Rail Town Development and land use plan for Lat Krabang West and East New Urban Communities is presented in Fig. 25.

### 2.4.2 Rail Town Development Plan around Lat Krabang East Station

(1) General conditions

The project site is located between Hua Takhe Station and Khlong Luang Phaeng Station, which is mostly covered by agricultural land used as paddy fields.

The advantages of this area for the integrated urban and railway development are summarized as follows;

- New Station construction is possible taking into consideration interval (distance) between stations and available open land.
- The service areas of the new station are undeveloped awaiting urban development.
- The construction of the new station and the railway improvement are deemed to create high development potential around the station resulting in a great increase in land value.
- The expected high land value may help the IURD System, including the value capture work efficiently and effectively. This project should be a successful model of urban area development through the IURD System.
- The new station is to give great benefits to land owners and developers. This is expected to help gain good coordination and consensus among them for the implementation of the urban project.
- This area is located at the central points of the Lat Krabang East new town. (This is the reason why this area is selected for the new town center)
- In addition to the rail transport service, the accessibility to the planned interchange of Chonburi Expressway and Chachoengsao Expressway will be quite high.
- This area is located close to the special business zone 1, planned on the east side of SBIA.
- The existing road is available for access to the new station. Development can start immediately after the construction of the station.

(2) Development and land use plan

Based on the new town development plan as proposed in the preceding section, the Urban Development and Land Use Plan is worked out as shown in Fig. 26. The land use planned includes the commercial area in the vicinity of the new station and other sites such as a university and parks.

