Chapter 16 Road Sector Development Plan

16.1 Road Network Improvement Plan

16.1.1 Introduction

As mentioned in Chapter 13.5, the main policies of the transport sector in the National Transport Plan is to develop a transport network system to support economic growth, assist social activities so as to decrease regional disparities, and to develop infrastructure resilient to the impact of climate change.

This chapter discusses the various measures to realize the policies established.

16.1.2 Planning Methodology

Figure 16.1.1 illustrates the planning process of the road network development plan. The development projects or the candidate projects that will contribute in improving the existing road network will be selected by integrating the projects that are being implemented or are on the course of planning by MTI with the proposed improvement works to improve the present road network.

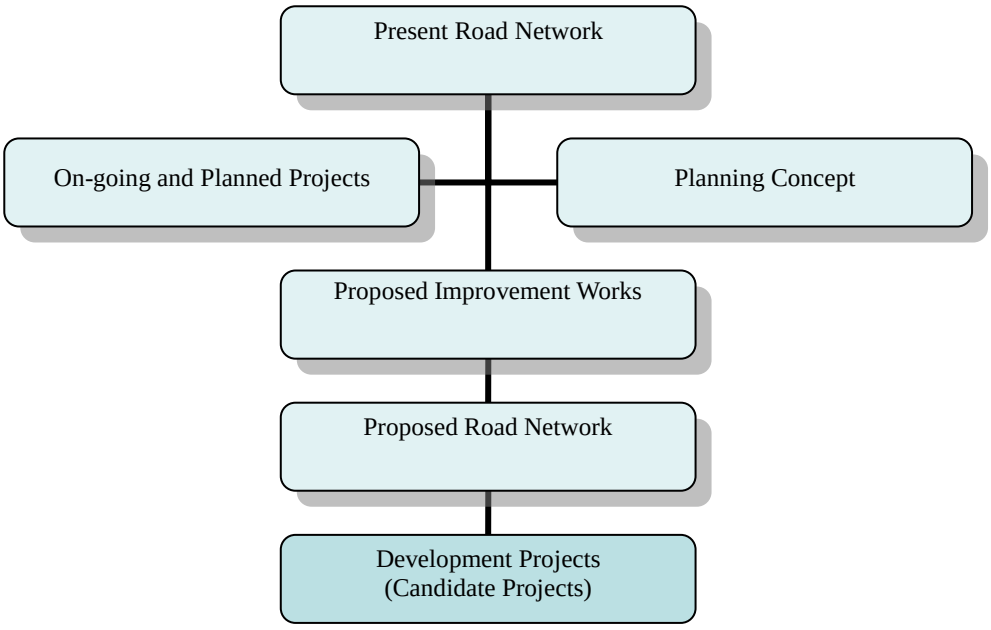


Figure 16.1.1 Planning Process of Road Network Development Plan
Source: JICA Study Team

16.1.3 Present Road Network

Although, the total road network in Nicaragua totals to 23,647km, only the basic road network under the jurisdiction of MTI, which totals to approximately 8,517 km (trunk road and collector road) will be targeted for road network development plan.

16.1.4 Integration of On-going and Planned Projects

On-going projects and planned projects for fiscal year 2014-2016 were identified and those that needed to be included in the NTP were selected. Currently, there are some projects that are on-going. There are some more that has been planned for implementation in MTI's investment plan for 2014-2016. The lists of these projects are provided in chapter 8. Where the on-going projects are mostly related to renovation of existing roads, many of the planned projects are yet to find a financial resource for commencement of construction work. Therefore, these projects, with an

exception to the three projects mentioned below, have been included in the improvement works in the NTP. The three projects hereunder are on-going and are expected to be completed shortly. The first two projects are related to new construction. However, these roads are planned in the NTP to be upgraded to a higher class from its present class as mentioned in the succeeding section. The third project is rehabilitation of NIC-21A from El Pajero to Muy Muy.

i) NIC-71 (Nueva Guinea to Bluefields)
ii) Nueva Esperanza to El Tortuguero
iii) NIC-21A (El Paraíso to Muy Muy)

16.1.5 Planning Concept

Figure 16.1.2 illustrates the basic concept of the improvement works for realizing the road sector development strategies mentioned in the previous chapter.

Concept 'A' targets enhancing intermodal connectivity and multimodal transport systems by strengthening the principal corridors that would minimize the travel time between the Atlantic side and Pacific Side international class ports.

Concept 'B' targets improvement of the existing roads in high potential productive area to reduce the vehicle operation cost and enhance the industrial activities.

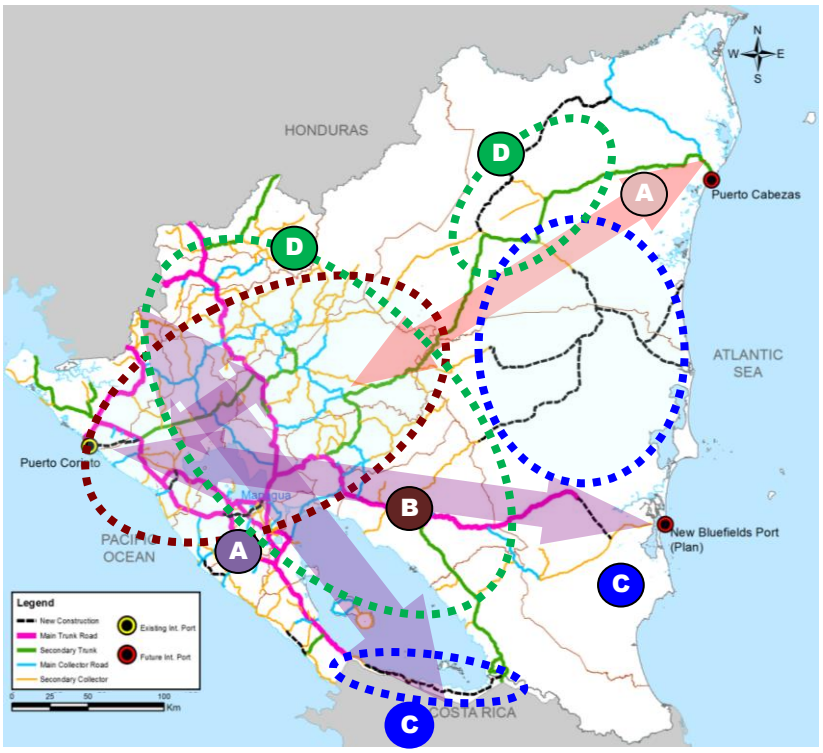


Figure 16.1.2 Planning Concept
Source: JICA Study Team

Concept 'C' aims to provide reasonable access to strengthen communications and regional activities of communities in the eastern side of the country that currently have no accessible roads.

Concept 'D' aims to establish road network resilient to natural disasters to minimize adverse effect on life of people and economy due to damages to infrastructure induced by natural disasters.

The basic directions followed in planning the improvement works are as follows:

i) Utilization of existing roads to the possible extent
ii) Enhancement of Functional and hierarchical road network
iii) Securing safe and stable road and structures
iv) Maintaining service level
v) Guide future land use

16.1.5.1 Functions and Characteristics of Roads and Design Standard

Nicaragua applies SIECA Standards, which is complemented by the American standards recommended by AASHTO. Although the SIECA standard is based on AASHTO, certain criteria are seen to vary from by AASHTO recommendations, mainly because of modifications undertaken to adapt to the regional conditions. One such example is the standards for widths (lanes, shoulders, sidewalks). It not only differs from the recommended values of AASHTO, but also do not correspond to the functional classification.

Therefore, the study recommends application of AASHTO's standard for planning the roads. The proposed functions, characteristics and major design criteria are recommended as shown in Table 16.1.1. The cross sections to be applied for each class are shown in Figure 16.1.3 and Figure 16.1.4, which is followed by brief explanation of each cross section elements.

Table 16.1.1 Proposed Functions, Characteristics and Design Standard

Class / Item	ARTERIALS		COLLECTORS		Local Roads
	Main Trunk	**Secondary Trunk**	**Main Collectors**	**Secondary Collectors**	
Function	Important road network for Central American Region and connect departmental capitals and economical centers with populations over 50,000 people.	Important road network for Nicaragua at a National Level and connect departmental capitals, important economic centers as well as provide access to border posts and connect primary arterials	Important road network for Nicaragua at a regional level, Connect with one or more departmental capitals with population over 10,000 people, connect urban areas not covered by arterials and connect secondary arterials.	Important road network for Nicaragua at a regional level, connect regions or municipalities to the national road network, connect regions or municipalities with more than 5,000 population to the national road network	Important road network for Nicaragua at a municipality level and Lies under MTI jurisdictions but do not meet the requirements of upper category roads
Correspondence to SIECA classification	Central American Road Mesoamerican Highway	Primary National Road	Secondary National Road	Tertiary National Road	Municipality Road
Traffic Flow AADT (vehicles per day)	1000 or more	⩽500<1000	approximately 500	50 or more	50 or less
Design Traffic by lane (ADT) (Unit: thousand)	17 – 18 (International Corridors) 10 – 12 for others	10 – 12	10 – 12 (9 in case of 2-lane)	10 – 12 (9 in case of 2-lane)	
Design Speed (km/h)	100, 80, 60	80, 60, 50	60, 50, 40	50,40,30	40, 30, 20
Target Speed (km/h)	60	40	30	20	20
Right of Way (m)	40m	40m	40m	20m	20m
Level of Service	B	B	C,D	C,D	D
Lane Width (m)	3.6	3.6	3.3	3.0	3.0
Median Width (m) Urban only	6.0 -10.0	2.0 – 9.0	3.0 – 4.8	3.0 – 4.8	None
Shoulder (m)	0.6 - 2.5	0.6 - 1.8	0.6 – 1.5	0.3 - 1.2	0.5
Sidewalk (m) Urban only	2.0 – 4.5	2.0 – 4.5	2.0 – 3.5	If required	If required

Note 1: Service Level B: Reasonably free flow, C:Stable flow D:Approaching unstable flow
Note 2: Number of lane is decided based on future traffic demand forecast
Source: Red Vial Nicaragua 2011, MTI and AASHTO

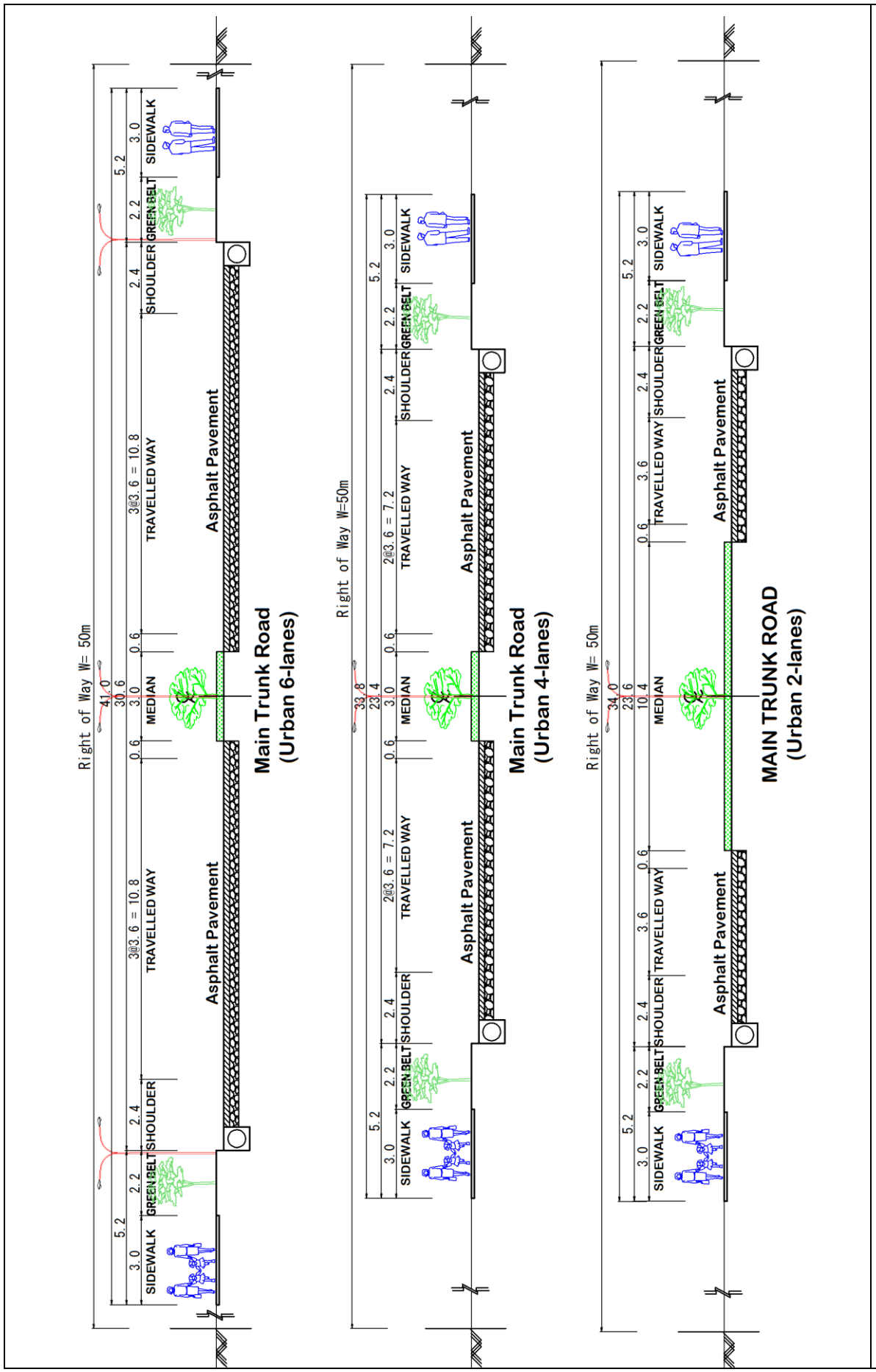


Figure 16.1.3 Proposed Standard Cross Section for Main Trunk Road (Urban Area)

Source: JICA Study Team

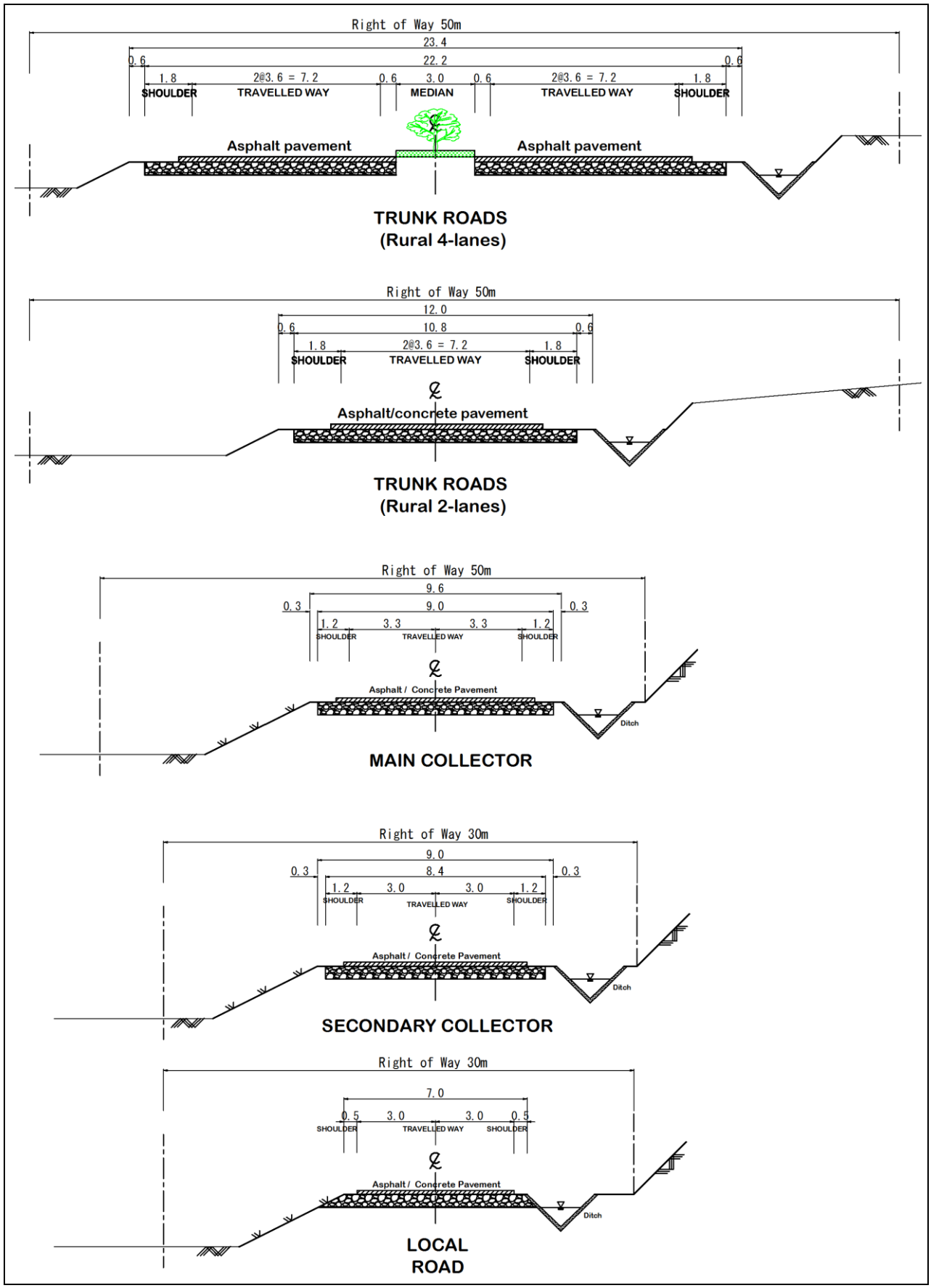


Figure 16.1.4 Proposed Standard Cross Section for Each Functional Claffication

Source: JICA Study Team

(1) Pavement Type

Pavement type selection is a management decision process. The successful application of the pavement-type selection process requires a multidisciplinary approach and needs to take into account various factors such as construction cost (initial and life cycle cost), design life, traffic type, traffic volume, functional classification, ambient climate condition etc. Roads in Nicaragua have either asphalt, concrete, adoquín, or gravel pavement. The main trunk roads and most of the secondary trunk roads and collector roads in the western side of the country basically have asphalt pavement. Concrete pavement is observed in the eastern part of the country.

The improvement works proposed in the NTP assumes application of asphalt pavement. In general, the study team recommends asphalt concrete on all roads, particularly the trunk roads. Generally asphalt pavement has advantages from the point of view of initial investment cost, repair, maintenance, splitting and cracking, and driving formability compared with hydraulic concrete.

Application of concrete pavement or adoquín can be considered on collector roads, especially in the eastern side of the country where traffic volume is less and the materials are locally available and it does not require high level technology or heavy special equipment to construct. It also generates employment opportunities for the community. However, it should be noted that the pavement type and structure should be determined based on the actual requirements of the site.

(2) Drainage facilities

The major reason for deterioration of road condition is improper drainage system. Adequate drainage facilities are recommended to be provided in all roads in the urban area and along the following segments of a rural road.

- lowest section of a sag curve,
- where the longitudinal grade (profile) exceeds 3 percent,
- a cut section (rain from the road side in-flows to the road),
- creek or streams, and
- swampy area, rivers or watershed area,

(3) Road Ancillary facilities

To endorse safety and smooth operation of traffics, provision of road ancillary facilities is important and these facilities should comply with the standards of the country. Recommendation for provision on the roads proposed is discussed hereunder.

1) Guardrails

The major locations where guardrails are recommended to be installed are;

- along the outer side of a sharp (acute) curve ,
- along the valley side or over the stretch where the vertical height of an embankment exceeds 3 meters
- in front of large sized side open ditch
- at the approach of a bridge

2) Traffic Signs

Traffic signs are an essential part of supplementary facilities and an effective means of achieving safety and efficiency of a road, as it supplements the physical layout of a road by informing, pre-warning and controlling the drivers. In general, there are three types of traffic signs;

- Regulatory signs; indicate legal requirements of traffic movement
- Warning signs; indicate conditions that may be hazardous to road users
- Guiding/informatory signs; convey information or guidance to the driver

All types of road signs are recommended to be provided on the roads proposed for new construction.

3) Road Marking

Like road signs, all roads proposed for new construction are recommended to be marked either for the purpose to supplement the traffic signs or serve independently to indicate certain regulations or hazardous conditions.

There are three general types of road marking: pavement marking, object markers, and road studs.

- Pavement markings: Centerlines, lane lines, side/edge lines, and no overtaking lines are recommended. For nighttime visibility, small glass beads are recommended to be mixed with paint or thermoplastic before applying to the road, given that the road has an asphalt pavement.
- Object Markers: physical obstructions in or near carriageway that are not removable or removable is impractical are recommended to be adequately marked by painting or highly visible material.
- Road Studs: Hybrid marking consisting of both reflective road markings and reflective studs can be useful for night time driving in unlit areas. Use of these studs is recommended for roads in urban area and rural areas where the roads have asphalt pavement.

4) Street Lightning

Street lightning improves the safety of a road. General statistics worldwide indicate that the nighttime accident rate is higher than during daylight hours, which may be attributed to impaired visibility. Therefore, it is effective to provide lights along the roads where there are plenty of pedestrians and at critical points where in the past repeated accidents have occurred. Also, lightning is recommended to be provided along the proposed bypasses and peripheral road.

(4) Standards for Planning of Bridges

MTI uses a Terms of Reference (TOR) during the contract out of the design work. In general, it allows the consultant to follow a standard, usually SIECA or the American (LFRD), as far as the output meets the requirements stipulated in the TOR.

The TOR of MTI usually stipulates applying the recently updated requirements of the AASHTO LFRD Hydraulic Design Series Number 5 from FHWA standards, which takes into consideration in the design to moderate possible seismic forces. Not having the standards in MTI, the planning division does not have full knowledge of the design work and is quite dependent upon the consultants. Therefore, it is recommended that the following standards, manual and specifications be designated as the official standards of MTI for the design purpose of bridges and culverts, and capacity enhancement of the concerned personals be conducted through technical cooperation.

STANDARDS

- AASHTO LRFD Bridge Design Specifications, 4th Ed., 2007
- AASHTO Standard Specifications for Highway Bridges, 17th Ed., 2002

REFERENCES

- Specifications for Highway Bridges, Japan Road Association, 2002
- Specification for River Facilities, Japan River Association, 1998

16.1.6 Proposed Improvement Works

The proposed improvement works for solving the issues of the existing road network consist of the following works;

i) Development of new roads,
ii) Improvement of existing roads,
iii) Rehabilitation of existing roads,
iv) Surface improvement of other roads
v) Provision of new bridges
vi) Measures against road disasters

Improvement and rehabilitation works are defined in this development works based on the practice in Nicaragua as follows:

Improvement:

Improvement is defined as the works conducted without any changes or modifications of the original centerline of the existing road. This covers works like widening, partial and temporal maintenance of road surface and reconstruction. Reconstruction here means works undertaken to reconstruct the entire pavement structure of a segment, for example from gravel pavement to asphalt pavement.

Rehabilitation:

It is undertaking of major improvement works where the initial centerline of the existing road and other elements maybe modified to meet the required design criteria as in the case of upgrading an existing road to a higher class and essentially consists of re-pavement, widening, and modification of geometric requirements.

16.1.6.1 Development of New Roads

Fourteen (14) roads have been proposed in various parts of the country, much of which is concentrated in the eastern region. Location of these roads is shown in Figure 16.1.5. These roads are expected to form an integral part of the existing road network and contribute in achieving the long term development visions of the National Transport Plan.

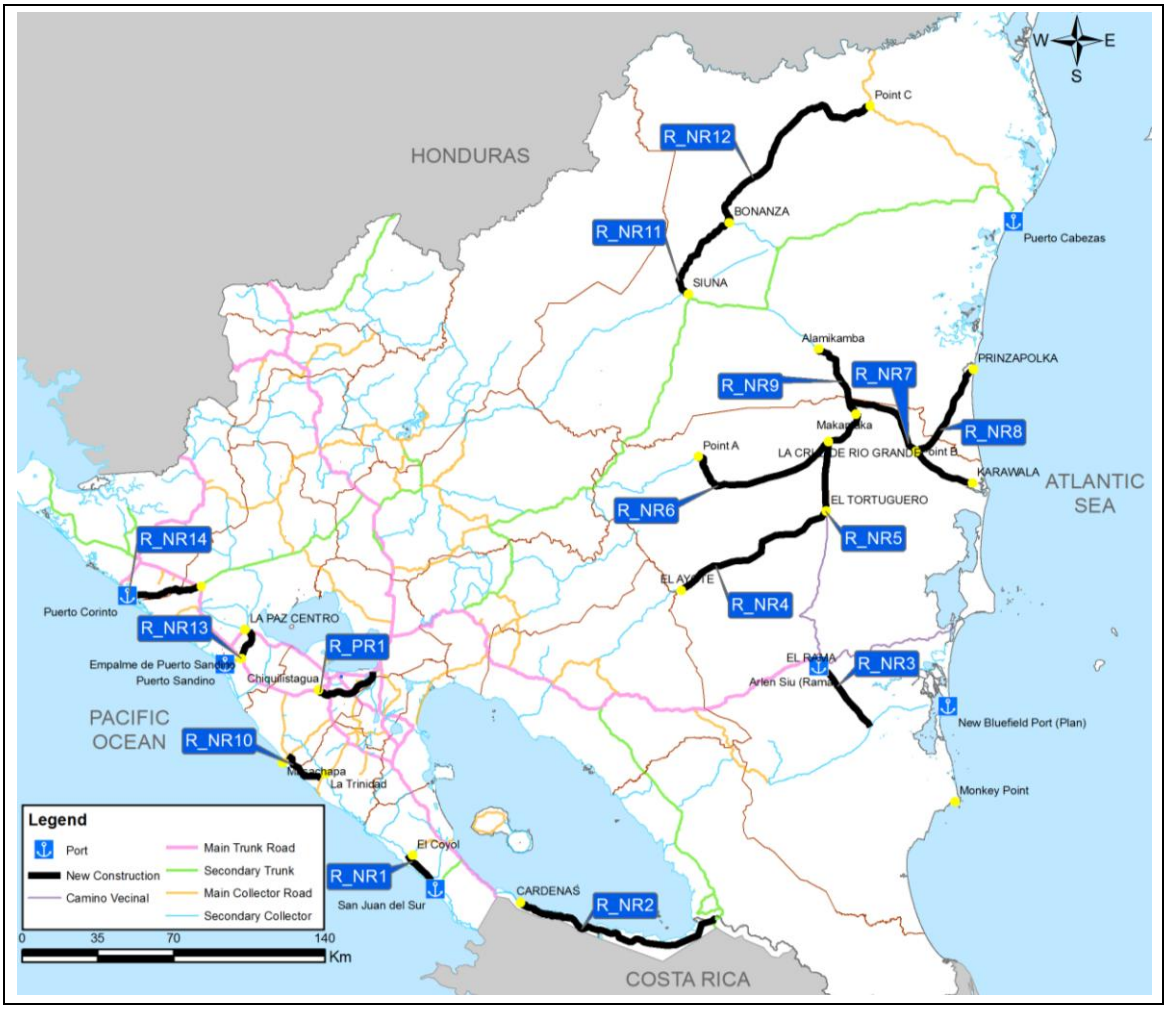


Figure 16.1.5 Locations and Outline of Newly Proposed Roads
Source: JICA Study Team

The proposed roads total to an approximate length of 793.4 km, which comprises 81.1 km of main trunk road, 284.5km of main collectors and 427.8km of secondary collectors. The proposed roads can be divided into four categories based on its functions. Brief explanation including objective, description and outcomes of each category is as follows.

(1) Bypasses

1) Objective

To provide a short cut avoiding the built-up area, which would allow through traffic flow without interference from local traffic, as well as reduce congestion in the urban area and improve road safety.

2) Description

At present, international traffics travelling along the Pacific Corridor and those calling and leaving the existing port Corinto run through built-up areas such as Leon and Chinandega, causing traffic congestion and adverse environmental impacts at these cities. In order to improve such condition, two bypasses as shown in Figure 16.1.6 are proposed. Bypass-1 consists of R_NR13, NIC-22 and NIC-16. R_NR13 is a newly proposed road, to be raised of category to main trunk which is approximately 15.5 km long and links main trunk road NIC-12A with NIC-22. It starts at El Empalme Puerto Sandino on NIC-12A and ends at La Paz Centro at the intersection of NIC-28 and NIC-22.

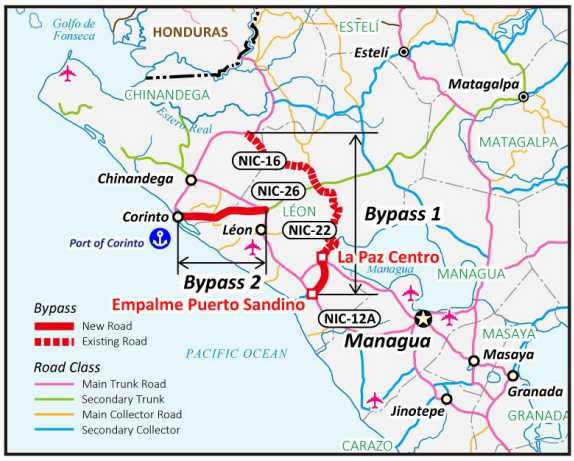


Figure 16.1.6 Proposed Bypasses
Source: JICA Study Team

NIC-22 and NIC-16 are collector roads and needs to be improved and upgraded to main trunk roads in order to function as a bypass.

Bypass-2 on the other hand is a new road approximately 33km long and connects the existing port town Corinto with national highways NIC-12A and NIC-26 at the intersection of these two roads at Telica.

Both the bypasses are designated as an international corridor and are proposed to be classified into the main trunk road. These roads will have 4-lanes, based on the results of the traffic demand forecast, and the cross section for main trunk rural type shown in Figure 16.1.3 will apply. Pavement type is proposed to be asphalt pavement, which is similar to the existing pavement type.

3) Outcome

- Reduction of travel time (Figure 16.1.7). Time required to travel from Empalme Puerto Sandino to Villa 15 de Julio thru bypass-1 (Route-B) compared to existing route (Route-A) is reduced by 7% or more.
- Time required to travel from Corinto to Telica thru bypass-2 (Route-D) compared to existing route (Route-C) is reduced by 31% or more.
- Mitigation of traffic congestion at Leon and Chinandega
- Improvement of environment at Leon and Chinandega

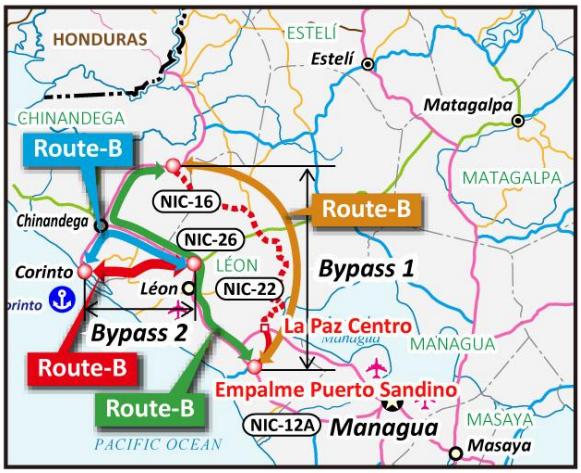


Figure 16.1.7 Reduction of Travel Time
Source: JICA Study Team

(2) Peripheral Road

1) Objective

To provide a road to decongest and improve the traffic flow of the existing main trunk roads by diverting traffics whose trips do not originate from or end in the center of Managua City.

2) Description

An enlarged map showing the proposed peripheral road is illustrated in Figure 16.1.8. Having an approximate length of 32.6 km, the road will connect national highway NIC-12A with national highway NIC-01 at the east of the airport. The alignment of the road runs in the east-west direction in the suburbs, avoiding high residential areas at the south of Managua City. It will cross with NIC-02 and NIC-04 at about a 10km radial distance from the center of Managua. As this road connects two major trunk roads, the peripheral road is also proposed to be classified as a major trunk road and will have four-lanes as necessitates by the traffic demand forecast. However, it may be constructed to have 2-lanes in the initial stage. An urban 2-lanes or 4-lanes, as shown in Figure 16.1.3, are recommended to be applied as the standard cross section.

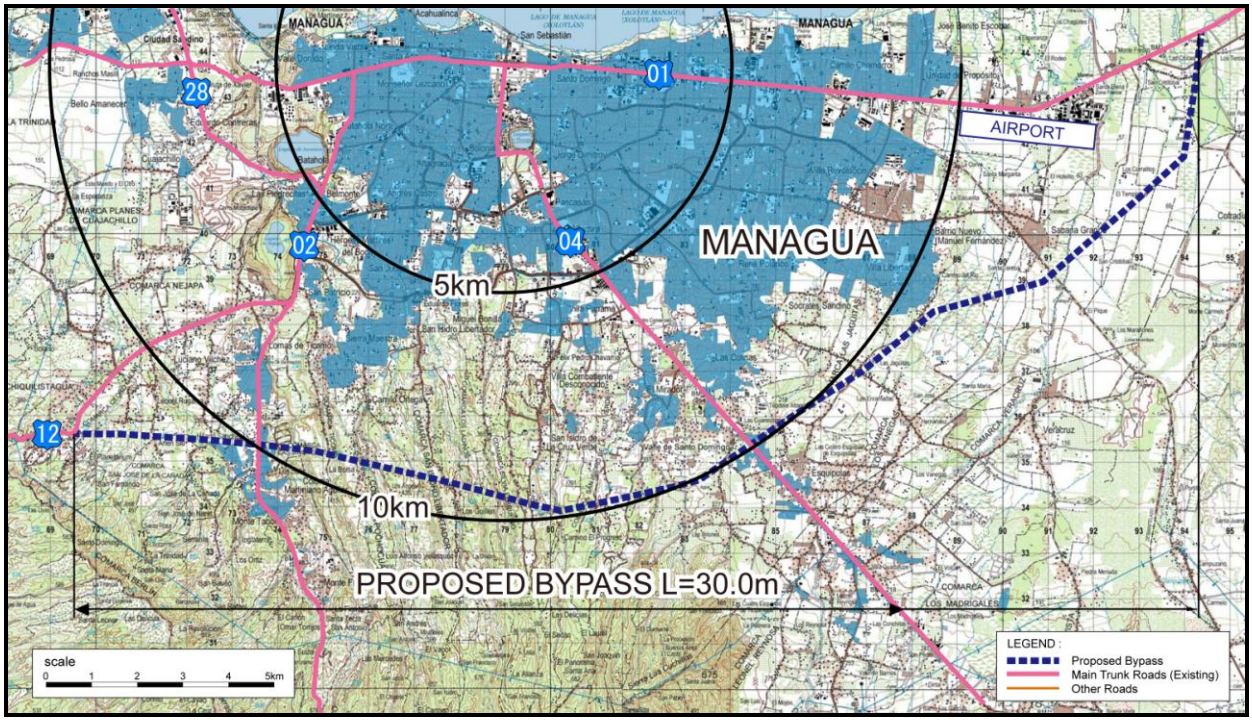


Figure 16.1.8 Proposed Peripheral Road
Source: JICA Study Team

3) Outcome

- Reduction of travel time (Figure 16.1.9)
  Time required to travel from Nandaime (NIC-2) to San Benito (NIC-1) thru peripheral road (Route-B) compared to the existing route (Route-A) is reduced by 25%
- The road will allow traffics on north-south corridors (NIC-1, NIC-2, and NIC-4) to swiftly travel to east-west direction without having to enter the capital city of Managua.
- It will contribute in mitigating traffic congestion and improving environment of Managua and the abutting area.

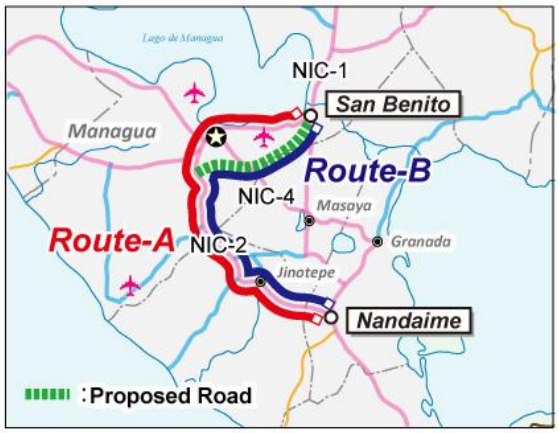


Figure 16.1.9 Comparison of Travel Time
Source: JICA Study Team

(3) Redundant Road

1) Objective

To provide a road that would function as a redundant road (back up road) of the Northern Corridor, which is the only current road connecting to the north-east region, so as to enhance access to the region during natural calamities.

2) Description

NIC-21B, the only road linking Puerto Cabezas, a port town where the existing domestic port is currently undergoing development works for upgrading, is a secondary trunk road designated as the Northern Corridor. This corridor is expected to play a vital role in transporting freight after completion of the port upgrading work. As such, it is not only a strategically important road but also a life-line of the people of the abutting communities. However, this road is extremely vulnerable to natural disasters and is often impassable. Roads R_NR11 and R_NR12 are proposed as alternative roads for NIC-21B. The former road, which is approximately 53.5km long connects Siuna with Bonanza and is functionally classified as main collector. The latter road is an extension of the former road connecting Bonanza with NN-73 at Point C (La Tronquera) and is approximately 72.1km long. It is functionally classified into secondary collector.

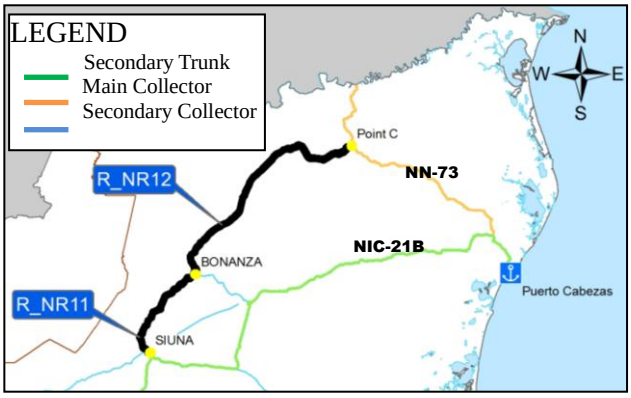


Figure 16.1.10 Proposed Alternative Road
Source: JICA Study Team

3) Outcome

- The roads can function as alternative (backup) roads of NIC-21B during disaster period.
- The roads can function as a bypass connecting Siuna with Point 'C' to reduce the travel time from Point 'C' to Siuna by 26% in comparison to the existing route (NN-73 – NIC-21B).
- This can function as feeder roads in future for local roads connecting communities along River Coco.

(4) Other Roads (Missing Links)

1) Objective

To provide new roads to link communities in the eastern part of the country where there are either no proper access or are only accessible by water transport currently.

2) Description

Ten (10) new roads as indicated by R_NR1 to R_NR10 in Figure 16.1.11 are proposed. The total length of these roads is approximately 633km. R_NR3, R_NR5, and R_NR9 are functionally classified into main collectors while others are classified into second collectors. All these roads are planned to have 2-lanes and the cross section shown in Figure 16.1.4 is proposed. At this stage, asphalt pavement has been chosen for these roads. However, it is recommended that the pavement type to be applied should be determined during the design stage taking into consideration various factors such as the initial and life-cycle cost, construction efficiency, characteristic of the roads and subgrades, available material etc. as application of concrete pavement or Adoquin might prove advantageous in terms of climate, available material and technology, job opportunities of the communities.

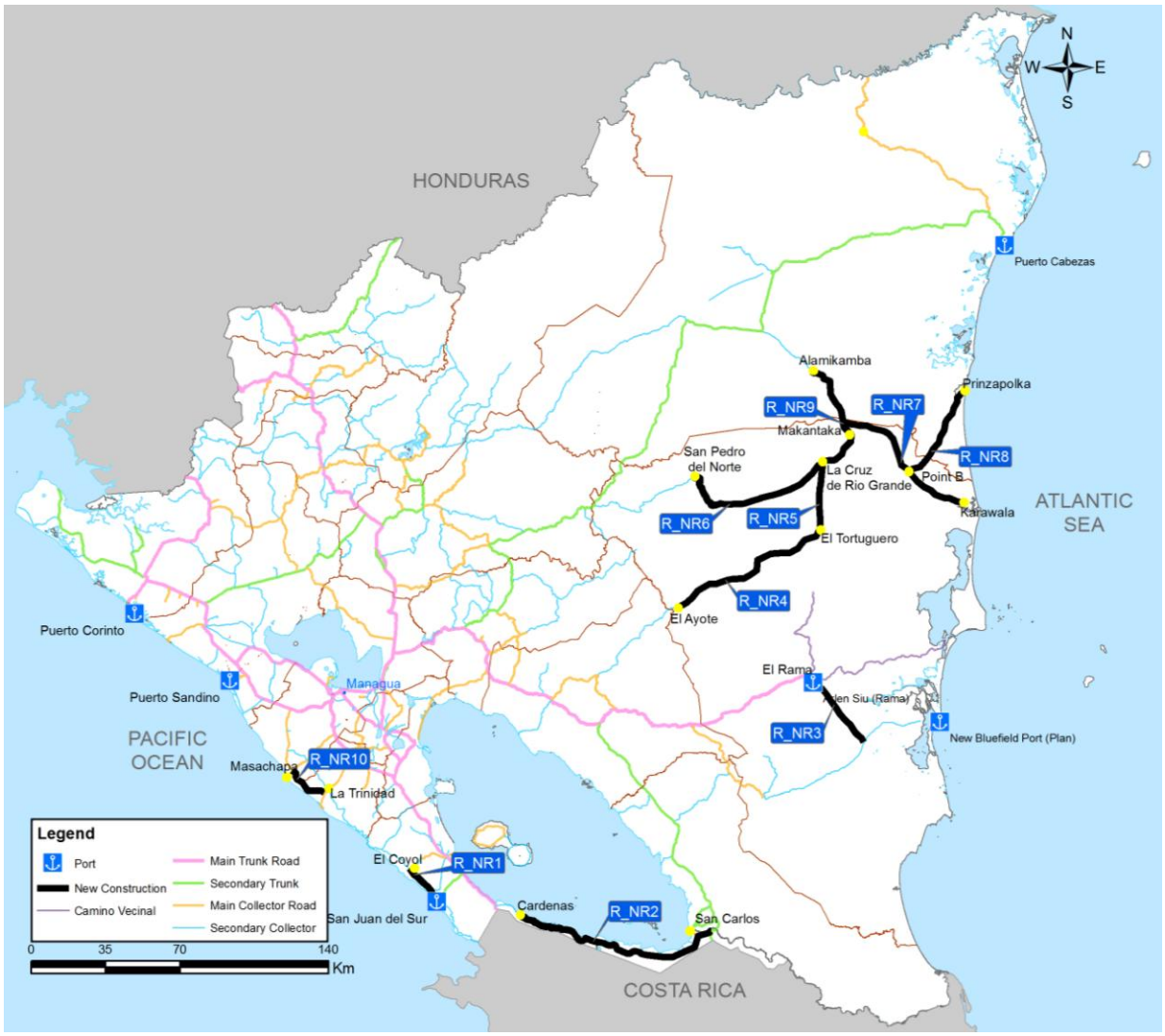


Figure 16.1.11 Other Proposed Roads (Missing Links)
Source: JICA Study Team

3) Outcome

- 27 communities, mostly in the Atlantic side that had no proper road access will be accessible.
- Road network that will strengthen links between the east and the west side will be strengthened.
- Road network that will strengthen links between the north and south side of the country in the eastern region will be strengthened.

16.1.6.2 Improvement of Existing Roads

(1) Widening

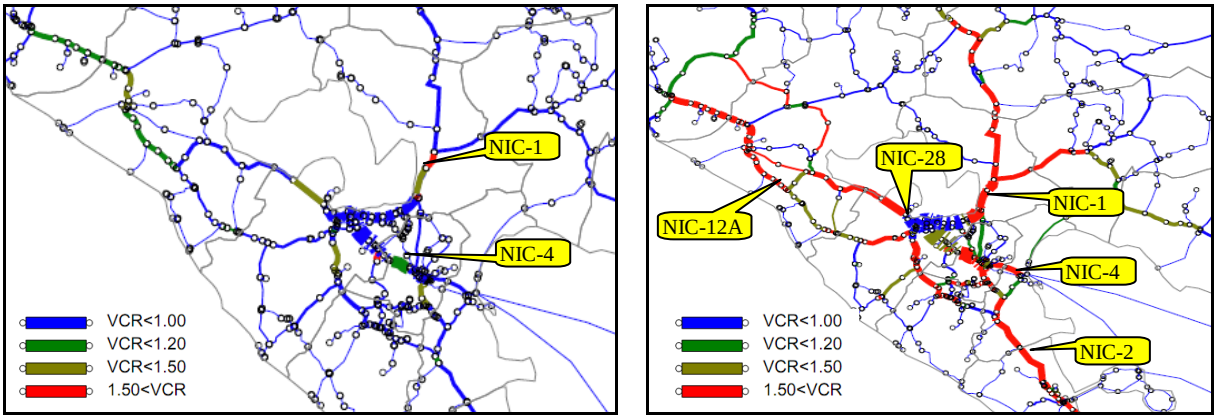
1) Objective

To provide additional lanes on the existing roads for mitigating traffic congestion and improve environment of abutting areas.

2) Description

Figure 16.1.12 shows the volume-capacity ratio (VCR) of the existing roads. The left figure (a) shows the present condition, while the right figure (b) shows the VCR in 2033 without implementation of improvement works. The red line indicates the segments where the traffic volume has exceeded the capacity (VCR>1.5) of the roads. The figure in the left shows that a

segment along NIC-1 and NIC-4 is already experiencing occasional congestion while the figure in the right side shows that the congestion will spread to NIC-2, NIC-12A and NIC-28 including the ones already mentioned above, if remedial works are not undertaken.



(a) VCR of Existing Roads (2013)

(b) VCR of Existing Roads (2033) (without improvement works)

Figure 16.1.12 Volume Capacity Ratio of Existing Roads

Source: JICA Study Team

In order to mitigate the congestion, the roads highlighted in Figure 16.1.13 are proposed for widening. On NIC-4, the segment between Jean Paul Genie Road and Masaya, which is approx. 19.6 km long, is proposed to be widened to 6-lanes from its present 4-lanes. On the other hand, NIC-1, NIC-2, NIC-12A and NIC28) are proposed to be widened to 4-lanes from its present 2-lanes and the total length accounts to approximately 388.2 km. The cross section for rural main trunk as shown in Figure 16.1.4 is proposed. All the segments are proposed to be provided with asphalt pavement.

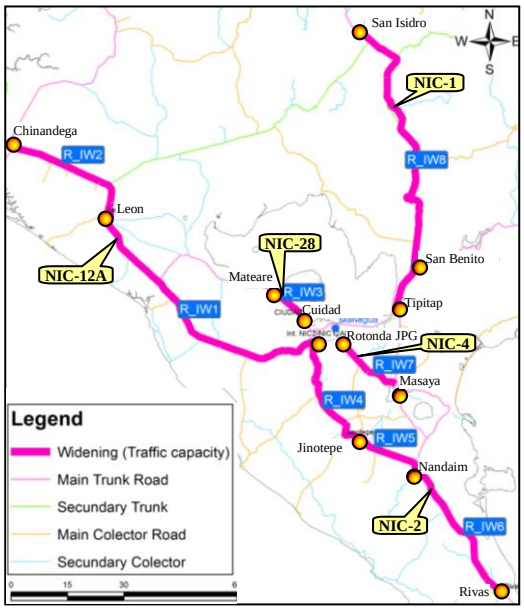


Figure 16.1.13 Segments for Widening

Source: JICA Study Team

3) Outcome

- Secure smooth traffic flow and mitigation of traffic congestion
- Improve environment of suburban and urban areas

(2) Reconstruction of Existing Roads

1) Objective

To reconstruct existing road segments with pavement in significantly deteriorated condition.

2) Description

As mentioned in Chapter 8, a significant segment of secondary trunk roads and collector roads are in deteriorated condition causing abrupt drop of average vehicle speed, significant reduction of level of service and increase of riding discomfort. Also it is in such a state that the vehicles travelling these roads might even suffer damage to their tires, axles, springs and chassis and furthermore, increase the vehicle operation costs and the number of serious accidents.

To remedy the situation, these roads need to be reconstructed. The existing pavement of the damaged sections needs to be demolished, removed and repaved by reposing the road base. The segments of the roads that need to be repaved are indicated by green lines in Figure 16.1.14. These roads have been selected from the importance of role they play in supporting the economic activities of the highly potential productive areas. The segments consist of secondary trunk roads

and main collectors. NIC-9, NIC-12B and NIC21B are secondary trunk roads and totals to an approximate length of 437.5 km. All other roads are main collector and are approximately 388.2 km long. Application of asphalt pavement is proposed for all roads. However, the pavement type particularly for main collector roads is recommended to be reconsidered during the design stage based on the actual requirements of the site.

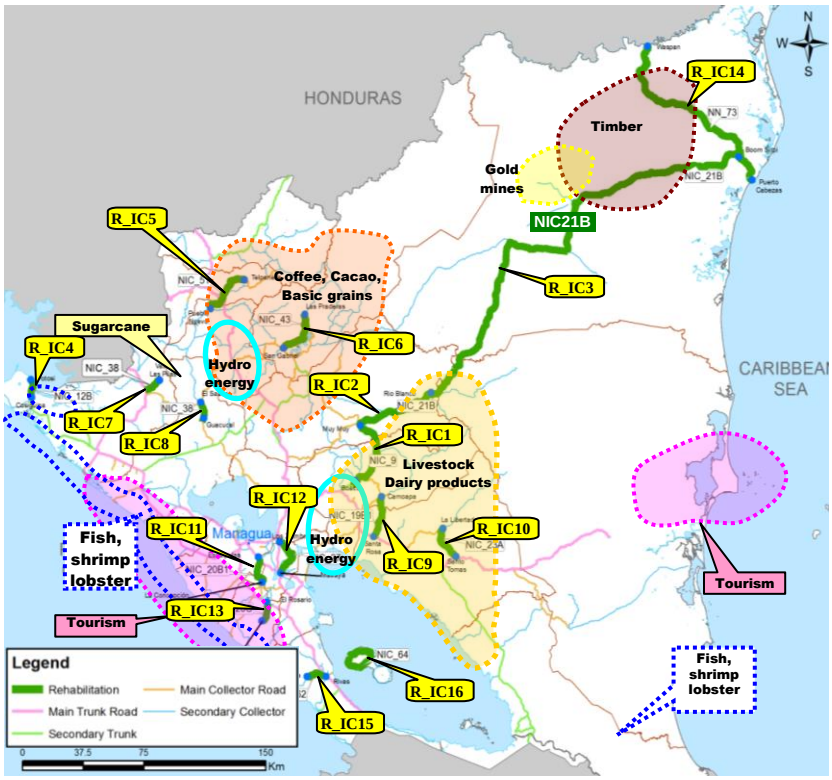


Figure 16.1.14 Segments of Existing Roads Proposed for Reconstruction
Source: JICA Study Team

3) Outcome

- Puerto Cabezas, which is approximately 515 km away from Managua, will be reachable in 8.5 hours; approximately 5 hours faster than now (reduction of travel time by about 40%)
- Reduce vehicle operation cost and contribute in enhancing industrial/agricultural activities
- Increase riding comfort and reduce serious accidents

16.1.6.3 Rehabilitation of Existing Roads

(1) Objective

To rehabilitate existing roads to satisfy the design criteria necessitated by upgrading the functional classification

(2) Description

Figure 16.1.15 shows the segments of the existing roads that are proposed for rehabilitation.

Figure 16.1.15 Proposed Roads for Rehabilitation

Source: JICA Study Team

Rehabilitation consists of upgrading of functional classification, improvement of alignments, carriageway widening, reconstruction of pavement, and other necessary ancillary works. Outline of upgrading with respect to each classification is summarized in Table 16.1.2.

Table 16.1.2 Outline of Proposed Roads for Rehabilitation

Codes	Upgrading Road Class		Reason	Total Length (km)	Remarks
	From	To			
R_IR	S.T	M.T	International corridor Segment	130.0	Only re-classification (No improvement work required)
R_IR9, R_IR10	S.C	M.T	International corridor (Bypass)	70.4	Cross section shown in Figure 16.1.4 (2-lane rural trunk road) to be applied
R_IR1, R_IR2, R_IR8, R_IR13	M.C	S.T	Connects with trunk road at both ends	348.9	
R_IR2-1,R_IR8 -1, R_IR12	S.C	S.T	Connects to international port or to secondary trunk road	293.4	
R_IR4, R_IR6, R_IR7,R_IR11	S.C	M.C	Connects with higher tier of roads	220.7	Cross section shown in Figure 16.1.4 (2-lane main collector) to be applied
R_IR3, R_IR5	Local	S.C	Connects with main collector at either end	156.0	Cross section shown in Figure 16.1.4 (2-lane secondary collector to be applied

Source: JICA Study Team

At this stage, asphalt pavement type is proposed for all roads. However, reconsideration for application of different pavement type, especially on collector roads is recommended during design stage, based on the actual requirements for each road.

(3) Outcome

- Improves hierarchical system of basic road network
- Contributes in strengthening the transport corridors
- Upgrading of R_IR8 and R_IR8-1 will provide an alternate road (redundant road) for NIC-21B to function during natural disaster

16.1.6.4 Pavement and Surface Improvement of Other Roads

(1) Objective

To improve surface condition (pavement) of all roads that doesn't have a hard surface within the basic road network of MTI jurisdiction.

(2) Description

This work aims to undertake refilling and fixing of potholes (gravel road), wearing and rutting of surfaces and provide with a hard surface (asphalt or concrete pavement). The target roads include all roads except for those highlighted in Figure 16.1.16 in the basic road network that lies under MTI jurisdiction. These roads account to a total length of approx. 4,372 km. Breakdown of the roads for each classification is as follows:

a) Secondary trunk road : approx. 37 km
b) Main collector road : approx. 42 km
c) Secondary collector road : approx. 1,793 km
d) Local roads : approx. 2,500 km

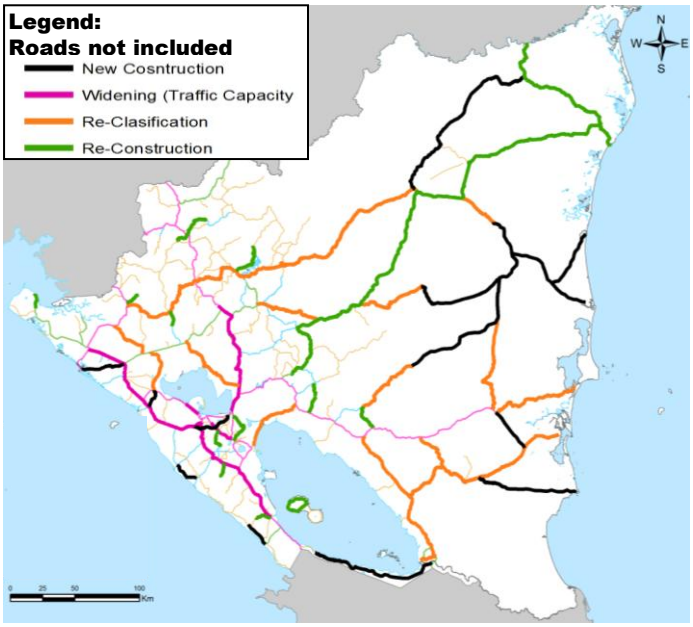


Figure 16.1.16 Roads for Pavement and Surface Improvement
Source: JICA Study Team

(3) Outcome

- Improves reliability and efficiency of existing road network
- Reduces of vehicle operation cost
- Increases travel speed and riding comfort

16.1.6.5 Provision of New Bridges

(1) Objective

To provide structures to span water channels on newly proposed roads and on existing roads where there are no such structures.

(2) Description

The newly proposed roads require provision of bridges at 17 locations. On the other hand, there are 8 locations on the existing roads where there is no bridge (missing link) to cross the river. At some of these locations, for example on Wawa River and Malacatoya River, traffics have to depend on ferries to cross the river, and most of the other locations are passable only during dry season.

Under such situation, provision of bridges is indispensable. Figure 16.1.17 shows the location of these bridges, while the outline of these bridges is listed in Table 16.1.3. The abbreviation 'NB' stand for new bridge on new roads and 'MB' stands for new bridge on missing links.

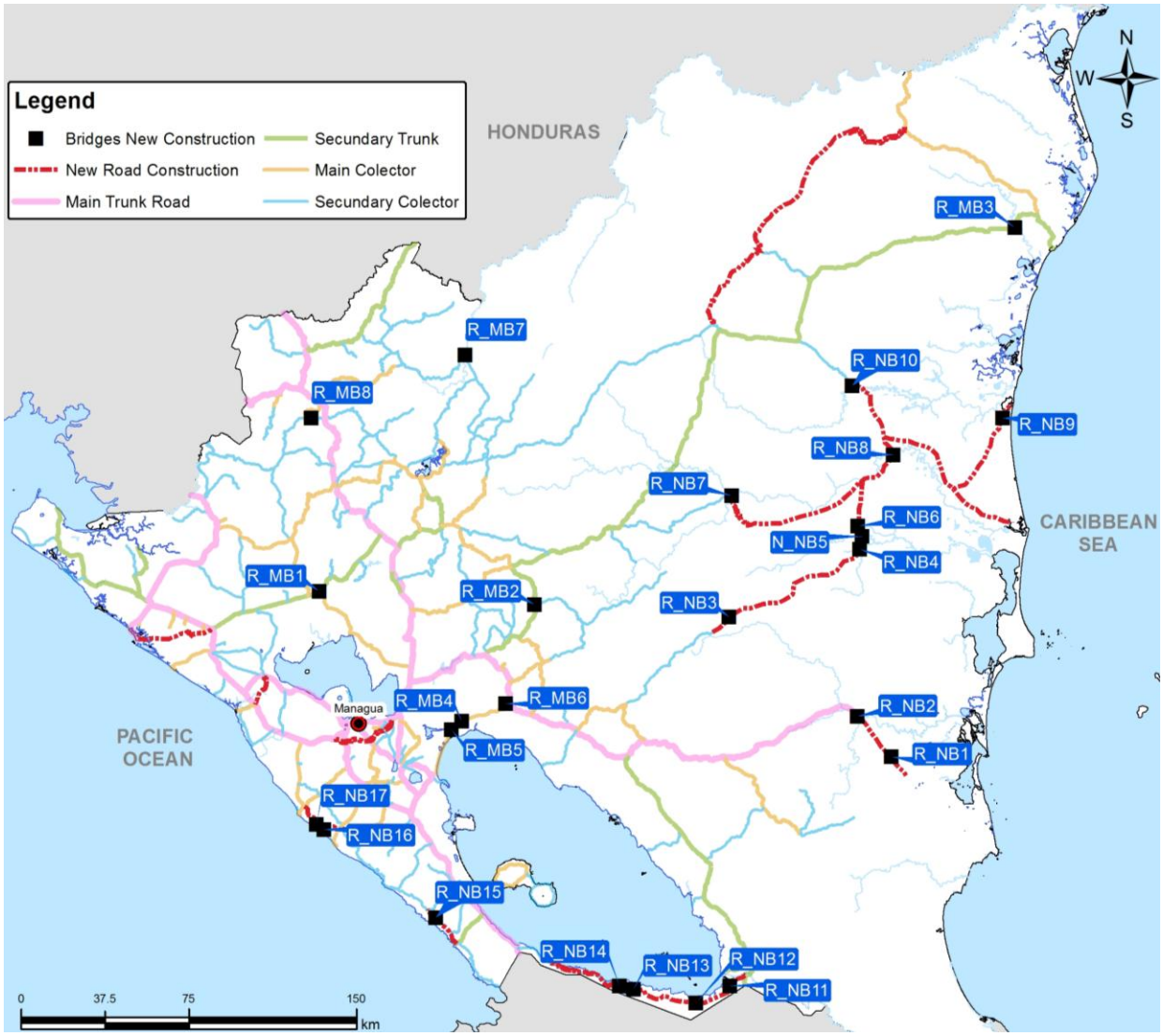


Figure 16.1.17 Location of New Bridges
Source: JICA Study Team

(3) Outcome

- Elimination of missing links and improvement of connectivity of the roads

Table 16.1.3 Outline of Newly Proposed Bridges

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed	
				Type/Width (m)	Length (m)
R_NB1	Mahogany River	R.A.A.S	New (R3) (M.C)	3-span(15+20+15) RC T Girder, w=10.0m	50
R_NB2	El Rama River	R.A.A.S	New (R3) (M.C)	4-span(4 x 50m) PC Box Girder, w=10.0m	200
R_NB3	Nawawas River	R.A.A.S	NN-23B (R4) (M.C)	3-span(3x20) RC T Girder, w=10.0m	60
R_NB4	Waspado River	R.A.A.S	NN-23B (R5) (M.C)	2-span(2x20) RC T Girder, w=10.0m	40
R_NB5	Kurinwas River	R.A.A.S	NN-129 (R5) (M.C)	3-span(15+20+15) RC T Girder, w=10.0m	50
R_NB6	Grande de Matagalpa-1	R.A.A.S	NN-129 (R5) (M.C)	2-span(2 x 17.5) RC T Girder, w=10.0m	35
R_NB7	Grande de Matagalpa-2	R.A.A.S	NIC-13 (R6) (S.C)	3-span(25+25+25) PC I Girder, w=9.0m	75
R_NB8	Makantaka (Rio Grande)	R.A.A.S	NIC-39 (R9) (M.C)	3-span(3x50) PC Box Girder, w=10.0m	150
R_NB9	Kuanwatla	R.A.A.N	New (R8)	2-span(2x15)	30

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed	
				Type/Width (m)	Length (m)
			(S.C)	RC T Girder, w=9.0m	
R_NB10	Alamikamba (Rio Prinzapolka)	R.A.A.N	New (R9) (M.C)	4-span(4x30) PC I Girder, w=10.0m	120
R_NB11	Frio River	Rio S. juan	New (R2) (S.C)	3-span(20+20+20) RC T Girder, w=9.0m	60
R_NB12	Zapote River	Rio S. juan	New (R2) (S.C)	3-span(20+20+20) RC T Girder, w=9.0m	60
R_NB13	Guacalito River	Rio S. juan	New (R2) (S.C)	2-span(2x20) RC T Girder, w-9.0m	40
R_NB14	Colon	Rio S. juan	New (R2) (S.C)	2-span(2x20) RC T Girder, w=9.0m	40
R_NB15	Brito River	Rivas	New (R1) (S.C)	1-span PC I Girder, w=9.0m	35
R_NB16	El Tular River	Carazo	New(R10) (S.C)	1-span PC I Girder, w=9.0m	30
R_NB17	Tecolapa River	Carazo	New (R10) (S.C)	1-span PC I Girder, w=9.0m	32
BM1	Puente El Tamarindo	Leon	NIC-70 A (MC)	4-span(4 x 25) PC I Girder, w=10.0m	100
BM2	Puente Baguas	Boaco	NIC-31 (S.C)	2-span(2 x 18.5) RC T Girder, w=9.0m	37
BM3	Puente Wawa Boom	R.A.A.N	NIC-21B (S.T)	5-span(5x31) PC I Girder, w=10.8m	155
BM4	Puente Malacatoya River	Granada	NIC-39 (M.C)	3-span(3 x 25) PC I Girder, w=10.0m	75
BM5	El Paso de Panaloya	Granada	NIC-39 (M.C)	6-span (6 x 50) PC Box Girder, w=10.0m	300
BM6	Puente Tecolostote #2 (El Papayal)	Boaco	NIC-39 (M.C)	4-span(4 x 25) PC I Girder, w=10.0m	100
BM7	Wiwili	Nueva Segovia	NIC-43&NIC-51 (S.C)	5-span (5 x 50) PC Box Girder, w=9.0m	250
BM8	Puente Rio Abajo	Esteli	NN-8 (M.C)	2-span(2 x 20) RC T Girder, w=10.0m	40

Source: JICA Study Team

16.1.6.6 Replacement of Damaged and Temporary Bridges

(1) Objective

To replace bridges on the existing roads those are structurally weak.

