Most of the areas along the east coast of Kab. Deli Serdang and part of Kab. Asahan which were covered with mangrove and nipah/palm forest, were converted into shrimp ponds, cacao plantation and palm oil plantation due to the big demand and higher price for these crops in the world market.

The lowland area which consist of swamps and scrubs were changed into plantation, paddy field, settlement and small scale industry especially along the national road.

In the middle reaches of Ular, Percut and Padang rivers there are old rubber plantations converted into oil palm, cacao and coconut plantations.

The industrial area along the roads in Medan has expanded to the north and east (Medan-Belawan), to the south (Medan-Lubuk Pakam), to the west (Medan-Binjai and Medan-Deli Tua). Therefore, the paddy fields and part of plantations may soon be occupied by industrial area.

Based on the current tendency of land use, the recommended land development is delineated by MPW as shown Fig. 4-2.

4.2 Regional Development

Economic Development Plans

The Fifth Five-Year Development Plan (Repelita V) was prepared aiming as a "take off" era before entering into the Second Long Term Development Plan.

(1) Policy Directions of Repelita V

The objective of Repelita V is twofold; namely,

(a) To increase the living standard of the entire population; and

(b) To build a strong foundation for the next development stage.

In conformity with the broad pattern of the First Long Term Developmen Plan, Repelita V continues to give special emphasis on economic development. The aims of economic development are to achieve a balanced economic structure, which consists of the agricultural sector for consolidating food self-sufficiency and promoting product diversity, and the industrial sector for promoting industries that increase exports, absorb substantial manpower, process agricultural products and produce industrial machinery.

Repelita V is also dealing with the urgent problem of providing adequate productive employment opportunities for the rapidly growing labor force. About 11.9 million new job seekers, many of whom are young and educated, will enter the labor market over the next five years.

The management of natural resources should be extended over the principles of ecological balance. Natural resources and environment must be managed so as to make the greatest possible contribution to current development and prosperity of the population as well as to be continuously provided for future generations.

To attain a harmonious implementation, the development trilogy, namely adequate economic growth, more equitable income distribution and greater national stability should be taken into consideration.

(2) Economic Growth and Structural Change

Within Repelita V, economic growth rate is estimated to reach an average of 5.0% per annum. Population growth rate is also expected to reach an average of 1.9% per annum, and the real income per capita will increase by about 3.1% per annum.

The 5.0% growth rate of the overall GDP is associated with an anticipated 6% growth in the sectors other than oil and natural gas. Anticipated growth rates of the main sectors in the next five years are as follows:

Anticipated Growth Rates

Sector	Growth Rate (%)
1. Agriculture	3.6
2. Mining and Quarrying	0.4
3. Manufacturing	8.5
4. Construction	6.0
5. Trade	6.0
6. Transportation and Communication	6.4
7. Other Sectors	6.1

Source: Fifth Five-YearDevelopmentPlan, 1989/90-1993/94, BAPPENAS.

The agriculture sector's growth rate is supported by a 3.2% increase in rice production, which is required to consolidate food self-sufficiency. The industrial sector is expected to increase through acceleration of non-oil and natural gas exports.

The economic structure in the next five years is also expected to become more balanced. The share of the agricultural sector will decline from 23.2% to 21.6%, while the share of the industrial sector is expected to increase from 14.4% to 16.9%.

(3) Basic Strategy of North Sumatra Province in Sectors

In achieving the annual regional economic growth of 6.0% including oil and natural gas or 6.2% excluding oil and natural gas, the development shall be well-balanced either sectorally or regionally. The policy of economic development will be emphasized on:

(a) Industry

Industries which produce export commodity and absorb more manpower, especially agro-industry and capital goods industry are highlighted. The industrial sector's rate of growth is projected at 10.98% per annum and its share is 19.72% at the end of Repelita V.

(b) Agriculture

To attain food self-sufficiency and increase other agriculture products, the growth rate of the agricultural sector is targeted at 4.73% per annum on average, and its share is 31.57% at the end of Repelita V.

(c) Tourism

To develop the regional tourism resources and tourism potential as one of the regional economic activities, it is expected to achieve the target of 854,714 tourists within Repelita V, and they will stay for about 12 days with average expenditures of US$120 per day.

Water Resources Development Plans

(1) Water Resources Development Within Repelita V

Water resources development under Repelita V is still concentrated on the irrigation sector. The development policies on irrigation are specifically aimed at the enhancement of operation and maintenance activities and the increase of irrigation networks.

The expansion of irrigation networks will be carried out in areas outside of Java in order to maintain self-sufficiency and compensate for the decrease of paddies in Java. The following table shows the selected targets in the irrigation sector.

Targets of Irrigation Sector Expansion

(Unit: 1,000 ha)

Activity	Repelita IV	Repelita V
1. Improvement and Maintenance of Irrigation Networks		
- O&M	5,400.0	5,800.0
- Rehabilitation	561.0	334.3
2. Construction of New Irrigation Networks	344.8	500.0
3. Swamp Area Development		
- Reclamation	225.5	444.2
- Pond Improvement	9.0	60.0
- Pond Development	3.0	10.0
4. Flood Control	359.0	450.0

Source: BAPPENAS, Fifth Five-Year Development Plan, 1989/90-1993/94.

(2) Water Resources Development in North Sumatra

The technical irrigation area was increased from 51,362 ha to 53,854 ha or 1.05% per annum from 1983 to 1987. The semi-technical irrigation area was decreased from 63,744 ha to 59,549 ha or 1.68% per annum, but the simple irrigation area was increased and upgraded to semi-technical from 53,049 ha in 1983 to 76,845 ha in 1987 or an increase of 8.84% per annum.

In Kab. Deli Serdang, only swamp development was planned especially in the lower reaches of Percut River. About 900 ha are to be reclaimed with financial assistance from the World Bank, and another 1,000 ha will be developed with financing by APBN (Anggaran Pendapatan dan Belanja; National Budget).

In Kab. Simalungun, the main development sector is also irrigation, with emphasis on rehabilitation and maintenance as financed by:

(a) APBN for about 8,206 ha in 47 irrigation schemes.
(b) OECF loan for one scheme (total area is not fixed)
(c) ADB loan for about 22,928 ha covering 52 irrigation schemes.

Medan Urban Development Project

The study on Medan Urban Development, Housing, Water Supply and Sanitation Project was commenced in 1978 and completed in October 1980, under the supervision of the Directorate General of Housing Building Planning and Urban Development (DGCK), Ministry of Public Works. It was financed partly by ADB.

The study covered the whole area of Kodya. Medan and its scope are as follows:

(a) Preparation of a long term urban development plan.

(b) Preparation of a feasibility study for housing development projects including a Kampung Improvement Programme and a Sites and Services and Low Cost Housing Scheme.

(c) Development of a long-range Master Plan for water supply, wastewater drainage and solid wastes systems in Medan and its vicinity through the year 2000.

(d) Preparation of First Stage Feasibility Studies for water supply, wastewater, drainage and solid wastes systems to meet needs through the year 1990.

(e) Detailed engineering for the First Stage Sites and Services Scheme and the Low Housing Scheme.

Based on the study, the first stage program was implemented starting in 1982. Technical assistance from ADB was also requested in 1988 by the GOI for the second stage of MUDP, namely the Second Medan Urban Development Project (MUDP II).

In MUDP II, the project was rather expanded consisting of 11 components. The scopes of work are as follows.

(1) Part A: Water Supply

Development of the final phase extension of the Deli Tua Water Treatment Plant; provision of two reservoirs, pumping stations, transmission mains and expansion of the distribution system including house connections within Kotamadya Medan.

(2) Part B: Sewerage

Augmentation of the Kera Sewerage Pumping Station and construction of two smaller pumping stations; laying of sewers and laterals, and house connections within Kotamadya Medan.

(3) Part C: Drainage

Improvement of Lower Kera River Main, provision of secondary drains to divert stormwater from the Kera Basin to other higher capacity channels as well as Sei Sulang Saling and associated secondary open drains, secondary open and covered box and pipe drains, Kampung Improvement Program drains and drainage improvement works at the University of North Sumatra and Martubung, plus procurement of maintenance equipment.

(4) Part D: Solid Waste Management

Extension of the Solid Waste Management System to six additional city precincts (Kecamatan) in the portion of Kotamadya Medan not served through the MUDP and the development of transfer depots requiring a new landfill site, transfer locations, transfer depots, a workshop in East Medan and equipment including solid waste containers, hand carts, dust bins, bulldozers, wheel loaders, landfill, compactors, vehicles, motorcycles and tipper truck.

(5) Part E: Kampung Improvement Program and Market Infrastructure Improvement Program

Provision in the Kampung Improvement Program of basic infrastructure including water supply, solid waste management, local drainage, footpaths, culverts, shallow wells and sanitation facilities, and promotion of community participation activities in 14 kampung areas within Kotamadya Medan consisting of about 570 hectares. The Market Infrastructure Improvement Program will include provision of roads, footpaths, parking facilities, drains, sanitation, water supply, solid waste management and other infrastructure rehabilitation works in 13 market areas.

(6) Part F: Urban Road and Traffic Management

Construction of the southern section of the outer ring road within Kotamadya Medan, and improvement of Jl. Katamso, Jl. Monginsidi, Jl. Iskandar Muda and Jl. Gatot Subroto; provision of traffic management schemes and two corridor improvement schemes involving bridge widening and traffic engineering along Jl. Raden Saleh and Jl. Zainul Arifin; improvement of road access in the Martubung area.

(7) Part G: Small Towns Infrastructure Improvement

Extension of basic infrastructure facilities including water supply, drainage, flood control, roads, sanitation, solid waste management, Kampung Improvement Program and market infrastructure improvement in the towns of Pancur Batu, Deli Tua, Tanjung Morawa, Tembung, Lubuk Pakam and Binjai.

(8) Part H: Flood Control

Provision of sub-regional drainage and flood control measures to reduce the frequency of flooding in and around Kotamadya Medan; Improvement of the channel for the Deli River, Sikambing River, Putih River, and Kera River. Civil works include normalization and excavation

of channel lining, construction of levees, river bank improvement, and bridge improvement installation.

(9) Part I: Institutional Development and Training

Provision of incremental administrative services and initial operation and maintenance, consulting services for engineering design, construction supervision, project implementation, institution building, training, public information and studies on water resources, flood protection and pollution control, base mapping, sanitation and KIP strategy, cost recovering and income generation measures and a strategy plan for the Metropolitan Medan Region.

The implementation schedule of each component is presented in Fig. 4-5. Other than the above, the MUDP II includes some overall studies for flood control and water supply covering a wide area from Belawan River to Serdang River which occupies about a half of the area of this Study.

Other Development on Infrastructure

(1) Transportation

(a) Road

The development plan was made with emphasis on the expansion of the road networks in growth centers and production centers. By the end of Repelita V, national and provincial road networks are expected to cover 43,000 km, while the length of asphalt paved roads is expected to increase to 93,900 km. In addition, artery/collector roads of 1,600 km, municipality roads of 344 km, and bridges totaling 4,200 m will be constructed.

(b) Railway

The development plan for railways will focus on increasing their load capacity, service quality and management efficiency. For this purpose 1,835 km of tracks will be rehabilitated and 175 underpass and overpass bridges will be constructed to sustain a total load capacity of 2,500 tons.

The route which are now not operated due to bad condition is estimated at about 68.76 km. Furthermore, in the long term program there are plans to build and develop a new modern commuter train service in MEBIWANTI (Medan, Binjai, Belawan, and Tebing Tinggi) area, which will be tentatively scheduled in the year 2000 to 2025 (MEBIWANTI Railway Project).

(c) Sea Port

Development of sea communication/transportation is also expected to facilitate expansion of inter-regional trade and to increase competitiveness of domestic products in domestic and foreign markets.

During Repelita V, the national fleet capacity will be increased by 178,500 DWT, the load sailing fleet by 22,000 DWT; the small holders sailing fleet by 50,000 DWT; the special sailing fleet by 119,800 DWT; and passenger ships by 40,000 DWT.

(d) Airport

Air transport service will be extended to a greater number of regional areas. In Repelita V, the growth rate of demand for domestic air transport, international air transport and pioneering air transport is expected to reach 8.6%, 9.1% and 11.2% per annum, respectively.

In North Sumatra, there are air transport facilities managed by:

- The Polonia Airport administered by Perum Angkasa Pura I Cabang Polonia Medan under the Directorate General of Air Transport, i.e., Class I Medan Polonia Airport.

- The North Sumatra Regional Office of Transport for Class IV pioneer airport such as Binaka-Gunung Sitoli; Sibolga; Sibisa-Parapat, Aek Godang-Padang Sidempuan

- The plantations such as Aek Nabara, Gunug Pamela, Pabatu, Torgamba, Kota Pinang, Bah Jambi, Helvetia, Berangin, Teluk Dalam, Ajamu, Perlabian, etc.

Medan Polonia Airport is the biggest airport in North Sumatra. It has good facilities for either domestic or international use and expected to be still in good condition until the year 2005. After that year it should be moved to another area in Kab. Deli Serdang.

(2) Electricity and Energy

Domestic energy demands are to be met as much as possible through the utilization of existing non-oil energy resources such as natural gas, geothermal energy, hydropower and coal.

In Repelita V, the overall installed capacity of electric generating power for the whole country is planned to increase by 3,697 MW, comprising:

Hydropower	:	369 MW
Diesel power plant	:	323 MW
Natural gas power plant	:	120 MW
Geothermal plant	:	290 MW
Steam power plant	:	1,495 MW
Gas and steam power plant	:	1,100 MW

In North Sumatra Province, the target of installed capacity is 265.5 MW, and at the end of Repelita IV, only 164.3 MW or 69.9% was accomplished. The remaining will be reached within Repelita V. The energy sources in the province are potentially oil, natural gas and hydropower.

The potential energy sources in North Sumatra Province are not yet fully utilized. The hydropower potential from the seven rivers are not developed, especially in the study area, although the demand with a growth of about 13.6% per annum cannot still be fully provided. Hydropower potential in the province was estimated at 1,900 MW and only about 603 MW was utilized.

TABLES

Table 2-1 GOVERNMENT LEGISLATION

Sector	Legislation
1. Environmental Impact Assessment (EIA)	Government Regulation No.U29/1986
2. Land Use	Act 5 of 1960 covering fundamentals of agrarian law
	Ordinance 148 of 1968 covering town building
	Act 5 of 1974 : Basic Principle of administration in the Region
	Act 5 of 1979 : Administration in the Village
3. Water Quality	Act 11 of 1974 addressing water resources development
	Act 4 of 1960 : the Indonesian waters
	Act 1 of 1973 : the Indonesian Continental Shelf
	Act 5 of 1983 : the Indonesian Economic Exclusion Zone
4. Air Quality	(no specific legislation)
5. Solid Wastes	(entrusted to the provinces and local administrations and no national legislation)
6. Nature Conservation	Act 5 of 1967 : Basic Law on Forestry, the Nature Protection Ordinance

Table 2-2 ENVIRONMENTAL EFFECTS CONSIDERED IN SCREENING

Environmental Effects	
PHYSICAL/CHEMICAL :	ECOLOGICAL EFFECTS :
(1) Water	- Vegetation
- Groundwater	- Wildlife
- Suface Water	- Fish
	- Terrestrial Habitats and Communities
(2) Land	
- Soil Erosion	
- Flood Plain Usage	
- Buffer Zones	
- Soil Suitability for Use	
- Compatibility of Land Use	SOCIO-ECONOMIC EFFECTS :
- Unique Physical Features	- Demography
- Compaction and Setting	- Economy and Manpower
- Stability	- Regional Transportation
- Earthquakes	- Housing and Community Infrastructure
(3) Atmosphere	- Health Education and Social Services
- Air Characteristics	- Local Government
- Wind	- Lifestyle and Qality of Life
(4) Noise	
- Intensity	
- Duration	

Source : A Manual for the Implementation of ANDAL Studies in the Ministry of Public Works, 1987

Table 2-3 MAJOR VEGETATION TYPES IN SUMATRA

Soil/Water	Location	Soil	Elevation	Vagatation Type
Dry Land	Inland	Zonal soils	Lowland, up to 1,200 m	Lowland forest
			Mountains 1,200 - 2,100 m	Lower montane forest
			Mountains 1,200 - 3,000 m	Upper montane forest
			Mountains 3,000 m +	Subalpine forest
		Podzolized sands	Mostly lowland	Heath Forest
		Limestone	Mostly lowland	Forest over limestone
				Beach vegetation
Water Table high (at least periodically)	Coastal			Mangrove
	Saltwater			Brackish water forest
	Brackish water			Peatswamp forest
	Freshwater	Oligotrophic peats		Fresh water/Seasonal swamp forest
		Eutrophic (muck and mineral soils)		

Source : The Ecology of Sumatra 1987

Table 2-4 POPULATION CLASSIFIED BY RELIGION IN THE STUDY AREA, 1988

(Unit : thousands)

Area	Islam	Catholic	Christian	Hindu	Buddhism	Others
Kab. Deli Serdang	1,208	39	235	2	42	-
	(79.2)	(2.6)	(15.4)	(0.1)	(2.8)	
Tebing Tinggi City	73	1	13	-	13	-
	(73.0)	(1.0)	(13.0)		(13.0)	
Medan City	1,222	33	309	15	228	-
	(67.6)	(1.8)	(17.0)	(1.0)	(12.6)	
Study Area	2,503	73	557	17	283	-
	(72.9)	(2.1)	(16.2)	(0.5)	(8.2)	
North Sumatra	6,400	431	2,830	23	415	-
	(63.4)	(4.3)	(28.0)	(0.2)	(4.1)	
Indonesia	(86.9)	(3.1)	(6.5)	(1.9)	(1.0)	(0.6)

Note : Figures in parentheses indicate percentage (%).

Source : North Sumatra In Figures 1988, Statistic Indonesia 1988

Table 2-5 POPULATION CLASSIFIED BY ETHNIC GROUPS IN THE STUDY AREA, 1988

No.	Ethnic Group	Popolation Percent (%)
1.	J a v a	38.63
2.	Batak (Karo, Toba, Simalungun, etc)	24.85
3.	M e l a y u	14.51
4.	C h i n e s e	12.00
5.	O t h e r s	9.21
	T o t a l	100.00

Source : Karl Pelzer (1978) in Mubyarto (1990) (projection)
Reid (1979) in Silalahi, B (1982)
Population Statistic of North Sumatra (1988)

Table 2-6 HISTORICAL AND CULTURAL ASSETS IN THE STUDY AREA

No.	Name	Area/Size (ha/m2)	Year of Construction	Location
	MEDAN CITY			
1.	Mosque of Sunggal	17 x 17 m2	1979	Medan Sunggal
2.	Great Mosque of Medan	40 x 50 m2	-	Medan
3.	Old Mosque of Labuhan	20 x 30 m2	-	Labuhan Deli
4.	Place of Maimun	50 x 60 m2	-	Medan
5.	Old town Cina	5 ha	1988	Labuhan Deli
6.	Vihara Budha	30 x 40 m2	1985	Medan
7.	Klenteng Cina	20 x 30 m2	-	Labuhan Deli
8.	Building of Avros	30 x 50 m2	-	Medan Johor
	KAB. DELI SERDANG			
9.	Castle of Putri Hijau	30 x 40 m2	-	Delitua
10.	Old Cannon	1 m	-	Sei Rampah
11.	Old Cannon	1 m	-	Firdaus
12.	Old Cannon	2.25 m	-	Sei Rampah
13.	Cemetery at Tengku Naji Besar	4 x 5 m2	-	Pantai Cermin
14.	Holy Place of Datuk Jabat	2 x 3 m2	-	Pantai Cermin
15.	Cemetery of Datuk Rencah	4 x 5 m2	-	Pantai Cermin
16.	Cemetery of Datuk Rebai	4 x 5 m2	-	Pantai Cermin
17.	Ancient Cannon of Lele	1 m	-	Rantau Panjang
18.	Mosque of Rantau Panjang	20 x 20 m2	-	Rantau Panjang
19.	Mosque of Serdang	30 x 50 m2	-	Rantau Panjang
20.	Doll of Pangulu Balang	-	-	Lubuk Pakam
21.	Cemetery of Sultan Serdang	-	-	Gunung Rintih
22.	Cemetery of Thab Simar Basyarsyah	2 m	-	Perbaungan
23.	Cemetery of King	2	-	Sipispis
24.	Stone of Ingotan	-	-	Sipispis
25.	Cave of Kemang	-	-	Sibolangit
26.	Old Klenteng of Pantai Cermin	-	-	Pantai Cermin
	TEBING TINGGI CITY			
27.	Old Town of Tebing Tinggi	4 ha	-	Tebing Tinggi

Source : Kantor Wilayah Departemen Pendidikan dan Kebudayaan Sumatera Utara (1988/1989). Data Status Bangunan Sejarah Purbakala, Medan.

Table 2-7 NUMBER OF HOSPITAL, BEDS AND HEALTH CENTERS IN THE STUDY AREA, 1988

Area	General Hospital	Bed	Health Center	Per thousand Populations		
				Hospital	Bed	Health Ctr
Kab. Deli Serdan	2	153	43	0.0013	0.10	0.028
T. Tinggi City	2	136	4	0.02	1.36	0.040
Medan City	19	2,181	31	0.011	1.21	0.017
Study Area	23	2,470	78	0.007	0.72	0.023
North Sumatra	53	6,316	302	0.005	0.62	0.030

Source: North Sumatra in Figures 1988

Table 2-8 NUMBER OF SUFFERERS BY KINDS OF DISEASES, 1988

No.	Kind of Diseases	Number of Sufferers					
		Kotamadya Medan	/'000	Kotamadya T. Tinggi	/'000	Kabupaten Deli Serdang	/'000
1.	Diarhea/Cholera	30,487	16.9	1,713	16.6	15,384	10.7
2.	Influenza	137,246	76.0	31	0.3	4,076	2.8
3.	Lung Tuberculosis	8,728	4.8	788	7.7	5,304	3.7
4.	Bronchitis	-	-	270	2.6	6,612	4.6
5.	Ricketzia	-	-	-	-	4,356	3.0
6.	Ascaris	3,681	2.0	-	-	5,308	3.7
7.	Scabies	3,978	2.2	-	-	5,568	3.9
8.	Pulmonary Diseases	19,924	11.0	13,271	128.8	75,360	52.4
9.	Small Fox	2,915	1.6	26	0.3	1,692	1.2
10.	Cough	-	-	5	0.0	456	0.3
11.	Gastric Diseases	-	-	754	7.3	19,584	13.6
12.	Skin Diseases	2,710	1.5	3,749	36.4	17,320	12.0
13.	Caries	22,002	12.2	163	1.6	5,640	3.9
14.	Conjunctivities	7,492	4.1	-	-	2,940	2.0
15.	Bacillary	4,923	2.7	-	-	-	-
16.	Mostoid	7,542	4.2	-	-	-	-
17.	Hepatitis	231	0.1	-	-	-	-
18.	Other Diseases (rabies, deficiency, etc.)	1,393	0.8	772	7.5	12,432	8.6

Source : Suamtera Utara Dalam Angka 1988

Table 2-9(1/10) RESULTS OF LABORATORY TEST

Location : Belawan River (Sampanan)

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	< 0.001	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	> 39.000	36.000	27.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.133	0.450	0.500
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	10.000	12.000	6.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	50.000	60.000	30.000
14.	Odor	-	ibid - 207	Like mud	Like mud	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	7.45	7.20	7.70
17.	BOD	mg/l	Std. Methods (*) - 507	16.173	228.770	13.100
18.	COD	mg 02/l	ibid - 508A/Titrimetry	25.200	39.270	21.600
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	45.300	67.900	93.700
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	10.600	21.200	10.600
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry - EDTA	49.200	36.600	40.930
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.073	0.275	0.240
24.	Manganese	mg/l	ASTM-D.858-77/AAS	0.020	0.050	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	Not detected	Not detected	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	< 0.010	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	0.100	< 0.050
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.500	1.330	1.500
30.	Temperature	C	Direct measurement with thermometer	30.000	28.500	29.500
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	6.510	5.270	4.820
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	10.660	7.310	9.870
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	91.333	114.000	131.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	85.000	120.000	100.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(2/10) RESULTS OF LABORATORY TEST

Location : Deli River (Kuala)

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	1 b 1 d	< 0.001	0.003	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	> 39.000	38.000	34.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.500	0.570	0.500
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	1.000	1.000	1.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	20.000	20.000	20.000
14.	Odor	-	ibid - 207	Normal	Normal	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	7.65	7.65	8.20
17.	BOD	mg/l	Std. Methods (*) - 507	11.880	8.530	12.800
18.	COD	mg 02/l	ibid - 508A/Titrimetry	19.013	14.270	21.600
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	84.733	75.400	103.700
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	13.270	26.500	25.400
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry - EDTA	74.200	66.170	60.500
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.020	0.155	0.160
24.	Manganese	mg/l	ASTM-D.858-77/AAS	Not detected	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	- ibid -	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	< 0.005	< 0.005
28.	Anion Active Agent (as HBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	< 0.050	< 0.050
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	9.670	9.830	8.500
30.	Temperature	C	Direct measurement with thermometer	27.50	26.50	27.50
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	8.610	8.140	6.260
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	17.767	14.870	15.500
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	136.000	123.000	131.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	140.000	130.000	150.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(3/10) RESULTS OF LABORATORY TEST

Location : Percut River (Sibiru-Biru)

