Table 3.3.13-Rain Water Retention Area and its Retention Volume

Location	Retention Area (ha)	Retention Volume (m^3)
- Improved khlongs (total length: 4,000 m.)	5.2	89,000
- Open space along khlong	7.3	73,000
- Drainage pipes	0	20,000
Total	12.5	182,000

Location of improved khlongs and open space are as shown in **Figure 3.3.16**. As a result, the total retention area is 12.5 ha or 5.1% to the development area (245 ha), and which surpasses the DDS's guideline figure of 5%. The total retention volume of 182,000 m^3 also surpasses the required retention volume of 148,000 m^3.

2.3.6 Land Filling

Low ground unused land of the study area shall be reclaimed up to an elevation +1.0 m. as mentioned in the section 1.3.5 *"Drainage and Flood Protection System"*.

The quantity of required soil for such reclamation will be about 1,300,000 m^3. However, this is the figure which has been estimated from the map made in 1987 which contains very rough ground elevation data. Therefore, the accurate quantity of required soil shall be estimated after the completion of on-site topographic survey which will be carried out on October 1992.

Figure 2.1.15 shows a plan of the reclaimed area, improved khlongs and allocation of open space along khlongs. The reclaimed area is about 70% of the study area, and its reclamation height is 0.30 m. to 1.20 m.

Most of the existing large-size buildings, such as a TV station, a government housing bank, the school, wat, Royal City Avenue, hospital, hotel, and office buildings stand on the comparatively high filled land. Those are left as it is. As well as the commercial buildings and housings located between Rama IX and government housing bank which stand in good condition shall also be left as is.

For construction of new roads and building lots in the study area, 16 low-rise commercial buildings, 527 houses including squatters along the railway and one factory building are required to be removed.

2.3.7 Public Utility

(1) Sewerage and Water Supply System

1) Outline of Sewerage and Water Supply System

Water shall be supplied by the MWA (Metropolitan Waterworks Authority) to the study area through the existing main pipeline. Waste water generated in the developed study area shall be treated by a waste water treatment plant, which may be constructed in the study area, and the treated water shall be discharged to khlongs.

Figure 3.315-Profile of Khlong Khamen

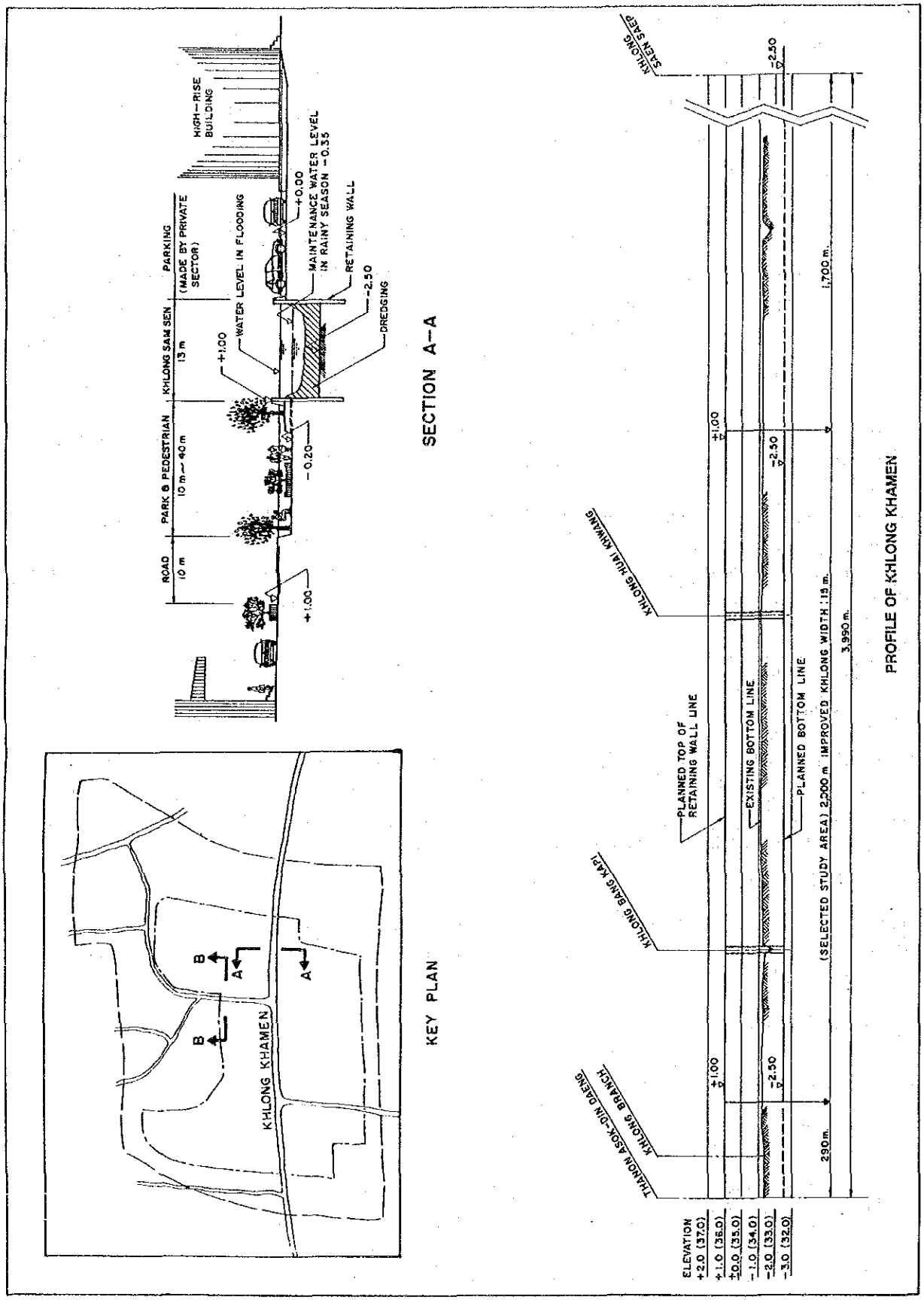
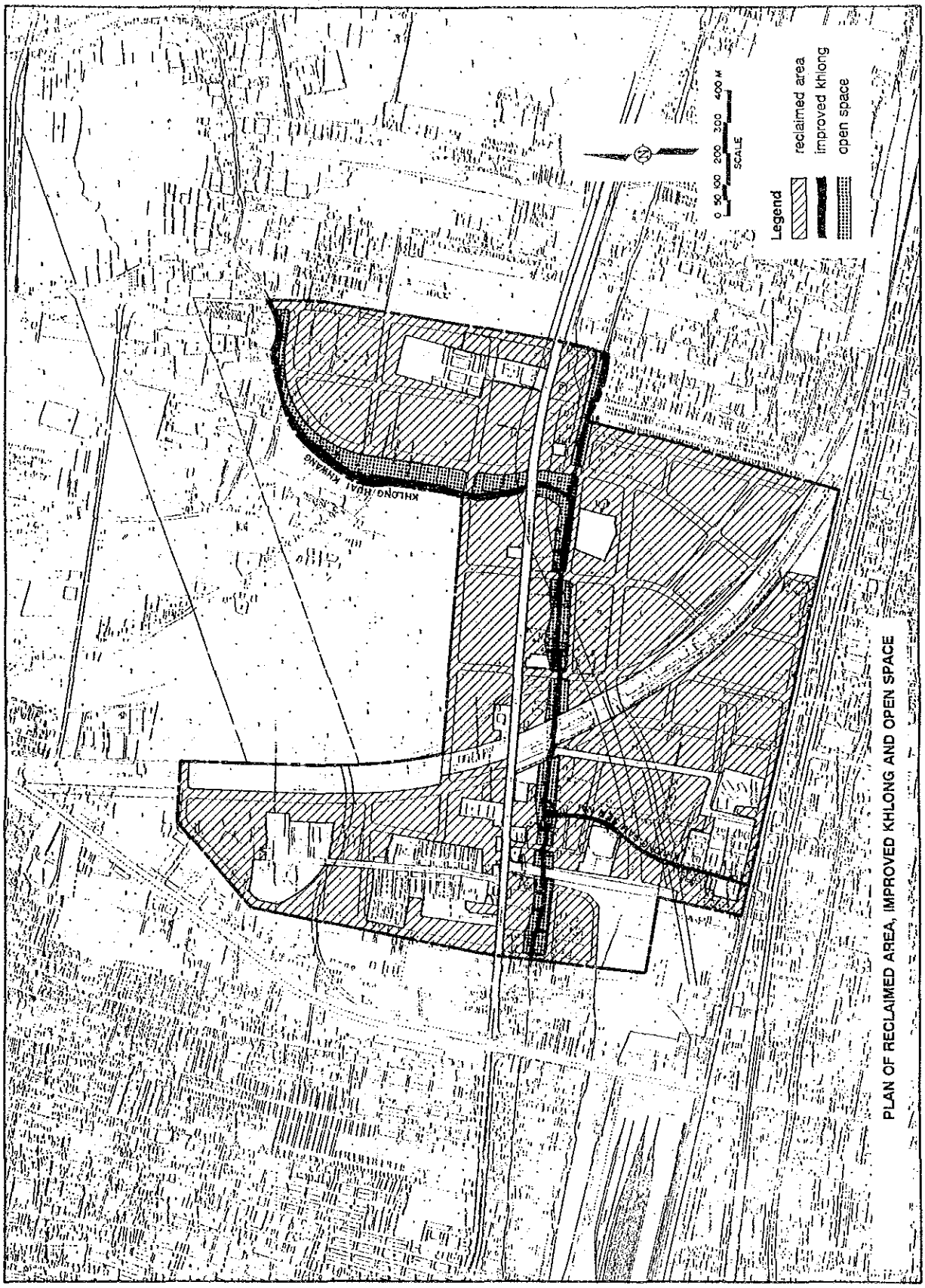


Figure 3.3.16-Plan of Reclaimed Area, Improved Khlong and Open Space



There are two other different themes regarding water to be considered for development of the study area. The first is purification of the polluted khlong water, and the second is recycle of treated water in terms of effective use of limited water resources.

2) Purification of Polluted Khlong Water

The DDS of the BMA is tackling the purification of polluted khlong water by developing a sewerage system district by district and construction of aeration pond as temporary measures until completion of such sewerage system.

At present, the study area is located outside of the BMA's sewerage project. Therefore, even if the waste water in the study area is treated completely, the water quality of khlongs in the study area may not be improved drastically because of the inflow of polluted water from upstream.

Therefore, until completion of the sewerage system of Huai Khwang drainage area by the BMA, an aeration canal for purification of khlong water shall be allocated in the study area.

3) Recycle of Treated Water

The MWA is supplying piped water in Bangkok. They are implementing the works for expanding their service coverage by developing new pipeline network in the new urbanized area, and are implementing the works for increasing the capacity of purification, transmission and distribution of the water for the existing served area in order to meet the increased water demand due to the growth of economic activities and high density urban development.

In/around the study area, the MWA's transmission and distribution pipelines are completed. **Figure 3.3.17** shows the MWA's existing pipelines and the planned distribution pipelines to be installed in accordance with the new road network of the study area after development.

The MWA's served demand in the year 2007 of the study area (800 ha) will be 411 l/sec. The total water demand of the developed study area will be 400-450 l/sec. From the quantity-wise, a recycle system of 40 l/sec. capacity may be required at the later stage of the development.

The development of recycle system of treated water within the high density business district is quite promising.

Table 3.3.14 shows the water quality standard for recycle use of treated water in Japan. From the late 1970s, many recycle systems of treated water have been introduced in Japan in business districts such as Shinjuku, Yokohama, Kobe and Makuhari-chiba.

Figure 3.3.17 - Water Supply Pipeline

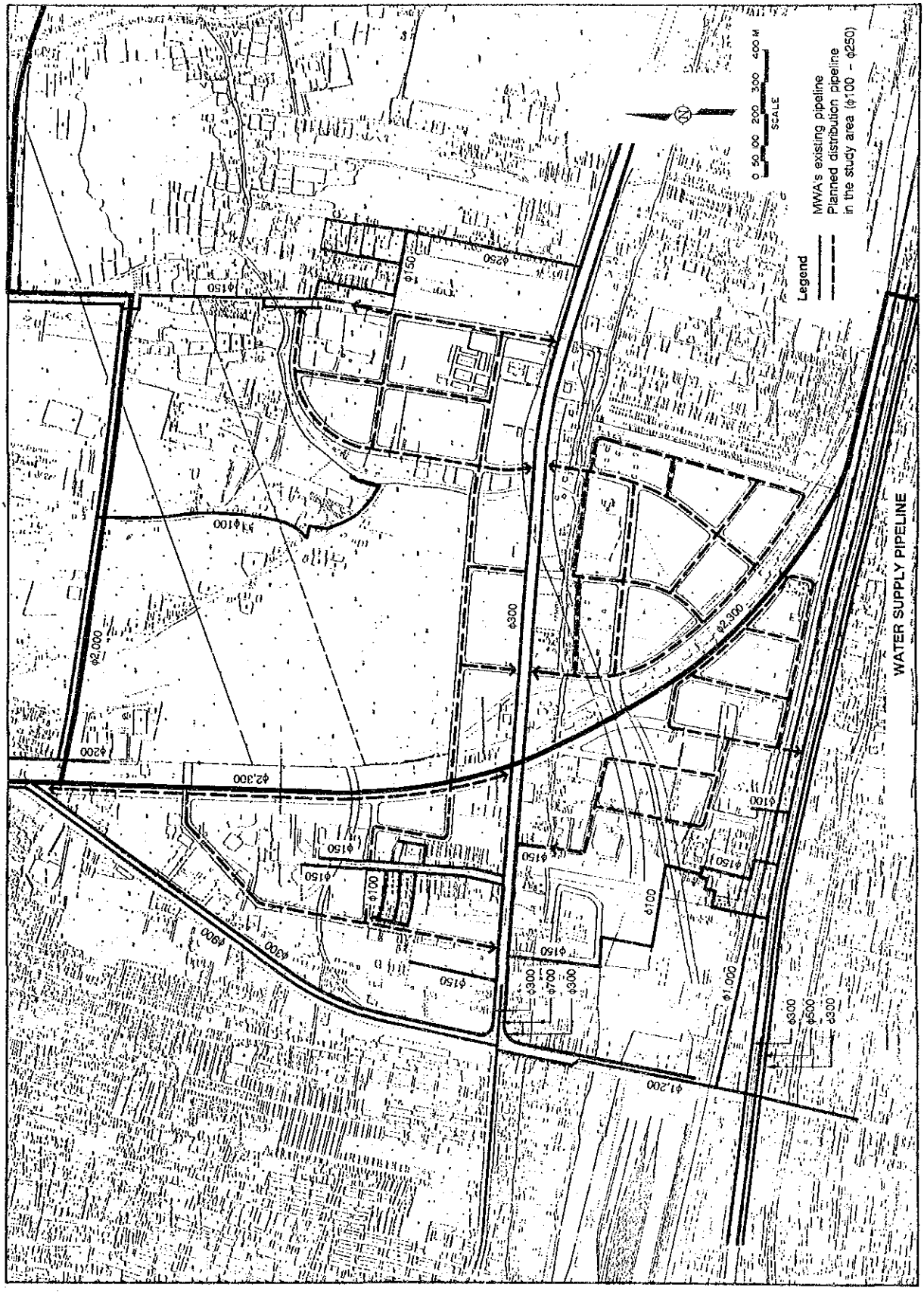


Table 3.3.14 Water Quality Standard for Recycle Use

Item	Standard	
	For Scenic Use	For Playing Use
BOD	less than 10 mg/l	less than 3 mg/l
PH	5-8 ~ 8.6	5.8 ~ 8.6
Turbidity	less than 10	less than 5
Colour	less than 40	less than 10
Odor	not to be discomfort	not to be discomfort
Coliform group	less than 1000/100 ml	less than 50/100 ml

A recycle system of treated water of the study area shall be developed in the following manners:

1. A waste water treatment plant for the study area shall be constructed in the study area. The effluent water quality shall be BOD less than 20 mg/l which meets to rank A of the PWD's water quality standard.

2. An advanced water treatment plant shall be constructed in a building in the high density business district. A part of the water which is treated in the waste water treatment plant shall be transferred to this advanced water treatment plant.

3. The water which is treated BOD less than 10 mg/l in the advanced water treatment plant shall be distributed to each high-rise building in the high density business district for the use of toilet flushing, cooling and gardening. Every high-rise buildings in the high density business district shall be designed to have two kinds of water supply lines as fresh potable water and recycle treated water.

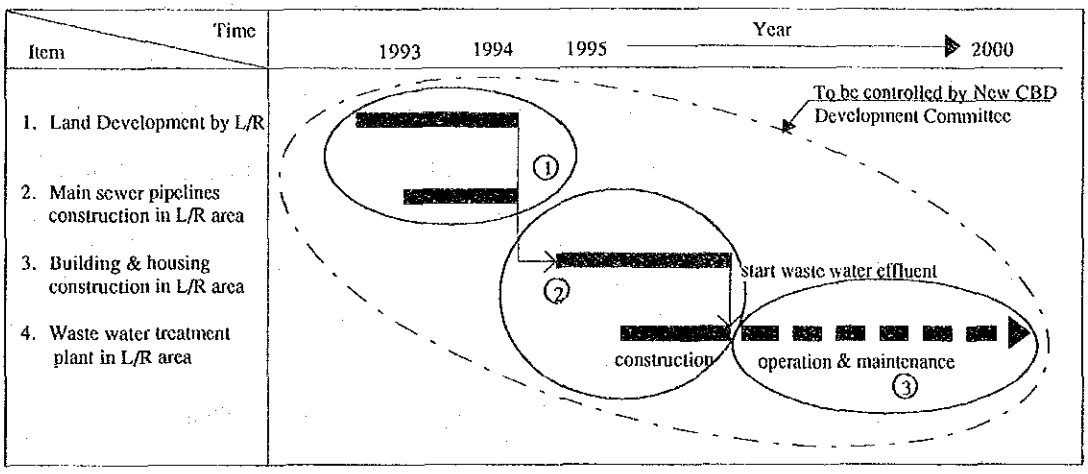
4) Sewerage System Development

The study area is located outside of the BMA's on-going sewerage project. Therefore, for the time being the sewerage system of the study area shall be developed as private facilities.

The PWD (Public Works Department) of the Ministry of Interior specifies the standard for discharged water quality, and every developer observes it at the time of application for building permit. Therefore, even if the present development system is taken for development of the study area, sewage treatment facilities will be constructed by developers block by block even under the present regulations.

In order to lessen the developer's burden for providing sewerage system and to make an easy conversion of the sewerage system to the BMA's public sewerage system in the future, a centralized sewage treatment plant and main sewer pipeline system should be considered. This private centralized sewerage system shall be completed in the following three stages and different cost sharing bodies as shown in **Figure 3.3.18**.

Figure 3.3.18-Expected Development Process for Sewerage System and the Bodies Concerned



No.	Bodies to share the cost	Cost for sewerage system development
①	L/R implementation body	- Land for waste water treatment plant - Construction cost for main sewer pipelines
②	Building & housing developer	- Construction cost for waste water treatment plant
③	User of building & housing	- Cost for operation and maintenance

- First Stage:

  Construction of main sewer pipeline and provision with the land for waste water treatment plant at the cost of the L/R implementation body.

- Second Stage:

  Construction of waste water treatment plant at the cost of building and housing developers.

- Third Stage:

  Operation and maintenance at the cost of users of housings and buildings.

For completion of this system, the establishment of a committee who controls not only the L/R implementation but also building development for a 10 year period of development after the L/R is absolutely necessary. Unless the committee is organized or has strong leadership toward completion of an integrated new CBD development with sound financial background, this plan will not be realized.

(2) Electricity/Tele-communication

The study area is located in the mid-urban area, and the main lines of electricity and tele-communication services around the study area are completed.

MEA (Metropolitan Electricity Authority) shall supply electricity and TOT (Telephone Organization of Thailand) shall supply tele-communication services to the developed study area.

2.3.8 Public Urban Facilities

(1) Educational Facilities

Based on the forecast for 2001 of the Bangkok General Plan, the percentage of pupils/students to the total population in Bangkok is as follows;

Kindergarten/nursery	:	2.4 %
Primary school	:	9.9 %
Secondary school	:	7.2 %

According to the General Plan or the standard of Department of General Education, Ministry of Education (D.G.E.), 20 m^2/pupil shall be provided as school facilities.

Although Land Sub-division Act is not applicable to the study project, supposing four people live in 1 lot of land, the following schools should be prepared.

