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THE FEASIBILITY STUDY ON ARTERIAL ROAD DEVELOPMENT PROJECT IN THE CENTRAL EASTERN REGION OF PARAGUAY

FINAL REPORT

Environmental Study Report

FEBRUARY, 1997

CENTRAL CONSULTANTS INC.

THE FEASIBILITY STUDY ON ARTERIAL ROAD DEVELOPMENT PROJECT IN THE CENTRAL EASTERN AREA IN THE REPUBLIC OF PARAGUAY

FINAL REPORT

(Volume II - Environmental Study Report)

FEBRUARY, 1997

CENTRAL CONSULTANTS INC. (JAPAN)
IN ASSOCIATION WITH
YACHIYO ENGINEERING CO., LTD. (JAPAN)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF PUBLIC WORKS AND COMMUNICATIONS
THE REPUBLIC OF PARAGUAY

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ARTERIAL ROAD DEVELOPMENT PROJECT
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TABLE OF CONTENTS

CHAPTER 7 FORECASTS OF ENVIRONMENTAL IMPACTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1-1 Background of the Environmental Study

This report compiles the Environmental Study results of the Feasibility Study on the Arterial Road Development Project in the Central Eastern Area of the Republic of Paraguay, which was conducted by the JICA (Japan International Cooperation Agency) Study Team following a request from the Paraguayan Government.

This Environmental Study was required as a part of the JICA Study, and also as a indispensable part of road development project studies in Paraguay, which will serve as a basis for the Environmental Impact Assessment required prior to the implementation of the road development projects.

1-2 Purpose and Components of the Environmental Study

1-2-1 Purpose of the Environmental Study

It is necessary for development projects to harmonize with the surrounding natural, social and living environments in order to ensure sustainable development in a country. As a result, the environmental impact must be considered at every stage of a project cycle, as shown on Figure 1.2.1.

Environmental studies are an important part of this project, and their important purpose is "in advance of the implementation of a project, to investigate the possibilities of serious impact by the development project, to evaluate investigation results, and to plan adequate measures to avoid or mitigate that impact if necessary'.

In this regard, the Environmental Study of the Project includes the following two studies;

i) To conduct an Initial Environmental Evaluation (IEE) study to clarify the necessity of the Environmental Impact Assessment (EIA) for the Project.

ii) To conduct an Environmental Impact Assessment (EIA) for the Project.

iii)To prepare IEE and EIA reports in accordance with the contents required by Law No.294 in Paraguay, and guidelines set by the relevant international authorities.

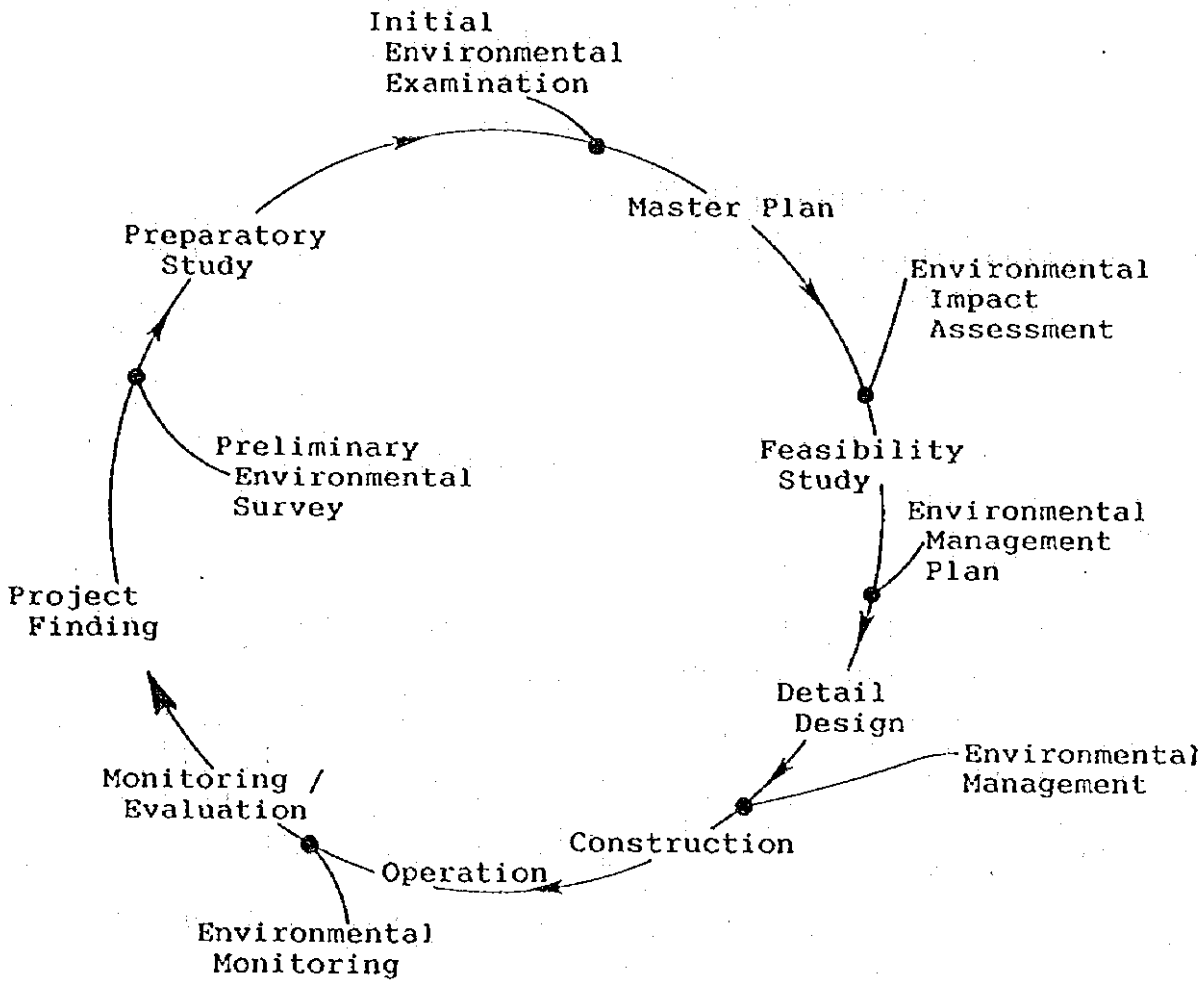


Figure 1.2.1 Environmental Considerations in the Project Cycle

1-2-2 Initial Environmental Evaluation (IEE)

The interim stage of the JICA Study aim at setting planning frameworks and selecting optimum alternative routes for the Project. The Environmental Study in this stage calls for conducting an Initial Environmental Evaluation of the Project. The purpose of the IEE is to evaluate the environmental impact of the Project in general, and to clarify the necessity of an Environmental Impact Assessment study in the next stage.

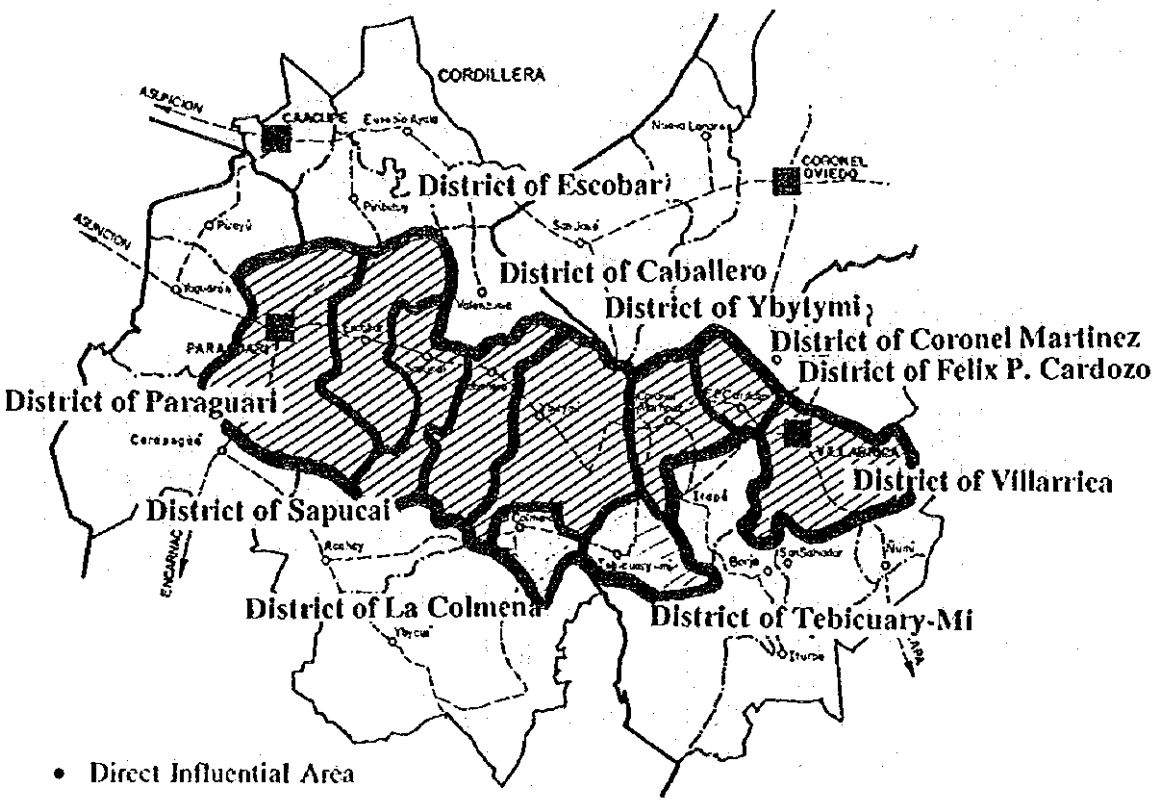
1-2-3 Environmental Impact Assessment (EIA)

After the interim stage, the main objective of the JICA Study is to conduct a feasibility study for the selected optimum route of the Project. The Environmental Study in this stage aims to conduct an Environmental Impact Assessment study according to the laws of Paraguay, as well as guidelines set by the relevant international development authorities.

1-3 Objective Area of the Environmental Study

The objective area of the Study was set in two levels as shown on Figure 1.3.1.

- Direct Influential Area : It is the area that will be directly influenced by the project, limited by the boundaries of the 10 Districts of the two Departments of Parguarí and Guairá, through which the project road will pass.
- Indirect Influential Area : It is the area that will be indirectly influenced by the project, limited by the boundaries of the two Departments of Parguarí and Guairá.



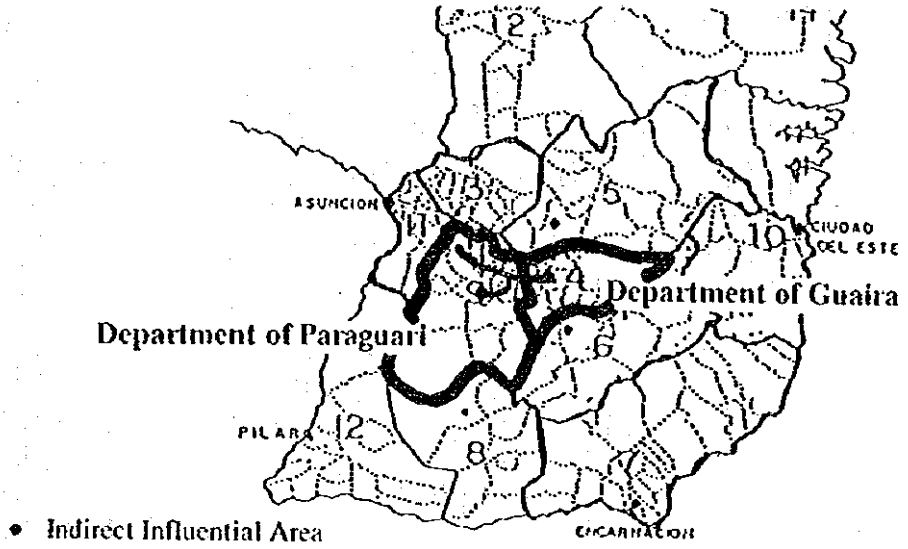


Figure 1.3.1 Objective Area of the Study

1-4 Basic Approach of the Environmental Study

The Environmental Study was conducted according to the procedure shown in Figure 1.4.1. The major items of the Study are as follows:

(1) Initial Environmental Evaluation (IEE)

1) To confirm the legal implications of the EIA in Paraguay
2) To identify the contents of the Project
3) To identify the environmental factors of the Project
4) To identify the existing environmental conditions of the objective area
5) To identify the environmental items influenced by the Project
6) To identify the magnitude of the Project's impact (Screening and Scoping) and to evaluate the necessity and scope of the EIA, and also to select items of further investigation to forecast the expected impacts
7) To investigate in detail the existing conditions of the environmental items selected in 6) above
8) To evaluate and compare the environmental impacts of alternative routes
9) To clarify the necessity and contents of the EIA study

(2) Environmental Impact Evaluation (EIA)

10) To review IEE studies according to the selected definite alternative route
11) To select items, and to forecast the character and magnitude of environmental impacts
12) To set environmental standards and evaluate impacts
13) To formulate adequate plans and programs to mitigate environmental impacts and to conserve desirable environmental conditions
14) To determine project feasibility from an environmental viewpoint
15) To prepare the EIA report

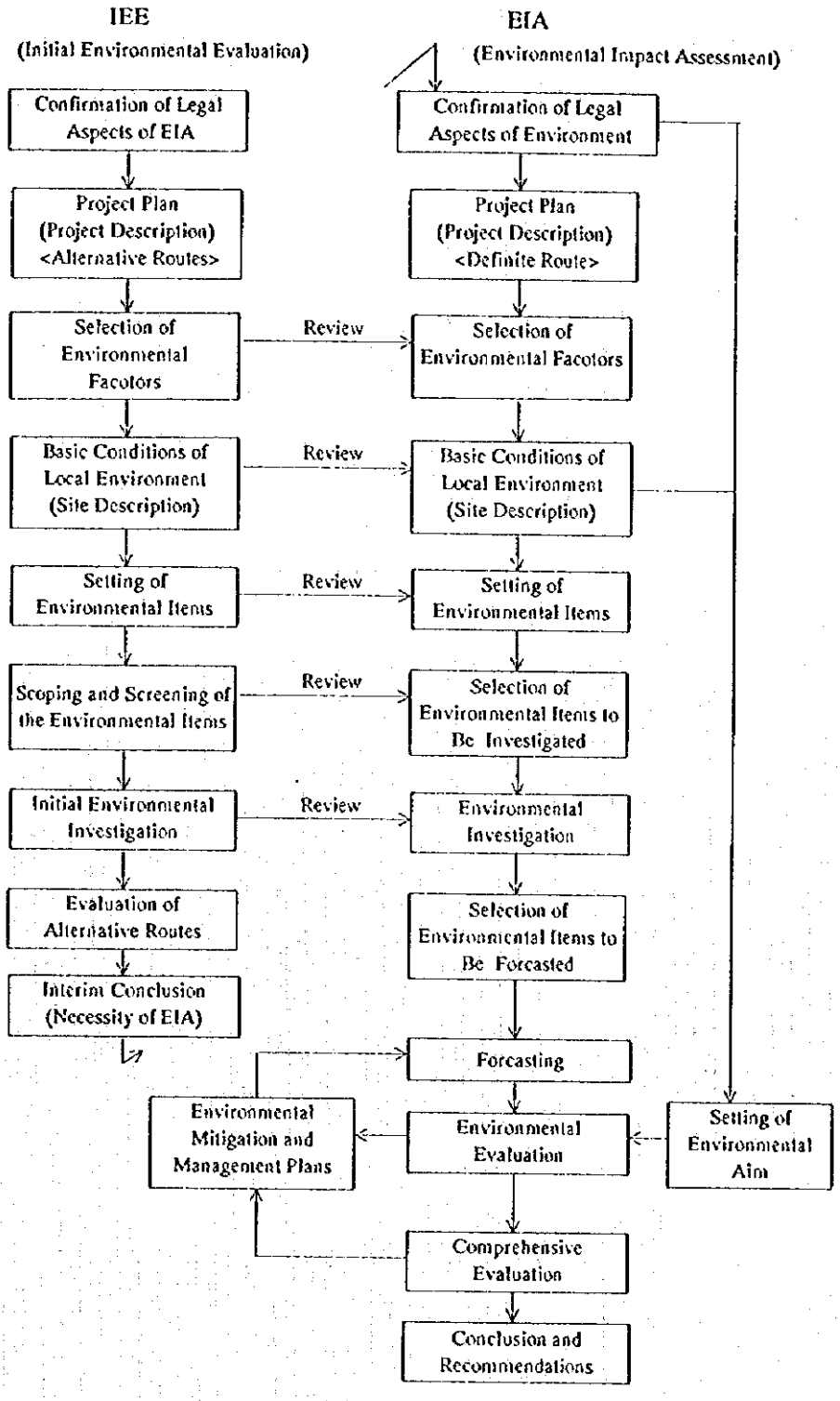


Figure 1.4.1 Basic Flow of the Environmental Study

CHAPTER 2

LEGAL ASPECTS

CHAPTER 2 LEGAL ASPECTS

2.1 Legal Framework for EIA (Environmental Impact Assessment) in Paraguay

2.1.1 Laws and Regulations Related to (EIA)Environmental Impact Assessment

(1) Law No.294

In 1993, Law No.294 was instituted as the first law related to the EIA in Paraguay. Law No.294 identified the general objectives, contents, processes, and institutional framework of the EIA. Although the regulations set forth by this law are now being discussed in Congress, MOPC control of the road project is required the EIA.

Prior to the establishment of Law No.294, Directive No.8462 was established by MOG in 1991, with the aim of regulating the implementation of the EIA for road projects. This Directive also established an EIA committee.

2.1.2 Institutional Framework of Environmental Impact Assessment(EIA)

(1) MAG (Ministry of Agriculture and Stock Farming)

The Ministry of Agriculture and Livestock (MAG=Ministerio de Agricultura y Ganaderia) is responsible for environmental protection and preservation in Paraguay. As one of the three subsecretariats under the minister, the subsecretariat for natural resources and environment has three departments in charge of national forests, national parks, and wildlife and environmental control, respectively, as shown in Figure 2.1.1.

The Department of Environmental Control (DOA=Direccion de Ordenamiento Ambiental) also has three subdepartments in charge of environmental control, environmental impact evaluation, and regional environmental control, respectively.

(2) DOA (Department of Environmental Control)

The DOA in MAG is responsible for evaluating all the EIAs in Paraguay. It also functions as a secretariat for the Inter-institutional Committee (CI = Commission Inter-institutional), which is in charge of evaluating and approving all the EIA reports submitted by the authorities responsible for the project.

(3) CI (Inter-institutional Committee)

Under Directive No.8462, issued in 1991, the Inter-institutional Committee for road development projects was established with members from the following authorities: MOPC Road department, MOPC Environmental Unit, UNDI (Institute of the Paraguayan Indigenous People) Technical Coordinator, MAG Planning Coordinator, MAG Department of National Forests, MAG Department of National Parks and Wildlife, and MAG Department of Environmental Control.

(4) MOPC Environmental Unit (UA=Unidad Ambiental)

As the section responsible for the environmental aspects of the MOPC road development projects, the Environmental Unit (UA=Unidad Ambiental) was established in 1993 under the rubric of the Road Department. To implement road development projects, environmental study reports shall be coordinated with UA, and submitted to the CI through the UA of MOPC and the DOA of MAG. These shall be finalized after CI approval is obtained.

2.2 Laws and Regulations Related to the Environment

There is no unified environmental law in Paraguay; however, there are many individual laws and regulations related to the natural and social environment. Below, some of the most representative laws and regulations are summarized.

2.2.1 Constitution and International Conventions

(1) National Constitution

In 1967, the Constitution lay down a basic approarch to the environment. Article 94, for example, states that the government should promote econonic development by using the avilable natural resources. Article 132 atates that the government is in charge of the preservation of forests and renewable natural resources in Paraguay, and should therefore follow rules of reasonable exploitation, conservation, and renovation.

In 1992, the Constitution lay down the basic approarch that should be taken toward the environment. This new constitution included many articles related the environment, and emphasized the right to a healthy environment and the need for environmental protection. Sample articles are provided:

Article 6: Quality of Life
Quality of life will be promoted by the government through the implementation of suitable plans and policies that identify important factors such as poverty, handicaps, and age.

