

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
TRANSPORT COUNCIL OF LIMA AND CALLAO
MINISTRY OF TRANSPORTATIONS AND COMMUNICATIONS OF THE REPUBLIC OF PERU

**THE MASTER PLAN FOR
LIMA AND CALLAO METROPOLITAN AREA
URBAN TRANSPORTATION IN
THE REPUBLIC OF PERU
(Phase 1)**

**FINAL REPORT
(Volume – II)**

AUGUST, 2005

**YACHIYO ENGINEERING CO., LTD
In Association With
PACIFIC CONSULTANTS INTERNATIONAL**

Exchange Rates: October 2004

US\$ 1.00 = Soles S/. 3.29

US\$ 1.00 = ¥ 109.95

Preface

In response to a request from the Government of the Republic of Peru, the Government of Japan decided to conduct the Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru (Phase 1) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Koichi TSUZUKI of Yachiyo Engineering Co., Ltd., to Peru, seven times between January 2004 and May 2005. In addition, JICA set up an advisory committee headed by Dr. Hisao Uchiyama, Tokyo University of Science between January 2004 and May 2005, which examined the Study from specialist and technical points of view.

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

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

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

August 2005

Kazuhisa MATSUOKA
Vice President
Japan International Cooperation Agency

Letter of Transmittal

August 2005

Mr. Kazuhisa MATSUOKA
Vice President
Japan International Cooperation Agency

Dear Sir:

It is a great honor for me to submit herewith the final reports of the Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru (Phase 1).

A study team, which consists of Yachiyo Engineering Co., Ltd. and Pacific Consultants International, and headed by myself, conducted field surveys, data analysis and planning works of the master plan study in Peru based on the terms of references instructed by the Japan International Cooperation Agency (JICA) from January 2004 to August 2005.

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

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

I also wish to express my sincere appreciation to JICA, Consejo de Transporte de Lima y Callao, Ministry of Transportations and Communications, the Embassy of Japan in Peru, and other concerned government authorities for their valuable advice and cooperation given to us in the course of the Study.

Yours Faithfully,

Koichi TSUZUKI
Team Leader,
The Master Plan for Lima and Callao
Metropolitan Area Urban Transportation in
the Republic of Peru (Phase 1)

TABLE OF CONTENTS

(VOLUME – I)

SUMMARY

1. INTRODUCTION	1-1
1.1. Study Objectives	1-1
1.2. Target Year of the Study	1-1
1.3. The Study Area	1-1
1.4. Scope of the Study	1-2
1.5. Study Progress	1-5
1.6. Study Organizations	1-6

PART - I CURRENT CONDITIONS

2. CURRENT SOCIOECONOMIC CONDITIONS	2-1
2.1. POPULATION TREND	2-1
2.2. ECONOMIC ACTIVITIES	2-2
2.3. HISTORICAL BACKGROUND OF THE URBANIZATION	2-7
2.4. MAJOR CHARACTERISTICS OF LAND USE AND URBANIZATION	2-9
2.4.1. General	2-9
2.4.2. Central Lima Area	2-10
2.4.3. North Lima Area	2-10
2.4.4. South Lima Area	2-10
2.4.5. East Lima Area	2-11
2.4.6. Callao Area	2-11
3. PERSON TRIP CHARACTERISTICS	3-1
3.1. OUTLINE OF TRANSPORT SURVEYS	3-1
3.1.1. Survey Framework	3-1
3.1.2. Person Trip Survey	3-2
3.1.3. Premises for Analysis in this Chapter	3-3
3.2. DATABASE BUILDING	3-10
3.2.1. Introduction	3-10
3.2.2. Selected Samples and Effective Sample Size	3-10
3.2.3. Expansion	3-11
3.2.4. Calibration	3-11
3.2.5. Analysis of ESTRATO	3-13
3.3. URBAN TRANSPORT DEMAND CHARACTERISTICS	3-13
3.3.1. Socio-economic Profile of Residents	3-13

3.3.2.	Overall Travel Demand.....	3-20
3.3.3.	Origin and Destination.....	3-25
3.3.4.	Urban Transport Services.....	3-33
3.3.5.	Interface with Other Cities.....	3-46
3.4.	DISCUSSION ON OTHER ASPECTS	3-49
3.4.1.	Travel demand of people in poverty	3-49
3.4.2.	Characteristics of non-motorized travel demand.....	3-52
3.4.3.	Access to Bus Stops.....	3-55
3.4.4.	Role of Paratransit	3-56
3.4.5.	Analysis on Travel Cost.....	3-60
4.	ROAD FACILITY CONDITIONS AND TRAFFIC CHARACTERISTICS	4-1
4.1.	ROAD FACILITY CONDITIONS	4-1
4.1.1.	Road Facility Administration.....	4-1
4.1.2.	Road Facility Classification.....	4-1
4.1.3.	Existing Arterial Road Network	4-2
4.1.4.	Road Facility Standards.....	4-3
4.1.5.	Road Network Extension and Road Width.....	4-4
4.1.6.	Road Structure	4-5
4.1.7.	Conditions of pavement and drainage facilities.....	4-5
4.1.8.	Intersections.....	4-5
4.1.9.	Conditions of Sidewalks, Parking Spaces.....	4-6
4.2.	CURRENT ROAD TRAFFIC CHARACTERISTICS	4-6
4.2.1.	Traffic Volume	4-6
4.2.2.	Travel Speed	4-17
4.3.	CARGO TRANSPORT.....	4-23
4.3.1.	Outline of Cargo Transport Demand.....	4-24
4.3.2.	demand of business entity.....	4-33
5.	PUBLIC TRANSPORT CONDITIONS.....	5-1
5.1.	GENERAL	5-1
5.2.	PRESENT PUBLIC TRANSPORT DEMAND.....	5-1
5.2.1.	Bus Passengers.....	5-1
5.2.2.	Boarding and Alighting Passengers at Bus Stops	5-5
5.2.3.	Bus Traffic Volumes on Arterial Roads	5-7
5.2.4.	Bus, Taxi and Colectivo in 2004.....	5-10
5.3.	BUS SERVICE.....	5-13
5.3.1.	Bus Routes	5-14
5.3.2.	Bus Operation	5-19
5.3.3.	Bus Facilities	5-28
5.3.4.	Bus Tariff	5-33
5.3.5.	Bus Fleets.....	5-35
5.3.6.	Bus Company.....	5-38
5.3.7.	Bus Administration	5-41
5.3.8.	Bus User Conditions	5-43
5.4.	OUTLINE OF RAILWAYS	5-46
5.4.1.	Summary of the Railway Conditions in Peru	5-46

5.4.2.	Antecedents of trams in Lima	5-48
5.4.3.	Conditions of Railway Line 1 South - North	5-49
5.5.	TAXI SERVICE	5-55
5.5.1.	Taxi	5-56
5.5.2.	Colectivo	5-68
5.5.3.	Moto-taxis	5-76
5.6.	CURRENT PROBLEMS AND ISSUES	5-82
6.	TRAFFIC CONTROL AND MANAGEMENT CONDITIONS	6-1
6.1.	TRAFFIC SIGNAL CONTROL CONDITIONS	6-1
6.1.1.	Facilities	6-1
6.1.2.	Signal Fasing System	6-2
6.1.3.	Bottlenecks At Signalized Intersections	6-5
6.2.	TRAFFIC REGULATIONS	6-8
6.2.1.	One-Way Traffic Regulation	6-8
6.2.2.	Curb Parking Regulation	6-8
6.2.3.	Speed Limit Regulation	6-8
6.2.4.	Median Bus-Exclusive Lane Regulation	6-8
6.2.5.	Truck Ban Regulation	6-8
6.3.	TRAFFIC SAFETY CONDITIONS	6-10
6.3.1.	Traffic Accidents	6-10
6.3.2.	Traffic Education And Driving License System	6-15
6.4.	PRESENT PARKING CONDITIONS	6-18
6.4.1.	Parking Survey	6-18
6.4.2.	Parking Survey Results	6-20
6.5.	EXISTING ISSUES, OPPORTUNITIES AND CONSTRAINTS	6-24
6.5.1.	Problems And Issues Of Traffic Flow And Control	6-24
6.5.2.	Problems And Issues Of Traffic Control And Management Facilities	6-25
7.	TRAFFIC ADMINISTRATION, INSTITUTION AND LEGISLATION	7-1
7.1.	NATIONAL ORGANIZATIONS AND INSTITUTIONS	7-1
7.1.1.	General Conditions	7-1
7.1.2.	National Transport Organizations and Institutions	7-4
7.2.	TRANSPORT ORGANIZATIONS AND INSTITUTIONS OF THE MML	7-8
7.2.1.	Transport Organizations at the MML	7-10
7.3.	TRANSPORT ORGANIZATIONS AND INSTITUTIONS OF THE MPC	7-14
7.4.	ORGANIZATIONS AND INSTITUTIONS OF THE CTLC	7-16
7.5.	LEGISLATIONS REGARDING TRANSPORT	7-17
7.5.1.	General law of Transport and Ground Transit	7-17
7.5.2.	Decrees	7-17
7.5.3.	Regulations	7-18
7.6.	ORGANIZATIONAL, INSTITUTIONAL AND LEGISLATIVE ISSUES	7-18

7.6.1.	Issues of the MML and the MPC	7-18
7.6.2.	Issues of the Municipality of Lima	7-18
7.6.3.	Issues for the Implementation of the Master Plan	7-19
8.	TRANSPORT DEVELOPMENT PLAN BY GOVERNMENT OF PERU..	8-1
8.1.	URBAN DEVELOPMENT PLANS.....	8-1
8.1.1.	Review of Existing Development Plans	8-1
8.2.	ROAD DEVELOPMENT PROJECTS	8-10
8.2.1.	Execution of Road Facility Projects	8-10
8.2.2.	Current Situation of the Main Projects	8-10
8.3.	BUS TRANSPORT DEVELOPMENT PLANS	8-12
8.3.1.	Development Plan in the Last 30 Years	8-12
8.3.2.	On-Going Related Projects in Lima.....	8-17
8.3.3.	On-going Related Projects in Callao	8-19
8.3.4.	Protransporte's Project (COSAC Project).....	8-19
8.4.	EXISTING RAILWAY PROJECTS.....	8-21
8.4.1.	Evolution Condition of Railway Type Transportation Projects	8-21
8.4.2.	Previous Studies on Railway Type Development Projects	8-27
8.4.3.	AATE' Activities (Railway Public Corporation)	8-29
8.4.4.	Metropolitan Transportation Committee (TRANSMET)	8-29
8.4.5.	North-South Electric Train Extension Line Project	8-32
8.4.6.	Construction Project of the East - West Urban Train Line.....	8-35
8.4.7.	Future Projects	8-37
9.	CURRENT URBAN TRANSPORT PROBLEMS AND ISSUES	9-1
9.1	SUMMARY OF EXISTING TRANSPORT AND TRAFFIC STATISTICAL DATA.....	9-1
9.2	TRANSPORT PROBLEMS AND ISSUES	9-3
(VOLUME – II)		
PART-II TRANSPORT DEMAND FORECAST/PLANNING		
10.	FUTURE SOCIOECONOMIC FRAMEWORK	10-1
10.1.	POPULATION PROJECTION	10-1
10.2.	MACRO ECONOMIC PROJECTION	10-4
10.3.	CONSIDERATION OF FUTURE URBAN STRUCTURE	10-7
10.4.	BASIC POLICIES FOR FUTURE LAND DEVELOPMENT TOWARDS 2025.....	10-12
10.5.	DISTRIBUTION OF FUTURE POPULATION AND EMPLOYMENT BY TRAFFIC ZONE	10-17
11.	FUTURE TRAVEL DEMAND	11-1

11.1.	TRAVEL DEMAND MODEL	11-1
11.1.1.	Model Structure	11-1
11.1.2.	Trip Production Model.....	11-2
11.1.3.	Trip Generation and Attraction Model.....	11-3
11.1.4.	Trip Distribution Model.....	11-5
11.1.5.	Modal Split Model.....	11-7
11.1.6.	Traffic Assignment Model	11-9
11.2.	ESTIMATION OF FUTURE HOUSEHOLDS BY ESTRATO RANK	11-10
11.3.	PROJECTION OF TRAVEL DEMAND	11-11
11.3.1.	Total Number of Trips.....	11-11
11.3.2.	Trip Generation and Attraction	11-12
11.3.3.	Trip Distribution	11-15
11.3.4.	Modal Split	11-16
11.3.5.	Traffic and Transport Demand on Road and Transport Networks..	11-18
11.3.6.	Hourly Trip OD Tables in Peak Hour	11-20
12.	FUTURE TRANSPORT NETWORK ANALYSIS.....	12-1
12.1.	GENERAL PLANNING CONDITIONS IN THE STUDY AREA.....	12-1
12.1.1.	General Conditions of the Study Area in 2025	12-1
12.1.2.	Necessity of Preparation of Transport Master Plan	12-11
12.1.3.	Urban Transport Planning Policy and Strategies	12-12
12.2.	ROAD NETWORK PLAN	12-16
12.2.1.	Road Network Planning Policy and Strategies	12-16
12.2.2.	Future Road Network to be Adopted for the Study	12-18
12.3.	PUBLIC TRANSPORT PLAN	12-19
12.3.1.	Public Transport Issues	12-19
12.3.2.	Public Transport Planning Policy and Strategy.....	12-23
12.4.	FORMULATION OF TRANSPORT NETWORK ALTERNATIVE PLAN	12-27
12.4.1.	Transport Mode to be Examined in the Study	12-27
12.4.2.	Concrete Conditions for Preparation of Transport Network Alternative Plan	12-27
12.4.3.	Transport Scenario of Lima and Callao Metropolitan Area in 2025	12-33
12.4.4.	Identification of Basic Transport Network Case by Scenario.....	12-35
12.4.5.	Formulation of Alternative for Transport Network Plan in 2025....	12-47
12.4.6.	Projects Formulated by Alternative Transport Plan	12-47
12.4.7.	Project Cost Estimate in Alternative Plans	12-48
12.5.	EVALUATION AND SELECTION OF ALTERNATIVE TRANSPORT NETWORK PLAN	12-54
12.5.1.	Evaluation Process.....	12-54
12.5.2.	Evaluation of Master Plan Alternatives	12-56
12.5.3.	Comprehensive Evaluation of Master Plan in 2025	12-66
12.5.4.	Verification for evaluation of alternative transport network by gis analysis.....	12-74
13.	ROAD FACILITIES SECTOR PLAN	13-1
13.1.	EXISTING ROAD NETWORK.....	13-1

13.1.1.	Existing Road Conditions	13-1
13.1.2.	Existing Road Network Pattern	13-3
13.2.	FUTURE ROAD NETWORK PLAN IN 2025	13-4
13.2.1.	Environmental Consideration for Future Road Network Plan	13-4
13.2.2.	To Cope with the Future Road Network Plan	13-5
13.2.3.	Future Road Network Plan of the Study in 2025	13-6
13.2.4.	Traffic Volume Assignment on the Future Road Network	13-6
13.2.5.	Verification of the Future Road Network	13-8
13.3.	INTERSECTION IMPROVEMENT PLAN	13-10
13.3.1.	Intersections to be Improved on Arterial Roads	13-10
13.3.2.	Priority of Implementation of the Intersection Improvement Plans	13-11
13.4.	IDENTIFICATION OF ROAD NETWORK PLAN	13-14
13.4.1.	Formulation of Road Network Plan	13-14
13.4.2.	Outline of Plans	13-20
13.4.3.	Project Cost Estimate for Road Facilities Development Plans	13-31
14.	TRUNK BUS TRANSPORT SECTOR PLAN	14-1
14.1.	GENERAL	14-1
14.2.	ENVIRONMENTAL CONSIDERATION	14-3
14.3.	TYPE OF BUS SERVICE	14-3
14.4.	BUS OPERATION SYSTEM	14-6
14.5.	BUS FLEET	14-7
14.6.	BUSWAY FACILITY	14-8
14.6.1.	Trunk Busway	14-8
14.6.2.	Bus Stop Spacing	14-9
14.6.3.	Trunk Bus Network	14-10
14.6.4.	Busway Capacity	14-13
14.6.5.	Trunk Bus Demand	14-15
14.7.	IDENTIFICATION OF PROJECTS	14-16
14.8.	BUS FACILITIES	14-36
14.8.1.	Importance of Transfer Facilities	14-36
14.8.2.	Type of Bus Facilities	14-36
14.8.3.	Location of Bus Facilities	14-37
14.8.4.	Design Concept of Busway Facility	14-39
14.8.5.	Plan of Busway Facilities	14-39
14.8.6.	Passenger Facilities in Busway Terminal / Station	14-43
14.8.7.	Model Plan of Busway Terminal/Station/Stop	14-44
14.9.	PROJECT COST ESTIMSTE FOR TRUNK BUS PROJECTS	14-49
14.9.1.	Conditions of Project Cost Estimate	14-49
14.9.2.	Unit Cost of Each Working Items	14-49
14.9.3.	Project Cost by Each Trunk Bus Project	14-50
15.	RAILWAY TRANSPORT SECTOR PLAN	15-1
15.1.	GENERAL	15-1
15.2.	ENVIRONMENTAL CONSIDERATION	15-1

15.2.1.	Urban Railway Conditions in Latin America.....	15-1
15.2.2.	Requirement of Railway Development in Lima	15-2
15.3.	TECHNICAL CHARACTERISTICS	15-3
15.3.1.	Natural Condition	15-3
15.3.2.	Design Criteria.....	15-4
15.4.	RELATED RAILWAY REGULATIONS	15-5
15.4.1.	Basic Concept for the Operation of Urban Railways.....	15-5
15.4.2.	Right of Way	15-6
15.4.3.	Maintenance System of Fixed Installations	15-6
15.5.	EXISTING RAILWAY CONDITIONS	15-7
15.5.1.	Standard Conditions.....	15-7
15.5.2.	Scale of Depot.....	15-7
15.5.3.	Present conditions of Existing Railway (Line 1)	15-8
15.6.	BASIC STRATEGY OF RAILWAY PLANNING.....	15-8
15.6.1.	Impact of urban railway transport.....	15-8
15.6.2.	Creation of an Integrated Public Transport Network.....	15-9
15.6.3.	Railway Related Business.....	15-11
15.6.4.	Subsidies for Construction of Urban Railway Line.....	15-12
15.7.	FUTURE RAILWAY DEVELOPMENT PROGRAM	15-14
15.7.1.	Railway Network Plan	15-14
15.7.2.	Railway Development Network Plan until 2025	15-16
15.7.3.	Railway Development Operation System.....	15-18
15.7.4.	Adequate Transport Mode (Heavy rail / Light rail).....	15-22
15.7.5.	Operation Planning	15-23
15.8.	IDENTIFICATION OF NETWORK DEVELOPMENT PROJECTS.....	15-24
15.8.1.	Description of Each Railway Network	15-24
15.8.2.	Project Cost Estimate.....	15-24
16.	TRAFFIC MANAGEMENT SECTOR PLAN	16-1
16.1.	APPROACH AND METHODOLOGY	16-1
16.2.	TRAFFIC MANAGEMENT PLAN	16-1
16.2.1.	plan description.....	16-3
16.3.	MIDDLE AND LONG-TERM PLAN.....	16-19
16.3.1.	Area Traffic Control System and Traffic/Road Information System.....	16-20
16.3.2.	Bus Location Information System and Bus Priority Signal Control System on Trunk Roads.....	16-23
16.4.	PROJECT COST FOR TRAFFIC MANAGEMENT SECTOR.....	16-25
17.	INITIAL ENVIRONMENTAL EXAMINATION (IEE).....	17-1
17.1.	NATURAL CONDITION	17-1
17.1.1.	Location	17-1
17.1.2.	Climate.....	17-1
17.1.3.	Topography	17-4
17.1.4.	Geology.....	17-5
17.1.5.	Hydrology	17-5
17.1.6.	Soil.....	17-6

17.1.7.	Vegetation	17-6
17.1.8.	Flora.....	17-7
17.1.9.	Fauna.....	17-7
17.1.10.	Classification of Ecological Life Zones.....	17-8
17.2.	SITUATION OF NATURAL AND SOCIAL ENVIRONMENT	17-9
17.2.1.	Natural Environment	17-9
17.2.2.	Social Environment	17-13
17.3.	SITUATION OF THE PRESERVATION OF RUINS AND CULTURAL ASSETS.....	17-15
17.3.1.	Administration of the Preservation of Ruins and Cultural Assets ..	17-15
17.3.2.	Ruins of Former Inhabitants	17-15
17.3.3.	Lima Historical Center Zone	17-18
17.3.4.	Old Buildings and Urban Monuments	17-21
17.3.5.	Cultural Assets of Callao	17-23
17.3.6.	Construction in Registered Cultural Assets	17-24
17.3.7.	Management of Buried Cultural Assets	17-25
17.3.8.	Principal Regulations on Cultural Assets Management.....	17-25
17.4.	ENVIRONMENTAL REGULATIONS AND PROCEDURES.....	17-26
17.4.1.	Environment and Natural Resources Code.....	17-26
17.4.2.	Environmental Impact Evaluation System	17-26
17.4.3.	Environmental Impact Evaluation on Road and Transport Projects in Lima and Callao.....	17-27
17.4.4.	Environmental Control Standards and Emission Limits.....	17-28
17.4.5.	Anti-Pollution Regulations of Callao	17-29
17.4.6.	Other Environmental Regulations	17-30
17.5.	PROCEDURE OF INHABITANTS RELOCATION AND PROJECT CASES.....	17-32
17.5.1.	Procedure of Land Acquisition	17-32
17.5.2.	Procedure of Expropriation.....	17-33
17.5.3.	Acquisition of Illegally Occupied Land.....	17-33
17.5.4.	Project Cases of Inhabitants Relocation	17-33
17.6.	PROCEDURE OF INHABITANTS PARTICIPATION AND PROJECT CASES.....	17-34
17.6.1.	Democracy in Peru	17-34
17.6.2.	Citizens' Participation System	17-35
17.6.3.	Inhabitants' Administration in Lima	17-36
17.6.4.	Inhabitants' Administration in Callao	17-39
17.6.5.	Inhabitants' Participation in Environmental Affairs	17-40
17.6.6.	Inhabitants Management in PROTRANSPORTE Project.....	17-41
17.6.7.	Inhabitants' Management in Other Project Cases	17-42
17.7.	ROADSIDE NOISE SURVEY	17-42
17.7.1.	Outline of Field Survey.....	17-42
17.7.2.	Results and Discussions.....	17-43
17.8.	ROADSIDE AIR QUALITY SURVEY	17-45
17.8.1.	Outline of the Field Survey.....	17-45
17.8.2.	Results and Discussions.....	17-46
17.9.	SCOPING AND SCREENING	17-47
17.9.1.	Introduction.....	17-47
17.9.2.	Environmental Scoping	17-49
17.10.	DISCUSSIONS ON ENVIRONMENTAL AND SOCIAL	

CONSIDERATIONS.....	17-66
17.10.1. Environmental Consideration (Bio-Physical Environment)	17-66
17.10.2. Social Consideration (Socio-Cultural Environment).....	17-68
17.10.3. Study Plan of Environmental Impact Assessment	17-70
17.11. PUBLIC INVOLVEMENT	17-80
17.11.1. Inventory of Stakeholders.....	17-80
17.11.2. Characteristics of Low Income People	17-84
17.11.3. Characteristics of Bus Drivers	17-87
17.11.4. Characteristics of NGOs	17-93
17.11.5. Characteristics of Universities.....	17-93
17.11.6. Seminars	17-95
17.11.7. Specialist Stakeholder Meeting.....	17-98
17.11.8. Information Disclosure	17-104
18. PREPARATION OF THE URBAN TRANSPORT MASTER PLAN IN 2025.....	18-1
18.1. PROPOSED PROJECTS FOR THE COMPREHENSIVE URBAN TRANSPORT MASTER PLAN	18-1
18.1.1. The Road Facility Development Projects	18-1
18.1.2. Railway Transport Development Projects	18-3
18.1.3. Trunk Bus Transport Development Projects.....	18-3
18.1.4. Traffic Management Development Projects	18-4
18.2. FORMULATION OF COMPREHENSIVE URBAN TRANSPORT MASTER PLAN IN 2025	18-5
19. PREPARATION OF THE IMPLEMENTATION PROGRAM.....	19-1
19.1. PROJECT PRIORITY.....	19-1
19.1.1. Identification of Project Priority	19-1
19.2. IMPLEMENTATION SCHEDULE AND INVESTMENT	19-10
19.2.1. Implementation Schedule	19-10
19.2.2. Investment Cost	19-10
20. EVALUATION OF LONG TERM MASTER PLAN	20-1
20.1. ECONOMIC EVALUATION	20-1
20.1.1. Methodology.....	20-1
20.1.2. Economic Benefit	20-2
20.1.3. Economic Project Cost	20-4
20.1.4. Cost-Benefit Analysis	20-4
20.2. FINANCIAL EVALUATION	20-7
20.2.1. Introduction.....	20-7
20.2.2. Present Financial Status of Each Organization	20-8
20.2.3. Taxation Systems and Tax Revenue.....	20-9
20.3. ENVIRONMENTAL EVALUATION.....	20-12
20.4. TRAFFIC EVALUATION	20-14
20.5. SOCIAL IMPACT	20-24
20.5.1. Ensuring of Transport Employment.....	20-24

20.5.2. Scrapped of Existing Bus Fleets	20-25
20.6. OVERALL EVALUATION	20-26

(VOLUME – III)

