAPTER 1 BACKGROUND OF THE PROJECT

Under the 5th National Five-Year Development Plan starting in 2006, the Government of the Republic of Zambia (GRZ) aims at preservation of the existing infrastructure and construction of new infrastructure in the road sub-sector and has launched a Road Sector Investment Program II (ROADSIP II) for overall road network rehabilitation in the country. The ROADSIP II has put the priority on the urban road development for economic vitalization of growth pole cities, in particular, Ndola and Kitwe cities in the Copperbelt Province where the most important mineral resources are concentrated on and relevant industries are developed. The urban road development of Ndola and Kitwe cities are therefore urgent matters.

In this context, GRZ requested the Government of Japan (GOJ) for Grant Aid, particularly the Project for Improvement and Maintenance of Ndola and Kitwe City Roads (The Project). The Project aims to facilitate the smooth and stable urban transportation and thus to vitalize the local socio-economic activities by improving main roads which are selected among the roads urgently required for improvement in administrative, industrial, commercial and residential zones.

In response to the request of GRZ, GOJ decided to conduct a basic design on the above project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Zambia the Basic Study Team to Zambia to conduct a field survey in February 2007 and again sent a mission to discuss a draft basic design in August 2007. The report was finalized in October 2007.

The Project will cover improvement of the existing roads including nine (9) roads with total length of 12.73km in Ndola City and fourteen (14) roads with total length of 11.63km.

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 BASIC CONCEPT OF THE PROJECT

2.1.1 Overall Goal and Project Purpose

The Government of the Republic of Zambia (GRZ) has launched the 5th National Five-Year Development Plan (2006-2010) having national socio-economic objectives aiming at sustainable development, employment generation, and poverty reduction. Under the Plan, the transport sector has to support and enhance economic restoration, environmental sustainability, and social service accessibility through efficient management of national resources by preservation of the existing infrastructure and construction of new infrastructure. In this context, the road sub-sector plays an important role to enhance international and national freight and passenger transport and thus contributes as a base of economic development.

In 1997, GRZ established a "Committee of Ministers on Road Management" consisting of MWS, MLGH and other relevant authorities and prepared a Road Sector Investment Program (ROADSIP) for overall road network rehabilitation. The first ROADSIP was implemented from 1998 to 2002 and the second ROADSIP was prepared as a ten-year plan commenced in 2004 and will be ended in 2013. The second ROADSIP has put the priority on urban road development for economic vitalization of growth pole cities and towns and to support local economic activities and social services. Among these cities and towns, Ndola and Kitwe cities in the Copperbelt Province have been selected as the strategic cities, where the most important mineral resources are concentrated on and relevant industries are developed. The urban road development of Ndola and Kitwe cities are therefore urgent issues.

In the first ROADSIP, a total of 40,311km are registered as Core Road Network including Trunk Road (3,088km), Main Road (3,691km), District Road (13,707km), Urban Road (5,294km), and Primary Feeder Road (14,333). Total 3,075km (approximately 7%) was improved by 2002. Priority sections of the urban road network totaling 125km was selected and improved in the major cities which were Lusaka (55km), Ndola (35km), and Kitwe (35km). This was followed by improvement of 49km in Lusaka and 45km in other five towns in the Copperbelt Province. For Ndola City and Kitwe City, only 6.6% and 6.0% of total roads, which are 530km for Ndola City and 582km for Kitwe City, were improved. Thus the present urban road improvement program is still inadequate. The delay of improvement hampered smooth and stable urban transport and efficient economic activities of mineral and other industries, commercial and social services of the citizen. To solve these problems, GRZ has launched Urban Road Support Program in ROADSIP II to develop urban roads of 775km in total with 76.6 million US$ for all nine provincial capitals including Ndola City and 15 major cities including Kitwe City. The Project is selected as priority in this program.

Ndola City intends to develop the efficient arterial road network to connect with the administrative, the commercial, the industrial and the residential zones. In particular, low-cost housing for low and middle income groups is being developed in the southern residential zone, and the improvement of the commuting roads connecting the residence zone and the central administrative and commercial zones becomes an urgent issue. In addition, improvement of collector road networks in each zone, such as the northern residential zone, Central Business District (CBD), the industrial zone, and the southern residential zone also become the city's high priority projects. Most pavements of these roads have been deteriorated and in bad condition due to lack of drainage system and maintenance and then vehicles including public buses barely passable at slow speed. This road condition is a major problem for the people to do their daily activities such as commuting to offices, factories, schools, hospitals and shopping.

Kitwe City is the center of the copper mining and other related industries. The development of the minor arterial and collector roads network in industrial zone, commercial zone and residential zone was given high priority since these roads have been deteriorated and damaged severely due to the increase of heavy vehicles and then vehicles barely passable at slow speed. Such road condition is a problem in transportation and daily activity of the people.

Hence the Project Overall Goal aims to facilitate smooth and stable urban transportation and to vitalize the local socio-economic activities by achieving the Project Purpose which is to improve major roads selected out of the urgently required ones in administrative, industrial, commercial and residential zones.

2.1.2 Basic Concept of the Project

To achieve the above Project Purpose, the Project Inputs are to implement the improvement of the priority roads and to conduct road maintenance and management after the project completion. Thus the Project will contribute to socio-economic development in Ndola and Kitwe, and then Zambia. The components of the Project for the Japanese assistance is to improve nine (9) roads with 12.73km long in Ndola City and fourteen (14) roads in Kitwe City.

2.1.3 Environmental and Social Consideration

The Environmental Protection and Pollution Control Act is legally in command of regulations to control pollution due to water, air, waste, toxic, noise and so on including land development. The Environmental Council of Zambia (ECZ) is the official agency in charge for the environmental administration including evaluation of environmental reports submitted by project owners and conducting environmental inspection and monitoring.

Land development projects are required to prepare environmental impact assessment reports (EIA) including pollution control plans for ECZ's evaluation and approval. However, projects deemed to cause no environmental pollution are not required to prepare EIAs but to prepare environmental project briefs instead. Since this project is to rehabilitate existing road and no additional land is necessary, the Ministry of Local Government and Housing (MLGH) prepared the environmental project brief and then environmental approval (as attached in Appendix 5) was issued by ECZ.

2.2 BASIC DESIGN OF THE REQUESTED JAPANESE ASSISTANCE

2.2.1 DESIGN POLICY

(1) Requested Japanese Assistance

The original request of the project was to improve 48 roads with a total length of 49.7 km (21 roads making 25.4 km in Ndola and 27 roads making 25.4 km in Kitwe). In the Preliminary Study of the project which was conducted from July to August 2006, the request for improvement of 51 roads with a total length of 62.1 km (21 roads making 29.8 km in Ndola and 30 roads making 32.3 km in Kitwe) and road safety facilities and road maintenance equipment were confirmed. As a result of the Preliminary Study of the project, improvement of 23 roads with a total length of 23.6 km (9 roads, 11.7 km in Ndola and 14 roads, 11.9 km in Kitwe) and road safety facilities and road maintenance equipments were confirmed in this study. About 800 m long extension of Chambeshi Road (N8) was then additionally requested and accepted.

After the basic design of the roads, the project roads were re-identified as 23 roads with a total length of 24.36 km (9 roads, 12.73 km in Ndola and 14 roads, 11.63 km in Kitwe). The requested road safety facilities were included but the requested road maintenance equipment was not included in the Japanese assistance.

(2) Consideration of Natural Conditions

The optimum road improvement plan will be developed on the basis of the detailed site condition survey data such as topographic survey data, roadbed soil data, pavement material property data and so on. The rainfall data on the site will be used for the drainage facility design and for construction planning.

(3) Consideration of Socio-Economic Conditions

The road will be designed in consideration to accommodate the present traffic condition and also in anticipation to future traffic growth in terms of traffic volume and components. Pavements will be designed in consideration of the presence of overloaded heavy vehicles.

Footpaths will be planned where a large number of pedestrians are anticipated. Access ways will be planned where roadside houses / factories need to be connected to the roads. Ditch covers or concrete slabs will be planned where newly constructed roadside ditches obstruct the residents' activities. Intersections causing traffic jams and/or traffic accidents will be planned to improve the situations.

(4) Consideration of Construction and Procurement Conditions

Local materials and products will be used as much as possible. The materials will be selected in consideration of the quality, cost, reliability of supply and so on. Construction plan will be prepared in consideration of procurement of materials, equipment, labor and other conditions.

(5) Consideration of Utilization of Local Contractors

Engineers and laborers are available locally. However, the engineers able to manage the construction of urban roads are rarely available, therefore, Japanese engineers will be arranged to train the local engineers.

(6) Consideration of Road Maintenance

Minimizing maintenance requirements will be considered in the structural design. The structural problems affecting the existing road and drainage facilities will be studied further and integrated in the design. The road and drainage facilities will be designed in such a way that special materials and/or equipments will not be necessary for the maintenance. Open ditch which is easy in maintenance will be adopted as much as possible.

(7) Establishment of Grading of Designing Criteria

Generally, urban roads are classified into major arterial, minor arterial, collector and local. The project roads are classified into minor arterial and collector. The road widths and design standards of the project roads will be adjusted corresponding to their road class. The Zambia's design standards and criteria will be adopted principally, but with reference to American Association of State Highway and Transportation Officials (AASHTO) and Japanese design standards.

(8) Consideration of Construction Method

Construction methods commonly used in Japan and other countries will be adopted in the construction planning to secure the construction quality. Safety and pollution free method will be considered in the construction planning. Detour roads will be provided during the construction. Material tests and measurement tests procedures and criteria will be clearly specified in the contract documents.

(9) Environmental and Social Considerations

The road alignment will follow the existing roads to avoid the road right-of-way acquisition and to minimize the relocation of buildings and utilities. Existing pavement and drainage

facilities will be utilized as much as possible in the road improvement to minimize the waste. The spoil and other waste will be treated properly to avoid environmental pollution. Detours for the public traffic during construction will be provided. Cutting of street trees will be avoided by bending roads and ditches.

(10) Cost Efficiency

The road facilities will be designed with the top priority to secure the required functions and durability. However, the cost efficiency will also be considered in the design. The major items to be considered are as follows:

- Existing pavement, drainage and ancillary facilities will be re-used as much as possible.
- Materials will be selected in comparison of all costs.
- Traffic control on over-load trucks and streets with prohibition to heavy vehicles will be considered.
- The facility capacities will be determined in anticipation to the present and future needs.
- Footpaths will be provided only at the road sections having a large traffic of pedestrians.

2.2.2 BASIC DESIGN

2.2.2.1 Road Design

(1) Road Width

The project roads were classified into minor arterial and collector road as shown in the Table 2.2.2-1. With reference to AASHTO and Japanese standards, 3.25 m wide carriageway was proposed for the major arterial roads and 3.05 m for the collector roads. Road width components of the project roads are shown in Figure 2.2.2-1. A 2 m wide footpath was proposed for the road sections used by many pedestrians.

Table 2.2.2-1 Classification of the Project Road

	Ndola City Roads	Kitwe City Roads
Minor Arterial	N3: Makoli Avenu N9: Livingstone Road	K1: Dr. Aggrey Avenue
Collector Road	N1: Vitanda Street N2: Kaunda Drive N4: Independence Way N5: Zambia Road N6: Matelo Road N7: Lukasu Road N8: Chambeshi Road	K2: Euclid Road K3: Zomba Road K4: Blantyre Road K5: Eshowe Road K6: Matuka Avenue K7: Kantanta Street K8: Natwange Road K9: Mutentemuko Road K10: Miseshi Street K11: Kanongesha Road K12: Mulilakwenda Road K13: Lilogwe Road K14: Independence Service Lane

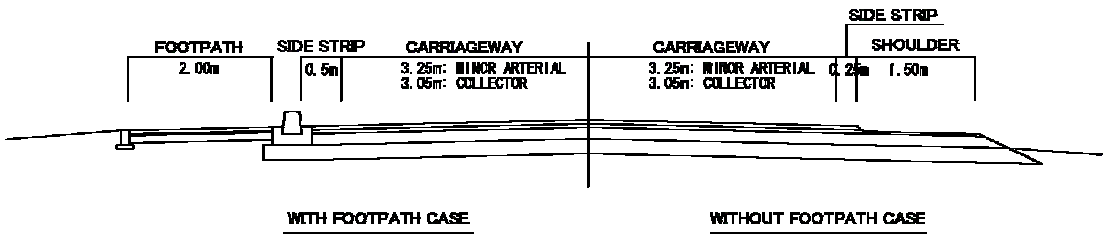


Figure 2.2.2-1 Road Width Components

(2) Road Geometric Design

Geometric standards of the project roads are shown in Table 2.2.2-2. The road alignment was designed to follow the existing roads. The normal crown slope of 2.5 %, which is the standard in Zambia, was proposed. Super-elevation was not considered in the urban sections.

Table 2.2.2-2 Road Geometric Standards

	Minor Arterial	Collector
Carriageway Width (m)	3.25	3.05
Design Speed (km/h)	50	40
Minimum Horizontal Curve (m)	100	60
Minimum Vertical Curve (m)	700	450
Minimum Horizontal Curve Length (m)	80	70
Minimum Vertical Curve Length (m)	40	35
Maximum Slope (%)	6.0	7.0
Minimum Tangent Length of Widening and Super-elevation (m)	40	35

2.2.2.2 Pavement Rehabilitation Plan

(1) Pavement Rehabilitation Method

The existing pavements of the project roads are mostly bituminous surface treatment (approximately 4 cm thick) over cement-mixed-stabilized base course (approximately 10 cm thick) and waste rocks (approximately 20 cm thick). Since the existing pavements are low class and have been badly deteriorated at all sections, rehabilitation of all the sections will be necessary. The following two pavement rehabilitation methods were proposed as shown in Table 2.2.2-3.

Pavement Reconstruction Method

Existing pavement will be completely removed, and then sub-base course, base course and asphalt concrete surface course will be installed after re-compaction on the roadbed. This method will be adopted where the pavement base/sub-base course is badly damaged (the pavement has many potholes or pavements has been completely removed.) or an increase in the pavement elevation with an overlay on the existing pavement is not applicable.

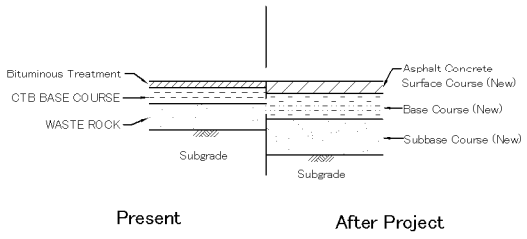
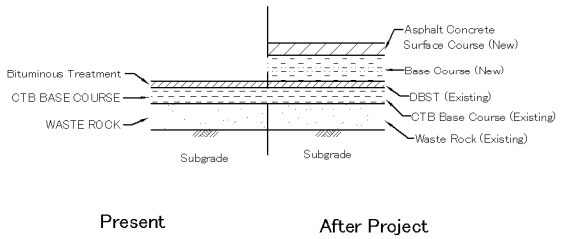
Overlay Method (Utilizing Existing Pavement as Subbase Course)

Base course and asphalt concrete surface course will be overlaid on the existing pavement after filling up potholes and leveling the depressed portions with sub-base course material. This method will be adopted where pavement damage is limited within the surface course (Pavement is cracked but without many potholes) and the rise of the pavement elevation (ranging from 20 to 30 cm) due to overlay is tolerable.

Asphalt overlay (overlaying only asphalt concrete surface course) will not be adopted for the following reasons:

- Asphalt overlay needs about 10 cm thick asphalt concrete surface course to bear against the design traffic load since the existing pavement has low bearing capacity.
- Asphalt overlay needs very thick leveling course with asphalt concrete to form the required road surface alignment because the existing pavement surface is rough.
- Since the existing pavement is narrower than the proposed pavement width, sub-base course and base course are necessary to be widened before the asphalt overlay. Besides, the strength difference between the existing pavement area and the widened area may cause cracks on the overlaid pavement surface.

Table 2.2.2-3 Pavement Rehabilitation Method

Pavement Reconstruction Method	Overlay (Utilizing Exinsting Pavement as Subbase Course)
	

Application of Pavement Rehabilitation Method

Road sections to be rehabilitated with the method of pavement reconstruction or overlay (utilizing existing pavement as sub-base course) are identified on the basis of the pavement

condition survey data which is shown in Appendix 7. The final plan of the application of the rehabilitation method is determined in consideration on continuity of the pavement work, width and slope gaps between existing pavements and the planned pavements and elevation adjustment to intersected roads and access roads and also roadside parking areas. The pavement rehabilitation method by section is shown in Table 2.2.2-4 later.

(2) Pavement Structural Design Data

Data necessary for the pavement structural design was obtained from the following sources:

Design Criteria

AASHTO Guide for Design of Pavement Structures, 1993

Design Period

10 years (2010-2020)

Design Traffic Volume

Traffic survey data obtained in this study is used. Traffic survey data is shown in Appendix 7.

18-kip Equivalent Single Axle Load per Vehicle by Vehicle Type

The 18-kip equivalent single axle load per vehicle by vehicle type was calculated on the basis of the axle load survey data and the axle load equivalency factors provided in AASHTO guide. The Axle load survey of the heavy vehicles along the project roads was conducted by the study team. The calculation of the 18-kip Equivalent Single Axle Load per Vehicle by Vehicle Type is shown in Appendix 7.

18-kip Equivalent Single Axle Load for Design Period

The 18-kip equivalent single axle load for design period by project road was obtained by multiplying 18-kip equivalent single axle load per vehicle by vehicle type and design period traffic volume by type. The 18-kip equivalent single axle load for design period by project road is shown in Appendix 7.

Existing Pavement Structure

The existing pavement structure was surveyed by test pitting at the road shoulders to find out the pavement material conditions and the pavement layers thickness. The existing pavement structures were surveyed at every 500 m along the project roads. The existing pavement structure survey data is shown in Appendix 7.