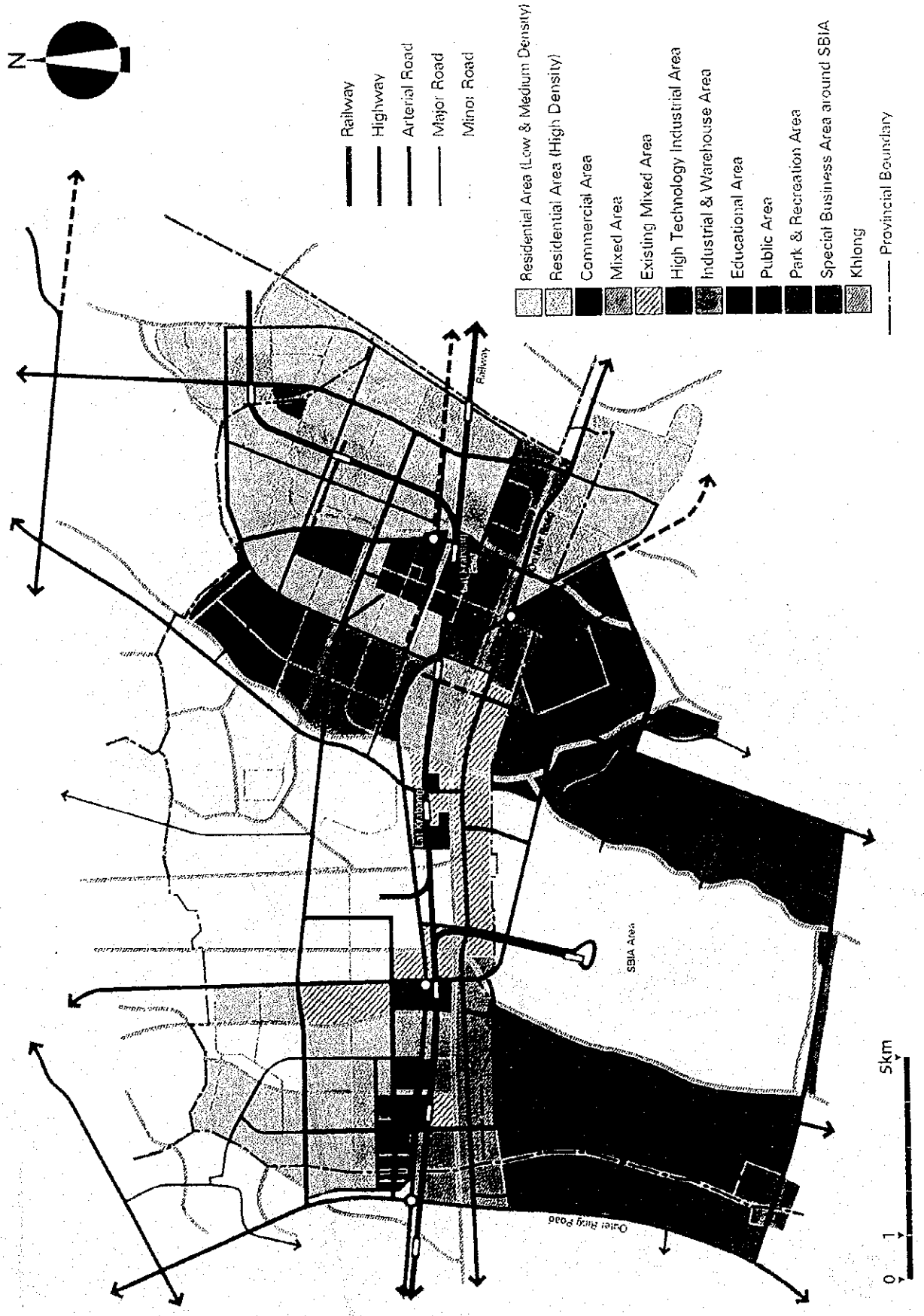



Fig. 25 Urban Development and Land Use Plan

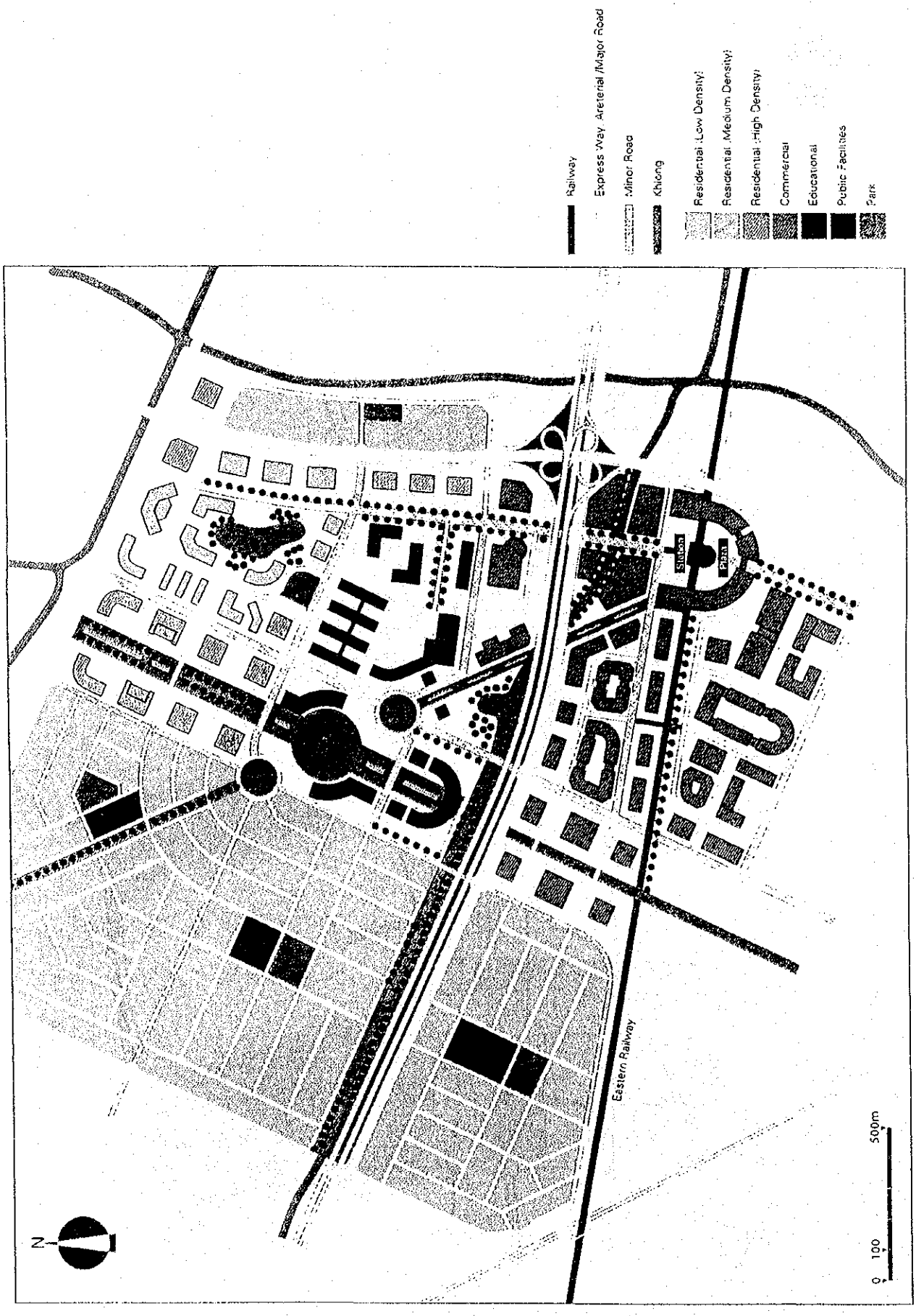



Fig. 26 Conceptual Land Use Development around Lat Krabang East Station

## 2.5 Model Urban Area Development (Approx. 100 ha)

### 2.5.1 General

In this chapter, a conceptual development plan of the area around Lat Krabang East Station (new station) is presented.

Objectives of this planning process are summarized as follows:

- Suggestion of planning measures for the Model Urban Area to ensure successful implementation.
- Creation of an urban core to induce Lat Krabang East New Town to rail-oriented urban development.
- Providing an appropriate set of urban infrastructures.

An area of approximatly 100 ha is cut out for the Model Urban Area. The criteria for selection are set as follows:

- Lat Krabang East Station has to be the nucleus of the project area in order to make an urban development plan integrated with the railway.
- The project area is expected to have high development potential.
- The project area has to have an appropriate number of lots in order to avoid complicated coordination among land owners.
- The future land use of the project area should be unified as far as possible.
- Infrastructure improvement is needed prior to other areas and should take the tendency of urbanization in surrounding areas into account.

In accordance with the above-mentioned criteria, a project area of 120.9 ha is selected.

### 2.5.2 Basic Framework

The Model Urban Area is proposed around Lat Krabang East Station where rapid train service will be provided as well as local train service.

Basic policies of city planning and development for the 120.9 ha Model Urban Area are summarized as follows:

- Creation of a new town center integrated with railway station
- Connection development between the north and south sides of the railway
- Creation of efficient/functional urban structures
- Inducement of systematic urbanization for areas around the model urban area

### 2.5.3 Measures of Land Acquisition

(1) Traditionally developed practices

The traditionally developed practices in urban and land development and implementation, among others are:

i) Voluntary land donation to infrastructure construction, especially road construction.

ii) Advertisement system (public solicitation) for public real estate development without specifying the development sites, represented by the systems applied to the industrial estate by IEAT and the housing estate by NHA.

iii) Land purchase for public development without exactly specifying the sites to prevent speculation or land price hikes, easing the negotiations on purchasing land, and so on.

(2) Existing legal arrangement of land acquisition

The urban and land developments are mostly initiated and implemented by the private sector in Thailand. The urban and land development by the public sector is quite limited as follows, leaving most of the urban developments to the private real estate business and market.

- Social welfare type projects such as low cost housing, slum-upgrading and others by NHA.

National economic development type projects such as the export processing zone and industrial estate development by IEAT, the Agricultural land consultation projects to achieve the national goal of the increase of agricultural production.

It appears quite difficult to develop such large service areas of railways as planned in this study. It necessitates the development of innovative measures for urban and land management and development. The existing legal arrangement is summarized in Table 22.

Table 22 Legal Arrangement of Urban and Land Management

| Act | Legal Power | Act | Royal Decree | Ministerial Regulation |
|---|---|---|---|---|
| Expropriation Act | Expropriation | | Lands to be expropriated | |
| Public Works Act | Expropriation | | Royal decree based on Expropriation Act | |
| Agricultural Land Consolidation Act | Expropriation of land of dissidents | | Areas of land consolidation programme Expropriation | |
| Town Planning Act | Compulsory | Specific plan | | General Plan |
| Industrial Estate Authority of Thailand Act | Expropriation | | Export processing zone | General Industrial Zone |
| National Executive Council Decree No. 316 (National Housing Authority) | No power to expropriate Expropriation in slum upgrading | | National executive council decree Acquisition of land Clearance of degenerate settlements | Rules, Procedures Conditions |
| Subdivision Control Act | No power to expropriate | | | |

### 2.5.4 Forecast of Land Price Increase by Railway Improvement and Development Gains

(1) Forecast of land price increase

According to the "National Urban Development Policy Framework" by NESDB, the relationship between land prices (1990) and distance from the center of Bangkok is shown in the following equation. (Fig. 27)

$$Vx = e^{-0.06x + 16.6}$$

where x: distance from center of Bangkok (km)
Vx: land price at a point x (million baht/rai)

Use of improved railways shall cut down travel time by half compared to road use. Accordingly, it is supposed that the average land price after railway improvement around Lat Krabang East Station will become equal to the average land price at a point half the distance from the center of Bangkok to the Model Urban Area. Therefore, the increase rate around Lat Krabang East Station can be estimated at 3.31. The average land price before the project is approximately 1,500 baht/$m^2$ in accordance with actual data on land transactions.

