CHAPTER 4. PLANNING

4.1 Planning Concept

The drainage improvement plan should integrate not only structural measures but also non-structural measures so as to attain the preferable flood-free environment as well as the effective use of water resources in the entire catchment.

Explanation:

Historically, stormwater was considered as a resource to be quickly disposed. The notion was to remove it from the contributing area as rapidly as possible. More recently, however, stormwater has been looked upon as a resource to be captured and utilized for groundwater recharge, recreation, and other purposes and/or detained as a water quality control or peak-flow reduction measure. The principal mechanism employed is storage. This approach is also consistent with the regulatory policy in Malaysia that requires construction of detention pond for flood control to the land development activities with an area of 10 ha or more.

(1) Basic Considerations in Urban Hydrology and Control Measures

The drainage network is one of the crucial infrastructures in the urban areas to upgrade the living standard of the people. On the contrary, the improvement of drainage system will directly affect the downstream areas as the adverse effects in the following mechanisms.

(a) Before the drainage improvement, stormwater inundates in various places over the catchment.

(b) The drainage improvements facilitates to quick collect and dispose without inundation within a certain level.

(c) From the hydrological viewpoints, urbanization tends to increase a runoff coefficient, while drainage improvement diminishes a flood concentration time. Compounding both effects, flood peak discharge drastically swells.

(d) Further the time required for drainage improvement is usually much shorter than the one for river improvement in the lower reaches, since most part of drainage improvement including trunk and secondary drainage networks can be achieved utilizing the private capital in line with the urban development.

(e) As the results of the above unbalanced process, stormwater will rush into a river channel and serious flood damage will occur in the lower reaches where mostly urban centers are located, if the river channel has not enough flow capacity.

In addition, although the flooding along the drainage channel frequently takes place, the damage is usually not so serious because of short duration and shallow depth of flooding. On the contrary, the damage becomes serious, once the flooding occur along the river course. Thus, the particular attention should be paid to the following conditions, in order to establish the drainage improvement plan properly.

(a) Present conditions, such as land use, channel flow capacities and so on, of both drainage and river systems,

(b) Future land use projection in entire river basin, and

(c) Future possibility/program of river improvement works.

(2) Measures to Preserve Natural Hydrological Functions of Catchment

A river system and its basin originally kept the following hydrological functions creating the harmonious environment. However, human activities, urbanization in particular, may seriously affect the natural hydrological cycle of the basin in both dry and rainy seasons.

Table 4.1 Natural Hydrological Function in River System

Typical Topography	Location	Typical Land Use before Urbanization	Hydrological Function	Hydrological Adverse Effects through Urbanization
hill, tableland and mountain	head-waters	forest, plantation, dry cropland	• groundwater recharge through infiltration • reduction of surface runoff rate through infiltration and prolonging flood concentration on natural surface	• sharpening and enlarging flood hydrograph due to decrease of infiltration rate and shortening of flood concentration • dry-up of small river stream during dry season
valley-bottom plain and back-swamp	middle reaches	swampy area and paddy field	• groundwater recharge through infiltration • flood retarding along	• sharpening and enlarging flood hydrograph due to
delta and coastal plain	lower reaches		river course	decrease of flood retarding • lowering groundwater level

Once these natural functions are destroyed through human activities, restoration works of the functions, for instance groundwater recharge, might be very difficult and costly. In order to avoid these wasteful repetitions, the following policies should be adopted for selection of drainage improvement measures. The following also includes typical measures, for example.

(a) To preserve the original hydrological functions : Designation of natural or river reserves,

(b) To reduce the adverse effects : Construction of detention/retention facilities, and

(c) To enhance the original functions : Construction of retarding basin.