(2) Description

As identified in Chapter 8.2, many crossings on rivers are provided by temporary bridges such as warren truss or those that are currently in a damaged state caused by past disasters. Scouring at piers and abutment is also prominent at many locations. These bridges are very vulnerable not only against natural disasters but also in normal time due to its weak structural condition. Countermeasures to avoid these bridges from falling down or being washed away needs immediate attention. The locations of these bridges are shown in Figure 16.1.18 and the outline is summarized in Table 16.1.4 and Table 16.1.5.

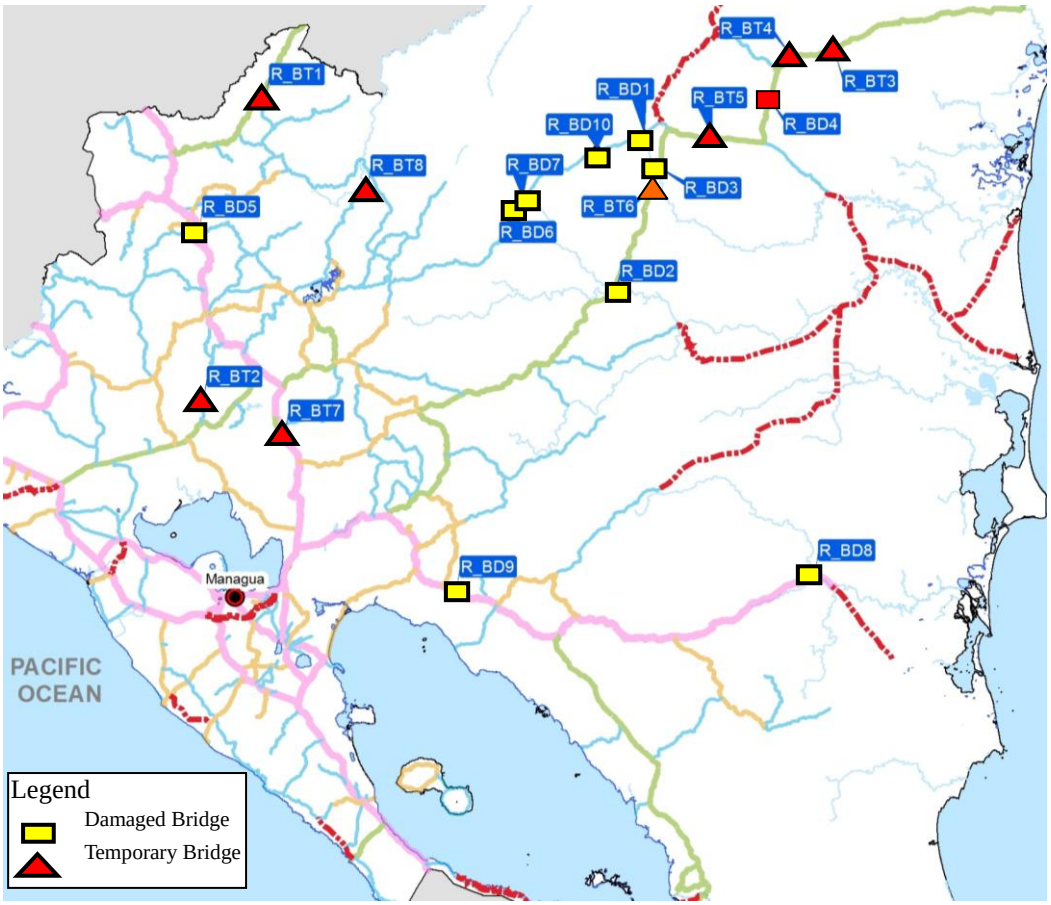


Figure 16.1.18 Location of Damaged and Temporary Bridges
Source: JICA Study Team

Table 16.1.4 Outline of Temporary Bridges to be Replaced

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed	
				Type/Width (m)	Length (m)
R_BT1	Puente San Judas	Nueva Segovia	NN-19 (M.C)	1-span PC I Girder, w=10.0m	25
R_BT2	Puente Santa Rosa Del Penon	Leon	NIC-35C (S.C)	3-span(2x15.5+20) RC T Girder, w=9.0m	51
R_BT3	Puente La Potranca	R.A.A.N	NIC-21B (S.T)	2-span(2x20) RC T Girder, w=10.8m	40
R_BT4	Puente Sunsin No.2	R.A.A.N	NIC-21B (S.T)	2-span(2x18.5) RC T Girder, w=10.8m	37
R_BT5	Puente Rio Luku	R.A.A.N	NIC-21B (S.T)	2-span(2 x 16.5) RC T Girder, w=10.8m	31
R_BT6	Puente Rio Labu	R.A.A.N	NIC-21B (S.T)	3-span(3 x 30) PC I Girder, w=10.8m	90
R_BT7	Puente Pasle	Matagalpa	NN-129 (M.C)	2-span(2 x 17.5) RC T Girder, w=10.8m	35
R_BT8	Puente Rio El Cua (La Maroanosa)	Jinotega	NIC-43 (S.C)	3-span(3 x 25) PC I Girder, w=10.0m	75

Source: JICA Study Team

Table 16.1.5 Outline of Damaged Bridges to be Replaced

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed	
				Type/Width (m)	Length (m)
R_BD1	Puente Wani	R.A.A.N	NIC-5 (S.C to S.T)	3-span(3x47) PC Box Girder, w=10.8m	141
R_BD2	Puente El Tuma (Mulukuku)	R.A.A.S	NIC-21B (S.T)	5-span(3x40+55) PC I Girder, Steel Truss, w=10.8m	175
R_BD3	Puente Prinzapolka	R.A.A.N	NIC-21B (S.T)	3-span(3x31) PC I Girder, w=10.8m	93
R_BD4	Puente Banacruz	R.A.A.N	NIC-21B (S.T)	2-span (2*22.5) RC T Girder, w=10.8	45
R_BD5	Puente Paso Real (Esteli)	Estelí	NIC-3 (S.C to S.T)	3-span (3*25) PC Box Girder, w=10.8m	75
R_BD6	Puente Rio Zinica	R.A.A.N	NIC-5 (S.C to S.T)	2-span (2*20.5) RC T Girder, w=10.8m	41
R_BD7	Puente San Pablo	R.A.A.N	NIC-5 (S.C to S.T)	2-span (2*18) RC T Girder, w=10.8m	36
R_BD8	Puente La Esperanza	R.A.A.S	NIC-7 (M,T)	6-span (2*17+4x50) RC T Girder and PC Box Girder, w=10.8m	234
R_BD9	Puente Cuisala	Chontales	NIC-7 (M,T)	1-span PC Box Girder, w=10.8m	50
R_BD10	Puente Rosa Grande	R.A.A.N	NIC-5 (S.C to S.T)	3-span (2*14+20) RC T Girder, w=10.8m	48

Source: JICA Study Team

(3) Outcome

- Improve connectivity of road network
- Realize reliable structure against disasters

16.1.6.7 Road Disaster Prevention Plan

(1) General

Road disasters in Nicaragua are generally caused by two phenomena; hurricanes (floods, heavy rainfall) and earthquakes. The common disasters triggered by these phenomena are, but not limited to;

- Slope failure
- Rock Fall
- Landslide
- Debris flow
- Collapse of bridge and scouring of bridge pier and foundation

(2) Selection of Countermeasures for each Type of Road Disasters

Selection of countermeasure depends on the type of road disaster to be treated. Wrong selection can result into application of ineffective uneconomic measures. A simple method of selecting suitable countermeasures in relation to the types of road disasters where they are aptly applicable is summarized in Table 16.1.6.

Table 16.1.6 Applicable Countermeasures in Relation to Type of Road Disasters

Countermeasures \ Road Disaster			Cut Slope Failure	Embankment Slope Failure	Fall	Landslide	Debris Flow
Drainage work	Surface drainage		✓	✓	✓	✓	
	Sub-surface drainage		✓	✓		✓	
Protection work	Vegetation		✓	✓	✓	✓	
	Spraying		✓		✓		
	Pitching		✓	✓	✓		
	Crib		✓	✓	✓		
Earthwork	Removal		✓		✓		
	Recutting		✓		✓		
	Re-filling			✓			
	Earth Removal					✓	
	Counterweight					✓	
Structural work	Retaining wall	Stone	✓	✓			
		Gravity	✓	✓		✓	
		Supported	✓	✓			
		Gabion	✓	✓		✓	
	Anchoring		✓		✓		
	Foot protection			✓			
	Piling						
Fixing work	Supporting				✓		
	Anchoring				✓		
Catch work			✓		✓		
Rock fall prevention work					✓		
Hillside work							✓
Torrent work							✓
Sabo work							✓
Avoidance	Route relocation		✓				✓
	Bridge		✓				✓

Source: JICA Study Team

16.1.6.8 Proposed Development Projects

The projects that can be proposed from among the improvement works identified in the previous section can be divided into road and bridge related projects. Projects related to roads are summarized in Table 16.1.7 under the following categories.

i) New road construction (Road network improvement)

ii) Road improvement (Capacity enhancement)

iii) Improvement/upgrading road class

iv) Improvement/rehabilitation

Similarly, the projects related to bridge are summarized under the following categories.

i) Newly proposed bridges on new proposed roads

ii) Newly proposed bridges existing roads (Missing link)

iii) Replacement of temporary or damaged bridges

iv) Repairing of temporary or damaged bridges

Table 16.1.7 Proposed Road Projects (1/2)

Code	Road Segment (From - To)	Proposed			Cost (million US$)	Remarks (Supporting Sytrategies)
		Road Class	No. of Lanes	Length (km)		
Grand Total					**7663.892**	
New Roads				**793.4**	**874.88**	
R_PR1	Chiquilistagua(NIC-12) - San Benito(NIC-1)	M.T(Urban)	4	32.6	183.119	SR-2, SR-4
R_NR1	San Juan del Sur - El Coyol	S.C	2	22.5	17.63	SR-2
R_NR2	Cardenas - Santa Fé	S.C	2	102.0	75.934	SR-2
R_NR3	El Rama - Las Brenas	M.C	2	36.0	42.306	SR-1, SR-2, SR-3
R_NR4	El Ayote - El Tortuguero	S.C	2	82.7	70.167	SR-3
R_NR5	El Tortuguero - La Cruz De Río Grande	M.C	2	32.0	26.348	SR-3
R_NR6	San Pedro del Norte - La Cruz De Río Grande	S.C	2	76.5	60.628	SR-3
R_NR7	Makantaka - Karawala	S.C	2	72.1	49.15	SR-3
R_NR8	Point B (Marinlaya Creek) - Prinzapolka	S.C	2	47.0	32.112	SR-3
R_NR9	La Cruz de Río Grande - Alamikamba	M.C	2	62.5	51.516	SR-3
R_NR10	La Trinidad - Masachapa	S.C	2	25.0	22.611	SR-3
R_NR11	Siuna - Bonanza	M.C	2	55.0	53.508	SR-3, SR-5
R_NR12	Bonanza - Point C (La Tronquera)	M.C	2	99.0	72.134	SR-3, SR-5
R_NR13	Empalme Puerto Sandino - La Paz Centro	M.T	4	15.5	40.677	SR-1, SR-2, SR-3
R_NR14	Empalme de Telica - Puerto Corinto	M.T	4	33.0	77.04	SR-1, SR-2, SR-3
Improvement (Widening of main trunk road for increasing capacity)					**1127.9**	
R_IW1	NIC-2 Int. - Leon (NIC-12A)	M.T	4 (2)	87.3	225.78	SR-1,SR-4
R_IW2	Leon - Chinandega (NIC-12A)	M.T	4 (2)	57.4	158.07	SR-1,SR-4
R_IW3	C. Sandino - Mateare (NIC-28)	M.T	4 (2)	17.8	46.55	SR-1,SR-4
R_IW4	NIC-12A Int. – Jinotepe (NIC-2)	M.T	4 (2)	44.0	123.90	SR-1,SR-4
R_IW5	Jinotepe - Nandaime (NIC-2)	M.T	4 (2)	36.5	84.38	SR-1,SR-4
R_IW6	Nandaime - Rivas (NIC-2)	M.T	4 (2)	51.9	129.14	SR-1,SR-4
R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)	M.T	6 (4)	19.6	116.27	SR-1,SR-4
R_IW8	Tipitapa – San Isidro (NIC-1)	M.T	4 (2)	93.3	243.78	SR-1,SR-4
Improvement (Reconstruction of pavement, no widening)					**387.53**	
R_IC1	Boaco - Muy Muy (NIC-9)	S.T	2	50.9	25.22	SR-3,SR-5
R_IC2	Muy Muy - Rio Blanco (NIC-21B)	S.T	2	58.5	27.32	SR-3,SR-5
R_IC3	Rio Blanco - Puerto Cabezas (NIC-21B)	S.T	2	315.7	158.42	SR-1,SR-2,SR-3,SR-5
R_IC4	Cosiguina - Potosi (NIC-12B)	S.T	2	12.4	5.60	SR-1,SR-2,SR-3,SR-5
R_IC5	Telpaneca - Pueblo Nuevo (NIC-38&51)	M.C	2	53.0	23.95	SR-2,SR-5
R_IC6	Cuyalli – San Rafael Del Norte (NIC-41)	M.C	2	36.9	15.24	SR-3,SR-5
R_IC7	NIC-24B – Ville Las Pilas (NN-270)	M.C	2	11.5	5.20	SR-3,SR-5
R_IC8	El Sauce – Guacucal (NIC-38)	M.C	2	10.6	4.38	SR-3,SR-5
R_IC9	Santa Rosa – Camoapa (NIC-19B1)	M.C	2	27.8	12.56	SR-2
R_IC10	La libertad – Santo Tomas (NIC-23A)	M.C	2	22.9	10.35	SR-2
R_IC11	Esquipulas – La Concepcion (NIC-20B1)	M.C	2	18.8	6.60	SR-2,SR-5
R_IC12	Masaya - Zambrano (NIC-27)	M.C	2	25.0	11.63	SR-2,SR-4
R_IC13	El Rosaria – La Conquista (NIC-20C)	M.C	2	13.5	5.58	SR-2
R_IC14	Boom Siril – Waspan (NN-73)	M.C	2	115.0	51.97	SR-3,SR-5
R_IC15	Rivaz - Tola (NIC-62)	M.C	2	13.2	5.45	SR-2,SR-5
R_IC16	Peripheral road Ometepe Island (NIC-64)	M.C	2	40.0	18.08	SR-3,SR-5

Note: Numbers inside parenthesis is the initial number of lanes

M.T.:Main Trunk, S.T.: Secondary Trunk, M.C.:Main Collector, S.C.:Secondary Collector

Source: JICA Study Team

Table 16.1.7 Proposed Road Projects (2/2)

Code	Road Segment (From - To)	Proposed			Cost (million US$)	Remarks (Supporting Sytrategies)
		Road Class	No. of Lanes	Length (km)		
Rehabilitation (widening of existing, re-classification for satisfying)				**1089.4**	**911.8**	
R_IR1	Granada - Tecolostote (NIC-39)	M.C to S.T	2	54.3	47.80	SR-2, SR-4
R_IR2	La Gateada - Nueva Guinea (NIC-71)	M.C to S.T	2	58.5	50.32	SR-1, SR-2
R_IR2-1	Nueva Guinea - Bluefields (NIC-71)	S.C to S.T	2	77.2	68.42	SR-1, SR-2,SR-3
R_IR3	EI Rama - Kukra Hills - Laguna de Perlas	Local to S.C	2	71.0	39.10	SR-2, SR-3
R_IR4	Santa Domingo - EI Ayote (NIC23B)	S.C to M.C	2	53.0	31.57	SR-2, SR=3
R_IR5	Nueva Esparanza - EI Tortuguero	Local to S.C	2	85.0	48.70	SR-2
R_IR6	Rio Blanco - San Pedro del Norte (NIC-13C)	S.C to M.C	2	71.5	39.85	SR-2, SR-3
R_IR7	Empalme Almikamba - Alamikamba (NN-2)	S.C to M.C	2	34.0	24.77	SR-3
R_IR8	EI Escudo - Empalme La Viola (Various)	M.C to S.T	2	175.0	268.00	SR-1, SR-2, SR-3, SR-5
R_IR8-1	Empalme La Viola. - Siuna (NIC-21B) (NIC-57 54&5)	S.C to S.T	2	175.0	Included	SR-1, SR-2, SR-3, SR-5
R_IR9	Malpaisillo - Villa 15 de Julio (NIC68INN252)	S.C to M.T	4	34.0	80.58	SR-1, SR-4
R_IR10	La Paz Centro - Malpaisillo (NIC-22)	S.C to M.T	4	36.4	86.87	SR-1, SR-4
R_IR11	Empalme San Ramon - Matiguas (NIC-33)	S.C to M.C	2	62.2	36.68	SR-2, SR-5
R_IR12	Pajaro Negro - EI Triunfo (NN-114)	S.C to S.T	2	41.2	35.33	SR-1, SR-3
R_IR13	EI Empalme - San Jacinto (NIC-70A)	M.C to S.T	2	61.1	53.85	SR-1, SR-2,SR-4
Improvement (Pavement program + local road improvement)				-	**1824.40**	
R_IR	All roads without hard pavement in the basic network of 8,500 km that is not included in the above list			4,372	1824.40	All Strategies
Maintenance work (85.9 million US$ 1st year and increment of 1.3 million US$ per year)					**2506.90**	
R_MR	Maintenance of entire basic network (8,500km+newly proposed road including bridges)			-	2506.90	All Strategies
Protection works against disasters					**30.50**	
R_DM	Provision and replacement of culverts, provision of falling prevention device on existing bridge, road slope protection scour protection at substructures			-	30.50	SR-5

Note: Numbers inside parenthesis is the initial number of lanes
M.T.:Main Trunk, S.T.: Secondary Trunk, M.C.:Main Collector, S.C.:Secondary Collector

Source: JICA Study Team

Table 16.1.8 Proposed Bridge Projects (1/2)

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed		Cost million US$	Remarks (Supporting Sytrategies)
				Type/Width (m)	Length (m)		
GRAND TOTAL						**148.84**	
NEW BRIDGES (on proposed road)						**47.24**	
R_NB1	Mahogony River	R.A.A.S	New (R3) (M.C)	3-span(15+20+15) RC T Girder, w=10.0m	50	1.51	SR-1 , SR-2, SR-3
R_NB2	El Rama River	R.A.A.S	New (R3) (M.C)	4-span(4 x 50m) PC Box Girder, w=10.0m	200	12.04	SR-1 , SR-2, SR-3
R_NB3	Nawawas River	R.A.A.S	NN-23B (R4) (M.C)	3-span(3x20) RC T Girder, w=10.0m	60	1.34	SR-3
R_NB4	Waspedo River	R.A.A.S	NN-23B (R5) (M.C)	2-span(2x20) RC T Girder, w=10.0m	40	1.21	SR-3
R_NB5	Kurinwas River	R.A.A.S	NN-129 (R5) (M.C)	3-span(15+20+15) RC T Girder, w=10.0m	50	1.51	SR-3
R_NB6	N/A	R.A.A.S	NN-129 (R5) (M.C)	2-span(2 x 17.5) RC T Girder, w=10.0m	35	0.95	SR-3
R_NB7	Grande de Matagalpa	R.A.A.S	NIC-13 (R6) (S.C)	3-span(25+25+25) PC I Girder, w=9.0m	75	1.65	SR-3
R_NB8	Makantaka (Rio Grande)	R.A.A.S	NIC-39 (R9) (M.C)	3-span(3x50) PC Box Girder, w=10.0m	150	9.94	SR-3
R_NB9	Kuanwatla	R.A.A.N	New (R8) (S.C)	2-span(2x15) RC T Girder, w=9.0m	30	0.82	SR-3
R_NB10	Alamikamba (Rio Prinzapolka)	R.A.A.N	New (R9) (M.C)	4-span(4x30) PC I Girder, w=10.0m	120	8.81	SR-3
R_NB11	Frio River	Rio S. juan	New (R2) (S.C)	3-span(20+20+20) RC T Girder, w=9.0m	60	1.32	SR-3
R_NB12	Zapote River	Rio S. juan	New (R2) (S.C)	3-span(20+20+20) RC T Girder, w=9.0m	60	1.32	SR-3
R_NB13	Guacalito River	Rio S. juan	New (R2) (S.C)	2-span(2x20) RC T Girder, w-9.0m	40	1.09	SR-3
R_NB14	Colon	Rio S. juan	New (R2) (S.C)	2-span(2x20) RC T Girder, w=9.0m	40	1.09	SR-3
R_NB15	Brito River	Rivas	New (R1) (S.C)	1-span PC I Girder, w=9.0m	35	0.95	SR-2, SR-3
R_NB16	El Tular River	Carazo	New(R10) (S.C)	1-span PC I Girder, w=9.0m	30	0.82	SR-2, SR-3
R_NB17	Tecolapa River	Carazo	New (R10) (S.C)	1-span PC I Girder, w=9.0m	32	0.87	SR-2, SR-3
NEW BRIDGES (to connect missing link)						**46.57**	
BM 1	Puente El Tamarindo	Leon	NIC-70 A (MC)	4-span(4 x 25) PC I Girder, w=10.0m	100	1.70	SR-2, SR-5
BM 2	Puente Baquas	Boaco	NIC-31 (S.C)	2-span(2 x 18.5) RC T Girder, w=9.0m	37	1.01	SR-2, SR-5
BM 3	Puente Wawa River	R.A.A.N	NIC-21B (S.T)	5-span(5x31) PC I Girder, w=10.8m	155	6.33	SR-l , SR-2, SR-3,SR-5
BM 4	Puente Malacatoya River	Granada	NIC-39 (M.C)	3-span(3 x 25) PC I Girder, w=10.0m	75	1.67	SR-2
BM 5	El Paso de Panaloya	Granada	NIC-39 (M.C)	6-span (6 x 50) PC Box Girder, w=10.0m	300	18.06	SR-2
BM 6	Puente Tecolostote #2 (El Papayal)	Boaco	NIC-39 (M.C)	4-span(4 x 25) PC I Girder, w=10.0m	100	1.69	SR-l , SR-2
BM 7	Wiwili	Nueva Segovia	NIC-43&NIC-51 (S.C)	5-span (5 x 50) PC Box Girder, w=9.0m	250	14.90	SR-2, SR-3
BM 8	Puente Rio Abajo	Esteli	NN-8 (M.C)	2-span(2 x 20) RC T Girder, w=10.0m	40	1.21	SR-2, SR-3

Source: JICA Study Team

Table 16.1.8 Proposed Bridge Projects (2/2)

Code	Bridge or River Name	Location (Dept)	Road Name (Class)	Proposed		Cost million US$	Remarks (Supporting Sytrategies)
				Type/Width (m)	Length (m)		
REPLACEMENT OF SUBSTANDARD BRIDGES (Temporary)						**12.51**	
R_BT1	Puente San Judas	Nueva Segovia	NN-19 (M.C)	1-span PC I Girder, w=10.0m	25	0.76	SR-2, SR-3,SR-5
R_BT2	Puente Santa Rosa Del Penon	Leon	NIC-35C (S.C)	3-span(2x15.5+20) RC T Girder, w=9.0m	51	1.39	SR-2, SR-5
R_BT3	Puente La Potranca	R.A.A.N	NIC-21B (S.T)	2-span(2x20) RC T Girder, w=10.8m	40	1.23	SR-l, SR-2, SR-3,SR-5
R_BT4	Puente Sunsin No.2	R.A.A.N	NIC-21B (S.T)	2-span(2x18.5) RC T Girder, w=10.8m	37	1.21	SR-l, SR-2, SR-3,SR-5
R_BT5	Puente Rio Luku	R.A.A.N	NIC-21B (S.T)	2-span(2 x 16.5) RC T Girder, w=10.8m	31	1.01	SR-l, SR-2, SR-3,SR-5
R_BT6	Puente Rio Labu	R.A.A.N	NIC-21B (S.T)	3-span(3 x 30) PC I Girder, w=10.8m	90	4.20	SR-l, SR-2, SR-3,SR-5
R_BT7	Puente Pasle	Matagalpa	NN-129 (M.C)	2-span(2 x 17.5) RC T Girder, w=10.8m	35	1.06	SR-2, SR-5
R_BT8	Puente Rio El Cua (La Maroanosa)	Jinotega	NIC-43 (S.C)	3-span(3 x 25) PC I Girder, w=10.0m	75	1.65	SR-2, SR-5
REPLACEMENT OF SUBSTANDARD BRIDGES (Damaged)						**42.52**	
R_BD1	Puente Wani	R.A.A.N	NIC-5 (S.C to S.T)	3-span(3x47) PC Box Girder, w=10.8m	141	6.15	SR-l, SR-2, SR-3,SR-5
R_BD2	Puente El Tuma (Mulukuku)	R.A.A.S	NIC-21B (S.T)	5-span(3x40+55) PC I Girder, Steel Truss,	175	7.76	SR-l, SR-2, SR-3,SR-5
R_BD3	Puente Prinzapolka	R.A.A.N	NIC-21B (S.T)	3-span(3x31) PC I Girder, w=10.8m	93	3.97	SR-l, SR-2, SR-3,SR-5
R_BD4	Puente Banacruz	R.A.A.N	NIC-21B (S.T)	2-span (2*22.5) RC T Girder, w=10.8	45	1.43	SR-l, SR-2, SR-3,SR-5
R_BD5	Puente Paso Real (Esteli)	R.A.A.N	NIC-3 (S.C to S.T)	3-span (3*25) PC Box Girder, w=10.8m	75	1.80	SR-l, SR-2, SR-3,SR-5
R_BD6	Puente Rio Zinica	R.A.A.N	NIC-5 (S.C to S.T)	2-span (2*20.5) RC T Girder, w=10.8m	41	1.34	SR-l, SR-2, SR-3,SR-5
R_BD7	Puente San Pablo	R.A.A.N	NIC-5 (S.C to S.T)	2-span (2*18) RC T Girder, w=10.8m	36	1.18	SR-l, SR-2, SR-3,SR-5
R_BD8	Puente La Esperanza	R.A.A.S	NIC-7 (M,T)	6-span (2*17+4x50) RC T Girder and PC Box Girder, w=10.8m	234	14.99	SR-l, SR-2, SR-5
R_BD9	Puente Cuisala	Chontales	NIC-7 (M,T)	1-span PC Box Girder, w=10.8m	50	2.33	SR-l, SR-2, SR-3,SR-5
R_BD10	Puente Rosa Grande	R.A.A.N	NIC-5 (S.C to S.T)	3-span (2*14+20) RC T Girder, w=10.8m	48	1.57	SR-l, SR-2, SR-3,SR-5

Source: JICA Study Team

16.2 Road Safety Development Plan

16.2.1 Introduction

Traffic accidents are caused by a combination of various factors. Any combination of many factors may result in an accident. Since traffic accidents generally cannot be attributed to a single cause, effective road safety improvement measures require an approach from the standpoint of the so-called "the three (3) Es" that is 'Engineering', 'Education' and 'Enforcement'.

Based on the foregoing "the three Es" principle, current situation on road safety will be identified as follows; road safety facilities, vehicle inspection, traffic accident characteristics, emergency assistance, road safety education, road user behaviors and traffic laws and regulations. Especially, contributing factors of traffic accident in Nicaragua will be verified by the accident data base, road structure and physical/mental conditions of drivers and pedestrians, in order to plan appropriate and rational safety development plan. The road safety development plan will be proposed through the discussion of current problems and issues from the "the three Es" aspect that is 'Engineering', 'Education' and 'Enforcement'. With regard to the road safety facility measures, the plan is composed of the improvement plan for whole national roads and the plan for project roads.

16.2.2 Installation of Road Safety Facilities

In general, at a national level, road safety facilities are not in place. From the engineering point of view, current traffic accidents are generally caused by lack of a well-developed traffic management facility such as signal lights, marking of channelization including center line and pedestrian crossing, regulatory/warning facilities, and insufficient side clearance of the road. In addition, it

is seen that the occurrence of traffic accidents around intersections, including merging/diverging from the side roads is extremely high. In terms of driver and pedestrian behavior, it is observed that drivers generally pay little attention to the pedestrians and hazardous locations along the national roads. This attitude must be changed with pedestrian traffic considered as important as vehicular traffic, through the provision of safe and convenient facilities and the according of sufficient priority to pedestrians on roads. In order to understand the merits of road safety facilities, it is necessary that the road safety facility should be installed in the correct place. The typical hazardous locations (black Spots) are defined by the sections of small radius bend, long straight, major intersection, in front of public building, entrance of town/village, entrance of bridge, and animal crossings. The basic combination plan for the installation of road safety facilities at typical hazardous locations is shown in Figure 16.2.1, and a typical combination plan of road safety facilities is illustrated in Figure 16.2.1. It is highly recommended that the road safety facility at the hazardous locations (black spots) will be installed based on the typical combination plan.

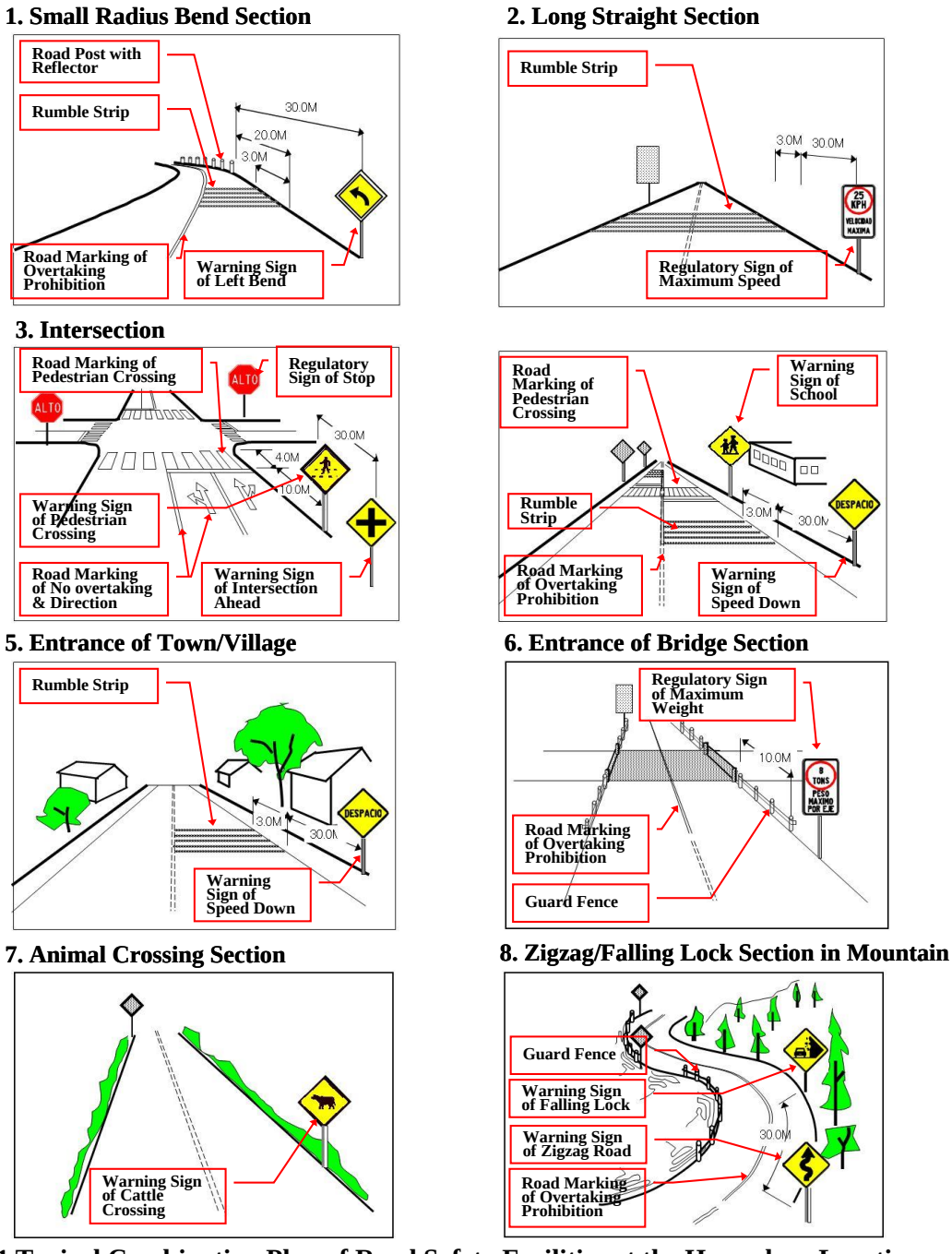


Figure 16.2.1 Typical Combination Plan of Road Safety Facilities at the Hazardous Locations

Source: JICA Study Team

16.2.3 Practical Realization and Enhancement for the Road Safety National Committee

At present, the road safety system has generally established involving key government agencies such as Road Safety National Committee (hereinafter refer to as the "CONASEV"), MTI/local governments, National Police and Ministry of Education. However, the present CONASEV is not retained sufficient function. In order to implement a good coordination and management, via the CONASEV, the CONASEV will be enhanced by the staff's reinforcement and it function.

(1) Enhancement Plan of CONASEV Function

CONASEV office should be early break away from the National Traffic Safety Area (DSTN, Dirección Seguridad de Transito Nacional in Spanish) a Secretariat, and the CONASEV should hold an independent authority and will be enhanced by effective function and staffing. The CONASEV should function as four (4) sections, in order to implement their duties of administration, statistical data, training and education, and operation and management. The staff for CONASEV will be seconded to the secretariat from member agencies such as the MTI, National Police and etc. The organization and activities of the CONASEV are shown in Figure 16.2.2.

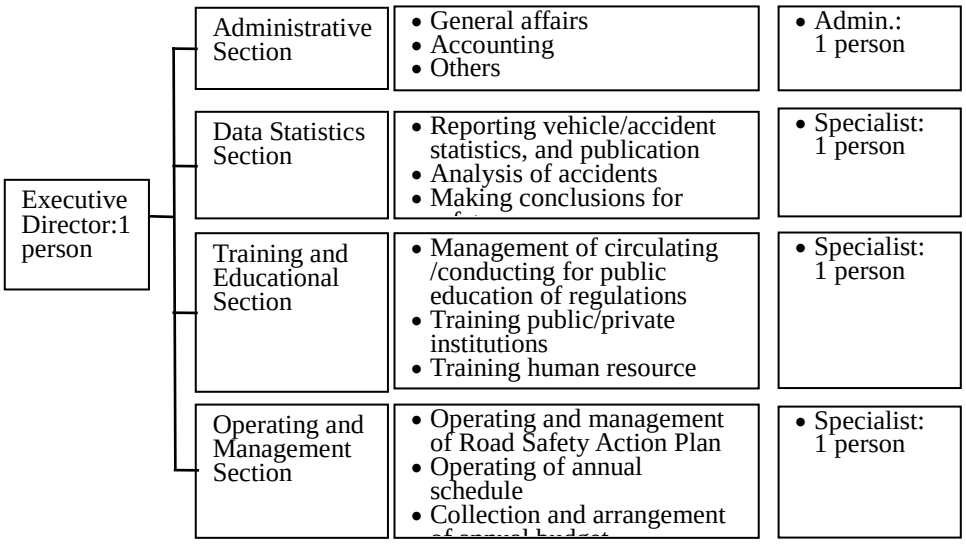


Figure 16.2.2 Proposed Organization and Activities of CONASEV
Source: JICA Study Team

The CONASEV, as an advisor to the National Police, has the following functions:

a) Promote civil society participation in the problem of land traffic, particularly the safety of the population, road safety education and accident prevention.

b) Coordinate the actions of private organism carrying out activities related to education and road safety.

c) Propose and promote education provisions and actions for traffic and accident prevention to the National Police and Traffic Safety specialists.

d) In coordination with the Ministry of Transportation and Infrastructure, provide advice on the organization, planning and supervision of road safety education programs promoted by the Enforcement Authority of this Law.

e) Establish the necessary coordination with national and international organizations, with the aim of promoting mutual cooperation with the implementing authority of this Law in order to provide support in the implementation of road safety education and accident prevention projects and any other functions as stipulated by law.

(2) Formulation of 5-Year Action Road Safety Programs (5-Year RSAP)

The CONASEV has established National Road Safety Strategy (NRSS) 2005-2010 in order to

reduce road traffic accidents. However, as the result of the report (EVALUACIÓN DE LA ESTRATEGIA NACIONAL DE SEGURIDAD VIAL 2005-2010, AGOSTO 2013) for the assessment of road safety strategy, the report is mentioned that many results were not achieved. It is necessary that the method and the strategy of the NRSS should be revised.

In response on the situation above, it was identified that the measures from "the 3 Es" aspect will be established in accordance with a consistent policy of the target final goal and systematic schedule. It is, therefore, recommended that the 5-Year RSAP should be revised as the 5-Year National Road Safety Strategy for CONASEV. The overall RSAP is proposed as below:

1. Enforcement of National Road Safety Committee (CONASEV) for coordination and management of road safety
2. Road accident data system
3. Road safety funding
4. Road safety audit-hazardous locations (Traffic Accident Monitoring System)
5. Road environment and road design
6. Road safety education for children
7. Law enforcement
8. Technical inspection
9. Drivers training
10. Emergency assistance to traffic victims
11. Road safety public campaign
12. Partnerships with private and non government organization
13. Road accident costing
14. Road safety research institution

(3) Objectives

The objective of traffic accident monitoring plan is to formulate the accident monitoring system by introducing five functions of database system, analysis system, planning system, implementation system, and follow-up system, for target groups of road planners and engineers and National Police.

(4) Formulation of Traffic Accident Monitoring Plan by Target Group

The target group for the traffic accident monitoring plan (hereinafter refer to as the "TAMS) will be divided to two (2) groups; a) road planners and engineers for relevant government agencies such as CONASEV, MTI, MECD, AMUNIC, MINSA and etc., and b) National Police such as researcher and statistics specialist for traffic accidents. The traffic accident monitoring plan focuses on the introduction of technical method for traffic accident measures. The traffic accident monitoring plan (TAMS) consists of the following five (5) functions (see Figure 16.2.3):

- Investigation and database system: study of accident statistics, and investigation of user's behavior;
- Analysis on hazardous locations and confirmation of problems: examination of accident records, collection of relevant materials, field investigation, extraction of accident pattern frequently, and presumption of accident causes;
- Planning of measures: selection of measures corresponding to presumed causes, examination of applicability on measures, clarification of effects and side effects of measures, and examination of combination on measures;
- Implementation of countermeasures: cost estimation for measures, examination of finance, consultation with agencies concerned, explanation to residents, decision on sequence of implementation, and implementation, and
- Follow-up system: measurement of effect of countermeasures, comparison before and after, campaign of traffic safety education, and strengthen of traffic enforcement by traffic police

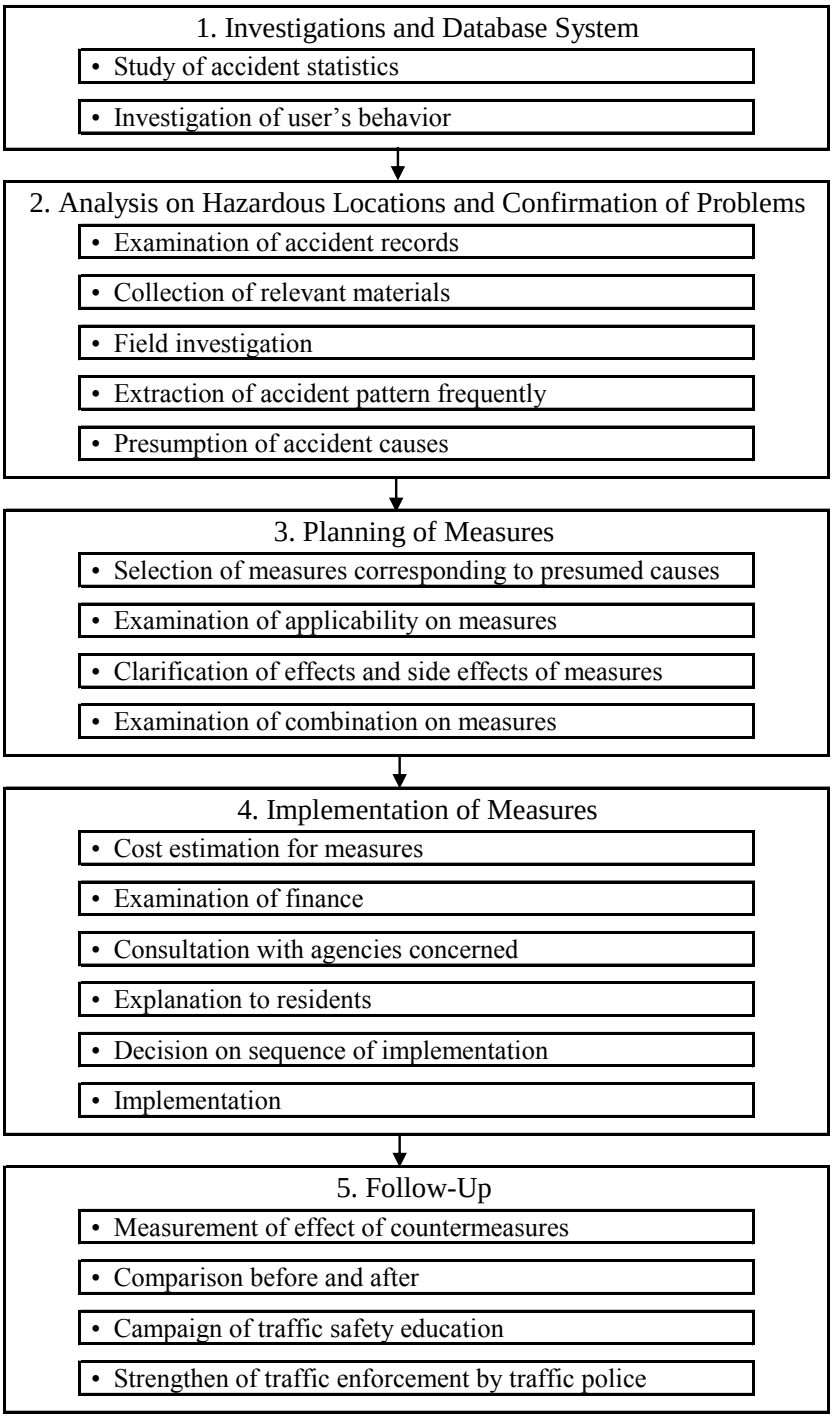


Figure 16.2.3 Procedure of Key Works for TAMS
Source: JICA Study Team

(5) Traffic Accident Database System

1) Coded Items for the Accident-Recording Sheet

Information for any one accident should be contained in a single accident report form, and should be designed so that it can be used directly for computer data entry. Current coded items of accident-recording sheets in Nicaragua are insufficient for assessment of road safety. The information related to collision type and location details should be revised, in order to analyze hazardous locations (black spots) and confirmation of problems. The type of collision and road conditions should be described in more detail.

The following coded items by category will be proposed in the formulation of accident-recording

sheet as shown in Table 16.2.1.

Table 16.2.1 Coded Items by Category for Accident-Recording Sheet

Category	Major Items
1. Registration of report	• Police station/report No./officer name/date.
2. Date of accident	• DD/MM/YY
3. Time of accident	• H/M
4. Severity of accident (4 items)	• Fatal injury/serious injury/slight injury/damage only
5. Place of accident (4 items)	Street name/administrative zone/detailed location (distance from landmark)/GPS coordinates (in middle term)
6. Weather conditions (4 items)	Clear/cloudy/foggy/rain.
7. Road type (18 items)	Straight/roundabout/curve/X-junction/T-junction/Y-junction/bridge/ slope National road//km No./major road in city/minor road in city/local road/other Paved/unpaved/construction site/unknown
8. Cause of accident (36 items)	Human error: speed/failure to respect traffic rights/failure to respect/ right of way/driving against flow of traffic/failure to respect traffic signs/ dangerous over taking/using mobile phone/wrong use of high beam/alcohol abuse/drug abuse/careless lane change/fatigue or illness/other Road condition: potholes/dirt/sand/gravel/dust/animal on the road/ object on the road/other Weather condition: Rain/cloudy/mist/wet road/other Vehicle defeat: brake failure/tire blow out/steering wheel failure/ headlight failure/load falling off/other
9. Collision type (12 items)	Head-on/rear end/right-angle/side swipe/overturned/fell alone (for two wheelers)/hit object on the road/hit object off the road/ hit parked vehicle/hit pedestrian/hit animal/other
10. Hit and run	Yes/No
11. Vehicle involved (10 items)	Bus/minibus/microbus/trailer/truck/pickup/car/motorcycle/ mototaxi (Caponera)/other
12. Movement condition (10 items)	Going straight ahead/right turn/left-turn/U-turn/overtaking/ reversing/sudden start/sudden stop/parking/other
13. Violation (9 items)	Excess speed/driving against traffic flow/failure to respect right of way/failure to respect necessary distance/careless lane change/ without driving license/aggressive driving/mechanical failure/ other
14. Driver: name/gender/age	Xxxx/male/female/xx
15. Driver: residence (4 items)	Province/other province/foreigner/unknown
16. Driver: occupation (19 items)	Child/student/worker/vender/mototaxi driver/taxi driver/ house keeping/farmer/fisherman/professional/business man/teacher/ tourist/police/solder/other government employee/unemployed/ unknown/other
17. Driver: wearing helmet or sheet belt	Yes/No/N.A/unknown
18. Driver: driving license	Yes/No/N A/unknown
19. Driver: substance use	Alcohol: Yes/suspected/No/unknown Drugs: Yes/suspected/No/unknown
20. Driver: severity of injure	No apparent injury/superficial injury/moderate/severe/died at the accident site
21. Detailed accident scene sketch	Place conditions/place of collision
22. Brief description of accident	Comments by reporter, about accident condition
23. Name of reporter	Signature/traffic department/officer

Source: JICA Study Team

2) Data Processing and Statistics System

To analyze traffic accident, the collection, accumulation, and analysis of various fundamental data, by location and by area, is essential. The statistics based on accident-recording sheets should be collected and accumulated. A database should be formulated and information supplied to those who are concerned with traffic accident prevention and improvement of traffic safety facilities. In consequence of data processing, an annual statistics of traffic accident will be published periodically.

a) Examination of Accident Records

Based on the collection of data on traffic accidents occurred at and around hazardous locations, an interpretation of traffic accident record will be done. The following interpretation should be

recommended.

- Traffic accident report in which the statements of drivers and pedestrians concerned and the views of police.
- Key items of accident-recording sheet: type of accident, road and traffic conditions, state of traffic violation, outline of accident, heedlessness of person secondarily involved, grade of responsibility, and sketch of scene with primarily/secondarily person involved.

b) Collection of Relevant Materials

In addition to the summarization of traffic accidents records, it is necessary to summarize road and traffic conditions at and around the hazardous locations. The following interpretation should be recommended.

- Road conditions should be summarized such as road width, pedestrian crossing, stopping line of vehicles and lane mark, placement of guard fence, roadside conditions, traffic lights and signs, and bus stop.
- The items of relating to traffic conditions should be summarized such as traffic flow volume, and pedestrian crossing traffics.
- In addition, signal phase and traffic regulation should be summarized.

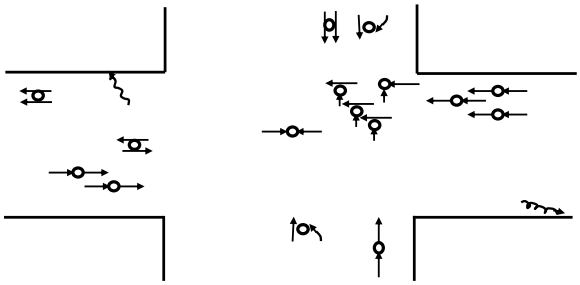
c) Field Investigation

In order to understand the field conditions, an investigation of road and traffic conditions should be carried out. The important aspects of field investigation, at the outset, are to summarize the causes and effects of the accidents occurred, to rearrange data regarding roadside conditions, to pick out traffic data necessary for analysis, to review traffic management scheme applied at the hazardous location concerned, and subsequently to understand the general characteristics of the hazardous location. The following field investigation should be recommended.

- Right-turn and left-turn traffic, vehicle behavior, pedestrian behavior, road condition (main and miner road), land use in proximity of location, and visibility of signal lights/signs and location.

d) Extraction of Accident Pattern Frequently

Collect data on traffic accidents having occurred at the around hazardous location concerned, and record these data in a sample of collision diagram as shown in Figure 16.2.4, it is desirable to collect a lot of data ranging over a long period under the condition that road and traffic have not sustainability changed.



Driver Involved		Injury or Damage		Accident Type		Weather	
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
←	Vehicle (Forward)	●	Fatality	→	Head-on collision	R	Raining
↔	Vehicle (Backward)				Side-swipe on passing		
← - -	Motorcycle	⊘	Serious		Side-swipe on overtaking	S	Snow
←	Bicycle			←	Rear-end collision		
← -	Pedestrian	⊗	Injury		Right angle collision	W	Wet surface
⇐	Train				Side collision		
⊠	Parking/stopping vehicle	○	Physical damage		Side collision at left-turn	F	Fog
				↜	Deviation from road		
				↜	Fall before collision	I	Icy surface

Figure 16.2.4 A Sample of a Collision Diagram
Source: JICA Study Team

e) Presumption of Accident Causes

Based on the analysis of field investigation including the road/traffic conditions, and extraction of accident pattern frequently, the accident causes at the hazardous location will be presumed. Generally, the causes of traffic accident will be indicated by accident pattern and road conditions.

3) Planning Measures

The task is to plan measures based on the accident causes. The key tasks are, a) selection of measures corresponding to presumed causes, b) examination of applicability on measures, c) clarification of effects and side effects of measures, and d) examination of combination on measures. In this section, the target hazardous location for planning measure will be assumed a case of intersection.

a) Selection of Measures Corresponding to Presumed Cause

The improvement of an accident-prone intersection should be identified the basic conditions of the intersection such as the area of intersection (sufficient or not), and actual traffic flow (smooth or complicated). These items are fundamental to minimize accident and should be most identified prior to detail planning. Table 16.2.2shows presumed countermeasures by type of accidents.

Table 16.2.2 Presumed Countermeasures by Types of Accident

Countermeasures and Accident Types	Vehicle-to-vehicle accident			Pedestrian accident	Bicycle accident
	Right angle collision	Side collision at left-turn	Rear-end collision at crossing		
1. New installation of traffic lights [1)]	O	-	-	O	?
2. Addition of signal light for vehicles [2)]	O		O	-	-
3. Exclusive left-turn phase (green arrow) [3)]		O		O	?
4. "Stop" regulation (installation of signs and markings)	O	-	-	-	-
5. Improvement of visibility of "Stop" sign (illuminated sign)	?	-	-	-	-
6. Exclusive left-turn lane (change of center line) [4)]	-	-	O	O	-
7. High skid resistant pavement at entrance of intersection [5)]	-	-	O	-	

Notes: O: Effective. ?: It is thought to be effective, but has not been made clear as of yet. More follow-up survey is necessary. -: The relation between the accident type and countermeasures has not been clarified.
1: There are some cases where rear-end collisions occur more. 2: Side-collision at left-turn increases. 3: Rear-end collision increases. 4: Rear-end collision increases. 5 Attention should be paid to noise level. Road surface conditions should be continuously maintained.
Source: The planning and Design At-Grade Intersection, Japan Society Traffic Engineer

b) Examination of Applicability on Measures

Adequate countermeasures must be examined for preventing accidents according to the details of accidents. It is, however, regrettable that the present conditions, which effect many kinds of countermeasures at intersection, are only rarely grasped. Therefore, based on the understanding of

field conditions and effects of measures, an examination of applicability on selected measures corresponding to presumed causes should be implemented carefully.

c) Impact of the implementation of measures

Actually, some countermeasures are implemented simultaneously. In medical treatment, for example, just as the administration of medicines always has the problem of side effects, it is also necessary to pay attention to side effects and ripple effects without fall when implementing measures for preventing accidents. In some cases, there is transformation in accident type by measures for preventing accident. Even though the measures are implemented especially to prevent one accident type, not only this accident type but also other types must be compared. And sufficient study is necessary when other accident type increase even if that accident type decreases. This is because there are some cases in which measures give rise to bad influence; i.e. side effects of the implementation of measures.

d) Examination of Combination on Measures

Since Table 16.2.2 comprehensibly shows measures according to the type of accidents, a minute study is absolutely necessary because the best countermeasure for an accident type varies with many kinds of factors of each intersection and even the same countermeasure will have different effects depending on the spots or methods adaptation.

4) Implementation of Measures

The task is to implement the proposed measures based on selected planning measures. The key tasks are, a) cost estimation for measures, b) examination of finance, c) consultation with agencies concerned, d) explanation to residents, and e) implementation.

5) Follow-Up

The task is to follow up the measures implemented. The key tasks are: 1) measurement of effects of countermeasures, 2) comparison of before/after surveys, and 3) execution of campaign and enforcement.

After implementation of measures, it is necessary to check in the after study whether or not measures are functioning as expected. Among evaluations for implemented measures, the main method is the comparison between the before-and-after studies for traffic accidents. The following main factors for evaluation will be recommended as shown in Table 16.2.3.

In addition, the follow-up for traffic safety education for drivers, pedestrians and traffic trainers by introducing the implementation of workshop and campaign propaganda will be executed.

Table 16.2.3 Main Factor for Comparative Evaluation between Before-And-After Studies

Evaluation Items	Comparison Method	Factor
a) Comparison of number of accidents	• Number of decrease	-
	• Rate of decrease	• All accidents, • By accident type.
b) Comparison of accident rate	• Difference in accident rate	-
	• Rate of decrease in accidents	• All accidents, • By accident type.
c) Comparison of the degree of the damage	• Decrease in number of casualties	• Decrease in number of casualties of much greater damage than definite standard. • Decrease in number of casualties of much greater damage than special standard (fatalities, etc.).
	• Rate of decrease in degree of damage (number of casualties per accident, etc.)	-
d) Comparison of accident cost	• Comparison with all accident costs.	-

	• Comparison between investment in measures for preventing accidents and benefit of decrease in number of accidents	-

Source: JICA Study Team

16.2.4 Formulation of Traffic Safety Education System

The objective of the traffic safety education plan is to formulate the road safety education and campaign program for target groups of the professional drivers, the traffic trainers and the general public.

(1) Proposal of A Pilot Traffic Safety Education Program

As previously pointed out in the proposal of 5-Year RSAP, the traffic safety education system was formulated in the Action Plan No. 6 "Road Safety Education for Children" and Action Plan No.11 "Road Safety Public Campaign. Therefore, this section discusses that traffic safety education focuses on short term program. In order to examine and to identify an influence and effect of proposed program, it is highly recommended that a pilot traffic safety education program by using the method of workshop and campaign propaganda will be conducted. The pilot traffic safety education program is composed of a workshop and campaign propaganda on street.

1) Methodology

The programs of traffic safety education are comprised of the following 5 parts.

- Organizing practical demonstration team: staffing, activity assignment;
- Scheduling of activities: periodic meeting, scheduling of each activities;
- Preparation of education materials: texts, video films, lecture materials for workshop, design of pamphlet/sticker/uniform (T-shirts)/slogan for campaign/text paper;
- Training education by workshops: lecture by Nicaraguan Experts for road users/local residents;
- Execution of traffic safety campaign: campaign propaganda by mass media and campaign on street by school students/staff, and
- Impact study of workshop and campaign: participants in the workshop (before/after) and practical demonstration team.

The programs are classified into 3 levels such as the professional drivers, the traffic trainers and the general public. Level 1 is a workshop for government-employed drivers/public utility drivers. This program aims at the professional drivers of public utilities. Level 2 is a workshop for training trainers such as traffic police. Level 3 is a traffic safety campaign for the general public. Each workshop will be conducted by using materials prepared as texts.

2) Organizing Practical Demonstration Team for Workshop and Campaign Propaganda on Street

The practical demonstration team, which composes of CONASEV, MTI and the National Police will conduct the traffic safety education program and campaign. Based on the results of this program and campaign, the sustainable activities of traffic safety education system will be conducted.

3) Implementation of Workshop

a) Preparation of Educational Materials

In order to clarify the technique of traffic safety education and implementing method, texts for traffic safety education will be prepared by the practical demonstration team, which is comprised of target, contents and methods. The traffic safety workshop and campaign will be conducted by using the text. The text for Level 1 and Level 3 is comprised of 5 lectures such as 1) ethics, 2) responsibility of drivers, 3) driving manners, 4) traffic safety (defensive driving and basic

troubleshooting), and 5) traffic rule and regulation. The text for Level2 is comprised of 5 lectures such as 1) organizing traffic safety education and promotion, 2) traffic safety education efficiency guideline, 3) role of traffic police and traffic enforcement, 4) driver license and 5) driver school.

b) Execution of workshop

The workshop will be executed during 1 day; the lecture for road users will be implemented by Nicaraguan Experts (CONASEV, MTI and National Police).

4) Implementation of Campaign Propaganda

a) Propaganda by Mass Media

The campaign propaganda using mass media will be done. The type of mass media is composed of 6 types such as 1) TV spots, 2) advertising of newspaper, 3) radio broadcasting, 4) banners on street, 5) poster and 6) pamphlets.

b) Participation of School Students in the Campaign on Street

School students will be participated in the campaign propaganda. The school students gather at the corner of the signalized intersection, and they distribute stickers and pamphlets to pedestrians and drivers.

c) Driving Guidance and Enforcement by National Police Officers

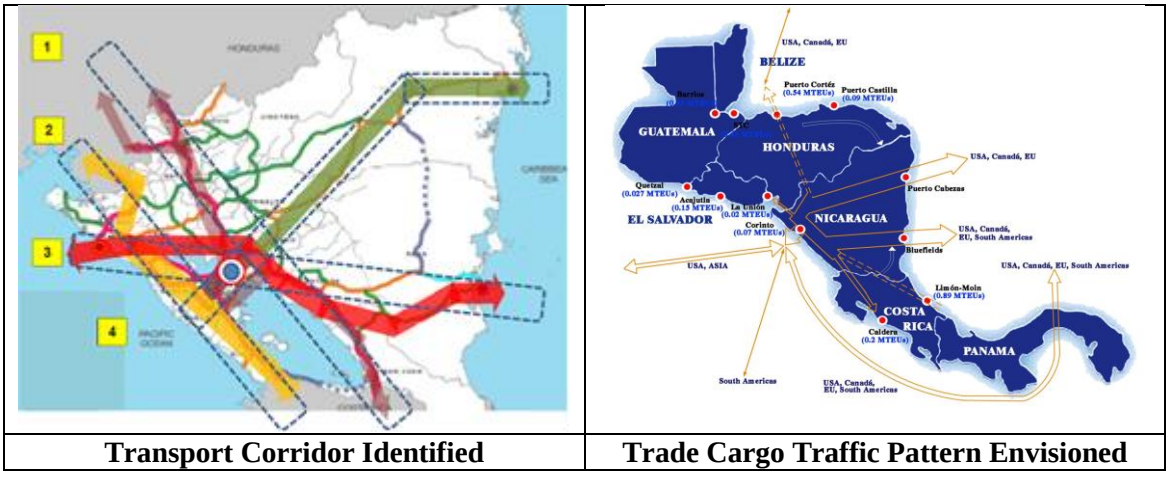
At the signalized intersection, the vehicles at each approach intersection will be controlled and drivers will be guided on proper driving manner by the National Police officers. The main activities of National Police officers are as follows: to guide drivers stop their vehicles before the stop line, to guide drivers who are driving to use proper lane, and to guide pedestrians to walk on designated pedestrian crossing.

Chapter 17 Transport Corridor and Logistics Development Plan

17.1 Transport Corridor Development Plan

(1) Definition of Transport Corridor

Transport corridor can be defined as the transport links formed to serve as the major trunk route of land transport between terminals of subject link and play an important role for an effective and dynamic transport of cargo and passengers in one country. The transport corridor often traverses plural number of countries and is structured by road, ports at both terminals of the link, railway, cross-border trade facilities, major telecommunication link (optical fiber, microwave link, etc.), power grid, oil pipeline, alike. The terminal of a transport link is commonly composed of sea port, Inland Container Depot (ICD), logistic park, and major cities. Figure 17.1.1 illustrates the identified transport corridors of Nicaragua that are composed of such elements and key components mentioned above and the trade cargo traffic pattern envisioned toward the future.



Transport Corridor Identified	Trade Cargo Traffic Pattern Envisioned

Figure 17.1.1 Identified Transport Corridors of Nicaragua and Trade Cargo Traffic Pattern Envisioned

Source: JICA Study Team

(2) Transport Corridors Identified

The outlines of transport corridors identified are as follows.

1. **The Pacific Corridor:** This corridor exists at present and traverses Nicaragua from north to south along the Pacific Coast and links between CBPs at north. The Pan American Highway forms a southern part of this corridor;
2. **The Atlantic Corridor:** This corridor exists at present and traverses Nicaragua from north to south along the inner part of the Pacific Coast and the eastern lake shore of the Lake Nicaragua. The Pan American Highway forms a northern part of this corridor;
3. **The Central Corridor:** This corridor does not exist at present but it is planned to be an important transport corridor of Nicaragua that traverses from east to west connecting with the Puerto Corinto in Chinandega Department along the Pacific Coast and Bluefields in RAAS along the Atlantic Coast; and
4. **The Northern Corridor:** This corridor likewise does not exist at present but it is planned to be an important transport corridor of Nicaragua as well and it traverses the northern part of Nicaragua from east to west linking Managua and Bilwi Port of Puerto Cabezas in RAAN.

(3) Key Components of Each Transport Corridor

Table 17.1.1 tabulates the abstract feature and key components of each transport corridor.

