5. FACILITIES AND INFRASTRUCTURE DEVELOPMENT

5.01 Land Grading

Due to the high cost of borrow materials for embankment construction, it is indispensable to set the land elevations that will minimize the required volume of embankments. In this regard, the elevation of primary and secondary roads need to be planned at the lowest possible level to comply with the minimum thickness of road pavement and minimum depth of covering for piping works. Based on the planned road elevation, the elevation is chosen for the plots of land.

In the past flood protection master plan in the BMA area, the existing ground level was set at 0. 4 – 0. 8 m MSL for the undeveloped areas and 1.0 – 1. 5 m MSL for the developed areas. Outside the polder system, the high water level (HWL) in *khlong* Pravet, *khlong* Nung, and *khlongs*, which flow into *khlong* Pravet from the south, is planned at 0. 6 m MSL which is at the same level in the existing conditions for the 5-year return period. Inside the polder system, the HWL in *khlong* Mae Chan and *khlong* Song is set at 0. 4 m MSL at the lowest HWL thereof.

Based on conditions given above, the standard elevation will be planned for the main roads, plots of developed lands, parks, and polder dikes. The land elevation plan and the typical cross-section of the study area are prepared to show the planned elevations.

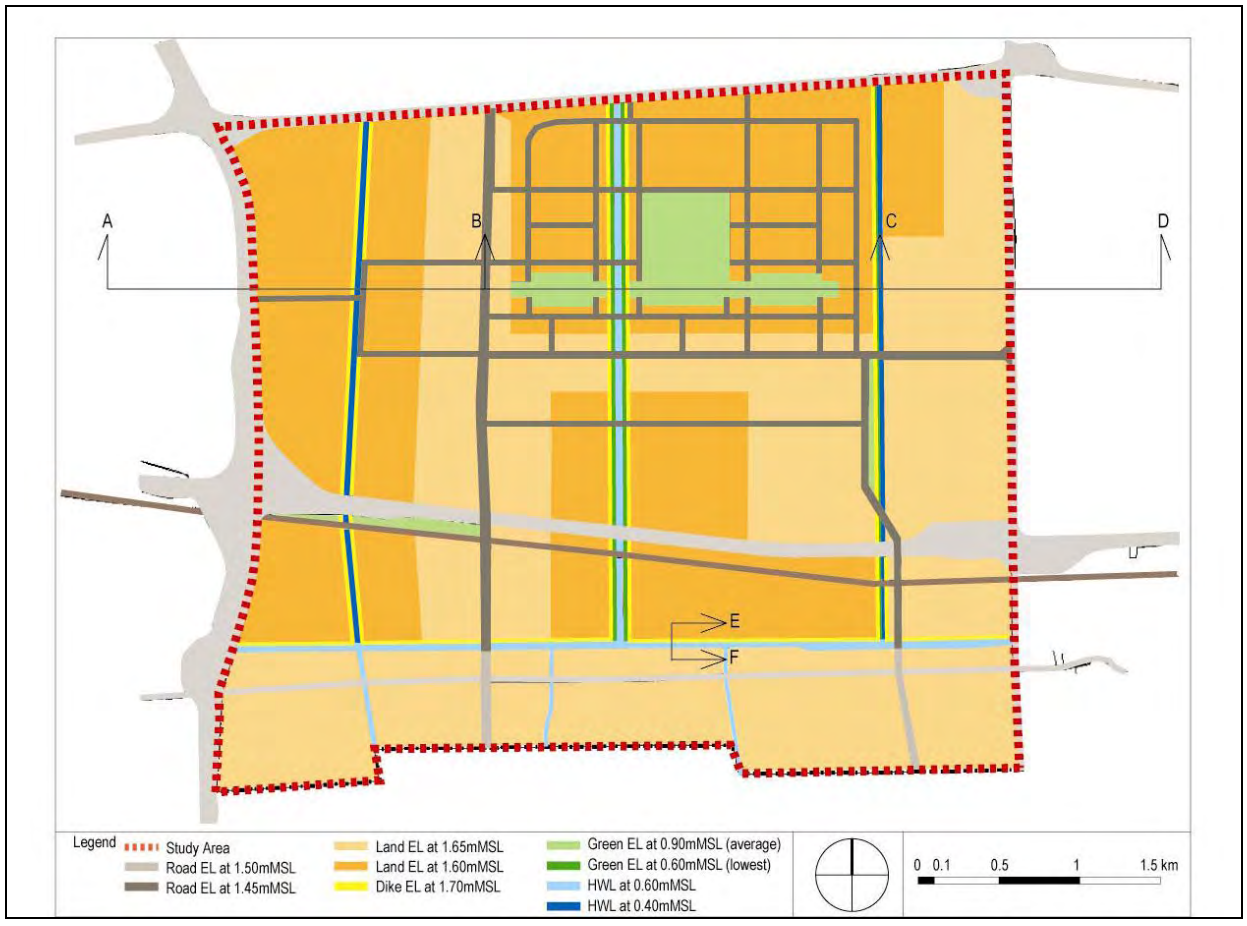


Figure 5.01: Land Elevation Plan

5.02 Public Transport Planning

(1) Access to Public Transport

The Lat Krabang Subcenter will have 168,000 population and 100,000 workers in the area of about 1,900ha in the ultimate stage. This will generate commuter trips and business trips between the subcenter and central Bangkok. The transportation demand analysis indicates the necessity of a kind of mass transit system to support the demand for travel trips, but also implies that ridership might not be high enough in view of financial viability. For this situation, the following three alternatives have been analyzed:

(A) Medium Transit System

(B) Feeder Transit System from SRT lines

(C) Express Buses

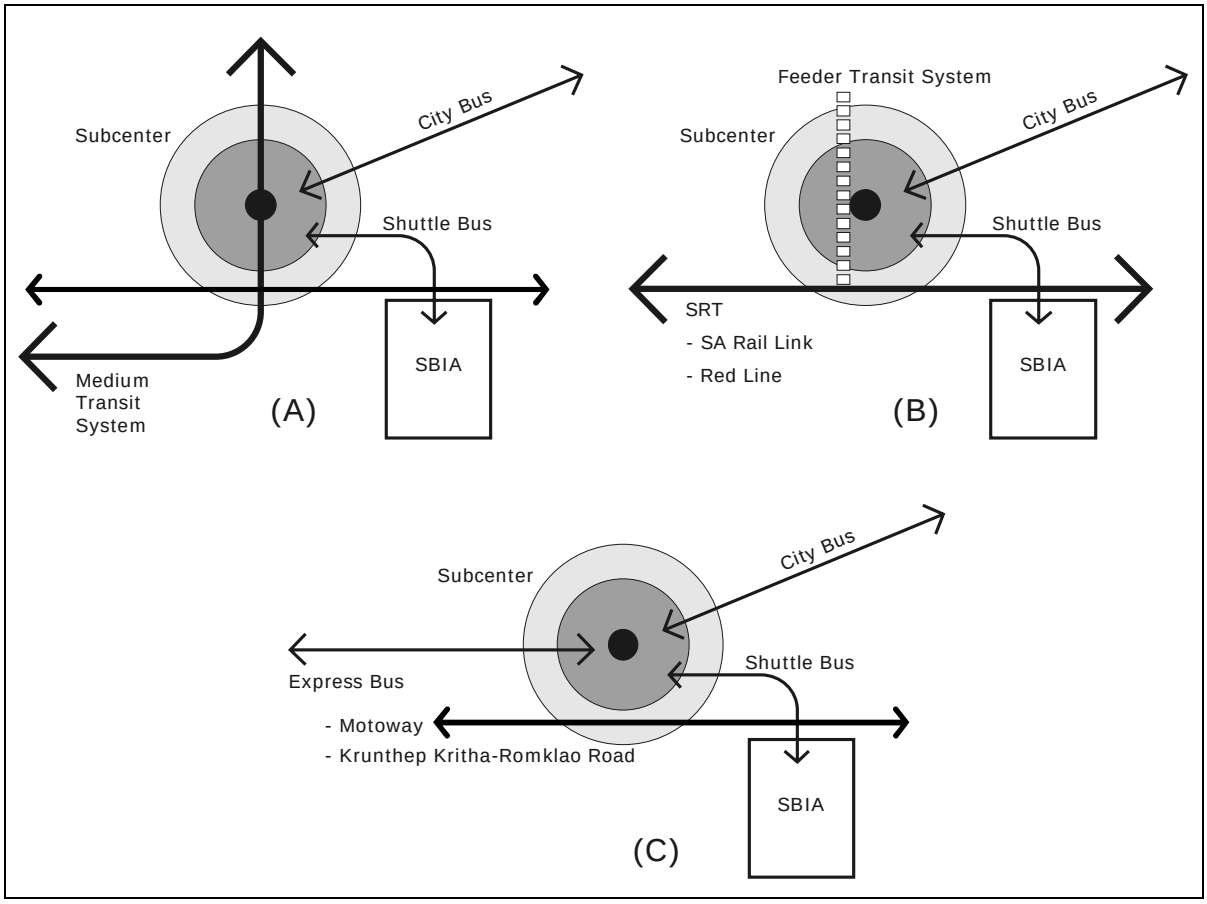


Figure 5.02: Access to Mass Transit

Traffic volume on roads will be too heavy to dedicate any lanes for Express Buses. Wat Lanboon St. is not included in the future plan of the Red Line at the moment, so the feeder transit from the station is a future issue. The Medium Transit System is a revised version of Sky Train Extension and it will attract investors and increase the land value. **Therefore, it is proposed to introduce the Medium Transit System.**

Medium Transit System: The Medium Transit System is the recommended transit system having medium features between bus and heavy rail as:

1) Capacity: larger than bus, lower than heavy rail;
2) Distance between stops: longer than bus, shorter than heavy rail;
3) Initial investment: larger than bus, smaller than heavy rail;
4) Frequency and reliability: same as heavy rail;
5) Speed: faster than bus, slower than heavy rail.

