PROPOSED ROUTE NO. IM – 19

Changwat :   Roi Et

A. Selaphum (J.R 23) – B. Kham Phon Sung (J.R 2136)

Length   ·   46.0 K M .

SUMMARY

PROPOSED ROUTE   IM-19

Item	Description
Changwat	Roi Et
Origin	A. selaphum (J.R.23)
Destination	B. Kham Phon Sung (J.R.2136)
Length	
Total	46.0 km
Improvement Section	46.0 km
DOH Road	R.2259 46.0 km
ARD Road	0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good Poor
Terrain	Flat and Rolling
Influence Area	
Area	340 km^2
Population (1982)	37,600
Principal Crops	Paddy
Traffic (ADT)	
Existing	283
1993	896
2001	1,132
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	95,310 . 10^3 ฿
Economic	86,000 . 10^3 ฿
IRR	17.1 %
B/C	1.48
Recommendation	For further consideration

National Highway
Provincial Road
Proposed Route
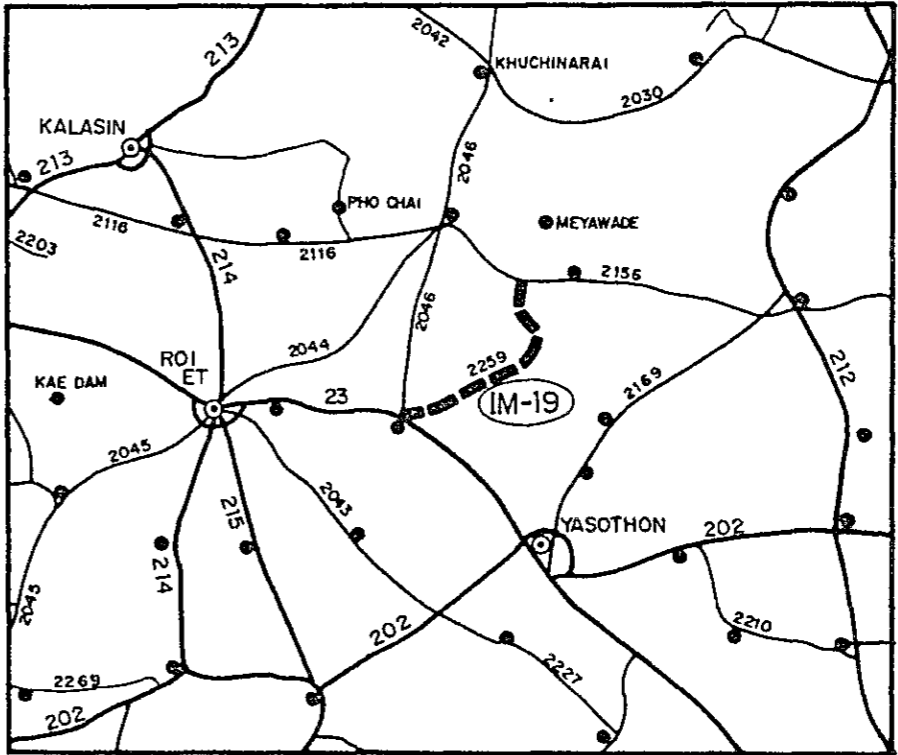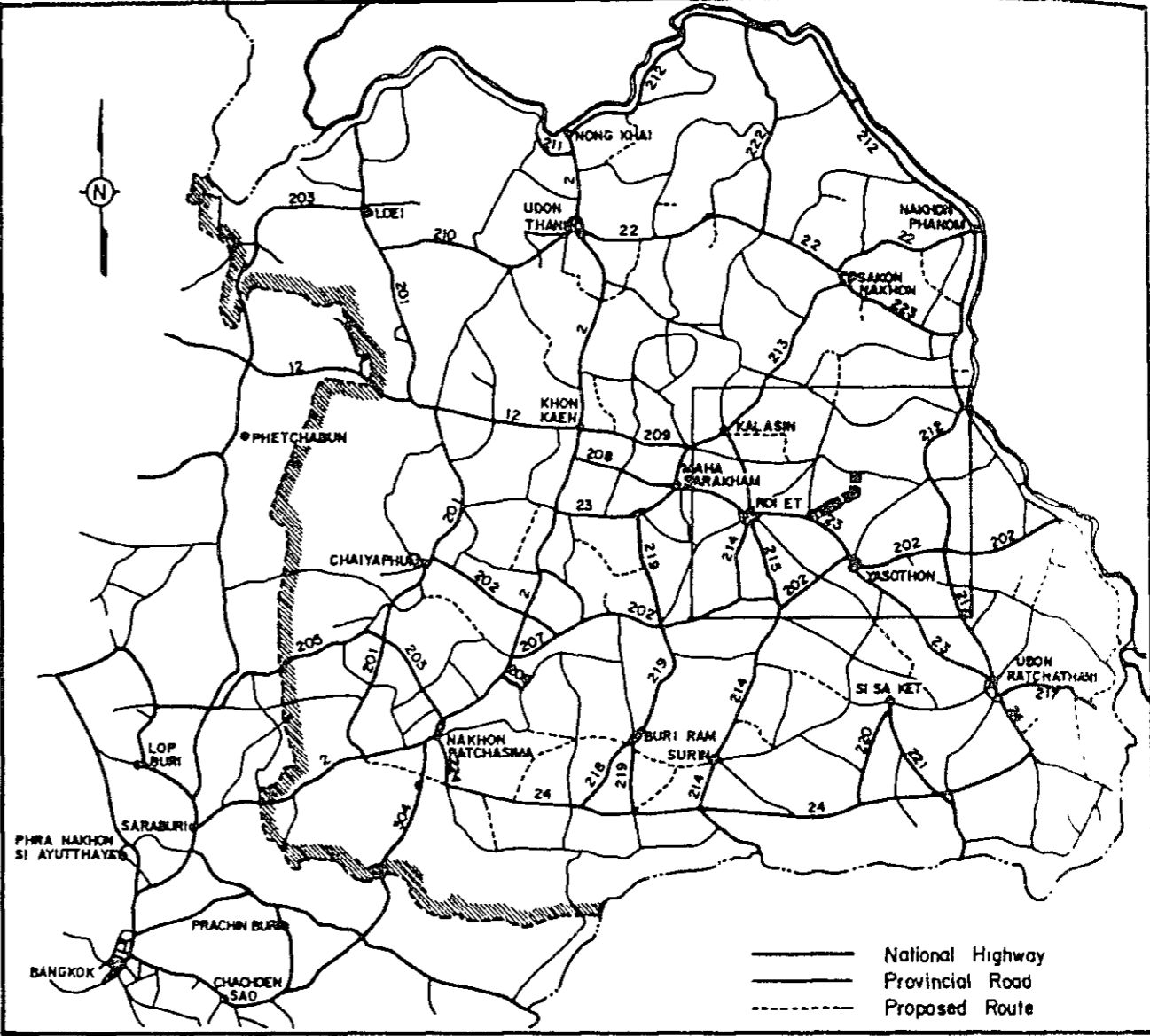
1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the east part of Changwat Roi Et.

The route, starting at Amphoe Selaphum on Route 23, runs northeastward

passing through Ban Na Thom, Ban Na Pho and Ban Dong Bung and ends at

Ban Kham Phon Sung on Route 2136. Its total length is 46.0 km.

(Figure 19.5.2)

The terrain is almost flat and rolling. In the influence area, there

exists several villages with total population of 37,600. There are

three medical centers, one hospital and one secondary school along the

proposed route. Amphoe Nong Phok near the end of the proposed route

has one hospital and one secondary school.

The proposed route, upon conpletion, will form an important part of

road network to connect two highways, Route 23 and 2136 in the agricultur-

ally developed area.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is

summarized in Table 19.1.1. The details are shown as the results of

inventory survey in Table 19.1.2.

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:
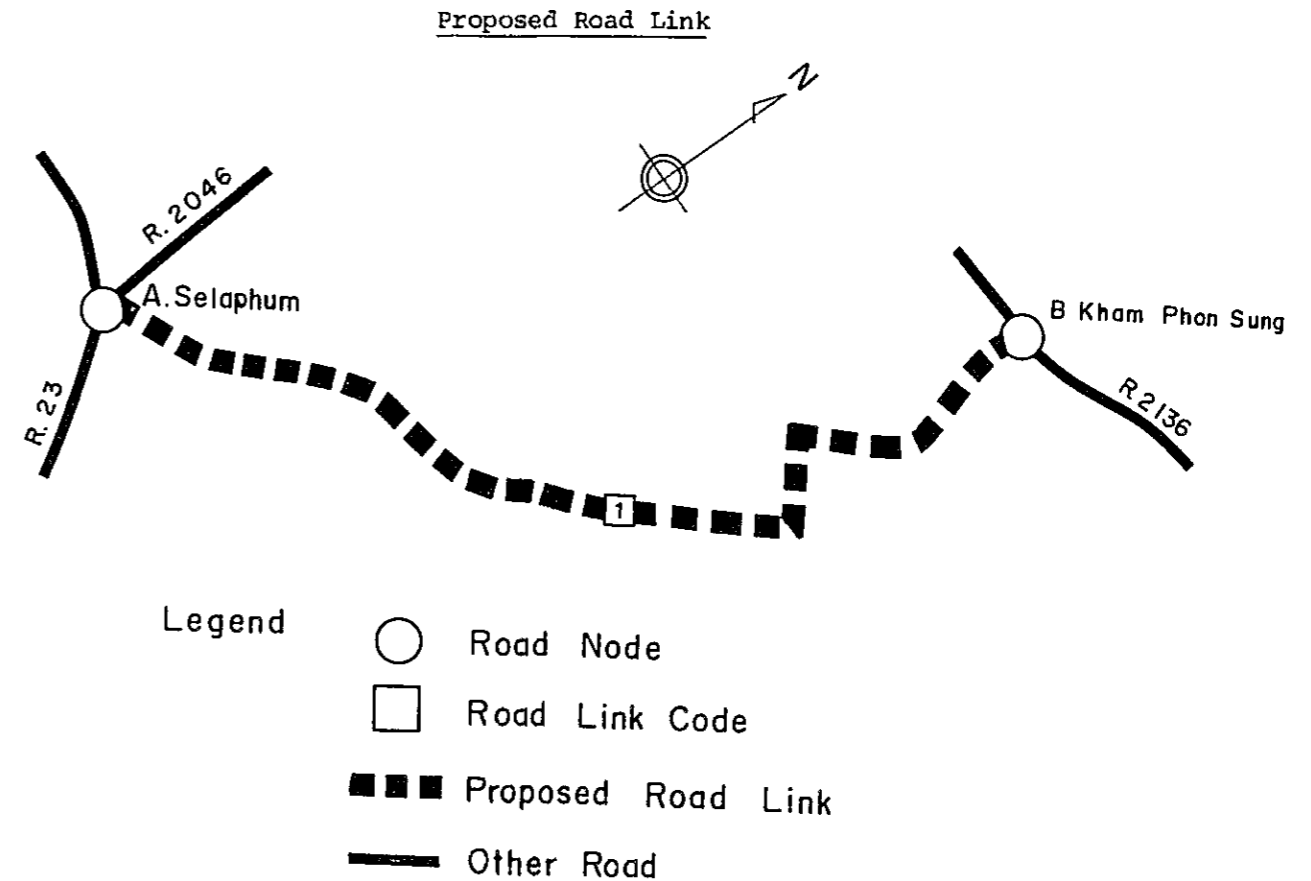
Proposed Road Link

Legend

◯ Road Node

▢ Road Link Code

■■■ Proposed Road Link

▬▬ Other Road

Traffic Volume in Base Year

Sourse (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	17	91	77	31	–	10	10	40	7	283

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	2152

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	113	47	160

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	1.4	1.2	1.1
PASSENGER MOVEMENT	5.4	5.6	5.7

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 – 1987	1987 – 1993	1993 – 2001
NON-AGRI.	7.0	7.2	7.4
AGRICULTURE	0.1	0.1	0.0
FREIGHT	5.0	5.1	5.2

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	7.9	42.1	35.6	14.4	0.0	14.9	14.9	59.7	10.4
	1987	9.1	40.9	31.0	16.4	2.6	15.5	15.2	53.2	16.1
	1993	10.6	39.4	25.5	18.9	5.6	16.1	15.5	45.4	22.9
	2001	12.5	37.5	18.1	22.2	9.7	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 19.2.1.

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	27	93	49	8	136	13	46	14	387	371	758
1993	41	98	73	22	168	16	45	23	486	410	896
2001	68	99	121	53	227	20	45	41	674	458	1132

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields. Very few of ground nuts, maize and beans are grown in the upland field. Unused cultivable land for both paddy and upland fields remain widely in the area.

Land use and capability conditions in the area of influence are shown in Table 19.3.1 and Figure 19.3.1.

A typical cropping calendar in the Roi Et area is shown in Figure 19.3.2.

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 19.3.2

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 19.3.3.

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 19.3.4. 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)	/1 Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	Length (Km)	/1 Road Class	Nos. of Wooden Narrow Bridge
1	Flat & Rolling	46.0	3	0	16	46.0	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 and poor alignment

Road 3 : Laterite Road with poor surface condition and alignment

Road 4 : Earth Road

VOC saveings, 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)	14,873	21,203	33,806

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 19.5.1

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$\geq$80%	15.0cm
Soil Aggregate Subbase	CBR$\geq$20%	15.0cm
Selected Material	CBR$\geq$6%	20.0cm

Pipe Culvert

Standard Size : ϕ 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 19.5.2

Alignment of the route is shown in Figure 19.5.2

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 19.5.1.

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

F4 Standard (DBST)	L = 46.0 Km
Financial Cost	95,310 . 10^3 ฿
Economic Cost	86,000 . 10^3 ฿

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 19.6.1.

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 19.7.1.

Table 19.1.1   SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	A. Selaphum (J.R. 23)		
Destination	B. Khan Phon Sung (J.R. 2136)		
Length			
Total		46.0 km	
Improvement Section		46.0 km	
DOH Road	R. 2259	46.0 km	
ARD Road		0 km	
Others		0 km	
New Alignment Section		0 km	
Terrain	Flat and Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.0 m – 7.5 m, 7.0 m (Weighted average)		
Embankment Section			
Length		46.0 km	
Height	0.2 m – 2.5 m		
Cut Section			
Length		0 km	
Depth	m – m		
Surface Type and Condition			
SBST or DBST	Good	1.5 km	
Soil Aggregate	Good – Poor	44.5 km	
Earth		0 km	
Pipe Culvert	47 each		
Box Culvert	0 each	0 m	
Bridge			
Permanent Bridge	1 each	60.5 m	
Narrow Concrete Bridge	16 each	353.2 m	(4m)
Wooden Bridge	each	m	
Overflow Section	1 place	1.0 km	

Table 19.1.2   ROAD INVENTORY(1)

PROPOSED ROUTE NO. __IM-19__   ROUTE NO. 2259   __A. SELAPHUM (J.R.23) ∿ B. KHAM PHON SUNG (J.R.2136)__   L = __46.0__ ㎞

ROI ET

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. DONG PRASOET H = 400 P = 3500		B. SAI KHAO H = 140 P = 840		B. NONG THAO H = 130 P = 900		B. NONG PHUK TOP H = 500 / B. THA LAT H = 110 P = 770 / B. NA THOM H = 150 P = 500				B. NONG KUNG H = 420 P = 2940		B. NA PHO H = 400 P = 2800	B. NONG PHA H = 400 P = 2100		B. SAAT NADI H = 223 P = 1575

TERRAIN

	Flat						Rolling									Flat

CROSS SECTION

	Formation Width (m)	7.50	8.00			6.50	6.00	6.50		7.50		6.00	7.00		6.00
Embankment Height (m)	0.20	0.80		0.60	0.20	0.30	0.20		1.30	0.60	0.40	0.60	1.30	0.30	2.50 / 0.20
Cutting Depth (m)															

PAVEMENT

Type/Length	DT	Laterite
Condition	Good / Fair	Poor

FLOODING

Overflow Length(㎞)/Height(m)						L=1.0 H=0.5										

LAND USE

Left	Paddy		Bush	Paddy		Bush	Paddy		Kenaf	Paddy
Right	Paddy		Bush	Paddy		Bush	Paddy		Bush	Paddy

PIPE CULVERT

Total Number	47 Pipes

BOX CULVERT & BRIDGE

Station (Km)	7.2	9.3 9.4 9.8	10.9	12.8	13.0	14.9	22.6	26.8	28.1
Dimension	C-Br. 4.50 × 12.50	C-Br. 4.20 × 40.50 C-Br. 4.30 × 40.30 C-Br. 9.50 × 60.50	C-Br. 4.50 × 19.00	C-Br. 4.40 × 30.00	C-Br. 4.30 × 25.00	C-Br. 4.20 × 12.50	C-Br. 4.50 × 12.00	C-Br. 4.50 × 20.50	C-Br. 4.30 × 16.00

RIGHT OF WAY (m)

ALIGNMENT

Horizontal	Fair
Vertical	Fair

ROUTE NO., AGENCIES   DOH 2259

L = __46.0__ Km.

