No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
ADMINISTRADORA BOLIVIANA DE CARRETERAS (ABC)

THE STUDY
ON
PREVENTIVE MEASURES
AGAINST
ROAD DISASTERS ON MAIN NATIONAL ROADS
IN
THE REPUBLIC OF BOLIVIA

FINAL REPORT

OCTOBER 2007

CENTRAL CONSULTANT INC.
in association with
EARTH SYSTEM SCIENCE CO., LTD.

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Preface

In response to a request from the Government of the Republic of Bolivia, the Government of Japan decided to conduct a study on Preventive Measures against Road Disasters on Main Roads in the Republic of Bolivia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Akiomi Shimazu of Central Consultant INC., and consists of Central Consultant INC. and Earth System Science Co., Ltd. between October 2005 and October 2007.

The team held discussions with the officials concerned of the Government of the Republic of Bolivia and conducted the study. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

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

October 2007

EIJI HASHIMOTO
Deputy Vice President
Japan International Cooperation Agency

Letter of Transmittal

We are pleased to submit to you the study report on Preventive Measures against Road Disasters on Main Roads in The Republic of Bolivia.

This Study was conducted by Central Consultant Inc., in association with Earth System Science Co., Ltd., under a contract to JICA, during the period of October, 2005 to October, 2007. In conducting The Study, we have examined the features of Capacity Development in the area of road disaster prevention with due consideration to the present situation of The Republic of Bolivia and formulate the Plan of Preventive Measures against Road disasters on Main Roads in The Republic of Bolivia.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA and Administradora Boliviana de Carreteras (ABC). We would also like to express our gratitude to the officials concerned of The Ministry of Foreign Affairs, The Vise-Ministry of Transport and The Embassy of Japan in The Republic of Bolivia throughout our study.

We hope this study will contribute to the further promotion of the administration of road disaster prevention in Bolivia.

October 2007

Very truly yours,

AKIOMI SHIMAZU
Leader
The study on Preventive Measures
against Road Disasters
on Main National Roads
in the Republic of Bolivia

BRIEFING

Ⅰ OUTLINE OF THE STUDY IMPLEMENTATION

Chapter 1 Introduction

The purpose of the study is to support capacity development in road disaster prevention in Bolivia through the following;.

- building an appropriate road inspection and maintenance system
- cultivating the necessary human resources through the following activities:
  - ・road disaster hazard diagnosis
  - ・formulation of slope repair and disaster countermeasure works
  - ・design supervision, estimation and construction supervision of slope countermeasure works and road structures

Chapter 2 Outline of the Study Implementation

Assistance is provided to Administradora Boliviana de Carreteras (ABC) to implement the following items.

(1) Formation of Capacity Development Plan
(2) Support of Capacity Development through Preparation of Road Disaster Inventory, Establishment of Database System, Preparation of Road Disaster Prevention Management Manual, Technology Transfer through Implementation of Pilot Works and Activity for Awareness of Road Disaster Prevention

The study has been conducted from October 2005 to August 2007. Implementation organization consisted of the task team of ABC and the Steering Committee of upper institutions. The task team has a role of substantial work supported by advice from JICA study team. The task team was composed of engineers and administrators from each department headed by general manager and head of maintenance department.

Ⅱ CURRENT SITUATION ON ROAD ADMINISTRATION

Chapter 3 General Condition of Roads

The general situation in Bolivia regarding roads has been studied in society, natural environment and road network, with particular attention given to the natural features of Bolivia, such as topography, geology and climate, that are closely related to road disasters.

Chapter 4 Current Situation Survey on Road Administration and Disaster Prevention

The situation of road administration has been studied in organization, financial state, road maintenance system, development plan and IIRSA.

In Bolivia the concept of road disaster prevention which aims to protect the road from disasters before the occurrence is not recognized well socially. And ABC herself dose not have organization, system and budget for disaster prevention, but for maintenance of roads. Due to the lack of the budget, restoration after the occurrences is treated as full demand.

AS for the daily maintenance the micro-empresas organized in local village bases are in charge by man power works such as road cleaning, weeding, repairing potholes of pavement, keeping drainage etc.

Ⅲ FORMATION OF CAPACITY DEVELOPMENT PLAN

Chapter 5 Formation of Capacity Development Plan on Road Disaster Prevention Management

(1) Formation of Overall Capacity Development Plan

The super goal of the CD plan is designated as “Road Disaster are Reduced in Bolivia” and the overall goal as “Continuous Road Disaster Preventive Management is Executed in ABC”. The proposed 7 projects are as follows; ①Establishment of Road Disaster Preventive Department (unit),②Road Disaster Preventive Technology Improvement,③Establishment of Road Disaster Preventive Management System, ④Improvement of Emergency Response in Disaster Prevention,⑤Road Information Enhancement and Discloser,⑥Improvement of Tender Procedures in Road Disaster Prevention,⑦formulation of Strategy Program of Disaster Prevention Budget.

(2) Scope of the CD Plan in the JICA Study

The scope of implementation of the CD Pan in the JICA Study in the context of the overall implementation plan is lay in the project 1 to project 3, mainly coincide with project 2. As the most fundamental tools, preparation of road disaster inventory, establishment of database system and preparation of road disaster prevention management manual have been designated. And for technology transfer at the site, implementation of pilot works has been planned. And for activity for awareness of road disaster prevention, holding seminars has been planned.

Ⅳ CAPACITY DEVELOPMENT ACTIVITIES IN THE JICA STUDY

Chapter 6 Site Survey and Creation of Road Disaster Registration System

The road disaster inventory aims to be a fundamental tool for the road maintenance system by recording the disasters and by storing them in the designated format which covers the road net under ABC.

A register of 259 selected hazard spots was created. The disaster inventory was firstly prepared as the diagnosis card for critical spots and then additional information is to be added in the occasions of disaster happenings. On the prevalence to all national roads, the newly established UPD (Road Disaster Prevention Unit) is in charge of the administration with close relation to regional offices of ABC.

Chapter 7 Database System for Road Disaster Prevention

For the systematic utilization of stored and accumulated data, the system is composed of M.S.Access and GIS (Geographical Information System) under discussions with ABC counterpart and JICA study team. And the data of 259 critical spots diagnosed in the inventory has been installed into the system. And the data of trials in Route 3 was added to the disaster inventory.

Chapter 8 Road Disaster Prevention Management Manual

The manual has been prepared taking into consideration, in particular, the implementation system of road maintenance management in Bolivia which consists of the micro-empresas (micro companies), the Supervisors, ABC Regional Offices, ABC Head Office and keeping in mind of feasibility.

The manual consists of following five guides;

Guide I	Determination of High Hazard Control Sections
Guide II	Disaster Prevention Works in Routine Maintenance
Guide III	Management for Imminent Danger
Guide IV	Emergency Response
Guide V	Disaster Prevention Measures

The full text of the manual is attached in separate volume

The manual has been revised through the trial use on one section of route 3 under La Paz Regional Office in the period of July 2006 to April 2007.

Ⅴ TECHNOLOGY TRANSFER AND AWARENESS OF DISASTER PREVENTION

Chapter 9 Implementation of Pilot Project

The goal is capacity development in the area of disaster prevention through the execution of pilot works, by means of training in surveys, planning, design, cost estimation, preparation of contract documents, bidding and assessment, work supervision etc.

The site is located at km426+300 on route 7 in Bermejo area, Santa Cruz. In this site the river flows nearby at the road foot and some embankment shoulder failure occurs. Accordingly the protection works from the river flow and the countermeasure works for embankment failure are planned,

The pilot works was scheduled for 4 months from the beginning of October 2006 to the end of January. However in consequent of unexpected sharp change of the subsurface topography and the abnormal climate condition and the traffic close of connecting road of this year, the completion was delayed to the middle of March counting 5.5 months

Through the execution of the pilot works, training for live treatments of problems in disaster prevention works have been experienced with new countermeasures of the crib works applied in the pilot works.

Chapter 10 Awareness of Road Disaster Prevention Management

Totally 4 seminars including preliminary one have been held in La Paz and in Santa Cruz for all stakeholders of roads. The seminars have covered introduction of Japan practice, explanation of the CD plan of the study, disaster related experiences in Bolivia, site visit for the pilot works. And discussions on appropriate technical support with institutional management, close relationship among UPD and related agencies at central and local levels, securing appropriate manpower, prevalence of road disaster prevention manual, holding periodic seminar etc. have been made.

To hold seminars is proved to make important role to enlighten the necessity of disaster prevention activity for all stakeholders of roads.

Ⅵ EVALUATION ON THE CAPACITY DEVELOPMENT ACTIVITIES

Chapter 11 Monitoring and Evaluation on the Development Project

The purpose of the monitoring and evaluation were to facilitate the capacity development for ABC staff concerned through the CD activities designated in the JICA project.

Monitoring (1) was undertaken from September to October 2006 and Monitoring (2) from January to February 2007, respectively. Terminal evaluation was conducted from May to June 2007 by the ABC-JICA evaluation team.

In the course of monitoring necessary adjustment and amendment have been done on each CD activity items.

At the monitoring(2) approval of CD Plan, establishment of the disaster prevention unit and incorporation into POA which are part of the first and second items have been authorized..

Chapter 12 Terminal Evaluation Results

Relevance, effectiveness and impact of the study have been evaluated as very high or mostly achieved through the overall monitoring and evaluation carried out on the base of five evaluation criteria. .

However, efficiency and sustainability have been deemed as moderately low being affected by lack of full-time participation to the activity. For keeping and developing sustainability, introduction of system of assistance by experienced donors will be important in this stage of just established organization which does not have experiences on the disaster prevention management.

Ⅶ CONCLUSIONS AND RECOMMENDATIONS

Chapter 13 Conclusions and Recommendations

The CD Plan and the fundamental tools have been prepared for implementation of road disaster prevention management for all national roads. The most important concern is that how ABC will enhance and sustain these activities regarding road disaster preventive management using knowledge and know-how obtained after termination of the study.

SEPARATE VOLUME

ROAD DISASTER PREVENTION MANAGEMENT MANUAL

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Abbreviation

AASHTO	American Association of State Highway and Transportation Officials
ABC	Administradoda Boliviana de Carreteras
AC	Asfalt Concrete
ANDINO	Grupo Andino
BID	Banco Inter-americano de Desarrollo
BM	Banco Mundial
CAF	Corporación Andina de Fomento
CD	Capacity Development
CN	Cuenta Nacional de Carreteras
CNCV	Cuenta Nacional de Conservacion Vial
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
FONPLATA	Fondo Financiero para el Dasarrollo de la Cuenca del Plata
GDP	Gross Domestic Product
GIAS	Geographical Information and Analysis System
GNI	Gross National Income
HIPC	Highly Indebted Poor Countries
IDB (BID)	Banco Inter-americano de Desarrollo
IEE	Initial Environmental Examination
IIRSA	Iniciativa para la Integración de la Infraestructura Regional Sudamericana
INE	Instituto Nacional de Estadística
JICA	Japan International Cooperation Agency (Agencia de Cooperación Internacional de Japón)
KfW	Kreditanstalt fur Wiederaufbau
M/D	Minutes of Discussions
MERCOSUR	Mercado Común del Sur
PASA	Plan of Execution and Environmental Monitoring
PC	Prestressed Concrete
PCM	Project Cycle Management
PDM	Project Design Matrix
PL-480	Public Law 480
PMRD Database	Preventive Measure against Road Disasters Database
POA	Programacion Operativa Anual
PPM	Program for Prevention and Mitigation
PROEX	Brazilian Development Bank
PROVIAL	Programa de Conservacion Vial con Microempresas
RC	Reinforced Concrete
SAM	Management Administration System
SNC	Servicio Nacional de Caminos
SEARPI	Servicio de Encauzamiento de Aguas y Regularización del Río Rirai
SENAMHI	Servicio Nacional de Meteorologia e Hidrologia
SEPCAM	Servicio Prefectural de Caminos
TGN	Tesoro General Nacional
UPD	Unidad de Prevencion de Desastres
VIPFE	Viceministerio de Inversion Publica y Financimient Externo

Route 3 – 126.5km

A cliff of steeply dipping jointed sandstone. Rock fall will occur by block separation. Outcrop continues from 2.3 km to 3.1 km.

Route 3 – 299.0km

Outcrop of gently dipping reddish brown sandstone and siltstone. Steep cliffs of massive sandstones are formed by erosion of les.

Route 7 – 270.9km

Large-scale landslide. Stability of the sliding block should be investigated.

Route 4 – 119.2km

Severe disaster site of debris flow, where the existing bridge was destroyed. Existence of natural dam, which caused by slope failure along the tributary stream, is supposed.

Route 16

General View.

Route 16 – 196.8km

A disaster site of debris flow. The volume of debris is estimated at 200m^3.

Route 16 – 248.3km

Large-scale rock fall of massive jointed sandstone, which caused by block separation along the downhill-dipping joint plane.

A Typical Measure - Gabion

Micro-empresa in Working (Cutting Grasses)

Disaster Spot Survey

Disaster spot survey on the way to Chulumani. (January 2006)

Fallen Rocks

Brrmejo, SCZ on Route 7 (February 2007)

Site of Collapsed Rocks and Mud
Bermejo, SCZ on Route 7 (February 2007)

Collapse of Road Caused by Rain Water
Bermejo, SCZ on Route 7 (February 2007)

Waitig Line of Vehicles due to Road Close
Angostura, SCZ on Route 7 (February 2007)

Site Survey Meeting
(December 2005)

PCM Meeting
(December 2005)

Interview
(December 2005)

Working in the Study Office
(February 2006)

Preparatory Seminar
for Road Disaster Prevention (La Paz)
(February 2006)

Counterpart Meeting
(May 2006)

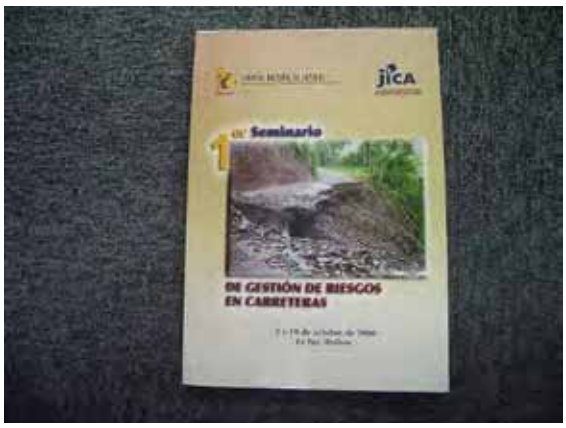
Manual Meeting with Regional Office Engineers
(June 2006)

Mannual Meeting
(June 2006)

Site Briefing on Disaster Registration Recording
(January 2007)

Micro-Empresas
Simple Rain Gauge Monitoring Orientation Meeting with Micro-Empresas (July 2006)

Pilot Works Design Meeting
(August 2006)



Proceedings of the first seminar
October 9-10, 2006

First Seminar on Road Disaster Prevention
La Paz October 9-10, 2006

Pilot Works Site before Start
Bermejo, SCZ on Route 7

Pilot Works during Construction
River revetment work (November 2006)

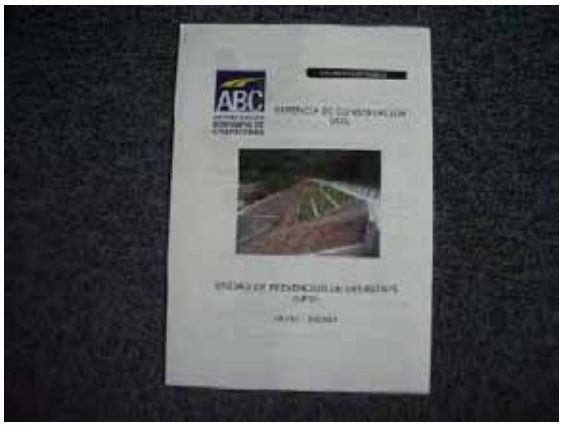
Pilot Works after Completion
(March 2007)

Discussin Meeting on the Pilot Works
At SCZ Regional Office (February 2007)

Site Visit in the 2nd Seminar
Bermejo, SCZ on Route 7 (June 2007)

Steering Committee
September 4, 2007

Road Disaster Prevention Management Manual



Action Plan of UPD for road disaster prevention management

Chapter 1
Introduction

Chapter 1 Introduction

1.1 Background of the Study

Bolivia is a landlocked country where the main means of transport is by land. The total population of approximately 8.3 million people lives in 314 urban and rural communities in a country three times the size of Japan (approximately 110km^2) and 70~80% of the movement and transportation of people, farm produce and daily necessities between the communities is dependent on road transport.

However, nine-tenths of the total road length of approximately 60,000km and two-thirds of the national road length of approximately 8,000km are still unpaved roads of gravel or earth and they are poorly maintained. Reflecting the country's varied climate and geological and topographical conditions, large-scale mudslides, rockfalls, erosion, flooding and landslides frequently occur here and there, particularly in the rainy season which lasts from November to March, resulting in major losses, especially for the peasants who eke out a living by taking their produce to market. Furthermore, even if the damaged road is repaired, the lack of technology means that similar damage occurs repeatedly in the same place.

National roads are being constructed in Bolivia based on the "National Transportation Plan" and "Strategic Road Plan", but neither plan makes any mention of road disaster prevention nor any organizations or specialists are trained in road disaster prevention.

On the other hand, the Andean Development Corporation (CAF), an international financial institution of which Bolivia is a key member, promotes the Integration of Regional Infrastructure in South America (IIRSA), and improvement of arterial roads in Bolivia in order to promote infrastructure integration with neighboring countries is a matter of common concern not only for Bolivia but for the South American region.

Under these circumstances, this study was requested of Japan with the aim of supporting capacity development for road disaster prevention in Bolivia. The study includes:

- diagnosis of places where there is a risk of natural disaster
- preparation of a road disaster prevention plan
- preparation of a road disaster prevention manual
- implementation of trial works in selected places
- transfer of road disaster prevention technology

Against this background, JICA dispatched the Preparatory Study Team in March 2005 and held discussions with related organizations on the Bolivian side. As a result of verifying the background of the Bolivian government's request and reviewing the content and scope of the study and the implementation conditions, the Japanese government agreed to implement the study on road disaster prevention and signed the Scope of Work (S/W).

1.2 Objectives of the Study

The purpose of this study is to support capacity development in road disaster prevention by the Bolivia side through the following, based on the Minutes of Meeting and Scope of Works signed between the Preparatory Study Team and the SNC on 23 March 2005. The study has been succeeded from SNC to the newly established ABC (Administradora Boliviana de Carreteras) by the law No.3507 of October 27, 2006 as the acting organization.

- building an appropriate road inspection and maintenance system
- cultivating the necessary human resources through the following activities:
  - road disaster hazard diagnosis
  - formulation of slope repair and disaster countermeasure works
  - design supervision, estimation and construction supervision of slope countermeasure works and road structures

1.3 Study Areas

The study area shall be the section of road between Cotapata and Yucumo on Route 3 (275km), between Colomi and Ivirgarzama on Route 4 (172km), between Epizana and El Torno on Route 7 (337km) and between Charazani and Apolo on Route 16 (164km). The location of the roads are shown in *Figure 1.3.1* and in *Figure 1.3.2* with topographical condition.

Figure 1.3.1 Study Area (1)

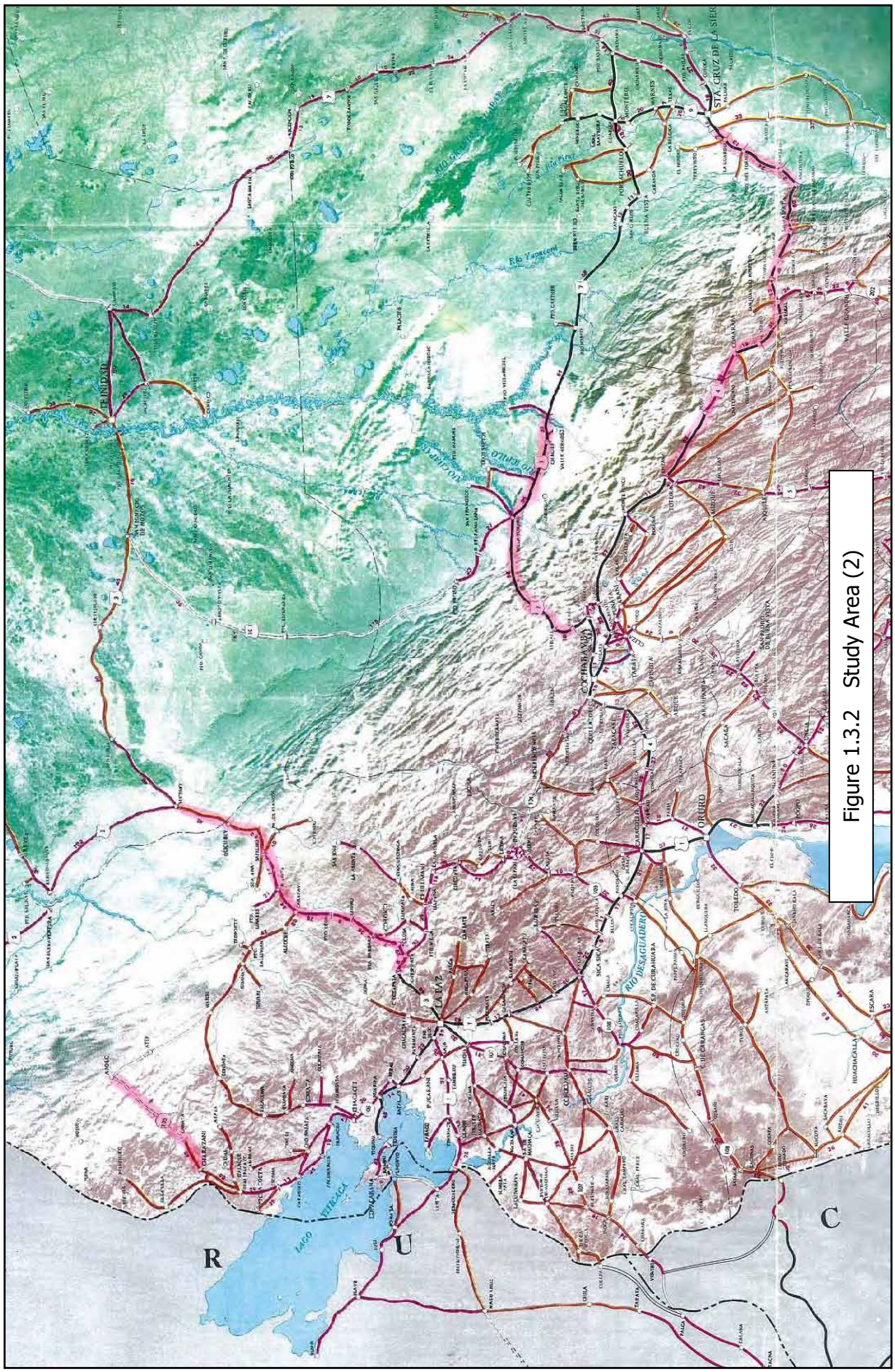


Figure 1.3.2 Study Area (2)

Chapter 2

Outline of the Study Implementation

Chapter 2 Outline of the Study Implementation

2.1 Outline of the Study

The purpose of this study is to support capacity development in road disaster prevention and the contents of the study consist of the following items.

