

THE KINGDOM OF THAILAND
MINISTRY OF INTERIOR
DEPARTMENT OF TOWN AND COUNTRY PLANNING

CITY PLANNING MANUAL

VOLUME IV LAND USE PLANNING

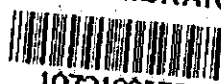
THE STUDY ON
APPLIED TECHNOLOGY FOR
MAKING CITY PLAN

JANUARY 1989

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VOLUME IV

LAND USE PLANNING

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CHAPTER 1

LAND USE PLANNING AND ITS OBJECTIVES

CHAPTER 1

LAND USE PLANNING AND ITS OBJECTIVES

A plan prescribing the use of property is the heart of the General Plan as stated in Section 17 of the Town Planning Act, B.E. 2518. A land use plan reflects human and physical interaction in the future and represents the future image of a community in terms of its various activities, their locations and intensity.

Land use planning is concerned with the proper management of land resources. It is designed to guide the use of land through various regulatory and promotional measures to maintain and develop a better urban environment.

CHAPTER 2

PLANNING PROCEDURES AND APPROACHES

PLANNING PROCEDURES AND APPROACHES

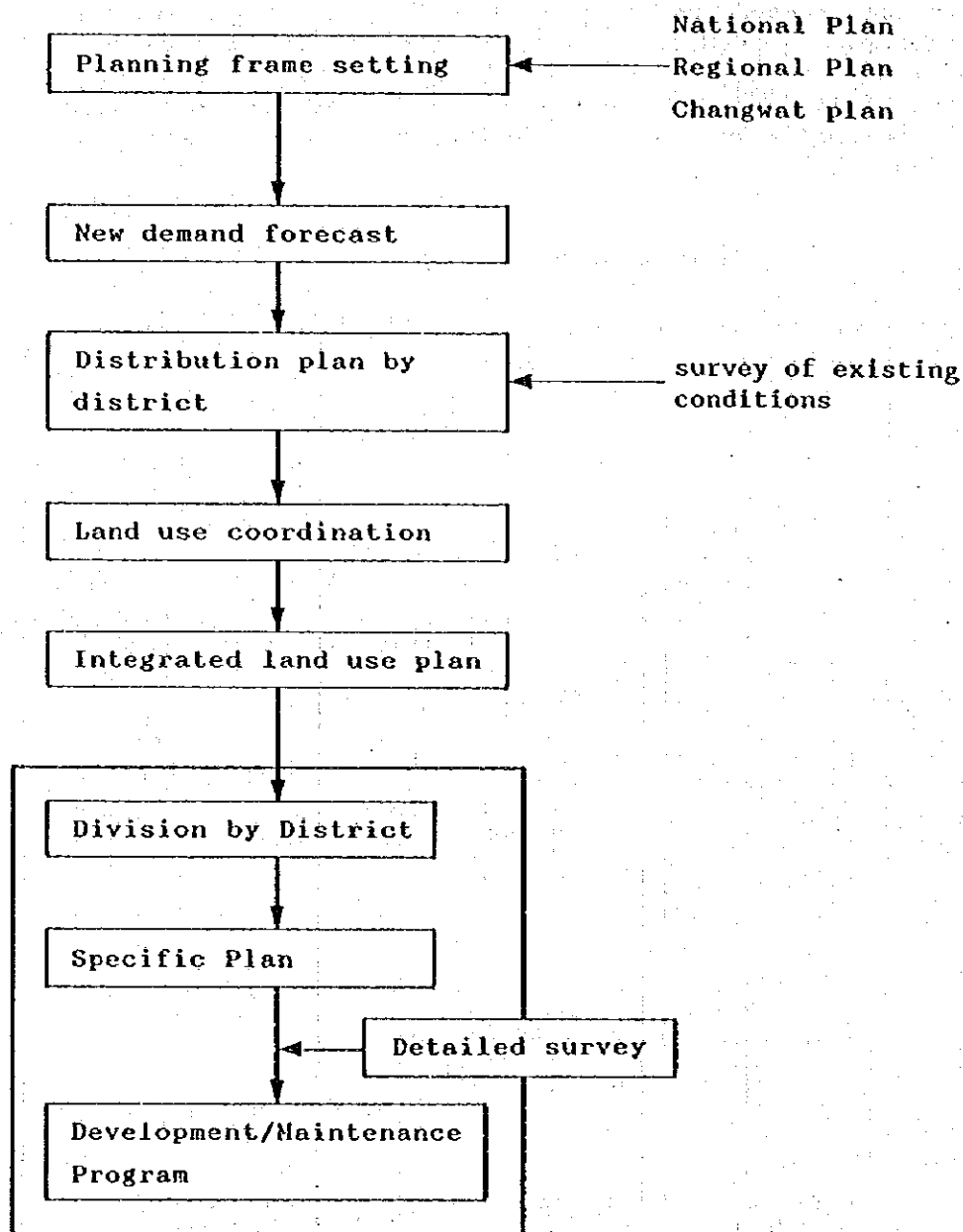
Land use planning proceeds as shown in the Fig. 1. After setting the planning boundary, it requires basic studies on the socio-economic, physical and environmental aspects of the community under study, the depth of which usually depends on the complexity of its socio-economic and physical structures and the availability of the necessary data and information thereof.

Planning Procedure Fig. 1-1

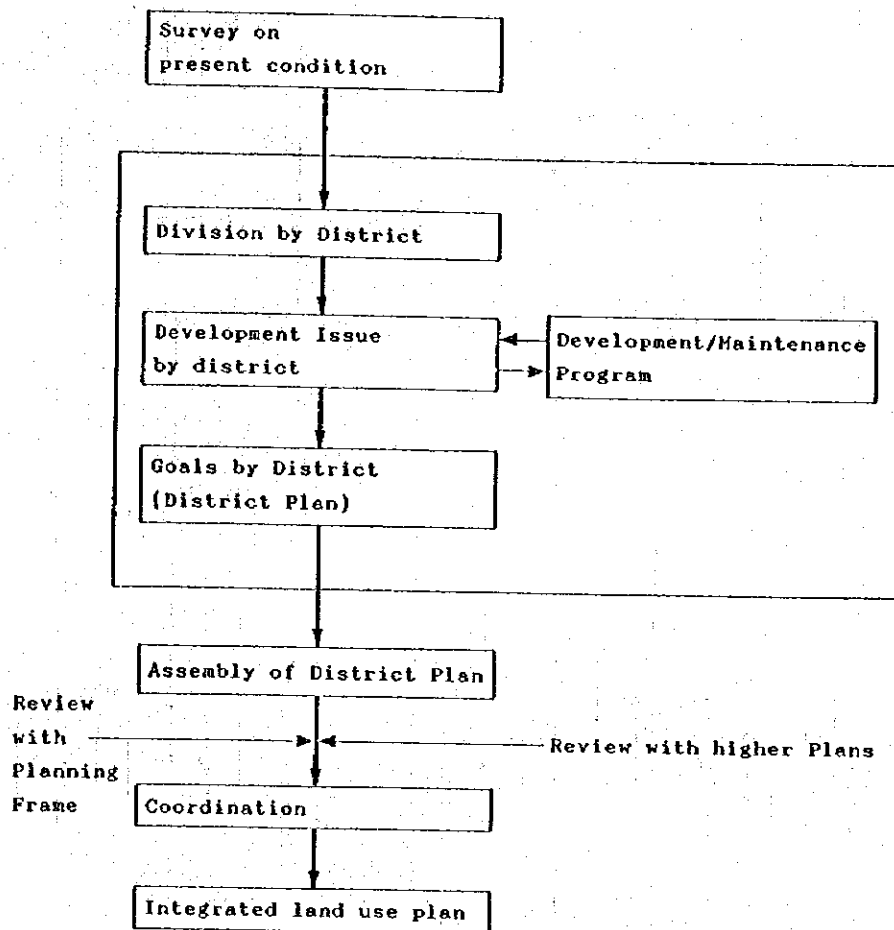
Work Stage	Procedure	Tasks contents	Outputs
A. Preparatory Work	1 Preparation ↓ 2 Basic Survey	1 Listing of data Map making 2 Data Collection	. Base map . List of required data . Surveyed map
B. Analysis and Evaluation	3 Demand Projection ↓ 4 Scale Setting of urbanized area ↓ 5 Distribution plan	3 Population projection & industrial forecast 4 Grasp of urban space structure and direction of development 5 Grasp of density structure 6 Assessment of present land use 7 Examination of land use constraints	. Planning frame . Assessed land use constraint map . Summary of the planning issues
C. Formulation of plan	6 Formulation of draft plan	8 Division of urban and suburban areas 9 Coordination with the higher level 10 Formulation of draft plan	. Land use policies . Setting of goals . Land use plan map
D. Evaluation and Compilation	7 Evaluation of draft plan ↓ 8 Compilation ↓ 9 Document	11 Examination by district 12 Examination of implementation measures 13 Proposals to the related plans and coordination	. Divisional map by district . Land use plan map and document

Basically there are two different approaches in land use planning, deductive and inductive, as shown below.

