CHAPTER 15

COST ESTIMATE

15.1 UNIT COST ANALYSIS

The project cost was estimated based on the December 1994 prices with breakdown of foreign and local currency components and a tax component. The foreign exchange rates used were as follows:

1 US$ = 24.10 ₱ = 100 ¥en

A market price survey was conducted to obtain information on market or prevailing prices of construction materials, labor cost and equipment cost. Based on these prices, a unit cost analysis was conducted to develop unit costs for construction items. Unit prices of major construction materials, labor cost, equipment cost and unit costs of major construction items are presented in Tables 15.1-1, 2, 3 and 4, respectively.

15.2 PROJECT COST

The project cost consists of the following:

- Construction cost
- Right-of-way acquisition and compensation cost
- Engineering services cost for the detailed design and construction supervision

15.2.1 Construction Cost

Estimated construction cost by road link and proposed contract package is presented in Table 15.2-1. A total construction cost was estimated at 4,311.0 Million pesos, composing of 55% of a foreign currency component (or 2,367.2 Million pesos), 29% of a local currency component (or 1,256.4 Million pesos) and 16% of a tax component (or 687.4 Million pesos).

Construction cost by major work items and by area distribution is shown in Table 15.2-2.

Roadway rehabilitation cost shares the highest accounting for 62.1% of a total construction cost, followed by countermeasures cost against flood accounting for 19.5%.

Reflecting very bad condition of the Study Road in Agusan del Sur, the said province requires the highest investment, followed by Davao del Norte.

TABLE 15.1-1 MARKET PRICE OF CONSTRUCTION MATERIALS IN MINDANAO

(December 1994 Prices)

Price No.	Description	Unit	Unit Price (P)
1	Portland Cement	bag	100.00
2	Reinforcing Steel Bar, Gr. 40	kg.	22.00
3	Reinforcing Steel Bar, Gr. 60	kg.	22.50
4	Gasoline, Premium	lit.	9.30
5	Gasoline, Regular	lit.	8.91
6	Diesel	lit.	8.30
7	Lumber, Yakal or Apitong	bd.ft.	23.40
8	Form Lumber	bd.ft.	14.60
9	MC-70 Cutback Asphalt	tonne	11,127.00
10	Emulsified Asphalt SS-1	tonne	11,990.00
11	Asphalt Cement Pen. 60-70	tonne	10,623.00
12	Asphalt Cement Pen. 85-100	tonne	10,593.00
13	Filler	lit.	14.30
14	RCPC 910mm dia.	m	1,450.00
15	RCPC 1220mm dia.	m	1,950.00
16	RCPC 1520mm dia.	m	3,600.00
17	Gabions Steelmesh, 2mx1mx1m	ea.	2,653.00
18	Structural Steel	kg.	53.50
19	Royalty for Quarry	m^3	10.00

SOURCE: Study Team Survey

TABLE 15.1-2 LABOR COST

(December 1994 Prices)

Labor Category	Hourly Rate (Pesos)	Daily Rate (Pesos)
Foreman	38.58	308.64
Assistant Foreman	35.83	286.64
Heavy Equipment Operator	34.33	274.64
Light Equipment Operator	29.90	239.20
Carpenter	31.45	251.60
Mason	31.45	251.60
Steelman	31.45	251.60
Skilled Laborer	31.45	251.60
Driver	26.33	210.64
Unskilled Laborer	18.21	145.68

SOURCE:
- DPWH District Engineering Offices in Regions X and XI
- National Wage Council
- Department of Labor and Employment
- Social Security System

TABLE 15.1-3 HOURLY COST OF CONSTRUCTION EQUIPMENT

(December 1994 Prices)

	Construction Equipment	Hourly Cost (P)
1.	Tractor Crawler with Dozer, 11t , 110 HP	1,027.00
2.	Tractor Crawler with Dozer, 21t , 200 HP	2,012.00
3.	Wheel Loader , 0.57 cu.m. , 39 HP	247.00
4.	Wheel Loader , 0.77 cu.m. , 50 HP	297.00
5.	Wheel Loader , 1.24 cu.m. , 80 HP	621.00
6.	Wheel Loader , 1.62 cu.m. , 100 HP	775.00
7.	Backhoe Crawler , 0.6 cu.m. 92 HP	780.00
8.	Dumptruck , 6.1 cu.m. , 190 HP	543.00
9.	Motorized Grader, 10 t , 110 HP	673.00
10.	Macadam Roller, 10 - 12t , 105 HP	769.00
11.	Tandem Roller , 8 t , 82 HP	856.00
12.	Tandem Roller , 9-10t , 105 HP	901.00
13.	Vibratory Roller , 12t , 175 HP	1,074.00
14.	Pneumatic Roller , 12t , 175 HP	688.96
15.	Sheepsfoot Roller , Towed Type,5-8t	218.75
16.	Asphalt Sprayer	757.00
17.	Asphalt Paver , 3.1 m	926.00
18.	Transit Mixer , 5 cu.m. , 190 HP	961.00
19.	Concrete Breaker	123.15
20.	Concrete Saw, 180 kg. , 5 HP	147.15
21.	Sand Blaster , 1.35 t , 82 HP	135.50
22.	Concrete Vibrator (small works)	119.81
23.	Concrete Vibrator with Engine , 145 kgs.,3 HP	225.40
24.	Vibratory Tamper , 80 kgs. 3 HP	98.00
25.	Air Compressor	649.00
26.	Generator , 100 kw	306.06
27.	Mobile Screening and Washing Plant , 60 tph	927.45
28.	Batching Plant , 60 tph	1,114.90
29.	Crushing Plant , 60 tph	1,410.80
30.	Water Truck , 6 cu.m. , 140 HP	1,437.00
31.	Water Truck , 1 cu.m.	1,054.00
32.	Water Pump	119.00
33.	Mixer , 1 1/2 - 2 bagger	159.62
34.	Mixer , 3 -4 bagger	181.73
35.	Pick-up , 41 hp	314.00
36.	Bar Cutter	73.56

SOURCE: Associated Construction Equipment Lessors (ACEL)

TABLE 15.1-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (1/3)

(December 1994 Prices)

Item No.	DESCRIPTION	UNIT	UNIT COST (Peso)	COMPONENT (%)		
				Foreign	Local	Tax
1	EARTHWORK					
1-1	Clearing and Grubbing	sq. m.	8.00	54	33	13
1-2	Surplus Common Excavation (Roadway and Shoulder)	cu. m.	100.00	54	31	15
1-3	Surplus Common Excavation (Drainage and Side Ditch Structure)	cu. m.	165.00	57	27	16
1-4	Surplus Rock Excavation	cu. m.	350.00	54	31	15
1-5	Structure Excavation	cu. m.	220.00	57	27	16
1-6	Embankment from Roadway/Drainage Excavation	cu. m.	200.00	62	22	16
1-7	Embankment from Borrow	cu. m.	265.00	62	22	16
1-8	Removal of Existing PCC Pavement	sq. m.	155.00	57	29	14
1-9	Subgrade Preparation of Gravel Surface	sq. m.	20.00	60	25	15
1-10	Subgrade Preparation of Existing PCC Pavement	sq. m.	55.00	60	25	15
1-11	Subgrade Preparation for Shoulder	sq. m.	20.00	60	25	15
1-12	Removal of Existing RCPC	ea.	10,200.00	60	25	15
1-13	Removal of Existing RCBC	ea.	25,500.00	60	25	15
2	SUBBASE AND BASE COURSE					
2-1	Aggregate Subbase Course	cu. m.	320.00	58	28	14
2-2	Aggregate Base Course	cu. m.	400.00	58	28	14
2-3	Crushed Aggregate Base Course	cu. m.	480.00	60	25	15
2-4	Bituminous Treated Base Course	cu. m.	1,700.00	62	22	16
2-5	Cement Treated Base Course	cu. m.	1,400.00	61	23	16
2-6	Lean Mix Concrete Layer	cu. m.	3,000.00	53	30	17
3	PAVEMENT SURFACE COURSE					
3-1	Bituminous Prime Coat	Ton	22,000.00	58	22	20
3-2	Bituminous Tack Coat	Ton	23,000.00	58	22	20
3-3	Joint/Crack Sealing	m.	45.00	55	31	14
3-4	Bituminous Concrete Surface Course (Hot Laid)	Ton	2,450.00	58	22	20
3-5	Bituminous Concrete Binder Course (Hot Laid)	Ton	2,400.00	58	22	20
3-6	PCC Pavement (t=23cm)	sq. m.	750.00	53	31	16
3-7	PCC Pavement (t=25 cm)	sq. m.	830.00	53	31	16
3-8	PCC Pavement (t=28 cm)	sq. m.	915.00	53	31	16
3-9	PCC Pavement for Shoulder (t=18 cm)	sq. m.	620.00	53	31	16
3-10	Aggregate Surface Course for Shoulder	cu.m.	480.00	60	25	15
4	BRIDGE STRUCTURE					
4-1	Bridge Excavation (A.O.W.L.)	cu. m.	280.00	60	24	16
4-2	Bridge Excavation (B.O.W.L.)	cu. m.	550.00	56	30	14
4-3	Foundation Fill	cu. m.	380.00	57	27	16
4-4	Removal of Existing Concrete Bridge	m.	30,000.00	53	32	15
4-5	Structural Concrete for PC Superstructure	cu. m.	6,800.00	53	30	17
4-6	Structural Concrete for RC Superstructure	cu. m.	4,400.00	53	30	17
4-7	Structural Concrete for Minor/Substructure	cu. m.	4,000.00	53	30	17
4-8	Structural Concrete for RC Thin Members	cu. m.	4,900.00	53	30	17
4-9	Lean Concrete	cu. m.	3,000.00	53	30	17
4-10	Reinforcing Steel Bar (Grade 40)	kg	33.50	50	36	14
4-11	Reinforcing Steel Bar (Grade 60)	kg	34.00	50	36	14
4-12	Structural Steel	kg	65.00	59	23	18

TABLE 15.1-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (2/3)

(December 1994 Prices)

Item No.	DESCRIPTION	UNIT	UNIT COST (Peso)	COMPONENT (%)		
				Foreign	Local	Tax
4-13	Precast Concrete Pile (0.4m x 0.4m)	m	2,500.00	53	30	17
4-14	Cast-in-place Concrete Bored Pile (1.10m dia.)	m	15,000.00	60	22	18
4-15	PC Girder (AASHTO Type, L=20m)	Each	290,000.00	55	27	18
4-16	PC Girder (AASHTO Type, L=25m)	Each	380,000.00	55	27	18
4-17	PC Girder (AASHTO Type, L=30m)	Each	450,000.00	55	27	18
4-18	PC Girder (AASHTO Type, L=35m)	Each	620,000.00	55	27	18
4-19	Timber Structure for Detour Bridge	m	20,000.00	30	56	14
4-20	Reinforced Concrete Railing	m	650.00	50	36	14
4-21	Deck Slab Reconstruction	sq. m.	2,710.00	52	32	16
4-22	Painting Structural Steel (including sand blasting), 4 coats	sq. m.	270.00	55	27	18
4-23	Removal of Existing Concrete	cu. m.	3,100.00	50	36	14
4-24	Repair of Beam Crack/spall	m	1,100.00	56	28	16
4-25	Repair of Slab Crack/spall	sq.m.	660.00	56	28	16
4-26	Widening of Pier/Abutment Seat	m	16,500.00	56	27	17
4-27	Mechanical Connection Device	ea.	53,000.00	68	14	18
4-28	Removal of Asphalt on Deck Slab	sq. m.	160.00	54	30	16
5	SLOPE PROTECTION					
5-1	Re-cutting of Surface Soil	cu. m.	110.00	55	30	15
5-2	Re-cutting of Soft Rock	cu. m.	380.00	58	27	15
5-3	Re-cutting of Hard Rock	cu. m.	530.00	58	27	15
5-4	Re-filling of Common Material	cu. m.	380.00	57	27	16
5-5	Concrete Spray (t=15 cm)	sq.m.	1,200.00	59	27	14
5-6	Stone Pitching	cu. m.	1,500.00	51	35	14
5-7	Supported Type Concrete Wall	cu.m.	4,000.00	53	30	17
5-8	Supported Type Stone Masonry	cu.m.	2,200.00	51	35	14
5-9	Cast-in-place Crib	sq.m.	2,100.00	58	27	15
5-10	Gabion	cu.m.	3,400.00	47	39	14
5-11	Horizontal Underdrain	m	980.00	56	29	15
5-12	Berm Ditch	m	600.00	52	33	15
5-13	Seeding	sq. m.	22.00	10	76	14
5-14	Grouted Riprap	cu.m.	1,500.00	51	35	14
5-15	Stone Masonry	cu.m.	1,800.00	51	35	14
6	DRAINAGE STRUCTURE					
6-1	RCBC, 1-1.8 x 2.0	m	31,000.00	55	30	15
6-2	RCBC, 1-2.4 x 2.4	m	40,000.00	55	30	15
6-3	RCBC, 1-3.0 x 3.0	m	49,000.00	55	30	15
6-4	RCBC, 2-1.8 x 2.0	m	54,000.00	55	30	15
6-5	RCBC, 2-2.4 x 2.4	m	70,000.00	55	30	15
6-6	RCBC, 2-3.0 x 3.0	m	85,000.00	55	30	15
6-7	Wing Wall for RCBC, 1-1.8 X 2.0	Each	48,000.00	53	32	15
6-8	Wing Wall for RCBC, 1-2.4 X 2.4	Each	63,000.00	53	32	15
6-9	Wing Wall for RCBC, 1-3.0 X 3.0	Each	79,000.00	53	32	15
6-10	Wing Wall for RCBC, 2-1.8 X 2.0	Each	67,000.00	53	32	15
6-11	Wing Wall for RCBC, 2-2.4 X 2.4	Each	87,000.00	53	32	15
6-12	Wing Wall for RCBC, 2-3.0 X 3.0	Each	105,000.00	53	32	15
6-13	RCPC, 0.61m dia.	m	2,400.00	56	29	15
6-14	RCPC, 0.91m dia.	m	3,900.00	56	29	15
6-15	RCPC, 1.07m dia.	m	4,500.00	56	29	15
6-16	RCPC, 1.22m dia.	m	7,800.00	56	29	15
6-17	RCPC, 1.52m dia.	m	11,500.00	56	29	15
6-18	Catch Basin for 0.61m dia. RCPC	Each	9,500.00	53	32	15
6-19	Catch Basin for 0.91m dia. RCPC	Each	14,000.00	53	32	15

TABLE 15.1-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (3/3)

(December 1994 Prices)

Item No.	DESCRIPTION	UNIT	UNIT COST (Peso)	COMPONENT (%)		
				Foreign	Local	Tax
6-20	Catch Basin for 1.07m dia. RCPC	Each	17,000.00	53	32	15
6-21	Catch Basin for 1.22m dia. RCPC	Each	19,000.00	53	32	15
6-22	Catch Basin for 1.52m dia. RCPC	Each	23,500.00	53	32	15
6-23	Side Ditch Type A	m	3,100.00	52	34	14
6-24	Side Ditch Type B	m	4,950.00	52	34	14
6-25	Side Ditch Type C	m	6,000.00	52	34	14
6-26	Side Ditch Type D	m	9,200.00	52	34	14
6-27	Underdrain (Granular Material, 15cm slotted PVC pipe, Filter Cloth)	m	810.00	51	35	14
6-28	Water channel (w=1.5m)	m	3,100.00	54	31	15
6-29	Water channel (w=2.0m)	m	6,000.00	54	31	15
6-30	Loose Boulder Toe	cu.m.	450.00	54	31	15
6-31	Concrete Sheet Pile	sq.m.	6,250.00	59	27	14
7	MISCELLANEOUS FACILITIES					
7-1	Miscellaneous facilities such as road markings, signs, guard rails, etc.	Km	80,000.00	56	29	15
9	ENGINEER'S FACILITY, OTHER GENERAL REQUIREMENT AND MOBILIZATION/DEMOBILIZATION					
9-1	Engineer's facility, other general requirement and mobilization/demobilization	(10% of civil work cost)				

TABLE 15.2 - 1 SUMMARY OF CONSTRUCTION COST

(December 1994 Prices)

LINK NO.	LINK LENGTH (Km.)	REHABILITATION / IMPROVEMENT COST (Million Pesos)																						PROPOSED CONTRACT PACKAGE				
		ROADWAY REHABILITATION				BRIDGE REHABILITATION				SLOPE PROTECTION				COUNTERMEASURES AGAINST FLOOD				ENGR'S FACILITY, OTHER GEN. REQUIREMENT & MOBILIZATION /DEMOBILIZATION				T O T A L				COST PER CONTRACT PACKAGE (Million Pesos)				CONTRACT PACKAGE
		Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	Foreign	Local	Tax	Total	
01	8.76	4.3	2.6	1.2	8.1	1.5	0.6	0.5	2.6	2.3	1.2	0.7	4.2	-	-	-	-	0.8	0.4	0.2	1.5	8.9	4.8	2.6	16.4					
02	24.02	24.6	13.6	6.9	45.1	0.9	0.4	0.3	1.6	3.3	2.1	0.9	6.3	-	-	-	-	2.9	1.6	0.8	5.3	31.7	17.7	8.9	58.3	111.0	63.8	31.8	206.6	1
03	21.51	16.9	8.5	5.0	30.4	9.6	5.8	2.9	18.3	-	-	-	-	37.5	23.2	10.5	71.2	6.4	3.8	1.8	12.0	70.4	41.3	20.2	131.9					
04 - 1	22.36	71.2	39.1	20.1	130.4	11.7	6.3	3.4	21.4	14.7	8.1	4.1	26.9	35.0	20.2	9.7	64.9	13.3	7.4	3.7	24.4	145.9	81.1	41.0	268.0	145.9	81.1	41.0	268.0	2
04 - 2	20.86	13.3	7.3	3.7	24.3	12.8	8.2	3.8	24.8	-	-	-	-	76.1	44.1	20.8	141.0	10.2	6.0	2.8	19.0	112.4	65.6	31.1	209.1	112.4	65.6	31.1	209.1	3
05	11.20	18.2	9.4	5.2	32.8	4.4	2.3	1.3	8.0	-	-	-	-	3.6	2.1	1.1	6.8	2.6	1.4	0.8	4.8	28.8	15.2	8.4	52.4					
06	10.93	2.8	1.5	0.7	5.0	7.8	4.5	2.3	14.6	-	-	-	-	7.7	4.0	2.1	13.8	1.8	1.0	0.5	3.3	20.1	11.0	5.6	36.7	75.8	40.3	21.6	137.6	4
07	7.97	19.6	10.1	5.6	35.3	-	-	-	-	4.8	2.7	1.3	8.8	-	-	-	-	2.4	1.3	0.7	4.4	26.8	14.1	7.6	48.5					
08 - 1	13.27	103.5	59.1	29.3	191.9	1.3	0.9	0.4	2.6	10.1	5.4	2.8	18.3	-	-	-	-	11.5	6.5	3.3	21.3	126.4	71.9	35.8	234.1	126.4	71.9	35.8	234.1	5
08 - 2	15.05	59.2	32.1	17.0	108.3	30.4	18.7	9.1	58.2	-	-	-	-	-	-	-	-	9.0	5.1	2.6	16.7	98.6	55.9	28.7	183.2	98.6	55.9	28.7	183.2	6
09	24.43	145.2	77.0	42.4	264.6	16.8	11.0	5.0	32.8	4.1	2.4	1.2	7.7	-	-	-	-	16.6	9.0	4.9	30.5	182.7	99.4	53.5	335.6	182.7	99.4	53.5	335.6	7
10 - 1	13.86	71.2	32.7	21.3	125.2	6.1	3.2	1.8	11.1	0.1	0.0	0.0	0.1	-	-	-	-	7.7	3.6	2.3	13.6	85.1	39.5	25.4	150.0	85.1	39.5	25.4	150.0	8
10 - 2	16.83	92.1	40.6	27.7	160.4	11.1	6.0	3.3	20.4	0.5	0.3	0.1	0.9	-	-	-	-	10.4	4.7	3.1	18.2	114.1	51.6	34.2	199.9	114.1	51.6	34.2	199.9	9
11	25.59	147.9	66.8	44.5	259.2	4.2	2.5	1.3	8.0	0.1	0.1	0.0	0.2	-	-	-	-	15.2	6.9	4.6	26.7	167.4	76.3	50.4	294.1	167.4	76.3	50.4	294.1	10
12-1	14.78	35.3	17.0	10.2	62.5	2.2	1.0	0.6	3.8	0.4	0.3	0.1	0.8	81.1	43.2	22.3	146.6	11.9	6.2	3.3	21.4	130.9	67.7	36.5	235.1	130.9	67.7	36.5	235.1	11
12 - 2	12.64	78.7	42.9	22.3	143.9	0.3	0.1	0.0	0.4	0.1	0.1	0.0	0.2	-	-	-	-	7.9	4.3	2.2	14.5	87.0	47.4	24.5	159.0	87.0	47.4	24.5	159.0	12
13	18.45	126.3	71.0	35.6	232.9	11.4	7.4	3.5	22.3	2.7	1.5	0.8	5.0	-	-	-	-	14.0	8.0	4.0	26.0	154.4	87.9	43.9	286.2	154.4	87.9	43.9	286.2	13
Monkayo Bypass	(2.40)	-	-	-	-	-	-	-	-	-	-	-	-	50.4	29.2	14.9	94.5	5.0	2.9	1.5	9.5	55.4	32.1	16.4	104.0	55.4	32.1	16.4	104.0	14
14	29.50	94.5	44.2	28.5	167.2	10.5	5.7	3.1	19.3	5.6	3.2	1.7	10.5	5.0	2.4	1.4	8.8	11.6	5.6	3.5	20.6	127.2	61.1	38.2	226.4	127.2	61.1	38.2	226.4	15
15	31.39	172.1	80.6	52.5	305.2	1.3	0.9	0.4	2.6	3.2	2.0	1.0	6.2	-	-	-	-	17.7	8.4	5.4	31.4	194.3	91.9	59.3	345.4	194.3	91.9	59.3	345.4	16
16-1	9.49	19.6	11.0	5.7	36.3	5.1	2.7	1.5	9.3	-	-	-	-	-	-	-	-	2.5	1.4	0.7	4.6	27.2	15.1	7.9	50.2	205.4	106.2	61.2	372.7	17
16-2	2.51	-	-	-	-	-	-	-	-	-	-	-	-	162.0	82.8	48.4	293.2	16.2	8.3	4.8	29.3	178.2	91.1	53.2	322.5					
16-3	15.04	27.3	15.0	7.7	50.0	3.9	2.5	1.2	7.6	0.4	0.2	0.1	0.7	-	-	-	-	3.2	1.8	0.9	5.8	34.8	19.5	9.9	64.1	90.4	53.2	25.5	169.2	18
17	14.67	48.4	29.3	13.5	91.2	2.2	1.4	0.7	4.3	-	-	-	-	-	-	-	-	5.1	3.1	1.4	9.6	55.7	33.8	15.6	105.1					
18	18.25	88.5	54.3	24.4	167.2	5.0	3.6	1.5	10.1	-	-	-	-	-	-	-	-	9.4	5.8	2.6	17.7	102.9	63.7	28.5	195.0	102.9	63.7	28.5	195.0	19
TOTAL	403.36	1,480.7	765.7	431.0	2,677.4	160.5	95.7	47.9	304.1	52.4	29.6	14.8	96.8	458.4	251.2	131.2	840.8	215.2	114.2	62.5	391.9	2,367.2	1,256.4	687.4	4,311.0	2,367.2	1,256.4	687.4	4,311.0	TOTAL

