- The families living in the reservoir area are limited to road side hamlets, and thus scattered houses together with those along the diversion channel route have a total population of 500 to 550 families.

- Losses of lands through inundation would affect persons who are living in scattered small communes along sections of roads located above the FSL.

- The project would affect existing local access roads, in particular:

  i. Route 345 between An Loc and Ap Tra Tanh linking sections of major rubber plantations, and
  ii. Route 304 between the newly established villages of Ap Tan An (Binh Long district) and Ap Ba Nho and Route 14 (Phuoc Long district) using local boats to cross the Be River.

Conclusion and Recommendations

The Fu Mieng multipurpose project requires a comprehensive EIA, including detail assessment of diverting water to Dau Tieng reservoir. The proposed reservoir and surrounding area warrant particular attention in terms of watershed management and erosion control due to the past history of destruction of vegetation in this area during the 2nd Indochina War. The compensation and resettlement issues, although not extensive, could be complicated because land has been under re-occupation and redevelopment for agriculture in the past 10 to 15 years, so land status and holding entitlements may be uncertain. The project is considered to offer diverse and effective economic returns and to be environmentally and socially acceptable.

9.2.4 Issue Relevant to the Phuoc Hoa Diversion Scheme

According to the optimal water allocation study, it is confirmed that water diversion of an amount of 60 m^3/sec from the Be River to the Dau Tieng reservoir will make it possible to irrigate an area of 88,300 ha extending in the HCMC-Long An delta.

As an alternative to divert water from the Fu Mieng multipurpose reservoir, the Phuoc Hoa irrigation dam with the diversion channel to the Dau Tieng reservoir was considered (refer to Chapter 8).

The superiority between the Fu Mieng diversion and the Phuoc Hoa diversion is compared in the water allocation study discussed in Appendix X, however, the difference in the economic net benefit between the two schemes was marginal, even if Fu Mieng shows more

attractiveness and furthermore costs used for the optimal water allocation study were relied on the rather preliminary ones estimated in Phase II study period.

To clarify and confirm this issue, the economic comparison is made for following three envisaged schemes (refer to Figure 8.2) based on the refined design and estimated cost:

Scheme A : Fu Mieng multipurpose dam and Phuoc Hoa irrigation low weir with a pumping station,

Scheme B : Fu Mieng hydropower (single purpose) and Phuoc Hoa dam (high weir) with a diversion channel, and

Scheme C : Phuoc Hoa dam (high weir) and diversion channel without Fu Mieng.

The present value of economic net benefit and the EIRR for three schemes are calculated, and the results are summarized as follows:

	Present Value, million US$	EIRR, %
Scheme A :	114.5	11.38
Scheme B :	77.7	10.85
Scheme C :	21.1	10.27

From the above, it is confirmed that Scheme A is the best option among the three schemes; that is, Fu Mieng diversion is more attractive than that of Phuoc Hoa diversion. It is noted that project costs and benefits gained from the Phuoc Hoa irrigation project are also counted in the above economic comparison.

9.2.5 Economic Evaluation

The economic evaluation of the Fu Mieng multipurpose project is made based on the total project cost and its power benefit, together with the project costs and benefits gained from an incremental irrigation area of 88,300 ha in Dau Tieng, HCMC-Long An delta.

The cash flow for the analysis is shown in Table 9.6.

As seen from Table, the net benefit at a discount rate of 10 % is US$ 67.8 million and the EIRR is 11.32 %. Thus, it is confirmed that the Fu Mieng multipurpose project is economically viable as the diversion alternative of the Be-Saigon diversion project (the final

selection between Fu Mieng and Phuoc Hoa as the diversion alternatives will be made in future detailed study in future).

In respect of the environmental aspect of the project, it is to be noted that the inundation area of the project is relatively large and may involve complicated compensation and resettlement problems, and therefore the implementation of the project should carefully be judged taking into consideration the large-scale socio-economic benefits contributing to the regional development gained from an incremental irrigation of 88,300 ha against the possible environmental issue.

9.3 Irrigation Master Plan Projects

9.3.1 Selected Irrigation Master Plan Projects

The study of optimal allocation of water available in the Dong Nai River basin selected eight irrigation master plan projects with some variation in development areas from potential areas, besides the Rural Agricultural Development Project (RADP) aiming to rehabilitate and construct small irrigation schemes. The selected master plan projects are categorized into five development packages in view of similarity of individual projects, trans-basin diversions of water resources and regional developments as shown below:

Development Package	Area (ha)	Master Plan Project
1. Rural Agricultural Development Project (RADP)	128,987	1.1 Small Existing Irrigation Schemes (67,745 ha) 1.2 New Small Irrigation Scheme (61,242 ha)
2. Phan Ri-Phan Thiet Irrigation Project	39,700	2.1 Phan Ri Irrigation Scheme (29,700 ha) 2.2 Phan Thiet Irrigation Scheme (10,000 ha)
3. Lower La Nga Plain Irrigation Project	31,620	3.1 Ta Pao Irrigation Scheme (19,000 ha) 3.2 Vo Dat Irrigation Scheme (12,620 ha)
4. Phuoc Hoa Irrigation Project	45,680	Phuoc Hoa Irrigation Project (45,680 ha)
5. Dau Tieng Extension and HCMC-Long An Delta Irrigation Project	125,560	5.1 Dau Tieng Extension Irrigation Scheme (48,390 ha) 5.2 HCMC Irrigation Scheme (46,000 ha) (*1) 5.3 Long An Irrigation Scheme (31,170 ha)
Total		371,547 ha

(*1): including on-going Hoc Mon-Bac Binh Chanh Irrigation Scheme of 12,197 ha

9.3.2 Rural Agricultural Development Project

The Rural Agricultural Development Project (RADP) aims at increasing the farmers' income, enhancing the living standard in the rural area, creating job opportunities and ultimately narrowing down the economic disparity between urban and rural areas. The prime objectives of RADP are to rehabilitate and improve the existing irrigation schemes including exploiting water

resources and to construct new small scale irrigation schemes, which are not covered by the selected eight master plan projects. However, the RADP is not focused only on the irrigation and drainage facilities, but also on the improvement of rural facilities related to the agricultural development. Besides, attention is to be given to upgrading the institutional framework in rural areas including agricultural supporting systems and farmers' cooperatives.

The objective areas of RADP are those of the existing small irrigation schemes and new small scale irrigation schemes scattered throughout the Study Area as listed in Table 9.7 and as shown in Figure 9.4, excluding HCMC and Long An province where large scale master plan projects are contemplated. All the candidate schemes for RADP are preliminarily screened. The preliminary screening of candidate irrigation schemes for RADP is made by excluding those covered by the master plan projects, and results in selecting 118 existing small irrigation schemes with a total area of 50,082 ha and 58 new schemes with 52,294 ha in total. The construction cost of RADP is preliminarily estimated to be US$ 231 million in total, consisting of US$ 58 million for the existing schemes and US$ 173 million for the new schemes.