21. EFFECTIVENESS OF TRAFFIC AND TRANSPORT BY MASTER PLAN	21-1
21.1. ANALYTICAL PROCEDURE	21-1
21.2. TRAFFIC DEMAND ANALYSIS IN THE MORNING PEAK HOUR....	21-3
21.2.1. Peak Hour Travel Demand Analysis	21-3
21.2.2. Summary of Traffic and Transport Effectiveness	21-21
21.3. INFLUENCE OF FARE RATE.....	21-22
21.3.1. Procedure to Forecast a Modal Share	21-23
21.3.2. Sensitivity Analysis for Public Transport Fare Rate	21-24
21.4. INFLUENCE OF MASS TRANSIT ON LOWER INCOME POPULATION	21-25
21.4.1. Lower Income Population Survey for Transport	21-26
21.4.2. Issues of Public Transport on Poor People	21-36
21.4.3. Recommendation of Fare System and Feeder Bus Network	21-38
21.5. ECONOMIC SENSITIVITY ANALYSIS	21-39
21.5.1. Moderate Economic Scenario	21-40
21.5.2. Projection of Future Travel Demand by Scenario.....	21-41
21.5.3. Comparison of Both Scenarios	21-42
21.5.4. Evaluation of Master Plan Scenario.....	21-43
22. SHORT TERM ACTION PLAN IN 2010.....	22-1
22.1. IDENTIFICATION OF SHORT TERM ACTION PLAN IN 2010	22-1
22.1.1. General.....	22-1
22.1.2. Short-Term Action Plan	22-2
22.2. TRAVEL DEMAND IN 2010	22-4
22.2.1. General.....	22-4
22.2.2. Socioeconomic Framework	22-4
22.2.3. Projection of Travel Demand.....	22-5
22.3. EVALUATION OF SHORT-TERM PROJECTS.....	22-11
22.3.1. Passenger Demand on Public Transport	22-11
22.3.2. Shortening of Commuter Hour	22-15
22.3.3. Decrease of Number of Operated Fleets.....	22-15
22.3.4. Number of Operated Fleets on Each Line.....	22-16
22.3.5. Change of Total Proceeds	22-19
22.3.6. Improvement of Traffic Conditions	22-19
22.3.7. Economic Benefit for the 2010 Project.....	22-23
22.4. HIGH PRIORITY PROJECTS FOR FURTHER STUDY IN 2010	22-24
22.4.1. Procedure of Identification of High Priority Projects	22-24
22.4.2. Selected High Priority Projects.....	22-25
22.5. DESCRIPTION OF HIGH PRIORITY PROJECT	22-26
22.5.1. Railway Projects	22-26

22.5.2. Trunk Busway Projects	22-34
22.6. SUMMARY OF THE SHORT-TERM AND HIGH PRIORITY PROJECT COSTS.....	22-37
23. TRAFFIC MANAGEMENT PLAN	23-1
23.1. TRAFFIC SIGNAL CONTROL IMPROVEMENT PLAN.....	23-1
23.1.1. Necessity And Objectives	23-1
23.1.2. Functions.....	23-1
23.1.3. Intersections To Be Covered By The Signal Control System	23-2
23.1.4. Basic Control Concept	23-5
23.1.5. Equipment And Devices	23-5
23.1.6. Facility Plan	23-7
23.1.7. Cost Estimates For Traffic Signal Control Improvement Plan	23-16
23.1.8. Urgent Action Plan For Traffic Signal Control System	23-17
23.2. TRAFFIC SAFETY EDUCATION PROGRAMS.....	23-19
23.2.1. Necessity And Objectives	23-19
23.2.2. Programs For Traffic Safety Education	23-19
23.2.3. Institutional Improvement.....	23-19
23.2.4. Increase of Traffic Safety Education Programs And Campaign Programs	23-20
23.2.5. Cost Estimates For Traffic Safety Education Programs.....	23-28
23.3. TRAFFIC ACCIDENT MONITORING PLAN (TRAFFIC SAFETY AUDIT SYSTEM).....	23-28
23.3.1. Necessity And Objectives	23-28
23.3.2. System Function of Tsas	23-29
23.3.3. Task Description	23-31
23.3.4. Cost Estimates For Traffic Accident Monitoring System (Traffic Safety Audit System).....	23-36
23.4. TRANSPORTATION DEMAND MANAGEMENT PLAN (TDM).....	23-36
23.4.1. Necessity And Objectives	23-37
23.4.2. Plan Description.....	23-37
23.4.3. Urgent Action Plan For Transportation Demand Management Plan (TDM).....	23-44
23.4.4. Cost Estimates For Transportation Demand Management Plan (TDM).....	23-44
23.5. IMPROVEMENT PLAN OF PARKING CONTROL SYSTEM	23-44
23.5.1. Necessity And Objectives	23-44
23.5.2. plan description.....	23-45
23.5.3. Cost Estimates For Improvement Plan Of Parking Control System	23-49
23.6. IMPROVEMENT PLAN OF MOTOR VEHICLE INSPECTION SYSTEM.....	23-49
23.6.1. Necessity And Objectives	23-49
23.6.2. Plan Description.....	23-50
23.6.3. Cost Estimates For Improvement Plan Of Motor Vehicle Inspection System.....	23-54
24. URGENT ACTION PLAN.....	24-1
24.1. GENERAL	24-1

24.1.1.	Objectives and Study Area.....	24-1
24.1.2.	Planning Policy.....	24-3
24.2.	IDENTIFICATION OF URGENT ACTION PLAN.....	24-3
24.2.1.	Identification of Urgent Action Project.....	24-3
24.2.2.	Outline of Recommended Projects.....	24-7
24.2.3.	Estimated Project Cost.....	24-9
24.2.4.	Evaluation of Urgent Action Plan.....	24-11
25.	INSTITUTIONAL AND OPERATIONAL ORGANIZATION FOR THE TRUNK BUS OPERATION SYSTEM	25-1
25.1.	OPERATIONAL ORGANIZATION FOR TRUNK BUS SYSTEM.....	25-1
25.1.1.	Existing Bus Operation.....	25-1
25.1.2.	Problems addressed in the current bus system.....	25-4
25.1.3.	implementation of trunk busway system.....	25-5
25.1.4.	Organization Issues.....	25-9
25.1.5.	Concession.....	25-21
25.1.6.	social impacts and Related businesses.....	25-25
25.2.	INSTITUTIONAL ORGANIZATION FOR REALIZATION OF MASTER PLAN.....	25-28
25.2.1.	Activity Items for Realization of Master Plan.....	25-28
25.2.2.	Institutional Organization for Realization of Master Plan.....	25-28
25.2.3.	Suggestion for Existing Organizations.....	25-31
26.	FINANCIAL PROCUREMENT FOR MASTER PLAN PROJECTS.....	26-1
26.1.	Project Cost of Master Plan.....	26-1
26.1.1.	Summary of Total Project Cost.....	26-1
26.1.2.	Financial Availability in General.....	26-2
26.2.	Basic Policy for Financial Procurement.....	26-2
26.2.1.	General.....	26-2
26.2.2.	Basic Directions.....	26-3
26.3.	Examples and Experiences in Japan as a Reference.....	26-5
26.3.1.	Automobiles and Tax Burden.....	26-5
26.3.2.	Taxes related to Automobiles and Resources for Roads.....	26-6
26.3.3.	Historical Trend of Vehicle Related Taxes.....	26-6
26.3.4.	Total Budget for Road Investment.....	26-7
26.4.	Initial Ideas to Increase Financial Sources.....	26-8
26.4.1.	Some Candidate Ideas.....	26-8
26.4.2.	Initial Estimation of Some Ideas.....	26-10
26.4.3.	Expected Balance.....	26-14
26.5.	Private Sector Participation.....	26-18
26.5.1.	General.....	26-18
26.5.2.	PPI Examples in the Study Area.....	26-20
27.	RECOMMENDATIONS.....	27-1

LIST OF TABLES

(VOLUME – I)

Table 1.5-1	Major activities of the Study	1-5
Table 2.1-1	Population Trend in Peru and the Metropolitan Area of Lima and Callao, 1940-2004	2-2
Table 2.1-2	Annual Population Growth Rate in Peru and the Metropolitan Area of Lima-Callao, 1940-2004	2-2
Table 2.2-1	Gross Domestic Product of Peru by Economic Sectors, 1970-1990 (at 1979 Constant Prices)	2-3
Table 2.2-2	GDP by Economic Sectors, 1991-2004 (at 1994 Prices).....	2-4
Table 2.2-3	GDP Annual Growth Rate by Economic Sectors, 1991-2004	2-4
Table 2.2-4	GRDP of the Department of Lima and Callao by Economic Sectors, 1970-1995 (at 1979 prices)	2-4
Table 2.2-5	Share of the GRDP of the Department of Lima and Callao in the National Products, 1970-1990	2-5
Table 2.2-6	Annual Growth Rate of the GRDP by Economic Sector in the Department of Lima and Callao, 2001-2004.....	2-5
Table 2.2-7	Estimated GRDP by Economic Sector in the Department of Lima and Callao, 2001-2004 at 1994 constant prices).....	2-5
Table 2.2-8	National Poverty Statistics, 1997-2000	2-7
Table 2.4-1	Population Trends in the Metropolitan Area of Lima and Callao by Geographical Areas, 1972-2004	2-9
Table 2.4-2	Annual Population Growth Rate in the Metropolitan Area of Lima and Callao by Geographical Areas, 1972-2004.....	2-9
Table 2.4-3	Populations Trends by District in the Metropolitan Area of Lima and Callao, 1972-2004	2-13
Table 3.1-1	Outline of Transport Surveys	3-1
Table 3.1-2	Person Trip Survey Schedule	3-2
Table 3.1-3	Zoning.....	3-3
Table 3.1-4	Trip Purpose	3-4
Table 3.1-5	Representative Mode and Its Integration.....	3-4
Table 3.1-6	Zoning System.....	3-5
Table 3.2-1	Effective samples.....	3-10
Table 3.2-2	Calibration on Screen Line at Rimac River.....	3-11
Table 3.2-3	Distribution of Households by Estrato	3-13
Table 3.3-1	Population and Households	3-14
Table 3.3-2	Population by Sex.....	3-15
Table 3.3-3	Economic Activity by Sex.....	3-15
Table 3.3-4	Distribution of Population by District.....	3-17
Table 3.3-5	Housing Condition by Area.....	3-19
Table 3.3-6	Property of Electrical Appliances.....	3-19
Table 3.3-7	Overall Travel Demand	3-20
Table 3.3-8	Number of Trips by Trip Purpose	3-20
Table 3.3-9	Number of Trips by Trip Mode.....	3-21

Table 3.3-10	Peak Ratio.....	3-23
Table 3.3-11	Average Travel Time.....	3-24
Table 3.3-12	Average Travel Time.....	3-24
Table 3.3-13	Number of Trips Traveling between Areas.....	3-25
Table 3.3-14	Number of Trips Traveling by Motorized Mode between Areas.....	3-25
Table 3.3-15	Vehicle Ownership.....	3-33
Table 3.3-16	Number of Vehicles Owned.....	3-33
Table 3.3-17	Modal Share by Area and Purpose.....	3-37
Table 3.3-18	Reasons for Not-Using Public Transport.....	3-38
Table 3.3-19	Average Travel Time by Integrated Zone.....	3-42
Table 3.3-20	Combination of Mode.....	3-44
Table 3.3-21	Trip Pattern by Integrated Zone.....	3-45
Table 3.3-22	Traffic Volume Counted.....	3-46
Table 3.3-23	Numbers of Passenger Trips Counted.....	3-47
Table 3.4-1	Demographic Features of Poor Families.....	3-50
Table 3.4-2	Car Ownership of Poor Families.....	3-50
Table 3.4-3	Demographic Feature of Poor Families.....	3-50
Table 3.4-4	Trip Rate of Poor Families.....	3-50
Table 3.4-5	Trip Rate of Poor Family.....	3-51
Table 3.4-6	Non-motorized Trip Rate.....	3-52
Table 3.4-7	Travel Time and Travel Distance.....	3-54
Table 3.4-8	Access Time to Bus Stop.....	3-55
Table 3.4-9	No. of Trips by Paratransit.....	3-56
Table 3.4-10	Transport Cost in Households by Income Rank.....	3-61
Table 4.1-1	Road Facility Standards of the Municipality of Lima.....	4-4
Table 4.1-2	Road Facility Extension.....	4-4
Table 4.2-1	Outline of Traffic Survey.....	4-7
Table 4.2-2	Summary of Traffic at Screen Line Stations.....	4-11
Table 4.3-1	Number of Freight vehicle (J.C. Airport, Callao Port, Market and Oil refinery).....	4-26
Table 4.3-2	Freight Volume of Each Survey.....	4-32
Table 4.3-3	Transport Company Surveyed (5 companies).....	4-33
Table 5.2-1	Comparison of Bus Passengers and Bus Fleets in 2004.....	5-10
Table 5.2-2	Roads with Higher Camioneta Ratio.....	5-11
Table 5.2-3	Traffic Volumes on Major Roads by Type of Vehicle.....	5-12
Table 5.2-4	Roads with Higher Colectivo Ratio.....	5-12
Table 5.3-1	Number of Buses Registered in the GGTU (Callao) in 2004.....	5-36
Table 5.3-2	Bus Ages Registered in Callao (As of July 2003).....	5-37
Table 5.4-1	Rail Structure.....	5-50
Table 5.4-2	Route Outline.....	5-51
Table 5.4-3	Dimension of Wagons.....	5-52
Table 5.4-4	List of Yard Equipment.....	5-54

Table 5.5-1	Number of Taxies by Age in Lima in February 2004	5-57
Table 5.5-2	Number of Taxies in Callao	5-58
Table 5.5-3	Average Number of Employees, Drivers and Taxies from the Survey	5-59
Table 5.5-4	Characteristics of Taxi Operation.....	5-61
Table 5.5-5	Empty Taxi Ratio	5-61
Table 5.5-6	Average Daily Operation Distance.....	5-66
Table 5.5-7	Number of Colectivos Owned by Taxi Companies According to Age and Road.....	5-69
Table 5.5-8	Number of Authorized Taxies (Colectivos) by Vehicle Weight on the Via Expresa	5-69
Table 5.5-9	Number of Colectivos Operated on the Via Expresa Authorized /Unauthorized by the DMTU.....	5-69
Table 5.6-1	Summary of Existing Public Transport	5-86
Table 6.1-1	Locations of Bottlenecks at Signalized Intersections	6-7
Table 6.3-1	Annual Traffic Accidents in the Study Area	6-10
Table 6.3-2	Number of Traffic Accidents by Types of Vehicles.....	6-11
Table 6.3-3	Number of Traffic Accidents by Type of Accident.....	6-12
Table 6.3-4	Number of Traffic Accidents by Causes	6-13
Table 6.4-1	Characteristics of Off-Street Charged Parking Facilities	6-20
Table 6.4-2	Off-Street Parking Situation by Type of Purpose.....	6-21
Table 6.4-3	On-Street Parking Situation by Type of Purpose	6-23
Table 7.1-1	Transport Organizations in the Metropolitan Area of Lima and Callao	7-2
Table 8.1-1	Major Urban Development Plans and Relevant Studies in the Metropolitan Area of Lima and Callao	8-2
Table 8.1-2	Population Projection in the Metropolitan Development Plan for Lima-Callao 1990-2010.....	8-6
Table 8.1-3	Populations Trends by District in the Metropolitan Area of Lima and Callao, 1972-2004	8-9
Table 8.3-1	Bus Operation Characteristics of Nine (9) Roads	8-18
Table 8.4-1	Existing Railways Projects – List of the Last 30 years	8-23
Table 8.4-2	Summary of the Project Installations	8-33
Table 8.4-3	Bidding Process Schedule	8-35
Table 8.4-4	Scope of civil works	8-35
Table 8.4-5	East - West-East Line	8-36
Table 9.1-1	Socioeconomic and Trip Characteristic Indices	9-1
Table 9.1-2	Public Transport and Traffic Management Conditions	9-2

(VOLUME – II)

Table 10.1-1	Population Projection for the Metropolitan Area of Lima and Callao, 2004-2025	10-2
Table 10.2-1	Real GDP Growth Rate in Latin American Countries, 1992-2004 ..	10-4
Table 10.2-2	Projection of GDP Growth Rate, 2001-2020	10-5
Table 10.2-3	Projection of Macro Economic Indicators, 2004-2025	10-5

Table 10.2-4	Projection of the GRDP in the Departments of Lima and Callao, 2004-2025	10-6
Table 10.2-5	Projection of the GRDP by Economic Sector in the Departments of Lima and Callao, 2004-2025	10-6
Table 10.2 6	Projection of Working Population by Economic Sector in the Metropolitan Area of Lima and Callao, 2004-2025	10-7
Table 10.5-1	Distribution of the Future Population, 2004, 2010 and 2025	10-19
Table 10.5-2	Distribution of Future Population 2025 by District.....	10-20
Table 10.5-3	Distribution of the Future Working Population, 2004, 2010 and 2025	10-21
Table 10.5-4	Distribution of Future Population by Estrato	10-23
Table 11.1-1	Model Structure	11-2
Table 11.1-2	Trip Production Rate	11-3
Table 11.1-3	Parameter of Trip Generation and Attraction Model	11-4
Table 11.1-4	Parameters of Trip Distribution Model	11-6
Table 11.1-5	Parameters of Intrazonal Model	11-6
Table 11.1-6	Model Structure of Logit Model.....	11-8
Table 11.1-7	Coefficient of Utility Function	11-8
Table 11.1-8	Average Occupancy and PCU	11-9
Table 11.2-1	Number of Population (6 years or above) by Estrato in 2004 and 2025	11-11
Table 11.3-1	Summary of Socioeconomic Indices and Travel Demand	11-12
Table 11.3-2	Travel Demand by Estrato.....	11-12
Table 11.3-3	Trip Generation and Attraction by Integrated Zones in 2004 and 2025	11-13
Table 11.3-4	Modal Share of Person Trips (persons/day)	11-16
Table 11.3-5	Future Travel Demand in Peak Hour.....	11-20
Table 12.1-1	Summary of Socioeconomic and Travel Demand.....	12-2
Table 12.1-2	Number of Trip by Estrato	12-3
Table 12.1-3	Characteristics and Conditions of Extremely Poverty.....	12-16
Table 12.4-1	Number of Bus Passenger on each trunk road.....	12-29
Table 12.4-2	Comparison of Area Size by Population between 2004 and 2025 ...	12-32
Table 12.4-3	Major Concept and Solution Traffic Axis of Case	12-46
Table 12.4-4	Alternative for Basic Transport Network	12-47
Table 12.4-5	Relationship between Alternative Plan and Projects.....	12-47
Table 12.5-1	Project Cost and Length of Alternatives	12-54
Table 12.5-2	Cost and Benefit Analysis	12-58
Table 12.5-3	Evaluation Items by Alternative Scenarios	12-67
Table 12.5-4	Evaluation Matrix by Alternative Scenarios	12-67
Table 12.5-5	Evaluation of Transport Network Alternatives	12-78
Table 12.5-6	Population Covered by Railway Line.....	12-82
Table 13.2-1	Number of Lanes Required on Major Roads.....	13-9
Table 13.3-1	Scoring Points of Each Intersection	13-13
Table 13.4-1	List of Road Development Projects.....	13-17

Table 14.6-1	Hierarchy of Trunk Busway	14-9
Table 14.6-2	List of Trunk Busway Network Projects	14-10
Table 14.6-3	Guideline of Scheduled Passenger Line Capacity	14-14
Table 14.6-4	Service Frequency and Transport Capacity of Trunk Bus Line	14-15
Table 14.6-5	Passenger Demand in Each Project	14-15
Table 14.7-1	Before and After Busway Construction.....	14-17
Table 14.7-2	Before and After Busway Construction on Arterial Road.....	14-18
Table 14.8-1	Facilities in the busway terminals, stations and stops	14-44
Table 14.9-1	Unit cost of Major Working Items	14-50
Table 14.9-2	Construction Cost by Each Trunk Bus Project.....	14-51
Table 14.9-3	Construction Cost by Each Trunk Bus Project.....	14-52
Table 14.9-4	Construction Cost by Each Trunk Bus Project.....	14-53
Table 14.9-5	Construction Cost by Each Trunk Bus Project.....	14-54
Table 14.9-6	Construction Cost by Each Trunk Bus Project.....	14-55
Table 14.9-7	Construction Cost by Each Trunk Bus Project.....	14-56
Table 14.9-8	Project Cost By each Trunk Bus Project	14-57
Table 15.3-1	Factor of Seismic Zone.....	15-4
Table 15.5-1	Standard Conditions	15-7
Table 15.6-1	Subsidy System in Japan	15-13
Table 15.6-2	Subsidies in Foreign Countries.....	15-13
Table 15.7-1	Line Characteristic.....	15-14
Table 15.7-2	Stage Development Plan.....	15-16
Table 15.7-3	Passenger Demand on Line-1 Project.....	15-20
Table 15.7-4	Railway Transport Capacity based on Different Conditions.....	15-21
Table 15.7-5	Summary of Peak Hour Railway Operation Frequency	15-21
Table 15.7-6	Transport Capacity	15-23
Table 15.7-7	Preliminary Operation Planning (LRS).....	15-23
Table 15.8-1	Project Digest (Line 1: Stage 2)	15-25
Table 15.8-2	Project Digest (Line 1: Stage 3)	15-26
Table 15.8-3	Project Digest (Line 2)	15-28
Table 15.8-4	Project Digest (Line 3: Stage 1)	15-30
Table 15.8-5	Project Digest (Line 3: Stage 2)	15-31
Table 15.8-6	Project Digest (Line 4: Stage 1)	15-33
Table 15.8-7	Unit Cost of Each Working Item.....	15-35
Table 15.8-8	Project Cost of Each Railway Project.....	15-36
Table 16.2-1	Proposed Measures for the Short-Term Plan.....	16-2
Table 16.2-2	Measures of TDM Schemes	16-11
Table 16.2-3	Proposed Inspection Items.....	16-19
Table 16.2-4	Sample of Format Sheet for Technical Inspection Items	16-19
Table 16.3-1	Proposed Measures for the Middle and Long-Term Plan.....	16-20
Table 16.4-1	Project Cost for Traffic Management Sector.....	16-26
Table 17.1-1	Monthly Average of Daily Highest Temperature.....	17-1

Table 17.1-2	Monthly Average of Daily Lowest Temperature	17-1
Table 17.1-3	Monthly Precipitation	17-2
Table 17.1-4	Relative Humidity	17-2
Table 17.3-1	Chronology and Archaeological Sites in the Lima Area.....	17-16
Table 17.3-2	Principal Regulations on Cultural Assets Managements.....	17-25
Table 17.4-1	National Environmental Quality Standard of the Atmosphere.....	17-28
Table 17.4-2	Values of Transition	17-28
Table 17.4-3	Referential Values	17-28
Table 17.4-4	Limit for Vehicles with Motors of Gasoline, Liquefied Petroleum Gas and Natural Gas (light, medium, heavy vehicles) (Year of fabrication: 2003 and after).....	17-29
Table 17.4-5	Limit for Vehicles with Motor of Diesel (light, medium, heavy vehicles)	17-29
Table 17.4-6	National Environmental Quality Standard of Noise.....	17-29
Table 17.4-7	National Environmental Regulations	17-31
Table 17.4-8	Environmental Regulations of Lima	17-31
Table 17.4-9	Environmental Regulations of Callao	17-32
Table 17.6-1	Districts Offices of Neighbors' Participation in Lima.....	17-37
Table 17.6-2	Districts Offices of Neighbors' Participation in Callao.....	17-39
Table 17.6-3	Habitat nuclei and inhabitants in Ventanilla	17-40
Table 17.7-1	Noise Measurement	17-43
Table 17.7-2	Field Survey Schedule (Noise).....	17-43
Table 17.8-1	Air Quality Measurement	17-45
Table 17.8-2	Field Survey Schedule (Air Quality).....	17-46
Table 17.9-1	Expressway, Trunk Busway and Railroad Project	17-48
Table 17.9-2	Environmental Scope (Section of the Peripheral Road of Lima)	17-54
Table 17.9-3	Environmental Scope (Extension of Autopista Ramiro Priale).....	17-54
Table 17.9-4	Environmental Scope (Urban Peripheral Road)	17-55
Table 17.9-5	Environmental Scope (La Costa Verde Expressway of Lima).....	17-55
Table 17.9-6	Environmental Scope (La Costa Verde Expressway of Callao).....	17-56
Table 17.9-7	Environmental Scope (Extension of Paseo de la República to the South)	17-56
Table 17.9-8	Environmental Scope (Construction of New Bridges over the Rímac River).....	17-57
Table 17.9-9	Environmental Scope (Road Tunnel Construction)	17-57
Table 17.9-10	Environmental Scope (Av. Universitaria Norte: Railway & Trunk Busway).....	17-58
Table 17.9-11	Environmental Scope (Av. Tomas Valle: Railway & Trunk Busway).....	17-58
Table 17.9-12	Environmental Scope (Av. Venezuela: Trunk Busway)	17-59
Table 17.9-13	Environmental Scope (Av. Brazil: Trunk Busway)	17-59
Table 17.9-14	Environmental Scope (Av. Angamos: Trunk Busway).....	17-60
Table 17.9-15	Environmental Scope (Av. Grau: Trunk Busway)	17-60
Table 17.9-16	Environmental Scope (Carretera Central and Av. N. Ayllón: Trunk Busway).....	17-61

Table 17.9-17	Environmental Scope (Av. La Molina: Trunk Busway)	17-61
Table 17.9-18	Environmental Scope (Peripheral Road of Callao: Expressway and Trunk Busway)	17-62
Table 17.9-19	Environmental Scope (Carretera Panamericana Norte: Expressway, Trunk Busway and Railway)	17-62
Table 17.9-20	Environmental Scope (Av. Canta Callao: Expressway and Trunk Busway).....	17-63
Table 17.9-21	Environmental Scope (Av. Huaylas, Paseo de la República, Av. 9 de Diciembre, Av. Alfonso Ugarte, Av. Caquetá and Av. Tupac Amaru: Expressway and Trunk Busway).....	17-63
Table 17.9-22	Environmental Scope (Av. Nestor Gambetta: Expressway and Trunk Busway)	17-64
Table 17.9-23	Environmental Scope (Av. Elmer Faucet: Expressway and Trunk Busway).....	17-64
Table 17.9-24	Environmental Scope (Av. Javier Prado, Sanchez Carrion and La Marina : Expressway, Trunk Busway and Railway).....	17-65
Table 17.9-25	Environmental Scope (Av. Universitaria : Expressway, Trunk Busway and Railway).....	17-65
Table 17.9-26	Environmental Scope (Próceres de la Independencia : Expressway, Trunk Busway and Railway).....	17-66
Table 17.10-1	Major Environmental Tasks to be required for the full-scale EIA Study	17-76
Table 17.10-2	Description of Current Environment Conditions	17-77
Table 17.10-3	Field Environmental Survey (Bio-Physical)	17-78
Table 17.10-4	Field Environmental Survey (Socio-Cultural).....	17-79
Table 17.10-5	Impact Assessment Study.....	17-80
Table 17.11-1	Registered Number of Vehicles and Estimated Number of Workers.....	17-82
Table 17.11-2	Organizations of Public Transport.....	17-82
Table 17.11-3	Governmental Offices Concerned	17-83
Table 17.11-4	Characteristics of Socio-Economic Strata D and E.....	17-84
Table 17.11-5	Percentage of Estrato E Population	17-84
Table 17.11-6	Districts with more than 50% of Estrato E Population.....	17-85
Table 17.11-7	Characteristics of Poverty and Extreme Poverty Households.....	17-86
Table 17.11-8	Distribution of Residence by Zones	17-88
Table 17.11-9	Districts of Drivers Residence and Stratum D and E Population	17-88
Table 17.11-10	Distribution of Age.....	17-88
Table 17.11-11	Educational Background of Drivers and Collectors	17-89
Table 17.11-12	Results of Projectional Tests	17-90
Table 17.11-13	Results of Psychometric Tests.....	17-90
Table 17.11-14	Result of Age - Mental Intelligence Quotient Test (Kent IQ Test)..	17-90
Table 17.11-15	Age and Educational Background of Drivers and Collectors.....	17-92
Table 17.11-16	Result of Inquiry about Perspective for Transport Labor.....	17-93
Table 17.11-17	Hypothetical Analysis of Operators on Motivations	17-93
Table 17.11-18	Universities and Higher Education Institutes	17-94
Table 17.11-19	Number of Participants in the First Seminar (Jan.30, 2004)	17-96

