PROPOSED ROUTE NO. IM - 11

Changwat : Udon Thani

B. Thung Yai (J.R. 2096)- K.A. Thung Fon

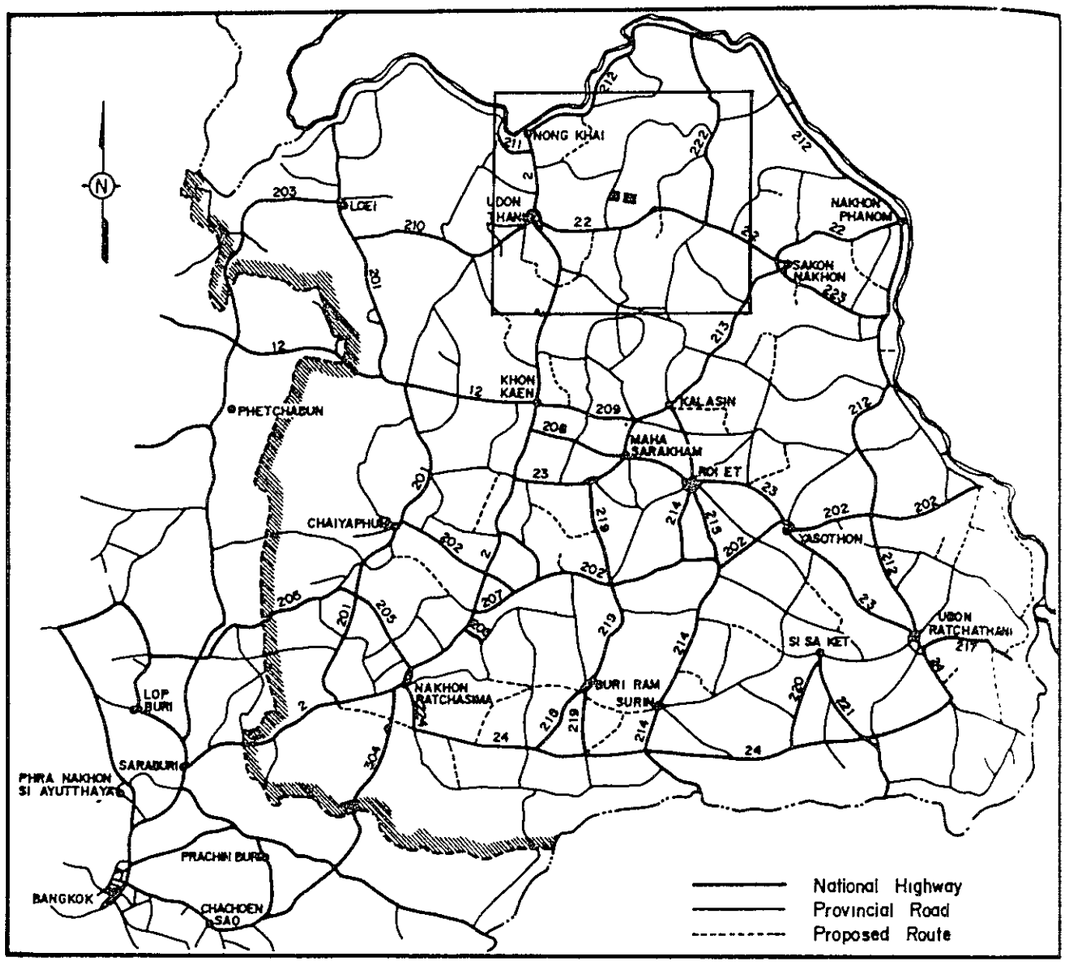
Length : 8.3 KM.

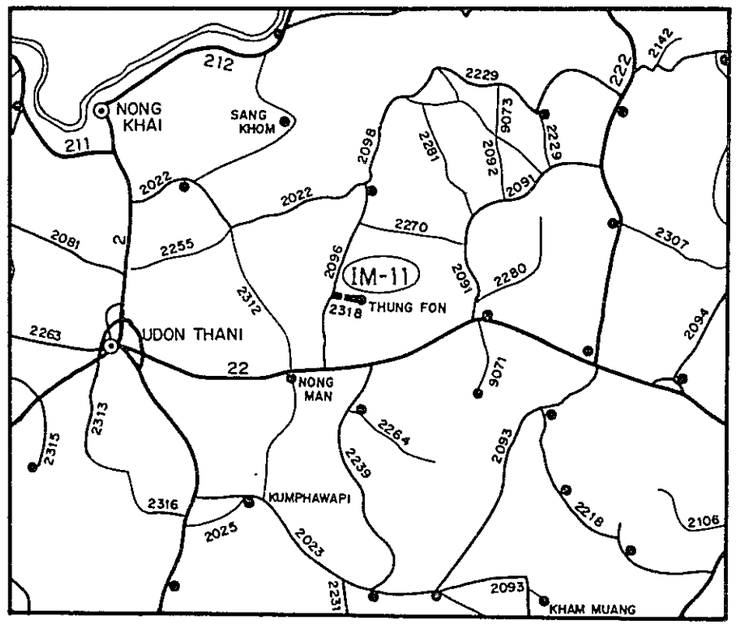
SUMMARY

PROPOSED ROUTE IM- 11

Item	Description
Changwat	Udon Thani
Origin	B. Thung Yai (J.R.2096)
Destination	K.A. Thung Fon
Length	
Total	8.3 km
Improvement Section	8.3 km
DOH Road	0 km
ARD Road	8.3 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Rolling
Influence Area	
Area	59 km^2
Population (1982)	7,700
Principal Crops	Paddy
Traffic (ADT)	
Existing	74
1993	297
2001	392
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	18,823 . 10^3 ฿
Economic	17,001 . 10^3 ฿
IRR	5.1 %
B/C	0.51
Social Impact	High
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the east part of Changwat Udon Thani. The route, starting at Ban Thung on Route 2096 runs eastward and ends at King Amphoe Thung Fon. Its total length is 8.3 km. (Figure 11.5.2)

The terrain is almost rolling. In the influence area, there exist a few villages with total population of 7,700. There are two medical centers, and one secondary school along the proposed route.

The proposed route, upon the completion, will play vital role to connect King Amphoe Thung Fon with highway of Route 2096.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are summarized in Table 11.1.1. The details are shown as the results of inventory survey in Table 11.1.2.

2. TRAFFIC

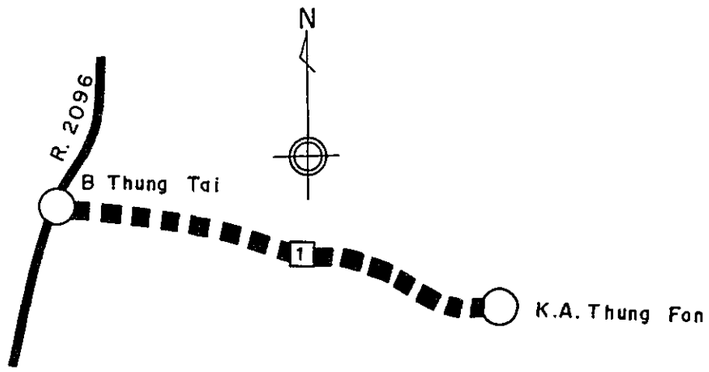
2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the subject road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated referring to the DOHs traffic records and manual classified count as shown below:

Proposed Road Link



Traffic Volume in Base Year

Source (base year)	Link No	Vehicle Type									
		P/C	P/P	L/B	M/B	M/B	P/T	4/T	6/T	10/T	ADT
DOH (1981) /1	1	17	11	10	13	2	2	5	7	-	67
Manual Counts (1982)	1	1	41	4	5	-	5	18	5	-	79
Estimated	1	9	26	7	9	1	4	12	6	-	74

Note: /1 Route 2318 Section 0100 Section km 0 + 500

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road links were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	451

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	16	9	24

2.4 Future Growth of Transport Movement

The Growth rates of passenger and freight movements for the periods of 1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula described in 7.3.3-2) of the Main Report. The basis for the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.3	1.0	1.0
PASSENGER MOVEMENT	5.3	5.4	5.6

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	6.9	7.0	7.2
AGRICULTURE	0.3	0.3	0.3
FREIGHT	4.5	4.6	4.7

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed in 7.3.3-3) of the Main Report.

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into traffic volume by vehicle type applying future traffic composition as shwon in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	17.3	50.0	13.5	17.3	1.9	18.2	54.5	27.3	0.0
	1987	17.2	50.1	13.0	16.6	3.1	17.9	44.4	29.3	8.4
	1993	17.0	50.3	12.5	15.7	4.5	17.5	32.2	31.7	18.5
	2001	16.8	50.5	11.8	14.5	6.4	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the following table and details by road link by traffic type are shown in Table 11.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	13	10	13	2	41	9	6	2	295	154	249
1993	17	13	16	5	54	6	6	3	118	179	297
2001	25	18	22	9	78	3	6	6	167	225	392

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields.

Unused cultivable land for upland fields remains a little in the area along Route No. 2096.

Land use and capability conditions in the area of influence are shown in Table 11.3.1 and Figure 11.3.1. A typical cropping calendar in the Udon Thani area is shown in Figure 11.3.2.

3.2 Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shwn in Table 11.3.2.

Farmgate prices and production costs of the selected crops are estimated as follows, referring to the Changwat data and field survey information as shown in Table 11.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 11.3.4. The difference between NPV of with project case and NPV of without project cast is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link No.	Terrain	Without Project Length (km)	1) Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	With Project Length (km)	1) Road Class Case 1	Case 2	Nos. of Wooden Narrow Bridge
1	Rolling	8.3	3	4	0	8.3	1(F4)	2A(F5)	0

1)
Road 1: Paved Road

Road 2A: Laterite Road with good surface condition and alignment

Road 2B: Laterite Road with good surface condition but poor alignment

Road 3: Laterite Road with poor surface condition and alignment

Road 4: Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were caclulated as follows.

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	812	1,162	1,824
2A (F5)	618	918	1,474

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard : F4 (if not feasible, F5)

Geometric Design : AASHTO (Rural Highways)

Typical Cross Section : as shown in Figure 11.5.1

Minimum Height of Embankment

Ordinary Section : 1.0m

Approach of Bridge in Flat Area : 2.0m

Flood Section : 0.7m (above flood level)

Pavement Structure

In case of F4 Standard

DBST : 2.5cm

Crushed Stone Base CBR≥80% : 15.0cm

Soil Aggregate Subbase CBR≥20% : 15.0cm

Selected Material CBR≥ 6% : 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR≥20% : 15.0cm

Selected Material CBR≥ 6% : 20.0cm

Pipe Culvert

Standard Size : ø 100cm

Standard Interval

Paddy Area : 200 m

Others : 500 m

Box Culvert

Standard Size : 2.4m x 2.4m

Location : as required

Bridge

Standard Type (width 7.0m)

Short Span Bridge : RC - Slab

Long Span Bridge : PC - Girder

Location : as shown in Bridge List in Figure 11.5.2

Alignment of the route is shown in Figure 11.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 11.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 ₱)		Remark
		Financial Cost	Economical Cost	
F4 (DBST)	8.3	18,823	17,001	
F5 (Soil Aggregate)	8.3	12,398	11,157	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 11.6.1 and 11.6.2. The result indicates that the proposed project seems to be not feasible under F4 Standard and F5 Standard in case the opening year is 1987.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 11.7.1. Social impacts of the proposed route are considerably high.

Table 11.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	B. Thung Yai (J.R. 2096)		
Destination	K.A. Thung Fon		
Length			
Total			8.3 km
Improvement Section			8.3 km
DOH Road			0 km
ARD Road			8.3 km
Others			0 km
New Alignment Section			0 km
Terrain	Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	5.5 m - 9.0 m, 7.5 m (Weighted average)		
Embankment Section			
Length			8.3 km
Height	0.2 m - 0.4 m		
Cut Section			
Length			0 km
Depth	m - m		
Surface Type and Condition			
SBST or DBST			0 km
Soil Aggregate	Poor		8.3 km
Earth			0 km
Pipe Culvert	2 each		
Box Culvert	0 each		0 m
Bridge			
Permanent Bridge	0 each		0 m
Narrow Concrete Bridge	0 each		0 m (4m)
Wooden Bridge	4 each		49.0 m
Overflow Section	1 place		0.5 km

Table 11.1.2 ROAD INVENTORY

PRCPOSED ROUTE NO. IM-11 ROUTE NO. 2318 B. THUNG YAI (J.R. 2096) ∿ K.A. THUNG FON L = 8.3 Km.

UDON THANI

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
VILLAGE - Name - Household (H) - Population (P)		B. THUNG YAI H = 219 P = 1240				B. THUNG FON H = 670 P = 5000											
TERRAIN		Rolling															
CROSS SECTION	Formation Width (m)	5.50	9.00		7.00												
	Embankment Height (m)	0.30	0.20		0.40	0.20											
	Cutting Depth (m)																
PAVEMENT	Type/Length	Laterite															
	Condition	Poor															
FLOODING	Overflow Length(Km)/Height(m)					L=0.5 H=0.4											
LAND USE	Left	Bush	Paddy														
	Right	Bush	Paddy														
PIPE CULVERT	Total Number	2 Pipes															
BOX CULVERT & BRIDGE	Station (Km)			3.7		6.4 6.4 6.7											
	Dimension			W-Br. 4.00 x 8.00		W-Br. 4.50 x 13.00 W-Br. 4.50 x 12.50 W-Br. 4.50 x 15.50											
RIGHT OF WAY (m)																	
ALIGNMENT	Horizontal	Fair															
	Vertical	Fair															
ROUTE NO., AGENCIES		DOH 2318															

Table 11.2.1 TRAFFIC VOLUME ON ROUTE IM - 11

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	11	11	15	15	22	22
	I	2	2	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	13	13	17	17	25	25
L/B	N+D	9	9	11	11	15	15
	I	1	1	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	10	10	13	13	18	18
M/B	N+D	11	11	14	14	19	19
	I	2	2	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	13	13	16	16	22	22
H/B	N+D	2	2	4	4	8	8
	I	0	0	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	2	2	5	5	9	9
P/P&T	N+D	36	36	47	47	68	68
	I	5	5	7	7	10	10
	DV	0	0	0	0	0	0
	TOTAL	41	41	54	54	78	78
4/T	N+D	7	7	5	5	2	2
	I	1	1	1	1	0	0
	DV	0	0	0	0	0	0
	TOTAL	9	9	6	6	3	3
6/T	N+D	5	5	5	5	5	5
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	6	6	6	6	6	6
10/T	N+D	1	1	3	3	5	5
	I	0	0	0	0	1	1
	DV	0	0	0	0	0	0
	TOTAL	2	2	3	3	6	6
ADT	N+D	82	82	102	102	145	145
	I	12	12	15	15	22	22
	DV	0	0	0	0	0	0
	TOTAL	95	95	118	118	167	167
M/C	N+D	140	140	163	163	206	206
	I	14	14	16	16	19	19
	DV	0	0	0	0	0	0
	TOTAL	154	154	179	179	225	225
TOTAL	N+D	222	222	265	265	351	351
	I	27	27	32	32	41	41
	DV	0	0	0	0	0	0
	TOTAL	249	249	297	297	392	392

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

Figure 11.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – II

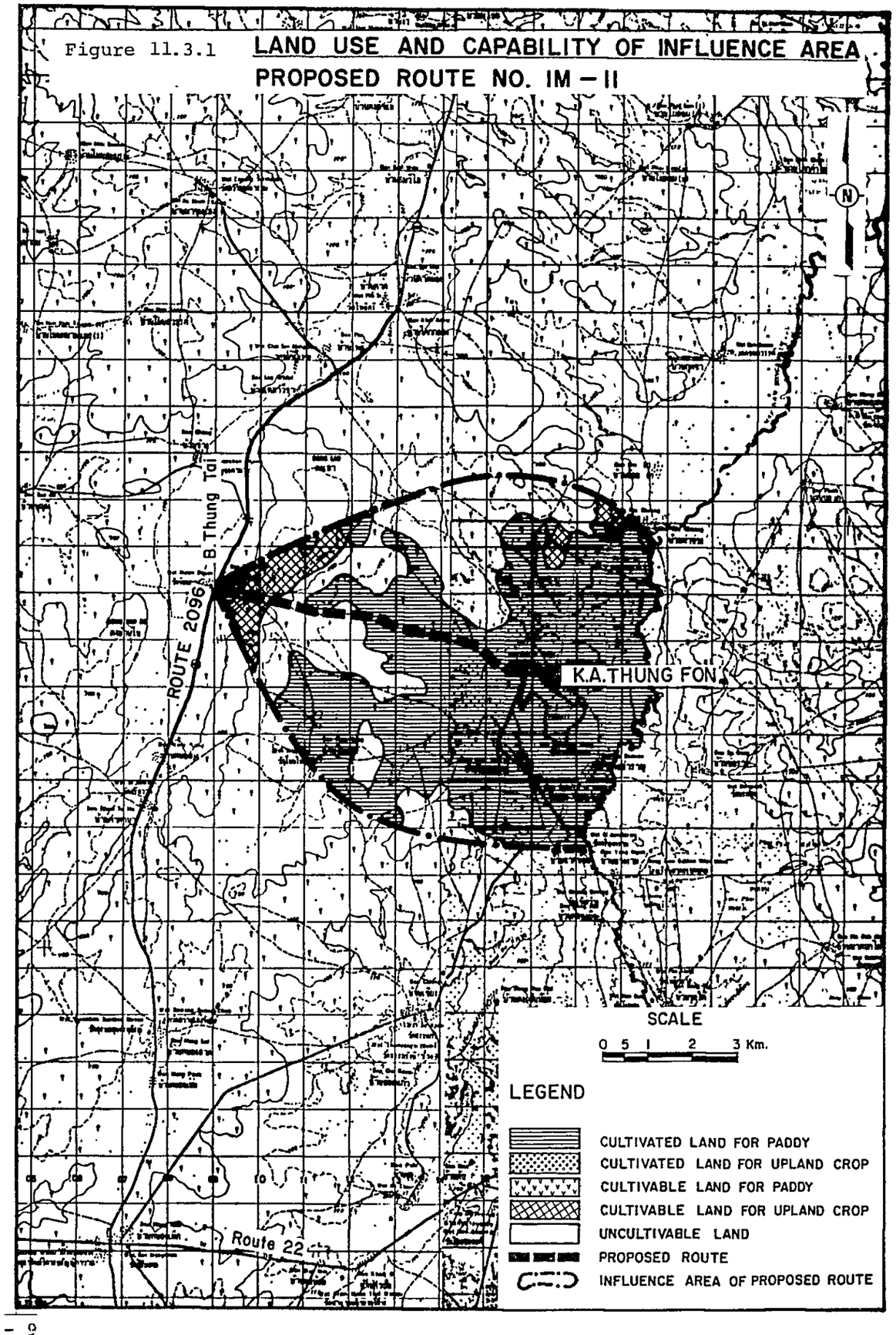


Figure 11.3.2 CROPPING CALENDAR

0200 CHANGWAT UDON THANI

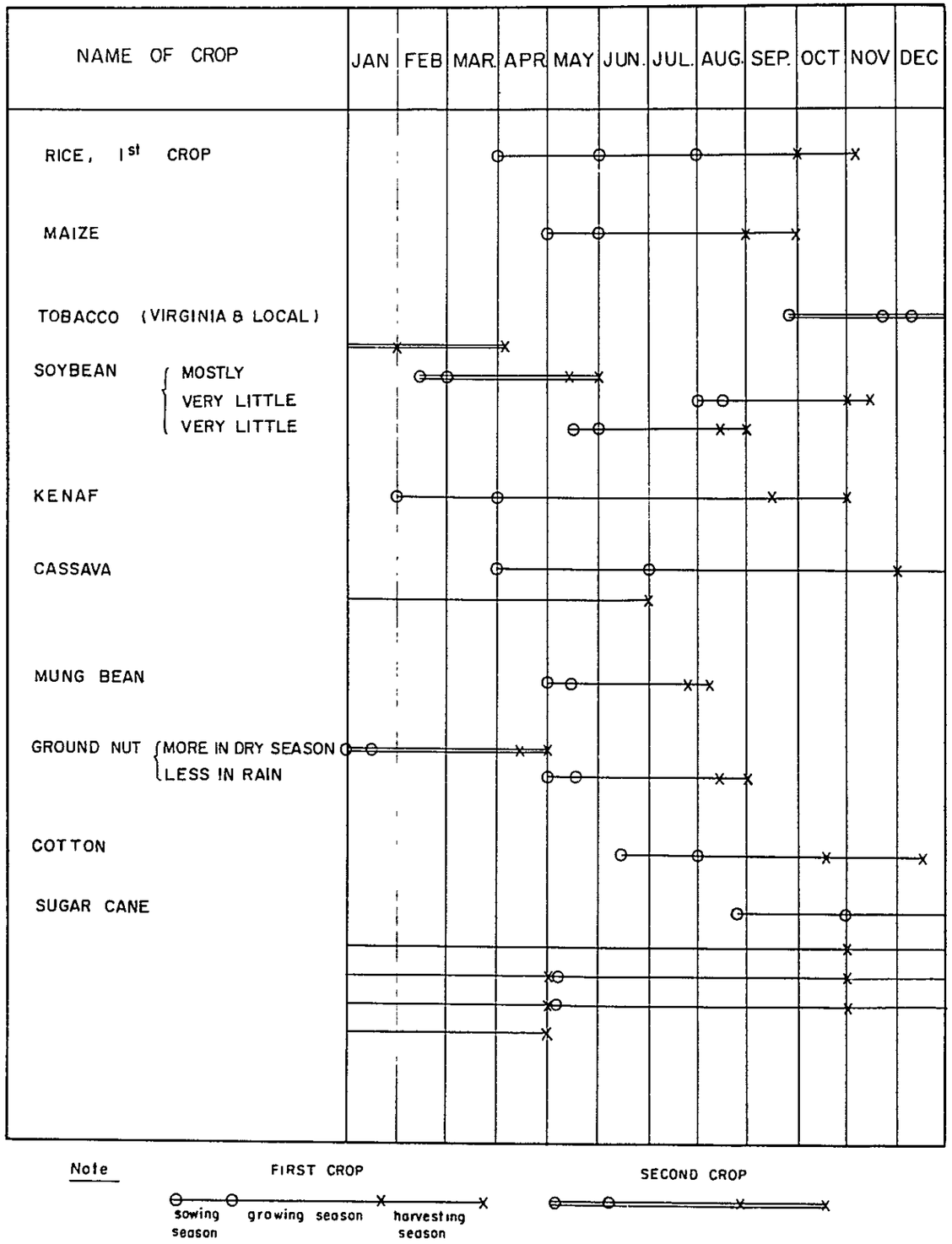


TABLE 11.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		25.000 (40.0)	-	25.000 (40.0)	-	2.188 (3.5)	2.188 (3.5)
0209	THUNG FON	25.000 (40.0)	-	25.000 (40.0)	-	2.188 (3.5)	2.188 (3.5)