(3) Planning Policy

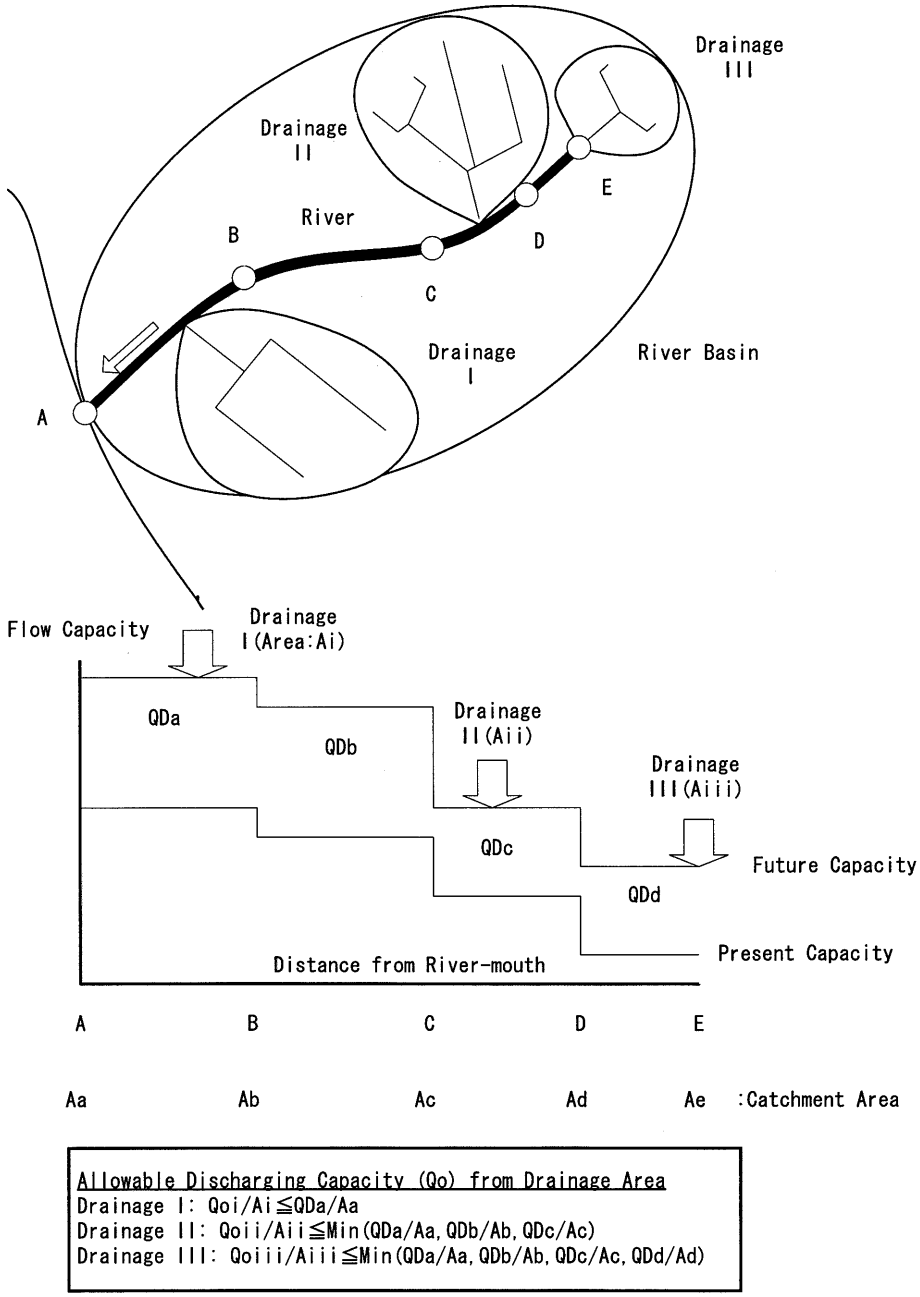
The following points are basic policies indispensable for establishment of comprehensive planning in drainage improvement.

Harmonious Balance of Design Discharges between River and Drainage

Design discharge flowing from drainage area into a river course should be always equal to or smaller than a certain value derived from the design discharge or present flow capacity of the river channel. There might be various methodologies to coordinate discharges

between river and drainage channel. Fig. 4.1 illustrates a concept on a simple solution of establishment of an allowable design discharge out of a drainage basin.