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	0.002	0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	> 39.000	> 39.000	36.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.167	0.150	0.200
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	2.000	2.000	2.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	40.000	40.000	30.000
14.	Odor	-	ibid - 207	Normal	Normal	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	8.05	8.10	8.25
17.	BOD	mg/l	Std. Methods (*) - 507	8.150	8.470	11.700
18.	COD	mg 02/l	ibid - 508A/Titrimetry	15.230	13.500	18.350
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	102.630	107.780	116.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	35.760	31.800	21.200
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	83.650	88.780	79.900
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.123	0.132	0.140
24.	Manganese	mg/l	ASTM-D.858-77/AAS	Not detected	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	- ibid -	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	< 0.005	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	< 0.050	0.090
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.933	1.870	2.000
30.	Temperature	C	Direct measurement with thermometer	27.00	27.50	28.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	10.780	11.560	7.140
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	18.973	21.300	22.300
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	131.500	139.000	122.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	185.000	190.000	210.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(4/10) RESULTS OF LABORATORY TEST

Location : Ular River (Paku)

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	< 0.001	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	> 39.000	> 39.000	38.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.567	0.513	0.500
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	10.000	16.000	9.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	40.000	60.000	40.000
14.	Odor	-	ibid - 207	Like mud	Like mud	Like mud
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	7.70	7.15	7.60
17.	BOD	mg/l	Std. Methods (*) - 507	12.120	21.087	17.200
18.	COD	mg 02/l	ibid - 508A/Titrimetry	21.547	32.033	27.800
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	100.033	82.500	91.300
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	8.840	15.333	10.660
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry - EDTA	52.433	37.567	48.560
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.153	0.113	0.130
24.	Manganese	mg/l	ASTM-D.858-77/AAS	0.066	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	Not detected	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	< 0.005	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	< 0.050	0.120
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.000	1.367	1.500
30.	Temperature	C	Direct measurement with thermometer	26.50	25.50	25.50
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	8.073	5.560	6.230
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	11.626	7.293	10.700
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	112.000	105.333	103.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	165.000	150.000	170.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(5/10) RESULTS OF LABORATORY TEST

Location : Padang River (Sampanan)

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	0.002	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group					
	Bacteria	*MPN/100 ml*	*Std.Methods (*) - 908/MPN Test*	*> 39.000*	39.000	*> 39.000*
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.133	0.156	0.160
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	6.000	5.000	6.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	50.000	40.000	40.000
14.	Odor	-	ibid - 207	Normal	Normal	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	7.20	7.10	7.05
17.	BOD	mg/l	Std. Methods (*) - 507	12.320	17.733	14.330
18.	COD	mg 02/l	ibid - 508A/Titrimetry	18.773	28.767	24.650
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	62.566	40.300	71.900
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	6.187	9.730	5.300
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	24.200	30.600	17.230
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.033	0.053	0.060
24.	Manganese	mg/l	ASTM-D.858-77/AAS	Not detected	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	- ibid -	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	< 0.005	< 0.005
28.	*Anion Active Agent*					
	(as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	< 0.050	< 0.050
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.333	1.050	1.100
30.	Temperature	C	Direct measurement with thermometer	29.00	27.50	28.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	3.950	4.663	2.110
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	4.193	5.270	3.970
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	132.667	74.000	86.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	62.000	55.000	55.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(6/10) RESULTS OF LABORATORY TEST

Location : Medan/Deep Well-Tirtanadi/Jln. Langkat-Belawan

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	1 b 1 d	0.002	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	Not detected	Not detected	Not detected
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.530	0.567	0.600
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	4.000	4.000	4.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	30.000	30.000	35.000
14.	Odor	-	ibid - 207	Like mud	Like mud	Like mud
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	6.95	7.15	7.25
17.	BOD	mg/l	Std. Methods (*) - 507	15.230	17.170	12.300
18.	COD	mg O2/l	ibid - 508A/Titrimetry	26.720	25.267	21.600
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	121.967	120.173	112.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	6.890	15.900	10.600
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry - EDTA	48.400	37.600	36.300
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.103	0.126	0.160
24.	Manganese	mg/l	ASTM-D.858-77/AAS	0.020	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	Not detected	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	0.009	0.030	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	< 0.050	0.050
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.067	1.133	1.200
30.	Temperature	C	Direct measurement with thermometer	32.00	31.00	32.50
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	7.890	6.970	6.280
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	8.393	4.580	5.790
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.200	0.200	0.200
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	200.333	136.333	119.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	640.000	610.000	630.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(7/10) RESULTS OF LABORATORY TEST

Location : Medan/Shallow Well (1)/Kecamatan Medan Labuhan

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	< 0.001		< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300		< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	2.00	4.00	4.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.500	0.930	0.900
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	2.00	5.000	4.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	30.000	50.000	40.000
14.	Odor	-	ibid - 207	Normal	Like mud	Like mud
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	6.70	7.20	6.55
17.	BOD	mg/l	Std. Methods (*) - 507	10.560	20.433	13.900
18.	COD	mg O2/l	ibid - 508A/Titrimetry	18.453	36.660	24.200
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	223.470	371.300	371.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	68.933	79.600	67.800
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	216.933	207.330	202.670
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.153	0.139	0.140
24.	Manganese	mg/l	ASTM-D.858-77/AAS	Not detected	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	- ibid -	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	0.050	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	< 0.050	0.240	0.130
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	18.667	21.170	20.000
30.	Temperature	C	Direct measurement with thermometer	28.00	27.00	29.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	25.567	23.930	22.710
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	51.270	49.760	49.530
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	0.117	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.400	0.400	0.400
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	260.000	412.333	398.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	700.000	670.000	650.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(8/10) RESULTS OF LABORATORY TEST

Location : Medan/Shallow Well (2)/Titi Kuning-Kec. Medan Johor

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	< 0.001	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	34.000	>39.000	30.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	4.830	3.290	3.850
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	1.000	1.000	2.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	20.000	20.000	30.000
14.	Odor	-	ibid - 207	Normal	Normal	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	6.50	6.85	6.20
17.	BOD	mg/l	Std. Methods (*) - 507	12.480	11.670	11.600
18.	COD	mg 02/l	ibid - 508A/Titrimetry	18.400	18.233	18.400
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	358.667	321.200	346.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	76.070	84.900	79.600
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	281.670	234.000	256.670
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.250	0.242	0.240
24.	Manganese	mg/l	ASTM-D.858-77/AAS	Not detected	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	- ibid -	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	< 0.005	0.030	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	5.100	< 0.050	0.060
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	9.830	11.167	11.000
30.	Temperature	C	Direct measurement with thermometer	27.50	27.50	28.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	35.130	26.010	34.070
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	63.900	57.500	55.350
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	0.100	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.200	0.200	0.200
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	420.000	368.670	383.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	600.000	550.000	580.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-9(9/10) RESULTS OF LABORATORY TEST

Location : Tebing Tinggi/Deep Well-Tirtabulian/Puskesmas Lubuk Baru

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	- ibid -	- ibid -
3.	Organic Mercury	mg/l	i b i d	< 0.001	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	- ibid -	- ibid -
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	- ibid -	- ibid -
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	- ibid -	- ibid -
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	- ibid -	- ibid -
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	Not detected	Not detected	Not detected
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	0.533	4.870	5.000
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	3.000	2.000	2.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	30.000	30.000	30.000
14.	Odor	-	ibid - 207	Like sulphide	Like sulphide	Like sulphide
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	7.90	8.25	8.15
17.	BOD	mg/l	Std. Methods (*) - 507	14.640	18.950	15.700
18.	COD	mg 02/l	ibid - 508A/Titrimetry	21.250	31.533	24.650
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	91.567	134.000	131.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	14.667	15.900	10.400
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	21.800	60.300	14.500
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.283	0.217	0.300
24.	Manganese	mg/l	ASTM-D.858-77/AAS	0.083	0.050	0.060
25.	Copper	mg/l	ASTM-D.1688-77/AAS	0.043	0.030	0.030
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	Not detected	Not detected	Not detected
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	0.007	< 0.005	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	0.130	< 0.050	0.100
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	1.133	1.170	1.500
30.	Temperature	C	Direct measurement with thermometer	35.00	35.50	35.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	3.257	14.070	2.100
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	4.193	4.597	2.950
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	Not detected	Not detected	Not detected
34.	Salinity	g/kg	Std.Methods (*)-205	0.200	0.200	0.200
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	298.000	164.000	249.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	489.000	580.000	500.000

(*) : *Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.*

Table 2-9(10/10) RESULTS OF LABORATORY TEST

Location : Tebing Tinggi (Shallow Well)- Kampung Melayu

No.	Parameters	Unit	Methods/Description	(1) Level (Av.Value)	(2) Level (Av.Value)	(3) Level (Av.Value)
1.	Cyanide Ions	mg/l	ASTM-D.2036-75/Colorimetry	Not detected	Not detected	Not detected
2.	Mercury	mg/l	ASTM-D.3223-73/Cold Vapor AAS	- ibid -	-ibid-	-ibid-
3.	Organic Mercury	mg/l	i b i d	0.002	< 0.001	< 0.001
4.	Organophosphorus	mg/l	Std.Methods (*) - 424F/Colorimetry	< 0.300	< 0.300	< 0.300
5.	Cadmium	mg/l	ASTM-D.3557-78/AAS	Not detected	Not detected	Not detected
6.	Lead	mg/l	ASTM-D.3559-78/AAS	- ibid -	-ibid-	-ibid-
7.	Chromium	mg/l	ASTM-D.1687-77/AAS	- ibid -	-ibid-	-ibid-
8.	Arsenic	mg/l	ASTM-D.2972-78/AAS	- ibid -	-ibid-	-ibid-
9.	Fluoride	mg/l	ASTM-D.1179-72/Colorimetry	- ibid -	-ibid-	-ibid-
10.	Coliform Group Bacteria	MPN/100 ml	Std.Methods (*) - 908/MPN Test	< 39.000	38.000	38.000
11.	Nitrate Nitrogen	mg/l	ASTM-d.992-71/Colorimetry	4.670	4.933	5.000
12.	Turbidity	NTU	Std.Methods (*)-214A/Nephelometric Method	5.000	4.000	3.000
13.	Color	Color Units	ibid - 204A/Visual Comparison	40.000	40.000	30.000
14.	Odor	-	ibid - 207	Normal	Normal	Normal
15.	Taste	-	ibid - 211	Normal	Normal	Normal
16.	pH Value	-	Direct measurement with pH-meter	6.050	6.20	5.95
17.	BOD	mg/l	Std. Methods (*) - 507	11.790	17.920	16.700
18.	COD	mg 02/l	ibid - 508A/Titrimetry	19.630	27.700	27.200
19.	Dissolved Material	mg/l	ibid - 209B/Gravimetry	237.000	110.130	168.000
20.	Ammonium Nitrogen	mg/l	ASTM-D.1426-79/Colorimetry	Not detected	Not detected	Not detected
21.	Chlorine Ions	mg/l	ASTM-D.512-67/Titrimetry	4.950	4.933	5.240
22.	Hardness	mg/l	ASTM-D.1126-67/Titrimetry-EDTA	50.000	55.900	98.000
23.	Iron	mg/l	ASTM-D.1068-78/AAS	0.103	0.217	0.250
24.	Manganese	mg/l	ASTM-D.858-77/AAS	0.023	Not detected	Not detected
25.	Copper	mg/l	ASTM-D.1688-77/AAS	Not detected	- ibid -	- ibid -
26.	Zinc	mg/l	ASTM-D.1691-77/AAS	- ibid -	- ibid -	- ibid -
27.	Phenols	mg/l	Std.Method (*)-510.D/GLC	<0.005	< 0.005	< 0.005
28.	Anion Active Agent (as MBAS)	mg/l	ibid - 512B/Colorimetry	0.870	0.250	0.350
29.	Sulphate Ions	mg/l	ASTM-D.515-78/Colorimetry	2.000	1.500	1.600
30.	Temperature	C	Direct measurement with thermometer	26.00	28.00	27.00
31.	Magnesium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	6.740	10.780	21.520
32.	Calcium	mg/l	ASTM-D.511-77/Titrimetry-EDTA	10.660	8.537	10.700
33.	Nitrite Nitrogen	mg/l	ASTM-D.154-67/Colorimetry	0.170	0.233	0.670
34.	Salinity	g/kg	Std.Methods (*)-205	0.000	0.000	0.000
35.	Evaporation Residue	mg/l	ibid - 209A/Gravimetry	296.000	186.000	189.000
36.	Conductivity	umhos/cm	ibid - 205/Electrical Conductivity	185.000	199.000	180.000

(*) : Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

Table 2-10(1/4) WATER QUALITY STANDARDS IN INDONESIA (DRINKING WATER)

	Parameter	Unit	Maximum Value	Explanation
	PHYSICAL :			
1.	Odour	-	-	No odour
2.	Total dissolved solid (TDS)	mg/l	1000	
3.	Turbidity	NTU Scale	5	
4.	Taste	-	-	No taste
5.	Temperature	C	Air, 3 C	
6.	Colour	TCU Scale	15	
	INORGANICS :			
1.	Mercury	mg/l	0.001	
2.	Aluminium	mg/l	0.2	
3.	Arseric	mg/l	0.05	
4.	Barium	mg/l	1.0	
5.	Iron	mg/l	0.3	
6.	Flouride	mg/l	0.5	
7.	Cadmium	mg/l	0.005	
8.	Alkalinity (CaCo3)	mg/l	500	
9.	Chloride	mg/l	250	
10.	Chromium, Hexavalent	mg/l	0.05	
11.	Manganese	mg/l	0.1	
12.	Sodium	mg/l	200	
13.	Nitrogen, as Nitrite	mg/l	10	
14.	Nitrogen, as Nitrate	mg/l	1.0	
15.	Silver	mg/l	0.15	
16.	Ph	-	6.5 - 8.5	As min. and max.
17.	Selenium	mg/l	0.01	
18.	Zinc	mg/l	5	
19.	Cyianide	mg/l	0.1	
20.	Sulphate	mg/l	400	
21.	Sulphide, as H2S	mg/l	0.05	
22.	Copper	mg/l	1.0	
23.	Lead	mg/l	0.05	
	ORGANICS :			
1.	Aldrin and Dieldrin	mg/l	0.0007	
2.	Benzene	mg/l	0.01	
3.	Benzo (n) pyrene	mg/l	0.00001	
4.	Chlordane (Total isomer)	mg/l	0.0003	
5.	Chloroform	mg/l	0.03	
6.	2,4 - D	mg/l	0.10	
7.	D D T	mg/l	0.03	
8.	Detergen	mg/l	0.5	
9.	1,2 - Dichloroethene	mg/l	0.01	
10.	1,1 - Dichloroethene	mg/l	0.0003	
11.	Heptachlor and Heptachlor-epoxide		0.003	
12.	Hexachlorobenzene	mg/l	0.00001	
13.	Lindane	mg/l	0.004	
14.	Methoxychlor	mg/l	0.03	
15.	Pentachlorophenolic	mg/l	0.01	
16.	Pesticides Total	mg/l	0.1	
17.	2,4,6 - Trichlorophenelic	mg/l	0.01	
18.	Organic Compound (KMnO4)	mg/l	10	
	MICROBIOLOGY :			
1.	Coliforms fecal	Total/100 ml	0	
2.	Coliform Total	Total/100 ml	3	
	RADIOACTIVITY :			
1.	Gross Alpha Activity	Bq/l	0.1	
2.	Gross Beta Activity	Bq/l	1.0	

Source : Peraturan Pemerintah Republik Indonesia
No. 20 Tahun 1990

Table 2-10(2/4) WATER QUALITY STANDARDS IN INDONESIA (DRINKING WATER THROUGH TREATMENT)

No.	Parameter	Unit	Maximum Value	Explanation
	PHYSICAL :			
1.	Temperature	C	Normal	No odour
2.	Total dissolved solid (TDS)	mg/l	1000	
	INORGANICS :			
1.	Mercury	mg/l	0.001	
2.	Nitrogen, as amonia	mg/l	0.5	
3.	Arseric	mg/l	0.05	
4.	Barium	mg/l	1	
5.	Iron	mg/l	5	
6.	Flouride	mg/l	1.5	
7.	Cadmium	mg/l	0.01	
8.	Chloride	mg/l	600	
9.	Chromium, Hexavalent	mg/l	0.05	
10.	Manganese	mg/l	0.5	
11.	Nitrogen, as Nitrite	mg/l	10	
12.	Nitrogen, as Nitrate	mg/l	1	
13.	Dissolved Oxygen (DO)	mg/l	*	Recommended more than 6
14.	Ph	-	5 - 9	
15.	Selenium	mg/l	0.01	
16.	Zinc	mg/l	5	
17.	Cyianide	mg/l	0.1	
18.	Sulphate	mg/l	400	
19.	Sulphide, as H2S	mg/l	0.1	
20.	Copper	mg/l	1	
21.	Lead	mg/l	0.1	
	ORGANICS :			
1.	Aldrin and Dieldrin	mg/l	0.017	
2.	Chlordane (Total isomer)	mg/l	0.003	
3.	D D T	mg/l	0.042	
4.	Endrin	mg/l	0.001	
5.	Phenolic	mg/l	0.002	
6.	Heptachlor and Heptachlor-epoxide	mg/l	0.018	
7.	Carbon Chloroform exstrac	mg/l	0.5	
8.	Lindane	mg/l	0.056	
9.	Methoxychlor	mg/l	0.035	
10.	Oil and Grease	mg/l	Nihil	
11.	Organo phosphate and Carbamate	mg/l	0.1	
12.	Methylene Blue Active Substance (Surfactans)	mg/l	0.5	
13.	P C B	mg/l	Nihil	
14.	Toxaphene	mg/l	0.005	
	MICROBIOLOGY :			
1.	Coliforms fecal	Total/100 ml	2,000	
2.	Coliform Total	Total/100 ml	10,000	
	RADIOACTIVITY :			
1.	Gross Alpha Activity	Bq/l	0.1	
2.	Gross Beta Activity	Bq/l	1.0	

Source : Peraturan Pemerintah Republik Indonesia
No. 20 Tahun 1990

Table 2-10(3/4) WATER QUALITY STANDARDS IN INDONESIA (FISHERY AND LIVESTOCK FARMING)

No.	Parameter	Unit	Maximum Value	Explanation
	PHYSICAL :			
1.	Temperature	C	Normal, 3 C	No odour
2.	Total dissolved solid (TDS)	mg/l	1000	
	INORGANICS :			
1.	Mercury	mg/l	0.002	
2.	Nitrogen, as amonia	mg/l	0.02	
3.	Arseric	mg/l	1	
4.	Flouride	mg/l	1.5	
5.	Cadmium	mg/l	0.01	
6.	Chlorine	mg/l	0.003	
7.	Chromium, Hexavalent	mg/l	0.05	
8.	Nitrogen, as Nitrate	mg/l	0.06	
9.	Dissolved Oxygen (DO)	mg/l	*	Recomended more than 3
10.	Ph	-	6 - 9	
11.	Selenium	mg/l	0.05	
12.	Zinc	mg/l	0.02	
13.	Cyianide	mg/l	0.02	
14.	Sulphide, as H2S	mg/l	0.002	
15.	Copper	mg/l	0.02	
16.	Lead	mg/l	0.03	
	ORGANICS :			
1.	B H C	mg/l	0.21	
2.	D D T	mg/l	0.002	
3.	Endrin	mg/l	0.004	
4.	Phenolic	mg/l	0.001	
5.	Oil and Grease	mg/l	1	
6.	Organo phosphate and Carbamate	mg/l	0.1	
7.	Methylene Blue Active Substance (Surfactans)	mg/l	0.2	
	RADIOACTIVITY :			
1.	Gross Alpha Activity	Bq/l	0.1	
2.	Gross Beta Activity	Bq/l	1.0	

Source : Peraturan Pemerintah Republik Indonesia No. 20 Tahun 1990

Table 2-10(4/4) WATER QUALITY STANDARDS IN INDONESIA
(AGRICULTURE ,URBAN, INDUSTRY AND HYDROELECTRICITY)

No.	Parameter	Unit	Maximum Value	Explanation
	PHYSICAL :			
1.	Electric Conductivity	Umbos/cm (25 C)	2.250	Depending on kind of the plant, the maximum vakue fir the plant which is not sensitive
2.	Temperature	C	Normal, 3 C	According to local condition
3.	Total dissolved solid	mg/l	2.000	Depending on kind of the plant, the maximum vakue fir the plant which is not sensitive
	INORGANICS :			
1.	Mercury	mg/l	0.005	
2.	Arseric	mg/l	1	
3.	Boron	mg/l	1	
4.	Cadmium	mg/l	0.01	
5.	Cobalt	mg/l	0.02	
6.	Chromium, Hexavalent	mg/l	1	
7.	Manganese	mg/l	2	
8.	Sodium	mg/l	60	
9.	Nickel	mg/l	0.5	
10.	Ph	-	6 - 9	
11.	Selenium	mg/l	0.05	
12.	Zinc	mg/l	2	
13.	Sodium Absorption Ratio (SAR)	mg/l	18	Depending on kind of the plant, the maximum vakue fir the plant which is not sensitive
14.	Copper	mg/l	0.2	
15.	Lead	mg/l	1	
16	Residual Sodium Carbonate (RSC)	mg/l	1.25-2.5	1.25 for the sensitive plant and 2.50 for the unsensitive plant
	RADIOACTIVITY :			
1.	Gross Alpha Activity	Bq/l	0.1	
2.	Gross Beta Activity	Bq/l	1.0	

Source : Peraturan Pemerintah Republik Indonesia
No. 20 Tahun 1990

Table 3-1 RESULTS OF WATER SAMPLING AND TEST

PREPARATERS			DOWN STREAM DELI RIVER				DOWN STREAM PERCUT RIVER				DOWN STREAM PADANG RIVER						DAM SITE		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Colour		PtCo	150.0	102.0	117.0	75.0	192.0	133.0	184.0	157.0	231.0	85.0	207.0	113.0	95.0	164.0	24.0	23.0	29.0
2. Odour			Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
3. PH			6.30	6.60	6.80	6.80	5.90	6.80	6.70	6.90	6.70	7.00	7.20	7.05	6.95	6.90	7.90	7.60	7.70
4. Taste			Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor	Nor
5. Turbidity		FTU	25.00	18.00	75.00	14.00	31.00	26.00	31.00	29.00	35.00	19.00	51.00	95.00	27.00	36.00	4.00	3.00	3.00
6. Temperature		%C	27.40	30.90	29.80	30.90	27.50	28.10	27.70	28.20	28.70	31.00	29.50	29.10	31.50	32.00	28.60	26.30	26.90
7. Ammonium	(NH4)	mg/l	1.84	1.09	0.88	0.26	0.70	0.52	0.95	0.67	0.77	0.48	0.67	0.47	0.48	0.44	0.00	0.00	0.00
8. Calcium	(Ca)	mg/l	16.64	18.72	16.64	16.64	29.12	16.64	14.56	24.96	33.28	10.40	10.40	4.16	6.24	6.24	24.96	22.88	20.80
9. Copper	(Cu)	mg/l	0.80 a	0.40 a	0.35 a	0.07 a	0.36 a	0.31 a	0.29 a	0.21 a	0.22 a	0.12 a	0.10 a	0.08 a	0.06 a	0.04 a	0.02 a	0.02 a	0.02
10. Iron	(Fe)	mg/l	0.50	0.20	0.40	0.03	0.80	0.20	0.03	0.04	0.08	0.18	0.08	0.07	0.06	0.06	0.06	0.14	0.04
11. Manganese	(Mn)	mg/l	1.00 b	0.60 a	0.50 a	0.00	0.62 b	0.18 a	0.20 a	0.12 a	0.20 a	0.06 a	0.04	0.04	0.03	0.02	0.07	0.08	0.07
12. Magnesium	(Mg)	mg/l	0.70	3.79	5.05	5.05	46.75	5.05	5.05	1.26	7.58	2.53	1.26	3.79	3.79	7.58	5.05	7.58	5.05
13. Zinc	(Zn)	mg/l	0.04	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
14. Chloride	(Cl)	mg/l	43.33	33.85	56.88	37.86	656.53 b	56.88	32.47	32.47	35.70	6.71	13.41	20.12	26.83	26.83	33.54	33.54	26.83
15. Fluoride	(F)	mg/l	0.14 a	0.36 a	0.27 a	0.41 a	0.22 a	0.54 a	0.21 a	0.56 a	0.00	0.50 a	0.56 a	0.72 a	0.37 a	0.20 a	0.15 a	0.14 a	0.16
16. Nitrate	(NO3)	mg/l	1.02	0.72	1.21	1.75	1.30	1.01	1.30	0.97	1.42	1.25	1.41	1.02	1.13	0.95	0.40	0.40	0.20
17. Nitrate	(NO2)	mg/l	0.003 a	0.002 a	0.004 a	0.002 a	0.002 a	0.006 a	0.008 a	0.004 a	0.005 a	0.004 a	0.005 a	0.003 a	0.004 a	0.005 a	0.02 a	0.02 a	0.02
18. Phosphate	(PO4)	mg/l	1.42	0.72	0.63	0.15	0.75	0.70	0.62	0.22	0.95	0.53	0.27	0.15	0.62	0.65	0.38	0.16	0.35
19. Sulphate	(SO4)	mg/l	10.00	8.00	16.00	15.00	77.50	10.00	10.00	9.00	10.00	0.00	5.00	0.00	0.00	0.00	11.00	9.00	11.00
20. Barium	(Ba)	mg/l	0.18 a	0.80 a	0.08 a	0.02 a	0.04 a	0.04 a	0.04 a	0.04 a	0.04 a	0.02 a	0.02 a	0.02 a	0.02 a	0.02 a	0.01 a	0.01 a	0.01
21. Cadmium	(Cd)	mg/l	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01
22. Cyanide	(CN)	mg/l	0.12 b	0.09 b	0.02 a	0.01 a	0.12 b	0.10 b	0.09 b	0.01 a	0.04 a	0.02 a	0.02 a	0.01 a	0.03 a	0.02 a	0.01 a	0.01 a	0.01
23. Chrom Heaxavalent	(Cr4)	mg/l	0.05 a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24. Lead	(Pb)	mg/l	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10 a	0.10
25. Mercury	(Hg)	mg/l	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	<0.001 c	0.001
26. Selenium	(Se)	ppb	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00 a	5.00
27. BOD.5 days 20%C		mg/l	20.12 a	17.20 a	18.76 a	5.51 a	22.97 a	12.60 a	17.38 a	26.60 a	36.40 a	15.20 a	21.60 a	10.40 a	13.20 a	11.10 a	8.90 a	8.60 a	8.60
28. COD. (by K2Cr207)		mg/l	26.24 a	23.68 a	22.96 a	13.12 a	42.64 a	26.24 a	22.96 a	36.08 a	42.60 a	24.88 a	44.16 a	18.93 a	25.95 a	18.93 a	13.39 a	11.90 a	11.90
29. Organic Matter (KmnO4)		mg/l	27.81	22.18	14.03	13.04	27.81	22.17	25.91	24.71	28.44	26.59	37.22	20.96	25.34	21.20	10.90	10.95	10.32
30. Surfactans Anionic as MBAS		mg/l	0.25	0.13	0.12	0.05	0.07	0.05	0.15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
31. Dissolved Solid		mg/l	139.0	103.0	87.5	79.9	11.6	84.2	81.9	93.9	85.3	43.1	37.1	36.2	40.5	39.4	105.0	110.0	103.0
32. Dissolved Oxygen		mg/l	4.40	4.80	5.60	5.80	5.40	5.50	5.50	5.70	5.50	4.90	4.05	4.70	4.80	4.70	4.50	4.60	4.70
33. Residue on Evapporation		mg/l	166.0	236.0	180.0	180.0	1.4	260.0	222.0	254.0	314.0	210.0	196.0	56.0	84.0	52.0	178.0	188.0	196.0
34. Suspended Solid		mg/l	27.0	133.0	92.5	100.1	281.0	175.8	140.1	180.1	228.7	166.9	153.9	19.8	43.5	12.6	73.0	78.0	93.0
35. Oil & Grease		mg/l	4.00 b	3.00 b	2.00 b	0.00 b	5.00 b	3.00 b	3.00 b	1.00 b	1.00 b	2.00 b	2.00 b	1.00 b	1.00 b	1.00 b	0.00 b	0.00 b	0.00
36. Phenolic Compound		mg/l	0.006 b	0.006 b	0.006 b	0.050 b	0.007 b	0.007 b	0.006 b	0.005 b	0.000 b	0.007 b	0.006 b	0.006 b	0.005 b	0.005 b	0.010 b	0.010 b	0.010
37. Sulfide		mg/l	0.044 b	0.020 b	0.054 b	0.013 b	0.027 b	0.029 b	0.027 b	0.004 b	0.029 b	0.080 b	0.016 b	0.022 b	0.021 b	0.039 b	0.000 b	0.000 b	0.010
38. M.O. Alkanity	CaCO3	mg/l	106	117.8	129.5	129.5	176.7	141.3	141.3	153.1	141.3	159.03	182.59	164.92	141.36	129.58	223.82	179.06	188.48
39. P.P Alkalinity	CaCO3	mg/l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40. Total Alkalinity	CaCO3	mg/l	106.0	117.8	129.5	129.5	176.7	141.3	141.3	153.1	141.3	159.0	182.6	164.9	141.4	129.6	223.8	179.1	188.5
41. Total Hardness	CaCO3	mg/l	67.60	62.40	62.40	62.40	265.20	62.40	57.20	67.60	114.40	36.40	31.20	26.00	31.20	46.80	83.20	88.40	72.80
42. Total P.		mg/l	0.44	0.22	0.18	0.03	0.22	0.20	0.17	0.05	0.29	0.15	0.08	0.03	0.20	0.19	0.08	0.03	0.10