9.3.3 Phan Ri-Phan Thiet Irrigation Project

The study of optimum water allocation concludes that the Phan Ri-Phan Thiet irrigation project should be developed with an area of 39,700 ha, consisting of 29,700 ha in Phan Ri plain and 10,000 ha in Phan Thiet plain. The proposed Luy reservoir has a function of regulating water released from the Dai Ninh power station as well as the natural flow of the Luy River, while the Ca Giay reservoir having an irrigation capacity of 2,000 ha will be constructed from the year 1996. The general layout of the Phan Ri-Phan Thiet irrigation project is shown in Figure 9.5, and its irrigation system diagram is shown in Figure 9.6. The major features of the project are summarized below:

Description		Unit	Headwork	
			Ca Giay Res.	Luy Res.
Water Source	From own basin	m^3/sec	1.39	5.26
From Dong Nai Basin		m^3/sec	0	24.46
Net Reservoir Storage Volume		million m^3	30	110
Irrigation Area	Phan Ri plain	ha	2,000	27,700
	Phan Thiet plain	ha	0	10,000
Max. Diversion Water Requirement		m^3/sec	2.36	47.20

The proposed Luy dam is located on the main stream of the Luy River, about 1 km downstream of the confluence of its tributary named the Da Ke Trou River and about 24 km north-west of Phan Ri town. The proposed Luy damsite has a relatively flat topography on the about 4 km wide river bed and moderately steep abutments. The geology at the dam site is characterised by

intrusive granite and overlying basaltic rocks, having sufficient bearing strength except for possible leakage from the reservoir through probable unconsolidated river deposits lying beneath the basaltic rocks. Judging from the topographic and geological conditions, a rockfill type dam is recommended by utilizing rock and filter materials widely available in and around the damsite except for core materials.

With the results of topographic survey and geological investigation carried out in the Master Plan Study, a preliminary design of the Luy dam is prepared as shown in Figures 9.7 and 9.8. Its major features are summarized below:

- Type of dam		Center core rockfill
- Full supply level (FSL)	EL. m	129.0
- High water level (HWL)	EL. m	132.0
- Dead water level (DWL)	EL. m	120.0
- Gross storage volume	million m^3	137.0
- Net storage volume	million m^3	110
- Dam Height and crest length		
Main dam	m	33.0 and 1,870
Sub-dam - 1	m	4.0 and 430
Sub-dam - 2	m	5.0 and 580
- Type of spillway		Side overflow
- Design flood discharge	m^3/sec	1,000
- Max. outlet discharge	m^3/sec	48
- Total embankment volume	million m^3	2.8

Two main canals are required; one is the west main canal commanding west half of the project area and also conveying water to the Phan Thiet plain of 10,000 ha area and the other east main canal. The proposed routes of main canals have a relatively flat topography, however it may encounter rock layers at relatively shallower depth in several places according to the field reconnaissance, although further extensive topographical and geological investigations are needed. The major features of main canals are summarized below:

		West Main Canal	East Main Canal
Command Area	ha	21,700	16,000
Length	Km	25.5	8.0
Head discharge	m^3/sec	25.6	18.9
Canal slope		1 : 10,000	1 : 10,000
Canal base width	m	12.0 to 6.0	9.0 to 5.0
Canal height	m	3.5 to 3.3	3.5 to 2.5
Excavation volume	million m^3	1.3	0.4
Embankment volume	million m^3	0.4	0.2

The construction cost of Phan Ri-Phan Thiet irrigation project is updated to be US$ 209.1 million in total including both the Luy and the Ca Giay dams. The Phan Ri-Phan Thiet irrigation project will be implemented on a stagewise development basis. The total construction period is set tentatively at 10 years, assuming the annual development of irrigation area to be about 4,000 ha.

The economic internal rate of return (EIRR) is estimated for two alternative cases either the development combined with the Ca Giay reservoir and its irrigation system or independent from them. The EIRR in the former case is calculated at 12.6%, while the latter is 14.8%. The Phan Ri-Phan Thiet irrigation project is economically feasible even constructing both the dams. Taking into account a possible risk that the commission of Dai Ninh power project would delay beyond the year 2003 anticipated, the development plan of the Ca Giay reservoir irrigation system ahead of the Phan Ri-Phan Thiet irrigation project is justified from an economic point of view.

9.3.4 Lower La Nga Plain Irrigation Project

Against the potential development area of 23,000 ha, the Ta Pao irrigation scheme is to be formulated with an irrigation area of 19,000 ha as the result of the optimum water allocation study. The reduced 4,000 ha is allocated to the flood-prone area of about 4,700 ha estimated by the flood mitigation study, which corresponds to 4,000 ha in net approximately. While, the Vo Dat irrigation scheme is to be formulated with an irrigation area of 12,620 ha for the potential development area of 15,000 ha. The reduced 2,380 ha is allocated to the right bank of the La Nga River with an area of 2,800 ha in net, classified as forest in the land use data. Thus, all the right bank area of the La Nga River is excluded from the irrigation development area. The general layout of both the schemes is shown in Figure 9.9.

Two diversion weirs will be constructed on the main stream of the La Nga River; one is the Ta Pao weir and the other is the Vo Dat weir. Major features of both the diversion weirs are as follows:

Description	Unit	Ta Pao Weir	Vo Dat Weir
Catchment area	Km^2	2,000	3,080
Type of weir		Rockfill	Rockfill
Full supply level	EL. m	125	105
Crest Length	m	120	204
Dam height	m	10	12
Embankment volume	1,000 m^3	100	340
Concrete volume	1,000 m^3	20	32

The construction cost for the 19,000 ha area of the Ta Pao irrigation scheme including the diversion weir is updated at US$ 77.3 million in total. While, the cost of the Vo Dat irrigation schemes with 12,620 ha is updated at US$ 83.2 million in total. The EIRR of both the schemes is assessed at 12.2% and 9.9%, respectively.

9.3.5 Phuoc Hoa Irrigation Project

The study of optimum water allocation selects the Phuoc Hoa irrigation project as one of the master plan projects with an area of 45,680 ha by pump irrigation method without the large Phuoc Hoa dam. The investment cost of the Phuoc Hoa irrigation project is estimated at US$ 220.2 million as described in Section 6.3. The EIRR is estimated at 10.9 % in case of irrigation scheme only, while it would be increased to 17.3% when the benefit of domestic and industrial water supply is added.

Although the Phuoc Hoa irrigation scheme is selected as one of the master plan projects with remaining agricultural development concept unchanged from the planning report made by the Government in the year 1995, the way of agricultural development in the southern area of Song Be province by the Phuoc Hoa irrigation scheme would have to be substantially re-assessed before entering in the implementation in view of the following three aspects:

Socio-economic aspect

- Prospects of future land use in the southern part of the scheme area (southern Ben Cat district, Tan Uyen district and Thuan An district) situated close to the core zone of Southern Focal Economic Area (SFEA); and

- Farmers' willingness to convert the cashew plantation with an area of about 7,200 ha (ages of trees more or less 10 years) into paddy and upland crops fields.