Article 7: Right to a Healthy Environment
Everybody has the right to a healthy and ecologically balanced environment. Priority objectives include preservation, conservation, renovation, and improvement of the environment.

Article 8: Environmental Protection
If any activity causes an important change in the environment, it will be regulated by law. Similarly, any activity that may cause any adverse effect will be prohibited. For example, the assembly, manufacture, import, commercialization, possession or use of nuclear chemical or biological weapons, and the introduction of toxic waste are strictly forbidden. All ecological offences will be punished by law. Any damage caused to the environment will create an obligation to rectify said damage.

ORGANIGRAMA INDICANDO LA UBICACION A NIVEL MINISTERIAL
DE LA AUTORIDAD NACIONAL AMBIENTAL

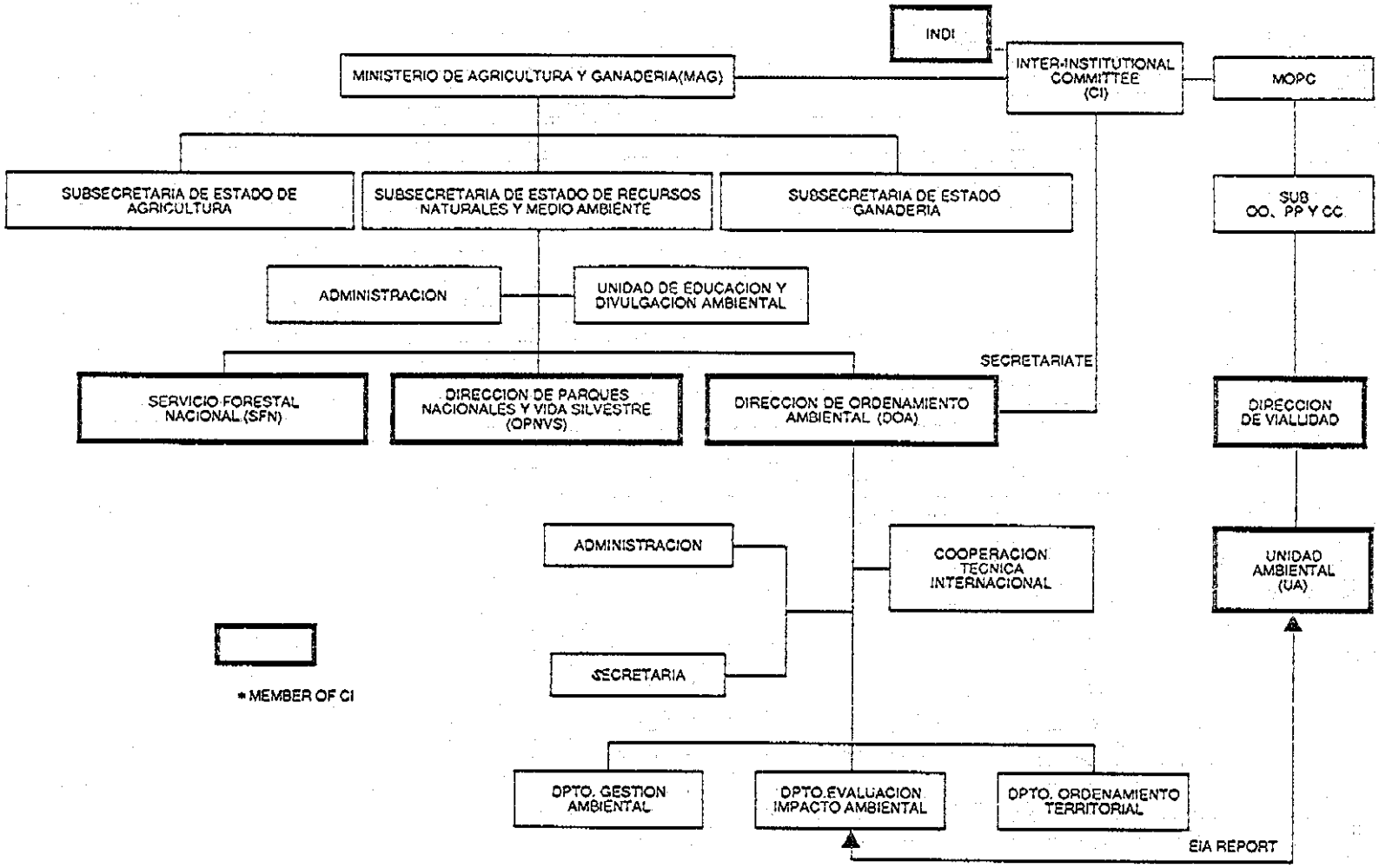


Figure 2.1.1 Organizations Related to EIA

(2) International Conventions

The international conventions related to the environmental laws that Paraguay has ratified can be summarized as follows:

- Convention prohibiting the development, production, and stockpiling of bacterial (biological) and chemical weapons, Washington, 1972
  - subscribed by Paraguay on 9 June, 1972
- Convention prohibiting trade in endangered species of wild fauna and flora, Washington, 1973
  - subscribed by Paraguay on 13 Feb., 1973
- United Nations convention on the Law of Sea, Montego Bay, 1982
  - subscribed by Paraguay on 13 Feb., 1973
- United Nations convention on climatic changes, Conference on the environment and development. Earth summit, Rio de Janeiro, 1993
  - incorporated by law 251/93
- United Nations convention on biological diversity, Conference on the environment and development. Earth summit, Rio de Janeiro, 1993
  - incorporated by law 253/93
- Ramusar convention, Ramusar, 1971
  - incorporated by law 350/94

2.2.2 Legal Aspects of the Natural Environment

The following is a list of principal laws related to the conservation and protection of the natural environment of Paraguay.

- Law 422/77 : concerning Forests
- Law 40/90 : concerning National Commission for the protection of natural resources
- Law 96/92 : concerning Wildlife
- Law 352/94 : concerning Reserve Area
- Law 536/95 : concerning Forestation and Reforestation

2.3 Organizations Related to the Environment

In Paraguay there is no independent authority in charge of comprehensive environmental administration; however, there are several organizations involved in this area.

(1) MAG

The state sub-secretariat of natural resources and environment was created by decree 1924/89. It is made up of three institutions:

- The National Forests Service, created in 1973, ruled by decree 11.68 1 in 1975.
- The National Parks and Wild Life Administration , ruled by decree 19.165 in 1967
- The Environmental Order Administration, created in 1989 by decree 3.439.

They have three main aims:

- To propose, make and execute environmental policies.
- To develop a system of geographical and environmental information and research.
- To suggest and implement institutional mechanisms of control and inspection.

(2) MOPC

MOPC is in charge of public works, that is, roads, transportation, energy, tourism, mining, and communications. In this regard, the following organizations are also involved with environmental administrative works:

- State sub-secretariat of public works (Unidad Ambiental)
- State sub-secretariat of minerals and energy (Mineral Resourses)
- AMMP - National administrartion of navigation and airports
- ANDE - National administration of electricity

(3) Others

The following related organizations exist in other ministries.

- SENASA under the Ministry of Health
- Technical assessor for environmental coordination under the Ministry of Education
- National institute of indigenous people under the Ministry of Defence
- Direction of meteorology and hydrology under the Ministry of Defence
- CORPOSANA (Corporation of Sanitary Works)

CHAPTER 3

PROJECT DESCRIPTION

CHAPTER 3 PROJECT DESCRIPTION

3-1 Purpose of the Project

3-1-1 Purpose of the Project

The road network is a major and very important part of the infrastructure of Paraguay, a landlocked country with no access to the sea. In 1990, more than 85% of the country's total freight was transported by road. However, the country's roads are in poor condition, and have long held back conomic development. Of the total extent of roads in the country, 28,067 km, national roads account for only 3,444 km, which means that only 9.4% of the roads are paved.

As part of the Master Plan for National Transport 2010 and the National Road Development Plan, the Ministry of Public Works and Communications (MOPC) has developed and improved the road network in many part of the country. This project represents a part of those plans.

The Project entitled "Arterial Road Development Project in the Central Eastern Area of the Republic of Paraguay" purposes the following:

i) To develop an all-weather paved road along a route connecting national roads No.2 and No.8, through the towns of Paraguari and Villarrica, said road being expected to function as a bypass route for national roads No.2 and No.7, along which much traffic is concentrated.

ii) To develop a paved branch road along the route mentioned above to La Colmena, in order to promote the agricultural development of the surrounding area.

3-1-2 Execution Body

The body in charge of executing the Project is the Ministry of Public Works and Communications (MOPC) of the Republic of Paraguay, through the Department of Roads (Dirección de Vialidad) under the Subsecretariat of Public Works.

Maintenance work on the road will be implemented under the control of two MOPC maintenance offices, the Acahay section office in Distrito-1 and the Ñumí office in Distrito-8. The body responsible for analyzing and controlling of the Environmental Impact Assessment Study in the MOPC is the Environmental Unit (Unidad Ambiental) of the MOPC.

3-2 Location of the Project

3-2-1 Environmental Location of the Project

The location of the Project was determined on the basis of three different environmental categories as follows:

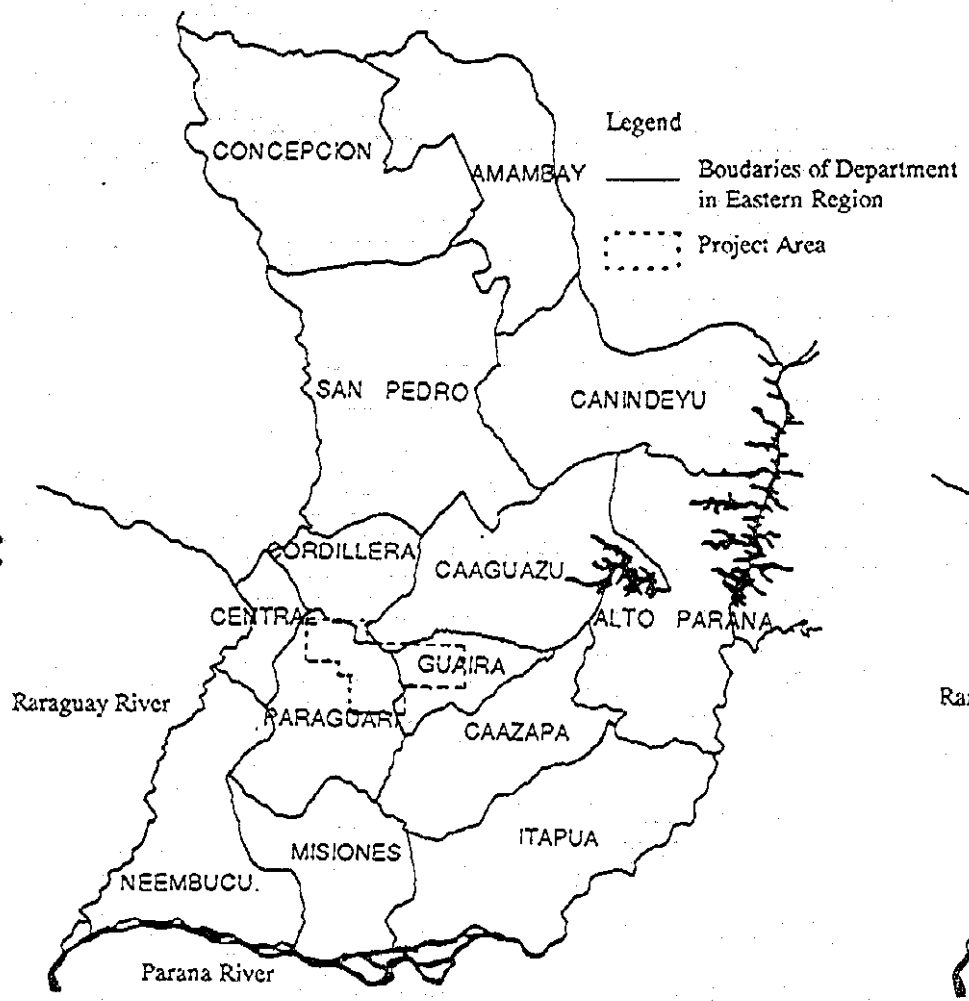
(1) Location of the Administrative Boundaries

The regional administrative system in Paraguay consists of four strata, that is, Región (Region), Departamento (Department), Distrito (District) and Municipalidad or Campaña (Municipality or Villages).

The Project is located in the Eastern Region, consisting of two Departments, Paraguarí and Guairá. Of the 17 Districts in the Department of Paraguarí, the Project road will pass through 7 Districts (Paraguarí, Escobar, Sapucaí, Caballero, Ybytymí, Tebicuary Mí, and La Colmena). Of the 16 Districts in the Department of Guairá, the Project road will pass through 3 Districts (Coronel Martínez, Félix Pérez Cardozo, and Villarrica). In total, the Project will extend over 10 Districts, as shown in Figure 3.1.1.

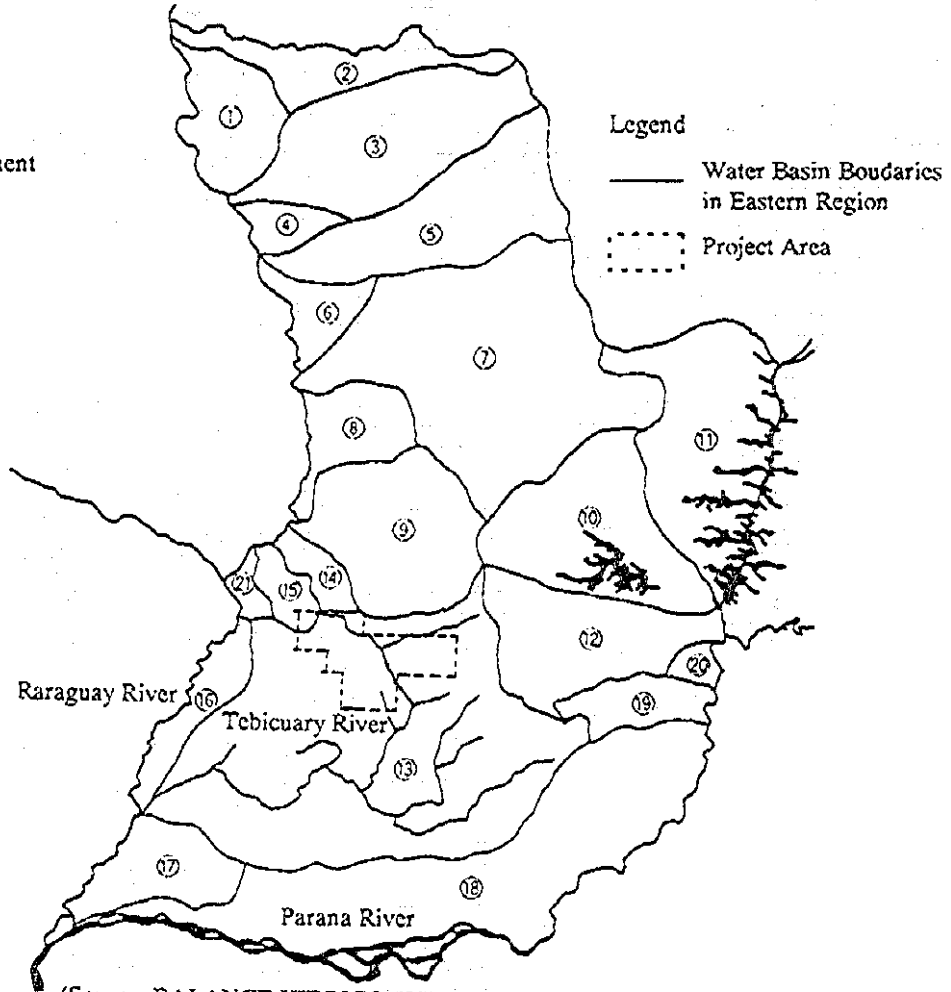
(2) Location of Hydrographical Boundaries

The water basins in the Eastern Region of Paraguay are divided into 21 parts as shown in Figure 3.1.2. The project road route will be limited to the water basin of the Tebicuary River. Five branch basins are located in the area. They are Arroyo Caanabe, Arroyo Paso Pypucu-Yhaca, Arroyo Tebicuary Mí, Arroyo Jhu, and Arroyo Mitay-Bobo.



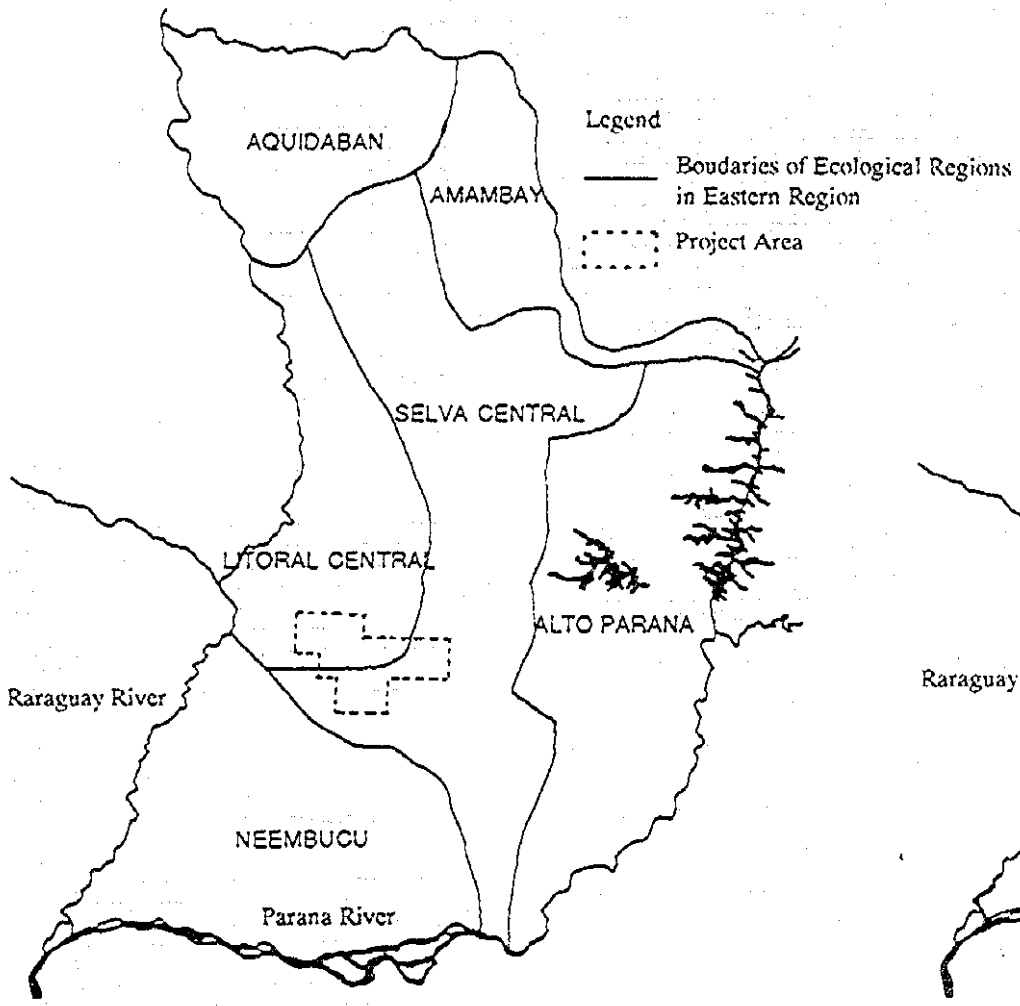
(Source: MAPA DE RUTAS, DSGM, 1995)