- 1,600 m^2 of kindergarten/nursery for 500 lots (2,000 people)
- 8,000 m^2 of primary school for 2,000 lots (8,000 people)
- 32,000 m^2 of secondary school for 4,000 lots (16,000 people)

The standard service distance of the educational department of BMA is as follows:

- Primary school : 2 km (The schools should have distance more than 3 km.)
- Secondary school : 5 km
- High school : 10 km

The standard number of pupils per class is 35 to 40.

a) Kindergarten/nursery

Considering service distance, six to seven kindergartens for 60 to 80 pupils should be distributed in the community. The total area of the facility will be 8,640 m^2.

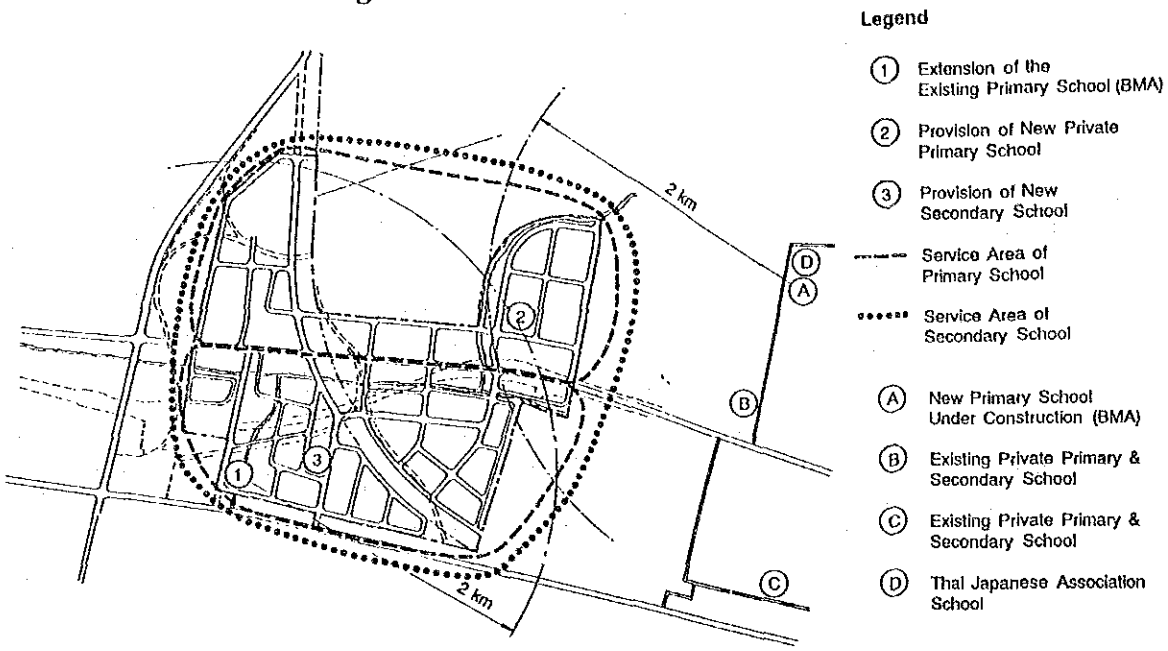
Kindergarten/nursery can be managed in buildings such as condominiums or primary schools without their exclusive site.

b) Primary school

In 2001, the number of pupils for primary schools will be about 1,440.

According to the standard of the Department of Education, BMA, the planning area is covered by the BMA primary schools, one of which is existing in the planning area and the other is under construction in the Concept Plan area.

Figure 3.3.19-Location of Schools



LOCATION OF SCHOOLS

The existing BMA primary school (7,320 m^2, 24 classes, 900 pupils) will serve mainly the south community (south part of Rama 9 road). Applying 40 pupils per class, this school has a capacity of 960 pupils and the area of 19,200 m^2 should be required or 11,900 m^2 be extended. The extension and improvement should also cope with the government's education plan which aims to provide basic education for handicapped people, school dropouts, urchins, old people and less-educated people.

Considering that only 42% of school age children enter the BMA school, and that the standard service distance of the BMA seems too long, a private primary school with a capacity of 480 pupils (9,600 m^2) should be introduced in Zone 2.

c) Secondary school

In the center of the planning area, a secondary school for 1,400 students with the area of 28,000 m^2 should be prepared.

d) High school, Vocational school et cetera.

In the light of the characteristics of the Master Plan area are a cultural and information center, a high school, vocational schools, and international school should be introduced to the area.

Though no standard has been set for these schools in Thailand, some 30,000 m^2 should be prepared for a high school or an international school.

Language schools, business schools, art and design schools etc., can be housed in office buildings.

Considering the size of the study area, a university or college will not be introduced.

(2) Religious facility

The existing temple Wat Uthai Tharam shall be conserved.

(3) Health care

a) Hospital

In the master plan area, there is a new large private hospital with 300 beds and 400 personnel (Praram 9 hospital).

b) Health Center

A BMA health center should be introduced in the master plan area.

(4) Cultural facilities

In addition to the existing Thailand Culture Center, a library, art gallery, a museum etc., should be introduced.

(5) Institutional

a) Police station

The service will be covered by the existing Makkasan police station.

b) Fire station

A fire station with close access to a major road should be introduced with fire fighting equipment for high-rise buildings.

(6) Parking Facility

Basically, parking will have to be prepared in each building in accordance to the ministerial regulation on car parking under the Building Control Act, which stipulates provision of car parking depending on the classification of buildings. For example, large buildings (more than 15 m high or more than 1,000 m^2 of building area or more than 2,000 m^2 of total floor area) shall have 1 car parking space per 120 m^2 of floor area.

On street parking will be allowed on the roads of 30 m and 20 m width and part of 16 m wide roads.

2.3.9 Building/Landscaping

(1) Townscape

"Townscape" is defined as visual environment of town or city. Landscape is the general word for visual environment, but townscape has been used with emphasis on artificial structures, buildings in particular.

Townscape is considered very important for amenity and attractiveness of living environment. Orderly, pleasant and beautiful townscape should be aimed as the second city center.

A city is formed in combination with infrastructure and buildings. Infrastructure will be designed in the land readjustment project however buildings will not be regulated directly.

Attractive townscape will be made through both restricting method and guiding method upon the total design of the town.

The design policy will be set according to respective land use.
The following will be proposed;

-	Residential area	:	Attractive living environment with amenity rich with green
-	Commercial/business area	:	Spacious, fascinating and orderly pubic open space in network with line of high-rise buildings

(2) Design of Public Space

The design of public space will be a key of townscape.

The following shall be carefully designed, so as to create fascinating space and to form "green network" for pedestrians.

-	Road	:	Pavement, Planting, Street furniture, Sign
-	Park	:	Vegetation, Pavement, Sign, Lighting
-	Mall	:	Pavement, Planting, Street furniture
-	Promenade	:	Pavement, Planting, Street furniture

In the design of public space, the following characteristics of Bangkok should be taken into consideration.

(3) Building Control Act

By the Department Control Regulation of City Planning Division BMA, large buildings shall not be constructed within 15 m from the boundary of Rama 9 road. Although small buildings are not regulated, it would be fine if the facade of buildings should be in line.

Table 3.3.15-Characteristics in the Design of Public Space

Characteristics	Countermeasure
• Hot - strong sun shine	• Creation of shadow by trees, shelters, etc.
• Heavy traffic	• Provision of pedestrian way and formation of pedestrian network with parks and vegetation
• Frequent taxi service	• Provision of taxi zone
• Short walking distance - service of motorcycle taxi	• Provision of motorcycle zone at entrance of minor roads to a main road
• Unrecognizable traffic signs and road network	• Provision of traffic and guiding sign of ordered design

In accordance with Building Control Act, setback of buildings from site boundary is regulated depending on the height of the building. For example, a building not more than 6 m high shall have setback of 2 m and a building more than 15 m high shall have setback of 6 m. Though there is no regulation on limit of building floor area ratio to the site area, the height shall be limited according to the distance from the boundary and thus the form of the building is to be regulated.

For attractive townscape the building line should have same setback so that the height of the buildings should be same category. For example in detached housing area the setback shall be 2 m and in commercial area the setback shall be 6 m.

To gather equal size of plots will contribute to easier formation of orderly townscape.

(4) Toward Formation of Attractive City

District planning will be effective for this purpose.

In case of no related legislation, there is a possibility for agreement of land owners for orderly townscape.

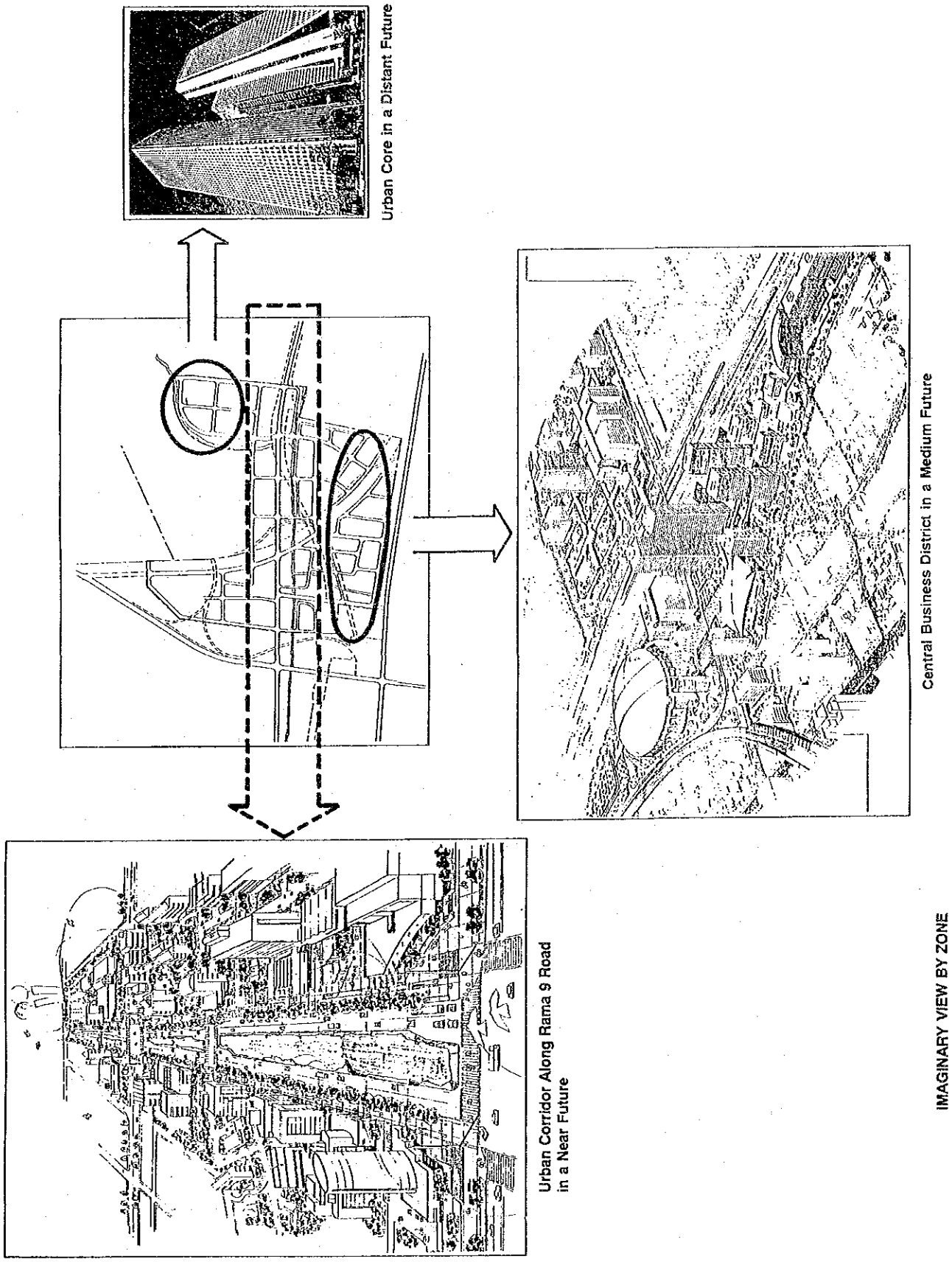
The following method will be considered for realization of the townscape.

- Set-back of buildings from the boundary of public roads
- Restriction of height of building depending on the distance from the opposite side of the fronting road (as stipulated in the existing Building Control Act)
- Restriction of maximum height
- Restriction of land use

(The following use will be prohibited according to the General Plan category: factory, warehouse, large fuel storage, explosive manufacturer or storage, livestock farming, silo, cemetery or crematory, refuse disposal, used material shop, slaughter- house)

- Detailed land use plan of the district
- Restriction of total floor area ratio
- Bonus of additional floor area according to provision of public space
- Design, material and color code for facade of buildings

Figure 3.3.20-Imaginary View by Zone



2.4 Evaluation of Land Readjustment Design

2.4.1 Checks on Land Readjustment Design

Table 3.3.16-Checks on Land Readjustment Design

(1) 1)	**Design Policy** Solution of Development Issued	
a	Thavimit area should be developed maintaining environments along the Skytrain routes	A park is planned for environmental protection along the siding of the Skytrain route.
b	Congestion on Rama 9 Road near Rachadapisek should be alleviated.	The completion of the Second Stage Expressway will alleviate the congestion. Development of the Skytrain and the Hopewell projects is expected to reduce the share of road traffic.
c	New development of the SRT's land should be developed in harmony with surroundings.	Major roads crossing the SRT's land is planned. Also an arterial road is planned parallel to the land.
d	The ETA's workshop needs development coordination.	. Regarding the area which ETA preliminarily planned as a residential unit of the staff, the study team unofficially proposed ETA from an urban planning point of view that the area has high potential for commercial development mixed with residences. . The study team also unofficially proposed that Tiam Ruam Mit Road crossing the planned workshop is expected to be maintained, for example, as a flyover.
e	Existing canals and green areas should be utilized.	Khlong Huai Khwang (Khlong Suat Yai) and Khlong Sam Sen Nai will be maintained and a green network connecting parks is planned along the canals.
f	Areas along Rama 9 Road should have complex building development with green areas.	The areas along Rama 9 Road are designated as a commercial area except that areas along canals are designated as a green area.
g	The Royal City Avenue should have functional integration with surroundings.	An arterial road is planned to cross the Avenue. A park is planned to face the Avenue's central plaza.
h	On both sides of the Royal City Avenue, high development potential should be realized by improvement of access.	In this area, an integrated road network is planned for commercial and residential development.
i	Connection between Tiam Ruam Mit Road/Pracha Utit Road and Rama 9 Road should be improved.	Connecting arterial roads are planned.
j	Access across the railway should be improved.	Arterial streets crossing the railway are planned. The streets will pass under the elevated railways of the Hopewell project.
2)	Conformity to Design Policy	To develop a new CBD, large blocks are designed for commercial areas. Infrastructure and public facilities of high standards are designed. The L/R project is to realize area-wise integrated urban development.

Table 3.3.16-Checks on Land Readjustment Design (Continued)

3)	Realization of Design Themes	
a	Innovative CBD of high efficiency and high grade for the 21st century	To accommodate an innovative CBD, an integrated high grade road network,utilities and urban facilities as well as high green coverage ratio are designed.
b	Innovative area-wise urban development	To achieve planned urban development, the land readjustment scheme is adopted.
c	Innovative mass rapid transit systems	To solve problems of traffic congestion, pollution and waste of energy, maximum utilization of the mass transit systems is designed.
(2)	**Block Design**	
1)	Size and Shape of Blocks Suitable to Land Use and Buildings to be Located	Well designed (see Volume II - 1.3.2)
2)	Consistency between Allocation of Blocks and Access Roads	Details are designed in the next phase
(3)	**Road Design**	
1)	Hierarchical Network of Roads	The following types of roads are integrated to form a hierarchical network i. Expressway ii. Arterial street iii. Major street (25 m) iv. Major street (20 m) v. Minor street distributive vi. Green network vii. Access road
2)	Alignment, Width and Functions of Arterial Streets	In addition to Rama 9 Road stretching east and west, new arterial roads stretching north and south and serving new urban areas are planned. The width is 30 m. They are for inter-district traffic.
3)	Land Use along Arterial Streets	Most areas along arterial roads are commercial and business areas
4)	Alignment, Width and functions of Major Streets	Major roads with 20 m width and 20 m width are spaced at 200 m to 300 m intervals. The former are main roads to delineate districts and the latter are main roads in each district.
5)	Exclusion of Through Traffic from Major Residential Streets	Through traffic is planned to flow along arterial streets. Traffic generated from commercial areas are planned to flow though major streets in the areas to arterial streets.
6)	Avoidance of Too Long Straight Road Sections	One 25 m major road has a straight section of approximately 1.5 km. Other roads consist of shorter straight sections.
7)	Comfort for Pedestrians	Arterial streets, major roads and minor street distributive have sidewalks with trees. A green network is designed to provide pedestrians with comfort and amenity.
8)	Road Network and Open space for Safety in Emergency	A sufficient number of roads with sufficient width are designed. They are connected to parks and open space along the canals, which has a flood regulation function.

Table 3.3.16-Checks on Land Readjustment Design (Continued)

9)	Connection of Green Network and Major Facilities	The green network connects parks and canals. It is also connected to the SRT's mall. Primary schools are planned along the network.
10)	Trees on Roads and Green network	On roads and a green network, trees will be planted to provide pedestrians with shades and amenity.
11)	Access to Stations and Stops	Access to planned stations of the Hopewell project is integrated in the road network. Bus stops are planned at the stations for ordinary and feeder services.
(4)	**Design of Parks and Green Space**	
1)	Establishment of Green Network	The planned green network integrates canals and parks and is connected to the SRT's mall.
2)	Green Officiation of Set-back	Set-back of buildings facing major roads and tree planting in the set back areas are proposed.
3)	Allocation of Parks	Three parks are planned so that each park corresponds to each neighborhood unit.
4)	Area of Parks	The area of parks conforms to the General Plan's standard of 6.1 sq. m per resident. Small scale parks such as Children's parks are not specified in the master plan.
(5)	**Design of Drainage**	
1)	Consistency with Road Design	Drainage is designed along planned roads.
2)	Consistency with Capacity of Downstream	The planned flow volume is within the capacity of the down stream
3)	Multi Utilization of Flood Regulation Areas	Flood regulating functions are borne by open space along the canals, which functions as a green network, small parks and pedestrians' ways.
(6)	**Design of Supply and Disposal Facilities**	Regarding water supply, electricity and telephone, trunk lines are existing. Major lines are designed along new roads so that branch lines can be installed according to the build-up of each area. Sewerage treatment systems are expected to be installed by developers according to the regulations.
(7)	**Design of Public Urban Facilities**	Primary and secondary schools are planned by considering the population forecast and the planned pedestrians' network.
(8)	**Land Filling**	The land use, road and drainage plans as well as flood protection are considered for land filling design.

2.4.2 Comparison of Urban Environments Before and After Land Readjustment

Table 3.3.17-Comparison of Urban Environments Before and After Land Readjustment

Elements to be Conserved	
Canals	To be part of a green network with a flood regulation function
Natural Assets	Parks and a green network is planned by utilizing and improving the existing natural assets such as grass land, ponds as well as canals.
Wat	The area of Wat Uthai Tharam is conserved.
Community Environments	Existing townscape of Thavimit Road area is to be maintained and improved
Hazardous and Negative Elements	
Natural Disasters	Water retention areas are secured. Low land is to be filled.
Traffic accidents	Sidewalks and separate pedestrian ways are to be developed. An integrated road network and public transport systems are planned.
Air pollution	Utilization of new mass transit systems, land use control and installation of green buffers
Noise	Renewal of the SRT's system, land use control and installation of green buffers
Poor Residential Conditions	Improvement infrastructure promotes rebuilding deteriorated houses.
Lacking Elements	
Road Network	A new road network is to be developed.
Public Transport	Two new mass rapid transit systems are to be introduced. Bus services are to be improved in coordination with MRT.
Parks and Other Community Facilities	Three new parks with a green network and two schools in addition to existing Uthai Tharam School are planned.

2.4.3 Comparison of Infrastructure and Public Facilities Before and After Land Readjustment

In the Master Plan Study Area, the comparison of infrastructure and public facilities before and after the land readjustment are shown in Table 3.3.18.