1) Preparation of Capacity Development Plan
2) Preparation of Road Disasters Inventory as technical elements
3) Preparation of Road Disaster Prevention Manual as technical elements
4) Support of Capacity Development through the implementation of Pilot Works and Seminar
5) Activity for concept of disaster prevention through seminars
6) Evaluation and Revision of the Capacity Development Plan and the Road Disaster Prevention Manual

The implementation flow is shown in *Figure 2.1.1* or *Figure 2.1.2*. The assign schedule of the study team is also shown in *Table 2.1.1*.

The study for the first year period (from October 2005 to March 2006) covered the item (1), (2) and (3). The study for the second year period (from May 2006 to March 2007) covered item (4) and (5) including following up of item (1), (2) and (3). The study for the third year period (from May 2007 to September 2007) covered item (5) and (6) including following up of item (2) and (3).

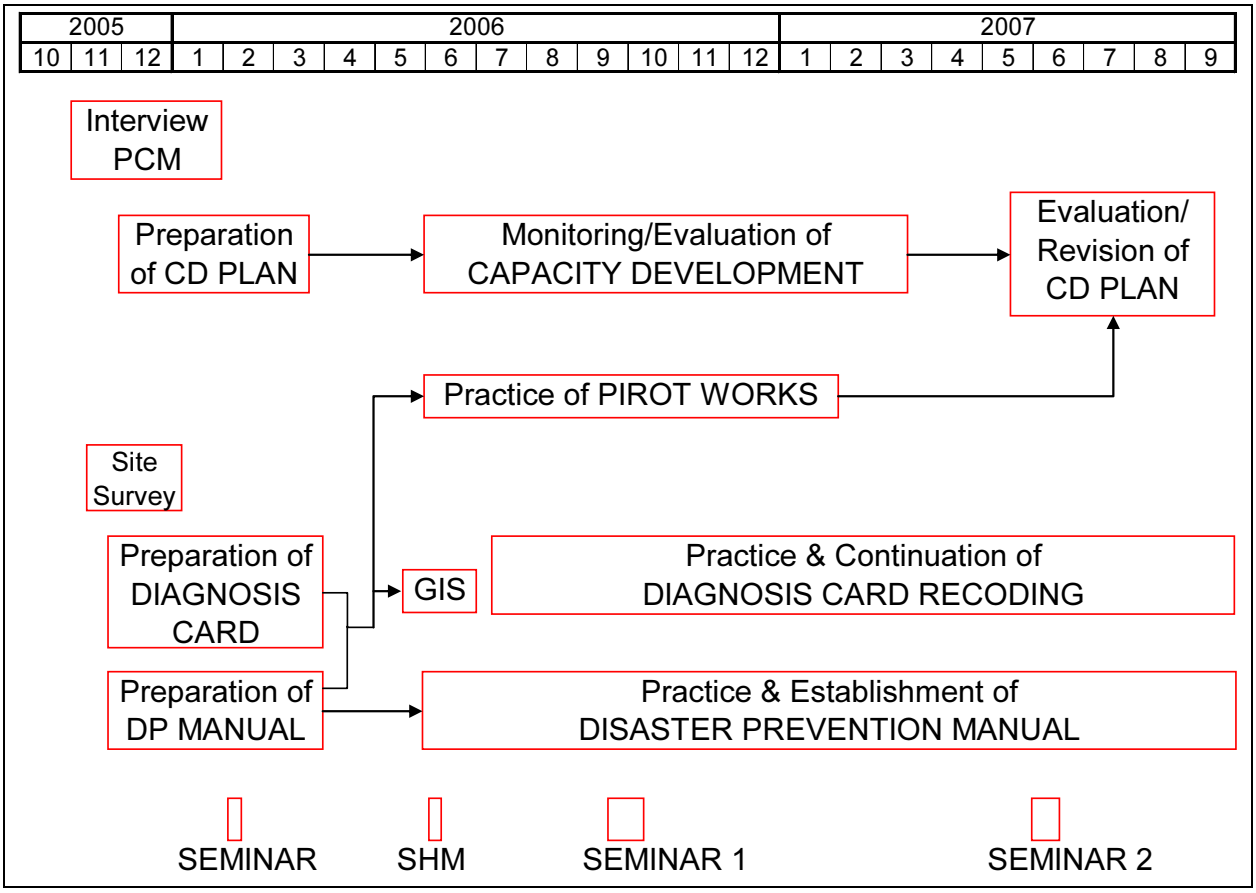


Figure 2.1.1 Total Arrangement of Work Schedule

Table 2.1.1 Assignment Schedule

Name	Assignment	2005			2006												2007								
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mr. Akiomi SHIMAZU	Team Leader/ Road Disaster Prevention Planner	10/29	50	12/17	1/14	40 2/22			5/9	60	7/7	8/19	38 9/25				1/13	45 2/26			5/16	38 6/22			15
Mr. Yukishi TOMIDA	Deputy Team Leader/ Capacity Development Specialist	10/29	50	12/17	1/14	60	3/14		5/9	45 6/22			9/15	30 10/14			1/13	45 2/26			5/16	38 6/22			15
Mr. Hirofumi TAKAYAMA	Design Specialist for Road Disaster Prevention				1/14	60	3/14		5/29	60	7/27										5/16	38 6/22			
Mr. Fumihiko YOKOO	Disaster Prevention manual/ Pilot Project Planner		42 11/5	12/16	1/14	60	3/14		5/14	75	7/27						1/30	30 2/28			5/16	38 6/22			
Mr. Kazuharu SAITO	Geologist for Collapse Mechanism		30 11/5	12/4									9/18	30 10/17											
Mr. Masahiko HAYASHI	Natural Condition Survey Engineer		42 11/5	12/16	1/14	36 2/18			5/20	45	7/3														
Mr. Junichi WADA	Consutruction Planning and Cost Estimation Specialist / Supervisor								5/20					308					3/23		5/16	38 6/22			
Mr. Mikio KAJIMA	Environmental Specialist					24 2/19	3/14			6/13	45 7/27														
Mr. Manuel Fernando Franco	Capacity Development Specialist		37 11/7	12/13	1/30	40	3/10		5/11	40 6/19			9/20	25 10/14			1/15	40 2/23			5/18	33 6/19			
Mr. Hiroyoshi YAMADA	GIS Database								5/24	30 6/22															
Ms. Midori OISHI	Interpreter	10/29	50	12/17	1/14	60	3/14		5/9	80	7/27		9/18	30 10/17			1/13	45 2/26			5/16	38 6/22			15
Mr. Masato NIDAIRA	Project Coordinator	10/29	30 11/27			30 2/13	3/14				7/20	68	9/25				1/30	30 2/28			5/16	38 6/22			
Mr. Hodaka IGO	Project Coordinator	10/29	50	12/17																					
Mr. Toru KOIKE	Project Coordinator								5/24	30 6/22															
Mr. Kengo OHASHI	Project Coordinator																				5/16	38 6/22			

* The dates indicates the daparture date and the arrival date of Japan
* Arrival Date and Departure Date will be subject to some minor changes

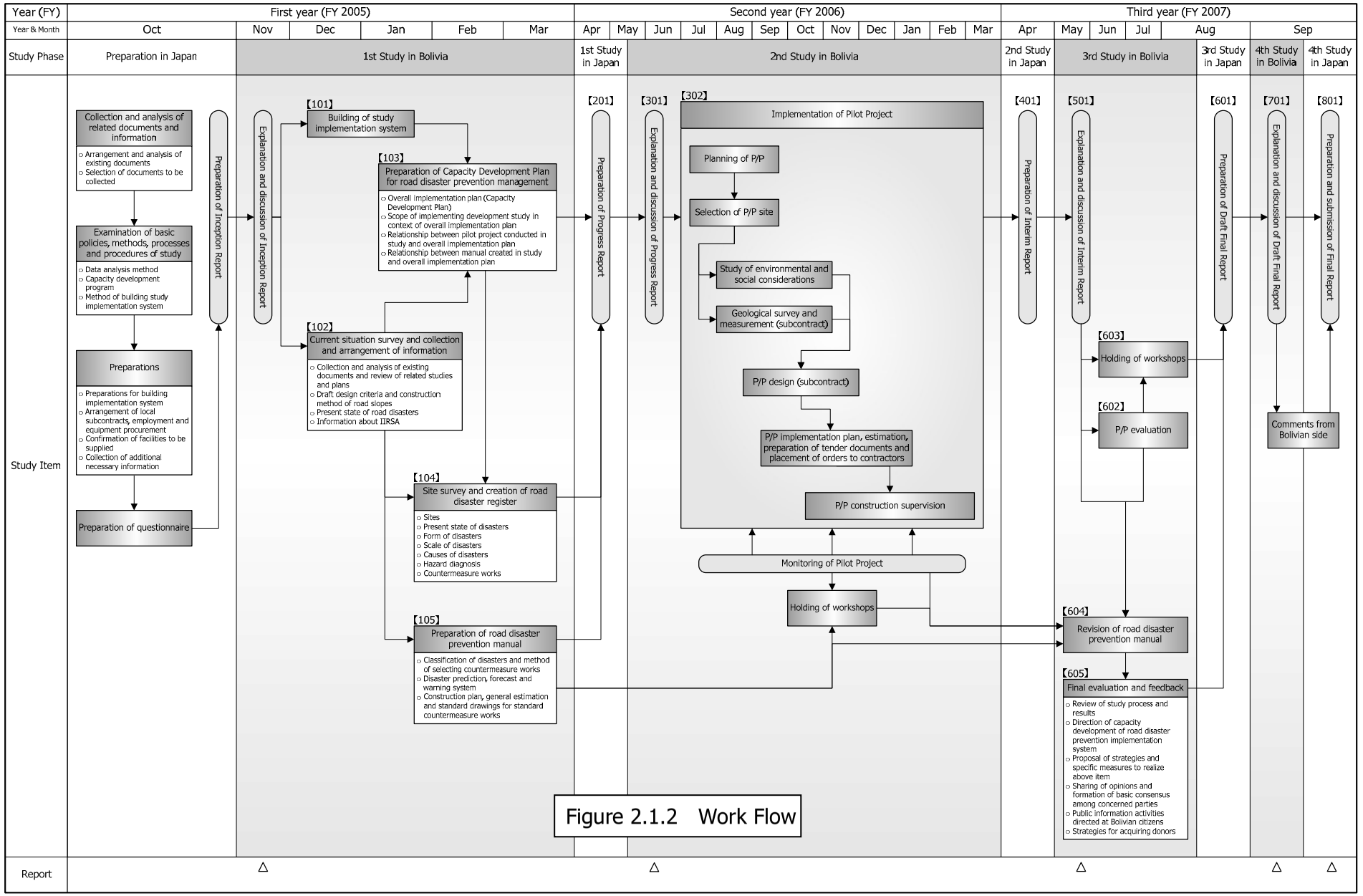


Figure 2.1.2 Work Flow

2.2 Implementation System of the Study

The organization of ABC is shown if *Figure 2.2.1*. ABC is put under supervision of Viceministerio de Transportes, Ministerio de Servicio y Obras Publicas. ABC is composed of headquarter office in La Paz and ten regional offices. The headquarter is composed of six departments (Planning, construction, maintenance, social environment, financial administration and law administration) under the command of the general manager (Gerente General) assigned by the president. The number of personnel of ABC is abort 280 in which 180 is for head quarter and 10 to 11 each for regional office. The length of national road under administration is over 15,600 km (28% for paved, 37% for gravel and 35% for earth). The budget of ABC is composed of national budget mainly for maintenance of road network and foreign fund (credit and donation) for construction and improvement including new roads. The national budget is come from CN (special account for road maintenance established by toll, heavy weight tax and part (15%)of hydro-carbonization tax) 2005 of which is about 34.6 million dollars. The foreign fund of 2005 is about 188 million dollars. The role of ABC staff is, not for direct construction by self power, but financial administration and supervision of national road network

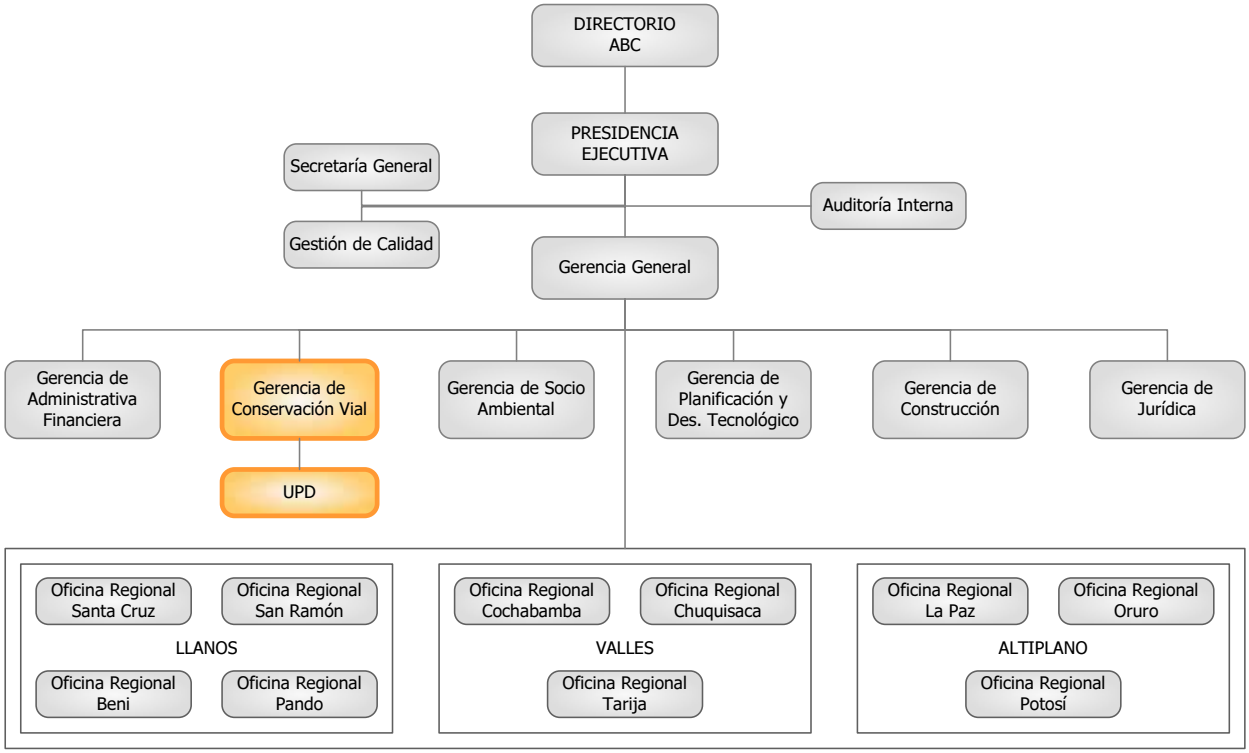


Figure 2.2.1 Organization of Administradora Boliviana de Carreteras (ABC)

The Implementation system for preparing capacity development plan is shown in *Figure 2.2.2* in which the steering committee and the task team are established.

The steering committee is composed of the ministry of foreign affairs (Ministerio de Relaciones Exteriores y Culto), the vice-minister's office of public investment and foreign lending (Viceministerio de Inversion Publica y Financiamient Exterio), the vice-minister's office of transport (Viceministerio de Transpoetes) and the president of ABC. Under the steering committee the task team has a role of substantial work and it is headed by general manager and composed of head of maintenance department as team leader, the managing engineer of maintenance department as coordinator and seven personnel from different specialties (social environment, hydrology, geotechnology, geology, design, cost estimation and public investment).

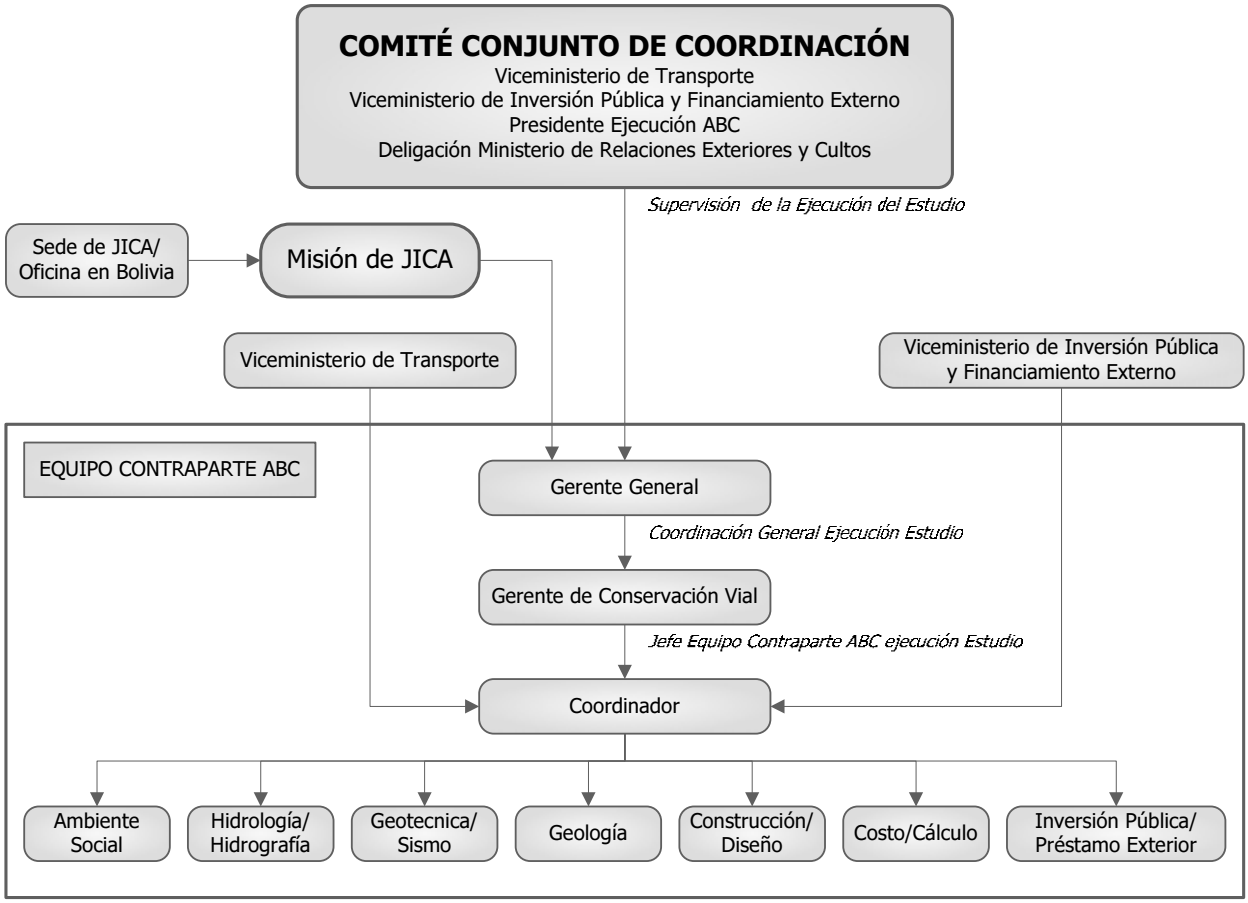


Figure 2.2.2 Organization of the Steering Committee and the Task Team

2.3 Implementation Schedule of the Study

For the first year period the studies implemented were as follows; first current situation survey and data collection (personnel, organization, donor etc.) were made and sort-out/arrangement of the problems /proposal toward solutions in implementing the capacity development are carried out through the PCM (Project Cycle Management) meetings. Meanwhile site survey were performed to grasp vulnerability and situation of the disasters for the study area. And several meetings on site survey and disaster prevention manual were held by various specialty group of engineers. Also preparatory seminar (introduction of Japanese practice on road disaster prevention management and interim progress of capacity development plan) for ABC staff including regional offices were held on February 20th, 2006.

The study items and implemented schedule for the first year period are shown in *Table 2.3.1 ~ Table 2.3.3*.

For the second year period the proposed capacity development plan of the first year has been monitored and evaluated through the following implementation items of technology transfer.

1) Implementation of Pilot Works
2) Establishment and Trials of Road Disaster Data Base System
3) Trial Implementation of Road Disaster Inventories
4) Application Trials of Road Disaster Prevention Management Manual
5) Monitoring for Pilot Works and Technology Transfer
6) Activity for awareness of disaster prevention through seminars
7) Activity for authorization of the Capacity Development Plan for Road Disaster Prevention

Among which Item 7 of authorization of the CD plan is most important for the progress of the study. The implementation schedules for the second year study are shown in *Table 2.3.4*.

For the third year period, the CD Plan and the Road Disaster Prevention Management Manual have been revised through monitoring for the CD activities in the JICA study while the second seminar was held at Santa Cruz where the pilot works site was located. And finally terminal evaluation and recommendation have been proposed for further sustainable activities for road disaster prevention in Bolivia.

The study items and implemented schedule for the third year are shown in Table 2.3.5.

The notes of the meetings of steering committee and task team meetings are shown in the back part of this report.

