

JAPAN INTERNATIONAL COOPERATION AGENCY

**MINISTRY OF PUBLIC WORKS AND COMMUNICATIONS
THE REPUBLIC OF PARAGUAY**

**THE FEASIBILITY STUDY FOR THE IMPROVEMENT
OF THE NATIONAL ROAD ROUTE 2 AND ROUTE 7
IN THE REPUBLIC OF PARAGUAY**

FINAL REPORT



MARCH, 2000

YACHIYO ENGINEERING CO., LTD. (JAPAN)

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Preface

In response to a request from the Government of the Republic of Paraguay, the Government of Japan decided to conduct the Feasibility Study for the Improvement of the National Road Route 2 and Route 7 in the Republic of Paraguay and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Toshihiro HOTTA of Yachiyo Engineering Co., Ltd., to Paraguay, three times between March 1999 and January 2000. In addition, JICA set up an advisory committee headed by Hiromi SAITO, Tohoku Region Construction Bureau, Ministry of Construction between April 1999 and January 2000, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Paraguay and conducted a field survey in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

Finally, I wish to express my sincere appreciation to officials concerned of the Government of the Republic of Paraguay for their close cooperation extended to the team.

March 2000

Kimio FUJITA

President

Japan International Cooperation Agency

Letter of Transmittal

March 2000

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Sir:

It is a great honor for me to submit herewith the final reports of the Feasibility Study for the Improvement of the National Road Route 2 and Route 7 in the Republic of Paraguay.

A study team of Yachiyo Engineering Co., Ltd., headed by myself, conducted field surveys, data analysis and planning works of the feasibility study in Paraguay based on the instructions from the Japan International Cooperation Agency (JICA) from March 1999 to January 2000.

The study team held thorough discussions and investigations with officials concerned of the Government of Paraguay, accordingly, various traffic surveys, present conditions analysis, preliminary engineering design, environmental impact assessment, preparation of implementation program, and project evaluation. The results were compiled in the final report, main and summary volumes.

On behalf of the team, I wish to express my heartfelt appreciation to the officials concerned of the Government of Paraguay for their warm friendship and cooperation extended to us during our stay in Paraguay.

I also wish to express my sincere appreciation to JICA, the Ministry of Public Works and Communications, Technical Planning Secretariat, the Embassy of Japan in Paraguay, and other concerned government authorities for their valuable advice and cooperation given to us in the course of the Study.

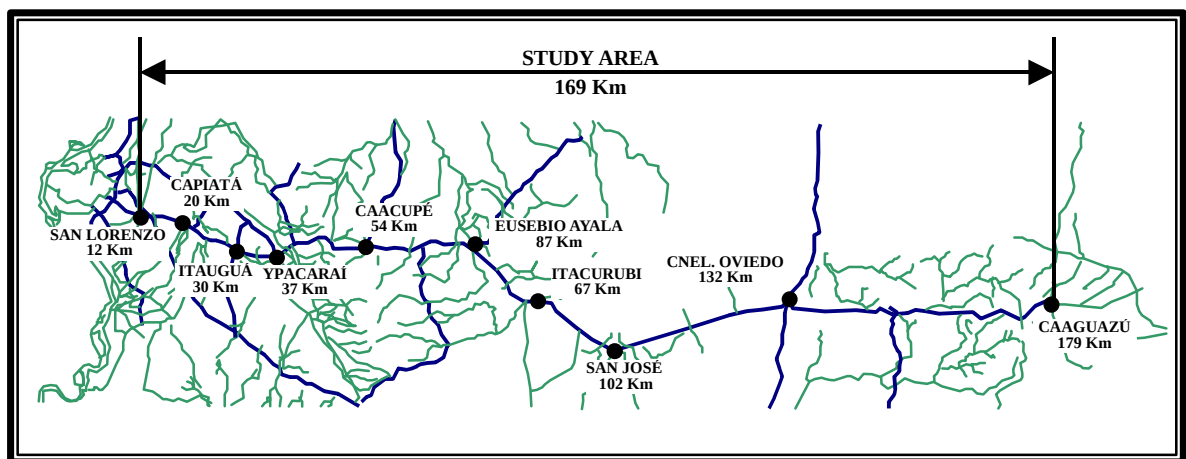
Yours Faithfully,

— 堀 田 俊 宏 —

Toshihiro HOTTA

Team Leader,
The Feasibility Study for the Improvement
of the National Road Route 2 and Route 7
in the Republic of Paraguay

Study Name	The Republic of Paraguay The Feasibility Study for the Improvement of the National Road Route 2 and Route 7																						
Study Period	March 1999 to March 2000																						
Counterpart Agency	Directorate of Highway, Ministry of Public Works and Communications																						
Objectives of the Study	1) To conduct a feasibility study for the improvement of the National Road Route 2 and Route 7 with a target year of 2010; and 2) To transfer relevant technology to the Paraguayan counterpart personnel in the course of the Study.																						
Study Schedule	The Study in Paraguay commenced in March 1999 and completed in January 2000. Afterwards, the Study continued in Japan until March 2000 when the Final Report was submitted																						
Proposed Projects	1) Mini-bypasses The existing road passes through the built-up areas of Ypacarai, Caacupe, Itacurubi, and San Jose, where heavy vehicle often run in front of houses. The road width in these cities is narrower than that on the inter-city sections and often causes accidents resulting from mixed traffic of inter-city high-speed vehicles and local traffic. Since it is necessary to separate them to ensure safety, it is proposed that bypasses be constructed to circumvent the built-up areas. 2) Provision of Climbing Lanes Ascending sections with a long, steep gradient slow down the traveling speed of heavy vehicles and reduce the road capacity as a result. In such sections, many traffic accidents occur, involving those trying to overtake slow vehicles. Based on the AASHTO design standard, another lane will be provided for slow heavy vehicles to travel in sections with a gradient of over 3% continuing for more than 500m. 3) Flyover Intersection in Coronel Oviedo At the existing intersection near the town of Coronel Oviedo, many traffic accidents occur. In order to realize smooth traffic flows from Coronel Oviedo, where urbanization is taking place, and Routes 2 and 7, the rotary intersection will be grade separated, and a flyover will be constructed. <table border="1"> <thead> <tr> <th></th><th>EIRR</th><th>NPV (Gs. Million)</th><th>B/C</th></tr> </thead> <tbody> <tr> <td>Whole Project</td><td>25%</td><td>87,069</td><td>2.3</td></tr> <tr> <td>Bypass</td><td>28%</td><td>73,585</td><td>2.5</td></tr> <tr> <td>Climbing Lane (Coronel Oviedo)</td><td>20% (8%)</td><td>14,137 (- 2,835)</td><td>1.8 (0.7)</td></tr> <tr> <td>Flyover</td><td>9%</td><td>- 652</td><td>0.8</td></tr> </tbody> </table> A rapid increase in traffic demand on National Road Route 2 and Route 7 and its growing importance in MERCOSUR will require the provision of four lanes for the entire section before 2020. For the target year, 2010, various road improvements have been proposed in this Study on the basis of this assumption of a complete four-lane road.				EIRR	NPV (Gs. Million)	B/C	Whole Project	25%	87,069	2.3	Bypass	28%	73,585	2.5	Climbing Lane (Coronel Oviedo)	20% (8%)	14,137 (- 2,835)	1.8 (0.7)	Flyover	9%	- 652	0.8
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Location Map