Sub-grade California Bearing Ratio (CBR)

Samples of the sub-grade (roadbed) soil were taken every 500 m along the project road for a laboratory test. The CBR test results are shown in the Appendix 7.

Pavement Materials

The following materials were selected as the result of comparison in terms of quality, cost, constructability and reliability of the supply capacity.

- Surface course: Asphalt concrete
- Base course: Granular material (CBR>80)
- Sub-base course: Crushed stone (CBR>30)
- Embankment: Excavated soil from roadway or soil from borrow pit (CBR>6)

(3) Calculation of Pavement Thickness for Pavement Reconstruction Case

Calculation Method

The calculation formula and constants are given in AASHTO Guide for Design of Pavement Structures, 1993.

$$Log10(W18)=ZR\times S0+9.36\times Log10(SN+1)-0.20+\{Log10[\triangle PSI/(4.2-1.5)]/[0.40+1094/(SN+1)5.19]\}+2.32\times Log10(MR)-8.07$$

Where,

W18: 18-kip equivalent single axle load for design period by project road
ZR: Standard deviate=0 (when Reliability=50%)
S0: Combined standard error=0.45 (for asphalt pavement)
SN: Structural Number=a1*D1+a2*m2*D2+a3*m3*D3
(a: Layer coefficient、m: Drainage coefficient, D: Layer thickness (inch)
⊿PSI: Po-Pt
P0: Initial design serviceability index=4.2（for asphalt pavement）
Pt: Terminal serviceability index=2.0 (for non-arterial road)
MR: Resilient Modulus=1500*CBR

Layer Coefficient

a1=0.35（Asphalt concrete）
a2=0.13（Granular base course）
a3=0.11（Crushed stone sub-base）

Drainage Coefficient

m2=0.9（Base course with 5-25% saturation duration of fair drainage condition）
m3=0.8（Subbase course with 5-25% saturation duration of fair drainage condition）

Required structural number (SN) of each road was obtained using the above equation. The thicknesses of surface course, base course and sub-base course are proposed to make the proposed pavement SN no less than the required SN. The calculation for the pavement thickness of the project roads are shown in Appendix 7.

(4) Calculation of Pavement Thickness for Overlay (utilizing existing pavement as sub-base course)

The thicknesses of surface course and base course to be overlaid on the existing pavement are proposed to make the proposed pavement SN no less than the required SN. The calculation for the pavement thickness to be overlaid on the existing pavement of the project roads are shown in Appendix 7.

(5) Summary of Pavement Structural Thickness

The summary of the pavement structural thickness is shown in Table 2.2.2-5.

Table 2.2.2-4 Application of Pavement Rehabilitation Method

No.	Road Name	Road Length (km)	Pavement Reconstruction Method		Overlay (Utilizing Existing Pavement as Subbase Course) Method		Remarks
			Section	Length (km)	Section	Length (km)	
N1	Vitanda Street	0.86	0 - 860	0.86	—	—	
N2	Kaunda Drive	0.30	0 - 295	0.30	—	—	
N3	Makoli Avenue	0.88	825 - 880	0.06	0 - 825	0.83	
N4	Independence Way	1.73			0 - 1726	1.73	
N5	Zambia Road	2.54	0 - 700	0.70	700 - 1200	0.50	
			1200 - 1800	0.60	1800 - 2339	0.54	
			0 - 102	0.10	—	—	Branch Rd-1
			0 - 96	0.10	—	—	Branch Rd-2
N6	Matelo Road	0.38	0 - 380	0.38	—	—	
N7	Lukasu Road	1.00	400 - 1000	0.60	0 - 400	0.40	
N8	ChambeshiRoad	4.67	200 - 500	0.30	0 - 200	0.20	
			2780 - 4674	1.89	500 - 2780	2.28	
N9	Livingstone Road	0.38	0 - 375	0.38	—	—	
K1	Dr.Aggrey Avenue	0.99	0 - 993	0.99	—	—	
K2	Euclid Road	0.59	0 - 587	0.59	—	—	
K3	Zomba Road	0.37	0 - 370	0.37	—	—	
K4	Blantyre Road	0.45	0 - 449	0.45	—	—	
K5	Eshowe Road	0.49	0 - 485	0.49	—	—	
K6	Matuka Avenue	0.36	0 - 363	0.36	—	—	
K7	Kantanta Street	2.37	600 - 1100	0.50	0 - 600	0.60	
					1100 - 2371	1.27	
K8	Natwange Road	0.90			0 - 904	0.90	
K9	Mutentemuko Road	1.08	800 - 1075	0.28	0 - 800	0.80	
K10	Miseshi Street	0.91	0 - 913	0.91	—	—	
K11	Kanongesha Road	0.72	0 - 724	0.72	—	—	
K12	Mulilakwenda Road	0.71	0 - 705	0.71	—	—	
K13	Lilogwe Road	0.62	0 - 623	0.62	—	—	
K14	Independence S. L.	1.07	0 - 1069	1.07	—	—	
Total		24.36		14.31	—	10.05	

Table 2.2.2-5 Summary of Pavement Structural Thickness

No.	Road Name	Existing Pavement Reconstruction				Overlay (Utilizing Existing Pavement as Subbase Course)		
		Asphalt Concrete Surface Course	Asphalt Concrete Bider Course	Granular Base Course	Crushed Stone Subbase Course	Asphalt Concrete Surface Course	Asphalt Concrete Bider Course	Granular Base Course
N1	Vitanda Street	5.0	5.0	15.0	25.0	—	—	—
N2	Kaunda Drive	5.0	5.0	15.0	15.0	—	—	—
N3	Makoli Avenue	5.0	5.0	15.0	20.0	5.0	5.0	10.0
N4	Independence Way	5.0	—	15.0	30.0	5.0	—	15.0
N5	Zambia Road	5.0	5.0	10.0	20.0	5.0	5.0	10.0
N6	Matelo Road	5.0	5.0	15.0	20.0	—	—	—
N7	Lukasu Road	5.0	5.0	15.0	20.0	5.0	5.0	15.0
N8	Chambeshi Road	5.0	—	15.0	25.0	5.0	—	15.0
N9	Livingstone Road	5.0	5.0	15.0	20.0	—	—	—
K1	Dr. Aggrey Avenue	5.0	—	15.0	20.0	—	—	—
K2	Euclid Road	5.0	—	10.0	15.0	—	—	—
K3	Zomba Road	5.0	—	10.0	15.0	—	—	—
K4	Blantyre Road	5.0	—	10.0	10.0	—	—	—
K5	Eshowe Road	5.0	—	10.0	15.0	—	—	—
K6	Matuka Avenue	5.0	—	15.0	20.0	—	—	—
K7	Kantanta Street	5.0	—	20.0	25.0	5.0	—	20.0
K8	Natwange Road	5.0	—	15.0	20.0	5.0	—	15.0
K9	Mutentemuko Road	5.0	—	15.0	20.0	5.0	—	15.0
K10	Miseshi Street	5.0	5.0	15.0	15.0	—	—	—
K11	Kanongesha Road	5.0	—	15.0	15.0	—	—	—
K12	Mulilakwanda Road	5.0	—	15.0	20.0	—	—	—
K13	Lilogwe Road	5.0	—	10.0	15.0	—	—	—
K14	Independence Service Lane	5.0	—	15.0	25.0	—	—	—

2.2.2.3 Drainage Facility Design

Installation of drainage ditches was planned where rain water pools on roadside due to lack of drainage facility. Ditches and pipes clogged due to their undersized capacity were planned to be replaced with other ones of larger size. Damaged ditches were planned to be repaired. Buried ditches and pipes due to poor maintenance were planned to be cleaned by removing mud.

Drainage ditches made of stone masonry were planned as the standard type considering the cost, maintenance requirements and constructability and others. Concrete ditches were planned where the construction space is limited. Concrete covered ditches were planned where ditches cross the access roads. Reinforced concrete pipes were used where drainage crosses the roads.

(1) Size of the drainage structure

Drainage structure's sizes were determined on the basis of the rain discharge analysis. However, the small size structures tend to be clogged with mud, so the ditches were designed to be no smaller than 50 cm in width and the pipes were designed to be no smaller than 60 cm in diameter.

Design Rainfall Intensity

The design rainfall intensity was derived by Gambel's method using 10 years rainfall data recorded at Ndola Airport Weather Station which is the nearest weather station from the site. The rainfall data is shown in Appendix 7. The design rainfall intensity is as follows:

- For design ditches: 49.3 mm/h (3-year return period)
- For design cross pipes: 64.7 mm/h (5-year return period)

Calculation of Discharge

The project road drainage system map which was prepared on the basis of the topographic map and the site survey is shown in Appendix 7. The discharge at the check points (the most downstream point and merge point of ditches/pipes) were calculated using Rational Formula as below:

$$Q = 1/3.6 \times A \times C \times I$$

Where, Q: Discharge (m3/sec)
A: Catchment area (km2)
C: Runoff coefficient (Road=0.8, Commercial area=0.8, Residence area=0.6, Industrial area=0.7)
I: Rainfall intensity (mm/h)

Calculation of the discharge is shown in Appendix 7.

Calculation of Required Drainage Facility Size

The velocity and the water depths of the design discharge at the check points were calculated using the following Manning formula. The drainage ditch and pipe size were planned to have about 20% additional dischargeable capacity.

$$V = 1/n \times R^{(2/3)} \times I^{(1/2)}$$

Where, V: Velocity (m/sec)
n: roughness coefficient (Concrete pipe= 0.013, Concrete ditch= 0.015, Stone masonry ditch= 0.025)
R: Hydraulic mean depth (Discharge sectional area / Wetted perimeter)
I: Slope of ditch

The velocity should be maintained at 0.6～3.0 m/sec for concrete ditches/pipes and 0.6～2.0 m/sec for stone masonry ditch. The stone masonry ditch inner surface will be roughened where the velocity would be faster than this or the slope will be gentled by providing stairs along the ditches. The roughness coefficient will be 0.03 in case the stone masonry ditch has rough surface. The velocities and depths at check points are shown in Appendix 7.

(2) Countermeasures to avoid conflicts with underground utilities

Power cables, telephone cable, water pipes and sewer pipes exist along the project roads. The sewer pipes seldom conflict with the planned drainage structures since the sewer pipes are deeper than 1.5 m from the surface. However, power cables, telephone cables and water pipes are about 60 cm deep from the surface (High voltage power cable is about 1 m deep.), while the depths of drainage ditches and pipes vary from 80 to 95 cm from the surface. The conflicts can be avoided by shifting the ditch locations where ditches are planned to be installed parallel to the utilities. However, the utilities are required to be relocated downward where drainage structures are planned to be installed across the utilities. Otherwise, the utilities should be relocated upward and to be provided with protection devices. The relocation of the underground utilities should be undertaken by the Zambian side. The underground utility location map indicating probable conflict spots are shown in Appendix 8.

2.2.2.4 Box Culvert Design

A small bridge (4 m wide, 6 m long) on Dr. Aggrey Avenue across Kitwe Stream is damaged. It was planned to be replaced with a reinforced concrete box culvert.

(1) Box Culvert Dimension Design

The width of the box culvert was planned to be 10 m since the river width at the site is around 10 m. Three-barrel-box type was planned since no large size debris or trees flow down from the upstream. The height was planned to provide a 70 cm freeboard above the maximum flood

level. The thickness of the slabs and walls were planned on the basis of the structural calculation. The wheel load as specified in British Standard was used for the structural design.

(2) Box Culvert Foundation Design

The subsoil under the box culvert was surveyed using portable cone penetration tester. The surface is a 1.5 m thick soft soil over boulders or bed rock. The surface soft soil was planned to be replaced with crushed stones.

2.2.2.5 Ancillary Road Facility Design

(1) Road Safety Facilities

The following facilities which are necessary for road safety were planned to be installed:

- Sign board ("Stop", "Intersection ahead", "Sharp curve ahead", "Crosswalk ahead")
- Centerline and edge lines
- Road markings (Crosswalk, Stop line, Left/right turn arrow)
- Humps (at schools and hospitals)

(2) Access ways

Access ways connecting the project roads to the roadside houses and factories will be excavated for installation of drainage ditches. The areas of the access ways affected by the excavation were planned to be restored using low class pavement (3 cm thick asphalt concrete) or crushed stone surfacing (10cm thick).

(3) Footpath

Footpaths were planned to be attached to the project roads where there is a large traffic of pedestrians. The footpaths were planned with pre-cast tile (50 cm x 50 cm) surfacing which is common in Zambia. Concrete kerbs were planned to be installed between the footpath and the carriageway for the safety of pedestrians. Edge blocks were planned to be installed at the edge of the footpath to prevent it from erosion. Sodding was planned on the embankment slopes for footpaths.

(4) Road Shoulder Surfacing

Road shoulders were planned to be surfaced with 3 cm thick asphalt concrete for the convenience of pedestrians to walk and vehicles to stop and also for prevention from erosion.

(5) Improvement of Intersections

Left turn lane was planned to be provided for the following intersections since the traffic jams frequently occur there.

- Makoli Avenue across Nkana Drive (National Road No.3)
- Independence Way across Nkana Drive (National Road No.3)

- Dr. Aggrey Avenue across Chibuluma Road

The intersection of Matelo Road and President Avenue frequently experiences traffic accidents. One of the major reasons for the accidents is that the intersection is too wide hereby posing conflicts and confusion among different traffic flows. As a countermeasure, a traffic island was planned to be installed in the intersection.

(6) Bus Stop

Chambishi Road and Matuka Avenue are bus routes. The roads were planned to be widened to provide a large space for bus stops.

2.2.3 BASIC DESIGN DRAWINGS

Basic Design Drawings are shown in the following pages.
The components of the Japanese assistance are shown in Table 2.2.3-1.

Table 2.2.3-1 Components of Japanese Assistance

Component	Specification	Quantity
Road Length	Ndola City (12.73 km)、Kitwe City (11.63 km)	24.36 km
Pavement Work	Asphalt Concrete Surface Course (T=50mm, Ave. Width= 7.9m)	192,012 ㎡
	Asphalt Concrete Binder Course (T=50mm, Ave. Width= 7.9m)	60,355 ㎡
	Granular Base Course (T=100mm～200mm, Ave. Width=9.9m)	239,536 ㎡
	Crushed Stone Subbase Course (T=100mm～300mm, Ave. Width=9.9m)	205,538 ㎡
Road Shoulder Surfacing	Asphalt Concrete Surface Course (T=30mm, Ave. Width=1.25m)	45,211 ㎡
Footpath Surfacing	Precast Tile (50cm x 50cm) Surfacing (Width=2.0m))	6,907 ㎡
	Crushed Stone Subbase Course (T=100mm～150mm, Width=2.0m)	7,196 ㎡
Access Way Surfacing	Asphalt Concrete Surface Course (T=30mm) + Subbase Course (T=150mm)	467 Spot
	Crushed Stone Surfacing (T=100mm)	467 Spot
Drainage Structures	Stone Masonry Ditch (Bottom Width=500～1200mm)	21,688 m
	U-Shape Concrete Ditch (Bottom Width=500～1200mm)	10,990 m
	L-Shape / Rolled Gutter Ditch	3,881 m
	Cross Pipe (Diameter=600～1200mm)	1167 m
Box Culvert	3-Barrel Box (Width=10m (3+4+3) x Height=3.5m x Width=13.1m)	1 Site
Kerbs	Concrete Kerb (Barrier Type)	4,152 m
	Edge Block	3,602 m
Sign Boards		179 Each
Lane Marking	Centerline, Edge Line	68.36 km
Road Marking	Crosswalk, Stop Line, Left/Right Turn Arrows	217 Spot
Hump		6 Spot

BASIC DESIGN STUDY

ON

THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS

IN

THE REPUBLIC OF ZAMBIA

DRAWINGS

JAPAN INTERNATIONAL COOPERATION AGENCY

DRAWING INDEX

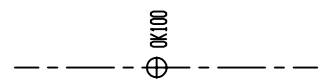
ABBREVIATIONS

AC	Asphalt Concrete
Ave.	Average
ACW-A～F	Access Way-Type
BOULDERS-DIC-L	Boulders for Drain Discharge-Large
BOULDERS-DIC-S	Boulders for Drain Discharge-Small
BC	Begining of Curve
BP	Begining Point
CB-DGL	Catch Basin for L-Shaped Gutter Ditch
CB-DGR	Catch Basin for Rolled Gutter Ditch
CB-Pnum.	Catch Basin-Pipe diameter
DC-num.	Concrete Ditch-Bottom Width
DC-num.-C	Concrete Ditch-Bottom Width-With Cover
DC-num.L-C	Covered Concrete Ditch-Bottom Width Large
DG-L	Gutter Ditch L-Shaped
DG-LS	Gutter Ditch L-Shaped Traffic Passable
DG-R	Rolled Gutter
DM-num.	Masonry Ditch-Bottom Width
DM-num.-C	Covered Masonry Ditch-Bottom Width
DM-num.-H	High Masonry Ditch-Bottom Width
DM-num.-L	Low Masonry Ditch-Bottom Width
DM-num.-V	Hight Variable Masonry Ditch-Bottom Width
DP-num.A～D	Drainage Pipe-Diameter Type A～D
EC	End of Curve
EP	End Point
FP-A	Footpath Type A (Precast Panel)
FP-B	Footpath Type B (Precast Block)
HWC	Concrete Head Wall
HWM	Masonry Head Wall
∞	Infinity
KERB-alphabet	Kerb Type
L	Length of Elements of Alignment
MH	Man hole
PVC-num.	PVC Pipe-Diameter
R	Radius of Curvature
SLAB	Precast Slab

SYMBOLS

Project Road

Project Road (Out of Limits)

