Chapter 9 Case Study: Semarang-Solo-Yogyakarta Corridor

The Case Study focuses on the Semarang – Solo – Yogyakarta corridor, which is seen to potentially have a high need for transportation services. The projects/programs that are of high priority for the establishment of a "Central Java Regional Railway System" are studied in detail including institutional setup and financial arrangement.

9.1 Commuter Railway Service Development Plan

9.1.1 Passenger Demand

(1) SP Survey Analysis

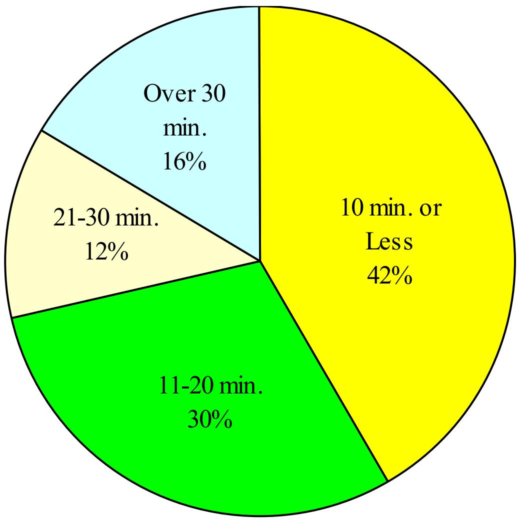
As a part of the Study, Stated Preference (SP) Survey on Railway Use was conducted in the residential areas along the proposed commuter railway corridors: namely, Semarang – Kendal, Semarang – Demak, Semarang – Brumbung, Solo – Klaten, Solo – Sragen, Yogyakarta – Klaten, and Yogyakarta – Wates commuter railway lines. The SP Survey in the residential areas along the railway corridors mainly aims at analyzing the willingness of residents to utilize the planned new commuter trains to go to the city (i.e., Semarang, Solo, or Yogyakarta). The obtained information was utilized to forecast the ridership of the new commuter railway lines for economic and financial analyses as well as proper operation planning.

This survey was conducted by interviewers in August and September, 2008. Samples for the interview were taken from total 2,083 adult individuals (of age 17 or older) consisting of 1,302 workers, 274 students, and 507 adult non-workers who live along the proposed commuter rail corridors. Interviewed households were selected on a random basis; however, we attempted to select those who live close to the existing or planned commuter railway stations. The survey was made by visiting the sample households and each adult individual was interviewed in person. Average number of persons per household is around 4.3, and there are about 2.7 adults and 1.7 workers per household on average. Average household monthly income is around Rp. 1.3 million per month.

1) Travel Characteristics

According to the interview result, 59% of the workers have a workplace in the city, and 74% of the students go to school in the city. Frequencies of to-work and to-school trips are 4.2 and 4.4 times per week on average, respectively. Average travel time to the city did not vary much among workers, students, and non-workers, and it was around 30 minutes per one way.

Composition of walking distances (in the unit of travel time) from the nearest commuter railway station is shown in Figure 9.1.1. In some cases, the station is currently not operated for passenger services or does not exist, but is only planned. Thus, the actual walking time may not be correct; however, it is the time that the respondents think it takes to the nearest station. Since it was attempted to select respondents in residential areas that are relatively close to the commuter railway stations, the majority of respondents live within a "walking" distance from the station.

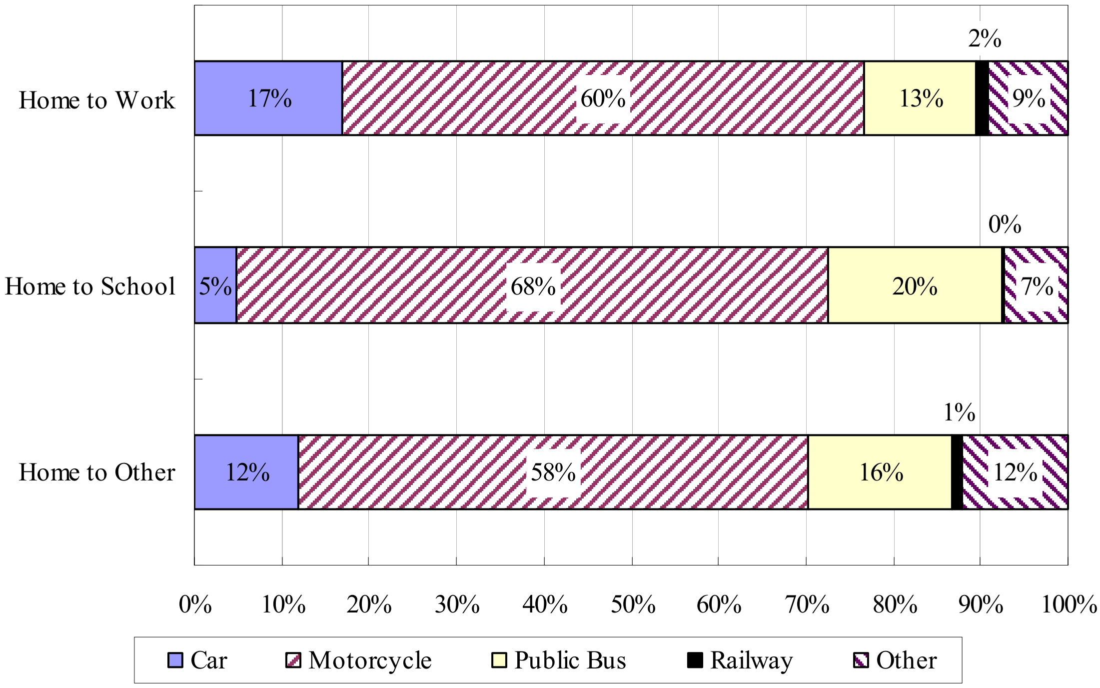


Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.1.1 Walking Distance from the Nearest Commuter Railway Station

2) Preference on Mode Choice

Current mode shares to go to the city are presented by trip purpose (i.e., from home to work, school, and other) in Figure 9.1.2. Overall, motorcycle has by far the largest share for all the purposes. For work purpose, car has the second largest share (17%) and it is greater than the share of public transport (bus: 13%, railway: 2%). On the other hand, for school and other purposes, the share of public transport is larger than the share of car. At present, use of the railway is very low for all purposes.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.1.2 Transportation Mode Shares by Trip Purpose

According to the survey, respondents who take public transport spend an average of Rp. 6,200 for a one-way trip to the city, as shown in Table 9.1.1. For car and motorcycle users, cost for a one-way trip is estimated based on the monthly cost of fuel and parking for the vehicle they use. Average cost for a one-way trip to the city by car is about Rp. 10,000, which is higher than the public transport fare. On the other hand, average cost for a one-way trip by motorcycle is about Rp. 3,200, which is about half of the public transport fare.

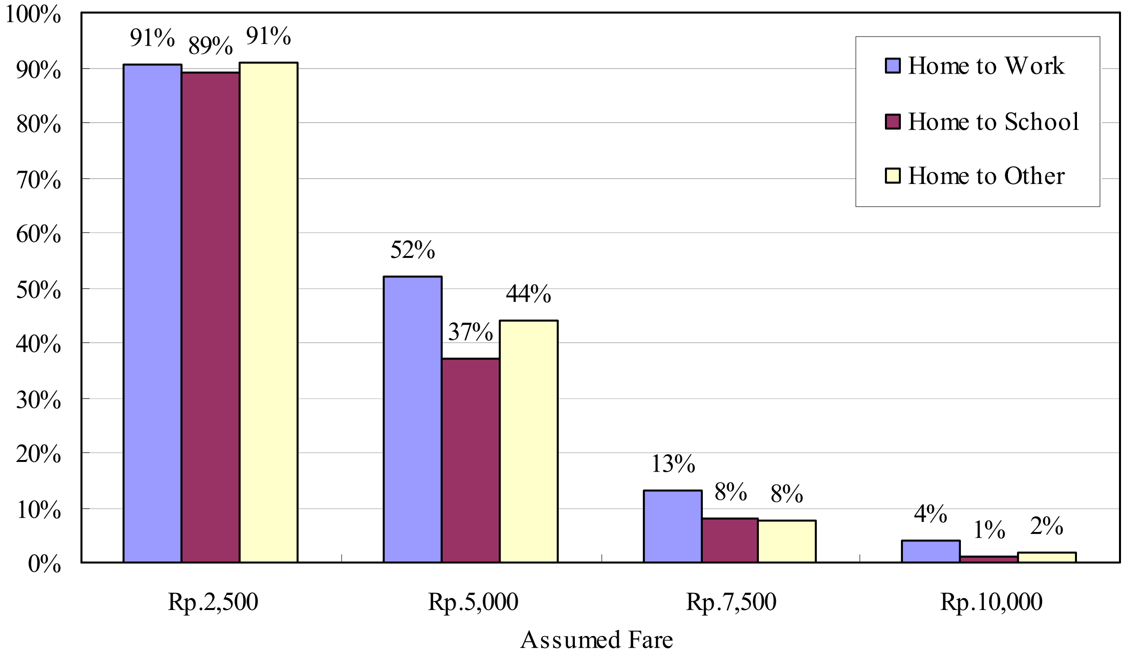
Table 9.1.1 Average Cost Spent for a One-Way Trip to the City

Travel Mode	Public Transport	Taxi	Car*	Motorcycle*
Average One-Way Cost (Rp.)	6,200	29,000	10,000	3,200

* One-way trip cost for car and motorcycle is estimated based on the monthly cost.
Source: CJRR Study Team (SP survey on Railway Use, 2008)

Then, the survey asked the respondents whether they would choose the proposed commuter railway services under the assumed fare levels of Rp. 2,500, Rp. 5,000, Rp. 7,500, and Rp. 10,000. It was assumed that, a new commuter railway was available serving the stations shown in the project map of each corridor in Section 8.1.2. New, safe, air-conditioned trains were assumed to be used for this service. The travel time to the city by railway was assumed to be around 25 minutes (or based on an average commercial speed of 40 – 60 km/h) with a frequency of every 10 minutes during the peak hour and every 30 minutes during the off-peak hour. Feeder bus service was also assumed to be provided for easier access to/from each station.

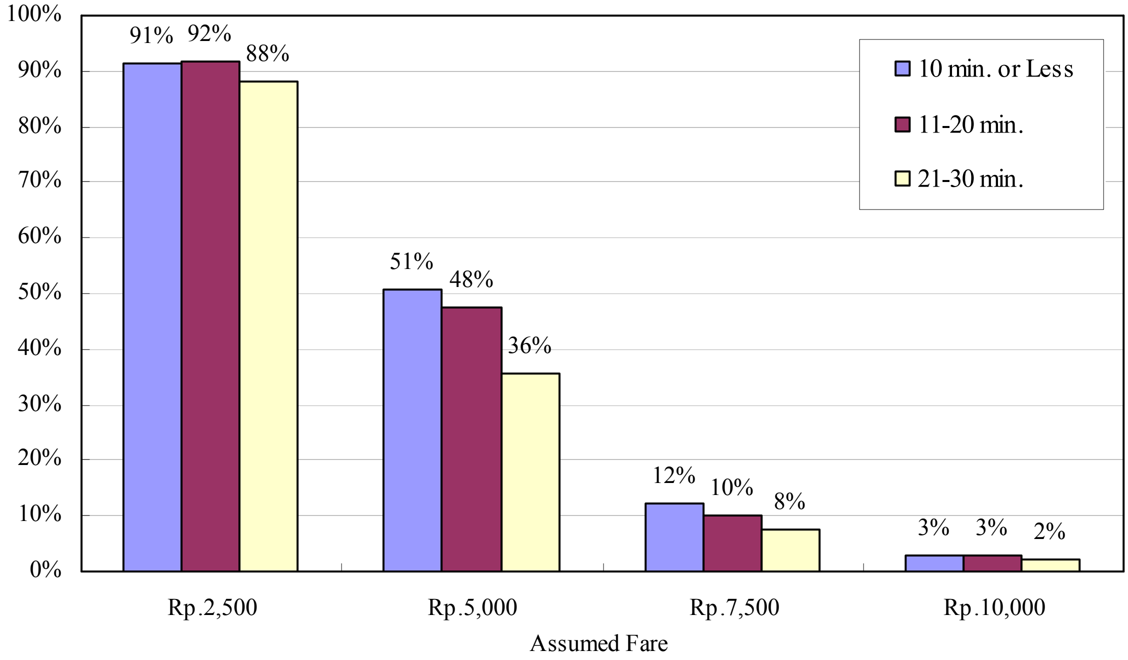
The result is shown by trip purpose in Figure 9.1.3. Overall, the respondents are sensitive to the railway fare. For workers to go to work in the city, for example, 91% of them answered that they would choose the commuter railway under the assumed one-way fare of Rp. 2,500. This ratio drops to 52% if the fare is Rp. 5,000. Under the assumed fares of Rp. 7,500 and Rp. 10,000, the ratio of choosing the commuter rail is as small as 13% and 4%, respectively. Respondents who go to school or other places in the city are even more price-sensitive. On the other hand, analysis by in-vehicle time or travel distance on the railway brought no significant differences in the willingness to pay. This may be because a flat tariff system has been applied for bus services in and around major cities such as Semarang, Solo, and Yogyakarta and the respondents are not used to the concept of a distance-proportional tariff.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.1.3 Ratio of Those Who Would Choose Commuter Railway by Trip Purpose

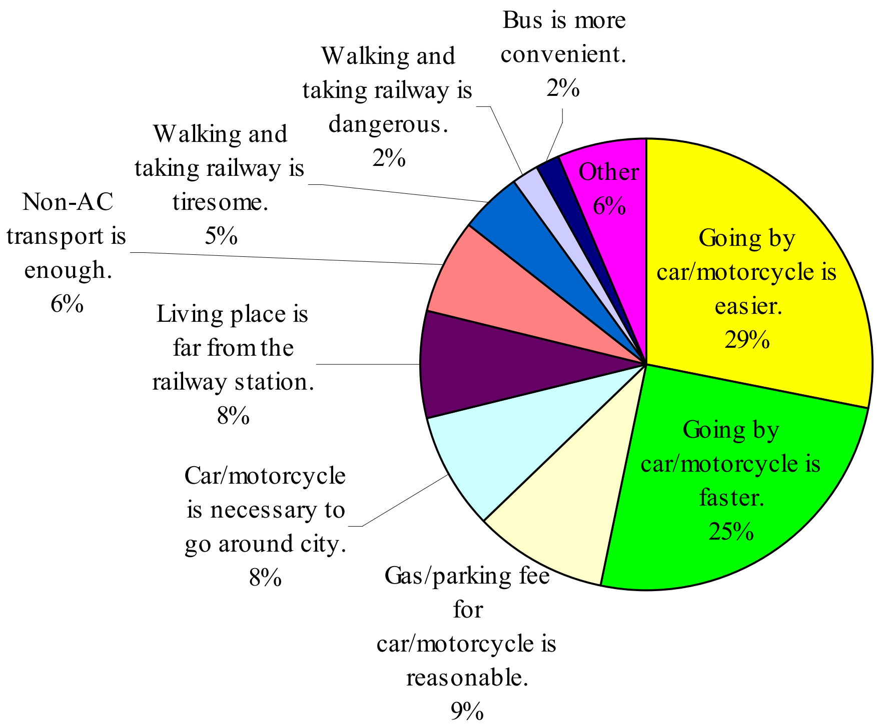
Ratios of those who would choose the commuter railways are recalculated by walking distance (time) to the nearest station as shown in Figure 9.1.4. If the railway fare is too low or too high, differences in the ratios of choosing the commuter railway tend to be small regardless of the walking distance. However, if the fare is moderate (e.g., Rp. 5,000), those who live closer to the railway stations tend to be more willing to take the railway.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.1.4 Ratio of Those Who Would Choose Commuter Railway by Walking Distance

The above results are based on the stated preference, and, in fact, all the respondents who answered yes may not actually choose the new commuter railway. Thus, besides the fare issues, possible reasons why they might not use the new commuter railway were also asked, and the result is shown in Figure 9.1.5. No significant differences were observed across the trip purposes. The biggest reasons are the ease (29%) and shorter travel time (25%) in taking a private vehicle. For example, they do not have to wait for or change trains but they can sit in the vehicle and will arrive at the destination faster if they use a private vehicle. These advantages may be highly valued by the car and motorcycle users, while fewer respondents (16%) consider the current fuel and parking fees as reasonable. On the other hand, some respondents negatively regard the railway, giving reasons that walking and taking railway is tiresome or dangerous, although the shares are relatively small.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.1.5 Reasons that Respondents May Not Use the New Commuter Railway

(2) Demand Projection

1) Methodology

In a metropolitan area, it is difficult to study the impact of a new transport infrastructure by focusing only on the target railway corridor, because there are significant interactions and relations across areas not only on a certain single corridor but also throughout the region. Among others, since the planned commuter railway lines run not only in the suburban areas but also through the existing urban areas, it is necessary to take the whole metropolitan area into consideration for comprehensive forecast of the railway passenger demand as well as the benefits of each commuter rail project. Hence, future transportation demand forecast in an urban area was conducted in order to obtain comprehensive OD trip tables and forecast the number of passengers on the planned railway corridor as well as line loadings of passengers between stations.

Three major metropolitan areas in this Case Study corridor are listed in Table 9.1.2. While there would be a more precise definition, kotas and kabupatens are selected to cover areas served by the relevant commuter railway lines. Since Solo and Yogyakarta are located only 60 km apart from each other, these two metropolitan areas are essentially continuous. Therefore, for the purpose of demand forecasting, they are regarded as one area, namely, Yogyakarta – Solo metropolitan area.

Table 9.1.2 Metropolitan Areas in the Case Study Corridor

Metropolitan Area	Kota/Kabupaten	Commuter Railway Line
Semarang Metropolitan Area	Kota Semarang, Kab. Semarang, Kab. Kendal, Kab. Demak	Semarang – Kendal Semarang – Demak Semarang – Brumbung (Semarang Monorail)
Solo Metropolitan Area	Kota Surakarta, Kab. Sragen, Kab. Karanganyar, Kab. Sukoharjo, Kab. Klaten, Kab. Boyolali	Solo – Klaten Solo – Sragen (Solo Tramway)
Yogyakarta Metropolitan Area	Kota Yogyakarta, Kab. Sleman, Kab. Bantul, Kab. Kulon Progo, Kab. Gunung Kidul, Kab. Klaten	Yogyakarta – Klaten Yogyakarta – Wates (Bantul Tramway)

Source: CJRR Study Team

The Study Team employs the following approach to forecast the demand of the new commuter railways. First, land use along the railway corridor was reviewed and trip generations were calculated by trip purpose with the latest land use information. To this end, a traffic analysis zone (TAZ) system was developed for each metropolitan region. In this Study, each kecamatan has been defined as a TAZ. Each TAZ includes only one station basically, which can provide the information of boarding and alighting passengers by station. If two or more stations are located in a TAZ, forecasted passenger volume for this TAZ will be split into each station in proportion to the population of desa that each station belongs to.

A variety of socio-economic attributes were obtained for each TAZ: namely, population, number of workers by industrial sector (i.e., at residential place), and number of employments by industrial sector (i.e., at workplace). These zonal indicators are estimated based on the following statistics that are available for the Case Study corridor.

- Population (by kecamatan)
- Area by land use (agricultural field, paddy, and settlement & activity place)
- Working population by industrial sector from "Labor Force Situation (Statistical Bureau or *Badan Pusat Statistik*, BPS)" (by kabupaten/kota)
- Employment population by industrial sector from "Economic Census (BPS)" (by kabupaten/kota)
- Employment population statistics in the manufacturing sector by size of establishment (by kecamatan)

- Manufacturing establishment statistics by size (by kecamatan)
- Manufacturing establishment directory
- Total urban and rural areas (by kecamatan)

As described in Sections 9.2.4 and 9.2.5, additional population, workers, and employments that are planned in the housing and urban developments along the commuter railway corridors have also been included in the socio-economic attributes.

Trip production (generation) of zone i, P_i, and attraction of zone j, A_j, are estimated from simple regression models that are generally expressed as follows:

$$P_i = \alpha_0 + \alpha_1 X_{1,i} + \alpha_2 X_{2,i} + \cdots\cdots + \alpha_n X_{n,i}$$

$$A_j = \beta_0 + \beta_1 X_{1,j} + \beta_2 X_{2,j} + \cdots\cdots + \beta_n X_{n,j}$$

where,

$X_{n,i}$, $X_{n,j}$: zonal indicators,

α, β : parameters,

n : total number of zonal indicators.

Second, based on the trip production and attraction of each TAZ, trip distribution patterns (origin and destination patterns) in the metropolitan area were developed for each trip purpose. To allow for a more accurate representation of the distribution of travels, the base year person trip OD matrix were stratified by trip purpose. The trip purposes were categorized into five basic categories, namely:

- Home-based work (consisting of “home-to-work” and “work-to-home” trips),
- Home-based school (consisting of “home-to-school” and “school-to-home” trips),
- Home-based other (consisting of “home-to-other” and “other-to-home” trips),
- Non-home-based business, and
- Non-home-based other.

Trip distribution patterns were estimated with the use of a gravity model of the doubly-constrained type which is expressed as follows:

$$T_{ij} = \frac{P_i A_j F_{t,ij} K_{ij}}{\sum_i \sum_j P_i A_j F_{t,ij} K_{ij}}$$

where,

T_{ij} : trips produced in zone i and attracted to zone j,

P_i : trips produced in zone i,

A_j : trips attracted to zone j,

$F_{t,ij}$: empirically derived travel factor for time t between zones i and j,

K_{ij} : specific sector-sector adjustment factor to allow for the effect of travel linkages not otherwise explained by the gravity model.

In simple terms the formula states that the trip productions in zone *i* will be distributed to each zone *j* according to the relative attractiveness of zone *j*. Each *j*'s attractiveness is determined by the product of its attractions and some function of the spatial separation between *i* and *j*. The function of spatial separation $F_{t,ij}$ is the indefinite portion of the equation. It could be described by an expression in the form of: power function, exponential function, etc. However, to facilitate application, most gravity model processes use a lookup function to obtain empirical values for the function based upon the impedance. These curves are usually called "Friction Factor Curves".

Then, taking mode choice into consideration, the total amount of patronage on the different transport modes was estimated including ridership of the planned new commuter railway lines. In general, the factors influencing mode choice may be classified into three groups, namely : (i) characteristics of the trip maker, hereby represented by their income group, (ii) characteristics of the journey, represented by their trip purpose and geographical location, and (iii) characteristics of the transport facilities, represented by such quantitative factors as travel time and travel cost.

For the general purposes of demand forecasting in this Study, an aggregate approach was used whereby the model is based on zonal rather than individual information. The information available for the potential modal shares of the commuter railway under assumed fare levels is the above-mentioned interview survey results (i.e., stated preference for using the new commuter railway services), the observed modal split, the characteristics of the traveling population, and the operational characteristics of the competing urban transport modes.

2) Projected Demand

Present desire lines by trip purpose (i.e., home-based work, home-based other, non-home- based business, and non-home-based other) are made based on the trip distribution in each metropolitan area as shown in Figure 9.1.6 to Figure 9.1.13. As statistics related to the number of students by TAZ were not available, home-based school trips could not be properly estimated.

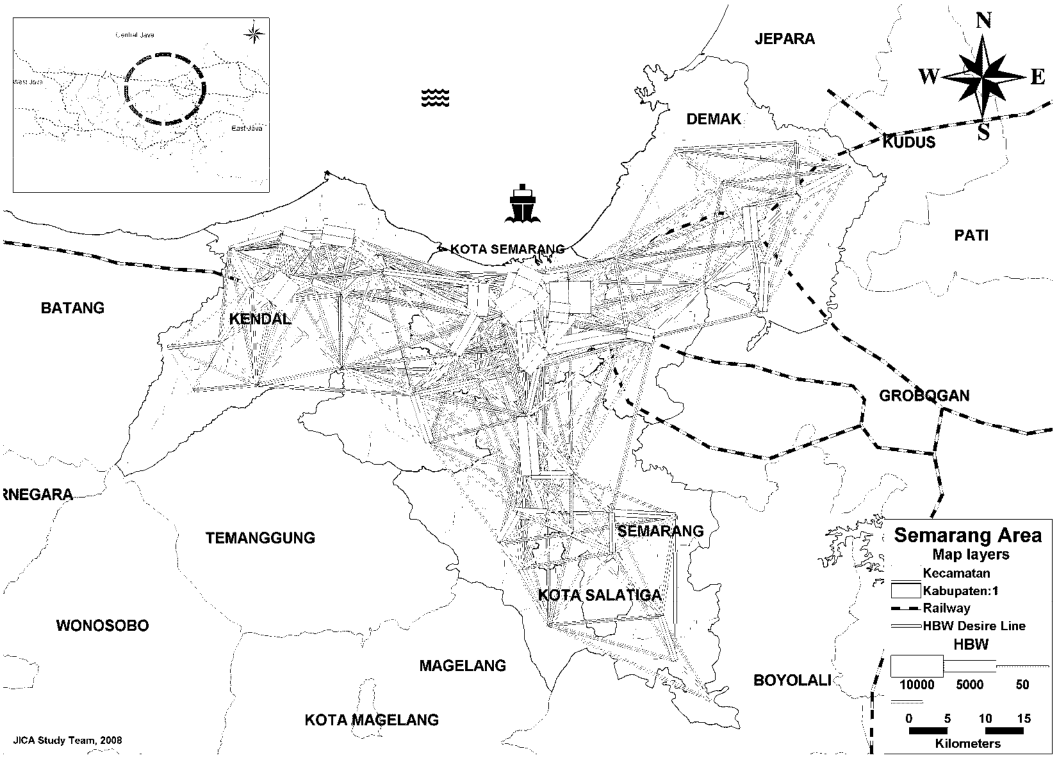


Figure 9.1.6 Home-Based Work Desire Lines in Semarang Area (2008)

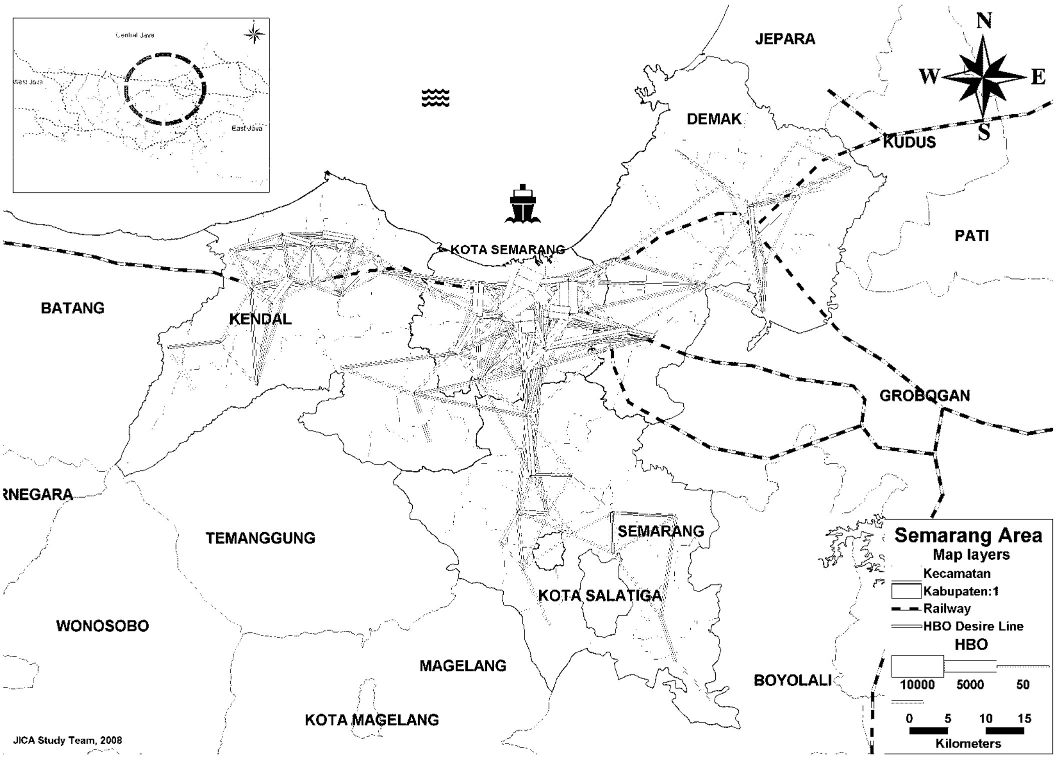


Figure 9.1.7 Home-Based Other Desire Lines in Semarang Area (2008)

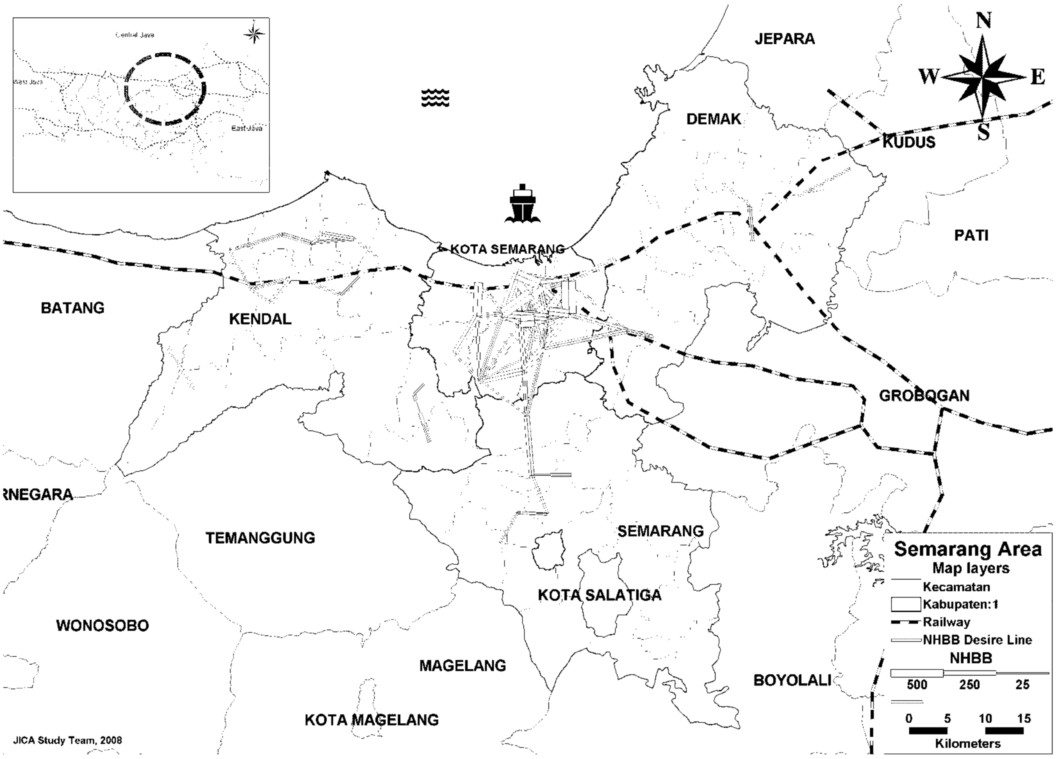


Figure 9.1.8 Non-Home-Based Business Desire Lines in Semarang Area (2008)

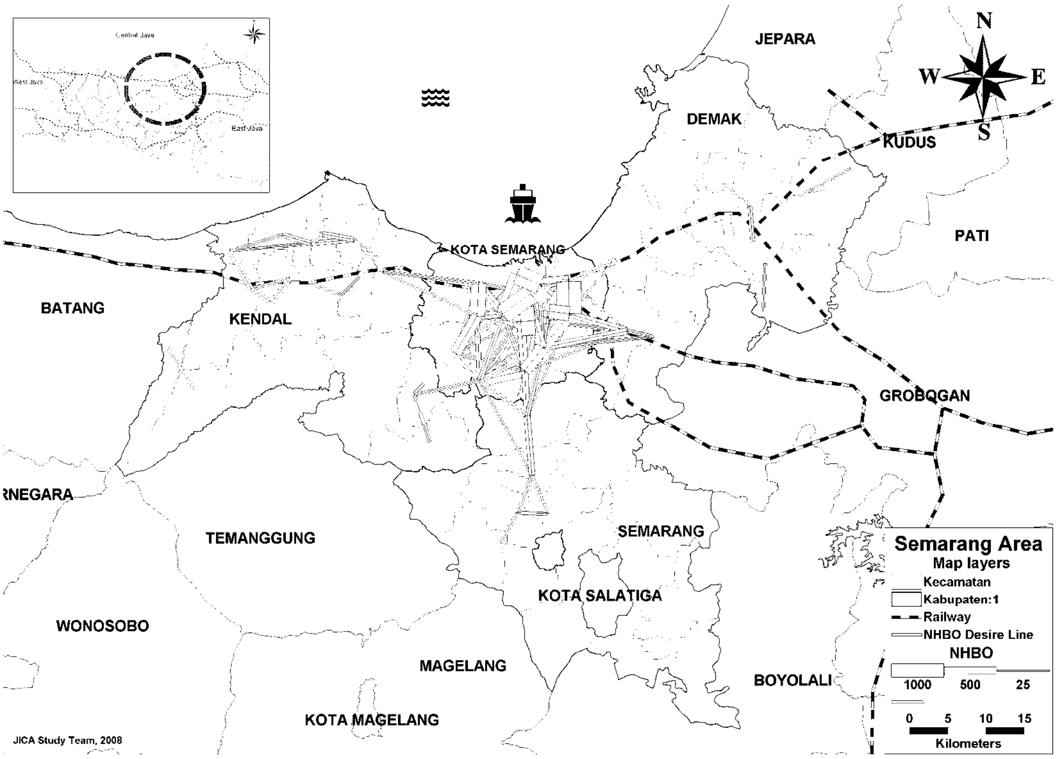


Figure 9.1.9 Non-Home-Based Other Desire Lines in Semarang Area (2008)