OUTLINE OF THE STUDY

The Republic of Paraguay

The Feasibility Study for the Improvement of the National Road Route 2 and Route 7

Study Period: March 1999 to March 2000

Counterpart Agency: Directorate of Highway,
Ministry of Public Works and Communications

1. Background of the Study

National Road Route 2 and Route 7, with an extension of 320km, are the main arterial highways linking the capital city, Asuncion (population of approximately 455,000) with the second largest city, Ciudad del Este (population of about 62,000). Running through the country from the east to west, this road leads to Brazil and Argentina and helps connect the Atlantic and Pacific sides of the continent. Moreover, this is Paraguay's busiest route in terms of traffic volume and designated as the country's main artery in the Master Plan Study of National Transportation in Paraguay conducted by JICA in 1993.

Furthermore, since the establishment of MERCOSUR (Mercado Comun del Cono Sur, or South American Common Market) in January 1995, freight traffic has intensified between Paraguay and neighboring countries. In recent years, the export volume in ton has been increasing by roughly 10%, and the number of automobiles is projected to increase, from the level in 1998, by 1.77 times in 2010 and by 2.62 times in 2020. In addition, since 80% of the domestic freight transport takes place on roads, road construction and improvements are essential for developing industry and promoting trade in the country.

However, most sections of Routes 2 and 7 have only two lanes with a width of 6.5m and do not have left-turning lanes or climbing lanes. It is obvious that a further increase in traffic volume in future will make it difficult for the routes to accommodate traffic.

In this context, the Road Department of the Ministry of Public Works and Communications (MOPC), acting through the Government of Paraguay, requested the Government of Japan to provide technical cooperation in conducting a feasibility study for a plan to improve National Road Route 2 and Route 7 so as to realize a smooth traffic flow on the routes.

2. Objectives of the Study

The objectives of the Study are the following:

- 1) To conduct a feasibility study for the improvement of the National Road Route 2 and Route 7 with a target year of 2010; and
- 2) To transfer relevant technology to the Paraguayan counterpart personnel in the course of the Study.

3. Study Area

The study area covers the section between San Lorenzo (km 14) and Caaguazu (km 183) of the National Road Route 2 and 7 (approximately 169 km).

4. Study Schedule

The Study in Paraguay commenced in March 1999 and completed in January 2000. Afterwards, the Study continued in Japan until March 2000 when the Final Report was submitted.

5. Contents of the Study

The Study mainly consisted of the following items.

- 1) Collection and analysis of the existing data and information
- 2) Various surveys, including traffic, environment, topography, and soils
- 3) Selection of basic planning policies and design standards
- 4) Traffic demand forecast
- 5) Preliminary designs of priority projects
- 6) Environmental impact assessment
- 7) Formulation of an implementation plan
- 8) Economic evaluation and financial analysis
- 9) Overall project evaluation

6. Proposed Projects

(1) Mini-bypasses

Table 6.1 shows the summary of the proposed mini-bypass projects. All the projects are found feasible from technical, environmental, and economic perspectives.

Table 6.1 Mini-bypass Projects

Items	Description
Classification	Regional Arterial Road
Designed Speed	60 to 80km/hour
Forecast Traffic Volume in 2010	Ypacarai 8,900 pcu/day
	Caacupe 11,200 pcu/day
	Itacurubi 13,300 pcu/day
	San Jose 13,300 pcu/day
Number of Lanes	Four: Ypacarai and Caacupe
	Two: Itacurubi and San Jose
Road Structure	
Length	Ypacarai: 5,175m, Caacupe: 7,000m Itacurubi: 6,120m, San Jose: 5,420m
Total Project Cost	US\$ 43.4 million
EIRR	25%

(2) Climbing Lanes

Based on the design standards defined in the AASHTO, climbing lanes will be provided in sections with gradient of over 3% continuing for more than 500m.

Table 6.2 Climbing Lane Projects

Items	Description
Classification	Regional Arterial Road
Designed Speed	Passenger Vehicles: 60km/hour Heavy Vehicles: 30 to 40km/hour
Road Structure	Roadway: 3m Shoulder: 1.5m
Length	13.4km in total
Project Cost	US\$ 27.9 million in total
EIRR	20%

(3) Grade Separation of Intersection

The existing rotary intersection near Coronel Oviedo causes many traffic accidents. Thus, grade-separation has been proposed in order to ensure a safe, smooth traffic flow into and from Coronel Oviedo where urbanization is taking place.

Table 6.3 Grade Separation of Intersection

Items	Description
Classification	Regional Arterial Road
Designed Speed	60km/hour
Road Width	Two lane (1.50 + 3.65 + 3.65 + 1.50)
Road Structure	PC Concrete Bridge (2@25.85+35.85+2@25.85)
Length	500m
Project Cost	US\$ 2.5 million
EIRR	9%

(4) Urgent Maintenance

The road inventory survey identifies locations with frequent occurrence of traffic accidents, inadequate traffic facilities, and decreasing traffic capacity. Based on these findings, improvement schemes have been proposed to increase traffic capacity.

a. Intersection Improvements

Many existing at-grade intersections on the study section do not have left-turning lanes and needs some improvements. The following intersections will be installed with left-turning lanes within their right-of-ways to increase the road capacity and reduce potential risks of traffic accidents.

