CHAPTER VII

ENVIRONMENTAL ASPECTS

VII ENVIRONMENTAL ASPECTS

7.1 General

The environmental studies were carried out focusing on the following items:

- Planning factors for the water resources management,
- Examination of the maintenance flow estimation methods,
- Investigation of the environmental legal system in the Philippines,
- A study for the demand management,
- An environmental study for each dam projects,
- Proposal to make ECO-DAMs, and
- Assessment of environmental impact on water supply projects

7.2 Planning Factors for Water Resources Management

7.2.1 Water Conservation and Wastage Prevention through Demand Management

The realistic water prices, when properly introduced and administered, can help ensure efficient use of water and encourage the effective operation and maintenance. These enable to recover capital investments, generate funds for extension of water supply services to other areas, and protect the environment by reducing the quantity of wastewater. Concerning irrigation water use, pricing for agricultural water also could significantly reduce the wastage of resources.

Likewise, saving of water use will contribute much to alleviate environmental impact due to the water resources development. The conceivable water saving measures are as follows:

- Improvement of the efficiency of piped water conveyance
- Prohibition of the illegal connection
- Recycling use of water
- Use of the lower grade water
- Water saving devices

7.2.2 Groundwater Management

Groundwater management contributes to conserve the environment condition as well. The following measures are conceivable for the groundwater management:

- Control of the groundwater exploitation through drilling and water abstraction permit/license, levy charge, monitoring
- Conjunctive use of surface and groundwater which enables to recover and maintain groundwater table
- Land zoning and land use restriction
- Reforestation

7.3 Examination of the Maintenance Flow Estimation Methods

From the engineering viewpoint, the following two (2) items should be studied to alleviate the adverse effect of the decreased flow after the implementation of the water resources development projects:

- Maintenance flow for the scenic view of flow (SVMF),
- Maintenance flow for ecosystem preservation (EPMF).

7.3.1 Criteria to Judge the Scenic View of Flow (SVMF)

Scenic view of flow (SVMF) is judged with the angle of depression when an observer watches the river downward along the river flow. The angle of depression is less than 5 degree. The value of "W/B" is considered to be an index for scenic view, where "W" is water surface width in meter and "B" is river width in meter. For smaller rivers, the value of "W/B" can be derived from the river cross sectional profile. The relationship between the satisfaction degree of people concerning the flow and "W/B" values is obtained from the psychological experiment performed in Japan. According to the results of the experiment, the dissatisfaction thereon is proved to be negligible if the value of "W/B" is equal or more than 0.2.

7.3.2 Criteria to Judge the Flow for Ecosystem Preservation (EPMF)

In Japan, some fish chosen from 12 species are usually set as the object of study, and scarce species are also included in some cases. Although as a matter of course the fish in the Philippines are different from those in Japan, it is strongly recommended that fish species that can serve as the representative indicator are selected. The criteria to judge the preservation of the 12 fish species are given in Table 7-1.

Table 7-2 shows an example of the EPMF setting on a seasonal basis. This example also considers the 5 sections at reference points along a river. This example explains how to set the criterion values when the very limited and sometimes duplicated information are available with respect to the living conditions of the fish.

7.4 Environmental Legal System in the Philippines

With regard to the environmental legal systems in the Philippines, the following four (4) items were studied:

- Environmental Impact Statement (EIS) System
- Soil Erosion
- Deforestation
- National Integrated Protected Areas System (NIPAS)

7.4.1 Environmental Impact Statement (EIS) System

The Philippines Environmental Impact Statement (EIS) System was established by virtue of Presidential Decree (PD) No.1586, 1979. The EIS system covers projects and undertakings categorized as Environmentally Critical Projects (ECPs) and projects located in Environmentally Critical Areas (ECAs).

The ECP covers the projects that have a high potential for negative environmental impacts. Under the DAO 96-37, the projects and undertakings shown in Table 7-3 are defined as the ECPs. The ECA is an area that is considered ecologically sensitive. The area is subject to ECA if it exhibits any of the characteristics shown in Table 7-4. All projects or undertakings falling within the category of ECP or projects located within the ECAs are required to first secure an Environmental Compliance Certificate (ECC) prior to construction and operation thereof.

7.4.2 Soil Erosion

In the 1993 study of the Bureau of Soils and Water Management, approximately 5.2 million ha or 17.3% of the country was classified as severely eroded, 8.5 million ha or 28.3% as moderately eroded and 8.8 million ha or 29.3% are slightly eroded area as shown in Table 7-5. The total eroded area is 22.5 million ha in total (5.2+8.5+8.8) or 75% of the total land area of the Philippines (30 million ha). The land areas with no apparent erosion cover only 7.1 million ha or 23.7%, while 0.4 million ha or 1.3% are unclassified. Of the severely eroded areas, Mindanao island has the biggest share of 2.4 million ha or 46.1%. In Luzon Island most of eroded areas are categorized into the moderately and slightly eroded areas.

7.4.3 Deforestation

Forests in the Philippines are among the most diverse in the world. However, they are also among the most endangered. The country's forests have been steadily shrinking at an average rate of 2% per annum, resulting in adverse impacts to the environment and shortage in raw materials supply for the wood-based industries. About 27.5 million ha of virgin forests in 1575 have been reduced to 0.8 million ha in 1994.

The management of forest is entrusted to the Forest Management Bureau. Table 7-6 shows the trend of the commercial forests area and the forest type composition. It exhibits the average forest-decreasing rate of 2% between 1990 and 1994. In 1989, the Philippines had 6.3 million ha of natural forest or 21% of the total land area of 30 million hectares. As shown in Table 7-7, only 5.6 million ha or 19% of the total land area remain under forest cover, or it decreased at an annual average rate of 2% after 1989 as shown in Table 7-6.

7.4.4 National Integrated Protected Areas System (NIPAS)

The passage of Republic Act No. 7586 or the National Integrated Protected Areas System (NIPAS) Act of 1992 is an explicit recognition of the need to protect and maintain what remains of the country's biodiversity. It declares to secure the perpetual existence of all native plants and animals through the establishment of a comprehensive system of integrated protected areas within the classification of national park as provided for in the Constitution. The National Integrated Protected Areas System (NIPAS) encompasses outstandingly remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, biogeographic zones and related ecosystems, whether terrestrial, wetland or marine, all of which shall be designated as "protected areas".

In the NIPAS, the following areas are categorized into the protected areas:

i) Strict nature reserve,
ii) Natural park,
iii) Natural monument,
iv) Wildlife sanctuary,
v) Protected landscape and seascape,
vi) Resource reserve,
vii) Natural biotic areas and
viii) Other categories established by law, conventions or international agreements which the Philippine Government is a signatory.

7.5 Study for Demand Management

7.5.1 Meaning of Demand Management

Water conservation through demand management will contribute a lot to alleviate environmental impact due to the water resources development, as mentioned in the foregoing Section 7.2. The conceivable water saving measures are listed as follows:

For municipal and industrial water usage:
- Improvement of the efficiency of piped water conveyance
- Prohibition of illegal connection
- Recycling use of water
- Use of the lower grade water
- Water saving devices

For irrigation water usage:
- Reducing the seepage from the unlined irrigation canals
- Change of the irrigation types, for example, to the micro-irrigation

- Change of the crop types to less water consuming crops
- Appropriate maintenance of the irrigation system

The unit water consumption in the service area of MWSS was 159 lpcd in 1995 and is projected to increase to 258 lpcd in 2025. On the other hand, total unit water consumption was 361 (Lpcd) in 1995 and 368 (Lpcd) in2025, and non-revenue water (NRW) percentage is set to be decreased from 56% in 1995 to 30% in 2025. Accordingly, it is clear that drastic demand management measure should be implemented to attain the reduction of the non-revenue water ratio, and further reduction of this percentage is strongly recommended.

In Metro Cebu, the present water demand of 1.7 m^3/sec has already exceeded the exploitable amount of groundwater in the area and is forecast to sharply increase to 7.8 m^3/sec after 2,000. Although a lot of water supply projects were identified and proposed to meet the future water demand for Metro Cebu, the implementation thereof might be associated with the issue. For instance, the realization of Bohol-Cebu water supply project may lead to the social conflict in relation to water conveyance between the different two islands. Besides, since some of the identified dams are located in the Protected Area of the NIPAS system, these projects may encounter the considerable difficulty in acquiring the approval of PAWB-DENR. It is considered that the installation of desalination plants is one alternative thereto as a last measure.

The demand management measures, especially improvement of the efficiency of piped water conveyance and prohibition of illegal connection, should be implemented for these cities and other major cities in the Philippines.

7.5.2 Vision of Sustainable Water Resources Management

"Pacific institute for studies in development, environment, and security" presents California Water 2020: A Sustainable Vision in 1995. This vision insists that water consumption reduction can be attained with the demand management measures as shown below, in spite of the sharp increase of the population and the agricultural production.

For urban area:
- Replacement of the superannuated infrastructures in the buildings.
- Install the water saving devices of the new standard in the new buildings.
- Use reclaimed water in watering the plants growing in the private houses' garden.
- Growing of the plants that consume less water.

For agriculture:
- Plant the crops of less water consumption.
- More effective irrigation technique.

For industry:
- Reduction of the percentage of the high water consumption industry.

For institutional:

- Set the water price that can facilitate the effective usage of the water.
- Regulation by law, such as usage of the water-saving toilet and shower, and growth of the native plant instead of the turf.

7.6 Environmental Study for Each Dam Site

The environmental study for each of the dam sites proposed and/or identified in this study was conducted based on the "Guideline of the Environmental Impact Study for the Dam Construction Planning, JICA, 2/1990".

The Philippines Environmental Impact Statement (EIS) System says that major dams with storage volumes equal to or exceeding 20 million cubic meters are Environmental Critical Projects (ECPs), and are required to first secure an Environmental Compliance Certificate (ECC) prior to construction and operation. Hence, every dam designated in this project needs to gain a ECC and Environmental Impact Assessment is needed for these projects. Concerning the screening procedure, Environmental Impact Assessment is indispensable and further study is thought to be unnecessary.

Concerning the scoping procedure, the three (3) points shown below were studied for forty-nine (49) dams listed in Table 7-8:

- Water Quality Classification designated by the Philippine government,
- Protected Area under the NIPAS system, and
- Existence of the mining deposit.

Concerning the dams, the natural environment and ecosystem as well as the land use/vegetation and the soil erosion were examined as long as data and information were available. Table 7-8 shows that 63 % of the total number of the dams or 31 dams have some kind of mining deposits in their catchments. It is noticeable on the Agno river. Besides, the 15 dam sites are located in the Protected Area of the NIPAS system including Kanan dam and Mananga II dam, to which a special consideration should be paid.

7.7 Proposal to Make ECO-DAMs

A dam is one of the largest facilities and is usually constructed on a beautiful natural river. Hence, it is undeniable to give various effects on natural ecosystem. From time to time, a strong opposition against dam construction on such rivers took place, especially from the concerned people of natural environmental conservation. Currently in the USA, dam construction is said to be almost completely given up, and removal of some existing dams that lost economical value is said to be started.

The situation in Philippines may be somewhat different from the one in the USA. The Philippines anticipates rapid increase of its population and also improvement of the living standard. These factors usually demand the increase of the water consumption, not only

concerning for the domestic usage but also for the irrigation, industrial and service usage and power generation. If increase of the water resources consumption is really unavoidable, construction of water development facilities, especially dams and reservoirs is also inevitable.

If construction of dams and reservoirs is really inevitable, these facilities should be ECO-DAM, that is the dam with affluent natural ecosystem. Of course it is no way to recover the exterminated species, ECO-DAM cannot become the substitute for them. Conservation of the endangered and threatened species is the prerequisite for any dam construction. With conservation of these endangered and threatened species, ECO-DAM shall contribute for the conservation and promotion of the natural ecosystem and global environment.

Many natural ecosystems have already been destroyed or exterminated on vast Philippines land, ECO-DAM with environmental restoration of these areas may improve the situation of the natural environment significantly.

The basic idea of ECO-DAM is "Wonderland Meshed with Forest and Lake". Promotion of ECO-DAM consists of two (2) basic strategies, that is, developing the whole dam and reservoir region into;

- Bio-Torp, and
- Eco-School

Bio-Torp is defined as "the living space of the society of living creatures". Developing the whole dam and reservoir region into Bio-Torp means practicing various measures to present abundant living sites for the living creatures in the dam and reservoir region. It is instructive to present the space for people to encounter with the natural environment, in order to educate them with the manner to manage the natural ecosystem. Dam and reservoir may become an ECO-School that assumes this function, and people can experience and learn about natural environment. Figure 7-1 shows the image of ECO-DAM and Table 7-9 shows the strategy of ECO-DAM. With these figure and table, the outline of ECO-DAM will be grasped.