Table 17.1.1 Key Components of Each Corridor

Component	Trunk Road		Sea Port		Airport	Logistic Park	Agro-processing Park
Corridor	**From**	**To**	**Pacific**	**Atlantic**			
Pacific Corridor	Guasaule CBP	Penas Blancas CBP			A.C. Sandino	Managua West LP	1. Chinandega APP
Atlantic Corridor	El Espinio CBP	Los Ranchos CBP	Puerto Corinto		A.C. Sandino	Managua East LP	1. Matagalpa APP
Central Corridor	Puerto Corinto Port	Bluefields Port	Puerto Corinto	Bluefields Port	Bluefields Airport	Bluefields LP	1. Bluefields APP 2. Nueva Guinea APP
Northern Corridor	Managua	Puerto Cabezas		Bilwi Port	Bilwi Airport	Puerto Cabezas LP	1. Puerto Cabezas APP

Source: JICA Study Team

(4) Strategic Investment for Creation of Transport Corridor

Under limited financial resources and scarce government budget, the transport infrastructure development should be carried out strategically pursuant to the development visions and direction set forth. The subject of investment is to be selected carefully in accordance with the development priority and concentrated to achieve the objectives of investment program in as effective as possible. The formulation of plans to develop the transport corridor is one of the solutions to achieve the utmost investment effects in view of improvement of logistic performance in Nicaragua. As discussed in Chapter 22.4 Economic Analysis,, transforming the traffic pattern of international / regional trade cargo attributes a high investment return in view of transport economy. Therefore, the concentration of investment to develop the new transport corridors are thought be imperative for substantial improvement and development of transport infrastructure in Nicaragua. It is to be noted that the effects of development or improvement of transport corridor is not limited only to ensure a higher investment return in view of transport economy but accelerates the economic development of areas or regions under the influential zones along the transport corridor in particular and the national economy in general.

The development of new transport corridor such as the Central Corridor and the Northern Corridor will not serve only for the strong development and expansion of national economy but also narrow the gap between the regions as well as alleviate the poverty in the area where the poverty occurrence is high at present such as RAAN and RAAS departments.

(5) Stage-wise Development of Transport Corridor

The transport corridor can be developed as an Economic Corridor to make such a transport corridor play as a backbone of region or area where such corridor traverses. A plausible development sequence of a transport corridor to an economic corridor by stage is as follows:

Stage-1 Transport Corridor: Provision of links physically between areas or regions

Stage-2 Multimodal Transport Corridor: Integration of various modes of transport along the transport corridor created (Land transport, maritime transport, inland water transport, air transport, railway transport, etc.)

Stage-3 Logistic Corridor: Harmonization of the institutional framework of multimodal transport so as to facilitate the efficient flow of cargo and passengers

Stage-4 Economic Corridor: Promotion of direct investment to various economic sectors such as agriculture sector, industrial sector, tourism sector, etc. thereby generating economic activities along the less-developed areas in the region but along the Logistic Corridor.

At any rate the physical linkage and logistics facilitations is prerequisite to form the economic corridor as presented above.

(6) Development Plan of Each Key Components

The development plans of each key component forming the transport corridor development are presented in respective sub-chapter in this report and their project profiles are presented in Chapter 23 Project Profile.

17.2 Logistics System Development Plan

(1) Objectives of the Logistics System Development

The objectives of an improvement of logistic system in one country are to get right product to the right customers in the right place at the right tie with the least transport cost in totality by an integrated approach. A proper logistic system ensure a high cargo transport performance thereby increase the competitiveness of export commodities of nation and save transport cost incurred to import necessary commodities for economy and to meet with the social needs.

(2) Framework of Logistic System

Figure 17.2.1 illustrates the framework of logistic system. It is to be noted that the logistic system is structured not only by the hard components such as transport infrastructures but also by the soft components such as institutional set up, transport service providers, and entities engages with daily trade business.

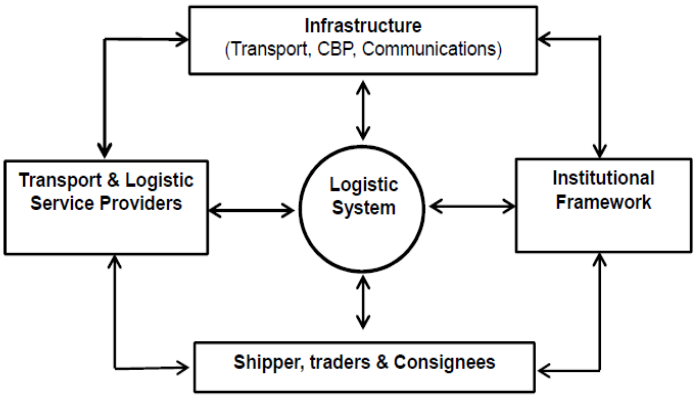


Figure 17.2.1 Framework of Logistic System
Source: JICA Study Team

When all components that structure the logistic system work properly at the highest possible efficiency the logistic performance of one country will reach to the highest level. However, the limitation of one component determines the level of logistic performance. Therefore, the development of each component is to be realized in harmonious way and in an integrated manner.

(3) Factors of Logistics Performance

The World Bank carries out annual monitoring to compare the logistic performance of 150 countries in the world. Followings are the points of evaluation.

1) **Infrastructures:** Quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology);
2) **International Shipment**: Ease of arranging competitively priced shipments;
3) **Customs:** Efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including Customs;
4) **Logistic Competence:** Competence and quality of logistics services (e.g., transport operators, customs brokers);
5) **Tracking and Tracing:** Ability to track and trace consignments; and
6) **Timeliness**: Timeliness of shipments in reaching destination within the scheduled or expected delivery time.

At present the logistic performance index of Nicaragua is comparatively low as 107th among 150 countries surveyed world-wide in 2012.

(4) Solutions to Improve the Logistics Performance of Nicaragua

The solutions to improve the logistic performance of Nicaragua and the expected results can be summarized as follows:

1) **Infrastructures:** Sea ports, roads, and airport that structure each transport corridor identified are to be improved or developed. The infrastructure to reinforce and expand the use information technology is to be prepared;
2) **International Shipment**: Develop the new sea ports along the Atlantic Coast to diversify the international trade routes and to enable the choice of ports easier so as to arrange competitively priced shipments;
3) **Customs:** The customs clearance process is to be simplified thereby speed of customs clearance increase and formalities can be predicted by consigner / consignees. Regional agreements on cross-border trade procedures are to be made by member countries aiming at operating a single-window and single-stop system. The cross-border trade infrastructure is to be designed and developed in accordance with the agreed rules and procedures. Necessary equipment for customs clearance including inspection of dangerous cargoes and quarantine are to be provided;
4) **Logistic Competence:** The competence and quality of logistics services or transport operators are to be fostered and improved;
5) **Tracking and Tracing:** Ability to track and trace consignments is to be improved; and
6) **Timeliness**: Timeliness of shipments in reaching destination within the scheduled or expected delivery time are ensured by use of information technologies and foster the professional spirits of the transporter as well as logistic service providers. The warehouses are to be provided at strategic places or develop the logistic parks at strategic locations along the transport corridor and immediate behind the sea ports.

The development of logistic parks accelerates the implementation of such solutions listed above.

17.3 Establishment of Logistic Parks, Agro-processing Parks and Improvement of CBPs

(1) Locations of Logistic Parks, Agro-processing Parks and CBPs

Figure 17.3.1 illustrates the locations of logistic parks, agro-processing parks and CBPs that are considered as the key components for the logistic infrastructure development plan.

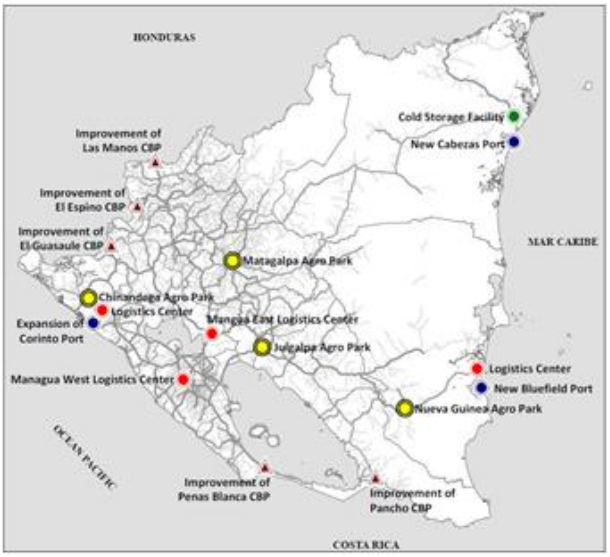


Figure 17.3.1 Locations of Logistic System Development Plan
Source: JICA Study Team

17.3.1 Project for Establishment of Logistic Parks (LPs)

Objectives of Logistic Parks: The objectives of logistic parks are as follows:

1) Consolidation of containerizable cargoes[1] for Less Container Load shipment (LCL)[2]so as to optimize the space of one container fully. This way of shipment of goods reduces the freight cost for Small-medium sized Enterprises (SME) who engages with international / regional trade (i.e. shipper, trader, consigner, etc.)
2) Increase the loading ratio by securing return cargo to the trucks delivered their containerized cargo to the logistic park. This way of shipment of container increases the Loading Ratio (LR)[3] of each truck that undertakes the land transport on the way to return to the original point of such truck. Therefore, the transport cost of goods can be reduced or make the price of goods at the market competitive.
3) The necessary works for customs clearance of goods (i.e. documentations, payment of tax and levy, quality inspection, etc.) can be prepared prior to enter into the cross-border trade facility (i.e. sea port, airport, CBP, etc.) thus the waiting time of trucks at customs can be shorten thereby reduce the transport cost.
4) Warehouses provided in the LP are possible to store the goods as inventory of shipper / trader to make their delivery of goods to the consignees, wholesalers, retailers, etc. easier in timely manner or make Just-In-Time (JIT)[4] delivery of goods to purchaser of goods possible.
5) Provision of refrigerated warehouses provided in the LP is possible to store the perishable goods for SMEs who are not afforded to own their own refrigerated storing facility.

Locations of Logistic Parks: The project envisages the establishment of logistic parks at strategic locations along the transport corridor. Table 17.3.1 shows the location of logistic parks planned and proposed.

Table 17.3.1 Proposed Location of Logistic Parks Development Projects

Department	Location-1	Location-2
Pacific Corridor	Behind Puerto Corinto	West of Managua
Atlantic Corridor	Matagalpa	East of Managua
Central Corridor	Behind Bluefields Port	
Northern Corridor	Behind Bilwi Port	

Source: JICA Study Team

Outline of Logistic Parks: The area of one logistic park is around 45,000 m^2. The park is consisted of warehouse, truck parking area, utility delivery system, administration buildings, etc. Figure 17.3.2 illustrates a typical plan of logistic park and images of logistic park.

[1] Containerizable cargoes means the cargo is possible to be shipped by container unlike non- containerized cargo such as bulk, break-bulk or liquid cargo which is difficult or not suitable to be loaded to one container.

[2] Less Container Load (LCL) means that one container is used by several consigners unlike the case of Full Container Load shipment (FCL) which is used only one consigner by filling full space of one container by consigners cargo. LCL shipment is arranged by shipping / trucking / forwarding company or logistic service providers whose transport service is of an integrated nature.

[3] Loading Ratio (LR) means the ratio of loading cargo on one truck / ship. The LR of truck that has no cargo loaded on the way back to the original point is 0.5. While the same but with return cargo or the truck use their trip fully with cargo loaded is 1.0. The transport cost of goods by truck at LR1 fully utilize the Vehicle Operation Cost (VOC) is the least transport cost per ton-km for moving of goods from one place to the other.

[4] Just-In-Time method is the modern method of delivering goods to the final customer by shipper of goods when the final customer needs such goods as scheduled thereby eliminating excessive inventory at the premised of final customer so as to keep price competitiveness of the final customer (often manufacturers) as high as possible.

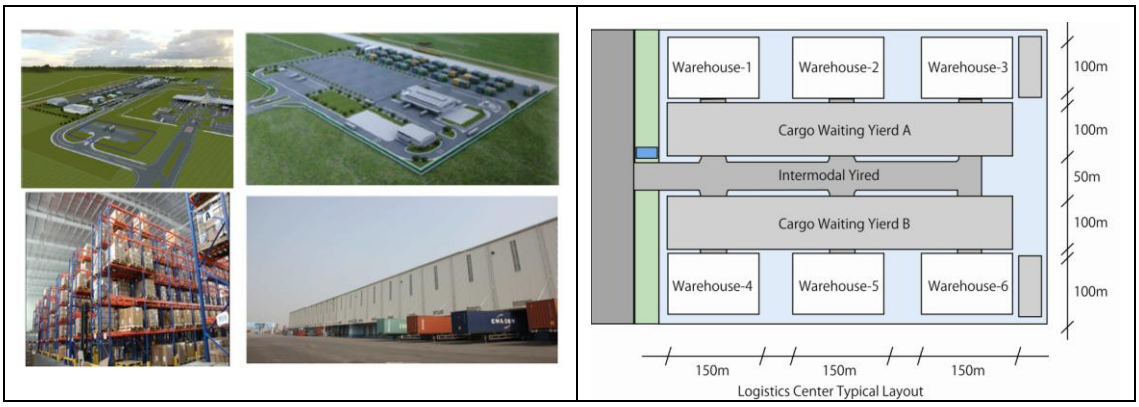


Figure 17.3.2 Typical Area Plan of Logistic Parks and Its Image

Source: JICA Study Team prepared the images from various website of logistic providers in Thailand and Vietnam

Mode of Investment: The land for LP can be prepared by the government on its own land or purchase a proper land for LP from the private land owner and the necessary infrastructure including the utility delivery system (i.e. main power supply, stand-by power system, water supply, communication system, etc.) and waste treatment system (i.e. solid waste treatment plant, liquid waste treatment plant, etc.) can be provided by the government. Such land prepared for the operation of LP can be leased out to plural number of private logistic providers, forwarders, warehousing operators, truckers, etc. who want to use such facilities for their own business. Such type of contract is called the Land-lord Type Contract. In such a way the private investors / transport business operators are possible to utilize such infrastructure easily so as to increase the transport business performances.

17.3.2 Project for Establishment of Agro-processing Parks (APPs)

Objectives of Agro-processing Parks: The objectives of Agro-processing Parks (APP) project are as follows:

1) Enhancement of agricultural products exports which is main stay of foreign currency earnings of Nicaragua can be realized;
2) Value on the agricultural products can be added;
3) Participation of small-medium scale farmers on value added activities on their agricultural products can be promoted to share the income by all;
4) Expanding markets accelerate the production volume of and added value on agricultural products; and
5) Rationalize the flow of agricultural products from farm to the APP and to the market makes the agricultural product exports of Nicaragua more competitive.

Locations of Agro-processing Parks: The project envisages the establishment of agro-processing parks at strategic locations along the transport corridor. Table 17.3.2 shows the location of logistic parks.

Table 17.3.2 Location of Agro-processing Parks Development Projects

Corridor	Location-1		Location-2	
	Department	City	Department	City
Pacific Corridor	Chinandega	Chinandega		
Atlantic Corridor	Matagalpa	Matagalpa		
Central Corridor	Boaco	Juigalpa	RAAS	Nueva Guinea
Northern Corridor	RAAN	Puerto Cabezas		

Note: See Figure 17.3.1

Source: JICA Study Team

Agro-processing Activities: Table 17.3.3 tabulates the possible products produced but not limited through processing of various kinds of agricultural products as the raw materials. The raw materials

to be processed at each APP planned should be the major agricultural products cultivated in respective department and their surrounding department. For instance the main raw materials to be processed at Chinandega AAP may be beans; at Matagalpa AAP may be coffee and horticulture products; at Juigalpa and Nueva Guinea may be beef meats and cow milk; and at Puerto Cabezas may be woods, marine products, and horticultural products.

Table 17.3.3 Plausible Agricultural Products Produced by APP

Raw Material	Product-1	Product-2	Product-3	Product-4
Meat (Beef, hog, chicken, etc)	Processed	Frozen	Offal	Leather
Cow Milk	Processed	Cheese	Skim milk	Dried milk
Beans (Soya beans, ground nuts, etc.)	Dried	Edible oil	Cake	Fertilizer
Grains (Wheat, rice, sorghum, etc)	Milled	Edible oil	Cake	Fodder
Marine (fish, shrimp, lobster, etc)	Peeled	Frozen	Prepared	Fodder
Fruits and Vegetables	Packed	Frozen	Dried	Prepared
Woods	Sawn lumber	Veneer	Complex	Furniture
Horticulture products (Flower, etc)	Fresh	Cut	Stock	Ornament

Source: JICA Study Team

Outline of Agro-processing Parks: The area of one agro-processing park or the industrial estate specifically designed for processing, storing and delivery of agricultural products is around 4,000 m^2 – 6,000 m^2 depending on what agricultural products to be processed stored and delivered. Figure 16.3.3 illustrates a typical plan of agro-processing-park and image of such park. The key components of APP are as follows:

i) Land prepared with ample size of access road;

ii) Infrastructure for utility delivery services (i.e. power, water, communication, etc)

iii) Infrastructure for liquid and solid waste treatment system;

iv) Warehouses for products in general and refrigerated warehouse in particular;

v) Administration building that houses the laboratory for quality inspection and quarantine; offices for logistic service providers; and general administration.

Mode of Investment: The land for Logistic Park (LP) can be prepared by the government on its own land or purchase a proper land for APP from the private land owner and the necessary infrastructure including the utility delivery system (i.e. main power supply, stand-by power system, water supply, communication system, etc.) and waste treatment system (i.e. solid waste treatment plant, liquid waste treatment plant, etc.) can be provided by the government. Such land prepared for the operation of APP can be leased out to plural number of industrial company engaging the processing of agricultural products, association of small-medium scale farmers, individual investor engaging with export of agricultural products, etc. who want to use such facilities for their own business. Such type of contract is called the Land-lord Type Contract. In such a way the private investors are possible to utilize such infrastructure easily so as to increase the added-value on agricultural products for both export market and domestic market.

17.3.3 Project for Expansion and Improvement of Cross-border Trade Infrastructure (CBTI)

Objectives of Agro-processing Parks: The objectives of expansion and improvement of Cross-border Trade Infrastructure Project are as follows:

1) Enhancement of regional trade among member countries forming the Central American region by facilitating cross-border trade among such countries;

2) Contributing economic growth of the member countries by means of reducing the transport costs especially by streamlining the flow of goods through the cross-border facilities (i.e. customs clearance, quarantine procedures, inspection of dangerous goods, etc.)

Locations of Cross-border Points (CBPs): The project envisages the expansion of CBTI and improvement of their performances for customs clearing operation and management of dangerous

goods and traffic at CBPs. The locations of CBPs are indicated in Figure 17.3.3.

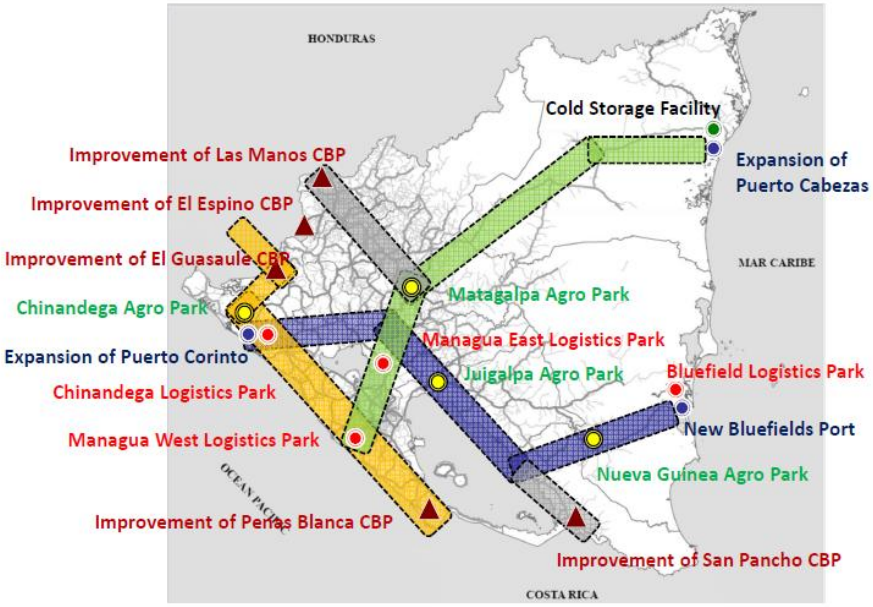


Figure 17.3.3 Project Locations of CBTI in Nicaragua
Source: JICA Study Team

Estimated Cargo Volumes Through CBPs: The estimated international and regional cargo volumes passing through the CBPs are shown in Table 17.3.4.

The estimation of cargo volume at each CBP is carried out are based on both CASE-1 that does not consider the development of new ports planned to be developed along the Atlantic Coasts namely Bilwi Port and Bluefields Port; and CASE-2 that considers the development of these ports along the Atlantic Coast to transform the international trade traffic pattern.

Table 17.3.4 Estimated Cargo Volume for Each CBP

(Unit: '000 tonnes per year)

CBP	Neighboring Country	CASE-1			CASE-2	
		2013	2023	2033	2023	2033
Las Manos	Honduras	210	470	880	460	1,210
El Espino	Honduras	130	280	430	290	470
Guasaule	Honduras	920	2,090	4,080	1,650	3,210
Penas Blancas	Costa Rica	530	1,160	1,590	560	890
Los Ranchos	Costa Rica	0	20	240	20	200
Total		1,790	4,020	7,220	2,980	5,960
Change in times		1.0	2.3	4.0	1.7	3.3

Note:
1) The above estimated volumes do not include the volume of transit cargo passing through Nicaragua.
2) The approximate volume of transit cargo is around 30% of the estimated volume.
3) The ratio of transit cargo volume is determined based on the result of traffic survey in 2013.

Source: JICA Study Team

As shown in the above table, the cargo volume passing through CBPs is expected to increase 3.3 to 4.0 times of 2013 by 2033 or in coming 20 years. At present in 2013 the waiting time for customs clearance at CBPs in north is around 12 hours in average and the same at CBP in south is around 24 hours. Unless this situation is rectified otherwise the performance of CBP operation would hinder the sound economic growth.

Improvement of CBP or CBTI projects: At present as of December 2013 the review of regional trade performance including the preparation of improvement plans of CBPs in the Central American region that is composed of 7 countries (i.e. Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica and Panama) has been on going by the consultants hired by the World Bank

aiming at facilitation of regional trade. The major aim of said study is to prepare and improve the Cross-border Trade Agreement (CBTA) thereby introduce Single-window and Single-stop system in this region. The feature of CBTI projects to be planned aiming at improvement of customs clearance performance by streamlining and simplification of the procedures in collaboration with countries directly concerned at the border gates should be prepared in accordance with the outcome of legislation of CBTA by member countries in the future. Under such situation the design on the CBTI project has not been carried out however the projects are identified as the key components forming a part of transport corridor improvement and development projects.

Lacking of Necessary Equipment and IT System: The designs of CBTI projects cannot be carried out since the outcomes of CBTA has not been available as mentioned in preceding paragraph, yet the needs of improving the performances of CBPs have been identified. All CBPs lack a provision of equipment or X-ray machine to check the dangerous cargoes loaded on trucks as well as the Electronic Data Interchange (EDI) and electronic fund transfer (EFT) system.

Chapter 18 Public Passenger Transport Development Plan

The intercity bus transportation in Nicaragua has been established in proportion as the trends of passenger demand and bus operation supply; therefore, many buses operate in competition of each other in the national road network. There is need for the efficient bus route operation network and a large capacity bus in consideration of good accessibility and efficient mobility. In addition, many old aged bus fleets are operating in poor vehicle maintenance, and the bus terminal facility is poor condition due to a lack of well-developed bus service system, this situation leads to a lack of comfort and safety operation for bus passengers. Therefore, an appropriate systematic public passenger transport development plan will be recommended taking into consideration the importance of strengthening the passenger public transport system for safe and smooth operation on roads.

The public passenger transport demand plan consists of 1) Formulation of "Hub-and Spoke" Bus Network, 2) Introduction of Large Capacity Bus, 3) Improvement of Bus Terminal and Construction of Roadside Station "Michi-no-Eki", 4) Improvement of Mechanical Vehicle Inspection and Promotion of Road Safety Education, 5) Formulation for Computerized Registration System of Operation License and Statistic Data and 6) Reform the Law No. 524.

18.1 Reorganization of Route on "Hub-and-Spoke" Bus Network System

The introduction of "Hub-and-Spoke" Bus Network System (hereinafter refer to as the "HAS system") that consists of the trunk service by trunk bus network and local service by feeder bus network is proposed instead of the present destination-based system. The trunk bus routes with increased frequency will be operated among Department Capitals and the feeder bus routes will be operated from the cities and villages to the bus terminal on the trunk bus network. The trunk bus route will be operated by a large capacity bus and express bus in order to increase effective carrying capacity. The feeder bus route will be operated by a micro bus in proportion to the local demand, and take transfer at the bus terminal providing connectivity. This will bring the effects to reduce operating costs as well as increase the operating efficiency. HAS system consists of a network with trunk bus routes (approximate total distance:1,750km) and feeder bus routes (approximate total distance:2,320km), respectively Figure 18.1.1.

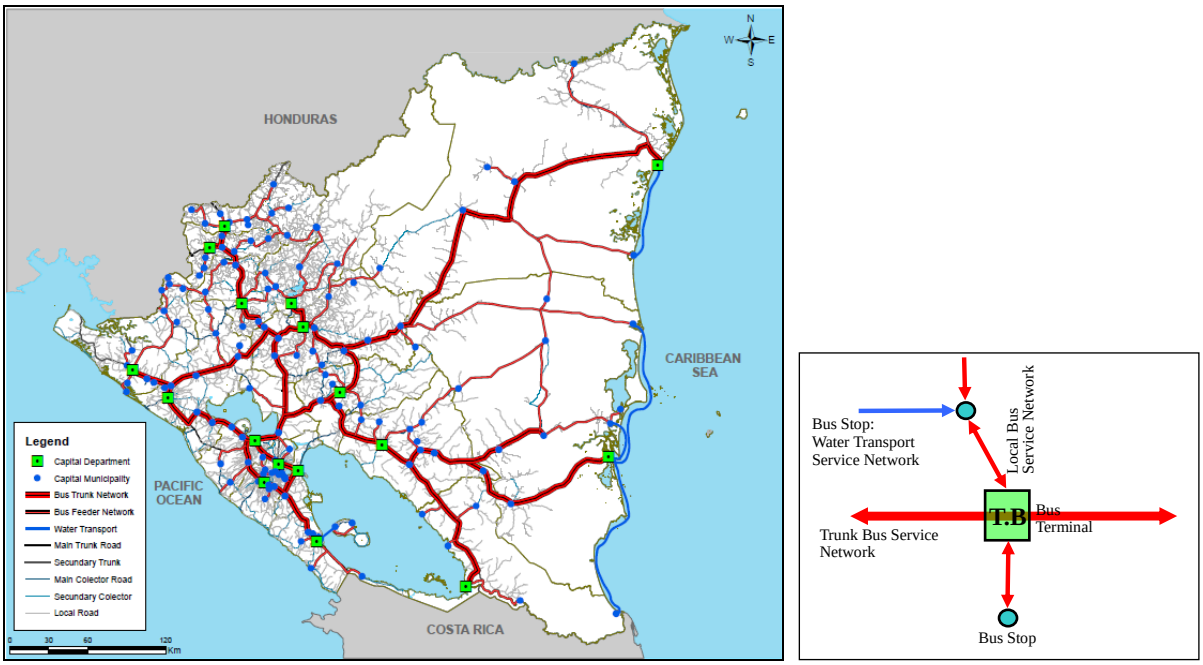


Figure 18.1.1 Reorganization of Route on HAS Bus Network System
Source: JICA Study Team

18.2 Introduction of Large Capacity Bus

(1) Future Bus Passenger Demand in Trunk Bus Route and Future Demand of Large Capacity Bus

Future bus passenger demand in trunk bus route was forecasted based on the results of passenger survey conducted by Directorate General of Land Transportation (DGTT) of MTI in 44 interurban bus routes and the results of traffic survey by JICA Study Team. On the basis of these surveys and OD table of bus passengers in 2013, an OD table of future bus passengers was prepared also taking into account future economic indicators and bus network. And the traffic assignment was made by computer simulation (JICA-STRADA) based on daily bus passenger demand in each section of bus network in order to forecast the future daily bus passenger demand in each section of bus network. The future demand of large capacity bus with a capacity of 60 passengers by the trunk bus route was estimated based on the result of future daily public bus passenger. (See Table 18.2.1)

1) Future Daily Public Bus Passenger Demand in Trunk Interurban Bus Routes

The future daily public bus passenger demand is shown in Figure 18.2.1. The number of present daily passenger ranges 100 to 7,700 passengers (2-way volume). The large passenger demand is expected on NIC-1 at 400-10,300 passengers, NIC-4 at 2,100-5,300 passengers, NIC-12A at 1,900-3,700 passengers, NIC-28 at 2,600 passengers and NIC-2 at 2,000 passengers respectively. The number of passenger in 2033 is expected to range 220 to11,440 passenger/day (2-way volume).

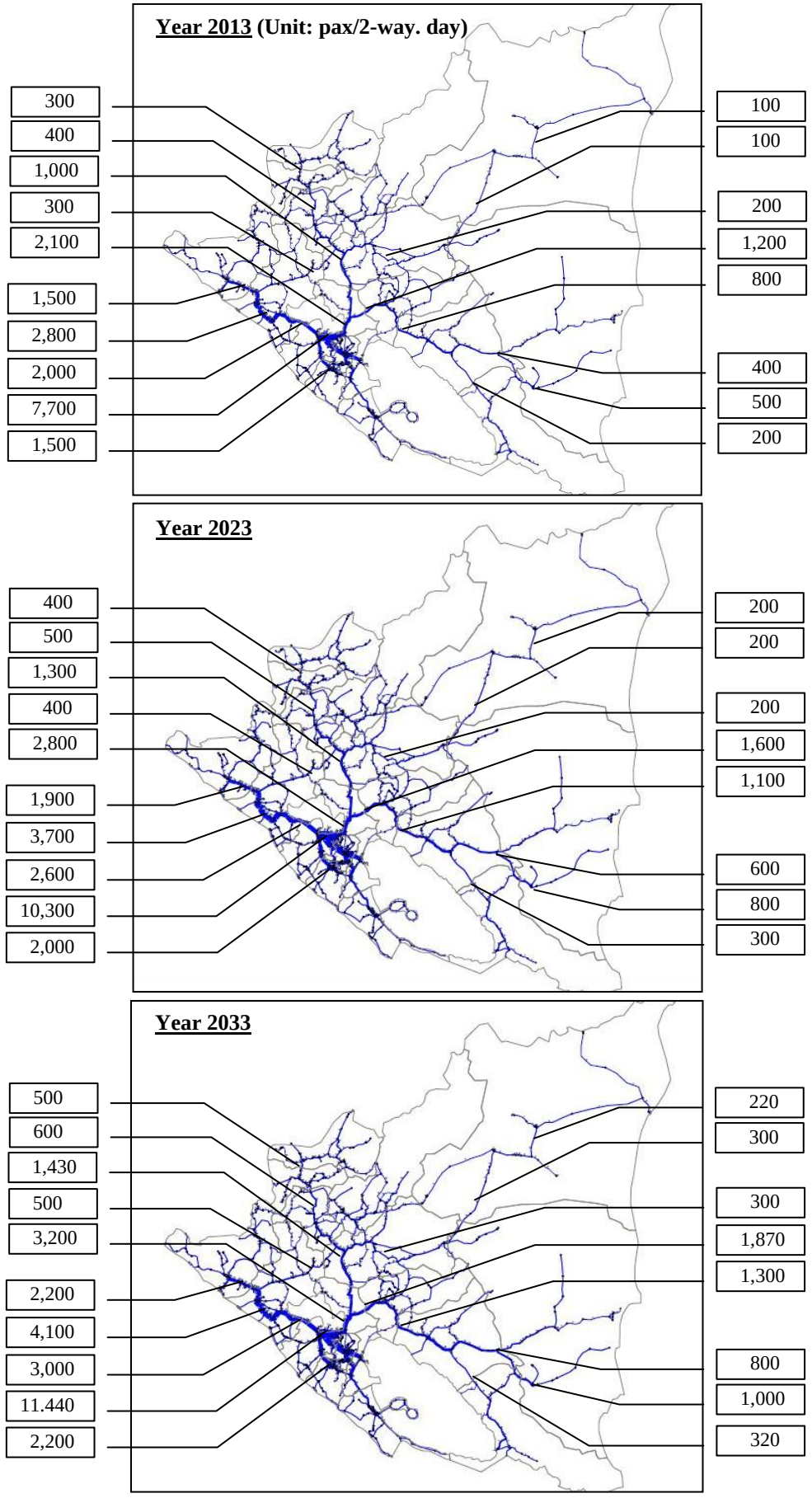


Figure 18.2.1 Future Daily Public Bus Passenger Demand of Each Section in Bus Network

Source: JICA Study Team

2) Future Demand of Large Capacity Bus by 44 Trunk Interurban Route

Based on the future daily public bus passenger demand by route, Table 18.2.1 shows the future demand of large capacity bus for 44 interurban bus route. The required daily volume of large capacity bus by trunk route was estimated in the range of 2 and 104 buses (2-way volume) in 2023, and 2 and 116 buses (2-way volume) in 2033 respectively. The total introduction buses was estimated at 1,000 buses in 2023 and 1,124 buses in 2033.

Table 18.2.1 Future Demand of Large Capacity Bus for 44 Interurban Bus Route

Department	Municipality	No.	Route (Origin -Destination)	Required Bus Fleet	
				Y 2023	Y 2033
Carazo	Jinotepe	1	Jinotepe-Managua (near El Crucero)	34	38
		2	Jinotepe-Masaya	38	42
		3	Jinotepe-Masaya (near La Concha)	30	34
Rivas	Rivas	4	Rivas-Managua	24	26
		5	Rivas-Jinotepe	24	26
Jinotega	Jinotega	6	Jinotega-Managua	14	18
Chontales	Juigalpa	7	Juigalpa-Managua	24	30
		8	Juigalpa-Rama	18	22
		9	Juigalpa-Nueva-Guinea	10	12
Estelí	Estelí	10	Estelí-Managua	12	12
		11	Estelí-Ocotal	4	4
		12	Estelí-Somoto	10	12
		13	Estelí-Matagalpa	26	30
		14	Estelí-León	6	6
		15	Masaya-Estelí	4	4
		16	Estelí-Jalapa	2	2
		17	Estelí-San Rafael-Jinotega	4	4
		18	Estelí-Jícaro-Murra	2	2
León	León	19	León-Managua	56	62
		20	León-Chinandega-Corinto	92	102
		21	León-Malpaisillo-San Isidro	34	36
Nueva Segovia	Ocotal	22	Ocotal-Managua	16	20
		23	Ocotal-Managua	14	18
Chinandega	Chinandega	24	Chinandega-Matagalpa	2	2
		25	Masaya-Chinandega	4	4
Matagalpa	Matagalpa	26	Matagalpa-Managua	40	46
		27	Matagalpa-León	4	4
		28	Matagalpa-Jinotega	20	22
		29	Matagalpa-Jinotega-Guayaca	4	4
Boaco	Boaco	30	Boaco-Managua	18	20
Madriz	Madriz	31	Somoto-Managua (Express Bus)	6	6
		32	Somoto-Ocotal	4	4
Masaya	Masaya	33	Masaya-Managua,Roberto Huembes Market (Express Bus)	62	70
		34	Masaya-Matagalpa	4	4
		35	Masaya-Tipitapa (Express Bus)	18	20
		36	Masaya-Jinotepe (Ordinary Bus)	32	34
Granada	Granada	37	Granada-UCA-Managua	44	52
		38	Granada-Oriental-Managua	14	16
		39	Granada-Masaya	40	46
		40	Granada-Nandaime	30	36
		41	Granada-Jinotepe	14	16
		42	Granada-Rivas	10	10
Managua	Managua	43	Chinandega-Managua (Express Bus)	28	30
	Tipitapa	44	Cristo Rey-Tipitapa-Managua (Ordinary Bus)	104	116
Total				1,000	1,124

Source: JICA Study Team

(2) Proposed Large Capacity Bus

Depend on the adoption of HAS Bus Network System and the future daily public bus passenger demand in trunk bus network, the large capacity bus will be introduced, offering both lower

operating costs and higher service reliability. One door regular large bus with 60 passengers (including 11 auxiliary seats) will be proposed for the trunk bus network.

(3) Project Cost Estimate

The project cost for the introduction of large capacity bus was estimated at 92.4 million US dollars in 2023 and at 103.4 million US dollars in 2033 respectively.

18.3 Improvement of Bus Terminal and Construction of Road Side Station

(1) Improvement of Bus Terminal

The existing problems and issues of bus terminals are pointed out as follows; 1) lack of service facilities for passengers, 2) small land area for terminal and parking, 3) necessity to separate from market facilities to mitigate the chronic congestion due to mixed traffic flows with market and other shops, and 4) necessity to create transfer function with feeder buses. In order to ensure efficient and comfortable service and transfer function between trunk service and feeder service, a bus terminal improvement plan is proposed. The target year of the plan will be set in 2023 as a short-middle term plan.

1) Land Area of Bus Terminal and Parking

The capacity required of bus berth and land area of the bus terminal area is determined based on the future passenger demand and future bus fleet with consideration for operation period and dispatching schedule aiming at target year 2023. The bus berth required by bus terminal is in the range of 2-6 berths. The largest number of bus berth required at 6 berths is observed at the Masaya bus terminal. For the Managua bus terminal, in consideration of directional allocation of bus terminal for the North, South and East, the number of bus berth required per each directional bus terminal is at about 4 berths. The land area required by number of berth is at 6,520 m^2 for 2-3 berths, 8,300 m^2 for 3-4 berths and 9,620 m^2 for 5-6 berths respectively. Table 18.3.1 Shows the bus terminal location by bus berth required.

Table 18.3.1 Number Required of Bus Berths and Land Area by Major Target Bus Terminal

Department	Municipality	No.	Bus Terminal	Bus Fleet Required		Total Bus Berth and Land Area in 2023		
				2023	2033	Operation Period/Bus Dispatching Schedule	Total Bus Berth Required	Land Area Required (M^2)
Carazo	Carazo	1	Jinotepe	172	190	12 hrs, 15 min	5	9,620
Rivas	Rivas	2	Rivas	58	62	12 hrs, 30 min	3	8,300
Jinotega	Jinotega	3	Jinotega	42	48	12 hrs, 30 min	3	8,300
Chontales	Chontales	4	Juigalpa	52	64	12 hrs, 30 min	3	8,300
Estelí	Estelí	5	Estelí	70	76	12 hrs, 30 min	4	8,300
León	León	6	León	192	210	12 hrs, 15 min	5	9,620
Nueva Segovia	Nueva Segovia	7	Ocotal	38	46	12 hrs, 30 min	3	8,300
Chinandega	Chinandega	8	Chinandega	126	138	12 hrs, 15 min	4	8,300
Matagalpa	Matagalpa	9	Matagalpa	100	112	12 hrs, 30 min	5	9,620
Boaco	Boaco	10	Boaco	18	20	12 hrs, 30 min	2	6,520
Madriz	Madriz	11	Somoto	34	40	12 hrs, 30 min	2	6,520
Masaya	Masaya	12	Masaya	232	258	12 hrs, 15 min	6	9,620
Granada	Granada	13	Granada	152	176	12 hrs, 15 min	4	8,300
Managua	Managua for 3 B.T	14	Managua	496	562	12 hrs, 15 min	4 x 3	8,300
	Tipitapa	15	Tipitapa	122	136	12 hrs, 15 min	4	8,300

Source: JICA Study Team, 2013

2) Layout of Typical Bus Terminal by Type

The layout of typical bus terminal by type will be proposed in Figure 18.3.1. The Alternative Type

1 takes an advantage for the site condition at entrance and exit from/to two different roads, in contrast, the Alternative Type 2 takes an advantage for only in case which is constructed in front of main road. These alternatives will be proposed depending on the site condition. The typical bus terminal is comprised of road area (trunk bus terminal and feeder bus transfer terminal), footway area, platform with shelter and building area (restaurant, toilet, kiosk and ticket counter).

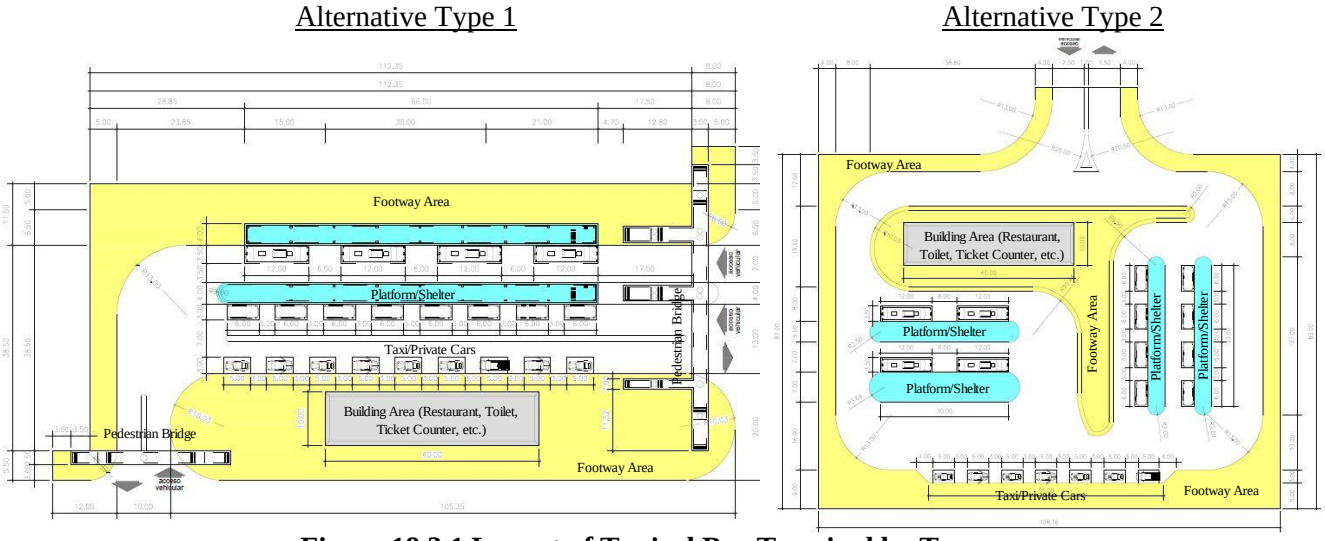


Figure 18.3.1 Layout of Typical Bus Terminal by Type
Source: JICA Study Team

3) Project Cost Estimate

For the bus terminal improvement plan targeted in 2023, the Alternative Type 2, which is lower than construction cost of the Alternative Type 1, is proposed. The cost for each berth size is shown as follows: 0.82 million US dollars for 6-5 berth, 0.71 million US dollars for 4-3 berth and 0.56 million US dollars for 2berth. The total project cost for 17 bus terminals is estimated at 11.95 million US dollars.

(2) Construction of Roadside Station

1) Function of Roadside Station

The construction of roadside station is planned to promote the road service facility for the safe driving and comfortable service for road users such as public bus and private vehicles, and contributing tourism promotion and local economy. The function of roadside station is mainly classified into three (3) functions such as 1) the Rest Facility for public toilet, parking and public bus stop, 2) the Information Facility for road/traffic condition guidance, regional information guidance (tourism spots and events) and emergency contact for traffic accident/disaster and 3) the Regional Partnership Facility for restaurant, direct sale store, shop of special local products and holding of events. The operation and management of roadside station will be conducted by introducing the third sector system with public- private partnership that aims to take advantage of business expertise in the private sector to ensure the sustainable profitability.

2) Main Factors for Development of Successful Roadside Station

The roadside station has linked to road transport with local and regional development goals. The following four (4) factors seem to be the reasons for the development of successful roadside station.

- The cost of the roadside station construction will be paid by public sector (Government), in addition, the public sector will be provided the support for the operation. On the other hand, the private sector (local community) will provide with a venue for activities. Accordingly, the project of roadside station will contribute to the long-term aim of regional development.

- In the planning stage of the project, the local residents will be involved and participate on an equal bases, because, the organization, role, construction and operation of the roadside station will be clarified in a through the exchange of their views and opinions.

- The Roadside Station is attractive to drivers and travelers according the multi-service at a single facility for the rest area, toilet, restaurant, shopping and information of tourism, etc.

- The sales promotion of local product will be important to success for the management of roadside station, for instance, to provide distinctive local product where cannot be obtained elsewhere, the effort are made to encourage the local resident or local farm/fishery producers to provide a variety of products by using local resources in inventive way.

3) Location Planed of "Roadside Station"

The candidate locations of roadside station were roughly selected based on the Road Network Characteristics (accessibility, volume of through traffic), traffic flow condition (guaranteed a profitable traffic volume) and regional characteristics (local products, tourist attractions). Following seven (7) roadside stations will be constructed in the trunk roads such as NIC-1, NIC-2, NIC-7 and NIC-12A as shown in Figure 18.3.2 below.

- No.1: NIC-2, Nandaime - Rivas
- No.2: NIC-12A, Leon - Chinandega
- No.3: NIC-1, Ciudad Dario - Sebaco
- No.4: NIC-21B Rio Blanco - Mulukuku
- No.5: NIC-7, Juigalpa - Acoyapa
- No.6: NIC-1, Estelí - Palacaguina
- No.7: NIC24B, Guasaule - Somotillo

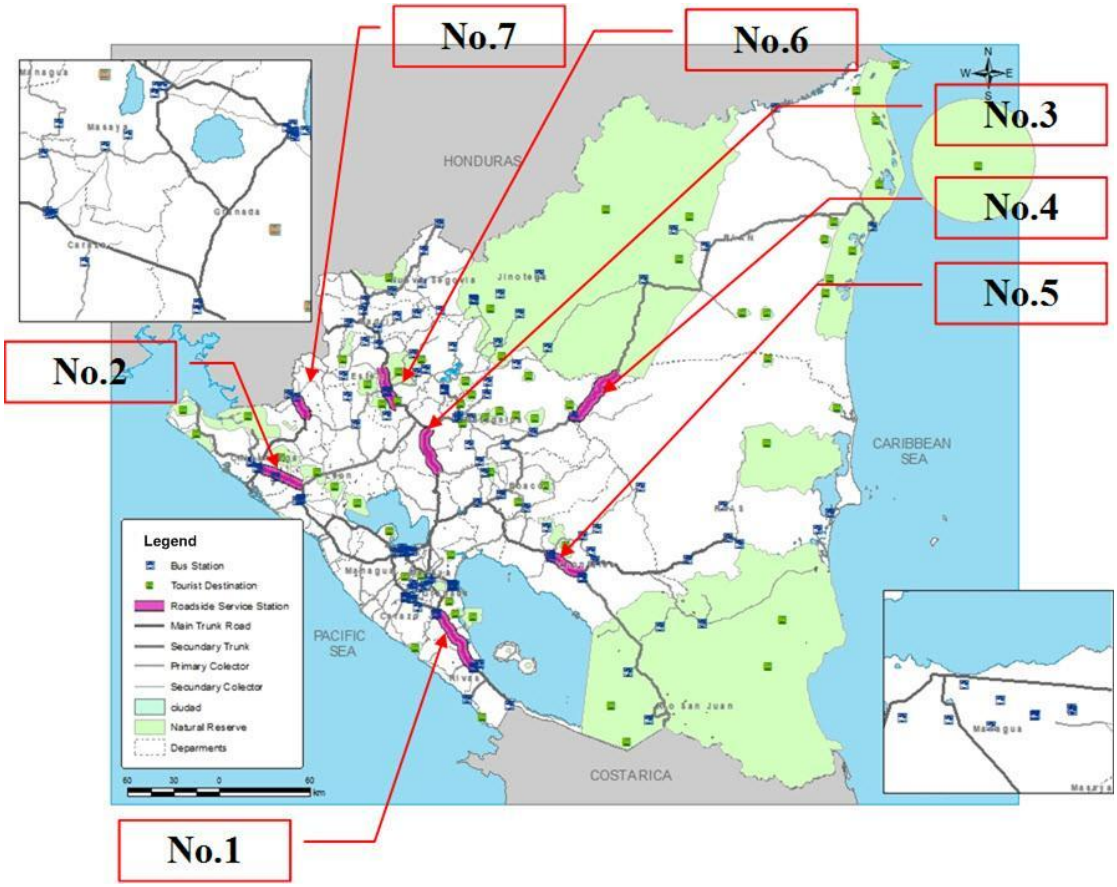


Figure 18.3.2 Seven (7) Candidate Locations of Roadside Station
Source: JICA Study Team

4) Layout of Typical Roadside Station

The layout of typical Roadside Station is proposed in Figure 18.3.3. A compact style facility will

be made an appeal of "Festivity" and "Amenity" to the road user without felling of pressure, and will be also made an appeal of "Landmark". The total area of site will be estimated at 4,700 m^2, which is comprised of parking area at 1,600 m^2, road and plaza area at 1,200 m^2, building area at 650 m^2 and other area such as green area at 1,250 m^2.

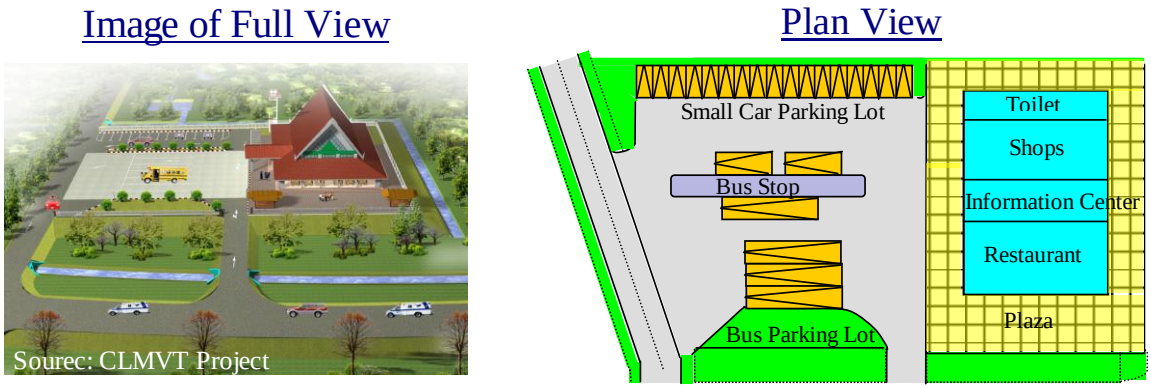


Figure 18.3.3 Layout of Typical Roadside Station
Source: JICA Study Team

5) Project Cost Estimate

The project cost for the construction of one roadside station is estimated at 0.6 million US dollars (including operation cost). The total project cost for the seven (7) roadside stations was estimated at 4.2 million US dollars.

18.4 Improvement of Mechanical Vehicle Inspection and Promotion of Road Safety Education

The improvement of mechanical vehicle inspection and promotion of road safety education is proposed to ensure safety motor vehicles and to attain save-energy, low-pollution, and harmonization with other social economy, in addition, to mitigate the traffic accident involving the public transport operators.

(1) Improvement Plan of Mechanical Vehicle Inspection System

Traffic accidents occur due to negligence of drivers and pedestrians. Through optimum vehicle maintenance based on vehicle periodic inspection, the traffic accidents involving vehicles can be reduced, which then allows the safe public passenger transport.

1) Current Mechanical Vehicle Inspection System

In recent years, the public transport vehicle (buses/taxies) inspection system in Nicaragua was realized by licensed private companies and the vehicle inspection was finally approved by the National Police. However, from this year 2013, the vehicle inspection procedure for public transport vehicle was changed that the vehicle inspection could be licensed to complete responsibility of the MTI and Municipality. The inspection system was revised through change in 2005. However, the quality of existing technical inspection by licensed private companies, the MTI and the National Police is quite simple, through the mechanical professionals by their visual observation. It is necessary that more rigorous technical inspection items by a standard should be adopted.

2) Inspection Items proposed for Standard

Current vehicle inspection consists of the following components: confirmation of vehicle registration (chassis, body, engine), consistent with the registration (chassis, body, engine) and general inspection of the measures taken. New inspection item proposed is comprised of 1) Part I: Chassis, 2) part II: Body, 3) Part III: Lamp. Each part is composed of detailed items. The detailed

items for technical inspection are shown in Table 18.4.1. A sample of a format sheet for the technical inspection items is shown in Table 18.4.2.

Table 18.4.1 Inspection Items Proposed of Standard

Part		Items	No. of Sub-items	Bus/Taxi
I. Chassis	1	Frame	3	●
	2	Bumper	3	●
	3	Turning control system	4	●
	4	Disc wheel	1	●
	5	Tires	2	●
	6	Axle	1	●
	7	Spring	1	●
	8	Shock absorber	2	●
	9	Mud flap	6	●
	10	Hand brake	2	●
	11	Parking brake	6	●
	12	Engine	3	●
	13	Exhaust system	5	●
	14	Drive train system	3	●
	15	Ignition system	1	●
	16	Electric system	6	●
	17	Horm	6	●
	18	Fuel tank	4	●
	19	Speedometer	3	●
	20	Tachometer	3	●

Part		Items	No. of Sub-items	Bus/Taxi
II. Body	1	Windshield and glass bod	4	●
	2	Rear view mirror	2	●
	3	Wiper	4	●
	4	Sun visor	1	-
	5	Rear body	4	-
	6	Letter, Picture or any mark	7	●
	7	Body color	1	●
	8	Roof	2	●
	9	Floor	2	●
	10	Side window	7	●
	11	Entrance door	8	●
	12	Emergency door	7	●
	13	Driver seat	3	●
	14	Passenger seat	2	●
	15	Driver cab	3	-
	16	Driver partition	2	●
	17	Passenger grip	4	●
	18	Bell for stop signal	2	●
	19	Fluorescent pad	13	●
	20	Safety belt	1	●

Part		Items	No. of Sub-items	Bus/Taxi
III. Lamp	1	High beam lamp	7	●
	2	Low beam lamp	5	●
	3	Lamp for vehicle width	7	●
	4	Turning lamp	8	●
	5	Tail lamp	5	●
	6	Stop lamp	6	●
	7	Reversing lamp	6	●
	8	License plate lamp	6	●
	9	and categories (for	12	_
	10	Inside vehicle lamp	5	●
	11	Lamp for route plate	2	●
	12	Side lamp (option)	10	●
	13	Side turn lamp (option)	5	●
	14	Fog lamp (option)	7	●
	15	High mount stop lamp	9	●
	16	Other lamps	1	●

Source: JICA Study Team

Table 18.4.2 Sample of a Format Sheet for Technical Inspection Items

Part	Items		How to check	Bus/Taxi
III. Lamp	1	High beam lamp	1. White or light yellow	●
			2. 2 units	●
			3. Fixed at the front in the same level both left & right each one	●
			4. Both of them must be the same color	●
			5. Fixed higher than the ground at least 40cm but not exceed 1.35m	●
			6. They will be lightened whenever tail lamps are lightened except in case of temporary signal	●
			7. Additional 2 units are allowed (option)	●
	2	Low beam lamp	1. White or light yellow same as high beam lamp	●
			2. 2 units	●
			3. Fixed at the front in the same level both left & right each one	●
			4. Fixed higher than the ground 40cm but not exceed 1.35m. And the length from the edge must not exceed 40 cm.	●
			5. They will be lightened whenever tail lamps are lightened	●

Source: JICA Study Team

(2) Facility Plan Proposed for Vehicle Inspection System

A suitable vehicle inspection is to obey the inspection items proposed and standards and understand

the merit of safety vehicles. In this plan, a computerized automatic vehicle inspection system will be proposed. This automatic vehicle inspection system consists of 5 blocks, and each block inspect the different elements such as confirmation of registration, brake function, lights, exhaust and body, etc. and overall assessment is done at the end of process. Figure 18.4.1 shows the arrangement of a computerized automatic vehicle inspection system.

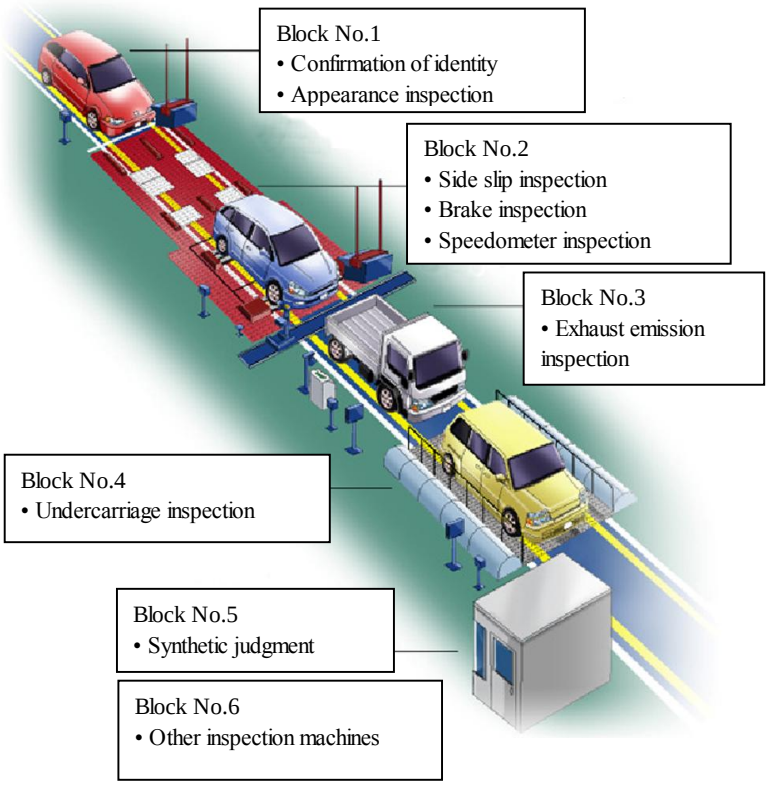


Figure 18.4.1 Arrangement of Major Inspection Items
Source: Motor Vehicle Inspection and Registration Guide in Japan.

1) Project Cost Estimate

A complete set of Computerized Vehicle Inspection System will be installed in Managua City. The project cost is estimated at 18.6 million US dollars.

(3) Promotion of Road Safety Education for Public Transport Operators

The training program for public transport operators for road safety by introducing a safe driving manager in public entities will be proposed, in order to mitigate the traffic accident involving the public transport operators. It is important that operators of public transport such as buses and taxis recognize the importance of respecting traffic rules and that the road safety managers understand the safe handling duty to implement road safety programs. That is, the assignment of road safety manager in public transport entity is proposed to educate their drivers. In particular, the preparation of guide and training workshops is proposed as described below.

- Development of guide for safe handling managers of public transport operators
- Training for safe handling managers through workshops

18.5 Formulation for Computerized Registration System of Operation License and Statistic Data

The computerized registration system of operation license and the statistics data is proposed to formulate the data basic system for the registration of operation license and statistics of bus operation system, by using a computer means in a consistent manner.

(1) Current Computerized Registration System for the Operation License and Statistic Data

The computerized registration system for the operation license and statistic data in the DGTT Office was currently established, which is the so-called the "SIG-DGTT" (Sistema de Información General). Currently this system is in the process of upgrading by adding the statistical data of bus operation. The system of SIG-DGTT is comprised of 1) Registration Module (registration, data processing, storage), 2) Delegation Module (connection and exchange of data on line), 3) Transport Regulation Module (Operating data, routes, fleet, fee, etc.) and 4) Concession Management Module (management of concession). It is necessary to promote the development of the system to update the data to implement the public bus transport improvement plan.

(2) Data Base for Transport Regulation Module

At present, the transport regulation module has been formulated based on the existing data base from the bus companies. However, these data base was collected from the limited information of bus companies; for instance, the data of passenger trip characteristics is not enough, which is one basic element in the development of bus route network, bus fleet and new bus mode. It is highly recommended that the plan of passenger characteristics survey will be carried out in order to obtain the latest data base of passenger demand to complement Transport Regulation Module.

18.6 Reform of the Law No. 524

When the MTI tries to modify bus service network or upgrading the operating system, it is required to grant the concession to private bus operators. Law No. 524, General Land Transport law defines: Concessions will be awarded in accordance with the quotas allocated by the last PNT. In future, the legal reform will be necessary in Nicaragua in case of planning / implementing of public transport reorganization (bus, taxi), operating schedule modification, introduction of s large capacity bus and modification of fee, etc.

The following dispositions of Law No. 524are proposed to be reformed: 1) Reforms to the current valid regulatory legal framework, 2) Transformation of the public transport model, 3) Create moratorium regulations to new concession, 4) Create the competency that allows MTI to practice the sector stewardship, 5) Create the conditions for other transport modes and 6) Establish the State's obligation in the formulation of public policies. Discussion should be promoted on these points of reforms.

Chapter 19 Water Transport Sector Development Plan

The water transport sector development plan composes several plans in 5 different areas as follows:

1. Expansion and improvement of existing sea port;
2. Development of new sea port;
3. Development of inland water transport (IWT);
4. Improvement of lake ports; and
5. Improvement of maritime transport system

19.1 Expansion and Improvement of Existing Sea Port

19.1.1 Expansion and Improvement of Puerto Corinto Port

(1) Present Situation of Puerto Corinto

Feature of Puerto Corinto: The Puerto Corinto is one of six commercial ports of Nicaragua under the management of EPN and it is one of five ports complies with the international standards (PBIP-ISPS Code). It is the largest port in Nicaragua and located along the Pacific Coast. Figure 19.1.1 illustrates the outline of the Puerto Corinto.

Figure 19.1.1 Outlook of Puerto Corinto
Source: ENP

As shown in the above photos the Puerto Corinto, this port is naturally secured against the waves of the Pacific Ocean. The port has 2 berths of which total length is 610 m. The one berth having berth length 370 m serves for general cargoes and the other berth having a berth length 240 m serves for containers, respectively. At the eastern end of these berths there exists a loading facility for bulk cargoes but it has not been used at present. A new cargo handling facilities for the bulk cargo is planned to be constructed at this location and its purchasing process has been on-going as of December 2013. At the western end of these berths there exists a jetty for liquid cargoes, equipped with four Alba ships (medusas in Spanish and dolphins in English). The port depth varies from 12.60 m to 13.25 m at high tide. The port is managed by EPN, with a staff of 240 people, and the stevedoring works are undertaken by three private stevedoring companies authorized by DGTA and hired by EPN: ESENSA, EMTRAMPSA, and COSEPORSA.

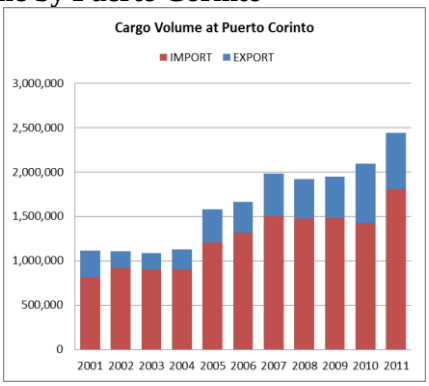
Cargo Handling Volume: Table 19.1.1 shows the historical change of cargo handling volume by type of trade and the number of ship calls per year. The total cargo volume handled by the Puerto

Corinto in 2012 was 2.6 million tonnes. The same in 2001 was 1.1 million tonnes, thus, it has increased at almost 1.45 times in 11 years or grown at 8.2% per year. The number of ship calls has increased at almost 1.60 times in the same period or grown at 8.8% per year. The volume of inbound cargo has increased at almost 2.2 times and the same of outbound cargo has increased at 2.0 times or 9.6% and 11.6% per year, respectively.