(1) Deductive approach (Fig. L-2)

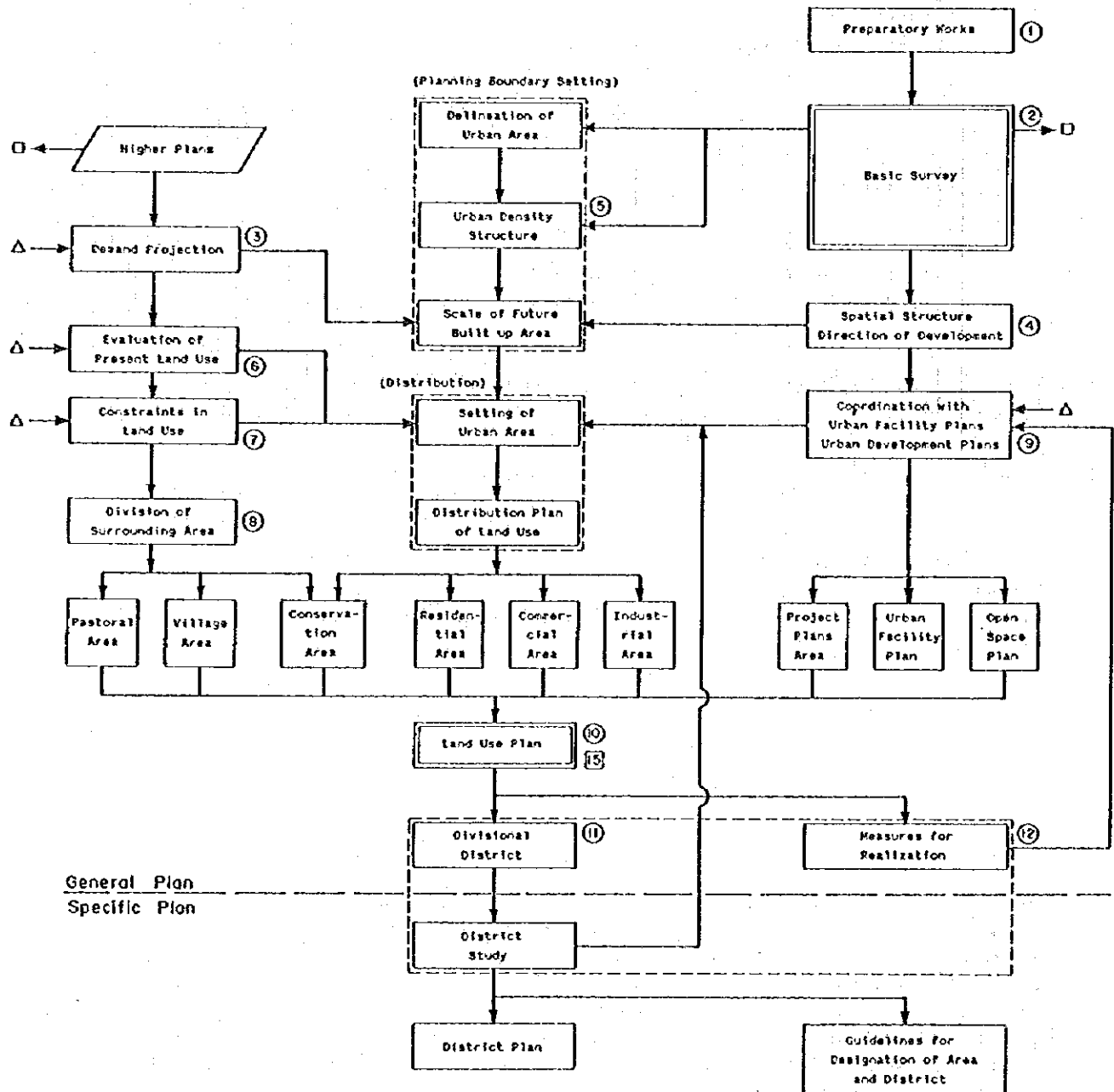


(2) Inductive approach (Fig. L-3)



Such a megalopolis as Bangkok, will have a number of complex urban problems due to caused by the recent rapid and intensive as well as extensive developments which make heavy demands on the limited capacity of the infrastructure. The problems linked to the urban structure like traffic congestion require a long time for solution owing to the long history of urban structuring. Also, the problems vary by district in their nature and intensity. Therefore, both the inductive and deductive approaches have to be employed for the comprehensive planning of large cities. A deductive approach is more useful in a goal oriented development approach stemming from the requirements of higher level development plans. On the other hand, an inductive approach is oriented to the specific problems at district level and requires a more detailed survey. When applied to large and densely populated areas like BMA, the survey requires more manpower and money but help facilitate the preparation of a specific plan later stage. The inductive approach is useful also in planning a small community where there will be no dramatic structural changes. Fig. 4 shows the overall planning flow based on the deductive approach.

Fig. L-4 BASIC PLANNING FLOW OF LAND USE



CHAPTER 3
METHODOLOGY

3.1 Preparatory Work3.1.1 Preparation for Survey

Prior to the field survey, a list of the data and information required and a base map should be prepared.

3.1.2 Basic Survey

Under the present institutional set up of the DTCP, the field survey is conducted by the Mapping Div. for existing land use, and the Engineering Div. for infrastructure and utilities. However, some data and information are at present not covered by either of the above divisions as shown below Table L-1, land use planner may have to conduct such research and analyze the results himself.

Table L-1 Survey Items and Physical Scope of Survey

Survey Items	Physical Scope of Survey					
	P.A.	M.	A.	C.	R.	N.
(1) Natural conditions						
a. Topography (M)	x					
b. Hydrogy (E)	x			x	x	
c. Soil	x					
d. Geology	x					
e. Meteorology	x	x		x		
(2) Social conditions						
a. Population (R&A)	x	x	x	x	x	x
b. Household (R&A)	x	x		x	x	x
c. Labor Force (R&A)	x			x	x	x
d. Student (R&A)	x	x		x	x	x
e. Pollution	x	x	x			
(3) Economic conditions						
a. Employment (Sector) (R&A)	x	x	x	x	x	x
b. Agriculture (P.R&A)	x	x	x	x		
c. Industry (P.R&A)	x	x	x	x	x	x
d. Commerce (P.R&A)	x	x	x	x	x	
e. Building permits	x	x		x		
f. Land value (R&A)	x	x				
(4) Physical conditions						
a. Infrastructure (E)	x	x	x	x	x	
b. Utilities (E)	x	x	x	x		
c. Housing/Building (P.R&A, M)	x	x		x		
d. Public facilities (E.R&A)	x	x	x	x		x
e. Land resources (P.M)	x	x				
f. Cadastral map	x	x				
g. Ruins and cultural assets	x	x	x			

Note: () after the survey item indicates the name of the responsible division.

M for Mapping Division
E for Engineering Division
R&A for Research and Analysis Division

P placed in front of the division's abbreviation denotes that the data and information are partially collected by the division.

The physical scope of the survey is indicated as follows:-

P.A. for Planning Area
M for Municipality
A for Amphoe
C for Changwat
R for Region
N for Nation

The information concerning national, regional and changwat are usually shown in the studies for regional plans and changwat structure plans made by the Regional Planning Division. Also development plans and specific project plans prepared by the Specific Planning Division for sanitary districts are available. In case where the area is outside the sanitary district, usually a rural development plan prepared by the Rural Planning Division is available. Information on approved public investment projects, planned projects and such large private planned investment projects as industrial commercial and tourism related projects that are assumed to make a substantial impact on land use have to be collected.

3.2 Analysis and Evaluation

3.2.1 Items to Be Analyzed

(1) Natural and historical conditions

Purposes

- a. To identify the characteristics of a community by analysis of the natural conditions on which urbanization took place.
- b. To identify major development issues concerning the urban structure and to look for a proper direction for improvement by considering the structure and the historical and cultural assets through historical analysis.
- c. To examine suitability for land development.

Items

- a. Topography and Hydrology
- b. Soil and Geology
- c. Meteorology
- d. Historical data and information on urban development

(2) Trend and existing conditions of land use

Purposes

- a. To determine the trend and existing conditions of land use and to prepare a base for evaluation of the existing land use.
- b. To determine on the trend and existing conditions of the factors, such as urban facilities, which have influenced urban land use.
- c. To identify areas suitable for future land development.

Items

- a. Existing land use.
- b. Trend on land sub-division activities.
- c. Population distribution
DID (Densely Inhabited District) development
- d. Development of transportation facilities and public facilities.
- e. Trend of urban development projects.
- f. Land ownership and value.
- g. Population changes.
- h. Employment and structural changes.
- i. Trend of industrial activities.
- j. Trend of commercial activities.
- k. Housing stock.
- l. Trend of housing construction.
- m. Occurrence of natural disaster/pollution (type, location).
- n. Ruins and cultural assets (kind, location).
- o. Application of the other related Acts.
- p. Development potential of residential, industrial and commercial areas.
- q. Position of the planning area and or the municipality in the contexts of the higher level development plans.

3.2.2 Analytical Methods

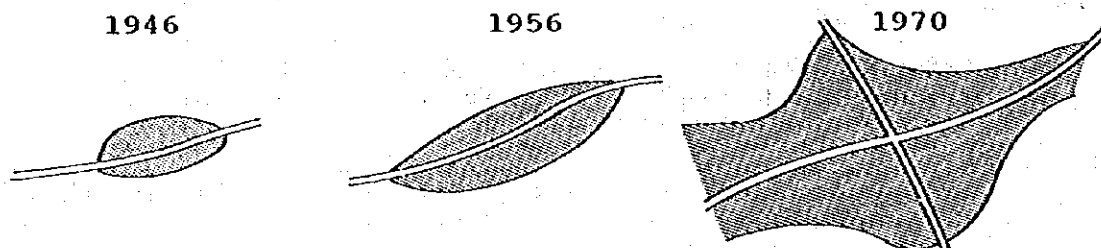
(1) Analysis of natural conditions

An analysis of natural conditions such as topographic slope, hydrology, vegetation, soil and geology is carried out to evaluate an area's development potential from a physical point of view which has then to be synthesized with economic and social factors for comprehensive evaluation. Slope is one of the key determinants for demarcation of suitable areas for development. An area with 10%-30% slope is considered marginal for residential development. A study of hydrology is concerned with water supply, flood and drainage development. Areas with good soil should be conserved for agriculture which is shown in the agricultural land classification map prepared by the Ministry of Agriculture and Cooperatives. Area with good load bearing capacity are suitable for building heavy structures. A windrose can be used to guide land use layout so as to avoid or minimize the impact of air pollution, noise, etc. produced by industrial activities. The most commonly used analytical technique for the analysis of natural conditions is the "overlay map technique".