TABLE 11.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			27.35	-	-	-	-	-	-	-	-	27.45
1987			27.68	-	-	-	-	-	-	-	-	27.78
1993	WITHOUT	PROJECT	28.01	-	-	-	-	-	-	-	-	28.11
	WITH	PROJECT	28.01	-	-	-	-	-	-	-	-	28.11
2001	WITHOUT	PROJECT	28.47	-	-	-	-	-	-	-	-	28.57
	WITH	PROJECT	28.47	-	-	-	-	-	-	-	-	28.57
CROP YIELD (KG/RAI)												
1981			220.0	-	-	-	-	-	-	-		
1987			221.3	-	-	-	-	-	-	-		
1993	WITHOUT	PROJECT	222.7	-	-	-	-	-	-	-		
	WITH	PROJECT	226.7	-	-	-	-	-	-	-		
2001	WITHOUT	PROJECT	224.4	-	-	-	-	-	-	-		
	WITH	PROJECT	234.0	-	-	-	-	-	-	-		
CROP PRODUCTION (TON)												
1981			6,017	-	-	-	-	-	-	-	-	6,242
1987			6,126	-	-	-	-	-	-	-	-	6,360
1993	WITHOUT	PROJECT	6,237	-	-	-	-	-	-	-	-	6,479
	WITH	PROJECT	6,350	-	-	-	-	-	-	-	-	6,593
2001	WITHOUT	PROJECT	6,389	-	-	-	-	-	-	-	-	6,640
	WITH	PROJECT	6,662	-	-	-	-	-	-	-	-	6,917

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 11.3.3 FARMGATE PRICE AND PRODUCTION COST

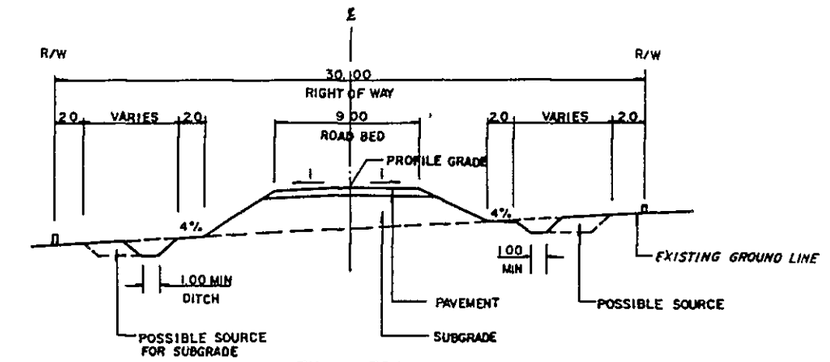
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	-	-	-	-	-	-	-
WITH PROJECT (1987 - 2001)	3,984	-	-	-	-	-	-	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	582	-	-	-	-	-	-	-
WITH PROJECT (1987 - 2001)	602	-	-	-	-	-	-	-

TABLE 11.3.4 NET PRODUCTION VALUE

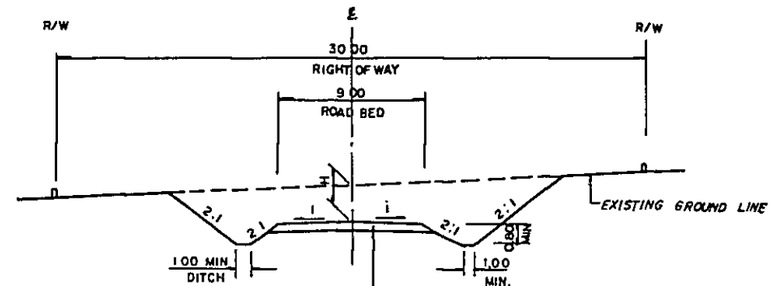
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	7,703	89	7,792	7,743	90	7,833
1993	7,941	90	8,031	8,435	93	8,528
2001	8,266	92	8,358	9,406	98	9,504

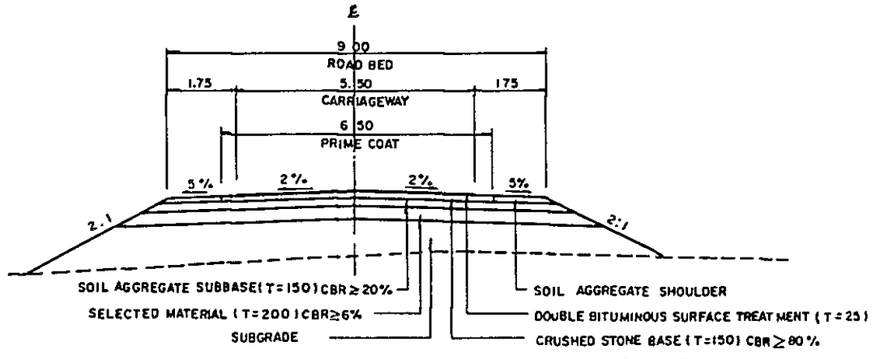
Figure 11. 5. 1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



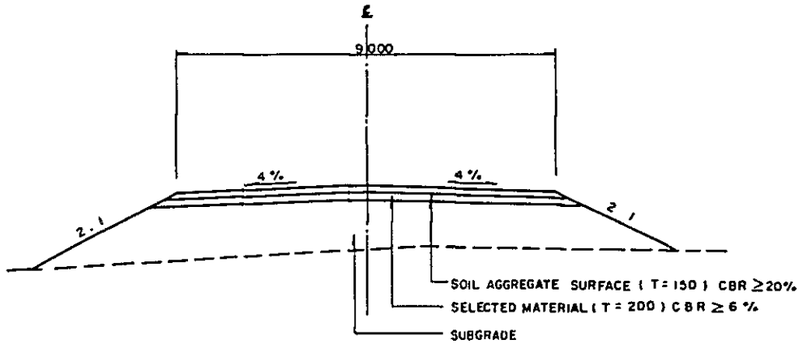
FILL SECTION



CUT SECTION



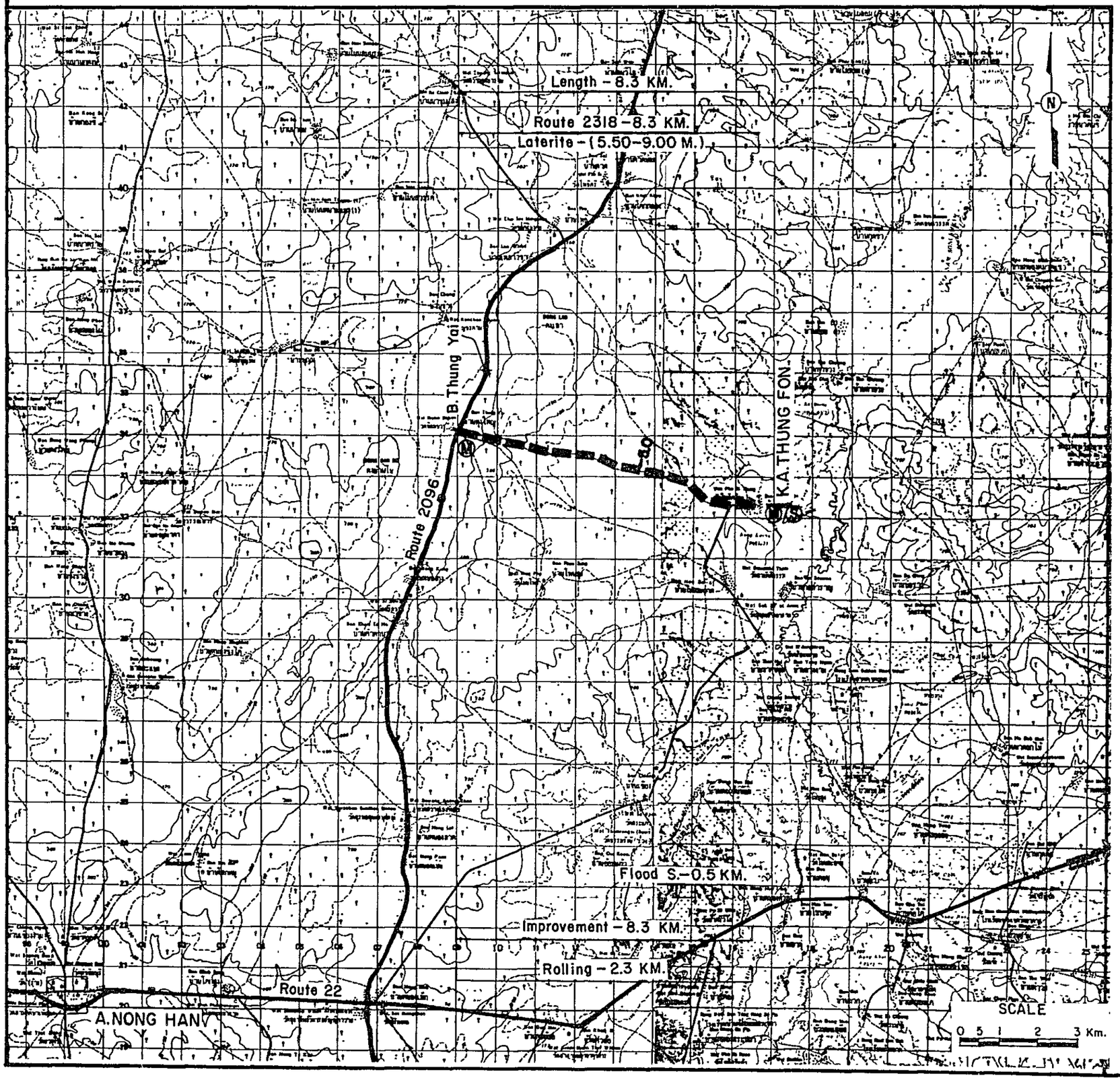
DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)



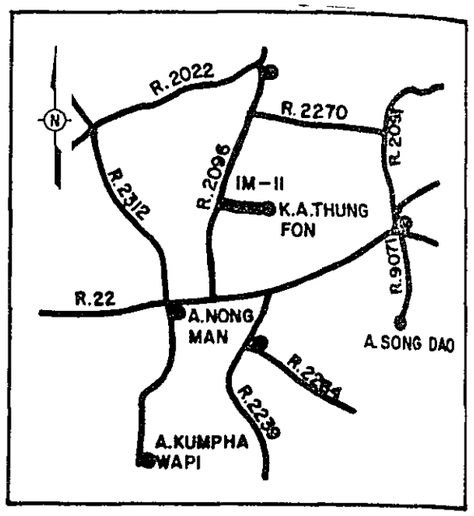
SOIL AGGREGATE SURFACED ROAD (Class F5)

Figure 11.5.2

PROPOSED ROUTE NO. IM – II C. UDON THANI B. THUNG YAI (J.R. 2096) – K.A. THUNG FON
ROUTE NO. 2318 L = 8.3 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	3.7	C–7.00 x 10.00	W–4.00 x 8.00
2	6.4	C–7.00 x 16.00	W–4.50 x 13.00
3	6.4	C–7.00 x 16.00	W–4.50 x 12.50
4	6.7	C–7.00 x 18.00	W–4.50 x 15.50

LEGEND

- PROPOSED ROUTE (IMPROVEMENT)
- PROPOSED ROUTE (NEW CONSTRUCTION)
- PAVED ROUTE
- UNPAVED ROUTE
- INVENTORY SURVEY ROUTE
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

Table 11.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-11 (8.3 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	(DBST) Financial Cost (10^3฿)	(DBST) Economic Cost (10^3฿)	(Soil Aggregate Surface) Q'ty	(Soil Aggregate Surface) Financial Cost (10^3฿)	(Soil Aggregate Surface) Economic Cost (10^3฿)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	19	285	259	19	285	259
Excavation - Soil	m^3	20	0	0	0	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0	0	0	0
Embankment	m^3	45	46,800	2,106	1,916	46,800	2,106	1,916
Selected Material	m^3	80	17,600	1,408	1,253	17,600	1,408	1,253
Soil Aggregate Surface or Subbase	m^3	105	11,800	1,239	1,102	11,800	1,239	1,102
Crushed Stone Base	m^3	370	8,100	2,997	2,757	1,500	555	510
Soil Aggregate Shoulder	m^3	105	3,500	367	327	600	63	56
Prime Coat and DBST	m^2	55	45,700	2,514	2,263	8,300	457	411
Pipe Culvert	m	2,100	360	756	695	360	756	695
Box Culvert	m	16,000	0	0	0	0	0	0
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	60	2,400	2,136	60	2,400	2,136
Sub Total (a)				14,073	12,711		9,269	8,341
Miscellaneous Works (a) x 7%				985	890		649	584
Total (b)				15,058	13,601		9,918	8,925
PHYSICAL CONTENGENCY (b) x 15%				2,259	2,040		1,488	1,339
ENGINEERING AND ADMINISTRATION (b) x 10%				1,506	1,360		992	893
Sub Total				3,765	3,400		2,480	2,232
LAND ACQUISITION								
Highly Developed Land	ha	50,000	0	0	0	0	0	0
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				0	0		0	0
GRAND TOTAL				18,823	17,001		12,398	11,157

Table 11.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	6,800	0	0	0	0	8,530	0
1986	10,201	0	0	0	0	11,425	0
1987	0	41	812	-53	800	0	714
1988	0	117	870	-50	937	0	747
1989	0	193	929	-48	1,074	0	764
1990	0	269	987	-46	1,210	0	769
1991	0	345	1,045	-43	1,347	0	764
1992	0	421	1,104	-41	1,484	0	752
1993	0	497	1,162	-38	1,621	0	733
1994	4,017	578	1,245	-35	1,788	1,817	722
1995	0	659	1,327	-31	1,956	0	705
1996	0	740	1,410	-28	2,123	0	684
1997	0	822	1,493	-24	2,291	0	658
1998	0	903	1,576	-20	2,458	0	631
1999	0	984	1,659	-17	2,626	0	602
2000	0	1,065	1,741	-13	2,793	0	572
2001	-7,821	1,146	1,824	-10	2,960	-1,429	541
TOTAL	13,197	8,780	19,184	-497	27,466	20,343	10,358

DISCOUNTED ECONOMIC COSTS :	20,343
DISCOUNTED ECONOMIC BENEFITS :	10,358
AGRICULTURAL DEVELOPMENT BENEFIT	2,902
VOC SAVING	7,723
RMC SAVING	-268
NET PRESENT VALUE :	-9,985
BENEFIT COST RATIO :	0.51
INTERNAL RATE OF RETURN :	5.1 %

Table 11.6.2 COST AND BENEFITS

(F5 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	2,231	0	0	0	0	2,799	0
1986	8,926	0	0	0	0	9,997	0
1987	0	41	618	-17	642	0	573
1988	0	117	668	-15	770	0	614
1989	0	193	718	-13	898	0	639
1990	0	269	768	-11	1,026	0	652
1991	0	345	818	-10	1,153	0	654
1992	0	421	868	-8	1,281	0	649
1993	0	497	918	-6	1,409	0	637
1994	726	578	987	-3	1,562	328	631
1995	0	659	1,057	-1	1,716	0	619
1996	0	740	1,126	2	1,869	0	602
1997	0	822	1,196	5	2,022	0	581
1998	0	903	1,265	7	2,175	0	558
1999	0	984	1,335	10	2,329	0	534
2000	0	1,065	1,404	13	2,482	0	508
2001	-5,132	1,146	1,474	15	2,635	-938	481
TOTAL	6,751	8,780	15,220	-31	23,969	12,186	8,933

DISCOUNTED ECONOMIC COSTS :	12,186
DISCOUNTED ECONOMIC BENEFITS :	8,933
AGRICULTURAL DEVELOPMENT BENEFIT	2,902
VOC SAVING	6,076
RMC SAVING	-46
NET PRESENT VALUE :	-3,254
BENEFIT COST RATIO :	0.73
INTERNAL RATE OF RETURN :	8.8 %

Table 11.7.1 SOCIAL INDICATORS

(Proposed Route IM-11)

Population (1,000)	
1982	: 7.7
1993	: 8.7
Average travelling speed, without (kph)	: 40
Isolation	
Access to Amphoe	
Average distance to Amphoe (km) 1/	: 4.0
Per capita time savings (10^{-4})	: 0.052
Score	: 153
Access to Artery Highway	
Average distance to highway (km) 1/	: 8
Per capita time savings (10^{-4})	: 0.102
Score	: 222
Impassability	
Impassable week a year	: 1
Impassability per year	: 0.019
Impassability per capita (10^{-4})	: 0
Score	: 0
Health	
Access to Hospital	
Average distance to Hospital (km) 1/	: 4.0
Per capita time savings (10^{-4})	: 0.051
Score	: 119
Access to Medical Facilities	
Average distance to facilities (km) 1/	: 2.0
Per capita time savings (10^{-4})	: 0.026
Score	: 104
Education	
Access to Secondary School	
Number of Student in 1993 (1,000) 2/	: 1.5
Average distance to school (km)	: 4.0
Per capita time savings (10^{-4})	: 0.296
Score	: 160
Teacher Intensity	
Number of teachers 3/	
University graduate	: 3
Total	: 27
Number of Student	: 597
Indicators	
E1 4/	: 5.0
E2 5/	: 45.2
E 6/	: 50.2
Degree of Improvement 7/	: 1.36
Score	: 87
Disparity	
G.P.V. in 1993 (Mn B) 8/	
With project	: 25.50
Without project	: 24.4
Per capita G.P.V. in 1993 (B)	
With project (W)	: 2,931
Without project (w)	: 2,805
Degree of Disparity	
(A/W) - (A/w) 9/	: 0.04
Score	: 71
Total Score	: 916

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:

Number of university graduate teachers	438
Number of Teachers	1,285
Number of student	25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.

PROPOSED ROUTE NO. IM-12

Changwat : Sakon Nakhon

A. Sawang Daen Din (J.R.22) - A. Song Dao

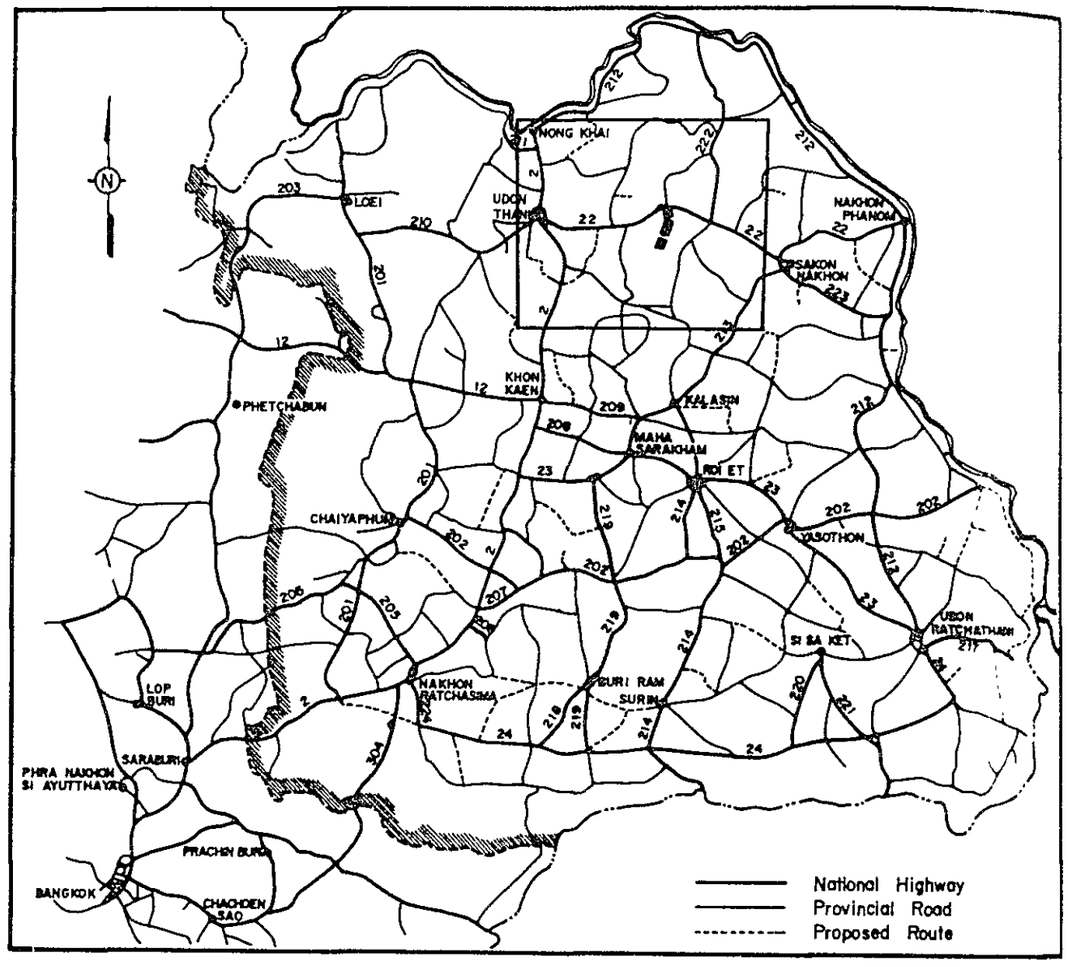
Length : 18.1 KM.