7.8 Preliminary Environmental Evaluation for Priority Water Supply Schemes for Major Cities

Concerning the water supply projects for Metro Manila, Metro Cebu and Baguio City, the environmental impacts which may occur due to the implementation of those projects were evaluated from the social and natural aspects. The impact items selected for the evaluation are as follows:

i) Inundation of agricultural land

ii) Resettlement of inhabitant
iii) NIPAS protected area
iv) Mineral deposits or water quality
v) Endangered rare species

The evaluation results of the water supply projects from natural and social environmental aspects are shown in Table 7-17 and summarized below:

Results of Preliminary Evaluation of Water Supply Projects

No.	Major City	Name of Project	Item of Significant Environment Impact which may occur due to the implementation
1.	Metro Manila	Kanan-Umilay Transbasin	B & C
2.	Metro Manila	Massim and Bayabas Dam	B & D
3.	Metro Manila	Kaliwa-Cogeo Water Supply	None
4.	Metro Manila	Pampanga-Novaliches Water Supply	None
5.	Metro Cebu	Malubog-Mananga Transbasin	D
6.	Metro Cebu	Lusaran-Pulanbato Transbasin	D
7.	Metro Cebu	Bohol-Cebu Water Supply	A & B
8.	Baguio City	Laboy Dam	None
9.	Baguio City	Laboy Weir and Ponds	None

Note: Environmental impact items;
A: Inundation of agricultural land
B: Resettlement of inhabitant
C: NIPAS protected area
D: Mineral deposits or water quality
E: Endangered rare species

As for the Metro Manila water supply, the Kanan-Umilay transbasin and Massim & Bayabas Dam Projects are associated with some environmental impacts which need to be clarified in the subsequent study stage. Besides, there is a high possibility that the Tipolo dam included in the Bohol-Cebu water supply project will inundate a large agricultural area as well as the residential area due to the creation of a reservoir.

Table 7-1 CRITERION OF FLOW TO JUDGE THE PRESERVATION OF 12 FISHES

Name of Fishes	Water Depth (cm)				Water Velocity (cm/s)			
	Incubation	Fry	Maturated	Spawn	Incubation	Fry	Maturated	Spawn
Salvelinus leucomaenis f. pluvius	winter-spring	spring-summer	all the year	autumn	winter-spring	spring-summer	all the year	autumn
		--5		4-24			20	--20
Salvelinus leucomaenis	winter-spring	spring-summer	all the year	summer-autumn	winter-spring	spring-summer	all the year	summer-autumn
		--5		4-24			20	--20
Salmo (Parasalmo) masou masou	winter-spring	spring-summer	all the year	summer-autumn	winter-spring	spring-summer	all the year	summer-autumn
				--40				--50,10-35
Salmo (Parasalmo) masou macrosto.	winter-spring	spring-summer	all the year	summer-autumn	winter-spring	spring-summer	all the year	summer-autumn
				10-30				30
Salmo (Oncorhynchus) keta	winter-spring	spring-summer	sea	autumn-winter	winter-spring	spring-summer	sea	autumn-winter
				30	10-14	20		20,0-40
Plecoglossus altivelis altivelis	autumn-winter	spring	summer-autumn	summer-autumn	autumn-winter	spring	summer-autumn	summer-autumn
			20	30-60	3	40-60		30-70,60-120
Leuciscus (Tribolodon) hakonensis	autumn	winter-spring	all the year	spring-summer	autumn	winter-spring	all the year	spring-summer
				20-70				30-70
Zacco platypus	autumn	winter-spring	all the year	summer	autumn	winter-spring	all the year	summer
		--10		5-20,5-10		--10		5-30
Zacco temminckii	autumn	winter-spring	all the year	summer	autumn	winter-spring	all the year	summer
		--10		5-20,5-10		--10		5-30
Cottus pollux	summer	summer-autumn	all th year	winter-spring	summer	summer-autumn	all th year	winter-spring
			20-90	30				10-100
Cottus nozawae	summer	autumn-spring	all th year	summer	summer	autumn-spring	all th year	summer
			20-90	30				10-100
Sicyoplerus japonicus	summer	autumn-spring	all the year	summer	summer	autumn-spring	all the year	summer
				20-100				

Note; spring: March-May, summer: June-August, autumn: September-November, winter: December-February

Table 7-2 AN EXSAMPLE OF EPMF ESTIMATION

(1) Water Depth (cm)

Sections of River	A	B				C				D				E			
Season	-	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter
Fish Species																	
a) *Leuciscus (Tribolodon) hakonensis*		(20)-70	(20)-70	(20)	(20)	(20)-70	(20)-70	(20)	(20)	(20)-70	(20)-70	(20)	(20)				
b) *Zacco platypus*		--10, (5)	5-10,5-20, (5)	-, (5)	--10, (5)	--10, (5)	5-10,5-20, (5)	-, (5)	--10, (5)			Not selected for study					
c) *Placoglossus altivelis altivelis*			Not selected for study			--, (20)	20,30-60, (30)	20,30-60, (30)	--, (20)	--, (20)	20,30-60, (30)	20,30-60, (30)	--, (20)				
d) *Salmo (Parasalmo) masou macrostomus*			Not selected for study				Not selected for study				Not selected for study			(10)	10-30, (10)	10-30, (10)	(10)
Criterion		20	20	20	20	20	30	30	20	20	30	30	20	10	10	10	10
Note		For a) fish, in spring and summer, value for spawn is chosen. The lower one of (20) is set. For a) fish, in autumn and winter, no value is given. Then, value for spring and summer is used for this case. For b) fish, in summer, two values for spawn is given. The lower one is same of (5) for both case, and is chosen. For b) fish, in spring and winter, only upper one for fry is given. Then, value for summer is used for this case. For b) fish, in autumn, no value is given. Then, value for summer is used for this case. Criterion Value Determination Compare the values of fish a) and b) for each season. The bigger (stricter) value is chosen.					For a) and b) fish, it is same with B case. For c) fish, in summer and autumn, two values of 20 for maturated and 30-60 for spawn is given. Select the bigger (stricter) case of 30-60, and the lower one of 30 is chosen. For c) fish, in winter and spring, no value is given. Because fish c) lives all the year, and the value for maturated of 20 is used for this case. Criterion Value Determination Compare the values of fish a), b) and c) for each season. The bigger (stricter) value is chosen.			For a) and c) fish, it is same with C case. Criterion Value Determination Compare the values of fish a) and c) for each season. The bigger (stricter) value is chosen.				For d) fish, in summer and autumn, value for spawn is chosen. The lower one of (10) is set. For d) fish, in winter and spring, no value is given. Then, value for summer and autumn is used for this case. Criterion Value Determination Only the value for d) fish is given, and this is chosen.			

(2) Water Velocity (cm/s)

Sections of River	A	B				C				D				E			
Season	-	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter
Fish Species																	
a) *Leuciscus (Tribolodon) hakonensis*		(30)-70	(30)-70	(30)	(30)	(30)-70	(30)-70	(30)	(30)	(30)-70	(30)-70	(30)	(30)				
b) *Zacco platypus*		--10, (5)	5-30, (5)	(5)	--10, (5)	--10, (5)	(5)-30	(5)	--10, (5)			Not selected for study					
c) *Placoglossus altivelis altivelis*			Not selected for study			(40)-60	30-70,(60)-120	30-70,(60)-120	3, (3)	(40)-60	30-70,(60)-120	30-70,(60)-120	3, (3)				
d) *Salmo (Parasalmo) masou macrostomus*			Not selected for study				Not selected for study				Not selected for study			(30)	--30, (30)	--30, (30)	(30)
Criterion		30	30	30	30	40	60	60	30	40	60	60	30	30	30	30	30
Note		For a) fish, in spring and summer, value for spawn is chosen. The lower one of (30) is set. For a) fish, in autumn and winter, no value is given. Then, value for spring and summer is used for this case. For b) fish, in summer,values for spawn 5-30 is given. The lower one of (5) is chosen. For b) fish, in spring and winter, only upper one for fry is given. Then, value for summer is used for this case. For b) fish, in autumn, no value is given. Then, value for summer is used for this case. Criterion Value Determination Compare the values of fish a) and b) for each season. The bigger (stricter) value is chosen.					For a) and b) fish, it is same with B case. For c) fish, in summer and autumn, two values of 30-70, and 60-120 for spawn is given. Select the bigger (stricter) case of 60-120, and the lower one of 60 is chosen. For c) fish, in spring, value of 40-60 is given for fry. The lower one of (40) is chosen. Criterion Value Determination Compare the values of fish a), b) and c) for each season. The bigger (stricter) value is chosen.			For a) and c) fish, it is same with C case. Criterion Value Determination Compare the values of fish a) and c) for each season. The bigger (stricter) value is chosen.				For d) fish, in summer and autumn, value for spawn is chosen. The value of (30) is set. For d) fish, in winter and spring, no value is given. Then, value for summer and autumn is used for this case. Criterion Value Determination Only the value for d) fish is given, and this is chosen.			

(3) Criterion for Flow (m^3/s) = Water Depth (cm) * Water Velocity (cm/s) * Water Width (m)(=W) / 10,000 = The Value Shown Below * W

Sections of River	A	B				C				D				E			
Season	-	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter	spring	summer	autumn	winter
Criterion		0.06W	0.06W	0.06W	0.06W	0.08W	0.18W	0.18W	0.06W	0.08W	0.18W	0.18W	0.06W	0.03W	0.03W	0.03W	0.03W

Table 7-3 ENVIRONMENTALLY CRITICAL PROJECTS (ECPs)

A. Heavy Industries	1. Non-Ferrous Metal Industries	
	2. Iron and Steel Mills	
	3. Smelting Plants	
	4. Petroleum and Petri-Chemical Indutries, including Oil and Gas	
B. Resource Extractive Indutries	1. Major Mining and Quarrying Projects	
	2. Forestry Projects	# Logging, # Major Wood Processing Projects, # Forest Occupancy (Occupancy of people residing within public forests for livelihood purposes and associated management projects.) # Introduction of Flora & Fauna in Public/Private Forests # Extraction of Mangrove Products, # GrazingProjects
	3. Fishery Projects	# Dikes for/and fishpond development projects
C. Infrastructure Projects	1. Major Dams	This shall refer to all impoudment structures and appurtenances with storage volumes equal to or exceeding 20 million cubic meters.
	2. Major Power Plants	This shall refer to power generating plants utilizing, or are run by, fossil fuels, geothermal resources, the nuclear fission process, natural river discharge, pondage or pump storage. This classification shall include all nuclear power plants, all geo-thermal power plants, thermal power plants with rated capacities equal to or exceeding 10 megawatts and hydroelectric power plants with rated capacities equal to or exceeding 6 megawatts.
	3. Major Reclamation Projects	This shall refer to projects which involve the filling or draining of areas (foreshore, marshes, swanps, lakes, rivers, etc) to or exceeding 1ha.
	4. Major Roads and Bridges	This shall refer to the construction of all natioanl and provincial roads and bridges and any significant extension or improvement thereof which will: a) Traverse any highly developed urban area(s); b) Affect the hydrology of the traversed area(s); and c) Substantially increase or impede traffic flow.
D. Golf Course Projects		

Table 7-4 ENVIRONMENTALLY CRITICAL AREAS (ECAs)

A. All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries.

B. Areas set aside as aesthetic potential tourist spots.

C. Areas which constitute the habitat for any endangered or threatened species of indigenous Philippines wildlife (flora and Fauna).

D. Areas of unique historic archaelogical or scientific interest.

E. Areas which are traditionally occupied by cultural communities or tribes (indigenous cultural communities).

F. Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)

G. Areas with critical slopes.

H. Areas classified as prime agricultural lands.

I. Recharged areas of aquifers --- Recharged areas of aquifers shall refer to sources of water replenishment where rainwater or seepage actually enters the auifers.
Areas under this classification shall be limited to all local or non-national watershed and geothermal reservationas.

J. Water bodies characterized by one or any combination of the following conditios:

1. tapped for domestic purposes
2. within the contorolled and/or protected areas declared by appropriate authrities
3. which support wildlife and fishery activities.