Note :

Location : 1. Labuhan Deli 2. Guru Patimpus 3. Raden Saleh 4. Titi Kuning 5. Percut 6. Cinta Damai 7. Tegal Sari 8. Amplas I 9. Amplas II 10. GSBK 11. Brohol I 12. Brohol II 13. Mangga Dua Dalam 14. Tambangan 15. Upstream Dam Site 16. Dam Site 17. Downstream Dam Site

a = above maximum value advisable
b = above maximum value acceptable
c = under maximum value detected

Table 3-2 RESULTS OF AIR QUALITY ANALYSIS

Location/Item	NOX (mg/m3)	NH3 (mg/m3)	SO2 (mg/m3)	H2S (mg/m3)	Pb (mg/l)	H2S (mg/m3)	Noise Level(dB)
Dam Site Area							
- Sibiru-biru	0.0018(0.0108)a	Ud	Ud	Ud	Ud	57.76(346.56)b	56.4 - 68.2
- Pertumbukan	0.0024(0.0144)a	Ud	Ud	Ud	Ud	64.10(384.6)b	34.4 - 44.6
Deli River							
- Tit Kuning	0.0024(0.0144)a	Ud	Ud	Ud	Ud	66.52(399.1)b	52.0 - 56.2
- Labuhan Deli	0.0076(0.456)	Ud	Ud	Ud	0.37(2.22)b	108.33(649.98)a	62.8 - 77.4
Percut River							
- Guru Patimpus	0.0037(0.0222)	Ud	Ud	Ud	Ud	37.75(214.5)a	54.6 - 56.8
- Amplas	0.0025(0.015)a	Ud	Ud	Ud	0.71(4.26)b	158.65(951.9)b	50,2 - 66.2
Padang River							
- Measuring Value	0.0018(0.108)a	0.0002(0.0012)a	0.013(0.78)a	Ud	0.71(4.26)b	158.65 a	50.2 - 66.2

(Note) Value in parenthesis is after conversion into 24 hours.

Ud : Undetected

a : Below standard quality

b : Above standard quality

Table 3-3(1/2) NUMBER AND KIND OF PLANKTONS (PHYTOPLANKTONS)

No.	ORGANISM	Dam Site					PERCUT RIVER					DELI RIVER				PADANG RIVER				
		I	II	III	IV	V	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	X
1	Ankistrodesma	1					1												
2	Chactophora												1		3				
3	Diatomae	32	6	10	13	15	32	6	10	13	15	6	5	4	9	5	10	11	4	
4	Euglena	7	5	5	10	14	7	5	5	10	14	6	3	5	2	5	5	2	4	
5	Fragillaria	3				25	3				25									
6	Gyosigma	1			1		1			1										
7	Gomphonema	1			11		1			11										
8	Melosira		4					4												
9	Microcystis		2	2				2	2			2	1	1	6					
10	Closterium	4		1	6	3	4		1	6	3									
11	Navicula	5					5					2		2	8					
12	Gedogonium	2	1	2	1		2	1	2	1			1	2						
13	Oscillatoria	28	5	10	13	15	28	5	10	13	15	25	6	5	7	5	4	5	3	
14	Ophillia	2					2													
15	Spirogyra		10	2	6	3		10	2	6	3	2	1	2			1	1		
16	Volvax	5	4	4	9	13	5	4	4	9	13	10	7	4	5	9	4	5	1	
17	Zymnema		2		2	1		2		2	1	2	5		3					
18	Anabaena											3	6	8	1	2				
19	Chara											1					1			
20	Coelastrum											3	1	2		2		2		
21	Nostoc														2			3		
22	Thoria											1		1						
23	Oluthrix											2								
24	Pleurococus																			
25	Amphanizemenen															10	3	4	1	
26	Cymbella															1	5	4	4	
27	Tabelleria															2	5	12	8	
	Total Phytoplankton	91	39	36	73	64	91	39	36	73	64	65	39	36	44	44	39	49	25	
	Shanon Diversity Index	0.787	0.881	0.787	0.919	0.733	0.787	0.881	0.787	0.919	0.733	0.887	0.947	0.961	0.909	0.909	0.906	0.897	0.763	

Table 3-3(2/2) NUMBER AND KIND OF PLANKTONS (ZOOPLANKTONS)

No.	ORGANISM	Dam Site					PERCUT RIVER					DELI RIVER				PADANG RIVER				
		I	II	III	IV	V	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	X	
1	Auraera								1											
2	Dinoplisis							5												
3	Chanthocanytus	1			1					1			1				1			
4	Cyclops	1			1	2			1	1	1		1	2						
5	Dafnia	4								4										
6	Epirtilis		5	13		7		18	21	5		5	13		7	3	1		19	
7	Euchlaris							2												
8	Pilodina							4	1			5					1	1		
9	Notius	3			2	1				1				2	1			1		
10	Ratipera	3		2			2	6		3			2							
11	Paramaecium	3				1	2	2	3	2					1	5	1	5	2	
12	Stentor		5			7						5			7					
13	Vorticella	6	15	2	1	2	5	2	3	6		15	2	1	2				1	
14	Pterodina	2								3				2						
15	Diurella																		1	
16	Nauplius																		1	
17	Stylonicia																	3		
	Total Zooplankton	21	31	17	7	20	9	40	29	6	21	31	17	7	20	8	3	11	24	
	Shanon Diversity Index	0.820	0.456	0.308	0.518	0.649	0.432	0.728	0.406	0.196	0.820	0.456	0.308	0.518	0.644	0.128	0.477	0.540	0.343	

Table 3-4(1/4) NUMBER OF VEGETATION (LAUSIMEME DAM)

No.	Name of Species	Sampling Point													Total	F	D	K	FR (%)	DR (%)	KR (%)	IV	SDR
		1	2	3	4	5	6	7	8	9	10	11	12	13									
1	Artocarpus elasticus Rewin	2				1	1		3		1			2	10	6	0.091	12.50	6.59	3.15	3.14	12.08	4.29
2	Aleurites Moluccana. Wild	3								2		1			6	3	0.010	7.50	3.29	1.83	1.87	6.99	2.33
3	Albizzia Falcata. Back	2		3				12		4					21	4	0.066	26.25	4.40	6.71	6.60	17.71	5.90
4	Arenga Pinnata (Wurmb). Merr				3		1		1		1				6	4	0.018	7.50	4.40	1.83	1.87	8.10	2.70
5	Artocarpus integra. Merr		2							1					3	2	0.009	3.75	2.20	0.91	0.94	4.05	1.35
6	Bambusa. Sp										30		11		41	2	0.128	51.25	2.20	13.00	12.89	28.09	9.36
7	Baccaurea montleyana Muell			2				1		1			1		5	4	0.015	6.25	4.40	1.52	1.57	7.49	2.50
8	Brugmansia candida. Pers									1					1	1	0.003	1.25	1.10	0.30	0.31	1.71	0.57
9	Coccos nucifera. l		4		1										5	2	0.015	6.25	2.20	1.52	1.57	5.29	1.76
10	Coffea arabica				20	50		3			10				83	4	0.261	103.75	4.40	26.52	26.10	57.02	19.61
11	Durio zibathinus. Merr	1		2								1			4	3	0.012	5.00	3.29	1.22	1.26	5.77	1.92
12	Daemonorops. sp								1		6		12		19	3	0.059	23.75	3.29	5.99	5.97	15.25	5.08
13	Datua metel. L										2			1	3	2	0.009	3.75	2.22	0.91	0.94	4.05	1.35
14	Erithrina subumbrans. Merr				2	1									3	2	0.009	3.75	2.22	0.91	0.94	4.05	1.35
15	Eugenia aquea Burm. f				1										1	1	0.003	1.25	1.10	0.30	0.31	1.71	0.57
16	Garcinia mangostana					3									3	1	0.009	3.25	1.10	0.91	0.94	2.95	0.98
17	Aportea stimulans. Meq.				1										1	1	0.003	1.25	1.10	0.30	0.31	1.71	0.57
18	Havea brasilienssis.Muell.Agr.				1	2									9	4	0.028	11.25	4.40	2.85	2.83	10.08	3.36
19	Lansium Domesticum		2	1	1	1						5		1	5	4	0.015	6.25	4.40	1.52	1.57	7.49	2.50
20	Jasminum Multiflorum. L			1				1		1					2	2	0.006	2.50	2.20	0.61	1.63	3.44	1.15
21	Ocinum sanctum. L				1		1								2	2	0.006	2.50	2.20	0.61	0.63	3.44	1.15
22	Adina Fogifolia				2										2	1	0.006	2.50	1.10	0.61	0.63	2.34	0.78
23	Pasidium guajava. L		1							1					2	2	0.006	2.50	2.20	0.61	0.63	3.44	1.15
24	Mangifera indica				1										1	1	0.003	1.25	1.10	0.30	0.31	1.17	0.57
25	Musa paradisiaca. Linn		15		6				6		5				32	4	0.100	40.00	4.40	10.16	10.06	24.62	8.21
26	Senicio sonchipolius. Moench	1						1							2	2	0.006	2.50	2.20	0.61	0.63	3.44	1.15
27	Pithecellobium jiringa. Jack	1		1	1		1					2		1	7	6	0.022	8.75	6.59	2.24	2.20	11.03	3.68
28	Shorea. sp						1								5	2	0.015	6.25	2.20	1.52	1.57	5.29	1.76
29	Octomeles sumaterana. Miq			1		1									2	2	0.006	2.50	2.20	0.61	0.63	3.44	1.55
30	Pithecellobium dulche. Benth											2		2	4	2	0.006	5.00	2.20	0.61	1.26	4.07	1.36
31	Delonik regia							1	1				4	2	4	3	0.012	5.00	3.29	1.22	1.26	5.77	1.92
32	Peper aduncum. L				1						10				11	2	0.054	13.75	2.20	0.61	3.46	6.27	2.09
33	Parkia speciosa. Hassk					1									2	2	0.006	2.50	2.20	0.61	0.63	3.44	1.15
34	Pedadenia javanica. J. Js			2											2	1	0.006	2.50	1.10	0.30	0.63	2.03	0.68
35	Peronema canescens. Jack								3						4	2	0.012	5.00	2.20	0.61	1.26	4.07	1.36
36	Spium baccatum						2								2	1	0.006	2.50	1.10	0.30	0.63	2.03	0.68
37	Averrhoe belimbi. L	1								1		1		1	3	3	0.009	3.75	3.29	1.22	0.94	5.45	1.82
	Total	11	24	13	42	60	7	19	15	12	65	12	28	10	318	93	1.05	397					

Table 3-4(2/4) NUMBER OF VEGETATION (DELI RIVER)

No.	Name of Species	Sampling Point 1	2	3	4	Total	F	D	K	FR (%)	DR (%)	KR (%)	IV	SDR
1	Eleusina indica	70				70	1	0.140	87.50	7.14	13.86	14.08	35.08	11.69
2	Brachiaria mutica	22				22	1	0.040	27.50	7.14	3.96	4.42	15.52	5.17
3	Berreria Leavis	30				50	1	0.060	37.50	7.14	5.94	6.03	19.11	6.37
4	Euphorbia hirta	3				3	1	0.010	3.75	7.14	0.99	0.60	8.73	2.91
5	Cynodon dactylon	235				0	1	0.470	293.75	7.14	46.53	47.28	100.95	33.65
6	Euphorbia prunifolia	12				3	1	0.030	15.00	7.14	1.98	2.41	11.53	3.84
7	Phyllanthus urinaria	8				235	1	0.020	10.00	7.14	1.98	1.60	10.72	3.57
8	Paspalum conjugatum		9		21	12	2	0.060	37.50	14.28	5.94	6.03	26.25	8.75
9	Setaria plicata		16			8	1	0.030	20.00	7.14	2.97	3.21	13.32	4.44
10	Ottochaloa nodosa			31		30	1	0.060	38.75	7.14	5.94	6.23	19.31	6.43
11	Mikania micrantha			15		16	1	0.030	18.75	7.14	2.97	3.01	13.12	4.37
12	Commelina diffusa			10		31	1	0.020	12.50	7.14	1.98	2.01	11.13	3.71
13	Calopogonium caeruleum					15	1	0.030	18.75	7.14	2.97	3.01	13.12	4.37
	TOTAL	380	25	56	36	497	14	1.010	621.25					

Table 3-4(3/4) NUMBER OF VEGETATION (PERCUT RIVER)

No.	Name of Species	Sampling Point 1	2	3	4	5	Total	F	D	K	FR (%)	DR (%)	KR (%)	IV	SDR
1	Euphorbia Prunifolia		5				5	1	0.007	6.25	4.17	0.71	0.71	5.59	1.86
2	Ageratum conyzoides		12	42			54	2	0.077	67.50	8.33	7.76	7.70	23.79	7.93
3	Imperata cylindrica		21		29		50	3	0.071	62.50	12.50	7.16	7.13	26.79	8.93
4	Cynodon dactylon	27	30	125			182	4	0.259	227.50	16.66	26.10	25.96	68.72	22.91
5	Sida rhombifolia			4			4	1	0.005	5.00	4.17	0.50	0.57	5.24	1.75
6	Emilia sonchifolia			2			2	1	0.002	2.50	4.17	0.20	0.28	4.65	1.55
7	Mimosa pudica			33	15		48	2	0.068	60.00	8.33	6.85	6.85	22.03	7.34
8	Mikania Micrantha			31	21		52	2	0.074	65.00	8.33	7.46	7.42	23.21	7.74
9	Eleusina indica			70			70	1	0.099	87.50	4.17	9.98	9.99	24.14	8.05
10	Cyclosorus aridus				7		7	1	0.009	8.75	4.17	0.91	1.00	6.08	2.03
11	Colopogonium caeruleum				115		115	1	0.164	143.75	4.17	16.53	16.41	37.11	12.37
12	Cyperus rotundus	16				12	28	2	0.039	35.00	8.33	3.93	3.99	16.25	5.42
13	Sporobolus diander					70	70	1	0.099	87.50	4.17	9.98	9.99	24.14	8.05
14	Setaria Plicata					11	11	1	0.015	13.75	4.17	1.15	1.57	7.25	2.42
15	Ceratopteris Thalictroides	3					3	1	0.004	3.75	4.17	0.40	0.43	5.00	1.67
	TOTAL	46	68	307	187	93	701	24	0.99	876.25					

Table 3-4(4/4) NUMBER OF VEGETATION (PADANG RIVER)

No.	Name Species	Sampling Point 1	2	3	4	5	Total	F	D	K	FR (%)	DR (%)	KR (%)	IV	SDR
1	Imperata cylindrica	6					6	1	0.009	7.50	4.76	0.90	0.93	6.59	2.20
2	Ipomoea batatas	9					9	1	0.014	11.25	4.76	1.40	1.39	7.55	2.52
3	Mikania micrantha H.B.K	57	6		5		68	3	0.105	85.00	14.29	10.50	10.49	35.28	11.76
4	Passflora Foetida. L	5		15			20	2	0.031	25.00	9.52	3.10	3.09	15.71	5.24
5	Brachiaria distachya. L	69		107			176	2	0.272	220.00	9.52	27.20	27.16	63.88	31.94
6	Cyclosorus aridus		15		15		30	2	0.046	37.50	9.52	4.60	4.63	18.75	6.25
7	Mimosa invisa		2				2	1	0.003	2.50	4.76	0.30	0.31	5.37	1.79
8	Paspalum conjugatum, Berg		62		96	23	181	3	0.279	226.25	14.29	27.90	27.93	70.12	23.37
9	Axonopus compresus					49	49	1	0.076	61.25	4.76	7.60	7.56	19.92	6.64
10	Colocasia esculentum		35	35		5	75	3	0.116	93.75	14.29	11.60	11.57	37.46	12.49
11	Amaranthus spinosus		16	16			32	2	0.049	40.00	9.52	4.90	4.94	19.36	6.45
	TOTAL	146	136	173	116	77	648	21	1.000	810.00					

Table 3-5 TYPE OF BIRDS, WILD ANIMALS AND FISHES AROUND LAUSIMEME DAM SITE

No.	Local Name	Scientific Name	Remark
Birds			
1	Ayam hutan	Arboropilla rubicentris	Protected
2	Beo	Picus minicensniasensis	
3	Burunghantu	Strigidae sp.	Protected
4	Cawi	Dicrurus longicandatus intermidius	
5	Cip - cip		
6	Elang	Heliostus sp	
7	Enggang	Annorhinus galantium	Protected
8	Gagak Hitam	Corvusense	Protected
9	Nggurisa	Anarrhinus Galentius	Protected
10	Gelatik	Psaltria sp	
11	Jalak	Struus contra	
12	Kakak tua	Cacatua sp	
13	Kalong	Peterocorpus edulis	
14	Kelelawar	Chizoptera sp	
15	Ketilang	Picnonotus cafer	
16	Kiung Laut	Haleyor chioris	
17	Layang-layang	Hirunando tahitica	
18	Lisik	Picoides induccencis	
19	Ndekah	Dicaeum trochilcum	
20	Ngguak	Treron sp	
21	Pelatuk	Picoides macci	
22	Pencala Boang	Geopelia striata	
23	Perkutut		
24	Puling	Geopelia staita	
25	Punai	Treron vernans	
26	Pungguk	Ninox sentulata malaccensis	
27	Puyuh	Arborophilla rubirostis	
28	Ruak - ruak	Amauromis phornicurus	
29	Tekukur	Steptopela tranque	
Wild Animals			
1	Babi hutan	Sus scrova	
2	Belua	Petauriste petaurista	Protected
3	Beruang Medau	Halarotas malayenas	Protected
4	Biawak	Varanus salvator	
5	Imbau	Siamang	
6	Kambing hutan	Petaurista petaurista	Protected
7	Kancil	Tragales javanicus	Protected
8	Kera	Antropodia	
9	Kukang	Nycticebus cancang	Protected
10	Kulikap(Lutung)	Phythecus Pyrrahus	
11	Landak	Alteropus macrorerum	Protected
12	Monyet	Muscacus symnomolygus	
13	Musang	Mustella hamakeri	
14	Pedi		
15	Runci - runci		
16	Suimih		
17	Terenggiling	Manis javanica	Protected
18	Tikus	Rattus tiomanicus	
19	Tupai	Tupaia javanica	
20	Sawabatik		
Freshwater Fishes			
1	Belut	Hemisilarus heteroryuchus	
2	Cancan		
3	Gabus	Ophiocephalu striatus	
4	Jurung	Clupea fimbriata	Protected
5	Kura - kura	Gerres punctatus	
6	Lele	Clerium melonaderma	
7	Mujahir	Tilapia mozambica petern	
8	Paitan	Platycephalus indicas BLKRI	
9	Penyu	Sillago sihama forste	
10	Rabai - rabai	Macrotrema caligaus	
11	Sepat	Eleutheronema setradactylum show	

Table 3-6 LOCATION AND NUMBER OF SOCIO-ECONOMIC INTERVIEW SURVEY

Project/Subdistrict	Affected Village	No. of respondent
LAUSIMEME DAM		
Sibiru-biru	(1) Penen	10
	(2) Partumbukan	10
	(3) Kuala Dekkah	10
	(4) Sarilaba Kenjahe	10
	(5) Tj. Berampu	10
	(6) Kerapat	10
FLOODWAY		
Medan Johor	(1) Gedung Johor	10
	(2) Kedai Durian	10
	(3) Titi Kuning	10
	(4) Sukamaju	10
Medan Denai	(5) Kampung Baru	10
	(6) Marindal I	10
DELI RIVER IMPROVEMENT		
Medan Johor	(1) Gedung Johor	10
	(2) Kedai Durian	10
Medan Denai	(3) Tanjung Mulia	10
Labuhan Deli	(4) Helvetia	10
Medan Labuhan	(5) Pekan Labuhan	10
Medan Belawan	(6) Bagan Deli	10
PERCUT RIVER IMPROVEMENT		
Patumbak	(1) Sigara - Gara	10
	(2) Lantasan Baru	10
Percut sei Tuan	(3) Tembung	10
	(4) Bandar Setia	10
	(5) Cinta Damai	10
	(6) Percut	10
PADANG RIVER IMPROVEMENT		
Tebing Tinggi	(1) Bah Sumbu	10
	(2) Naga Kesiangan	10
	(3) Paya Lombang	10
	(4) Paya Pasir	10
Bandar Khalifah	(5) Sungai Serimah	10
	(6) Pekan Bandar Khalifah	10