Built-up area between San Lorenzo-Ypacarai:	5 locations.
Caaguazu :	1 location

b. Installment of Traffic Safety Facilities

The reduction of shoulder widths just before crossing the bridge often leads to crashes against bridge structures. In addition, other sections that need to improve safety facilities include acute curves and intersections lacking in traffic safety signs.

It is necessary for MOPC to launch these proposed urgent projects immediately within a budgetary limit. Thus, this plan does not suggest large-scale improvements in the facilities posing impediments but warning devices for road users to foresee potential dangers. Such devices are as follows.

- Installment of studs on the road surface before and after bridges
- Installment of warning signs before acute curves
- Improvement of intersections of new bypasses and existing roads

c. Maintenance and Renovation

The road and bridge inventory survey shows those bridges that require urgent renovation. In particular, some bridges deserve urgent treatments because of its age and heavy weight repeatedly placed by the traffic. The improvement plan identifies these locations and renovation schemes. The following projects have been proposed:

- Repair of bridges
- Overlay

7. Project Evaluation

7.1 Environmental Evaluation

a. Resettlement

All mini-bypass projects and the construction of a climbing lane in Coronel Oviedo will require resettlement of some residents. According to the interview survey conducted to 266 households to be affected by the projects, most of them, or 265, expressed their support for the implementation of the projects.

b. Natural Environment

A bypass route will pass near a nature protection area around Ypacarai Lake. Road design should consider means for minimizing impact on this swamp area, such as an adequate drainage plan.

7.2 Economic Evaluation

The total project cost amounts to US\$82 million, including US\$73.6 million for construction and US\$8.4 for compensation and land acquisition.

Table 7.1 Results of Economic Evaluation

	EIRR	NPV (Gs. Million)	B/C
Whole Project	25%	87,069	2.3
Bypass	28%	73,585	2.5
Climbing Lane (Coronel Oviedo)	20% (8%)	14,137 (- 2,835)	1.8 (0.7)
Flyover	9%	- 652	0.8

An EIRR for the whole project, excluding the urgent maintenance, has been found to be 25%, and the benefit-cost ratio found to be 2.3. Both indicators show that the project is economically feasible. For each individual project, when not accounting for benefits of accident reduction, the climbing lane project in Coronel Oviedo and the flyover project register low EIRRs. However, in considering the importance of the road and the need for keeping consistency in design standards, the improvement project is worth implementing.

7.3 Financial Evaluation

Based on an assumption that the study section will be operated as a tolled highway with the same toll rate and collection method as today (Gs5,000 for passenger vehicles, Gs10,000 for buses, and Gs15,000 for trucks), a financial analysis has been conducted to examine financial viability of the project through toll collection. The project costs include every cost item including the urgent projects except for land acquisition and compensations. As a result, the FIRR has been found to be around 15%. In case the toll is raised to a similar level currently employed in the tolled section on Route 7 (likewise, Gs6,000, Gs12,000, and Gs18,000, respectively), it will increase to 20%.

It is supposed that this project were to be implemented with private capital. The current interest rate from private banks ranges from 22% to 24%. With the annual inflation rate of 5%, the real interest rate in Paraguay is estimated at 17% to 19%. Therefore, the FIRR with current toll level may not be so attractive for a private venture.

TABLE OF CONTENTS

GENERAL

1 INTRODUCTION

1.1	Background of the Study	1-1
1.2	Objectives of the Study	1-2
1.3	Study Area	1-2
1.4	Target Year.....	1-2
1.5	Study Flow.....	1-2
1.6	Study Organization	1-4
1.7	Technology Transfer	1-5
1.8	Study Schedule	1-6

2 PHYSICAL PROFILE OF THE STUDY AREA

2.1	Topography.....	2-1
2.2	Climate	2-3
2.3	Geology	2-4
2.4	Natural Calamities	2-7

3 DEMOGRAPHIC AND ECONOMIC CONDITIONS

3.1	Population.....	3-1
3.2	Gross Domestic Product (GDP)	3-1
3.3	Agricultural Production	3-4
3.4	Employment	3-7
3.5	Inflation	3-8
3.6	External Commerce	3-9
3.7	Balance of Payment.....	3-11
3.8	Revenue and Expenditure of the Central Government.....	3-12
3.9	Public Debt	3-14

4 ORGANIZATION OF TRAFFIC AND ROAD CONSTRUCTION ISSUES

4.1	Air, Water, and Land Traffic in Paraguay.....	4-1
4.2	Organizations related to Transport	4-3
4.3	Organization of MOPC.....	4-4
4.4	Construction Procedures for New Roads.....	4-8
4.5	Implementation Schedule	4-10
4.6	Annual Budget of the Direction of Roads	4-13
4.7	Road Operation and Maintenance Systems.....	4-13
4.8	Toll Road	4-17

5 LAND USE AND DEVELOPMENT PLAN

5.1	Present Land Use	5-1
5.2	Future Land Use	5-4
5.3	Development Plan	5-5

6 ROAD NETWORK OF THE STUDY AREA

6.1	Transportation System	6-1
6.2	Function of National Roads of Paraguay.....	6-3
6.3	Road Situation	6-6
6.4	Existing Road Network	6-8
6.5	Future Road Network	6-9

SURVEY AND ANALYSIS

7 EXISTING ROAD CONDITION

7.1	General	7-1
7.2	Road Structure Conditions	7-4
7.3	The Situation of Road Maintenance	7-5
7.4	Bridge Condition	7-7

8 EXISTING TRAFFIC CONDITIONS

8.1	Roadside Traffic Count Survey	8-1
8.2	Roadside OD Survey	8-2
8.3	Intersection Traffic Count Survey	8-5
8.4	Travel Time Survey	8-5
8.5	Axle Load	8-7
8.6	Observation on Factors Affecting Traffic Flow	8-9
8.7	Level of Service by Road Section and Intersection.....	8-13