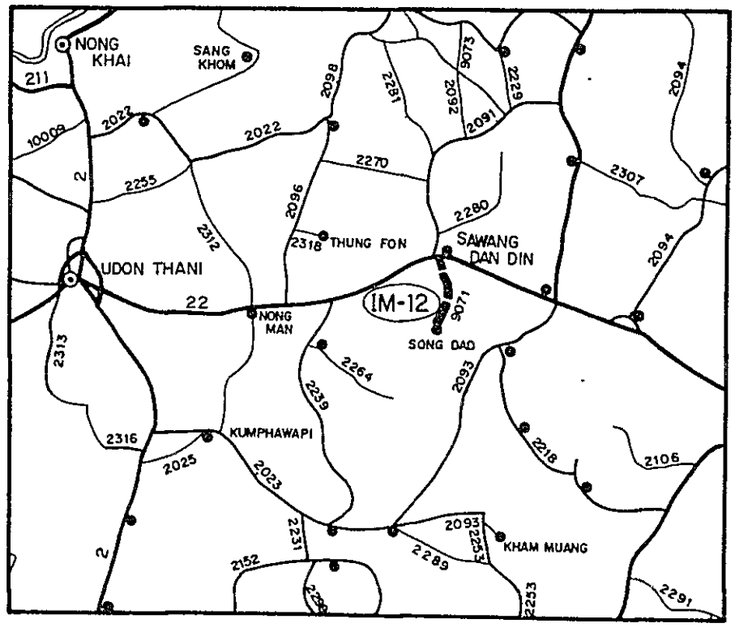
SUMMARY

PROPOSED ROUTE IM-12

Item	Description
Changwat	Sakhon Nakhon
Origin	A. Sawang Daen Din (J.R.22)
Destination	A. Song Dao
Length	
Total	18.1 km
Improvement Section	18.1 km
DOH Road	0 km
ARD Road	18.1 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good
Terrain	Rolling
Influence Area	
Area	164 km^2
Population (1982)	11,500
Principal Crops	Paddy
Traffic (ADT)	
Existing	255
1993	861
2001	1,116
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	35,903 . 10^3 ฿
Economic	32,590 . 10^3 ฿
IRR	12.5 %
B/C	1.04
Social Impact	High
Recommendation	For immediate implementation

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the West part of Changwat Sakon Nakhon. The route, starting at Amphoe Sawang Daen Din on Route 22, runs Southward passing through Ban Puai, Ban Nong Thum and Ban Lao Yai and ends at Amphoe Song Dao. Its total length is 18.1 km. (Figure 12.5.2)

The terrain is almost rolling. In the influence area, there exists several villages with total population of 11,500. There are one medical center, one hospital and one secondary school along the proposed route.

The proposed route, upon completion, will play vital role to connect Amphoe Song Dao with artery highway, Route 22.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 12.1.1. The details are shown as the results of inventory survey in Table 12.1.2.

2. TRAFFIC

2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the proposed road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated basing on manual classified counts as shown below:

Proposed Road Link

Traffic Volume in Base Year

Source (base year)	Link No.	Vehicle Type									
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	ADT
Manual Counts (1982)	1	3	75	46	27	-	8	33	37	6	255

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms

of tonnage per day on the proposed road link were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	1517

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	261	73	333

2.4 Future Growth of Transport Movement

The growth rates of passenger and freight movements for the periods of 1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula described in 7.3.3-2) of the Main Report. The basis for the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 – 1987	1987 – 1993	1993 – 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.2	1.1	1.0
PASSENGER MOVEMENT	5.2	5.5	5.6

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 – 1987	1987 – 1993	1993 – 2001
NON-AGRI.	6.7	7.0	7.2
AGRICULTURE	0.1	0.1	0.1
FREIGHT	5.3	5.5	5.7

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into traffic volume by vehicle type applying future traffic composition as shown in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	2.0	49.7	30.5	17.9	0.0	7.7	31.7	35.6	25.0
	1987	4.9	46.8	27.0	18.8	2.5	10.1	27.6	35.4	26.8
	1993	8.3	43.3	22.9	20.0	5.4	13.1	22.6	35.2	29.1
	2001	12.9	38.7	17.5	21.5	9.4	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the following table and details by road link by traffic type are shown in Table 12.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE .

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	10	57	40	5	114	41	53	40	359	352	711
1993	22	62	54	15	143	44	69	57	466	395	861
2001	50	67	83	36	198	46	100	91	670	446	1116

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all of cultivated land in the influence area is covered by paddy fields. In the upland field, cassava ranks first followed by maize, kenaf, sugar cane and ground nuts. There are rather large unused cultivable land for upland field but no land for paddy fields.

Land use and capability conditions in the area of influence are shown in the Table 12.3.1 and Figure 12.3.1. A typical cropping calendar in the Sakon Nakhon area is shown in Figure 12.3.2.

3.2 Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shown in Table 12.3.2.

Farmgate prices and production costs of the selected crops are estimated as follows, referring to che Changwat data and field survey information as shown in Table 12.3.3.

Based on the above projected production volume, farmgate prices, production costs and land proparation cost estimated separately, net production value (NPV) was obtained as shown in Table 12.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link No.	Terrain	Without Project: Length (km)	Without Project: 1) Road Class	Without Project: Nos. of Wooden Bridge	Without Project: Nos. of Narrow C.Bridge	With Project: Length (km)	With Project: 1) Road Class	With Project: Nos. of Wooden Narrow Bridge
1	Rolling	18.1	2B	3	1	18.1	1 (F4)	0

1) Road 1: Paved Road

Road 2A: Laterite Road with good surface condition and alignment

Road 2B: Laterite Road with good surface condition but poor allignment

Road 3: Laterite Road with poor surface condition and alignment

Road 4: Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were calculated as follows.

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Cladd	1987	1993	2001
1 (F4)	3,879	5,583	9,102

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard : F4 (feasible)

Geometric Design : AASHTO (Rural Highways)

Typical Cross Section : as shown in Figure 12.5.1

Minimum Height of Embankment

Ordinary Section : 1.0m

Approach of Bridge in Flat Area : 2.0m

Flood Section : 0.7m (above flood level)

Pavement Structure

In case of F4 Standard

DBST : 2.5cm

Crushed Stone Base CBR≥80% : 15.0cm

Soil Aggregate Subbase CBR≥20% : 15.0cm

Selected Material CBR≥ 6% : 20.0cm

Pipe Culvert

Standard Size : ø 100cm

Standard Interval

Paddy Area : 200 m

Others : 500 m

Box Culvert

Standard Size : 2.4m x 2.4m

Location : as required

Bridge

Standard Type (width 7.0m)

Short Span Bridge : RC - Slab

Long Span Bridge : PC - Girder

Location : as shown in Bridge List in Figure 12.5.2

Alignment of the route is shown in Figure 12.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 12.5.1.

Total financial and economic construction costs by applied road class F4 are as given below:

F4 Standard (DBST) L = 18.1 km

Financial Cost	$35,903.10^3$ ฿
Economic Cost	$32,590.10^3$ ฿

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 12.6.1.

The result indicates that the proposed project seems to be feasible under F4 Standard (DBST).

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 12.7.1. Social impacts of the proposed route are considerably high.

Table 12.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	A. Sawang Daen Din (J.R. 22)		
Destination	A. Song Dao		
Length			
Total			18.1 km
Improvement Section			18.1 km
DOH Road			0 km
ARD Road			18.1 km
Others			0 km
New Alignment Section			0 km
Terrain	Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.0 m - 9.0 m, 7.3 m (Weighted average)		
Embankment Section			
Length			18.1 km
Height	0.3 m - 1.0 m		
Cut Section			
Length			0 km
Depth	m - m		
Surface Type and Condition			
SBST or DBST			0 km
Soil Aggregate	Good		18.1 km
Earth			0 km
Pipe Culvert	8 each		
Box Culvert	0 each		0 m
Bridge			
Permanent Bridge	0 each		0 m
Narrow Concrete Bridge	1 each		28.5 m (4m)
Wooden Bridge	3 each		25.0 m
Overflow Section	1 place		1.0 km

Table 12.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-12 ROUTE ARD A.SAWANG DAEN DIN (J.R. 22) ∿ A. SONG DAO L = 18.1 Km.

SAKON NAKHON

STATION (Km): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

Item		Station (Km)	Value
VILLAGE - Name - Household (H) - Population (P)		0	A. SAWANG DAEN DIN
		4	B. PUAI H = 400 P = 4000
		8	B. NONG THUM H = 500 P = 4500
		14	B. LAO YAI H = 150 P = 900
		18	A. SONG DAO H = 500 P = 5300
TERRAIN		0 – 2	Flat
		2 – 18.1	Rolling
CROSS SECTION	Formation Width (m)	0 – 2	6.00
		2 – 6	9.00
		6 – 10	7.00
		10 – 12	8.00
		12 – 14	6.00
		14 – 16	7.00
		16 – 18.1	6.50
	Embankment Height (m)	0 – 2	1.00
		2 – 4	0.30
		4 – 5	0.50
		5 – 8	1.00
		8 – 10	0.70
		10 – 12	0.80
		12 – 14	0.30
		14 – 16	0.80
		16 – 18.1	0.40
	Cutting Depth (m)		
PAVEMENT	Type/Length	0 – 18.1	Laterite
	Condition	0 – 18.1	Good
FLOODING	Overflow Length(Km)/Height(m)	12 – 13	L=1.0 H=1.0
LAND USE	Left	0 – 2	Paddy
		2 – 5	Bush
		5 – 10	Paddy
		10 – 11	Sugar Cane
		11 – 18.1	Cassava
	Right	0 – 2	Paddy
		2 – 5	Bush
		5 – 10	Paddy
		10 – 11	Sugar Cane
		11 – 18.1	Cassava
PIPE CULVERT	Total Number	0 – 18.1	8 Pipes
BOX CULVERT & BRIDGE	Station (Km) / Dimension	0.2	W-Br. 4.00 x 6.50
		1.5	W-Br. 4.50 x 7.00
		1.7	W-Br. 4.50 x 7.00
		12.7	W-Br. 3.50 x 4.50
		17.7	C-Br. 4.50 x 28.50
RIGHT OF WAY (m)		0 – 12	12.0
		12 – 15	10.0
		15 – 18.1	12.0
ALIGNMENT	Horizontal	0 – 18.1	Fair
	Vertical	0 – 18.1	FRir
ROUTE NO., AGENCIES		0 – 18.1	ARD

Table 12.2.1 TRAFFIC VOLUME ON ROUTE IM - 12

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	9	9	20	20	43	43
	I	1	1	3	3	6	6
	DV	0	0	0	0	0	0
	TOTAL	10	10	22	22	50	50
L/B	N+D	50	50	54	54	58	58
	I	7	7	8	8	9	9
	DV	0	0	0	0	0	0
	TOTAL	57	57	62	62	67	67
M/B	N+D	35	35	47	47	72	72
	I	5	5	7	7	11	11
	DV	0	0	0	0	0	0
	TOTAL	40	40	54	54	83	83
H/B	N+D	5	5	13	13	31	31
	I	1	1	2	2	5	5
	DV	0	0	0	0	0	0
	TOTAL	5	5	15	15	36	36
P/P&T	N+D	99	99	124	124	172	172
	I	15	15	19	19	26	26
	DV	0	0	0	0	0	0
	TOTAL	114	114	143	143	198	198
4/T	N+D	36	36	38	38	40	40
	I	5	5	6	6	6	6
	DV	0	0	0	0	0	0
	TOTAL	41	41	44	44	46	46
6/T	N+D	46	46	60	60	87	87
	I	7	7	9	9	13	13
	DV	0	0	0	0	0	0
	TOTAL	53	53	69	69	100	100
10/T	N+D	35	35	49	49	79	79
	I	5	5	7	7	12	12
	DV	0	0	0	0	0	0
	TOTAL	40	40	57	57	91	91
ADT	N+D	312	312	405	405	583	583
	I	47	47	61	61	87	87
	DV	0	0	0	0	0	0
	TOTAL	359	359	466	466	670	670
M/C	N+D	327	327	371	371	428	428
	I	24	24	24	24	18	18
	DV	0	0	0	0	0	0
	TOTAL	352	352	395	395	446	446
TOTAL	N+D	639	639	776	776	1010	1010
	I	71	71	85	85	106	106
	DV	0	0	0	0	0	0
	TOTAL	711	711	861	861	1116	1116

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

Figure 12.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM - 12

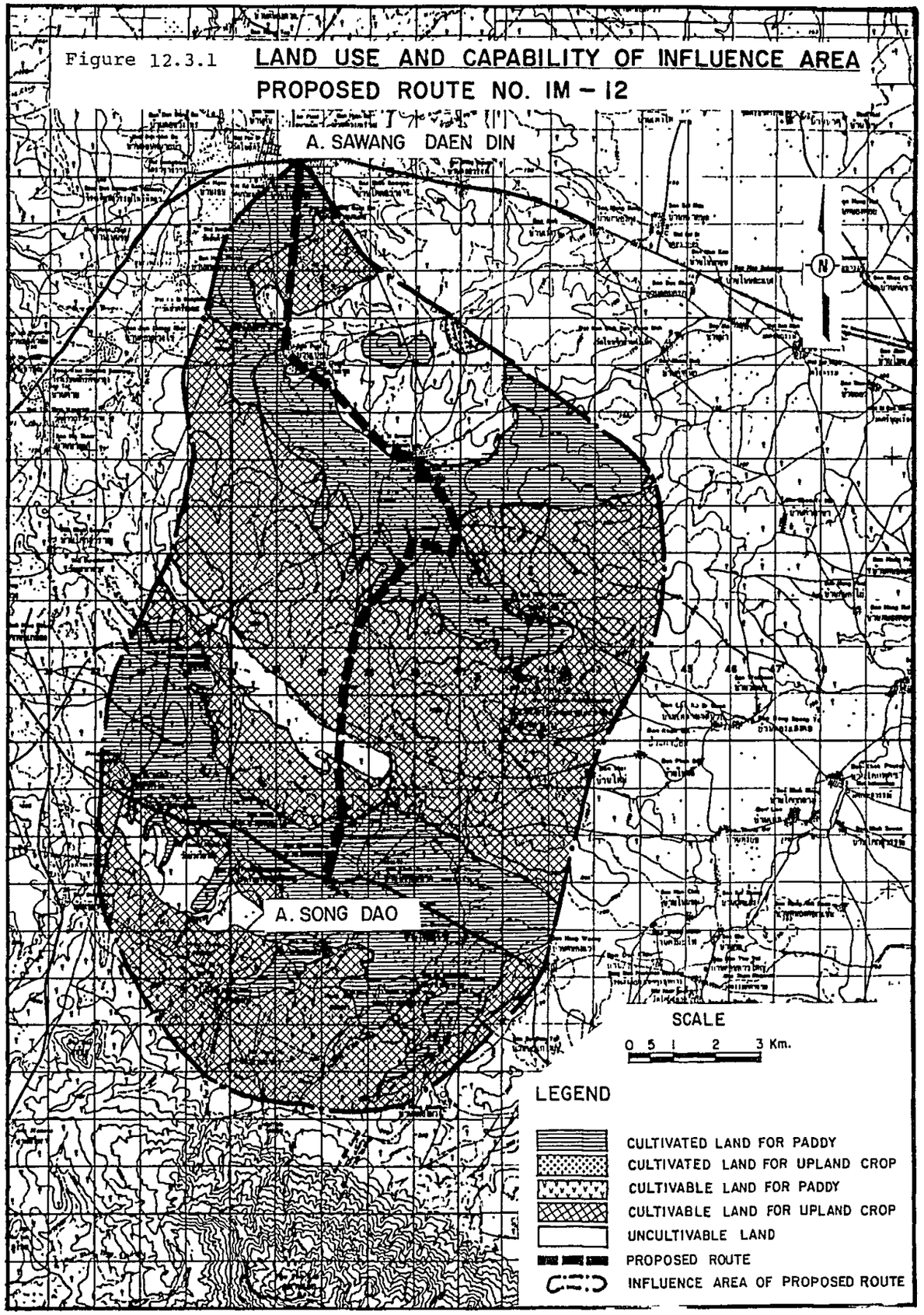


Figure 12.3.2 CROPPING CALENDAR

0400 CHANGWAT SAKON NAKHON

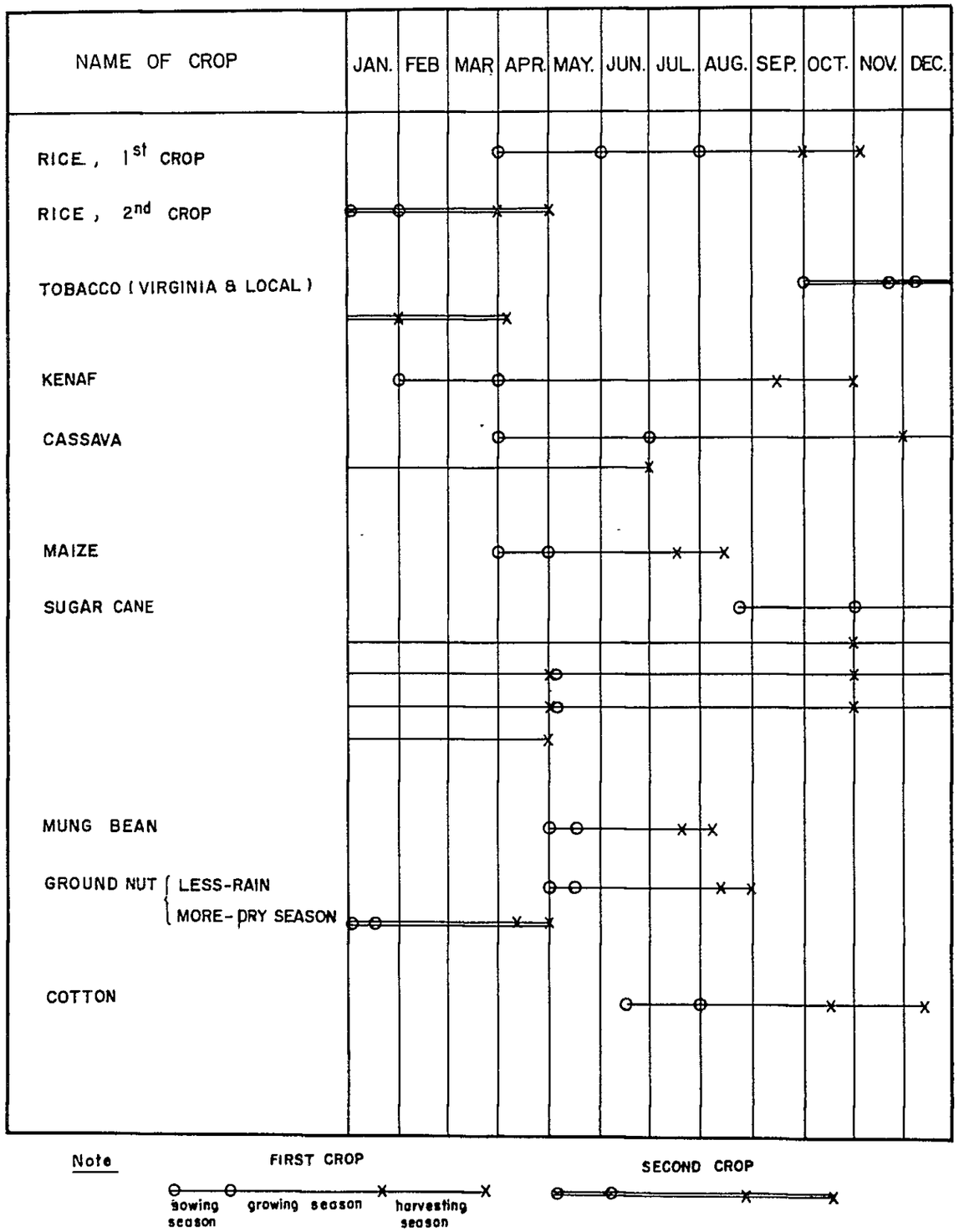


TABLE 12.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		31.875 (51.0)	0.313 (0.5)	32.188 (51.5)	-	52.500 (84.0)	52.500 (84.0)
0404	SAWANG DAEN DIN	12.500 (20.0)	0.313 (0.5)	12.813 (20.5)	-	12.500 (20.0)	12.500 (20.0)
0407	SONG DAO	19.375 (31.0)	-	19.375 (31.0)	-	40.000 (64.0)	40.000 (64.0)

TABLE 12.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			30.84	0.83	-	0.25	1.98	0.49	0.85	-	4.40	35.24
1987			30.84	0.83	-	0.26	1.99	0.48	0.84	-	4.40	35.24
1993	WITHOUT	PROJECT	30.84	0.82	-	0.27	2.00	0.48	0.83	-	4.40	35.24
	WITH	PROJECT	30.84	0.77	-	0.24	2.21	0.42	0.76	-	4.40	35.24
2001	WITHOUT	PROJECT	30.84	0.80	-	0.29	2.02	0.47	0.82	-	4.40	35.24
	WITH	PROJECT	30.84	0.75	-	0.26	2.23	0.42	0.74	-	4.40	35.24
CROP YIELD (KG/RAI)												
1981			233.8	260.0	-	189.0	2580.0	4000.0	161.0	-		
1987			235.2	261.6	-	189.0	2580.0	4072.5	161.0	-		
1993	WITHOUT	PROJECT	236.6	263.1	-	189.0	2580.0	4146.4	161.0	-		
	WITH	PROJECT	239.5	266.3	-	190.1	2595.5	4171.3	161.0	-		
2001	WITHOUT	PROJECT	238.5	265.2	-	189.0	2580.0	4247.0	161.0	-		
	WITH	PROJECT	245.3	272.8	-	191.7	2616.4	4306.6	161.0	-		
CROP PRODUCTION (TON)												
1981			7,210	217	-	47	5,103	1,960	136	-	7,463	14,673
1987			7,254	216	-	49	5,141	1,974	135	-	7,515	14,769
1993	WITHOUT	PROJECT	7,297	215	-	51	5,173	1,987	133	-	7,559	14,856
	WITH	PROJECT	7,385	204	-	46	5,735	1,772	122	-	7,879	15,264
2001	WITHOUT	PROJECT	7,356	213	-	55	5,214	2,003	131	-	7,615	14,971
	WITH	PROJECT	7,564	206	-	49	5,824	1,800	120	-	7,998	15,563

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 12.3.3 FARMGATE PRICE AND PRODUCTION COST

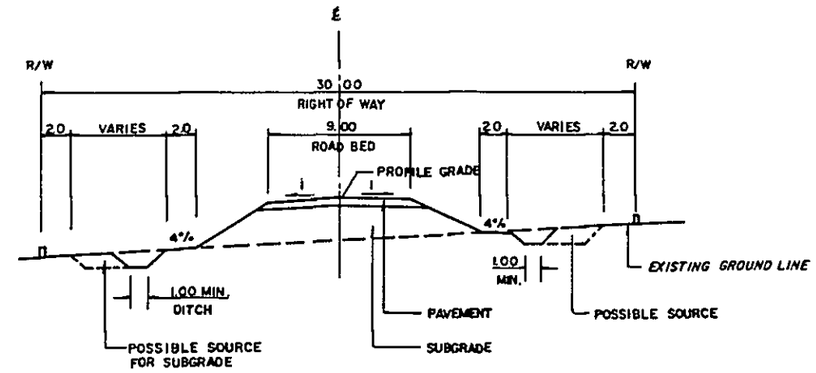
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,663	2,235	-	6,664	546	594	4,614	-
WITH PROJECT (1987 - 2001)	3,755	2,291	-	6,664	560	594	4,729	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	586	438	-	1,010	759	2,130	631	-
WITH PROJECT (1987 - 2001)	606	458	-	1,030	779	2,180	631	-

TABLE 12.3.4 NET PRODUCTION VALUE

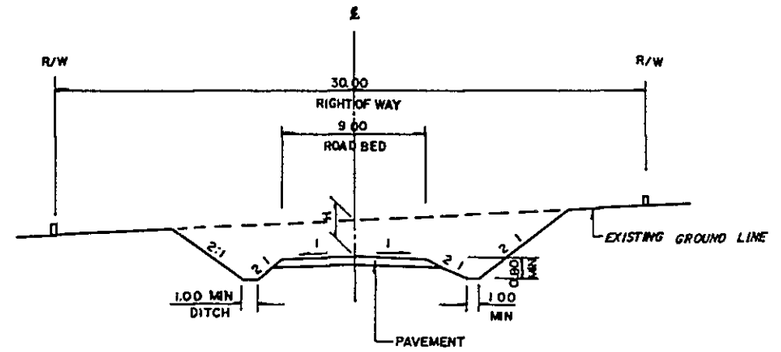
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	8,493	1,715	10,208	8,544	1,728	10,272
1993	8,653	1,744	10,397	9,038	1,889	10,927
2001	8,867	1,785	10,652	9,711	1,971	11,682

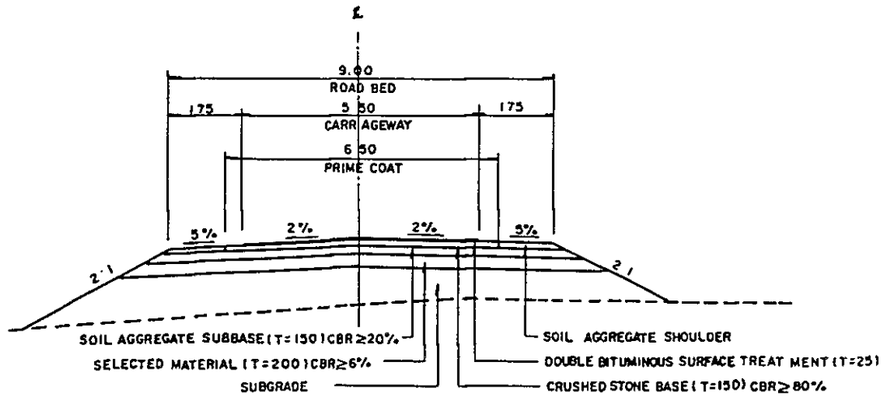
Figure 12.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



FILL SECTION



CUT SECTION

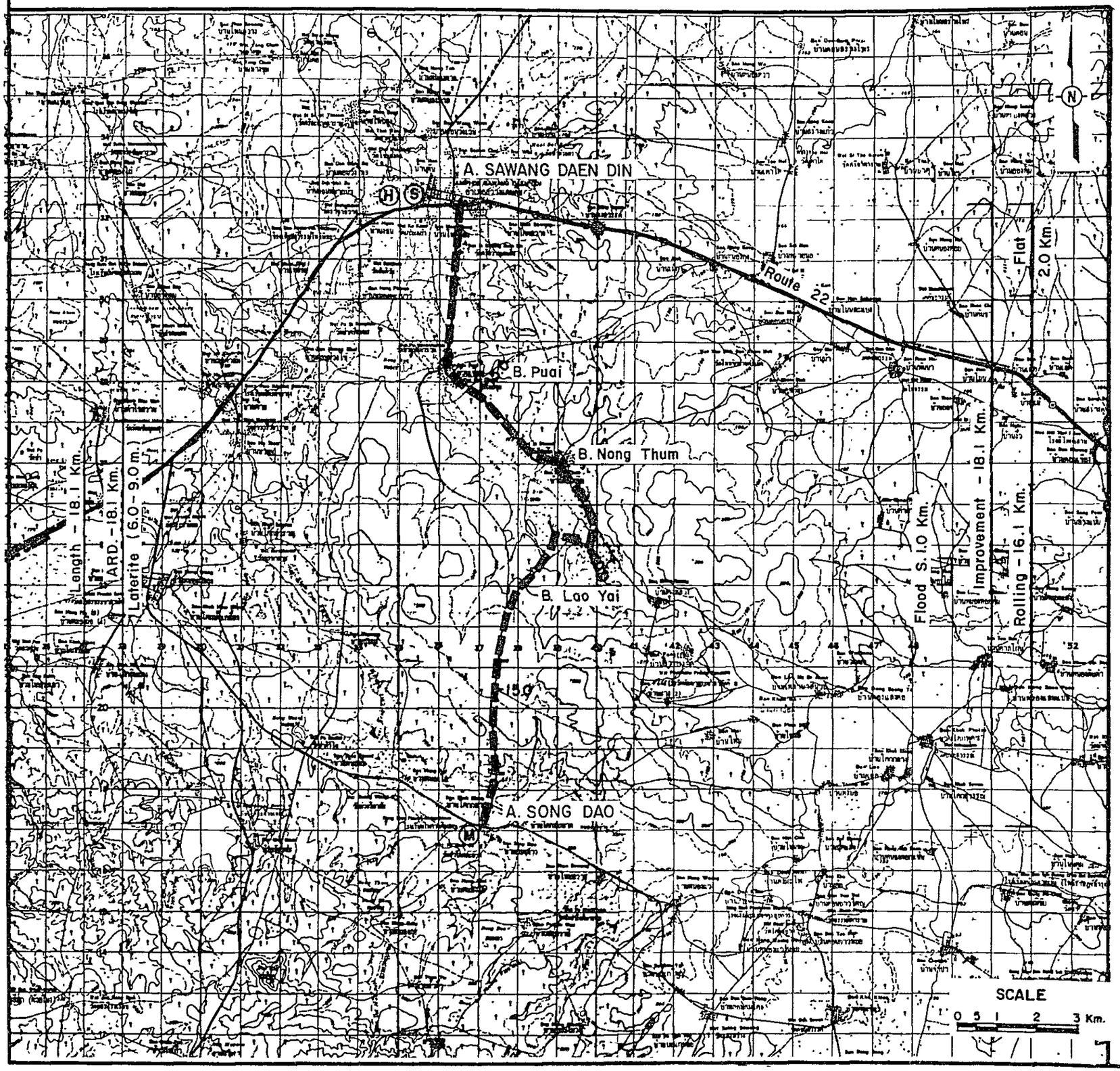


DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

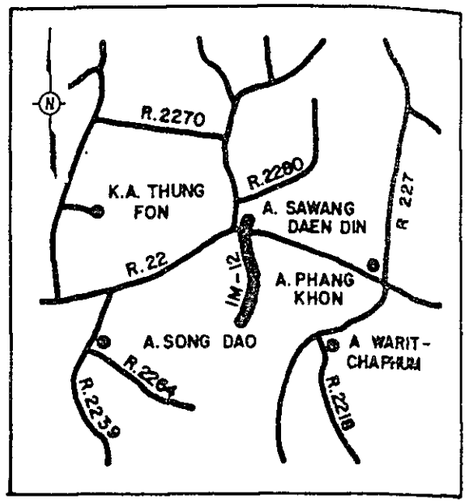
Figure 12.5.2

PROPOSED ROUTE NO. IM-12 C. SAKON NAKHON A. SAWANG DAEN DIN (J.R. 22) - A. SONG DAO

ROUTE NO. ARD (9071) L= 18.1 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	0.2	C-7.00 x 9.00	W-4.00 x 6 50
2	1.5	C-7.00x 9.00	W-4 50 x 7 00
3	1.7	C-7.00x 9.00	W-4 50 x 7 00
4	12.7	(BOX CULVERT)	W-4 50 x 4 50
5	17.7	C-7.00 x 28.50	C-4 50 x 28 50

LEGEND

- PROPOSED ROUTE (IMPROVEMENT)
- PROPOSED ROUTE (NEW CONSTRUCTION
- PAVED ROUTE
- UNPAVED ROUTE
- INVENTORY SURVEY ROUTE
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

Table 12.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-13 (18.1 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	(DBST) Financial Cost (10^3฿)	(DBST) Economic Cost (10^3฿)
DIRECT CONSTRUCTION COST					
Clearing and Grubbing	ha	15,000	41	615	559
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	62,000	2,790	2,538
Selected Material	m^3	80	38,400	3,072	2,734
Soil Aggregate Surface or Subbase	m^3	105	26,900	2,824	2,513
Crushed Stone Base	m^3	370	17,600	6,512	5,991
Soil Aggregate Shoulder	m^3	105	7,600	798	710
Prime Coat and DBST	m^2	55	99,600	5,478	4,930
Pipe Culvert	m	2,100	520	1,092	1,004
Box Culvert	m	16,000	20	320	288
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	56	2,340	1,993
Sub Total (a)				25,741	23,264
Miscellaneous Works (a) x 7%				1,802	1,628
Total (b)				27,543	24,892
PHYSICAL CONTENGENCY (b) x 15%				4,131	3,734
ENGINEERING AND ADMINISTRATION (b) x 10%				2,754	2,489
Sub Total				6,885	6,223
LAND ACQUISITION					
Highly Developed Land	ha	50,000	28	1,400	1,400
Less Developed Land	ha	15,000	5	75	75
Sub Total				1,475	1,475
GRAND TOTAL				35,903	32,590

Table 12.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST: CONST. COST	BENEFITS: AGRI. BENEFIT	BENEFITS: VOC SAVING	BENEFITS: RMC SAVING	BENEFITS: TOTAL	DISCOUNTED(12%): COST	DISCOUNTED(12%): BENEFIT
1984	0	0	0	0	0	0	0
1985	13,036	0	0	0	0	16,352	0
1986	19,554	0	0	0	0	21,900	0
1987	0	64	3,879	17	3,959	0	3,535
1988	0	142	4,163	26	4,330	0	3,452
1989	0	219	4,447	34	4,700	0	3,346
1990	0	297	4,731	43	5,071	0	3,223
1991	0	375	5,015	52	5,442	0	3,088
1992	0	452	5,299	61	5,812	0	2,945
1993	0	530	5,583	70	6,183	0	2,797
1994	8,760	593	6,023	83	6,699	3,963	2,705
1995	0	655	6,463	97	7,214	0	2,602
1996	0	718	6,903	110	7,730	0	2,489
1997	0	780	7,342	124	8,246	0	2,371
1998	0	843	7,782	137	8,762	0	2,249
1999	0	905	8,222	151	9,278	0	2,126
2000	0	968	8,662	164	9,793	0	2,004
2001	-15,788	1,030	9,102	177	10,309	-2,884	1,883
TOTAL	25,562	8,569	93,615	1,345	103,529	39,331	40,813

DISCOUNTED ECONOMIC COSTS :	39,331
DISCOUNTED ECONOMIC BENEFITS :	40,813
AGRICULTURAL DEVELOPMENT BENEFIT	2,937
VOC SAVING	37,422
RMC SAVING	454
NET PRESENT VALUE :	1,482
BENEFIT COST RATIO :	1.04
INTERNAL RATE OF RETURN :	12.5 %

Table 12.7.1 SOCIAL INDICATORS

(Proposed Route IM-12)

Population (1,000)		
1982	:	11.5
1993	:	13.0
Average travelling speed, without (kph)	:	48
Isolation		
Access to Amphoe		
Average distance to Amphoe (km) 1/	:	4.5
Per capita time savings (10^{-4})	:	0.038
Score	:	115
Access to Artery Highway		
Average distance to highway (km) 1/	:	18
Per capita time savings (10^{-4})	:	0.097
Score	:	194
Impassability		
Impassable week a year	:	1
Impassability per year	:	0.019
Impassability per capita (10^{-4})	:	0.022
Score	:	183
Health		
Access to Hospital		
Average distance to Hospital (km) 1/	:	9.0
Per capita time savings (10^{-4})	:	0.048
Score	:	112
Access to Medical Facilities		
Average distance to facilities (km) 1/	:	5.0
Per capita time savings (10^{-4})	:	0.026
Score	:	104
Education		
Access to Secondary School		
Number of Student in 1993 (1,000) 2/	:	2.5
Average distance to school (km)	:	4.5
Per capita time savings (10^{-4})	:	0.160
Score	:	83
Teacher Intensity		
Number of teachers 3/		
University graduate	:	-
Total	:	16
Number of Student	:	422
Indicators		
E1 4/	:	-
E2 5/	:	37.9
E 6/	:	37.9
Degree of Improvement 7/	:	1.80
Score	:	115
Disparity		
G.P.V. in 1993 (Mn B) 8/		
With project	:	33.3
Without project	:	32.2
Per capita G.P.V. in 1993 (B)		
With project (W)	:	2,562
Without project (w)	:	2,477
Degree of Disparity		
(A/W) - (A/w) 9/	:	0.04
Score	:	71
Total Score	:	977

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:

Number of university graduate teachers	438
Number of Teachers	1,285
Number of student	25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.

PROPOSED ROUTE NO. IM - 13

Changwat : Sakon Nakhon / Nakhon Phanom

B. Chuam (J.R.2094) - A. Na Wha

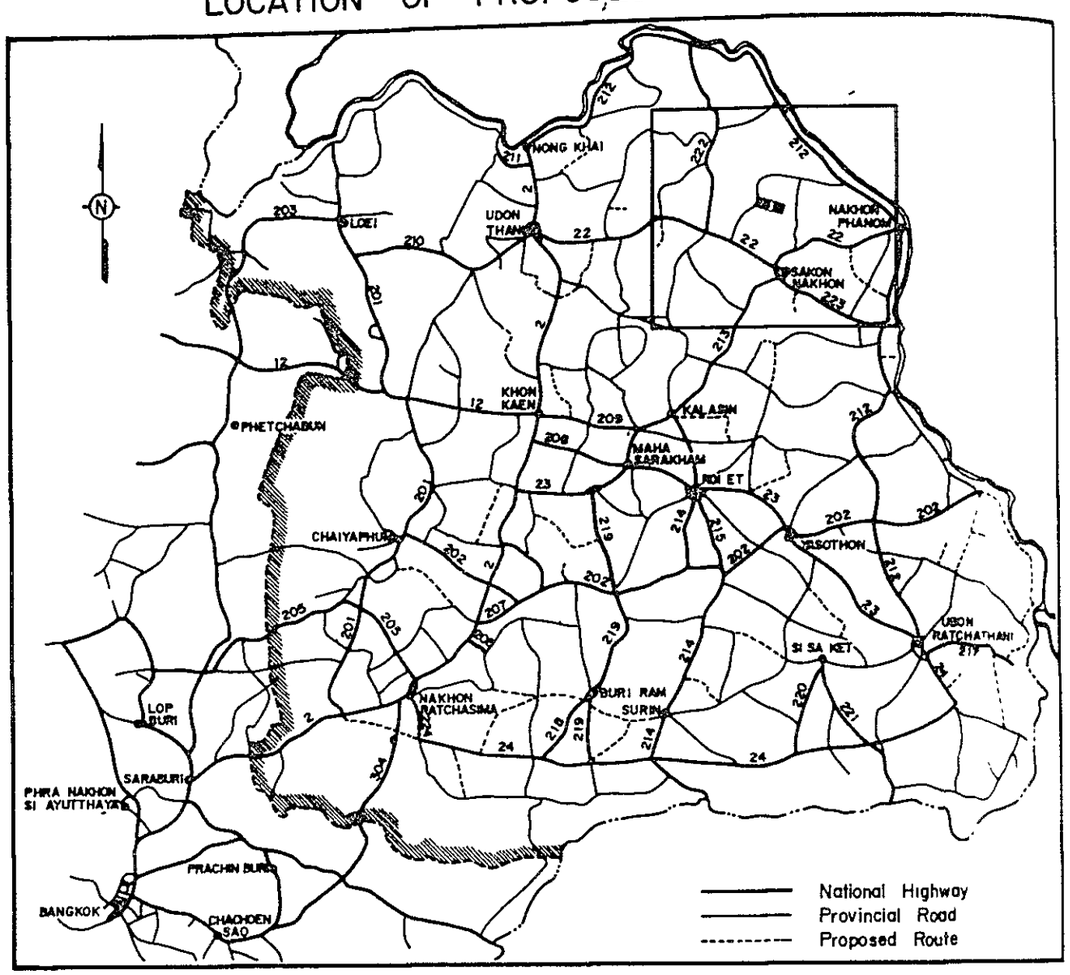
Length : 19.8 KM.