A. SELAPHUM (J.R. 23)　B. KHAM PHON SUNG (J.R. 2136) (Cont'd)

UDON THANI

PROPOSED ROUTE NO. __IM-19__　ROUTE NO. 56

STATION (Km)	30	32	34	36	38	40	42	44	46
VILLAGE – Name – Household (H) – Population (P)			B. NA PHENG H = 300 P = 2100	B. DONG BUNG H = 300 P = 1500			B. KHOK TAN H = 110 P = 800		B. KHAM PHON SUNG H = 250 P = 1350
TERRAIN					Flat				
CROSS SECTION – Formation Width (m)	6.50	7.00	6.50	6.00	6.50	7.00	6.50		
– Embankment Height (m)	0.20	0.50	0.30	0.30	1.00	0.30	1.00		
– Cutting Depth (m)									
PAVEMENT – Type/Length				Laterite					
– Condition	Fair	Poor		Fair		Poor			
FLOODING – Overflow Length(m)/Height(m)									
LAND USE – Left	Paddy	Kenaf	Bush	Paddy	Kenaf	Paddy			Bush
– Right	Paddy	Bush		Paddy	Bush	Paddy	Sugar Cane		Bush
PIPE CULVERT – Total Number									
BOX CULVERT & BRIDGE – Station (Km)		32.9	34.5	35.6 36.8	38.2	40.9			
– Dimension		C-Br. 4.40 × 30.00	C-Br. 4.30 × 24.00	C-Br. 4.40 × 20.50 C-Br. 4.30 × 12.00	C-Br. 4.4 × 14.00	C-Br. 4.20 × 24.4			
RIGHT OF WAY (m)									
ALIGNMENT – Horizontal		Fair			Poor	Fair			
– Vertical				Fair					
ROUTE NO., AGENCIES				DOH 2259					

Table 19.2.1　TRAFFIC VOLUME ON ROUTE IM - 19

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	24	24	35	35	59	59
	I	4	4	5	5	9	9
	DV	0	0	0	0	0	0
	TOTAL	27	27	41	41	68	68
L/B	N+D	81	81	85	85	86	86
	I	12	12	13	13	13	13
	DV	0	0	0	0	0	0
	TOTAL	93	93	98	98	99	99
M/B	N+D	43	43	63	63	106	106
	I	6	6	10	10	16	16
	DV	0	0	0	0	0	0
	TOTAL	49	49	73	73	121	121
H/B	N+D	7	7	19	19	46	46
	I	1	1	3	3	7	7
	DV	0	0	0	0	0	0
	TOTAL	8	8	22	22	53	53
P/P&T	N+D	119	119	146	146	197	197
	I	18	18	22	22	30	30
	DV	0	0	0	0	0	0
	TOTAL	136	136	168	168	227	227
4/T	N+D	11	11	14	14	18	18
	I	2	2	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	13	13	16	16	20	20
6/T	N+D	40	40	39	39	39	39
	I	6	6	6	6	6	6
	DV	0	0	0	0	0	0
	TOTAL	46	46	45	45	45	45
10/T	N+D	12	12	20	20	35	35
	I	2	2	3	3	5	5
	DV	0	0	0	0	0	0
	TOTAL	14	14	23	23	41	41
ADT	N+D	336	336	422	422	586	586
	I	50	50	63	63	88	88
	DV	0	0	0	0	0	0
	TOTAL	387	387	486	486	674	674
M/C	N+D	346	346	386	386	439	439
	I	25	25	25	25	20	20
	DV	0	0	0	0	0	0
	TOTAL	371	371	410	410	458	458
TOTAL	N+D	682	682	808	808	1024	1024
	I	76	76	88	88	108	108
	DV	0	0	0	0	0	0
	TOTAL	758	758	896	896	1132	1132

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

Figure 19.3.1   LAND USE AND CAPABILITY OF INFLUENCE AREA
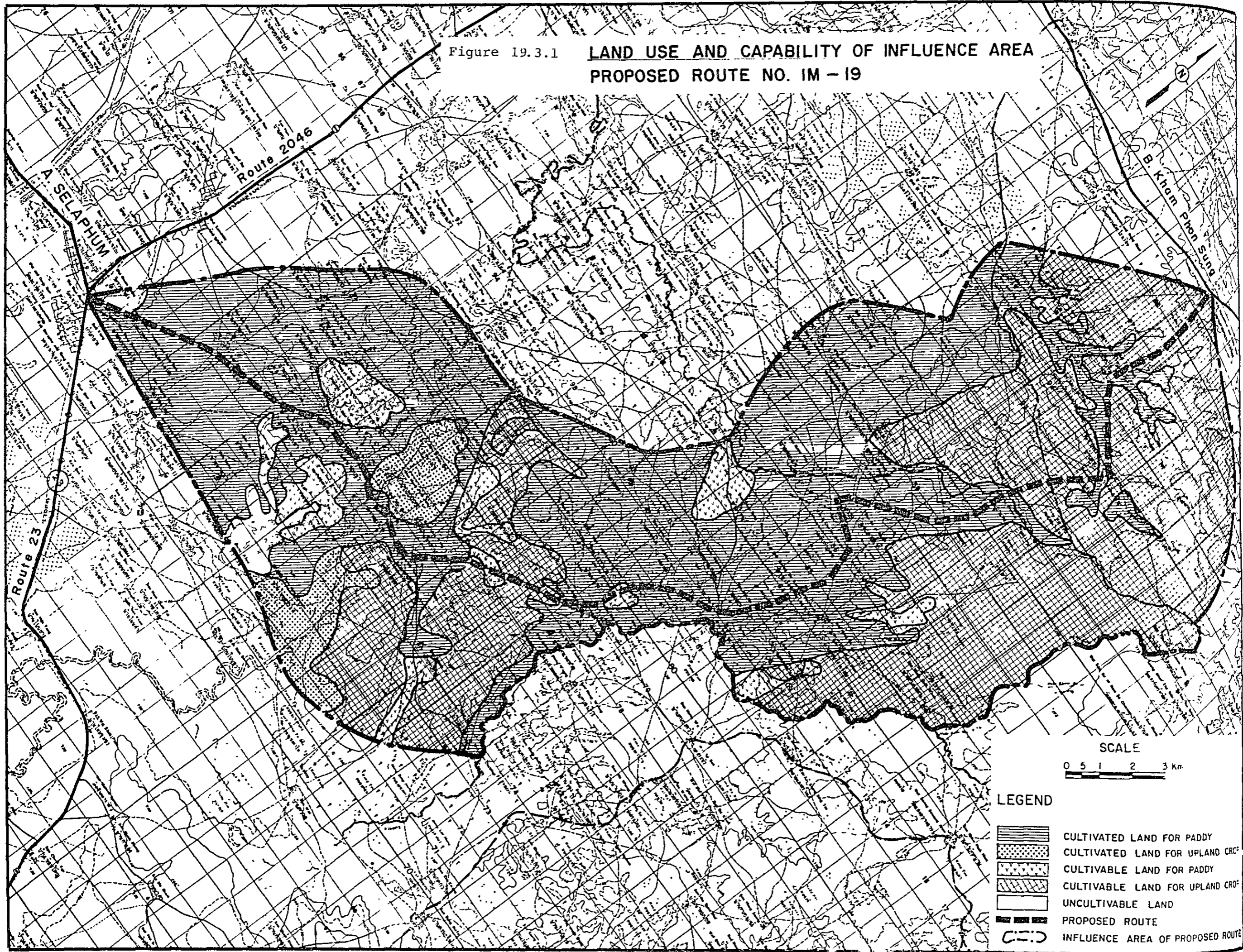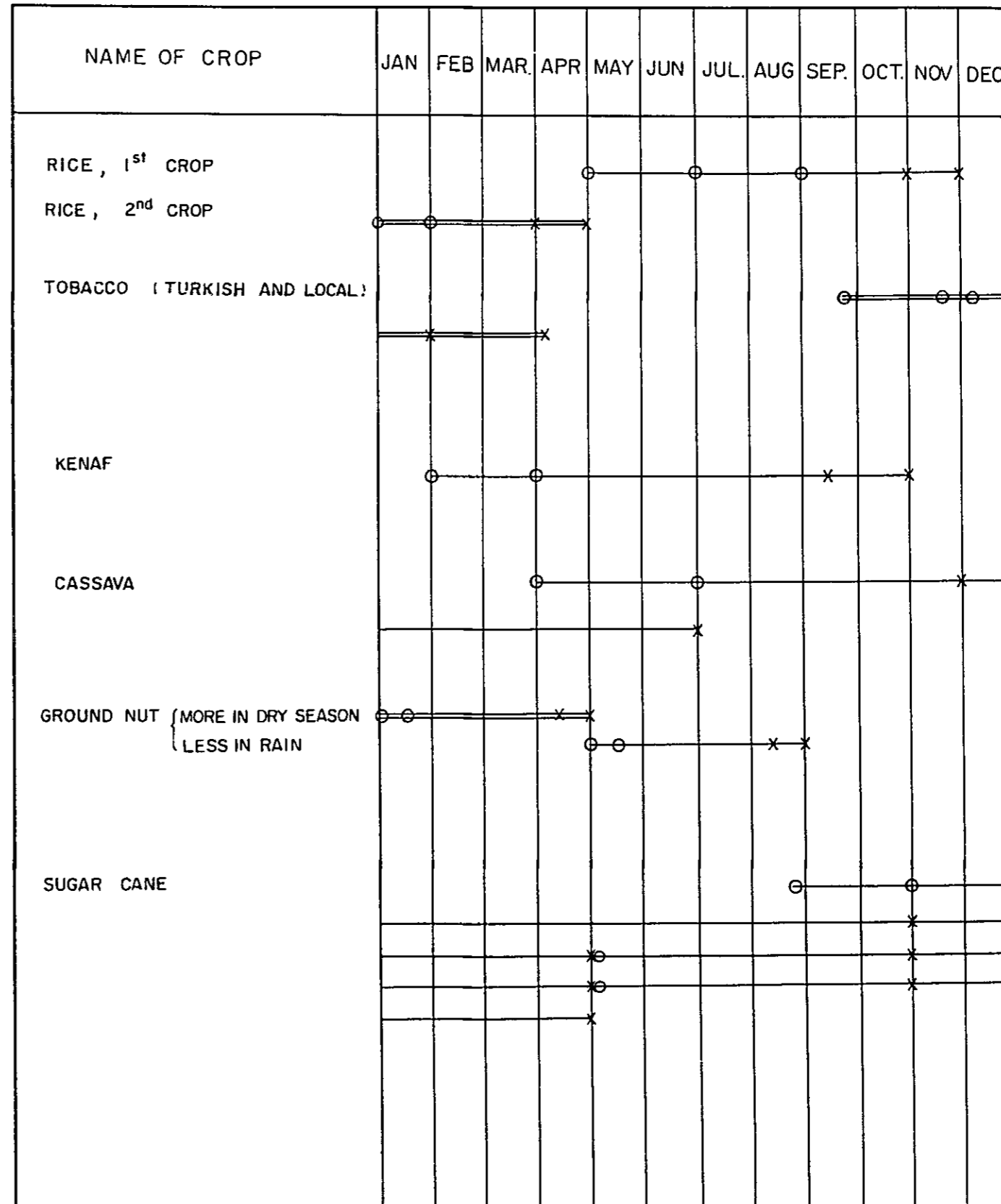PROPOSED ROUTE NO. IM – 19

SCALE

0 5 1   2   3 Km.

LEGEND

CULTIVATED LAND FOR PADDY
CULTIVATED LAND FOR UPLAND CROP
CULTIVABLE LAND FOR PADDY
CULTIVABLE LAND FOR UPLAND CROP
UNCULTIVABLE LAND
PROPOSED ROUTE
INFLUENCE AREA OF PROPOSED ROUTE

Figure 19.3.2 <u>CROPPING CALENDAR</u>

0900 CHANGWAT____<u>ROI ET</u>____

NAME OF CROP	JAN	FEB	MAR.	APR	MAY	JUN	JUL.	AUG	SEP.	OCT.	NOV	DEC
RICE , Ist CROP					⊖————————⊖————————⊖————————×————×							
RICE , 2nd CROP	⊖——⊖————————×————×											
TOBACCO (TURKISH AND LOCAL)										⊖————————⊖—⊖		
	═══×════════×											
KENAF	⊖————————⊖————————————————×————×											
CASSAVA	⊖————————⊖——————————————————————————×											
	════════════════════×											
GROUND NUT ⎰MORE IN DRY SEASON	⊖–⊖════════×—×											
⎱LESS IN RAIN					⊖–⊖════════×–×							
SUGAR CANE									⊖————————⊖			
			××						×			
			×⊖						×			
			×⊖						×			
			×									

Note   FIRST CROP   SECOND CROP

⊖————⊖————————×————————×   ⊖——⊖════════×————×
sowing   growing season   harvesting
season   season
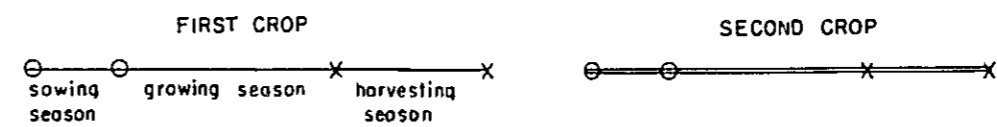
19 - 11

TABLE 19.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM'2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		127.375 (203.8)	3.750 (6.0)	131.125 (209.8)	11.250 (18.0)	69.375 (111.0)	80.625 (129.0)
0903	PHON THONG	18.750 (30.0)	–	18.750 (30.0)	–	7.500 (12.0)	7.500 (12.0)
0905	NONG PHOK	11.125 (17.8)	–	11.125 (17.8)	–	25.000 (40.0)	25.000 (40.0)
0907	SELAPHUM	97.500 (156.0)	3.750 (6.0)	101.250 (162.0)	11.250 (18.0)	36.875 (59.0)	48.125 (77.0)

TABLE 19.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA	(1000 RAI)											
1981			118.12	0.25	0.06	0.37	3.32	–	–	–	4.00	122.12
1987			118.12	0.25	0.07	0.37	3.46	–	–	–	4.15	122.27
1993	WITHOUT	PROJECT	118.12	0.25	0.08	0.37	3.60	–	–	–	4.30	122.43
	WITH	PROJECT	118.12	0.22	0.07	0.35	3.67	–	–	–	4.30	122.43
2001	WITHOUT	PROJECT	118.12	0.24	0.10	0.35	3.62	–	–	–	4.30	122.43
	WITH	PROJECT	118.12	0.21	0.08	0.33	3.68	–	–	–	4.30	122.43
CROP YIELD	(KG/RAI)											
1981			232.1	180.0	115.0	161.9	2100.0	–	–	–		
1987			232.1	181.1	116.4	161.9	2100.0	–	–	–		
1993	WITHOUT	PROJECT	232.1	182.2	117.8	161.9	2100.0	–	–	–		
	WITH	PROJECT	236.3	185.5	119.2	162.9	2112.7	–	–	–		
2001	WITHOUT	PROJECT	232.1	183.6	119.7	161.9	2100.0	–	–	–		
	WITH	PROJECT	242.0	191.5	123.1	164.2	2129.6	–	–	–		
CROP PRODUCTION	(TON)											
1981			27,413	45	7	59	6,969	–	–	–	7,095	34,508
1987			27,413	45	8	59	7,267	–	–	–	7,394	34,807
1993	WITHOUT	PROJECT	27,413	45	10	59	7,569	–	–	–	7,698	35,111
	WITH	PROJECT	27,910	41	8	56	7,745	–	–	–	7,863	35,773
2001	WITHOUT	PROJECT	27,413	43	12	56	7,605	–	–	–	7,730	35,143
	WITH	PROJECT	28,587	40	10	54	7,843	–	–	–	7,959	36,546

NOTE : SYMBOL "–" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 19.3.3   FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 − 2001)	3,451	2,060	6,695	7,128	587	−	−	−
WITH PROJECT (1987 − 2001)	3,537	2,112	6,695	7,128	602	−	−	−
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 − 2001)	540	359	558	989	724	−	−	−
WITH PROJECT (1987 − 2001)	553	379	578	1,009	744	−	−	−

TABLE 19.3.4   NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	30,755	1,843	32,598	31,632	1,873	33,505
1993	30,755	1,921	32,676	33,390	2,009	35,399
2001	30,755	1,931	32,636	35,785	2,063	37,848

Figure 19.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

FILL SECTION

CUT SECTION

DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)
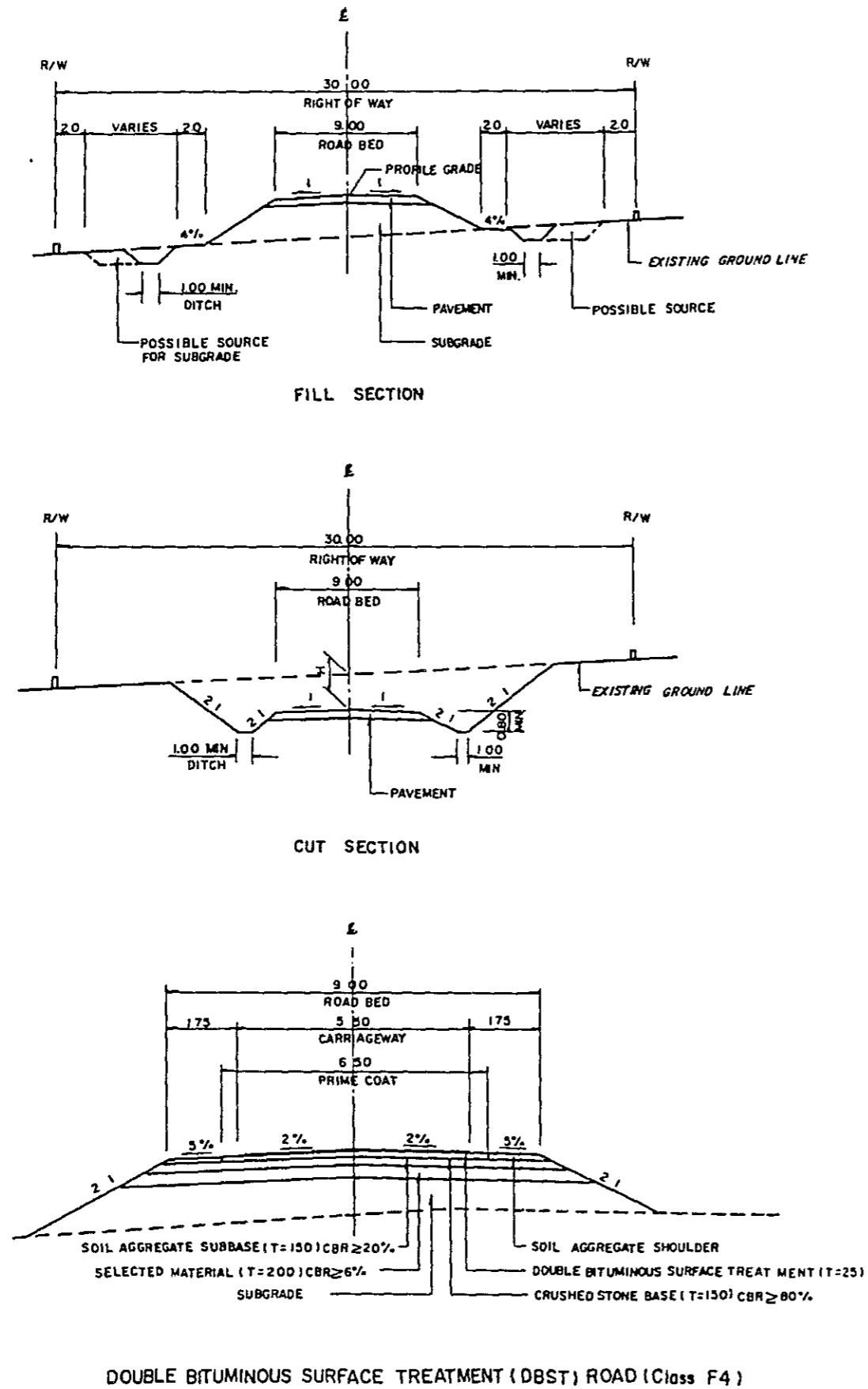
Figure 19.5.2 **PROPOSED ROUTE NO. IM-19** **C. ROI ET** **A. SELAPHUM (J.R. 23) – B. KHAM PHON SUNG (J.R. 2136)**
ROUTE NO. 2259 **L = 46.0 Km.**

Length – 46.0 Km.
Route 2259 – 46.0 Km.
D.T. or Laterite – (6.0 – 8.0 m.)

