Directorate General of Railways
Ministry of Transportation
The Republic of Indonesia

THE PREPARATORY SURVEY FOR JAKARTA MASS RAPID TRANSIT EAST-WEST LINE PROJECT

FINAL REPORT

DECEMBER 2013

JAPAN INTERNATIONAL COOPERATION AGENCY
NIPPON KOEI CO., LTD.
JR EAST CONSULTANTS COMPANY

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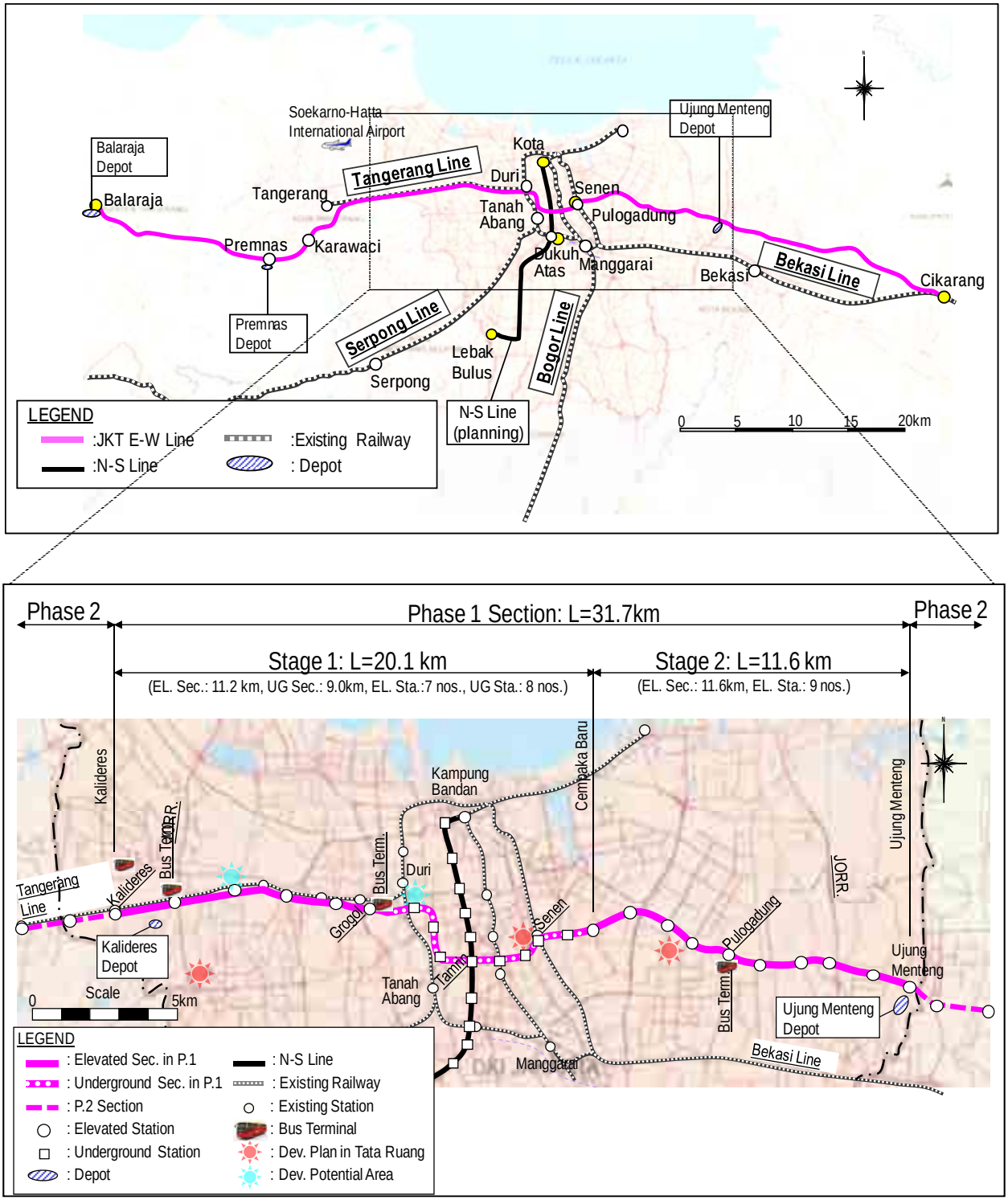
LOCATION MAP



JICA PREPARATORY SURVEY
FOR
JAKARTA MASS RAPID TRANSIT EAST-WEST LINE PROJECT

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Abbreviation

AC	Alternate Current
AFC	Automatic Fare Collection
AMDAL	Environmental Impact Assessment Report
ANDAL	Environmental Impact Statement
ARSDS	Arterial Roads Development Study in Jakarta Metropolitan Area
ATO	Automatic Train Operation
ATP	Automatic Train Protection

ATS	Automatic Train Supervision
BAKOSURTANAL	National Mapping and Survey Agency
BPN	National Land Board (Badan Pertanahan Nasional)
BRT	Bus Rapit Transit
BUMD	Regional-Owned Enterprises (Badan Usaha Milik Daerah)
BUMN	State-Owned Enterprises (Badan Usaha Milik Negara)
CAT	City Air Terminal
CBD	Central Business District
CBTC	Communication-Based Train Control
CCTV	Closed-Circuit Television
CDM	Clean Development Mechanism
CIL	Computarized Interlocking System
CWR	Continuous Welded Rail
DC	Direct Current
DG	Diesel Generator
DGR	Directorate General of Railway
DKI Jakarta	Special Capital City Jakarta (Daerah Khusus Ibukota Jakarta)
DPU	Public Works Agency (Dinas Pekerjaan Umum)
DTST	Double Tube Single Track
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ER	Electric Room
ERP	Enterprise Resource Planning
ERP	Electronic Road Pricing
FAM	Fare Adjustment Machine
FGD	Focus Group Discussion
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographic Information System
GRDP	Gross Regional Domestic Product
IC	Integrated Circuit
IEC	International Electro technical Commission
IMO	Indonesian Railway Technical Standard
IP	Implementation Plan
ISO	International Organization for Standardization
JABODETABEK	Jakarta, Bogor, Depok, Tangerang and Bekasi (Great Jakarta)
JABOTABEK	Jakarta, Bogor, Tangerang and Bekasi
JICA	Japan International Cooperation Agency
JKT	Jakarta
JMDP	Jabotabek Metropolitan Development Plan
JST	JICA Study Team

JTA	JABOTABEK Transportation Authority
JUTPI	JABOTABEK Urban Transportation Policy Integration
JWG	Joint Working Group
KA-ANDAL	TOR of Environmental Impact Statement
KRL	Electrified Rail (Kereta Rel Listrik)
KV	Kilo volt
LARAP	Land Acquisition and Resettlement Action Plan
LPC	Land Procurement Committee
LV	Low voltage
MCA	Multi Criteria Analysis
MPA	Metropolitan Priority Area
MRT	Mass Rapid Transit
MRTJ	PT. Mass Rapid Transit Jakarta
NAMA	Nationally Appropriate Mitigation Action
OCC	Operational Control Center
OD	Origin and Destination
ODA	Official Development Assistance
OHC	Over Head Catenary
OP	Operational Policy
PCC	Power Control Center
PCM	Public Consultation Meeting
PDD	Project Design Document
PHPDT	Peak Hour Peak Direction Traffic
PLN	National Electricity Company (Perusahaan Listrik Negara)
PPP	Public Private Pertnership
PSD	Platform Screen Door
PT KAI	PT Kereta Api Indonesia
RKL	Environmental Management Plan (Rencana Pengelolaan Lingkungan)
ROW	Right of Way
RPJM	Medium-term National Development Plan of Indonesia (Rencana Pembangunan Jangka Menengah)
RPL	Environmental Monitoring (Rencana Pengelolaan Linkungan)
RSS	Receiving SubStation
SCADA	Supervisory Control and Data Acquisition
SITRAMP	Study on Integrated Transportation Master Plan for Jabodetabek
STDT	Single Tube Double Track
STEP	Special Terms of For Economic Partnership
STRASYA	General Specification for Standard Urban Railway System for Asia
TDM	Transportation Demand Management
TOD	Transit Oriented Development
TOM	Ticket Office Machine
TSS	Traction SubStation
TVM	Ticket Vending Machine

UKL	Environmental Management Direction (Upaya Pengelolaan Lingkungan)
UKP4	Presidential Work Unit for Development Monitoring and Control (Unit Kerja Presiden bidang Pengawasan dan Pengendalian Pembangunan)
UPL	Environmental Monitoring Direction (Upaya Pemantauan Lingkungan)
UPS	Uninterruptible Power Supply
WBC	West Bajir Canal

Chapter 1 Introduction

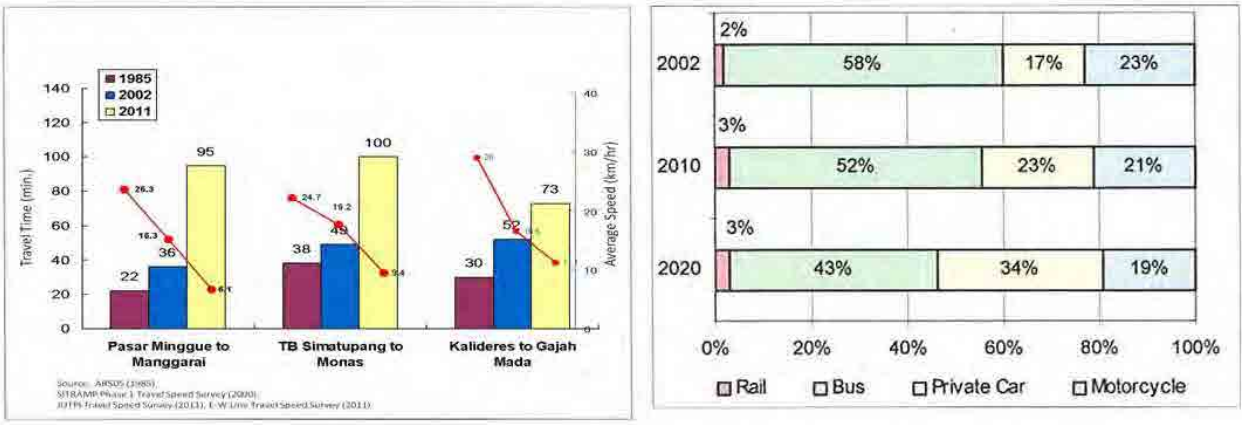
1.1 Background of the Study

The population of JABODETABEK[1] area, the center of the Indonesian economy and commerce, has increased 1.4 times over the past 15 years, from 17 million in 1990 to 26.6 million in 2010[2]. The economic status of the area has contributed to about 30% of Indonesia's gross domestic product (GDP). The number of registered motor vehicles in the area has rapidly increased from 3.26 million in 2000 to 9.99 million in 2009[3], and further increase is anticipated in the near future.

Source: JICA Study Team

Photo 1.1-1 Traffic Congestion in Jakarta

According to the past study conducted by JICA, traffic modal split shared by road traffic in JABODETABEK is approximately 97% (refer to Figure 1.1-1). It shows a high degree of reliance on road traffic, which causes chronic traffic congestion as shown in Photo 1.1-1. Consequently, the average travelling speed has decreased to as low as 10 km/hr during peak hours.



Source: Study on Integrated Transportation Master Plan II (SITRAMP 2) by JICA in 2004

Figure 1.1-1 Downward Trend of Average Traffic Speed and Increased Tendency of Vehicle and Motorcycle Traffic Share in Jakarta

In the Medium-Term National Development Plan of Indonesia (hereinafter referred to as Rencana Pembangunan Jangka Menengah 2010–2014 or RPJM 2010–2014), the following were raised as the development objectives of the transport sector: 1) the expansion of transport infrastructure and capacity, 2) the improvement of access to transport infrastructure, 3) the improvement of safety of transport infrastructure, 4) the rebuilding of existing systems for transportation services, and 5) the development of mitigation and adaptation measures against climate change. Especially in the urban transport sector, this project has been cited as a solution to meet the need for the enhancement of railway networks.

Meanwhile, the Study on Integrated Transportation Master Plan II (hereinafter referred to as SITRAMP 2) by the Japan International Cooperation Agency (JICA) in 2004 showed the

[1] JABODETABEK, an acronym for "DKI Jakarta, Bogor, Depok, Tangerang, Bekasi"
[2] Data source; Badan Pusat Statistik (Statistics Indonesia)
[3] Data source; Komisi Kepolisian Indonesia (Independent Commission of Police Research Indonesia)

importance of establishing an integrated public transport network in order to encourage citizens to utilize public transportation. In the Study, a transportation system in the east and west directions was proposed for the development of Jakarta Metropolitan Area. Prior to east-west transportation axis, Japanese loan has been continuously provided since 2006 for the Jakarta Mass Rapid Transport Project (Lebak Bulus to Bunderan HI, so-called MRT North-South Line), and an extension line up to Kampung Bandan is being planned. Jakarta MRT East-West is important not only in dealing with the improvement of passenger-friendliness and the increasing number of passengers, but also in expanding railway networks.

Based on the above facts, in order to confirm the possibility of loan provision to this project, JICA, in December 2011, exchanged minutes of discussion (MoD) through discussion among the stakeholders such as the National Development Planning Agency (hereinafter referred to as BAPPENAS), the Directorate General of Railways (hereinafter referred to as DGR), DKI Jakarta and PT Mass Rapid Transit Jakarta (hereinafter referred to as PT. MRTJ) on the contents of the preparatory survey, and agreed to dispatch a Study Team.

1.2 Objectives

The primary objectives of the JICA Preparatory Survey are as follows:

【a】 Select a primary route out of the five alternative routes shown in the pre–feasibility study (hereinafter called Pre-FS), and conduct a feasibility study, including preliminary design and project cost estimates.
【b】 Study the route for smooth transfer ensuring transit-oriented development (TOD) and through operation with existing railway networks.
【c】 Estimate climate change mitigation impact.
【d】 Prepare an implementation program (I/P) for realization of the project.
【e】 Transfer technology to counterpart personnel.

1.3 Study Area

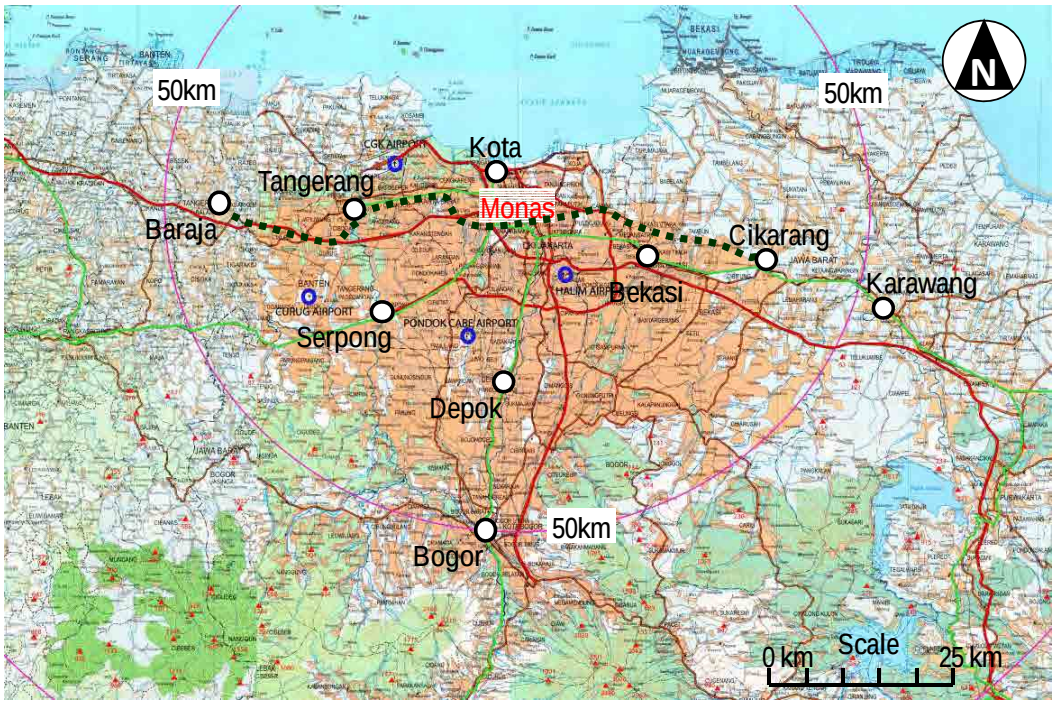
The Study Area is defined as the proposed route of the Jakarta MRT East–West Line Project, between Balaraja in Banten Province and Cikarang in West Java Province, which is about 87.3 km (refer to Figure 2.3-1). The area for the feasibility design is set at the Phase 1 section of the project.

Chapter 2 Necessity of the Project

2.1 Current Situation of the Transportation Sector in JABODETABEK

Traffic congestion has been a serious issue in the urban areas of Jakarta due to the great amount of traffic influx, such as motorbikes, private cars, buses and trains. Such traffic comes from the Botabek region – Jakarta's commuter belt – wherein the population has been rapidly increasing. The number of trips between DKI Jakarta and BODETABEK (an acronym for JABODETABEK without DKI Jakarta) in 2010[1] has increased 1.5 times from 2002, while the number of registered motorcycles has tripled. In effect, the number of traffic accidents in the center of Jakarta has doubled, 95% of which comes from motorcycle-related accidents. This reveals that the traffic situation in Jakarta is continuously worsening every year. Although the present commuter zone extends 30~40 km outward from the city like Bekasi (the expansion was driven taking the opportunity of construction of Cipularang Toll Road), the prospect says that the commuter belt development will expand to 80 km from the center of Jakarta within the next decade.

At the same time, it is quite a difficult situation to increase road capacity by widening and/or new construction. Such situation needs an alternative transport solution to restrain passenger cars from flowing in to the inner city district.



Source: Illustrated by JICA Study Team

Figure 2.1-1 Sphere of the Jakarta Metropolitan Area

In December 2010, the Memorandum of Cooperation was signed and agreed between the Governments of Japan and Indonesia for the concept of the Metropolitan Priority Area (hereinafter referred to as MPA) for Investment and Industry in JABODETABEK area. Based on this MPA concept, the First Steering Committee of the MPAs endorsed a list of potential fast-track projects for the JABODETABEK MPA to cope with the promotion of the investment environment of Jakarta Metropolitan Area. Parts of the fast-track projects for MPA were proposed to cope with relieving traffic congestion.

[1] JUTPI; JABODETABEK Urban Transportation Policy Integration
* The study conducted by JICA to update the master plan of transportation section in JABODETABEK region (i.e. SITRAMP 2).

With reference to the above political policies related to the traffic congestion relief in JABODETABEK area, JICA has currently launched the Study on JABODETABEK Urban Transportation Policy Integration (hereinafter referred to as JUTPI) from 2009. This technical assistance study is now currently reviewing SITRAMP 2. The counterpart authority of this technical assistance study is the Urban Transport Policy Integration Action Board under the Coordination Ministry of Economic Affairs. This board is currently waiting for the presidential approval to be authorized to handle JABODETABEK's urban transport policy issues.

2.2 Coherence with Plans and Policies of the Transport Sector at the National and Provincial Levels

SITRAMP 2, the Master Plan of public transportation section in JABODETABEK area, proposes three public transportation corridors for East-West axes in the region. These three corridors have been considered in the Pre F/S as alternative routes for the MRT East-West Line (i.e. Alternative 1A, 1B and 4; these will be discussed in the subsequent chapter).

Three of the routes (Alternatives 1A, 1B and 4, will be discussed in the subsequent chapter) of the MRT East–West Line Project proposed in the Pre-FS are also in SITRAMP 2, which is the base transport master plan of the JABODETABEK area.

Additionally, these routes were also planned in the 2011–2030 regional master plan of DKI Jakarta, which will be issued within this year.

In the master plan of JUTPI, the East–West Line will also be regarded as the prioritized route in the public transport network from the updated traffic characteristics.

As mentioned in the previous section, there are a total of 17 potential fast-track projects for JABODETABEK MPA. These fast-track projects are shown in Table 2.2-1 below, which also include East–West Line.

Table 2.2-1 Fast-Track Project in Jakarta Metropolitan Area by 2013

SECTOR	POSSIBLE FAST-TRACK PROJECT
1.International Port	1.1 Improvement and expansion of Tanjung Priok Port
	1.2 Development of a new international port
2.Upgrading the Industrial Area to the East of Jakarta	2.1 Smart Community (including a pilot project for the Smart Grid)
	2.2 Improvement of road network within the industrial area to the east of Jakarta
3.Mass Transportation Network	3.1 **Jakarta Mass Rapid Transit (MRT):S-NI, S-NII, East–West Line**
	3.2 Improvement of the JABODETABEK Commuter Railway System
4. Road Network	4.1 Improvement of road network in JABODETABEK
5.Airport and Related Infrastructure	5.1 Construction of access railway to Soekarno-Hatta International Airport
	5.2 Expansion of Soekarno-Hatta International Airport
6. Water Supply and Sewage System	6.1 Water supply project for JABODETABEK
7. Waste Management System	7.1 Construction of the West Java Regional Solid Waste Treatment and Final Disposal
8. Flood Management System	8.1 Reconstruction of East Pump Station at Pluit
9. Electric Power / Energy Infrastructure	9.1 Construction of Java–Sumatra Interconnection Transmission Line
	9.2 Construction of Indramayu Coal-fired Power Plant
	9.3 Construction of Banten Coal-fired Power Plant
	9.4 Development of Gas-fired Power Plant and Floating Storage Regasification Unit (FSRU)
	9.5 Development of Rajamandala Hydroelectric Power Plant

Source: Joint Press Release on the First Steering Committee of the Metropolitan Priority Areas for Investment and Industry, Annex I, March 17, 2011

At the same time, Unit Kerja Presiden bidang Pengawasan dan Pengendalian Pembangunan or the Presidential Working Unit for Supervision and Management of Development (hereinafter referred to as UKP4), which is the consultative body for the President, has been established in order to accelerate the alleviation of traffic congestion of Jakarta Metropolitan Area. The UKP4 has planned 17 action steps in order to reduce traffic congestion. Promotion of the construction of MRT facilities is also included in these action steps.

Table 2.2-2 UKP4's 17 Action Steps for Traffic Congestion Alleviation in Jakarta Metropolitan Area

MANAGEMENT STEPS
1. Application of electronic road pricing (ERP)
2. Sterilization of bus way lane (bus rapid transit) especially in four major lanes
3. Improvement of road facilities (structure–infrastructure)
4. Examining the on-street parking policy and law enforcement
5. Additional two bus way lanes
6. Special gas prices for transportation
7. Rehabilitation of inefficient small bus transport
8. Optimization of KRL JABODETABEK by re-routing
9. Elimination of illegal transport
10. **Acceleration of MRT development**
11. Establishment of JABODETABEK Transportation Authority
12. Revision of the Integrated Transportation Master Plan
13. Double-double track project of KRL JABODETABEK
14. Hastening of KRL inner-circle development which is integrated with the mass transportation system
15. Additional toll roads
16. Compilation of the motorized vehicles limitation policy
17. Land preparation for park-and-ride facilities to support KRL

Source: UKP4

2.3 Review of the Pre-FS

Pre-feasibility study (Pre-F/S) for MRT East-West Line has been carried out in 2010 by JICA, as a part of the Preparatory Survey for Jakarta MRT System North-South Line Extension Project. In this Study, technical reassessment of this Pre-FS and reexamination of the route selection will be made in this report. Moreover, the detailed implementation plan will be formulated and proposed.

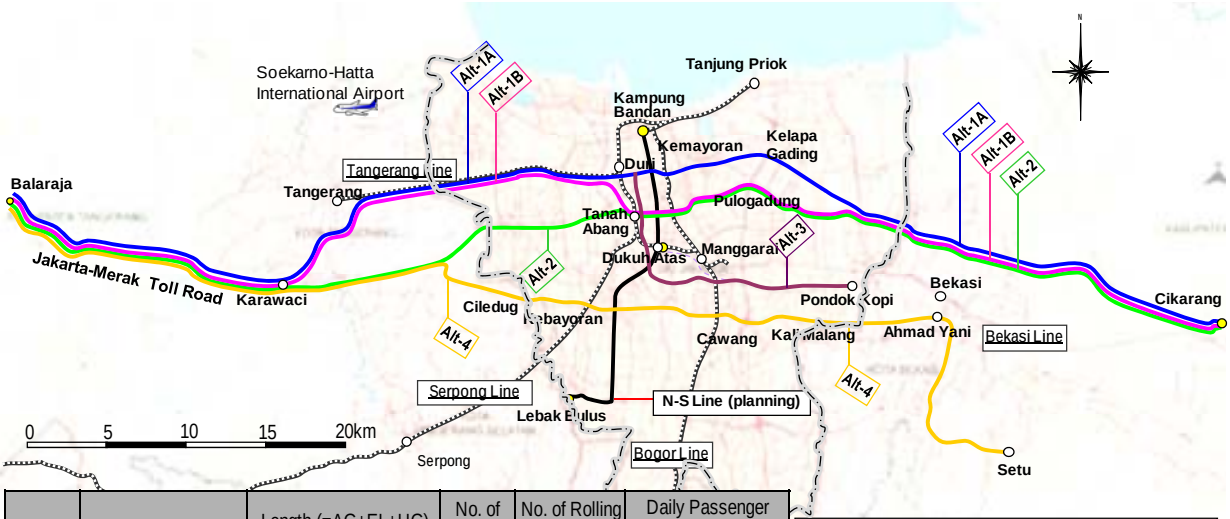
2.3.1 Contents of the Pre-FS

The Regional Trunk Transportation System Development Strategy was proposed in SITRAMP 2 in 2004, in order to establish a robust transport system in terms of regional development. In the master plan, the following measures were judged necessary:

- Improvement of the function of trunk transportation network which links important logistics facilities (such as Tanjung Priok Port, Soekarno-Hatta International Airport, and Industrial Complex);
- Strengthening of access to major facilities for passenger transportation (such as airports, intercity bus terminals, and central station);
- Development of the transportation system to establish an East–West urban development policy in JABODETABEK (Tangerang~Bekasi); and
- Strengthening of access between urban centers.

This Pre-F/S has set up five alternative routes as shown in Figure 2.3-1. The outline for these five alternative routes is summarized in Table 2.3-1.

Comparative studies of the alternative routes for East–West Line were performed mainly focusing on the demand forecast and technical aspects. The Pre-FS has recommended Alternative 1A, which is the northern route among the alternatives.



Route		Section	Length (=AG+EL+UG) (km)	No. of Station (nos.)	No. of Rolling Stock (nos.)	Daily Passenger	
						Y2020 (pax.)	Y2030 (pax.)
Alt-1	A	Balaraja - Cikarang	87.3 (=16.5+58.2+12.6)	46	144	964,000	1,306,000
	B		86.6 (=16.5+57.6+12.5)	48	144	954,000	1,304,000
Alt-2			82.2 (=0.0+71.2+11.0)	44	162	536,000	961,000
Alt-3		Roxy - Pondok Kopi	20.7 (=0.0+0.0+20.7)	19	66	209,000	266,000
Alt-4		Balaraja -- Setu	78.2 (=0.0+65.9+12.3)	41	156	836,000	1,255,000

LEGEND
Alt-1A Route
Alt-1B Route
Alt-2 Route
Alt-3 Route
Alt-4 Route
N-S Line
Existing Railway

Source: Generated by the JICA Study Team from the Preparatory Survey for Jakarta Mass Rapid Transit System North–South Line Extension Project）

Figure 2.3-1 Five Alternative Routes in the Pre-FS

Table 2.3-1 Outline of the Project for Five Alternative Routes in the Pre-FS

		Alternative 1A	Alternative	Alternative 2	Alternative 3	Alternative 4
Length (No. of Stations)	At grade Elevate Undergroun Tota	16.5 km 10 Sta. 58.2 km 25 Sta. 12.6 km 11 Sta. 87.3 km 46 Sta.	16.5 km 10 Sta. 57.6 km 27 Sta. 12.5 km 11 Sta. 86.6 km 48 Sta.	0.0 km 0 Sta. 71.2 km 34 Sta. 11.0 km 10 Sta. 82.2 km 44 Sta.	0.0 km 0 Sta. 0.0 km 0 Sta. 20.7 km 19 Sta. 20.7 km 19 Sta.	0.0 km 0 Sta. 65.9 km 32 Sta. 12.3 km 9 Sta. 78.2 km 41 Sta.
	(Phase 1)	Perumnas-Pulogeban 45.3 km, 29 Sta.	Perumnas-Pulogeban 45.8 km, 32 Sta.	Perumnas-Pulogeban 40.4 km, 28 Sta.	Roxy-Pondok 20.8 km, 19 Sta.	Raden Ahmad Yani 33.4 km, 25 Sta.
	(Phase 2)	Bararaja-Perumna 27 km, 6 Sta. Pulogebang - Ckarang 23.6 km, 10 Sta.	Bararaja-Perumna 27 km, 6 Sta. Pulogebang - Ckarang 23.6 km, 10 Sta.	Bararaja-Perumna 18.3 km, 6 Sta. Pulogebang - Ckarang 23.5 km, 10 Sta.		Balaraja - Ciredug 29.2 km, 11Sta. Rawa Lumbu - Setu 16.1 km, 5 Sta.
Daily Passenger Demand 2020 (passenger)	(Phase 1)	964,00	954,00	536,00	209,00	836,00
	(Phase 2)	1,306,00	1,304,00	961,00	266,00	1,255,00
Peak Hour Per Directional Traffic (passenger/hr/direction)	(Phase 1)	76,75	68,84	30,19	12,64	45,61
	(Phase 2)	79,60	73,20	40,41	15,76	54,53
Operational Speed	(Phase 1)	40.0 km/hr	38.5 km/hr	39.3 km/hr	32.8 km/hr	43.8 km/hr
	(Phase 2)	44.3 km/hr	43.6 km/hr	44.0 km/hr	-	51.8 km/hr
Travel Time (One-way)	(Phase 1)	1 hr, 5 min	1 hr, 9 min	1 hr, 2 min	37 min	1 hr, 47 min
	(Phase 2)	1 hr, 55 min	1 hr, 58 min	1 hr, 51 min	-	1 hr, 47 min
Operational Headway	(Phase 1)	8 cars 1.5 min	8 cars 1.5 min	6 cars 3 min	6 cars 6 min	8 cars 2.5 min
	(Phase 2)	8 cars 1.5 min	8 cars 1.5 min	6 cars 2 min	6 cars 5 min	8 cars 2 min
Train Composition		(6 cars) Tc-M-M-T-M-Tc, (8 cars) Tc-M-M-T-T-M-M-Tc				
Gauge		106 7mm				
Track		Ballasted (At Grade Section, inside depot and workshop), Ballastless (Elevated Section / Underground)				
Traction System		1500V DC, Overhead Catenary System				
No. of Substations		22	22	1	6	1
Signalling System		ATP (Automatic Train Protection), ATS (Automatic Train Supervision), Track Circuit				
Telecommunication System		Telephone Network, Public Address, Train Radio, Central Clock System, Closed Circuit TV, Data Transmission System				
Other E&M Systems		Platform Screen Doors (Underground Section), Automatic Fare Collection, Lifts & Escalators				
Maintenance Facilities (Area)	Depo /Worksho	Balaraja (8.7 ha)	Balaraja (8.7 ha)	Balaraja (8.7 ha)	Pondok Kopi (5.0 ha)	Balaraja (8.7 ha)
	Sub Depot	Kalideres (8.7ha) as Phase 1	Kalideres (8.7ha) as Phase 1	Tanah Abang (4.3 ha) as Phase 1		Kali Malang (8.7 ha.) as Phase 1
Land Acquisition (Area)	Depot /Workshop	Balaraja (8.7 ha) Kalideres (8.7 ha) as Phase 1	Balaraja (8.7 ha) Kalideres (8.7ha) as Phase 1	Balaraja (8.7 ha) Tanah Abang (0.5 ha) as Phase 1	Pondok Kopi (5.0 ha)	Balaraja (8.7 ha) Kali Malang (8.7 ha) as Phase 1
	Along the Route	8.0 ha	6.0 ha	5.4 ha	None	7.3 ha
Remarks		Use of Tangerang Line	Use of Tangerang Line		Use of ex monorail alignment (Blue Line)	Use of Kali Malang (TBD) Corridor

Source: Generated by the JICA Study Team from the Preparatory Survey for Jakarta Mass Rapid Transit System North–South Line Extension Project

2.3.2 Key Issues Which Needs Consensus

One of the objectives of this Study is to set up the fundamental directions for the project implementation. Among the contents of the implementation program, the project scope, implementation schedule, project cost, environmental consideration, etc., are the most important issues which need to be settled in the earlier stage based on informed consensus among the stakeholders for further effective implementation.

The MRT East–West Line has a relatively long urban railway which is over 80 km in length. Accordingly, huge investment is required. In effect, efficient and effective stepwise development should be considered in dealing with the important issues above. Source: JICA Study Team

Figure 2.3-2 shows 14 key issues which need consensus among the stakeholders during the implementation stage.