Table 19.1.1 Changes of Cargo Handling Volume by Puerto Corinto

(Unit: to nes/Year)

YEAR	IMPORT	EXPORT	T TAL	Ship Call
2001	812,966	301,822	1,114,789	264
2002	916,756	189,973	1,106,729	241
2003	901,432	186,040	1,087,472	225
2004	904,558	222,012	1,126,569	238
2005	1,200,683	376,474	1,577,157	300
2006	1,312,860	346,683	1,659,543	400
2007	1,502,473	481,767	1,984,240	460
2008	1,476,257	442,231	1,918,488	443
2009	1,482,459	465,498	1,947,957	404
2010	1,423,506	667,107	2,090,613	449
2011	1,806,938	631,029	2,437,967	431



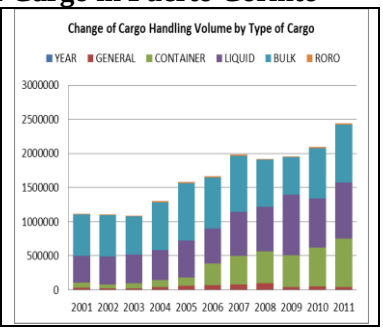
Source: JICA Study Team prepared based on the data obtained from EPN

Table 19.1.2 shows the changes of cargo handling volume by type of cargo.

Table 19.1.2 Changes of Cargo Handling Volume by Type of Cargo in Puerto Corinto

(Unit: tonnes/year)

YEAR	GENERAL	CONTAINER	LIQUID	BULK	RORO	TOTAL
2001	33,652	68,764	394,507	603,516	14,350	1,114,789
2002	22,503	56,651	408,576	604,595	14,403	1,106,729
2003	25,097	70,704	417,411	563,370	10,890	1,087,472
2004	45,100	96,054	441,810	702,601	10,657	1,296,222
2005	61,707	122,659	533,031	842,866	16,895	1,577,157
2006	68,633	315,478	517,216	741,886	17,024	1,660,236
2007	74,351	422,104	648,331	817,585	21,869	1,984,240
2008	92,321	467,513	660,687	684,062	13,906	1,918,489
2009	38,377	468,852	881,607	552,184	6,977	1,947,957
2010	45,471	576,702	715,415	739,567	13,458	2,090,613
2011	39,317	713,197	816,284	851,582	17,588	2,437,967
2012	42,675	774,104	885,995	924,307	19,090	2,646,169



Source: JICA Study Team prepared based on the data obtained from EPN

Container Handling Volume: As shown in the above table the container handling volume of Puerto Corinto in 2012 was 774,000 tonnes or almost 65,000 TEUs while these of 2001 were 68,760 tonnes or almost 9,600 TEUs. Thus it has increased almost 6.8 times in 11 years or grown at 19.0% per year which is tremendous. As the figure illustrates it is clear that a substantial increase of cargo volume handled by Puerto Corinto is attributed by a rapid increase of container hadling volume. Table 19.1.3 shows the changes of container volume handled by Puerto Corinto.

Table 19.1.3 Changes of Container Handling Volume by Puerto Corinto

Year	Container Box	20-footer	40-footer	Box	TEUs	Average Tonnage	20-footer	40-footer
2002	5,664	1,888	3,776	5,664	8,870	6.39	21%	79%
2003	6,957	2,319	4,638	6,957	10,957	6.45	21%	79%
2004	9,374	3,125	6,249	9,374	15,675	6.13	20%	80%
2005	11,368	3,789	7,579	11,368	18,002	6.81	21%	79%
2006	28,093	9,364	18,729	28,093	46,088	6.85	20%	80%
2007	35,128	11,709	23,419	35,128	58,555	7.21	20%	80%
2008	36,219	12,073	24,146	36,219	58,880	7.94	21%	79%
2009	35,549	11,850	23,699	35,549	56,189	8.34	21%	79%
2010	41,194	13,731	27,463	41,194	64,937	8.88	21%	79%
2011	50,654	16,885	33,769	50,654	80,119	8.90	21%	79%

Source: JICA Study Team prepared the table based on data obtained from EPN

The average weight of container is 8.9 tons per TEU and the share between 20-footer container and 40-footer container is 20:80.

At present 6 – 7 shipping companies use the Puerto Corinto namely MAERSK, NYK, APL, MSC,

CMA, China Shipping, CSAV, etc. The maximum size of container ship calls the port is 27,000 DWT. An average loading / unloading volume of container is around 300 TEUs per ship. Although there exist one shore container gantory crane most of the container ships call Puerto Corinto uses their own gears. Therefore, the berthing time is relatively long and port productivity is considered as relatively low.

Cargo Demand Forecast: The cargo demand forecast of the Puerto Corinto in 2023 and 2033 are 1.68 million tonnes and 3.2 million tonnes per year excluding the volume of liquid cargo, respectively. The volume of container is estimated at 83,000 TEUs and 104,000 TEUs, respectively.

Ship Call by International Cruisers: The number of port call to Puerto Corinto by the internatioal cruisers of more than 20,000 DWT is around 11 times in the past 10 years. Although the berthing time of such cruisers is around 48 hours the occupation of berth by cruiser often hinder the berthing the cargo ships especially the container ships.

Number of Berths: Although the cargo volume handled by Puerto Corinto is not much at present however as it is only one port operating in Nicaragua to deal with most of international cargoes of any kinds the port operation is complex as a large-scale port in other countries. The berth functions as a multipurpose berth at present however as the handling volume of container increases at least one berth is to be assigned specifically for the container ships.

Support Facility for Cargo Handling: The cargo handling yard space often limit the cargo handling capacity and quite influential to the cargo handling capacity of the port. As the Puerto Corinto commenced its operation as the first commercial port of Nicaragua in 19th century and it has expanded to date to meet with ever increasing cargo demand the immediate behind of the port has been already filled by the residential areas since the town has been expanded and developed as the port city since long time ago. Thus, the space available for cargo handling yard is quite limited and there exist no room for futher expansion.

Port Access Road: As discussed above the town behind Puerto Port has been developed and expanded continuously since the time Puerto Corinto started its operation the access road attached to the port is narrow and space for widening of the access road within the town is quite difficult.

Cargo Handling Equipment: Table 19.1.4 shows the major cargo handling equipment in Puerto Corinto at present.

Table 19.1.4 Container Handling Equipment Operating in Puerto Corinto

Equipment	Quantity (Unit)	Remarks
Shore Gantory Crane	1	Spreader Capacity: 40 tons Capacity: 22 boxes per hour Make: 1975
Prime mover	9	 
Container chassis	15	
Container stacker	4	 
Forklift	21	

Source: JICA Study Team prepared based on the data and information obtained from EPN

Customs Clearance Operation: In the past the customs clearance operation has been done in the administration builiding located inside of the port premises. It took almost 2.5 hours per one consigner with processing around 74 documents by 17 persons. However, this has been shortened to around 30 minutes by simplification of processing 55 documents by 4 persons. This was achieved by a provision of ante-port (preliminary processing of customs and shiping documents) located at around 1.5 km away from the port. However, the Port Electronic Data Interchange System (EDI) has not been introduced yet in Puerto Corinto although most of the ports located in neigboring countries along the Atlantic Coast has already operating Port EDI.

Issues to be Addressed: The cargo demand forecast for Puerto Corinto toward 2033 is 4.6 million excluding petroleum products in the case if no international class port is developed at the Atlantic Coast or 3.2 million in the case if the international ports are developed along the Atalantic Coast. To address such issues the Puerto Corinto is needed to be expanded to meet with ever increasing cargo demand and the efficiency of cargo handling should be maximized at least investment cost.

(2) Outline of the Puerto Corinto Expansion Project

The Project envisages the expansion of Puerto Corinto and increase the cargo handling capacity to meet with the ever increasing cargo demand. The Project is composed of three (3) key components as follows:

i. Provision of two (2) berths that is possible to accommodate two container ships at the same time as a short-term plan;
ii. Provision of cargo handling equipments as a short-term plan;
iii. Preparation of port access roads;
iv. Introduction of Port EDI as a short-term plan; and
v. Expansion of container handling yard behind the present port premises as a medium term plan;
vi. Development of new berths at the eastern end of the port as a long-term plan.

The outline of each projects are as described below by order.

1) Reformation of one existing berth for container ship berth

The one berth currently used for general cargo beside present container berth is to be reformed to a container berth having berth length of 230 m to accommodate the container ship of which length is around 210 m. The works required is demolishing present Cargo Freight Station (CFS) or warehouse and provide the rails to move the shore gantory crane to this new berth. The estimated cost for the demolishing existing CFS and reformation of general cargo berth to a container berth is estimated to be at US$ 15.0 million.

2) Provision of container handling equipment

There exists one shore gantory crane having handling capacity of 22 boxes per hour with lifting capacity of 40 tonnes. However this crane is quite old and its designed capacity cannot be achieved at present. Most of the shipping company preferes to use the shore gantory crane at the port and avoid to use their own ship gears. Most of the container ships serving along the Atlantic Coast of the Central America and the South America are operated under feeder service most of them are of Lift-on Lift-off (Lo-Lo)type container ship. As the cargo handling efficiency by ship's own gear is low when it is compared with the use of shore gantory crane, the shipping company prefers to use the shore gantory crane so as to shorten berthing time as much as possible.

Table 19.1.5 tabulates the cargo handling equipment recommended but not limited to add on top of existing fleet of cargo handling equipment at Puerto Corinto. The total cost estimated to this component of the project is US$ 15.0 million.

Table 19.1.5 Cargo Handling Equipment for the Puerto Corinto

Equipment	Quantity (Units)
Shore gantory crane	2
Rubber Tired Gantory Crane	2
Prime mover	8
Container chassis	16
Container stacker	2

Source: JICA Study Team

3) Preparation of port access road

The widening of the road in the town immediately behind the port in Puerto Corinto is quite difficult because of density of residential area is quite high and a construction of new elevated road linking between backyard and the port along the coast line is possible but its investment cost is enormously high as well. Therefore, the regulating several roads as one way road to enter into or exit from the port are recommended. Figure 19.1.2 illustrates the proposed relevant road accessing to the port entrance gates. The estimated cost of this project is US$ 5.0 million.

Figure 19.1.2 Proposed Port Access Road Regulating Plan

4) Introduction of port EDI system

Cargo handling capacity depends on the length and number of berthes, area of container handling yard or container terminal, number and type of cargo handling equipment used, and cargo handling management system. A Port EDI system is recommended to be introduced for the cargo handling management system so as to avoid an excessive investment to the port infrastructure but increased cargo handling efficiency as well as shorten time for lengthy customs clearance procedures. The cost on an introduction of EDI cannot be estimated simply as it depends on the opeation and management plan of the port and level of integration with other operation such as customs clearance etc. However, it is around US$ 4.0 million as an indicative cost.

5) Expansion of container yard behind the port premises

The port cargo handling capacity depends on the area of container yard as well. Figure 19.1.3 illustrates the areas where the container yard is proposed to be expanded. However, it requires a large number of resettlement of residents the difficultities of negotiation with existing residents cannot be estimated and the cost for relocation cannot be estimated at present.

Figure 19.1.3 Proposed Areas for the Expansion of Container Yard

6) Development of new multipurpose berth(s)

The Puerto Corinto plays an important role for the expansion and promotion of trade of Nicaragua thus it functions as an integrated port complex handling bulk, break-bulk, liquid and container cargoes. Those projects described above are mostly related to the expansion and improvement of handling capacity of container cargo. If two berths for container ships would be realized as planned above the available berth length for general cargo ships will become around 130 m. As the port calls by the ships of which length is 150 m – 210 m accounts for around 80% of the total ship calls. One or two berths for general cargo or for multipurpos berth(s) is recommended to be provided. Figure 19.1.4 presents the plan on a construction of new berths at the easten end of existing port.

The estimated cost for the new berths as planned is US$ 170 million.

Figure 19.1.4 Plan on Development of New Berths

(3) Notes on the Puerto Corinto Expansion Project

The expansion of cargo handling capacity of the Puerto Corinto is imperative however as the backyard of the port is congested by the residential area and the access to the port would continue to be one of the important issues to be addressed toward the future. It is recommended to carry out the preparation of the master plan for the Puerto Corinto Development Plan taking into consideration of finding the best solution in this regard.

19.1.2 Expansion and Improvement of Bilwi Port

(1) Present Situation of Bilwi Port

Feature of the Bilwi Port at Present: As shown in Figure 19.1.5, the major facility of this port is a jetty made of wood. The size of this jetty is 461m long and 7 m width. Present jetty was reconstructed after original one was destroyed by hurricane in the past. The original length of jetty was 1,500 m long. The water depth at the tip of jetty is shallow therefore the size of ship that can be moored with this jetty is limited. The maximum cargo vessel size to accommodate at present is 4,000 DWT of which length is 109 m with 4.8 m draft. Before the Hurricane Felix attacked Nicaragua's Caribbean Coast hard in 2007 the draft was 5.6m. This is to be noted strongly that once a hurricane of the Caribbean Sea occurs and hits the Atlantic Coast of Nicaragua the channel dredged will be easily buried by a huge volume of drafted sand of sea bottom. The elevation of the jetty is 3.0m from the sea level (MWL) and the tidal difference is 0.5 m. Although the detailed data was not available with regard to the cargo volume handled to date, there was one record of 15,000 tonnes of liquid cargo was unloaded. This jetty is used often for unloading of marine products landed (mostly lobster) and loading of ice blocks and materials needed for fishing.

Cargo Demand Forecast: The cargo demand forecast of Bilwi Port for 2023 and 2033 are 1.3 million tonnes and 1.68 million tonnes, respectively.

(2) Outline of the Bilwi Port Improvement Project

Although the Bilwi Port has not played an important role as the international port to serve the need of economy in the northern part of the Atlantic Coast of Nicaragua yet, its potentiality to serve as an international port is quite high subject to the completion of links between Managua and Puerto Cabezas and port capacity of New Bilwi Port planned. A drastic change of international trade cargo traffic can be foreseen so far.

AlbaNISA of Venezuelan and Nicaraguan joint venture investment company has already prepared the plan and the detailed designs of new Bilwi Port of which major component is a jetty made of concrete has been prepared for the implementation of the project. Figure 19.1.5 illustrates the outline of this plan.

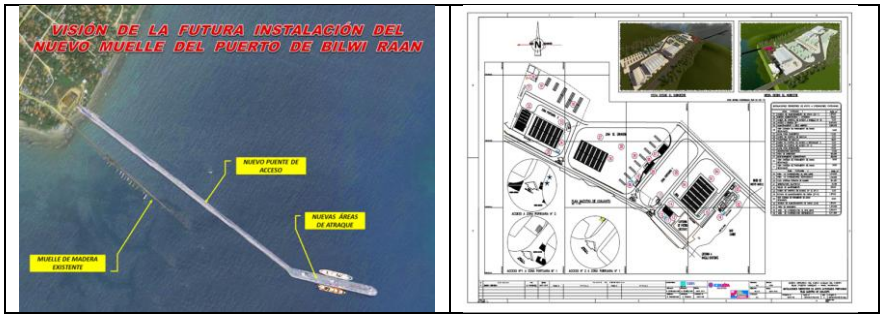


Figure 19.1.5 Plan of New Bilwi Port
Source: Albanisa S.A.

(3) Notes on the New Bilwi Port Project

The feasibility study of New Bilwi Port has been completed and preliminary design of the port and supporting facilities for the construction of New Bilwi Port has been already prepared as well. The implementation of the project is likely to go on in coming year. However, it is not clear whether the

port designed is capable to handle 1.0 million tons of cargo a year since the area of berth is narrow and the distance between the coast and berth is almost 1,500 m and the cargo is to be transported by trailer trucks along this narrow jetty.

The feasibility study has been carried out and completed however it is not known whether a sufficient depth of study on the oceanographic conditions has been done and analyzed to reflect such conditions to the basic design of the port infrastructure. A vulnerability of physical structure of jetty although it is made of concrete against the hurricane often occurred in the Caribbean Coast is not known therefore an in-depth study in this respect is needed to be carried out to confirm its technical feasibility of the project.

19.2 Development of New Sea Port along the Atlantic Coast or Bluefields

(1) Background of the Project

It was the dream of Nicaragua transport sector entities to have an international class commercial port along the Atlantic Coast for a long time as it is located within the territory of Nicaragua thus no crossing the borders are required and the maritime distance from Nicaragua to the countries located at the Atlantic side can be shorten substantially. This means the transport cost especially for the import cargo can be reduced substantially as well.

One of the candidate sites for the development of new port was the Monkey Point and a plan has been prepared for Monkey Point Port Development Project. However, this project composed of not only a port but also a large-scale town that support the port operation and management as well as a road linking with the Atlantic Corridor of which length is more than 600 km. The port designed faces directly with the Atlantic Ocean and the port is protected by an artificial breakwater. At present, no human and economic activity takes place at the candidate location. The location is covered by natural rain forest and the backyard of the selected site is hilly terrain. The estimated cost is more than US$ 400 million (port alone).

Another candidate site was Bluefields. Bluefields is situated at the mouth of the Escondido River and engulfed by the Bluefields Bay. There has been a port called El Bluff and it has served as a transit port for centuries. Bluefields is a capital city of RAAS and its population is more than 70,000 however this city has been physically isolated by swamp and low land forest. At present, the road linking with the Atlantic Corridor or Nueva Guinea and Bluefields City has been under construction with the financial assistance of both the World Bank and JICA.

The candidate site for new port in and around Bluefields City was thought to be not appropriate as it is located near the mouth of the Escondido River and the water depth of the Bluefields Bay is quite shallow as it is almost 2.5 m in average throughout the area of the Bluefields Bay. However, if a proper technology is applied to prevent the sedimentation for channel and berth front and the cost is reasonable then the Bluefields can be considered as an appropriate port location taking into consideration that the location is closed to existing city of 70,000, airport, protection by natural breakwater, and so on.

(2) Preliminary Site Survey on Candidate Site for New Port

Figure 19.2.1 shows the points selected as the candidate site for new port. The survey took place in November 2013 to compare the merits and demerits of each site taking into consideration of vulnerability of port infrastructure against possible hurricane, oceanographic conditions such as tide, maneuverability of cargo handling, estimated cost, connectivity and accessibility with the main land, economic activity in and around the bay, social matters such as indigenous population, environment in general, etc. As a result of preliminary studies on comparison of nine (9) candidate sites the site in the Bluefields Bay and close to the airport is selected. However, the final selection should dependent on the result of in-depth study on oceanographic data, meteorological data, morphologic data, berth metric data, bottom soil data, water quality data, environmental impact assessment, etc.

Table 19.2.1 shows the comparison of rough cost estimation of each candidate site. The major

factor for cost comparison are the volume of capital dredging of channel, construction cost of breakwater, submersible dyke for protection of sedimentation, berth, terminal, causeway, access bridge, access road, etc.

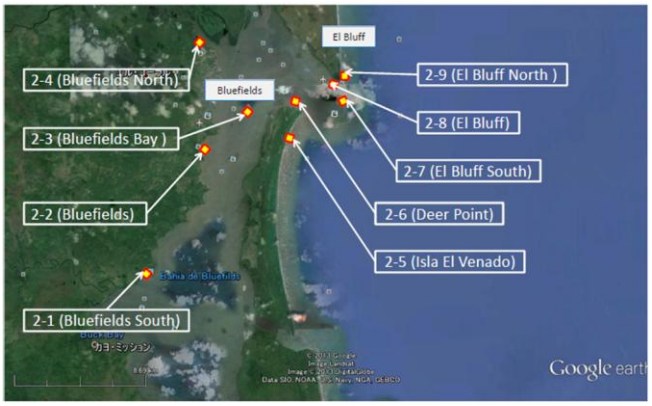


Figure 19.2.1 Candidate Sites Selected for New Bluefields Port
Source: JICA Study Team

Table 19.2.1 Cost Comparison of Candidate Sites

No.	Candidate Site	Cost (US$ Mill)	Channel L (km)	Dyke L (km)	Breakwater L(km)	Access bridge L (km)	Access road L (km)
1	Bluefields South	282	16.0	19.1	3.5	0	10.0
2	Bluefields	247	12.9	12.9	1.8	0	5.3
3	Bluefields Bay	235	8.9	6.4	2.1	1.8	6.2
4	Bluefields North	250	13.4	6.4	2.1	0	4.5
5	Isla El Venado	332	5.6	0	5.4	3.1	7.5
6	Deer Point	238	5.8	3.0	2.1	3.1	8.8
7	El Bluff South	341	2.0	0	5.1	6.6	6.7
8	El Bluff	289	4.9	1.8	0	7.1	7.2
9	El Bluff North	335	0.8	0	3.4	6.6	8.0

Note:
1) Dyke means a submersible dyke planned to be constructed on the bottom of the sea and designed to protect direct entering of suspended materials that occurs sedimentation of channel and beth front.
2) The cost of cargo handling equipment, etc. is included in the total cost at US$ 20 million.
Source: JICA Study Team

(3) Conceptual Design of New Bluefields Port

Among 8 candidate sites two alternative plans are selected for further comparison. These are the plan on site of Bluefields and Bluefields Bay. The candidate sites facing directly with the Atlantic Ocean were eliminated as the length of breakwater is relatively long and their costs are so high although those sites do not needs the channel dredging works. In addition to these factors, the accessibility and maneuverability are comparatively low.

Figure 19.2.2 illustrates the plans of those selected two alternatives.

Alternative-1 Bluefields

Alternative-2 Bluefields Bay

Figure 19.2.2 Alternative Plans of New Bluefields Port
Source: JICA Study Team

Figure 19.2.3 illustrates the typical section of wharf and general layout of container yard together with their images. The berth length is planned to be 450 m which is capable to accommodate 2 feeder ships of around 25,000 DWT. The water depth is planned to be 12.0 m.

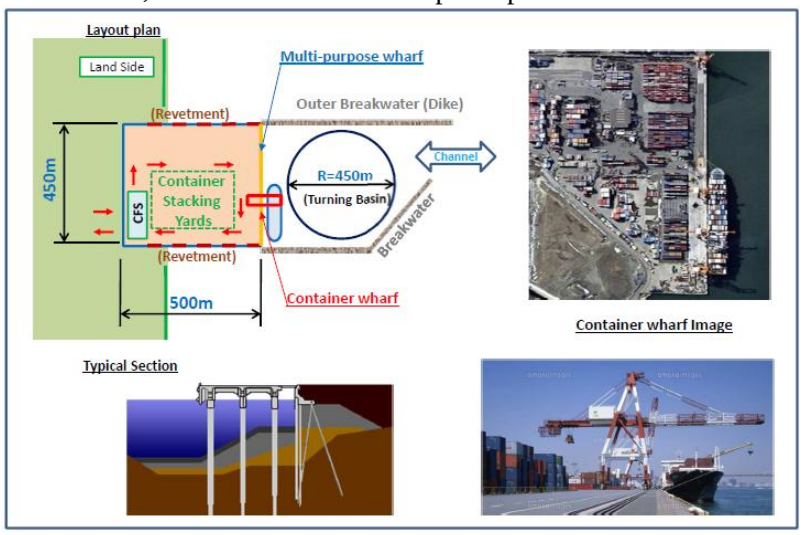


Figure 19.2.3 Conceptual Plan of New Bluefields Port and its Image
Source: JICA Study Team

(4) Estimated Cost of the Project

As discussed in preceding section the final selection of project site should be dependent on an integrated comparison of technical as well as economic and financial viability analysis. However, the preliminary estimated cost for this new port can be set at US$ 250 million for economic and financial analysis in this report.

(5) Investment Mode

The New Bluefields Port can be implemented under the Public-Private-Partnership type investment contract between the government agency or EPN and the private container terminal operator or logistic company qualified and selected by EPN as the concessionaire or terminal operator. Under the Land-lord Type Contract, the government agency would invest to the common structures such as wharf, channel, breakwater, dyke, access road, etc. and the concessionaire would invest to the preparation of container yard and provision of cargo handling equipment such as gantry crane, RTG, forklifts, stackers, yard truck, yard chassis, etc. The owner of the port would lease out to the concessionaires the right of use of wharf and container yard under the agreement and a certain percentage of the annual revenue of the terminal operator will be paid to the port owner as a land-lord.

19.3 Development of inland water transport (IWT)

(1) Background of the projects

The economic disparity between the departments located at the Atlantic side (RAAN and RAAS) and the Pacific side is quite significant. The major cause of this disparity is the geological conditions of RAAN and RAAS in general. Throughout both departments the land is low, flat and swampy and because of high precipitation the low land forest is dense. The climate condition is another factor. A constant north easterly wind throughout a year bring a relatively wet air to whole areas of both department from the coast to the mild mountain range run through north-south and traversing a center part of the country cause a high precipitation of this area. Therefore, there run a numerous rivers and streams. This makes difficult to construct the road network and therefore the people in RAAN and RAAS depend on the rivers for their transportation. Under such a condition, the Project envisages to develop and maintain the inland water transport network to meet with the daily transport needs of the people and their livelihood as well as welfare.

(2) Feature of the projects

The inland water transport is a traditional transport mode of the people in both RAAN and RAAS as the road network has not been developed fully covering these departments. Major rivers run from west to east and run off to the shore of the Atlantic Coast. Major livelihood of the populations reside along the Atlantic Coast is a coastal fishery. It is not easy to access to the market for them as the products are to be transported by boat for a distant market several kilometers away from their base along the coast which is often dangerous because of sudden change of weather, gale, high wave, strong tide, etc. If there is a canal along inner part of the Atlantic Coast this will serve as a trunk line to be used for water transport throughout a year as the water surface of canal is calm and protected for safe and speedy water transport. Although the inland water transport is a common and popular transport mode in both department there are no public transport system using a water bus or boat can accommodate 30 – 40 passengers together with cargo bay. One components of the project is a provision of such water transport bus.

(3) Number of Expected Beneficiaries

The population of RAAN and RAAS are around 314,000 and 306,000, respectively. Of which around 1/3 of the total populations lives along the Atlantic Coast. The project envisages development and maintenance of inner coastal canal along the Atlantic Coast and provision of the public water transport. Therefore, the total number of beneficiaries relevant to this project can be estimated at around 100,000 in RAAN and 50,000 in RAAS.

(4) Components of the project

The project is composed of three key components as follows:

i. Development and rehabilitation of inner coastal canal network for water transport;

ii. Provision of fleets of canal dredging and maintenance works; and

iii. Provision of inland water buses.

19.3.1 Inner Coastal Canal Development and Rehabilitation Project

(1) Outline of the project

This project envisages the development by canal dredging and rehabilitation of existing canal or river to suitable for inland water transport aiming at safe and smooth water transport in both RAAN and RAAS. The total length of the canal is 250 km stretching from Plankila along the Coco River in RAAN to the Bluefields Bay in RAAS. Figure 19.3.1 illustrates the alignment of planned canal and sections where the canal dredging is needed.

The width of canal is 10 m sufficient for a boat passing each other and its depth is – 3 m. The length of canal that require dredging works to cut and open the canal linking with the rivers is estimated to be around 98 km in total of 13 sections. The estimated cost of dredging is around US$ 15.8 million.

(2) Mode of Operation

The dredging works is planned to be carried out under forced account system based on the budget appropriated to the road maintenance organization. The key equipment or fleet for dredging works is planned to be provided through one component of the project which is outline in following section.

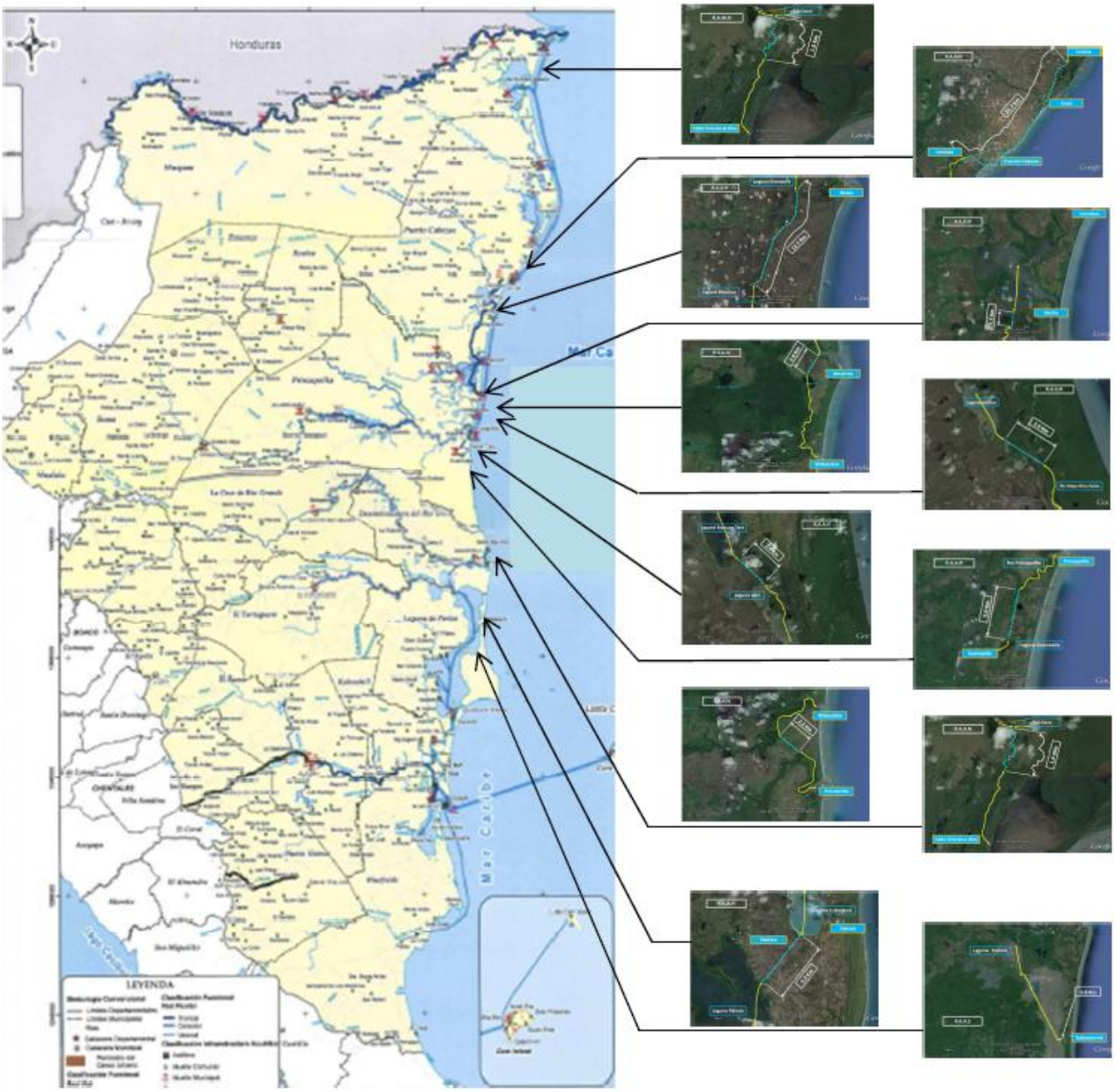
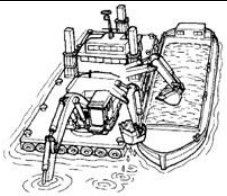


Figure 19.3.1 Inner Coastal Canal Development and Rehabilitation Project
Source: JICA Study Team

19.3.2 Project for provision of Canal Dredging Fleet

This project envisages provision of a fleet of dredging equipment for the dredging works required to complete the Inner Coastal Canal Development and Rehabilitation Project and its maintenance work needed after the completion of said project. Table 19.3.1 tabulates the list of equipment to compose one fleet for dredging works.

Table 19.3.1 Equipment for Fleet of Dredging Works

Equipment	Quantity (Unit)		Image
Dredger with Excavator	1	Dredging works	
Barges	2	For transporting dredged soil	
Long Arm Hydraulic Excavator	1	For unloading dredged soil to dump on land	
Tug boat	1	Moving barges	
Motor boat	1	For supervising the works	

Source: JICA Study Team

19.3.3 Project for provision of Water Buses

This project envisages provision of three (3) units of river and canal water transport buses having accommodation capacity of 30 – 40 passengers furnished with a cargo bay for transportation of goods. Three (3) units of this type of boat have been already provided under the grant-in-kind of the World Bank. Two units of them were delivered to Puerto Cabezas and one unit was delivered to Bluefields already. The estimated cost of the project is US$ 1.2 million.

The docks along the river and canal for the water transport in RAAN and RAAS are planned to be constructed by concerned municipality government where the docks are demanded by population residing along the river and canal.

Chapter 20 Airport Development Plan

20.1 Augusto C. Sandino International Airport

20.1.1 Runways

A single runway with efficient taxiway system is possible to handle annual aircraft movements of 195,000 to 240,000[1]. Since the result of annual aircraft movement demand forecast was approximately 77,000 in 2033, current single runway is judged possible to handle the demand even beyond 2033.

B737-800 is the model of major aircraft landing this airport that is demanded by airline companies among current aircrafts landing at Augusto C. Sandino International Airport. Taking into account the trend of airline preference for the route between North America and Central America, small size jet aircraft such as B737-800 and A320 will remain be used toward the future. According to the aircraft characteristics that relates to the airport planning, B737-800 requires 3,100 m runway length at Augusto C. Sandino International Airport. It is necessary to extend the runway to 3,100 m to improve safety aircraft operation and to cope with the demand. Figure 20.1.1 is the photos of typical B737-800 model jet aircraft and view of passenger terminal from the top of command tower of Augusto C. Sandino International Airport.

Figure 20.1.1 View of Augusto C. Sandino International Airport and B737-800
Source: JICA Study Team

20.1.2 Apron

Location of the existing passenger terminal area at the north side of the runway of Augusto C. Sandino International Airport cannot satisfy full ICAO compliance of the airport because the tail wing of small size jet aircraft in the apron penetrates the transitional surface, which is ICAO Standard for the precision approach runway. Also, the distance between the parallel taxiway and the runway is 150 m and it is less than the ICAO recommendation of 176 m for Code D aircraft in instrument approach runway.

To solve above issues it is recommended to relocate the apron for larger size aircraft to the southern side of the runway.

According to the results of air traffic demand forecast, jet aircraft might be introduced to the domestic routes by year 2020 so that it is recommended to construct a new international and domestic passenger building in the south side of the runway. The existing international passenger building would be used for general aviation and office space.

It conflicts with current EAAI's plan to construct a cargo terminal in the south however there are plenty of spaces in the southern area so that both cargo terminal and passenger terminal can be constructed together. Detailed study is required to prepare a future development plan in the area.

Phased development plan is recommended to construct the new terminal area. The new apron in the

[1] ICAO Planning Manual Part 1 Master Plan

south should have capacity of 6 parking spots for small size jet, 1 spot for twin turboprop and 3 spots for small turboprop in 2033. The following table shows facility requirements for the new apron in 2020, 2025, 2030 and 2033.

Table 20.1.1 New Apron Spot Requirements

	International			Domestic		
	SJ	**TTP**	**STP**	**SJ**	**TTP**	**STP**
2020	5	1	1	1	2	1
2025	5	1	1	2	2	1
2030	6	1	2	3	2	1
2033	6	1	3	3	2	2

Source: JICA Study Team

20.1.3 Passenger Building

Capacity of the existing international passenger building is estimated to be able to handle 600 peak hour passengers and the floor area is 24,900 sq.m. Thus, the floor area per peak hour passenger is 41.5 sq.m to provide better service level to the new international building, 45 sq.m per peak hour passengers is adopted to calculate required floor area of the new international passenger building. For calculation of domestic passenger building, generic area per peak hour passenger of 30 sq.m per peak hour passenger is adopted. The table below shows requirements of buildings.

Table 20.1.2 Facility Requirements of Passenger Building at Augusto C. Sandino International Airport

International				
Year	**Annual Passenger**	**Busy day passenger**	**Busy Hour Passenger (PHP)**	**Passenger Building Area (45 sq.m/PHP)**
2015	1,319,500	4,400	326	14,651
2020	1,815,000	6,100	440	19,793
2025	2,485,600	8,300	605	27,225
2030	3,420,300	11,500	829	37,284
2033	4,148,200	13,900	1,140	51,304
Domestic				
Year	**Annual Passenger**	**Busy day passenger**	**Busy Hour Passenger (PHP)**	**Passenger Building Area (30 sq.m/PHP)**
2015	187,300	700	48	1,434
2020	261,400	900	62	1,873
2025	365,000	1,300	87	2,614
2030	509,500	1,700	122	3,650
2033	622,400	2,100	170	5,095

Source: JICA Study Team

Comparing the facility requirement and the existing passenger building, it is necessary to expand the capacity of the international passenger building or to build a new building by 2025.

20.1.4 Proposed Development Plan

Figure 20.1.2 illustrates the direction of transferring the passenger and cargo terminal in the future.

Short Term
- Airport Master Plan Study
- Expansion of the runway to 3,100 m to the east

Medium Term
- Development of southern terminal area with new aprons, international and domestic passenger building, road and car parks.

Long Term
- Development of cargo terminal

Figure 20.1.2 Expansion Plan of A. C. Sandino International Airport
Source: JICA Study Team

20.2 Puerto Cabezas Airport

20.2.1 Facility Requirements

Puerto Cabezas Airport is the second largest airport in Nicaragua in terms of passenger volume. The passenger is composed of 39,483 domestic and 1,276 international passengers in 2011. According to the results of the air traffic demand forecast, annual arrival of domestic passengers will reach to 173,500 and the peak day passenger is projected to be 579 in 2033. Currently, twin turboprop aircraft with 40 seats (ATR42) is operated for this airport. Taking into consideration of the peak day passengers in future, it is expected that small size jet aircraft will be operated for the domestic routes. Since the runway length is 2,471 m and the pavement strength is PCN 54/R/C/Y/W, the runway is adequate to operate small size jet for domestic route. However, this length is not adequate to operate small jet with full load, so that runway extension will be required in future.

Passenger building should be developed to meet with future demand. As the share of international passenger volume is estimated at low, no special facility for international passenger will be required.

The following table summarizes facility requirements of the airport.

Table 20.2.1 Facility Requirements of Puerto Cabezas Airport

	Annual Passengers	Busy Day Passengers	Busy Hour Passenger	Apron Spot	PTB Area
2015	51,030	171	20	TTP:1	700
2020	71,850	240	26	SJ:1 TTP:1	910
2025	100,910	337	36	SJ:1 TTP:2	1,260
2030	141,480	472	51	SJ:2 TTP:2	1,785
2033	173,180	578	71	SJ:2 TTP:2	2,485

Source: JICA Study Team

Puerto Cabezas is popular for sea products and there is potential to export these products to USA. Therefore, it is recommended to build the cold storage facilities within the airport and processing plants of the intermediaries, and secure the export channels to promote the export of these local fishery products.

Construction of fuel supply facility is also recommended. Because fuel supply to aircraft is only possible in Augusto C. Sandino Airport, utilization of aircraft in domestic route is limited.

20.2.2 Development Plan

Figure 20.2.1 illustrates the perspective view of Puerto Cabezas Airport expansion plan.

Short Term
- Construction of a new passenger building
- Construction of a new fuel storage

Medium Term
- Construction of a new cargo terminal

Long Term
- Extension of the runway

Figure 20.2.1 Perspective View of Puerto Cabezas Expansion Plan
Source: JICA Study Team

20.3 Bluefields Airport

20.3.1 Facility Requirements

The passenger arrival volume was 32,530 as a domestic passenger and 6,196 as an international passenger in 2011. ATR42 is currently used. There are 2 daily flights to Corn Island as of November 2013. According to the air traffic demand forecast, annual domestic passengers will be 152,800 and international passengers will be 320,000 in 2033. To consider the volume, small size jet aircraft will be operated in domestic routes by that time.

As the existing runway is not designed for small jet aircraft, runway extension and pavement overlay will be required.

Apron expansion and new passenger building will be required. Table below summarized facility requirements of Bluefields Airport.

Table 20.3.1 Facility Requirements of Bluefields Airport

	Annual Passengers	Busy Day Passengers	Busy Hour Passenger	Apron Spot	PTB Area
Domestic					
2015	37,380	125	17	TTP:1	595
2020	52,620	176	19	TTP:1	665
2025	73,910	247	27	SJ:1 TTP:1	945
2030	103,630	346	37	SJ:1 TTP:2	1,295
2033	126,850	423	52	SJ:2 TTP:2	1,820
International					
2015	8,460	29	29	TTP: 1	1,015
2020	12,450	42	32	TTP: 1	1,120
2025	17,790	60	32	TTP: 1	1,120
2030	25,420	85	32	TTP: 1	1,120
2033	31,490	105	32	TTP: 1	1,120

Source: JICA Study Team

There is a plan to develop Bluefields port. To construct a new cargo facility on the south side of the airport is recommended. Because there is no fuel supply in the airport, operation of aircraft is limited, it is recommended to construct fuel storage in the airport.

20.3.2 Development Plan

Figure 20.3.1 illustrates the basic plan of Bluefields Airport Expansion Plan.

Short Term
- Rehabilitation of runway pavement
- Expansion of the runway strip and to cut trees at the south west part of the airport
- Construction of a new fuel storage

Medium Term
- Construction of a new passenger building in new terminal area

Long Term
- Construction of a new cargo terminal
- Extension of the runway

Figure 20.3.1 Basic Plan of Bluefields Airport Expansion Plan
Source: JICA Study Team

20.4 Corn Island Airport

20.4.1 Facility Requirements

There were 30,546 domestic passengers and 4,058 international passengers in 2011 in Corn Island Airport. ATR42 is used between Bluefields and Corn Island. According to the air traffic demand forecast, annual domestic passenger will be 139,990 and international will be 19,930 in 2033. Small size jet aircraft may be introduced in the future. To accommodate jet aircraft, runway extension and overlay work and expansion of the runway strip will be required. Apron for small jet aircraft and turboprop aircraft will also be required. Construction of passenger building to handle both international and domestic passenger will be required.

Table 20.4.1 Facility Requirements of Corn Island Airport

	Annual Passengers	Busy Day Passengers	Busy Hour Passenger	Apron Spot	PTB Area
Domestic					
2015	41,250	138	16	TTP:1	560
2020	58,080	194	21	TTP:1	735
2025	81,570	272	30	TTP:1	1,050
2030	114,360	382	41	TTP:2	1,435
2033	139,990	467	58	SJ:1 TTP:2	2,030
International					
2015	5,350	18	20	TTP: 1	700
2020	7,880	27	28	TTP: 1	980
2025	11,260	38	20	TTP: 1	700
2030	16,090	54	30	TTP: 1	1,050
2033	19,930	67	40	TTP: 1	1,400

Source: JICA Study Team

The operation of the airport is limited to day light time because there is no airfield lighting system. Airfield Lighting System for night time operation will expand the time of airport operation and also as this is an isolated island, extension airport operation time will be useful for emergency cases. It is recommended to install airfield lighting system.

20.4.2 Development Plan

Figure 20.4.1 illustrates the basic plan of Bluefields Airport Expansion Plan.

Short Term
- Installation of airfield lighting system
- Rehabilitation of airfield pavements
- Installation of new fence

Medium Term
- Construction of a new control tower
- Construction of a new passenger building

Long Term
- Expansion of the runway strip

Figure 20.4.1 Basic Plan of Corn Island Airport Expansion Plan
Source: JICA Study Team

20.5 San Carlos Airport

20.5.1 Facility Requirements

As the runway slope is steep and narrow, and there is no space to expand the airport. For this reason there is a plan to construct a new airport at the eastern side of the airport. However, it should be considered that the road between San Carlos and Managua had been improved and it takes approximately 4 hours by car and 6 hours by bus to Managua.

San Carlos has potential for tourism development because there is an old fortress and San Juan River. It is recommended to construct the new airport with basic facilities only such as gravel runway and a small passenger building but to secure the area for future expansion.

Figure 20.5.1 San Carlos Airport Runway View
Source: JICA Study Team

Table 20.5.1 Facility Requirements of San Carlos Airport

	Annual Passengers	Peak Day Passengers	Apron Spot
2015	4,290	15	STP:2
2020	6,030	21	STP:2
2025	8,480	29	STP:2
2030	11,880	40	STP:3
2033	14,550	49	STP:3

Source: JICA Study Team

20.5.2 Development Plan

Short Term
- To construct new airport with gravel runway and small passenger building

Medium Term
- Construction of runway pavement
- Expansion of apron area

Long Term
- Expansion of passenger building

20.6 Bonanza Airport

20.6.1 Facility Requirements

Bonanza Airport is located in Bonanza Municipality. Because road condition between Bonanza to neighboring town, Rosita, is bad and it takes approximately 3 hours from Bonanza to Rosita. The existing airport plays important role for people in Bonanza and for the mining company. If the road between Bonanza and Rosita would be developed, the airport in Rosita could serve for Bonanza Municipality but until that time Bonanza Airport should be maintained.

As there is no complete fence, it is necessary to construct boundary fence for safe aircraft operation. As Bonanza Municipality prepared city development plan and airport is included in the project. It is recommended to develop the terminal area and new access road. As the airport surrounded by hills it is not possible to introduce jet aircraft in the airport.

Table 20.6.1 Facility Requirements of Bonanza Airport

	Annual Passengers	Peak Day Passengers	Apron Spot
2015	14,200	48	STP:2
2020	20,000	67	STP:2
2025	28,080	94	STP:3
2030	39,380	132	STP:4
2033	48,200	161	STP:5

Source: JICA Study Team

20.6.2 Development Plan

Short Term
- To construct new boundary fence

Medium Term
- To construct new passenger building

20.7 Rosita Airport

20.7.1 Facility Requirements

Rosita airport has not been used since 2006 because of an issue with landowner of the airport area. The airport is located in flat area and there is potential to develop large airport. Since road condition between neighboring towns such as Bonanza and Siuna is bad, it is recommended to re-open the airport to provide direct access to Managua from Rosita.

The facility requirements of Rosita airport are same as the Bonanza Airport.

20.7.2 Development Plan

Short Term

- To construct new boundary fence
- To construct a new gravel runway

Medium Term

- To construct new passenger building

20.8 Siuna Airport

Siuna airport is located in the middle of Siuna town. One side of the runway is hill and the other side is valley. A main road is running along the runway and the other side of the runway is hill. There are many obstacles in the terminal area including Government buildings. It is very difficult to develop the airport to comply with safety standard.

It is recommended to close the airport and develop the road to Rosita airport.

20.9 San Juan de Nicaragua Airport

San Juan de Nicaragua Airport is located in the southeast edge of the country close to Costa Rica border. The airport was constructed in 2012. The airport was constructed to intend to develop the tourism in the area but there is not many tourist hotel and capacity to accommodate large volume of tourist. To consider the scale of tourism development in the area, it is reasonable to presume current airport is adequate for the future.

Figure 20.9.1 Airport Facilities and Runway views from San Juan de Nicaragua Airport

20.10 Ometepe Airport

Ometepe Airport is in La Paloma, located 2 km from Moyogalpa at the northwestern side of the Ometepe Island in Nicaragua Lake. The airport was under construction as of November 2013. The airport is developed for tourism development. The current airport facility is adequate for future demand and no development will be required in near future.

Figure 20.10.1 Airport Facilities and Runway views from Ometepe Airport

Chapter 21 Expected Environmental Impacts of the Master Plan

21.1 Introduction

This is a general preliminary assessment of expected social and environmental impacts of the Master Plan. The methods of assessment were by (i) examining various maps such as elevation map, protected area map, wetland map, topographic map, etc. and by (ii) utilizing knowledge of national engineers working within the Team and MTI engineers. Maps clearly illustrate projects that might fall inside nature reserve or projects that might pass through wetland or mountainous areas. This information provides an initial idea if a project would generate high impact on the environment. Likewise, discussions with engineers familiar with the area provide unique insight on the cultural heritage of the communities that might be negatively affected by the projects. Figure 21.1.1 shows the location of the road improvement projects and the environment protection area.

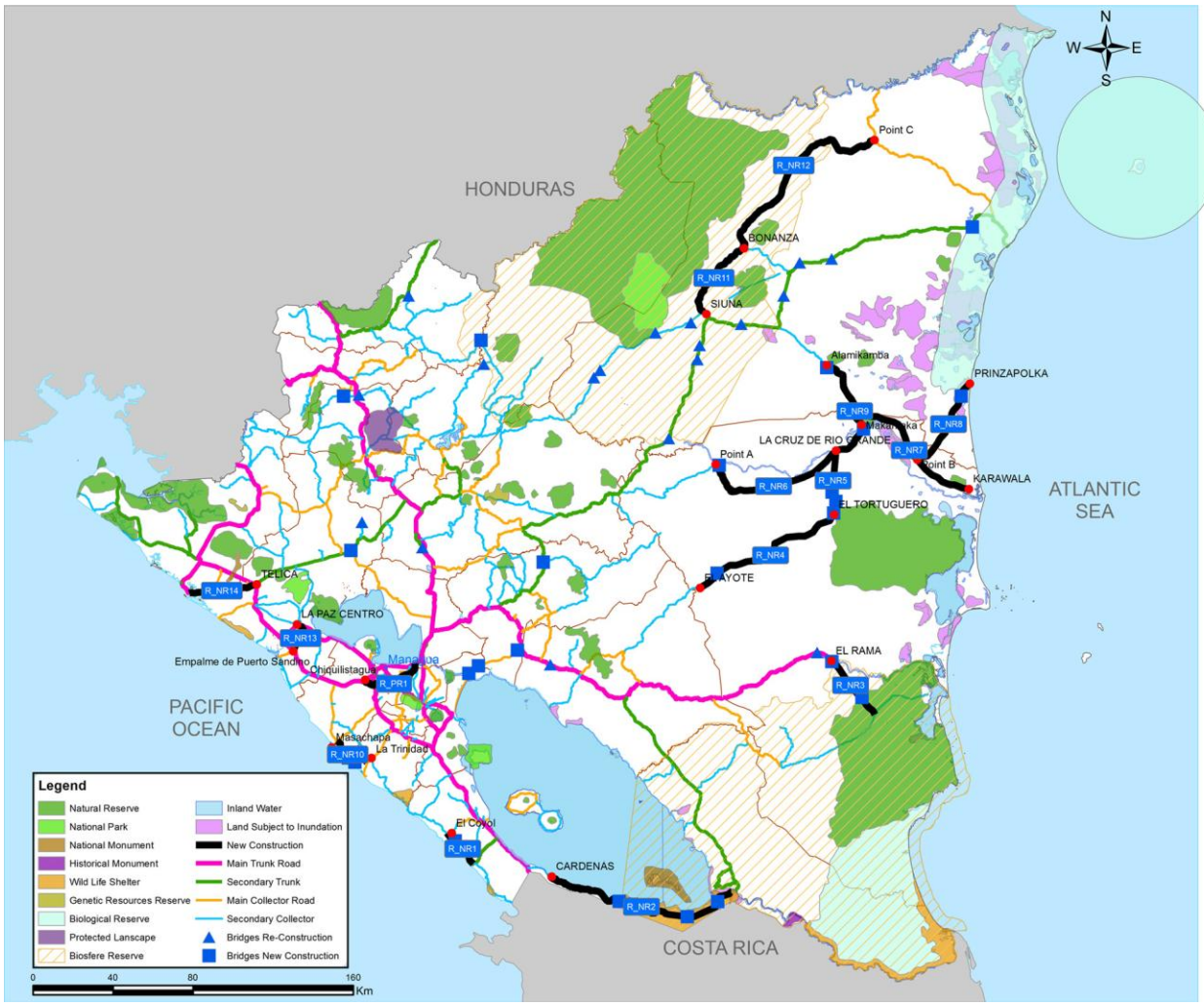


Figure 21.1.1 New Road Construction and Reserve Areas
Source: JICA Study Team

21.2 Road and Bridge Projects within Nature Reserves

21.2.1 Road Projects

The locations of road projects are presented in Figure 21.2.1 for main trunk roads subject for widening, Figure 21.2.2 for roads subject for pavement upgrade, and Figure 21.2.3 for roads need to be widen to satisfy design criteria. The above-mentioned maps show projects that will pass along environmentally sensitive areas.

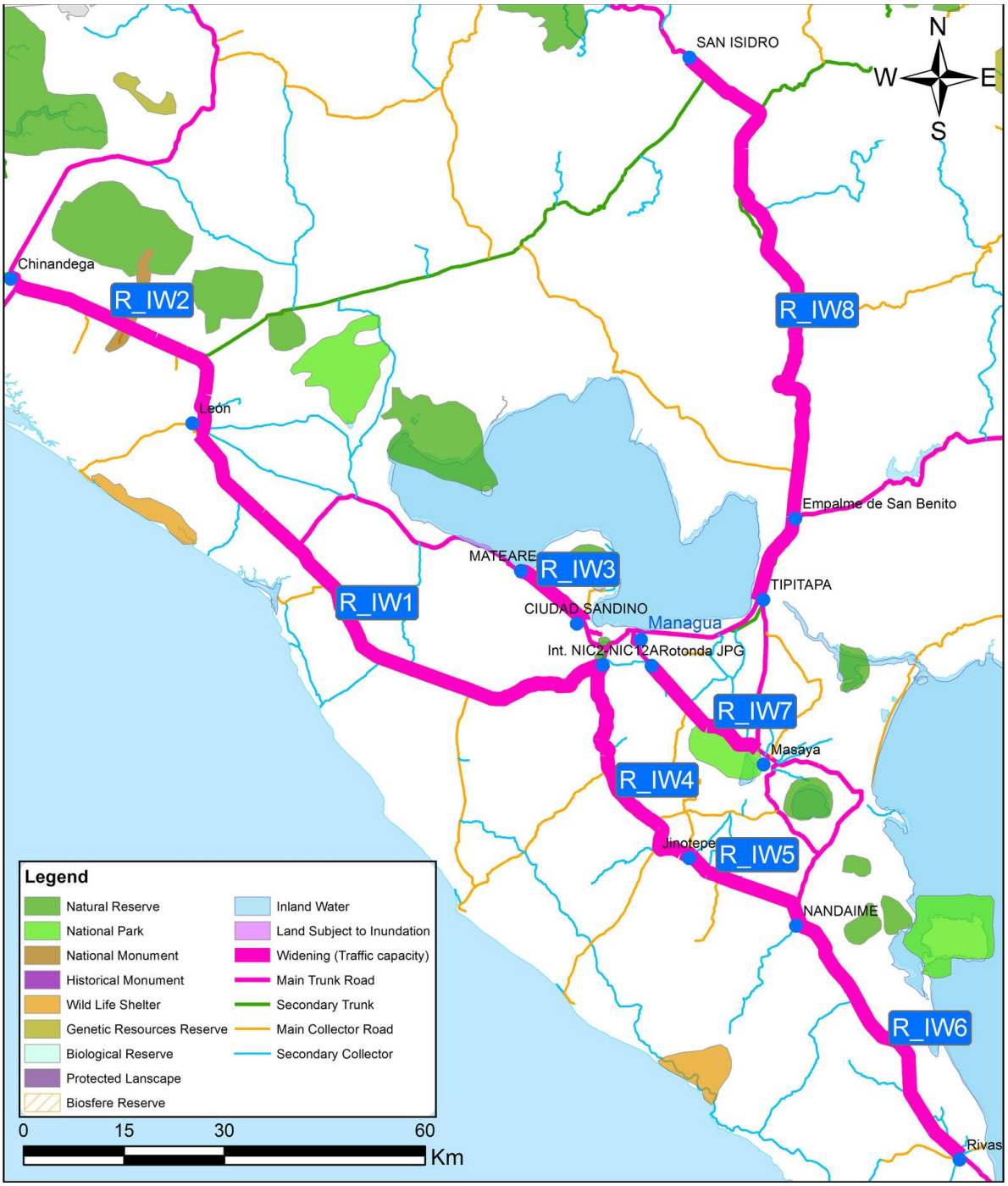


Figure 21.2.1 Main Trunks Roads subject for widening and Reserve Areas
Source: JICA Study Team

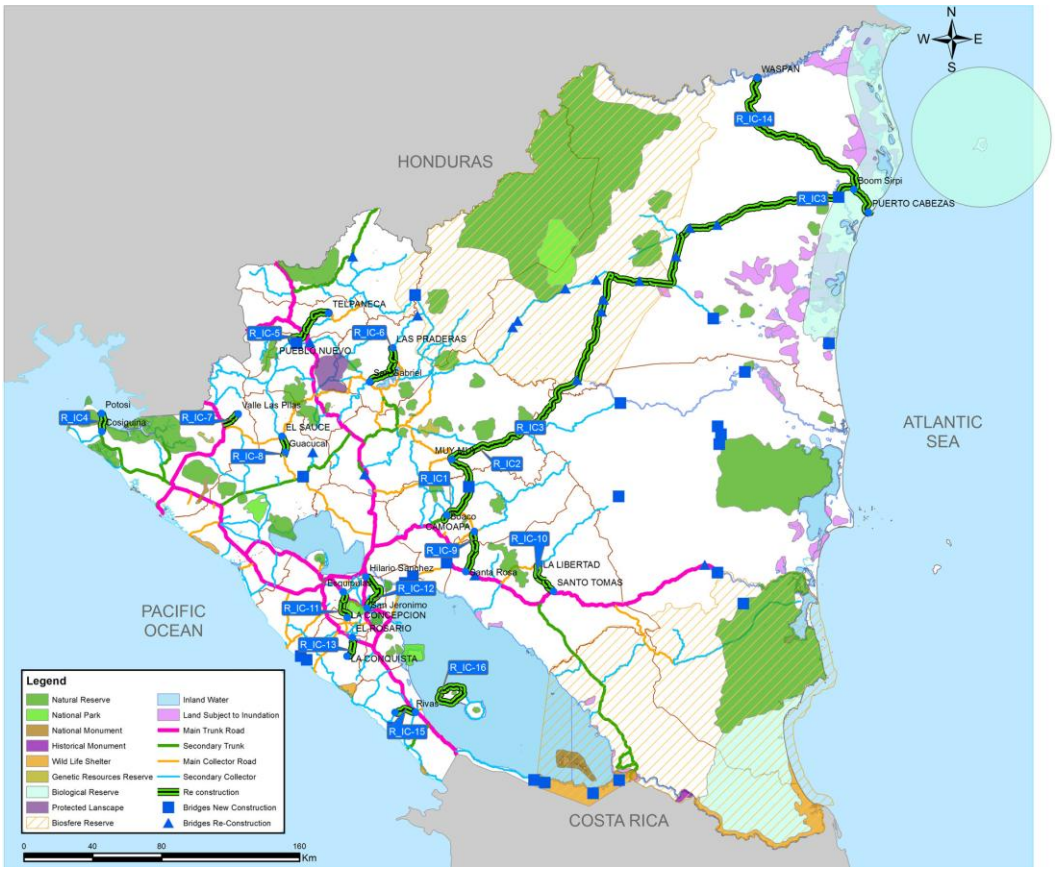


Figure 21.2.2 Roads subject for pavement upgrading and Reserve Areas
Source: JICA Study Team

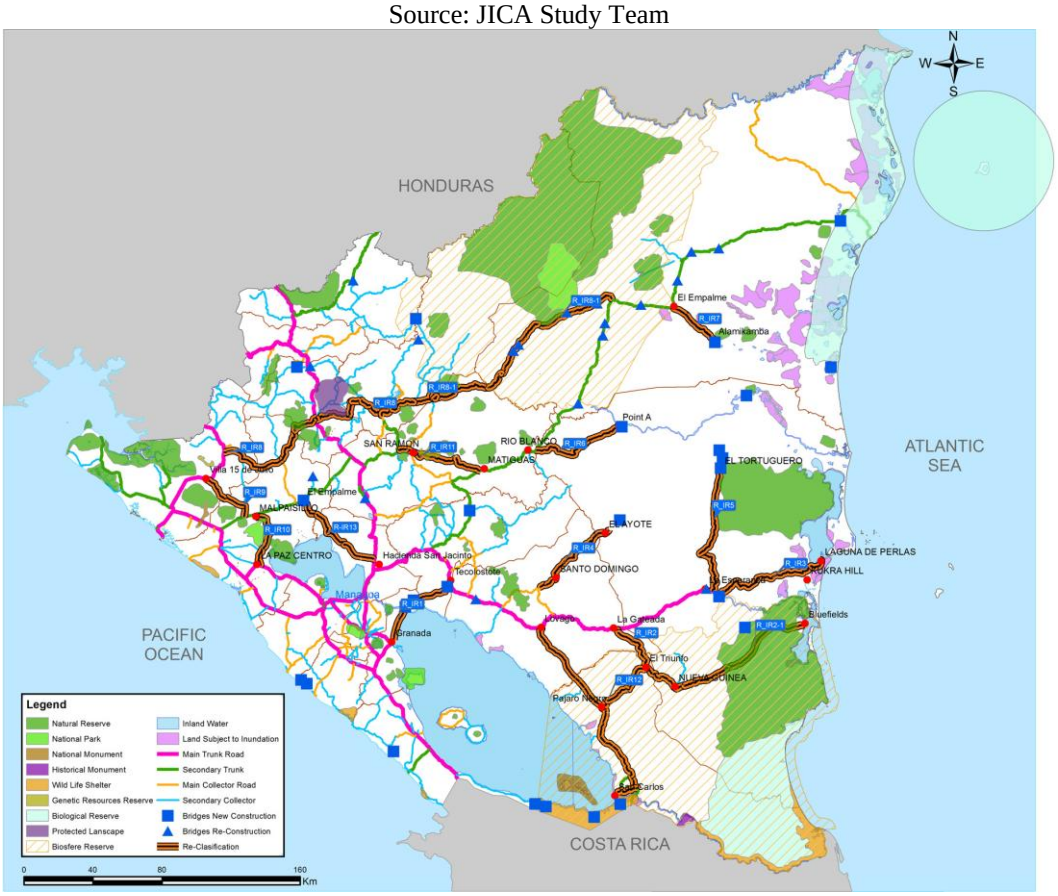


Figure 21.2.3 Roads subject for widening to satisfy design criteria and Reserve Areas
Source: JICA Study Team

21.2.2 Bridge Projects

The location of bridge project is presented in the Figure 21.2.4. By looking at this map, it is easy to identify bridge projects located inside the environmentally sensitive areas. Obviously, projects inside the reserve area require careful planning to carry out construction works to minimize environmental impacts.