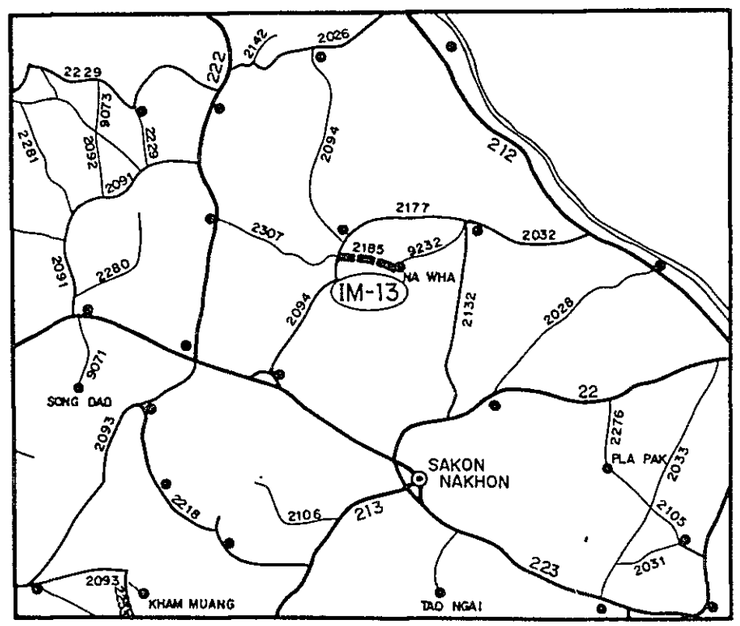
SUMMARY

PROPOSED ROUTE IM- 13

Item	Description	
Changwat	Sakhon Nakhon /Nakhon Phanom	
Origin	B. Chuam (J.R.2094)	
Destination	A. Na Wha	
Length		
Total		19.8 km
Improvement Section		19.8 km
DOH Road	R.2185	19.8 km
ARD Road		0 km
Others		0 km
New Alignment Section		0 km
Surface Type and Condition	Soil Aggregate, Poor	
Terrain	Flat	
Influence Area		
Area		140 km^2
Population (1982)		15,800
Principal Crops		Paddy
Traffic (ADT)		
Existing		69
1993		309
2001		410
Proposed Standard	F4 (DBST)	
Construction Cost		
Financial		37,519 . 10^3 ฿
Economic		33,915 . 10^3 ฿
IRR		6.6 %
B/C		0.61
Recommendation	For further consideration	

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two changwat of Sakon Nakhon and Nakhon Phanom. The route, starting at Ban Chuam on Route 2094, runs southeast-ward passing through Ban Khok Sa-At, Ban Seo and Ban Tan and ends at Amphoe Na Wha. Its total length is 19.8 km (Figure 13.5.2).

The terrain is almost flat. In the influence area, there exists several villages with total population of 15,800. There are no medical center, but one hospital and one secodary school along the proposed route.

The proposed route, upon completion, will play vital role to connect Amphoe Na Wha with Route 2094.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are summarized in Table 13.1.1. The details are shown as the results of inventory survey in Table 13.1.2.

2. TRAFFIC

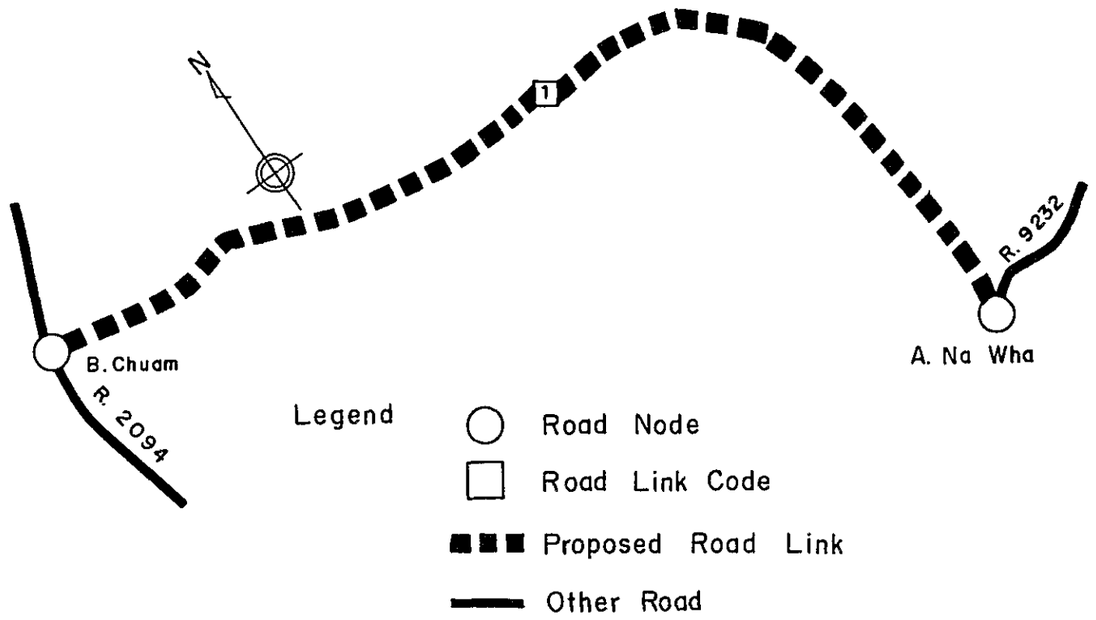
2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the subject road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated referring to the DOHs traffic records and manual classified count as shown below:

Proposed Road Link



Traffic Volume in Base Year

Source (base year)	Link No	Vehicle Type									
		P/C	P/P	L/B	M/B	M/B	P/T	4/T	6/T	10/T	ADT
DOH(1981)	1/1	2	25	14	16	5	4	13	16	8	103
Manual Counts (1982)	1	-	5	-	7	-	1	7	7	3	30
Estimated	1	1	15	7	12	3	3	10	12	6	69

Note: /1 Route 2185 , Section 0100

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road links were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	525

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	39	48	87

2.4 Future Growth of Transport Movement

The growth rates of passenger and freight movements for the periods of 1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula described in 7.3.3-2) of the Main Report. The basis for the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 – 1987	1987 – 1993	1993 – 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.7	1.4	1.2
PASSENGER MOVEMENT	5.7	5.8	5.9

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 – 1987	1987 – 1993	1993 – 2001
NON-AGRI.	7.4	7.5	7.6
AGRICULTURE	0.2	0.2	0.2
FREIGHT	3.4	3.4	3.5

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into traffic volume by vehicle type applying future traffic composition as shown in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	2.6	39.5	18.4	31.6	7.9	9.7	32.3	38.7	19.4
	1987	4.7	37.4	19.1	30.0	8.8	11.6	28.0	37.7	22.7
	1993	7.2	34.9	19.9	28.2	9.8	13.9	22.8	36.6	26.7
	2001	10.5	31.6	20.9	25.7	11.3	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road link is shown in the following table and details by road link by traffic type are shown in Table 13.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	3	11	17	5	26	11	15	9	96	156	252
1993	6	16	22	8	34	10	16	12	123	186	309
2001	13	26	32	14	48	8	18	16	175	235	410

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields.

Very few of cassava, sugar cane and kenaf are grown in the upland field.

Land use and capability conditions in the area of influence are shown in Table 13.3.1 and Figure 13.3.1. A typical cropping calendar in the Sakon Nakhon area is shown in Figure 13.3.2

3.2 Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shown in Table 13.3.2.

Farmgate prices and production costs of the selected crops are estimated as follows, referring to the Changwat data and field survey information as shown in Table 13.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 13.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link No.	Terrain	Without Project: Length (km)	Without Project: /1 Road Class	Without Project: Nos. of Wooden Bridge	Without Project: Nos. of Narrow C.Bridge	With Project: Length (km)	With Project: /1 Road Class Case 1	With Project: /1 Road Class Case 2	With Project: Nos. of Wooden Narrow Bridge
1	Flat	19.8	3	4	0	19.8	1 (F4)	2A(F5)	0

/1 Road 1: Paved Road

Road 2A: Laterite Road with good surface condition and alignment

Road 2B: Laterite Road with good surface condition but poor alignment

Road 3: Laterite Road with poor surface condition and alignment

Road 4: Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were calculated as follows.

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	2,134	2,891	4,336
2A(F5)	1,452	2,027	3,128

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard : F4 (if not feasible, F5)

Geometric Design : AASHTO (Rural Highways)

Typical Cross Section : as shown in Figure 13.5.1

Minimum Height of Embankment

Ordinary Section : 1.0m

Approach of Bridge in Flat Area : 2.0m

Flood Section : 0.7m (above flood level)

Pavement Structure

In case of F4 Standard

DBST : 2.5cm

Crushed Stone Base CBR≥80% : 15.0cm

Soil Aggregate Subbase CBR≥20% : 15.0cm

Selected Material CBR≥ 6% : 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR≥20% : 15.0cm

Selected Material CBR≥ 6% : 20.0cm

Pipe Culvert

Standard Size : ø 100cm

Standard Interval

Paddy Area : 200 m

Others : 500 m

Box Culvert

Standard Size : 2.4m x 2.4m

Location : as required

Bridge

Standard Type (width 7.0m)

Short Span Bridge : RC - Slab

Long Span Bridge : PC - Girder

Location : as shown in Bridge List in Figure 13.5.2

Alignment of the route is shown in Figure 13.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 13.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 ₱)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	19.8	37,519	33,915	
F5 (Soil Aggregate)	19.8	24,489	22,065	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 13.6.1 and 13.6.2.

The result indicates that the proposed project seems to be not feasible under F4 Standard and F5 Standard in case the opening year is 1987.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 13.7.1.

Table 13.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	B. Chuam (J.R. 2094)		
Destination	A. Na Wha		
Length			
Total		19.8	km
Improvement Section		19.8	km
DOH Road	R. 2185	19.8	km
ARD Road		0	km
Others		0	km
New Alignment Section		0	km
Terrain	Flat		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width		8.0	m
Embankment Section			
Length		19.8	km
Height	0.3 m - 5.5 m		
Cut Section			
Length		0	km
Depth	m - m		
Surface Type and Condition			
SBST or DBST		0	km
Soil Aggregate	Poor	19.8	km
Earth		0	km
Pipe Culvert	22 each		
Box Culvert	0 each	0	m
Bridge			
Permanent Bridge	1 each	80.0	m
Narrow Concrete Bridge	0 each	0	m (4m)
Wooden Bridge	4 each	51.5	m
Overflow Section	0 place	0	km

Table 13.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-13 ROUTE No. 2185 B. CHUAM (J.R. 2094) ~ A. NA WHA L = 19.8 Km.

SAKHON NAKORN/NAKHON PRANOM

STATION (Km)		0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
VILLAGE - Name - Household (H) - Population (P)		B. CHUAM H = 200 P = 1500; B. KOK SAAT H = 291 P = 2690; B SEO H = 267 P = 2610; B. TAN H = 420 P = 2000; B. NA WHA H = 800 P = 4800
TERRAIN		Flat
CROSS SECTION	Formation Width (m)	8.00
	Embankment Height (m)	1.00; 2.00; 0.40; 2.50; 5.50; 2.50; 0.30; 0.50
	Cutting Depth (m)	
PAVEMENT	Type/Length	Laterite
	Condition	Poor
FLOODING	Overflow Length(Km)/Height(m)	
LAND USE	Left	Paddy; Bush; Paddy
	Right	Paddy
PIPE CULVERT	Total Number	22 Pipes
BOX CULVERT & BRIDGE	Station (Km)	0.6; 1.1; 11.4; 13.9; 15.3
	Dimension	W-Br. 4.00 x 10.50; W-Br. 4.50 x 10.50; W-Br. 4.00 x 15.50; C-Br. 8.00 x 80.00; W-Br. 4.00 x 15.00
RIGHT OF WAY (m)		
ALIGNMENT	Horizontal	Fair
	Vertical	Fair
ROUTE NO., AGENCIES		DOH 2185

Table 13.2.1 TRAFFIC VOLUME ON ROUTE IM - 13

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	2	2	5	5	11	11
	I	0	0	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	3	3	6	6	13	13
L/B	N+D	10	10	14	14	23	23
	I	1	1	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	11	11	16	16	26	26
M/B	N+D	15	15	20	20	28	28
	I	2	2	3	3	4	4
	DV	0	0	0	0	0	0
	TOTAL	17	17	22	22	32	32
H/B	N+D	4	4	7	7	12	12
	I	1	1	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	5	5	8	8	14	14
P/P&T	N+D	23	23	29	29	42	42
	I	3	3	4	4	6	6
	DV	0	0	0	0	0	0
	TOTAL	26	26	34	34	48	48
4/T	N+D	9	9	9	9	7	7
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	11	11	10	10	8	8
6/T	N+D	13	13	14	14	16	16
	I	2	2	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	15	15	16	16	18	18
10/T	N+D	8	8	10	10	14	14
	I	1	1	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	9	9	12	12	16	16
ADT	N+D	84	84	107	107	152	152
	I	13	13	16	16	23	23
	DV	0	0	0	0	0	0
	TOTAL	96	96	123	123	175	175
M/C	N+D	142	142	169	169	215	215
	I	15	15	17	17	20	20
	DV	0	0	0	0	0	0
	TOTAL	156	156	186	186	235	235
TOTAL	N+D	225	225	276	276	367	367
	I	27	27	33	33	43	43
	DV	0	0	0	0	0	0
	TOTAL	252	252	309	309	410	410

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

Figure 13.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – 13

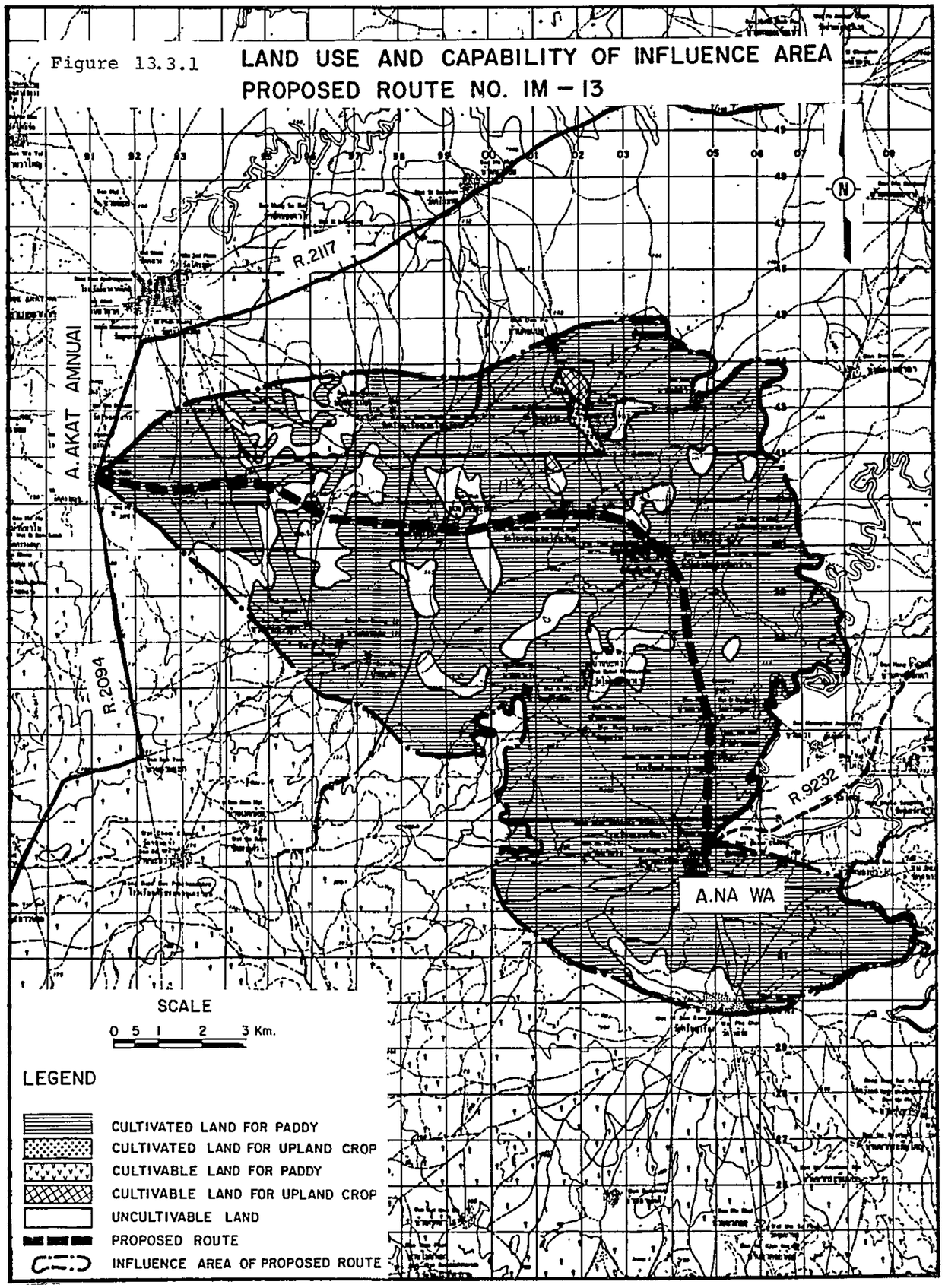
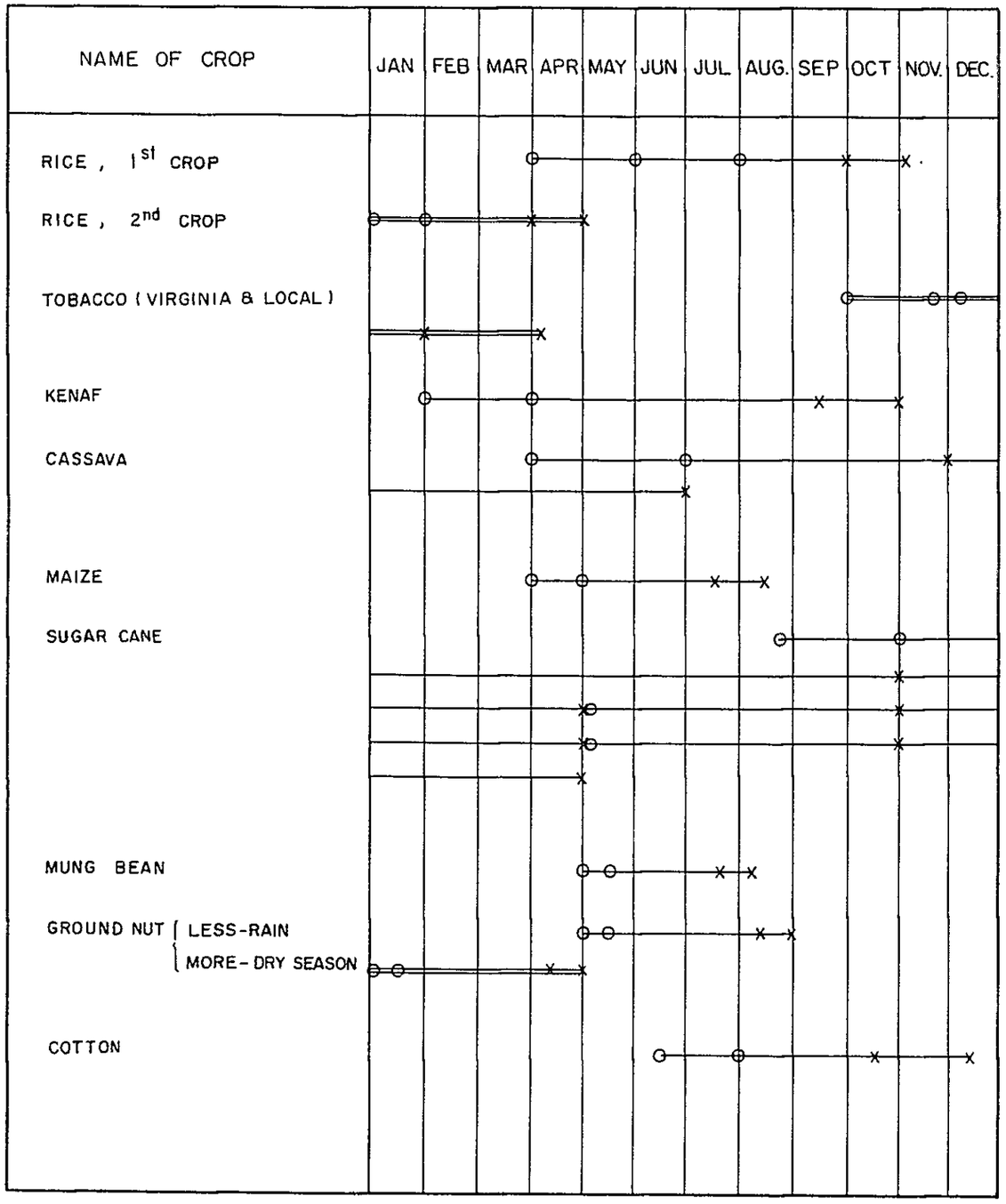