	Items	Contents to be achieved a settlement among Stakeholders
Route	(1) Route Selection	- One Target Route from Five Pre-F/S alternatives
Phasing	(2) Phasing	- Stepwise development by proper phasing of long urban railway
Technical	(3) Demand Forecast	- Forecasted Scenario, Target Year, Peak Ratio,
	(4) Train Operation Plan	- Train Formulation, Congestion Ratio, Headway, No. of Train and etc.
	(5) Alignment Plan	- Location of At Grade/ Elevated / Underground Section, Transition Section, Location of Station
	(6) Depot Plan	- Location, function outline, layout of depot
	(7) System	- Outline of Specification Systems - Location of Receiving Substation (RSS)
	(8) Rolling Stock	- Outline of Specification
	(9) Cost Estimate	- Total Project Cost
	(10) Construction Method & Schedule	- Practical Construction Period
Implemen-tation	(11) Implementation Structure	- Setting up process of Effective O&M operator - Formulation of Practical Implementation Structures
Financial	(12) Financial Arrangement	- Budget Demarcation, Cost Demarcation between Central & Regional Gov.
	(13) Financial & Economical	- Viable EIRR & realistic FIRR(Rail & Non-Rail Revenue, O&M Cost, Grace Period, FIRR, EIRR and etc.)
EIA	(14) AMDAL & LARAP	- Formulation, Submission / Approval of AMDAL & LARAP

Source: JICA Study Team

Figure 2.3-2 Key Issues which need Consensus

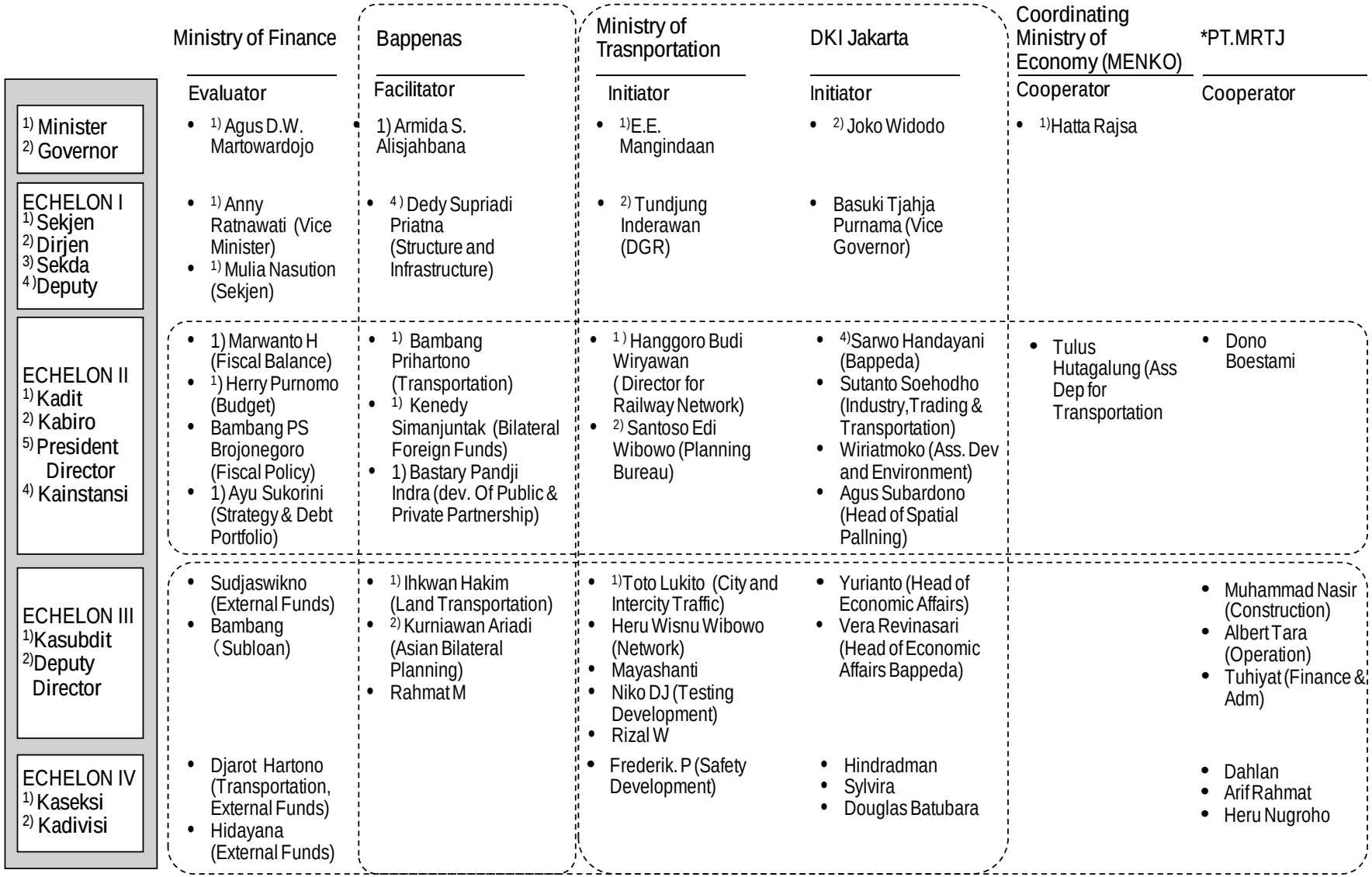
2.3.3 Consensus among Stakeholders

Consensus on the above key issues among the stakeholders such as the Directorate General of Railways (DGR), BAPPENAS, Ministry of Finance, DKI Jakarta, Banten Province, West Java Province and PT MRTJ is needed to ensure smooth implementation.

In addition, the project includes not only the importance of railway planning itself, but also project phasing and financial sharing between the central and regional governments, etc. which may bring problems regarding recognition by the stakeholders.

Thus, it is necessary to build a consensus involving the stakeholders. Our study approach is to make a day-to-day interview with the stakeholders and to formulate the implementation program in consideration of the stakeholders' opinions.

The main stakeholders for this project are shown in Figure 2.3-3 below.



Source: JICA Study Team

Figure 2.3-3 Stakeholder Map

2.4 Review of Necessity for Implementation of the Project

The Jakarta MRT North–South Line Project is the first MRT (Mass Rapid Transit) system in Indonesia. It will be become the backbone of the north–south axis. The project is currently ongoing and expected realization is within the next six years. East–West Line is an essential route for rail-based public transport to function. As described in the previous sections, MRT East-West Line project is considered as one of the most prioritized projects in JABODETABEK Area.

The validity of the project will be confirmed technically, financially and environmentally (AMDAL, LARAP and greenhouse gas reduction) in the subsequent chapters.

Chapter 3 Route Selection

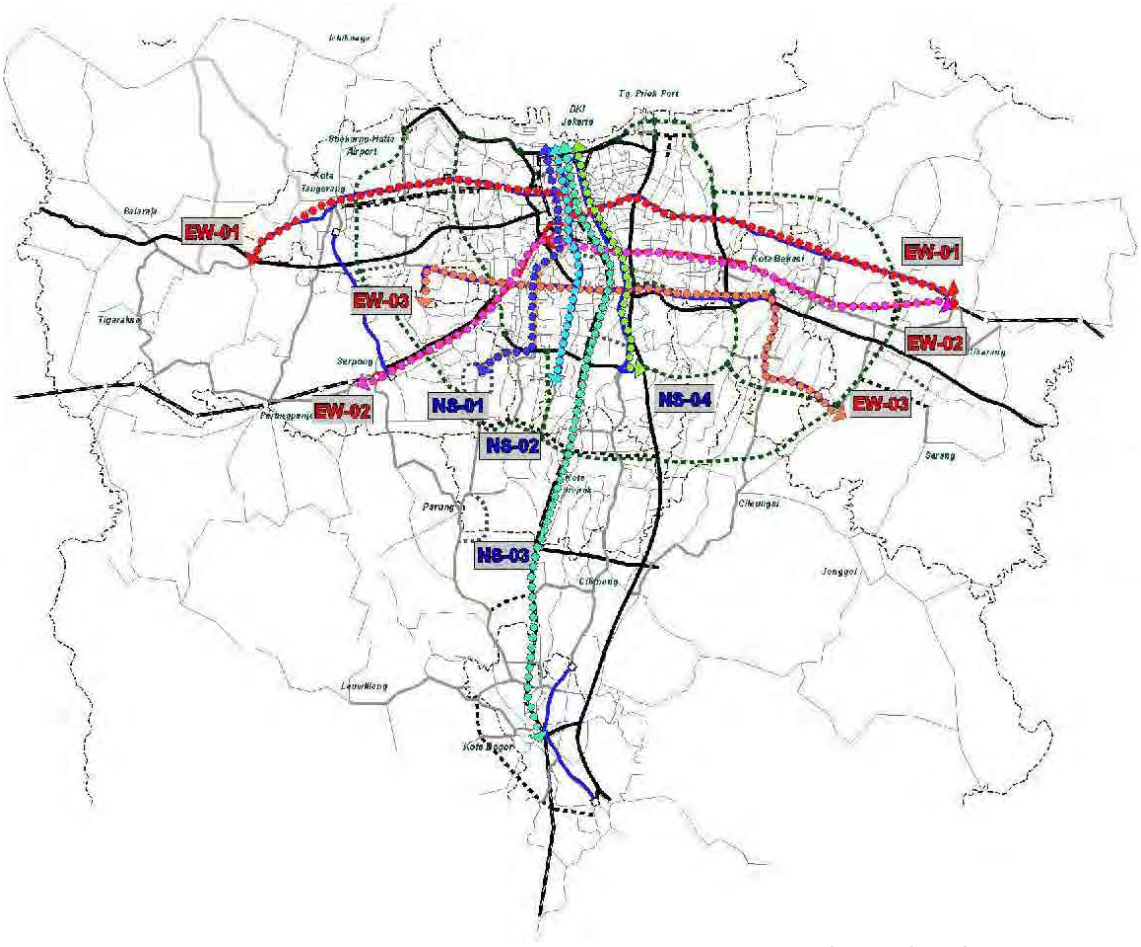
3.1 Review of Pre-Feasibility Study (Pre-FS)

3.1.1 Alternatives of the Route

In the latest transport master plan, the Study on Integrated Transportation Master Plan for JABODETABEK Phase 2 (SITRAMP 2) in 2004, it was recommended that a highly-efficient public transportation network was important to promote further utilization of public transportation. It was also recommended that Mass Rapid Transit (MRT) East–West Line is necessary to develop the East–West Axis of JABODETABEK Area. In the previous JICA Pre-FS, five alternative routes have been proposed and compared basically based on SITRAMP 2.

(1) Five Alternative Routes in the Pre-FS

Figure 3.1-1 shows the public transportation master plan in SITRAMP 2. For East-West Axis, "EW-01" and "EW-03" were planned as bus rapid transit (BRT) in the short-term development. In the long-term development, it was proposed that these two routes will be converted to MRT eventually.



Source: SITRAMP 2

Figure 3.1-1 Location of SITRAMP Development Corridor

EW-01 and EW-03 were proposed as Alternative 1A and Alternative 4, respectively in the Pre-FS. Based on these two alternatives, Alternative 2 is developed as the intermediate concept in the Pre-FS.

The remaining Alternative 3 follows the same route of the monorail blue line, which was planned for but not yet realized, subsequent to the monorail green line.

Brief descriptions of these five routes are summarized as follows, and the route alignments are referred to in Figure 3.1-2:

Alternative 1A

Alternative 1A begins at Balaraja in its western edge, and passes through Karawaci, Duri, Kemayoran, and Kelapa Gading, and finally ends at Cikarang. (The total length of this route is 87.3 km, 70.8km of which is to be newly constructed, while 16.5km of which is in parallel with existing Tangerang Line)

This route is along the existing Tangerang Line from Tanah Tinggi to Duri. The daily rates of boarding passengers were projected in the Pre-FS to be 964,000 pax/day in 2020, and 1,306,000 pax/day in 2030.

Alternative 1B

Alternative 1B begins at Balaraja and passes through Karawaci, Tanah Abang, and Pulogadung, and finally ends at Cikarang. (The total length of this route is 86.6 km, 70.1km of which is to be newly constructed, while 16.5km of which is in parallel with existing Tangerang Line) Almost all sections of this route are same as that of Alternative 1A except for the alignment from Duri up to the intersection point with Alternative 1A around the eastern side of Jakarta Outer Ring Road. The daily rates of boarding passengers were projected in the Pre-FS to be 954,000 pax/day in 2020, and 1,304,000 pax/day in 2030.

Alternative 2

Alternative 2 begins at Balaraja and passes through Karawaci, Tanah Abang, and Pulogadung, and finally ends at Cikarang. (The total length of which is 82.2 km.)

This alternative runs in parallel to Jakarta–Merak Toll Road from Balaraja to Tanah Abang. The daily rates of boarding passengers were projected in the Pre-FS to be 536,000 pax/day in 2020, and 961,000 pax/day in 2030.

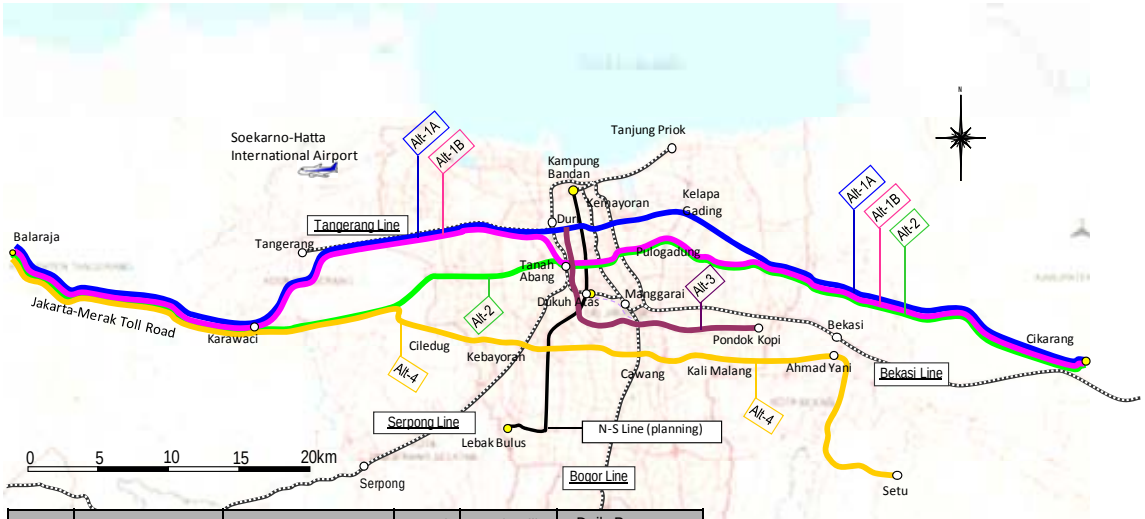
Alternative 3

Alternative 3 begins at Roxy which is a densely populated area. It passes through Tanah Abang and ends at Pondok Kopi. (The total length of which is 20.7 km.) The daily rates of boarding passengers were projected in the Pre-FS to be 209,000 pax/day in 2020, and 266,000 pax/day in 2030.

Alternative 4

Alternative 4 begins at Balaraja and passes through Karawaci, Ciledug, Kebayoran, Cawang, Kali Malang, and Ahmad Yani and ends at Setu. (The total length of which is 78.2 km.)

This route runs in parallel to Jakarta–Merak Toll Road from Balaraja to Ciledug. The daily rates of boarding passengers were projected in the Pre-FS to be 836,000 pax/day in 2020, and 1,255,000 pax/day in 2030.



Route		Section	Length (=AG+EL+UG) (km)	No. of Station (nos.)	No. of Rolling Stock (nos.)	Daily Passenger	
						Y2020 (pax.)	Y2030 (pax.)
Alt-1	A	Balaraja - Cikarang	87.3 (=16.5+58.2+12.6)	46	144	964,000	1,306,000
	B		86.6 (=16.5+57.6+12.5)	48	144	954,000	1,304,000
Alt-2			82.2 (=0.0+71.2+11.0)	44	162	536,000	961,000
Alt-3		Roxy - Pondok Kopi	20.7 (=0.0+0.0+20.7)	19	66	209,000	266,000
Alt-4		Balaraja -- Setu	78.2 (=0.0+65.9+12.3)	41	156	836,000	1,255,000

Source: JICA Study Team

Figure 3.1-2 Location Map Showing the Five Alternative Routes

(2) Relationship with Land Use of JABODETABEK

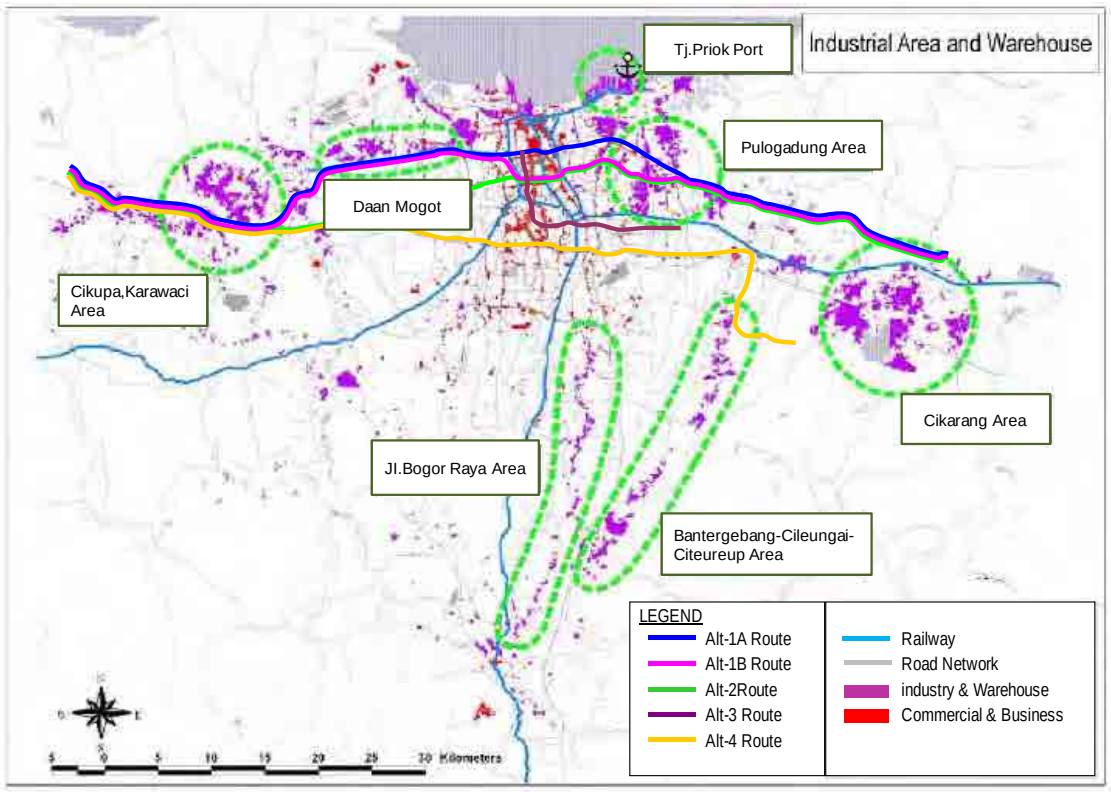
The connectivity to business districts, such as the working area in central DKI Jakarta, and factory areas in suburban areas of JABODETABEK, is the crucial function of MRT to promote further utilization of the said areas.

The relationship between the proposed route and existing land use are discussed below.

Suburban Area

Figure 3.1-3 shows the relationship between five alternatives, and main industrial area and warehouses, which are usually located in the suburban area of JABODETABEK.

Alternatives 1A and 1B cover four industrial areas, while Alternatives 2 and 4 covers three and two, respectively. Alternative 3 does not cover the main industrial area and warehouses as it converge within urban area of DKI Jakarta.



Source: The Study on Integrated Transportation Master Plan for JABODETABEK (Phase 2)

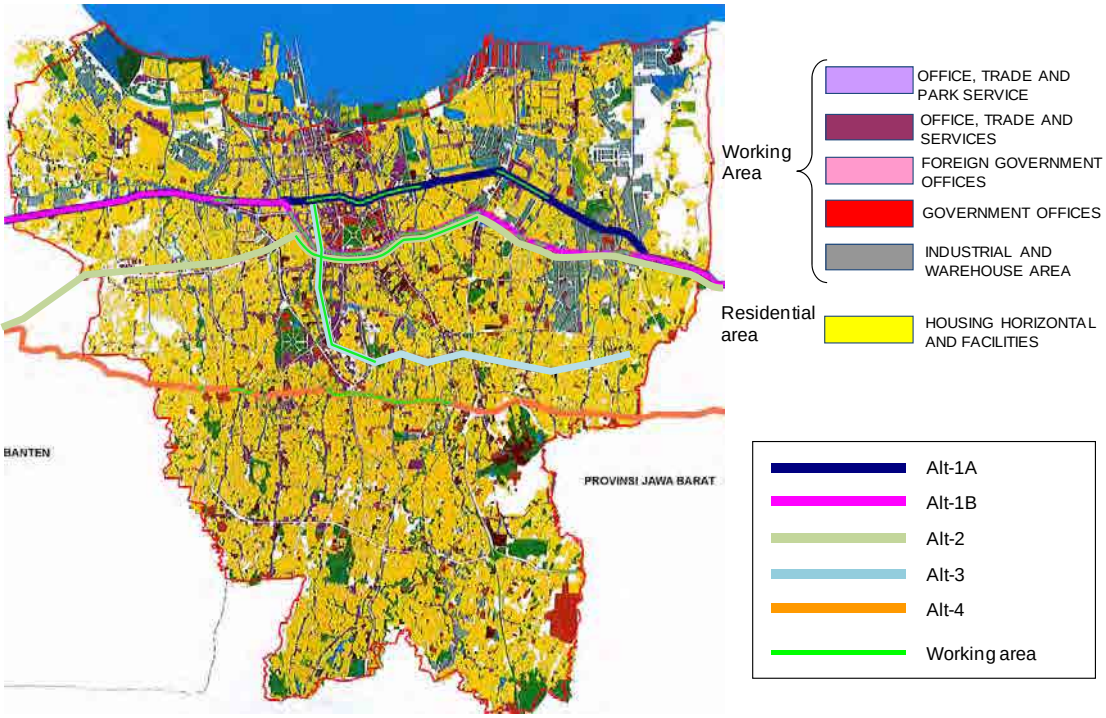
Figure 3.1-3 Present Industrial Area Distribution in the JABODETABEK Region

Working Area in the Central DKI Jakarta

Figure 3.1-4 shows the relationship between the five alternative routes and land use in the latest DKI Jakarta Master Plan.

From the figure, Alternatives 1A, 1B, 2, and 3 clearly exhibit the relationship of the routes to the main business districts in the central DKI Jakarta. Alternatives 1A, 1B and 2 penetrate from the east suburban area to the west suburban area via the central main business area. Alternative 3 appears to cover the eastern part of central DKI Jakarta than its west part.

Alternative 4 serves as link to residential areas and not the business district. Moreover, it indicates the needed transfer to other public transportation in order to reach the business district within DKI Jakarta.



Source: Master Plan "Comfortable Green & Sustainable Prosperity JAKARTA 2030"

Figure 3.1-4 Situation on Working and Residential Areas

(3) Past Evaluation of Five Alternatives in the Pre-FS

In the previous Pre-FS, a comparison study has been carried out in terms of cost, demand and environmental aspects. As a result of the comparison study, Alternative 1A was selected in the Pre-FS as the priority route of MRT East–West Line. Alternatives 4 and 2 were the succeeding priority routes. In the comparison, Alternative 1B was not selected because its route is almost the same route as that of Alternative 1A. A summary of the results of the comparison study in the Pre-FS is shown in Table 3.1-1 below.

Table 3.1-1 Overall Evaluation of MRT East-West Corridor Alternatives

Evaluation Item	Evaluation Rating				
	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Alternative 4
Cost	B	B	B	A	B
Demand	A	A	B	C	A
Engineering Aspect	A	B	B	B	B
Land Acquisition	B	B	B	C	C
Alternative Public Mode of Transportation	A	C	B	B	A
Consistency with Transportation Master Plan	A	B	B	B	A
Contribution to Center Development	A	B	B	B	B
Economic Efficiency	A	A	B	C	A
Overall Evaluation	A	B	B	C	A-

Note (*): A: Bette, B: Fair, C: Worst

Source: JICA Pre-FS Study

3.1.2 Related Development Projects

The development projects related to MRT East–West Line are described as follows:

(1) Highway Development

Three highway development projects, namely Six Inner Toll Road, Non Toll Road, and Bekasi-Cawang-Kali Malang-Kampong Melayu (Becakayu) Toll Road directly interfaces with the MRT East–West Line project (refer to Figure 3.1-5).

Six Inner Toll Road

- Semanan–Sunter (18.9 km)
- Duri Pulo–Kp. Melayu (11.4 km)
- Sunter–Bekasi Raya (8.8 km)
- Kemayoran–Kp. Melayu (9.6 km)
- Ulujami–Tanah Abang (8.3 km)
- Pasar Minggu–Casabalanca (9.6 km)

The basic design activities for the above six toll roads have been completed. Public-private partnership (PPP) scheme was assumed in their actual implementation. PPP tender for investors will be scheduled in the first half of 2012 and will include "Semanan–Sunter" and "Sunter–Pulo Gebang" sections as the priority routes from among others. The second batch of tender may include "Kp. Melayu–Tanah Abang" and "Kp. Melayu–Kemayorang", and then "Ulujami–Tanah Abang" and "Pasar Minggu Tanah Abang" will be subsequently executed.

If the section of "Semanan–Sunter" will start in the first half of 2012, its inauguration will is expected to be in 2014.

Further detailed design for each section will be carried out by the investor selected through the PPP tender.[1]

Non Toll Road

- Kp. Melayu–Tanah Abang
- Pageran Antasari–Kemayoran Barui
- Ciredug–Tenderan
- Pasar Minggu–Manggarai

The above four routes were planned by DKI Jakarta officials as freeways without toll.

Two of the above routes, namely the part of "Kp. Melayu–Tanah Abang" and "Pageran Antasari–Kemayoran Bar" are currently under construction. Furthermore, based on the discussion with the officials of DKI Jakarta, "Ciredug–Blok M" will be more prioritized than the above fourth route.[2]

[1] Interview with Dinas PU and Design Consultant
[2] Interview with Dinas PU and Design Consultant

Source: JICA Pre-FS Study

Photo 3.1-1 Casablanca Flyover

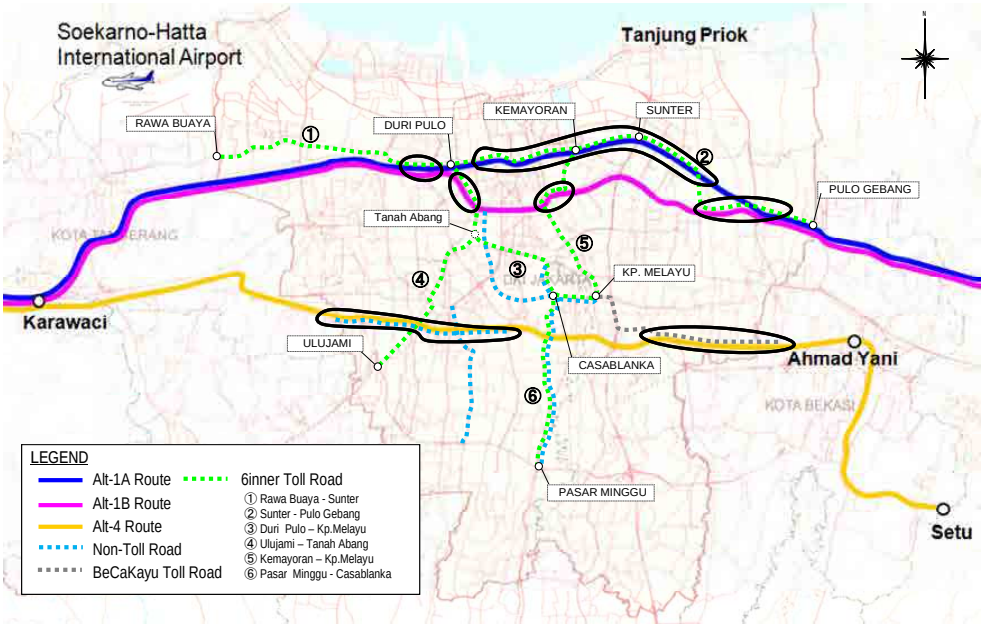
Source: JICA Pre-FS Study

Photo 3.1-2 Pageran Antasari Toll Road

Bekasi–Cawang–Kali Malang–Kampong Melayu (Becakayu) Toll Road

Implementation of this route was scheduled in the Bina Marga Master Plan. A build-operate-transfer (BOT) investor has already been selected and has constructed part of the viaduct structures before the rupiah crisis in 1997. However, even after such crisis, construction activities have remained suspended. It is not clear whether the project will resume or will be terminated.

The abovementioned highway developments have overlapping alignments with some of the sections of the five alternatives of MRT East–West Line as shown in Figure 3.1-5. These sections require coordination with relevant authorities concerning the detailed alignments, structure interfaces, etc.



Source: JICA Study Team

Figure 3.1-5 Over rap between MRT E-W line route and Highway Development

(2) Public Transportation Development

Jakarta MRT North–South Line

Jakarta MRT North-South Line was planned from Lebak Bulus to Kampung Bandang (total length of which is 23 km) as the first MRT system with an underground section.

The section from Lebak Bulus to Sisingamangaraja was designed as an elevated section while the section from Senayan to Bunderan HI as an underground section.

The remaining section from Bunderan HI to Kampung Bandang was planned as an underground section in the study.[3]

(3) Airport Line

The current number of users of Soekarno-Hatta International Airport has drastically increased with around 2.9% per year growth, which may result in the shortage of the airport's capacity in the near future. In order to solve such problem, the Government of Indonesia is planning to construct a third runway and expand the third terminal of the airport. On the other hand, existing access to the airport mostly depends on road transportation only with some sections of the airport toll road, serving as access to the airport, have been widened in 2009. However, heavy traffic congestion during heavy rains and in the evening and morning peak hours at Jakarta City has not been solved yet. In order to cope with the further increase in traffic and number of airport passengers in the future, the momentum for development of a new mass rapid urban transport system including the construction of an urban high-speed railway system is currently considered.

For the route, two types of alignment are mainly considered. One is by utilizing the existing Tangerang Line connecting to the western line, while the other is a new line in parallel to the existing toll road that connects to the western line.

Its implementation was assumed to be through PPP scheme.

(4) Double Tracking for Tangerang Line Project

Double tracking works of Tangerang Line is divided into two sections, namely Section 1 from Tangerang to Kalideres, and Section 2 from Kalideres to Duri. According to Satker JABODETABEK–Directorate General of Railways (DGR) engaged as project management unit for the works, contractor selection has been completed for both sections, wherein civil works have been started. In Section 1, resettlement works have been fully completed, while such works in Section 2 is also almost completed[4].

In order to clarify the current progress of double tracking works, site survey along Tangerang Line was carried out in June 2011. Furthermore, the Study Team confirmed that resettlement activities have been actually completed in most of Tangerang Line where civil works are already being executed. DGR intends to complete the works by the end of 2012, and will start its operation in 2013 after the commissioning and test run.

(5) Circular Line Development of JABODETABEK Railway

Through a study made by Korean consultants, circular operation of Ciliwung Express has started in 2007. However, there is shortage in rolling stocks.

Train frequency was reduced and only counterclockwise operation is being operated.

In the near future, track alignment at Jatinegara will be improved to eliminate switch back operation, and the number of rolling stocks will be increased to enhance train frequency.

(6) Busway Development

Currently, TransJakarta operates ten busway routes, i.e. Corridors 1 to 10. According to the DKI master plan, additional five routes will be newly developed in the near future, bringing the total number of BRT lines to as many as 15 routes. A schematic diagram of the entire TransJakarta route plan, including those currently in operation, is shown in Figure 3.1-6. Except for these 15 routes, there is an idea to add another two routes in the plan, but is still subject to evaluation.

[3] JICA Preparatory Survey for Jakarta Mass Rapid Transit System North–South Line Extension Project
[4] Interview with Satker Jabodetabek

The present progress of 15 TransJakarta routes is summarized in Table 3.1-2. Although consultant selection for the detailed design of additional five routes (Corridors 11 to 15) has already been done, only the detailed design works for Corridors 11 and 12 have been finished. For Corridor 11, environmental impact assessment (EIA) (AMDAL) approval is in process. Subsequently, through contractor selection, it was expected that the works will be completed in July 2011. It appears that Corridors 13 to 15 are so far temporarily suspended due to the lack of DKI Jakarta's budget, as elevated structure has been selected for these corridors[5].