Figure 3.1.1 Location of Administrative Boundaries



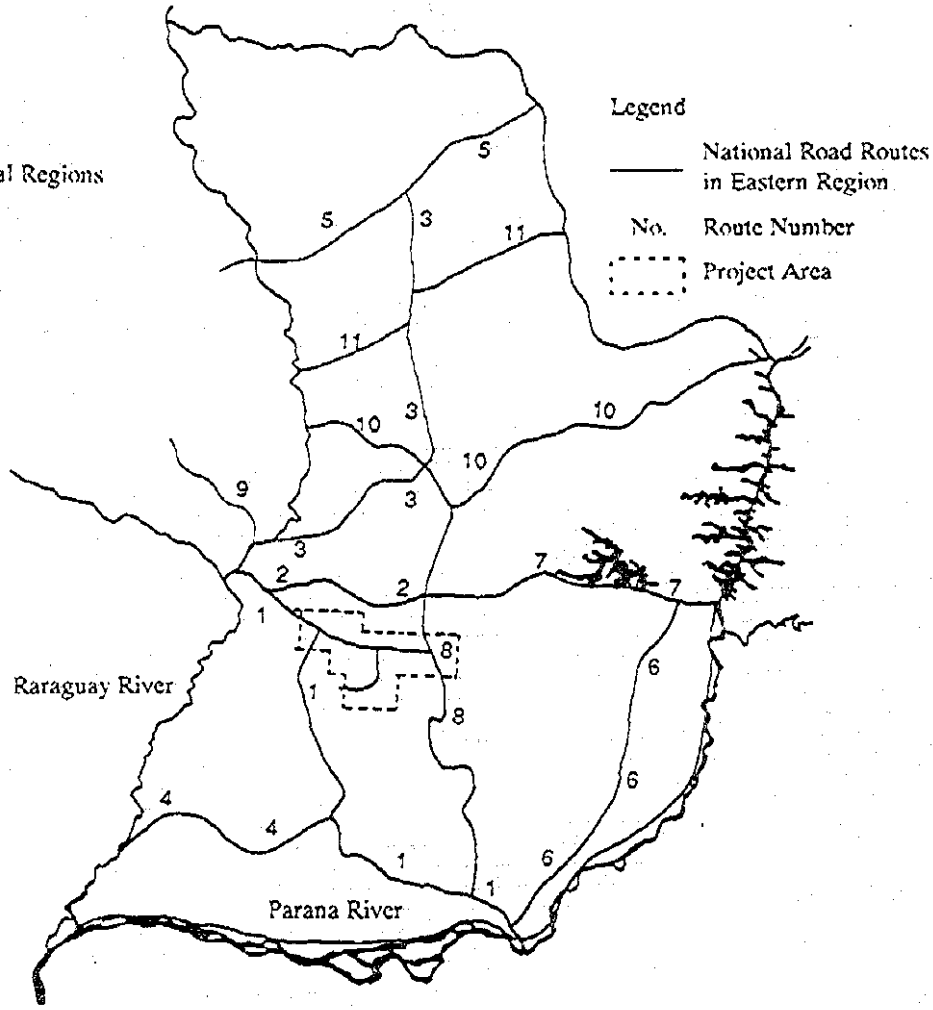
(Source: BALANCE HIDRICO SUPERFICIL DEL PARAGUAY, 1992, UNESCO/DMH/DINAO)

Figure 3.1.2 Location of Water Basin Boundaries



(Source: MAG/CDC, 1990)

Figure 3.1.3 Location of Ecological Regions



(Source: MOPC, 1995)

Figure 3.1.4 Location of National Road Network

(3) Location of Eco-regional Boundaries

The Conservation Data Center (CDC = Centro de Datos para la Conservación) divided the Eastern Region of Paraguay into 6 parts in a study entitled "Priority Areas for Conservation in the Eastern Region of Paraguay". Eco-regions were determined by grouping natural conditions such as watersheds, soil types, and vegetation types into similar categories. Each eco-region has a different type of ecosystem.

The boundaries of the 6 Eco-regions are shown in Figure 3.2.3. It will be noted that the project road will pass through two Eco-regions, "Selva Central" which means "riverside area" and "Litoral Central" which means "forest area".

(4) Location within the National Road Network

The location of the project road within the national road network system is shown in Figure 3.2.4. The project road is located within the triangular network consisting of National road No.1 in the west, No.8 in the east, and Nos.2 and 7 in the north. Within this triangle, the project road will connect No.1 with No.8 at Paraguarí and Villarrica. Since this route runs parallel to Nos.2 and 7, it is also expected to function as a bypass route for Nos.2 and 7 as well.

3-2-2 Overview of the Area Surrounding the Project Road

(1) Road Distances

The Project Area is located approximately 60 km from Asunción to the southeast. From Paraguarí to Villarrica, the east-west road extends about 90km, and from this road, La Colmena lies about 15 km to the south.

(2) Socio-Economic Conditions

According to the national census taken in 1992, the total population of the Project Area is about 110,000. The Districts in the Departments of Paraguarí and Guairá have almost equal population; however, in Guairá, 80% of the total population lives in Villarrica.

Table 3.2.1 Population of the Project Area (1992)

Name of District	Population (Persons)			Households (No.)
	Urban	Rural	Total	
Paraguarí Department	44,035	163,178	207,213	43,872
1) Paraguarí	7,060	11,425	18,485	4,033
2) Escobar	427	8,012	8,439	1,840
3) Sapucaí	1,422	4,640	6,062	1,312
4) Caballero	943	5,541	6,484	1,365
5) Ybytymí	614	6,356	6,970	1,431
6) La Colmena	2,280	2,595	4,875	1,051
7) Tebicuary Mí	195	3,553	3,748	732
Subtotal	12,941	42,122	55,063	11,764
Guairá Department	46,782	113,777	160,559	33,554
1) Coronel Martínez	1,528	4,558	6,086	1,369
2) Félix Pérez Cardozo	633	4,011	4,644	951
3) Villarrica	27,381	15,457	42,838	9,729
Subtotal	29,542	24,026	53,568	12,049
Grand Total	42,483	66,148	108,631	23,813

Source: DGEEG (Directrate General de Estadisticas, Encuentas y Censos)

This area is characterized as the sugar-cane production center of Paraguay. Along the Tebicuary Mí River, most of agricultural land is used to grow sugar-cane, which is sent to sugar-cane factories in Tebicuary, Paraguarí, and Villarrica.

Other major products in this area include cotton, corn, cassava, and livestock. Some horticultural products such as vegetables and fruits can be found in La Colmena, thanks to the paved road that connects this town with Asunción, the country's largest market. Although other areas along the project road could produce similar products, existing road conditions do not permit them to be transported, especially in the rainy season.

(3) Natural Conditions and Land Use

The Project Area is located beyond the central mountain range known as "Cordillera de los Altos", where the watershed dividing the water basin of the main stream of the Tebicuary Mí River and its branch "Arroyo Caanabe" is located. The highest point of the existing road is about 160-170 m at Sapucaí, which is located in the mountain range, and the lowest point is about 110m, which is located along the Tebicuary Mí River.

Land use in the area can be divided into four categories: lowlands, low hills, hills, and mountains. Of these, only the low hills and hills are settled and are used for agricultural activities. Part of the lowlands along the existing roads are used for pasture, but density is low.

3-2-3 Present Conditions of Existing Roads

(1) Division of Road Sectors

Existing roads in the area can be divided into 5 sectors in accordance with environmental conditions :

i) Sector-A Paraguarí - Caballero

ii) Sector-B Caballero - Colonel Martínez

iii) Sector-C Colonel Martínez - Villarrica

iv) Sector-D La Colmena - Tebicuary Mí

v) Sector-E Tebicuary Mí - Tebicuary

The physical conditions of each sector are summarized in Table 3.2.2.

Table 3.2.2 Physical Conditions of Existing Roads

Road Sector		Total Length	Highest Point	Lowest Point
from	to			
A	Paraguarí - Caballero	33.2 km	175 m	110 m
B	Caballero - Martínez	51.2 km	135 m	110 m
C	Martínez - Villarrica	20.0 km	175 m	110 m
D	La Colmena - Tebicuary Mí	18.0 km	185 m	110 m
E	Tebicuary Mí - Tebicuary	17.6 km	125 m	110 m

(2) Sector-A Paraguarí - Caballero

The existing road from Paraguarí to Caballero starts from a crossing with national road No.1 in the southern corner of the city of Paraguarí. The route passes through residential areas in Paraguarí, and after crossing the national railway, it goes along the mountains of the "Cordillera de los Altos". In the mountainous area, road conditions are very rough because of surface erosion caused by mountain streams.

At Sapucaí, the existing road goes up steep slopes around 20 m and goes down in the town area of Sapucai, afterward it runs along the national railway Caballero. In this section, the average Right of Way (R.O.W) is 20 m to 25 m, and it can be easily expanded except in town areas.

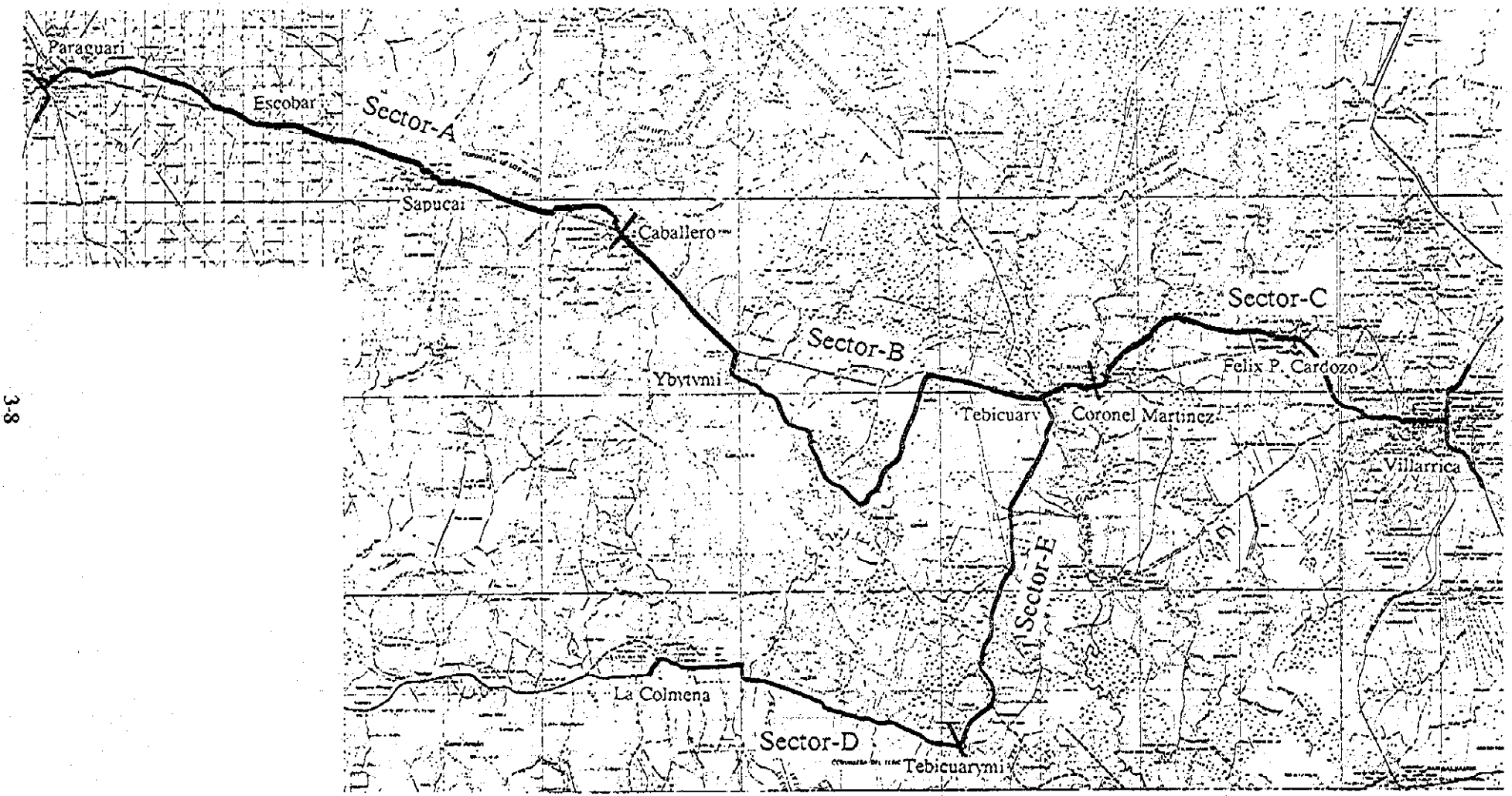


Figure 3.2.1 Map of Existing Roads

(3) Sector-B Caballero - Colonel Martínez

The existing road from Caballero to Colonel Martínez runs along the fringe of lowlands, expanding about 15 km from the Tebicuary Mí River. The road connects Ybytymí, Hector L. Vera, and Tebicuary, reaching Colonel Martínez. Road conditions are better than Section-A, but in some points, more serious damage to road surfaces can be seen.

In this Section, there are major bridges across branch rivers ; near Caballero, Ybytymí, and Tebicuary. Those bridges are constructed with wooden structures, which means that their strength and width do not permit expansion to accommodate future traffic flow.

In this section, the average R.O.W can be secured more than 30m because there are no obstacles on either side of the road.

(4) Sector-C Colonel Martínez - Villarrica

The existing road from Colonel Martínez to Félix Pérez Cardozo runs along the lowlands and low hill areas. After Feéix Pérez Cardozo, the road runs into a hilly and cultivated area up to Villarrica. The road to Villarrica connects with the road passing through the center of the city, and connects with national road No.8 at the west end of the city.

Road conditions vary depending on location; lowlands are better and hilly areas are worse as in the case of Sector-A. Average R.O.W is observed less than 15 m in hilly areas, and it is considered that expansion of R.O.W. in this area will have a serious impact on agricultural lands. It is also considered that the existing route in Villarrica will have a great negative impact on residential areas along the route if it remains.

(5) Sector-D La Colmena - Tebicuary Mí

The existing road from La Colmena Tebicuary Mí runs along the northern mountain edges of the "Cordillera del Tebicuary Mí". Roadside areas are mostly occupied by sugar-cane fields and cultivated farms. The road level is generally under the roadside areas, and the cutting slopes are bared and without protection. In this section, the average R.O.W is approximately 20 m, and it will not be easy to expand without cutting into agricultural lands.

(6) Sector-E Tebicuary Mí - Tebicuary

Existing roads between Sector-B and Sector-D comprise three routes; Route-1 connecting Ybytymí and La Colmena, Route-2 connecting the same but through Hector L. Vera, and Route-3 connecting Tebicuary Mí and Tebicuary. These are the objectives of alternative study for selecting an optimum route between Sector-B and Sector-D.

Routes-2 and 3 have similar conditions because they run through the lowlands along Arroyo Tebicuary Mí. Roadside areas in the lower hilly area are densely cultivated with sugar-cane. Since Route-1 runs along the mountains, it has steep slopes near La Colmena and its width is limited to only 6-10 m.

3-3 Outline of the Project

3-3-1 General

The outline of the project is summarized as shown in Table 3.3.1.

Table 3.3.1 Project Outline

Item	Contents
1 Background of the Project	-Development and promotion of agricultural and livestock products is the important policy in Paraguay -Transportation facilities in Paraguay is not sufficient to meet demand -Paraguay has made great efforts to improve road conditions and networks
2 Project Purposes	-To mitigate the congestion of actual traffic on National Road No.2 as a bypass of that route -To enable easy access from the project area to Aunsion -To contribute to the agricultural development of the surrounding area of the project road.
3 Location	-Paraguari (Department of Paraguari) - Villarrica (Department of Guaira) -La Colmena (Department of Paraguari) - the above road
4 Execution Body	-Ministry of Public Works and Communications (MOPC) Directorate of Highway
5 Beneficiaries	-Total Population 587,612 -Department of Paraguari 203,012 -Department of Guaira 384,600
6 Project Outline	
6-1 Type	-New Development (Most part of the road will utilize existing right of way, expansion of them and new land acquiring sections are included)
6-2 Character	-Arterial Road , Out of Urban Area, Flat and Hilly Area
6-3 Road Level	-Provincial Road (Not a National Road)
6-4 Target Year Traffic Volume	-2005 Maximum Volume : Section Paraguari -Escobar 2,372 vehicles / day -2015 Maximum Volume : Section Paraguari -Escobar 3,562 vehicles / day
6-5 Design Speed	-80 km / h
6-6 Length	-121.1 km (Paraguari - Villarrica 83.0 km) (Tebicuay - La colmena 38.1 km)
6-7 Width & Lanes	- Right of Way : Paraguari - Villarrica 40 m : Tebicuary - La Colmena 30m : Urban Areas 20m - 30m depending on the existing R.O.W -Road Width : 12m (Carriage 2 x 3.5m = 7m, Shoulder 2 x 2.5m = 5m) -Lane : 2 lanes
6-8 Structures	-Embankment with at least 0.5m from the existing road level except for the existing urban areas -2 Large Bridges -At Tebicuary on the Tebicuary Mi River (Length = 85 m for the river and 5 x 26m for flood plain) -At Arroyo Tebicuary Mi (Length = 50m) -25 Small and Medium Scaled Bridges (Span of 5m to 30 m)

3-3-2 Design Criteria

The criteria of the geometric design and the typical cross section of the proposed road are shown in Table 3.3.2 and Figure 3.3.1.

Table 3.3.2 Geometric Design Criteria for the Study Road

Geometric Criterion	Value	
	Flat Land	Hilly Land
Road classification	I-b(2lanes,>1400v./day	
Design vehicle	SR (Semi-remolque)*1	
Design speed	100km/h	80km/h *2
Stopping sight distance	>210 m	>140 m
Passing sight distance	>680 m	>560 m
Radius of horizontal alignment	>375 m	>230 m
Grade for vertical alignment	<3 %	<4.5 %
Superelevation rates	<8%	
Normal cross slope	2%	
Lane width	2 ~3.5 m=7.0 m	
Shoulder width	2 ~2.5 m	
Total width of the road cross section	>12.0 m	
Gradient of embankment slope	1:4 (h<2 m), 1:2(h>2 m)	
Gradient of cut slope	1:2 (soil), 1:1(rock)	
Standard Width of Right of Way	40 m *3	

Note - *1 : "Norma" specifies 4 types of vehicles: passenger car, conventional truck, truck, and semi-trailer. The dimensions of the semi-trailer, which is the biggest and most important vehicle for road design are also defined as follows:
- total width = 2.6 m
- total length = 16.8 m
- min. radius of the outside front wheel when turning = 13.7 m
- min. radius of the inside back wheel when turning = 6.0 m

*2 : A design speed of 60km/h can be applied in some special and limited sections as exceptional cases.
*3 : The width of the "Right of Way" could be reduced in urban areas or in special limited areas.
*4 : When other criteria must be required to determine, the standards of the United States and Japan may be adopted.
*5 : In the branch section toward La Colmena, where the future traffic demand will be less than 1,400 vehicles per day, the geometric criteria described in this table should be adopted; however, this diminished traffic demand should be taken into account in the pavement structure determination.

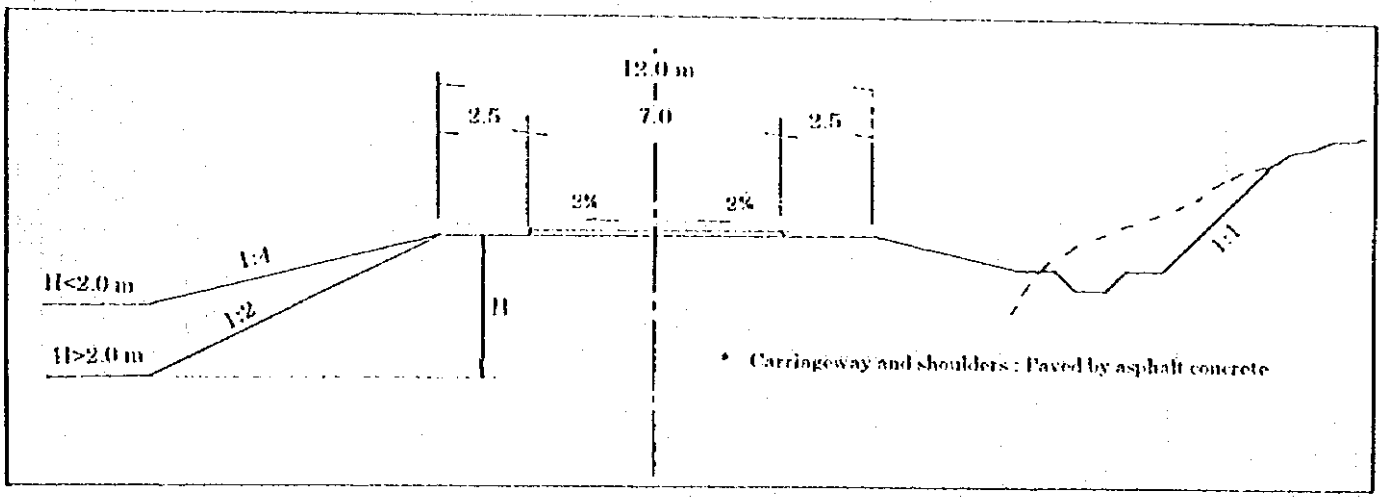


Figure 3.3.1 Typical Cross Section of the Study Road

3-3-3 Principals of Alignment Design

Road alignment design for horizontal and vertical designs are based on the following principles:

(1) Horizontal alignment

- It is to be considered that the maximum use of the present road shall be selected except in the following cases.
- When the present road runs through a town area, a bypass route shall be preferred in order to avoid any negative impact on living conditions in the town.
- When the present road runs through agricultural land, a bypass route shall be preferred in order to minimize loss of cultivated lands due to expansion of the planned road.
- When the present road winds around lowlands, short cut routes shall be preferred except in cases where the natural drainage system would be affected.