K. Mangrove areas characterized by one or any combination of the following conditions:

1. with primary pristine and dense young growth
2. adjoining mouth of major river systems
3. near or adjoining to traditional productive fry or fishing grounds
4. which act as natural buffers against shore erosion, strong winds and storm floods
5. on which people are dependent for their livelihood

L. Coral reefs characterized by one or any of the combination of the following conditions:

1. with 50% and above live coralline cover
2. spawning and nursery grounds for fish
3. which act as natural breakwater of coastlines

Table 7-5 AREA DISTRIBUTION OF EROSION CLASSES BY ISLAND GROUPING, 1993

(Unit: million hectares)

Island Grouping	Erosion Class										Total	
	No Apparent		Slight		Moderate		Severe		Unclassified			
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Luzon	4.1	57.7	4.1	46.6	4.1	48.2	1.7	32.7	0.2	50	14.2	(47)
Visayas	1.2	16.9	1.7	19.3	1.5	17	1.1	21.2	0.1	25	5.6	(19)
Mindanao	1.8	25.4	3	34.1	2.9	34.1	2.4	46.1	0.1	25	10.2	(34)
Philippines	7.1	23.7	8.8	29.4	8.5	28.3	5.2	17.3	0.4	1.3	30	(100)

Source: Bureau of Soils and Water Management - Department of Agriculture

Note:

No apparent erosion	-	Sedimentation, deposition
Slight erosion	-	Formation of incipient erosion, mainly sheet and rills and tiny incision along trails and creeks (1 rill/100 m.); no gully
Moderate erosion	-	Occurrence of a considerable numbre of well-defined rills and gullies along waterways and slope breaks on cultivated land (1-4 rills/100 m; 24 gullies/100m.);
Severe erosion	-	Dominance of rock outcrops and 80% of parent materials exposed with patches of thin veneer of grass; an intensity of 74 gullies/100 m distance across slope and landslides providing special features around steep slopes
Unclassified erosion	-	Quarry, river wash and open pit mines

Table 7-6 FOREST TYPE, 1990-1994

(Unit: hectares)

Year	Forest Type											
	Total		Dipterocarp		Pine		Submarginal		Mossy		Mangrove	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
1990	6,158,800	100	4,148,800	67.9	236,400	3.7	527,400	8.5	1,113,700	18	132,500	2.1
1991	6,015,400	100	4,029,200	67	235,100	4	519,500	8.6	1,102,400	18.3	129,200	2.1
1992	5,900,200	100	3,936,800	66.7	233,900	4	511,700	8.7	1,091,500	18.5	126,300	2.1
1993	5,787,458	100	3,846,658	66.5	232,700	4	503,900	8.7	1,080,800	18.7	123,400	2.1
1994	5,686,055	100	3,767,555	66.2	231,500	4.1	496,500	8.7	1,070,000	18.8	120,500	2.1

Source: Forest Management Bureau

Table 7-7 DEFORESTATION BY REGION, 1990-1995

(Unit: hectares)

Region	1990						1991						1992					
	Causes						Causes						Causes					
	Kaingin	Illegal Logging	Forest Fire	Others*	Total		Kaingin	Illegal Logging	Forest Fire	Others*	Total		Kaingin	Illegal Logging	Forest Fire	Others*	Total	
	Area	Area	Area	Area	Area	%	Area	Area	Area	Area	Area	%	Area	Area	Area	Area	Area	%
CAR	0	0	2,648.00	51	2,699.00	17.36	0	0	604.93	0	604.93	8.36	0	0	2,429.19	0	2,429.19	4.73
1	29	0	833	489	1,351.00	0.9	44.97	0	398.01	458.4	901.38	12.46	0	0	1,136.11	0	1,136.11	2.21
2	0	0	2,256.00	468	2,724.00	18	0	0	303.45	0	303.45	4.2	0	0	2,886.90	0	2,886.90	5.62
3	0	0	2,792.00	0	2,792.00	18	270	3	2,706.00	0	2,979.95	41.2	0	0	9,937.83	0	9,937.83	19.34
4	0	0	839.99	84	923	6	87	0	1,694.00	0	1,781.00	24.62	34.75	0	368.5	0	368.5	0.79
5	0	0	0	0	0	0	12	26.6	0	0	38.6	0.05	0	0	459.5	0	459.5	0.89
6	89	15	439	1,403.00	1,946.00	13	81.25	0	77.5	72	230.75	3.19	0	0	2,259.36	0	2,259.36	4.4
7	22	0	295	196	513	3.3	5	22	45	0	72	0.09	34.14	0	2,718.10	0	2,718.10	5.36
8	0	0	283	0	283	2	0	0	0	0	0	0	0	0	551.48	0	551.48	1.07
9	82	29	2	0	113	0.07	72.01	0	36.13	0	108.14	2	17	0	975.39	0	975.39	1.93
10	486	45	1,495.00	177	2,193.00	14.1	0	0	0	0	0	0	0	0	11,392.24	0	11,392.24	22.17
11	12	0	0	0	12	0.01	187	20	6	0	213	2	0	0	14,712.17	0	14,712.17	28.62
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,483.61	0	1,483.61	2.87
ARMM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHIL.	720	89	11,872.00	2,868.00	15,549.00	100	759.23	71.6	5,871.02	530.4	7,232.25	100	85.89	0	51,310.38	0	51,398.27	100

(Unit: hectares)

Region	1993						1994						1995					
	Causes						Causes						Causes					
	Kaingin	Illegal Logging	Forest Fire	Others*	Total		Kaingin	Illegal Logging	Forest Fire	Others*	Total		Kaingin	Illegal Logging	Forest Fire	Others*	Total	
	Area	Area	Area	Area	Area	%	Area	Area	Area	Area	Area	%	Area	Area	Area	Area	Area	%
CAR	0.00	0	1,438.92	0	1,438.92	8.06	0	0	205.27	0	205.27	0.2	355	7.86	1,479.07	0	1,841.93	7.64
1	0.00	0	1,032.83	0	1,032.83	6	0	0	1,850.56	720.4	2,570.96	25	24.73	0	1,678.96	720.4	1,703.69	7.07
2	0.00	0	3,682.68	0	3,682.68	20.62	0	0	905.3	0	905.3	9	25.11	0	4,296.65	0	4,321.76	17.93
3	0.00	0	4,842.49	0	4,842.49	27.11	248.7	0	1,809.84	96.85	2,155.39	21	0	0	1,808.94	12	1,820.94	7.56
4	0.00	0	1,946.56	15.1	2,017.41	11.29	90.08	107.16	305	135	637.24	6.2	0.8	1	14.15	2,238.40	2,254.35	9.35
5	0	0.00	374	2,226.79	2,601.04	14.56	5.23	0	108.74	0	113.97	1.1	3.31	0	0	10,993.00	10,996.31	45.62
6	0.00	0	1,124.17	0	1,124.17	6.3	4.5	0.2	0	0	4.7	0.01	0	0	183.54	0	183.54	0.76
7	0	0	166.4	0	166.4	0.09	129.15	0	555.3	0	584.45	7	0	0	432.8	70.55	503.35	2.09
8	0	0	415.41	0	415.41	2.33	11.32	0	99.3	33.91	144.53	1.4	0	0	43	0	43	0.18
9	0	0	15.9	0	50.24	0.03	11.91	0	5	0	16.91	0.01	0	0	204	0	204	0.85
10	0	0	186.13	200	386.13	2.16	11.32	0	1,677.46	0	1,688.78	16.33	0	0	153.54	40	193.54	0.8
11	0	0	63.97	0	63.97	0.04	6.35	0	148	0	154.35	1.5	0	0	36.07	0	36.07	0.15
12	0	0	40.4	0	40.4	0.02	1,010.00	0	50	0	1,060.00	10.25	0	0	0	0	0	0
ARMM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHIL.	0.00	0.00	15,329.86	2,441.89	17,862.09	100	1,528.56	107.36	7,719.77	986.16	10,341.85	100	408.95	8.86	10,330.72	13,353.95	24,102.48	100

Source: Planning and Policy Studies Service, DENR

Table 7-8 LIST OF DAMS

Number	Name of Dams	&: Protected Area #: Mining Deposite	Latitude & Longitude	Region	Province	River	
						River System	Tributary
1-1	Cura		N18-09'10", E120-50'57"	WRR I	Ilocos Norte, Laoag City	Laoag	
1-2	Tina		N18-06'45", E120-50'23"	WRR I	Ilocos Norte, Laoag City	Laoag	
1-3	Gasgas	#	N18-04'55", E120-49'01"	WRR I	Ilocos Norte, Laoag City	Laoag	
2-1	Palsiguan		N17-49'45", E120-43'47"	WRR I	Abra	Tineg	Palsiguan
2-2	Nueva Era	#	-	WRR I	Ilocos Norte	Laoag	
3-1	Binongan	#	N17-45'00", E120-52'00"	WRR I	Abra	Abra	Binongan
3-2	Tineg Weir	#	-	WRR I	Abra	Abra	
4	Supo		N17-12', E120-40'	WRR I	Ilocos Sur/ Abra	Abra	Abra
5	Agbulu	#	N18-03', E121-07'	WRR II	Kalinga-Apayao	Abulug	Apayao
6	Gined	#	N18-05'18", E121-15'36"	WRR II	Kalinga-Apayao	Abulug	Apayao
7	Bantay		N17-54'52", E121-49'39"	WRR II	Cagayan	Cagayan	Paret
8	Chico IV	&, #	N17-23'18", E121-13'37"	WRR II	Kalinga-Apayao	Chico-Cagayan	Chico
9	Abuan	#	N17-05'05", E122-03'03"	WRR II	Kalinga-Apayao	Cagayan	Ilagan
10	Mallig #2	&	-	WRR II	Kalinga-Apayao/Mountain	Cagayan	Mallig
11	Siffu #1	&	-	WRR II	Mountain	Cagayan	Siffu
13	Mateno	&, #	N16-24'40", E121-03'20"	WRR II	Nueva Viscaya	Cagayan/ Magat	Matuno
14	Didu Yon	#	N16-15'57", E121-26'47"	WRR II	Quirino	Cagayan	Didu Yon
15	Maikong Dam	#	N16-37', E120-43'	WRR III	Benguet	Amburayan	Maikong
16	Amburayan Dam	#	N16-36', E120-40'	WRR III	Benguet	Amburayan	Amburayan
17	Boloc Dam II	&, #	N16-34', E120-49'	WRR III	Benguet	Agno	Agno
18	Mount Caas Dam	#	N16-32', E120-47'	WRR III	Benguet	Agno	Agno
21	Tebbo Dam	&, #	N16-15'20", E120-43'	WRR III	Benguet	Agno	Agno
22	San Roque	&, #	N16-07'54", E120-41'00"	WRR III	Pangasinan	Agno	Agno
23	Balog-Balog	#	N15-25'51", E120-21'18"	WRR III	Tarlac	Agno	Tarlac/ Bulsa
25	Abaca	&, #	-	WRR III	Nueva Viscaya	Cagayan	Caseenan-Abaca
26	Conwap	#	-	WRR III	Quirino	Cagayan	Caseenan
28	Umiray	#	-	WRR III	Quezon	Umiray	
29	Bayabas	#	N14-57', E121-07'	WRR III	Bulacan	Pampanga	Bayabas
30	Maasim	#	N15-00'02", E121-02'	WRR III	Bulacan	Pampanga	Maasim
31	Laiban	#	-	WRR III	Rizal/ Quezon	Agos	Kaliwa
32	Kanan	&, #	N14-48'40", E121-30'42"	WRR IV	Quezon	Agos	Kanan
34	Sipocot	&, #	N13-47", E122-57"	WRR V	Camarines Sur	Bicol	Sipcot
35	Talisay	#	N13-13', E123-28'	WRR V	Albay	Bicol	Talisay
36	Panay	&	N11-12'58", E122-27'09"	WRR VI	Capiz	Panay	Panay
37	Bago	&	N10-33'05", E123-09'18"	WRR VI	Negros Occ.	Bago	Bago
38	Ilog No.1	&	N9-52', E122-51'	WRR VI	Negros Occ.	Ilog -Hilabangan	Ilog
40	Maludog	#	-	WRR VII	Cebu	-	-
41	Mananga II	&, #	N10-09'39", E123-47'57"	WRR VII	Cebu	Mananga	Mananga
42	Lusaran	#	-	WRR VII	Cebu	Balamban	Balamban
43	Cebu Fo	#	-	WRR VII	Cebu		
44	Tipolo Dam Project		-	WRR VII	Bohol	Inabanga	Waig
45	Tumaga	&	-	WRR IX	Zamboanga Der Sur	Tumaga	Tumaga
46	Bulanog-Batang		-	WRR X	Bukindon	Cagayan	Cagayan
47	Davao I		N7-35'30", E125-21'00"	WRR XI	Davao der Sur.	Davao	Davao
48	Davao II		-	WRR XI	Davao der Sur.	Davao	Davao
49	Davao IIR		N7-16'30",E125-18'50"	WRR XI	Davao der Sur.	Davao	Suwawan
50	Dimoloc		N6-20'20", E125-24'	WRR XI	Davao der Sur.	Buayan-Malungun	
51	Pulangi III	#	N7-57'00", E125-16'00"	WRR XII	Bukidnon	Pulangi	Pulangi
52	Maganoy Multi		N6-30', E124-30'	WRR XII	Sultan Kudarat	Cabilanan	Cabilanan

Table 7-9 STRATEGY OF ECO-DAM

Basic Idea

ECO-DAM: Wonderland Meshed with Forest and Lake

Basic Strategy 1

BIO-TORP FORMATION

Strategy 1	Action
Environmental Assessment	■Environmental Assessment ■Follow Up Monitoring

Strategy 2	Action
Setting the Route and Site of the Related Facilities	■Related Road ■Production Site of Dam Material ■Filling Site of the Remaining Soil

Maximum possible consideration are taken when the route and the site of the related facilities are set.