Fig. 4.1 Planning Concept for Allowable Design Discharge out of Drainage Area



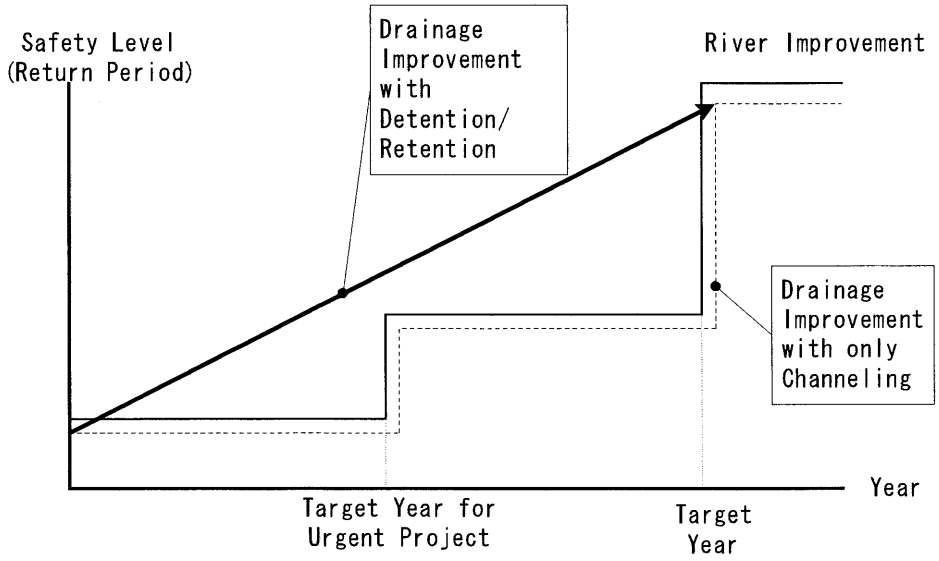
Allowable Discharging Capacity (Qo) from Drainage Area
Drainage I: $Qoi/Ai \leqq QDa/Aa$
Drainage II: $Qoii/Aii \leqq Min(QDa/Aa, QDb/Ab, QDc/Ac)$
Drainage III: $Qoiii/Aiii \leqq Min(QDa/Aa, QDb/Ab, QDc/Ac, QDd/Ad)$

Proper Consideration of Step-wise Implementation*4-1

Sometimes, delay of river improvement or low flow capacity of river channel might be a constraint factor for smooth and early implementation of drainage improvement. This problem might be resolved through a step-wise implementation program with a proper time schedule. Further, detention/retention and retarding facilities are very effective measures under such conditions because of no increment of discharge out of the drainage basin.

Fig. 4.2 explains necessity of adoption of storage strategy for early implementation of drainage improvement. Using detention/retention ponds, drainage system can be upgraded independently of progress of river channel improvement. From the temporal planning viewpoints, the source control or storage strategy has a great advantage compared with quick disposal or conventional channel improvement strategy.

Fig. 4.2 Step-wise Planning and Advantage of Detention/Retention Strategy



Farsighted Selection of Alternative Measures

As explained in the preceding section, a deep insight into mechanism of hydrological change and effects of measures taken is indispensable for selection of alternative measures. The measures should be taken in due consideration of their effects on hydrological cycle as well as their flood control effects.

Proactive Utilization of Planning Results for Administrative Guidance

Generally urban drainage area can be divided into the two parts, existing urbanized area and future-developing area. The following are major work items in each area throughout drainage improvement planning.

(a) Evaluate the existing drainage networks in the urbanized area, and

(b) Establish the future drainage network layout in the future-developing area.

For the future-developing area, the output of planning may be drainage limits and design discharge. A responsible agency should guide the land developers to make a land grading following the drainage limits in principle, and design the drainage network in their developed area within the limits of the design discharge. Thus, the drainage improvement plan should guide the land development activities to the proper way in hydrological aspects.

In Japan, the local government normally provides the drainage network and perimeter map

overlaying on the topographic map with a scale of 1:10,000 to 20,000. Based on the drainage network and perimeter map and design stormwater discharge in the downstream trunk drain, the local government guides land developers to design the appropriate drainage sub-network and necessary flood detention facilities.

4.2 Planning Procedures

4.2.1 Overall Planning Procedures

There are ordinarily two phases of the planning process, reconnaissance and judgement of the project viability. Plan formulation for integrated drainage improvement requires particular attentions to setting of design conditions and selection of alternative measures to fulfil the external conditions.

Explanation:

The following flow diagram illustrates the ordinary procedures and study contents to formulate the integrated drainage improvement plan.

Fig. 4.3 Overall Planning Procedures

Phase 1: Reconnaissance

initial preparation	data/information collection
↓	
preliminary investigations including field reconnaissance	clarification of existing drainage system and land use, identification of problems and possible solutions
↓	

Phase 2: Judgement of Project Viability

setting of design conditions	target year, design scale, land use projection, external conditions (permissible discharge to be accepted to receiving water, if necessary)
↓	
initial drainage system layout	drainage limits, configuration of drainage system, initial computation of draining discharge
↓	
configuration of alternatives	selection and integration of applicable alternatives (to fulfil external conditions)
↓	
comparative study	hydraulic and hydrological analysis, cost-benefit analysis
↓	
selection of optimum plan	plan selection through consideration of minimum cost and intangible effects on social and environmental fields

The following sections will explain the technical matters of the procedures, drainage system layout and configuration of alternatives. Others are described in the previous chapter, Hydraulic and Hydrological Analysis, and in the preceding section, Planning Concept.