Table 17.11-20	Number of Participants in the Second Seminar (Aug.11, 2004)	17-96
Table 17.11-21	Number of Participants in the Third Seminar (February 18th, 2005).....	17-97
Table 17.11-22	Number of Participants in the Fourth Seminar	17-98
Table 17.11-23	Number of Participants in Specialist Stakeholder Meeting (Nov.23, 2004)	17-101
Table 17.11-24	Numbers of Participants in the Second Stakeholder Meeting (January 12th, 2005).....	17-102
Table 17.11-25	Number of Participants in the Third Stakeholder Meeting (January 18th, 2005).....	17-103
Table 17.11-26	Numbers of Participants in the Fourth Stakeholder Meeting (January 24th, 2005).....	17-104
Table 18.1-1	List of Projects for National and Regional Expressway Plan.....	18-1
Table 18.1-2	Project List for Metropolitan Expressway Plan.....	18-2
Table 18.1-3	Project List for Arterial and Collector Roads Development Plan	18-2
Table 18.1-4	Project List for Railway Development Sector Plan.....	18-3
Table 18.1-5	Project List for Trunk Bus Sector Plan.....	18-4
Table 18.1-6	List of Projects for Traffic Management Plan.....	18-4
Table 20.1-1	Vehicle Operating Cost	20-3
Table 20.1-2	Travel Time Cost.....	20-3
Table 20.1-3	Benefit-Cost Analysis of the Master Plan as a Whole	20-6
Table 20.1-4	Benefit-Cost Analysis without TTC savings.....	20-7
Table 20.1-5	Summary of Sample Sensitivity Cost-Benefit Analysis.....	20-7
Table 20.1-6	Comparative Economic Analysis by Stage	20-7
Table 20.2-1	Gasoline and Tax.....	20-12
Table 20.4-1	Average Travel Speed by Mode	20-17
Table 20.5-1	Social Impacts on Master Plan	20-24
Table 20.5-2	Approximately Number of Bus Fleet and Average Age of Bus.....	20-25

(VOLUME – III)

Table 21.2-1	Hourly Number of Public Transport Passengers By Mode.....	21-5
Table 21.2-2	Total Travel Time and Average Travel Time in the Peak Hour.....	21-10
Table 21.2-3	Total Number of Operated Fleets and Coaches in the Peak Hour....	21-14
Table 21.2-4	Total Fare Proceeds in the Peak Hour	21-15
Table 21.2-5	Number of Service Frequencies and Passengers by Line in the Peak Hour in 2025.....	21-16
Table 21.2-6	Average Travel Speed and Volume-Capacity on Roads	21-18
Table 21.3-1	Hourly Public Transport Passengers and Ratio by Mode against Fare Rate.....	21-25
Table 21.4-1	Walking Time and Travel Time of Bus Transport	21-33
Table 21.4-2	User Opinions Regarding Request of Lower Fare Rates.....	21-37
Table 21.4-3	User Opinion Regarding Request of Preparation of Bus Route	21-38
Table 21.5-1	Comparison of Travel Demand by Scenario	21-42
Table 22.2-1	Number of Population (6 years or above) by Stratum.....	22-4

Table 22.2-2	Summary of Socioeconomic Indices and Travel Demand (6 years or more)	22-5
Table 22.2-3	Travel Demand by Estrato	22-5
Table 22.2-4	Trip Generation and Attraction by Integrated Zones in 2004 and 2010 (Exclusive of “to home” purpose)	22-6
Table 22.2-5	Modal Share of Person Trips (persons/day) in 2010	22-7
Table 22.3-1	Hourly Number of Public Transport Passengers By Mode	22-11
Table 22.3-2	Total Travel Time and Average Travel Time in the Peak Hour	22-15
Table 22.3-3	Average Travel Distance by Years	22-15
Table 22.3-4	Total Numbers of Operated Fleets and Coaches in the Peak Hour ..	22-15
Table 22.3-5	Number of Service Frequencies and Passengers by Line in the Peak Hour	22-16
Table 22.3-6	Total Fare Proceeds in the Peak Hour	22-19
Table 22.3-7	Average Travel Speed and Volume-Capacity on Roads in 2010	22-20
Table 22.3-8	Cost- Benefit Analysis of Short-Term Projects in 2010	22-23
Table 22.4-1	Passenger Volumes and B/C Ratio by Projects	22-24
Table 22.4-2	Project Outline for Investment Cost and Passengers	22-26
Table 22.5-1	Project Cost of Short Term in 2010	22-26
Table 22.5-2	Passenger Demand on Line 1 Project	22-28
Table 22.5-3	Railway Transport Capacity based on Different Conditions	22-30
Table 22.5-4	Peak Hour Operation Frequency in 2010 at Railway Line-1	22-30
Table 22.5-5	Type of Structure by Section	22-31
Table 22.5-6	Project Cost of Line-1(Section 2 and 3)	22-32
Table 22.5-7	Service Frequency and Transport Capacity of the Trunk Bus System	22-35
Table 22.5-8	Number of Service Frequencies and Passengers by Line in the Peak Hour	22-36
Table 22.5-9	Project Cost of Short Term in 2010	22-37
Table 22.6-1	Summary of the Short-Term and High Priority Project Costs	22-38
Table 23.1-1	Identified Signalized Intersections	23-4
Table 23.1-2	Number of Detectors by Functions	23-11
Table 23.1-3	Project Cost for Traffic Signal Control Improvement Plan Including Improvement of Intersection and Traffic Safety Facilities	23-16
Table 23.1-4	Average Travel Speed on Major Roads during Peak Periods	23-17
Table 23.1-5	Identified Signalized Intersections	23-18
Table 23.1-6	Project Cost Estimates	23-18
Table 23.2-1	A Sample Text for Level 1 and Level 3	23-23
Table 23.2-2	A Sample Text for Level 2	23-24
Table 23.2-3	Programs for Traffic Safety Education	23-26
Table 23.2-4	Project Cost for Traffic Safety Education Programs	23-28
Table 23.3-1	Coded Items by Category	23-31
Table 23.3-2	Presumed Countermeasures by Type of Accident	23-34
Table 23.3-3	Main Factor for Evaluation Between Before-And-After Studies	23-36
Table 23.3-4	Project Cost for Traffic Accident Monitoring System	

	(Traffic Safety Audit System).....	23-36
Table 23.4-1	Trip Decrease by Staggered Office and School Control	23-39
Table 23.4-2	Alternative for Restriction of Vehicles with Plates in Final Number	23-40
Table 23.4-3	Alternative for Restriction of Vehicles with Plates in Final Number in Bogotá.....	23-41
Table 23.4-4	Effects of “Peak and Plate” Control in Bogotá.....	23-41
Table 23.4-5	Total Number of Trips by Alternatives in the Peak Hour	23-42
Table 23.4-6	Average Travel Speed and Volume-Capacity Ratio on Road	23-42
Table 23.4-7	Restriction of Vehicles with Plates in Final Number	23-44
Table 23.4-8	Project Cost for Transportation Demand Management Plan (TDM) by Introducing License-Plate Numbering Control	23-44
Table 23.5-1	Project Cost for Improvement Plan of Parking Control System	23-49
Table 23.6-1	Proposed Inspection Items.....	23-51
Table 23.6-2	A Sample Format Sheet for Technical Inspection Items.....	23-51
Table 23.6-3	Equipment by Block No.	23-53
Table 23.6-4	Project Costs for the Improvement Plan of the Motor Vehicle Inspection System.....	23-54
Table 24.1-1	Relationship between the Traffic Congestion Axis and Solution Projects.....	24-2
Table 24.2-1	Traffic Congestion in Urbanized Areas.....	24-4
Table 24.2-2	Outline of Av. 28 de Julio Improvement Project	24-7
Table 24.2-3	Outline of Av. N Ayllón Improvement Project.....	24-7
Table 24.2-4	Outline of Intersection between Av. N. Ayllón and Av. 28 de Julio Improvement Project.....	24-8
Table 24.2-5	Outline of Intersection between Av. Ancash and Av. Riva Agüero Improvement Project.....	24-8
Table 24.2-6	Outline of Synchronized Signal System on Av. Arequipa Project...24-9	
Table 24.2-7	Outline of License - Plate Numbering Control Project	24-9
Table 24.2-8	Project Cost	24-10
Table 24.2-9	Intangible Benefit and Social Impacts of Each Project	24-11
Table 25.1-1	Characteristics of the Existing Bus Operation.....	25-1
Table 25.1-2	Summary of the Operation of Selected Bus Companies	25-3
Table 25.1-3	Basic Busway Data in Latin America	25-7
Table 25.1-4	Public Transport Clusters in Lima and Callao	25-10
Table 25.1-5	Summary of Metro Projects under the PPP Scheme	25-15
Table 25.1-6	Summary of Case	25-19
Table 25.1-7	Comparison of Public Contract and Concession Contract	25-23
Table 25.1-8	Examples of Subsidies in the Recent PPP Railway Projects.....	25-25
Table 25.1-9	Profits and Losses of Japanese Metro Railway Companies	25-27
Table 25.2-1	The List of Major Organizations and Authorities for Transport and Traffic Fields.	25-29
Table 25.2-2	Responsible Existing Organization and Activities (1)	25-30
Table 25.2-3	Responsible Existing Organization and Activities (2)	25-30
Table 26.1-1	Summary of Proposed Project Costs	26-1

Table 26.3-1	Taxes Related to Automobiles in Japan (2001).....	26-5
Table 26.3-2	Taxes related to Automobiles.....	26-6
Table 26.3-3	Historical Trend of Vehicle Related Taxes in Japan.....	26-7
Table 26.3-4	Composition of Budgets for Roads, 2003.....	26-7
Table 26.3-5	Historical Trends of Budgets for Roads.....	26-8
Table 26.3-6	Road Investment and National Economy.....	26-8
Table 26.4-1	Estimated Traffic Volumes on Major Expressways.....	26-12
Table 26.4-2	Estimated Total of Public Passengers.....	26-12
Table 26.4-3	Basic Condition of JBIC Loan.....	26-14
Table 26.4-4	Available Funds in Basic Years.....	26-15
Table 26.4-5	Summary of Costs for Short-term plan (excludes on-going).....	26-17
Table 26.4-6	Summary of Available Funds, 2005-2010.....	26-18
Table 26.5-1	Number of PPI in the 1990s.....	26-19
Table 26.5-2	Types of PPI by Region.....	26-19
Table 26.5-3	Types of PPI by Sector.....	26-20

LIST OF FIGURES

(VOLUME – I)

Figure 1.3-1	the Study Area	1-2
Figure 1.4-1	Flow Chart	1-4
Figure 1.6-1	Organization Chart for the Study	1-6
Figure 2.4-1	Map of the Metropolitan Area of Lima-Callao	2-12
Figure 3.1-1	Manzanas Sampled for the Person Trip Survey	3-3
Figure 3.1-2	Location of Traffic Zone (1).....	3-7
Figure 3.1-3	Location of Traffic Zone (2).....	3-8
Figure 3.1-4	Location of Traffic Zone (3).....	3-9
Figure 3.2-1	Database Building	3-10
Figure 3.2-2	Calibration Points	3-12
Figure 3.2-3	Fitness.....	3-12
Figure 3.3-1	Population Structure	3-14
Figure 3.3-2	Changes from CENSUS in 1993	3-14
Figure 3.3-3	Population Distribution	3-16
Figure 3.3-4	Day/Night Population.....	3-18
Figure 3.3-5	Modal Share by Trip Purpose.....	3-21
Figure 3.3-6	Demand by Integrated Zone	3-22
Figure 3.3-7	Hourly Distribution	3-22
Figure 3.3-8	Hourly Distribution (excluding walk trips).....	3-23
Figure 3.3-9	Average Travel Time by Traffic Zone	3-24
Figure 3.3-10	Origin and Destination by Travel Mode.....	3-26
Figure 3.3-11	Trip Distribution by Integrated Zone	3-28
Figure 3.3-12	Vehicle Ownership by Household Income Level.....	3-34
Figure 3.3-13	Modal Share by Age Group.....	3-34
Figure 3.3-14	Modal Share by Household Income Level	3-35
Figure 3.3-15	Modal Share by Vehicle Ownership.....	3-36
Figure 3.3-16	Modal Share by Vehicle Availability	3-36
Figure 3.3-17	Walking Distance to the Nearest Bus Stop.....	3-39
Figure 3.3-18	Walking Distance to the Nearest Bus Stop.....	3-39
Figure 3.3-19	Travel Time Distribution.....	3-40
Figure 3.3-20	Travel Time Comparison.....	3-40
Figure 3.3-21	Modal Share by Travel Distance	3-41
Figure 3.3-22	Distribution of Trip Length	3-41
Figure 3.3-23	Comparison of Travel Time by Distance	3-42
Figure 3.3-24	Average Travel Time to the City Center	3-43
Figure 3.3-25	Mode Change in Public Transport.....	3-44
Figure 3.3-26	Cordon Line Survey Stations.....	3-46
Figure 3.3-27	Destination of Trips (Station CL-1, from North)	3-47
Figure 3.3-28	Origin of Trips (Station CL-1, from North)	3-48

Figure 3.3-29	Destination of Trips (Station CL-6, from South)	3-48
Figure 3.3-30	Origin of Trips (Station CL-6, from South)	3-49
Figure 3.4-1	Poor Family Ratio by Traffic Zone	3-50
Figure 3.4-2	Modal Share.....	3-51
Figure 3.4-3	Travel Distance.....	3-52
Figure 3.4-4	Travel Time Distribution.....	3-52
Figure 3.4-5	Bicycle Ownership	3-53
Figure 3.4-6	Bicycle and Vehicle Ownership	3-53
Figure 3.4-7	Age Group of Non-motorized Trip Makers.....	3-53
Figure 3.4-8	Household Income Level of Non-motorized Trip Makers	3-54
Figure 3.4-9	Trip Purpose Composition.....	3-54
Figure 3.4-10	Trip Purpose Composition.....	3-55
Figure 3.4-11	Poor Accessibility to Bus Stops	3-56
Figure 3.4-12	Paratransit Mode for Trip Purposes.....	3-57
Figure 3.4-13	Age Distribution of Paratransit User	3-57
Figure 3.4-14	Usage of Paratransit Mode by Household Income	3-58
Figure 3.4-15	Frequent Usage Area of Para transit Mode	3-59
Figure 3.4-16	Cost by Transport Mode.....	3-60
Figure 3.4-17	Cost by Trip Purpose	3-60
Figure 4.2-1	Traffic Survey Stations.....	4-7
Figure 4.2-2	Traffic Volume Crossing Screen Lines	4-8
Figure 4.2-3	Traffic Volume on Rimac River Screen Line (Vehicle/day).....	4-9
Figure 4.2-4	Traffic Volume on Rimac River Screen Line (Passenger/day).....	4-9
Figure 4.2-5	Traffic Volume on South Pan-American Screen Line (Vehicle/day).....	4-10
Figure 4.2-6	Traffic Volume on South Pan-American Screen Line (Passenger/day)	4-10
Figure 4.2-7	Hourly Traffic Volume on Rimac River Screen Line (Vehicle/day).....	4-12
Figure 4.2-8	Hourly Traffic Volume on Rimac River Screen Line (Passenger/day)	4-12
Figure 4.2-9	Hourly Traffic Volume on South Pan-American Screen Line (Vehicle/day).....	4-13
Figure 4.2-10	Hourly Traffic Volume on South Pan-American Screen Line (Passenger/day)	4-13
Figure 4.2-11	Modal Share on the Screen line.....	4-14
Figure 4.2-12	Traffic Volume Counted in Periods from 6:00 to 7:00	4-15
Figure 4.2-13	Traffic Volume Counted in Periods from 7:00 to 8:00	4-15
Figure 4.2-14	Traffic Volume Counted in Periods from 8:00 to 9:00	4-16
Figure 4.2-15	Traffic Volume Counted in Periods from 9:00 to 10:00	4-16
Figure 4.2-16	Main Road with Travel Speed Below 20km/h	4-19
Figure 4.2-17	Travel Speed in the Morning Peak Time.....	4-20
Figure 4.2-18	Travel Speed in Non Peak Time.....	4-21
Figure 4.2-19	Travel Speed in the Night Peak Time.....	4-22

Figure 4.2-20	Locations of Bottleneck at the Intersection	4-23
Figure 4.3-1	Freight Traffic Count Survey Result at the Cordon Point	4-25
Figure 4.3-2	Ratio of Freight Vehicle at Point of CL-1 to CT-2 (Inbound)	4-27
Figure 4.3-3	Ratio of Freight Vehicle at Point of CL-1 to CT-2 (Outbound).....	4-28
Figure 4.3-4	Ratio of Freight Volume of Survey Points (inbound)	4-30
Figure 4.3-5	Ratio of Freight Volume of Survey Points (outbound)	4-31
Figure 4.3-6	Transport Company Location to Be Surveyed	4-33
Figure 5.2-1	Numbers of Passengers by All Buses and Omnibus in 2004	5-3
Figure 5.2-2	Numbers of Passengers by Microbus and Camioneta in 2004	5-4
Figure 5.2-3	Major Bus Passenger Corridors in 2004.....	5-5
Figure 5.2-4	Boarding and Alighting Characteristics on Route No. EO-29	5-6
Figure 5.2-5	Boarding and Alighting Characteristics on Route No. IO-81	5-6
Figure 5.2-6	Numbers of Bus Volumes by Total Buses and Omnibus in 2004	5-8
Figure 5.2-7	Numbers of Bus Volumes by Microbus and Camioneta in 2004	5-9
Figure 5.2-8	Bus Fleet Composition Ratio in 2004	5-10
Figure 5.2-9	Relationship between Volume and Ratio of Camioneta.....	5-11
Figure 5.2-10	Relationship between Authorized and Unauthorized Taxi Volumes	5-12
Figure 5.2-11	Relationship between Colectivo Volume and Ratio of Colectivo....	5-13
Figure 5.3-1	Study Contents of Bus Transport Service	5-14
Figure 5.3-2	Conditions of Bus Routes by the DMTU in Lima (As of July 20, 2003)	5-16
Figure 5.3-3	Number of Bus Routes Inscribed in the DMTU.....	5-17
Figure 5.3-4	Road Segments with Heavy Bus Routes and Higher Service Frequencies	5-18
Figure 5.3-5	Number of Bus Routes that Pass through Av. Tupac Amaru.....	5-18
Figure 5.3-6	Distribution of Route Service Distance (km) authorized by the DMTU	5-19
Figure 5.3-7	Number of Bus Service Frequencies/hour authorized by the DMTU	5-20
Figure 5.3-8	Ratio of Bus Volume between Counted Volume and Authorized Frequency	5-20
Figure 5.3-9	Distribution of Travel Time from House to Destination by Passengers Interviewed in the whole Area.....	5-21
Figure 5.3-10	Distribution of Travel Time from House to Bus Stop.....	5-21
Figure 5.3-11	Composition Ratio of Travel Time greater than 60 Minutes	5-22
Figure 5.3-12	Desired and Actual Travel Times from House to Destination	5-22
Figure 5.3-13	Relationship between the Actual and Desired Travel Times	5-23
Figure 5.3-14	Bus Operation Speed in the Morning Peak in 2004	5-24
Figure 5.3-15	Dwelling Times according to Boarding and Alighting Passengers..	5-25
Figure 5.3-16	Boarding Time by Type of Bus	5-25
Figure 5.3-17	Alighting Time by Type of Bus.....	5-26
Figure 5.3-18	Waiting Time at Bus Stops.....	5-26
Figure 5.3-19	Number of Bus Transfers	5-27

Figure 5.3-20	Higher Ratio Areas of Transfer Times (1 Time or More).....	5-27
Figure 5.3-21	Present Busway Network in Lima.....	5-28
Figure 5.3-22	Typical Cross Section of the Busway on Paseo de la República	5-29
Figure 5.3-23	Busway on Paseo de la República.....	5-29
Figure 5.3-24	Bus Stop Facility on Av. Venezuela in Callao.....	5-30
Figure 5.3-25	Bus Deposit of Bus Company.....	5-30
Figure 5.3-26	Long Distance Bus Terminal of a Private Bus Company.....	5-31
Figure 5.3-27	Location of Inter-municipal Bus Terminals.....	5-32
Figure 5.3-28	Paid Transportation Fee.....	5-34
Figure 5.3-29	Ratio of Passengers Who Paid Transportation Fee (S/. 2.0 or more) to Total.....	5-34
Figure 5.3-30	Bus Passenger Opinions Regarding Bus Fare Rates.....	5-35
Figure 5.3-31	Comparison to Actual and Desired Fare Rates.....	5-35
Figure 5.3-32	Yearly Fluctuation of the Number of Bus Fleets Owned by Companies in Lima.....	5-36
Figure 5.3-33	Age Distribution of Existing Bus Fleet in Lima.....	5-37
Figure 5.3-34	Number of Registered Bus Companies Since 1993 to 2003.....	5-38
Figure 5.3-35	Distribution of the Number of Bus Fleets registered in Companies in Lima.....	5-39
Figure 5.3-36	Distribution of the Number of Bus Fleets Inscribed in Companies in Callao.....	5-39
Figure 5.3-37	Bus Company Organization.....	5-40
Figure 5.3-38	Organization of the DMTU of the Municipality of Lima.....	5-42
Figure 5.3-39	Organization of the GGTU of the Municipality of Callao.....	5-43
Figure 5.3-40	Composition Ratio of Trip Purposes.....	5-44
Figure 5.3-41	Composition Ratio of the Frequency of Public Transport Use.....	5-44
Figure 5.3-42	Composition Ratio of Types of Buses Used Most Frequently.....	5-45
Figure 5.3-43	Composition Ratio of Reasons of Public Transport Use.....	5-45
Figure 5.3-44	Composition Ratio of Other Public Transport Uses.....	5-46
Figure 5.3-45	Distribution of User's Opinion for Current Public Transport Problems.....	5-46
Figure 5.4-1	Central Line (East – West Line).....	5-47
Figure 5.4-2	Railway Network.....	5-49
Figure 5.4-3	Construction Clearance.....	5-51
Figure 5.4-4	Route Outline Map.....	5-52
Figure 5.4-5	Layout of the Wagon Yard.....	5-53
Figure 5.5-1	Study Contents of Taxi Services.....	5-56
Figure 5.5-2	Age Distribution of Taxies in Lima.....	5-57
Figure 5.5-3	Number of Taxies by Type of Fuel.....	5-59
Figure 5.5-4	Opinions regarding Administration.....	5-60
Figure 5.5-5	Composition ratio of Trip Purposes of Taxi Users.....	5-62
Figure 5.5-6	Distribution of Travel Time of Taxi Users.....	5-62
Figure 5.5-7	Distribution of the Taxi Fare Rate.....	5-63
Figure 5.5-8	Composition Ratio of Other Public Transport Uses.....	5-63

Figure 5.5-9	Composition Ratio of Reasons of Taxi Use	5-63
Figure 5.5-10	Distribution of User's Opinions regarding Taxi Problems.....	5-64
Figure 5.5-11	Composition Ratio of Type of Taxi Operated.....	5-64
Figure 5.5-12	Composition Ratio of the Working Pattern of Drivers.....	5-65
Figure 5.5-13	Composition Ratio of Type of Taxi Possession	5-65
Figure 5.5-14	Composition Ratio of Working Hour	5-66
Figure 5.5-15	Type-1 (Off-line bays) of Taxi Stations in Lima.....	5-67
Figure 5.5-16	Type-2 (On-line bays) of Taxi Stations in the Central Area of Lima.....	5-67
Figure 5.5-17	Location of Taxi Stations in Lima.....	5-67
Figure 5.5-18	Colectivo parked near Suburban Area.....	5-68
Figure 5.5-19	Colectivo Survey Routes	5-70
Figure 5.5-20	Composition ratio of Trip Purposes of Colectivo Users	5-71
Figure 5.5-21	Distribution of Travel Time of Colectivo Users.....	5-71
Figure 5.5-22	Distribution of Colectivo Fare Rate	5-72
Figure 5.5-23	Composition Ratio of Other Public Transport Uses.....	5-72
Figure 5.5-24	Composition Ratio of Reasons of Colectivo Use	5-73
Figure 5.5-25	Distribution of User's Opinion for Colectivo Problems.....	5-73
Figure 5.5-26	Composition Ratio of Type of Colectivo Operated.....	5-74
Figure 5.5-27	Composition Ratio of the Working Pattern of Drivers.....	5-74
Figure 5.5-28	Composition Ratio of Type of Colectivo Possession	5-75
Figure 5.5-29	Composition Ratio of Working Hour	5-75
Figure 5.5-30	Relationship between Route Distance and Number of Daily Trips..	5-76
Figure 5.5-31	A Typical Type of Moto-taxi	5-76
Figure 5.5-32	Moto-taxi Survey Locations	5-77
Figure 5.5-33	Composition ratio of Trip Purposes of Moto-taxi Users	5-78
Figure 5.5-34	Distribution of Travel Time of Moto-taxi Users	5-78
Figure 5.5-35	Distribution of the Moto-taxi Fare Rate	5-79
Figure 5.5-36	Composition Ratio of Other Public Transport Uses.....	5-79
Figure 5.5-37	Composition Ratio of Reasons of Moto-taxi Use.....	5-80
Figure 5.5-38	Distribution of User's Opinion for Moto-taxi Problems	5-80
Figure 5.5-39	Composition Ratio of the Working Pattern of Drivers.....	5-81
Figure 5.5-40	Composition Ratio of Type of Moto-taxi Possession.....	5-81
Figure 5.5-41	Composition Ratio of Working Hour	5-81
Figure 5.5-42	Average Number of Trips by Moto-taxi.....	5-82
Figure 5.6-1	Existing Public Transport Service in Low Income Residential Areas	5-83
Figure 5.6-2	Problems of Existing Public Transport.....	5-87
Figure 6.1-1	Location of Signalized Intersections in Study Area	6-1
Figure 6.1-2	Control Area in Callao Central Area	6-2
Figure 6.1-3	Remote Detector Microwave Sensor (RTMS) with Auto Video Camera.....	6-3
Figure 6.1-4	Control Area in the Lima Central Area	6-4