Table 3.1-2 Current Progress of TransJakarta Project

Corridor	Route Plan	No. station/bus (nos)	Status
Corridor 1	Blok M - Kota	20 (1 with other Corridor + 1 with skywalk)	in Operation
Corridor 2	Pulo Gadung - Harmoni	23 (2 with other Corridor + 1 with skywalk)	Ditto
Corridor 3	Kali Deres - Harmoni	16 (5 with other Corridor + 1 with skywalk)	Ditto
Corridor 4	Pulo Gadung - Dukuh Atas 2	17 (3 with other Corridor + 2 with skywalk)	Ditto
Corridor 5	Kampung Melayu - Ancol	16 (1 with other Corridor + 2 with skywalk)	Ditto
Corridor 6	Ragunan - Kuningan	20 (2 with other Corridor + 1 with skywalk)	Ditto
Corridor 7	Kampung Melayu - Kampung Rambutan	14 (2 with other Corridor + 1with skywalk)	Ditto
Corridor 8	Harmoni - Lebak Bulus	23 (3 with other Corridor + 1 with skywalk)	Ditto
Corridor 9	Pluit - Pinang Ranti	29 (6 with other Corridor + 3 with skywalk)	Ditto
Corridor 10	Cililitan - Tanjung Priok	22 (2 with other Corridor + 3 with skywalk)	Ditto
Corridor 11	Kampung Melayu - Pulo Gebang	Station : 19 (16 new + 3 existing) Bus: 44 units	・Detail Design completed in 2010 ・AMDAL In Process ・Construction to complete end of 2011
Corridor 12	Pluit - Tanjung Priok	N.A	・Detail Design completed in 2010
Corridor 13	Ciledug - Blok M	N.A	・Suspended
Corridor 14	Kali Malang - Blok M	N.A	・Suspended
Corridor 15	Depok - Manggarai	N.A	・Suspended
Corridor 16	(Conceptinal Stage)	N.A	(Conceptinal Stage)
Corridor 17	(Conceptinal Stage)	N.A	(Conceptinal Stage)

Source: JICA Study Team based on collected documents

[5] Interview with Dinas Perhubungan

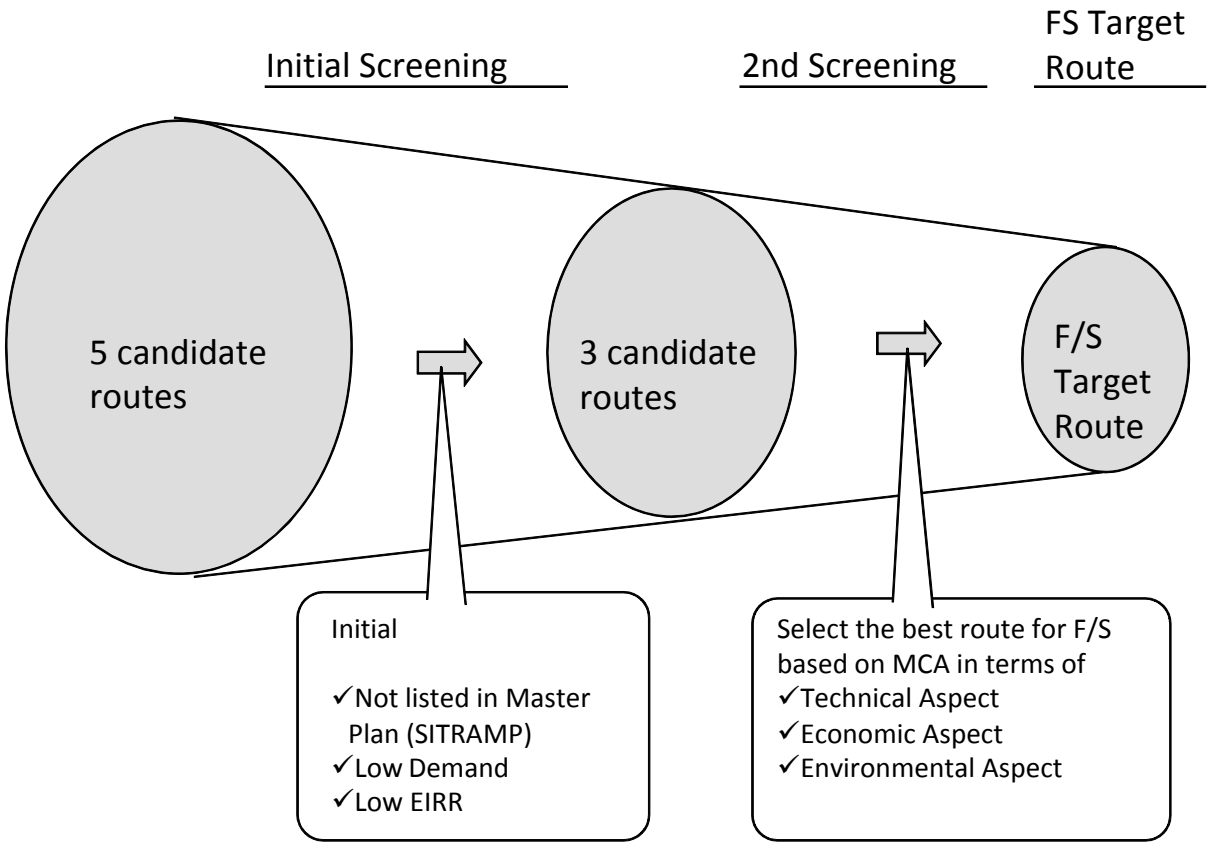
Source: http://bataviabusway.blogspot.com/2008/01/63-halte-dan-27-jembatan-mulai-dibangun.html

Figure 3.1-6 TransJakarta Route Map (including route plans)

3.2 Evaluation Criteria for Route Selection

3.2.1 Evaluation Flow

Route selection process is executed to identify the most priority target route among the five possible routes. In the route selection process, two-step screening is applied. The first step is to screen out the alternative routes, which aim at clearly identifying the lower priorities in terms of profitability, necessity and consistency with the government's master plan. As for the final route selection, a second screening which consists of setting more detailed evaluation items in terms of technical, economical and environmental aspects of the routes is executed. As a result of screening, one route is recommended as the target route for this study to confirm its feasibility.



Source: JICA Study Team

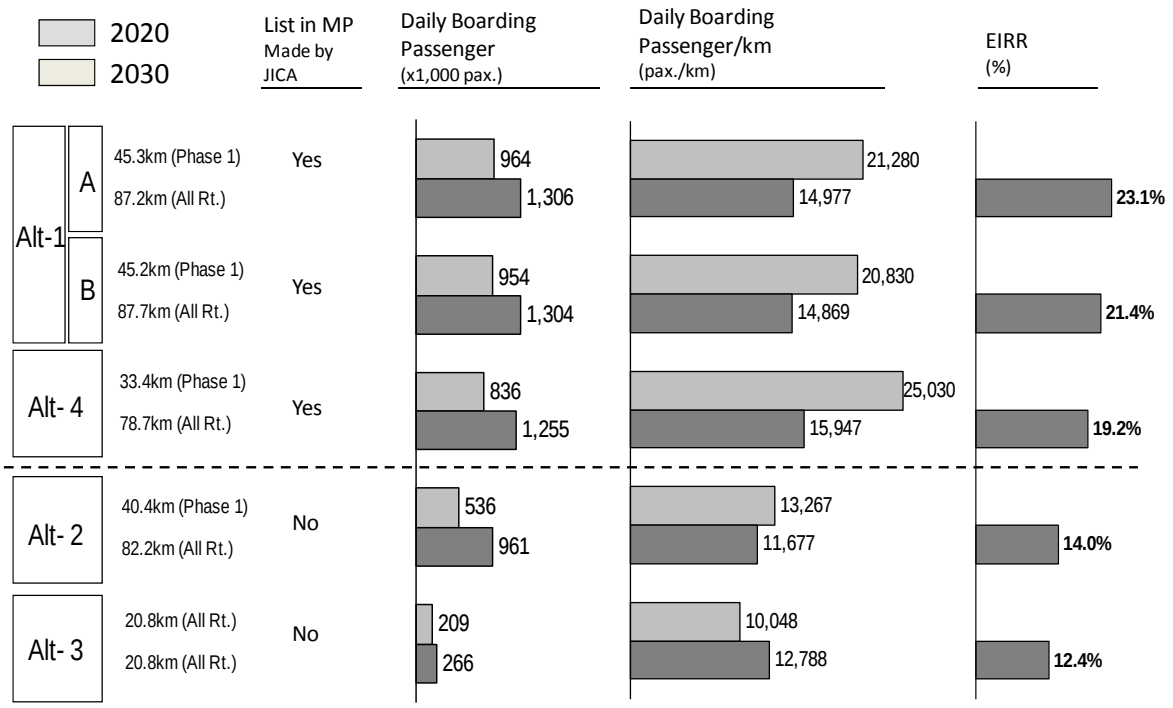
Figure 3.2-1 Route Selection Process

3.2.2 Initial Screening

In the initial screening, the relatively low priority routes are screened out from among the five routes, and further detailed comparative studies of the remaining routes were conducted. In the first step of screening, the passenger demand per km, the economic internal rate of return (EIRR) and consistency with the transport master plan (SITRAMP 2) are confirmed for each route. Passenger demand per km and EIRR values are referred to in the Pre-FS.

As shown in Figure 3.2-2, Alternatives 2 and 3 are relatively rated low and distinctly different from the other three routes. In addition to the demand and EIRR, both alternatives were not listed in the transport master plan. Alternative 2 is the intermediate option between Alternatives 1 and 4. Meanwhile, Alternative 3 was originally planned as the monorail after SITRAMP 2.

As a result of the initial screening, Alternatives 2 and 3 are eliminated.



Source: Generated by the JICA Study Team based on SITRAMP and JICA Pre-FS Study

Figure 3.2-2 Initial Screening Result

3.2.3 Setting Up the Multi Criteria Analysis (MCA)

As a result of the first stage screening in the previous section, three routes were selected as candidates for second stage screening. Prior to the screening, the evaluation criteria in MCA were established. In setting up the detailed indicators of MCA, it was aimed to evaluate a variety of perspectives to cover necessary aspects in MRT projects. Moreover, in order to identify the project's advantages and disadvantages after scoring, each criteria was categorized into three classifications, namely "*Technical Aspect*", "*Economical Aspect*" and "*Environmental Aspect*", depending on the characteristics of the criteria. The detailed indicators and criteria of MCA are shown in Table 3.2-1.

Each indicator uses a quantifiable item as much as possible for purposes of evaluation. If it is unavoidable to use qualitative items, relative comparison between candidates is applied to avoid biased scoring. Each score will be recalculated considering the weight, which reflects the importance of the criteria. The weight is basically determined in consideration of the importance of each item for the usual MRT and other railway projects. Particularly, the environmental aspect is evidently a vital item in the recent projects within JABODETABEK area, and smooth realization without social problem is one of the keys for the success of the project. Thus, the environmental item is more prioritized among other aspects.

The items in the detailed criteria and the results of scoring are described in the next section.

Table 3.2-1 Criteria in MCA

Aspect	Evaluation Criteria	Weight	Low (1 point)	Middle (2 points)	High (3 points)	Criteria set by
A. Technical (35%)	a-1) Constructability (Obstacles)	10%	More than 50 nos.	10 nos. – 50 nos.	Less than 10 nos.	Nos of obstacle. One (1) obstacle in every 2/5-10/10km (*Route length 90km)
	a-2) Constructability (Exiting Road Width)	10%	More than 20 km	10 km – 20 km	Less than 10 km	Narrow road length. Ratio of narrow road length to route length (20%/ 10%/ >10%)
	a-3) Connectivity to Airport Link	5%	Unrealistic	Difficult	Possible	Accessibility to the existing airport
	a-4) Connectivity to N-S Line	5%	Difficult	Fair	Good	Accessibility to the existing stations (underground, at-grade, elevated)
	a-5) Connectivity to Public Transportation Network	5%	Less than 5 links	5 -10 links	More than 10 links	Nos of public trans-portation facility. One in every 20/10-20/10km.
B. Economical (25%)	b-1) Cost per km	5%	More than 7500 mil. yen	5000 - 7500mil. Yen	Less than 5000 mil. Yen	
	b-2) EIRR	10%	Less than 15 %	15 % - 20%	More than 20%	
	b-3) Daily Passenger Demand per km	10%	Less than 10,000 pax.	10,000 – 25,000 pax.	More than 25,000 pax.	
C. Environmental (40%)	c-1) Land Acquisition	15%	More than 225,000 m^2	135,000 – 225,000 m^2	Less than 135,000 m^2	Area of Land Acquisition. 25/15-25/15% of route length.
	c-2) Resettlement Houses (Existing ROW of Road)	20%	More than 450 houses	225 – 450 houses	Less than 225 houses	Nos of resettlement houses. 2.5/2.5-5/5 nos per km.
	c-3) Noise & Vibration Impact (Sensitive Area, Hospital, School and Mosque)	5 %	More than 100 nos.	50 – 100 nos.	Less than 50 nos.	Nos of sensitive area One (1) nos per 1/ 1-2/ 2km

Source: JICA Study Team

3.3 Comparative Study of Alternative Routes in the Pre-FS

3.3.1 Evaluation

(1) Technical Aspect

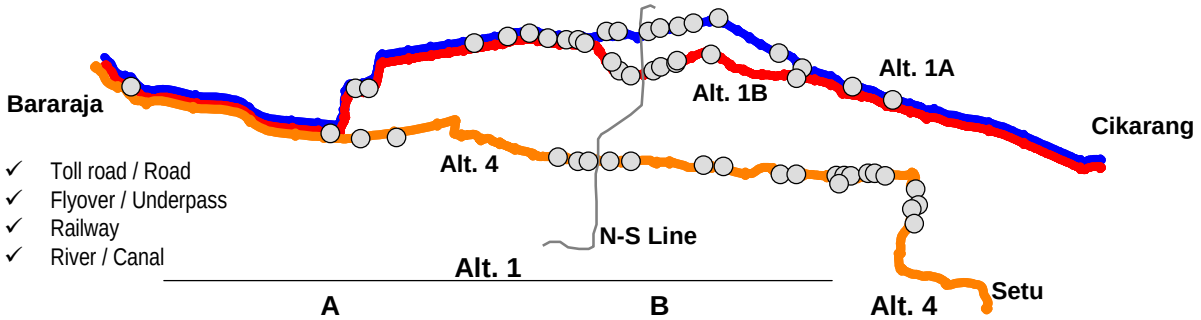
1) Constructability (Existing Obstacles)

In the construction of MRT facilities, there are normally several construction difficulties such as the provision of overpass above existing bridges, installation of underpass below a bridge while avoiding the existing pile foundation, etc. These obstacles will become construction risks

during actual implementation. Thus, the following obstacle points are counted for every route and evaluated as part of the constructability aspect:

- relatively huge river which serve as control points for underpass or overpass structures
- existing bridges with long spans that need to be crossed over
- existing bridges with alignments that need to be shifted to avoid existing piles and special care for adjacent construction works and occasional execution of underpinning method
- existing railway line under operation which need sophisticated construction method to occurrence of subsidence due to tunneling
- existing underpass structure with alignments that need to be shifted and/or special care for adjacent construction works.

The number of obstacles is shown in Figure 3.3-1. Based on these, it was found out that the number of obstacles are exactly the same for all the alternatives.



	Alt. 1		Alt. 4
	A	B	
List of Main Obstacles	Overpassing Jakarta-Merak Toll Road	Overpassing Jakarta-Merak Toll Road	Overpassing Jakarta-Merak Toll Road
	IC of Jakarta Merak Tol Road	IC of Jakarta Merak Tol Road	IC of Jakarta Merak Tol Road
	Overpassing Jakarta-Merak Toll Road	Overpassing Jakarta-Merak Toll Road	Kali Angke
	Cisadane River	Cisadane River	Underpass
	Flyover in parallel to alignment	Flyover in parallel to alignment	Overpass in parallel to the alignment
	Flyover in parallel to alignment	Flyover in parallel to alignment	Overpassing Serpong Line
	JORR (underpassing)	JORR (underpassing)	Underpass
	Cenkareng Drain	Cenkareng Drain	Antasari Flyover (underpassing structure)
	Kali Angke	Kali Angke	Kali Grogol
	Flyover along Jl.Daan Mongot	Flyover along Jl.Daan Mongot	Flyover in parallel to the alignment
	Kali Grogol	Kali Grogol	Jl.Gatoto Subroto
	Toll Road (LETJEN S.Parman)	Toll Road (LETJEN S.Parman)	Flyover in parallel to the alignment
	Banjir Canal	Banjir Canal	Kali Cideng
	Kali Krendang	Caringin	Cawang Junction (Flyover 1)
	Kali Cideng	Jaobtabek Western Line	Cawang Junction (Flyover 2)
	Kali Krukut	Flyover Jatibaru	Cawang Junction (Flyover 3)
	Central Line	Jabotabek central Line	Cawang Junction (Flyover 4)
	Underpass of Eastern Line	Kali Ciliwung	Kali Malang Toll Road (Plan)
	Inner Ring Road (plan)	Pasar Senen Flyover	Kali Malang
	Intra-urban	Underpass Senen	JORR
	Cakung Drain	Intra Urban Toll Road	Jl.Ahmad Yani
	JORR (overpassing)	JORR (underpassing)	Kali Malang
	East Banjir canal	East banjir Canal	Overpass Jakarta Cikampek
	Kali Bekasi	Kali Bekasi	Kali Bekasi
	Total 24 nos	Total 24 nos	Total 24 nos

Source: JICA Study Team

Figure 3.3-1 Number of Obstacles on Constructability

2) Constructability (Existing Road Width)

The other aspect of constructability during construction is traffic management, which is normally one of the key issues in MRT construction such as in congested JABODETABEK area.

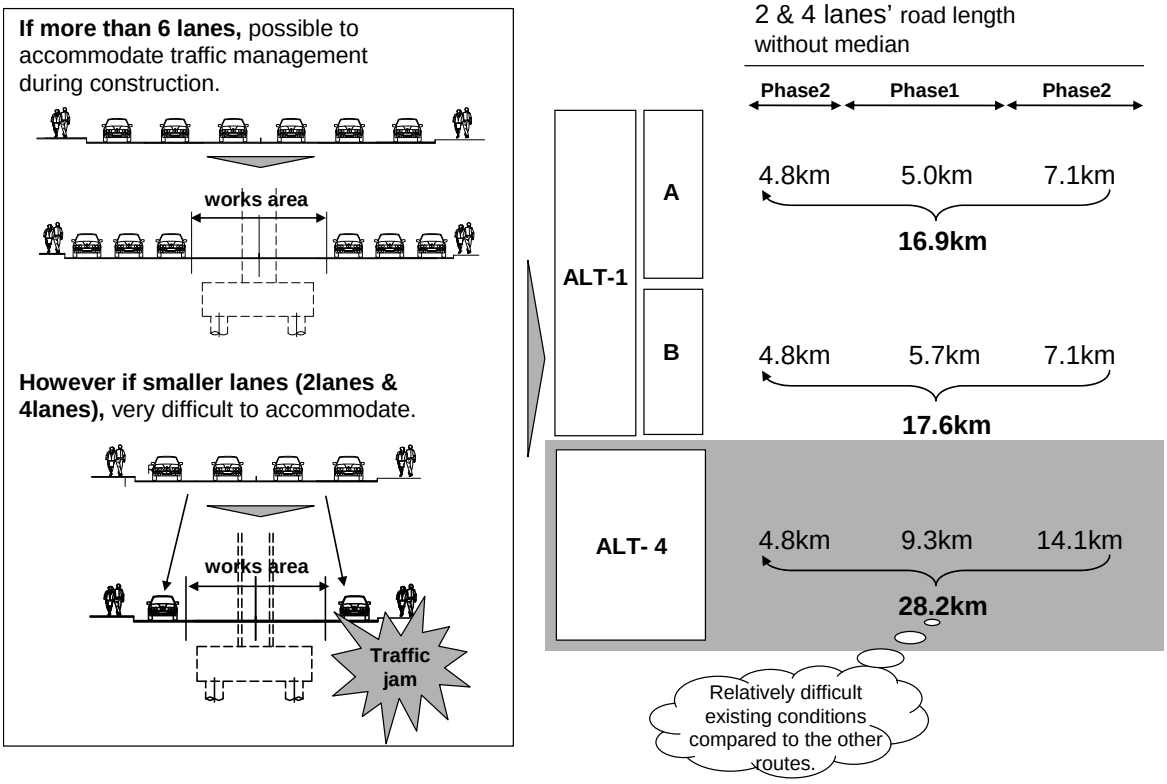
In cases where there are roads with more than four lanes with a center median strip and sidewalk (e.g. total > 22 m width), it may not be necessary to reduce the number of lanes even

during construction, which is initiated by temporarily reducing the lane width or sidewalk width, and eliminating the center median. If the median strip does not exist, in case the road has more than six lanes, it is normally possible to apply traffic management during construction as shown in Figure.

Thus, to assess the constructability in terms of traffic management during construction, the total length of two/four-lane roads without median along the project route are summed up.

From the result of the calculation shown in Figure 3.3-2, Alternative 4 exhibits the longest route wherein the most difficult traffic management will be necessary during construction. Especially, the said route runs along Jl. Ciledug Raya, which is a four-lane road with heavy traffic and is most usually congested (refer to Photo 3.3-1). The said section is the most difficult in terms of traffic management.

In accordance with the result of this survey, Alternative 1A has the highest score in this category. And Alternative 1B has the second highest score.



Source: JICA Study Team

Figure 3.3-2 Constructability (Total Road Length of 2-4 lane Carriageway without Median)

Source: JICA Study Team

Photo 3.3-1 Current Situation of Alt-4 Jl.Ciredug Raya (e.g. 4 lane Carriageway without Wide Median)

3) Connectivity to Airport Link

As mentioned in Section 3.1.2 above, airport link is currently being considered in the implementation.

In this evaluation item, the connectivity between this airport link and the MRT East–West Line were evaluated for all the alternatives.

The candidate routes of the airport link are currently under review, with various other routes being discussed. The candidate routes are mainly divided into two types. One will use the existing railway line (Tangerang Line) while the other will be constructed as a new line, up to the connection point around Angke of the Western Line.

Considering the current candidate route of airport link, whatever the case may be, Alternative 4 does not exhibit high relevance. Thus, the route which is regarded with high relevance and will contribute to the function of linking the airport and city center can be either Alternatives 1A or 1B.

4) Connectivity to North–South Line

As described in Section 3.1.2 above, North–South Line is the first state-of-the-art MRT system in Jakarta. Thus, public transportation innovation and transit oriented development are highly expected.

For further utilization of this MRT network, the linkage of MRT North–South Line and MRT East-West Line is a considerable factor in establishing the transit facility at crossing point.

The transit facility normally needs consistency between its function and traffic characteristics, and smooth transit should be ensured. For example, the former is related to an easily understandable transit path, which meets the requirements from the viewpoint of traffic characteristics, while the latter is mainly related to shorter transit distance.

Considering the ease of establishing transit facilities, which ensures the above requirements, Alternatives 1A and 1B have advantage over Alternative 4 since both stations are underground.

In addition to the above user-friendliness aspect, the construction of the connection line linking the tracks of MRT North–South Line and MRT East–West Line should be considered to expand the possibility of effectively using the resources of North–South line. If the connection line is installed, the following benefits can be achieved:

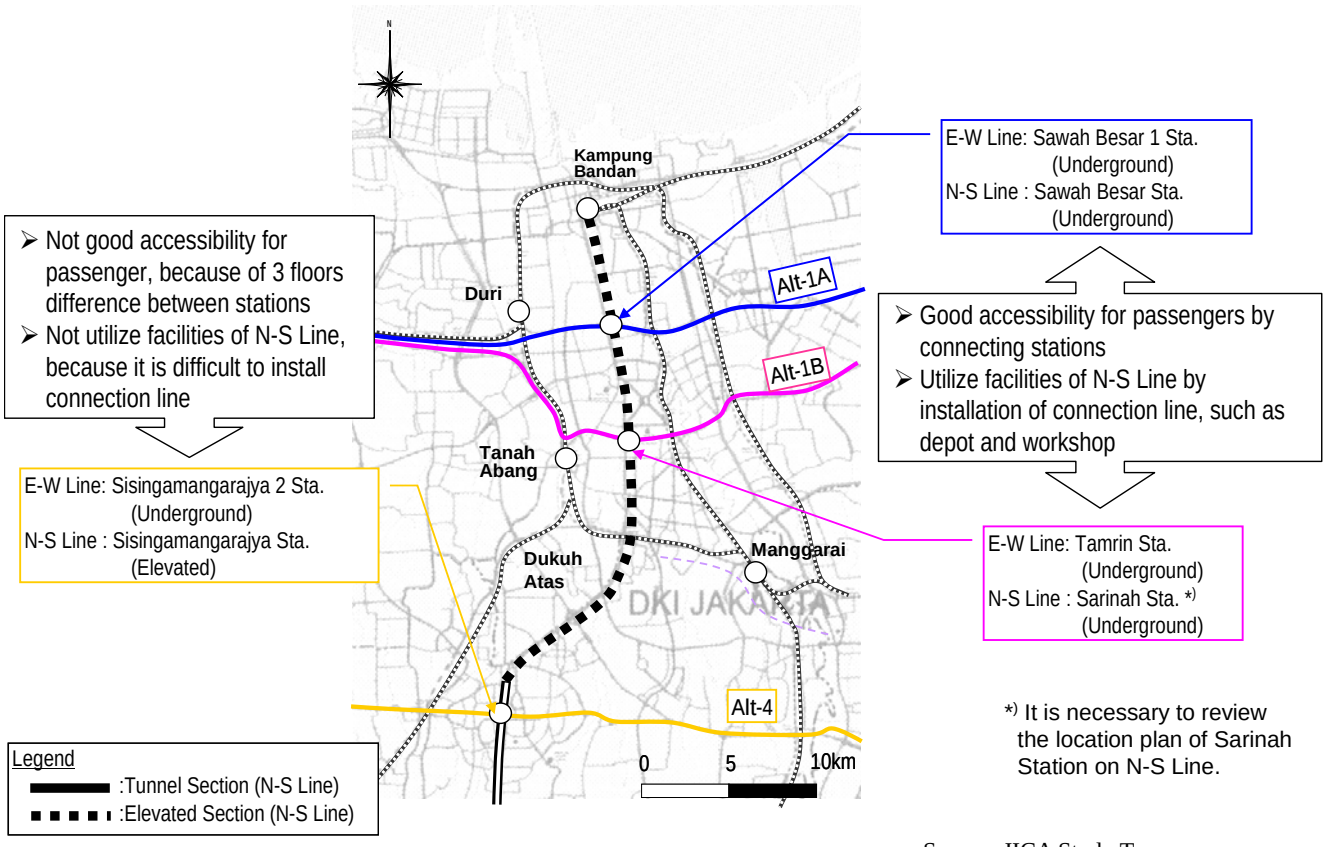
- Share of use of Lebak Bulus Depot and Workshop between MRT East–West Line and MRT North–South Line
- Share the rolling stocks between both lines for flexible train management and operation (e.g. in case of absence of standby trains)
- Share in maintenance equipment and transportation of maintenance materials between each line
- Transport of rolling stocks for North–South Line by the PT. Kereta Api Indonesia (KAI) operation line, via MRT East–West Line.

In terms of ease of construction of the connection line, Alternative 4 is practically difficult because of the need to connect the underground section to the elevated section within the limited right-of-way (ROW) around Sisingamangaraja.

Table 3.3-1 Situation of Connection Point between alternatives of E-W line and N-S line

	Transit Station of East–West Line	Ease of Connection	Transit Station of North–South Line	
Alternative 1A	Sawah Besar 1 Station (Underground)	• Good accessibility for passengers by connecting stations • Utilize facilities of North–South Line by installation of the connection line, such as depot and workshop	Sawah Besar Station (Underground)	N-S line
Alternative 1B	Thamrin Station (Underground)		Sarinah Station (Underground)	
Alternative 4	Sisingamangaraja Station (Underground)	• Bad accessibility for passengers, as three floors are needed between stations • Facilities of North-South Line could not be utilized, because it is difficult to install the connection line	Sisingamangaraja Station (Underground)	

Source: JICA Study Team



Source: JICA Study Team

Figure 3.3-3 Connectivity between alternatives of E-W line and N-S line

5) Connectivity to Public Transportation

Existing Railways

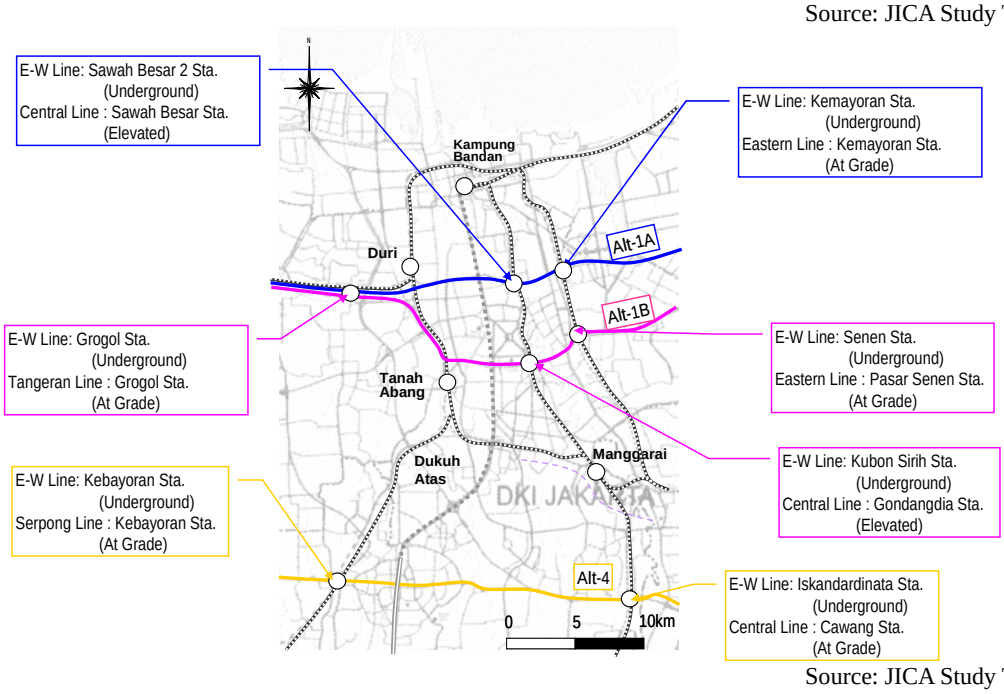
In JABODETABEK area, the most dominant mode of transportation is still motorized cars, which are dependent on road networks. This overdependence on road networks will incur further serious traffic congestion. Thus, the enhancement of the traffic capacity of transport infrastructure is one of the urgent issues. In order to promote utilization of public transportation, which provokes the modal shift from private to public mode, the expansion of the railway network is indispensable.

The crossing points in each alternative, which enable physical integration of lines, are shown in the Table 3.3-2 below.

Table 3.3-2 Situation of Connection Point between alternatives of E-W line and Existing Railways

	Alternative1A	Alternative 1B	Alternative 4
Tangerang Line	Grogol Sta. [At Grade] (East–West Line: Grogol Sta.[Underground])		
Serpong Line			Kebayoran Sta.[At Grade] (East–West Line: Kebayoran Sta. [Underground])
Central Line	Sawah Besar Sta. [Elevated] (East–West Line: Sawah Besar 2 Sta. [Underground])	Gondengdia Sta. [Elevetad] (East–West Line: Kubon Sirih Sta. [Underground])	Cawang Sta.[At Grade] (East–West Line: Iskandardinata Sta. [Underground])
Eastern Line	Kemayoran Sta. [At Grade] (East–West Line: Kemayoran Sta. [Underground])	Pasar Senen Sta. [At Grade] (East–West Line: Senen Sta. [Underground])	
Number of Crossing Points	3	3	2

Source: JICA Study Team



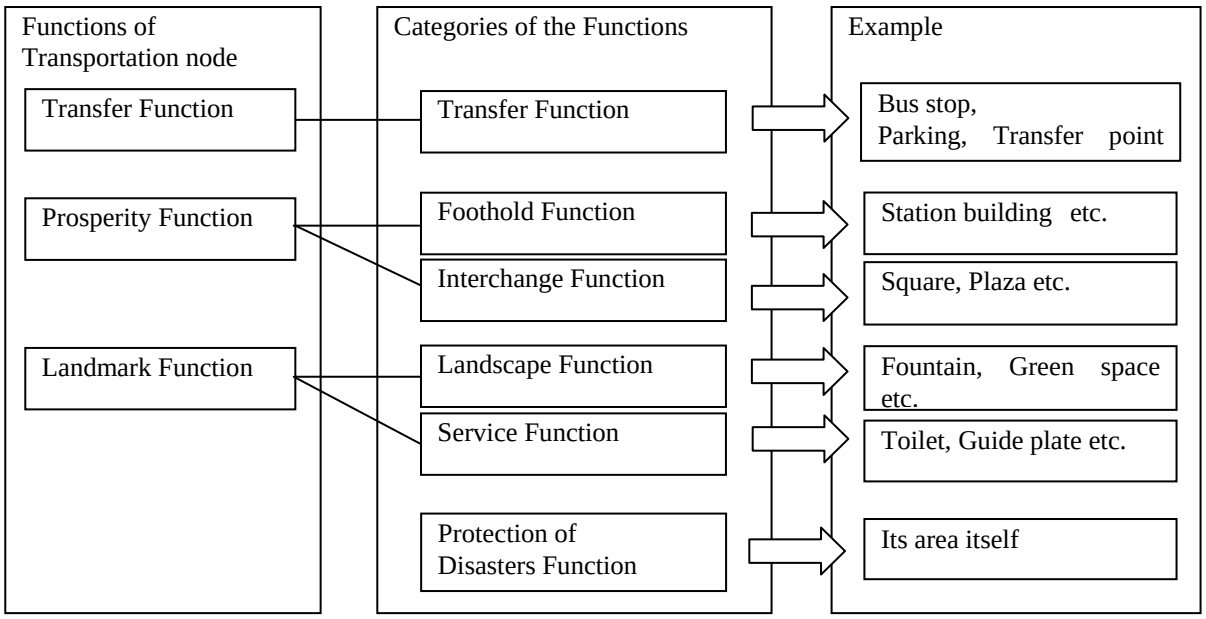
Source: JICA Study Team

Figure 3.3-4 Connectivity between alternatives of E-W line and Existing Railways

Connectivity to the Other Public Transportation Network

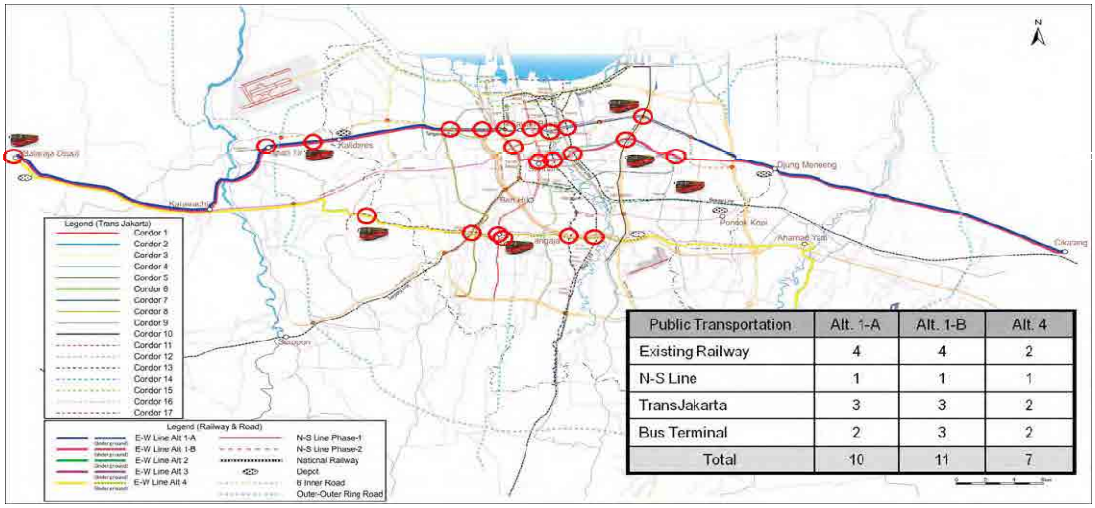
The crossing points normally include three functions, namely transit function, transportation hub and landmark.

Table 3.3-3 Functions of Transportation Nodes



Source: The design guideline for Station Plaza (Ministry of Land, Infrastructure, Transport and Tourism.)

The more locations which satisfy the above three functions, the higher transit oriented development potential. Figure 3.3-5 shows such potential locations, which is possible for transit oriented developments. Alternatives 1A, 1B and 4 includes ten, eleven and seven locations, respectively. In accordance with the result of this survey, Alternative 1B has the highest score in this category.



Source: JICA Study Team

Figure 3.3-5 Connectivity between alternatives of E-W line and Other Public Transportation

(2) Economical Aspect

Economic parameters such as EIRR and daily passenger demand per km were already discussed in the previous initial screening for the five alternative routes. In the second screening, three basic economic factors were evaluated, including the cost factor (i.e. cost per

km) by relative comparison. The results are shown in Table 3.3-4 and each value is referred from the Pre-FS.

1) Cost per Kilometer

The cost per km values among the three alternatives were compared.

If the cost per km is small, it means that the length of the underground section is relatively short compared to the elevated and at-grade section. Through the site reconnaissance, the transition points, which connect the underground section and elevated/at-grade section, can be considered understandable.

From the results of comparison, the cost per km among the three alternatives have no significant differences and are still at a reasonable level of unit cost.

2) EIRR

Based on the Pre-FS, all EIRR values satisfy the threshold figure of 12%. Alternative 4 has the largest passenger demand per km and the highest economic benefit among the three alternatives. However, since that alternative includes a longer underground section than the others, and is more costly, its EIRR is relatively lower than that of others.

3) Daily Passenger Demand per Kilometer

In Japan, 20,000 pax/km at the opening stage is generally recognized as the navigation benchmark to implement the MRT project in terms of demand. Pre-FS values satisfy this threshold and become the corroborating evidence for EIRR higher than 12%. It was noted that Alternative 4 has the largest daily passenger demand per km among the three alternatives.

Table 3.3-4 Comparison in Terms of Economic Aspects

Evaluation Criteria	Weight	Alt. 1		Alt. 4
		A	B	
b-1) Cost per km	5%	JPY 5,200 mil	JPY 5,300 mil	JPY 5,600 mil.
b-2) EIRR	10%	23.1 %	21.4%	19.2%
b-3) Daily Passenger Demand per km	10%	21,280 pax.	20,830 pax.	25,030 pax.

Source: Generated by the JICA Study Team from the results of the JICA Pre-FS study.

(3) Environmental Aspect

Among the environmental aspects, 1) Land Acquisition, 2) Resettlement Houses, and 3) Noise and Vibration Impacts (Sensitive Area, Hospital, School and Mosque) were considered and evaluated.

1) Land Acquisition

The necessary area for land acquisition was calculated at the sections of each alternative where there is a need for widening of the existing ROW, acquiring private land due to steep curves, and so on. If the median strip has enough width that can be utilized for construction of piers, and existing BRT lanes, which will be demolished after the MRT start its operation, land acquisition need not be considered.

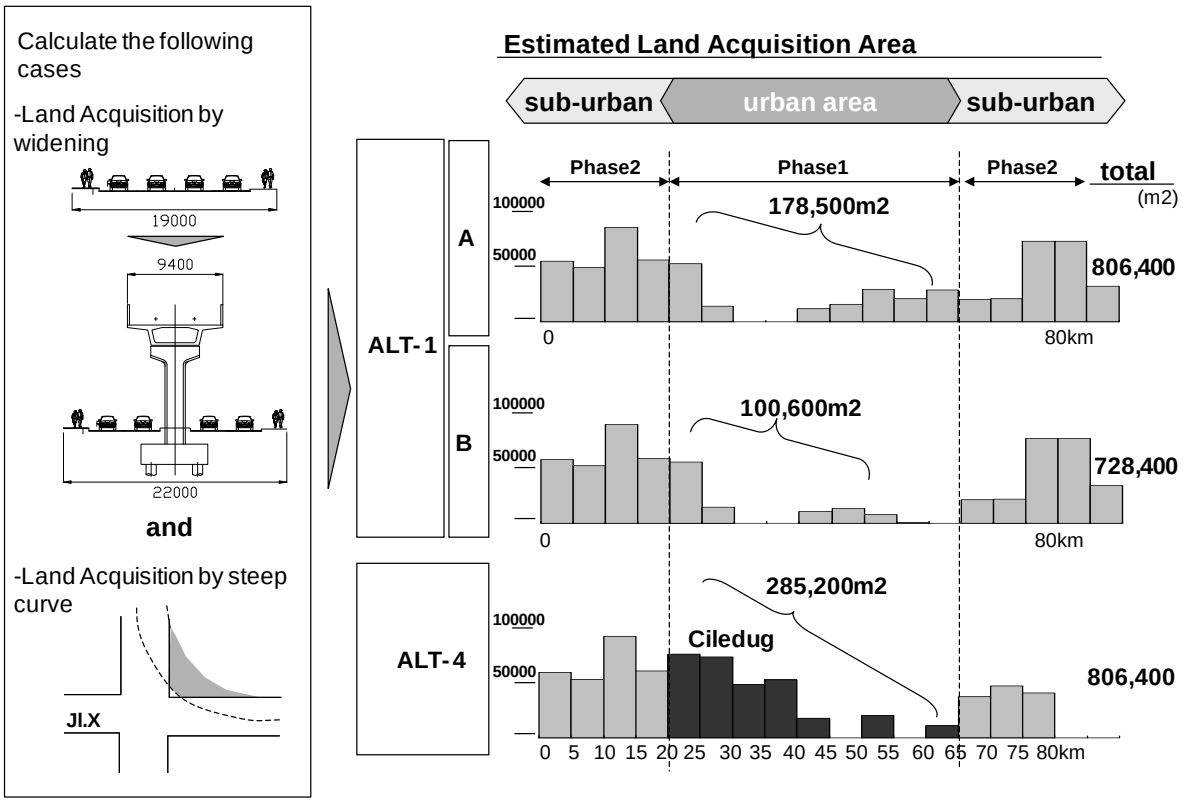
In addition, in the case where underground structures pass under private lands, land acquisition of such areas are also taken into consideration because the legal framework for handling such case is still not legislated in Indonesia, and thus some sort of compensation for will probably be necessary.[6]

Considering the fact that the alignment of Phase 2 section may possibly be changed in the future, and that it is obvious Phase 1 section covers more demand than that of Phase 2 since the

[6] Interview with BPN officials

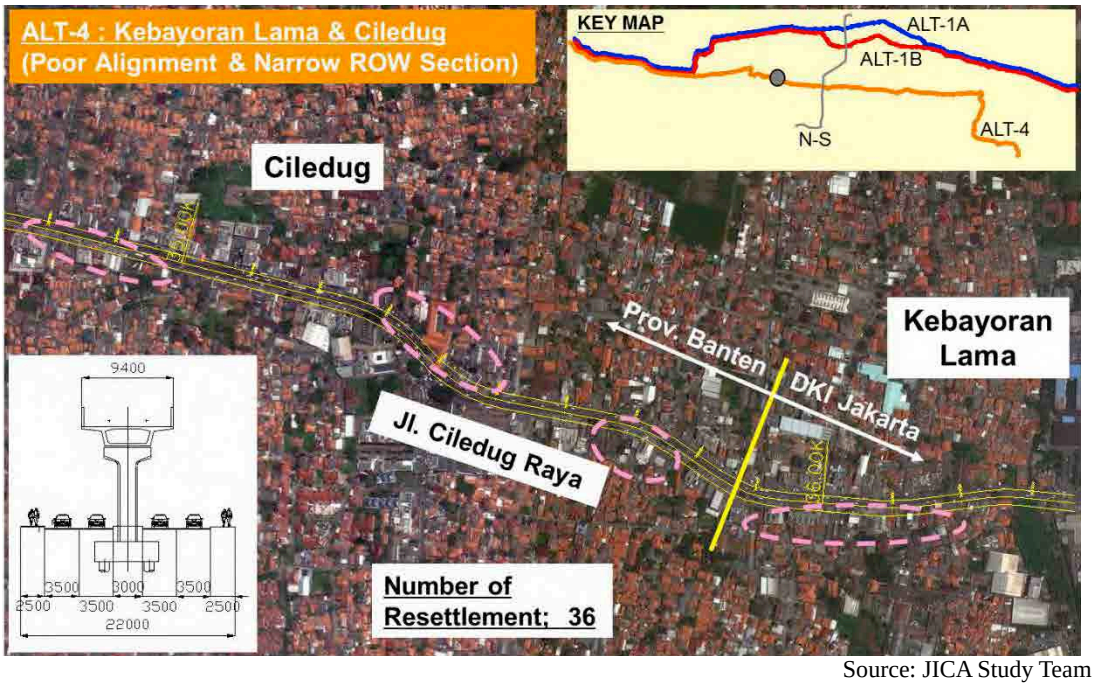
alignment runs in the center of Jakarta, higher priority should be given to Phase 1. For this regard, only Phase 1 section was evaluated.

As a result of the evaluation, Alternative 4 requires the highest land acquisition area (285,200 m2) in Phase 1, wherein land is expensive and land acquisition is generally difficult. This is expected because the existing ROWs in Jl. Ciredug Raya and Jl. Hasym Asyari are very narrow, and MRT's alignment cannot follow the same alignment as that of the steep road.



Source: JICA Study Team

Figure 3.3-6 Land Acquisition in Each Alternative



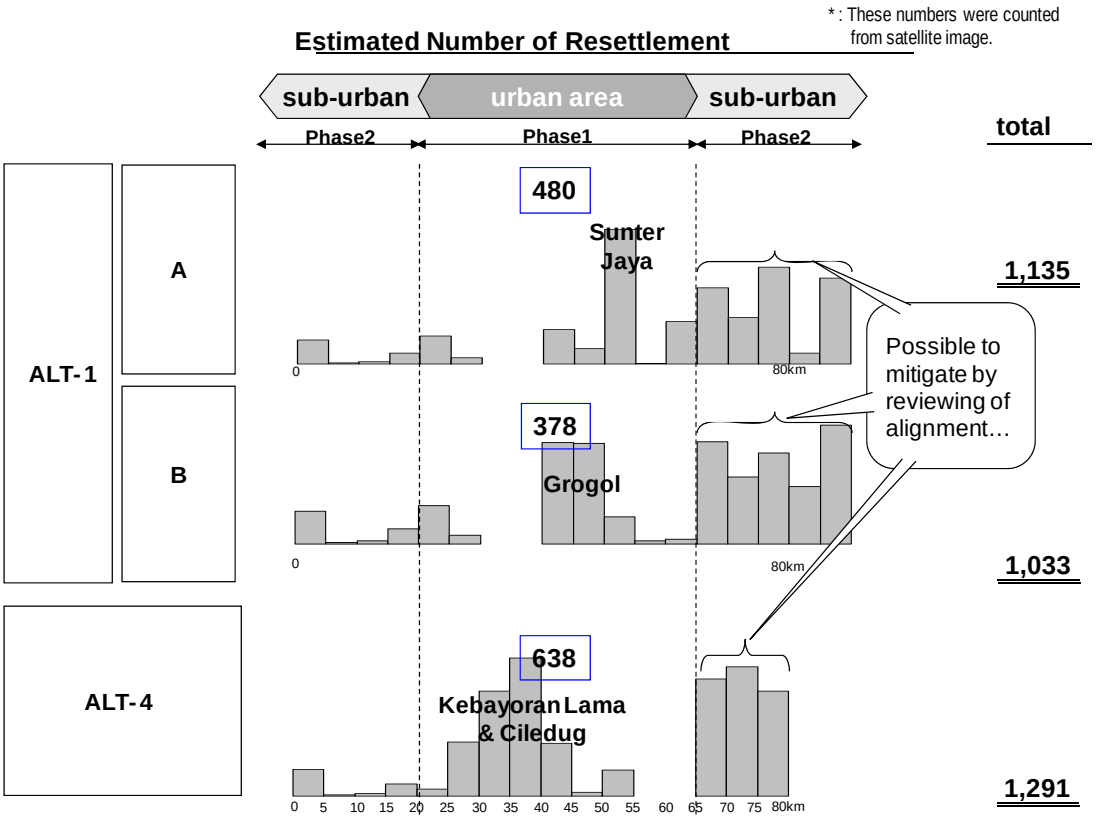
Source: JICA Study Team

Figure 3.3-7 Situation of ROW for Alt-4 in Jl. Ciledug Raya

2) Resettlement Houses

In addition to land acquisition, the number of houses to be resettled due to the MRT project, is also evaluated. Similar to the land acquisition aspect, the evaluated area is limited only in the phase 1 area.

As a result of the evaluation, the number of houses in Alternative 4 appears to be the largest. Particularly, most resettled houses are owned by middle and high class levels of residents, causing difficulty in executing resettlement procedures.



Source: JICA Study Team

Figure 3.3-8 No of Houses to be Resettled in every alternatives

3) Noise and Vibration Impacts (Sensitive Area, Hospital, School and Mosque)

Public facilities, i.e., sensitive receptors (e.g. hospitals, schools and mosques), which need special attention in terms of noise and vibration were counted along the MRT corridor.

As a result of counting, the number of sensitive receptors along Alternative 4 is relatively higher than that of other alternatives. There is a high possibility to take mitigation measures like anti-vibration sleepers and sound insulation walls.

Table 3.3-5 No. of Sensitive Receptors along the Route

Sensitive Area	Alt. 1		Alt. 4
	A	B	
Hospital	11	11	23
School	23	22	38
Mosque	16	16	22
Total	50	49	83

Source: JICA Study Team

(4) Evaluation Result

1) Scouring Result

Based on the criteria in Figure 3.2-1, each item was scored based on three-grade evaluation. Each point was calculated into the weighted score and then the total scores were calculated.

As a result of the calculations, Alternative 1B has the highest score. Details of the scores are shown in Table 3.3-6.

Table 3.3-6 Scoring Results by MCA

Aspect	Evaluation Criteria	Weight	Alt. 1				Alt. 4	
			A		B			
			Q'ty	Score	Q'ty	Score	Q'ty	Score
A. Technical (35%)	a-1) Constructability (Obstacles)	10%	24 nos.	2 (0.20)	24 nos.	2 (0.20)	24 nos.	2 (0.20)
	a-2) Constructability (Exiting Road Width)	10%	16.9 km	2 (0.20)	17.6km	2 (0.20)	28.2 km	1 (0.10)
	a-3) Connectivity to Airport Link	5%	Possible	3 (0.15)	Possible	3 (0.15)	Unrealistic	1 (0.05)
	a-4) Connectivity to N-S Line	5%	Good	3 (0.15)	Good	3 (0.15)	Fair	2 (0.10)
	a-5) Connectivity to Public Transportation Network	5%	10 links	3 (0.15)	11 links	3 (0.15)	7 links	2 (0.10)
	Technical Aspect Total	35%	0.85		0.85		0.55	
B. Economical (25%)	b-1) Cost per km	5%	JPY 5,200 mil	2 (0.10)	JPY 5,300 mil	2 (0.10)	JPY 5,600 mil.	2 (0.10)
	b-2) EIRR	10%	23.1 %	3 (0.30)	21.4%	3 (0.30)	19.2%	2 (0.20)
	b-3) Daily Passenger Demand per km	10%	21,280 pax.	2 (0.20)	20,830 pax.	2 (0.20)	25,030 pax.	3 (0.30)
	Economical Aspect Total	25%	0.60		0.60		0.60	
C. Environmental (40%)	c-1) Land Acquisition	15%	178,500m^2	2 (0.30)	100,600 m^2	3 (0.45)	285,200 m^2	2 (0.30)
	c-2) Resettlement Houses (Existing ROW of Road)	20%	480 nos.	1 (0.20)	378 nos.	2 (0.40)	638 nos.	1 (0.20)
	c-3) Noise & Vibration Impact (Sensitive Area, Hospital, School and Mosque)	5 %	50 nos.	3 (0.15)	49 nos.	3 (0.15)	83 nos.	2 (0.10)
	Environmental Aspect Total	40%	0.65		1.00		0.60	
Total Score			**2.10**		**2.45**		**1.75**	
Rank			**2nd**		**1st**		**3rd**	

Source: JICA Study Team

3.3.2 Selected Route

The above results of evaluation were presented during the coordination meetings participated by stakeholders (DGR, DKI Jakarta, West Java Province, Banten Province, MRTJ, etc.) held on April 26 and May 25 2011.

Through the above coordination meetings, Alternative 1B was decided by the stakeholders as the target route for further feasibility study, which was acceptable to DGR.

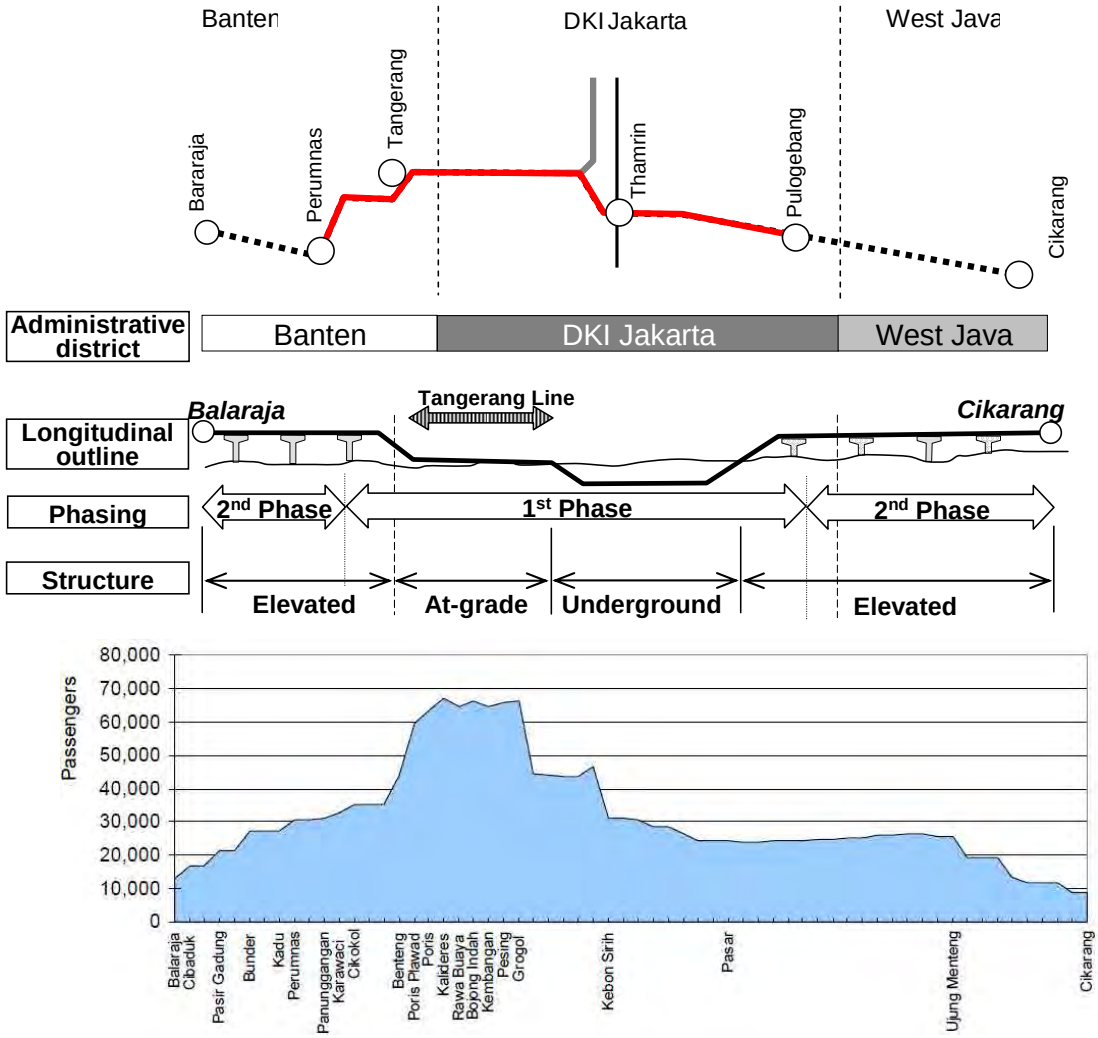
3.4 Phasing

3.4.1 Issues of Cross-Border Project

According to the phasing plan as shown in Figure 3.4-1, the alignment extends beyond the provincial borders of DKI Jakarta and Banten Province up to Perumanas on the west and goes up to Pulogebang on the east. It is presupposed that MRT East–West Line uses the existing Tangerang Line.

Because of the cross-border railway project, there are a lot of stakeholders. It will be difficult to reach consensus if not to promote this MRT project in the DKI Jakarta. It requires a

considerable amount of time to win agreements from all of the stakeholders. It will cause some trouble in early project realization.



Source: Prepared by the JICA Study Team based on Pre-FS

Figure 3.4-1 Outline of the Phasing Plan in the Pre-FS

From the results of the review of the phasing plan in the Pre-FS, it has been found difficult to apply the phasing plan for this project, as several issues related to management and early project realization have been identified. The following describes the issues identified through the review of the Pre-F/S:

【a】 In the case of cross-border alignment, the authority to approve the EIA will be the Ministry of Environment, which is the state level authority to give approval in accordance with AMDAL. Since the procedure to complete EIA approval takes a long period, additional time has to be considered for the project implementation.

【b】 The cost demarcation, which had been agreed between the central and DKI Jakarta governments for the MRT North–South Line Project, has to be discussed and agreed again among the central government and two local governments, which for sure, will make the issues much more complex and require longer time to achieve an agreement.

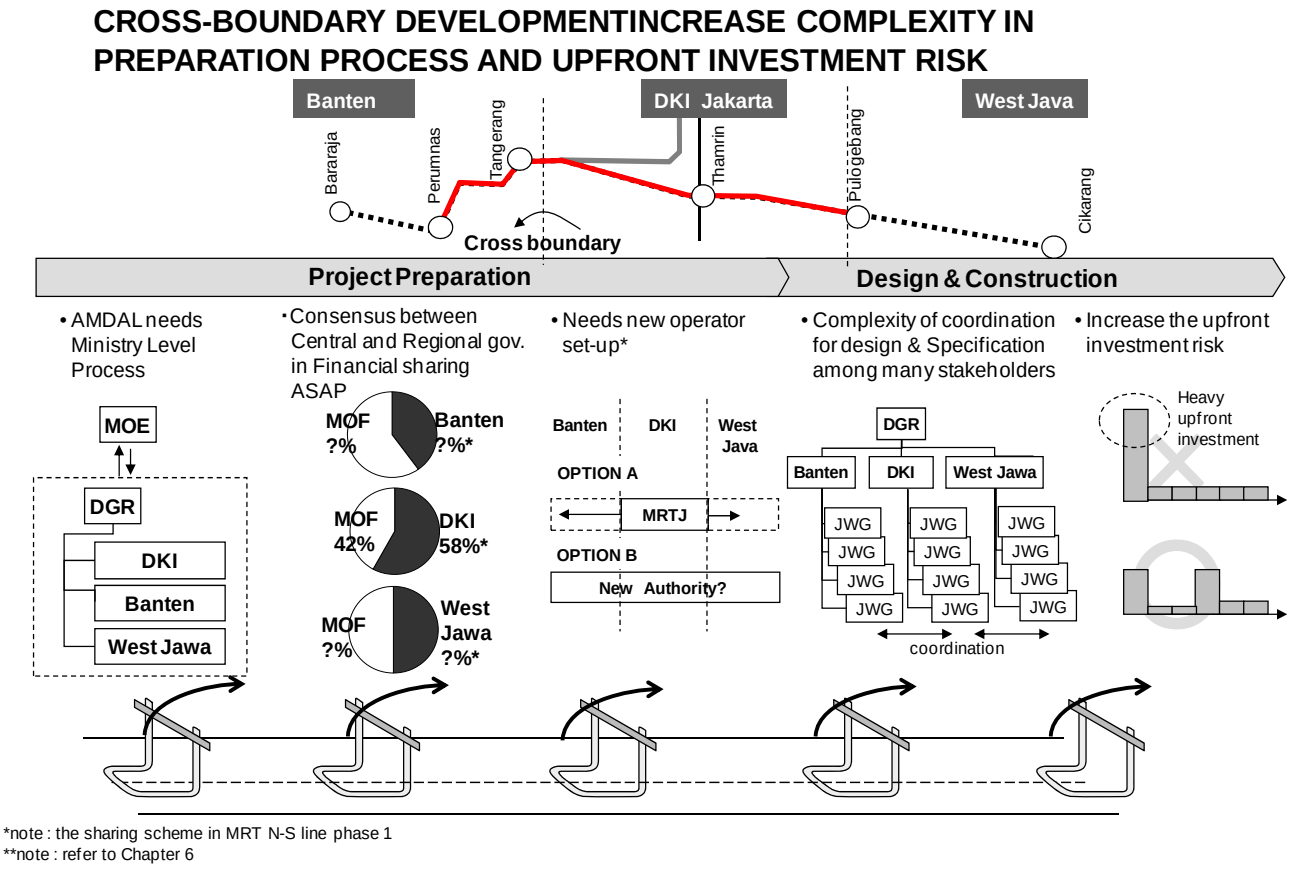
【c】 In the case of the cross-border railway project, the project implementation organization has to be a government enterprise (such as Badan Usaha Milik Negara (BUMN), which is a state-owned enterprise). A new implementation organization needs to be established, as local governmental enterprises such as Badan Usaha Milik Daerah (BUMD), which is a

regional owned enterprise like PT. MRTJ, the operator of North–South Line, are not allowed to operate such kind of projects[7].

【d】 The consensus among the central government, three provincial governments and MRT operator will be required in the design and construction stage. It is expected that brainstorming and assessment of opinions and suggestions through coordination will be complex and thus, project realization will fall behind schedule.

【e】 The total length of the Phase 1 section will be over 40 km, making a much higher construction cost at approximately JPY 264 billion. In effect, an excessive initial investment risk is a concern.

Although the use of Tangerang Line by MRT East–West Line was assumed in the Pre-FS, there will be many difficulties to overcome if the MRT alignment crosses with the provincial borders, such as difference in operation systems (i.e., East–West Line and Tangerang Line applies different systems), and coordination with the operation of Tangerang Line.



Source: JICA Study Team

Figure 3.4-2 Complexity and Increase in Risk due to Crossing Provincial Borders

The issues raised by the cross-border alignment can be solved if the alignment is located within DKI Jakarta. However, the phasing plan in the Pre-FS implies that the Phase 1 route should be selected from the section that keeps high sectional traffic (from Perumunas 2 to Pulogebang) in order to absorb as many passenger demand as possible by extending the route beyond provincial border.

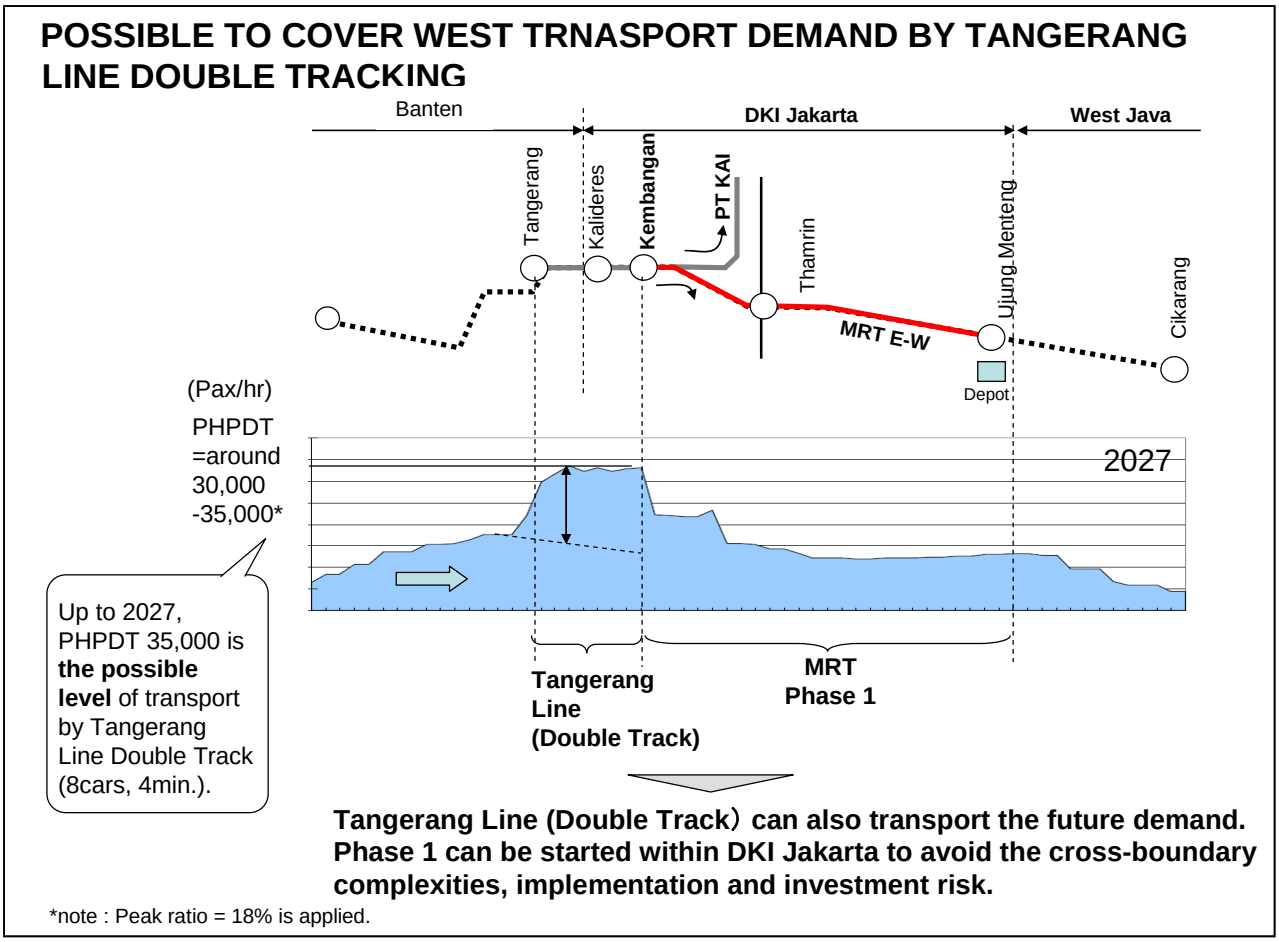
[7] "Indonesian Railway Law 23rd-2007" stipulates that business permit for cross-border railway operation should be given to a central government (BUMN). A regional-owned enterprise (BUMD) such as PT.MRTJ is not allowed to be a railway operator of cross-border project. Details described late in Chapter 6.

Meanwhile, double tracking works of Tangerang Line have been started and are expected to be completed in 2012. The improvement of transportation capacity was also anticipated by renovating its signal system and others in the future.

Considering these situations, it is understood that the double-tracked Tangerang Line will be able to carry the traffic volume between Duri and Tangerang, which has the highest cross-sectional traffic volume as shown in Figure 3.4-3. This means that it does not necessarily require the extension of Phase 1 of the MRT project up to Banten Province in order to avoid the issues caused by the cross-border alignment

(Note: Figure 3.4-3 shows the estimated demand once the entire East–West Line including Phase 2 is open. However, considering only Phase 1, the peak hour peak direction traffic (PHPDT) in Tangerang Line section is supposed to be at 30,000~35,000 person/hr/direction.)

Due to the abovementioned reasons, it was proposed that Phase 1 will be within DKI Jakarta.

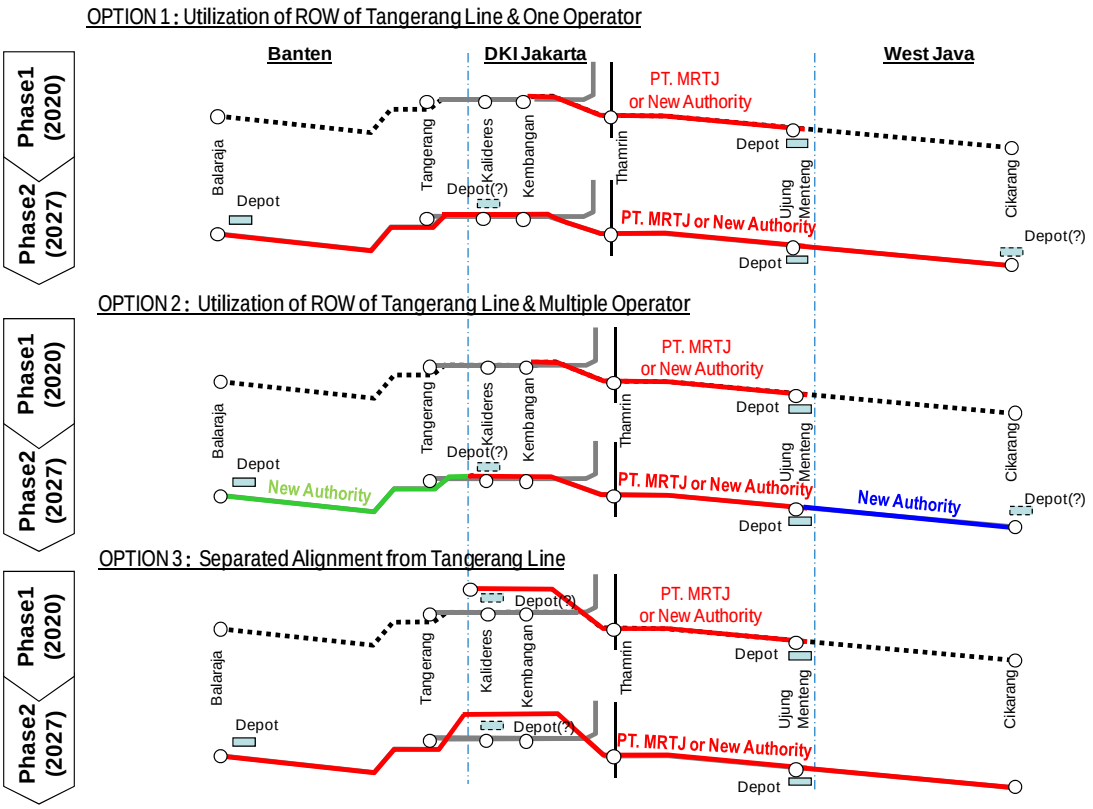


Source: JICA Study Team using the figures in the Pre-FS

Figure 3.4-3 Transport Demand of Tangerang Line (Double Track) and East–West Line

3.4.2 Options of MRT East–West Line Development in Phases 1 and 2

In this section, the range of options for Phase 1 will be discussed. It is necessary to consider the Phase 2 section when studying the route area because both Phases 1 and 2 are located within the DKI Jakarta area. There are three possible options for Phase 1 section as described below. In the following discussion, through-operation with Tangerang line or use of existing Tangerang line track for MRT East-West operation is not considered. It is based on the premise that MRT East-West line will be totally independent from Tangerang line. Figure 3.4-4 illustrates the possible options.



Source: JICA Study Team

Figure 3.4-4 Phasing Scenario of each Option

Option 1: Route along ROW of Tangerang Line, plus one operator

As described in the previous section, since it is expected that the transportation capacity of the Tangerang line will increase because of the on-going double-track project of Tangerang line, and that demand in the near future can be covered by the said project (refer to Figure 3.4-3), it is proposed that MRT East-West line avoids overlapping with the existing Tangerang line to avoid excessive initial investment cost requirements, although the alignment of MRT East-West Line on the west will be planned along the ROW of Tangerang line. However, at least one station should be constructed as a transfer station with the Tangerang line, with its design taking into account commuter-friendliness and convenience. Existing stations of the Tangerang line after crossing with MRT East-West line starting with Taman Kota (existing Kembangan Station, presently not used), Bojon Indah continue westwards. Since Taman Kota station does not have a suitable connection with other modes of transportation (i.e. road traffic), it will not be considered as a well-designed transfer station. It is recommended by the JICA Study Team that a new station be constructed near the vacant lot located on the north side of Tangerang line between Taman Kota and Bojon Indah stations, along with the development plan around the station (details to be discussed later in Section 4.8). As a transfer station with the Tangerang line and with the aim to connect the MRT East-West line with existing road traffic and to attract as many passengers as possible through the development plan around the station, it is proposed that the new station at this site, which has been named Kembangan(2) station in this study, be the first station for the western portion of Phase 1 of the MRT East-West line.

In this option, it is assumed that either PT. MRTJ, which is expected to be the implementing agency for the Project's Phase 1, or a newly established organization (BUMN) will take over the operation of the Project, and that the entire MRT East-West line which covers three provinces will be operated by a single company.

Option 2: Route along ROW of Tangerang Line, plus multiple operators

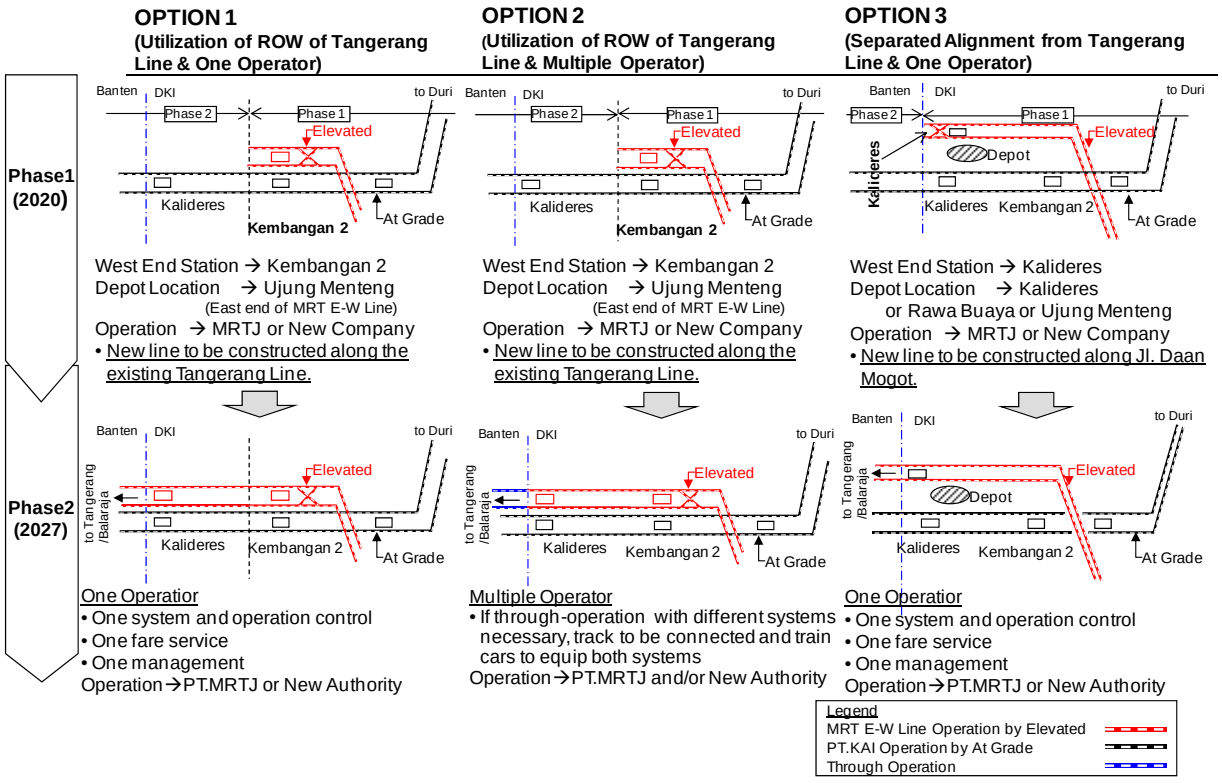
As is the case with Option 1, the route starts with Kembangan on the west and ends with Ujung Menteng on the east. It is also assumed that PT. MRTJ will be the implementing agency for Phase 1 of the Project. However, operation of Phase 2 of the Project in the non-DKI Jakarta area will be handled by Regional-Owned Enterprises (BUMD).

In case the railway systems in Banten province and West Java province are found to be different from the DKI Jakarta system, the rolling stock of MRT East-West line will have to be equipped to operate on more than two systems.

Option 3: Completely separate operations of Tangerang Line and MRT East-West Line

This is the option in which the operations of Tangerang Line and MRT East–West Line are completely separate. The west end of Phase 1 can be extended up to Kalideres where there is a candidate location for the depot, which is near the provincial border of DKI Jakarta and Banten Province. Elevated structures will be constructed along Jl. Daan Mogot. Six inner roads are planned along Jl. Daan Mogot, and since the new MRT structure will run in parallel with these inner roads, additional land acquisition and resettlement will be needed. There is no required coordination with Tangerang Line operation even for Phase 2 since the two lines are completely separate.

Figure 3.4-5 shows the Phasing Scenario of Phase-1 & 2 in each option. Table 3.4-1 shows the comparison table of the options.



Source: JICA Study Team

Figure 3.4-5 Phasing Scenario of Phase-1 & Phase-2 in each Option

Table 3.4-1 Comparison Table of Phasing Scenario

Aspect	Evaluation Criteria	OPTION 1 (L=89.6km)		OPTION 2 (L=89.6km)		OPTION 3 (L=91.6km)	
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
A. Technical (30%)*1	a-1) Systems Integration (10%)	Not Necessary		Not Necessary	Possibility of different systems for each operator	Not Necessary.	
		3 (0.3)		1 (0.1)		3 (0.3)	
	a-2) Constructability (10%)	Parallel with Tangerang Line		Parallel with Tangerang Line		Overlap with 6 inner roads	
		2 (0.2)		2 (0.2)		1 (0.1)	
	a-3) Implementation Organization (10%)	Separate Operations		Separate Operation	Multi Operation	Separate Operation	
		3 (0.3)		1 (0.1)		3 (0.3)	
	Sub-total	**0.8**		**0.4**		**0.7**	
B. Economical (30%)*1	b-1) Cost per km (15%)	8.0 million yen /km	4.8 million yen /km	8.0 million yen /km	4.8 million yen /km	7.3 million yen /km*	4.8 million yen /km
		2 (0.3)		2 (0.3)		2 (0.3)	
	b-2) Price of Train per train set (6 trains) (15%)	990 million yen / set		990 million yen / set		990 million yen / set	
		2 (0.3)		2 (0.3)		2 (0.3)	
	Sub-total	**0.6**		**0.6**		**0.6**	
C. Environmental (40%)*1	c-1) Land Acquisition (LA) (20%)	8,000 m^2	Limited LA in future	8,000 m^2	Limited LA in future	42,000 m^2	Huge LA in future
		2 (0.4)		2 (0.4)		1 (0.2)	
	c-2) Resettlement (RSM) (20%)	70 nos.	Limited RSM in future	70 nos.	Limited RSM in future	400 nos.	Huge RSM in future
		2 (0.4)		2 (0.4)		1 (0.2)	
	Sub-total	**0.8**		**0.8**		**0.4**	
Total Score		**2.20**		**1.80**		**1.70**	
Rank		**1st**		**2nd**		**3rd**	

Source: JICA Study Team

*Although cost per km of Phase 1 in Option 3 is slightly less than others, the total project cost of Option 3 is higher than others as its total route length is the longest.

*1) Basically, percentage for each category (A, B and C) is set equally, however, percentages for C (environmental) is set 10% higher than others as this item is vital for the project realization.

*2) Scores for each evaluation item are set as follows,
3 points; Positive, 2 points: Fair, 1 point: Negative,

As a result of the comparison of the options shown in the Table above, Option 1 has gained the highest score. The main advantages of Option 1 are the following: systems integration with Phase-2 is not required; under this scenario, there is no possibility of complex operation by more than two operators; and also, resettlement and land acquisition is minimized. Consequently, Phase 1 (within DKI Jakarta) of the Project is set in the section between Kembangan(2) to Ujung Menteng.

3.5 Stage Construction

In the previous study, the Phase 1 was decided to be the section from Kembangan (2) to Ujung Menteng. If the Phase 1 was constructed in a lump, the large project cost would be a severe burden for the Indonesian government since the term of repayment is overlapped with the repayment for Jakarta MRT North – South line. Hence, the Phase 1 should be constructed stage by stage.

3.5.1 Study Area

The following conditions were considered to set each construction stage for the Phase 1.

- Network of public transport: Connection between Jakarta MRT North – South line and the conventional railway of central and eastern line
- Efficient use of Lebak Bulus Depot of Jakarta MRT North – South line: to construct a link line
- Land acquisition for Ujung Menteng depot: Since not enough land for rolling stock inspection and repair can be acquired in Kembangan Depot, Ujung Menteng depot has to have enough space for rolling stock inspection and repair.
- Minimization of construction cost and effect on the current traffic flow

The Phase 1 section is divided into the following two stages on the east and west with Tamrin station at the center.

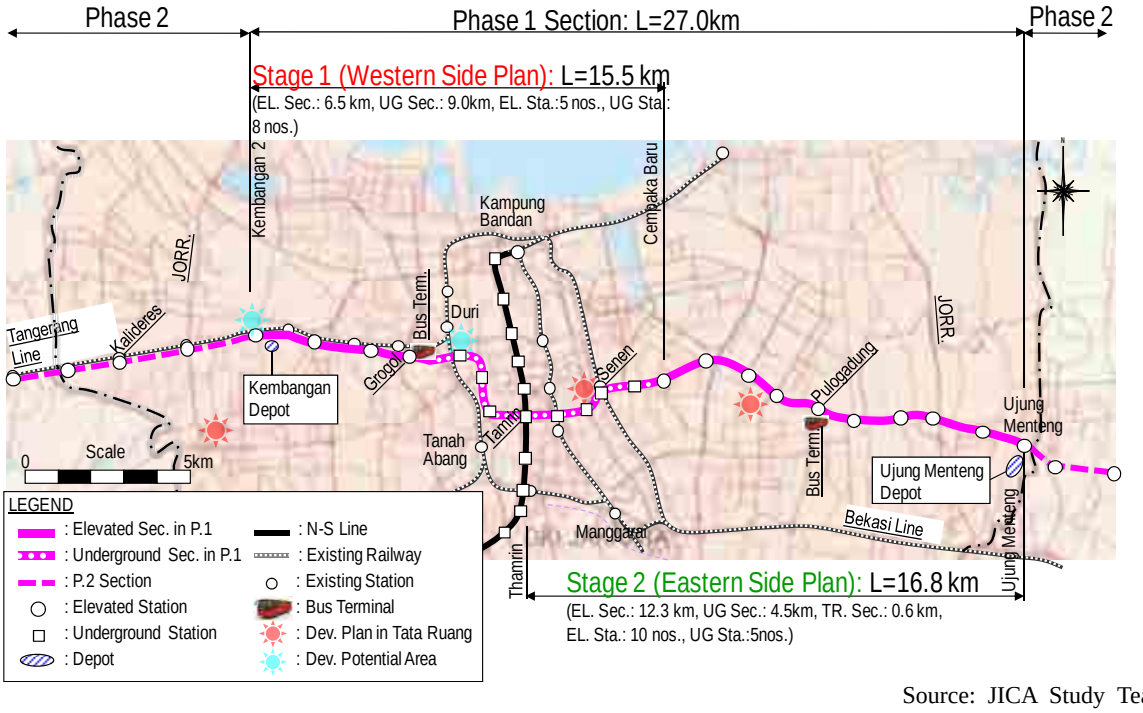
1) West side development (Stage 1):

The west end is Kembangan 2 station, which will be connected to Tangerang line and have a sufficient land for rolling stock inspection and repair. The east end is Cempaka Baru station which is the first elevated station in the east. The section length is 15.5 km including 6.5 km viaduct and 9.0 km tunnel. The five stations are elevated, and the eight stations are underground.

2) East side development (Stage 2):

The west end is Tamrin station crossing with Jakarta MRT North-South line, and the east end is Ujung Menteng station which is elevated and has sufficient land for the facility of rolling stock inspection and repair in the plan. The section length is 16.8 km including 12.3 km viaduct and 4.5 km tunnel. The ten stations are elevated, and the 5 stations are underground. If the west end was extended to Grogol elevated station, the total length would be approximately 22 km almost as long as the Phase one section length, so underground Tamrin station was selected as the west end.

The staging plan of Phase 1 is shown in the following figure.



Source: JICA Study Team

Figure 3.5-1 Studied stages of Phase 1

3.5.2 Comparison Study

To determine whether the Stage 1 should be prioritized or the Stage 2 should be prioritized, the two construction sequences are compared by evaluating technical aspects for connectivity with public transport and urban development areas, social and environmental aspect, sectional passenger demand and construction cost.

(1) Technical Evaluation

Connectivity with public transport and urban development areas and operational aspect are evaluated as technical aspects.

1) Connectivity with public transport and urban development area

If the Stage 1, the west side development, is prioritized, the line is connected to public transport and urban development area at eight points: 5 railway lines including future plans (Tangerang line, western line, Jakarta MRT North-South line, central line, eastern line), bus terminal (Grogol bus terminal), and two urban development areas (Duri and Senen regional development). At the connection with western line, a new station facility is required around Roxy area.

If the Stage 2, the east side development, is prioritized, the line is connected to public transport and urban development area at six points: 3 railway lines including future plans (Jakarta MRT North-South line, central line, eastern line), bus terminal (Pulogadun bus terminal), and two urban development areas (Senen, Pulogadung regional development). At the connection with western line, a new station facility is required around Roxy area.

2) Operational aspect

In the case preceding the Stage 1, because it is difficult for Kenbangan depot to have the function of rolling stock inspection and repair due to the land constraint, a link line to Jakarta MRT North-South line is required to connect to Lebak Bulus Depot where facilities for rolling stock inspection and repair and maintenance machines are available. Additionally, when the entire section of Phase 1 is open, there will be two depots, Ujung Menteng and Kenbangan, at the both ends, and it enables an efficient and various operation plans with few deadheadings. However, a part of Indonesian Bank's land might be required for the link line construction.

In the case preceding the Stage 2, a link line to Jakarta North-South line is not necessary because facilities for roiling stock inspection and repair can be constructed at Ujung Menteng station, so Indonesian Bank's land is not a concern. On the other hand, the operation cannot be coordinated with Jakarta MRT North-South line, and depot on the side of Kembangan is not necessary after the total section of Phase-1 opens. As the result, number of deadheadings is more than the case preceding the Stage 1, and operation plan has more constraints.

(2) Natural and Social Environmental Impact

Natural and social environmental impacts were evaluated in each case.

1) Natural Environment

Since the site of Phase 1 did not include areas designated for nature conservation or endangered species, no differences was found in the studied cases.

2) Social Environment

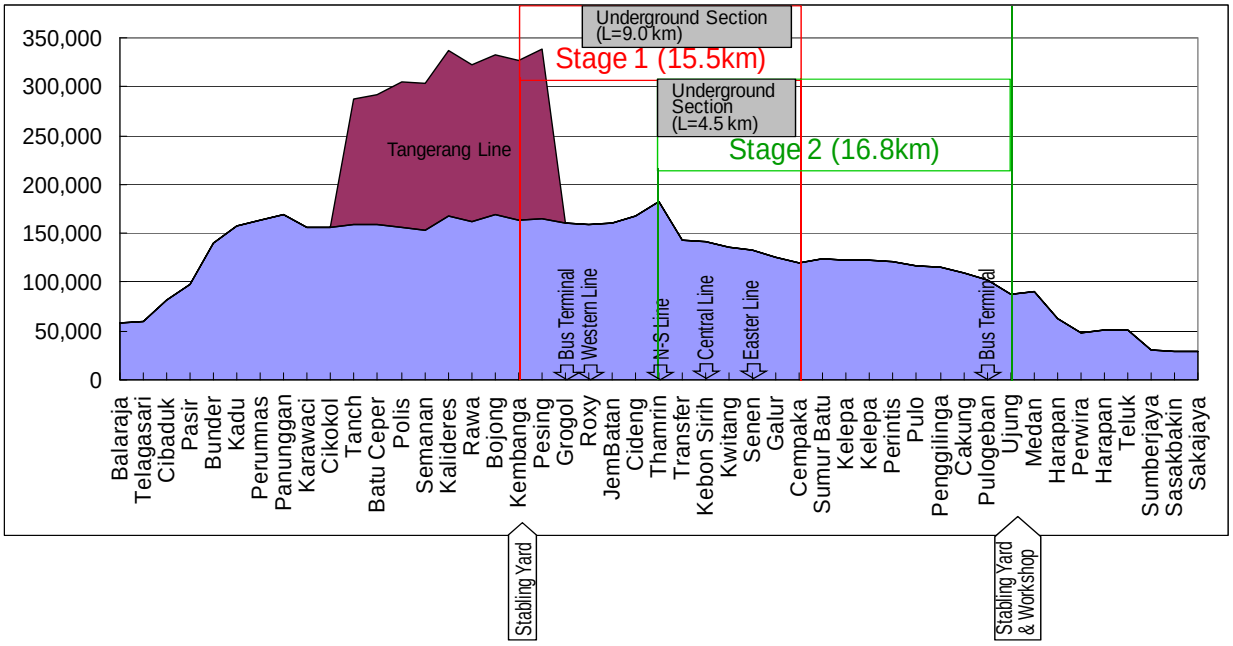
The number of structures to be resettled and affected was estimated from the satellite picture for the Stage 1 and 2. In the case preceding the Stage 1, 171 structures should be resettled, and 206 are affected. In the case preceding the Stage 2, 77 and 162 are estimated to be resettled and affected respectively.

The reason why the case preceding the Stage 1 involves more structures than the other case is that it requires resettlements in a long section along the existing Tangerang line to connect.

(3) Passenger Demand

The following figure shows the future daily passenger demand in 2024 when the East – West line is completed estimated in the pre-feasibility study.

In the case preceding Stage 1, the daily demand is 1,403,000 passenger trips/day and 90,900 passenger trips/day/km. On the other hand, the daily demand of the case preceding Stage 2 is 1,303,000 passenger trips/day and 71,600 passenger trips/day/km. Hence, the case preceding Stage 1 is estimated to have more demand than the other case.



Source: JICA Study Team

Figure 3.5-2 Sectional Passenger Volume

(4) Construction Cost

The construction cost was estimated separately by civil works, system, depot and rolling stock. The total construction cost of the case preceding Stage 1 is 144.8 billion yen, and it was 155.7 billion yen for the case preceding Stage 2.

(5) Comparison Result

The Table 3.5-1 summarizes the comparison discussed above. The Stage 1 section has more hub pints with other public transports and development area. The initial construction cost is less by about 9%, and since turn-back facilities is constructed in a viaduct section, the future cost would be less as well. Moreover, the future demand is higher than the Stage 2 section, so the Sage 1 section should be prioritized. With respect to the number of affected structures, the Stage 1 section would have more impact. However, the same impact is expected when the entire Phase 1 is constructed.

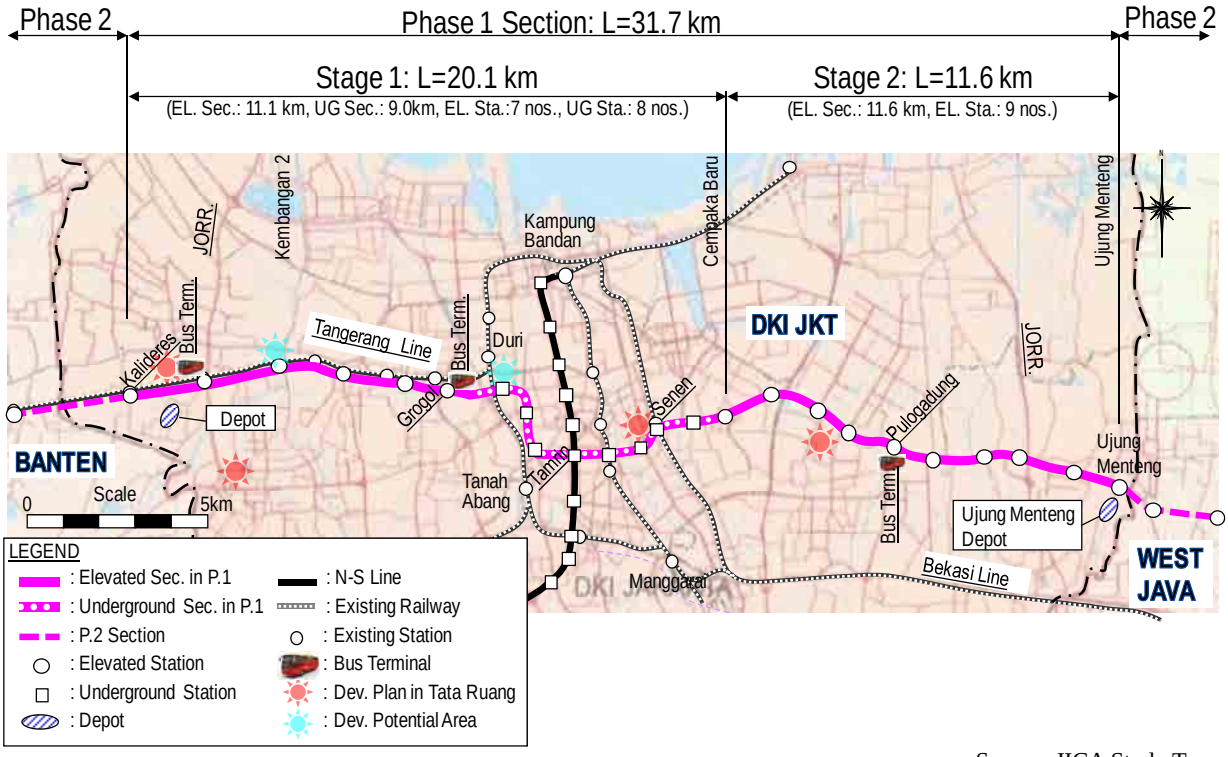
Table 3.5-1 Comparison Table of Phasing Scenario

Item	Stage 1 Priority Plan: Western Side Plan (Kenbangan - Cempaka Baru)	Stage 2 Priority Plan: Eastern Side Plan (Thamrin – Ujung Menteng)
1. Technical Aspect 1) Connectivity with public transport and development areas 2) Operational aspect	◎ 8 nos. (Tangerang Line /Western Line /N-S Line / Central Line / Eastern Line / Grogol Bus Terminal/ Kembangan, Duri & Senen Dev. Plan Area) ● There is not enough space for workshop at Kembangan Depot area. Therefore, Lebak Bulus Depot on N-S Line will be utilized temporary by connection line. And also, it is required to use the land of Bank Indonesia. ◎ It is possible to utilize not only inspection and maintenance cars of N-S Line, and but also escape line in case of emergency by this connection line. ◎ It is decreased no passenger service in with both depots in Phase 1.	● 6 nos. (N-S Line / Central Line / Eastern Line / Pulogadun Bus Terminal, Senen /&Pulogadung Dev. Plan Area) ◎ It is possible to keep a space for Workshop at Ujung Menteng Depot. Hence, it is not necessary to install connection line. ● It is required inspection and maintenance cars without connection line. ● It is increased no passenger service, because stabling yard is only at Ujung Menteng Depot in Phase 1.
(2) Environment 1) Natural Environment 2) Social Environment Impact The number of structures to be resettled and affected	◎ No natural conservation area ● 171 structures (206 structures in Phase 1)	◎ No natural conservation area ◎ 77 structures (162 structures in Phase 1)
(3) Passenger Demand (Sectional Pax. Vol.)	◎ Total Sectional Daily Pax. Vol. : 1,403,000 pax./day (2024) ◎ Total Sectional Daily Pax. Vol. per km : 90,600 pax./km/day (2024)	● Total Sectional Daily Pax. Vol. : 1,303,000 pax./day (2024) ● Total Sectional Daily Pax. Vol. per km : 71,600 pax./km/day (2024)
(4) Estimated Construction Cost 1) Civil 2) System 3) Depot 4) Rolling Stock	JPY 144,800 Mil. JPY 94,800 Mil. JPY 32,900 Mil. JPY 4,700 Mil. JPY 12,400 Mil.	JPY 157,700 Mil. JPY 95,800 Mil. JPY 38,500 Mil. JPY 9.400 Mil. JPY 14,000 Mil.
(5) Comprehensive Evaluation	1st	2nd

Source: JICA Study Team

3.6 Phasing and Staging

Based on the proposal of the JICA Study Team and the discussion, the Stage 1 was specified as the section from Kembangan 2 to Cempaka Baru. Afterwards, at coordination meeting with JICA and the related agencies of Indonesia held in July 2012, all the section in DKI Jakarta was included in Phase-1, so the Phase 1 section was changed from Kalideres to Ujung Menteng, and it was agreed that the section within the Phase 1 was divided into the section from Kalideres to Cempaka Baru as Stage 1 and the section from Cempaka Baru to Ujung Menteng as Stage 2.



Source: JICA Study Team

Figure 3.6-1 Final fixed phasing and staging plans

3.7 Review of Modal Choice Model in SITRAMP 2

3.7.1 Technical Report in SITRAMP 2

Land use within the JABODETABEK region has been rapidly undergoing diversification, expansion and intensification. Hence, in SITRAMP 2, research and analysis for regional transportation have been made, and the technical reports on these issues have been prepared. In Vol. 2 of the Technical Report entitled “Transportation Model and Demand Forecast“, studies on methodologies for transport modeling and demand forecasting have been implemented. This report contains the following:

1) Zone system and network development
The transportation network model consists of several elements such as:

- Zone centroids and connectors
- Highway networks
- Public transport networks
- Public transport lines and operational data

2) Trip generation model
For trip production and attraction modeling, explanatory parameters and values were found to be different between urban and rural areas. Total trips and average trip rates for urban and rural areas were summarized by mode and by income level.

3) Trip distribution model
Each zone links with all other zones via the transportation network. Trip distribution model was created using the gravity model.

4) Modal choice model

For the demand forecast in SITRAMP, an aggregate approach was used for mode selection model, which is based on zones rather than individual information. However, for more specific analysis such as traffic restraint examination, disaggregate models were developed.

5) Modeling for assessment of traffic demand management (TDM)
In order to predict the impacts of the proposed TDM, discrete choice models were developed based on questionnaire surveys answered by TransJakarta passengers. This was developed as an aggregate model for the purpose of creating major demand forecast models, and using it to forecast car-person trips.

6) Transport demand forecast
The forecast total trip productions for 2010 and 2020 were compared to the actual trip production in 2002.

3.7.2 Modal Split Model of North-South Line Phase 1 Project

Data used in traffic demand forecasting for North-South Line Phase 1 Project were based on person-trip data of SITRAMP 2. Moreover, the trip generation model is also the same with the model used for SITRAMP. Therefore, the same modal split generated from SITRAMP 2 was used in the traffic demand forecast.

As described earlier in Item 5 of Section 3.4.1, this model was developed in order to predict TDM impacts. In SITRAMP 2, an aggregated model was developed and used as the main demand forecast model, and applied in forecasting future car- person trips.

The following is the model formula:

$$P_{private} = 1 / (1 + \exp(U_{private} - U_{public}))$$

where:
$P_{private}$ = Probability of using private transport mode
$U_{private}$ = Private transport utility mode
U_{public} = Public transport utility mode

The private and public transport utility modes (Uprivate and Upublic) include travel time, TDM/ERP (road pricing) fare, and public transportation fares (bus, MRT and railway).

The alternative transport utility modes are functions of the generalized time which includes TDM/ERP fare, public transport fares (bus, busway, MRT, railway, etc.), and travel time. The constant (C) in the following formula includes the net effect of other attributes not explicitly included in the model, i.e. income levels. The utility function in the multinomial logit model takes the following form:

$$U_{private} - U_{public} = \{\beta \times (T_{private} - T_{public})\} + C$$

where:
U = Utility
T = Generalized time (total composite time expressed in minutes)
C = Constant

The parameters were estimated by income group using maximum likely techniques, as shown in Table 3.7-1 below.

Table 3.7-1 Parameters

Income	β	Constant
High	0.031367	-0.03471
Middle	0.031367	1.24977
Low	0.031367	2.28757

Source: SITRAMP 2

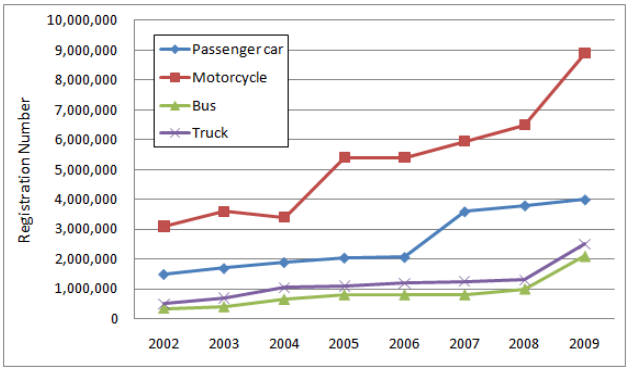
This modal split was used in the demand forecast for MRT North–South Line Phase1. Demand forecasting was carried out under the assumption that TDM/ERP (road-pricing) was applied in the Base and Enhanced Cases. Using this modal split model for the traffic demand forecast of the North–South Line Phase 1 Project, appropriate results were obtained.

3.7.3 Modal Split Model of the Traffic Demand Forecast

For the traffic demand forecast of the MRT East-West Line, the origin–destination (OD) table obtained from the person-trip surveys in SITRAMP 2 by JICA was used as the basic data. It is necessary to confirm the transition of OD from 2002 to the present. Since the study of SITRAMP 2 was conducted in 2002, there is a need to verify the transition of the OD tables until 2011, and adjust them to future values by focusing on the economic and social framework. Similarly, the modal split model needs to give emphasis on the current economic and social framework. For these reasons, the existing conditions are being investigated, which include willingness-to-pay, and transportation preferences. Furthermore, the aggregate model from the survey results is being estimated.

(1) Registration Trends according to Organization

The number of registered transportation vehicles in Jakarta increases every year. Based on the growth rate of the number of registrations, the increase in the number of motorcycles from 2008 to 2009 is considerable, which is about 25%. Such cases may also be similar in terms of the number of registered cars in the future.

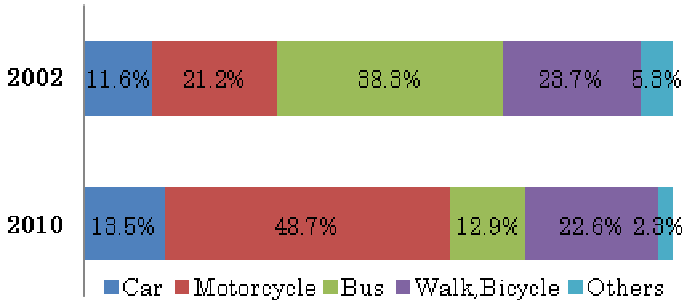


Source: The fact by Citizens Coalition for Transportation Demand Management [TDM Coalition]

Figure 3.7-1 Trends in Institutional Registration in DKI Jakarta

(2) Organization Allotment Rate at Current State

The ratio of motorcycle use increases greatly when comparing the organization allotment rate to Jakarta by commuters between 2002 and 2010. Moreover, the ratio of car use also increases while that of other traffic modes show a decreasing trend.



Note: Cars include taxi and bajai, while others include railway and ojek
Source: Preliminary figures of JUTPI Commuter Survey

Figure 3.7-2 Percent Share of the Current State Agency (Commuters to DKI Jakarta)

3.7.4 Analysis of Questionnaire Survey

In order to analyze the selection characteristic of the existing modes of transportation, surveys were done at selected main traffic points on the MRT East–West Line. One way to analyze survey results, based on the basic theory of random utility theory, is the application of disaggregate logical model which is commonly used in estimating the parameters of choice models. It is the technique in which a disaggregate model relates the selection process of an individual to the method of predicting transport demand. This method uses the data in which the four-step assumption method is applied to the person-trip survey results in the zones. While assuming a parameter in the application of this disaggregate logical model, the characteristics of a transportation mode choice is determined using the assumed parameter.

In this survey, 1,151 samples have been collected, and 1,098 of which have been used for the estimate as effective samples.

(1) Survey Area and Methods of Analysis

MRT East–West Line, where transport demand is large (Pulogadung, Tangerang, and Bekasi), is chosen as the research area along the railroad line, and it is in this area where interviews were conducted for private car, motorbike and bus users, as well as other users of gas stations near the railroad that are part of the existing traffic.

Table 3.7-2 Survey Area and Number of Samples

Survey Area	Classification	Survey Location	Number of Samples
Pulogadung	Gas Station	SPBU 34.10605 JI. R Suprapto	160
Pulogadung	Gas Station	SPBU Jend. Suprapto	80
Tangerang	Gas Station	SPBU Daan Mogot	80
Bekasi	Gas Station	SPBU-Kemerdekaan Pulogadung-34-13202	80
Tangerang	Gas Station	SPBU Tanah Tinggi	80
Tangerang	Bus stop	Trans Jakarta Kalideres	110
Bekasi	Station	Stasium Kranji	111
Tangerang	Station	Stasium Tangerang	110
Tangerang	Bus Terminal	Terminal Kalideres	120
Pulogadung	Bus Terminal	Terminal Pulo Gadung	110
Pulogadung	Bus Terminal	Terminal Busway Pulogadung	110

Source: JICA Study Team

The Survey forms include questions on gender, income, ownership of private car or motorbike. Regarding the selection of modes of transportation, respondents were asked to choose from the different modes available, MRT, railroad, bus, Trans Jakarta (BRT), car, and motorbike, as their main means of commuting to the central part of Jakarta and commuting to school. The transportation expenses and the travel time required for each mode of transportation are also shown.

(2) Estimation of the Parameters

1) Income Level

Data collected for each level indicate the number of segments and income level. The collected questionnaires were tabulated below, with more Middle-Income earners included in the sample than either High or Low income earners.

Table 3.7-3 Income Level and Number of Samples

Income Level	Monthly Income(Rp.)	Number of Samples
High	7,000,000～	97
Middle	1,000,000～7,000,000	949
low	～1,000,000	52
Total		1098

Source: JICA Study Team

The parameter, t value, and the likelihood ratio which were used in the next table are shown. In this table, Time shows a duration-sensitive parameter, and Cost shows the expense parameter.

As for the reliability of a point estimate, usually, if the absolute value of t is 4 or more, it is said that the degree of reliability is higher.

Table 3.7-4 Analysis of Income Level

Case	Estimated parameter		t values	Likelihood ratio
High	Time	-0.034865750	-5.3442	0.15
	Cost	0.000033294	2.2395	
Middle	Time	-0.026865920	-14.3604	0.09
	Cost	-0.000009944	-4.2261	
Low	Time	-0.029315040	-2.6795	-
	Cost	-0.000151868	-1.9648	

Source: JICA Study Team

For each investigation area, the following table shows the assumed assignment rate for each mode of transportation in the middle income bracket using the assumed parameter.

The tables for Tangerang and Bekasi show higher preference for MRT. This is due to the advantage of MRT for time-constrained trips.

Table 3.7-5 Estimated Modal Share (Middle of Income Level)

(Pulogadung)

Mode	Time(Minute)	Fare(Rp.)	Parameter		Modal Share (%)
			Time	Fare	
MRT	33	4,000	-0.02686592	-0.000009944	22.5
Rail	28	4,000			25.7
Bus	75	5,000			7.2
BRT	65	3,500			9.6
Car	41	50,000			11.5
Motorcycle	30	7,000			23.6
				Total	100.0

(Tangerang)

Mode	Time(Minute)	Fare(Rp.)	Parameter		Modal Share (%)
			Time	Fare	
MRT	57	8,500	-0.02686592	-0.000009944	25.0
Rail	80	4,500			14.0
Bus	110	5,000			6.2
BRT	80	3,500			14.1
Car	84	62,000			7.1
Motorcycle	45	11,000			33.6
				Total	100.0

(Bekasi)

Mode	Time(Minute)	Fare(Rp.)	Parameter		Modal Share (%)
			Time	Fare	
MRT	52	5,500	-0.02686592	-0.000009944	32.9
Rail	65	4,500			23.4
Bus	150	5,000			2.4
BRT	105	8,500			7.7
Car	105	60,000			4.6
Motorcycle	55	10,000			29.0
				Total	100.0

Source: JICA Study Team

By the same method as the previous table, the MRT selection ratio is compared, and income levels, High, Medium and Low, are shown in the following table.

The High-Income earners can afford high expenses and thus prefer to use private car, which then results to low utilization rate of MRT for this income level. While commuters who belong to middle and low income levels tend to choose the modes of transportation which are faster.

Table 3.7-6 Income Level and Selected Ratio of MRT

Unit:%

	Pulogadung	Tangerang	Bekasi
High	0.4	0.3	0.7
Middle	22.5	25.0	32.9
Low	28.4	23.0	41.1

Source: JICA Study Team

2) Analysis by Income Level (North-South Line)

Comparisons were carried out by estimating the parameters on locations such as on MRT East-West Line. The survey for the North-South Line was conducted on five different locations, Blok M, Dukuh Atas, Kota, Lebak Bulus, and Harmoni. The participation rate on the survey classified according to income levels are: Low 1,287, Middle 3,834, and High 629, for a total of 5,750 interviewees.

Table 3.7-7 Parameters (North-South Line)

Case	Estimated parameter		t values	Likelihood ratio
High	Time	-0.0417412000	-12.3144	0.08
	Cost	0.0000332935	11.5333	
Middle	Time	-0.0409020400	-30.9612	0.02
	Cost	-0.0000127524	-8.1019	
Low	Time	-0.0400612700	-17.6648	0.01
	Cost	-0.0000135942	-4.9861	

Source: JICA Study Team

The following table is the assignment rate of the mode of transportation at Bekasi using the middle income parameter as assumed for the North-South Line.

By comparison of modal share (comparison of figures in Table 3.5-5 and Table 3.5-8), the modal share (%) of MRT is higher by 5% in the case of MRT East-West line than MRT North-South Line, modal share of motorcycle in the case of East-West line is higher by 3 %. The ratio is falling compared to other modes. In contrast to the MRT East-West Line, the Middle-Income users of the North-South Line rank time as more important, and tend to choose the mode of transportation based on this result.

Table 3.7-8 Estimated Modal Share (Middle of Income Level to North-South Line)

Mode	Time(Minute)	Fare(Rp.)	Parameter		Modal Share (%)
			Time	Fare	
MRT	52	5,500	-0.04090204	-1.27524E-05	38.2
Rail	65	4,500			22.8
Bus	150	5,000			0.7
BRT	105	8,500			4.2
Car	105	60,000			2.2
Motorcycle	55	10,000			31.9
				Total	100.0

Source: JICA Study Team

3) Analysis by Age (MRT East-West Line)

The sample data grouped according to age are: Under 29 has 331 samples, between 30～49 has 663 samples, over 50 has 94 samples, for a total of 1,088 samples.

The estimated parameter result is shown in the following table.

Table 3.7-9 Parameters (Age Level)

Age Bracket	Estimated parameter		t values	Likelihood ratio
Under_29	Time	-0.026121650	-8.4318	0.07
	Cost	-0.000031485	-5.0798	
Between 30-49	Time	-0.028901240	-12.4749	0.11
	Cost	-0.000001848	-0.7498	
Over_50	Time	-0.019961410	-3.8248	0.11
	Cost	-0.000014628	-1.8077	

Source: JICA Study Team

The inputs used on the trial calculation are the time required and expense determined for Pulogadung Station using the assumed parameter. The capacity factors of MRT for each age category are: under 29 (24.5%), 30～49 (22.2%), over 50 (23.8%), and the differences between age groups are not significant.

4) Analysis by Car and Motorcycle Ownership

Of the 1,097 samples collected from the MRT East-West Line, 461 samples comprise the private car and motorbike owners, while 636 samples are not owners of either cars or motorbikes. The assumed results of the parameter are as follow.

Table 3.7-10 Parameters (Car)

Case	Estimated parameter		t values	Likelihood ratio
Car(with)	Time	-0.032766070	-10.9943	0.09
	Cost	0.000010629	4.2334	
Car(without)	Time	-0.025864550	-11.5414	0.10
	Cost	-0.000046094	-7.3608	

Source: JICA Study Team

The inputs to the trial calculation are the time required and expenses determined for Pulogadung Station. The capacity factors of MRT for each age group are: 19.3% for private car and motorcycle owners, and 25.3% for those without cars or motorcycles.

3.7.5 Parametric Analysis

The individual's selection of the preferred means of transportation was checked from parameter estimation.

- In the analysis according to income level of MRT East-West Line, the Middle and Low classes tend to choose a mode of transportation that is cheap and fast. High-income class tend to choose a mode of transportation with high expenses, such as a private car.
- The result according to income level was compared with the North-South Line. Mode of transportation selection is dependent on other factors.
- The tendency for users of the north-south line to give priority to time is evident. The difference was not checked in the results of the analysis by age of the mode of transportation.
- In the comparison of private car and motorbike owners, the tendency to choose MRT is low.

It may be difficult to apply the estimated parameters in this study to the modal choice model of four-step method since its basic date is obtained from SITRAMP 2 in 2002 and the composition of the data is different.

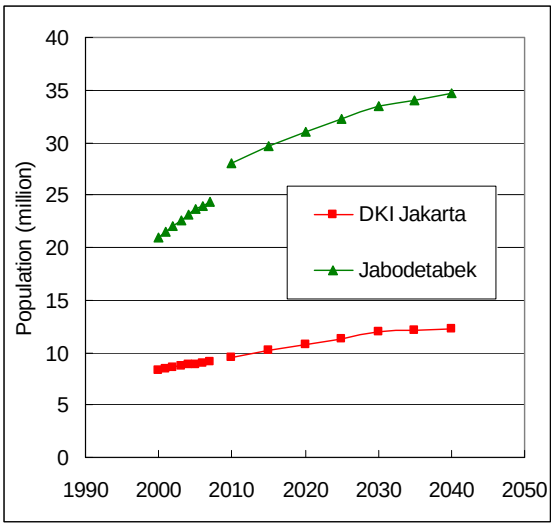
3.8 Passenger Demand Forecast

3.8.1 Demand Forecast Frameworks

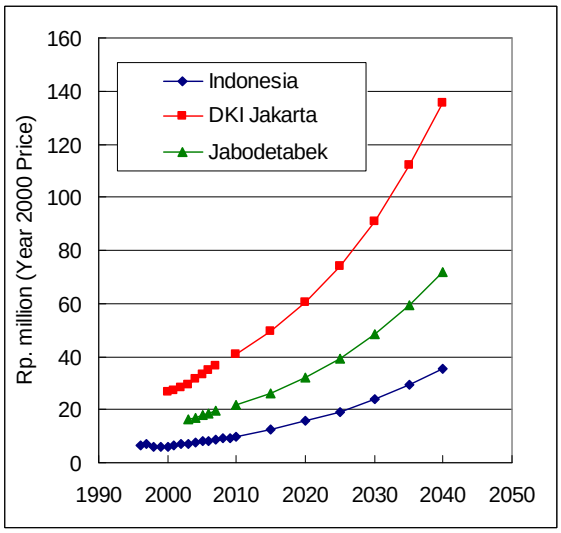
(1) Social Economic Frameworks

Transportation studies on JABODETABEK, which have continued under many projects, started with the Arterial Road System Development Study (ARSDS) through SITRAMP, up to JABODETABEK Urban Transportation Policy Integration (JUTPI) by JICA, face the new stage of public mass transportation. Recently, the MRT North–South Line Study, the MRT North–South Line Extension Study, the Pre-FS of MRT East–West Line, the Railway Enhancement Study and so on, were carried out by JICA. They all emphasize that mass transportation should share a larger part of traffic demand, especially railways including MRT, which are important for public transportation. In order to forecast the demands of MRT, socioeconomic frameworks in the future were reviewed, which follow the past studies, unless they contradict with the present conditions and new future plans.

Population is increasing year by year especially in the BODETABEK region although the growth ratio in DKI Jakarta comes a slightly slow down. Present population has been over 28 millions in 2010 census by BPS, which is about 10% of all Indonesia. The growth will continue until around 35 millions, which might be over than the limit of environment. The growth of GRDP is higher than populations. The growth ratio is estimated to be nearly 5% per year, therefore GRDP per capita will reach about twice within 15 or 20 years. It means JABODETABEK will be a huge developed wealthy city in the next 20 years.



Population



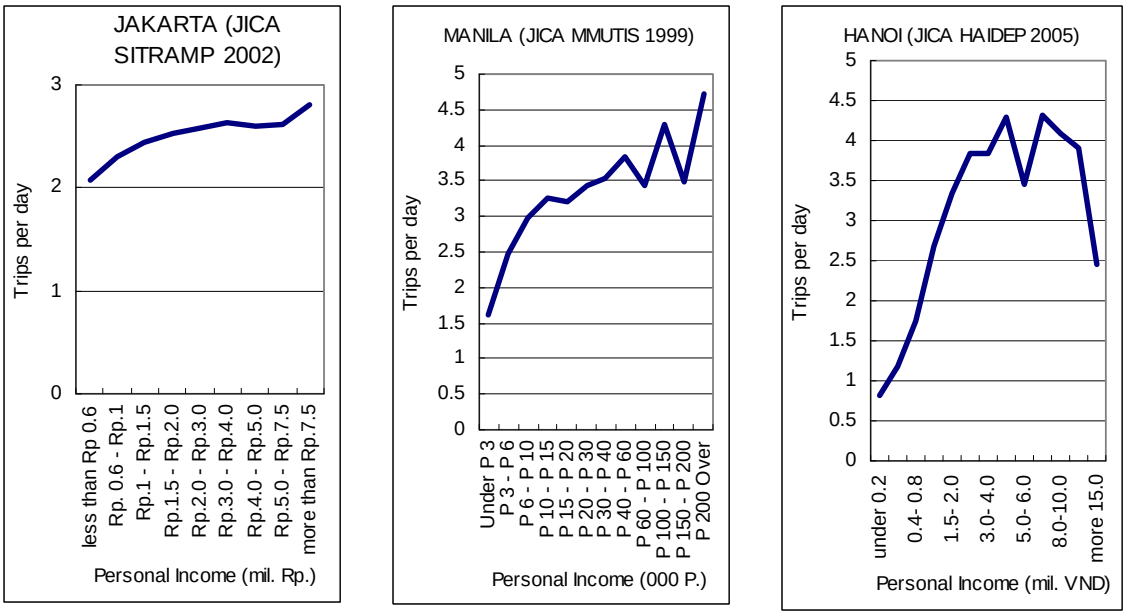
GRDP per capita

Source: BPS, UN World Population Prospects, other JICA Studies and the JICA Study Team

Figure 3.8-1 Socioeconomic Framework

(2) Traffic Demand Frameworks

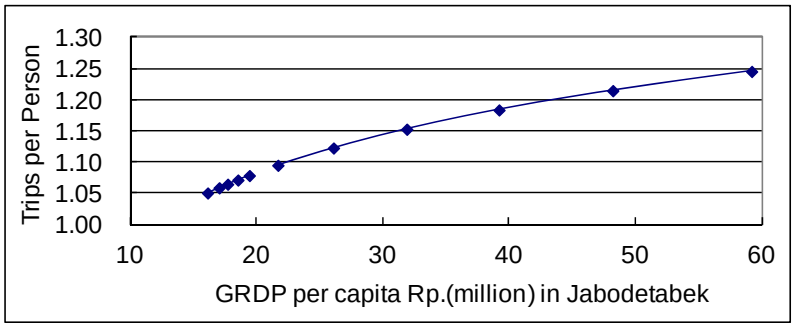
Traffic demands increase according to the population and economic activities. Figure 3.8-2 shows that the number of person trips increase in proportion to the income level of any city. It also shows the net trips based on the home visit survey in each city conducted by JICA. The difference includes those traveling either on foot or not. The growth of GRDP per person trip in JABODETABEK will also increase in the future with the improvement of income levels.



Source: JICA

Figure 3.8-2 Increase of Person Trips by Income Level

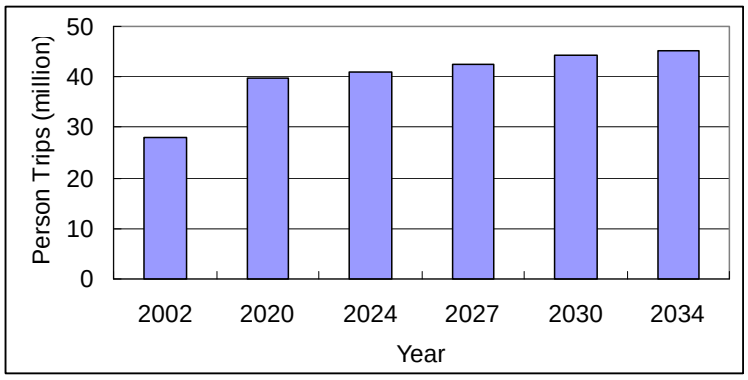
Therefore, the demands are pushed up because of the rapid growth of economic activities due to the increase of GRDP, even if the growth ratio of population is comparatively not so high. The generated trips per person, considering the covered population, are shown in Figure 3.8-3. In the figure, the horizontal line is the GRDP per capita. However, the model might not be sufficiently accurate because the trend was plotted by area for only one year (2002) based on SITRAMP by JICA. In order to achieve accuracy, further surveys in multiple years will be necessary.



Source: SITRAMP/Pre-FS Study by JICA and assumptions by the JICA Study Team

Figure 3.8-3 Growth of Traffic Generation Unit

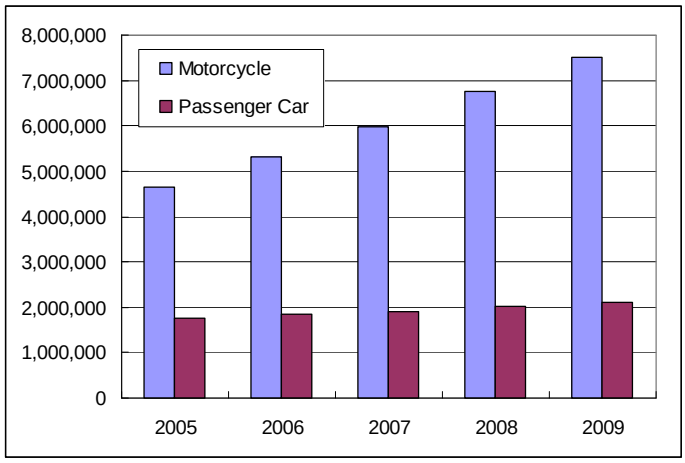
As a result, the total trips in the future were estimated, which serve as the framework for the traffic demand forecast. These were used in other studies by JICA. It only shows the increasing trend in growth rate in the future beyond 2030, because the total trip estimations seem to be more accurate than re-estimating based on population and GRDP per capita. Thus, trips by zone almost correspond to that of the past Pre-FS and related JICA studies.



Source: SITRAMP/Pre-FS Study by JICA and assumptions by the JICA Study Team

Figure 3.8-4 Forecasted Total Trips in JABODETABEK

Recently, the increase in number of motorcycles along the roads is remarkable. Since its price becomes affordable for most people, the use of motorcycles seems more preferred in order to avoid traffic jams. In the past five years, the registered number of cars in Jakarta increased by 20%, while motorcycles increased by more than 60%. According to a survey in 2009, roads in Jakarta will be congested due to the size of parked cars considering that the length of roads per car is about 3.4 m, which will only be 1.8 m in case motorcycles are included. Even if the width of roads is considered, road density remains very poor. The increase of private transportation mode vehicles results in the decrease of public transportation modes.



Source: Ditlantas Polda Metro Jaya

Figure 3.8-5 Registered Vehicles in DKI Jakarta

As shown in the Figure 3.8-6 below, the ratio of public transportation modes by mass transportation is decreasing, and will further go down in the future. Although the decrease of public transportation mode reflects the number of wealthy residents considering the increase in car and motorcycle ownerships, the transportation situation is not desirable as the significant volume of private transportation modes create traffic jams, resulting in inefficiency of infrastructure. Therefore, such situation on mass transportation networks is an urgent issue.

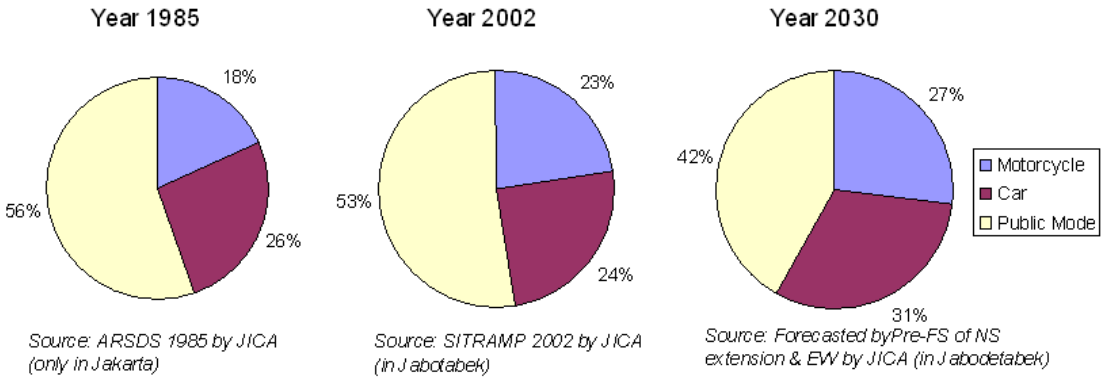
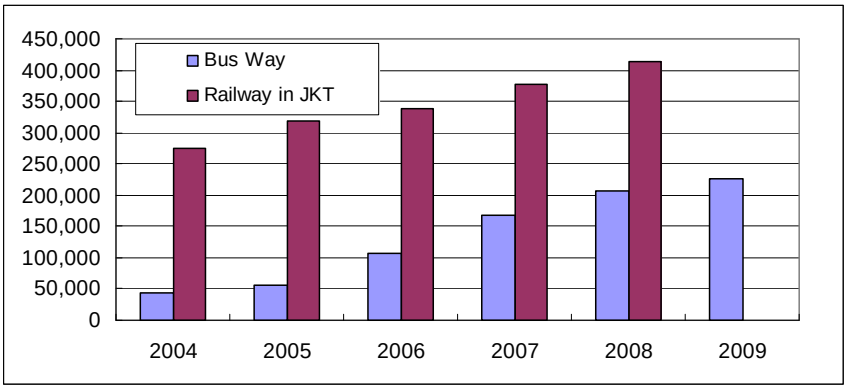


Figure 3.8-6 Change in Modal Share

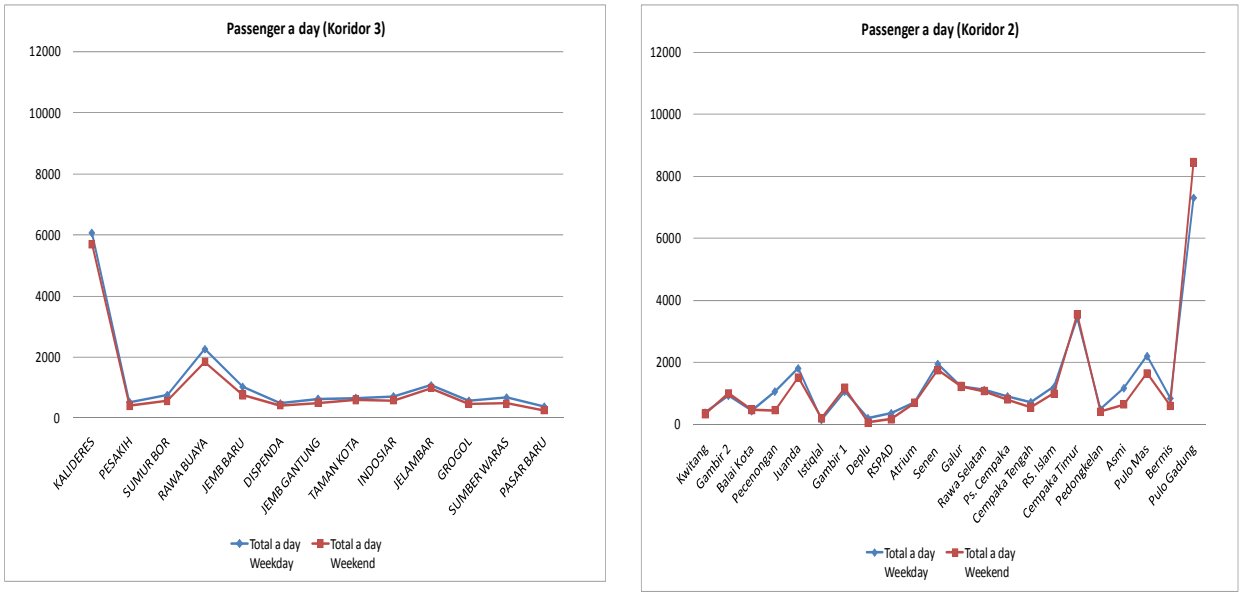
In spite of the decrease in ratio, the number of users of mass transportation increases steadily considering the increase of total trips. Busway attracts more users based on the multiplication of routes. In terms of the number of passengers, about 50% of railway passengers were accounted, which was 226,000 daily passengers in 2008. The demands for railway also grew up in recent years although it faced a temporary fall in the past. Destination of about 94% of the railway passengers is to JABODETABEK; therefore, they are also potential users of MRT. If mass transportation attracts more users than the trend reveals, this indicates modal shift from private to public transportation modes. The promotion of mass transportation modes is important in solving traffic problems, wherein MRT will play a major role.



Source: PT. TransJakarta, and PT. KAI Cabang

Figure 3.8-7 Average Daily Passengers

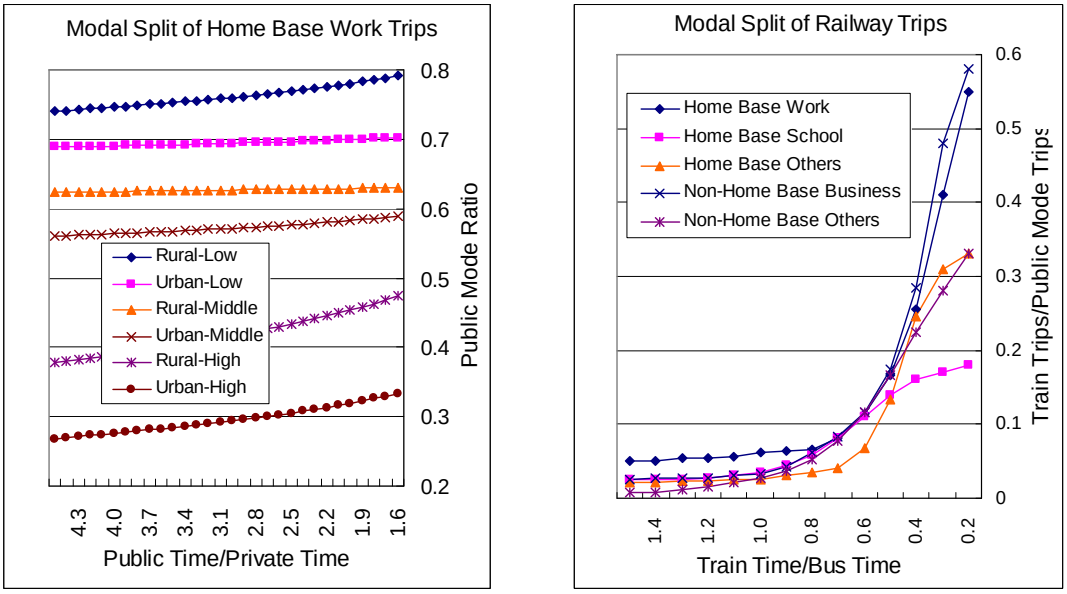
The daily passengers along planning MRT East-West Line were determined. The passengers at the sides of Pulo Gadung and Kalideres, which are at the outer side of the city center, were high but the numbers at sections are unknown because only boarding passengers were counted in the vertical axis.



Source: PT. TransJakarta

Figure 3.8-8 Daily Passengers on Corridors 2 and 3 in 2009

Modal share was surveyed as described in section 3.5, which was used as basis in establishing the OD tables. It is known that modal share depends on the time ratio between private time/public time, or railway time/bus time according to SITRAMP. Therefore, the demand forecast should be carried out based on the OD tables after the modeling according to the impedance of traffic assignment, which will be estimated from the different planning network. However, the traffic assignment is usually estimated after forecasting of the OD tables. This study uses the latter usual process as traffic assignment after forecast the OD tables, because these have been estimated based on the modal split model of time impedance.

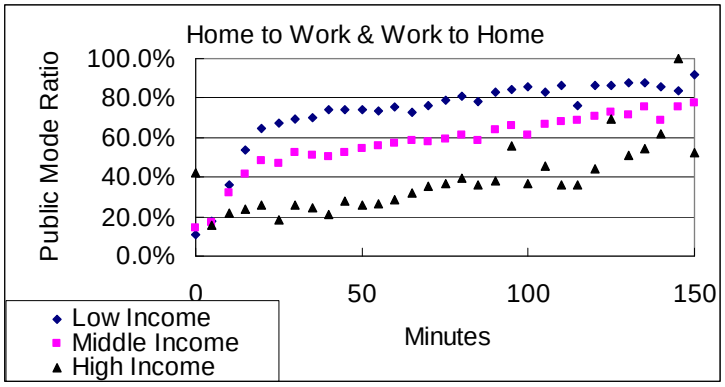


Source: SITRAMP by JICA (2002)

Figure 3.8-9 Modal Split by Time Ratio

Generally, in JABODETABEK, the higher the income, the higher the number of those who prefer to use private transportation modes. Although the increase of private transportation in the total trips comes from those with high income, the result based on SITRAMP 2002 shows that such group will use railway mode for commuting of long distances. Under the condition that

the average speed of private mode comes down to about 10 km/hr, there is a possibility of modal change from private to public transportation mode. Based on the travel speed survey in this study, it was found out that there were occasions when speed was only 13 km/hr.



Source: SITRAMP by JICA (2002)

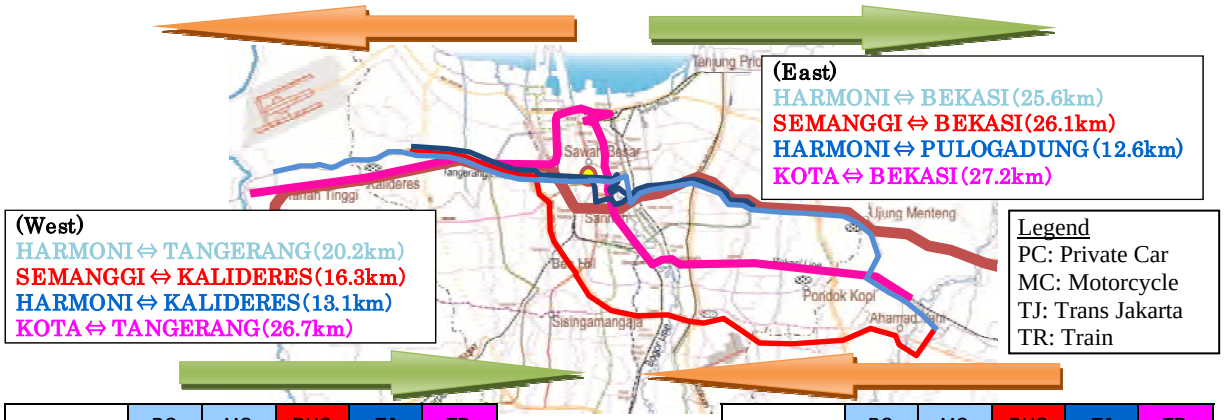
Figure 3.8-10 Public Mode Ratio

	PC	MC	BUS	TJ	TR
Morning	20	22	26	25	42
Off Peak	29	30	30	27	32
Evening	20	25	22	29	38

Unit: km/h

Morning : 7:00~
Off Peak :12:00~
Evening :16:00~

	PC	MC	BUS	TJ	TR
Morning	26	28	59	21	42
Off Peak	24	30	39	23	48
Evening	15	20	25	14	41



	PC	MC	BUS	TJ	TR
Morning	13	17	22	20	40
Off Peak	20	26	17	27	33
Evening	25	30	14	23	39

Unit: km/h

Morning : 7:00~
Off Peak :12:00~
Evening :16:00~

	PC	MC	BUS	TJ	TR
Morning	16	20	15	17	28
Off Peak	24	27	23	20	53
Evening	16	24	26	10	55

Source: JICA Study Team

Figure 3.8-11 Results of the Travel Speed Survey

(3) Other Assumptions for Forecast

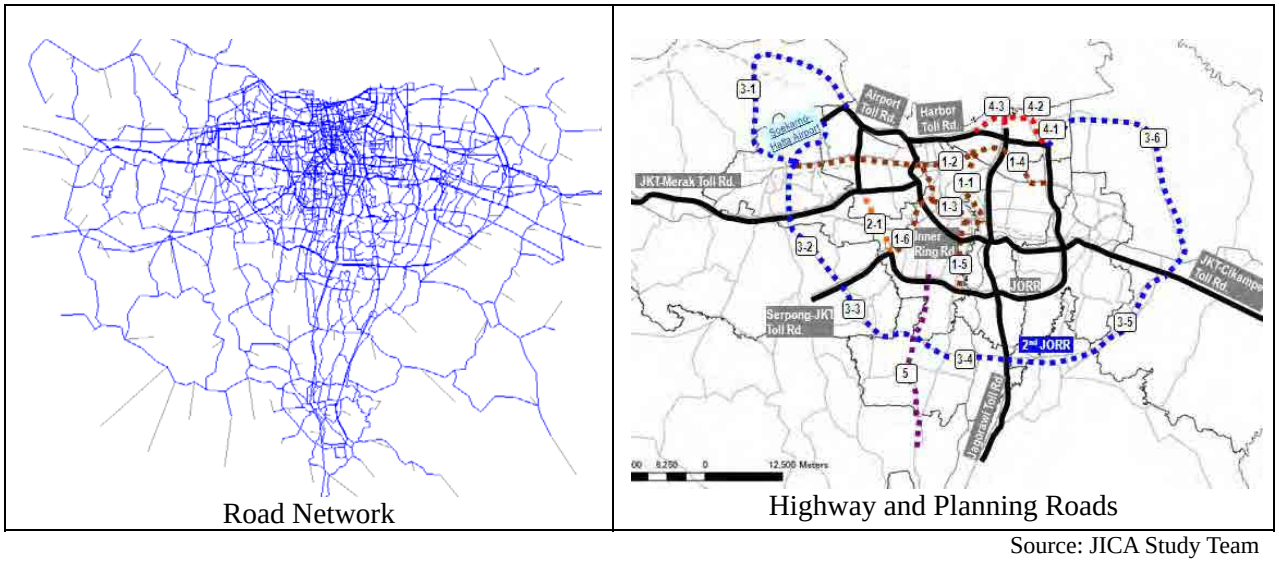
For the traffic demand forecast, several assumptions were made. Some of them were classified by case. The change of modal share has been reflected in the Pre-FS and the Study Team's surveys.

Transit-oriented development (TOD) was considered in the Pre-FS, thus, this study uses the result obtained at MRT stations. The total trips in JABODETABEK for the TOD case is the same as that for the non-TOD case since the former does not affect the total population and

overall GRDP, but promotes the development near stations. The effects by TOD are separated by case study.

Electronic road pricing (ERP) and TDM was not considered in the forecast because they are not fixed by the government and the MRT plan has no direct influence on the decision although TOD is the result of the MRT plan. The influence by TDM will be considered in the master plan.

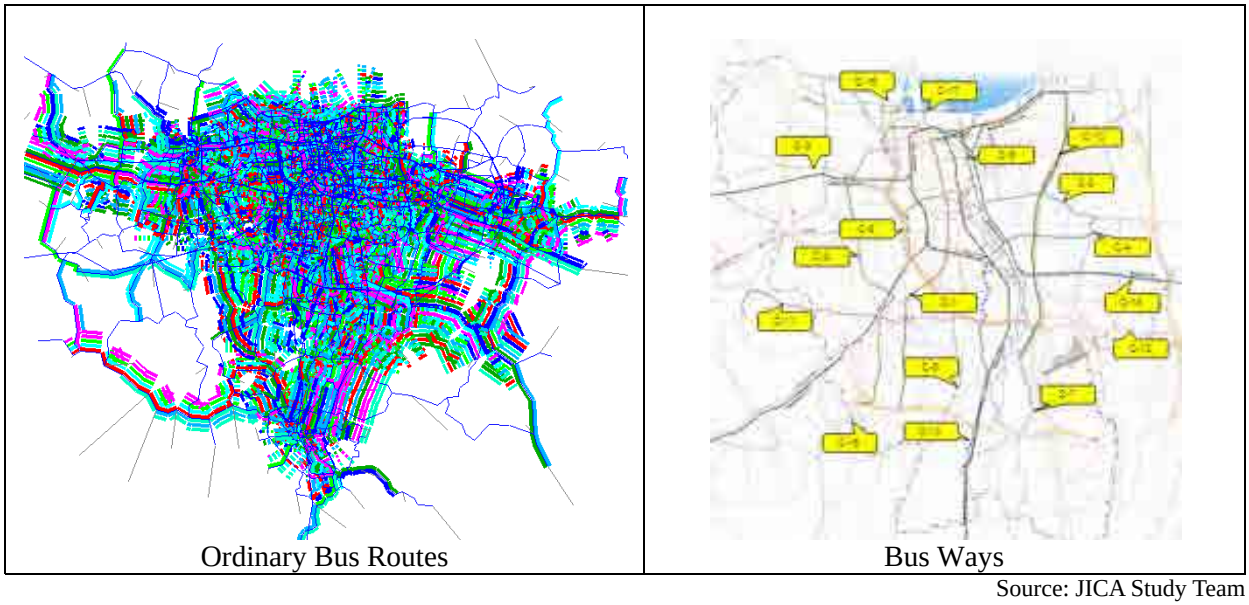
All planned roads, which have been known and fixed in the future, were combined in the future network. These include the completion of the outer ring road, outer-outer ring road, six inner tolls, and arterial roads that are under construction.



Source: JICA Study Team

Figure 3.8-12 Road Network

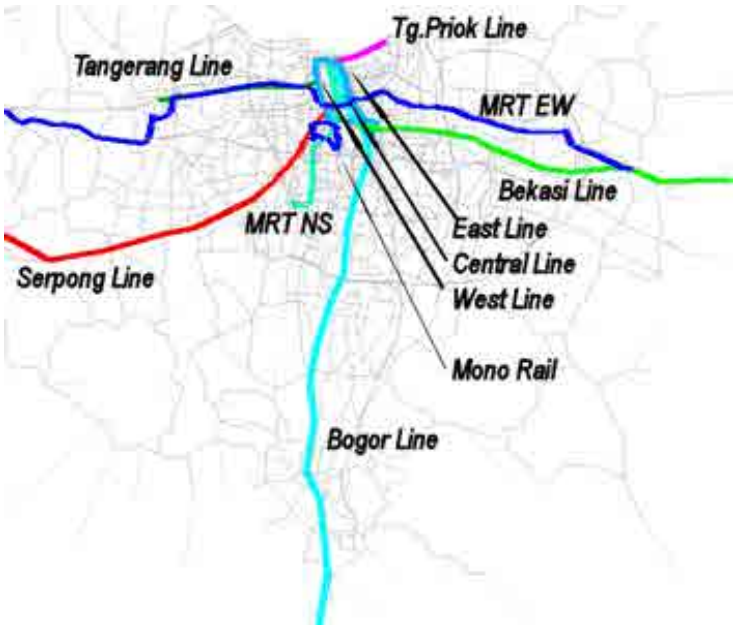
Bus networks and busways were combined in the transit network for the forecast. On the bus network, the JICA Study has started, about 1,400 existing bus routes were assumed. Corridor 1 of the busway will be replaced by MRT North–South Line, hence, it was excluded. Corridor 2 was also excluded in MRT East–West Line, while Corridor 3 was included because its route is slightly different from the MRT East–West route of Alternative 1B.



Source: JICA Study Team

Figure 3.8-13 Bus Network

Although the Railway Enhancement Plan by JICA has been proceeding, the basic policy of the plan can be considered in the forecast, which is reflected by the frequent operations and adequate speed. Tangerang Line will have enough capacity with its double tracks; Tanjung Priok Line is improved; Serpong Line is activated; Loop operation from East Line to West Line is assumed; Shortcut lines of railways between Serpong Line, Tangerang Line and West Line can be reflected by the frequent connections in the forecast. The monorail green line is also completed in the future network.

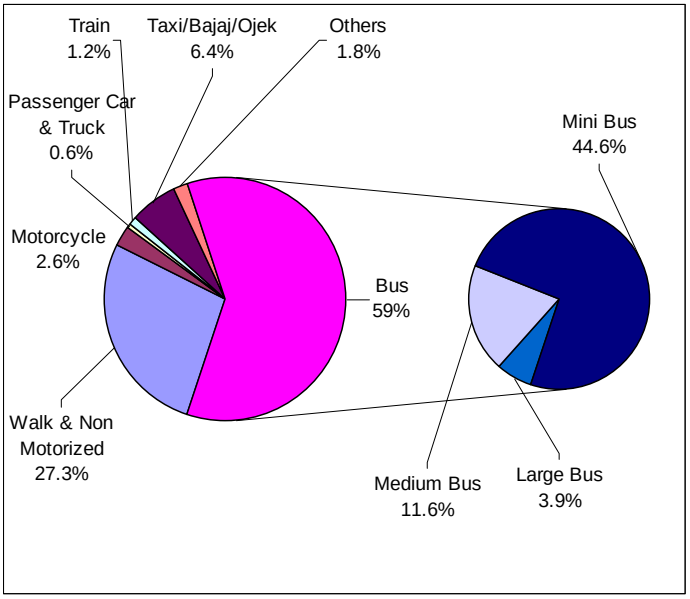


Source: JICA Study Team

Figure 3.8-14 Railway Network

Concerning the airport line, the next assumptions were set. The Soekarno-Hatta International Airport is one of the largest airports in the world and it has accommodated up to 42 million passengers in 2010. As a result of many passengers and traffic jams, railway access was requested. Railway access was assumed by the connection between the airport and Kalideres, although there are other different plans such as the northern extension of West Line or the backside connection from the airport. The case of the northern extension might almost be the same as the case of without airport line in this forecast since the demands flow directly into West Line. The full capacity of the existing Soekarno-Hatta International Airport might be reached by around 2020. And thus requiring it to be expanded, or another new airport will be constructed. Although the location of the second new airport has not been decided yet, it will be located out of JABODETABEK. Therefore, the generated/attracted trips at the existing airport were adjusted according to the JICA Study.

It was assumed that people access the MRT stations through either the existing bus network or on foot. From SITRAMP 2, about 60% people access the railway stations by bus and about 30% by non-motorized means. In the past, the ratio of motorcycle was very small, but has increased at present. For the promotion of MRT, feeder service and park and ride facilities are important. In the forecast, their effect was not countable, except for the TOD.



Source: SITRAMP by JICA (2002)

Figure 3.8-15 Access Mode to Station

It performed under assumption below prediction development based on the transportation network development project currently planned by MPA, JUTIP, and a master plan 2030.

Table 3.8-1 By Year Transportation Network Development

Transportation Network	Measures	Real measures	Y2021	Y2024	Y2027	Y2030	Y2041 & After	Remarks
Jakarta MRT	N-S Line	Lebak Bulus – KP Bandan	○	○	○	○	○	Base Case / Enhanced Case
	E-W Line (Stage 1 in Phase-1)	Kalideres – Cenpaka Baru	○	○	○	○	○	
	E-W Line (Phase-1)	Kalideres – Ujung Menteng	-	○	○	○	○	
	E-W Line (Phase-2)	Balaraja - Cikarang	-	-	○	○	○	
Railway	PT. KAI Railway Improvement	Racket Operation	○	○	○	○	○	
		Serpong – Western line short cut link	-	○	○	○	○	
		Airport Access Link	○	○	○	○	○	
	Monorail Construction	Green Line	○	○	○	○	○	
Road Network	The six inner toll roads	Kemayoran-Kampung Melayu / Rawa Buaya-Sunter / Kampung Melayu-Tanah Abang-Duri Pulo / Sunter-Pulo Gebang / Pasar Minggu-Casablanca / Ulujami-Tanah Abang	○	○	○	○	○	
Bus	Trans Jakarta		○	○	○	○	○	
	Bus rerouting centered around MRT station		○	○	○	○	○	
TDM	Private Car Use Control	"3-in-1" Policy	○	○	○	○	○	
		Road Pricing	○	○	○	○	○	
TOD	Transit Oriented Development	Station Area Development	○	○	○	○	○	
		Park and Ride	○	○	○	○	○	

○: to be realized

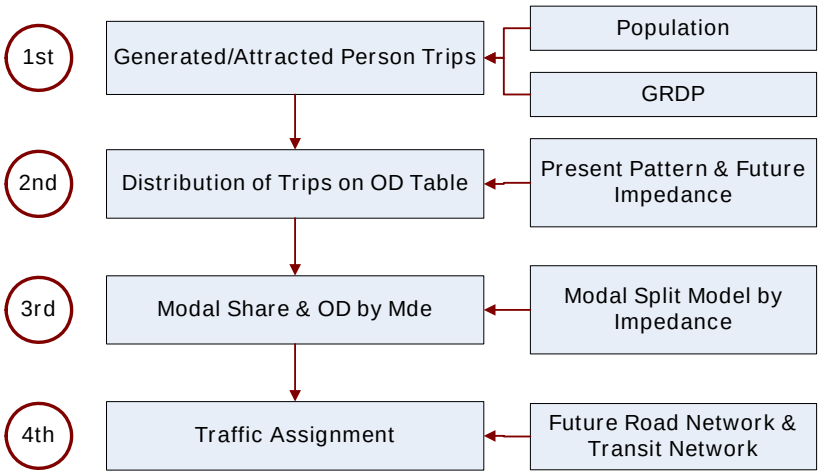
（Source: JICA Study Team）

3.8.2 Demand Forecast for Passenger Volume of MRT East–West Line

In order to forecast traffic demand, the relevant data, such as past studies and person trip data etc., should be collected at the very beginning stage and those should be reviewed carefully, and then, if necessary, supplemental traffic survey will be conducted. As will be described later, since the demand is forecasted by four-step method, which is ordinary demand forecast method, the forecasting model should be established before analysis. After the calculation is made by four-step method, the result will be studied for further analysis.

(1) Forecast Flow

The traffic demand forecast was processed according to a four–step method. The first step is the estimation of generated/attracted trips by zone. Since the estimation of generated/attracted traffic needs socio-economic and land use analysis, and so forth, of each zone, these were referred to the JICA Study. The estimation of OD distribution by the generated/attracted trips in the second step also utilizes the results of the home interview survey from SITRAMP 2. The modal share at the third step was revised by the most recent survey. The final or fourth step involves calculation on the future network, as described in the previous chapter, by multiple stage assignment, which has 80 divisions according to mode and income group.



Source: JICA Study Team

Figure 3.8-16 Four–Step Method of Demand Forecast

Also, the cause of increase in passengers based on Transit Oriented Development (hereinafter referred to as TOD) is as follows.

- Large-scale development around the stations, for example, in Senen St.
- Developments on unused land within 500-meter radius of the stations

The increase in passenger traffic based on the developments on unused land stem largely from the enhanced accessibility and increased asset value with MRT Operation. It is especially prominent in the station influence areas, which is within a 500-meter radius of each station that subsequent residential-and-business district developments can occur on these locations. As a result, several buildings are planned to be established under regulatory control for building coverage.

i) Calculation of the increase in gross floor space inside a station's influence area

In each influence area, all buildings and undeveloped sites are upgraded to maximum capacity, and is estimated through the use of satellite imagery. The gross floor space in each station influence area is calculated according to the space and land use regulation of building coverage in DKI Jakarta. Each land area is categorized according to use, whether for business, public or residential use.

ii) Calculation of the increase of MRT passengers, based on the gross floor space increase generated by i)

First, passenger increase in business and public areas are as follows:

- Employee increase per 10 m^2 (= employee increase)
- Increase in passenger traffic shall be 120% of employee increase, taking into account the people that will go to the buildings, such as customers and users.
- 30% will use MRT

From the figures mentioned above, the MRT passenger increase in business and public areas is calculated according to the following formula:

[Increase in the Number of MRT passenger in business and public areas] = [Gross floor space increase of business and public areas] / 10*1.2*0.3

Second, increase in passengers from residential areas is as follows:

- Resident increase per 18 m^2
- 25% would use MRT as the transportation mode

From the figures mentioned above, the MRT passenger increase in residential area is calculated according to the following formula:

[Number of MRT passenger increase in residential area]= [Gloss floor space increase of residential] / 18*2.0 / 5.0

The assumed passenger volume mentioned above is made up of either boarding or alighting passengers. This is not clarified as either passenger on boarding station or alighting one. So, this volume is equated with OD distribution according to the four-step method. The passenger volume of alighting is equated to the boarding one.

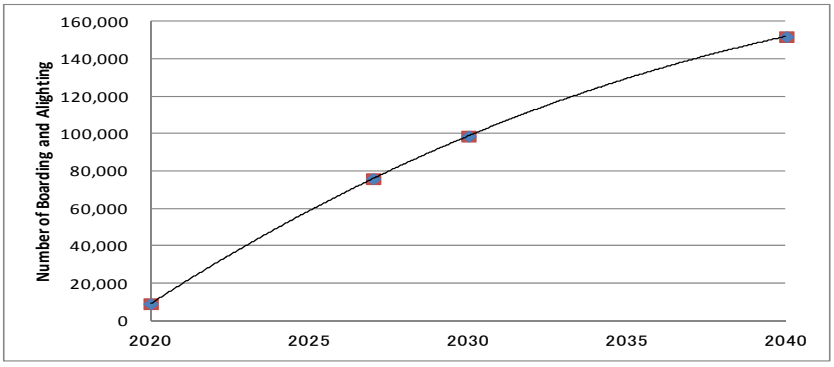
The increase in passengers by TOD is described as follows. The completion of TOD will take a long time. The growth of passenger traffic is shown in Figure 3.8-17. This is calculated using the growth curve model.

Table 3.8-2 Number of passengers by TOD

Unit: Passenger/Day

Station	Boarding	Station	Boarding	Station	Boarding
Balaraja	5,343	Kembangan 2	4,569	Kelepa Gading Timur	5,392
Telagasari	1,709	Kembangan	2,209	Perintis	3,759
Cibaduk	5,795	Pesing	1,121	Pulo Gadung	3,443
Pasir Gadung	2,414	Grogol	2,338	Penggilinga	3,222
Bunder	7,559	Roxy	1,689	Cakung Barat	803
Kadu	3,831	JemBatan Tomang	1,516	Pulogebang	3,744
Perumnas 2	3,957	Cideng	2,423	Ujung Menteng	4,304
Panunggangan	2,418	Thamrin	2,346	Medan Satri	1,564
Karawaci	2,868	Transfer from N-S Line	14,078	Harapan laya	3,578
Cikokol	1,955	Kebon Sirih	2,809	Perwira	4,357
Tanch Tinggi	2,345	Kwitang	1,665	Harapan Baru	4,183
Batu Ceper	1,103	Senen	3,270	Teluk Pucung	2,300
Polis	1,460	Galur	2,116	Sumberjaya	2,866
Semanan	2,422	Cempaka Barat	1,500	Sasakbakin	1,883
Kalideres	2,746	Sumur Batu	2,380	Sakajaya	1,250
Rawa Buaya	2,557	Kelepa Gading Barat	4,139	Cikarang	2,709
Sub total	**50,483**	**Sub total**	**50,169**	**Sub total**	**49,358**
				Total	**150,010**

Source: JICA Study Team



Source: JICA Study Team

Figure 3.8-17 Upward trend of predicted annual number of passengers

(2) Forecasted Result by Year

Traffic demand on MRT East–West Line was forecasted for each case. Such cases are shown in Table 3.8-3. The demand forecasts are for years 2021 2024 2027, 2031 and 2041. Year 2021 was set as the opening of the Stage 1 section(Kalideres, to Cempaka Baru), and Year 2024 was set as the opening of the Phase 1 which is assumed to consist of two cases from Kalideres, to Ujung Menteng. The Phase-2 section, which is between Balaraja and Cikarang, will be completed in 2027. The forecast for 2041 was set for the trend in the future. OD tables were prepared with/without TOD by year. For economic or financial analysis, the case with TOD was considered the better case to adopt because MRT stations will serve as the core of development, especially in suburban areas. Two cases (with and without cases) on the airport access line were also assumed.

Table 3.8-3 Forecast Cases

Section	Annual
Phase-1 (Stage 1) Kalideres– Cempaka Baru	2021, 2024
Phase-1 (Stage 2) Kalideres– Ujung Menteng	2024, 2027
Phase-2 Balaraja – Cikarang	2027, 2031, 2041

Source: JICA Study Team

The result of demand forecasting for each case is shown in the following table. Computed by the four-step method, under Base Case, is the number of passengers per day. The demand forecast for the Enhanced Case is computed by adding the number of passengers generated from TOD to the Base Case.

The results shown in the table below are in terms of PHPDT (Peak-Hour Peak-Direction Traffic), transportation density, and average trip length.

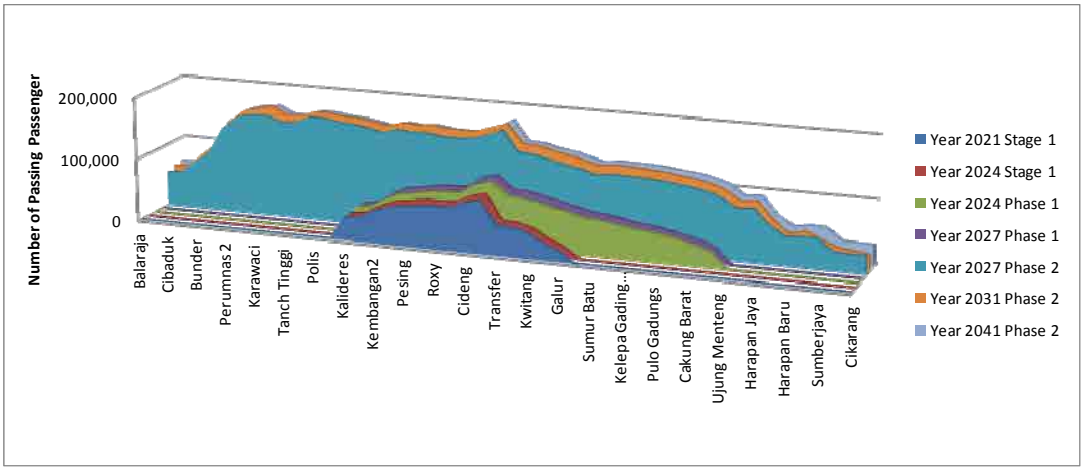
Table 3.8-4 Demand Forecast Result

	Passenger & PHPDT	Base Case	Enhanced Case
Y2021	Passenger (Pax./day)	252,600	254,500
	PHPDT (Pax./hour)	14,900 Cideng-Thamrin	15,000 Cideng-Thamrin
	Transport density (Passenger *1,000km)	2,107	2,120
	Av. Trip Length (km)	8.3	8.3
Y2024	Passenger (Pax./day)	264,000	267,800
	PHPDT (Pax./hour)	15,700 Cideng-Thamrin	15,900 Cideng-Thamrin
	Transport density (Passenger *1,000km)	2,183	2,210
	Av. Trip Length (km)	8.3	8.3
Y2024	Passenger (Pax./day)	405,500	415,100
	PHPDT (Pax./hour)	17,900 Cideng-Thamrin	18,200 Cideng-Thamrin
	Transport density (Passenger *1,000km)	3,638	3,610
	Av. Trip Length (km)	9.0	8.7
Y2027	Passenger (Pax./day)	428,200	454,800
	PHPDT (Pax./hour)	18,800 Cideng-Thamrin	19,500 Cideng-Thamrin
	Transport density (Passenger *1,000km)	3,796	3,895
	Av. Trip Length (km)	8.9	8.6

	Passenger & PHPDT	Base Case	Enhanced Case
Y2027	Passenger (Pax./day)	1,181,300	1,256,300
	PHPDT (Pax./hour)	30,500 Batu Ceper-Polis	32,200 Batu Ceper-Polis
	Transport density (Passenger *1,000km)	19,200	20,368
	Av. Trip Length (km)	16.3	16.2
Y2031	Passenger (Pax./day)	1,194,600	1,305,300
	PHPDT (Pax./hour)	30,500 Batu Ceper-Polis	32,700 Batu Ceper-Polis
	Transport density (Passenger *1,000km)	19,500	20,956
	Av. Trip Length (km)	16.2	16.1
Y2041	Passenger (Pax./day)	1,227,700	1,427,700
	PHPDT (Pax./hour)	30,600 Panunggangan-Karawaci	33,900 Panunggangan-Karawaci
	Transport density (Passenger *1,000km)	20,100	22,427
	Av. Trip Length (km)	15.8	15.7

Source: JICA Study Team

Figure 3.8-18 shows the annual passengers along MRT East–West Line. These are the basic cases, which is connected to Kembangan II. At the west part of MRT East–West Line, most passengers who prefer to use public transport have no other choice in reaching the MRT except through bus routes, since there are no stations at the west side from the end of Tangerang Line. Hence, the number of passengers who selected the west side of MRT East–West Line is high considering that it provides shorter time access to the center of Jakarta. At the east side, the demand extends continuously to the terminal because of the Bekasi Line. The increase due to the extension of MRT East–West Line is higher than the annual growth of demand as the total trips by public transport mode will significantly increase yearly as forecasted from the OD tables.



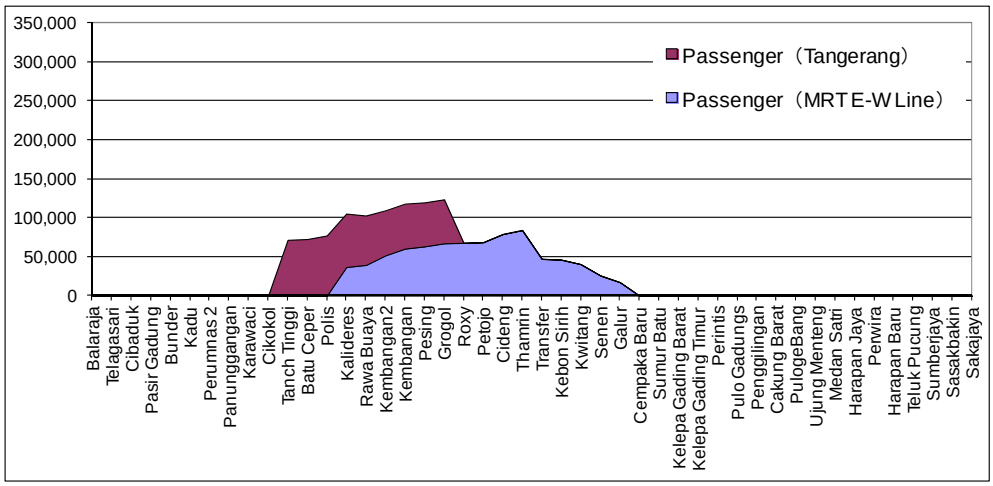
Source: JICA Study Team

Figure 3.8-18 One Way Passengers on MRT East–West Line (Base Case)

The Figure 3.8-19, Figure 3.8-21 Figure 3.8-21and Figure 3.8-22 show the section volume for one directional traffic flow along the MRT for Stage 1 in 2021, Phase 1 in 2024 and for Phase 2 in 2027 and 2041. Since the horizontal line was plotted only by station name, it is not proportional to distance. In the sections parallel to Tangerang Line, the total passengers of the MRT and Tangerang Line are shown in different colors. Thus, the forecasts can be separated in order to identify those for Tangerang Line. Although passengers between Tanch Tinggi and

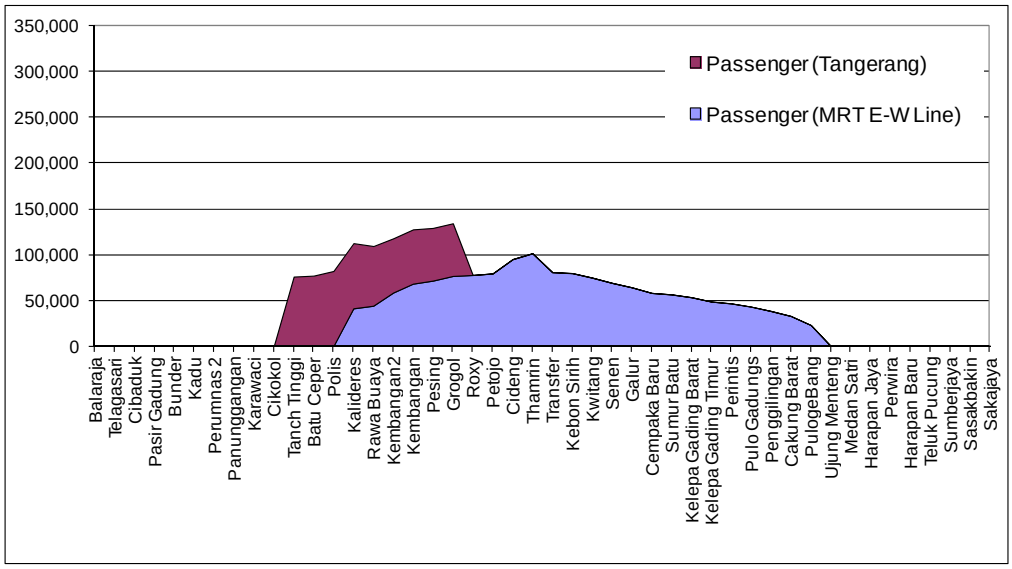
Grogol on Tangerang Line are shown in the figure with a different color for 2021, it does not mean that the station serves as connection between the MRT and Tangerang Line, because the traffic are assigned on two links where passengers can transfer by paying a separate fare.

Maximum passenger capacity in the MRT is experienced only at the transfer station of Thamrin to North–South Line, although the combined passengers with Tangerang Line reach the peak at Grogol Station. Moreover, the share between the MRT and Tangerang Line is almost the same at the parallel sections because both were subject to the same conditions in the forecast. If the services for passengers such as the frequency or speed are different, the line that provides better service gets bigger traffic share. Parallel lines are not different in terms of traffic assignment. The MRT carries more passengers even from Balaraja to the center of Jakarta because the weak characteristics of the mass transportation network on the west side.



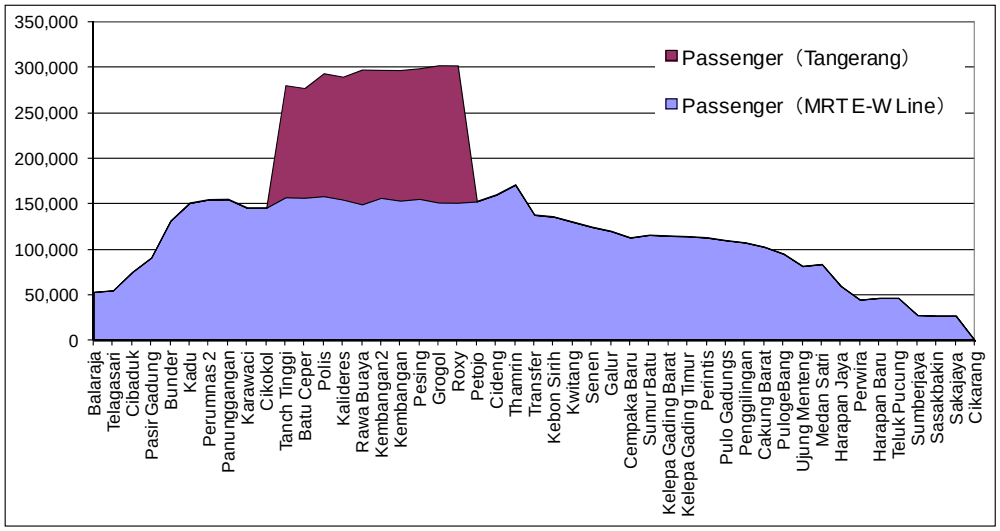
Source: JICA Study Team

Figure 3.8-19 Demand in 2021 of MRT East–West Line and Tangerang Line



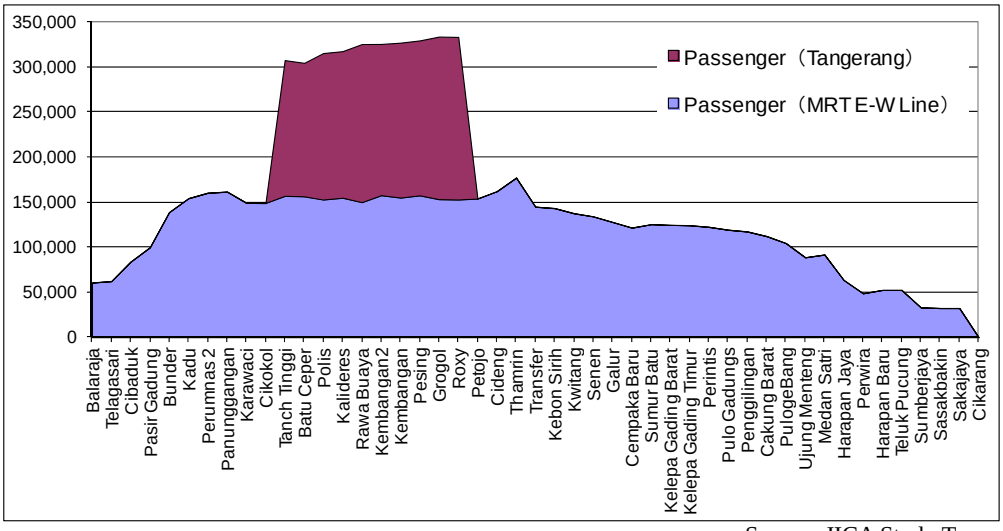
Source: JICA Study Team

Figure 3.8-20 Demand in 2024 of MRT East–West Line and Tangerang Line



Source: JICA Study Team

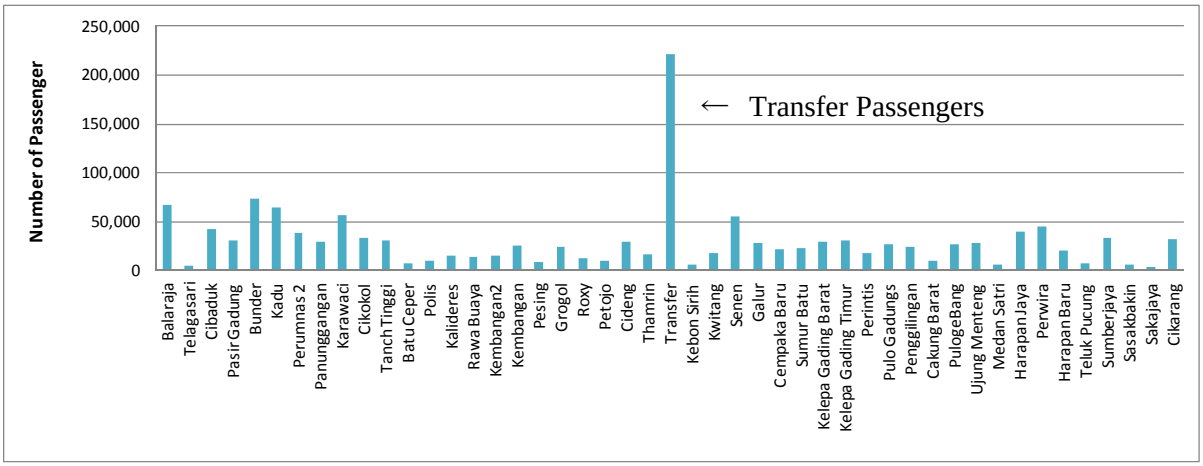
Figure 3.8-21 Demand in 2027 of MRT East–West Line and Tangerang Line



Source: JICA Study Team

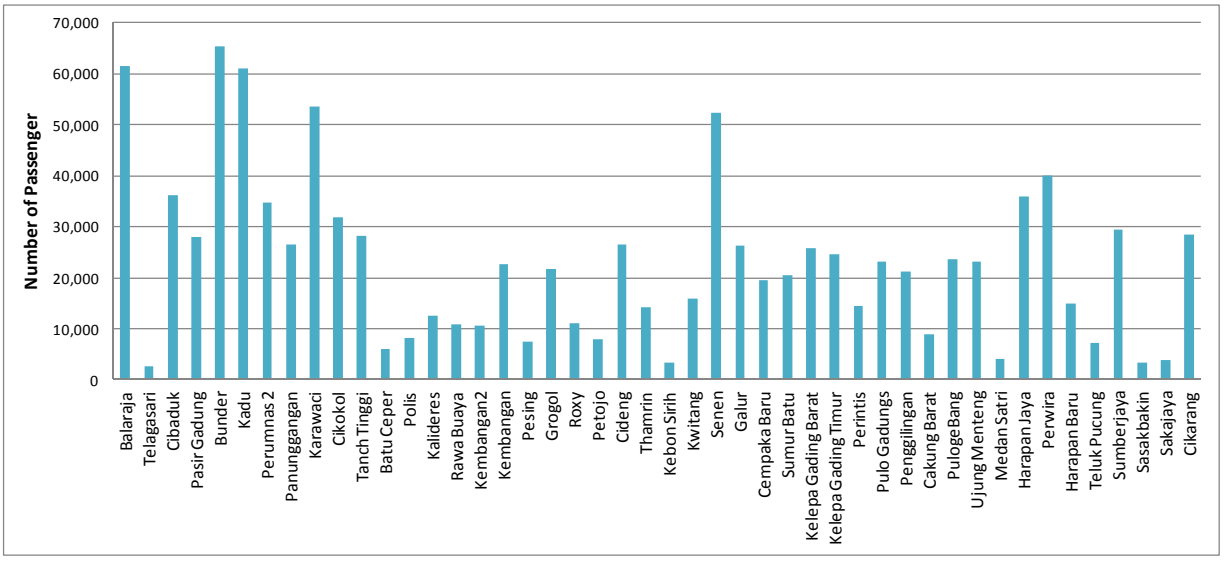
Figure 3.8-22 Demand in 2040 of MRT East–West Line and Tangerang Line

Boarding/alighting passengers at each station in 2041 are shown in Figure 3.8-23 and Figure 3.8-24. Transfer passengers were included in Figure 3.8-23, but are excluded in Figure 3.8-24. At some stations, the reason why passenger traffic volumes are very low, considering the high values, is due to the technical zone system in the simulation. Since the size of the zone is sometimes larger than the distance between stations, trips in the traffic assignment are biased to some stations. Therefore, it is better to emphasize that the forecast is the average of the passenger traffic for the two directional flows.



Source: JICA Study Team

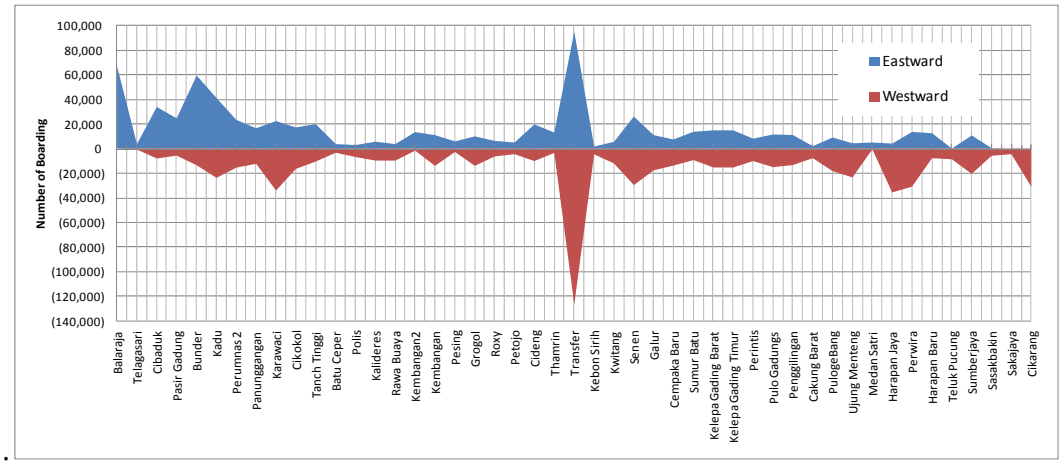
Figure 3.8-23 Boarding Passengers at Station Including Transfer Passengers (Enhanced Case)



Source: JICA Study Team

Figure 3.8-24 Boarding Passengers at Station Excluding Transfer Passengers (not Transfer passengers, Enhanced Case)

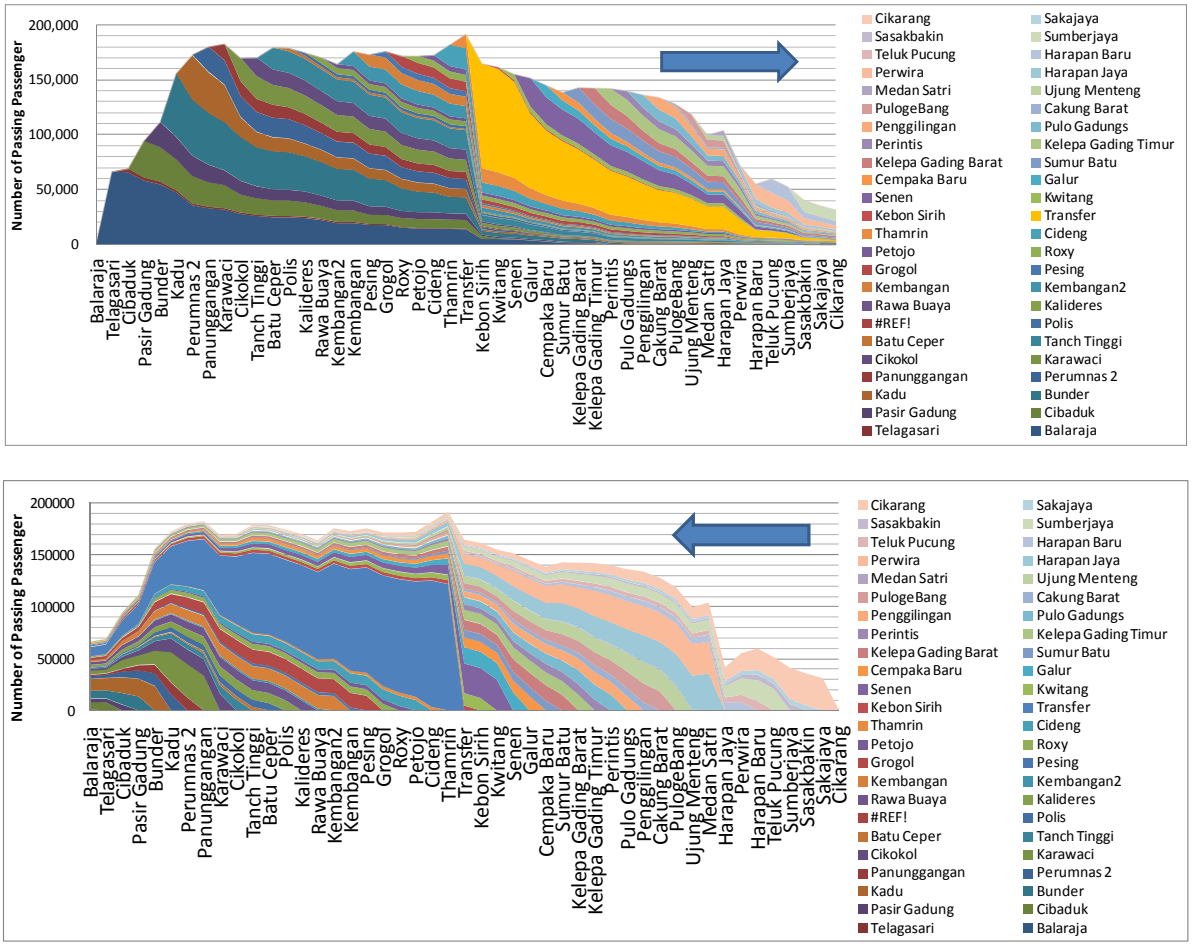
Basically, the number of boarding passengers traveling eastward is the same as those alighting from the westward direction because of the daily trips. Similarly, boarding passengers traveling westward is the same as those getting off from the eastward location. The Figure 3.8-25 below shows the boarding/alighting passengers for the two directions.



Source: JICA Study Team

Figure 3.8-25 Boarding/Alighting Passengers by Direction (Enhanced Case) in 2041

The details of demand forecast for passengers in 2041 by section, direction, and boarding stations is shown in Figure 3.8-26. The share of both eastward and westward passengers transferring from/to the North–South Line is large. On the other hand, the share of passengers passing through the center of Jakarta from/to the east and west is not as large.



Source: JICA Study Team

Figure 3.8-26 Passengers by Boarding Station (Enhanced Case) in 2041

(3) Comparison by Case

Table 3.8-5 shows the annual growth of passengers under base case scenario. The number of passengers steadily increases yearly, but not rapidly. If rapid growth is required, promotion of services such as common fare system in JABODETABEK, park and ride services, and shared bicycle services will be necessary. The extension from Phase 1 to Phase 2 attracts about twice the number of passengers and the average increase of passenger traffic for each section is about 35%.

Table 3.8-5 Total Daily Passengers

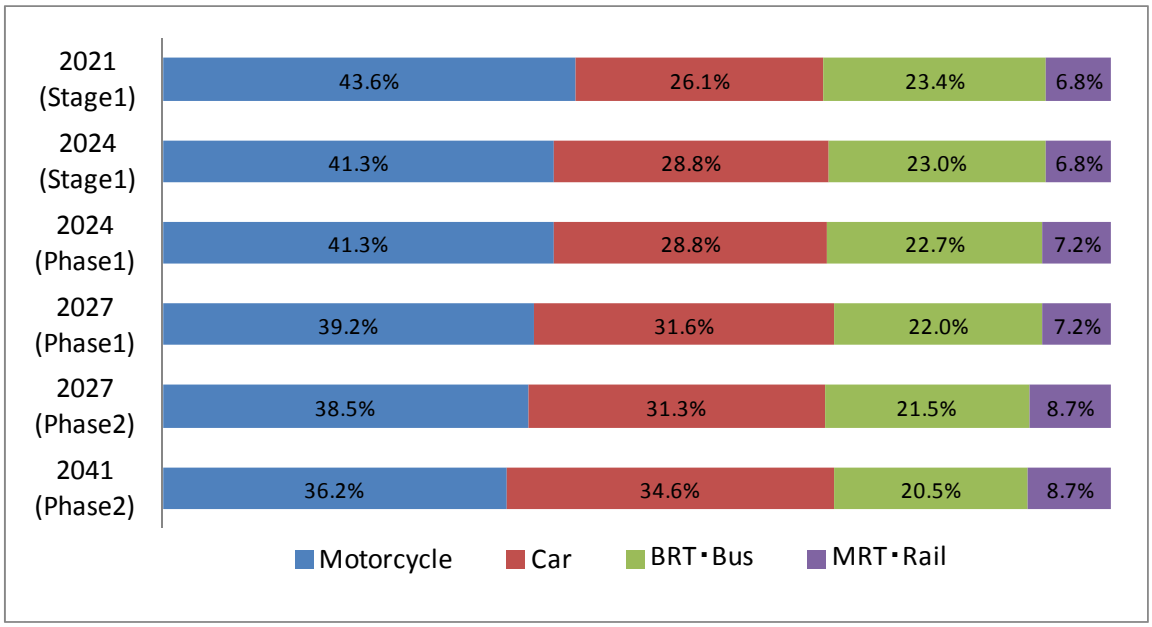
		2024	2027	2041
Number of Passengers (Pax./day)	Only Phase- 1	405,500	428,200	453,000
	Phase- 2	-	1,184,600	1,227,700
Transport density (Passenger ＊1,000km)	Only Phase- 1	3,600	3,800	4,000
	Phase- 2	-	19200	20,100
Average Trip Length (km)	Only Phase- 1	9.0	8.9	8.8
	Phase- 2	-	16.3	15.8

Source: JICA Study Team

(4) Modal shift by MRT East-west Line Introduction

The following table shows the modal shift due to the introduction of the MRT East-West Line.

While there is a decrease in the percent share of motorcycles, there will be an increase in the percentage of car users. The impact of the introduction of the MRT East-West Line during Stage1 of MRT·Rail is the increase in modal share to 6.8% of total transportation. During the time interval between Stage1 to Phase1, MRT-Rail's share will increase from 6.8% to 7.2% of total transportation. During the time interval between Phase1 to Phase2, MRT-Rail's share will increase from 7.2% to 8.7%.



Source: JICA Study Team

Figure 3.8-27 Change in modal share for Phases 1 and 2

Table 3.8-6 Modal shifts for Phases 1 and 2

Year	Motorcycle	Car	BRT ・Bus	MRT ・Rail	Total
2021(Stage 1 in Phase1)	43.6%	26.1%	23.4%	6.8%	100.0%
2024(Stage 1 in Phase1)	41.3%	28.8%	23.0%	6.8%	100.0%
2024(Stage 2 in Phase1)	41.3%	28.8%	22.7%	7.2%	100.0%
2027(Phase1)	39.2%	31.6%	22.0%	7.2%	100.0%
2027(Phase2)	38.5%	31.3%	21.5%	8.7%	100.0%
2041(Phase2)	36.2%	34.6%	20.5%	8.7%	100.0%

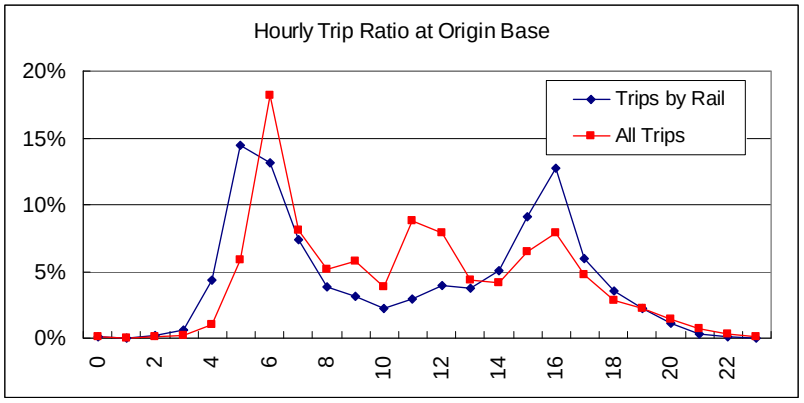
Source: JICA Study Team

(5) Peak Ratio

Provided that the peak ratio is defined by the ratio of maximum traffic volume per day against daily traffic volume, the peak ratio at JABODETABEK railway stations will become very high because the train operation is concentrated in peak hour. The boarding peak ratio at Bogor and Bekasi Stations, and the alighting peak ratio at Kota Station might exceed 25%. According to references on railways and other surveyed results, such ratio was used for the forecast in the Pre-FS by JICA. However, it seems that the peak ratio is not so high based on generated trips at origin base.

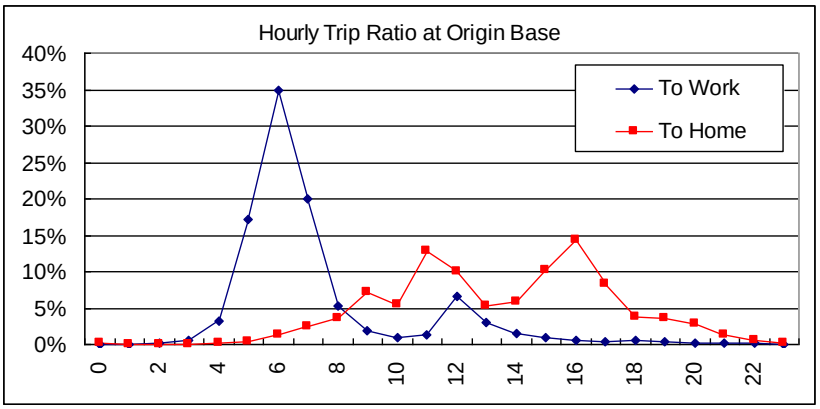
The home interview survey for SITRAMP 2 showed that the peak ratio of generated trips is about 18% from 6:00 a.m. to 7:00 a.m. Trips by railway are concentrated on the 5:00 p.m. to 6:00 p.m. time zone, with a ratio of 14%. The peak in the evening is lower than that in the morning, which is almost the same for road transport. With regards to the trip purpose, the ratio of 35% for work-related trips is higher than that of other trip purposes. However, they will be more evenly distributed considering the departure time in this case is limited to the case where trip start with one's home.

MRT passengers do not include only commuters in the morning, and the directions of their travel are not always the same. Therefore, it is certain that the peak ratio of MRT East-West Line will be less than 35%. From this survey, the peak was estimated to be about 20%.



Source: SITRAMP by JICA (2002)

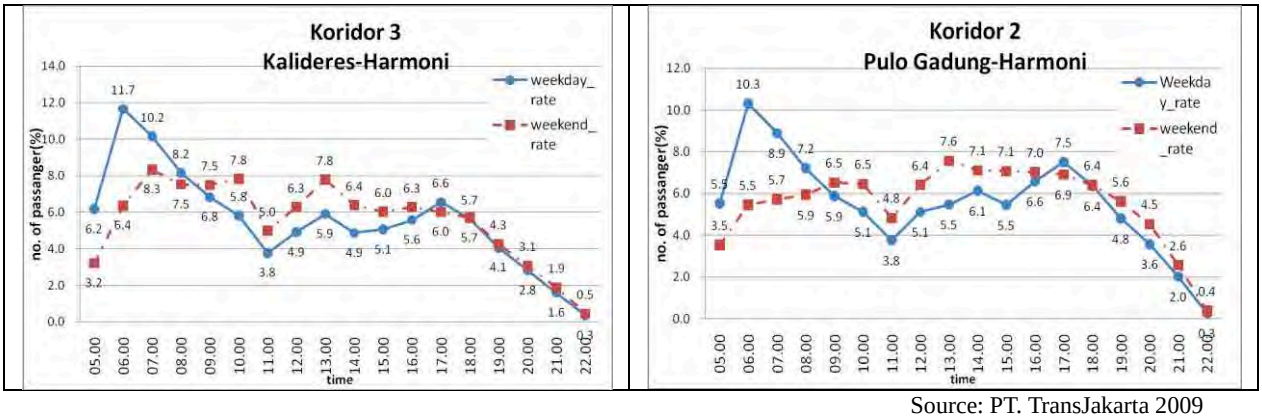
Figure 3.8-28 Peak Ratio of Generated Trips



Source: SITRAMP by JICA (2002)

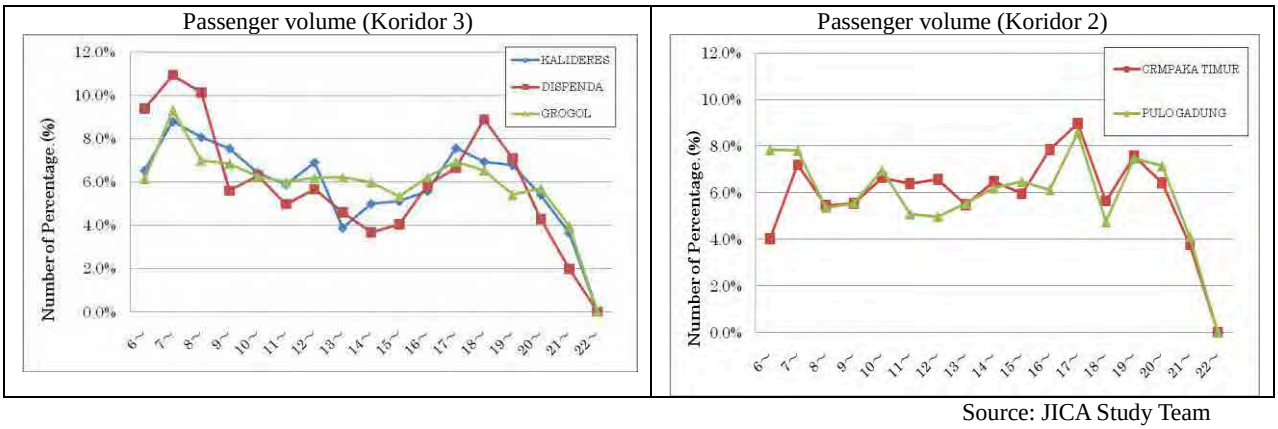
Figure 3.8-29 Peak Ratio of Generated Trips by Purpose

For reference purposes, the peak ratio on busways along similar locations of MRT East-West Line is shown in Figure 3.8-30 below. Corridor 2 at the east side and Corridor 3 at the west side from the center of Jakarta run along the future MRT East–West Line. The peak ratio of Corridors 2 and 3 are 10.3% and 11.7%, respectively. Based on the passenger count survey in this study, the maximum peak rate for both corridors are 10.5%, and 10.9%, respectively. Although these are important trunk lines between the east and west, the concentration in the early morning is not so high compared to those obtained from the home interview surveys. In all busways, the highest peak ratio is 14% in Corridor 7 between Kampung Rambutan and Kampung Melayu. In Corridor 1, the evening peak is higher than the morning peak. Even though these are the averages of the peak and off-peak directions, the maximum peak ratio will be about 20% in the peak direction.



Source: PT. TransJakarta 2009

Figure 3.8-30 Weekday and Weekend Hourly Ratio of Busways on Corridors 2 and 3



Source: JICA Study Team

Figure 3.8-31 Result of Passenger Count Survey: Hourly Ratio

(6) Calculation method of PHPDT(Peak Hour Peak Direction Traffic)

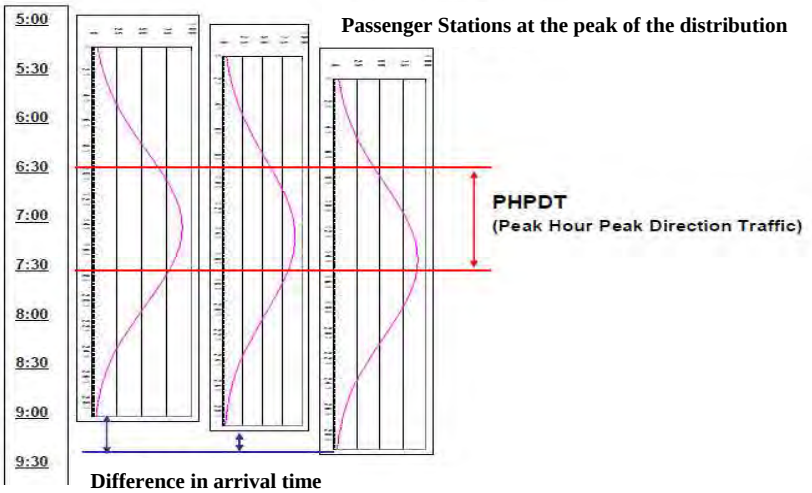
The main parameter of the MRT Operations Plan is calculated according to the above-mentioned data for investigation. The PHPDT is calculated using the distribution modeling of alighting volume based on the boarding passenger traffic.

1) Condition Precedent

- The passenger flow volume for each direction on the maximum loaded section, which is based on the result of demand forecast, is given.
- The distribution of passenger volume in each time zone is assumed to be the same as the condition for TransJakarta, which is the existing BRT System in Jakarta city.
- The proportion of passenger volume during peak-period to the total in one day is given according to the TransJakarta conditions mentioned above.
- The passenger volume of MRT during the peak-period is assumed to have a normal distribution.

2) Concrete Steps

- Collecting analogous data on passenger volume for each station
  - Collecting the distribution data for each station according to the condition of Trans Jakarta
  - Calculating the proportion of passenger volume during peak-period, which is between 5 a.m. to 10 a.m., to the total for one day
- Confirmation of passenger volume for both stations of the most loaded section
  - Access to information on passenger flow volume for each station according to the OD Matrix
- Calculation of boarding passenger volume for each station during the peak-period
  - Calculating the passenger volume of each station during the peak-period based on the proportion of passenger volume during peak-period to the total for one day
- Chart of normal distribution
  - Preparing normal distribution chart of passenger volume for each station during the peak-period based on the average and root-mean-square deviation data of the existing situation of TransJakarta
  - Plotting the variations on the Normal Distribution Chart every minute
- Calculation of PHPDT based on the normal distribution mentioned above
  - Calculating the PHPDT per one hour based on the normal distribution, which includes the amount of time required to travel from each station to the section of the maximum loaded section



Source: JICA Study Team

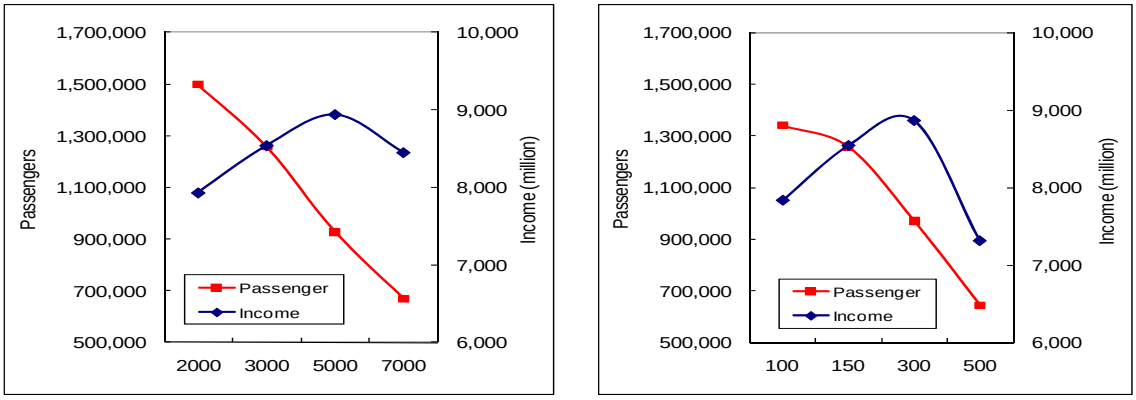
Figure 3.8-32 Conceptual Diagram of how to Calculate the PHPDT

3) Calculation Results

The PHPDT was calculated with the application of the arrival distribution wherein the peak is clearly attributed as due to morning congestion at the terminal stations of BRT. It shows the peak ratio of 18 % in Pulo Gadung (Corridor 2), 20% in Kalideres (Corridor 3) and 14% in Lebak Bulus (Corridor 8). With reference to these figure, the peak ratio is assumed at 18% for MRT East-West Line.

(7) Optimized Fare

The maximum income by fare depends on the optimized fare system for the MRT. In the above forecasts, it was assumed that the basic fare is Rp 3,000 and the proportional fare is Rp 150/km. If either basic fare or proportional fare is higher, the number of passengers becomes lower. The maximum income considering basic fare is around Rp 5,000 while that for proportional fare is about Rp 300/km. Therefore, the combination of slightly higher fare than the preliminary assumption will push up the total income.



Base Fare Proportional Fare

Note(*):These cannot be divided as the transfer fare is not set in the forecast and due to technical requirements on the forecast method.

Source: JICA Study Team

Figure 3.8-33 Optimized Fare by Income (*) for MRT East–West, North–South and Airport Lines