(2) Vertical Alignment Design

- In areas prone to flooding, the elevation of the designed sub-base course must be more than 100 cm above the maximum flood level.
- In areas not prone to flooding, the elevation of the design sub-base course must be 50 cm or more above the natural level of the present terrain.
- In road sectors crossing the existing railway, the existing elevation of the railway will be adopted.
- In road sections close to the bridges, the elevations proposed on the basis of hydrological studies for the bridges will be adopted.
- A lower level than the existing road with excavation shall not be adopted.

3-3-4 Road Plan

In accordance with the planning principles above, the final road alignment was designed after the studies of alternative routes, as shown in Figure 3.3.2.

3-3-5 Bridges and Drainage Facilities

Bridges are utilized at sites where rivers or larger streams intersect the present road. For medium-sized and small river sections or places with insufficient drainage, drainage facilities such as box culverts or corrugated pipes are provided according to the

surrounding conditions or construction cost factors. The summary of them are shown in Table 3.3.3 and Figure 3.3.3.

Table 3.3.3 Summary of Bridges and Drainage Facilities

Section /Length	Bridges							Culverts	
	5m	10m	15m	20m	25m	30m	30 m -	Box	Pipe
Paraguari - Sapucai		1						42	0
Sapucai - Caballero					1			0	5
Caballero - Ybytymi			1	1				2	5
Ybytymi - Tebicuary	3	4	2			1	215m*1	2	0
Tebicuary - Martinez						3		0	0
Martinez - F. L. Cardozo								5	0
F.L. Cardozo - Villarrica								4	10
La Colmena - Tebicuary		1	5	1		1	50m*2	8	16
Total	3	6	8	2	1	5	2	63	36

Note ; *1) Tebicuary Mi River : complex of 85m bridge for the river and 5 x 26m bridges for low lied area.
*2) Arroyo Tebicuary M : 2 spans of 25m bridges
Box Culvert : 3.0 m x 3.0 m
Pipe Culvert : D = 1.2 m

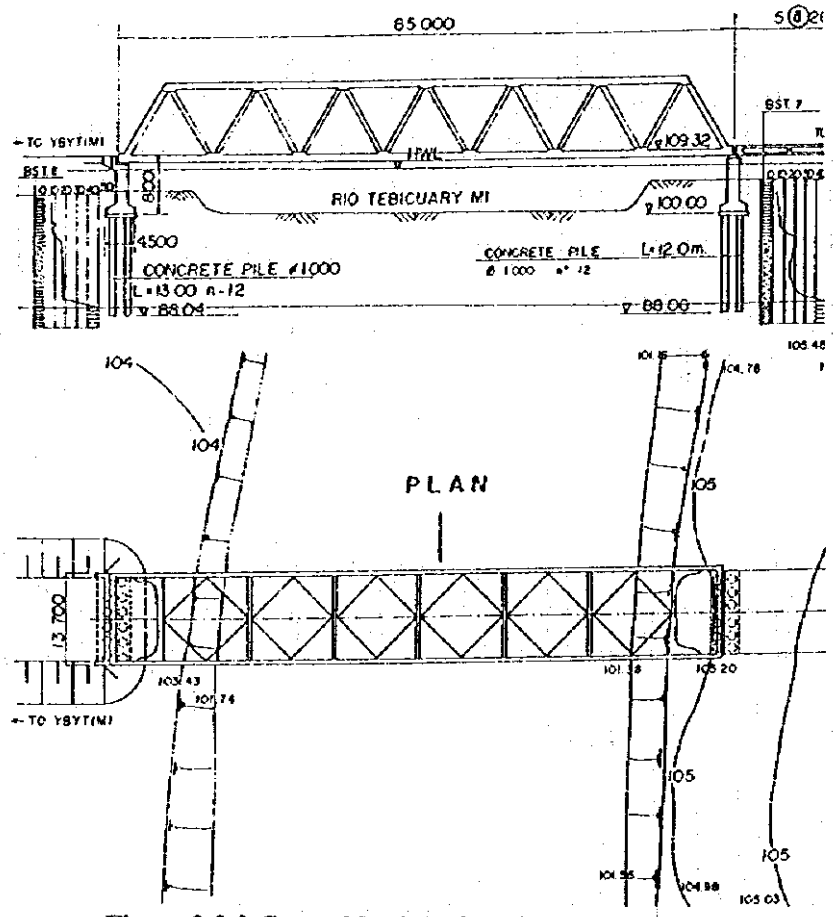


Figure 3.3.3 General Design of Tebicuary Mi Bridge

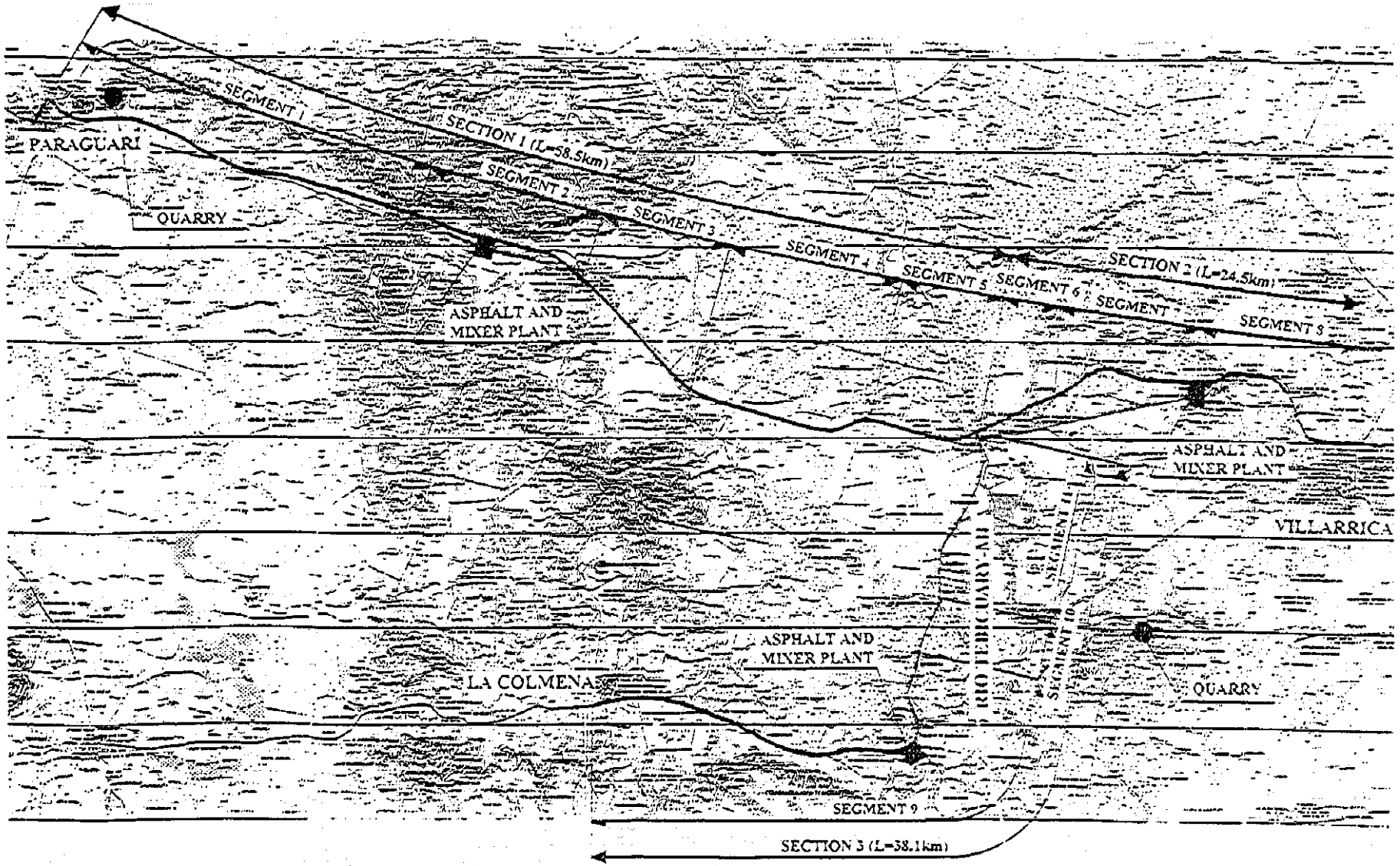


Figure 3.3.2 Route Map of the Project Road

3-3-6 Quarry Sites

The road embankment materials shall basically be taken from the soils in the ROW of the road area; however, the following materials for road construction, which cannot be found in the ROW of the road shall be taken from surrounding quarry sites.

i) Materials for the Sub-base Course (rocks and gravel)

ii)Materials for the base course and the surface layers (sand and gravel)

iii)Aggregates for bridge concrete (sand and gravel)

3-3-7 Construction Works

(1) Activities

To identify the negative environmental impact of the road construction work in detail, it is necessary to identify the components and volume of the construction works or activities. Project construction works were classified as follows:

1) Preparatory Works

Land acquisition

Clearance of R.O.W. (plant cutting, top soil removal, removal of buildings, and resettlement, if necessary)

Building of construction yards and workers camps

Temporary detour roads and bridge construction (to maintain the existing traffic flow)

2) Construction Works

Earth Work (cutting fresh soil and embankments)

Excavation of quarries

Removal and construction of culverts and other drainage structures

Construction of bridges

Grading road base

Shoulder protection

Asphalt paving

3) Finishing Works

Installation of traffic safety facilities

Installation of signals and markings

(2) Construction Equipment

The following construction equipment shall be utilized during the construction stage. This equipment is expected to have a great environmental impact in the construction period; therefore, it is studied in the implementation plan of the Project;

Bulldozer / Back-hoe / Tractor shovel / Dump Truck / Vibrating roller / Motor grader / Concrete Mixer / Asphalt plant / Asphalt finishing machine / Stone crusher

(3) Construction and Operation Schedule

The construction of the project road was planned to complete in 3 years, as shown in Figure 3.3.4. The construction plan recommended to devide the objective road into three sub-sections as follows;

- 1st sub-section : Paraguari - Tebicuary Mi River (right bank)
- 2nd sub-section : Tebicuary Mi River (right bank) - Villarrica
- 3rd sub-section : La Colmena - Tebicuary

The longest bridge on the Tebicuary Mi River will be included in the 2nd sub-section.

The construction camps shall be located separately for each sub-section, intermediate point of each sub-section.

3-3-8 Environmental Regulations for Road Construction

MOPC has prepared general technical specifications of environmental considerations in road construction projects, entitled ETAGs (Especificaciones Technicas del Ambientales Generales). This regulation defines the general items that the contractor of the project must follow in order to prevent construction works from having a negative impact on the environment.

It is also regulated that special technical specifications on environmental considerations shall be prepared according to the specific conditions of each project. Such specifications will be entitled ETAEs (Especificaciones Téchnicas del Ambientales Especiales). Those above will be regulated by being attached to the contract documents.

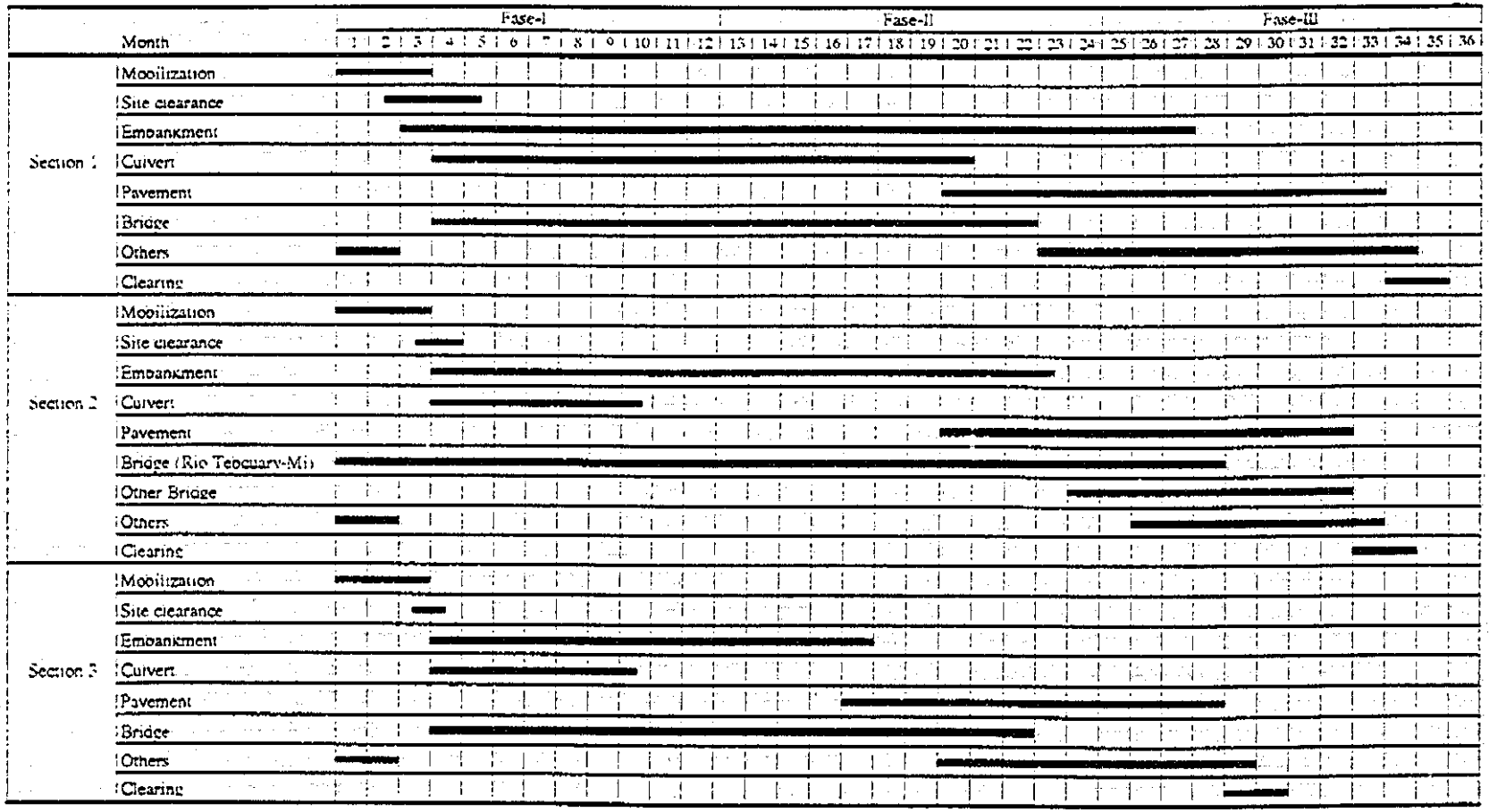


Figure 3.3.4 Construction Schedule

3-4 Effects of the Project

3-4-1 Positive Effects

The expected positive effects of the construction and operation of the project road are as follows:

(1) Moderation of Traffic Concentration on National Road Nos.2 and 7 as a Result of the Project Road's Bypass Function

The project road connects national road No.1 at Paraguarí and national road No.8 at Villarrica. This connection of paved roads would shorten the total length between Villarrica and Asunción by 33 km, from 178 km through the route via national road Nos.2 and 7 to 145 km through the route via the project road and national road No.1.

Since, this would especially effect the southern areas of Villarrica, providing traffic flow to Asunción in the area with real time and travel benefits, it is expected that existing traffic flow utilizing the route via national road Nos.2 and 7 will diverted to the route via the project road. As a result of this diversion, existing traffic flow on the national road Nos.2 and 7, where the traffic volume is too concentrated, will be reduced, and the environmental problems expected in the future if there were no bypass route will be avoided.

(2) Improvement of Accessibility to Major Traffic and Logistics Facilities in Asunción

By the 8th Road Development Plan of the World Bank, the road network of Asunción, which connects major traffic and logistic facilities such as bus terminals, central food wholesale markets, export ports, and large factories, would be greatly improved. The project road will be connected with this network directly through national road No.1, which would also serve as a new bypass route separating with the chronically congested point at San Lorenzo, which is the result of the convergence of national road Nos.2 and 1 at that point.

In this connection, the project road will contribute to improving accessibility to the traffic and logistics facilities in Asunción from the area surrounding the project road, as well as the areas connected to them such as the southern part of Villarrica.

(3) Promotion of Rural Developments

The project road can also be expected to have the following positive effects on the areas along the roads:

1) Promotion of new economic activities

Connecting major towns with all-weather paved road will promote settlements along the project road, and the start of suburban industries such as horticulture, dairy production, etc., which were previously difficult to promote because of traffic problems arising during the rainy season due to the unpaved conditions of existing roads.

2) Upgrading of living conditions

By making the distance between major towns shorter, inhabitants along the project road can enjoy better living conditions because they will have access to the better social facilities concentrated in the major towns.

3) Moderation of population outflow

By shortening the access time to major towns, inhabitants can commute from areas in which they are currently living by utilizing public or private transportation. This will contribute to a moderate outflow of inhabitants to major towns in search of job or educational opportunities.

4) Promotion of effective land use

As a result of the above-mentioned effects, effective land use would be promoted through various development projects such as agricultural land developments to widen production, leading to factory development, and the greater utilization of labor forces.

3-4-2 Negative Effects

In general, the road development project would adversely affect the following items:

i) Removal of settlement along existing roads

ii) Deterioration of the natural ecosystem

iii) Contamination of air, and the generation of noise and vibration

Clearly, the Project would influence several environmental items. Therefore, these must be evaluated. Compared with the expected positive effects, however, the negative effects of the Project are considered to be much less important, especially since the project road will mostly use the existing road, and the area that will be newly developed will be very

limited. Accordingly, it will be possible to manage or mitigate the adverse effects by following the construction regulations of ETAGs and some special specifications, as well as by carefully assessing the environmental impact.

CHAPTER 4

SITE DESCRIPTION

CHAPTER 4 SITE DESCRIPTION

4-1 Limitation of the Objective Area

This section summarizes the existing environmental conditions of the objective area of the project. The limitation of the objective area may vary by environmental item as follows:

(1) Objective Area Related to Environmental Items

The objective area varies depending on the nature of each particular environmental item. For example, available data on climatic conditions will only permit descriptions on a regional level. In the case of hydrological conditions, it will be necessary to investigate the maximum extent of the water basins that the project will affect. As a result, the objective area for environmental items was determined according to each particular item.

(2) Objective Area Related to Social Items

For socio-economic environmental items, the objective area was limited by the administrative boundaries of the districts through which the project road will run and where the influence of road development could be directly estimated. Peripheral areas were added when necessary.

(3) Objective Area Related to Legal Items

Items related to laws governing some aspect of the environment such as legal limitations to protected natural areas and reserves for indigenous peoples were described in the same manner as social environmental items, but were used only for reference in the eastern region or at a national level no legal limitations existed in an area.

4-2 Basic Conditions of the Natural Environment

The basic conditions of the objective area related to environmental items are summarized for the following 7 items according to the available data and information.

i) Topography and geology

ii) Soils

iii) Hydrology (underground water, rivers and lakes, water quality)

iv) Climate

v) Fauna and flora (including "eco-region")

vi) Landscape and scenery

4-2-1 Topography, Geology, and Soil

(1) Topography

The Republic of Paraguay is a land-locked country in the center of South America bordering on Brazil, Argentina, and Bolivia. The area of the country is about 407 thousand km^2, which makes it a little wider than Japan. From a topographical viewpoint, the country is divided into two zones, i.e. a flat Western region and a hilly Eastern region.