(2) Historical analysis of urban development

This is to analyze the development of urban form so as to characterize a community. The location of major structures influencing land use such as trunk roads, railways, industrial estates, universities and other public facilities are to be chronologically summarized, together with maps of urban forms at corresponding years.

Example: Fig. L-5 Development of Urban Form



(3) Trends and existing conditions of land use

Existing land use

As mentioned in 3.1.2, existing land use maps are prepared by the Mapping Division at two different scales, one is 1:4,000 and the other is 1:10,000. The standard land use classification used by the Mapping Division is outlined below. For details, refer to V-II Mapping.

Land Use	Rai	%
Residential Area		
Commercial Area		
Governmental Area		
Industrial Area		
Warehouse Area		
Religious Area		
Utility Area		
Recreation and Stadium Area		
Livestock		
Roads/Sois		
School and Education Area		
Rivers, Canal		
Agriculture, Forests and Vacant Area		

In the map at a scale 1:4,000, shop houses are classified but categorized into commercial area in the map at a scale 1:10,000. In the land use plan, residential areas are divided into two to three categories of low density, medium density and high density & commercial.

Industrial area and warehouse area are categorized as industrial and warehouse areas under the same color. Vacant lands available for future development have to be separated from agriculture and forest use.

Trend on land sub-division activities

Before land is sub-divided into residential lots a development license has to be obtained from the Lands Department. In analysis of the licenses issued over the past three to five years with pertinent information as to number of lots, size of lot and location, will provide a base for forecasting the future direction of development, and the assumption of future housing types and density.

Population distribution

When historical data are available, prepare a map at a scale 1:10,000 showing quinquennial change in DID (Densely Inhabited District) where there is a density of more than 6 persons per rai with over 5,000 population, together with that of semi DID where the developed land occupies more than one third of the area with over 3,000 population.

Example: Table L-2 Changes in Built Up Area

	1970	1975	1980
DID	500 rai	700 rai	1,000 rai
Semi DID	1,000 rai	800 rai	1,200 rai
Built Up Area	1,500 rai	1,500 rai	2,200 rai

Demarcation of DID and semi DID, which constitute a built up area, with different color pencil on the map by the year of reference will provide a clear picture of urban growth pattern for a land use planner to consider. Semi DID is demarcated with a broken line.

For detailed population density analysis, the statistical enumeration district is used for analysis and prepare a dot map and a density map are prepared as shown below Fig. L-6. Each dot usually represent 150 persons which can be adjusted according to the size of enumeration district and its density. Six ranges are use for density map as shown in Fig. L-7.

When population data in mesh is available as shown in Fig. L-8, a density contour map can be made for closer visual examination.

Fig. L-6

Dot Map

. 150 persons

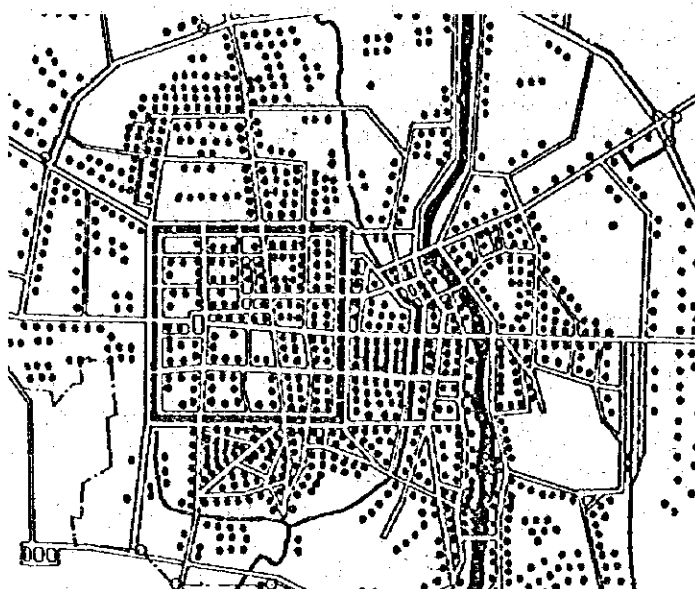
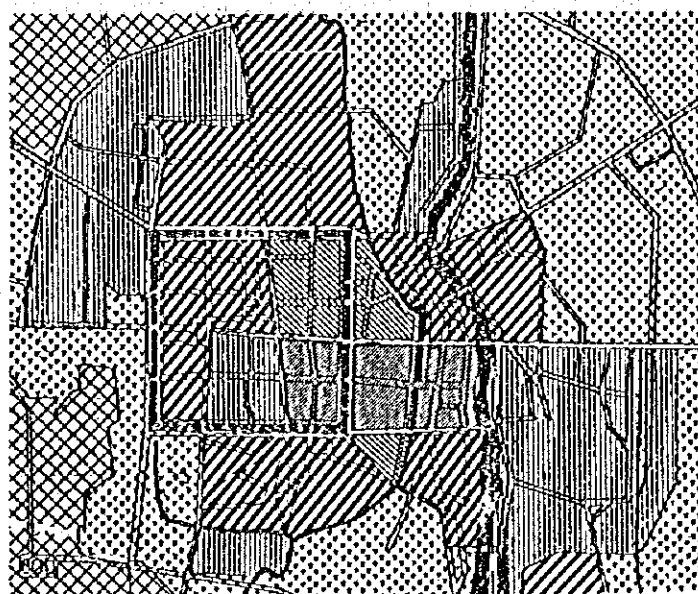


Fig. L-7 Density Map









DENSITY	PERSON / KM. ²	PERSON / (RAI)
	--- < 1,000	(1.6)
	1,001 - 4,000	(1.6) (6.4)
	4,001 - 6,000	(6.4) (9.6)
	6,001 - 9,000	(9.6) (14.4)
	9,001 - 11,000	(14.4) (17.6)
	--- > 11,000	(17.6)

Fig. L-8

Population Data in Mesh

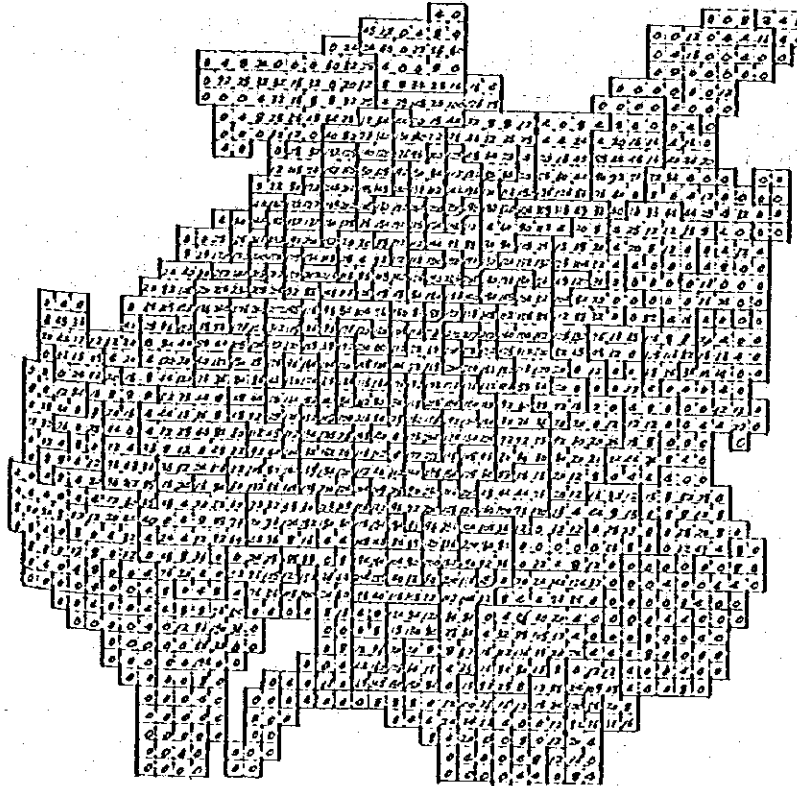
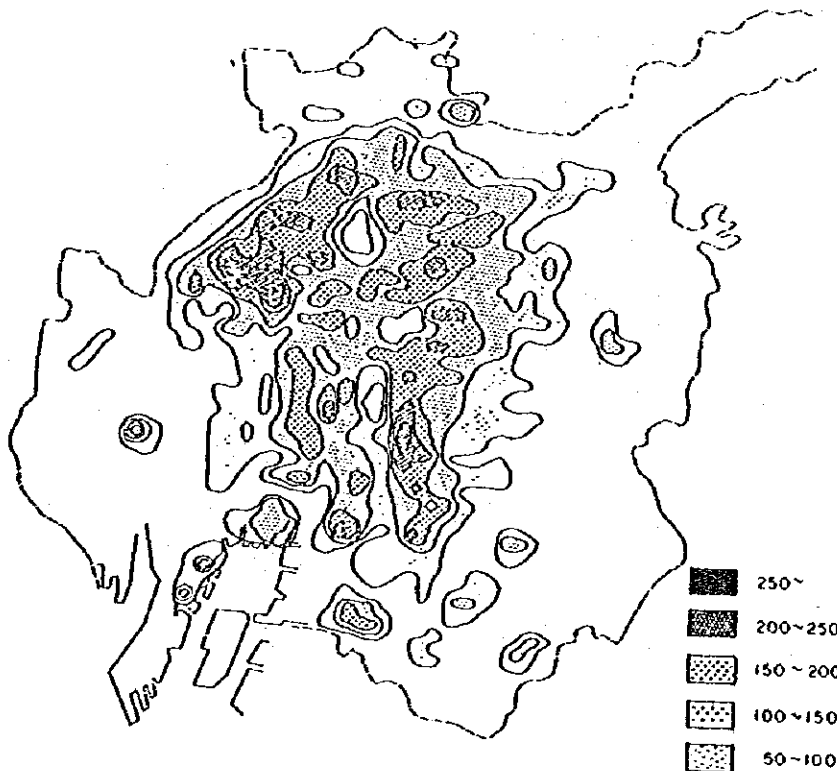


Fig. L-9 Population Density Contour Map



Development of transportation facilities and public facilities

A public urban facility will influence land use to a great extent depending on its type, size and location. Transportation facilities such as roads, railways and ports are key factors to be considered. Firstly, prepare a list of facilities (existing and planned) as shown in Table L-3 and locate them in a map at a scale 1:10,000. For detail, refer V-V and V-VI for Transport and Urban Facilities.