9 ROADSIDE ENVIRONMENTAL SURVEY

9.1	Legislative and Institutional Framework related to Environment.....	9-1
9.2	Environmental Characteristics in the Study Area.....	9-5
9.3	Air Pollution and Noise Level	9-21

10 REVIEW OF PRESENT DESIGN CONCEPT AND STANDARDS

10.1	Highway Design Standard	10-1
10.2	Structural Design Standards	10-1

11 FUTURE SOCIO-ECONOMIC FRAMEWORK

11.1	Population.....	11-1
11.2	GDP	11-1
11.3	Agricultural Products.....	11-3
11.4	Vehicle Registration.....	11-3
11.5	Exports and Imports	11-5

12 FUTURE TRAFFIC DEMAND

12.1	Methodology.....	12-1
12.2	Present OD Table.....	12-3
12.3	Zoning.....	12-5
12.4	Trip Generation and Attraction Model	12-8
12.5	Future OD Table	12-12
12.6	Future Traffic Demand	12-12

SELECTION OF THE BEST ALTERNATIVE

13 PLANNING CONCEPT

13.1	Planning Policy.....	13-1
13.2	Regional Planning Concept	13-2
13.3	Recommended Improvement Level of Service	13-4
13.4	Geometric Design Standard.....	13-6
13.5	Typical Cross Section	13-7

14 IMPROVEMENT METHOD

14.1	Proposed Improvement Measures	14-1
14.2	Specific Problems on National Route 2 and 7.....	14-1
14.3	Construction of Mini Bypass Road	14-4

15 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

15.1	Environmental Items	15-1
15.2	Examination of the Environmental Situation	15-2
15.3	Summary of the IEE	15-8
15.4	Conclusion of IEE	15-10

16 SELECTION OF THE BEST ALTERNATIVE

16.1	Bypass Routes	16-1
16.2	Position of Climbing Lane.....	16-4

FEASIBILITY STUDY

17 PRELIMINARY DESIGN

17.1	Natural Condition	17-1
17.2	Mini Bypass Road Design	17-11
17.3	Climbing Lane Design.....	17-13
17.4	Safety Facility Design	17-15
17.5	Pavement Design	17-16
17.6	Bridge Design	17-19

18 PROJECT COST ESTIMATES

18.1	Condition of Cost Estimates	18-1
18.2	Construction Cost	18-6
18.3	Land Acquisition and Compensation cost.....	18-6
18.4	Project Cost	18-7
18.5	Project Implementation	18-9
18.6	Operation and Maintenance Cost	18-10

19 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

19.1	Introduction	19-1
19.2	Methodology.....	19-2
19.3	Social Environmental Impact Assessment	19-5
19.4	Natural Environmental Impact Assessment	19-17
19.5	Pollution	19-22
19.6	Countermeasures and Environmental Management Plan.....	19-24
19.7	Household Opinion Survey	19-27

20 ECONOMIC EVALUATION

20.1	Methodology and Assumptions	20-1
20.2	Results of the Evaluation.....	20-11
20.3	Financial Analysis	20-16

PROJECT IMPLEMENTATION

21 MAINTENANCE PLAN

21.1	Recommendation for Road Maintenance	21-1
------	---	------

22 OVERALL EVALUATION AND RECOMMENDATIONS

22.1	Overall Evaluation.....	22-1
22.2	Recommendations	22-6

LIST OF TABLES

Table 1.7.1	The Held Workshop Schedule	1-6
Table 1.8.1	Time Schedule of the Study	1-7
Table 3.1.1	Population in 1992 and 1997	3-1
Table 3.2.1	GDP at Current Prices	3-1
Table 3.2.2	GDP and Value Added by Sector at Constant Prices of 1982	3-2
Table 3.2.3	Growth in GDP and Value Added by Sector.....	3-2
Table 3.2.4	Supply and Demand on National Account at 1992 Prices.....	3-3
Table 3.2.5	Growth in Total Supply and Demand	3-3
Table 3.3.1	Production of Major Agricultural Crops.....	3-4
Table 3.3.2	Production of Major Agricultural Crops by Department in 1997/1998	3-5
Table 3.3.3	Production of Major Perennial Crops	3-5
Table 3.3.4	Production of Perennial Agricultural Crops by Department in 1997/98.....	3-6
Table 3.3.5	Major Livestock Production	3-6
Table 3.3.6	Livestock Distribution in 1997/1998	3-7
Table 3.4.1	Change in Urban Unemployment	3-7
Table 3.4.2	Unemployment and Underemployment in 1998	3-8
Table 3.5.1	Price Indexes.....	3-8
Table 3.6.1	Registered Exports by Type of Commodity.....	3-9
Table 3.6.2	Registered Exports by Destination.....	3-9
Table 3.6.3	Registered Import by Type of Commodities.....	3-10
Table 3.6.4	Registered Imports by Origin.....	3-10
Table 3.7.1	Balance of Payment	3-11
Table 3.8.1	Revenue and Expenditure of the Central Government	3-12
Table 3.8.2	Expenditure by Ministry.....	3-13
Table 3.9.1	Public Debt	3-14
Table 4.5.1	Works in Execution.....	4-10
Table 4.5.2	Works with Guaranteed Finance	4-11
Table 4.5.3	Works with Financing in Process	4-12
Table 4.5.4	Candidate Works for Self-financing.....	4-12
Table 4.5.5	Total Investment for Road Construction.....	4-12
Table 4.6.1	Direction of Roads' Annual Budget.....	4-13
Table 4.7.1	Personnel in District Offices	4-15
Table 4.7.2	Machinery in District Offices	4-15
Table 4.8.1	Toll Rates	4-18
Table 4.8.2	Data on Annual Operation of Public Toll Collection	4-19
Table 4.8.3	Contents of Concession Works.....	4-20
Table 4.8.4	Basic Financial Information.....	4-20
Table 4.8.5	Toll Rates of New Road by Tape Pora (excerpt)	4-21
Table 5.1.1	Basic Data of the 3 Departments	5-1
Table 6.1.1	International transportation by mode in 1997	6-2
Table 6.2.1	Population, Industry and Number of cars owned	6-4
Table 6.2.2	Nature, Recreation and Culture	6-5