Table 2.3.1 The Study Items and Implemented Schedule (10/31-12/14: CD and Manual)

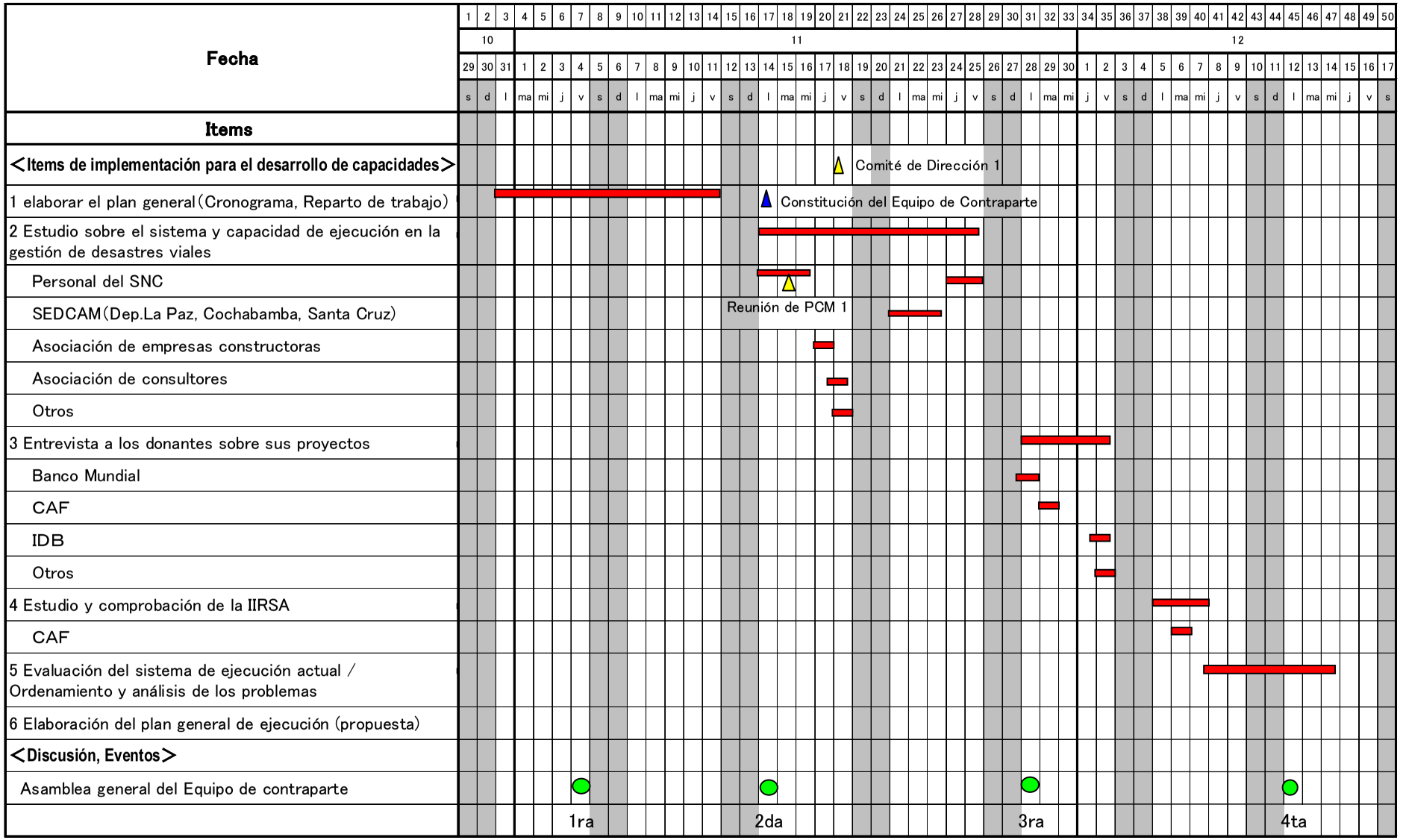


Table 2.3.2 The Study Items and Implemented Schedule (10/31-12/14: Site survey)

	11																										12															
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	sa	do	lu	ma	mi	ju	vi	sa	do	lu	ma	mi	ju	vi	sa	do	lu	ma	mi	ju	vi	sa	do	lu	ma	mi	ju	vi	sa	do	lu	ma	mi	ju	vi	sa	do	lu	ma	mi	ju
[Ruta 3] La Paz⇔Coroico **– Visita al sitio**				◆▶ Todos los miembros del proyecto, Contraparte de SNC																																						
[Ruta 4] Cochabamba⇒Santa Cruz **– Visita al sitio (El Sillar, Yapacaní)** **– Inspección sencilla**						◆▶ Ing.Shimazu, Tomida, Yokoo, Saito, Hayashi, Igo y Contraparte de SNC																																							
[Ruta 7] Santa Cruz⇒Cochabamba **– Inspección sencilla**							◆▶ Ing.Shimazu, Tomida, Yokoo, Saito, Hayashi, Igo y Contraparte de SNC																																							
[Ruta 4] Cochabamba⇒Santa Cruz **– Inspección detallada**								◀▬▶ Ing.Saito, Hayashi, Igo y Contraparte de SNC		◀▬▶																																				
[Ruta 7] Santa Cruz⇒Cochabamba **– Inspección detallada**											◀▬▬▬▬▶ Ing.Saito, Hayashi, Igo y Contraparte de SNC				◀▬▶																														
[Ruta 16] La Paz⇔Apolo **– Inspección sencilla** **– Inspección detallada**																				◀▬▶		◀▬▶					Ing.Shimazu, Tomida, Saito, Hayashi, Igo y Contraparte de SN Notas: Retornarán Ing.Shimazu,Tomida, Saito Ing.Hayashi, Igo y Contraparte de SNC																														
[Ruta 3] La Paz⇔Yucumo **– Inspección sencilla** **– Inspección detallada**																											◀▬▬▬▬▬▬▬▬▶ Ing.Hayashi, Igo y Contraparte de SNC																														

Table 2.3.3 The Study Items and Implemented Schedule (1/15-3/11)

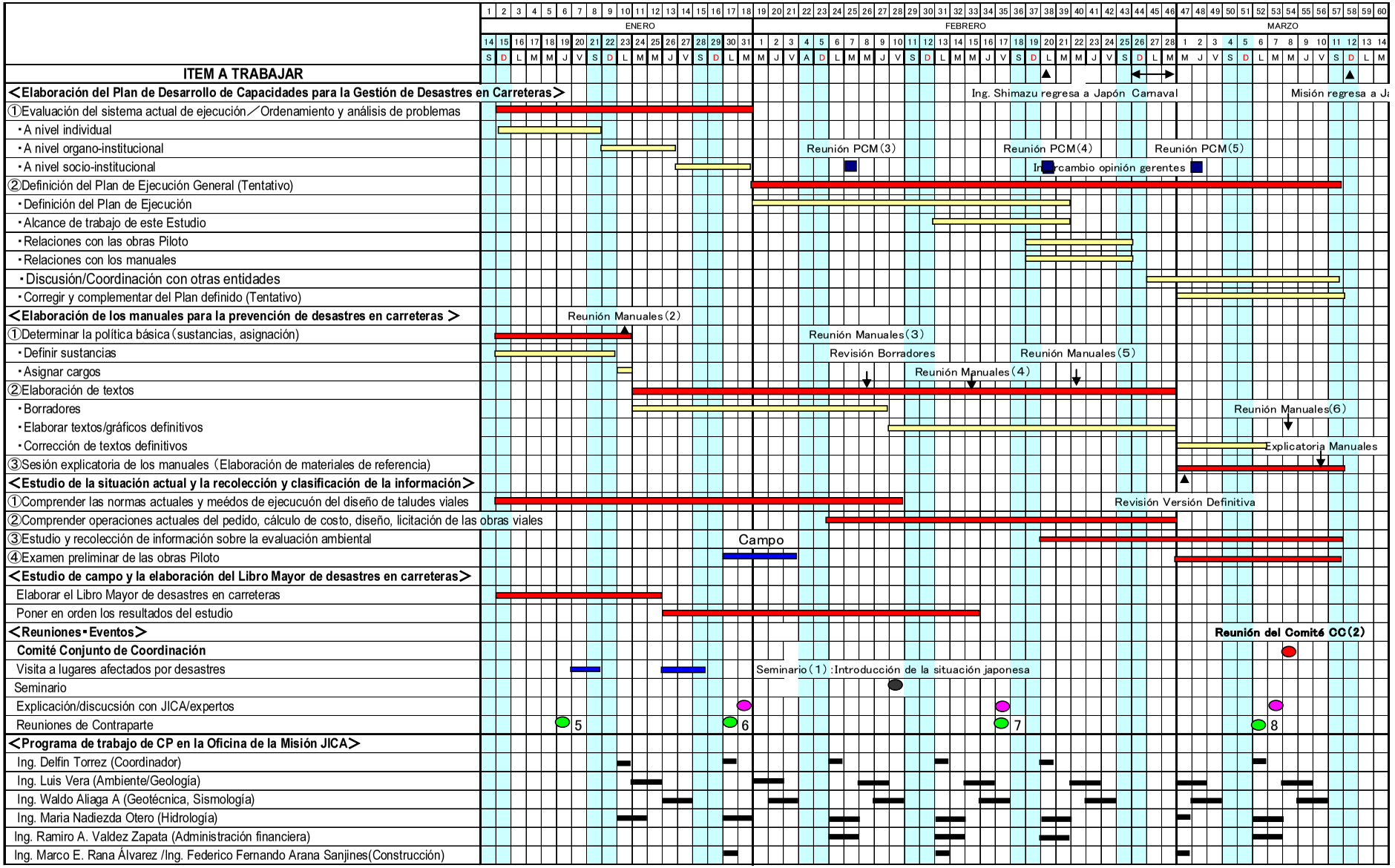


Table 2.3.4 Work Schedule for 2nd year

Programa de trabajo	Año 2006									Año 2007		
	ABR	MAY	JUNIO	JUL	AGO	SEP	OCT	NOV	DIC	ENE	FEB	MAR
<Explicación y deliberación del Informe de Progreso>												
<Ejecución del Proyecto Piloto>												
・Plan del Proyecto Piloto/Selección del sitio												
・Estudio sobre impacto ambiental de la etapa inicial(IEE)												
・Apoyo al encargo y ejecución del estudio geológico(contratación local)												
・Apoyo al encargo de diseño y supervisión de diseño. Diseño(Contratación local)												
・Plan de ejecución・Cálculo de costos												
・Apoyo al encargo de las obras piloto												
・Ejecución de obras (contratación local) y control de ejecución												
<Estructuración y aplicación de la base de datos del Libro Mayor de desastres en carreteras>												
・Estructuración de la base de datos del libro mayor de desastres												
・Definición del diseño global de la gestión de desastres en carreteras												
<Mejoramieno técnico/transferencia técnica a realizarse en este Estudio>												
・Autorización y afianzamiento de manuales, y su orientación y modificción en la obra												
Correción/perfeccionamiento de manuales												
Explicación dn la Oficina Central y Oficinas Regionales de la ABC												
Definición de los tramos donde implementarse												
Capacitación de las personas relacionadas en los tramos de implementación (Central + Regionales)												
Implementaciñon (Campamento)												
・Orientación en el lugar de trabajo sobre la elaboración, mantenimiento, actualización del Libro Mayor de Desastres												
Definir el formato del Libro												
Definir los tramos donde implementarse												
Capacitación de las personas relacionadas en los tramos de implementación (Central + Regionales)												
Implementaciñon (Campamento)												
<Monitoreo/Evaluación del Proyecto Piloto y la transferencia técniaca>												
・Definición de método y normas para el monitoreo y evaluación												
・Ejecución del monitoreo/evaluación												
<Establecimiento del Plan DC>												
・Discusiones sobre el Plan de DC (ViceTrans, SNC, Oficinas Regionales de SNC, Donantes, Interesados)												
・Modificación del Plan DC												
<Organización del Seminario-Taller>												
Preparación del Seminario-Taller												
Celebración del Seminario-Taller												
<Capacitación en el sitio de las obras pitolo>												
<Otras reuniones>												
Reunión de contraparte												
Reunión del monitoreo-evaluación de DC												
Reunión preparatoria del Seminario-Taller												
Reunión general de donantes												
Reunión de interesados												
Reunión del Comité Conjunto de Coordinación												

Table 2.3.5 Work Schedule for 3rd year

Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
	MAYO																JUNIO																							
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	M	J	V	S	D	L	M	M	J	V	S	D	L	M	M	J	V	S	D	L	M	M	J	V	S	D	L	M	M	J	V	S	D	L	M	M	J	V
<Traslado>	▬																																			▬	▬	▬
(Items a realizarse>																																						
Explicación del Informe Intermedio		═	═																																			
Sintetización del Proyecto Piloto		═	═	═	═	═	═	═	═	═	═																											
Revisión del Manual de Prevención de Desastres en Carreteras		═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═			
・Revisión del segundo borrador, última versión		═	═	═																																		
・Correción según resultados del ensayo						═	═	═	═	═	═	═																											
・Elaboración / Completación del manual, versión definitiva													═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═										
・Explicación del manual, versión definitiva（ABC Central, Regionales de La Paz, Santa Cruz）																												═	═	═	═	═		═	═			
Revisión del Libro Mayor de Desastres						═	═	═	═	═	═	═	═	═	═	═	═	═	═																			
・Verificación de los resultados del ensayo						═	═	═	═	═	═																											
・Corrección del Libro Mayor de Desastres													═	═	═	═	═	═	═																			
Organización del segundo seminario						═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═					
・Definición de ideas básicas（exponentes, participantes, local）						═	═																															
・Elaboración, preparación de los documentos de exposición							═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═											
・Preparación del local																											═	═	═									
・Celebración del seminario（exposición de resultados／visita local）																														═	═	═						
Complementación de la identificación de puntos críticos en la ruta 7												═	═	═	═	═	═																					
Evaluación final						═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═			
・Colección/ordenamiento de materiales (productos, documentos) para la evaluación						═	═	═	═	═	═	═	═	═	═	═	═	═	═																			
・Elaboración del informe de evaluación final																				═	═	═	═	═	═	═	═	═	═	═	═	═	═	═	═			
(Reuniones)																																						
Reporte a JICA/Embajada		△																																	△			
Contraparte						◎														◎														◎				
Comité Conjunto de Coordinación																																		◎				
Donantes																											◎											
Evaluación del Desarrollo de Capacidades							◎													◎																		

Chapter 3

General Condition of Roads

Chapter 3 General Condition of Roads

3.1 Socio-economic Conditions

Bolivia has a per capita GNI of around US $900 and is described as one of the most underdeveloped countries in South America. The population currently stands at 8.98 million as of 2006. In the area of domestic politics, the transition was made from military rule to civilian rule in 1982 and reforms are being carried out towards introduction of a market economy. The government has changed through general elections held every 4 years, but in recent years there have been so many changes of government that it has given rise to elements of instability in a number of areas, such as relations with neighboring Chile, natural gas export policy and taxation system problems. Formulated in the time of President Sanchez de Lozada, "Plan Bolivia" was aimed at comprehensive national development focusing on creation of employment and reduction of poverty through investment of public works, but with so many changes of government, it does not function adequately. As for the state of the Bolivian economy, 80% of total exports rely on primary products, especially agricultural and mining products, and the economy is in deep recession as a result of the downturn in the global economy and the economies of neighboring countries. Bolivia enjoys good relations with Japan and has a high number of Japanese immigrants, especially in the state of Santa Cruz.

The general socioeconomic situation of Bolivia is shown in *Table 3.1.1* and *Table 3.1.2*.

Table 3.1.1 Socioeconomic situation of Bolivia (1)

System of government	*1	Constitutional republic
Head of state	*1	President Juan Evo Morales Aima (since 22 January 2006)
Date of independence	*2	6 August 1825
Main races/tribes	*1	Indian 55%, mixed race 32%, European 13%
Main languages	*1	Spanish, Quechua, Aymara
Religion	*1	Catholic
Date of membership of United Nations		November 1945
Date of membership of World Bank		December 1954
Date of membership of IMF		December 1954
National land area	*1	1,098,581 km
Capital	*1	La Paz (constitutional capital: Sucre)
Principal cities		Santa Cruz, Cochabamba
Population	*2	9,119,152 (2007) 8,989,046 (2006)
Population density	*2	8.30 persons/km^2 (2007) 8.18 persons/km^2 (2006)
Population growth rate	*2	1.42% (2007) 1.45% (2006)
Labor force	*2	4.30 million (2006) 4.22 million (2005)
Unemployment rate	*2	7.8% (2006) 8.0% (2005)

*1 Country overview (Ministry of Foreign Affairs)
*2 The World Factbook 2006 (CIA)
*3 World Development Indicators 2005
*4 JETRO Database (JETRO)

Table 3.1.2 Socioeconomic situation of Bolivia (2)

Compulsory education	*3	8 years
Primary education enrolment rate	*3	97% (2000)
Secondary education enrolment rate	*3	48% (2001)
Adult literacy rate	*2	Overall 87.2%, men 93.1%, women 81.6% (2003)
Average life expectancy	*2	Overall 66.19 years, men 63.53 years, women 68.97 years (2007)
Under-five mortality rate	*3	80 per 1000 persons (2000)
Currency	*1	Boliviano
Exchange rate	*1	US$ 1.00 = Bs 7.90 (Jan 2007)
Financial year	*2	1 January to 31 December
National budget (revenue)	*2	US$ 4,153 million (2006) US$ 2,848 million (2005) US$ 2,264 million (2004)
National budget (expenditure)	*2	US$ 3,619 million (2006) US$ 3,189 million (2005) US$ 2,769 million (2004)
GDP (official exchange rate)	*2	US$ 10,330 million (2006) US$ 9,657 million (2005)
GDP growth rate (real)	*2	4.5% (2006) 4.1% (2005)
GDP composition by industry	*3	Agriculture 16%, mining 29%, service industries 56% (2001)
Employment by industry (men)	*3	Agriculture 2%, mining 35%, service industries 63% (1990)
Employment by industry (women)	*3	Agriculture 0%, mining 12%, service industries 87% (1990)
Inflation rate	*1	4.6% (2005)
Main industries	*1	Mining (zinc, tin, gold), agriculture (soy, lumber, sugar)
Main trade goods (exports)	*1	Jewelry, gold, zinc, soya, tin, lumber, sugar, natural gas, lead, silver, Brazil nuts
Main trade goods (imports)	*1	Machinery, steel, automobiles, electrical appliances
Main trading partners (exports)	*2	Brazil 42.7%, USA 12.0%, Argentine, 10.6%, Colombia 7.5%, Japan 6.1%, Peru 4.7% (2006)
Main trading partners (imports)	*2	Brazil 24.6%, Argentine, 18.8%, Chile 12.2%, USA 9.2%, Peru 7.3% (2006)
Total trade (exports)	*2	US$ 3,668 million (2006) US$ 2,371 million (2005) US$ 1,986 million (2004)
Total trade (imports)	*2	US$ 2,934 million (2006) US$ 1,845 million (2005) US$ 1,595 million (2004)
Exports to Japan	*4	US$ 183.6 million (2006) US$ 81.1 million (2005) US$ 88.1 million (2004)
Imports from Japan	*4	US$ 39.6 million (2006) US$ 38.4 million (2005) US$ 28.4 million (2004)
Foreign currency reserves	*2	US$ 3,303 million (2006) US$ 1,798 million (2005) US$ 1,214 million (2004)
Foreign debt	*1	US $3,252.1 million (2007)

*1 Country overview (Ministry of Foreign Affairs)
*2 The World Factbook 2006 (CIA)
*3 World Development Indicators 2005
*4 JETRO Database (JETRO)

3.2 Natural Conditions

3.2.1 Geography of Bolivia

The geography of Bolivia is unique among the nations of South America. Bolivia is one of two landlocked countries on the continent and also has the highest altitudes. The main features of Bolivia's geography include the Altiplano, a highland plateau, mountain and valley of the Andes, and Lake Titicaca (Lago Titicaca), the largest lake in South America and the highest commercially navigable lake on Earth.

Figure 3.2.1 Geography of Bolivia

3.2.2 Andes Orogenic Zone

<u>The formation of The Cordillera Andes</u>

The Cordillera Andes at the west edge of South America was uplifted in late Cenozoic, that extends south-north ward for a distance about 9,500 km in width of 300 to 700 km. The Cordillera Andes is subdivided by tectonic valley that strikes south - north. The Central Andes is formed east central and west area that is most exposed high mountains. These zones form the so-called Cordillera de los Andes. Volcanoes of activity distributed the west area. The Pacific cost of Andes is coast mountain area and inland of Andes is spread shield of the Precambrian system continuing Cordillera Oriental. Andes is Cordillera of continental edge, the crust is thickened by multi orogeny from late Paleozoic on, having the property of island arc of Trench, Benioff zone, active volcano.

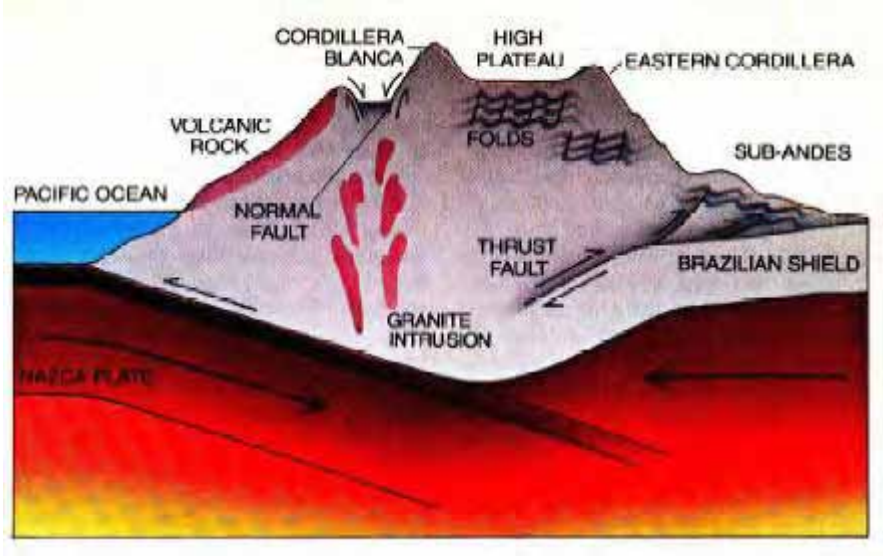


Figure 3.2.2 Andes Orogenic Zone

BOLIVIAN ANDES are shown in a simplified cross section *Figure 3.2.7*. The mountains are supported by a deep crustal root. Under the western Cordillera Blanca the crust has been thickened by intrusions of volcanic material rising above the Nazca plate as it plunges under South America. The convergence of the two plates also thickens the crust by pushing it together, or shorting it. Folded rock formations in the eastern sub-Andes prove that the crust there is being shortened and lifted up as the Brazilian shield is thrust under the mountains. Folded sedimentary rock in the high plateau suggests it was formed earlier by the same process. Hence many workers think crustal shorting rather than volcanism is primarily responsible for the height of the Andes and the thickness of the crust. Although the sides of the range are still being pushed together, the crust in the high Andes is stretching: on the western side of the Cordillera Blanca great blocks of crust have dropped down along normal faults. The Andes may be collapsing as the horizontal forces that support them diminish.

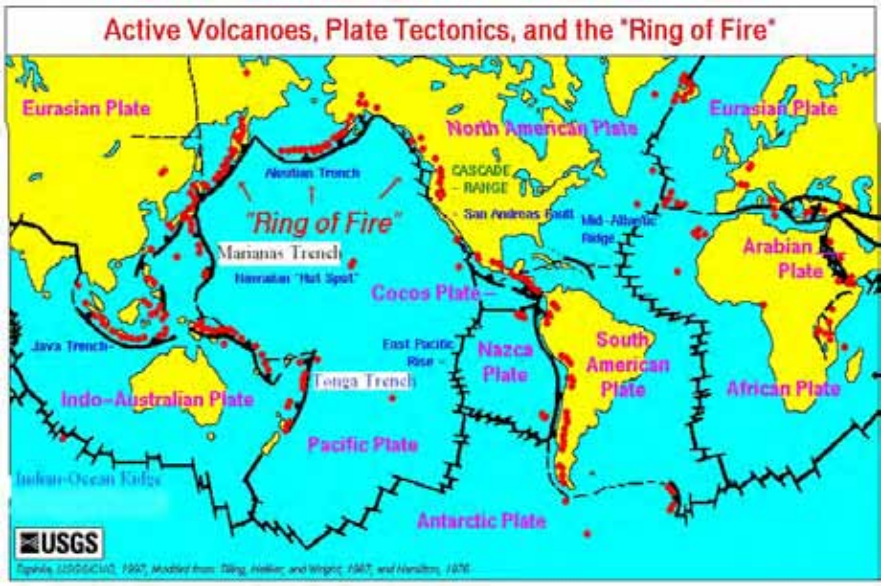


Figure 3.2.3 Active Volcanoes, Plate Tectonics, and the "Ring of Fire"

3.2.3 Topography of Bolivia

The Republic of Bolivia, located in the center of the south American Continent, has an area of 1,098,581 square kilometers and is bordered by Peru, Brazil, Paraguay, Argentina and Chile. The country can roughly be divided into two major topographical regions; a mountain area of the Andes on the western side of the country and a low flat area covered with vegetation. These two regions can be further subdivided as shown below: (See, *Figure 3.2.4* and *Figure 3.2.5*)

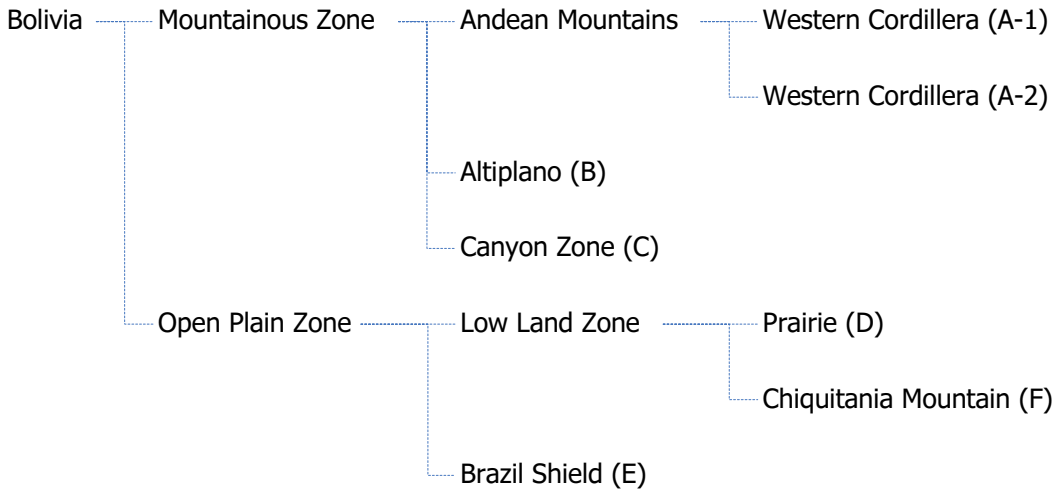


Figure 3.2.4 Classification of Topography

An investigation 4 line runs through the valley zone from the east Andes Mountains, and it is even a polder, and each applicable area is different as follows.