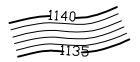


Center Line of Proposed Road

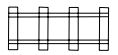
Point of Intersection

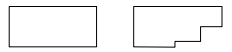
Existing Road Edge

Fence



Contour Lines


Rail Road


Buildings (Houses, Shops, Factories, Offices)

Gasoline Stand


Tree

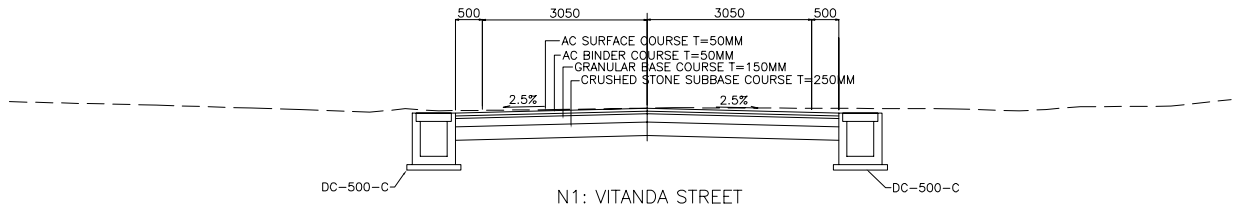

Street Light

Electric Pole

Telephone Pole

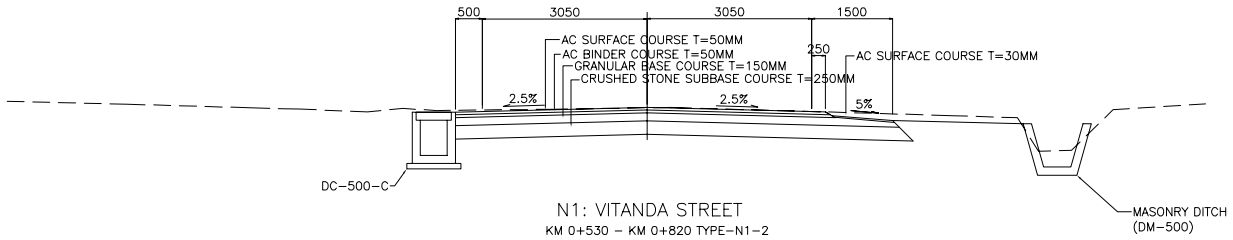
Man hole

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	ABBREVIATION AND SYMBOLS / ALL DRAWINGS	SCALE / NONE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONAL / JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO / 0



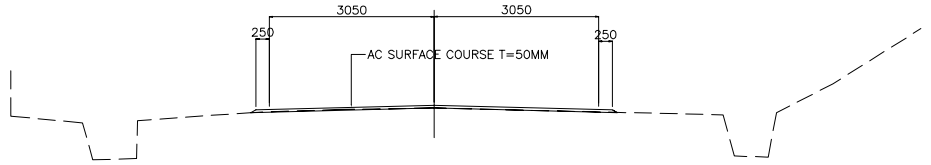
N1: VITANDA STREET

KM 0+000 – KM 0+530: TYPE–N1–1



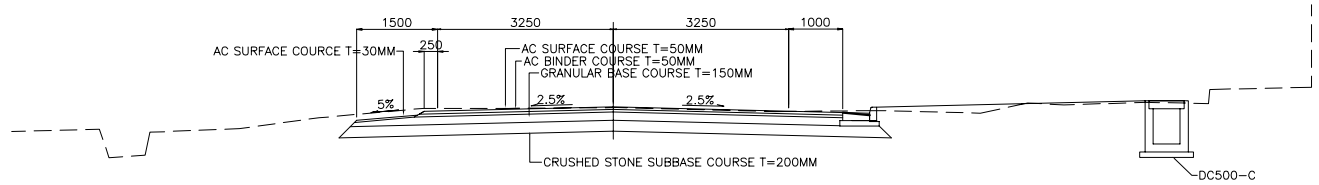
N1: VITANDA STREET

KM 0+530 – KM 0+820 TYPE–N1–2



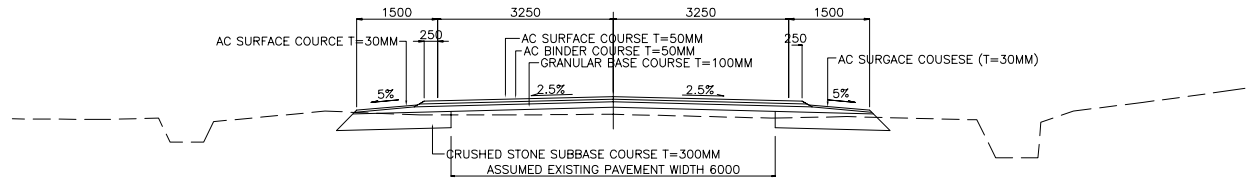
N1: VITANDA STREET

KM 0+820 – KM 0+859.180: TYPE–N1–3



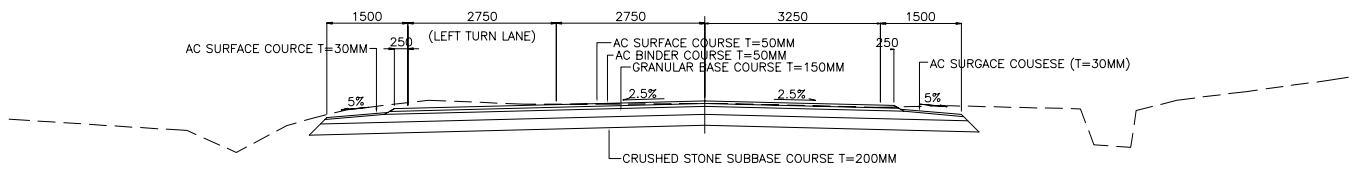
N3: MAKORI AVENUE

KM 0+193– KM 0+300: TYPE–N3–2



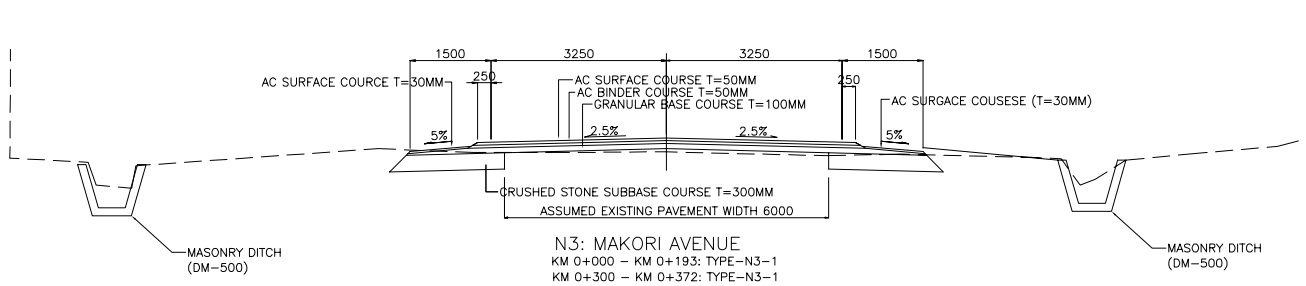
N3: MAKORI AVENUE

KM 0+372– KM 0+825: TYPE–N3–3



N3: MAKORI AVENUE

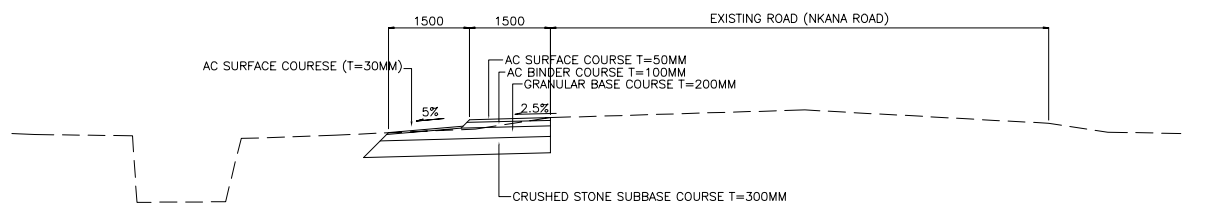
KM 0+825 – KM 0+880.641: TYPE–N3–4



N3: MAKORI AVENUE

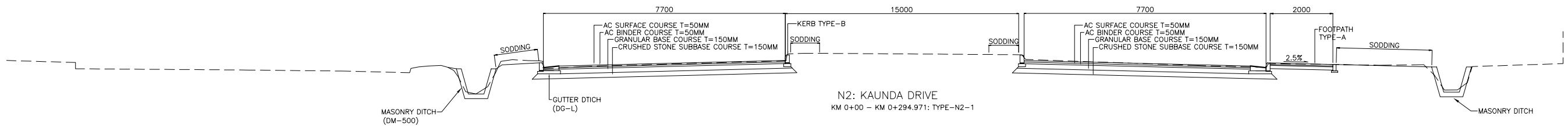
KM 0+000 – KM 0+193: TYPE–N3–1

KM 0+300 – KM 0+372: TYPE–N3–1



N3: MAKORI AVENUE

WIDENING OF INTERSECTION: TYPE –N3–5



N2: KAUNDA DRIVE

KM 0+00 – KM 0+294.971: TYPE–N2–1

MOTE:
1. CONSTRUCTION OF DRAINAGE STRUCTURES ARE NOT NECESSARY WHERE EXISTING ONES ARE IN FAIR CONDITION.
2. DRAINAGE STRUCTURE'S LOCATIONS AND SIZES FOR CONSTRUCTION ARE INDICATED IN THE PLANS.
3. REMOVAL OF EXISTING DRAINAGE STRUCTURES ARE INDICATED IN THE SEPARATE TABLE.
4. REMOVAL OF THE EXISTING PAVEMENT SHALL BE UNDER ITEM CLEARING AND GRUBBING.
5. CONTRACTOR SHALL IDENTIFY LOCATION OF UNDERGROUND UTILITIES PRIOR TO EXCAVATION AND AVOID DAMAGE OF THEM. ANY DAMAGE OF UTILITY IS THE RESPONSIBILITY OF CONTRACTOR.

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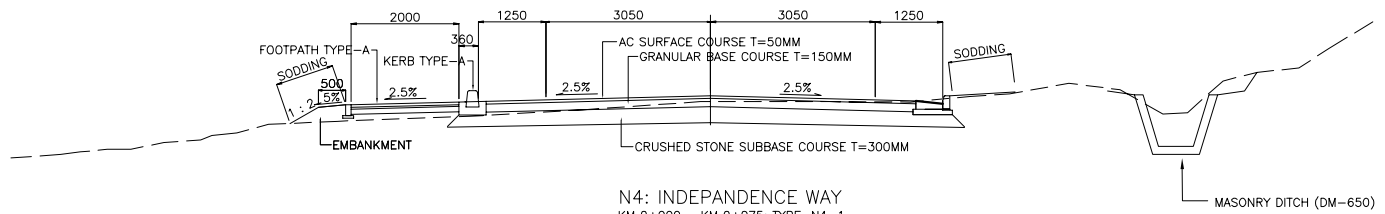
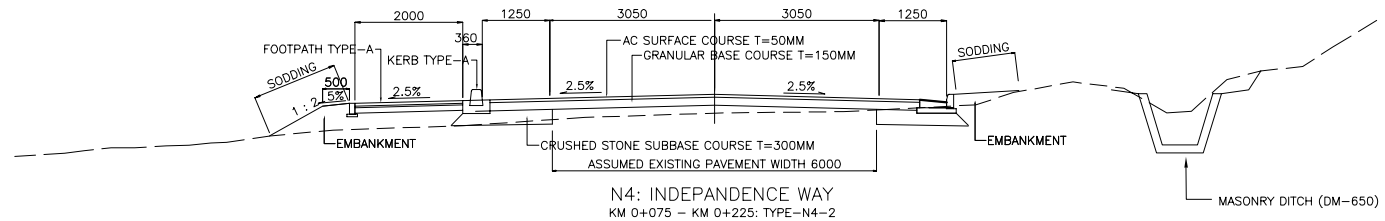
			NDOLA CITY ROADS (1)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		TY– 1



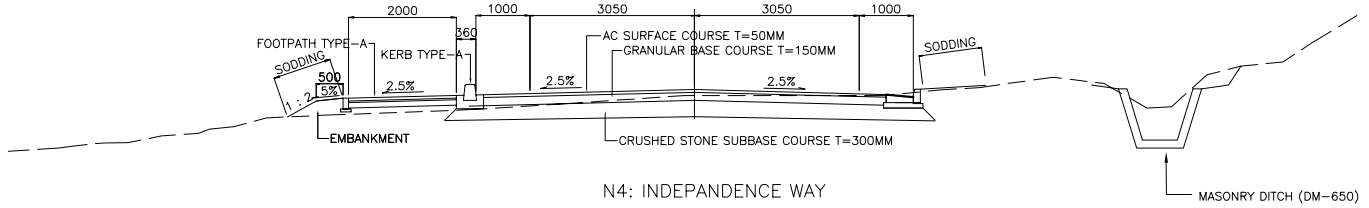
N4: INDEPANDENCE WAY

KM 0+000 – KM 0+075: TYPE-N4-1
KM 0+225 – KM 0+325: TYPE-N4-1
KM 0+525 – KM 0+600: TYPE-N4-1
KM 0+800 – KM 0+975.3: TYPE-N4-1