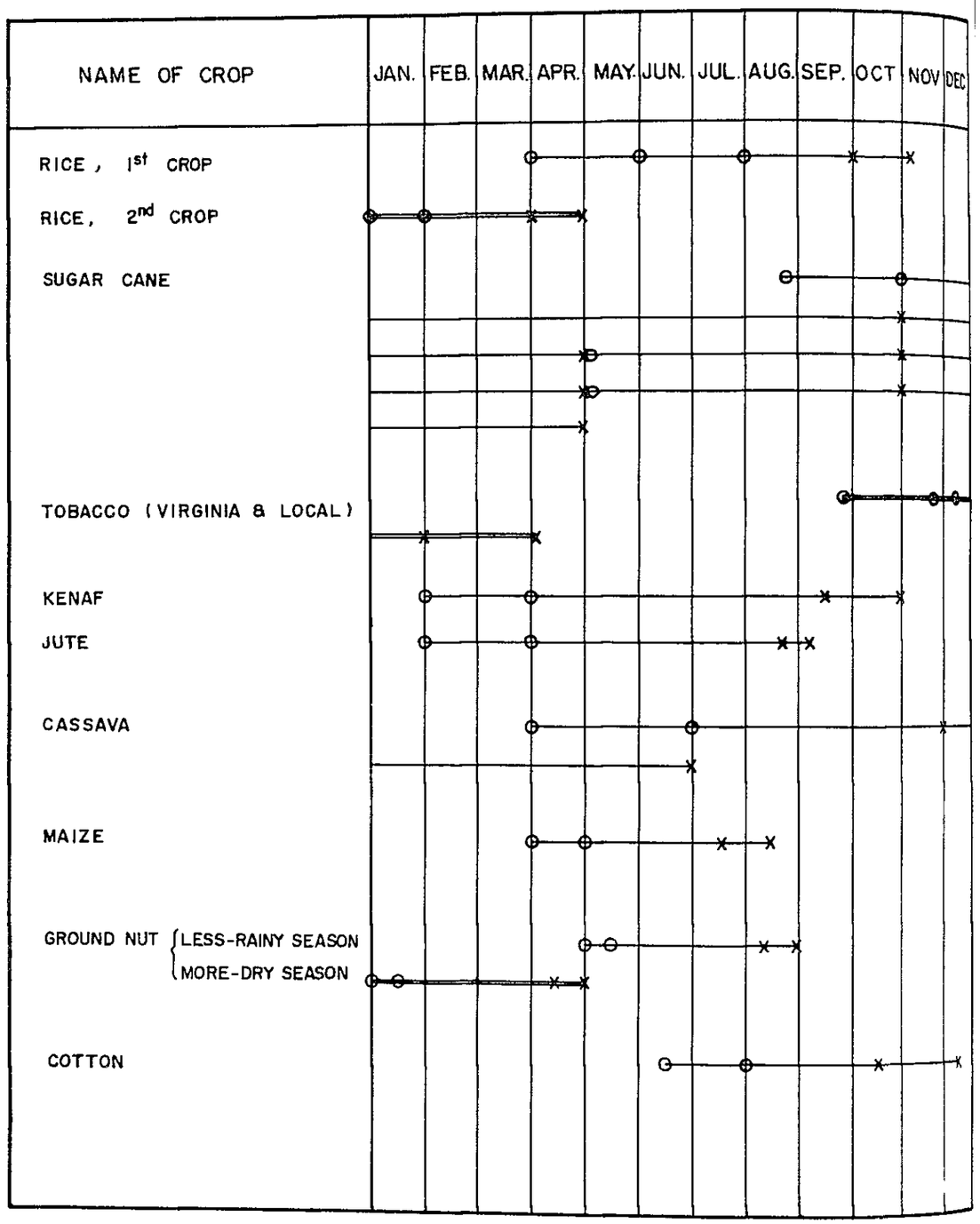
Figure 13.3.2 CROPPING CALENDAR(1)

0400 CHANGWAT SAKON NAKHON



CROPPING CALENDAR(2)

0500 CHANCWAT NAKHON PHANOM



Note

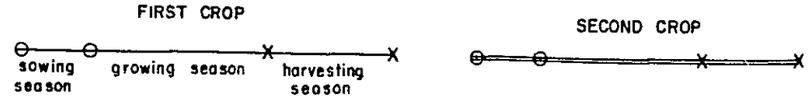


TABLE 13.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		75.000 (120.0)	0.313 (0.5)	75.313 (120.5)	-	0.313 (0.5)	0.313 (0.5)
0406	AKAT AMNUAI	13.750 (22.0)	-	13.750 (22.0)	-	-	-
0504	NA WA	61.250 (98.0)	0.313 (0.5)	61.563 (98.5)	-	0.313 (0.5)	0.313 (0.5)

TABLE 13.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			75.38	-	-	-	0.16	0.06	0.09	-	0.32	75.70
1987			75.38	-	-	-	0.17	0.06	0.09	-	0.34	75.72
1993	WITHOUT	PROJECT	75.38	-	-	-	0.19	0.06	0.10	-	0.36	75.74
	WITH	PROJECT	75.38	-	-	-	0.20	0.07	0.10	-	0.38	75.76
2001	WITHOUT	PROJECT	75.38	-	-	-	0.21	0.07	0.10	-	0.39	75.77
	WITH	PROJECT	75.38	-	-	-	0.23	0.07	0.10	-	0.41	75.80
CROP YIELD (KG/RAI)												
1981			208.3	-	-	-	2500.0	6500.0	175.0	-		
1987			209.5	-	-	-	2500.0	6539.1	175.0	-		
1993	WITHOUT	PROJECT	210.8	-	-	-	2500.0	6578.4	175.0	-		
	WITH	PROJECT	214.6	-	-	-	2500.0	6618.0	175.0	-		
2001	WITHOUT	PROJECT	212.5	-	-	-	2515.0	6631.2	175.0	-		
	WITH	PROJECT	221.6	-	-	-	2535.2	6724.6	175.0	-		
CROP PRODUCTION (TON)												
1981			15,700	-	-	-	391	366	16	-	775	16,474
1987			15,794	-	-	-	427	390	17	-	836	16,630
1993	WITHOUT	PROJECT	15,889	-	-	-	467	417	17	-	903	16,792
	WITH	PROJECT	16,177	-	-	-	513	445	17	-	977	17,154
2001	WITHOUT	PROJECT	16,017	-	-	-	526	455	17	-	1,000	17,017
	WITH	PROJECT	16,702	-	-	-	582	489	17	-	1,091	17,793

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 13.3.3 FARMGATE PRICE AND PRODUCTION COST

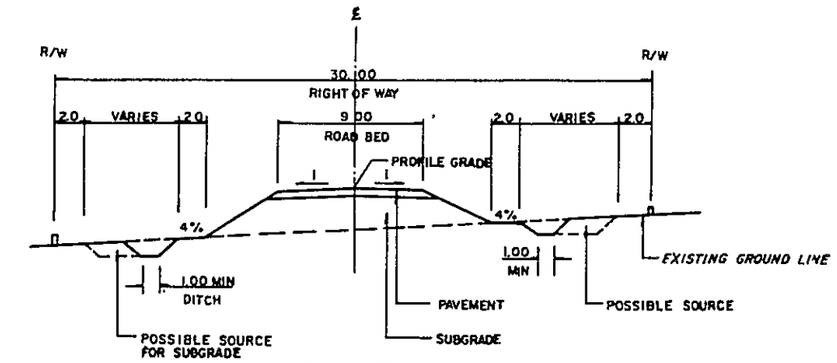
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,635	-	-	-	515	702	3,430	-
WITH PROJECT (1987 - 2001)	3,726	-	-	-	528	702	3,516	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	536	-	-	-	759	2,506	511	-
WITH PROJECT (1987 - 2001)	554	-	-	-	779	2,531	511	-

TABLE 13.3.4 NET PRODUCTION VALUE

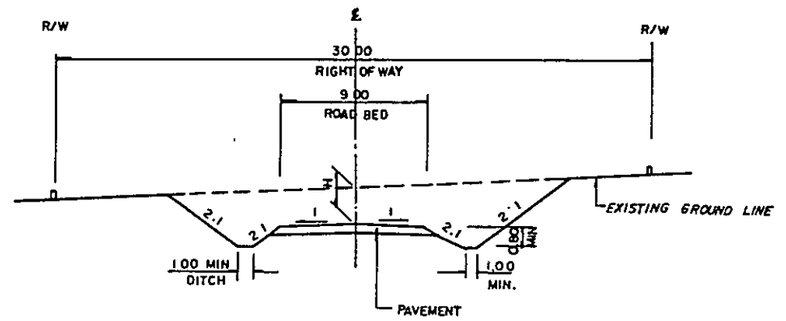
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	17,031	233	17,264	17,090	235	17,325
1993	17,377	251	17,628	18,516	274	18,790
2001	17,840	277	18,117	20,472	310	20,782

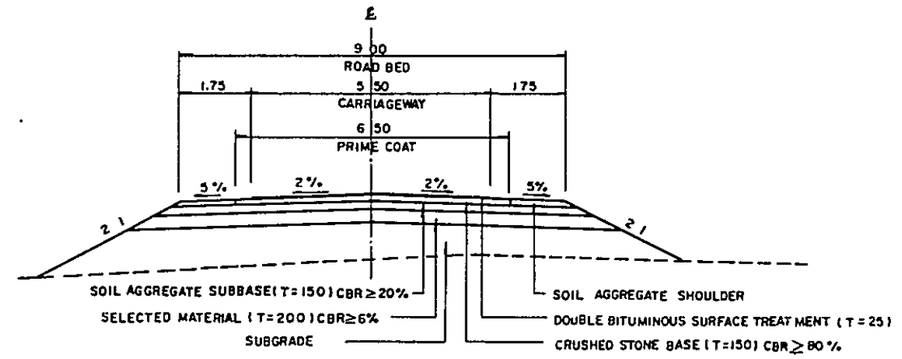
Figure 13.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



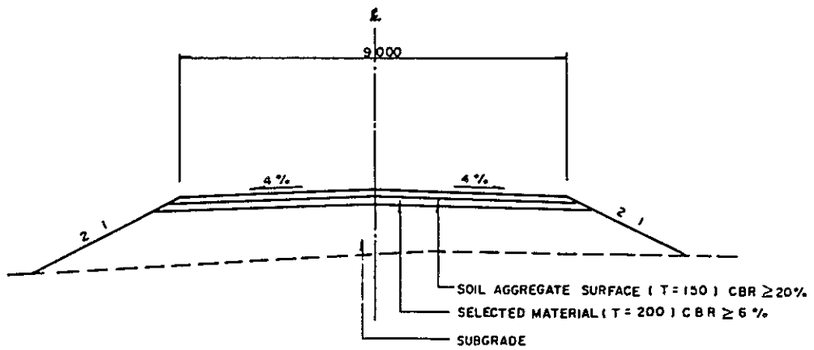
FILL SECTION



CUT SECTION



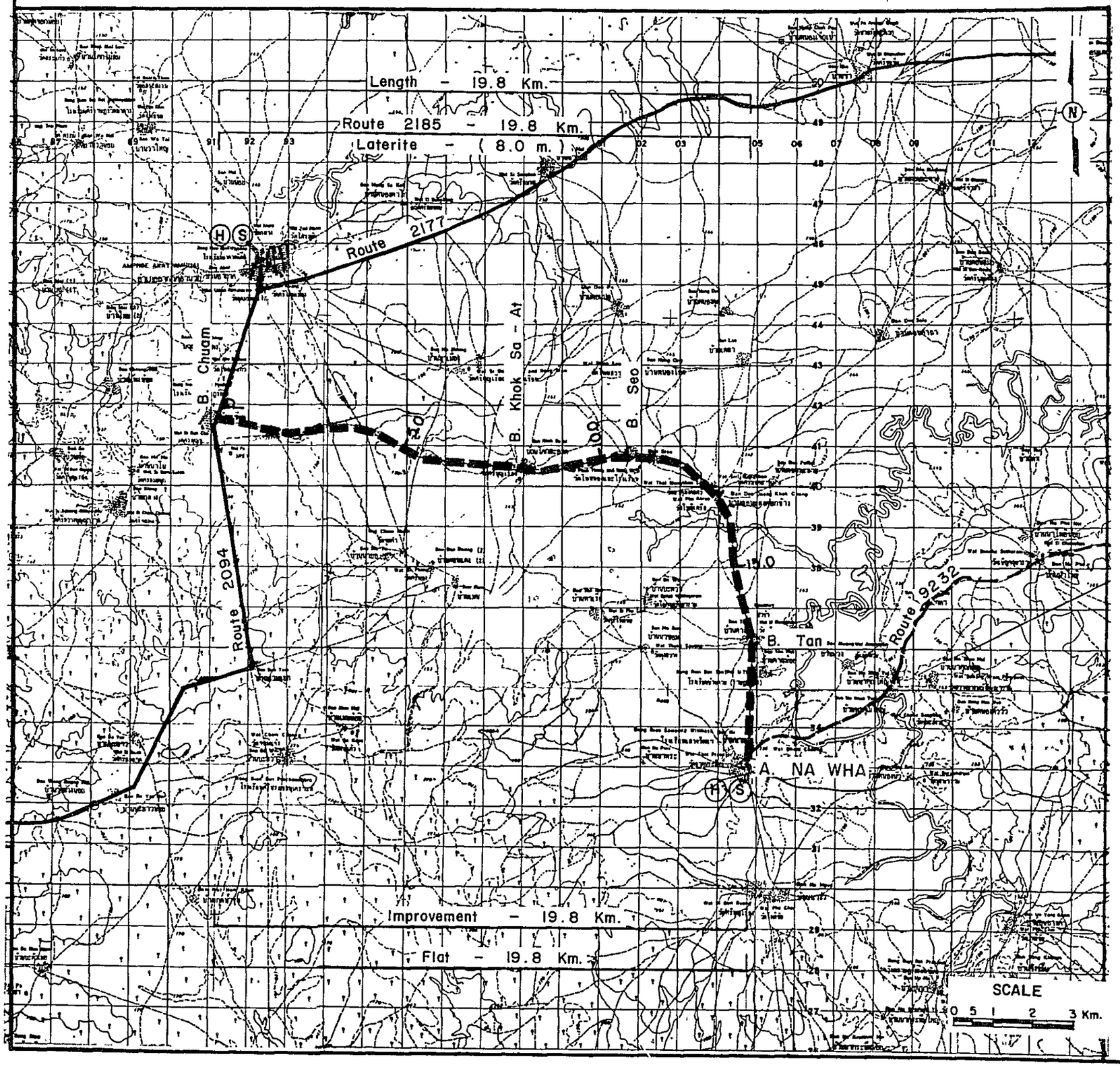
DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)



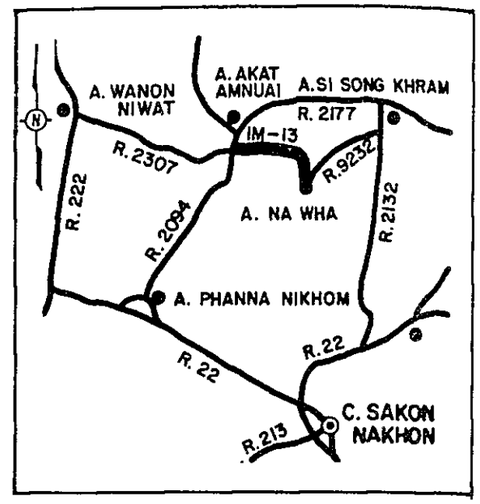
SOIL AGGREGATE SURFACED ROAD (Class F5)

Figure 13.5.2

PROPOSED ROUTE NO. IM-13 C. SAKON NAKHON B. CHUAM (J.R.2094) - A. NA WHA NAKHON PHANOM ROUTE NO. 2185 L = 19,8 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	0.6	C-7.00 x 14.00	W-4.00x10 50
2	1.1	C-7.00 x 14.00	W-4.50x10 50
3	11.4	C-7.00 x 18.00	W-4.00x15 50
4	13.9	—	C-8.00x80 00
5	15.3	C-7.00 x 18.00	W-4.00x15 00

LEGEND

- PROPOSED ROUTE (IMPROVEMENT)
- PROPOSED ROUTE (NEW CONSTRUCTION)
- PAVED ROUTE
- UNPAVED ROUTE
- INVENTORY SURVEY ROUTE
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

Table 13.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-13 (19.8 km)

Items	Unit of Q'ty	Financial Unit Rate ₱	(DBST) Q'ty	(DBST) Financial Cost (10^3₱)	(DBST) Economic Cost (10^3₱)	(Soil Aggregate Surface) Q'ty	(Soil Aggregate Surface) Financial Cost (10^3₱)	(Soil Aggregate Surface) Economic Cost (10^3₱)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	44	660	600	44	660	600
Excavation - Soil	m^3	20	0	0	0	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0	0	0	0
Embankment	m^3	45	59,100	2,659	2,420	59,100	2,659	2,420
Selected Material	m^3	80	42,000	3,360	2,990	42,000	3,360	2,990
Soil Aggregate Surface or Subbase	m^3	105	29,400	3,087	2,747	29,400	3,087	2,747
Crushed Stone Base	m^3	370	19,300	7,141	6,569	5,900	2,183	2,008
Soil Aggregate Shoulder	m^3	105	8,300	871	775	2,500	262	233
Prime Coat and DBST	m^2	55	108,900	5,990	5,391	33,000	1,815	1,634
Pipe Culvert	m	2,100	820	1,722	1,584	820	1,722	1,584
Box Culvert	m	16,000	0	0	0	0	0	0
Long Span Bridge	m	80,000	0.	0	0	0	0	0
Short Span Bridge	m	40,000	64	2,560	2,278	64	2,560	2,278
Sub Total (a)				28,051	25,357		18,309	16,497
Miscellaneous Works (a) x 7%				1,964	1,775		1,282	1,155
Total (b)				30,015	27,132		19,591	17,652
PHYSICAL CONTENGENCY (b) x 15%				4,502	4,070		2,939	2,648
ENGINEERING AND ADMINISTRATION (b) x 10%				3,002	2,713		1,959	1,765
Sub Total				7,504	6,783		4,898	4,413
LAND ACQUISITION								
Highly Developed Land	ha	50,000	0	0	0	0	0	0
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				0	0		0	0
GRAND TOTAL				37,519	33,915		24,489	22,065

Table 13.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	13,566	0	0	0	0	17,017	0
1986	20,349	0	0	0	0	22,791	0
1987	0	61	2,134	-136	2,059	0	1,839
1988	0	244	2,260	-131	2,373	0	1,892
1989	0	427	2,386	-126	2,687	0	1,912
1990	0	610	2,513	-122	3,001	0	1,907
1991	0	793	2,639	-117	3,314	0	1,881
1992	0	976	2,765	-113	3,628	0	1,838
1993	0	1,159	2,891	-108	3,942	0	1,783
1994	9,583	1,347	3,072	-101	4,317	4,335	1,744
1995	0	1,535	3,252	-94	4,693	0	1,692
1996	0	1,723	3,433	-88	5,069	0	1,632
1997	0	1,912	3,614	-81	5,444	0	1,565
1998	0	2,100	3,794	-74	5,820	0	1,494
1999	0	2,288	3,975	-68	6,195	0	1,420
2000	0	2,476	4,155	-61	6,571	0	1,345
2001	-15,601	2,665	4,336	-54	6,946	-2,850	1,269
TOTAL	27,897	20,315	47,219	-1,474	66,060	41,293	25,212

DISCOUNTED ECONOMIC COSTS : 41,293

DISCOUNTED ECONOMIC BENEFITS : 25,212

AGRICULTURAL DEVELOPMENT BENEFIT	6,668
VOC SAVING	19,294
RMC SAVING	-749

NET PRESENT VALUE : -16,080

BENEFIT COST RATIO : 0.61

INTERNAL RATE OF RETURN : 6.6 %

Table 13.6.2 COST AND BENEFITS

(F5 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	8,826	0	0	0	0	11,071	0
1986	13,239	0	0	0	0	14,828	0
1987	0	61	1,452	-51	1,462	0	1,306
1988	0	244	1,548	-48	1,744	0	1,390
1989	0	427	1,644	-45	2,026	0	1,442
1990	0	610	1,740	-42	2,308	0	1,467
1991	0	793	1,835	-38	2,590	0	1,470
1992	0	976	1,931	-35	2,872	0	1,455
1993	0	1,159	2,027	-32	3,154	0	1,427
1994	2,904	1,347	2,165	-28	3,484	1,314	1,407
1995	0	1,535	2,302	-24	3,814	0	1,375
1996	0	1,723	2,440	-19	4,144	0	1,334
1997	0	1,912	2,577	-15	4,474	0	1,286
1998	0	2,100	2,715	-10	4,805	0	1,233
1999	0	2,288	2,852	-6	5,135	0	1,177
2000	0	2,476	2,990	-1	5,465	0	1,118
2001	-10,150	2,665	3,128	3	5,795	-1,854	1,059
TOTAL	14,819	20,315	33,346	-390	53,271	25,358	19,946

DISCOUNTED ECONOMIC COSTS : 25,358

DISCOUNTED ECONOMIC BENEFITS : 19,946

AGRICULTURAL DEVELOPMENT BENEFIT	6,668
VOC SAVING	13,508
RMC SAVING	-230

NET PRESENT VALUE : -5,412

BENEFIT COST RATIO : 0.79

INTERNAL RATE OF RETURN : 9.4 %

Table 13.7.1 SOCIAL INDICATORS

(Proposed Route IM-13)

Population (1,000)		
1982	:	15.8
1993	:	18.7
Average travelling speed, without (kph)	:	40
Isolation		
Access to Amphoe		
Average distance to Amphoe (km) 1/	:	4.5
Per capita time savings (10^{-4})	:	0.027
Score	:	79
Access to Artery Highway		
Average distance to highway (km) 1/	:	20
Per capita time savings (10^{-4})	:	0.119
Score	:	259
Impassability		
Impassable week a year	:	2
Impassability per year	:	0.038
Impassability per capita (10^{-4})	:	0.020
Score	:	167
Health		
Access to Hospital		
Average distance to Hospital (km) 1/	:	5.0
Per capita time savings (10^{-4})	:	0.030
Score	:	70
Access to Medical Facilities		
Average distance to facilities (km) 1/	:	3.0
Per capita time savings (10^{-4})	:	0.018
Score	:	72
Education		
Access to Secondary School		
Number of Student in 1993 (1,000) 2/	:	3.4
Average distance to school (km)	:	5.0
Per capita time savings (10^{-4})	:	0.163
Score	:	88
Teacher Intensity		
Number of teachers 3/		
University graduate	:	-
Total	:	15
Number of Student	:	279
Indicators		
E1 4/	:	-
E2 5/	:	(51.0)
E 6/	:	51.0
Degree of Improvement 7/	:	1.34
Score	:	85
Disparity		
G.P.V. in 1993 (Mn B) 8/		
With project	:	60.9
Without project	:	58.4
Per capita G.P.V. in 1993 (B)		
With project (W)	:	3,257
Without project (w)	:	3,123
Degree of Disparity		
(A/W) - (A/w) 9/	:	0
Score	:	0
Total Score	:	820

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:

Number of university graduate teachers	438
Number of Teachers	1,285
Number of student	25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.