	Western Cordillera	Altiplano	Eastern Cordillera	Canyon Zone	Low Land Zone	Ciquitania Mountain	Brazil Shield
Route16			●				
Route 3			●	●	▲		
Route 4				●	●		
Route 7			▲	●	●		

The Study area is located in the Canyon Zone, and the detailed topography there is described in "2.3 Existing Project Road" of this Chapter.

In respect to Geological description, refer Chapter 3.

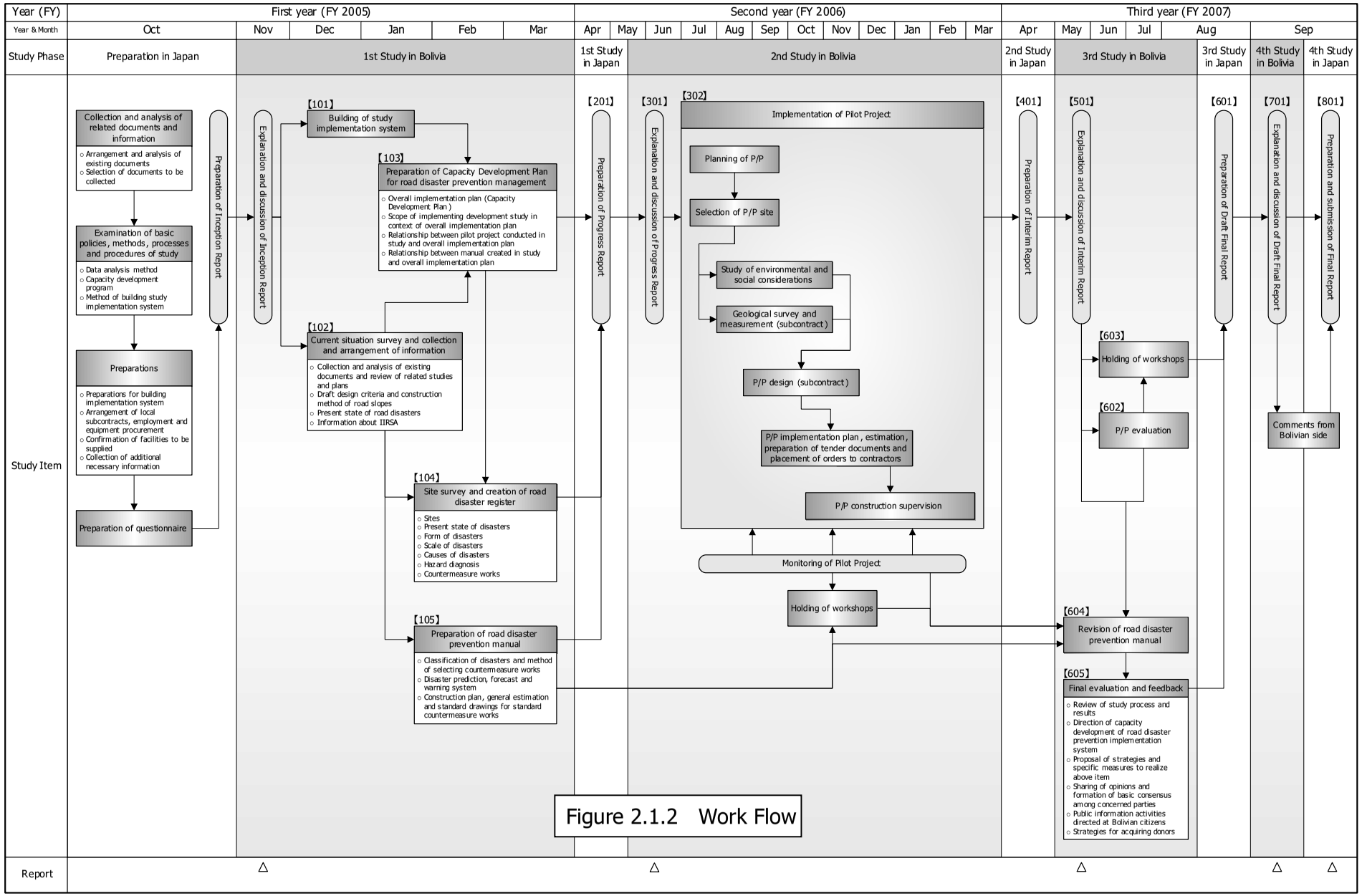


Figure 2.1.2 Work Flow

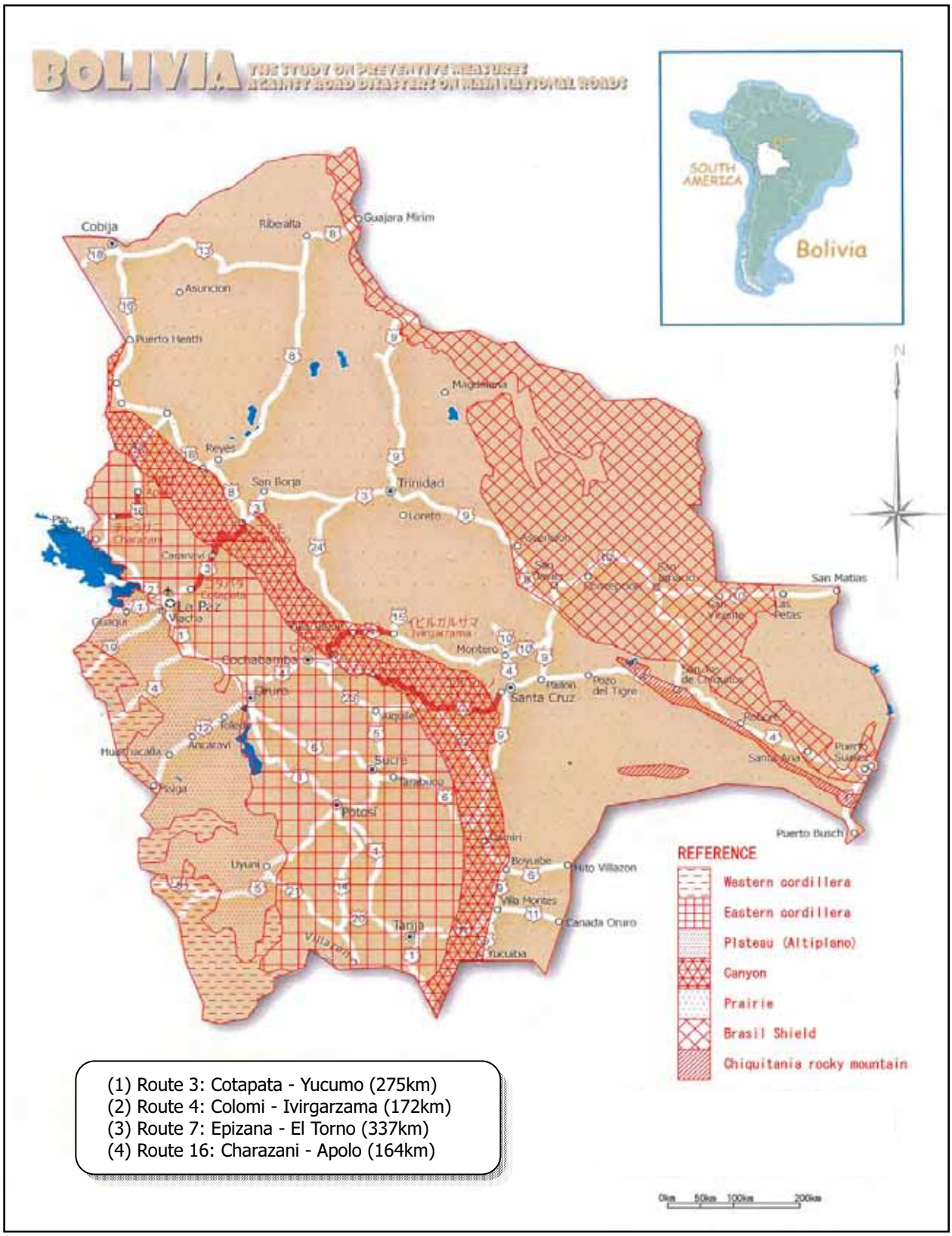


Figure 3.2.5 Classification of Topography

3.2.4 Geology in Bolivia

A geological map is shown in *Figure 3.2.6* and geological province map of Bolivia is shown in *Figure 3.2.7*.

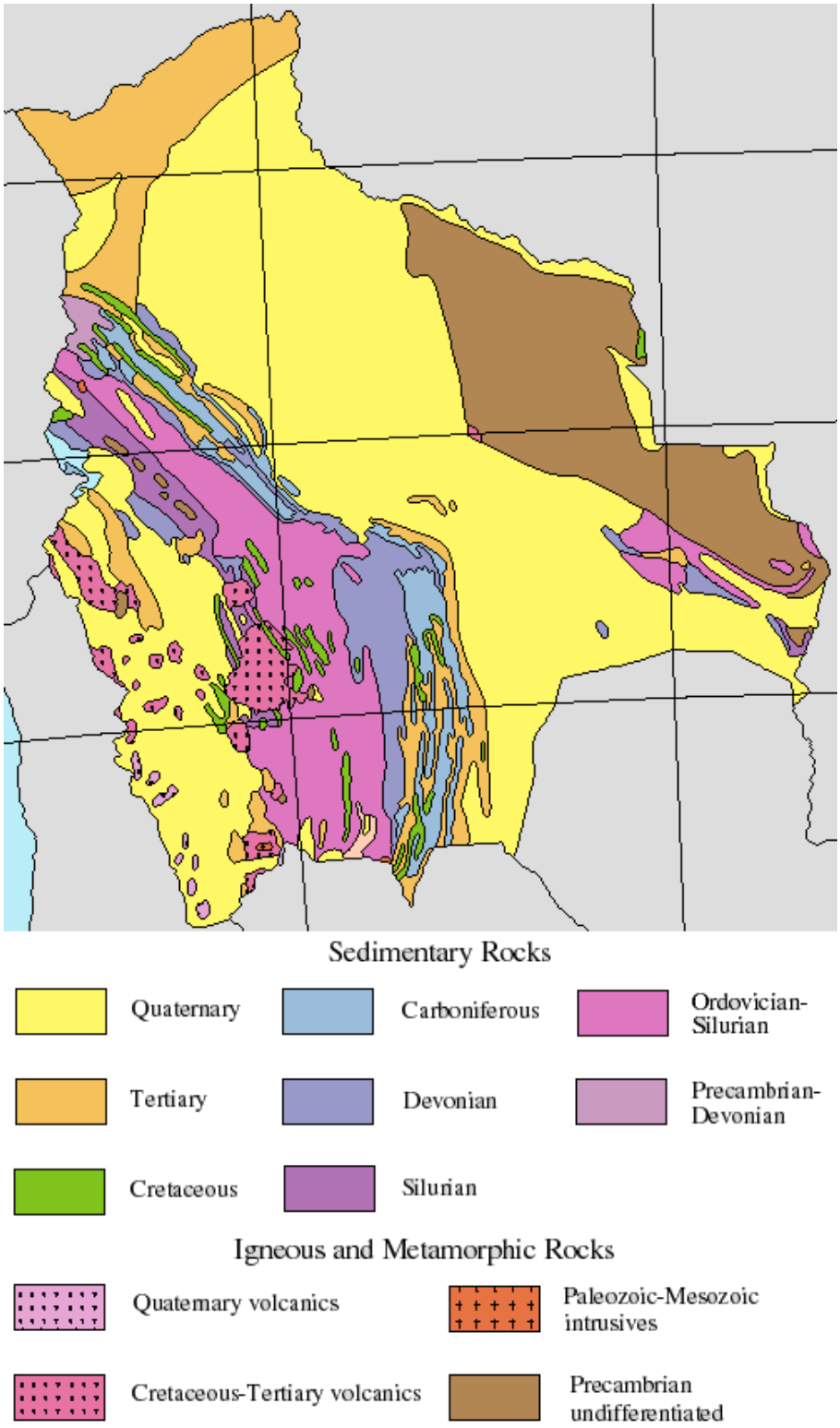
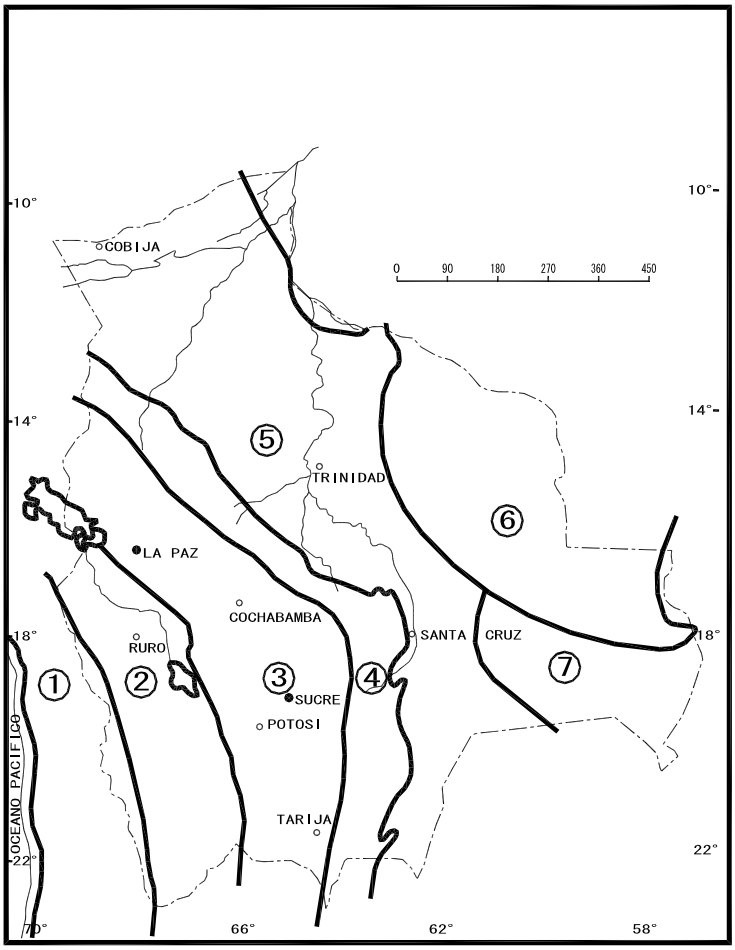


Figure 3.2.6 Geologic Map of Bolivia

Northern Bolivia is divided into six or seven geological province stretching in belts from the north west to the south east. These provinces are titled;

(1) West Andes
(2) Puna Surface (Altiplano)
(3) East Andes Zone
(4) Sub - Andes
(5) Amazonian Lowland
(6) Brazilian Shield



(1) West Andes
(2) Puna Surface(Altiplano)
(3) East Andes
(4) Sub－Andes
(5) Amazonian Lowland
(6) Brazilialn Shield
(7) Brazilialn Mountains

Figure 3.2.7　Geologic Province Map of Bolivia

3.2.5 Topographic Climate

Climatic conditions in Bolivia vary widely according to the latitude and height above sea level. The inhabited areas of the country can be divided into the following three zones based on their characterized climate. A Bolivian river, rainfall and temperature are shown in *Figure 3.2.8 ~ 3.2.11*.

(1) Altiplano Area (Plateau and Canyon zone)

The Altiplano Area is a cold dry zone situated on the west side of Bolivia between the Eastern and Western Cordilleras and has an annual average temperature of 5 to 20 degrees centigrade, with a daily maximum of 25 degrees and daily minimum of 10 degrees below zero.

The windows that carry rain towards the Altiplano Area are those blowing from the Amazon River Basin, but they reach the high plateau after having discharged most of their humidity on low, flat land areas (Beni area) and on the Canyon Zone which stretches along the slope of the eastern side of the Andean Cordillera.

This phenomenon causes sparse rainfall on the high plateau of the Altiplano Area. Consequently, the annual average rainfall over the Plateau Area is normally less than 500 mm, except in some places like the Titicaca Lake where rainfall can be from 600 mm to 800 mm. This happens even though the southern plateau has an extremely cold dry climate throughout a year due to the influence of the cold winds blowing form the south.

(2) Beni Area (Amazonian low land area)

This area is commonly called “Llanos Benianos (Plain in Beni)”. It has a hot humid climate and the average temperature varies between 20 and 30 degrees centigrade with only slight changes among the seasons. Annual rainfall is ordinary from 1000 mm to 3000 mm, but in some places on the border with the Cordillera, like the Chapare region, the rainfall sometimes reaches up to 4000 mm annually.

In general, the climate of the Beni Area is tropical with a rainy season in summer and a dry season during autumn, winter and spring. The rainy season occurs when the air masses coming from the Atlantic Ocean travel over the Andes at high altitude.

(3) Chaco Area (La Plata low land area)

This dry area is located in the south eastern part of the country. A warm steppe climate with dry winter characterizes this area where the average annual temperature is between 20 and 25 degrees centigrade and the annual rainfall is around 1000 mm. The temperature decreases abruptly in this area when cold fronts from the south pole reach it.

The annual average temperature and rainfall in Bolivia is shown in *Figure 3.2.10* and *Figure 3.2.11*.

The Project Site is located in the Canyon Zone, and is very near to the boundary shared with the Beni Area. (See *Figure 3.2.8* and *Figure 3.2.9*). Consequently, climate there is fairly similar to the Beni Area rather than in the Altiplano Area.

The outline of the rainfall of every project road, it is shown the next *Table 3.2.1* (It is limited to the project range). It is much rain very much so that it may be represented in the Siberian area Route 4.

Table 3.2.1 Annual Rainfall of Study Road

annual rainfall (mm)	0～200	200～600	600～1000	1000～400	1400～2000	2000～3000	3000～5000
Route16			●	●			
Route3				●	●		
Route4				・	・	・	●
Route7			●				

(4) Water

No attempt has been previously made to compile information on the use of the water of Bolivia's rivers. The survey team could not get any information on it.

More water is used for agriculture than any other purpose, but, furthermore, it is not by means of the planned construction of irrigation systems and dams but small streams and ponds near their farms.

Regarding the measures used to obtain a supply of water for urban areas, typically a small dam is constructed upstream on a river which flows near the city, and water from its reservoir is carried by means of channels or pipelines to a purification and treatment plant or a pumping station from which it is pumped to urban residential areas, commercial areas and industrial regions.

Most of this water is for normal household or commercial use and because there are few industries which use large volumes of water, no pipeline specifically for industrial water has been laid.

For example, in the case of La Paz, a dam built in the mountains upstream on La Paz river gathers water from thawed snow and ice from the Chacarutaya mountains, from which the water is carried by a man-made channel to an upstream part of the city where is alkalinity is neutralized by use of calcium hydroxide; after purification it is pumped up and piped to urban areas as drinking water. Although this is the water which is used as industrial water by all factories and plants in the city because there are no large industrial consumers, there appear to be no problems related to such use. In the cause of a brewery in La Paz, this water is distilled before use. Water quality is not good.