Table 3-7(1/3) SUMMARIES OF THE RESULT OF INTERVIEW SURVEY ON SOCIO-ECONOMIC AND SOCIO-CULTURAL CONDITION

No.	Environmental Component	Unit	DAMSITE			FLOODWAY			DELI RIVER IMPROVEMENT			PERCUT RIVER IMPROVEMENT			PADANG RIVER IMPROVEMENT		
			TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE
I	DEMOGRAPHY																
1	Number of Population	Nos	529,386	500,001-750,000	4	1744 - 405	>1,500,000	1	526,091	500,001 - 750,000	4	526,091	500,001 - 750,000	4	195,182	< 500,000	5
2	Population density in rural	Nos	94	51 - 100	2	300	> 100	1	195	> 100	1	195	> 100	1	203	> 100	1
	Population density in urban	Nos	2100	> 2000	1	7000	> 2000	1	4052	> 2000	1	4052	> 2000	1	2716	> 2000	1
3	Total growth population	%	3.91	> 3.50	1	3.5	3.01 - 3.05	2	3.22	3.01 - 3.5	2	3.22	3.01 - 3.5	2	0.73	< 2.00	5
4	Motality in 1000 population	Nos	12	< 20	5	16	> 20	5	14	< 20	5	14	< 20	5	11	< 20	5
5	Baby Mortality	Nos	7	< 50	5	7	> 50	5	9	< 50	5	9	< 50	5	8	< 50	5
6	Child Mortality	Nos	2	< 5	5	2	> 50	5	2	< 5	5	2	< 5	5	1	< 5	5
7	Percentage of labour among society	%	25	< 40	5	26	> 40	5	25	< 0	5	25	< 0	5	24	< 40	5
8	Sex Ratio	%	0.98	0.7 - 0.99	4	0.96	0.90 - 0.99	4	92.7	0.90 - 0.99	4	92.7	0.90 - 0.99	4	98.8	0.90 - 0.99	4
9	Family Size	Nos	7.3	7 - 8	3	6	5 - 6	4	6	5 - 6	4	6	5 - 6	4	5	5 - 6	4
10	Number of Ethnic group in society	Nos	3		3	9	> 5	5	5	> 5	5	5	> 5	5	8	> 5	5
II	ECONOMIC																
11	Job Availability	grade	12.5	> 10	1	14	> 10	2	15	> 10	1	15	> 10	1	9	5 - 10	2
12	Percentage of Working People	%	13.8	< 25	1	35	31 - 35	3	29	25 - 30	2	29	25 - 30	2	27	25 - 30	2
13	Income average in rural per month	grade	9300	8001 - 10000	4	8150	8001 - 10000	4	8,300	8001 - 1000	4	8,300	8001 - 1000	4	8,000	7001 - 8000	3
	Income average in urban per month	grade	16500	> 15000	5	15000	12001-15000	4	14500	12001-15000	4	14500	12001-15000	4	13000	12001-15000	4
14	Level of Primary Cost Price	grade	13	> 10	1	18	> 10	1	15	> 10	1	15	> 10	1	13	> 10	1
III	LAND USE																
A	RESIDENTIAL																
15	Percentage of residential area in village	%	4	< 5	5	75		1	4	< 20	2	4	< 20	1	12	< 20	1
	Percentage of residential area in town	%	3	< 10	5			-	3	< 5	4	3	< 5	5	3	< 5	5
B	AGRICULTURE and CULTURE																
16	Percentage of Agriculture area	%	79	< 50	5	8	< 10	1	78	> 50	2	78	> 50	5	84	> 50	5
17	Percentage of Poultry and fishery area	%	3	< 5	1	0	< 5	1	8	5 - 10	2	3	< 5	1	6	5 - 10	2

Table 3-7(2/3) SUMMARIES OF THE RESULT OF INTERVIEW SURVEY ON SOCIO-ECONOMIC AND SOCIO-CULTURAL CONDITION

No.	Environmental Component	Unit	DAMSITE			FLOODWAY			DELI RIVER IMPROVEMENT			PERCUT RIVER IMPROVEMENT			PADANG RIVER IMPROVEMENT		
			TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE
18	Percentage of industry in Village	%	1			-	-	-	5	< 5	5	1	< 5	5	0	< 5	5
	Percentage of industry in town	%	2	< 10	5	5	< 10	5	14	10 - 15	4	2	< 10	5	2	< 10	5
19	Percentage of conservation forest in village	%	1	< 10	1	-	-	-	9	< 10	1	1	< 10	1	0	< 10	1
	Percentage of conservation forest in town	%	1	< 2	1	1	< 10	5	6	5 - 7	3	1	< 2	1	1	< 2	3
IV	SOCIAL CULTURAL																
A	EDUCATION																
20	Percentage of children attend the class	%	81	81 -90	4	85	81 - 90	4	89	81 - 90	4	82	81 - 90	4	75	71 - 80	3
	Level of education	grade	27	21 - 30	3	34	31 - 40	4	36	31 - 40	4	30	21 - 30	3	28	31 - 40	3
B	HOUSING																
21	Type of house building	type	56.1		2			4			4			4			3
22	Housing Availability	grade			3			4	7	7 - 10	4	7	7 - 10	4	6	5 - 7	4
23	Time of living	year	6	> 5	5			5	6	> 5	5	6	> 5	5	6	> 5	5
C	HEALTH																
24	Health condition	%	3.5	< 5	5	3	< 5	5	2.5	< 5	5	3.5	< 5	5	3.5	< 5	5
25	The way to keep health condition in village	%	51	> 50	5	62	< 50	5	67	> 50	5	54	> 50	5	60	> 50	5
	The way to keep health condition in town	%	82	81 - 90	4	91	91 - 100	5	97	91 - 100	5	84	81 - 90	4	92.5	91 - 100	5
D	CULTURE and CUSTOM																
26	Indonesian Language Capability	%	100	> 70	5	100	> 70	5	100	> 70	5	100	> 70	5	100	> 70	5
27	People active in religion	%	85	> 70	5	80	> 70	5	67.5	61 - 70	4	90	> 70	5	60	51 - 60	4
28	Number of priest in 1000 people	nos	8	5 - 10	3	13	> 10	5	14	> 10	5	11	> 10	5	7	5 - 10	3
														3			3
V	PUBLIC FACILITIES																
A	EDUCATION FACILITIES																
29	Type of education facilities in village	grade			2			3			3			2			3
	Type of education facilities in town	grade			3			5			5			3			3
30	Class size	grade	30	30 - 35	4	28	<30	5	26	<30	5	30	30 - 35	4	35	30 - 35	4

Table 3-7(3/3) SUMMARIES OF THE RESULT OF INTERVIEW SURVEY ON SOCIO-ECONOMIC AND SOCIO-CULTURAL CONDITION

No.	Environmental Component	Unit	DAMSITE			FLOODWAY			DELI RIVER IMPROVEMENT			PERCUT RIVER IMPROVEMENT			PADANG RIVER IMPROVEMENT		
			TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE	TEST	RANGE	SCALE
31	Student - teacher ratio	%	38	< 50	3	21	< 50	5	21	< 50	5	20	< 50	5	26	< 50	5
32	Level of teacher education for primary school				3			5			3			3			3
B	HEALTH SERVICE																
33	Number of Medical staf in 1000 population	nos	1	1	3	2	> 1	5	3	> 1	5	1	1	3	2	> 1	5
D	WATER SUPPLY and ELECTRICITY																
34	Number of water supply customer in village	nos	14	< 50	1	40	< 50	1	45	< 50	1	15	< 50	1	80	51 - 100	2
	Number of water supply customer in town	nos	75	< 100	1	350	301 - 400	4	350	301 - 400	4	85	< 100	1	312	301 - 400	4
35	Number of electric supply customer in village	nos	115	101 - 150	3	135	101 - 150	3	135	101 - 150	3	120	101 - 150	3	115	101 - 150	3
	Number of electric supply customer in town	nos	710	701 - 800	4	875	> 800	5	910	> 800	5	750	701 - 800	4	835	> 800	5
VI	LAW																
A	CRIMINAL																
36	Level of criminal in 1000 people	nos	2	< 5	4	4	< 5	4	4	< 5	4	2	< 5	4	2	< 5	4
37	Thief in 1000 people	nos	3	< 10	4	5	< 10	4	6	< 10	4	2	< 10	4	2	< 10	4
38	Murder or suicide in 1000 people	nos	0	0	5	1	< 4	4	1	< 4	4	0	0	5	0	0	5
39	Teenage crime in 1000 people	nos	3	< 10	4	2	< 10	4	4	< 10	4	2	< 10	4	1	< 10	4
B	HOUSEHOLD																
40	Number of divorce in 1000 people	nos	2	< 5	5	2	< 5	5	3	< 5	5	1	< 5	5	2	< 5	5
41	Number of drop-out from School in 1000 pupil	nos	8	< 10	5	7	< 10	5	8	< 10	5	6	< 10	5	5	< 10	5

Table 3-8 CRITERIA FOR GIVING SCALE ON ENVIRONMENTAL QUALITY

Environmental Component	Unit	Scale 1	2	3	4	5
ATMOSPHERE						
1. Temperature	%C	> 3 or < 10	> 32 - 35 ; 10 - 14	29 - 31 ; 15 - 18	26 - 28 ; 19 - 21	21 - 25
2. Noise Level	dB	> 100	71 - 100	51 - 70	20 - 50	< 20
3. Wind Speed	Km/Hour	> 40	31 - 40	21 - 30	11 - 20	< 10
4. Humidity	%	< 40 ; > 100	40 - 50; 90 - 100	51 - 60 ; 80 - 89	61 - 69 ; 71 - 79	70
FIELD						
5. Type Formation		Change very bad	Change bad	Medium	Change Light	Not Change
6. Thickness of Organic Matter	Cm	No Organic Matter	< 5 Cm	5 - 10 Cm	10 - 20 Cm	> 20 Cm
7. Erosion	ton/ha/year	Very Heavy (> 480)	Heavy	Moderate (60-1,800)	Light (15 - 60)	Very Light (< 15)
QUANTITY AND QUALITY OF WATER						
8. Turbidity		Very Muddy	Turbid	Moderate turbid	Clear with colour	Clear no Colour
9. Colour		Brown Black	Brownish	Yellow	Yellowish	Light
10. Odour		Very Bad	bad	Moderate	Light	Normal
11. Taste		Salty	Light salty	Accid	Light accid	Normal
12. pH		< 3.5 : > 10.5	3.5-4.5; 9.5-10.5	4.5 - 5.5; 8.5 - 9.5	5.5 - 6.5; 7.5 - 8.5	6.5 - 7.5
13. Temperatue	%C	< 0 : > 50	41 - 50 ; 0 - 3	31 - 40 ; 3 - 7	21 - 30 ; 7 - 10	11 - 20
14. Dissolved Oxygen (DO)	mg/l	< 4.0	4 - 5	5.1 - 6	6.1 - 7	> 7
15. Total Dissolved Material	mg/l	-	-	-	-	-
16. BOD	mg/l	> 50	30 - 50	10 - 30	2 - 10	< 2
17. COD	mg/l	> 600	300 - 600	100 - 300	40 - 100	< 40
18. NO2 (Nitrite)	mg/l	> 5	1 - 5	0.1 - 1	0.01 - 0.1	< 0.01
19. NO3 (Nitrate)	mg/l	> 100	50 - 100	10 - 50	5 - 10	< 5
20. Pb (Leed)	mg/l	> 7.5	5 - 7.5	2.5 - 5	0.05 - 2.5	< 0.05
21. Dust Content	ppn	> 875	826 - 875	251 - 625	150 - 250	< 50
BIOLOGY						
22. Covered by Vegetation		< 10 %	10 % - 25 %	26 % - 50 %	51 % - 75 %	> 75 %
23. Phytoplankton						
24. Zooplankton						
25. Pisces		1 - 2 Types Fauna	3 - 5 Types Fauna	6 - 10 Types Fauna	11 - 15 Types Fauna	15 Types Fauna
26. Aves		1 - 2 Types Fauna	3 - 5 Types Fauna	6 - 10 Types Fauna	11 - 15 Types Fauna	15 Types Fauna
27. Flora Variety		1 Type Flora	6 - 10 Types Flora	11 - 20 Types Flora	21 - 30 Types Flora	30 Types Flora
28. Fauna Variety		1 - 2 Types Fauna	3 - 5 Types Fauna	6 - 10 Types Fauna	11 - 15 Types Fauna	15 Types Fauna
29. Coliform	MPN/10ml	> 16.000	12.000 - 16.000	8.000 - 12.000	4.000 - 8.000	0 - 4.000
30. Colifecal	MPN/10ml	> 10.000	2.000 - 10.000	1.001 - 2.000	1 - 100	0
SOCIO-ECONOMIC & SOCIO-CULTURAL						
31. Income	Rp.1000/M	< 80	80 - 125	125 - 180	181 - 220	> 222
32. Perception and Behaviour	%	Pos. 10	Pos. 20	Pos. 30	Pos. 40	Pos. 50
	Pos-Neg resp	Neg. 50	Neg. 40	Neg. 30	Neg. 20	Neg. 10
33. Social Conflict	%	Pos. 10	Pos. 20	Pos. 30	Pos. 40	Pos. 50
	Pos-Neg resp	Neg. 50	Neg. 40	Neg. 30	Neg. 20	Neg. 10
34. Security						
35. Transportation		earth road	Gravel road	Mix type	Asphalt	Asphalt Hotmix
36. Socio Facilities		0	1 - 2	SD - Poly - Mosque	4 - 6	Available
37. Transport Facilities		Difficult	-	Relative Difficult		any motor car
38. Small Holder	%	< 20.5	20 - 30.5	31 - 40.5	41 - 50	> 50

Table 3-9 BASIC EVALUATION ON ENVIRONMENTAL COMPONENT

ENVIRONMENTAL COMPONENT	Dam Construction (1)		(2)		(3)		Floodway Construction (1)		(2)		(3)		Dell River Improvement (1)		(2)		(3)		Percut River Improvement (1)		(2)		(3)		Padang River Improvement (1)		(2)		(3)	
	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%	SCALE	%
ATMOSPHERE																														
1 Air Temperature	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	2	40
2 Noise Level	3	60	3	60	3	60	3	60	5	100	3	60	3	60	3	60	3	60	3	60	3	60	3	60	3	60	3	60	3	60
3 Wind Speed	5	100	5	100	3	60	-	-	-	-	-	-	5	100	5	100	3	60	5	100	5	100	3	60	5	100	5	100	3	60
4 Humidity	5	100	5	100	2	40	5	100	3	60	2	40	5	100	3	60	2	40	5	100	3	60	2	40	5	100	3	60	2	40
FIELD																														
5 Land Formation	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	2	40	5	100	4	80	3	60
6 Thincknees of Organic Matter	5	100	2	40	2	40	5	100	2	40	2	40	4	80	2	40	2	40	5	100	2	40	2	40	5	100	2	40	2	40
7 Erosion	4	80	5	100	2	40	4	80	5	100	2	40	5	100	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
QUALITY AND QUANTITY RIVER FLOW																														
8 Turbidity	5	100	5	100	3	60	4	80	3	60	2	40	4	80	3	60	2	40	4	80	3	60	2	40	4	80	3	60	2	40
9 Colour	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
10 Odour	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40
11 Taste	5	100	5	100	2	40	-	-	-	-	-	-	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40
12 pH	4	80	4	80	2	40	-	-	-	-	-	-	5	100	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40
13 Temperature	4	80	4	80	2	40	-	-	-	-	-	-	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40
14 Dissolved Oxygen (DO)	5	100	3	60	2	40	-	-	-	-	-	-	5	100	3	60	2	40	5	100	3	60	2	40	5	100	5	100	2	40
15 Total Dissolved Material	4	80	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
16 BOD	4	80	4	80	2	40	-	-	-	-	-	-	4	80	3	60	2	40	4	80	3	60	2	40	4	80	3	60	2	40
17 COD	4	80	5	100	2	40	-	-	-	-	-	-	4	80	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
18 NO2 (Nitrite)	4	80	5	100	3	60	5	100	5	100	2	40	5	100	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
19 NO3 (Nitrate)	4	80	5	100	2	40	5	100	5	100	2	40	5	100	5	100	2	40	4	80	5	100	2	40	4	80	5	100	2	40
20 Pb (Leed)	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40
21 Dust Content	4	80	4	80	2	40	5	100	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40	4	80	5	100	2	40
BIOLOGY																														
22 Covered by Vegetation	4	80	5	100	3	60	5	100	2	40	3	60	5	100	3	60	3	60	5	100	5	100	3	60	5	100	5	100	3	60
23 Phytoplankton	4	80	5	100	3	60	5	100	3	60	3	60	4	80	4	80	3	60	4	80	3	60	3	60	4	80	3	60	3	60
24 Zooplankton	4	80	2	40	3	60	5	100	2	40	3	60	4	80	3	60	3	60	4	80	2	40	3	60	4	80	2	40	3	60
25 Benthos	-	-	-	-	-	-	4	80	2	40	3	60	4	80	2	40	3	60	4	80	2	40	3	60	4	80	3	60	3	60
26 Pisces	4	80	5	100	3	60	4	80	5	100	3	60	4	80	4	80	3	60	4	80	5	100	3	60	4	80	5	100	3	60
27 Aves	4	80	5	100	3	60	4	80	5	100	3	60	4	80	4	80	3	60	4	80	5	100	3	60	4	80	5	100	3	60
28 Flora Variety	4	80	5	100	3	60	4	80	2	40	3	60	4	80	2	40	3	60	4	80	2	40	3	60	4	80	2	40	3	60
29 Fauna Variety	4	80	5	100	3	60	4	80	3	60	3	60	4	80	4	80	3	60	4	80	5	100	3	60	4	80	4	80	3	60
30 Coliform	4	80	5	100	3	60	-	-	-	-	-	-	4	80	5	100	3	60	4	80	5	100	3	60	4	80	5	100	3	60
31 Colifecal	4	80	4	80	3	60	-	-	-	-	-	-	4	80	5	100	3	60	4	80	5	100	3	60	4	80	5	100	3	60
SOCIO ECONOMY & SOCIO CULTURE																														
32 Income	5	100	2	40	3	60	5	100	2	40	3	60	5	100	3	60	3	60	5	100	2	40	3	60	5	100	2	40	3	60
33 Perception and Behaviour	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40	4	80	4	80	2	40
34 Social Conflict	4	80	4	80	3	60	4	80	4	80	3	60	4	80	3	60	3	60	4	80	4	80	3	60	4	80	3	60	3	60
35 Security	4	80	4	80	3	60	4	80	4	80	3	60	4	80	3	60	3	60	4	80	4	80	3	60	4	80	3	60	3	60
36 Transportation	4	80	3	60	3	60	4	80	3	60	3	60	4	80	4	80	3	60	4	80	5	100	3	60	4	80	3	60	3	60
37 Social Facilities	4	80	3	60	3	60	4	80	3	60	3	60	4	80	4	80	3	60	4	80	3	60	3	60	4	80	3	60	3	60
38 Transport Facilities	4	80	3	60	2	40	4	80	3	60	3	60	4	80	4	80	3	60	4	80	5	100	2	40	4	80	3	60	3	60
39 Small Holder	4	80	4	80	3	60	4	80	4	80	3	60	4	80	2	40	3	60	4	80	3	60	2	40	4	80	4	80	3	60
TOTAL VALUE	162	3,240	159	3,180	95	1,900	132	2,640	110	2,200	76	1,520	169	3,380	150	3,000	97	1,940	166	3,320	156	3,120	95	1,900	166	3,320	154	3,080	98	1,960
MAXIMUM SCALE	190	3,800	190	3,800	190	3,800	150	3,000	150	3,000	150	3,000	195	3,900	195	3,900	195	3,900	195	3,200	195	3,900	195	3,900	195	3,900	195	3,900	195	3,900
PERCENTAGE	85	85	84	84	50	50	88	88	73	73	51	51	87	87	77	77	50	50	85	104	80	80	49	49	85	85	79	79	50	50
FINAL SCALE	5	5	5	5	3	3	5	5	4	4	3	3	5	5	4	4	3	3	5	5	4	4	3	3	5	5	4	4	3	3

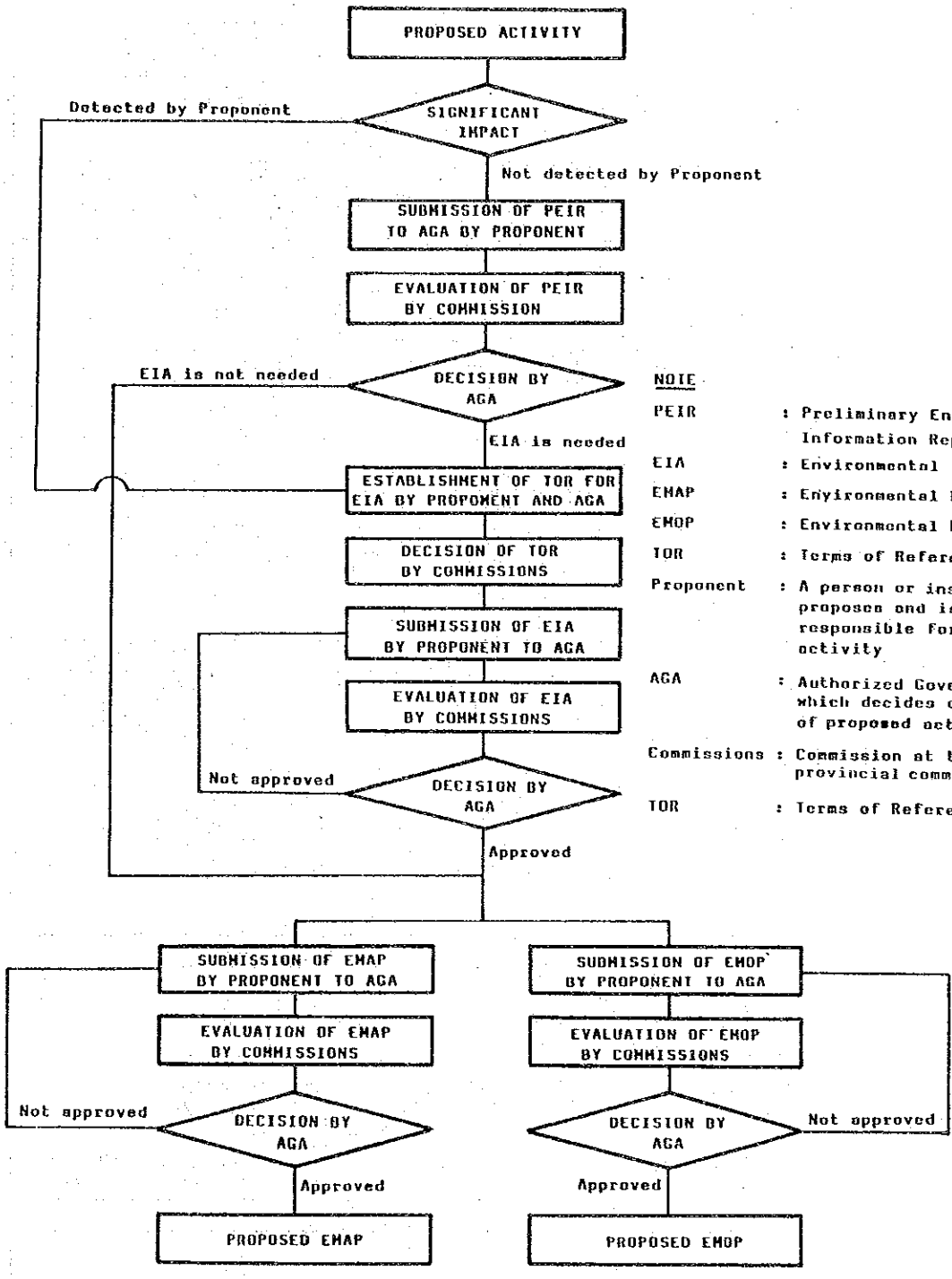
Note (1) : Importance of Resources
(2) : Environment Conditions
(3) : Sensitivity of Management

Table 4-1 LAND USE CONDITION IN KABUPATEN DELI SERDANG YEAR 1976 and 1985

No.	Land Use	1976		1985		Changes
		(ha)	%	(ha)	%	
1.	Residential Area	17,883	4.02	20,022	4.49	+ 11.96
2.	Paddy Field					
	1 x Paddy /Year	71,000	15.95	47,371	10.63	- 33.31
	2 x Paddy /Year	22,067	4.96	45,419	10.19	+ 105.82
3.	Large Scale Plantation	136,768	30.72	135,461	30.40	- 0.96
4.	Public Plantation	31,397	7.05	33,458	7.51	+ 6.65
5.	Dry Land	81,002	18.19	84,112	18.88	+ 3.84
6.	Forest	76,200	17.12	73,153	16.42	- 3.99
7.	Pond	940	0.21	1,073	0.24	+ 14.15
8.	Swampy Area	3,216	0.72	2,568	0.58	- 30.72
9.	Scrub, Alang-alang Grass	4,742	1.07	2,407	0.54	- 49.24
10.	Special Use	-	-	510	0.11	- 100.00
	T o t a l	445,215	100.00	445,554	100.00	