Table 6.2.3	Import / Export Freight by Means of Transportation	6-5
Table 6.2.4	Function of National Road Route.....	6-6
Table 6.3.1	Road Length by Pavement Type Unit: km	6-8
Table 7.1.1	Number of Traffic Accidents	7-2
Table 7.1.2	Traffic Congestion Rate and Level of Service	7-3
Table 7.4.1	Result of Investigation of Bridges	7-17
Table 8.1.1	12 hours Heavy Vehicle Ratio of Roadside Count	8-1
Table 8.2.1	Sample Number of Roadside Origin-Destination Survey	8-3
Table 8.2.2	Daily Traffic Generation and Attraction in 1999	8-4
Table 8.3.1	12 hours Heavy Vehicle Ratio of Intersection Count	8-5
Table 8.5.1	Axle Load Distribution Pattern by Type of Axle.....	8-8
Table 8.5.2	Axle Load Equivalency Factors	8-8
Table 8.6.1	24h/12h Traffic Volume Ratio on National Road 2 at San Jose.....	8-9
Table 9.1.1	List of Other Laws, Decrees and Ordinances related to the Environment	9-2
Table 9.1.2	International Conventions and Treaties	9-3
Table 9.1.3	Other Entities related to Environmental Issues and Protection	9-5
Table 9.2.1	Meteorological Conditions in the Study Area.....	9-6
Table 9.2.2	List of Endangered Fauna	9-7
Table 9.2.3	Natural Reservoirs and Parks around the Study Area	9-8
Table 9.2.4	Five River Sub-basin in the Study Area	9-12
Table 9.2.5	Population by District	9-14
Table 9.2.6	House and Household.....	9-14
Table 9.2.7	Economic Activities by Sectors.....	9-16
Table 9.2.8	Occupational Categories.....	9-16
Table 9.2.9	Number of Public Bus Stops and Taxis	9-17
Table 9.2.10	Public Infrastructure.....	9-17
Table 9.2.11	Urban and Rural Zones in the Study Area.....	9-19
Table 9.2.12	Air Pollutant Survey Result (<i>San Lorenzo</i>), Average Value	9-19
Table 9.2.13	Water Quality of <i>Lago Ypacaraí</i>	9-20
Table 9.2.14	Agrochemicals used in Paraguay	9-20
Table 9.3.1	Survey results of Air Pollution	9-21
Table 9.3.2	Noise Level in the Study Area.....	9-24
Table 9.3.3	Noise Level Standard of Asuncion Municipality	9-25
Table 9.3.4	Noise Level Standard during Construction	9-25
Table 9.3.5	Environmental Quality Standard for Noise of Japan.....	9-26
Table 9.3.6	Traffic Volume at Noise Level Monitoring Point Both Directions	9-26
Table 10.2.1	Load Combinations for Working Stress Design	10-4
Table 11.3.1	Future Main Agriculture Products.....	11-3
Table 11.4.1	Vehicle Registration in 1999	11-4
Table 11.4.2	Coefficient for Forecast	11-4
Table 11.4.3	Future Registered Vehicles in Paraguay (Medium Case)	11-4
Table 11.5.1	Estimated Total Export in 2010 and 2020	11-5
Table 11.5.2	Estimated Shares in Exports from Related Ports in 2010 and 2020	11-5
Table 11.5.3	Estimated Amount of Exports from Related Ports in 2010 and 2020 ..	11-6
Table 11.5.4	Total Import in 2010 and 2020	11-6

Table 11.5.5	Estimated Shares in Imports to Related Ports in 2010 and 2020	11-7
Table 11.5.6	Estimated Amount of Imports to Related Ports in 2010 and 2020	11-7
Table 12.2.1	Present Traffic Volume by Range.....	12-4
Table 12.3.1	Zoning and All Mode Vehicle Generation and Attraction.....	12-7
Table 12.4.1	Correlated Parameters for the Generation/Attraction Model.....	12-9
Table 12.4.2	Parameters of Generation/Attraction Model	12-9
Table 12.4.3	MERCOSUR-related Annual Export Volume	12-11
Table 12.4.4	Average Loading Volume by Traffic Survey.....	12-12
Table 12.4.5	Additional MERCOSUR-related Goods Vehicle Volume.....	12-12
Table 12.5.1	OD Volume and Increase Ratio	12-12
Table 13.3.1	Level of Service of the Existing Road with Forecast Traffic Volume..	13-5
Table 13.4.1	Improvement Design Standard of the National Route 2 and 7.....	13-6
Table 15.1.1	Environmental Items.....	15-1
Table 15.3.1	Evaluation Categories.....	15-8
Table 15.3.2	Summary of the IEE	15-9
Table 15.4.1	Environmental Items requiring Further Study and the Study Plan	15-11
Table 17.1.1	Work Area for Topographical Survey	17-1
Table 17.1.2	Outline of Boring	17-3
Table 17.1.3	Summary of the Borrow Pits Investigation	17-6
Table 17.1.4	Rainfall Depth during the Flood of November 1994 at Villarrica	17-7
Table 17.1.5	Rainfall Intensity Values at Various Frequencies.....	17-9
Table 17.1.6	Probable Discharge at the Site	17-10
Table 17.1.7	Drainage Facilities	17-10
Table 17.3.1	Acceleration Lane Length.....	17-14
Table 17.5.1	Design Traffic.....	17-16
Table 17.5.2	Design ESAL and Cumulative 18-kip ESAL	17-17
Table 17.5.3	Suggested Levels of Reliability for Various Functional Classifications.....	17-17
Table 17.5.4	Structural Number (S _{Ni}).....	17-18
Table 17.5.5	Layer Coefficients.....	17-18
Table 17.6.1	Material Strength.....	17-19
Table 17.6.2	Concrete Bridge Types and Standard Span Length.....	17-20
Table 17.6.3	Type of Superstructure for Proposed Bridges	17-20
Table 17.6.4	Abutment Types and Standard Height	17-22
Table 18.1.1	Wage.....	18-1
Table 18.1.2	Material Cost	18-2
Table 18.1.3	Project Cost Composition	18-3
Table 18.1.4	Summary of Bill of Quantities for Package 1	18-4
Table 18.1.5	Summary of Bill of Quantity for Package 2.....	18-5
Table 18.2.1	Construction Cost.....	18-6
Table 18.4.1	Summary of Project Cost	18-7
Table 18.5.1	Project Implementation Schedule.....	18-9
Table 18.6.1	Maintenance and Operation Cost	18-16
Table 19.1.1	Environmental Items requiring EIA and Further Study	19-1
Table 19.1.2	Projects List	19-1
Table 19.2.1	Survey Area	19-2