At the moment, a study on introduction of a segregated bus lane including elevated section along Onnut Road is in progress. Although the segregated bus lane can increase the capacity of public transport, it might not be enough to meet the estimated travel demand. Instead of the bus lanes, introduction of a Medium Transit System along Onnut Road is desirable for the subcenter. Examples of Medium Transit Systems are Monorail and Automated Guideway Transit.

(2) Intermodal Transit Facilities at Lat Krabang Station

The land development of the subcenter will start before the introduction of the Medium Transit System, while the SA Rail Link will start its operation soon with Lat Krabang Station for the City Line. The passenger demand is forecast to be 39,700 boarding in 2025. Lat Krabang Station is very near to the subcenter and it will provide access to the subcenter before the operation of the Medium Transit System if an adequate feeder transit system is provided with Intermodal Transit Facilities (ITF), or a "Station Plaza".

However, accessibility to Lat Krabang Station is poor and the space for an ITF is very limited; the necessary area of the Station Plaza for Lat Krabang Station is calculated at 7,000sq. m. Although it has been proposed to move the location of Lat Krabang Station to the west of Rom Klao Road where vacant area is available for the Station Plaza, the SA Rail Link project has already started under the original plan. Therefore, it is necessary to provide the station east of Rom Klao Road with access from the subcenter.

As a whole, the motorway overpass with a west station plaza is the best way to provide access to Lat Krabang Station; however, there still remain others for station plaza and access routes except for Direct Access. On the other hand, the potential for land development is high near the station west of Rom Klao Road with large empty lots. **Therefore, it is proposed to construct a station plaza west of Rom Klao Road with urban development.**

5.03 Road Network

(1) Regional Arterial Road Network

The following are the basic considerations for the road network planning.

- Routes of major roads which form parts of the regional arterial road network shall be set so that the routes agree with the routes proposed by Suvarnabhumi Aerotropolis Development Plan (SADP) and BMA Comprehensive Plan-2 (BCP2) as much as possible.
- Routes shall be set to minimize negative social impact such as resettlement and separation of local communities.

5 Study, Investigation, Review and Updating of the Feasibility Study of Suvarnabhumi Airport Rail Link

- Intersection/junction points shall be set to maintain smooth traffic flow.
- Maintain necessary horizontal distance from canals to ensure stability of soft ground.

In consideration of the above, three major roads are proposed as regional arterial roads.

NS-1 Road: This road is a regional principal road connecting Onnut Rd. and Ram Indra Rd. in parallel with OBRR and Romklao Rd. Particular considerations are as follows.

- Section between BMA Krungthep Kretha-Romklao Rd. and Sukhapiban2 Rd. : Vacant land for new road construction is very limited due to high occupation density in an already built-up area. Only the land along the proposed route shown in the figure is available for new road construction, thus the route will be fixed as shown in the figure.
- Connection to Onnut Rd. : Considering the highly built up area and local community area to be preserved, access points to Onnut Rd. are limited to two locations on both sides of the preserved community area. The access point on the west side of the community area has been selected.
  The alignment of NS-1 Rd. is almost the same as the route A3 road proposed in SADP. SADP proposed another new north-south road (A4 road) parallel with Romklao Rd. It will be impossible to build this road because of the limitation of available land. Since BCP2 proposed only one new north-south road in this area, BCP2's proposal can be satisfied by construction of NS-1 Rd.

NS-2 Road: This road should have the following functions.

- New access to Onnut Rd. from the project area.
- Major access route to Lad Krabang railway station for the New Airport Rail Link Line.

Considering the limitation of availability of land along Onnut Rd. , vacant land on the east side of the community area is considered to be a possible site for the new road construction. The road alignment shall be along the east side of Klong Song south of BCH and then swing to run along the west side of Klong Song north of the BCH to minimize negative social impact (resettlement problems).

EW-1 Road: This road is a major internal east-west secondary road connecting two north-south arterial roads, Romkalo Rd. (existing) and NS-1 Rd. (proposed). The route of the road was decided by the location of its junction with Romklao Rd. , which was selected based on the following conditions.

- to have sufficient open space for construction of ramps for the new junction (a grade separated junction shall be applied).
- to have sufficient distance from the Romklao Interchange of BCH to maintain smooth traffic flow under weaving traffic flow conditions.

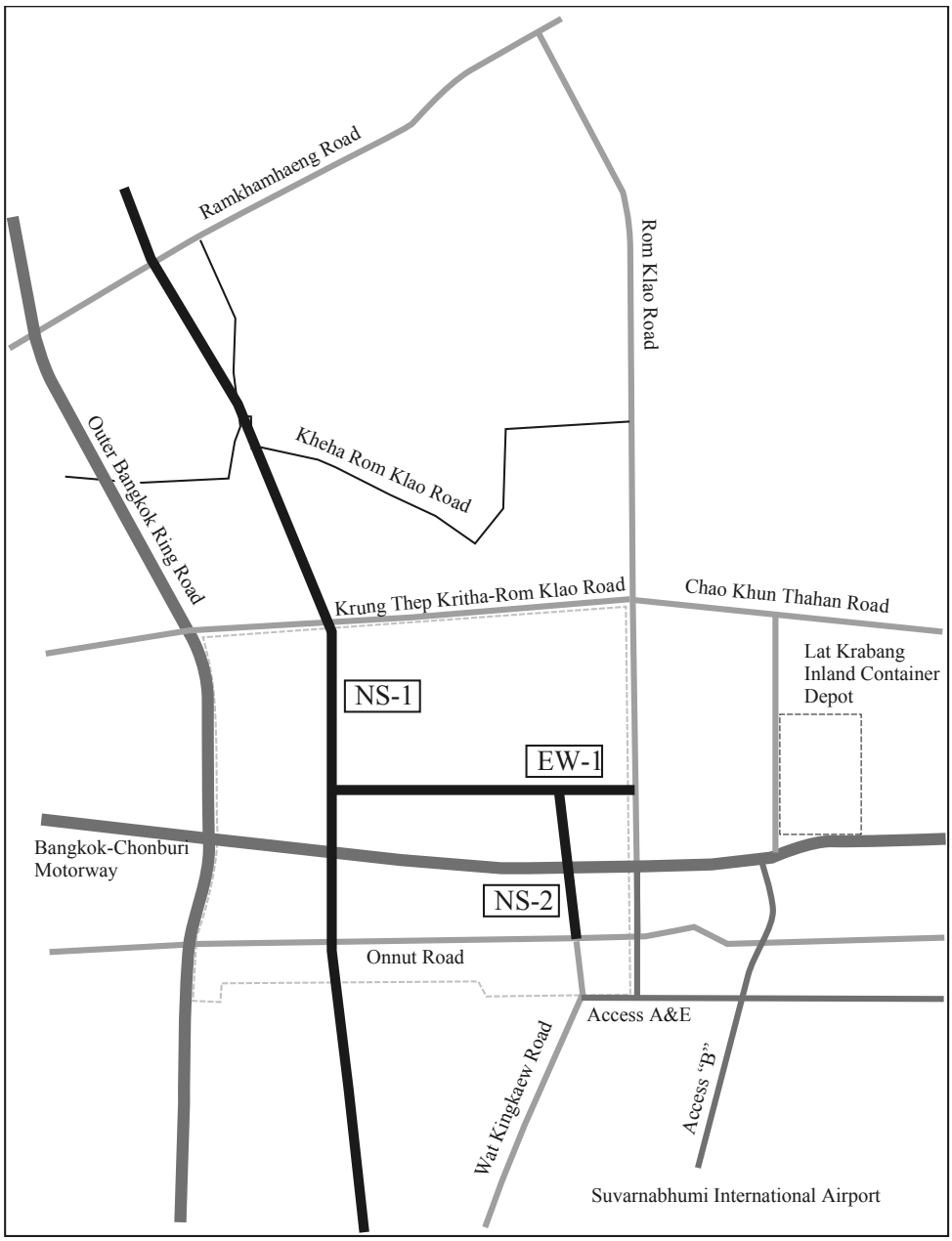


Figure 5.03: Major Road Network

(2) New Interchange Linking with OBRR

At the present, there are two linkages between OBRR and BCH, Onnut interchange and Romklao interchange. The location of Onnut interchange is in the southernmost part of the project area, thus it does not provide direct access from the motorways to the subcenter core area. Romklao interchange, located on the west of the subcenter core area is crowded with the traffic from Romklao Rd. and ICD. Hence additional linkage from the motorways to the subcenter core area is highly recommended. Considering the physical conditions of the project area, the best suitable location for the new linking interchange is suggested at the intersection between OBRR and Krungthep Kretha-Romklao Rd. (under construction).