Improvement – 46.0 Km.
Flat – 11.0 Km. Rolling – 17.0 Km. Flat – 28.0 Km.
Flood S – 1.0 Km.
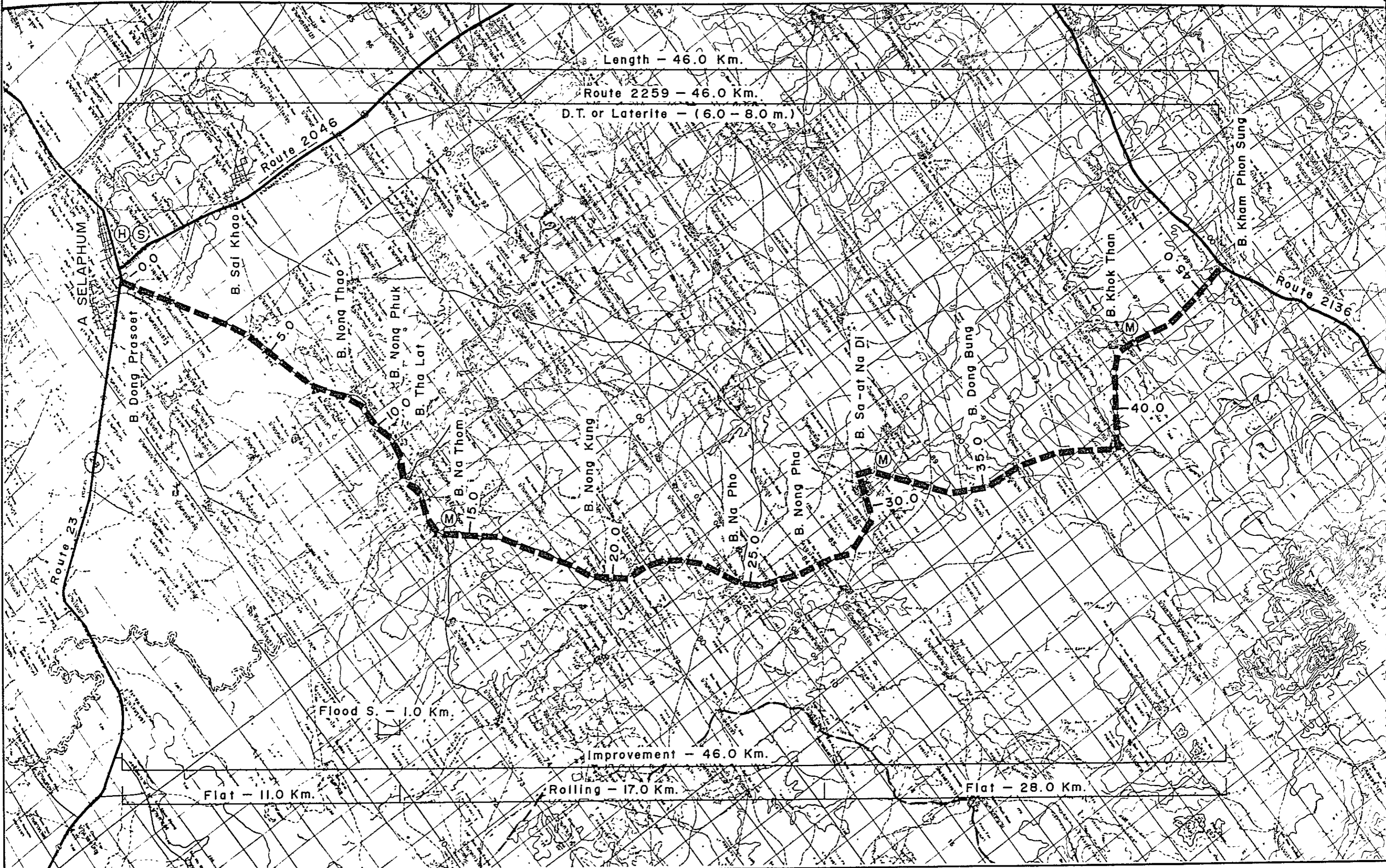
A. SELAPHUM (J.R. 23) – B. KHAM PHON SUNG (J.R. 2136)
ROUTE NO. 2259
L = 46.0 Km.

LOCATION MAP
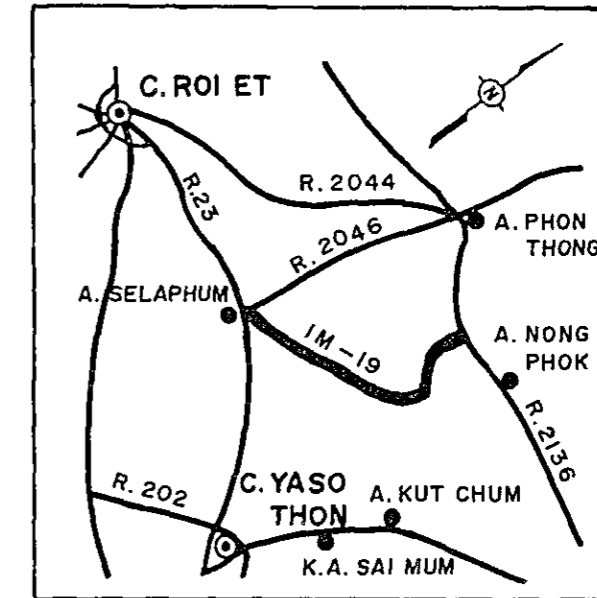
BRIDGE LIST

No	Station Km.	Proposed Bridge	Existing Bridge
1	7 2	C – 7.00 x 12 50	C – 4 50 x 12 50
2	9.3	C – 7.00 x 40 50	C – 4.20 x 40 50
3	9 4	C 7 00 x 40 30	C – 4 30 x 40.30
4	9 8	—	C – 9 50 x 60.50
5	10 9	C – 7 00 x 19 00	C – 4 50 x 19 00
6	12.8	C – 7.00 x 30 00	C – 4.40 x 30 00
7	13.0	C 7 00 x 25.00	C – 4 50 x 25.00
8	14.9	C – 7.00 x 12 50	C – 4 20 x 12 50
9	22.6	C – 7.00 x 12.00	C – 4.50 x 12 00
10	26.8	C – 7.00 x 20 50	C – 4.50 x 20.50
11	28. 1	C – 7.00 x 16.00	C – 4 30 x 16.00
12	32 9	C – 7.00 x 30.00	C – 4 40 x 30 00
13	34 5	C – 7.00 x 24 00	C – 4.30 x 24 00
14	35 6	C – 7 00 x 20.50	C – 4 40 x 20.50
15	36.8	C – 7.00 x 12.00	C – 4 30 x 12.00
16	38 2	C – 7.00 x 14.00	C – 4 40 x 14 00
17	40 9	C – 7 00 x 24 40	C – 4 20 x 24 40

LEGEND

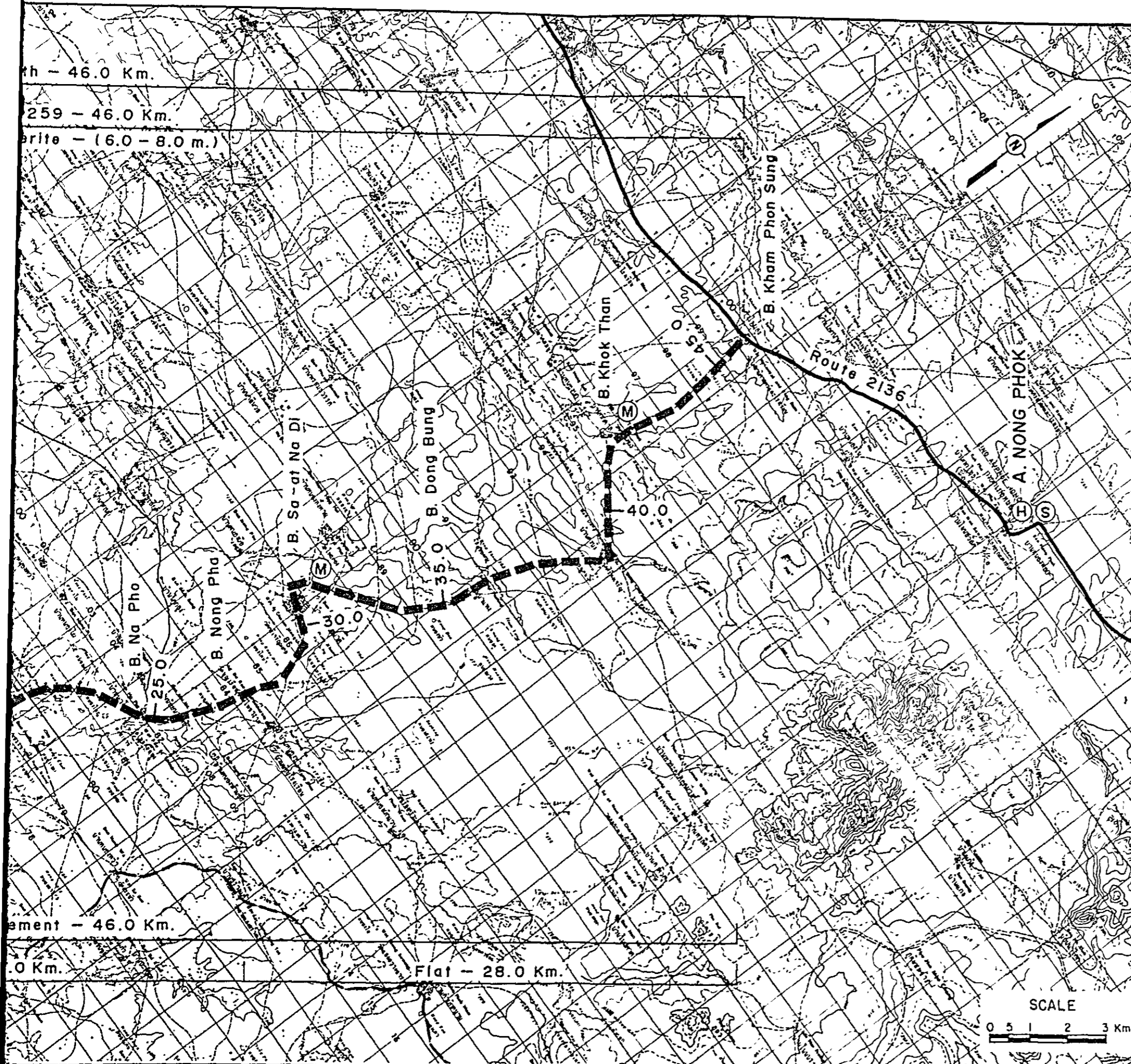|	
▬▬▬▬▬	PROPOSED ROUTE (IMPROVEMENT)
▬▬▬▬▬	PROPOSED ROUTE (NEW CONSTRUCTION)
———	PAVED ROUTE
– – – –	UNPAVED ROUTE
••••••	INVENTORY SURVEY ROUTE
(H)	HOSPITAL
(M)	MEDICAL CENTER
(S)	SECONDARY SCHOOL

SCALE

0 5 1 2 3 Km

Table 19.5.1   <u>CONSTRUCTION QUANTITIES AND COSTS   IM-19   (46.0 km)</u>

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	106	1,590	1,446
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	136,300	6,133	5,581
Selected Material	m^3	80	93,900	7,512	6,685
Soil Aggregate Surface or Subbase	m^3	105	65,800	6,909	6,149
Crushed Stone Base	m^3	370	43,200	15,984	14,705
Soil Aggregate Shoulder	m^3	105	18,600	1,953	1,738
Prime Coat and DBST	m^2	55	243,700	13,404	12,064
Pipe Culvert	m	2,100	1,740	3,654	3,361
Box Culvert	m	16,000	0	0	0
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	353	14,120	12,566
Sub Total (a)				71,260	64,299
Miscellaneous Works (a) x 7%				4,988	4,501
Total (b)				76,248	68,800
PHYSICAL CONTINGENCY (b) x 15%				11,437	10,320
ENGINEERING AND ADMINISTRATION (b) x 10%				7,625	6,880
Sub Total				19,062	17,200
LAND ACQUISITION					
Highly Developed Land	ha	50,000	0	0	0
Less Developed Land	ha	15,000	0	0	0
Sub Total				0	0
GRAND TOTAL				95,310	86,000

Table 19.6.1 <u>COST AND BENEFITS</u>

(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	17,200	0	0	0	0	24,165	0
1985	43,000	0	0	0	0	53,939	0
1986	25,800	0	0	0	0	28,896	0
1987	0	907	14,873	308	16,088	0	14,365
1988	0	1,210	15,928	363	17,501	0	13,952
1989	0	1,512	16,983	418	18,913	0	13,462
1990	0	1,815	18,038	473	20,326	0	12,918
1991	0	2,118	19,093	528	21,739	0	12,335
1992	0	2,420	20,148	583	23,151	0	11,729
1993	0	2,723	21,203	637	24,564	0	11,111
1994	22,264	3,028	22,779	720	26,527	10,071	10,714
1995	0	3,333	24,354	803	28,490	0	10,274
1996	0	3,638	25,929	886	30,453	0	9,805
1997	0	3,943	27,505	969	32,416	0	9,319
1998	0	4,247	29,080	1,051	34,379	0	8,824
1999	0	4,552	30,655	1,134	36,342	0	8,329
2000	0	4,857	32,231	1,217	38,305	0	7,838
2001	−39,560	5,162	33,806	1,300	40,268	−7,227	7,357
TOTAL	68,704	45,465	352,607	11,389	409,461	109,844	162,330

DISCOUNTED ECONOMIC COSTS :   109,844

DISCOUNTED ECONOMIC BENEFITS :   162,330

  AGRICULTURAL DEVELOPMENT BENEFIT   16,463
  VOC SAVING   141,661
  RMC SAVING   4,205

NET PRESENT VALUE :   52,487

BENEFIT COST RATIO :   1.48

INTERNAL RATE OF RETURN :   17.1 %

Table 19.7.1 SOCIAL INDICATORS

(Proposed Route IM-19)

Population (1,000)		
1982	:	37.6
1993	:	43.2

Average travelling speed, without (kph)	:	40

Isolation

Access to Amphoe

Average distance to Amphoe (km)1/	:	15.2
Per capita time savings (10^{-4})	:	0.039
Score	:	115

Access to Artery Highway

Average distance to highway (km)1/	:	-
Per capita time savings (10^{-4})	:	-
Score	:	100

Impassability

Impassable week a year	:	1
Impassability per year	:	0.019
Impassability per capita (10^{-4})	:	0.004
Score	:	33

Health

Access to Hospital

Average distance to Hospital (km)1/	:	13.0
Per capita time savings (10^{-4})	:	0.033
Score	:	77

Access to Medical Facilities

Average distance to facilities (km)1/	:	3.7
Per capita time savings (10^{-4})	:	0.010
Score	:	40

Education

Access to Secondary School

Number of Student in 1993 (1,000)2/	:	8.6
Average distance to school (km)	:	13.0
Per capita time savings (10^{-4})	:	0.168
Score	:	91

Teacher Intensity

Number of teachers3/

University graduate	:	1
Total	:	19
Number of Student	:	505

Indicators

E1 4/	:	2.0
E2 5/	:	37.6
E 6/	:	39.6
Degree of Improvement7/	:	1.73
Score	:	110

Disparity

G.P.V. in 1993 (Mn B)8/

With project	:	103.9
Without project	:	99.6

Per capita G.P.V. in 1993 (B)

With project (W)	:	2,405
Without project (w)	:	2,306

Degree of Disparity

(A/W) - (A/w)9/	:	0.06
Score	:	107

Total Score	:	673

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 - 20

Changwat · Ubon Ratchathani

 B. Na Hai (J R.2049) - A. Kut Khao Pun

Length · 17.2 KM.

SUMMARY

PROPOSED ROUTE   IM- 20

Item	Description
Changwat	Ubon Ratchathani
Origin	B. Na Hai (J.R.2049)
Destination	A. Kut Khao Pun
Length	
Total	17.2 km
Improvement Section	17.2 km
DOH Road	R.2197 17.2 km
ARD Road	0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat and Rolling
Influence Area	
Area	116 km^2
Population (1982)	17,900
Principal Crops	Paddy
Traffic (ADT)	
Existing	102
1993	399
2001	517
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	32,869 . 10^3 ฿
Economic	29,666 . 10^3 ฿
IRR	8.4 %
B/C	0.73
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE
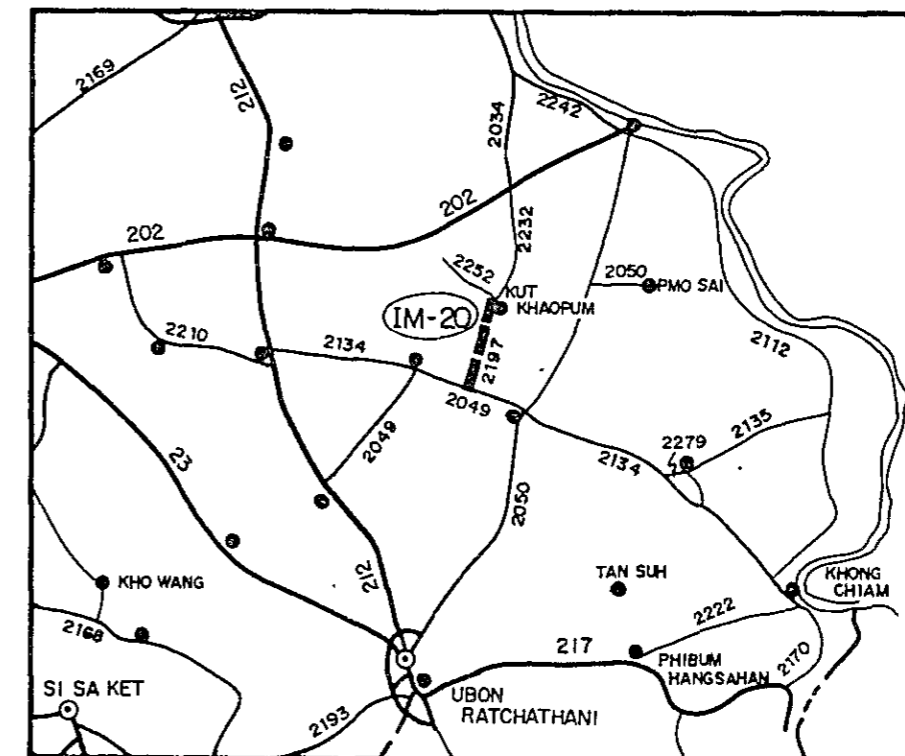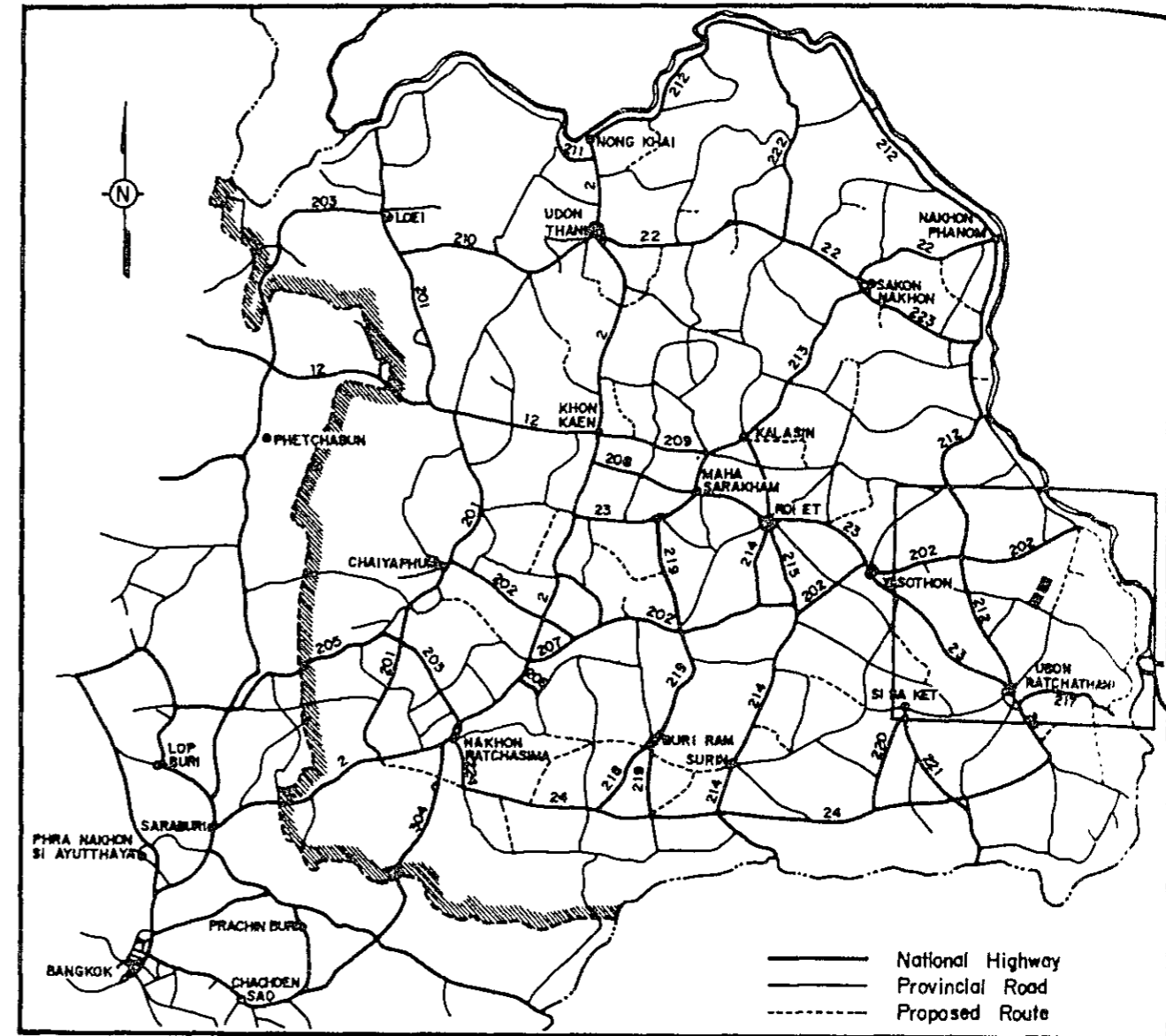
National Highway
Provincial Road
Proposed Route

1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the north part of Changwat Ubon Ratchathani. The route, starting at Ban Na Hai on Route 2049, runs northward passing through Ban Pao, and Ban Ka Bin and ends at Amphoe Kut Khapun, the intersection of Route 2232 with Route 2252. Its total length is 17.2 km. (Figure 20.5.2)

The terrain is almost flat and rolling. In the influence area, there exists several villages with total population of 17,900. There is two medical centers, no hospital and one secondary school along the proposed route.