Strategy 3	Action
Minimizing the Area of the Environmental Change	■Related Road ■Remaining Soil ■Test Water Storage ■Temporary Road

Employ the plan, structure and method of construction that minimize the change of the living and growing environment of the animals and plants.

Strategy 4	Action
Prompt Recovery of the Temporary Change	■Denuded Land ■Land after the Temporary Facilities Removal

Promote the prompt recovery of the ecosystem when temporary change is incurred.

Strategy 5	Action
Reducing the Adverse Effect When Permanent Environmental Change is Conducted	■Lost of the Living and Germing Site ■Cutting off the Living Site ■Construction Conducted ■Operational Facility ■Catch the Invader

Reduce the each advance effects when permanent environmental change is conducted.

Strategy 6	Action
Formation of New Environment that Presents Living Spaces for Various Living Creatures	■Paradise for Various Living Creatures ■Related Facilities

Form the new environment and device the related facilities that present living spaces for various living creatures.

Strategy 7	Action
Reduce the Soil Erosion and Soil Precipitation Rate in the Reservoir	■Soil Protection and Watershed Management ■Sabo Dam at the Mouth of the Influent River ■Forest Protection ■Reforestation in the Watershed

Reduce the soil erosion in the watershed of the reservoir, and also reduce the soil precipitation rate in the reservoir.

Basic Strategy 2

ECO-SCHOOL EDUCATION

Strategy 1	Action
Experience and Study the Nature System	■Eco Museum ■*Nature Observation Meeting* ■Pamphlet

Furnish the site for visitors to experience and study the nature system.

Strategy 2	Action
Base Site for Eco Tour	■Base Site Facilities ■*Service for the visiting tourist groups*

Base site setting for Eco Tour into the surrounding forests.

Strategy 3	Action
Checkpoit for Forest Entrance	■Eco Museum ■Sightsseing Route ■Reservoir

Dam and reservoir can function as the check point for forest entrance of visitors.

Table 7-10 NAME OF PROJECT AND PURPOSE OF DEVELOPMENT FOR THE ON-GOING/PROMISSING PROJECTS IN THE PHILIPPINES

No	Name of Project	Purpose of Development
1	Tina Casgas Cura Multi-purpose Project (Feasibility Study by Asiatic Consultants, Inc. DPWH-May 1980	Multi-purpose (flood control protection, irrigation and hydropower generation)
2	Pabsiguan-Nueva (Feasibility Report on Ilocos Norte Irrigation Project in the Phil. Phase II by JICA) - Dec 1980	To increase agri. production; to generate hydro-power; to create employment opportunity; to improve the socio-economic conditions.
3	Agbulu Hydroelectric Project (Feasibility Study by COI ENCO Power Consulting Ltd. in association with ELC Electro consult S.P.A. NAPOCOR - July 1992)	Hydropwer Development
4	Genod Hydroelectric Power Project (Basic Design Report on Apayao-Abulog River Hydro-electric Development Project by New Japan Eng'g Consultants, Inc. w/ NAPOCOR)- Aug 1979	Hydropower Development
5	Abuno Hydropower Project (Feasibility Study by Lahmeyer International and Nippon Koei Co. with NAPOCOR) - April 1996	Hydropower Development
6	Magat River Project (Feasibility Report by USAID and NIA) - June 1973	Multi-purpose project with irrigation and power generation as its major functions. Municipal water supply, fish and recreation are secondary functions while flood control is an incidental purpose.
7	Matuno River Development Project (Feasibility Study by JICA and NIA Vol. I- Main Report) Febarary 1981	Multi-purpose (agriculture, hydropower and flood control)
8	Balog-Balog Multi-purpose Project- (Feasibility Study-Main Report- ELC, Holtech & NIA) - July 1980	Development of water resources for sustained year-round irrigation and for power genration; flood control; siltation control; water supply for domestic and industrial consumers and environmental conservation.
9	Casecnan Transbasin Project Phased Scheme (Phase I)- (Feasibility Study-Main Report-NAPOCOR and ELC Electroconsult)- October 1994	To divert the water of Casecnan catchment to the existing Pantabangan Reservoir for energy generation and irrigation purposes.
10	Casecnan Transbasin Project Phased Scheme (Phase II) - (Feasibility Study - Main Report by NAPOCOR and ELC Electro Consult) - October 1994	Expansion of Pantabangan and Masiway plants, rehabiltation of the UPRIS and the development of new irrigation areas.
11	Small Scale Technical Assistance: Water Resources Management (Angat Reservoir) by ADB and NWRB.	Development of a water allocation and compensation scheme which would meet the demand of the sectors drawing water from the Angat Reservoir, particularly in the event of drought in the near future years.
12	Bayabas Damsite (Water Resources Development Project Pre-Feasibility Study for Additional Water Supply to AMRIS by ELC electroconsult, Asiatic Consultant Inc., World Bank, NIA, NWRB).	Provision of additional water source for the Angat Maasim Rivers Irrigation Systems (AMRIS)
13	Maasim Damsite (Water Resources Development Project Pre-Feasibility Study for Additional Water Supply to AMRIS by ELC electroconsult, Asiatic Consultant Inc., World Bank, NIA, NWRB).	Provision of additional water source for the Angat Maasim Rivers Irrigation Systems (AMRIS)
14	Panay River Basin - wide Flood Control Study by JICA and DPWH- November 1985	Ameliorate the flood problems of the Panay River.
15	Mananga II (Cebu Water Supply Project Phase II by Electrowatt Eng'g. Services Ltd. in association with Trans-Asia Consultants Group, Inc. and ADB, LWUA, Metro Cebu Water District) - February 1991	Water source for Metro Cebu Water District (MCWD)
16	Pulangui III Multipurpose Project (Feasibility Study by Engineering and Development Corporation of the Philippines, and MERALCO Ind. Eng'g. Services Corp. with NAPOCOR)- May 1982	Power, irrigation, flood control, fishery development, water-based recreation, pollution abatement and other related purposes.
17	Ilago Hydroelectric Project (Feasibility Study by Shawinigan Eng'g. Company Ltd. and NAPOCOR) - January 1982	Hydro-power development Irrigation- provision of some flow regulation for the downstream NIA diversion at Maao.
18	Umiray-Angat Transbasin Study- (Feasibility Study by Sinotech Eng'g. Consultants, Inc., Wang, Riedel and Assoc., Inc., C. Lotti and Associate SPA, DCCD Eng'g. Corp., ADB and MWSS)- February 1992	Water Supply-diversion of water from the Umiray basin to Angat Reservoir for augmenting the water supply for Metro Manila.

Table 7-11 CONTENTS OF SOCIAL AND ECONOMIC BENEFIT FOR THE ON GOING/PROMISSING PROJECT IN THE PHILIPPINES (1)

No.	Positive Benefit	Negative Benefit
1	Increase in agricultural crop production; growth of medium and small scale industries; power; irrigation; flood control and fishery benefits.	Inundation of unproductive and denuded areas as well as secondary growth vegetation consisting primarily of ipil-ipil, cogon and talahib, negative impact on the ecological system notably on the terrestial and aquatic ecologies.
2	Agricultural benefits; hydropower benefits, contribution to self-sufficiency of staple food, increase in employment opportunity; correction of income inequality; relief in energy; effect to improve transp. network; increase in income during construction period, benefit of inland fishery in the Nueva Era reservoir.	No unfavorable repercussions on the overall environment
3	Improved navigability of the river downstream from the dam economic benefits- which will be generated by environmental programs that would re-establish the earning capacity of the project beneficiaries social benefits- improved living conditions of the people	Resettlement of the local population; inundation as a consequence of water impoundment
4	Power Benefits	Submersion of the upper reaches of Genel Dam site. Resettlement of affected inhabitants.
5	Improved general economic conditions Improved land use	Inundation of farming areas Reduction in aesthetic value of the region.
	Preservation of the natural habitat for the Aetas Increase in job and business opportunities during construction period of the dam . Reduction in illegal logging/fishing operations.	
6	Offers opportunities for increased crop production, power generation, and other secondary functions; promotion of regional and national economic development.	Will cause some adverse environmental impacts (stream and air pollution); Inundation of land (4,460 has.); Relocation of people that would be submerged by the reservoir.
7	Economic development in the region; increased farm income and stabilization of the standard of living for area residents and hydroower and flood control benefits.	No mention
8	Irrigation benefits- enable to cope with irrigation water requirement of the crops. Hydropower benefits - production of energy.	No unfavorable repercussion on the overall environment.
9	Hydropower benefits- additional energy production in the amount of 733 gwh per year Irrigation benefits- development of additional 33,000 hectares.	Resettlement of some 30 families in the Abaca and Conwap reservoir area.
10	20%-30% increase on household income Irrigation benefits - expansion of new irrigation areas up to a maximum of 76,500 has.	Environmental effects
	Hydropower benefits - total additional energy production in the amount of 1020 gwh per year New job opportunities	
11	Economic benefits Additional water supply for irrigation Improved water allocation	No mention
12	Potential for providing additional water supply to the Angat-Maasim Rivers Irrigation System (AMRIS), will give Dona Remedios Trinidad a good chance for rapid development.	Negative effect on the environmental and social conditions- deforestation Export crops produced within the project area are likely to receive negative effects.

Table 7-12 CONTENTS OF SOCIAL AND ECONOMIC BENEFIT FOR THE ON-GOING PROMISSING PROJECT IN THE PHILIPPINES(2)

No.	Positive Benefit	Negative Benefit
13	Potential for providing additional water supply to the Angat-Maasim River Irrigation System (AMRIS)	Inundation of several marble quarries operating within the proposed reservoir; inundation of several houses and a spring which is the source of domestic water for the barangay, inundation of several existing roads; loss of properties.
14	Flood control benefits- alleviate damage from floods of flood prone areas which are centers of agricultural production and economic activities. Power benefits - supplement existing power supply by NAPOCOR which is insufficient.	Relocation of housings for the lower reaches of the Maayon river and the middle reaches of the Mambusao river excluding Mambusao town.
15	Provision of employment during construction and operational phase of the project.	There are families living in the area to be inundated by the reservoir and its immediate buffer area that have to be resttled to suitable locations outside the watershed.
16	Direct economic benefits from power, irrigation, flood control and fishery; pollution abatement; dollar earnings; dollar savings; increase in government revenues; enhances wildlife conservation, recreation and tourism; assure groundwater supply for municipal use.	Resttlement and relocation of affected population within reservoir area; relocation of existing facilities; removal of natural vegetative cover of the reservoir and the area for concrete structures.
17	Irrigation benefits Temporary upsurge of economic activity in the area during construction stage; Associated infrastructure will contribute to the economic well-being of the locality; Improve communications.	Minor resettlement (no more than 5 families; existing dependence of adjacent settlements on the river will be disturbed; massive structurs will replace agricultural areas and the reservoir will flood river banks.
18	Increase in the water supply withdrawals from the Angat reservoir by some 24 m^3/s; Provision of drinking water to an additional population of 2.8 million in the MWSS service area; Increase of flow available in the Angat Reservoir for hydro-electric production in the existing plants; Increase agricultural production.	Reduced flow in the Umiray River during project operation which will affect the navigation by motorized bancas; siltation, erosion and river bed changes due to Umiray Diversion; project settlement at Umiray Diversion site may have significant impact for de-forestation, deterioration of landscape, pollution of the river, spreading of water-borne diseases, disturbance to wildlife.