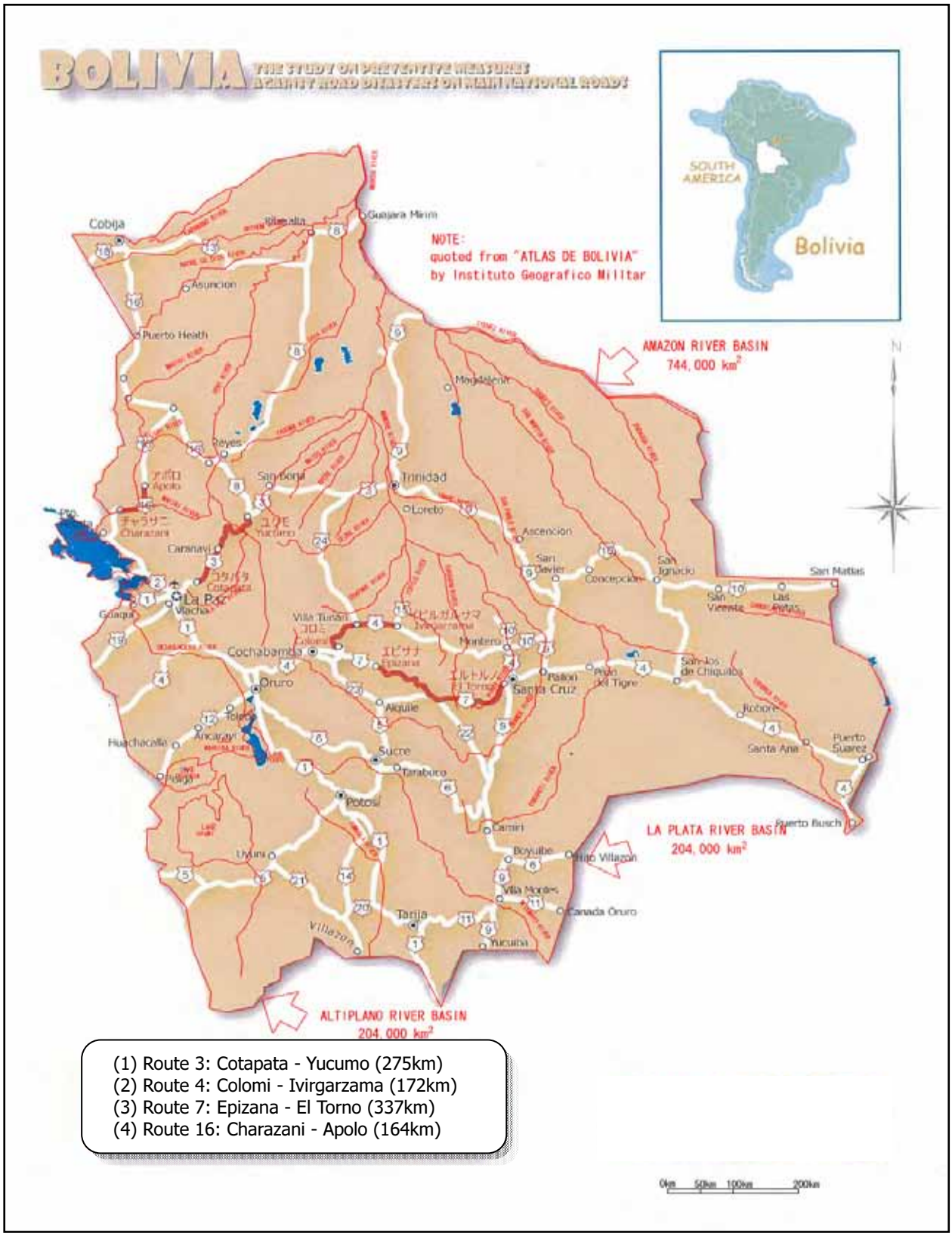


Figure 3.2.8 River System in Bolivia

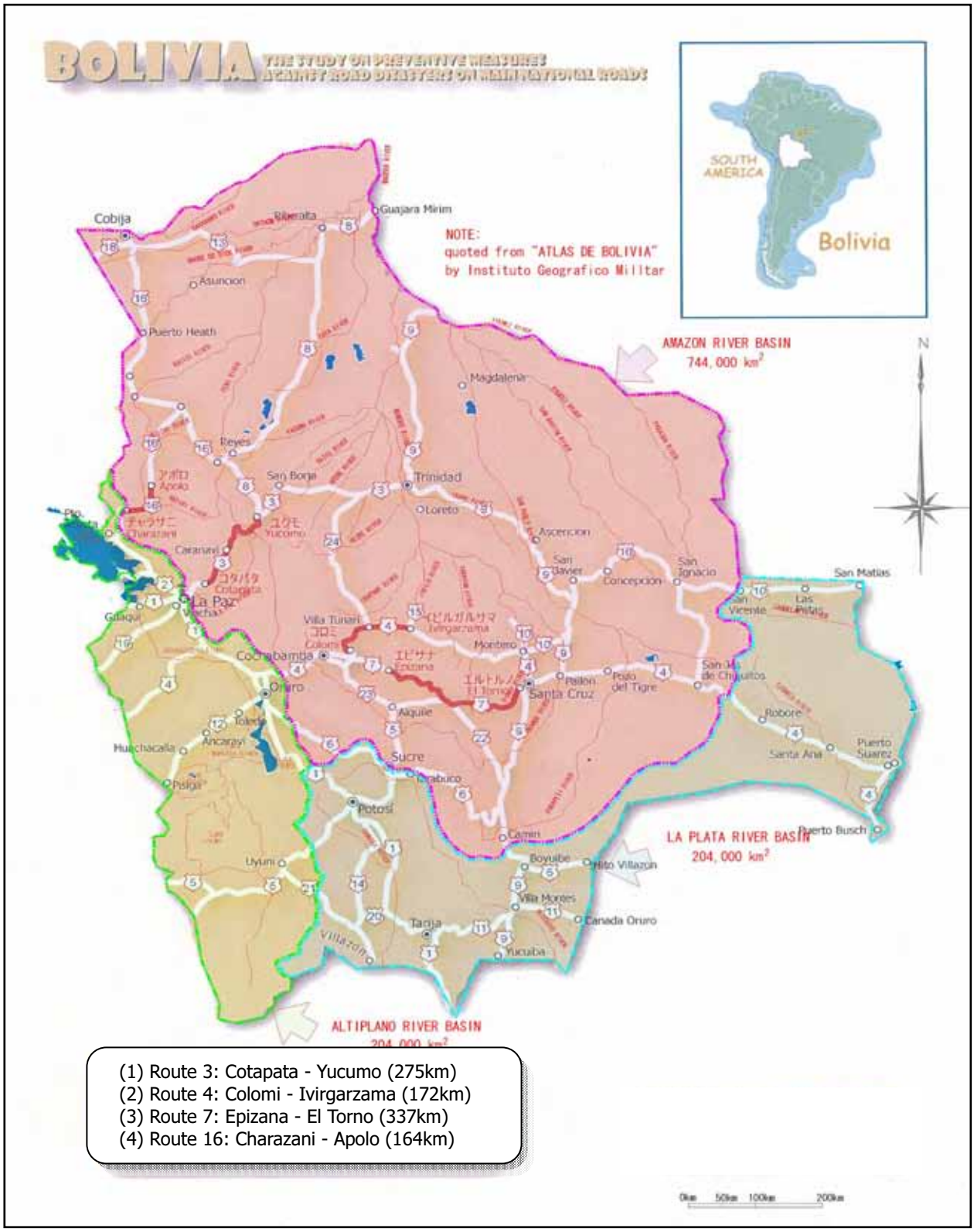


Figure 3.2.9 River Basin in Bolivia

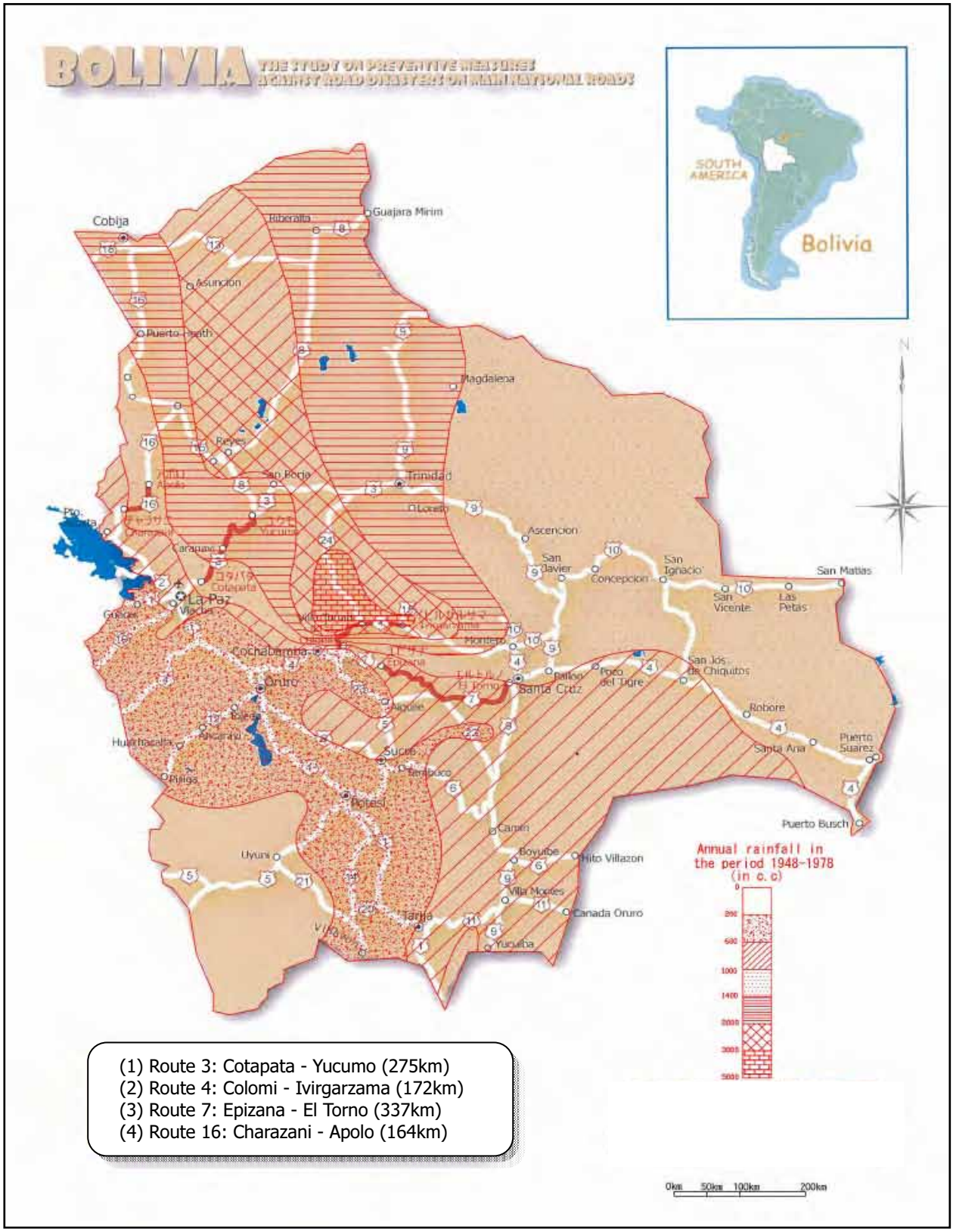


Figure 3.2.10 Annual Rainfall in Bolivia

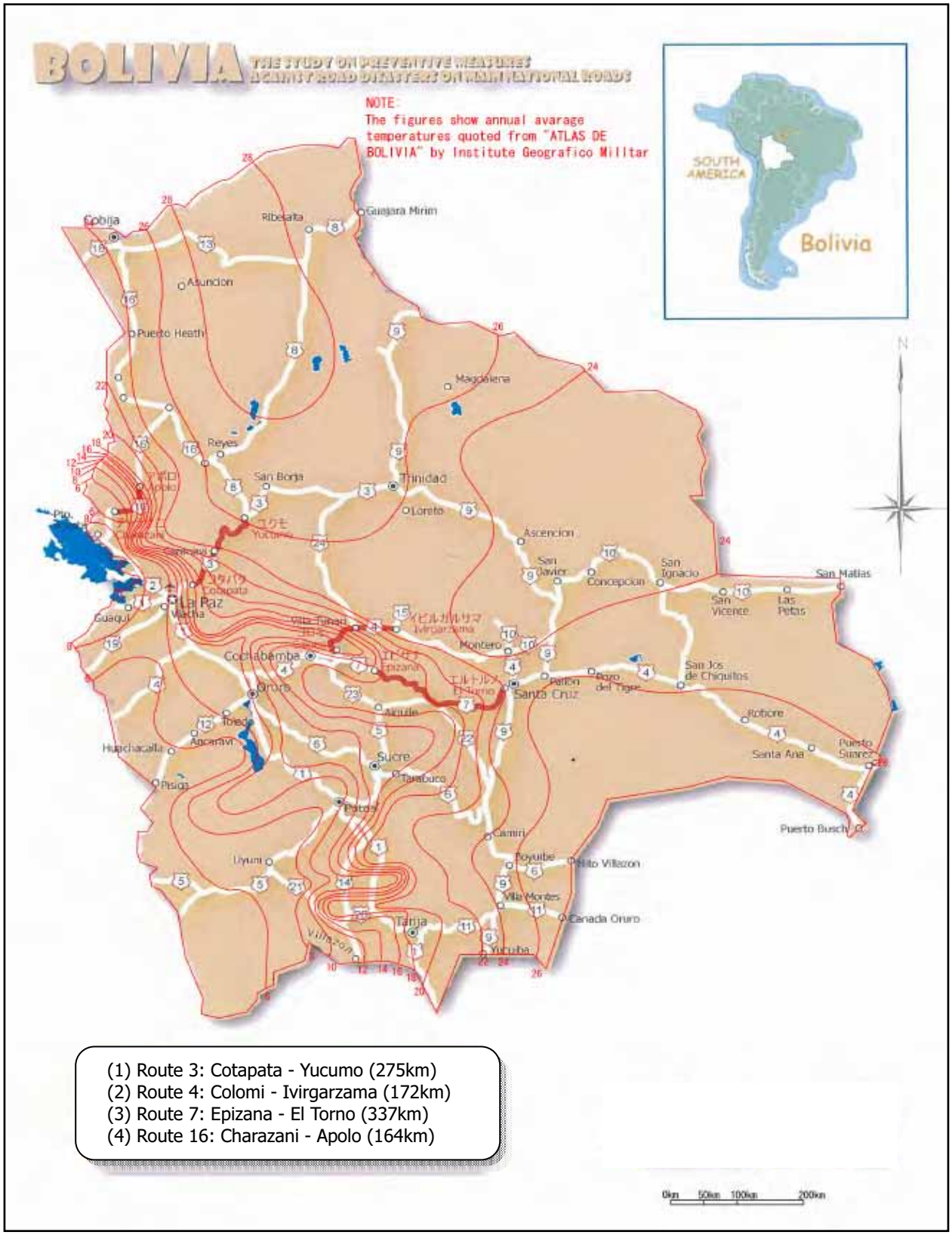


Figure 3.2.11 Annual Average Temperatures in Bolivia

3.3 State of the Roads

Road construction in Bolivia is the most backward in South America, due to topographical restrictions generated by a vast 1,100,000 km² area of rugged terrain that varies widely from plateaus (Altiplano) that reach heights of 5,000m to valleys (Valles) at altitudes of 1,000m to 2,000m and low-lying plains (Llanos) including the Amazon, combined with frequent landslides and flooding, not to mention technical difficulties and high construction costs.

Under such unfavorable conditions for road construction, the Bolivian government is pursuing economic development. In particular, from 1990 to 1994, construction of a major highway corridor was undertaken by improvement of Route 3, Route 9, Route 4 and Route 1 with funds from international agencies such as the Inter-American Development Bank (IDB), Corporacion Andina de Fomento (CAF) and River Plate Basin Financial Development Fund (FONPLATA), in an effort to improve distribution efficiency on trunk roads linking La Paz, Yucumo, Trinidad, Santa Cruz, Cochabamba, Oruro and La Paz. However, decentralization of the entire government began in 1995 and ABC, the public corporation responsible for road management, transferred much of its authority to the regions. As a result, an integrated approach to road construction for the whole country is lacking and construction standards continue to lag. To improve this situation, in 1999 control of the national road network was restored to ABC and importance began to be given to national policies in an attempt to boost Bolivia's economic recovery by promoting exports. Additionally, globalization of the South American economy was stimulated by MERCOSUR and IIRSA and road construction in Bolivia shifted towards construction of the export corridor.

The highway network system managed by ABC is shown in the project location map at the beginning of this report. *Table 3.3.1* shows the state of overall road construction in Bolivia, including regional roads other than trunk roads.

Table 3.3.1 State of Roads in Bolivia (as of December 2005)

(km)

Region	National Highway				State Highway				Municipal Roads				Total			
	Paved	Gravel	Earth	Total	Paved	Gravel	Earth	Total	Paved	Gravel	Earth	Total	Paved	Gravel	Earth	Total
La paz	668	814	985	2,467	63	2,442	17	2,522	19	1,428	3,870	5,317	750	4,684	4,872	10,306
Chuquisaca	214	400	335	949	0	950	379	1,329	4	539	3,337	3,880	218	1,889	4,051	6,158
Tarija	383	457	339	1,179	44	841	222	1,107	12	2,066	1,333	3,411	439	3,364	1,894	5,697
Cochabamba	664	406	209	1,279	66	2,493	1,507	4,066	2	1,518	1,425	2,945	732	4,417	3,141	8,290
Santa cruz	1,427	820	1,905	4,152	5	1,011	2,491	3,507	12	604	4,568	5,184	1,444	2,435	8,964	12,843
Oruro	576	566	56	1,198	0	570	126	696	6	431	3,319	3,756	582	1,567	3,501	5,650
Potosí	260	1,046	477	1,783	0	598	927	1,525	2	989	7,461	8,452	262	2,633	8,865	11,760
Beni	169	1,045	892	2,106	8	100	1,032	1,140	0	312	1,096	1,408	177	1,457	3,020	4,654
Pando	33	289	230	552	0	88	453	541	0	34	591	625	33	411	1,274	1,718
Total	4,394	5,843	5,428	15,665	186	9,093	7,154	16,433	57	7,921	27,000	34,978	4,637	22,857	39,582	67,076

Source: Gerencia de Planificación y Desarrollo Tecnológico del ABC

Of the total 67,076km of roads, ABC manages 15,665km of trunk roads (approx. 23%). With only 28% (4,394km) of trunk roads paved, top priority is given to paving the export corridor. Promotion of industry by construction of all-weather roads, including other regional roads, is an urgent issue.

Chapter 4

Current Situation Survey on Road Administration and Disaster Prevention

Chapter 4 Current Situation Survey on Road Administration and Disaster Prevention

4.1 System on Road Administration

4.1.1 Organization

As stated in chapter two, ABC is in charge of active management of road construction, improvement and maintenance of national roads under supervisory administration of the vise-minister of Transport (Viceministro de Transportes). The total length of national road has reached over 15,000 km (total length of road in Bolivia is now about 60,000 km including prefectural and municipal roads).

SNC, the predecessor of ABC, had administrated construction, improvement and maintenance of all roads in Bolivia directly by own staff and machineries since it's establishment of 1961. In 1955 following the decentralization policy of the government, SNC had transferred her property of power(machineries and related staff) to prefectural departments of roads (SEDCAM or SEPCAM) and SNC herself had changed to the organization to administrate all national roads by outsourcing power(private consultants, private contractors etc.). And in 2002 large scale reform of personnel and organization has been made by the aid of the World Bank to increase efficiency and transparency. Then after, SNC has been dissolved and reorganized into two independent agencies by the law No.3506 and No.3507 of October 27, 2006, one as the "Servicio Nacional de Caminos en Liquidacion" for charge of the debts(pasivos) and the lawsuits(procesos), other as the "Administradora Boliviana de Carreteras" for charge of planning and administration of national trunk roads.

The administration role of construction, improvement and large maintenance such as periodical repair of pavements is concentrated in the headquarter of ABC owing financial source from foreign aids of loan. The daily or ordinary maintenance of national roads is executed by the ten regional offices distributed in every prefecture. For the ordinary maintenance, as stated in 4.1.3, the maintenance administration system of the World Bank is introduced where the road network is divided into 35 sections (tramos) and for each section one-year-base contract of administration of maintenance is made with private sectors. The financial source for ordinary maintenance is from domestic fund of CN (special national account for road maintenance) which is composed of toll, heavy weight tax and part of hydro-carbonization tax.

The organization chart of ABC is shown in *Figure 2.2.1* for the time being in succeeding to SNC. The role of each department is stated in the organization act as follows;

- Secretaria General (Secretary General): Assurance of efficient and proper information flow inside or outside of ABC through information process, adjustment, following up and development of information system.
- Gestion De Calidad (Quality Control Section): Introduction of quality control system in line with standard of ISO9001 and ISO2000.
- Auditoria Interna (Audit Section): Evaluation of inner inspection, financial situation, efficiency of service performance.
- Gerencial General (General Management Department): Adjustment/coordination, monitoring and supervision of active departments including regional offices with technical, administrative support and advice.

- Gerencia De Planificacion y Desarrollo Tecnologico (Planning and Technology Development Department): Proper planning and design aiming at assuarance of road activity quality through strengthen of organization and technology development.
- Gerencia De Construccion (Construction Department): Increase of value of road property through rehabilitaton, rebuilding, improvement and construction.
- Gerencia De Conservacion Vial (Road Maintenance Department): Preservation of road property and implementation of service for road users.
- Gerencia De Socioambiental (Social Environment Department): Introduction of enviromnent evaluation in the implementation of road projects in the framework of sustainable development.
- Gerencia De Administrativa Financiera (Financial Administration Department): Implementation of financial administration basing on acts.
- Gerencia De Juridica (Law Department): Supervision of service performance by road act and inspection and following up of all suits relating ABC.

The number of staff in ABC is 281 (180 for headquarter) as of 2005 as shown *Table 4.1.1* in which number of engineers is 102 (56 for headquarter).

Table 4.1.1 Number of staff in ABC（2005）

(unit: person)

Personnel	La Paz Hq.	Regional Office										Total
		La Paz	Chuquisaca	Tarija	Cocha-bamba	Santa Cruz	Oruro	Potosí	Beni	Pando	San Ramón	
Engineer	56	4	5	5	5	5	4	4	5	5	4	102
Secretary	4			1	1	1				1		8
Economist	11											11
Inspector	21	1				1	2		1	1	1	28
Planner	4											4
Lawyer	10											10
Accountants	15	1	1	1	1			1	1			21
Expert	19	1					1	2			1	24
Specialist	7											7
Assistant	14	1	1	1	1	1	1	1	1	1	1	24
Chauffeur	19	3	3	3	3	2	2	2	3	1	1	42
Total	180	11	10	11	11	10	10	10	11	9	8	281

4.1.2 Financial State

Financial situation for road investment is shown in *Table 4.1.2* and *Table 4.1.3* as approved annual governmental budget with allocated field and its allocation to ABC and as implemented amount respectively where the fiscal year starts from January.

The budget of 2006 fiscal year is about 762 million U.S. dollars in which about 47 % of it is from foreign assistance (loan etc.).

Table 4.1.2 Governmental Budget of Bolivia and Allocation to ABC (approved base)

(in million U.S. dollars)

Sector	2003		2004		2005		2006	
	Budget	%	Budget	%	Budget	%	Budget	%
Productive	**77.087**	**12.0**	**60.085**	**12.0**	**65,741**	**11.2**	**97,512**	**12.8**
Hydrocarbon	0	0	0	0	0	0	11,078	1.5
Mineral	6.192	1.0	3.816	0.8	4.686	0.8	5.108	0.7
Industry	9.912	1.5	8.649	1.7	6,891	1.2	11.718	1.5
Agriculture	60.984	9.5	47.621	9.5	54,164	9.3	69.607	9.1
Infrastructure	**248.701**	**38.8**	**211.789**	**42.3**	**318,118**	**54.4**	**430,543**	**56.5**
Transport	220.623	34.4	183.966	36.7	287.460	49.2	375.389	49.3
Energy	12.567	2.0	17.268	3.4	23,299	4.0	39.981	5.2
communication	48	0.0	21	0.0	27	0.0	33	0.0
Water resource	15.463	2.4	10.534	2.1	7,331	1.3	15.139	2.0
Social	**260.106**	**40.6**	**188.394**	**37.6**	**157,811**	**27.0**	**189.731**	**24.9**
Health	58.563	9.1	53.325	10.6	39,652	6.8	53.488	7.0
Education	86.334	13.5	48.336	9.7	29,964	5.1	39.861	5.2
Sanitation	52.114	8.1	37.409	7.5	50,061	8.6	34.778	4.6
Housing	63.095	9.8	49.323	9.8	38,134	6.5	61.603	8.1
Others	**54.875**	**8.6**	**40.615**	**8.1**	**42,709**	**7.3**	**44.338**	**5.8**
TOTAL	**640.769**	**100**	**500.884**	**100**	**584,380**	**100**	**762.123**	**100**
Allocation to ABC	148.357	23.2	114.384	22.8	217,973	37.3	221.785	29.1

Source: VIPFE http://www.vipfe.gov.bo/

Table 4.1.3 Implemented Amount of the Budget and its allocation to ABC

(in million U.S. dollars)

Sector	2003		2004		2005		2006	
	Impltd	%	Impltd	%	Impltd	%	Impltd	%
Productive	**48,730**	**9.8**	**54.799**	**9.1**	**71.503**	**11.4**	**97,787**	**11.1**
Hydrocarbon	0	0	0	0	3,975	0.6	7,338	0.8
Mineral	2,858	0.6	1.148	0.2	3.292	0.5	3,062	0.3
Industry	5,023	1.0	4.449	0.7	6.778	1.1	11,396	1.3
Agriculture	40,849	8.2	49.202	8.2	57.459	9.1	75,990	8.6
Infrastructure	**227,651**	**45.5**	**296.710**	**49.3**	**326.018**	**51.8**	**481,468**	**54.7**
Transport	203,408	40.7	264.280	43.9	288.675	45.9	409,475	46.6
Energy	13,181	2.6	17.816	3.0	20.296	3.2	44,118	5.0
communication	34	0.0	135	0.0	288	0.0	1,284	0.1
Water resource	11,028	2.2	14.478	2.4	16.759	2.7	26,591	3.0
Social	**186,926**	**37.4**	**221.053**	**36.7**	**193.991**	**30.8**	**262,730**	**29.9**
Health	37,011	7.4	45.032	7.5	40.365	6.4	61,151	7.0
Education	65,742	13.2	54.214	9.0	42.492	6.8	75,191	8.5
Sanitation	33,597	6.7	67.347	11.2	51.242	8.1	56,452	6.4
Housing	50,575	10.1	54.462	9.1	59.891	9.5	69,935	8.0
Others	**36,491**	**7.3**	**29.045**	**4.8**	**37.671**	**6.0**	**37,484**	**4.3**
TOTAL	**499,798**	**100**	**601.608**	**100**	**629.183**	**100**	**879,469**	**100**
Allocation to ABC	136,462	27.3	188.177	31.3	195.368	31.1	171,644	19.5

Source: VIPFE http://www.vipfe.gov.bo/

For budget allocation in sectors in these years, 40 to 50 % of the budget has been allocated to the transport sector and 20 to 30 % to ABC as independent organization. It is read that the investment to road development is lay as most priority. The implemented amount has turned to more than the approved budget, comparing to 2003 or before.