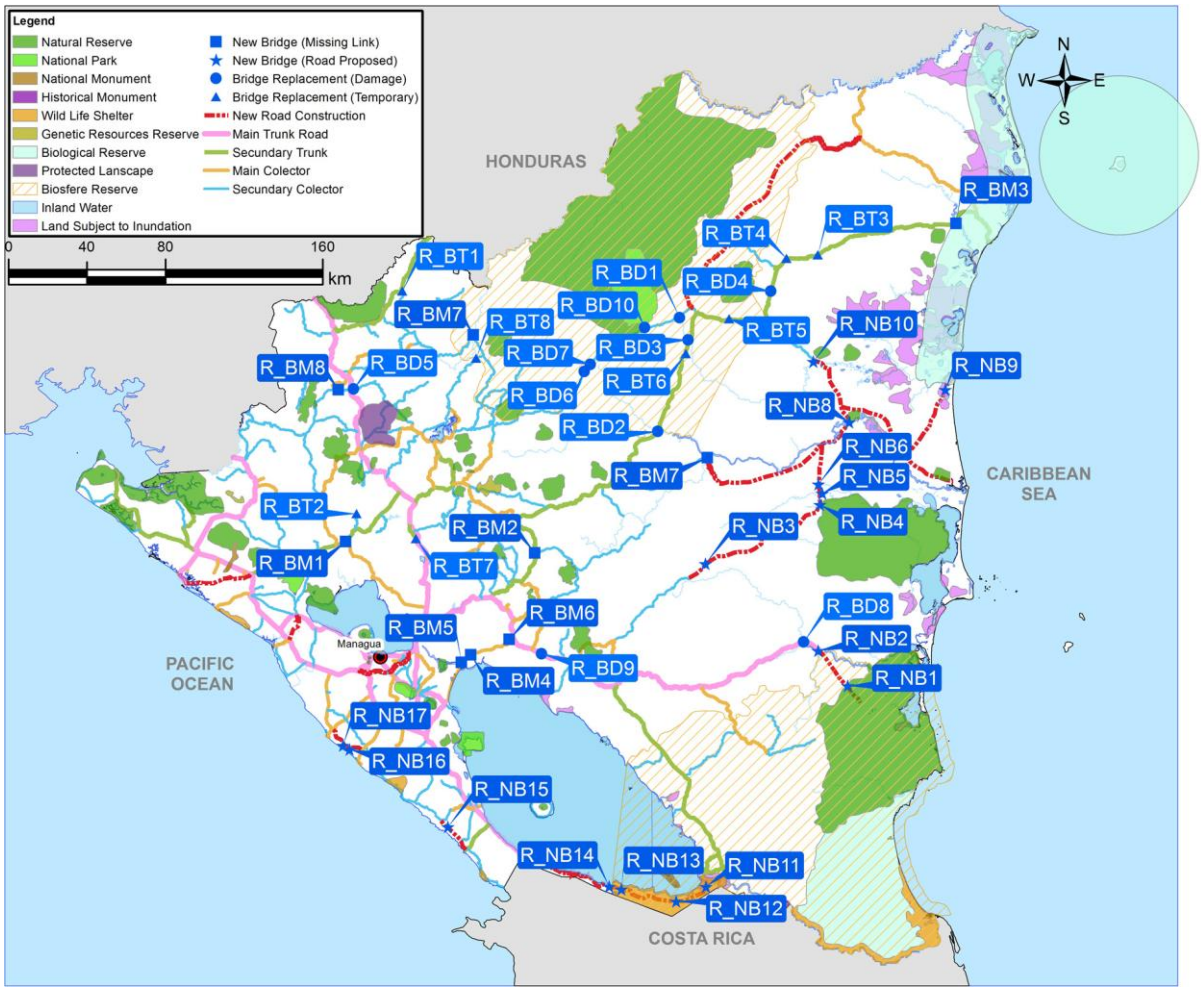


Figure 21.2.4 Location of Bridge Projects and Reserve Areas
Source: JICA Study Team

21.3 Scoping of Projects

The scoping of projects was defined through the workshops held between JICA Study Team, MTI engineers and the personnel responsible of environment issues. There was only limited information regarding the generality of projects like their approximate geographical location and environment protection area. Drawing up the scope was conducted with the scoping matrix method shown in Table 21.3.1 - Tabla.21.3.10. On the other hand, a detailed definition of scope of evaluation was not made. The results of the scoping related to Environmental Impact Assessment of the projects are shown below:

- Construction of New Road (Table 21.3.1)
- Road Improvement by Widening of Main Trunks (Table 21.3.2)
- Road Improvement by Upgrading of pavement (Table 21.3.3)
- Road Rehabilitation by Widening to satisfy design criteria (Table 21.3.4)
- Bridge Projects (Table 21.3.5)
- Bus related Projects (Table 21.3.6)
- Marine and Water Sector Projects (Table 21.3.7)

- Aviation Sector Projects (Table 21.3.8)
- Logistics related Projects (Table 21.3.9)

Table 21.3.1 Scoping Matrix for Road Projects (New Road Construction)

Code	Road Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
R_PR1	Chiquilistagua (NIC-12) - San Benito(NIC-1)		○	○		○	○		○			○	○			○	○				○		○			○	○							○		○	○	Urban road
R_NR1	San Juan Del Sur - El Coyol		○	○		○			○			○	○			○	○				○		○				○							○		○	○	
R_NR2	Cardenas - Santa Fe		○	○		○			○			○	○		○	○	○		○		○		○				○							○		○	○	Wildlife Refuge
R_NR3	El Rama - Las Brenas		○	○		○	○		○			○			○			○	○		○		○				○			○				○		○	○	Natural reserve
R_NR4	El Ayote - El Tortuguero		○	○		○	○		○			○			○				○		○		○				○							○		○	○	
R_NR5	El Tortuguero - La Cruz De Rio Grande		○	○		○	○		○			○			○			○	○		○		○				○							○		○	○	
R_NR6	San Pedro Del Norte - La Cruz de Rio Grande		○	○		○	○		○			○	○		○		○		○		○		○				○							○		○	○	
R_NR7	Makantaka - Karaw ala		○	○		○	○		○			○	○		○	○	○	○	○		○		○				○			○				○		○	○	Natural reserve
R_NR8	Point B - Prinzapolka		○	○		○	○		○			○	○		○	○	○	○	○		○		○				○			○				○		○	○	Inundation area and biological reserve area
R_NR9	La Cruz De Rio Grande - Alamikamba		○	○		○	○		○			○	○		○	○	○		○		○		○				○			○				○		○	○	Likely to pass thru reserved area
R_NR10	La Trinidad - Masachapa		○	○		○	○		○			○	○			○	○				○		○			○	○							○		○	○	
R_NR11	Siuna - Bonanza		○	○		○			○			○	○			○	○		○		○		○				○							○		○	○	Biosphere reserve and mountainous area
R_NR12	Bonanza - Point C		○			○			○			○	○			○	○		○		○		○				○							○		○	○	Biosphere reserve
R_NR13	Empalme Puerto Sandino - La Paz Centro		○			○	○		○			○	○			○	○				○		○				○							○		○	○	
R_NR14	Empalme de Telica - Puerto Corinto		○			○			○			○	○		○	○	○				○		○				○							○		○	○	

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.2 Scoping Matrix for Road Projects (Widening of Main Trunk Road)

Code	Road Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
R_IW1	NIC-2 Int. - León (NIC-12A)		○			○	○		○														○			○										○	○	
R_IW2	León - Chinandega (NIC-12A)		○			○	○		○														○			○										○	○	
R_IW3	C. Sandino - Mateare (NIC-28)		○			○	○		○														○			○										○	○	
R_IW4	NIC-12A Int. – Jinotepe (NIC-2)		○			○	○		○														○			○										○	○	
R_IW5	Jinotepe - Nandaime (NIC-2)		○			○	○		○														○			○										○	○	
R_IW6	Nandaime - Rivas (NIC-2)		○			○	○		○														○			○										○	○	
R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)		○			○	○		○														○			○										○	○	
R_IW8	Tipitapa – San Isidro (NIC-1)		○	○		○	○		○							○							○			○										○	○	with bridge

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.3 Scoping Matrix for Road Projects (Reconstruction – change of pavement)

Code	Road Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
R_IC1	Boaco - Muy Muy (NIC-9)		○	○		○	○		○							○									○				○							○	○	with bridge
R_IC2	Muy Muy - Rio Blanco (NIC-21B)		○	○		○	○		○							○									○				○							○	○	with bridge
R_IC3	Río Blanco - Puerto Cabezas (NIC-21B)		○	○		○	○		○							○									○				○				○	○		○	○	Miskito community
R_IC4	Cosiguina - Potosí (NIC-12B)		○			○	○		○																○				○							○	○	
R_IC5	Telpaneca - Pueblo Nuevo (NIC-38&51)		○	○		○	○		○							○									○				○							○	○	with bridge
R_IC6	Cuyalli – San Rafael Del Norte(NIC-41)		○			○	○		○																○				○							○	○	
R_IC7	NIC-24B – Ville Las Pilas (NN-270)		○			○	○		○																○				○							○	○	
R_IC8	El Sauce – Guacucal (NIC-38)		○			○	○		○																○				○							○	○	
R_IC9	Santa Rosa – Camoapa (NIC-19B1)		○			○	○		○																○				○							○	○	
R_IC10	La Libertad – Santo Tomas (NIC-23A)		○			○	○		○																○				○							○	○	
R_IC11	Esquipulas – La Concepción (NIC-20B1)		○			○	○		○																○				○							○	○	
R_IC12	Masaya - Zambrano (NIC-27)		○			○	○		○																○				○							○	○	
R_IC13	El Rosaria – La Conquista (NIC-20C)		○			○	○		○																○				○							○	○	
R_IC14	Boom Siril – Waspan (NN-73)		○			○	○		○						○										○				○							○	○	Biological reserve
R_IC15	Rivas - Tola (NIC-62)		○			○	○		○																○				○							○	○	
R_IC16	Peripheral road Ometepe Island (NIC-64)		○			○	○		○																○				○							○	○	

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.4 Scoping Matrix for Road Projects (Widening to Satisfy Design Criteria)

Code	Road Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
R_IR1	Granada - Tecolostote (NIC-39)		○	○		○	○		○						○	○																						with bridge and soft soil
R_IR2	La Gateada - Nueva Guinea (NIC-71)		○			○	○		○						○	○																						Biosphere reserve area
R_IR2-1	Nueva Guinea - Bluefields (NIC-71)		○	○		○	○		○						○	○		○																		○	○	Natural and biosphere reserve
R_IR3	El Rama-Kukra Hills-Laguna de Perlas		○	○		○	○		○						○	○		○																		○	○	Passes wetland
R_IR4	Santa Domingo - El Ayote (NIC23B)		○			○	○		○																													
R_IR5	Las Esparanza - El Tortuguero		○			○	○		○																													Natural reserve
R_IR6	Río Blanco - San Pedro del Norte (NIC-13C)		○			○	○		○																													
R_IR7	El Empalme - Alamikamba (NN-288)		○			○	○		○																													
R_IR8	Int. of NIC-24B- End of NIC 54(Various)		○			○	○		○																													Mountainous area with frequent rain shower
R_IR8-1	NIC 54&Int. of NIC-21B(NIC-57,54&5)		○			○			○																													Mountainous area with frequent rain shower
R_IR9	Malpaisillo - Villa 15 de Julio(NIC68/NN252)		○			○			○																													
R_IR10	La Paz Centro - Malpaisillo (NIC-22)		○			○			○																													
R_IR11	Empalme San Ramon - Matiguas (NIC-33)		○			○	○		○																													
R_IR12	Pajaro Negro - El Triunfo (NN-114)		○			○	○		○																													Biosphere reserve area
R_IC13	El Empalme – San Jacinto (NIC-70A)		○			○	○		○																													

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.5 Scoping Matrix for Bridge Projects (1/2)

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
	NEW BRIDGE ON EXISTING ROAD																																					
R_NB1	Mahogany River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	In nature reserve
R_NB2	El Rama River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Biosphere reserve
R_NB3	Nawawas River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB4	Waspedo River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Nature reserve
R_NB5	Kurinwas River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB6	N/A (No name yet)		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB7	Grande de Matagalpa		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB8	Makantaka (Río Grande)		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Nature reserve
R_NB9	Kuanwatla		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Inundated area
R_NB10	Alamikamba (Prinzapolka River)		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB11	Frio River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Wildlife Refuge
R_NB12	Zapote River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Wildlife Refuge
R_NB13	Guacalito River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	Wildlife Refuge
R_NB14	Colon		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB15	Brito River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB16	El Tular River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
R_NB17	Tecolapa River		◯	◯			◯		◯			◯	◯		◯	◯	◯			◯																◯	◯	
	NEW BRIDGE ON MISSING LINKS																																					
BM1	El Tamarindo Bridge		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM2	Baquas Bridge		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM3	Wawa River Bridge		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯										◯						◯	◯	Moskito community & Biological reserve
BM4	Malacatoya River Bridge		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM5	El Paso de Panaloya		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM6	Tecolostote #2 Bridge (El Papayal)		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM7	Wiwili		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	
BM8	Río Abajo Bridge		◯	◯		◯	◯		◯			◯	◯			◯	◯			◯																◯	◯	

Source: JICA Study Team

Table 21.3.5 Scoping Matrix for Bridge Projects (2/2)

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
	REPLACEMENT OF TEMPORARY BRIDGE																																					
R_BT1	San Judas Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT2	Santa Rosa Del Peñón Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT3	La Potranca Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT4	Sunsin No.2 Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT5	Luku River Bridge		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BT6	Labu River Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT7	Pasle Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BT8	El Cua River Bridge (La Maroanosa)		○	○		○	○		○			○	○			○	○			○																○	○	
	REPLACEMENT OF DAMAGE BRIDGE																																					
R_BD1	Wani River		○	○		○	○		○			○	○			○	○			○																○	○	
R_BD2	El Tuma Bridge (Mulukuku)		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD3	Prinzapolka Bridge		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD4	Banacruz Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BD5	Paso Real Bridge(Esteli)		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD6	Zinica River Bridge		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD7	Puente San Pablo Bridge		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD8	La Esperanza Bridge		○	○		○	○		○			○	○			○	○			○																○	○	Biosphere reserve
R_BD9	Cuisala Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_BD10	Rosa Grande Bridge		○	○		○	○		○			○	○			○	○			○																○	○	
R_MR	Maintenance of entire basic network		○			○	○		○																											○	○	
R_DM	Provision and replacement of infrastructure against disaster		○			○	○		○																											○	○	

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.6 Scoping Matrix for Bus Related Projects

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land us	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
B_F	Big Capacity Bus for Inter-Urban Bus route*																																					
B_T	Bus Terminal (Big Size Buses)		○				○													○			○			○								○		○	○	
B_T	Bus Terminal (Middle Size Buses)		○				○													○			○			○								○		○	○	
B_T	Bus Terminal (Small Size Buses)		○				○													○			○			○								○		○	○	
B_RS	Roadside Station		○				○													○														○		○	○	
B_I	Bus Inspection Workshop																			○														○		○	○	

Note: * Not appropriate to carry out project scoping

○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.7 Scoping Matrix for Port and Water Transport Related Projects

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
	PORT PROJECTS																																					
W_EP_1	Expansion of Puerto Corinto		○	○	○	○	○	○	○	○		○	○		○	○	○	○					○			○										○	○	
W_NP_1	Construction of New Bluefields Port		○	○	○	○	○	○	○	○		○	○		○	○	○	○	○	○			○				○			○			○			○	○	Reserve area
W_EP_1	Expansion of Puerto Cabezas		○	○	○	○	○	○	○	○		○	○		○	○	○	○	○																	○	○	Biological reserve
	WATER TRANSPORT																																					
W_IW_1	Inland Water Way along Atlantic Coast		○	○	○	○	○	○	○	○		○	○		○	○	○	○	○					○	○				○	○			○	○		○	○	
W_NW_1	Channel Dredging Fleet*																																					
W_NW_2	Passenger Boats for Public Water Transport Services in RAAN*																																					
W_NW_3	Passenger Boats for Public Water Transport Services in RAAS*																																					
W_NW_4	Improvement of River and Lake Ports		○	○	○	○	○	○	○	○		○	○		○	○	○	○	○					○	○					○			○	○		○	○	

Note: * Not appropriate to carry out project scoping

○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.8 Scoping Matrix for Aviation Related Projects

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land use)	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
A_ER_1	Runway Extension of A. C. Sandino		○			○	○										○									○										○	○	
A_ET_1	Exp. of International Passenger Terminal		○			○	○										○									○										○	○	
A_RT_1	Rehabilitation of Domestic Passenger Terminal		○			○	○										○									○										○	○	
A_NT_1	Const. of New Passenger Terminal at South Side		○			○	○										○			○			○			○								○		○	○	Land aqquisition
A_NA_1	Const. of New Apron and Taxiway at South Side		○			○	○										○						○											○		○	○	Land aqquisition
A_NC_1	Const. of New Cargo Terminal Building at South Side		○			○	○										○			○			○											○		○	○	Land aqquisition
A_EA_1	Exp. of Apron for Cargo Terminal at South Side		○			○	○										○						○			○								○		○	○	Land aqquisition
A_RR_1	Rehab. of Runway Pavement at Bluefields Airport		○			○	○										○																			○	○	
A_ER_2	Expansion of Runway Strip at Bluefields Airport		○			○	○										○																			○	○	
A_NF_1	Const. of New Fuel Yard at Bluefields Airport						○																													○	○	
A_NT_2	Const. of New Passenger Terminal at Bluefields Airport		○			○	○										○			○																○	○	
A_NA_2	Const. of New Apron at Bluefields Airport		○			○	○										○																			○	○	
A_ER_3	Extension of Runway of Bluefields Airport		○			○	○										○			○																○	○	
A_NC_2	Const. of New Cargo Terminal at Bluefields Airport		○			○	○										○			○																○	○	
A_NA_3	Const. of New Apron at Bluefields Airport		○			○	○										○			○																○	○	
A_NT_3	Const. of New Passenger Terminal at Bilwi Airport		○			○	○										○			○																○	○	
A_NF_3	Construction of New Fuel Yard at Bilwi Airport						○																													○	○	
A_NC_2	Construction of New Cargo Terminal at Bilwi Airport		○			○	○										○			○																○	○	
A_EA_2	Extension of Runway at Bilwi Airport		○			○	○										○			○																○	○	
A_RR_2	Rehab. of Runway Pavement at Corn Island Airport		○			○	○																													○	○	
A_NF_4	Installation of Airfield Lighting System at Corn Island Airport																																					
A_NF_5	Installation of New Fence at Corn Island Airport																																					
A_NF_6	Construction of New Control Tower at Corn Island Airport						○										○			○																○	○	
A_ER_3	Expansion of Runway Strip at Corn Island Airport		○				○										○																			○	○	

Note: ○ Likely to cause significant negative impact

Source: JICA Study Team

Table 21.3.9 Scoping Matrix for Logistics Related Projects

Code	Project Name /Environmental Items	**Human Health and Society**	Air pollution	Water pollution	Soil contamination	Waste	Noise and vibration	Offensive odor	Accident	Hazardous materials	**Natural Environment**	Topography & geographical features	Soil erosion	Groundwater	Ground subsidence	Riverbed sediment	Hydrological situation	Coastal zone (mangroves, coral reefs, tidal flats, etc.)	Fauna, flora and biodiversity	Landscape	Global warming / Climate change	**Social Environment**	Involuntary resettlement	Local economy such as employment & livelihood	Travelling and mobility	Relocation of existing facilities	Land use and utilization of local resources (change of land us	Social capital and local decision-making system	Existing social infrastructure and services	Vulnerable groups, indigenous and / or Afro-descendants	Gender	Children's right	Cultural heritage	Local conflict of interests	Water usage or water right and membership	Sanitation	Infectious disease such as HIV/AIDS	Remarks
F_IC_1	Improvement of CBTF at Guasaule)		◯				◯					◯					◯			◯					◯				◯					◯		◯	◯	
F_IC_2	Improvement of CBTF (El Espinio)		◯				◯					◯					◯			◯					◯				◯					◯		◯	◯	
F_IC_3	Improvement of CBTF (Las Manos)		◯				◯					◯					◯			◯					◯				◯					◯		◯	◯	
F_IC_4	Improvement of CBTF (Penas Blancas)		◯				◯					◯					◯			◯					◯				◯					◯		◯	◯	
F_IC_5	Improvement of CBTF (San Pancho)		◯				◯					◯					◯			◯					◯				◯					◯		◯	◯	
F_NL_1	Managua East Logistic Park		◯				◯					◯					◯			◯														◯		◯	◯	
F_NL_2	Managua West Logistic Park		◯				◯					◯					◯			◯														◯		◯	◯	
F_NL_3	Chinandega Logistic Park		◯				◯					◯					◯			◯														◯		◯	◯	
F_NL_4	Bluefields Logistic Park		◯				◯					◯					◯			◯														◯		◯	◯	
F_NA_1	Chinandega Agro-processing Estate		◯				◯					◯					◯			◯														◯		◯	◯	
F_NA_2	Matagalpa Agro-processing Estate		◯				◯					◯					◯			◯														◯		◯	◯	
F_NA_3	Juigalpa Agro-processing Estate		◯				◯					◯					◯			◯														◯		◯	◯	
F_NA_4	Nueva Guinea Agro-processing Estate		◯				◯					◯					◯			◯														◯		◯	◯	
F_NA_5	Cold Storage at Bilwi						◯																											◯		◯	◯	

Note: CBTF = Cross Border Trade Facility

◯ Likely to cause significant negative impact

Source: JICA Study Team

21.4 Expected Environmental Impacts of the Master Plan

The expected major social and environmental impacts of construction of new infrastructure are divided into (i) before and during construction period and (ii) operation and maintenance period. The results of the impact assessment for each project obtained through the discussion in the working groups for scoping are shown below.

21.4.1 Road and Bridge Projects

The followings are the evaluation results of: Construction of new roads, Road improvement by widening of main trunks, Road improvement by upgrading of pavement and Road rehabilitation by widening to satisfy design criteria.

(1) Construction of New Roads

1) Before and During Construction Period

- Land acquisition from private land owners for road right of way is necessary to all roads which could create local conflicts.
- Most of the new roads are passing environmentally critical areas thus losing of flora and disturbance of fauna might occur.
- The construction of about 875 km new road would contribute negatively in global warming due to substantial cutting of trees that help absorb heat.
- Communal land of indigenous people along the Caribbean Coast might be affected by some projects.
- Topographic and geographical features might be modified due to cutting and filling particularly those roads in high elevation which could result to soil erosion if proper measures are not in place.
- New road project normally involved involuntary resettlement. The urban road project is certain to create involuntary resettlement.
- Ground subsidence might turns out to be a serious issue particularly to roads passing low/wet land located along the Caribbean Coast.
- During construction period, air and noise pollution, vibration and dust will be generated which could affect residents nearby the project site.
- Riverbed sediment might become temporary issue to road project with bridge during construction. As a result water pollution in terms of increase in level of siltation might also occur.
- Sanitation during construction might become an issue if proper disposal facility is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

2) Operation and Maintenance Period

- Accident might increase as a result of increased speed.
- Air and noise pollution will increase due to increased traffic.
- After construction, the new roads will make accessibility easy. This new access will contribute to the change of land use to some areas (e.g. from forestry to farming).

(2) Road Improvement by widening of main trunks

1) Before and During Construction Period

- Road widening is almost sure to create involuntary resettlement and land acquisition.
- During construction period, air and noise pollution, vibration and dust will be generated which could affect residents living near the project site.
- Relocation of existing facilities such as water pipes, telephone lines, electric cables, etc. might be carried out.
- During construction, riverbed sediment might become temporary issue to road project with bridge. As a result water pollution in terms of increase in level of siltation might also occur.
- Waste would come mostly from soil cutting and other dredged materials that have to be

removed and dumped to designated area.
- Sanitation might become an issue if proper disposal is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

2) Operation and Maintenance Period
- Accident might increase due to increased speed.
- Air and noise pollution will increase due to increased traffic
- Increase in surface run-off due to widening of paved surface of the road

(3) Road Improvement by Upgrading of Pavement

1) Before and During Construction Period
- During construction period, air and noise pollution, vibration and dust will be generated which could affect residents nearby the project site.
- Some road projects have bridges and therefore during construction, riverbed sediment might become temporary issue. As a result water pollution in terms of increase in level of siltation might also occur.
- Traveling and mobility might be affected due to temporary closure of road as a result of construction works. This temporary road closure might affect also access to existing social infrastructure services.
- Some projects run deep into the areas of indigenous people which could affect these vulnerable people and create local conflict.
- Sanitation might become an issue if proper disposal is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

2) Operation and Maintenance Period
- Accident might increase due to increased speed as a result of improved pavement
- Air and noise pollution will increase due to increased traffic
- Increase in surface run-off due to paved surface.

(4) Road Rehabilitation by widening to satisfy design criteria

1) Before and During Construction Period
- Relocation of existing facilities such as water pipes, telephone lines, electric cables, etc. might be carried out particularly at the beginning and end of each road project close to major settlements.
- During construction period, air and noise pollution, vibration and dust will be generated which could affect residents nearby the project site.
- Some road projects have bridges and therefore during construction, riverbed sediment might become temporary issue. As a result water pollution in terms of increase in level of siltation might also occur.
- Some road projects passes through low laying areas with soft ground thus ground subsidence might emerge as an issue.
- Some road projects are located in areas which experience intense and frequent rainfall (e.g. Siuna) thus any obstruction to water flow might create flooding.
- Cutting and filling to road projects located in mountainous areas with frequent rainfall might contribute to soil erosion if not correctly handle.
- Some projects run deep into the areas of indigenous people which could affect these vulnerable people and create local conflict.
- Sanitation might become an issue if proper disposal is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

2) Operation and Maintenance Period
- Accident might increase due to increased speed as a result of improved pavement

- Air and noise pollution will increase due to increased traffic
- Increase in surface run-off due to widening of paved surface

21.4.2 Bridge Projects

(1) Before and During Construction Period

- Water pollution will increase temporarily in terms of water turbidity during soil cutting, construction of embankment, installation of piers, and other construction works.
- Level of siltation might also temporarily increase as a result of construction works
- Waste as a result of dredging, soil cutting, tree cutting, etc. might be emerge as a serious issue during construction
- Air pollution, noise and vibration will also increase due to generated vehicular traffic bring in/out construction materials. Noise and vibration of actual construction work and machine noise might also be an issue.
- Sanitation might become an issue if proper disposal is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

(2) Operation and Maintenance Period

- The new bridges might contribute in acceleration of change of land use (e.g. from forestry to farming use) due to improved accessibility.
- The new bridge will also change the landscape of the area and the new generated vehicular traffic will increase air and noise pollution.

21.4.3 Bus related Projects

(1) Before and During Construction Period

- Construction of bus terminal inside the city will increase air and noise pollution as well as vibration.
- Relocation of existing facilities such as water pipes, telephone lines, etc. might be necessary.
- Although exact location of bus terminals are not yet identified, experience shows that large-scale project inside the city involves involuntary resettlement.
- Securing large area to be used as terminal is expected to create local conflict with the land owners.
- For Roadside Stations, modification of the land's topography as well as cutting of trees might be necessary.
- Sanitation might become an issue if proper disposal is not provided. Likewise, issue of disease such as HIV can be an issue if not properly address due to accumulation of large number of migrant workers.

(2) Operation and Maintenance Period

- The new structure will affect the landscape of the area.
- Sanitation might emerge as an issue if vendors are not organized as observed in other countries
- For Roadside Station, the attracted vehicular traffic will contribute in air and noise pollution. Likewise, concreting of expansive parking space will increase run-off water.
- For bus terminals inside the city, new traffic attracted in the facility will contribute to traffic congestion thus air and noise pollution.

21.4.4 Marine and Water Sector Projects

(1) Before and During Construction Period

- Securing large vacant land for new port project might create local conflict.
- Increase in air pollution, water pollution, vibration and siltation is expected during the construction stage.
- Large scale cutting, soil dredging, and filling is expected for new port which could create

several impacts in the area.
- Dredging will also have significant impact in terms of marine life, and perhaps even modification of flow regimes. Dumping of the substantial waste generated from dredge soil will also be a serious issue.
- For the case of new Bluefields Port, ecological impacts are also anticipated since the area is covered by the natural reserve of the country.
- Inadequate management of inland waterways dredging could create negative impacts on the surrounding environment.

(2) Operation and Maintenance Period
- Construction of new port will dramatically alter the landscape of the area.
- During operation, leak of hazardous materials like oil from ships would be a serious concern
- Offensive odor might come from the cargoes of these ships like fish and other cargoes with strong odor.

21.4.5 Aviation Sector Projects

(1) Before and During Construction Period
- Land acquisition is necessary to some projects in urban area like the expansion of Augusto C. Sandino International Airport and housing resettlement is one of the most focused issues.
- Increase in air pollution, noise and vibration is expected during construction. Likewise waste that would come from soil works (cutting, extracting, and filling) would necessitate proper dumping.
- Relocating of existing facilities due to expansion like drainage pipes, water pipes, telephone cables, electric cables, etc., might be necessary.
- Due to rugged terrain of some airports (Bluefields and Bilwi), further expansion of runway might entail heavy cutting and filling of soil.
- Concentration of large number of migrant workers might pose a challenge in terms of sanitation as well as infectious disease.

(2) Operation and Maintenance Period
- One of the reasons for expansion of Augusto C. Sandino International Airport is to accommodate projected increase of passenger users by serving large aircraft. Increase in the size of aircraft will bring increase level of noise.
- Landscape of the area will likely be affected by imposing structure (e.g. control tower, new terminal) that would be added to the existing airport.

21.4.6 Logistics related Projects

(1) Before and During Construction Period
- There would be increase in air pollution, noise and vibration during construction period.
- Acquisition of land from private individuals might take place for logistic parks and agro-processing estate which could create local conflict.
- Cutting of trees and modification of land's topography and geography might be necessary for construction of these sprawling facilitate.
- During improvement works of the five cross border facilities, flow of traffic might be affected thus people's access to service might also be affected.
- The concentration of large number of migrant workers might pose a challenge in terms of sanitation as well as infectious disease.

(2) Operation and Maintenance Period
- Landscape of the area will likely be affected due to these massive infrastructure developments.
- New attracted vehicular traffic will increase air, noise and vibration.

Chapter 22 Project Prioritization and Evaluation

22.1 Summary of Transport Sector Master Plan and Projects

The proposed projects in the transport sector plan are summarized as Table 22.1.1 by transport sub-sector. Total project cost is 8,826 million US$. The most of the project cost is occupied by land transport sector (road), which is about US$ 7,812.7 million with 89% share. The total length of road improvement project is 7,488km and the bridge projects with more than 30m length account 43 bridges. he land transport (Road) sector project included the MTI rural road development project with 4372 km. The project location is shown in the

Figure 22.1.1.

Table 22.1.1 Summary of Transport Master Plan Projects

Sub-Sector	Project Cost Million US$	Project Summary
Land Transport Sector (Road)	7,812.7	Road Length = 7,488km Bridge; 43 locations, 3, 486m
Land Transport Sector (Bus)	138.2	Bus Fleet = 1124, Bus Inspection depot =1 Bus Terminal= 17, Roadside Station =7
Water Transport Sector	57.5	Canal Improvement =24 km Boat Replacement, Doc Repair
Maritime Transport Sector	381.0	Corinto, Bilwi, Bluefields and others
Aviation Sector	361.0	Managua, Bluefield, Bilwi, Corn Island
Logistic Sector	75.6	Cross Border Point =5, Logistic Center =5 Agro Business Park =4
Total	8,826.0	

Source: JICA Study Team

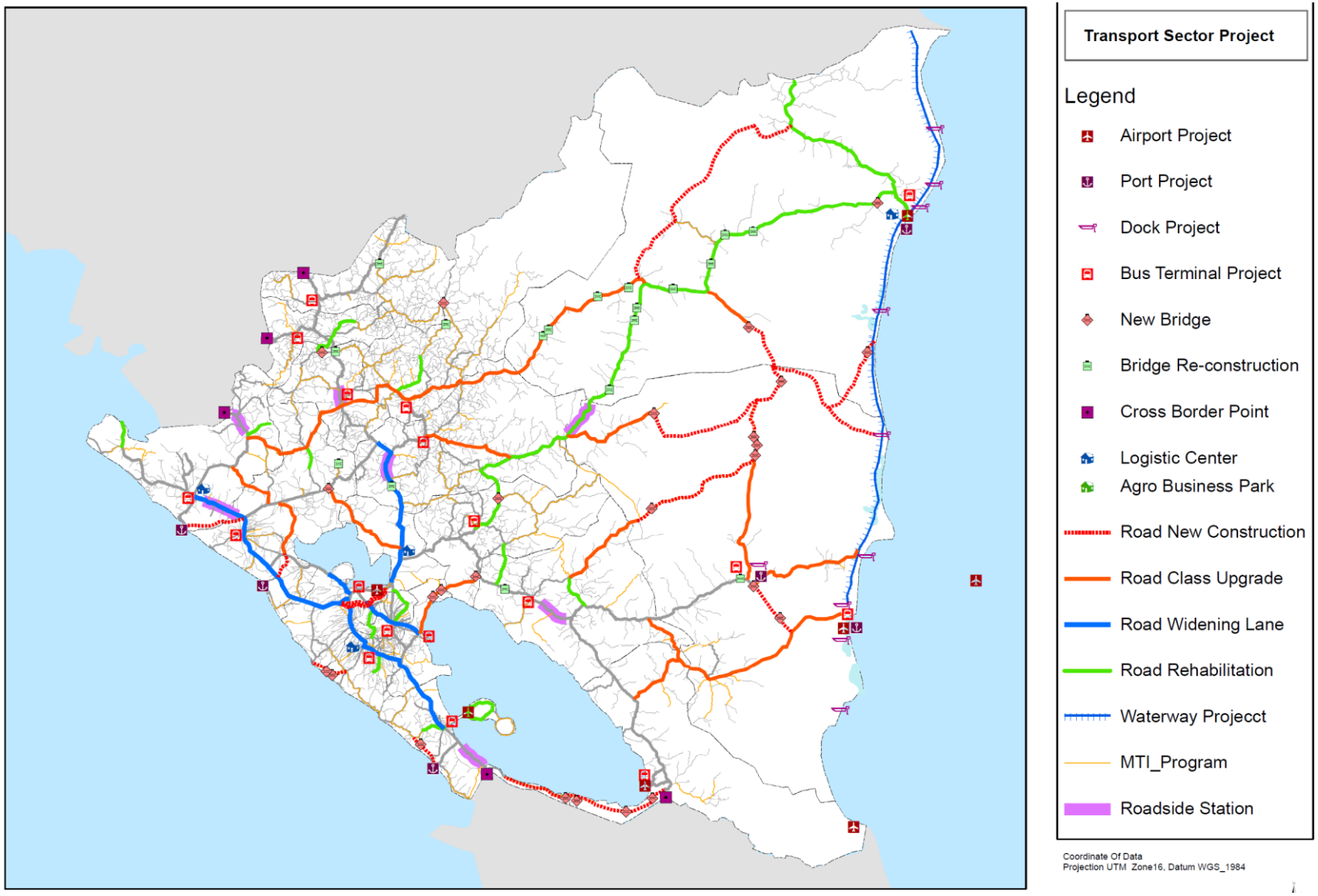


Figure 22.1.1 Location Map of Master Plan Project

Source: JICA Study Team

22.2 Investment Fund Analysis

(1) Analysis of Public Investment Fund on Transport Sector

Funding of transport infrastructure in Nicaragua is severely constrained due to low level of general revenue, much subsidy and inadequate pricing to secure social activity, etc. The total MTI budget is about 134 million US$ in 2013 including the administrative expense. Among that, the public investment fund is about 121 million US$ in 2013. This is 1.7% of GDP including administrative expenses and 1.25% GDP for Investment. MTI budget comes from 30 % national revenue, 50 % ODA loan, 20% ODA grant in last 5 years average.

Table 22.2.1 Public Investment Budged of MTI (unit million Cordoba)

	2008	2009	2010	2011	2012	2013
PIP Total	1,788.38	2,287.97	2,622.77	2,893.00	3,131.49	3,420.28
Current Expenses	226.93	285.10	244.92	277.81	308.88	338.95
Capital Expenditure (Investment)	87%	88%	91%	90%	90%	90%
Capital Expenses	1,561.45	2,002.87	2,377.85	2,615.19	2,822.61	3,081.33
National Resources	338.44	539.45	658.09	884.10	938.90	1118.42
External Resources	1223.01	1463.42	1719.76	1,731.09	1883.71	1,962.91
Loan	888.27	1,246.46	1,462.24	1,327.30	852.23	1,157.77
Donation	334.74	216.96	257.54	403.79	1,031.47	805.14
PIP in million US$	92.33	112.49	122.79	129.04	132.97	134.13

Source: MTI, (PIP=Public Investment Program)

The budget of FOMAV for the past 5 years from 2008 till 2012 is summarized in the following table.

Table 22.2.2 Maintenance Budget of FOMAV (unit: million US$)

Item	2008	2009	2010	2011	2012
Fuel Tax Rate	12%	15%	16%	16%	16%
Annual Revenue (million US$)	22.16	30.05	30.98	31.55	37.59
Municipal Subsidy (20%) (million US$)	4.43	6.01	6.2	6.31	7.52
FOMAV Maintenance Budget (million US$)	17.72	24.04	24.78	25.24	30.07

Source: Aplicación de recursos en mantenimiento vial 2008-2012

(2) Investment Funding Scenario

An exercise has been made to estimate the future scenario of the transport sector funding for different assumed levels of dependency on ODA. The total budget for the transport sector is the sum of the budget for the aforementioned organizations, MTI, FOMAV, ENP, EAAI and INAC. The three scenarios are as follows:

a). Scenario 1: National fund increases in proportion of GDP growth rate and heavy dependence on ODA continues as the existing situation (70%).
b). Scenario 2: National fund increases in proportion of GDP growth rate Dependence on ODA decreases gradually from 70% (2013) to 50% (2033).
c). Scenario 3: National fund increases in proportion of GDP growth rate Dependence on ODA more decreases gradually from 70% (2013) to 33% (2033).

Available public investment fund is estimated 4,818 to 7,554 million US$ in total next 20 years, dependency on ODA share (not included private investment fund).

Table 22.2.3 Public Investment fund for Transport Sector from 2014 to 2033

(Unit; million US$ in 2013 constant price)

	Scenario 1 (ODA=70% in 2033)	Scenario 2 (ODA=50% in 2033)	Scenario 3 (ODA = 33% in 2033)
MTI (National Fund)	1281.6	1281.6	1281.6
MTI (ODA Loan)	3203.9	1986.1	1580.2
MTI (ODA, Grant)	1281.6	469.7	169.2
FOMAV	1591.5	1591.5	1591.6
Others (EPN, EAAI, INAC, etc)	196.0	196.0	196.0
Total	7554.5	5524.9	4818.5

Source: JICA Study Team

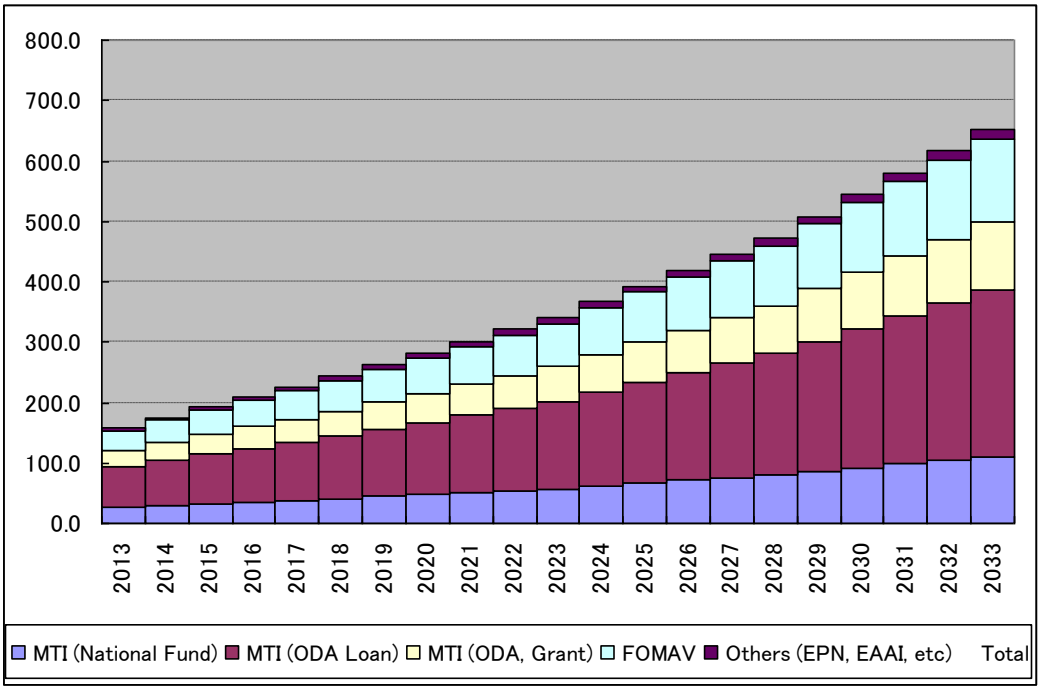


Figure 22.2.1 Senario1(MTI Budget; National=30%, Loan=50%, Grant=20% in 2033)

Source: JICA Study Team

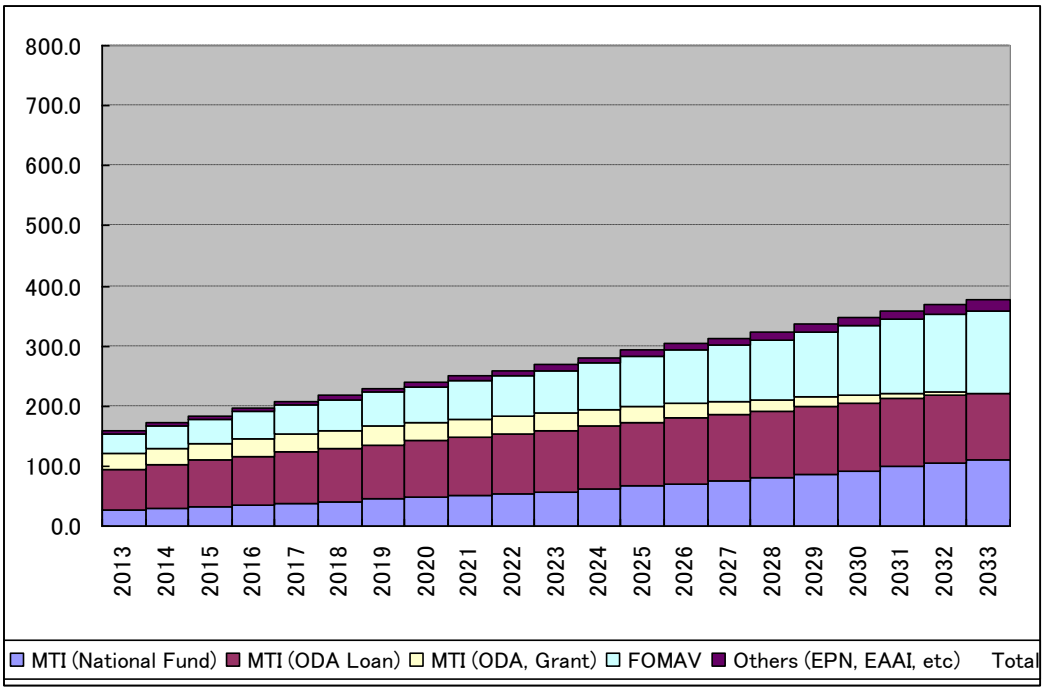


Figure 22.2.2 Senario2 (MTI Budget; National=50%, Loan=50%, Grant=0% in 2033)

Source: JICA Study Team

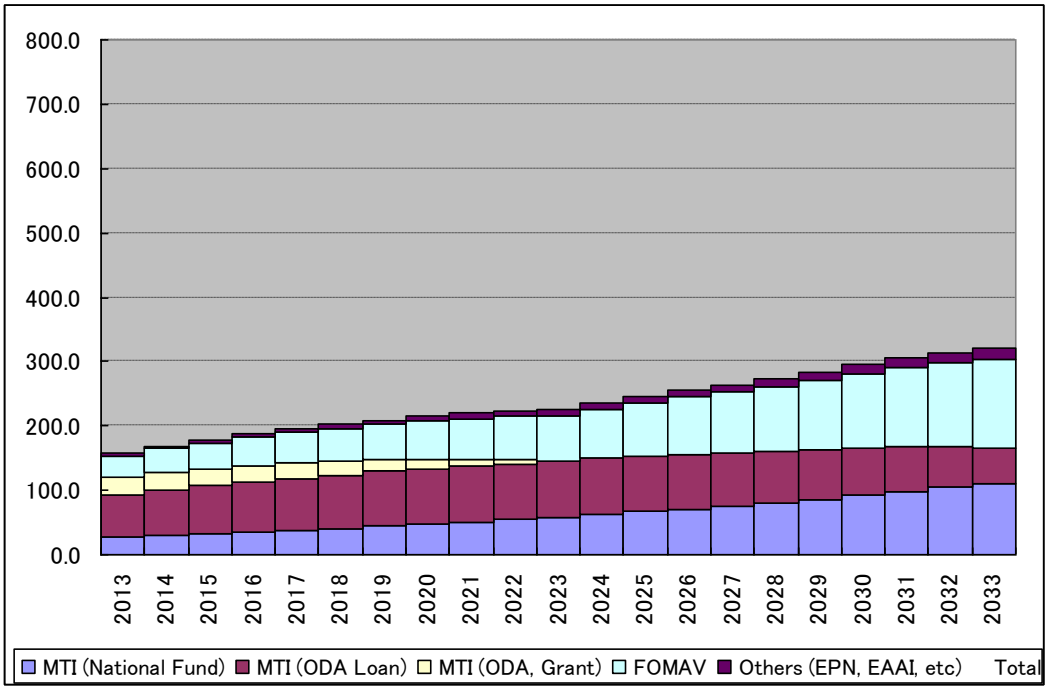


Figure 22.2.3 Senario3 (MTI Budget; National=67%, Loan=33%, Grant=0% in 2033)
Source: JICA Study Team

(3) Comparison between Investment Budget and Project Cost

Available investment budget related road, land and water transport under MTI and FOMAV jurisdiction is US$4,622 – US$7,358 million, instead required project cost under JICA-PNT and FOMAV is US$ 8,080 million. The project cost of maritime, aviation and logistic sector is US$ 746 million, which expected from the private sector loan or PPP fund, because generating income form the project.

Table 22.2.4 Comparison between Investment Budget and Project Cost

Sector	Fund Type	Budget Scenario 1 ODA= 70% in 2033	Budget Scenario 2 ODA=50% in 2033	Budget Scenario 3 ODA=33% in 2033	Project Cost
Public Sector Project	MTI (National Fund)	1281.6	1281.6	1281.6	8,080
	MTI (ODA Loan)	3203.9	1986.1	1580.2	
	MTI (ODA, Grant)	1281.6	469.7	169.2	
	FOMAV	1591.5	1591.5	1591.6	
	Sub-Total	7358.5	5,328.90	4622.4	
		(91%)	(66%)	(57%)	
PPP and Private sector Project	Others (EPN, EAAI, INAC etc.)	196	196	196	746
	Gov. Private / PPP Fund	?	?	?	
Total		7554.5	5524.9	4818.5	8,826

Source: JICA Study Team

Considering the debt relief of $ 4500 million that was given by the IMF in 2004 and the downward trend in ODA allocation into the public sector in recent years, Scenario 2 is the most realistic. However, it is only possible to ensure 66% of investment budget for the master plan project among the land transport and water transport sub-sector. These sector projects are managed by MTI and should be covered by all public funds. Therefore, it is necessary to prioritize the project that was proposed in the master plan, Nicaragua will take the project steadily based on the project priority.

As for maritime, aviation and logistic sub-sector, project implementation is expected as PPP projects with private and public capital. It is important for these kinds of projects to develop the investment environment.

22.3 Project Prioritization

Based on the results of public fund analysis, it became clear that it is important to make the priority among the proposed projects. The project prioritization expectedly gives stead implementation. In this section the methodology of project prioritization is described.

22.3.1 Approach of Project Prioritization

Project evaluation is frequently conducted by means of precise costs and benefits. This evaluation technique is widely recognized as appropriate for appreciating the contribution of a project to long-term sustainable economic development. The analysis of costs and benefits is centered on quantifiable parameters without possible implications generated by efforts to assess non-quantifiable variables. But the value of projects is not only defined by its monetary performance, but also increasingly by external non-quantifiable variables.

This consideration underlies the selection of a multi-criteria analysis (MCA) for the prioritization of the Master Plan projects and programs. The key advantage of MCA is that it allows integrating into a comprehensive assessment both quantifiable and non-quantifiable variables, offering therewith a full-scale multi-dimensional appreciation of different development alternatives facilitating at the end its ranking and prioritization. The reason for evaluating the Master Plan candidate projects by means of an MCA is in order to be as strong as possible in an effort to appreciate a range of strategic variables using an algorithm-based calculation methodology. The generated information will enable decision-makers to formulate a reasoned decision under consensus conditions, rather than according to exclusively financial or economic rationales.

The rank-weighting evaluation method of the study will in particular incorporate arguments generally excluded in traditional (numerical) evaluation methods to allow comparing possible investment alternatives against concrete monetary and non-monetary policy objectives,

The prioritization process in JICA-PNT ranks the selected projects on the basis of a range of established evaluation criteria and applies weighting techniques and sensibility testing to appreciate the contribution of different projects to achieving policy objectives according to different priorities.

The key features of the proposed evaluation method are:

- The use of objectively verifiable indicators (OVI) to guarantee an evaluation that reduces the risk of data manipulation thanks to the potential to verify the validity of the variables;
- The allocation of weights to evaluation criteria based upon a range of variables considered realistic and in line with socio-economic and political policy priorities that guarantees that those projects considered most "important" are given a suitable and equitable evaluation; and,
- Sensitivity testing of the different alternatives to assess the level to which any particular alternative contributes to the achievement of specific objectives and to identify the true boundaries that projects contribute to improving current situation.

The detailed settings of the model have been thoroughly tested on their relevance, quality and consistency. Several tests were conducted to investigate the relevance of the criteria and the quality of the weighting system.

The OVI parameters, factors and weightings attached thereto were reviewed in detail with person concerned of MTI and other institution as well as 4th Stakeholder meeting in November 2013. The exchange of information was most helpful and beneficial. Complete consensus on factors and weightings was achieved. Conclusions of the consensus building process are part and parcel of the MCA and project prioritization process.

22.3.2 Evaluation Indicators

The objectively verifiable indicators (OVI) used in the multi-criteria evaluation are summarized in Table 22.3.1 and briefly explained hereafter. The evaluation indicators are grouped into 6 categories as;

- Development Strategy Indicators
- Economic Indicators
- Social Indicators
- Environment Indicator
- Implementation Indicators
- Project Maturity

The evaluation indicators by evaluation group are as Table 22.3.1.

Table 22.3.1 Evaluation Indicators for project prioritization

Group	Evaluation Indicators
Development Strategy Indicators;	➢ Compliance with Long Term Development Vision toward to 2033, ➢ Compliance with Sector Development Vision ➢ Compliance with Transport Sector Development Vision and Policy ➢ Overall Development Strategy relevant to Transport Corridor Development /Classification of Project (International, Regional, Domestic or Road Class)
Economic Indicators;	➢ Demand, ➢ Cost Efficiency (Unit Cost), ➢ Economic Viability (IRR or B/C), ➢ Scale of Beneficiaries, ➢ Influenced Area
Social Indicators;	➢ Project Location (Pacific, Central, Atlantic), ➢ Contribution to Poverty Alleviation (GDP per Capita)
Environment Indicators;	➢ Human Health impact ➢ Natural Environment Impact, ➢ Social Environment Impact, ➢ Vulnerability against Disaster (Alternative)
Implementation Indicators;	➢ Scale of Project (Cost) ➢ Private Sector Involvement, ➢ Regulatory Set-up, Related Project
Project Maturity	➢ Project Progress Situation (On-going, Committed with/ without Funding, F/S, Design, plan only)

Source: JICA Study Team

22.3.3 Weight of Evaluation Indicators

Based on the discussion with MTI and the relevant agencies, the weight of the evaluation group and indicators are shown in Table 22.3.2. The weight of development strategy indicators is 20 points, 30 points for economic indicators, 20 points for social indicators, 20 points for environmental indicators and 10 points for implementation indicators. The total points sums up to 100 points.

Each index is divided into 2-5 stages, the weight of the index point is given. The some indicators cannot be quantified, which is divided into 2-5 levels by a qualitative assessment, then the weight of the index point is given as following the Table below. If the indicator assessment is not identified, the average score or the medium will be given.

Table 22.3.2 Weight of Evaluation Indicators

Group	Evaluation Indicators		Score	Rank1 Low	Rank2	Rank3	Rank4	Rank5 High
Development Strategy Indicator Weight = 20 point	Compliance with Long Term Development Vision	Economic Objective	2	No	-	-	-	Yes
		Social Objective	2	No	-	-	-	Yes
		Environmental Objective	1	No	-	-	-	Yes
	Compliance with Sector Development Vision	1st Economic Sector	3	No	-	-	-	Yes
		2nd Economic Sector	1	No	-	-	-	Yes
		3rd Economic Sector	1	No	-	-	-	Yes
	Compliance with Transport Sector Development Vision and Policy	TP1	1.5	No	-	-	-	Yes
		TP2	1.5	No	-	-	-	Yes
		TP3	1.5	No	-	-	-	Yes
		TP4	0	No	-	-	-	Yes
		TP5	0.5	No	-	-	-	Yes
	Overall Development Strategy relevant to Transport Corridor Development		5	Yes	-	-	-	Yes
Economic Indicators Weight = 30 point	Demand (vehicle /day),	Road Project	5	<500	500-2000	2000-5000	5000-10000	>100000
		Bridge Project	5	<80	80-120	120-160	160-200	>200
		Other Project	5	small		middle		big
	Cost Efficiency (Unit Cost; million US$/km),	Road Project	5	<400	400-600	600-800	800-1000	>1000
		Other Project	5	big		middle		small
	Economical Viability (B/C)		5	<0.5	0.5-1.0	1.0-1.5	1.5-2.0	>2.0
	Economical Viability (IRR)		5	<6%	6%-12%	12%-18%	18%-24%	>24%
	Scale of Beneficiaries (Population)		5	small	-	middle	-	big
	Scale of Influenced Area (GDP)		5	small	-	middle	-	big
Social Indicators Weight = 20 point	Project Location (Pacific, Central, Atlantic),		10	Pacific	-	Central	-	Atlantic
	Contribution to Poverty Alleviation (GDP per Capita)		10	>1400	1200-1400	1000-1200	800-1000	<800
Environment Indicators Weight = 20 point	Human Health and Society Impact		5	big	-	middle	-	small
	Natural Environment Impact,		5	big	-	middle	-	small
	Social Environment Impact,		10	big	-	middle	-	small
Implementation Indicators Weight = 10 point	Scale of Project (Cost)		2	big	-	middle	-	small
	Private Sector Involvement		3	PPP	-	-	-	Gov
	Project Progress Situation		5	-	-	F/S	Design	On-going

Source: JICA Study Team

22.3.4 Result of MCA

The key points of each project are shown in Table 22.3.3 based on the assessment results conducted with MCA. The above points mean the degree of importance of each project, although it does not directly express the priority. The implementation plan for phase shall be prepared in accordance with the priorities that will be finally identified through the discussion with related parties of MTI and other institutions based on the results of the analysis of the related projects, projects of adjacent sections and maturity of each project.