Table 7-13 LAND USE, POPULATION AND HOUSEHOLD IN DAM/RESERVOIR AREA OF THE PROPOSED PROJECT FOR THE MASTER PLAN

Name of Project Area	Name of Project	Name of Dam/Reservoir/ Weir	Land Use in the Area: Agriculture %	Agriculture km2	Grass with shrub %	Grass with shrub km2	Woodland %	Woodland km2	Bushes/wood %	Bushes/wood km2	Brushwood with Coconut %	Brushwood with Coconut km2	Barren land %	Barren land km2	Others %	Others km2	Total %	Total km2	Name of Province	Name of Municipality	Name of Barangay	No. of Household	No. of Population
	Kanan-Umiray Transbasin Project	Kanan					95%	38							5%	2	100%	40	Quezon	General Nakar	Sablan	109	618
																					San Marcelino	56	241
																					TOTAL	165	859
	Maasin Dam Project	Maasin	72%	6.48	28%	2.52											100%	9	Bulacan	Angat	Bunsuhan	118	530
																					San Lorenzo	14	74
																					TOTAL	132	604
Metro Manila	Bayabas Dam Project	Bayabas	29.32%	1.22			74.68%	3.08									100%	4.8	Bulacan	Dona Remedios	Bayabas	16	82
																					Bakiran-Sampalucan	13	58
																					TOTAL	29	140
	Kalawa Water Conveyance Project	Weir					100%	3.75									100%	3.75	Rizal	Teresa	Mamatid	3	14
																					Sto. Niño	11	53
																					TOTAL	14	67
	Bohol -Cebu Water Supply Project	Tapalo (Inabanga) (Phase II)	83%	12.75	3%	0.45	10%	1.500							2%	0.3	100%	15	Bohol	Danao	Tabok	67	306
																					Sta. Fe	64	370
																					Magtangtang	122	651
																					San Agustin	56	430
																					TOTAL	309	1,757
	Mahiboy - Manalan Transbasin Project	Mahiboy			70%	2.1			29%	0.84	2%	0.06	2%				100%	3	Cebu	Toledo City	Tumlasay	6	30
																					Dapitan	32	122
																					Putingbato	56	303
																					Gen. Climaco	34	197
																					Biga	10	56
																					Loay	6	38
																					TOTAL	146	747
Metro Cebu	Malubog - Manalan Transbasin Project	Manalan II	16%	0.24	19%	0.285			65%	0.975							100%	1.5	Cebu	Talisay	Bonbon Cemo IV	22	105
																						17	86
																					TOTAL	39	191
	Lusaran - Pulantubig Transbasin Project	Pulantubig	2%	0.009									98%	0.441			100%	0.45	Cebu	Cebu City	Pulantubig	41	206
																					TOTAL	41	206
		Lusaran	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	100%	2.50			100%	2.5	Cebu	Compostela	Tag-ube	14	70
																				Cebu City	Lusaran	63	310
																				Balamban	Cansomoroan	7	36
																				Lapu-Lapu City	Canjulatod	2	10
																					TOTAL	86	426
	Labay-Baguio (Large scheme)	Labay Weir			2%	0.0075							98%	0.368			100%	0.375	Benguet	Baguio	Loacan	8	25
																					TOTAL	8	25
	Labay-Baguio (small scheme)	Weir											100%	0.2			100%	0.2	Benguet	Tuba	Tabiak	2	7
Baguio City																					TOTAL	2	7
		(Reservoir I, II & III)			70%	0.7	5%	0.05					25%	0.25			100%	1	Benguet	La Trinidad	Tawang	167	905
																					Lubas	10	52
																					Ambiong	185	941
																					Beckel	39	142
																					TOTAL	401	2,040

Table 7-14 EVALUATION OF SOCIAL AND NATURAL ENVIRONMENT IMPACT OF WATER SUPPLY PROJECT

Major City	Name of Water Supply Project	Type of Development (Name of Dam/Reservoir or Weir)	Social Impact			Natural Impact			
			Agricultural Land to be Inundated	Influence on Indigenous People	Resettlement of Inhabitants	NIPAS Protected Area	Mineral Deposits	Rare or Endangered Species	Water Quality
Metro Manila	Kanan-Umiray Transbasin	Kanan	D	D	B	+	Not Reported	Reported	Expected to be A
	Massim Dam	Massim	B	D	B	-	Producing/Abandoned	---	A
	Bayabas Dam	Bayabas	C	D	C	-	Producing/Abandoned	---	A
	Kaliwa-Cogeo Water Supply	Weir	C	D	D	-	Not Reported	---	---
	Pampanga-Novaliches Water Supply		D	D	D	-	Not Reported	---	---
Metro Cebu	Bohol Cebu Water Supply	Tipolo	A	D	A	-	Not Reported	---	B
	Malubog-Mananga Transbasin	Malubog	D	D	B	-	Producing/Abandoned	---	A
		Mananga II	C	D	C	+	Producing/Abandoned	---	B
	Lusaran-Pulanbato Transbasin	Pulanbato	D	D	C	---	---	---	---
		Lusaran	D	D	C	-	Producing/Abandoned	---	A
Baguio City	Laboy Dam	Laboy Dam	D	C	D	---	---	---	---
	Laboy Weir	Weir	D	C	D	---	---	---	---

Notes

1. The degree of social adverse impact on agricultural land was measured based on the area of agricultural lands to be inundated by the creation of dam/reservoir area as follows:
   - A: Over 10 km^2
   - B: 10 - 5 km^2
   - C: 1 - 5 km^2
   - D: Less than 1 km^2
2. The degree of impact on "indigenous people" and "Resettlement of Inhabitants" was measured based on the number of inhabitants as follows:
   - A: more than 1,000
   - B: 1,000 - 500
   - C: Less than 500 - 100
   - D: Less than 100
3. For NIPAS Protected Area, "+" means the existence of the protected area in the dam/reservoir area, and "-" means the non-existence.
4. For Water Quality, "A" means the Public Water Class II, and "B" means the Recreational Water Class I, in the Classification of Waters table.
5. "---" means that no data and information thereon are available.

CHAPTER VIII

INSTITUTIONAL ASPECTS

VIII INSTITUTIONAL ASPECTS

8.1 General

In order to manage the limited water resources, the Study proposed measures to strengthen the water-related institution as a component of the Master Plan. A lot of studies have been undertaken by the Government of the Philippines so far, to address the various issues on water and the need for more efficient integration and coordination of all water-related activities with a more focussed approach on water resources management. These include the technical assistance study on "Action Plan for Reforms Relating to the National Water Resources Board" prepared for the Government of the Philippines, financed by the Government of Japan with the World Bank as Executing Agency. One of the few recommendations of the study incorporated by the World Bank in its on-going Water Resources Development Project (WRDP) is the institutional action plan which is the Straightening of the NWRB comprising establishment of 3 regional offices, support through incremental staff, training, equipment, strategic studies and local consultancy services.

Another important major study was done by the President task Force on Water Resources Development and Management (PTTFWRDM) created under Executive Order No. 374 to transform the fragmented and conflicting institutional structure into a coherent framework for effective local action on sustainable water management. The output of said study is a Design Report on the Water Resources Authority of the Philippines. This report proposed the establishment of an agency known as the Water Resources Authority of the Philippines (WRAP) responsible for integrated planning and regulation of the water resources sector.

The above studies are fully incorporated in establishing the institutional strengthening plan of the Study which consists of two measures : the tentative measure and the ultimate measure.

8.2 Water Resources Management

Water resources development and management has been one of the most significant political subjects in the Philippines although it is blessed with such annual precipitation depth of more than 2,000 mm. The biased distribution of rainfall in terms of time and place might be attributable to the present water crisis. Accordingly, water resources development and its management have been one of the main tasks for the Government to remedy the effects of the skewed distribution. Various agencies have handled the following development and management works;

- Water resources planning : NEDA, NWRB, LLDA, MWSS, LWUA, DPWH, NIA, DILG and DA
- Water resources assessment : NWRB, MWSS, BRS, PAGASA, LWUA and NPC
- Water quality and sanitation : DOH, EMB, EHS, MWSS and LWUA

- Watershed management : DENR, NIA, BSWM, NPC and WD

Amongst, NWRB, composed of secretaries from six departments as the board member, plays the main role of water resources development and management works. It makes policy and program for the government's water resources development and management, which include water resources allocation. NWRB investigates and evaluates water permit application and duly grants the water right to the applicants. NWRB is in a position to reflect the conditions and constraints of water resources over the national socio-economic policies and strategies which are to be formulated by NEDA.

The assessment of water resources is another assignment of NWRB. Measurement of hydrologic phenomena and the compilation thereof are important works to be carried out by NWRB together with BRS and PAGASA and other water using agencies. NWRB evaluates the collected data to assess the water resources potential.

For various reasons, water resources management in the country has been hampered so far to some extent. The conflicts and problems have emerged among water users. Water quality is deteriorated seriously. To cope with those situations, PTFWRM has been established recently in order to investigate the present impediments. It drafted a bill to create a regulatory body for water resources development and management.

8.3 Legal Arrangement

Laws and codes have backed up the water management activities by the various agencies mentioned above. The legal arrangements on this matter are as follows:

The Philippines Constitution	:	stipulates that all waters belong to the State.
The Water Code of the Philippines	:	define the scope of the rights and obligations of water users and identify the administrative agencies.
The Civil Code of the Philippines	:	the conditions to use public waters.
Public Service Law	:	the establishment of Public Service Commission which duly transferred a part of the function to NWRB.
Local Government Code	:	decentralization of water management.
Executive Order 557	:	authorization of the Rural Water Works Development Corporation. Functions thereof are transferred duly to LWUA.
Republic Act No. 6234	:	creation of MWSS
The provincial Water Utilities Act of 1973	:	authorize to formulate local water districts (WD).

The BOT Law	: almost all development projects may be prosecuted through BOT scheme.

Sometime in August 1997, the Presidential Task Force on Water Resources Management and Development (PTFWRDM) drew up a legislative proposal to create a new body to take charge of the overall management, development and administration of the country's water resources. The measure seeks to create the Water Resources Authority of the Philippines (WRAP) as a new entity to take over the functions, powers and responsibilities of the National Water Resources Board (NWRB). The proposal is a bold attempt to rationalize the organization and functions of government agencies related to water.

The measure had been appropriately filed in the House of Representatives of the Philippine Congress, as House Bill No. 9896. In October 1997, the President of the Philippines certified to the "necessity of the immediate enactment" of the bill "in order to meet the public emergency consisting of the water crisis and ensure the availability of safe potable and affordable water which is indispensable for sustainable economic development."

8.4 Major Institutional Impediment

The country's recent rapid socio-economic development has, on the other hand, incurred some impediments in water resources development and management. The foregoing observations represent institutional impediments in water resources management. Some observation may present problems for which solutions may be evolved in the short run. Others may require remedies that would entail some time, while others may still need a phased timetable.

The following conclusions are drawn from the above observations:

(i) There is a need to strengthen NWRB as an interim measure and make it capable to handle water use regulation and economic pricing regulation.

(ii) There is a need for government to rationalize and define the institutional responsibility for water data collection, water assessment, water resources planning and water use regulation and allocation.

(iii) The institution tasked for water use regulation must have the authority and the enforcement capability to implement its policies, rules and regulations. That agency should be in a position to prosecute violations of the laws and rules for the proper management of water resources.

(iv) There is a need to enact laws and regulations to entice the entry of the private sector (PSP) in water resources development and water distribution.

(v) The government must address the issue of water rights and the corresponding mechanism to assure unhampered use of those rights even in the face of unwarranted political intervention.

(vi) There is a need to amend PD 198 to clarify the ownership of water districts and define

to whom proceeds of privatization shall accrue once a water district is privatized.

(vii) There is a felt need for an apex body to effectively administer the quantitative, qualitative and economic regulation of water resources.

8.5 Proposed Institutional Enhancement Plan

8.5.1 Circumstances for Plan Formulation

The Study clarified the existing institutional situations as discussed in the former sections. There are some aspects to be improved in legal and organizational arrangements, which have been the impediments to the water resources management and development.

In order to enhance such administrative situations, the Study contemplated and proposed a plan to enhance such situation. It was foreseeable that legal and organizational revisions requisit to clear a complicated procedures and take a considerable time period. In this accord the Study proposed an approach with two steps.

The first step is to strengthen the regulatory capability of the existing NWRB through the improvement of the organization, staffing and technical ability thereof. The proposed improvements require least legal revision and are expected to be effective rather easily without spending time for the procedures. This proposal is a tentative measure to enhance the situation immediately.