Figure 6.1-5	Traffic Control Center	6-5
Figure 6.1-6	Traffic Lights and Vehicle Sensor.....	6-5
Figure 6.1-7	Locations of Bottlenecks at Signalized Intersections.....	6-6
Figure 6.2-1	Truck Ban Regulation in Study Area	6-9
Figure 6.3-1	Annual Traffic Accidents in the Study Area.....	6-10
Figure 6.3-2	Number of Accidents and Fatalities per 1,000 Registered Vehicles.....	6-11
Figure 6.3-3	Number of Traffic Accidents by Types of Vehicles.....	6-12
Figure 6.3-4	Number of Traffic Accidents by Type of Accident.....	6-13
Figure 6.3-5	Number of Traffic Accidents by Cause.....	6-14
Figure 6.3-6	Locations of Black Spots in Study Area.....	6-15
Figure 6.3-7	Motor Vehicle Driving School at the Touring y Automóvil Club del Peru.....	6-18
Figure 6.4-1	Location of Parking Lots for Parking Facility Survey	6-19
Figure 6.4-2	Distribution of Cumulative Parking Duration	6-21
Figure 6.4-3	Typical Fluctuation of Hourly-Parked Vehicles.....	6-22
Figure 6.4-4	Distribution of Cumulative Parking Duration	6-23
Figure 6.4-5	Typical Fluctuation of Hourly-Parked Vehicles.....	6-23
Figure 7.1-1	Organization Chart of MTC	7-6
Figure 7.2-1	Organization Chart of the Metropolitan Municipality of Lima.....	7-9
Figure 7.2-2	DMTU' Organization Chart	7-11
Figure 7.2-3	Flowchart of the Metropolitan Planning Institute	7-11
Figure 7.3-1	Organization Chart of the MPC.....	7-15
Figure 7.4-1	Organization Chart of the CTLC	7-17
Figure 8.1-1	Concept of Decentralization of Urban Activities	8-7
Figure 8.1-2	Territorial Units of Metropolitan Planning (UTPM).....	8-8
Figure 8.2-1	Main Projects that have been Evaluated.....	8-11
Figure 8.3-1	Flowchart of Past Transport Studies.....	8-14
Figure 8.3-2	Bus Transport Network Proposed in the “Transport Plan” in 1989	8-15
Figure 8.3-3	Seven (7) Mass Transit Networks Proposed in PROTUM.....	8-15
Figure 8.3-4	Bus Feeder Networks Related to Seven Mass Transit Networks in PROTUM	8-16
Figure 8.3-5	Proposed Busway in PROTUM and COSAC-1	8-16
Figure 8.3-6	Nine (9) Study Roads Selected for the DMTU Project.....	8-18
Figure 8.3-7	Organization Chart of Protransporte.....	8-19
Figure 8.4-1	125 Km Plan	8-21
Figure 8.4-2	70 Km Plan	8-22
Figure 8.4-3	Railway Network Project (1998) Short Term Proposal.....	8-27
Figure 8.4-4	Railway Network Project (1998) Long Term Proposal.....	8-28
Figure 8.4-5	AATE Organization Chart.....	8-29
Figure 8.4-6	TRANSMET Organization Chart.....	8-30
Figure 8.4-7	Metropolitan Lima Integrated Transport Network System	8-31
Figure 8.4-8	Summary of the Extension Project Installations.....	8-34

Figure 8.4-9	Short-Term Project	8-37
Figure 8.4-10	North-South Line Extension Plan.....	8-38
Figure 8.4-11	AATE Long Term Plan	8-38

(VOLUME – II)

Figure 10.1-1	Population Projection of Lima and Callao Metropolitan Area.....	10-3
Figure 10.3-1	Mono-centric Ramified Development Pattern (Alternative – 1).....	10-8
Figure 10.3-2	Poly-centric Decentralized Development Pattern (Alternative – 2).....	10-8
Figure 10.3-3	Sustainable New Town Development Pattern (Alternative – 3).....	10-9
Figure 10.3-4	Schematic Concept of North-South Regional Development Corridor	10-10
Figure 10.3-5	Schematic Concept of Future Urban Structure in the Metropolitan Area of Lima and Callao	10-11
Figure 10.3-6	Urban Development Scenario for the Metropolitan Area of Lima and Callao.....	10-12
Figure 10.4-1	Existing Urban Centers and Future Decentralized Urban Sub-Centers	10-14
Figure 10.4-2	Land Use Plan in 2025	10-16
Figure 10.5-1	Population Projection of Lima and Callao Metropolitan Area.....	10-17
Figure 10.5-2	Population Density in 2004 by Traffic Zone.....	10-19
Figure 10.5-3	Population Density in 2025 by Traffic Zone.....	10-19
Figure 10.5-4	Increment of Working Population between 2004 and 2025 by Traffic Zone.....	10-22
Figure 10.5-5	Population Distribution of Estrato A and B in 2004 by Traffic Zone.....	10-24
Figure 10.5-6	Population Distribution of Estrato A and B in 2025 by Traffic Zone.....	10-24
Figure 10.5-7	Population Distribution of Estrato C in 2004 by Traffic Zone.....	10-24
Figure 10.5-8	Population Distribution of Estrato C in 2025 by Traffic Zone.....	10-24
Figure 10.5-9	Population Distribution of Estrato D in 2004 by Traffic Zone	10-25
Figure 10.5-10	Population Distribution of Estrato D in 2025 by Traffic Zone	10-25
Figure 10.5-11	Population Distribution of Estrato E in 2004 by Traffic Zone.....	10-25
Figure 10.5-12	Population Distribution of Estrato E in 2025 by Traffic Zone.....	10-25
Figure 11.1-1	Flowchart of Forecasting Model	11-2
Figure 11.1-2	Classification of Modal Split.....	11-7
Figure 11.2-1	Composition of Population by Estrato	11-11
Figure 11.3-1	Trip Generation and Attraction in 2025 (All Purposes exclusive of To home).....	11-13
Figure 11.3-2	Trip Generation and Attraction (exclusive of To home) in 2004 and 2025	11-14
Figure 11.3-3	Trip Desire Line by All Purposes in 2004 and 2025	11-15
Figure 11.3-4	Daily Trip Desire Line by Public Modes in 2004 and 2025.....	11-17
Figure 11.3-5	Daily Trip Desire Line by Private (Car and Taxi) Modes in 2004 and 2025	11-17
Figure 11.3-6	Traffic Demand on Present Road and Transport Networks in 2004.....	11-18

Figure 11.3-7	Traffic Demand on Present Road and Transport Networks in 2025 (Without Case)	11-19
Figure 11.3-8	Peak Hour Trip Generation and Attraction by Public Mode in 2004 and 2025	11-22
Figure 11.3-9	Peak Hour Trip Generation and Attraction by Private Mode in 2004 and 2025	11-23
Figure 11.3-10	Peak Hour Trip Desire Lines by Public Modes in 2004.....	11-24
Figure 11.3-11	Peak Hour Trip Desire Lines by Private Modes in 2004.....	11-25
Figure 11.3-12	Peak Hour Trip Desire Lines by Public Modes in 2025.....	11-26
Figure 11.3-13	Peak Hour Trip Desire Lines by Private Modes in 2025.....	11-27
Figure 12.1-1	Hourly Trip Generation by Purpose in 2004 from Person Trip Survey	12-3
Figure 12.1-2	Modal Split by Estrato for “To work” in 2025	12-4
Figure 12.1-3	Modal Split by Trip Purpose (Business and Private) in 2025	12-4
Figure 12.1-4	Modal Split by Estrato in 2004 and 2025	12-4
Figure 12.1-5	Generation of Estrato E and Its Composition Ratio	12-5
Figure 12.1-6	Attraction of Estrato E and Its Composition Ratio.....	12-5
Figure 12.1-7	Trip Generation and Attraction in Estrato A, B, C and D by Trip Purpose (exclusive of To home) in 2004 and 2025.....	12-6
Figure 12.1-8	Trip Generation and Attraction in Estrato E (exclusive of To home) in 2004 and 2025	12-7
Figure 12.1-9	Trip Desire Line in Estrato A, B, C, D by All Purposes in 2004 and 2025	12-8
Figure 12.1-10	Trip Desire Line in Estrato E by All Purposes in 2004 and 2025	12-9
Figure 12.1-11	Trip Desire Line in Estrato A, B, C and D by “to work/to school” in 2004 and 2025	12-10
Figure 12.1-12	Trip Desire Line in Estrato E by “to work/to school” in 2004 and 2025	12-10
Figure 12.1-13	Urban Transport Policies, Strategies, and Targets	12-14
Figure 12.1-14	Basic Transport Network in the Study Area.....	12-15
Figure 12.2-1	Transport Axis to be Reinforced	12-17
Figure 12.2-2	Conceptual Plan for Cargo Diversion Routes	12-18
Figure 12.3-1	Problems for Bus Routes	12-19
Figure 12.3-2	Problems for Bus Companies	12-20
Figure 12.3-3	Problems for Small Buses	12-21
Figure 12.3-4	Future Planning Strategy	12-26
Figure 12.4-1	Desired line for all purpose in 2025	12-28
Figure 12.4-2	Desired line for public transport in 2025.....	12-28
Figure 12.4-3	Location of Heavy Person Trip Roads	12-29
Figure 12.4-4	Location of Heavy Bus Route and Frequency.....	12-31
Figure 12.4-5	Road Facilities and Institutional Facilities Location Map.....	12-33
Figure 12.4-6	Scenario for Transport Mode Selected	12-35
Figure 12.4-7	Railway Development Priority Scenario Case F-1.....	12-36
Figure 12.4-8	Railway Development Priority Scenario Case F-2.....	12-37
Figure 12.4-9	Railway Development Priority Scenario Case F-3.....	12-38

Figure 12.4-10	Basic Railway Network on Case-F-1	12-39
Figure 12.4-11	Basic Railway Network on Case F-2.....	12-40
Figure 12.4-12	Basic Railway Network on Case F-3.....	12-40
Figure 12.4-13	Trunk Bus Development Priority Scenario Case B-1.....	12-41
Figure 12.4-14	Trunk Bus Development Priority Scenario Case B-2.....	12-42
Figure 12.4-15	Trunk Bus Development Priority Scenario Case B-3.....	12-43
Figure 12.4-16	Basic Trunk Bus Network on Case B-1	12-44
Figure 12.4-17	Basic Trunk Bus Network on Case B-2	12-44
Figure 12.4-18	Basic Trunk Bus Network on Case B-3	12-45
Figure 12.4-19	Basic Transport Network on Alternatives (1)	12-50
Figure 12.4-20	Basic Transport Network on Alternatives (2)	12-51
Figure 12.4-21	Basic Transport Network on Alternatives (3)	12-52
Figure 12.4-22	Basic Transport Network on Alternatives (4)	12-53
Figure 12.5-1	Evaluation Process of Master Plan Alternatives	12-55
Figure 12.5-2	Population Ratio Covered by Alternatives	12-56
Figure 12.5-3	Covered Population per Alternative Network Length.....	12-56
Figure 12.5-4	Relationship between B/C and NPV	12-58
Figure 12.5-5	Relationship between Investment Cost and Vehicle Speed	12-59
Figure 12.5-6	Relationship between Cost/km and NPV/km	12-59
Figure 12.5-7	Relationship between Investment Cost and Volume-Capacity Ratio.....	12-60
Figure 12.5-8	Daily Number of Dispatched Buses and Railway Coaches.....	12-60
Figure 12.5-9	CO2 Vehicular Emission Loading.....	12-62
Figure 12.5-10	Environmental Benefit (Reduction of CO2 Vehicular Emission Loading).....	12-62
Figure 12.5-11	CO2 Vehicular Emission Loading by Vehicle Type.....	12-63
Figure 12.5-12	Daily Passenger Volumes in Alternative-A	12-69
Figure 12.5-13	Daily Passenger Volume in Alternative-B	12-69
Figure 12.5-14	Daily Passenger Volumes in Alternative-C.....	12-69
Figure 12.5-15	Daily Passenger Volumes in Alternative-D	12-69
Figure 12.5-16	Daily Passenger Volume in Alternative-E	12-70
Figure 12.5-17	Daily Passenger Volume in Alternative-F.....	12-70
Figure 12.5-18	Daily Passenger Volume in Alternative-G	12-70
Figure 12.5-19	Daily Passenger Volume in Alternative-H	12-70
Figure 12.5-20	Daily Passengers Volume in Alternative-I.....	12-71
Figure 12.5-21	Daily PCU Volumes on Road in Alternative-I.....	12-71
Figure 12.5-22	Daily Passenger Volumes in Alternative-J.....	12-71
Figure 12.5-23	Daily PCU Volumes on Road in Alternative-J.....	12-71
Figure 12.5-24	Daily Passenger Volumes in Alternative-K	12-72
Figure 12.5-25	Daily Passenger Volumes in Alternative-L.....	12-72
Figure 12.5-26	Daily Passenger Volumes in Alternative-M.....	12-72
Figure 12.5-27	Daily PCU Volumes on Road in Alternative-M.....	12-72
Figure 12.5-28	Daily Passenger Volumes in Alternative-N	12-73

Figure 12.5-29	Daily PCU Volumes in Alternative-N.....	12-73
Figure 12.5-30	Daily Passenger Volumes in Alternative-O	12-73
Figure 12.5-31	Formulation of Population in Grid	12-75
Figure 12.5-32	Future Population in Grid.....	12-76
Figure 12.5-33	Formulation of OD Matrix in Grid.....	12-77
Figure 12.5-34	Master Plan Alternative Alt – M	12-79
Figure 12.5-35	Master Plan Alternative Alt – N.....	12-80
Figure 12.5-36	Master Plan Alternative Alt – O.....	12-81
Figure 12.5-37	Stations on Line N° 1	12-83
Figure 12.5-38	Stations on Line N° 2.....	12-84
Figure 12.5-39	Stations on Line N° 3	12-85
Figure 12.5-40	Stations on Line N° 4.....	12-86
Figure 12.5-41	Stations on Line N° 5.....	12-87
Figure 13.1-1	Existing Road Network by Number of Lanes	13-2
Figure 13.1-2	Conceptual Existing Road Network	13-4
Figure 13.2-1	Future Road Network in 2025	13-7
Figure 13.2-2	Traffic Volume on the Future Road Network (2025).....	13-8
Figure 13.3-1	Locations of the Intersection to be Improved on Arterial Roads	13-11
Figure 13.4-1	Location of Road Construction and Improvement Plans	13-18
Figure 13.4-2	Location of Intersection Improvement Plans	13-18
Figure 13.4-3	Location of Road Widening Plans.....	13-19
Figure 13.4-4	Location of Construction Roads in New Housing Area.....	13-19
Figure 14.1-1	Outline of Trunk Bus System.....	14-2
Figure 14.3-1	Feasibility and Warrants of Busway.....	14-4
Figure 14.6-1	Trunk Busway Network in the Master Plan	14-11
Figure 14.6-2	Typical Cross Section Location of Trunk Busway.....	14-12
Figure 14.6-3	Typical Cross Section Location of Exclusive Trunk Bus Lane	14-12
Figure 14.6-4	Typical Cross Section Location of Trunk Bus Priority Lane	14-13
Figure 14.7-1	Proposed Trunk Busway Network.....	14-16
Figure 14.7-2	Typical Cross Section of Trunk Busway on Expressway	14-17
Figure 14.7-3	Typical Cross Section of Trunk Busway on Arterial road	14-18
Figure 14.7-4	Typical Cross Section of Trunk Busway on Arterial road (Av. Universitaria)	14-18
Figure 14.7-5	Trunk Busway Av. Nestor Gambetta	14-19
Figure 14.7-6	Trunk Busway Av. Panamericana Norte	14-20
Figure 14.7-7	Trunk Busway Av. Universitaria Norte.....	14-21
Figure 14.7-8	Trunk Busway Av. Canta Callao.....	14-22
Figure 14.7-9	Trunk Busway Av. Universitaria.....	14-23
Figure 14.7-10	Trunk Busway Av. Tomas Valle.....	14-24
Figure 14.7-11	Trunk Busway Av. Elmer Faucett.....	14-25
Figure 14.7-12	Trunk Busway Paseo de la República	14-26
Figure 14.7-13	Trunk Busway Próceres de la Independencia.....	14-27

Figure 14.7-14	Trunk Busway Av. Venezuela.....	14-28
Figure 14.7-15	Trunk Busway Av. Brasil.....	14-29
Figure 14.7-16	Trunk Busway Av. Javier Prado.....	14-30
Figure 14.7-17	Trunk Busway Av. Angamos.....	14-31
Figure 14.7-18	Trunk Busway Av. Grau.....	14-32
Figure 14.7-19	Trunk Busway Carretera Central.....	14-33
Figure 14.7-20	Trunk Busway Av. La Molina.....	14-34
Figure 14.7-21	Trunk Busway Av. Panamericana Sur.....	14-35
Figure 14.8-1	Types of Terminals, Stations and Busway Stops.....	14-37
Figure 14.8-2	Location of Terminals and Stations.....	14-38
Figure 14.8-3	Design Concept for Busway Facility.....	14-39
Figure 14.8-4	Conceptual Location of North Comprehensive Bus Terminal.....	14-41
Figure 14.8-5	Conceptual Location of East Comprehensive Bus Terminal.....	14-42
Figure 14.8-6	Conceptual Location of South Comprehensive Bus Terminal.....	14-42
Figure 14.8-7	Busway Stop of Road Center Type.....	14-45
Figure 14.8-8	Conceptual Location of At Grade Busway Station in a Site on the Road.....	14-46
Figure 14.8-9	Conceptual Plan of At Grade Busway Station in a Site on the Road.....	14-47
Figure 14.8-10	Conceptual Plan of Busway Stop.....	14-48
Figure 15.2-1	Urban Transport System in Latin America.....	15-1
Figure 15.2-2	Comparison of Population in Urban Area and Railway Length.....	15-2
Figure 15.6-1	Conceptual Plan for the Connection of Railway Station and Bus Stop.....	15-10
Figure 15.6-2	Option of Feeder Service.....	15-11
Figure 15.6-3	Unit of Discharge of Carbon Dioxide.....	15-12
Figure 15.7-1	Urban Railway Lines.....	15-15
Figure 15.7-2	Railway Development Network until 2025.....	15-17
Figure 15.7-3	Existing Traffic System.....	15-18
Figure 15.7-4	Relationship between Railway System and Bus System.....	15-19
Figure 15.7-5	Relationship between Railway and Feeder Bus System.....	15-19
Figure 15.8-1	Location of Railway Line -1.....	15-27
Figure 15.8-2	Location of Railway Line 2.....	15-29
Figure 15.8-3	Location of Railway Line 3.....	15-32
Figure 15.8-4	Location of Railway Line 4.....	15-34
Figure 16.2-1	Plan Area Specified for Area Traffic Signal Control System of Traffic Lights.....	16-4
Figure 16.2-2	System Configuration.....	16-5
Figure 16.2-3	Plan Locations of Synchronized Traffic Control Systems.....	16-6
Figure 16.2-4	Proposed Signal Phase System.....	16-7
Figure 16.2-5	A Sample of the Basic Control Method for the Bus Priority Signal Control System.....	16-8
Figure 16.2-6	A Sample of the Widening Plan at Approach of Intersection.....	16-9
Figure 16.2-7	Layout of a Scramble Phase.....	16-13

Figure 16.2-8	Concept of Parking Control System	16-14
Figure 16.2-9	Parking Ticket Machine	16-15
Figure 16.2-10	Outline of Parking Ticket System	16-15
Figure 16.2-11	Procedure of Key Works for the TSAS	16-17
Figure 16.2-12	Proposed Vehicle Inspection System	16-18
Figure 16.3-1	System Configuration for Traffic Information System with Area Traffic Control.....	16-21
Figure 16.3-2	Relationship between the Traffic Control System and the Traffic Information System	16-22
Figure 16.3-3	Location of Information Indication Unit (Traffic Message Sign Board).....	16-23
Figure 16.3-4	Information Board and Mechanism of Bus Location System	16-24
Figure 16.3-5	Bus Priority Traffic Signal Control System on Normal Roads	16-25
Figure 17.1-1	Figure Mean Monthly Precipitation	17-2
Figure 17.1-2	Wind Direction Model.....	17-3
Figure 17.1-3	Model of Inversion Layer of Temperature	17-4
Figure 17.1-4	Model of Atmospheric Valleys in which the Polluted Air may remain	17-4
Figure 17.1-5	Chillón River	17-6
Figure 17.1-6	Rímac River.....	17-6
Figure 17.1-7	Lurín River	17-6
Figure 17.1-8	Underground Water Service	17-6
Figure 17.1-9	Desert Landscape.....	17-7
Figure 17.1-10	Cultivated Field	17-7
Figure 17.1-11	Villa Swamp	17-8
Figure 17.2-1	Situation of Nitrogen Dioxide Pollution.....	17-9
Figure 17.2-2	Situation of Sulfur Dioxide Pollution.....	17-10
Figure 17.2-3	Situation of Total Particulate Matter (SPM, PM-10) Pollution.....	17-10
Figure 17.2-4	Situation of Particulate Matter (PM-2.5) Pollution	17-11
Figure 17.2-5	Situation of Lead Pollution.....	17-11
Figure 17.3-1	Main Archaeological Ruins in the Lima Area.....	17-17
Figure 17.3-2	Pachacámac's Ruins	17-17
Figure 17.3-3	Maranga's Ruins.....	17-18
Figure 17.3-4	Pucllana and Huallamarca's Pyramid.....	17-18
Figure 17.3-5	City Wall	17-19
Figure 17.3-6	Lima Historic Center Zone and UNESCO World Heritage	17-20
Figure 17.3-7	Plaza Mayor.....	17-20
Figure 17.3-8	Mayor's House at Plaza Mayor	17-21
Figure 17.3-9	San Francisco Temple	17-21
Figure 17.3-10	Balta Bridge.....	17-21
Figure 17.3-11	Eastside City Wall	17-21
Figure 17.3-12	Old Buildings and Cultural Monuments.....	17-22
Figure 17.3-13	Real Felipe Fortress.....	17-23

Figure 17.3-14	Plaza Grau	17-23
Figure 17.3-15	Old Mansions.....	17-24
Figure 17.6-1	San Juan de Lurigancho.....	17-38
Figure 17.7-1	Site Location map (Preliminary Roadside Noise Survey).....	17-43
Figure 17.7-2	Noise Measurement Results (Nov/04).....	17-44
Figure 17.7-3	Noise Measurement Results (Nov/04).....	17-45
Figure 17.8-1	Location Map (Preliminary Roadside Air Quality Survey).....	17-46
Figure 17.8-2	Roadside A/Q Survey (PM 10, November/04).....	17-47
Figure 17.10-1	Flowchart of Environmental Approval Process.....	17-72
Figure 17.10-2	EIA Working Frame (Tentative)	17-75
Figure 17.11-1	Tendency of Emotional Stability by Age	17-91
Figure 17.11-2	Tendency of Sociality by Age	17-91
Figure 17.11-3	JICA Study Poster	17-105
Figure 18.2-1	Comprehensive Urban Transport Master Plan of Lima and Callao in 2025	18-9
Figure 19.1-1	Procedure for Identification of Project Priority.....	19-2
Figure 19.1-2	Cost / Benefit Analysis by Project in 2004 and 2025 Road and Transport Network	19-4
Figure 19.1-3	Relationship between B/C and Project Cost/km in 2004 Road Network	19-4
Figure 19.1-4	Relationship between B/C and B-C in 2004 Road Network	19-5
Figure 19.1-5	Average Travel Speed by Project in Road Network in 2004	19-6
Figure 19.1-6	Average Travel Speed by Project in Road Network in 2025	19-6
Figure 19.1-7	Saving Time by Project in 2004 Road Network.....	19-7
Figure 19.1-8	Relationship between Population of Estrato E and Project Cost.....	19-7
Figure 19.2-1	Distribution of Annual Investment Cost by Project	19-11
Figure 19.2-2	Accumulated Investment Cost by Project	19-12
Figure 19.2-3	Implementation Schedule for Master Plan	19-13
Figure 20.1-1	Concept of Cost-Benefit Analysis	20-2
Figure 20.4-1	Traffic Volume in PCU-km on Road	20-15
Figure 20.4-2	Traffic Volume in Passenger-km by Public Transport.....	20-15
Figure 20.4-3	Travel Time in PCU-hour.....	20-16
Figure 20.4-4	Travel Time in Passenger-hour	20-16
Figure 20.4-5	Rates of Change of Travel Speed	20-17
Figure 20.4-6	Ratio of Distance with a Volume-capacity Ratio of Over 1.0.....	20-17
Figure 20.4-7	Traffic Demand on Present Road and Transport Networks in 2004.....	20-19
Figure 20.4-8	Traffic Demand (2004 Network/2010 OD for Upper Row and 2010 Network/2010 OD Table for Bottom Row)	20-20
Figure 20.4-9	Traffic Demand (2004 Network/2020 OD for Upper Row and 2020 Network/2020 OD Table for Bottom Row)	20-21
Figure 20.4-10	Traffic Demand (2004 Network/2025 OD for Upper Row and 2025 Network/2025 OD Table for Bottom Row)	20-22
Figure 20.4-1	Traffic Demand on Roads excluding Trunk Bus and Railway passengers (2025 Network/2025 OD Table).....	20-23