Technical and project economic aspects

- Possibility of groundwater irrigation development for the upland crops and fruits based agriculture in the southern part of the scheme area instead of constructing a long stretched canal from the Phuoc Hoa headwork which requires a large quantity of earthworks (about 15 million cu.m.); and
- Land use for diversified agriculture instead of paddy monoculture being developed in the land along the small streams by exploiting those surface and groundwater resources.

Environmental aspect:

- Natural and social environmental impacts by creating the Phuoc Hoa reservoir, having a large water surface area of about 38 km^2 despite using shallow active storage depth of only 2 m out of about 25 m in the maximum depth of the reservoir.

9.3.6 Dau Tieng Extension and HCMC-Long An Delta Irrigation Project

The Fu Mieng multipurpose project is selected as the most viable water diversion scheme from the Be River to HCMC-Long An delta area through the Dau Tieng reservoir as compared with an alternative diversion from Phuoc Hoa reservoir. This results in optimizing the scale of Dau Tieng Extension and HCMC-Long An delta irrigation project with an area of 113,390 ha in total. The economic viability of the Fu Mieng multipurpose project by both the hydropower and agricultural benefits is verified by the updated construction costs of all the related project facilities as discussed in Section 9.2. It is to be noted here that further studies are required for finally selecting either of Fu Mieng or Phuoc Hoa diversion scheme due to marginal difference in economic viability.

The construction cost of Dau Tieng Extension and HCMC-Long An delta irrigation project is updated at US$ 242.5 million in total and the individual project costs without the Fu Mieng dam are shown below:

Irrigation Scheme	Irri. Are (ha)	Cost (million US$)
Dau Tieng Extension	48,390	74.0
HCMC Delta	46,000 (*1)	93.6 (*2)
Long An Delta	31,200	74.9
Total	113,390	242.5

(*1): including area of Hoc Mon-Bac Binh Chanh irrigation project

(*2): excluding cost of Hoc Mon-Bac Binh Chanh irrigation project

The incremental irrigation area benefited by the Fu Mieng multipurpose project is given as the difference between the condition of future with-project and future without-project, and those of the respective schemes are estimated as follows:

Unit: ha

Scheme	Future With	Future Without	Incre. Area
Dau Tieng Extension	48,390	18,000 (*1)	30,390
HCMC Delta	46,000	12,200 (*2)	33,800
Long An Delta	31,200	0	31,200
Total	125,590	30,200	95,390

(*1): Additional water available in the Saigon River besides irrigating the present 45,000 ha in Dau Tieng Existing area

(*2): Irrigation area of the Hoc Mon-Bac Binh Chanh irrigation project irrigated by the natural flow of the Saigon River.

In evaluating economic viability of the Dau Tieng Extension and HCMC-Long An delta irrigation project owing to the Fu Mieng multipurpose project, the costs of the Fu Mieng dam and the diversion canal have to be shared by the irrigation schemes. As estimated in Section 9.2, the economic cost amounting to US$ 127 million should be allocated to the irrigation project and it is further allocated to the respective schemes depending upon the irrigation area and benefit, i.e. US$ 82 million to Dau Tieng Extension, US$ 24 million to HCMC delta and US$ 21 million to Long An delta. The EIRR is calculated for the individual schemes as well as the overall Dau Tieng Extension and HCMC-Long An delta irrigation project as shown below:

	EIRR (%)
Overall Project	10.5
Dau Tieng Extension irrigation scheme	10.8
HCMC Delta irrigation scheme	8.0
Long An Delta irrigation scheme	8.6

The above values suggest that the Dau Tieng Extension and HCMC-Long An delta irrigation project be economically viable as a whole, although the EIRR is in a marginal level.

9.3.7 Impact of Master Plan Projects

The impact of master plan projects is evaluated by the outputs of the projects in terms of increment of paddy production and increment of cultivating area of cash crops. The increment paddy production is estimated at 1.16 million tons including the Rural Agricultural Development Project. While the increased cultivating area of cash crops in the eight master plan projects would be about 165,000 ha including sugarcane of 19,800 ha and cotton of 13,200 ha as estimated below:

Project	Develop. Area (ha)	Increment Paddy Product. (ton)	Increment of Cultivating Area of Cash Crops			
			Sugarcane (ha)	Cotton (ha)	Other Crops (ha)	Total (ha)
Phuoc Hoa	45,680	99,730	2,110	0	34,810	36,920
Dau Tieng Extension	48,39	54,200	0	0	59,030	59,030
Phan Ri	32,000	152,160	5,850	6,400	10,670	22,920
Phan Thiet	10,000	39,270	1,830	2,000	3,880	7,710
Ta Pao	19,000	92,150	1,980	2,300	3,720	8,000
Vo Dat	12,600	78,200	2,270	2,520	1,930	6,720
HCMC Delta	46,000	165,830	5,620	0	14,840	20,460
Long An Delta	31,200	138,870	140	0	3,160	3,300
RADP	102,680	337,860	-	-		- -
Total	347,550	1,158,270	19,800	13,220	132,040	165,060

By implementing all the master plan projects, the paddy production in the Study Area is expected to increase to about 3 million tons in the year 2015 from the present 1.8 million tons level. This will meet about 50% of the total demand in the Study Area in the year 2015, assuming the population increase by 7.3 million and anticipated per capita consumption of 285 kg/year. The irrigation development to the full extent under the optimum utilization of water resources in the Dong Nai and surrounding basins would contribute to the stable food supply in the Study Area

While, the cultivating area of cash crops is expected to increase remarkably. In particular, cultivation area of sugarcane in the eight master plan project areas will share one-third of target increasing area of about 60,000 ha in the Study Area, and those of cotton share the half of the target 25,000 ha as well.

9.3.8 Initial Environmental Examination

(1) General Environmental Issues

The irrigation developments associate typically with such social effects as compensation to the land acquisition for project facilities, disruption to local communities and agricultural activities during construction. In general, the farming communities involved agree with implementation of irrigation schemes, provided adequate compensation and relocation of lands are satisfactory. Such problems are serious in particular schemes near major urban areas such as Phuoc Hoa and HCMC delta where landholdings are small and complete displacement of landholders may take place.