The Eastern region of Paraguay is topographical divided into three zones; a Mountainous Zone, a Hilly Zone and a Plain Zone.

1) Mountainous Zone

High mountains run from north to south in the region, acting as a watershed dividing the two major rivers of Paraguay; the Paraná River and the Paraguay River. The names of major ranges are from the north, "Cordillera de Amamby", "Cordillera de Mbaraca Yu", "Cordillera de Ybytyruzu," and "Cordillera de San Rafael". These ranges have peaks 500m to 850m above sea level, with the highest point being San Rafael in the "Cordillera de Ybytyruzu".

2) Hilly Zone

Apart from the main mountain ranges noted above, a lower mountain range named "Cordillera de Altos" is located in the center of southeastern part of the region. The mountains range from about heights in around 400 m to 500 m, becoming higher to the south. The area surrounding of the mountain range is hilly land, with hills 100 m to 150 m above sea level. The project road passes beyond this area at Paraguarf and La Colmena, reaching the mountains of the "Cordillera de Ybytyruzu" at Villarrica.

3) Plain Zone

Along the Paraguay River and its branch, the Tebicuary River, there are lower plains about 90 m to 100 m above sea level. The areas downstream are swampy, and the lower plains upstream are but prone to floods. The project road passes these areas, which were formed by the Tebicuary Mf River, a branch of the Tebicuary River.

(Source: Paraguay Informaciones Generales y Touristicas, 1989, Victoria Veron)

Figure 4.2.1 Topographical Conditions

(2) Geology

According to the "MAPA GEOLOGICO 1986" as shown in Figure 4.2.2, the geological conditions of the central area of the Eastern Region of Paraguay can be summarized as follows:

i) The oldest formation can be seen in the southern part of the "Cordillera de Altos". It is known as the Rfo Tebicuary Formation, which was formed in the Preterozoic era (600 - 2500 million years ago) and consists of granite.

ii) From the Paleozoic era, the Caapucu Formation in Cambria (500-600 million years ago) forms the western part of the "Cordillera de Altos", and the Caacupe and the Itacurubi Formation Group in the Siluru period (395-435 million years ago) forms the northern part of the same. The Independencia Formation Group, consisting of the formations of

San Miguel and Tacuary, from the Permic period (225-280 million years ago) and other formations from the Carbonic period (280-345 million years ago) are also located in the Mountainous Zone.

iii) From the Mesozoic era, the Misiones Formation, which was formed in the Triassic period (195-225 million years ago) can be seen in the wider areas of the mountain ranges in the center of the region. Since this formation consists of sandstone, many quarry sites, from which construction materials can beextracted, are in this area. Formations from the Cretacic period (65-141 million years ago) can also be seen in the wider areas of the western part of the region along the Paraná River. Formations from the same age can also be seen in the "Cordillera de Altos" which separates them from the Patino Formation around the town of La Colmena.

iv) From the Cenozoic era, the Nemby Formation from the Terciaric period (2-65 million years ago) can be found between Asunción and Paraguarí. The remaining parts of the lower riverside area were formed during the Quatronatic period (2 million years ago) by sedimentation carried by the Tebicuary River.

The major formations in the area surrounding the project road can be summarized as follows:

1) Permic period (Independencia Formation Group)

a) San Miguel Formation

This formation is part of the Independent Formation Group, and primarily consists of arcosica sandstone. It is generally solid, occasionally with poor stratification, friable, interpreted as the depositional facie of beaches, followed by fine sandstone alternating with scales of a fluvial origin, lacuatrine, deltaic, and plain marine.

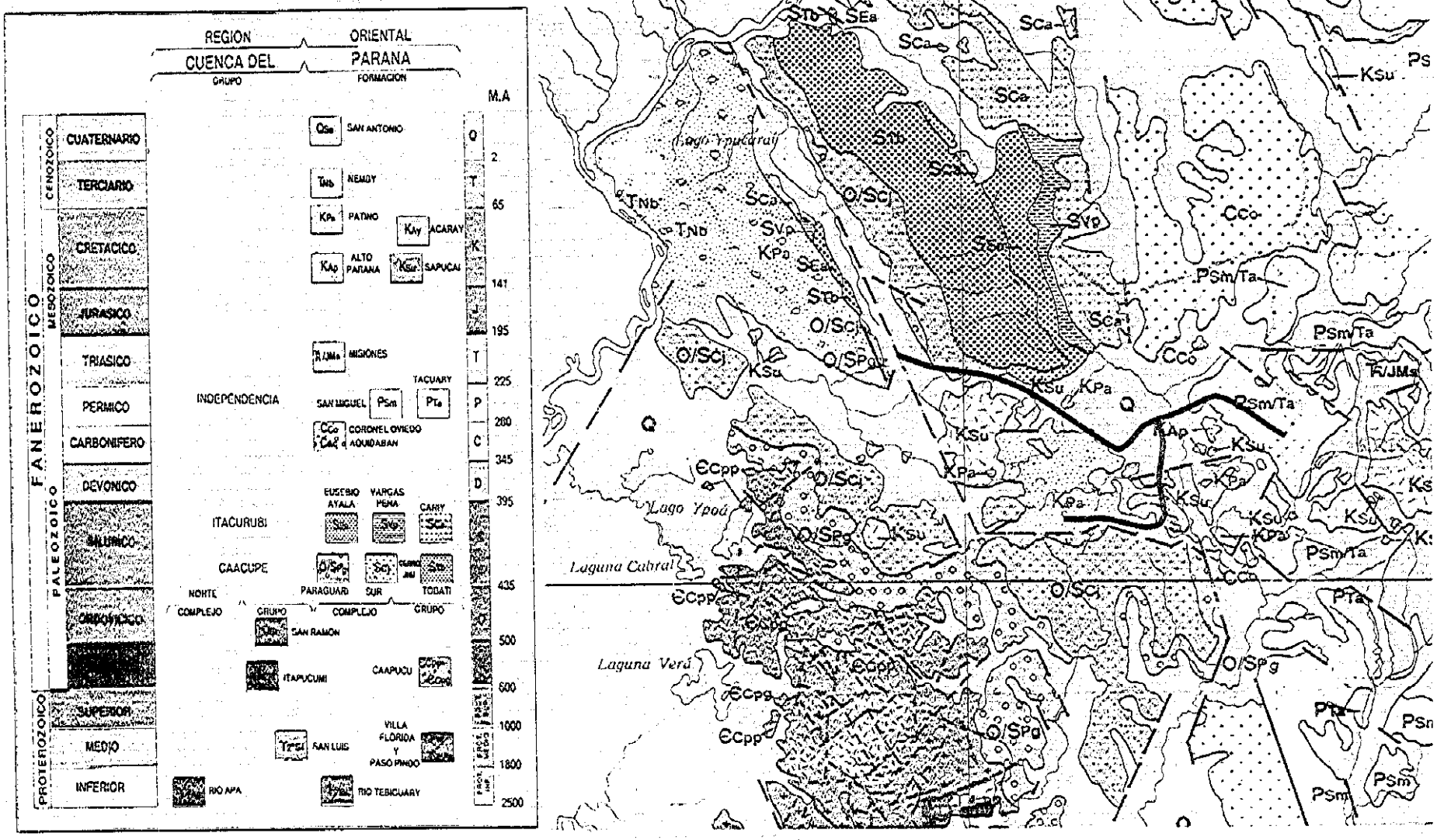
b) Tacuary Formation

This formation consists of a series of siltitas, lutites and sandstone of calcareous and fine grains, and is generally eolitic. They present a great variety of colours. General characteristics show for this formation a sedimentary environment near the sea shore, on a paleoline of emerged coast, slightly raised and stable.

2) Cretacic period

c) Sapucai Formation

This formation is connected with the Ybyturuzú intrusion. It is made up locally of esexitas, shonkinitas, nefelina-sienita, with the addition of crystalline fine-grains rocks, with extrusive parts, containing basalt alkaline , nefelitic, tefritas, traquitas, fonolitas, tufas of riolítica, and intrusive gaps (Palmieri, 1983).



Source: MAPA GEOLOGICO 1986, Government of Paraguay and U.N.

Figure 4.2.2 Geological Map

d) Patino Formation

This formation is made up ofconglomerated sediments on the bed and sandstone toward the top, with a strong red colour.

(3) Soil Conditions

According to the Soil Map of the World prepared by FAO-UNESCO, based on the 10 categories proposed by the United States Agricultural Department, soils in the project area are in the "Ultisol" category, which is defined as soil that contains ironic or aluminumic materials with advanced weathering. Because fewer organic processes are involved in soil formation as a result of the hard climatic conditions of Paraguay, aerial soil conditions greatly depend on geological formations for their origin. According to the Brazilian Soil Reference System, the soil conditions in the Paraguarí and Guairá Departments were summarized as follows in "Atlas Ambiental de la Región Oriental del Paraguay, Universidad Nacional de Asunción".

1) Soils in the Paraguarí Department

- Soils in the mountain ranges are sandy with quartz and "Litosol" delivered by sandstone, as well as red and red-yellow "Podosolicos" from sandy feldspar rock.
- In hilly areas, soils consist of "Planosol", "Litosol" and red-yellow "Podosolicos".
- Soils in the plain areas are sandy with water, "Planosol", and slightly humid Gley.

2) Soils in the Guairá Department

- The main soils in the mountain ranges are "Litosol" and "Cambisol", which are derived from the alcalic rocks of the Ybytyruzu mountains.
- In the hilly areas surrounding Villarrica, soils are mainly red-yellow "Podosolicos", which are derived from the geological formations of the Permic and Carbonic age.
- The alluvial soils in the lowlands are "Planosol" , "Plintosol", and slightly humid Gley.

4-2-2 Hydrology

(1) Underground Water

According to the "Mapa Hidrogeológico 1986" (Hydrogeological Map), underground water levels around the project road are very high near the Paraguarí side up to the Tebicuary Mí River, less than 1m from ground level. Water even springs out of some wells.

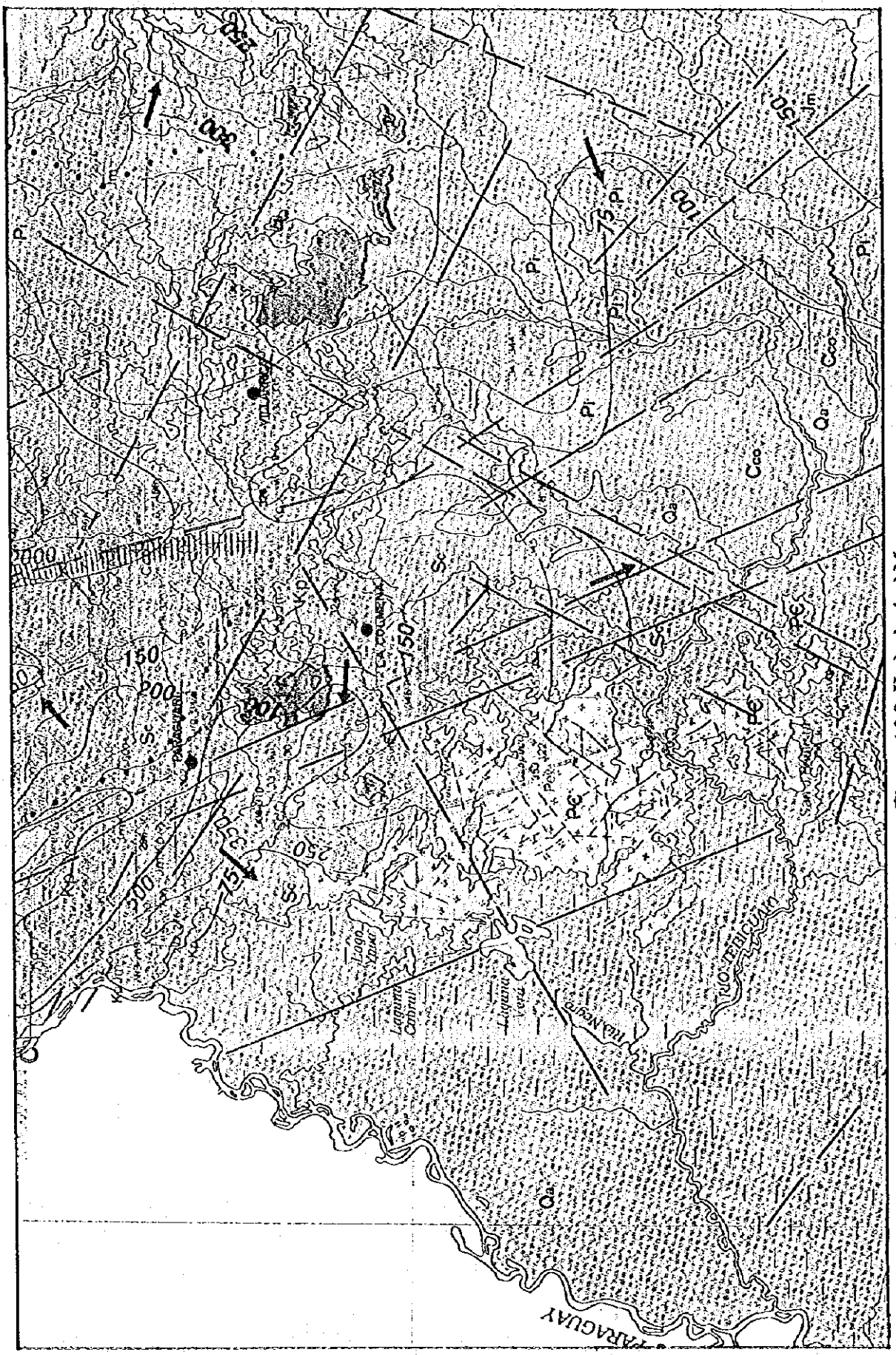


Figure 4.2.3 Hydrological Map

However, near the Villarrica side, water levels are moderate around 10 m to 15 m from ground level. The only area where springs can be seen is on the east side of the "Cordellerra de los Altos" mountain range.

Underground water flows in the same direction as the surface water and is separated from north to south by the project road route.

(2) Surface Water (Rivers and Lakes)

In the Eastern Region of Paraguay, the water basin is divided as shown in the figures in the Chapter 2 of this report. The project area is included in the water basin of the Tebicuary River, which occupies the largest area in the region. This basin can be divided into two major sub-basins of the Tebicuary Mí River in the east and the Caanabe River (Arroyo=branch river) at Sapucai.

The branch streams cross the project road routes at many points. The larger streams are the Tebicuary Mí River at Tebicuary, the Paso Pypucu River and Pirayuvy River between Caballero and Ybytymí, and the Arroyo Tebicuary Mí between Tebicuary and Tebicuary Mí.

The Tebicuary Mí River is the largest river in the area, having a width of 80 m to 100 m. It originates in the Ybyturuz mountain range. It is a naturally meandering river, and many horse-shoe bends can be seen along the course of the river. Lowlands spread widely on both sides of the Tebicuary Mí River, and the area has flooded several times, that is when it rains more than 2,000 mm in a year. There are no lakes with a wide surface area, but many small ponds can be seen along the project road route.

Serious flooding of the Tebicuary Mí River was recorded in 1989 and 1994, and the maximum water level in 1994 was recorded at the town of Tebicuary, where water levels reached the top of the existing railway embankment.

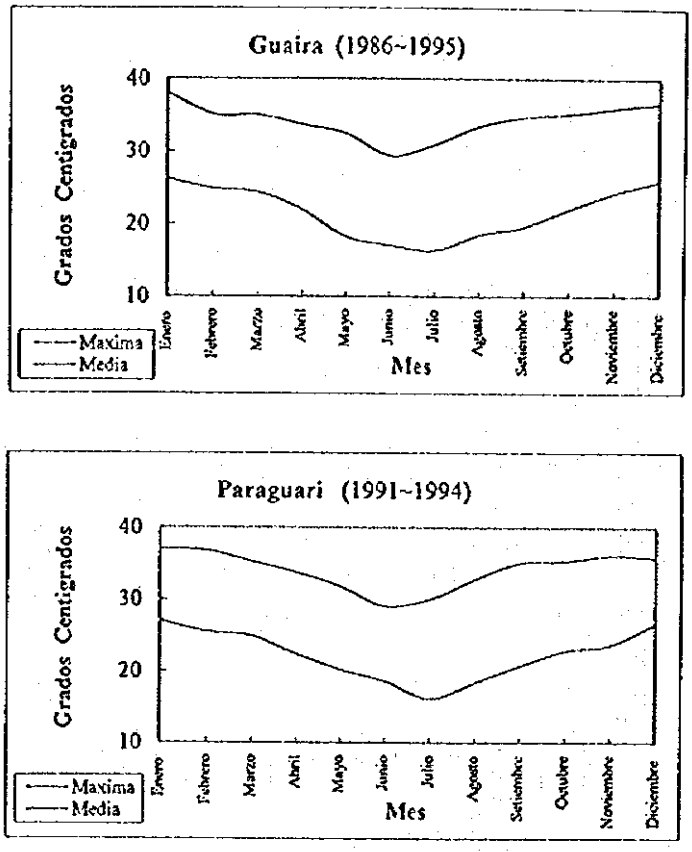
4-2-3 Climate

The climate in the Department of Paraguarí and Guairá can be classified as Cfa of Keoppen, that is temperate and very rainy. The average temperature in Paraguay gradually decreases from west to east. It is about 22 degrees centigrade in the area surrounding the project area. The hottest time of the year (more than 20 degrees higher than the annual average) is from October to April, and lower period (15 -20 degrees below the annual average) is from May

to September.

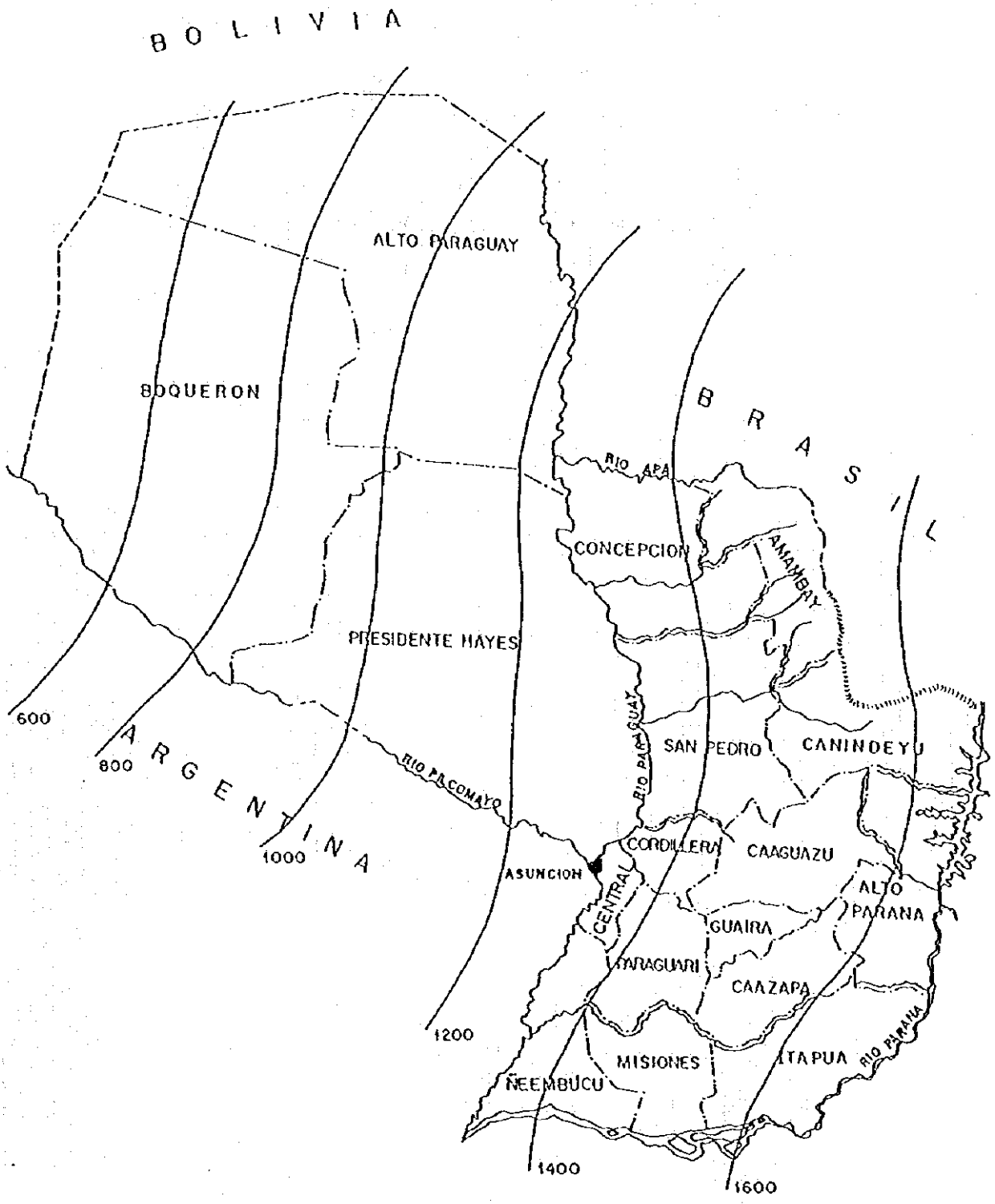
Meanwhile, annual rainfall in Paraguay raises from west to east, totaling about 1,400 mm to 1,600 mm annually. The dry season in the area is from July to September. All the other months are rainy. During the dry season, monthly rainfall is around 100 mm.