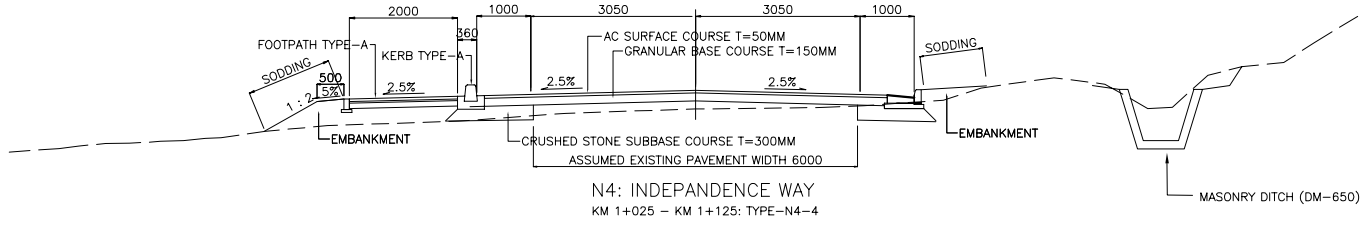
N4: INDEPANDENCE WAY

KM 0+075 – KM 0+225: TYPE-N4-2
KM 0+325 – KM 0+525: TYPE-N4-2
KM 0+600 – KM 0+800: TYPE-N4-2



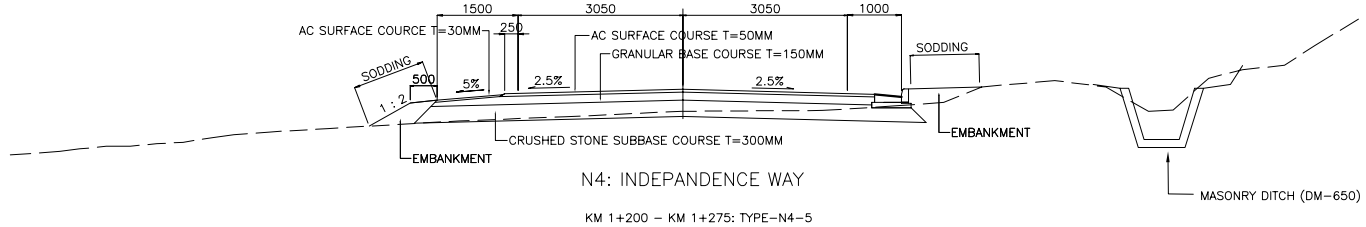
N4: INDEPANDENCE WAY

KM 0+975.3 – KM 1+025: TYPE-N4-3
KM 1+125 – KM 1+200: TYPE-N4-3



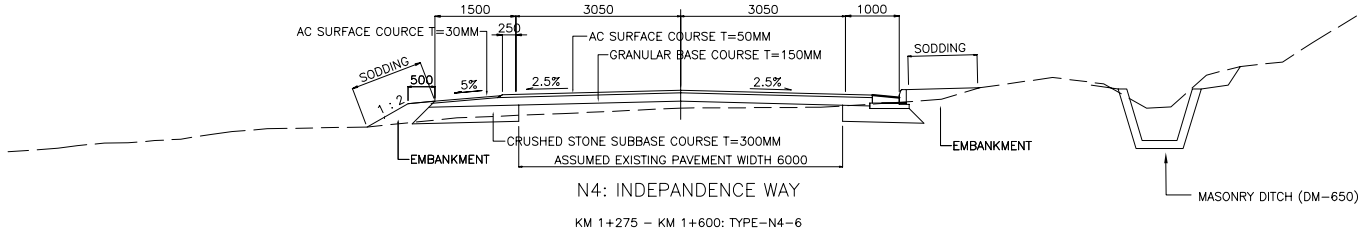
N4: INDEPANDENCE WAY

KM 1+025 – KM 1+125: TYPE-N4-4



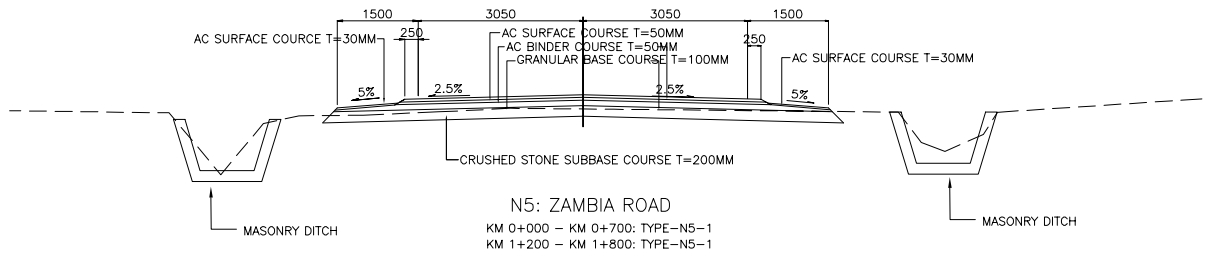
N4: INDEPANDENCE WAY

KM 1+200 – KM 1+275: TYPE-N4-5
KM 1+600 – KM 1+726.3: TYPE-N4-5



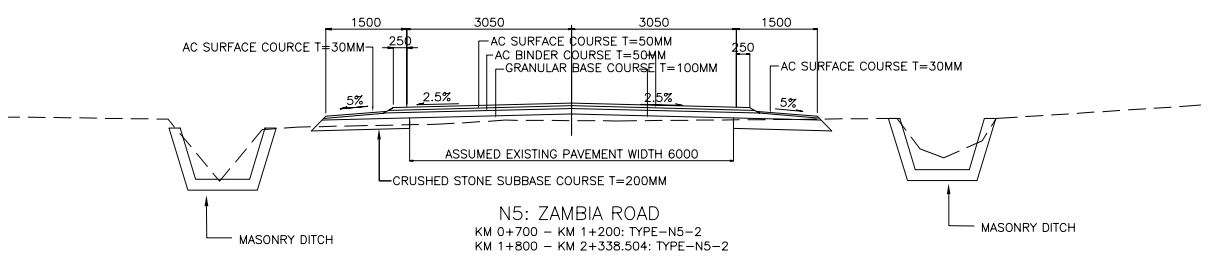
N4: INDEPANDENCE WAY

KM 1+275 – KM 1+600: TYPE-N4-6



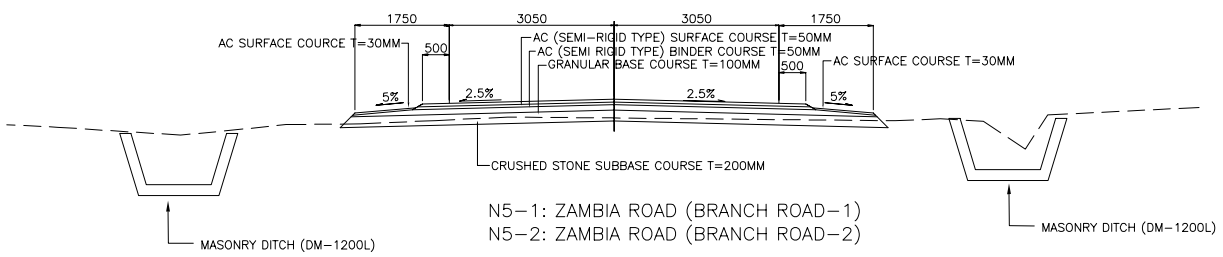
N5: ZAMBIA ROAD

KM 0+000 – KM 0+700: TYPE-N5-1
KM 1+200 – KM 1+800: TYPE-N5-1



N5: ZAMBIA ROAD

KM 0+700 – KM 1+200: TYPE-N5-2
KM 1+800 – KM 2+338.504: TYPE-N5-2



N5-1: ZAMBIA ROAD (BRANCH ROAD-1)
N5-2: ZAMBIA ROAD (BRANCH ROAD-2)

K1: KM 0+000 – KM 0+102.243: TYPE-N5-3
K2: KM 0+000 – KM 0+096.348: TYPE-N5-3

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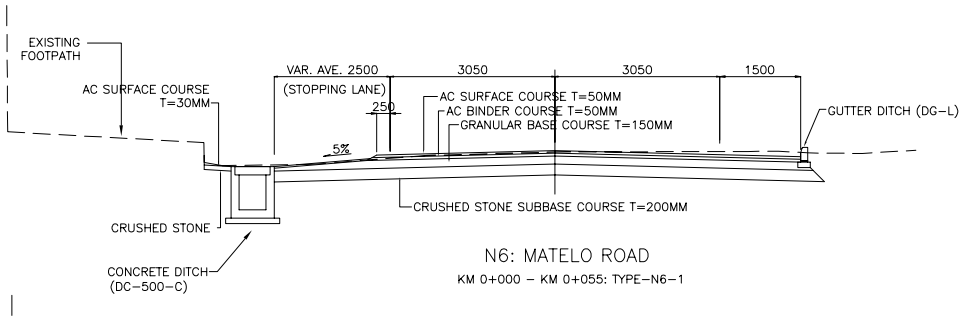
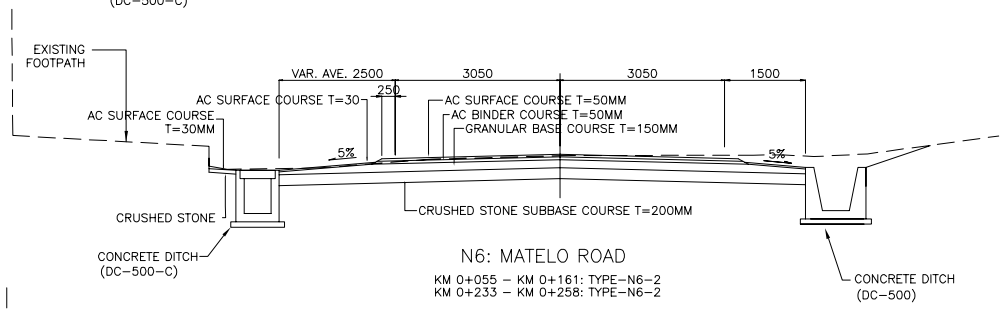
			NDOLA CITY ROADS (2)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED

DATE	SHEET NO
	TY-2



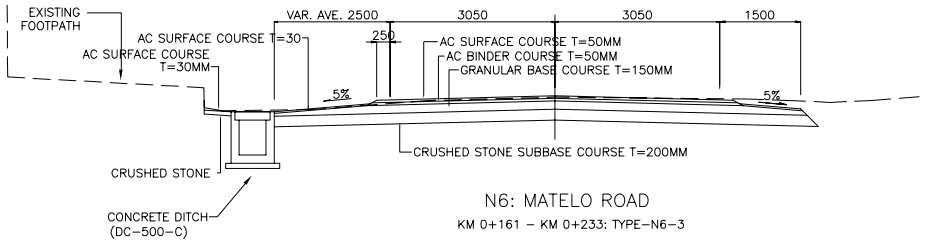
N6: MATELO ROAD

KM 0+000 – KM 0+055: TYPE–N6–1



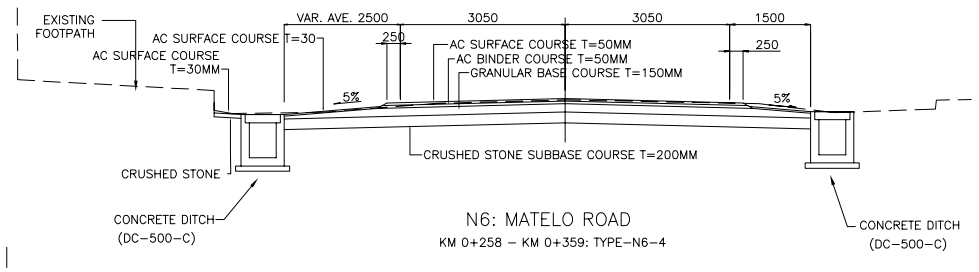
N6: MATELO ROAD

KM 0+055 – KM 0+161: TYPE–N6–2
KM 0+233 – KM 0+258: TYPE–N6–2



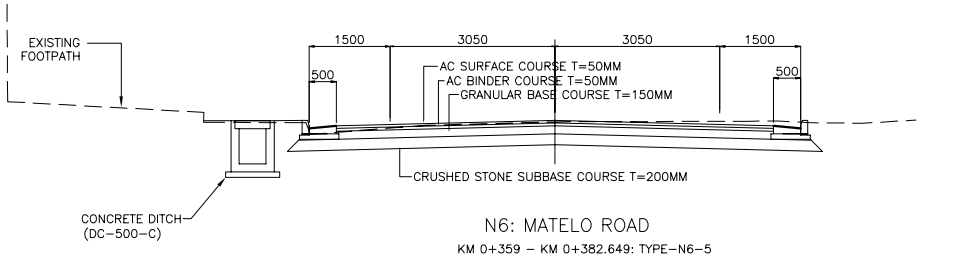
N6: MATELO ROAD

KM 0+161 – KM 0+233: TYPE–N6–3



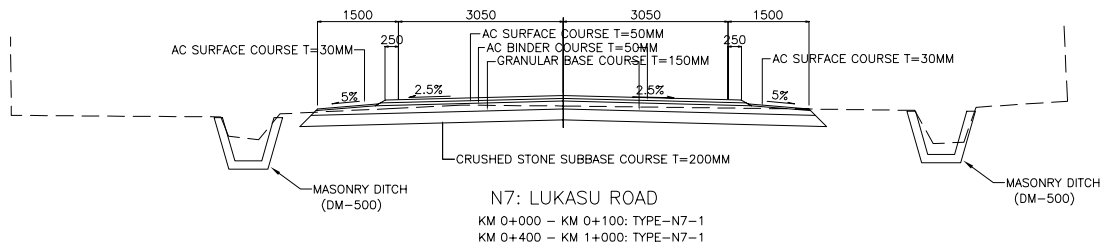
N6: MATELO ROAD

KM 0+258 – KM 0+359: TYPE–N6–4



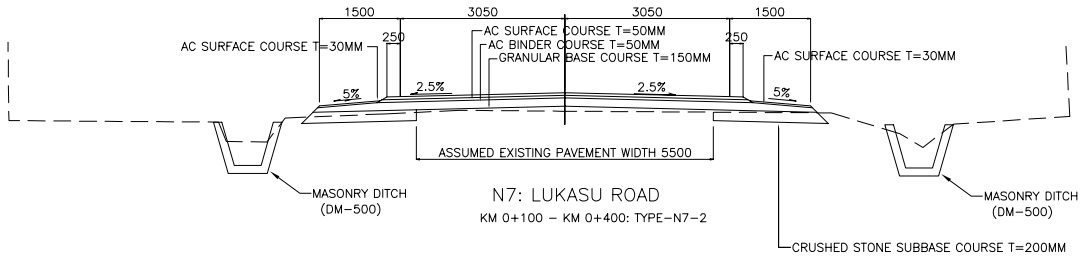
N6: MATELO ROAD

KM 0+359 – KM 0+382.649: TYPE–N6–5



N7: LUKASU ROAD

KM 0+000 – KM 0+100: TYPE–N7–1
KM 0+400 – KM 1+000: TYPE–N7–1

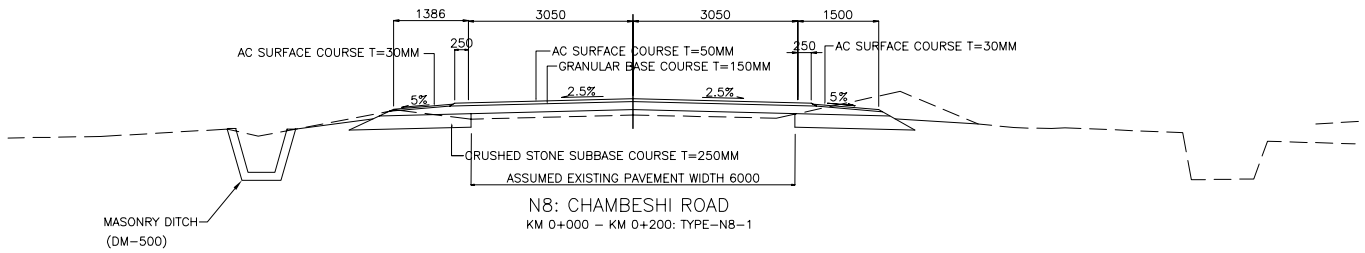


N7: LUKASU ROAD

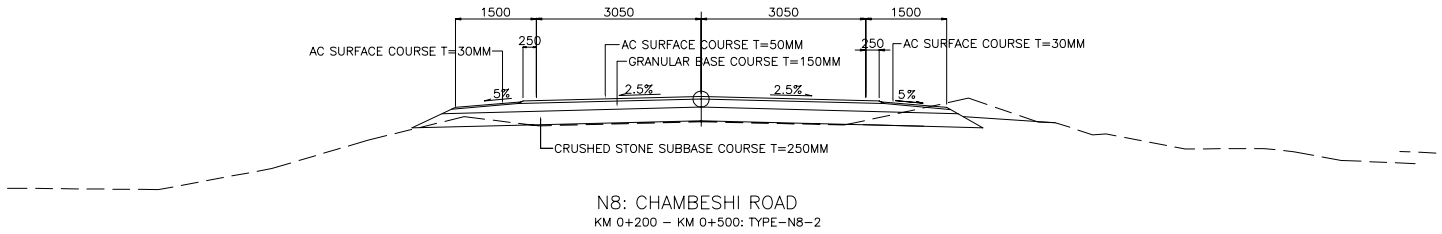
KM 0+100 – KM 0+400: TYPE–N7–2

2-22

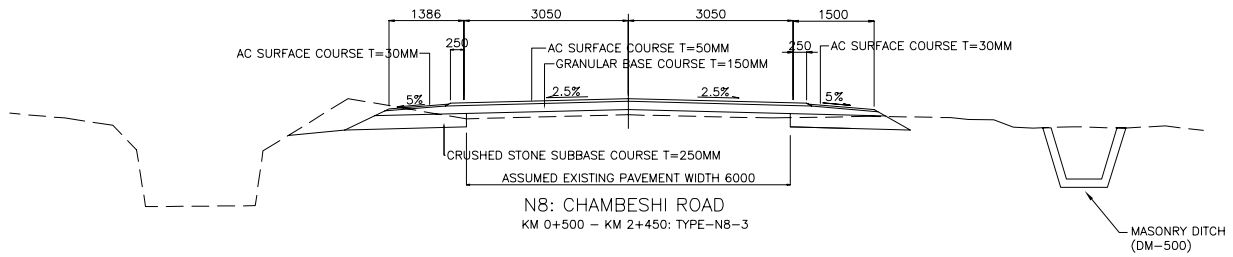
MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TYPICAL CROSS SECTIONS	SCALE		APPROVED	KATAHIRA & ENGINEERS INTERNATIOANL JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED	DATE	SHEET NO
			NDOLA CITY ROADS (3)	S=1:70		DATE		SUBMITTED		TY–3



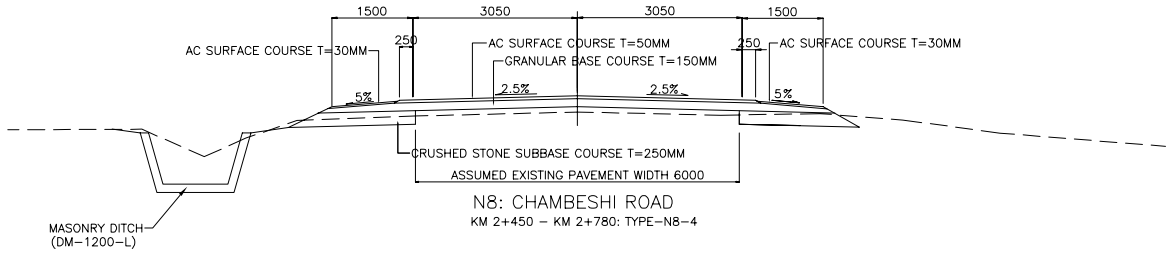
N8: CHAMBESHI ROAD
KM 0+000 – KM 0+200: TYPE–N8–1



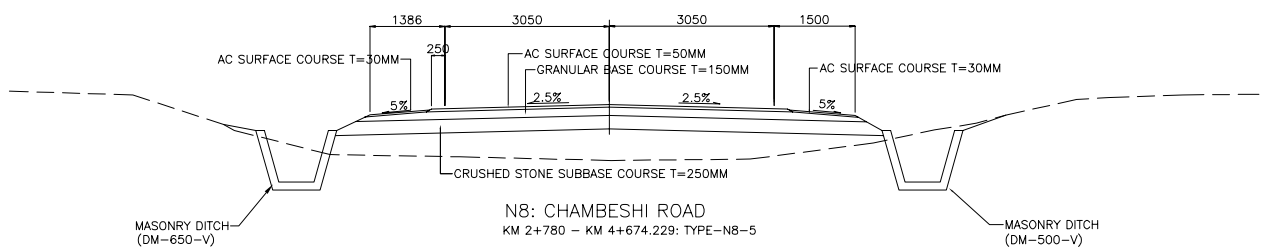
N8: CHAMBESHI ROAD
KM 0+200 – KM 0+500: TYPE–N8–2



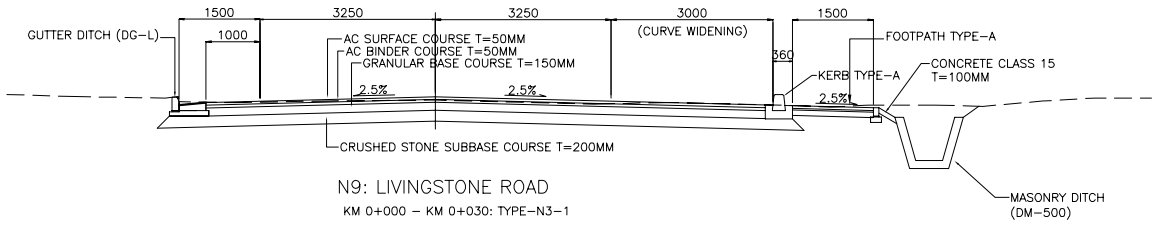
N8: CHAMBESHI ROAD
KM 0+500 – KM 2+450: TYPE–N8–3