The RADP as well as large scale irrigation projects proposed in the Master Plan have several common environmental and social effects requiring mitigation measures of them. These will include:

a) Alteration to water quality in streams within irrigation areas and downstream receiving water due to use of fertilizers and pesticides as well as leaching of soils, i.e. acid sulphate soils in Mekong delta and other near coastal irrigation areas;

b) Possible effects on traditional use of local water resources due to changes in local surface and groundwater hydrology and quality;

c) Effects on local farming including crop losses during construction and initial development periods;

d) Need for providing local farmers with adequate agricultural supporting services which are enable them to readily capitalize on irrigation development benefits available;

e) Need for public-relations education and involvement of project beneficiaries into water resource allocation and project management through water user associations and so on;

f) Need for integration of effective soil erosion and watershed management programmes associated with introducing compatible resource development such as fish ponds and community agro-forestry components into individual schemes to maximize utilization of water resources as well as to protect inhabitants; and

g) Possible effects on medico-ecological and public health aspects, particularly water-related diseases like malaria.

(2) Key Issues Relating to Master Plan Projects

Rural Agricultural Development Project

The rehabilitation and improvements to numerous small, medium and large scale irrigation projects scattered throughout the Study Area are considered to be environmentally and socially acceptable. The general effects outlined above will be applied to EIA, and particular attention should be given to the local effects on water quality, water availability for domestic use, upgrading the accessibility of communities to extension and credits services, the setting-up of water user associations and the monitoring of environmental and social effects of project implementation.

Phan Ri-Phan Thiet Irrigation Project

The potential environmental and social impacts by the Phan Ri-Phan Thiet irrigation project are considered to be complex, particularily in connection with the Luy reservoir. Thus, EIA is definitely required paying attention to:

a) changes in hydrological situation including flood in the Luy River basin due to water released from the Dai Ninh power station and creation of the Luy reservoir;

b) possible environmental degradation in the middle and lower reaches of the Luy River when water from Dai Ninh is un-regulated particularly in the initial development period, i.e. flood damage, erosion and sedimentation due to increased river discharge;

c) effect on ethnic communities by construction of the Luy reservoir;

d) impacts on local communities and on environmental factors such as encroachment into forests by providing access to the Dai Ninh power station located in upper end of the Luy River basin;

e) possible downstream flood control requirements in the coastal plain areas in terms of associated changes in regime and sedimentation induced by irrigation development; and

f) potential ecological effects on estuary zones by seasonal changes in regime and water quality as well as potential inflows and build-up of agro-chemical residues.

Lower La Nga Plain Irrigation Project

The following particular issues should be taken into consideration in carrying out the EIA for both the Ta Pao and Vo Dat irrigation schemes:

a) need to maintain the seasonal flood regime in the Lac Bien catchment in order to preserve its wetland ecology values for the Lac Bien/ Nui Ong National Park; and

b) Effect on ethnic minority groups who are traditional residents or who have been transmigrated to the irrigation scheme or surrounding areas;

Phuoc Hoa Irrigation Scheme

Construction of the upstream Fu Mieng reservoir would permit the Phuoc Hoa irrigation by constructing a small weir and a pumping station. The critical issues to be resolved in respect of the project implementation and management relate to the following:

a) probable effect of HCMC/Bien Hoa industrial development on the irrigated agricultural land in such a way as official or unofficial conversion to other uses and land holdings by absentee landholders caused by land speculation; and

b) acceleration of water pollution problems already exiting in the main streams and rivers.

Dau Tieng Extension and HCMC-Long An Delta Irrigation Project

For Dau Tieng Extension irrigation project, the environmental and social effects associated with expansion of the Dau Tieng Extension and Tay Ninh irrigation schemes would be as outlined in general environmental issues. Specifically, an appropriate water quality monitoring programme should be included in project budgeting and implementation plans.

For HCMC-Long An delta irrigation project, the major issues are land compensation and water quality. In particular, the following considerations will be needed in connection with water quality problem:

a) long term effects on water and soil quality relating to acid sulphate soil areas such as increased surface water acidity during construction of canals, localized acidity due to leaching during irrigation, effects on surface and groundwater and build-up of soil acidity without effective soil management techniques like raised beds;

b) downstream ecological effects in the estuary zones due to changes in regime and water quality; and

c) needs for a managed environmental monitoring and remedial action plan for the construction phase, particularly needs for water for flushing and dilution during canal excavation and land reclamation activities.

9.4 Water Supply Project along National Highway No. 51

9.4.1 Strategies for Water Source Development

Water demand centres of the water supply project along National Highway No. 51 are divided into five based on the industrial development plan. Following show the five demand centres (refer to Figure 9.10) with their water demands in the year 2000 and 2015 respectively (refer to Sub-section 6.4.1):

Name of demand centre	Industrial areas included in the demand centre	Water demand in the centre, m^3/day	
		2000	2015
1. Bien Hoa	Bien Hoa and Ho Nai	158,000	354,000
2. Tam Phuoc	Tam Phuoc and An Phuoc	21,000	244,000
3. Nhon Trach	Nhon Trach and Long Thanh	59,000	384,000
4. Phu My	Go Dau, Phu My and Thi Vai	84,000	331,000
5. Vung Tau	Ba Ria, Vung Tau and nearby towns	102,000	412,000
	Total	424,000	1,725,000

The first task to prepare a concrete development plan for the project is to list up development alternatives made by combining several water sources available in the vicinities so as to meet the water demands of each centre for the time horizon up to the year 2015. The second task is to select the optimal alternative from among the development alternatives as the development plan of the water supply project along National Highway No. 51. Following discuss the water sources available for the project as well as the selection of the development plan from among the alternatives conceived.

9.4.2 Water Sources

(1) Groundwater

Development potential of groundwater in the area, which is considered as a measure to meet immediate demand or a "make-up" measure, is estimated by demand centre as follows:

Name of demand centre	Development potential of groundwater, m^3/day
1. Bien Hoa	-
2. Tam Phuoc	25,000 to 35,000
3. Nhon Trach	55,000
4. Phu My	25,000
5. Vung Tau	35,000 (including 20,000 m^3/day already exploited)

(2) Reservoir projects

There are several rivers with a catchment area of tens to hundreds km^2 in the project area such as the La Buong, Ca, Phuoc Thai, Da Den and Ray rivers as shown in Figure 9.11. For each of those rivers, reservoir projects are proposed for irrigation and water supply as summarized in Table 9.8, and their location is referred to Figure 9.11.

La Buong reservoir

La Buong reservoir, the development stage of which is under the master plan level, to be built in the La Buong River will be used as a water source of the Tam Phuoc demand centre. The development capacity of the La Buong reservoir for water supply is estimated at 220,000 m^3/day by setting the proposed Full Supply Level (FSL) of El. 50.0 m and Minimum Operation Level (MOL) of El. 48.0 m. A preliminary geological study for the proposed dam suggests insufficient bearing strength and high permeability from the foundation, thus recommending the construction of earthfill type dam. A preliminary development plan of the La Buong reservoir is given in Figure 9.12.