The average wind speed in Paraguarí is 3.5 m/sec, and the dominant wind directions are north - south in Paraguarí and northeast - south in Villarrica. The maximum velocity is 5 to 8 m/sec.



(Source: Dirección de meteorología y Hidrogía)

Figure 4.2.4 Monthly Maximum and Average Temperature



(Source: Dirección de meteorología y Hidrogía)

Figure 4.2.5 Annual Rainfall Isohyet in Paraguay

4-2-4 Fauna and Flora

(1) Vegetation

Natural vegetation in Paraguay is clearly separated according to topographic features, that is, mountains, hills and lowlands. Natural tropical rain forests are found in the mountain ranges, although these are being rapidly deforested. Most of the existing forests in the hilly area are artificial secondary forests grown after deforestation. Meanwhile, vegetation in the lowlands is very simple and dominated by grasses except in the riverside forests. According to the "Uso de la Tierra y Deforestación", the study area includes the following 4 vegetation types:

i) Bosque (Forest)
ii) Bosque Galeria (Gallery Forest)
iii) Campo Alto (Hilly Grassland)
iv) Campo Bajo (Lower Grassland)

1) Bosque (Forest)

Around the project road, the natural forests have been nearly deforested or degraded even in the mountain areas. At the Department level, they can be found only in the western part of the Guairá Department, that is, the Ybyturuzu mountains west of Villarrica. Almost all of the forests in "Cordillerra de los Altos" are gone, and have been turned into agricultural lands.

According to FMB/WWF research conducted in 1994, the plant species in the natural forests of the Eastern Region are very diversified, totaling about 960 different species. However, existing forests in the project area have substantially fewer species.

2) Bosque Galeria (Gallery forest along the river)

Along the rivers and branch streams, continuous forest can be seen. This is very typical of the hilly areas and lowlands. Most of the trees are less than 15 m high and 10 m to 20 m wide, depending on the width of the rivers. The widest forest is the one that runs along the Tebicuary Mf River. This forest is about 50 m to 100 m wide.

The dominant species in the gallery forestsare as follows:
Luehea divaricata (caavoveti), *Cecropia pachstachya* (ambay), *Inga affinis* (inga), *Inga urguensis* (inga), *Peltophorum dubium* (yvyra pyta), *Allophylus edulis* (koku)

3) Campo Alto (Hilly grasslands)

This area includes the hilly land above the maximum flood level, which is used for human settlements, crop cultivation, and livestock farming. This hilly land includes the natural formation of pulse, and its high topography places it above any flooding. This land has been closed, and is now used for extensive cattle raising. Closed fields are made up of trees with special characteristics, i.e., they are not tall and have a bark rich in cork because they have adapted to an environment where fires are common in the fields.

The main species of trees are, *Gochnatia polymorpha* and *Anadenathera sp.* The herbaceous classification is rich in compound species, *Malpighiaceas, Apocynaceas, cactaceas,* and *bromeliaceas.*

They both present a very similar physiognomy, and therefore they could be easily confused. Sanjurjo (1993) stated that it could be proved that forests decreased, while closed areas increased.

4) Campo Bajo (Lower grasslands)

The vegetation type in the lowlands is heavily influenced by periodical flooding and the high level of underground water. Only shorter grasses grow well here and the biodiversity in this area is very limited.

The dominant species in this area are as follows:
Ludwigia bonariensis, Ludwigia hassleriana, Ludwigia lagunae, Pontederia cordata, Eleocharis nodulosa, Scleria sp, Scoparia montevidensis aeschynomene sp., Eichhornia crassipes

(2) Fauna

Within the ecological mosaic, this region has two predominant macro-ecosystems: the mountain chain and the open fields of the lowlands. The mountain area still has forests that house the habitats for mammals and birds.

The swamplands create an essential habitat for most of the area's amphibians and reptiles, which are either partially or entirely aquatic. The building of the road and other infrastructure will affect the water volume of humidifiers in the sense of helping its drainage or acting as a dike. Typical species which are found in the area surrounding of the project site are as follows:

1) Amphibians and reptiles

There are many amphibious communities in alluvial zones consisting of swamps or marshlands. Most of the habitats are natural, although some are found on manmade sites resulting from many civil works and rural development programs. The constant development of communities and rural towns has caused a decrease in the amphibian and reptile populations. New settlements together with the existing towns and colonies are generally built on lands covered by trees. That causes remarkable damage to natural habitats. Moreover, those rural towns need water garbage disposal sites.

The decreased number of these species could cause the increase or decrease of other species of animals and so on down the chain. As a result, there would be a fall in the quality of the wild life and a slow of the extinction ecosystem and corresponding habitats. As habitats are altered or destroyed, the populations of *hyla*, *Ololygon, Leptodactylus, and Bufo* also decrease.

Consequently, many of the species native to this region are already considered rare, for instance the *Caiman latirostris, Tupinambis teguixin* and *Eunectes notaeus*. Moreover, these species have also been hunted for their commercial value.

2) Birds

The number of wild bird communities in the area has generally decreased. Many of species, however, are distributed widely, and are therefore resistant to changes. They are: *Egretta, Syreigma sibiltatrix, Polyborus plancus, Vanellus chilensis, Columbina picui, Crotophaga ani, Caprimulgus parvulus, Podager nacunda, Chloroceryle americana, Furnarius rufus, Pitangus sulphuratus etc.*

Farming activity is semi-extensive, although agricultural machines are generally not used. As a result, it has been possible to preserve the natural habitats in the area. Typical samples belong to the following families: *Certhia, Ardeidae, Cathartidae, Accipitridae, Falconidae, Rallidae, Jacanidae, Cahradriidae, Tinamidae, Columbidae, Cuculidae, Strigdae, Caprimulgidae, Trochilidae, Picidae, Dendrocolaptidae, Furnaridae, Formicaridae,* and *Tyrannidae.*

3) Mammals

Big and medium-sized mammals are the most affected by anthropic activities. Therefore, it is not surprising to note the absence of animals such as *Cebidae, Myrmecophagidae, Felidae, Tayassuidae and Cervidae*. The primary natural ecosystems are extinct although secondary and tertiary formations, as well as exotic species, do remain. Since primary

natural ecosystems have disappeared, it is probable that many wild mammals have been eliminated from the region as well.

Biodiversity has been seriously damaged, and today only a decreased population remains in the area. They are: *Didelphis, albiventris, Dasypus novemcinctus, Cavia, Hydrochaeris Hydrochaeris, Procyon cancrivorus, and Cerdocyon.* Those are among the most representative species.

4-2-5 Landscape and Scenery

The major landscape components of the project area consist of natural topographic features such as mountains with steep cliffs and wide plains. In addition to these, continuous rows of forests along rivers (Bosque galleria) serve as important landmarks in the vast plains.

Moreover small mountains in the plains are also characteristic landmarks. No major scenic tourist spots are mentioned in the official tourist guide.

4-3 Basic Conditions of the Socio-Economic Environment

The Basic conditions of the objective area that are related to the socio-economic environment can be classified into the following six types according to the available data and information:

i) Administrative boundaries (area, length of proposed road by district)

ii) Demography (size of population, family, age structure, pop. growth)

iii) Human settlements (urbanization ratio, density, urban area) and living conditions (housing, schools, public health)

iv) Land Use

v) Economy (sectorial labor force, products)

vi) Land ownership

4-3-1 Administrative Boundaries

The objective area for socio-economic environmental items encompasses the 10 districts through which the project road passes, and the two Departments of Paraguarí and Guairá as a whole are considered for reference. The estimated length of the project road within each district is provided in Table 4.3.1.

Table 4.3.1 Length of the Project Road in Each District

Department	District	Area	Road Length (km)			
		(km²)	Main	Alternative 1	Alternative 2	Alternative 3
Paraguarí	1) Paraguarí	396.09	7.21			
	2) Escobar	175.96	8.55			
	3) Sapucai	199.46	12.90			
	4) Caballero	236.61	7.93			
	5) Ybytymí	412.20	40.73		10.14	9.61
	6) La Colmena	113.07	-	11.99	0.55	4.87
	7) Tebicuary Mí	96.62	-	14.07		
	Sub Total	1,630.01	77.32	26.06	10.69	14.48
Guairá	1) Coronel Martínez	208.27	14.78	9.50		
	2) Felix P. Cardozo	90.09	8.80			
	3) Villarrica	302.95	3.32			
	Sub Total	601.31	26.90	9.50		
Objective Area Total		2,231.32	104.22	35.56	10.69	14.48

4-3-2 Demography

(1) Population Growth

According to the census taken in 1992, the total population of the whole country is 4.15 million, which represents an increase of 1.37 times (an annual growth rate of 3.2%)

compared with 3.03 million counted in the last census carried out in 1982.

The population of the Paraguarí Department, where the project area is located, has not increased much, from 204 thousand inhabitants in 1982 to 208 thousand inhabitants in 1992, with an average growth rate of 0.2%. Meanwhile the population of the Guairá Department, where part of the project area is also located, increased from 143 thousand inhabitants in 1982 to 162 thousand inhabitants in 1992, with an average annual growth rate of 1.2%. Both are lower than the national average.

Table 4.3.2 Population growth by Department and District

Department	Population		Annual Increase
	1982	1992	
Paraguay Total	3,029,830	4,152,588	3.20%
Paraguarí	204,399	207,213	0.14%
Guairá	143,510	160,559	1.13%

Source : DGEEC, 1994

(2) Household and Family Size

The total number of household in the objective area was estimated as 23,813 in 1992, and the average persons per household was around 4.6 persons, lower than the average of the department as a whole. Only the district of Tebicuary Mí is over 5.0 persons per household, while others are at nearly an equal level.

Table 4.3.3 Household by Department and District

Department	District	Population (1992)	Household (1992)	Average per hh
Paraguarí	All districts	207,213	43,872	4.72
Guairá	All districts	160,559	33,554	4.79
Paraguarí	1) Paraguarí	18,485	4,033	4.58
	2) Escobar	8,439	1,840	4.59
	3) Sapucai	6,062	1,312	4.62
	4) Caballero	6,484	1,365	4.75
	5) Ybytymí	6,970	1,431	4.87
	6) La Colmena	4,875	1,051	4.64
	7) Tebicuary Mí	3,748	732	5.12
	Sub Total	55,063	11,764	4.68
Guairá	1) Coronel Martínez	6,086	1,369	4.45
	2) Félix P. Cardozo	4,644	951	4.88
	3) Villarrica	42,838	9,729	4.40
	Sub Total	53,568	12,049	4.45
Objective Area Total		108,631	23,813	4.56

Source : DGEEC, 1994

(3) Age Structure

The population divided into three age groups in the objective area is as shown below. The objective area has higher ratio of old people than the national total of 4.6%, and the Department of Paraguarí has much higher than Guairá. Of the 10 districts, Caballero has the highest ratio of 8.3%.

Table 4.3.4 Age Structure by Department and District

Department	District	Age Group Ratio (%)		
		0-14 years	15-64 years	65 - years
Paraguay Total		41.5%	53.9%	4.6%
Paraguarí	All districts	42.3%	50.4%	7.2%
Guairá	All districts	43.4%	51.0%	5.6%
Paraguarí	1) Paraguarí	38.3%	55.0%	6.7%
	2) Escobar	44.0%	47.8%	8.2%
	3) Sapucai	42.4%	49.8%	7.9%
	4) Caballero	44.4%	47.3%	8.3%
	5) Ybytymí	45.0%	48.1%	6.9%
	6) La Colmena	40.6%	52.1%	7.3%
	7) Tebicuary Mí	43.3%	50.6%	6.0%
	Sub Total	41.7%	51.0%	7.3%
Guairá	1) Coronel Martínez	38.4%	55.1%	6.5%
	2) Félix P. Cardozo	42.9%	49.9%	7.2%
	3) Villarrica	38.2%	55.0%	6.8%
	Sub Total	38.6%	54.6%	6.8%
Objective Area Total		40.2%	52.8%	7.0%

Source : DGEEC, 1994

4-3-3 Human Settlements and Living Conditions

(1) Urbanization Ratio

In the objective area, there are 11 urban areas. Paraguarí, Escobar, Sapucai, Caballero, Ybytymí, La Colmena, Tebicuary Mí, Coronel Martínez, Félix Pérez Cardozo and Villarrica are the center of districts, and in addition to these, Tebicuary in the district of Coronel Martínez is also a town. The largest town is Villarrica with population of about 30,000, followed by Paraguarí with a population about 7,000.

The average urbanization rate of the objective area is 39%, which is higher than the average of department total, i.e., 21% in Paraguarí and 29% in Guairá. The most urbanized district is Villarrica (64%), following La Colmena (47%). The other districts are all less than 40%.

Table 4.3.5 Urban and rural population

Department	District	Population (1992)	Urban	Rural	Urbanization Ratio
Paraguarí	All districts	207,213	44,035	163,178	21.3%
Guairá	All districts	160,559	46,782	113,777	29.1%
Paraguarí	1) Paraguarí	18,485	7,060	11,425	38.2%
	2) Escobar	8,439	427	8,012	5.1%
	3) Sapucai	6,062	1,422	4,640	23.5%
	4) Caballero	6,484	943	5,541	14.5%
	5) Ybytymí	6,970	614	6,356	8.8%
	6) La Colmena	4,875	2,280	2,595	46.8%
	7) Tebicuary Mí	3,748	195	3,553	5.2%
	Sub Total	55,063	12,941	42,122	23.5%
Guairá	1) Coronel Martínez	6,086	1,528	4,558	25.1%
	2) Félix P. Cardozo	4,644	633	4,011	13.6%
	3) Villarrica	42,838	27,381	15,457	63.9%
	Sub Total	53,568	29,542	24,026	55.1%
Objective Area Total		108,631	42,483	66,148	39.1%

Source : DGEEC, 1994

(2) Housing Conditions

The total number of houses in the objective area is 23,729, which is slightly less than the number of households. It can be said, however, that one house has been secured for each household. Looking at housing conditions by equipment, they may be summarized as follows:

- About 50% of all houses are supplied with electricity, although this varies from one to another district
- About 25% of all houses are connected to a water supply system
- About 23% of all houses have a drainage treatment system
- More than 66% of all houses use wood or coal as their primary energy source

(3) Education

The school attendance ratio at primary school level is around 90% in every district, while at secondary school level, it is around 20% to 30%, although it is higher in major towns. The number of schools in the objective area is shown in Table 4.3.7.

(4) Public Health Services

There are 52 health care service facilities in the objective area according to the data obtained from the Ministry of Health.

Table 4.3.6 Housing Conditions

Department	District	Number of Houses	Electricity Supply (%)	Water Supply(%)	Treated Drainage (%)	Energy by Wood (%)
Paraguarí	All districts	43,792	36.1	18.0	16.5	79.2
Guairá	All districts	33,489	38.2	15.6	13.7	74.8
Paraguarí	1) Paraguarí	4,005	65.2	28.3	28.5	60.1
	2) Escobar	1,840	14.5	5.4	11.1	94.1
	3) Sapucai	1,311	48.3	41.8	19.6	89.8
	4) Caballero	1,365	14.2	11.1	12.8	92.4
	5) Ybytymí	1,431	15.3	11.6	9.0	92.0
	6) La Colmena	1,046	55.1	30.4	24.6	62.7
	7) Tebicuary Mí	731	0.3	0.0	5.5	91.7
	Sub Total	11,729	38.4	20.6	18.8	78.6
Guairá	1) Coronel Martínez	1,369	53.5	6.2	16.1	66.9
	2) Félix P. Cardozo	951	21.0	17.0	4.2	90.9
	3) Villarrica	9,680	69.4	34.4	30.5	49.0
	Sub Total	12,000	63.8	29.8	26.8	54.4
Objective Area Total		23,729	51.2	25.3	22.8	66.3

Source : DGEEC, 1994

Table 4.3.7 Educational Conditions

Department	District	Attendance Primary (%)	Attendance Secondary(%)	No. of Primary	No. of Intermediate
Paraguarí	All districts	89.2	18.5		
Guairá	All districts	87.4	19.8		
Paraguarí	1) Paraguarí	91.5	30.9	7	2
	2) Escobar	89.9	14.0	3	2
	3) Sapucai	88.3	18.2	4	1
	4) Caballero	90.1	13.2	6	1
	5) Ybytymí	89.6	13.5	12	3
	6) La Colmena	92.9	27.7	7	1
	7) Tebicuary Mí	92.5	18.0	3	1
	Sub Total	90.7	19.4		
Guairá	1) Coronel Martínez	94.1	23.6	6	4
	2) Félix P. Cardozo	88.4	11.0	7	1
	3) Villarrica	90.7	34.2	20	9
	Sub Total	91.1	22.9		
Objective Area Average		90.9	21.1	75	15

Source : DGEEC, 1994

Table 4.3.8 Public Health Facilities

Department	District	Regional Hospitals	Health Center	Hospital Center	Others	Total No. of Facilities
Paraguarí	1) Paraguarí	1	-	1	4	6
	2) Escobar	-	-	1	4	5
	3) Sapucai	-	2	1	2	5
	4) Caballero	-	1	1	4	6
	5) Ybytymí	-	-	1	3	4
	6) La Colmena	-	1	1	3	5
	7) Tebicuary Mí	-	-	1	3	4
	Total	1	4	7	23	35
Guairá	1) Coronel Martínez	-	-	1	3	4
	2) Félix P. Cardozo	-	-	1	3	4
	3) Villarrica	1	-	1	7	9
	Total	1	-	3	13	17
Objective Area Total		2	4	10	36	52

Source : DGEEC, 1994

4-3-4 Land Use

According to the "Uso de la Tiera y Deforestación en la Región Oriental del Paraguay period 1984 -1991, Universidad Nacional de Asunción", the land use area ratio of the Paraguarí and Guairá Departments has the following characteristics.