Data Source : Data Pokok Kabupaten DATI II
Deli Serdang, 1988

FIGURES

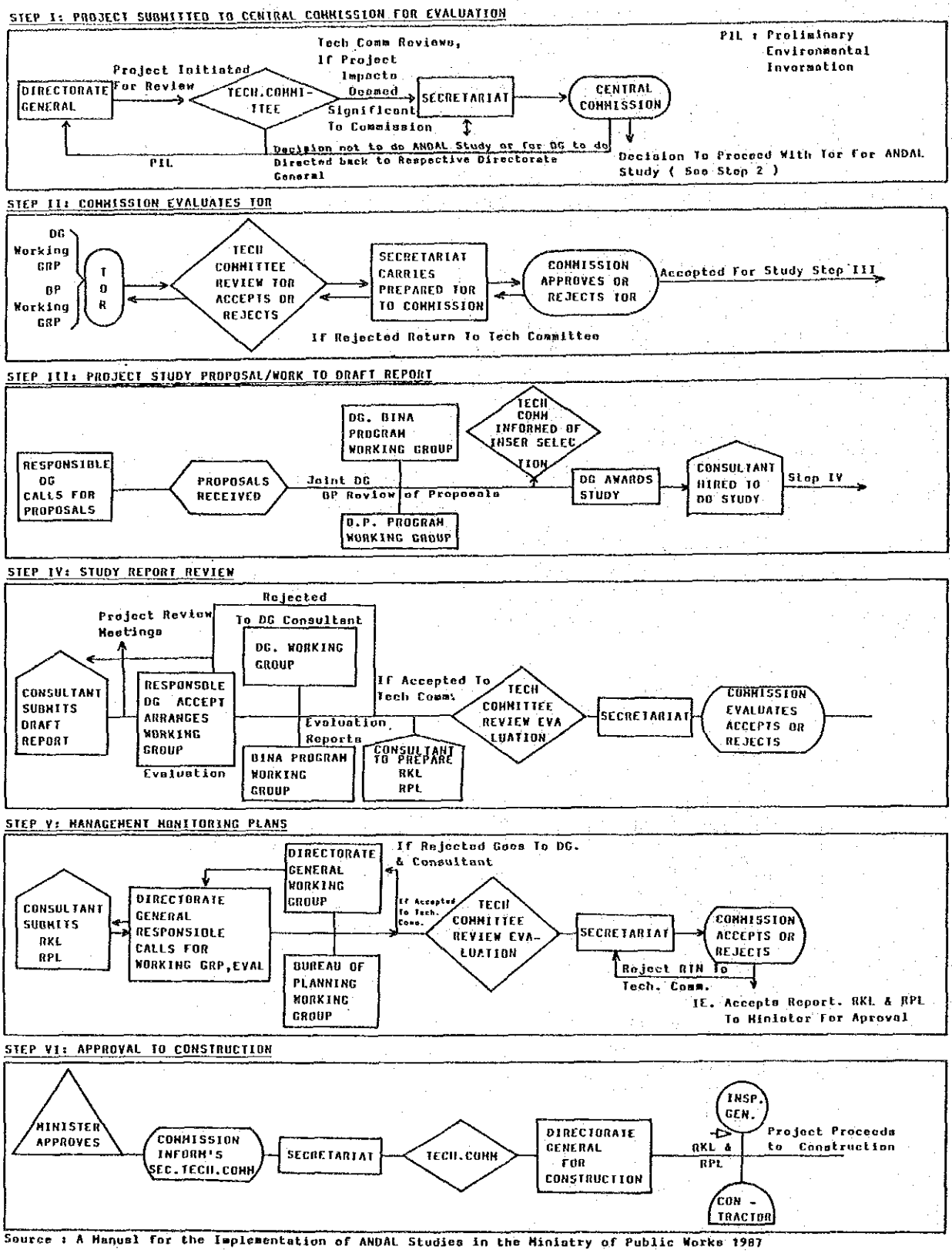


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

PROCEDURE FOR ENVIRONMENTAL IMPACT ASSESSMENT BY GOVERNMENT REGULATION

Fig.2-1



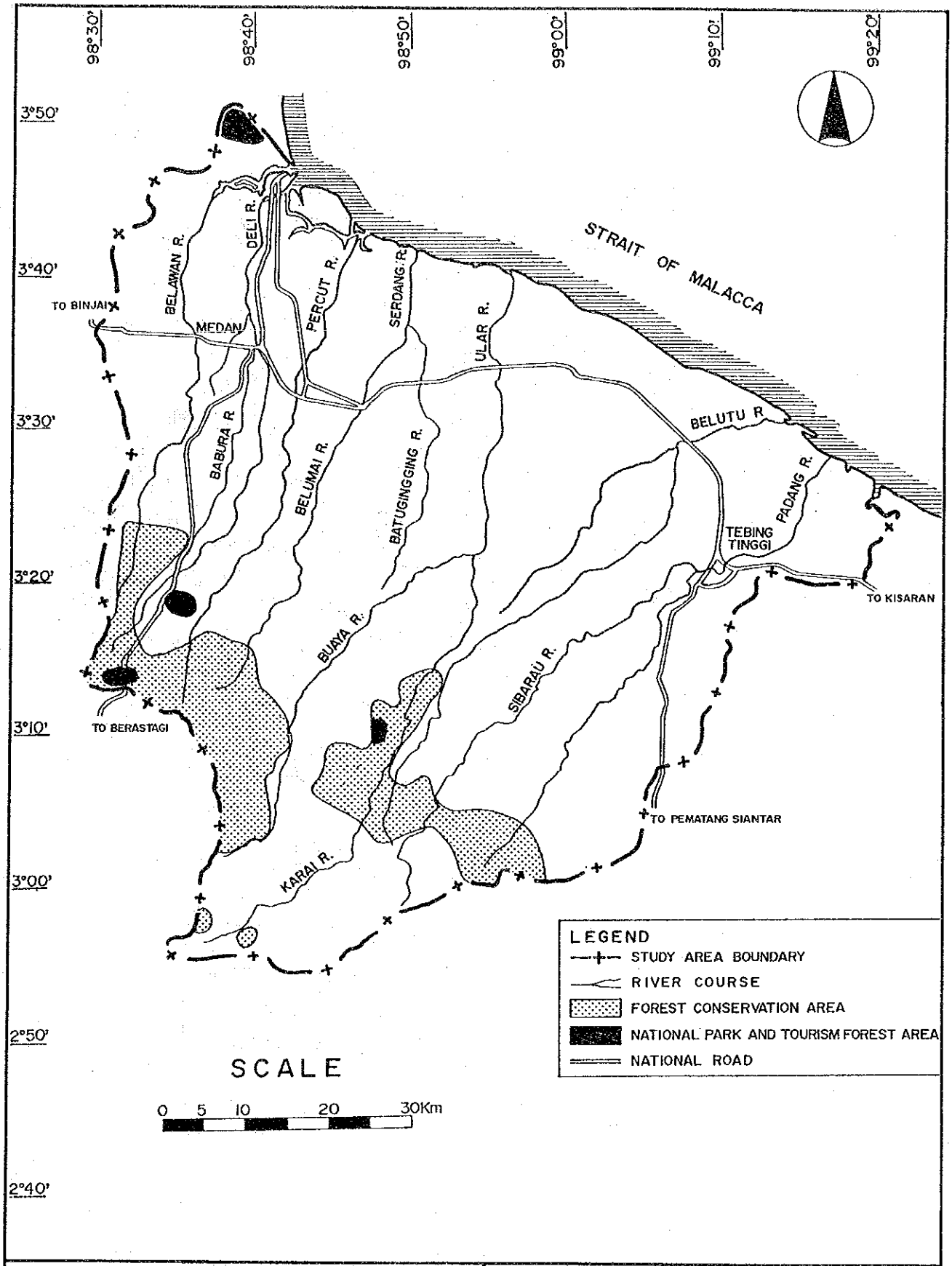
Source : A Manual for the Implementation of ANDAL Studies in the Ministry of Public Works 1987

THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

PROCEDURE FOR ENVIRONMENTAL IMPACT ASSESSMENT BY MPW

Fig.2-2

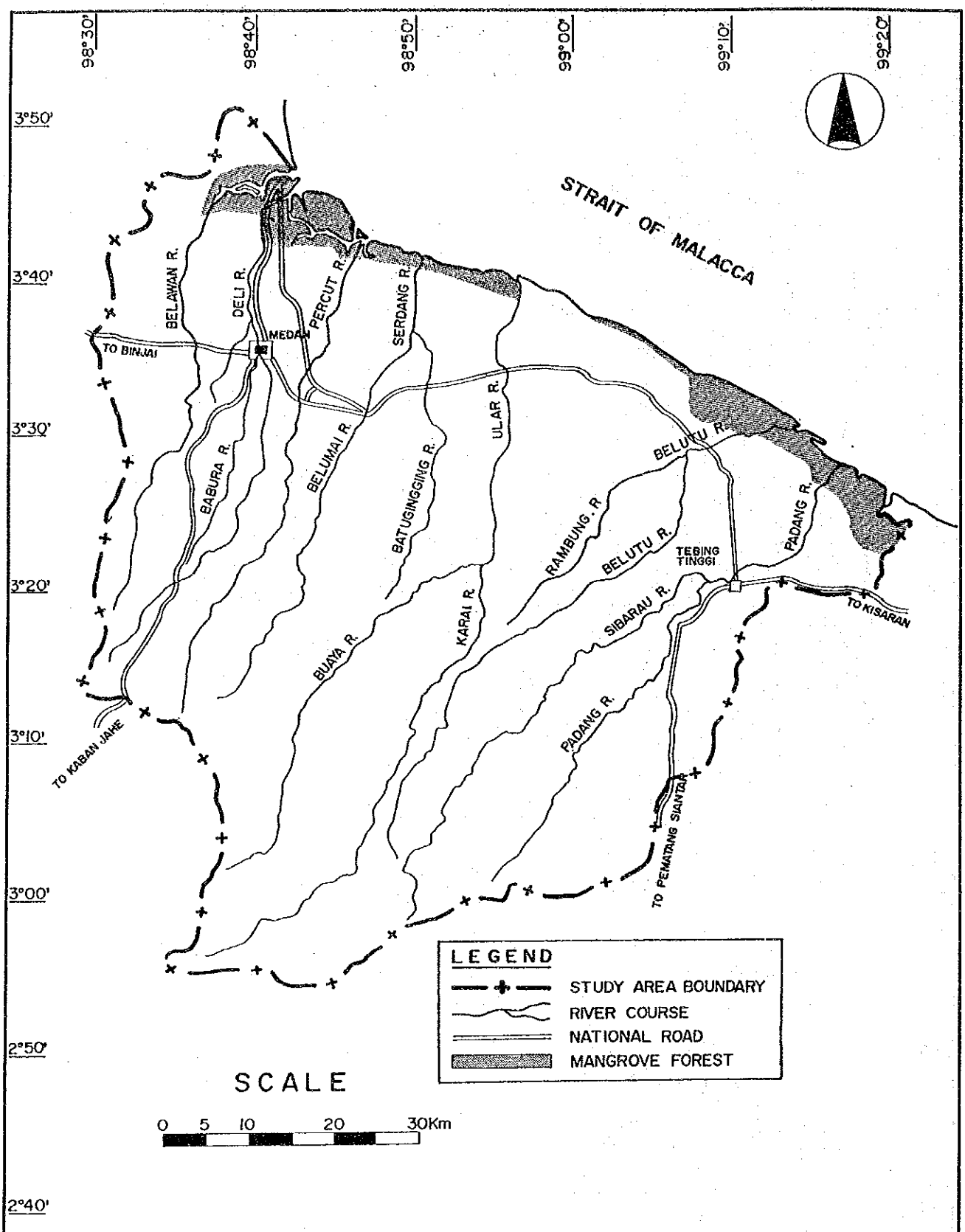


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

NATURE CONSERVATION AREA

Fig.2-3

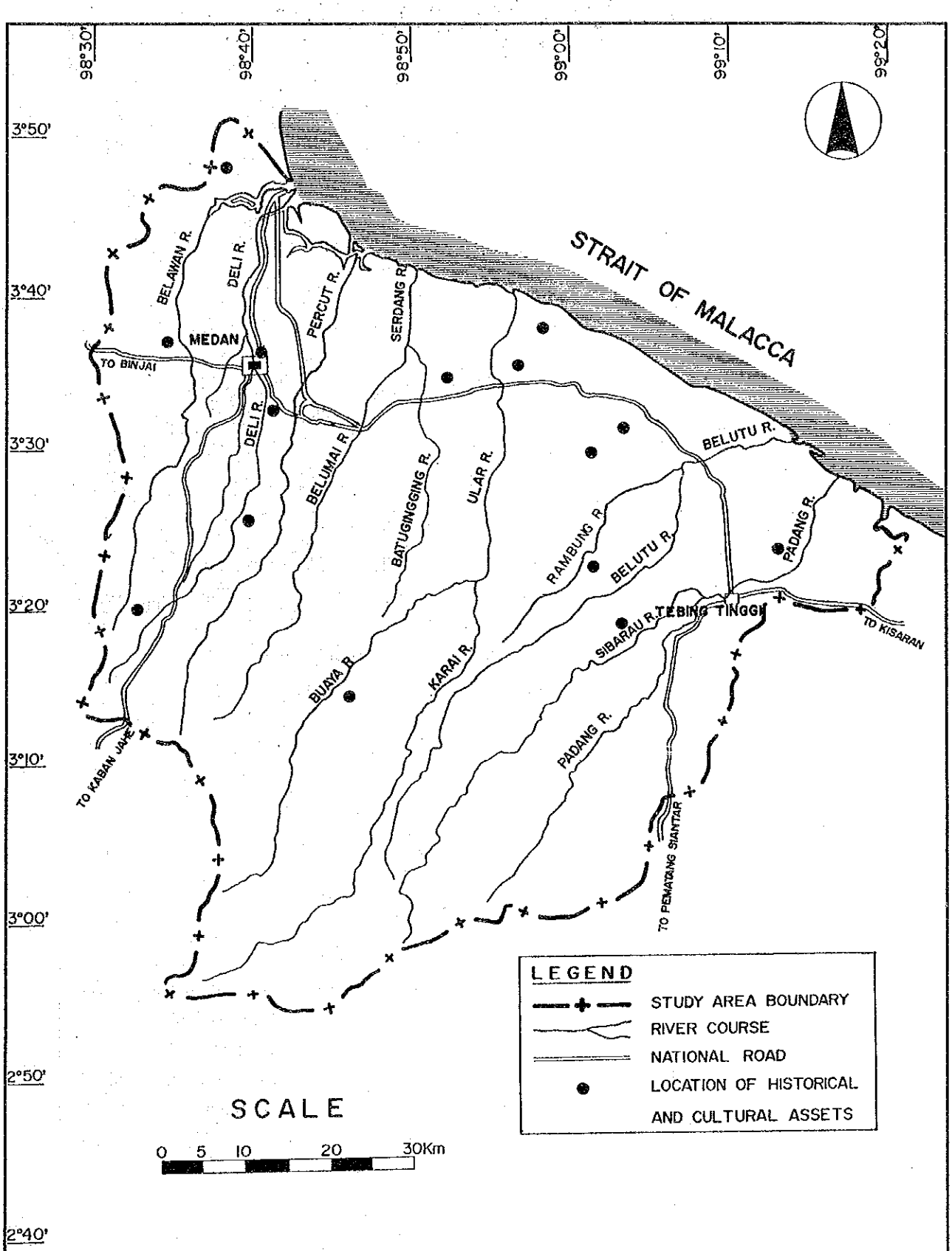


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

MANGROVE FOREST AREA

Fig.2-4

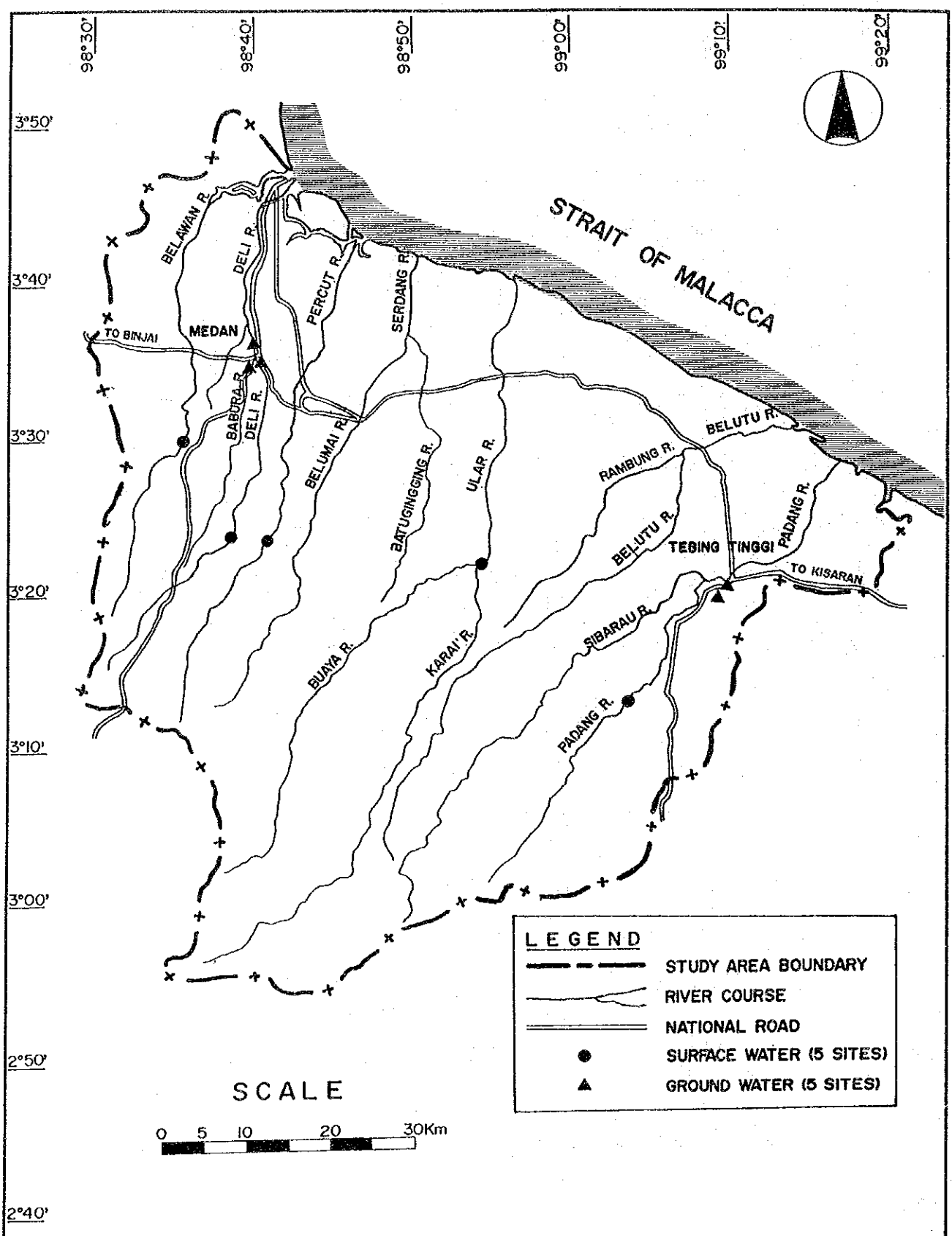


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION OF HISTORICAL AND CULTURAL ASSETS

Fig.2-5

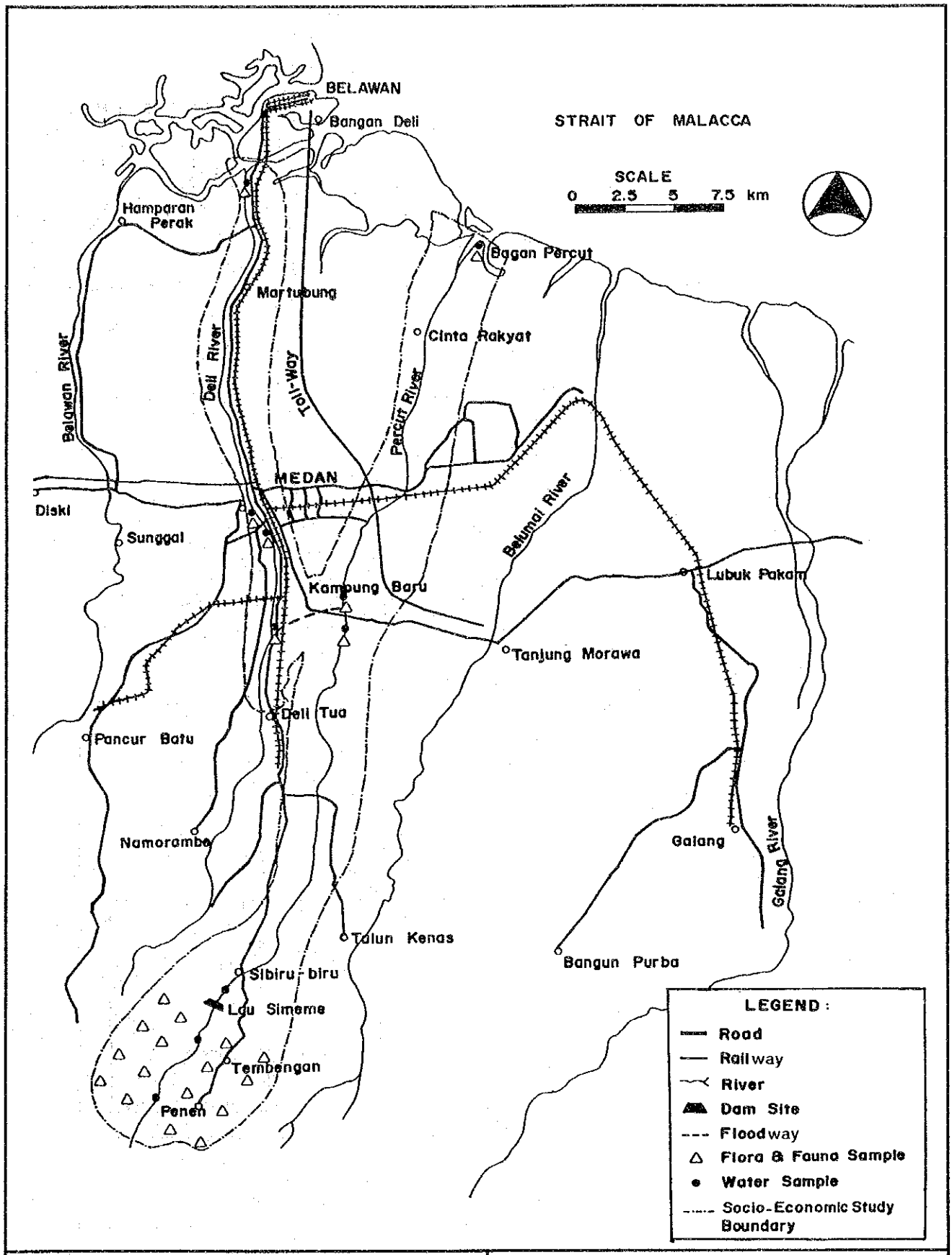


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

WATER SAMPLING SITES

Fig.2-6

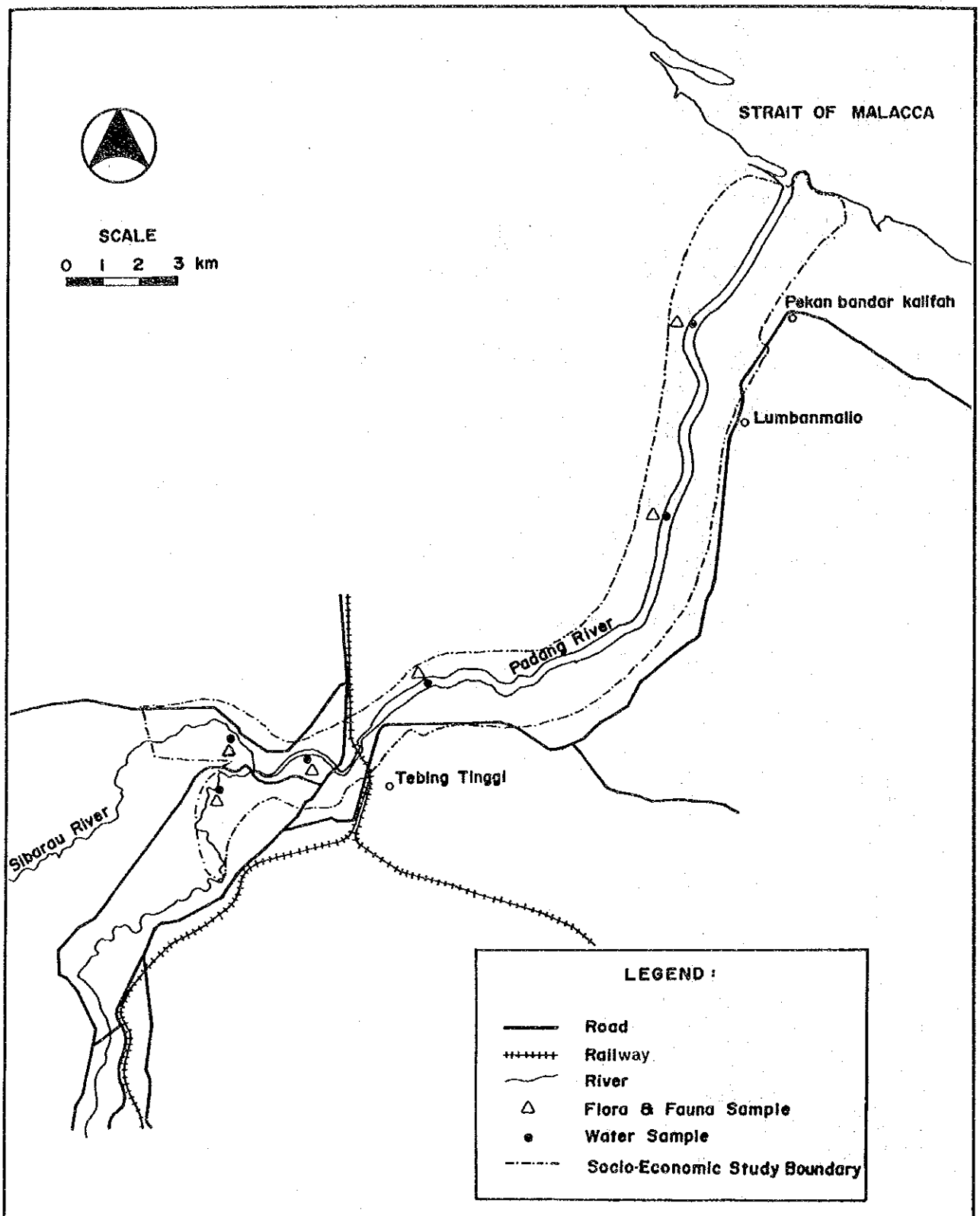


THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

ENVIRONMENTAL IMPACT STUDY AREA (DELI AND PERCUT RIVERS)

Fig.3-1(1/2)