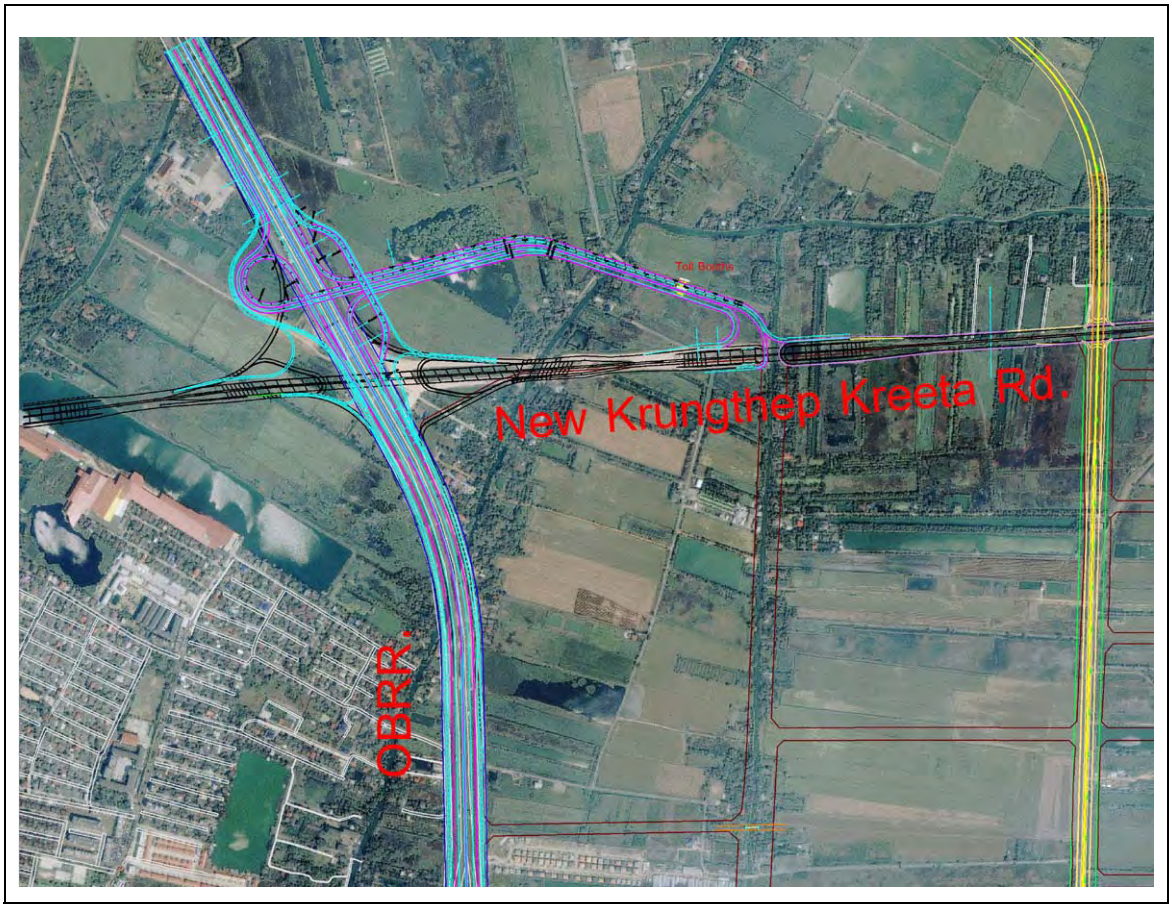


Figure 5.04: Proposed New Interchange linking OBRR and Krungthep Kretha-Romklao Rd.

5.04 Flood Protection

Based on the analysis of the problem in the existing conditions, the study area is in some danger of flooding. A flood protection and drainage improvement project shall be required for the subcenter development including the measures listed below.

1) To keep the water level in the *khlong* network low enough enable the drainage from the plots of lands to the *khlong* network at good condition. From this point of view, the sub-polder system surrounding the study area will be developed to protect against flood from outside the study area.

2) To keep the water level in *khlongs* at the control level utilizing the main drainage system consisting of pumping stations and gates.

3) To keep the discharge into *khlong* Pravet after the development not more than that of existing conditions to prevent the surrounding area from flooding. Since the study area is just as if the retention ponds for the surrounding areas, it shall be indispensable to regulate the discharge from the retention ponds.

Main facilities for flood protection in the study area are illustrated in the figure below.

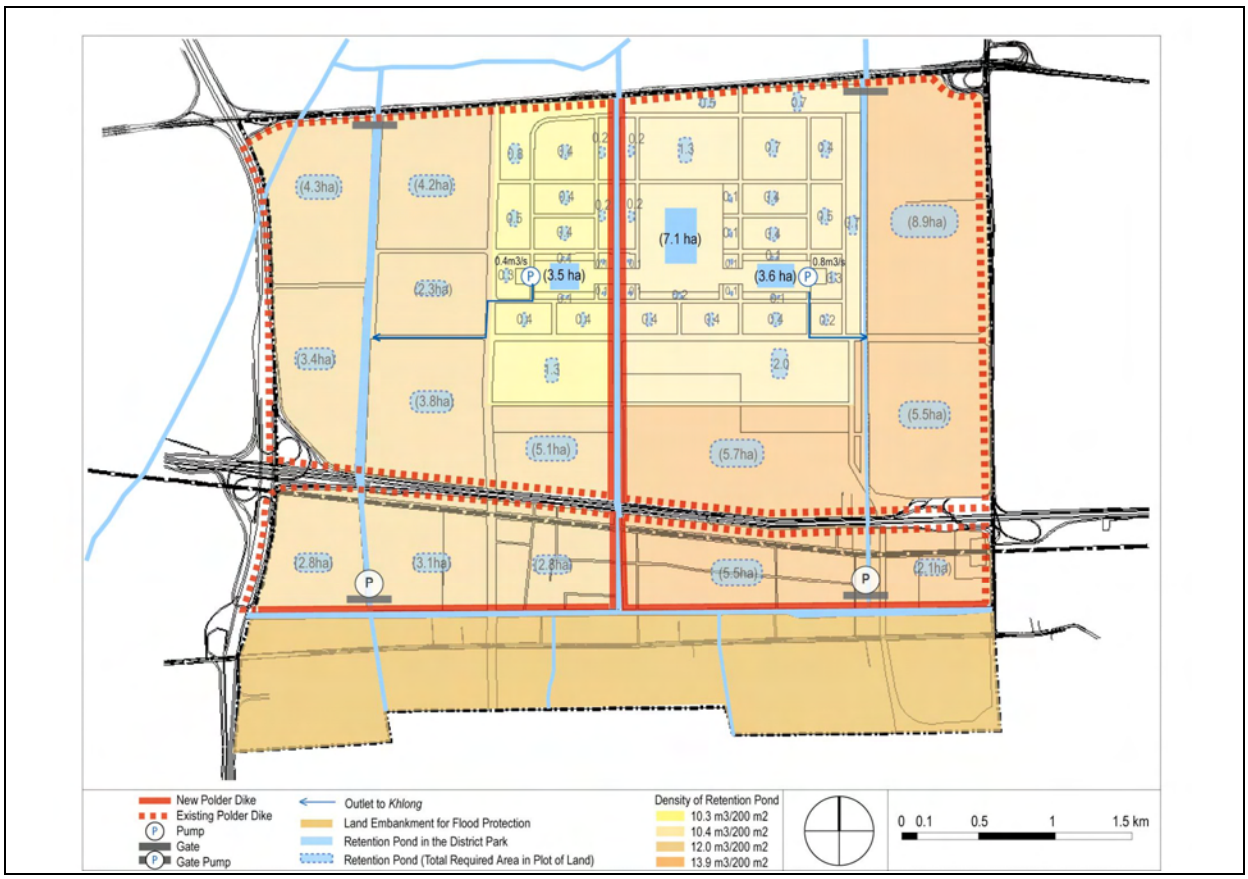


Figure 5.05: Flood Protection Facilities in 2035

5.05 Utilities

(1) Water Supply

The Minburi MWA office supplies the drinking water to the study area via two pumping stations (PS), namely Lat Krabang PS and Minburi PS. The existing two pumping stations will have the capacity necessary to meet the increased demand produced by the subcenter development.