The second step is to create an independent authority for the national and regional water resources management and development. The proposed authority should occupy the summit of the apex structure of the organization. The Study nominated the new authority as Philippines Water Resources Authority substituting the existing NWRB.

Reconstituting the NWRB into a Philippine Water Resources Authority (PWRA) would raise the status of the regulatory body as the premier organization in water resources management.

The law, which would create the PWRA, should provide the Authority with the same status as NEDA and its Director General should be given a Cabinet rank to raise the level of its leadership. This is necessary in order that the head of the Authority will not be subordinate to the heads of other government agencies who are also stakeholders in the use of water resources.

The Board of Trustees of PWRA shall be composed of the secretaries from DPWH, DILG, DOH, DOJ, DTI and DENR with the Director General of PWRA as ex-officio member. Board meetings shall take up only policy issues and review of policy papers prepared by the staff of PWRA. In case of conflicts arising from the interpretation of existing laws and policies, the Board shall be authorized by law to reconstitute itself as a quasi-judicial body empowered to resolve the conflicts brought before PWRA.

All plans and programs including privatization of water resources development shall be submitted to PWRA for review to ensure that such activities are within the context of the Water Resources Management Master Plan (a primary responsibility of the PWRA). This should be supported by a national policy dictating to all concerned that the seal of approval by PWRA is necessary for all projects involving water resources. The concept can be associated with the ECC required by DENR for all development projects.

The new regulatory body will also take charge of the economic and price regulation as well as quantity and quality regulation of water resources. Service/efficiency regulation will also be a key function of PWRA.

Meanwhile PTFWRM drafted the WRAP Bill and placed it to the House of Representatives of the Philippine Congress. The Bill was appropriately filed as House Bill No. 9896. The proposals in the second step of the Study and the Bill are close each other . The Study judged that almost all of the proposal in the second step could be achieved when the Bill is legislated.

Consequently the Study concluded to propose two steps improvement plan as follows;

1st step: Strengthening of the existing NWRB
2nd step: Early legislation of WRAP Bill and enactment thereof

The proposals of both steps are discussed in detail in the subsequent sections.

8.5.2 Strengthening NWRB to Improve Water Resources Management

A series of major reform activities were proposed to enhance on an interim basis NWRB's capability as a prime regulator in water resources management. Among these, the tentative measures are action steps which can be undertaken without the necessary legislative enactments. These include the following:

- Attach NWRB to the Office of the President and later on to the DENR as an interim measure.
- Replace the member representatives to the NWRB Board (such as MWSS, NIA, LWUA, etc.) who are actually stakeholders in water resources management with other agencies who have no stakes in water resources.
- Strengthen the prosecution arm of NWRB by assigning Department of Justice lawyers to the agency for fixed periods and on rotation basis.
- Establish regional offices to effectively regulate and monitor the water resources activities on site rather from a distant Central Office.

- Approval of plans and programs of water resources agencies before its submission to the Investment Coordinating Committee (ICC) for final approval.

- Policy-making role in water resources management shall be vested in the Board members of NWRB while the regulatory function of the agency should be delegated to the Executive Director and his officers.

- Policy making functions shall cover formulation and approval of guidelines, advisory role related to the day to day activities of the agency, approval of plans and programs of NWRB and the framework for a Water Resources Master Plan. This will require mobilizing in the offices the engineers including those specialized in dam engineering.

- Regulatory functions shall include issuance and enforcement of water rights, water allocation, water utility regulation and granting of Certificates of Public Convenience (CPCs) and other regulatory responsibilities.

8.5.3 Creation of the Water Resources Authority of the Philippines

The Water Resources Authority of the Philippines (WRAP) is a necessary element in the water resources framework. WRAP is analogous to the hub of a wheel which holds all the other parties together all the actions and programs of the multiple parties involved in water resources management. This piece of legislation when implemented will facilitate and precipitate reforms required to integrate planning and regulation of water resources in the Philippines. WRAP will have the following institutional features:

- WRAP will be in the same level of authority of the National Economic Development Authority (NEDA).

- The Director General will have the rank of a Cabinet Secretary.

- WRAP can also create river basin and watershed authorities as needed by the sector.

- WRAP will also have field offices which will implement regulatory policies, issue licenses to parties requiring permits, monitor compliance, accumulate pertinent water data, resolved conflicts and conduct community based consultations in planning and resource allocation.

- A Consultative Council will also be organized at the field level to ensure that the community and other segments of the society are involved in the management of the water resources in the coverage area of the field offices.

- A Water Resources Adjudication Board composed of the Director General

(DG) and two full time independent personalities to be appointed by the DG will be created to exercise quasi-judicial functions in conflict resolution.

- The WRAP organization will have units for Legal Services, Regulatory Services, Information Systems and Finance. The Central Office will have a small core staff and will have higher level salaries to attract the best. Besides, the office of the authority should be mobilized by the engineers who are specialized in dam engineering and other relevant disciplines, in order to undertake or have a strong initiative in the preparation of a Water Resources Master Plan.

- The field offices will carry out the operating functions of WRAP on water resources management in accordance with the guidelines provided by the national office. The field offices shall also be responsible mobilizing community based decisions on planning studies for the development and management of the water resources in their respective communities.

- The legislation creating the WRAP will also contain provisions which will abolish the National Water Resources Board (NWRB).

Inspite of the seemingly "water resources super body" profile of the WRAP, it shall maintain a coordinative relationship with other water resources agencies. Among the key functions that will be shouldered by WRAP and its effects on the agencies affected are shown below:

WRAP Responsibilities Absorbed from Other Offices	Offices Affected	Functions Retained by Other Offices/Affected Agencies
Community Awareness and Information	NWRB	None
Integration and Expansion of Water Data Bank	NWRB	Continued collection of water data by DENR, DPWH, DOH, PAGASA & Other Agencies.
Integrated Water Regulation ▪ Water Permits ▪ Water Allocation ▪ Water Rights Trading ▪ Set Standards for surface, ground and drinking water including sewerage ▪ Water Source Protection	 NWRB NWRB NWRB DENR, DOH	 None None None Control for waste water discharges & drinking water quality DENR: Primary responsible for source protection programs.
License/Register Monopoly ▪ Water, sewerage and irrigation services (public or private)	NWRB LWUA, MWSS LGU, BWSA	None Due diligence on loan repayment; oversight of contract; register/license if private
Economic Regulation ▪ Annual raw water fee ▪ Tariffs for water/sewerage services ▪ Irrigation Fees	 NWRB LWUA, MWSS LGU, DPWH NIA	 None Due diligence on loan repayment, apply principles under oversight Collect approved fees for national systems; apply principles for communal systems
Approve Water Privatization	ICC/NEDA	Only water authority not delegated to WRAP

8.5.4 Establishment of Two Regulatory Bodies (one for economic regulation and another for water resources regulation)

The NEDA Report, rendered by a consulting firm commissioned by the World Bank to evaluate the soundness of a dual regulatory body, concluded that it is essential for a separate entity to undertake the economic regulation of private utilities. Economic regulation was envisioned to be a permanent government activity since the potential for promoting competition in the water sector is even more limited than in such areas as power, telecommunication and transport. Considering that the NEDA Resolution (series of 1994)

advocated the privatization of existing water districts, this government action was timely since there are quite a number of big and medium sized water districts (i.e. Davao, Cagayan de Oro, Metro Cebu, Naga, Metro Ilocos Norte, Bulacan Water Districts and Calamba) which have started to entertain various arrangements for private sector participation in water supply. Depending on how many districts are privatized, economic regulation would, however, emerge as an important regulatory activity.

The report indicated that economic regulation is much different from resource regulation, as the former generally entails financial and business management skills rather than those of resource planning, engineering and enforcement.

On the other hand, the primary function of NWRB is resource regulation and the administration of the Water Code. However, the Code makes no reference to economic regulation and NWRB's role in this regard was acquired through reforms and assumption of functions formerly handled by the defunct Public Service Commission. The current direction of privatization makes planning in the area rather difficult. The present trend of privatization in the water sector suggests that sale of assets (dams, distribution networks, treatment plants and other components) once unlikely is becoming an attractive option to private sector and the water districts as a result of huge capital requirements to sustain developments in the industry. Another mode of privatization which has been palatable to other players in the industry is the provision of exclusive franchises to operate facilities owned by the water districts. There is currently no consensus whether the legal base for such an operation remains with LWUA or NWRB in the context of regulating operations.

Considering the uncertainties faced by the water sector in the event that privatization of the water utilities "catches fire", the NEDA report suggests that a national agency be designated to advise and support water districts and other utilities in negotiating with local and foreign investors. This agency must assume substantial role which will include economic regulation and NWRB having a strengthen mandate for resource regulation.

CHAPTER IX

DATABASE

IX DATABASE

9.1 General

The average annual precipitation in the Philippines is 2,000 mm or more. The country which is blessed with water resources is, on the other hand, devastated from time to time by capricious flooding. On the contrary, the skewed rainfall distribution in terms of time and place is liable to bring drought damages to the country. To cope with the situation, various meteo-hydrologic gauging stations have been established all over the country in order to observe and monitor the situation. All of the water related agencies of the Philippines such as DPWH, NWRB, NIA, NPC and PAGASA have carried out hydrologic studies in addition to the establishment of gauging stations. Most of the studies have planned the countermeasures to these disasters. Some measures such as multipurpose dam scheme and river improvement works are implemented and are in operation.

Meteo-hydrologic data, the results of the previous studies and the inventory of the planned and existing facilities are indispensable for the National Water Resources Management Master Plan Study. Likewise, establishing a system which enables sharing such data jointly among the agencies concerned may contribute much to make the agency's activity effective because such data and information are, so far, obtained mostly by individual agencies and masked unintentionally to other agencies.

9.2 Existing Database

The National Water Resources Board conducted the Philippine Groundwater Summary Project in May, 1989 with financial assistance from the National Statistical Coordination Board. The primary purpose of the project was to consolidate all existing groundwater data and to provide summary of statistics. It also aimed at improving the compilation and reporting of groundwater data.

The Philippine Groundwater Data Bank project, which was financed by UNDP and spearheaded by LWUA, was conducted in 1988. The NWRB, together with other water agencies, participated in this project setting the seat for Central Data Bank in NWRB. The Philippine Groundwater Data Bank (PGDB) inclusive of Geographic Information System has been established to consolidate all well data into one comprehensive national computerized system, followed by systematic mapping of groundwater potential. The PGDB has also designed the adequate standard data entry forms to be used for encoding data.

The water rights database has been designed to consolidate all groundwater permits. The printed output gives a tabular form of all water permit grantees, addresses, permit numbers, location, source of water, amount of water granted, usage and the date of grant.

9.3 New Database System Constructed by the Study

9.3.1 Objective of Database System

The objectives of the database to be established in the Study are set forth below:

(1) To store the meteorological and hydrological data and information in the manner that affords an easy retrieval, and thereby the system supports the efficiency of the Study activity.

(2) To store the water-related inventory with regard to the existing study, plan, design and already implemented facility in the manner that afford an easy retrieval, and thereby the system supports the efficiency of the Study activity.

(3) To distribute complete data and information described above to right place and right person through accessing to the database which is to be managed and maintained by NWRB after completion of the Study.

9.3.2 Overall Design of Database System

In order to store the latest data at any time, the database must have the function of addition and renewal. To afford easy access, it is very important that the database system is able to retrieve visually. Along with this policy, the improvement of the interface for users to avail mapping information was highlighted. The system to be established in this study must be flexible against the future expansion in the volume of data and the technical development in both software and hardware. The adaptability to the existing data and system is required to avail the existing data and system to the maximum extent. Acquired knowledge and technique should be observed and a set-back due to the shift of system should be avoided. The structure of the database system is shown in Figure 9-1.

The overall design of the database system was carried out considering, 1) System, 2) Data volume / Turn around time / Output form, 3) Language, 4) Input devices, 5) Processing, 6) Output, 7) Storage / File structure, 8) Backup, 9) Power. Besides, the design work for each sub-database was done in order of 1) Purpose, 2) Contents of the data, 3) Method of the retrieval, 4) Contents of the indication, 5) Flow of the display, 6) Design of the screen image, 7) Method to add and renew the data.

9.3.3 Selected Hardware and Software

The hardware and software were prepared in line with the design of database system. Prepared computer system is shown in Figure 9-2. In this study, the Operating System (OS) was selected to be Microsoft Windows NT 4.0. There are three reasons for this selection. One of them is that Windows NT 4.0 has the sufficient processing ability. The second reason is the superiority in user's interface. The third reason is the easy management because NWRB has a lot of experience in the operating system. The

Database Management System (DBMS) is indispensable in case of handling the large-scale data and information. Therefore, the advancement of processing speed of the database system was striven by using DBMS. In this project, the DBMS was selected to be Microsoft Access 97. There are two points to be considered in the selection, the efficiency and the compatibility.