Table 19.2.2	Laws, Norms and Guidelines concerning EIA	19-3
Table 19.3.1	Population and Number of Households around the Mini Bypass Projects	19-5
Table 19.3.2	Indigenous Communities in the Survey Area	19-6
Table 19.3.3	Illegal Settlement.....	19-6
Table 19.3.4	Average Income.....	19-7
Table 19.3.5	Commercial Activities of Areas of Bypass Project along Route 2	19-7
Table 19.3.6	Total Area.....	19-8
Table 19.3.7	Agricultural Products/year (Average of 4 years; 1991- 1994).....	19-9
Table 19.3.8	Cattle in Three Departments	19-9
Table 19.3.9	Cattle Rising Area in Three Departments.....	19-9
Table 19.3.10 (1)	<i>Nicho</i> in the Section from 131 km to 181 km	19-12
Table 19.3.10 (2)	<i>Nicho</i> in the Section from 131 km to 181 km	19-13
Table 19.3.11	Potable Water Supply System.....	19-14
Table 19.3.12	Solid Waste Management.....	19-15
Table 19.3.13	Locations of Flooding.....	19-16
Table 19.3.14	Traffic Accidents on Routes 2 and 7 in 1998	19-16
Table 19.4.1	Soil Erosion Level in Eco-regions.....	19-17
Table 19.4.2	Fauna and Flora by Ecological Regions	19-18
Table 19.4.3	Endangered Fauna and Flora by Ecological Regions.....	19-19
Table 19.4.4	Fauna (Bird) observed in Survey Area	19-19
Table 19.4.5	Fauna (Reptile) Observed in Survey Area.....	19-20
Table 19.4.6	Fauna (Mammal) Observed in Survey Area	19-20
Table 19.4.7	Flora Observed in Survey Area	19-21
Table 19.5.1	Air Pollutants Improvement Quantity by Bypass Project.....	19-22
Table 19.5.2	Air Pollutants Improvement Quantity by Climbing Lane Project	19-22
Table 19.5.3	Air Pollutants Total Improvement Quantity	19-22
Table 19.5.4	Noise Level Forecast in Bypass Project (dB(A)).....	19-23
Table 19.5.5	Noise Level Forecast in Climbing Lane Project (dB(A))	19-23
Table 19.7.1	Sampling Number	19-27
Table 19.7.2	Average Income/ month	19-29
Table 19.7.3	Number of Family Members	19-29
Table 19.7.4	Term of Settlement.....	19-29
Table 19.7.5	Status of House Ownership.....	19-29
Table 19.7.6	Houses Used for Job Activities.....	19-29
Table 19.7.7	Construction Structure of Interviewee's House	19-30
Table 19.7.8	Construction Material of Interviewee's House	19-30
Table 19.7.9	Total Constructed Area.....	19-30
Table 19.7.10	Houses with Connection of Basic Services	19-30
Table 19.7.11	Price of House	19-30
Table 19.7.12	Access Time to Educational Facility.....	19-31
Table 19.7.13	Access Time to Medical Care Facility.....	19-31
Table 19.7.14	Participation in Community Activity.....	19-31
Table 19.7.15	Type of Community Activities Participated.....	19-31
Table 19.7.16	Rate of Vehicle Ownership	19-31
Table 19.7.17	Total Number of Vehicles Owned	19-31

Table 19.7.18	Major Objectives of Use of Routes 2 & 7	19-32
Table 19.7.19	Major Problems of Use of Route 2 & 7 Identified Interviewees	19-32
Table 19.7.20	Approval/disapproval Regarding Road Improvement Project	19-32
Table 19.7.21	Major Reasons for the Approval	19-32
Table 19.7.22	Necessary Requirements to be considered for Resettlement.....	19-33
Table 19.7.23	Necessary Compensation Measures for Resettlement	19-33
Table 19.7.24	Necessary Infrastructures in the Area to be resettled	19-33
Table 20.1.1	Aggregate Unit VOC by Type of Vehicle and by Traveling Speed.....	20-3
Table 20.1.2	Unit TTC by Type of Vehicle	20-5
Table 20.1.3	Characteristics of Traffic Accidents on National Road 2 and 7	20-6
Table 20.1.4	Number of Victims in One Traffic Accident.....	20-7
Table 20.1.5	Examples of Costs of Death and Injury by Traffic Accidents.....	20-7
Table 20.1.6	Unit Cost of Accidents	20-7
Table 20.1.7	Unit Cost Air Pollution (NO _x) to be Applied in Japan	20-8
Table 20.1.8	Unit Cost Air Pollution (NO _x) Applied.....	20-8
Table 20.1.9	Influence of Noise Reduction on Prices of Residential Land.....	20-9
Table 20.1.10	Assumptions of Affected Areas.....	20-9
Table 20.2.1	VOC and TTC Saving in 2010	20-11
Table 20.2.2	Traffic Accidents in Sections of Flyover and Alignment Improvement.....	20-12
Table 20.2.3	Reduction Accident Cost by Flyover and Alignment Improvement..	20-12
Table 20.2.4	Benefits of Reduced Air Pollution	20-12
Table 20.2.5	Benefits of Noise Reduction	20-12
Table 20.2.6	Economic Cost of Land.....	20-13
Table 20.2.7	Cost-Benefit Stream and Economic Indicators of the Whole Project	20-13
Table 20.2.8	Economic Indicators of the Project Components	20-14
Table 20.2.9	Economic Indicators with Consideration of Accident Cost Reduction	20-14
Table 20.2.10	Economic Indicators with Accounting for Environmental Improvement	20-15
Table 20.2.11	VOC and TTC Saving in Case of 10% Decrease in Traffic Volume..	20-15
Table 20.2.12	Economic Indicators in Case of 10% Decrease in Traffic Volume.....	20-15
Table 20.2.13	Economic Indicators in Case of 10% Increase in Costs.....	20-16
Table 20.3.1	Applied Toll	20-16
Table 20.3.2	Estimates of Toll Revenue.....	20-17
Table 20.3.3	Estimates of Toll Revenue (Case-1).....	20-17
Table 22.1.1	Projection of Major Indices.....	22-1
Table 22.1.2	Traffic Volume by Section.....	22-1
Table 22.1.3	Existing Road Capacity and Traffic Demand	22-2
Table 22.1.4	Mini-bypass Projects.....	22-2
Table 22.1.5	Climbing Lane Projects	22-2
Table 22.1.6	Project Costs	22-5