The proposed route, upon completion, will play vital role to connect Amphoe Kut Khao Pun with highway of Route 2049.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are summarized in Table 20.1.1. The details are shown as the results of inventory survey in Table 20.1.2.
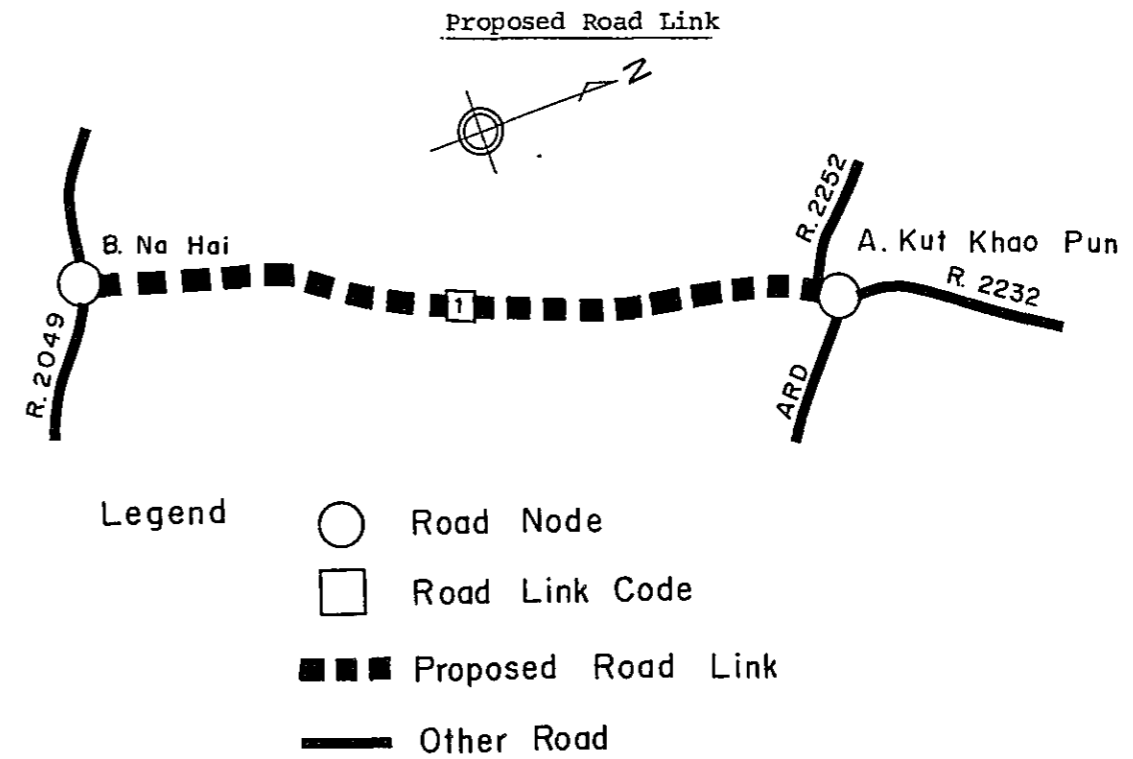
2. TRAFFIC

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 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
DOH (1981)	1[1]/	45	17	13	16	6	3	8	18	2	128
Manual Counts (1982)	1	–	15	18	7	–	2	7	21	–	70
Estimated	1	23	16	16	12	3	3	8	20	1	102

Note: [1]/   Route 2197   Section 0100   Station Km 1+300

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	725

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	38	22	60

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 Reports. 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	1.0	0.9
PASSENGER MOVEMENT	5.2	5.4	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	0.0	0.0
FREIGHT	4.3	4.5	4.6

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	32.9	22.9	22.9	17.1	4.3	9.4	25.0	62.5	3.1
	1987	27.9	27.8	21.1	17.8	5.4	11.4	22.6	55.3	10.7
	1993	21.9	33.8	18.9	18.6	6.8	13.8	19.8	46.6	19.8
	2001	13.9	41.8	16.0	19.7	8.6	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 20.2.1.

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	28	21	18	5	32	8	20	4	136	198	335
1993	29	25	25	9	50	7	17	7	170	229	399
2001	27	31	38	17	88	7	15	14	236	281	517

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land is covered by paddy fields. Unused cultivable land, for both paddy and upland field, is quite limited.

Land use and capability conditions in the area of influence are shown in Table 20.3.1 and Figure 20.3.1.

A typical cropping calendar in the Ubon Ratchathani area is shown in Figure 20.3.2.

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 20.3.2.

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 20.3.3.

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 20.3.4. 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 / Case 2	Nos. of Wooden Narrow Bridge
1	Flat & Rolling	17.2	3	5	0	17.2	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)	2,188	3,127	4,926
2A (F5)	1,556	2,307	3,719

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 20.5.1

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$\geq$80%	15.0cm
Soil Aggregate Subbase	CBR$\geq$20%	15.0cm
Selected Material	CBR$\geq$6%	20.0cm

In case of F5 Standard

Soil Aggregate Surface	CBR$\geq$20%	15.0cm
Selected Material	CBR$\geq$6%	20.0cm

Pipe Culvert

Standard Size	: ϕ 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 20.5.2.

Alignment of the route is shown in Figure 20.5.2.

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 20.5.1.

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

Total Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10^3 ₱)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	17.2	32,869	29,666	
F5 (Soil Aggregate)	17.2	22,284	20,038	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 20.6.1 and 20.6.2.

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 20.7.1.

Table 20.1.1   SUMMARY OF ROAD INVENTORY

Item	Description			
Origin	B. Na Hai (J.R. 2049)			
Destination	A. Kut Khao Pun			
Length				
Total			17.2	km
Improvement Section			17.2	km
DOH Road	R. 2197		17.2	km
ARD Road			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, 6.8 m (Weighted average)			
Embankment Section				
Length			17.2	km
Height	0.5 m – 1.35 m			
Cut Section				
Length			0	km
Depth		m – m		
Surface Type and Condition				
SBST or DBST			0	km
Soil Aggregate	Poor		17.2	km
Earth			0	km
Pipe Culvert	50	each		
Box Culvert	0	each	0	m
Bridge				
Permanent Bridge	0	each	0	m
Narrow Concrete Bridge	0	each	0	m (4m)
Wooden Bridge	6	each	81.0	m
Overflow Section	0	place.	0	km

Table 20.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-20   ROUTE NO. 2197   B. NA HAI (J.R. 2049) ∿ A. KUT KHAO PUN   L = 17.2

UBON RATCHATHANI

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. NA HAI H = 168 P = 681	B. NASAHAI H = 43 P = 215		B. PAO H = 240 P = 1200	B. PHOK H = 230 P = 1150		B. NON MA KHUA H = 58 P = 290 / B. KABIN H = 160 P = 900	B. NON DOK KOD H = 21 P = 105	B. KUT KHAO PUN H = 235 P = 1175							
TERRAIN		Flat	Rolling	Flat			Rolling	Flat	Rolling	Flat							
CROSS SECTION	Formation Width (m)	7.00	5.50	7.00		6.50	8.00	6.00	7.00	6.50							
	Embankment Height (m)	1.00	1.35	0.80		0.50	0.75	1.00	0.50	0.85							
	Cutting Depth (m)																
PAVEMENT	Type/Length				Laterite												
	Condition				Poor												
FLOODING	Overflow Length(Km)/Height(m)																
LAND USE	Left	Paddy	Forest	Paddy	Forest	Paddy	Forest	Paddy		Forest							
	Right	Paddy	Forest	Paddy	Forest		Paddy			Forest	Paddy						
PIPE CULVERT	Total Number					50 Pipes											
BOX CULVERT & BRIDGE	Station (Km)	0.7 0.9 1.9		5.1				11.3	14.5								
	Dimension	W-Br. 4.20 x 15.50 / W-Br. 4.00 x 10.50 / W-Br. 4.00 x 10.50		W-Br. 4.10 x 4.00				W-Br. 4.20 x 20.40	W-Br. 4.00 x 20.10								
RIGHT OF WAY (m)																	
ALIGNMENT	Horizontal				Fair												
	Vertical				Fair												
ROUTE NO., AGENCIES					DOH 2197												

Table 20.2.1   TRAFFIC VOLUME ON ROUTE IM - 20

LINK		YEAR 1987		1993		2001	
		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	24	24	25	25	23	23
	I	4	4	4	4	4	4
	DV	0	0	0	0	0	0
	TOTAL	28	28	29	29	27	27
L/B	N+D	18	18	22	22	27	27
	I	3	3	3	3	4	4
	DV	0	0	0	0	0	0
	TOTAL	21	21	25	25	31	31
M/B	N+D	16	16	21	21	33	33
	I	2	2	3	3	5	5
	DV	0	0	0	0	0	0
	TOTAL	18	18	25	25	38	38
H/B	N+D	5	5	8	8	15	15
	I	1	1	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	5	5	9	9	17	17
P/P&T	N+D	28	28	43	43	77	77
	I	4	4	7	7	12	12
	DV	0	0	0	0	0	0
	TOTAL	32	32	50	50	88	88
4/T	N+D	7	7	6	6	6	6
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	8	8	7	7	7	7
6/T	N+D	17	17	15	15	13	13
	I	3	3	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	20	20	17	17	15	15
10/T	N+D	3	3	6	6	12	12
	I	1	1	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	4	4	7	7	14	14
ADT	N+D	118	118	148	148	205	205
	I	18	18	22	22	31	31
	DV	0	0	0	0	0	0
	TOTAL	136	136	170	170	236	236
M/C	N+D	181	181	209	209	258	258
	I	18	18	20	20	23	23
	DV	0	0	0	0	0	0
	TOTAL	198	198	229	229	281	281
TOTAL	N+D	299	299	357	357	463	463
	I	36	36	42	42	53	53
	DV	0	0	0	0	0	0
	TOTAL	335	335	399	399	517	517

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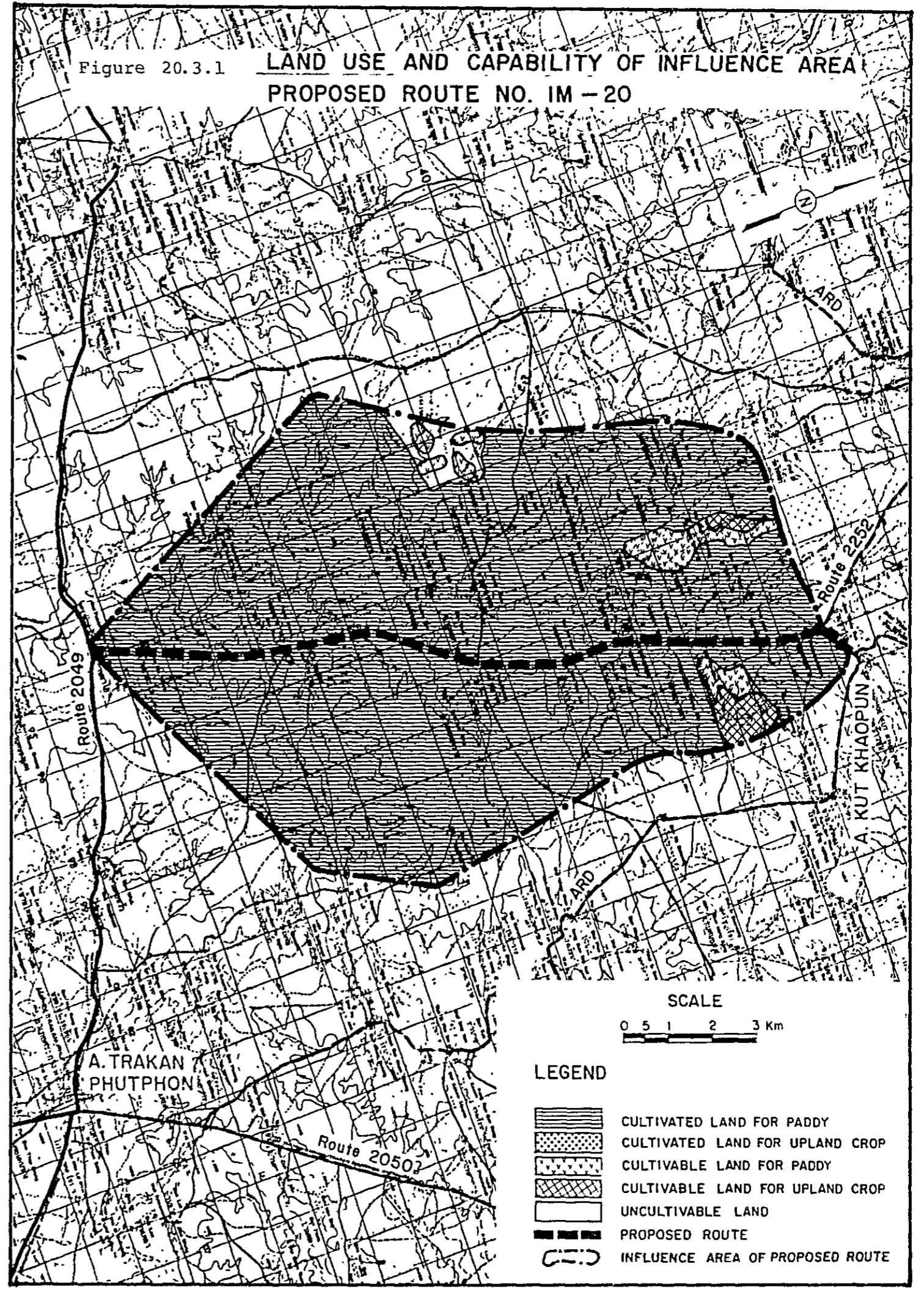DV : DEVELOPED TRAFFIC   I : INDUCED TRAFFIC

Figure 20.3.1   LAND USE AND CAPABILITY OF INFLUENCE AREA PROPOSED ROUTE NO. IM - 20

SCALE
0 5 1 2 3 Km

LEGEND

- CULTIVATED LAND FOR PADDY
- CULTIVATED LAND FOR UPLAND CROP
- CULTIVABLE LAND FOR PADDY
- CULTIVABLE LAND FOR UPLAND CROP
- UNCULTIVABLE LAND
- PROPOSED ROUTE
- INFLUENCE AREA OF PROPOSED ROUTE

Figure 20.3.2 **CROPPING CALENDAR**

I IOO CHANGWAT_____UBON RATCHATHANI_____

NAME OF CROP	JAN	FEB.	MAR	APR.	MAY.	JUN.	JUL.	AUG.	SEP	OCT	NOV.	DEC.
RICE, 1st CROP				⊕———	———⊕———	———⊕———	———	———✕—	—✕		
RICE, 2nd CROP	⊕—	—⊕———	—✕——✕									
KENAF			⊕—	—⊕———	———	———	———	———✕—	—✕		
CASSAVA			⊕—	———	———⊕—	———	———	———	———✕		
				✕							
GROUND NUT {MORE IN DRY SEASON	⊕—⊕—	———	—✕—✕								
{LESS IN RAIN.				⊕—⊕—	———	———✕—✕				
COTTON					⊖—	—⊕———	———	———✕—	—✕	
MAIZE				⊕—⊕—	———	———✕—✕				

Note :   FIRST CROP   SECOND CROP

⊖——⊖————————✕————✕   ⊖——⊖————————✕————✕
sowing   growing season   harvesting
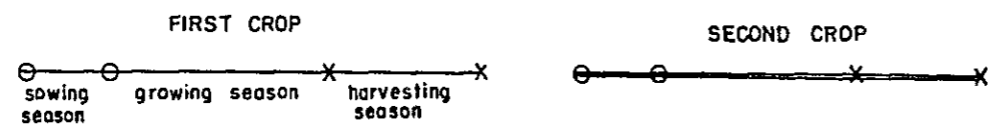season   season

TABLE 20.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM·2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		67.500 (108.0)	–	67.500 (108.0)	2.500 (4.0)	1.250 (2.0)	3.750 (6.0)
1110	KUT KAOPUN	25.625 (41.0)	–	25.625 (41.0)	1.875 (3.0)	1.250 (2.0)	3.125 (5.0)
1111	TRAKAN PHUTPHON	41.875 (67.0)	–	41.875 (67.0)	0.625 (1.0)	–	0.625 (1.0)

TABLE 20.3.2 CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)											
1981		62.88	–	–	–	0.10	–	–	–	0.10	62.98
1987		63.18	–	–	–	0.10	–	–	–	0.10	63.29
1993	WITHOUT PROJECT	63.18	–	–	–	0.11	–	–	–	0.11	63.29
	WITH PROJECT	63.18	–	–	–	0.12	–	–	–	0.12	63.30
2001	WITHOUT PROJECT	63.18	–	–	–	0.11	–	–	–	0.11	63.30
	WITH PROJECT	63.18	–	–	–	0.12	–	–	–	0.12	63.31
CROP YIELD (KG/RAI)											
1981		179.7	–	–	–	1400.0	–	–	–		
1987		179.7	–	–	–	1425.4	–	–	–		
1993	WITHOUT PROJECT	179.7	–	–	–	1451.2	–	–	–		
	WITH PROJECT	183.0	–	–	–	1468.7	–	–	–		
2001	WITHOUT PROJECT	179.7	–	–	–	1486.4	–	–	–		
	WITH PROJECT	187.4	–	–	–	1528.5	–	–	–		
CROP PRODUCTION (TON)											
1981		11,300	–	–	–	138	–	–	–	138	11,438
1987		11,355	–	–	–	146	–	–	–	146	11,501
1993	WITHOUT PROJECT	11,355	–	–	–	155	–	–	–	155	11,510
	WITH PROJECT	11,561	–	–	–	169	–	–	–	170	11,731
2001	WITHOUT PROJECT	11,355	–	–	–	168	–	–	–	168	11,523
	WITH PROJECT	11,842	–	–	–	186	–	–	–	187	12,028