PROPOSED ROUTE NO. IM-14

Changwat : Sakon Nakhon

J.R. 223 - K.A. Tao Ngai

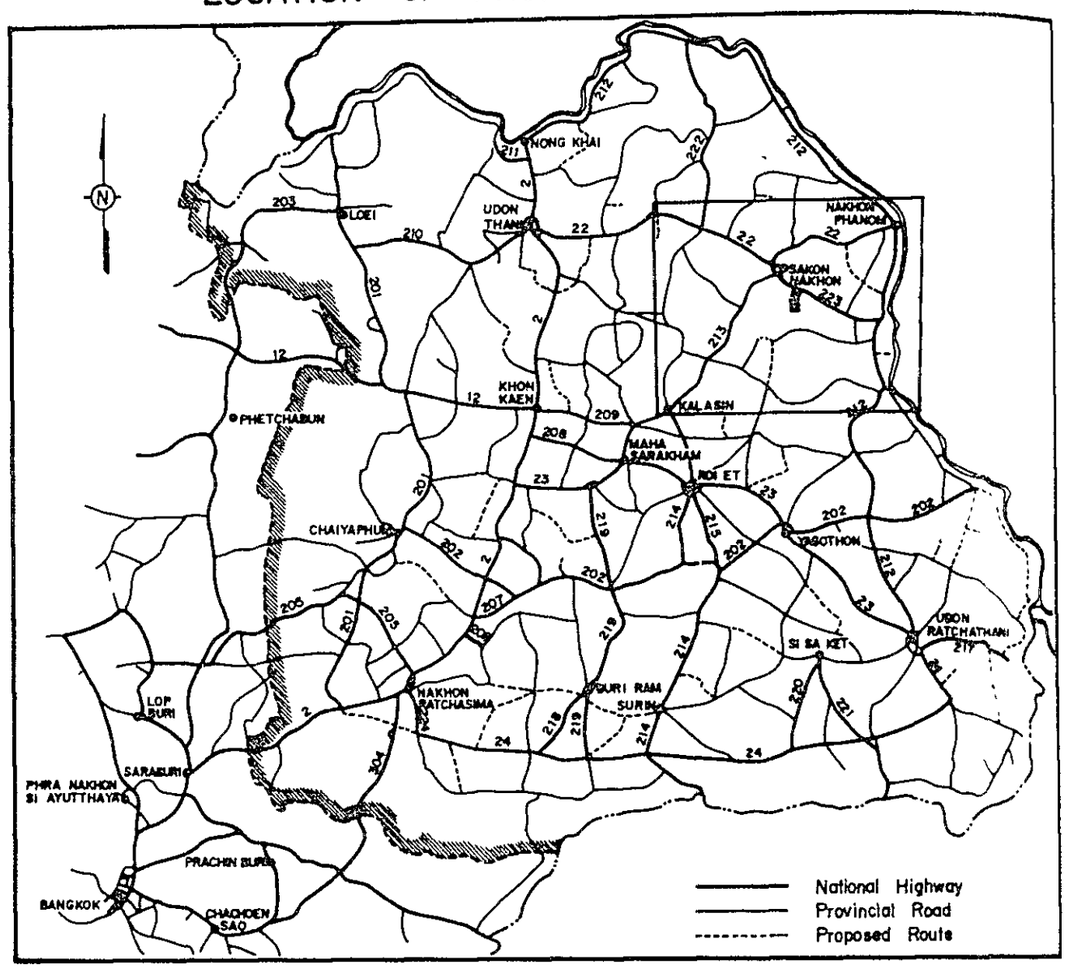
Length : 12.0 KM.

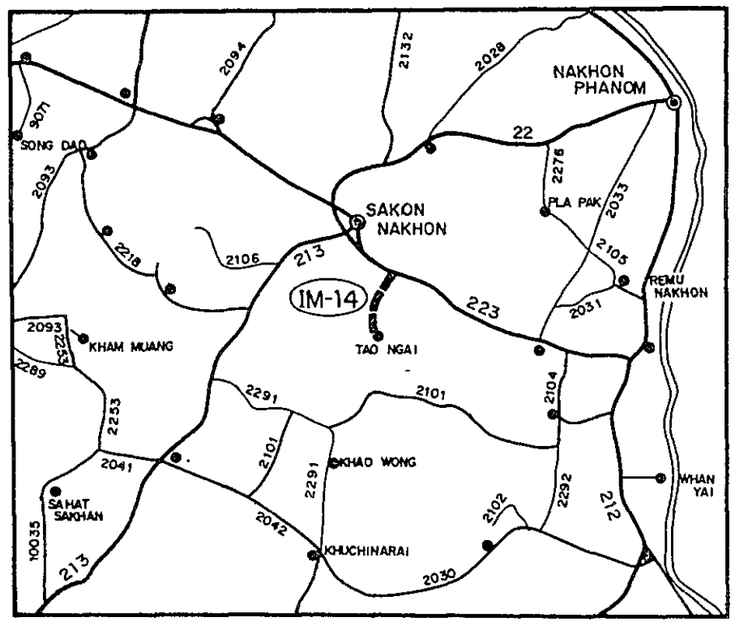
SUMMARY

PROPOSED ROUTE IM-14

Item	Description
Changwat	Sakhon Nakhon
Origin	J.R.223
Destination	K.A. Tao Ngai
Length	
Total	12.0 km
Improvement Section	12.0 km
DOH Road	0 km
ARD Road	12.0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat and Rolling
Influence Area	
Area	58 km^2
Population (1982)	6,600
Principal Crops	Paddy
Traffic (ADT)	
Existing	95
1993	384
2001	495
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	27,687 . 10^3 ฿
Economic	25,135 . 10^3 ฿
IRR	3.7 %
B/C	0.43
Social Impact	High
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of Route

The proposed route is located in the South part of Changwat Sakon Nakhon. The route, starting at the intersection with Route 223, runs southward passing through Ban Non Hom, Ban Nong Bua and ends at King Amphoe Tao Ngai. Its total length is 12.0 km (Figure 14.5.2).

The terrain is almost flat and rolling. In the influence area, there exists several villages with total population of 6,600. There are two medical centers, no hospital and one secondary school along the proposed route.

The proposed route, upon completion, will play vital role to connect king Amphoe Tao Ngai with artery highway of Route 223.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 14.1.1. The details are shown as the results of inventory survey in Table 14.1.2.

2. TRAFFIC

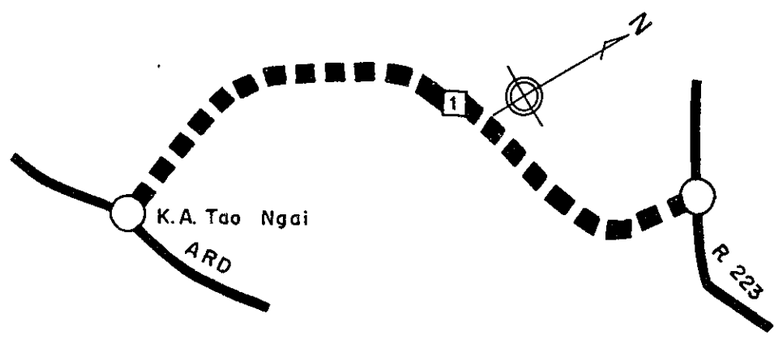
2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the subject road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated basing on manual classified counts as shown below:

Proposed Road Link



Legend

- Road Node
- Road Link Code
- Proposed Road Link
- Other Road

Traffic Volume in Base Year

Source (base year)	Link No	Vehicle Type									
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	ADT
Manual Counts (1982)	1	2	19	47	1	-	2	5	19	-	95

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road links were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	780

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	40	6	46

2.4 Future Growth of Transport Movement

The growth rates of passenger and freight movements for the periods of 1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula described in 7.3.3-2) of the Main Report. The basis for the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.2	1.1
PASSENGER MOVEMENT	5.5	5.6	5.7

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.1	7.2	7.3
AGRICULTURE	0.1	0.1	0.1
FREIGHT	6.2	6.3	6.4

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.1	0.1

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into traffic volume by vehicle type applying future traffic composition as shown in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	2.9	27.5	68.1	1.4	0.0	7.7	19.2	73.1	0.0
	1987	4.8	28.4	55.8	8.0	3.0	10.1	18.4	63.1	8.4
	1993	7.2	29.4	41.0	15.8	6.6	13.1	17.4	51.0	18.5
	2001	10.2	30.8	21.3	26.2	11.5	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road link is shown in the following table and details by road link by traffic type are shown in Table 14.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	5	54	8	3	31	6	20	3	128	195	323
1993	9	51	20	8	41	6	18	7	160	224	384
2001	18	38	46	20	62	7	16	15	222	273	495

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields. Kenaf and cassava are planted a little in the upland field. Unused cultivable land remained in mainly for upland field.

Land use and capability conditions in the area of influence are shown in Table 14.3.1 and Figure 14.3.1.

A typical cropping calendar in the Sakon Nakhon area is shown in 14.3.2

3.2 Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shown in Table 14.3.2.

Farmgate prices and production costs of the selected crops are estimated as follows, referring to the Changwat data and field survey information as shown in Table 14.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 14.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link		Without Project				With Project			
No.	Terrain	Length (km)	Road Class /1	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	Length (km)	Road Class /1 Case 1	Road Class /1 Case 2	Nos. of Wooden Narrow Bridge
1	Flat & Rolling	12.0	3	1	1	12.0	1(F4)	2A(F5)	0

/1 Road 1: Paved Road

Road 2A: Laterite Road with good surface condition and alignment

Road 2B: Laterite Road with good surface condition but poor alignment

Road 3: Laterite Road with poor surface condition and alignment

Road 4: Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were calculated as follows:

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	1,122	1,676	2,825
2A(F5)	724	1,120	1,935

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard	:	F4 (if not feasible, F5)
Geometric Design	:	AASHTO (Rural Highways)
Typical Cross Section	:	as shown in Figure 14.5.1
Minimum Height of Embankment		
Ordinary Section	:	1.0m
Approach of Bridge in Flat Area	:	2.0m
Flood Section	:	0.7m (above flood level)

Pavement Structure

In case of F4 Standard

DBST		:	2.5cm
Crushed Stone Base	CBR≥80%	:	15.0cm
Soil Aggregate Subbase	CBR≥20%	:	15.0cm
Selected Material	CBR≥ 6%	:	20.0cm

In case of F5 Standard

Soil Aggregate Surface	CBR≥20%	:	15.0cm
Selected Material	CBR≥ 6%	:	20.0cm

Pipe Culvert

Standard Size	:	ø 100cm
Standard Interval		
Paddy Area	:	200 m
Others	:	500 m

Box Culvert

Standard Size	:	2.4m x 2.4m
Location	:	as required

Bridge

Standard Type (width 7.0m)		
Short Span Bridge	:	RC - Slab
Long Span Bridge	:	PC - Girder
Location	:	as shown in Bridge List in Figure 14.5.2

Alignment of the route is shown in Figure 14.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 14.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 ₱)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	12.0	27,687	25,135	
F5 (Soil Aggregate)	12.0	18,518	16,796	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 14.6.1 and 14.6.2. The result indicates that the proposed project seems to be not feasible under F4 Standard and F5 Standard in case the opening year is 1987.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicator of social impacts are tabulated in Table 14.7.1. Social impacts of the proposed route are considerably high.

Table 14.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	J.R. 223		
Destination	K.A. Tao Ngai		
Length			
Total		12.0 km	
Improvement Section		12.0 km	
DOH Road		0 km	
ARD Road		12.0 km	
Others		0 km	
New Alignment Section		0 km	
Terrain	Flat and Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.0 m - 8.0 m, 7.6 m (Weighted average)		
Embankment Section			
Length		12.0 km	
Height	0.2 m - 0.5 m		
Cut Section			
Length		0 km	
Depth	m - m		
Surface Type and Condition			
SBST or DBST	Poor	1.8 km	
Soil Aggregate	Poor	10.2 km	
Earth		0 km	
Pipe Culvert	17 each		
Box Culvert	0 each	0 m	
Bridge			
Permanent Bridge	0 each	0 m	
Narrow Concrete Bridge	1 each	24.5 m	(4m)
Wooden Bridge	0 each	0 m	
Overflow Section	1 place	2 km	

Table 14.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-14 ROUTE NO. ARD J.R. 223 ∿ K.A. TAO NGAI L = 12.0 Km.

SAKHON NAKHON

Item	Sub-item	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
VILLAGE - Name - Household (H) - Population (P)			B. PHAI LOM H = 160 P = 960 / B. NON HOM H = 260 P = 1560		B. NONG BUA H = 220 P = 1360			KA. TAO NGAI H = 1000 P = 6500									
TERRAIN		Flat		Rolling	Flat		Rolling										
CROSS SECTION	Formation Width (m)			8.00			6.00	7.50									
	Embankment Height (m)		0.30	0.20	0.30	0.40	0.30 / 0.40	0.50									
	Cutting Depth (m)																
PAVEMENT	Type/Length	La.	DT	La. / DT	La. / DT		Laterite										
	Condition				Poor												
FLOODING	Overflow Length(Km)/Height(m)						L=2.0 H=2.5										
LAND USE	Left	Paddy		Bush	Paddy		Bush / Paddy										
	Right	Paddy		Bush	Paddy		Bush / Paddy										
PIPE CULVERT	Total Number				17 Pipes												
BOX CULVERT & BRIDGE	Station (Km)						10.8										
	Dimension						C-Br. 4.00 x 24.50										
RIGHT OF WAY (m)				10.0													
ALIGNMENT	Horizontal			Fair													
	Vertical			Fair													
ROUTE NO., AGENCIES				ARD													

Table 14.2.1 TRAFFIC VOLUME ON ROUTE IM - 14

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	4	4	8	8	16	16
	I	1	1	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	5	5	9	9	18	18
L/B	N+D	47	47	44	44	33	33
	I	7	7	7	7	5	5
	DV	0	0	0	0	0	0
	TOTAL	54	54	51	51	38	38
M/B	N+D	7	7	17	17	40	40
	I	1	1	3	3	6	6
	DV	0	0	0	0	0	0
	TOTAL	8	8	20	20	46	46
H/B	N+D	3	3	7	7	18	18
	I	0	0	1	1	3	3
	DV	0	0	0	0	0	0
	TOTAL	3	3	8	8	20	20
P/P&T	N+D	27	27	36	36	54	54
	I	4	4	5	5	8	8
	DV	0	0	0	0	0	0
	TOTAL	31	31	41	41	62	62
4/T	N+D	5	5	5	5	6	6
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	6	6	6	6	7	7
6/T	N+D	17	17	16	16	14	14
	I	3	3	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	20	20	18	18	16	16
10/T	N+D	2	2	6	6	13	13
	I	0	0	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	3	3	7	7	15	15
ADT	N+D	111	111	139	139	192	192
	I	17	17	21	21	29	29
	DV	0	0	0	0	0	0
	TOTAL	128	128	160	160	222	222
M/C	N+D	177	177	205	205	251	251
	I	18	18	20	20	22	22
	DV	0	0	0	0	0	0
	TOTAL	195	195	224	224	273	273
TOTAL	N+D	288	288	343	343	443	443
	I	34	34	41	41	51	51
	DV	0	0	0	0	0	0
	TOTAL	323	323	384	384	495	495

NOTE

N : NORMAL TRAFFIC D : DIVERTED TRAFFIC

DV : DEVELOPED TRAFFIC I : INDUCED TRAFFIC

Figure 14.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA PROPOSED ROUTE NO. IM - 14