Song Ca-1 and Song Ca-2 reservoirs

Two reservoirs, Song Ca-1 and Song Ca-2, both of which are under the master plan level, to be built in the Ca River will supply water to the domestic and industrial use of Nhon Trach demand centre. The joint operation of both reservoirs makes it possible to develop an amount of 270,000 m^3/day. For this estimate, FSL and MOL for Song Ca-1 are set at El. 80.0 m and El. 61.0 m respectively, whilst El. 60.0 m and El. 52.0 m for FSL and MOL of Song Ca-2 respectively. A preliminary geological study points out the problem that there is a high possibility of leakage from the reservoir through the basaltic rocks with horizontally continuous open cracks and underlying old river deposit consisting of unconsolidated permeable sand and gravel. Judging from the topographic and geological condition at the site, an earthfill type dam is recommended. Figure 9.13 depicts a preliminary development plan of Song Ca-1 and Song Ca-2 reservoirs.

Phuoc Thai reservoir

Phuoc Thai reservoir, the development stage of which is under the master plan level, is proposed to be built with a catchment area of 90 km^2 in the Phuoc Thai River. Due to the small catchment, development capacity of water to be conveyed to Phu My demand centre is limited to an amount of 120,000 m^3/day. For the simulation, FSL and MOL of the Phuoc Thai reservoir are set at El. 20.0 m and El. 16.0 m respectively. A preliminary geological study discusses that the riverbed at the damsite is covered with alluvial deposits of mainly sand with layers of clay or gravel, suggesting possibilities of leakage from the reservoir. This situation

would only allow the construction of earthfill type dam at the proposed damsite. A preliminary development plan of the Phuoc Thai reservoir is shown in Figure 9.14.

Da Den reservoir

The feasibility study of the Da Den reservoir was carried out by a local company, proposing a development of 100,000 m^3/day for the domestic and industrial use in the Ba Ria-Vung Tau area. In this study, FSL and MOL of the Da Den reservoir are set at El. 40.0 m and El. 27.0 m respectively. A simulation study suggests that it is possible to develop an amount of 250,000 m^3/day for domestic and industrial use in Ba Ria-Vung Tau area. Taking into consideration the fact that water demand in the Ba Ria-Vung Tau including the Phu My area grows rapidly, the development scale of Da Den reservoir would be desired to be as large as possible. A preliminary geological survey confirmed that there exists exposure of siltstone at and around the damsite, recommending the construction of a rockfill type dam. A preliminary development plan of the Da Den reservoir is shown in Figure 9.15.

Song Ray reservoir

The Song Ray reservoir project under the pre-feasibility study level is expected to supply water to the Ba Ria-Vung Tau area. A simulation study by setting FSL and MOL at El. 70.0 m and El. 48.0 m respectively shows development capacity of 1,400,000 m^3/day which warrants to meet the water demand of Ba Ria-Vung Tau including the Phu My area far beyond the target year 2015. A preliminary geological survey confirmed both banks are covered with basalt at the damsite, recommending the construction of rockfill type dam. A preliminary development plan of the Song Ray reservoir is shown in Figure 9.16.

A simulation study is carried out by applying 10-year drought runoff. Construction costs for the proposed six reservoir projects are estimated based on the preliminary design as given in Table 9.9.

(3) Dong Nai River water

The Dong Nai River water is one of the most promising water sources for the water supply project along National Highway No. 51 in terms of quality and quantity; that is, ample water is available to meet the water demand of the area (1.7 million m^3/day) in the year 2015.

Intake: The proposed intake site is located at Thien Tan (refer to Figure 9.11) mainly due to the fact that the pipeline to Vung Tau becomes shortest when the intake is placed in the upstream reaches of Hoa An/Bien Hoa.

Pipeline Route: Figure 9.11 shows a pipeline route temporarily proposed between the Thien Tan intake site and Ba Ria. The pipeline is planned to run along the new express way which will be constructed parallel to existing National Highway No. 51.

(3) Development Alternatives

Following three are conceivable development alternatives prepared by combining three water sources discussed above, groundwater, reservoir projects and the Dong Nai River water;

Alternative 1:

	Development stage		
Demand centre	Stage I	Stage II	Stage III
1. Bien Hoa	Thien Tan	Thien Tan	Thien Tan
2. Tam Phuoc	groundwater	Thien Tan	Thien Tan
3. Nhon Trach	groundwater	Thien Tan	Thien Tan
4. Phu My	groundwater	Da Den	Song Ray
5. Vung Tau	groundwater	Da Den	Song Ray

Alternative 2:

	Development stage		
Demand centre	Stage I	Stage II	Stage III
1. Bien Hoa	Thien Tan	Thien Tan	Thien Tan
2. Tam Phuoc	groundwater	Thien Tan	Thien Tan
3. Nhon Trach	groundwater	Thien Tan	Thien Tan
4. Phu My	groundwater	Da Den	Thien Tan
5. Vung Tau	groundwater	Da Den	Thien Tan

Alternative 3:

	Development stage		
Demand centre	Stage I	Stage II	Stage III
1. Bien Hoa	Thien Tan	Thien Tan	Thien Tan
2. Tam Phuoc	groundwater	Thien Tan	Thien Tan
3. Nhon Trach	groundwater	Song Ca 1 & 2	La Buong
4. Phu My	groundwater	Da Den	Song Ray
5. Vung Tau	groundwater	Da Den	Song Ray

Stage I is the project to be implemented urgently to meet immediate water demand, whilst Stage II is the project to be developed by early 2000's and Stage III is the project to be implemented for meeting the water demand in the year 2015.

The basic idea of Alternative 1 is to rely on the Dong Nai River water as a water source for the demand centres in the Dong Nai province, whilst local rivers for the demand centres in the Ba Ria-Vung Tau province, i.e. Da Den and Song Ray reservoirs. Alternative 2 basically intends to supply the Dong Nai River water up to the farthest Vung Tau demand centre, although water demand of Stage II in the Phu My and Vung Tau demand centres is required to be met with the Da Den reservoir due to the time period necessary for the construction of pipeline. Alternative 3 is the plan to seek water sources to the local rivers as much as possible.

An attempt to select the optimal alternative from among the above three alternatives is made to determine the entire development plan of the water supply project along National Highway No. 51. Table 9.10 shows the installation timing and development scale of each water source to be developed for meeting future water demand of the five demand centres in Alternative 1, whilst Table 9.11 and 9.12 are for Alternatives 2 and 3, respectively.

Tables 9.13, 9.14 and 9.15 summarize the cost required for the construction of respective projects given in Alternatives 1, 2 and 3 by assuming a unit rate of US$ 170 m^3/sec/m for the pipeline, a unit rate of US$ 200/m^3 for the treatment plant and a rate of US$ 250/m^3 for groundwater development. For dam cost, Table 9.9 is referred to.