(VOLUME – III)

Figure 21.1-1	Analytical Procedures for Effectiveness of the Master Plan in 2025.....	21-2
Figure 21.2-1	Procedure of Traffic Demand Analysis.....	21-4
Figure 21.2-2	Peak Hour Traffic Demand of All Modes (2004 Network/2004 Peak Hour OD).....	21-5
Figure 21.2-3	Peak Hour Traffic Demand of All Modes (2004 Network/2025 Peak OD: Without Project Case for Upper Part, and 2025 Network/2025 Peak OD Table: With Project Case for Bottom Part).....	21-6
Figure 21.2-4	Difference of Peak Hour Travel Demand between “With Project” and “Without Project” Cases.....	21-7
Figure 21.2-5	Peak Hour Traffic Demand by Trunk and Railway Transport for Upper Part and by Conventional Bus for Bottom Part (2025 Network/2025 Peak OD).....	21-8
Figure 21.2-6	2004 Peak Hour Traffic Demand of Public Transport for UpperPart, and 2025 Peak Hour Traffic Demand (Without Project Case) for Bottom Part.....	21-9
Figure 21.2-7	Population Ratio Covered by Public Transport.....	21-11
Figure 21.2-8	Population Ratio Covered by Private Mode.....	21-11
Figure 21.2-9	Population Ratio by Estrato Covered by Public Transport.....	21-11
Figure 21.2-10	Area of Travel Time Covered by Public Transport Every 15 Minutes.....	21-12
Figure 21.2-11	Area of Travel Time Covered by Private Mode Every 15 Minutes.....	21-13
Figure 21.2-12	Line Configurations of BT7011 and 7012 in Railway (TP-02 and 03).....	21-17
Figure 21.2-13	Line Configurations of BC2021 and 2022 in Trunk Bus (BP-02).....	21-17
Figure 21.2-14	Traffic Volumes on Av. Tupac Amaru Parallel to the Mass Transit Lines.....	21-19
Figure 21.2-15	Traffic Volumes on Av. Universitaria Parallel to the Mass Transit Lines.....	21-19
Figure 21.2-16	Traffic Volumes on Av. Oscar R. Benavides.....	21-20
Figure 21.2-17	Traffic Volumes on Av. Arequipa.....	21-20
Figure 21.2-18	Traffic Volumes on Av. Los Próceres de La Independencia Parallel to the Mass Transit Lines.....	21-20
Figure 21.2-19	Location of the Roads.....	21-21
Figure 21.3-1	Evaluation Procedure of Fare Rate.....	21-23
Figure 21.3-2	Procedure to Forecast a Modal Share of Public Transport.....	21-24
Figure 21.3-3	Distribution of Composition Ratio of Hourly Public Transport Passengers by Mode against Fare Rate.....	21-25
Figure 21.4-1	Analytical Procedure of Influence of Mass Transit on the Lower Income Population.....	21-26
Figure 21.4-2	Procedure of Data Analysis for Lower Income Survey.....	21-28
Figure 21.4-3	Conditions of Electric Power.....	21-29
Figure 21.4-4	Conditions of Water Supply.....	21-29
Figure 21.4-5	Housing Conditions.....	21-30
Figure 21.4-6	Employment Conditions.....	21-30
Figure 21.4-7	Type of Occupation for Regular Job.....	21-31

Figure 21.4-8	Type of Occupation for Temporary Job	21-31
Figure 21.4-9	Transport Modes to Working Place.....	21-31
Figure 21.4-10	Travel Time by Mode to Working Place.....	21-32
Figure 21.4-11	Paid Fare Rate of Public Transport	21-32
Figure 21.4-12	Fare Impression	21-33
Figure 21.4-13	Average Walking Time by 4 Integrated Zones	21-34
Figure 21.4-14	Reasons to Hesitate Using a Bus	21-35
Figure 21.4-15	User Opinion for Public Transport Improvement.....	21-35
Figure 21.4-16	Demand for Bus Transport (Extreme Poverty)	21-36
Figure 21.4-17	Demand for Bus Transport (Poverty).....	21-36
Figure 21.4-18	Summary of Recommendation	21-39
Figure 21.5-1	Influence on Travel Demand According to a Change of Economic Growth Rate.....	21-40
Figure 21.5-2	Composition Ratio of Population by Estrato Rank According to Economic Growth Ratio.....	21-41
Figure 21.5-3	Composition Ratio of Population by Estrato Rank According to Both Economic Scenarios	21-41
Figure 21.5-4	Distribution of Trips by Economic Growth Ratio of GRDP/ capita/annum	21-42
Figure 21.5-5	Difference of Trips by Economic Growth Scenario.....	21-43
Figure 22.1-1	Analytical Procedure for Evaluation of the Short-Term Plan in 2010.....	22-1
Figure 22.1-2	Short-Term Action Plan Network in 2010	22-3
Figure 22.2-1	Comparison of Population by Stratum	22-4
Figure 22.2-2	Trip Generation and Attraction in 2010 (All Purposes exclusive of To home).....	22-6
Figure 22.2-3	Daily Trip Desire Line by Public Modes in 2004 and 2010.....	22-8
Figure 22.2-4	Daily Trip Desire Line by Private (Car and Taxi) Modes in 2004 and 2010	22-8
Figure 22.2-5	Daily Traffic Demand on Present Road and Transport Networks in 2004.....	22-9
Figure 22.2-6	Daily Traffic Demand on Present Road and Transport Networks in 2010 (Without Case)	22-10
Figure 22.3-1	Peak Hour Traffic Demand of All Modes (2004 Network/2025 Peak OD: Without Case for Upper Row, and 2025 Network/2025 Peak OD Table: With Case for Bottom Row).....	22-12
Figure 22.3-2	Peak Hour Traffic Demand by Trunk and Railway Transport for Upper Row and by Conventional Bus for Bottom Row (2010 Network/2010 Peak OD).....	22-13
Figure 22.3-3	2004 Peak Hour Traffic Demand of Public Transport for Upper Row, and 2010 Peak Hour Traffic Demand (Without Case) for Bottom Row	22-14
Figure 22.3-4	Line Configurations of BC2011 and 2012 in Trunk Bus (BP-01 and 03)	22-17
Figure 22.3-5	Line Configurations of BC2031 and 2032 in Trunk Bus (BP-04).....	22-17
Figure 22.3-6	Line Configurations of BC2061 and 2062 in Trunk Bus (BP-12).....	22-18

Figure 22.3-7	Line Configurations of BC2051 and 2052 in Trunk Bus (BP-13).....	22-18
Figure 22.3-8	Traffic Volumes on Av. Tupac Amaru Parallel to the Mass Transit Lines	22-20
Figure 22.3-9	Traffic Volumes on Av. Universitaria Parallel to the Mass Transit Lines	22-21
Figure 22.3-10	Traffic Volumes on Av. Oscar R. Benavides	22-21
Figure 22.3-11	Traffic Volumes on Av. Arequipa.....	22-21
Figure 22.3-12	Traffic Volumes on Av. Los Próceres de La Independencia Parallel to the Mass Transit Lines	22-22
Figure 22.3-13	Location of the Roads.....	22-22
Figure 22.4-1	Relationship between Cost Benefit and Passenger Volumes by Projects.....	22-25
Figure 22.5-1	Location Map of the Railway Route of Line-1	22-27
Figure 22.5-2	Passenger Demand on the Line-1 Project in 2010.....	22-29
Figure 22.5-3	Passenger Demand on the Line-1 Project in 2025.....	22-29
Figure 22.5-4	Traffic Volumes on Av. Tupac Amaru Parallel to the Mass Transit Lines	22-32
Figure 22.5-5	Traffic Volumes on Av. Los Próceres de La Independencia Parallel to the Mass Transit Lines	22-33
Figure 22.5-6	Location Map of the Trunk Busways Selected as High Priority Projects	22-34
Figure 23.1-1	Signalized Intersections in Specified Areas to be Covered by the ATC System	23-2
Figure 23.1-2	Major Roads to be Covered by the Synchronized System	23-3
Figure 23.1-3	Signalized Intersections on Major Roads in the Southern part of the City to be Covered by the Synchronized System.....	23-3
Figure 23.1-4	Signalized Intersections on Major Roads in the Western part of the City to be Covered by the Synchronized System.....	23-4
Figure 23.1-5	Signalized Intersections on Major Roads in the Northern part of the City to be Covered by the Synchronized System.....	23-4
Figure 23.1-6	Exclusive Left-Turn Lane by Cutting off Median.....	23-8
Figure 23.1-7	Exclusive Left-Turn Lane by Shifting Center Line.....	23-8
Figure 23.1-8	Traffic Queue of Left Turning Traffic at Signalized Intersections ..	23-8
Figure 23.1-9	Standard Scramble Crosswalk.....	23-9
Figure 23.1-10	Key Intersections and Sub-Areas	23-10
Figure 23.1-11	Standard Location Plan of Detectors for an Approach of Key Intersection.....	23-10
Figure 23.1-12	Standard Location Plan of Detectors for Left-Turn Actuation.....	23-10
Figure 23.1-13	Standard Location Plan of Detectors for Obtaining Traffic Statistics.....	23-11
Figure 23.1-14	Standard Location Plan of Detectors for the Bus Priority Traffic Signal System.....	23-11
Figure 23.1-15	Type of Vehicle Detector	23-12
Figure 23.1-16	Standard Installation Plan for Detector and Cabinet	23-13
Figure 23.1-17	Standard Installation Plan for Local Controllers Related to Near Intersections.....	23-14
Figure 23.1-18	Communication Network of Transmission Equipment.....	23-14

Figure 23.1-19	Layout of Traffic Control Center	23-15
Figure 23.1-20	Signalized Intersections on Av. Arequipa, Av. Petit Thouars and Av. Arenales to be Covered by the Synchronized System.....	23-17
Figure 23.2-1	A Sample Pamphlet	23-25
Figure 23.3-1	Procedure of Key Works for TSAS.....	23-30
Figure 23.3-2	A Sample of a Collision Diagram	23-33
Figure 23.4-1	Plan Area for Staggered Office and School Control	23-38
Figure 23.4-2	Hourly Attraction Fluctuation for Work/School Purpose in the Central Area	23-39
Figure 23.4-3	Modal Shares of Alternative Cases in 2010	23-42
Figure 23.4-4	Peak Hour Traffic Volumes on Av. Tupac Amaru.....	23-43
Figure 23.4-5	Peak Hour Traffic Volumes on Av. Aviación.....	23-43
Figure 23.5-1	Plan Location for Charged On-Street Parking Lots on Minor Streets.....	23-46
Figure 23.5-2	A Sample Design of a Parking Ticket	23-46
Figure 23.5-3	Outline of Parking Ticket System	23-47
Figure 23.5-4	Procedure for Regulation of Parking Violation.....	23-48
Figure 23.5-5	Standard Design of Unit Parking Area and Guide Sign	23-49
Figure 23.6-1	Procedure of Motor Vehicle Inspection	23-50
Figure 23.6-2	Arrangement of Major Inspection Items	23-53
Figure 24.1-1	Study Area of Urgent Action Plan.....	24-3
Figure 24.2-1	Location of Each Project	24-10
Figure 25.1-1	Location of Recommended Trunk Bus Routes	25-8
Figure 25.1-2	Stakeholders in PPP and its Interactions	25-11
Figure 25.1-3	Organization Scheme and Co-Relations among the Transport Clusters	25-12
Figure 25.1-4	Classification and Interrelation of Major Risks in the PPP Scheme	25-13
Figure 25.1-5	Bus Route System.....	25-18
Figure 25.1-6	Operating Organization Alternatives.....	25-20
Figure 25.1-7	Major Clusters in Concession Scheme	25-22
Figure 26.4-1	Total Available Revenues.....	26-15
Figure 26.4-2	Available Revenue by Year.....	26-16
Figure 26.4-3	Balance of Revenue and Cost.....	26-16

List of Abbreviations

¥	Yen
AASHTO	American Association of State Highway and Transportation
AATE	Autonomous Authority of the Special Project of Electric Mass Transport System for Lima and Callao
ACI	American Concrete Institute
AIT	Asian Institute of Technology
AMETUR	Metropolitan Association of Urban Transport Enterprises
Art.	Article
ASETRAP	Association of Peruvian Transport Enterprises
ASETUM	Association of Mass Urban Transportation Companies from
ASETUP	Association of Urban Transportation Companies from Peru
ASPEC	Peruvian Association of Consumers and Users
ATC	Applied Technology Council
ATLM	Lima and Callao Metropolitan Transport Authority
ATP	Automatic Train Protection System
Av.	Avenue
CBD	Central Business District
CCTV	Closed Circuit Television System Camera
CEMTU - PERU	Urban Carriers Company Corporation from Peru
CEPAL	Economic Commission for Latin American and Caribe
CEPRI	Special Committee of Private Investment Promotion
CGT	General Confederation of Transport
CIDATT	Investigation and Advisory Center of Terrestrial Transport
CNG	Compressed Natural Gas
CNSV	National Road Safety Council
COFOPRI	Commission of Informal Property Formalization
CONAM	National Environmental Council
CONATA	National Assessment Council for Real Estate
CONATRAP	National Confederation of Public Transport Companies
CONECSA	Business Consortium of Callao
CONFIEP	National Confederation of Private Business Institutions
CORDELICA	Development Corporation for Lima and Callao
CORPAC	Peruvian Corporation of Airports and Commercial Aviation
COSAC	High Capacity Segregated Corridor
COSAC I	High Capacity Segregated Corridor Phase I
CPU	Central Processing Unit
CTC	Central Train Control System
CTLC	Transport Council of Lima and Callao

DC/CD	Direct Credit
dd-S	Subtropical Desiccated Desert
DESCO	Study and Development Promotion Center
DGAC	General Direction of Civil Aviation
DGAS	General Direction of Social Environmental Affairs
DGCF	General Direction of Railway Transportation
DGCT	General Direction of Ground Circulation
DGDU	General Direction of Urban Development
DGTA	General Direction of Marine Transportation
DGTE	General Direction of Transport
DGTO	General Direction of Transit
DGTU	General Direction of Urban Transport (Callao)
DMTU	Municipal Direction of Urban Transport (Lima)
DNI	National Identification Document
dp-PT	Tropical Low-mountain Semi-dry
ds-S	Subtropical Super-dry Desert
ECAs	Environmental Quality Standard Annual Program
EIA	Environmental Impact Assessment
EIA-d	Detailed Study of Environmental Impact
EIA-sd	Semi-detailed Study of Environmental Impact
EMAPE	Municipal Toll Administration Company
ENAPU	Port Services of Peru
ENATRU	National Corporation for Urban Transport
Ex.	Express Way (Freeway)
FINVER	Finver-Callao Investment Fund
FONAM	National Environmental Fund
FONCOMUN	Municipal Compensation Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gases
GPS	Geographical Positioning System
GRDP	Gross Regional Domestic Product
HH	Household
HOV	High Occupancy Vehicle
IBRD/WB	International Bank for Reconstruction and Development /World Bank
ICAO	International Civil Aviation Organization
IDB	Inter-American Development Bank
IEE	Initial Environmental Examination
IFC/CFI	International Finance Corporation

IMP	Metropolitan Planning Institute
INC	National Institute of Culture
INDECI	National Institute of Civil Defense
INEI	National Institute for Statistics and Information
INVERMET	Metropolitan Investment Fund
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LaeqT	Continuous Sound Pressure Level equivalent to that with Adjustment A
LCTA	Lima and Callao Metropolitan Transport Authority
Leq	Noise Parameter
M/C	Motorcycle
M/P	Master Plan for Lima and Callao Metropolitan Area Urban Transportation in the Republic of Peru
MEF	Ministry of Economy and Finance
MIGA/OMGI	Multilateral Investment Guarantee Agency
MML	Metropolitan Municipality of Lima
MOP	Ministry of the Presidency
MPC	Province Municipality of Callao
MTC	Ministry of Transportation and Communications
MTPE	Ministry of Work and Employment Promotion
NGO	Non-Governmental Organization
NMT	Non-motorized Transport
OD	Origin Destination
OECD	Organization for Economic Cooperation and Development
OGPP	Directorate of Management Information
OIT	Office of Technical Information
OPP	General Office of Planning and Budgets
PAR	Displaced People Return Support Program
PCU	Passenger Car Unit
PFI	Private Finance Initiative
PG/R	Progress Report
PISA	Integral Atmospheric Security Plan
PM	Particulate Matter
PNP	National Police
PPP	Public Private Partnership
PROINVERSION	Private Investment Promotion Agency
PROLIMA	Lima Historic Center Municipal Recuperation Program
PRONAA	National Program of Nourishment Assistance
PROTRANSPORTE	Investments Plan Elaboration Project for Lima's Metropolitan Transport

PROTUM	Metropolitan Urban Transport Project
PROVIAS	Special Project of Transport Infrastructure
PT	Person Trip
PTUL	Lima Urban Transport Program
RC	Reinforced Concrete
RIT	Integrated Transport Network
RTMS	Remote Detector Microwave Sensor
S/.	Soles
SAT	Tributary Administration Service
SEDAPAL	Drinking Water and Sewerage Service of Lima
SEIA	National System of Environmental Impact Evaluation
SERPOST	Postal Services of Peru
SETAME	Metropolitan Taxi Service
SITC	Southern Inter Tropical Convergence
SPM	Suspended Particulate Matter
SUNARP	National Superintendence of Public Registration
SUNAT	National Superintendence of Tributary Administration
TDM	Traffic Demand Management
TRANSMET	Metropolitan Transport Committee of Lima
TSAS	Traffic Safety Audit System
TTC	Travel Time Cost
TUPA	Unique Text of Administrative Procedure
UIC	International Union of Railways
UNESCO	United Nations Education, Science and Culture Organization
US\$	American Dollar
USTDA	Feasibility Study on Urban Railway Project in Lima
UTPM	Territorial Units of Metropolitan Planning
VOC	Vehicle Operation Cost
VIVD	Video Vehicle Detection System

PART II

TRANSPORT DEMAND
FORECAST/PLANNING

CHAPTER 10

Future Socioeconomic Framework

10. FUTURE SOCIOECONOMIC FRAMEWORK

10.1. POPULATION PROJECTION

There is no official data available regarding future population projection in the Metropolitan Area of Lima and Callao. The Study Team estimated a future population for 2010 (mid-term) and 2025 (long-term), as a socioeconomic framework for the analysis of future transport demand in the Metropolitan Area.

The INEI is the government agency in charge of publishing official statistical data, including the data of the national population census. The latest national population census was implemented in 1993, and since then it has not been undertaken until now¹. The INEI estimated a recent population by Department, Province and District from 1990 to 2005, in the report entitled “*Perú: Proyecciones de Población por Años Calendario según Departamentos, Provincias y Distritos*,” (Peru: Population Projections by Departments, Provinces and Districts) published in 2002. This is the only reliable data source to know the recent population of the Metropolitan Area of Lima and Callao. The Study team, therefore, employed 8,043,256² habitants prepared by the INEI, as the basis for the present population of the Metropolitan Area in the year 2004.

Regarding the future population projection, there are several studies undertaken by the INEI and other agencies. Some of the important studies are:

- a) Population Projection and Estimation in Peru, 1950-2050 (*Perú: Estimaciones y Proyecciones de Población, 1950-2050*), published by the INEI in 2001³
- b) Urban Growth Tendencias in Metropolitan Lima towards the Year 2015 (*Tendencias Del Crecimiento Urbano de Lima Metropolitana Al Año 2015*), published by the INEI in 1997
- c) Metropolitan Development Plan for Lima and Callao, 1990-2010 (*Plan de Desarrollo Metropolitano de Lima and Callao 1990-2010*), published by the Institute for Metropolitan Planning (IMP) in 1989.⁴

The population projections in each study mentioned above are different, and there is no official population projection data for the Metropolitan Area of Lima and Callao.

The future population of the Metropolitan Area during the period between 2004 and 2025 was estimated based on the current population data published by the INEI⁵. For the comparative purpose, the following three cases were examined:

- a) Case-1: Extrapolative projection based on the actual number of the population from 1990 to 2005
- b) Case-2: Projection by using the trend of growth rate of the Metropolitan Area from 1990 to 2005
- c) Case-3: Projection by using the trend of percentage share of the Metropolitan Area in the country from 1990 to 2005

¹ According to the INEI, the next national housing and population census will be implemented in 2005. In 1999, the INEI implemented a pre-census survey.

² The INEI modified the recent population of the Metropolitan Area of Lima and Callao in 2004, from 8,049,619 habitants to 8,043, 256 habitants. The Study Team used the modified data of population.

³ The urban and rural population projection was made by the INEI in 2002, entitled “*Perú: Estimaciones Y Proyecciones de Población, Total, Urbano y Rural Por Años Calendario y Edades Simples, 1970-2025*.”

⁴ The study, *Plan de Desarrollo Metropolitano de Lima and Callao 1990-2010*, was made in 1989, before the implementation of the population Census of 1993, and therefore, the population projection in this study is obsolete and not accurate. The population of 2010 estimated by the study is 10,337,081, which is too large in terms of the recent trend.

⁵ “*Perú: Proyecciones de Población por Años Calendario según Departamentos, Provincias y Distritos*,” (Peru: Population Projections by Calendar Year according to Departments, Provinces and Districts) in 2002

The results of the population projection are shown in Table 10.1-1. The population projections of 2025 are not much different in each case: 10,920,302 habitants in the case-1, 10,568,785 habitants in the case-2, and 10,993,498 habitants in case-3. When we look at the past population trend, the case-3 shows more accurate results⁶. In addition, when we compare the results with other unofficial population projection data, such as the “*Tendencias Del Crecimiento Urbano De Lima Metropolitana Al Año 2015*” (Urban Growth Tendencies in Metropolitan Lima towards the Year 2015) prepared by the INEI, the case-3 shows more reasonable results than those in the other cases⁷. With a series of discussions with the relevant agencies, including the INEI, Ministry of Economy and Finance, and IMP, the Study Team selected the estimation of the case-3, that is, 8,886,181 habitants in 2010 and 10,993,495 habitants in 2025, as a basis for the future population framework of the Metropolitan Area of Lima and Callao. Figure 10.1-1 shows the population projection made by the study team, compared to other projection data.

Table 10.1-1 Population Projection for the Metropolitan Area of Lima and Callao, 2004-2025

Year	Case (1): Extrapolative Projection		Case (2): Projection by using the Growth Rate Trend		Case (3): Projection by using the Percentage Share Trend	
	Population	Average Growth Rate (%)	Population	Average Growth Rate (%)	Population	Average Growth Rate (%)
2004	8,043,256	-	8,043,256	-	8,043,256	-
2010	8,868,690	1.64	8,851,532	1.61	8,886,181	1.67
2015	9,552,506	1.50	9,479,694	1.38	9,601,927	1.56
2020	10,236,404	1.39	10,056,938	1.19	10,313,413	1.44
2025	10,920,304	1.30	10,568,785	1.00	10,993,495	1.29

Note: The present population in 2004 is the data prepared by the INEI.

Source: The JICA Study Team

⁶ Among the three cases, the result estimated in case-3 (4,886,935 habitants in 1981) is more accurate to the Census data of 4,835,793 habitants.

⁷ According to the report published by the INEI, *Tendencias Del Crecimiento Urbano De Lima Metropolitana Al Año 2015*, the population was estimated to be 9,641,938 habitants in 2015. The population projections made by the study team are 9,552,506 habitants in case-1, 9,479,694 habitants in case-2 and 9,601,927 habitants in case-3. The result of case-3 is more close to the data of 9,641,938 projected by the INEI.

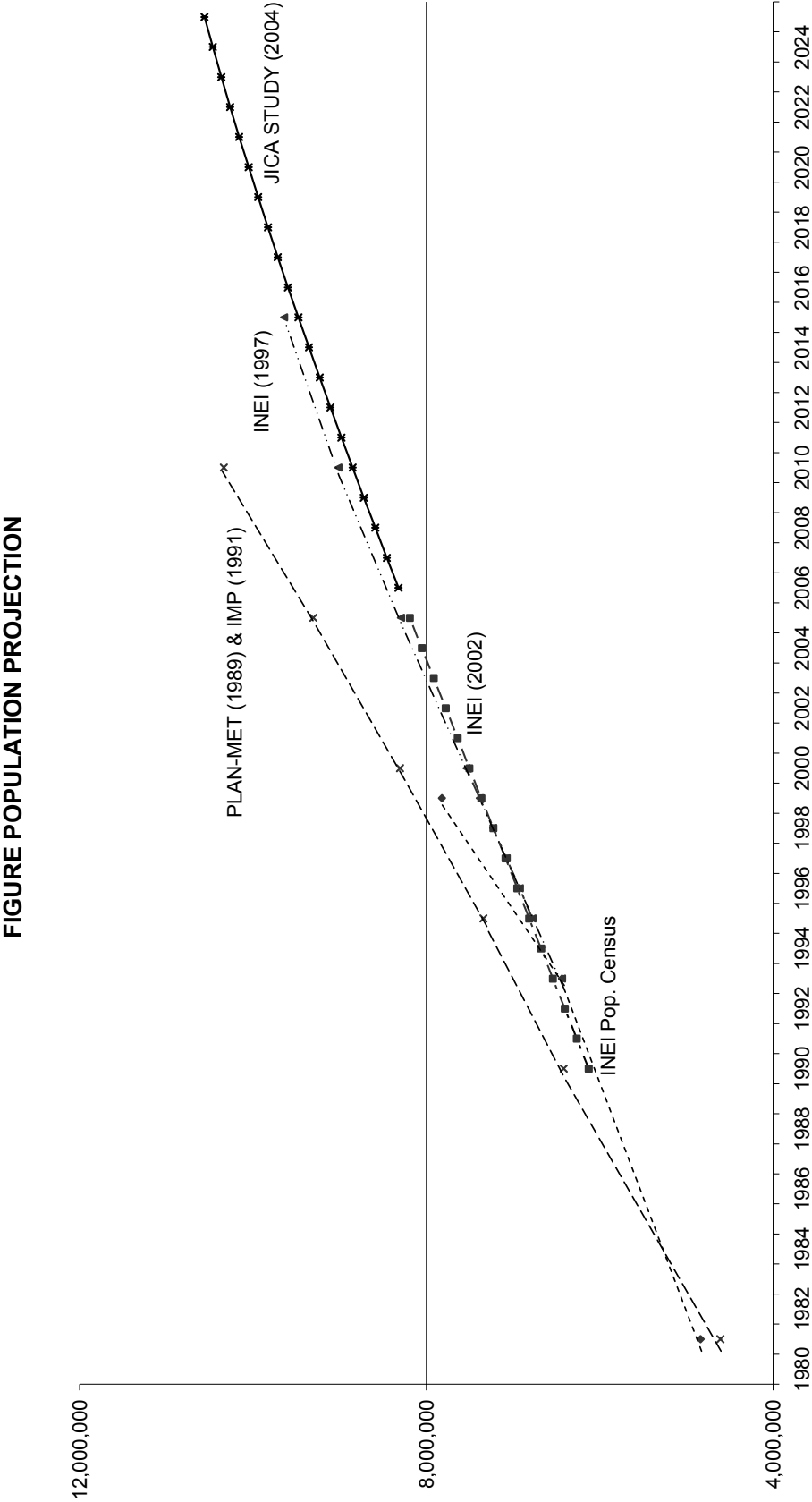


Figure 10.1-1 Population Projection of Lima and Callao Metropolitan Area

10.2. MACRO ECONOMIC PROJECTION

(1) National GDP

The Peruvian economy has experienced a relatively high growth rate over the last decade. Table 10.2-1 shows the real GDP (Gross Domestic Product) growth rates in Latin American countries during the period between 1992 and 2004. The average national GDP growth rate of Peru was 4.0 percent during the period, although there was a wide range of fluctuation. The Peruvian economy showed the third highest GDP growth rate among the Latin American countries, following Chile (4.9 percent) and Costa Rica (4.8 percent).