TABLE 15.2-2 CONSTRUCTION COST BY MAJOR ITEM AND AREA

(Unit: Million Pesos)

Major Work Item	Area Distribution							
	Surigao del Norte (Link 01-03) (L=54.29km)	Agusan del Norte (Link 04-05) (L=54.42km)	Butuan City (Link 06-07) (L=18.90km)	Agusan del Sur (Link 08-12) (L=136.45km)	Davao del Norte (Link 13-16) (L=106.38km)	Davao City (Link 17-18) (L=32.92km)	Total (L=403.36km)	
Roadway Rehabilitation	83.6	187.5	40.3	1,316.0	791.6	258.4	2,677.4	(62.1%)
	(3.1%)	(7.0%)	(1.5%)	(49.2%)	(29.6%)	(9.6%)	(100%)	
Bridge Rehabilitation	22.5	54.2	14.6	137.3	61.1	14.4	304.1	(7.1%)
	(7.4%)	(17.8%)	(4.8%)	(45.2%)	(20.1%)	(4.7%)	(100%)	
Slope Protection	10.5	26.9	8.8	28.2	22.4	0	96.8	(2.2%)
	(10.9%)	(27.8%)	(9.1%)	(29.1%)	(23.1%)	(0%)	(100%)	
Countermeasures	71.2	212.7	13.8	146.6	396.5	0	840.8	(19.5%)
Against Flood	(8.5%)	(25.3%)	(1.6%)	(17.4%)	(47.2%)	(0%)	(100%)	
Engineer's Facility,	18.8	48.1	7.8	162.8	127.2	27.3	392.0	(9.1%)
Other General Requirement	(5.1%)	(13.1%)	(2.1%)	(44.3%)	(28.0%)	(7.4%)	(100%)	
& Mobilization/Demobilization								
Total	206.6	529.4	85.3	1,790.9	1,398.8	300.1	4,311.1	(100%)
	(4.8%)	(12.3%)	(2.0%)	(41.5%)	(32.4%)	(7.0%)	(100%)	

15.2.2 Right-of-way Acquisition and Compensation Cost

Nature of the project is the rehabilitation of the existing road, and most works can be implemented within the existing road right-of-way, therefore, requirement for road right-of-way acquisition is minimal. Only the following areas require road right-of-way acquisition:

- where a bridge is to be reconstructed parallel to the existing bridge (7 bridge sites)
- where a road elevation is to be raised and embankment toe exceeds the existing road right-of-way (Simulao flood section, L = 3.0 km)
- Monkayo Bypass (2.20 km)
- Liboganon River Bank (6.2 km)

Road right-of-way acquisition and compensation cost was estimated at 40.6 million pesos as shown in Table 15.2-3.

TABLE 15.2-3 ROAD RIGHT-OF-WAY ACQUISITION AND COMPENSATION COST

(December 1994 Prices)

Location	Link No.	Land Area To Be Acquired (m^2)	Unit Cost (₱)	Estimated Cost (Million ₱)
1. Bridge Reconstruction Site				
Sanghan Bridge	05	1,000	100.00	0.1
Lagcogangan Bridge	10-2	1,000	100.00	0.1
Tagbayagan Bridge	10-2	1,000	100.00	0.1
Gabanan Bridge	13	1,000	100.00	0.1
Tina Bridge	14	1,000	100.00	0.1
Banlag Bridge	14	1,000	100.00	0.1
Liboganon Bridge	16	4,000	200.00	0.8
Sub-total		10,000		1.4
2. Section of Road Elevation to be raised				
Flood Section 12 (Simulao Section)	12-1	39,000	200.00	7.8
3. Monkayo Bypass	-	66,000	100.00	6.6
4. Liboganon River Bank	16	124,000	200.00	24.8
Total		239,000		40.6

15.2.3 Engineering Services Cost for Detailed Design and Construction Supervision

Engineering services cost for a detailed design ranges from 3 to 5% of construction cost, and a construction supervision from 5 to 9%. An average of 4% of construction cost was adopted for the detailed design and 7% for the construction supervision for this project.

TABLE 15.2-4 ENGINEERING SERVICES COST

(December 1994 Prices)

	Estimated Cost (Million Pesos)
Detailed Design	172.4
Construction Supervision	301.8
Total	474.2

15.2.4 Estimated Project Cost

Estimated project cost is summarized in Table 15.2-5.

TABLE 15.2-5 PROJECT COST

(December 1994 Prices)

Component	Estimated Cost (Million Pesos)
Construction Cost	4,311.0
Road Right-of-way and Compensation Cost	40.6
Detailed Design	172.4
Construction Supervision	301.8
Total	4,825.8

PART III

PROJECT EVALUATION AND IMPLEMENTATION

CHAPTER 16

ECONOMIC EVALUATION

16.1 METHODOLOGY AND BASIC ASSUMPTIONS

The economic evaluation of the road rehabilitation project was made following the normative cost-benefit analysis, by comparing the economic cost of the project with the economic or social benefit which will be brought about by the project. Among applied techniques and assumptions, the followings are to be noted.

16.1.1 General

(1) Implementation Year

All the rehabilitation works are assumed to be implemented within one year of 1997. Actually, the detail design works and land acquisition will be done before the year of implementation and some large-scale works will take more than a year. The cash out-flows before 1997 for these works are converted to the 1997 value, using 15% of interest rate. Thus, the initial year of benefit stream is 1998.

(2) Project Life

Economic life of the project is 20 years (1998 - 2017), although the physical life may be much longer than this. As the discount rate in the Philippines is rather high, the cost and the benefit generated after 20 years and later will not affect much on the evaluation results.

(3) Discount rate

The rate of the capital opportunity cost is estimated at 15% by NEDA. This rate is generally used as the discount rate for the evaluation of infrastructure projects in the Philippines. In this Study, the same rate is applied.

16.1.2 Cost

(1) Economic Cost

The conversion from the financial cost to the economic cost is made concerning the following four points: a) deduction of transfer cost (tax), b) application of shadow exchange rate, c) application of the shadow wage rate, and d) conversion to 1997 value.

(2) Maintenance Cost

Periodic maintenance costs over the project life are accounted in the cost stream. If the final maintenance is still effective in the year 2017, the residual value is

accounted in 2018 as a negative cost.

16.1.3 Benefit

(1) Cost Saving Benefit

Economic benefits by the road rehabilitation are mainly derived from the cost savings in vehicle operating cost, travel time cost, road maintenance cost and detour travel cost, generating while some section of the road is impassable.

(2) Rise of Land Value

For frequently flooding sections, some counter-measures against flood are proposed. If a road-side area is completely protected from flood by this project, the land of such area will be utilized more effectively and the production of economic value there will also rise. This economic benefit will reflect on the land value.

(3) Two-lane Road Capacity

Economic benefits are taken into account for 20 years (1998 - 2017). In this period, traffic of some sections will exceed the capacity of two-lane road, while the recommended rehabilitation plan does not include any widening works. Thus, traffic benefits shall be accounted only up to the capacity of the two-lane road (20,000 vehicles/day).

16.1.4 Evaluation

(1) Economic Evaluation Indicators

Economic feasibility of the project is judged based on the following three economic indicators.

- Internal Rate of Return (IRR)
- Net Present Value (NPV)
- Benefit/Cost Ratio (B/C)

(2) Sensitivity Analysis

Sensitivity analyses are made changing the following three conditions: a) Cost increase, b) Transport demand decrease, and c) Ignoring passengers time value which is a source of the economic benefits.

16.2 ECONOMIC COST

The estimated cost of the road rehabilitation project in the previous chapter(15) are expressed at the 1994 financial (market) price and then, they are to be converted to the economic cost for the purpose of the economic evaluation. The conversion is done by modifying the financial cost through the following three procedures.

16.2.1 Deduction of Transfer Cost

The financial cost presented in Chapter 15 is already sub-divided into three categories: foreign currency portion, local currency portion and tax. This tax covers the value added tax and the import duties of heavy construction tools and machineries. They are not economic cost from the viewpoint of national economy, but only internal transfer payments. Thus, the tax amounts are deducted from the financial cost.

16.2.2 Application of Shadow Exchange Rate

The shadow exchange rate (SER) is estimated using the formulae, below:

$$SER = OER / SCF$$

$$SCF = \frac{M + X}{(M + T_M) + (X + T_X)}$$

Where: SER: Shadow exchange rate in domestic price value of a foreign currency.
OER: Official exchange rate in domestic price value of a foreign currency.
SCF: Shadow conversion factor
M: CIF value of visible imports
X: FOB value of visible exports
T_M: Value of total import duties
T_X: Value of total export subsidies

Available Government data and experts in the Philippines suggests that a SCF value is in the range of 0.8 to 0.9. NEDA suggests the relevant Authorities to use 1.2 as the value of 1/SCF in a feasibility study. Then, every foreign currency portion is multiplied by 1.2, also in this Study.

16.2.3 Application of Shadow Wage Rate

Developing countries are usually characterized by an over-supply of unskilled labor, especially in the rural areas. The value of marginal product of unskilled labor in rural area will be less than the average wages paid to unskilled labor which are usually established by law such as minimum wage system.

On the other hand, skilled labor working in the project areas would be valued at the market rate. If they are not employed at market wage rate, they would work at higher wages in other areas. For this reason, the shadow wage rate (SWR) is

applied only to unskilled labor costs.

According to the NEDA's guideline, the unskilled labor cost is estimated at 60% of the market wage rate in the Philippines. Then, the SWR of 60% is applied to the unskilled labor cost in the financial cost which is assumed 5% of the total cost.

16.2.4 Estimated Economic Cost

The economic cost was further converted to the equivalent single year cost, applying 15% of interest rate, to such costs scheduled to invest before 1997 or for more than one year as engineering cost and land acquisition cost.

The economic cost of the project is accounted the sum of 4.61 billion pesos or 95.6% of the financial cost.

ECONOMIC COST OF THE PROJECT
(Million Peso)

Work Item \ Cost	Financial	Economic
Road Rehabilitation	3,269.1	3,111.8
Bridge Rehabilitation	372.7	354.1
Slope Protection	118.2	113.2
Flood Protection	1,065.8	1,035.2
Total	4,825.8	4,614.3

16.3 ECONOMIC BENEFITS

16.3.1 Types of Economic Benefit

This trunk road rehabilitation project aims mainly at improvement of service level for the present and future traffic. Therefore, benefit estimation is limited only to the direct benefits, not including indirect benefits such as regional and industrial development impacts.

Major sources of the direct benefits will be the savings in various types of economic costs, due to the better road conditions. Only one exception is the socio-economic benefit of improvement of land value by solving flood problems. Economic benefits accounted in this Study are summarized as shown in Table 16.3-1.

TABLE 16.3-1 ECONOMIC BENEFIT TYPE

Major Work Item	Sub-item	Economic Benefit
Road Rehabilitation	Carriageway Pavement	* VOC saving * Savings of routine maintenance cost
	Shoulder Pavement	* VOC saving due to less side-friction * Savings of periodic maintenance cost
	Drainage Facility	* VOC savings not to pass flooded section * Savings of periodic maintenance cost
Bridge Rehabilitation	Rehabilitation & Replacement	* Savings of detour VOC cost during impassable period * Savings of temporary bridge cost
	Widening of carriageway	* Savings of VOC due to capacity increase
	Widening of Side-walk	* Savings of VOC due to less side-friction
Slope Protection		* Savings of VOC due to no one-lane section * savings of restoration cost
Countermeasures against Flood		* Savings of VOC * Savings of periodic maintenance cost * Savings of restoration cost * Rise of land value in no more flooded area

16.3.2 Method of Benefit Quantification

(1) VOC Saving

For economic evaluation of a road project, DPWH is using a computer software named ECOVAL. As long as there is no particular reason, the same algorithm as ECOVAL's will be used to calculate VOC also in this Study.

For the first step of the ECOVAL system, basic road traffic costs under the optimum road and traffic conditions are estimated by type of vehicles. Basic traffic costs are composed of three cost categories: a) Running cost (proportional to operated distance), b) Fixed cost (proportional to running time) and c) Passenger's time cost.

The basic traffic cost is modified, as the second step, in order to adjust then to actual road and traffic conditions, considering such factors as surface condition (roughness), gradient, road-side friction, curves, sight distance, congestion rate, etc. Detail algorithm of ECOVAL is shown in Appendix 16-1.

The basic economic vehicle operating costs shown in Table 16.3-2 are used in this study. They are as of June, 1994.

TABLE 16.3-2 BASIC VEHICLE OPERATING COST

Vehicle Type	Running Cost (P/km)	Fixed Cost (P/min)	Time Cost (P/min)
Car/Van	2.290	0.123	0.868
Jeepney	1.610	0.593	0.971
Bus	3.650	0.835	3.675
Truck	4.930	0.937	0.000
Tricycle	0.530	0.232	0.177
Motorcycle	0.460	0.007	0.224

(2) Savings of Detour Cost

If an existing bridge is kept in poor condition, without any rehabilitation nor replacement, the risk of its becoming unserviceable will be high. On the contrary, rehabilitation or replacement of a bridge will prolong its durable life and reduce the probability of unserviceability of the bridge. while the bridge is unusable, traffic passing the bridge must take a detour route, which will accrue additional travel cost. The benefit of a bridge rehabilitation project is defined as the difference of expected value of losses between "with project" case and "without project" case.

In this Study, the annual probability of unserviceability of a bridge is assumed to follow a logistic equation below.

$$P(t) = 1 / (1 + e^{-0.2(t-y)})$$

Where: P(t) : Probability of bridge unserviceability by year t
y : Bridge life (year)
t : Year

The probability of a bridge's unserviceability in year t is given by:

$$dP(t) = P(t) - P(t-1)$$

(3) Savings of Maintenance Cost

Shoulder pavement and drainage facilities will prolong the life of the pavement of carriageway. Based on the future axle load estimated on the results of traffic forecast, timings for the next pavement and the third pavement of carriageway are calculated for both cases of "with project" and "without project", using a basic formula of rigid pavements in the AASHTO Highway Design Manual which is shown below.

$$\log_{10}(W_{18}) = Z_R \times S_0 + 7.35 \times \log_{10}(D + 1)$$

$$- 0.06 + \frac{\log_{10}\left[\frac{dPSI}{4.5-1.5}\right]}{1 + \frac{1.624 \times 10^7}{(D + 1)^{8.46}}}$$

$$+ (4.22 - 0.32 \times p_t)$$

$$\times \log_{10}\left[\frac{S_t' \times C_d \times (D^{0.75} - 1.132)}{215.63 \times J \left[D^{0.75} - \frac{18.42}{(E_c/k)^{0.25}}\right]}\right]$$

Where

W_{18} = predicted number of 18-kip equivalent single axle load applications.
Z_R = standard normal deviate,
S_0 = combined standard error of the traffic prediction and performance prediction
D = thickness (inches) of pavement slab,
dPSI = difference between the initial design serviceability index, P_0, and the design terminal serviceability index, p_t,
S'_c = modulus of rupture (psi) for portland cement concrete used on a specific project
J = load transfer characteristics of a specific design
C_d = drainage coeffecient,
E_c = modulus of elasticity (psi) for portland cement concrete, and
k = modulus of subgrade reaction (pci).

The benefit of shoulder pavement and drainage facilities is defined as the capital opportunity cost during the year to pave in "without case" to that in "with case".

(4) Rise of Land Value

The price of flooding land is assumed to rise by 10 pesos/m^2 in total. This rise will take place over three years immediately after the countermeasure project is implemented and the land becomes free from flood.

Table 16.3-3 shows current land price in Tagum area, comparing the land prices of flooding and non-flooding area, by three types of land use. Even in case of coconut field which is the cheapest among three, difference of 25 to 30 pesos/m^2 is observed between the flooding and non-flooding area. Based on these data, the above assumption can be judged as a realistic or rather conservative one.

TABLE 16.3-3 LAND VALUE IN TAGUM

(at 1994 market price)

Land Use	Flood Area	Non-flood Area
Agricultural		
Coconut Field	17 - 75	50 - 100
Paddy Field	15 - 100	60 - 150
Residential		
Poblacion(5km radius)	-	300 - 1,000
Rural(beyond 5km)	-	100 - 500

Source: DPWH, District Office of Davao del Norte

16.3.3 Estimated Economic Benefit

Economic benefits are taken into account for 20 years (1998 - 2017). In this period, traffic of some sections will exceed the capacity of two-lane road, while the recommended rehabilitation plan does not include any widening works. Thus, traffic benefits shall be accounted only up to the capacity of the two-lane road (20,000 vehicles/day).

Discounting annual benefits accruing over 20 years to the 1997 value, total benefit is estimated to be 10.06 billion pesos, of which 73% will be generated by road rehabilitation, 12% by countermeasures against flood, 11% by bridge rehabilitation and 4% by slope protection (Table 16.3-4).

Savings in vehicle operating cost is a dominant source of benefit, namely, 77% of the total benefit, followed by 10% of savings in detour cost.

TABLE 16.3-4 ECONOMIC BENEFIT DURING 1998 - 2017

(Million Pesos discounted to 1997 value)

	Economic Benefit						Total
	VOC Saving	Detour Cost Saving	Maint. Cost Saving		Restoration Cost Saving	Rise of Land Value	
			Periodic	Routine			
Road							
Pavement	3,401.8	-	-	170.6	-	-	3,572.4
Shoulder	1,460.4	-	8.4	-	-	-	1,468.8
Drainage	2,114.3	-	210.2	-	-	-	2,324.5
Bridge							
Rehabilitation	-	879.6	-	-	163.3	-	1,042.9
Widening	19.7	-	-	-	-	-	19.7
Slope Protection	335.8	-	-	-	55.8	-	391.6
Countermeasures against Flood							
Road	388.4	-	7.7	-	-	-	396.1
Bridge	-	153.3	-	-	29.6	-	182.9
Drainage/Dike	-	-	-	-	404.8	258.0	662.8
Total	7,720.4	1,032.9	226.3	170.6	653.5	258.0	10,061.7

16.4 COST-BENEFIT ANALYSIS

16.4.1 Evaluation Results

Firstly, the road rehabilitation project is evaluated as a whole and secondly, by the project by major work items. Lastly, the project is divided into 18 links and each of them is evaluated also by major work items.

The overall internal rate of return(IRR) is estimated at 30.5%, which is far beyond the interest rate of capital opportunity (15%). Thus, this rehabilitation project as a whole is concluded as a highly feasible one from the economic point of view. Its NPV is 5,447.4 million pesos at 1994 price, 2.18 times of the investment (Table 16.4-1).