Economic evaluation to select the optimal alternative from among the proposed three alternatives is based on the present worth (primal discount rate is 10 %) and EIRR (economic internal rate of return) methods, demonstrating the highest net benefit of US$ 63.5 million and an EIRR of 12.9 % in Alternative 1 as summarized below:

	Alternatives		
	1	2	3
Benefits, million US$	303.3	303.3	303.3
Costs, million US$	239.8	241.4	275.5
Net benefit, million US$	63.5	61.9	27.8
EIRR, %	12.9	12.8	11.1

Furthermore, all the water supply plans for five demand centres proposed in Alternative 1 demonstrate economic viability by showing the EIRR higher than 10 % as summarized below:

	Economic Index	
Demand Centre	Net Benefit, million US$	EIRR, %
1. Bien Hoa	9.4	13.2
2. Tam Phuoc	13.2	14.5
3. Nhon Trach	22.2	14.4
4. Phu My	7.1	11.3
5. Vung Tau	11.6	12.0

Cash flows to evaluate economic viability of three Alternatives are shown in Tables 9.16, 9.17 and 9.18, and a unit rate of US$ 0.15/m^3, which is the average water tariff derrived from the revenue of HCMC water apply system, is applied for the benefit calculation.

Owing to the fact that Alternative 1 shows the highest net benefit among three alternatives as well as the fact that the water supply projects proposed for the respective demand centres are economically sound, Alternative 1, the basic idea of which is to seek the water source to the

Dong Nai River for the demand centres in Dong Nai province, whilst Da Den and Song Ray reservoirs for the demand centres in Ba Ria-Vung Tau province, is selected as the development plan for the water supply project along National Highway No. 51.

Since this water supply project along National Highway No. 51 is in the stage to select the best alternative, IEE was not carried out in this study, however, some environmental issues to be taken into consideration when the project is implemented are touched in Appendix IV as reference.

10. IMPLEMENTATION PLAN OF THE SELECTED MASTER PLANS

10.1 Implementation Schedule and Fund Management

10.1.1 Implementation Schedule

A total of six, master plan projects (except for Item 7 referred to Section 8.4), which are to be developed within coming 20 years by the target year 2015, are selected from five sectors, i.e. (1) Rural agricultural development projects, (2) Rural water supply projects, (3) Two hydropower projects, (4) Be-Saigon diversion project, (5) Eight large scale irrigation projects including Song Luy reservoir project and (6) Water supply project along National Highway No. 51. An implementation schedule for those projects is prepared by incorporating necessary lead time such as feasibility study and detailed design as given in Figures 10.1, 10.2 and 10.3, which include the implementation schedule for the Dai Ninh project and the HCMC water supply project as well for reference.

The preparation of the implementation schedule for the hydropower projects including Fu Mieng as the Be-Saigon diversion project and water supply project along National Highway No. 51 are straightforward since the demands of respective sectors are clearly defined and the input timing of these projects are determined accordingly to keep up with the growth rates of the respective demands in time series up to the target year 2015 (refer to Appendix X, Formulation of Master Plant Projects).

As for eight irrigation master plan projects, the plan to build the reservoir projects in the Dong Nai River basin as well as project viability and socio-economic needs in the region is given the high priority in preparing the implementation schedule of those projects, i.e. commissioning of Dai Ninh for the Phan Ri and Phan Thiet projects in the year 2002, whilst the year 2005 to 2009 for Fu Mieng. Further detailed discussions for preparing the implementation schedule of the irrigation master plans are referred to Appendix VI.

Improvement and rehabilitation of small scale irrigation projects as part of rural agricultural development need a study including feasibility study to determine the implementation order of numerous projects prior to actual construction works (refer to Figure 10.2). The implementation of new projects will be undertaken with a slight time delay of two years for that of improvement and rehabilitation projects in consideration of the required preparation period towards the implementation. While the determination of implementation order among the projects is awaited by the coming feasibility study, the priority in implementation should be placed on the projects which are not involved in the eight large scale irrigation projects. Among those not included in the eight large projects, following are main factors to be taken into consideration the implementation order:

i. Technical aspect;
ii. Socio-economic aspect;
iii. Institutional aspect; and
iv. Economic and financial aspect.

Rural water supply projects also need a study and investigation to select the priority communes and their drilling sites of wells prior to the actual construction works. This sort of study and investigation will iterate every five years by splitting the implementation of all the projects into five packages (refer to Figure 10.3). Although priority communes are selected through the study carried out prior to the actual implementation of rural water supply projects, basic approaches to select the priority communes would be as follows:

i. Poverty and remoteness;
ii. Less availability of aquifer;
iii. Afflicted area by less rainfall, salinity intrusion and acid water;
iv. Large water demand; and
v. Administration support.

10.1.2 Fund Management

With the construction costs estimated in Chapter 9 and the implementation schedule discussed above, a disbursement schedule of all the master plan projects invested over a time horizon of coming 20 years from the year 1996 to 2015 is prepared as given in Table 10.1.

The availability of public fund, which is defined as public investment consisting of government investment through ministries and departments, to be allocated to the master plan projects is assessed by comparing the public fund invested in the Study Area, i.e. one city and nine provinces.

The estimate of public fund invested in the Study Area is made with the prediction of all the public investment in the nation from GDP projected up to the year 2015, followed by the projection of ratio of public fund invested in the Study Area to the public investment in the nation (for detail, refer to Appendix I, Socio-economy and Institution).

The master plan projects selected in this study belong to hydropower, irrigation and water supply sectors, the share of which is estimated at 20 %, 10 % and 5 % respectively in the public investment of the Study Area based on the past performance. Applying a rate of 35 %, which is the sum of shares for the three public sectors, to the public fund in the Study Area, funds available for hydropower, irrigation and water supply are estimated by dividing a time period of 20 years into four phases; Phase I for a time period of the year 1996 to 2000, Phase

II for a time period of the year 2001 to 2005, Phase III for a time period of the year 2006 to 2010 and Phase IV for a time period of the year 2011 to 2015.

Table 10.2 shows the results of comparison between the estimated allocated fund available and the investment required for implementing the master plan projects.

Total investment requirements necessary for the implementation of the master plan projects are nearly VND 1,870 billion during Phase I, VND 12,010 billion during Phase II, VND 13,330 billion during Phase III and VND 3,080 billion during Phase IV, corresponding to 8.7, 36.3, 27.0 and 4.4 % of the projected total public investment allocation to the Study Area in the respective phases, whilst 24.9, 103.8, 77.1 and 12.5 % of the public funds allocated to the hydropower, irrigation and water supply sectors in the Study Area. The study on fund management tells that the total investment costs for the master plan projects during Phase II will require a marginally larger share of the projected public fund availability.

However, taking into consideration the future promised development in the region as well as the importance of three sectors to boost its economic development, a total investment of some VND 30,300 billion for the master plan projects is judged to fall within the reasonable share of the total public investment to be allocated to the Study Area.