The budgetary situation of ABC in these three years is shown in *Table 4.1.4* as spent breakdown and *Table 4.1.5* as financial source breakdown. In spent breakdown it is indicated that about 80 % of the budget is for road construction and about 20 % is for road maintenance, while in financial source breakdown about 90 % of the budget is from foreign assistance.

Table 4.1.4 Spent breakdown of ABC budget

(in thousand U.S. dollars)

Fiscal year	2002		2003		2004	
Budget / Implted	**Budget**	**Implted**	**Budget**	**Implted**	**Budget**	**Implted**
Personnel cost	6,077	3,100	4,686	3,936	4,448	4,448
Fixed Expense	24,270	21,302	41,417	28,386	37,762	27,183
Road Investment	196,014	114,887	209,138	136,461	261,960	188,176
Construction	156,795	93,011	155,152	113,643	202,114	151,153
Plan/Design	4,014	1,394	2,319	510	3,721	1,318
Maintenance	22,645	10,654	49,736	21,643	54,385	34,802
Restration	12,559	9,827	1,931	666	1,741	905
Total	226,360	139,288	255,241	168,784	304,172	219,809

Source: ABC

Table 4.1.5 Financial source breakdown of ABC budget

(in thousand U.S. dollars)

Fiscal year	2002		2003		2004	
Budget / Implted	**Budget**	**Implted**	**Budget**	**Implted**	**Budget**	**Implted**
Domestic source	54,873	18,360	24,584	9,803	43,912	2,562
CNCV	17,282	1,733	11,389	4,118	21,550	2,562
APLOCAL	37,591	16,627	13,195	5,685	22,362	
Foreign source	141,141	96,527	184,554	126,658	218,048	185,614
Collateral	2,793	504	2,676	200	5,461	2,976
CAF	57,901	37,170	74,552	49,293	81,801	70,550
PROEX	28,624	22,667	23,098	17,251	39,929	36,713
BM	21,599	15,468	50,783	39,092	58,854	48,592
BID	16,520	12,677	19,731	13,533	11,353	4,451
KFW	3,105	4,444	2,520	1,911	483	481
PL-480						
NPG						
EXIMIBANK	3,966		2,022	423	4,497	490
FONPLATA			6,576	4,661	8,712	8,452
OPEC					1,169	892
JBIC						
Japan	5,285	3,231	1,096	294	442	507
Others	1,348	366	1,500		5,347	11,510
Total	196,014	114,887	209,138	136,461	261,960	188,176

Source: ABC

For foreign assistance the amount in agreement base and the amount implemented as of third quarter of 2005 are shown in *Table 4.1.6*. The assistance from CAF is largest as 40% followed by the world bank, PROEX and BID as about 14 % each.

For maintenance of national roads CN (special national account for road maintenance, renamed from CNCV) has been established. It is composed of toll, heavy weight tax and part of hydro-carbonization tax (5%~15%). The situation of CN income is shown in *Table 4.1.7*. The maintenance budget is to be kept in the level of at least 20 million U.S. dollars annually.

Table 4.1.6 Foreign Funds Amount in Agreement and Implementation

(in thousand U.S. dollars)

Source of Funds	Amount in agreement		Implemented as of 3rd, 2005	
	Total	%	Total	%
BID	163,981	13.3	30,041	18.3
BM	182,698	14.8	121,562	66.5
CAF	500,589	40.5	311,657	62.3
FONPLATA	57,000	4.6	16,441	28.8
PROEX	178,378	14.4	112,758	63.2
KFW	39,866	3.2	39,158	98.2
FONDO NORDICO	83,822	6.8	358	0.4
EXIMIBANK	23,000	1.9	911	4.0
OPEC	5,600	0.5	926	16.5
Total	1,234,933	100.0	633,811	51.3

Source: SNC year book 2004-2005

Table 4.1.7 Situation of CN

(in thousand U.S. dollars)

Breakdown	2003	2004
Hydro-carbonization tax	8,150	11,125
Toll/weight (70% for SNC)	10,080	12,003
Total	18,230	23,128

Source: SNC year book 2004-2005

4.1.3 Situation of Road Maintenance

Road maintenance is executed in following four categories.

a) Routine Maintenance

The routine maintenance works are executed for 35 sections (tramos) by 10 regional offices. The contract of one-year-base maintenance work is made with private firm for each section and ABC herself supervises on it. The content of the routine maintenance works are mainly for road cleaning, weeding, repairing potholes of pavement, keeping drainage etc. in which local contractors can join without special or heavy machinery.

The budget of annual routine maintenance is from CNCV as stated in 4.1.2 which amounts to about 20 million U.S. dollars.

b) Periodical Maintenance

The periodical maintenance is mainly for large repair works such as overlay of asphalt, exchange of drainage pipes, repair of bridges. The periodical maintenance is administrated in all country bases not by regional offices but by the ABC headquarter through the evaluation including patrol investigation.

The frequency of the work is averagely 7 to 8 years for each section according to the evaluation by the headquarter. The financial source for the periodical maintenance is from the World Bank where 58 million U.S. dollars is allocated for the period of three years (2004~2006) through the program of general maintenance administration plan

c) Emergency Operation

This work is for emergency treatments for keeping traffic by removal of obstacles such as large stones or rocks, or embankment failure

d) Minor Works

This work is for small repairing such as small excavation or repairing ditches.

The item a) and b) above are executed in schedule. The integral maintenance including the item a) ~ d) are set for some special important sections

The maintenance situation of national road in 2005 is shown in *Figure 4.1.1*. The prevention work is newly established mainly for strengthen bridges. No attempts have been made for prevention of slope failures.

Figure 4.1.1 Situation of Maintenance for National Roads in 2005

Figure 4.1.2 shows the organization of routine maintenance in regional office. In each office one head engineer and tree follow-up engineers are disposed. One follow-up engineer has the area of about 400 km. Actually the maintenance works for averagely 400 km are executed by private contractors with ordinary machines and micro-empressas under the supervision of individual consultant (supervisor). The supervisor (selected by proposals) has three-year contract (with renewal in each year) for the maintenance works

One micro-empressa is composed of about 7 laborers of manual works for drainage cleaning, weeding or small repair in transporting by their bicycles every day and their covering area is about 30 kms. Periodically they receive training of the knowledge about technique of maintenance, law systems, environment activities, sanitation etc. through the supervisors, resulting improvement of their quality of activities. The system of micro-empressas have been established in 2002 by the aid of the world bank and by the maintenance aid of CAF. They have been established in each village bases and they execute the works nearby the home-places. This leads to polite and prompt works successfully. They are counted in number 350 empressas in all Bolivia and 20~50 in each regional office as of 2005.

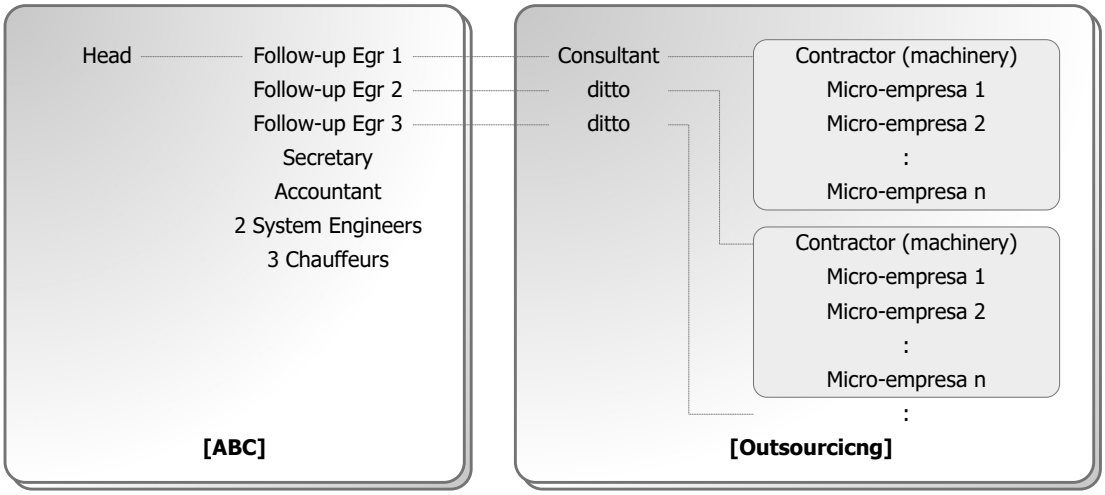


Figure 4.1.2 Organization of Maintenance in Regional Office

4.2 Situation on Approaching to Road Disaster Prevention

4.2.1 Situation on Road Disasters

(1) Situation on Disasters

The roads in Bolivia which are spreading different zone of climate, topography and geology have been facing to severe natural disasters through the year. Vast land of over one million square km is up and down rolling which is divided in Altiplano of 5000 m, Valleys of 1000~2000 m and low-flat land of Amazon.

In rainy season such disasters of collapse of slopes, rock falls, embankment failures, debris flows, land slides, floods etc. have occurred. The limitation for road alignment plan in cost and the lack of preventive measures on slopes also the cause of disasters. Such disasters are classified as follows;

- Rock Fall (Desprendimiento de rocas)
- Collaspe (Derrumbe de precipicio)
- Rock Mass Failure
- Slow-move Landslide (Dislizamiento)
- Debris Flow (Flujo de detritus)
- Embankment Failure

Adding to above disasters, bridge disasters by scouring of the foundation or by debris flow and flooding over roads in flat-lands have been occurred for which are out of this study scope though.

(2) Record of Disasters

In the course of site survey of this study, the diagnosis cards have been prepared for 259 disaster potential spots along the study area in which the disaster pattern of rock fall and collapse are dominant as stated in chapter 6.

As for such disaster records, there has been no accumulation of records in ABC headquarter. It is similar situation in the regional offices and no attempts have been made to uniform data system and to collect disaster records although the consultant (supervisor) has prepared road inventory periodically which contains the data of road conditions of pavements, retaining walls, etc.

It will be important to unify road inventory and disaster records including road close periods and restoration information.

Apart from the disaster record, ABC has the publicity system of road net condition almost in the real time bases by means of web site of ABC. The real time information is transmitted to ABC headquarter from the supervisor in regional offices every day, indicating traffic passable conditions in 4 levels caused by natural disaster, bridge accident, or road blockade etc.

(3) System of Disaster Restoration

a) Warning and Detection of Disasters

The micro-empressas or the contractor for routine maintenance are in charge of warning and finding of disasters. When they find disasters, such information is transmitted to the supervisor by telephone etc. The supervisor, in his judge on the situation of disasters, transmit the information to ABC regional office. When emergency is confirmed, the head of regional office orders to control traffic gates and requests the police office for proper traffic regulation.

b) Emergency Treatment

Prior to the restoration, emergency treatment such as piling up of sand bags, install of drain pipes or tentative fill etc. are executed by the contractor in charge of routine maintenance under the order of the supervisor in the approval of the regional office.. When the cost is beyond the routine contract, excess is covered by CNCV. And more, the supervisor submits the proposal of restoration works to the regional office for further restoration procedure.

c) Restoration Works

On the basis of the proposal from regional offices, ABC headquarter executes the design, bidding, supervision. The financial source for restoration is tentatively applied by CNCV, while the request for foreign aid such as collateral fund is made for the deficit. The budget for restoration has not been applied before hand. It is applied at the occurrence bases.

4.2.2 Situation on approaching to Road Disaster Prevention

(1) System for Road Disaster Prevention

In Bolivia the concept of road disaster prevention which aims to protect the road from disasters before the occurrence is not recognized well socially. And ABC herself dose not have organization, system and budget for disaster prevention, but for maintenance of roads. Due to the lack of the budget, restoration after the occurrences is treated as full demand.

Generally some directors or engineers of ABC and concerned really recognize the importance of the road disaster prevention. Partly information on risk spots and road inventory are prepared by the consultant (supervisor) in regional offices. It will be effective to develop those systems for establishment of disaster prevention.

Although public investment for roads have been progressed as stated in 4.4 owing to foreign fund, the projects on the view of disaster prevention have been counted only two as follows among all for new construction and pavement improvement;

The one is the install study on road disaster risk system (land slide warning system) for the slope protection works in the 49 km section between Cotapata and Santa Barbara (Route 3) by BID. This project is the first one counted for road disaster prevention in ABC and this is now in the process of bidding. The other one is the study for dangerous slopes in El Sillar area in route 4 by BID and it is now in the process of bidding. Apart from those two projects, none has been following.

CAF has a program for disaster prevention and disaster reduction as PREANDINO which assist member country for disaster reduction, disaster prevention and administration of risk. This program is driven by technical cooperation and the ministry of sustainable development (Ministerio de Desarrollo Sostenible) takes charge of it. PREANDINO was founded three years ago, while ABC took no action yet.

For the entire security in national level, the national emergency management committee (Centro de Operaciones de Emergencia Nacional) has been organized under the ministry of defence(Ministerio de Defensa Nacional). This committee has organized for liaison between governmental organizations on roles and action plans in the case of national emergency. ABC has taken part in it. It has no direct relation to road disaster prevention.

(2) Disaster Prevention Measures

The roads in mountainous area run along the valleys so they are threatened by destruction of mountain slopes and by erosion from rivers. It is necessary to install proper drainage facilities and protection measures against increased river water.

As the present situation of national roads in mountainous area, almost all slopes have been cut without any protection against heavy rains and valley side slopes also left in natural condition without no protection against erosion from river water flow. For necessary spots the following measures have been observed commonly.

- gabion wall
- concrete retaining wall
- drainage works(longitudinal slope drainage, cross underground drainage pipes)
- berms in cutting slopes

In the recent practice by BID in the section between Cotapata and Santa Barbara in route 3, the following measures have been observed.

- shotcrete on slopes
- anchoring
- rock net

The way of planning of present situation has following problems;

- Collapse along slope surface is due to heavy rains. Although gabions or drainage works have been installed at the foot of the slope, collapsed debris has overflowed on such works due to lack of protection works on slope surfaces of upstream. Present practice of this type of measures shows no permanent effects resulting repeated removal works of debris
- For slope surface protection of above mentioned type, local vegetation may be applied in the places of proper condition as inexpensive protection measures
- For rock falls no special protection has been taken due to comparatively easy removal of fallen materials for traffic recovering. Catch retaining wall with net or pocket space may be effective in proper alignment and road width.
- For debris flow along upstream valley, measures of gabion wall is so weak for strong attack of the flow or the opening of the drainage culvert is not sufficient for the flow volume, causing big overflow to the road surface. This type of disaster causes long term traffic regulation.
- Embankment shoulder failure requires big works like river erosion protection, concrete retaining walls and partial fill works. As emergency treatment widening to hill side works have been taken causing another problem of slope collapse..
- In the case of landslide (slow-move landslide), generally it is important to analyze the mechanism and area of movement in spot by spot, Usually large scale of measures or alternatives and long term survey are required.
- In general the lack of proper guides for planning and design causes difficulties in evaluating effectiveness of the installed works.

(3) Technical Standards

Up to now, the technical standards which have been regulated in ABC are counted for following two standards.

- Manual y Normas para el Diseno Geometrico de Carrentaras, SNC 1990
  (SNC Geometric standard of national roads)

- Unidad Tecnica de Pesaje, Bolivia, Boletin Informativo
  (Law for transportation No.1769:Size and weight limit for automobile)

As for the technical standards for bridges and pavements, AASHTO has been introduced in general.

While for the standard for slopes and drainage, no specific notes are shown in AASHTO about cut slope gradient guide etc. so that the design is done by technical judgment of individual consultant applying design software of the field concerned. In these cases the system to judge and to evaluate the proper use of input data becomes important.

(4) Technical level of local firms

Owing to the active investment on road construction, local firms of contractors and consultants are also active in the work type of direct contract, joint venture or subcontract under foreign firms, resulting good accumulation of technical experiences.

(a) Contractors:

About 800 contractors have registered in the contractors conference which have activities of interchange with universities for participating training of reporting or seminar etc. The major contractors with over 400 staff (including laborers) and heavy machineries/facilities are counted more than ten by the interview survey. Those major contractors have well experienced of direct contract with foreign fund projects of roads/bridges. While middle ranked contractors have experiences in road maintenance works with ordinary construction machineries like dump trucks, shovels, tractors etc.

(b) Consultants:

About 80 consultant firms have registered in the consultant association for public works. The activities of the association are not so special but some trainings or information exchanges. Major consultant firms have experienced in design and supervision of pre-stressed concrete structures or road construction works by foreign fund projects. While there are few firms for geological survey.

(5) Situation of materials and machinery procurement

The materials for public works such as cement, sand, stone, timber are supplied domestically. The cement products are in good condition in quality and quantity supplied by the plants in big city bases. While the supply for the freshly mixed concrete is limited near by big cities.

The steel products like reinforcing bars are imported from Brazil or others and those are supplied in ordinary market basis excepting special structural steel products.

As for the construction machineries, ordinary ones for road and bridge are easy to get by the rental system in the market excepting special use machineries.

(6) Situation of procurement method

The procurement method of contracts for survey or construction is generally performed by general competitive bidding. The bidding scale for construction consists of four ranks in which the border amounts are 500,000 Bs, 8,000,000 Bs and 40,000,000 Bs with required construction results and year of

experiences. In the case of emergency restore works due to disasters, nominated competitive biddings are permitted to perform with requirement of work results and abilities.

4.3 Social Environmental Consideration

4.3.1 General

Since the Environmental Law (No. 1333) was established as basic law on April 27, 1992 in Bolivia, full-fledged environmental consideration has been executed and various laws and regulations related to the environment were established and amended based on the Environmental Law.

All of the projects are regulated to go through the Environmental Procedure including the Environmental License according the Environmental Law (No. 1333, 1992/4/27), thus disaster prevention works as the Pilot Project are also unexceptional.

The content and exertive schedules of the Environmental Procedure for the Pilot Project are described as below.

4.3.2 Environmental Legislation

The environmental legislations and standards of Bolivia are shown in *Table 4.3.1* and *Table 4.3.2* to *Table 4.3.5*, respectively.

Particularly, the Environmental Impact Assessment (EIA) is executed based on the Environmental Law.

4.3.3 Environmental Procedure

The content of Environmental Procedure and workflow of Environmental Impact Assessment are shown in *Figure 4.3.1* and *Figure 4.3.2*, respectively.

Environmental Card, which is prepared based on the execution plan of project, will be submitted to the prefectural government or Ministry of Sustainable Development, and applied projects are classified into four categories namely Category 1 to 4. In case that the project covers astride plural prefectures, submitting administration is designated to the Ministry of Sustainable Development. Format and Environmental Matrix of the Environmental Card are shown in *Table 4.3.6* and *Table 4.3.1*, respectively.

The content of Environmental Impact Assessment for each category designated by the Environmental Procedure is shown as below.

- Category 1: Implementation of full-scale Environmental Impact Assessment
  (Selection of all environmental items.)
- Category 2: Implementation of partial Environmental Impact Assessment
  (Selection of specified environmental items, that impacts are anticipated.)
- Category 3: Submission of PPM (Program for Prevention and Mitigation) and PASA (Plan of Execution and Environmental Monitoring)
- Category 4: Not necessary to execute EIA

Table 4.3.1 Laws and Regulations related to the Environment (1)

No.	Name	Number and Date of Establishment	Objectives and Contents
1.	Political State Constitution	Law No. 1615, February 6, 1995	The law constitutes the base of the juridical and political classification of the country, synthesizing in a unit the diversity of standards of the country.
2.	Environmental Law	Law No. 1333, April 27, 1992	The law concerns the protection and conservation of natural resources, regulating the human activity for improvement the quality of the human life, and promoting the sustainable development.
3.	Regulation of the Environmental Law	Supreme Ordinance No. 24176, December 8, 1995	It regulates the Environmental Law, and incorporating six specified regulations with the environment.
4.	General Regulation of Environmental Management	Supreme Ordinance No. 24176, December 8, 1995	It concerns environmental aspects related to the formulation and establishment of environmental policies.
5.	Regulation of Environmental Prevention and Control	Supreme Ordinance No. 24176, December 8, 1995	It concerns the institutional frame of the national ambit, departmental, urban and sectors in charge of the prevention process and environmental control.
6.	Regulation of Air Pollution	Supreme Ordinance No. 24176, December 8, 1995	It concerns the application ambit, the corresponding institutional frame and the procedures to evaluate and control the air quality.
7.	Regulation of Water Contamination	Supreme Ordinance No. 24176, December 8, 1995	It concerns the institutional frame in national, departmental, urban, and sector levels. The objectives are to regulate the quality and the protection of the water resources.
8.	Regulation of Activities with Dangerous Substances	Supreme Ordinance No. 24176, December 8, 1995	It concerns the ambit of application and the institutional frame in national, departmental, urban, and sector levels. The regulation consists of establishment of the program of Inter sectoral for danger substances and the technical procedures of the management and generation of danger substances register and license.
9.	Regulation of Solid Waste Management	Supreme Ordinance No. 24176, December 8, 1995	It concerns the ambit of application, institutional frame and the technical procedures for the evaluation and control for the management and disposition of solids waste.
10.	National Road System	Supreme Ordinance No. 25134, January of 1999	It includes all of the national roads as state property, and their function.
11.	Law of Economic Reactivation	Law No. 2064	It concerns the road policies and function of the Master Plan regarding the surface transportation.
12.	Law for Loads	Law No. 1769, April 10, 1997	It concerns the establishment of weight for vehicles and permissible dimensions of highways, in order to preserve the road infrastructure.
13.	Law of Ratification of the Convention on Biological Diversity	Law No. 1580, July 15, 1984	It concerns the conservation of biological diversity, sustainable use of wild life, and fair shear of benefits derived from the use of the genetic resources.