LIST OF FIGURES

Figure 1.5.1	Study Flow.....	1-3
Figure 1.6.1	Study Organization	1-4
Figure 2.1.1	Location Map of Study Area	2-1
Figure 2.2.1	Climate Classification.....	2-4
Figure 2.3.1	Soil Map.....	2-5
Figure 2.3.2	Hydro-geology	2-5
Figure 2.3.3	Geological Map of Study Area.....	2-6
Figure 2.4.1	Hydrography.....	2-7
Figure 2.4.2	Hydro-geological Map	2-8
Figure 4.1.1	Transportation of Paraguayan Imports per Mode.....	4-1
Figure 4.2.1	Organizations related to Transport	4-3
Figure 4.3.1	Organization of the MOPC	4-5
Figure 4.3.2	Organization of the OPIT	4-6
Figure 4.3.3	Organization of the Direction of Roads	4-7
Figure 4.7.1	Organization of Department of Road Conservation.....	4-13
Figure 4.7.2	Administrative Map of Road Conservation	4-14
Figure 4.8.1	Location of Toll Plazas	4-17
Figure 4.8.2	Organizational Structure of Toll Collection System.....	4-18
Figure 5.1.1	Present Land Use.....	5-3
Figure 5.3.1	Alternatives for Route between Atlantic Ocean and Pacific Ocean	5-7
Figure 5.3.2	Zoning of Land Use in the Future	5-8
Figure 5.3.3	Expansion of Built-up Area	5-9
Figure 5.3.4	Recreation Area and its Development Area.....	5-10
Figure 5.3.5	Construction Area of Vehicle Restriction and Planning Area	5-11
Figure 5.3.6	Road Planning Alternatives	5-12
Figure 5.3.7	Project Area and Location of Bus Terminal.....	5-13
Figure 6.1.1	Paraguay's Export Route.....	6-1
Figure 6.1.2	Trunk Road Network	6-3
Figure 6.5.1	Road Network	6-10
Figure 7.1.1	Location Map of the National Road Route 2 and Route 7.....	7-1
Figure 7.3.1	Existing Cross Section.....	7-6
Figure 7.4.1	Location Map of Existing Bridges	7-8
Figure 8.1.1	Traffic Survey Location Map.....	8-1
Figure 8.2.1	Desired Lines.....	8-2
Figure 8.4.1	Travel Time Survey Results.....	8-6
Figure 8.5.1	Procedure to Determine Axle Load	8-7
Figure 8.6.1	24h/12h Traffic Volume Ratio on National Road 2 at San Jose.....	8-9
Figure 8.6.2	Annual Traffic Volume Fluctuation on Target Route	8-10
Figure 8.6.3	24hours Annual Average Traffic	8-10
Figure 9.1.1	Organizational Chart of DOA.....	9-4
Figure 9.2.1	National Parks, Reservoirs and Protected Areas of Paraguay	9-9
Figure 9.2.2	Ypacaraí Managed Resources Reservoir (Reserva de Recursos Manejados Ypacarai).....	9-10
Figure 9.2.3	Geology of the Study Area.....	9-11

Figure 9.2.4	River Basins in the Oriental Region of Paraguay	9-13
Figure 9.2.5	Indigenous Communities in <i>Caaguazú</i> Department	9-15
Figure 9.3.1	SPM Concentration in the Study Area.....	9-21
Figure 9.3.2	TSP Concentration in the Study Area	9-22
Figure 9.3.3	Pb Concentration in the Study Area.....	9-22
Figure 9.3.4	NO _x Concentration in the Study Area.....	9-23
Figure 9.3.5	Noise Levels in the Study Area	9-25
Figure 9.3.6	Correlation between Traffic Volume and Noise Level	9-27
Figure 10.2.1	"B" Truck Loading.....	10-2
Figure 11.1.1	Present and Future Population Trend in Paraguay.....	11-1
Figure 11.2.1	GDP Past Trend in Paraguay	11-1
Figure 11.3.1	Corn Production Past Trend in Paraguay.....	11-3
Figure 11.4.1	Vehicle Registration Past Trend per Type in Paraguay	11-3
Figure 11.5.1	Trend of Exports Amount in Recent Years.....	11-5
Figure 11.5.2	Trend of Import Amount in Recent Years	11-6
Figure 12.1.1	Future Demand Forecast Process	12-2
Figure 12.2.1	Annual Traffic Increase Ratio	12-3
Figure 12.2.2	Present OD Development Process	12-3
Figure 12.2.3	Present Traffic Volume by Range.....	12-4
Figure 12.3.1	Zoning Intention.....	12-5
Figure 12.3.2	Zoning Map	12-6
Figure 12.4.1	Trip Generation and Attraction.....	12-10
Figure 12.4.2	OD Added Area for MERCOSUR Goods Vehicle	12-11
Figure 12.6.1	Future Traffic Demand in 2010	12-13
Figure 12.6.2	Future Traffic Demand in 2020	12-14
Figure 13.1.1	Location Map of Route from Asuncion to Ciudad Este	13-1
Figure 13.2.1	Development Pattern	13-3
Figure 13.5.1	Typical Cross-section.....	13-7
Figure 13.5.2	Existing Road Extension Plan	13-8
Figure 14.2.1	At-grade Intersection	14-2
Figure 14.2.2	Fly-over Intersection.....	14-2
Figure 14.2.3	Speed-distance Curves for Typical Heavy Trucks of 300 lb/hp for Deceleration	14-3
Figure 14.3.1	Location of Bypass Roads.....	14-4
Figure 15.2.1	Ratio of Economic Activities by Sector in the Study Area	15-2
Figure 16.1.1	Mini Bypass Route of Ypacarai.....	16-1
Figure 16.1.2	Mini Bypass Route of Caacupe	16-2
Figure 16.1.3	Mini Bypass Route of Itacurubi.....	16-3
Figure 16.1.4	Mini Bypass Route of San Jose	16-4
Figure 16.2.1(1/3)	Position of Climbing Lane	16-5
Figure 16.2.1(2/3)	Position of Climbing Lane	16-6
Figure 16.2.1(3/3)	Position of Climbing Lane	16-7
Figure 17.2.1	Ypacarai Bypass Typical Cross Section.....	17-11
Figure 17.3.1	Typical Cross Section of Climb Lane	17-13
Figure 17.3.2	Profile of Climb Lane	17-14
Figure 17.3.3	Plan of Climbing Lane.....	17-14