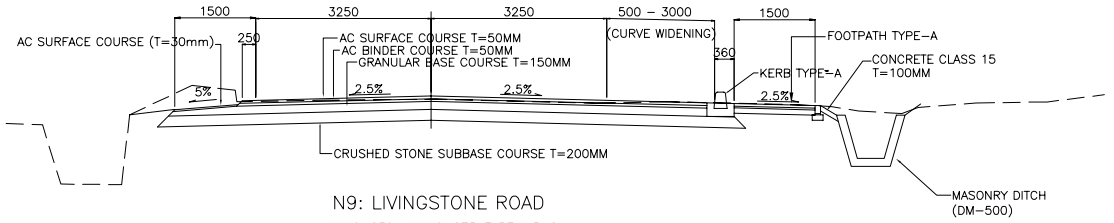
N8: CHAMBESHI ROAD
KM 2+450 – KM 2+780: TYPE–N8–4



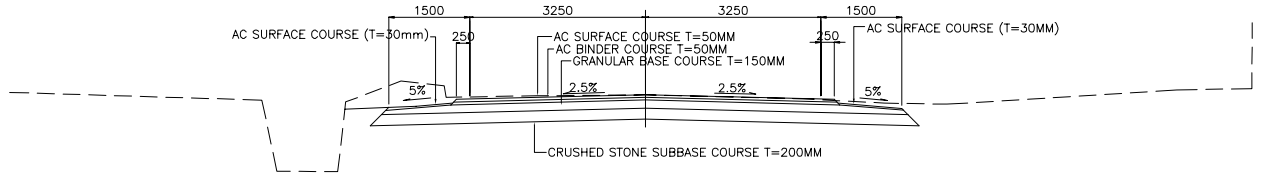
N8: CHAMBESHI ROAD
KM 2+780 – KM 4+674.229: TYPE–N8–5



N9: LIVINGSTONE ROAD
KM 0+000 – KM 0+030: TYPE–N3–1

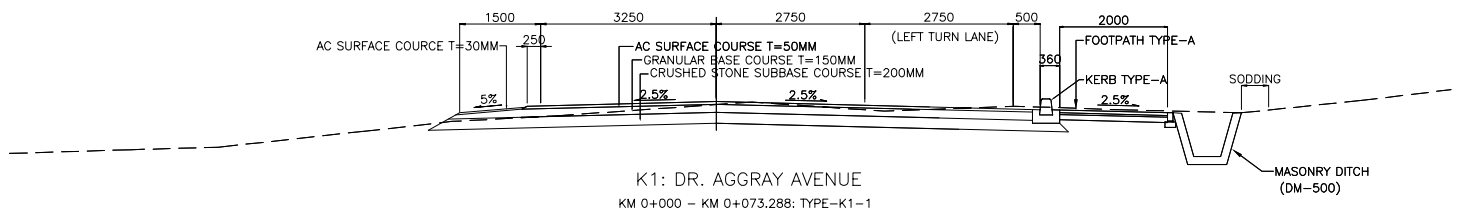


N9: LIVINGSTONE ROAD
KM 0+030 – KM 0+075: TYPE–N3–2



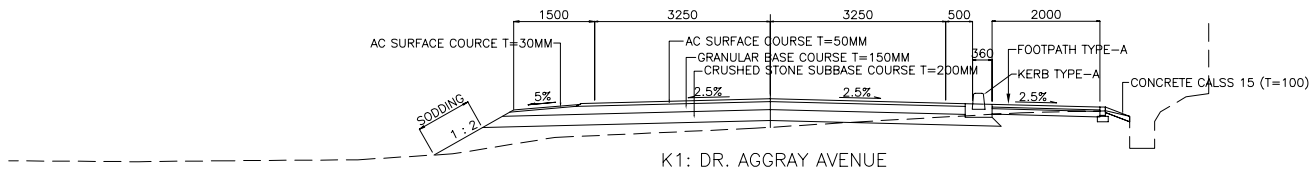
N9: LIVINGSTONE ROAD
KM 0+075 – KM 0+375: TYPE–N3–3

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TYPICAL CROSS SECTIONS	SCALE		APPROVED	KATAHIRA & ENGINEERS INTERNATIOANL	PREPARED CHECKED	DATE	SHEET NO
			NDOLA CITY ROADS (4)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		TY–4



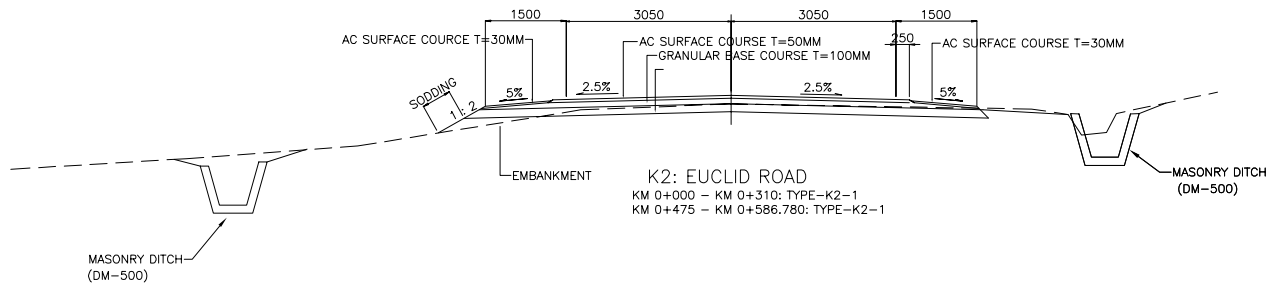
K1: DR. AGGRAY AVENUE

KM 0+000 – KM 0+073.288: TYPE–K1–1



K1: DR. AGGRAY AVENUE

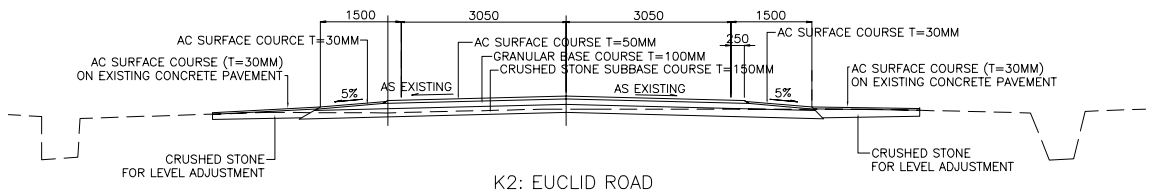
KM 0+073.288 – KM 0+992.684: TYPE–K1–2



K2: EUCLID ROAD

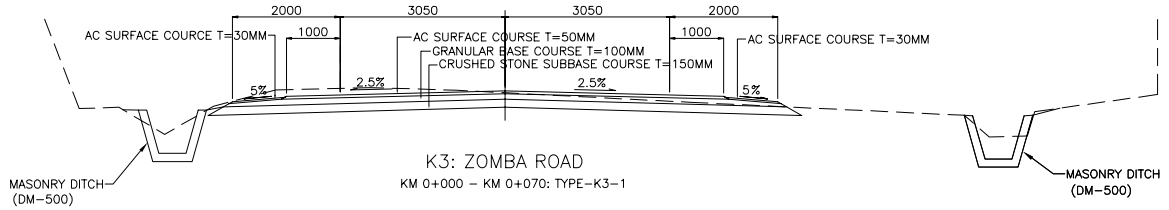
KM 0+000 – KM 0+310: TYPE–K2–1

KM 0+475 – KM 0+586.780: TYPE–K2–1



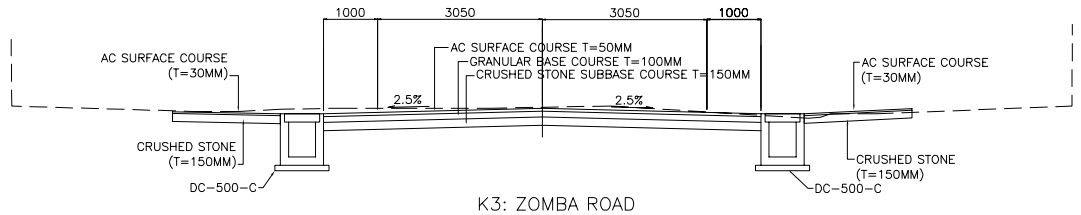
K2: EUCLID ROAD

KM 0+310 – KM 0+475: TYPE–K2–2



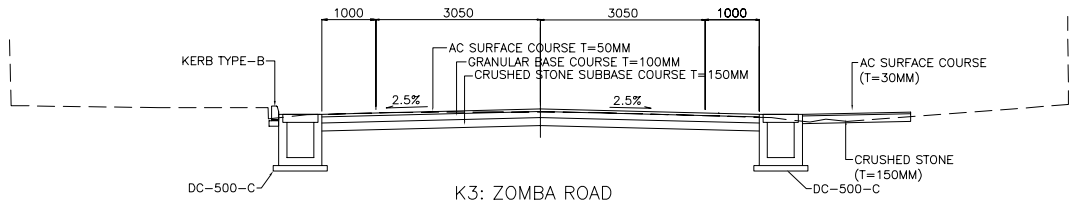
K3: ZOMBA ROAD

KM 0+000 – KM 0+070: TYPE–K3–1



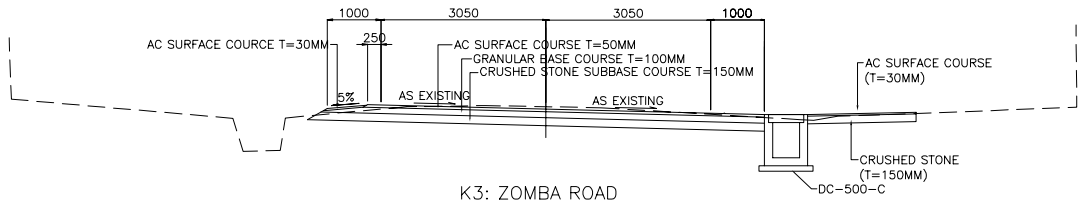
K3: ZOMBA ROAD

KM 0+070 – KM 0+185: TYPE–K3–2



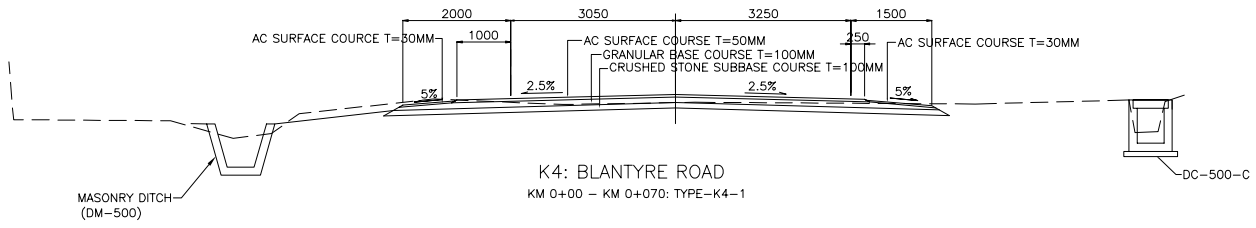
K3: ZOMBA ROAD

KM 0+185 – KM 0+240: TYPE–K3–3



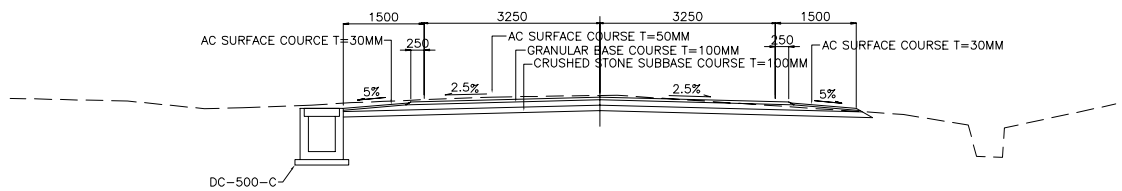
K3: ZOMBA ROAD

KM 0+240 – KM 0+369.743: TYPE–K3–4



K4: BLANTYRE ROAD

KM 0+00 – KM 0+070: TYPE–K4–1



K4: BLANTYRE ROAD

KM 0+070 – KM 0+448.884: TYPE–K4–2

MOTE:
1. CONSTRUCTION OF DRAINAGE STRUCTURES ARE NOT NECESSARY WHERE EXISTING ONES ARE IN FAIR CONDITION.
2. DRAINAGE STRUCTURE'S LOCATIONS AND SIZES FOR CONSTRUCTION ARE INDICATED IN THE PLANS.
3. REMOVAL OF EXISTING DRAINAGE STRUCTURES ARE INDICATED IN THE SEPARATE TABLE.
4. REMOVAL OF THE EXISTING PAVEMENT SHALL BE UNDER ITEM CLEARING AND GRUBBING.
5. CONTRACTOR SHALL IDENTIFY LOCATION OF UNDERGROUND UTILITIES PRIOR TO EXCAVATION AND AVOID DAMAGE OF THEM. ANY DAMAGE OF UTILITY IS THE RESPONSIBILITY OF CONTRACTOR.

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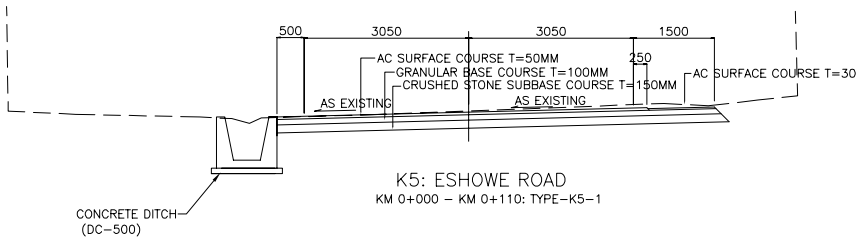
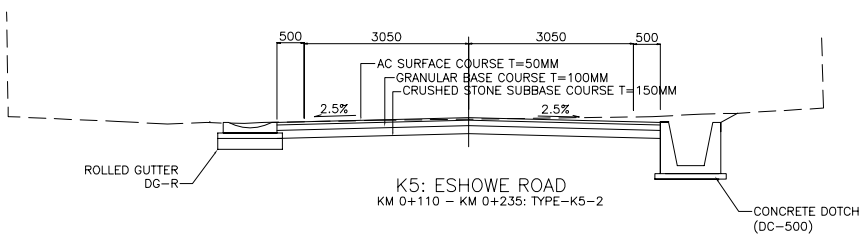
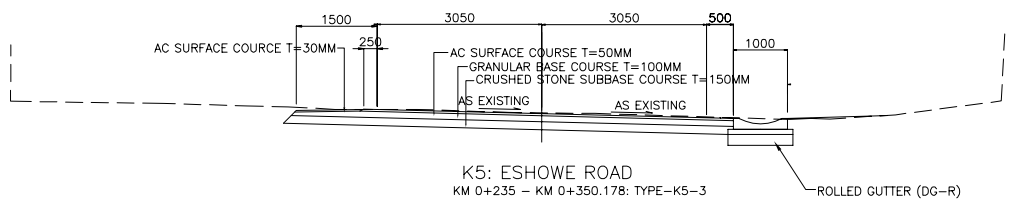
			KITWE CITY ROADS (1)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		TY–5



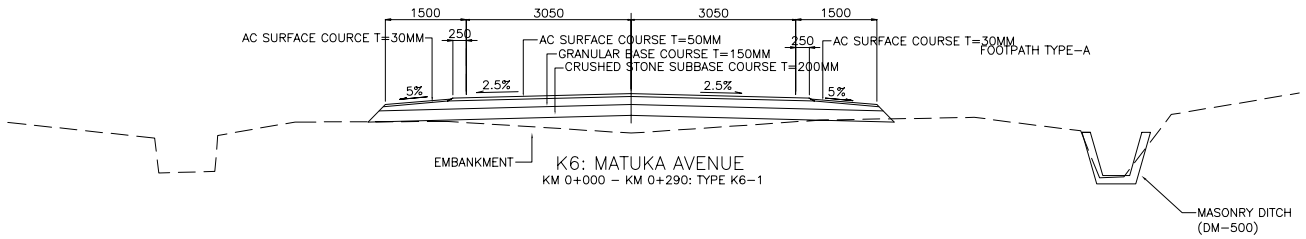
K5: ESHOWE ROAD
KM 0+000 – KM 0+110: TYPE-K5-1



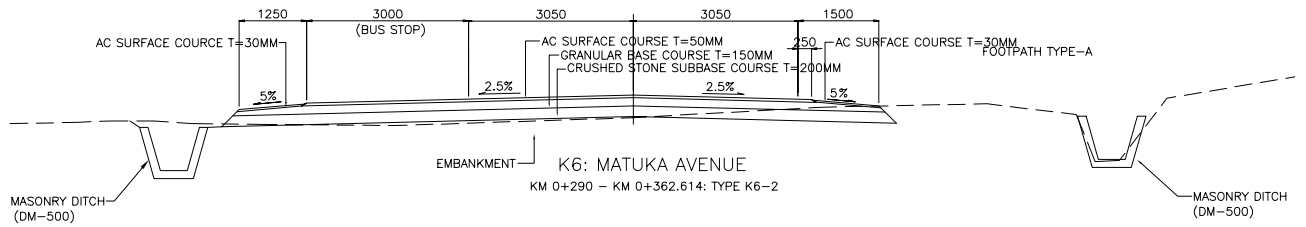
K5: ESHOWE ROAD
KM 0+110 – KM 0+235: TYPE-K5-2



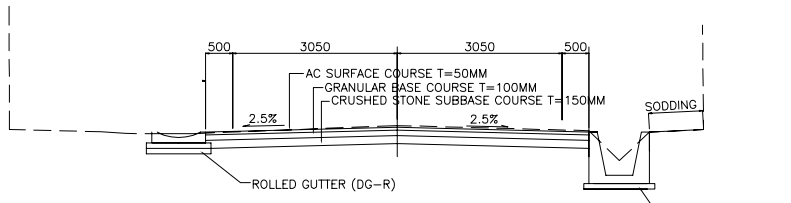
K5: ESHOWE ROAD
KM 0+235 – KM 0+350.178: TYPE-K5-3