Table 4.3.1 Laws and Regulations related to the Environment (2)

No.	Name	Number and Date of Establishment	Objectives and Contents
14.	Forest Law	Law No. 1700, July 12, 1996	It includes the forest regime of Bolivia with the premise of rational use, protection, restoration and conservation of the forest resources, and the rational and sustainable use is compared with the economic interests, environmental and social aspects.
15.	Mining Law	Law No. 1777, April 17, 1997	It includes the domain of all activities of mineral resources.
16.	Environmental Regulation for Mining Activities	Supreme Ordinance No. 24782, July 31, 1997	It concerns the establishment of procedures simplified for the mining activities, as well as the best practices for the environmental aspects.
17.	Law of Concession	Law No. 1874	It concerns to establish limits of the juridical regime of expropriation and to be presented in the stage of construction of a public work.
18.	Land Expropriation Law	Law No. 1884	It concerns the step of expropriations to the prefecture and municipalities for the road construction.
19.	Law on Municipalities	Law No. 2028	It concerns the reach of the attributions of the municipalities.
20.	Law on the National Service of Land Reform	Law No. 1715 October 18, 1996	It guarantees the proprietary right of the land.
21.	Legislation on the Archaeological Patrimony	Supreme Ordinance No. 24781, July 31, 1997	It concerns the general regulation for the protection areas and has objectives to consider and take care of the archaeological patrimony of the country.
22.	Agreement 169 of the ILO	Ratified with Law No. 1257, July 11, 1991	It recognizes the right of indigenous and tribal people and commits to approve their recognition and protection of their rights, especially including their lands and territories.
23.	Law on Popular Participation	Law No. 1551, April 22, 1994	Promoting the citizen participation in the preservation of the natural resources and environment with education campaigns.

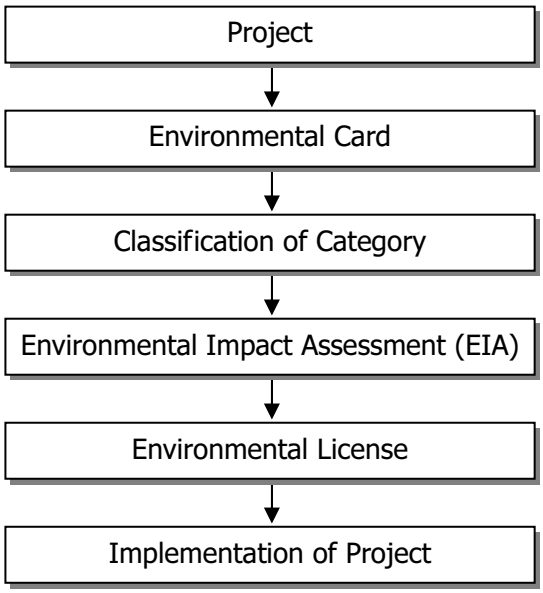


Figure 4.3.1 Content of the Environmental Permission

Table 4.3.2 Environmental Standards for Air (1)

(1) Air Quality

Contaminant		Standard Value	Period and Characterization
Carbon Oxide	CO	10 mg/m^3	Mean in 8 hrs.
		40 mg/m^3	Mean in 1 hr.
Sulfur Dioxide	SO_2	80 ug/m^3	Yearly mean
		365 ug/m^3	Average in 24 hrs.
Nitrogen Dioxide	NO_2	150 ug/m^3	24 hrs.
		400 ug/m^3	Yearly mean
Suspended Particulate Matter	SPM	260 ug/m^3	24 hrs.
		75 ug/m^3	Yearly mean
Particulate Matter of 10 micrometer	PM-10	150 ug/m^3	24 hrs.
		50 ug/m^3	Yearly mean
Ozone	O_3	236 ug/m^3	Maximum in hourly average

1 atm : 760 mmHg
Temperature : 298 K (25 ℃)

Table 4.3.2 Environmental Standards for Air (2)

(2) Environmental Standards of Heavy Metals, etc. for Air

Components	Standard Value	Period and Characterization
Pb	1.5 ug/m^3	Seasonal mean
As	50 ug/m^3	Yearly mean
Cd	40 ug/m^3	Yearly mean
Mn	2 ug/m^3	Yearly mean
Hg	1 ug/m^3	Yearly mean
V	0.2 ug/m^3	Yearly mean
Zn	50 ug/m^3	Yearly mean
HSO_3	150 ug/m^3	Average in 24 hrs.
F	50 ug/m^3 200 ug/m^3	Yearly mean Average in 0.5 hrs.
Cl	100 ug/m^3	Yearly mean
Dichloromethane	1 ug/m^3	Average in 24 hrs.
Trichloroethylene	1 ug/m^3	Average in 24 hrs.

Table 4.3.3 Environmental Standards for Noise

Condition	Time	Noise level: dB(A)
Fixed source of noise	6:00 a.m. ~ 10:00 p.m.	68
	10:00 p.m. ~ 6:00 a.m.	65
	Maximum noise in 15 minutes	115±3
	Maximum noise in 1 second	140
	Around hospital, school, pre-school, bead house, etc.	55
Public road	-	75
Others	Airport, highway, heliport, etc.	Necessary to confirm by Health Center

Table 4.3.4 Classification of Water

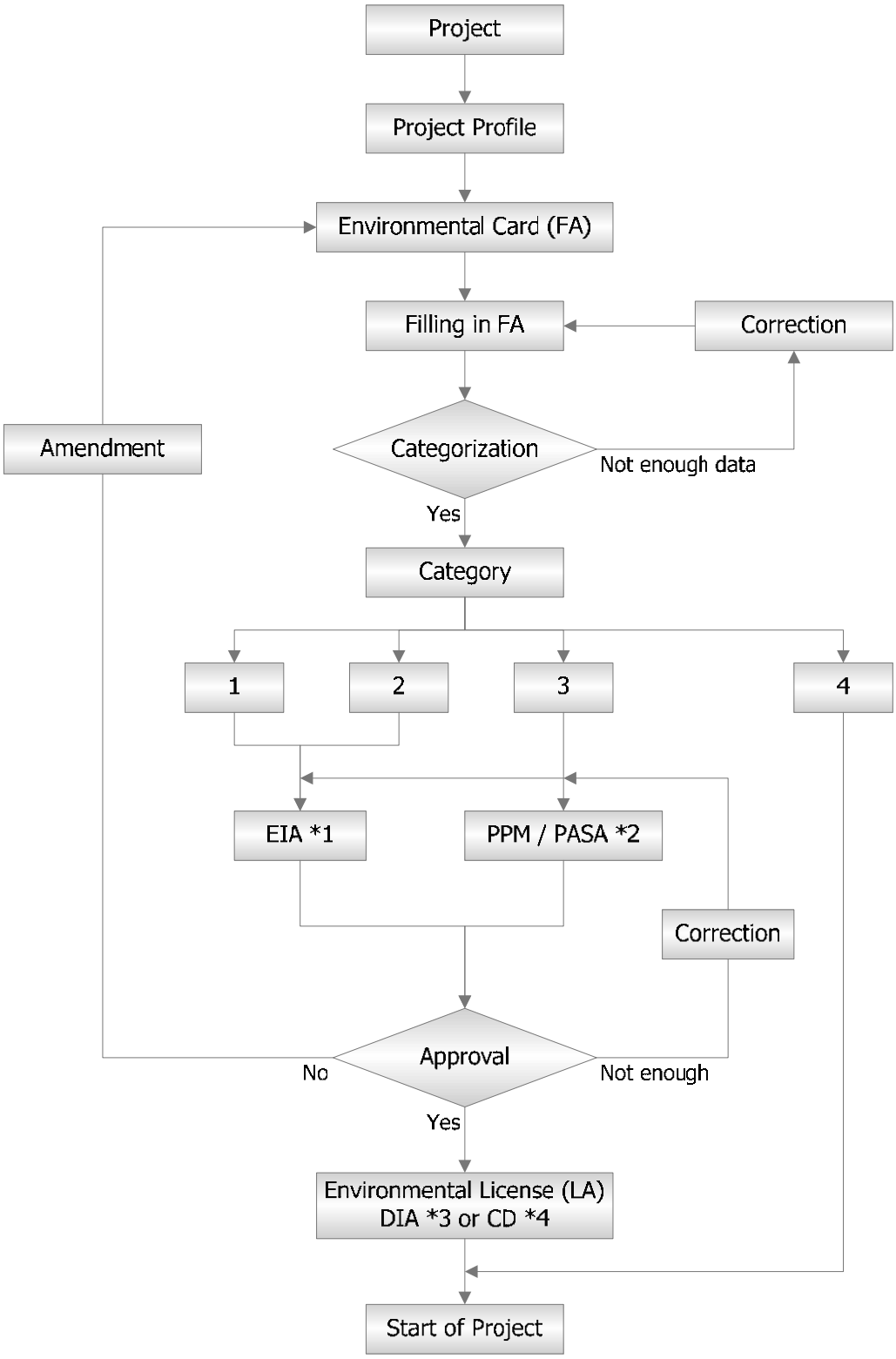
Classification of Water	Remarks
Class - A	Quality for drinking water without treatment or simple treatment
Class - B	Water for general use with physical and/or biological treatment
Class - C	Water for general use with physical, chemical and biological treatment
Class - D	Lowest quality of water with much treatment including SS, etc.

Table 4.3.5 Environmental Standards for Water Quality (1)

No.	Parameters	unit	carcino-genicity	Class A	Class B	Class C	Class D
1	pH		No	6.0 - 8.5	6.0 - 9.0	6.0 - 9.0	6.0 - 9.0
2	Temperature	℃		+/-3 ℃	+/-3 ℃	+/-3 ℃	+/-3 ℃
3	Total dissolble solid	mg/L		1000	1000	1500	1500
4	Oil and fat	mg/L	No	Not exist	Not exist	0.3	1
5	BOD 5	mg/L	No	< 2	< 5	< 20	< 30
6	COD	mg/L	No	< 5	< 10	< 40	< 60
7	Coliform (MPN)	N/100mg	No	< 50 or < 5 as 80% of samples	< 1000 or < 200 as 80% of samples	< 5000 or < 1000 as 80% of samples	< 50000 or < 5000 as 80% of samples
8	Parasite	N/L		< 1	< 1	< 1	< 1
9	Color (mg Pt/L)	mg/L	No	< 10	< 50	< 100	< 200
10	DO	mg/L	No	> 80 %	> 70 %	> 60 %	> 50 %
11	Turbidity	mg/L	No	< 10	< 50	<100, <2000 (in river)	<200, <10000 (in river
12	Solid sediments	mg/L-ml/L	No	< 10mg/L	30 mg/L - 0.1 ml/L	< 50 mg/L - < 1 ml/L	100 - < 1 ml/L
13	Al	mg/L		0.2	0.5	1.0	1.0
14	NH_3	mg/L	No	0.05	1.0	2	4
15	Sb	mg/L	No	0.01	0.01	0.01	0.01
16	Total As	mg/L	Yes	0.05	0.05	0.05	0.1
17	(Banceno)	mg/L	Yes	2.0	6.0	10.0	10.0
18	Ba	mg/L	No	1.0 - 0.05	1.0	2.0	5.0
19	Be	mg/L	Yes	0.001	0.001	0.001	0.001
20	B	mg/L		1.0	1.0	1.0	1.0
21	Ca	mg/L	No	200	300	300	400
22	Cd	mg/L	No	0.005	0.005	0.005	0.005
23	(Clanuros)	mg/L	No	0.02	0.1	0.2	0.2
24	Cl	mg/L	No	250	300	400	500
25	Cu	mg/L	No	0.05	1.0	1.0	1.0
26	Co	mg/L		0.1	0.2	0.2	0.2
27	Cr^{6+}	mg/L	Yes	0.05 as Total Cr	0.05 as Cr^{6+}	0.05 as Cr^{6+}	0.05 as Cr^{6+}
28	Cr^{3+}	mg/L	No	0.6 as Total Cr	0.6 as Cr^{3+}	0.6 as Cr^{3+}	1.1 as Cr^{3+}
29	1,2-Dichloroethane	mg/L	Yes	10.0	10.0	10.0	10.0
30	1,1-Dichloroethane	mg/L	Yes	0.3	0.3	0.3	0.3
31	Sn	mg/L	No	2.0	2.0	2.0	2.0
32	Phenols	mg/L	No	1	1	5	10
33	Soluble Fe	mg/L	No	0.3	0.3	1.0	1.0
34	F	mg/L	No	0.5 - 1.7	0.5 - 1.7	0.5 - 1.7	0.5 - 1.7
35	P	mg/L	No	0.4	0.5	1.0	1.0
36	Mg	mg/L	No	100	100	150	150
37	Mn	mg/L	No	0.5	1.0	1.0	1.0
38	Hg	mg/L	No	0.001	0.001	0.001	0.001
39	Li	mg/L		2.5	2.5	2.5	5
40	Ni	mg/L	Yes	0.05	0.05	0.5	0.5

Table 4.3.5 Environmental Standards for Water Quality (2)

No.	Parameters	unit	carcino-genicity	Class A	Class B	Class C	Class D
41	NO_3	mg/L	No	20	50	50	50
42	N	mg/L	No	< 1.0	1.0	1.0	1.0
43	NO_2	mg/L	No	6	12	12	12
44	Pb	mg/L	No	0.05	0.05	0.05	0.1
45	Ag	mg/L	No	0.05	0.05	0.05	0.05
46	Pentachlorophenol	mg/L	Yes	5.0	10.0	10.0	10.0
47	Se	mg/L	No	0.01	0.01	0.01	0.05
48	Na	mg/L	No	200	200	200	200
49	Suspended soilds	mg/L		Not exist	Not exist	Not exist	< 1 mm^2
50	SO_4	mg/L	No	300	400	400	400
51	S	mg/L	No	0.1	0.1	0.5	1.0
52	SAAM	mg/L		0.5	0.5	0.5	0.5
53	Tetrachloroethane	mg/L	No	10	10	10	10
54	Trichloroethane	mg/L	Yes	30	30	30	30
55	Carbon tetrachloride	mg/L	Yes	3	3	3	3
56	2,4,6-Trichlorophenc	mg/L	Yes	10	10	10	10
57	U	mg/L		0.02	0.02	0.02	0.02
58	V	mg/L	No	0.1	0.1	0.1	0.1
59	Zn	mg/L	No	0.2	0.2	5.0	5.0
60	Aldrin	mg/L	Yes	0.03	0.03	0.03	0.03
61	Clordane	mg/L	Yes	0.3	0.3	0.3	0.3
62	DDT	mg/L	Yes	1.0	1.0	1.0	1.0
63	Endrin	mg/L	No	Not use	Not use	Not use	Not use
64	Endosulfan	mg/L	No	70	70	70	70
65	Heptachlor	mg/L	Yes	0.1	0.1	0.1	0.1
66	Lindane (γ-BHC)	mg/L	Yes	3.0	3.0	3.0	3.0
67	Methoxychlor	mg/L	No	30	30	30	30
68	Biphenyl polichloride	mg/L		2.0	-	-	-
69	PCB	mg/L	Yes	-	0.001	0.001	0.001
70	Toxaphene	mg/L	Yes	0.01	0.01	0.01	0.05
71	Demeton	mg/L	No	0.1	0.1	0.1	0.1
72	Guthion	mg/L	No	0.01	0.01	0.01	0.01
73	Malthion	mg/L	No	0.04	0.04	0.04	0.04
74	Paration	mg/L	No	Not use	Not use	Not use	Not use
75	Carbaryl	mg/L		-	0.02	0.02	0.023
76	2,4-D	mg/L	Yes	100	100	100	100
77	2,4,5-TP	mg/L	Yes	10.0	10.0	10.0	10.0
78	2,4,5-T	mg/L	Yes	2.0	2.0	2.0	2.0
79	Alpha radiation	Bq/L	Yes	0.1	0.1	0.1	0.1
80	Beta radiation	Bq/L	Yes	1.0	1.0	1.0	1.0



**1: EIA (Environmental Impact Assessment),*
**2: PPM (Program for Prevention and Mitigation), PASA (Plan of Execution and Environmental Monitoring),*
**3: DIA (Environmental Declaration),*
**4: CD (Certification of Development)*

Figure 4.3.2 Work Flow of the Environmental Impact Assessment

Table 4.3.6 Environmental Card (1)

MINISTRY OF SUSTAINABLE DEVELOPMENT
VICE MINISTER OF NATURAL RESOURCES, ENVIRONMENTAL AND FORESTAL DEVELOPMENT
DIRECTORATE GENERAL OF ENVIRONMENT
FORM: ENVIRONMENTAL CARD NO.

1. GENERAL INFORMATION

DATE OF FILLING:	PLACE:	
PROMOTER:	SUBCONTRACTOR:	
RESPONSIBLE RECORD TO THE CARD:		
Full Name:	Profession:	
Position:	Consultant Register No.:	
Department:	City:	
Address:	House Phone No.:	P.O. Box:

2. INFORMATION OF PRODUCTIVE UNIT

COMPANY OR INSTITUTION:			
CORPORATE PERSON:			
PRINCIPAL ACTIVITY:			
BELONGING GROUP OR ASSOCIATION:			
REGISTORATION NO.:	DATE/CAPITAL:	TAXPAYER IDENTIFICATION NUMBER:	
PERMANENT ADDRESS (City/Location):		Town:	
Province:	County:	Street:	
Zone:	Phone No.:	Fax No.:	P.O. Box:
Legal Address in case of any Notification or Conjuration:			

3. IDENTIFICATION AND LOCATION OF THE PROJECT

PROJECT NAME:				
PROJECT LOCATION: City and/or County:				
District:	Province:		Department:	
Latitud:	Longitud:		Altitud:	
Cadastral Code:		Cadastral Register No.:		
Registration of Royal Rights:	Code:	Sheet:	Year:	County:
ADJACENT SITEs AND DEVELOPMENT ACTIVITIES:				
North:				
South:				
East:				
West:				
LAND USE:	Actual Use:		Potentiality of Land Use:	
Certification of Land Use:	Extended by:		Date:	

Note: Location drawing as annexes, land use certificate and air photographs.

4. DESCRIPTION OF PROJECT SITE

USE OF SURFACE:	Total Surface Area:	m2	Specific project Area:	m2
LAND DESCRIPTION:				
Topography and Gradient:				
Groundwater Level:				
Water Quality:				
Predominant Vegetation:				
Natural Drainage System:				
Human Activities:				

Table 4.3.6 Environmental Card (2)

5. PROJECT DESCRIPTION

ACTIVITY	Sector:	Sub-sector:	
	Specific Activity:		
KIND OF PROJECT:	New ( )	Expansion ( )	Others ( )
STAGE OF PROJECT:	Exploration ( )	Execution ( )	Operation ( )
	Maintenance ( )	Planning ( )	Closure ( )
PROJECT SITE:			
OBJECTIVES OF THE CREDIT:			
GENERAL OBJECTIVES OF THE PROJECT:			
SPECIFIC OBJECTIVES OF THE PROJECT:			
RELATION WITH OTHER PROJECTS:			
It's part of:	One Plan ( )	Program ( )	Isolated Project ( )
Description of Program or Plan:			
UTILITY LIFE TIME OF THE PROJECT:		Years:	Months:

( ): Use only for the Ministry of Sustainable Development and Environment.

6. ALTERNATIVES AND TECHNOLOGIES

Are alternatives of location considered ?	Yes ( )	No ( )
If the answer is YES, How many alternatives ?, Which one selected ?, Why ?		
Describing the Technogies (machinery, equipments, etc.), and the process that will be applied in the project.		
TECHNOLOGY:		
MACHINERY AND EQUIPMENTS:		
Description:	**Capacity:**	

7. TOTAL INVESTMENT

STAGE OF STUDY:	Pre-Feasibility ( )	Feasibility ( )	Detail Design ( )
PROJECT INVESTMENT:		Total Cost us$:	
SOURCE OF FINANCE:	us$:	us$:	

8. ACTIVITIES

In this section, the activities for each stage must be descrived.

ACTIVITY	**DESCRIPTION**	**LENGHT OF TIME**	
		QUANTITY	**UNIT**
1			
2			

Table 4.3.6 Environmental Card (3)

9. HUMAN RESOURCES

QUALIFIED	Permanent:	Non permanent:
NON-QUALIFIED	Permanent:	Non permanent:

10. NATURAL RESOURCES OF THE PROJECT AREA (WHO WILL BE USED ?).

DESCRIPTION	VOLUME OR QUANTITY
1	
2	

11. RAW MATERIALS

a) RAW MATERIALS			
NAME	**QUANTITY**	**UNIT**	**ORIGEN**

b) ENERGY	**QUANTITY**	**UNIT**	**ORIGEN**

12. WASTES

TYPE	DESCRIPTION	ORIGIN	QUANTITY	FINAL DISPOSITION OR RECEIVER
LIQUIDS				
SOLIDS				
GASES				

13. NOISE (Origin and Noise Level)

ORIGIN:
MINIMUN LEVEL (dB):
MAXIMUN LEVEL (dB):

14. INDICATION OF STORAGE METHOD AND PLACES OF THE MATERIALS

15. INDICATION OF PROCESS FOR TRANSPORTATION AND MANIPULATION OF THE MATERIALS

16. INFERRED ACCIDENTS AND/OR CONTINGENCY

Table 4.3.6 Environmental Card (4)

17. ENVIRONMNETAL CONSIDERATIONS

SUMMARY OF THE ENVIRONMENTAL IMPACTS AS "KEY" (IMPORTANTS)
Consideration of negative and/or possitive impacts, short or long period, and temporary or permanent, and direct or indirect.

EXECUTION	OPERATION AND MAINTENANCE	CLOSING

PROPOSAL MITIGATION MESSURES AGAINST THE IMPACTS AS "KEY" (IMPORTANTS)
Indication for each stage (Execution, Operation, Maintenace and Closing).

EXECUTION	OPERATION AND MAINTENANCE	CLOSING

18. DECLARATION OF JUDGEMENT

The applicants, , of the project, , as promotor and resposible engineer of the elaboration of the Environmental Card, give faith, of truthful information detailed on this documnet and we asume responsability in case of don't be true the information presented on this documnet that has Voluntary Confession Quality.

Signature:

PROMOTOR RESPONSIBLE ENGINEER

Name:
I.D.:

Table 4.3.7 Environmental Matrix

MINISTRY OF SUSTAINABLE DEVELOPMENT
VICE MINISTER OF NATURAL RESOURCES, ENVIRONMENTAL AND FORESTAL DEVELOPMENT
DIRECTORATE GENERAL OF ENVIRONMENT
MI: MATRIX OF IMPACT IDENTIFICATION
PROJECT:

ENVIRONMNETAL FACTORS	AIR								WATER										SOIL						ECOLOGY									NOISE				SOCIO ECONOMIC								
	DIFFUSION FACTOR	SPM	SOx	NOx	CO	PHOTOCHEMICALS	TOXICS	SMELL	VARIATION OF FLOWOUT	FAT AND OIL	SUSPENDED SOLIDS	TEMPERATURE	ALCALINITY AND ACIDITY	BOD 5	DISSOLUVED OXIGEN	DISSOLVED SOLIDS	NITRATES	TOXICS	COLIFORMS	SALINITY AND ALCALINITY	COMPACTION	NITRATES	EROSION	IRRIGATION	SOIL USE	TERRESTRIAL FAUNA	ORNIS	AQUATIC FAUNA	TERRESTRIAL FLORA	URBAN GREENERY AREAS	ACUATIC FLORA	HARVEST TIME	VECTORS	LANDSCAPE	PHYSICAL EFECTS	COMUNICATION	WORK EFFICIENCY	SOCIAL BEHAVIOR	LIFE STYLE	PHYSICAL SYSTEMS	COMMUNITIES	EMPLOYMENT	PUBLIC INCOME	PERSONAL INCOME	PUBLIC PROPERTIES	PRIVATE PROPERTIES
ACTIVITIES OF THE PROJECT																																												
EXECUTION																																												
- Setting Camp and Operation																																												
- Operation of Machinery and Equipments																																												
- Construction, Cleaning and Repairment of Drainage																																												
- Crusher and Concrete Plants																																												
- Development and Production of Aggregates																																												
- Reposition and Rehabilitation of Embankments and Shoulders																																												
- Slope Protection and Stabilization																																												
- Measuring of collapse																																												
- Construction of stoneworks																																												
- Installation of Fence, Lights and Traffic Signals																																												
- Revegetation works																																												
- Vertical and Horizontal Alignment in a Curve																																												
OPERATION OF THE PROJECT																																												
- Traffic																																												

4.4 Development Plan

4.4.1 IIRSA

IIRSA (Iniciativa para la Integracion de la Infraestructura Regional Suramericana) was established in August 2000 for promotion of general development of infrastructures in South American countries of transport, energy and communication fields. All 12 countries have been joined with main body as ANDINO (Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile) and MERCOSUR (Argentina, Uruguay, Paraguay, Brazil).