Table L-3 Inventory of Public Facilities

Facility Name	Existing	Planned
Roads	Highway	
Railways		
Automobile Terminals	Truck Bus	
Ports	River Sea	
Airport		
Sewerage	Treatment Plant	
Waste Disposal	Incineration Plant Dumping Site	
Education	University College Vocational Secondary	
Cultural Facility	Public Libirary Museum	
Religious Facility	Temple Church Mosque	
Parks		
City Hall		
State Hospital		
Wholesale Market		
Slaughter House		

Trends of urban development projects

Show those urban development projects other than the land sub-division projects stated in b. of this section and plot them on a map of scale 1:10,000.

Table L-4 List of Urban Development Projects

Project	Completed or under Implementation	Planned
NHA Housing Project		
Private Housing Project		
IEAT Industrial Estate		
Private Industrial Estate		
Urban Renewal Project		

Land ownership and land value

This is to point out large parcels of land of more than 50 rai owned by public institutions as well as private citizens by analysis of the cadastral map and plotting them on the same map stated at e. These large parcel of land have substantial impact on future land use. Also illustrate the land value information along the major roads in the same map to examine development potential.

Population changes

Firstly, prepare a table as shown below and compare the changes in growth rate and share percentage among the different areas to analyze the factors responsible for those changes. The results will provide a base for future population projections. Also, changes in demographic structure have to be analyzed for estimation of future labor force, student number and also housing demand.

Example: Table L-5 Population Changes

Year	M	1	PA	2	A	3	C	4	R
		X		X		X		X	
1970	100,000	83.3	120,000	80.0	150,000	30.0	500,000	14.2	3,500,000
1975	110,000	78.6	140,000	82.4	170,000	30.9	550,000	14.1	3,900,000
1980	--	--	--	--	--	--	--	--	--
1985	--	--	--	--	--	--	--	--	--

M - Municipal Area	1 - $M/PA \times 100$
PA - Planning Area	2 - $PA/A \times 100$
A - Amphoe	3 - $A/C \times 100$
C - Changwat	4 - $C/R \times 100$
R - Region	

In the regional cities public facilities such as state hospital and universities temporarily attract people from the surrounding areas due to the higher level of services they provide, which makes it complicated to analyze the statistics. For example, when a baby born in a hospital of a regional city and gets a birth certificate from the hospital, he or she is registered in the city regardless of mother's domicile. Accordingly, the fertility rate and out migration rate of the city becomes very high. Special care has to be paid in this regards when analysing fertility rate and migration rate.

Employment and structural changes

Industrial activities require a certain amount of space and the density of worker depends on the type of work done. The activities can be broadly classified into three industrial groups, i.e., primary industry (agriculture, forestry and fishing), secondary industry (mining, manufacturing and construction) and tertiary industry (service). The primary industry requires a larger area per worker due to its nature, e.g. agriculture. The secondary industry, especially manufacturing requires factory space and its space requirement per worker depends on the type of activity but generally it is larger than that required by office workers in the tertiary industry.

The balance among the three groups will characterize the future outlook of a city and shape the land use. Since urbanization takes place on agricultural land, analysis of employment change in the primary industry has to be done. Degree of income disparity of agricultural household against other two industrial group will provide a base to judge a future trend of agricultural employment. For details, refer to V-III Socio-Economic Analysis.

Trend of industrial production

Industrial activity measured by production in terms of Baht or ton, meter, M^3 , etc. is another parameter for industrial land requirement. When the data are available for the existing industries, analyze these data by type of industry for land requirement per worker and per unit of production. Growth potential has to be examined through trend analysis. If not available, national data from the Ministry of Industry (MOI), the Board of Investment (BOI) and the Industrial Estates Authority of Thailand (IEAT) have to be analyzed. However, for estimating the industrial land requirement in land use planning of the general plan, it will be sufficient to broadly categorize industries into three types of light, medium and heavy. Light industries are of those labour intensive and clean ones such as rice mill, bakery, weaving, clothing, wood working etc. Heavy industries include such as cement, iron and steel, petrochemical etc. They are capital intensive and polluting types. Other industries can be categorized as medium industries.

Trend of commercial activities

Commercial activities in terms of employment, sales and floor area have to be analyzed. When such data are not available, look for those of similar cities or changwat, regionals and or the country as a whole and analyze sales and floor area. Analysis of the building permits for commercial use and the actual employment data surveyed by the R & A division will give floor area or land area requirement per worker too.

Housing stock

Analyze the housing stock data by type of structure (single family detached, multi-family) and building materials use (wooden, concrete, etc.) and estimate housing shortage. When such data are available as degree of dilapidation on the stock, analyze the number of replacement units which normally do not require new plots.

Trend of housing construction

Analyze the building permits for residential use by type, floor area and materials used. From the total annual units constructed, substruct those replacement units estimated in the above k. Type of housing unit and floor area will provide a base for estimation of land requirements for residential use. Source of information is the local PWD office or municipal office.

Occurrence of natural disasters/pollution

Prepare a list showing occurrence of natural disasters and pollution and plot them on map of scale 1:10,000 and investigate the necessary preventive measures taken by the authorities for probability of future occurrence. Source of information is the local PWD office and or municipal office.

Table L-6 List of Types of Natural Disasters and Types of Pollution Occurring in the Planning Area

Type	Location
Destroyed river banks	
Flooding	
Land slide	
Air pollution	
Noise	
Bad odor	

Ruins and cultural assets

Those ruins and cultural assets designated by the Department of Fine Arts or the local authority must be conserved according to the requirement of the respective laws, ordinances and regulations. Prepare a list of those cultural assets and plot them on map of scale 1:10,000.

Table L-7 List of Ruins and Cultural Assets

Kind	Location
Ruins	
Uncovered	
Covered	
Cultural Assets	
Buildings	

Application of the other related acts

Apart from the above Archaeological Objects, Archaeological Places, Arts and Culture and Museum Affairs Act B.E. 2504, examine if other related Acts are applied to the area such as Act on Area Under Fire B.E. 2476, Land Development Act B.E. 2526, Public Health Act B.E. 2484, Factory Act B.E. 2512, Act on Canals B.E. 2446, National Park Act B.E. 2504, Act on Expropriation B.E. 2497 and Enhancement and Conservation of National Environment Quality Act B.E. 2518 and 2521.

Development potential of residential, industrial and commercial areas

The results of analysis made in items a) to f) and e) to o) have to be synthesized to evaluate development potential of the non-constrained vacant areas for residential, industrial and commercial uses respectively. As an analysis and evaluation technique, the overlay map technique discussed in item a) can be further applied for elimination of constrained areas and eventual selection of the suitable areas for specific development. Another technique is called "Weight Scores Technique" or "Potential Surface Analysis (PSA)" which quantifies the value of each cell of lands in grid form and evaluate by use of a micro computer.

Profiles of PSA are as follows:

Potential Surface Analysis (PSA) is used to analyze the potential for land development in every area on the map from the highest to the lowest, by considering information on physical, social, economic and environmental conditions.

It is able to analyze suitable land area for development and is capable of evaluating the weight of each information differently and enabling the planner to select from many alternatives.

However, if there are too many variables, the calculation may become complicated, but they can be fed easily into the computer for calculation.

PSA is a method developed from the sieve mapping technique. It changes a land surface into a graphic display of the sieve mapping technique. This change may be made whether it concerned information on the physical condition, economic, social the environment by measuring, then calculating together, even though the units of measurement of each factor may be different.

Basically PSA has the following three stages:

- a) Determination of various factors which will indicate locations for different activities.
- b) Evaluation of the result of the factors on the map.
- c) Illustration of the result of the factors on the map.

Advantages and limitations of the PSA system:

- a) Advantages of the PSA system
 - (1) For use in a positive potentiality to give rating as to suitability of the various land surface for development which will show the priority of land development.
 - (2) Is a method to digest the assumption of policy from the technical point of view and is capable of fixing the type of each development.
 - (3) Able to adjust in the event that the value of the various factors or various objectives have changed due to a change in policy. With the capability in adjusting is able to calculate the assumed value and the changed value form easy testing methods.
 - (4) Such above mentioned technique has an all-round capability, therefore, it can be used in the control of change and can estimate the outcome (situation) economically, as, such technique was based on t presumption, and the forecasting of avarious factors scattered within the land surface.
 - (5) Is a technique which can easily respond to change in the planning policy by constructing a model of weight rating to the objectives, being a technique in which the potentiality of the area can be developed through employment of a valid and reliable evaluation.
 - (6) Able to bring it into use in making various scales within one surface.
 - (7) Can be used at various steps of the lay-out procedure, that is, during the making of the plan or during the plan evaluation.

- (8) The whole process of the said technique is a process for fixing the target, therefore, there is a flexibility in arranging the importance of target.

b) Limitations of the PSA system

- (1) Is a technique for which value of the various factors have to be fixed, in spite of the fact that fixation of a factor value may not be done distinctly.
- (2) This technique is used for seeking the development potential for land use for each activity separately, meaning that is, it is not capable of showing the potential for land use for every activity at the same time.