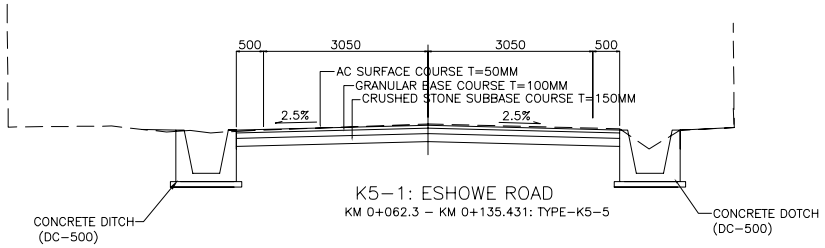
K6: MATUKA AVENUE
KM 0+000 – KM 0+290: TYPE K6-1



K6: MATUKA AVENUE
KM 0+290 – KM 0+362.614: TYPE K6-2

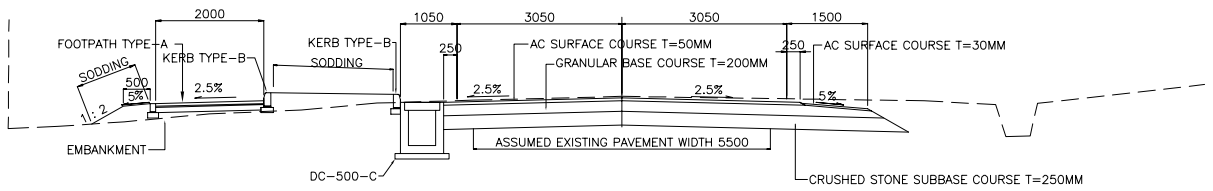


K5-1: ESHOWE ROAD
KM 0+000 – KM 0+062.3: TYPE-K5-4



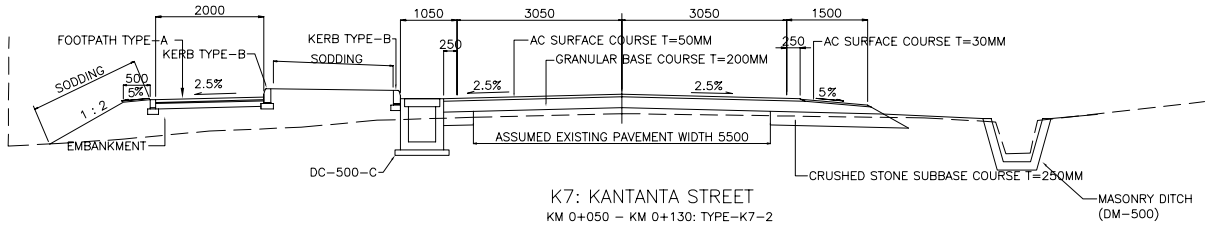
K5-1: ESHOWE ROAD
KM 0+062.3 – KM 0+135.431: TYPE-K5-5

MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TYPICAL CROSS SECTIONS	SCALE		APPROVED	KATAHIRA & ENGINEERS INTERNATIOANL	PREPARED CHECKED	DATE	SHEET NO
			KITWE CITY ROADS (2)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		TY-6



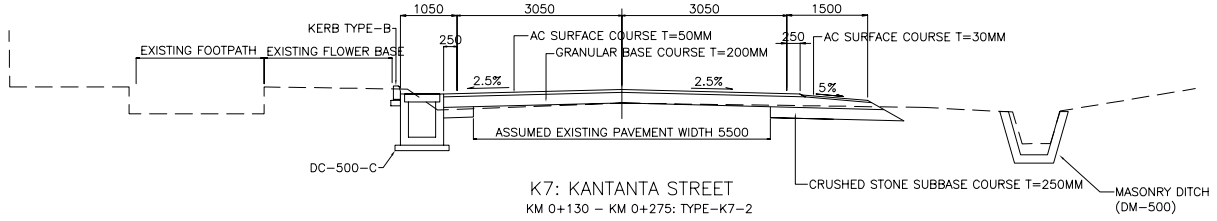
K7: KANTANTA STREET

KM 0+000 – KM 0+050: TYPE-K7-1



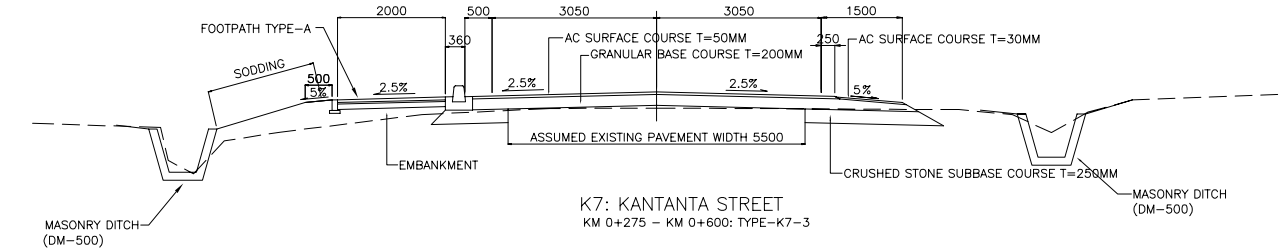
K7: KANTANTA STREET

KM 0+050 – KM 0+130: TYPE-K7-2



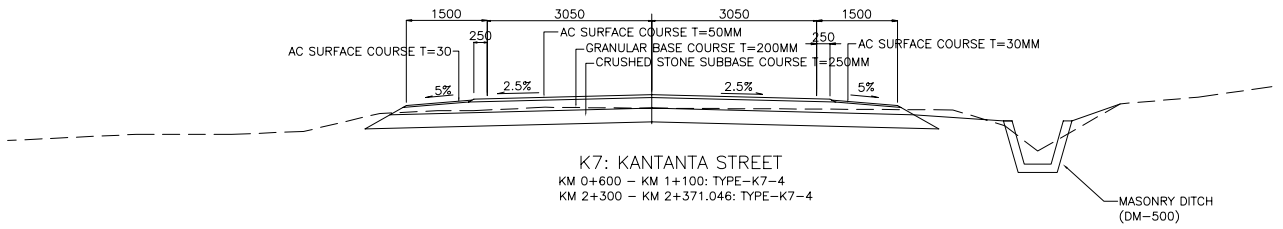
K7: KANTANTA STREET

KM 0+130 – KM 0+275: TYPE-K7-2



K7: KANTANTA STREET

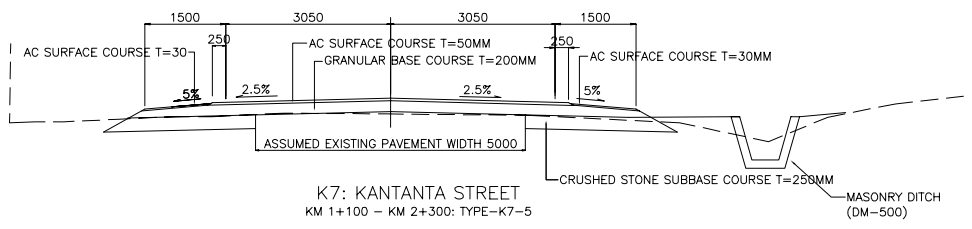
KM 0+275 – KM 0+600: TYPE-K7-3



K7: KANTANTA STREET

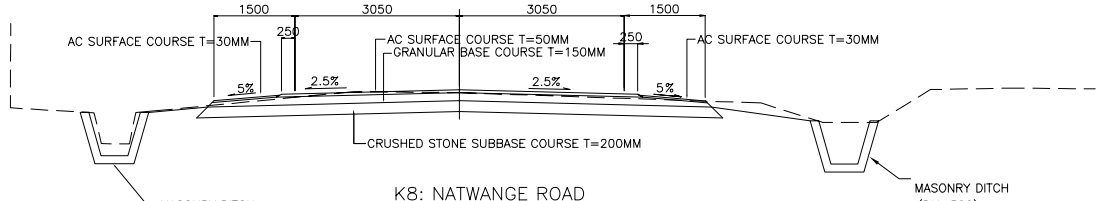
KM 0+600 – KM 1+100: TYPE-K7-4

KM 2+300 – KM 2+371.046: TYPE-K7-4



K7: KANTANTA STREET

KM 1+100 – KM 2+300: TYPE-K7-5

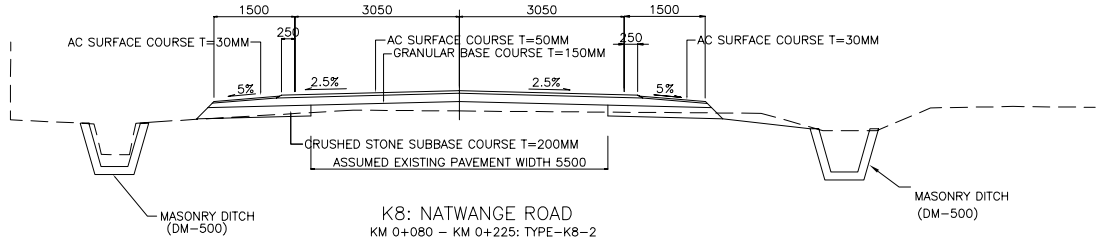


K8: NATWANGE ROAD

KM 0+000 – KM 0+080: TYPE-K8-1

KM 0+225 – KM 0+255: TYPE-K8-1

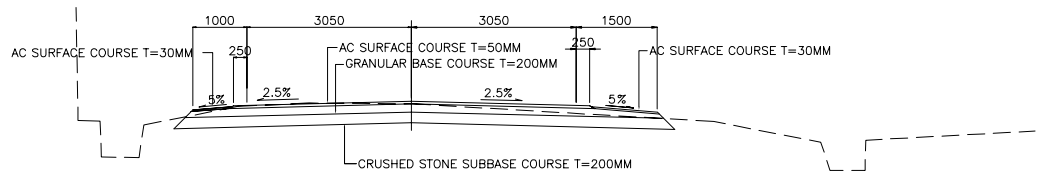
KM 0+480 – KM 0+670: TYPE-K8-1



K8: NATWANGE ROAD

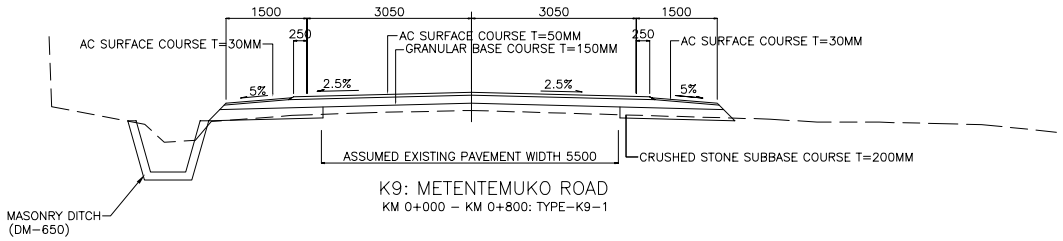
KM 0+080 – KM 0+225: TYPE-K8-2

KM 0+255 – KM 0+480: TYPE-K8-2



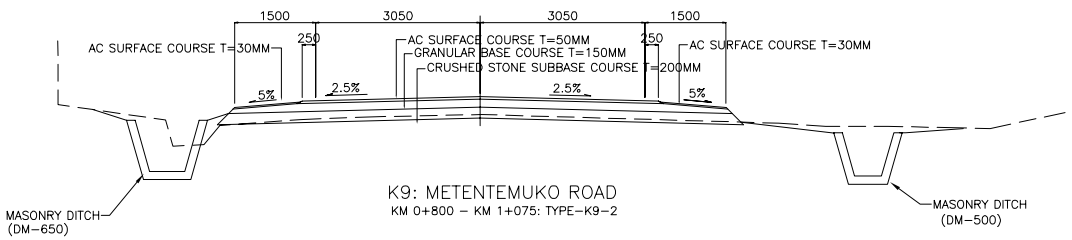
K8: NATWANGE ROAD

KM 0+670 – KM 0+904.181: TYPE-K8-3



K9: METENTEMUKO ROAD

KM 0+000 – KM 0+800: TYPE-K9-1



K9: METENTEMUKO ROAD

KM 0+800 – KM 1+075: TYPE-K9-2

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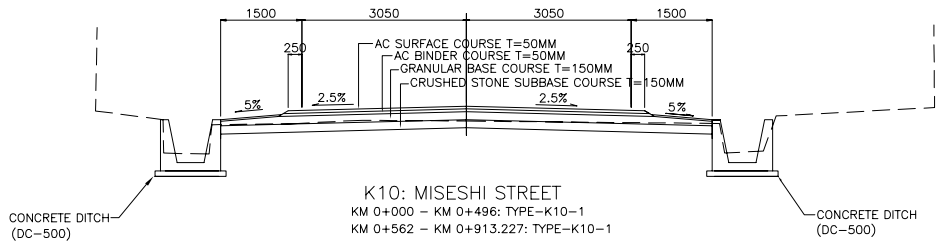
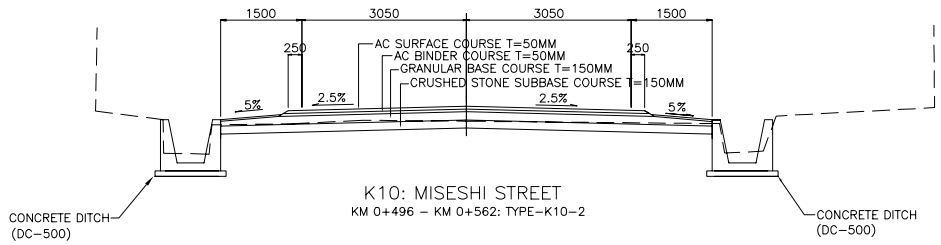
			KITWE CITY ROADS (3)	S=1:70		DATE		SUBMITTED		TY-7