Table 3.3.18-Comparison of Infrastructure and Public Facilities Before and After Land Readjustment

Category	Item	Index	Before L/R	After L/R	Remarks
Road	Road ratio	Road area/Total area x 100	2.2%	20.2%	
	Road length ratio	Road length/Total area x 100	0.07%	0.9%	
	Length of roads narrower than 4 m	Length of roads narrower than 4 m	0 m	0 m	
	Length of sidewalks	Length of sidewalks	3,500 m	46,700 m	including pedestrian ways
	Access to stations/stops	Maximum distance	1,000 m	300 m	
Plot	Ratio of plots without access	Area of plots without access/Total area x 100	n.a.	0%	
Park and Green Space	Park ratio	Park area/Total area x 100	0%	3%	After L/R, 3% of parks plus 3% of open green space along canals
Drainage Facility	Sewerage coverage ratio	Area with sewerage/Total area x 100	0%	0%	
	Inundation area ratio	Flood prone area/Total area x 100	20%	0%	
Supply and Disposal Facilities	Tap-water supply area ratio	Area with tap-water supply/Total area x 100	100%	100%	
	Electricity supply area ratio	Area with electricity supply/Total area x 100	100%	100%	
	Gas supply area ratio	Area with gas supply/Total area x 100	0%	0%	
Public Urban Facility	Access to nursery/kindergarten	Maximum distance	n.a.		
	Access to primary school		2,000 m	1,000 m	
	Access to secondary school		Private school 2,000 m	1,000 m	
	Access to shopping areas		1,500 m	500 m	

3. Land Readjustment Project Analysis

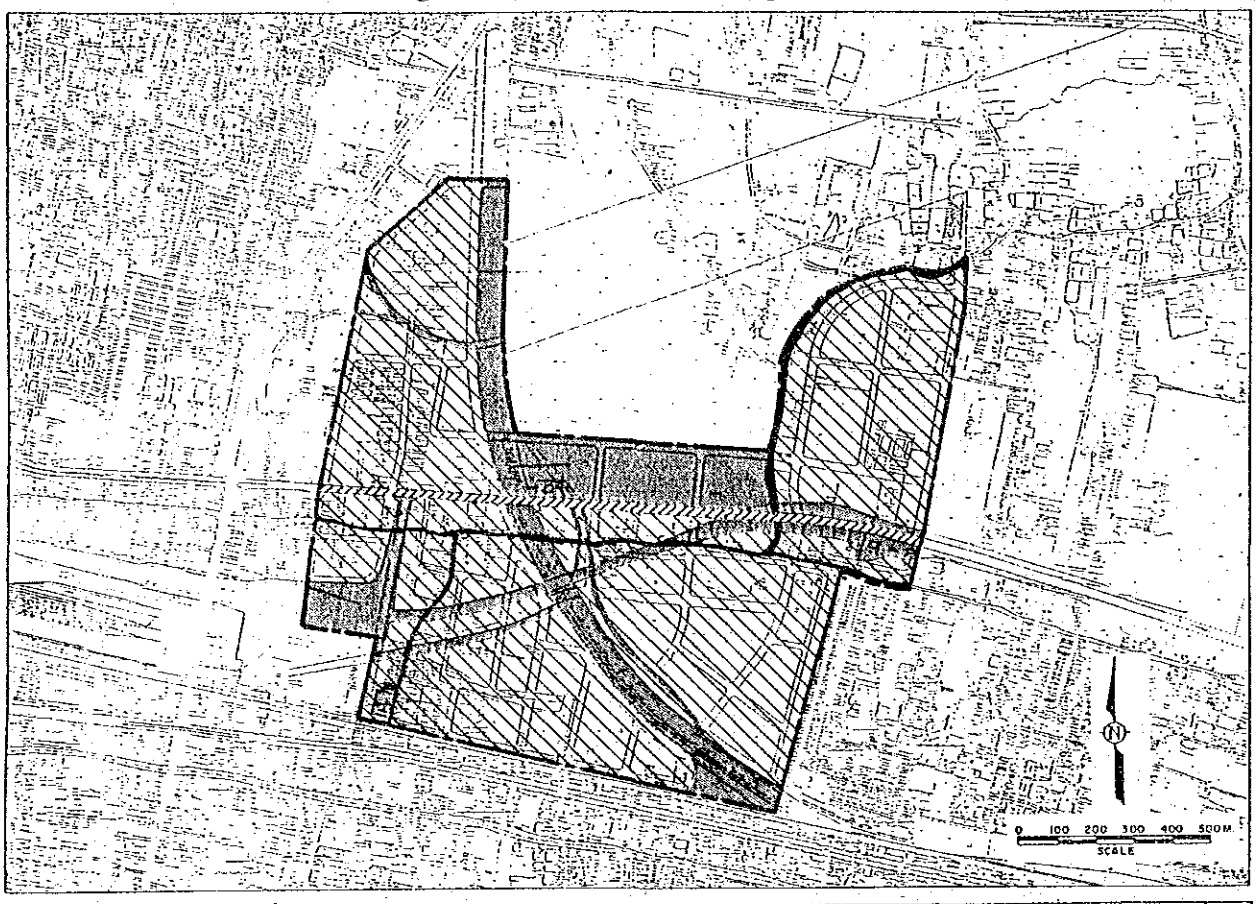
3.1 Comparative Analysis of Land Use

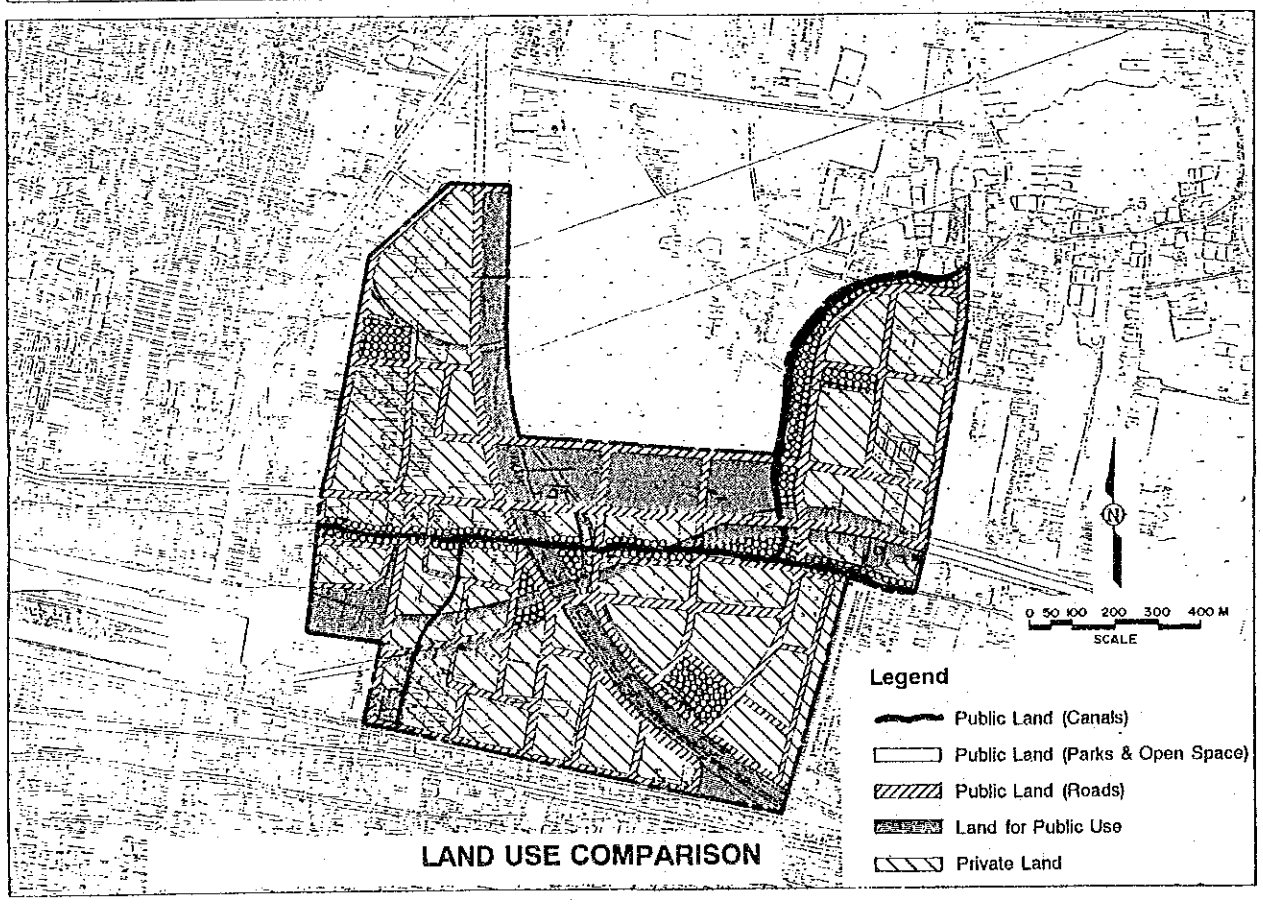
(1) Land Use Comparison

Table 3.3.19-Land Use Comparison

	Category	Before Project		After Project	
		Area(m^2)	Ratio	Area(m^2)	Ratio
Public Land	Arterial Road	53,000	2.2%	218,000	8.9%
	Major Road	0	0.0%	222,000	9.1%
	Minor Road	0	0.0%	55,000	2.2%
	Sub Total	53,000	2.2%	495,000	20.2%
	Canal	48,000	2.0%	52,000	2.1%
	Retention Area	0	0.0%	73,000	3.0%
	Park	0	0.0%	74,000	3.0%
	Sub Total	48,000	2.0%	199,000	8.1%
	Total	101,000	4.1%	694,000	28.4%
Land for public use	Express Way	144,200	5.9%	136,700	5.6%
	Skytrain Workshop	143,600	5.9%	117,300	4.8%
	Skytrain(MRT)	48,200	2.0%	38,900	1.6%
	Royal City Avenu	115,900	4.7%	111,700	4.6%
	SRT(Government)	92,900	3.8%	88,500	3.6%
	School	7,000	0.3%	6,000	0.2%
	Total	551,800	22.6%	499,100	20.4%
Private Land	Residential	288,000	11.8%		
	Commercial	130,000	5.3%		
	Private Road	41,000	1.7%		
	Government	148,000	6.1%		
	Wat	23,000	0.9%		
	Agriculture	10,000	0.4%		
	Unused Land	1,152,200	47.1%		
	Total	1,792,200	73.3%	1,152,000	47.1%
	Reserved Land	0	0.0%	99,900	4.1%
	Adjustment	0	0.0%	0	0.0%
	Grand Total	2,445,000	100.0%	2,445,000	100.0%

Figure 3.3.21-Land Use Comparison





(2) List of Public Land after Land Readjustment Project

Table 3.3.20-List of Public Land after Land Readjustment Project

Public Land	Width (m)	Length (m)	Area (m^2)	Remark
Land for Road				
- Arterial road	30	7,460	218,000	* A part of Roma ‡X is less than 30 m in width.
- major road	25	2,610	65,000	
- major road	20	7,870	157,000	
- Minor street	16	3,460	55,000	
Total of road		21,400	495,000	
Land for Khlong				
- Khlong Kamen	13	1,920	25,000	
- Khlong Huai Kwang	15	1,320	20,000	
- Khlong Sam Sen Nai	10/12	660	7,000	
Total of Khlong		3,900	52,000	
Land for Open Space & Park				
- Open space along khlong				
Kh. Kamen	10/30	1,700	30,000	
Kh. Huai Kwang	15/60	1,200	43,000	
Sub-total			73,000	
- Park			74,000	* 5 places
Total of open space & park			147,000	
Total of Public Land			694,000	

(3) Areas before Land Readjustment

1) Data of the land ownership is based on the first and second site surveys.
2) Areas of public land (roads and canals) are measured on the present condition map with a scale of 1/4000.
3) Areas of on-going large scale projects (the Second Stage Expressway, the Skytrain Project and the Royal City Avenue) are measured also on the present condition map with a scale of 1/4000.

(4) Areas after Land Readjustment

1) Areas of public land (roads, canals and parks) are measured on the master plan map with a scale of 1/4000.
2) It is assumed that the Expressway Project and the Skytrain Project acquire their land. Areas where their land intersects planned roads, canals, etc of the master plan are assumed to be transferred to the public land (national or BMA's).

3.2 Project Cost

Project cost for implementation of L/R is composed of the following items:

(1) Cost for compensation to the owners whose buildings are removed.

(2) Cost for infrastructure development such as land filling, road, park & green and drainage works.

Public utility works such as sewer pipe, water supply and electricity works may be excluded from the project cost depending on the negotiation with state enterprises at the time of project implementation. In such case it may be constructed by the state enterprises, and the users shall pay both of the connection and consumption charge to the enterprises.

(3) Survey and design fee for infrastructure development and land replotting.

(4) Cost for operation of the L/R implementation body.

(5) Repayment of interest of borrowed capital for L/R implementation (for the detail, Section 3.4 Financial Plan is referred to)

Regarding the estimation of physical compensation and construction cost, the following data are applied to:

a. BMA standard cost produced by Design Division, Department of Public Works.

b. Standard cost produced by Public Works Department, Ministry of Interior.

c. NHA's cost data on their past experienced development project.

d. The market price data which were collected through interviews form several leading contractors in Bangkok.

The project cost for the 245 ha development is summarized in **Table 3.3.21.** The amount of total project cost will be 3.0 billion baht or 1,220 B/m^2. **Table 3.3.22** shows the quantity and estimation of compensation cost, and **Table 3.3.23** for infrastructure development cost.

3.3 Land Contribution

(1) Contribution Ratio (Table 3.3.24.(1))

1) Calculation of the overall contribution is for area of building lots, which correspond to "land for public use" and "private land" of **Table 23.3.20.**

2) For reference, contribution ratios of land for public use and private land are calculated respectively.

As a result, the contribution ratio of the land for public use is calculated at 9.39 % because uniform contribution ratio can not be applied to some of the land.

Due to the low contribution ratio of the land for public use, the contribution ratio of the private land is 35.76 %. It is studied in the replotting design that some private land should be allowed to contribute less ratios of land.

Table 3.3.21-Project Cost

Item	Amount (x1,000 Bt)	Remark
1. Compensation cost	735,000	Refer to Table 2.3
2. Infrastructure development cost	1,509,000	Refer to Table 2.4
3. Survey and design fee	135,000	6% of item (1.+2.)
4. Operation cost	119,000	5% of item (1.+2.+3.)
Sub total	2,498,000	1,022 Bt/m^2
5. Repayment of interest	499,000	Interest rate : 12% Project period: 7 years
Total Project Cost	2,997,000	1,226 Bt/m^2

Table 3.3.22-Compensation Cost

Work item	Unit	Price	Quantity	Amount (Bt)
1. Demolikion of buildings				14,320,000
1.1. Wooden buildings				
1) Commercial (9 buil.)	m^2	120	4,000	480,000
2) Residential (481 houses)	m^2	120	52,000	6,240,000
1.2. RC buildings				
1) Commercial (7 buil.)	m^2	200	11,000	2,200,000
2) Residential (46 houses)	m^2	200	24,000	4,800,000
3) Factory (1 build.)	m^2	200	3,000	600,000
2. Reconstruction of buildings				654,000,000
1.1. Wooden buildings				
1) Commercial (9 buil.)	m^2	5,500	4,000	22,000,000
2) Residential (481 houses)	m^2	5,000	52,000	260,000,000
1.2. RC buildings				
1) Commercial (7 buil.)	m^2	15,000	11,000	165,000,000
2) Residential (46 houses)	m^2	7,500	24,000	180,000,000
3) Factory (1 build.)	m^2	9,000	3,000	27,000,000
TOTAL				668,320,000
Physical conringensy (10% of TOTAL)				66,832,000
GRAND TOTAL				735,152,000 (301 Bt/m^2)

Table 3.3.23-Infrastructure Development Cost

Work item	Unit	Unit Price	Quantity	Amount (Bt)
1. Land filling work	m3	340	1,300,000	442,000,000
2. Road work				346,200,000
2.1. Arterial road W=30m	m	19,500	5,500	107,250,000
2.2. Major road W=25m	m	17,300	2,600	44,980,000
2.3. Major road W=20m	m	11,800	7,400	87,320,000
2.4. Minor street W=16m	m	9,900	3,500	34,650,000
2.5. Bridge works (7 place)	m	15,000	4,800	72,000,000
3. Park & Green work				36,900,000
3.1. Gardening of public park	m^2	400	74,000	29,600,000
3.2. Planting on open space along khlongs	m^2	100	73,000	7,300,000
4. Drainage work				332,460,000
4.1. Khlong improvement	m	30,000	6,100	183,000,000
4.2. Dredging	m3	100	89,000	8,900,000
4.3. Open space excavation	m3	50	56,000	2,800,000
4.4. Aeration facilities	Ls		1	30,000,000
4.5. Drainage pipe				
1) dia. 400-500	m	1,800	14,000	25,200,000
2) dia. 600-800	m	2,800	12,000	33,600,000
3) dia. bigger than 1,000	m	4,800	10,200	48,960,000
Total of work item 1.+ 2.+ 3.+ 4.				1,157,560,000
5. Public utility works				214,170,000
5.1. Sewer pipe work				91,920,000
1) dia. 200-250	m	2,100	14,000	29,400,000
2) dia. 300-400	m	2,600	14,200	36,920,000
3) dia. bigger than 500	m	3,200	8,000	25,600,000
5.2. Water supply work	m^2	25	2,445,000	61,125,000
5.3. Electricity work	m^2	25	2,445,000	61,125,000
TOTAL				1,371,730,000
Physical coningency (10% of TOTAL)				137,173,000
GRAND TOTAL				1,508,903,000 (617 Bt/m^2)

3) Contribution ratios are subject to change due to revision of the plan. They can also be changed depending on how to divide the planning area into sub-areas for implementation in the next phase.

(2) Private Land Price

Land prices before and after the land readjustment are estimated as follows in order to :

i. decide if the project can generate reserve land and to
ii. estimate the reserve land area.

1) Land Price before Land Readjustment

Official land prices of the master plan area are available from the Land Office. Due to the public nature of land readjustment projects, the average land price of the area is calculated based on official land prices at locations where the prices are thought to be appropriate.

The average land price of areas with different prices is calculated as follows. The average is 15,200 Baht per square meter.

Table 3.3.24-Contribution Ratio & Proposed Reserved Land Area

(1) Contribution Rate

			Contribution Land Area			Contribution Rate		
Total Private Land Use (A) (sqm)	Total Adjusted Land Area A (sqm)	Private Land Area after PJ Included Reserved Land E (sqm)	Contribution Area for Public Use P (sqm)	Contribution Area for Reserved Land R (sqm)	Added up Land Area D (sqm)	Contribution Rate for Public p=P/A (%)	Contribution Rate for Reserved Land r=R/A (%)	Final Contribution Rate d=D/A (%)
2,344,000	2,344,000	1,751,000	593,000	99,900	692,900	25.30	4.26	29.56
Land or Pub	550,000	(499,100)						9.39
Private Land	(1,152,000)							35.76

(2) Private Land Price

Private Land Area (A) (sqm)	Adjusted Land Area A (sqm)	Land Price before PJ (Unit) a=V/A (Baht/sqm)	Land Price before PJ (Total) V=Aa (TB)	Land Area after PJ E (sqm)	Land Price after PJ (Unit) e=V'/E (Baht/sqm)	Land Price after PJ (Total) V'=Ee (TB)	Increased Ratio y=e/a
2,344,000	2,344,000	15,200	35,628,800	1,751,000	30,00	52,530,000	1.97

(3) Proposed Reserved Land Area

Total Land Price before PJ V (TB)	Total Land Price after PJ V' (TB)	Increased Land Price (Total) Delta V=V'-V (TB)	Land Price per sqm after PJ e (Baht/sqm)	Maximum Land for Reserved Land Rmax=DV/e (sqm)	Reserved Land Area R (sqm)	Ratio R/Rmax (%)	Remarks
35,628,800	52,530,000	16,901,200	30,000	563,373	99,900	17.73	

TB: Thousand Baht

Table 3.3.25-Official Land Price (CVA Data)

No.	Baht/sq.wa	Area (sq.wa)	Total (1000 Baht)
1	20,000	288,748	5,774,960
2	30,000	693,031	20,790,930
3	50,000	112,649	5,632,450
4	70,000	313,074	21,915,180
5	90,000	150,884	13,579,560
6	120,000	409,386	49,126,320
7	140,000	35,914	5,027,960
Total		2,003,686	121,847,360
Average		60,811 (B/sq wa)	=60,800 (B/sq wa) =15,200 (B/sq.wa)

2) Land Price after Land Readjustment

Land prices after the land readjustment is estimated based on estimated official land prices as in the case before the project.

Land prices after the project are calculated by the following assumptions and method.

a. The land prices after the land readjustment are assumed to be at a level of the present price of the area of Yaohan because of the availability of infrastructure and public facilities.

b. The prices assumed above are the following 3 ranks.