Table 10.2-1 Real GDP Growth Rate in Latin American Countries, 1992-2004

Country	Av. Growth	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Argentina	1.7	9.6	5.9	5.8	-2.9	5.5	8.0	3.8	-3.4	-0.8	-4.4	-11.0	3.0	4.5
Bolivia	3.3	1.7	4.3	4.8	4.7	4.5	4.9	5.0	0.3	2.4	1.6	2.7	2.5	
Brazil	2.6	-0.3	4.5	6.2	4.2	2.5	3.1	0.1	1.0	4.0	1.4	1.5	2.8	3.5
Chile	4.9	10.9	6.6	5.0	9.0	6.9	6.7	3.3	-0.5	4.2	2.8	2.0	3.1	4.8
Colombia	2.4	3.7	4.6	6.0	4.9	1.9	3.3	0.8	-3.8	2.4	1.4	1.6	2.0	3.3
Costa Rica	4.8	8.8	7.1	4.6	3.9	0.8	5.4	8.3	8.0	1.8	1.2	2.9	5.6	
Ecuador	2.5	3.0	2.2	3.7	2.1	3.0	5.2	2.2	-5.7	0.9	5.1	3.0	3.5	5.2
Mexico	2.9	3.7	1.8	4.4	-6.1	5.4	6.8	5.1	3.6	6.7	-0.3	0.9	2.3	3.7
Paraguay	1.5	1.7	4.0	3.0	4.5	1.1	2.4	-0.6	-0.1	-0.6	2.4	-2.5	2.5	
Peru	4.0	-0.4	4.8	12.7	8.6	2.5	6.9	-0.6	0.9	2.7	0.6	5.2	4.0	4.5
Uruguay	1.0	8.3	3.5	7.0	-2.3	5.0	5.4	4.4	-3.4	-1.9	-3.1	-10.8	-2.0	4.5
Venezuela	0.1	7.0	-0.4	-3.0	4.8	0.0	6.9	0.6	-5.5	3.8	2.8	-8.9	-17.0	13.4

Source: CEPAL – Balance Preliminar de las Economías de América Latina y el Caribe 2003, International Monetary Fund, “World Economic Outlook 2003”

Regarding the future economic projection, the Ministry of Economy and Finance prepared a study report entitled “Study for the Elaboration of Macroeconomic Projections”⁸ in the year 2000. In this report, three types of future economic development scenarios were examined with the projection of GDP growth rates during the period between 2001 and 2020 (Table 10.2-2). For example, the first scenario shows the trend of moderate growth of per capita GDP: from 1.7 percent, during the period between 2001 and 2005, to 2.7 percent, between 2016 and 2020. The second scenario shows the continuous trend of moderate-high growth of per capita GDP: from 2.1 percent, during the period between 2001 and 2005, to 3.4 percent, between 2016 and 2020. The third scenario shows the trend of low growth of per capita GDP: from 1.4 percent, during the period between 2001 and 2005, to 1.8 percent, between 2016 and 2020. This study report does not indicate which scenario is the most appropriate as a target of the national economy in the future.

⁸ Grupo Maximixe, Study for the Elaboration of Macroeconomic Projections, Prepared for the Ministry of Economy and Finance, 2000.

Table 10.2-2 Projection of GDP Growth Rate, 2001-2020

Year	Scenario-1: Moderate Growth		Scenario-2: Moderate-High Growth		Scenario-3: Low Growth	
	Per Capita GDP (%)	Real GDP* (%)	Per Capita GDP (%)	Real GDP* (%)	Per Capita GDP (%)	Real GDP* (%)
2001-2005	1.7	3.2	2.1	3.6	1.4	2.9
2006-2010	2.1	3.5	2.6	4.0	1.6	3.0
2011-2015	2.4	3.7	3.0	4.3	1.7	3.0
2016-2020	2.7	3.9	3.4	4.6	1.8	3.0

Note: * The real GDP growth rate is adjusted by the population data estimated by the JICA study team.

Source: Grupo Maximixe, Study for the Elaboration of Macroeconomic Projections, Prepared for the Ministry of Economy and Finance, 2000.

In general, future macro economic projection is an uncertainty, because the national economy is always affected by external forces and unpredictable changes of global economy. Therefore, there is no concrete measure to select the appropriate scenario of future economic projection. The study team, however, found that the second scenario (moderate-high growth) seemed to be quite probable, according to the recent trend of the national economy. In addition, the future macro economic framework is characterized as a target or objective to be achieved in the long-term future. Through a series of discussions with the Ministry of Economy and Finance, the study team employed the moderate-high growth scenario, as a long-term economic framework for the Master Plan Study of Urban Transport in the Metropolitan Area of Lima and Callao.

Based on the per capita GDP growth rate in the moderate-high growth scenario mentioned above, the real GDP growth rate was estimated by the study team during the period between 2004 and 2025. Table 10.2-3 shows the results of the projection. The average growth rates of real GDP are: 3.6 percent during the period between 2004 and 2005, 4.0 percent between 2006 and 2010, 4.3 percent between 2011 and 2015, 4.6 percent between 2016 and 2020, and then 4.9 percent between 2021 and 2025.

Table 10.2-3 Projection of Macro Economic Indicators, 2004-2025

Year	Per Capita GDP Growth Rate (%)	National Population Growth Rate* (%)	Real GDP Growth Rate*** (%)
2004-2005	2.1	1.50	3.6
2006-2010	2.6	1.40	4.0
2011-2015	3.0	1.31	4.3
2016-2020	3.4	1.19	4.6
2021-2025	3.8 **	1.04	4.9

Note: * The national population growth rate is based on the data from "Perú: Estimaciones y Proyecciones de Población, 1950-2050" published by the INEI in 2001.

** The per capita GDP growth rate during the period between 2021 and 2025 is projected by the study team based on the trend of the growth rate during the period between 2001 and 2020.

*** The Real GDP Growth Rate was estimated by the study team

Source: The JICA Study Team

(2) GRDP in the Departments of Lima and Callao

The Study team estimated the GRDP (Gross Regional Domestic Product) in the Departments of Lima and Callao, based on the past trend of the percentage share of the regional product in the national economy⁹ and the growth rate of the GRDP prepared by the study report for the Ministry of Economy and Finance (MEF)¹⁰. Table 10.2-4 shows the

⁹ There is no data available on the GRDP in the Department of Lima and Callao since 1996. The study team estimated the percentage share of the GRDP in the national GDP to be 45 percent in 2001, based on the past information prepared by the INEI and other agencies.

¹⁰ Grupo Maximixe, Study for the Elaboration of Macroeconomic Projections, Prepared for the Ministry of Economy and

estimated values of the GRDP in the Departments of Lima and Callao during the period between 2004 and 2025. According to the projection, the GRDP in the Departments of Lima and Callao will increase from 60,830 million Soles in 2004 to 76,202 million Soles in 2010 and to 148,053 million Soles in 2025. The percentage share of the Departments of Lima and Callao in the national GDP will slightly decrease from 44.3 percent in 2004 to 44.0 percent in 2010 and to 43.5 percent in 2025.

There is no data available on the current GRDP by economic sector. The Study team estimated the GRDP by economic sector, based on the past data prepared by the INEI.¹¹ Regarding the future projection, the study report¹² projected the growth rates by economic sector during the period between 2001 and 2020. Based on this data, the study team estimated the GRDP by economic sector during the period between 2004 and 2025 (Table 10.2-5).

Table 10.2-4 Projection of the GRDP in the Departments of Lima and Callao, 2004-2025

Year	National GDP*	GRDP in the Departments of Lima and Callao		
	Million Soles	Million Soles	Growth Rate** (%)	Share in Peru (%)
2004	137,167	60,830		44.3
2005	142,363	62,977	3.53	44.2
2010	173,167	76,202	3.89	44.0
2015	214,141	93,599	4.20	43.7
2020	268,811	116,802	4.53	43.5
2025	341,947	148,053	4.86	43.3

Note: * The GDP was estimated based on the latest data of 117,590 million Soles in 1999 (1994 constant price) prepared by the Central Reserve Bank of Peru (Annual Report 2002).

** The GRDP growth rate during the period between 2004 and 2020 is based on the report, Study for the Elaboration of Macroeconomic Projections, prepared for the Ministry of Economy and Finance in 2000. The growth rate between 2021 and 2025 was estimated by the study team based on the trend of the growth rate during the period between 2001 and 2020.

Source: The JICA Study Team

Table 10.2-5 Projection of the GRDP by Economic Sector in the Departments of Lima and Callao, 2004-2025

(1994 price)

Year	Primary Sector		Secondary Sector		Tertiary Sector		Total	
	Million Soles	Share (%)	Million Soles	Share (%)	Million Soles	Share (%)	Million Soles	Share (%)
2004	2,661	4.4	23,118	38.0	35,050	57.6	60,830	100.0
2005	2,736	4.3	23,927	38.0	36,313	57.7	62,977	100.0
2010	3,234	4.2	28,915	37.9	44,053	57.8	76,202	100.0
2015	3,987	4.3	35,969	38.4	53,844	57.3	93,599	100.0
2020	5,031	4.3	45,491	38.9	66,280	56.7	116,802	100.0
2025	6,460	4.4	58,195	39.3	83,397	56.3	148,053	100.0

Note: The growth rates in each economic sector during the period between 2004 and 2020 were prepared by the report, "Study for the Elaboration of Macroeconomic Projections." The growth rate between 2020 and 2025 was estimated by the study team based on the trend from 2004 to 2020.

Source: The JICA Study Team

Finance, 2000.

¹¹ The INEI prepared the GRDP by economic sector in the Departments of Lima and Callao during the period between 1970 and 1995.

¹² Grupo Maximixe, Study for the Elaboration of Macroeconomic Projections, Prepared for the Ministry of Economy and Finance, 2000.

(3) Working Population in the Metropolitan Area of Lima and Callao

The current number of working population by economic sector in the Metropolitan Area of Lima and Callao was prepared by the Ministry of Work and Employment Production (MTPE)¹³. Based on the current number of working population and the growth rate of the GRDP, the future working population in the Metropolitan Area was estimated by economic sector during the period between 2004 and 2025. Table 10.2-6 shows the results of the projection. The total number of the working population will increase from 3,568,168 persons in 2004 to 4,287,347 persons in 2010 and to 6,085,526 persons in 2025. The share of the primary sector is 0.7 percent in 2004, and it will be stable until 2025. The share of the secondary sector will increase slightly from 19.8 percent in 2004 to 20.9 percent in 2025. The share of the tertiary sector will decrease slightly from 79.5 percent in 2004 to 78.3 percent in 2025.

Table 10.2-6 Projection of Working Population by Economic Sector in the Metropolitan Area of Lima and Callao, 2004-2025

Year	Primary Sector		Secondary Sector		Tertiary Sector		Total	
	Person	%	Person	%	Person	%	Person	%
2004	25,803	0.7	707,090	19.8	2,835,275	79.5	3,568,168	100.0
2005	27,254	0.7	754,651	20.0	2,995,143	79.3	3,777,048	100.0
2010	30,326	0.7	838,571	19.9	3,418,450	79.4	4,287,347	100.0
2015	34,426	0.7	983,526	20.3	3,833,418	79.0	4,851,370	100.0
2020	39,487	0.7	1,130,652	20.7	4,305,144	78.6	5,475,283	100.0
2025	44,626	0.7	1,273,066	20.9	4,767,834	78.3	6,085,526	100.0

Note: The working population by economic sector was estimated based on the current data during the period between 1996 and 2003 prepared by the Ministry of Labor. The future projection was made based on the growth rates of the GRDP by sector.

Source: The JICA Study Team

10.3. CONSIDERATION OF FUTURE URBAN STRUCTURE

According to the population framework discussed in the previous section, the Metropolitan Area of Lima and Callao will increase its population from 8,043,000 habitants in 2004 to 10,993,000 habitants in 2025. The increased population will be nearly 3.0 million habitants in total during the period between 2004 and 2025. The future transport demand is closely related to the distribution of population and urban activities. For this purpose, this section examined three alternatives of future urban structure in the Metropolitan Area of Lima and Callao. They are: (1) Mono-centric Ramified Development Pattern; (2) Poly-centric Decentralized Development Pattern; and (3) Self-Sustainable New Town Development Pattern.

(1) Alternative-1: Mono-centric Ramified Development Pattern

In the Mono-centric Ramified Development Pattern (Figure 10.3-1), the major urban activities in the Metropolitan area will continue to concentrate itself in the central area of Lima, and the residential areas will expand in the valleys, along the existing ramified roads: such as the Panamericana Norte, Av. Rosa de America, and Av. Tupac Amaru in the North; Carretera Central and Av. La Molina in the East; and the Panamericana Sur and Av. Pachacutec in the South. The agricultural lands in the valleys will be nearly lost in a near future by the urban expansion to the outskirts. Major economic activities will still be concentrated in the existing metropolitan center, the triangle of Lima, Callao and

¹³ The working population by economic sector in the Metropolitan Area of Lima and Callao during the period between 1996 and 2003 was prepared in the Programa de Estadísticas y Estudios Laborales (PEEL – Program of Statistics and Work Studies), The Ministry of Work and Employment Production.

Miraflores. The decentralization of economic activities will not proceed effectively, and the traffic congestion in the central area will be beyond the limit. The regeneration of the historical center of Lima is essential to maintain urban services and economic activities.

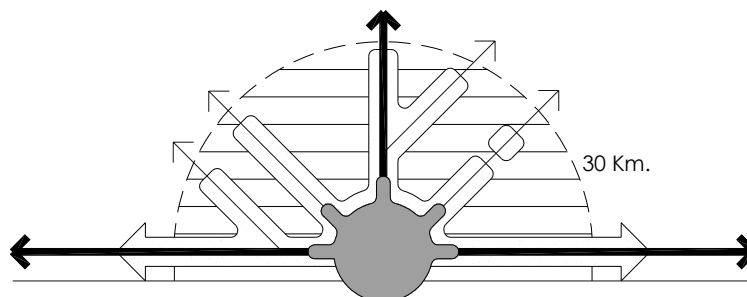


Figure 10.3-1 Mono-centric Ramified Development Pattern (Alternative – 1)

(2) Alternative-2: Poly-centric Decentralized Development Pattern

In the Poly-centric Decentralized Development Pattern (Figure 10.3-2), new sub-centers will be developed in the areas within 10-15 kilometer distance from the center of Lima. This concept was originally proposed by the Municipality of Metropolitan Lima in 1989¹⁴. The potential sites for the sub-center are the districts of Los Olivos and Comas to the North, Santa Anita and Ate to the East, and Villa El Salvador and Villa Maria Del Triunfo to the South. Some economic activities, especially the employments in the tertiary sector, will be decentralized from the central area of Lima to the sub-centers. Urban development and investment will be intensified in the sub-centers, which will mitigate the traffic congestion in the central area. From the long-term perspective, further urbanization will spill over beyond the 30-kilometer radius from the center of Lima. These areas will cause poor living environments because of the lack of basic infrastructure and urban services. Strong measures will be necessary to avoid disordered urbanization in the outskirts of the Metropolitan Area.

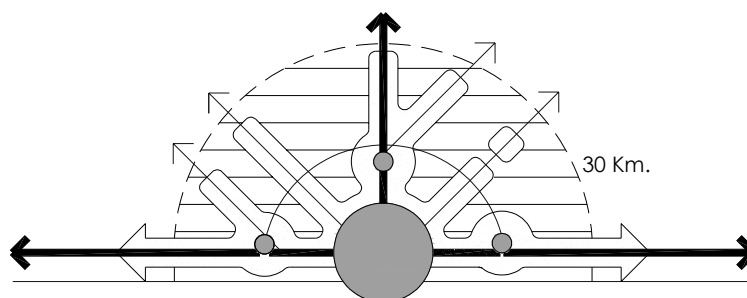


Figure 10.3-2 Poly-centric Decentralized Development Pattern (Alternative – 2)

¹⁴ Plan de Desarrollo Metropolitano de Lima and Callao 1990-2010 (Metropolitan Development Plan for Lima and Callao 1990-2010), Municipality of Metropolitan Lima, 1989.

(3) Alternative-3: Self-Sustainable New Town Development Pattern

In this pattern (Figure 10.3-3), self-sustainable new towns will be developed in the outside of a 30-kilometer radius from the center of Lima. The potential sites for the new towns are Ancon and Carabayllo in the North and Lurin, Punta Hermosa and Punta Negra in the South. These new towns will be characterized as self-sustainable towns and will create employments for the surrounding habitants. Some industries, now located in the central area of Lima, will be relocated in the new towns. Cargo terminals and inter-city bus terminals will be developed in strategic places in the new town, and mass transit will be necessary to connect between the center of Lima and the new towns. From a regional development perspective, these new towns will function as a catalyst to reinforce the North-South regional development corridor in the future.

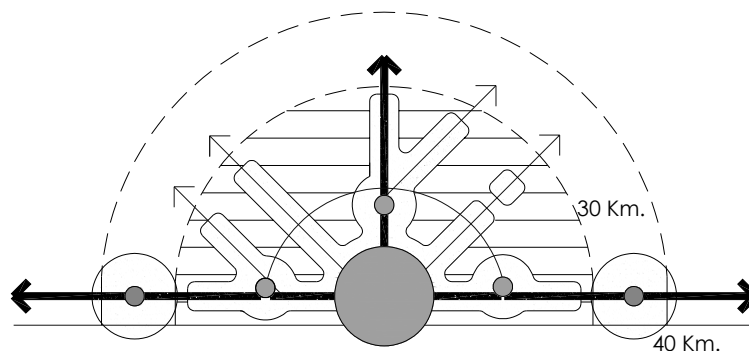


Figure 10.3-3 Sustainable New Town Development Pattern (Alternative – 3)

(4) Evaluation of Future Urban Structure

The trend scenario, mono-centric ramified urban structure (Alternative-1), will cause excessive concentration of urban activities and traffic in the central area of Lima. Due to the limitation of available land, urban growth will expand towards the valleys of the Rimac, Chillón and Lurin Rivers. If the present urban growth pattern continues, the agricultural land in the river basins of Chillón and Lurin will disappear in a near future. Furthermore, serious urban and environmental problems would be accelerated, such as long travel times to work, poor living environment in the surrounding areas, and contamination of water and air. This is the worst scenario of the future Metropolitan structure.

The polycentric decentralized urban structure (Alternative-2) is necessary to decentralize existing urban activities from the central area to the strategic sub-centers. The employment opportunities will be generated in these sub-centers, and new residential areas with high- and medium-densities will be developed around the sub-centers. In addition, a ring road will encourage the developments of the sub-centers, and it will alleviate the heavy traffic congestion in the central area. The polycentric decentralized urban structure was originally proposed in 1989, but the actual development of the sub-centers and ring roads has not been implemented smoothly until now.¹⁵

The third alternative, self-sustainable new town development pattern is the most suitable urban structure in terms of a balanced development in the Metropolitan Area. Although the term “new town” was not used, the Metropolitan Development Plan proposed the mixed use with farming industry in the areas beyond the 30-kilometer radius to the north and south. These areas may be potential sites for the future development of self-sustainable

¹⁵ Recently, the Municipality of Metropolitan Lima approved the formulation of a new urban development plan for 2020, which includes updating zoning of land use and district plans. The new plan will follow the basic concept of the previous plan encouraging the development of three sub-centers.

new towns. It is, however, not an easy task to develop new towns, and a strong leadership of the government and a mutual collaboration between public and private sectors are essential. The sustainable new town developments should be considered to avoid the spillover of urban growth outside the 30-kilometer radius. In a distant future, the new towns will strengthen the development of the North-South regional corridor, such as the axis from Lima to Huaral, Huacho and Barranca in the North and to Cañete and Chincha in the South (Figure 10.3-4).

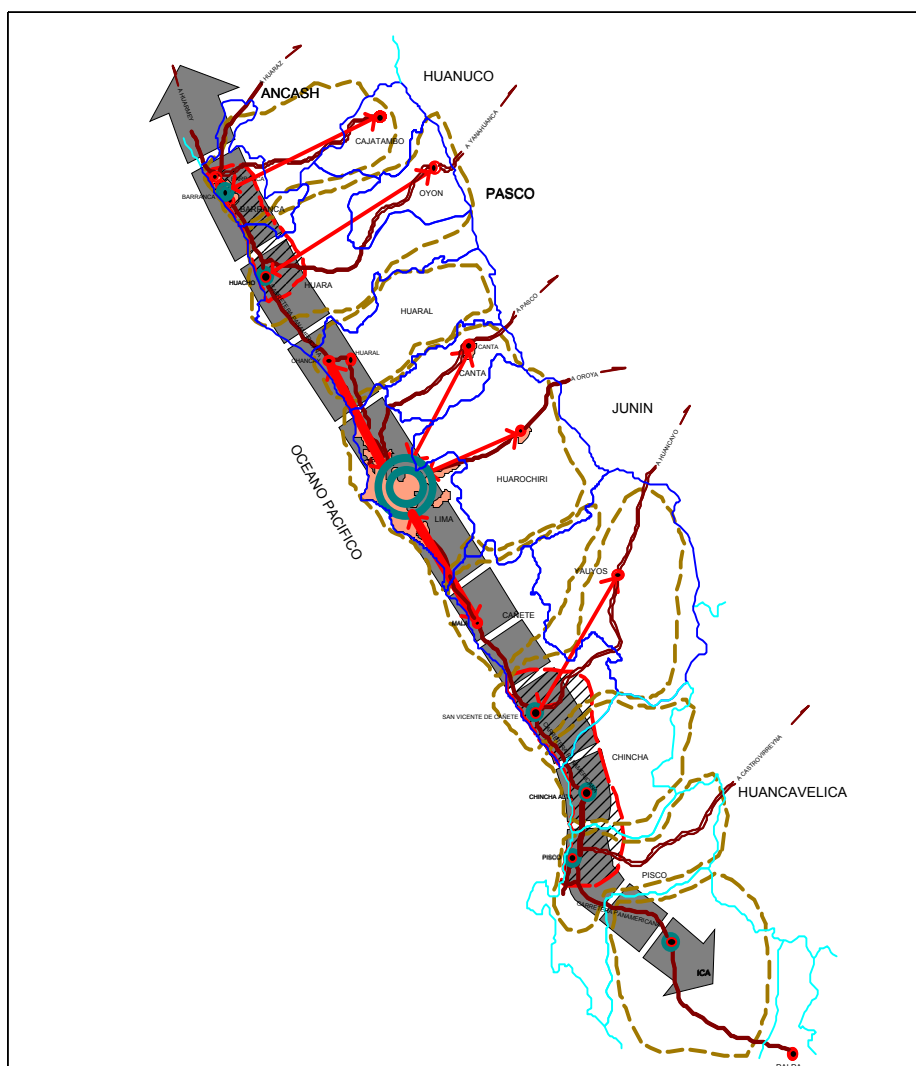


Figure 10.3-4 Schematic Concept of North-South Regional Development Corridor

Based on a series of discussions with the relevant agencies, including the IMP and the Ministry of Housing, the Study Team selected the Poly-centric Decentralized Development Pattern (Alternative-2) as the most probable metropolitan structure by the year 2025. The third alternative, the self-sustainable new town development pattern, may be the better option in terms of balanced development, but it will need a large investment for the development of infrastructure. Accordingly, the areas outside the 30-kilometer radius from the center of Lima will be developed after 2025. Figure 10.3-5 shows the future conceptual urban structure and Figure 10.3-6 shows the urban development scenario for the Metropolitan Area of Lima and Callao.