10.2 Management Systems for the Master Plan Projects

10.2.1 Institutional Arrangements for Implementing the Dong Nai Projects

In terms of development of the Study Area, it will be better to treat it as a spatial unit. Administratively, each of ten (10) provinces concerned may be treated as a unit, which is a part of the so-called provincial administration under the Provincial/City People's Committee (PPC or CPC).

For the implementation of this "Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development", the Vietnamese government has already established a preliminary management system (Steering Committee) for supervising the Study. Thus, it is proposed to consolidate it as a foundation for further development. The following are some general ideas on how to strengthen the management system and to enable the smooth implementation of the master plan projects:

a) First of all, the central government should promote human resource development in cooperation with the local authorities. To develop the capabilities of local authorities in planning, implementing and managing the water resources development project as well as

rural development ones, it is required to increase the number of staff in charge and to provide them proper training.

b) In accordance with the decentralization of administration system, it is necessary to reassess the role of each local authority, to provide it with functional responsibilities and to improve the capabilities, especially to plan, coordinate and finance the projects.

c) The information system for water resources and rural development management should be established/consolidated to ensure the smooth and prompt implementation of the projects so that useful data can be timely distributed to those who need them, even at any levels.

d) Since it is difficult to promote the water resources and rural development effectively unless local authorities are really autonomous, financial decentralization should be strongly performed together with institutional reform.

Basically, it seems to be practical to make most of the existing system or to develop the existing "Steering Committee for the Master Plan Study". Therefore, institutional arrangements proposed here are to establish a "Committee" in charge of development of the Dong Nai River and Surrounding Basins (tentatively called as "Dong Nai Water Resources Development Committee: DWRDC"), based on the existing management system.

The DWRDC may consist of chairmen of ten (10) Provincial/City People's Committees concerned and representatives from the Ministries/Agencies relevant to the water resources development. This Committee may be chaired by the Project Management Office (PMO) director. Figure 10.4 shows the proposed structure for implementing the master plan projects.

10.2.2 Project Management System

To enable the institutions concerned to assume specific water resources development roles in a region (area), a new institution called a "Project Management Office (PMO)" may be established under the "DWRDC" to facilitate the coordination at every national, ministry/department and regional/provincial levels.

The development administration with the DWRDC/PMO is described below for national, regional/provincial and local levels.

Supervision and coordination at the national level

As a national governing body on the water resources development management, the Dong Nai Water Resources Development Committee (DWRDC) will assume policy formulation, final decision and approval on the water resources development management matters.

The functions of this Committee are to provide overall policy and guidance, to review annual and multi-year projects/programmes, to supervise their implementation at the regional level and to promote institutional and financial capabilities in its management system.

As a working office, the Project Management Office (PMO) is responsible for the coordination of the overall regional development management activities and for the review, recommendation and advisory matters for the DWRDC. Major tasks of the PMO are to formulate the development projects, their screening, coordination, monitoring and evaluation and to submit them for final approval by the DWRDC.

The inter-regional and inter-provincial projects/programmes will be coordinated at the Ministry of Planning and Investment (MOPI), and Evaluation Commission for State Projects, Office of the Government levels.

Management and coordination at the provincial level

At the provincial level, the existing Department (Services) of Construction Management in each Provincial/City People's Committee will be strengthened with the support of PMO (refer to Figure 10.5).

Main functions of PMO to be effected through DWRDC are the following :

- to review and update the Master Plan occasionally,
- to review the projects/programmes of line agencies, and to coordinate and integrate them for submission to MOPI, Office of the Government and Evaluation Commission for State Projects,
- to identify fund sources for implementation of the projects,
- to prepare/initiate the regional water resources development, multi-sector projects/ programmes and/or integrated area development, and
- to promote investment opportunities to the Dong Nai River basin area.

Monitoring and evaluation at the provincial level

At the local government level, the Department of Construction Management and Department of Science Technology and Environment in each People's Committee concerned will undertake the monitoring and evaluation of the projects and will submit revised proposals for the annual and multi-year projects/programmes to DWRDC.

To improve and strengthen the capabilities of the existing development management system, it is recommended to start an "institutional supporting programme", which comprises the following major components:

a) To assist the DWRDC/PMO activities and ensure the smooth implementation of the development projects, this programme will dispatch from the central office an experienced development expert to the PMO for a time period of five years.

b) Principal ministries/agencies, i.e. MOPI, MOARD, MOID, VPC, MOC, MOSTE, and agencies concerned will assign/dispatch the experts in planning, implementing and managing the water resources and regional development projects to the PMO. They will undertake the counterpart training.

c) This programme will assist this decentralized management system for 10 years mainly by means of providing the salary of experts and certain local staff and necessary equipment like personal computers.

d) To deal with a large volume of data and information, it is necessary to standardize the document formats as simple as possible, while the equipment and instruments for filing/keeping the system will be provided with appropriate instructions and procedures.

e) While the regional water resources development management is a joint responsibility of the central and local governments, especially at the initial stage, its effectiveness and success will depend largely on their skills and resources. To realize the expected satisfactory results, it is vital to provide training seminars and workshops with a view of disseminating all development related information to the interested people.

PMO may play important roles in implementing this programme. The following functions seem particularly relevant :

a) to provide technical assistance to local governments comprising districts and communes/precincts for the preparation of provincial (or local) development plans,

b) to prepare simple standardized document formats and system for various data necessary for water resources development management, including monitoring and evaluation of project/programme implementation, and

c) to organize training seminars and workshops as mentioned above.

For the purposes of operation and maintenance, the completed irrigation and water supply projects (systems) will be transferred under the supervision of the Provincial/City People's Committee(s) concerned (People's Committees Enterprises). As for the power generating structures and facilities, their operation and maintenance will be carried out by the Electrical Power Company under the supervision of the Vietnamese Power Corporation (VPC).

Considering the optimal utilization of water resources available in the Dong Nai River basin area, it is essential to keep close contacts among all agencies concerned, because their problems are inter-related and complementary. The Dong Nai Water Resources Development Committee

(DWRDC) proposed above will play a pivotal role in their coordination, collaboration and settlement of problems.

10.3 Selection of Priority Projects

The master plan projects proposed in this Study aims to develop water resources available in the Dong Nai River and its surrounding basins in the time horizon up to the target year 2015 for two major objectives; (i) rural development in the Study Area and (ii) economic development mainly for SFEA.

The former objective is expected to be attained through the implementation of rural agricultural development projects and rural water supply projects. The latter intends to contribute to economic development through the enhancement of the production level of hydropower, staple foods through the large scale irrigation projects and domestic and industrial water supply.

The master plan projects are composed of five independent sectors with different development objectives, and in this respect, priority projects to proceed to the feasibility study stage or the next advanced stage are proposed to be selected from each of the following five sectors:

- Small scale irrigation project,
- Rural water supply project,
- Hydropower project,
- Large scale irrigation project, and
- Large scale water supply project.