However, the above-mentioned equation expresses only the tendency of average land prices by distance from the CBD. The actual land prices vary at the same distance, as Fig. 27 shows. It is deemed that the difference in land prices are caused by land use, condition of infrastructure and so on. The other regressive line showing the highest land price by distance is drawn as shown in Fig. 27. Those land prices are supposed to represent the price of land in the urban center or commercial center located in/around Bangkok.

After the development, the 500 m radius area of Lat Krabang East Station, namely the Model Urban Area, is characterized as follows;

- Model Urban Area shall be the center of a new town with a population of 200,000.
- Agricultural land shall be converted into highly improved commercial/business area.
- The area shall have prominent convenience because of proximity to the railway station.

It is presumed that the land price of the Model Urban Area will increase to 12,500 baht/$m^2$, which is the present land price of the local urban center located 20 km away from the center of Bangkok, because of the railway improvement and characteristics of development.

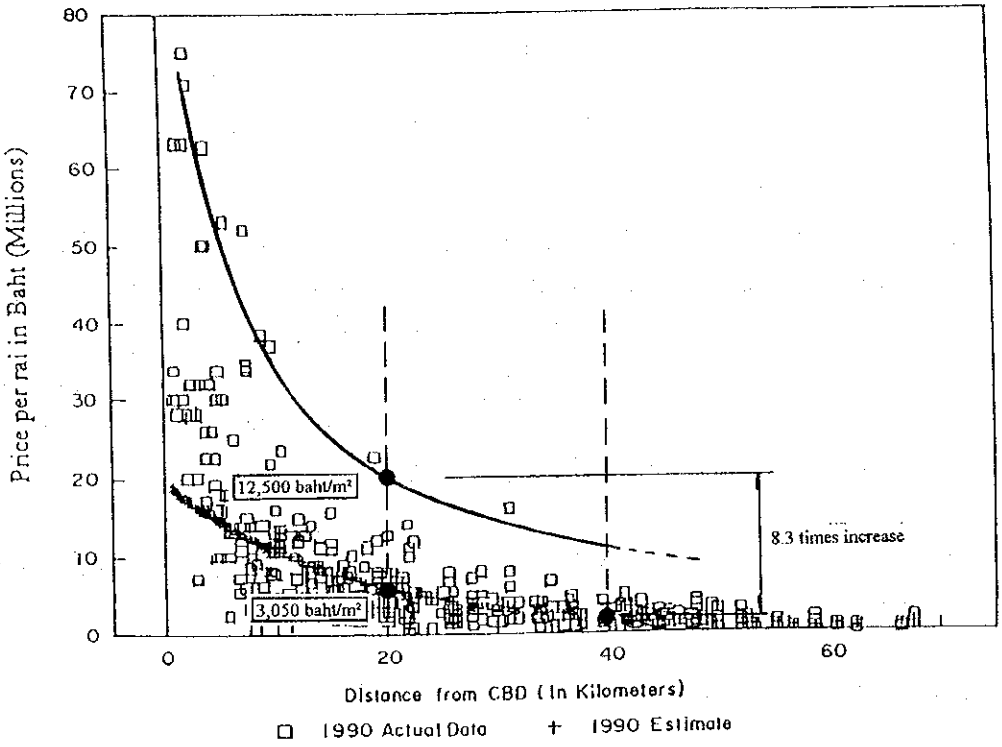



Fig. 27 Land Price as a Function of Distance

(2) Development gains

Based on the above assumption, development gains of this area of 120 ha are roughly estimated.

As will be seen later, the maximum reserved land area possible to be obtained in this land readjustment project is 652,000 $m^2$, out of which 114,000 $m^2$ will be sold to pay the cost of this project. Therefore, 6,725 million baht, which can be obtained by selling the remaining 538,000 $m^2$ of land, can be regarded as "development gains".

Those development gains should be returned to the land owners and public sectors as well as invested in the railway improvement which has played an important part in the land price increase.

The most appropriate measures and systems should be chosen to realize this in accordance with the actual circumstances of the field. If the SRT itself or the SRT Urban Corporation, newly established for this purpose, execute land readjustment projects directly, development gains can be returned for related railways investment.

### 2.5.5 Execution by Land Readjustment

(1) Lot/block design

The lot/block design is to determine the appropriate size, shape and location of lots and blocks encompassed by roads, in consideration of land use, space design, image of the urban environment, building development, replotting, road networks and so on. The determination of lot/block design is to be a factor affecting the urban environment and social life style in future. This is also related to the amount of public lands and contribution ratio which is one of the determinants of project feasibility.

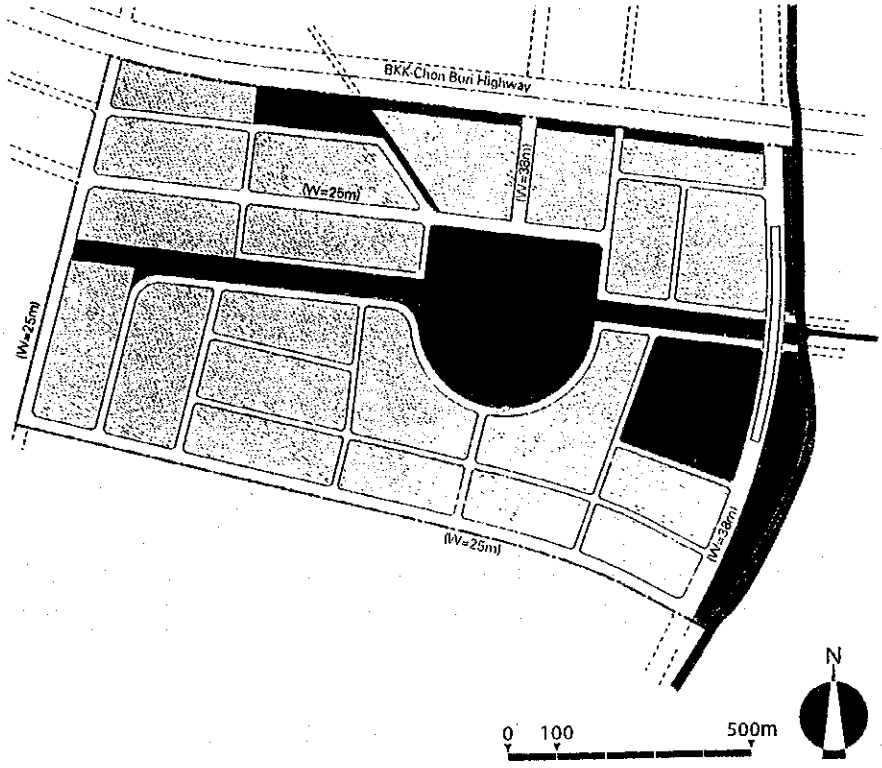
Basic lot units are assumed to be about 3,000 sq. m and 6,000 sq. m according to the size of existing lots.

(2) Summary of land readjustment design

The land readjustment design and comparison of land use before and after the project is shown in Fig. 28 and Table 23.