Although the PSA system has some weak points, it may still be considered having sufficient capability in area analysis and evaluation. Since PSA is a technique with a large amount of figures involved for calculation, the use of a computer in analyzing will produce a quick result and is more accurate.

Fig. L-10 shows a schematic diagram of PSA and Fig. L-11 illustrates the concept of computer application. Fig. L-12 and 13 show an example of calculation of weight scores and of graphic presentation of the result.

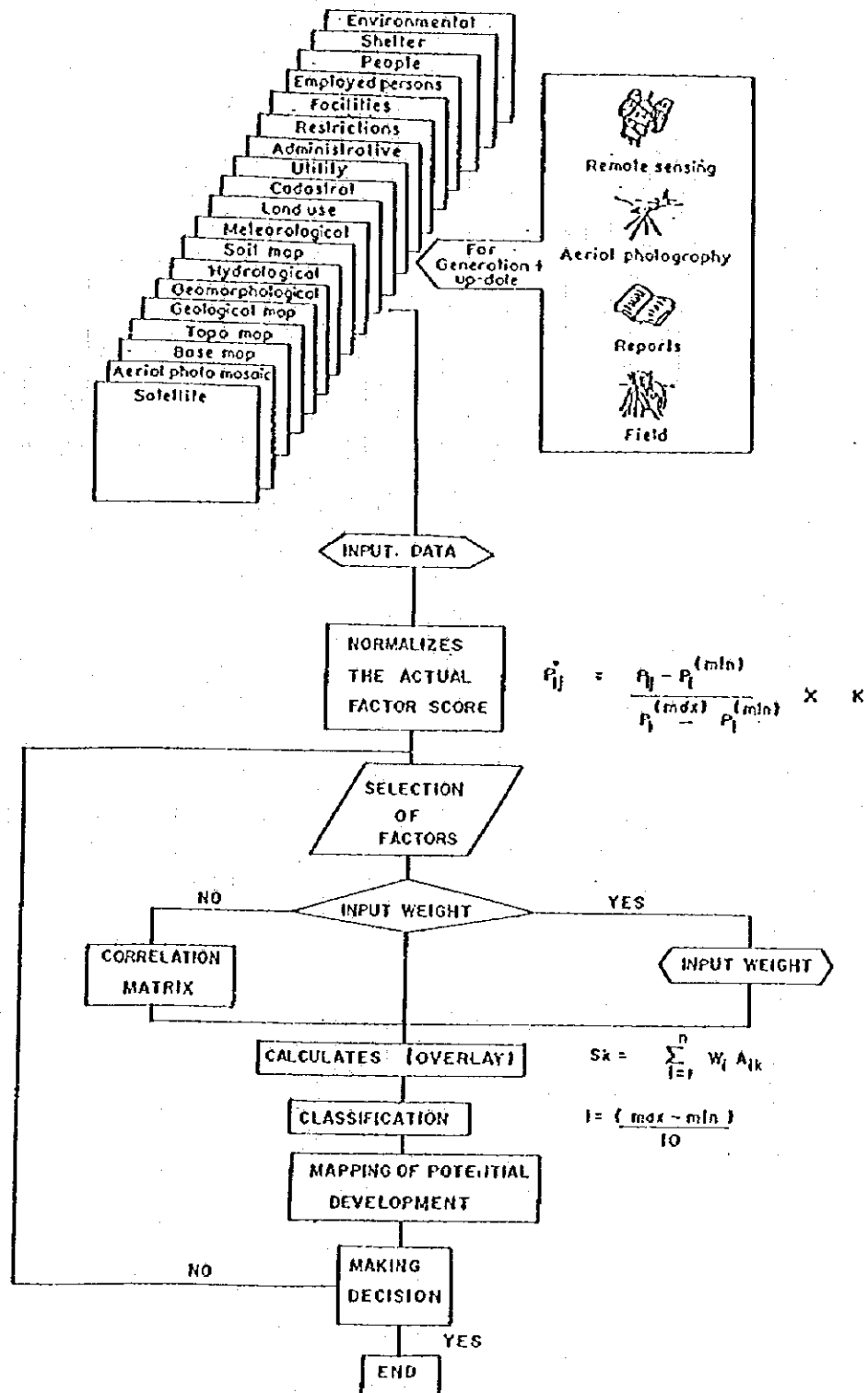
3.2.3 Results of Analysis

Results of analysis and evaluation will be summarized in the form of a map, table and explanatory notes. They are as follows:

(1) Spatial structure and direction of development

- a. Division of the built up area
 - existing/on going/new
- b. Division of agricultural land
 - promotion area/non promotion areas
- c. Sub-division projects
 - on going/planned
- d. Primary roads
 - existing/planned
- e. Railroads and railroad stations
 - existing/planned
- f. City hall, large scale parks, etc.
 - existing/planned
- g. Other large facilities
 - public (university/air and sea port/cemetery etc.)
 - private (factory etc.)

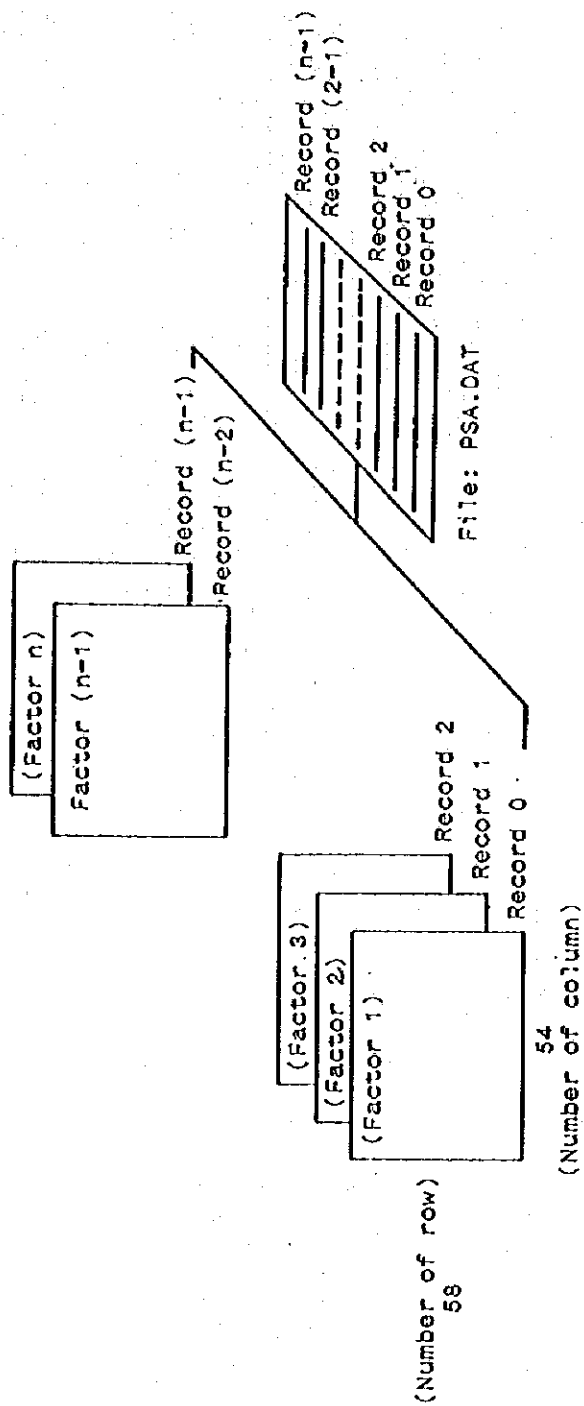
Fig. L-10



Scheme of PSA-Processing for Quantitative Area Analysis

Fig. I-11

COMPUTER AID FOR SPATIAL PLANNING



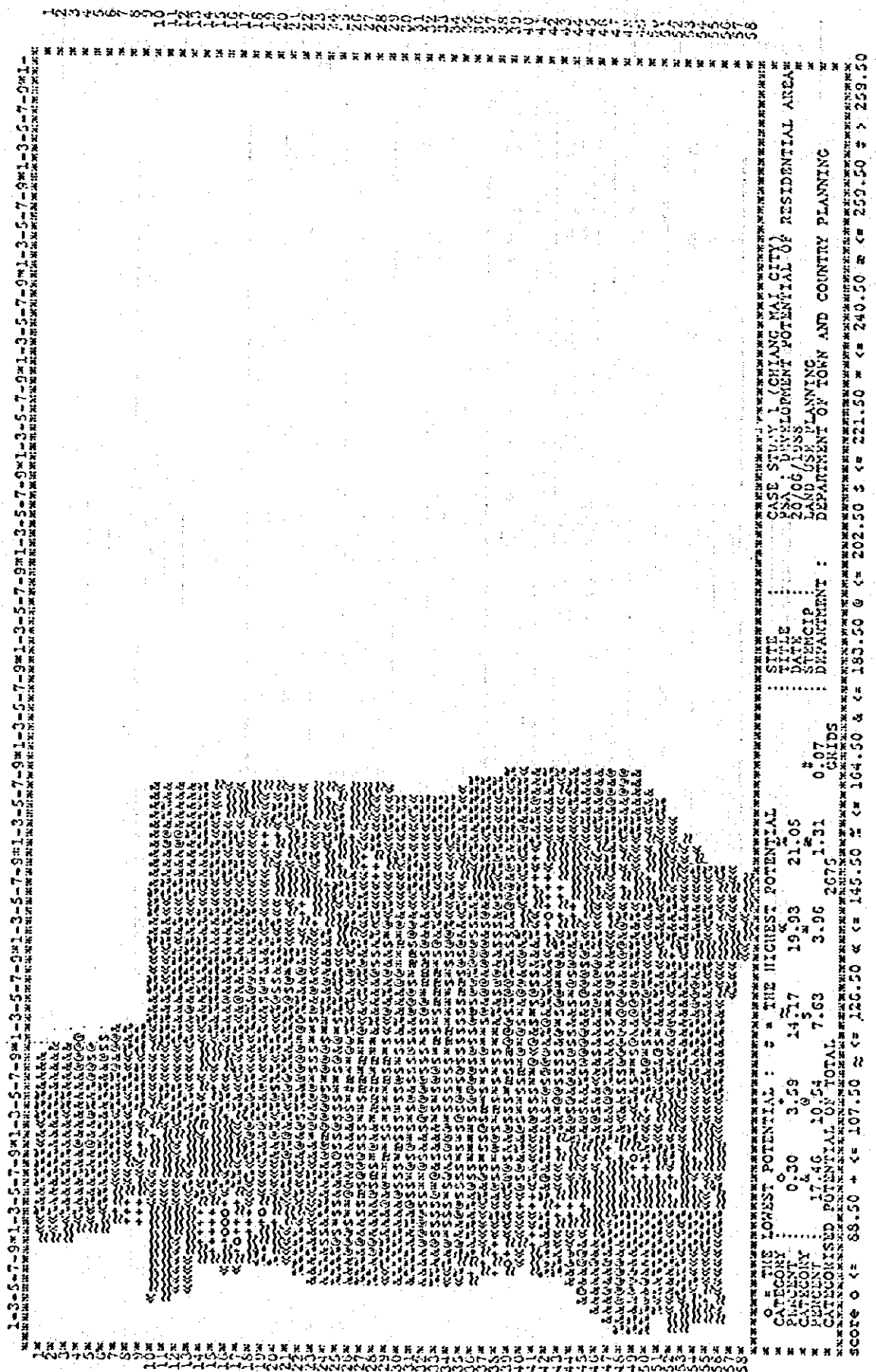
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Fig. L-12