The activities of IIRSA are to propose and coordinate on the development plans for infrastructures from the member countries, not to supply funding.

The IIRSA plan has been constructed by reflecting the development policy of member countries. The headquarter is in Argentine and their administration fund is supplied by BID, CAF and FONPLATA. The board is composed of 4 to 5 members from each country headed by minister level officials and their roles are mainly for coordination between countries.

IIRSA has constructed main 10 development axes in South America as shown in *Figure 4.4.1* taking account of topography, economic activities and traffic flows.

Figure 4.4.1 General Development Plan of IIRSA (10 axes)

Among the IIRSA axes, sic axes of Andino, Peru-Brasil-BoliviaLa, Hidrovia Paraguay-Parana, Capricornio, Interoceanico Central, Andino del Sur are directly related to Bolivia. Apparently the Interoceanico axis which transverses active zone of Bolivia in east and westward is the most important.

As stated before, IIRSA mainly coordinate on the promotion of development plan of each countries not covering the adjustment of technical matters such as standardization on roads and their facilities over the member countries. It will become necessary to coordinate or to adjust the levels of design of road amenities, logistics, environments, issue on border pass etc. And more the plan of IIRSA has not included view point of disaster prevention and further plan to do so is not clear at the present time.

4.4.2 Development Plan

In Bolivia the investments for new constructin, improvement and maintenance of national road network are executed owing to the fund from CAF, BID, and the World Bank, PROEX etc. By the policy of the vice-ministry of transport, those investments have been made along with the scheme of IIRSA.

The development corridors concerning national roads have been set as shown in *Figure 4.4.2* to *Figure 4.4.6* according to IIRSA Plan. As stated before the east-west corridor located in the interoceanico axis is the most important. The route 4 and the route 7 consist this corridor and the service level of these routes have big influence on the activity in interoceanico axis.

The vice-ministry of transport has made out the plan in the field of transport as shown in *Table 4.4.1* in which 29 plans of roads, rail ways and river transport are listed. The individual plans of ABC have a link to those plans, as shown in *Figure 4.2.7* for planning stage and as shown in *Figure 4.2.8* for construction stage. ABC is executing 74 projects in 2005 and two of which are related disaster prevention as stated in 4.2.2 (1).

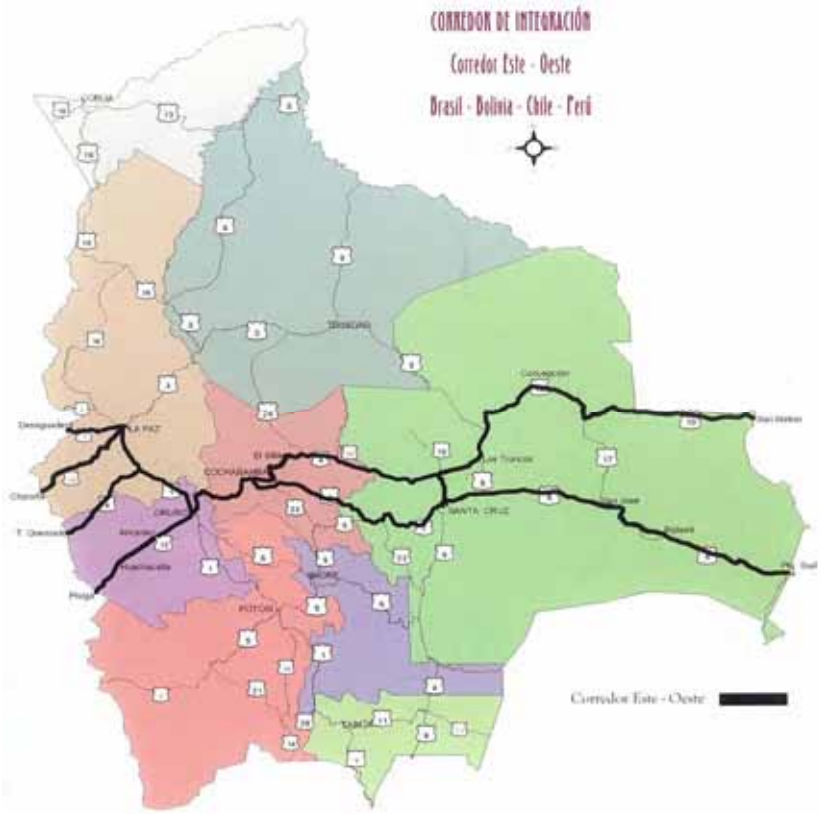


Figure 4.4.2 East-West Corridor

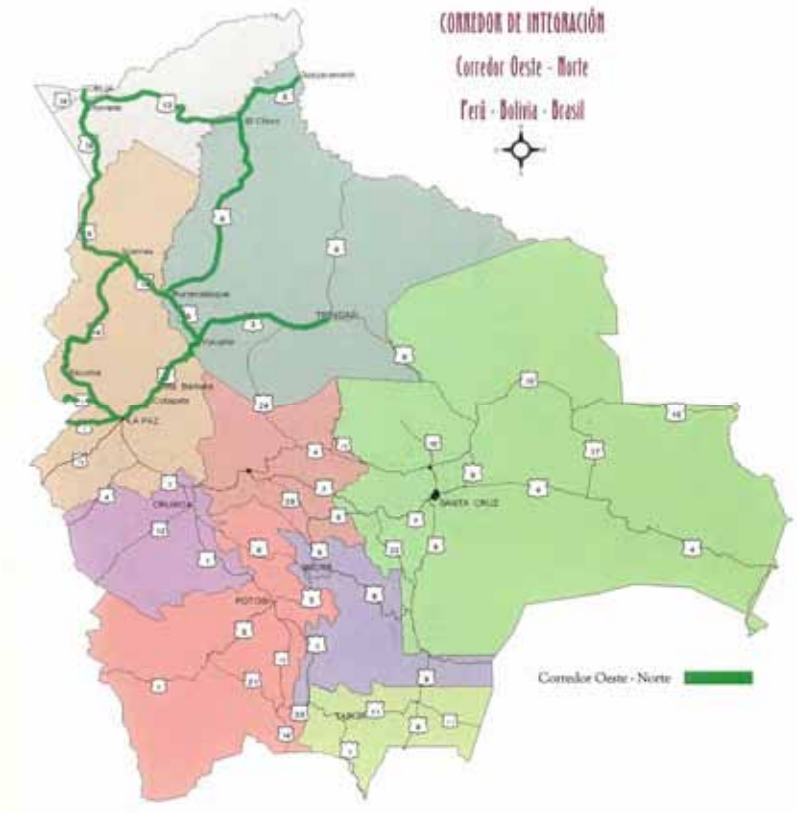


Figure 4.4.3 North-West Corridor

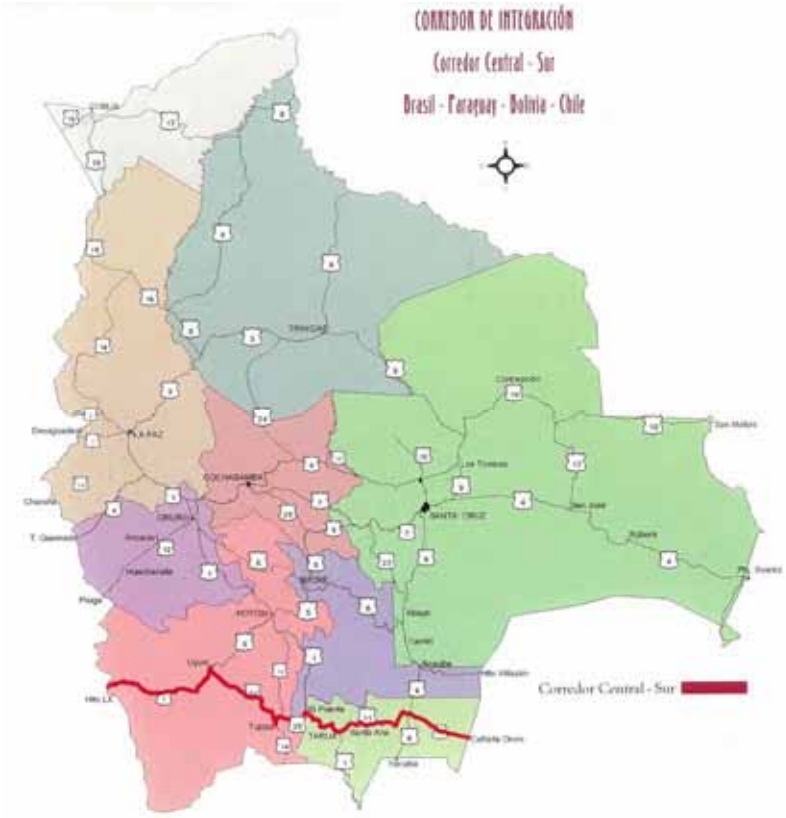


Figure 4.4.4 Central South Corridor

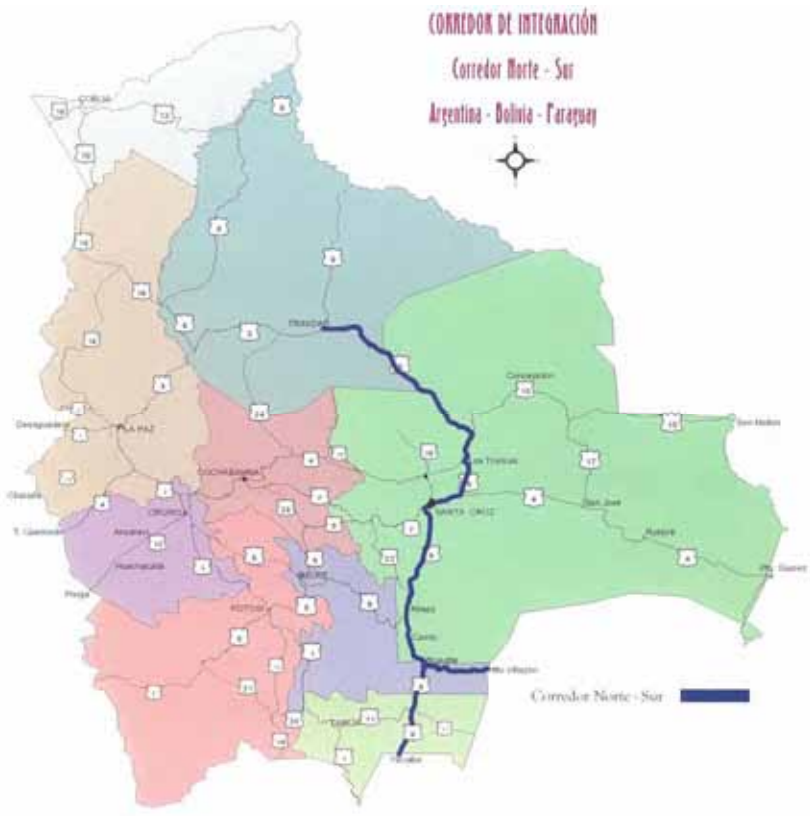


Figure 4.4.5 North-South Corridor

Figure 4.4.6 South-West Corridor

Table 4.4.1 Development Plan in Transport in Bolivia

EJE	Nº	NOMBRE PROYECTO	EJE Y GRUPO IIRSA	LONGITUD KMS	UBICACIÓN DEPARTAMENTO BOLIVIA	CARÁCTER	MONTO TOTAL	SE REQUIERE	FINANCIAMIENTO
EJE ANDINO	1	CARRETERA POTOSÍ TARIJA	Eje andino Grupo 8	363	Potosí - Sucre - Tarija	Nacional	180,000,000.00	Conclusión de carretera y puentes	PROEX -CAF - TGN
	2	CEBAF Desaguadero - BOLIVIA - PERÚ	Eje Andino - Grupo 8		La Paz	Bi- Nacional PE - BO	5.000.000.00	Ejecución de la Obra	Sin financiamiento
	3	Conexión Ferroviaria Puno - El alto	Eje Andino - Grupo 9	BO 24 PE 146	La Paz	Bi- Nacional BO - PE	198,000,000.00	Estudios y construcción de ferrovía	Sin financiamiento
EJE PERÚ - BRASIL - BOLIVIA	4	CARRETERA GUAYARAMERÍN - RIBERALTA - YUCUMO - LA PAZ - PUENTE BINACIONAL GUAYARAMERÍN - GUAJARAMIRÍN	Eje Perú - Brasil - Boilivia Grupo 2	1132	La Paz - Beni	Nacional y Bi-nacional (BO-BR)	250,000,000.00	Estudios, construcción carretera y puentes	Estudios carretera - Fondo Nórdico construcción - sin financiamiento
	5	CARRETERA COBIJA - EL CHORRO	Eje Perú - Brasil - Bolivia Grupo 2	371	Pando - Beni	Nacional	80,000,000.00	Conclusión de Estudios, construcción carretera y puentes	Sin financiamiento
	6	CARRETERA YUCUMO - TRINIDAD	Eje Perú - Brasil - Bolivia Grupo 2	281	Beni	Nacional	200,000,000.00	Conclusión de Estudios, construcción de carretera y puentes	construcción sin financiamiento
	7	CARRETERA (COBIJA) - KM 19 - NAREUDA EXTREMA	Eje Perú - Brasil - Bolivia Grupo 2	76	Pando	Nacional	22,665,647.00	Construcción de carretera	construcción sin financiamiento
	8	CEBAF Brasilea - Cobija - BOLIVIA - BRASIL	Eje Perú - Brasil- Bolivia - Grupo 2		Cobija	Bi - Nacional BR -BO	2,000,000.00	Estudios y ejecución de la obra	Sin financiamiento
	9	CEBAF Extrema BOLIVIA - PERÚ	Eje Perú - Brasil- Bolivia - Grupo 2		La Paz	Bi- Nacional PE - BO	1.500.00.00	Ejecución de la Obra	Sin financiamiento
	10	Hidrovía Ichilo - Mamoré	Eje Perú Brasil Bolivia - Grupo 3	1398	Beni - Cochabamba - Santa Cruz	Nacional	20,000,000.00	Conclusión de Estudios y ejecución de la obra	Sin financiamiento
	11	Navegación Río Beni y Afluentes (Orthon y Madre de Dios)	Eje Perú Brasil Bolivia - Grupo 3	2200	Beni - La Paz	Nacional	40.000.000.00	Estudios y ejecución de la obra	Sin financiamiento
EJE INTEROCEANICO	12	CARRETERA CAÑADA ORURO - VILLAMONTES - TARIJA - ESTACIÓN AVAROA	Eje Interoceánico Grupo 1	995	Tarija, Sucre, Potosí	Nacional	477,000,000.00	Tramo Cañada Oruro - Tarija, 377 Km. culminación de construcción (U$ 181 MM) Tramo Tarija - Estación Abaroa 618 Km: Estudios, construcción de carretera (U$ 297 MM)	Tramo Cañada Oruro - Tarija: CAF, TGN Tramo Tarija - Estación Abaroa: Sin financiamiento
	13	CARRETERA POTOSÍ - TUPIZA - VILLAZÓN	Eje Interoceánico Grupo 1	355	Potosí	Nacional	123,000,000.00	Tramo Bella Vista - Cotagaita: Culminación de construcción Tramo Cotagaita - Villazón : Construcción de carretera (U$ 62 MM)	Tramo Bella Vista - Cotagaita: PROEX, CAF, TGN Tramo Cotagaita - Villazón: sin financiamiento para construcción
	14	CEBAF Ollague - Estación Abaroa - BOLIVIA - CHILE	Eje Interoceánico - Grupo 1		Potosí	Bi- Nacional CHI - BO	1,600,000.00	Estudios y ejecución de la obra	Sin financiamiento
	15	CEBAF Infante Rivarola - Cañada Oruro - BOLIVIA - ARGENTIN	Eje Interoceánico - Grupo 1		Tarija	Bi- Nacional PAR - BO	1,200,000.00	Estudios y ejecución de la obra	Sin financiamiento
	16	CARRETERA PAILÓN - SAN JOSÉ - PUERTO SUÁREZ	Eje Interoceánico Grupo 3	592	Santa Cruz	Nacional	317,900,000.00	Puente Pailas: Conclusión de construcción Paraíso - El Tinto: Conclusión de construcción El Tinto – San José: Conclusión de construcción San José - Roboré: Conclusión de construcción Roboré – El Carmen: Conclusión de construcción El Carmen- P. Suárez - Arroyo Concepción: Construcción	EXIMBANK, TGN, BID, UE, CAF, TGN
	17	Ferrocarril Motacucito - Puerto Bush y Puerto	Eje Interoceánico - Grupo 3	143	Santa Cruz	Nacional	135,000,000.00	Estudios concluidos. Construcción en proceso de concesión	financiamiento por Concesión
	18	CEBAF Puerto Suárez - Corumbá - BOLIVIA - BRASIL	Eje Interoceánico - Grupo 3		Santa Cruz	Bi- Nacional BR - BO	2,000,000.00	Estudios y ejecución de la obra	Sin financiamiento
	19	CARRETERA CONCEPCIÓN - SAN MATÍAS	Eje Interoceánico Grupo 4	474	Santa Cruz	Nacional	256,000,000.00	Estudios, construcción carretera y puentes	Estudios: BID construcción sin financiamiento
	20	CARRETERA OKINAWA - PUENTE BANEGAS - LOS TRONCOS	Eje Interoceánico Grupo 4	31	Santa Cruz	Nacional	50,000,000.00	Estudios, construcción carretera y puentes	Sin financiamiento
	21	CEBAF San Matías - Porto Limao - BOLIVIA - BRASIL	Eje Interoceánico - Grupo 4		Santa Cruz	Bi- Nacional BR - BO	2,000,000.00	Estudios y ejecución de la obra	Sin financiamiento
	22	REHABILITACIÓN TRAMO "EL SILLAR"	Eje Interoceánico Grupo 5	33	Santa Cruz	Nacional	30,000,000.00	Concluir los estudios . Construcción	Estudios: BID Construcción sin financiamiento
	23	CARRETERA ORURO - PISIGA	Eje Interoceánico Grupo 5	232	Oruro	Nacional	91,000,000.00	Toledo - Ancaravi y Huachacalla - Pisiga Construcción de obras Ancaravi - Huachacalla - Conclusión de obras	CAF, Gob. Italia, TGN
	24	CARRETERA ANTIGUA SANTA CRUZ - COCHABAMBA	Eje Interoceánico Grupo 5	503	Cochabamba - Santa Cruz	Nacional	N/D	Preparar proyecto de rehabilitación. Ejecución	Sin financiamiento
	25	REHABILITACIÓN PUENTE "LA AMISTAD"	Eje Interoceánico Grupo 5	0.28	Santa Cruz	Nacional	3,200,000.00	Conclusión diseño puente nuevo Rehabilitación puente antiguo	Rehabilitación Puente Antiguo: Eximbank - Corea Sin financiamiento para construcción puente nuevo (monto N/D)
	26	Interconexión ferrocarril Andino - Oriental (Cliza - Buen Retiro)	Eje Interoceánico - Grupo 5	384	Santa Cruz - Cochabamba	Nacional	400,000,000.00	Estudios y construcción de ferrovía	Sin financiamiento
	27	CEBAF Pisiga - Colchane - BOLIVIA - CHILE	Eje Interoceánico - Grupo 5		Oruro	Bi- Nacional CHI - BO	2,000,000.00	Estudios y ejecución de la obra	Sin financiamiento
EJE CAPRICORNIO	28	PUENTE BINACIONAL SALVADOR MAZA - YACUIBA	Eje Capricornio Grupo 2	30 Mts.	Tarija	Bi- Nacional AR - BO	5,400,000.00	Conclusión Diseño Final. Construcción	Gestión de financiamiento BID
	29	CEBAF Yacuiba - Salvador Maza - BOLIVIA - ARGENTINA	Eje Capricornio - Grupo 2		Tarija	Bi- Nacional AR - BO	3,300,000.00	Conclusoón Diseño Final y ejecución de la Obra	Gestión de financiamiento BID

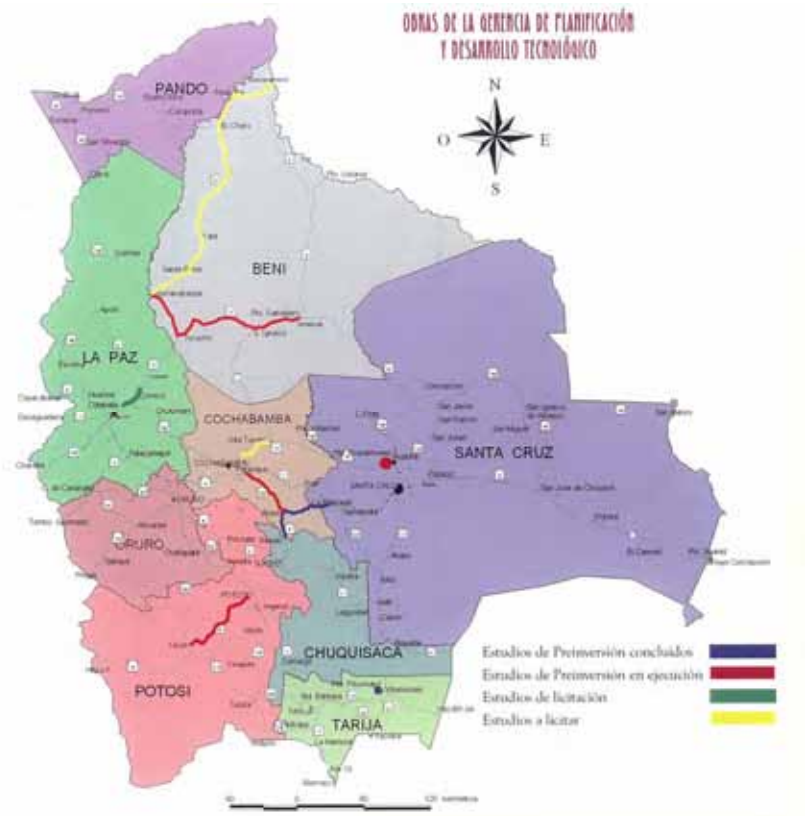


Figure 4.4.7 ABC Roads in Planning and Studying (2005)

Figure 4.4.8 ABC Roads in Construction (2005)