Table 23 Land Use Comparison

| Classification \ Before/after execution | | Before execution | | After execution | |
|---|---|---|---|---|---|
| | | Area(㎡) | Percentage | Area(㎡) | Percentage |
| Public Land | Road | 11,200 | 0.93 | 219,600 | 18.16 |
| | Railway | 59,200 | 4.90 | 59,200 | 4.90 |
| | Others | 19,200 | 1.59 | 142,950 | 11.82 |
| | Total | 89,600 | 7.42 | 421,750 | 34.88 |
| Private Land | Housing | 0 | 0 | 787,250 | 65.12 |
| | Commercial | 0 | 0 | | |
| | Agriculture | 1,119,400 | 92.58 | | |
| | Total | 1,119,400 | 92.58 | 787,250 | 65.12 |
| Grand total | | 1,209,000 | 100.00 | 1,209,000 | 100.00 |



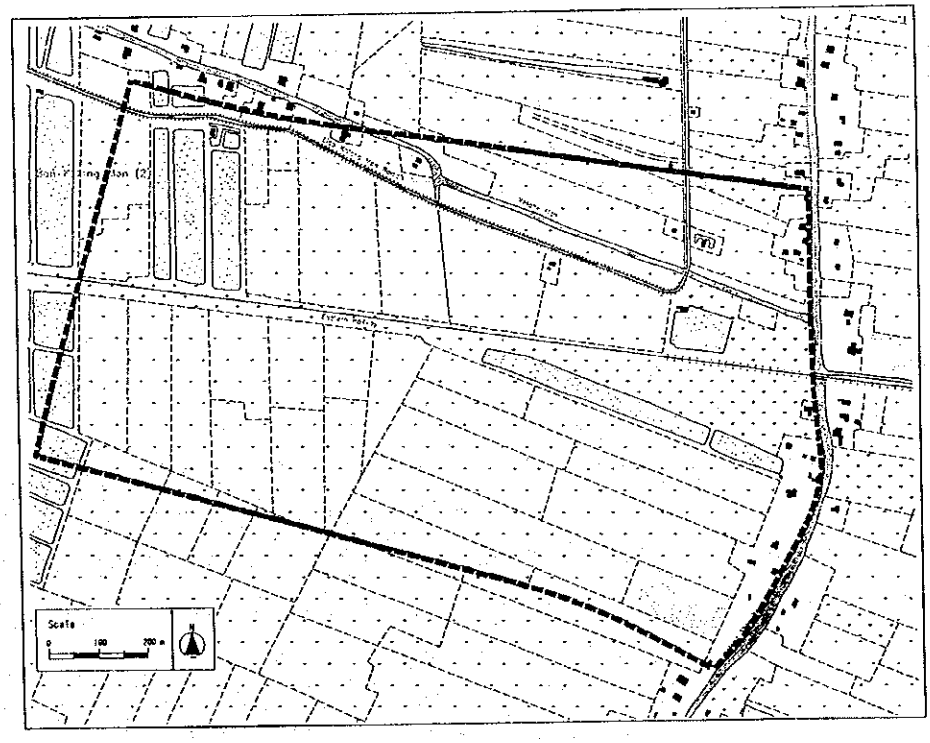



Fig. 28 Land Readjustment Design and Existing Land Use

(3) Contribution rate and reserved land

Contribution rate and reserved land of the proposed land readjustment project are shown in Tables 24 and 25.

Table 24 Contribution Rate

| Private Land before Project | Private Land after Project | | Contribution Land Area | | Contribution Rate | | |
|---|---|---|---|---|---|---|---|
| | Private Land including Reserve Land | Private Land excluding Reserve Land | Contribu-tion Area for Public Use | Total Public and Reserve Land | Contribution Rate for Public use | Contribution Rate for Reserve Land | Aggregated Contribution Rate |
| A ($m^2$) | B ($m^2$) | C ($m^2$) | D=A- B ($m^2$) | E=A- C ($m^2$) | F=D/A*100 (%) | G=M/A*100 (%) | H=E/A*100 (%) |
| 1,119,400 | 787,250 | 673,250 | 332,150 | 446,150 | 29.67 | 10.18 | 39.86 |

Table 25 Proposed Reserved Land

| Total Land Price before Project | Land Price before Project (Unit) | Total Land Price after Project | Increased Land Price (Total) | Land Price after Project (Unit) | Maximum Land Area for Reserved Land | Reserved Land Area | Ratio |
|---|---|---|---|---|---|---|---|
| I=A*a (million baht) | a (baht) | J=B*b (million baht)) | K=J-I (million baht)) | b (baht) | L=K/b ($m^2$) | M ($m^2$) | N=M/L*100 (%) |
| 1,679.10 | 1,500 | 9,840.63 | 8,161.53 | 12,500 | 652,922 | 114,000 | 17.46 |

(4) Project cost

Project cost is shown in Table 26.

A total project cost includes total construction costs and total interest due for loans. However, interest charges are calculated for project length and various revenue sources; actual total project costs shall be calculated in the course of the Financial Plan which shall be proposed in the latter stage of this study.

Table 26. Summary of Project Cost

| Item | Amount (thousand baht) | Remarks |
|---|---|---|
| 1. Compensation Cost | 28,700 | |
| 2. Infrastructure Development Cost | 1,023,430 | |
| 3. Survey and Design Fee | 147,300 | |
| 4. Operation Cost | 119,950 | |
| Subtotal | 1,319,380 | |
| 5. Repayment of Interest | | To be estimated by financial plan |
| Total Project Cost | 1,319,380 | Not including interest |

### 2.5.6 System for Urban Development around Railway Stations

(1) Developing and implementing organization.

A corporation specialized for the integrated urban and railway development (IURD) may be established, if necessary. The type of corporation will be one of the following:

i) Government corporation
- Development arm of SRT (one of the SRT organizations)
- SRT's subsidiary
- NHA's subsidiary
- Independent corporation joined by SRT, NHA, IEAT, etc.

ii) Joint venture by the public and private sector

iii) Private development corporation

(2) Aims of the integrated urban and railway development corporation

The integrated urban and railway development (IURD) corporation aims at

i) Accelerating urban/housing development in the IURD zone and materializing the IURD development plan.

ii) Channeling the development benefits to SRT through urban development business. In this context, it is quite important to strengthen and expand the power of the NHA and IEAT, especially in the IURD zone as follows:

· The power of the NHA and IEAT should be strengthened and expanded so as to have the capacity for developing large-scale new towns in the IURD zone.

· The MRSP study recommended to developing the industrial estate in or close to the urban area. It intends to urge IEAT to pay more attention to industrial town development, not only to industrial estate development isolated from urban activities. Hi-tech new town is a typical example of a project to be implemented by IEAT in this regard.

· To this end, legal powers such as those of pre-emption of land and land expropriation should be granted to the development projects of the NHA, IEAT and others, exceptionally in the IURD zone.