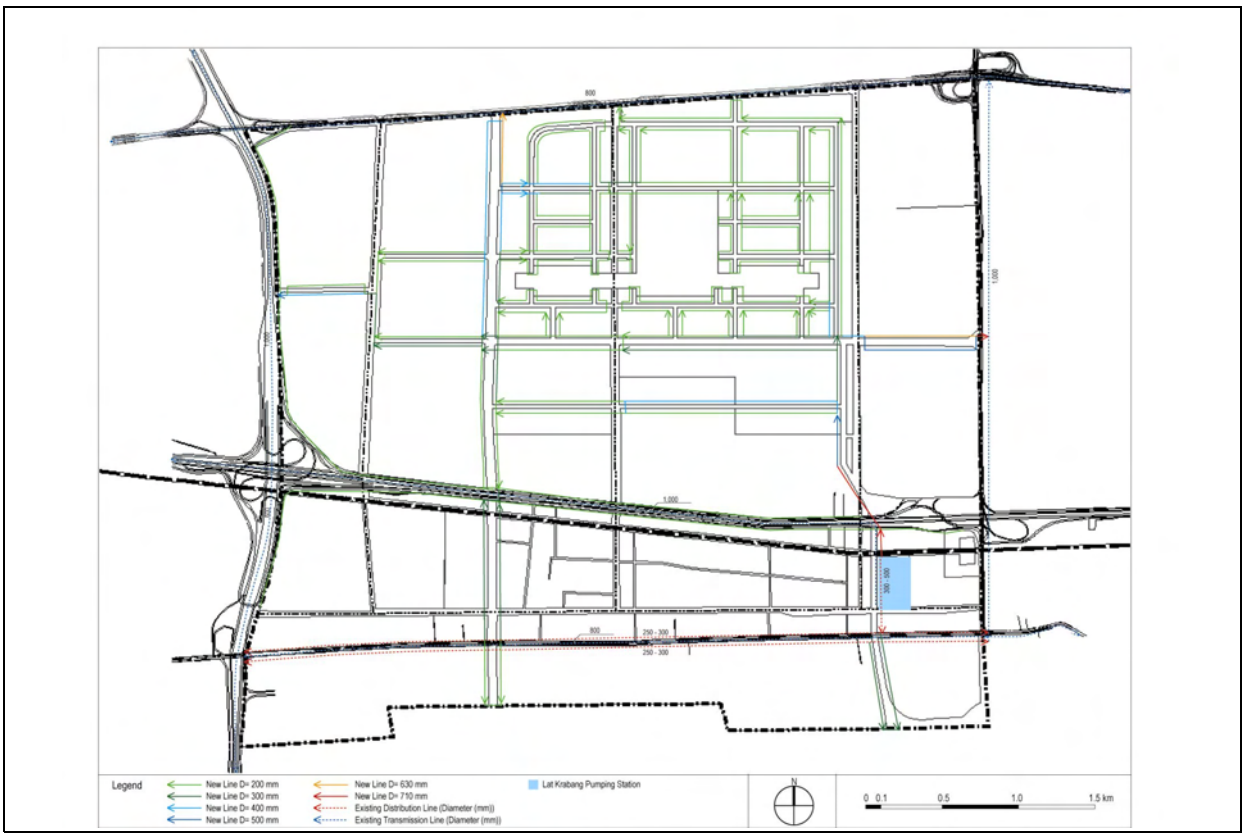


Figure 5.06: Plan of Water Supply Distribution System in 2035

(2) Waste Water

The study area is located outside the central wastewater treatment systems operated by BMA. Every building is required to be equipped with a treatment system and discharge the water treated in compliance with the regulation for the quality of effluent water into an approved drain and/or the *khlongs*.

The wastewater system in the study area shall consist of a central treatment plant together with a separate system north of the expressway and a combined system in the south.

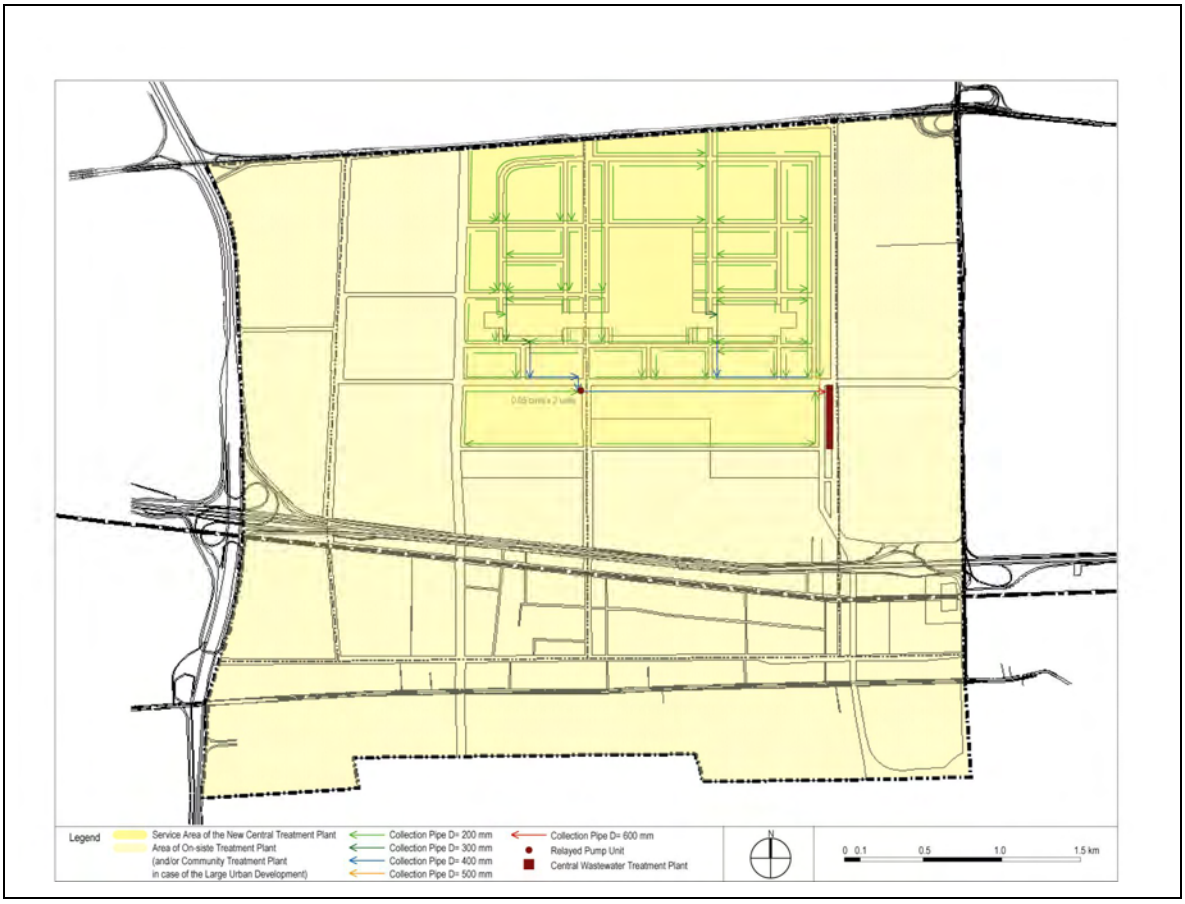


Figure 5.07: Plan of Wastewater Collection System in 2035

(3) Electric Power

The MEA currently has a plan to develop a new secondary substation of 60 MVA for the power demand increase around the new second airport. It is recommended to double that and provide a new secondary substation of 60 MVA x 2 to serve the additional power demand produced by the new second airport development and the subcenter development. The new substation is proposed to be located in the greenery buffer area along NS2 road.

The primary 24 kV distribution lines will be installed along the primary and secondary roads to form a looped system. In the early stages, the power will be supplied from the existing Rom Klao substation though the new substation located in the greenery area along NS 2 road and another facility will be installed near the Rom Klao road to serve the power demand increase in the study area in the latter stages.

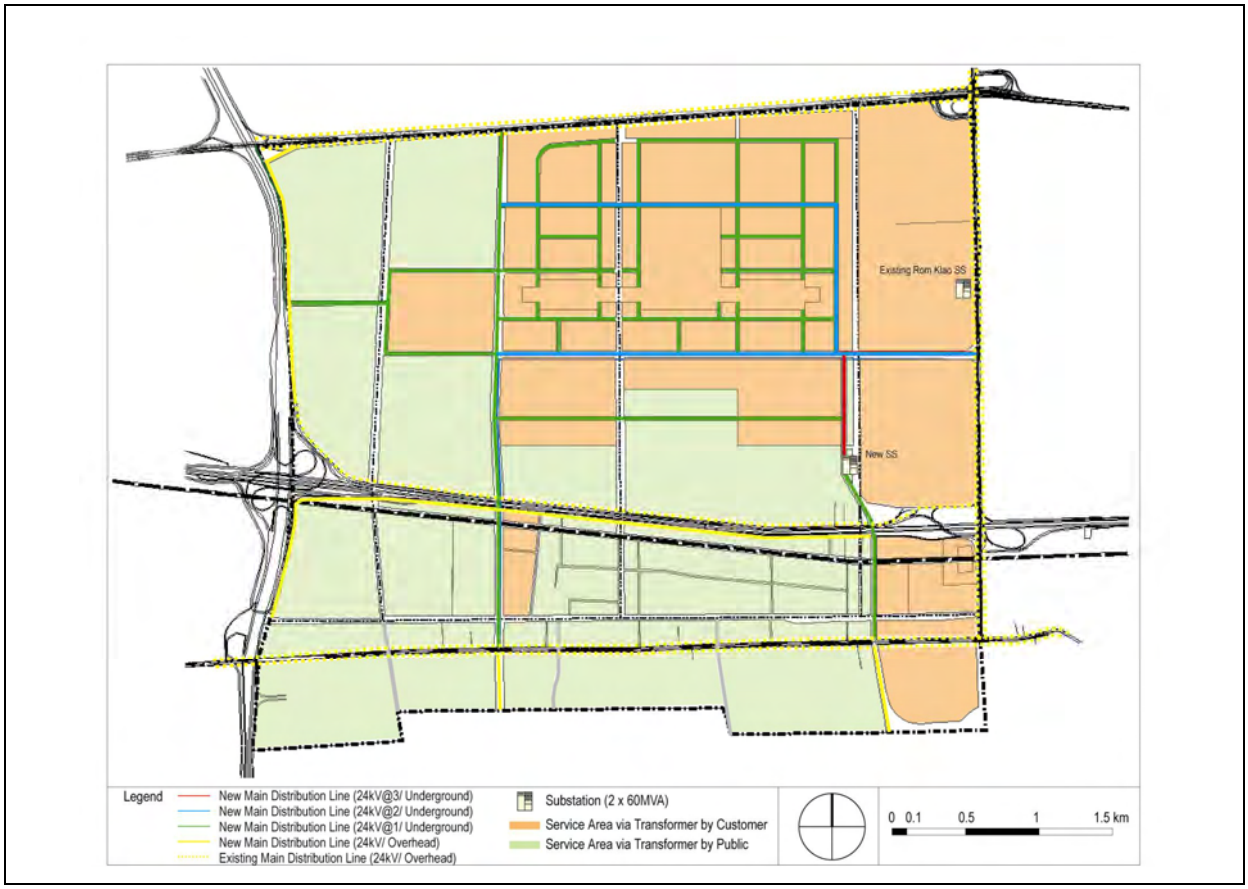


Figure 5.08: Plan of Power Distribution in 2035

(4) Telecommunication

The primary distribution lines of 1,200 pairs and 600 pairs are to be installed along the primary and secondary roads. The areas of Residential – Low Rise, Residential – Medium Rise, and Culture Town are to be served by the public telephone panel. The required number of the transformer units is estimated at 30 units. In the remaining areas, the customers with the large demands may install the transformer equipment in the properties thereof.