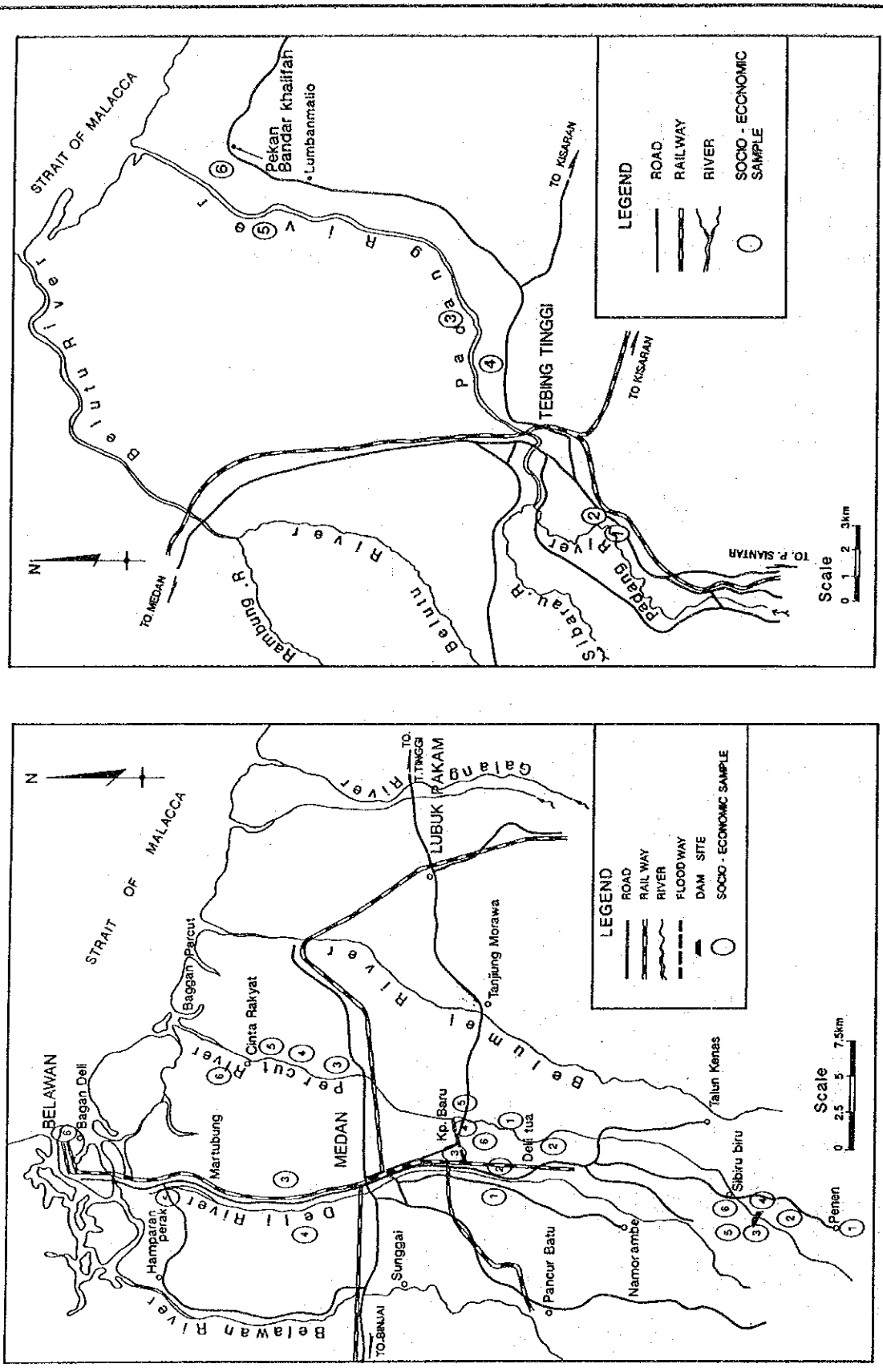
THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA	ENVIRONMENTAL IMPACT STUDY AREA (PADANG RIVER)
JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.3-1(2/2)

THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

PHYSICAL, CHEMICAL, AND BIOLOGICAL INVESTIGATION SITES

Fig.3-2



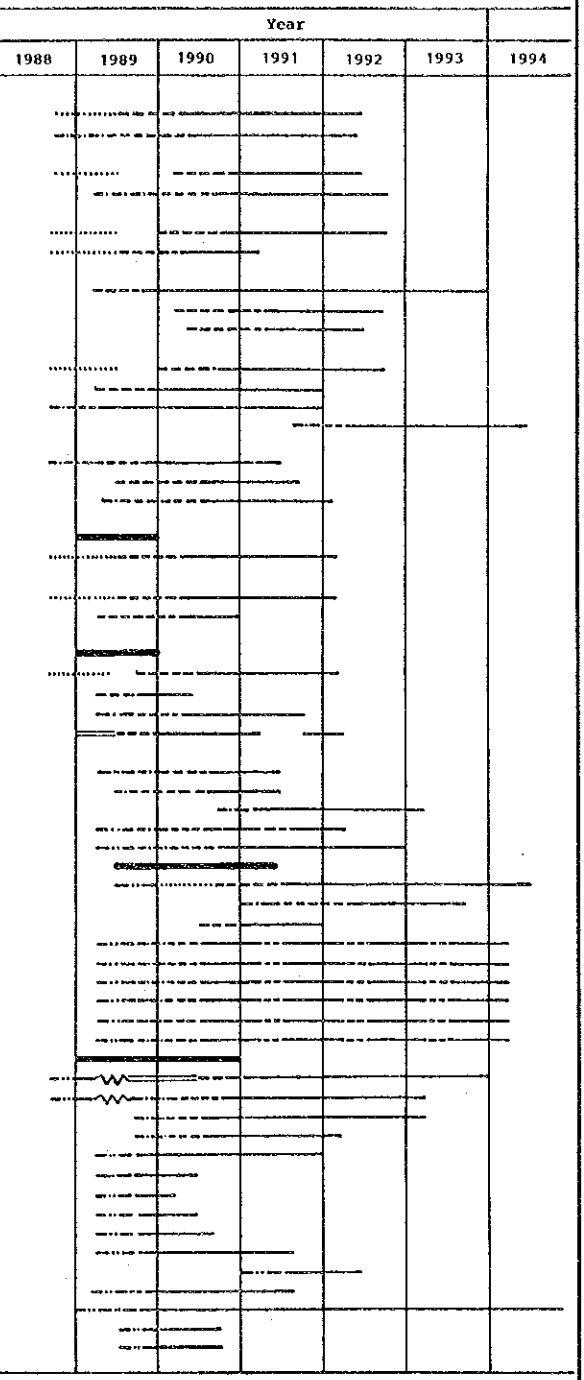
THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

SOCIO-ECONOMIC AMD SOCIO-CULTURAL INVESTIGATION SITES

Fig.3-3

Part	Sector	No.	Activity Description
A.	WATER SUPPLY	1.0	Deli Tua Water Treatment Plant
		1.1	Civil Works
		1.2	M/E Equipment
		2.0	Reservoirs and Booster Pump Stations
		2.1	Civil Works
		2.2	M/E Equipment
		3.0	Transmission Mains
		3.1	Civil Works
		3.2	Pipe Supply
		4.0	Minor Distribution Mains
		4.1	Civil Works
		4.2	Pipe Supply
		5.0	Supply of Water Meters
B.	SEWERAGE	6.0	Construction of Sewers
		6.1	Civil Works
		6.2	Supply of Pipes
			House Connections Zones I-III
			Zones IV-VIII
		7.0	Construction of Pump Stations U/G.
		7.1	Civil Works
		7.2	M/E Equipment
		8.0	Kera Pump Station M/E Equipment
C.	DRAINAGE	9.0	Lower Kera River Improvements
			Land Acquisition
			Civil Works
		10.0	Construction pipe and box drains
		10.1	Civil Works
		10.2	Supply pipe and box culvert
		11.0	Sei Sulang Improvement
			Land Asquisition
			Civil Works
		12.0	Supply of Drains Maintenance Equip.
		13.0	USU Drains/KIP Drains
		13.1	Martubung Landfill/Drains
D.	SWM	14.0	Extention of Collection System
		14.1	Civil Works
		14.2	Equipment
		14.3	Operations (PDK)
E.	KIP	15.0	Kampung Improvement
	MIP	16.0	Market Infrastructure Improvement
F.	URBAN ROADS	17.0	Land Acquisition
		17.1	Civil Works
		17.2	Outer Ring Road
		17.3	Martubung Roads
G.	SMALL TOWNS INFRA - STRUCTURE	18.0	Infrastructure - Kodya Binjai
		18.1	Lubuk Pakam
		18.2	Deli Tua
		18.3	Pancur Batu
		18.4	Tembung
		18.5	Tanjung Morawa
H.	FLOOD CONTROL	19.0	Land Acquisition
		19.1	S. Deli Helir
		19.2	S. Kera
		19.3	S. Sikambing
		19.4	S. Putih
I.	INSTITUTIONAL DEVELOPMENT & CONSULTING SERVICES	20.0	MMR Urban Strategy Review (in house)
		20.1	Urban Sanitation Strategy, M.M.R.
		20.2	K.I.P. Studies
		20.3	Urban Water Resources Study
		20.4	Medan River Basins Study
		20.5	Base Mapping Project
		20.6	Underground Utilities Mapping
		20.7	Training Project for L.G. Staff
		20.8	Advisors for Implementation & Inst. Dev.
		20.9	T/A Urban Transportation (A.D.B.)
		20.10	T/A Land Consolidation Project Prep'n.



Contractor Prequalification
Feasibility Review
Consultant Recruitment
Design and Prequalification
Design
Procurement
Construction Implementation
Land Acquisition

THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

IMPLEMENTATION SCHEDULE OF MUDP II

Fig.4-3

Table 3-10 MATRIX OF DECISION MAKING ANALYSIS FOR DAM CONSTRUCTION

ACTIVITIES	INITIAL LIVING ENVIRONMENT BEAUTY			PREPARATION							DAM CONSTRUCTION							FACILITIES			POST CONSTRUCTION										DIFFERENCES		
ENVIRONMENTAL COMPONENT	Relative Weight	Percentage	Scale	Land Compensation, Road Dam Site, Facilities	Land Clearing & Stripping	Mobilization Personal and Equipment	Stock Material, Natural & Man-made	Construction of Access Road	Construction of Diversion	Construction of Temporary Dam	Cut & Fill	Soil Improvement	Foundation	Cast & Scaffolding	Fixing Support Component	Offices / Houses	Water Supply	Mechanical	Telecommunication	Landscape	Filling Dam	Spilling	Desilting	Oiling	Canal Cleaning	Keep Protection Dike	Total Value	Maximum Value	Average Percentage	Scale	Percentage	Scale	Change of Environmental Beauty = Change of Scale & Weight Relative
	A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ATMOSPHERE																																	
1 Air Temperature	2.52	80	4		3															4							7	10	70	4	-10	-1	-2.52
2 Noise Level	1.89	60	3		2									2	2			2									8	20	40	2	-20	-1	-1.89
3 Wind Speed	3.14	100	5		4													4									8	10	80	4	-20	-1	-3.14
4 Humidity	3.14	100	5		4													4									8	10	80	4	-20	-1	-3.14
FIELD																																	
5 Land Formation	2.52	80	4		3			3	3		3	3					3				3		3				24	40	60	3	-20	-1	-2.52
6 Thinness of Organic Matter	1.26	40	2		1			1			1	1								3	1		1				9	35	26	2	-14	-2	-2.52
7 Erosion	3.14	100	5		4																	4					8	10	80	4	-20	-1	-3.14
QUALITY AND QUANTITY RIVER FLOW																																	
8 Turbidity	3.14	100	5		4		4		4	4	4	4	4				5						4		4	4	45	55	82	5	-18	-1	-3.14
9 Colour	3.14	100	5		4				4	4	4	4													4		24	30	80	4	-20	-1	-3.14
10 Odour	3.14	100	5																						4		4	5	80	4	-20	-1	-3.14
11 Taste	3.14	100	5																				4				4	5	80	4	-20	-1	-3.14
12 pH	2.52	80	4																				3				3	5	60	3	-20	-1	-2.52
13 Temperature	2.52	80	4		3																		3				6	10	60	3	-20	-1	-2.52
14 Dissolved Oxygen (DO)	1.89	60	3																					4			4	5	80	4	20	1	1.89
15 Total Dissolved Material	3.14	100	5		4					2															4		10	15	67	4	-33	-2	-6.29
16 BOD	2.52	80	4																						3		3	5	60	3	-20	-1	-2.52
17 COD	3.14	100	5																						3		3	5	60	3	-40	-2	-6.29
18 NO2 (Nitrite)	3.14	100	5		4		4																				8	10	80	4	-20	-1	-3.14
19 NO3 (Nitrate)	3.14	100	5		4		4																				8	10	80	4	-20	-1	-3.14
20 Pb (Lead)	2.52	80	4		3		3																				6	10	60	3	-20	-1	-2.52
21 Dust Content	2.52	80	4		3	3		3																			9	15	60	3	-20	-1	-2.52
BIOLOGY																																	
22 Covered by Vegetation	3.14	100	5		4			4			4										4						16	20	80	4	-20	-1	-3.14
23 Phytoplankton	3.14	100	5														4				4		4	4	4		20	25	80	4	-20	-1	-3.14
24 Zooplankton	1.26	40	2														1				1		1	1	1		5	25	20	1	-20	-1	-1.26
25 Pisces	3.14	100	5														4				4		4				12	15	80	4	-20	-1	-3.14
26 Aves	3.14	100	5		4			4			4									4							16	20	80	4	-20	-1	-3.14
27 Flora Variety	3.14	100	5		4			4			4									4	4						20	25	80	4	-20	-1	-3.14
28 Fauna Variety	3.14	100	5		4			4			4									4	4						20	25	80	4	-20	-1	-3.14
29 Coliform	3.14	100	5																		4		4				8	10	80	4	-20	-1	-3.14
30 Colifecal	2.52	80	4																		3		3				6	10	60	3	-20	-1	-2.52
SOCIO-ECONOMY & SOCIO-CULTURE																																	
31 Income	1.26	40	2	3		3																					6	10	60	3	20	1	1.26
32 Perception and Behaviour	2.52	80	4	3	3	3		5								3		5	5								27	35	77	4	-3	-1	-2.52
33 Social Conflict	2.52	80	4	3		3																					6	10	60	3	-20	-1	-2.52
34 Security	2.52	80	4	3		3		5										5	5								21	25	84	5	4	1	2.52
35 Transportation	1.89	60	3					5																			5	5	100	5	40	2	3.77
36 Social Facilities	1.89	60	3					4								4	4										12	15	80	4	20	1	1.89
37 Transport Facilities	1.89	60	3					5																			5	5	100	5	40	2	3.77
38 Small Holder	2.52	80	4	3				5																			8	10	80	4	0	0	0.00
TOTAL VALUE	100	3180	159	15	69	15	15	52	11	10	28	12	4	2	2	7	21	20	10	19	32	4	34	9	27	4	422						
MAXIMUM SCALE		3800	190	25	100	25	20	65	15	15	40	20	5	5	5	10	30	25	10	25	50	5	55	15	40	5		610					
PERCENTAGE		84	84	60	69	60	75	80	73	67	70	60	80	40	40	70	70	80	100	76	64	80	62	60	68	80			69				
FINAL SCALE		5	5	3	4	3	4	4	4	4	4	3	4	2	2	4	4	4	5	4	4	4	4	3	4	4				4			
DIFFERENCE PERCENTAGE																															-15		
DIFFERENCE RELATIVE WEIGHT																																-1	
AVERAGE RELATIVE WEIGHT	2.63																																
RELATIVE SETTING ENVIRONMENT SCALE & RELATIVE WEIGHT																																	-2.63

Table 3-11 MATRIX OF DECISION MAKING ANALYSIS FOR FLOODWAY CONSTRUCTION

ACTIVITIES	INITIAL LIVING ENVIRONMENT BEAUTY			PREPARATION			FLOOD WAY CONSTRUCTION						POST CONSTRUCTION							DIFFERENCES		
ENVIRONMENTAL COMPONENT	Relative Weight	Percentage	Scale	Land Compensation	Land Clearing & Stripping	Construction of Access Road	Dreging of River Channel	Fill for Embankment	Compacting & Shaping Leeve Embankment	Construction of Slope Protection	Construction of Inspection Road	Plant Grass and Trees	Grass Cutting	Canal Cleaning	Desilting	Total Value	Maximum Value	Average Percentage	Scale	Percentage	Scale	Change of Environmental Beauty = Change of Scale & Weight Relative
	A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ATMOSPHERE																						
1 Air Temperature	3.64	80	4		3							5				8	10	80	4	0	0	0.00
2 Noise Level	4.55	100	5	4	4	4	4	4	4	4	4					32	40	80	4	-20	-1	-4.55
3 Humidity	2.73	60	3		2							4				6	10	60	3	0	0	0.00
FIELD																						
4 Land Formation	3.64	80	4	3	3	3		3		3	3				3	21	35	60	3	-20	-1	-3.64
5 Thinness of Organic Matter	1.82	40	2	1	1	1		1		1	1	3			1	10	40	25	2	-15	-2	-3.64
6 Erosion	4.55	100	5		4									4		8	10	80	4	-20	-1	-4.55
QUALITY AND QUANTITY RIVER FLOW																						
7 Turbidity	2.73	60	3											2	2	4	10	40	2	-20	-1	-2.73
8 Colour	4.55	100	5											4	4	8	10	80	4	-20	-1	-4.55
9 Odour	4.55	100	5											4	4	8	10	80	4	-20	-1	-4.55
10 Total Dissvolved Material	4.55	100	5											4	4	8	10	80	4	-20	-1	-4.55
11 NO2 (Nitrite)	4.55	100	5		4	4										8	10	80	4	-20	-1	-4.55
12 NO3 (Nitrate)	4.55	100	5		4	4										8	10	80	4	-20	-1	-4.55
13 Pb (Lead)	3.64	80	4		3	3										6	10	60	3	-20	-1	-3.64
14 Dust Content	3.64	80	4	3		3					3					9	15	60	3	-20	-1	-3.64
BIOLOGY																						
15 Covered by Vegetation	1.82	40	2		1	1					1	3				6	20	30	3	-10	-1	-1.82
16 Phytoplankton	2.73	60	3											2	2	4	10	40	2	-20	-1	-2.73
17 Zooplankton	1.82	40	2											1	1	2	10	20	1	-20	-1	-1.82
18 Benthos	1.82	40	2											1	1	2	10	20	1	-20	-1	-1.82
19 Pisces	4.55	100	5											4	4	8	10	80	4	-20	-1	-4.55
20 Aves	4.55	100	5		4	4					4	5				17	20	85	5	-15	-1	-4.55
21 Flora Variety	1.82	40	2		1	1					1	2				5	20	25	2	-15	-2	-3.64
22 Fauna Variety	2.73	60	3		2	2					2	4				10	20	50	3	-10	-1	-2.73
SOCIO-ECONOMY & SOCIO-CULTURE																						
23 Income	1.82	40	2		3	3					3					9	15	60	3	20	1	1.82
24 Perception and Behaviour	3.64	80	4	3	3	5					5					16	20	80	4	0	0	0.00
25 Social Conflict	3.64	80	4	3	3	3					3					12	20	60	3	-20	-1	-3.64
26 Security	3.64	80	4	3		5					5					13	15	86	5	6	1	3.64
27 Transportation	2.73	60	3			4					4					8	10	80	4	20	1	2.73
28 Social Facilities	2.73	60	3			4					4					8	10	80	4	20	1	2.73
29 Transport Facilities	2.73	60	3			4					4					8	10	80	4	20	1	2.73
30 Small Holder	3.64	80	4	3	3	5					5					16	20	80	4	0	0	0.00
TOTAL VALUE	100	2200	110	23	48	63	4	8	4	8	52	26	0	26	26	288						
MAXIMUM SCALE		3000	150	40	85	95	5	15	5	15	80	35	0	45	50		470					
PERCENTAGE		73	73	58	56	66	80	53	80	53	65	74	0	58	52			61				
FINAL SCALE		4	5	4	4	4	4	3	4	3	4	5	0	3	3				4			
DIFFERENCE PERCENTAGE																				-12		
DIFFERENCE RELATIVE WEIGHT																					-1	
AVERAGE RELATIVE WEIGHT	3.33																					
RELATIVE SETTING ENVIRONMENT SCALE & RELATIVE WEIGHT																						-3.33

Table 3-12(1/3) MATRIX OF DECISION MAKING ANALYSIS FOR RIVER IMPROVEMENT (DELI RIVER)

ACTIVITIES	INITIAL LIVING ENVIRONMENT BEAUTY			PREPARATION			RIVER TRAINING CONSTRUCTION						POST CONSTRUCTION							DIFFERENCES		
ENVIRONMENTAL COMPONENT	Relative Weight	Percentage	Scale	Land Compensation	Land Clearing & Stripping	Construction of Access Road	Dreging of River Channel	Fill for Embankment	Compacting and Shaping Embankment	Construction of Slope Protection	Construction of Inspection Road	Plant Grass and Trees	Grass Cutting	Canal Cleaning	Desilting	Total Value	Maximum Value	Average Percentage	Scale	Percentage	Scale	Change of Environmental Beauty = Change of Scale & Weight Relative
	A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ATMOSPHERE																						
1 Air Temperature	2.67	80	4		3							5				8	10	80	4	0	0	0.00
2 Noise Level	2.00	60	3			2	2		2		2		2	2		12	30	40	2	-20	-1	-2.00
3 Wind Speed	3.33	100	5													0	0	0	0	0	0	0.00
4 Humidity	2.00	60	3													0	0	0	0	0	0	0.00
FIELD																						
5 Land Formation	2.67	80	4		3	3		3		3	3	5			3	23	35	66	4	-14	-1	-2.67
6 Thinckness of Organic Matter	1.33	40	2		1	1		1		1	1	3			1	9	35	26	2	-14	-1	-1.33
7 Erosion	3.33	100	5		4											4	5	80	4	-20	-1	-3.33
QUALITY AND QUANTITY RIVER FLOW																						
8 Turbidity	2.00	60	3		2		2							2		6	15	40	2	-20	-1	-2.00
9 Colour	3.33	100	5				4							4		8	10	80	4	-20	-1	-3.33
10 Odour	3.33	100	5				4							4		8	10	80	4	-20	-1	-3.33
11 Taste	3.33	100	5												4	4	5	80	4	-20	-1	-3.33
12 pH	3.33	100	5				4							4		8	10	80	4	-20	-1	-3.33
13 Temperature	2.67	80	4		3											3	5	60	4	-20	-1	-2.67
14 Dissolved Oxygen (DO)	2.00	60	3				4							4		8	10	80	4	20	1	2.00
15 Total Dissolved Material	3.33	100	5		4	4	4				4			4		20	25	80	4	-20	-1	-3.33
16 BOD	2.00	60	3				2							2		4	10	40	2	-20	-1	-2.00
17 COD	3.33	100	5				4							4		8	10	80	4	-20	-1	-3.33
18 NO2 (Nitrite)	3.33	100	5		4	4										8	10	80	4	-20	-1	-3.33
19 NO3 (Nitrate)	3.33	100	5		4	4										8	10	80	4	-20	-1	-3.33
20 Pb (Lead)	2.67	80	4			3	3									6	10	60	4	-20	-1	-2.67
21 Dust Content	2.67	80	4		3	3			3							9	15	60	4	-20	-1	-2.67
BIOLOGY																						
22 Covered by Vegetation	2.00	60	3		2	2		2	2		2	4	2		4	20	40	50	3	-10	-1	-2.00
23 Phytoplankton	2.67	80	4				3							3		6	10	60	4	-20	-1	-2.67
24 Zooplankton	2.00	60	3				2							2		4	10	40	2	-20	-1	-2.00
25 Zooplankton	1.33	40	2				1							1		2	10	20	1	-20	-1	-1.33
26 Pisces	2.67	80	4				3							3		6	10	60	4	-20	-1	-2.67
27 Aves	2.67	80	4		3	3		3			3	5				17	25	68	4	-12	-1	-2.67
28 Flora Variety	1.33	40	2		1	1		1			1	2				6	25	24	2	-16	-1	-1.33
29 Fauna Variety	2.67	80	4		3	3		3			3	4				16	25	64	4	-16	-1	-2.67
30 Coliform	3.33	100	5												4	4	5	80	4	-20	-1	-3.33
31 Colifecal	3.33	100	5												4	4	5	80	4	-20	-1	-3.33
SOCIO-ECONOMY & SOCIO-CULTURE																						
31 Income	2.00	60	3			3					3					6	10	60	4	0	1	2.00
32 Perception and Behaviour	2.67	80	4	3	3	4					4	4	3	4		25	35	71	4	-9	-1	-2.67
33 Social Conflict	2.00	60	3	2		4					3					9	15	60	4	0	1	2.00
34 Security	2.00	60	3			3					2					5	10	50	3	-10	-1	-2.00
35 Transportation	2.67	80	4	3		4					4					11	15	73	4	-7	-1	-2.67
36 Social Facilities	2.67	80	4	3												3	5	60	4	-20	-1	-2.67
37 Transport Facilities	2.67	80	4	3		4					4					11	15	73	4	-7	-1	-2.67
38 Small Holder	1.33	40	2			1	1	1			2					5	20	25	2	-15	-1	-1.33
TOTAL VALUE	100	3000	150	14	43	56	43	14	7	4	41	32	7	43	20	324						
MAXIMUM SCALE		3900	195	25	75	95	75	35	15	10	75	40	15	70	30		560					
PERCENTAGE		77	77	56	57	59	57	40	47	40	55	80	47	61	67			58				
FINAL SCALE		4	4	3	3	3	3	2	3	2	3	4	3	4	4				3			
DIFFERENCE PERCENTAGE																				-19		
DIFFERENCE RELATIVE WEIGHT																					-1	
AVERAGE RELATIVE WEIGHT	2.56																					
RELATIVE SETTING ENVIRONMENT SCALE & RELATIVE WEIGHT																						-2.56

Table 3-12(2/3) MATRIX OF DECISION MAKING ANALYSIS FOR RIVER IMPROVEMENT (PERCUT RIVER)