The URD legal system must clearly stipulate the authorities and legal power of the urban development projects and implementing organization in the IURD zone system. For example, the NHA, IEAT or other agencies can be implementing agencies of land readjustment, new town development, etc.

(3) Cost sharing by beneficiaries

The boundary of the IURD zone corresponds to the boundary of locational areas of beneficiaries of railway improvement. The cost sharing system by beneficiaries is comprised of the following three (3) measures:

i) Taxation (general/special)
ii) Compulsory or optional contributions from the special beneficiaries like the real estate developers and landowners
iii) Development profit created through urban development implemented directly by the railway operator

(4) SRT Urban Development Corporation

Special consideration must be given to the urban and land development around the station, including the station plaza. The land use of the district around the station is crucial for urbanization within the service area as a whole because it must work as an urban center or commercial center regulating and leading the urbanization within the entire service area of the station.

It is recommended that the SRT Urban Development Corporation be established with the view of achieving public purposes such as construction of the station plaza and urban development of the station front lands. The corporation shall be engaged in the real estate development and management in front of the station, namely construction of commercial/office space, condominiums, amusements and others.

The existing SRT act in force allows the SRT to invest in the joint venture with the private sector (less than 49% share holder), but not to have an affiliated company. It is reported the SRT itself sought the revision of the act in order to do it.

The corporation is to purchase pieces of land around the station in advance. The acquired lands are replotted and consolidated in front of the station, including the site of the station plaza.

## 2.6 Railway Improvement Implementation Program

### 2.6.1 Railway Improvement Plan

(1) General

Improvement of railway transport service should promote integrated urban development along the lines and have sufficient transport capacity for the demand generated by urban development.

Remarkable innovation of railway facilities, rolling stock, management and so on is necessary. Especially, in order to divert customers from road-oriented to rail-oriented transport .

(2) Main items of improvement

1) Commuter service

By the following improvements between Yommarat and Chachoengsao in the 50 km radius area, urban transport service of high speed (max. 120 km) and high frequency (10 min. each headway of rapid and local trains in rush hour) will be provided.

a) Yommarat - Hua Mak (13.0 km)

This section is to be improved by the Hopewell Project. Therefore, electrification will be executed in this Project.

b) Hua Mak - Khlong Luang Phaeng (24.1 km)

The following improvements will be executed as the "first step":

- Electrification
- Strengthening structures, tracks, signaling system, etc.
- Improvement of station facilities
- Introduction of electric railcars
- Establishment of a depot and a workshop

c) Khlong Luang Phaeng - Chachoengsao (20.1km)

The above improvements will be executed as the "second step".

d) Other improvement items

- Improvement of at-grade crossings with roads
- Provisional service by diesel railcars

2) SBIA access service

By construction of a branch line between Lat Krabang and SBIA North Terminal, convenient airport access service (20 min. headway, travel within 30 min.) will be provided.

Lat Krabang - SBIA North Terminal (5.1 km)
- Construction of a railway line including electrification
- Introduction of electric railcars

3) Intercity express service

By introducing high-performance comfortable diesel railcars, utilizing most of the existing railway facilities, intercity express service between Bangkok CBD and ESB (1 hour headway, max. 120 km/h) will be provided.

Hua Lamphong - Map-Ta-Phut
- Introduction of diesel railcars
- Reinforcement of at-grade crossing safety devices
- Increase of crossing loops and refuge tracks

### 2.6.2 Estimated Investment Cost of Railway Improvement

Estimated investment cost of the proposed railway improvement, based on the items of improvement and the demand forecast, is shown in Table 27.

Table 27 Railway Improvement Investment Cost

(million baht)

| Item \ Case | | Alternative 1 Improvement for commuter service | Alternative Improvement for airport access service | Alternative 3 Improvement for intercity express service |
|---|---|---|---|---|
| Facil- | Lan | 264 | 264 | 264 |
| ities | Civil work | 793 | 1,260 | 1,265 |
| const- | Track | 447 | 589 | 662 |
| ruction | Building | 464 | 550 | 550 |
| | Electrification | 3,443 | 3,485 | 3,485 |
| | Signalling/Telecom. | 1,340 | 1,434 | 1,953 |
| | Machinery | 466 | 512 | 512 |
| | Sub total | 7,217 | 8,094 | 8,691 |
| | Contingency (10%) | 724 | 811 | 874 |
| | Total | 7,941 | 8,905 | 9,565 |
| Rolling stock | | 5,009 | 5,332 | 8,212 |
| Grand total | | 12,950 | 14,237 | 17,777 |
| Local currency | | 5,236 | 5,923 | 6,234 |
| Foreign currency | | 7,714 | 8,314 | 11,543 |

### 2.6.3 Implementation Program

Proposed railway improvement investment will be executed in three "five years" steps. Estimated cost for each of the three steps is shown in Table 28.

Table 28 Implementation Program of Investment

(million baht)

| Step \ Case | | Alternative 1 Improvement for commuter service | Alternative 2 Improvement for airport access service | Alternative 3 Improvement for intercity express service |
|---|---|---|---|---|
| Step I | 1996-2000 | 8,070 | 9,180 | 11,440 |
| Step II | 2001-2005 | 3,770 | 3,920 | 4,560 |
| Step III | 2006-2010 | 1,110 | 1,140 | 1,780 |
| Total | | 12,950 | 14,240 | 17,780 |

## 2.7 Economic/Financial Evaluation of Railway Improvement

### 2.7.1 Economic Evaluation

(1) Methodology

Steps required in the economic evaluation are as follows:

- Estimation of tangible benefits to which costs/values can be assigned
- Estimation of intangible benefits to which costs/values cannot be assigned
- Calculation of EIRR
- Sensitivity analysis

(2) Estimation of tangible benefits

The tangible benefits identified for this project are as follows.

- Operation cost savings of the SRT
- Time cost savings
- Savings of road maintenance cost
- Savings from prevention of derailment

(3) Estimation of intangible benefits

a) Project implementation period

Significant benefits will derive from the project during the implantation phase. They are summarized as follows:

- Direct employment for people working on the project
- Indirect benefits from the increased income of those employed on the project
- Improved employment prospects after the project for those trained on the job

b) Ongoing benefits

Other intangible benefits due to the improvement of the Eastern Line are extensive and briefly explained below

· Increase in reliability and safety in travel

· Provision of security in mobility and opportunities for further improvement of road and rail transport through competition

· Provision of improved access to community health facilities, which will make it easier for trained health officers to attend the communities, for medical specialists to more readily visit patients who normally cannot avail themselves of their services due to inaccessibility and for patients to visit more highly equipped facilities in other towns. It will also provide a means of transport

· Promotion of effective land use, which is an important aspect in a country where population density is relatively high

· Much fewer negative environmental implications than road transport

· Employment generation effect

· Effective for stimulating industrial structure evolution (Since more people can be transported faster after the project, the industrial structure is expected to shift to higher value-added sectors.)