The primary distribution lines are planned to be underground to eliminate the congested overhead lines from the landscape.

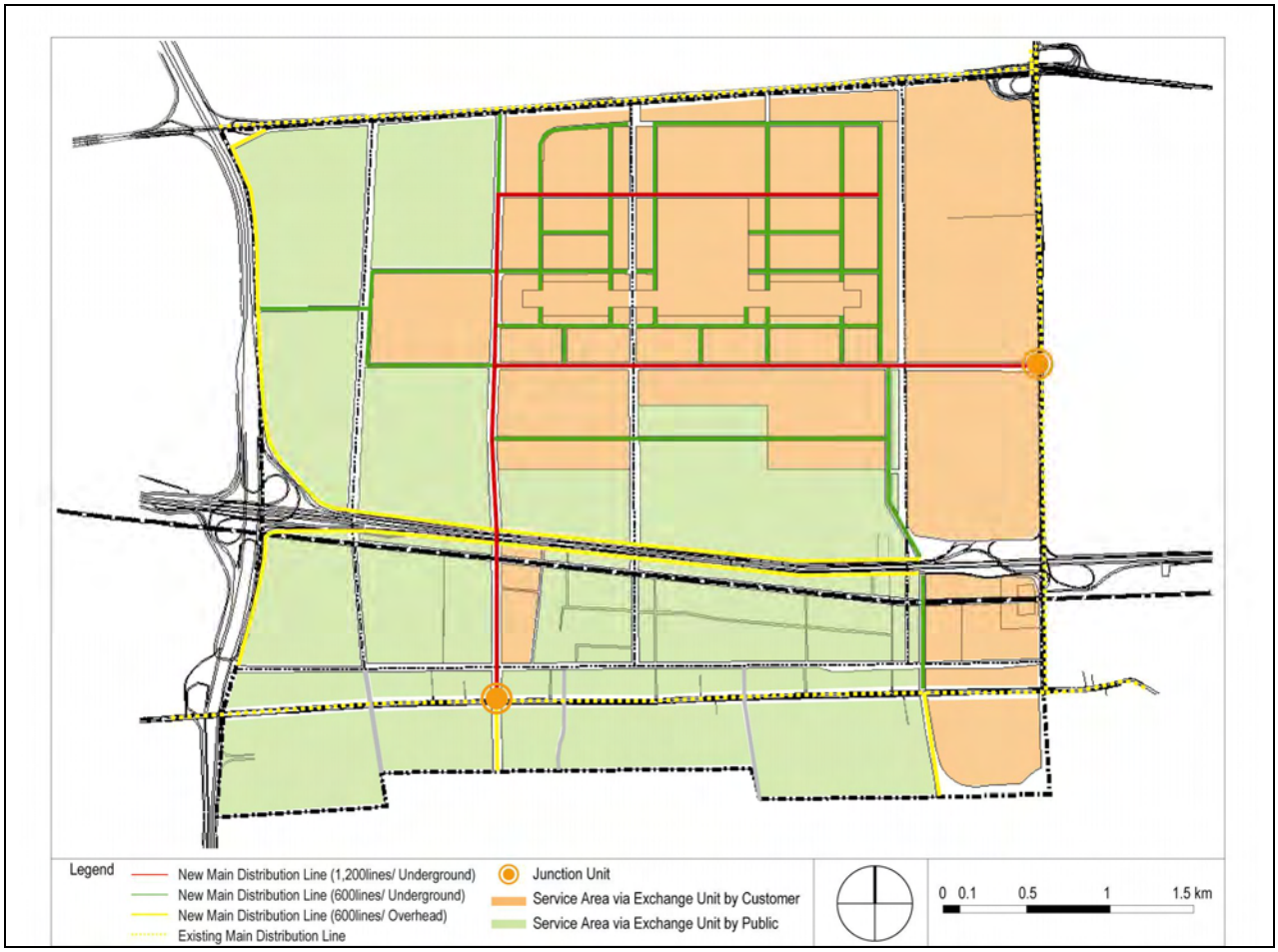


Figure 5.09: Plan of Communication Network System in 2035

(5) Solid Waste Management

The Lat Krabang district office of the BMA conducts the solid waste collection works for the district. After the collected waste arrives at the On-nut transfer station it is then carried to the sanitary landfill site in the Bang Plee district of the Samut Prakan province. A new landfill site is located 100 km east of the transfer station, opened in 2005 and has an area of 64 ha to serve a capacity of 3,500 ton/day of solid waste from the On-nut transfer station for a period of five years. As the life span of this disposal site is only five years, the BMA will be required to provide a new disposal site as a task for the solid waste management of the whole administrative area.

5.06 Planning of Public Facilities

(1) Neighborhood Unit

The neighborhood units have been planned in order to more or less evenly distribute the communal units as they are defined by the service areas of the primary schools in the study area. The BMA comprehensive plan and the DPT standard provide different definitions of the service area of a primary school.

1) In the DPT standard, the number of households per primary school is specified at 14,000 households for nine schools. Based on the average household size of 3. 9

persons/household, as determined from the social survey, the average population per primary school is estimated at around 6,000 persons.

2) In the BMA comprehensive plan, the service range is specified to be 1.0 km in radius. Since the average population density is set at 37 persons/ha in the BMA area, the average population per primary school is estimated at 11,600 persons.

Based on those requirements, the standard neighborhood unit is defined as having a population of 5,000 – 10,000 persons in the range of 1.0 km in radius. As a result, the study area is divided into 17 neighborhood units.

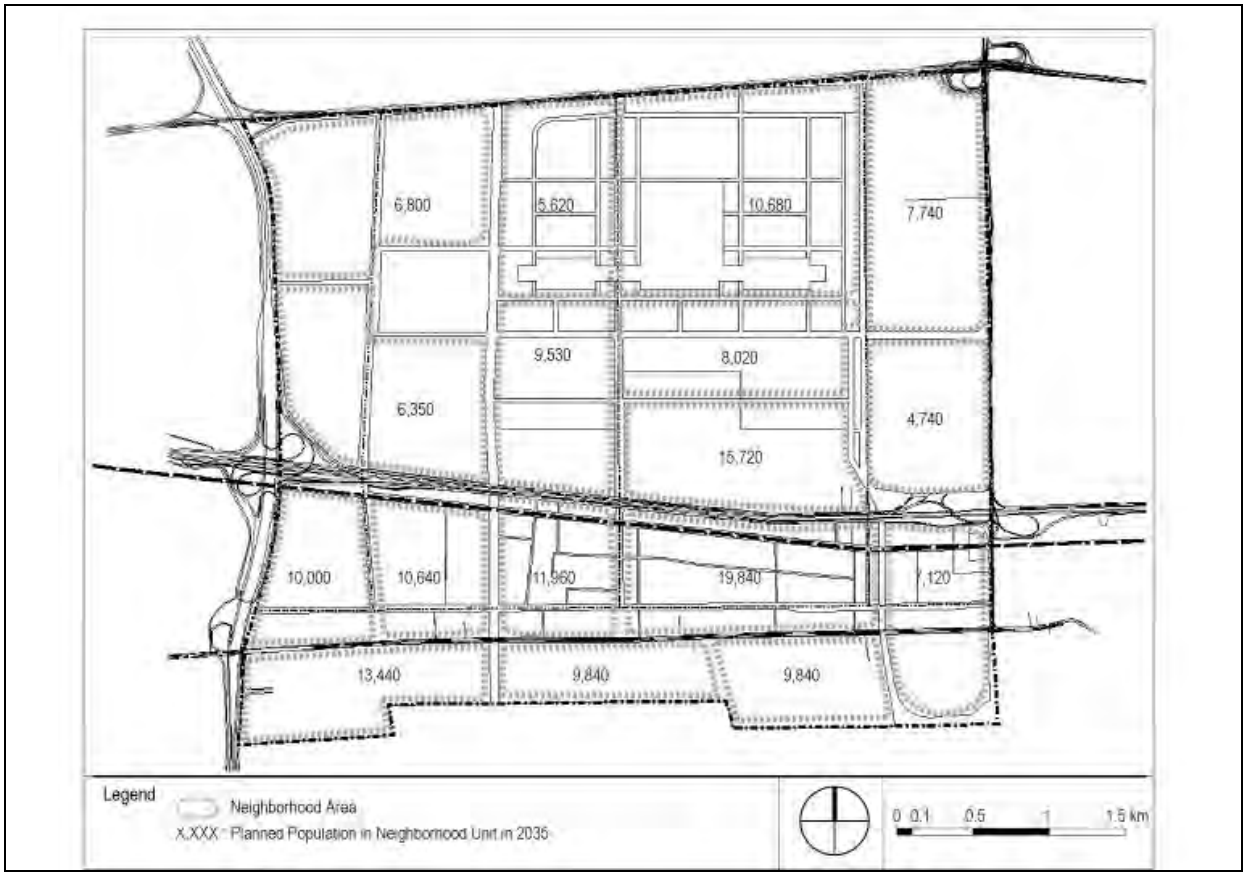


Figure 5.10: Distribution of Neighborhood Units and Population

(2) Basic Composition of Public Facilities

A neighborhood unit shall be provided with the public facilities for education, medical service, green areas, social welfare, and social security that are required to form the basic living conditions for the residents. The public services are physically provided by the facilities as listed below.