- Forest area is limited in both Departments, especially in the Paraguarí Department where there are no natural forests.
- Deforestation is very advanced in Guairá Department, and the same area of existing natural forest was lost from 1984 to 1991.
- Agricultural land is almost the same in terms of area in both Departments, that is, about 260 thousand hectares.
- In Paraguarí, the area of hilly meadows equals that of agricultural land.
- In Paraguarí, there is more inundable lower meadow area than in Guairá, and it is used for livestock farming

Table 4.3.9 Land Use Area and Ratio

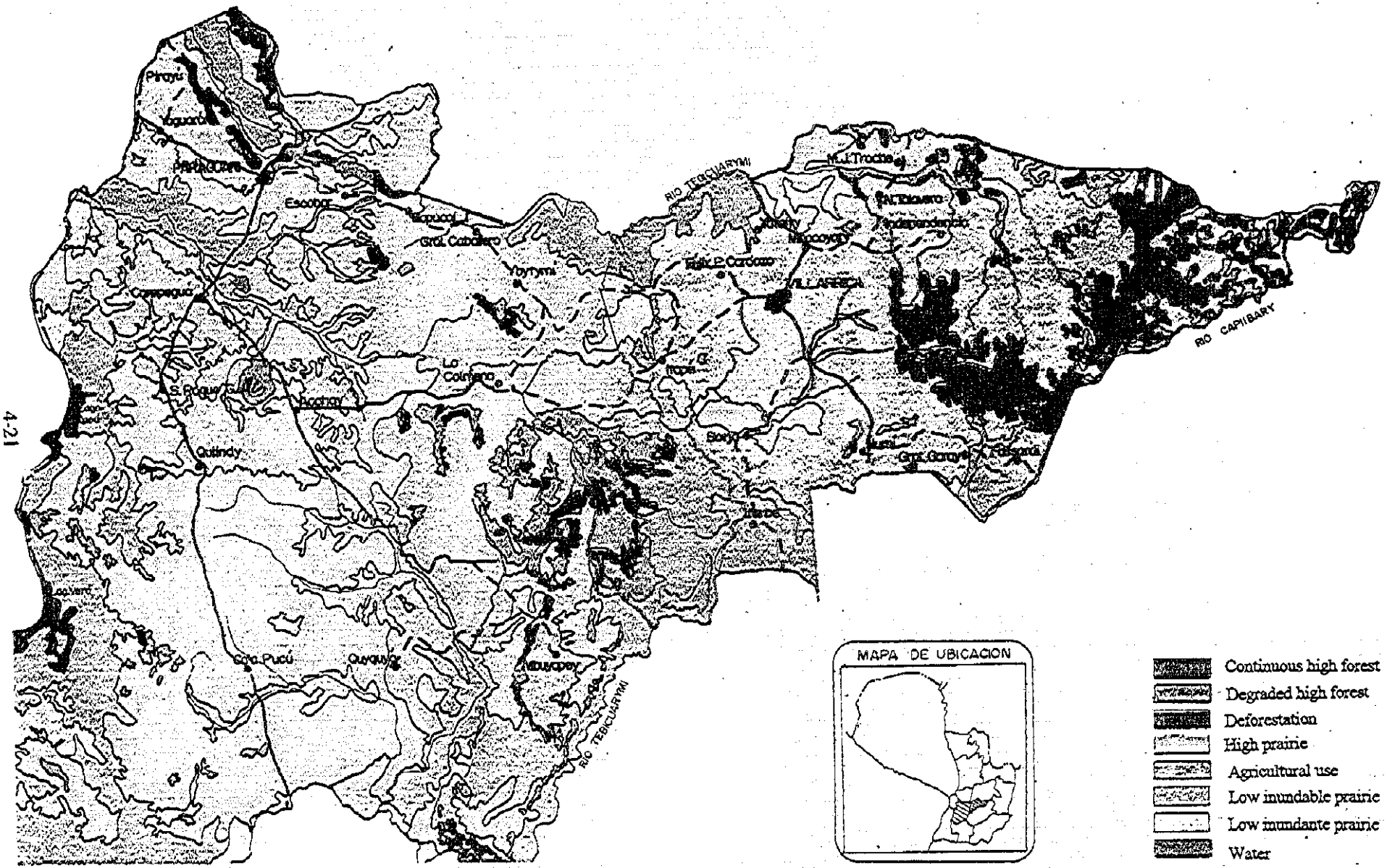
Land Use Categories	Paraguarí Department		Guairá Department	
	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)
Natural forest	-	0.0%	24,766	6.4%
Degraded Natural Forest	33,402	3.8%	29,102	7.6%
Sub Total	**33,402**	**3.8%**	**53,868**	**14.0%**
Deforestated Land	13,776	1.6%	22,461	5.8%
Agricultural Land	263,977	30.3%	262,721	68.3%
Hilly Meadow	269,013	30.9%	18,977	4.9%
Sub Total	**546,766**	**62.8%**	**304,159**	**79.1%**
Inundable Lower Meadow	258,979	29.8%	26,573	6.9%
Inundated Lower Meadow	25,714	3.0%	-	0.0%
Water Surface	5,639	0.6%	-	0.0%
Sub Total	**290,332**	**33.4%**	**26,573**	**6.9%**
Total Area	**870,500**	**100.0%**	**384,600**	**100.0%**

Source : DGEEC, 1994

4-3-5 Economic Activities

(1) Working Population by Economic Sector

Table 4.3.10 below shows the working population ratio of the three economic sectors. This information is based on the results of a 1992 census. The major sector of the objective area is the primary sector with a share of approximately 60%. The secondary and tertiary sectors share about 20% each.



(Source; Uso de la Tiera y Deforestación en la Región Oriental del Paraguay period 1984 -1991, Universidad Nacional de Asunción)

Figure 4.3.1 Land Use Map

Their shares, however, vary with the district. For example, the primary sector accounts for less than 50% in Paraguarí, Villarrica, and Coronel Martínez. The former two towns are characterized as service towns for the region, which is indicated by their figures of more than 40% for the tertiary sector. Coronel Martínez has a specific economic structure because a major sugar factory is located there. This explains the figure of 33% for the secondary sector.

Table 4.3.10 Working Population Share by Economic Sector

Department	District	Primary Sector	Secondary Sector	Tertiary Sector
Paraguarí	All districts	56.7	22.9	20.4
Guairá	All districts	60.5	16.8	22.7
Paraguarí	1) Paraguarí	34.3	22.7	43.0
	2) Escobar	78.4	12.0	9.6
	3) Sapucai	63.8	9.6	26.6
	4) Caballero	81.1	8.0	10.9
	5) Ybytymí	87.9	3.9	8.2
	6) La Colmena	53.9	15.0	31.1
	7) Tebicuary Mí	88.9	2.8	8.3
Guairá	1) Coronel Martínez	48.2	33.4	18.5
	2) Félix P. Cardozo	80.9	8.7	10.5
	3) Villarrica	23.9	29.0	47.1

Source : DGEEC, 1994

(2) Agricultural Production

Agricultural production in the objective area is summarized in Table 4.3.11. The principal products of the area are sugar cane, cotton, corn and green beans.

The two Departments of Paraguarí and Guairá accounted for 50% of the total production of sugar cane in Paraguay in 1991, and the objective area represents 13% of the national total. Of the 11 districts, Ybytymí Tebicuary Mí, Coronel Martínez, and Villarrica have a large share of this production, i.e., more than 50,000 tons.

In the agricultural sector, cattle raising is also a basic economic activity in the area, but the production volume is generally small scale, with less than 10 cows per household.

(3) Industrial Production

The major industry in the area is sugar production with four factories located around the objective area. Their locations are Azucarera Paraguaya in Tebicuary, Azucarera Friedman in Villarrica and two other in Paraguarí and Iturbe.

Table 4.3.11 Agricultural Products

Area \ Products			Cotton			Sugar Cane			Corn			Green Beans		
			1991	1995	Share	1991	1995	Share	1991	1995	Share	1991	1995	Share
Paraguay Total		ton	631,728		100%	2,817,091		100%	401,339		100%	40,458		100%
Paraguarí + Guairá Total		ton	56,323	56,323	9%	1,412,387		50%	28,894		7%	6,863		17%
Project Area Total		ton	7,479	7,479	1%	365,721		13%	8,154		2%	1,809		4%
Paraguarí Department Total		ton	32,478	22,891	100%	260,693	262,940	100%	14,987	18,260	100%	4,565	5,041	100%
		ha.	25,413	16,442	100%	6,044	6,165	100%	15,671	16,370	100%	5,784	7,200	100%
District	1) Paraguarí	ton	352	248	1%	2,527	2,549	1%	251	306	2%	102	113	2%
		ha.	266	172	1%	71	72	1%	250	261	2%	132	164	2%
	2) Escobar	ton	994	701	3%	994	701	0%	4,002	4,036	22%	146	161	3%
		ha.	762	493	3%	762	493	8%	149	152	1%	203	253	4%
	3) Sapucai	ton	9	10	0%	2,645	2,668	1%	558	681	4%	191	211	4%
		ha.	9	0	0%	221	226	4%	500	523	3%	225	280	4%
	4) Caballero	ton	1,515	1,068	5%	2,270	2,290	1%	785	957	5%	259	286	6%
		ha.	587	380	2%	37	38	1%	302	315	2%	113	41	2%
	5) Ybytymí	ton	1,517	1,069	5%	54,383	54,852	21%	856	1,044	6%	432	477	9%
		ha.	1,006	651	4%	953	972	16%	764	798	5%	418	520	7%
	6) La Colmena	ton	937	660	3%	6,876	7,021	6%	351	428	2%	212	234	5%
		ha.	640	14	3%	366	373	6%	288	301	2%	215	268	4%
	7) Tebicuary Mí	ton	495	349	2%	89,456	90,227	34%	184	224	1%	78	86	2%
		ha.	343	222	1%	1,817	1,853	30%	166	173	1%	88	110	2%
Guairá Department Total		ton	23,845	15,673	100%	1,151,694	1,048,050	100%	13,907	16,558	100%	2,298	5,203	100%
		ha.	16,745	12,355	100%	20,149	20,550	100%	10,378	11,984	100%	2,745	5,728	100%
District	1) Coronel Martínez	ton	39	26	0%	84,536	76,928	7%	70	83	1%	38	86	2%
		ha.	40	30	0%	1,394	1,422	7%	90	104	1%	43	90	2%
	2) Félix P. Cardozo	ton	125	82	1%	27,988	25,469	2%	168	200	1%	76	177	3%
		ha.	109	80	1%	632	645	3%	228	263	2%	131	273	5%
	3) Villarrica	ton	1,496	983	6%	84,046	76,482	7%	929	1,106	7%	275	623	12%
		ha.	1,190	878	7%	1,896	1,934	9%	761	879	7%	329	687	12%

Source : DGEEC, 1994

Other industries can be found in the area, but these are micro-companies or home-based industries. They produce gods for local consumption such as the bricks and tiles, crafts, footwear, sugar cane alcohol, leather goods, ceramics, brooms, and candy.

4-3-6 Land Ownership

Land tenure in the objective area is summarized in Table 4.3.12 according to census data obtained in 1992. In general, it has the following main characteristics:

- More than 80% of the land is privately owned.
- Rented lands account for less than 3-4% except in La Colmena where it is 7%.
- The share of occupied land varies according to district, with the smallest share of 2% in Paraguarí, Escobar, and Coronel Martínez, and the largest share of more than 20% in Cardozo and Villarrica.

Table 4.3.12 Land Ownership

Department	District	Privately Owned		Rented		Occupied		Others		Land total	
		1*	2*	1*	2*	1*	2*	1*	2*	1*	2*
Paraguarí	All districts	90%	30.9	3%	4.3	6%	3,6	1%	5.1	100%	18.3
Guairá	All districts	84%	19.0	3%	2.8	13%	3.6	1%	2.6	100%	10.9
Paraguarí	1) Paraguarí	95%	62.7	3%	9.2	2%	2.6	0%	6.0	100%	40.0
	2) Escobar	95%	31.3	3%	2.4	2%	1.9	0%	2.9	100%	18.5
	3) Sapucai	81%	12.6	3%	3.0	15%	4.5	1%	8.3	100%	9.2
	4) Caballero	83%	20.5	2%	2.8	15%	4.8	1%	1.4	100%	12.2
	5) Ybytymí	84%	41.9	2%	2.6	9%	3.8	5%	8.6	100%	17.4
	6) La Colmena	83%	20.5	7%	8.4	9%	5.0	0%	4.5	100%	14.6
	7) Tebicuary Mí	87%	20.0	1%	1.3	9%	2.3	3%	6.0	100%	10.4
Guairá	1) Coronel Martínez	93%	44.8	4%	13.2	2%	1.4	2%	2.1	100%	24.3
	2) Félix P. Cardozo	75%	8.4	2%	0.6	23%	2.3	0%	0.5	100%	4.5
	3) Villarrica	77%	12.3	2%	2.8	21%	3.5	0%	0.3	100%	7.4

Source : DGEEC, 1994
Note : 1*- share in total (%), 2*- area per lot (ha)

4-4 Environmental Laws and Regulations

In this section, the following area control measures are summarized.

i) National parks and natural reserves

ii) Indigenous communities

4-4-1 National Parks and Wildlife Reserves

In Paraguay, laws and regulations aimed at conserving the natural environment area under the control of MAG, DPNVS (Department of National Parks and Wildlife). There are 3 control categories:

- National parks
- Natural monuments
- Reserves

Since 1994, these areas have been managed under the comprehensive control system known as SINASIP (Sistema Nacional de Areas Silvestre Protegidas - National System for Wildlife Protection Areas) with the cooperation of USAID and NGO. There are 44 areas, including proposed areas, in SINASIP with three different management bodies:

- Governmental control
- Private and semi-public company control
- Control by special organizations

In the objective area, there are no registered areas related to SINASIP, however, there are three areas in the land surrounding the objective area:

① Natural Monument of Macizo Achahay

- Legal base : Decreto 13,682/92
- Area : 2,500 ha.
- Location : 30 km south of Praguarf

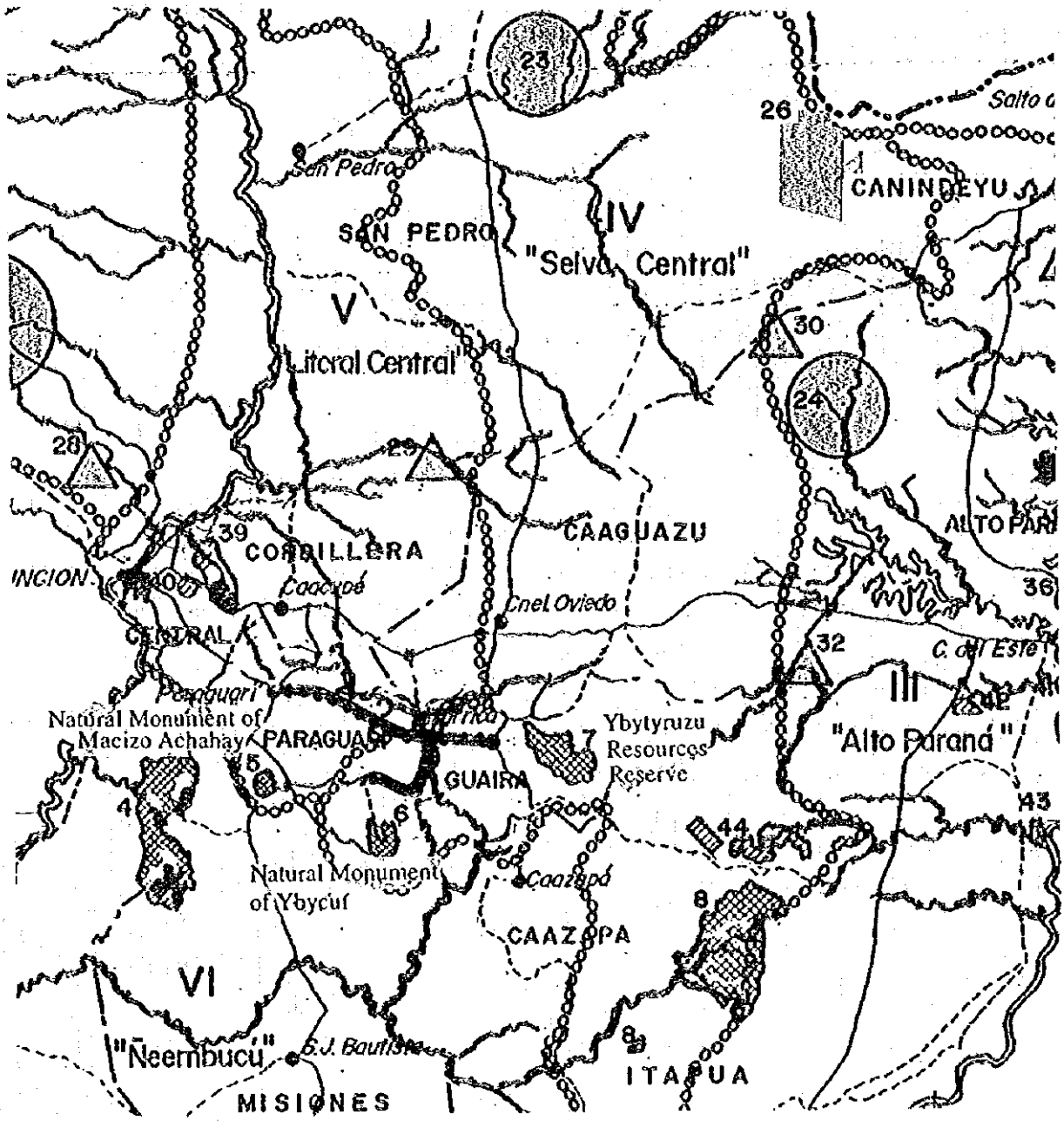
② Natural Monument of Ybycuf

- Legal base : Decreto 32,772/73
- Area : 5,000 ha.
- Location : 23 km south of La Colmena

③ Ybytyruzu Resources Reserve

- Legal base : Decreto 5,815/90
- Area : 24,000 ha.
- Location : 14 km east of Villarrica

The locations of these areas are shown in Figure 4.4.1.



Legend

Protection Area by Governmental Management

Protection Area by Private and/or Semi-Public Management

Protection Area by Special Organization's Management

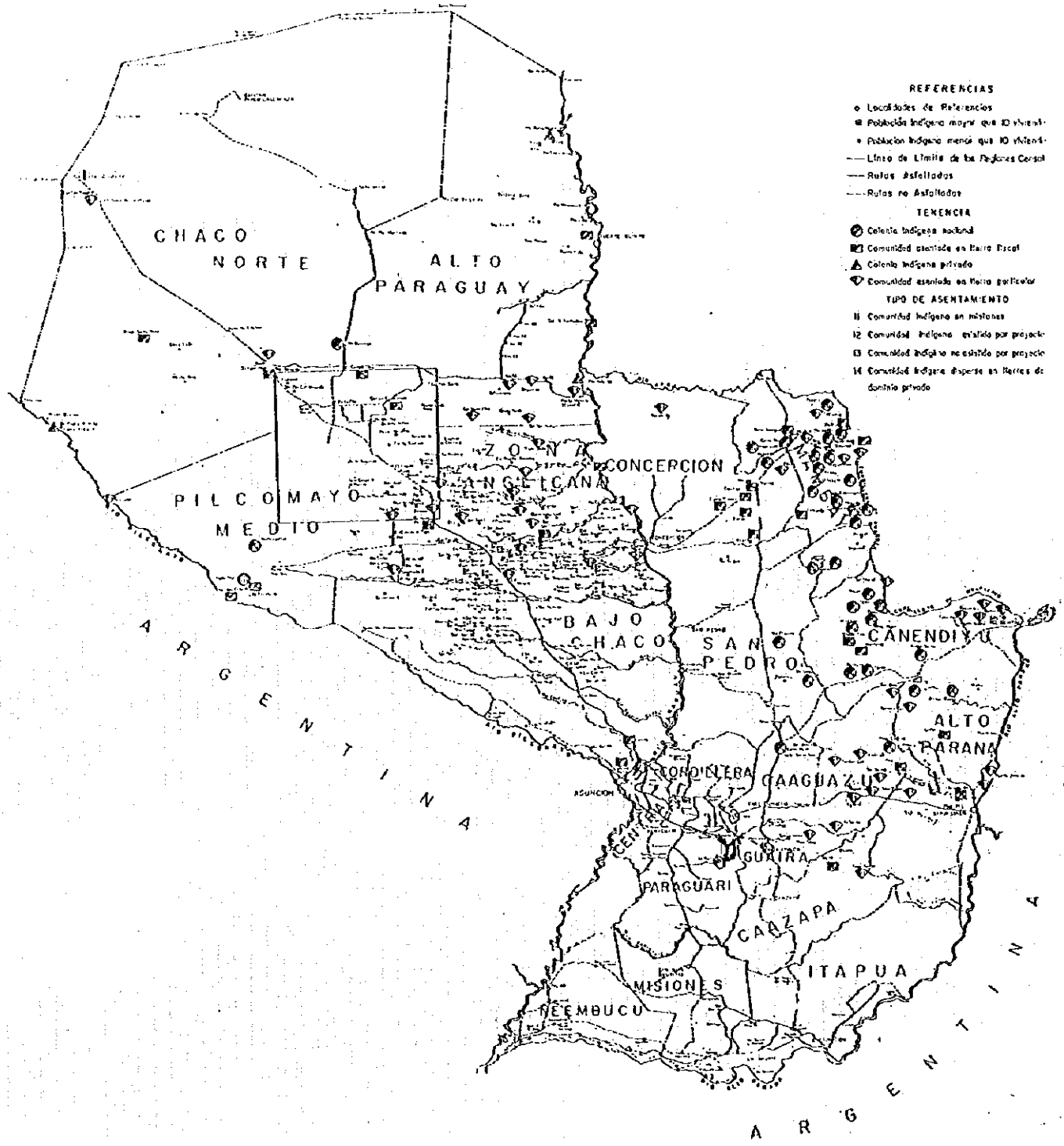
(Source; SINASIP, Ministerio de Agricultura y Ganadería)

Figure 4.4.1 National Parks and Reserves

4-4-2 Indigenous Communities and Reserves

The Paraguayan constitution talks about indigenous communities and their rights in Articles 62 to 67. At present, there are 17 indigenous groups in Paraguay, and their communities are protected by the law 904/81, which ensures the social and cultural preservation of native communities , and the defense of their traditions and patrimony.