· Effective for stimulating the demand for travel

· Technological transfer effect (This project will bring advanced technologies in various fields to Thailand, to stimulate modernization of local industries.)

· Natural resource saving effect (A considerable energy consumption volume can be saved by substituting road-based transport modes into an electric railway transit system.)

· Alleviation of traffic accidents on roads

(4) Examination of results

In order to evaluate the project, three alternatives are set up as follows:

Alternative 1: Commuter service improvement integrated with urban development

Alternative 2: Alternative 1 and SBIA access service establishment

Alternative 3: Alternative 2 and intercity express service improvement

Three major economic indicators are calculated for these three alternatives, based on forecasted demand in both cases of current third class and second class fare levels which are shown in Tables 29 and 30.

Table 29 Result of Economic Evaluation Current 3rd Class Fare Level

| Item \ Alt. | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| B/C | 2.28 | 2.81 | 1.99 |
| N.P.V.* | 12,282 | 19,036 | 13,567 |
| IRR | 16.3 | 18.7 | 15.3 |

* million baht

Table 30 Result of Economic Evaluation Current 2nd Class Fare Level

| Item \ Alt. | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| B/C | 2.08 | 2.55 | 1.81 |
| N.P.V.* | 10,316 | 16,374 | 11,114 |
| IRR | 15.2 | 17.5 | 14.1 |

* million baht

As a result of economic evaluation, the economic internal rate of return (EIRR) is 14-19% in any case, which shows that this project will be feasible from the view point of socio-economy, especially in the case of commuter service improvement incorporated with SBIA access service establishment (Alternative 2).

Sensitivity analysis, in the case of Alternative 2 on the current 2nd class fare level, is shown in Table 31.

Table 31 Sensitivity Analysis (Alternative 2 / 2nd Class Fare Level)

| Cost \ Demand | -20% | -10% | ±0% | +10% |
|---|---|---|---|---|
| +20% | 13.1 | 14.3 | 15.4 | 16.5 |
| +10% | 14.0 | 15.2 | 16.4 | 17.5 |
| ± 0% | 15.0 | 16.3 | 17.5 | 18.7 |
| -10% | 16.2 | 17.5 | 18.8 | 20.0 |

(5) Examination of the benefits of alleviation air pollution

The air within the BMA area is seriously polluted by road vehicle exhaust. If some part of the road-based urban transport modes are replaced by the rail-based transport network, the benefit of alleviation of air pollution can be expected. In this study, the figure is deduced in a simple way, based upon some studies of Japanese urban areas, adjusted by the Thai and the Japanese per capital national income. It is estimated that 816 baht per car per annum can be saved within the area. Needless to say, it is necessary to deal with this figure very carefully because of its rough estimation.

### 2.7.2 Financial Evaluation

(1) Prerequisites of financial evaluation

Prerequisites of financial evaluation are set up as follows.

a) Target year and project life

Target year: 2010
Project life: 30 years, 1996-2025

b) Foreign exchange rate

1 baht = 4 yen
1 US dollar = 25 baht

c) Tax

Both import taxes and 7% of value-added tax are eliminated from cost and expenses.

d) Interest and terms/conditions of financing

No interest is calculated in the financial internal rate of return (FIRR). In finance, program terms and conditions shown in Table 32 are taken into consideration.

Table 32 Terms/Conditions of Financing

| Item / Source | Interest rate (% p.a.) | Term (year) | Grace (year) | Repayment |
|---|---|---|---|---|
| Governmental loan | 2.7 | 25 | 7 | Semi-annual installment |
| Institutional overseas loan | 7.0* | 20 | 5 | Semi-annual installment |
| Domestic loan | 12.0-13.0 | 7-10 | various | Various |

* 6 months variable

e) Cost of labor

The nominal merge is used for the cost of labor.

f) Fare level

· Commuter service:
  Current 3rd class: 0.215 baht/km
  Current 2nd class: 0.44 baht/km
  Upper limit: 1 baht/km (actually averaged to 0.7 baht/km)
· SBIA access service
  Same as commuter service
  10 baht for Lat Krabang - SBIA North Terminal
  20 baht for Lat Krabang - SBIA North Terminal
· Intercity express service
  0.6 baht/km (current 2nd class fare combined with charges for express, seat reservation and air-conditioning)

g) External free fund

The fund for all investments, excluding purchase of rolling stock, is raised

· 100% by SRT's own money and borrowing
· 50% by external free fund
· 60% by external free fund
· 70% by external free fund

h) Project package alternatives

3 alternative project packages explained previously also adopted.

(2) Examination of results

Calculated financial internal rate of return (FIKK) in various cases explained above is shown in Table 33.

Table 33 Financial Situations Classified by Alternatives and their Conditions

| Alternatives and Conditions | | | | | FIRR (%) |
|---|---|---|---|---|---|
| Aiternatives | | Fare | | External Free Funds | |
| | | Eastern Line | SBIA Line | | |
| Alt. 1 | a) | 3rd class | -- | -- | -4.09 |
| | b) | 2nd class | -- | -- | 2.69 |
| | c) | Upper limit | -- | -- | 5.41 |
| | d) | 3rd class | -- | 50% | -1.74 |
| | e) | 2nd class | -- | 50% | 6.05 |
| | | **2nd class** | -- | **60%** | **7.06** |
| | | 2nd class | -- | 70% | 8.28 |
| Alt. 2 | a) | 3rd class | 3rd class | -- | -3.20 |
| | | 3rd class | 10 baht | -- | -1.46 |
| | | 3rd class | 20 baht | -- | 0.18 |
| | b) | 2nd class | 2rd class | -- | 3.43 |
| | | 2nd class | 10 baht | -- | 4.32 |
| | | 2nd class | 20 baht | -- | 5.36 |
| | c) | Upper limit | Upper limit | -- | 6.14 |
| | | Upper limit | 10 baht | -- | 6.86 |
| | d) | 3rd class | 10 baht | 50% | 1.29 |
| | e) | 2nd class | 10 baht | 50% | 8.12 |
| | | **2nd class** | **10 baht** | **60%** | **9.29** |
| | | 2nd class | 10 baht | 70% | 10.75 |
| Alt. 3 | a) | 3rd class | 10 baht | -- | 2.26 |
| | b) | 2nd class | 10 baht | -- | 6.08 |
| | c) | Upper limit | 10 baht | -- | 8.01 |
| | d) | 3rd class | 10 baht | 50% | 5.16 |
| | e) | 2nd class | 10 baht | 50% | 9.68 |
| | | **2nd class** | **10 baht** | **60%** | **10.74** |
| | | 2nd class | 10 baht | 70% | 12.01 |

As shown in Table 33, in a basic case of 2nd class fare level and external free fund of 60% for grand facilities, FIRR is 7.06% on Alternative 1 (commuter service improvement only), 9.29% on Alternative 2 (Alternative 1 and SBIA access service establishment) and 10.74% on Alternative 3 (Alternative 2 and intercity express service improvement for ESB).