1) Education: Pre-primary, primary, junior secondary, senior secondary, and vocational schools,
2) Medical service: Health centers and general hospitals,
3) Green area: Pocket parks, neighborhood parks, and district parks,
4) Social welfare: Day nurseries, youth centers, and community centers, and
5) Social security: Police stations and fire stations.

In order to realize the synergic effect of communal activities, the public facilities are distributed into the four different levels based on the service range. At the basic level of 1.0 km in radius, the primary school is planned as the core facility in the community. At this level, a youth center and neighborhood park are allocated next to the primary school. At the lower level of 0. 5 km in radius, the pre-primary school is considered as the core facility of which the function will be strengthened by the day nursery and pocket park. At the upper level of 1. 5 km, the secondary schools are proposed as the core units, each of which is to be supported by a community center with a library and center for the aged. At the higher level or district level, the regional facilities are the general hospital and district park.

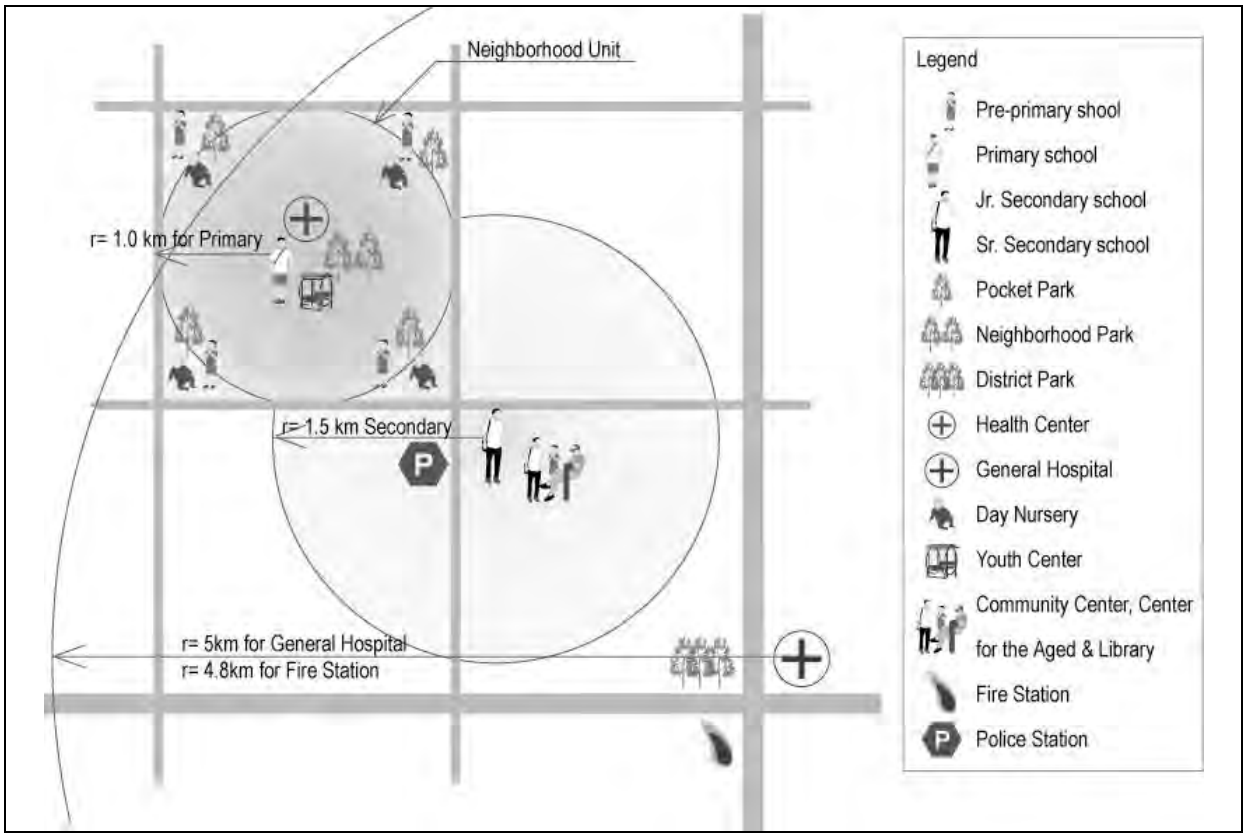


Figure 5.11: Layout of Public Facilities

5.07 Cost Estimation

Implementation cost for the subcenter development of 1,945 ha is estimated at 214,701 million baht which includes the construction, engineering services, and project management costs. In addition to this, the implementation cost for the regional transport system shall be 2,951 million baht for NS1, NS2, and EW1 roads and the interchange at the OBRR.

Item		Construction	Engineering Service	Project Management	Total	Share
		mil. baht	mil. baht	mil. baht	mil. baht	%
Transport	Primary and Secondary Roads	2,360.1	188. 8	254. 9	2,803. 8	1. 29
	Interchange	957. 2	76. 6	103. 4	1,137.1	0. 52
	LRT	9,387. 6	751.0	1,013. 9	11,152. 5	5.12
Flood Protection	Drainage System	694. 4	55. 5	75.0	824. 9	0. 38
	Khlong Improvement	874. 2	69. 9	94. 4	1,038. 6	0. 48
	Retention Pond in District Park	44. 7	3. 6	4. 8	53.1	0.02
Water Supply	Distribution System	116. 9	9. 3	12. 6	138. 8	0.06
Wastewater	Collection System	112. 6	9.0	12. 2	133. 8	0.06
	Central Treatment Plant	57. 5	4. 6	6. 2	68. 3	0.03
Power Supply	Distribution System	470. 2	37. 6	50. 8	558. 6	0. 26
	Substation and Transformers	263. 8	21.1	28. 5	313. 4	0.14
Communication	Distribution System	305. 9	24. 5	33.0	363. 4	0.17
	Exchange System	12. 3	1.0	1. 3	14. 6	0.01
Solid Waste	Collection System	96. 8	7. 7	10. 5	115.0	0.05
Parks and Green areas	Earthwork	162.1	13.0	17. 5	192. 6	0.09
	Planting	926.1	74.1	100.0	1,100. 2	0. 51
Land Develop.	Earthwork	6,995.1	559. 6	755. 5	8,310. 2	3. 82
	Road, Utility, and Pond	24,441. 8	1,955. 3	2,639. 7	29,036. 9	13. 34
Building	Private	129,065. 7	10,325. 3	13,939.1	153,330.1	70. 45
	Public	5,864. 2	469.1	633. 3	6,966. 7	3. 20
Total		183,209.1	14,656. 7	19,786. 6	217,652. 5	100.00
	Excl. NS1, NS2, EW1, and IC	180,654. 2	14,528. 9	19,518. 3	214,701. 4	98. 64

6. STRATEGIC DEVELOPMENT PLAN

6.01 Planning Principles

The Strategic Development Plan was formulated in order to visually present considerations on how to materialize the master plan discussed in the previous chapters. The strategy for development of the Lat Krabang sub-center area was formulated focusing on the suitable implementation body for the various land blocks and facilities to be constructed. The plan also clarifies the areas to be intensively developed from the areas in which the goal can be achieved by urban management.

6.02 Component Categories

The categories of areas and facilities that comprise the strategic development plan are as follows:

(1) Area based categories

- Areas to be developed by a land adjustment scheme, as integrated super block development in these areas is strategically important and suitable for adoption of the land readjustment scheme. These areas include the RD&D city area and the Lat Krabang Station development area.
- Areas to be developed by public/private partnerships, as super block developments are desired but not suitable for implementation by the land readjustment scheme. These areas include the Wat Ranboon Station development area and the Value Creation Center area.

- Areas to be managed by regulative and incentives measures residual in the urban planning system of BMA. This is because the main players in these areas are likely to be small scale development and household investment. This category covers the majority of the Study Area.
- Areas to be managed by a combination of the urban management system as well as community based development schemes of BMA, as these areas are strategically important but already heavily inhabited. This category is designed to support development efforts originated by local citizens.

(2) Facility based categories

- Facilities to be developed by national governmental agencies, as these facilities are for interregional purposes. These facilities include the rail transit systems connecting the central area of Bangkok to various areas throughout the Study Area.
- Facilities to be developed by BMA as its ordinary annual investment program, as these facilities are necessary to support the entire set of sub-center functions and can be managed by public works within the area of BMA. Typical facilities include regional roads, canals, and various utility infrastructures.
- Facilities to be developed by implementation bodies for super-block developments, as users of these facilities are mostly limited to those workers and visitors in the super block development area.