K10: MISESHI STREET

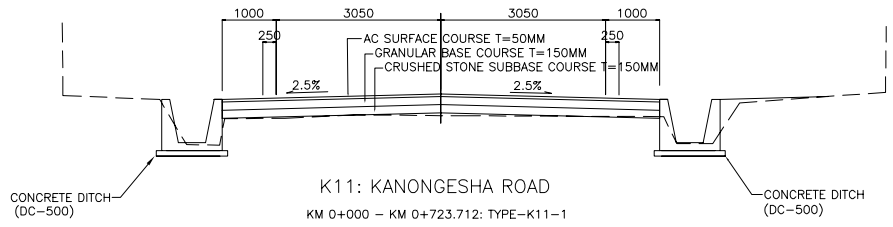
KM 0+000 – KM 0+496: TYPE-K10-1

KM 0+562 – KM 0+913.227: TYPE-K10-1



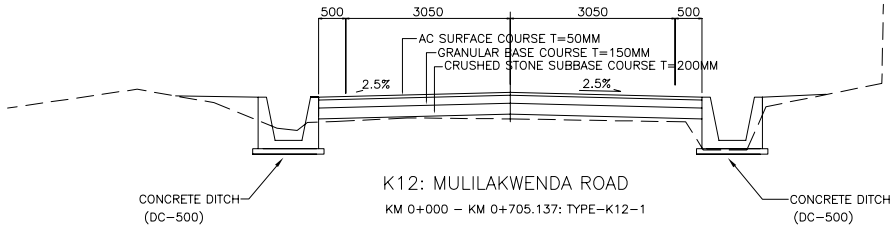
K10: MISESHI STREET

KM 0+496 – KM 0+562: TYPE-K10-2



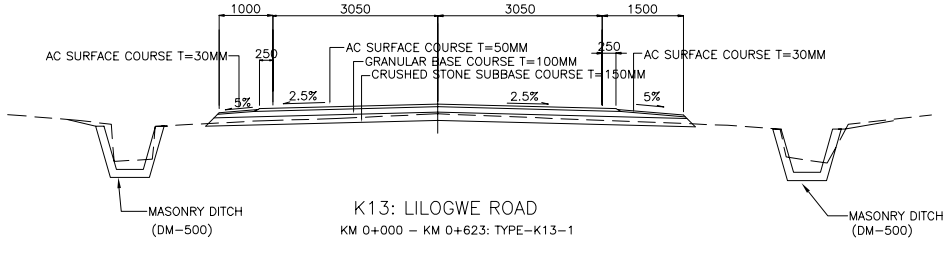
K11: KANONGESHA ROAD

KM 0+000 – KM 0+723.712: TYPE-K11-1



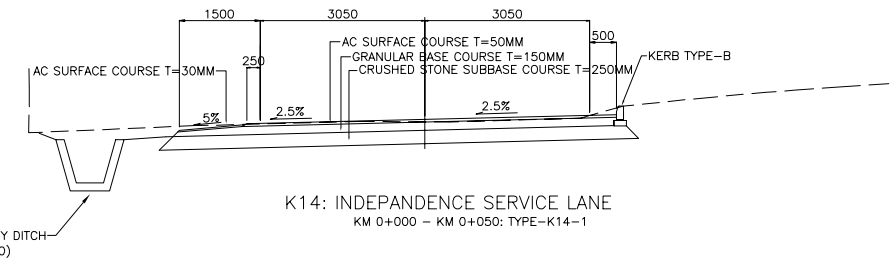
K12: MULILAKWENDA ROAD

KM 0+000 – KM 0+705.137: TYPE-K12-1



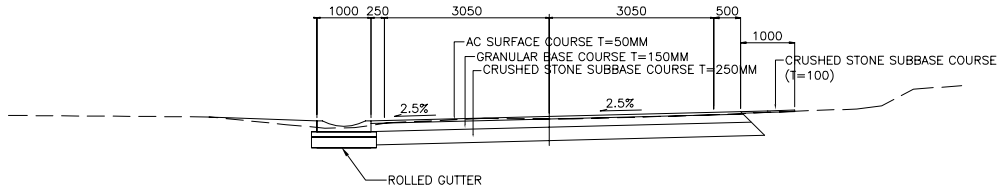
K13: LILOGWE ROAD

KM 0+000 – KM 0+623: TYPE-K13-1



K14: INDEPANDENCE SERVICE LANE

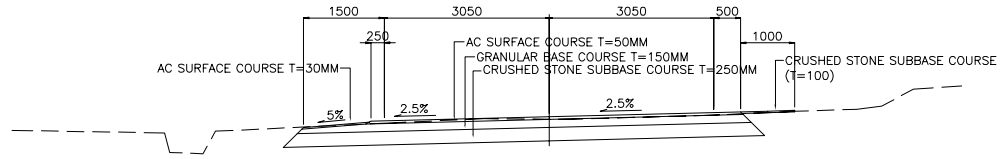
KM 0+000 – KM 0+050: TYPE-K14-1



K14: INDEPANDENCE SERVICE LANE

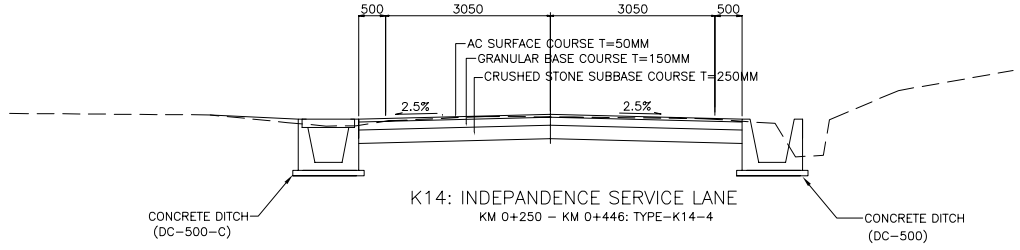
KM 0+050 – KM 0+191: TYPE-K14-2

KM 0+726 – KM 0+961: TYPE-K14-2



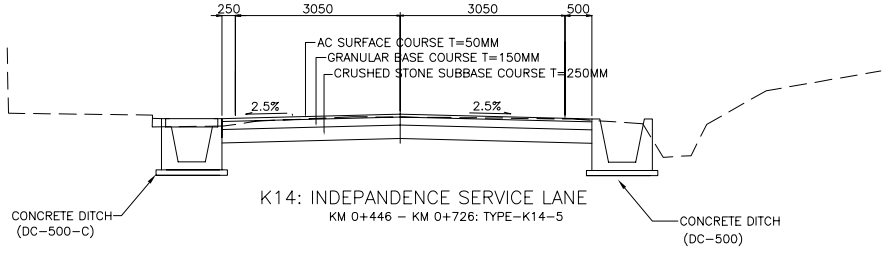
K14: INDEPANDENCE SERVICE LANE

KM 0+191 – KM 0+250: TYPE-K14-3



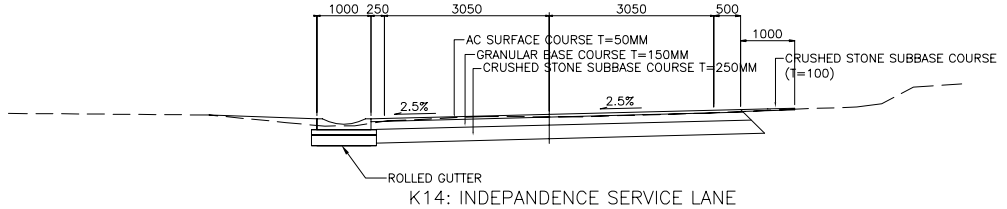
K14: INDEPANDENCE SERVICE LANE

KM 0+250 – KM 0+446: TYPE-K14-4



K14: INDEPANDENCE SERVICE LANE

KM 0+446 – KM 0+726: TYPE-K14-5



K14: INDEPANDENCE SERVICE LANE

KM 0+961 – KM 1+068.489: TYPE-K14-6

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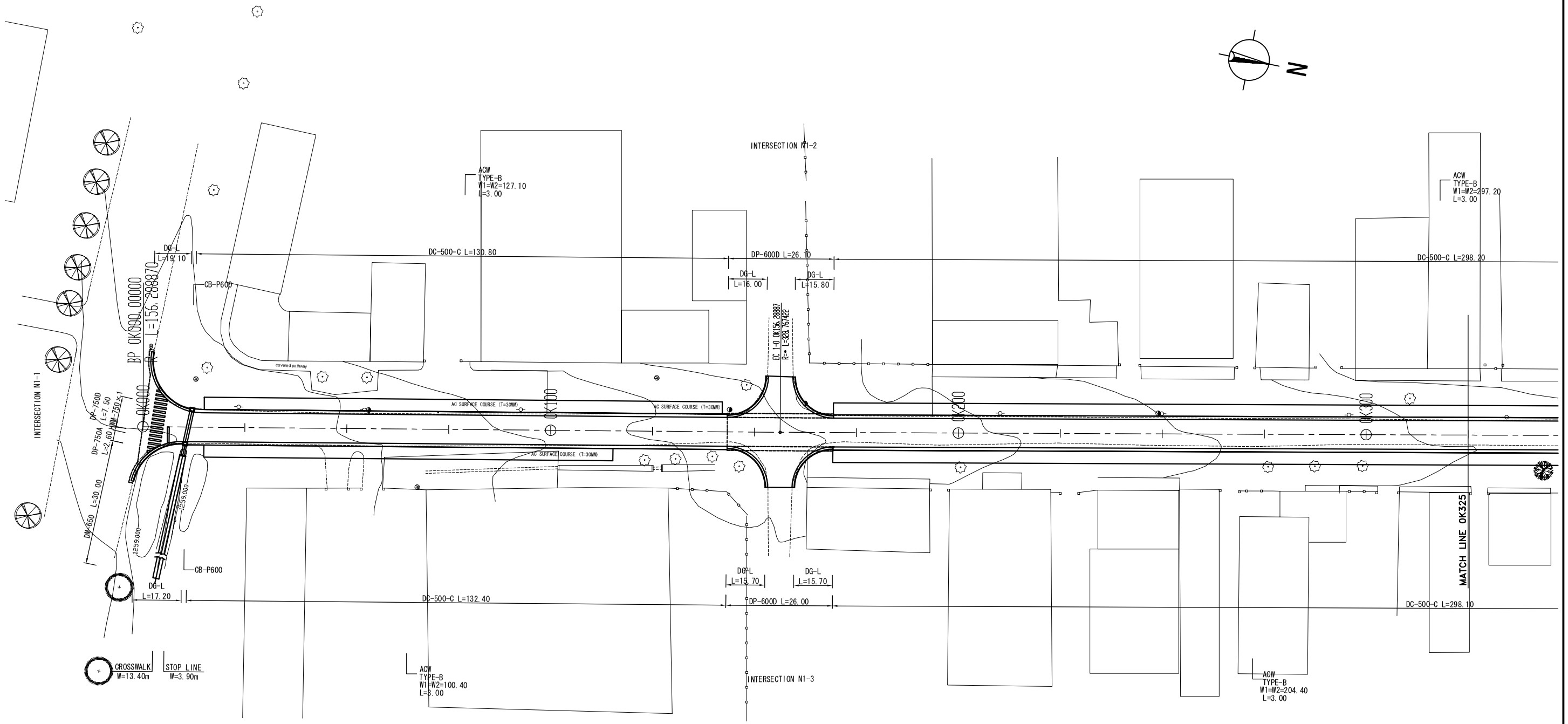
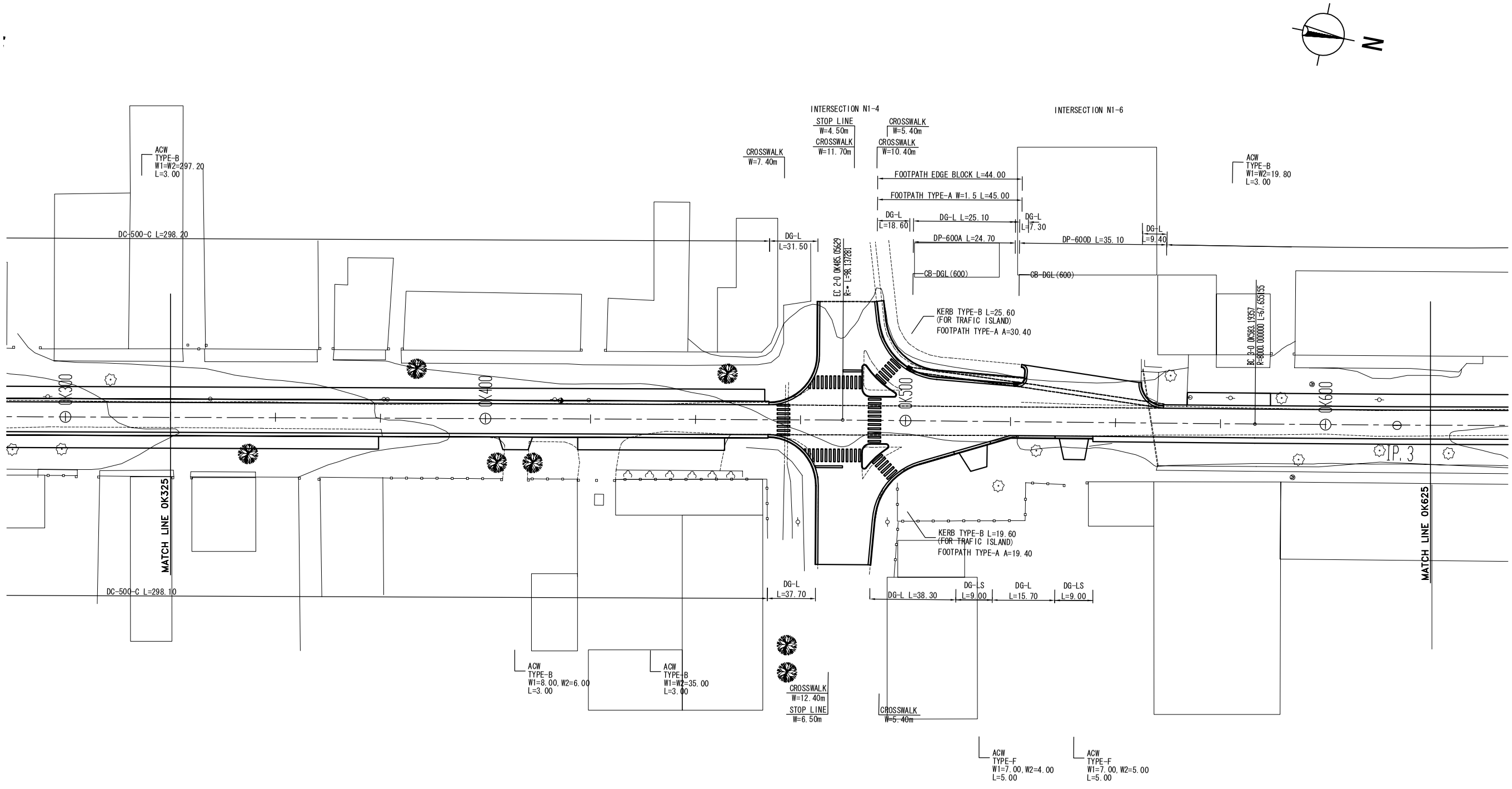
			KITWE CITY ROADS (4)	S=1:70		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		TY-8

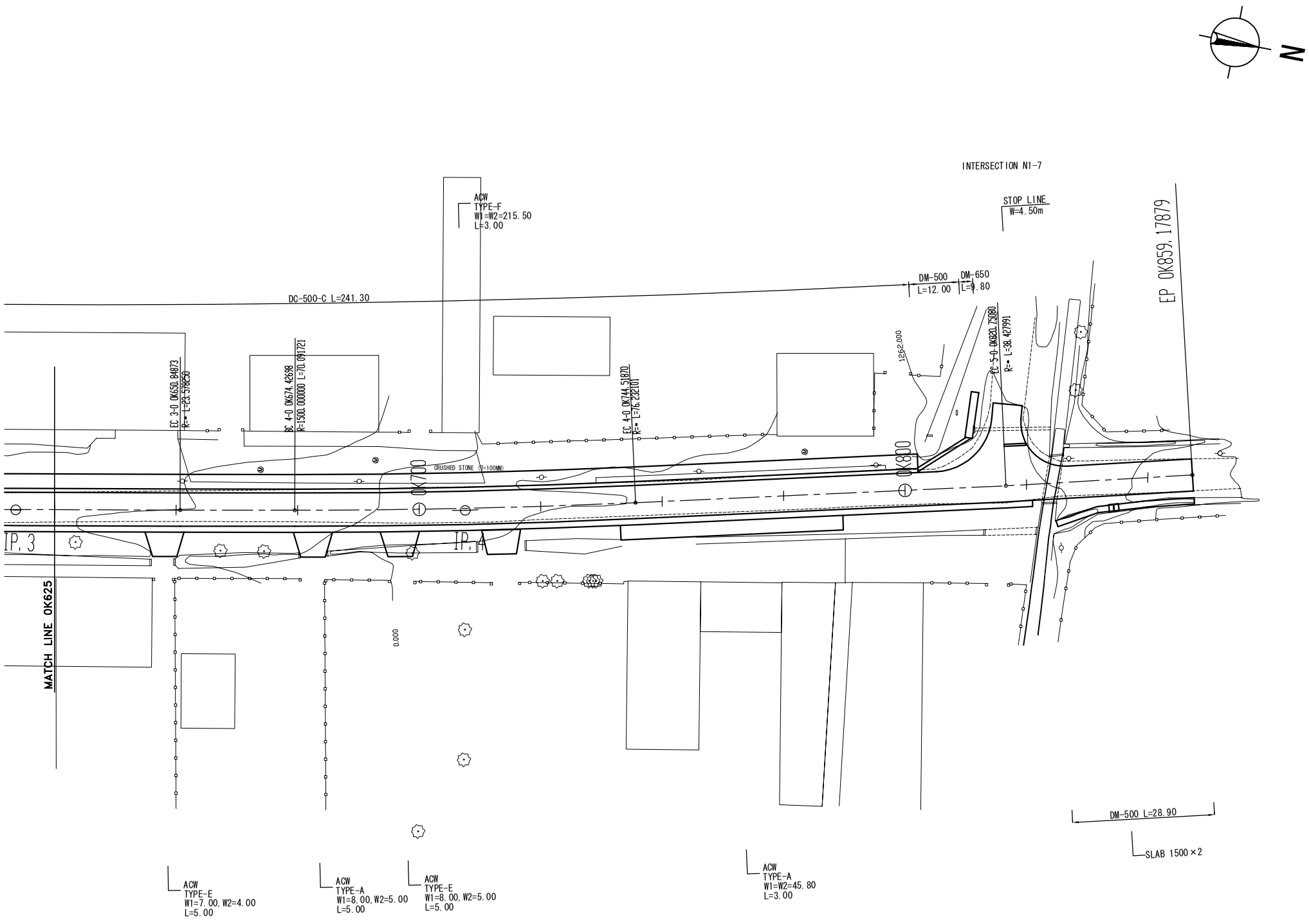


MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONAL / JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N1: VITANDA STREET(1/3)	S=1:500						PL-1