(1) Rural Agricultural Development

As the rural agricultural development project, identified are a total of 229 projects, of which 164 projects are improvement and rehabilitation of existing ones, whilst 65 projects are new implementation. Of 229 projects, a total of 53 projects are included in the command area of eight large scale irrigation master plan projects, and thus are screened out from the priority list to advance to the next study stage as small scale irrigation projects.

Remaining 176 projects are classified into two; 118 exiting projects requiring rehabilitation and 58 new projects. Taking into consideration the fact that improvement and rehabilitation of existing projects can be expected to gain the quick and high returns with low costs, implementation priority should be given to the improvement and rehabilitation of existing projects. Among the 118 existing projects, implementation order can hardly be determined at this moment due to the fact that investigation for them has not been undertaken through this study. Thus, a study to determine the implementation order among them as well as a feasibility

study for the projects selected as top priority for implementation shall be carried out toward their implementation.

A Terms of Reference (TOR) for the study of feasibility of the small scale irrigation project is prepared as attached in Attachment-2 of Appendix X.

(2) Rural Water Supply Project

A total of 1,207 projects are proposed to be implemented as rural water supply projects for the 170 communes in the Study Area. As done for the rural agricultural development project, in-depth study has not been carried out for the rural water supply project, but only the communes, which require the project, are identified through this Study.

The in-coming study for the rural water supply projects will thus commence with the work of selecting priority communes to implement the project, followed by the feasibility studies for the projects to be implemented in the priority communes.

A TOR for the feasibility study of the rural water supply project is prepared as attached in Attachment-3 in Appendix X.

(3) Hydropower Project

A total of three projects, i.e. Dong Nai No. 3 and No. 4 and Fu Mieng, are proposed as the hydropower master plan projects in this study. Dong Nai No. 3 and No. 4 are recommended to be developed as a combined project with a total installed capacity of 420 MW in aiming at harnessing available hydropower potential efficiently. Their commissioning year is expected at the beginning of the year 2008.

On the other hand, Fu Mieng is a multipurpose project with development objectives of hydropower and irrigation. The proposed installed capacity as a hydropower project is 55 MW, whilst the net incremental area by implementing Fu Mieng diversion is 88,300 ha in the Dau Tieng Extension and HCMC-Long An delta irrigation areas. The expected commissioning year of the Fu Mieng multipurpose project is proposed at the beginning of the year 2010 taking into account the irrigation development scenario. It is to be noted that further detailed studies are needed for comparing two projects, i.e. Fu Mieng and Phuoc Hoa, as alternatives of the Be-Saigon diversion project.

Since the combined development of Dong Nai No. 3 and No. 4 is expected to be installed earlier as well as to give greater contribution to the rapidly growing power demand than Fu Mieng, the former is selected as the priority project of hydropower sector.

A TOR for the feasibility study on Dong Nai No. 3 and No. 4 is included in Attachment-4 of Appendix X.

(4) Large Scale Irrigation Project

A total of eight projects, which are Phuoc Hoa, Dau Tieng Extension, Phan Ri, Phan Tiet, Ta Pao, Vo Dat, Long An delta and HCMC, are proposed as the large scale irrigation master plans. Those are categorized into five development packages in view of similarity of individual projects, trans-basin diversions of water and regional developments as shown below:

Development Package	Area (ha)	Master Plan Project
1. Phan Ri-Phan Thiet Irrigation Project	39,700	1.1 Pha Ri Irrigation Scheme (29,700 ha)
		1.2 Phan Thiet Irrigation Scheme (10,000 ha)
2. Lower La Nga Plain Irrigation Project	31,620	2.1 Ta Pao Irrigation Scheme (19,000 ha)
		2.2 Vo Dat Irrigation Scheme (12,620 ha)
3. Phuoc Hoa Irrigation Project	45,680	Phuoc Hoa Irrigation Project (45,680 ha)
4. Dau Tieng Extension and HCMC-Long An Delta	125,560	4.1 Dau Tieng Extension Irrigation Scheme (48,390 ha)
		4.2 HCMC Irrigation Scheme (46,000 ha)(*1)
		4.3 Long An Irrigation Scheme (31,170 ha)
Total		242,560 ha

(1*): including on-going Hoc Mon-Bac Binh Chanh Irrigation Scheme of 12,197 ha

To select a priority project from among the above four development packages, an evaluation is carried out by applying three elements on the projects, i.e. (i) social impacts translated as degree of contribution to the regional development, (ii) maturity of projects translated as whether or not the project has proceeded to a higher study stage toward implementation and (iii) economic viability. Following shows the evaluation result to select the priority project from among the above five packages based on the three evaluation criteria:

Development Package	Master Plan Project	Area (ha)	Social Impact	Maturity	Economic Viability	Priority Ranking
Phan Ri-Phan Thiet Irrigation Project	Phan Ri	29,700	A	B	A	1
	Phan Thiet	10,000	A	C	A	
Lower La Nga Plain Irrigation Project	Ta Pao	19,000	A	C	A	3
	Vo Dat	12,620	B	C	C	
Phuoc Hoa Irrigation Project	Phuoc Hoa	45,680	B	B	B	2
Dau Tieng Extension and HCMC- Long An Delta Project	Dau Tieng Extension	48,390	B	B	B	4
	HCMC Delta	46,000	C	C	C	
	Long An Delta	31,170	C	C	C	

Phan Ri-Phan Thiet project shows the highest attractiveness to proceed to the feasibility study stage based on the above three criteria, and therefor is selected as the priority project of the large scale irrigation project.

A TOR for the feasibility study on Phan Ri-Phan Thiet irrigation project is attached in Attachment-5 of Appendix X.

(5) Large Scale Water Supply Project

Water supply project along National Highway No. 51 is selected as one of master plan projects in this study. According to the master plan level study of the project carried out in this study, it is recommended to supply domestic and industrial water from the Dong Nai River to three demand centres of Bien Hoa, Tam Phuoc and Nhon Trach in Dong Nai province by burying pipelines as a major component. On the other hand, Da Den and Song Ray reservoir projects are proposed to be built as a major component for supply domestic and industrial water to the Phu My and Vung Tau demand centres in Ba Ria-Vung Tau province.

A development alternative to include these three projects shows the highest economic viability among three alternatives, and furthermore those three are required to be developed urgently for meeting the rapidly growing water demand. Taking into account these facts, a package project to include these three projects is recommend to be selected as a priority project to proceed to the feasibility study stage.

A TOR for the feasibility study on the water supply project along National Highway No. 51 is attached in Attachment-6 in Appendix X.

(6) Institutional Strengthening

It is considered that the overall and integrated planning, coordination and management among relevant organizations and authorities concerned are essential for successful implementation of the water resources development in the Study Area as discussed in Section 10.2. In this respect, a TOR for Action Plan on Institutional Strengthening for Implementation of the Dong Nai Water Resources Development Project is prepared and attached in Attachment-7 in Appendix X.