The following figure shows the Strategic Development Plan by category of area and facilities mentioned above.

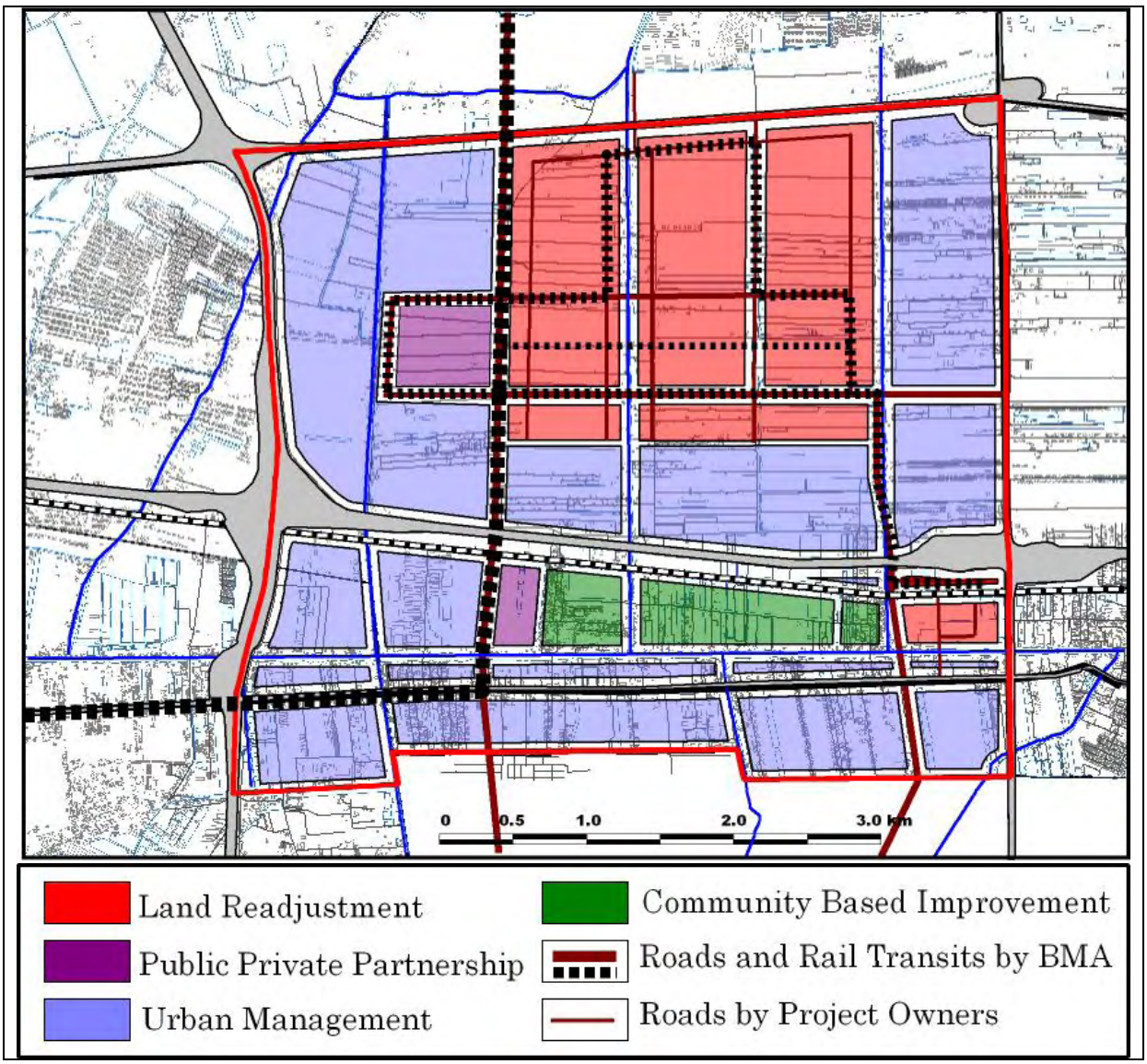
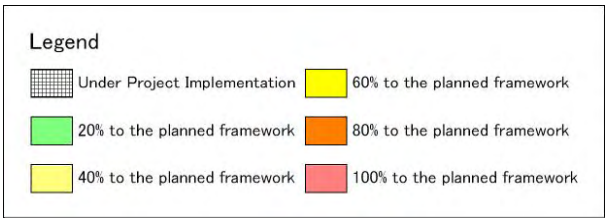


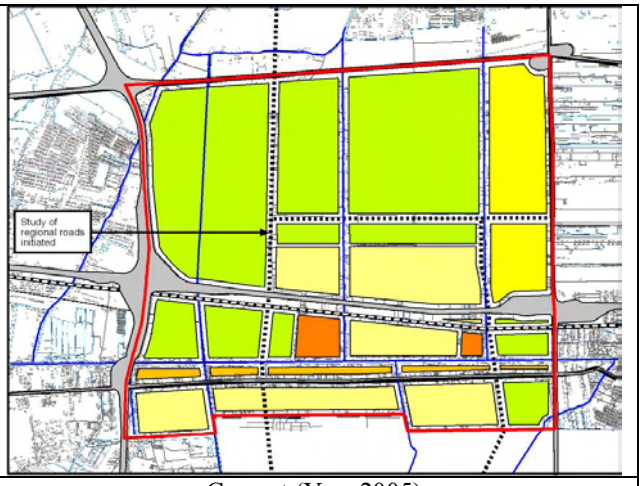
Figure 6.01: Strategic Development Plan by Category of Area and Facilities

6.03 Development Phasing

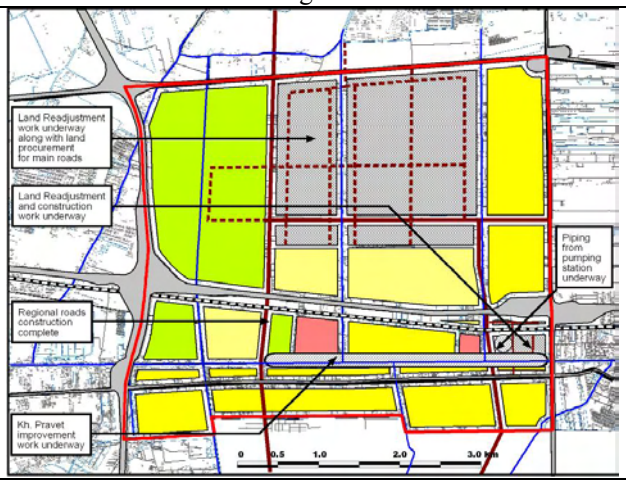
The timing of development for the major facilities and super-block areas is also proposed in the strategic plan. The primary considerations for the planning of phasing placed importance on the leveling of investment load by BMA for annual budget allocation toward the target year of 2035. The following figure shows the Strategic Development Plan by phasing.



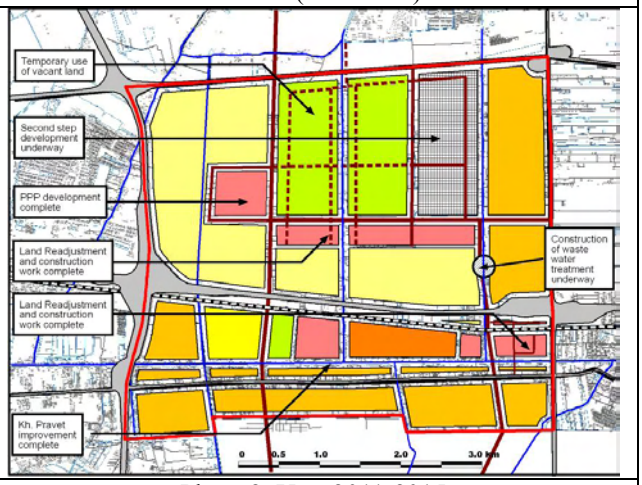
Legend



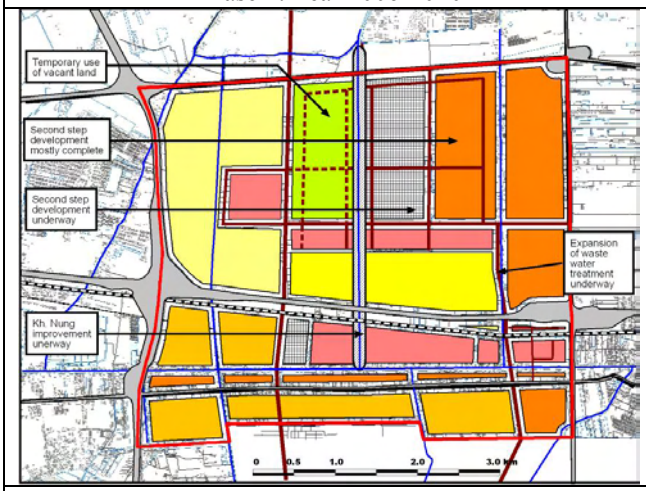
Current (Year 2005)