No.1 = 90,000 B/sq.wa
No.2 = 120,000 B/sq.wa
No.3 = 140,000 B/sq.wa

c. By comparing the above 3 ranks with planned conditions of infrastructure and public facilities in each area, the areas are classified into the 3 ranks.

Table 3.3.26-Areas of Different Ranks of Land Prices after Land Readjustment

No.	Baht/Sq.wa	Area (Sq.wa)	Total (1m000 Baht)
1	90,000	399,200	35,928,000
2	120,000	754,700	90,564,000
3	140,000	597,100	83,594,000
Total		1,751,000	210,086,000
Average		119,980 (B/Sq.wa) = 30,000 (B/Sq.wa)	

As shown above, the average land price after the land readjustment is estimated at 30,000 Baht per square meter.

(3) Reserve Land Area

1) Planned Area of Reserve Land

A total of 99,900 sq.m of reserve land is planned as shown in **Table 3.3.27**. The planned price of the reserve land is 30,000 B/sq.m. The income from the sale of the reserve land is to be used for the total project cost of 2,997,000 thousand Baht (**Table 3.3.21**).

2) Uses of Reserve Land

The reserve land should be effectively used for public urban facilities or business districts by promoting location of these facilities in order to maximize the benefit of the whole area. Therefore the reserve land is consolidated in each sub-area.

Reserve land planned as land for public use such as schools, etc can be sold out in a special way to ensure the planned use.

3.4 Financial Plan

(1) Income

Table 3.3.27 Income Source

Category	Amount (1000 Baht)	Calculation
National & local government's subsidies	0	
Sales of reserve land	2,997,000	30,000 B/sq.m*99,900sq.m
Shared defrayment of public facilities by the management authority	0	
Others	0	

Here the sales of the reserve land are assumed to be as the only project income. However, to supply well developed plots and to reduce burdens of the participants for public facility development, national or local government's subsidies, burden sharing of public bodies in charge of infrastructure or public facilities and other sources are needed.

The following discussions assume that the shared defrayment of public facilities by the management authority is paid by BMA for the planned arterial roads of 30 m wide. This assumption necessitates establishment of a new legal system.

1) The shared defrayment of public facilities by the management authority is within the range of the costs of acquiring the land for the public facilities.

2) Estimation of the development cost of the arterial roads in the master plan area

Road area = 218,000 sqm (Width = 30 m, Length = 5,500 m)
Unit land price = 15,200 B/sqm (Land price before L/R)
Land price = Road area × Unit land price
= 3,313,600 thousand Baht

3) Shared defrayment of public facilities by the management authority

The maximum range the defrayment is the land price calculated above, that is 3,313,600 thousand Baht. While the total project cost is 2,997,000 thousand Baht. Therefore the actual defrayment is not reduced by the range. It is calculated that the actual defrayment is 90 % of the land acquisition cost.

4) Impact on the contribution ratio

In the case that the total project cost is paid by the shared defrayment of public facilities by the management authority, income from the reserve land is not necessary and the contribution to generate the reserve land is also unnecessary. **(Table 3.3.24)**

Therefore, the contribution is needed only for producing public land and the contribution ratio is calculated at 25.3 %. Thus the contribution ratio of ordinary plots is reduced by 5.5 %.

5) The above case assumed that the whole project cost is paid by the shared defrayment of public facilities by BMA. In actual cases, the project cost items should be classified into those to be paid by the sales of reserve land and those to be paid by the shared defrayment.

(2) Expenses

The expenses are shown in **Table 3.3.21** and **Table 3.3.22**.

(3) Annual Financial Plan

1) Project period

The project period of 7 years assumed here is the minimum target period. In reality, the project may need more time due to various factors caused by relocation of buildings, the magnitude of the master plan area (244.5 ha) and so forth.

2) Construction

The construction period is assumed to be 4 years considering that the construction must follow relocation of buildings. The period for relocation is assumed to be 3 years.

3) Sales of reserved land

The sales are assumed to start in the third year considering that these are the only project income and so early construction and early sales of the reserve land are expected.

4) Interest on loan

Interest on loans is decided by negotiation with financial institutes. Here annual interest rate of 12 % is assumed according to NHA.

4. SELECTION OF PROJECT AREA

About 100 ha of Project Area for the study on Implementation Plan is cut out of the master plan area of 300 ha.

4.1 Criteria of Selection

The criteria of selection are set up as follows.

(1) Implementability

a. Appropriate size of pilot project area.

Since L/R project is first and unexperienced project to be implemented in Thailand, 100 ha project site seems to be too large for one pilot project. In this respect it is recommendable that L/R project of 100 ha be divided or phased out in some number of pilot projects of appropriate size.

In other words the project area is selected so as to cover the pilot project areas.

Table 3.3.28-Annual Financial Plan

Year	1	2	3	4	5	6	7	Total
Expenses								
Construction	0	380,000	400,000	400,000	329,000	0	0	1,509,000
Compensation	0	245,000	245,000	245,000	0	0	0	735,000
Survey & Design	25,000	25,000	16,000	16,000	16,000	18,000	19,000	135,000
Interest	2,700	45,600	131,500	138,300	127,000	53,900	0	499,000
Administration	20,000	15,000	15,000	14,000	15,000	20,000	20,000	119,000
Total	47,700	710,600	807,500	813,300	487,000	91,900	39,000	2,997,000
Income								
National & Local government's subsidies	0	0	0	0	0	0	0	0
Shared defrayment of public facilities by the management authority	0	0	0	0	0	0	0	0
Sales of reserve land	0	0	750,000	750,000	750,000	747,000	0	2,997,000
Total	0	0	750,000	750,000	750,000	747,000	0	2,997,000
Balance	-47,700	-710,600	-57,500	-63,300	+263,000	+655,100	-39,000	±0
Loan	47,700	710,600	57,500	63,300	0	0	0	879,100

b. Exclusion of areas with complexity in project implementation as much as possible.

It may be a wise decision to avoid the area where many other projects are converged. Necessary coordination with them will be time/energy consuming efforts, hence resulting in hinderance of smooth and quick implementation of the first pilot project.

c. Exclusion of areas with complicated land rights and subdivided lands.

Pilot project implementation should be launched first in the area with relatively small number of land owners and large tract of lands.

d. Relatively independent area in terms of infrastructure services.

The areas where L/R development projects have to be dependent on the off site infrastructure to be constructed are not recommendable for the first pilot project.

(2) Tendency of Urbanization and Development Potentials

a. Areas to be built up in the sequence of urbanization.

Area-wise urban development through the area along the Rama IX Road toward the zone 2 seems to be properly in a sequence of current urbanization in the planning area.

b. Development Potentials.

As stated before high development potentials are foreseen in zone 3 and 4, depending upon the large scale transport infrastructure projects.

- Zone 3

In spite of the fact that zone 3 is closed up by the existing track of train (STR) and Royal City Avenue, development potentials shall be tapped with the new construction of road connecting Petchaburi Road and Rama IX Road and Hopewell system station.

- Zone 4

As same in the zone 3 high potential is foreseen in connection with construction of skytrain and station.

Taking into consideration the schedule of the above mentioned two (2) transport projects it appears that urban development in zone 3 is more realistic than that in zone 4.

(3) Demonstration Effect to Thai Society

Implementation of the pilot project has a strategic meaning to provide the Thai society with a show window (or model) of L/R, through which L/R system will be more and more recognized and accepted by Thai people.

In this respect the pilot projects should be placed in the areas where they can make a great contribution to give impressive/tangible/visual effects to the Thai people in general.

a. Landscape of the built-up area developed by L/R in the area along Rama IX Road and zone 2 is to give good impression to the passers-by on the Rama IX Road. (Demonstration effect)

b. If the road connecting the new Petchburi Road and Rama IX Road through the zone 3 is constructed by the L/R project it will be greatly appreciated by Bangkok people, because lack of secondary and distributor roads is one of the main impending issues in improving traffic condition in Bangkok.

c. Area-wise integrated L/R urban development including transportation plaza in front and feeder network of public transport service such as buses and the others centering on the railway station and commercial development in connection with the Hopewell system project will be evaluated as a model to be followed in the Bangkok city planning and development.

4.2 Selection of Project Area

It may be true that there are no areas which meet all the conditions and criteria as evaluated above. However the following two points must be taken into consideration.

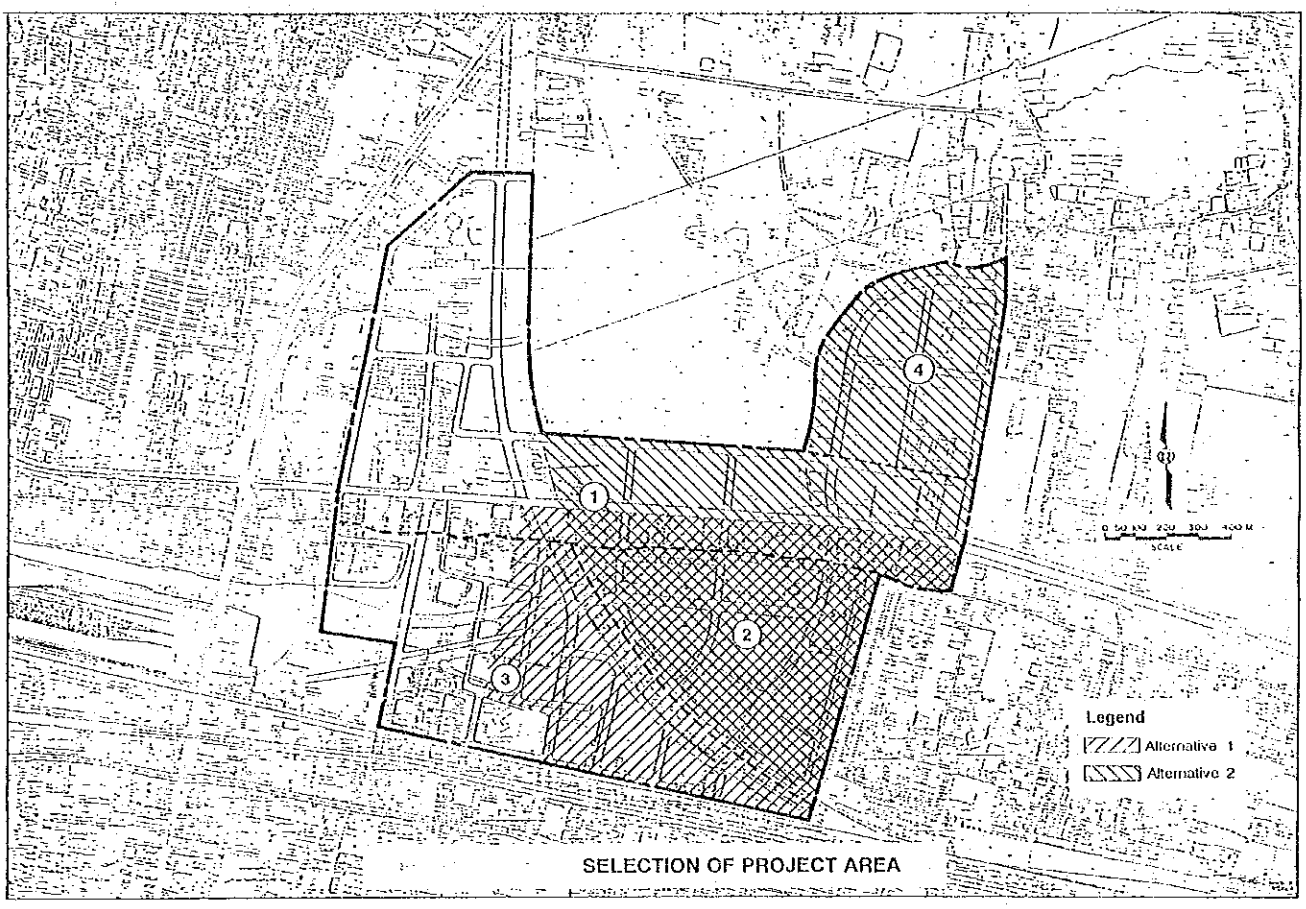
(1) Urban development covering the area of Rama IX Road and expanded toward zone 2 in the current urbanization sequences seems to be most realistic and safe (there seem relatively no serious problems to become impediments to smooth implementation of the L/R project.

(2) The challenging urban development projects in connection with the large scale transport project in zone 3 and 4 should be implemented in a little bit longer term of time. Consequently it is proposed to include in the project area of 100 ha, [1]. the area stretching from the Rama IX Road (a part of zone 1) to the zone [2], and 2. either zone 3 or zone 4, totaling around 100 ha, shown in **Figure 3.3.22.**

1) In the former area (zone 1 + zone 2) an implementation plan for a pilot or experimental L/R project shall be formulated in the next stage of the study.

2) In the latter area (zone 3 or 4) a preparatory implementation plan for the challenging urban development project through L/R shall be formulated.

Figure 3.3.22-Selection of Project Area



Part III.
Land Readjustment Project Planning

Volume IV.
L/R Project Study

Volume IV: L/R Project Study

1. Introduction

The L/R Project formation and feasibility study were executed within the development and project framework previously set in the concept plan of the survey area (800 ha), and the Master Plan of the planning area (300 ha).

Among the 125 ha of the project area, 85 ha [zone (2) and (3)] were covered by the JICA study team, and the remaining 40 ha [zone (4)] by the DTCP counter part team (**Figure 3.4.1** - Selection of Project Area)

The L/R project is programmed with an aim to developing a business center which becomes a part of the New CBD of Bangkok, proposed in the Concept Plan and Master Plan.

2. Project Area

In the Concept Plan study a new Bangkok CBD was proposed to be developed in the survey area stretching 800 ha. Subsequently, three urban development centers constituting the CBD were proposed in the planning area covering 300 ha. The project area of 120 ha covers the three urban development centers including Zone (2) of 50 ha, Zone (3) of 35 ha, and Zone (4) of 40 ha as shown in the figure of selection of project area.

A more detailed boundary of the project area of Zone (2) and (3) - 85 ha - is shown in **Figure 3.4.2.**

The project area is encompassed by the Rama IX road, the SRT Railway, the subdivision road on the west, and the east line excluding the built up area.

3. Existing Condition of Project Area

3.1 Basis Features of Project Area

The basis features of the project area are summarized as follows.

(1) Pocket Land = Open Land

While Bangkok's built-up area has been expanding outward, the project area was left as open land (so-called pocket lands in the built-up area). The area still remains in rural land use conditions or as a rural community in spite of the fact the immediate adjacent areas are densely constructed.

This appears to be due to the SRT railway blocking the urbanization penetration in the area and the absence of the Rama IX road that was recently constructed.

Consequently, the project area features agricultural land uses with some farm houses located along the khlong. (At present many farmlands became grass lands, or unused lands because of abandonment of farming.)

Figure 3.4.1-Selection of Project Area

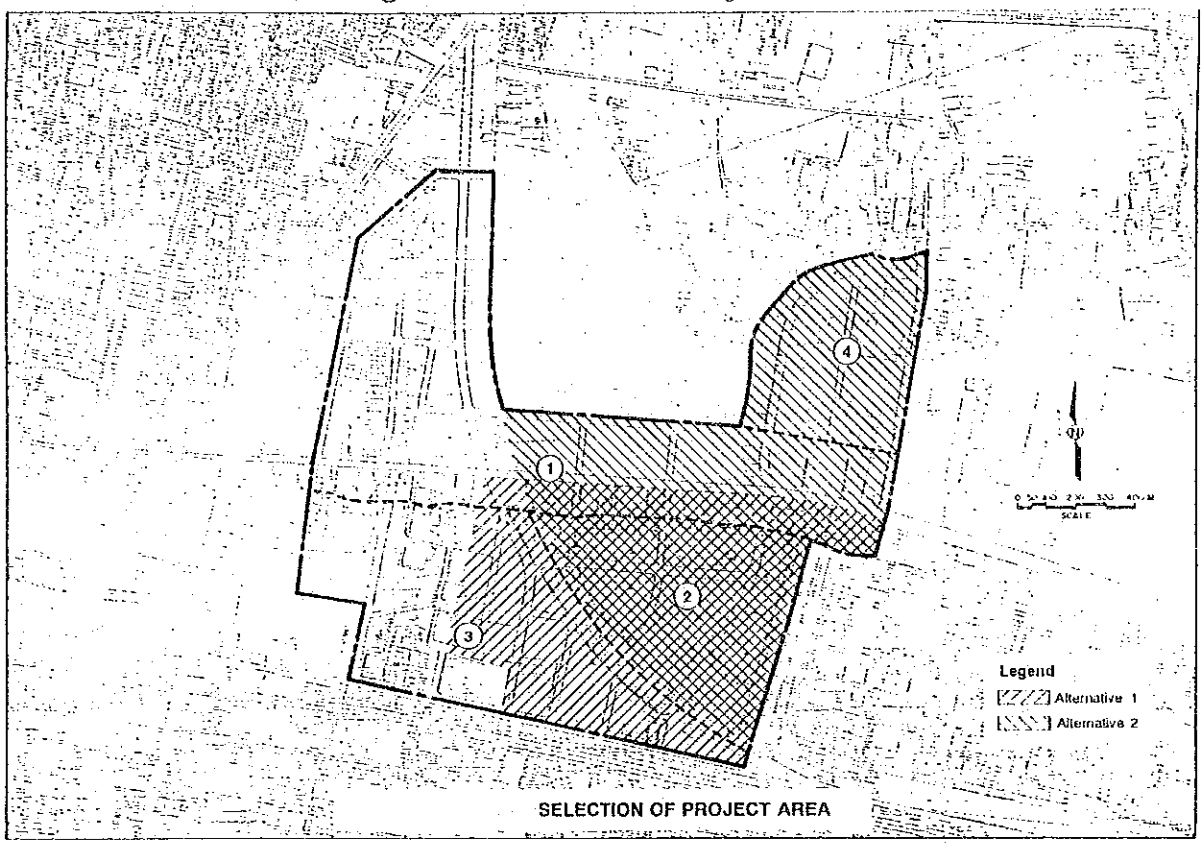
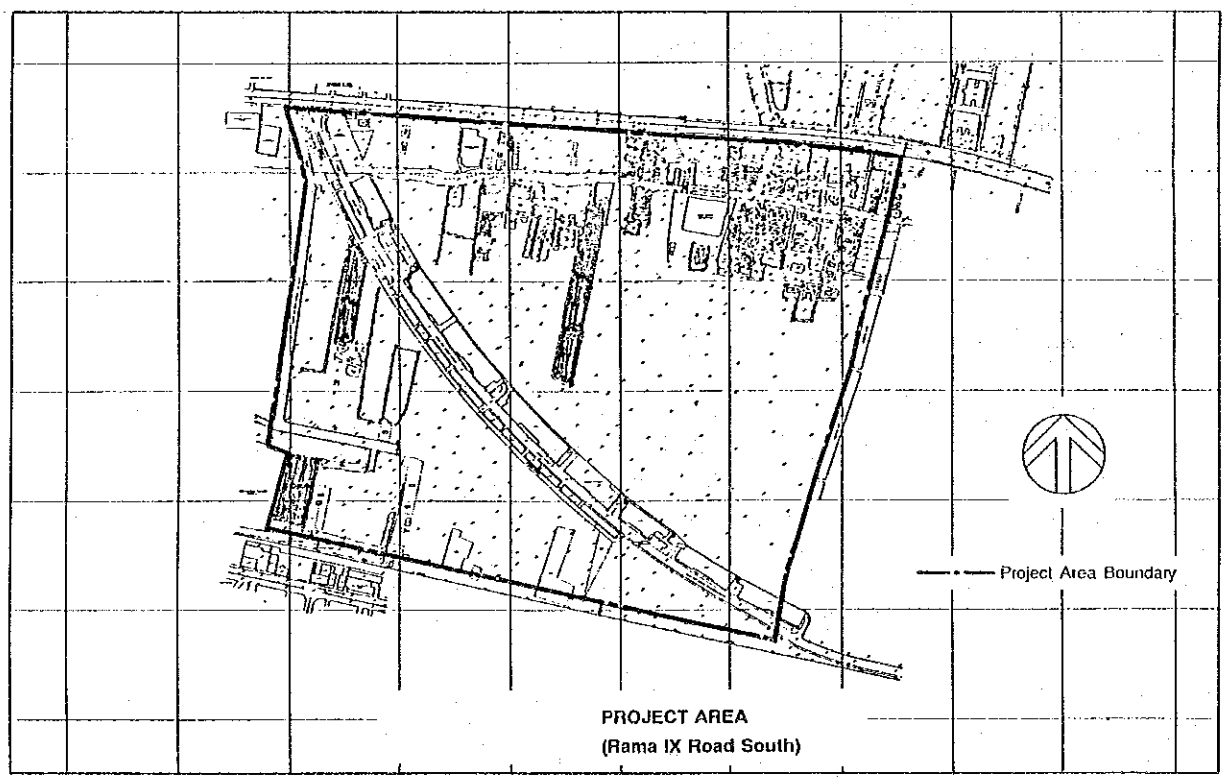


Figure 3.4.2-Project Area Boundary



(2) Rapid Urbanization

The construction of the Rama IX gave rise to urbanization in the project area resulting in a conflict between urban land use and agricultural land use.