NOTE : SYMBOL "–" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 20.3.3   FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,741	-	-	-	577	-	-	-
WITH PROJECT (1987 - 2001)	3,835	-	-	-	591	-	-	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	392	-	-	-	677	-	-	-
WITH PROJECT (1987 - 2001)	406	-	-	-	737	-	-	-

TABLE 20.3.4   NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	17,726	15	17,741	17,918	11	17,929
1993	17,726	17	17,743	18,708	15	18,723
2001	17,726	21	17,747	19,784	20	19,804

Figure 20.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

FILL SECTION

CUT SECTION

DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)
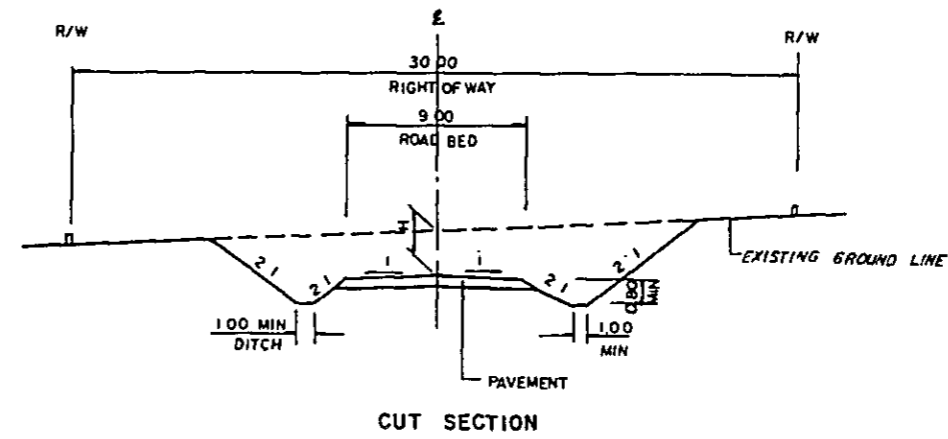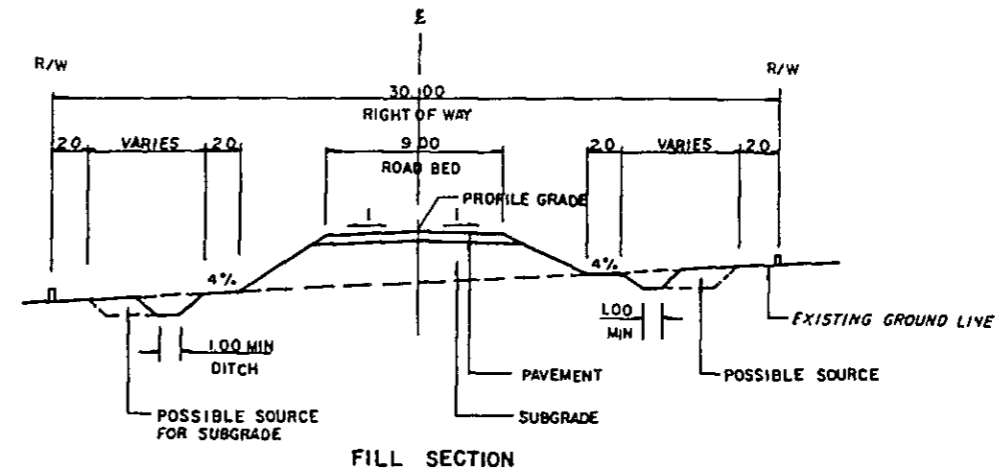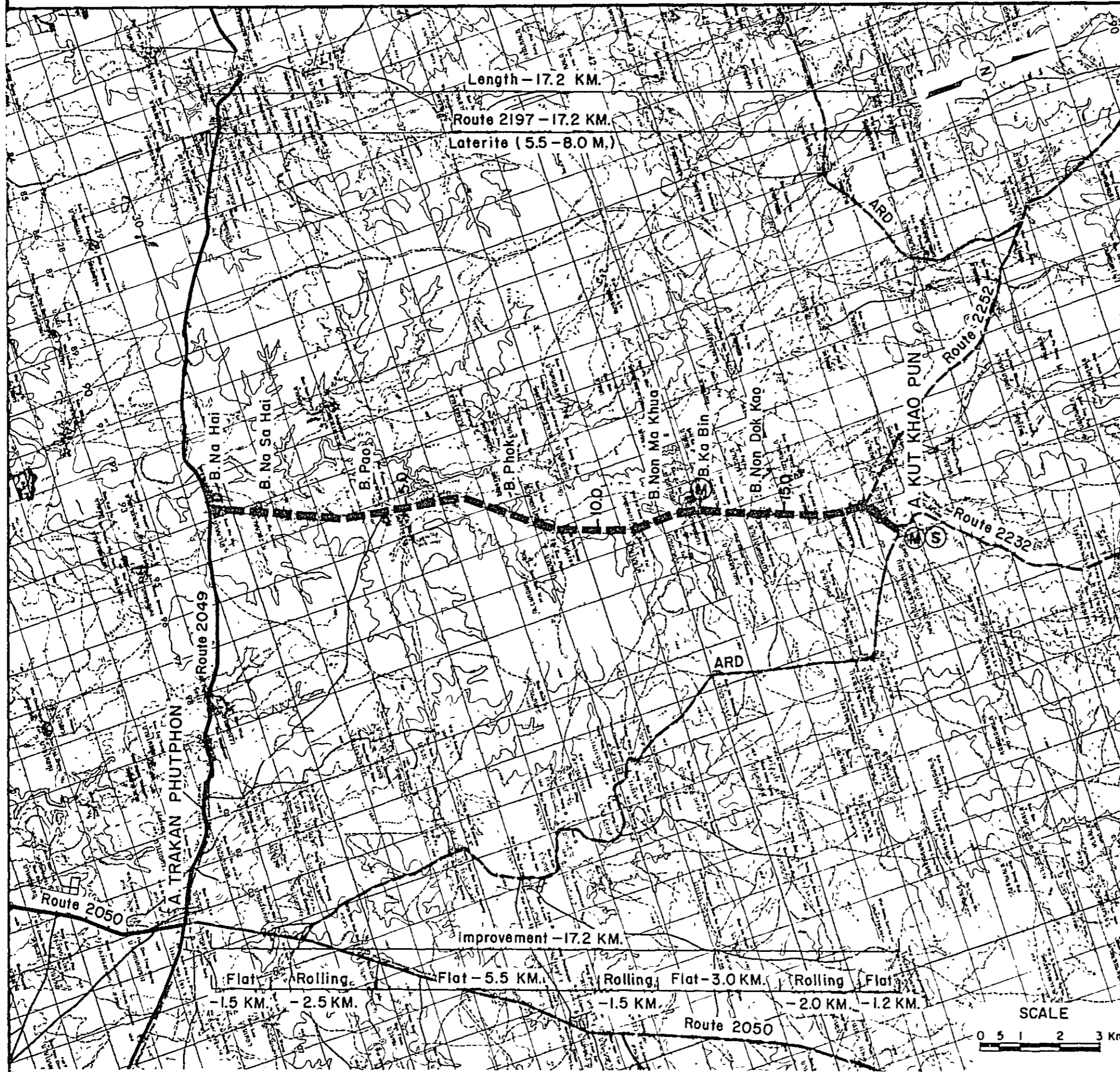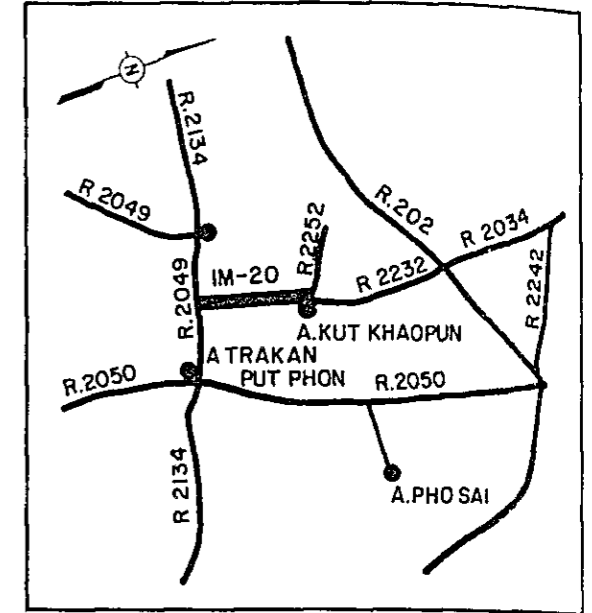
SOIL AGGREGATE SURFACED ROAD (Class F5)
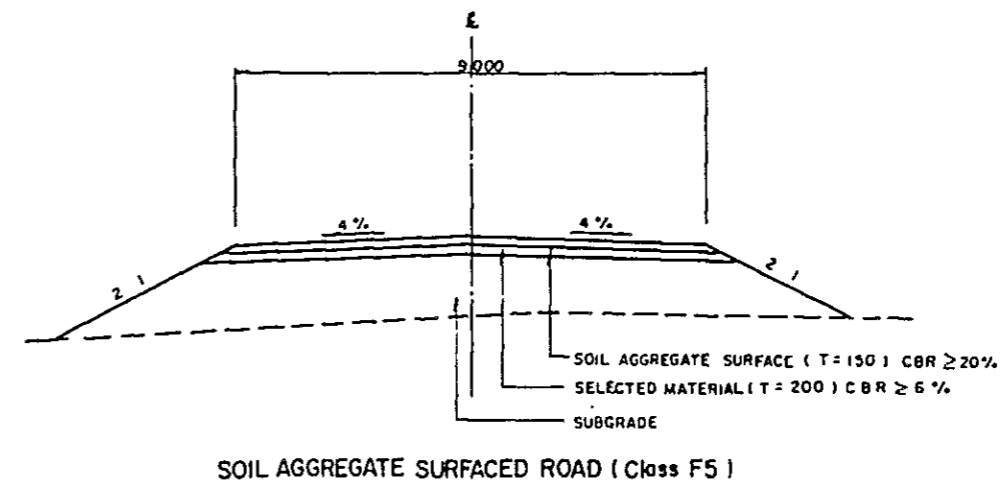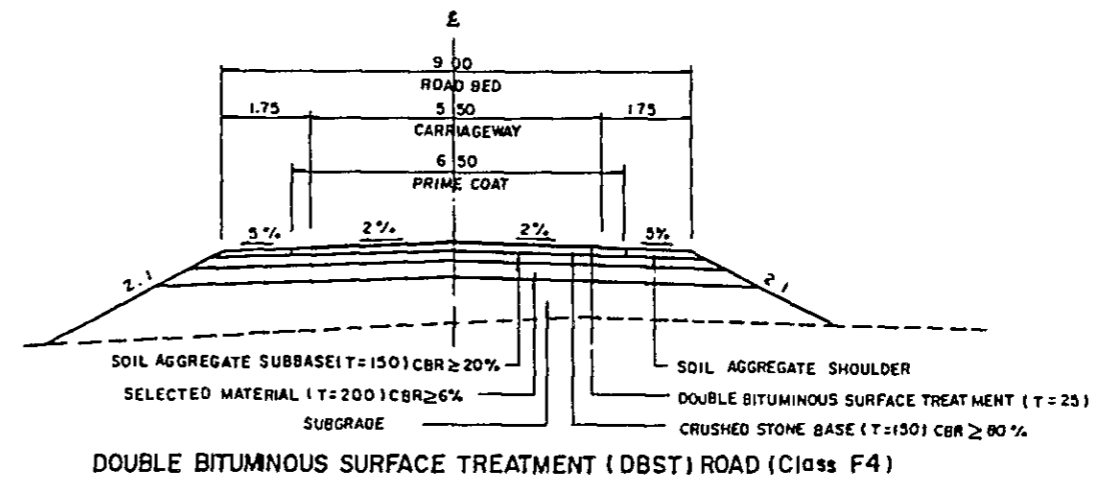
Figure 20.5.2

PROPOSED ROUTE NO. IM-20   C.UBON RATCHATHANI   B. NA HAI (J.R.2049) – A. KUT KHAO PUN
ROUTE NO. 2197   L = 17.2 Km.

LOCATION MAP

Length – 17.2 KM.

Route 2197 – 17.2 KM.

Laterite (5.5 – 8.0 M.)

Improvement – 17.2 KM.

Flat Rolling. Flat – 5.5 KM. Rolling. Flat-3.0 KM. Rolling Flat
–1.5 KM. –2.5 KM.   –1.5 KM.   –2.0 KM. –1.2 KM.

SCALE

0 5 1   2   3 Km.

BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	0.7	C-7.00 x 18.00	W-4.20 x 15.50
2	0.9	C-7.00 x 14.00	W-4.00 x 10.50
3	1.9	C-7.00 x 14.00	W-4.00 x 10.50
4	5.1	(BOX CULVERT)	W-4.10 x 4.00
5	11.3	C-7.00 x 24.00	W-4.20 x 20.40
6	14.5	C-7.00 x 24.00	W-4.00 x 20.10

LEGEND

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

Table 20.5.1   CONSTRUCTION QUANTITIES AND COSTS   IM-20 (17.2 km)

Items	Unit of Q'ty	Financial Unit Rate ß	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost $(10^3 ß)$	Economic Cost $(10^3 ß)$	Q'ty	Financial Cost $(10^3 ß)$	Economic Cost $(10^3 ß)$
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	40	600	546	40	600	546
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	34,400	1,548	1,408	34,400	1,548	1,408
Selected Material	m^3	80	36,500	2,920	2,598	36,500	2,920	2,598
Soil Aggregate Surface or Subbase	m^3	105	25,500	2,677	2,382	25,500	2,677	2,382
Crushed Stone Base	m^3	370	16,800	6,216	5,718	5,900	2,183	2,008
Soil Aggregate Shoulder	m^3	105	7,200	756	672	2,500	262	233
Prime Coat and DBST	m^2	55	94,600	5,203	4,683	33,000	1,815	1,634
Pipe Culvert	m	2,100	350	735	676	350	735	676
Box Culvert	m	16,000	20	320	288	20	320	288
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	90	3,600	3,204	90	3,600	3,204
Sub Total (a)				24,575	22,180		16,661	14,981
Miscellaneous Works (a) x 7%				1,720	1,553		1,166	1,049
Total (b)				26,295	23,733		‑17,827	16,030
PHYSICAL CONTINGENCY (b) x 15%				3,944	3,560		2,674	2,405
ENGINEERING AND ADMINISTRATION (b) x 10%				2,630	2,373		1,783	1,603
Sub Total				6,574	5,933		4,457	4,008
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				32,869	29,666		22,284	20,038

Table 20.6.1 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	11,866	0	0	0	0	14,885	0
1986	17,799	0	0	0	0	19,935	0
1987	0	188	2,188	-81	2,295	0	2,049
1988	0	320	2,345	-75	2,590	0	2,064
1989	0	452	2,501	-68	2,884	0	2,053
1990	0	583	2,657	-61	3,179	0	2,021
1991	0	715	2,814	-55	3,474	0	1,971
1992	0	847	2,970	-48	3,769	0	1,910
1993	0	979	3,127	-41	4,064	0	1,838
1994	8,325	1,113	3,351	-31	4,434	3,766	1,791
1995	0	1,248	3,576	-21	4,803	0	1,732
1996	0	1,383	3,801	-12	5,173	0	1,665
1997	0	1,518	4,026	-2	5,542	0	1,593
1998	0	1,653	4,251	8	5,912	0	1,517
1999	0	1,787	4,476	18	6,281	0	1,440
2000	0	1,922	4,701	28	6,651	0	1,361
2001	-13,646	2,057	4,926	38	7,021	-2,493	1,283
TOTAL	24,344	16,765	51,711	-404	68,072	36,092	26,288

DISCOUNTED ECONOMIC COSTS :   36,092

DISCOUNTED ECONOMIC BENEFITS :   26,288

    AGRICULTURAL DEVELOPMENT BENEFIT   5,777
    VOC SAVING   20,811
    RMC SAVING   -299

NET PRESENT VALUE :   -9,804

BENEFIT COST RATIO :   0.73

INTERNAL RATE OF RETURN :   8.4 %

Table 20.6.2 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	8,015	0	0	0	0	10,054	0
1986	12,023	0	0	0	0	13,464	0
1987	0	188	1,556	-20	1,725	0	1,540
1988	0	320	1,682	-15	1,987	0	1,584
1989	0	452	1,807	-10	2,248	0	1,600
1990	0	583	1,932	-5	2,510	0	1,595
1991	0	715	2,057	0	2,772	0	1,573
1992	0	847	2,182	5	3,034	0	1,537
1993	0	979	2,307	10	3,296	0	1,491
1994	2,904	1,113	2,484	18	3,615	1,314	1,460
1995	0	1,248	2,660	25	3,933	0	1,418
1996	0	1,383	2,837	32	4,252	0	1,369
1997	0	1,518	3,013	39	4,570	0	1,314
1998	0	1,653	3,190	47	4,889	0	1,255
1999	0	1,787	3,366	54	5,207	0	1,193
2000	0	1,922	3,543	61	5,526	0	1,131
2001	-9,217	2,057	3,719	69	5,845	-1,684	1,068
TOTAL	13,725	16,765	38,333	311	55,409	23,149	21,128

DISCOUNTED ECONOMIC COSTS :   23,149

DISCOUNTED ECONOMIC BENEFITS :   21,128

    AGRICULTURAL DEVELOPMENT BENEFIT   5,777
    VOC SAVING   15,296
    RMC SAVING   55

NET PRESENT VALUE :   -2,021

BENEFIT COST RATIO :   0.91

INTERNAL RATE OF RETURN :   11.0 %

Table 20.7.1 SOCIAL INDICATORS

(Proposed Route IM-20)

Population (1,000)

1982	:	17.9
1993	:	20.1

Average travelling speed, without (kph) : 40

Isolation

Access to Amphoe

Average distance to Amphoe (km)$\underline{1}$/	:	4.3
Per capita time savings (10^{-4})	:	0.024
Score	:	71

Access to Artery Highway

Average distance to highway (km)$\underline{1}$/	:	17
Per capita time savings (10^{-4})	:	0.094
Score	:	204

Impassability

Impassable week a year	:	-
Impassability per year	:	0
Impassability per capita (10^{-4})	:	0
Score	:	0

Health

Access to Hospital

Average distance to Hospital (km)$\underline{1}$/	:	8.5
Per capita time savings (10^{-4})	:	0.047
Score	:	109

Access to Medical Facilities

Average distance to facilities (km)$\underline{1}$/	:	5.2
Per capita time savings (10^{-4})	:	0.029
Score	:	116

Education

Access to Secondary School

Number of Student in 1993 (1,000)$\underline{2}$/	:	3.0
Average distance to school (km)	:	5.0
Per capita time savings (10^{-4})	:	0.187
Score	:	101

Teacher Intensity

Number of teachers$\underline{3}$/

University graduate	:	3
Total	:	17
Number of Student	:	416

Indicators

E1 $\underline{4}$/	:	7.2
E2 $\underline{5}$/	:	40.9
E $\underline{6}$/	:	48.1
Degree of Improvement$\underline{7}$/	:	1.42
Score	:	91

Disparity

G.P.V. in 1993 (Mn B)$\underline{8}$/

With project	:	44.9
Without project	:	42.6

Per capita G.P.V. in 1993 (B)

With project (W)	:	2,209
Without project (w)	:	2,119

Degree of Disparity

(A/W) - (A/w)$\underline{9}$/	:	0.05
Score	:	89

Total Score : 781

Note:

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

$\underline{2}$/ 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.

$\underline{3}$/ Numbers of the sample areas

$\underline{4}$/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

$\underline{5}$/ (Total of Teachers)/(Total Number of Student) x 1,000

$\underline{6}$/ Sum of $\underline{4}$/ and $\underline{5}$/

$\underline{7}$/ 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

$\underline{8}$/ Estimated gross value of crop production in the areas of influence

$\underline{9}$/ "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-21

Changwat : Ubon Ratchathani

A.Trakan Phut Phon (J.R.2049)-A.Khemarat (J.R.202)

Length · 65.3 KM.

SUMMARY

PROPOSED ROUTE   IM-21

Item	Description	
Changwat	Ubon Ratchathani	
Origin	A. Trakan Phut Phon (J.R.2049)	
Destination	A. Khemarat (J.R.202)	
Length		
Total		65.3 km
Improvement Section		65.3 km
DOH Road	R.2050	51.9 km
ARD Road		13.4 km
Others		0 km
New Alignment Section		0 km
Surface Type and Condition	Soil Aggregate, Good	
Terrain	Flat and Rolling	
Influence Area		
Area		440 km^2
Population (1982)		47,400
Principal Crops		Paddy
Traffic (ADT)		
Existing		305
1993		1,046
2001		1,453
Proposed Standard	F4 (DBST)	
Construction Cost		
Financial		112,410 . 10^3 ฿
Economic		101,589 . 10^3 ฿
IRR		14.3 %
B/C		1.20
Recommendation	For immediate implementation	
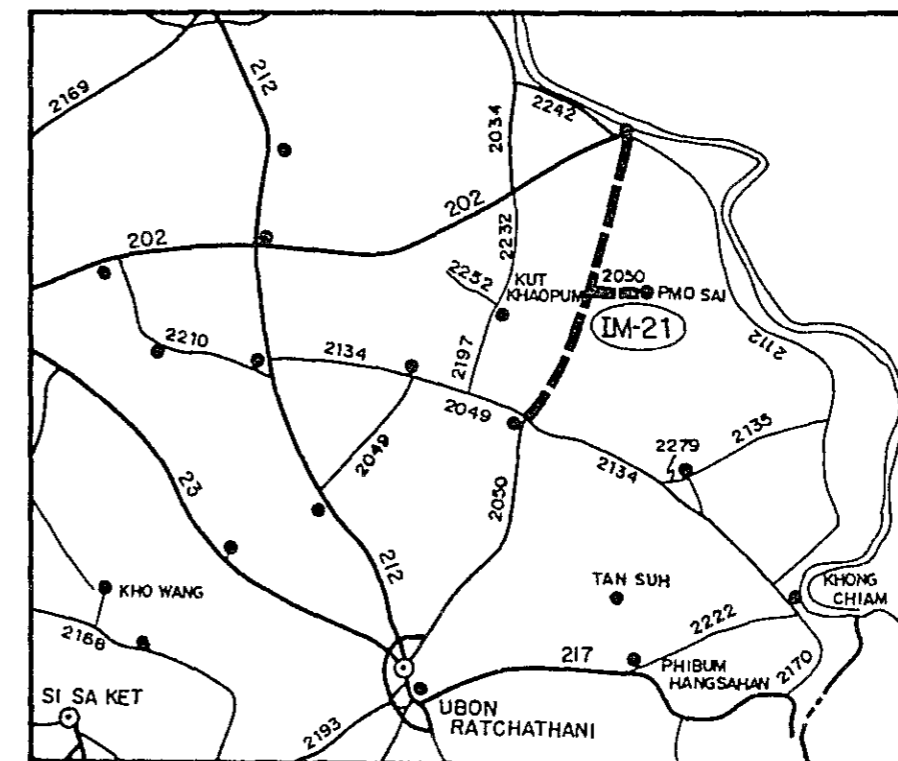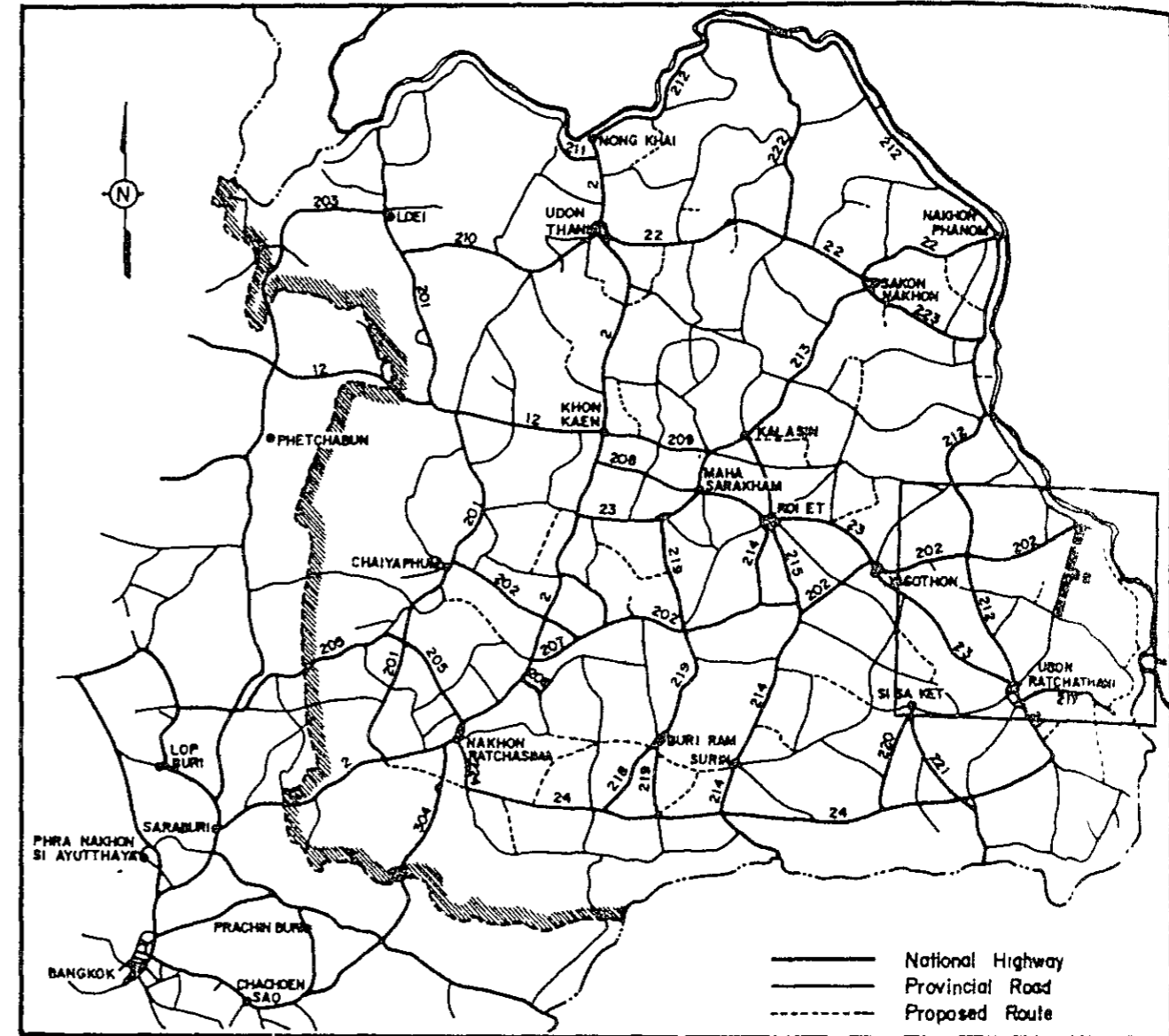
LOCATION OF PROPOSED ROUTE

———— National Highway
——— Provincial Road
-------- Proposed Route

1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the north part of Changwat Ubon Ratchathani.

The route, starting at Amphoe Trakan Phut Phon on Route 2049, runs northward

passing through Ban Hua Ngua, the intersection of the road to King Amphoe

Pho Sai and Ban Non Bok and ends at Amphoe Khemarat on Route 202.

Its total length is 65.3 km. including a branch road to King Amphoe.

(Figure 21.5.2)

The terrain is almost rolling. In the influence area, there exists several

villages with total population of 47,400. There one medical center,

two hospitals and three secondary schools along the proposed route.

The proposed route, upon completion, will form an important part of

road netwrok to connect this area with Changwat Ubon Ratchatani together

with paved section of Route 2050 and also play vital role to connect

isolated King Amphoe Pho Sai with Route 2050.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are

summarized in Table 21.1.1.

The details are shown as the results of inventory survey in Table 21.1.2.

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 referring

to the DOHs traffic records and manual classified counts as shown below:

Proposed Road Link

Legend   ◯ Road Node

◻ Road Link Code

■■■ Proposed Road Link

▬ Other Road
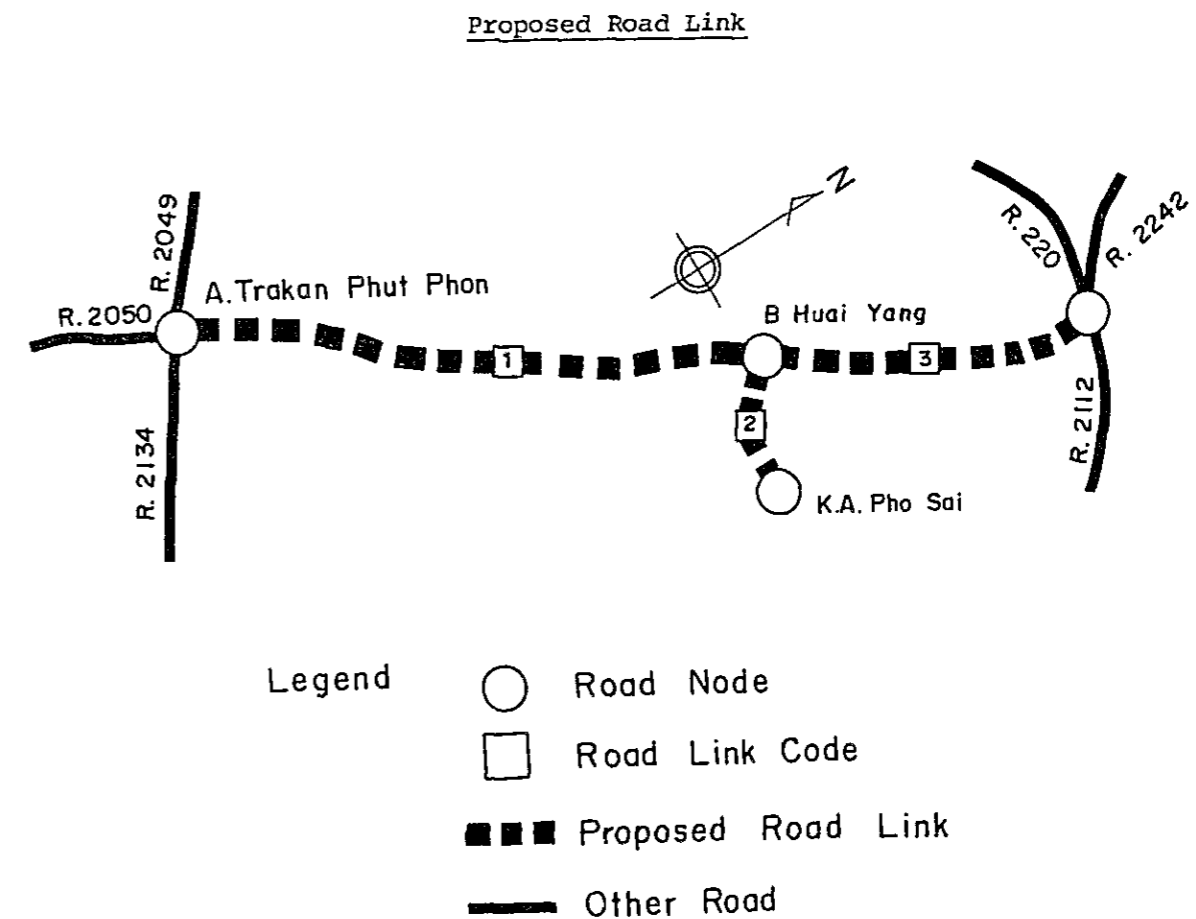
Traffic Volume in Base Year

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
DOH (1981)	1 [1/]	41	56	45	55	77	9	28	37	12	360
	2	n.a.									
	3 [2/]	24	80	55	68	37	13	40	42	4	362
Manual Counts (1982)	1	–	19	4	6	25	2	6	13	2	97
	2	–	7	–	5	1	1	–	5	–	19
	3	n.a.									
Estimated	1	41	56	45	55	77	9	28	37	12	360
	2	–	7	–	5	1	1	–	5	–	19
	3	24	80	55	67	37	13	40	42	4	362

Note: 1/ Route 2050   Section 0201   Station Km 12+000

2/ Route 2050   Section 0201   Station Km 50+000

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	5101
2	793
3	3986

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	173	37	210
2	44	9	53
3	134	29	163

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	1.0	0.9
PASSENGER MOVEMENT	5.2	5.4	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	1.0	0.7	0.2
FREIGHT	5.7	5.9	5.9

2.5 Induced and Deveoped 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	0.3	0.3

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 compositon 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	15.0	20.4	16.4	20.1	28.1	10.5	32.6	43.0	14.0
	1987	13.5	23.5	17.9	21.9	23.1	12.4	27.6	40.6	19.4
	1993	12.1	26.6	19.4	23.8	18.1	14.4	22.6	38.2	24.8
	2001	10.2	30.8	21.3	26.2	11.5	17.0	16.0	35.0	32.0
2	1982	0.0	54.1	0.0	37.7	8.2	17.9	0.0	82.1	0.0
	1987	3.6	50.5	4.4	33.2	8.4	17.6	4.2	69.7	8.4
	1993	7.8	46.3	9.6	27.7	8.6	17.4	9.3	54.8	18.5
	2001	13.5	40.6	16.6	20.4	8.9	17.0	16.0	35.0	32.0
3	1982	9.1	30.4	20.9	25.5	14.1	13.1	40.4	42.4	4.0
	1987	9.5	30.5	21.0	25.7	13.3	14.3	33.1	40.2	12.4
	1993	9.8	30.6	21.1	25.9	12.5	15.5	25.8	38.0	20.8
	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 links is shown in the following table and details by road link by traffic type are shown in Table 21.2.1.

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	41	64	84	66	110	27	41	15	447	375	823
1993	57	99	126	ы	165	26	44	26	623	423	1046
2001	88	179	220	96	290	24	52	47	997	457	1454

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields. Upland crops such as cassava ground nuts and kenaf are also planted but limited. Unused cultivable land, mainly for upland field, remains in the central part of the area.

Land use and capability conditions in the area of influence are shown in Table 21.3.1 and Figure 21.3.1.

Typical cropping calendar in the Ubon Ratchathani area is shown in Figure 21.3.2.

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 21.3.2.

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 21.3.3.

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 21.3.4. 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

		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	Nos.of Wooden Narrow Bridge
1	Rolling	31.0	2B	0	0	31.0		0
2	Flat & Rolling	13.4	3	4	0	13.4	1 (F4)	0
3	Rolling	20.9	2B	4	0	20.9		0

/1 Road 1 : Paved Road

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

Road 2B : Laterite Road with poor surface condition and alignment

Road 3 : Laterite Road with poor surface condition and alignment

Road 4 : Earth Road

VOC savings, obtained from the difference of total link VOC in the cases of ith 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)	14,077	20,246	32,072

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 21.5.1
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   : ϕ100cm

    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 21.5.2

Alignment of the route is shown in Figure 21.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost to-gether with unit rate by work item are shown in Table 21.5.1.

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

    F4 Standard (DBST) L = 65.3 km

        Financial Cost   112,410 . 10^3 ฿

        Economic Cost   101,589 . 10^3 ฿

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 21.6.1.

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 indicator of social impacts are tabulated in Table 21.7.1.

Table 21.1.1 SUMMARY OF ROAD INVENTORY

Item	Description			
Origin	A. Trakan Phut Phon (J.R. 2049)			
Destination	A. Khemarat	(J.R. 202)		
Length				
Total			65.3	km
Improvement Section			65.3	km
DOH Road	R. 2050		51.9	km
ARD Road			13.4	km
Others			0	km
New Alignment Section			0	km
Terrain	Flat and Rolling			
Alignment (Hori./Vert.)	Fair / Fair			
Formation Width	5.0 m – 8.0 m, 7.4 m (Weighted average)			
Embankment Section				
Length			65.3	km
Height	0.2 m – 1.25 m			
Cut Section				
Length			0	km
Depth	m – m			
Surface Type and Condition				
SBST or DBST	Good		9.8	km
Soil Aggregate	Good		42.1	km
Earth			0	km
Pipe Culvert	71 each			
Box Culvert	0 each		0	m
Bridge				
Permanent Bridge	6 each		209.0	m
Narrow Concrete Bridge	0 each		0	m (4m)
Wooden Bridge	8 each		215.9	m
Overflow Section	0 place		0	km

Table 21.1.2 ROAD INVENTORY (1)

PROPOSED ROUTE NO. IM-21   ROUTE NO. 2050   A. TRAKAN PHUT PHON (J.R. 2049)~ A. KHEMARAT (J.R. 202)   L = 51.9 km.

UBON RATCHATHANI

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. MUANG DIAD H=80 P=400	B. DONMAK AY H=175 P=1500			B. DONSAI H=360 P=1400	B. HUANGUA H=24 P=140		B. SRANG PHON H=40 P=400			B. PHORNSAWAN H=10 P=50		B. KHUNKHAM H=50 P=250		B. BAK H=47 P=235
TERRAIN	Flat	Rolling														
CROSS SECTION — Formation Width (m)	7.50	7.00	7.00	7.00	5.00					7.50						
CROSS SECTION — Embankment Height (m)	1.00	0.60	0.30	0.40	0.60	1.25 / 0.65	1.00	0.30		0.20		0.50	0.30		0.20	
CROSS SECTION — Cutting Depth (m)																
PAVEMENT — Type/Length	Laterite								D.T					Laterite		
PAVEMENT — Condition	Good															
FLOODING — Overflow Length(Km)/Height(m)																
LAND USE — Left	Paddy	Bush	Paddy	Forest	Paddy	Orchard / Paddy / Orchard	Forest	Paddy	Forest							Paddy
LAND USE — Right	Paddy	Bush	Paddy	Forest	Paddy	Orchard / Paddy / Orchard	Forest	Paddy	Forest							Paddy
PIPE CULVERT — Total Number																
BOX CULVERT & BRIDGE — Station (Km)						11.2				18.2				25.3		
BOX CULVERT & BRIDGE — Dimension						C-Br. 9.00 x 80.00				C-Br. 9.00 x 18.00				C-Br. 9.00 x 30.00		
RIGHT OF WAY (m)																
ALIGNMENT — Horizontal						Fair										
ALIGNMENT — Vertical						Fair										
ROUTE NO., AGENCIES						DOH 2050										

PROPOSED ROUTE NO. IM-21   ROUTE NO. 2050   A. TRAKAN PHUT PHON (J.R.2049) ∿ A. KHEMARAT (J.R.202) (Cont'd)   L = 51.9 Km.

UBON RATCHATHANI

STATION (Km)	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
VILLAGE – Name / – Household (H) / – Population (P)	B. HUAI YANG H = 140 P = 900			B. MUANG THAO H = 124 P = 624	B. NONBOK H = 30 P = 150	B. DANHUANG H = 525	B. NACHAROEN			B. SAIPHUN H = 250 P = 1290	B. SAI YOI H = 20 P = 100					
TERRAIN	Flat									Rolling						
CROSS SECTION — Formation Width (m)	7.50									8.50						
CROSS SECTION — Embankment Height (m)	1.00	0.30	0.0	0.75	0.20	1.00	0.30	1.00	0.30	0.20	0.30	0.50				
CROSS SECTION — Cutting Depth (m)																
PAVEMENT — Type/Length	Laterite			D.T		Laterite				D.T	Laterite					
PAVEMENT — Condition	Good															
FLOODING — Overflow Length(Km)/Height(m)																
LAND USE — Left	Paddy									Forest						
LAND USE — Right	Paddy									Forest						
PIPE CULVERT — Total Number																
BOX CULVERT & BRIDGE — Station (Km)	30.7 / 31.8		34.3 / 35.1	36.5 / 37.8						48.1						
BOX CULVERT & BRIDGE — Dimension	C-Br. 9.00 x 15.00 / C-Br. 9.00 x 30.00		C-Br. 9.00 x 36.00 / W-Br. 4.50 x 30.00	W-Br. 4.50 x 45.00 / W-Br. 4.50 x 25.30						W-Br. 4.30 x 17.00						
RIGHT OF WAY (m)																
ALIGNMENT — Horizontal	Fair															
ALIGNMENT — Vertical	Fair															
ROUTE NO., AGENCIES	DOH 2050															

PROPOSED ROUTE NO. __IM-21__   ROUTE NO. ARD   __B. HUAIYANG ∿ K.A. PHOSAI__   L = __13.4__ ㎞

UBON RATCHATHAI

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. HUAIYANG H = 180 P = 900			B. LUM PHUK H = 150 P = 750 / B. DONYIAN H = 150 P = 750 / B. PHALAI H = 400 P = 2000			B. LEO H = 75 P = 275 / B. PHOSAI									
TERRAIN				Rolling												
CROSS SECTION Formation Width (m)				5.50												
Embankment Height (m)			0.00			0.30										
Cutting Depth (m)																
PAVEMENT Type/Length				Laterite												
Condition				Poor												
FLOODING Overflow Length(Km)/Height(m)																
LAND USE Left	←— Forest			Paddy												
Right	Forest			Paddy												
PIPE CULVERT Total Number				12 Pipes												
BOX CULVERT & BRIDGE Station (Km)	0.7			6.0	8.6 / 8.8											
Dimension	W-Br. 3.50 x 30.50			W-Br. 4.0 x 10.00	W-Br. 3.40 x 38.50 / W-Br. 3.00 x 19.60											
RIGHT OF W (m)	7.50		30.00													
ALIGNMENT Horizontal				Fair												
Vertical				Fair												
ROUTE NO., AGENCIES			ARD													

Table 21.2.1 TRAFFIC VOLUME ON ROUTE IM - 21

YEAR		1987				1993				2001			
LINK		1	2	3	AVR.	1	2	3	AVR.	1	2	3	AVR.
P/C	N+D	51	3	33	35	68	9	47	49	99	24	77	77
	I	8	0	5	5	10	1	7	7	15	4	12	11
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	59	3	37	41	78	10	54	57	114	28	89	88
L/B	N+D	68	3	72	56	108	11	101	86	205	30	161	155
	I	10	1	11	8	16	2	15	13	31	4	24	23
	DV	0	0	0	0	0	0	0	0	1	0	1	1
	TOTAL	78	4	83	64	125	12	117	99	237	34	185	179
M/B	N+D	83	27	88	73	133	31	124	109	253	37	198	191
	I	12	4	13	11	20	5	19	16	38	6	30	29
	DV	0	0	0	0	1	0	0	0	1	0	1	1
	TOTAL	95	31	102	84	154	36	143	126	292	42	228	220
H/B	N+D	88	7	46	58	102	10	60	69	111	16	86	83
	I	13	1	7	9	15	1	9	10	17	2	13	13
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	101	8	53	66	117	11	69	80	128	19	100	96
P/P&T	N+D	101	46	118	95	167	58	163	143	325	80	254	252
	I	15	7	18	14	25	9	24	21	49	12	38	38
	DV	0	0	0	0	1	0	1	1	1	0	1	1
	TOTAL	116	53	136	110	192	67	188	165	375	92	293	290
4/T	N+D	27	1	31	23	27	3	27	22	26	7	21	21
	I	4	0	5	3	4	0	4	3	4	1	3	3
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	31	1	36	27	32	4	31	26	31	8	24	24
6/T	N+D	40	20	38	35	46	18	40	38	58	15	45	45
	I	6	3	6	5	7	3	6	6	9	2	7	7
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	46	24	44	41	53	21	46	44	67	17	52	52
10/T	N+D	19	2	12	13	30	6	22	22	53	13	41	41
	I	3	0	2	2	4	1	3	3	8	2	6	6
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	22	3	14	15	35	7	25	26	61	15	47	47
ADT	N+D	477	110	438	389	681	146	583	540	1130	222	882	864
	I	71	16	66	58	102	22	87	81	169	33	132	130
	DV	0	0	0	0	3	1	2	2	5	1	4	3
	TOTAL	548	126	504	447	786	168	673	623	1304	256	1018	997
M/C	N+D	404	171	393	353	463	208	444	404	497	270	495	450
	I	23	17	24	22	16	20	21	18	0	23	5	6
	DV	0	0	0	0	0	0	0	0	0	1	0	0
	TOTAL	427	188	418	375	479	228	465	423	497	294	500	457
TOTAL	N+D	881	281	832	742	1144	354	1027	945	1627	492	1377	1314
	I	95	33	90	81	118	42	108	99	169	56	137	136
	DV	0	0	0	0	3	1	3	2	5	1	4	4
	TOTAL	975	314	922	823	1265	396	1138	1046	1801	550	1518	1454

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

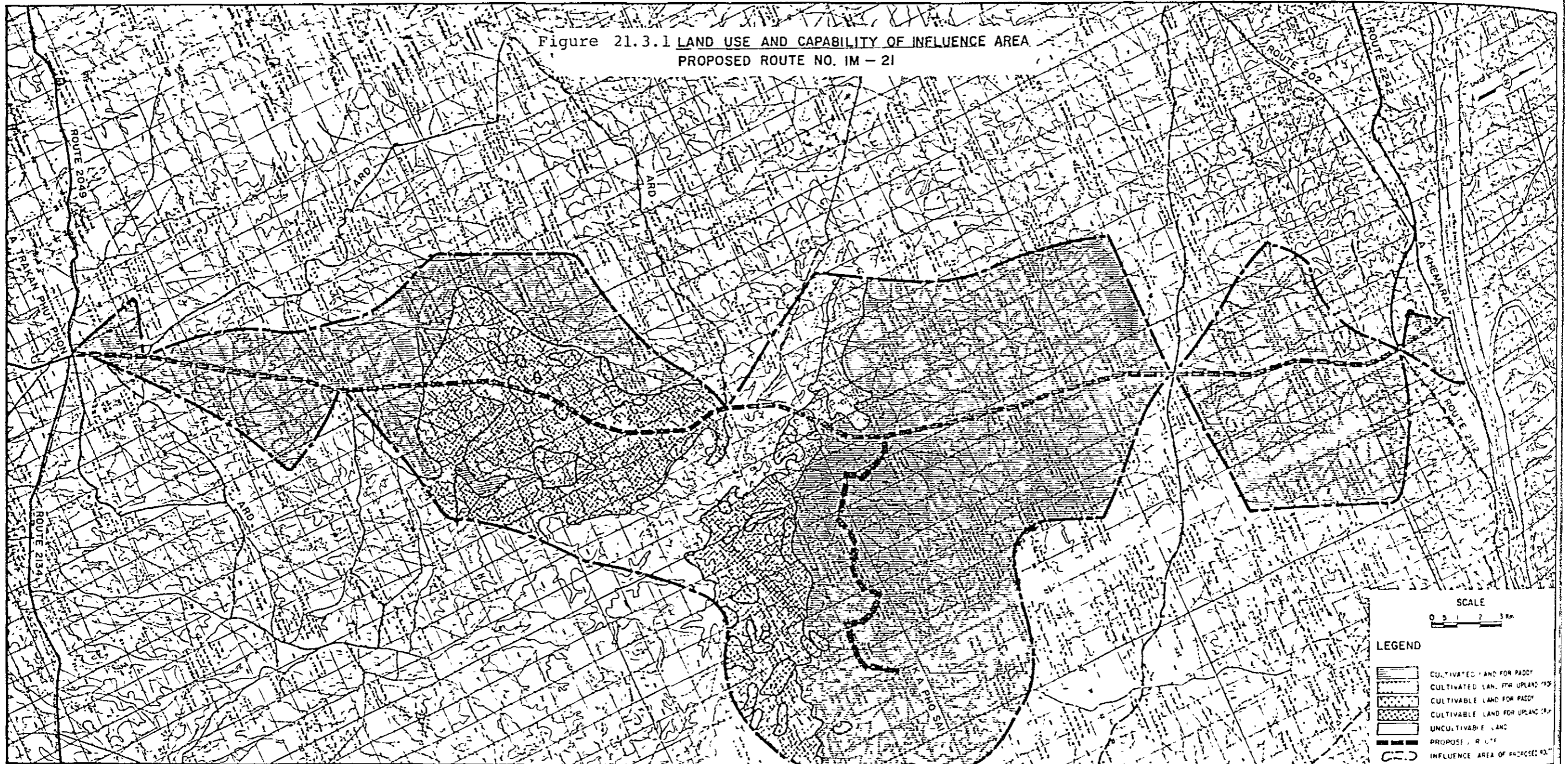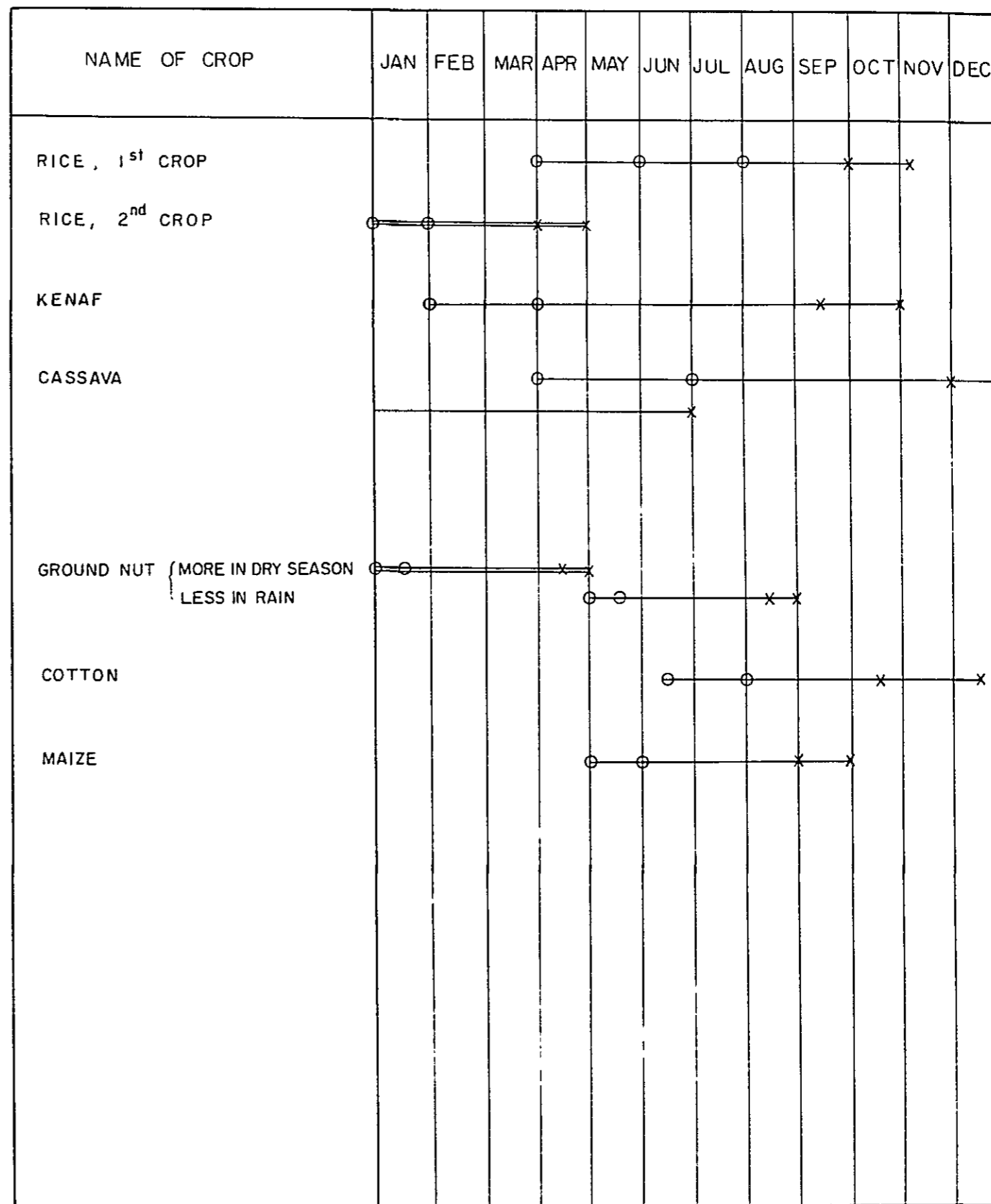Figure 21.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM — 2I

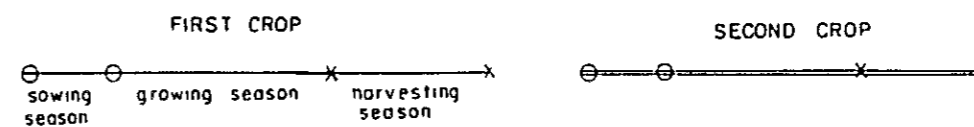# Figure 21.3.2 CROPPING CALENDAR

1100 CHANGWAT____UBON RATCHATHANI____

NAME OF CROP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RICE, 1st CROP				⊖————	————⊖————	————⊖————	————✕——✕				
RICE, 2nd CROP	⊖═⊖══	══✕——✕									
KENAF		⊖————	————⊖————	————————————————	————✕——✕				
CASSAVA			⊖————	————————⊖————	————————————————————————————✕		
	————————————	————————————✕									
GROUND NUT {MORE IN DRY SEASON	⊖═⊖══	══════✕——✕								
LESS IN RAIN				⊖—⊖————	————————✕—✕				
COTTON						⊖————	————⊖————————	————✕————————✕	
MAIZE				⊖————	————⊖————————	————✕——✕			

Note   FIRST CROP   SECOND CROP

⊖——⊖————————————————✕————✕   ⊖——⊖——————————✕————✕
sowing   growing season   harvesting
season   season

TABLE 21.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

AMPHOE	AMPHOE	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
CODE	NAME	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		196.875 (315.0)	4.375 (7.0)	201.250 (322.0)	4.375 (7.0)	48.125 (77.0)	52.500 (84.0)
1103	KHEMARAJ	158.125 (253.0)	4.375 (7.0)	162.500 (260.0)	2.938 (4.7)	16.250 (26.0)	19.188 (30.7)
1110	KUT KAOPUN	11.250 (18.0)	—	11.250 (18.0)	0.813 (1.3)	10.625 (17.0)	11.438 (18.3)
1111	TRAKAN PHUTPHON	27.500 (44.0)	—	27.500 (44.0)	0.625 (1.0)	21.250 (34.0)	21.875 (35.0)

TABLE 21.3.2 CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA	(1000 RAI)										
1981		184.22	—	—	0.33	4.01	—	0.25	—	4.63	188.85
1987		195.55	—	—	0.33	4.18	—	0.25	—	4.80	200.35
1993	WITHOUT PROJECT	202.14	—	—	0.33	4.36	—	0.25	—	4.98	207.12
	WITH PROJECT	202.14	—	—	0.37	4.99	—	0.26	—	5.66	207.80
2001	WITHOUT PROJECT	202.14	—	—	0.33	4.61	—	0.25	—	5.23	207.37
	WITH PROJECT	202.14	—	—	0.37	5.28	—	0.26	—	5.95	208.09
CROP YIELD	(KG/RAI)										
1981		166.8	—	—	199.4	1985.3	—	147.4	—		
1987		167.8	—	—	199.4	1985.3	—	147.4	—		
1993	WITHOUT PROJECT	168.8	—	—	199.4	1985.3	—	147.4	—		
	WITH PROJECT	171.9	—	—	200.6	1997.2	—	147.4	—		
2001	WITHOUT PROJECT	170.2	—	—	199.4	1985.3	—	147.4	—		
	WITH PROJECT	177.5	—	—	202.2	2013.3	—	147.4	—		
CROP PRODUCTION	(TON)										
1981		30,732	—	—	66	7,959	—	38	—	8,066	38,798
1987		32,819	—	—	66	8,299	—	38	—	8,406	41,226
1993	WITHOUT PROJECT	34,129	—	—	66	8,654	—	38	—	8,761	42,891
	WITH PROJECT	34,748	—	—	75	9,969	—	38	—	10,086	44,834
2001	WITHOUT PROJECT	34,403	—	—	66	9,150	—	38	—	9,258	43,661
	WITH PROJECT	35,875	—	—	76	10,626	—	39	—	10,744	46,619

NOTE : SYMBOL "—" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 21.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,741	–	–	8,693	577	–	4,666	–
WITH PROJECT (1987 - 2001)	3,835	–	–	8,693	591	–	4,783	–
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	411	–	–	1,022	677	–	653	–
WITH PROJECT (1987 - 2001)	422	–	–	1,042	698	–	653	–

TABLE 21.3.4 NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	42,405	2,207	44,612	43,422	2,234	45,656
1993	44,598	2,290	46,888	48,039	2,687	50,726
2001	45,623	2,408	48,031	52,364	2,881	55,245

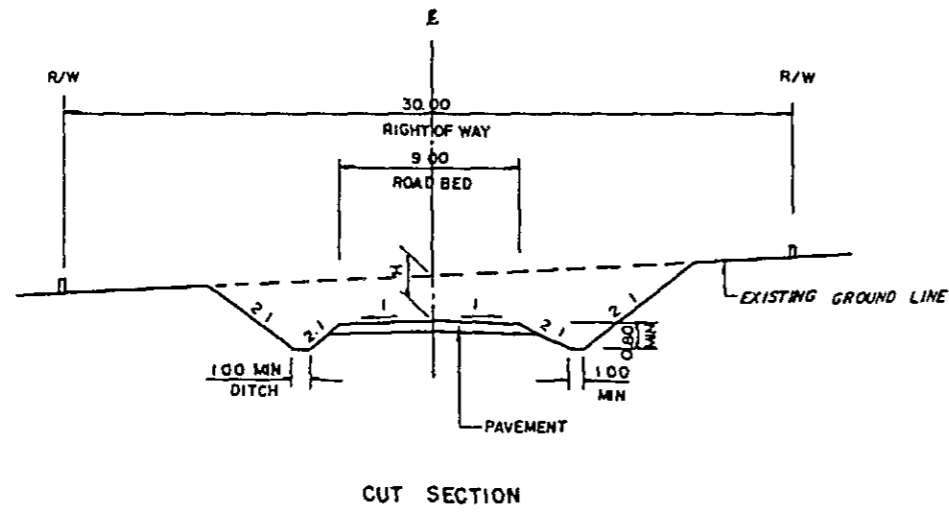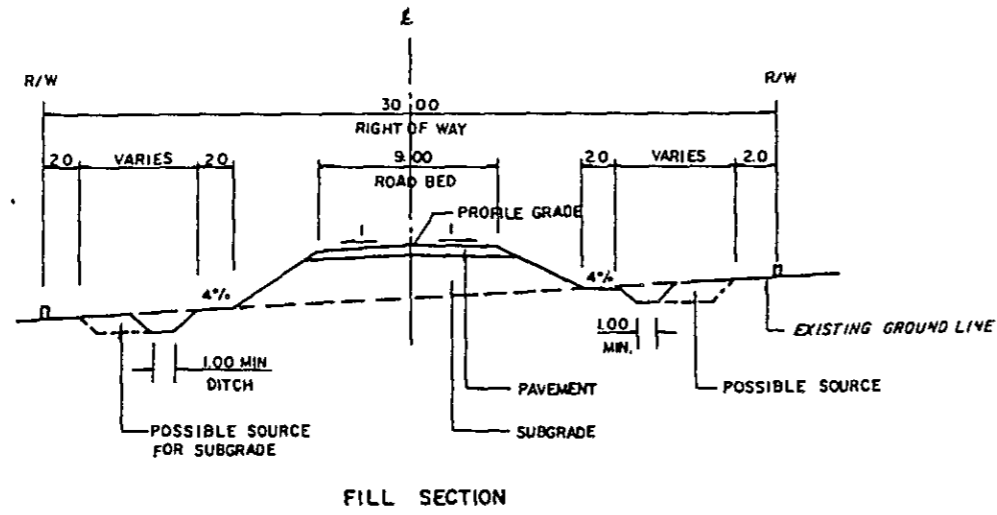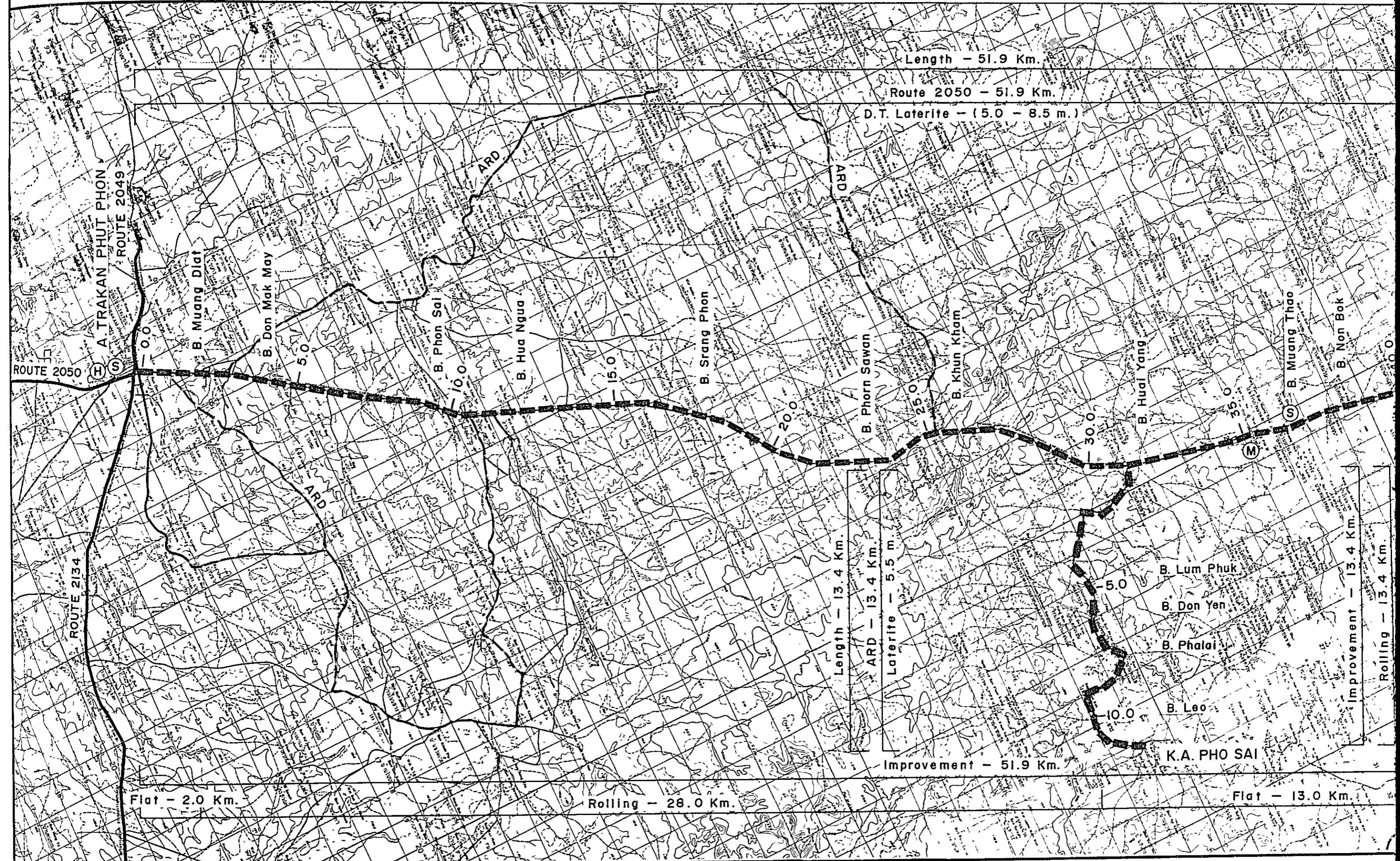Figure 21.5.1   TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE
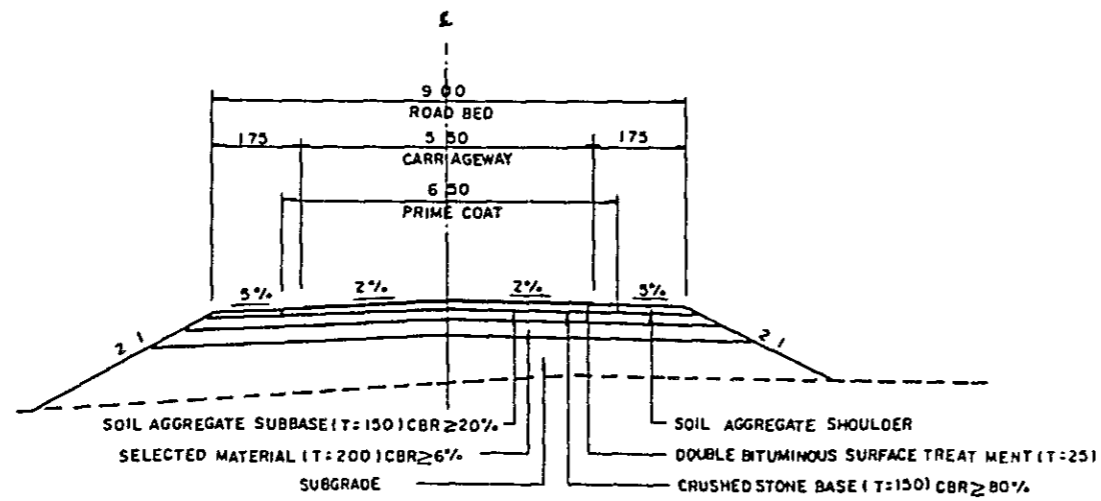
FILL   SECTION

CUT   SECTION

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

Length – 51.9 Km.

Route 2050 – 51.9 Km.

D.T. Laterite – (5.0 – 8.5 m.)

A. TRAKAN PHUT PHON

ROUTE 2049

B. Muang Dlat

B. Don Mak May

B. Phon Sai

B. Hua Ngua

B. Srang Phon

B. Phorn Sawan

B. Khun Kham

B. Huai Yong

B. Muang Thao

B. Non Bok

ROUTE 2050

ARD

ARD

ROUTE 2134

Length – 13.4 Km.

ARD – 13.4 Km.

Laterite – 5.5 m.

Improvement – 13.4 Km.

Rolling – 13.4 Km.

B. Lum Phuk

B. Don Yen

B. Phalai

B. Leo

K.A. PHO SAI

Improvement – 51.9 Km.

Flat – 2.0 Km.

Rolling – 28.0 Km.

Flat – 13.0 Km.

LOCATION MAP

R.202
R.2034
R.2197
R.2232
R.2049
A. KUT KHAO PHUN
R.2050
IM−21
A. KHE MARAT
A. TRAKAN PHUT PHON
R.2134
K.A. PHO SAI
R.2112
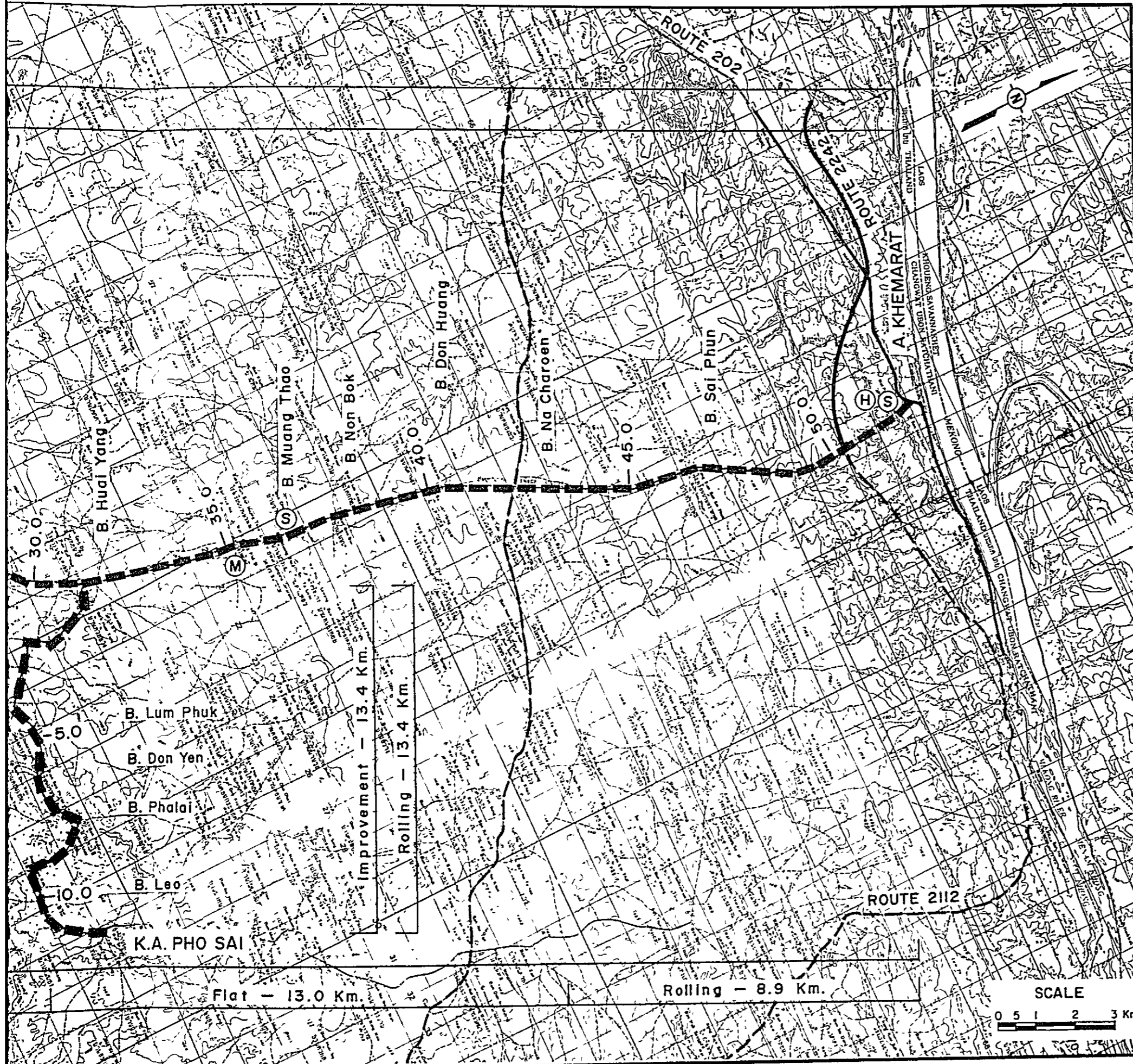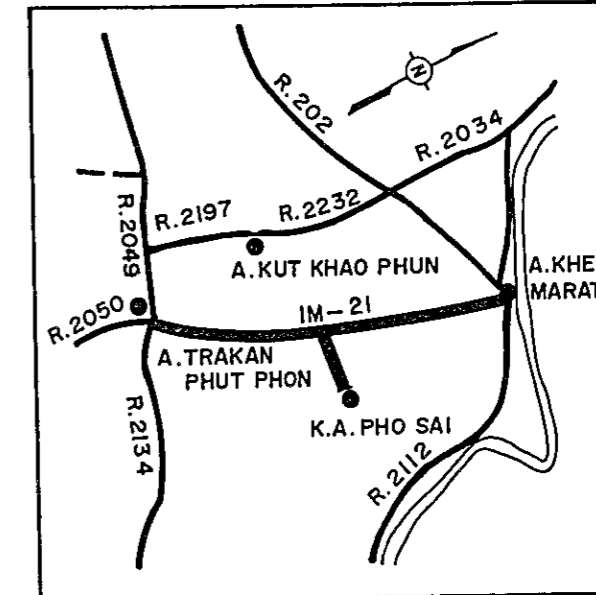
BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	11.2	−	C − 9.00 x 80.00
2	18.2	−	C − 9.00 x 18.00
3	25.3	−	C − 9.00 x 30.00
4	30.7	−	C − 9.00 x 15.00
5	31.8	−	C − 9.00 x 30.00
6	34.3	−	C − 9.00 x 36.00
7	35.1	C − 7.00 x 32.00	W − 4.50 x 30.00
8	36.5	C − 7.00 x 50.00	W − 4.50 x 45.00
9	37.8	C − 7.00 x 28.00	W − 4.50 x 25.30
10	48.1	C − 7.00 x 20.00	W − 4.30 x 17.00
		(ARD)	
1	0.7	C − 7.00 x 34.00	W − 3.50 x 30.50
2	6.0	C − 7.00 x 12.00	W − 4.00 x 10.00
3	8.6	C − 7.00 x 42.00	W − 3.40 x 38.50
4	8.8	C − 7.00 x 22.00	W − 3.00 x 19.60

LEGEND

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

SCALE
0 5 1 2 3 Km.

Table 21.5.1   CONSTRUCTION QUANTITIES AND COSTS   IM-21 (65.3 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	Q'ty	Financial Cost (10^3฿)	Economic Cost(10^3฿)
DIRECT CONSTRUCTION COST					
Clearing and Grubbing	ha	15,000	150	2,250	2,047
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	237,100	10,669	9,709
Selected Material	m^3	80	117,700	9,416	8,380
Soil Aggregate Surface or Subbase	m^3	105	82,400	8,562	7,700
Crushed Stone Base	m^3	370	54,100	20,017	18,415
Soil Aggregate Shoulder	m^3	105	23,300	2,446	2,177
Prime Coat and DBST	m^2	55	305,300	16,792	15,113
Pipe Culvert	m	2,100	1,990	4,179	3,844
Box Culvert	m	16,000	0	0	0
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	240	9,600	8,544
Sub Total (a)				84,022	75,932
Miscellaneous Works (a) x 7%				5,882	5,315
Total (b)				89,904	81,247
PHYSICAL CONTINGENCY (b) x 15%				13,486	12,187
ENGINEERING AND ADMINISTRATION (b) x 10%				8,990	8,125
Sub Total				22,476	20,312
LAND ACQUISITION					
Highly Developed Land	ha	50,000	0	0	0
Less Developed Land	ha	15,000	2	30	30
Sub Total				30	30
GRAND TOTAL				112,410	101,589

Table 21.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	20,318	0	0	0	0	28,545	0
1985	50,794	0	0	0	0	63,716	0
1986	30,477	0	0	0	0	34,134	0
1987	0	1,044	14,077	124	15,244	0	13,611
1988	0	1,492	15,105	163	16,759	0	13,360
1989	0	1,939	16,133	201	18,274	0	13,007
1990	0	2,387	17,162	240	19,789	0	12,576
1991	0	2,835	18,190	279	21,303	0	12,088
1992	0	3,282	19,218	318	22,818	0	11,560
1993	0	3,730	20,246	357	24,333	0	11,007
1994	31,605	4,165	21,725	414	26,303	14,297	10,624
1995	0	4,600	23,203	471	28,274	0	10,196
1996	0	5,035	24,681	529	30,244	0	9,738
1997	0	5,470	26,159	586	32,215	0	9,261
1998	0	5,905	27,637	643	34,185	0	8,775
1999	0	6,340	29,115	701	36,156	0	8,286
2000	0	6,775	30,594	758	38,126	0	7,801
2001	-46,474	7,210	32,072	815	40,097	-8,491	7,326
TOTAL	86,720	62,208	335,316	6,598	404,121	132,201	159,216

DISCOUNTED ECONOMIC COSTS :   132,201

DISCOUNTED ECONOMIC BENEFITS :   159,216

AGRICULTURAL DEVELOPMENT BENEFIT   22,184
VOC SAVING   134,710
RMC SAVING   2,322

NET PRESENT VALUE :   27,014

BENEFIT COST RATIO :   1.20

INTERNAL RATE OF RETURN :   14.3 %

Table 21.7.1 SOCIAL INDICATORS

(Proposed Route IM-21)

Population (1,000)		
1982	:	47.4
1993	:	53.3

Average travelling speed, without (kph)	:	48

Isolation

Access to Amphoe

Average distance to Amphoe (km)1/	:	9.4
Per capita time savings (10-4)	:	0.012
Score	:	35

Access to Artery Highway

Average distance to highway (km)1/	:	34
Per capita time savings (10-4)	:	0.044
Score	:	96

Impassability

Impassable week a year	:	-
Impassability per year	:	0
Impassability per capita (10-4)	:	0
Score	:	0

Health

Access to Hospital

Average distance to Hospital (km)1/	:	16.3
Per capita time savings (10-4)	:	0.021
Score	:	49

Access to Medical Facilities

Average distance to facilities (km)1/	:	11.1
Per capita time savings (10-4)	:	0.014
Score	:	56

Education

Access to Secondary School

Number of Student in 1993 (1,000)2/	:	10.1
Average distance to school (km)	:	10.0
Per capita time savings (10-4)	:	0.069
Score	:	37

Teacher Intensity

Number of teachers3/

University graduate	:	-
Total	:	16
Number of Student	:	387

Indicators

E1 4/	:	-
E2 5/	:	41.3
E 6/	:	41.3
Degree of Improvement7/	:	1.66
Score	:	105

Disparity

G.P.V. in 1993 (Mn B)8/

With project	:	140.0
Without project	:	133.5

Per capita G.P.V. in 1993 (B)

With project (W)	:	2,627
Without project (w)	:	2,505

Degree of Disparity

(A/W) - (A/w)9/	:	0.05
Score	:	89

Total Score	:	467

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.