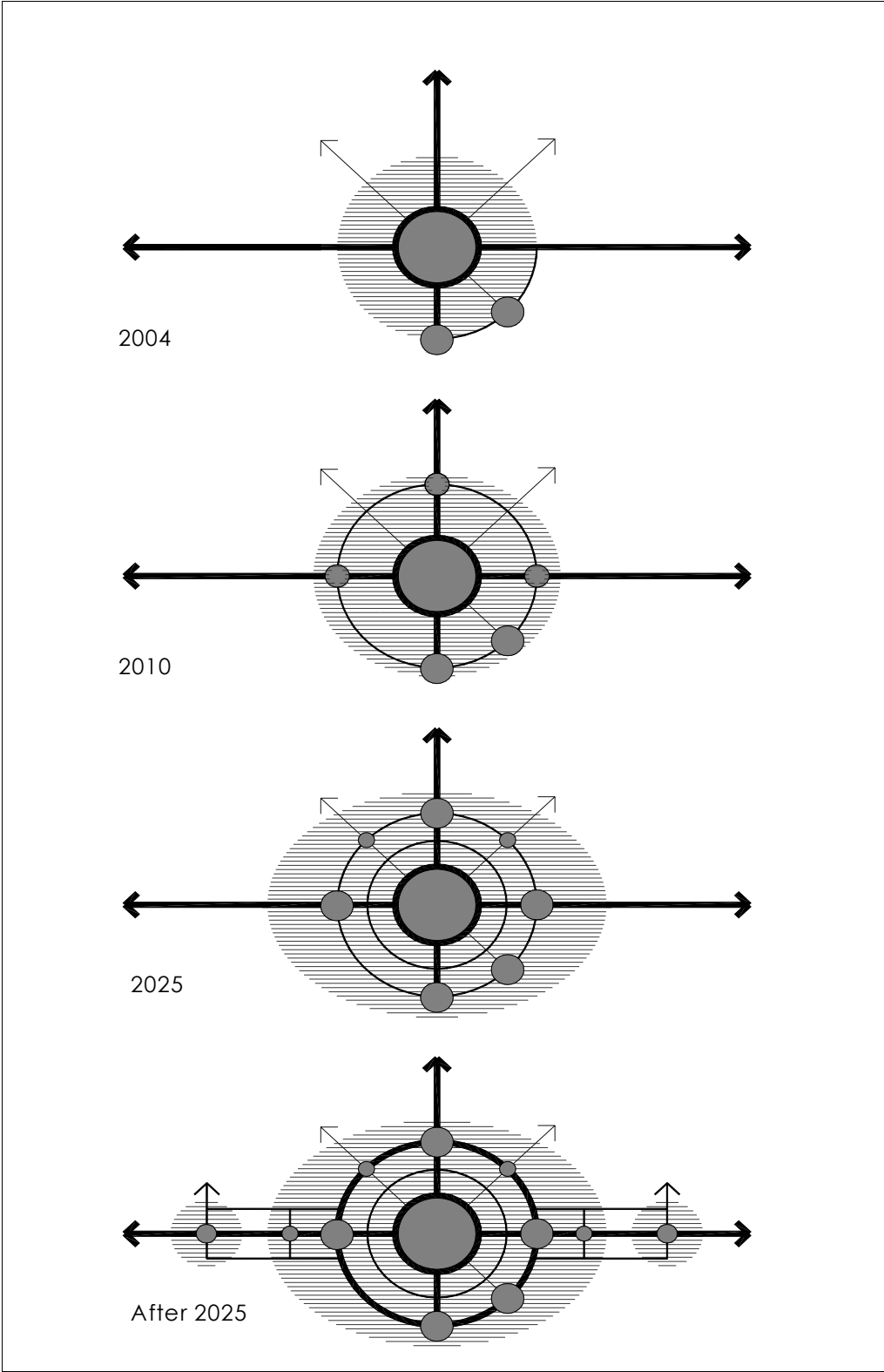


Figure 10.3-5 Schematic Concept of Future Urban Structure in the Metropolitan Area of Lima and Callao

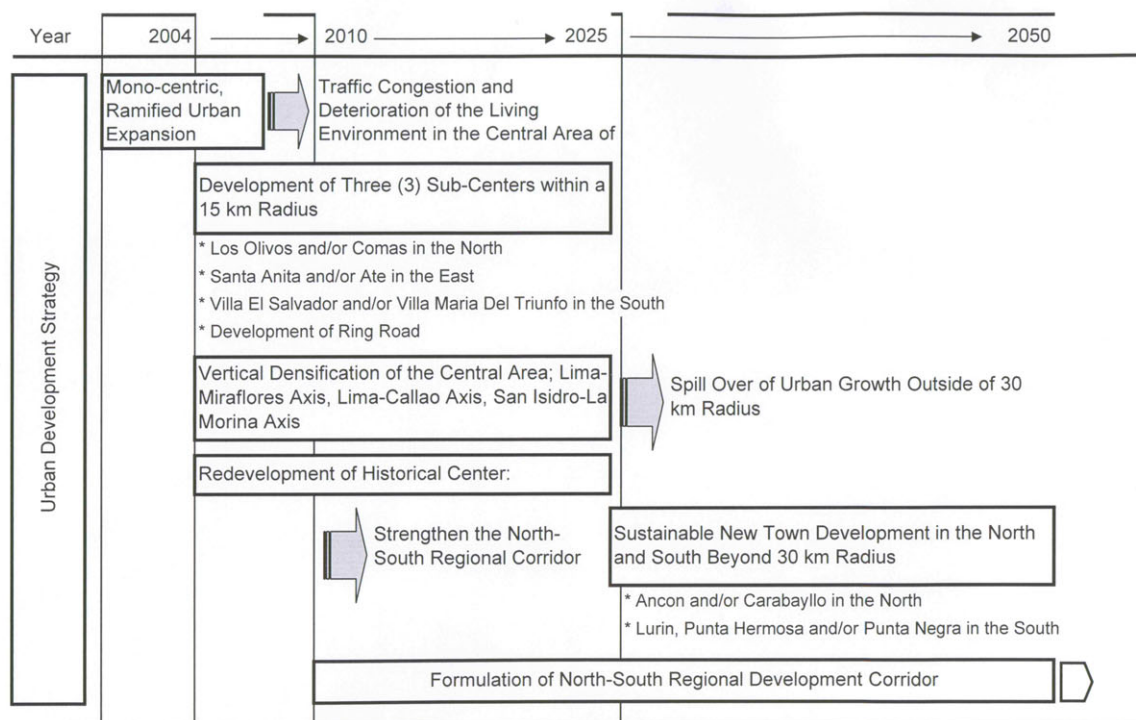


Figure-6 Urban Development Scenario

Figure 10.3-6 Urban Development Scenario for the Metropolitan Area of Lima and Callao

10.4. BASIC POLICIES FOR FUTURE LAND DEVELOPMENT TOWARDS 2025

The study team selected the poly-centric decentralized development pattern (Alternative-2) for the analysis of future traffic demand in 2025. In order to achieve the poly-centric decentralized urban structure, the governments need to establish land development policies to control urban development. The basic land development policies can be described as follows.

(1) To consolidate the Metropolitan Services in the Central Area

The Historical Center of Lima, including the districts of Lima and Rimac, will strengthen its functions as political, administrative and institutional center on a metropolitan and national level. Applying a special regime defined by a Municipal Regulation from the Province of Lima (Regulation 201), the historical monuments and buildings in the area should be restored as cultural and tourism attractions. The traffic regulations should be strengthened to avoid over congestion of the traffic in the central area.

The Lima–Miraflores Axis, including the districts of Lima, Breña, Jesús María, Lince, San Isidro, Surquillo and Miraflores, will consolidate the business and commercial activities at a metropolitan level. The areas along the Paseo de la República and Av. Arequipa will promote the mixed use of financial, commercial and institutional activities with vertical densification of residential areas.

The Lima and Callao Axis, the current industrial zones along Av. Argentina, Colonial and Venezuela, will be transformed to high-density housing areas. These areas will encourage the revitalization of the urban environment and population restoration in the central area.¹⁶

¹⁶ Based on discussions with the IMP, July 22, 2004.

The Coastal Axis, including the districts of La Punta, Callao, La Perla, San Miguel, Magdalena Del Mar, San Isidro, Miraflores, Barranco and Chorrillos, will consolidate the metropolitan recreational use as well as medium-density residential areas. The recreational area along the coast will be a tourism attraction.

The San Isidro-La Molina Axis, including the districts of San Isidro, San Borja, Santiago de Surco and La Molina, especially the area along Av. Javier Prado, will consolidate the mixed use of commercial and business activities with vertical densification of residential areas.

(2) To Promote Decentralization of Urban Services in Sub-Centers

The development of the sub-centers will encourage a decentralization of urban activities that are currently concentrated in the central area of Lima. The sub-centers will promote commercial and business activities at district and inter-district level, and their surrounding areas are occupied by medium and high-density residential areas.

The sub-centers will be located in the districts of Comas and/or Los Olivos in the north, Santa Anita and/or Ate in the east, and Villa El Salvador and/or Villa Maria Del Triunfo in the south. In order to encourage the development of sub-centers, some incentive measures should be provided, such as tax incentives.

In addition to the three sub-centers, it is recommended that new commercial and service centers at district level should be developed in terms of the future population growth in the outskirts of the Metropolitan Area. The potential areas of the new commercial centers are Puente Piedra in the north, Canto Grande of San Juan Lurigancho and Chosica of Lurigancho in the east, and Lurin in the south. Figure 10.4-1 shows the existing cores and future potential locations of sub-centers and urban service centers at district level.

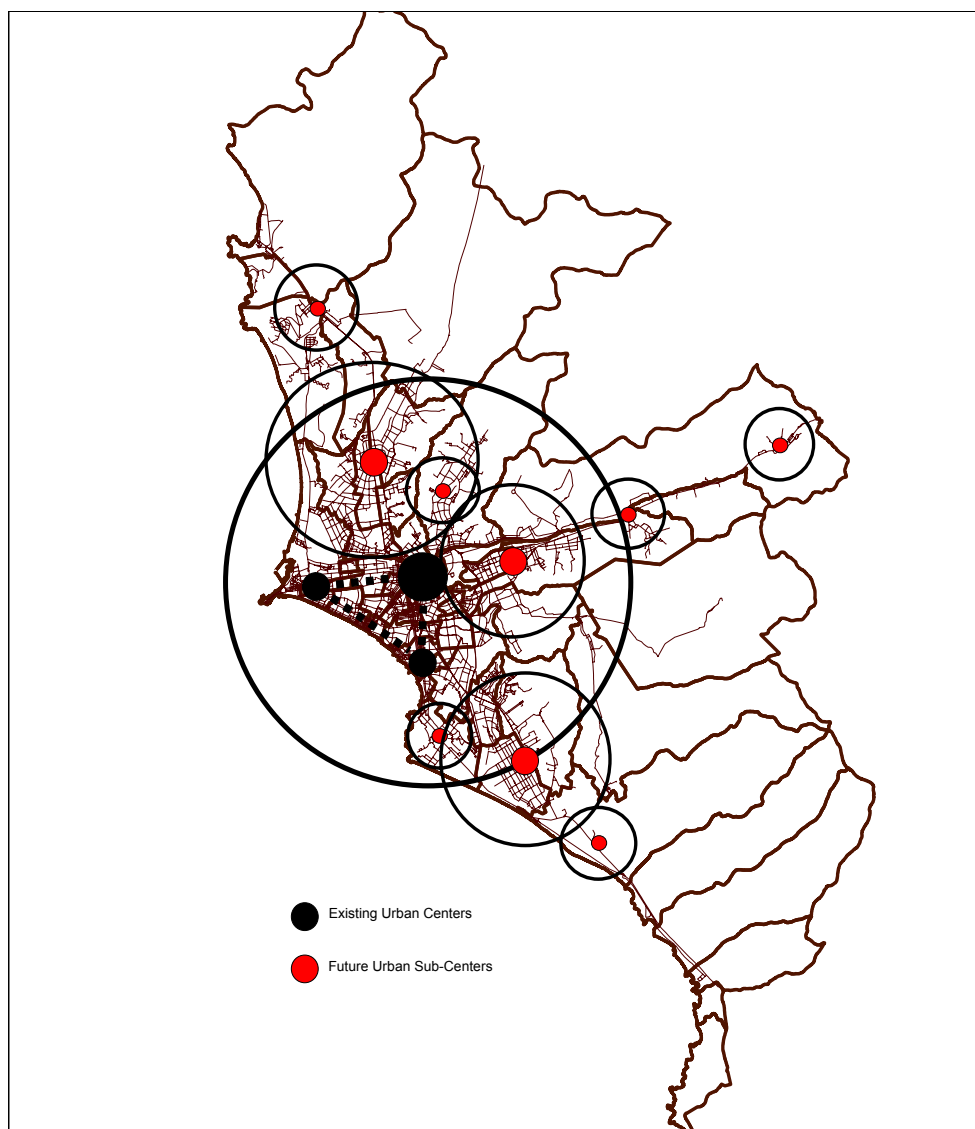


Figure 10.4-1 Existing Urban Centers and Future Decentralized Urban Sub-Centers

(3) To Consolidate the Existing Industrial Areas

The industries will be located in the strategic areas along the Panamericana Norte, the Carretera Central and the Panamericana Sur, outside of the central area. In addition, there are specific locations of industrial parks in Villa El Salvador, Zárata in San Juan Lurigancho, Cajamarquilla in Lurigancho, and Ventanilla and Gambetta in Callao.

In the area of immediate influence of the industrial zones, the mixed use as transition and complementary activities is proposed, such as the small industries, commerce and other urban services.

(4) To Develop Urban Service Equipments at District Level

The basic urban service equipments should be developed according to the population increase at district level, which includes primary and secondary schools, hospitals, parks and other service facilities.

(5) To Develop Informal Housing

A large number of informal housing occupy the outskirts of the Metropolitan area. The most critical issue in the informal housing is the lack of basic infrastructure and deterioration of their living environment. It is recommended that the informal housing should be combined with some productive activities, that is, the mixed use of industrial or agricultural activity. The potential sites of informal housing with the mixed use are: Carabayllo, Ventanilla and Ancon in the north, Punta Hermosa, Punta Negra and San Bartolo in the south, and Caballero and Huachipa in the east.

(6) To Preserve Agricultural Land

Many agricultural lands in the Rimac river basin have been lost and transformed into the residential areas over the last few decades. With strong measures of land management, the agricultural lands in the Chillón and Lurín river basins should be preserved. For this purpose, the upper stream areas of the rivers should be protected as ecological and natural reserves.

Based on the basic development policies mentioned above, the study team prepared a future land use plan in 2025 for the Metropolitan Area of Lima and Callao. In terms of planning perspective, preparation of future land use plan is always controversial because land use is a complex texture created by political decision and a variety of economic activities. If there are no strong measures and government initiatives to control future land development, the future land use plan would be meaningless. Furthermore, unexpected changes of economy or haphazard developments of informal settlements would cause different land use pattern. In this study, the future land use plan is prepared as a parameter to estimate future distributions of population and employment for the analysis of traffic demand.

The future land use plan was prepared based on the following sources: 1) Metropolitan Development Plan for Lima and Callao, 1990-2010 (*Plan de Desarrollo Metropolitano de Lima and Callao, 1990-2010*) published by the IMP in 1989; 2) Land use zoning maps in each district prepared by the IMP (scale is mostly 1:10,000); and 3) On-going and planned projects identified through available documents and interviews to the relevant agencies, including the IMP, Municipality of Lima and Ministry of Housing. The future land use plan is shown in Figure 10.4-2.

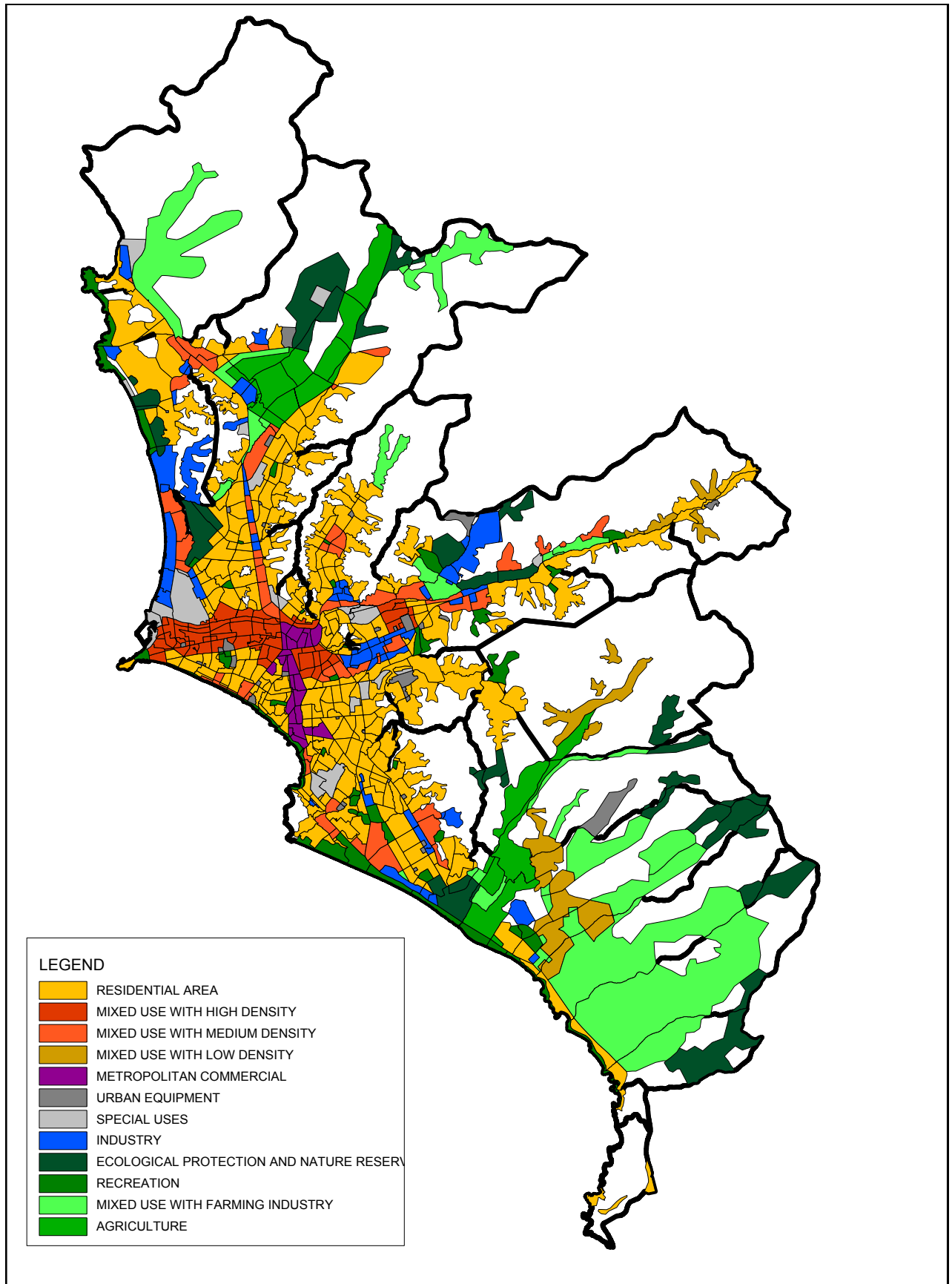


Figure 10.4-2 Land Use Plan in 2025

10.5. DISTRIBUTION OF FUTURE POPULATION AND EMPLOYMENT BY TRAFFIC ZONE

(1) Definition of the Traffic Zone

The traffic zone is a basic unit for the analysis of future transport demand and supply. For this purpose, the study team divided the Metropolitan Area of Lima and Callao into 427 traffic zones, in consideration of the administrative boundaries, population census zone boundaries, and land use pattern, physical boundaries such as rivers, arterial roads, railways and slopes.

(2) Methodology of Population by Traffic Zone

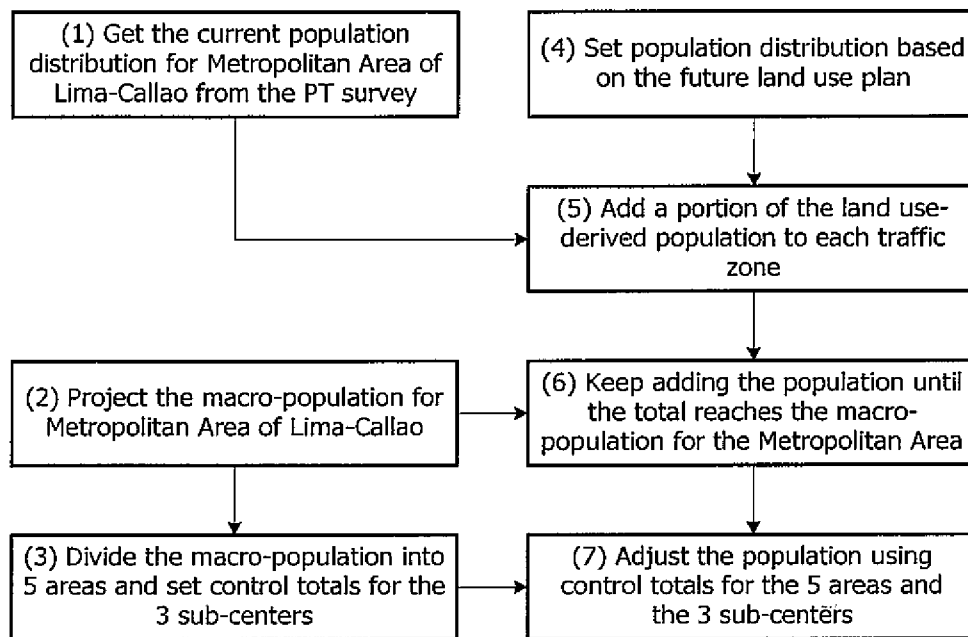


Figure 10.5-1 Flowchart of Projection Process of Future Population Distribution by Traffic Zone

The projection process of future population distribution by traffic zone in 2010 and 2025 is illustrated in Figure 10.5-1, and each work item in the process is described as follows:

- (1) From the results of the Person Trip (PT) survey, the current population in 2004 of each traffic zone is obtained. This is the current population distribution and it is the basis for the projection of future population of each traffic zone in 2010 and 2025.
- (2) Based on the several sources prepared by INEI, such as long-term population projection for Peru and official statistical data for Lima and Callao provinces, future macro-population in the Metropolitan Area of Lima-Callao is estimated.
- (3) The future macro-population in the Metropolitan Area of Lima-Callao is divided into five areas (Central, North, South, and East Lima, and Callao), taking the balance of future regional development into consideration. In addition to this, the proposed three sub-centers in which intensive urban development is proposed are considered separately from the future macro-population distribution. (The future regional development policies and proposed sub-centers development are discussed in section 10.4 of this report.)
- (4) Apart from the current population distribution based on the result of PT survey, another population distribution is prepared based on the future land use pattern as a parameter to project future population distribution in each traffic zone. The land use-derived population in each traffic zone is calculated by multiplying the area of

each land use type (i.e. residential, commercial, industry, agriculture and so on) and the estimated population densities by each land use type. Thus the land use-derived population is a result of population estimation based on future land use pattern and population density by type of land use in each traffic zone.

- (5) The land use-derived population in each traffic zone obtained in (4) does not reflect the current population derived from the PT survey, and the aggregated population in the Metropolitan Area, which is an accumulation of the land use-derived population in each traffic zones, is not equal to the macro-population obtained in (2). In this study, we assumed that the future increment of population in each traffic zone will follow the tendency of the land use-derived population distribution. Thus, a certain percentage of the land use-derived population is added to the current population in each traffic zone.
- (6) The percentage of the land use-derived population to be added to each traffic zone are determined so as to be equal the accumulated population in the Metropolitan Area to the macro-population that was projected in (2), as a control total.
- (7) Finally, the future population in each traffic zone calculated in (6) is aggregated by five areas (Central, North, South, and East Lima, and Callao) as well as by three sub-centers. The future populations of traffic zones in the five areas and three sub-centers are adjusted to meet with the control totals that were estimated in (3).

(3) Distribution of Future Population by Traffic Zone

The future population by traffic zone was allocated in considerations of the future land use pattern and population density by land use category¹⁷ in 2025. In our estimation, the total population will increase by nearly 3.0 million habitants between 2004 and 2025. Table 10.5-1 summarizes the results of future population distribution in the areas of Central, North, South and East Lima and Callao. East Lima will increase by about 835,000 habitants from 2004 to 2025, followed by North Lima with about 453,000 habitants and South Lima with about 721,465 habitants. Although the central area shows population decrease in the recent year, it is estimated to increase the population by a vertical densification of the residential area and a transformation of the land use from industrial use to residential use, particularly in the area along the Lima and Callao axis. The distribution of future population in 2025 by district¹⁸ is shown in Table 10.5-2. The population densities by traffic zone in 2004 and 2025 are illustrated in Figure 10.5-2 and Figure 10.5-3.

¹⁷ The Study Team used the average population density to estimate preliminary future population by traffic zone. The average population densities are: 10 person/ha in mixed farming area, 60 persons/ha in low density mixed use area, 110 persons/ha in industry, commercial, medium-low density residential and medium-low density mixed use areas; 160 persons/ha in medium density residential and medium density mixed use areas; and 210 persons/ha in medium-high density residential and medium-high density mixed use areas. Then, the number of population by traffic zone was adjusted by the existing population of 2004 in each traffic zone and the control total of increasing population from 2004 to 2025.

¹⁸ Due to methodological limitations, some districts, such as La Molina and San Isidro, shows higher population growth than that is estimated by the trend, and the districts, such as San Juan de Miraflores and San Juan de Lurigancho, shows lower population growth than that is estimated by the trend.