Out of the said NPV, 78% is attributed to the road rehabilitation works, of which IRR is also as high as 32.5%. As long as IRR concerns, the slope protection work has the highest rate of return of 45.0%. However, its investment is not large comparing to others, so that its NPV stands for only 5% of the total.

Every works by link are also economically viable, as shown in Table 16.4-2. Roughly speaking, IRR of each link is high proportionally to its traffic demand. Link 14 to 18 where future traffic volumes will exceed the capacity of two-lane road of 20,000 vehicles/day show IRRs higher than 30%. Figure 16.4-1 illustrates the relation between IRR and NPV by link.

TABLE 16.4-1 ECONOMIC EVALUATION INDICATORS

Work Item	IRR(%)	NPV	B/C
Road Rehabilitation	32.5	4,254.2	2.37
Bridge Rehabilitation	33.6	708.5	3.00
Slope Protection	45.0	278.2	3.46
Flood Protection	18.7	206.6	1.20
Whole Project	30.5	5,447.4	2.18

16.4-2 Sensitivity Analysis

Sensitivity analyses are conducted to test the impact of changes in the input conditions of this economic evaluation. The analyses are made concerning the following three conditions:

1) Project cost is increased by 20%, 50% and the critical percent which makes its IRR 15%.

2) The increment of future traffic is lessened by 20%, 50% and 100%. The last case means that the present AADT will be unchanged in the future.

3) Savings of passenger's time cost is deducted from the VOC saving benefit. This is because some people denny the value of passengers' fractional time saved by a transport project.

Table 16.4-3 presents the results of the above sensitivity tests by major work item. The project as a whole will become unfeasible only when the estimated project cost increases by 118% or 2.18 times of the estimate in Chapter 15. The countermeasure projects against flood are rather sensitive to the cost; a 20% cost-up will make the project unfeasible.

The project will remain feasible even under the condition where no traffic increase occurs in the future. Also, deduction of passenger's time saving benefit does not affect much on the feasibility of the project.

Thus, sensitivity analysis proves that the benefit of the Project is quite stable against the change in traffic demand and the project cost.

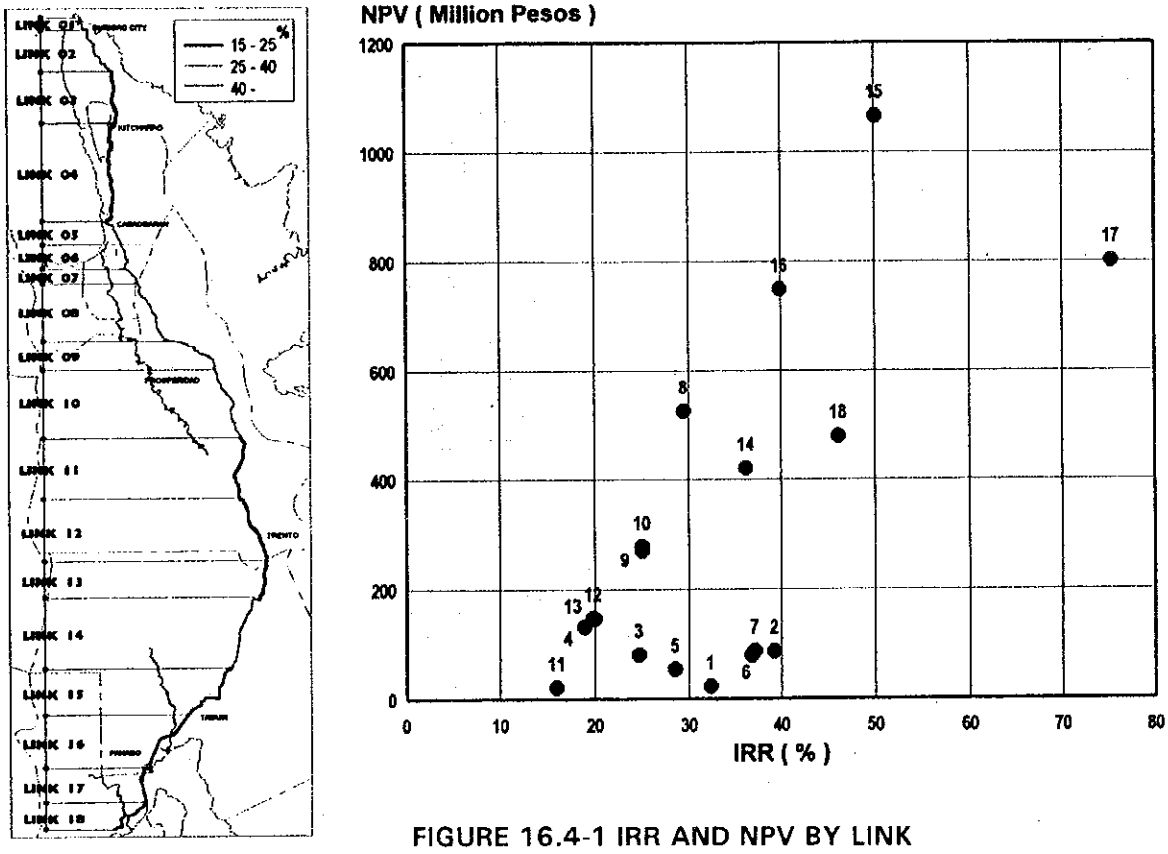


FIGURE 16.4-1 IRR AND NPV BY LINK

TABLE 16.4-2 ECONOMIC EVALUATION INDICATORS BY LINK

LINK NO.	Road Rehabilitation			Bridge Rehabilitation			Slope Protection			Flood Protection			Total		
	IRR(%)	NPV	B/C	IRR	NPV	B/C	IRR	NPV	B/C	IRR	NPV	B/C	IRR	NPV	B/C
1	38.9	15.0	2.58	19.9	1.7	1.59	30.2	5.8	2.21	-	-	-	22.4	22.6	2.31
2	41.9	75.1	2.42	20.5	1.1	1.59	31.8	10.2	2.38	-	-	-	39.2	86.4	2.39
3	26.4	21.8	1.62	22.6	17.6	1.83	-	-	-	24.9	41.6	1.50	24.7	81.0	1.58
4	19.0	48.4	1.27	23.4	52.0	1.97	15.9	1.8	1.06	17.2	29.6	1.12	18.9	131.8	1.26
5	28.7	33.4	1.87	35.9	20.4	3.17	-	-	-	15.6	0.3	1.04	28.5	54.1	1.98
6	75.8	15.6	3.62	37.7	45.6	3.69	-	-	-	28.6	17.9	2.11	36.8	79.0	3.02
7	36.9	67.6	2.65	-	-	-	37.8	19.5	2.89	-	-	-	37.1	87.1	2.70
8	31.8	469.4	2.34	16.9	12.6	1.18	39.0	43.9	3.05	-	-	-	29.5	525.8	2.19
9	24.0	204.4	1.66	19.7	16.0	1.42	76.3	50.3	6.62	-	-	-	25.0	270.7	1.76
10	24.7	235.2	1.71	19.3	14.1	1.38	256.1	28.7	23.96	-	-	-	25.0	277.9	1.76
11	15.8	15.2	1.05	18.8	3.3	1.36	125.4	2.5	10.35	-	-	-	16.0	21.1	1.07
12	19.2	67.4	1.28	73.4	58.5	12.65	154.5	15.7	13.82	15.5	5.5	1.03	19.8	147.0	1.34
13	19.0	76.4	1.28	36.8	49.6	2.92	34.9	9.4	2.62	16.6	11.2	1.10	20.0	146.6	1.35
14	27.4	187.4	1.97	90.0	168.2	8.45	35.3	18.3	2.50	56.4	47.1	4.29	36.2	420.9	2.74
15	49.5	1,007.4	3.87	51.1	19.1	7.36	80.4	39.0	6.46	-	-	-	50.1	1,065.6	3.95
16	88.7	566.4	6.63	59.6	96.0	5.71	550.9	33.1	40.74	18.4	53.5	1.14	39.9	749.0	2.49
17	69.5	674.2	7.31	178.8	127.1	26.72	-	-	-	-	-	-	75.4	801.3	8.17
18	48.1	473.9	3.41	19.8	5.7	1.48	-	-	-	-	-	-	46.1	479.6	3.31
Total	32.5	4,254.2	2.37	33.6	708.5	3.00	45.0	278.2	3.46	18.7	206.6	1.20	30.5	5,447.4	2.18

TABLE 16.4-3 SENSITIVITY ANALYSIS

(1) IRR (%)

Case	Conditions	Road Rehabilitation	Bridge Rehabilitation	Slope Protection	Countermeasures against Flood	Whole Project
Base Case	-	32.5	33.6	45.0	18.7	30.5
Cost	20% up	27.8	29.6	38.4	15.0	25.9
	50% up	22.8	25.4	31.7	11.1	21.3
	118% up	16.3	19.3	23.0	5.9	15.0
Traffic Increase	20% less	28.7	31.8	43.9	18.2	27.5
	50% less	26.6	28.7	42.1	17.2	25.4
	100% less	26.0	21.6	38.8	15.5	23.9
No Passenger's Time Value	-	23.4	29.5	38.4	17.6	23.4

(2) NPV (Million Pesos)

Case	Conditions	Road Rehabilitation	Bridge Rehabilitation	Slope Protection	Countermeasures against Flood	Whole Procect
Base Case	-	4,254.2	708.5	278.2	206.6	5,447.5
Cost	20% up	3,631.8	637.7	255.6	0.0	4,525.1
	50% up	2,698.3	531.4	221.6	(311.0)	3,140.3
	118% up	582.2	290.7	144.7	(1,017.6)	0.0
Traffic Increase	20% less	2,768.1	597.9	255.5	170.0	3,791.5
	50% less	2,088.8	432.0	221.5	116.2	2,858.5
	100% less	1,904.9	155.5	164.8	240.9	2,466.1
No Passenger's Time Value	-	1,857.4	522.8	211.1	140.9	2,732.2

(3) B/C

Case	Conditions	Road Rehabilitation	Bridge Rehabilitation	Slope Protection	Countermeasures against Flood	Whole Procect
Base Case	-	2.37	3.00	3.46	1.20	2.18
Cost	20% up	1.97	2.50	2.88	1.00	1.82
	50% up	1.57	2.00	2.31	0.80	1.47
	118% up	1.09	1.38	1.59	0.55	1.00
Traffic Increase	20% less	1.89	2.69	3.26	1.16	1.82
	50% less	1.67	2.22	2.96	1.11	1.62
	100% less	1.61	1.44	2.46	1.02	1.49
No Passenger's Time Value	-	1.60	2.48	2.87	1.14	1.59

16.4.3 Optimal Year of Implementation

The first year benefit (FYB) of 1998 is already larger than the 15% of the project cost as shown in Table 16.4-4. It may be reasonable to consider that the optimal year to start a project is the year when its benefit exceeds the capital opportunity cost. From this point of view, the commencement of this project is already too late, even in 1997. Therefore, an urgent implementation, not behind the proposed schedule, is recommended.

TABLE 16.4-4 FIRST YEAR BENEFIT(FYB) OF THE PROJECT

(Million Peso)

Work Item	FYB	Cost	FYB/Cost
Road Rehabilitation	903.3	3,111.8	29.0%
Bridge Rehabilitation	67.3	354.1	19.0%
Slope Protection	40.4	113.2	35.6%
Flood Protection	238.4	1,035.2	23.0%
Whole Project	1,249.4	4,614.3	27.1%

16.5 OTHER UNQUANTIFIABLE BENEFITS

The Study Road composes a part of the national backbone road. Moreover, in the study area of Region X and Region XI, road network has not been well developed and only a few sections of the Study Road have their substitute route. If some road section become unserviceable, social and economic activities in the surrounding area will be hindered and social cost for these activities will be increased. Beside the benefits accounted in the previous sections, there are undoubtedly other significant benefits, direct or indirect, although they are very difficult to quantify in money terms. Discussions below are the examples of what inconvenience or dis-economy will occur, if the trunk road become unserviceable, even for a short period.

(1) To lose access to public facilities

Public facilities such as high schools, hospitals, recreational and social facilities are not enough in the Study Area. People who live on the opposite side of the damaged road section leading to these public facilities will lose their access to the facilities.

(2) To lose emergent opportunity

One who is living in the influenced area will lose an opportunity of a trip with an urgent or emergent purpose such as a business negotiation, his friend's or relative's death or marriage. In another case, he may lose the opportunity to

sell his agricultural products and to buy daily necessities or production inputs just at proper time.

(3) To damage national security

If a road is unusable, it is difficult for the military and police authorities to capture criminal elements. The rehabilitation of roads may have important contribution to mobility of these government authorities and assist in the improvement of social environment including peace and security.

(4) To discourage regional development

Many rural development program are planned and carried out in the Philippines for encouraging productive activities and improvement living conditions. The unserviceability of roads may reduce benefits from these programs.

CHAPTER 17

ENVIRONMENTAL IMPACT ASSESSMENT

17.1 ENVIRONMENTAL IMPACT ASSESSMENT IN THE PHILIPPINES

17.1.1 Philippine Environmental Laws

Environmental management, as a national government policy came into effect two decades ago. It was only recently that environmental issues and concerns have been elevated to the level of public awareness and government regulations as a result of a closer examination of the role and influence of man on the environment. As a necessary consequence, environmental laws were passed and became the guidelines of law enforcement agencies as well as the population in the proper management of the environment.

The beginnings of the Philippine Environmental Law may be traced to the enactment of Letter of Instruction No. 422, issued by the President of the Philippines, which directed all agencies involved in environmental protection to be organized as one coordinating body to assess the current efforts and programs involving environmental protection. This presidential directive resulted in the creation of the Inter-Agency Committee on Environmental Protection (IACEP). The IACEP, meanwhile endorsed to the president the creation of the National Environmental Protection Council (NEPC) which was established based on Presidential Decree No. 1121 on April 1977.

On June 6, 1977, the President issued LOI No. 549 and P.D. 1151. LOI 549 included instructions for the establishment of an administrative system for Environmental Impact Assessment (EIA) while the enactment of P.D. No. 1151 paved the way for the declaration of the Philippine Environmental Policy. It was also on this day that the Philippine Environment Code was embodied under P.D. No. 1152.

A year later, on June 11, 1978, the establishment of an Environmental Impact Statement (EIS) System was enacted under P.D. No. 1586. However, the publication of the EIS Rules and Regulations in the official gazette in June 21, 1982 marked the formal adoption and implementation of the EIS System of the nation.

17.1.2 Environmental Impact Statement System

1) EIS System Procedure

Procedures concerning the preparation, review and evaluation and decision upon environmental impact statements encompass different stages (see Figure 17.1-1).

Initial Environmental Examination (IEE) as project screening determines whether a project falls within the EIS System, what level of analysis and documentation

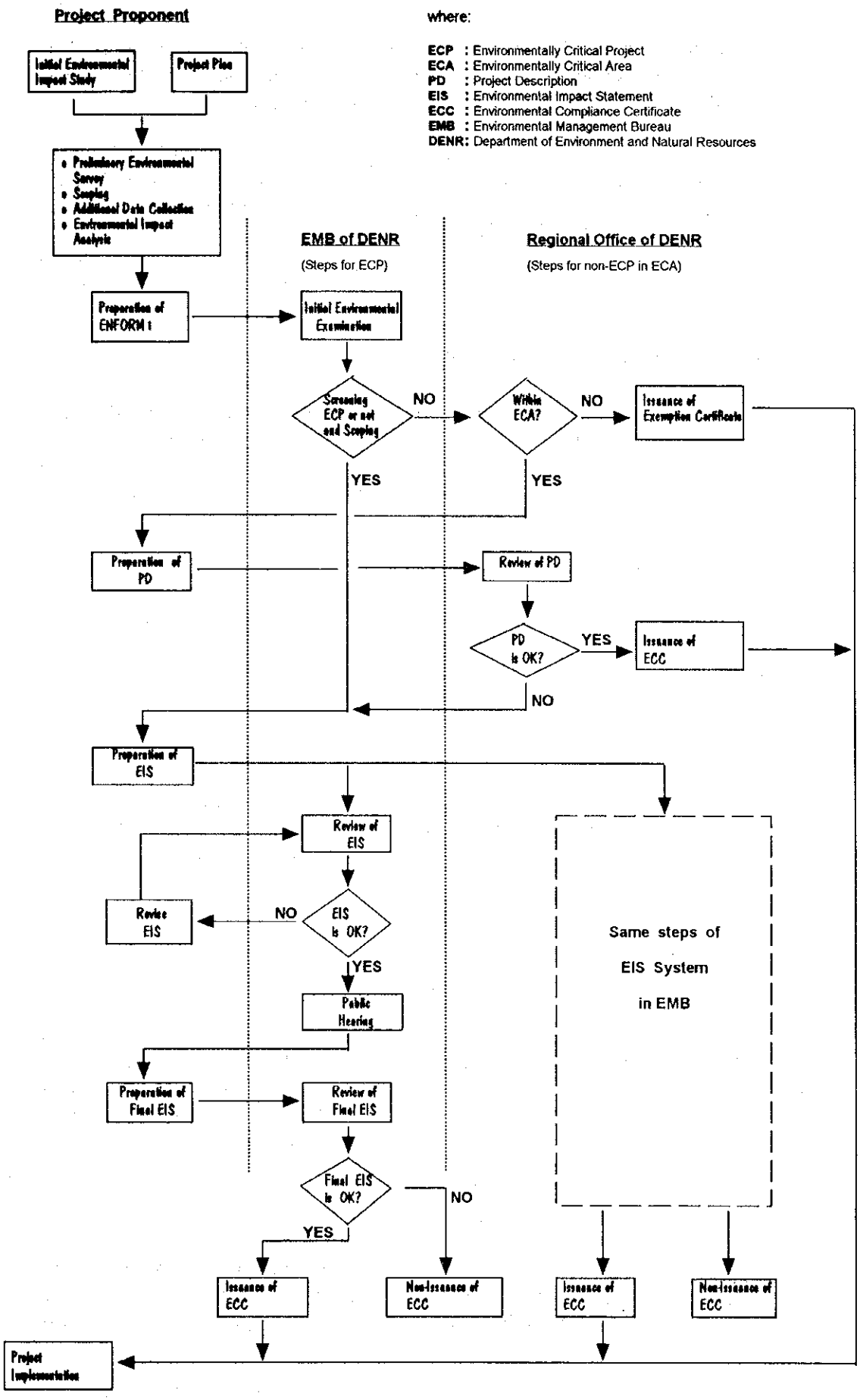


FIGURE 17.1-1 EIS PROCESS DIAGRAM

(Project Description or EIS) will be required, and who will issue an ECC. The project proponent submits ENFORM I to serve as the basis for determining whether the project is within the purview of the EIS System.

A project that is categorized as an Environmentally Critical Project (ECP) falls under the authority of Environmental Management Bureau (EMB) of Department of Environment and Natural Resources (DENR) and must follow the steps identified for preparation of an EIS. A non-critical project located in an Environmentally Critical Area (ECA) falls under the authority of DENR Regional Offices and must follow the steps identified for preparation of Project Description (PD) and possibly EIS.

2) Initial Environmental Examination (IEE)

IEE is essentially a checklist of the probable environmental effect of a proposed project. The checklist includes the different environmental aspects either physically or socio-economically. Depending on the IEE, it will be decided whether a more detailed statement on the environmental impact of the project shall be required or not.

3) Project Description (PD)

This document is required if a project is not an ECP but shall be located in an ECA. The description will include the type and purpose of the project, environmental setting, socio-economic indicators, sources of environmental impact and proposed environmental management measures.

4) Environmental Impact Statement (EIS)

The statement elaborates on and is therefore much more detailed than the PD. It refers to the documentation of the studies of the environmental impact of a project including a discussion on the direct and indirect consequences and impacts upon human welfare and ecological and environmental integrity. The statement should contain all relevant environmental information and details about the project.

5) Public Participation

The EIS System includes provisions for public participation, in the review and assessment of project proposals, through a public hearing process. In this process, citizens are given the chance to review and discuss the proposed project with concerned agencies. The primary benefit of such an exercise is the exchange of information and views and the resolution of conflicts in order to provide a venue to understand community values.

6) Environmental Compliance Certificate (ECC)

The certificate of compliance serves as the go-signal for the implementation of the project according to approved guidelines. It is issued by the President or his duly authorized representative certifying that the project under considera-

tion will not bring about an unacceptable environmental impact.

17.1.3 Environmentally Critical Projects and Areas

The section four (4) of P.D. No. 1586 on June, 1978 proclaimed Environmentally Critical Areas and Projects. Based on P.D. No. 1586, Proclamation No. 2146 on December, 1981 enumerated and defined environmentally critical projects by type and 10 environmentally critical areas.

Furthermore, the detailed technical discussions in accordance with these enactments were continued among EMB staffs of DENR, and made up as OFFICE CIRCULAR NO. 3 on 1983 to ensure an effective implementation of EIS System. (Refer to Appendix 17.2).

17.1.4 Environmental Administration

1) Concerned Agencies

The Department of Environment and Natural Resources is mandated to implement the EIS System. The Environmental Management Bureau of DENR provides overall direction and review of the EIS and issues the ECC for all Environmentally Critical Projects (ECPs).

Projects not classified as ECPs are reviewed and approved at the DENR Regional level. DENR Regional offices are mandated to implement the EIS System pursuant to DENR Administrative Order 21. Regional Offices are responsible for the review and issuance of ECCs for all Project Descriptions and EIS for non-critical projects located in ECAs. DENR Regional Offices are also responsible for issuance of exemption certificates for projects not under the purview of the EIS System.

2) Environmental Policy

With the country's rapidly growing population exerting more pressure to the already fragile environment and limited natural resources base, the nation's environmental thrust will focus on the following issues, while in keeping with global concerns and efforts to save the remaining gene pools and maintain biodiversity:

- to promote the sustainable use of the country's resources.
- to meet increasing domestic and foreign demand for natural resources including those needed for agro-industrial development.
- to ensure protection of the country's biological resources and its diversity, vital ecosystem functions and overall environmental quality.
- to intensify efforts towards the provision of greater access and participation by local communities in the management and utilization of natural resources and in the protection of the environment.

- to ensure the integration and complementation of development efforts in the management of the environment and natural resources.

- to encourage the adaption and utilization by private sector of efficient and environmentally-sound technologies.

- to identify measures that will augment public and private investments in environment and natural resources section.

17.2 ENVIRONMENTAL PRESERVATION REQUIREMENT

The following environmental preservation requirement is set as environmental targets for the Study in accordance with the policy of the country and world-wide necessity to preserve environmental aspects:

- to enhance the social and economical activities on various sectors

- to promote the sustainable use of the country's resources

- not to hinder a common right of community and society

- to minimize alteration or change of natural circumstances on topography/geology, surface/ground water stream, meteorology, landscape, etc.

- to ensure protection of the country's biological resources and its diversity, and vital ecosystem function

- to obey environmental standards declared in Philippines like air pollution, water quality and noise pollution

17.3 ENVIRONMENTAL CHARACTERISTICS OF THE PROJECT AREA

17.3.1 Vegetation

1) Philippines

The major vegetational formations in the Philippines can be grouped into two recognizable forest formations-lowland rain forests, and lower montane forests (see Figure 17.3-1).

Lowland rain forest, of which there are several different aspects, is found from sea level to 1000 m or more. It is a forest formation in which the optimum development is of three tree layers over shrub and ground cover. Most widespread is the diptorocarp forest accounting for some three-quarters of lowland rain forest. Seasonal molave forest, swamp forest, mangrove forest and strand woodland also belong within the lowland category.

At about 1000 m, the humid lowlands give way to a cooler more temperate mid-mountain region where the forests of the lower montane formation are found. Typically these are the pine and oak forests where the dipterocarps and their associates no longer predominate.

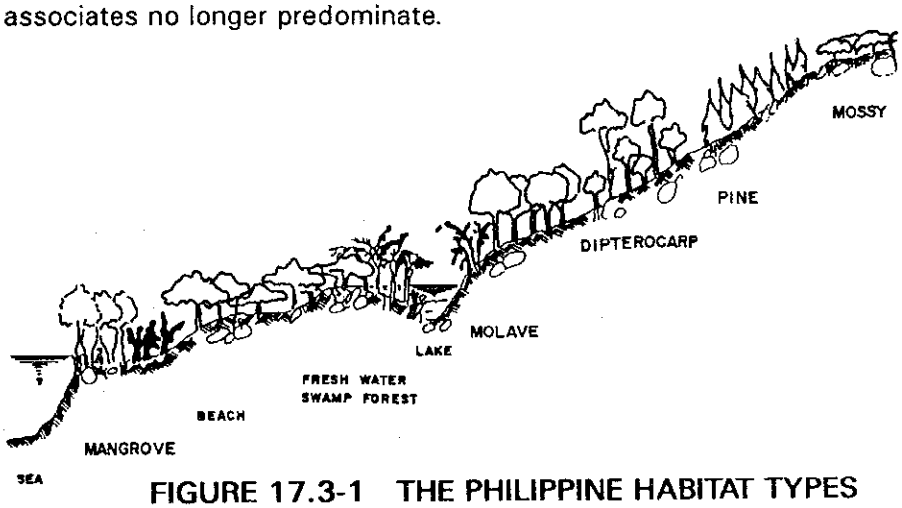


FIGURE 17.3-1 THE PHILIPPINE HABITAT TYPES

2) Along the Study Road

The vegetation along the Study Road are classified into eight major groups presented below. Figure 17.3-2 and Appendix 17.5 show shares in percent of each group every 10 km.

0: artificial (housing lot, factory and waste land)
1: rice field, grassland
2: plantation (include small scale farm)
3: afforestation (plant with economic importance)
4: lower copse (lower than approximate 5m)
5: higher copse (higher than approximate 5m)
6: wet land (aquatic plant)
7: mangrove forest (mangrove,nipa)

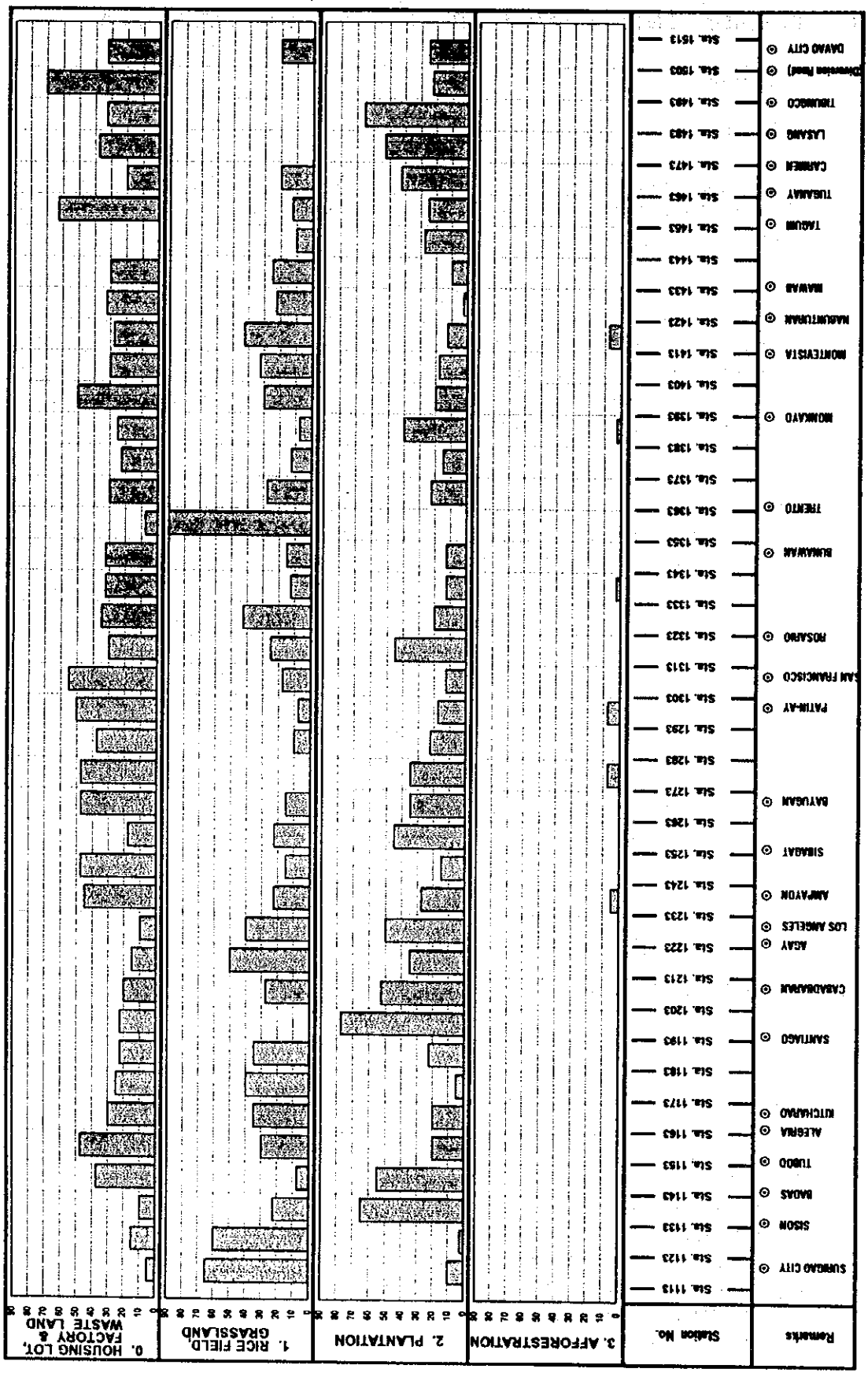


FIGURE 17.3-2 OCCUPANCY BY VEGETATION TYPE (1)

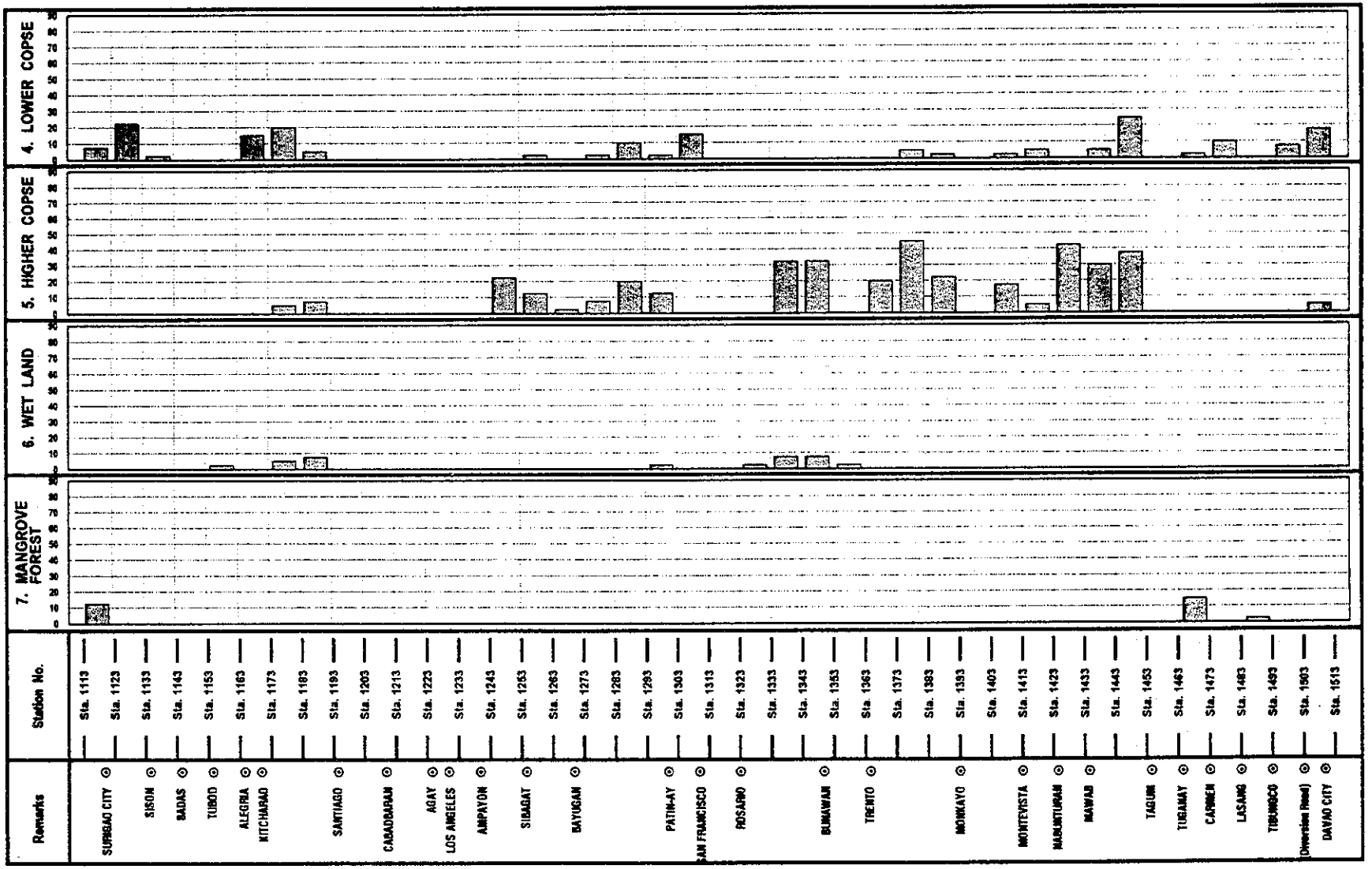


FIGURE 17.3-2 OCCUPANCY BY VEGETATION TYPE (2)

The main components are "artificial", "rice field and grassland" and "plantation" which share 31%, 24% and 28% of the total, respectively. The share of three groups above amounts to more than 80%, therefore, majority of the area along the Study Road is utilized artificially and natural vegetation is rather scarce.

17.3.2 Environmentally Critical Areas

In the Study Area, there are six watershed forest reserve areas and a national park known as Mainit Hot Springs National Park, situated in the municipality of Compostela, Davao del Norte. These environmentally critical areas (ECAs) are summarized in Table 17.3-1 and Figure 17.3-3. However, these ECAs are not traversed by the Study Road, thus are not affected by the Project.

Other critical areas such as wilderness areas, game refugees and bird sanctuaries, mangrove forest reserve, tourist spots, areas of unique historic, archeological or scientific interests and areas traditionally occupied by cultural communities or tribes are non-existing in the Study Area.

TABLE 17.3-1 PROTECTED AREAS IN REGION X AND XI

Region	Province/City	National Parks	Games Refugees and Bird Sanctuaries	Wilderness Areas	Mangrove Forest Reserve	Watershed Forest Reserve
Region X	Surigao del Norte			•16 Islands/ Islets ($41.9\ km^2$)	•8 Islands	•Surigao WFR (Sison,Malinao, San Francisco, $9.72 km^2$)
	Agusan del Norte					•Cabadbaran WFR (Cabadbaran, $160.3\ km^2$)
	Agusan del Sur					•Andanan River WFR (Sibagai, Bayugan, $151.0\ km^2$) •Mt.Magdiwala WFR (San Francisco, $16.6\ km^2$)
	Other Provinces outside the Area	•Mt.Malindang ($532.6\ km^2$) •Initao ($0.6\ km^2$) •Mt.Kitanglad Range ($313.0\ km^2$)				•4 Watershed Forest Reserve ($1,149.7\ km^2$)
Region XI	Davao del Norte	•Mainit Hotsprings ($13.8\ km^2$)			•Samal Island	•Andap WFR New Bataan, $67.3\ km^2$)
	Davao City					•Malagos WFR (Gulanga, $2.4\ km^2$)
	Other Provinces outside the Study Area	•Mt.Apo ($728.1\ km^2$)		•Pandasan Island ($0.1\ km^2$)	•Baculin Point-Lucod Point •Tangulo Point-Kinablangan Island •Labigan to Valencia •6 Islands	•4 Water Forest Reserve ($1,032.7\ km^2$)

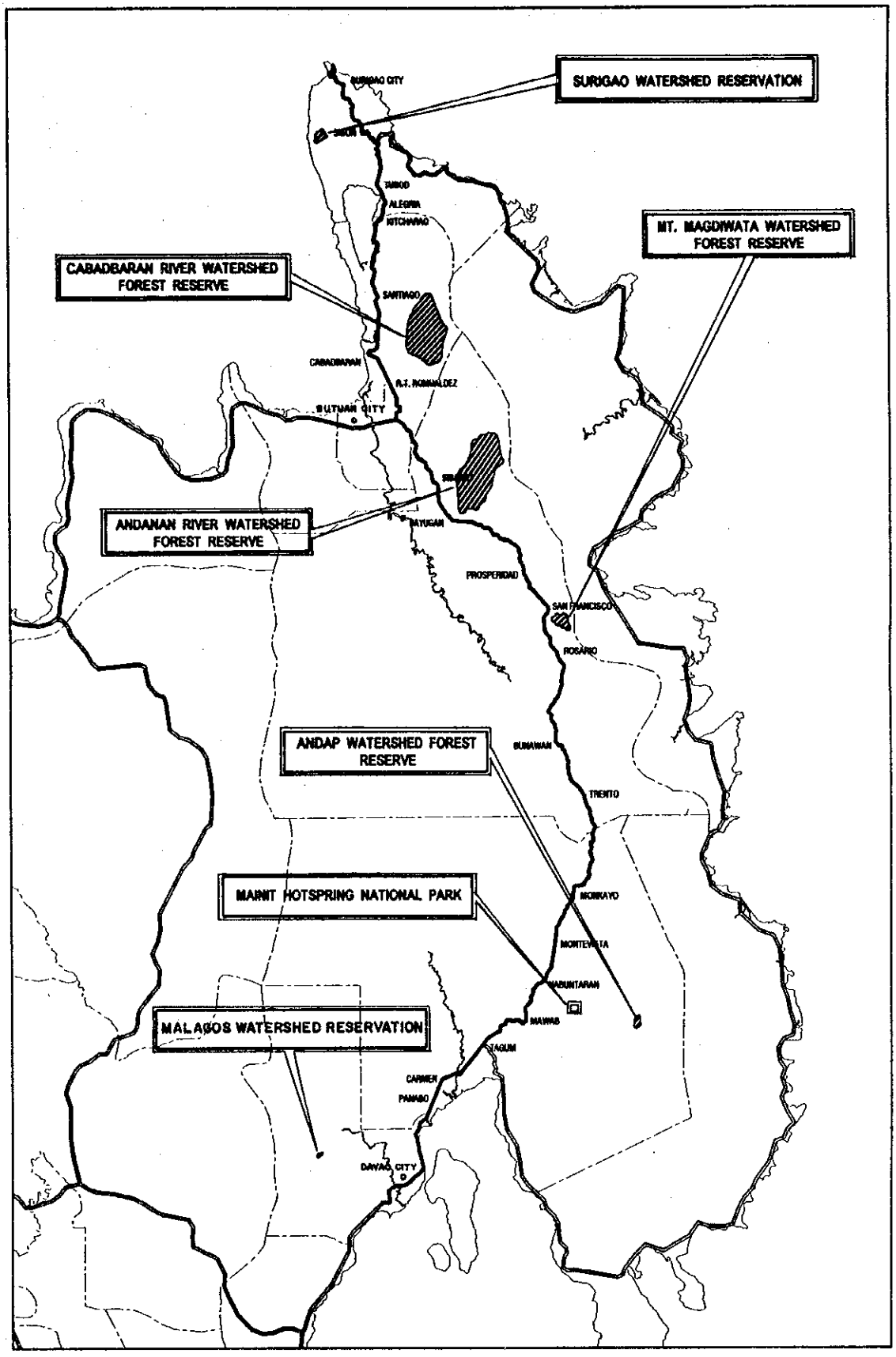


FIGURE 17.3-3 LOCATION MAP OF WATERSHED AREAS AND NATIONAL PARK

17.4 ENVIRONMENTAL IMPACTS OF THE PROJECT

Since an infrastructure project, specially large - scale project, plays a vital role for regional and national development, at the same time, extends its influence over diverse sectors. Thus, the study team precisely checked environmental factors from various standpoints and stages of the project mainly referring to Environmental Impact Statement (EIS) system and guidelines in the Philippines.

17.4.1 Scoping on Environmental Impacts

The efforts on initial environmental impact study were focused on the formulation of scoping matrix which was utilized initially to assess the severities on environmental impacts by the Project based on information from existing sources, field data and the Project activities. The result is shown in Table 17.4-1. The formats for screening/scoping of JICA MODEL are shown in Appendix 17.6.

17.4.2 Social Impacts

1) Resettlement

Nature of the project is the rehabilitation of the existing road, and most works can be implemented within the existing road right-of-way, therefore, requirement for road right-of-way acquisition is minimal. The land areas to be acquired and the number of families/houses affected are shown in Table17.4-2.

TABLE 17.4-2 LAND ACQUISITION AND AFFECTED FAMILIES

Location	Land Area to be Acquired (sq.m.)	No. of Affected Families
1. Section of Road to be raised (Flood Section 12: Simulao Section)	39,000	41
2. Monkayo Bypass	66,000	few 1/
3. Liboganon River Bank	124,000	few 1/

1/: Exact numbers were not available.

TABLE 17.4-1 SCOPING ON ENVIRONMENTAL IMPACTS OF THE PROJECT

Environmental Factor		Roadway Rehabilitation: Pavement Rehabilitation	Roadway Rehabilitation: Shoulder Rehabilitation	Roadway Rehabilitation: Drainage Rehabilitation	Bridge Rehabilitation	Slope Protection	Countermeasures for flood section	Construction of bypass road
Social Environment	1. Resettlement	NONE	NONE	NONE	NONE	NONE	C	C
	2. Economical activity	+B	+B	+B	+B	+B	+A	+B
	3. Traffic, life facilities	(Rehabilitation phase) -B; (Operation phase) +A	C	NONE	(Rehabilitation phase) -B; (Operation phase) +A	+A	(Rehabilitation phase) -B; (Operation phase) +B	+A
	4. Community disruption	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	5. Historic spot, cultural assets	NONE	NONE	NONE	NONE	NONE	NONE	C
	6. Water right, common right	NONE	NONE	NONE	(Rehabilitation phase) C	NONE	(Operation) C	(Rehabilitation phase) C
	7. Sanitation	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	8. Waste	NONE	NONE	NONE	(Rehabilitation phase) -B	NONE	NONE	NONE
	9. Disaster	NONE	NONE	NONE	+A	+A	+A	+A
Natural Environment	10. Topography/ geology	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	11. Soil erosion	NONE	NONE	NONE	NONE	+B	NONE	NONE
	12. Ground water	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	13. Lake/river	NONE	NONE	NONE	+B	NONE	C	NONE
	14. Coast/sea	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	15. Animals and plants	NONE	NONE	NONE	NONE	NONE	C	C
	16. Meteorology	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	17. Landscape	NONE	NONE	NONE	NONE	C	NONE	NONE
Pollution	18. Air pollution	(Rehabilitation phase) C	(Rehabilitation phase) C	(Rehabilitation phase) C	(Rehabilitation phase) C	NONE	(Rehabilitation phase) C	(Rehabilitation phase) C
	19. Water pollution	NONE	NONE	NONE	(Rehabilitation phase) C	NONE	(Rehabilitation phase) C	(Rehabilitation phase) C
	20. Soil pollution	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	21. Noise/ Vibration	(Rehabilitation phase) C; (Operation phase) +B	(Rehabilitation phase) C	(Rehabilitation phase) C	(Rehabilitation phase) -B	NONE	(Rehabilitation phase) C	(Rehabilitation phase) C; (Operation phase) +B
	22. Land subsidence	NONE	NONE	NONE	NONE	NONE	NONE	NONE
	23. Nasty smell	NONE	NONE	NONE	NONE	NONE	NONE	NONE

NOTE: A: Significant impact
B: Slight impact
C: Unclear
NONE: None or negligibly small impact

+ : Positive impact
- : Negative impact

2) Economic Activities

a) Macroeconomy

The Medium-Term Philippine Development Plan sets forth the macro-economic targets for the years 1993 to 1998. Mindanao was identified as the major growth center to be developed with the specific growth directions. The investment to infrastructural facilities like this Project vitally supports the area to become a major growth center.

b) Land Productivity

The countermeasures against flood by this project will make possible for the currently flooded areas to be more efficiently used and consequently increase in land productivity as well as land value. Thus, the Project will provide significant favorable impact on land use and land productivity. The survey conducted for the flood section No. 18 at Liboganon River by the District Engineering Office in Tagum shows significant differences in land value between the flood area and the non-flooded area as shown in Table 17.4-3.

TABLE 17.4-3 LAND VALUE DIFFERENCE BETWEEN FLOODED AREA AND NON-FLOODED AREA AT FLOOD SECTION NO. 18

Land Use	Land Value (₱/sq.m)	
	Flooded Area	Non-flooded Area
Residential (beyond 5 km radius from Poblacion)	40-100	100-500
Coconut Field	10-75	50-100
Rice Field	15-100	60-150

Source: DEO, Tagum

3) Traffic Management During Construction

a) Roadway Rehabilitation

In principle, roadway rehabilitation works are executed side by side (or traffic lane by lane). During the construction of one side, the other side is open to traffic in one-way operation controlled by signal (traffic signal or manually). Traffic capacity of one-way operation is determined by a length of one-way operation and shown in Table 17.4-4 (refer to Appendix 17.7).

TABLE 17.4-4 TRAFFIC CAPACITY OF ONE-WAY OPERATION

UNIT: Vehicle/day

One-way operation	Traffic Capacity
100 m	11,800
200 m	9,800
300 m	8,400

For most of the sections of the Study Road, one-way operation of 300 m can be adopted, however, the section from Tagum in Davao del Norte to the end of the Project in Davao City will require the one-way operation to limit to 100 meters with careful traffic management and traffic safety measures. In this section, effective utilization of shoulder as a traffic lane during construction should be planned.

b) Bridge Rehabilitation

Traffic volumes will exceed one-way operation capacity at three bridge rehabilitation sites, namely Bunawan Bridge, Ilang Bridge and Panacan Bridge in Davao City during construction. At these bridge sites, two-lane temporary detour bridge is recommended to be constructed.

4) Traffic After Implementation of the Project

a) Traffic Cost Saving

The improvement of road surface condition will greatly contribute to savings in traffic costs. The roadway rehabilitation covers 213.88 kilometers in total which is 53.7% of full stretch of the Study Road to sustain proper road conditions.

It is expected that, the total saving of running cost will reach to 374.5 Million pesos in 2000. This impact by the Project is significant.

b) Traffic Interruption

There are many sections which would suffer traffic interruption due to flooding, bridge collapse, or slope failures, among which 30 sections are highly potential. The Project will drastically decrease such potential and greatly contribute to providing reliable means of transportation.

c) Traffic Accidents

According to the traffic accident report of Surigao City in 1994, the accidents of"vehicle vs. vehicle" cases were dominant accounting for 57%, followed by "vehicle vs. pedestrians" cases for 29%. The shoulder pavement proposed as a part of roadway rehabilitation of the Project, gives beneficial impacts on traffic accidents.

5) Historical Spots and Cultural Assets

Based on interviews with local people along the Study Road and information obtained from staffs of responsible agencies, areas of unique historic, archeological or scientific interests do not exist.

Likewise, areas traditionally occupied by ethnic groups or tribes are non-existing along the Study Road.

6) Fishery Activities

The inland fishing is not active along the Study Road. The fish ponds for commercial use are observed only around Gov. Miranda Bridge (station 1466 + 750) near town of Tagum. Impact on fishery activities will be minimal or negligible.

7) Construction Wastes

In general, the pavement reconstruction/rehabilitation works generate construction wastes because of removals of existing pavement. In this Study, pavement design considered the full utilization of existing pavement structure as much as possible to minimize generation of construction waste.

In bridges or slopes, generating sources of wastes are rather limited to about and less than 10% to total number of rehabilitation bridges and failed/potential slopes, respectively. Therefore, impact on wastes will be slight.

Table 17.4-5 shows generating sources of construction waste.

TABLE 17.4-5 GENERATING SOURCES OF CONSTRUCTION WASTES

Rehabilitation Works Major Item	Sub Item	Total Construction Length (km)	Cause of Wastes
1. Pavement Rehabilitation	- PCC Reconstruction involving removal of existing pavement	22.7 km.	- Removal of existing pavement
(Total length of pavement rehabilitation 213.9 km)			
2. Bridge Rehabilitation	- Total Reconstruction	8 bridges	- Destruction of existing bridge
	- Dredging	10 bridges	- Dredging riverbed
(Total number of rehabilitation bridges 117 bridges)			
3. Slope Protection	- Recutting	6 slope	- Removal of ground slope
(Total number of slope failures 76 slopes)			

8) Disaster

A total of 76 spots along the road were identified as failed/potential slopes to be protected. The Project will eliminate future failures of these slopes.

17.4.3 Natural Environmental Impacts

1) Soil Erosion

Soil erosion is defined as detachment and transport of soil. Slope failure is one of the main causes of soil erosion along the Study Road. Among 76 slopes to be protected, embankment slope failure is dominant, numbering about 61 failures or 80% of total number of slopes, followed by cut slope failure numbering 8 slopes or 10%.

Most slope failures are lower than 20 m in height and narrower than 60 m in width. The discharge volume of eroded soil from these slopes is deemed to be small in quantity, taking into consideration of the scale of slopes. The Project will protect these slopes and erosion will be controlled, thus the impact by the Project is slightly positive to natural ecosystems.

2) Lake/River

In principal, riverbed dredging as part of bridge rehabilitation works is favorable to smooth water flow and to maintain a discharge capacity of river. The proposed flood protection dike, flood interception canal and cut-off channel as a flood control system prevent irregular water flow of rivers. Thus, the Project has advantageous impacts on river or lakes.

3) Animals and Plants

The Study Road traverses mostly cultivated areas as shown in Figure 17.4-1. The passage of the Study Road through a secondary forest or bushland is very limited which was only observed in the sections near towns of Sison (northern part of the Project Road), Prosperidad, Bunawan and Trento (middle part). The Study Road does not affect the virgin forests and protected areas such as national park and watershed forest reserves which are given utmost consequence on ecology and recognized as habitat for various plants and wildlife.

It is judged that impact on flora and fauna is none or negligibly small taking into consideration of the nature of the Project (rehabilitation of existing road) and vegetational conditions along the road.

4) Landscape

An assessment of impact on landscape is rather subjective, thus difficult to quantify. The Project Team worked out the assessment of impacts by conducting the interview. Photographs of failed slopes before rehabilitation were presented and briefed about rehabilitation work to be adopted to interviewees. It resulted "the majority of effects on landscape was" none or negligible and followed by "positive". These are mainly due to existing site conditions which were already eroded and gave desolated scenery to visitors. Impacts on landscape is judged to be none or negligible, otherwise beneficial.

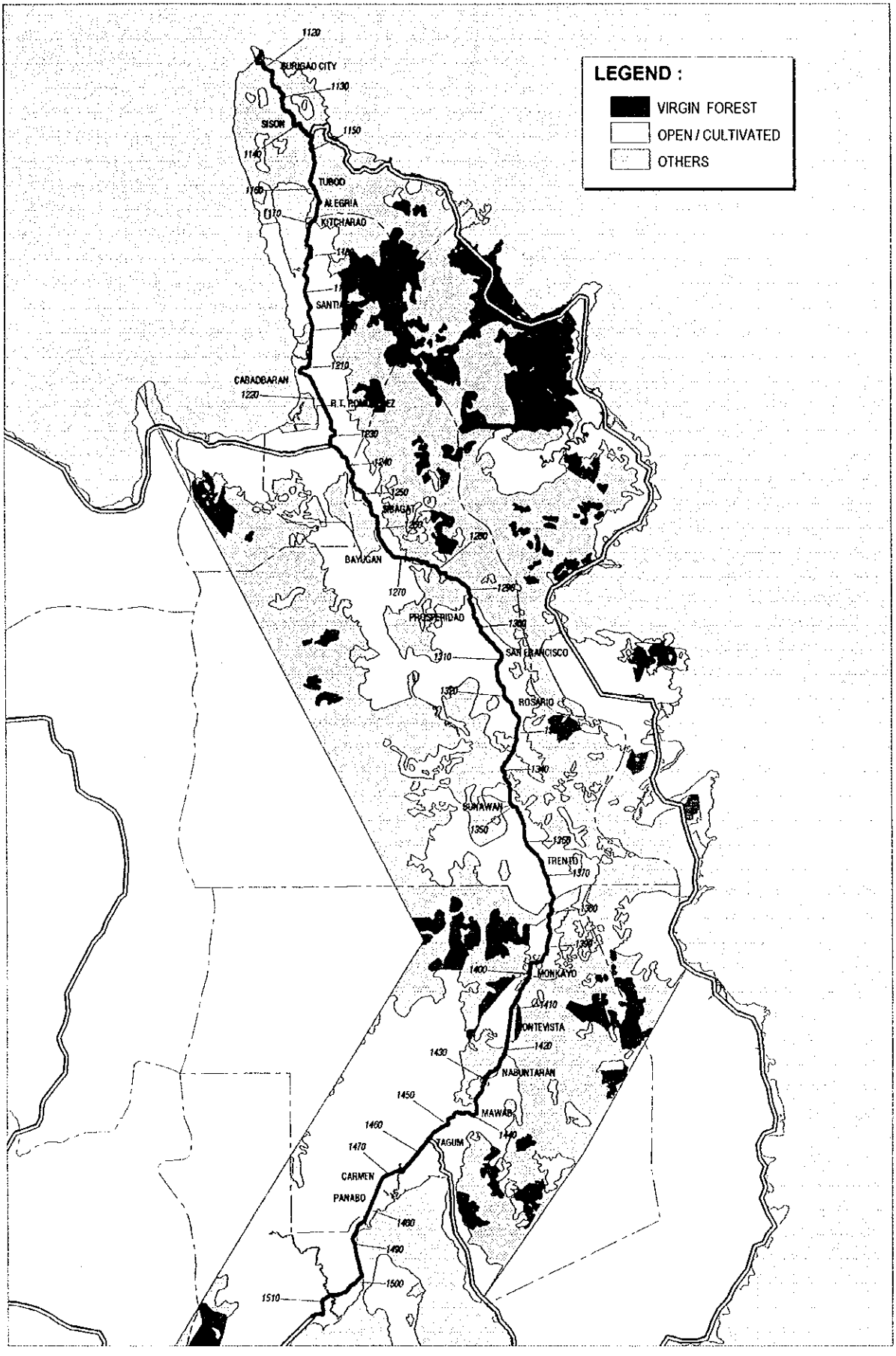


FIGURE 17.4 - 1 VIRGIN FOREST AND CULTIVATED AREA

- Total number of slope failures presented ---------- 14 slopes (over 10 m in height)

- Answered as "Positive" effect on landscape ---------- 4 slopes
- Answered as "Negative" effect on landscape ---------- 1 slope
- Answered as "None" or negligibly small effect on landscape ---------- 9 slopes

17.4.4 Impacts on Pollution

1) Air Pollution

The use of computerized software is inevitable to predict existing/future air quality level by the defusion of exhaust gas from vehicles on the Study Road. In this Study, Puff model was applied and its brief explanation is presented in Appendix 17.8. The prediction was done in heavy traffic sections based on traffic volume in 2000 as a target year, using standard (not actual) exhaust emission.

The results of prediction were checked and compared with National Ambient Air Quality Standards (see Table 17.4-6). The air pollution along the Study Road will be extremely low compared to National Standards, thus, this impact is negligible.

TABLE 17.4-6 RESULTS OF PREDICTION (CARBON MONOXIDE)

Section No.	Results of1/ Prediction (PPM)	National Standards (PPM)
Section - 19	0.57	30.0
Section - 20	1.00	30.0
Section - 21	1.49	30.0

1/: Predicted carbon monoxide density at the edge of road right-of-way.

2) Water Pollution

A fresh surface water such as river and lake, was classified into six categories by National Environmental Standards and also the best usage of each was defined. Appendix 17.9 shows the surface water classification of the river at each bridge site. Majority of dredging works are proposed in waterways classified as class - C. When a dredging work is executed in a cautious manner, adverse impacts on environment will be negligible. There are bridge rehabilitation works in the rivers classified as A such as Legaspi Creek, Jagupit and

Guinoyoran Rivers, however, these rivers are shallow and narrow, therefore, adverse impacts on overall water quality will be negligible.

3) Noise Pollution

From the general viewpoints of rehabilitation works, the Project does induce beneficial impacts rather than adverse impacts on noise pollution mainly due to minimizing speed changes of running vehicles on the road and smooth traffic. Accordingly, impact on noise pollution by the Project will be judged as none or slightly positive. The future noise levels were predicted for reference at critical sections based on the traffic volumes in the year 2000 to compare with National Standards. The methodology adopted is shown in Appendix 17.10.

Results of prediction are shown in Table 17.4-7. Noise level in the section from Mawab in Davao del Norte to inside Davao City will exceed standard noise level. However, this is not due to the Project, but normal traffic increase. "With" the Project, noise level will be less than that of "without" the Project, since the Project greatly improve pavement surface condition. Therefore, it is judged that the Project will provide favourable impact on noise pollution.

TABLE 17.4-7 PREDICTION RESULTS ON TRAFFIC SECTIONS 19, 20 AND 22

Trafffic Section No.	Predicted Hour	Predicted Noise Level (dba)	Noise Standard	
			Category of "A" (dBA)	Category of"B" (dBA)
Section 19 (Mawab-Tagum)	Morning 7- 8	59	50	60
	Daytime 16-17	60	55	65
	Evening 18-19	60	50	60
	Nightime 22-23	44	45	55
Section 20 (Tagum-Carmen)	Morning 8- 9	61	50	60
	Daytime 16-17	64	55	65
	Evening 18-19	65	50	60
	Nightime 22-23	48	45	55
Section 22 (Panabo-Davao City)	Morning 8- 9	64	50	60
	Daytime 16-17	66	55	65
	Evening 18-19	67	50	60
	Nightime 22-23	51	45	55

Note: "A"- a section or contiguous area which is primarily used for residential purposes;
"B"- a section or contiguous area which is primarily commercial area;

17.4.5 Overall Environmental Impacts

Overall environmental impacts are summarized in Table 17.4-8

TABLE 17.4-8 OVERALL ENVIRONMENTAL IMPACTS BY THE PROJECT (1/2)

Evironmental Factor		Impacts	Remarks
A. Social Environment	1. Resettlement	Slight negative impacts	- 41 affected families in Simulao Section
	2. Economic Activities	Significant positive impact	- Enhancement of economic activities in Region X and XI - Enhancement of activities of construction sector - Increase of land productivity and land value
	3. Traffic, Life Facilities	Slight negative impact	- Increase of traffic congestion in Traffic section 21 and 22 (during roadway rehabilitation) - Increase of traffic congestion in three bridge rehabilitation sites (during bridge rehabilitation)
		Significant positive impact	- Decrease of running costs - No traffic interruption at disaster potential spots - Fewer traffic accidents against pedestrians (after implementation)
	4. Community Disruption	None	
	5. Historic Spots, Cultural Assets	None	- No historic spots/cultural assets observed
	6. Water Right, Common Right	Negligibly small impact	- Small fish catch in Project Area
	7. Sanitation	None	
	8. Waste	Slight negative impact	- Removal of existing pavement (22.7 km.) - Destruction of existing bridges (8 bridges) - Dredging river beds (10 spots) - Recutting of slopes (6 spots)
	9. Disaster	Significant positive impact	- Prevention of disaster occurence (30 critical spots observed)

TABLE 17.4-8 OVERALL ENVIRONMENTAL IMPACTS BY THE PROJECT (2/2)

B. Natural Environment	10. Topography/ Geology	None	
	11. Soil Erosion	Slight positive impact	- Prevention of soil erosion due to slope protection (76 slopes)
	12. Ground Water	None	
	13. Lake/ River	Slight positive impact	- Prevention of irregular surface water flow of river
	14. Coast/Sea	None	
	15. Animals and Plants	Negligibly small impact	- Virgin forest not affected - Traversing mostly cultivated areas
	16. Mateorology	None	
	17. Landscape	Negligibly small impacts	- Improvement of existing desolated landscape on eroded slopes
C. Pollution	18. Air Pollution	Negligibly small impact	- Acceptable levels of air pollution
	19. Water Pollution	Negligibly small impact	- Most rivers classified into C or D - Only creek or small water stream Classified into A
	20. Soil Pollution	None	
	21. Noise/ Vibration	Negligibly small impacts	- Decrease of noise level due to fewer speed changes of vehicles - Excess of noise level over standard in 2000
	22. Land Subsidence	None	
	23. Nasty Small	None	

17.5 MITIGATING MEASURES

As the result of the environmental assessment of the Project, three negative impacts were clarified among 23 factors.

- Resettlement of affected families in Simulao flood prone section.
- Traffic congestions during construction works in the sections in and near Davao City.
- Wastes materials during construction.

17.5.1 Resettlement

Due to nature of the Project, requirement for road-right-of-way acquisition is minimal. Only Simulao flood prone section is subject to this issue where 41 families will be affected. To minimize friction between the project proponent and communities and to implement the Project smoothly, these are recommended:

- DPWH as the project proponent should designate and prepare the proper relocation sites near the existing housing lots.
- DPWH should acquire lands and compensate lots/house owners or rightful persons at current market price.

17.5.2 Traffic Congestion During Construction

Roadway rehabilitation

Roadway rehabilitation works are executed side by side. During the construction of one side, the other side is open to traffic in one way operation controlled by signal. Traffic sections 21 and 22 have the heaviest traffic volumes of about 15,100 vehicles per day and 14,300 vehicles per day in the year 2000, respectively. These traffic volumes exceed one way operation road capacity which is 11,800 veh/day when rehabilitation works are executed by 100 meter length. The one way operation road capacity is increasing in accordance with its shorter unit length, but in the Project, the 100 m length is set as the minimum rehabilitation unit length taking into consideration of the efficiency of the works. It is recommended to effectively use shoulder space for traffic management during the pavement rehabilitation works.

Bridge rehabilitation

As to traffic management during bridge rehabilitation works, three ways are planned.

(1) Method A: Detour road construction
(2) Method B: Usage of existing road in full width
(3) Method C: Usage of existing road in partial width

One way operation capacity was calculated assuming the application of Method C. The traffic management is critical only at four bridge sites where future traffic volumes in the year 2000 exceed the one way operation capacity. They are as follows:

- Gov. Miranda Bridge
- Bunawan Bridge
- Ilang Bridge
- Panacan Bridge

Among them, new Gov. Miranda Bridge is planned to be constructed along alternative road alignment in Liboganon Section, thus the existing bridge is still available for traffic during the construction. In other three bridges, the construction of temporary two-lane bridge is recommended from the viewpoint of the traffic management.

17.5.3 Wastes Material During Construction

Listed below are the rehabilitation work types with their length/number of sites which are main sources of wastes during construction in the Project.