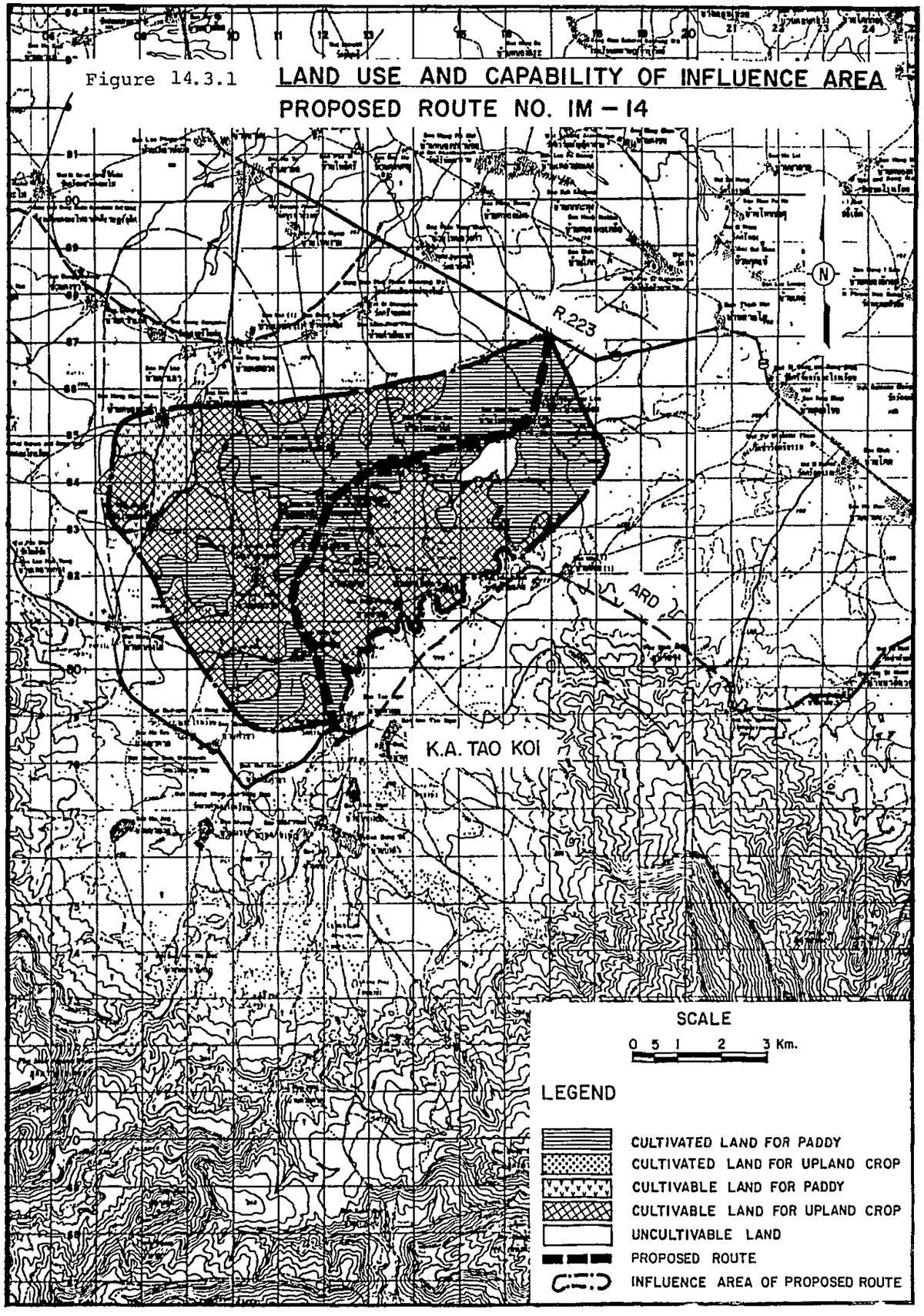


Figure 14.3.2 CROPPING CALENDAR

0400 CHANGWAT SAKON NAKHON

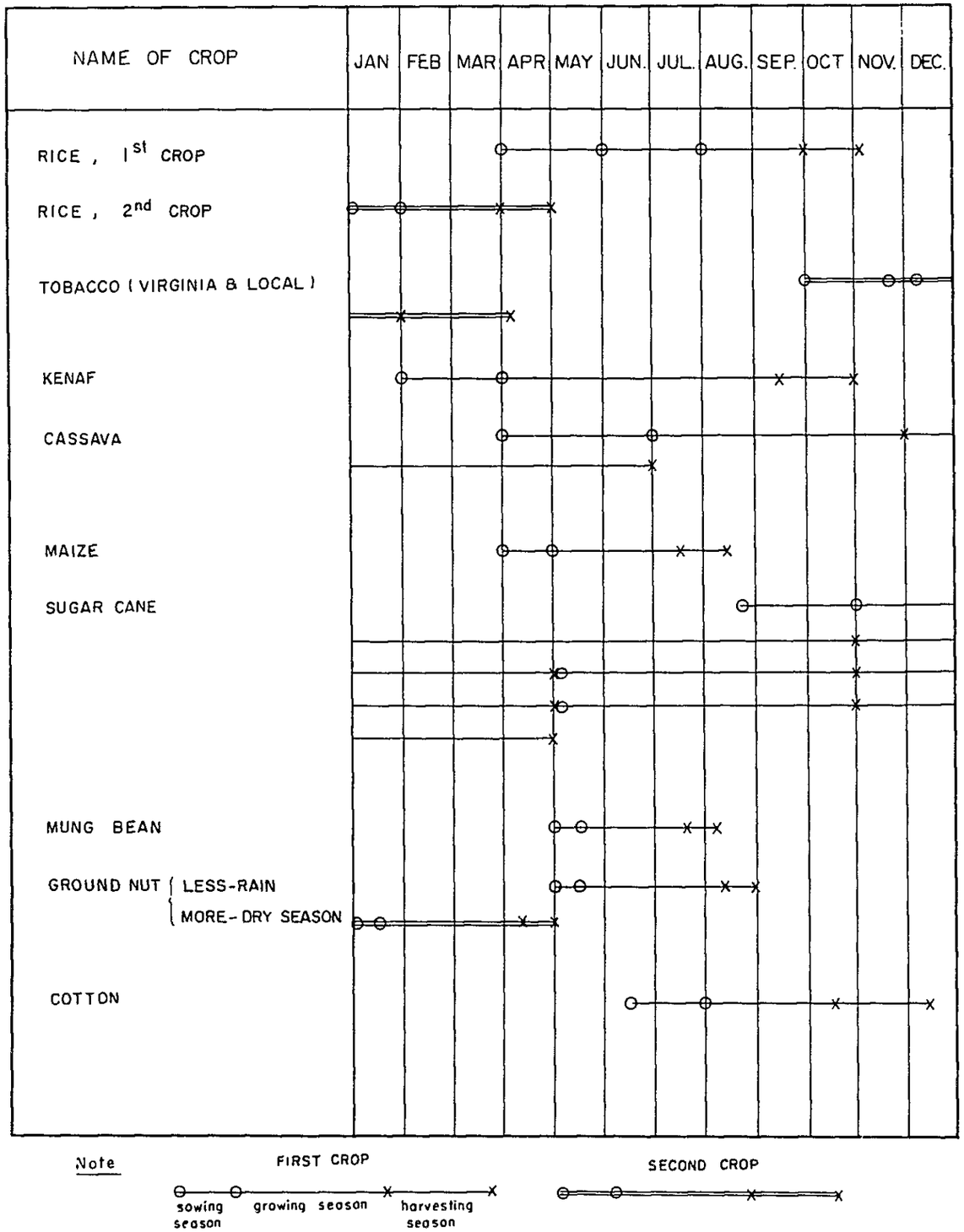


TABLE 14.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		15.625 (25.0)	-	15.625 (25.0)	1.563 (2.5)	18.125 (29.0)	19.688 (31.5)
0401	M. SAKHON NAKHON	9.375 (15.0)	-	9.375 (15.0)	-	5.625 (9.0)	5.625 (9.0)
0404	SAWANG DAEN DIN	6.250 (10.0)	-	6.250 (10.0)	1.563 (2.5)	12.500 (20.0)	14.063 (22.5)

TABLE 14.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			14.91	-	-	-	0.08	-	0.05	-	0.20	15.11
1987			15.00	-	-	-	0.08	-	0.05	-	0.20	15.21
1993	WITHOUT	PROJECT	15.09	-	-	-	0.08	-	0.05	-	0.21	15.30
	WITH	PROJECT	15.09	-	-	-	0.09	-	0.05	-	0.22	15.32
2001	WITHOUT	PROJECT	15.22	-	-	-	0.08	-	0.05	-	0.21	15.43
	WITH	PROJECT	15.22	-	-	-	0.10	-	0.05	-	0.23	15.45
CROP YIELD (KG/RAI)												
1981			210.2	-	-	-	2580.0	-	161.0	-		
1987			210.2	-	-	-	2580.0	-	161.0	-		
1993	WITHOUT	PROJECT	210.2	-	-	-	2580.0	-	161.0	-		
	WITH	PROJECT	214.1	-	-	-	2595.5	-	161.0	-		
2001	WITHOUT	PROJECT	210.2	-	-	-	2580.0	-	161.0	-		
	WITH	PROJECT	219.3	-	-	-	2616.4	-	161.0	-		
CROP PRODUCTION (TON)												
1981			3,136	-	-	-	201	-	8	-	282	3,417
1987			3,154	-	-	-	205	-	8	-	287	3,441
1993	WITHOUT	PROJECT	3,173	-	-	-	209	-	8	-	292	3,465
	WITH	PROJECT	3,231	-	-	-	246	-	9	-	330	3,561
2001	WITHOUT	PROJECT	3,199	-	-	-	214	-	8	-	299	3,498
	WITH	PROJECT	3,336	-	-	-	254	-	9	-	341	3,677

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 14.3.3 FARMGATE PRICE AND PRODUCTION COST

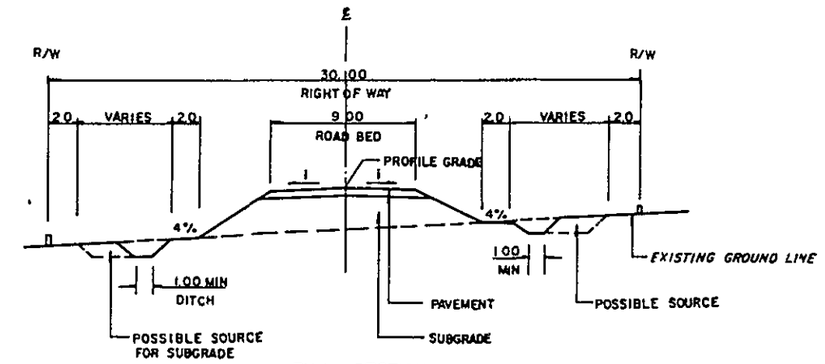
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,663	-	-	-	546	-	4,614	-
WITH PROJECT (1987 - 2001)	3,755	-	-	-	560	-	4,729	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	548	-	-	-	759	-	631	-
WITH PROJECT (1987 - 2001)	562	-	-	-	779	-	631	-

TABLE 14.3.4 NET PRODUCTION VALUE

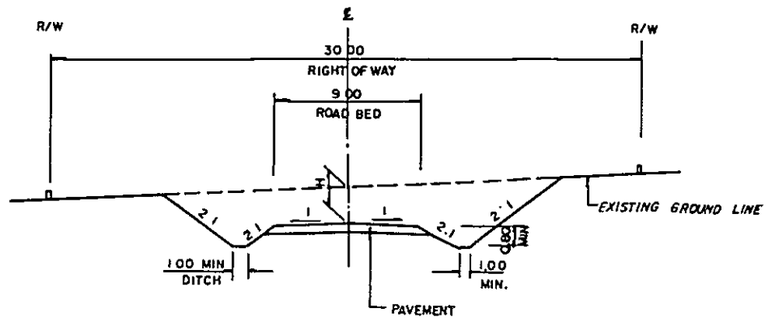
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	3,333	71	3,404	3,416	74	3,490
1993	3,353	75	3,428	3,653	88	3,741
2001	3,380	76	3,456	3,979	92	4,071

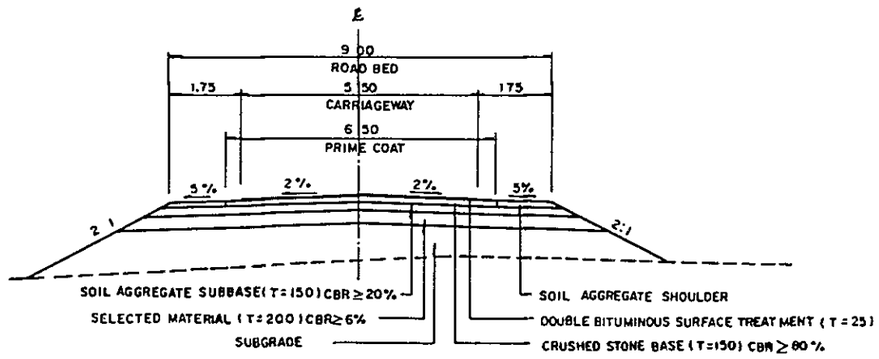
Figure 14.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



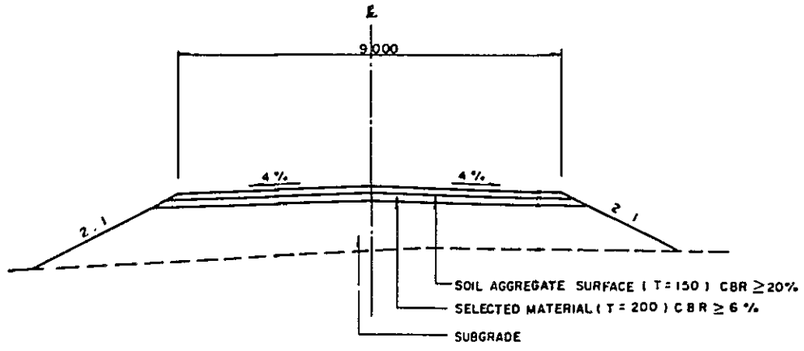
FILL SECTION



CUT SECTION



DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

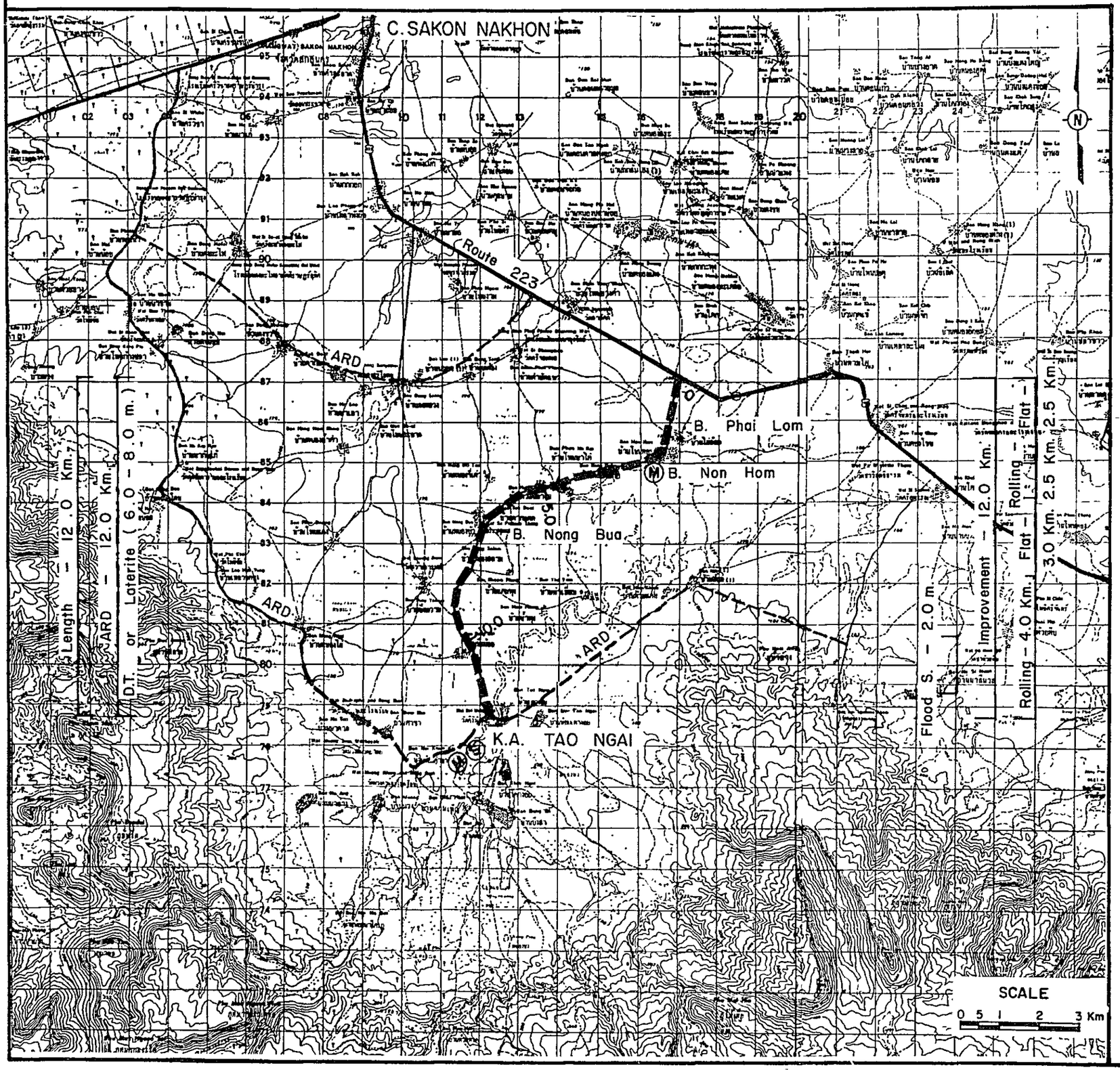


SOIL AGGREGATE SURFACED ROAD (Class F5)

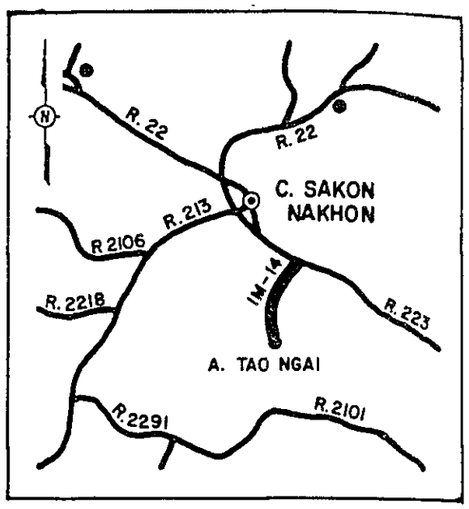
Figure 14.5.2

PROPOSED ROUTE NO. IM-14 **C. SAKON NAKHON** **J.R. 223 – K.A. TAO NGAI**

ROUTE NO. ARD L = 12.0 Km



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	10.2	C-7.00 x 30.00	–
2	10.8	C-7.00 x 24.50	C-4.00 x 24 50

LEGEND

- PROPOSED ROUTE (IMPROVEMENT)
- PROPOSED ROUTE (NEW CONSTRUCTION)
- PAVED ROUTE
- UNPAVED ROUTE
- INVENTORY SURVEY ROUTE
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

Table 14.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-14 (12.0 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	(DBST) Financial Cost (10^3฿)	(DBST) Economic Cost (10^3฿)	(Soil Aggregate Surface) Q'ty	(Soil Aggregate Surface) Financial Cost (10^3฿)	(Soil Aggregate Surface) Economic Cost (10^3฿)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	27	405	368	27	405	368
Excavation - Soil	m^3	20	0	0	0	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0	0	0	0
Embankment	m^3	45	136,400	6,138	5,585	136,400	6,138	5,585
Selected Material	m^3	80	21,600	1,728	1,537	21,600	1,728	1,537
Soil Aggregate Surface or Subbase	m^3	105	15,100	1,585	1,411	15,100	1,585	1,411
Crushed Stone Base	m^3	370	9,900	3,663	3,369	500	185	170
Soil Aggregate Shoulder	m^3	105	4,300	451	401	200	21	18
Prime Coat and DBST	m^2	55	56,100	3,086	2,777	2,500	138	124
Pipe Culvert	m	2,100	360	756	695	360	756	695
Box Culvert	m	16,000	0	0	0	0	0	0
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	55	2,200	1,958	55	2,200	1,958
Sub Total (a)				20,013	18,105		13,157	11,870
Miscellaneous Works (a) x 7%				1,401	1,267		921	831
Total (b)				21,414	19,372		14,078	12,701
PHYSICAL CONTENGENCY (b) x 15%				3,212	2,906		2,112	1,905
ENGINEERING AND ADMINISTRATION (b) x 10%				2,141	1,937		1,408	1,270
Sub Total				5,353	4,843		3,520	3,175
LAND ACQUISITION								
Highly Developed Land	ha	50,000	16	800	800	16	800	800
Less Developed Land	ha	15,000	8	120	120	8	120	120
Sub Total				27,687	25,135		920	920
GRAND TOTAL				27,687	25,135		18,518	16,796

Table 14.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	10,054	0	0	0	0	12,612	0
1986	15,081	0	0	0	0	16,891	0
1987	0	86	1,122	-57	1,151	0	1,028
1988	0	123	1,215	-51	1,287	0	1,026
1989	0	161	1,307	-45	1,422	0	1,012
1990	0	198	1,399	-39	1,558	0	990
1991	0	236	1,492	-33	1,694	0	961
1992	0	273	1,584	-27	1,830	0	927
1993	0	311	1,676	-22	1,965	0	889
1994	5,808	349	1,820	-12	2,156	2,627	871
1995	0	387	1,963	-3	2,347	0	846
1996	0	425	2,107	7	2,538	0	817
1997	0	463	2,251	16	2,729	0	785
1998	0	501	2,394	25	2,920	0	750
1999	0	539	2,538	35	3,111	0	713
2000	0	577	2,681	44	3,302	0	676
2001	-12,059	615	2,825	54	3,493	-2,203	638
TOTAL	18,884	5,242	28,373	-110	33,505	29,927	12,929

DISCOUNTED ECONOMIC COSTS : 29,927

DISCOUNTED ECONOMIC BENEFITS : 12,929

AGRICULTURAL DEVELOPMENT BENEFIT 1,861
VOC SAVING 11,226
RMC SAVING -158

NET PRESENT VALUE : -16,998

BENEFIT COST RATIO : 0.43

INTERNAL RATE OF RETURN : 3.7 %

Table 14.6.2 COST AND BENEFITS

(F5 STANDARD)

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	6,718	0	0	0	0	8,427	0
1986	10,078	0	0	0	0	11,287	0
1987	0	86	724	-12	798	0	712
1988	0	123	790	-8	906	0	722
1989	0	161	856	-3	1,014	0	722
1990	0	198	922	2	1,122	0	713
1991	0	236	988	7	1,231	0	698
1992	0	273	1,054	12	1,339	0	678
1993	0	311	1,120	16	1,447	0	654
1994	242	349	1,222	24	1,594	109	644
1995	0	387	1,324	32	1,742	0	628
1996	0	425	1,426	40	1,890	0	608
1997	0	463	1,527	47	2,038	0	586
1998	0	501	1,629	55	2,185	0	561
1999	0	539	1,731	63	2,333	0	535
2000	0	577	1,833	71	2,481	0	508
2001	-8,223	615	1,935	78	2,628	-1,502	480
TOTAL	8,815	5,242	19,081	424	24,748	18,322	9,451

DISCOUNTED ECONOMIC COSTS : 18,322

DISCOUNTED ECONOMIC BENEFITS : 9,451

AGRICULTURAL DEVELOPMENT BENEFIT 1,861
VOC SAVING 7,486
RMC SAVING 104

NET PRESENT VALUE : -8,871

BENEFIT COST RATIO : 0.52

INTERNAL RATE OF RETURN : 5.8 %

Table 14.7.1 SOCIAL INDICATORS

(Proposed Route IM-14)

Population (1,000)		
1982	:	6.6
1993	:	7.6
Average travelling speed, without (kph)	:	40
Isolation		
Access to Amphoe		
Average distance to Amphoe (km) 1/	:	3.0
Per capita time savings (10^{-4})	:	0.044
Score	:	133
Access to Artery Highway		
Average distance to highway (km) 1/	:	12
Per capita time savings (10^{-4})	:	0.175
Score	:	350
Impassability		
Impassable week a year	:	4
Impassability per year	:	0.077
Impassability per capita (10^{-4})	:	0.060
Score	:	500
Health		
Access to Hospital		
Average distance to Hospital (km) 1/	:	6.0
Per capita time savings (10^{-4})	:	0.089
Score	:	207
Access to Medical Facilities		
Average distance to facilities (km) 1/	:	2.3
Per capita time savings (10^{-4})	:	0.034
Score	:	136
Education		
Access to Secondary School		
Number of Student in 1993 (1,000) 2/	:	1.5
Average distance to school (km)	:	6.0
Per capita time savings (10^{-4})	:	0.447
Score	:	232
Teacher Intensity		
Number of teachers 3/		
University graduate	:	-
Total	:	6
Number of Student	:	157
Indicators		
E1 4/	:	-
E2 5/	:	38.2
E 6/	:	38.2
Degree of Improvement 7/	:	1.79
Score	:	114
Disparity		
G.P.V. in 1993 (Mn B) 8/		
With project	:	12.4
Without project	:	11.9
Per capita G.P.V. in 1993 (B)		
With project (W)	:	1,697
Without project (w)	:	1,556
Degree of Disparity		
(A/W) - (A/w) 9/	:	0.15
Score	:	268
Total Score	:	1,940

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:

Number of university graduate teachers	438
Number of Teachers	1,285
Number of student	25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.