Table 10.5-1 Distribution of the Future Population, 2004, 2010 and 2025

(Unit: persons)

Area	Year			Increase	
	2004	2010	2025	2004-2010	2010-2025
Central Lima	2,239,144	2,420,873	2,895,250	181,729	474,377
North Lima	1,728,968	1,881,640	2,182,784	152,672	301,144
South Lima	1,428,428	1,620,090	2,149,883	191,662	529,793
East Lima	1,763,395	2,008,245	2,598,992	244,850	590,747
Callao	883,129	955,333	1,166,589	72,204	211,256
Total	8,043,064	8,886,181	10,993,498	843,117	2,107,317

Source: The JICA study team

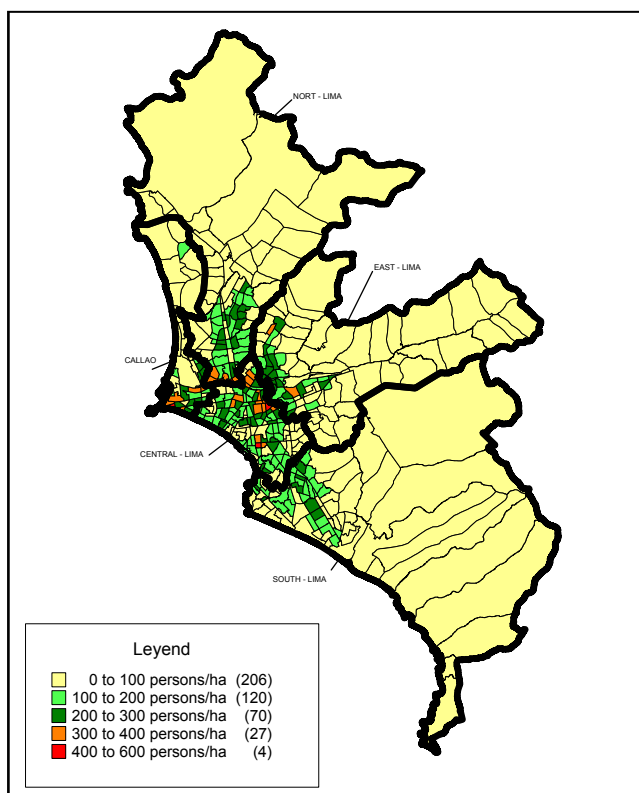


Figure 10.5-2 Population Density in 2004 by Traffic Zone

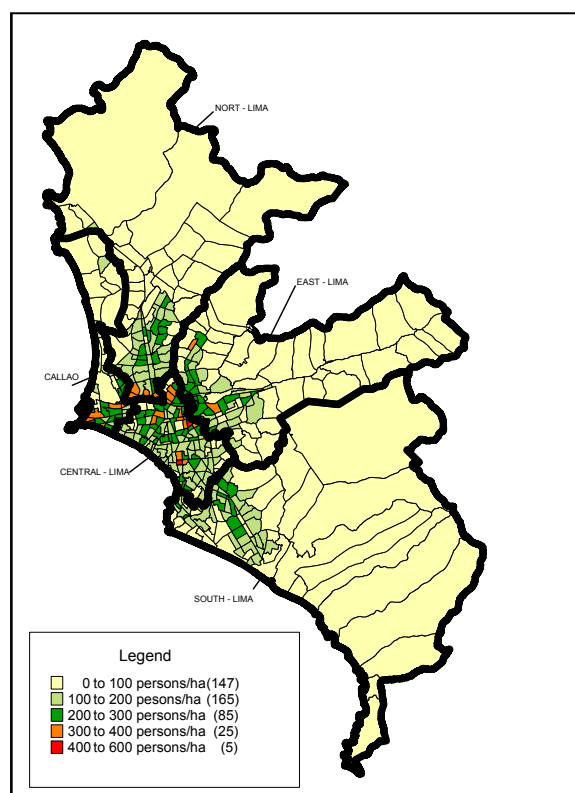


Figure 10.5-3 Population Density in 2025 by Traffic Zone

Table 10.5-2 Distribution of Future Population 2025 by District

Area	District Name	Area(ha)	2004	Pop. Density 2004	2010	Pop. Density 2010	2025	Pop. Density 2025
TOTAL LIMA		270,590	7,159,935	26.5	7,930,848	29.3	9,826,909	36.3
Central Area	Lima	2,169	345,325	159.2	356,697	164.5	389,291	179.5
	Barranco	276	47,176	171.2	51,614	187.3	57,132	207.4
	Breña	322	96,700	300.8	94,900	295.2	96,751	300.9
	Jesús María	436	68,097	156.3	73,489	168.7	79,276	182.0
	La Victoria	912	233,692	256.4	236,838	259.8	245,223	269.0
	Lince	277	73,071	263.7	71,276	257.2	72,666	262.2
	Magdalena del Mar	328	55,266	168.4	57,387	174.9	62,516	190.5
	Pueblo Libre	464	82,131	177.0	84,822	182.8	86,474	186.3
	Miraflores	919	96,592	105.1	106,050	115.4	123,729	134.6
	Puente Piedra	5,110	175,369	34.3	235,628	46.1	421,275	82.4
	Rímac	1,218	213,470	175.3	215,095	176.6	219,286	180.1
	San Borja	1,040	126,937	122.1	140,890	135.5	157,594	151.6
	San Isidro	974	71,890	73.8	94,051	96.6	164,698	169.1
	San Luís	351	61,476	175.2	60,647	172.9	61,828	176.2
	San Miguel	965	132,863	137.7	139,321	144.4	150,020	155.5
Santiago de Surco	3,468	258,427	74.5	301,881	87.1	405,250	116.9	
Surquillo	463	100,662	217.4	100,287	216.6	102,241	220.8	
Central Area		19,689	2,239,144	113.7	2,420,873	123.0	2,895,250	147.0
North Area	Ancon	32,303	21,971	0.7	32,588	1.0	62,685	1.9
	Carabaylo	35,749	164,872	4.6	177,653	5.0	258,122	7.2
	Comas	4,939	494,635	100.1	527,335	106.8	609,537	123.4
	Independencia	1,609	207,464	128.9	209,682	130.3	220,167	136.8
	Los Olivos	1,839	305,045	165.9	316,377	172.1	339,679	184.7
	San Martín de Porres	3,642	511,356	140.4	570,697	156.7	562,458	154.5
	Santa Rosa	1,991	23,625	11.9	47,308	23.8	130,136	65.4
North Area		82,072	1,728,968	21.1	1,881,640	22.9	2,182,784	26.6
South Area	Chorrillos	3,697	260,551	70.5	298,348	80.7	347,625	94.0
	Cieneguilla	22,660	14,351	0.6	30,581	1.3	79,634	3.5
	Lurín	18,747	51,202	2.7	78,740	4.2	167,873	9.0
	Pachacamac	17,275	32,453	1.9	50,398	2.9	109,498	6.3
	Pucusana	3,058	4,604	1.5	4,605	1.5	4,695	1.5
	Punta Hermosa	12,096	5,411	0.4	17,005	1.4	55,411	4.6
	Punta Negra	13,430	4,394	0.3	18,251	1.4	63,987	4.8
	San Bartolo	5,308	3,572	0.7	7,467	1.4	17,207	3.2
	San Juan de Miraflores	2,072	378,138	182.5	383,406	185.1	397,849	192.0
	Santa María del Mar	791	0	0.0	1,280	1.6	3,904	4.9
Villa el Salvador	3,405	337,252	99.0	344,656	101.2	403,584	118.5	
Villa María del Triunfo	7,448	336,500	45.2	385,353	51.7	498,616	66.9	
South Area		109,987	1,428,428	13.0	1,620,090	14.7	2,149,883	19.5
East Area	Ate	8,397	359,364	42.8	448,492	53.4	571,545	68.1
	Chaclacayo	4,189	41,892	10.0	58,350	13.9	111,537	26.6
	El Agustino	1,357	166,499	122.7	169,908	125.3	185,719	136.9
	La Molina	4,982	140,362	28.2	200,759	40.3	379,427	76.2
	Lurigancho	24,785	128,055	5.2	173,185	7.0	309,345	12.5
	San Juan de Lurigancho	14,059	769,668	54.7	789,699	56.2	842,551	59.9
Santa Anita	1,073	157,555	146.9	167,852	156.5	198,868	185.4	
East Area		58,841	1,763,395	30.0	2,008,245	34.1	2,598,992	44.2
Callao Area	Callao	4,897	382,090	78.0	414,343	84.6	528,837	108.0
	Bellavista	459	86,445	188.4	90,510	197.2	96,633	210.6
	Carmen de la Legua	194	45,824	236.0	45,770	235.7	46,663	240.3
	La Perla	330	68,431	207.5	68,447	207.5	69,780	211.6
	La Punta	60	7,362	122.5	8,848	147.2	12,043	200.4
Ventanilla	8,171	292,977	35.9	327,415	40.1	412,633	50.5	
Callao Area		14,111	883,129	62.6	955,333	67.7	1,166,589	82.7
TOTAL LIMA & CALLAO		284,700	8,043,064	28.3	8,886,181	31.2	10,993,498	38.6

(Source: JICA Study Team)

(4) Distribution of Future Working Population by Traffic Zone

According to our estimation, the total working population will be increased by nearly 2.5 million persons in the Metropolitan Area: from 3,568,000 persons in 2004 to 6,086,000 persons in 2025. The distribution of the increased working population by sector was estimated based on the future locations of the industries. The employments of the primary sector will be located mainly in the river basins of Chillón and Lurín. The increased employments of the secondary sector will be located at strategic places along the Panamericana Norte, Panamericana Sur and Carretera Central as well as proposed industrial parks outside the central area of Lima. The increased employments of the tertiary sector will be allocated in the proposed three (3) sub-centers.

Although the tertiary employments will be located in the three sub-centers to promote decentralized urban structure, the existing central area will maintain its major functions as political, administrative, commercial and financial center on a national and metropolitan level. The central area of Lima will show a moderate growth of the tertiary employments, which will be achieved through the urban renewal of the historical center of Lima (Cercado) and a vertical densification of urban activities, particularly in the Lima-Miraflores axis and the San Isidro-La Molina axis. Table 10.5-3 summarizes the distribution of the future working population in the Central, North, South and East Lima, and Callao. Figure 10.5-4 shows the increment of the working population between 2004 and 2025 by traffic zone. According to this figure, a large number of increased working populations can be seen in the north, south and east, particularly the areas outside of 10 km radius from the central area.

Table 10.5-3 Distribution of the Future Working Population, 2004, 2010 and 2025

(Unit: persons)

Area	Year			Increase	
	2004	2010	2025	2004-2010	2010-2025
Central Lima	2,451,554	2,640,316	2,856,138	188,762	315,822
North Lima	291,774	369,059	645,548	77,285	256,489
South Lima	192,782	312,445	617,515	119,663	295,070
East Lima	361,869	563,418	1,061,109	201,549	457,691
Callao	270,196	422,109	905,215	151,913	453,106
Total	3,568,178	4,307,347	6,085,525	738,169	1,778,178

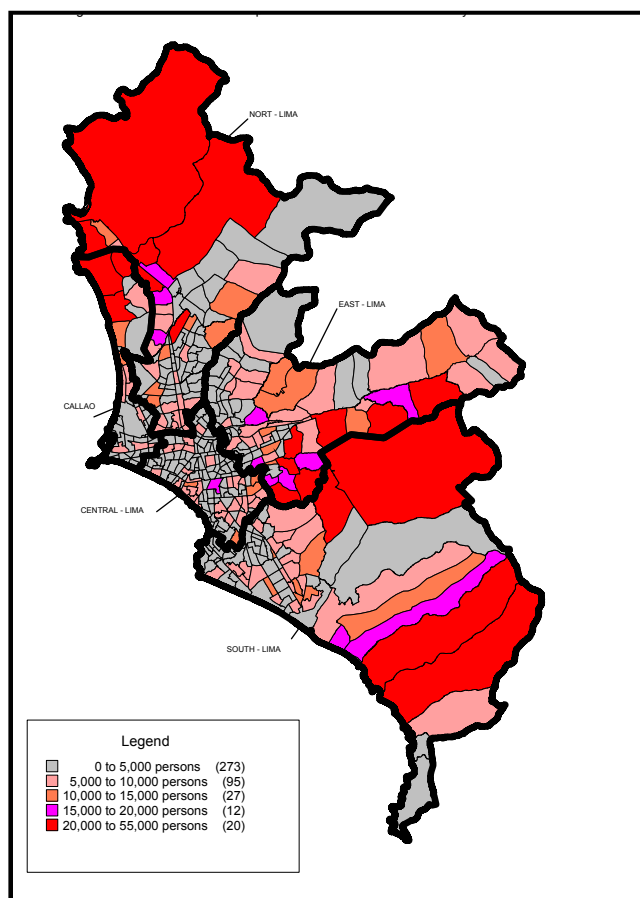


Figure 10.5-4 Increment of Working Population between 2004 and 2025 by Traffic Zone

(5) Distribution of the Future Population by Social Estrato

Based on the analysis of the Parson Trip survey conducted by the Study Team and the data prepared by the INEI¹⁹, the present population was classified into five categories of socioeconomic Estratos (from A-high, B-medium high, C-medium, D-medium low to low-E). The Study Team estimated future population distribution by the socioeconomic Estrato, based on the macro economic projection discussed in the section 10.2 of this report. Table 10.5-4 summarizes the distribution of population in 2004 and 2025 by each socioeconomic Estrato.

According to our estimation, the socioeconomic structure will be changed significantly from 2004 to 2025. The population of socioeconomic Estratos A (high) and B (medium high) will increase from 1,635.8 thousands persons in 2004 to 3,817.2 thousands persons in 2025, and the percentage shares in the total population will also increase from 20.2% to 34.7% during the period. Due to the economic growth of per capita income, the population of socioeconomic Estrato D (medium low) will decrease from 3,306.9 thousands persons or 41.1% in 2004 to 2,425.4 thousands persons or 22.1% in 2025. The population of socioeconomic Estrato E (low) will also decrease from 1,228.8 thousands persons or 15.3% in 2004 to 1,007.2 thousands persons or 9.2% in 2025.

¹⁹ Planos Estratificados de Lima Metropolitana Nivel de Manzanas Segun Estratos Cocioeconomicos de Los Hogares, 1998, INEI.

Table 10.5-4 Distribution of Future Population by Estrato

Estrato	Number of Population(1,000 persons)		Increase (B)-(A)
	2004 (A)	2025 (B)	
Estratos A&B	1,635.8	3,817.2	2,181.4
Estrato C	1,871.6	3,743.7	1,872.1
Estrato D	3,306.9	2,425.4	-881.5
Estrato E	1,228.8	1,007.2	-221.6
Total	8,043.1	10,993.5	2,950.4

The population distribution in 2004 and 2025 by socioeconomic Estrato are illustrated through Figure 10.5-5 to Figure 10.5-12. According to these figures, the distribution of each socioeconomic Estrato shows a centrifugal pattern from the center to outskirts. For instance, the population of high and medium-high socioeconomic Estratos is concentrated in the central areas and it will expand mostly to the vicinities within 10-15 km radius from the existing central area. The population of medium socioeconomic Estrato occupies the areas outside of high and medium-high socioeconomic Estratos and will expand to the outside of 15 km radius. The population of medium-low and low socioeconomic Estratos occupies the areas outside of medium socioeconomic Estratos and will expand to the far outside, beyond 30 km radius. This population distribution pattern by socioeconomic Estrato tells us that future transportation planning in the Metropolitan Lima and Callao must pay much attention to the mobility of the people in medium-low and low socioeconomic Estratos who will live in the area far away from the existing central area.

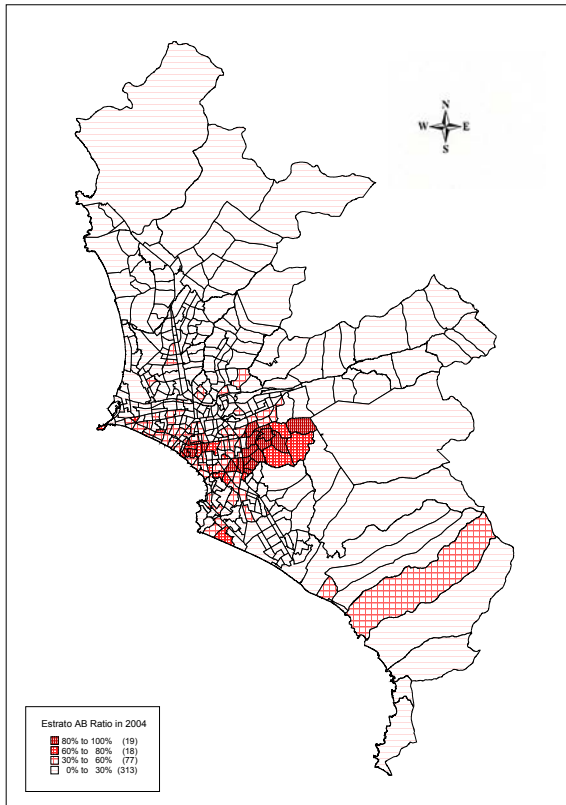


Figure 10.5-5 Population Distribution of Estrato A and B in 2004 by Traffic Zone

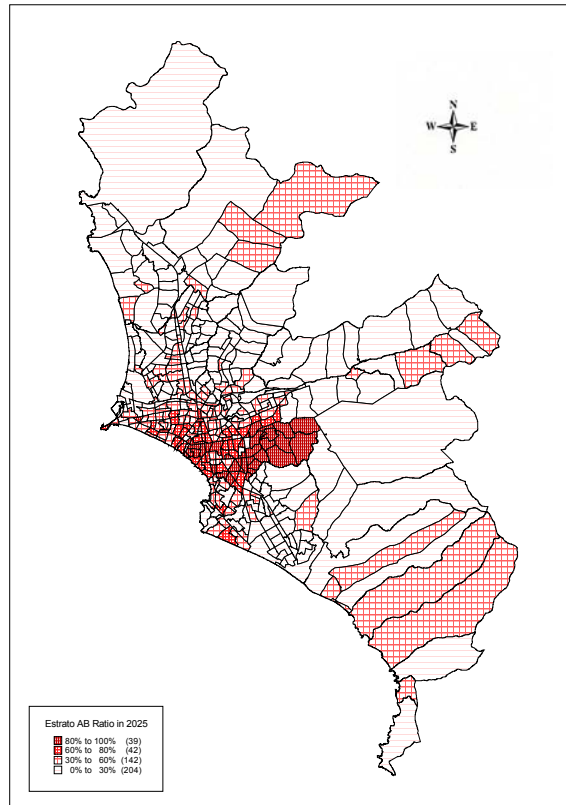


Figure 10.5-6 Population Distribution of Estrato A and B in 2025 by Traffic Zone

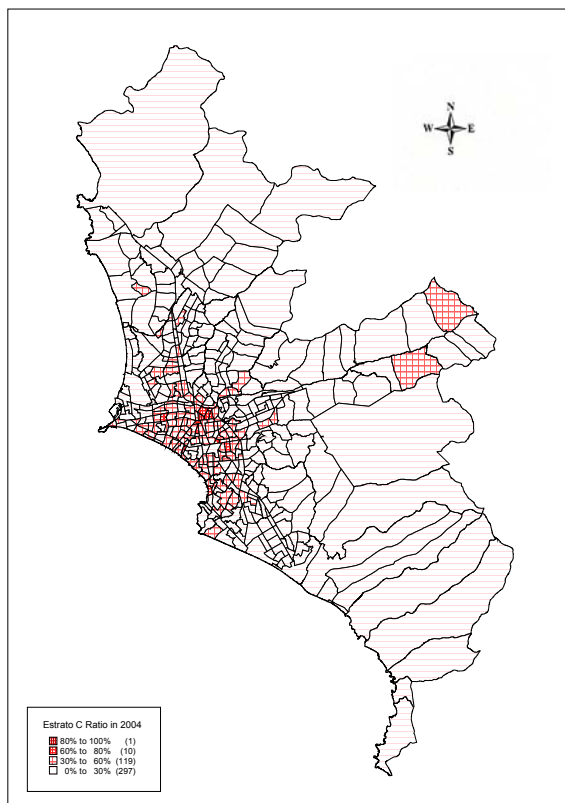


Figure 10.5-7 Population Distribution of Estrato C in 2004 by Traffic Zone

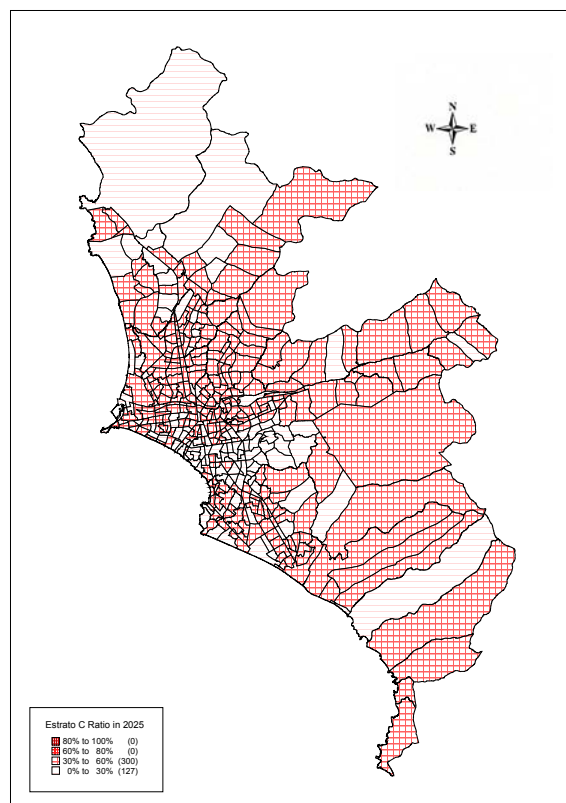


Figure 10.5-8 Population Distribution of Estrato C in 2025 by Traffic Zone

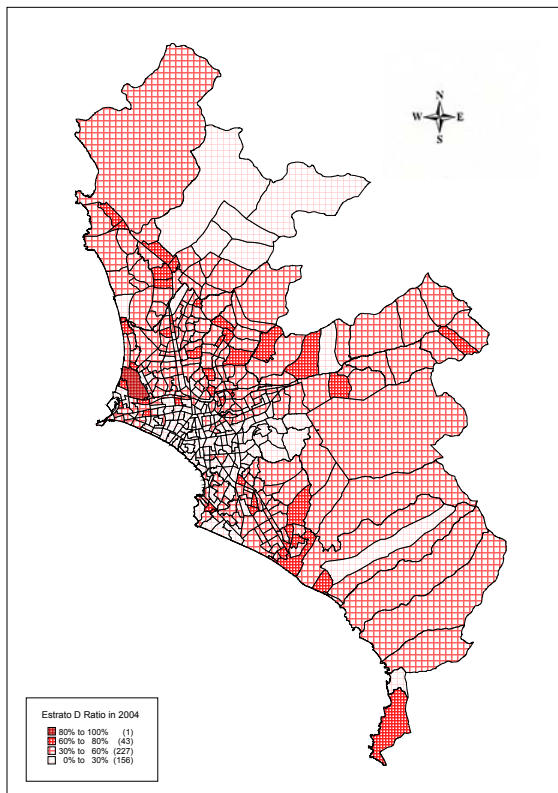


Figure 10.5-9 Population Distribution of Estrato D in 2004 by Traffic Zone

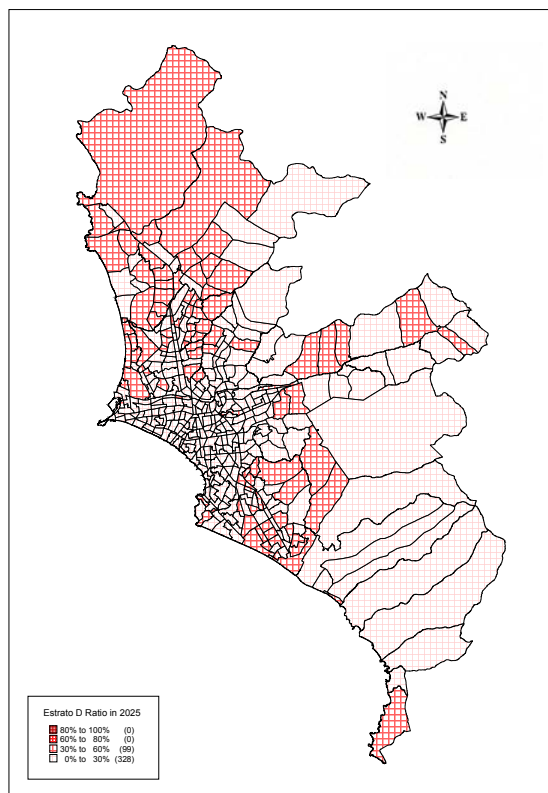


Figure 10.5-10 Population Distribution of Estrato D in 2025 by Traffic Zone

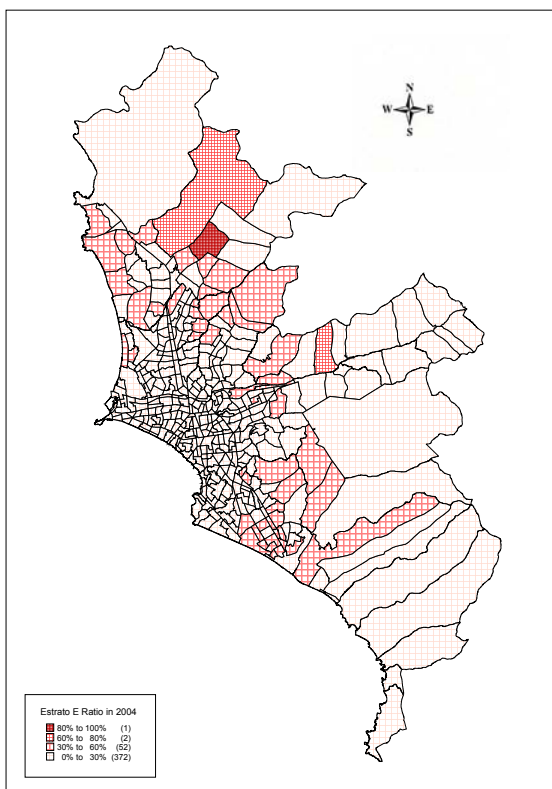


Figure 10.5-11 Population Distribution of Estrato E in 2004 by Traffic Zone

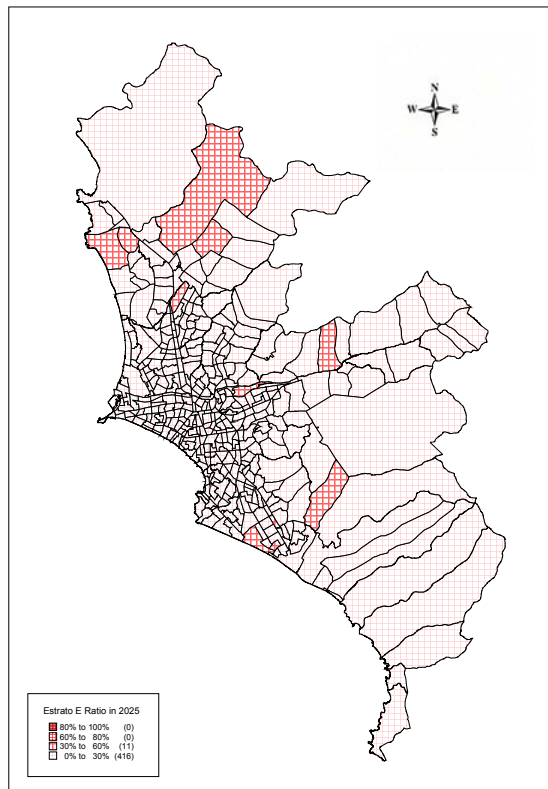


Figure 10.5-12 Population Distribution of Estrato E in 2025 by Traffic Zone