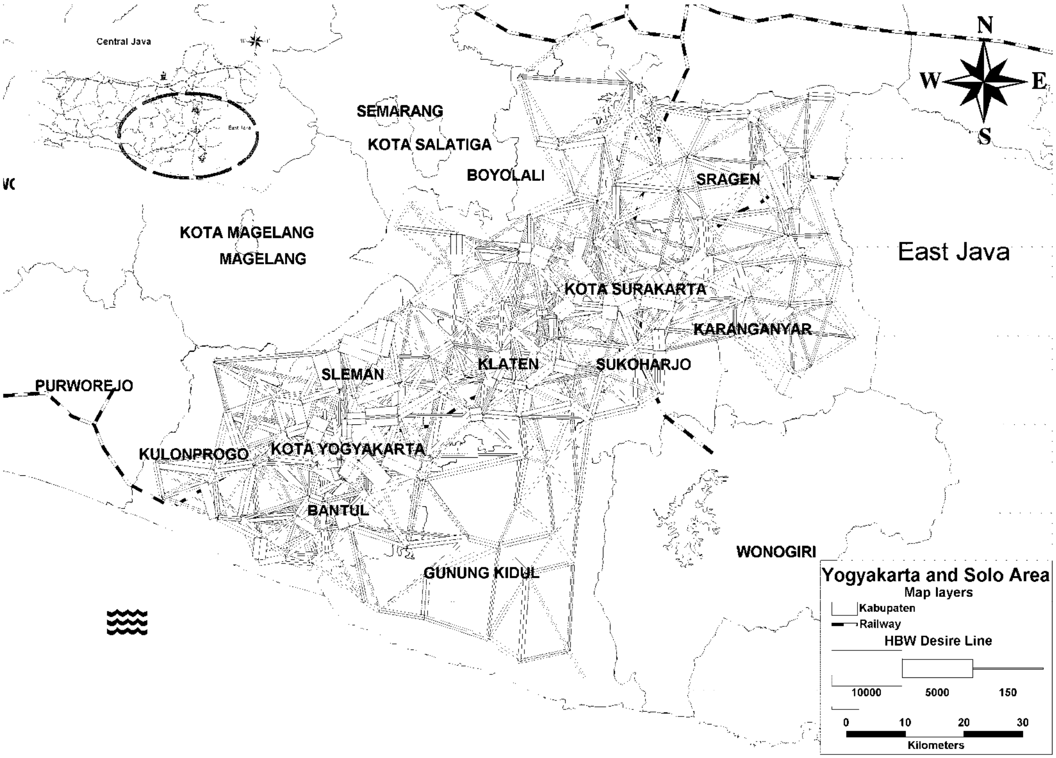


Figure 9.1.10 Home-Based Work Desire Lines in Yogyakarta – Solo Area (2008)

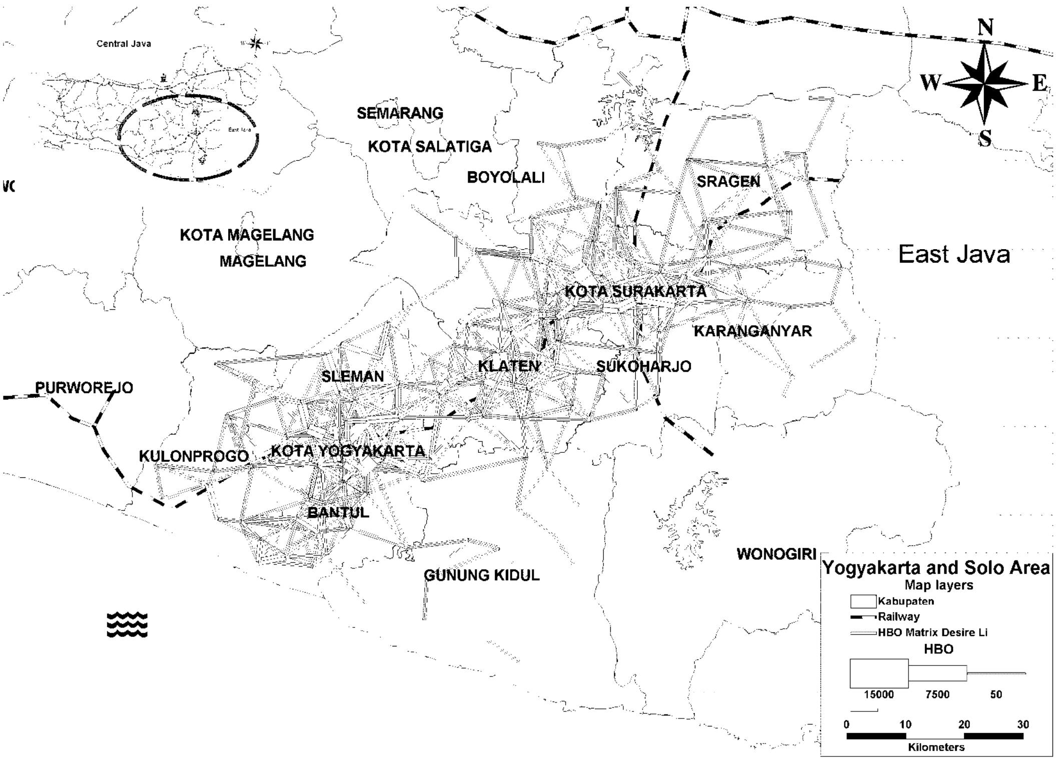


Figure 9.1.11 Home-Based Other Desire Lines in Yogyakarta – Solo Area (2008)

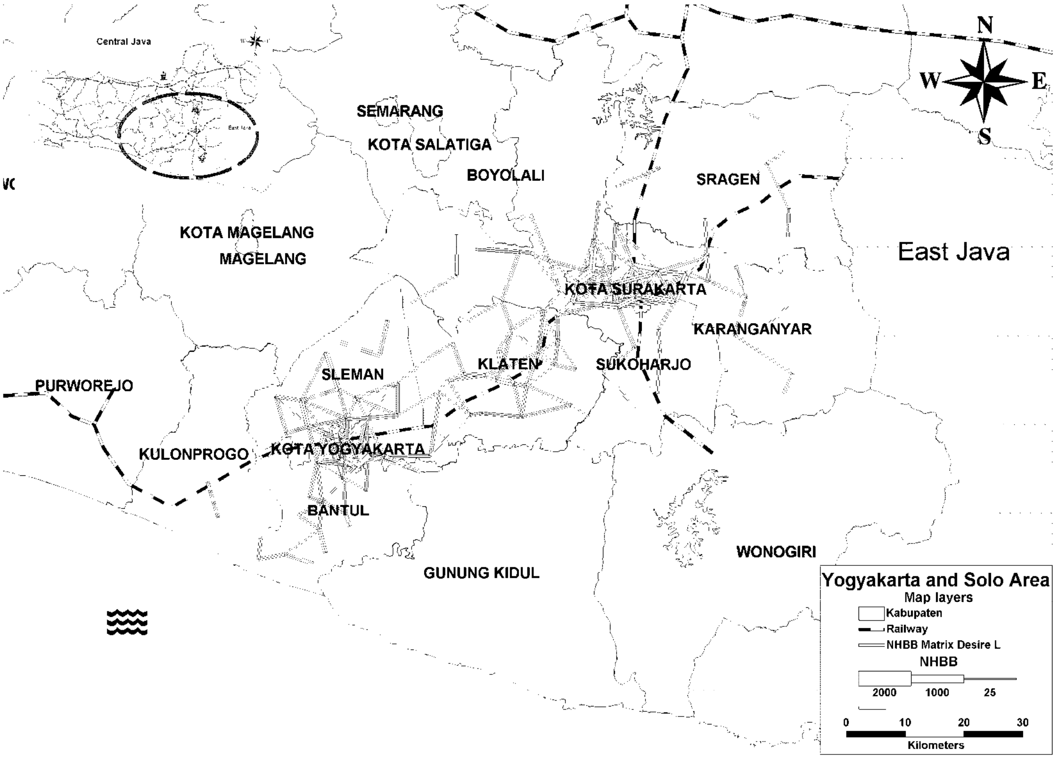


Figure 9.1.12 Non-Home-Based Business Desire Lines in Yogyakarta – Solo Area (2008)

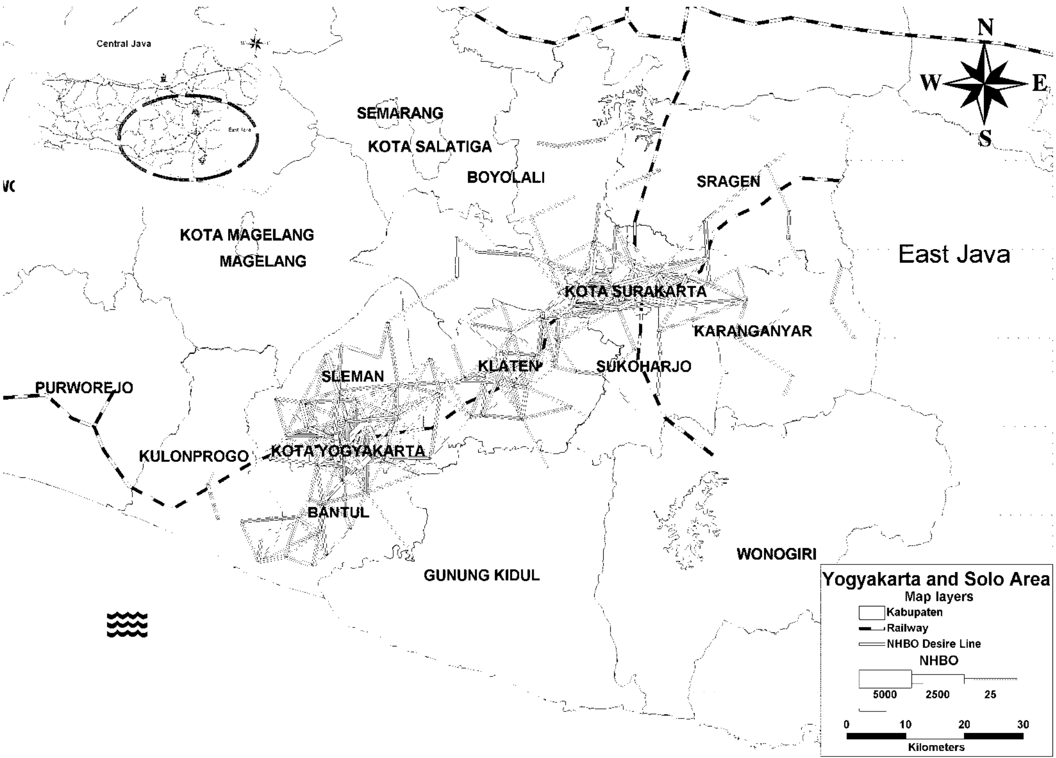


Figure 9.1.13 Non-Home-Based Other Desire Lines in Yogyakarta – Solo Area (2008)

Desire lines or OD trip volumes shown in the above drawings include all modes, and a part of volumes of origin and destination zones along the planned commuter railway lines are split into railways and other travel modes based on the assumed modal shares. While, as the SP survey result shows, the potential mode share of the commuter railway will significantly vary depending on the fare, the following demand forecast is based on the flat fare of Rp. 5,000. According to the SP survey result, around half of the respondents would be willing to take the commuter railway under the fare of Rp. 5,000. This fare level also seems to be appropriate as compared to the current fare of longer-distance Prameks train (e.g. Yogyakarta – Solo: Rp. 7,000).

For forecast of demand in future years, the commuter railway ridership is subject to the growth of GRDP per capita in each metropolitan area. The total daily boarding passengers for each commuter railway line in 2020 and 2030 are presented in Table 9.1.3. Furthermore, line loading, or railway passenger volume between stations, in a peak hour is one of the important planning parameters for train operation planning of the new commuter railways. The table also shows the maximum hourly passenger loading that is estimated based on the morning peak ratio of commuting trips to the city derived from the SP survey results. While it is different depending on each commuter rail line which has different OD patterns, it is around 10% – 15% of the total daily passenger volume.

Table 9.1.3 Commuter Railway Demand Forecast in Years 2020 and 2030

Railway Line	Year 2020		Year 2030	
	Daily Volume (pax/day)	Peak Line Loading (pax/hour/direction)	Daily Volume (pax/day)	Peak Line Loading (pax/hour/direction)
Semarang-Kendal Commuter (Alt. 1)	42,000	5,700	64,000	8,600
Semarang-Kendal Commuter (Alt. 2)	40,000	5,700	61,000	8,600
Semarang-Demak Commuter	24,000	3,800	37,000	5,700
Semarang-Brumbung Commuter	37,000	5,800	56,000	8,800
Solo-Klaten Commuter	58,000	4,700	88,000	7,100
Solo-Sragen Commuter	32,000	2,700	48,000	4,100
Yogya-Klaten Commuter	70,000	6,800	106,000	10,300
Yogya-Wates Commuter	37,000	5,000	56,000	7,600
Semarang Monorail	28,000	2,500	42,000	3,700
Solo Tramway	25,000	3,500	38,000	5,200
Yogya-Bantul Tramway	17,000	1,500	25,000	2,300

Note: Under the assumed fare of Rp. 5,000.
Source: CJRR Study Team

9.1.2 Profile of service and System Improvement

(1) Requirements and Objectives of Commuter Railway Planning

The commuter train projects aim to provide the following service levels as basic requirements.

- Serving commuting sphere and satellite cities within 30 km distance from each regional core.
- Frequent operation with double track for all commuter lines
- From 10 to 20 minutes headway at peak hours, and 30 to 60 minutes headway at off peak hours depending on the traffic forecast
- Express and local train services at average speed of 50 and 35 km/h respectively
- Safe and reliable operations with automated signaling, train control and telecommunication systems
- Environmental friendly and energy efficient service employing electricity-based traction system
- Increased number of stations with approximately 3km of distance between each stops

- User-friendly station facilities, such as high platform, commercial establishments, and barrier free considerations (elevators, toilets, signage, tactile tiles, slopes etc)
- Comfortable railcar interiors (Second hand electric railcars procured from international market, i.e. Japan)
- Improved accessibilities to stations (Station plaza, feeder services etc)

(2) Route Alignment

Based on such objectives and requirements of the commuter train services, route alignments for the same were identified as discussed below. (Note however, that Semarang – Demak Commuter is treated later as optional due to its significant capital investment cost.)

1) Semarang Commuters

Semarang Commuters consist of 3 commuter lines, namely:

- **Semarang – Kendal Commuter** (Beginning at Semarang Tawang and running through Semarang Poncol – Kaliwung, diverging from existing railroad to north west along National Road, and ending up at Kendal with total length of around 29 km.)
- **Semarang – Demak Commuter** (Beginning at Semarang Tawang and running along National Road and ending up at Demak, with total length of around 24 km.)
- **Semarang – Brumbung Commuter** (Beginning at Semarang Tawang and running through Alastuwa – Brumbung and ending up at Brumbung, with total length of around 14 km.)

2) Solo Commuters

Solo Commuters consist of 2 commuter lines, namely:

- **Solo – Klaten Commuter** (Beginning at Solo Balapan and running through Purwosari – Gawok and ending up at Klaten, with total length of around 29 km.)
- **Solo – Sragen Commuter** (Beginning at Solo Balapan and running through Kemiri – Masaran and ending up at Sragen, with total length of around 29 km.)

3) Yogyakarta Commuters

Yogyakarta Commuters consist of 2 commuter lines, namely:

- **Yogya – Klaten Commuter** (Beginning at Yogyakarta (Tugu) and running through Lempunyangan – Maguwo – Brambangan and ending up at Klaten, with total length of around 30 km.)

- **Yogya – Wates Commuter** (Beginning at Yogyakarta (Tugu) and running through Patukan - Sentolo and ending up at Wates, with total length of around 28 km)

Table 9.1.4 Summary of Route Alignment

No.	Name of railway	Itinerary	Length (km)	Note
1	Semarang – Kendal Commuter	Semarang Tawang Station- Semarang Poncol Station- Kaliwung Station- Kendal Station	29.0	Double track (currently single track) Running on viaduct at around Semarang City center & on ground for remaining section. A 21km section sharing with Java North Main Line. Providing a new 4km spur line from Kaliwung to Kendal.
2	Semarang – Demak Commuter	Semarang Tawang Station- - National Road- Demak Station	24.0	Double track (currently abandoned) Running on viaduct.
3	Semarang – Brumbung Commuter	Semarang Tawang Station- - Brumbung Station	14.0	Double track (currently single track) Whole section sharing with the existing single-track railway from Semarang Tawang to Brumbung. Running on ground.
4	Solo – Klaten Commuter	Solo Balapan Station- Klaten Station	29.0	Double track (existing) Running on ground. Whole section sharing with Java South Main Line.
5	Solo – Sragen Commuter	Solo Balapan Station- Sragen Station	29.0	Double track (currently single track) Running on ground. Whole section sharing with Java South Main Line.
6	Yogya – Klaten Commuter	Yogyakarta (Tugu) Station- Lempunyangan Station – Maguwo Station – Prambanan Station – Klaten Station	30.0	Double track (existing) Running on ground. Whole section sharing with Java South Main Line.
7	Yogya – Wates Commuter	Yogyakarta (Tugu) Station- Wates Station	28.0	Double track (existing) Running on ground. Whole section sharing with Java South Main Line.
	Total		**183.0**	

Alternative: Single Track at Semarang - Demak Corridor – *estimated traffic at the section appears to be lower than other commuters and may possibly be handled with single track. However, decisions on single-or-double track shall be made in accordance with a plan to provide passenger and freight rail transport at Semarang – Demak – Rembang – Pati – Kudus corridor. At least civil structure should be made as that for double track, to secure the provision for upgrading at a later date.*

Alternative: Single Track at Solo – Sragen Corridor – *estimated traffic at the section appears to be lower than other commuters and may possibly be handled with single track. Unless budget allows, double tracking of the section could be implemented subsequently when the passenger demand becomes sufficient.*

(3) Alignment, Plane and Spatial Locations

Alignment, plane and spatial locations of proposed commuter railways are presented in the following table.

Table 9.1.5 Features of Commuter Railways Network

No.	Line	Length (km)	Running on viaduct		Running on ground		Note
			From - To	Length (km)	From - To	Length (km)	
1	Semarang – Kendal Commuter	29.0	Semarang Tawang – Ring Road	4.0	Ring Road - Kendal	25.0	Running on viaduct at Semarang City center, where surrounded by ring road. Running on ground at remaining section.
2	Semarang – Demak Commuter	24.0	Semarang Tawang - Demak	24.0			Running on viaduct.
3	Semarang – Brumbung Commuter	14.0	Semarang Tawang – Ring Road	3.0	Ring Road - Brumbung	11.0	Running on viaduct at Semarang City center, where surrounded by ring road. Running on ground at remaining section.
4	Solo – Klaten Commuter	29.0			Solo Balapan – Klaten	29.0	Running on ground.
5	Solo – Sragen Commuter	29.0			Solo Balapan - Sragen	29.0	Running on ground.
6	Yogya – Klaten Commuter	30.0			Yogyakarta (Tugu) - Klaten	30.0	Running on ground.
7	Yogya – Wates Commuter	28.0			Yogyakarta (Tugu) - Wates	28.0	Running on ground.
	Total	**183.0**		**31.0**		**152.0**	

Alternative: Track running on ground at Semarang City center *– if the alignment runs at grade in and around Semarang, capital investment cost could be reduced, yet it will require land acquisition for double tracking and level crossing inside city will in the future become the bottleneck for the City's transport network.*

Alternative: Track running mainly on ground and partially elevated at Semarang - Demak Corridor – *similar to the above. At grade option requires construction of access road to the station, which may be distanced from the national road due to land availability.*

(4) Arrangement of Stations

In order to serve largest possible demand at the vicinity of each city, proposed commuter railways will provide stations at every 3 km as a benchmark. Each station is different in dimensions, depending on their functions and volumes and by their spatial arrangement: at grade station or elevated station.

Table 9.1.6 Proposed Station Arrangement on Semarang – Kendal Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Semarang Tawang	0+000	0	Elevated	Stop	Stop	Beginning station
2	Semarang Poncol	2+000	2,000	Elevated	Stop	Stop	Terminal station
3	SK 1	5+000	3,000	At grade		Stop	New station
4	Jenekah	8+000	3,000	At grade		Stop	
5	SK 2	11+000	3,000	At grade		Stop	New station
6	Mangkang	15+000	4,000	At grade		Stop	
7	SK 3	18+000	3,000	At grade		Stop	New station
8	Kaliwung	20+000	2,000	At grade	Stop	Stop	
9	SK 4a-2	23+000	3,000	At grade		Stop	New station
10	SK 4a-1	29+000	6,000	At grade	Stop	Stop	New sta., End sta.

Table 9.1.7 Proposed Station Arrangement on Semarang – Demak Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Semarang Tawang	0+000	0	Elevated	Stop	Stop	Beginning station
2	SD 1	5+000	5,000	Elevated		Stop	New station
3	SD 2	7+000	2,000	Elevated		Stop	New station
4	SD 3	10+000	3,000	Elevated		Stop	New station
5	SD 4	12+000	2,000	Elevated		Stop	New station
6	SD 5	15+000	3,000	Elevated		Stop	New station
7	SD 6	18+000	3,000	Elevated		Stop	New station
8	SD 7	20+000	2,000	Elevated		Stop	New station
9	SD 8	22+000	2,000	Elevated		Stop	New station
10	SD 9	24+000	2,000	Elevated	Stop	Stop	New sta., End sta.

Table 9.1.8 Proposed Station Arrangement on Semarang – Brumbung Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Semarang Tawang	0+000	0	Elevated	Stop	Stop	Beginning station
2	SKD 1	3+000	3,000	At grade		Stop	New station
3	SKD 2	5+000	2,000	At grade		Stop	New station
4	Alastuwa	7+000	2,000	At grade		Stop	
5	SKD 3	11+000	4,000	At grade		Stop	New station
6	Brumbung	14+000	3,000	At grade	Stop	Stop	New sta., End sta.

Table 9.1.9 Proposed Station Arrangement on Solo – Klaten Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Solo Balapan	0+000	0	At grade	Stop	Stop	Beginning station
2	Purwosari	3+000	3,000	At grade	Stop	Stop	
3	YS 11	5+000	2,000	At grade		Stop	New station
4	YS 10	7+000	2,000	At grade		Stop	New station
5	Gawok	9+000	2,000	At grade	Stop	Stop	
6	YS 8	12+000	3,000	At grade		Stop	New station
7	Delangu	14+000	2,000	At grade		Stop	
8	YS 9	16+000	2,000	At grade		Stop	New station
9	Ceper	20+000	4,000	At grade	Stop	Stop	
10	YS 7	23+000	3,000	At grade		Stop	New station
11	Katandan	26+000	3,000	At grade		Stop	
12	Klaten	29+000	3,000	At grade	Stop	Stop	End station

Table 9.1.10 Proposed Station Arrangement on Solo – Sragen Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Solo Balapan	0+000	0	At grade	Stop	Stop	Beginning station
2	Solo Jebres	2+000	2,000	At grade	Stop	Stop	
3	Palur	6+000	4,000	At grade		Stop	
4	SS 1	8+000	2,000	At grade		Stop	New station
5	Kemiri	11+000	3,000	At grade	Stop	Stop	
6	SS 2	13+000	2,000	At grade		Stop	New station
7	SS 3	16+000	3,000	At grade		Stop	New station
8	SS 4	18+000	2,000	At grade		Stop	New station
9	Masaran	20+000	2,000	At grade	Stop	Stop	
10	SS 5	22+000	2,000	At grade		Stop	New station
11	SS 6	24+000	2,000	At grade		Stop	New station
12	SS 7	26+000	2,000	At grade		Stop	New station
13	Sragen	29+000	3,000	At grade	Stop	Stop	End station

Table 9.1.11 Proposed Station Arrangement on Yogya – Klaten Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Yogyakarta	0+000	0	At grade	Stop	Stop	Beginning station
2	Lempuyangan	2+000	2,000	At grade	Stop	Stop	
3	YS 1	6+000	6,000	At grade		Stop	New station
4	Maguwo	8+000	8,000	At grade	Stop	Stop	
5	YS 2	10+000	2,000	At grade		Stop	New station
6	Kalasan	12+000	2,000	At grade		Stop	
7	YS 3	14+000	2,000	At grade		Stop	New station
8	Brambangan	17+000	3,000	At grade	Stop	Stop	
9	YS 4	20+000	3,000	At grade		Stop	New station
10	Srowoto	23+000	3,000	At grade		Stop	
11	YS 5	25+000	2,000	At grade		Stop	New station
12	YS 6	29+000	4,000	At grade		Stop	New station
13	Klaten	30+000	1,000	At grade	Stop	Stop	End station

Table 9.1.12 Proposed Station Arrangement on Yogya – Wates Commuter

No.	Station name	Station (km)	Distance (m)	Spatial location	Express train stops	Local train stops	Note
1	Yogyakarta	0+000	0	At grade	Stop	Stop	Beginning station
2	WY 1	2+000	2,000	At grade		Stop	New station
3	Patukan	4+000	2,000	At grade		Stop	
4	WY 2	6+000	2,000	At grade		Stop	New station
5	WY 3	8+000	2,000	At grade		Stop	New station
6	Rewewulu	9+000	1,000	At grade		Stop	
7	WY 4	11+000	2,000	At grade		Stop	New station
8	WY 5	14+000	3,000	At grade		Stop	New station
9	Sentolo	18+000	4,000	At grade	Stop	Stop	
10	WY 6	22+000	4,000	At grade		Stop	New station
11	WY 7	25+000	3,000	At grade		Stop	New station
12	Wates	28+000	3,000	At grade	Stop	Stop	End station

(5) Civil Works

Highlights of civil works for commuter rail projects are described as follows:

- **Track elevation inside Semarang City** – This aims to mitigate the impact of heavy flooding on railway track in Semarang City center. Another benefit of this is to remove level crossings and reduce traffic disorder inside the city. Type of structure should be studied subsequently, but pre-cast concrete box girders on single pier may be able to minimize the land acquisition.
- **Construction of elevated structure** – This work is required when the corridor in unable to secure ROW to construct railroad, only Semarang – Demak Corridor will be concerned among all commuter projects. An elevated viaduct will be constructed over the road median. Pre-cast concrete box girder and single pier at road median is preferred method.
- **Embankment works and sub-base construction for new track** – This is to construct substructure for the railroad by filling up selected materials for embankment. Only spur line from Kaliwung to Kendal is of such concern.
- **Sub-base construction for double tracking** – This is same as the above, but required for those lines to upgrade from single track to double track. Semarang – Kendal, Semarang – Brumbung, Solo – Sragen Commuters will require this work.
- **Roadbed improvement** – Existing single track at Semarang – Brumbung Corridor is not in desired condition and requires roadbed improvement for speed up and high axis load.
- **Bridge improvement** – Most of the bridges laid on the corridor require improvement. Sections recently double tracked will be excluded.
- **Crossing barrier at level crossing** - Providing crossing barriers and signals at major level crossings for all commuter projects.

- **Fencing** – Fence construction along boundaries of ROW between stations at urbanized area. This aims to prevent people and animals from coming into tracks.

Table 9.1.13 Civil Works Summary (Commuter Trains)

	Civil Work Items	Sem -Ken	Sem -Dem	Sem -Brum	Sol -Kla	Sol -Sra	Yog -Kla	Yog -Wat
A.	Track elevation inside Semarang City	X (7km)						
B.	Construction of elevated structure		X (21km)					
C.	Embankment works and sub-base construction for new track	X (7km)						
D.	Sub-base construction for double tracking	X (17km)		X (11km)		X (29km)		
E.	Roadbed improvement			X (11km)				
F.	Bridge improvement	X	X	X		X		
G.	Crossing barrier at level crossing	X	X	X	X	X	X	X
H.	Fencing	X	X	X	X	X	X	X

(6) Trackworks

Trackworks will be executed following embankment construction. Highlights of trackworks for Commuter Trains are described as follows:

- **New track construction (ballasted track)** – Sections where construct new single track or undertake double tracking, except elevated section, will require construction of ballasted track.
- **New track construction (ballastless track)** – Elevated section, i.e. inside Semarang City and Demak Commuter, will require construction of ballastless track. This costs higher but allows significant reduction of maintenance burdens.
- **Track rehabilitation** – This is required when existing track is in poor condition. Desired standard is: R54/R50 rail, fishplate rail joint, double elastic type fastening, PC sleeper and 30cm depth of ballast as specified in Jabotabek Railway.

Table 9.1.14 Trackworks Summary (Commuter Trains)

	Trackwork Items	Sem -Ken	Sem -Dem	Sem -Brum	Sol -Kla	Sol -Sra	Yog -Kla	Yog -Wat
A.	New track construction (ballasted track)	X (7km)		X (11km)		X (29km)		
B.	New track construction (ballastless track)	X (7km)	X (21km)					
C.	Track rehab. (rail/fastening/ sleepers/ballasts)	X (25km)		X (11km)				

(7) Station Building and Passenger Facilities

Highlights of station works for Commuter Trains are described as follows:

- **New station construction (at grade)** – Sections where undertake double tracking, except elevated section, will require this work. It covers construction of station building (standard types of Java Main Lines), high platform (1100 mm height) for commuter trains, over-bridge & underpass, and other passenger facilities (ticket counters, ticket gates, standard toilets, kiosks, passenger information boards etc) as similar to existing stations.
- **New station construction (elevated) –** Elevated section, i.e. inside Semarang City and Demak Commuter, will require this work. Construction of station structure by pre-cast concrete box girders is suggested, but concrete rigid frame may possibly reduce the cost. Having concourse below platform level is a normal practice.
- **Station improvement** – This work is required to improve existing stations and suit the requirements for commuter train operation. It shall basically secure the same level as "new station construction (at grade)".
- **Installation of barrier free facilities –** This work is required for all stations (or priority stations at initial stage unless budget allows) and aims to provide services for all passengers including aged, physically impaired and other reduced mobility (such as expected mothers and small children). Work items include, but are not limited to: elevators, slopes, tactile tiles, signage, disabled person's toilets, Braille, handrails, anti-slip floors and providing sufficient width at passenger flow line.
- **Station plaza and access improvement –** This work is required for almost all stations. The work includes construction of station plaza for transfer between commuter train and other transportations as well as improvement of access road to commuter train stations.

Table 9.1.15 Station Works Summary

	Station Works Items	Sem -Ken	Sem -Dem	Sem -Brum	Sol -Kla	Sol -Sra	Yog -Kla	Yog -Wat
A.	New station construction (at grade)	X	X	X	X	X	X	X
B.	New station construction (elevated)	X	X					
C.	Station improvement	X	X	X	X	X	X	X
D.	Installation of barrier free facilities	X	X	X	X	X	X	X
E.	Station plaza and access improvement	X	X	X	X	X	X	X

(8) Train Operation Plan

The salient features of the proposed train operation plan are:

1. Running of services for 18.5 hours of the day
2. Station dwell time of 30 seconds
3. Reverse time at terminal of 5 minutes
4. Scheduled speed of 50 km/h for express and 35 km/h for local trains
5. Headways at peak hours not longer than 15 minutes
6. Headway at off peak hours around 30 minutes

Note: 5. and 6. are applicable to the sections except where demand is significantly low

To meet the projected traffic demand, 6-car trains with headway of 15 minutes at peak hours has been examined. It appears for most of the lines that a reasonable capacity at peak hours will be given with the operation concept. Also, the same trainset with headway of 20 minutes for Semarang – Demak Commuter and with headway of 30 minutes for Solo – Sragen Commuter will better suit the expected demand. In case of any mismatch in the capacity provided and the actual traffic, the capacity can be moderated suitably by either varying the train composition or adjusting the headway. However it should be noted that keeping the same train composition will easily allow direct-through inter-operation between each sections.

Table 9.1.16 Summary of Commuter Train Operation at Peak Hours (2015)

Section	Peak Hour Peak Direction Trips (PHPDT)	Operation Plan in 2015 (peak hours)					
		Express trains		Local trains		Total	
		No. of trains/hr	Head -way	No. of trains/hr	Head -way	No. of trains/hr	Head -way
Commuter railways:							
- Semarang - Kendal	4,714	2	30	2	30	4	15
- Semarang - Demak	3,099	1	60	2	30	4	20
- Semarang - Brumbung	4,801	2	30	2	30	4	15
- Solo - Klaten	3,867	2	30	2	30	4	15
- Solo - Sragen	2,237	1	60	1	60	2	30
- Yogyakarta- Klaten	5,603	2	30	2	30	4	15
- Yogyakarta- Wates	4,159	2	30	2	30	4	15

Note: 6-car trainset average capacity – 1,508 passengers (crush load - 6 passengers per square meter)

Table 9.1.17 Summary of Commuter Train Operation at Peak Hours (2025)

Section	Peak Hour Peak Direction Trips (PHPDT)	Operation Plan in 2025 (peak hours)					
		Express trains		Local trains		Total	
		No. of trains/hr	Head -way	No. of trains/hr	Head -way	No. of trains/hr	Head -way
Commuter railways:							
- Semarang - Kendal	6,958	2	30	3	20	5	12
- Semarang - Demak	4,573	1	30	2	30	3	20
- Semarang - Brumbung	7,086	2	30	3	20	5	12
- Solo - Klaten	5,707	2	30	2	30	4	15
- Solo - Sragen	3,301	1	60	1	60	2	30
- Yogyakarta- Klaten	8,270	2	30	3	20	5	12
- Yogyakarta- Wates	6,138	2	30	3	20	5	12

Note: 6-car trainset average capacity – 1,508 passengers (crush load - 6 passengers per square meter)

(9) Rolling Stock Plan

1) Vehicle Concept

6-car EMU trains are preferably composed of: Tc + Mp + M + Mp + M + Tc

(where M: car with traction motors, Mp: motor car with pantograph and transformer, converter and inverter, Tc: trailer car with driving cabin.)

***Alternative: Prameks Type DMU** – Prameks type DMU trains are composed of one front car with traction motors and driving cabin (Mc), intermediate trailer cars (T) and one trailer car with driving cabin (Tc) at the rearmost. Due to the motors at the front car, capacity of 5-car DMU train is almost equal to 4-car EMU train.*

2) Procurement Plan

The number of cars required in operation is estimated in accordance with the projected ridership. In addition to the number of cars in service on line at peak hour, say 10% (but minimum one) more train-set must be added and maintained in standby at each line.

Table 9.1.18 Rolling Stock Procurement Plan for Initial Year (Commuter Trains)

No.	Section	Express/ Local	Distance (km)	Ave. speed (kph)	Round trip time (mins)	Head -way (mins)	No. of trains in service	Stand -by	Total no. of trains	Cars per train	Total no. of cars
1.	Sem – Ken	E	29km	50	79.6	30	3	1	8	6	48
		L		35	109.4	30	4				
2.	Sem – Dem	E	24km	50	67.6	60	2	1	7	6	42
		L		35	92.3	30	4				
3.	Sem – Bru	E	14km	50	43.6	30	2	1	5	6	30
		L		35	58.0	30	2				
Semarang Commuters Total (without Semarang - Demak Commuter)											120 (78)
4.	Sol – Kla	E	29km	50	79.6	30	3	1	8	6	48
		L		35	109.4	30	4				
5.	Sol – Sra	E	29km	50	79.6	60	2	1	5	6	30
		L		35	109.4	60	2				
Solo Commuters Total											78
6.	Yog – Kla	E	30km	50	82.0	30	3	1	8	6	48
		L		35	112.9	30	4				
7.	Yog – Wat	E	28km	50	77.2	30	3	1	8	6	48
		L		35	106.0	30	4				
Yogyakarta Commuters Total											96
Commuter Trains Grand Total (without Semarang - Demak Commuter)											294 (252)

(10) Train Control Systems

A 15 minutes headway operation with 3km of station distance gives a concept of blocking at each station. The train control system for commuter trains should employ automatic blocking system, which is composed of: i) automatic blocking devises, ii) continuous track circuits, iii) communication devises at home, departure and blocking locations, iv) control devises (cable and relay), v) interlocking devises, vi) protection equipments at level crossings, and vii) Centralized Traffic Control (CTC) system..

1) Signaling

Signaling system should envisage a Color Light Multi Aspect operated under Automatic Signaling System. Based on a concept of blocking at stations, signals will be installed at stations and at level crossings (crossing signal and automatic interlocking with crossing barriers). Signaling system should include vital Computer Based Interlocking (CBI) equipments at primary stations and providing vital transmission links to Field Units at non-interlocking stations and line-side equipments.

2) Telecommunication

Telecommunication systems for commuter trains should include: i) Radio system, ii) Data Transmission System (DTS) – optical fiber transmission system as preferred, iii) Telephone exchanges, iv) Dedicated telephone terminals, v) Dispatching telephone, vi) Concentrated function telephone, vii) Talk back system, and vii) Clock system.

3) CTC (Centralized Traffic Control)

Centralized Traffic Control (CTC) will be made at Operation Control Center (OCC) in a building dedicated to the various operation activities of commuter and other trains. The OCC will supervise monitoring and controlling of the operating activities, such as: i) regulation of trains running in all the sections and stations of the line, ii) entry and exit of trains from depots, iii) control and management of the power supply for the traction and stations, iv) management of disruption of train running time tables, v) management of emergency situations, vi) monitoring of operation and performances of all the installation of the system, vii) communication with public and announcement to passengers, viii) TVCC video monitoring of the stations, platforms, accesses and other points crucial to safety and security, and others. Locations of OCC will be at Semarang (Kendal-Semarang-Brumbung Line) and Solobalapan (Klaten-Solo-Sragen Line).

(11) Power Supply System

1) Station Power Supply

Electrical Power Supply System for the Stations power requirements should be taken from the existing Power Supply along the route where applicable and available.

2) Traction Power Supply

The Rolling Stock Traction Supply System is recommended to be a Overhead Catenary System (OCS). It is recommended that commuter trains electrification requirements should be implemented via an Automatic Transmission (AT) based TPS in conjunction with an OCS traction feed system.

3) Power Substation

Traction sub-stations are required to be set up for feeding power supply. In order to cater to traction load as per train operation plan, it is envisaged to provide traction sub-stations (TSS) at alternate stations, say every 10 km interval. The TSS along with Auxiliary Sub-Stations (ASS) will be located at station building itself at mezzanine or platform level inside a room. An additional TSS will be located in the maintenance depot.

(12) Maintenance Facilities

1) Location

Maintenance and repairing workshops for facilities and equipment of commuter lines are planned to locate at Klaten Station, instead of existing location at Lempuyangan Station. Kendal-Semarang-Burumbung Line requires a maintenance facility for EMU (depot-cum-workshop function is desirable) at Semarang Poncol Station and Wates-Yogyakarta-Klaten Line has a maintenance depot for EMU at Klaten and Klaten-Solo-Sragen Line has a maintenance depot for EMU at Solo Jebres.

2) Capacity

Required capacities for each maintenance facility are presented in the following table. It should be, however, noted that each maintenance facility shall also cater for existing rolling stock of both passenger and freight trains. Dimensions and functions (i.e. serviceable for diesel-driven railcars/locomotives, passenger coaches and freight wagons) of the depots and workshops shall be determined in accordance with total number of rolling stock using the lines.

Table 9.1.19 Maintenance Facility Plan (Commuter Trains)

Depot/Workshop	Maintenance Level	No. of Cars (2015)
Klaten (Solo Commuters and Yogya Commuters)	**EMU** Light Maintenance	96 cars
	EMU Heavy Maintenance	174 cars
Semarang Poncol (Semarang Commuters)	**EMU** Light Maintenance	120 cars
	EMU Heavy Maintenance	
Solo Jebres (Solo Commuters)	**EMU** Light Maintenance	78 cars

Note: Number of cars for existing traffic is not included in the table.

3) Workshop Equipment

The workshop facilities within the main workshop layout shall at least include: i) buildings for the maintenance activities, ii) office accommodation for supervision, management and training, iii) secure stores for housing spare parts and consumables, iv) security to control access to and within the main workshop, v) maintenance management centre, and vi) technical management department.

4) Maintenance System

Maintenance facility for EMU has the performances of: i) daily check, monthly check and yearly check, ii) service depot for wheel, motor, bogy, body and electric devices. Maintenance system shall consist of preventative and corrective maintenance.

(13) Land Acquisition Area

Land area required for commuter trains is calculated in the following principle:

- Separating the land areas required for the main lines, stations, and maintenance facilities.
- The land required for main lines is 10 m width for single track construction.
- Double tracking will be implemented within existing ROW, thus no land acquisition will be required.
- The land area required for stations is 1,000 m2 for small sized and 2,000 m2 for large sized as similar to the existing condition. Station plaza and station front development will require additional 4,000 m2 and 2,000 m2 respectively.
- The land area for maintenance workshop at Klaten is estimated as 15 ha, while maintenance facilities at Semarang Poncol and Solo Jebres will be constructed within the existing area.

Table 9.1.20 Summary of Land Acquisition Area for Commuter Trains

No.	Commuter Line	Scale of land acquisition (m2)				Note
		Railway Track	Station and Plaza	Depot and Workshop	Total	
1	Semarang – Kendal	90,000	18,000	0	108,000	Workshop for Semarang Commuters will be at existing site
2	Semarang – Demak	0	30,000	0	30,000	
3	Semarang – Brumbung	0	14,000	0	14,000	
4	Solo – Klaten	0	15,000	*	15,000	Land acquisition for workshop shall be shared between Solo and Yogya Commuters
	Solo – Sragen	0	21,000	0	21,000	
5	Yogya – Klaten	0	18,000	150,000*	168,000	
6	Yogya – Wates	0	24,000	0	24,000	
	Total	**90,000**	**140,000**	**150,000**	**380,000**	

9.1.3 Project Cost Estimate

(1) Capital Investment Cost

Capital investment cost estimate for commuter trains has been prepared covering civil, station, electrical, signaling and telecommunication works, rolling stock, maintenance facilities.

1) Semarang Commuters

Capital investment cost for Semarang Commuters varies depending on the development scenario (i.e. with or without Demak Commuters and elevated or at grade track inside Semarang City). Also, each decision on type of rolling stock (i.e. new EMU, second hand EMU or DMU) gives different cost estimates.

Table 9.1.21 Capital Cost Estimate for the Section at Semarang City Center

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Total Amount	
			Track Elevation	Track At Grade		Track Elevation	Track At Grade
1	**Civil Works**		31.5	2.8		31.5	2.8
1.1	Elevated Structure	Km	31.5	0.0	4.5	31.5	0.0
1.2	At Grade Structure	Km	0.0	2.8	0.4	0.0	2.8
2	**Station Works**		11.6	5.6		11.6	5.6
2.1	Elevated Station	Ea.	9.6	0.0	3.2	9.6	0.0
2.2	At Grade Station	Ea.	0.0	3.6	1.2	0.0	3.6
2.3	Provisions for Sem Tawang&Poncol	Ea.	2.0	2.0	1.0	2.0	2.0
3	**Trackworks**		7.0	2.8		7.0	2.8
3.1	Ballastless Track	Km	7.0	0.0	1.0	7.0	0.0
3.2	Ballasted Track	Km	0.0	2.8	0.4	0.0	2.8
4	**Sig, Telecom & Traffic Control**	Km	8.1	4.0		8.1	4.0
4.1	Sig & Telcom incl. sta. equipments	Km	4.1	0.0	0.58	4.1	0.0
4.2	CTC	Ea.	4.0	4.0	4.0	4.0	4.0
5	**Traction Power Supply**		7.5	7.5		7.5	7.5
5.1	Overhead Catenary System	Km	3.5	3.5	0.5	3.5	3.5
5.2	Power Substation	Ea.	4.0	4.0	4.0	4.0	4.0
6	**Rolling Stock -2nd hand/New**	Ea.	0.0	0.0	0.1/1.0	0.0	0.0
7	**Maintenance Facility**	LS	24.0	24.0	24.0	24.0	24.0
	Total		**89.7**	**46.7**		**89.7**	**46.7**

Table 9.1.22 Capital Cost Estimate for Semarang Commuter Projects

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity			Unit Price	Total Amount	
			Sem -Ken	Sem -Dem	Sem -Brm		w Dem	w/o Dem
1	**Civil Works**						112.8	18.3
1.1	At Grade Structure (Rehab.)	Km	0	21	11	0.15	96.8	2.3
1.2	At Grade Structure (Construction)	Km	25	0	11	0.48	16.0	16.0
2	**Station Works**						37.3	8.5
2.1	At Grade Station (Rehab./upgrade)	Ea.	3	9	2	0.5	31.3	2.5
2.2	At Grade Station (Construction)	Ea.	3	0	2	1.2	6.0	6.0
3	**Trackworks**			0			16.6	16.6
3.1	Ballasted Track (Rehab.)	Km	16		11	0.24	26.8	5.8
3.2	Ballasted Track (Construction)	Km	25	21	11	0.30	31.8	10.8
4	**Sig, Telecom & Traffic Control**	Km	25	0	11	0.58	21.0	21.0
5	**Traction Power Supply**			21			46.3	34.0
5.1	Overhead Catenary System	Km	25		11	0.5	40.5	18.0
5.2	Power Substation	Ea.	2	21	2	4.0	26.5	16.0
6	**Rolling Stock -2nd hand/New**	Ea.	48	3	30	0.1/1.0	19.8/198	7.8/78
7	**Maintenance Facility**	Ea.	0	42	0	24.0	4.2	0.0
	Total						**257.9 /365.9**	**106.2 /176.4**

Alternative: DMU Option – *DMU option will not require Traction Power Supply System, but second hand cars are generally unavailable in the international market. Also, it should be noted that DMU needs more cars to provide the same service due to disadvantage in acceleration and braking performance. Estimated cost for the option is: 344.9 million USD (with Demak Commuter) and 169.4 million USD (without Demak Commuter) which exclude improvement of existing tracks at Semarang City center.*

Table 9.1.23 Capital Cost for Each Alternative of Semarang Commuter Projects

Million USD in year 2008 price level

	Alternatives	Track Elevation		Track At Grade	
		With Demak	W/o Demak	With Demak	W/o Demak
A.	EMU New	455.6	266.1	412.6	223.1
B.	EMU Second Hand	347.6	195.9	304.6	152.9
C.	DMU	423.1	247.6	380.1	204.6

2) Solo Commuters

Capital investment cost for Solo Commuters has been studied and presented in the following tables. Each decision on type of rolling stock (i.e. new EMU, second hand EMU or DMU) gives different cost estimates.

Table 9.1.24 Capital Cost Estimate for Solo Commuter Projects

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Amount		Total Amount
			Sol -Kla	Sol -Sra		Sol -Kla	Sol -Sra	
1	**Civil Works**					0.0	10.4	10.4
1.1	At Grade Structure (Rehab.)	Km	0	0	0.15	0.0	0.0	0.0
1.2	At Grade Structure (Construction)	Km	0	29	0.36	0.0	10.4	10.4
2	**Station Works**					9.0	5.1	14.1
2.1	At Grade Station (Rehab./upgrade)	Ea.	6	3	0.5	3.0	1.5	4.5
2.2	At Grade Station (Construction)	Ea.	5	3	1.2	6.0	3.6	9.6
3	**Trackworks**					0.0	13.9	13.9
3.1	Ballasted Track (Rehab.)	Km	0	29	0.18	0.0	5.2	5.2
3.2	Ballasted Track (Construction)	Km	0	29	0.3	0.0	8.7	8.7
4	**Sig, Telecom & Traffic Control**	Km	29	29	0.58	16.9	16.9	33.8
5	**Traction Power Supply**					26.5	26.5	53.0
5.1	Overhead Catenary System	Km	29	29	0.5	14.5	14.5	29.0
5.2	Power Substation	Ea.	3	3	4.0	12.0	12.0	24.0
6	**Rolling Stock -2nd hand/New**	Ea.	48	30	0.1/1.0	4.8/48	3.0/30	7.8/78.0
7	**Maintenance Facility**	Ea.	0.45	0	24.0	10.8	0.0	10.8
	Total					68.0	75.9	143.9/214.1

Alternative: DMU Option – *Estimated cost for the option is: 177.3 million USD*

3) Yogyakarta Commuters

Capital investment cost for Yogyakarta Commuters has been studied and presented in the following tables. Each decision on type of rolling stock (i.e. new EMU, second hand EMU or DMU) gives different cost estimates.

Table 9.1.25 Capital Cost Estimate for Yogyakarta Commuter Projects

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Amount		Total Amount
			Yog -Kla	Yog -Wat		Yog -Kla	Yog -Wat	
1	**Civil Works**					0.0	0.0	0.0
1.1	At Grade Structure (Rehab.)	Km	0	0	0.15	0.0	0.0	0.0
1.2	At Grade Structure (Construction)	Km	0	0	0.36	0.0	0.0	0.0
2	**Station Works**					11.4	3.4	14.8
2.1	At Grade Station (Rehab./upgrade)	Ea.	6	2	0.5	3.0	1.0	4.0
2.2	At Grade Station (Construction)	Ea.	7	2	1.2	8.4	2.4	10.8
3	**Trackworks**					0.0	0.0	0.0
3.1	3.1 Ballasted Track (Rehab.)	Km	0	0	0.18	0.0	0.0	0.0
3.2	Ballasted Track (Construction)	Km	0	0	0.3	0.0	0.0	0.0
4	**Sig, Telecom & Traffic Control**	Km				21.5	16.3	37.8
4.1	Sig & Telcom incl. sta. equipments	Km	30	28	0.58	17.5	16.3	33.8
4.2	CTC	Ea.	1	0	4.0	4.0	0	4.0
5	**Traction Power Supply**					27.0	27.0	54.0
5.1	Overhead Catenary System	Km	30	30	0.5	15.0	15.0	30.0
5.2	Power Substation	Ea.	3	3	4.0	12.0	12.0	24.0
6	**Rolling Stock -2nd hand/New**	Ea.	48	48	0.1/1.0	4.8/48	4.8/48	9.6/96
7	**Maintenance Facility**	Ea.	0.55	0	24.0	13.2	0.0	13.2
	Total					77.9	51.5	215.9/129.5

Alternative: DMU Option – *Estimated cost for the option is: 178.6 million USD*

(2) Operation and Maintenance Cost

Operation and Maintenance (O&M) costs consist of energy costs, personnel costs, maintenance materials costs and consumable costs. Unit costs and quantities are based on those of international standards, those obtained through the discussion with PT. Kereta Api (Persero) (PT. KA) and those referred from the Study on Double Tracking of Jabotabek Railway.

Table 9.1.26 Method of Calculating O&M Cost

No.	Cost Item	Method of Calculation
A.	**Energy Cost**	
	Electricity Cost Related to Train Operation	(unit electric power consumption) x (unit cost per km) x (annual running distance) x (number of rolling stock)
	Electricity Cost Related to Stations	(electricity cost per unit station) x (number of stations)
	Diesel Fuel Cost Related to Train Operation *(Not Applicable to EMU)*	(unit diesel fuel consumption) x (unit cost per litter) x (annual running distance) x (number of rolling stock)
B.	**Personnel Cost**	
	Personnel Cost for Train Operation	(unit personnel cost for operation) x (no. of operation staff)
	Personnel Cost for Maintenance	(unit personnel cost for maintenance) x (no. of operation staff)
C.	**Maintenance Material Cost**	
	Maint. Material Cost for Civil Work	1.5% of civil capital cost (assuming that maintenance cost for elevated structure with ballastless track is 20% of that for at grade structure with ballasted track
	Maint. Material Cost for E&M	2.0% of E&M capital cost
	Maint. Material Cost for Rolling Stock	1.5% of rolling stock capital cost (assuming that new and second hand cars requires same maintenance volume)
D.	**Consumables Cost**	
	Consumables for Civil Work	3.0% of maintenance material cost for civil work
	Consumables for E&M	3.0% of maintenance material cost for E&M work
	Consumables for Rolling Stock	3.0% of maintenance material cost for rolling stock

1) Semarang Commuters

Table 9.1.27 O&M Cost Estimate for Semarang Commuters

USD in year 2008 price level

No.	Cost Item	Sem - Ken	Sem - Dem	Sem - Brum	Total Amount	
					w Dem	w/o Dem
A.	**Energy Cost**					
	Electricity Cost Related to Train Operation	435,625	425,766	389,348	1,250,738	824,973
	Electricity Cost Related to Stations	500,000	550,000	161,111	1,211,111	661,111
	Diesel Fuel Cost Related to Train Operation	0	0	0	0	0
	Sub-Total	935,625	975,766	550,459	2,461,850	1,486,084
B.	**Personnel Cost**				0	0
	Personnel Cost for Train Operation	763,200	806,400	451,200	2,020,800	1,214,400
	Personnel Cost for Maintenance	403,200	489,600	302,400	1,195,200	705,600
	Sub-Total	1,166,400	1,296,000	753,600	3,216,000	1,920,000
C.	**Maintenance Material Cost**				0	0
	Maint. Material Cost for Civil Work	373,868	75,946	180,488	630,302	554,356
	Maint. Material Cost for E&M	336,400	278,400	162,400	777,200	498,800
	Maint. Material Cost for Rolling Stock	720,000	630,000	450,000	1,800,000	1,170,000
	Sub-Total	1,430,268	984,346	792,888	3,207,502	2,223,156
D.	**Consumables Cost**				0	0
	Consumables for Civil Work	11,216	2,278	5,415	18,909	16,631
	Consumables for E&M	10,092	8,352	4,872	23,316	14,964
	Consumables for Rolling Stock	21,600	18,900	13,500	54,000	35,100
	Sub-Total	42,908	29,530	23,787	96,225	66,695
	Grand Total	**3,575,201**	**3,285,642**	**2,120,734**	**8,981,576**	**5,695,935**

2) Solo Commuters

Table 9.1.28 O&M Cost Estimate for Solo Commuters

USD in year 2008 price level

No.	Cost Item	Sol - Kla	Sol - Sra	Total Amount
A.	**Energy Cost**			
	Electricity Cost Related to Train Operation	435,625	435,625	871,249
	Electricity Cost Related to Stations	600,000	650,000	1,250,000
	Diesel Fuel Cost Related to Train Operation	0	0	0
	Sub-Total	1,035,625	1,085,625	2,121,249
B.	**Personnel Cost**			0
	Personnel Cost for Train Operation	888,000	921,600	1,809,600
	Personnel Cost for Maintenance	576,000	518,400	1,094,400
	Sub-Total	1,464,000	1,440,000	2,904,000
C.	**Maintenance Material Cost**			0
	Maint. Material Cost for Civil Work	373,868	373,868	747,736
	Maint. Material Cost for E&M	336,400	336,400	672,800
	Maint. Material Cost for Rolling Stock	720,000	450,000	1,170,000
	Sub-Total	1,430,268	1,160,268	2,590,536
D.	**Consumables Cost**			0
	Consumables for Civil Work	11,216	11,216	22,432
	Consumables for E&M	10,092	10,092	20,184
	Consumables for Rolling Stock	21,600	13,500	35,100
	Sub-Total	42,908	34,808	77,716
	Grand Total	**3,972,801**	**3,720,701**	**7,693,501**

3) Yogyakarta Commuters

Table 9.1.29 O&M Cost Estimate for Yogyakarta Commuters

USD in year 2008 price level

No.	Cost Item	Yog - Kla	Yog - Wat	Total Amount
A.	**Energy Cost**			
	Electricity Cost Related to Train Operation	437,246	433,902	871,147
	Electricity Cost Related to Stations	650,000	600,000	1,250,000
	Diesel Fuel Cost Related to Train Operation	0	0	0
	Sub-Total	1,087,246	1,033,902	2,121,147
B.	**Personnel Cost**			0
	Personnel Cost for Train Operation	950,400	888,000	1,838,400
	Personnel Cost for Maintenance	590,400	561,600	1,152,000
	Sub-Total	1,540,800	1,449,600	2,990,400
C.	**Maintenance Material Cost**			0
	Maint. Material Cost for Civil Work	386,760	360,976	747,736
	Maint. Material Cost for E&M	348,000	324,800	672,800
	Maint. Material Cost for Rolling Stock	720,000	720,000	1,440,000
	Sub-Total	1,454,760	1,405,776	2,860,536
D.	**Consumables Cost**			0
	Consumables for Civil Work	11,603	10,829	22,432
	Consumables for E&M	10,440	9,744	20,184
	Consumables for Rolling Stock	21,600	21,600	43,200
	Sub-Total	43,643	42,173	85,816
	Grand Total	**4,126,448**	**3,931,451**	**8,057,899**

9.1.4 Integration with Housing Development along the Corridor

(1) Development Concept

Integrated housing development is proposed along the commuter railway lines. The development concepts for housing area, railway station, station plaza and related facilities are as follows.

Railway Station and Station Plaza

Railway station should be designed for achieving international standards. Barrier free concept is appropriate to be included the plan.

Station plaza should have a terminal for public transportation facilities including feeder services, pedestrian walkway and commercial area such as shopping mall and banks.

Access Road

Access roads are to be improved to link between railway station and residential area as well as between railway station and arterial road.

Housing Development (small scale)

- Area: 30~50 ha
- Target Population: 1,000~1,500
- Housing Unit: 300~500 detached units
- Facilities: Basic infrastructure, shopping mall, commercial facilities, bank, open space, medical facilities, religious facilities, police office, kindergarten/ primary school

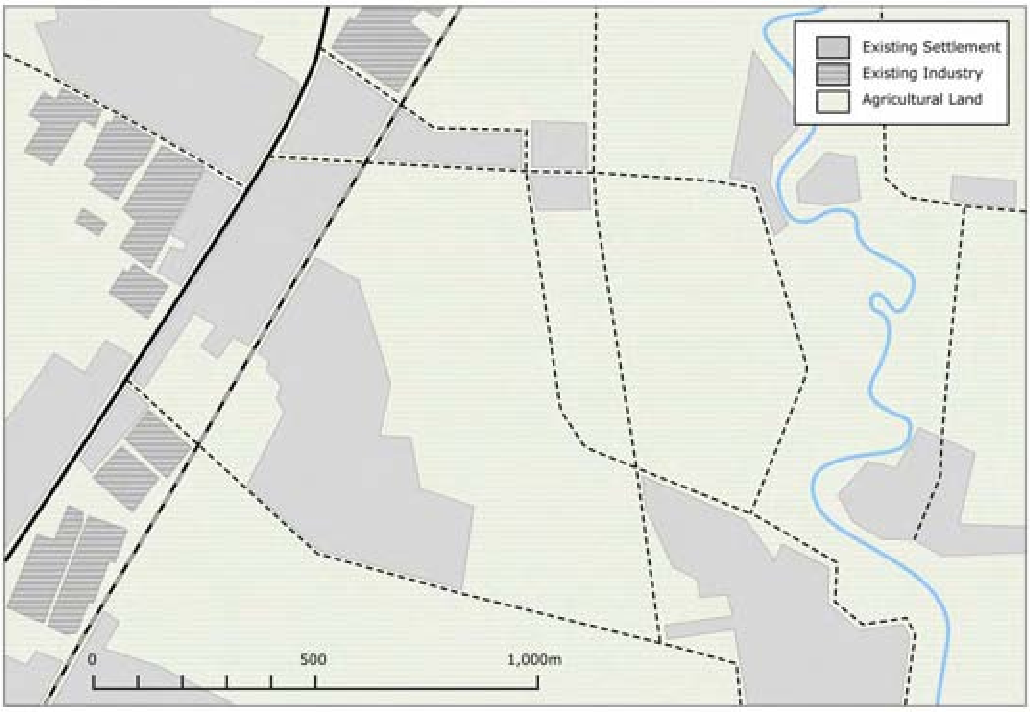
Housing Development (large scale)

- Area: above 70~100 ha
- Target Population: 2,000~3,000
- Housing Unit: 700~1,000 detached units
- Facilities: Basic infrastructure, large suburban shopping mall, commercial facilities, bank, recreational facilities, open space, medical facilities/ clinics, religious facilities, police office, school, bus terminal for public transportation

Housing development will be comprehensive improvement which includes development of not only basic infrastructure such as electricity, water supply, sewage, and telecommunication, but also inducement of social facilities for education, medical care, religious and police office. For larger housing development, a suburban shopping mall which is connected directly with a new railway station is proposed. This development will offer people the use of the railway for commuting on weekdays as well as for shopping on weekends.

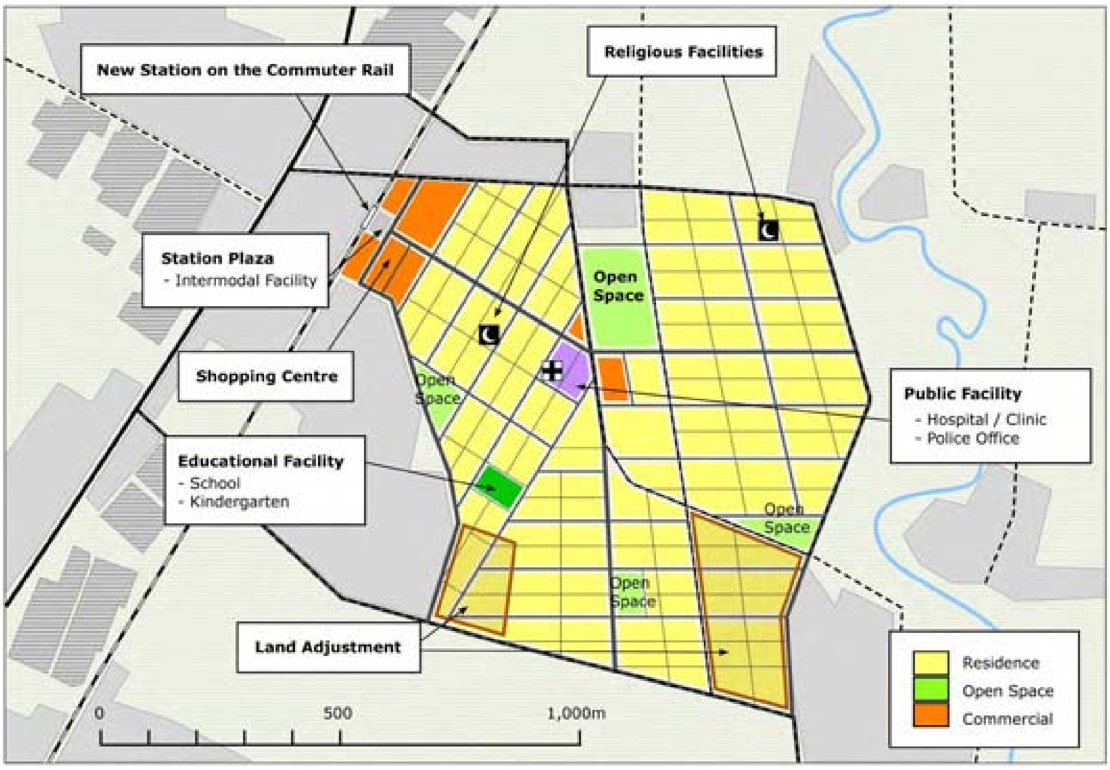
Plan of housing development area is depended upon the existing conditions in surrounding areas. In case there are existing settlements in the planned area, land adjustment could contribute to create integrated housing development. The general idea is shown in a series of following figures.

Proposed size of housing development area is based upon middle density with low-rise buildings such as detached houses. For taking account of food security and minimizing land conversion from agricultural land to settlement, the housing development area supposed to be smaller by means of high-dense development. Thus, to apply middle- and high-rise buildings into this plan is able to minimize development area. This kind plan could coordinate with other local policy including food security.



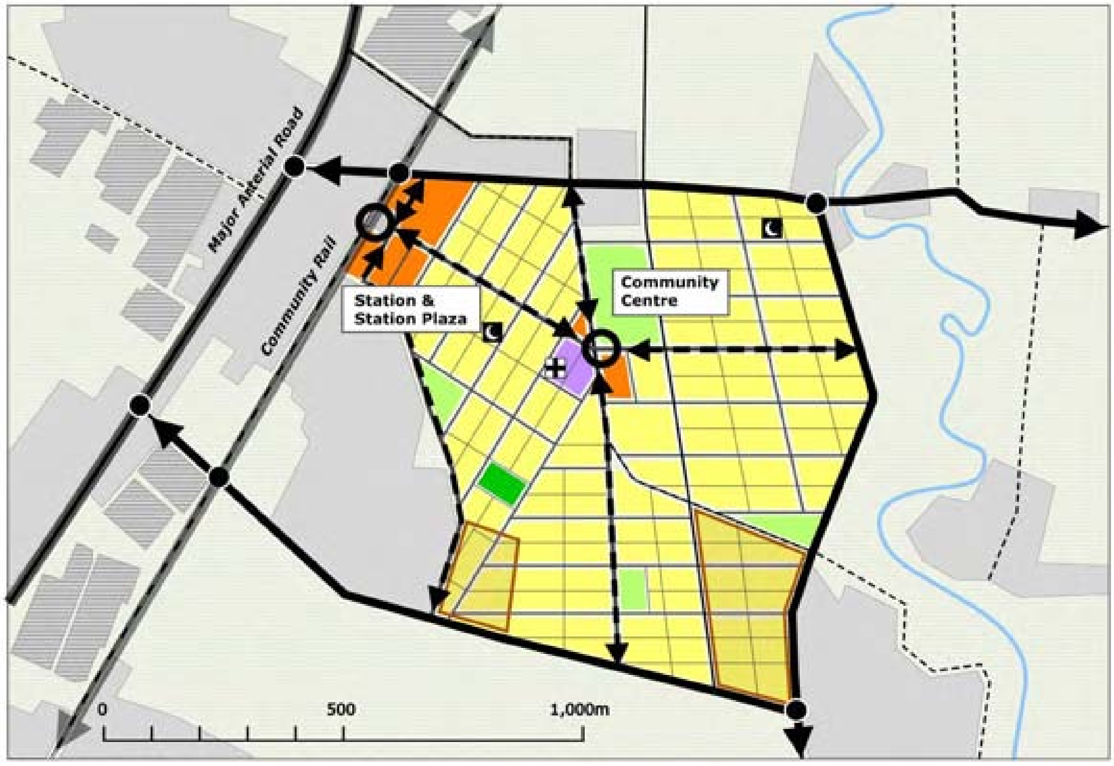
Source: CJRR Study Team

Figure 9.1.14 Existing Condition of the Site for Housing Development



Source: CJRR Study Team

Figure 9.1.15 Plan for Housing Development

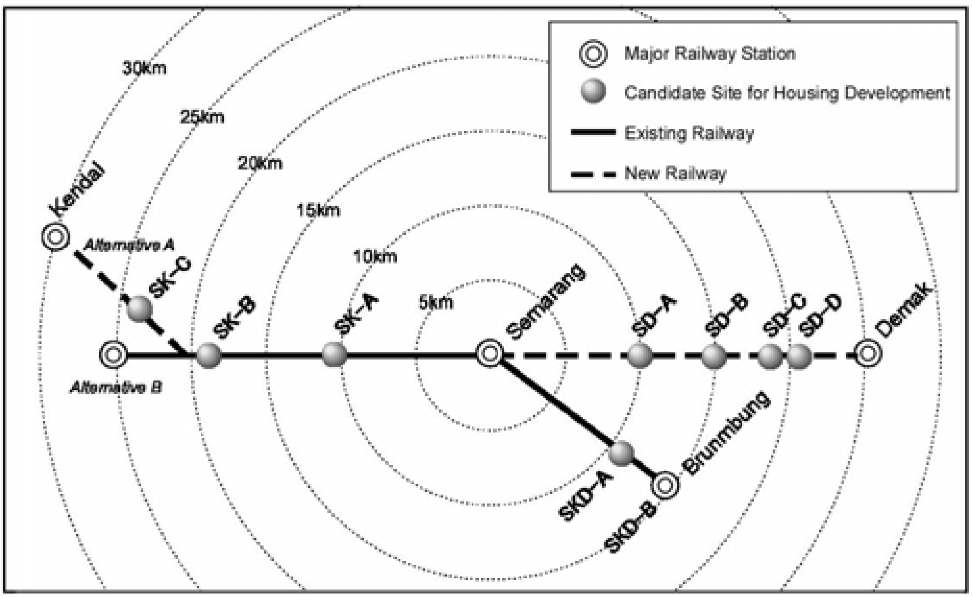


Source: CJRR Study Team

Figure 9.1.16 Access Plan of Housing Development Area

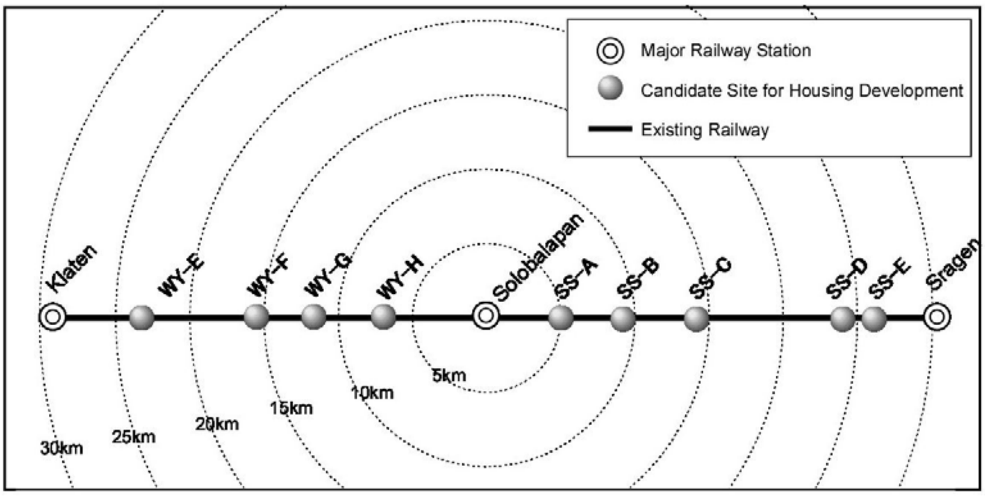
(2) Distribution of Housing Development

In consideration of convenience for commuting, housing development areas are proposed along the commuter railway lines and within 30 km from the major cities of Semarang, Solo and Yogyakarta as shown in Figure 9.1.17, Figure 9.1.18 and Figure 9.1.19.



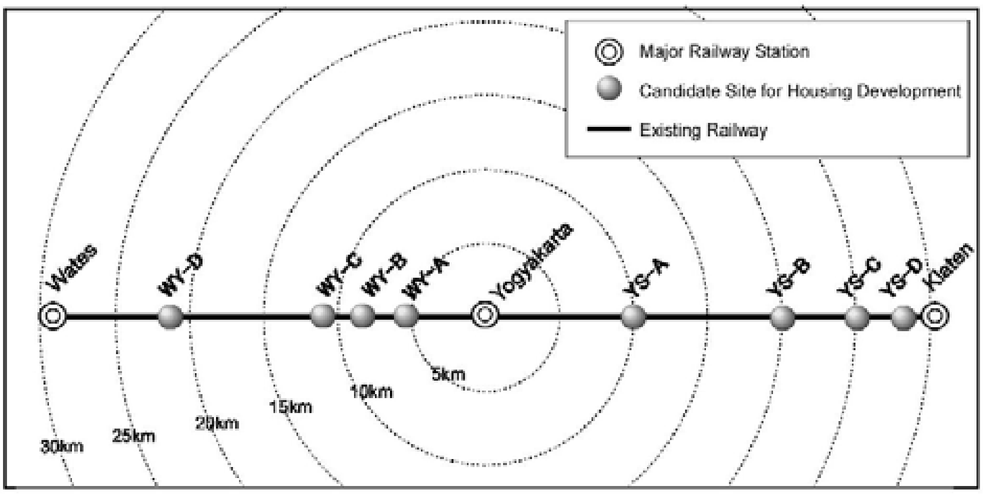
Source: CJRR Study Team

Figure 9.1.17 Location of Housing Development with a Centre of Semarang



Source: CJRR Study Team

Figure 9.1.18 Location of Housing Development with a Centre of Surakarta



Source: CJRR Study Team

Figure 9.1.19 Location of Housing Development with a Centre of Yogyakarta

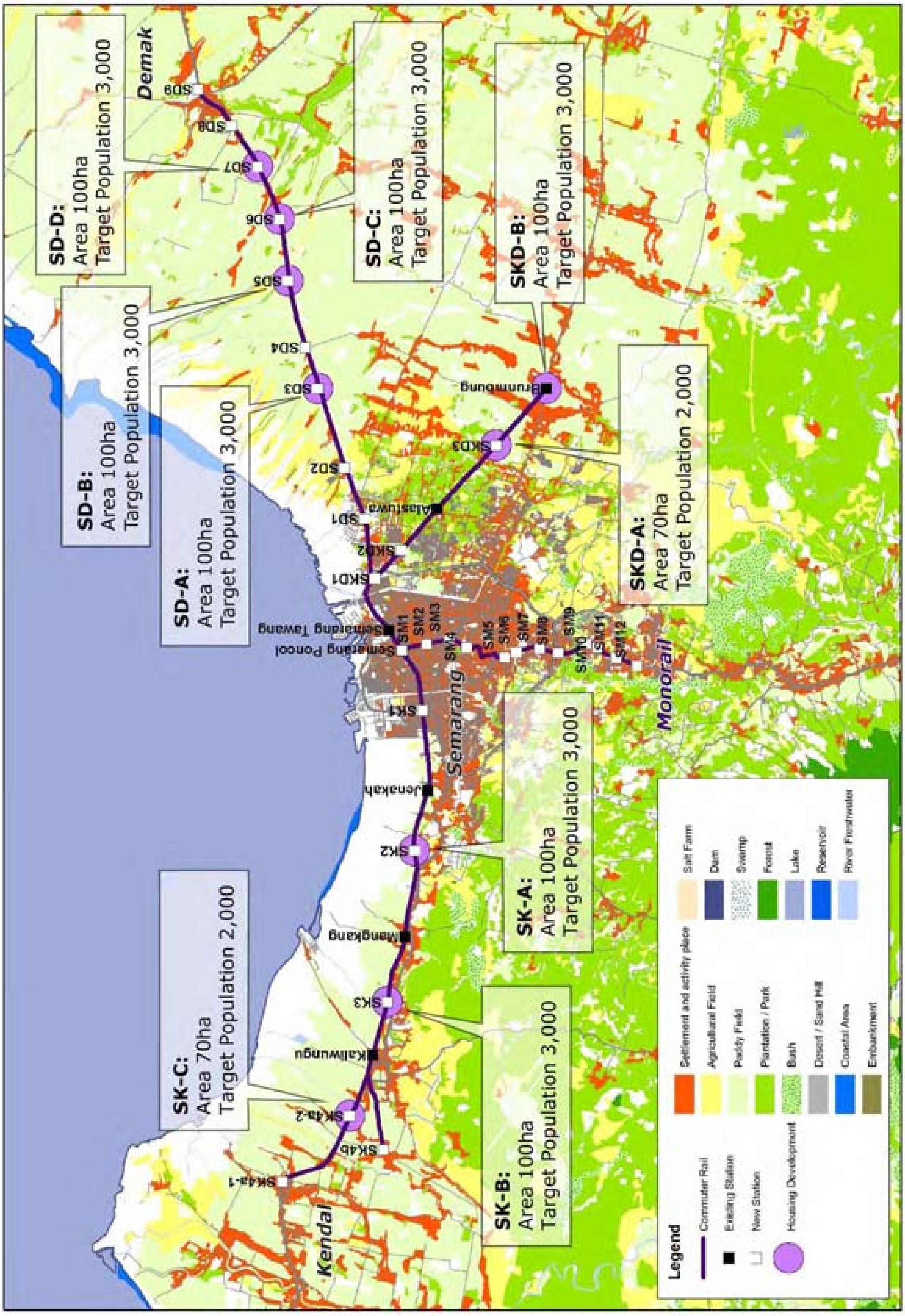
(3) Candidate Area for Housing Development

Each target population is listed in Table 9.1.30 and Table 9.1.31. The location of candidate sites are shown in Figure 9.2.8, 9.2.9 and 9.2.10

Table 9.1.30 List of Housing Developments: Kendal – Brumbung and Semarang - Demak

Name of Location	Distance from Based Station	Size of Development Area	Target Population	Kabupaten (Kecamatan)	Station Name
Kendal - Semarang – Brumbung					
SK-A	from Semarang 11 km	100 ha	3,000	Kota Semarang (Tugu)	SK2
SK-B	18 km	100 ha	3,000	Kendal (Kaliwungu)	SK3
SK-C	23 km	70 ha	2,000	Kendal (Brangsong)	SK4a-2
SKD-A	from Semarang 11 km	70 ha	2,000	Demak (Mranggen)	SKD3
SKD-B	14 km	100 ha	3,000	Demak (Mranggen)	Brunmbung
Semarang – Demak					
SD-A	from Semarang 101 km	100 ha	3,000	Demak (Sayung)	SD3
SD-B	15 km	100 ha	3,000	Demak (Karangtengah)	SD5
SD-C	18 km	100 ha	3,000	Demak (Karangtengah)	SD6
SD-D	20 km	100 ha	3,000	Demak (Demak)	SD7

Source: CJRR Study Team



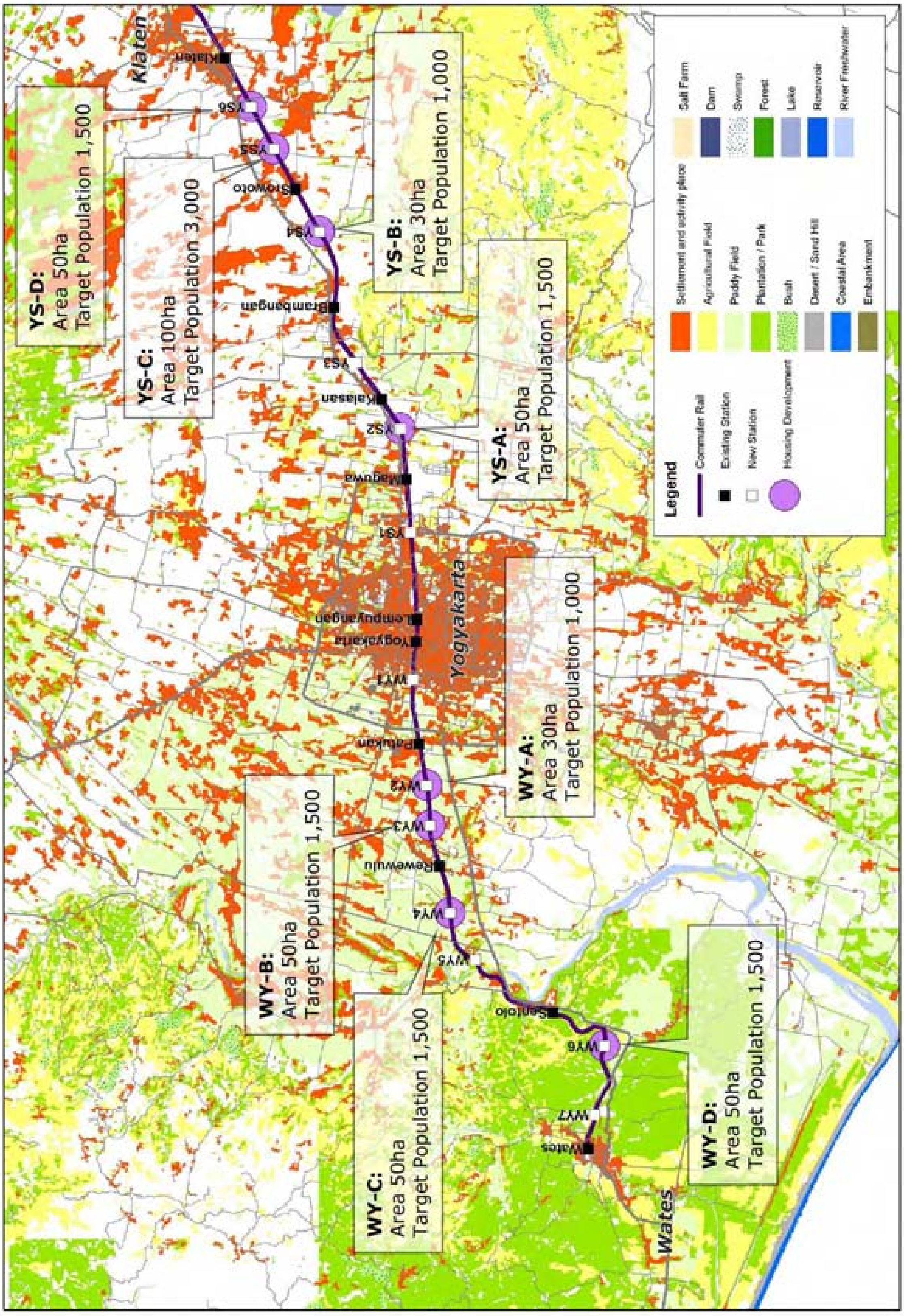
Source: JICA Study Team

Figure 9.1.20 Candidate Areas for Housing Development: Kendal – Semarang – Brumbung and Semarang - Demak

Table 9.1.31 List of Housing Developments: Wates - Sragen

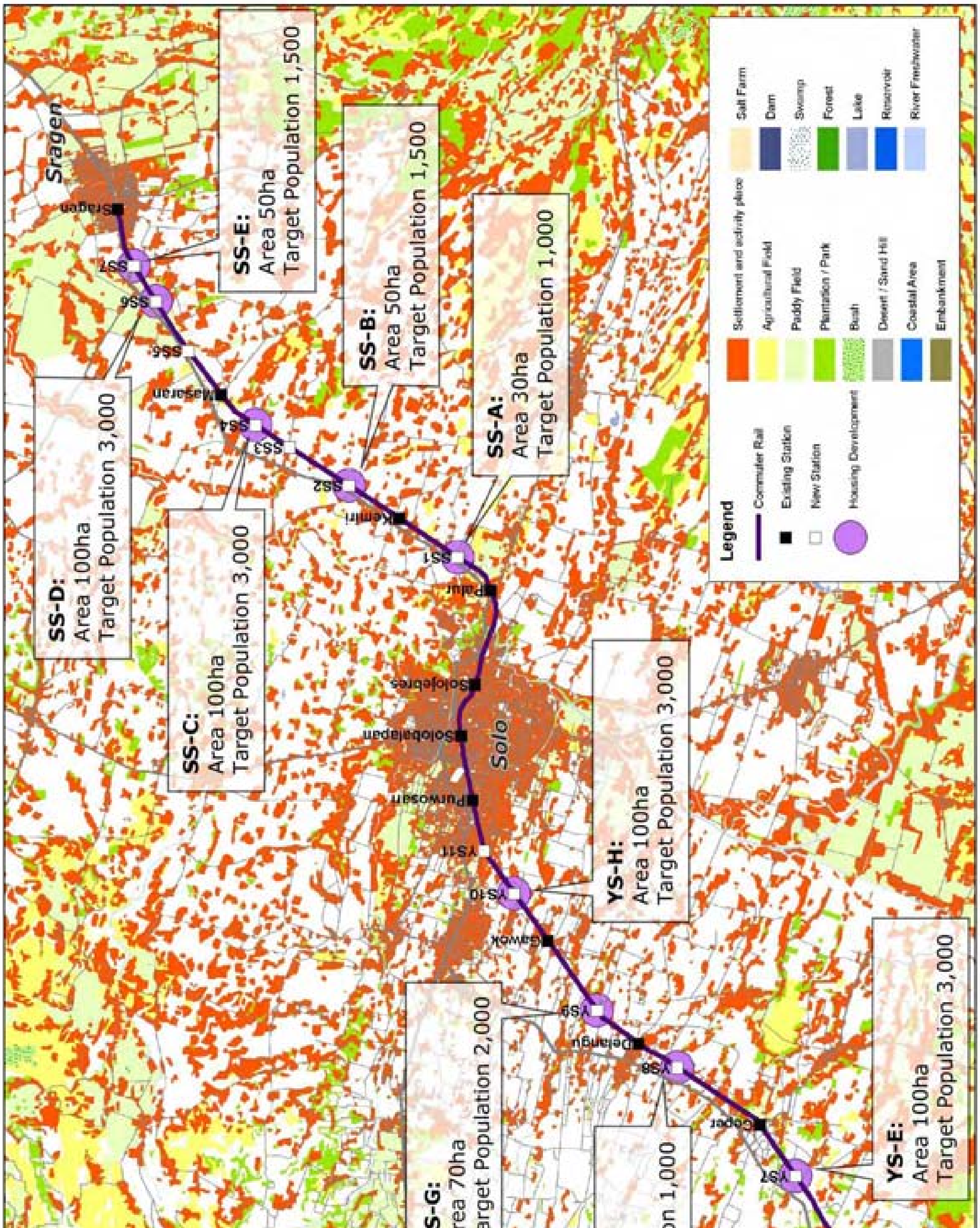
Name of Location	Distance from Based Station	Size of Development Area	Target Population	Kabupaten (Kecamatan)	Station Name
Wates - Yogyakarta – Klaten – Solo - Sragen					
WY-A	from Yogyakarta 6 km	30 ha	1,000	Sleman (Gamping)	WY2
WY-B	8 km	50 ha	1,500	Sleman (Gamping)	WY3
WY-C	11 km	50 ha	1,500	Bantul (Sedayu)	WY4
WY-D	22 km	50 ha	1,500	Kuronprogo (Sentolo)	WY6
YS-A	From Yogyakarta 10 km	50 ha	1,500	Sleman (Belbah)	YS2
YS-B	20 km	30 ha	1,000	Sleman (Kalasan)	YS4
YS-C	25 km	100 ha	3,000	Klaten (Jogonalan)	YS5
YS-D	29 km	50 ha	1,500	Klaten (Prambanan)	YS6
YS-E	from Solo 7 km	100 ha	3,000	Klaten (Ceper)	YS7
YS-F	12 km	30 ha	1,000	Klaten (Delanggu)	YS8
YS-G	16 km	70 ha	2,000	Klaten (Wonosari)	YS9
YS-H	23 km	100 ha	3,000	Sukoharjo (Gatak)	YS10
SS-A	from Solo 8 km	30 ha	1,000	Kranganyer (Jaten)	SS1
SS-B	13 km	50 ha	1,500	Kranganyer (Kebakkramat)	SS2
SS-C	18 km	100 ha	3,000	Sragen (Masaran)	SS4
SS-D	24 km	100 ha	3,000	Sragen (Sidoharjo)	SS6
SS-E	26 km	50 ha	1,500	Sragen (Sragen)	SS7

Source: CJRR Study Team



Source: CJRR Study Team

Figure 9.1.21 Candidate Areas for Housing Development: Wates – Yogyakarta - Klaten



Source: CJRR Study Team

Figure 9.1.22 Candidate Areas for Housing Development: Klaten – Solo - Sragen

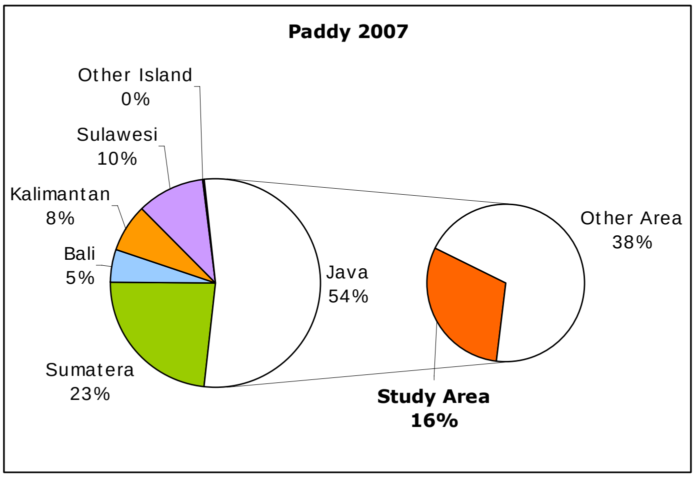
(4) Food Security

These candidate areas are currently used for agriculture; thus it does not need resettlement. Figure 9.1.23 indicates the existing condition of a candidate area which is an agricultural area in the suburbs of Kota Solo.

Source: CJRR Study Team, 2008

Figure 9.1.23 Existing Condition of Candidate Area for Housing Development

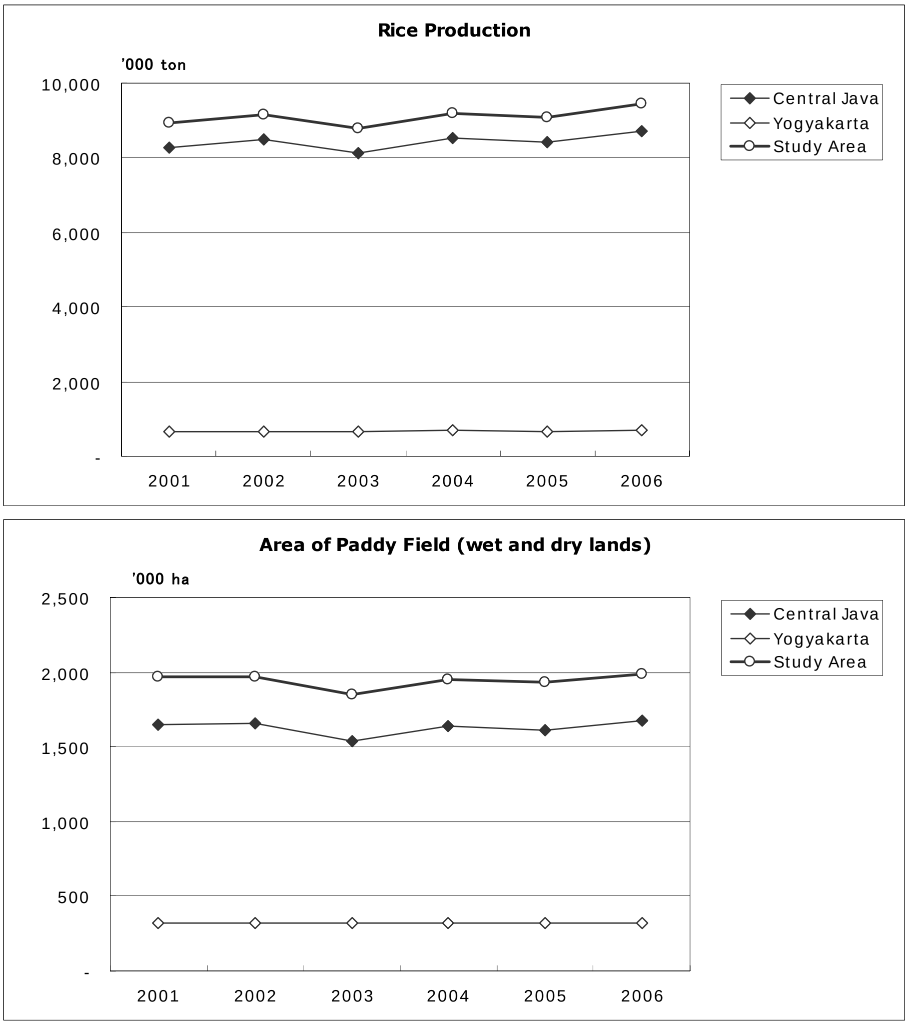
However, to take account of the food security policy in Indonesia is not negligible matter because the candidate areas are basically selected in existing paddy fields along the commuter railways. Agricultural is a major industry in the study area. Rice is the main product, and the amount of production makes up 16% of the total in Indonesia.



Source: BPS, agricultural statistics

Figure 9.1.24 Proportion of Rice Production in Indonesia

The rice acreage and amount of production in the study area have been steady increasing in recent years. The following figures show the rice acreage and production from 2001 to 2006.



Source: BPS, Dalam Angka Central Java 2007 and Dinas Pertanian Propinsi DIY (www.distan.pemda-diy.go.id)

Figure 9.1.25 Rice Production and Acreage in the Study Area from 2001 to 2006

Proposed area for housing development is shown in the following Table. These total areas account for very small ratio of total rice acreage, say, less than 0.1%. In case that middle- or/ and high-dense development will be applied in the implementation phase, the influenced area must be further smaller than this. Land conversion from paddy field into residential area in such small scale does not have large influence on agricultural industry and the policy of food security. In addition, improvement of productivity is expected to cover the loss by the development in future, such as, introducing mechanised farming and efficient irrigation systems, and using better fertilizer.

Table 9.1.32 Ratio of Development Area for Paddy Field in the Study Area

	Area of Paddy Field in 2007(ha)	Total Project Area (ha)	Percentage (%)
Central Java	1,672,315	1,700	0.10 %
DIY	318,580	180	0.06 %

Source: CJRR Study Team based upon BPS, Dalam Angka Central Java 2007 and Dinas Pertanian Propinsi DIY (www.distan.pemda-diy.go.id)

(5) Priority of Housing Development

To conduct all of the housing development at the same time as improvement of the commuter railways would be ideal for integrated development. However, from a practical viewpoint, it may be difficult to carry out all of the housing developments at the same time since large-scale infrastructure development is likely to take a certain time for not only permission and construction but also bringing occupants and commercial investors into the new development areas. To take account such difficulty, one of the practical strategies is to prioritize the order for the housing development.

The order of housing development is dependant upon the implementation of commuter railways. However, suburban area has been expanding near large cities such as Yogyakarta, Solo, and Semarang. The housing development in these areas could contribute to stop urban sprawl and to build well organized cities. In consideration of such circumstance, the housing development in near the cities should be selected as high priority.

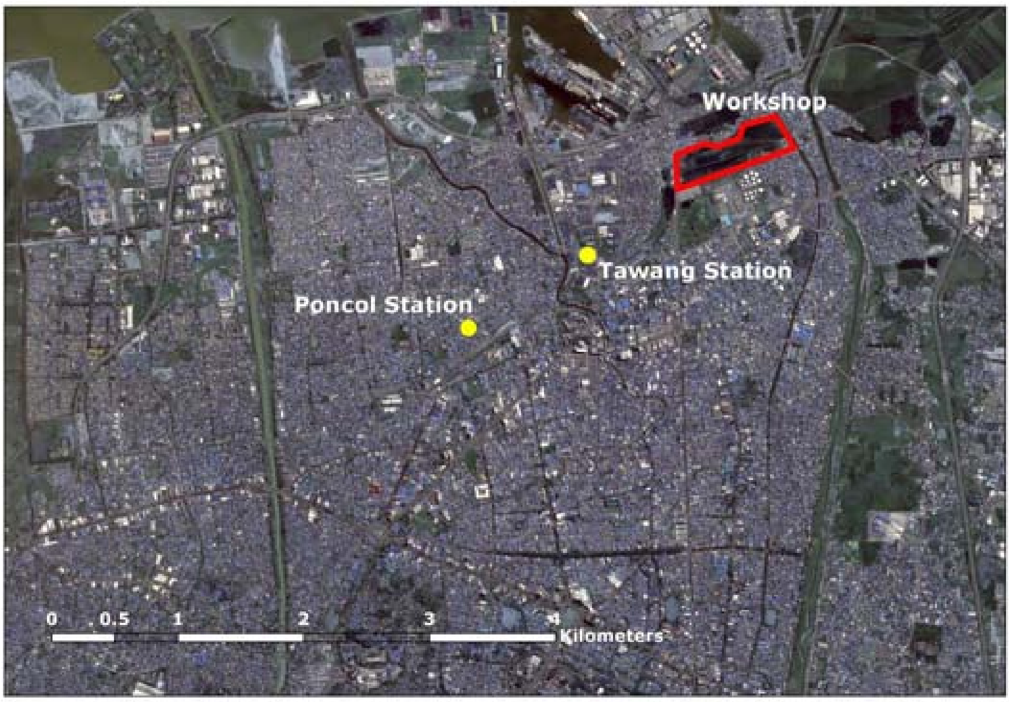
9.1.5 Urban Development at City Centre in Semarang and Yogyakarta

(1) Semarang

1) Current Condition

Existing workshop in Semarang is in the northern part of Semarang City, actually, in Kecamatan Semarang Timur, Kota Semarang. The exact location is east side of Tawang Station and between Ronggowarsito Street and Tambak Lorok Street. The total area is approximately 24 ha.

At the present time, the land is likely to suffer from flooding because of tidal inundation and land subsidence as well as other areas in Semarang city. For tackling this problem, a Japanese ODA loan project for "Urban Drainage System Improvement and Water Supply Works for the Western Area of Semarang City" has been conducted since 2006. The problem therefore should be solved by 2015 when the project is expected to be completed. The details of the project are explained in Section 8.2.2.



Source: CJRR Study Team

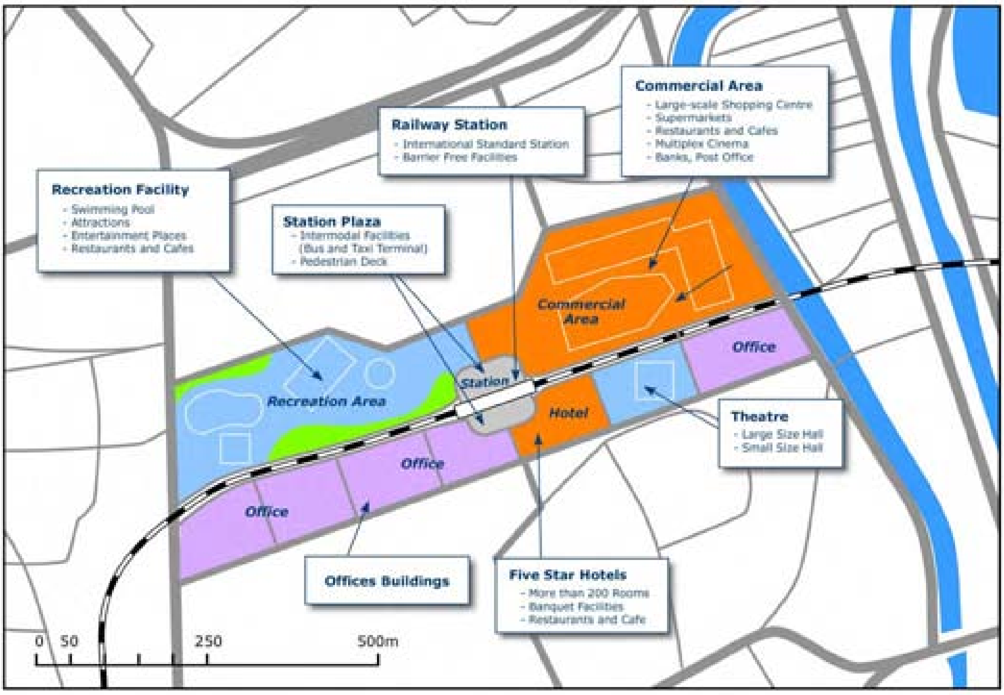
Figure 9.1.26 Location of the Workshop in Semarang

2) Development Concept

Semarang is the centre of regional economy for central java province. As the third largest port city in Java Island, trade and industry dominate the economic activities in Semarang. One of the important strategies is to further expand the economy, strengthen urban competitiveness, and improve the business environment.

This urban redevelopment could help to create business agglomeration by means of developing office buildings and required infrastructure. The well-developed business environment could attract businesses. In addition, to build a new railway station, to exploit the existing rail truck, could provide access to railway service including the commuter rail and airport link. To taking account of tourists and business passenger, is also an efficient idea to utilize this area to build hotels.

On the other hand, urban redevelopment needs to benefit the citizens. The plan is expected to include development of a theatre, large sized shopping centre including multiplex cinema and recreation facilities such as theme park and swimming pool. These facilities could induce passengers to use the commuter rail on weekends. The basic idea is shown in Figure 9.1.27.



Source: CJRR Study Team

Figure 9.1.27 Basic Idea for Urban Redevelopment in Semarang

Road network of surrounding area should be included in urban redevelopment plan. Required road development is proposed in the following figure.

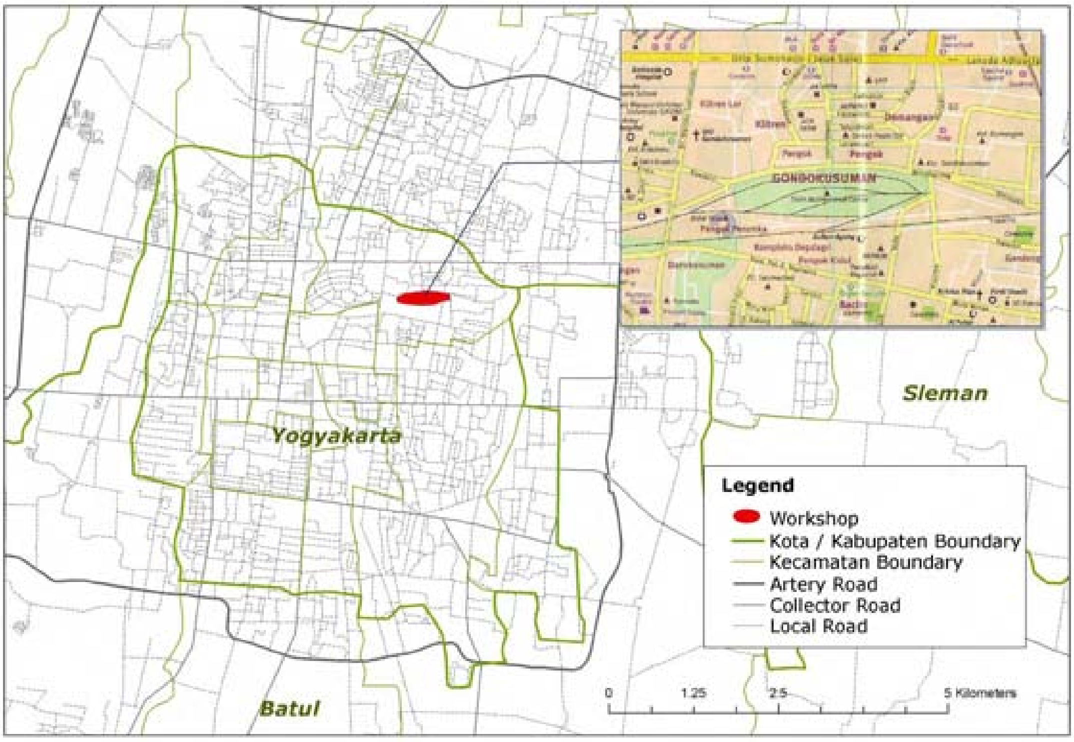
Source: CJRR Study Team

Figure 9.1.28 Road Network Plan for Urban Redevelopment in Semarang

(2) Yogyakarta

1) Current Condition

Existing workshop in Yogyakarta is in heart of Semarang City, actually, in Kecamatan Gondokusuman, Kota Yogyakarta. The exact location is east side of Lempuyangan Station and at 450 meter distance south from Solo Street. The total area is approximately 13 ha.



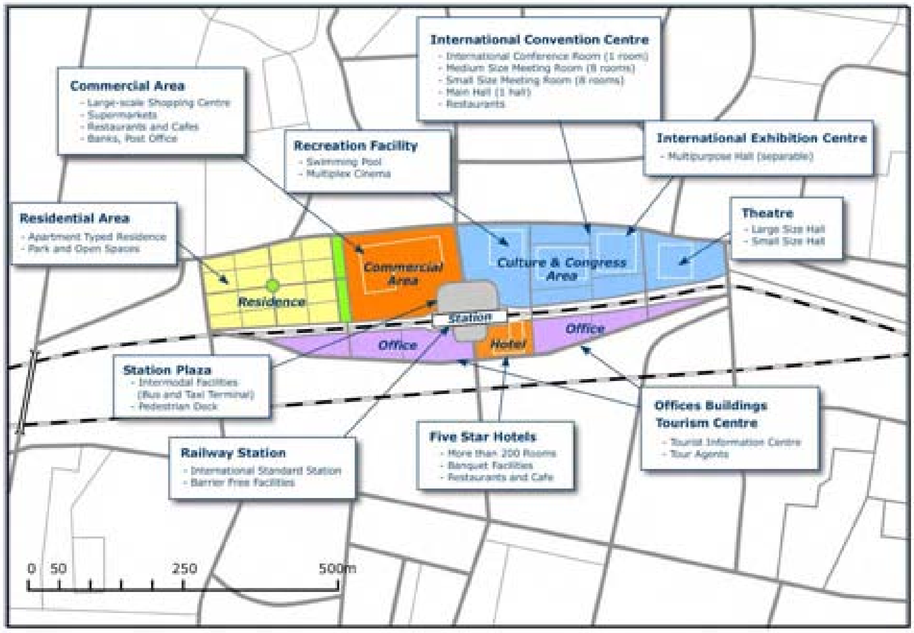
Source: CJRR Study Team, Periplus Travel Map

Figure 9.1.29 Location of the Workshop in Yogyakarta

2) Development Concept

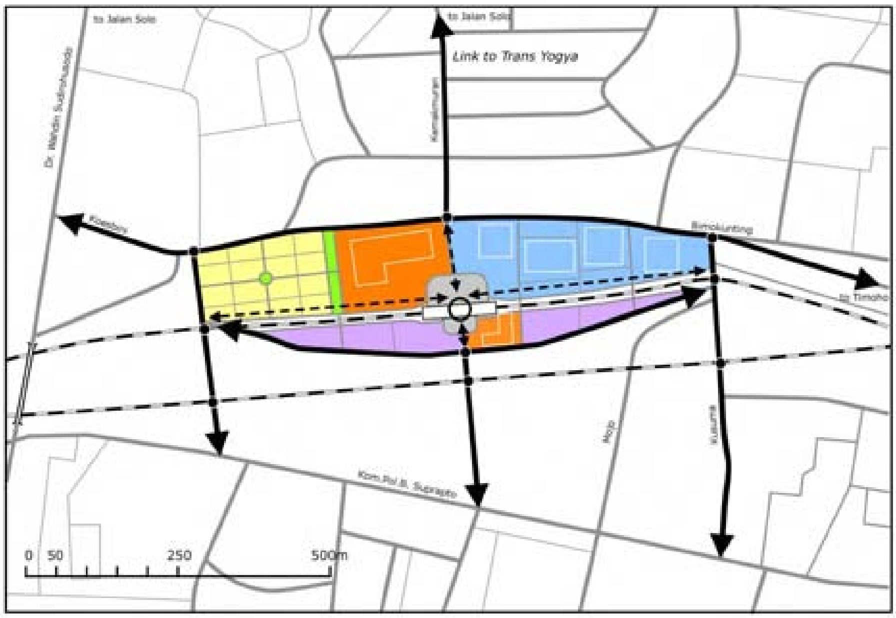
Yogyakarta is one of the popular tourist destinations as an ancient town with Javanese culture. Simultaneously, it is also well-known as a gateway to Borobudur and Prambanan, declared as World Heritage sites. To take advantage of this, Yogyakarta has the opportunity after development to become a place which holds international congresses like Bali. Accordingly, the redevelopment plan includes international convention hall and exhibition centre. For business passengers and tourists, high-end hotels of international standard are also planned in the area. In addition, building a new railway station, which exploits the existing rail truck, could provide railway service including the commuter rail and airport link.

On the other hand, the urban redevelopment needs to benefit the citizens. The plan is expected to include development of a theatre, shopping centre and recreation facilities including multiplex cinemas and swimming pool. These facilities could induce passengers use of the commuter rail on weekends. A basic idea shown in Figure 9.1.30, and the image of development are shown in through from Figure 9.1.32 to Figure 9.1.35.



Source: CJRR Study Team

Figure 9.1.30 Basic Idea for Urban Redevelopment in Yogyakarta



Source: CJRR Study Team

Figure 9.1.31 Road Network Plan for Urban Redevelopment in Yogyakarta

Source: CJRR Study Team

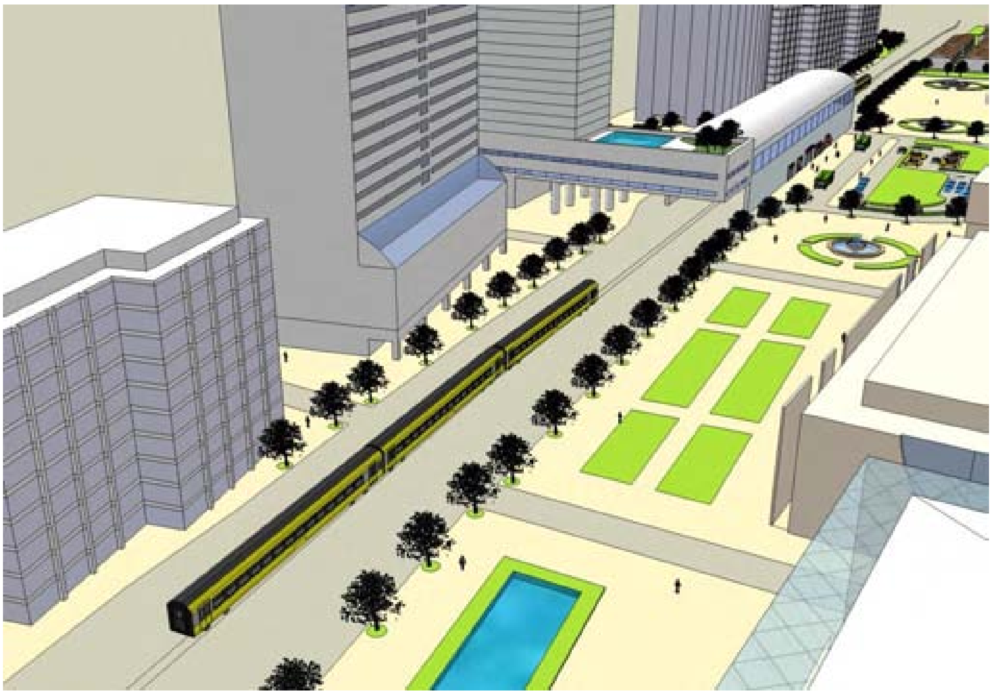
Figure 9.1.32 Image of Urban Redevelopment (1)

Source: CJRR Study Team

Figure 9.1.33 Image of Urban Redevelopment (2)

Source: CJRR Study Team

Figure 9.1.34 Image of Urban Redevelopment (3)



Source: CJRR Study Team

Figure 9.1.35 Image of Urban Redevelopment (4)

9.1.6 Institutional Setup of Railway Operation-Commuter Railway

The territory of the regional railway as proposed will include the Semarang – Solo – Yogyakarta corridor; our proposals for institution of rail commuter services are in the surrounding areas of each of those three cities. The regional railway will be the operator of the new commuter services, with the provincial government and real estate developer as partners in the organization. However, the timing of the establishing the regional railway may be different from the development of the rail commuter projects; we need to define the institutional setup of the organization to operate the proposed commuter railways.

Commuter railways have been proposed in the vicinity of Semarang, Solo and Yogyakarta. A private sector rail manager/operator will take the lead in this railway and there will be incentives to operate the commuter services efficiently and to cater to the requirements of the passengers. While some PT. KA passenger services may generate some excess cash over operating costs, few of the existing services can support the financing of replacement of rolling stock. We expect the private operator to purchase rolling stock for this service; he must obtain sufficient revenue to recover his investment as well as cover operating costs. This problem can be minimized to some extent by ensuring that all operating costs are reimbursed by central/provincial governments and that some supplemental income can be generated from the management fee from the provincial government for operating the service and from payments from the property investor reflecting benefits of developing property along the railway line.

The most critical issues that will have to be addressed within the institutional setup of the commuter railway are (i) the likely need for operating subsidies from the provincial government to supplement the funds from the central government for PSO payments; (ii) the operator of the commuter railway will likely need to purchase needed rolling stock for these new services; and (iii) the need for the real estate partner to make annual contributions to supplement the shortfalls from government sources for PSO and well as for infrastructure provision.

(1) Need for Operating Subsidies

To the extent that commuter operation will be economy trains, they will qualify for subsidy in the form of PSO payments; some commuter trains will likely be operated as "business" class trains; therefore the level of the fare is at the discretion of the operator, but will be not subsidized by PSO. The primary beneficiaries will be residents of Central Java province (Semarang and Solo commuter systems) and Yogyakarta (Wates – Yogya – Klaten services) this subsidy should originate from these two provincial governments, respectively. The necessary rolling stock (primarily EMU's) can be purchased by either the railway operator or the provincial government. If the "package" of the provincial railway includes sufficient incentives for the operator, the terms of the agreement with the operator could include procurement of passenger equipment. However, this will be investigated in further detail during implementation.

However, because of the fact that at present, the required level of PSO is not actually paid by the Government to PT. KA, private sector railway managers/operators may not show interest in managing passenger services. One solution is to provide the shortfall in the PSO payments from the Provincial governments, or to offer some guarantees that the operating losses will be reimbursed. Another possibility is to construct in the agreement of the regional railway that the real estate investor will make annual contributions to the income of the company in order to make up for the shortfall from government sources. The important factor is that if the private sector is expected to participate in operating rail commuter services, some of the risk associated with coverage of operating losses by means of subsidy need to be shared with government (central and provincial).

(2) Rolling Stock Acquisition

With a private sector railway manager/operator, and a performance – linked contract that would give the operator an incentive to manage the railway most effectively as well as income in the form of a management fee if performance targets are achieved. A part of the agreement to appoint this private railway manager/operator would include the obligation to acquire necessary rolling stock. While there is no guarantee that such an operator would be interested in the prospect of operating passenger trains in Indonesia, the chances of obtaining investment funding from the private sector operator would be significantly greater than from PT. KA.

(3) Real Estate Development Partner

With a high – density commuter network in operation in the vicinity of Semarang, Solo and Yogyakarta, the value of land adjacent to stations would increase significantly, making these locations attractive investments for property developers. It has been proposed to include in the operating company a real estate developer, and part of the agreement of association between the members of the operating company could be to pay an amount equal to the difference between operating costs and revenue of the commuter service.. This funding would help reduce any residual operating losses for the service due to shortages of funding from the government.

(4) Commuter Systems

We have identified three rail commuter systems in the Study area: (i) Semarang Commuter; (ii) Solo Commuter; and (iii) Yogyakarta Commuter. The following are the proposed organizations for each of these systems. PT. KA is shown as an optional participant in the organization. PT. KA will, of course, be involved as required to coordinate technical issues in interchanging of trains between the commuter railways and PT. KA.

Semarang Commuter

Government:
Central Java Province
Semarang City Governent
PTKA (optional)

Private Sector:
Railway manager
Property developer

Solo Commuter

Government:
Central Java Province
Solo City Government
PTKA (optional)

Private Sector:
Railway manager
Property developer

Yogyakarta Commuter

Government:
DIY
Yogyakarta City Govenment
PTKA(optional)

Private Sector:
Railway manager
Property developer

Figure 9.1.36 Proposed Organizations for Commuter Systems

We propose that PT. KA continue to provide track maintenance and train dispatching functions for these services; the services will be operated by the Railway Manager, who will hire his own locomotive and train crew members, purchase rolling stock and handle all ticket selling functions and other station services.

Though we have treated them as separate projects in our evaluation, the commuter systems proposed for Yogyakarta and Solo could be operated most efficiently as a single system. Trains, for example, could depart from Wates and operate all the way to Sragen, serving both markets. The train crew and rolling stock could then make a return trip to Wates. This would eliminate the need to turn train sets of each commuter at Klaten, in opposite directions, if they were operated as two separate systems.

9.1.7 Financial Arrangement of Commuter Railway Operation

(1) Basic Assumptions

1) General

a Project Operation

The following table indicates the operation starting year by Commuter project.

Table 9.1.33 Start Operation

Project Name	Operation start	Construction Year
Semarang Commuter	2015	2014
Solo Commuter	2010	2009
Yogya Commuter	2010	2009

Source: CJRR Study Team based on Past Studies
Footnote: Demak-Rembang Intercity include Demak Commuter project.

b Useful Life by Asset

The 30 year project life is defined only for the purpose of project evaluation. The assets invested in remain even after this period. The remaining value of the asset is appropriated as residual value at the last year of the project life. The following table indicates the useful life by asset.

Table 9.1.34 Economic Life by Category

Asset	Economic Life
Civil Works	50
Station Works	40
Track works	30
Signal, Telecom & Traffic Control	20
Traction Power Supply	30
Rolling Stock*	20
Maintenance Facility	30

Source: CJRR Study Team based on Past Studies
Footnote*: Economic life of second-hand rolling stock is assumed to be 10 years.

c Other

Other basic assumptions for are indicated below.

- Passenger Demand:	With development passenger demand
- PSO:	Without any regard for PSO of economy class train operation
- Subsidy:	Without any regard for subsidy
- Interest Rate:	1.5%, Japanese ODA Loan
- Discount Rate	8% = Interest Rate 9.5%(Bank Indonesia, 07 Oct 2008) – CPI 6.5%(Bank Indonesia, Feb 2008) + Risk Premium 5%

Source: CJRR Study Team

2) TAC (Track Access Charge)

The operation expense is assumed to be TAC (Track Access Charge) as an operation expense. TAC is basically assumed to cover both initial investment and O&M cost. The initial investment cost is divided into annual cost by the economic life by asset. In addition to TAC, land acquisition cost by project is added for the financial evaluation.

a Initial investment cost

The initial investment cost and schedule for the assumption of development scenario are shown in the table below. As mention in the table, the investment based on the development scenario is adjusted in proportion to the forecast demand in the future. In addition, Reinvestment cost should be considered when the economic life of the asset expires within the project life. In this analysis, when an asset expires within the project life, it is assumed there will be a reinvestment for the same asset in the following year.

b O&M cost

O&M cost is divided into energy cost, personnel cost, maintenance material cost, consumable cost and other costs including insurance and marketing cost. In this study, the Study Team assumes TAC increased based on O&M cost will increase corresponding to train operation volume based on future demand forecast.

The following table indicates TAC calculated to cover initial investment and O&M cost.

Table 9.1.35 TAC at Operation Start Year (Unit: Million Rp.)

Project Name	TAC	Breakdown	
		Initial	O&M
Semarang Commuter	87,164	28,947	58,217
	100%	33%	67%
Solo Commuter	140,124	56,836	83,288
	100%	41%	59%
Yogya Commuter	139,596	57,305	82,291
	100%	41%	59%

Source: CJRR Study Team

3) Revenue

a Demand

The Study Team assumed future passenger demand by class. The rate is set to expand business class passenger according to GRDP per CAPITA mentioned in Chapter 7. The table below indicates the composition rate of passenger demand. After year 2030, the rate in 2030 would be kept on until the end of project life by project.

Table 9.1.36 Future Passenger's Composition by Class

	Economy	Business	Executive	Total
2010	50.0%	35.0%	15.0%	100.0%
2015	43.8%	38.8%	17.5%	100.0%
2020	37.5%	42.5%	20.0%	100.0%
2025	31.3%	46.3%	22.5%	100.0%
2030	25.0%	50.0%	25.0%	100.0%

Source: CJRR Study Team

b Fare System

The Study Team assumes fare systems for passengers. Passenger fare system covers three classes mentioned above based on analysis of current fare system. The fare systems are indicated below. Fare system of executive class is set as same as business class.

Economy Class:	Fare(Rp.) = 59* Distance(Km) + 500
Business Class:	Fare(Rp.) = 300* Distance(Km) + 2,500
Executive Class:	Fare(Rp.) = 300* Distance(Km) + 2,500

Source: CJRR Study Team

4) Cash Flow

a Basic Case

The following table indicates the results of cash flow analysis, B/C and BEP (Break-Even Point) for ‘Commuter Train’ projects by class. Subsidy (including PSO) is not considered in “Basic Case” as revenue.

All commuter projects show negative condition according to results of cash flow analysis. However, the deficit amount decreases gradually decade after decade. By class, “Economy Class” is the most loss-making business, meanwhile the deficit amount in ‘Business Class’ and ‘Executive Class’ are smaller than ‘Economy Class’.

Table 9.1.37 Summary of Cash Flow (Unit: Million Rp.)

(Total)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Commuter	0.522	n/a	1,403,613	1,578,176	1,616,217	621,740	1,004,932	1,084,453	-781,873	-573,243	-531,765
Solo Commuter	0.384	n/a	1,781,828	2,018,834	2,204,635	547,732	940,550	1,251,936	-1,234,096	-1,078,285	-952,699
Yogya Commuter	0.480	n/a	1,771,755	2,008,495	2,192,071	680,692	1,168,894	1,555,895	-1,091,063	-839,601	-636,177
(Economy Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Commuter	0.134	n/a	540,024	434,748	404,054	66,285	67,512	67,359	-473,738	-367,236	-336,696
Solo Commuter	0.103	n/a	785,543	640,306	551,159	73,335	77,843	77,743	-712,207	-562,463	-473,416
Yogya Commuter	0.129	n/a	782,060	637,049	548,018	91,097	96,696	96,572	-690,963	-540,352	-451,446
(Business Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Commuter	0.717	n/a	589,773	771,951	808,109	377,727	626,313	678,063	-212,046	-145,638	-130,046
Solo Commuter	0.556	n/a	687,007	928,059	1,102,318	326,818	580,354	782,796	-360,188	-347,704	-319,522
Yogya Commuter	0.696	n/a	682,504	923,292	1,096,036	406,180	721,282	972,882	-276,324	-202,010	-123,154
(Executive Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Commuter	0.721	n/a	276,762	383,120	404,054	177,728	311,107	339,031	-99,035	-72,013	-65,023
Solo Commuter	0.562	n/a	309,279	450,470	551,159	147,579	282,352	391,398	-161,700	-168,117	-159,761
Yogya Commuter	0.703	n/a	307,191	448,154	548,018	183,415	350,916	486,441	-123,776	-97,238	-61,577

Source: CJRR Study Team

b Alternatives

As indicated above, the commuter railway service in the three metropolitan areas appears financially difficult for the railway operator. There are several options considered to reduce investment cost and operation & maintenance cost of the commuter railway.

1) Elevated Structure in Central area of Semarang City

It is recommended that railway track is elevated in the city center of Semarang to avoid the conflict with road traffic at railway crossings. The commuter railway service will have more frequent operation than at present, thus it would cause long waiting time at railway crossings for cars if it was at-grade. The elevated railway structure is desirable for railway operation but it increases investment cost for the project.

Tables 9.1.38 and 9.1.39 compare the impact of elevated structure construction on project finance. In Case 2, which assumes utilizing second hand electric cars and to provide PSO and other subsidies such as reduction of fuel subsidy and CO2 reduction through CDM (Clean Development Mechanism), B/C improves from 0.876 to 0.925, although B/C is still lower than 1.0.

2) Electric Cars

PT. KA has purchased many second-hand electric cars from Japan for Jabotabek railway. Although they are second-hand cars, they are able to work as required and easy to maintain for PT. KA mechanics. In addition, their reputation will be good among the railway passengers. It is proposed therefore to utilize second-hand electric cars to reduce initial investment cost. Utilization of such cars would increase B/C from 0.963 to 1.148 in case of Semarang Commuter with elevated structure case. Thus financial burden in the initial stage could be reduced.

3) Public Service Obligation (PSO)

In this financial analysis, it is assumed that the composition of economy class passengers, business class passengers and executive passengers is the same as at present, and will gradually shift upwards as household income increases. Since operational deficit from economy class passengers is significant, it appears difficult to operate trains without PSO. Comparing Case 1 (with PSO) with Case 3 (without PSO), necessity of PSO is apparent since B/C drops from 1.148 to 0.850. The low economy class fare is a heavy burden for the railway operator thus it requires commitment of the government to provide full PSO if the government sets low fare level or the government gives more freedom to the railway operator for tariff setting.

4) Urban Development

It is strongly recommended to integrate urban development with commuter railway system. The urban development includes housing development along the corridor and urban redevelopment in the city center. This urban development will increase railway passengers on the commuter railway service on one hand, but at the same time it attempts to realize the benefit incurred by improvement of railway service. Urban redevelopment is important not merely for internal development benefits but also it will increase off-peak railway passenger demand in daytime.

Comparison between Case 1 (with Urban Development) and Case 2 (without Urban Development) shows significant contribution of urban development. The ratio of B/C increases from 0.876 to 1.148 if urban development is incorporated.

5) Comparison among Three Commuter Rail Services

Among three proposed commuter railway services, the Yogya Commuter service indicates the most preferable results. The reason why Yogya commuter has better financial indicators is that double tracking work has been already completed in the section between Ketoarjo and Surakarta, which covers the whole section of the proposed Yogya commuter railway. Consequently the initial investment cost is relatively lower than the other two commuter railway systems. It is thus recommended to start commuter railway service in Yogya Commuter section in the beginning.

6) Implication

The results of financial analyses imply that the commuter railway project will not be feasible if government financial supports are not provided. In addition, the guidance from the local governments for integrated urban development such as change in land use plan and improvement of road network in surrounding area of the railway stations, are also required to implement the project.

For realize value from the housing development along the corridor and urban development in the city center, it needs involvement of experienced real estate company in the beginning stage. Either involvement of the real estate company in Central Java regional railway company or partnership with those property business companies is essential to develop this kind of mechanism.

Table 9.1.38 Alternative Analyses on Semarang Commuter with Track Elevation

	Train to be Purchased (New or Second hand)	PSO for Economy Class Train	Subsidy from Fuel Subsidy Cut and CDM (CO2)	Urban Development	B/C
Case 1	Second hand	Yes	Yes	Yes	1.148
Case 2	Second hand	Yes	Yes		0.876
Case 3	Second hand		Yes	Yes	0.850
Case 4	Second hand			Yes	0.601
Case 5	Second hand				0.315
Case 6	New Cars	Yes	Yes	Yes	0.963

Note: Interest Rate: 1.5 %

Table 9.1.39 Alternative Analyses on Semarang Commuter without Track Elevation

	Train to be Purchased (New or Second hand)	PSO for Economy Class Train	Reduction of Fuel Subsidy	Profit from Urban Development	B/C
Case 1	Second hand	Yes	Yes	Yes	1.221
Case 2	Second hand	Yes	Yes		0.925
Case 3	Second hand		Yes	Yes	0.929
Case 4	Second hand			Yes	0.656
Case 5	Second hand				0.344
Case 6	New Cars	Yes	Yes	Yes	1.005

Table 9.1.40 Alternative Analyses on Solo Commuter

	Train to be Purchased (New or Second hand)	PSO for Economy Class Train	Reduction of Fuel Subsidy	Profit from Urban Development	B/C
Case 1	Second hand	Yes	Yes	Yes	0.988
Case 2	Second hand	Yes	Yes		0.799
Case 3	Second hand		Yes	Yes	0.645
Case 4	Second hand			Yes	0.457
Case 5	Second hand				0.254
Case 6	New Cars	Yes	Yes	Yes	0.866

Table 9.1.41 Alternative Analyses on Yogya Commuter

	Train to be Purchased (New or Second hand)	PSO for Economy Class Train	Reduction of Fuel Subsidy	Profit from Urban Development	B/C
Case 1	Second hand	Yes	Yes	Yes	1.185
Case 2	Second hand	Yes	Yes		0.894
Case 3	Second hand		Yes	Yes	0.851
Case 4	Second hand			Yes	0.650
Case 5	Second hand				0.345
Case 6	New Cars	Yes	Yes	Yes	0.994

Source: CJRR Study Team

Based on the commuter railway service development scenario Case 1, which provides the most financially preferable condition for the project implementation, several investment scenarios on the share of initial investment cost have been examined as listed in Table 9.1.42.

Case 1: only rolling stocks are purchased by private company. The share of rolling stock amounts to 4.7 - 7.4% of the total investment cost depending on the section of the commuter line.

Case 2: rolling stocks and station facilities are to be provided by private company since housing area will be developed by a real estate company as a joint venture partner of the railway company. The share of rolling stock and station facilities amounts to 15.1 - 18.0% of the total investment cost.

Case 3: in addition to the rolling stocks and station facilities, a depot is also built by the private company. The share of rolling stock, depot and station facilities amounts to 22.6 - 31.0% of the total investment cost.

Table 9.1.42 Initial Cost Share of Private Railway Company

(unit: million USD)

	Case 1	Case 2	Case 3
Rolling Stock	Yes	Yes	Yes
Station Facility		Yes	Yes
Depot			Yes
Semarang Commuter (Elevated)	7.8	27.9	51.9
% composition in Total Initial Cost	4.7%	16.6%	31.0%
Solo Commuter	7.8	21.9	32.7
% composition in Total Initial Cost	5.4%	15.1%	22.6%
Yogya Commuter	9.6	23.4	37.6
% composition in Total Initial Cost	7.4%	18.0%	28.9%

Note: "Yes" indicates procurement by private railway company
Source: CJRR Estimate

FIRR in Case 1, in which case only rolling stock is procured by the private railway company, varies according to the service area of the commuter line from 12.4% in Solo to 23.9% in Yogya commuter railway service, with that of Semarang at 20.1%. These indicators could be attractive for private investors. In Case 3, in which the private company provides rolling stock, depot and station facilities, the FIRRs were estimated at low level between 0.9% and 9.4%. Thus it would be difficult to attract private companies to participate in the commuter railway business with these low internal rates of return.

Table 9.1.43 Financial Internal Rate of Return (FIRR)

(unit %)

	Case 1	Case 2	Case 3
Rolling Stock	Yes	Yes	Yes
Station Facility		Yes	Yes
Depot			Yes
Semarang Commuter	20.1	8.9	5.6
Solo Commuter	12.4	1.5	0.9
Yogya Commuter	23.9	13.1	9.4

Note: ”Yes” indicates procurement by private railway company
Source: CJRR Estimate

9.1.8 Environmental Impact Evaluation of Commuter Railway

Proposed commuter lines are planned to pass through urban city areas of Semarang, Solo and Yogyakarta. These projects contain double-tracking and new track construction with huge civil works except for the Wates – Yogyakarta – Solo corridor. Project areas include high density residential area and local business zone. Therefore land occupation, noise disturbance and traffic disturbance will be significant impacts. However, operation of community rail lines can be expected to mitigate traffic congestion, and to enhance modal shift to public transportation.

According to public hearing held in Yogyakarta, Suralarta and Semarang, most participants expect railway developments as well as commuter trains to improve public transportation and to lead economic growth.

North area of Semarang has suffered from flooding. Though flood control project has been implemented, anti-flooding railway design is strongly required. Additionally it is important to avoid accelerating flooding by drainage water from railway structures such as stations and elevated corridors. In Yogyakarta area, earthquakes have the potential to cause large disasters; hence seismic design is very important.

Kendal commuter Project had 2 alternatives. Alternative-1 was finally selected through the Case Study even though alternative-2 was recommendable from environmental viewpoint. Alternative–1 includes construction of new track so that land acquisition will be possibly generated. Therefore it is necessary to take appropriate land acquisition process.

Table 9.1.44 Impact Evaluation of Proposed Program (Commuter Train)

Environmental Issue Proposed Project	Natural Environment	Pollution	Social Environment	Key Environmental Issue
1: Kendal – Semarang – Burumbung and Demak Commuter (67 km)	C	A	A	Flooding, Noise disturbance, Construction waste, Land acquisition, Traffic disturbance
2: Klaten – Solo – Sragen Commuter (58 km)	D	A	A	Noise disturbance, Land acquisition, Construction waste, Traffic disturbance
3: Wates – Yogyakarta – Klaten Commuter (58 km)	C	A	B	Earthquake, Noise disturbance, Construction waste, Traffic disturbance

Note: A: Serious impact is predicted.
B: Some impact is predicted.
C: Unclear, need further evaluation.
D: No or less impact is predicted.

The number of private vehicles in Yogyakarta, Surakarta and Semarang has increased due to rapid urbanization and population growth. This situation will be accelerating serious traffic congestion and air pollution in future. Modal shift to public transportation is important in order to mitigate traffic congestion and air pollution. Commuter railway is expected to enhance modal shift. Therefore zero option (without case) is not recommendable even though it does not generate land acquisition and noise disturbance which are major negative impacts in development of commuter railway.

9.2 Freight Railway Service Development Plan

9.2.1 Freight Demand on the Corridor

Major origins/destinations of containers transported on the Semarang – Solo – Yogyakarta corridor to/from Tanjung (Tg.) Emas (Semarang) Port are two inland container depots (ICDs): namely, the planned Solo dry port and the existing Yogyakarta inland port. Both ICDs are planned to be connected to the railway freight corridor. In 2015, as forecasted in Section 7.2.2, about 99,000 TEUs and 50,000 TEUs of containers will be transported to/from Solo and Yogyakarta areas, respectively.

In this Study, the general target market share of containers transported by railway has been set as 70%. This may be achievable assuming a private railway operator who will be aggressive in providing freight transport services required by the customers. As for the freight transport especially between Tg. Emas and Solo, however, keener competition is expected with the road sector because construction of the toll road between Semarang and Solo (total length: 75.7 km) will be completed in 2012 and transportation by truck will be more advantageous.

The Ministry of Transportation predicts future volume of containers transported between Tg. Emas Port and the planned Solo dry port by railway, and it is presented in Table 9.2.1. Compared to the Study Team's estimate of forecast of total containers between Solo and its vicinity and Tg. Emas Port, the future railway share is around 50% though it may fluctuate by year. Thus, for containers to/from the Solo area, the target railway market share of 50% may be considered realistic after the completion of the Semarang – Solo toll road. It should be noted that this share will be achievable with railway freight services that are good enough to compete with the truck transport.

Table 9.2.1 Future Railway Share of Containers between Solo and Tg. Emas Port

Year	Total Containers to/from Solo*1 (TEUs/year)	Railway Share*2	
		(TEUs/year)	%
2015	98,605	50,684	51%
2020	122,660	64,688	53%
2025	152,001	78,702	52%

*1: Including Kota Solo, Kab. Boyolali, Kab. Sragen, Kab. Karanganyar, Kab. Sukoharjo, Kab. Klaten, and Kab. Wonogiri.
*2: Share of containers transported between the Solo dry port and Tg. Emas Port by railway.
Source: CJRR Study Team (total containers) and Ministry of Transportation (volume of containers by railway)

Projected future volume of containers and bulk commodities transported through the Semarang – Solo – Yogyakarta railway corridor is summarized in Table 9.2.2. Containers are based on the railway market share that is projected above, while other commodities are based on the current trend and/or future plan of the shippers as described in Section 7.2.3. Other bulk commodities such as fertilizer and steel are not included in the table because they are transported through only small part of the Case Study corridor, if any.

Table 9.2.2 Future Cargo Volume on Semarang-Solo-Yogyakarta Railway Corridor

Commodity	Section	Unit	Forecasted Volume		Remarks
			2015	2030	
Container	Solo Dry Port – Tg. Emas Port	TEU / day (both directions)	164	318	Based on the railway share of 50%
Container	Yogyakarta Inland Port – Tg. Emas Port	TEU / day (both directions)	116	224	Based on the railway share of 70%
Container	Kendal SEZ – Tg. Emas Port	TEU / day (both directions)	80	156	Based on the railway share of 70%
Cement	Cilacap – Yogyakarta, Solo, Semarang	ton / day	2,388	3,721	Based on the current trend and future plan
Sand	Gundih, Kalasan, Wates, Bojonegoro - Cilacap	ton / day	438	911	Based on the current trend
Coal	Kendal SEZ – Semarang – Solo, Wates	ton / day	3,377	6,268	Based on the future plan

Source: CJRR Study Team

9.2.2 Profile of Service and System Improvement

(1) Requirements and Objectives of Freight Railway Planning

The freight railway projects aim to provide the following service levels as basic requirements.

- Fast and reliable service
- Competitive with trucks running on toll road
- Headways able to deal with projected freight demand
- No/little time loss when crossover at single track section
- High operating rate of locomotives with periodical maintenance

(2) Route Alignment

1) Semarang – Solo – Yogyakarta (S-S-Y) Freight Corridor

Beginning at Semarang Port and running through Semarang Guddungg – Gundih – Solo Balapan – Klaten – Yogyakarta (Tugu) and having three freight hundling yards at Semarang Port, Solo Kelijembe Dryport and Yogyakarta Inland Container Deport (ICD) with total length of around 193 km.

2) Semarang – Solo – Wonogiri (S-S-W) Freight Corridor

Beginning at Semarang Port and running through Semarang Guddungg – Gundih – Solo Balapan, passing through 3 km of new shortcut line to Solokota, running on existing single track and ending up at Wonogiri. Having two freight hundling yards at Semarang Port and Solo Kelijembe Dryport with total length of around 147 km.

3) Kendal – Semarang Freight Corridor

Beginning at Semarang Port and running through Kaliwung and ending up at Special Economic Zone (SEZ) near Kendal. Having two freight handling yards at Semarang Port and Kendal SEZ with total length of around 29 km.

(3) Alignment, Plane and Spatial Locations

Alignment, plane and spatial locations of proposed freight corridors are presented in the following table.

Table 9.2.3 Features of Freight Corridors

No.	Line	Length (km)	Running on viaduct		Running on ground		Note
			From - To	Length (km)	From - To	Length (km)	
1	Semarang – Solo – Yogya Freight Corridor	193.0	Semarang Port – Ring Road	4.0	Ring Road – Yogya ICD	189.0	Running on viaduct from Semarang to the Port
2	Semarang – Solo – Wonogiri Freight Corridor	147.0	Semarang Port – Ring Road	4.0	Ring Road – Wonogiri Station	143.0	Running on viaduct from Semarang to the Port
3	Kendal – Semarang Freight Corridor	29.0	Semarang Port – Ring Road	7.0	Ring Road – Kendal SEZ	22.0	Running on viaduct from Semarang to the Port
	Total	**369.0**		**15.0**		**354.0**	

(4) Arrangement of Freight Terminals

Freight terminals are proposed in accordance with existing plan laid on/in the vicinity of each freight corridor. Freight railway projects will therefore include:

- **Semarang Port Access and Freight Terminal Improvement** – Beginning at Semarang Port and ending up at Semarang Gudang with total length of around 2 km. Including improvement of existing freight handling yard.
- **Solo Kalijambe Dryport Access and Freight Terminal Construction** – Beginning at Kalijambe Dryport and ending up at nearest railroad of Solo – Semarang Corridor with total length of around 2 km. including construction of freight handling yard.
- **Yogyakarta ICD Access and Freight Terminal Construction** – Beginning at Yogyakarta ICD and ending up at nearest railroad of Java South Main Line with total length of around 3 km. including construction of freight handling yard.
- **Kendal SEZ Access and Freight Terminal Construction** - Beginning at Kendal SEZ and ending up at nearest railroad of Java North Main Line with total length of around 5 km. Including construction of freight handling yard.

Table 9.2.4 Proposed Terminal Arrangement on S-S-Y Freight Corridor

No.	Freight Terminal name	Station (km)	Distance (m)	Spatial location	Note
1	Semarang Port	0+000	0	At grade	Beginning terminal
2	Solo Kalijambe Dryport	96+000	96,000	At grade	Freight terminal
3	Yogyakarta Inland Container Depot	193+000	83,000	At grade	End terminal

Table 9.2.5 Proposed Terminal Arrangement on S-S-W Freight Corridor

No.	Freight Terminal name	Station (km)	Distance (m)	Spatial location	Note
1	Semarang Port	0+000	0	At grade	Beginning terminal
2	Solo Kalijambe Dryport	96+000	96,000	At grade	Freight terminal
3	Wonogiri Freight Station	147+000	37,000	At grade	End terminal

Table 9.2.6 Proposed Terminal Arrangement on Kendal - Semarang Freight Corridor

No.	Freight Terminal name	Station (km)	Distance (m)	Spatial location	Note
1	Semarang Port	0+000	0	At grade	Beginning terminal
2	Kendal SEZ	29+000	29,000	At grade	Freight terminal

(5) Civil Works

Highlights of civil works for freight railway projects are described as follows:

- **Construction of freight handling yard** – This work is required to facilitate freight terminals. Semarang Port, Solo Dryport, Yogya ICD and Kendal SEZ are concerned.
- **Construction of elevated structure** – This work is required for Semarang Port Access to link Semarang Poncol and the Port and the section needs to be elevated to across over the elevated ring road. Also track elevation will avoid the impact of heavy flooding on freight train operation. Detailed study and coordination with relevant agencies are necessary to keep the sufficient clearance from planned high-voltage power cable across the alignment. Pre-cast concrete box girder and single pier is preferred method.
- **Embankment works and sub-base construction for new track** – This is to construct substructure for the railroad by filling up selected materials for embankment. All the access spur lines, except elevated section, require this work. Also new shortcut line from Solokota to Solo Balapan needs the same work.
- **Roadbed improvement** – Existing single track at Karangsono-Tanggung Section of S-S-Y Corridor is not in desired condition and requires roadbed improvement for speed up and high axis load.
- **Crossing barrier at level crossing** - Providing crossing barriers and signals at major level crossings for all projects, except where elevated.

Table 9.2.7 Civil Works Summary

	Civil Work Items	S-S-Y	S-S-W	Sem Port	Solo Dryport	Yogya ICD	Kendal SEZ
A.	Construction of elevated structure			X (2km)			
B.	Embankment works and sub-base construction for new track		X (3km)		X (2km)	X (3km)	X (5km)
C.	Roadbed improvement	X (31km)	X (33km)				
D.	Crossing barrier at level crossing	X	X	X	X	X	X

(6) Trackworks

Highlights of trackworks for freight railway projects are described as follows:

- **New track construction (ballasted track)** – Sections where construct new tracks, except elevated section, will require ballasting and track formation.
- **New track construction (ballastless track)** – Elevated section, i.e. Semarang Port Access will require construction of ballastless track. The cost is higher but allows significant reduction of maintenance burdens.
- **Track rehabilitation** – This is required when existing track is in poor condition. Desired standard is: R54/R50/R42 rail, fishplate rail joint, double elastic type fastening, PC sleeper and 30cm depth of ballast, considering 60-TEU loading. Especially from Karangsono to Tanggung at S-S-Y Corridor and from Solokota to Wonogiri at S-S-W Corridor need full rehabilitation works. Remaining section of Solo – Semarang Corridor requires light rehabilitation.

Table 9.2.8 Trackworks Summary

	Trackwork Items	S-S-Y	S-S-W	Sem Port	Solo Dryport	Yogya ICD	Kendal SEZ
A.	New track construction (ballasted track)				X (2km)	X (3km)	X (5km)
B.	New track construction (ballastless track)			X (2km)			
C.	Track rehabilitation (rails, fastenings and sleepers)	X (full:31, light:64 km)	X (full:21km)				

(7) Train Operation Plan

Freight traffic forecasts are composed of two elements: bulk commodities expressed in tons and containers expressed in TEU. To calculate number of trains to cater the projected demand, bulk commodities are converted into TEU applying 1 TEU = 15 tons.

Assumptions of transport capacities are made as follows:

- 26 container wagons per train, equals to 52 TEU loading per train
- 339 days/year, 20 hours/day for mainline operation.

Based on the above assumptions, freight train operations are planned as follows:

- If all wagons are loaded, an average of 15 trains per day will be required to move the projected traffic.
- Adding a factor for moving empty wagons; some wagons can be reloaded for return loads (sand, cement), however, others will return empty (coal, for example).
- 50% more trains will be operated to move loads plus empties; the total trains per day will be about 23 trains (1 way trips; about 12 pairs of freight trains daily).
- Allowing composition of different bulk wagons in the same train regardless of commodity types, total trains in 2015 becomes 21 trains per day.

Table 9.2.9 Summary of Freight Train Operation (2015)

Section	No. of TEU by railway per day		Operation Plan in 2015	
	Inbound	Outbound	No. of trains /day	Adjusted
Container Transport:				
1) Semarang–Solo–Yogya Freight Corridor				
- Semarang-Solo-Yogya ICD	58	58	2	1
- Semarang-Solo Dryport	72	92	2	1
2) Semarang–Solo–Wonogiri Freight Corridor				
- Semarang-Solo-Wonogiri	10	13	1	1
3) Kendal–Semarang Freight Corridor				
- Kendal SEZ-Semarang	0	80	2	2
Bulk Commodities Transport:				
1) Semarang–Solo–Yogya Freight Corridor				
- Semarang-Solo Dryport	0	256	5	5
2) Semarang–Solo–Wonogiri Freight Corridor				
- Semarang-Solo-Wonogiri	0	0	0	0
3) Kendal–Semarang Freight Corridor				
- Kendal SEZ-Semarang	0	225	5	5
4) Kendal–Semarang-Solo-Yogya F. Corridor				
- Kendal SEZ–Semarang-Solo-Yogya ICD	0	162	4	4
- Kendal SEZ-Semarang-Solo Dryport	0	92	2	2
Total			**23**	**21**

Table 9.2.10 Summary of Freight Train Operation (2025)

Section	No. of TEU by railway per day		Operation Plan in 2025	
	Inbound	Outbound	No. of trains /day	Adjusted
Container Transport:				
1) Semarang–Solo–Yogya Freight Corridor				
- Semarang-Solo-Yogya ICD	89	90	2	2
- Semarang-Solo Dryport	111	142	3	2
2) Semarang–Solo–Wonogiri Freight Corridor				
- Semarang-Solo-Wonogiri	15	20	1	1
3) Kendal–Semarang Freight Corridor				
- Kendal SEZ-Semarang	0	124	3	3
Bulk Commodities Transport:				
1) Semarang–Solo–Yogya Freight Corridor				
- Semarang-Solo Dryport	0	378	8	8
2) Semarang–Solo–Wonogiri Freight Corridor				
- Semarang-Solo-Wonogiri	0	0	0	0
3) Kendal–Semarang Freight Corridor				
- Kendal SEZ-Semarang	0	337	7	7
4) Kendal–Semarang-Solo-Yogya F. Corridor				
- Kendal SEZ–Semarang-Solo-Yogya ICD	0	247	5	5
- Kendal SEZ-Semarang-Solo Dryport	0	137	3	3
Total			**32**	**31**

(8) Rolling Stock Plan

1) Vehicle Concept

Since railway traffic at Solo – Semarang Corridor is manageable with single track and non-electrified system, diesel locomotive will be the preferred choice. It is advisable that diesel locomotive should be similar to those recently procured by PT. KA considering the maintenance requirements and labor skills. Weight of the locomotives shall be suitable for 52-TEU loading.

Freight wagons range from closed containers (normally 40’ x 1 or 20’ x 2 loading, 15.0 in length) to open type bulk wagons. Freight operators, forwarders, or shipping lines will prepare these wagons in accordance with their transport requirements.

2) Procurement Plan

Number of locomotives required is estimated in accordance with the expected train journeys as described below:

- Average travel speed will be around 50 to 60 km/h depending on the sections. With the speed, one locomotive can make at least one round trip each day at any sections.
- Aside from the number of locomotives required for operation, spare locomotives for regular maintenance and servicing shall be added.

- Availability of locomotives in service is 90% in principal, but some corridors can share spare locomotives when they have common sections.

Number and type of wagons required is estimated as follows:

- Rolling stock requirements will be primarily for moving bulk commodities (comprising about 45% of forecasted rail traffic) as there are sufficient numbers of containers available from shipping lines and freight forwarders; perhaps some additional container flat wagons would be required.
- Based on an estimated average net load of 25 tons per wagon, a total of 160 wagons would be required to be purchased to move the daily tonnage of bulk traffic forecasted. This may be shared by Semarang-Solo-Yogya Freight Corridor (135 wagons) and Kendal-Semarang Freight Corridor (25 wagons) in proportion to the forecasted volume of bulk commodities and train operation patterns.

Table 9.2.11 Locomotive Procurement Plan for Initial Year (Freight: by Section)

No.	Section	Distance (km)	Ave. speed (kph)	Trip time one way (hrs)	Round trips per day	Total no. of locos including spare
1.	Semarang–Solo–Yogya ICD	193km	55	3.4	1	2
2.	Semarang-Solo Dryport	99km	50	2.0	6	4
3.	Semarang-Solo-Wonogiri	147km	50	2.9	1	1
4.	Semarang-Kendal SEZ	29km	60	0.4	7	2
5.	Kendal-Semarang-Solo-Yogya	210km	55	3.8	4	4
6.	Kendal-Semarang-Solo Dryport	134km	50	6.0	2	2
Total						**15**

Table 9.2.12 Locomotive Procurement Plan for Initial Year (Freight: by Corridor)

No.	Freight Corridor	Distance (km)	Ave. speed (kph)	Trip time one way (hrs)	Total no. of locos including spare
1.	Semarang–Solo–Yogya Freight Corridor	193km	55	3.4	10
2.	Semarang-Solo-Wonogiri Freight Corridor	147km	50	2.9	1
3.	Kendal-Semarang Freight Corridor	29km	60	0.4	4
Total					**15**

(9) Train Control Systems

Freight Railways Projects will be integral part of the larger railway network in Central Java Region and freight trains are running on the same track as other trains. The systems shall be based on proposal for other sections of the previous projects (such as commuter projects) to ensure inter-operability and compatibility of the train control systems and rail operations of the entire railway network.

However to meet the requirements of the freight transport services, suggested train control systems are: i) Automatic Blocking System either based on computer and Microwave Balise Aided System, track circuit, or COMBAT system, ii) Fiber-and-Copper Cable or Optical Fiber Transmission System, iii) Train Radio System, iv) Telephone Exchange, v) Dedicated Telephone Terminals and vi) ATS. CTC for commuter trains will supervise and control the freight traffic as well.

(10) Maintenance Facilities

Maintenance and repairing workshops for freight trains are planned to be located in Semarang Poncol and Klaten.

Table 9.2.13 Summary of Maintenance Facility Plan (Freight Trains)

Depot/Workshop	Maintenance Level	No. of Locos (2015)
Klaten (New locomotive depot-cum-workshop)	**Locomotives and Wagons** Light Maintenance	6 locomotives 135 wagons
	Locomotives and Wagons Heavy Maintenance	6 locomotives 135 wagons
Semarang Poncol (Depo Loko Semarang)	**Locomotives and Wagons** Light Maintenance	9 locomotives 25 wagons

(11) Land Acquisition Area

Land area required for commuter trains is calculated in the following principle:

- Separating the land areas required for the main lines and spur lines. Construction of freight terminal will be within existing site and no land acquisition will be required.
- The land required for both main and spur lines is 10 m width for single track.

Table 9.2.14 Summary of Land Acquisition Area for Freight Railways

No.	Freight Railway Projects	Land acquisition area (m2)			Note
		Main line	Spur line	Total	
1.	Semarang – Solo – Yogyakarta Freight Corridor	0	0	0	
2.	Semarang – Solo – Wonogiri Freight Corridor	30,000	0	30,000	Shortcut route
3.	Semarang Port Access	0	0	0	
4.	Solo Dryport Access	0	20,000	20,000	
5.	Yogya ICD Access	0	30,000	30,000	
6.	Kendal SEZ Access	0	50,000	50,000	
7.	**Total**	**8,130**	**17,300**	**25,430**	

9.2.3 Project Cost Estimate

(1) Capital Investment Cost

Project Cost estimate for each freight corridors has been prepared covering civil, electrical, signaling & telecommunication works, rolling stock, maintenance facilities.

Table 9.2.15 Capital Cost Estimate for Semarang-Solo-Yogya Freight Corridor

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity				Unit Price	Total Amount
			Sem -Sol FC	Sem Port Access	Sol-Dry Port Access	Yogya ICD Access		
1	**Civil Works**							22.8
1.1	At Grade Structure (Light rehab.)	Km	64	0	0	0	0.15	9.6
1.2	At Grade Structure (Full rehab.)	Km	31	1	0	0	0.21	6.7
1.3	At Grade Structure (Construction)	Km	0	0	2	3	0.40	2.0
1.4	Elevated Structure (Construction)	Km	0	1	0	0	4.50	4.5
2	**Station/Freight Terminal Works**							9.9
2.1	At Grade Station (Upgrade)*	Ea.	5	0	0	0	0.18	0.9
2.2	Freight Handling Yard	Ea	0	1	1	1	3.00	9.0
3	**Trackworks**							47.8
3.1	Ballasted Track (Light rehab.)		64	0	0	0	0.18	11.5
3.2	Ballasted Track (Full rehab.)	Km	31	1	0	0	0.30	9.6
3.3	Ballasted Track (Const. at grade)	Km	0	1	2	3	0.30	1.8
3.4	Ballasted Track (Const. elevated)	Km	0	1	0	0	0.40	0.4
4	**Sig, Telecom & Traffic Control**	Km	95	2	2	1	0.25	24.5
5	**Locomotives**	Ea.	7	1	1	1	2.50	25.0
6	**Freight Wagons**	Ea.	135	0	0	0	0.05	6.7
	Total							**136.8**

Note: Semarang – Solo Freight Corridor *will require crossover tracks with effective length of 400m to allow passing and dwelling of freight trains. Upgrading cost for the same is included in 2.1.*

Table 9.2.16 Capital Cost Estimate for Solo-Wonogiri Freight Corridor and Kendal-Semarang Freight Corridor

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Total Amount	
			Solo-Wonogiri	Kendal-Semarang		Solo-Wonogiri	Kendal-Semarang
1	**Civil Works**					8.0	2.8
1.1	Elevated Structure	Km	33	0	0.21	6.9	0.0
1.2	At Grade Structure	Km	3	7	0.36	1.1	2.8
2	**Station Works**					0.4	3.0
2.1	At Grade Station (upgrade)*	Ea.	2	0	0.18	0.4	3.0
2.2	Freight Handling Yard	Ea.	0	1	3.0	0.0	0.0
3	**Trackworks**					6.8	2.1
3.1	Ballasted Track (Rehab./upgrade)	Km	33	0	0.18	5.9	0.0
3.2	Ballasted Track (Construction)	Km	3	7	0.3	0.9	2.1
4	**Sig, Telecom & Traffic Control**	Km	33	7	0.25	8.1	1.7
5	**Locomotives**	Ea.	1	4	2.5	2.5	0.0
6	**Freight Wagons**	Ea.	0	25	0.05	0.0	11.3
	Total					**25.8**	**20.9**

(2) Operation and Maintenance Cost

Operation & Maintenance costs consist of energy costs, personnel costs, maintenance materials costs and consumable costs. Personnel costs for operation and maintenance costs for infrastructure cover those for the spur lines only, and existing railroad sections where freight trains running are not included. O&M costs for each freight corridor are presented in the following table.

Table 9.2.17 O&M Cost Estimate for Freight Trains

USD in year 2008 price level

No.	Cost Item	Sem – Sol Yogyakarta Freight Corridor	Sem–Sol Wonogiri Freight Corridor	Kendal Semarang Freight Corridor
A.	**Energy Cost**			
	Electricity Cost Related to Train Operation	0	0	0
	Electricity Cost Related to Stations	0	0	0
	Diesel Fuel Cost Related to Train Operation	2,520,985	49,146	1,532,623
	Sub-Total	2,520,985	49,146	1,532,623
B.	**Personnel Cost**			
	Personnel Cost for Train Operation	216,000	129,600	120,000
	Personnel Cost for Maintenance	235,200	62,400	112,800
	Sub-Total	451,200	192,000	232,800
C.	**Maintenance Material Cost**			
	Maint. Material Cost for Civil Work	957,231	348,084	48,345
	Maint. Material Cost for E&M	465,500	161,700	24,500
	Maint. Material Cost for Rolling Stock	270,000	180,000	90,000
	Sub-Total	1,692,731	689,784	162,845
D.	**Consumables Cost**			
	Consumables for Civil Work	28,717	10,443	1,450
	Consumables for E&M	13,965	4,851	735
	Consumables for Rolling Stock	8,100	5,400	2,700
	Sub-Total	50,782	20,694	4,885
	Grand Total	**4,715,698**	**951,623**	**1,933,153**

9.2.4 Institutional Setup of Railway Operation-Freight Railway

The organization of the regional railway will include a private sector railway manager/operator, representative of the provincial government and coordination with PT. KA as necessary. The freight railway will not receive any subsidies, operations must be profitable, with all rolling stock and locomotives required purchased by the regional railway.

We have identified three freight railway opportunities: (i) Semarang-Solo-Yogyakarta; (ii) Wonogiri branch line; and (iii) Kendal SEZ. The following are the suggested institutional descriptions of each of these potential projects. Similar to the proposed commuter organizations, PT. KA is shown as an optional participant in the organization PT. KA will, of course, be involved as required to coordinate technical issues in interchanging of trains between the freight railway and PT. KA. This approach to the participation of PT. KA is the same for the freight railway projects for Kendal SEZ and Wonogiri branch line, described further in this section.

Freight Railway
Semarang-Solo-Yogja

Government:
Central Java Province
Pelindo III
PTKA (optional)

Private Sector:
Railway manager

Figure 9.2.1 Proposed Organizations for Semarang – Solo – Yogyakarta Freight Railway

The Semarang – Solo – Yogyakarta freight railway organization is similar to that shown for the regional railway – coordination with Semarang port will be important so we have suggested that Pelindo III be a partner in the organization. We recommend that the freight railway operator also be responsible for operating and managing the dry ports proposed in the vicinity of Solo and Yogyakarta. This will permit maximum coordination between the railway and container terminals.

Below is the proposed organization for the Kendal SEZ railway. However, as this project involves the construction of only a short branch line, it is recommended that the organization include only the establishment of a dry port operator; it may be more appropriate if the line were to be operated by PT. KA. Locomotives and additional rolling stock will have to be taken from the available fleet of PT. KA. However, as PT. KA has very few excess serviceable locomotives and wagons, it is recommended that this project be combined with the Semarang – Solo – Yogyakarta freight project.

Freight Railway
Kendal SEZ

Government:
Central Java Province
PTKA (optional)

Private Sector:
Dry Port Operator

Figure 9.2.2 Proposed Organizations for Kendal SEZ Freight Railway

We have evaluated the establishment of a freight railway for the Solo-Wonogiri branch line; a suggested organization plan is shown below. However, as the traffic on this line is small, and most will originate from a single company in Wonogiri, it might make more sense to offer the operation of this line to the single company generating traffic; it would feed this traffic to the Semarang-Solo-Yogyakarta freight railway (regional railway company) at Solo. If traffic increases, the establishment of a separate organization can be evaluated further.

Freight Railway
Wonogiri branch

Government:
Central Java Province
PTKA (optional)

Private Sector:
Railway manager

Figure 9.2.3 Proposed Organizations for Kendal SEZ Freight Railway

The most critical issues to be addressed in the institutional setup of the freight railway will be the definition of obligations to take responsibility for operating existing PT. KA trains (freight and passenger) on the Semarang-Solo-Yogyakarta route and the issue of train and engine crews-will they continue to be employees of PT. KA or transferred to CJR?

The following describes a suggested method for defining the existing functions of PT. KA that would be taken over by the Central Java railway regarding infrastructure, locomotives and rolling stock and workshops, followed by a review of the options of the status of train and engine crews. Below is a diagram showing boundaries of PT. KA DAOPs IV, V and VI; the proposed freight railway will include parts of DAOP IV and VI.

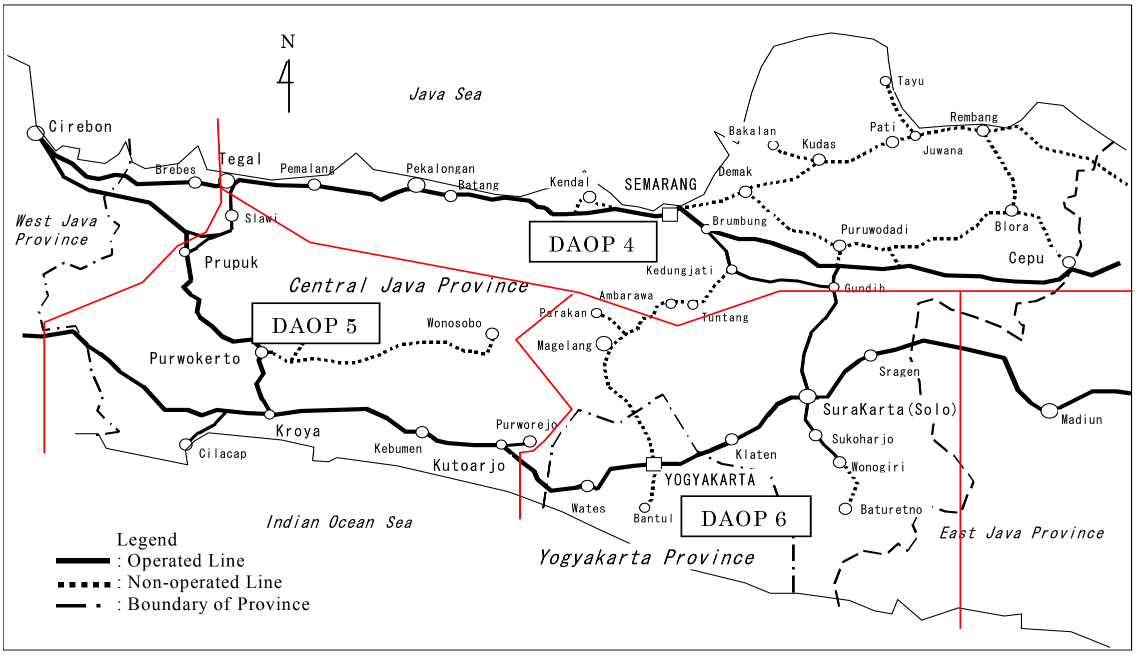


Figure 9.2.4 Boundaries of DAOP IV, V and VI

(1) Infrastructure

Infrastructure assets of PT. KA are the property of the central government (Directorate General of Railways, Ministry of Transport (MOT)). While it is not intended to transfer these assets to provinces, it is in the interest of improved transport services in Central Java that some capital investments should be made on some deteriorated sections. While it may be desirable for CJR to become the infrastructure operator of the line at some point in the future, it is recommended that during the initial phase of the regional railway development that PT. KA continue to maintain the line and control train operations.

While those station staff concerned with dispatching of trains will remain with PT. KA, station staff responsible for commercial purposes (loading and unloading of wagons, contacts with customers, selling of tickets/freight transport charges) will become CJR employees.

(2) Locomotives and Rolling Stock

It is recommended that CJR purchase locomotives and rolling stock necessary to operate new services within the CJR territory. Major maintenance of this newly-acquired rolling stock would be the responsibility of PT. KA at its workshops, though CJR will establish an inspection function and the capability to undertake minor repairs of rolling stock. CJR may also lease PT. KA locomotives and rolling stock, the cost of which would be a matter of negotiation between CJR and PT. KA.

(3) Workshops

While there are workshops located in Solo and Yogyakarta, it is recommended that they remain under the responsibility of PT. KA; should CRJ require services at these facilities for their equipment, payment will be made to PT. KA by CJR. A depot for EMUs is planned to be constructed at Kraten; operating costs of this facility would be paid by the CJR and possibly construction costs.

1) Organization Alternatives

There are several options for the organization structure of CJR including a provincial – owned enterprise or an Indonesian legal entity. The draft legislation permits both of these types of organizations ("business concerns") to construct, operate, maintain and manage railways in Indonesia. In either of these structures, the private sector railway manager will lead the activities of the railway with regard to procurement of traffic, negotiating tariff and establishing service standards and train operation. This private sector manager will likely include an Indonesian freight forwarder and an overseas experienced railway operator.

In effect this will amount to an "open access" system where trains, operated by PT. KA or CJR or any other operator will use railway infrastructure managed by an infrastructure manager. These operators will pay a track usage charge to the infrastructure manager (which will be PT. KA).

Details of the Central Java Railway organization are presented here, for the conducting of different types of railway service. There are differences in responsibilities and funding mechanisms; the important point is that for each organization alternative, there needs to be a financial incentive in order to attract a competent private sector railway manager; these financial incentives can be from management fees for operating passenger/commuter services or net revenue from new freight services developed.

The territory of the proposed Central Java Railway is proposed to be the existing railway lines between Semarang – Solo – Yogyakarta. Within this territory there are at present passenger and some freight trains operated (see Table 9.3.2); some passenger services are solely within the region while others carry passengers between east and west Java. We propose to implement commuter services in the vicinity of Semarang, Solo and Yogyakarta; airport links are proposed for Semarang and Solo; we also have projected significant increases in freight traffic over this line.

2) Existing Operations on Semarang-Solo Line

The Study Team made several trips over the lines of the proposed Central Java Railway. Some of the infrastructure needs to be improved and quality of passenger services offered is quite basic and not suited to growing the rail market share. Some passenger trains are operated with very old rolling stock in poor condition; other trains use the new Banyubiru equipment. The fare is low[1], but commensurate with the quality of service offered. Existing passenger equipment is non-air conditioned and do not have on-board toilet facilities. For a journey of greater than three hours, this is not suitable. Most express busses operating over the same route are equipped with air conditioning and toilet facilities. When the planned expressway is completed, these road services will become even more competitive. With some upgrading of the line and the addition of more suitable equipment (air-conditioned DMU's) a competitive service could be offered, and fares increased accordingly. This approach is recommended particularly in anticipation of the opening of a parallel expressway in the near future; existing services could not likely compete successfully with busses on the new expressway.

Passenger trains are operated on all lines, with the heaviest concentration on the Yogyakarta-Solo corridor. Freight services are operated over all lines, though net tonnages are small due to the operation of many 2-axle wagons. Based on existing timetables, the following are existing train frequencies on the sections of the proposed CJR line, as now operated by PT. KA:

Table 9.2.18 Existing PT. KA Trains on CJR Line

Track Section	Train Pairs per Day		Capacity (no. trains)
	Passenger	Freight	
Solo-Yogyakarta	44	16	260
Solo-Gundih	10	8	63
Gundih-Brumbung	10	4	43

Source: PT. KA train diagrams DAOPs IV, V and VI; 22 June 2007

3) Options: Full or Limited CRJ?

A critical issue is: should the CJR take over operation of existing passenger and freight services or just new services developed as a result of the proposed projects and PT. KA will continue to operate all existing trains? Another issue is should train and engine crews be taken over by CJR or should these employees continue to be PT. KA staff?

We have presented a description of alternatives below to help in evaluating a "Limited CJR" and compared with a "Full CJR". For both alternatives, PT. KA would continue to provide track maintenance functions, dispatch trains; infrastructure ownership will remain with the Government. In addition, in both alternatives minor repairs and inspection would be performed by CJR while major work would continue to be performed at PT. KA workshops. Station operations, for commercial functions at stations (excluding train control functions, which will remain with PT. KA) would be performed by CJR. The following table summarizes the alternatives.

[1] For example, the fare "business class" for the 140 km Sragen-Semarang journey is Rp 22,000.

Some features are common to both options, the payment of a management fee to CJR for services and the reimbursement to CJR for operating economy passenger trains from the PSO subsidy payments. The management fee would be paid to CJR, linked to a performance contract, paid by central/provincial governments.

Table 9.2.19 Summary of Responsibility Alternatives-Central Java Railway

Responsibility	Department of Land Transport	CJR	PT. KA	Infrastructure Manager
Infrastructure (both alternatives):				
Infrastructure ownership		✡		
Infrastructure maintenance				✡
Train dispatching				✡
Alternative 1:Limited CJR				
Station operations		✡		
Freight marketing		✡		
Train/engine crew			✡	
Locomotive/wagon ownership		✡	✡	
Rolling stock repairs		✡	✡	
Operate existing rail services			✡	
Operate new rail services		✡		
Alternative 2:Full CJR				
Station operations		✡		
Freight marketing		✡		
Train/engine crew		✡		
Locomotive/wagon ownership		✡	✡	
Rolling stock repairs		✡	✡	
Operate existing rail services		✡		
Operate new rail services		✡		

Source: Consultant's proposal

a Alternative 1: Limited CJR

Most passenger services now operated on the lines of CJR are subsidized through the PSO payments with the exception of business class and executive class trains. Commuter trains operated on the line can be either economy or business; only economy trains will attract PSO subsidy. As can be seen in Table 9.3.1, there are 44 passenger trains between Yogyakarta and Solo, and 10 trains on the line Solo – Gundih – Semarang. Under this limited option, PT. KA would continue to be responsible for train and engine crews for these trains. Any additional trains, including commuter services and airport links, would be operated by crews hired by CJR. CJR would undertake routine inspections and minor rolling stock repairs; any major repair work would be done by PT. KA in their workshops, to be reimbursed for this work by CJR.

Existing freight services would continue to be operated by PT. KA; any new services to be operated by CJR. Locomotives should be owned by CJR; train and engine crews would belong to PT. KA. PT. KA would pay to CJR for any services provided by CJR for PT. KA trains for new freight traffic, all revenue would accrue to CJR.

b Alternative 2: Full CJR

Under this option, all trains shown in Table 9.2.18, in addition to any new commuter and/or airport link services would be operated by the CJR train and engine crews. Income would be PSO subsidies for all existing and new economy trains as well as the management fee for operating the services.

All freight trains currently operated by PT. KA would be operated by CJR (over CJR lines) as well as any new freight business. Income would be payments from PT. KA for costs incurred by CRJ for the benefit of these trains as well as full revenue for any new services developed. CJR would undertake routine inspections and minor rolling stock repairs; any major repair work would be done by PT. KA in their workshops, to be reimbursed for this work by CJR.

Under this Full CJR, train and engine crews for all trains on CJR lines would be CJR employees.

4) Advantages/Disadvantages

The Limited CJR option has the advantage of minimizing the responsibilities of CJR and therefore, the time required for implementation and obtaining agreement from all parties. However, the CJR would be very much restricted in the scope of potential future income as only new services would generate income; in addition, control over train operation by continuing to have train and engine crews report to PT. KA, would also be limited.

The Full CJR option offers a more stable income base by including existing services as income – generating services. In addition, by making train and engine crews CJR employees, this increases the control of CJR over train operations. It would, however, be more complex to implement than the Limited CJR. Taking-over train and engine crews will require negotiations with PT. KA and labor unions regarding many issues (for example, seniority, pay levels, etc.). However, it is recommended the Full CJR option as it offers the greatest likelihood of financial security to the new regional railway company.

We have recommended that train dispatching remain under control of PT. KA, primarily because PT. KA will continue to perform maintenance on the infrastructure and to separate train control for a short section of line would not be feasible. **An infrastructure manager** should be appointed that would be in charge of allocating train paths and collecting track access charges in a non – discriminatory manner (treating PT. KA and non – PT. KA trains equally regarding track access charges and access to the infrastructure). While this infrastructure manager would ideally be an independent body, PT. KA could act as infrastructure manager, with oversight from MOT. While in the long term, if this concept of regional railways and train operation by private sector and provincial organizations is expanded, there will be the need for an independent infrastructure manager as well as a rail regulator. These independent organizations will promote the use of the rail infrastructure and ensure that the track access charges and agreements are implemented in a fair and non – discriminatory manner.

Summarized below are the organizational options for CJR:

- Train and engine crews: these can either remain with PT. KA or CJR can hire their own staff
- Station staff: all station staff can remain as PT. KA employees, or CJR can take over those stations staff involved with commercial matters (selling tickets, arranging freight transport documents)
- Train inspection and minor maintenance: this function can either be undertaken by PT. KA (as at present) or CJR can hire their own staff for this purpose.
- Operation responsibility (train and engine crews) of existing PT. KA trains on the lines to be operated by CJR (Semarang – Solo – Yogyakarta) can remain with PT. KA or CJR can take over.
- Capital costs of the CJR: costs for track, signaling and other fixed facilities could be the responsibility of the central and provincial governments; rolling stock acquisition costs as well as the cost for constructing the EMU depot at Kraten should be the responsibility of CJR. However, the amount of capital costs expected to be paid by the railway operator will depend on the amount of assurances that governments are willing to give, such as guarantee that full operating subsidy for those trains operated by CJR will be paid.

5) Need for Infrastructure Agreements between CJR and PT. KA

There will have to be negotiated between CJR and PT. KA an interchange agreement for the exchange of trains between the two companies at Yogyakarta, Solo and Semarang. This agreement will specify several items of common interest, particularly the responsibility of each party for inspection wagons, liability for damages if defective wagons are found, and compensation for emergency repair of such defective wagons.

9.2.5 Financial Arrangement of Freight Railway Operation

(1) Basic Assumptions

1) General

a Project Operation

The following table indicates the operation starting year by Freight Train project

Table 9.2.20 Start Operation

Project Name	Operation Start	Construction Year
Semarang Solo Yog (S-S-Y) Freight Corridor	2015	2014
Solo Wonogiri (S-W)Freight Corridor	2020	2019
Kendal SEZ	2020	2019

Source: CJRR Study Team

b Useful Life by Asset

Useful life by asset of freight train is also as same as Commuter Train projects.

c Other

Other basic assumptions for are indicated below.

- Subsidy: Without any regard for subsidy
- Interest Rate: 1.5%, Japanese ODA Loan
- Discount Rate 8% = Interest Rate 9.5%(Bank Indonesia, 07 Oct 2008) – CPI 6.5%(Bank Indonesia, Feb 2008) + Risk Premium 5%

Source: CJRR Study Team

2) TAC (Track Access Charge)

The method of TAC calculation is the same as Commuter Train in section 9.1.7. The following table indicates TAC calculated to cover the initial investment and O&M cost.

In case of freight transport, since the initial investment for the handling facilities for transportation freight is added as an alternative option, initial investment cost at container handling point is also a project condition.

Table 9.2.21 TAC at Operation Start Year (Unit: Million Rp.)

Project Name	TAC	Breakdown Initial	O&M
Semarang Solo Yogya (S-S-Y) Freight Corridor	123,144	43,855	79,289
	100%	36%	64%
Solo Wonogiri (S-W) Freight Corridor	13,922	9,015	4,906
	100%	65%	35%
Kendal SEZ	32,350	11,077	21,274
	100%	34%	66%

Source: CJRR Study Team

Table 9.2.22 Container Handling Machine (Unit: Million Rp.)

	QT	Price
Crane (50 ton)	1	7,682
Crane (30 ton)	1	5,909

Source: CJRR Study Team (based on interview to Japanese heavy industries, Aug 2008)

3) Revenue

a Demand

Cargo Demand is set as 'Economic Evaluation' in 8.3.1

b Fare System

Freight tariff is assumed to be the following:

Haulage Charge	Fare(Rp.) = 355* Distance(km) * ton
Handling Charge	Fare(Rp.) = 150,000* lift-on /off * TEU(Loaded)

Source: CJRR Study Team

4) Cash Flow

a Basic Case

The following table indicates the result of cash flow analysis, B/C and BEP (Break-Even Point) for 'Freight Train' projects. The Study Team considered another alternative which is with/without 'container handling facilities (CHF)'.

In case of without CHF, only S-S-Y Freight Corridor project is positive according to results of cash flow analysis. However, S.W. freight corridor project and Kendal SEZ project have deficit amount at the end of project evaluation term (30 years) and according to B/C results are less than 1. In the case of with CHF, all freight train projects are positive in terms of annual cash flow and also cumulative cash flow at the end of the project evaluation term.

Table 9.2.23 Summary of Cash Flow (Unit: Million Rp.)

(With C.H.F.)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
S-S-Y Freight Corridor	2.648	1	1,732,973	2,071,308	2,139,464	3,706,466	7,007,407	7,739,006	1,973,493	4,936,098	5,599,542
W-S Freight Corridor	1.884	7	320,522	334,213	320,622	380,321	1,006,636	1,006,636	59,799	672,423	686,014
Kendal SEZ	0.958	11	743,848	827,391	813,800	636,071	926,468	933,490	-107,777	99,077	119,690
(Without C.H.F.)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
S-S-Y Freight Corridor	1.979	1	1,678,610	2,016,946	2,085,101	2,502,112	5,270,637	5,895,852	823,502	3,253,692	3,810,751
W-S Freight Corridor	0.785	n/a	293,341	320,622	320,622	199,988	309,525	309,525	-93,353	-11,097	-11,097
Kendal SEZ	0.728	n/a	716,667	813,800	813,800	443,396	705,280	802,379	-273,271	-108,520	-11,421

Source: The Study Team
Footnote: C.H.F. means Container Handling Facilities

b Share of Initial Investment Cost by Private Railway Company

For the Solo - Semarang freight transport service, two scenarios of sharing of initial investment cost by private railway company has been prepared and financial viability examined.

Case 1: Rolling stock will be purchased by the private railway company. The cost of rolling stock is 31.8 million USD and this cost accounts for 30% of the total investment cost. In this case, revenue will be obtained from freight transport fare.

Case 2: In addition to rolling stock, container handling facilities will be procured by the private company. The cost of rolling stock and container handling facilities amounts to 41.7 million USD and it comprises about 40% of the total investment cost. In this case the railway company will receive fare revenue and container handling charge at the dry ports and the port.

Table 9.2.24 Initial Cost Share of Private Railway Company

(unit: million USD.)

	Case 1	Case 2
Rolling Stock	Yes	Yes
Handling Yard		Yes
Initial Cost	31.8	41.7
% of Total Investment Cost	29.8 %	39.1 %

Note: "Yes" indicates procurement by private railway company

Source: CJRR Estimate

The results of cashflow analysis are indicated in Table 9.2.26. FIRR of Case 1 was estimated at 26.3% while that of Case 2 was 36.7%. This implies that the railway freight transport business would run well even if the company invests in purchase of rolling stock. The business would be even better off if the company invests in container handling facilities and includes container handling business.

Table 9.2.25 Financial Indicators from Cash Flow Analysis

	Case 1	Case 2
NPV (billion USD)	1,736.0	3,055.0
FIRR	26.3%	36.7%
B/C	1.87	2.43

Source: CJRR Estimate

c Possible Subsidy Base

As mentioned in Section 6.2, the roads have been heavily damaged by overloaded trucks and both central and local governments have been paying cost for repair and rehabilitation of the damaged road. If trucks and trailers shift from road to railway, the damages could be reduced and the amount of reduced road maintenance cost could be utilized for railway system development.

Since the viability of the proposed railway freight project can be secured as analyzed, the reduction of road maintenance cost is not included in the financial analysis. If the regional railway company operates both freight and passenger trains, then this reduced amount of road maintenance cost could be included as one component of subsidy items.

Table 9.2.26 Benefit from Reduction of Pavement Damages

(unit: million Rp.)

Case	Case A	Case B		
Year of Benefit Counted	2010	2010	2020	2030
Solo - Semarang Freight Corridor	57,803	38,685	50,273	53,455
Wonogiri – Solo	2,911	2,216	2,447	2,596
Kendal SEZ	3,932	2,773	3,418	3,532
Demak-Rembang	10,641	8,066	8,943	9,515

Note:
Case A: Design period of pavement is 30 years. Major repair works are assumed to be conducted in 2010.
Case B: Design period of pavement is 10 years. Major repair works are assumed to be conducted in 2010, 2020 and 2030.
Prices are in real term, not social price.
Source: CJRR Estimate

9.2.6 Environmental Impact Evaluation of Freight Train

Basically this construction activity focuses on rehabilitation and upgrading of existing railway corridors except for Wonogiri – Solo route; therefore it is not expected to generate significant impacts such as land acquisition. During operation phase, noise disturbance in nighttime may rise due to increase in freight service.

Table 9.2.27 Impact Evaluation of Proposed Program (Freight Train)

Environmental Issue Proposed Project	Natural Environment	Pollution	Social Environment	Environmental Key Issue
1: Semarang - Solo Freight Corridor (109 km)	D	C	C	Noise disturbance
2: Wonogiri - Solo Freight Corridor (40 km)	D	C	B	Noise disturbance, Land acquisition
3: Semarang Port Access (3 km)	D	C	C	Noise disturbance
4: Solo Dry Port Access (2 km)	D	C	C	Noise disturbance
5: Yogyakarta Inland Port Access (24 km)	D	C	C	Noise disturbance

Note: A: Serious impact is predicted.
B: Some impact is predicted.
C: Unclear, need further evaluation.
D: No or less impact is predicted.

Improvement of freight train can lead modal shift in freight service from tracks to trains. It is expected to reduce air pollution and CO_2 emission. Therefore zero option (without case) is not recommendable.

9.3 Airport Link Development Plan

9.3.1 Passenger Demand

There are three airports along the Case Study corridor: Adi Sutjipto (Yogyakarta) Airport, Ahmad Yani (Semarang) Airport, and Adi Sumarmo (Solo) Airport. Each airport mainly serves its metropolitan area. Although all the three airports are utilized for both international and domestic flights, the ratio of international flight passengers to the total air passenger demand is small except for Adi Sumarmo (Solo) Airport, of which ratio is around 27% (as of 2006). Adi Sutjipto (Yogyakarta) Airport and Adi Sumarmo (Solo) Airport, which are located relatively close to each other (about 50 km), are planned to function as twin airports. That is, while Adi Sutjipto (Yogyakarta) Airport will be dedicated to domestic flights and a significant increase in domestic air passengers is expected, Adi Sumarmo (Solo) Airport plans to specialize in international flights as well as freight transportation. Thus, both airports will serve Yogyakarta – Solo metropolitan area in common. In addition to Adi Sutjipto (Yogyakarta) Airport, which has already been connected to the railway at Maguwo Station, if Adi Sumarmo (Solo) Airport is connected to the railway via Solo Airport Link, connectivity of these two airports will be significantly enhanced.

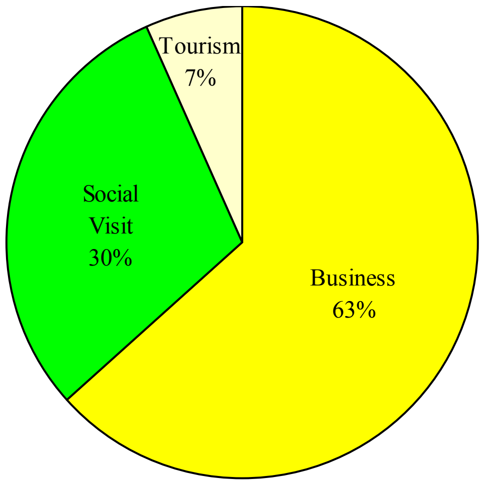
(1) SP Survey Analysis

As a part of the Study, SP Survey on Railway Use was conducted at Adi Sutjipto (Yogyakarta) Airport in order to understand their preference on mode choice to/from the airport as well as the OD patterns of passenger trips and traveler characteristics. The obtained information was utilized to forecast the ridership of the planned Semarang and Solo Airport Links and relevant commuter railways, especially Yogyakarta – Klaten Commuter Rail, which serves air passengers of Adi Sutjipto (Yogyakarta) Airport, in order to investigate economic and financial viability as well as proper operation planning.

The survey was conducted by interviewers on weekdays (September 9 – 11, 2008). Samples for the interview were taken from total 200 departing air passengers of domestic flights. According to the flight schedule, out of over 60 passenger flights per day, only a few flights were international and the rest are all domestic flights. The interviews were made face-to-face with passengers at the domestic flight departure waiting lounge.

1) Travel Characteristics

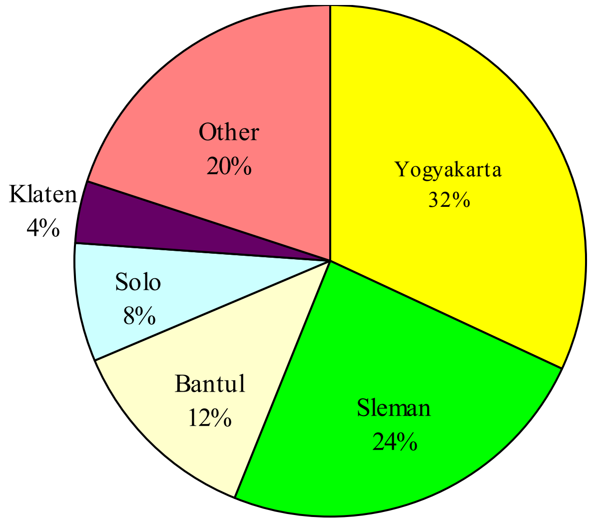
With respect to the respondents' air travel, purpose shares are shown in Figure 9.3.1. The most dominant purpose is business, followed by social visit, although this composition may vary depending on the season. According to the interview result, about two thirds of the respondents are traveling alone while the remaining one third is traveling with someone. In total, average number of passengers in a party is around 1.7. The average number of people who came to the airport to send off the air passengers is 0.7 per air passenger.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.3.1 Purpose Shares of Respondents' Air Travel

As for the interviewed air passengers' places of origin by kota/kabupaten (Figure 9.3.2), around 68% of them came from Kota Yogyakarta and its vicinity (Kab. Sleman and Kab. Bantul). About 8% and 4% respectively came from Kota Solo and Kabupaten Klaten, which could also be easily accessed by railway. In future, the share of domestic air passengers coming from the direction of Solo is expected to grow as Adi Sutjipto (Yogyakarta) Airport will serve more domestic flights.

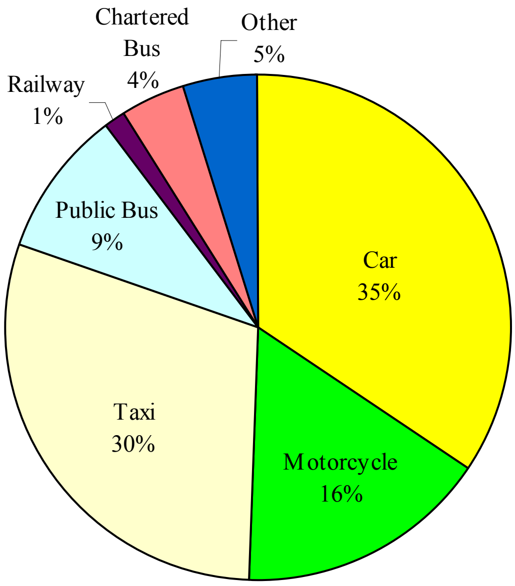


Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.3.2 Distribution of Air Passengers' Places of Origin

2) Preference on Mode Choice

As shown in the current mode shares in Figure 9.3.2, the majority of the respondents came to the airport by private vehicles (car: 35%, motorcycle: 16%). Taxi also has a significant share (30%). Use of public bus, including the new bus rapid transit service (Transjogja) which started the operation in February, 2008, has a share of 9%. As for railway, the share is only 1%, including the railway service (Prameks) which has added a new stop (Maguwo Station) in front of the airport since June, 2008. Those services are still new, and the total share of public transport is just 10% at present. However, further growth in ridership can be expected as the connectivity to both Yogyakarta and Solo metropolitan areas as well as to Adi Sumarmo (Solo) Airport will be enhanced particularly by adding better railway services including Yogyakarta – Klaten Commuter Rail, Solo Airport Link, and so on.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.3.3 Transportation Mode(s) Currently Used by Air Passengers

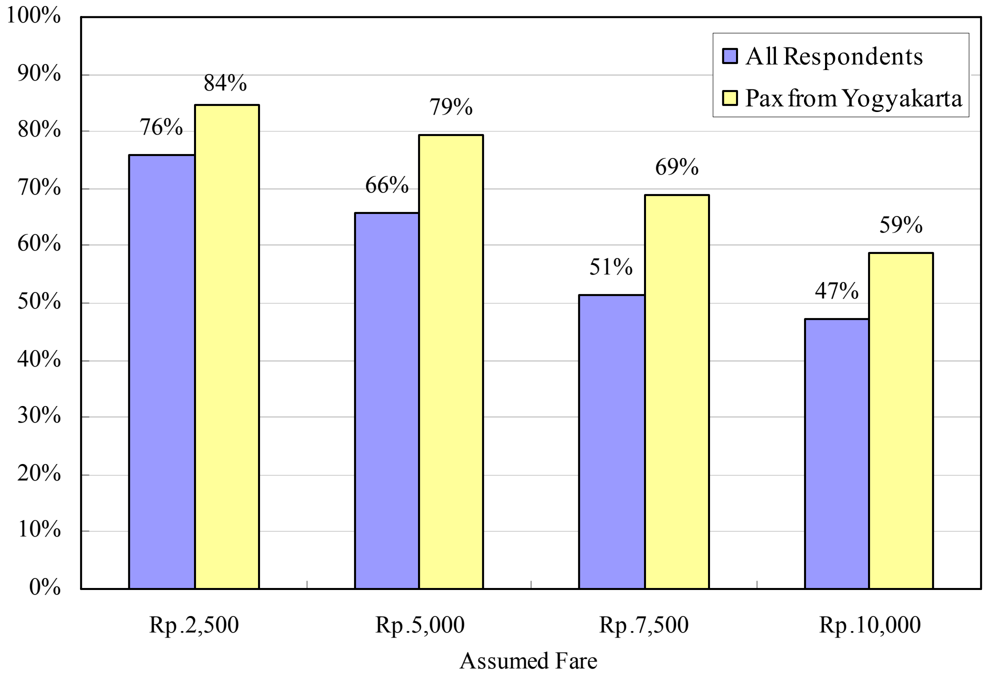
Average fare that the respondents paid for a one-way trip to Adi Sutjipto (Yogyakarta) Airport is analyzed by major origin place and presented in Table 9.3.1. According to the survey result, those who came from Kota Yogyakarta to the airport by public transport spent about Rp. 3,000 for a one-way trip on average, and those who came by taxi spent about Rp. 46,000 for a one-way trip. Average fare is higher from the surrounding kabupaten especially in the case of public transport.

Table 9.3.1 Average Fare Paid for a One-Way Trip to Adi Sutjipto Airport

Origin Place	Kota Yogyakarta	Kab. Sleman	Kab. Bantul	Kota Solo	Overall Average*
Public Transport	3,000	3,800	5,300	8,300	14,600
Taxi	46,000	44,000	51,000	158,000	60,000

* Including origins other than the listed kota/kabupaten.
Source: CJRR Study Team (SP survey on Railway Use, 2008)

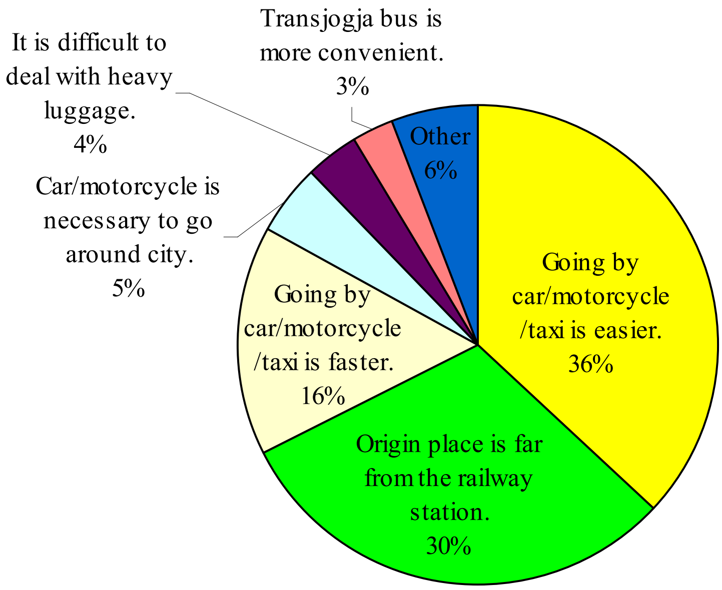
Then, the survey asked the respondents whether they would choose the new railway services including the proposed commuter railways under the assumed fare levels of Rp. 2,500, Rp. 5,000, Rp. 7,500, and Rp. 10,000 and the result is shown in Figure 9.3.4. The tendency is clearly different from what was observed in the SP survey for residents along the commuter railway lines. All respondents' preference for the new railway service is generally quite high. While the ratio of choosing the new railway service decreases as the fare becomes higher, nearly half of them answered that they would choose the new railway service even if the fare is as high as Rp. 10,000. Focusing on the passengers who came from Kota Yogyakarta only, the ratio of choosing the new railway service becomes even larger under all the assumed fare levels.



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Figure 9.3.4 Ratio of Air Passengers Who Would Choose the New Railway Service

The above results are based on stated preference, and, in fact, all the respondents who answered yes may not actually choose the new railway service. As such, possible reasons why they might not use the new railway were also asked, and the result is shown in Table 9.3.2. The biggest reason is the ease of taking a private vehicle or a taxi, taking a share of 36%. For example, they do not have to walk or transfer but they can sit in the vehicle if they use a private vehicle or a taxi. Such convenience may be highly valued by the respondents. Meanwhile, relatively few respondents recognize that taking a private vehicle or a taxi will be faster than traveling by the new railway service (16%), and no respondents answered that the current cost for private vehicles such as fuel or the taxi fare is reasonable (0%). However, the survey result implies that private vehicles or taxis are essentially more convenient in many ways to travel door-to-door between places of origin and the airport. This is also related to the second dominant reason that there is no railway station nearby the origin (30%) as well as other reasons such as the necessity of private vehicles for other trips in the city (5%) and the difficulty in dealing with heavy luggage (4%).



Source: CJRR Study Team (SP survey on Railway Use, 2008)

Table 9.3.2 Reasons that Air Passengers May Not Use the New Railway Service

(2) Demand Projection

Current average daily number of airport passengers is about 7,000 at Adi Sutjipto (Yogyakarta) Airport, 3,400 at Ahmad Yani (Semarang) Airport, and 2,600 at Adi Sumarmo (Solo) Airport as of 2006. Future passenger trips related to those three airports along the Case Study corridor are in accordance with the master plan of each airport as described in Section 5.3.3.

In addition, the result of the SP survey on Railway Use that was conducted at Adi Sutjipto (Yogyakarta) Airport shows that the number of people who come to the airport to send off or pick up passengers is around 0.7 persons per air passenger. In addition, 0.6 employees per air passenger have been estimated. Future number of people accompanying passengers as well as future number of employees at the airport is assumed to increase in proportion to the airport passengers.

For air passengers (and their accompanying people) and airport-related employees, railway mode share has been assumed based on the result of the SP survey conducted by the Study Team. Actual mode share may vary depending on each airport as well as places of travel origin/destination;

however, for simplicity, the result of stated preference of all respondents has been utilized in order to forecast the number of airport-related railway passengers on Semarang Airport Link and Solo Airport Link. Demand for railway passengers on these airport links under the assumed fare of Rp. 5,000 is forecasted in

Table 9.3.3.

Table 9.3.3 Demand Forecast for Railway Passengers on Airport Links

[Unit: passengers / day]

Year	Semarang Airport Link	Solo Airport Link
2020	15,200	7,200
2025	18,400	8,800
2030	19,000	9,700

Note: Under the assumed fare of Rp. 5,000.
Source: CJRR Study Team

9.3.2 Profile of service and System Improvement

(1) Requirements and Objectives of Airport Link Planning

The commuter train projects aim the following service level as basic requirements.

- Airport station at/adjacent to airport terminal building
- Dedicated to airport passengers
- Non-stop or limited stops
- Fast and reliable service
- Easy travelling with carrying heavy luggage
- Frequent operation with 30 minutes headways at peak hours
- Direct link to city center
- Airport to airport direct transfer (Solo – Yogyakarta)
- Able to check-in at City Air Terminal (optional)
- User-friendly station facilities, such as high platform, commercial establishments, and barrier free considerations (elevators, toilets, signage, tactile tiles, slopes etc)
- Comfortable railcar interiors
- Improved accessibilities to stations (Station plaza, feeder services etc)

(2) Route Alignment

Based on such objectives and requirements of the airport link services, route alignments for the same were identified as follows:

1) Semarang Airport Link

Beginning at Semarang Tawang and running through Semarang Poncol, diverging from existing railroad to the north, and ending up near terminal building of Achmad Yani (Semarang) Airport (proposed new location) with total length of around 9 km.

2) Solo – Yogyakarta Airport Link

Beginning at Adi Sumarmo (Solo) Airport and running on viaduct, connecting to existing railroad near Gawok, running through Klaten – Brambangan – Maguwo and ending up at Yogyakarta (Tugu) with total length of around 59 km.

(3) Alignment, Plane and Spatial Locations

Alignment, plane and spatial locations of proposed airport links are presented in the following table.

Table 9.3.4 Features of Airport Link Network

No.	Line	Length (km)	Running on viaduct		Running on ground		Note
			From - To	Length (km)	From - To	Length (km)	
1	Semarang Airport Link	9.0			Semarang Airport – Semarang Tawang	9.0	New construction of spur line with single track Running on ground
2	Solo – Yogyakarta Airport Link	57.0	Solo Airport – nearest road intersection	3.0	Road intersection – Yogyakarta (Tugu)	54.0	New construction of spur line with single track Mainly running on ground; section from Airport to nearest road intersection running on viaduct.
	Total	**66.0**		**3.0**		**63.0**	

Alternatives: At grade option for Solo – Yogya Airport Link – *The alignment of this alternative running to the east from airport terminal building, connecting with existing Solo - Semarang railroad, running through Solo Balapan – Purwosari – Gawok – Klaten – Brambangan – Maguwo and ending up at Yogyakarta (Tugu). This will make the trip time longer and need more railcars, but save infrastructure cost and give accessibility from/to Solo City.*

(4) Arrangement of Stations

In order to reach the destination (airport/city), proposed airport links will provide stations on "non-stop" or "limited-stops" basis.

Table 9.3.5 Proposed Station Arrangement on Semarang Airport Link

No.	Station name	Station (km)	Distance (m)	Spatial location	Note
1	Semarang Tawang	0+000	0	Elevated	Beginning station
2	Semarang Poncol	2+000	2,000	Elevated	Terminal station
3	Semarang Airport	9+000	9,000	At grade	Airport station (new)

Table 9.3.6 Proposed Station Arrangement on Solo – Yogyakarta Airport Link

No.	Station name	Station (km)	Distance (m)	Spatial location	Note
1	Solo Airport	0+000	0	Elevated	Beginning station (new)
4	Maguwo	49+000	49,000	At grade	Airport station (existing)
5	Yogyakarta (Tugu)	57+000	8,000	At grade	End station

Table 9.3.7 Proposed Station Arrangement on Solo – Yogya Airport Link (Alternative)

No.	Station name	Station (km)	Distance (m)	Spatial location	Note
1	Solo Airport	0+000	0	At grade	Beginning station (new)
2	Solo Balapan	12+000	12,000	At grade	Terminal station
3	Maguwo	63+000	51,000	At grade	Airport station (existing)
4	Yogyakarta (Tugu)	71+000	8,000	At grade	End station

(5) Civil Works

Highlights of civil works for Airport Link projects are described as follows:

- **Construction of elevated structure** – This work is required when the corridor is unable to secure ROW to construct railroad; only Solo – Yogyakarta Airport Link (3 km of total 7 km spur line) is of such concern. An elevated viaduct will be constructed over the road median. Pre-cast concrete box girder and single pier at road median is preferred method.
- **Embankment works and sub-base construction for new track** – This is to construct substructure for the railroad by filling up selected materials for embankment. Spur line from the existing track at west of Semarang to Semarang Achmad Yani (Semarang) Airport (4 km) and from the existing track at west of Gawok to Adi Sumarmo (Solo) Airport (4 km of total 7 km spur line).
- **Crossing barrier at level crossing** - Providing crossing barriers and signals at major level crossings for all airport link projects.

Fencing – Fence construction along boundaries of ROW between stations at urbanized area. This aims to prevent people and animals from coming into tracks.

Table 9.3.8 Civil Works Summary

	Civil Work Items	Semarang Airport Link	Solo – Yogya Airport Link
A.	Construction of elevated structure		X (3km)
B.	Embankment works and sub-base construction for new track	X (4km)	X (4km)
C.	Crossing barrier at level crossing	X	X
D.	Fencing	X	X

(6) Trackworks

Trackworks will be executed following embankment construction. Highlights of trackworks for Airport Links are described as follows:

- **New track construction (ballasted track)** – Sections where construct new tracks, except elevated section, will require ballasting and track formation.
- **New track construction (ballastless track)** – Elevated section, i.e. 3 km from Adi Sumarmo (Solo) Airport, will require construction of ballastless track. The cost is higher but allows significant reduction of maintenance burdens.

Table 9.3.9 Trackworks Summary

	Trackwork Items	Semarang Airport Link	Solo – Yogya Airport Link
A.	New track construction (ballasted track)	X (4km)	X (4km)
B.	New track construction (ballastless track)		X (3km)

(7) Station Building and Passenger Facilities

Highlights of station works for Airport Links are described as follows:

- **New station construction (at grade)** – Sections where undertake double tracking, except elevated section, will require this work. It covers construction of station building (standard types of Java Main Lines), high platform (1100 mm height) for commuter trains, over-bridge & underpass, and other passenger facilities (ticket counters, ticket gates, standard toilets, kiosks, passenger information boards etc) similar to existing stations.
- **New station construction (elevated)** – Elevated section, i.e. inside Semarang City and Demak Commuter, will require this work. Construction of station structure by pre-cast concrete box girders is suggested, but concrete rigid frame may possibly reduce the cost. Having concourse below platform level is a normal practice.

- **Installation of barrier free facilities –** This work is required for all stations (or priority stations at initial stage unless budget allows) and aims to provide services for all passengers including aged, physically impaired and other reduced mobility (such as expected mothers and small children). Work items include, but are not limited to: elevators, slopes, tactile tiles, signage, disabled person's toilets, Braille, handrails, anti-slip floors and providing sufficient width at passenger flow line.
- **Station plaza and access improvement** – This work is required for almost all stations. The work includes construction of station plaza for transfer between commuter train and other transportations as well as improvement of access road to commuter train stations.

Table 9.3.10 Station Works Summary

	Trackwork Items	Semarang Airport Link	Solo – Yogya Airport Link
A.	New station construction (at grade)	X (1)	
B.	New station construction (elevated)		X (1)
C.	Installation of barrier free facilities	X (2)	X (2)

(8) Train Operation Plan

As international practices, Airport Rail Links can suitably serve the airport users and keep the waiting time allowable with 30 minutes headways. This is used as a benchmark for planning train operation of two airport links.

Composition of the trains will be much different from the type of rolling stock. Either specially designed "Airport Express Train (AET)" which is dedicated to high-speed transport from the airport to the city centre (AET Option) or standard railcar (either EMU or DMU) identical to the commuter trains (Standard Railcar Option).

In the case of AET Option, all seats are reserved and both standard and first class accommodations may be provided. This will give the average capacity of 208 passengers/4-car train, which is much lower than that of Standard Railcar Option (990 passengers/4-car train).

To meet the projected traffic demand, 4-car trains with headway of 30 minutes at peak hours has been examined for both options. It appears at two airport links that a sufficient capacity at peak hours will be given with Standard Railcar Option. AET Option will require shorter headways or more cars per train. This will significantly impact capital investment cost.

Table 9.3.11 Summary of Airport Link Operation at Peak Hours (2015)

Section	PHPDT	Operation Plan in 2015 (peak hours)			
		No. of trains/hr		Headway (mins)	
		AET	Standard Railcar	AET	Standard Railcar
Airport Links:					
- Semarang Airport Link	1,087	5 (4-car)	2 (4-car)	12	30
- Semarang – Yogya Airport Link	518	3 (4-car)	2 (4-car)	20	30

Note: AET 4-car trainset average capacity – 208 passengers (all seats are reserved)

Note: Standard Railcar 4-car trainset ave. capacity – 990 passengers (crush load - 6 passengers per square meter)

Table 9.3.12 Summary of Airport Link Operation at Peak Hours (2025)

Section	PHPDT	Operation Plan in 2025 (peak hours)			
		No. of trains/hr		Headway (mins)	
		AET	Standard Railcar	AET	Standard Railcar
Airport Links:					
- Semarang Airport Link	1,674	5 (6-car)	2 (4-car)	12	30
- Semarang – Yogya Airport Link	800	3 (6-car)	2 (4-car)	20	30

Note: AET 6-car trainset average capacity – 312 passengers (all seats are reserved)

Note: Standard Railcar 4-car trainset ave. capacity – 990 passengers (crush load - 6 passengers per square meter)

(9) Rolling Stock Plan

1) Vehicle Concept

- **AET Option** – 4-car AET trains are composed of: Tc + M + M + Tc and 6-car AET trains are composed of: Tc + Mp + M + Mp + M + Tc (where M: car with traction motors, *Mp: motor car with pantograph and transformer, converter and inverter*, Tc: trailer car with driving cabin.)
- **Standard Railcar Option** - 4-car EMU trains are preferably composed of: Tc + M + M + Tc

***Alternative: Prameks Type DMU** – 5-car DMU trains (equal capacity to 4-car EMU train) is composed of: Mc + T + T + T + Tc (where Mc: car with traction motors , Tc: trailer car with driving cabin.)*

2) Procurement Plan

The number of cars required in operation is estimated in accordance with the projected patronage. In addition to the number of cars in service on line at peak hour, say 10% (but minimum one) more train-set must be added and maintained in standby at each line.

Table 9.3.13 Rolling Stock Procurement Plan for Initial Year (Airport Link)

No.	Section	Distance (km)	Ave. speed (kph)	Round trip time (mins)	Head -way (mins)	No. of trains in service	Stand -by	Total no. of trains	Cars per train	Total no. of cars
Airport Express Train Option										
1.	Sem AL	9km	65	26.6	30	3	1	4	4	16
2.	Sol–Yog AL	59km	80	98.5	20	5	1	6	4	24
Standard Railcar Option										
1.	Sem AL	9km	60	28.0	30	1	1	2	4	8
2.	Sol–Yog AL	59km	60	93.3	30	4	1	5	4	24

(10) Train Control Systems

Airport Link Projects will be part of the larger railway network in Central Java Region. The systems shall be based on proposal for other sections of the foregoing projects (such as commuter projects) to ensure inter-operability and compatibility of the train control systems and rail operations of the entire railway network. Therefore, the same specifications as commuter trains are recommended.

(11) Maintenance Facilities

Maintenance and repairing workshops and depots of Airport Links will be shared with other rail traffic in the same region. Details are described in the section of commuter trains 5.1.2 (12).

(12) Land Acquisition Area

Land area required for commuter trains is calculated in the following principle:

- Separating the land areas required for the main lines and stations.
- The land required for main lines is 10 m width for single track construction.
- The land area required for stations is 2,000 m2 for Airport Stations. Station plaza and station front development will require additional 4,000 m2.

Table 9.3.14 Summary of Land Acquisition Area for Airport Links

No.	Airport Link	Land acquisition area (m2)			Note
		Main line	Station area	Total	
1	Semarang Airport Link	40,000	6,000	46,000	
2	Solo – Yogya Airport Link	40,000	4,000	44,000	No land acquisition required for elevated section
	Total	**80,000**	**10,000**	**90,000**	

9.3.3 Project Cost Estimate

(1) Capital Investment Cost

Project Cost estimate for airport links has been prepared covering civil, station, electrical, signaling and telecommunication works, rolling stock, maintenance facilities.

1) Semarang Airport Link

Table 9.3.15 Capital Cost Estimate for Semarang Airport Link

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Amount	
			AET	Standard railcar		AET	Standard railcar
1	**Civil Works**					1.6	1.6
1.1	Elevated Structure	Km	0	0	4.5	0.0	0.0
1.2	At Grade Structure	Km	4	4	0.4	1.6	1.6
2	**Station Works**					1.2	1.2
2.1	Elevated Station	Ea.	0	0	3.2	0.0	0.0
2.2	At Grade Station	Ea.	1	1	1.2	1.2	1.2
3	**Trackworks**					1.6	1.6
3.1	Ballasted Track	Km	0	0	1.0	0.0	0.0
3.2	Ballastless Track	Km	4	4	0.4	1.6	1.6
4	**Sig, Telecom & Traffic Control**	Km	4	4	0.58	2.3	2.3
5	**Traction Power Supply**					2.0	2.0
5.1	Overhead Catenary System	Km	4	4	0.5	2.0	2.0
5.2	Power Substation	Ea.	0	0	4.0	0.0	0.0
6	**Rolling Stock -2nd hand/New (Airport Express Train)**	Ea.	16	8	0.1/1.0 (1.5)	24.0	0.8/8.0
7	**Maintenance Facility**	Ea.	0	0	24.0	0.0	0.0
	Total					32.7	9.5/16.7

2) Solo - Yogyakarta Airport Link

Table 9.3.16 Capital Cost Estimate for Solo – Yogyakarta Airport Link

Million USD in year 2008 price level

No.	Cost Item	Unit	Quantity		Unit Price	Amount	
			AET	Standard railcar		AET	Standard railcar
1	**Civil Works**					15.1	15.1
1.1	Elevated Structure	Km	3	3	4.5	13.5	13.5
1.2	At Grade Structure	Km	4	4	0.4	1.6	1.6
2	**Station Works**					3.2	3.2
2.1	Elevated Station	Ea.	1	1	3.2	3.2	3.2
2.2	At Grade Station	Ea.	0	0	1.2	0.0	0.0
3	**Trackworks**					4.6	4.6
3.1	Ballasted Track	Km	3	3	1.0	3.0	3.0
3.2	Ballastless Track	Km	4	4	0.4	1.6	1.6
4	**Sig, Telecom & Traffic Control**	Km	7	7	0.00	0.0	0.0
5	**Traction Power Supply**		7	7	0.9	6.3	6.3
6	**Rolling Stock -2nd hand/New (Airport Express Train)**	Ea.	24	24	0.1/1.0 (1.5)	36.0	2.4/24.0
7	**Maintenance Facility**	Ea.	0	0	24.0	0.0	0.0
	Total					69.3	31.6/53.2

(2) Operation and Maintenance Cost

Operation & Maintenance costs consist of energy costs, personnel costs, maintenance materials costs and consumable costs. Personnel costs for operation and maintenance costs for infrastructure cover those for the spur lines only, and existing railroad sections where Airport Rails running are not included.

Table 9.3.17 O&M Cost Estimate for Airport Links

USD in year 2008 price level

No.	Cost Item	Semarang Airport Link	Solo - Yogya Airport Link
Standard Railcar Option			
A.	**Energy Cost**		
	Electricity Cost Related to Train Operation	222,492	212,707
	Electricity Cost Related to Stations	400,000	181,250
	Diesel Fuel Cost Related to Train Operation	0	0
	Sub-Total	622,492	393,957
B.	**Personnel Cost**		
	Personnel Cost for Train Operation	158,400	196,800
	Personnel Cost for Maintenance	158,400	180,000
	Sub-Total	316,800	376,800
C.	**Maintenance Material Cost**		
	Maint. Material Cost for Civil Work	38,676	77,352
	Maint. Material Cost for E&M	19,600	39,200
	Maint. Material Cost for Rolling Stock	180,000	360,000
	Sub-Total	238,276	476,552
D.	**Consumables Cost**		
	Consumables for Civil Work	1,160	2,321
	Consumables for E&M	588	1,176
	Consumables for Rolling Stock	5,400	10,800
	Sub-Total	7,148	14,297
	Grand Total	**1,184,717**	**1,261,605**

9.3.4 Institutional Setup of Railway Operation-Airport Link

The organization and problems facing the management of airport link railways is very similar to that of the commuter railway; airport link trains will operate within the rail commuter zone, linking the station in the CBD with the airport, located generally between 6 and 10 km outside the urban area; we have identified airport link projects for Solo and Semarang; suggested organization plans are shown below.

Figure 9.3.5 Propose Organization for Airport Link

We have proposed that the airport authority in both cases be part of the organization, to maximize coordination as well as to take advantage of any funding assistance in constructing the airport station. While we have shown a separate private sector organization responsible for managing these links, it may be prudent to combine these airport services with the rail commuter organization in either Semarang or Solo, respectively. As the ridership projections are relatively low, we recommend that the airport customers be served most efficiently by incorporating the airport service into the schedule of the rail commuter operator.

As the projected ridership for each of the airport links is not high, it would be logical to incorporate train service to and from the airport with commuter service in the same area. In fact, a successful airport link project is dependent on the commuter service established in the same area. Therefore, it is unlikely that a separate institution would be required for the airport links; the rail commuter service operator/manager would operate the airport link services.

9.3.5 Financial Arrangement of Airport Link Railway Operation

(1) Basic Assumptions

1) General

a Project Operation

The following table indicates the operation starting year by Airport Link project

Table 9.3.18 Start Operation

Project Name	Operation start	Construction Year
Semarang Airport Link	2015	2014
Solo Airport Link	2020	2019

Source: The Study Team

b Useful Life by Asset

Useful life by asset of airport link train is also as same as Commuter Train projects.

c Other

Other basic assumptions for the analysis are indicated below.

- Passenger Demand: With development passenger demand
- PSO: Without any regard for PSO of economy class train operation
- Subsidy: Without any regard for subsidy
- Interest Rate: 1.5%, Japanese ODA Loan
- Discount Rate 8% = Interest Rate 9.5%(Bank Indonesia, 07 Oct 2008) – CPI 6.5%(Bank Indonesia, Feb 2008) + Risk Premium 5%

Source: The Study Team

2) TAC (Track Access Charge)

The method of TAC calculation is the same as Commuter Trains in section 9.1.7. The following table indicates TAC calculated to cover the initial investment and O&M costs.

Table 9.3.19 TAC at Operation Start Year (Unit: Million Rp.)

Project Name	TAC	Breakdown Initial	Breakdown O&M
Semarang Airport Link	27,026	13,401	13,624
	100%	50%	50%
Solo Airport Link	41,499	27,067	14,432
	100%	65%	35%

Source: The Study Team

3) Revenue

a Demand

The Study Team assumed future passenger demand by class. The rate is set to expand business class passenger according to GRDP per CAPITA mentioned in Chapter 7. The below table indicates the composition rate of passenger demand. After year 2030, the rate of 2030 would be maintained until the end of project life.

Table 9.3.20 Future Passenger's Composition

	Economy	Business	Executive	Total
2010	50.0%	35.0%	15.0%	100.0%
2015	43.8%	38.8%	17.5%	100.0%
2020	37.5%	42.5%	20.0%	100.0%
2025	31.3%	46.3%	22.5%	100.0%
2030	25.0%	50.0%	25.0%	100.0%

Source: The Study Team

b Fare System

Fare system of Airport Line Projects is same as Commuter Train projects mentioned above.

4) Cash Flow

a Basic Case

The following table indicates the result of cash flow analysis, B/C and BEP (Break-Even Point) for 'Airport Link' projects by class. Subsidy (including PSO) is not considered in "Basic Case" as revenue.

All Airport-link train projects have negative condition according to results of cash flow analysis. However, the deficit amount decreases gradually decade after decade. By class, "Economy Class" is the most loss-making business, meanwhile the deficit amount in 'Business Class' and 'Executive Class' are smaller than 'Economy Class'.

Table 9.3.21 Summary of Cash Flow (Unit: Million Rp.)

(Total)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Airport Link	0.725	n/a	246,657	277,510	279,082	163,726	226,837	233,415	-82,931	-50,673	-45,667
Solo Airport Link	0.254	n/a	358,278	376,538	376,538	86,362	105,611	105,611	-271,916	-270,927	-270,927
(Economy Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Airport Link	0.189	n/a	92,922	74,538	69,771	16,924	15,352	14,449	-75,999	-59,186	-55,321
Solo Airport Link	0.065	n/a	112,959	94,135	94,135	7,187	6,545	6,545	-105,773	-87,589	-87,589
(Business Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Airport Link	0.991	9	104,607	135,659	139,541	99,855	141,343	145,978	-4,752	5,684	6,436
Solo Airport Link	0.333	n/a	164,465	188,269	188,269	53,277	66,044	66,044	-111,188	-122,225	-122,225
(Executive Class)			Acc. TAC			Acc. Revenue			Acc. CF		
	B/C	B.E.P	-10	10-20	20-30	-10	10-20	20-30	-10	10-20	20-30
Semarang Airport Link	0.993	9	49,128	67,313	69,771	46,948	70,142	72,989	-2,180	2,829	3,218
Solo Airport Link	0.346	n/a	74,401	94,135	94,135	25,898	33,022	33,022	-48,502	-61,113	-61,113

Source: The Study Team

b Consideration on Fare Setting

Since airports are gateways to the Central Java region, it is desirable that the trains to be utilized for airport link railway services are new and comfortable ones. However the analysis indicates financial difficulty if a world-standard special train is installed for the service. If second hand cars are utilized and the fare is set at business class level, B/C ratio is almost 1.0 for Semarang Airport Link, while Solo Airport Link still remains low at 0.311. If the airport authority and local governments would like to have new special train for airport link service, they should provide subsidy and purchase trains instead of a railway operator.

Table 9.3.22 B/C Ratio for Airport Link Railway Service

Case	Base Case	Case A	Case B	Case C
Fare Level	Economy + Business	All Business Class	All Business Class	All Business Class
Train Type	Second Hand EC	Second Hand EC	New EC	Special Train for Airport Link
Semarang Airport Link	0.725	0.979	0.821	0.642
Solo Airport Link	0.254	0.311	0.235	0.193

Source: CJRR Estimate, 2008

9.3.6 Environmental Impact Evaluation of Airport Link Railway

Semarang monorail will be constructed with elevated structure; therefore land acquisition can be minimized. Monorail passes the city center and hillside; hence harmonization with city landscape is required.

Basically existing railway corridor is used for Solo tramway; therefore adverse impacts will not occur. However, benefit for tourism activity is expected by adequate design and harmonizing with the landscape. Yogyakarta - Batul Tramway will need land acquisition.

Although Semarang and Solo airport links consist of construction of new short-length tracks, it is possible to minimize impact by adequate route selection and countermeasures.

During evaluation of Solo Airport Link under the Case Study, alternative-1 was finally selected because of more effective train service between Yogyakarta and Solo Airport. Alternative-1 consists of construction of partly elevated structure. Though alteranative-1 requires land acquisition, it can be minimized by adequate route design and installing elevated structure.

Table 9.3.23 Impact Evaluation of Proposed Program (Urban Railway and Airport Link)

Environmental Issue Proposed Project	Natural Environment	Pollution	Social Environment	Key Environmental Issue
1: Semarang Monorail (9 km)	D	B	C	Noise disturbance, Construction waste, Traffic disturbance, Landscape
2: Solo Tramway (11 km)	D	B	C	Noise disturbance, Traffic disturbance, Landscape
3: Yogyakarta – Bantul Tramway (29 km)	D	B	A	Noise disturbance, Traffic disturbance, Land Acquisition
4: Semarang Airport Link (9 km)	D	A	C	Noise disturbance, Construction waste, Land acquisition, Traffic disturbance
5: Solo Airport Link (7 km)	D	A	B	Noise disturbance, Construction waste, Land acquisition, Traffic disturbance

Note: A: Serious impact is predicted.
B: Some impact is predicted.
C: Unclear, need further evaluation.
D: No or less impact is predicted.

Urban railway and airport link are expected to enhance modal shift which leads mitigation of traffic congestion and air pollution. Therefore zero option (without case) is not recommendable even though it does not generate land acquisition and noise disturbance which are major negative impacts in development of urban railway and airport link.

Chapter 10 Conclusions and Recommendations

10.1 Present Problem of Railway Transportation

The current railway transportation in the Central Java region has been facing various problems. The railway passenger transport has decreasing demand in competition with low cost air carriers and private passenger cars and buses on the expressway. Furthermore many customers of railway freight transport have also shifted to trucks and trailers due to longer travel time and unreliability of operation.

In order to provide better and reliable railway service, there are many aspects to be improved. Transport capacity even on the main line is limited, although the currently double tracking project is implemented on the Java south main line by a Japanese ODA loan and those on the north line has been implemented by own government budget. Since most of the sections are still single track, thus once accident and trouble happen, then it is be difficult to recover the train operation to normal status.

Signaling system is mixed with Centralized train control (CTC) and conventional one and higher authority given to station master than chief of CTC center thus train control cannot be made centrally even though CTC system has been installed at some sections.

Aged and disordered trains often caused railway accidents and operation troubles and lead to delay of operation. The problem with rolling stock was brought about by insufficient maintenance and lack of spare part.

For freight transportation, in addition to deteriorated railway track and aged rolling stock, low priority of freight trains against passenger trains also makes freight train operation unreliable. Furthermore equipment for loading unloading are not available at some stations thus loading and unloading are made by workers. This insufficient tools and equipment also increase cargo handling time.

One of the crucial causes for the insufficient level of railway service is lack of financial sources of both the Central government and PT. Kereta Api (Persero) (PT. KA) for rehabilitation and improvement of the railway infrastructure and rolling stock.

Although the present railway transportation system in the region has various problems, the railway transport should play a primary role in public transportation system since it is economically efficient compared to the other modes of transportation especially for transporting large amount of passengers and commodities. Railway transportation is environmental friendly compared to rod transport and it consumes less energy. In the context of global warming issues, the railway contributes to reduction of greenhouse gas such as CO_2.

10.2 Anticipated Problem and Planning Issues

For establishing a railway development plan, not merely the present problems but also anticipated issues should be taken into consideration.

Urban population continues to increase in the metropolitan areas. Real household income would increase as a consequence vehicle ownership will increase. Then people would shift to private modes of transportation from public transportation. At present time traffic congestion in urban areas are not serious but in the future the shift to private mode would results in traffic congestion in the metropolitan areas. It would take considerable time to prepare well organized public transportation system; therefore, it is proposed to develop urban commuter railway service as a trunk public transportation system.

Reviewing the airport development master plan and respective air passenger demand for the three major airports in the region, air passenger demand is growing and it would require airport access by railway. The roles of Solo airport and Yogyakarta airport seems supplementary looking at the projected domestic and international passenger demand. The number of international air passengers in Solo airport would grow rapidly but the international air passenger demand in Yogyakarta appears to grow slowly. The airport rail link for Solo airport is connected to Yogyakarta.

Cargo volume transported by railway has been decreasing due to unreliability and less attractiveness of railway freight transport. Currently, bulky commodities such as cement, fertilizer, sand and coal which are suitable for railway transport are also carried by trucks and trailers. If the performance of railway transport is improved significantly then many shippers will come to utilize the railway again.

Various regional railway development projects have been identified in the long term railway system development plan. The development plan includes commuter railway service in three major metropolitan areas, freight train service, intercity passenger railway, urban railway in the city area.

10.3 Evaluation of Railway Projects

These railway projects were prioritized by economic evaluation, technical sequence between projects and preliminary environmental impact evaluation.

(1) Yogya Commuter Railway

Yogya commuter railway is a high priority project. Since the section between Wates and Klaten of the Yogya commuter railway has been double tracked, additional investment is relatively small compared to the other projects and this project does not have illegal occupants in the right of way (ROW) of the railway line.

(2) Semarang Commuter Railway

Semarang commuter railway indicates high priority in economic evaluation but it requires double tracking work and the proposed track elevation thus it take time for implementation. Urban drainage project is now being implemented and after six years from now on, the areas enclosed by east and west *Banjir Kanal* and the harbor road will be flooding free area. They will build dikes parallel to the harbor road thus close coordination should be needed.

(3) Solo Commuter Railway

Solo commuter railway is lower economic evaluation result compared to Yogya and Solo commuter service. This is partly attributable to the fact that Solo –Sragen section is less developed and this section is still single track therefore needs for investment for double track. However, Klaten - Solo section is already double tracked so that Yogyakarta comuuter railway may extend to Solo earlier than the whole section of Solo commuter railway.

(4) Solo and Semarang Airport Links

Both the Semarang airport link and the Solo airport link are important to provide railway service to airport passengers. The projected air passenger demands for both airports are however not large enough thus the project appears to be less feasible in economic sense. Thus it is proposed to combine service with commuter railway to reduce cost burden on common items. By combining the service with commuter railway it will reduce high peak ratio of passenger demand.

(5) Solo – Semarang Freight corridor

Solo – Semarang freight corridor development also indicates high priority in economic evaluation but it needs track elevation of railway line in Semarang city which is included in Semarang commuter railway project; thus the project should wait until the track elevation work is completed. The railway freight corridor development includes dryport development in Solo Kalijambe as well as Yogyakarta thus coordination between and dryport operator and freight railway operator is required.

(6) Yogyakarta – Magelang –Ambarawa – Kedungjati Intercity Railway

Yogyakarta – Magelang –Ambarawa – Kedungjati intercity railway train shows relatively low economic feasibility. Although a part of the abandoned railway line and right of way still exist along the corridor, railway tracks and bridges are already deteriorated thus it requires new railway construction over the whole section. Furthermore the section between Magelang – Ambarawa – Kedungjati is mountainous section thus the construction cost of the railway line is more expensive than flat terrain. On the other hand this section does not have sufficient passenger demand since most of them are through traffic. Yogyakarata -

Magelang section has larger demand compared to the other two sections consequently it shows better economic evaluation result but it requires grade separated structure within the Ring Road of Yogyakarta.

10.4 Requirements in Railway System Development

10.4.1 Universal Design for Physically Challenged

At present availability of the railway facilities for the physically challenged is still vey limited in the region. It is sometimes difficult to ride on the trains due to the gap between floor of train and ground even for able-bodied people. Since it is essential to provide a satisfactory mode of transportation for all members in the society, it is recommended to develop transportation facilities for the physically challenged. Since this requires funds for provision of facilities such as elevators, escalators, rest rooms for the physically challenged and it will take time to provide them at all the stations; thus, gradual improvement of such facilities should be incorporated in the railway system development plan.

10.4.2 Transit Oriented Development (TOD)

For urban commuter railway service, Transit oriented development (TOD) is a key strategy to develop urban railway financially viable. TOD is a development concept to integrate urban land use with a mass transit system. High-density housing and commercial development should be incorporated with transport nodes, i.e. railway stations.

In this case, the local government should be responsible to develop access roads to railway stations and a station plaza should also be built to accommodate transfer from access mode to a train. The local government should accommodate land use change by revising land use plan (Rencana Tata Ruang Kota) from previous one.

10.5 Application for Environmental Permission

Under recent policy on decentralization, Indonesia National Government has transferred roles and responsibilities on environmental management to local government. Regarding Environmental Impact Assessment (or *Analisis Mengenai Dampak Lingkungan*, AMDAL) in Indonesia) that is environmental permission for project implementation. In case a project location is in a province, Provincial Environmental Impact Regulatory Body (or *Badan Pengendalian Dampak Lingkungan*, BAPEDALDA) or kabupaten shall manage evaluation and decision on environmental permission.

Yogyakarta Special Province and Central Java Province have own environmental management system. National regulation, "Ministry of Environment Decree No. 11/2006" states type and scale of project to be required to complete AMDAL. Both local governments use this regulation for decision for classification of projects. Table 10.5.1 describes project scale of each type (Railway sector, Road sector and related) to require AMDAL.

Table 10.5.1 Sector and/or Type of Project to Require AMDAL

Sector / Type of Project	Scale to Require AMDAL
Transportation and Communication Sector	
Railway network Development - Length Underground Railway	 ≥ 25 km All unit
Integrated Terminal Development - Area Extent	 ≥ 2 ha
Industrial Sector	
Industrial Zone including integrated industrial complex)	All unit
Industrial activity excluding cement, pulp/paper, petrochemical, ship building, ammunition / explosive and above a) Urban Area - Metropolitan area - Large city - Medium city - Small town b) Rural Area	 ≥ 5 ha ≥ 10 ha ≥ 15 ha ≥ 20 ha ≥ 30 ha
Public Work Sector	
Toll Road Construction - Length	 ≥ 5 km
Road Development a) Metropolitan Area - Length - Land occupied b) Medium town - Length - Land occupied c) Rural Area - Length - Land occupied	 ≥5 km ≥ 5 ha ≥10 km ≥10 ha ≥30 km ≥30 ha
Development of Subway, Underpass, Tunnel Bridge	≥ 2 ha ≥ 500 m
Housing / Settlement Development a) Metropolitan Area b) Big City Area c) Town Area	 ≥ 25 ha ≥ 50 ha ≥ 100 ha
Development of Office, Education, Commercial, Trade, Religious Center - Area extent - Building	 ≥ 5 ha ≥ 10,000 m^2
Tourism Sector	
a) Tourism Area b) Recreation Park c) Golf Course	All units ≥ 100 ha All units

Source: Ministry of Environment Decree No. 11/2006

This regulation explains that railway developments, with scale exceeding 25 km, require AMDAL. Proposed master plan includes smaller programs, however the above regulation also states that Governor can recommend taking AMDAL in case the said project predicts adverse impact. It is understood that large-scale land acquisition, degradation of natural ecosystem, e.g. can cause adverse impacts. Therefore it is recommendable to take AMDAL or same level of assessment. The Table below lists projects under

Case Study with necessity of AMDAL.

Table 10.5.2 Necessity of AMDAL in Each Program under Case Study

Project	AMDAL under Regulation	EIA Recommended	Evaluation
Commuter Train			
Semarang Commuter (67 km)	Need	A	Need double-tracking, elevated line, new stations
Solo Commuter (58 km)	Need	A	Need double-tracking, elevated line, new stations
Yogyakarta Line (58 km)	No	B	Use existing double-tracking but need new stations.
Urban Railway and Airport Link			
Semarang Monorail (9 km)	No	B	Need elevated line. Monorail needs new technology.
Solo Tramway (11 km)	No	C	Short length, use existing line, but in urban area.
Yogyakarta Tramway (29 km)	Need	A	Long length, need land acquisition
Semarang Airport Link (9 km)	No	C	Short length.
Solo Airport Link (7 km)	No	B	Short length but need partly elevated line.
Fright Train			
Semarang - Solo Corridor (109 km)	No	C	Use existing line, basically rehabilitation work
Wonogiri – Solo Corridor (40 km)	No	C	Use existing line, basically rehabilitation work
Semarang Port Access (3 km)	No	C	Short length
Solo Dry Port Access (2 km)	No	C	Short length
Yogyakarta Inland Port Access (24 km)	No	B	Short length of new line (2 km), new station

A: Recommended AMDAL
B: Some Recommended AMDAL or UKL/UPL
C: Less Recommended, probably UKL/UPL

Land acquisition is one of the most crucial impacts possibly caused by railway developments. Some proposed programs require large-scale land acquisition and resettlement. Therefore it is strongly recommended to provide Land Acquisition and Resettlement Action Plan (LARAP) Study. The following issues shall be considered in the LARAP Study.

- Adequate Estimation of Compensation.
  If necessary and/or possible, market price based compensation is recommendable because NJOP based price is too small to secure the same level of assets.

- Income Recovery
  Land acquisition and resettlement may cause change and/or loss of opportunity. Therefore supporting program focusing income recovery is important. The program shall be considered with below viewpoints:

  - Priority recruitment and/or business permission under projects.

- Job training, skill improvement training.

- Establishment of Resettlement Site
  In case new relocation site is necessary to be constructed, the following issues are important:
  - Adequate installation of infrastructures such as water supply, sewerage, electricity, social facilities.
  - Consultation on social conflict between resettlement people and original residents.
  - Adequate consideration to community customs including religious issues.

Humanitarian perspective for illegal settlement
Even though illegal settlement does not have rights of land occupation, it is recommendable to take the humanitarian perspective to support their better life style. Otherwise such an issue can generate local conflict and raise negative perception among the people, and lead to stagnating of project implementation.

10.6 Institutional Setup for Regional Railway System Development

Insufficient management capability on railway business and lack of discipline of employees are regarded as a cause of inefficient railway service provision. At the same time deteriorated railway infrastructure and aged rolling stock are also a cause of unsatisfactory level of railway service. The Central government has limited budget for railway infrastructure development and improvement, while PT. KA is also suffering from shortage of revenue. Therefore it is essential to expand funding sources for investment.

Since the new railway law allows local governments and private sector to be involved in the railway business, participation of new business entities will support to increase available funds for railway development.

(1) Organization Structure

It is recommended to establish a Central Java Regional Railway (CJR) with strong private sector participation, to strengthen railway service, make it more competitive, and to provide an additional source of capital investment funds to grow the railway business in the Central Java region. The Rail Operator would be the strong driving force of the CJR and come from the private sector. There are several alternative ways to structure this concept as described below.

(i) Establish a Local Government Owned Enterprise (LOE) to develop and administer a performance based contract for the Rail Operator. The Rail Operator would likely include an Indonesian freight forwarder and an overseas organization experienced in railway operations. PT. KA would maintain and dispatch the railway line and the Rail Operator would market the freight business, operate trains (freight and passenger, if commuter service is included) collect revenue and manage the railway business aggressively to increase rail market share and increase operating efficiency.

(ii) The second alternative would be to establish a LOE responsible for train operations which would be a joint venture with the private sector rail operator. Composition of the rail operator would be similar to that described in the first alternative.

(iii) A third alternative would be to establish a joint venture between PT. KA, individual shippers and the private sector rail operator. Under this third alternative, there would be no change in the structure or manner in which track access fees are administered or paid.

(2) The Bidding Process for Rail Operator

Then Central Java Railway operator (Rail Operator) will be selected from interested private companies thorough a process of competitive bidding. Service levels will be determined by the provincial government and all bidders must agree to achieve at least, these standards of service. An important component of the bidding selection criteria would be the requirement that the Rail Operator purchase rolling stock necessary to support the service; bidders could offer to make additional investments in the line. Bidding criteria could include such items as track access charge to pay to PT. KA and the government (central and provincial), passenger fare level and management fee. In this way, the desired service levels would be achieved at the lowest possible cost and with the greatest efficiency.

(3) Recommended Institutional Alternative

Three institutional alternatives were presented for the proposed Central Java Railway. While it is possible to establish the railway along the lines of any of these three, their impacts on the objectives of establishing this organization will likely be different. These objectives include creating an organization structure favorable for private sector involvement that would lead to increased freight traffic moving by rail through innovative rail operating and marketing practices as well as efficient operation of rail commuter systems in accordance with the performance contract with the provincial government. This private sector involvement would likely include an Indonesian freight forwarder and a rail operator from overseas. Involvement of the private sector would also provide an additional source of project finance for purchase of locomotives and rolling stock, as well as possibly some additional investments in the railway system. Perception of risk by the private sector company, will have a direct impact on their willingness to participate and to make these investments.

The likelihood of positive private sector influence and financial contribution would be greatest under Alternative #1 or #2; it is unlikely that Alternative #3 would produce a successful private sector contribution.

10.7 Conditions to Materialize Railway System Development

In the financial analysis of the Study, it is assumed that the initial investment cost for railway infrastructure development will be paid as Track Access Charge (TAC), taking depreciation of facilities into account. It is also assumed that this TAC is paid by railway operators according to train car * kilometers of passenger trains, freight trains and the existing trains operated by PT. KA. Financial feasibility appears good for the Semarang – Solo freight transport corridor; however, if the other railway system development cannot be achieved and if they cannot share the TAC, the cost burden to the freight corridor development becomes heavier. Thus viability of the freight corridor would be worse. This implies that financial viability of the projects is obtained only if all the proposed projects are implemented and they share the initial investment costs among the projects.

Cargo demand of railway transport was projected based on the transport plan of materials and products of shippers; thus reliability of forecast is high. On the other hand, container transport demand carried by railway depends on the comparative advantage of railway transport service over road transport. In this regard, it is important to develop industrial estate next to a dry port, and redevelop the railway branch line to container yard to reduce time and cost due to double handling. It is important to attract shippers by reducing disadvantages of railway freight transportation through minimizing loading and unloading time and cost at the both ends. These developments require coordination among the relevant agencies. Directorate General of Railways and Transportation Bureau of Local government should take lead to materialize these developments. Furthermore a new regional railway company should undertake aggressive marketing to increase container demand.

In the Study, urban commuter railway services are proposed in the three metropolitan areas (Semarang, Solo and Yogyakarta) where urban transportation problems are expected to be more severe. It should be noted that railway passenger demand would not increase by only railway service improvement. Increased demand requires having an integrated railway system development with urban redevelopment in the city center and housing development along the railway corridor. These urban developments would increase not merely railway passenger demand and subsequent revenue from ticket sales but also increase profits from real estate business. This is a commonly practiced mechanism to absorb development benefit as revenue from property business. Railway business in Indonesia is not able to adequately maintain and upgrade the railway infrastructure and rolling stocks merely with railway transport revenue since this amount is limited. Consequently it is fundamentally required to expand the revenue base for railway system improvement. To implement housing development and urban development, first of all, the change of land use in the spatial plan at local level is required. To develop the surrounding areas of railway stations local government should develop station plaza, park and ride facility, access roads to the stations and road network in the surrounding area in collaboration with a real estate company. Without such supports from central and local governments, the railway system development will not be materialized and the expected effects would not be achieved.

In addition, conditions for private sector to enter the railway transportation business should be clearly defined in order to attract them. For instance, the method of calculation of subsidy should be clearly defined; otherwise the private sector regard it too risky and they will be reluctant to participate in the business.

As mentioned above, to materialize the proposed railway projects, it is indispensable to implement the following measures by relevant agencies in timely manner.

Table 10.7.1 Actions to be taken to Materialize Proposed Railway Projects

Agency	Timing	Action
Directorate General of Railways, Ministry of Transport (MoT)	Prior to establishment of Provincial Government Owned Enterprise	To establish task force to define a role of central and provincial governments in regional railway system development
	Prior to commuter railway service and Prior to the start of the Semarang - Tegal and Semarang – Cepu intercity passenger train service	To speed up double tracking on the Java north main line.
	Prior to start of Semarang commuter railway service	To give priority for double tracking to Kendal - Semarang - Brumbung section
	Prior to the start of Semarang – Solo freight railway transport	To improve railway infrastructure on the Semarang – Solo corridor in collaboration with Provincial government
	Prior to start of Semarang – Solo freight railway transport	To coordinate with relevant agencies(Directorate General of Highways, Ministry of Public Works, Dinas PU, Pelindo III, Power Plant, Kota Semarang Government, regarding Tg. Emas port access line
Provincial Government	Prior to the start of regional railway service	To establish Provincial government owned enterprise (Central Java Railway Company) To formulate railway service standard and quantity and quality of the required railway service in the region.
	Prior to the start of Semarang – Solo – Yogyakarta freight railway transport	To develop integrated dryport and industrial estate near railway line
Kabupaten/Kota Governmnet	Prior to the start of the commuter railway service	To make modification on land use plan which enables housing development along the railway corridor To develop station plaza and access road to the railway station
Private Railway Company	Prior to the start of railway service	To purchase of rolling stock To develop housing area along the railway corridor To develop urban facilities in the center of the city To purchase loading/unloading equipment for freight transport

10.8 Next Action

To materialize the regional railway system development projects recommended in the Study, it is recommended to establish task force team between Directorate General of Railways, Ministry of Transport and Central Java Province and DIY Governments for creating Central Java Railway (CJR) company. The task force team should define the role and responsibility of central government and provincial government in the regional railway system development.