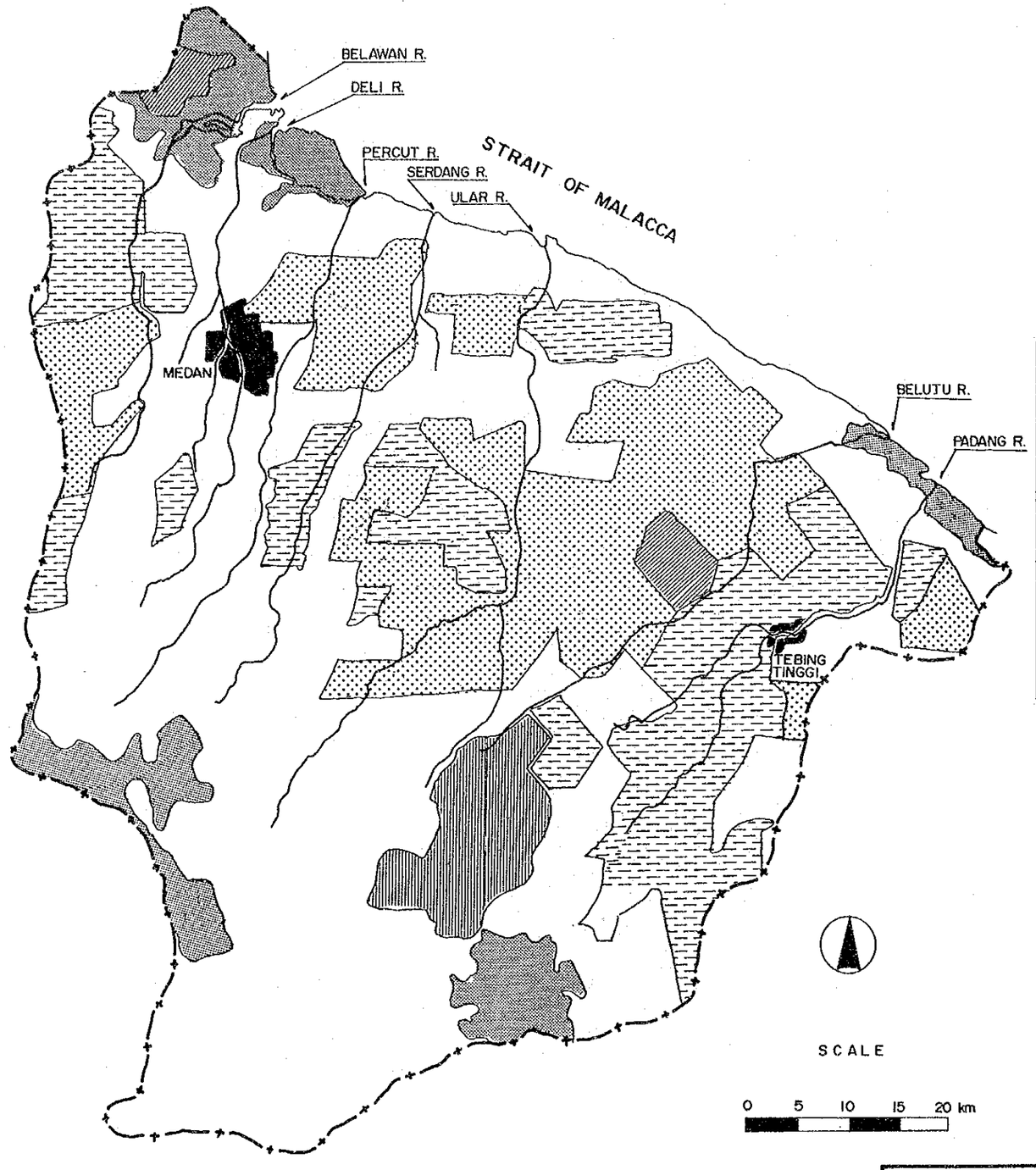
ACTIVITIES	INITIAL LIVING ENVIRONMENT BEAUTY			PREPARATION			RIVER TRAINING CONSTRUCTION						POST CONSTRUCTION							DIFFERENCES		
	Relative Weight	Percentage	Scale	Land Compensation	Land Clearing & Stripping	Construction of Access Road	Dreging of River Channel	Fill for Embankment	Compacting and Shaping Embankment	Construction of Slope Protection	Construction of Inspection Road	Plant Grass and Trees	Grass Cutting	Canal Cleaning	Desilting	Total Value	Maximum Value	Average Percentage	Scale	Percentage	Scale	Change of Environmental Beauty = Change of Scale & Weight Relative
ENVIRONMENTAL COMPONENT	A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ATMOSPHERE																						
1 Air Temperature	2.56	80	4		3							5				8	10	80	4	0	0	0.00
2 Noise Level	1.92	60	3			2	2		2		2		2	2		12	30	40	2	-20	-1	-1.92
3 Wind Speed	3.21	100	5													0	0	0	0	0	0	0.00
4 Humidity	1.92	60	3													0	0	0	0	0	0	0.00
FIELD																						
5 Land Formation	2.56	80	4		3	3		3		3	3	5			3	23	35	66	4	-14	-1	-2.56
6 Thinckness of Organic Matter	1.28	40	2		1	1		1		1	1	3			1	9	35	26	2	-14	-1	-1.28
7 Erosion	3.21	100	5		4											4	5	80	4	-20	-1	-3.21
QUALITY AND QUANTITY RIVER FLOW																						
8 Turbidity	1.92	60	3		2		4							4		10	15	67	4	7	1	1.92
9 Colour	3.21	100	5				4							4		8	10	80	4	-20	-1	-3.21
10 Odour	3.21	100	5												4	4	5	80	4	-20	-1	-3.21
11 Taste	3.21	100	5												4	4	5	80	4	-20	-1	-3.21
12 pH	3.21	100	5				4							4	4	12	15	80	4	-20	-1	-3.21
13 Temperature	2.56	80	4		3											3	5	60	3	-20	-1	-2.56
14 Dissolved Oxygen (DO)	1.92	60	3				4							4		8	10	80	4	20	1	1.92
15 Total Dissolved Material	3.21	100	5		4	4	4				4			4		20	25	80	4	-20	-1	-3.21
16 BOD	1.92	60	3				2							2		4	10	40	2	-20	-1	-1.92
17 COD	3.21	100	5				4							4		8	10	80	4	-20	-1	-3.21
18 NO2 (Nitrite)	3.21	100	5		4	4										8	10	80	4	-20	-1	-3.21
19 NO3 (Nitrate)	3.21	100	5		4	4										8	10	80	4	-20	-1	-3.21
20 Pb (Lead)	2.56	80	4			3	3									6	10	60	3	-20	-1	-2.56
21 Dust Content	2.56	80	4		3	3			3							9	15	60	3	-20	-1	-2.56
BIOLOGY																						
22 Covered by Vegetation	3.21	100	5		4	4		4		4	4	5	4		4	33	40	83	5	-18	-1	-3.21
23 Phytoplankton	1.92	60	3				4							4		8	10	80	4	20	1	1.92
24 Zooplankton	1.28	40	2				1							1		2	10	20	1	-20	-1	-1.28
25 Zooplankton	1.28	40	2				1							1		2	10	20	1	-20	-1	-1.28
26 Pisces	3.21	100	5		4		4							4		12	15	80	4	-20	-1	-3.21
27 Aves	3.21	100	5			4	4	4			4	5		4	4	29	35	83	5	-17	-1	-3.21
28 Flora Variety	1.28	40	2		1	1		1			1	2			1	7	30	23	2	-17	-1	-1.28
29 Fauna Variety	3.21	100	5		4	4		4			4	5			4	25	30	83	5	-17	-1	-3.21
30 Coliform	3.21	100	5												4	4	5	80	4	-20	-1	-3.21
31 Colifecal	3.21	100	5												4	4	5	80	4	-20	-1	-3.21
SOCIO-ECONOMY & SOCIO-CULTURE																						
32 Income	1.28	40	2			2					2					4	10	40	2	0	0	0.00
33 Perseption and Behaviour	2.56	80	4	3	3	4					4	4	3	4	4	29	40	73	4	-8	-1	-2.56
34 Social Conflict	2.56	80	4	3		4					4					11	15	73	4	-7	-1	-2.56
35 Security	2.56	80	4		3						3					6	10	60	3	-20	-1	-2.56
36 Transportation	3.21	100	5	4		5					5					14	15	93	5	-7	-1	-3.21
37 Social Facilities	1.92	60	3	3												3	5	60	3	0	0	0.00
38 Transport Facilities	3.21	100	5	4		5					5					14	15	93	5	-7	-1	-3.21
39 Small Holder	1.92	60	3			2	2	2			3					9	20	45	3	-15	-1	-1.92
TOTAL VALUE	100	3120	156	17	50	59	47	19	5	8	49	34	9	46	41	384						
MAXIMUM SCALE		3900	195	25	80	90	75	35	10	15	75	40	15	70	60		590					
PERCENTAGE		80	80	68	63	66	63	54	50	53	65	85	60	66	68			65				
FINAL SCALE		4	4	4	4	4	4	3	3	3	4	5	3	4	4				4			
DIFFERENCE PERCENTAGE																				-15		
DIFFERENCE RELATIVE WEIGHT																					-1	
AVERAGE RELATIVE WEIGHT	2.56																					
RELATIVE SETTING ENVIRONMENT SCALE & RELATIVE WEIGHT																						-2.56

Table 3-12(3/3) MATRIX OF DECISION MAKING ANALYSIS FOR RIVER IMPROVEMENT (PADANG RIVER)

ACTIVITIES	INITIAL LIVING ENVIRONMENT BEAUTY			PREPARATION			RIVER TRAINING CONSTRUCTION						POST CONSTRUCTION							DIFFERENCES		
	Relative Weight	Percentage	Scale	Land Compensation	Land Clearing & Stripping	Construction of Access Road	Dreging of River Channel	Fill for Embankment	Compacting and Shaping Embankment	Construction of Slope Protection	Construction of Inspection Road	Plant Grass and Trees	Grass Cutting	Canal Cleaning	Desilting	Total Value	Maximum Value	Average Percentage	Scale	Percentage	Scale	Change of Environmental Beauty = Change of Scale & Weight Relative
ENVIRONMENTAL COMPONENT	A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ATMOSPHERE																						
1 Air Temperature	2.60	80	4		3							4				7	10	70	4	-10	-1	-2.60
2 Noise Level	1.95	60	3			2	2		2		2		2	2		12	30	40	2	-20	-1	-1.95
3 Wind Speed	3.25	100	5													0	0	0	0	0	0	0.00
4 Humidity	1.95	60	3													0	0	0	0	0	0	0.00
FIELD																						
5 Land Formation	2.60	80	4		3	3		3		3	3	4			3	22	35	63	4	-17	-1	-2.60
6 Thinckness of Organic Matter	1.30	40	2		1	1		1		1	1	3			1	9	35	26	2	-14	-1	-1.30
7 Erosion	3.25	100	5		4											4	5	80	4	-20	-1	-3.25
QUALITY AND QUANTITY RIVER FLOW																						
8 Turbidity	1.95	60	3		2		2							2		6	15	40	2	-20	-1	-1.95
9 Colour	3.25	100	5				4	4						4		12	15	80	4	-20	-1	-3.25
10 Odour	3.25	100	5											4		4	5	80	4	-20	-1	-3.25
11 Taste	3.25	100	5													0	0	0	0	0	0	0.00
12 pH	3.25	100	5													0	0	0	0	0	0	0.00
13 Temperature	2.60	80	4	3											4	7	10	70	4	-10	-1	-2.60
14 Dissolved Oxygen (DO)	3.25	100	5				5							4		9	10	90	5	-10	-1	-3.25
15 Total Dissolved Material	3.25	100	5		4	4	4				4			4		20	25	80	4	-20	-1	-3.25
16 BOD	1.95	60	3				2							2		4	10	40	2	-20	-1	-1.95
17 COD	3.25	100	5				4							4		8	10	80	4	-20	-1	-3.25
18 NO2 (Nitrite)	3.25	100	5		4	4										8	10	80	4	-20	-1	-3.25
19 NO3 (Nitrate)	3.25	100	5		4	4										8	10	80	4	-20	-1	-3.25
20 Pb (Lead)	2.60	80	4			3	3									6	10	60	3	-20	-1	-2.60
21 Dust Content	3.25	100	5		4	4			4							12	15	80	4	-20	-1	-3.25
BIOLOGY																						
22 Covered by Vegetation	3.25	100	5		4	4					4	5	4		4	25	30	83	5	-17	-1	-3.25
23 Phytoplankton	1.95	60	3				2							2		4	10	40	2	-20	-1	-1.95
24 Zooplankton	1.30	40	2				1							1		2	10	20	1	-20	-1	-1.30
25 Zooplankton	1.95	60	3				2							2		4	10	40	2	-20	-1	-1.95
26 Pisces	3.25	100	5				4							4		8	10	80	4	-20	-1	-3.25
27 Aves	3.25	100	5		4	4					4	5				17	20	85	5	-15	-1	-3.25
28 Flora Variety	1.30	40	2		1	1					1	3			1	7	25	28	2	-12	-1	-1.30
29 Fauna Variety	2.60	80	4		3	3					3	5			3	17	25	68	4	-12	-1	-2.60
30 Coliform	3.25	100	5												4	4	5	80	4	-20	-1	-3.25
31 Colifecal	3.25	100	5												4	4	5	80	4	-20	-1	-3.25
SOCIO-ECONOMY & SOCIO-CULTURE																						
32 Income	1.30	40	2	3		2					2					7	15	47	3	7	1	1.30
33 Perception and Behaviour	2.60	80	4	3	3	4					4	4	3	4	4	29	40	73	4	-8	-1	-2.60
34 Social Conflict	1.95	60	3	2		2					2					6	15	40	2	-20	-1	-1.95
35 Security	1.95	60	3		3	3					3					9	15	60	3	0	0	0.00
36 Transportation	1.95	60	3			2					2					4	10	40	2	-20	-1	-1.95
37 Social Facilities	1.95	60	3	2	2	4					4	4				16	25	64	4	4	1	1.95
38 Transport Facilities	1.95	60	3	2	4	4					4					14	20	70	4	10	1	1.95
39 Small Holder	2.60	80	4	3	3						5					11	15	73	4	-7	-1	-2.60
TOTAL VALUE	100	3080	154	18	56	58	35	8	6	4	48	37	9	39	28	346						
MAXIMUM SCALE		3900	195	35	90	95	60	15	10	10	80	45	15	65	45		565					
PERCENTAGE		79	79	51	62	61	58	53	60	40	60	82	60	60	62			61				
FINAL SCALE		4	4	3	4	4	3	3	3	2	3	5	3	3	4				4			
DIFFERENCE PERCENTAGE																				-18		
DIFFERENCE RELATIVE WEIGHT																					-1	
AVERAGE RELATIVE WEIGHT	2.56																					
RELATIVE SETTING ENVIRONMENT SCALE & RELATIVE WEIGHT																						-2.56

Table 3-13 MATRIX OF COMPATIBILITY OF IMPACT FOR DAM CONSTRUCTION

ACTIVITIES	ACCESS ROAD								DAM CONSTRUCTION										FACILITIES							POST CONSTRUCTION										
ENVIRONMENTAL COMPONENT	Land Clearing	Stripping	Cut & Fill	Compaction & Sloping	Treatment	Construction of Drainage	Electrict & Telephon	Bridge & Culvert	Land Clearing	Stripping	Construction of Diversion	Cut & Fill	Soil Improvement	Foundation	Cast & Scaffolding	Reinforcement Bar	Concreting	Fixing Support Component	Finishing	Land Clearing	Stripping	Offices / Houses	Water Supply	Mechanical	Electrical	Telecommunication	Landscape	Filling Dam	Spilling	Release Required Water	Desilting	Oiling	Painting	Canal Cleaning	Keep Protection Dike	Total Value	Maximum Value	Average Percentage	Scale
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
ATMOSPHERE																																							
1 Air Temperature	3	3							3	3										3	3			3			3									24	40	60	3
2 Noise Level	2		2	2					2			2		2			2	2		2				2												20	50	40	2
3 Humidity																																				0	0	0	0
FIELD																																							
4 Land Formation	3		3	3		3			3			3	3							3						3	3									30	50	60	3
5 Thickness of Organic Matter	1		1	1					1			1	1							1							1									8	40	20	1
6 Erosion	4			5					4																											13	15	87	5
QUALITY AND QUANTITY RIVER FLOW																																							
7 Turbidity	4					4			4		4		4	4														4		4	4			4	4	44	55	80	4
8 Colour	4					4			4		4		4	4														5		5	4			4	4	46	55	84	5
9 Odour																																		4		4	5	80	4
10 Temperature	3																																			3	5	60	3
11 Total Oissolved Material	4					4			4								4											5		5				4		30	35	86	5
12 BOD																																		2		2	5	40	2
13 COD																																		4		4	5	80	4
14 NO2 (Nitrite)	4																																			4	5	80	4
15 NO3 (Nitrate)	4																																			4	5	80	4
16 Pb (Lead)	3																																			3	5	60	3
17 Coliform																						4														4	5	80	4
18 Colifecal																						4														4	5	80	4
19 Dust Content	3								3								3	3						3												15	25	60	3
BIOLOGY																																							
20 Covered by Vegetation	4		4						4			4																5								16	20	80	4
21 Phytoplankton																												3								5	5	100	5
22 Zooplankton																												3								3	5	60	3
23 Benthos																												3								3	5	60	3
24 Pisces																												5								5	5	100	5
25 Aves	4		4						4			4																								16	20	80	4
26 Flora Variety	4		4						4			4																								16	20	80	4
27 Fauna Variety	4		4						4			4																								16	20	80	4
SOCIO-ECONOMY & SOCIO-CULTURE																																							
28 Income							3	3														3														9	15	60	3
29 Perception and Behaviour	3						5	5														5	5		5	5		5								38	40	95	5
30 Social Conflict							4	4														3														11	15	73	4
31 Security							4	4														3			5	5										21	25	84	5
32 Transportation	4			4			4	4														4														20	25	80	4
33 Social Facilities	4			4			4	4														4	4		4	4		5								37	45	82	5
34 Transport Facilities	4			4			4	4														4														20	25	80	4
35 Small Holder							4	4														4														12	15	80	4
TOTAL VALUE	73	3	22	23	0	15	32	32	44	3	8	22	12	10	0	0	9	5	0	9	3	38	9	8	14	14	6	44	0	14	8	0	0	22	8	510			
MAXIMUM SCALE	105	5	35	35	0	20	40	40	65	5	10	35	20	15	0	0	15	10	0	20	5	50	10	15	15	15	10	55	0	15	10	0	0	30	10		715		
PERCENTAGE	70	60	63	66	0	75	80	80	68	60	80	63	60	67	0	0	60	50	0	45	60	76	90	53	93	93	60	80	0	93	80	0	0	73	80			71	
FINAL SCALE	4	3	4	4	0	4	4	4	4	3	4	4	3	4	0	0	3	3	0	3	3	4	5	3	5	5	3	4	0	5	4	0	0	4	4				4



LEGEND

RIVER COURSE

STUDY AREA BOUNDARY

LAND STATUS

: Agreed Production Forest

: Forest Conservation Area

OTHERS

: Recommended Development Area

: Large Scale Private Plantation

: Government Own Plantation

: Plantation

SOURCE : 1. Land Status and Recomended Development Area series RePPProt, 1988.

2. Rencana Pembangunan Perkeretapian di Wilayah Sumatera Utara (RPPSU), 1989.

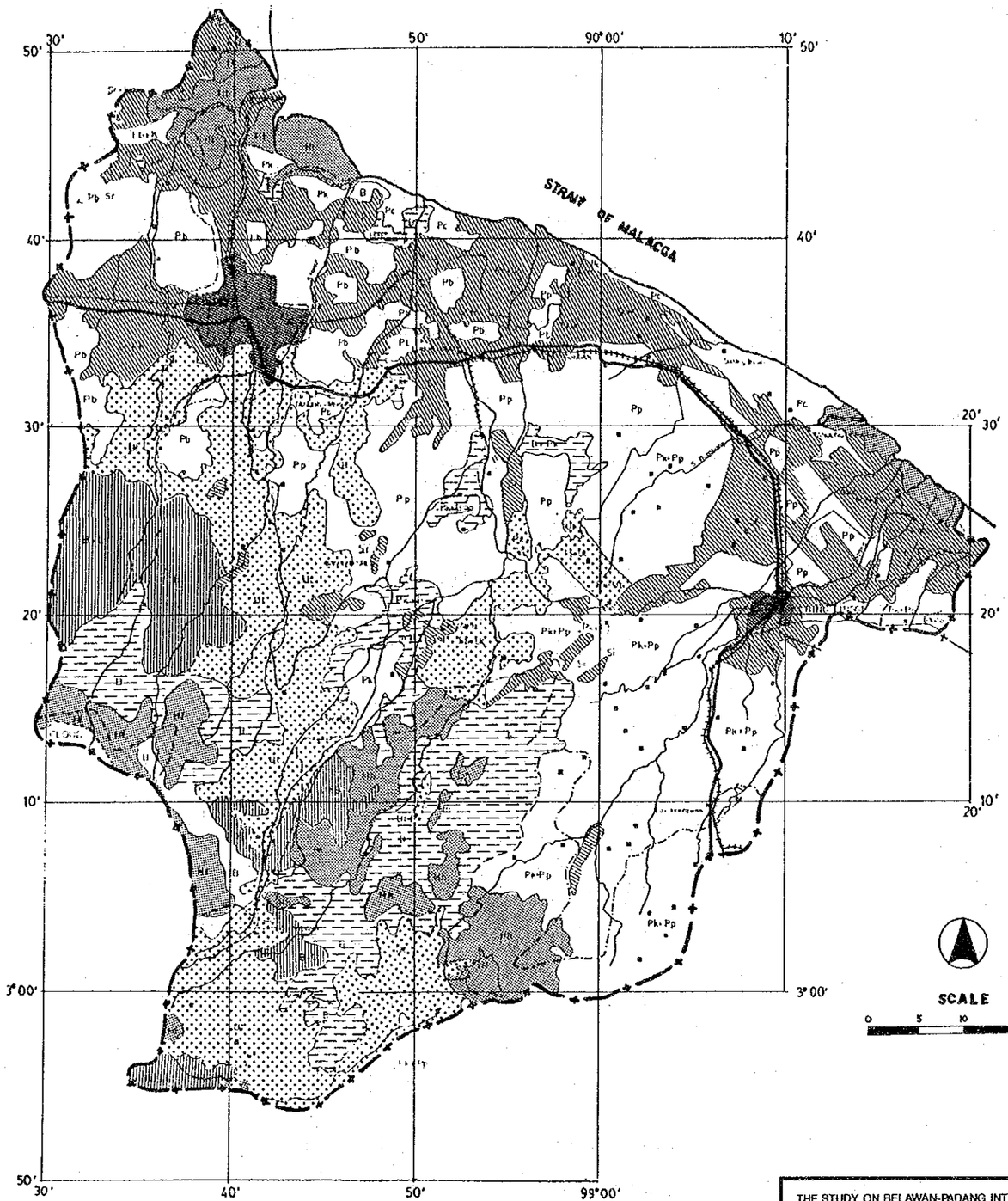
3. MEDIWANTI RAILWAY PROJECT, Seminar Perkeretapian di Sumatera Utara - Aceh, 1990.

THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

RECOMMENDED LAND USE MAP

Fig.4-2



LEGEND

- STUDY AREA BOUNDARY
- RIVER COURSE
- KABUPATEN BOUNDARY
- MAIN ROAD
- RAILWAY
- LAND USE BOUNDARIES DEFINITE, INDEFINITE

SETTLEMENT
Towns, Villages, Industrial Areas, Recreation Area, Airport and others settlements.

WETLAND
Irrigated Wetland Rice, Rainfed Wetland Rice, Tidal Wetland Rice Ponds etc.

TREE CROPS/ESTATES
Palm Oil, Rubber, Tobacco and Coconut.

UP LAND PERMANENT CULTIVATION
Up Land Crops, Undifferentiated.

SHIFTING CULTIVATION
Shifting Cultivation, includes scrub and Alang-Alang Grass.

FOREST
Sub Montane Forest Usually 1000-2000 m
Lowland Forest Usually 1000m, Tidal Forest undifferentiated includes Mangrove, Nipah and Palm, Swamp Forest undifferentiated.

BUSH
Secondary Forest, Bush, Scrub Outside the Forest Cultivation Cycle.

SCALE
0 5 10 15 20 Km

THE STUDY ON BELAWAN-PADANG INTEGRATED RIVER BASIN DEVELOPMENT IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

PRESENT LAND USE MAP

Fig.4-1

WS

WATER SUPPLY PLAN

STUDY ON BELAWAN-PADANG
INTEGRATED RIVER BASIN DEVELOPMENT

SUPPORTING REPORT

WATER SUPPLY PLAN

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SUPPORTING REPORT

WATER SUPPLY PLAN

1. INTRODUCTION

This supporting report describes the present condition of water utilization in the study area, especially municipal and domestic water supply, and figures out the future water supply system based on a water balance study.

Presently, water in the study area is utilized for municipal and domestic water supply, irrigation, aquaculture, and river maintenance flow. The demand for more municipal and domestic water supply is felt mainly in Medan City and the surrounding kecamatans, and Tebing Tinggi City. The demand in other kecamatans in the study area is so small that new water supply systems in these areas is not required.

Irrigation water requirement is not sufficiently met, although the irrigation system in the study area is rather developed compared with other areas in North Sumatra. Water demand for aquaculture does not affect the water balance so much because water utilization for this purpose is not so consumptive. River maintenance flow has never been fixed in the study area, so that it is proposed in this study.

The present and future conditions of water supply potential are presented in the supporting reports on Hydrology and Dam and Reservoir.

2. PRESENT CONDITION OF WATER UTILIZATION

2.1 Municipal and Domestic Water

The most recent condition of the municipal water supply system in North Sumatra is as shown in Table 2-1, and the municipalities which are included in the study area are shown in Table 2-2. The existing condition of water source and use of the municipal and domestic water supply is summarized as below.

Medan

(1) Water Source

The existing water supply system of Medan City is as shown in Fig. 2-1. The water sources are the surface flow of Belawan River and Deli River, the springs in the mountain slope and the groundwater by shallow and deep wells.