Urbanization has occured in the project area in such numbers as follows.

- In coincidence with the construction booms in Bangkok in the late 1980's and early 1990's; large scale buildings such as hotels and offices located along the Rama IX road.
- Subdivision of large tract of lands is becoming prominent awaiting urbanization in the project area.

(3) Large Scale Projects

Large scale projects such as an expressway, a mass transit system, and the Royal City Avenues, etc., have been planed to traverse the project area.

3.2 Natural Conditions

(1) Weather Condition

Major wind direction and velocity are of the South West direction at 4.1 knot (average per year), and precipitation is 343.3 mm (maximum) in September and 9.1 mm (minimum) in January.

(2) Surface Land

The ground level of the area is -0.5 m to 2.0 m above sea level.

(3) Vegetation

Warm weather in the area has produced grass as the primary vegetation for the entire area and palm are dominant along the canal.

3.3 Socio-Economic Condition

Parcels of lands are orderly placed perpendicularly along the Khlong. This indicates that the lands in the area were agricultural in use and water is drawn from the Khlong. However most parcels now are classified as grass lands or unused land in the land registrations of the Department of Land.

This indicates the socio-economics of the area no longer depends on an agricultural-based industry, and has shifted to urban industry and is awaiting further urbanization.

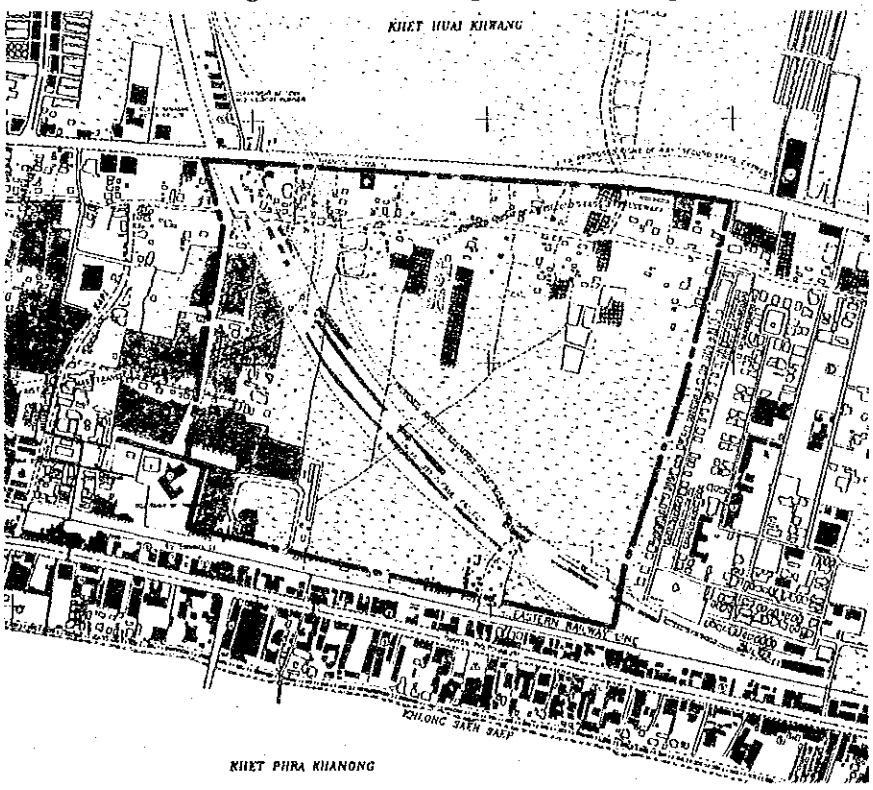
3.4 Land Use

As shown in the figure of existing land use, the land use of the project area is structured by the following components

1) grass land or unused land largely stretching in the central part of the project area
2) commercial area of shopping mall (Royal City Avenue) including the grass land
3) large scale buildings located along the Rama IX road
4) small houses and facilities located along the Khlong

As shown in **Table 2.3.1** of existing land use area, a large part of the area is still open land.

Figure 3.4.3-Existing Land Use Map



3.5 Buildings

Building distribution in the area is shown in **Figure 3.4.4.**

All the buildings except for the major establishments, are small structures.

3.6 Lands

3.6.1 Landownership

The following basic characteristics are described in regard to landownership in the project area.

Table 3.4.1-Existing Land Use Area

	Category	Before Project	
		Area (m^2)	Ratio (%)
Public Land	CBD arterial road	0	0.00%
	District road	0	0.00%
	Distribution road	0	0.00%
	Access road	270	0.03%
	Sub Total	270	0.03%
	Canal	21,477	2.50%
	Open space	0	0.00%
	Park	0	0.00%
	Sub Total	21,477	2.50%
	Sub Grand Total	21,477	2.53%
Land for Public Use	Expressway	39,621	4.62%
	Skytrain Workshop	0	0.00%
	Skytrain (MRT)	18,305	2.13%
	Royal City Avenue	93,025	10.84%
	ETA	22,450	2.62%
	School	0	0.00%
	Sub Total	173,401	20.21%
Private Land	Residential	0	0.00%
	Commercial	0	0.00%
	Private Road	0	0.00%
	Government	0	0.00%
	Wat	0	0.00%
	Agriculture	0	0.00%
	Unused Land	660,004	76.92%
	Sub Total	660,004	76.92%
	Sub Grand Total	833,405	97.12%
	Reserved Land	0	0.00%
	Adjustment	2,933	0.00%
	Grand Total	858,085	100.00%

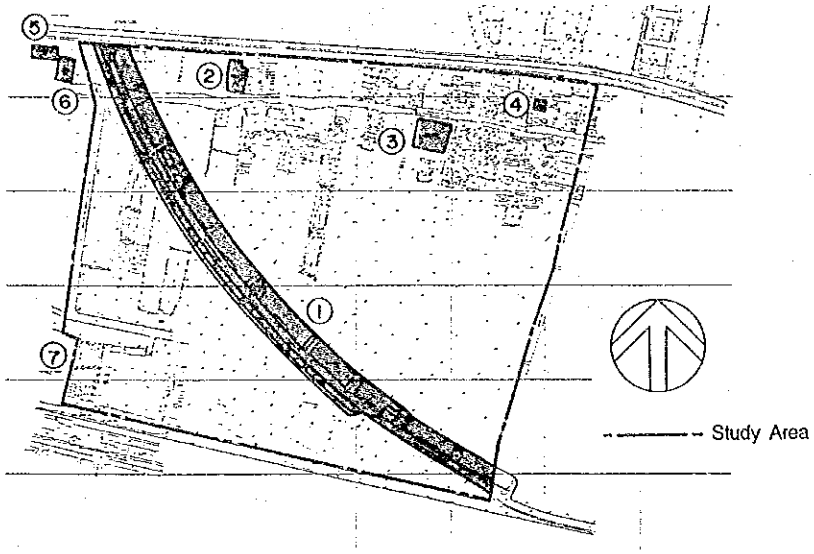
Table 3.4.2-Existing Building

	Number of Building
Commercial	23
Factory	0
Education	0
Government	0
Shop Houses	0
Residential	104
Religion	0
Others	0
Total	127

(1) A Relatively Large Portion of Government Lands

Because many government projects such as an expressway, a mass transit system and the Royal City Avenue, government lands (or lands for public use) occupy a large portion of the project area.

Figure 3.4.4 - Building Distribution and Major Establishment



(2) Scarce Public Lands

With a small amount of public land for Rama IX and Khlong, there is scarcely any existing public lands in the project area.

3.6.2 Land Subdivision

Comparatively large tracts of lands were appraised perpendicularly along the Khlong representing the typical agricultural land of Thailand.

It was found that in the recent cadastral map that many of the large tracts have been subdivided into smaller pieces of land in accordance with urbanization taking place in the project area.

As shown in **Figure 3.4.6** of the cadastral maps, and **Table 3.4.3** of lands by size of ownership the following patterns are prominent in the project area.

1) Size of lands not being subdivided range from 10,000 m^2 to 20,000 m^2.

2) Size of lands being subdivided range from 1,500 to 2,000 m^2.

This is another indication of urbanization documented in the land titles.

Table 3.4.3-Lands by Size of Ownership

		Number of Lot
1.	Less than 100 m^2	11
2.	100 - 200 m^2	27
3.	201 - 500 m^2	32
4.	501 - 1000 m^2	62
5.	1001 - 2000 m^2	80
6.	More than 2001 m^2	80
TOTAL		292

Figure 3.4.5-Landownership

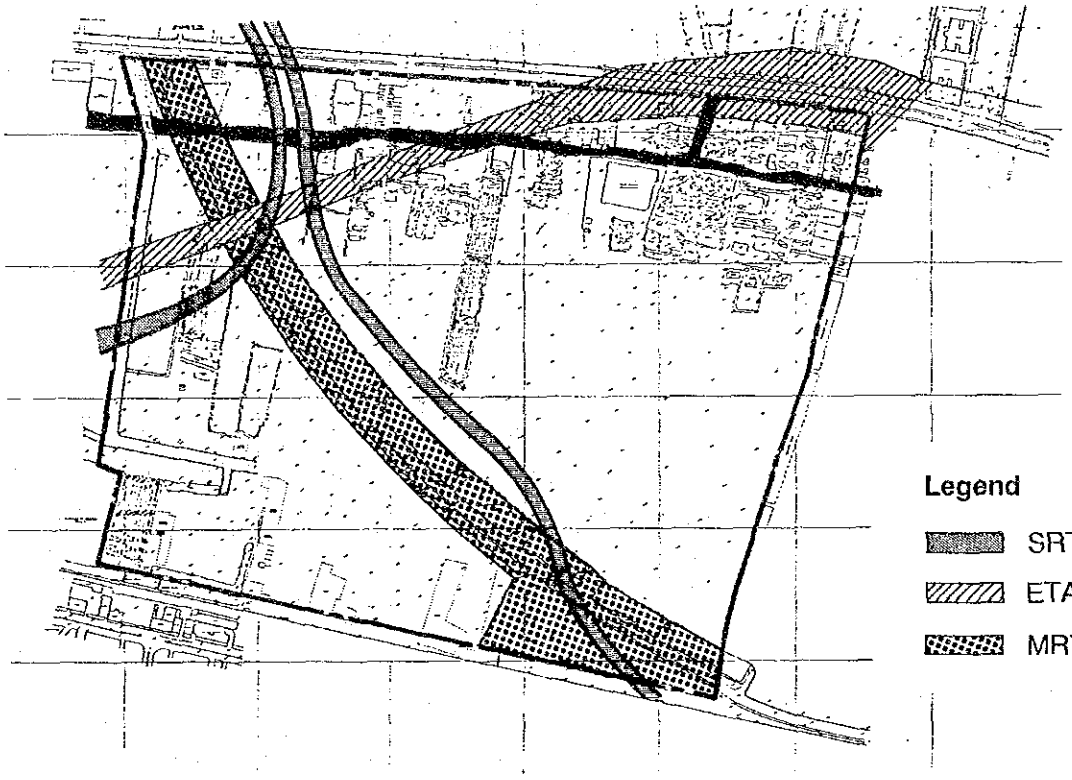
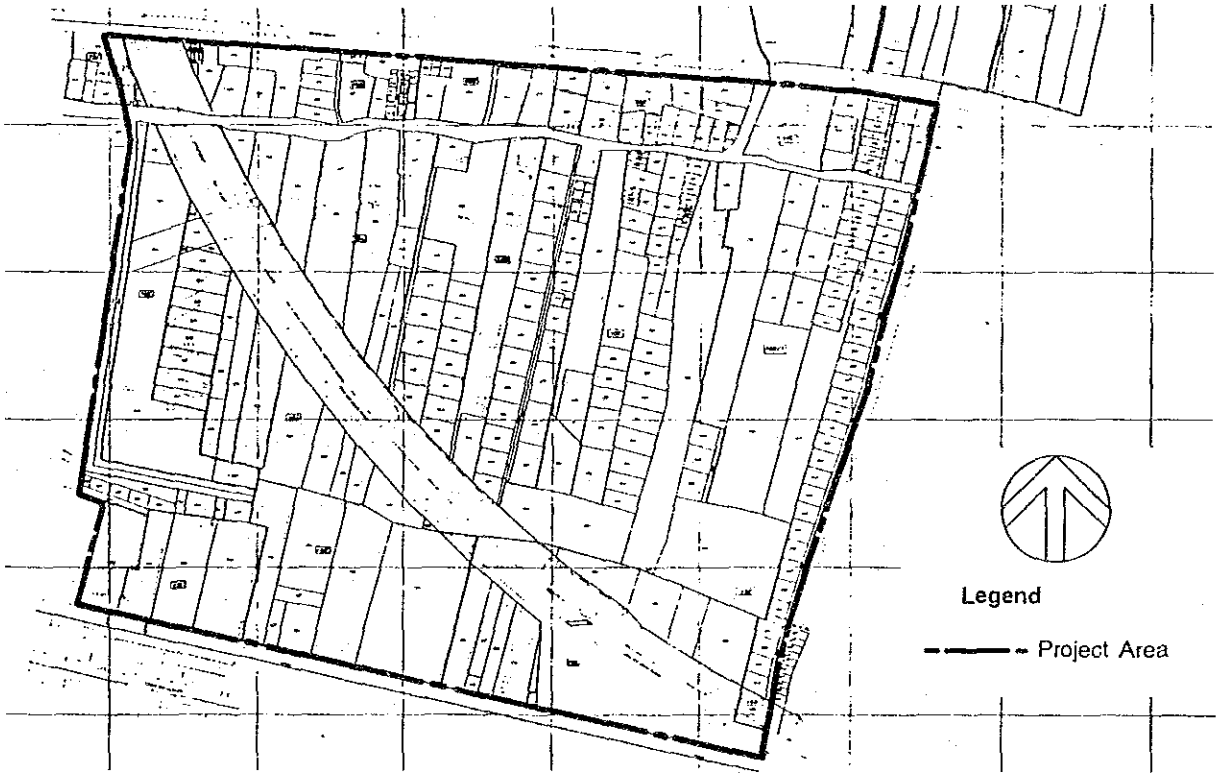


Figure 4.3.6-Cadastral Map



3.6.3 Characteristics of Landownership

The result of the opinion poll survey conduced in the study indicates the following characteristics of landowners in the project area.

1) Most of the landowners in the project area are absentee owners (70% of landowners resides outside of the project area).

2) Composition of landowners by sex indicates 59.4% are male and 45.4% are female.

3) Composition of landowners by profession reveals business operator are 25.8%, Office workers are 21.6%, and housewives 18.6%

4) Source of landownership indicates those who purchased land are 79.2%, and those who inherited are 12.5%

5) Duration of holding the land shows 11 - 15 years and 16 - 20 years are the model groups (This means purchases before land speculation boom)

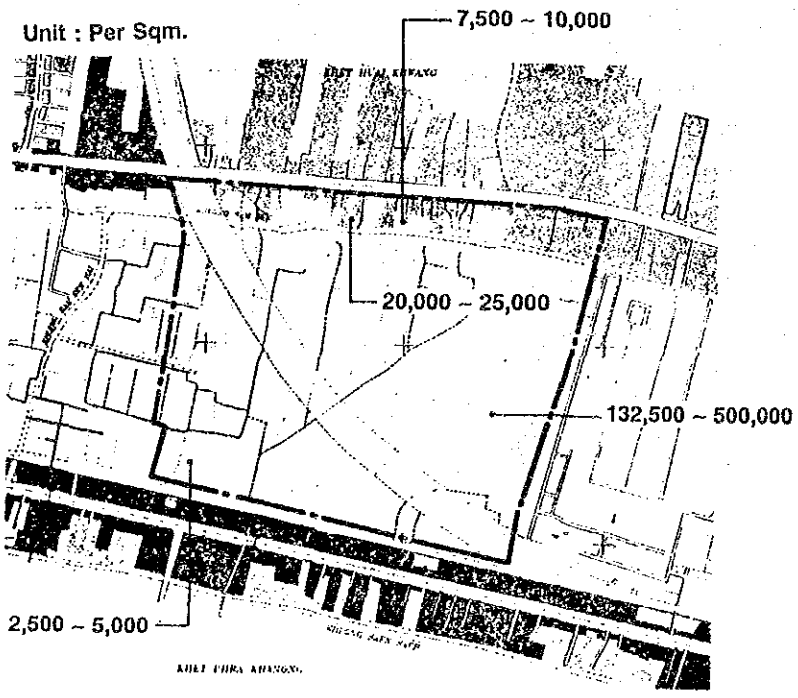
3.6.4 *Official Land Price*

The official land prices are shown in **Figure 3.4.7** vary depending upon the location.

1) About 100,000 Baht/wa along Rama IX Road
2) 10,000 - 20,000 Baht/wa in the project area except the area of 1)

There seems to be a significant gap in official land prices for the land along the arterial road such as the Rama IX Road and land without an access road.

Figure 3.4.7-Official Land Price Map



3.7 Infrastructure

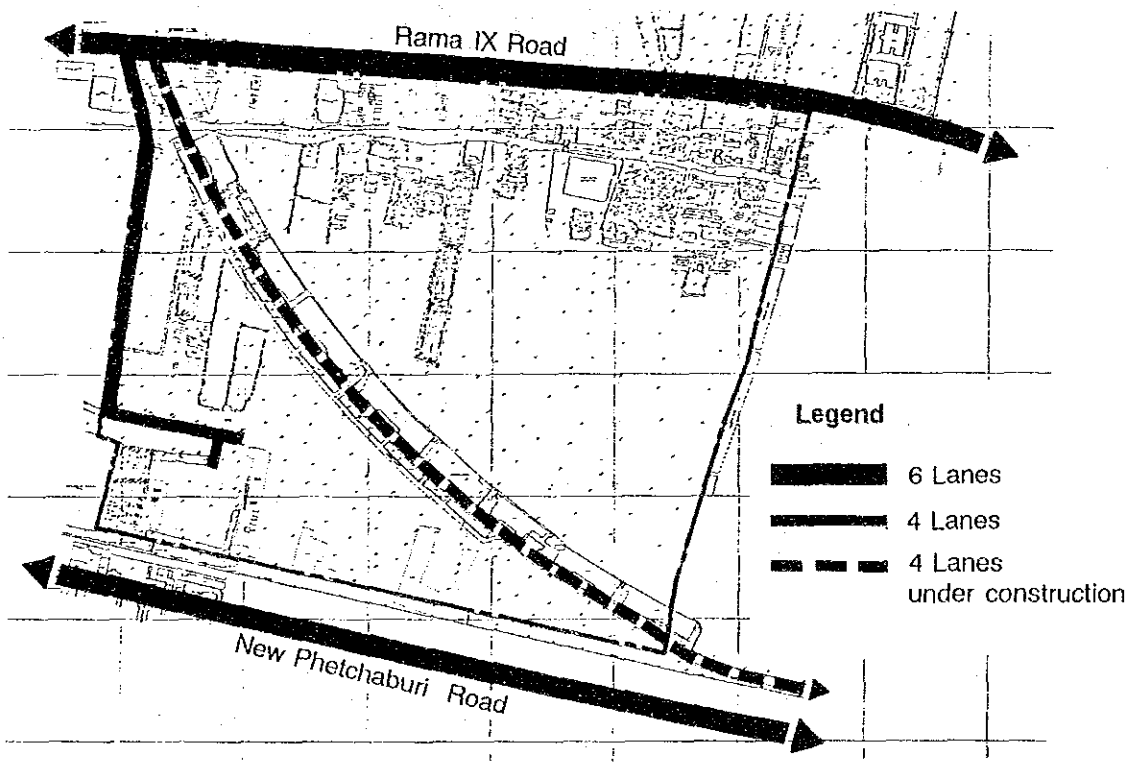
3.7.1 Road

Few roads have been developed in/around the project area.