9.3.4 Construction of Database System

The database systems have been constructed in line with the design of system. The relationship of the respective sub-system is shown in Figure 9-3. The features of each sub-system are described below:

(1) Rainfall database

Rainfall database has 2 tables for information of gauging station and time series data. It is possible to retrieve the system from retrieval menu or region mapping information.

(2) Surface flow database

This database also consists of two tables. One of them includes such information of stream gauging stations as name, location, region, river basin and so on. The other one is a table of daily time series data. It is possible to retrieve the system from retrieval menu or region mapping information.

(3) Dam inventory database

The data set includes information of location, purpose, hydrology, reservoir, dam structure and others on the reservoir type projects, which were gathered through the Study.

(4) Mapping information

Mapping information system was adopted in order to assist database retrieval visually. The retrieval method of this function is shown in Figure 9-4. The map data have already been generated by NWRB using MicroStation.

9.3.5 Additional Database

In the second stage field investigation, the socio-economic, irrigation and groundwater database sub-systems were newly constructed to expand those constructed in the first stage field investigation. With respect to the database sub-system constructed in the first stage investigation, the additional data on the dam inventory database were stored. Besides, the function of the computer system such as import from file, export to file and drawing graph were significantly enhanced in comparison with that in the first stage field investigation.

In addition, the operation manual for the database was prepared by the Database Expert in order for the NWRB's staff to easily and properly operate and maintain the constructed database system, since the database system and its equipment such as hardware, software and other materials were going to be transferred to NWRB after the completion of this study.

(1) Socio-Economy Database

The socio-economic data is the basis for forecasting municipal and industry water demand and agricultural water demand. Storing these data is very useful in comprehending the grounds for the socio-economic projection and also in updating them in the future when necessary. This database stores the data such as population, employment and GDP of each province, which were collected and/or projected by the Study Team.

(2) Agricultural Data (Irrigation Database)

This database deals with the salient features of National Irrigation System (NIS) and irrigation water requirement data of each province. These data and information have been gathered mainly from NIA and BSWM by the Study Team, and were encoded by NWRB 's staff. A table of 115 schemes of NIS and 90 irrigation projects have been stored in the database for the initial installation. This database consists of three master tables. One of them is the salient features of NIS, and other two are prepared for the irrigation water requirement data. The standard outputs from this database are as follows;

(3) Groundwater Database

This database focuses on deep well and spring water data of Level III system which deal mainly with the municipal and industrial water use. The number of water resources facilities for deep well, spring and surface water in each water district, its quantity of water and population served in the water district are stored in the database.

(4) Probability Calculation Tool

This was developed as a tool to estimate easily the probability of hydrologic events such as rainfall and discharge data. With respect to the methodology of the frequency analysis, Gumbel method and Log Pearson Type III distribution were adopted, since these methods are in general used all over the world. The input data of hydrologic events are encoded directly on the form of this tool, and can also be read from external file such as Microsoft Excel. Besides, this tool can print out the log-normal probability paper with plotting position by Hazen's formula.

9.4 Preparation of Operation Manual for Database

The operation manual was prepared to guide the operation and maintenance of the constructed new database system. The manual is shown in Attachment to Part-K of the Supporting Report. In this manual, retrieval method on how to add/edit data and output samples of each database sub-system is described visually. The beginner will be able to acquire the operation step by step because the method of operation is shown with examples. Besides, it contains useful advice in the operation and maintenance, especially in judging the necessity for taking a backup file of the database system.

9.5 Development Plan of National Water Information Network

The design and establishment of a National Water Information System (NWIN) is one of the sub-components of the water management of World Bank–Water Resources Development Project (WRDP). In the World Bank-WRDP Report dated October 1996, NWIN is a computer-based network system that electronically links the databases of the collection agencies and provides easy access to user agencies. This is envisaged to be done via modems in the medium term under WRDP, in which NWRB will act as the central database to which the various agencies will be linked. The database that will ultimately be linked to NWIN will include, but not be limited to hydrologic, hydrogeologic, meteorologic, physiographic databases including related infrastructures, socio-economic, environmental and library databases. The generating agencies under the medium-term are PAGASA, BRS, EMB, DENR, GMB, LWUA and NIA. These agencies including NEDA as a major user agency will be responsible for maintaining their respective databases which will be in their custody. The NWIN structure would allow each agency to operate the system independently.