• PCC reconstruction (Type - 1)	22.74 km.
• Total reconstruction of bridge	8 bridges
• Dredging	10 bridges
• Recutting of slope	6 slopes

The following measures are recommended to cope with construction wastes:

- Wastes should be treated properly in accordance with the direction of field supervisors or engineers and DPWH standard specification.
- Salvable materials should be utilized as materials for rehabilitation works as much as possible.
- Monitoring should be strictly conducted by the field supervisors to check manners applied to disposal or conditions of wastes at the construction sites.

CHAPTER 18

IMPLEMENTATION PROGRAM

18.1 FUND AVAILABILITY

Fund availability for this project is the key factor to formulate a realistic implementation schedule. Fund availability was studied based on the past and future DPWH budget for the highway sub-sector and past budget allocation to major foreign-assisted projects.

DPWH budget for the highway sub-sector grew from 6,662 Million pesos in 1991 to 11,837 Million pesos in 1995. About 56 to 93% of the budget were allocated to the foreign-assisted projects as shown in Table 18.1-1. According to the 1993-1998 Medium Term Public Investment Program (MTPIP), budget for the highway sub-sector is planned to be drastically increased from 1996 to 1998. It is expected that about 13,500 Million pesos and 15,500 Million pesos will be allocated to foreign-assisted projects in 1997 and 1998, respectively.

Table 18.1-2 shows the past allocation of budget to major foreign-assisted projects. The project with similar nature to this project is the OECF-assisted Road Rehabilitation Project under the special road rehabilitation loan, which received a big allocation of 1,433 Million pesos in 1993 and 1,459 Million pesos in 1994. These figures represent 15 to 18% of total budget for the foreign-assisted projects. Other projects received mostly an allocation of 500 to 850 Million pesos which represents 5 to 11% of total budget for the foreign-assisted projects.

Assuming that 10% of total budget for the foreign-assisted projects would be the moderate allocation for a single project, this project could receive about 1,350 Million pesos and 1,540 Million pesos at current prices in 1997 and 1998, respectively. These figures will be about 1,100 to 1,180 Million pesos in December 1994 prices under the assumption that an escalation rate would be about 8% per annum.

TABLE 18.1-1 DPWH BUDGET FOR HIGHWAY SUB-SECTOR

(unit : Million Pesos at current prices)

		1991	1992	1993	1994	1995	1996	1997	1998
1993-1998 Medium Term Public Investment Program 1/	Arterial Roads	-	-	6,702	5,826	6,571	11,067	13,765	15,694
	Other National Roads	-	-	4,059	5,368	6,387	6,567	8,714	10,019
	Total	-	-	10,761	11,194	12,958	17,634	22,479	25,713
DPWH Infrastructure Program 2/	Foreign Assisted Projects	3,886 (58%)	9,762 (92%)	9,475 (93%)	7,810 (74%)	6,617 (56%)	10,580	13,500	15,430
	Locally Funded Projects	2,776 (42%)	841 (8%)	674 (7%)	2,807 (26%)	5,220 (44%)	7,054	8,979	10,283
	Total	6,662 (100%)	10,603 (100%)	10,149 (100%)	10,617 (100%)	11,837 (100%)	17,634	22,479	25,713

SOURCE: 1/ 1993-1998 Medium Term Public Investment Program, October 1994
2/ DPWH 1994 & 1995 Infrastructure Program

NOTE: DPWH Infrastructure Program for the period from 1996 to 1998 was assumed to be the same as the planned budget under the Medium Term Public Investment Program. Allocation for the foreign assisted projects was assumed to be 60% of the total budget.

TABLE 18.1-2 PAST BUDGET ALLOCATION TO MAJOR FOREIGN ASSISTED PROJECTS

(Unit: Million Pesos at current prices)

Project	1992	1993	1994	1995
• OECF-assisted Road Rehabilitation Project under Special Road Rehabilitation Loan	1,262	1,433	1,459	652
• OECF-assisted West & Northwest Leyte Roads Improvement Project, Phase II	535	361	535	204
• OECF-assisted Disaster Prevention and Rehabilitation Project along Philippine Japan Friendship Highway and Naguilian Road	149	326	754	177
• OECF-assisted Metro Manila Circumferential Road 5 (C-5) and Radial Road 4 (R-4) Project	571	411	220	250
• IBRD-assisted Highway Management Project (nationwide)	120	737	300	1,698
• ADB-assisted 4th Roads Improvement Project (nationwide)	455	817	395	198
• ADB-assisted 5th Roads Improvement Project (nationwide)	420	485	860	662

SOURCE: DPWH 1995 Infrastructure Program

The Study Team discussed with the DPWH officials on the most probable budget allocation for this project. DPWH's opinions were as follows:

- It would be most appropriate to plan the implementation schedule with the budgetary framework of 1,000 Million pesos per year.
- Considering the nature of the project, it should be completed as soon as possible. DPWH will make utmost effort to provide more budget for the early completion of the project.

It was concluded that the implementation schedule be planned with the budgetary framework of 1,000 Million pesos (in December 1994 prices) per year.

18.2 IMPLEMENTATION SCHEDULE

18.2.1 Priority of Contract Packages

All contract packages can not be implemented simultaneously due to the limitation of available fund, contract packages should be prioritized to arrive at the most practical and appropriate implementation schedule.

1) Basic Considerations for Prioritization

Two factors, i.e. road conditions and traffic volume, were considered in rating the contract packages. The project is to rehabilitate the most important trunk road in the country which should be always kept in good condition, therefore, road condition should be the primary factor to be considered in prioritization. Traffic volume is another factor. When road conditions of two road sections are almost the same, a section with heavier traffic volume should be prioritized higher.

Using two factors, the degree of inconvenience to road users was evaluated as follows:

Degree of inconvenience = (Road condition) x (Traffic volume)

Economic evaluation results were not considered in prioritization. When there are two sections with almost same traffic volume, a section in worse condition than the other require higher investment to correct physical defects, which may result in lower economic evaluation result. Thus, this factor was not considered.

2) Prioritization Method

Calculation of Point

The degree of inconvenience to road users was expressed by the point which was calculated in accordance with the following formula:

Point = Ft x Fd/l
where:
Ft = Point based on AADT in year 2000 (maximum Ft = 2.0)
Ft = $(AADT/1,000)^{1/2}$
Fd = Point based on deffects of a road
Pavement: 3.0x(length in km of lane with RRI $\leq$ 1.0)
2.0x(length in km of lane with 1.0 < RRI $\leq$ 2.0)
1.0x(length in km of lane with 2.0 < RRI $\leq$ 3.0)
Bridge: 3.0x(Number of TOTAL RECONSTRUCTION Bridges)
2.0x(Number of PARTIAL RECONSTRUCTION Bridges)
1.0x(Number of OTHER REHABILITATION Bridges)
Slope: 1.0x(Number of Slopes to be protected)

Flood Section:

3.0x(length in km of flood section with severity A)
2.0x(length in km of flood section with severity B)
1.0x(length in km of flood section with severity C)
(3.0 km was considered to be the maximum length in this evaluation)

l = length in km of a contract package

Prioritization

Contract packages were classified into four priority groups (A to D), basically in accordance with the point obtained by a contract package. A contract package with higher point has higher priority. Another factors considered were as follows:

- Continuity of construction between adjacent contract packages
- Implementation status of related projects
- Budgetary framework for this project

3) Priority of Contract Packages

Table 18.2-1 and Figure 18.2-1 shows the priority of each contract package. In consideration of budgetary framework for this project, number of contract packages for each priority group was determined as follows:

Priority A : 6 contract packages
Priority B : 5 contract packages
Priority C : 3 contract packages
Priority D : 5 contract packages

Following contract packages were adjusted their priority:

- Package 17 was included in Priority A considering the on-going dike construction project along Libuganon River.
- Packages 14 and 15 were included in Priority B which involves countermeasures against flood at Monkayo area, therefore, both packages were prefered to be implemented simultaneously.
- Packages 10 and 12 were included in Priority C in consideration of continuity of construction.

TABLE 18.2-1 PRIORITY OF CONTRACT PACKAGES

Package	Length	AADT	Fd					Fd/l	Ft	Point	Order	Priority
			Road	Bridge	Slope	Flood	Total	(km)				
1	54.294	1704	15.11	13.00	7.00	9.03	44.14	.81	1.31	1.06	19	D
2	22.361	1046	11.66	10.00	10.00	8.79	40.45	1.81	1.02	1.85	16	D
3	20.857	1332	7.40	9.00	00	15.14	31.55	1.51	1.15	1.75	17	D
4	30.091	3094	12.66	18.00	5.00	1.28	36.94	1.23	1.76	2.16	12	C
5	13.273	3390	41.07	2.00	12.00	.00	55.07	4.15	1.84	7.64	1	A
6	15.050	2767	30.45	8.00	.00	.00	38.45	2.55	1.66	4.25	4	A
7	24.430	1998	77.29	17.00	16.00	.00	110.29	4.51	1.41	6.38	2	A
8	13.858	2346	32.86	5.00	2.00	.00	39.86	2.88	1.53	4.41	3	A
9	16.835	1751	14.81	10.00	5.00	.00	29.81	1.77	1.32	2.34	9	B
10	25.587	1260	35.18	6.00	1.00	.00	42.18	1.65	1.12	1.85	15	C
11	14.776	1491	27.04	2.00	4.00	9.00	42.04	2.85	1.22	3.47	8	B
12	12.644	1650	20.67	1.00	1.00	.00	22.67	1.79	1.28	2.30	10	C
13	18.449	1677	41.70	7.00	3.00	.00	51.70	2.80	1.29	3.63	6	A
14	2.400	1696	.00	.00	.00	7.20	7.20	3.00	1.30	3.91	5	B
15	29.496	2193	29.08	9.00	4.00	.00	42.08	1.43	1.48	2.11	13	B
16	31.394	4043	27.18	4.00	4.00	.00	35.18	1.12	2.00	2.24	11	B
17	12.006	8322	6.41	6.00	.00	9.00	21.41	1.78	2.00	3.57	7	A
18	29.706	11707	20.53	7.00	2.00	.00	29.53	.99	2.00	1.99	14	D
19	18.248	8788	8.31	2.00	.00	.00	10.31	.57	2.00	1.13	18	D

18.2.2 Implementation Schedule

The implementation schedule for the project was established in consideration of priority of each contract package and budgetary framework of 1,000 Million pesos per year.

The implementation schedule and the annual fund requirement is presented in Table 18.2-2. The proposed schedule of each activity is as follows:

Detailed Design : 18 months (May 1995-October 1996)
Right-of-way Acquisition : To be completed prior to start of construction
Construction : 69 months (April 1997-December 2002)
Construction Supervision : 69 months (April 1997-December 2002)

In view of the magnitude of the project, DPWH should tap external financing sources and the fund preparation should be completed within 1996.

The maximum fund will be required in 2001 amounting to 964 Million pesos in December 1994 prices. In other years, 490 to 896 Million pesos will be required, for which budget allocation can be attainable from the fact that bigger allocation has been made to the similar project.

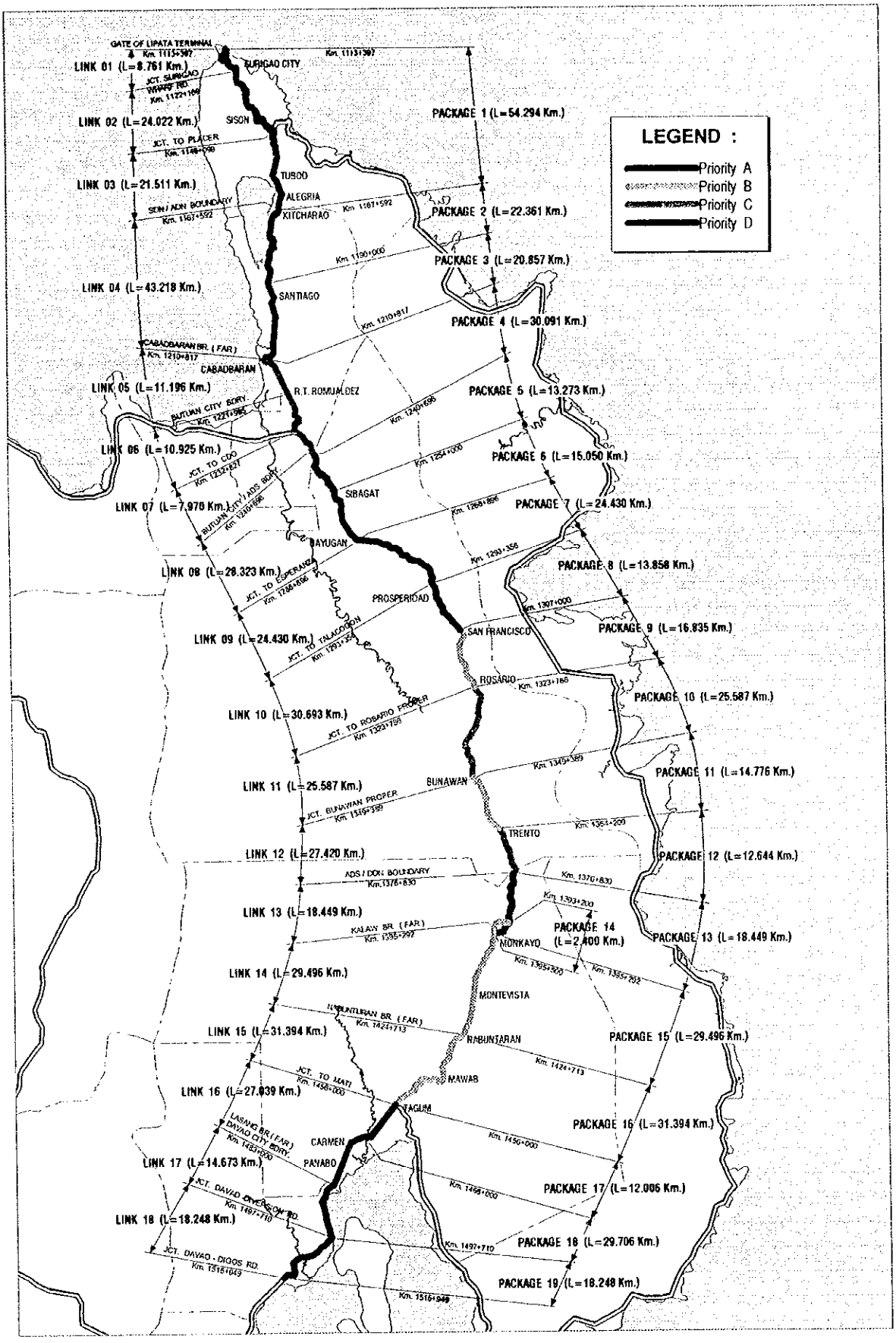
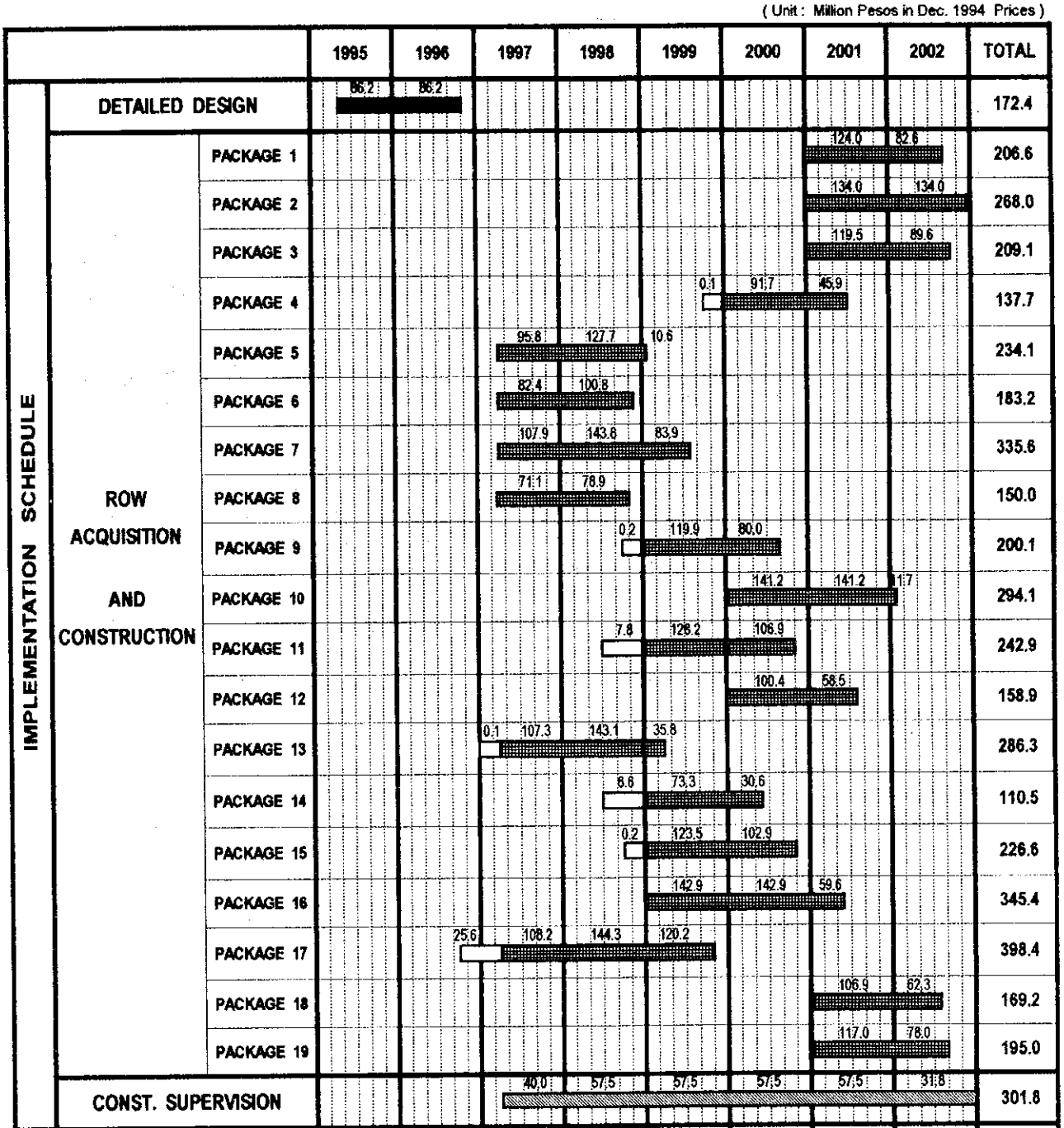


FIGURE 18.2-1 PRIORITY OF CONTRACT PACKAGES

TABLE 18.2-2 IMPLEMENTATION SCHEDULE

(Unit : Million Pesos in Dec. 1994 Prices)



ANNUAL FUND REQUIREMENT	1995	1996	1997	1998	1999	2000	2001	2002	TOTAL
DETAILED DESIGN	86.2	86.2	-	-	-	-	-	-	172.4
ROW ACQUISITION	-	-	25.7	14.8	0.1	-	-	-	40.6
CONSTRUCTION	-	-	572.7	738.6	838.3	796.6	906.6	458.2	4,311.0
CONST. SUPERVISION	-	-	40.0	57.5	57.5	57.5	57.5	31.8	301.8
TOTAL	**86.2**	**86.2**	**638.4**	**810.9**	**895.9**	**854.1**	**964.1**	**490.0**	**4,825.8**

LEGEND : Detailed Design; Construction; ROW Acquisition; Construction Supervision

CHAPTER 19

MAINTENANCE

19.1 CURRENT MAINTENANCE SYSTEM

19.1.1 General

Maintenance is defined as the process of preserving and restoring existing road infrastructure facilities in good operating condition, lengthen their useful life, and, hence, avoid premature and costly rehabilitation or reconstruction.

Under the current maintenance system of DPWH, maintenance work is divided into Maintenance Work by Administration (MBA) under the Philippine Highway Maintenance Management System (PHMMS) and Maintenance Work by Contract (MBC).

In both cases, mandated to undertake the necessary and required services for the maintenance of national roads and bridges are the Maintenance Sections of the various District/City Engineering Offices (DEO/CEO) nationwide in close coordination with the Regional Offices concerned, while the Bureau of Maintenance (BOM) provides technical assistance and guidelines for the efficient and economical implementation of the maintenance functions. The Regional Equipment Services (RES) under the direction and supervision of the Bureau of Equipment (BOE), provides to DEO/CEO the minimum fleet of road maintenance equipment to be used for maintenance works by administration.

19.1.2 Maintenance Organization and Management

Maintenance of national roads and bridges is under the responsibility of DPWH through its concerned agencies as follows (see Figure 19.1-1):

Overall Planning and Technical Assistance/Guidance to Field Offices

- Bureau of Maintenance
- Bureau of Equipment

Implementing Arm of Road/Bridge Maintenance

- Regional Offices
- District/City Engineering Offices

Functions of each agency are presented in Appendix 19-1.

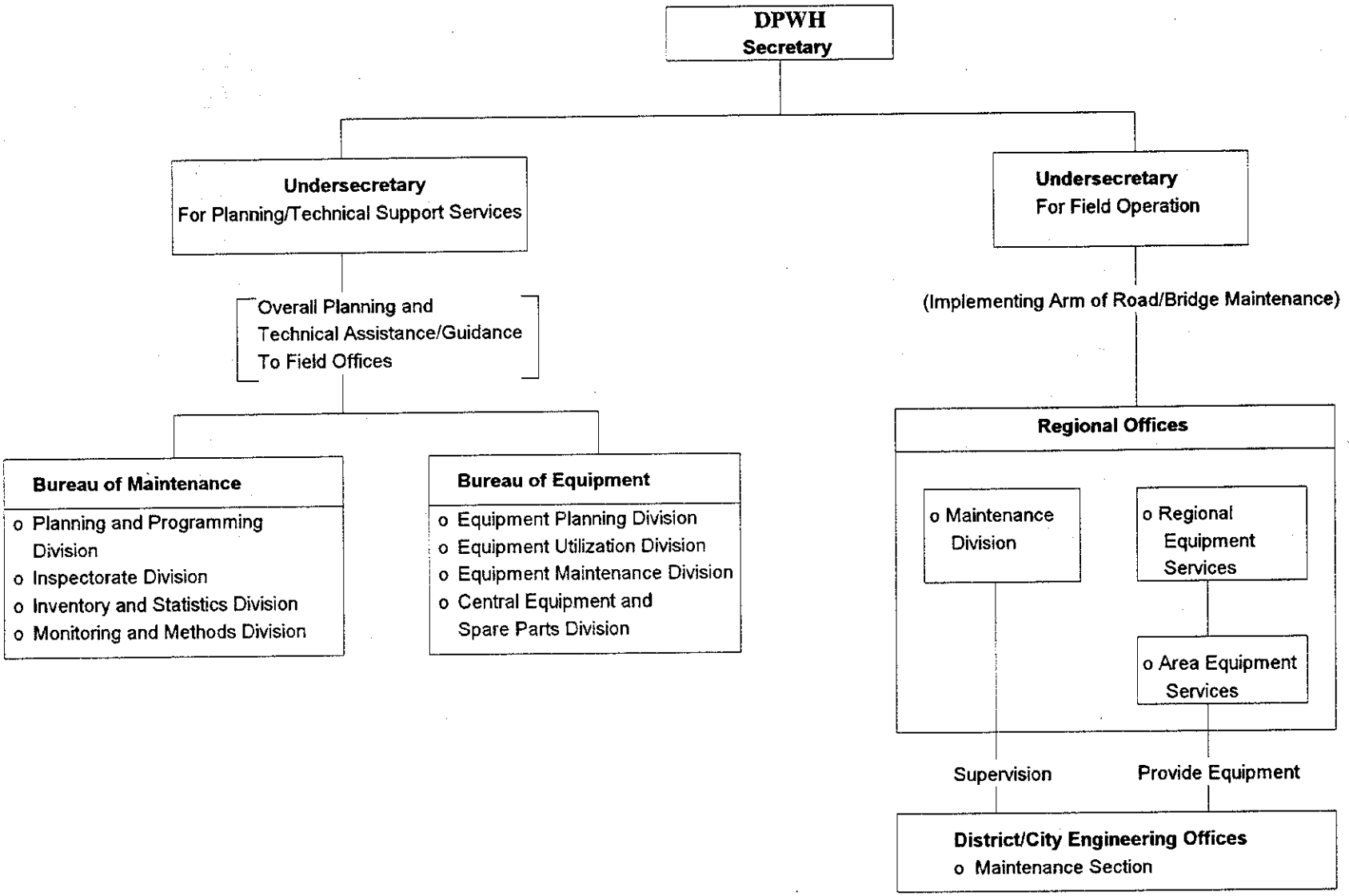


FIGURE 19.1-1 DPWH ORGANIZATION RELATED TO ROAD/BRIDGE MAINTENANCE

19.1.3 Maintenance Budget

Maintenance budget and allocation of funds to Regional Offices and DEO/CEO are determined by the Equivalent Maintenance Kilometer (EMK) system. The EMK System is expressed as follows:

Maintenance Funds = Basic Cost x EMK

Basic Cost	: Cost to maintain one equivalent-maintenance-kilometer for one year
EMK	: Equivalent-maintenance-kilometer to be determined by a physical length times EMK Factors. EMK factors are established for type of pavement, width of roadway and traffic volume as shown in Table 19.1-1.

Table 19.1-2 shows the basic cost, EMK and maintenance budget for national roads for the last five (5) years.

TABLE 19.1-2 MAINTENANCE BUDGET FOR THE LAST FIVE YEARS

	Basic Cost/EMK	Physical Kilometer (National Roads)	EMK	Maintenance Budget (₱Million)
1990	P20,500	26,304	49,882	1,023
1991	P20,500	26,362	49,805	1,021
1992	P28,049	25,768	49,401	1,386
1993	P31,517	25,957	52,702	1,661
1994	P33,500	26,115	52,746	1,767

SOURCE: Highlights of the Regular 1993 & 1994 DPWH Budget, DPWH Other data from BOM.

Funds alloted for the maintenance and repair of roads are released to the respective DEO/CEO every quarter. Five percent of the total road maintenance fund allocated for each region shall be set aside for the maintenance of roads newly converted to or taken over as national roads for the current year.

To provide a ready fund for emergencies, another five percent of the budget for every DEO/CEO is retained at the Regional Offices as Immediate Response Fund (IRF). This fund will be used for the immediate repair of roads and bridges damaged by natural calamities or for emergency activities.

TABLE 19.1-1 EMK FACTORS

A) SURFACE & TRAFFIC FACTORS

TRAFFIC, AADT	1	25	50	75	100	150	200	300	400	600	1000
UNPAVED											
LOW NO GRANULAR SURFACE	0.35	0.40	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
MEDIUM 100 MM - 200 MM G.S.	0.40	0.60	0.90	1.40	1.90	2.20	2.40	2.50	2.60	0.28	3.10
HIGH 200 MM > G.S.	0.40	0.60	0.85	1.00	1.45	1.90	2.10	2.30	2.50	2.90	3.50

TRAFFIC, AADT	200	400	600	1000	1500	2000	3000	5000	10000	15000	20000	30000	50000	70000	100000
BITUMINOUS															
LOW 10 MM - 30 MM	1.10	1.55	2.10	2.50	2.60	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
MEDIUM 31 MM - 60 MM	1.00	1.25	1.55	2.00	2.20	2.30	2.40	2.50	2.64	2.64	2.64	2.64	2.64	2.64	2.64
HIGH 61 MM - 100 MM	0.70	0.85	0.95	1.20	1.65	1.85	1.95	2.10	2.20	2.30	2.45	2.75	3.15	3.65	4.45
EXTRA STRENGTH 100 MM >	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.15	1.20	1.25	1.33	1.48	1.68	1.93	2.33
CONCRETE															
CONCRETE (20cms and above)	0.50	0.60	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.23	1.38	1.58	1.83	2.23

B) WIDTH FACTORS

PAVED (ASPHALT OR CONCRETE)

		WIDTH <	7.50	M	=	1.00	30.00	M	<WIDTH <	32.50	M	=	2.50
7.50	M	<WIDTH <	10.00	M	=	1.15	32.50	M	<WIDTH <	35.00	M	=	2.65
10.00	M	<WIDTH <	12.50	M	=	1.30	35.00	M	<WIDTH <	37.50	M	=	2.80
12.50	M	<WIDTH <	15.00	M	=	1.45	37.50	M	<WIDTH <	40.00	M	=	2.95
15.00	M	<WIDTH <	17.50	M	=	1.60	40.00	M	<WIDTH <	42.50	M	=	3.10
17.50	M	<WIDTH <	20.00	M	=	1.75	42.50	M	<WIDTH <	45.00	M	=	3.25
20.00	M	<WIDTH <	22.50	M	=	1.90	45.00	M	<WIDTH <	47.50	M	=	3.40
22.50	M	<WIDTH <	25.00	M	=	2.05	47.50	M	<WIDTH <	50.00	M	=	3.55
25.00	M	<WIDTH <	27.50	M	=	2.20	50.00	M	<WIDTH <			=	3.70
27.50	M	<WIDTH <	30.00	M	=	2.35							

UNPAVED (GRAVEL OR EARTH)

	<WIDTH <	5.00	M	=	0.80
5.00	<WIDTH <	7.50	M	=	1.00
7.50	<WIDTH <	10.00	M	=	1.20
10.00	<WIDTH <	12.50	M	=	1.40
12.50	<WIDTH <	15.00	M	=	1.60
15.00	<WIDTH <			=	1.80

C) BRIDGE FACTORS (PER METER)

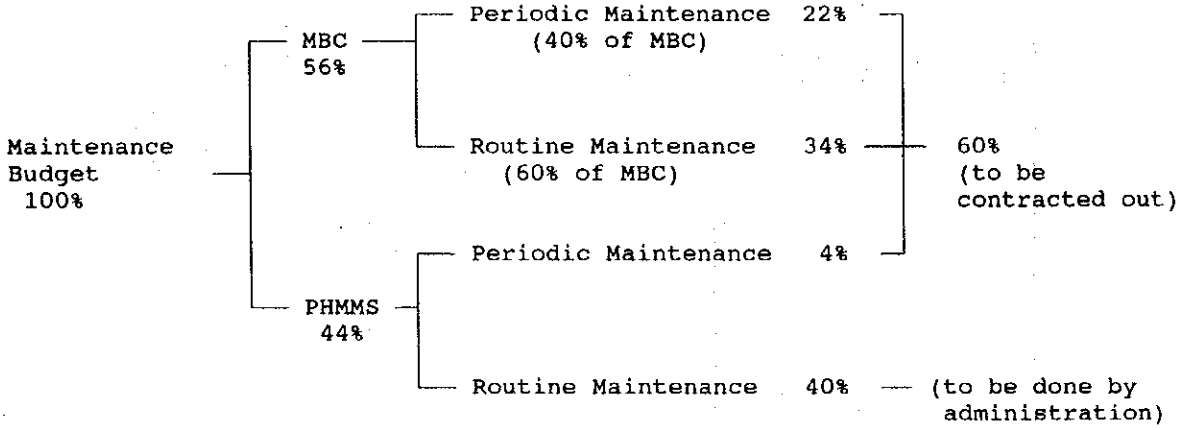
Concrete Bridge	:	0.01
Steel Bridge	:	0.04
Temporary Bridge (Timber/Bailey)	:	0.10

19.1.4 Maintenance Planning and Programming

Maintenance planning and programming is carried out within the following framework:

- Maintenance budget allocation for routine maintenance and periodic maintenance
- Maintenance budget allocation for Maintenance under PHMMS and Maintenance by Contract (MBC)

In 1993, budget allocation was specified as follows:



Based on feature inventory data, the annual maintenance work program and performance budget (AMWP/PB) is prepared for the road sections under PHMMS and the annual work program (AWP) is prepared for the road sections under MBC.

19.1.5 Maintenance Procedure

Maintenance Work By Administration (MBA) under PHMMS

The maintenance by administration follows the concept of PHMMS. Under this system, routine maintenance is undertaken by maintenance crews of DEO/CEO, while periodic maintenance is contracted out to private contractors.

Maintenance activities are determined through inspection conducted by district/city or regional personnel, and complaints by the public. The District/City Area Engineer is responsible for conducting routine inspections of all the roads in the area at least once in 15 days. Semi-monthly schedule is prepared for each area by the District/City Area Engineers and approved during a scheduled meeting conducted by the District/City Maintenance Engineer.

Maintenance Work under MBC

Under MBC, all routine and periodic maintenance activities selected for MBC sections are contracted out through competitive bidding at the DEO/CEO. The contract amounts usually ranges from one million to two million per contract, and normally lasts for about 9 months until the end of a year.

Maintenance works are scheduled on a tri-monthly basis. The tri-monthly work schedule states the activities, the corresponding quantities, the location and the deadline for the activities to be undertaken.

Daily records are taken by the foreman or Area Engineer at DEO/CEO level to record all activities on site and measurements of all completed works. Each week, the accomplishment and the corresponding quantities are summarized and agreed upon between the Contractor and DEO/CEO. Every month, the accomplishment is summarized in the Monthly Summary Sheet. The summary sheet is used by the contractor to substantiate his request for payment and also used for contract monitoring in the Regional and BOM levels.

19.2 MAINTENANCE OF THE STUDY ROAD

19.2.1 Overview

The Study Road covers a total of 403.4 kilometers starting from Lipata Ferry Terminal in Surigao City up to the junction between Davao Diversion Road and Davao-Digos Road in Davao City.

The Study Road which traverses seven (7) DPWH Engineering Districts is accounted for 31.8% of the total national roads maintained by these Districts as shown in the Table 19.2-1.

TABLE 19.2-1 SHARE OF STUDY ROAD IN EACH DEO

	Road Length (km)		
District/City	Total National Road	Study Road	(%)
• Surigao del Norte 1st	225.1	54.3	24.1
• Agusan del Norte	131.4	54.4	41.4
• Butuan City	89.6	18.9	20.9
• Agusan del Sur 1st	257.9	136.5	52.8
• Davao del Norte 2nd	190.7	69.2	36.3
• Davao del Norte 1st	165.6	37.2	22.4
• Davao City	206.3	32.9	16.0
TOTAL	1,266.6	403.4	31.8

SOURCE: Questionnaire from Study Team

In order to have a proper perspective on how the Study Road is being maintained, a Questionnaire on national roads/bridges maintenance was circulated to all DEO/CEO concerned in October 1994. Simultaneously, interviews were also conducted to district maintenance engineers who are responsible for the operation and management of maintenance activities.

19.2.2 Maintenance Activities

Maintenance By Contract (MBC)

At present, 299.4 kilometers (or 74%) of the Study Road length is being maintained by MBC as shown in Table 19.2-2.

TABLE 19.2-2 MBC SECTIONS ALONG STUDY ROAD

District/City	Road Length (km) Study Road	MBC	(%)
• Surigao del Norte 1st	54.3	54.3	100
• Agusan del Norte	54.4	54.4	100
• Butuan City	18.9	-	-
• Agusan del Sur 1st	136.5	54.0	40
• Davao del Norte 2nd	69.2	66.6	96
• Davao del Norte 1st	37.2	37.2	100
• Davao City	32.9	32.9	100
TOTAL	403.4	299.4	74

SOURCE: Questionnaire from Study Team

Table 19.2-3 shows MBC activities of each DEO. MBC activities differ from one District Office to another. Where pavement condition is relatively good, maintenance activities are concentrated on vegetation control, shoulder works and cleaning of ditches. Whereas, on bad pavement condition sections, slab replacement is being focused on.

Maintenance By Administration (MBA)

Maintenance activities of road sections not included in MBC are undertaken by MBA. For example, in Butuan City Sub-Engineering District, the whole Study Road section is being maintained by MBA, since the pavement condition is still good, and maintenance activities are minimal.

Notable among MBA activities are vegetation control, cleaning of ditches, shoulder repairs, and minor bridge repairs. Emergency works caused by calamities like removing of slide, and restoration of slips are also done by administration.

19.2.3 Maintenance Budget

For the fiscal year 1994, the total maintenance budget allocated to concerned DEO/CEO within the study area amounts to 80.858 million pesos, showing an increase of about 10.8% from the 1993 total maintenance budget (Refer to Table 19.2-4). Of this amount, 46.28 million pesos (or 57%) was contracted out for MBC and the remaining 43% was allocated for MBA. For the Study Road, 10.459 million pesos was allocated for MBC (Refer to Table 19.2-5).

TABLE 19.2-3 MBC ACTIVITIES ALONG THE STUDY ROAD

ACT. NO.	DESCRIPTION OF ACTIVITIES	UNIT	DISTRICT/SUB-DISTRICT ENGINEERING OFFICES						TOTAL
			SURIGAO D. NORTE	AGUSAN D. NORTE	AGUSAN D. SUR	DAVAO D. NORTE2nd	DAVAO D. NORTE1st	DAVAO CITY	PPH
			1113.397 ~ 1167.592 (L = 54.3 km)	1167.592 ~ 1221.985 (L = 54.4 km)	1303.000 ~ 1366.000 (L = 54.00 km)	1379.400 ~ 1445.992 (L = 66.6 km)	1445.992 ~ 1483.013 (L = 37.2 km)	1483.013 ~ 1515.949 (L = 32.9 km)	(L = 299.4 km)
201.01	Vegetation Control	sq.m.	264,488	167,761	502,000	-	49,550	30,000	1,013,799
141.01	Cleaning of ditches	lm.	53,153	-	-	-	-	2,000	55,153
141.02	Cleaning of culverts	lm.	3,244	-	-	-	-	1,200	4,444
141.05	Cleaning of line-canal	lm.	-	-	-	-	-	2,500	2,500
131.03	Spot gravelling of shoulder	cu.m.	-	-	-	-	-	1,100	1,100
131.04	Reshaping of unpaved shoulder	sq.m.	193,405	401,010	432,000	-	-	300,000	1,326,415
63x	Regravelling of shoulder	cu.m.	1,470	1,818	113	-	1,700	2,400	7,501
121.11	Cracks & joint sealing	ltrs.	-	-	-	195	-	3,500	3,695
121.13	Repair of paved surface using ready-mixed bituminous materials	cu.m.	-	-	48	-	-	-	48
121.01	Cut out & excavate in existing PCCP, square patch to vertical edge to a depth of 230mm.	sq.m.	-	220	-	1,854	814	-	2,888
121.04	Excavate in existing stabilized based, up to a depth of 150mm.	sq.m.	-	-	-	1,146	-	-	1,146
121.05	Excavate in existing stabilized based, up to a depth of 300mm.	sq.m.	-	-	184	-	-	-	184
121.10(7)	Patching of PCCP, t = 230mm; 7-days conc.	sq.m.	-	-	184	1,854	814	-	2,852
121.10(4)	Patching of PCCP, t = 230mm; 14-days conc.	sq.m.	-	220	-	-	-	-	220
66x(7)	PCC pavement reconstruction, t = 230mm; 7-days concrete	sq.m.	-	-	255	2,608	241	-	3,104
66x(14)	PCC pavement reconstruction, t = 230mm; 14-days concrete	sq.m.	85	-	-	-	-	-	85
66x(28)	PCC pavement reconstruction, t = 230mm; 28-days concrete	sq.m.	-	-	-	-	-	90	90
101.08	Level & compact unpaved road surfaces including side drains by means of mechanical equipment	sq.m.	-	-	6,600	-	-	-	6,600
121.06	Patching of gravel road base	cu.m.	-	12	-	172	-	-	184
61x	Regravelling of road sections	cu.m.	-	-	241	-	-	-	241
999.000	Extra Works	ls.	-	-	l.s.	l.s.	l.s.	-	l.s.
					(P187,100)	(P4387,140)	(P150,000)		(P775,240)

SOURCE: Questionnaire from Study Team

TABLE 19.2-4 ANNUAL MAINTENANCE BUDGET ALLOCATION (1991-1994)

DISTRICT/CITY	ALLOCATED MAINTENANCE BUDGET (MP)			
	1991	1992	1993	1994
Surigao del Norte 1st	6.583	5.366	10.279	14.087
Agusan del Norte	3.806	3.552	6.029	6.413
Butuan City	4.241	4.768	6.395	6.793
Agusan del Sur 1st	7.168	8.704	14.050	15.239
Davao del Norte 2nd	7.552	7.869	12.199	13.117
Davao del Norte 1st	6.740	7.725	11.739	12.121
Davao City	7.772	10.235	12.257	13.088
TOTAL	43.862	48.219	72.948	80.858

SOURCE: Questionnaire from Study Team.

TABLE 19.2-5 MAINTENANCE BUDGET ALLOCATION (1994)

DISTRICT/CITY	BUDGET ALLOCATION (MP)				
	DISTRICT ALLOCATION			Study Road	
	MBC	MBA	Total	MBC	MBA
Surigao del Norte 1st	7.746	6.341	14.087	1.374	N.A.
Agusan del Norte	3.435	2.978	6.413	1.381	N.A.
Butuan City	3.804	2.989	6.793	0.000	N.A.
Agusan del Sur 1st	5.730	9.509	15.239	1.434	N.A.
Davao del Norte 2nd	8.526	4.591	13.117	4.102	N.A.
Davao del Norte 1st	7.878	4.243	12.121	1.037	N.A.
Davao City	9.161	3.927	13.088	1.131	N.A.
TOTAL	46.280 (57%)	34.578 (43%)	80.858 (100%)	10.459 (13%)	N.A.

SOURCE: Questionnaire from Study Team.
NOTE : N.A. = Not Available

19.2.4 Maintenance Organization and Personnel of Maintenance Section of DEO

The Maintenance Section of DEO/CEO is organized into two (2) units; the Planning & Programming Unit and the Field Operation Unit. The Planning & Programming Unit is responsible for the preparation of program of works, plans, status reports, monitoring and collating all maintenance reports for all maintenance activities undertaken by the DEO/CEO. Likewise, it also extend logistical support to Field Operation Unit like requisition of spare parts, fuel, etc.

The Field Operation Unit is responsible for the supervision of contractors for MBC Sections, and implementation of actual maintenance activities in the field. It is divided into several areas, with each area headed by an Area Engineer. The Area Engineer who is directly responsible for the supervision and implementation of all maintenance activities within the area, is assisted by foremen.

The organizational chart of Agusan del Sur District Office's Maintenance Section is presented in Figure 19.2-1 (Also refer to Appendix 19.2 for other DEO/CEO). The summary of maintenance personnel is shown in Table 19.2-6.

19.2.5 Maintenance Equipment

Majority of units of the road maintenance equipment assigned to DEO/CEO are antiquated or more than 10 years old. As shown in Table 19.2-7, out of 86 units, 39 units (or 45%) are non-operational. According to DEO/CEO, most units of road maintenance equipment stay longer at repair shops, thus, maintenance activities are oftenly impaired. Insufficiency of equipment maintenance fund is further aggravating equipment conditions.

19.2.6 Maintenance Problems

Maintenance problems raised by officials of DEO/CEO are summarized in Table 19.2-8. Most common problems are:

- Insufficient maintenance fund
- Delays in release of fund
- Poor equipment condition, frequent breakdown of equipment, delay in repair of equipment and insufficient number of operational equipment

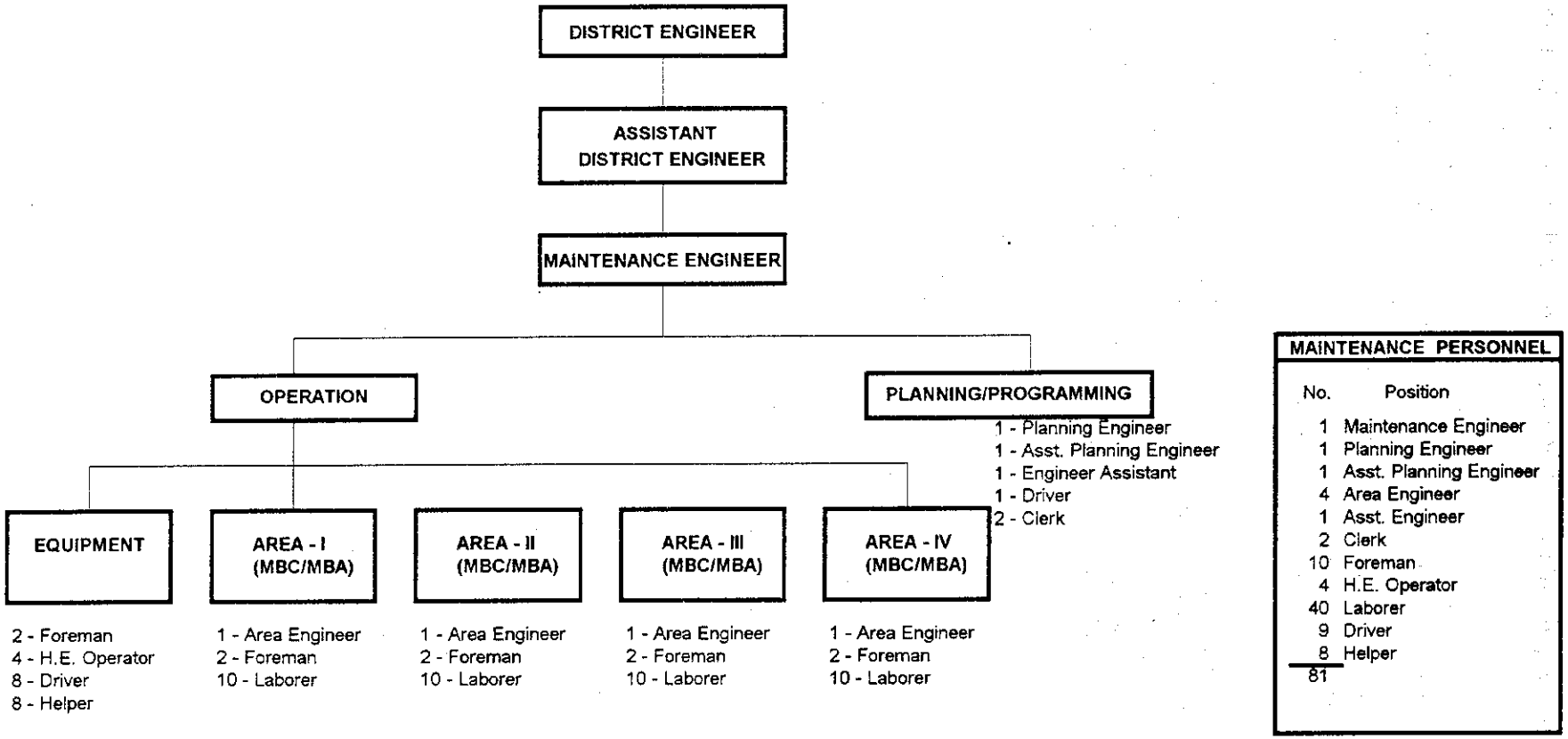


FIGURE 19.2-1 ORGANIZATION CHART OF MAINTENANCE SECTION AGUSAN DEL SUR FIRST ENGINEERING DISTRICT

TABLE 19.2-6 MAINTENANCE PERSONNEL

POSITIONS	DISTRICT/SUB-DISTRICT ENGINEERING OFFICES						
	SURIGAO DEL NORTE (L = 225.145 km)	AGUSAN DEL NORTE (L = 131.370 km)	BUTUAN CITY (L = 89.582 km)	AGUSAN DEL SUR (L = 257.854 km)	DAVAO DEL NORTE 2nd (L = 190.662 km)	DAVAO DEL NORTE 1st (L = 165.647 km)	DAVAO CITY (L = 206.33 km)
Maintenance Engineer	1	1	1	1	1	1	1
Planning Engineer	1	1	-	1	1	1	1
Asst. Planning Engineer	1	-	-	1	-	1	1
Area Engineer	4	2	3	4	2	2	3
Programming Engineer	-	1	-	-	-	-	-
Programming Architect	-	1	-	-	-	-	-
Monitoring Engineer	-	-	-	-	-	1	-
Engineer Assistant	-	-	2	1	-	-	1
Foreman	6	4	5	10	7	7	7
HE Operator	1	3	1	4	4	5	8
Carpenter	2	-	-	-	7	-	-
Equipment Helper	-	-	-	8	-	-	-
Driver	5	4	5	9	6	2	4
Laborer	22	8	8	40	27	20	24
SUB-TOTAL	43	25	25	79	55	40	50
Electrician	-	1	-	-	-	-	-
Mechanic	-	-	-	-	1	-	-
ROW Agent	-	-	-	-	-	1	-
Painter/Photographer	-	1	-	-	-	-	-
Clerk	3	-	-	2	-	-	-
SUB-TOTAL	3	2	0	2	1	1	0
TOTAL	46	27	25	81	56	41	50

SOURCE: Questionnaire from Study Team

TABLE 19.2-7 MAINTENANCE EQUIPMENT BY CONDITION

TYPE OF EQUIPMENT	DISTRICT/CITY ENGINEERING OFFICES														TOTAL	
	SURIGAO D. NORTE (L = 225.145 km)		AGUSAN D. NORTE (L = 131.370 km)		BUTUAN CITY (L = 89.582 km)		AGUSAN D. SUR (L = 257.854 km)		DAVAO D.NORTE2nd (L = 190.662 km)		DAVAO D. NORTE1st (L = 165.647 km)		DAVAO CITY (L = 206.33 km)			
	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L	OPR'L	N-OPR'L
DUMP TRUCK	* 2	3	-	2	2	-	2	1	1	-	2	-	-	2	9	8
ROAD GRADER	* 2	1	1	-	1	-	1	-	2	-	1	1	2	1	10	3
PAYLOADER	1	-	-	-	-	-	-	-	1	-	-	1	-	1	2	2
ROAD ROLLER	-	* 1	-	1	-	-	1	-	1	-	1	-	1	1	4	3
ROAD MAINTENER	* 1	-	-	-	-	-	-	-	1	-	-	-	1	1	3	1
EXCAVATOR	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	3
SERVICE VEHICLE	1	5	-	4	3	-	4	2	4	1	1	1	2	2	15	15
TANKER	-	-	-	-	-	-	1	-	1	-	-	-	-	-	2	-
VIBRATORY COMPACTOR	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
2-BAGGER CONC. MIXER	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
MINI-ROCK CRUSHER	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
ASPHALT KETTLE	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	1
TOTAL	7	10	1	8	6	0	9	6	11	1	6	4	7	10	47	39

NOTE: OPR'L - Operational, Serviceable
N-OPR'L - Non-operational, awaiting repair or under repair
* - Rental

SOURCE: Questionnaire from Study Team

TABLE 19.2-8 MAINTENANCE PROBLEMS

PARTICULARS	DISTRICT/CITY ENGINEERING OFFICES						
	SURIGAO D. NORTE	AGUSAN D. NORTE	BUTUAN CITY	AGUSAN D. SUR	DAVAO D. NORTE2nd	DAVAO D. NORTE1st	DAVAO CITY
o Budget: enough, not enough	Not enough; 70% more	Not enough; 100% more	Not enough;100% more	Not enough;100% more	Not enough; 30% more	Not enough;150% more	Not enough;100% more
o Budget Release: timely or not	Not timely; 3rd month of the year	Not timely; 3rd month of the year	Not timely; 3rd month of the year	Not timely; 3rd month of the year	Not timely; 3rd month of the year	Not timely; 3rd month of the year	Not timely; 3rd month of the year
o Organization: enough personnel or not	Not enough; needs more technical personnel	Field personnel not enough	Enough personnel but mostly casuals	Enough personnel	Enough personnel	Not enough; needs additional laborers	Not enough; needs additional laborers
o Tendering procedure for MBC: Simple or Complicated	SIMPLE	SIMPLE	SIMPLE	SIMPLE	SIMPLE	SIMPLE	SIMPLE
o Management Procedure for MBC: well stablished, too much office work, etc.	Too much office work during preparation only.	Well-established	Well-established	Well-established	Too much office work during preparation only.	Too much office work during preparation only.	Well-established but for future inspection of COA, work accomplished is hardly quantified.
o Maintenance equipment	Old equipment; needs replacement	Inadequate and most are non-operational; needs replacement.	Inadequate; needs 2 new service vehicle	Insufficient and Inefficient	Poor efficiency	Needs additional operational equipment	Mostly under repair
o Availability of Materials for Maintenance	Enough materials	Enough materials	Enough materials	Enough materials but needs crusher	Enough materials	Enough materials	Aggregate Base Course is scarce, hauling distance is about 30-50 km. away.
o Others	o Political intervention	o Annual allocations for MBC contracts must include service vehicles for inspection. o Funding provisions should likewise be considered to accomodate DPWH inspectorate team from Region and BOM.	o Lack of budgetary personnel; All Area Engineers and Engineer Asst. are daily wage personnel and are charge against maintenance fund.	o Equipment very old; repair cost is high. o Permanent laborers were retirable; less productive. o Unpredictable weather condition.	o Poor communications during emergency. o Provincial Engineer's Office (PEO) provide emergency equipment.	o Poor communications during emergency.	o Permanent laborers were retirable; less productive. o Procurement process for spare parts takes time due to bidding requirements, thus, equipments lay idle.

SOURCE: Questionnaire from Study Team

19.3 COMMENTS ON MBC BY DEO/CEO

19.3.1 Maintenance By Contract (MBC)

Maintenance by Contract (MBC) was introduced in 1987 under the technical assistance from ADB. Following satisfactory results of pilot projects and consistent with the government policy of privatization, DPWH adopted a five year (1990-1994) implementation plan of MBC nationwide. As shown in Table 19.3-1, the plan is expressed as percentage of contract amounts which includes work contracted out for both PHMMS and MBC to the total maintenance budget.

TABLE 19.3-1 MBC IMPLEMENTATION PLAN

	Target for MBC (% of Total Maintenance Budget)				
Year	1990	1991	1992	1993	1994
Original Target	40%	51%	61%	72%	84%
Revised Target	40%	50%	50%	60%	70%

Source: BOM

Although the Government slowed down the implementation of MBC and revised the 1994 target to an attainable figure of 70% to the total maintenance budget, Congress enacted otherwise in the 1994 General Appropriations Act. A maximum of thirty percent (30%) of the total maintenance budget for national roads and bridges was allocated for MBC, and 70% for MBA. It is a complete reversal of the 70/30 budget sharing for MBC & MBA respectively.

19.3.2 Comments on MBC by DEO/CEO

Comments on MBC by DEO/CEO are summarized in Table 19.3-2, while Table 19.3-3 shows assessment of MBC contractors by DEO/CEO.

TABLE 19.3-2 COMMENTS ON MBC BY DEO/CEO

DISTRICT/CITY	ADVANTAGE	DISADVANTAGE
Surigao del Norte 1st	- Supervision is easier since the contractor do the work while gov't engineer only check and recommends.	- During emergency, MBC contractors can't be mobilize immediately, because of necessary legal procedures in awarding contract.
Agusan del Norte	- Contractors can respond immediately to calamities due to availability of funds, manpower and machine. - Lessen over-employment of emergency laborers that usually drains maintenance fund.	- Occasionally contractors fail to meet work schedule because their equipments were used to other bigger projects. - MBC cost programming is generally high probably due to accepted DPWH standard. - Unsatisfactory work performance due to lack of proper maintenance training and orientation.
Butuan City	- Minimal equipment maintenance.	- Only if contractor is arrogant and bad performance.
Agusan del Sur 1st	- Less labor supervision. - Less paper works. - No worry for financial benefits of maintenance crews.	- Emergency works cannot be responded immediately by contractors due to legality. - Sometimes contractors fail to meet the work schedule because their equipments were used to other bigger projects.
Davao del Norte 2nd	- No response	- No response
Davao del Norte 1st	- No response	- High unit prices due to high factor of safety use in the preparation of AMWP. - Sometimes contractor don't follow work schedule.
Davao City	- Lessen procurement - Augment equipment deficiencies - Laborers can be hired and terminated anytime.	- Costly due to indirect cost mark-up. - Less responsive during emergency. - Workmanship are unsatisfactory due to lack of proper maintenance training and orientation. - MBC works starts late, prompting the agency to undertake maintenance by force account. - MBC reduced maintenance crew of Administration, however, in the absence of MBC, Administration do the maintenance with less manpower. - Maintenance is easier and quality is better under MBA.

SOURCE: Questionnaire from Study Team

TABLE 19.3-3 ASSESSMENT OF MBC CONTRACTORS BY DEO/CEO

DISTRICT/CITY	FINANCIAL CAPABILITY	EQUIPMENT OWNED	PERSONNEL SKILLS
Surigao del Norte 1st	- Financially capable	- Sufficient - Operational	- Maintenance oriented - Recruited from DPWH
Agusan del Norte	- Financially capable	- Sufficient - Operational	- Not maintenance oriented
Butuan City	- Financially capable	- Sufficient - Operational	- Not maintenance oriented
Agusan del Sur 1st	- Financially capable	- Sufficient - Operational	- Not maintenance oriented
Davao del Norte 2nd	- Financially capable	- Sufficient - Operational	- Maintenance oriented
Davao del Norte 1st	- Financially capable	- Sufficient - Operational	- Not maintenance oriented
Davao City	- Financially capable	- Sufficient - Operational	- Not maintenance oriented

SOURCE: Questionnaire from Study Team

19.4 RECOMMENDATIONS ON FUTURE MAINTENANCE OF THE STUDY ROAD

Upon completion of the rehabilitation/reconstruction works of the Study Road, its conditions will be very much improved and maintenance burden of the Study Road will be greatly lessened. However, maintenance activities can not be eliminated. Future maintenance of the Study Road should be pursued focusing on the following:

- Road conditions of the sections where no rehabilitation works are implemented under this project will be continuously aggravated. Maintenance efforts should be focused on these sections.
- Twenty-eight bridges were classified as bridges only for maintenance and required repair and maintenance works are proposed in this report. DEO/CEO should prepare a maintenance work schedule for these bridges and undertake required repair/maintenance.
- Inspection of completed road sections/bridges should be strengthened to identify early stage of distresses and/or damages, thereby preventive measures can be implemented at a proper timing.
- For flood sections and mountainous sections, concrete side ditches and cross drainages are proposed to be constructed. These drainage facilities must be always cleaned in order for them to function properly. Otherwise, prevention of floods or premature pavement deterioration will not be realized.
- For several bridges, dredging of river bed is included in the project. It should be understood that dredging is the continuous efforts to be done by DEO/CEO even after the completion of the project.

General comments on the present maintenance system are as follows:

- As pointed out by DEO/CEO and other study reports, the Government should make continuous effort to increase maintenance budget.
- Release of maintenance budget should be made at a proper timing.
- Financial capability and equipment of MBC contractors, seems to be adequate, however, most contractors' engineers are not accustomed to maintenance activities. Training of MBC contractors' engineers should be implemented.
- With the introduction of MBC system, DPWH will have less manpower and equipment. Proper system should be established to cope up with natural calamities and other emergency cases.
- Most units of DPWH-owned maintenance equipment are reported to be antiquated and not functioning. About 30% of maintenance budget are still used for MBA. Equipment conditions should be re-assessed and proper measures should be taken.

CHAPTER 20

CONCLUSION AND RECOMMENDATIONS

20.1 CONCLUSION

Needs of the Project

The Study Road suffers from various problems such as progressive deterioration of pavement, structural and hydraulic problems in bridges, repeated slope failures in mountainous areas and frequent occurrence of floods, resulting in aggravation of riding quality, rise of transport cost and even traffic interruptions for a certain period. To cope with such problems, various rehabilitation/improvement works are proposed including pavement rehabilitation, shoulder improvement, drainage improvement, weak subgrade treatment, bridge rehabilitation, slope protection and countermeasures against flood. The proposed project will make the road solid, reliable and comfortable.

Feasibility of the Project

The project was discussed on its viability from various points of view and concluded to be feasible from every aspect as summarized below:

a) **Technical Aspect**

All proposed works can be completed by usual construction methods commonly used in the Philippines in accordance with the DPWH Standard Specifications. All necessary equipment and materials are easily obtained at sites. Thus, no technical problem is expected in the project implementation.

b) **Economic Aspect**

Economic evaluation proves a high economical viability of the project for all work components in all road links.

c) **Financial Aspect**

The project can be implemented within reasonable budgetary framework in accordance with the proposed schedule.

d) **Environmental Aspect**

No adverse environmental impact is foreseen except relocation of a few inhabitants, traffic interference during construction and generation of construction wastes, which will be easily solved/mitigated by providing resettlement sites in the vicinity for the first problem, by proper traffic management for the second problem and by proper disposal of waste materials for the third problem. On the other hand, the project will give preferable impacts such as activation of socio-economic activities, improved accessibility to social facilities, decrease of soil erosion, etc.

e) **Social and Developmental Aspects**

The project will contribute to improvement of social environment and promote the regional development by providing reliable means of transport.

20.2 RECOMMENDATIONS

1) **Early Implementation**

It is highly recommended to implement the project in the earliest possible time, as justified by the economic evaluation. The project can be implemented without financial problem in accordance with the proposed implementation schedule, which is prepared taking into account the reasonably estimated fund availability for each year. The implementation should, however, be hastened if there is a fair prospect of increased fund for the project.

2) **Mitigation Measures of Environmental Impacts**

Due considerations should be given to mitigate adverse environmental impacts. Possible adverse impacts are relocation of a few inhabitants, traffic interference during construction and waste material like old pavement resulting from construction work. As a countermeasure for the relocation problem, a proper relocation plan should be prepared including provision of resettlement area in the vicinity. To minimize the traffic interference during construction, due consideration should be given such as opening of at least one lane to traffic and maintenance thereof in comfort and safety, proper traffic control, provision of safety devices, etc. Waste material should be carefully disposed in accordance with the DPWH Standard Specification so as not to create environmental problem.

3) **Maintenance Requirements**

The implementation of the project will greatly lessen the maintenance burden of the Study Road but not totally eliminate it. Future maintenance should focus on:

- Maintenance of the sections where no rehabilitation work is proposed.
- Minor repair works of the bridges not covered by the project.
- Cleaning of drainage facilities, especially side ditches and cross drainages in flood sections and mountainous sections.
- Periodic dredging of riverbed sediments, especially for the bridges where dredging is proposed in the project.
- Strengthening of monitoring/inspection system for execution of preventive measures at a proper timing.

4) Conduct of Related Projects

It is recommended to undertake the related projects to maximize the effect of this project. The related projects include:

- Widening of Congested Section

  Traffic volume in the section in and near Davao City is high. Especially, a 21.6-km section from Davao del Norte-Davao City boundary up to Buhangin Junction on the Davao City Diversion Road is congested even now and the traffic demand on this section is expected to exceed its capacity by the early 2000's. This section needs to be widened soon. The widening should be planned well coordinated with the widening of the road going to Davao City center.

- Improvement of Access Roads

  Many access roads branch off from the Study Road. Most of them are in very poor condition. Improvement of these roads will result in more effective use of the Study Road.

- River Control

  The project area suffers from floods due to uncontrolled rivers. Although this project aims to prevent the road from flood, it will not cover all shallow floods nor all roadside areas. Therefore, river control projects are desired.