Existing Situation Measured by subject		Measured Values (Highest Best)	Values Converted to 0-100 Range		Values Multiplied by Weight	Values Added to give Potential
			Range	Weight		
Existing Situation	Landscapes	13	0 TO 28	50 X 4	200	Expression of Potential Surface
	Agriculture	2	1 TO 6	20 X 3	60	
	Services	555	80 TO 772	70 X 1	70	
	Residential Environment	3	0 TO 6	30 X 4	200	
Existing Situation	Annoyance	41	0 TO 10.2	40 X 2	80	Potential Situation
Expression of	Job Access	552	28 TO 747	88 X 3	264	
	Labour Access	56	18 TO 2289	73 X 2	146	
	Shop Access	551	101 TO 618	87 X 2	174	
	Road Access	4000	1 TO 3100	90 X 45	405	
	Rail Access	98	35 TO	58 X 45	261	

Coventry-Solihull-Warwickshire sub-regional study
: Example of the calculation of a residential development
potential surface
(Source : Wannop, 1972 p. 162)

Fig. L-13



The above information shown in the map presents a basic framework of the existing land use.

(2) Density structure and scale of future built up areas

- a. existing built up area
- b. on-going built up area
- c. future built up area
- d. rural areas

Quinquennial change in population by area and its density shall be shown in map and table.

Areas to be excluded for habitation area : with more than 10 rai of industrial, educational, religious, park, other large scale facilities and flood plains, etc.

Establishment of the density of built up areas is commonly done in either of two ways.

- i Case study of similar cities where the current trend of urbanization, targeted level of residential area etc. are considered for establishing average density.
- ii Assume future density structure and establish the sub-divisional density taking into consideration the current density and urbanization trend.

(3) Evaluation of present land use

Out of the four major urban functions of habitation, production (employment), green (reproduction), and transportation, the first three directly concern land use. They are graphically shown according to the classification of each sector.

Habitation sector

Classification of residential areas

- old and orderly formed settlements
- collectively developed detached housing areas
- collectively developed multi-family housing areas
- planned residential development areas
- dilapidated, dense and poor residential areas
- low and medium density residential areas

Production sector

- major industrial areas
large/small and medium
- major commercial and business areas
main center/sub-centers
- major institutional areas
government centers, university etc.

Green sector

- forested areas
- river and water front areas
- major parks larger than neighborhood park
- scenic places, ruins, cultural assets
- natural conservation areas

Land use constraints

- areas with more than 30% slope
- swamps, poor sub-soil areas
- flood prone areas
- buried cultural assets areas
- agricultural promotion areas
- forest reserve, scenic areas etc.

(4) Evaluation of development potentials

Potential areas for residential, industrial and commercial development identified through either overlay method, sieve and/or PSA shall be shown in a map accompanied by table indicating the respective areas and locations.

a. Residential areas	rai
b. Industrial areas	"
c. Commercial areas	"

3.3 Land Demand Projection

Based on the results of the analysis and evaluation in 3.2, quantitative forecasting of future urban land demand will follow. Estimation of future land use to cope with community expansion and population growth may be considered from the requirements of each category of land use activity, since land use has different characteristics and roles.

In this section, future land demand will be discussed in terms of the three sectors of land use, namely the residential sector, the employment sector and the open space sector. The residential sector is divided into two to three groups depending on population density. The employment sector is divided into three groups of agricultural and fisheries (primary), industrial(secondary), and commercial and services (tertiary). The open space sector is divided into two groups of recreational and environmental. There are two approaches in estimating the future urban land requirement. One is a macro approach, that is to estimate through division of the future urban population by an average urban population density. The other is a micro or sum-up approach, that is to sum up each category of the land use mentioned above. In practice, to estimate the future land demand requires the two approaches to be tried.

3.3.1 Macro Approach

Firstly, urban population will be estimated by subtracting the estimated agricultural population from the future targeted population. Then an assumption has to be made on population density. The simplest way is to assume an average density of urban area and divide the future urban population by the average density. Another way is to assume two to three densities according to division of the urban areas i.e. built up area, on going built up area and future built up area.

Built up area

Density of the built up area generally ranges from 15-20 persons per rai and tends to be stabilized.

On going built up area

Development has taken place in recent years and the area is expected to have continued development due to availability of developable lands. Density can be assumed in the range of 10-15 persons per rai.

Future built up area

As the area is for future development, density can be assumed depending on the types of project discussed under section 3.2.

In this case, those industrial lands already located outside of the DID or one in large scale located in the DID have to be added to the summed up areas.

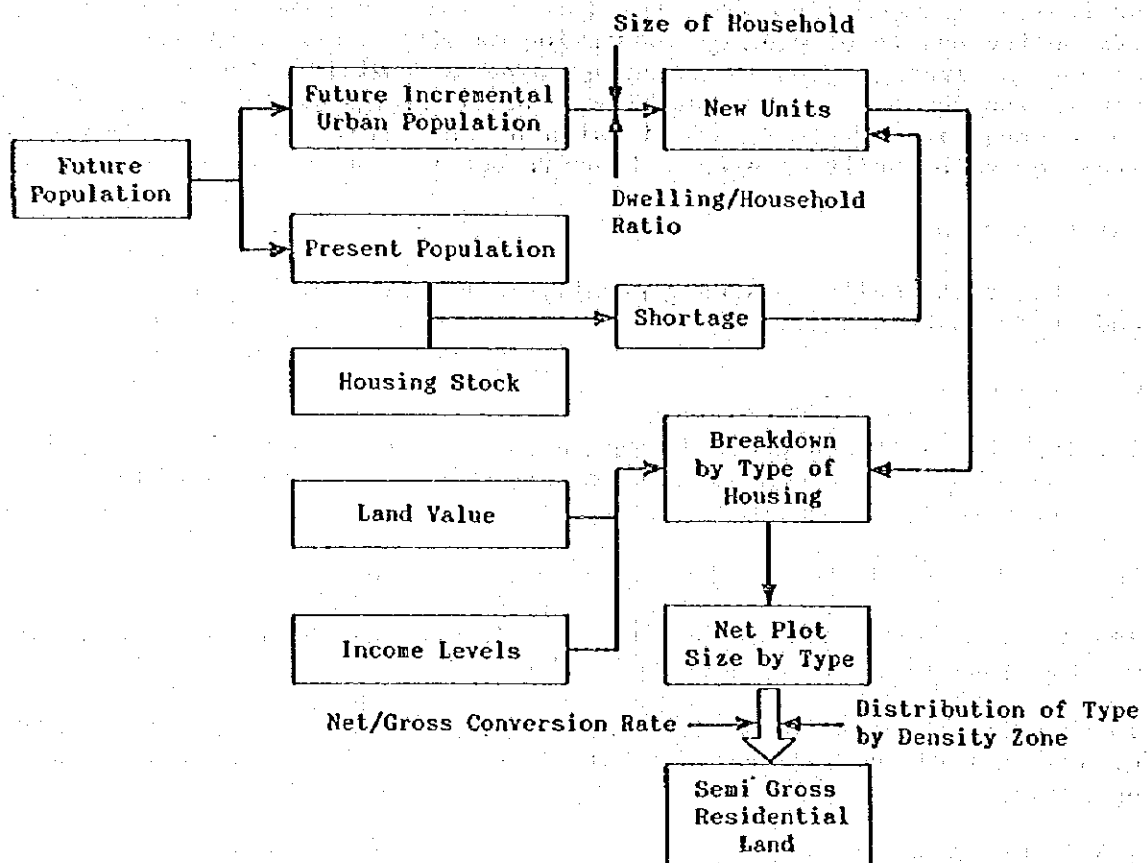
3.3.2 Micro Approach

Residential land

Factors considered for estimation of the future residential land requirement are economic and social. Economic factor is usually the financial ability of the future home buyers. Level of income is considered a determinant of plot size, and housing type. Social factor is usually change in family structure and life style. As economic development progress as, young labor force tends to out migrate from rural areas to urban areas where they form a new family. Size of such new families tend to become smaller. A study flow of residential land demand is shown below Fig. L-14.

Future incremental urban population is derived from subtracting present population and future agricultural population from the future targeted population. Generally the size of agricultural household is bigger than that of urban household which is now around 5 persons. Also the dwelling/household ratio is smaller in rural areas. For future estimate of urban dwelling units, the ratio can be set at 1.