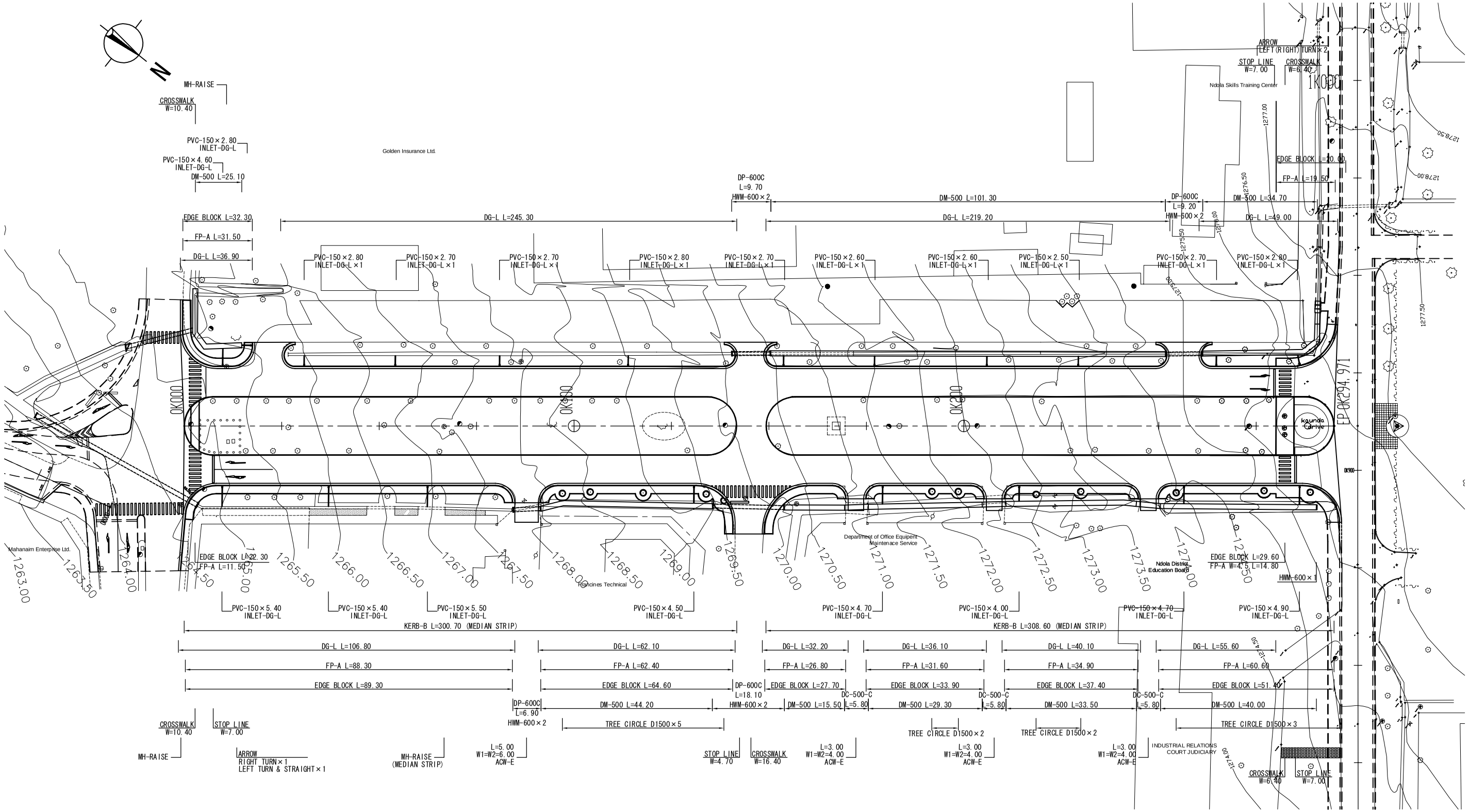


INTERSECTION N1-5

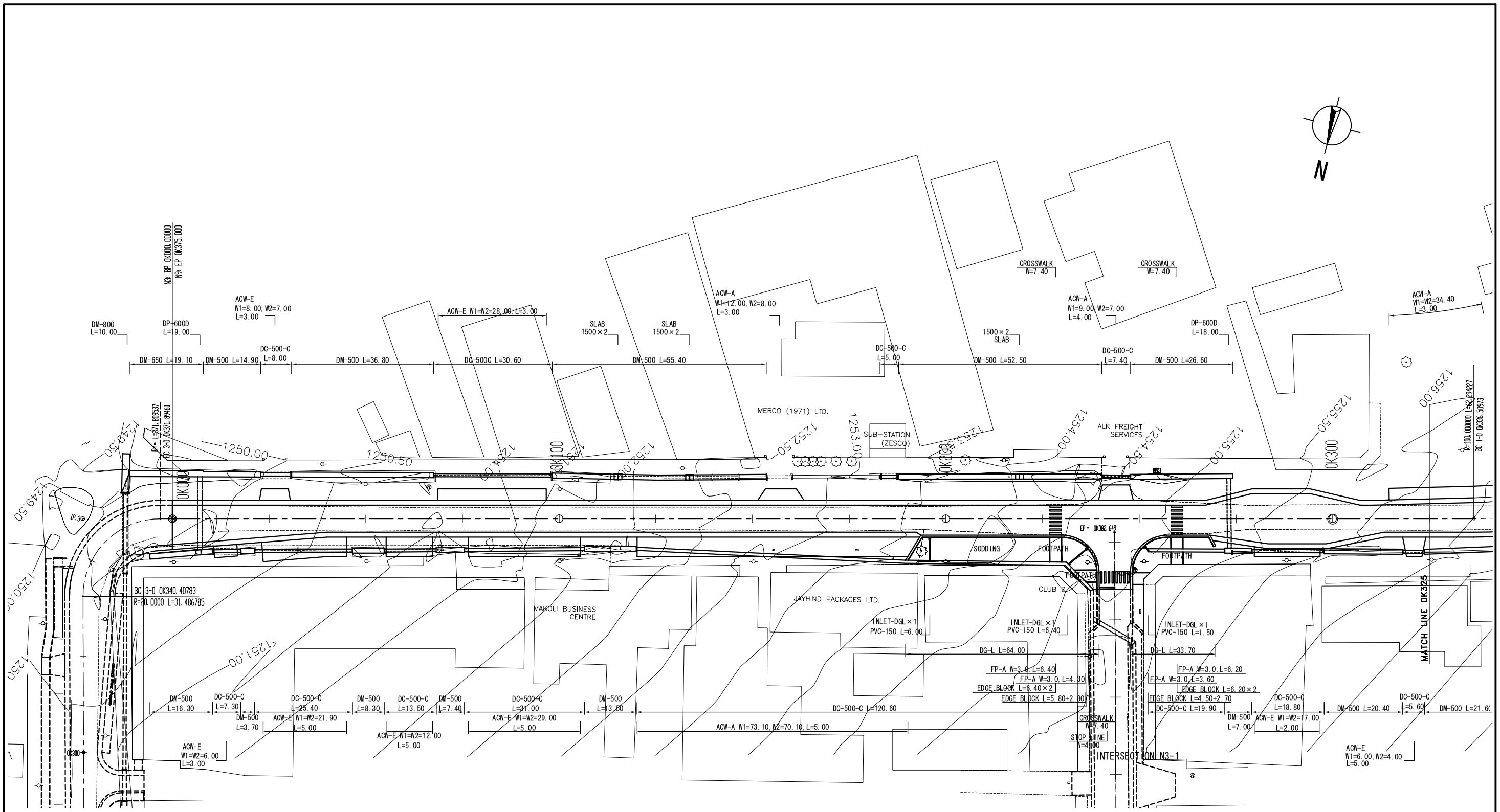
MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONANL JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N1: VITANDA STREET(2/3)	S=1:500						PL-2



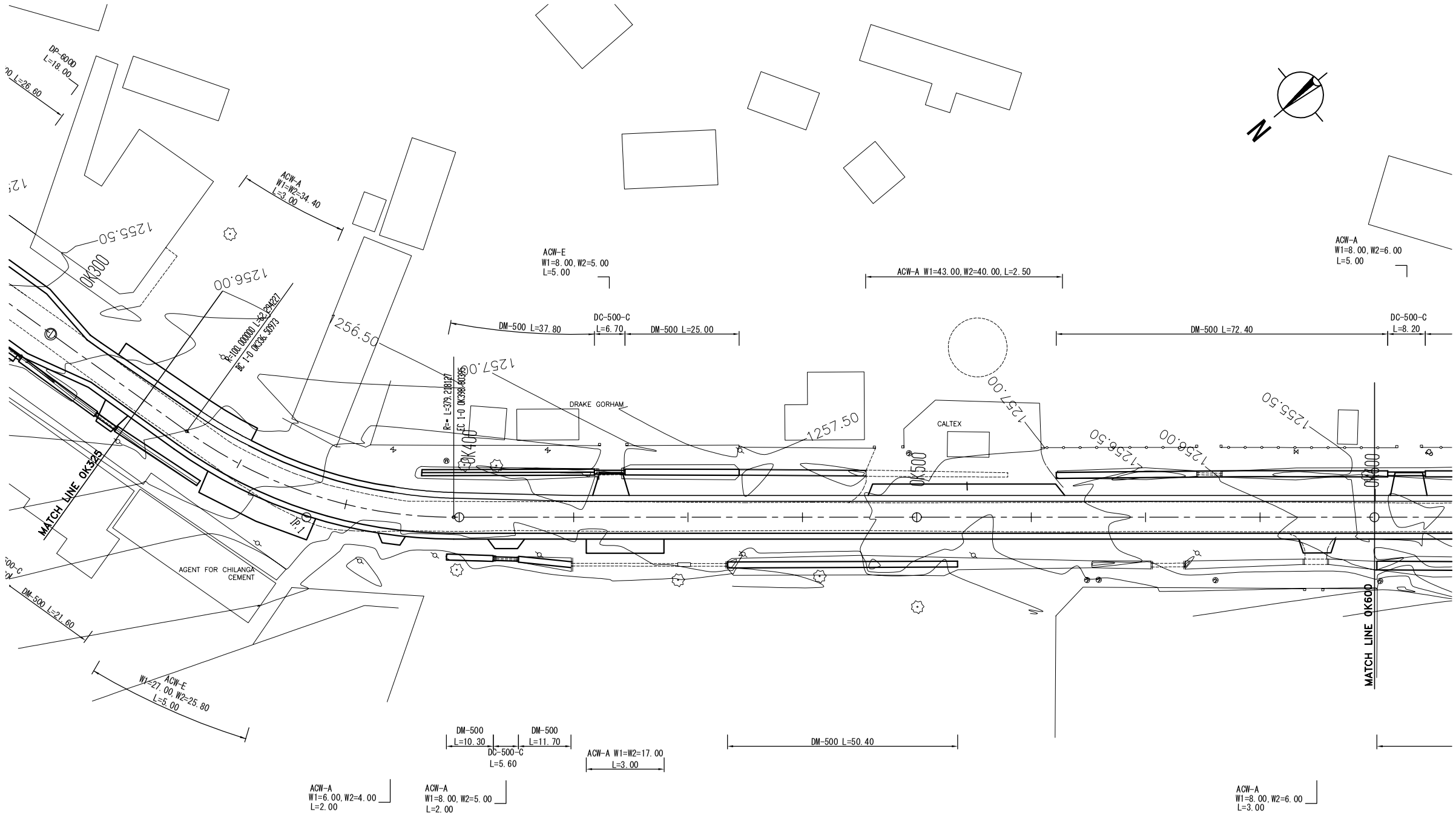
MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONANL JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N1: VITANDA STREET(3/3)	S=1:500						PL-3



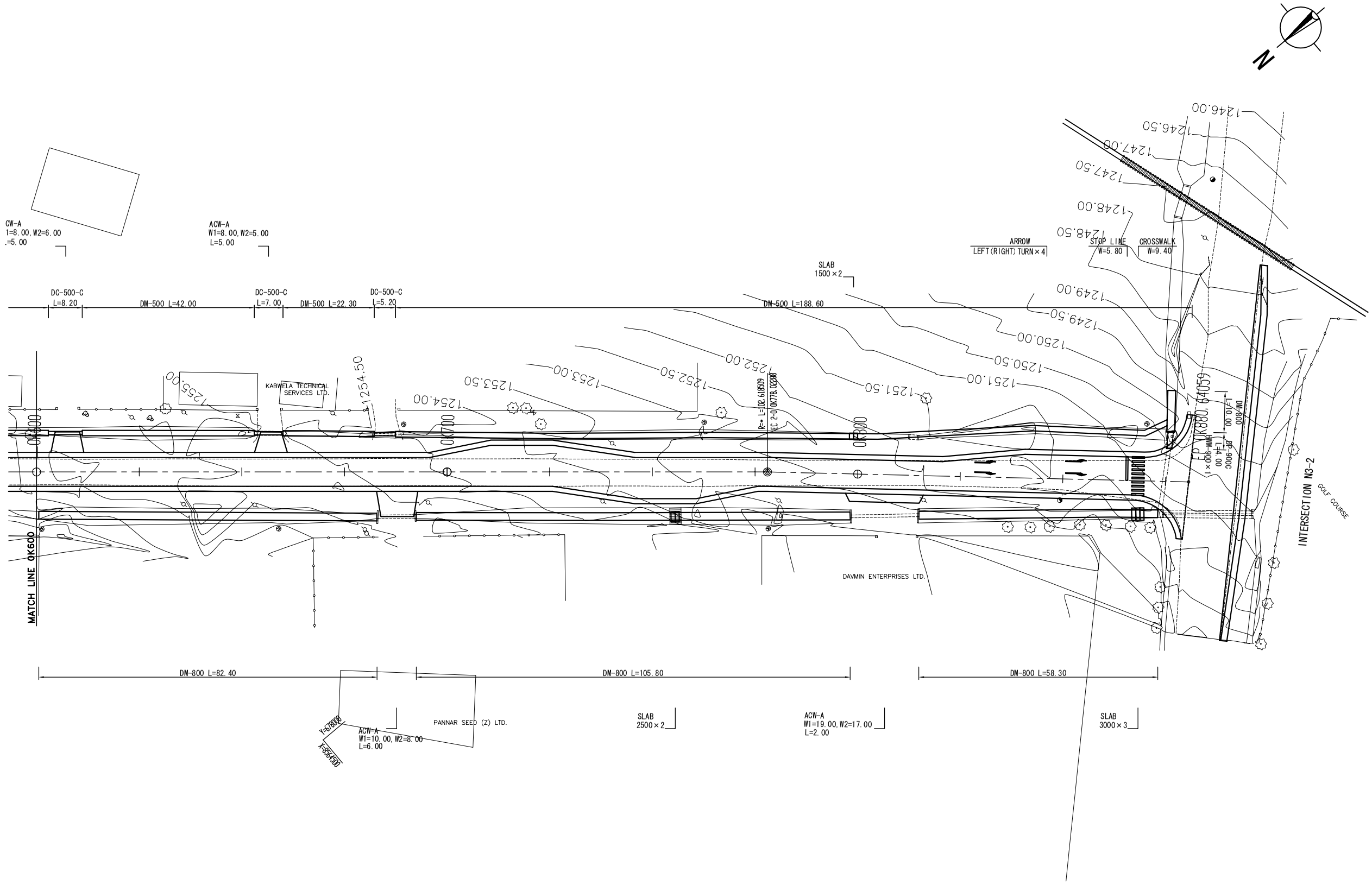
MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED	KATAHIRA & ENGINEERS INTERNATIONAL JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED	DATE	SHEET NO
			N2: KAUNDA DRIVE	S=1:500		DATE		SUBMITTED		PL-4



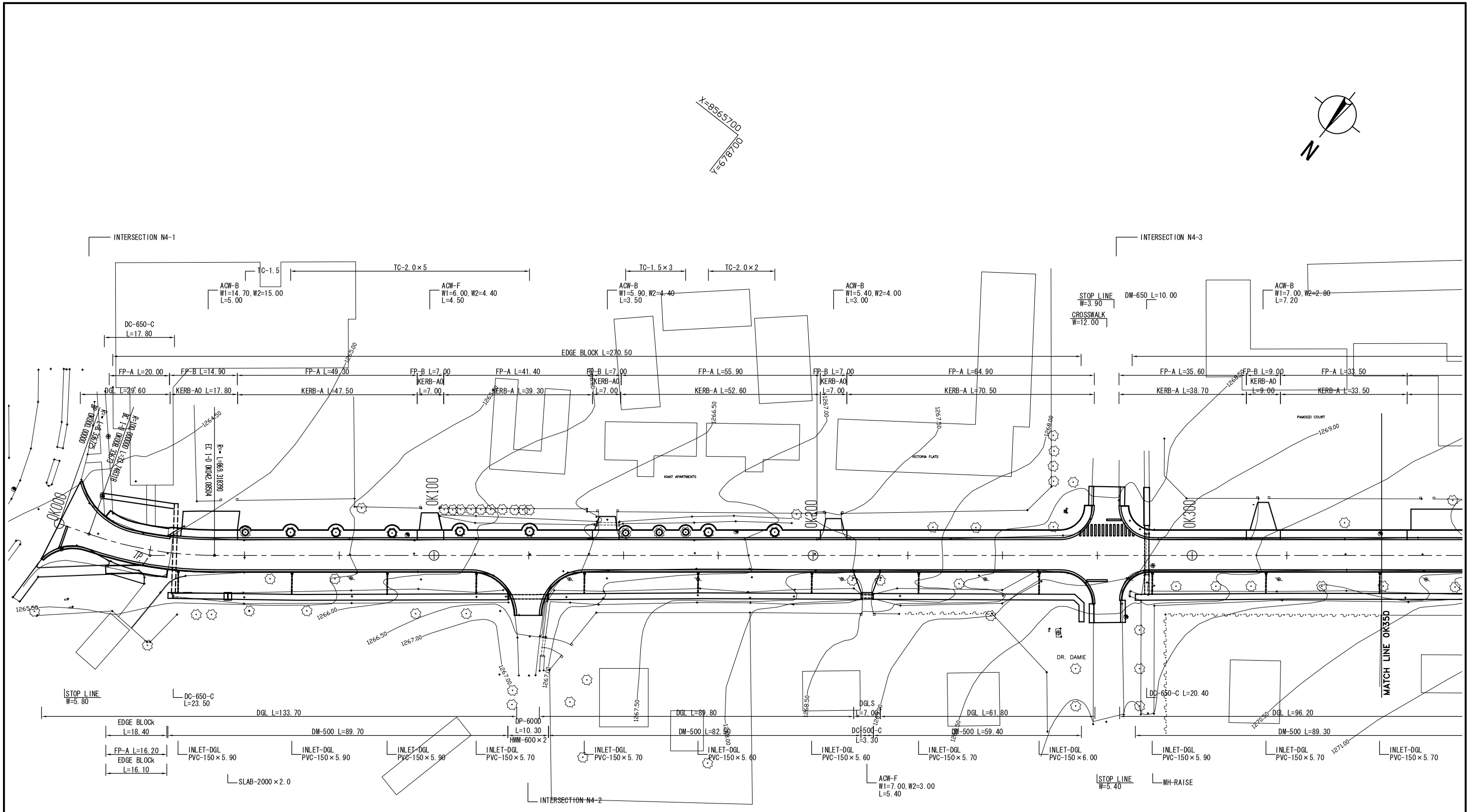
MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONANL / JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N3: MAKOLI AVENUE (1/3)	S=1:500						PL-5



MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONANL / JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N3: MAKOLI AVENUE (2/3)	S=1:500						PL-6



MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED	KATAHIRA & ENGINEERS INTERNATIONAL	PREPARED CHECKED	DATE	SHEET NO
			N3: MAKOLI AVENUE (3/3)	S=1:500		DATE	JAPAN ENGINEERING CONSULTANTS	SUBMITTED		PL-7



MINISTRY OF LOCAL GOVERNMENT AND HOUSING THE REPUBLIC OF ZAMBIA	BASIC DESIGN FOR THE PROJECT FOR IMPROVEMENT AND MAINTENANCE OF NDOLA AND KITWE CITY ROADS IN THE REPUBLIC OF ZAMBIA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	PLAN	SCALE		APPROVED / DATE	KATAHIRA & ENGINEERS INTERNATIONANL JAPAN ENGINEERING CONSULTANTS	PREPARED CHECKED / SUBMITTED	DATE	SHEET NO
			N4: INDEPENDENCE WAY(1/5)	S=1:500						PL-8