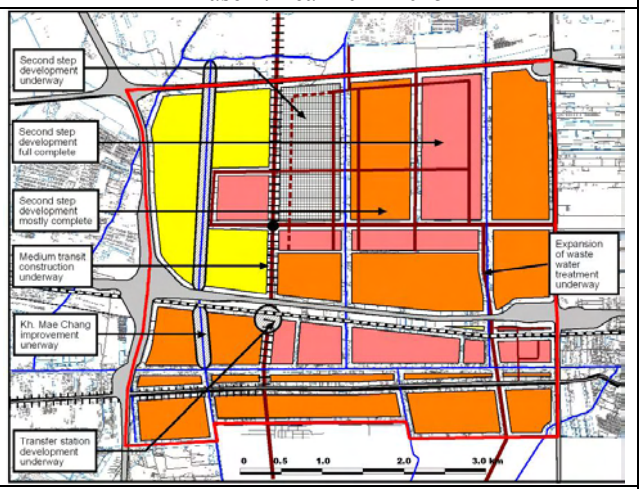
Phase 1: Year 2006-2010



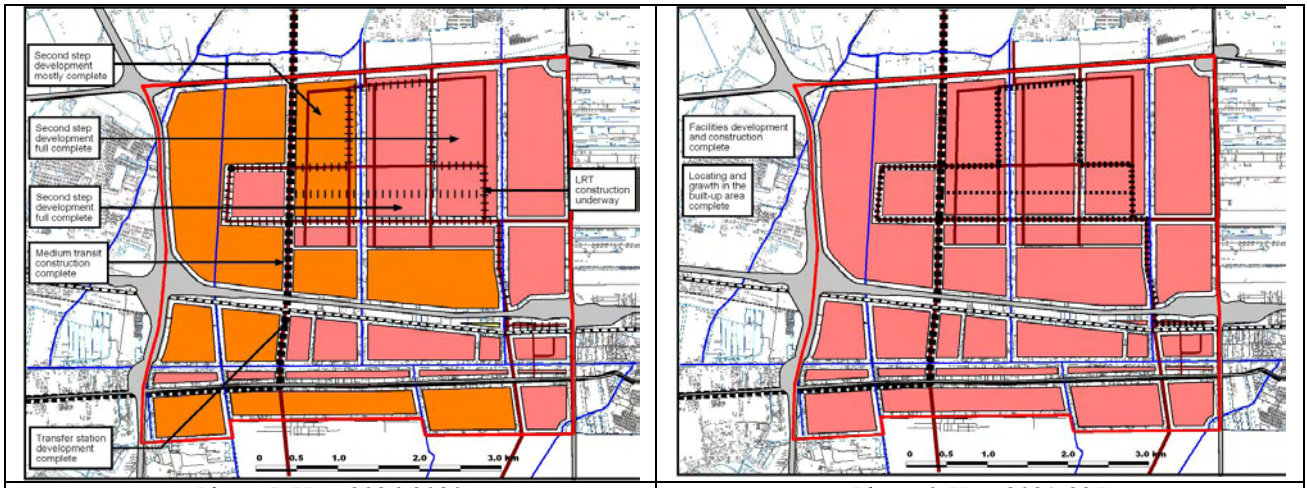
Phase 2: Year 2011-2015



Phase 3: Year 2016-2020



Phase 4: Year 2021-2025



Phase 5: Year 2026-2030	Phase 6: Year 2031-235

Figure 6.02: Phased Development Plan

6.04 Cost Allocation by Phase

The implementation cost, including O&M cost, is estimated for the period from 2006 to 2035, based on the phase-wise development plan for the subcenter as listed below.

1) The timing for the investment in the main roads and utilities is adjusted to the phase-wise development plan.
2) The timing for the investment in the land reclamation and the building works is adjusted to match the development level in each plot of land. The development level is estimated by the ratio of the population in every year to the population in 2035.
3) The timing for the investment in the public facilities is planned to provide 70% of the full capacity during the period in which the population increases from 30 % to 50 % of the planned population in 2035. The intermediate capacity at 70% is to be raised to 100 % when the population reaches the population projected for 2035.

Table 6.01: Implementation Cost for the Subcenter Development by Fiscal Year

Year	Public Sector for Project Cost			Private Sector			Public Sector for Regional Transport	Total
	Civil & Building Incl. PM	O&M	Sub-total	Civil & Building Incl. PM	O&M	Sub-total		
	mil. baht	mil. baht	mil. baht	mil. baht	mil. baht	mil. baht	mil. baht	mil. baht
2006	214	0	214	4,105	0	4,105	380	4,699
2007	214	2	216	4,972	21	4,993	383	5,592
2008	391	4	395	6,088	46	6,134	386	6,914
2009	214	6	220	7,080	76	7,156	389	7,766
2010	449	8	457	8,593	112	8,705	392	9,555
2011	519	11	530	8,439	155	8,594	16	9,140
2012	519	14	533	8,750	198	8,948	16	9,497
2013	646	17	664	8,763	242	9,005	16	9,685
2014	950	21	971	8,882	286	9,168	16	10,155
2015	488	26	514	9,201	330	9,532	16	10,062
2016	504	29	533	5,408	377	5,785	16	6,334
2017	389	32	421	6,015	404	6,419	16	6,856
2018	677	35	712	6,701	434	7,136	16	7,863
2019	446	39	484	7,630	468	8,097	16	8,598
2020	609	42	651	7,571	506	8,077	16	8,744
2021	621	45	667	5,317	544	5,862	243	6,772
2022	621	47	669	5,107	571	5,678	245	6,592
2023	471	49	520	6,234	597	6,830	247	7,598
2024	487	50	537	5,853	628	6,481	249	7,268
2025	437	69	506	7,571	658	8,229	321	9,056
2026	2,481	70	2,552	5,783	696	6,479	95	9,126
2027	2,503	91	2,593	5,981	725	6,706	95	9,395
2028	2,625	111	2,736	6,194	755	6,949	95	9,780
2029	2,503	132	2,635	6,418	786	7,204	95	9,933
2030	2,546	180	2,725	6,651	818	7,470	26	10,220
2031	300	200	500	3,867	852	4,719	26	5,244
2032	300	201	501	4,052	871	4,924	26	5,450
2033	300	203	502	4,246	892	5,138	26	5,666
2034	300	204	504	4,451	913	5,364	26	5,893
2035	300	160	460	4,667	936	5,603	26	6,088
Total	**24,024**	**2,097**	**26,121**	**190,593**	**14,897**	**205,490**	**3,929**	**235,540**

Note:
1) "Civil & Building" covers the construction, engineering service, and project management costs.
2) "O&M" for public sector covers the repair cost for primary and secondary roads.
3) "Regional Transport" covers the construction, engineering service, project management, and O&M costs for the interchange and NS1, NS2, and EW1 roads.

7. ECONOMIC ANALYSIS

7.01 Purpose of Economic Analysis

The purpose of the economic analysis in this study is to achieve a rational allocation of resources, leading to enhancement of incomes for investment or consumption. Economic analysis shall provide the identification, quantification, and valuation of project objectives or targets. In view of the study objective, the economic analysis herein shall determine whether the Lat Krabang Sub-Center development with approximately 1950ha of total area shall be economically viable and sustainable. Since the Lat Krabang Sub-Center is substantially large in investment scale, it is also important to assess its impact on the Thai economy.

7.02 Results of Economic Analysis

The calculation of EIRR and NPV was done by comparing project benefits and costs, both expressed in terms of economic prices over the project life. As is conventional practice, calculation of EIRR, NPV and B/C ratio was done by calculating only the stock effect (long term impact of the economic surplus to be generated by the completed urban area) and excluding the flow effect (short term impact of the construction investment). The estimate of the benefits herein, is limited to the increase in value added to be generated by the local enterprises' economic activities and the economic surplus of values generated in response to population growth. Various economic impacts arising from the Lat Krabang Subcenter development will reach beyond the direct boost that the Thai economy will receive. For instance, the attractiveness of the new urban space, reduced commuting cost and travel time by decentralization from the Bangkok CBD, tax revenue impacts etc. however, these economic impacts are broad and difficult to measure. Being based on the objective of the project, calculation of benefits shall be, herein, confined to direct user benefits; enterprises (employees) and inhabitants (population).

In terms of the discount rate to calculate NPV and B/C, 10% is used herein. Japan Bank of International Cooperation (JBIC) uses 10% as a common practice for projects for all countries. Likewise, the Asian Development Bank (ADB) uses 10 to 12%. The economic rate of return (EIRR) of this project is 26. 6% and the project is evaluated as viable in the economic aspect.

The NPV and B/C are as follows:

- Using the common practice of JBIC /ADB

NPV and B/C ratio @ 10% are 79 billion Baht and 1. 97, respectively.

- Using the weighted average of the Thai Government Bond and Bangkok Inter-bank Offered Rate

NPV and B/C @ 5. 3% are 192 billion Baht and 2. 94, respectively.

Table 7.01: Index for Economic Evaluation

EIRR	NPV @10%	B/C @ 10%	NPV @ 5. 3%	B/C@5. 3%
26. 3%	79 billion Baht	2. 2	191 billion Baht	2. 92

(Source): Calculated and prepared by JICA Study Team

8. PRE-FEASIBILITY STUDY FOR PILOT PROJECT

8.01 Objectives and Selected Area for Pilot Project

The objective of carrying out the pre-feasibility study on an area selected as a pilot project area is to fuel the momentum of the Lat Krabang subcenter development by providing key information based on more detailed planning and analysis. Another important objective is to enhance the capability of BMA in terms of planning and implementing land readjustment projects, for which Japan has provided technical assistance for more than a decade.

The pilot project area was selected from three super-block development areas indicated in the strategic development plan discussed above. Through a preliminary analysis of the land