- The project area is out flanked by the two (2) urban arterial roads of the Rama IX Road and the New Phetchaburi Roads
- A service road is constructed along the Royal City Avenue but limited to private use
- A private road constructed by the landowner

The traffic volumes on the above mentioned arterial roads were counted at 72,000 - 96,000 PCU as shown in **Figures 3.4.8 and 3.4.9**. The arterial roads also accommodate a bus service route and stops as shown in **Figure 3.4.10**.

Figure 3.4.8-Existing Road



EXISTING ROAD

Figure 3.4.9-Existing Traffic Volume

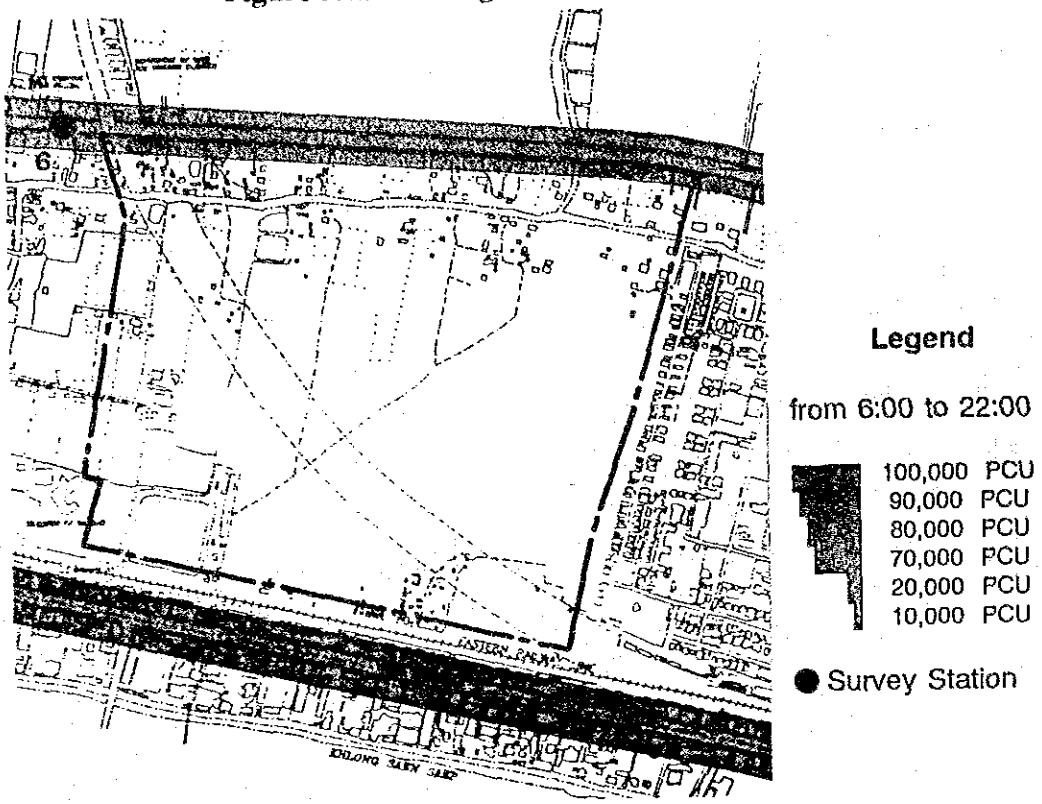
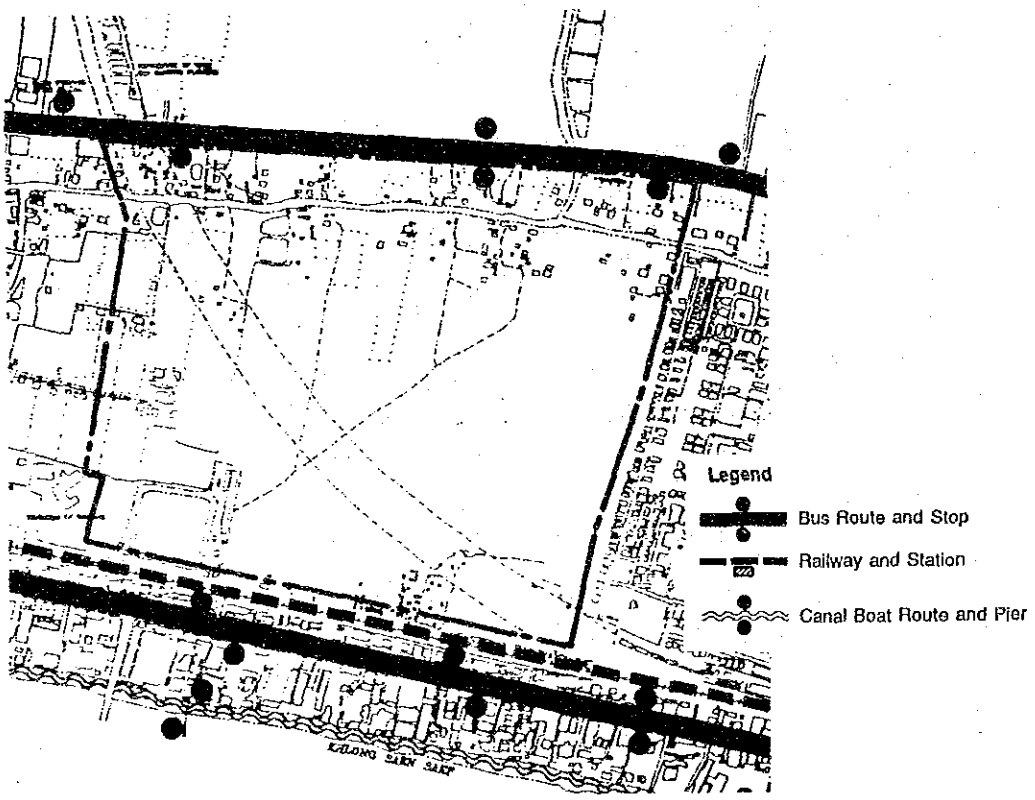


Figure 3.4.10-Bus Routes and Bus Stops



3.7.2 Water Supply

In/around the project area, the MWA's transmission and distribution pipelines are installed. Distribution line to serve the project area has not yet been developed.

4. Site Evaluation

In the project area under development, but where residential nor an urban area has been established, urban environmental problems are not documented.

The critical issue for site evaluation of the project area is what kinds of problems will emerge in using and developing the lands in the area, and/or, what urban problems the area will be plagued with if it follows traditional urbanization patterns common to the Bangkok Metropolitan Area.

The L/R project is designed to take preventive measures for these possible problems.

4.1 Problems Claimed on the Opinion Poll Survey

In the opinion poll survey conducted for this study, landowners responses to questions regarding problems associated with the use and development of their lands in the project area are summarized in **Table 3.4.4.**

The answers cover all the problems impeding land use and development in the area. Primary concerns expressed among others were floods and poor access to the land, followed by problems of public utility services, parking, et cetera.

Table 3.4.4-Problems in Using or Developing Land

Kind of Problems	No. of Respondent	%
· There is not an access road (or frontage) to the land	15	11.7
· There is only a poor access road (narrow, bad surface, crooked and so on)	33	25.8
· Flood	61	47.7
· Irregular shape of land (too narrow strip, not rectangle) resulting in inefficient land use	3	2.3
· Others (Drainage system, public service facility, parking lot)	16	12.5
Total	128	100.0

JICA Opinion Poll Survey

4.2 Forecast of Urbanization Pattern and Future Problems

4.2.1 Fragmented Build Up Area

With no measures for urbanization taken in the project area, traditional disorderly developments common to Bangkok's general built up area will proceed, resulting in fragmented built up areas led by unplanned soi roads.

As stated before, such building-up has not yet been observed because urbanization is blocked by the SRT railway on the south, and the Khlong Khamen on the north, in spite of the high development potentials in the project area.

Once an access road across the barrier is constructed in connection with land subdivision by a landowner, it is predicted that fragmented land subdivision and built-up area development will commence in the project area.

The landowners whose lands are located close to the arterial road, constructed a soi road in the subdivision development of the lands. Secondly, it will be followed by another land subdivision in such manner as the soi road is expanded into their lands. This pattern continues until the project area is filled up with the fragmented built up areas.

This building-up pattern can be typically observed in the residential area next to the project area on the east side. The soi type building-up patterns started on both sides of the New Phetchaburi Road and Rama IX and happen to face each other, where soi roads from the both sides were connected to be a district arterial road.

In the wake of such urbanization as stated above in the project area, the following future problems are anticipated.

(1) Inefficient/Dangerous Urban Area

The most significant problems inherent to the unplanned built-up area are *"inefficiency"* not only in infrastructure improvement, but also in the daily activities of people and urban industries in the project area.

- Crooked and narrow soi roads can hamper smooth access to lands and buildings and cause traffic congestion and impedance, and place pedestrians in dangerous situations as well.

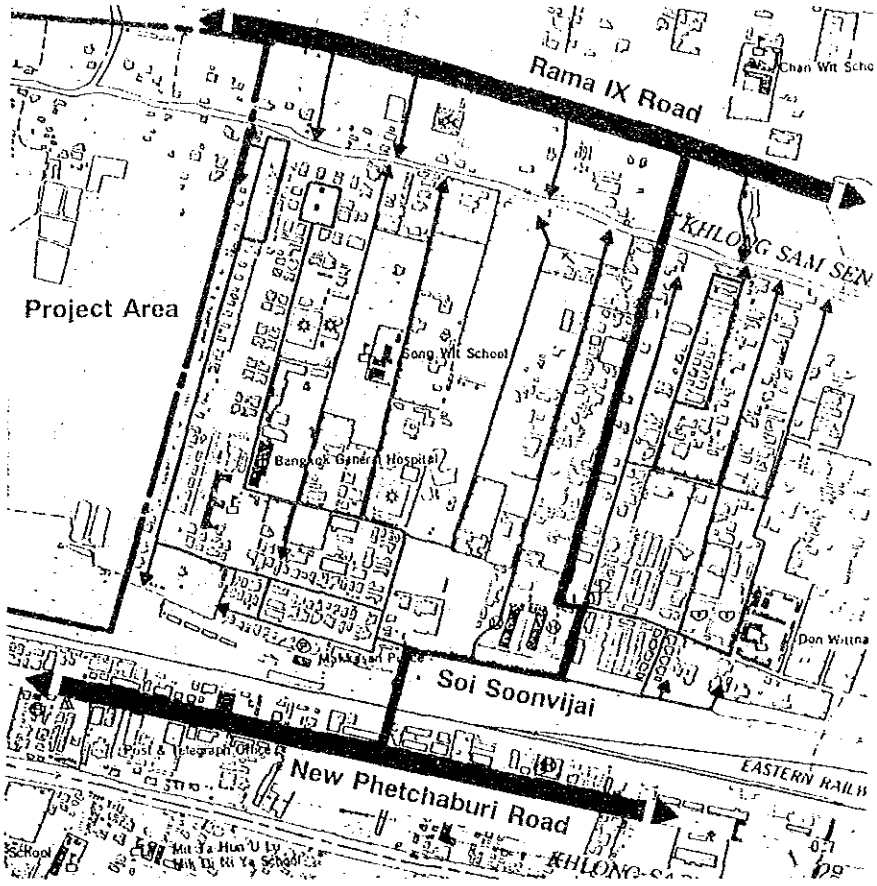
- In absence of a systematized road network in the area, an urban service function including disaster prevention activities such as fire fighting are not expected to be fully and effectively achieved.

  1. The roads and streets are to be provided not only for circulation but for spaces to accommodate public utilities such as a water supply pipeline, sewerage, electricity, and telecommunication lines.

     In this respect, efficient/effective public service cannot be expected without well-developed roads in the project area.

  2. The roads and streets are to provide open space which works as a buffer zone preventing fires from spreading and providing air ventilation to the area. Thus, the project area becomes dangerous and unpleasant without well-developed roads.

Figure 3.4.11-Development Pattern in the District Next to the Project Area



(2) Eye-Sore Landscape

Another characteristic of an unorderly built-up area is poor townscaping due to the uncomfortable landscape of densely accumulated buildings. While people may enjoy beautiful and comfortable living conditions within their compound property, poor townscaping in sight of their houses may tarnish the value of their properties.

The economic affordability of the Thai people has increased parallel with Thai economic growth and will raise awareness/perceptions of the importance of the living environment, including landscape. It will not be long before townscape becomes an important determinant of the value of real estate properties located in the town.

In this regard, creation of effective, comfortable landscape in this project area is considered one of the important planning issues for the L/R project.

4.2.2 Intrusion of Large Scale Projects into the Project Area

It may be noted that large scale projects such as an expressway, a mass transit system and the Royal City Avenue are planned in the project area without careful consideration of urban development and well balanced space arrangements in the area. In fact, the Royal City Avenue

traversing the area seems to work as a wall dividing the project area into two segments, thus hindering integrated urban development.

However, if it is permitted that a shopping mall on the Royal City Avenue is integrated into and coordinated with the urban development in the project area, it will offer an advantage and opportunity to create higher quality active urban center in the area.

For this purpose, the Royal City Avenue (or SRT who is the property owner) should be requested to open the shopping mall system including circulation system, to the public in the project area.

It is also expected to give benefits to the Royal City Avenue area because higher values (prosperity and dignity) shall be added to Royal City Avenue based on a well-developed urban center than in the unplanned built-up area.

4.3 Development Potential

As analyzed in the previous study regarding the concept plan and master plan, the project area is endowed with a high development potential to sustain a new Bangkok CBD. Development factors underlying the potentials are summarized as follows, focusing on the project area.

(1) Locational Advantages

The project area is located in the vicinity of the existing CBD of Bangkok and in the middle of the Bangkok expanded builtup area.

(2) Transport Infrastructure

At the moment, the project area is placed within the direct service area of Bangkok arterial road such as the New Phetchaburi road, Ratchada Phisek Road, and Rama IX Road which lead to major parts of Bangkok.

And more over, in the near future, it will be served by the expressway which is now under construction and will have three systems of mass transit. Especially, a public transport network will be developed over the Bangkok area. It will enhance the change of land use in Bangkok from land transport based urban structure to a mass railway system oriented structure.

In such an urban structure as stated above, it seems feasible to develop an urban center based on a public transport system in the project area.

(3) Open Land

With exception for the project area, there are no open lands left with advantageous conditions for developing an urban center.

4.4 Summary

In conclusion, the project area is prime land with significant potential and is a precious land resource for urban development in Bangkok. However, if it is exposed to unplanned urbanization, it will result not only in wasting precious land resources, but more seriously create problematic urban areas.

1) It may be said that the Bangkok urban area emerged as a result of the accumulation of land and building developments based on the individual interests of landowners. It is recognized that Bangkok is reaching the turning point where modernization of urban areas is required in response to the position of the international/economic standing of Thailand. This situation also involves people consciousness of the living environment so that greater value is placed on a good urban environment.

   In such a transition period, it must be stressed that creation of a good urban environment in the project area is crucial for providing quality property to the next generation, including the descendants of the landowners.

2) In spite of the government's (BMA) responsibility for urban development, it is difficult for the government to implement urban improvement projects covering all the metropolitan area of Bangkok.

   In this situation, landowner's participation/cooperation in urban development is vital for preserving and increasing their property value in the future.

5. Concept Plan Study

5.1 Planning Policy

5.1.1 Development Concept and System of the Planning Area

Urban development in the project area of 85 ha shall be in line with the New Bangkok CBD proposed in the concept plan for the survey area of 800 ha, and development system proposed in the master plan for the planning area of 300 ha.

(1) Development Concept of the New Bangkok CBD

The study area is one of the scarce and precious plots of land left in Bangkok. It implies that the best use of the study area should be made for improving, upgrading and reinforcing Bangkok city planning and development.

Consequently, development goals are set to develop a new innovative business district, more specifically as follows:

1) Innovative CBD of High Efficiency and High Grade Providing for the 21st Century

A New CBD will be planned to collectively accommodate the current dispersing urban functions such as hotels and offices, otherwise it threatens to result in an inefficient/unfunctional CBD with accumulation of scattered urban functions.

Moreover, additional advanced urban functions will be required to locate in Bangkok to serve the further growth of Thailand until Thailand becomes a NIES country, or a developed country, and Bangkok is considered a high level international city.

Indeed, Bangkok is in great need to develop urban spaces to accommodate the incoming up-graded and highly advanced urban business functions.

With the further international advancement of Thailand, the following business functions must be developed in the New CBD to strengthen Bangkok as a comprehensive international city.

- International Trade/Finance;
- Intellectual/Information Industries; and
- Sophisticated Culture and Art Industries

2) Innovative Area-Wise Urban Development (Land Readjustment)

In such a case as in the study area where urban sprawl development has started, an L/R is the only possible approach for area-wise development for the CBD by promoting cooperative efforts among landowners, and not resorting to outright land-purchases by the private or public sector. In other words, the implementation of a New CBD will not be realized without the utilization of the L/R.

3) Innovative Mass Rapid Transit Based Urban Development

It has been documented elsewhere that the MRT system has played an important role for land uses in such a way that high density and compact urban areas and/or urban centers will be created around their stations and along the system lines. This will be the first attempt for Bangkok to create an urban center with the reinforcement of mass rapid transit system. The relocation of population and employment to the stations areas, or to the areas along the MRT lines, would ease the accessibility to the MRT system. This will be a desirable shift in transport mode choice since as many trips as possible will change from road traffic to rail transport which will result in alleviating traffic congestion.

(2) Development System/Structure

An urban development system/structure covering the survey area and planning area were proposed in the previous studies of the Concept Plan and Master Plan.

These are preconditions for the L/R project in the project area of 85 ha.

1) Development Zoning of the Planning Area of 300 ha

The planning area covering 300 ha in the survey area, which was designated as a core area of the new Bangkok CBD consists of four (4) zones:

- Zone 1: Commercial/office complex; and
- Zone 2, 3, 4: Business office district - as shown in **Figure 3.4.12** of Development Zoning.

The project area selected covers Zone 2 and a part of Zone 3.

2) The development System/Diagram of the Planning Area of 300 ha.

Development system for the planning area of 300 ha was mapped out as shown in the development diagram of **Figure 3.4.13,** taking into consideration the following planning criteria.

a. Integrated/unified development of four zones as one CBD

The planning area of 300 ha can be a CBD in a manner that four zones are integrated and unified in serving the Bangkok Metropolitan Area.

Accordingly, a New CBD arterial road was proposed to connect each zone together. This arterial road is designed to achieve smooth and effective circulation in the CBD.

b. Maximization of Development Potential

At present urban development is constrained to the area along the Rama IX Road in spite of the high development potential. The proposed CBD arterial road is expected to work as a corridor for spreading the urban development into the depth of the each zone.

In addition, necessary measures to maximize the development potential of the planning area shall be taken as follows:

a. Direct access from the planning area to the Bangkok arterial roads such as the Phetchaburi Road and the Ratchada Road, is vital for tapping the land resource in the planning area.

This access from the New Phetchaburi Road will open up the area which was blocked due to no access and the increases land values for the area.

b. Well coordinated with the mass rapid transit system. It is a well known development method to create an urban center together with construction of a mass rapid transit system, which is deemed to attract many businesses around its station.