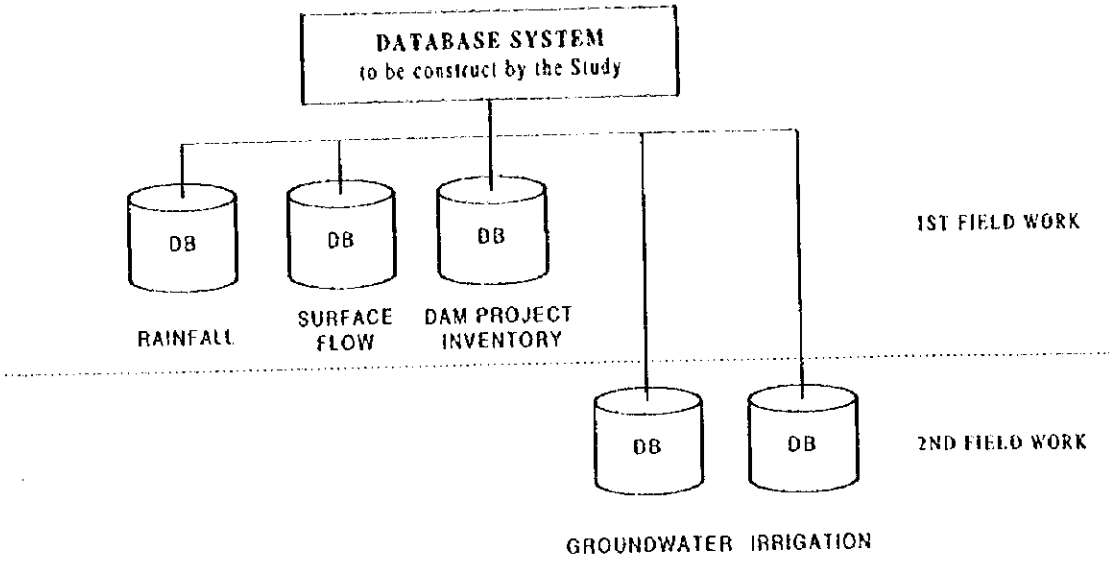

Figure 9-1 STRUCTURE OF THE DATABASE SYSTEM

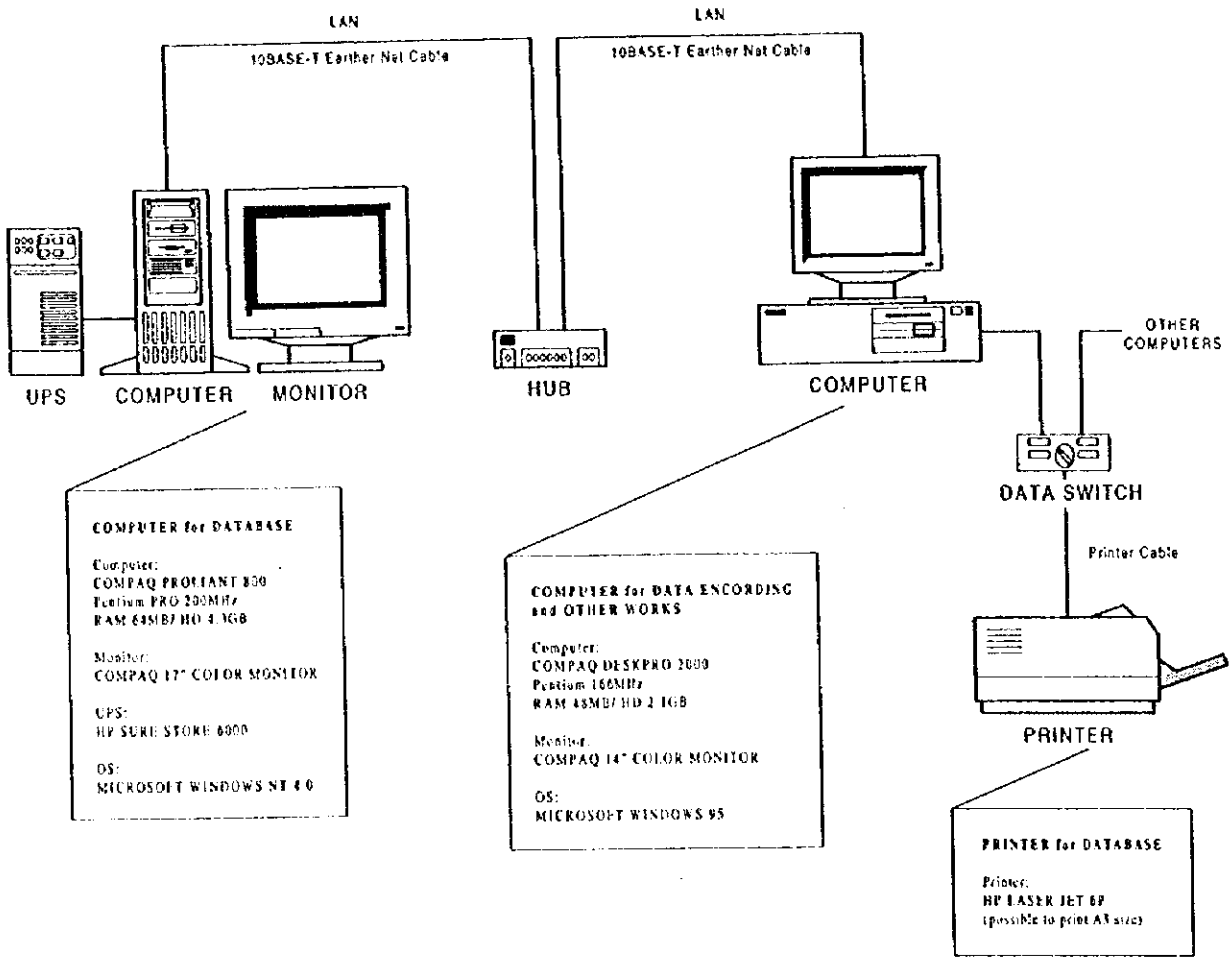

Figure 9-2 COMPUTER SYSTEM PREPARED BY STUDY TEAM

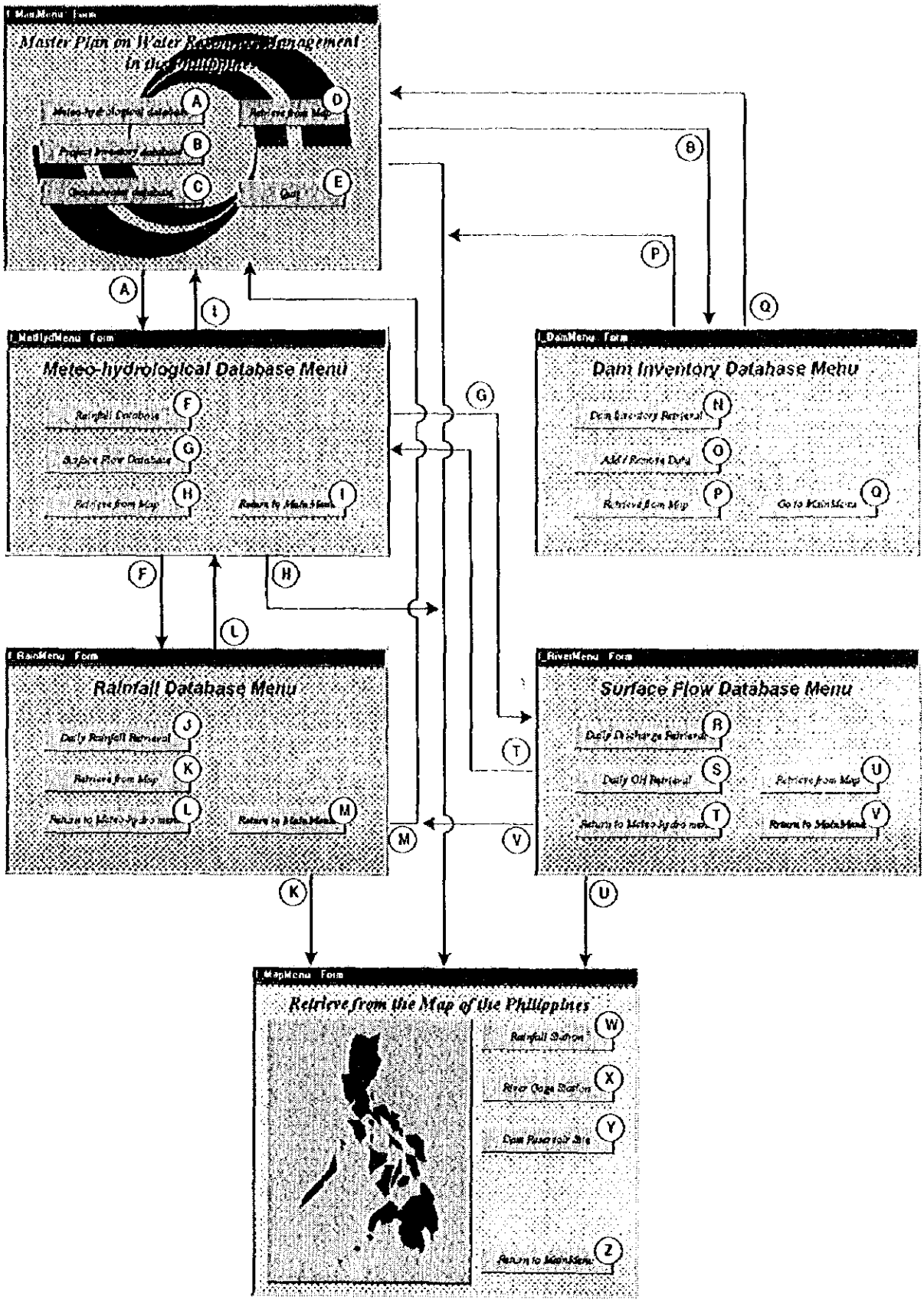

Figure 9-3 RELATIONSHIP BETWEEN EACH DATABASE SYSTEM

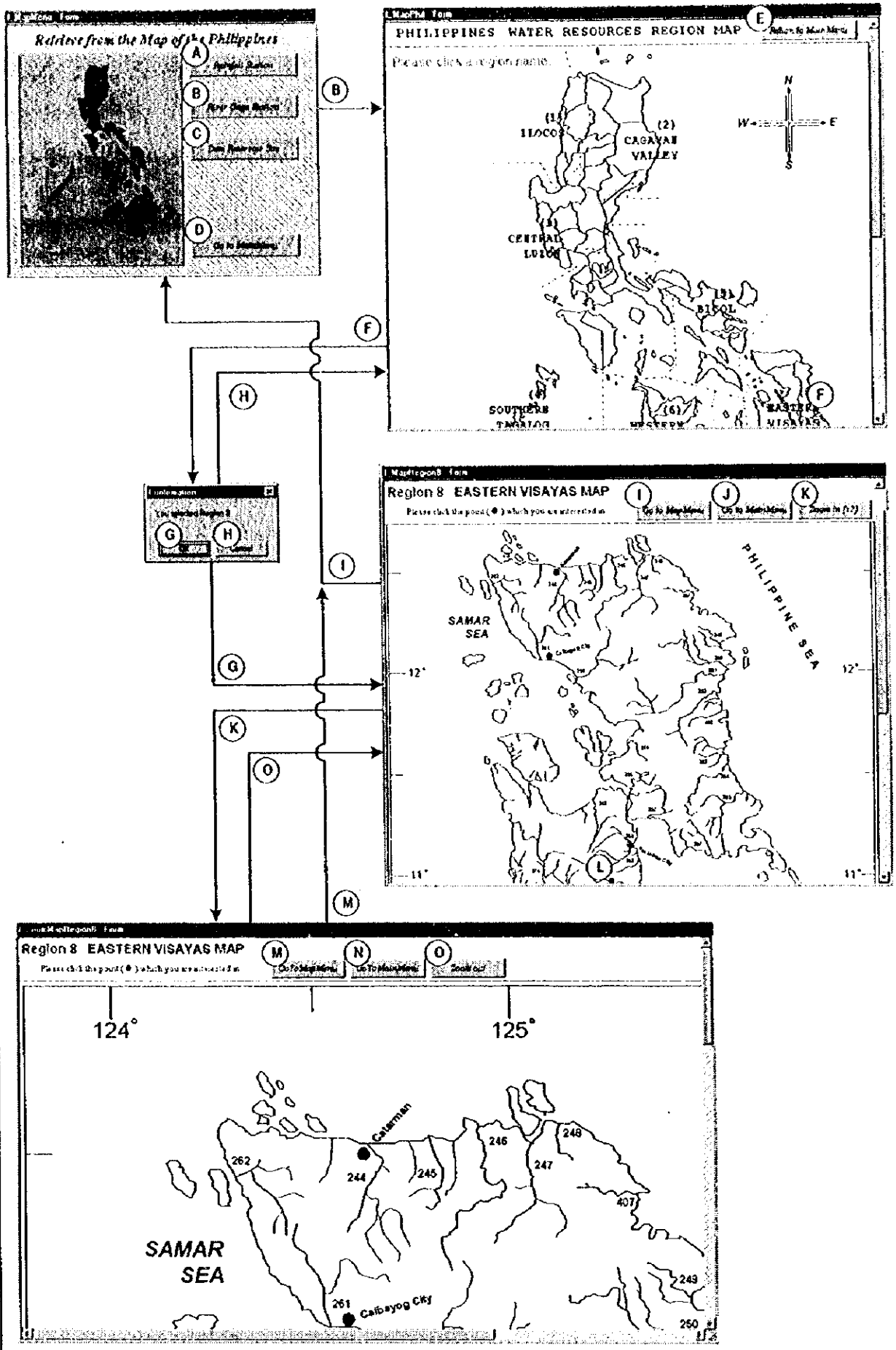

Figure 9-4 FLOW OF MONITOR SCREEN IMAGE ON THE RETRIEVAL USING PHILIPPINES MAP

CHAPTER X

RECOMENDATIONS

X RECOMENDATIONS

a) Promotion of the proposed short term strategies

The Study proposes a number of water resources development projects to cope with the projected serious water shortage in the future. Among those, the water resources development for the water supply to Metro Manila, Metro Cebu and Baguio City is assessed to be the most urgently necessary. The Study examined the soundness of the projects preliminarily, which constitute the framework to meet the future demands. Prior to the implementation of a feasibility study on the promising projects, it is recommended to carry out the regional master plan study for the specific basins where those projects are identified in the Study and previous studies. The master plan study should include various field investigations such as geological investigation works, hydrological investigation and topographic survey as required. The promising projects are expected to be examined at a prefeasibility study level based on the results of the field investigation. The social and environmental impact study on those projects should be performed in depth together with economic, financial and technical feasibility study.

From the viewpoint of sustainable development, it is recommended that the feasibility study on the prioritized water resources development project is to be associated with an adequate watershed management plan for the catchment, which is to be formulated on the basis of the results of the environmental study.

b) Execution of the proposed Interim Measure

The Study proposes the strengthening of the regulatory ability of the existing NWRB as an interim measure for institutional enhancement of water resources management. Legal arrangement requisite to the execution of the proposed interim measure is minimum and most of the revisions proposed may be attained with simple arrangement of by-laws. Meanwhile, the realization of the ultimate measure may take time. In this respect, the early execution of the proposed interim measure is recommended, unless the realization of the ultimate measure is ensured.

c) Improvement of data acquisition system and establishment of NWIN

Data on meteorology, hydrology and hydrogeology are fundamental for water resources management because these data determine the potentials of water resources. The accuracy of the data determines the accuracy of the potential estimation. The Study Team recognizes that there are some data, whose accuracy is doubtful. In addition to the accuracy, the established observatories are not sufficient in quantity and location. The construction of a nation-wide telemetered data acquisition system is recommended, since it affords continuous observation and thereby makes real time data available. It should be noted that the real time data are indispensable to conduct effective water management.

In the country, on the other hand, the streamflow records are being processed by the various agencies concerned such as BRS, NIA, NPC and kept in their independent

databases at present. In this respect, it is recommended to establish an integrated nation-wide database on the water resources by means of introducing a National Water Information Network (NWIN) which was proposed in the WRDP study carried out under the World Bank.

d) Environmental consideration

Since it is forecast that water shortage will become serious in the future, the water resources development through the provision of an impounding dam is imperative to meet the increasing water demand. Further, the construction of waterway structures to convey the water to the demand sites is indispensable. These large-scale construction works would affect the environment to some extent. Measures to alleviate such adverse effects should be considered and proposed in the next stage of the Study. It may be ideal if the provision of water resources facilities could improve the environmental condition, with measures inclusive of so called Eco-Dam. However, the environmental condition has a complicated interaction and it must be noted that a facility which is preferable to one portion of the environment may affect adversely the other portions.

e) Demand management

Economic growth and increase in population thrust up water demand naturally. The grade-up of life style is another reason for the high increase in water demand. Meanwhile, the Study found that present high unit yield of water demand is partly due to poor management of water supply.

The unaccounted-for water is estimated to be 50% on average for municipal water supply. The loss is mainly due to illegal pipe connecting and water tapping and the leakage from water transmission and distribution facilities. Irrigation efficiency is estimated to be very low. The water loss is mainly attributable to low farm efficiency and high conveyance loss. The master plan study assumed that these low efficiencies in municipal and irrigation water supply are to be improved gradually and the rate of loss in the municipal water supply will shrink to 20 to 30% in the year 2025. Another assumption adopted in the Study is the cyclic use of industrial water. In the year 2025, the unit price of piped water may become expensive especially in Metro Manila, Metro Cebu and Baguio City where the costs required for the water resources development is projected to become considerably high. Besides, the Study assumed that 3 times cyclic use of industrial water in some areas will become the common practice in the year 2025. The Study disclosed that a considerable investment in the sector of water resources development is necessary under the condition of the projected socio-economic framework. If the assumptions adopted are not realized, the necessary investment may be far beyond the ones estimated in the Study. The water management through the realization of these assumptions is fundamental to the water management of the country.

The Study clarified that agricultural water demand would occupy about 90 % of the total water demand of the country even in the year 2025. The surplus water which

would be created through thorough water management in the agricultural sector, especially increase of irrigation efficiency, should be allocated to other water use sectors in order to mitigate the water deficit in those sectors in the future. Hence, it is recommended to practice thorough water management to an extent that the surplus water can be allocated to other water use sectors in order to mitigate the water deficit in those sectors in the future. From the aspect of the effective water allocation which become necessary in the future, on the other hand, it is recommended to strengthen the regulatory ability of the existing NWRB as mentioned above.

f) Periodical review of master plan

The Study formulated and proposed water resources development and management plan adopting the water demand corresponding to the projected socio-economic conditions. The projection was made on the basis of the tentative economic development plan of NEDA as of July 1997. NEDA is preparing the formal economic plan which is going to be finalized by the end of March 1998. There may be some differences between the figures of the tentative one and the final one. In addition, the economic condition of a country is liable to change as time goes by. In some cases, the economic activities of a country are affected by global requirement. The Study adopts the NIA's policy to develop the potential irrigation area to the maximum extent until the year 2025 in the high economic scenario. This implies that the Philippine would be able to export a surplus of rice production which exceeds the requirement for the self-sufficiency of the country. However, the tendency of food consumption in Japan shows that the rice consumption of the country decreases as the per capita GDP increases. In order to correspond to the change of the situation, it is recommended to review the master plan periodically.

g) Execution of a master plan study for specific major river basin

It should be noted that the Study aims at the formulation of a nation-wide comprehensive master plan, which could suffice the projected water demands for the whole parts of the country by hurdling the barriers of watersheds, regions and administrations. In addition, the Study principally lines up the water source development projects proposed in the previous studies, including the storage type dam projects, as their main features have remained unchanged. In some cases, the storage type dam projects are planned to be developed for a single-purpose of hydropower. With regard to those hydropower projects, the Study contemplates that the water released from turbines will be utilized for other purposes such as irrigation and municipal water supply. Besides, the Study proposes new storage type schemes identified on topographic maps and examined at a study level of master plan.

As for the storage type dam projects, there may be a need to reformulate the project feature in harmony with the optimum allocation of costs and benefits in the respective water sectors, as unexpected change in water demand and use may take place in the future. Hence, it is recommended to carry out a separate study for the specific river basin in line with the water resources development framework which is specified by this

national water resources management master plan, if the execution of additional and detailed examinations on demand projection, potential assessment and optimization of the projects is judged to be required for the river basin.