Figure 17.4.1	Safety Facility.....	17-15
Figure 17.6.1	Cross Section of Bridge.....	17-21
Figure 17.6.2	Cross Section of Pier Flyover	17-22
Figure 18.4.1	Cost Component Ratio by the Construction Works	18-8
Figure 18.4.2	Cost Component Ratio by Project.....	18-8
Figure 18.4.3	Comparison of Construction per Kilometer	18-8
Figure 18.6.1	Main Maintenance Center, Maintenance Office and Toll Collection Office	18-12
Figure 18.6.2	Definition and Function of the Toll Road OMM System	18-13
Figure 19.2.1	Flowchart of EIA.....	19-4
Figure 19.7.1	Interviewee.....	19-27
Figure 19.7.2	Occupation.....	19-28
Figure 20.1.1	Procedure of Economic Evaluation.....	20-1
Figure 20.1.2	Aggregate Unit VOC.....	20-4

LIST OF ABBREVIATIONS

GSP	: Gross Domestic Products.
MOPC	: Ministerio de Obras Públicas y Comunicaciones.
MERCOSUR	: Mercado Común del Cono Sur. (South American Common Market)
JICA	: Japan International Cooperation Agency.
MAG	: Ministerio de Agricultura y Ganadería.
IDB	: Interamerican Development Bank.
BIRF	: International Reconstruction and Development Bank.
CADEX	: Brazilian Chamber of Commerce.
CAF	: Andean Development Corporation.
OECE	: Overseas of Economic Cooperation Fund of Japan.
S. Estanislao	: San Estanislao.
Corr. de Exportac.	: Corredor de Exportación.
Pav. Ruta 3	: Pavimentación Ruta 3.
SIAMV	: Sistema Integral de Mantenimiento Vial.
S.A.	: Sociedad Anónima.
PIB	: Producto Bruto Interno.
BCP	: Banco Central de Paraguay.
CONAVI	: Consejo Nacional de Viviendas.
Cnel. Oviedo	: Coronel Oviedo.
OD	: Origen - Destino.
EPEI	: Equivalente del Peso sobre cada Eje Individual.
CI	: Comisión Inter Institucional.
NTA	: Normas Técnicas Ambientales.
ETAG	: Especificaciones Técnicas Ambientales Generales.
MSPBS	: Ministerio de Salud Pública y Bienestar Social.
CORPOSANA	: Corporación de Obras Sanitarias.
SNF	: Servicio Nacional Forestal.
DPNVS	: Dirección de Parques Nacionales y Vida Silvestre.
DOA	: Dirección de Ordenamiento Ambiental.
EIA	: Evaluación de Impacto Ambiental.
INDI	: Instituto Paraguayo del Indígena.
IBR	: Instituto de Bienestar Rural.
SFN	: Servicio Forestal Nacional.
DMA	: Dirección de Medio Ambiente.
SENASA	: Servicio Nacional de Saneamiento Ambiental.
MIC	: Ministerio de Industria y Comercio.
IGM	: Instituto Geográfico Militar.
CDC	: Centro de datos para la Conservación.
PRODEP	: Proyecto de Descentralización del Paraguay.
USAID	: Agencia Estadounidense para el Desarrollo Internacional.
EAI	: Examen Ambiental Inicial.
VOC	: Costos Operativos de Vehículos.
TTC	: Costo de Tiempo de Viaje.

OPIT	: Oficina de Planificación Integral de Transporte.
FCE	: Factor de Conversión Estándar.
COC	: Costo de Oportunidad del Capital.
TIRE	: Tasa Interna de Retorno Económico.
VCN	: Valor Corriente Neto.
INF. INCL.	: Informe Inicial.
INF. PROG.	: Informe Progreso.
INF. INT.	: Informe Intermedio.
Org. de la Impl. del Plan:	Organización de la Implementación del Plan.
Cost. Est.	: Costo Estimativo.
Brr.	: Borrador.
Res. Alt.	: Resultado Alternativo.
INF. B. FINAL	: Informe Borrador Final.
Eval.	: Evaluación.
INF. FIN.	: Informe Final.
Ha.	: Hectáreas.
Kg.	: Kilogramo.
Ton.	: Tonelada.
Incre.	: Incremento.
Ao	: Arroyo.
Nº	: Número.
DINAC	: Dirección Nacional de Aeronáutica Civil.
CUD	: Carga Uniformemente Distribuida.
CP	: Carga Puntual.
STP	: Secretaría Técnica de Planificación.
EST.	: Estación.
ESAL	: Eje de Carga Simple Equivalente.
CITES	: Convención sobre el Comercio Internacional de Especies amenazadas de Fauna y Flora Silvestre.
SPM	: Materia de Partícula Suspendida.
COV	: Costos de Operación del Vehículo.
CTV	: Costo de Tiempo de Viaje.
NS	: Nivel de Servicio.
ESAL	: Carga de Eje Único Equivalente.
CBC	: Carga de Borde de Cuchilla.
SMA	: Sistema de Mantenimiento y Administración de Tráfico.
CPM	: Centro Principal de Mantenimiento.
OM	: Oficina de Mantenimiento.
FD	: Franjas de Dominio.
ONG	: Organizaciones no Gubernamentales.
SIG	: Sistema de Información Geográfica.
SAP	: Sistema de Administración de Pavimento.
FOB	: Free on Board.
TIRF	: Tasa Interna de Retorno Financiero.