Figure 3.4.12-Development Zoning

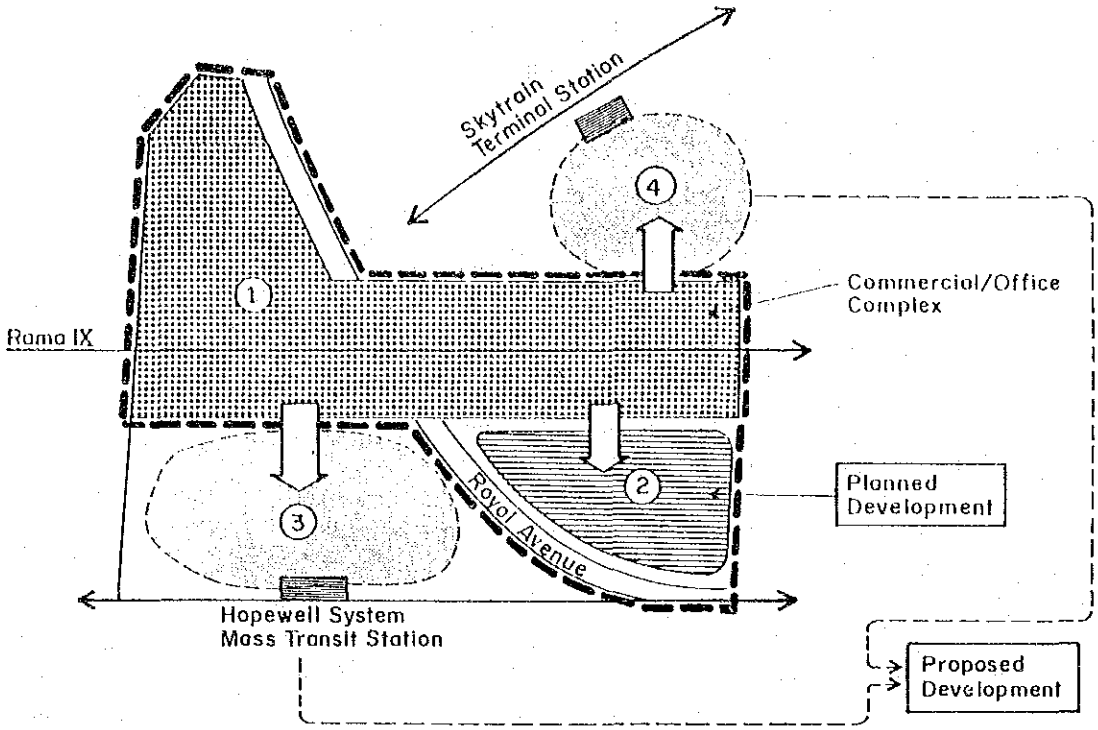
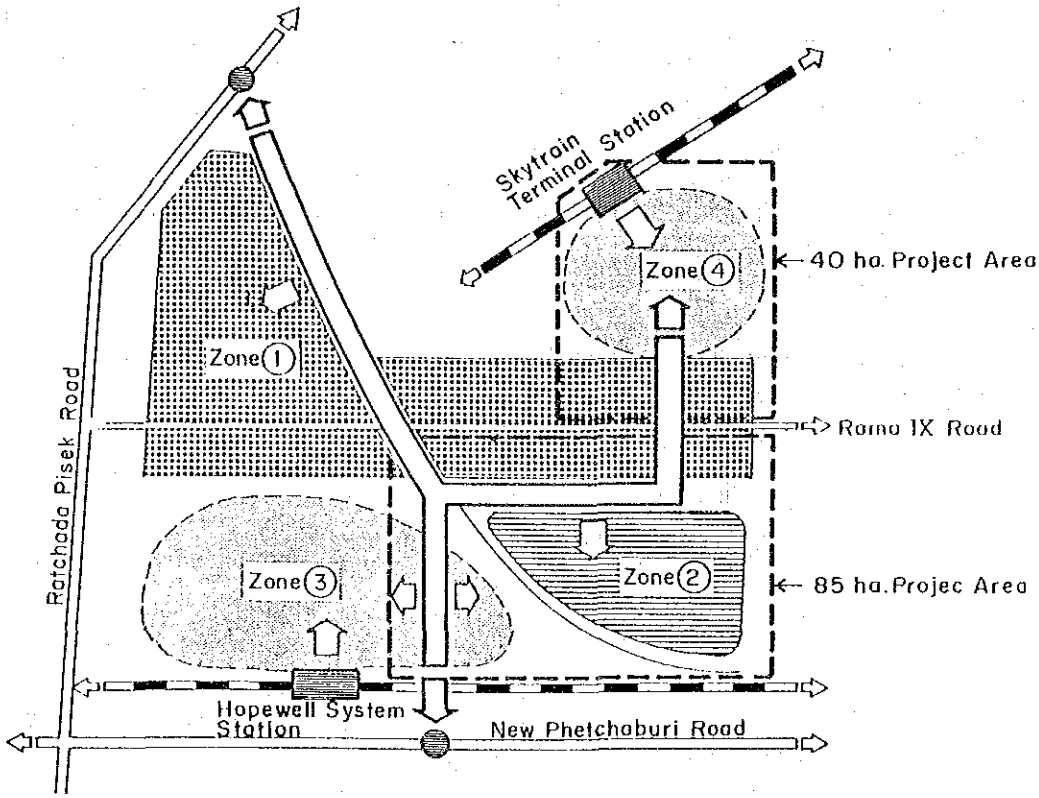


Figure 3.4.13-Development Diagram



In this respect it may be recommendable that urban development in the project area be well designed to accommodate the business activities attracted by the mass rapid transit system such as Hopewell system and Skytrain systems running in/around the project area.

5.1.2 Planning Policy

Specific planning policies for the urban development in the project area are set up under the planning framework represented by the development concept and systems of the planning area as described in the preceding section.

(1) Systematize the Building Up in the Project Area

As analyzed before, unorderly fragmented urbanization is foreseeable in the project area. To arrest this problem the first priority must be placed on the systematization of building up in the area.

(2) Collective Urban Unity as an Urban Center

The project area should not be divided into pieces. Instead it should be collective urban unity as a urban center in coordination with the planning framework set over the project area and such large scale project as Royal City Avenue.

(3) Flexible Approach

1) Social/Administrative Coordination Process

One of the basic rules of the L/R system is consultation or coordination with the people and agencies concerned with the project. The L/R is called an urban development method based on coordination, or coordination system for urban development.

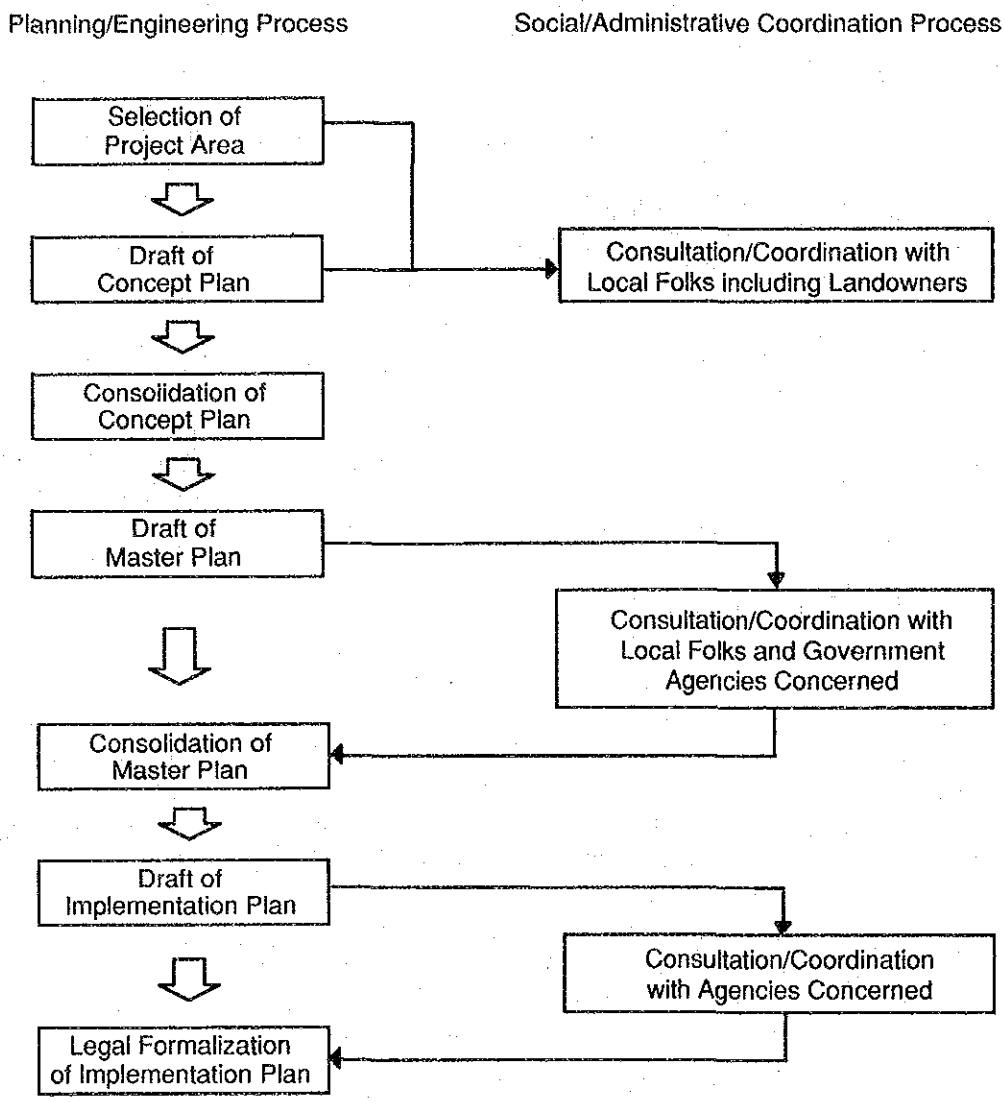
The planning and designing of the L/R must be made in consultation and coordination with the people concerned. This feature of the L/R reflects the planning procedures where consultations on the planning is secured at each stage of planning as shown in **Figure 3.4.14.**

In the process described above, consolidation of the plan must be made based on consultations with the people concerned in order to proceed to the next stage of planning.

It must be stressed that no feasible and practical plan and design can come out without the social/administrative coordination process. It is admitted that in this JICA study, the L/R plans and design are elaborated only through the planning/engineering process with no social/ administrative coordination process.

It is true that the Thai government will have to formulate again an L/R plan and design when it decides to implement this project. However, it is expected that the L/R plan and design proposed in this study will be used as a technical model or guidance tool in the course of actual implementation of an L/R project by the Thai government.

Figure 3.4.14-Planning Approach



Consequently, the planning for the L/R project in this study must be logical as well as flexible to accommodate changing planning conditions.

2) Implementation System

There isn't any doubt that practical L/R planning and designing must rely upon the L/R implementing system established in Thailand.

However, it is unfortunate that presently an implementing system through which this L/R project will be implemented has yet to be achieved. It must also be kept in mind that the L/R plan and design proposed in this study shall be changeable in response to the L/R system established in Thailand.

5.2 Concept Plan

The concept plan for the project area is set forth following the development system and land use plan for the planning area as set before.

5.2.1 Planning Goals

Planning goals for the project area are set in line with the idea of CBD development.

(1) Most Advanced/Height Grade (CBD)

Among the zones in the planning area, this project area enjoys the most practical and highest development potential as follows:

- Urban center development together with the Hopewell System and its expansion on Royal City Avenue in the future.
- Urban center development in the vicinity of a ramp of an urban expressway.
- Urban center development united with Royal City Avenue.

Taking advantages of the developments listed above, advanced business functions and industries (international finance, trade, information, and hi-tech) shall be induced so as to make the project area a modern urban center spearheading Bangkok's internationalization, advancement of the socioeconomy and industry.

(2) Multifunctional and Diversified Urban Center for the Next Generation

In addition to business offices, the multifunctional/diversified urban center including culture and art shall be a development target.

A variety of urban facilities of high quality including the longest one stop shopping mall in the Asia region, general hospital, 5-star hotels, and TV stations have been located in/around the project area in line with this development.

(3) High Quality Scenery/Landscape

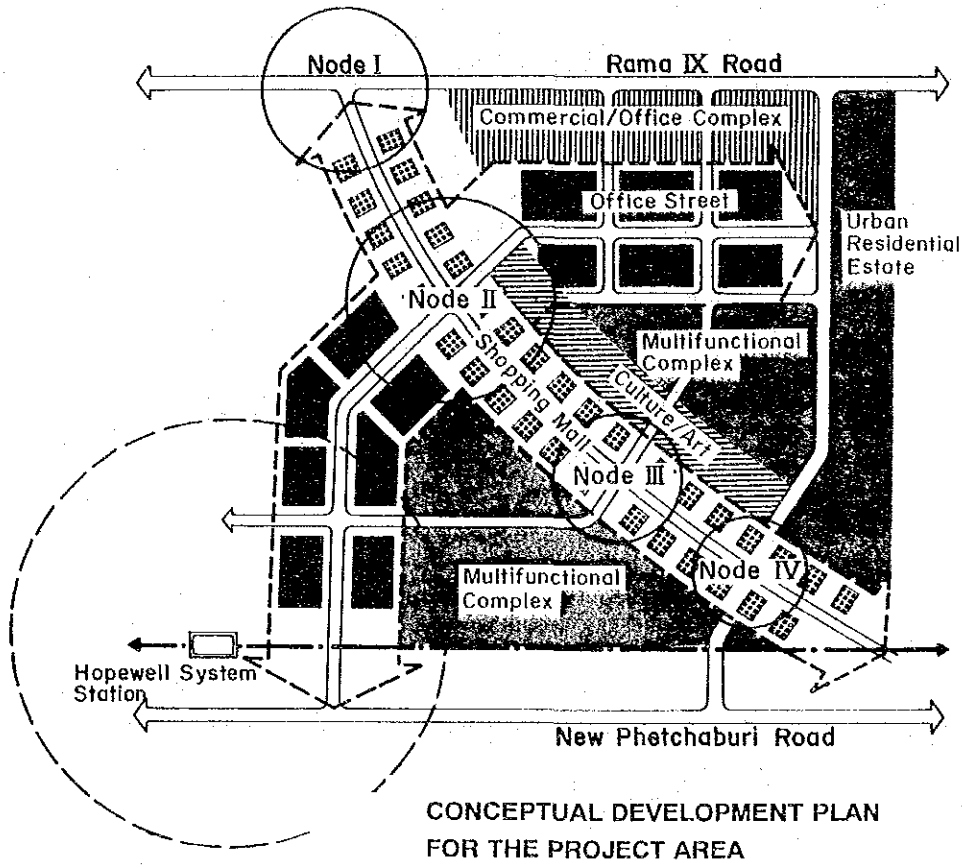
One of the essential conditions for a modern urban center is high quality scenery or landscape. This also it is contributive to higher values for individual property. One of the planning goals is set to create comfortable landscape and environment

through open space planning, vegetation/green planning and building developments.

5.2.2 Conceptual Development Plan

The conceptual Development Plan was worked out to attain the goals set above. (**Figure 3.4.15**)

Figure 3.4.15-Conceptual Development Plan for the Project Area



(1) Development Components

The major development components characterizing this urban center shall be *"modern office streets"* and *"a large scale shopping mall"* located on Royal City Avenue.

- As proposed before, best use must be made of Royal City Avenue for constructing an urban center in the project area.

  It was also mentioned that this will be beneficial to the center and the avenue.

- Modern office streets shall be constructed to be a major focus point of the planning area as well as the Bangkok Metropolitan Area.

Added to the major components are:

1) Commercial/office complex
(arterial road side location type building shall be accumulated along the Rama IX Road)

2) Multifunctional Complex
(a variety of urban activities supportive to the urban center)

3) Culture/Art Industries
(Emphasis must be placed on culture/art industries to be promoted in the future type urban center)

4) Urban Residential Estate
(accommodation facilities shall be provided for the executives and employees working in this urban center, and visitors)

(2) Development Structure

1) Development and Circulation

The office buildings, streets, and shopping mall shall constitute the backbone of urban development, space and circulation in the project area.

- Modern Office Streets

A group of modern office buildings shall be developed exclusively along the wide right of way of the New CBD arterial road aligned from New Phetchaburi Road through Zone 3 and 2 to Rama IX Road.

- Modern Shopping Mall

It may be safely said that successful development of the urban center shall be dependent upon the shopping mall. If the shopping mall (Royal City Avenue) can be merged into or cooperate with the urban center in terms of land use, urban services, business functions and circulation in the project area, it is apparent that an attractive urban center will grow in the area.

For this purpose, Royal City Avenue must be requested to participate in the urban center development or the L/R project, and adapt an open system to allow access to it from the project area in the circulation system. On this premise a conceptual development plan is set forth as shown in **Figure 3.4.15.**

2) Node of Development and Circulation

The crossing points between Royal City Avenue, offices, streets, and other major circulation in the project area, are transportation modes where people approaching from different directions happen to meet together.

The urban space in the project area is dramatized with those nodes as follows:

- NODE I

  NODE I is a gateway to Royal City Avenue as well as the urban center, where urban facilities such as parking, plaza and so on shall be provided.

- NODE II

  NODE II where the shopping mall and office street intersect, shall become the largest gathering point. Parks/plaza shall be built as a landscaped open space attached to the CBD arterial road going through the office streets district.

  In constructing the parks/plaza, use must be made of space under the elevated expressway and Skytrain, and irregular parcels of land for commercial use along these.

  There is a high probability that a general terminal of rapid transit systems such as the Skytrain and Hopewell expansion on Royal City Avenue running through this node, if/when these stations are operational.

- NODE III

  NODE III is located at the intersections with the pedestrian walkways stretching to the heart of the urban center. The CBD park developed in this node is designed to be a place of recreation and relaxation for daytime office workers.

- NODE IV

  NODE IV is an access point of the land transport (vehicles) from New Phetchaburi Road to Royal City Avenue where parking lots are provided.

5.2.3 Land Use Plan

Legal land use of the project area is Medium Density Residential Area (MDR Area) designated by the Bangkok General Plan. Under this category of land use, land use development other than residential use is allowable within 10% of the MDR area.

The commercial area, being categorized as land use other than residential use in this project area, shall be legally developed within the limit of the 10% of Zone 2.22 (about 720 ha) of MDR area in the Bangkok general plan. However, Zone 3 is deemed to exceed this limit.

Therefore land use revision of general plan to accommodate this development project will be necessary in the wake of review of the current general plan in the coming 5 years.

According to the categories of legal land use stipulated in the Bangkok general plan, either of the following land uses shall be designated over the project area.

I. Medium Density Residential Area all over the project area. (Same as the current land use in effect).

There is no legal land use system on which land use area other than the residential use must be indicated in terms of category and boundaries of the land use in the MDR area.

In this regard land use plan over the project area should be the same as the current legal land use in effect, since the urban center development can be allowed as far as the development area is below the 10% limitation.

II. Commercial Area

If land use other than the residential use in the MDR area must be indicated, land use over the project areas shall fall in commercial area according to the land use category of the general plan.

In this study, the land use plan as shown in **Figure 3.4.16** is set forth in order to indicate the main distribution pattern of urban activities/functions and composition of built-up areas which are to form a basis for the L/R planing /designing in the succeeding section.

Legend of the land use plan is summarized in **Table 3.4.5.**

Table 3.4.5-Legend of Land Use Plan

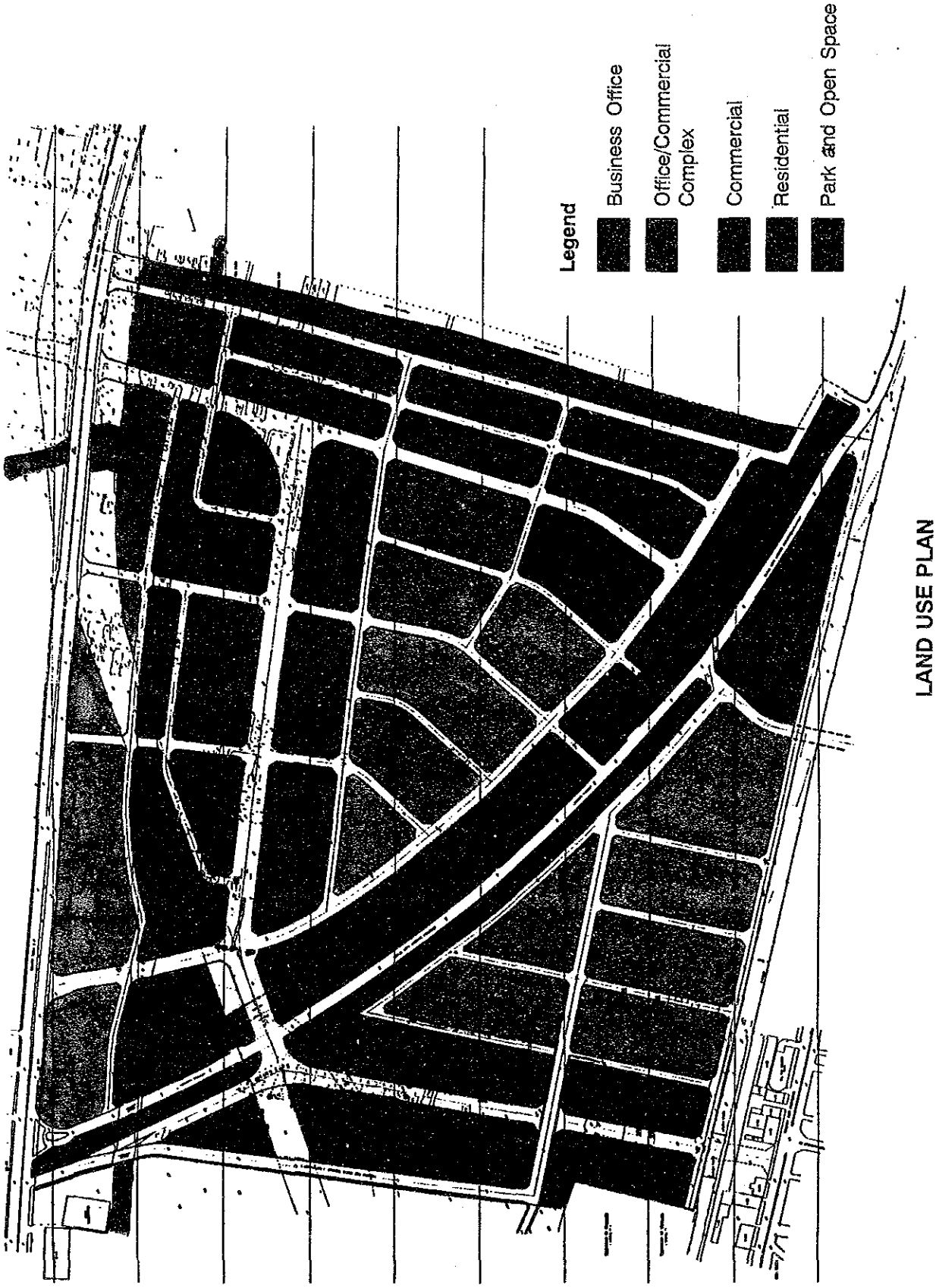
Land Use Category	Composition	Building Density	Size of Building
Business office	Office streets mainly consisting of large office building	High	Large
Office/commerci al complex	Mixture of office and commercial	I. High	I. Large
		II. Medium	II. Medium
Commercial	Mainly commercial building	Medium	Medium
Residential	Mainly housing	Medium	Medium to large

5.2.4 Transport Plan

(1) Transport System in the Planning Area

Under the Bangkok transport network comprising the expressway under construction, urban arterial roads such as New Phetchaburi Road, Rama IX Road, Ratchada Phisek Road and planned mass rapid transit systems such as the Skytrain, the Hopewell System and its expansion, the transport system covering the planning area was proposed. Highlighted in the proposed transport system is the New CBD arterial road system.