The springs in the vicinity of Sibolangit, about 40 km south of Medan, are the earliest sources of water supply to Medan. They consist of three (3) groups, the Rumah Sumbul, the Lau Bengkawang and the Lau Kaban (refer to Fig. 2-2). The average flow transmitted to Medan is about 46,300 m^3/day (540 l/s).

Intake structures on rivers are located at Sunggal and Deli Tua at the right banks of Belawan River and Deli River, respectively. The intake capacity of Sunggal is about 1,500 l/s, but the actual intake water is 1,050 l/s. As for Deli Tua, the intake capacity is estimated at 1,400 l/s, but the present production capacity of the treatment plant is only 350 l/s.

Groundwater is drawn by pumping from deep wells and shallow wells. Although many wells are used, only 22 deep wells are incorporated into the municipal water supply system of Medan as shown in Table 2-3 and Fig. 2-3 and three (3) of these wells were closed because of maintenance difficulties. The total production capacity is 300 l/s at present. Other than the deep wells of the water supply system, private deep wells and individual shallow wells are also used to draw groundwater, but the data on number of units and their capacities are not available.

In addition to the above, the Belawan Port Authority (BPA) owns an independent water supply system which draws water from 12 deep wells as shown also in Fig. 2-3 and Table 2-3. The water supply system is for potable water supply to ships and offices in the port compound. The total supply capacity is at about 150 l/s.

(2) Water Use

The total number of consumers served by the water supply system under PDAM Tirtanadi Medan is estimated at about 193,000 units as of May 1990 (refer to Table 2-4). Since the present population of Medan is about 1,730,000, the service ratio is estimated at only 30%.

In addition to the above piped water supply system, groundwater by deep wells is also utilized. The detailed data on the number of serviced houses are not available but the total capacity of 300 l/s is mainly for non-domestic water demand.

Other people are still utilizing shallow wells, even stream water. Though there is no available data, the depth of the shallow wells in the different parts of the city varies from one to seven meters and the per capita consumption is considered to be about 30 to 40 l/day, according to the field and interview survey at different sites.

Tebing Tinggi

(1) Water Source

The water source for the municipal water supply in Tebing Tinggi is only the surface flow of Padang River. An intake structure and a water treatment plant were constructed at Bulian in 1981, about 2 km west of the city center (refer to Fig. 2-4), and the intake capacity is about 60 l/s but the production capacity of the water treatment plant is only about 45 l/s.

There exist eight (8) deep wells, as shown also in Fig. 2-4 and Table 2-3, with the total capacity of about 30 l/s. Water from these deep wells is not utilized for domestic purpose because of its high temperature of about 50° C and hardness with high content of manganese and sulphate.

(2) Water Use

Under the PDAM Tebing Tinggi, the total number of consumers is about 2,400 units, corresponding to about 14,400 persons as of February 1990 (refer to Table 2-5). Thus, the present water supply service ratio is about 12% since the population is 117 thousand. The others utilize shallow wells, stream water and rainwater in water tanks.

Deli Serdang

(1) Water Source

Fourteen (14) kecamatans in Kab. Deli Serdang are at present provided with a water supply system with water sources from river flow, groundwater and springs. River surface water is utilized at Tanjung Morawa and Sei Rampah from Belumai River (Serdang River) and Belutu River, respectively, as shown in Fig. 2-5. The intake capacity (free intake) is 10 l/s at Tanjung Morawa and 20 l/s at Sei Rampah.

Other kecamatans such as Lubuk Pakam, Batang Kuis, Perbaungan, Dolok Masihul, Hamparan Perak, Tembung, Bandar Khalipah, Dolok Merawan, Pantai Cermin, Galang and Tiga Juhar are provided with deep wells with the intake capacity of about 60 l/s (refer to Table 2-3 and Fig. 2-6). However, three of them (Tembung, 5.0 l/s; Galang, 5.0 l/s and Dolok Masihul, 2.5 l/s) are not functioning at present due of some maintenance problems. Therefore, the actual total capacity is about 50 l/s.

(2) Water Use

Water supply systems in Kab. Deli Serdang are shown in Table 2-6. In accordance with the PDAM Deli Serdang, a total of about 3,000 households receive the supply service and this is only 1.1% of the total population of about 1.6 million in Kab. Deli Serdang (see details in Table 2-7). Almost all people still use shallow wells, stream water or rainwater in water tanks.

Non-Domestic Water

Based on the water consumption data of PDAM Medan, the use of non- domestic water such as institutional, commercial and industrial water use is estimated, especially for industrial water to grasp the actual water use condition. The record of water tariff collection in May 1990 of PDAM Medan shows the actual water consumption as below:

Actual Water Consumption (As of May 1990)

Item	Number of Units	Consumption (m^3/day)	Ratio (%)
Domestic Water	84,616	95,058 (1,100)	75
Non-Domestic Water	11,696	32,836 (380)	25
- Institutional	888	6,710 (78)	
- Commercial	10,672	16,769 (194)	
- Industrial	136	1,020 (12)	
- Others	-	8,337 (96)	
T o t a l	96,312	127,894 (1,480)	100

Note: Figures in parentheses are expressed in l/s.

The above table shows that about 25% of the total use is consumed for non-domestic purposes. Guidelines and standards of Cipta Karya and those proposed in the Repelita IV are summarized in Table 2-8.

Unaccounted loss of water is estimated at about 25% since the actual water production in May is 1,940 l/s (540 l/s from Sibolangit, 1,050 l/s from Sunggal and 350 l/s from Deli Tua).

The record also shows the number of consumers and water volume depending on scale of factory on the industrial water consumption, as follows.

Industrial Water Consumption

Item	Number of Units	Consumption (m^3/day)	Ratio (%)
Big Industry	102	865 (10)	85
Small Industry	34	155 (2)	15
T o t a l	136	1,020 (12)	100

Note: Figures in parentheses are expressed in l/s.

On the other hand, the provincial statistics (Sumatra Utara Dalam Angka) show that the number of employees is about 100 for large/medium scale factory and about 10 for small scale factory. The details are shown below. (Refer to Table 2-9.)

Factories in North Sumatra

Scale of Factory	Number of Factory	Number of Employees	Per-Factory Employee
Large/Medium	400	44,961	112
- Medan City	214	22,129	103
- T. Tinggi City	24	2,287	95
- Kab. D. Serdang	162	20,545	126
Small	2,165	17,305	8
- Medan City	1,353	10,817	8
- T. Tinggi City	106	960	9
- Kab. D. Serdang	706	5,528	8
T o t a l	2,565	62,266	3

From the above, about a half of the large factories in Medan receive the piped-water supply service, and most of the small factories utilize the groundwater though private deep wells. Unit consumption of the industrial water is estimated at about 90 l/day/employee for a large factory and 470 l/day/employee for a small factory.

In the whole Indonesia, the unit consumption of industrial water is, except large scale industrial estate development, 100 to 150 l/day/employee (130 l/day/employee on average was adopted for Ujung Pandang Water Supply Project in 1985). Thus, 170 l/day/employee for a small factory mentioned above is too big, and this could be reduced to one half or less since this type of small factory is considered as a household industry. Therefore, about 130 l/day/employee can be set as the average unit consumption of industrial water.

2.2 Irrigation Water

Agricultural Practice

Major crops in the study area are wetland rice, followed by upland rice, maize, cassava, soyabean, sweet potato, peanut and other beans. Rice is planted generally from October to November and harvested during February to April. Improved seed varieties of rice such as IR-46, Bah Bolon, Klara, Si-Gerbang, Si-Bogor and PB-56 are planted, but the utilization of fertilizers and agrochemicals is still in a low level.

Water Source and Use

The existing paddy fields in each river basin are shown in Table 2-10 and Fig. 2-7. Based on the inventory of the existing paddy field, the present condition is classified into the following four (4) categories in terms of water use. The water sources for these irrigation areas are only the river flow except the rainfed area.

Classification of Irrigation Area

Category	Area (ha)	Ratio (%)
1. Technical Irrigation Area	18,824	24.0
2. Semi-Tech. Irrigation Area	18,890	24.1
3. Simple Irrigation Area	25,952	33.1
4. Rainfed Area	14,700	18.8
T o t a l	78,366	100.0

In addition to the above, there exist 10,200 ha of swampy area with some portions partially cultivated and the potential for irrigation development is high.

The technical irrigation area is well provided with irrigation facilities and double cropping is practiced, i.e., a crop intensity of 200%. However, the semi-technical and simple irrigation areas can only attain the crop intensity of 120% on average. Most of the irrigation facilities in both areas require rehabilitation or improvement to upgrade the irrigation level.

2.3 Other Water Uses

Aquaculture Water

There exist three (3) types of aquacultural practice in the study area classified by the provincial fishery office (Dinas Perikanan Propinsi), namely (a) Mina Paddy, (b) Kolam and (c) Tambak. Mina Paddy and Kolam are the fresh water aquaculture conducted in paddies or fresh water fishponds to feed fish such as Tawes, Lele, etc. Tambak is the brackish water aquaculture conducted in the lowland area along the seashore, mainly for shrimp and tiger prawn.

In the study area, about 520 ha of Kolam and 280 ha of paddy exist as shown in Table 2-11, but the required water is mostly supplied by unused and/or circulated irrigation water. As for Tambak, out of a total of 2,100 ha, about 830 ha is in operation as shown in Table 2-12 and Fig. 2-8, as fresh water is supplied from rainfall.

Even if fresh water is needed, it will be obtained from the irrigation water. At present, only a few Tambaks utilize the shallow well and almost all Tambaks obtain fresh water from the irrigation and swamp in the vicinity.

Fresh water demand for aquaculture can be met by part of the irrigation water. Hence, it is excluded from the present study.

3. WATER BALANCE

3.1 Present Water Demand

Municipal Water

(1) General

In conformity with the Fifth Five-Year Development Plan (Repelita V), the service ratio of water supply in the urban area is upgraded to 80% from 75%, which had been adopted in the previous plan (Repelita IV). The per capita demand depending on the scale of city/kotamadya is set as follows:

Per Capita Water Demand in Urban Area

Class	Population	Per Capita Demand
Major Urban City	more than 1,000,000	120 l/c/day
Big City	500,000 - 1,000,000	100
Middle City	100,000 - 500,000	90
Small City	20,000 - 100,000	60

The above is considered to be a basic need, and a higher consumption of water is often observed in several cities, especially in major urban areas. As for the rural area with a population less than 20,000, some different criteria are employed as below:

Per Capita Water Demand in Rural Area

Class	Population	Per Capita Demand
Kecamatan Capital I	3,000 - 20,000	45 l/c/d
Kecamatan Capital II	less than 3,000	30 l/c/d

(2) Condition for Demand Estimation

Referring to the above criteria and the present water use condition in the study area, conditions for the estimation of water demand are set as follows:

(a) The target area for the water supply plan is the Medan Area (Medan City and six kecamatans serviced by PDAM Tirtanadi), Tebing Tinggi City and all kecamatans in Kab. Deli Serdang. (Refer to Fig. 3-1.)

(b) Per capita demand is the 130 l/s adopted by Repelita V.

(c) Non-domestic water such as institutional, commercial and industrial water in Medan is estimated at 40% of the domestic water, because:

- There is no big scale industrial estate development;
- Actual consumption record shows that non-domestic water is about 35% of the domestic water;
- Industrial water demand vary depending on its manufacturing system, type of machine and quality of product;
- Industrial structure in the study area cannot be abruptly changed or expanded in the near future; and
- The MUDP master plan study in 1980 also shows the ratio of non-domestic water as 32% to 40%.

As for Tebing Tinggi City, the non-domestic water use occupies 145% of the domestic water use according to the actual consumption as of May 1990. This cannot be adopted since the above ratio will be reduced much as the service ratio for the domestic water supply will be upgraded. Thus, the same ratio as that of Medan (40%) is employed for Tebing Tinggi. With regard to the kecamatan in Kab. Deli Serdang, the ratio of 10% is assumed for the non-domestic water use based on the statistics by DGCK.

(3) Estimated Water Demand

The estimated municipal water demands of the respective river basins are summarized as follows (see details in Table 3-1).

Estimated Water Demand

(Unit : m^3/day)

Name of City/River	Domestic Water	Non-Domestic Water	Total
Medan	168,773	67,509	315,042
T. Tinggi	11,408	4,563	21,294
Belawan	4,645	465	6,813
Deli	969	97	1,421
Percut	3,618	362	5,306
Serdang	4,169	417	6,114
Ular	5,421	542	7,951
Belutu	3,190	319	4,678
Padang	2,337	234	3,427
Total	204,530	74,508	372,046

Note: Water demands of Medan and T. Tinggi cities do not include water from those of Deli River and Padang River, respectively.

Irrigation Water

Irrigation water requirements are estimated based on the cropping pattern shown in Table 3-2, which was applied in the Ular River Project. The crop intensity is set at 200% for the technical irrigation area and 120% for the semi-technical and simple irrigation area in accordance with the current practice.

Aquaculture

Demand for aquaculture is not incorporated into the present Study, since it is met by the water utilized for irrigation purposes and the water of swamps in the vicinity.

River Maintenance Flow

The low flow of the river shall be maintained to avoid any serious change from the present condition. In general, river maintenance flow is determined to maintain the functions of a river on items such as (a) navigation, (b) fishing, (c) picturesque scenery, (d) salt intrusion, (e) clogging of river mouth, (f) riparian structures, (g) groundwater table, (h) flora and fauna, and (i) river water quality.

Among the said functions, only (d) and (i) will have some influence in the study area. The former is mainly for irrigation practice since there are intake structures in the downstream of six rivers except Deli River; the latter is evaluated for Deli River flowing through Medan urban area where many people still use river water for their daily activities. Therefore, river maintenance flow for the six rivers are not precisely determined because return flow of irrigation is expected to be so big to fulfill the requirement. For the purpose of environmental quality requirement, the river maintenance flow is determined to be in a range of 0.005 to 0.01 $m^3/s/km^2$.

As for the Ular River where improvement works was already completed, the specific discharge of 0.01 $m^3/s/km^2$ is adopted for the river maintenance flow. Therefore, the same specific discharge is employed for other rivers to estimate the river maintenance flow.

River Maintenance Flow

River	Catchment Area (km^2)	Maintenance Flow (m^3/s)
Belawan	647	5.2
Deli	358	2.9
Percut	186	1.5
Serdang	671	4.9
Ular	1,081	10.8
Belutu	500	4.9
Padang	919	9.2

3.2 Water Supply Potential

River Surface Flow

River flow fluctuates seasonally depending on the rainfall in the catchment area. The water supply potential from river flow is evaluated according to the water use pattern. In case of municipal water supply, the water use is rather constant.

Generally, water shortage in municipal/domestic water supply is not allowed even in a severe drought; once in 10 years. Irrigation water shall be secured, at least, in the droughtest year for 5 years.

The water supply capacity of each river is evaluated at the possible lowest intake point of the river. The residual area which is composed of the catchment of small rivers, drainage channels and swampy areas has some runoff from rainfall; however, water in the residual area is not evaluated to be the water supply potential in the Study.

Through the low flow analysis (refer to the Supporting Report on Hydrology), water supply potential of the river surface flow is evaluated as below:

Water Supply Potential of River Surface Flow

River	Intake Point	Catchment Area (km^2)	Drought Mean Discharge (m^3/s)			
			20-yr	10-yr	5-yr	Average
Belawan	Kp. Lalang	254	5.84	7.39	7.54	8.59
Deli	Simeme	158	5.07	5.70	6.12	7.13
Percut	Tembung*	171	6.06	6.81	7.31	8.52
Serdang	Tg. Morawa	250	8.18	9.03	10.70	12.10
Ular	Pulau Tagor	1,031	35.67	43.68	45.67	57.82
Belutu	Sei Rampah**	423	12.43	13.02	13.59	15.15
Padang	T. Tinggi	919	32.60	34.13	35.64	39.72
Total		3,206	105.85	119.76	126.57	149.12

* Specific discharge of Simeme (Deli River) is used with rainfall ratio.
** Specific discharge of T. Tinggi (Padang River) is used with rainfall ratio.

Groundwater

(1) Springs

The present total water production of springs around Medan City is 107,400 m^3/day as tabulated below.

Springs and Their Water Production

Spring	River Basin	Estimated Production (m^3/day)
Sibolangit	Deli	76,000
Tuntungan	Belawan	8,600
Tanjung Marihan	Serdang	10,800
Kampung Banta	Serdang	13,000
Total		107,400

From the springs, only about 46,000m^3/day from the Sibolangit springs has been utilized for the existing municipal water supply to Medan. Although the river basins seem to have some springs, the water from the unused springs passes into the rivers. Therefore, the existing water resources of springs are already involved in the low flow runoff of the river surface flow.

(2) Deep Wells

In the study area, as described in Section 2.1, there are totally 27 deep wells identified to have operation records. They are grouped into three geological areas; Medan, Belawan and T. Tinggi.

Geological Category of Deep Wells and Drawing Potential

Location/Name of Deep Well	Geology (Depth)	Permeability (cm/s)	Drawing Potential*
1. Medan Group, B. Kuis, Tembang & Hamparan Perak	Diluvium (30 m)	1×10^{-2}	25.0 l/s
2. Belawan Group, L. Pakam, P. Cermin, Perbaungan, Bandar, & Khalipah	Alluvium (30 m)	1×10^{-2}	12.5 l/s
3. Tebing Tinggi Group Dolok Merawan, Dolok Masihol & Galang	Toba Tuff (50 m)	1×10^{-3}	5.0 l/s

* Drawing capacity is estimated assuming that the operation duration is 12 hours per day.

In consideration of the influence radius on the groundwater level depending on the geology, the density of deep well is estimated at one in every 1.7 km^2, 1.5 km^2 and 0.8 km^2 for Diluvium, Alluvium and Toba Tuff, respectively. Furthermore, it is anticipated that the drawing capacity of deep wells will decrease to 85% in 2 to 3 years and 65% in 5 to 7 years.

Therefore, the groundwater potential by means of deep well is estimated for each river basin including the residual area. Although deep wells can be provided over the total area of river basin including the residual area at the aforementioned density, this assumption cannot be technically and economically realized. Hence, the development potential of groundwater, which is theoretically estimated as below, is understood as the maximum limit.

Development Potential of Groundwater

Name of River Basin	Total Area (km^2)	Main Geology	Development Potential (MCM/y)
1. Belawan	756	Al + TT	87.020
2. Deli	430	Di + Al	77.973
3. Percut	316	Di + Al	57.301
4. Serdang	886	Al + TT	101.984
5. Ular	1,522	Al + TT	175.191
6. Belutu	778	Al + TT	89.552
7. Padang	1,119	Al + TT	128.804

Note; Di : Diluvium, Al : Alluvium, TT : Toba Tuff

However, further groundwater development is not practically and technically feasible. Sudden lowering of the water table and some water contamination of wells in the urban area were observed.

Dam and Reservoir

As stated in the Supporting Report on Dam and Reservoir, there are eight (8) dam sites identified to have a storage capacity for supplying municipal and irrigation water. In the vicinity of Medan City, two (2) dams, namely Namobatang Dam on the Deli River and Lausimeme Dam on the Percut River will supply municipal water at 2,000 l/s and 3,700 l/s, respectively.

3.3 Water Balance

Water Balance Analysis

The present water balance between the demand and supply capacity is analyzed in each river basin. The simulation model is given in Fig. 3-2, on the basis of the following premise and conditions:

(a) Closely located kecamatans and paddies in the respective river basins are grouped together, although actual intake points for municipal water and irrigation water are scattered up or downstream along the river course.

(b) The present water demand is estimated based on the data in 1990. The municipal and irrigation water demands in the river basin are summarized as shown in Table 3-3. The river maintenance flow is excluded from the water demand, because some return flow from the irrigation area is expected.

(c) Flow regime with 5-day intervals for 20 years from 1969 to 1988 is adopted from the low flow runoff computation in the hydrological study. (Refer to Supporting Report on Hydrology.)

(d) From the flow regime, a drought discharge of a 10-year return period is applied commonly for both municipal and irrigation water.

(e) In the water supply system, priority is presumed in terms of the significance of water uses, i.e., municipal water is given a higher priority than irrigation water.

Present Water Balance

The results of the present water balance analysis for each river basin are summarized as follows, and simulation results for 20 years are presented monthly in Fig. 3-3.

(1) Belawan River Basin

The second droughtest year in 20 years from 1969 to 1988, namely the design drought year, is assessed to be 1985 when the proposed Tembengan Dam released a maximum of 0.837 m^3/s to meet the water demand of both municipal and irrigation water. Municipal water of 1.05 m^3/s was taken at Sunggal and supplied to Medan, and shortage of irrigation water arose mainly in the irrigation areas named Medan Kris (3,016 ha, semi-technical) and Suka Raya (201 ha, simple). Therefore, the Tembengan dam reservoir shall have a water supply capacity of 1,200,000 m^3.

(2) Deli River Basin

The design drought year is 1987, which is evaluated to be a 10-year return period of drought probability. The proposed Namobatang Dam is required to have a water supply capacity of approx. 2,800,000 m^3 to be able to discharge a maximum of 1.448 m^3/s to meet both the municipal water of 0.35 m^3/s and the irrigation requirements of Namo Rambe (3,280 ha, semi-technical) and Lausimeme (220 ha, semi-technical).

(3) Percut River Basin

The design drought year is 1987, when the required water supply capacity is estimated at only 400,000 m^3. The maximum dam release flow is 0.470 m^3/s to supply the irrigation water of Bandar Sidoras (3,457 ha, semi-technical). In February of the drought year 1987, the river flow at the estuary is estimated at zero.

(4) Serdang River Basin

This river basin has a surplus water after meeting the water demand for irrigation. In the second droughtest year 1976, the river flow at the estuary is estimated at 5.698 m^3.

(5) Ular River Basin

The Ular River Basin also has a surplus, although the irrigation system is the most highly developed among those of the river basins in the study area. Through the Ular River Project, paddy fields of 18,500 ha were upgraded to technical irrigation area with a cropping intensity of 200%. The surplus flow at the estuary is estimated at 11.208 m^3/s in the design drought year 1983.

(6) Belutu River Basin

This river basin has suffered from water shortage in almost every year. All water demands rise in the semi-technical irrigation areas scattered over the lower reaches such as Sei Belutu (5,100 ha). Pekan Dolok (625 ha), Cinta Kasih (360 ha), Bulian (300 ha), Pertambatan (145 ha) and Siromrawan (260 ha). The required water supply capacity in the design drought year 1979 is estimated at 15,000,000 $m^3$to be able to release the irrigation water of 3.851 m^3/s at maximum.

(7) Padang River Basin

The Padang River Basin is also categorized as a water surplus river. The surplus water at the estuary is estimated at 18.040 m^3/s in the design drought year 1979.

4. WATER SUPPLY PLAN

4.1 Future Water Demand

Municipal Water

Population projection, one of the most important factors for estimating the future demand of municipal and domestic water, is usually made on the basis of the trend of census population and intercensal population growth rate. Referring to the Supporting Report on Socioeconomy, the projected population at 5-year intervals for 1990 to 2010 are as follows:

Population Projection (1990 to 2010)

Region	Projected Population ('000)				
	1990	1995	2000	2005	2010
1. Indonesia	179,322	-	-	-	-
2. North Sumatra	10,256	-	-	-	-
3. Study Area	3,629	4,070	4,556	5,092	5,681
4. D. Serdang + Medan	3,334	3,753	4,218	4,735	5,306
5. D. Serdang	1,603	1,818	2,058	2,327	2,626
6. Medan City	1,731	1,935	2,160	2,408	2,680
7. T. Tinggi City	117	130	144	159	173
8. Simalungun*	178	186	193	199	202
9. Six Kecamatans**	453	543	644	737	820

* Seven kecamatans included in the study area.
** Under the service of PDAM Tirtanadi Medan

Among the kecamatans in Kab. Deli Serdang, there are seven (7) kecamatans currently receiving services under PDAM Tirtanadi Medan. They are Pacur Batu, Namo Rambe, Deli Tua, Sunggal, Labuhan Deli, Percut Sei Tuan and Sibolangit. In this water supply plan, six kecamatans (except Sibolangit) are included in the target area (Medan and six kecamatans are referred to as Medan Area). Therefore, the population projection is also made for the six kecamatans, as presented in the foregoing table.

The future demand for municipal water is computed on the basis of the standards and targets of Cipta Karya in Repelita V as follows:

Parameters for Water Supply Plan

Particulars	1990		2000		2010		2040	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Service Ratio (%)	75	60	80	70	85	80	90	85
Per Capita Consumption (l/d/p)	130	30	140	40	150	50	150	60
Ratio of Non-Domestic Use to Domestic Use (%)	40	10	40	10	40	10	40	10
Unaccounted Water Loss (%)	25	5	22	5	20	5	20	5

The future municipal/domestic water demand in both Medan and Tebing Tinggi cities and in each river basin in 2010 and 2040 are computed as shown in the following table. Details of future demands of all cities and kecamatans in every 5 years are given in Table 4-1.

Municipal/Domestic Water Demand in 2010

City/River Basin	Population (person: thousand)	Water Demand (m^3/d)
Medan City	2,679	597,723
Tebing Tinggi City	173	38,639
Belawan River Basin	536	24,811
Deli River Basin	112	5,177
Percut River Basin	417	19,322
Serdang River Basin	481	22,264
Ular River Basin	586	27,117
Belutu River Basin	360	16,675
Padang River Basin	261	12,074
Total	5,605	763,802

Irrigation Water Demand

The future demand for irrigation water is estimated on the assumption that the technical level of irrigation practice is upgraded in rank, i.e., simple and rainfed irrigation areas will become semi-technical and semi-technical will become technical. The swampy area is also assumed to become a semi-technical irrigation area. These changes in irrigation area and the water demand in each river basin are as follows: