26.2 AGRICULTURAL DEVELOPMENT

26.2.1 Present Condition

Almost all of cultivated land in the influence area is covered by paddy fields. Kenaf was the only main crop planted in upland fields in the 1983 crop year.

Land use and capability conditions in the area are shown in Table 26.2.1 and Figure 26.2.1. A typical cropping calendar in the area is shown in Figure 26.2.2.

26.2.2 Development Projection

Future agricultural development in the area of influence was projected for the two cases of "with and without project". The projected planted area, unit yields by crop, and the consequent production amount are shown in Table 26.2.2.

Based on the above projected production amount, farmgate prices and production costs estimated separately, net production value (NPV) was obtained as shown in Table 26.2.3. The difference in NPV between the two cases is deemed to be the development benefit of the study route.

FIGURE 26.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA

STUDY ROUTE NO. IM-26

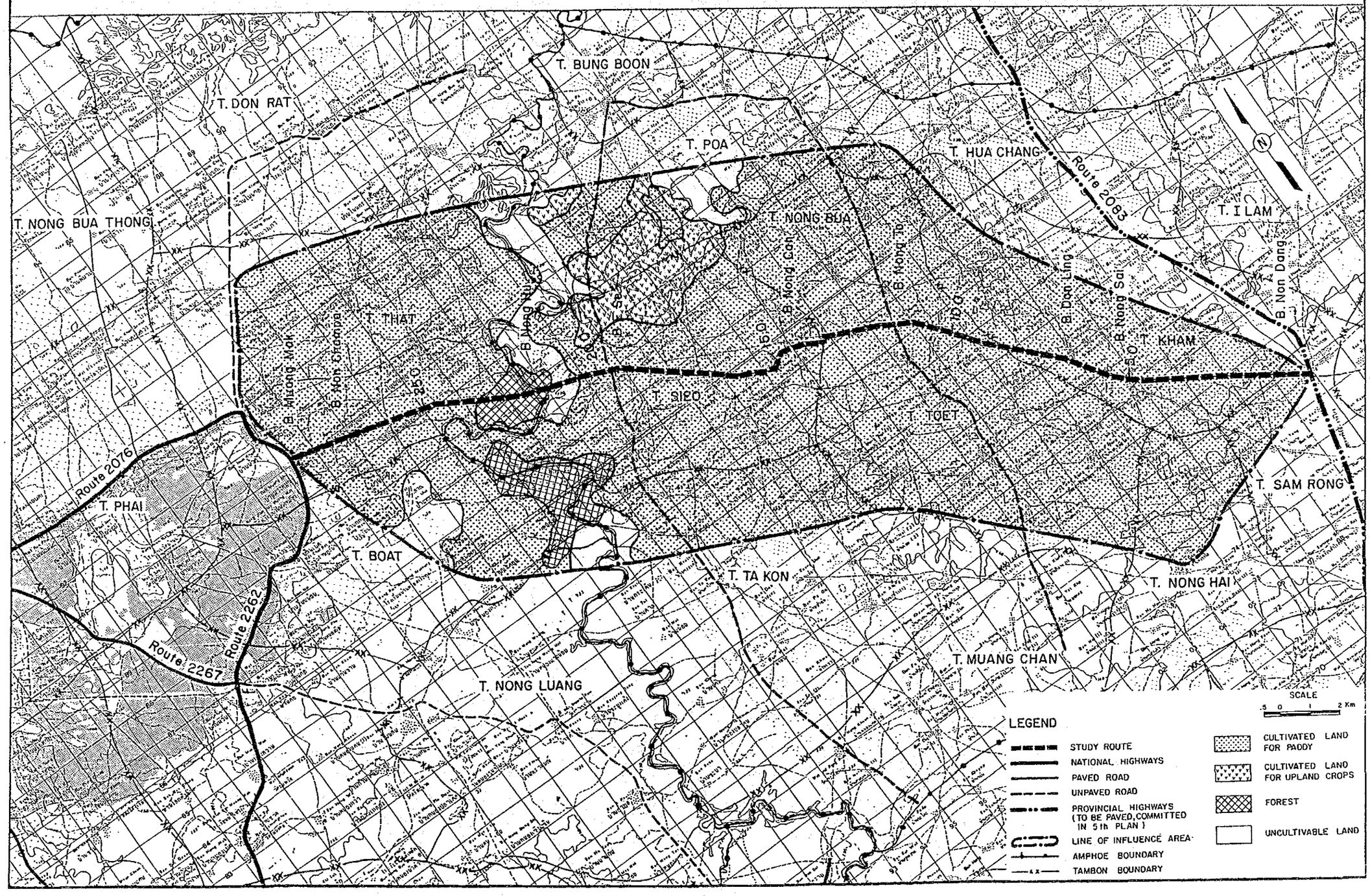
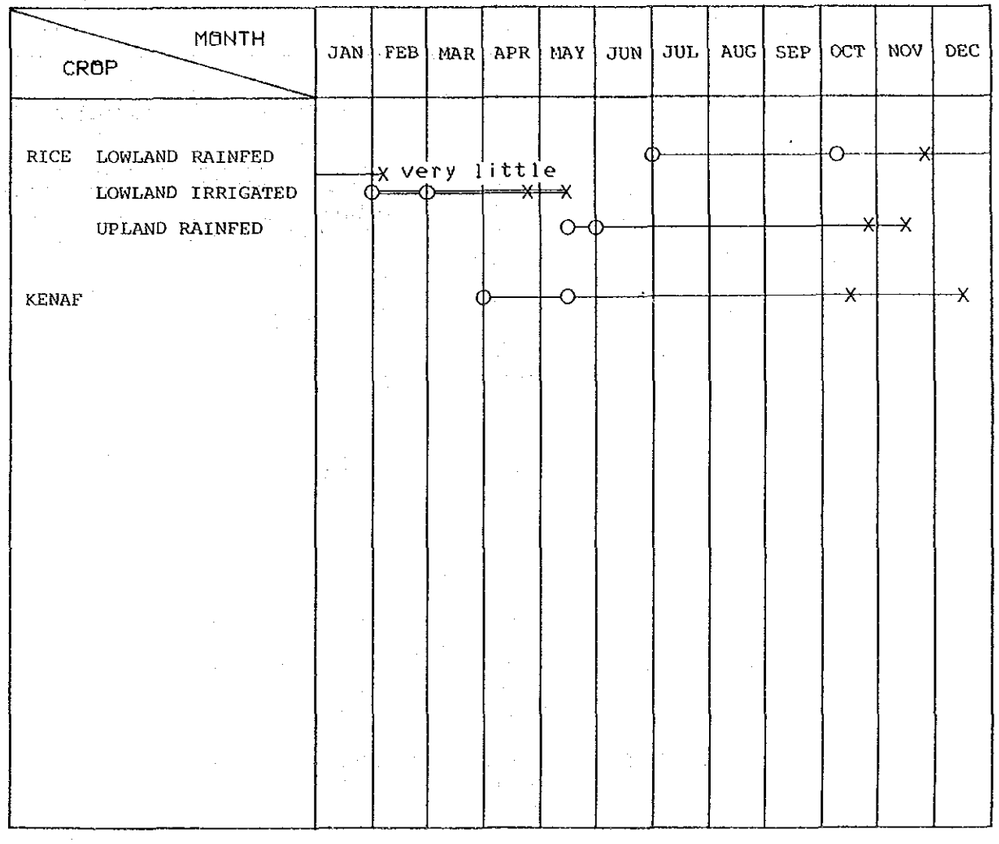


FIGURE 26.2.2 CROPPING CALENDAR

ROUTE IM-26

Related Amphoes: 1506 Rattana Buri
1605 Uthumphon Phisai
1611 K. Bung Boon



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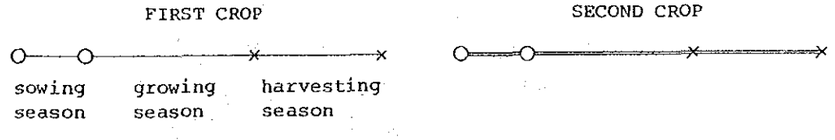


TABLE 26.2.1 CULTIVATED LAND

[UNIT : 1000 RAI (KM2)]

CHANGWAT NAME	AMPHOE NAME	CULTIVATED LAND PADDY FIELD	UPLAND FIELD	TOTAL
SURIN	RATTANABURI	29.82 (47.71)	0.00 (0.00)	29.82 (47.71)
SI SA KET	UTHUMPON PHISAI	75.25 (120.40)	2.25 (3.60)	77.50 (124.00)
	BUNG BOON	6.44 (10.30)	1.48 (2.37)	7.92 (12.67)
TOTAL		111.51 (178.42)	3.73 (5.97)	115.24 (184.38)

TABLE 26.2.2 CROP PRODUCTION

ITEM		RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
PLANTED AREA	(1000 RAI)												
BASE YEAR	(1983)	107.83	-	-	-	-	-	2.61	-	-	-	2.61	110.44
WITHOUT PROJECT	(1988)	107.83	-	-	-	-	-	2.61	-	-	-	2.61	110.44
	(1994)	107.83	-	-	-	-	-	2.61	-	-	-	2.61	110.44
	(2002)	107.83	-	-	-	-	-	2.61	-	-	-	2.61	110.44
WITH PROJECT	(1988)	107.83	-	-	-	-	-	2.65	-	-	-	2.65	110.48
	(1994)	107.83	-	-	-	-	-	2.87	-	-	-	2.87	110.70
	(2002)	107.83	-	-	-	-	-	3.21	-	-	-	3.21	111.04
CROP YIELD	(KG/RAI)												
BASE YEAR	(1983)	292.5	-	-	-	-	-	200.0	-	-	-		
WITHOUT PROJECT	(1988)	292.5	-	-	-	-	-	200.0	-	-	-		
	(1994)	292.5	-	-	-	-	-	200.0	-	-	-		
	(2002)	292.5	-	-	-	-	-	200.0	-	-	-		
WITH PROJECT	(1988)	293.2	-	-	-	-	-	200.0	-	-	-		
	(1994)	297.4	-	-	-	-	-	200.0	-	-	-		
	(2002)	303.0	-	-	-	-	-	200.0	-	-	-		
CROP PRODUCTION AMOUNT	(TON)												
BASE YEAR	(1983)	31,540	-	-	-	-	-	522	-	-	-	522	32,062
WITHOUT PROJECT	(1988)	31,540	-	-	-	-	-	522	-	-	-	522	32,062
	(1994)	31,540	-	-	-	-	-	522	-	-	-	522	32,062
	(2002)	31,540	-	-	-	-	-	522	-	-	-	522	32,062
WITH PROJECT	(1988)	31,615	-	-	-	-	-	529	-	-	-	529	32,144
	(1994)	32,064	-	-	-	-	-	575	-	-	-	575	32,639
	(2002)	32,672	-	-	-	-	-	642	-	-	-	642	33,314

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

TABLE 26.2.3 NET PRODUCTION VALUE

ITEM			RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
FARMGATE PRICE	(BAHT/TON)													
WITHOUT PROJECT	(1983 - 2002)		3,653	-	-	-	-	-	4,470	-	-	-		
WITH PROJECT	(1988 - 2002)		3,668	-	-	-	-	-	4,499	-	-	-		
CROP PRODUCTION COST	(BAHT/RAI)													
BASE YEAR		(1983)	700	-	-	-	-	-	790	-	-	-		
WITHOUT PROJECT		(1988)	700	-	-	-	-	-	790	-	-	-		
		(1994)	700	-	-	-	-	-	790	-	-	-		
		(2002)	700	-	-	-	-	-	790	-	-	-		
WITH PROJECT		(1988)	701	-	-	-	-	-	790	-	-	-		
		(1994)	709	-	-	-	-	-	790	-	-	-		
		(2002)	720	-	-	-	-	-	790	-	-	-		
NET PRODUCTION VALUE	(1000 BAHT)													
WITHOUT PROJECT		(1988)	39,736	-	-	-	-	-	271	-	-	-	271	40,007
		(1994)	39,736	-	-	-	-	-	271	-	-	-	271	40,007
		(2002)	39,736	-	-	-	-	-	271	-	-	-	271	40,007
WITH PROJECT		(1988)	40,373	-	-	-	-	-	290	-	-	-	290	40,663
		(1994)	41,159	-	-	-	-	-	316	-	-	-	316	41,475
		(2002)	42,205	-	-	-	-	-	352	-	-	-	352	42,557
NET VALUE ADDED	(1000 BAHT)													
1988			637	-	-	-	-	-	19	-	-	-	19	656
1994			1,423	-	-	-	-	-	45	-	-	-	45	1,468
2002			2,469	-	-	-	-	-	81	-	-	-	81	2,550

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

26.3 VOC SAVINGS

In accordance with the concept and data given in Section 3.4 of the Text Report, VOCs on the road link concerned were calculated in the two cases of "with and without project".

Road length by road class is shown in Table 26.3.1. Data for additional VOCs are shown in Table 26.3.2.

VOC savings, obtained as the balance of total link VOCs between the two cases, were calculated as shown in Table 26.3.3.

TABLE 26.3.1 ROAD LENGTH BY ROAD CLASS

(UNIT : KM)

LINK NO.	WITHOUT PROJECT CASE						WITH PROJECT CASE
	PAVED	LATERITE			EARTH	TOTAL	PAVED
		GOOD	FAIR	POOR			
1	-	-	1.1	17.0	-	18.1	18.1
2	-	-	4.3	6.0	-	10.3	10.3

TABLE 26.3.2 DATA FOR ADDITIONAL VOC COST

(UNIT OF LENGTH : M)

LINK NO.	CASE	CURVE									GRADE					VILLAGE		NO. OF INTER-SECTION	NO. OF TIMBER BRIDGE	NO. OF NARROW BRIDGE	NO. OF CORNER
		100	150	200	250	300	375	500	750	1500	1	2	3	4	5	NO.	LENGTH				
1	WITHOUT	-	-	-	-	-	-	-	705	2364	7600	-	100	-	-	3	900	6	-	-	-
	WITH	-	-	-	-	-	-	-	346	2364	7600	-	200	300	-	3	900	-	-	-	-
2	WITHOUT	-	-	-	-	402	-	287	136	-	2500	400	-	-	25	4	600	1	-	-	-
	WITH	-	-	-	-	402	-	287	136	-	2500	425	-	-	-	4	600	-	-	-	-

TABLE 26.3.3 VEHICLE OPERATING COST SAVING

(UNIT : 1000 BAHT)

LINK NO.	1988			1994			2002		
	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING
1	10,196	6,289	3,907	13,907	8,655	5,253	21,388	13,444	7,944
2	1,805	1,715	91	2,387	2,064	323	3,420	2,730	690
TOTAL	12,001	8,004	3,997	16,295	10,719	5,576	24,808	16,174	8,634

N O T E
(1) WITHOUT : WITHOUT PROJECT CASE
(2) WITH : WITH PROJECT CASE
(3) SAVING : VEHICLE OPERATING COST SAVING
(4) LINK NO. = 1 - 9 : PROPOSED LINK
(5) LINK NO. = 11 - 19 : SURROUNDING LINK

26.4 ENGINEERING

26.4.1 Soil and Materials

Existing subgrade soil and material sources in the vicinity of the study route investigated by DOH and their physical characteristics are shown in Figure 26.4.1 and Table 26.4.1, respectively.

Rock aggregate sources were assumed as shown below:

No.	Source	Description of Sample	Est. Quantity m^3
26/CS-1	KM. 13+400 Rt 2 KM. Surin-Prasat	Basalt	Plentiful
	KM. 14+450 Rt 2 KM. Surin-Prasat	Basalt	Plentiful
26/CS-2	KM. 14+450 Rt 2 KM. Surin-Prasat (Sirathanakit Quarry)	Basalt	Plentiful
26/CS-3	KM. 14+450 Rt 2.0 KM. Surin-Prasat	Basalt	Plentiful

FIGURE 26.4.1 SOIL AND MATERIAL SOURCES

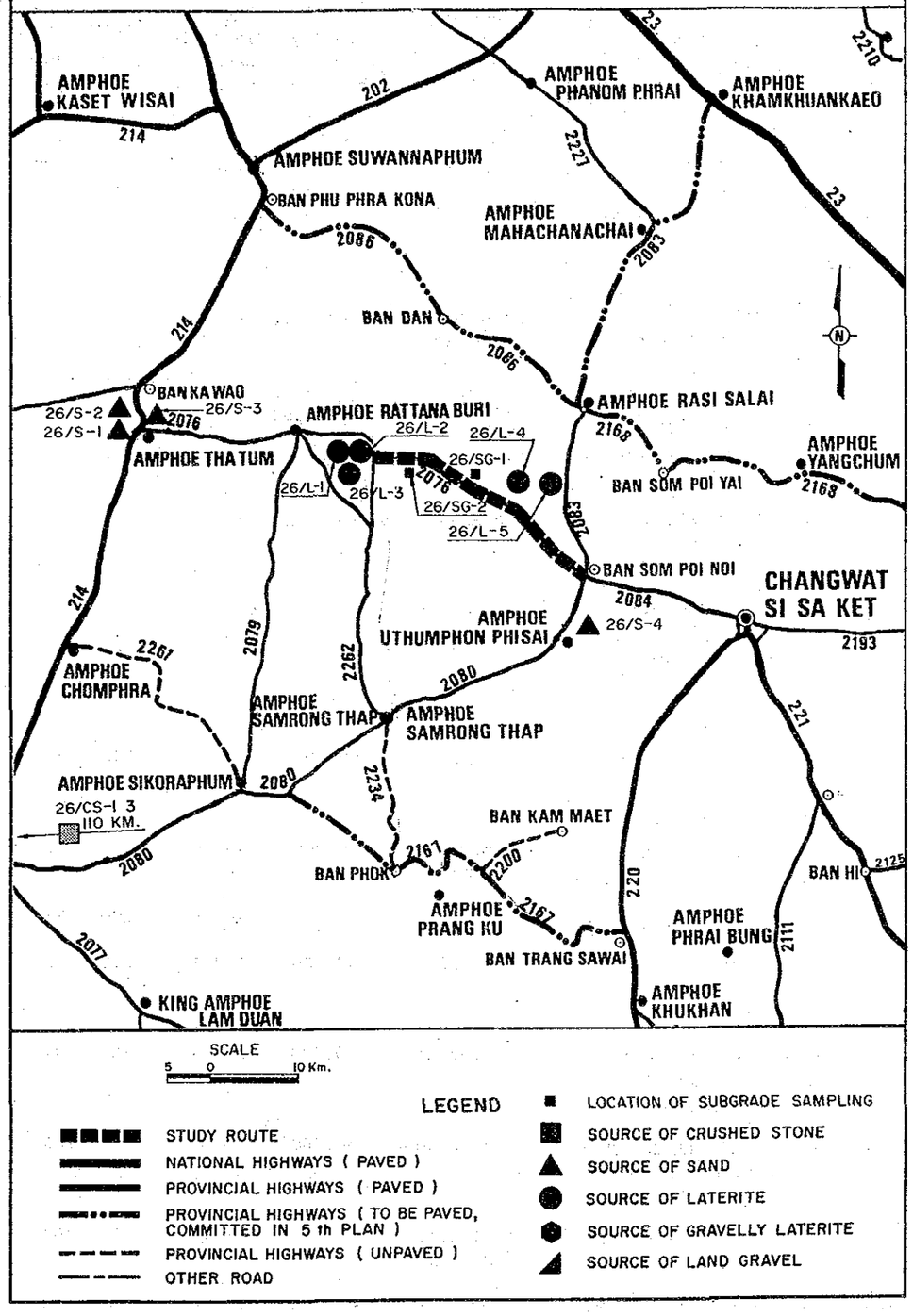


TABLE 26.4.1 PHYSICAL CHARACTERISTICS OF MATERIALS

No.	Source	Description of Sample	Est. Quantity m^3	AASHTO Classification	Sieve Analysis % Passing 50.0	25.0	19.0	9.5	#4	#10	#40	#200	Plasticity LL	PT	Comp. DH-T Stand. Opt. 95%	gm/cc	Lab. C.B.R. CBR 95%	Swell %	Durability Abr.	Dur.
SUBGRADE																				
26/SG-1.	KM. 19+600 Rt 12 M.			A-4						100	99.2	69.4	N-P		10.0	1.915	13.0	-		
26/SG-2.	KM. 24+800 Lt 15 M.			A-4					100	96.8	84.4	57.0	N-P		9.3	1.907	19.0	-		
SAND																				
26/S-1	KM. 2+700 Lt 300 M. Tha Tum - Suwan Na Phum	Huai Kudh Wien sand	Plentiful	A-3			100	99	98	66	2		N.P.							
26/S-2	KM. 53+000 Rt, Lt close to Surin - Tha Tum - Suwan Na Phum	Mun River sand	Plentiful												Less color than standard					
26/S-3	KM. 1+000 Lt, 1.5 KM. Tha Tum - Rattana Buri	Mun River sand	Plentiful	A-1-b					100	99	23	1	N.P.							
26/S-4	KM. 1+500 Rt 100 M. Uthumphon Phisai - Kam Kern Kaew	Mun River sand								100	54	1	N.P.		Same as standard color					
LATERITE																				
26/L-1	KM. 17+100 Rt 1 KM. Rattana Buri - Sri Saket	Red laterite	100,000	A-2-4	100	97	94	81	55	43	39	28	26.2	5.0					62.4	60.6
	KM. 1+100 Lt 1 KM. Tha Tum - Rattana Buri	Mun River sand	5,000	A-1-b				100	99	95	11	1	N.P.							
	L1:S1 = 3:2 by weight			A-2-4	100	98	96	89	73	67	27	17	N.P.		9.5	2.143	16.4	0.89		
26/L-2	KM. 30+000 Rt 5 KM. Sam Rong Tap - Rattana Buri	Laterite	100,000	A-2-4	100	96	91	63	46	38	30	18	27.3	8.6	6.8	2.229	30.5	0.04	43.2	63.3
26/L-3	KM. 30+000 Rt 3 KM. Sam Rong Tap - Rattana Buri	Laterite	150,000	A-2-4	100	97	96	83	65	57	47	31	N.P.						72.5	60.0
26/L-4	KM. 16+800 Lt 16 KM. Uthumphon Phisai - Kam Kern Kaew	Laterite	30,000			100	98	88	57	39	34	28	29.6	17.1					65.2	29.5
	L3:S1 = 3:2 by weight	Laterite and sand				100	99	91	69	56	39	19	17.0	10.0	10.4	2.122	63.9	-		
26/L-5	KM. 16+800 Lt 7.5 KM. Uthumphon Phisai - Kam Kern Kaew	Laterite	52,500	A-2-b	100	96	90	76	66	61	43	19	23.2	11.0	7.6	2.218	12.0	0.10	34.0	48.8

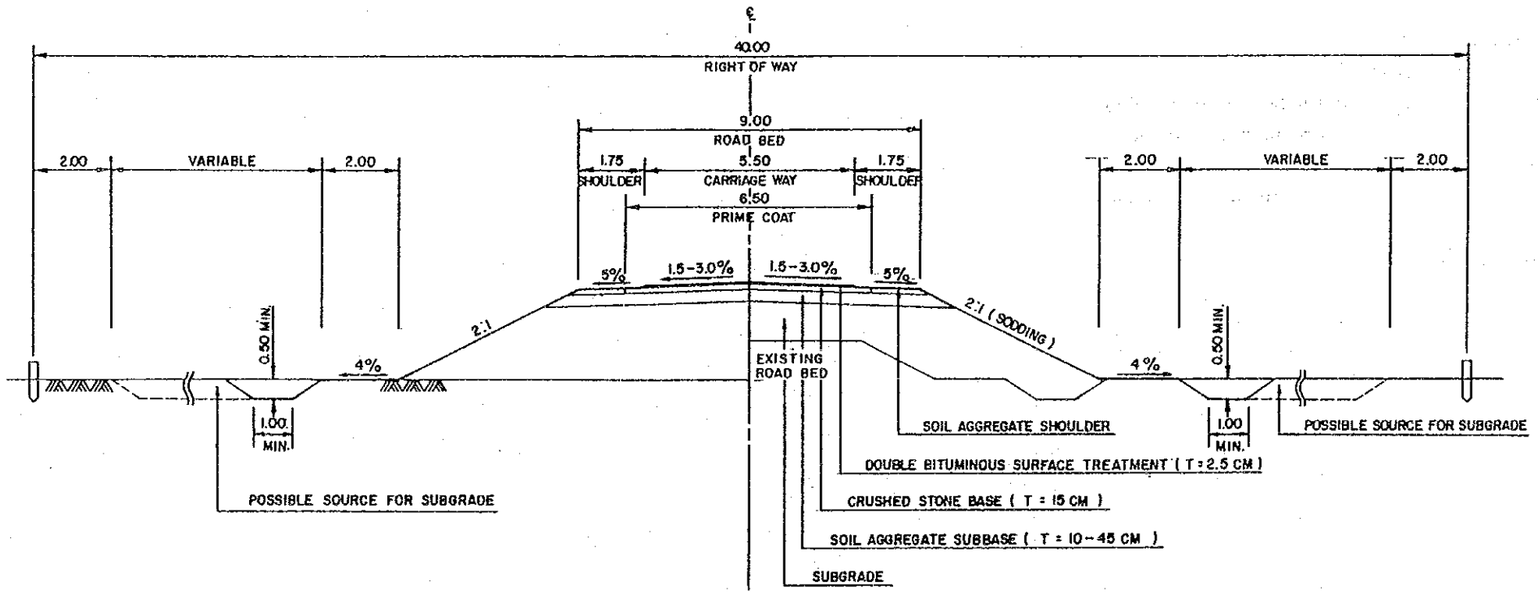
26.4.2 Preliminary Design

26.4.2.1 Design Criteria

Design Standard		: F4
Geometric Design Criteria		: DOH (Provincial Highway)
Typical Cross Section		: as shown in Figure 26.4.2
Minimum Height of Embankment in Flooding Section		: 0.7 m above flood level
Pavement Structure		
DBST		: 2.5 cm
Crushed Aggregate Base	CBR≥ 80%	: 15.0 cm
Soil Aggregate Subbase	CBR≥ 25%	: 10.0 cm (minimum requirement)
Selected Materials	CBR≥ 6%	: as required
Pipe Culvert		
Standardized type		: 80, 100, 120 & 150 cm in diameter
Location		: as required
Standard intervals		
Paddy area		: 200 m
Others		: 500 m
Box Culvert		
Standard size		: 1.5×1.5, 2.4×2.4 & 3.0×3.0 m
Location		: as required
Bridge		
Reinforced concrete standard type		: Width 9.0 m
Substructure		: Pile-bent type

The existing and designed plan and profile are shown in Drawings 26-1/26-4.

FIGURE 26.4.2 TYPICAL CROSS SECTION



PROVINCIAL HIGHWAY (CLASS F4)

26.4.2.3 Pavement Design

1) Cumulative number of ESA in one direction

- ESA conversion factors

Heavy bus	:	0.50
Medium truck	:	0.76
Heavy truck	:	1.24

- Forecasted ADT by vehicle type

Year	1988				1994			
Traffic/road link	1	2	3	4	1	2	3	4
Heavy bus	5	4	—	—	13	6	—	—
Medium truck	37	13	—	—	56	18	—	—
Heavy truck	30	8	—	—	38	11	—	—

- Cumulative number of ESA in one direction by road link

Road link	1	2	3	4
7 years (10^6)	0.105	0.033	-	-

2) Design CBR values

Road link	1	2	3	4
Design CBR (%)	9.8	15.5	-	-

3) Required thickness of pavement

Surfacing	:	DBST (2.5 cm)
Aggregate base	:	15 cm (CBR not less than 25%)
Subbase	:	Minimum requirement 10 cm

Road link	1	2	3	4
	10 cm	10 cm	-	-

4) Overlay required in 7 years

DBST resurfacing

26.4.2.4 Drainage and Structures

The locations of existing and designed RC box culverts and RC bridges and their dimensions are shown below:

STATION	EXISTING STRUCTURES		PROPOSED STRUCTURES	
	TYPE	SIZE	TYPE	SIZE
4 + 263	Box Culvert	3-1.8 x 1.8 x 8.0	Extd.	10.0 m
5 + 605	" "	3-1.8 x 1.5 x 9.0	Extd.	9.0 m
6 + 189	" "	3-1.8 x 1.8 x 10.0	Extd.	8.0 m
10 + 380	RC Bridge	8.0 x 22.0	-	-
16 + 272	" "	8.0 x 18.0	-	-
21 + 537	" "	8.0 x 130.0	-	-

26.4.3 Quantities and Construction and Road Maintenance Costs

The required construction costs were estimated based on the results of the preliminary design as shown in Table 26.4.2. Financial costs with breakdown into local and foreign currency portions, economic costs and residual values were estimated as follows and in 26.4.4:

IM—26 L=28.4 km (baht)

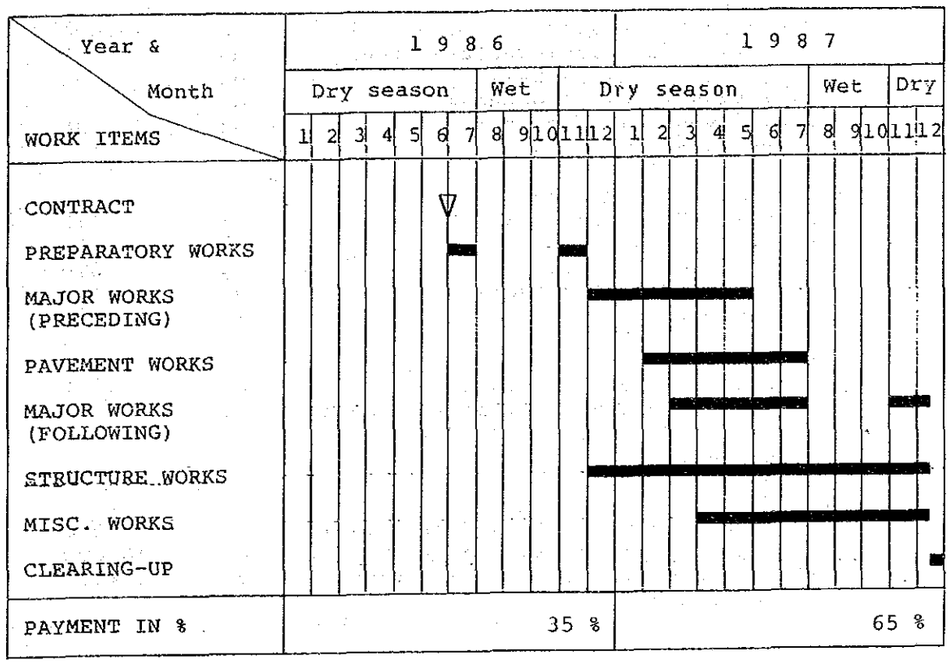
Financial cost	:	47,336,000
Economic cost	:	39,558,000
Residual value	:	16,175,000

The required road maintenance cost savings are shown in Table 26.4.3.

26.4.4 Construction and Disbursement Schedules

IM—26 **Length = 28.4 km**

Construction Schedule
Assumption: Completion date December 31, 1987



Yearly Disbursement Schedule
Assumption: Annual rise in prices

Year / Currency	Base year 1984	(1985)	1986	1987
Local	100	110.0	121.0	133.1
Foreign	100	106.5	113.4	120.8

LOCAL AND FOREIGN COMPONENTS OF CONSTRUCTION COST

(Route IM - 26)

(Unit : Million Baht)

	1986			1987			Total		
	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Construction Cost	8.1	8.3	16.4	15.3	15.6	30.9	23.4	23.9	47.3
Price Contingency	1.7	1.1	2.8	5.1	3.2	8.3	6.8	4.3	11.1
Total	9.8	9.4	19.2	20.4	18.8	39.2	30.2	28.2	58.4
	(0.36)	(0.35)	(0.71)	(0.76)	(0.70)	(1.45)	(1.12)	(1.04)	(2.16)

Remarks : L/C : Local Currency Portion
F/C : Foreign Currency Portion
( ) : US$ Equivalent (US$ 1 = 27 Baht)

TABLE 26.4.2 CONSTRUCTION QUANTITIES AND COSTS
(ROUTE IM—26 Length = 28.4 km)

DBST

Item	Unit	Financial Unit Rate B	Quantity	Financial Cost 1000 B			Economic Cost		Residual Value	
				Total	Local	Foreign	%	1000 B	%	1000 B
EARTHWORK							83		90	
Clearing & Grubbing	ha	10,000	69	690						
Roadway Excavation, Unclassified	m3	19	2,800	53						
Embankment, Common Soil	m3	38	208,400	7,919						
Embankment, Selected Material	m3	70	0	0						
Replacement of Soft Spot	m3	88	3,600	317						
Sub Total				8,979	4,579	4,400		7,453		6,707
SUBBASE & BASE COURSES							83		50	
Subbase, Soil Aggregate	m3	112	26,700	2,990						
Aggregate Base*	m3	372	27,600	10,267						
Cement Stabilized Base	m3	390	0	0						
Shoulder, Soil Aggregate	m3	120	10,700	1,284						
Sub Total				14,542	7,852	6,689		12,070		6,035
SURFACE COURSES							85		50**	
Asphaltic Prime/Tack Coat	m2	12	184,700	2,216						
Double Bituminous Surface Treatment*	m2	39	156,300	6,096						
Asphaltic Concrete Surfacing**	t	750	0	0						
Sub Total				8,312	3,657	4,655		7,065		0
STRUCTURES							83		50	
RC Pipe Culvert (D 1.0m Equivalent)	m	2,000	1,603	3,206						
RC Box Culvert (2.4mx2.4m Equivalent)	m	18,800	81	1,523						
RC Bridge(W=9.0m L=10m Equivalent)	m	46,500	0	0						
Sub Total				4,729	2,364	2,364		3,925		1,962
Total (a)				36,562	18,454	18,108		30,512		14,705
INCIDENTALS							83		0	
Miscellaneous Work ((a)x7%)	ls			2,559	1,280	1,280		2,124		0
CONTRACT AMOUNT (b)				39,121	19,733	19,388		32,637		14,705
PHYSICAL CONTINGENCIES ((b)x10%) (c)	ls			3,912	1,973	1,939		3,264		1,470
ENGINEERING AND SUPERVISION							85		0	
(((b)+(c))x10%) (d)	ls			4,303	1,721	2,582		3,658		0
LAND ACQUISITION							100		100	
Highly Developed Land	ha	50,000	0	0						
Less Developed Land	ha	15,000	0	0						
Sub Total (e)	ls			0	0	0		0		0
PROJECT COST ((b)+(c)+(d)+(e))				47,336	23,428	23,909		39,558		16,175
AVERAGE COST PER KM				1,667						

Note : * The unit prices are modified by aggregate haulage distance
** Rate is applied only for Asphaltic Concrete Surfacing

TABLE 26.4.3 ROAD MAINTENANCE COST SAVING

LINK NO.	YEAR	WITHOUT PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <A1>	ROAD CHARA. FACTOR <KA>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	WITH PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <X3>	ROAD CHARA. FACTOR <KB>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	ROAD MAINTE. COST SAVING (1000 BAHT)
1	1988	225.7	18.1	0.36	1.29	13,619	247	256.4	18.1	0.00	1.14	12,793	232	15
	1994	329.9	18.1	0.60	1.46	15,402	279	374.7	18.1	0.00	1.14	12,793	232	47
	2002	558.9	18.1	0.95	1.71	17,966	325	628.6	18.1	0.00	1.14	12,793	232	94
2	1988	83.3	10.3	0.03	1.06	11,183	115	113.7	10.3	0.00	1.14	12,793	132	-17
	1994	111.0	10.3	0.09	1.11	11,657	120	134.5	10.3	0.00	1.14	12,793	132	-12
	2002	163.1	10.3	0.22	1.19	12,548	129	175.8	10.3	0.00	1.14	12,793	132	-3
TOTAL	1988	174.1	28.4			12,735	362	204.7	28.4			12,793	363	-2
	1994	250.5	28.4			14,044	399	287.6	28.4			12,793	363	36
	2002	415.4	28.4			16,001	454	464.4	28.4			12,793	363	91

NOTE (1) TOTAL MAINTENANCE COST $T = U * L$

(2) UNIT MAINTENANCE COST $U = M * (KA \text{ or } KB) * FA * (1 + FR) * FE$

M ; SPECIFIED MAINTENANCE COST
WITHOUT PROJECT CASE M = 7,700 BAHT/KM
WITH PROJECT CASE M = 8,200 BAHT/KM

FA = 1.40 ADMINISTRATION FACTOR FOR DIRECT LABOUR OPERATION BY DOH
FR = 0.15 EMERGENCY REHABILITATION COST FACTOR
FE = 0.85 ECONOMIC MAINTENANCE COST FACTOR TO FINANCIAL MAINTENANCE COST

(3) ROAD CHARACTERISTIC FACTOR
WITHOUT PROJECT CASE $KA = 1.04 + 0.70 * A1$
WITH PROJECT CASE $KB = 1.14 + 0.05 * X3$

(4) FACTOR FOR ADT
WITHOUT PROJECT CASE $A1 = -0.1630 + 0.002320 * ADT$
WITH PROJECT CASE $X3 = -0.2034 + 0.000409 * (ADT / LANE)$; LANE = 2

26.5 EVALUATION

26.5.1 Economic Evaluation

The yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in the table below.

The results indicate that the improvement of this study route is feasible by employing the F4 standard with DBST surfacing.

COST AND BENEFIT STATEMENT OF ROUTE IM - 26

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	TOTAL COST	TOTAL BENEFIT
1986	13,845	0	0	0	0	17,367	0
1987	25,713	0	0	0	0	28,799	0
1988	0	656	3,997	-2	4,652	0	4,153
1989	0	791	4,260	5	5,056	0	4,031
1990	0	927	4,523	11	5,461	0	3,887
1991	0	1,062	4,786	17	5,865	0	3,728
1992	0	1,197	5,049	23	6,270	0	3,558
1993	0	1,333	5,313	29	6,675	0	3,382
1994	0	1,468	5,576	36	7,079	0	3,202
1995	10,223	1,603	5,958	42	7,604	4,624	3,071
1996	0	1,739	6,340	49	8,128	0	2,931
1997	0	1,874	6,723	56	8,653	0	2,786
1998	0	2,009	7,105	63	9,177	0	2,638
1999	0	2,144	7,487	70	9,702	0	2,490
2000	0	2,280	7,869	77	10,226	0	2,344
2001	0	2,415	8,252	84	10,751	0	2,200
2002	-16,175	2,550	8,634	91	11,275	-2,955	2,060
TOTAL	33,606	24,047	91,873	653	116,573	47,835	46,460
DISCOUNTED	47,835	9,058	37,196	206	46,460		

NET PRESENT VALUE : -1,375

BENEFIT/COST RATIO : 0.97

INTERNAL RATE OF RETURN : 11.6 %

FIRST YEAR RATE OF RETURN : 9.0 %

OPTIMUM OPENING YEAR : 1990

SENSITIVITY TESTS

ITEM	CASE		
	BASE	1	2
NET PRESENT VALUE	-1,375	-8,551	-8,344
BENEFIT/COST RATIO	0.97	0.84	0.83
INTERNAL RATE OF RETURN	11.6 %	9.9 %	9.6 %
FIRST YEAR RATE OF RETURN	9.0 %	7.8 %	7.6 %
COSTS	BASE	+15%	BASE
BENEFITS	BASE	BASE	-15%

26.5.2 Social Impact

The social impact brought about by the improvement of the Study Route is shown in the following social benefit indicators:

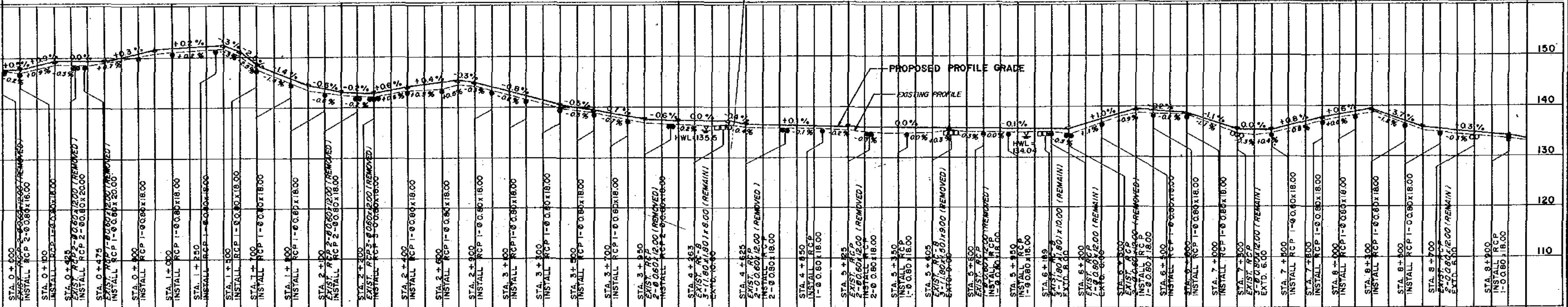
Construction Cost (million baht)	:	39.6
1) General Accessibility Benefit (million baht)	:	3.04
2) Education Benefit (million baht)	:	4.06
3) Medical Care Benefit (million baht)	:	0.070
4) Total Social Benefits (million baht) (1+2+3)	:	7.17
5) Social Benefit/Cost Ratio ($\times 10^{-2}$)	:	18.13
6) Ranking by Social Benefits	:	3
7) Weighted Production Value Gain/Cost ($\times 10^{-2}$)	:	4.22
8) Ranking by 7	:	13
9) Combined Ratio ($\times 10^{-2}$)	:	22.35
Overall Ranking	:	8

26.5.3 Overall Evaluation

It is concluded that, considering the overall ranking and possible schedule of the improvement of the study routes with due consideration to the prevailing opportunity cost of capital, the improvement of this study route with the opening year 1990 is recommended.

STUDY ROUTE IM-26	DWG. NO.
From B. SOM POI NOI To B. MUANG MAK	26-1
PLAN AND PROFILE	
STA 0+000 TO STA 9+000	

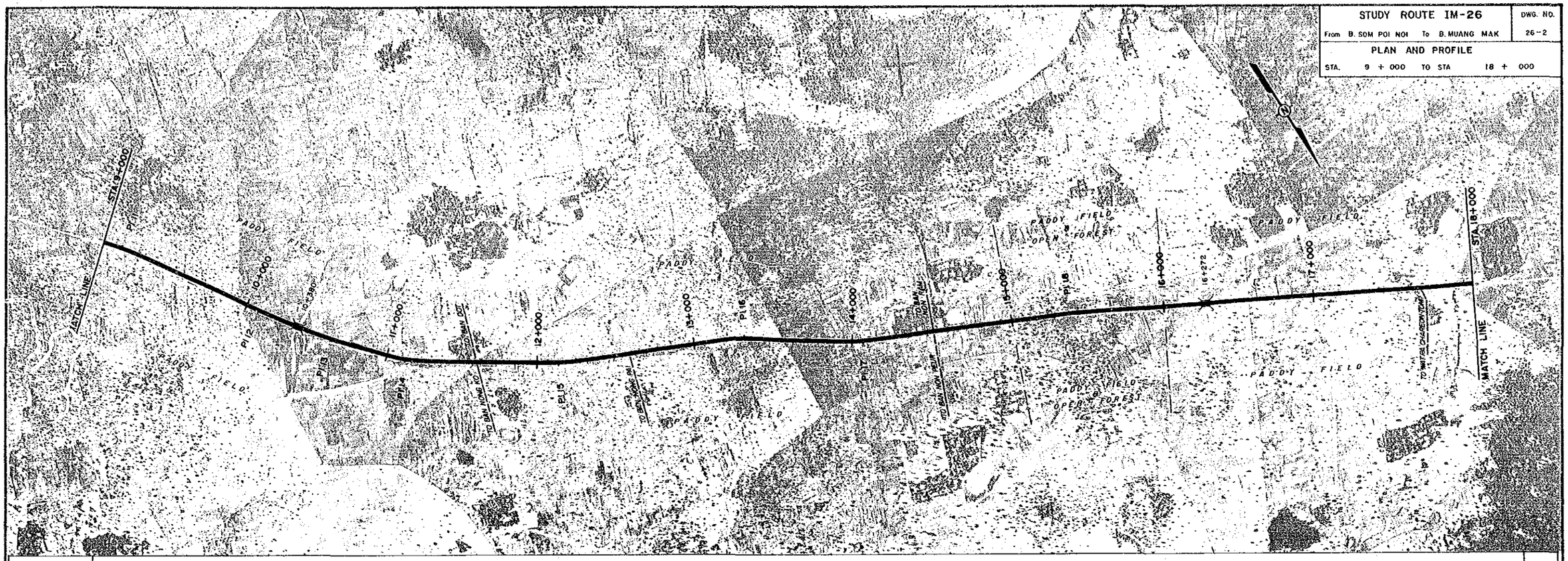
TERRAIN		FLAT
PAVEM'T	Type	LATERITE
	Condition	POOR
FLOODING	Length (m.) Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2076



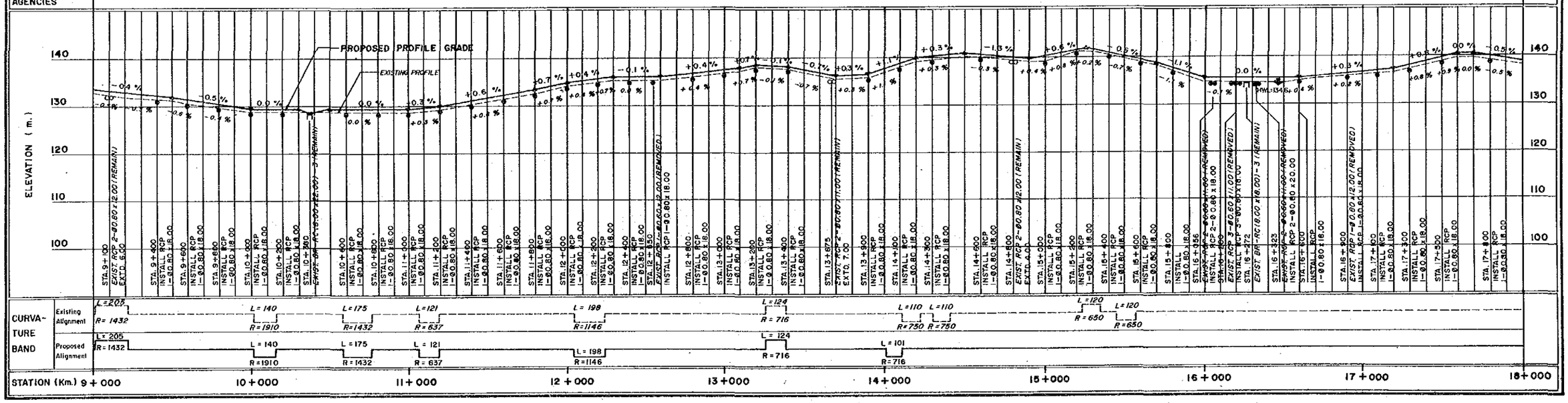
CURVATURE BAND	Existing Alignment	L = 583 R = 3820	L = 145 R = 1146	L = 279 R = 1146	L = 129 R = 1146	L = 268 R = 2865	L = 215 R = 2865
	Proposed Alignment	L = 583 R = 3820	L = 145 R = 1146	L = 279 R = 1146	L = 129 R = 1146	L = 268 R = 2865	L = 215 R = 2865

STATION (Km.) 0+000 1+000 2+000 3+000 4+000 5+000 6+000 7+000 8+000 9+000

STUDY ROUTE IM-26	DWG. NO.
From B. SOM POI NOI To B. MUANG MAK	26-2
PLAN AND PROFILE	
STA. 9 + 000 TO STA 18 + 000	



TERRAIN		FLAT
PAVEMENT	Type	LATERITE
	Condition	POOR / FAIR
FLOODING	Length (m.) / Height (m.)	600 / 0.20
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2076



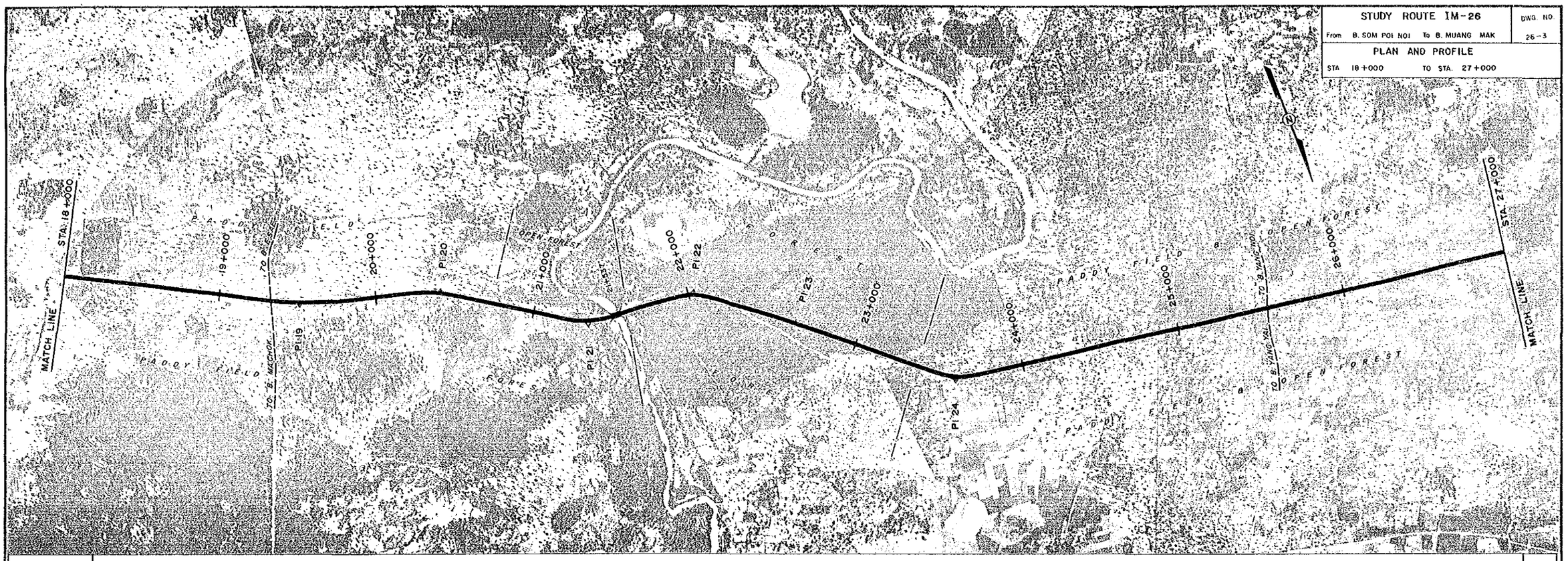
STUDY ROUTE IM-26

From B. SOM POI NOI To B. MUANG MAK

DWG. NO. 26-3

PLAN AND PROFILE

STA 18+000 TO STA. 27+000



TERRAIN		FLAT
PAVEM'T	Type	LATERITE
	Condition	FAIR / POOR / FAIR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2076

ELEVATION (m.): 140, 130, 120, 110, 100

PROPOSED PROFILE GRADE

EXISTING PROFILE

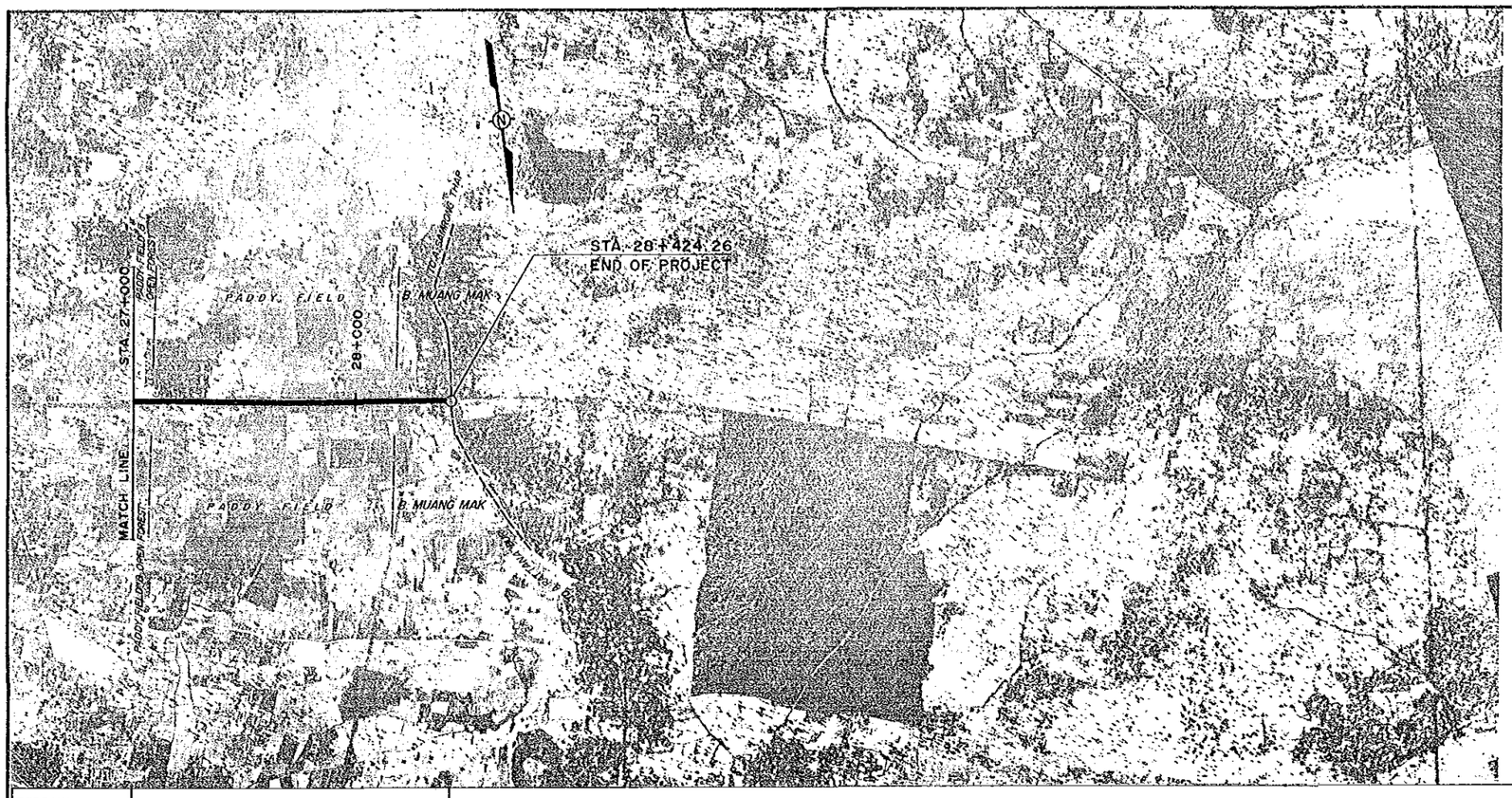
HWL =122.0

HWL =123.0

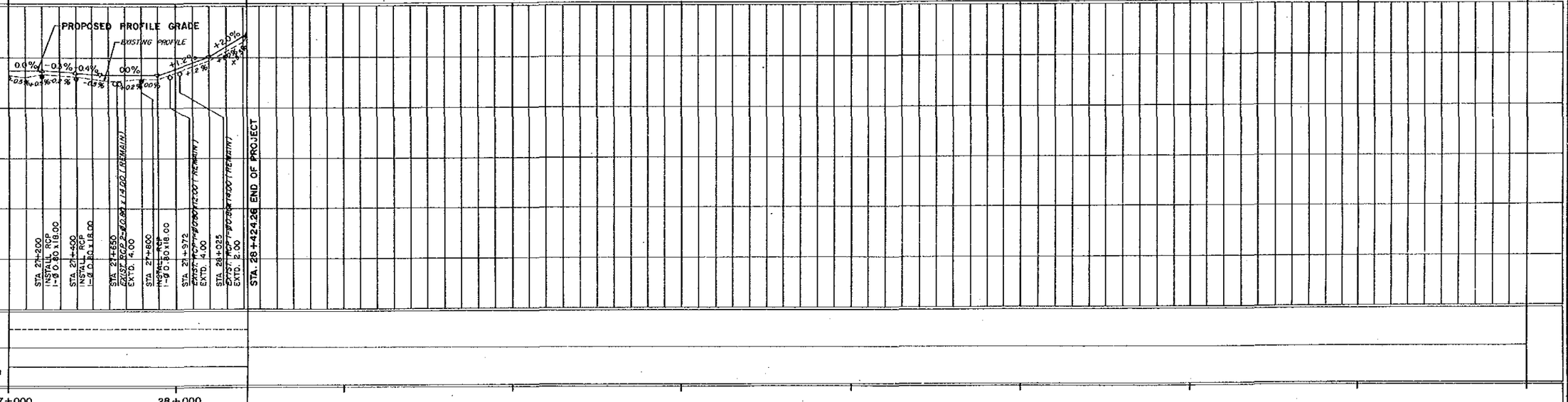
CURVATURE BAND	
Existing Alignment	L=136 R=716; L=137 R=573; L=109 R=286; L=123 R=286; L=150 R=573; L=170 R=286
Proposed Alignment	L=136 R=716; L=137 R=573; L=109 R=286; L=123 R=286; L=150 R=573; L=170 R=286

STATION (Km.) 18+000 19+000 20+000 21+000 22+000 23+000 24+000 25+000 26+000 27+000

STUDY ROUTE IM-26	DWG. NO.
From B. SOM POI NOI To B. MUANG MAK	26-4
PLAN AND PROFILE	
STA 27+000 TO STA 28+424.26	



TERRAIN		FLAT
PAVEM'T	Type	LATERITE
	Condition	FAIR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2076
CURVATURE BAND	Existing Alignment	
	Proposed Alignment	
STATION (Km.)		27+000 28+000



STUDY ROUTE NO. IM - 27

Changwat : Surin / Buri Ram

A. Chom Phra (J.R. 214) - B. Nong Khawao (J.R. 2079)

Length : 31.1 KM.

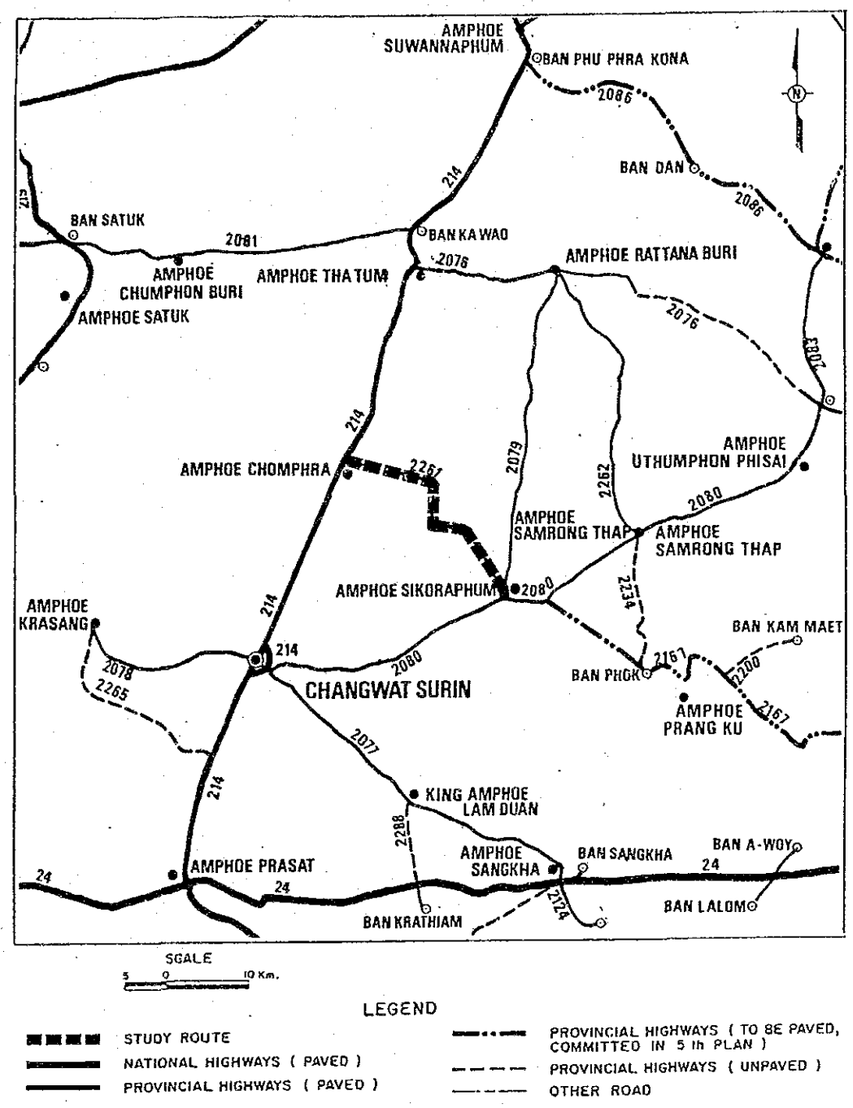
TABLE OF CONTENTS

SUMMARY

STUDY ROUTE IM-27

General		
Changwat	:	Surin/Buri Ram
Origin and Destination	:	A. Chom Phra—B. Nong Khawao
Connected Road Network	:	2079—214
Amphoe on Route	:	-
Number of Related Villages	:	10
Influence Area		
Area	:	215 km^2
Cultivated Area Ratio to Total Land Area in %	:	93
Population in 1983	:	37,400
Main Crops	:	Paddy & Beans
Number of Public Activities		
Public Health Service Centers	:	-
Hospitals Changwat Level	:	-
Amphoe Level	:	2
Schools Primary	:	6
Secondary	:	2
Traffic (ADT)	:	1984—159 1988—294 1994—380 2002—577
Nomenclature of Study Route		
Total Length	:	31.1 km
Improvement Section	:	31.1 km
DOH Road	:	31.1 km
ARD Road	:	-
Other Road	:	-
New Construction Section	:	-
Design Standard Employed	:	F4
Construction Cost in Baht		
Financial	:	50,333,000
Economic	:	42,064,000
Economic Indicators		
IRR	:	8.8% Ranking: 15
Social Impact		
Social B/C Ratio	:	0.273 Ranking: 4
Recommendations		
Opening Year	:	1993 Overall Ranking: 15

LOCATION OF STUDY ROUTE

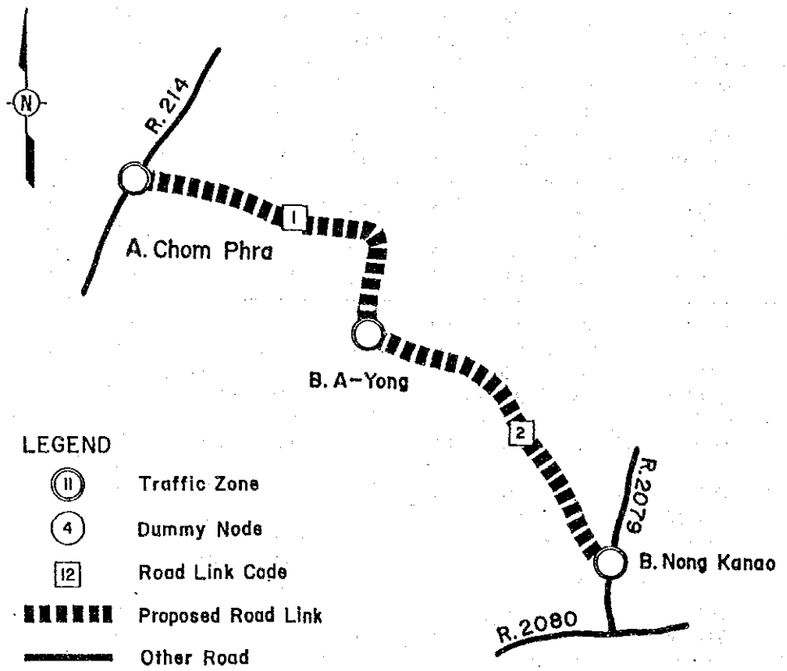


27.1 TRAFFIC

27.1.1 Method Employed in Traffic Forecasting

The growth rate method was employed in forecasting traffic because no diverted traffic after improvement was expected on this study route.

27.1.2 Assumed Road Link



27.1.3 Traffic Forecast

1) Items necessary for forecasting traffic were:
   - Traffic volume in base year
   - Passenger and freight movement in base year
   - Growth rates of passenger and freight movement
   - Rate of induced and developed movement
   - Traffic composition

TRAFFIC VOLUME IN BASE YEAR

LINK	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1	20	7	30	4	38	16	29	18	162	96	258
2	21	13	16	8	40	13	27	18	156	200	356
AVE.	21	10	23	6	39	14	28	18	159	149	307

PASSENGER AND FREIGHT MOVEMENT IN BASE YEAR

PROPOSED ROAD LINK	PASSENGER MOVEMENT (TRIPS PER DAY)	FREIGHT MOVEMENT (TONNAGE PER DAY)		
		NON-AGRI.	AGRI.	TOTAL
1	1082	150.2	59.5	209.7
2	994	144.4	57.2	201.7

GROWTH RATE OF PASSENGER MOVEMENT

(UNIT : % P.A.)

YEAR	PER CAPITA INCOME	POPULATION	PASSENGER MOVEMENT
1984 - 1988	3.1	1.4	5.8
1988 - 1994	3.1	1.2	5.6
1994 - 2002	3.1	1.0	5.5

GROWTH RATE OF FREIGHT MOVEMENT

(UNIT : % P.A.)

YEAR	NON-AGRI. FREIGHT	AGRI. FREIGHT	FREIGHT MOVEMENT
1984 - 1988	7.2	0.1	5.3
1988 - 1994	7.0	0.1	5.6
1994 - 2002	6.8	0.1	5.9

RATE OF INDUCED AND DEVELOPED MOVEMENT

(UNIT : %)

YEAR	INDUCED LINK 1	INDUCED LINK 2	DEVELOPED PASSENGER MOVEMENT	DEVELOPED NON-AGRI. FREIGHT MOVEMENT	DEVELOPED AGRI. FREIGHT MOVEMENT
1988	15.0	15.0	0.0	0.0	0.5
1994	15.0	15.0	0.0	0.0	3.2
2002	15.0	15.0	0.0	0.0	7.0

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER P/C	P/P	L/B	M/B	H/B	FREIGHT P/T	4/T	6/T	10/T
	1984	26.4	41.0	5.6	23.8	3.2	10.0	22.9	41.4	25.7
1	1988	29.2	40.3	5.0	21.4	4.0	10.7	20.2	43.3	25.8
	1994	33.4	39.3	4.1	17.8	5.3	11.7	16.3	46.2	25.9
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0
	1984	27.4	44.4	9.9	12.2	6.1	9.4	20.3	42.2	28.1
2	1988	30.0	43.0	8.4	12.4	6.3	10.2	18.2	43.9	27.7
	1994	33.8	40.8	6.1	12.6	6.6	11.4	15.1	46.5	26.9
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0

2) The following were output:
- Forecasted ADT
- Traffic volumes

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T	ADT	M/C	TOTAL
1988	50	11	28	9	80	18	41	25	262	308	570
1994	79	12	36	14	110	21	61	35	368	357	724
2002	144	11	48	26	167	23	104	54	577	422	999

TRAFFIC VOLUME ON ROUTE IM- 27 LINK COUNT= 2

	YEAR	1988 1	1988 2	1988 AVR.	1994 1	1994 2	1994 AVR.	2002 1	2002 2	2002 AVR.
	N+D	43	44	43	70	68	69	131	120	125
P/C	I	6	7	6	10	10	10	20	18	19
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	49	50	50	80	78	79	150	138	144
	N+D	7	12	10	9	12	10	10	9	10
L/B	I	1	2	1	1	2	2	2	1	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	8	14	11	10	14	12	12	11	11
	N+D	31	18	25	37	25	31	44	40	42
M/B	I	5	3	4	6	4	5	7	6	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	36	21	28	43	29	36	50	46	48
	N+D	6	9	8	11	13	12	23	22	23
H/B	I	1	1	1	2	2	2	4	3	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	7	11	9	13	15	14	27	25	26
	N+D	68	70	69	96	95	95	151	140	145
P/P&T	I	10	11	10	14	14	14	23	21	22
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	78	81	80	111	109	110	174	161	167
	N+D	17	14	16	19	17	18	20	19	20
4/T	I	3	2	2	3	3	3	3	3	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	20	17	18	22	19	21	23	22	23
	N+D	37	35	36	54	51	53	91	88	89
6/T	I	6	5	5	8	8	8	14	13	13
	DV	0	0	0	0	0	0	1	1	1
	TOTAL	43	40	41	63	59	61	106	102	104
	N+D	22	22	22	30	30	30	47	46	46
10/T	I	3	3	3	5	4	5	7	7	7
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	25	25	25	35	34	35	55	53	54
	N+D	232	224	228	327	312	319	518	484	500
ADT	I	35	34	34	49	47	48	78	73	75
	DV	0	0	0	1	1	1	2	2	2
	TOTAL	266	258	262	376	359	368	597	558	577
	N+D	289	285	287	339	333	336	406	396	401
M/C	I	20	20	20	20	20	20	20	20	20
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	310	305	308	360	353	357	427	417	422
	N+D	521	509	515	666	645	655	924	880	902
TOTAL	I	55	54	54	69	67	68	98	93	95
	DV	0	0	0	1	1	1	2	2	2
	TOTAL	576	563	570	736	713	724	1024	975	999

NOTE
N : NORMAL TRAFFIC D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC I : INDUCED TRAFFIC

27.2 AGRICULTURAL DEVELOPMENT

27.2.1 Present Condition

Almost all of the cultivated land in the influence area is covered by paddy fields. Beans, maize and kenaf were planted in upland fields in the 1983 crop year.

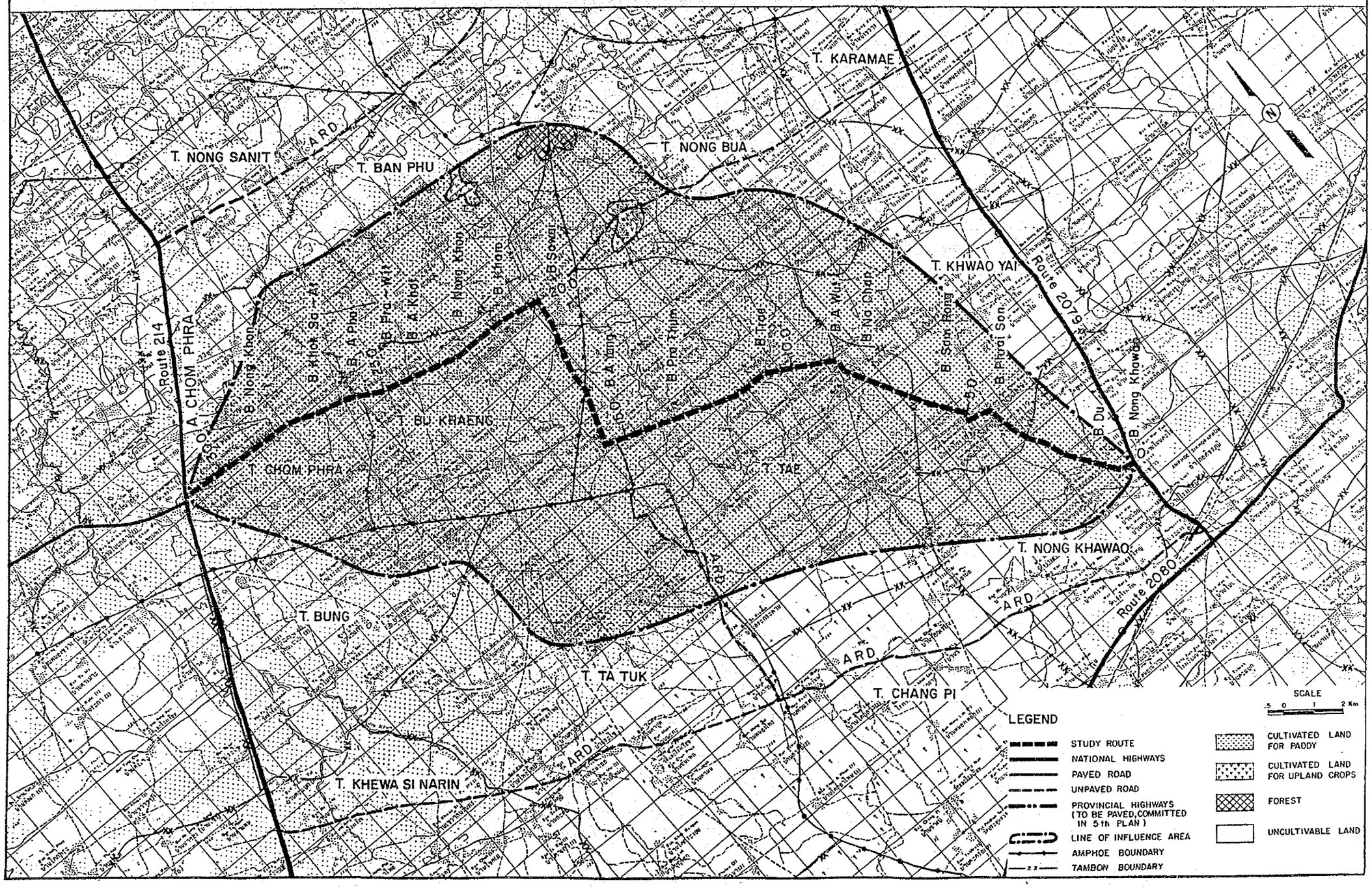
Land use and capability conditions in the area are shown in Table 27.2.1 and Figure 27.2.1. A typical cropping calendar in the area is shown in Figure 27.2.2.

27.2.2 Development Projection

Future agricultural development in the area of influence was projected for the two cases of "with and without project". The projected planted area, unit yields by crop, and the consequent production amount are shown in Table 27.2.2.

Based on the above projected production amount, farmgate prices and production costs estimated separately, net production value (NPV) was obtained as shown in Table 27.2.3. The difference in NPV between the two cases is deemed to be the development benefit of the study route.

FIGURE 27.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA STUDY ROUTE NO. IM-27

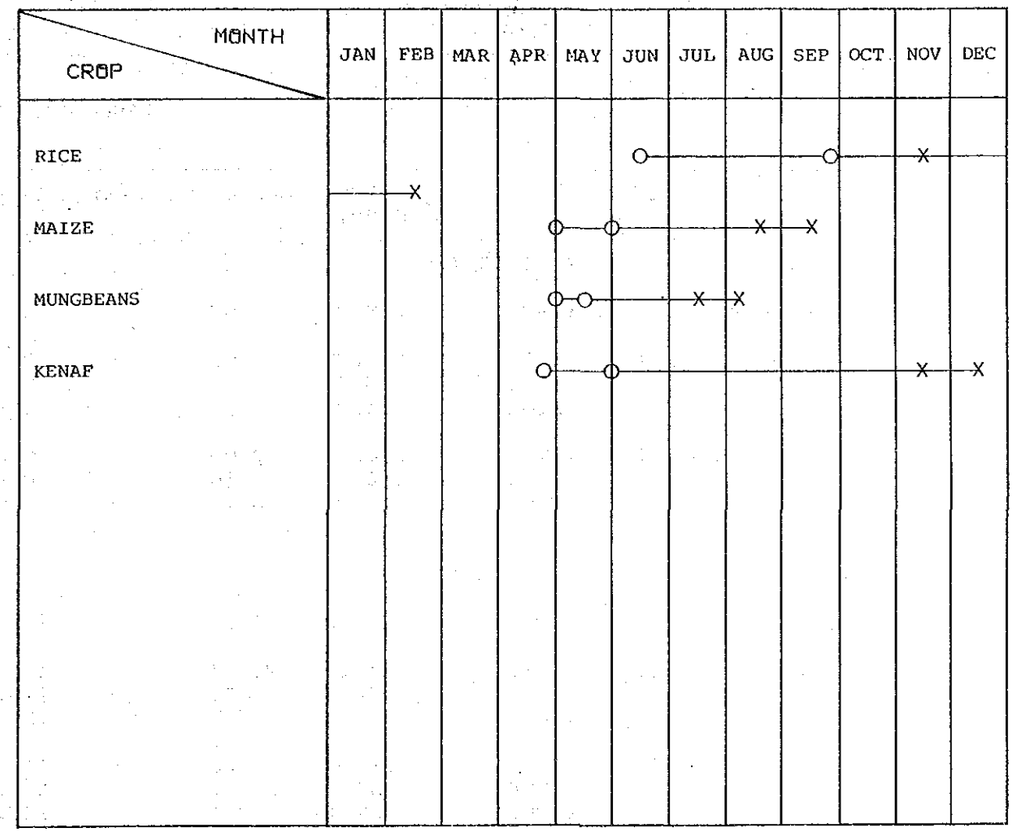


27-7 27-8

FIGURE 27.2.2 CROPPING CALENDAR

ROUTE IM-27

Related Amphoes: 1501 M. Surin
1504 Chom Phra
1508 Sikoraphum



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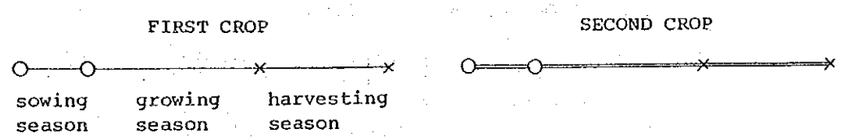


TABLE 27.2.1 CULTIVATED LAND

[UNIT : 1000 RAI (KM2)]

CHANGWAT NAME	AMPHOE NAME	CULTIVATED LAND		
		PADDY FIELD	UPLAND FIELD	TOTAL
SURIN	M. SURIN	12.94 (20.70)	0.00 (0.00)	12.94 (20.70)
	CHOM PHRA	46.94 (75.10)	0.25 (0.40)	47.19 (75.50)
	SIKHORAPHUM	62.69 (100.30)	0.75 (1.20)	63.44 (101.50)
TOTAL		122.57 (196.11)	1.00 (1.60)	123.57 (197.71)

TABLE 27.2.2 CROP PRODUCTION

ITEM		RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
PLANTED AREA	(1000 RAI)												
BASE YEAR	(1983)	115.22	0.07	-	0.30	-	-	0.02	-	-	-	0.39	115.61
WITHOUT PROJECT	(1988)	115.22	0.08	-	0.34	-	-	0.02	-	-	-	0.44	115.66
	(1994)	115.22	0.09	-	0.38	-	-	0.03	-	-	-	0.50	115.72
	(2002)	115.22	0.11	-	0.46	-	-	0.03	-	-	-	0.60	115.82
WITH PROJECT	(1988)	115.22	0.08	-	0.34	-	-	0.02	-	-	-	0.44	115.66
	(1994)	115.22	0.10	-	0.42	-	-	0.03	-	-	-	0.54	115.76
	(2002)	115.22	0.12	-	0.50	-	-	0.03	-	-	-	0.65	115.87
CROP YIELD	(KG/RAI)												
BASE YEAR	(1983)	265.5	209.2	-	115.0	-	-	180.0	-	-	-		
WITHOUT PROJECT	(1988)	266.9	213.4	-	116.7	-	-	180.0	-	-	-		
	(1994)	268.7	218.6	-	118.9	-	-	180.0	-	-	-		
	(2002)	271.0	225.7	-	121.7	-	-	180.0	-	-	-		
WITH PROJECT	(1988)	268.1	213.6	-	117.1	-	-	180.0	-	-	-		
	(1994)	277.3	220.1	-	121.4	-	-	180.0	-	-	-		
	(2002)	290.0	229.1	-	127.3	-	-	180.0	-	-	-		
CROP PRODUCTION AMOUNT	(TON)												
BASE YEAR	(1983)	30,591	15	-	35	-	-	4	-	-	-	53	30,644
WITHOUT PROJECT	(1988)	30,756	17	-	39	-	-	4	-	-	-	60	30,816
	(1994)	30,956	20	-	46	-	-	5	-	-	-	70	31,026
	(2002)	31,225	24	-	56	-	-	6	-	-	-	86	31,311
WITH PROJECT	(1988)	30,896	17	-	40	-	-	4	-	-	-	61	30,956
	(1994)	31,951	21	-	51	-	-	5	-	-	-	77	32,028
	(2002)	33,414	27	-	64	-	-	6	-	-	-	96	33,510

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

TABLE 27.2.3 NET PRODUCTION VALUE

ITEM			RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
FARMGATE PRICE	(BAHT/TON)													
WITHOUT PROJECT	(1983 - 2002)		3,653	2,627	-	6,953	-	-	4,687	-	-	-		
WITH PROJECT	(1988 - 2002)		3,669	2,643	-	6,969	-	-	4,719	-	-	-		
CROP PRODUCTION COST	(BAHT/RAI)													
BASE YEAR		(1983)	713	516	-	488	-	-	790	-	-	-		
WITHOUT PROJECT		(1988)	716	518	-	488	-	-	790	-	-	-		
		(1994)	720	521	-	488	-	-	790	-	-	-		
		(2002)	725	525	-	493	-	-	790	-	-	-		
WITH PROJECT		(1988)	718	518	-	488	-	-	790	-	-	-		
		(1994)	735	521	-	493	-	-	790	-	-	-		
		(2002)	760	525	-	498	-	-	790	-	-	-		
NET PRODUCTION VALUE	(1000 BAHT)													
WITHOUT PROJECT		(1988)	29,855	3	-	109	-	-	1	-	-	-	113	29,968
		(1994)	30,125	5	-	130	-	-	2	-	-	-	137	30,262
		(2002)	30,529	7	-	163	-	-	2	-	-	-	172	30,701
WITH PROJECT		(1988)	30,628	4	-	111	-	-	1	-	-	-	116	30,744
		(1994)	32,540	6	-	147	-	-	2	-	-	-	155	32,695
		(2002)	35,028	10	-	195	-	-	2	-	-	-	207	35,235
NET VALUE ADDED	(1000 BAHT)													
1988			773	1	-	2	-	-	0	-	-	-	3	776
1994			2,415	1	-	17	-	-	0	-	-	-	18	2,433
2002			4,499	3	-	32	-	-	0	-	-	-	35	4,534

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

27.3 VOC SAVINGS

In accordance with the concept and data given in Section 3.4 of the Text Report, VOCs on the road link concerned were calculated in the two cases of "with and without project".

Road length by road class is shown in Table 27.3.1. Data for additional VOCs are shown in Table 27.3.2.

VOC savings, obtained as the balance of total link VOCs between the two cases, were calculated as shown in Table 26.3.3.

TABLE 27.3.1 ROAD LENGTH BY ROAD CLASS

(UNIT : KM)

LINK NO.	WITHOUT PROJECT CASE						WITH PROJECT CASE
	PAVED	LATERITE			EARTH	TOTAL	PAVED
		GOOD	FAIR	POOR			
1	-	-	1.4	14.0	-	15.4	15.4
2	-	-	0.6	14.1	-	14.7	14.7

TABLE 27.3.3 VEHICLE OPERATING COST SAVING

(UNIT : 1000 BAHT)

LINK NO.	1988			1994			2002		
	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING
1	8,452	7,137	1,315	11,643	9,730	1,912	18,024	14,823	3,201
2	8,282	7,217	1,064	11,329	9,754	1,574	17,332	14,666	2,666
TOTAL	16,734	14,355	2,379	22,972	19,485	3,487	35,356	29,488	5,867

N O T E
(1) WITHOUT : WITHOUT PROJECT CASE
(2) WITH : WITH PROJECT CASE
(3) SAVING : VEHICLE OPERATING COST SAVING
(4) LINK NO. = 1 - 9 : PROPOSED LINK
(5) LINK NO. = 11 - 19 : SURROUNDING LINK

TABLE 27.3.2 DATA FOR ADDITIONAL VOC COST

(UNIT OF LENGTH : M)

LINK NO.	CASE	CURVE									GRADE					VILLAGE		NO. OF INTER-SECTION	NO. OF TIMBER BRIDGE	NO. OF NARROW BRIDGE	NO. OF CORNER
		100	150	200	250	300	375	500	750	1500	1	2	3	4	5	NO.	LENGTH				
1	WITHOUT	-	-	-	-	-	-	372	658	1532	3650	-	-	-	-	8	3400	3	-	-	-
	WITH	-	-	-	-	-	-	372	658	1532	3600	-	-	-	-	8	3400	-	-	-	2
2	WITHOUT	147	-	158	-	263	267	521	-	529	2200	100	-	-	-	7	1700	2	1	-	1
	WITH	147	-	158	-	263	267	521	-	529	2200	200	-	-	-	7	1700	-	-	-	2

27.4 ENGINEERING

27.4.1 Soil and Materials

Existing subgrade soil and material sources in the vicinity of the study route investigated by DOH and their physical characteristics are shown in Figure 27.4.1 and Table 27.4.1, respectively.

Rock aggregate sources were assumed as shown below:

No.	Source	Description of Sample	Est. Quantity m^3
27/CS-1	KM. 13+400 Rt 2 KM. Surin-Prasat	Basalt	Plentiful
	KM. 14+450 Rt 2 KM. Surin-Prasat	Basalt	Plentiful
27/CS-2	KM. 14+450 Rt 2 KM. Surin-Prasat (Sirathanakit Quarry)	Basalt	Plentiful
27/CS-3	KM. 14+450 Rt 2.0 KM. Surin-Prasat	Basalt	Plentiful

FIGURE 27.4.1 SOIL AND MATERIAL SOURCES

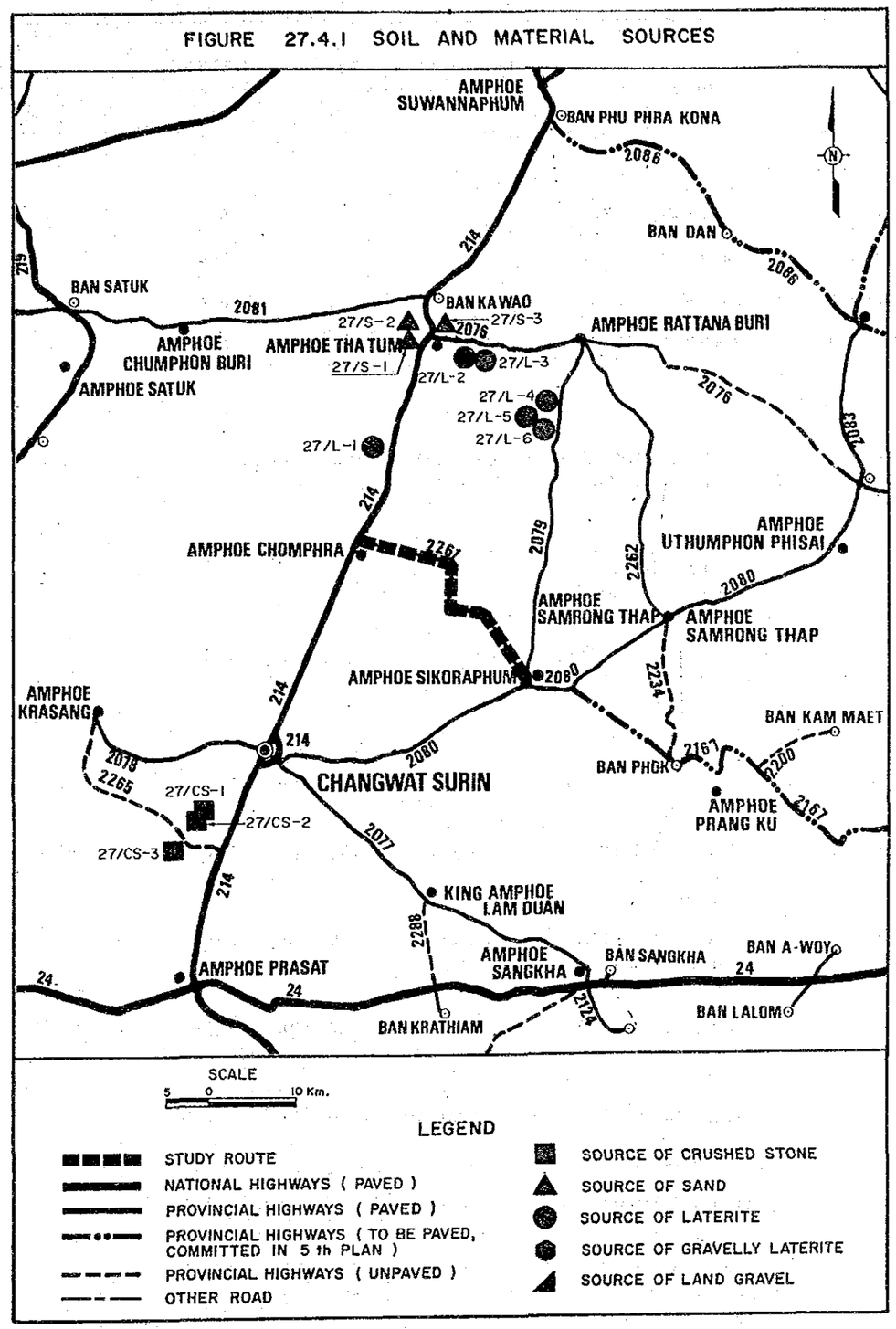


TABLE 27.4.1 PHYSICAL CHARACTERISTICS OF MATERIALS

No.	Source	Description of Sample	Est. Quantity m^3	AASHTO Classification	Sieve Analysis % Passing 50.0	25.0	19.0	9.5	#4	#10	#40	#200	Plasticity LL	PI	Comp. DH-T Stand. Opt. 95%	gm/cc	Lab. C.B.R. CBR 95%	Swell %	Durability Abr.	Dur.
SUBGRADE																				
27/SG-1.	KM. 5+500 Rt 13 M.			A-4					100	99.6	91.6	51.6	N-P		12.1	1.762	10.1	-		
27/SG-2.	KM. 12+000 Lt 15 M.			A-4						100	98.8	95.0	20.0	5.5	11.5	1.880	17.3	0.5		
27/SG-3.	KM. 20+000 Rt 15 M.			A-4						100	98.7	89.1	N-P		11.1	1.880	9.3	0.1		
27/SG-4.	KM. 28+000 Lt 15 M.			A-4						100	99.8	90.6	N-P		10.9	1.891	10.0	0.1		
SAND																				
27/S-1	KM. 2+700 Lt 300 M. Tha Tum - Suwan Na Phum	Huai Kudh Wien sand	Plentiful	A-3				100	99	98	66	2	N.P.							
27/S-2	KM. 53+000 Rt, Lt close to Surin - Tha Tum - Suwan Na Phum	Mun River sand	Plentiful																	
																			Less color than standard	
27/S-3	KM. 1+000 Lt, 1.5 KM. Tha Tum - Rattana Buri	Mun River sand	Plentiful	A-1-b					100	99	23	1	N.P.							
LATERITE																				
27/L-1	KM. 46+000 Lt 3,000 M. Surin - Tha Tum	Yellow laterite	200,000	A-2-4	100	96.2	-	64.5	-	30.8	25.9	20.1	32.1	8.9	7.0	2.100	15.4	0.42		
27/L-2	KM. 10+300 Rt 5 KM. Tha Tum - Rattana Buri	Laterite	100,000	A-1-a	100	98.0	96	76.0	47	31.0	26.0	19.0	N.P.		8.4	2.200	30.0	0.48	53.2	64.5
27/L-3	KM. 10+300 Rt 53 KM. Tha Tum - Rattana Buri	Laterite	30,000	A-1-a	100	97.0	96	79.0	52	37.0	29.0	17.0	N.P.		7.4	2.205	13.0	0.15	51.5	87.5
27/L-4	KM. 6+000 Rt 2,000 M. Rattana Buri - Sikoraphum	Yellow laterite	10,000	A-2-4	100	95.7	-	53.8	-	23.4	19.7	10.5	28.6	7.4	8.4	2.021	18.1	0.84		
27/L-5	KM. 6+100 Rt 3 KM. Rattana Buri - Sikoraphum	Laterite	100,000	A-2-6			100	99.0	82	38.0	32.0	24.0	28.2	13.4					4.0	41.7
	L1:S1 = 7:3 by weight	Laterite and sand		A-2-4			100	99.0	87	57.0	29.0	17.0	N.P.		9.3	2.095	25.0	0.02		
27/L-6	KM. 6+100 Rt 4 KM. Rattana Buri - Sikoraphum	Laterite	100,000	A-2-4				100	92	64.0	53.0	26.0	N.P.						37.8	40.0
	L2:S2 = 1:1 by weight	Laterite		A-2-4				100	97	81.0	38.0	15.0	N.P.		9.9	2.170	27.2	-		

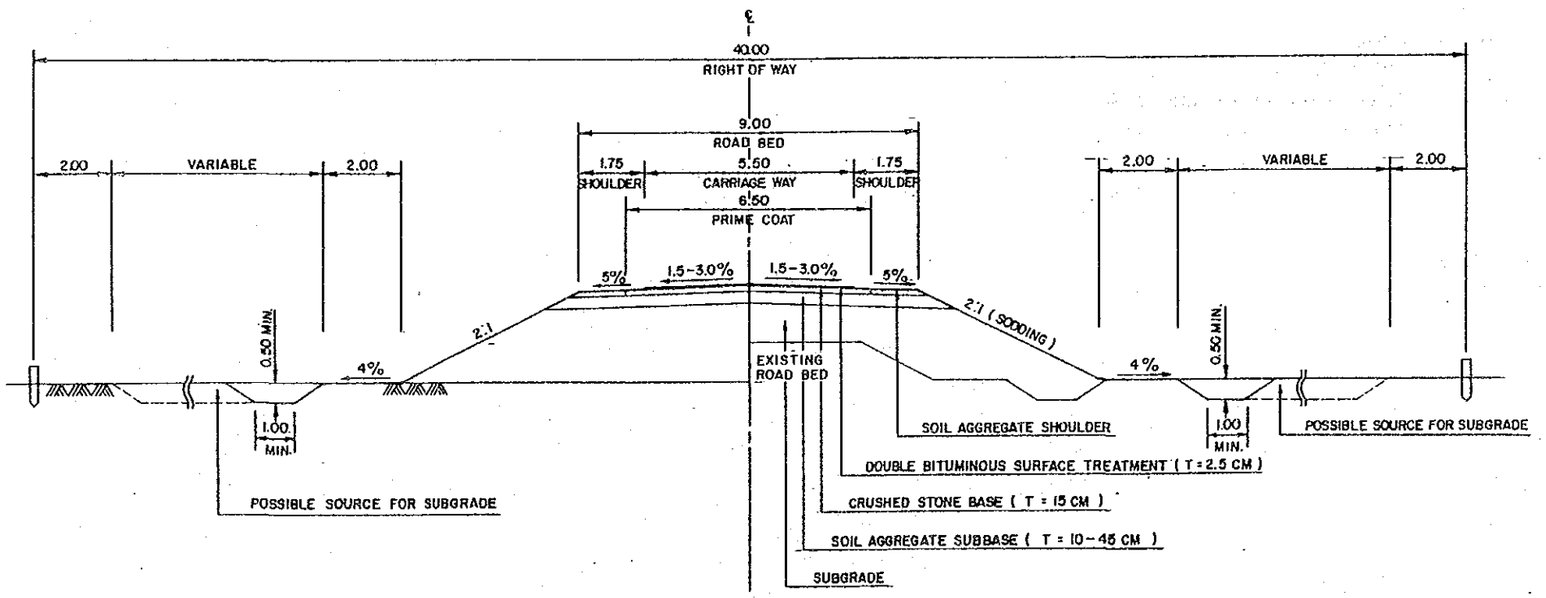
27.4.2 Preliminary Design

27.4.2.1 Design Criteria

Design Standard		: F4
Geometric Design Criteria		: DOH (Provincial Highway)
Typical Cross Section		: as shown in Figure 27.4.2
Minimum Height of Embankment in Flooding Section		: 0.7 m above flood level
Pavement Structure		
DBST		: 2.5 cm
Crushed Aggregate Base	CBR ≥ 80%	: 15.0 cm
Soil Aggregate Subbase	CBR ≥ 25%	: 10.0 cm (minimum requirement)
Selected Materials	CBR ≥ 6%	: as required
Pipe Culvert		
Standardized type		: 80, 100, 120 & 150 cm in diameter
Location		: as required
Standard intervals		
Paddy area		: 200 m
Others		: 500 m
Box Culvert		
Standard size		: 1.5×1.5, 2.4×2.4 & 3.0×3.0 m
Location		: as required
Bridge		
Reinforced concrete standard type		: Width 9.0 m
Substructure		: Pile-bent type

The existing and designed plan and profile are shown in Drawings 27-1/27-4.

FIGURE 27.4.2 TYPICAL CROSS SECTION



PROVINCIAL HIGHWAY (CLASS F4)

27.4.2.3 Pavement Design

1) Cumulative number of ESA in one direction

- ESA conversion factors

Heavy bus	:	0.50
Medium truck	:	0.76
Heavy truck	:	1.24

- Forecasted ADT by vehicle type

Year	1988				1994			
Traffic/road link	1	2	3	4	1	2	3	4
Heavy bus	7	11	—	—	13	15	—	—
Medium truck	43	40	—	—	63	59	—	—
Heavy truck	25	25	—	—	35	34	—	—

- Cumulative number of ESA in one direction by road link

Road link	*1*	2	3	4
7 years (10^6)	0.105	0.102	-	-

2) Design CBR values

Road link	1	2	3	4
Design CBR (%)	10.4	9.3	-	-

3) Required thickness of pavement

Surfacing	:	DBST (2.5 cm)
Aggregate base	:	15 cm (CBR not less than 25%)
Subbase	:	Minimum requirement 10 cm

Road link	1	2	3	4
	10 cm	10 cm	-	-

4) Overlay required in 7 years
DBST resurfacing

27.4.2.4 Drainage and Structures

The locations of existing and designed RC box culverts and RC bridges and their dimensions are shown below:

STATION	EXISTING STRUCTURES		PROPOSED STRUCTURES	
	TYPE	SIZE	TYPE	SIZE
25 + 155	Timber Bridge	4.0 x 15.0	RC Bridge	9.0 x 20.0

27.4.3 Quantities and Construction and Road Maintenance Costs

The required construction costs were estimated based on the results of the preliminary design as shown in Table 27.4.2. Financial costs with breakdown into local and foreign currency portions, economic costs and residual values were estimated as follows and in 27.4.4:

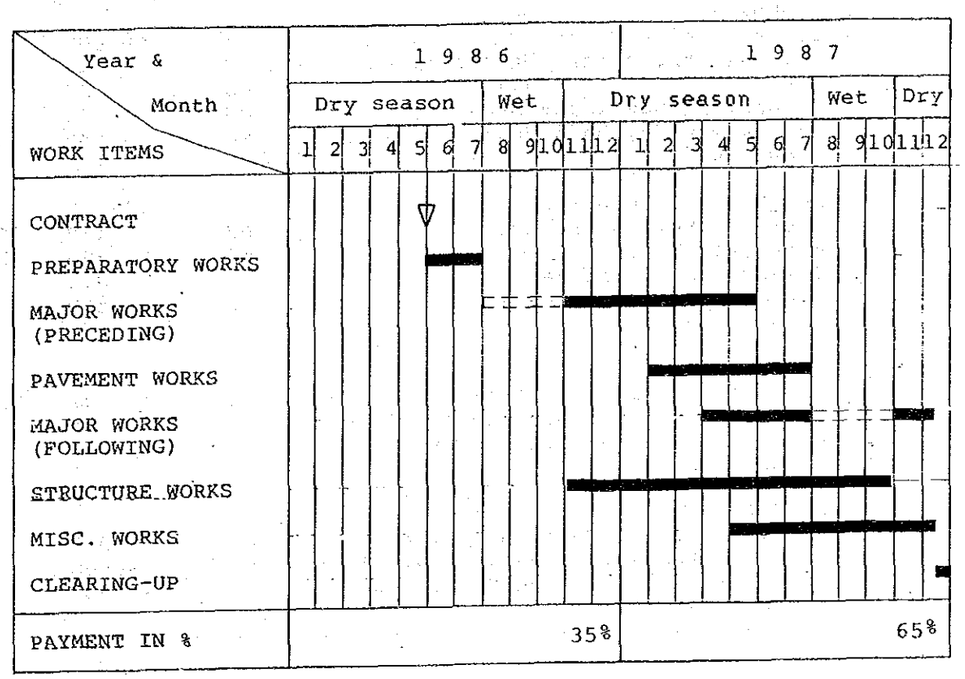
IM—27	L=31.1 km	(baht)
	Financial cost	: 50,333,000
	Economic cost	: 42,064,000
	Residual value	: 17,657,000

The required road maintenance cost savings are shown in Table 27.4.3.

27.4.4 Construction and Disbursement Schedules

IM—27 **Length = 31.1 km**

Construction Schedule
Assumption: Completion date December 31, 1987



Yearly Disbursement Schedule
Assumption: Annual rise in prices

Year / Currency	Base year 1984	(1985)	1986	1987
Local	100	110.0	121.0	133.1
Foreign	100	106.5	113.4	120.8

LOCAL AND FOREIGN COMPONENTS OF CONSTRUCTION COST

(Route IM - 27)

(Unit : Million Baht)

	1986			1987			Total		
	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Construction Cost	8.7	8.8	17.5	16.2	16.6	32.8	24.9	25.4	50.3
Price Contingency	1.8	1.2	3.0	5.4	3.5	8.9	7.2	4.7	11.9
Total	10.5	10.0	20.5	21.6	20.1	41.7	32.1	30.1	62.2
	(0.39)	(0.37)	(0.76)	(0.80)	(0.74)	(1.54)	(1.19)	(1.11)	(2.30)

Remarks : L/C : Local Currency Portion
F/C : Foreign Currency Portion
( ) : US$ Equivalent (US$1 = 27 Baht)

TABLE 27.4.2 CONSTRUCTION QUANTITIES AND COSTS
(ROUTE IM—27 Length = 31.1 km)

DBST

Item	Unit	Financial Unit Rate B	Quantity	Financial Cost 1000 B			Economic Cost		Residual Value	
				Total	Local	Foreign	%	1000 B	%	1000 B
EARTHWORK							83		90	
Clearing & Grubbing	ha	10,000	72	720						
Roadway Excavation, Unclassified	m3	19	0	0						
Embankment, Common Soil	m3	38	259,000	9,842						
Embankment, Selected Material	m3	70	0	0						
Replacement of Soft Spot	m3	88	4,000	352						
Sub Total				10,914	5,566	5,348		9,059		8,153
SUBBASE & BASE COURSES							83		50	
Subbase, Soil Aggregate	m3	112	29,300	3,282						
Aggregate Base*	m3	320	30,300	9,696						
Cement Stabilized Base	m3	390	0	0						
Shoulder, Soil Aggregate	m3	120	11,700	1,404						
Sub Total				14,382	7,766	6,616		11,937		5,968
SURFACE COURSES							85		50**	
Asphaltic Prime/Tack Coat	m2	12	202,200	2,426						
Double Bituminous Surface Treatment*	m2	38	171,100	6,502						
Asphaltic Concrete Surfacing**	t	750	0	0						
Sub Total				8,928	3,928	5,000		7,589		0
STRUCTURES							83		50	
RC Pipe Culvert (D 1.0m Equivalent)	m	2,000	1,861	3,722						
RC Box Culvert (2.4mx2.4m Equivalent)	m	18,800	0	0						
RC Bridge(W=9.0m L=10m Equivalent)	m	46,500	20	930						
Sub Total				4,652	2,326	2,326		3,861		1,931
Total (a)				38,876	19,587	19,289		32,445		16,052
INCIDENTALS							83		0	
Miscellaneous Work ((a)x7%)	ls			2,721	1,361	1,361		2,259		0
CONTRACT AMOUNT (b)				41,597	20,947	20,650		34,704		16,052
PHYSICAL CONTINGENCIES ((b)x10%) (c)	ls			4,160	2,095	2,065		3,470		1,605
ENGINEERING AND SUPERVISION							85		0	
(((b)+(c))x10%) (d)	ls			4,576	1,830	2,745		3,889		0
LAND ACQUISITION							100		100	
Highly Developed Land	ha	50,000	0	0						
Less Developed Land	ha	15,000	0	0						
Sub Total (e)	ls			0	0	0		0		0
PROJECT COST ((b)+(c)+(d)+(e))				50,333	24,872	25,460		42,064		17,657
AVERAGE COST PER KM				1,618						

Note : * The unit prices are modified by aggregate haulage distance
** Rate is applied only for Asphaltic Concrete Surfacing

TABLE 27.4.3 ROAD MAINTENANCE COST SAVING

LINK NO.	YEAR	WITHOUT PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <A1>	ROAD CHARA. FACTOR <KA>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	WITH PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <X3>	ROAD CHARA. FACTOR <KB>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	ROAD MAINTE. COST SAVING (1000 BAHT)
	1988	222.8	15.4	0.35	1.41	14,833	228	248.9	15.4	0.00	1.14	12,793	197	31
1	1994	323.6	15.4	0.59	1.57	16,559	255	351.2	15.4	0.00	1.14	12,793	197	58
	2002	537.0	15.4	0.95	1.83	19,231	296	556.5	15.4	0.00	1.14	12,793	197	99
	1988	212.8	14.7	0.33	1.39	14,662	216	241.2	14.7	0.00	1.14	12,793	188	27
2	1994	304.4	14.7	0.54	1.54	16,231	239	335.3	14.7	0.00	1.14	12,793	188	51
	2002	492.7	14.7	0.95	1.83	19,231	283	519.9	14.7	0.00	1.14	12,793	188	95
	1988	217.9	30.1			14,750	444	245.1	30.1			12,793	385	59
TOTAL	1994	314.2	30.1			16,399	494	343.4	30.1			12,793	385	109
	2002	515.4	30.1			19,231	579	538.6	30.1			12,793	385	194

NOTE (1) TOTAL MAINTENANCE COST $T = U * L$

(2) UNIT MAINTENANCE COST $U = M * (KA \text{ or } KB) * FA * (1 + FR) * FE$

M ; SPECIFIED MAINTENANCE COST
WITHOUT PROJECT CASE M = 7,700 BAHT/KM
WITH PROJECT CASE M = 8,200 BAHT/KM

FA = 1.40 ADMINISTRATION FACTOR FOR DIRECT LABOUR OPERATION BY DOH
FR = 0.15 EMERGENCY REHABILITATION COST FACTOR
FE = 0.85 ECONOMIC MAINTENANCE COST FACTOR TO FINANCIAL MAINTENANCE COST

(3) ROAD CHARACTERISTIC FACTOR
WITHOUT PROJECT CASE $KA = 1.16 + 0.70 * A1$
WITH PROJECT CASE $KB = 1.14 + 0.05 * X3$

(4) FACTOR FOR ADT
WITHOUT PROJECT CASE $A1 = -0.1630 + 0.002320 * ADT$
WITH PROJECT CASE $X3 = -0.2034 + 0.000409 * (ADT / LANE)$; LANE = 2

27.5 EVALUATION

27.5.1 Economic Evaluation

The yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in the table below.

The results indicate that the improvement of this study route is feasible by employing the F4 standard with DBST surfacing.

COST AND BENEFIT STATEMENT OF ROUTE IM - 27

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	TOTAL COST	TOTAL BENEFIT
1986	14,722	0	0	0	0	18,467	0
1987	27,342	0	0	0	0	30,623	0
1988	0	776	2,379	59	3,214	0	2,870
1989	0	1,052	2,564	67	3,683	0	2,936
1990	0	1,328	2,748	75	4,152	0	2,955
1991	0	1,604	2,933	84	4,621	0	2,937
1992	0	1,881	3,117	92	5,090	0	2,888
1993	0	2,157	3,302	100	5,559	0	2,816
1994	0	2,433	3,487	109	6,028	0	2,727
1995	11,050	2,696	3,784	119	6,599	4,998	2,665
1996	0	2,958	4,082	130	7,170	0	2,586
1997	0	3,221	4,379	141	7,741	0	2,492
1998	0	3,484	4,677	151	8,312	0	2,389
1999	0	3,746	4,975	162	8,883	0	2,280
2000	0	4,009	5,272	172	9,453	0	2,166
2001	0	4,271	5,570	183	10,024	0	2,051
2002	-17,657	4,534	5,867	194	10,595	-3,226	1,936
TOTAL	35,457	40,150	59,137	1,838	101,125	50,863	38,695
DISCOUNTED	50,863	14,534	23,459	703	38,695		

NET PRESENT VALUE : -12,168

BENEFIT/COST RATIO : 0.76

INTERNAL RATE OF RETURN : 8.8 %

FIRST YEAR RATE OF RETURN : 5.8 %

OPTIMUM OPENING YEAR : 1993

SENSITIVITY TESTS

ITEM	CASE		
	BASE	1	2
NET PRESENT VALUE	-12,168	-19,797	-17,972
BENEFIT/COST RATIO	0.76	0.66	0.65
INTERNAL RATE OF RETURN	8.8 %	7.3 %	7.1 %
FIRST YEAR RATE OF RETURN	5.8 %	5.1 %	5.0 %
COSTS	BASE	+15%	BASE
BENEFITS	BASE	BASE	-15%

27.5.2 Social Impact

The social impact brought about by the improvement of the study route is shown in the following social benefit indicators:

Construction Cost (million baht) : 42.1

1) General Accessibility Benefit (million baht) : 3.22
2) Education Benefit (million baht) : 3.86
3) Medical Care Benefit (million baht) : 0.074
4) Total Social Benefits (million baht) (1+2+3) : 7.15
5) Social Benefit/Cost Ratio ($\times 10^{-2}$) : 17.00
6) Ranking by Social Benefits : 4
7) Weighted Production Value Gain/Cost ($\times 10^{-2}$) : 10.27
8) Ranking by 7 : 7
9) Combined Ratio ($\times 10^{-2}$) : 27.27

Overall Ranking : 4

27.5.3 Overall Evaluation

It is concluded that, considering the overall ranking and improvement schedule of the study routes with due consideration to the prevailing opportunity cost of capital, the improvement of this study route with the opening year 1993 is recommended.