Table 22.3.3 Result of MCA (Road Project)

Group	Code	Project Name	Department	Development Strategy Score	Economic Indictor Score	Social Indicator Score	Environ-mental Indicator Score	Implemen-tation Indicators Score	Total Score
Road Construction	R_PR1	Chiquilistagua (NIC-12) - San Benito(NIC-1)	Managua	7.0	26	2	8	3	46.0
Road Construction	R_NR1	San Juan Del Sur - El Coyol	Rivas	6.5	10	9	11	5	41.5
Road Construction	R_NR2	Cardenas - Santa Fe	Rivas /Rio San Juan	8.0	13	13	10	4	48.0
Road Construction	R_NR3	El Rama - Las Brenas	RAAS	8.0	9	18	8	4	47.0
Road Construction	R_NR4	El Ayote - El Tortuguero	RAAS	8.0	12	18	10	4	52.0
Road Construction	R_NR5	El Toruguero - La Cruz De Rio Grande	RAAS	8.0	13	18	10	4.5	53.5
Road Construction	R_NR6	San Pedro Del Norte - La Cruz de Rio Grande	RAAS	8.0	12	18	9	4	51.0
Road Construction	R_NR7	Makantaka - Karawala	RAAS	8.0	8	18	6	4	44.0
Road Construction	R_NR8	Point B - Prinzapolka	RAAN	8.0	9	20	6	4.5	47.5
Road Construction	R_NR9	La Cruz De Rio Grande - Alamikamba	RAAS /RAAN	8.0	13	20	7	4	52.0
Road Construction	R_NR10	La Trinidad - Masachapa	Carazo	8.0	14	5	8	4.5	39.5
Road Construction	R_NR11	Suina - Bonanza	RAAN	6.0	14	20	10	4	54.0
Road Construction	R_NR12	Bonanza - Point C	RAAN	6.0	11	20	11	4	52.0
Road Construction	R_NR13	Empalme Puerto Sandino - Lapazcentro	Leon	11.5	10	7	11	4	43.5
Road Construction	R_NR14	Empalme de Telica - Puerto Corinto	Leon /Chinadega	6.5	15	7	11	4	43.5
Improvement (Widening)	R_IW1	NIC-2 Int. - Leon (NIC-12A)	Managua /Leon	12.0	26	2	13	3	56.0
Improvement (Widening)	R_IW2	Leon - Chinandega (NIC-12A)	Leon /Chinadega	12.0	25	7	13	3	60.0
Improvement (Widening)	R_IW3	C. Sandino - Mateare (NIC-28)	Managua	7.0	25	2	13	4	51.0
Improvement (Widening)	R_IW4	NIC-12A Int. – Jinotepe (NIC-2)	Managua /Carazo	12.0	21	2	13	3	51.0
Improvement (Widening)	R_IW5	Jinotepe - Nandaime (NIC-2)	Carazo	12.0	17	5	13	3	50.0
Improvement (Widening)	R_IW6	Nandaime - Rivas (NIC-2)	Granada /Rivas	12.0	24	7	13	3	59.0
Improvement (Widening)	R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)	Masaya /Granada	7.0	26	7	13	3	56.0
Improvement (Widening)	R_IW8	Tipitapa – San Isidro (NIC-1)	Managua / Matagalpa	12.0	26	6	12	3	59.0
Improvement (Reconstruction)	R_IC1	Boaco - Muy Muy (NIC-9)	Boaco /Matagalpa	14.5	21	13	12	4.5	65.0
Improvement (Reconstruction)	R_IC2	Muy Muy - Rio Blanco (NIC-21B)	Matagalpa	14.5	21	13	12	4.5	65.0
Improvement (Reconstruction)	R_IC3	Rio Blanco - Puerto Cabezas (NIC-21B)	RAAN	14.5	21	20	10	3	68.5
Improvement (Reconstruction)	R_IC4	Cosiguina - Potosi (NIC-12B)	RAAN	6.5	15	20	13	5	59.5
Improvement (Reconstruction)	R_IC5	Telpaneca - Pueblo Nuevo (NIC-38&51)	Madriz	6.5	16	13	12	4.5	52.0
Improvement (Reconstruction)	R_IC6	Cuyalli – San Rafael Del Norte (NIC-41)	Jinotega	6.5	12	15	13	5	51.5
Improvement (Reconstruction)	R_IC7	NIC-24B – Ville Las Pilas (NN-270)	Chinandega	6.5	12	7	13	5	43.5
Improvement (Reconstruction)	R_IC8	El Sauce – Guacucal (NIC-38)	Leon	6.5	14	7	13	5	45.5
Improvement (Reconstruction)	R_IC9	Santa Rosa – Camoapa (NIC-19B1)	Chontales	6.5	16	13	13	5	53.5
Improvement (Reconstruction)	R_IC10	La libertad – Santo Tomas (NIC-23A)	Chontales	6.5	11	13	13	5	48.5
Improvement (Reconstruction)	R_IC11	Esquipulas – La Concepcion (NIC-20B1)	Managua /Masaya	6.5	26	2	13	5	52.5
Improvement (Reconstruction)	R_IC12	Masaya - Zambrano (NIC-27)	Masaya	6.5	12	7	13	5	43.5
Improvement (Reconstruction)	R_IC13	El Rosaria – La Conquista (NIC-20C)	Carazo	6.5	11	5	13	5	40.5
Improvement (Reconstruction)	R_IC14	Boom Siril – Waspan (NN-73)	Chinandega	8.0	15	7	13	4	47.0
Improvement (Reconstruction)	R_IC15	Rivaz - Tola (NIC-62)	Rivas	6.5	14	9	13	5	47.5
Improvement (Reconstruction)	R_IC16	Peripheral road Ometepe Island (NIC-64)	Rivas	6.5	11	9	13	5	44.5
Rehabilitation (Re-classification)	R_IR1	Granada - Tecolostote (NIC-39)	Granada /Boaco	13.0	25	11	16	8	73.0
Rehabilitation (Re-classification)	R_IR2	La Gateada - Nueva Guinea (NIC-71)	RAAS	6.5	11	18	17	4	56.5
Rehabilitation (Re-classification)	R_IR2-1	Nueva Guinea - Bluefields (NIC-71)	RAAS	11.5	24	18	14	4	71.5
Rehabilitation (Re-classification)	R_IR3	El Rama-Kukra Hills-Laguna de Perlas	RAAS	8.0	9	18	14	4.5	53.5
Rehabilitation (Re-classification)	R_IR4	Santa Domingo - El Ayote (NIC23B)	Chontales	8.0	12	13	18	4.5	55.5
Rehabilitation (Re-classification)	R_IR5	Las Esparanza - El Tortuguero	RAAS	6.5	10	18	18	4	56.5
Rehabilitation (Re-classification)	R_IR6	Rio Blanco - San Pedro del Norte (NIC-13C)	RAAS	8.0	13	18	18	4.5	61.5
Rehabilitation (Re-classification)	R_IR7	El Elpalme - Alamikamba (NN-288)	RAAN	8.0	10	20	18	4.5	60.5
Rehabilitation (Re-classification)	R_IR8	Int. of NIC-24B- End of NIC 54 (Various)	Chinandega / Esteli	8.0	18	11	18	3	58.0
Rehabilitation (Re-classification)	R_IR8-1	NIC 54&Int. of NIC-21B (NIC-57,54&5)	Jinotega /RAAN	8.0	19	20	19	3	69.0
Rehabilitation (Re-classification)	R_IR9	Malpaisillo - Villa 15 de Julio (NIC68/NN252)	Chinandega /Leon	6.5	16	7	19	7	55.5
Rehabilitation (Re-classification)	R_IR10	Lapazcentro - Malpaisillo (NIC-22)	Leon	13.0	16	7	19	7	62.0
Rehabilitation (Re-classification)	R_IR11	Empalme San Ramon - Matiguas (NIC-33)	Matagalpa	13.0	19	13	18	4.5	67.5
Rehabilitation (Re-classification)	R_IR12	Pajaro Negro - El Triunfo (NN-114)	Rio San Juan	13.0	19	15	18	4.5	69.5
Rehabilitation (Re-classification)	R_IR13	El Empalme – San Jacinto (NIC-70A)	Leon /Managua	6.5	16	2	18	4	46.5
Improvement (MTI Program)	R_IR	Basic network of 4,372 km out of 8,500km	Nationwide	9.5	13.5	10	10	3	46.0

Source: JICA Study Team

Table 22.3.4 Result of MCA (Bridge Project)

Group	Code	Project Name	Department	Development Strategy Score	Economic Indictor Score	Social Indicator Score	Environ-mental Indicator Score	Implemen-tation Indicators Score	Total Score
New Bridge (on proposed road)	R_NB1	Mahogony River	RAAS	6.5	11.5	18	13	5	54.0
New Bridge (on proposed road)	R_NB2	El Rama River	RAAS	6.5	11.5	18	13	5	54.0
New Bridge (on proposed road)	R_NB3	Nawawas River	RAAS	6.5	12.5	18	13	5	55.0
New Bridge (on proposed road)	R_NB4	Waspedo River	RAAS	6.5	15.5	18	13	5	58.0
New Bridge (on proposed road)	R_NB5	Kurinwas River	RAAS	6.5	15.5	18	13	5	58.0
New Bridge (on proposed road)	R_NB6	N/A	RAAS	6.5	15.5	18	13	5	58.0
New Bridge (on proposed road)	R_NB7	Grande de Matagalpa	RAAS	6.5	13.5	18	13	5	56.0
New Bridge (on proposed road)	R_NB8	Makantaka (Rio Grande)	RAAS	6.5	13.5	18	13	5	56.0
New Bridge (on proposed road)	R_NB9	Kuanwatla	RAAN	6.5	11.5	20	13	5	56.0
New Bridge (on proposed road)	R_NB10	Alamikamba (Rio Prinzapolka)	RAAN	6.5	13.5	20	13	5	58.0
New Bridge (on proposed road)	R_NB11	Frio River	Rio San Juan	6.5	13.5	15	13	5	53.0
New Bridge (on proposed road)	R_NB12	Zapote River	Rio San Juan	6.5	13.5	15	13	5	53.0
New Bridge (on proposed road)	R_NB13	Guacalito River	Rio San Juan	6.5	11.5	15	13	5	51.0
New Bridge (on proposed road)	R_NB14	Colon	Rio San Juan	6.5	11.5	15	13	5	51.0
New Bridge (on proposed road)	R_NB15	Brito River	Rivas	6.5	13.5	9	13	5	47.0
New Bridge (on proposed road)	R_NB16	El Tular River	Carazo	6.5	17.5	5	13	5	47.0
New Bridge (on proposed road)	R_NB17	Tecolapa River	Carazo	6.5	17.5	5	13	5	47.0
New Bridge (Missing link)	R_BM1	Puente El Tamarindo	Leon	11.5	13.5	7	13	5	50.0
New Bridge (Missing link)	R_BM2	Puente Baquas	Boaco	11.5	18.5	13	13	5	61.0
New Bridge (Missing link)	R_BM3	Puente Wawa River	RAAN	11.5	15.5	20	13	5	65.0
New Bridge (Missing link)	R_BM4	Puente Malacatoya River	Granada	11.5	20.5	7	13	5	57.0
New Bridge (Missing link)	R_BM5	El Paso de Panaloya	Granada	11.5	20.5	7	13	5	57.0
New Bridge (Missing link)	R_BM6	Puente Tecolostote #2 (El Papayal)	Boaco	11.5	16.5	13	13	5	59.0
New Bridge (Missing link)	R_BM7	Wiwili	Jinotega	6.5	14.5	15	13	5	54.0
New Bridge (Missing link)	R_BM8	Puente Rio Abajo	Esteli	6.5	13.5	11	13	5	49.0
Bridge Replacement (Temporary)	R_BT1	Puente San Judas	Nueva Segovia	6.5	15.5	13	13	5	53.0
Bridge Replacement (Temporary)	R_BT2	Puente Santa Rosa Del Penon	Leon	6.5	12.5	7	13	5	44.0
Bridge Replacement (Temporary)	R_BT3	Puente La Potranca	RAAN	11.5	13.5	20	13	5	63.0
Bridge Replacement (Temporary)	R_BT4	Puente Sunsin No.2	RAAN	11.5	13.5	20	13	5	63.0
Bridge Replacement (Temporary)	R_BT5	Puente Rio Luku	RAAN	11.5	15.5	20	13	5	65.0
Bridge Replacement (Temporary)	R_BT6	Puente Rio Labu	RAAN	11.5	16.5	20	13	5	66.0
Bridge Replacement (Temporary)	R_BT7	Puente Pasle	Matagalpa	11.5	16.5	13	13	5	59.0
Bridge Replacement (Temporary)	R_BT8	Puente Rio El Cua (La Maroanosa)	Jinotega	6.5	16.5	15	15	5	58.0
Bridge Replacement (Damaged)	R_BD1	Puente Wani	RAAN	6.5	15.5	20	13	5	60.0
Bridge Replacement (Damaged)	R_BD2	Puente El Tuma (Mulukuku)	RAAN	11.5	14.5	20	13	5	64.0
Bridge Replacement (Damaged)	R_BD3	Puente Prinzapolka	RAAN	11.5	16.5	20	13	5	66.0
Bridge Replacement (Damaged)	R_BD4	Puente Banacruz	RAAN	11.5	13.5	20	13	5	63.0
Bridge Replacement (Damaged)	R_BD5	Puente Paso Real (Esteli)	Esteli	6.5	12.5	11	13	5	48.0
Bridge Replacement (Damaged)	R_BD6	Puente Rio Zinica	RAAN	6.5	15.5	20	13	5	60.0
Bridge Replacement (Damaged)	R_BD7	Puente San Pablo	RAAN	6.5	15.5	20	13	5	60.0
Bridge Replacement (Damaged)	R_BD8	Puente La Esperanza	RAAS	6.5	13.5	18	13	5	56.0
Bridge Replacement (Damaged)	R_BD9	Puente Cuisala	Chontales	11.5	15.5	13	13	5	58.0
Bridge Replacement (Damaged)	R_BD10	Puente Rosa Grande	RAAN	6.5	15.5	20	13	5	60.0
Maintenance Program	R_MR	Maintenance of entire basic network	Nationwide	11.0	15	10	16	3	55.0
Disaster Mitigation Program	R_DM	Provision and replacement of infrastructure against disaster	Nationwide	1.5	15	10	16	4.5	47.0

Source: JICA Study Team

Table 22.3.5 Result of MCA (Other Project)

Group	Code	Project Name	Department	Development Strategy Score	Economic Indictor Score	Social Indicator Score	Environ-mental Indicator Score	Implemen-tation Indicators Score	Total Score
Bus Fleet	B_FL	Big Capacity Bus for Inter-Urban Bus route	Nationwide	6.0	17.5	10	20	6	59.5
Bus Terminal	B_TB	Big Size of Bus Terminal	Nationwide	5.5	15	10	18	3	51.5
Bus Terminal	B_TM	Middle Size of Bus Terminal	Nationwide	5.5	15	10	18	3	51.5
Bus Terminal	B_TS	Small Size of Bus Terminal	Nationwide	5.5	15	10	18	3	51.5
Roadside Station	B_RS	Roadside Station	Nationwide	7.5	15	10	18	3	53.5
Bus Inspection Workshop	B_IN	Bus Inspection Workshop	Managua	3.5	15	10	18	3	49.5
Sea Port Development （Corinto)	W_EP_1	Expansion of Puerto Corinto	Chinandega	9.5	16.5	6	11	5	48.0
Sea Port Development （Bluefields)	W_NP_1	Construction of New Bluefields Port	RAAS	9.5	17.5	15	10	1	53.0
Sea Port Development （Cabezas)	W_EP1	Expansion of Puerto Cabezas	RAAN	9.5	14.5	15	11	6	56.0
Waterway	W_IW1	Inland Water Way along Atlantic Coast	RAAS /RAAN	3.5	15	15	8	5	46.5
Waterway	W_IW2	Maintenance of Inland Water Way	RAAS /RAAN	3.5	15	15	10	5	48.5
Waterway	W_NW1	Channel Dredging Fleet	RAAS /RAAN	3.5	15	15	15	5	53.5
Passenger Docs （RAAN)	W_NW2	Passenger Boats for Public Water Transport Services	RAAN	3.5	15	15	18	5	56.5
Passenger Docs （RAAS)	W_NW3	Passenger Boats for Public Water Transport Services	RAAS	3.5	15	15	18	5	56.5
Passenger Docs （River and Lake Port)	W_NW4	Improvement of River and Lake Ports	Nationwide	3.5	15	10	8	5	41.5
A. C. Sandino International Airport	A_ER_1	Runway Extension of A. C. Sandino	Managua	12.0	17.5	6	14	7	56.5
A. C. Sandino International Airport	A_ET_1	Expansion of Existing International Passenger Terminal	Managua	12.0	17.5	6	17	5.5	58.0
A. C. Sandino International Airport	A_RT_1	Rehabilitation of Existing Domestic Passenger Terminal	Managua	12.0	17.5	6	12	5.5	53.0
A. C. Sandino International Airport	A_NT_1	Construction of New Passenger Terminal at South Side	Managua	12.0	17.5	6	13	5	53.5
A. C. Sandino International Airport	A_NA_1	Construction of New Apron and Taxiway at South Side	Managua	12.0	17.5	6	19	7.5	62.0
A. C. Sandino International Airport	A_NC_1	Construction of New Cargo Terminal Building at South Side	Managua	10.5	17.5	6	18	5.5	57.5
A. C. Sandino International Airport	A_EA_1	Expansion of Apron for Cargo Terminal at South Side	Managua	10.5	17.5	6	14	7	55.0
Bluefield Airport	A_RR_1	Rehabilitation of Runway Pavement	RAAS	4.5	15	15	14	8	56.5
Bluefield Airport	A_ER_2	Expansion of Runway Strip	RAAS	4.5	15	15	17	5	56.5
Bluefield Airport	A_NF_1	Construction of New Fuel Yard	RAAS	4.5	15	15	18	5	57.5
Bluefield Airport	A_NT_2	Construction of New Passenger Terminal at North Side	RAAS	4.5	15	15	13	3	50.5
Bluefield Airport	A_NA_2	Construction of New Apron at North Side	RAAS	4.5	15	15	14	5	53.5
Bluefield Airport	A_ER_3	Extension of Runway	RAAS	4.5	15	15	13	5	52.5
Bluefield Airport	A_NC_2	Construction of New Cargo Terminal at South Side	RAAS	4.5	15	15	13	3	50.5
Bluefield Airport	A_NA_3	Construction of New Apron at South Side	RAAS	4.5	15	15	16	8	58.5
Bilwi Airport	A_NT_3	Construction of New Passenger Terminal	RAAN	4.5	15	15	16	6	56.5
Bilwi Airport	A_NF_3	Construction of New Fuel Yard	RAAN	4.5	15	15	18	8	60.5
Bilwi Airport	A_NC_2	Construction of New Cargo Terminal	RAAN	4.5	15	15	16	6	56.5
Bilwi Airport	A_EA_2	Extension of Runway	RAAN	4.5	15	15	16	8	58.5
Corn Island Airport	A_RR_2	Rehabilitation of Runway Pavement	RAAN	4.5	15	15	17	5	56.5
Corn Island Airport	A_NF_4	Installation of Airfield Lighting System	RAAN	4.5	15	15	20	5	59.5
Corn Island Airport	A_NF_5	Installation of New Fence	RAAN	4.5	15	15	20	5	59.5
Corn Island Airport	A_NF_6	Construction of New Control Tower	RAAN	4.5	15	15	17	5	56.5
Corn Island Airport	A_ER_3	Expansion of Runway Strip	RAAN	4.5	15	15	18	5	57.5
Cross Border Point (Guasaule)	F_IC_1	Cross-border Trade Facility of Guasaule CBP	Chinandega	9.5	17.5	6	17	8	58.0
Cross Border Point (El Espino)	F_IC_2	Cross-border Trade Facility of El Espinio CBP	Madriz	9.5	14.5	10	17	8	59.0
Cross Border Point (Las Manos)	F_IC_3	Cross-border Trade Facility of Las Manos CBP	Nueva Segovia	9.5	13.5	10	17	5	55.0
Cross Border Point (Penas Blancas)	F_IC_4	Cross-border Trade Facility of Penas Blancas CBP	Rivas	9.5	17.5	6	17	8	58.0
Cross Border Point (Psan Pancho)	F_IC_5	Cross-border Trade Facility of San Pancho CBP	Rio San Juan	9.5	13.5	10	19	5	57.0
Logistic Park (Mamagua East))	F_NL_1	Managua East Logistic Park	Managua	9.5	15	6	19	3	52.5
Logistic Park (Managua West)	F_NL_2	Managua West Logistic Park	Managua	9.5	15	6	17	3	50.5
Logistic Park (Chinadega)	F_NL_3	Chinandega Logistic Park	Chinandega	9.5	15	6	14	3	47.5
Logistic Park (Bluefileds)	F_NL_4	Bluefields Logistic Park	RAAS	9.5	15	15	14	3	56.5
Agro Processing Estate (Chinandega)	F_NA_1	Chinandega Agro-processing Estate	Chinandega	7.5	15	6	14	3	45.5
Agro Processing Estate (Matagalpa)	F_NA_2	Matagalpa Agro-processing Estate	Matagalpa	7.5	15	10	14	3	49.5
Agro Processing Estate (Juigalpa)	F_NA_3	Juigalpa Agro-processing Estate	Chontales	7.5	15	10	14	3	49.5
Agro Processing Estate (Nueva Guinea)	F_NA_4	Nueva Guinea Agro-processing Estate	RAAS	7.5	15	15	17	3	57.5
Agro Processing Estate (Bilwi)	F_NA_5	Cold Storage at Bilwi	RAAN	7.5	15	15	18	3	58.5

Source: JICA Study Team

22.4 Economic Analysis

This chapter presents the results of the evaluation of the economic viability of identified projects that is used in multi criteria analysis. It is concerned with the determination of the net benefits that will accrue to the economy as a result of the project. Only tangible costs and benefits are considered in the evaluation. The evaluation on each project aiming at determining their priorities and timing of implementation is carried out in an integrated way of project evaluation of which details are presented in other chapter.

22.4.1 Methodology of Economic Analysis

(1) Viability Indicators

The relevant economic viability criterion is derived from a procedure aimed at maximizing the overall objectives of the national economy. Economic viability is ensured by computation of the Economic Internal Rate of Return (EIRR) of the project. The EIRR is to be more than the opportunity cost of country where subject project is planned. As commonly adopted for the economic analysis in the Central American region by the international financial institutions 12 percent discount rate is used as the economic opportunity cost of capital and this rate is used to calculate the following economic viability indicators as well.

(i) EIRR Economic Internal Rate of Return
(ii) B/C Benefit Cost Ratio
(iii) NPV Net Present Value

1) EIRR

EIRR is the rate that shows the current-value of the total sum of the amount of annual net benefits of the project zero. It shows the efficiency of the project in view of national economy or more than the opportunity cost determined. This means that if the EIRR of a project is 12% then such a project is considered as viable and worth to consider for its implementation in view of national economy.

2) B/C

B/C is the ratio of the total amount of benefit to the total amount of the project expense. Generally, it can be said that an economy internal rate of return (EIRR) and Benefit-Cost ratio (B/C) show the economic viability of a project. It is assumed that if the EIRR is more than a predetermined opportunity cost or discount rate (i.e. 12%) B/C should be more than 1.0. A project of which B/C is computed at less than 1.0 is considered is not viable thus it is suggested to move its timing behind the project of which B/C is more than 1.0. However, in case of the projects covered in this study, the timing of implementation will be defined taking into account the social and environmental factors in addition to the economic factor

3) Net Present Value (NPV)

NPV is the sum of total amount of annual net benefit discounted at social discounted rate of the country. NPV shows the total sum of the current-value of social surplus amount produced by the project. When EIRR is more than 12% and B/C is more than 1.0, NPV shows positive value. On the contrary if EIRR is less than 12% or B/C is less than 1.0, NPV shows negative value. The amount of NPV computed can be used as the element to compare the competitiveness of respective project in view of national economy.

(2) Economic Cost[1]

The total construction costs of subject project are estimated firstly on the basis of the market price as financial costs and it is converted to the economic costs for the economic analysis. The monetary unit shown therein, therefore, is based on prevailing market prices of required goods and services at present or November 2013. Taxes composed of the current tax and import duties are subtracted as

[1] The detailed tax must be calculated in the design stage.

transfer payment from the total financial cost estimated. Tax rates applied for this subtraction were 16 % as value added tax on all prices estimated for local components and 5 % as import duties on all prices estimated for foreign components. The economic cost of all projects evaluated is estimated by subtracting 17% from the project cost estimated on market price and no acquisition cost of land is considered.

(3) Quantifiable Benefits

The benefits are estimated based on the comparison of the With Case and Without Case of the Project. The quantifiable benefits applied for the economic analysis of the projects of which aims are to develop and improve the transport performance are as follows:

1) Road

- Benefits due to saving of the Vehicle Operation Cost (VOC); and
- Benefits due to saving the Travel Time Cost (TTC)

2) Sea Port

- Benefits due to avoiding vessel waiting time or reduced turn-round times of ship in port;
- Benefits due to shorten a maritime transport distance because of changing its geographical location of port between new port and existing port; and
- Amalgamated benefits due to saving of land transport cost or trucking cost for port cargo because of changing geographical location of subject port as a new port and existing port.

3) Airport

- Benefits due to saving an economic operation cost of aircraft that plies between origin airport and destination airport when it is compared with the same by land transport or any other means of transport; and
- Benefits due to saving of an economic operation cost of aircraft which is larger and more economical than using current aircraft which is smaller than the aircraft planned to be introduced.

(4) Qualitative Benefits

The typical economic benefits accrued to the implementation of a project but cannot be computed quantitatively or are intangible and/or regarded as so called indirect benefits of project for the development and improvement of transport sector can be as follows:

- Contribution to enhancement of agricultural and industrial development along the transport corridor;
- Contribution to enhancement of value-added activities along project transport corridor;
- Facilitation of international and regional trade;
- Improvement of land productivity along project transport corridor;
- Increased tourism activities at potential tourism destinations along the transport corridor;
- Generation of additional short-term employment in the construction period; and
- Generation of job opportunities relevant to transport industries.

Those intangible benefits are not considered however these are considered for an integrated evaluation of a project taking into account other factors of which details are discussed in Chapter 22.3.

(5) Presumptions for Computing Economic Viability Indicators

In order to conduct the computation of economic viability indicators the project implementation framework has to be established and defined. The project implementation framework consists of the following components and their data.

(i) Investment plan period
(ii) Design and construction period
(iii) Project commissioning year
(iv) Project Life

(v) Currency

1) Investment plan period

The investment plan period is defined as the total time period between the start of the cost stream and the end of the cost and benefit stream. The cost stream is defined to start with the final engineering design of the Project and ended at the terminating year of its project life.

2) Design and construction period:

After the completion of the detailed design of the Project and the financial arrangement, the tender is called and contract will be awarded to the selected contractors to execute required work. The design and construction period counted from the date of awarding contractors to the contractor is assumed to be 2 to 5 years depends on its scale of subject project.

3) Project commissioning year:

The commissioning of the project is assumed to take place immediately after the year when all required construction works is completed and become ready for commissioning its operation.

4) Project Life:

The project life normally extends over a period of 20 - 30 years starting from the year of commissioning of the project operation. In the evaluation of the Project, thirty (30) years is considered applicable taking into account the scale and type of the project. During the investment plan period, the cost and benefits are recorded annually over the whole period separately for each benefit and cost components.

5) Currency:

The currency used in the economic evaluation is US Dollar. The exchange rate of Nicaraguan Cordoba to the United States Dollar is NIC 25.0 per US$ as of November 2013.

(6) Economic Costs

1) Composition of direct cost

The direct cost estimated for each subject project is as shown in Table 22.4.3.

2) Schedule for replacement of machinery

The replacement costs for major machinery were scheduled according to the assumption of life of relevant machine and equipment where such replacement is necessary during the project time frame. The residual value of assets is not considered.

3) Physical and price contingency

Price contingency is added on top of the direct costs estimated for the above at the rate of 5 % and physical contingency is added on such cost at the rate of 10%.

4) Operation and maintenance cost

The operation and maintenance costs are composed of cash-outflow throughout the project period where such cost is applicable for evaluation of the project. The rates of maintenance cost of project are as follows:

i) **Road:** Operation cost of road is not considered as all roads identified are not toll roads. Maintenance cost is estimated per kilometer for road project by road classification.

ii) **Sea Port:** Operation cost of relevant port is estimated by applying an average operation cost of port cargo handling cost analyzed per ton of cargo. Maintenance cost of facilities such as berth, pier, yard, administration buildings, etc. are estimated by applying a certain ratio to the total investment cost for the construction of such facilities. The cost for maintenance dredging is estimated as per schedule of major maintenance dredging (say each 5-year) as shown in its economic viability indicator calculation sheet for relevant port project.

iii) **Air Port:** Operation cost of airport is not considered for economic analysis. Maintenance cost of facilities such as runway, taxiway, apron, terminals, tower, administration buildings, etc. are estimated by applying a certain ratio to the total investment cost for the construction of such facilities.

(7) Formulas for Computation of Economic Benefits

1) Estimation of Economic Benefits from Road Project

The total saving of Vehicle Operation Cost (VOC) and Travel Time Cost (TTC) per each year due to investment to road project can be computed by applying the following formula:

$$ASTCT_1 = (((VOCT_1Wo + TTCT_1Wo) \times LWo \times AADTT_1) + (VOCT_2Wo + TTCT_2Wo) \times LWo \times AADT_2)) - ((VOCT_1W + TTCT_1W) \times LW \times AADT_1) + (VOCT_2Wo+TTCT_2W) \times LWo \times AADT_2))) \times 365$$

Where:

$ASTCT_1$	= Annual Saving of Transport Cost of Type-1 Vehicle due to increased speed of travel
$VOCT_1Wo$	= VOC of Type-1 vehicle at speed under without project conditions
$VOCT_1W$	= VOC of Type-1 vehicle at speed under with project conditions
$TTCT_1Wo$	= TTC of Type-1 vehicle at speed under without project conditions
$TTCT_1W$	= TTC of Type-1 vehicle at speed of under with project conditions
LWo	= Length of travel under without project condition
LW	= Length of travel under with project condition
$AADT_1$	= Annual Average Daily Traffic volume of Type1 vehicle

2) Estimation of Economic Benefits from Port Project

The reduction in vessel's waiting time due to investment to the port to increase its port capacity or to maintain the berth occupancy rate at appropriate level is considered can be computed by applying following formula:

$$ASCRVWT = (AWTVWo - AWTVW) \times DVC$$

Where:

ASCRVWT	= Annual Saving Cost due to Reduction of Vessel's Waiting Time
AWTVWo	= Waiting Time of Vessel in days under Without Project Case
AWTVW	= Waiting Time of Vessel in days under With Project Case
DVC	= Daily Vessel Cost

The annual vessel waiting time can be obtained by applying a queuing theory to approximate the waiting time based on the relationship between berth utilization ratio and average ship waiting time in accordance with the recommended formula to use for the port development planning by UNCTAD (A Handbook for Planners in Developing Countries, Second Edition 1985). More specifically the quantification of relationship between waiting time and berth utilization in units of average service time based on E2/E2/n system, which is considered as the best estimate of queuing time for specialized terminal, is applied.

3) Saving of land cargo transport for international freight

Under the master plan the development of new seaports along the Atlantic Coast is planned to be developed aiming at shorten the total running distance of land transport of international freight as well as eliminating truck waiting time at cross-border customs facilities. Table 22.4.1 summarizes the distance and truck waiting time at CBPs that can be eliminated due to the development of new ports along the Atlantic Coast for handling the international freight transport.

Table 22.4.1 Travel Distance and Waiting Time under Without Case

Port	Country	Distance	Waiting Time at CBP
		Km	Hours
Puerto Cortes	Honduras	470	24
Puerto Limon	Costa Rica	450	48
Puerto Corinto*[1]	Nicaragua	1,359	0

Note:

1. Almost 50% of the total cargo volume handled at Puerto Corinto of Nicaragua is destined to and imported from the countries located at the Atlantic side such as EU, eastern part of USA, Venezuela, Brazil, etc.
2. Those seaborne cargos to and from Puerto Corinto is transferred at the inlet and outlet of Panama Canal. The distance between Puerto Corinto and Balboa Port of Panama is around 1,284 km and the railway transferring the containers between Balboa Port and Colon Port of Panama is around 75 km: The container transfer between Balboa Port and Colon Port is undertaken by railway. (Annual transport volume is 670,000 TEUs)

Source: JICA Study Team

Table 22.4.2 shows the total annual freight volume in million ton-km in 2013, 2023 and 2033, respectively under Without Project Case and With Project Case as well as the difference between two cases.

Table 22.4.2 Estimated Freight Volume in Million Ton-km

With Project

Total (Including External Ports) (Unit: million ton-km)

Year	Export	Import	Domestic	Total
2013	401	2,150	1,520	4,072
2023	739	4,096	2,207	7,042
2033	1,147	9,344	2,855	13,345

Without Project

Total (Including External Ports) (Unit: million ton-km)

Year	Export	Import	Domestic	Total
2013	263	1,321	1,520	3,104
2023	580	2,287	2,207	5,074
2033	778	4,789	2,855	8,421

Difference between With and Without Project

Total (Including External Ports) (Unit: million ton-km)

Year	Export	Import	Domestic	Total
2013	138	829	0	967
2023	160	1,808	0	1,968
2033	368	4,556	0	4,924

Source: JICA Study Team

As shown in the above table, the difference of freight volume between two cases in ton-km is estimated to be almost 1 billion ton-km in 2013, 2 billion ton-km in 2023 and 5 billion ton-km in 2033. The type major vehicles transporting international freight or port cargo is container trailer truck that carries around 15 tons of containerized cargo in an average. The VOC of trailer truck running at 50 kph which is an average running speed of such type of vehicle along the main trunk road is estimated to be at US$ 0.0383 per ton-km. The maritime transport cost of 40 footer container between Puerto Corinto and Puerto Balboa of Panama is estimated at around US$650 per FEU or US$0.0319/ton-km assuming that an average weight of containerized goods is 15 tons per FEU. Based on these presumptions the transport cost saved due to use of new ports planned to be developed along the Atlantic Coast namely new Bluefields port and new Puerto Cabezas the amalgamated cost saved was computed as US$105 million in 2013, US$207 million and US$447 million in 2033, respectively.

As such the economic benefits delineated due to a shifting of the location of seaports for

international freight operation of Nicaragua is enormous and substantial.

22.4.2 Economic Viability Indicators Computed

Table 22.4.3 summarizes the results of computing economic viability indicators for road projects identified and seaport project.

As shown in the above table, EIRR is more than 12%, B/C is more than 1.0 and the NPV is positive, therefore, the project is considered as worth for investment and it is substantially contribute to the national economy. This high rate of return is attributed by a substantial transport development in view of both land transport and maritime transport. These projects can be considered as a key project to increase the transport performance of Nicaragua economically by make it possible to develop a new transport and economic corridor traversing the center part of the country from east to west as interoceanic transport corridor.

Table 22.4.3 Result of Economic Viability

Group	Code	Project Name	Department	Financial Cost	Economic Cost	Length	Demand Vehicle/day	Economic Viability		
								B/C	NPV	IRR
Road Construction	R_PR1	Chiquilistagua (NIC-12) - San Benito(NIC-	Managua	183.1	148.6	L=32.6km	25,596	3.48	332.68	32.1%
Road Construction	R_NR1	San Juan Del Sur - El Coyol	Rivas	17.6	15.1	L=22.5km	100	0.40	-9.00	2.6%
Road Construction	R_NR2	Cardenas - Santa Fe	Rivas /Rio San Juan	75.9	71.9	L=102.0km	193	0.75	-18.10	8.5%
Road Construction	R_NR3	El Rama - Las Brenas	RAAS	42.3	35.7	L=36.0km	113	0.30	-24.14	N.A.
Road Construction	R_NR4	El Ayote - El Tortuguero	RAAS	70.2	58.7	L=82.7km	194	0.74	-15.23	8.4%
Road Construction	R_NR5	El Toruguero - La Cruz De Rio Grande	RAAS	26.3	22.0	L=32.0km	145	0.52	-10.61	5.1%
Road Construction	R_NR6	San Pedro Del Norte - La Cruz de Rio	RAAS	60.6	50.6	L=76.5km	235	0.93	-3.36	10.9%
Road Construction	R_NR7	Makantaka - Karawala	RAAS	49.2	40.9	L=72.1km	41	0.18	-34.37	N.A.
Road Construction	R_NR8	Point B - Prinzapolka	RAAN	32.1	26.7	L=47.0km	57	0.24	-20.67	N.A.
Road Construction	R_NR9	La Cruz De Rio Grande - Alamikamba	RAAS /RAAN	51.5	42.9	L=62.5km	96	0.35	-27.97	1.6%
Road Construction	R_NR10	La Trinidad - Masachapa	Carazo	22.6	19.2	L=25.0km	100	0.36	-12.15	1.7%
Road Construction	R_NR11	Suina - Bonanza	RAAN	53.5	45.0	L=55.0km	204	0.64	-15.90	7.1%
Road Construction	R_NR12	Bonanza - Point C	RAAN	72.1	66.0	L=99.0km	121	0.45	-36.50	3.7%
Road Construction	R_NR13	Empalme Puerto Sandino - Lapazcentro	Leon	40.7	34.5	L=15.5km	360	0.45	-17.44	4.1%
Road Construction	R_NR14	Empalme de Telica - Puerto Corinto	Leon /Chinadega	77.0	65.3	L=33.0km	1,349	1.21	12.58	13.9%
Improvement (Widening)	R_IW1	NIC-2 Int. - Leon (NIC-12A)	Managua /Leon	225.8	193.7	L=87.3km	11,447	2.42	253.11	24.5%
Improvement (Widening)	R_IW2	Leon - Chinandega (NIC-12A)	Leon /Chinadega	158.1	135.6	L=57.4km	11,972	2.18	146.93	22.4%
Improvement (Widening)	R_IW3	C. Sandino - Mateare (NIC-28)	Managua	46.6	39.9	L=17.8km	16,318	3.47	90.70	32.3%
Improvement (Widening)	R_IW4	NIC-12A Int. – Jinotepe (NIC-2)	Managua /Carazo	123.9	106.3	L=44.0km	11,889	2.36	133.08	24.2%
Improvement (Widening)	R_IW5	Jinotepe - Nandaime (NIC-2)	Carazo	84.4	72.4	L=36.5km	7,074	2.16	77.90	22.4%
Improvement (Widening)	R_IW6	Nandaime - Rivas (NIC-2)	Granada /Rivas	129.1	110.8	L=51.9km	10,147	3.38	243.18	31.3%
Improvement (Widening)	R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)	Masaya /Granada	116.3	99.7	L=19.6km	40,808	5.92	442.17	47.1%
Improvement (Widening)	R_IW8	Tipitapa – San Isidro (NIC-1)	Managua / Matagalpa	243.8	185.0	L=93.3km	15,714	5.39	751.57	43.9%
Improvement (Reconstruction)	R_IC1	Boaco - Muy Muy (NIC-9)	Boaco /Matagalpa	25.2	21.6	L=50.9km	2,849	1.93	21.43	21.2%
Improvement (Reconstruction)	R_IC2	Muy Muy - Rio Blanco (NIC-21B)	Matagalpa	27.3	23.4	L=58.5km	2,332	1.74	18.69	19.5%
Improvement (Reconstruction)	R_IC3	Rio Blanco - Puerto Cabezas (NIC-21B)	RAAN	158.4	135.9	L=315.7km	909	1.47	68.07	16.8%
Improvement (Reconstruction)	R_IC4	Cosiguina - Potosi (NIC-12B)	RAAN	5.6	4.8	L=12.4km	100	0.66	-1.75	6.9%
Improvement (Reconstruction)	R_IC5	Telpaneca - Pueblo Nuevo (NIC-38&51)	Madriz	23.9	20.5	L=53.0km	757	0.92	-1.76	10.6%
Improvement (Reconstruction)	R_IC6	Cuyalli – San Rafael Del Norte (NIC-41)	Jinotega	15.2	13.1	L=36.9km	404	0.48	-7.52	3.4%
Improvement (Reconstruction)	R_IC7	NIC-24B – Ville Las Pilas (NN-270)	Chinandega	5.2	4.5	L=11.5km	212	0.38	-3.00	0.9%
Improvement (Reconstruction)	R_IC8	El Sauce – Guacucal (NIC-38)	Leon	4.4	3.8	L=10.6km	450	0.99	-0.03	11.6%
Improvement (Reconstruction)	R_IC9	Santa Rosa – Camoapa (NIC-19B1)	Chontales	12.6	10.8	L=27.8km	436	0.85	-1.81	9.6%
Improvement (Reconstruction)	R_IC10	La libertad – Santo Tomas (NIC-23A)	Chontales	10.3	8.9	L=22.9km	73	0.13	-8.36	N.A.
Improvement (Reconstruction)	R_IC11	Esquipulas – La Concepcion (NIC-20B1)	Managua /Masaya	6.6	5.7	L=18.8km	8,505	4.96	25.72	47.9%
Improvement (Reconstruction)	R_IC12	Masaya - Zambrano (NIC-27)	Masaya	11.6	10.0	L=25.0km	550	0.41	-6.35	1.7%
Improvement (Reconstruction)	R_IC13	El Rosaria – La Conquista (NIC-20C)	Carazo	5.6	4.8	L=13.5km	124	0.26	-3.91	N.A.
Improvement (Reconstruction)	R_IC14	Boom Siril – Waspan (NN-73)	Chinandega	52.0	44.6	L=115.0km	38	0.22	-37.71	N.A.
Improvement (Reconstruction)	R_IC15	Rivaz - Tola (NIC-62)	Rivas	5.5	4.7	L=13.2km	419	0.93	-0.36	10.8%
Improvement (Reconstruction)	R_IC16	Peripheral road Ometepe Island (NIC-64)	Rivas	18.1	15.5	L=40.0km	39	0.23	-13.01	N.A.
Rehabilitation (Re-classification)	R_IR1	Granada - Tecolostote (NIC-39)	Granada /Boaco	47.8	41.0	L=54.3km	6,126	5.52	183.14	45.4%
Rehabilitation (Re-classification)	R_IR2	La Gateada - Nueva Guinea (NIC-71)	RAAS	50.3	43.2	L=58.5km	858	0.60	-17.25	6.3%
Rehabilitation (Re-classification)	R_IR2-1	Nueva Guinea - Bluefields (NIC-71)	RAAS	68.4	58.7	L=77.2km	2,861	3.36	136.89	31.5%
Rehabilitation (Re-classification)	R_IR3	El Rama-Kukra Hills-Laguna de Perlas	RAAS	39.1	33.5	L=71.0km	131	0.30	-24.79	N.A.
Rehabilitation (Re-classification)	R_IR4	Santa Domingo - El Ayote (NIC23B)	Chontales	31.6	27.1	L=53.0km	391	0.58	-11.90	5.7%
Rehabilitation (Re-classification)	R_IR5	Las Esparanza - El Tortuguero	RAAS	48.7	41.8	L=85.0km	90	0.28	-31.28	N.A.
Rehabilitation (Re-classification)	R_IR6	Rio Blanco - San Pedro del Norte (NIC-13C)	RAAS	39.9	34.5	L=71.5km	235	0.84	-5.83	9.6%
Rehabilitation (Re-classification)	R_IR7	El Elpalme - Alamikamba (NN-288)	RAAN	24.8	21.2	L=34.0km	75	0.20	-17.11	N.A.
Rehabilitation (Re-classification)	R_IR8	Int. of NIC-24B- End of NIC 54 (Various)	Chinandega / Esteli	134.0	115.0	L=175.0km	772	0.64	-41.26	6.9%
Rehabilitation (Re-classification)	R_IR8-1	NIC 54&Int. of NIC-21B (NIC-57,54&5)	Jinotega /RAAN	134.0	115.0	L=175.0km	772	0.64	-41.26	6.9%
Rehabilitation (Re-classification)	R_IR9	Malpaisillo - Villa 15 de Julio	Chinandega /Leon	80.6	69.1	L=34.0km	2,859	1.82	52.18	19.4%
Rehabilitation (Re-classification)	R_IR10	Lapazcentro - Malpaisillo (NIC-22)	Leon	86.9	74.5	L=36.4km	2,278	1.37	25.33	15.4%
Rehabilitation (Re-classification)	R_IR11	Empalme San Ramon - Matiguas (NIC-33)	Matagalpa	36.7	31.5	L=62.2km	468	0.70	-9.89	7.6%
Rehabilitation (Re-classification)	R_IR12	Pajaro Negro - El Triunfo (NN-114)	Rio San Juan	35.3	30.3	L=41.2km	2,775	3.32	69.67	31.3%
Rehabilitation (Re-classification)	R_IR13	El Empalme – San Jacinto (NIC-70A)	Leon /Managua	53.8	46.2	L=61.1km	1,108	1.27	12.18	14.6%
Sea Port Development （Corinto)	W_EP_1	Expansion of Puerto Corinto	Chinandega	191.2	162.5			1.29	198.00	33.0%
Sea Port Development （Bluefields)	W_NP_1	Construction of New Bluefields Port	RAAS	273.2	232.2			2.71	519.00	27.0%

Source: JICA Study Team

22.5 Road High Priority Project form Multi Criteria Analysis

The top 10 priority projects based on Multi Criteria Analysis is shown in Table 22.5.1. Many of the top 10 projects with high total score is a road improvement project on trunk road located on the Caribbean side and central region in Nicaragua. These projects match with the strategy corridor proposed and will contribute greatly to both the social development for poverty area and enhancement of economic growth.

Most of the top 10 projects with economic indexes are road widening projects located at the pacific side. The road widening project much contribute to solve the traffic congestion, this will expect benefits of vehicle travel time.

Most of the top 10 projects with social indexes are related road improvement and road new construction projects at RAAN, RAAS area. By implementing these projects, the region relying on water transport is connected by land transport, the development of undeveloped resource becomes possible to lead to the activation of the socio-economic activities and contribute regional disparities and poverty reduction.

Table 22.5.1 High Priority Project of Road Improvement Project by Multi Criteria Analysis

High Score	Group	Code	Project Name	Department	Total Score	Economic Score	Social Score
Total Score Top 10	Rehabilitation (Re-classification)	R_IR1	Granada - Tecolostote (NIC-39)	Granada /Boaco	73.0	38	11
	Rehabilitation (Re-classification)	R_IR2-1	Nueva Guinea - Bluefields (NIC-71)	RAAS	71.5	35.5	18
	Rehabilitation (Re-classification)	R_IR12	Pajaro Negro - El Triunfo (NN-114)	Rio San Juan	69.5	32	15
	Rehabilitation (Re-classification)	R_IR8-1	NIC 54&Int. of NIC-21B (NIC-57,54&5)	Jinotega /RAAN	69.0	25.5	20
	Improvement (Reconstruction)	R_IC3	Rio Blanco - Puerto Cabezas (NIC-21B)	RAAN	68.5	34	20
	Rehabilitation (Re-classification)	R_IR11	Empalme San Ramon - Matiguas (NIC-33)	Matagalpa	67.5	32	13
	Improvement (Reconstruction)	R_IC1	Boaco - Muy Muy (NIC-9)	Boaco /Matagalpa	65.0	34	13
	Improvement (Reconstruction)	R_IC2	Muy Muy - Rio Blanco (NIC-21B)	Matagalpa	65.0	34	13
	Rehabilitation (Re-classification)	R_IR10	Lapazcentro - Malpaisillo (NIC-22)	Leon	62.0	29	7
	Rehabilitation (Re-classification)	R_IR8	Int. of NIC-24B- End of NIC 54 (Various)	Chinandega / Esteli	58.0	24.5	11
Economic Score Top 10	Improvement (Widening)	R_IW8	Tipitapa – San Isidro (NIC-1)	Managua / Matagalpa	59.0	37.5	6
	Improvement (Widening)	R_IW1	NIC-2 Int. - Leon (NIC-12A)	Managua /Leon	56.0	37.5	2
	Improvement (Widening)	R_IW2	Leon - Chinandega (NIC-12A)	Leon /Chinadega	60.0	36.5	7
	Improvement (Widening)	R_IW6	Nandaime - Rivas (NIC-2)	Granada /Rivas	59.0	35.5	7
	Improvement (Widening)	R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)	Masaya /Granada	56.0	32.5	7
	Improvement (Reconstruction)	R_IC11	Esquipulas – La Concepcion (NIC-20B1)	Managua /Masaya	52.5	32.5	2
	Improvement (Widening)	R_IW4	NIC-12A Int. – Jinotepe (NIC-2)	Managua /Carazo	51.0	32.5	2
	Road Construction	R_PR1	Chiquilistagua (NIC-12) - San Benito(NIC-	Managua	46.0	32.5	2
Social Score Top 10	Rehabilitation (Re-classification)	R_IR7	El Elpalme - Alamikamba (NN-288)	RAAN	60.5	14.5	22
	Road Construction	R_NR9	La Cruz De Rio Grande - Alamikamba	RAAS /RAAN	52.0	17.5	22
	Road Construction	R_NR8	Point B - Prinzapolka	RAAN	47.5	13.5	22
	Rehabilitation (Re-classification)	R_IR6	Rio Blanco - San Pedro del Norte (NIC-13C)	RAAS	61.5	17.5	20
	Improvement (Reconstruction)	R_IC4	Cosiguina - Potosi (NIC-12B)	RAAN	59.5	21.5	20
	Rehabilitation (Re-classification)	R_IR5	Las Esparanza - El Tortuguero	RAAS	56.5	14.5	20
	Road Construction	R_NR11	Suina - Bonanza	RAAN	54.0	18.5	20
	Rehabilitation (Re-classification)	R_IR3	El Rama-Kukra Hills-Laguna de Perlas	RAAS	53.5	13.5	20
	Road Construction	R_NR5	El Toruguero - La Cruz De Rio Grande	RAAS	53.5	17.5	20
	Road Construction	R_NR4	El Ayote - El Tortuguero	RAAS	52.0	16.5	20
	Road Construction	R_NR12	Bonanza - Point C	RAAN	52.0	15.5	20
	Road Construction	R_NR6	San Pedro Del Norte - La Cruz de Rio	RAAS	51.0	16.5	20
	Road Construction	R_NR7	Makantaka - Karawala	RAAS	44.0	12.5	20

Source: JICA Study Team

Chapter 23 Implementation Program

23.1 Stage-wise Plan

The stage-wise plan was formulated taking as its basis the results of project priority evaluation described in Chapter 22, realizing at the time the consultation with relevant agencies and the MTI to analyze the progress of other existing projects as well as to coordinate with other donor's projects. Furthermore the positional relationship of mutual project and the scale of the project are considered for distributing the projects list to short-term, medium-term and long-term program. The short-term plan is 2014-2018, the medium-term plan is 2019-2023 and the long-term plan is 2024-2033. Considering the shortage of the public investment fund for the next 20 years from 2014 to 2033 discussed, the part of the long term projects are postponed after 2033, super long term program.

Table 23.1.1 Project Cost by Staging (Short, Middle and Long Term)

Sub-Sector	Short Term	Middle Term	Long Term		Total
	2014-2018	2019-2023	2024-2033	After 2034	
Land Transport (Road)	737.1	1,867.3	2,650.7	2,557.5	7,812.7
Land Transport (Bus)	99.1	28.8	10.3	0.0	138.2
Maritime Transport Sector	190.6	190.6	0.0	0.0	381.2
Water Transport Sector	18.2	18.2	5.3	15.9	57.5
Aviation Sector	0.0	236.5	95.9	0.0	361.0
Logistic Sector	10.6	26.0	39.0	0.0	75.6
Total	1,055.5	2,367.3	2,801.3	2,573.4	8,826.1
(Share %)	12%	27%	32%	29%	100%

Source: JICA Study Team

The project cost by stage-wise, short and middle, long term projects are shown in Table 23.1.1. The each project list with stage wise and cost are shown in Figure 23.1.1 and Table 23.1.2

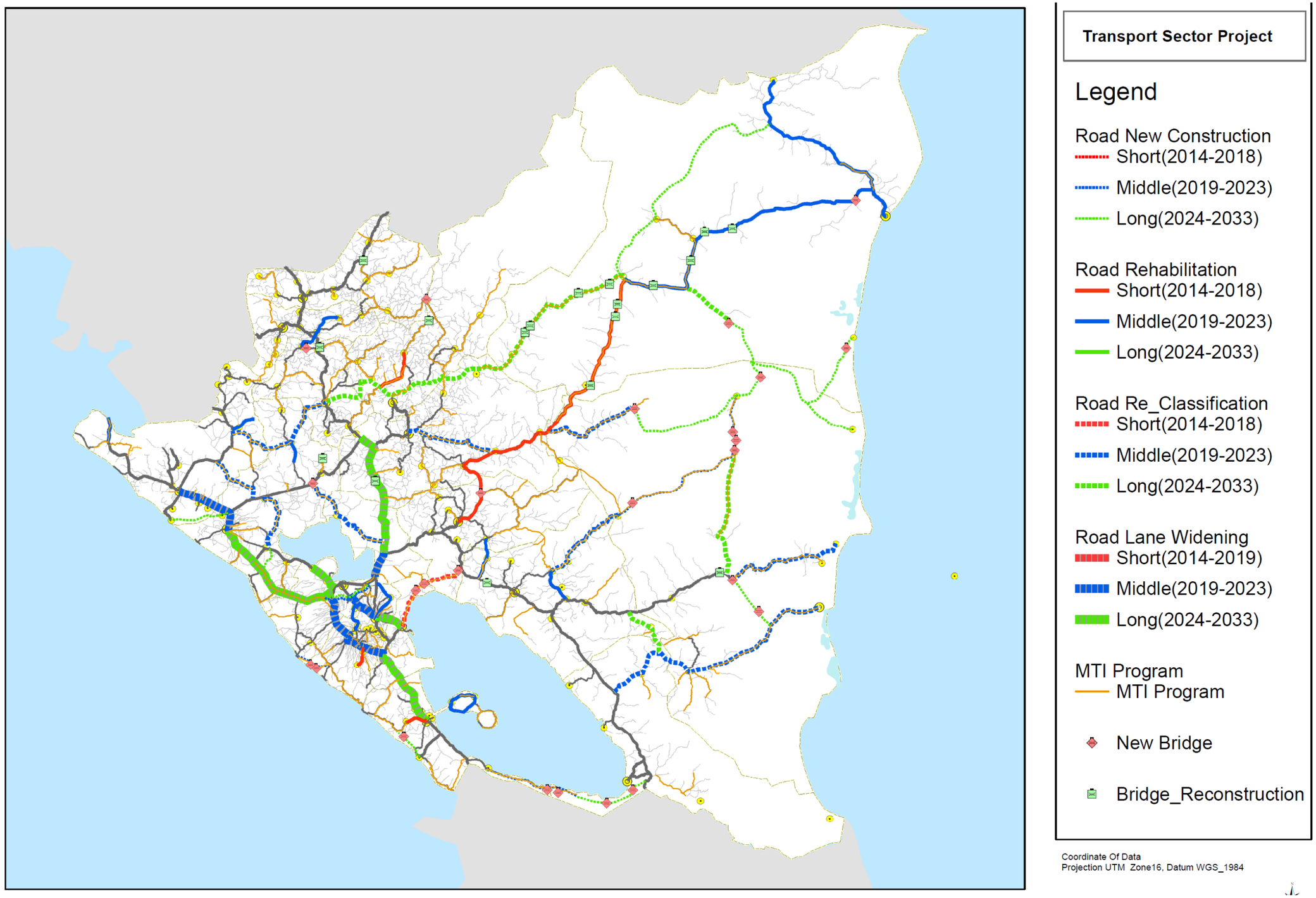


Figure 23.1.1 Project Staging Plan
Source: JICA Study Team

Table 23.1.2 Staging Plan No. 1

Sector	Group	Code	Project Name	Cost (million	Implementing Schedule				Implementing Schedule of Cost (US$ million)				Executing Agency	Investment Mode	Project Configuration
					2014-2018	2019-2023	2024-2033	2034-	2014-2018	2019-2023	2024-2033	2034-			
Land Transport (Road)	Road Construction	R_PR1	Chiquilistagua (NIC-12) - San Benito(NIC-1)	183.1		■	■			36.6	146.5		MTI	Gov	L=32.6km
Land Transport (Road)	Road Construction	R_NR1	San Juan Del Sur - El Coyol	17.6			■	■			8.8	8.8	MTI	Gov	L=22.5km
Land Transport (Road)	Road Construction	R_NR2	Cardenas - Santa Fe	75.9		■	■			15.2	60.7		MTI	Gov	L=102.0km
Land Transport (Road)	Road Construction	R_NR3	El Rama - Las Brenas	42.3			■	■			21.2	21.2	MTI	Gov	L=36.0km
Land Transport (Road)	Road Construction	R_NR4	El Ayote - El Tortuguero	70.2		■				70.2			MTI	Gov	L=82.7km
Land Transport (Road)	Road Construction	R_NR5	El Toruguero - La Cruz De Rio Grande	26.3		■				26.3			MTI	Gov	L=32.0km
Land Transport (Road)	Road Construction	R_NR6	San Pedro Del Norte - La Cruz de Rio Grande	60.6			■	■			30.3	30.3	MTI	Gov	L=76.5km
Land Transport (Road)	Road Construction	R_NR7	Makantaka - Karawala	49.2			■	■			24.6	24.6	MTI	Gov	L=72.1km
Land Transport (Road)	Road Construction	R_NR8	Point B - Prinzapolka	32.1			■	■			16.1	16.1	MTI	Gov	L=47.0km
Land Transport (Road)	Road Construction	R_NR9	La Cruz De Rio Grande - Alamikamba	51.5			■	■			25.8	25.8	MTI	Gov	L=62.5km
Land Transport (Road)	Road Construction	R_NR10	La Trinidad - Masachapa	22.6		■				22.6			MTI	Gov	L=25.0km
Land Transport (Road)	Road Construction	R_NR11	Suina - Bonanza	53.5			■	■			26.8	26.8	MTI	Gov	L=55.0km
Land Transport (Road)	Road Construction	R_NR12	Bonanza - Point C	72.1			■	■			36.1	36.1	MTI	Gov	L=99.0km
Land Transport (Road)	Road Construction	R_NR13	Empalme Puerto Sandino - Lapazcentro	40.7			■	■			20.3	20.3	MTI	Gov	L=15.5km
Land Transport (Road)	Road Construction	R_NR14	Empalme de Telica - Puerto Corinto	77.0			■	■			38.5	38.5	MTI	Gov	L=33.0km
Land Transport (Road)	Improvement (Widening)	R_IW1	NIC-2 Int. - Leon (NIC-12A)	225.8			■	■			112.9	112.9	MTI	Gov	L=87.3km
Land Transport (Road)	Improvement (Widening)	R_IW2	Leon - Chinandega (NIC-12A)	158.1		■				158.1			MTI	Gov	L=57.4km
Land Transport (Road)	Improvement (Widening)	R_IW3	C. Sandino - Mateare (NIC-28)	46.6			■	■			23.3	23.3	MTI	Gov	L=17.8km
Land Transport (Road)	Improvement (Widening)	R_IW4	NIC-12A Int. – Jinotepe (NIC-2)	123.9		■				123.9			MTI	Gov	L=44.0km
Land Transport (Road)	Improvement (Widening)	R_IW5	Jinotepe - Nandaime (NIC-2)	84.4		■				84.4			MTI	Gov	L=36.5km
Land Transport (Road)	Improvement (Widening)	R_IW6	Nandaime - Rivas (NIC-2)	129.1			■	■			64.6	64.6	MTI	Gov	L=51.9km
Land Transport (Road)	Improvement (Widening)	R_IW7	Jean Paul Genie Rd. - Masaya (NIC-4)	116.3			■	■			58.1	58.1	MTI	Gov	L=19.6km
Land Transport (Road)	Improvement (Widening)	R_IW8	Tipitapa – San Isidro (NIC-1)	243.8	■	■	■	■	24.4	24.4	97.5	97.5	MTI	Gov	L=93.3km
Land Transport (Road)	Improvement (Reconstruction)	R_IC1	Boaco - Muy Muy (NIC-9)	25.2	■				25.2				MTI	Gov	L=50.9km
Land Transport (Road)	Improvement (Reconstruction)	R_IC2	Muy Muy - Rio Blanco (NIC-21B)	27.3	■				27.3				MTI	Gov	L=58.5km
Land Transport (Road)	Improvement (Reconstruction)	R_IC3	Rio Blanco - Puerto Cabezas (NIC-21B)	158.4	■	■	■		31.7	31.7	95.1		MTI	Gov	L=315.7km
Land Transport (Road)	Improvement (Reconstruction)	R_IC4	Cosiguina - Potosi (NIC-12B)	5.6		■				5.6			MTI	Gov	L=12.4km
Land Transport (Road)	Improvement (Reconstruction)	R_IC5	Telpaneca - Pueblo Nuevo (NIC-38&51)	23.9		■				23.9			MTI	Gov	L=53.0km
Land Transport (Road)	Improvement (Reconstruction)	R_IC6	Cuyalli – San Rafael Del Norte (NIC-41)	15.2	■				15.2				MTI	Gov	L=36.9km
Land Transport (Road)	Improvement (Reconstruction)	R_IC7	NIC-24B – Ville Las Pilas (NN-270)	5.2		■				5.2			MTI	Gov	L=11.5km
Land Transport (Road)	Improvement (Reconstruction)	R_IC8	El Sauce – Guacucal (NIC-38)	4.4		■				4.4			MTI	Gov	L=10.6km
Land Transport (Road)	Improvement (Reconstruction)	R_IC9	Santa Rosa – Camoapa (NIC-19B1)	12.6		■				12.6			MTI	Gov	L=27.8km
Land Transport (Road)	Improvement (Reconstruction)	R_IC10	La libertad – Santo Tomas (NIC-23A)	10.3		■				10.3			MTI	Gov	L=22.9km
Land Transport (Road)	Improvement (Reconstruction)	R_IC11	Esquipulas – La Concepcion (NIC-20B1)	6.6		■				6.6			MTI	Gov	L=18.8km
Land Transport (Road)	Improvement (Reconstruction)	R_IC12	Masaya - Zambrano (NIC-27)	11.6		■				11.6			MTI	Gov	L=25.0km
Land Transport (Road)	Improvement (Reconstruction)	R_IC13	El Rosaria – La Conquista (NIC-20C)	5.6	■				5.6				MTI	Gov	L=13.5km
Land Transport (Road)	Improvement (Reconstruction)	R_IC14	Boom Siril – Waspan (NN-73)	52.0		■				52.0			MTI	Gov	L=115.0km
Land Transport (Road)	Improvement (Reconstruction)	R_IC15	Rivaz - Tola (NIC-62)	5.5	■				5.5				MTI	Gov	L=13.2km
Land Transport (Road)	Improvement (Reconstruction)	R_IC16	Peripheral road Ometepe Island (NIC-64)	18.1		■				18.1			MTI	Gov	L=40.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR1	Granada - Tecolostote (NIC-39)	47.8	■	■			23.9	23.9			MTI	Gov	L=54.3km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR2	La Gateada - Nueva Guinea (NIC-71)	50.3			■	■			25.2	25.2	MTI	Gov	L=58.5km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR2-1	Nueva Guinea - Bluefields (NIC-71)	68.4		■				68.4			MTI	Gov	L=77.2km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR3	El Rama-Kukra Hills-Laguna de Perlas	39.1		■				39.1			MTI	Gov	L=71.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR4	Santa Domingo - El Ayote (NIC23B)	31.6		■				31.6			MTI	Gov	L=53.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR5	Las Esparanza - El Tortuguero	48.7			■	■			24.4	24.4	MTI	Gov	L=85.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR6	Rio Blanco - San Pedro del Norte (NIC-13C)	39.9		■				39.9			MTI	Gov	L=71.5km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR7	El Elpalme - Alamikamba (NN-288)	24.8			■	■			12.4	12.4	MTI	Gov	L=34.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR8	Int. of NIC-24B- End of NIC 54 (Various)	134.0		■	■	■		26.8	53.6	53.6	MTI	Gov	L=175.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR8-1	NIC 54&Int. of NIC-21B (NIC-57,54&5)	134.0		■	■	■		26.8	53.6	53.6	MTI	Gov	L=175.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR9	Malpaisillo - Villa 15 de Julio (NIC68/NN252)	80.6		■				80.6			MTI	Gov	L=34.0km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR10	Lapazcentro - Malpaisillo (NIC-22)	86.9		■				86.9			MTI	Gov	L=36.4km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR11	Empalme San Ramon - Matiguas (NIC-33)	36.7		■				36.7			MTI	Gov	L=62.2km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR12	Pajaro Negro - El Triunfo (NN-114)	35.3		■				35.3			MTI	Gov	L=41.2km
Land Transport (Road)	Rehabilitation (Re-classification)	R_IR13	El Empalme – San Jacinto (NIC-70A)	53.8		■				53.8			MTI	Gov	L=61.1km
Land Transport (Road)	Improvement (MTI Program)	R_IR	Basic network of 4,372 km out of 8,500km	1824.4	■	■	■	■	18.2	18.2	36.5	1,751.4	MTI	Gov	L=4372.0km

Source: JICA Study Team

Table 23.1.3 Staging Plan No. 2

Sector	Group	Code	Project Name	Cost (million	Implementing Schedule				Implementing Schedule of Cost (US$ million)				Executing Agency	Investment Mode	Project Configuration
					2014-2018	2019-2023	2024-2033	2034-	2014-2018	2019-2023	2024-2033	2034-			
Land Transport (Road)	New Bridge (on proposed road)	R_NB1	Mahogony River	1.51			■	■			0.8	0.8	MTI	Gov	L=50m
Land Transport (Road)	New Bridge (on proposed road)	R_NB2	El Rama River	12.04			■	■			6.0	6.0	MTI	Gov	L=200m
Land Transport (Road)	New Bridge (on proposed road)	R_NB3	Nawawas River	1.34		■				1.3			MTI	Gov	L=60m
Land Transport (Road)	New Bridge (on proposed road)	R_NB4	Waspedo River	1.21			■	■			0.6	0.6	MTI	Gov	L=40m
Land Transport (Road)	New Bridge (on proposed road)	R_NB5	Kurinwas River	1.51			■	■			0.8	0.8	MTI	Gov	L=50m
Land Transport (Road)	New Bridge (on proposed road)	R_NB6	N/A	0.95			■	■			0.5	0.5	MTI	Gov	L=35m
Land Transport (Road)	New Bridge (on proposed road)	R_NB7	Grande de Matagalpa	1.65			■	■			0.8	0.8	MTI	Gov	L=75m
Land Transport (Road)	New Bridge (on proposed road)	R_NB8	Makantaka (Rio Grande)	9.94			■	■			5.0	5.0	MTI	Gov	L=150m
Land Transport (Road)	New Bridge (on proposed road)	R_NB9	Kuanwatla	0.82			■	■			0.4	0.4	MTI	Gov	L=30m
Land Transport (Road)	New Bridge (on proposed road)	R_NB10	Alamikamba (Rio Prinzapolka)	8.81			■	■			4.4	4.4	MTI	Gov	L=120m
Land Transport (Road)	New Bridge (on proposed road)	R_NB11	Frio River	1.32			■	■			0.7	0.7	MTI	Gov	L=60m
Land Transport (Road)	New Bridge (on proposed road)	R_NB12	Zapote River	1.32			■	■			0.7	0.7	MTI	Gov	L=60m
Land Transport (Road)	New Bridge (on proposed road)	R_NB13	Guacalito River	1.09			■	■			0.5	0.5	MTI	Gov	L=40m
Land Transport (Road)	New Bridge (on proposed road)	R_NB14	Colon	1.09			■	■			0.5	0.5	MTI	Gov	L=40m
Land Transport (Road)	New Bridge (on proposed road)	R_NB15	Brito River	0.95			■	■			0.5	0.5	MTI	Gov	L=35m
Land Transport (Road)	New Bridge (on proposed road)	R_NB16	El Tular River	0.82			■	■			0.4	0.4	MTI	Gov	L=30m
Land Transport (Road)	New Bridge (on proposed road)	R_NB17	Tecolapa River	0.87			■	■			0.4	0.4	MTI	Gov	L=32m
Land Transport (Road)	New Bridge (Missing link)	R_BM1	Puente El Tamarindo	1.70		■				1.7			MTI	Gov	L=100m
Land Transport (Road)	New Bridge (Missing link)	R_BM2	Puente Baquas	1.01	■				1.0				MTI	Gov	L=37m
Land Transport (Road)	New Bridge (Missing link)	R_BM3	Puente Wawa River	6.33		■				6.3			MTI	Gov	L=155m
Land Transport (Road)	New Bridge (Missing link)	R_BM4	Puente Malacatoya River	1.67	■				1.7				MTI	Gov	L=75m
Land Transport (Road)	New Bridge (Missing link)	R_BM5	El Paso de Panaloya	18.06	■				18.1				MTI	Gov	L=300m
Land Transport (Road)	New Bridge (Missing link)	R_BM6	Puente Tecolostote #2 (El Papayal)	1.69			■				1.7		MTI	Gov	L=100m
Land Transport (Road)	New Bridge (Missing link)	R_BM7	Wiwili	14.90		■				14.9			MTI	Gov	L=250m
Land Transport (Road)	New Bridge (Missing link)	R_BM8	Puente Rio Abajo	1.21			■				1.2		MTI	Gov	L=40m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT1	Puente San Judas	0.756				■				0.8	MTI	Gov	L=25m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT2	Puente Santa Rosa Del Penon	1.39				■				1.4	MTI	Gov	L=51m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT3	Puente La Potranca	1.23				■				1.2	MTI	Gov	L=40m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT4	Puente Sunsin No.2	1.21				■				1.2	MTI	Gov	L=37m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT5	Puente Rio Luku	1.01		■				1.0			MTI	Gov	L=31m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT6	Puente Rio Labu	4.20		■				4.2			MTI	Gov	L=90m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT7	Puente Pasle	1.06				■				1.1	MTI	Gov	L=35m
Land Transport (Road)	Bridge Replacement (Temporary)	R_BT8	Puente Rio El Cua (La Maroanosa)	1.65				■				1.7	MTI	Gov	L=75m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD1	Puente Wani	6.15			■				6.1		MTI	Gov	L=141m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD2	Puente El Tuma (Mulukuku)	7.76	■				7.8				MTI	Gov	L=175m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD3	Puente Prinzapolka	3.97		■				4.0			MTI	Gov	L=93m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD4	Puente Banacruz	1.43		■				1.4			MTI	Gov	L=45m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD5	Puente Paso Real (Esteli)	1.80		■				1.8			MTI	Gov	L=75m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD6	Puente Rio Zinica	1.34			■	■			0.7	0.7	MTI	Gov	L=41m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD7	Puente San Pablo	1.18			■	■			0.6	0.6	MTI	Gov	L=36m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD8	Puente La Esperanza	14.99	■				15.0				MTI	Gov	L=234m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD9	Puente Cuisala	2.33		■				2.3			MTI	Gov	L=50m
Land Transport (Road)	Bridge Replacement (Damaged)	R_BD10	Puente Rosa Grande	1.57			■	■			0.8	0.8	MTI	Gov	L=48m
Land Transport (Road)	Maintenance Program	R_MR	Maintenance of entire basic network	2,506.9	■	■	■		501.4	501.4	1,504.1		FOMAV	Gov	L=9293.0km
Land Transport (Road)	Disaster Mitigation Program	R_DM	Provision and replacement of infrastructure against disaster	30.5	■	■			15.3	15.3			MTI	Gov	
Land Transport (Bus)	Bus Fleet	B_FL	Big Capacity Bus for Inter-Urban Bus route	103.4	■	■	■		72.4	20.7	10.3		MTI	PPP	1124 Bus Fleet
Land Transport (Bus)	Bus Terminal	B_TB	Big Size of Bus Terminal	2.46	■	■			1.2	1.2			MTI	PPP	3
Land Transport (Bus)	Bus Terminal	B_TM	Middle Size of Bus Terminal	7.81	■	■			3.9	3.9			MTI	PPP	11
Land Transport (Bus)	Bus Terminal	B_TS	Small Size of Bus Terminal	1.68	■	■			0.8	0.8			MTI	PPP	3
Land Transport (Bus)	Roadside Station	B_RS	Roadside Station	4.2	■	■			2.1	2.1			MTI	PPP	7
Land Transport (Bus)	Bus Inspection Workshop	B_IN	Bus Inspection Workshop	18.6	■				18.6				MTI	PPP	1