Figure 3.4.16-Land Use Plan



Since the project area is to rely on this system, its outline is stated below.

1) Function and Service of the CBD Arterial Road

This arterial road is designed to be a main service road for each zone as well as connect the zones all together in the planning area with the direct access to the arterial roads like New Phetchaburi Road and Ratchada Phisek Road. The road is to lead the urbanization into the area.

In order to attain the smooth and efficient traffic service within the planning area this road system is separated from the existing arterial roads which at present are encountering serious traffic congestion.

2) Feeder Transport System of Mass Rapid Transit System

Improvement of the feeder transport system of the mass transit system being planned to run in/around the planning area is of great significance for raising transportation service level in the area as well as enhancing conversion of traffic from road transport to public railway system in Bangkok.

The New CBD arterial road with bus and taxi services also functioned as a main line of the feeder transport system connecting the railway stations and the major urban centers in the planning area. However it must be noted that flexibility is required in planning the feeder transportation system due to the fact that the location of the stations of the planned mass transit system have not yet been officially determined.

(2) Road Network Plan in the Project Area

With the New CBD arterial road being a main service road (from New Phetchaburi Road through Royal City Avenue to Rama IX Road) in the project area, the road network plan is proposed as follows.

1) Segregation System of Vehicle Traffic and Pedestrian Traffic

Vehicle traffic and pedestrian flow should be segregated as much as possible so as to prevent traffic accidents and improve environmental conditions for pedestrians.

In the proposed transport system in the project area, pedestrian and vehicle traffic should be organized in the segregation system as follows (**Figure 3.4.17**).

- It is predictable that a major pedestrian flow will emerge on the shopping mall of Royal City Avenue, through which the pedestrian network will be established in the project area.

- Another major pedestrian flow will be found on the New CBD arterial road running through the busiest office street. The arterial road should be constructed with affluent open space for the pedestrians.

2) Hierarchical Road Network System

It is apparent that the roads must be constructed so as to constitute a road network on which the traffic flow is systematized in the project area.

A well known road network of hierarchical system is proposed in the project area where the New CBD arterial road, district road and access roads are to be constructed. The proposed system is shown in **Figure 3.4.18**

5.2.5 Park and Green Network System

The master plan of the planning area (300 ha) proposed the CBD park and green network system with the green zone along the khlong being a pivotal component of the system. Following the CBD park and green system as stated above, parks/green are proposed as follows. (**Figure 3.4.19**)

(1) Pedestrian Park Located in NODE II

NODE II is a major gathering point of people, where the pedestrian park shall be constructed in connection with the pedestrian space created in the landscaped New CBD arterial road.

(2) CBD Park Located in NODE III

CBD park developed in NODE III is to provide a place of recreation and relaxation for the workers and shoppers in the project area.

(3) Khlong Green Park

Khlong Green Park shall be developed along the existing Khlong. It also works as a flood retention area.

5.2.6 Drainage and Flood Protection System

The master plan in the previous study also proposed drainage and flood protection system covering the CBD area (the planning area of 300 ha). The key components of the system are outlined as follow:

1. Improvement of Khlong Huai Khwang, Khlong Sam Sen and Khlong Sam Sen Nai to be main line of drainage in the planning area.
2. A rain water retention area as much as 5% of development land area and a retention volume of 605 m^3/ha.
3. Land filling up to the elevation +1.0 m.

The above system is basically applied to the project area (85.8 ha). The required area and volume of rain water retention of the project area is calculated to be 4.29 ha and 51,900 m^3 respectively.

The open space which is allocated along khlong functions as a rain water retention area in flooding. A part of the open space is located under the elevated expressway. The ground elevation of open space is +0.0 m. When it is dry, it will be utilized as pedestrian, park and playground.

All khlongs in the project area are dredged up to elevation -2.5 m. The sides of it are protected by concrete-made retaining wall, resulting in reinforcing rain water retention function.

For purification of polluted khlong water an aeration canal as shown in **Figure 3.4.20** is constructed in the wide open space along Khlong Sam Sen to the south of the Sunroute Hotel.

Rain water in the project area drains into a drainage pipe laid under the road, then it is discharged to the Khlong Sam Sen by gravity.

Figure 3.4.17-Segregated Flow System of Vehicles and Pedestrians

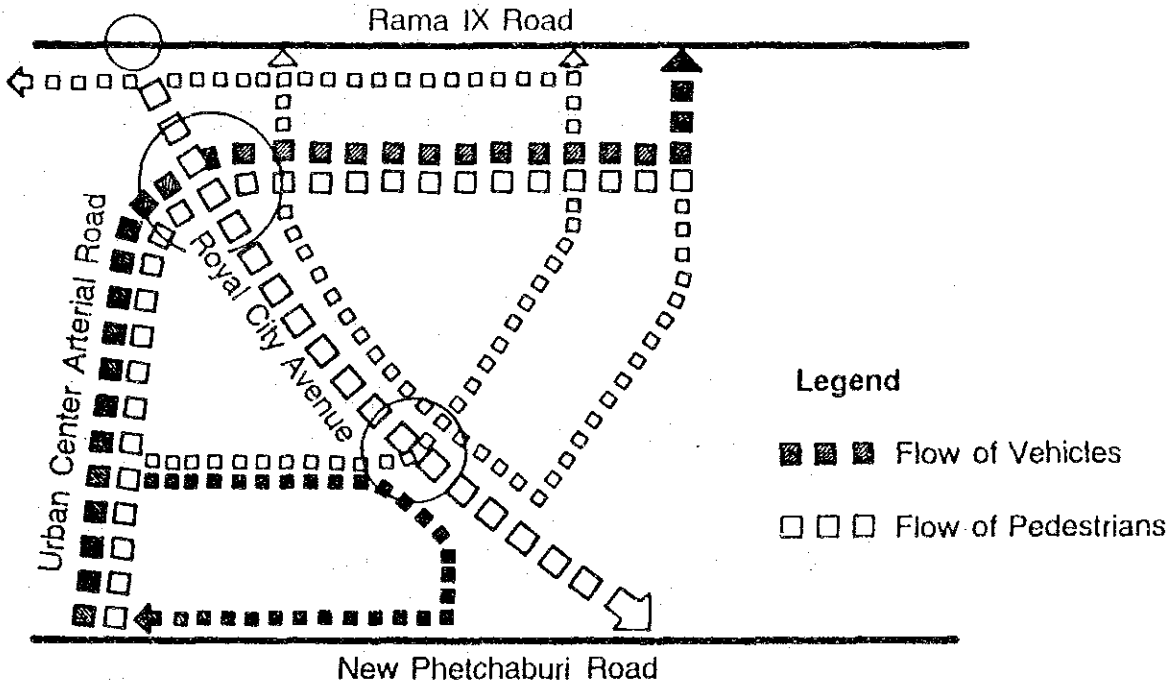
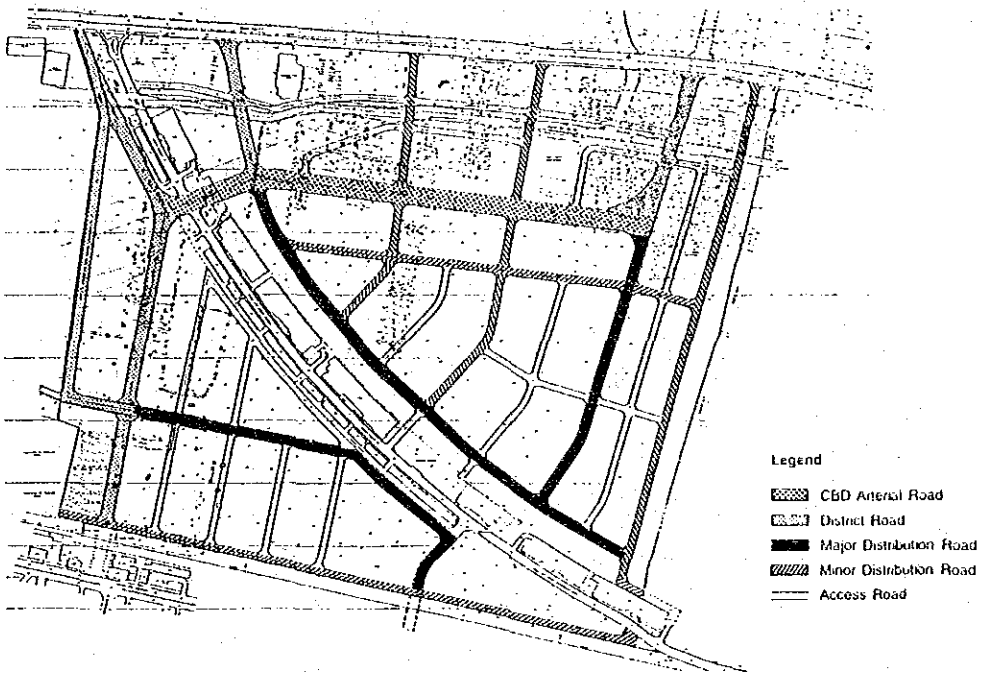
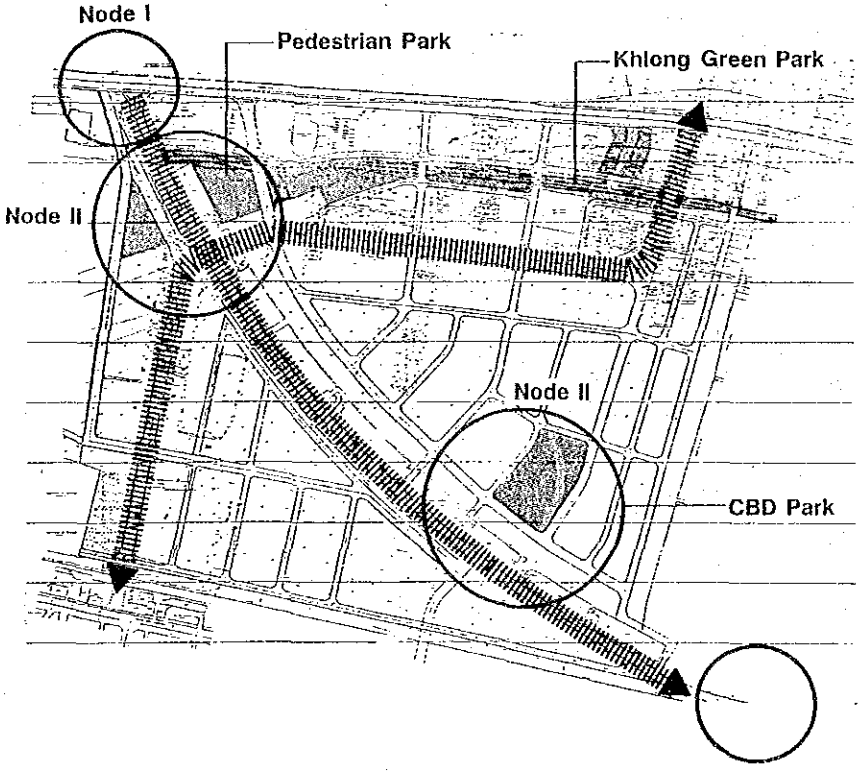


Figure 3.4.18-Proposed Hierarchical Road Network



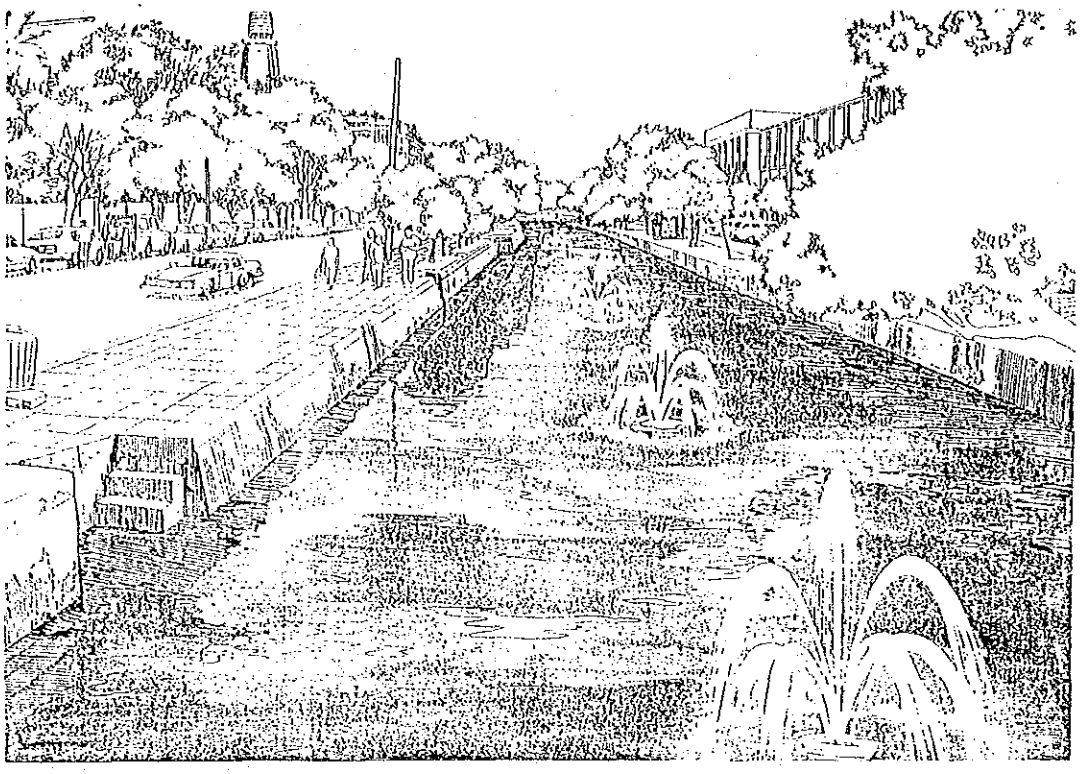
PROPOSED HIERARCHICAL ROAD NETWORK

Figure 3.4.19-Park and Green Network System



PARK AND GREEN NETWORK SYSTEM

Figure 3.4.20-Image Sketch of Aeration Canal



Source: The Feasibility Study on Purification of Khlong Water in Bangkok by JICA

5.2.7 Water Supply and Sewerage System

(1) Water Supply System

Water supply system of the CBD area has been studied in the previous master plan. The same system as shown below is applied to the project area.

1) In/around the study area, the MWA's water transmission and distribution pipelines are completed. Water supply pipeline for the CBD area shall be installed in accordance with the new road network being branched from such completed MWA's pipeline.

2) The MWA's served water demand in the year 2007 of the study area (800 ha) will be 411 lit/sec. The total water demand of the developed study area will be 400-450 lit/sec. From the quantity-wise, a recycle system of 40 lit/sec capacity may be required, when the CBD of intensive high density business district is completed. The manner of development of a recycle system is proposed as follows:

- A waste water treatment plant must be constructed in the study area by building developers in accordance with the BMA's standard. The effluent water quality shall be BOD less than 20 ppm.

- An advanced water treatment plant shall be constructed in a building in the intensive high density business district. A part of the water treated in

the waste water treatment plant is transferred to the advanced water treatment plant.

- In advanced water treatment plant, water is treated in BOD 10-5 ppm for the use of toilet flushing, cooling and gardening. Then, water is distributed to each high-rise building which is designed to have such two kinds of water supply lines as fresh potable water and recycle treated water.

(2) Sewerage System

The sewerage system for the future CBD area has been studied in the previous master plan study. Since the planning area is not included in the BMA's on-going sewerage improvement project, developers must construct the sewerage system themselves in accordance with the BMA's standard and the standard of PWD (Public Works Department) of Ministry of Interior regarding waste water disposal.

In the previous study, the following two systems were proposed:

1) Centralized sewerage system with a large-scale sewerage treatment plant and main sewer pipeline.

2) Community type sewerage system with a number of small-scale sewage treatment plants without main sewer pipeline.

A centralized system is advantageous to the conversion of this area's system into the BMA's public sewerage system in the future. However, for completing the centralized system there are two preconditions. The first is to establish a committee who controls the building development as well as the L/R project and a state enterprise under such a committee who manages this centralized sewerage system by phases as proposed in the previous study. The second is the planning of the building development should proceed in parallel with the L/R project.

At this moment since the above condition is not found, a community type sewerage system is applied to the project area. It can be flexibly arranged toward the building plan which is made in the future. This community type sewerage system shall be developed by block or a group of some blocks by developers. In a commercial and office block a sewage treatment plant will be constructed in a building.

5.2.8 Other Public Utilities

(1) Electricity/Telecommunication

Main transmission lines of electricity/telecommunication have been constructed in/around the project area. The service system of electricity and telecommunication in the project area shall be established by the Metropolitan Electricity Authority (MEA) and the Telephone Organization of Thailand (TOT), respectively.

(2) Garbage Collection

The project area is to be served by the BMA garbage collection system.

5.2.9 Urban Facilities

An integrated urban service system shall be recommended for establishment in cooperation between the public and private sectors. While the above-mentioned system should be developed over the CBD or planning area, the following urban facilities are recommended to be located in the project area.

1) Security/disaster prevention - police/fire services

2) Administrative Service - BMA branch offices

3) Culture/art - Thai culture, gallery, museum and so on in the culture/art zone.

5.2.10 Building/Landscaping

The land readjustment project is mainly to develop infrastructure which excludes building development and land use after the project. In this regard, a building development plan shall be formulated in order to integrated urban development. Accordingly, visual environment factor is important for the realization of the development. Regarding these points, the building plan and landscaping shall be examined as follows.

(1) Building Development Plan

Urban development in the project area shall be in line with the New Bangkok CBD proposed in the concept plan for the study area. Following this point, the building plan for the land readjustment master plan of project area (100 ha) shall be formulated for the successive integrated urban development as a New CBD. The following points shall be examined.

1) CBD scale buildings plan

2) Removal and renewal

3) Public facilities improvement

4) Building covenant and landscaping covenant

(2) Landscaping

In accordance with integrated urban development as a New CBD concept, visual elements are important factors for improving the environment. The majority of factors consist of public facilities so that landscaping shall be targeted there and landscaping in this project area shall be considered following three design key words.

- *"Amenity"*
- *"Safety"*
- *"Healthy"*

1) Landscape Design Method

Public space in the project area, road, park, etc., shall be designed suitably as a part of the urban landscape element which provides urban amenity. The following three points shall be considered.

- *"Landmark"*
- *"Eye stop"*
- *"Sequence"*

2) Landscaping for public space

Following public space shall be designed.

a. road

- pedestrian
- tree
- road alignment
- various texture pavement

b. park

- plaza
- fountain

c. node

- sign
- square

d. Canal

- water quality
- canal section design
- Alcove

e. other street public facilities

- indication (sign)
- litter case
- bench
- public lavatory