In each fare level case, this project is difficult to make feasible, unless an external free fund of more than 50% for grand facilities is introduced.

Sensitivity analysis (in the basic case (Alternative 1) of traffic demand decrease of 5% and 10%, investment cost increase of 5% and 10% and one of their combination) is shown in Table. 34

Table 34 Sensitive Analysis

Basic Case: Alternative 1 (Commuter service only)
2nd Class Fare (B. 0.44/km)
External Free Fund 60%

| Case | FIRR |
|---|---|
| (1) Basic Case | 7.06% |
| (2) In case Demand is decreased by 5% | 6.63% |
| (3) In case Demand is decreased by 10% | 6.17% |
| (4) In case Facil. Cost is increased by 5% | 6.84% |
| (5) In case Facil. Cost is increased by 10% | 6.64% |
| (6) In case both (2) & (4) occur | 6.41% |

On the basic case (Alternative 1), 15 years after 2005 when almost all investment for the grand facilities is finished, all borrowed money will have been repaid.

## 2.8 Environment Examination

### 2.8.1 Introduction

The Environment Examination carried out for the Feasibility Study of the Integrated Urban and Railway Development aims to identify and evaluate the impact of projects. Environment variables relating to both urban development and railway improvement were investigated to access their impact, and mitigation measures were proposed to reduce/project the negative impact.

### 2.8.2 Environmental Considerations

The existing environmental situation, project impact and proposed mitigation measures are discussed in the following sections.

(1) Noise and vibration

Noise and vibration are generated by both construction and operation of the project.

The Office of Environmental Policy and Planning (OEPP) has set guidelines for community noise, but no noise standard for train operation.

- Noise limit for health protection (L Aeq 24 hours) should be < 70 dB(A)
- Noise limit for annoyance (nuisance) level should be < 3 dB(A) above the ambient noise level

As for noise and vibration from construction activities, examples measured by various studies in Thailand and Japan and construction methods with little impact on the environment are examined. Particular problems have not come up.

As for noise and vibration generated by train operation, taking into consideration future urbanization along the lines, the following countermeasures are proposed:

- Installation of noise barriers where noise level exceeds the standard and where sensitive receptors exist
- Installation of track in an appropriate method taking into account both vibration and noise reduction
- Proper execution of routine and periodic maintenance

At present, in Thailand, there is no problem of vibration from train operation. With the improvement of track, vibration is expected to be reduced. However, proper maintenance of the track and its foundation is necessary.

(2) Water quality

In Thailand, effluent standards are presently employed for water pollution control. The Office of Environmental Policy and Planning (OEPP) has established the guidelines for analyzing water quality. As for impact to water quality of this project, the following are examined:

During the construction period, water quality may be affected from construction materials such as particles of gravel, sand, brick, and stone, particularly in the rainy season. However, this is of minor impact since it can be washed away by rain.

The existing operation of SRT trains may cause a little deterioration in water quality in several canals due to the direct discharge of waste water. However, this impact can be solved by installing septic tanks in the toilets and waste water should be treated before being discharged into canals or rivers.

The following measures to reduce the negative impact on water quality are proposed.

- Construction near rivers or canals must be carefully done to reduce adverse impact on water quality.
- Shelters for workers must be located at least 150 meters from water sources. In addition, proper toilets shall be provided adequately.
- Solid waste disposal into rivers or canals must be prohibited.

(3) Air quality

With the rapid growth of motorization, air pollution has become a severe problem, particularly in the urban area of the Bangkok Metropolis. In Bangkok, seventy percent of air pollution is generated by motor vehicles. The improvement of railways will attract some car users which will result in the reduction of air pollution. In addition, the introduction of electric trains will not generate additional air pollution. Therefore, it is much preferable for air quality that some car users will be diverted to railway users and most traffic demand which will increase from now on will be attracted to railways by improving the railways, because railways will not generate air pollution.

However, due to construction activities, air quality will deteriorate. It is strongly recommended that the following measures should be seriously taken into account during the construction period, especially in highly populated areas:

- Proper measures to avoid falling materials
- Frequently spray water on areas from where dust emit
- Maintenance of vehicles and engines in good condition
- Removed excess materials and water from construction sites as soon as construction is finished

(4) Land use

The improvement of railways would encourage urban development, particularly in the areas surrounding stations. Actually, the changes in land use have already started in some areas due to the expectation of the New Bangkok-Chonburi Highway and High Speed Train. The development of housing estates along railways will stipulate the use of trains rather than road transport as it is today. It is suggested that an appropriate landscape along the railways should be provided in community areas and around station areas.

(5) Aesthetic and archeological sites

Many temples are located in the eastern corridor. Since the improvement of railways will be done within the existing railway right-of-way, no land acquisition is required. Therefore, these important archeological sites will not be disturbed. However, when urban development, which is a main part of this project, is carried out these aesthetic and archeological sites as well as the existing housing, schools, etc. should be taken care of respectfully.

(6) Transport

The majority of trips between Bangkok and the eastern region are made by road transport. Vehicle composition is dominated by passenger cars, followed by light trucks.

There are several canals in the project area; therefore, water transport still plays a substantial role in some areas. The implementation of this project will not cause any obstruction to the waterways.

The improvement of railways is expected to attract a part of road transport which will result in reducing road congestion, air pollution and vehicle operating costs. On the other hand, more train operation, due to the expected higher ridership, would cause inconvenience to road transport at the railway crossings. However, these problems can be solved by elevating roads. The Study has proposed seven railway crossings, besides the four locations proposed by the Department of Highways (DOH), to be grade separation.

# CONCLUSION AND RECOMMENDATIONS

# 3. Conclusion and Recommendations

## 3.1 Conclusion

### 3.1.1 Necessity of the Integration of Urban Development and Railway Improvement

With the sharp increase in the number of automobiles, the road traffic congestion in the Bangkok Metropolis is becoming more serious every year causing heavy disruption of the urban environment due to the exhaust from automobiles. In order to improve this situation and restrain the road traffic which is expected to further increase in the future, it is necessary to urgently reinforce railways / mass rapid transit systems within the city and also to promote, as much as possible, a modal shift of traffic from automobiles to the railways between suburban areas and the city center.

However, the facilities of the SRT only which constitutes the suburban railway at present are in need of improvement, because they are lagging in modernization and the route has many at-grade crossings with roads in the center of Bangkok. On the other hand, most of the residential districts in the suburbs of Bangkok have developed along the main roads, and, therefore, the customary utilization of the railways has not occurred.

In view of these circumstances, housing development in the future should be implemented along the SRT routes in combination with SRT transport service improvement, so that a form of transport that enables the maximum utilization of the SRT can be created.

### 3.1.2 Evaluation of the Master Plan on the Integrated Urban and Railway Development

A master plan has been drawn up for the integrated urban and railway development. The plan aims to allocate 1.7 million of the estimated future population increase of 5 million in the Bangkok Metropolis to regions along the railway lines. It also aims to conduct railway facilities improvement, rolling stock modernization, and transport capacity reinforcement, in combination with the above population allocation. The total cost of the reinforcement projects for the Eastern, Northern, Southern and Maeklong Lines of the SRT is 51,680 million bahts. On the other hand, it is estimated that the total amount of the development benefits from the increase in land prices along the routes affected by these projects would be 454,000 million bahts.

To make a project feasible in the aspect of railway operation, it is necessary to obtain 1/2 to 3/4 of the amount of investment in facilities as an external free fund. In this respect, since the total amount of the development benefits would be about 15 times the amount of the necessary fund, it is considered that by establishing adequate organizations and systems there is a strong possibility of part of this development benefit being recycled for the investment in the SRT.

### 3.1.3 Model City Development

In this study, a plan for a model city centering around Lat Krabang East Station has been drawn up. In the plan for new town development which covers an area of 120 ha, the project cost will be 1,320 million bahts. In this case, it is estimated that this project will become effective when the contribution rate is 39.9% and the land readjustment method is used. The maximum area of the reserve land which can be produced is estimated to be 653,000$m^2$. Of this land, 114,000$m^2$ will be sold for the payment of the project cost. Accordingly, 6,740 million bahts, which will be obtained by selling the remaining 539,000$m^2$, can be regarded as the development benefit. This development benefit should be recycled not only to land owners and the public sector but also for investment in railway improvement, since a large part of the reason for the increase in land prices seen here is railway improvement.

At present, the SRT has no authority to participate in urban development. However, it is estimated that the development benefit can be recycled for railway investment to the maximum extent, if the SRT itself or the SRT Urban Development Corporation (to be newly established) carries out the land readjustment project by revising of the laws concerned.

### 3.1.4 Feasibility of the Railway Improvement for the Eastern Line of the SRT

Of the railway corridors in four directions proposed in the Master Plan, the Eastern Line of the SRT has been selected as a high-priority project, and economic and financial analysis has been made. As a result, it has been found that, when the present second class fare is applied, the project will be financially feasible if an external free fund is used for 60% of the ground facilities investment. The fund of about 4,770 million bahts is necessary for this.

In the model city development project, development benefits of 6,740 million bahts can be generated from the 120 ha of land around the stations. The percentage of these development benefits that can be recycled for railway improvement investment will depend on the

organizations and systems used. However, since the urban development area for the allocated population of 540,000 within the 50 km along the Eastern Line is about 4000 ha, the development benefit is estimated to highly exceed the amount of the necessary free fund, if detailed urban development plans are implemented for each community and for each area around the stations. To ensure sufficient recycling of the development benefit for railway improvement, it is necessary to revise the laws concerned, so that the SRT itself can participate in land development or an SRT Urban Development Corporation, which undertakes land development, can be established.

## 3.2 Recommendations

### 3.2.1 Tasks for Organizations and Systems for Implementing Urban Development

The project for integrated urban and railway development is quite substantial for implementing the planned urban development. For the full-fledged implementation of the integration of railway improvement and urban development, it is necessary to establish the following four institutionalized systems.

- Eastern Corridor Development Board
- System for integrated urban and railway development
- System for implementing land readjustment (Promotion)
- SRT Urban Development Corporation

### 3.2.2 Establishment of an Urban Railway Network Plan and Review of the General Plan

It is necessary to establish a comprehensive plan for integrated urban and railway development including intra-city rapid transit networks, suburban lines of the SRT, and land utilization plans for regions along these suburban lines. It is also necessary to review the General Plan, in order that the above comprehensive plan can be included in the General Plan. Such factors as station plazas and access roads to the stations should be clarified in the General Plan.

### 3.2.3 Consensus on Introducing an External Free Fund

This is one of the main items for the system for the integrated urban and railway development. It is necessary for the Thai Government to recognize the merits of urban development integrated with railway construction and improvement. It is also essential to achieve consensus within the Thai Government on the point that the beneficiaries of such development should bear a reasonable portion of the railway investment.

### 3.2.4 Promotion of the Ongoing Construction of Intra-city Rapid Transit Systems

The rapid transit system projects in Bangkok which are now in progress, such as Hopewell, BMA(Tanayon) and MRTA, are essential not only for the modal shift of intra-city traffic from automobiles to the railways but also for the final distribution of passengers arriving at the city center from the suburbs by the improved SRT. Especially, if the Hopewell Project is not completed by the time originally scheduled, the existing at-grade crossings with roads which are hampering punctual operation of trains arriving at the city center from the improved suburban lines of the SRT will remain a problem.

In this case, it will be difficult to effectively obtain railway improvement, and, accordingly, it will be impossible to provide sufficient benefits to commuters living in regions along the routes covered by the integrated development. Therefore, it is essential to promote these three projects of mass rapid transit system construction so that they can be completed by their target years.

### 3.2.5 Measures to Be Urgently Taken

(1) Stage-by-stage promotion of integrated urban and railway development

To promote the integrated urban and railway development, it is recommended as a first step, to urgently carry out the improvement of commuter transport to Khlong Luang Phaeng, in the 40 km radius area from the city center of Bangkok, together with integrated development of new towns in Lat Krabang East and Lat Krabang West. Then, it is advisable to proceed to the next step after widely fostering railway-oriented consciousness among commuters around Bangkok by realizing at an early date, a comfortable and reliable railway commuting system and after confirming the results of such efforts.

(2) Land procurement and administration by the public sector

It is necessary to strive for the early establishment of full-scale systems for implementing the urban development described above. At the same time, since land procurement and undesirable housing development by private sectors have already started in areas around the stations of the SRT even before the full-scale institutionalization of the above systems, advance procurement of land should be made by the public sector in specified areas (such as areas around scheduled sites of future stations) as part of the preparations for desirable urban development in the future.

(3) Regulation of land speculation

Since land prices around the new stations are expected to rise in the future, there is a great possibility that advance land procurement and speculation will be made by the private sector. Therefore, it is feared that smooth implementation of urban development around the new stations may become difficult. In this regard, in parallel with the establishment of many systems for implementing full-scale urban development, it is necessary for the Thai Government to take measures for regulating land speculation in areas around scheduled sites of future stations, etc.

(4) Elimination of at-grade crossings and promotion of grade separation

A major disadvantage of the SRT is that there are many at-grade crossings with roads in the railway. Nominally, the railway side has the priority in passing at these crossings. In reality, however, there are cases where a train must slow down, in front of a crossing or must stop for a long time giving up its right of way because of road traffic. This not only enormously decreases the positive effects of the railways but also makes the time road traffic spends going through crossings even longer because trains must stop once and resume operation at a slow speed. Therefore, it is hoped that the main at-grade crossings in the city center will be removed as a result of the promotion of the Hopewell Project. At the same time, it is necessary to proceed with the measures for at-grade crossings on the sections that are not covered by the Hopewell Project.

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