Fig. L-14



- Household income surveyed by the R&A division shall be classified into the three groups of low, medium and high income. It is generally said that the cost of housing in effective demand should be around 2.5 times of annual income or maximum allowable installment of 30% of monthly income of home buyer. Therefore the level of income tells the affordable type of housing of home buyer from financial view point. Housing type is classified into two, i.e. single family detached unit and multi family unit. Single family unit is usually owned by the high income group and located in low density zone. On the other hand, more low and medium income groups live in multi family units which are generally located in medium and high density zones. At present there is no standard definition of density classification but the following can be tentatively used as guidelines for future planning.

Low density zone	below 10 persons per rai
Medium density zone	10-20 " "
High density zone	20 up

Surveys on land value, land sub-division licenses and building permits will indicate the future likely size of plot. After calculation of the total plot areas, it is necessary to convert the areas into the semi gross areas which exclude those areas for industrial, educational, religious, park and other public facilities which occupy more than 10 rais.

Commercial land

Commercial land includes such activities as retail, wholesale and general business. There are two approaches in estimating commercial land. They are macroscopic approach and sum up approach. As the scale of commercial activity is correlated with the population in the planning area as well as in the sphere of commercial influences (market), it is necessary to compare with other similar cities in terms of number of shops, sales, and areas from the macro view point. This approach will enable the planner to search out a reasonable land requirement per capital for commercial use which is applicable to the Thai situation. The following is just an example, and needs to be replaced with Thai data.

Table L-8 Per Capita Commercial Area Requirement

Type of City	Per Capita/P.A.	Per Capita/Municipal
Metropolitan	15-20 m	20-30
Regional city	10-15 m	15-20
Changwat capital	8-12 m	10-15
Commercial city	6-10 m	8-12
Industrial city	4-8 m	6-10
Dormitory city	2-5 m	3-6
Average	10 m	15 m

As to retailing, the floor area requirement can be estimated as follows, if data area available.

$$\text{Daytime Shopping population} \times \frac{\text{Per Capita Shopping expenditure}}{\text{Amount of Sale per year per m}} \times \text{Share of Local consumption}$$

Another method is to estimate commercial land requirement based on future employment discussed in 3.2.2.1.

$$\text{Future Commercial Land} = \frac{\text{Tertiary Industry Employment} \times \text{Per Capita Floor Area}}{\text{Average Storey of Building} \times \text{Building Coverage Ratio}}$$

Per capita floor area will range from 10 m² to 20 m² and the average number of stories depends on the size of city. Except for Bangkok, probably an average of 2 stories can be used with building coverage ratio of 70%

The available DTCP standard for simple calculation of 16 shophouse per 1000 inhabitants and 16 workers per rai should be used as a basis and check with the existing figures of the city under study. If data are not available, look for those in a similar city or the Changwat.

3.3.3 Industrial land

There are two approaches. The first is based on the projected industrial outputs and the second is based on the projected industrial employment.

a. *Industrial output approach*

$$\text{Industrial Land} = \frac{\text{Total outputs}}{\text{Outputs per m}} \times \frac{1}{1\text{-Public Space Ratio}}$$

b. *Industrial employment approach*

$$\text{Industrial Land} = \text{Employment number} \times \frac{\text{per capita}}{\text{area m}^2} \times \frac{1}{1\text{-public space ratio}}$$

The above land productivity and worker density depends on the type of industry. Heavy industry category usually achieves higher land productivity with less worker density due to capital intensive type of operation. On the other hand light industry sector is land productivity is lower with higher worker density. Normally, as industrialization progresses, density tends to become lower due to structural change from labour intensive industries to capital intensive ones. An average density standard used for Litchfield/DTCP is 20 workers/rai, while IEAT uses 16 workers/rai.

The draft of the Bangkok Metropolitan General Plan uses the following classification and densities.

Table L-9 Density of Workers

Size Classification	Density/Rai	
	1983	2001
Service (less than 10 workers)	38	23
Small scale (11-49 workers)	32	19
Medium scale (50-499 workers)	26	16
Large scale (500 up)	28	n.a.

3.3.4 Agricultural Land

Urban growth tends to reduce the amount of agricultural land. As stated earlier, the balance will characterize the city. Basically it is necessary to conserve good agricultural lands of the land reform area and irrigated areas with high agricultural productivity. Such areas are important not only to serve as a main source of supply of fresh food to

the adjacent urban community but also as a kind of open space in the urban environment. As to the extent of change in land use of other agricultural land, this depends on the needs of the urban population as well as the willingness or not of agricultural households to continue farming for the foreseeable future (5 to 10 years). Therefore it is desirable to conduct an agricultural household survey to understand their intention and estimate the necessary agricultural lands to be maintained.

3.3.5 Recreation and Open Space

Such recreational space requirements as parks, zoos, sports fields are determined on the basis of separate studies. The recreational needs of a community varies by its population size, location and role in the Changwat or the region. Privately owned and managed facilities such as golf courses, leisure lands - safari and crocodile farms are also included in this category.

Open space is defined in the Town Planning Act as the area of land specified in a general plan or a specific plan as a mainly free space and for a specific purpose. Such spaces as green belts, buffer zones, lakes and rivers are included in this category. Determination of space requirements for these uses will depend on locally established criteria and considerations relevant to the purposes specified.

For details, refer to the Volume VI Urban Facilities.

3.4 Land Use Planning

Based on the outputs taken from Section 3.1 through 3.3, the work proceeds to the formulation of a draft land use plan which deals with setting up of goals and objectives, planning framework, land use policies and layout.

3.4.1 Setting Up of Goals and Objectives

Urban land use plan has to be rational and harmonious with the activities of agriculture, forestry and fishery of the surrounding areas and to be compatible with the goals and objectives of the community which aim to provide a healthy and cultured urban life and to allow functional urban activities. Each city has been formed through the long historical evolution of its natural, social and economic conditions, which are its background.

Urban land is not a mere composite of physical structures but is considered as a social and organic unity. Therefore those various factors which have developed the city have to be well considered in formulation of a city plan. Arbitrary planning without due consideration of the above historical background will not help the city be developed properly out rather will spoil its sound growth.

To set up the goals and objectives of a Land Use Plan requires consideration of the main problems of the urban community and

development issues facing it as well as the roles expected by the various levels of development plan such as, the National Economic and Social Development Plan, Regional Development Plan, Changwat (province) Structure Plan, and Municipality Development Plan or Sanitary District Development Plan.

Goals and objectives aim to solve urban problems and prepare for future expansion of the urban area, by primarily considering physical development. They are expressed qualitatively in the form of planning ideas and/or a future image. On the other hand, setting up the socio-economic framework is a quantitative task which helps more concretely to realize the above future image contained in the goals and objectives.

3.4.2 Land Use Policy

The land use policies shall deal with the following matters:

(1) Natural conditions

Outline the land use policy taking into consideration the characteristics of natural conditions. The result of analysis the urban natural structure composed of river system, topography and geology will indicate the future direction of land use from the natural conditions of a city. Policies on prevention of natural disasters such as floods, land slides and land subsidences as well as preservation and conservation of outstanding natural environment including natural scenic beauty shall be formulated.

(2) Historical conditions

Outline the land use policy viewing the individual character of the city which has been shaped through its own history. Take into consideration the historical changes in the spatial structure and land use, direct the future land use based on the proposed urban structure and formulate a conservation policy to conserve the townscape qualities of the city.

(3) Urban spatial structure

Based on the land use framework discussed in the above (1) and (2), outline the land use policy viewing from the future urban structure which can be grasped from the transportation network and configuration of the proposed urban development projects.

(4) Density plan

Based on the analysis and evaluation of 3.2.3 (2), a density plan shall be formulated. In this case, the future housing demand and their types have to be considered.

(5) Layout plan

From the result of evaluation of the present land use and evaluation of development potentials of the major land use categories, state the policy of setting centers and sub-centers for commercial and business. As for industrial areas, a policy has to be directed to either reduction or expansion of existing industrial areas and laying out new industrial

areas. Concerning residential areas, the policy has to be directed to laying out the zone by density as well as the one for conservation.

3.4.3 Layout

Though the major objectives of a land use plan are to secure functional urban activities, safe and convenient urban life and urban amenity, there are some important points to be considered for the formulation of a land use distribution plan.

(1) Residential areas

In the existing built up area, population density is stabilized and/or going to be stabilized. However the area has such problems as mixed land use of shops, offices and factories and environmental conflicts by high rise buildings. Change in housing type by replacement sometimes results in change in density. It is one of the important issues in land use planning to conserve good residential areas and to improve or renew dilapidated areas. With these factors in mind, residential areas are required to be sub-divided appropriately according to the level of density.

In the on going built up areas, necessary infrastructure and public facilities are generally insufficient. Accordingly it is not desirable to allow increase in density without appropriate control. In accordance with the level of development of infrastructure, the area should be sub-divided by density.

A new built up area is a district to be newly planned and developed. Generally speaking the new built up area is located in the suburban area and is developed mainly for detached single family housing. If an area lacks facilities for convenience in daily life, it is considered necessary to induce a relatively large scale sub-division project in strategic site. Such sites should be located in non swampy area and free from pollution and danger of natural calamity. When the area is far from the existing built up area, it should be guided to develop a community with at least 8,000 population which is considered reasonable to establish an elementary school.

(2) Commercial and business areas

CBD

Primary commercial and business facilities generally tend to locate in the central district of a city due to its easier accessibility and form a so called central business district (CBD). Taking account of future spheres of influence in economy and daily activities, a district has to be delineated for CBD where there is space to allow agglomeration of commercial, business, social and cultural facilities. And in a district where there are high density commercial and business facilities and public administrative facilities, considerations shall be made not only for functionality and convenience but also for urban amenity, which could be realized through aesthetic arrangement of public facilities including relaxation space for citizens. For this purpose, successive works are required for formulation of the specific plan for such areas as above.

Sub-center

For convenience of urban dwellers, sub centers have to be proportionately distributed where commercial activities at district level will be concentrated.

Distribution district

It is ideal to locate and relocate cargo distribution activity collectively along a highway in suburban area when such highway is planned to be developed.

(3) Industrial area

History of industrial area formation varies by city and pattern of industrial location also varies by type and scale of industry. Therefore industrial area distribution plan requires the following considerations.

Existing industries in urban area

As industrialization proceeds, each industry tends to change qualitatively. On the other hand the needs for expansion of residential area take place. Therefore industrial areas in urban area should be classified into two categories e.g. one for the area to be strictly preserved for industrial activity and another for the area to be promoted for conversion into residential area. Such local industries as traditional handicraft industries which are particular to a city and located in the residential area must be protected by designation of areas as industrial conservation while efforts will be made to improve the living environment as a whole.

New industrial area

Taking into consideration the needs for future industrial development, a careful study must be made in such manner as shown in the Fig. L-15.

(4) Recreation and open space

The area coming under the category of recreation and open space will be no less than 5 rai and its area requirement and location are determined by a separate study as stated in 3.3.5. Open space used as buffer shall be laid out systematically between the residential and industrial and commercial land uses for maintenance of urban amenity and prevention of disasters.

(5) Transportation

Land use planning and transportation planning are closely related. Particularly from the functional point of view, the following considerations are required.

- a. Commercial and industrial areas are directly connected with the primary road network.

- b. When a road is estimated to be overloaded by industrial and through traffic, a by pass road should be planned to allow smooth traffic flow and avoid negative impact on residential area.
- c. In the residential area surrounded by the primary roads, the interior area should be planned not to face through traffic.
- d. Commercial area in the central district should have detailed transportation facility plan taking account of estimated traffic of people and cargoes and floor area of the buildings.

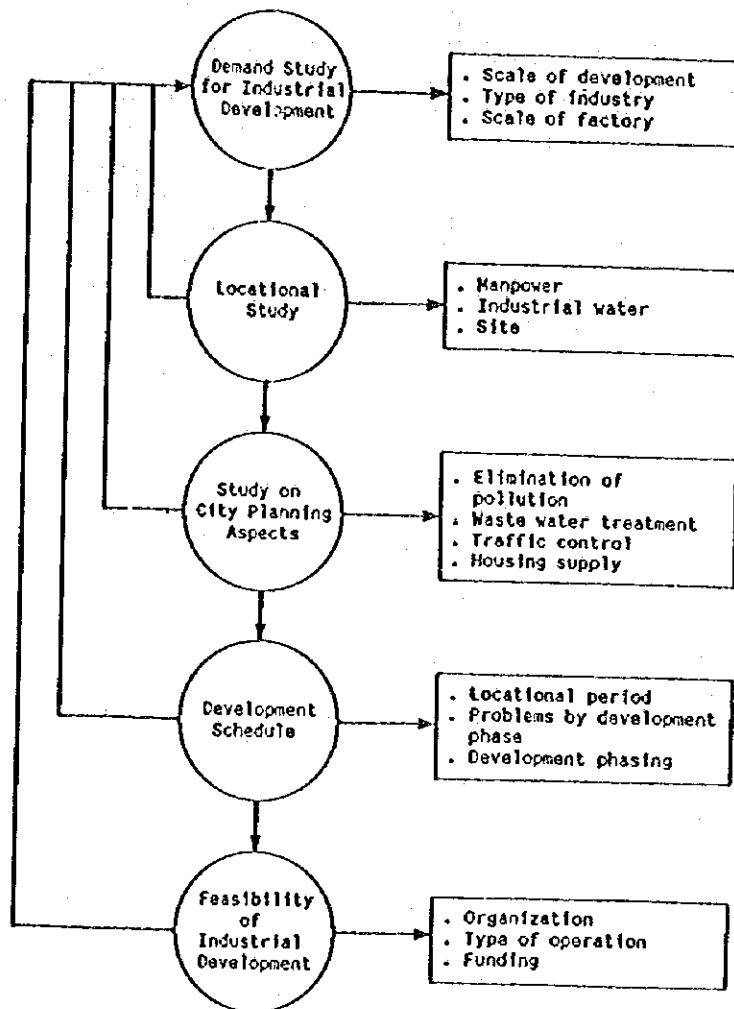


Fig. L-15 Study Flow of Industrial Development

3.4.4 Coordination with the Concerned Agencies

For ensuring successful control and implementation of the land use plan, coordination on policies, plans and projects of the concerned agencies is required at the director level prior to drafting a land use plan. Main agencies concerned with infrastructures and utilities are DOH, PWD, PWWA, PEA, ECAT and those concerned with land use are local authority, MOAC, MOIs, MOC, EB, BOI and DOL. In this stage, a conceptual layout plan prepared in 3.4.3 will be presented together with the list of policies, plans and projects of each agencies.

Second result of coordination at a higher level will be made on the draft land use plan at a later stage.

3.4.5 Compilation of the Draft Land Use Plan

The outputs of the proceeding sections shall be compiled as the draft land use plan which is composed of the following matters.

- a. Purpose of preparation and making of the General Plan
- b. Objectives of General Plan
- c. Physical features of the community
- d. Principles and/or patterns of future land use
- e. Classification of future land use (see Table L-10)
- f. Land use map
- g. Land use regulation

Table L-10 Classification of Land Use Plan in DTCP

Series	Categories	Colour
1.	Preservation Area for Residential Purposes	Diagonal yellow strip
2.	Low Density Residential Area	Yellow
3.	Medium Density Residential Area	Orange
4.	High Density Residential Area	Dark Brown
5.	Commercial and High Density Residential Area	Red
6.	Industrial and Warehouse Area	Purple
7.	Specific Industrial Area	Light Purple
8.	Warehouse Area	Violet
9.	Rural and Agricultural Area	Green
10.	Preservation Area for Rural and Agricultural Purposes	Green strip on white
11.	Agricultural Land Reformed Area	Brown strip on green
12.	Open Space for Recreation and Conservation of Environmental Quality	Light Green
13.	Educational Institution Area	Dark Green
14.	Open Space for Conservation of Environmental Quality and fishery	Light Blue
15.	Conservation of the Thai Identity, Art and Culture Area	Brown
16.	Religious Institution Area	Light Grey
17.	Governmental Institution, Public Utility and Facility Area	Blue

CHAPTER 4
PRESENTATION

CHAPTER 4

PRESENTATION

4.1 Planning Boundary

Topics to be presented to the DTCP Sub-Committee Board, the Provincial General Planning Advisory Board I, and to the public (Public Hearing I) include the following items:

- (1) Existing land use and its patterns, present condition and its problems.
- (2) Physical constraints and trend of urban growth.
- (3) Planning boundary to prevent the future possible problems and to support the expansion of urban growth in the target year.

Presentation Maps and Plan include: Administrative (Tambon) Boundary Map, Existing Land Use Map, Future Direction of Urban Expansion Plan, and Planning Boundary Map for Preparation and Making of General Plan.

4.2 Draft Land Use Plan

Topics to be presented to the DTCP Committee Board, the Planning Coordination Committee, the Provincial General Planning Advisory Board II, the public (Public Hearing II), and to the Board of Town Planning include the following items:

- (1) Planning boundary.
- (2) Objective of General Plan; planned population and population density.
- (3) Physical features of the community; existing land use and its patterns, physical constraints and trend of urban growth, crucial problems of the community, and development projects.
- (4) Purpose of preparation and making the General Plan; Objectives, Policies and Measures.
- (5) Principles or patterns of future land use.
- (6) Classification of future land use.
- (7) Land use regulation.

Presentation Maps and Plans include: Planning Boundary Map, Existing Land Use Map, Future Direction of Urban Expansion Plan, Development Potential of the Area Map, Future Land Use Plan, and Proposed Road Plan.

4.3 Land Use Plan

Topics to be presented to the Local Office and Operation Officer for the exhibitions on seminars of the Enforcement of the General Plan (Ministerial Regulation) include the following items:

- (1) The purpose of the preparation and making of the General Plan.
- (2) The General Plan Boundary.
- (3) The Plan prescribing the use of property as classified.
- (4) The Plan showing communication and transport project.
- (5) The details accompanying the plans.
- (6) The policy, measures and methods of implementation of the General Plan.

Presentation Maps, Plans and Figures include: General Planning Area Map, the Plan prescribing the use of property as classified, the Plan showing communication land transport project. The figure showing the use of land and building in a different ways according to the enforcement of the Ministerial Regulation.

CHAPTER 5

REVISION

CHAPTER 5

REVISION

Enforcement of the General Plan shall be caused by the issuance of the Ministerial Regulation. Within the General Plan boundary, no person shall be permitted to use the land in a different way from that prescribed in the General Plan nor act in contravention of the prescription of such General Plan.

The procedures for the revision of the General Plan every 5 years are as follows:

- (1) Every 6 months, planning officers, officers from the Programming and Evaluation Division, or local officers will collect, compile and evaluate data concerned i.e. Development Policy and Plan in various levels, and urban change and growth etc.
- (2) The meeting of Provincial Planning Advisory Committee I and Public Hearing I may be held to get more data and public opinion when it's time to decide whether the General Plan would be revised or not.
- (3) All the above decisions, information and evaluation may be submitted to the Board of Town Planning for Approval.
- (4) In case of revision of the General Plan, existing conditions of the General Plan area i.e. physical, socio-economic, land use and transportation have to be updated and comparatively analyzed.
- (5) Land use, transportation and communication system and land use regulation are the major items for the revision of General Plan.

Fig. L-16 Revision of General Plan after
5 Year-Term of Enforcement