Their locations are shown in Figure 4.4.2, which indicates that they are concentrated in Chaco in the Western Region and on the eastern borders of the Eastern Region. According to the 1981 location map and confirmation received from INDI, there are no any Indigenous Communities in the objective area.



(Source : Mapa de Comunidades Principales Tenencia y Tipo de Asentamiento, Censo Indígena 1981)

Figure 4.4.2 Location of Indigenous Communities

CHAPTER 5

INITIAL ENVIRONMENTAL EVALUATION

CHAPTER 5 INITIAL ENVIRONMENTAL EVALUATION

5-1 Purpose of IEE (Initial Environmental Evaluation)

The purpose of the IEE (Initial Environmental Evaluation) is as follows:

i) To evaluate the expected positive and negative impacts of the Project in general and to identify the necessity of EIA (Environmental Impact Assessment) based on the Project Description and the Site Description mentioned in the previous chapters. (Screening process)

ii) To clarify the important environmental items to be further investigated through the evaluation of the contents and the magnitude of their impact. (Scoping process)

iii) To clarify the policy of field investigations for selected important environmental items. (comprehensive evaluation)

iv) In addition, an evaluation to select the optimum alternative route on the basis of environmental aspects is also a purpose of IEE, but this will be carried out after the preliminary field investigation work is done. This is described in the following chapters.

5.2 Overview of Environmental Problems in Paraguay

In Paraguay, several serious environmental problems, similar to those found in other South American countries, exist.

(1) Deforestation

With the settlement of the land, more than 4 million ha of natural forest were cut in 10 years(1981-1990) according to the 1994 World Development Report of The World Bank. Total forest area was 12.9 million ha. in 1990, and it is estimated that around 25% of forest was lost in 1981, which means that 2.5% of forest was lost annually in that decade. Agricultural development, road construction, dam development, and industrial development projects also led to increased deforestration, while at the same time causing related environmental problems such as soil erosion, flooding and the disappearance of fauna. Thus the protection of natural forest lands and the replanting of forest areas is a very important environmental issue closely tied to the sustainable development of natural resources in Paraguay.

(2) Soil Erosion

In line with deforestration and agricultural development using large-scaled machinery, soil erosion has been aggravated, especially in the Southeastern Region of the country. The decrease in fertility is even more serious. Heavy rains in the crop rotation season is one of the major causes of soil erosion in the sloped fields. Therefore, appropriate measures for protecting against soil erosion such as appropriate land use, groundcover planting, etc. should be introduced.

(3) Water Contamination

Because of continuous soil erosion, almost all the rivers in Paraguay have a high volume of SS. Moreover, the amount of chemical fertilizer draining off agricultural lands and untreated wastewater from factories and homes have increased rapidly in recent years, causing increased contamination of rivers. As regional development progresses, this situation will become much more serious. Therefore, to safeguard public health, it is absolutely essential that water quality be improved and protected.

(4) Preservation of Wildlife

The nation's fauna has been disappearing along with its trees. Paraguay has more than 9.41 million ha. of natural reserves, which account for about 23% of the country. In these reserves, a wide variety of wildlife can be seen. However, many varieties of animals vanished due to deforestration and indiscriminate hunting. According to the National Wildlife Statistics, there are currently 27 endangered species which may soon become extinct; 14 species of mammals, 11 species of birds, and 2 species of reptiles.

(5) Pollution

Asunción, the capital of the country, suffers form various urban pollution problems such as air contamination, and excessive noise and vibration due to the rapid increase in the number of automobiles and their noncontrolled output of emissions. Environmental standards in this field are still limited and the emissions of automobiles are not being fully controlled. Urban pollution problems will be become ore serious as urban and road development progresses not only in the capital, but also in regional cities.

5-3 Setting of Environmental Items and Factors

The following screening methodology was used;

i) To assess the impact of road construction project activities which will affect the surrounding environment either directly or indirectly as "Environmental Factors".

ii) To determine the "Environmental Items" to be evaluated from the viewpoint of the purpose of the Environmental Impact Assessment.

iii) To evaluate the possibility of an environmental impact by Environmental Factors on the Environmental Items previously selected through the checklist method.

5-3-1 Setting "Environmental Factors"

The "Environmental Factors" of the Project was determined by the contents and activities identified in the Project Description in Chapter 3. Based on the components of the project, the major Environmental Factors that are expected to affect the regional environment are as follows at each stage of the Project:

(1) Construction Stage

1) Preparation work

- Land acquisition
- Cleaning up R.O.W.(Removing obstacles, Cutting woods, and Removing top soil, etc.)
- Building construction yards and workers' camps
- Construction of detour routes and temporary bridges

2) Construction work

- Earth work (cutting, filling embankments, etc.)
- Excavation of quarries
- Usage of heavy machines and dump trucks
- Waste disposal (domestic waste, dumping of unused soil, waste dump area)
- Construction and deconstruction of drainage facilities with water control
- Construction of bridges
- Paving
- Operation of plants (Batter, asphalt, concrete, etc.)

(2) Operation Stage

1) Existence of the road and road facilities

- Road embankment
- Road facilities (Bridges, culverts, etc.)

2) Utilization of the road

- Increase of traffic flow
- Transportation of people and goods

5-3-2 Setting "Environmental Items"

The environmental items to be evaluated in EIA are generally defined by Paraguayan Law No.294:

Article 1.)
"Environmental Impact , to all legal effects, shall be deemed to be all modifications of the environment caused by human works or activities that positively or negatively, directly or indirectly, affect life in general, biodiversity, the quality or any substantial part of the natural or environmental resources and their utilization, welfare, health, personal security, habits and customs, cultural patrimony, or means of legitimate existence."

Article 2.)
"EIA shall be deemed , to all legal effects, to be scientific research that permits identification, anticipation and estimation of environmental impacts of all works or activities proposed or in process.

According to the above, the following environmental items are listed up as "Environmental Items" to be evaluated for this Project considering the particular characteristics of Paraguay as well as general items related to road construction projects in general.

1) Natural environment

① Land (Topography and geology)
② Soil (Erosion)
③ Underground water
④ Water (Hydrology of rivers and lakes)
⑤ Sea and seashore
⑥ Fauna and flora
⑦ Climate (Meteorology)
⑧ Landscape

2) Social environment

① Resettlement
② Economic activities
③ Traffic and community facilities
④ Split of communities
⑤ Cultural properties
⑥ Water or common rights

⑦ Sanitation

⑧ Waste disposal

⑨ Risk of hazards

⑩ Indigenous communities

3) Living environment

① Air quality

② Water quality

③ Soil contamination

④ Noise and vibration

⑤ Land subsidence

⑥ Odors

The relation between the Environmental Items and Factors is summarized in general in the following matrix table.

Table 5.3.1 Relation between Environmental Items and Factors

Environmental Items	Environmental Impact Factors			
	Construction Stage		Operation Stage	
	Preparation works	Construction Works	Road Facilities	Road Operation
Natural Environment				
Physical items (land, soil, water, and climate)	+	+++		
Biological items (Fauna and flora)	+++	+	+++	+
Scenic items (landscape and serenity)	+		+	
Socio-economic Environment				
Social items (resettlement, community, etc.)	+++	+	+	+++
Economic items (economic activities, land ownership, water rights, etc.)		+		+++
Cultural items (ruins,indigenous communities)	+++	+++		
Public security items (waste, sanitation, hazards)	+	+	+	+
Living Environment (Pollution)				
Air, water, soil, land		+++		+++
Noise, Odors		+++		+++

Legend : +++ - expected large impact
+ - expected small impact
blank - expected very small impact

⑦ Sanitation

⑧ Waste disposal

⑨ Risk of hazards

⑩ Indigenous communities

3) Living environment

① Air quality

② Water quality

③ Soil contamination

④ Noise and vibration

⑤ Land subsidence

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Biological items (Fauna and flora)	+++	+	+++	+
Scenic items (landscape and serenity)	+		+	
Socio-economic Environment				
Social items (resettlement, community, etc.)	+++	+	+	+++
Economic items (economic activities, land ownership, water rights, etc.)		+		+++
Cultural items (ruins,indigenous communities)	+++	+++		
Public security items (waste, sanitation, hazards)	+	+	+	+
Living Environment (Pollution)				
Air, water, soil, land		+++		+++
Noise, Odors		+++		+++

Legend : +++ - expected large impact
+ - expected small impact
blank - expected very small impact

5-4 Screening to Identify the Necessity of an Environmental Impact Assessment

5-4-1 Methodology

Screening was involved the following steps:

i) To list possible impacts of the Project on each Environmental Item .

ii) To check whether such impacts could occur in the period of construction or during operation of the road in the area directly or indirectly influenced by the Project.

iii) To summarize results in a formatted sheet.

5-4-2 Screening Environmental Impacts of the Project

The possible impacts on each Environmental Item are shown below with the check results divided into three categories; (Yes, No or Unknown); and a summary is provided in Table 5.4.1.

(1) Screening of Natural Environmental Items (☐ Positive impact, ■ Negative impact)

① Land (Topography and geology)

■ Damage of valuable topographical or geological points---------- No
■ Change in land formations (cut or fill) ---------- Yes
■ Possibility of landslides, slumps, and other mass movements---------- Unknown
■ Embankments in unstable areas---------- Yes
■ Excavation of scenic areas for quarry sites---------- Yes

② Soil (Erosion)

■ Cutting trees and removing top soil for construction---------- Yes
■ Steep gradient of cutting and filling slopes---------- No
☐ Protection of road slopes by vegetative covering ---------- Yes

③ Underground water

■ Usage of underground water for construction ---------- No
■ Affect on sources or flow of underground water---------- No

④ Water (Hydrology of rivers and lakes)

■ Changes in water flow by construction of bridges---------- Yes
■ Interruption of subsoil and overland drainage pattern---------- Yes
■ Increased quantity of suspended sediments in streams---------- Yes
☐ Possibility of improving drainage system in the surrounding area ---------- Yes

5-4 Screening to Identify the Necessity of an Environmental Impact Assessment

5-4-1 Methodology

Screening was involved the following steps:

i) To list possible impacts of the Project on each Environmental Item .

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■ Damage of valuable topographical or geological points ---------- No
■ Change in land formations (cut or fill) ---------- Yes
■ Possibility of landslides, slumps, and other mass movements ---------- Unknown
■ Embankments in unstable areas ---------- Yes
■ Excavation of scenic areas for quarry sites ---------- Yes

② Soil (Erosion)

■ Cutting trees and removing top soil for construction ---------- Yes
■ Steep gradient of cutting and filling slopes ---------- No
☐ Protection of road slopes by vegetative covering ---------- Yes

③ Underground water

■ Usage of underground water for construction ---------- No
■ Affect on sources or flow of underground water ---------- No

④ Water (Hydrology of rivers and lakes)

■ Changes in water flow by construction of bridges ---------- Yes
■ Interruption of subsoil and overland drainage pattern ---------- Yes
■ Increased quantity of suspended sediments in streams ---------- Yes
☐ Possibility of improving drainage system in the surrounding area ---------- Yes

⑤ Sea and seashore

■ Landfills in coastal area ---------- No

■ Destruction of parts of unique reef uniquely ---------- No

⑥ Fauna and flora

■ Deforestation ---------- No

■ Cleaning of roadside planned ---------- Yes

■ Destruction of wild land or unique species ---------- No

■ Damage of territorial ecosystem by increase of traffic flow ---------- Unknown

■ Interruption of migratory routes, disturbance of wildlife habitats ---------- Unknown

■ Probability of unplanned or illegal timber cutting due to new road ---------- No

☐ Increase of roadside planting ---------- Yes

⑦ Climate (Meteorology)

■ Large-scale changes of land surface such as creation of lakes ---------- No

■ Large-scale facilities that will interrupt wind flow ---------- No

⑧ Landscape

■ Large-scale changes of landform ---------- No

■ Excavation of quarry sites ---------- Yes

■ Large-scaled or elevated road facilities ---------- Yes

☐ Cleaning and enrichment of roadside landscaping ---------- Yes

(2) Screening of Social Environmental Items (☐ Positive impact, ■ Negative impacts)

① Resettlement

■ Land acquisition of agricultural lands causing resettlement ---------- Yes

■ Land acquisition of housing area causing resettlement ---------- Yes

■ Land acquisition of commercial area causing resettlement ---------- Yes

☐ Promotion of urban redevelopment ---------- No

② Economic activities

■ Loss of agricultural production ---------- Yes

■ Changes in economic structure affecting poor peoples ---------- Unknown

■ Resettlement of large-scale industries ---------- No

☐ Creation of job opportunities for construction and related works ---------- Yes

☐ Promotion of agricultural production by improving transportation ---------- Yes

☐ Promotion of rural development and improvement of living conditions --- Yes

③ Traffic and community facilities

■ Increase in traffic congestion, accidents, pollution ---------- Yes

■ Deterioration of existing traffic facilities by new route---------- Yes

☐ Promotion of opportunities to have higher grade education ---------- Yes

☐ Promotion of better location (factories, warehouses etc.)---------- Yes

④ Split of communities

■ Interruption of major pedestrian route by new road ---------- Unknown

■ Split of community boundaries ---------- Unknown

☐ Promotion of close relations with distant communities---------- Yes

⑤ Cultural properties

■ Existence of valuable ruins and cultural assets---------- Yes

■ Damage of cultural assets by construction work- ---------- Unknown

☐ Promotion of tourism---------- Yes

⑥ Water or common rights

■ Existence of common rights area to be acquired for road ---------- No

■ Interruption of water rights to rivers---------- No

■ Interruption of fishery rights to rivers by construction work ---------- No

⑦ Sanitation

■ Creation of new pathways for disease vectors---------- No

■ Creation of stagnant water bodies in borrow pits, quarries, etc. ---------- No

■ Increase in waste disposal by rapid increase of traffic flow ---------- No

☐ Increase of higher health services ---------- Yes

⑧ Waste disposal

■ Unused construction materials such as soil, cut timber, etc.---------- Unknown

■ Untreated waste disposal from construction workers camps---------- Unknown

■ Dump sites ---------- Unknown

☐ Promoting an effective collection system of waste disposal---------- Yes

⑨ Risk of hazards

■ Large-scale earth works close to the housing areas---------- No

■ Possibility of unexpected hazards during heavy floods caused by
by road embankment and drainage facilities ---------- Unknown

☐ Promoting effective rescue system by utilizing paved road---------- Yes

⑩ Indigenous communities

■ Existence of indigenous communities surrounding the road---------- No

■ Possibility of reduction indigenous peoples' territory---------- No

(3) Screening of Living Environmental Items (☐ Positive impact, ■ Negative impact)

① Air quality

■ by rapid increase of toxic materials from traffic flow---------- No

■ by connection with heavy traffic road in town area ---------- Yes

☐ Decrease of toxic materials by the smoothing of traffic flow---------- Yes

② Water quality

■ by untreated inflow of sediments that damage water quality ---------- No

■ by untreated inflow of organic materials from construction camps --------- No

■ by outflow of oil, fuel, and grease in equipment yards---------- No

■ by large-scale construction works in rivers or lakes---------- No

☐ Improvement of water quality by development of drainage system --------- Yes

③ Soil contamination

■ by oil, fuel, and grease in equipment yards---------- No

■ by chemical materials for land improvement works---------- No

■ by asphalt emulsion in pavement works ---------- No

④ Noise and vibration

■ by heavy machine operation close to housing areas ---------- Unknown

■ by heavy traffic in weak land area---------- No

■ by connection with heavy traffic road in town area ---------- Yes

☐ Decrease of steep slopes causing noise along existing roads ---------- Yes

⑤ Land subsidence

■ by heavy use of underground water pumped up---------- No

■ by existence of mining areas close to planned road ---------- No

⑥ Odors

■ Usage materials with offensive odors during construction---------- No

5-4-3 Conclusion of the Screening (Necessity of EIA)

As a result of the screening process mentioned above, it was concluded that the EIA (Environmental Impact Assessment) was necessary for the Project, since a negative impact was expected to happen in 14 out of 24 environmental items. Unknown items are also included as further investigation items to clarify their impact in EIA.

Table 5.4.1 Screening Results

Environmental Items		Examples of Impact	Evaluation			Remarks
(1) Natural Environment						
①	Land(topography and geology)	-Changed valuable land features by earth work	Yes	No	Un-known	*Excavation on quarry sites*
②	Soil Erosion	-Increased erosion by cutting plants	Yes	No	Un-known	*Possibiliysy of removingt top soils*
③	Underground Water	-Cut water streams by large-scale earth work or tunnel work	Yes	No	Un-known	*No underground works*
④	Water (hydrological situation)	-Changed hydrological regime by construction work In rivers	Yes	No	Un-known	*Long bridge construction*
⑤	Coastal Zone	-Eroded beach by dredging and reclaimation work	Yes	No	Un-known	*Not of coastal zone*
⑥	Fauna and Flora	-Decreased population and species by changes of ecosystem	Yes	No	Un-known	*Cutting gallery forest*
⑦	Climate	-Changed climatic conditions by large-scale works or facilities	Yes	No	Un-known	*No related activities*
⑧	Landscape	-Changed scenic harmony by earth works and facilities	Yes	No	Un-known	*Road embankment and bridges*
(2) Social Environment						
①	Resettlement	-Taken over land ownership and right of living by land acquisi acquisition	Yes	No	Un-known	*Necessary to acquit land & houses for bypassroad*
②	Economic Activities	-Lost productive lands and change of economic structure	Yes	No	Un-known	*Loss of productive land*
③	Traffic and Community Facilities	-Increased traffic accidents -Noisy atmosphere	Yes	No	Un-known	*There are several community facilities*
④	Split of Communities	-Split of community by separating pedestrian routes	Yes	No	Un-known	*Depends on selection of alternative route*
⑤	Cultural Property	-Lost or damaged valuable religious facilities and ruins	Yes	No	Un-known	*There is a research site along the route*
⑥	Water Rights Rights of Common	-Lost or damaged water rights, rights of common, etc.	Yes	No	Un-known	*There is no water rights nor a very few commons*
⑦	Sanitation	-Increased disease vectors by garbage or stagnant water	Yes	No	Un-known	*No related activities*
⑧	Waste Disposal	-Generation of unused waste of construction materials	Yes	No	Un-known	*Depends on the generating volume*
⑨	Risk of Hazards	-Increased hazard risk such as landslide, flood, other disasters	Yes	No	Un-known	*Necessary to check during a flood*
⑩	Indigenous Communities	-Damaged living environment and resettlement of indigenous people	Yes	No	Un-known	*Non existent in the project area*
(3) Living Environment						
①	Air Pollution	-Contaminated by increase of toxic materials by vehicular traffic	Yes	No	Un-known	*Depends on traffic volume*
②	Water Pollution	-Contaminated by sediment and untreated harmful materials	Yes	No	Un-known	*No related activities*
③	Soil Contamination	-Contaminated by dust and chemical materials	Yes	No	Un-known	*No related activities*
④	Noise and Vibration	-Generated by increase of heavy traffic and weak land	Yes	No	Un-known	*Possible by construction machine in the towns*
⑤	Land subsidence	-Affected by pumping up underground water	Yes	No	Un-known	*No ralated activities*
⑥	Offensive Odors	-Generated by exhaust gas and usage of odoriferous materials	Yes	No	Un-known	*No ralated activities*
	Necessity of IEE or EIA	Necessary	-*There are several items that are expected to have negative impacts.*			
		Not Necessary				