Source: JICA Study Team

Table 23.1.4 Staging Plan No. 3

Sector	Group	Code	Project Name	Cost (million	Implementing Schedule				Implementing Schedule of Cost (US$ million)				Executing Agency	Investment Mode	Project Configuration
					2014-2018	2019-2023	2024-2033	2034-	2014-2018	2019-2023	2024-2033	2034-			
Maritime Transport Sector	Sea Port Development	W_EP_1	Expansion of Puerto Corinto	58.0					29.0	29.0			EPN	PPP	1 berth 230 m Container
Maritime Transport Sector	Sea Port Development	W_NP_1	Construction of New Bluefields Port	273.2					136.6	136.6			EPN	PPP	2 berth 230 m, - 12.0m, Channel 12.9km. Land-lord type contract with selected concessionaire for
Maritime Transport Sector	Sea Port Development	W_EP1	Expansion of Bilwi Port	50.0					25.0	25.0			EPN	PPP	1 berth 480 m concrete
Water Transport Sector	Waterway	W_IW1	Inland Water Way along Atlantic Coast	16.5					1.7	1.7	3.3	9.9	MTI	Gov	15 sections, Width 10m
Water Transport Sector	Waterway	W_IW2	Maintenance of Inland Water Way	10.0					1.0	1.0	2.0	6.0	MTI	Gov	
Water Transport Sector	Waterway	W_NW1	Channel Dredging Fleet	8.0					4.0	4.0			MTI	Gov	Purchase of barge mounted
Water Transport Sector	Passenger Docs	W_NW2	Passenger Boats for Public Water Transport Services in RAAN	4.0					2.0	2.0			MTI	Gov	Accommodation: 30-40 passengers, catamaran type
Water Transport Sector	Passenger Docs	W_NW3	Passenger Boats for Public Water Transport Services in RAAS	4.0					2.0	2.0			MTI	Gov	Accommodation: 30-40 passengers, catamaran type
Water Transport Sector	Passenger Docs	W_NW4	Improvement of River and Lake Ports	15.0					7.5	7.5			MTI	Gov	For enhancement of
Aviation Sector	A. C. Sandino International Airport	A_ER_1	Runway Extension of A. C. Sandino	46.0						31.3	10.1		EAAI	Gov	Up to 3,100 for A310
Aviation Sector	A. C. Sandino International Airport	A_ET_1	Expansion of Existing International Passenger Terminal	40.0						27.2	8.8		EAAI	PPP	
Aviation Sector	A. C. Sandino International Airport	A_RT_1	Rehabilitation of Existing Domestic Passenger Terminal	30.0						20.4	6.6		EAAI	PPP	
Aviation Sector	A. C. Sandino International Airport	A_NT_1	Construction of New Passenger Terminal at South Side	70.0						47.6	15.4		EAAI	PPP	Acquisition of land at south side is its
Aviation Sector	A. C. Sandino International Airport	A_NA_1	Construction of New Apron and Taxiway at South Side	30.0						20.4	6.6		EAAI	Gov	Acquisition of land at south side is its
Aviation Sector	A. C. Sandino International Airport	A_NC_1	Construction of New Cargo Terminal Building at South Side	30.0						20.4	6.6		EAAI	PPP	Acquisition of land at south side is its
Aviation Sector	A. C. Sandino International Airport	A_EA_1	Expansion of Apron for Cargo Terminal at South Side	40.0						27.2	8.8		EAAI	Gov	Acquisition of land at south side is its
Aviation Sector	Bluefield Airport	A_RR_1	Rehabilitation of Runway Pavement	5.0						3.2	1.9		EAAI	Gov	
Aviation Sector	Bluefield Airport	A_ER_2	Expansion of Runway Strip	5.0						3.2	1.9		EAAI	Gov	Extension: 300m
Aviation Sector	Bluefield Airport	A_NF_1	Construction of New Fuel Yard	2.0						1.3	0.7		EAAI	Gov	
Aviation Sector	Bluefield Airport	A_NT_2	Construction of New Passenger Terminal at North Side	5.0						3.2	1.9		EAAI	PPP	
Aviation Sector	Bluefield Airport	A_NA_2	Construction of New Apron at North Side	5.0						3.2	1.9		EAAI	Gov	
Aviation Sector	Bluefield Airport	A_ER_3	Extension of Runway	5.0						3.2	1.9		EAAI	Gov	Largest aircraft: B737
Aviation Sector	Bluefield Airport	A_NC_2	Construction of New Cargo Terminal at South Side	3.0						1.9	1.1		EAAI	PPP	
Aviation Sector	Bluefield Airport	A_NA_3	Construction of New Apron at South Side	5.0						3.2	1.9		EAAI	Gov	
Aviation Sector	Bilwi Airport	A_NT_3	Construction of New Passenger Terminal	4.0						2.0	2.0		EAAI	PPP	Plan and design completed
Aviation Sector	Bilwi Airport	A_NF_3	Construction of New Fuel Yard	3.0						1.5	1.5		EAAI	Gov	
Aviation Sector	Bilwi Airport	A_NC_2	Construction of New Cargo Terminal	3.0						1.5	1.5		EAAI	PPP	
Aviation Sector	Bilwi Airport	A_EA_2	Extension of Runway	10.0						5.0	5.0		EAAI	Gov	
Aviation Sector	Corn Island Airport	A_RR_2	Rehabilitation of Runway Pavement	5.0						2.5	2.5		EAAI	Gov	
Aviation Sector	Corn Island Airport	A_NF_4	Installation of Airfield Lighting System	1.0						0.5	0.5		EAAI	Gov	
Aviation Sector	Corn Island Airport	A_NF_5	Installation of New Fence	1.0						0.5	0.5		EAAI	Gov	
Aviation Sector	Corn Island Airport	A_NF_6	Construction of New Control Tower	3.0						1.5	1.5		EAAI	Gov	
Aviation Sector	Corn Island Airport	A_ER_3	Expansion of Runway Strip	10.0						5.0	5.0		EAAI	Gov	
Logistic Sector	Cross Border Point	F_IC_1	Cross-border Trade Facility of Guasaule CBP	10.0						5.0	5.0		DGA /	Gov	
Logistic Sector	Cross Border Point	F_IC_2	Cross-border Trade Facility of El Espinio CBP	2.0							2.0		DGA /	Gov	
Logistic Sector	Cross Border Point	F_IC_3	Cross-border Trade Facility of Las Manos CBP	2.0							2.0		DGA /	Gov	
Logistic Sector	Cross Border Point	F_IC_4	Cross-border Trade Facility of Penas Blancas CBP	10.0						5.0	5.0		DGA /	Gov	
Logistic Sector	Cross Border Point	F_IC_5	Cross-border Trade Facility of San Pancho CBP	10.0							10.0		DGA /	Gov	
Logistic Sector	Logistic Park	F_NL_1	Managua East Logistic Park	5.0						2.5	2.5		MTI	PPP	Infrastructure is to be developed by the public sector and the land parcels are rented out to the
Logistic Sector	Logistic Park	F_NL_2	Managua West Logistic Park	5.0						2.5	2.5		MTI	PPP	
Logistic Sector	Logistic Park	F_NL_3	Chinandega Logistic Park	5.0							5.0		MTI	PPP	
Logistic Sector	Logistic Park	F_NL_4	Bluefields Logistic Park	5.0							5.0		MTI	PPP	
Logistic Sector	Agro Processing Estate	F_NA_1	Chinandega Agro-processing Estate	4.4						4.4			MAGFOR	PPP	Infrastructure (Land, utilities, solid and liquid waste treatment units, etc.) is to be developed by the public sector and the land
Logistic Sector	Agro Processing Estate	F_NA_2	Matagalpa Agro-processing Estate	4.4					2.2	2.2			MAGFOR	PPP	
Logistic Sector	Agro Processing Estate	F_NA_3	Juigalpa Agro-processing Estate	4.4					2.2	2.2			MAGFOR	PPP	
Logistic Sector	Agro Processing Estate	F_NA_4	Nueva Guinea Agro-processing Estate	4.4					2.2	2.2			MAGFOR	PPP	
Logistic Sector	Agro Processing Estate	F_NA_5	Cold Storage at Bilwi	4.0					4.0				MAGFOR	PPP	

Source: JICA Study Team

23.2 Roadmap for Public Private Partnership (PPP) for Public Infrastructure Development

23.2.1 Needs for Private Finance for Public Infrastructure

Possible public investment fund (or budget) was estimated in Section 22.1. Three scenarios were studied and estimated as follows;

Table 23.2.1 Possible Public Investment Fund And Required Investment

Sector	Scenario	Possible Public Investment up to 2033 (Million US$)	Required Investment up to 2033 (Million S$)
Road, Land and Water Transport Sector	1	7,358.5	8,080
	2	5,328.9	
	3	4,622.4	
Maritime, Aviation and Logistics Sector	1	196.0	746
	2	196.0	
	3	196.0	

Source: JICA Study Team

For the road, land and water transport sector, under Scenario 1, the estimated public investment cannot cover required investment which means that the Government has to defer implementation of some projects or seek other source of fund such as the private financing for public investment.

For the maritime, aviation and logistics sector, the estimated possible public investment amount is only ¼ of the required investment. Therefore, the private financing for this sector should be seriously seeked. It is easy to say to introduce the private financing for the public infrastructure, but quite difficult in reality and legal, institutional and procedural arrangements etc. must be made prior to the implementation of public projects by a PPP modality.

23.2.2 Definition and Objectives of PPP

(1) Definition of PPP

The term **"Public-Private Partnership (PPP)"** describes a range of possible relationship among public and private entities in the context of infrastructure and other services. (Source: The Public-Private Partnership Handbook (2008, ADB))

(2) Objectives of PPP

1) Mobilization of Private Capital

- To deliver required public service to people as early as possible by mobilizing private capital, and to reduce the public sector's financial burden.
- The need of the private sector in entering into a PPP is to seek compensation of its services through fees for service, rendered, resulting in an appropriate return on capital.

2) Tool for Greater Efficiency

- The public sector has rather few incentives for efficiency structures into its organization and process and is rather poorly positioned to efficiently build and operate infrastructure.
- The private sector, however, enters into an investment with the clear goals of maximizing profits by increased efficiency in investment and operations with full utilization of the private sector's know-how and skills.

3) Faster Implementation

- The allocation of design and construction responsibility to the private sector, combined with payments linked to the availability of a service, provides significant incentives for private sector to deliver capital projects within shorter construction timeframes.

4) Reduced Whole Life Costs

- PPP Projects which require operational and maintenance service provision provide the private sector with strong incentives to minimize costs over the whole life of a project, something that is inherently difficult to achieve within the constraints of traditional public sector budgeting.

(3) Image of PPP Structure

Image of PPP structure for revenue (income) generating projects is shown in Figure 23.2.1. When a project can generate higher revenue, majority of a project can be done by a private sector and involvement of the public sector can be minimal.

On the other hand, when a project can generate less revenue, majority of responsibility of a project needs to be shouldered by the private sector.

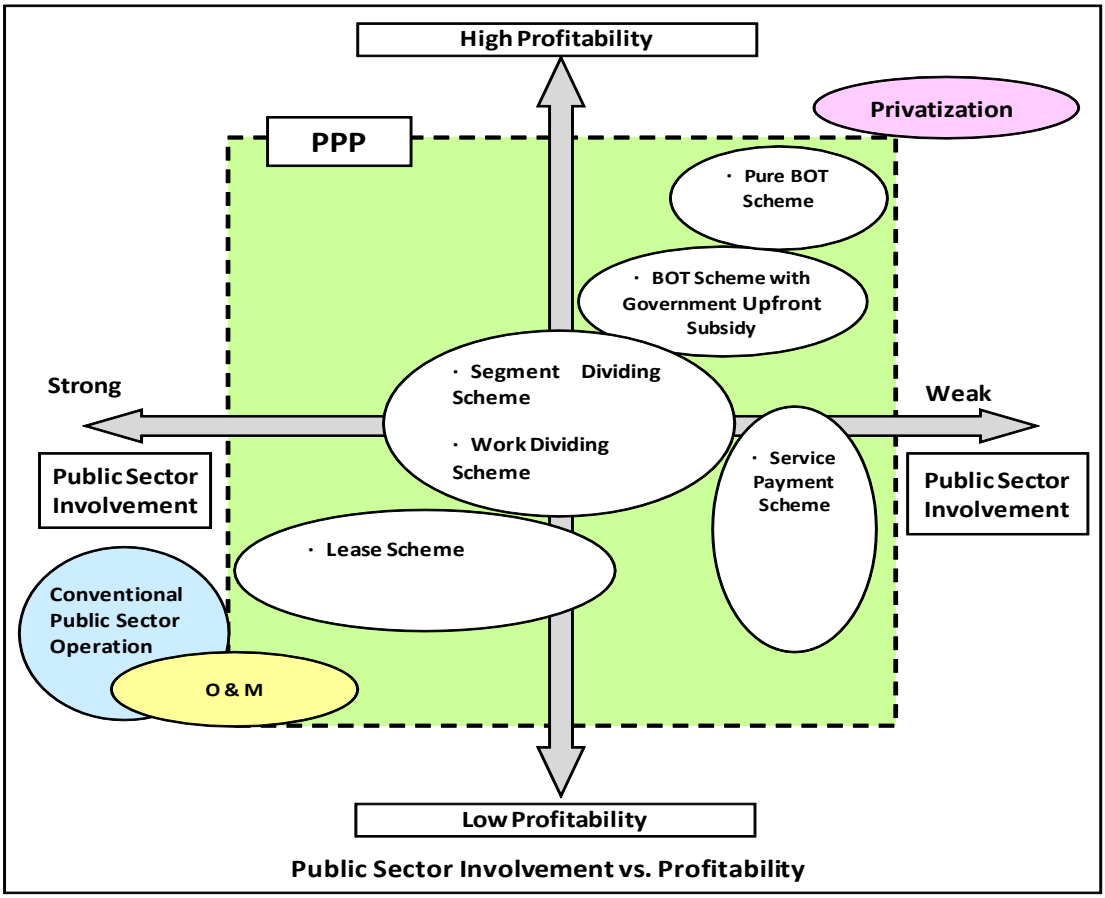


Figure 23.2.1 Image of PPP Structure
Source: JICA Study Team

23.2.3 PPP Modalities

(1) Revenue Generating Projects

The following projects can generate revenues as shown in Table 23.2.2.

Table 23.2.2 Revenue Generating Projects

Project	Sources of Revenue
Toll Road Project	• Toll Fee • Service Area Operation • Others
Port Project	• Cargo Handling Charge • Berth Charge • Others

Project	Sources of Revenue
Airport Project	• Landing Fee • Tenant Fee from restaurants, stores, etc at Terminal Building • Others

Source: JICA Study Team

Some of or all of investment can be recovered by revenues, therefore, there are high chances for the private sector to invest the project and recover all or some of its investment. When a private sector cannot recover all of its investment, the public sector can provide government's subsidy/Viability Gap Financing (VGF).

There are many kinds of PPP modalities or arrangements between the public and the private sectors in order for the private sector investment to be financially viable.

The Government's financial support for the private sector can be minimal when a project is highly profitable. On the other hand, when a project is less profitable, higher financial support of the Government is required in order for the private sector can be minimal when a project is less profitable, higher financial support of the Government is required in order for the private sector to recover its investment.

Typical PPP modalities are shown in Table 23.2.3.

Table 23.2.3 Typical PPP Modalities

	Responsibility	
	Public	**Private**
Type-1: Pure BOT Type	• Right-of-Way Acquisition	• Design, construction and O & M • Financing of above • Investments will be recovered by revenue of a project.
Type-2: BOT Type with Government's Subsidy/ Viability Gap Financing	• Right-of-Way Acquisition • Provide up-front subsidy/VGF	• Design, construction and O & M • Financing of above with Government's subsidy/VGF • Investment will be recovered by revenue of a project.
Type-3: Construction Work sharing Type between the Public and the Private	• Right-of-Way Acquisition • Design and Construction of the Government responsible portion of a Project • Portion constructed by the Government will be leased to the Private sector at agreed lease fee which varies from 0 to 100% of Government expenditure.	• Design and construction of the private sector responsible portion. • O & M of a total project. • Financing of above. • The private sector pays agreed lease fee of the Government constructed portion to the Government. • Investment and lease fee will be recovered from revenue of a total project.
Type-4: Service Payment Type	• Right-of-Way Acquisition. • During O & M period, the Government will pay service fee to the private sector, provided that agreed service level is attained by the private sector. • Revenue collected by a private sector usually turns over to the Government. • When revenue is not enough to pay service fee, the Government adds subsidy.	• Design, construction and O & M • Financing of above. • Receive service fee from the Government to recover investment.
Type-5: O & M Type	• Right-of-Way Acquisition • Design and Construction	• O & M • The private sector pays lease fee (or agreed amount) to the Government. • Lease fee ranges from 0 to 100% of Government investment.

Source: JICA Study Team

(2) Non-Revenue Generating Projects

The private sector financing for the non-revenue generating projects is also possible. Source of fund of such projects has been purely the national budget. The concept is that a project is initially financed by the private sector, and then the Government pays back to a private sector its investment at an annual installment basis from the national budget. In short, "Build now by a private sector, and then pay later by the Government".

Table 23.2.4 Concept of PP Non-Revenue Generating Project

			Source of Fund	Year											
				1	2	3	4	5	6	7	8	9	10	11	12
Case-1	Implemented by Conventional Way (all by the Government		National Budget	100	100	100	Gover	rntment Investment = 300							
				3-year Implementation: Higher Annual budget must be secured than Case-											
Case-2	Implemented by PPP	Private Sector	Finance a Project	150	150	Private Sector Investment = 300 + Loan Interest + Profit (Public Sector may complete a project in a shorter time)									
		Public Sector	Pay back to the Private (Construction Cost + Interest + Profit) from National Budget			Annual national budget = Private Sector Investment/10 years									
						* Amount of annual national budget required is much less than Case-1									

Source: JICA Study Team

1) Basic Rule of This Type of PPP

- If the private sector proposes to provide the same level of service as the Government, the implementing cost by the private sector must be cheaper than that of the Government at net present value basis.
- If the private sector proposes the same cost as the Government, the private sector must provide better level of service than the Government.

2) Advantages of This Type of PPP

- Since the annual budget allocation for a project under Case-2 is much less than Case-1, budget allocation becomes easier and additional projects will be accommodated in an annual budget, thus the Government can implement more projects and provide better services to the people.

3) Critical Issue on the part of the Private Sector

Under this type of PPP, the Government has to commit and guarantee to the private sector that the Government shall pay an agreed amount to the private sector over the concession period. There is a serious risk that the proposed budget by the Government is not approved by the Parliament. Multi-year budgeting system for this type of PPP projects that needs to be established.

Topics: PPP Experience of Other Latin American Countries in Infrastructure Projects

Brazil, Peru, Chile, Mexico and Colombia have made significant advances in PPP as an instrument for luring private sector's investment to fund infrastructure projects. These countries had launched several successful projects as diverse as port, airport, road, railway, irrigation, energy and even public buildings (e.g. Prison Complex in Minais Gerais). Colombia was the first Latin country to introduce PPP in 1993 in its ports in Cartagena and Santa Marta. Other countries followed but Peru made a distinction for its concession contract for Port of Paita which allows the Government to received more than 100 million USD as a result of the bidding process.

Airport projects financed through PPP have also strong presence of which some notable projects include Santiago International Airport (SCL) and Arturo Merino Benítez International Airport in Chile and the concession for the El Dorado Airport second runway in Colombia. Similarly, Brazil in 2006 achieved a railway project (4th Line of the Metro of Sao Paulo) through collaboration of public and private sectors. World Bank report (2013) noted that the whole project is based in the concession granted by the State of Sao Paulo, for a period of 30 years for maintenance and operation of a 12.8 km stretch of the Yellow Line subway, between Luz and Taboão.

PPP road projects are more common among these countries indicating the prime importance of this sector as well as perhaps easiness of packaging a viable contract. As shown in Table 1, there are many successful projects in road sector with varying type of concession package that can be a useful reference for Nicaragua. Main characteristics of PPP infrastructure projects in these countries are indicated in Table 2.

Table 1. PPP Road Projects in Other Latin American Countries

Country	Concession contracts	Type of concession	Concession Period*	Length (km)*	Infra-structure	Award of contract	Start of works	Amount of Investment (M US$)
Peru	IIRSA Sur	Co-financed	30 years	1,500.0	Greenfield	2005	2006	809.00
	IIRSA Norte	Self-financed	30 years	955.1	Greenfield	2005	2006	200.00
Chile	North Coastal Highway	Co-financed	30 years	42.3	Greenfield	1999	1999	480.00
	Melipilla bypass	Co-financed	30 years	8.7	Greenfield	2003	2003	20.00
Mexico	Monterrey-Cadereyta	Co-financed	30 years	29.5	Brownfield	1998	1998	60.00**
Colombia	Bosa - Granada - Girardot	Co-financed	30 years	125	Brownfield	2004	2004	80.00
	Pereira - La Victoria	Co-financed	16.5 years***	54.5	Brownfield	2004	2004	175.54

Source: Best Practices in Pub-Private Partnerships Financing in Latin America: the role of innovative approaches, World Bank, January 2013

Note 1: * Compiled by the JICA Study Team

Note 2: ** Currency is Mexican Peso

Note 3: *** The term of the concession contract has been estimated at 16.5 years, starting on September 27, 2004, date of signing the certificate of initiation of the contract, although the actual term will end when the expected revenue proposed by the concessionaire is attained. However, in no case may the contract's duration exceed 21 years from the date of signing the certificate of initiation of the contract.

Table 2. Comparative Analysis of Country's PPP

Parameters	Peru	Chile	Mexico	Colombia
1. Experience using PPPs	Short	Medium	Long	Medium
2. Importance of PPPs in public investment	Moderately important	Extremely important	Important	Important
	Growing	Stable	Growing	Stable
3. Transport infrastructure with largest investments	Roads	Roads	Roads	Roads
	Railways	Airports		Railways
	Airports	Urban infrastructure		Airports
		Public equipment		Ports
4. Most projects	Brownfield	Brownfield	Greenfield	Greenfield
			Brownfield	
5. Specific legislation on concessions or PPPs	Yes	Yes	No	No
	Not developed	Special law		
6. Average concession period	Legal maximum 60 years	Legal maximum 50 years	Legal maximum 30 years	Varying periods, anticipated revenue
		Varying periods		
7. Main source of payment	Users	Users	Users	Users
	Public contributions		Shadow tolls	
8. Bidding system	Open (technical and economic requirements)	Open (economic variable)	Open (less public contribution)	Open (economic variable)
9. Demand risk	Transferred to the Government	Reduced in contracts	Reduced in contracts	Reduced in contracts
10. Remuneration based on quality indicators	No	Only for road security	Yes, for shadow tolls	No
11. Financing	National banks	National banks	National banks	National banks
		Capital market	Capital market	
12. Frequency of renegotiations	High	Medium	High	High

Source: Best Practices in Pub-Private Partnerships Financing in Latin America: the role of innovative approaches, World Bank, January 2013

Chapter 24 Institutional and Regulation Plan

24.1 Institutional and Regulation Plan

24.1.1 Transport Policy

One of transportation policies is an "Organized transport institution, regulation and human capacity to enhance transport development (TP4)" as mentioned in Chapter 13. This policy aims to take into account the following directions.

(1) To reinforce the capacity of transport related organization,

(2) To acquire the enough skill and ability in transport sector,

(3) To strengthen the coordination among key players, and

(4) To create the framework for participation of private sector

In accordance with the above, JICA team has planned the basic concept to describe what Ministry of Transport and Infrastructure (MTI) is supposed to be about future transport sector related institution and regulation.

24.1.2 Issues and Current Action in MTI related Institution concern

The transport sectors are administered by MTI. MTI has encompassed and classified as political actor, regulator, go-between and executor to improve all transport sectors based on "National Plan of Human Development (PNDH) " and "Transportation and Infrastructure Strategic Plan of Nicaragua 2007-2011" (SP) . The SP has considered being the heart of the work of an organization and concluded the strength point of MTI organization as follows,

(1) MTI has the legal mandate to run through based on law and decree.

(2) MTI has experience in developing the Strategic Plan in 2007 so that MTI has the response to implement the future National Transportation Plan.

(3) MTI has a diverse group of professionals with experience to perform.

(4) MTI has maintained a smooth and effective communication under government institution.

(5) MTI has capacity for coordination with international donors.

(6) MTI created the public service center.

(7) MTI has a manual analysis and job descriptions for all positions available.

The SP also pointed out some improvements for growth of MTI function. JICA team has identified the issues and summarized the current status of making strategy/policy/plan, capacity of organization/personnel and operating system/equipment in MTI based on SP's conclusions and current interview survey as shown in Table 24.1.1.

Table 24.1.1 Identification of Issue and Current Status

Identification of Issue	Current Action and Status in MTI
[Strategy/Policy/Plan] 1. Policy, planning, capacity and organization are insufficient.	[Strategy/Policy/Plan] ➢ MTI is following the strategic plan based on PNDH and SP 2011. However, still under highly participative process. Coordination intuition is needed.
2. The plan / implementing capacity and organization of a new project are insufficient.	➢ JICA team has observed the budget of a new project is limited.
3. Domestic financial resources are insufficient.	➢ National budget is limited. Infrastructure project is depended on support of international donors.

Identification of Issue	Current Action and Status in MTI
4. Lack of updated methodology for development of investment program.	➢ JICA has been developing the proposed National Transportation Plan.
[Organization/Personnel] 5. Lack of experience in the implementation, monitoring and evaluation of strategic and operation plan	[Organization/Personnel] ➢ MTI has been implementing the National System of Public Investment (SNIP) to monitor this kind of procedure. Facilitation intuition is needed.
6. Institutional plans are not handled as a management tool.	➢ MTI will recruit international consultant to prepare future Strategic Institutional Plan.
7. The specialists about the plan/analysis/inspection of transportation are insufficient.	➢ It is necessary to develop the training course subject to plan/analysis/inspection.
8. Knowledge of concession for public transport is insufficient.	➢ Clause of concession under Law No. 524 is reviewing in MTI. ➢ Law on PPP has been processed. After enactment of this law, MTI should disseminate to staffs how going to apply.
9. Technical unit for disaster management is not established.	➢ Department of Road Management is in charge. Procedure of road disaster is needed to establish based on adequate management.
10. The organization control in a municipality level is too weak and is not operating enough.	➢ It is necessary to establish the inter-ministerial committee to coordinate the development of municipality and MTI regional office.
11. Slow administrative processes.	➢ MTI has been improving the system.
12. Training in the fundamental education level and technical knowledge for staff is not made enough.	➢ MTI is going on the training program supported by World Bank. ➢ It is necessary to develop the own training course for newly admission staffs.
[System/Equipment] 13. There is no optimal access to government information system and internal to MTI.	[System/Equipment] ➢ There are many useful data in MTI. MTI has to manage how to disseminate these data to practical use.
14. Lack of formal channel of communication between organizations of MTI.	➢ It is necessary to establish the inter-ministerial committee to discuss about development plan or other theme in MTI.
15. Deficiency in the maintenance and improvement of computer systems such as Bridge Management System, Application of HDM-4.	➢ There is a training course subject to practical software use funded by World Bank. However, only few staffs obtained knowledge. Those staffs should be trainers for other staffs to disseminate the knowledge.

Source: JICA Study Team

MTI has been recruiting the consultant to prepare the Strategic Institutional Plan (SPI) for the period of 2014-2018. SPI must be based on the definition of operative plans and budgetary programing to reach the aims that are searching with a view to the challenges of the sector in the 21st century.

The expected outputs are to develop the Institutional Diagnosis, Strategic Institutional Plan

2014-2018, Action Plan of Monitoring & Evaluation, and Training Plan and to propose the Organizational Structure necessary for the implementation of this Strategic Plan of MTI and the proposed National Transportation Plan.

24.1.3 Establishment of Transport Coordination Mechanism

24.1.3.1 Strengthening of Capacity Structure

In order to achieve the proposed National Transportation Plan and to improve the issues that of mentioned Table 24.1.1, there are 4 (four) factors to be secured related to institution as described in Figure 24.1.1.

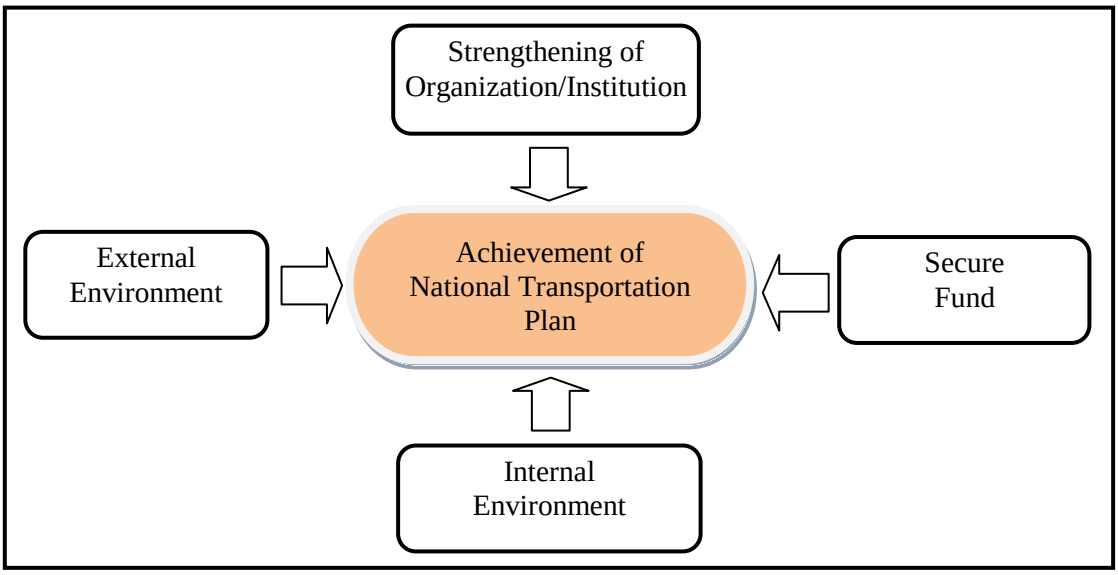


Figure 24.1.1 Strengthening of Capacity Structure
Source: JICA Study Team

(1) Strengthening of Organization/Institution

A key aim for strengthening the organization and institution in MTI should be to increase the effectiveness and efficiency to meet appropriate operational objectives.

1) Establishment of National Transport Implementation Committee,
2) Standardize the project cycle management, which consists of planning, implementation, monitoring and evaluation, and
3) Supporting for the move to privatization

(2) Secure Development Fund

Effective management of organization requires that budget levels are sufficient to keep the core assets in stable condition in the long term.

1) Law no. 574, Special tax (Fuel tax) for existing earmarked fund is sustained or increased,
2) Seeking to have aside from earmarked fund to develop for improvement projects, and
3) Introduction possibility of funding from private sector for execution

(3) Tackling of Internal Environment

Internal factor within the control of MTI can be split into technical and institutional level. Both of them are required the adequate manner.

1) Importance of initiative and ownership of organization,
2) Sharing of awareness of issues among MTI staffs,
3) Establishment of own training course to facilitate the capacity development,
4) Strengthening of coordination between cross-sectorial or inter-ministerial, and

5) Availability of management information such as system for road/bridge inventory and traffic data

(4) Expected External Environment

External factors are those, over which the organization itself has no direct control, but which constrain the way that organization can operate.

1) The proposed National Transport Plan to be approved by National Assembly,
2) Growth of macro economy,
3) Continuous support from international donors, and
4) Aggressive investment from private sector with protection by law

It is difficult for MTI to achieve to meet those factors in short term. However, all of organization concern should unify to tackle the current issues so as to implement the proposed National Transportation Plan accordingly.

The other hand, JICA team has emphasized the participant of private sector in Chapter 24.2 so that MTI and organization concern should improve the following governance standard to avoid the participant from unreasonable investors,-

- To ensure the independence from political intervention and an explicit purpose and role of each private investor as a legal system, as well as determine the accountability from each private investor.
- To consider for government regulatory commitment and transparency of decision making for the promotion of private investment.

24.1.3.2 Proposed National Transport Implementation Committee

There is an adequate institutional system, National System of Public Investment (SNIP) in MTI, which assesses for the projects not only transport sector but also other public sectors to facilitate development program at planning and implementation stage. This system aims to be for administrative agency, interagency coordinator nature of legal advice, and consultation of public investment projects for all of sectors and its institutions. The SNIP is functioning and the annual development plan in the country is determined in accordance with this process.

However, the decision process of formulation of development programs or selection of priority projects before applying this system for transport sector has not been established to ensure an integrated approach internally. In this regards, it is important that once the development programs for each transport sub sector are allocated, approval mechanisms shall provide institutional checks to determine inter-sectorial priorities. The coordination among the ministries must be done before decision of annual program and debated on the matters relating to the integration of all modes of transport on which the sectorial prioritization of investment are based.

Therefore, MTI shall find a suitable approach to establish and manage a national coordination keeping in view of institutional environment and requirements of trade and transport facilitation.

It is proposed that the National Transport Implementation Committee (the Committee) shall be established to remedy transport system and to deal with efficiency projects based on the proposed National Transportation Plan. The Committee shall discuss and evaluate subjects concerning national transport and advise the results after the discussions. The Committee would also convey the results to MTI concerned to take action. The Committee shall be headed by the Minister of MTI and comprised of representatives from all authorities concerned and key players from industry and academia, such as professor and representative of business community and bus association.

The Proposed Committee performance is summarized the following manners:

Table 24.1.2 Function of National Transport Implementation Committee

Purpose/Objective	➢ Development and acceleration of transport network ➢ Implementation, monitoring and assessment of proposed National Transportation Plan ➢ Strengthening of the coordination of traffic modes ➢ Harmonization of cross-discussion of the organization
Duty and Responsibility	➢ To study the strategy and policy to ensure proper coordination in the facilitation of all modes of transport ➢ To study, review comment and propose all laws and regulation on transport issues ➢ To supervise and encourage transport operators for modernization of transport fleets and introduction of advanced information technology ➢ To coordinate with all relevant organizations both domestic and abroad for collecting and sharing information/best practices ➢ To seek assistance or possible funding from international donors and private sector ➢ To closely cooperate and coordinate with the regional transport committees to reach common requirements on identification of regulations and harmonized documentations
Member	Chairman: Ministry of MTI Member: Vice Minister of MTI Director General of MTI Representative of Ministry of Finance and Public Credit Representative of Ministry of Energy and Mine Representative of National Port Authority Representative of Ministry of Industry and Commerce Representative of INAC Representative of Traffic Police Representative of RAAN Representative of RAAS Professor from UNI and UCA Representative of bus association Representative of COSEP
Frequency	4 times a year

Source: JICA Study Team

24.1.3.3 Proposed Coordination and Research Section

In order to sustain and facilitate the Committee, the contact office is to provide as a secretariat to support to the Committee under MTI organization. This section shall be in charge not only recording the discussion of the Committee but also carrying out research and development to provide technical support to the Committee. This section supposes to have three main functional tasks;

- Coordination: Focus on requirement, monitoring and analyzing of the domestic and bilateral or multi-lateral projects. This section shall mainly analyze the public investment fund on transport sector based on comparison between investment budget and project cost annually.
- Research: Focus on the research and analyses of the issues and needs of transport development.
- Information: Focus on the collection and dissemination of information and the establishment of a data bank in which all transport and road traffic related statistics. The data bank shall also keep all the result of traffic studies conducted by international donors.

24.2 Enhancement of Institutional Capacity for Sub Sector

24.2.1 Institutional Capacity of Road Maintenance Fund

Road maintenance fund (RF) of Nicaragua has adequate road maintenance on firm basis, such as fuel tax (16% per gallon of fuel), with monitoring to ensure efficient use of money accompanied by

annual report. However, this revenue from earmarked fund is lower than planned amount of maintenance works so that it is able to disrupt with the infrastructure development in the future. Technical point of view has been described in Chapter 15 so that this chapter has been noted from the viewpoint of institution and legislation with the validation and review of measures based on the following consideration.

(1) Stability of road fund

RFs continue to be impacted by "budget" allocations, with long elapsed time and large arrears. Revenue from the fuel tax is credited directly into the road fund account, regularly, creating a stable basis for the RFs. It may be too simplistic to assume that RFs will always be inviolate. It is essential to design RFs to maximize the probability that they will not be abused, rather than simply legislation a RF existence. The structural safeguards necessary to provide protection to the RFs require a strong political will. Full commercialization of the road sector would provide a strong barrier to such intervention.

In addition, adequate user representation and transparent dissemination of the activities are required to establish a check-and-balance system to improve accountability in the day-to-day activities. It is important for the RFs to be supported by well established enforcement tools to recover money owed to the RFs.

However, even the institution and management would be functioned, other sources of earmarked fund shall be sought to increase for development use other than national budget referring other countries practice as follows:

- Additional user charge (Part of tires or spare parts cost)
- Road and bridge toll
- Part of vehicle registration and inspection fees
- Part of driving license fee
- Part of fine for traffic violation
- Part of fine for overloaded vehicles
- International border transit fee (Temporary legislation)
- Introduction of Labor-based technology to reduce the construction cost

The other hand, FOMAV has been also planning to start the project for "Financial Sustainability and Institutional Strengthening Study for Maintenance Road Fund" to seek the road fund and management system.

(2) Performance monitoring

One of the requirements of RFs management is to set up arrangements for independent monitoring of performance of RFs and the quantity, quality, and cost of maintenance works. The RFs accounts shall be prepared on a quarterly basis and audited by an independent external auditor for example. Though preparation of audited accounts is a step forward in improving accountability in the use of RFs, the accounts shall be prepared without any explanation in the use of RFs.

Table 24.2.1 is summarized the assessment and indicator of RFs to improve the maintenance system in MTI.

Table 24.2.1 Assessment and Indicator of Road Fund

Strengthening Factor	Organization & Institution	Secure Fund
Expected Outcome	* Establishment of fund management system * Regal framework for seeking other fund * Enhancement of data bank * Training program for technical and administration * Participation system of private sector (Fund & Procurement)	* Management of fuel tax * Seeking the other fund allocation or new earmarked fund * Contractual framework of private sector fund

Strengthening Factor	Organization & Institution	Secure Fund
Viewpoint of Assessment or Indicator	* Justification and management of maintenance budget * Management of data bank * Capacity assessment for maintenance works * Transparency of procurement Procedure	* Monitoring of timely disbursement * Analysis of fund balance sheet * Settlement of complex task for participant of private sector

Source: JICA Study Team

(3) Key Lessons

Even institution and legislation become fulfilled, the available RFs are not sufficient in most countries to fully finance of the entire road network. To ensure efficient distribution of available resources it is imperative to: (i) define a high priority core network; (ii) prioritize the road network not only on the basis of economic return but also social and environmental returns; (iii) focus on maintaining this network in good condition; (iv) set up performance agreements between the fund administration and the executing road agency; (v) develop and implement the technical standards/handbooks with clear documentation of quality and quantity; (vi) create an enabling environment for small scale contractors to participate in road maintenance, such as Labor-based technology; and (vii) develop a road and bridge inventory (or a road data bank) including traffic data and actual road conditions with functional responsibilities system, such as method of HDM-4 and Bridge Management System in MTI.

24.2.2 Institution of Waterway Transport for Inner Coastal Development

In case of developing the water transport for passenger through utilization of canal where is located Plankila (Rio Coco) in RAAN and Bluefields bay in RAAS, organization structure should be prepared and decided to operate with sustainable manner. Prior to considering the organizational structure, MTI shall study the following four patterns of combination for operation structure to manage in this kind of waterway transport.

Table 24.2.2 Operation Pattern of Waterway Management

	Operation Structure	Advantage	Weakness
1	*Direct management by MTI	*Maintaining the quality of service to passengers	*High employment and maintenance costs
2	*Construction of facilities by MTI *Concessionaire to suitable private sector for operation & maintenance	*Reduce financial risk in future	*Necessity of effort to increasing passenger
3	*Fund, know-how and operation by Private *Subsidy or incentive from MTI	*Creation of new industries *Revitalization of the economy	*Necessity of effort to increasing passenger
4	*Full developing by private sector *Business approval and issuance of license by DGTA	*Risk avoidance for earning and operation	*Difficulty of keeping high public services

Source: JICA Study Team

Figure 24.2.1 is described in the recommendable operation structure for waterway transport and Table 24.2.3 is shown in role and responsibility matrix as each organization concern. Although for the legislation and most of facilities provisions are under responsibility of MTI, issuance of license and education are under DGTA. And private sector shall operate and maintain the waterway transport with subsidy or incentive from MTI. Therefore, MTI shall monitor and evaluate their performance regularly. However, in case of extension plan or some other peripheral development would be arisen, MTI shall require the Committee to discuss and obtain the comment.

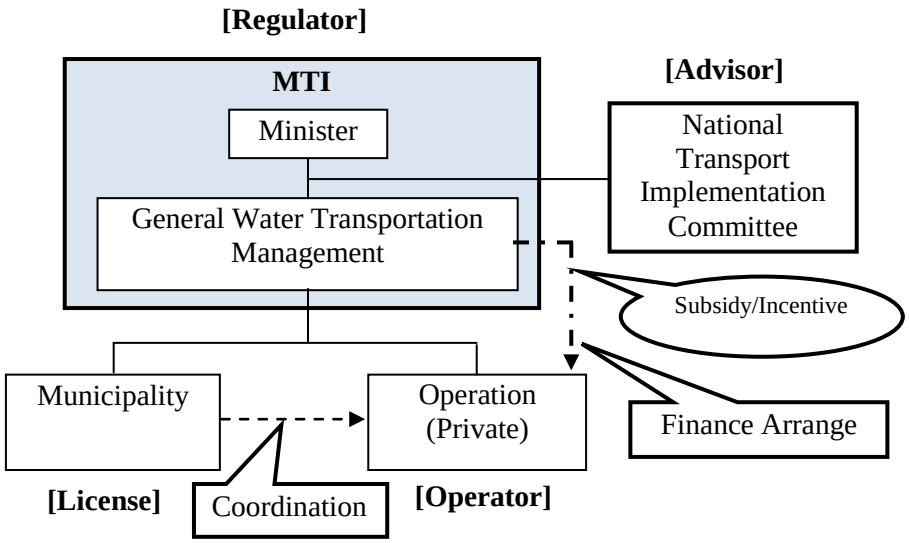


Figure 24.2.1 Operation Structure for Water Transport
Source: JICA Study Team

Table 24.2.3 Role and Responsibility in Water Transport

	Facility	Legislation	License	Operation	Education	Finance	Advise
MTI	R	R	R		(R)	(R)	(R)
Municipality					R		
Private	R			R		R	
Committee							R

R: Responsible (R): Party Responsible

Source: JICA Study Team

24.2.3 Responsible Office for Logistics Administration

24.2.3.1 Introduction

Currently, there have been favorable changes in international trade and logistics, which may greatly contribute to facilitation of movement of people and goods and promotion of investment within Central America Region. One of the changes was the implementation of the Central America customs union and bi-lateral agreements on cross border facilitation which would enhance more efficient and reliable transport connecting Nicaragua with neighbor countries markets and international ports in Pacific Ocean and Caribbean Sea. This will greatly contribute to changes in trade to/from/through Nicaragua by promoting higher mobility of goods and people and investment in the region.

In order to facilitate the growth of freight transport and logistics system, it is important to rethink not only development of infrastructure but also far-reaching reform in the legislative, regulatory, and managerial environment in logistics sector. The formal of policy making, rules of regional and national institution is one of component of strengthening system of logistics sector as mentioned in Chapter 17.

Therefore, related administration authority shall set up and excise the adequate legislation and institution for national level and follow the restrictive agreement under “Sistema de Integración Centroamericana (SICA)” for composing the Central America, accordingly.

24.2.3.2 Establishment of Logistics Office

The proposed National Transportation Plan consists of several projects and programs for relating to logistics sector under the current jurisdiction of concerned agencies. It is of great importance to properly coordinate the various concerned agencies, such as public and private sectors, so as to effectively implement the proposed projects and programs. Thus, the establishment of new national

level of logistics administration office under MTI as regulatory and the Committee as advisor is recommended.

(1) Logistics Office

Logistics office shall be established under MTI to function as regulatory office. It will also act as coordinator for several concerned agencies in the administration of logistics through the following major activities,

- Policy and planning in logistics development,
- Efficiency of cargo distribution,
- Planning on important matters concerning proper facilitation and regulation,
- Coordination of several concerned agent in the administration of logistics, and
- Project planning and implementation in logistics project such as logistics parks.

To carry out the tasks relevant to the above activities, the logistics office shall have at least following 3 sections as shown in Table 24.2.4.

Table 24.2.4 Task in Logistics Office

Section	Task
Planning Section	*Coordination of other agencies concerned with logistics *Master planning in logistics development *Foreign relations such as Cross-border Trade Infrastructure (CBTI) & Cross-border Trade Agreements (CBTA)
Project Section	*Review of plan for logistics parks *Approval of application for projects *Evaluation and monitor the projects
Administration Section	*Financial planning *Procurement and administration to private company *Personnel, accounting and management of office

Source: JICA Study Team

(2) Transport Implementation Committee

As the Committee has been mentioned the duty and responsibility in Table 24.1.2, policy, strategy and implementation of projects for logistics sectors shall be discussed in the Committee. And the Committee shall then convey the results to the logistics office under MTI to take action. Especially, The Committee shall coordinate and monitor the progress in implementing the SICA framework agreements on cross-border transport as well.

24.2.3.3 Enhancement of Institutional Connectivity for Corridor Development

JICA study team has focused the enhancement of institutional connectivity to set up the development of logistic system so as to improve the Cross-border Trade Infrastructure (CBTI) in parallel with the establishment of Cross-border Trade Agreement (CBTA) among composing Central America. The relevant authority is considering the specific integration initiatives related to corridor development. Table 24.2.5 is shown in policy and key activity in accordance with appropriate situation to strengthen the institution for corridor development.

Table 24.2.5 Key Activity for Institutional Connectivity

	Policy	Key Activity
1	Operationalizing the framework agreement on transport facilitation	➢ Improvement of Cross-border Trade Infrastructure (CBTI) in parallel with establishment of Cross-border Trade Agreement (CBTA)
2	Implementation the initiatives to facilitate interstate passenger land transportation	➢ Expedition the implementation of the existing bilateral and regional arrangements ➢ Developing a regional arrangement on facilitation of interstate passenger land transportation
3	Acceleration the free flow of goods in the region by eliminating barriers to merchandise trade	➢ Strengthening the behaviour principle based on Central American Customs Union Framework agreement

	Policy	Key Activity
4	Acceleration the development of an efficient logistics sector	➢ Removal of substantially all restrictions on trade in services for logistics services
5	Substantially improvement trade facilitation and Enhancement the border management capabilities in the region	➢ Developing the implementation of National Single Windows in the region ➢ Synchronising the procedures, formalities and practices in border management and its harmonisation to the extent in the region
6	Strengthening the institutional capacity in lagging areas in the region	➢ Facilitation the flow of technical assistance from the donor to Nicaragua and regional groupings for capacity building

Source: JICA Study Team

24.2.3.4 Attraction of Foreign Investment

Foreign investment is essential for improving of the logistics system, corridor development and enjoying from the significant tax benefits. However, there are still inadequate system, insufficient business know-how and lack of human resources in Nicaragua. JICA team has mentioned the following necessities to facilitate to the foreign investors.

(1) Transparency in market

Market transparency is a prerequisite for foreign investment. Private companies consider the market transparency to be a more important factor than incentives in attracting foreign investment in usual business practice. It is obvious that private companies prefer standardized interpretations of regulations. To achieve this, it is necessary to make great effort in minimizing the loopholes that induce personal discretion in interpretation of regulations as much as possible. However, modifications of regulations or preparation of detailed standardized interpretation and manuals of the regulations will require a long time to complete. In this regard, "Trouble Shooting Office" for foreign investors such as logistics office is a proven approach applied by logistic and agro-processing parks.

(2) Incentives

Incentives system is a popular tool used to attract investment. Several incentives are given to the foreign investors even currently in Nicaragua such as 100% income tax exemption for 10 years, 100% exemption on import taxes for machinery, equipment and raw materials, and others. Since Nicaragua is a latecomer to industrialization among Central America countries, there is a great need for Nicaragua to offer better incentives to compete favorably against them in attracting foreign investment. Nicaragua shall consider variety of incentives from various aspects which can generate a more attractive business environment compared to its competitor's countries. As regards foreign investment in logistics, the following measures and/or incentives are potential tools that could be used;-

- Compliance of Central America customs union Agreement
- Acceptable business in SEZ
- Longer length of income tax free period in the logistics parks or SEZ
- Application of special depreciation
- Favorable work permits for foreigners

Chapter 25 Capacity Development Plan

25.1 Purpose of Capacity Development

25.1.1 Concept of Capacity Development

Capacity Development (CD) refers to the ongoing process of enhancing the problem-solving abilities of organization by taking into account all the factors at the individual, organizational, and social levels. Capacity is defined as the ability of organizations to solve problems on their own. Capacity is not simply transferable and its sustainability is largely dependent on the initiative and ownership of the target organization involved.

For example, effective road development management would not only be limited to the sufficient know-how possessed by MTI and its staff, but also extend to various other elements. These include a role-sharing mechanism that involves the private sector such as contractor, communities such as roadside residents, and the government's department in charge such as an institutional setup that determines the technical standards, as well as the policies that set goals of road development (see Figure 25.1.1).

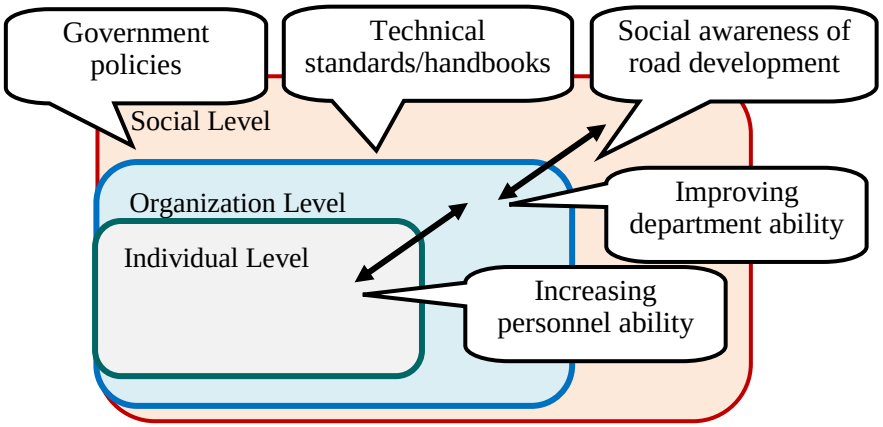


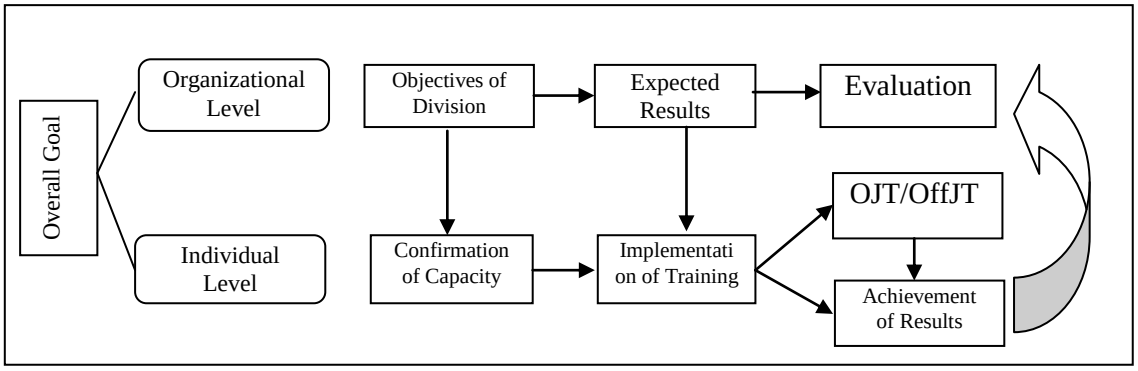
Figure 25.1.1 Concept of Capacity Development
Source: JICA Study Team

The based on the above, MTI shall consider the following concept of basic awareness to each target organization to improve.

- Each organization must be developing capacities by themselves
- Ownership by MTI is vital
- Joint efforts with the participation of each organization in MTI are important
- A long-term commitment is required
- Creating a sustainable mechanism after capacity training course
- Systemic thinking and program approaches
- A flexible approach responsive to the development needs and conditions

25.1.2 Evaluation of Capacity Development

The evaluation of capacity development (CD) is based on measuring the level of achievement of the expected results that the organization establishes. The following flowchart illustrates the institutional and individual approach to conduct the evaluation of CD.



The key of CD is the availability of strategies with institutional, organizational and individual viewpoints in the assistance program and its approaches when the concerned party tries to achieve the expected results.

It is also important to implement activities to achieve the goal by choosing a suitable process with specific indicators. To this end, the MTI must exercise strong leadership and tackle the problems, while the executives must continue to assess the processes.

Regarding to the method of evaluation of CD, it is necessary to refer the "concept of basic awareness to each target organization to improve." shown in the preceding paragraph of 25.1.1 and realize it in both qualitative and quantitative way.

Qualitative Evaluation	Quantitative Evaluation
Availability of training plans to achieve the expected results	Number of people who participated in training
	Comprehension of training content (confirmed by test)
Availability of action plans to achieve the expected results	Number of achieved projects
Existence of management goals (expected results) of the specific institution (division/ section)?	Extending pavement durability, Increase of pavement rate, Reduction of number of traffic accidents (road sector)
	Reduction of transportation costs, Time reduction of customs clearance, Increase of transport volume (logistic sector)
	Increase of frequency of use, increase of transport volume (port and airport sector)

25.1.3 Institutional Capacity of MTI

MTI should operate the institution establishing the overall goal, objectives of each division and the expected results to be achieved through the attainment of the objectives. To achieve the results and strengthen the institutional capacity, it is necessary to grasp the current situation of its capacity. For that purpose, the JICA Study Team consulted with the Department of Human Resources and classified the current capacity. Figure 25.1.2 shows four (4) main factors to improve the institutional capacity in view of individual, organization and social levels. Out of these four factors, “work procedures and work tools” is the most important. Work procedures include technical guidelines / hand books that lead the staffs to actually do the tasks in accordance with prescribed standard procedure. Another important factor of institutional capacity is the enhancement of capacity of staff. The enhancement of individual capacity can be achieved through teamwork in each division and section. However, it is inevitable that individual differences occur according to the academic and professional career, as well as the motivation. Currently in the MTI, there is cross-communication through the training, therefore the institutional flexibility is maintained. However, it will become increasingly necessary to identify the focus and capacity building manner by classifying factors. To this end, it is imperative to develop and implement training plans continuously to minimize the difference in individual capacity.

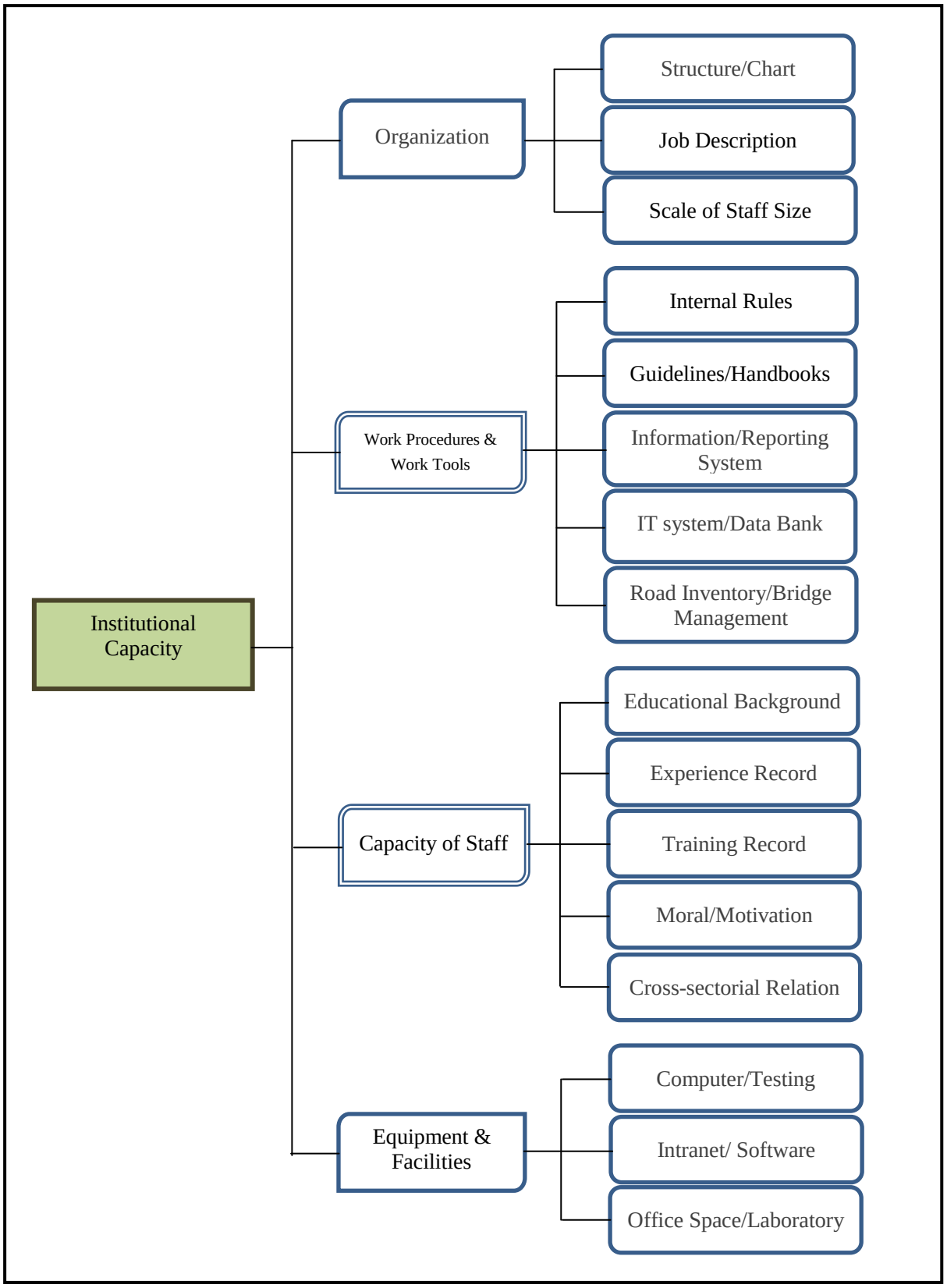


Figure 25.1.2 Factors Influencing Institutional Capacity
Source: JICA Study Team

25.1.4 Capacity Gap Assessment

Capacity gap assessment (CGA) is the starting point and essential part of the CD because it makes apparent the strength and weakness of the organization for which the training program is implemented.

(1) Methodology

One of the most commonly methods for assessing the existing capacity of an organization is to distribute questionnaires to the staffs of the organization and let each staff member evaluate his/her capacity. This method cannot avoid subjective judgment of each staff member but the average of the whole is supposed to indicate the existing situation correctly.

There are 10-20 questions covering the each sector involved in CD of target organization. The following items are shown for example of road sector. MTI shall prepare the questionnaires for each field of work.

1) Road condition survey
2) Design of road maintenance and construction works
3) Technical standards and handbooks
4) Material test
5) Work execution planning
6) Cost estimate
7) Knowledge and skill of inspection for quality control
8) Filing of data/drawings

The questionnaire shall ask two kinds of knowledge;

1) Level of knowledge needed for carrying out his/her duties and
2) Level of knowledge he/she actually possesses.

The level of knowledge is rated in the following 5 levels.

- Level 1: I do not know the subject at all; I have never heard of this word.
- Level 2: I know the subject but do not know what it is; I have heard the word but never learned anything about it.
- Level 3: I know what it is but cannot use in the actual work. I learned about it in school (university) or I have attended seminar/workshop but I have not used it and need some training to be able to use it in daily works.
- Level 4: I have used or referred or kept the subject to carry out the work in the past experience.
- Level 5: I can use the knowledge/skill in the daily works, perfectly and can teach other staffs.

The difference between the above two is considered to be the gap of knowledge for each field of work.

(2) Distribution and Collection of Questionnaire

The questionnaire shall be distributed to persons working in engineering-related departments and administration departments of MTI including regional offices. The date for collection of the filled questionnaire shall be two weeks later normally.

(3) Data Compilation

1) Coding

Human Resources Management office shall involve inputting non-numerical data, organization and position level of each staff member, it is necessary to assign code number for these data.

As for position level, coding numbers of 1 to 5 shall be given to various levels as shown below:

Table 25.1.1 Coding for Position Level

Code No.	MTI	Regional Office
1	Deputy Director, Chief of Office	Director, Deputy Director
2	Deputy Chief	Chief of Office
3	Sr. Engineer	Sr. Engineer
4	Engineer	Engineer
5	Technician	Technician

Source: JICA Study Team

2) Data Compilation and Analysis

Data shall compile in excel data sheets and excel is chosen as the tool for analysis of the data for its suitability.

(4) Analysis after the implementation of CGA

The CGA does clarify the required and existing skill within the capacity that both the organization and the individual possess. However, it is not an omnipotent methodology which makes analysis in an instant, but it is a method of analysis with the advantages and weaknesses (as described in the table below) that can be applied when the training plans are prepared.

Strengths	Weaknesses
Confirmation of individual capacity is possible.	If the training program is prepared according to the level of capacity, automatically it reveals the level of each participant.
It allows reflect the results in planning of training.	Intensive time and effort are needed in the implementation and analysis of CGA.
It can be used as a guide for determining remuneration and promotion.	There are peoples who respond in the contradictory way to the reality.
It can be used as a basis for explaining to acquire the training budget.	Given the large number of persons subject to EBC, there is a possibility that the results of analysis cannot be obtained.
It can serve as a guideline to indicate the next level to reach for each individual.	

25.2 Current practice of Capacity Development Program in MTI

(1) Existing Training Program of MTI

MTI planned the five years training program from 2008 to 2012 and requested to National Assembly in 2007. This program contained the institutional strengthening plan of MTI, which once implemented with the support of financial institutions, will give solution to the problems that are currently present in the institution, primarily the lack of trained staff throughout the process of the project cycle and the lack of equipment necessary for the performance of institutional functions.

MTI in its effort to improve the institutional capacity has raised the challenge of increasing and updating the levels of knowledge of technical staff in several stages. A training program for personnel engaged in the activity of road construction, road and transportation planning will be implemented in its different modalities. Within performance of this training program were proposed to obtain the following master or diploma: transportation engineering, administrative law or transportation planning that come to strengthen the institution professional, assessment and plan design solutions to problems that arise in the daily work of the different areas to which they belong.

Table 25.2.1 Summary of Proposed Training Course of MTI

Training Course	Required Person	Training Course	Required Person
Master of law and regulation of contracts	30	Specialization of hydrology	2
Master of land transport and routes	18	Specialization of structural engineering	6
Master of transportation planning	4	Specialization of topography	6
Graduate of project formation and evaluation	11	Master of pavement design	2
Diploma of project management	2	Master of transport economy	2
Specialization of cost and budget	6	Master of urban legislation	1
Specialization of road design	6	Graduate of project management	13
Specialization of geotechnical	6	Graduate of project audit	6
Specialization of hydraulics	6	Graduate of road works	10
Specialization of pavement	6	Graduate of administration network	1
Specialization of traffic	6	Graduate of functional management	4
		Total	152

Source: JICA Study Team

However, MTI has not performed approximately 80% of this training programs due to funds were limited. MTI has been seeking the training funds which maybe come from mainly external funds to carry out this program even year 2012 were over. JICA Study Team recommended continuing with training courses (see Table 25.2.2).

Table 25.2.2 Actual Performance of Training Course

No	SUBJECT/SOURCES OF FINANCING	CENTER OF STUDY	DURATION	PARTICIPANTS	AREAS (OFFICE)
	2008				
1	MASTER IN TELEMATIC AND NETWORKS	Universidad Iberoamericana de Ciencias y Tecnologìa (UNICIT)	2 YEARS	1	INFORMÀTICA (IT OFFICE)
2	POSTGRADUATE FORMULATION EVALUATION OF PUBLIC INVESTMENT PROJECT (EXTERNAL FUNDS)	Direcciòn General de Inversiòn Pùblica (General Direction of Public Investment)	3 MONTHS	2	ADQ - DGV
3	MASTER IN LAND TRANSPORT/ROUTES (WORLD BANK)	Universidad Nacional de Ingenierìa (UNI)	3½ YEARS	28	DGV,DGP,DGTT, DGNCDU, COERCO, PASTDANIDA, ECONS-3,FOMAV,
	TOTAL			31	
	2009				
4	MASTERS ADMINISTRATION OF CONTRACTS (IDB FUNDS)	Universidad Centroamericana (UCA)	2 YEARS	33	ADQ,DAL,DGV, DGP,DGAF, AUD INT, ECONS-3, COERCO,EICMEP
	TOTAL			33	
	2010				
5	IT Consulting web page update	Private Consultant	3 MONTHS	7	DS, REL. PUB, INFORMÀTICA
	TOTAL			7	
	2011				
6	POSTGRADUATE FORMULATION, EVALUATION AND ADMINISTRATION OF INVESTMENT PROJECTS WITH EMPHASIS ON TRANSPORTATION INFRASTRUCTURE (WB FUNDS)	Universidad Nacional de Ingenierìa (UNI)	6 MONTHS	14	DGV, DGP, ADQ, UGA, DS, FOMAV.
	TOTAL			14	

Source: JICA Study Team

No	SUBJECT/SOURCES OF FINANCING	CENTER OF STUDY	DURATION	PARTICIPANTS	AREAS (OFFICE)
		2012			
7	POSTGRADUATE QUALITY MANAGERS FORMATION IN THE PUBLIC SECTOR	Ministerio de Hacienda y Cr èdito Pùblico (Ministry of Finance)	3 MONTHS	3	CAPAI, DGV
8	GRADUATE SUSTAINABLE TRANSPORT	Universidad Nacional de Ingenierìa (UNI)	4 MONTHS	6	DGTT
9	INTENSIVE COURSE ON RIGHT OF CONTRACTS	MTI - Private Consultant	6 MONTHS	36	DGTT, DGV, DAL, ADQ, DGTA, RRHH, DGP, DGAF
10	GRADUATE IN RIGID PAVEMENT	Tecnologico de Monterrey	10 MONTHS	2	DGP, DGNCDU
11	COURSE IN ASPHALT PAVEMENT	Tecnologico de Monterrey	10 MONTHS	4	DGV,
	TOTAL			51	
		2013			
12	SPECIAL GRADUATE IN BUSINESS TAXATION	CETAE Academia Tributaria (TAXATION ACADEMY)	3 MONTHS	5	DS, DGAF, DAL, DGV
13	MASTER IN BUSINESS MANAGEMENT AND ADMINISTRATION	Universidad de Chile	20 MONTHS	1	DGV
14	LAW LABOUR/BUSINESS POSTGRADUATE	Universidad politecnica (UPOLI)	2½ MONTHS	1	RRHH
15	ASPHALT MIXTURES TESTING	Tecnologico de Monterrey	2 WEEKS	12	DGNCDU, DGV, COERCO, ADQ, UNAN, FOMAV, UNI, D
16	CONSTRUCTION MATERIALS TESTING	Tecnologico de Monterrey	2 WEEKS	12	DGNCDU, DGV, COERCO, ADQ, UNAN, FOMAV, UNI, D
17	SOIL TESTING	Tecnologico de Monterrey	2 SEMANAS	13	DGNCDU, DGV, COERCO, ADQ, UNAN, FOMAV, UNI, D
18	SECOND INTENSIVE COURSE IN RIGHT OF CONTRACTS	MTI- Private Consultant	6 MONTHS (IN PROCESS)	37	DGV, DAL, ADQ, RRHH, DGP, DGAF, DGNCDU, COERCO, FOMAV, EICMEP, ECONS-3, ENCOSE.
	TOTAL			81	

Source: JICA Study Team

The trainers were professors from university or foreign experts. This arrangement of trainers is very reasonable in the beginning stage of CD. Although it may be better to invite outside trainer(s) depending on the subject and availability of competent outside resource, it is realistic to invite the trainers within the MTI, including affiliated institutions.

(2) Evaluation report prepared by World Bank consultant

The preparation of report was considered in the plan of action of the technical visit conducted in March, 2012. World Bank (WB) has been developing institutional strengthening, which have helped to improve the management of the institution, making rational use of material and human resources with supporting program. These achievements have been realized by strengthening the skills of the staff through the various components referred to in the various Agreements credits. In order to have highly qualified personnel and equipment required to provide better service to the public, in compliance with the provisions of the National Human Development Plan and Strategic Plan of the MTI, this strengthening plan is a necessary continuity to be maintained for the proper development of the projects.

The justification of this evaluation report is that the implementation of the WB program has been contributing to the smooth functioning and operation of the areas involved, with which it aims to achieve the levels of acceptance of outcomes indicators, linked to MTI plans and programs.

(3) Review of Current Training Program

The JICA team has observed this training course and MTI program. Although there are several sessions in this training course where engineering and administration subjects are covered, these sessions are considered to cover general topics of road section, mainly. And WB is supporting not only arrangement of the training course and seminars but also provision of some equipment including office use and testing materials as well.

From those described above, the followings may be concluded:

1) The training course of MTI is designed for upgrading the capacity of MTI staff as government officials.
2) Trainees seem to be obtaining the certification of training course personally. Trainees should disseminate the knowledge to other colleague in his/her management office.

3) WB program covered the general knowledge of capacity but is not sustained to the future. Because fund and duration of support is limited.
4) Therefore, it is recommended that the training plan specifically should design for MTI original, especially trainers have to be MTI management and implement in a sustainable manner.
5) The transportation sub sector should be also designed other than road sector.

25.3 Proposal of Training Plan

Effective and efficient training is essential when capacity strengthening of an organization is intended. A preliminary training plan has been prepared based on the discussions between the relevant officials of MTI and workshop conducted by JICA team as well as the result of the review of the current status of existing training of MTI. This proposal of training plan shows content of training course, objective, outcome, and target organization but does not show details of implementation of the training courses. The details of training courses are discussed and decided by MTI management based on conducting of capacity gap assessment.

(1) Method of Improving One's Capacity

When someone hears the word 'training', he/she may think of a training event delivered to a group of people who are allowed to leave their daily work place (called 'group training). However, there are various ways to improve one's capacity. Methods of improving one's capacity are usually categorized those as shown in Figure 25.3.1. These methods are explained below:

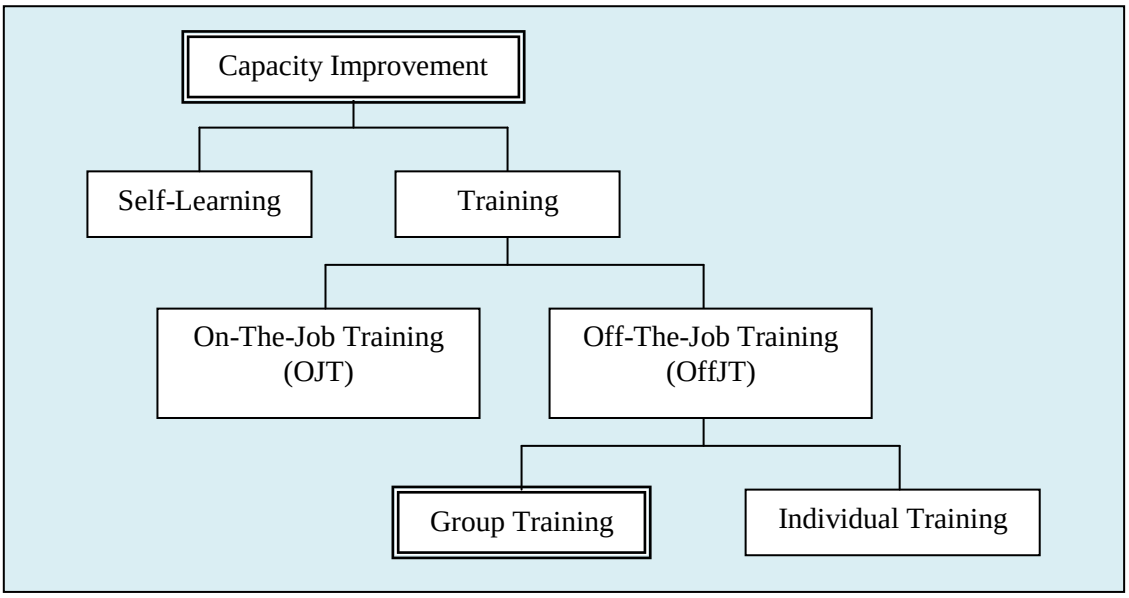


Figure 25.3.1 Methods of Capacity Improvement
Source: JICA Study Team

1) Self-Learning (Self-Development)

An organization generally establish management goals (expected results) and give a periodical training to their staff. However, it is also necessary that each individual make efforts to overcome their weakness that is identified in CGA and strengthen their capacity not only relaying on the training provided by the organization. The key to strengthen the individual capacity lies in recognizing the importance of self-learning. When someone is assigned to a new position, he or she will try to make efforts to do their best and achieve the expected results. This is usually done through learning with assistance of available reference. However, self-learning and self-development is difficult to achieve without a strong motivation of the person who intends to learn, so it is essential to have the tools mentioned above in Figure 25.1.2, in other words, to make the technical references that the institution have and do challenges constantly setting personal goals.

2) Types of Training

- On-the-job training (OJT): Training given in one's working place.
- Off-the-job training (OffJT): Training given outside of one's work place.

3) By the number of participants (usually applied to OffJT)

- Group training: Training where large number of trainees is trained together.
- Individual training: Training given on individual basis.

These types of training are compared in the following Table 25.3.1 and Table 25.3.2.

Table 25.3.1Comparison of OJT and OffJT

	OJT	OffJT
Description	• Training given through day-to-day work in one's work place. • Trainer can be trainee's manager of senior worker	• Trainee is discharged from daily duties and allowed to participate in training. • Usually implemented at location other than trainees work place (but can be in the same building).
Advantage	• Usually efficient and effective because training is done through actual works. • The outcome can be used immediately after completion of training. • Cost is minimal and usually does not need special budget. • Daily duties need not to be interrupted.	• Trainee can concentrate in the training. • Trainers can be selected from qualified persons. • Due to above, training can be efficient and effective, and can be implemented in shorter period than OJT.
Disadvantage	• Unless systematically planned, often interrupted/ignored when urgent works come in, or for any other reasons. • Can be biased or have some problem if the knowledge of trainer (manager or senior worker) is biased.	• Daily duties need to be interrupted. • Need certain amount of budget.

Source: JICA Study Team

Table 25.3.2 Comparison of Group Training and Individual Training

	Group Training	Individual Training
Description	• Large number of trainees is trained at the same time. • Contents of training are decided before trainees are selected.	• One trainee or small number of trainees is trained at one time. • Trainee is selected first and outline of training is decided. • Typical example is studying abroad for high-level education.
Advantage	• Many trainees can be trained at one time. • Cost per trainee is usually lower than individual training. • Thus, effective when large numbers of people need to be trained on particular subject in a short period. • Network of trainees is often created which later can help further improvement of trainees' capacity.	• Level of training can be freely set based on the objective and level of trainee. • Thus, high-level training, such as study of state-of-the-art engineering, is possible.
Disadvantage	• Effectiveness and efficiency may not be uniform over all trainees.	• Number of trainee is limited. • Therefore, is not suitable when large number of people need to be trained in a short period. • Cost per person is high.

Source: JICA Study Team

Although types of training are usually classified as above, there is no clear boundary between them. For example, OJT often needs to be supported by self-learning and actually self-learning is a part of OJT process. Another example of unclear boundary between types of training is that two persons

or more are invited to counterpart training in Japan but it is not called group training. Type of training has to be adopted considering the advantages and disadvantages as shown above. However, importance and effectiveness of OJT should not be underestimated.

(2) Target Level of Knowledge to be acquired through Training and Level of Trainee

A training course is designed to let the trainees acquire targeted level of knowledge and/or skill. Also, target group of the people to be trained is selected. These are necessary to achieve the objectives of the training course. JICA team has considered it appropriate to deliver training courses in two levels, intermediate level and advanced level, as briefly explained in Table 25.3.3. Target group of trainee are selected for each training course.

Table 25.3.3 Level of Training

Level	Description
Intermediate	Target is to teach how to actually supervise the works at the office and site. Main topics of training are fundamental points of using the standards/handbooks, knowledge of checking material, method of execution, checking the performance of works (for example).
Advanced	They are expected to be leader or advisor to other staff. After training, trainees are expected to know how to secure required quality, meaning and interpretation of standards/handbooks, procedures of lab tests and field tests and their problems, how to prevent use of sub-standard material, how to realize good execution (for example).

Source: JICA Study Team

(3) Trainer

In order to make the proposed training plan sustainable, trainers shall be selected among MTI staffs. Basic qualifications of trainers are as listed below:

Table 25.3.4 Qualification of Trainer

Condition	Description
Academic Knowledge	• Sufficient academic knowledge is required. This typically includes, minimum, university-level, desirably, graduate-level educational background on the subject. Nevertheless, basic theories of related transport sector need to be taught by trainer(s) with university-or-above educational background. • The trainer needs to be able to teach basic theory of the subject.
Practical Experience	• Rich experience obtained through positive participation in actual projects of the subject. The trainer is required to possess sufficient knowledge on actual cases of problems and solutions, prevention of the problem, etc.
Working Knowledge	• Based on the sufficient academic knowledge and practical experience as cited above, the trainer needs to have organized knowledge which can be used in actual works of the subject.
Presentation Skill	• The trainer needs to have good presentation skill. If a candidate for trainer needs improvement, 'training of trainers' (TOT) should be given.

Source: JICA Study Team

It is a matter of course that anyone cannot be expected to be a good trainer without training and experience. Accordingly, 'training-of-trainer' (TOT) is necessary after candidates of trainers are selected. Actual candidates of trainers shall be selected upon close consultation among MTI. One important consideration is that persons responsible for preparation of a standard/handbook or other similar document know the document best therefore; they should be the trainers in the introduction workshop of the said document.

(4) Training Evaluation

At the end of the training event, evaluation sheets are handed out to, and filled by all the participants. The items to be typically evaluated are as follows:

- Increase of the participant's knowledge on the subject and/or degree of understanding
- Teaching material
- Trainer's lecture
- Duration of the training event
- Usefulness

A training report should be prepared after the data of evaluation sheets are compiled and analyzed. End-of-training report should include the following information/data.

- General information (Title of the training and objective/target, date, venue, trainers etc.)
- Participants list (actual)
- Training material
- Cost (budget and actual expenditure)
- Result of analysis of evaluation sheets

The above data/information is very useful when similar training will be planned in the future.

(5) Log Frame of the Proposed Training Plan

Main focus of the proposed training plan is a total transport sector and the necessity of training courses shall be recommended by JICA team written in practical frame. This log frame (logical framework) here considers the CD of the overall MTI. Table 25.3.5 below shown is the log frame of the proposed training plan of each transport sector. This log frame is formulated in consideration of discussions in workshop and MTI program in 2007.

It is recommended that the training plan shall be reviewed again when the nominated key persons start the training courses. The ideas and requests from the practical operations staff (Human Resources Management Office) are very important to prepare in details of designing plan. The plan focuses on the CD and empowerment of organization that is the foundation of the governmental administration. The expected result has two parts that are i) targeting the improvement of individual capability and ii) targeting organizational empowerment.

The program should be well balanced to provide target organization with both engineering and administration skills. In other words, the MTI needs human resources with both engineering knowledge and administrative capacity. JICA team recommends again even training courses can be successful, dissemination of knowledge to other colleague is more important so that MTI should arrange to organize a harmonized holistic CD plan using practical OJT method.

Table 25.3.5 Log Frame of Capacity Development (Transport Planning)

	Indicator
[Overall Goal] To enhance the capacity for planning and management of environmentally sustainable transportation system based on concept of Green Economy which aims simultaneous pursuit of preservation and economic development.	1. Monitoring and evaluation of the proposed National Transportation Plan (NTP). 2. Socio-economic indicators (Production, income, population). 3. Degree of people satisfaction.
[Objective] To be able to propose the Action Plan on environmentally sustainable transport in consideration of current status of country.	1. Development of Action Plan for short term 2. Regional development plan that utilize the potential factor
[Expected outcome] 1. Participants can review and analyze the current	1. Monitoring the plan of each sector in

	Indicator
situation and issues of sustainable transportation system. 2. Participants can identify the direction and extension methods of policies, programs, and projects for sustainable transportation system. 3. Participants can draft an Action Plan. 4. Participants can propose an Action Plan to related organizations.	NTP. 2.1Regional development plan. 2.2Traffic demand forecast. 3.Prioritization of projects. 4.Discussion in the Committee.
[Activities] •Review of current situation of administration system. •Analysis of the national concept of transport network. •Review of initiatives and programs in Central America Region. •Review of transport planning and land use. •Review of city planning in nationwide. •Review of public transport planning and Traffic Demand Management (TDM). •Observation of environment and people-friendly related to transport infrastructure. •Analysis of budget request. •Preparation of action plan.	[Target Group] Middle ranking officer who have more than 3 years of experience in relevant sector.

Source: JICA Study Team

Table 25.3.6 Log Frame of Capacity Development (Road Administration)

	Indicator
[Overall Goal] To develop the capacity of road administration for the related government officials.	1. Monitoring of the proposed National Transportation Plan. 2. Differences between plan and actual development.
[Objective] To improve the road planning, construction and maintenance ability of the mid-level official in road sector. To confirm the participant's learning by a presentation based on knowledge acquired by lectures and site visits.	1. Budget for road improvement. 2. Ratio of pavement. 3. Average speed, traffic density and transportation cost. 4. Number of traffic accidents
[Expected outcome] 1. To understand the process of road planning and points to consider during preparation. 2. To understand the effects of road development and the evaluation method of the project. 3. To understand the process of road structure (mainly bridges) planning and points to consider during preparation. 4. To understand the road pavement. 5. To understand the new technologies and standards.	1.1Road planning for short term. 1.2Traffic survey 2. Road inventory. 3. Bridge Management System. 4. Design standard and specification. 5. Participation of the seminar, particularly the latest method and international standards.
[Activities] 【Subject related with Road Network Planning】 •Preparation method of road network planning. •Observation of other countries outline of road administration. •Practice of economics analysis, project evaluation and demand forecast. •Practice of disaster prevention plan in the road network. •Site observation. 【Subject related with Road Route Planning】 •Preparation of road route planning. •Review of road related legislation. •Practice of public involvement, environment impact assessment (EIA). •Inspection of road Structure（Bridges, Pavement. •Preparation and management of road construction method and construction machinery. •Practice of Road Safety. •Management of road maintenance and life cycle cost assessment.	[Target Group] 1. Engineers who graduate the university (civil engineering) or the equivalent. 2. A mid-level officer in charge of road planning and expected to be assigned to the leading position in the future.

Source: JICA Study Team

Table 25.3.7 Log Frame of Capacity Development (Road Maintenance)

	Indicator
[Overall Goal] To strengthen capacity of the organizations for road management and maintenance with knowledge and skills required for survey, planning, routine and periodic maintenance method with due considerations for cost and quality.	Adequate maintenance system is established.
[Objective] Road management and maintenance activities are improved in the target organizations.	1.Lengthen pavement's life-span. 2.Budget for maintenance works.
[Expected outcome] 1. Analysis of current understanding on road management and maintenance system. 2. Improvement of the sustainable road management and maintenance system. 3. Enhancement of basic knowledge on road management and maintenance such as road design and maintenance with due consideration for life-cycle cost. 4. Enhancement of basic skills such as survey, planning, routine and periodic maintenance (procurement, supervision, examination and disaster mitigation). 5. Consideration of necessary measures to strengthen road management and maintenance and draft action plans.	1.Annual report of maintenance work. 2.Annual plan of maintenance work. 3.Handbooks for method of maintenance works. 4.1 Contract of maintenance works. 4.2 Budget of maintenance works. 5.Action plan.
[Activities] •Preparation of framework of road maintenance and management (organization, budget, out-source, law). •Practice of road design standard, construction standards, construction management, and maintenance plan considering life cycle cost. •Study on emergent operation against natural disaster, temporary repair work, case study. •Site observation for basic skills in view of following manners: (1) management and maintenance with quality and cost effectiveness, (2) quality control for road management and maintenance, (3) measures to institutionalize proper road management and maintenance. •Preparation of action plan.	[Target Group] Civil engineers in charge of road management and maintenance activities (survey, planning and routine/periodic maintenance) with over 5 years working experiences.

Source: JICA Study Team

Table 25.3.8 Log Frame of Capacity Development (Logistics Sector)

	Indicator
[Overall Goal] To improve the distribution infrastructures of international corridors, as well as the institutional and operational arrangements which allow the infrastructure to function appropriate and effectively. To focus on improvement of the port cargo transport efficiency that is the issue of the ports as gateways of international corridors.	1. Establishment of Cross Border Trade Agreement. 2. Establishment of adequate management system.
[Objective] To improve the ability to facilitate logistic system and to cope with the current issues of this field. To enhance the capacity of the officer in charge of port planning or port administration for port planning, administration and operation.	1. Transportation cost. 2. Time for custom clearance. 3. Cargo volume.
[Expected outcome] 1. To understand the present situation and the issues of Cross Border. 2. To cover strategic thinking, planning & development, management of the transport, packing, handling, storing and information technology. 3. To understand the port administration and operation system, port cargo transport and the measures for strengthening international competitiveness. 4. To understand appropriate PPP introduction and measures to improve PPP conditions.	1. Collection of legislation documents. 2. Action plan. 3. Collection of documents and keeping to data bank. 4. Legislation and number of investors.
[Activities] •Analysis of current situation of domestic, regional distribution and international corridor. • Analysis of the selection of shipping companies calling at the ports. •Analysis of current situation of port cargo transport. • Structural analysis of the cost of port cargo transport. •Observation of the approach from the hardware aspect (efficiency improvement by infrastructure upgrading). •Observation of the approach from the software aspect (Port procedure simplification, coordination with the Customs, ICT). •Study on Framework of PPP in port sector. •Discussion on the issues on cargo dwell time and current challenges to reduce it. •Identification of problems, examination of countermeasures. •Preparation of action plan.	[Target Group] 1. Officials of governmental or public organization, being engaged in logistics with a position to carry out action plan. 2. Participant has more than three years of occupational experience in logistics sector.

Source: JICA Study Team

Table 25.3.9 Log Frame of Capacity Development (Port Sector)

	Indicator
[Overall Goal] To improve the port administration or management, and trainer company of maritime planning, to solve for current various issues.	1.Economic growth. 2.Tourism growth. 3.Development of waterway transport system.
[Objective] To consider on their own how to address various issues they have and then create Action Plan.	1.Capacity of Cargo volume. 2.Dependency on the use of ports. 3.Improvement of legal framework..
[Expected outcome] 1. Participants identify the current issues pertaining to port improvement. 2. Participants acquire and explain about basic technical knowledge for port improvement. 3. Participants learn about port development/planning methodology and preliminarily draft plans. 4. Participants determine and explain problematic surrounding ports in the region. 5. Participants formulate action plans that cover port-related global issues and sustainable efforts.	1.Clarification of issues. 2.Achievement of capacity development. 3.Design standard and specification. 4.1Regional development plan. 4.2EIA. 5. Action plan.
[Activities] •Review of current issues, policies and development planning. •Practice of port planning/designing and formulation of plans and designs. •Analysis of inspection system and port information. •Study on inspection and management system in surrounding ports in the region. •Practice of the maintenance and management as well as the effective use of port facilities. •Study on environmental conservation and environmental impact assessment. •Study on prevention of disasters of port facilities. •Preparation of action plan.	[Target Group] 1. A mid-level personnel whose responsibilities involve problem solving of global issues (such as maintenance, environment, disaster management, etc.). 2. Port engineers who have been engaged in practical business in the port field for at least three (3) years.

Source: JICA Study Team

Table 25.3.10 Log Frame of Capacity Development (Aviation Sector)

	Indicator
[Overall Goal] To obtain the basic knowledge on construction, management and maintenance of the airport development, and the opportunity to make efficient airport development plans with professional consultation.	1. Economic growth. 2. Tourism growth. 3. Development of air freight transport system.
[Objective] Participants may propose airport development plan considering construction, management and maintenance.	1. Number of passengers. 2. Extension of runway. 3. Expansion of Aircraft parking. 4. Knowledge of international standard.
[Expected outcome] 1. To summarize the current situation and challenge/concern on airport development planning. 2. To learn and explain the knowledge on airport develop plan considering construction, management and maintenance. 3. To formulate the draft airport development plan based on the situation and challenge/concern 4. To formulate and share the action plan among in the organizations.	1. Annual report. 2. Design standards. 3. Monitoring the plan of each sector in NTP. 4. Action plan.
[Activities] •Review and discussion on followings subject: (1) aviation administration, (2) airport Planning (elemental planning, public involvement), (3) airport management and maintenance (total management of primary facilities and terminal building), (4) study on latest technology (against national disaster). •Preparation of action plan.	[Target Group] 1. Officers in charge of planning, management and maintenance of airport development. 2. With more than 5 years of occupational experiences in the division of airport planning, management and maintenance, and will be in same occupation more than 3 years.

Source: JICA Study Team

Chapter 26 Conclusion and Recommendation

26.1 Conclusion

The Nicaragua National Transport Plan, formulated by the JICA Study Team, is composed of the following plans and programs in order to assist sustainable economic growth and contribute to reduction of poverty and regional disparity.

- Long term development vision targeting the year 2033
- Transport sector analysis based on the extensive transport survey
- Transport sector development vision targeting the year 2033
- Multi-modal National transport plan covering land, water and air transport targeting the year 2033
- Transport sector action plan and investment plan, stage-wising by short, middle and long-term development
- Implementation structure and capacity development plan to execute the proposed plans and programs

The study considered the transport situation and development strategy not only in Nicaragua but also in Central America Region in the analysis and planning stages. A total of six stakeholder meetings (including the Public Seminar which disclosed the output of the study) have been carried out during the study. Broad opinions on transport sector issues were collected and reflected into the plan. The study was carried out in close collaboration with concerned organizations particularly MTI. Likewise, a total of four Steering Committee meetings were conducted which ensured that consensus were reached among the major stakeholders. In addition, technology transfer to the concerned organizations was conducted in view of a need to update the NTP in the future.

MTI, as a key counterpart of this study was actively involved throughout the process at the technical and administrative matters with high motivation to acquire new knowledge.

The Long-term Development Vision, which set goals and direction of economic development and social development of Nicaragua, is a prerequisite of the National Transport Plan (NTP)_. The said vision is consistent with the National Human Development Plan (PNDH 2012-2016) formulated by the Government of Nicaragua. The NTP covers development plan for all transport sub-sectors such as land, water and air transport and took into account the integration of multi modal transport system. Likewise, passenger transport and logistics transportation plans and programs were also included. The NTP is integrated and comprehensive transport plan for Nicaragua which illustrates the future roadmap for transport sector. The proposed projects in the NTP encompassed completely new programs/projects as well as those proposed by related agencies.

In order to implement the transport sector projects and programs proposed in the National Transport Plan, it is necessary to maintain the balance between investment and budget. In this context, the implementation plans in the short, medium, long and very long term and investment plans were proposed. Furthermore, the preparation of plans for strengthening the implementation system and capacity of relevant organizations in the transport sector, which are necessary to support the implementation of the plans, was an important part of this study. The National Transport Plan that provides for a longer period vision should have a universal concept of development, but its implementation plan must be flexible to the economic and social situation in the future. To this end, it is dispensable to go updating the National Transportation Plan with a certain interval like every 10 years. Considering that, the experts of JICA Study Team made technical transfer regarding to the necessary technology in the transport sector of Nicaragua through the OJT and workshop training, etc.

We hope that the National Transport Plan, which was proposed in this study, will be implemented consistently and updated timely by Nicaraguan side.

26.2 Recommendation

To facilitate early realization of the NTP and to ensure that long term recommended projects are still effective and justifiable in the coming years, the following are recommended:

- The National Transport Plan should be authorized by the Government as the country's national transport plan. The proposed transport sector development vision and strategy should be kept and maintained while implementation timing is flexible.
- Green transport oriented, which is a harmonization of the development with environment to address climate change and vulnerability to disaster, must be observed during the implementation of the projects.
- Only 67% of the required investment budget for transport sector is covered over the next 20 years. This means that 33% are budgeted after 2034. The transport sector development, along with the other sectors such as energy, water and others, is an important sector for economic and social development of Nicaragua. Recognizing this, flexible public investment allocation for the transport sector should be considered.
- Private sector investment to transport sector development through PPP should be introduced. Organizational and institutional environment for private sector investment should be formulated immediately.
- This study proposes a step-wise development plan composed of short, medium and long term plan. As far as medium and long term plan is concerned, implementation schedule should be made flexible depending on the future changed of social and economic condition.
- The long-term development vision and socioeconomic framework which are the foundation of the NTP have to be adjusted depending on the future economic and social circumstances of Nicaragua. Periodic update by MTI is necessary to reflect changed in social and economic conditions.
- Nicaragua Grand Canal is not considered in the NTP due to lack of details (engineering, financial and environmental considerations). However, once the Grand Canal is built, its impact on the transport sector and economy of the country is very huge. Thus, when firm plan for Grand Canal is committed, the NTP should be updated.

APPENDIX

A.1 Road Development Plan of MTI Related to National Transport Plan

MINISTERIO DE TRANSPORTE E INFRAESTRUCTURA
DIVISIÓN GENERAL DE PLANIFICACIÓN
TRAMOS DE CARRETERAS ANEXOS AL PNT

						Millones US$		
Número	Red	Nombre del Tramo	Long. (km)	Departamento	Municipios	Preinversión	Inversión	Total
TRAMOS DE LA RED TRONCAL PRINCIPAL			**76.87**			**0.11**	**63.54**	**63.65**
1	NIC-7	San Lorenzo - Santo Tomás	9.00	Boaco, Chontales	San Lorenzo, Comalapa, Juigalpa, Santo Tomás		10.75	10.75
2	NIC-24b	Chinandega - Guasaule	32.00	Chinandega	Chinandega, Villanueva, Somotillo		24.00	24.00
3	NIC-28	Empalme Izapa - La Paz Centro	10.01	León	La Paz Centro	0.11	6.54	6.65
4	NIC-28	Las Piedrecitas - Mateare (4 Carriles)	18.07	Managua	Managua, Ciudad Sandino, Mateares		14.46	14.46
5	NIC-1	La Garita - Tipitapa (4 carriles)	7.79	Managua	Tipitapa		7.79	7.79
TRAMOS DE LA RED COLECTORA PRINCIPAL			**258.60**			**2.38**	**213.95**	**216.33**
6	NIC-49	Estelí - La Aceituna - El Sauce	43.78	Estelí	Estelí, El Sauce	0.47	27.14	27.62
7	NIC-70A	San Francisco Libre - Quebrada Honda	10.00	Managua	San Francisco Libre		6.20	6.20
8	NIC-70A	San Francisco Libre - Los Zarzales	28.42	Managua, León	San Fco. Libre, El Jicaral		18.57	18.57
9	NIC-8	Empalme Las Conchitas - Masachapa	32.86	Managua	San Rafael del Sur	0.35	27.93	28.29
10	NIC-64	Moyogalpa - La Flor - Altagracia	11.04	Rivas	Altagracia, Moyogalpa	0.12	6.84	6.96
11	NIC-23A	Empalme Sn. Pedro de Lóvago - Puente El Pastal (Lim. Mcpal. Sn Pedro de Lóvago/La libertad) - La Libertad	15.13	Chontales	Sn. Pedro de Lóvago, La Libertad	0.16	9.89	10.05
12	NN-73	Empalme Waspám - Santa Martha	30.49	RAAN	Puerto Cabezas	0.33	30.49	30.82
13	NN-73	Santa Martha - Waspám	86.88	RAAN	Puerto Cabezas, Waspán	0.94	86.88	87.82
TRAMOS DE LA RED COLECTORA SECUNDARIA			**1,663.54**			**12.97**	**1,096.73**	**1,109.70**
14	NIC-53	Macuelizo - Santa María	30.46	N. Segovia		0.33	19.91	20.23
15	NN-13	Ciudad Antigua - Lim. Dptal. Nva. Segovia/Madriz - Telpaneca	20.88	N. Segovia, Madriz	Ciudad Antigua, Telpaneca	0.23	13.64	13.87
16	NIC-55	El Jicaro - Murra	19.27	N. Segovia	Jicaro		8.64	8.64
17	NN-19	El Jicaro - La Mía	15.28	N. Segovia	El Jícaro, Jalapa	0.17	9.47	9.64
18	NIC-55	Murra - El Rosario	27.14	N. Segovia	Murra	0.29	17.74	18.03
19	NN-16	Las Vueltas - Las Cruces (Susucayán)	12.00	N. Segovia	Ciudad Antigua		7.84	7.84
20	NIC-51	Empalme Panalí - Santa Rosa de Ventilla - Wiwilí de Nueva Segovia	31.10	N. Segovia	Quilalí, Wiwilí	0.34	19.28	19.62
21	NN-26	Palacaguina - Lim. Mcpal. Palacaguina/Telpaneca - Los Lirios	19.30	Madriz	Palacagüina, Telpaneca	0.21	12.61	12.82
22	NIC-51	San Juan de Rio Coco - Las Cruces	14.00	Madriz	San Juan Río Coco		8.40	8.40
23	NN-8	Condega - Lim. Mcpal. Condega/Pueblo Nuevo - Pueblo Nuevo	10.16	Estelí	Condega, Pueblo Nuevo	0.11	6.64	6.75
24	NN-38	Empalme El Regadío - El Regadío	2.92	Estelí	Estelí	0.03	1.91	1.94
25	NN-38	Empalme El Regadio - Empalme Tranquera - S. J. Limay (P. Gualilica)	29.58	Estelí	Esteli		18.64	18.64
26	NIC-35B	Estelí - Escuela Miraflores	27.90	Estelí	Estelí	0.30	18.23	18.53
27	NIC-35B	Escuela Miraflores - Empalme Quiata	9.35	Estelí	Estelí, San Sebastián de Yalí	0.10	6.11	6.21
28	NIC-35A	Estelí (Inter Nic-1) - La Estanzuela	5.68	Estelí	Estelí	0.06	3.71	3.77
29	NIC-35A	La Estanzuela - Lim. Mcpal. Estelí/Sn. Nicolás - San José de la Laguna	10.77	Estelí	Estelí, San Nicolás	0.12	7.03	7.15
30	NIC-38	San Juan de Limay - Lim. Mcpal. Sn. Juan de Limay/Pueblo Nuevo - Paso Hondo	30.43	Estelí	Sn. Juan de Limay, Pueblo Nuevo	0.33	19.89	20.21
31	NIC-38	Paso Hondo - Pueblo Nuevo	5.50	Estelí	Pueblo Nuevo	0.06	3.59	3.65
32	NN-43	Empalme Chilamatillo - Lim. Dptal. Estelí/Jinotega - La Concordia	15.34	Estelí, Jinotega	Estelí, La Concordia	0.17	10.02	10.19
33	NIC-38	San Juan de Limay - Achuapa	16.00	Estelí	San Juan de Limay	0.07	8.11	8.18
34	NIC-32B	Sn. Fco. Del Norte - Lim. Dptal. Chinandega/Estelí - Sn. Juan de Limay	22.62	Chinandega, Estelí	Sn. Fco. del Norte, Sn. Juan de Limay	0.24	14.78	15.03
35	NN-255	Empalme Larreynaga - Larreynaga	6.35	León	Larreynaga		4.15	4.15
36	Nic. 68	Mina Limón - La Palma - Empalme Mayocunda	17.98	León	Larreynaga, Villanueva	0.19	11.75	11.94
37	NIC-60	Empalme Salinas Grandes - Salinas Grandes	12.07	León	León	0.13	7.89	8.02
38	Nic. 40	El Tránsito - La Gloria	10.25	León	Nagarote	0.11	6.70	6.81
39	NIC-40	Empalme El Tránsito - El Tránsito	12.48	León	Nagarote	0.13	8.16	8.29
40	NN-234	La Ceiba - La Paz Centro	17.26	León		0.19	11.28	11.47
41	NN 232	Nagarote - Venecia	22.64	León	Nagarote	0.19	14.79	14.99
42	NN 202 - NIC	Z. Franca - S. Grande - PROINCO - San Francisco - Tip Top	22.67	Managua	Managua, Nindiri		19.27	19.27
43	NIC-34B	La Trinidad - San Rafael del Sur	24.00	Carazo / Managua	Diriamba, San R. del Sur		16.80	16.80
44	NIC-34B	La Trinidad - Barranco Bayo - Las Salinas	52.10	Carazo	Diriamba, Jinotepe, Sta. Teresa	0.56	34.05	34.61
45	NN-197	Masatepe - San José - Monte Redondo	7.20	Masaya	Masatepe		4.71	4.71
46	NN-211	Ochomogo - Las Salinas	28.84	Rivas	Tola, Belén		18.85	18.85
47	NIC-62	Entrada El Guacalito - Las Salinas	18.87	Rivas	Tola	0.20	12.33	12.54
48	Nic-72	Rivas - El Bastón - Las Marias - Nacascolo - La Talanguera	24.68	Rivas	San Juan del Sur	0.27	16.13	16.39
49	NN-224	San Juan del Sur - El Ostional - El Naranjo	28.49	Rivas	San Juan del Sur		17.66	17.66
50	NIC-66	Cárdenas - Colón	30.88	Rivas	Cárdenas		20.18	20.18
51	NN-80	San Jose de los Remates - La Cañada	8.68	Boaco	San José de los Remates		5.67	5.67
52	NN-83	San José de los Remates - Lim. Mcpal. S J de Los R/Santa Lucía - Las	15.79	Boaco	Sn. J. de los Remates, Sta. Lucía	0.17	10.32	10.49
53	NIC-59	Boaquito - Santa Lucía	11.59	Boaco	Sta. Lucía	0.13	7.57	7.70
54	NIC-59	Santa Lucia - Boaco	5.00	Boaco	Santa Lucia, Boaco		3.27	3.27
55	NIC-59	Papaturro - Boaquito	3.53	Boaco	Sta. Lucía, Teustepe	0.04	2.31	2.34
56	NN-83	Las Mercedes - Lim. Mcpal. Santa Lucía/Boaco - Empalme La Florida	6.78	Boaco	Sta. Lucía, Boaco	0.07	4.43	4.50
57	NIC-61	Boaco - La Aurora	23.76	Boaco	Boaco	0.26	15.53	15.78
58	NIC-61	La Aurora - Lim. Dptal. Boaco/Matagalpa - El Lunal	13.70	Boaco, Matagalpa	Sn. J. de los Remates, Muy Muy	0.15	8.95	9.10
59	NIC-17	Rancho Rojo (Emp. Murra) - La Calamidad	9.74	Boaco	Camoapa		5.84	5.84
60	Nic. 17	La Calamidad - Empalme Masigue	11.75	Boaco	Boaco, Camoapa	0.13	7.68	7.81
61	NIC-31	Empalme Masigue - Empalme La Corona	9.66	Boaco	Camoapa, Boaco	0.10	6.31	6.42
62	NIC-31	El Portón - Santa Elisa - Empalme La Corona	22.49	Boaco	Boaco	0.24	14.70	14.94
63	NIC-17	Empalme Masigue - La Embajada - Río Quisaura - Villa Siquia	54.01	Boaco	Camoapa	0.58	35.29	35.88
64	NIC-23B	Santo Domingo - Los Chinamos	16.74	Chontales	Santo Domingo		16.15	16.15
65	NIC-37B	Juigalpa - Puerto Díaz	27.36	Chontales	Juigalpa	0.30	17.88	18.17
66	NIC-3	San Sebastian de Yalí - Condega	39.66	Jinotega	San Seb. Yali, Condega		20.42	20.42
67	NIC-35D	San Sebastián de Yalí - La Rica	23.21	Jinotega	San Sebastián de Yalí	0.25	15.17	15.42
68	NIC-41	San Gabriel - Las Cruces	25.12	Jinotega	Jinotega	0.27	15.57	15.85
69	NIC-51	Pantasma (Praderas) - Empalme Panalí - Quilalí	33.61	Jinotega	Pantasma, Quilalí	0.36	20.84	21.20
70	NIC-43	Pantasma (Praderas) - Estancia Cora - Empalme Maleconcito	35.76	Jinotega	Sta Ma. de Pantasma, Wiwili de Jinotega	0.39	22.17	22.56
71	NIC-43	Empalme Maleconcito - Wiwilí de Jinotega	12.61	Jinotega	Wiwilí de Jinotega	0.14	8.24	8.38
72	NN-51	Puente La Pavona - La Pita - Empalme Maleconcito	35.75	Jinotega	El Cua, Wiwilí de Jinotega	0.39	23.36	23.75
73	NN-46	La Trinidad - Sacaclí - San Gabriel	44.30	Jinotega	La Trinidad, Jinotega	0.48	28.95	29.43
74	NN-51	Empalme Peñas Blancas - Abisinia	7.37	Jinotega	El Cua	0.08	4.57	4.65
75	NN-51	Empalme Cerro Verde - Empalme El Portillo	12.30	Jinotega	Jinotega, El Cua		8.04	8.04
76	NN-66	Empalme El Portillo - El Cua	12.00	Jinotega	El Cua		7.84	7.84
77	NN-66	El Cua - San José de Bocay	32.63	Jinotega	El Cua, San José Bocay		19.76	19.76
78	NIC-47	Empalme Terrabona - Terrabona	17.90	Matagalpa	Terrabona		11.10	11.10
79	NIC-47	Terrabona (Instituto de Terrabona) - La Estrella	20.55	Matagalpa	Matagalpa	0.22	13.43	13.65
80	NIC-47	La Estrella - Matagalpa	13.51	Matagalpa	Matagalpa	0.15	8.83	8.97
81	NIC-9	Empalme San Francisco - San Ramón	4.70	Matagalpa	Matagalpa		4.00	4.00
82	NIC-33	San Ramón - Empalme El Jobo - Empalme El Bonete	52.70	Matagalpa	San Ramón, Matiguas	0.57	34.44	35.01
83	NIC-19A	Esquipulas - Empalme San Dionisio	28.10	Matagalpa	Esquipulas, San Dionisio		18.36	18.36
84	NIC-19A	San Dionisio - Planta Ocalca	15.57	Matagalpa	San Dionisio		10.17	10.17
85	NIC-5	La Carpa - Waslala	28.82	Matagalpa	Rancho Grande, Waslala	0.31	17.87	18.18
86	NIC-5	Waslala - Zinica - El Naranjo	39.23	RAAN	Waslala	0.42	25.64	26.06
87	NIC-5	El Naranjo - Empalme El Hormiguero	43.64	RAAN	Siuna	0.47	28.52	28.99
88	NIC-5	Empalme El Hormiguero - Siuna (Inter Nic-21)	14.87	RAAN	Siuna	0.16	9.72	9.88
89	NIC-13B	Río Blanco - Bocana de Paiwas	21.94	RAAS	Río Blanco, Paiwas		12.29	12.29
90	NN-288	Empalme Alamikamba - Alamikamba	33.60	RAAN	Prinzapolka	0.36	33.60	33.96
91	NIC-30	Rosita - Bonanza	32.12	RAAN	Rosita, Bonanza	0.35	32.12	32.47
92	NN-134	Nueva Guinea - Empalme Talolinga	28.95	RAAS	Nueva Guinea	0.31	18.92	19.23
TRAMOS DE LA RED CAMINOS VECINALES			**1,360.57**			**14.00**	**891.09**	**905.09**
93	NN-11	Dipilto Viejo - Lim. Mcpal. Dipilto/Macuelizo - Ococona	16.35	N. Segovia	Macuelizo	0.18	10.68	10.86
94	NN-15	Alalí - Las Camelias	17.50	N. Segovia	Sn. Fernando	0.19	11.44	11.63
95	NN-22	Jalapa - Monte Frío - La Florida	13.45	N. Segovia	Jalapa	0.15	8.79	8.93
96	NN-23	La Limonera (Jalapa) - El Escambray	5.85	N. Segovia	Jalapa	0.06	3.82	3.89
97	NN-20	Sabana Larga - Valle Siapalí	6.90	N. Segovia	El Jícaro	0.07	4.51	4.58
98	NN-33	San Lucas - Patio Grande - Quilalí	20.60	N. Segovia	Quilalí	0.22	13.46	13.68
99	NN-3	Somoto - Puente Las Lajas - Icalupe	29.56	Madriz	Somoto	0.32	19.32	19.64
100	NN-5	Somoto - Lim. Dptal. Madriz/Estelí - Guasuyuca - El Limón	19.58	Madriz, Estelí	Somoto, Pueblo Nuevo	0.21	12.80	13.01
101	NN-10	Totogalpa - El Cuje	13.05	Madriz	Totogalpa	0.14	8.53	8.67
102	NN-25	Palacaguina - Río Grande - La Plazuela	10.81	Madriz	Palacagüina	0.12	7.06	7.18
103	NN-35	Condega - El Peñasco	15.55	Estelí	Condega	0.17	10.16	10.33
104	NN-7	Empalme La Fraternidad - Lim. Mcpal. Sn. Juan de Limay/Pueblo Nuevo -	18.50	Estelí	Sn. Juan de Limay, Pueblo Nuevo	0.20	12.09	12.29

105	NN-37	Escuela de Agricultura - Escuela Miraflores	21.27	Estelí	Estelí	0.23	13.90	14.13
106	NN-39	Estelí - Rodeo Grande	13.98	Estelí	Estelí	0.15	9.14	9.29
107	NN-40	Achuapa - La Aceituna	16.53	León	achuapa	0.18	10.80	10.98
108	NIC-73	Tipitapa - San Juan	9.68	Managua	Tipitapa	0.10	6.33	6.43
109	NN 169	Santa Ana - El Boquete	13.00	Managua	Managua, El Crucero		11.05	11.05
110	NN-280	California - San Diego	13.15	Managua	Villa El Carmen		8.59	8.59
111	NN-287	San Gregorio - Buena Vista - Los Baltodanos - El Chilamate	9.69	Carazo	Diriamba	0.10	6.33	6.44
112	NN-196	La Paz de Carazo - San Pedro	5.20	Carazo	La Paz de Carazo	0.06	3.40	3.45
113	NN-204	Santa Teresa - El Sol	8.79	Carazo	Santa Teresa	0.09	5.74	5.84
114	NN-200	Pio XII - El Portillo - El Coyolar	13.08	Masaya	Nandasmo, Niquinohomo	0.14	8.55	8.69
115	NN-183	INCA - Comunidad Los 24	10.95	Masaya	Masaya	0.12	7.16	7.27
116	NN 149	Malacatoya - Tipitapa (Victoria de julio)	29.00	Granada	Granada, Tipitapa		18.95	18.95
117	NN-191	Monte Verde - Casa de Tejas	23.34	Granada	Granada	0.25	15.25	15.50
118	NN-217	Pica Pica - El Menco	10.22	Rivas	Buenos Aires, Potosí	0.11	6.68	6.79
119	NN-86	Buenaventura - Filas Verdes	11.00	Boaco	Boaco	0.12	7.19	7.31
120	NN-82	Boaco - Santa Inés	10.20	Boaco	Boaco	0.11	6.67	6.78
121	NN-93	Boaco Viejo - Yalwas	18.92	Boaco	Camoapa	0.20	12.36	12.57
122	NN-91	Sacal - Lomas de Cafén	9.14	Boaco	Boaco	0.10	5.97	6.07
123	NN-91	Lomas de Cafén - Boaco Viejo	8.02	Boaco	Boaco	0.09	5.24	5.33
124	NIC-13A	Empalme La Corona - San José de la Vega	15.96	Boaco	Boaco	0.17	10.43	10.60
125	NN-92	Lomas de Cafén - Peñas de Cafén	2.65	Boaco	Boaco	0.03	1.73	1.76
126	NN-95	Puente El Congo - El Paraíso	24.83	Boaco	Boaco	0.27	16.23	16.49
127	NN-101	Empalme La Viuda - Río Murra	9.18	Boaco	Camoapa	0.10	6.00	6.10
128	NN-89	Camoapa - Puente La Codorniz	14.43	Boaco	Camoapa	0.16	9.43	9.59
129	NN-90	Camoapa - El Tesorero	7.50	Boaco	Camoapa	0.08	4.90	4.98
130	NN-190	El Palo - Miramontes	10.71	Boaco	Sn. Lorenzo	0.12	7.00	7.11
131	NIC-37A	Cuapa - Comarca El Zancudo	23.15	Chontales	Juigalpa	0.25	15.13	15.38
132	NN-107	Empalme Betulia - Comarca Arena	23.19	Chontales	La Libertad	0.25	15.15	15.40
133	NN-109	Juigalpa - San Ramón	4.39	Chontales	Juigalpa	0.05	2.87	2.92
134	NN-110	Apompuá - Lim. Mcpal. Juigalpa/San Pedro de Lóvago - San Bartolo	12.60	Chontales	Juigalpa, Sn. Pedro de Lóvago	0.14	8.23	8.37
135	NN-112	La Palma - Pikin Guerrero - La Plazuela	35.50	Chontales	Acoyapa, Juigalpa	0.38	23.20	23.58
136	NN-125	San Pedro de Lóvago - El Apante	5.46	Chontales	Sn. Pedro de Lóvago	0.06	3.57	3.63
137	NN-124B	San Pedro de Lóvago - Bulgaria	22.16	Chontales	Sn. Pedro de Lóvago	0.24	14.48	14.72
138	NN-126	San Pedro de Lóvago - La Cusuca	6.08	Chontales	Sn. Pedro de Lóvago	0.07	3.97	4.04
139	NN-108	Los Chinamos - El Guineal (Río)	12.06	Chontales	Sto. Domingo	0.13	7.88	8.01
140	NN-123	Santo Tomás - El Jicarito	10.55	Chontales	Sto. Tomás	0.11	6.89	7.01
141	NN-127	La Pita - Los Mollejones	5.42	Chontales	Sto. Tomás	0.06	3.54	3.60
142	NN-128	Villa Sandino - Guarumo - El Guabo - Villa Campana	43.95	Chontales	Villa Sandino, Santo Tomás	0.47	28.72	29.20
143	NN-129	La Curva - Kamusaska	14.52	Chontales	Villa Sandino	0.16	9.49	9.65
144	NN-110	San Bartolo - Puertas de Paris	7.80	Chontales	Sn. Pedro de Lóvago	0.08	5.10	5.18
145	NN-115	El Almendro - El Silencio	9.78	Rio San Juan	El Almendro	0.11	6.39	6.50
146	NN-119	San Antonio - Marlon Zelaya - Buena Vista	16.70	Rio San Juan	El Castillo	0.18	10.91	11.09
147	NN-118	La Azucena - La Esperanza - Boca de Sabalos	24.50	Rio San Juan	San Carlos, El Castillo	0.26	15.44	15.70
148	NN-44	San Rafael del Norte - Los Chaguitones	19.50	Jinotega	San Rafael del Norte	0.21	12.74	12.95
149	NN-48	Sisle - Santa Fé - La Reforma	13.20	Jinotega	Jinotega	0.14	8.63	8.77
150	NN-49	La Porrita - Sacramento	20.85	Jinotega	Jinotega	0.23	13.63	13.85
151	NIC-43	Wiwilí - Wamblán	38.99	Jinotega	Wiwilí	0.42	25.48	25.90
152	NN-53	Los Robles - Palo Blanco	6.40	Jinotega	Jinotega	0.07	4.18	4.25
153	NN-52	Venecia - Zaragoza	15.45	Jinotega	Jinotega	0.17	10.10	10.26
154	NN-55	San José - La Colonia	14.10	Jinotega	Jinotega	0.15	9.21	9.37
155	NN-54	La Colonia - Lim. Dptal. Jinotega/Matagalpa - Empalme Sta. Rosa	17.04	Jinotega	Jinotega	0.18	11.14	11.32
156	NN-54	Empalme Sta. Rosa - Santa Rosa	1.96	Jinotega	Jinotega	0.02	1.28	1.30
157	NN-66	San José de Bocay - Ayapal	38.00	Jinotega	San José de Bocay	0.41	24.83	25.24
158	NN-63	El Tuma - km 164.053	1.22	Matagalpa	El Tuma	0.01	0.80	0.81
159	NN-63	km 166.79 - El Quebradón	10.76	Matagalpa	El Tuma	0.12	7.03	7.15
160	NIC-45	Empalme Tapasle - El Guapotal Central	8.89	Matagalpa	La Dalia	0.10	5.81	5.91
161	NN-64	Km 175.105 - Bul Bul	19.36	Matagalpa	La Dalia	0.21	12.65	12.86
162	NN-58	El Arenal - La Sultana	14.65	Matagalpa, Jinotega	Matagalpa, Jinotega	0.16	9.57	9.73
163	NN-60	Santa Emilia - El Roblar	18.65	Matagalpa	San Ramón	0.20	12.19	12.39
164	NIC-45	Empalme El Jobo - Pancasán	7.47	Matagalpa	Matiguás	0.08	4.88	4.96
165	NIC-45	Pancasán - Brasilia	15.89	Matagalpa	Matiguás	0.17	10.38	10.56
166	NIC-45	Brasilia - El Guapotal	9.25	Matagalpa	Matiguás	0.10	6.04	6.14
167	NN-70	Las Minitas - La Patriota	19.51	Matagalpa	Matiguás	0.21	12.75	12.96
168	NN-75	Sébaco - La Labranza	16.50	Matagalpa	Sébaco	0.18	10.78	10.96
169	NN-76	Cuajiniquilapa - Maunica	10.64	Matagalpa	Ciudad Darío	0.11	6.95	7.07
170	NN-79	Puente El Venado - Las Delicias	5.79	Matagalpa	Ciudad Darío	0.06	3.78	3.85
171	NN-251	Empalme El Muñeco - Wanawas	15.73	Matagalpa	Río Blanco	0.17	10.28	10.45
172	NN-71	Paiwitas - San José de Paiwas	6.32	Matagalpa	Río Blanco	0.07	4.13	4.20
173	NN-294	Puente Paiwas - Cabecera de Paiwas	2.21	Matagalpa	Río Blanco	0.02	1.44	1.47
174	NN-72	Empalme El Aulo (La Pedrera) - Empalme El Muñeco	3.64	Matagalpa	Río Blanco	0.04	2.38	2.42
175	NN-72	Empalme El Muñeco - San Andrés de Boboke	26.12	Matagalpa	Río Blanco	0.28	17.07	17.35
176	NN-295	Wanawana - Coop. Sandino	2.99	Matagalpa	Río Blanco	0.03	1.95	1.99
177	NN-253	Ubu Norte - Perro Mocho	9.27	Matagalpa	Río Blanco	0.10	6.06	6.16
178	NN-299	Baka - Cerro El Tigre	7.40	RAAN	Mulukuku	0.08	4.84	4.92
179	NN-297	Wilikón - Wasayamba	6.36	RAAN	Mulukuku	0.07	4.16	4.22
180	NN-131	Las Miradas - Kurinwás - San José	36.04	RAAS	Nueva Guinea	0.39	23.55	23.94
181	NN-132	El Corocito - El Chasmolar	10.00	RAAS	Nueva Guinea	0.11	6.53	6.64
182	NN-133	Nueva Guinea - Los Angeles - Nueva Holanda	23.40	RAAS	Nueva Guinea	0.25	15.29	15.54
183	NN-135	Empalme El Verdum - El Verdum - La Unión	26.17	RAAS	Nueva Guinea	0.28	17.10	17.38
184	NN-136	Empalme Yolaína - La Fonseca	25.72	RAAS	Nueva Guinea	0.28	16.81	17.09
185	NN-138	Empalme Nuevo León - La Providencia	9.20	RAAS	Nueva Guinea		6.01	6.01
OTROS CAMINOS VECINALES			**623.03**			**6.89**	**510.68**	**517.57**
186	NN	San José de Cusmapa - Aguas Calientes - El Taburete (SF del Norte)	29.57	Madriz	Cusmapa, Sn fco. Norte	0.32	18.63	18.95
187	NN	Acceso a Chinandega (4 Carriles)	7.00	Chinandega	Chinandega	0.06	5.60	5.66
188	NN	Hospital España - La Tejana	2.24	Chinandega	Chinandega		1.46	1.46
189	NN	San Sebastián - Pellizco Occidental	4.87	Chinandega	Chinandega		3.18	3.18
190	NN	Sirama Norte - Las Nubes	4.15	Chinandega	Chinandega		2.71	2.71
191	NN	Empalme Israel - El Bonete - La Palma	13.09	Chinandega	Villanueva	0.14	8.55	8.70
192	NN	Empalme Cosiguina - Buena Vista	27.32	Chinandega	El Viejo	0.30	17.85	18.15
193	NIC-12	Nueva Circunvalación León	10.20	**León**	**León**		10.20	10.20
194	NN	Ticuantepe - Sto. Domingo - San Judas	27.00	Managua	Managua, Ticuantepe		22.95	22.95
195	NN	El Rosario - Guisquiliapa	2.16	Carazo	El Rosario	0.02	1.41	1.43
196	NN	Sapoa - El Naranjo	25.59	Rivas	Cárdenas, San Juan del Sur	0.28	16.72	17.00
197	NN	Comalapa - San Francisco de Cuapa	20.00	Chontales	Comalapa, San Francisco de Cuapa	0.22	13.07	13.29
198	NN	El Zancudo - Amores del Sol - Comarca Arenas	30.00	Chontales	La Libertad	0.32	19.60	19.93
199	NN	La Libertad - Betulia - La Calamidad	57.71	Chontales	La Libertad	0.62	37.71	38.34
200	NN	Colonia Río Rama - Salto Grande	6.50	Chontales	El Coral	0.07	4.25	4.32
201	NN	Colonia Río Rama - El Tamboral - El Nisperal	13.00	Chontales, Rio San Juan	El Coral, El Almendro	0.14	8.50	8.64
202	NN	Colonia Río Rama - El Venado	8.00	Chontales, Rio San Juan	El Coral, El Almendro	0.09	5.23	5.31
203	NN	El Rótulo - Colonia Río Rama	5.62	Chontales	El Coral	0.06	3.67	3.73
204	NN	Providencia - Monkey Point	75.00	RAAS	Nueva Guinea, Bluefields	1.50	112.50	114.00
205	NN	Bocana de Paiwas - Villa Siquia	15.00	RAAS	Paiwas	0.16	9.80	9.96
206	NN	La Pañuela - La Parra - El Bambu	13.21	RAAS	El Ayote	0.14	8.63	8.78
207	NN	La Esperanza (El Areno) - Wapi	31.44	RAAS	El Rama	0.34	23.58	23.92
208	NN	Empalme Kukra Hill - Kukra Hill	6.50	RAAS	Kukra Hill	0.07	4.25	4.32
209	NN	Empalme Tumarín - El Tortuguero	25.00	RAAS	El Tortuguero, La Cruz de Rio Grande	0.27	25.00	25.27
210	NN	Empalme El Comején - Rancho Grande	4.37	Matagalpa	Rancho Grande	0.05	2.86	2.90
211	NN	Waslala - San Antonio de Yaró	31.45	RAAN	Waslala	0.34	20.55	20.89
212	NN	Waslala - San José de Caskita	13.80	RAAN	Waslala	0.15	9.02	9.17
213	NN	Siuna - El Dos - Rosita	55.36	RAAN	Siuna, Rosita	0.61	55.36	55.97
214	NN	Bonanza (Estadio) - Planta Hidroeléctrica El Salto	5.38	RAAN	Bonanza	0.06	3.52	3.57
215	NN	Bonanza (Estadio) - Laguna Siempre Viva	15.04	RAAN	Bonanza	0.16	9.83	9.99
216	NN	Waspám - Bilwaskarma - Koom	32.36	RAAN	Waspán	0.35	21.15	21.50
217	NN	Waspám - Kisalaya	5.10	RAAN	Waspán	0.06	3.33	3.39
TOTAL			**3,982.60**			**36.34**	**2,776.00**	**2,812.34**