PROPOSED ROUTE NO. IM - 30

Changwat : Buri Ram / Nakhon Ratchasima

A. Huai Thalaeng - B. Kasang (J R 218)

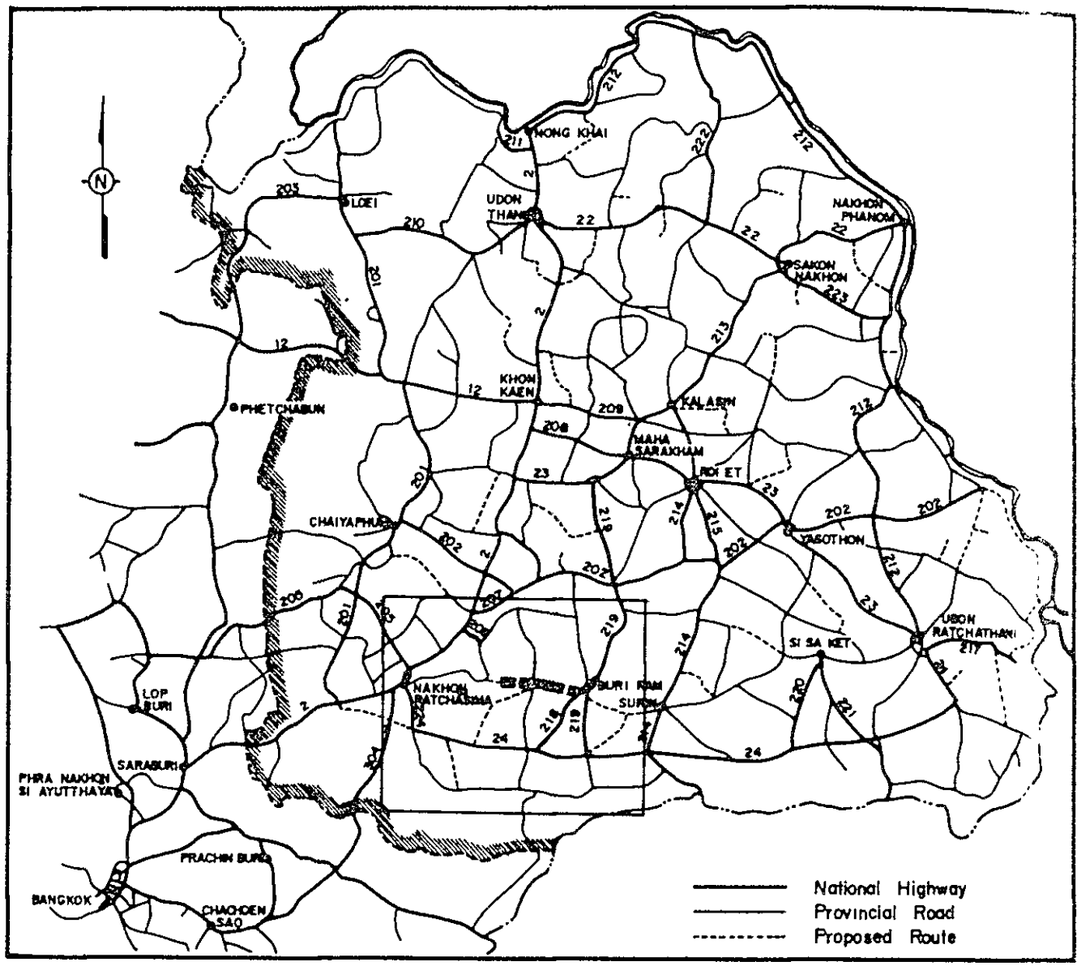
Length : 51 0 KM.

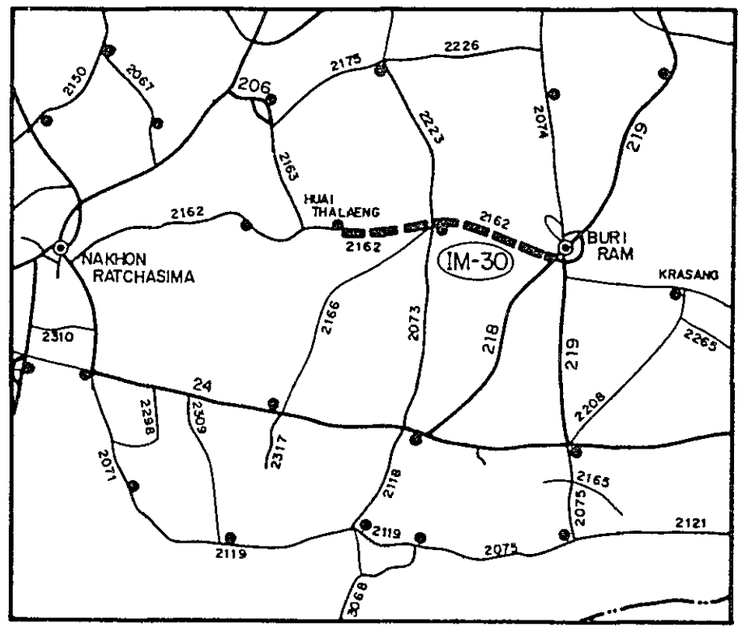
SUMMARY

PROPOSED ROUTE IM-30

Item	Description
Changwat	Buri Ram/Nakhon Ratchasima
Origin	A. Huai Thalaeng
Destination	B. Kasang (J.R.218)
Length	
Total	51.0 km
Improvement Section	44.5 km
DOH Road R.2162	42.0 km
ARD Road	0 km
Others	2.5 km
New Alignment Section	6.5 km
Surface Type and Condition	Soil Aggregate and Earth, Good ~ Poor
Terrain	Flat
Influence Area	
Area	269 km^2
Population (1982)	40,200
Principal Crops	Paddy
Traffic (ADT)	
Existing	184
1993	1,052
2001	1,427
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	96,372 . 10^3 ฿
Economic	87,320 . 10^3 ฿
IRR	14.6 %
B/C	1.24
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two Changwat of Nakhon Ratchasima and Buri Ram.

The route, starting at Amphoe Huai Thalaeng, runs eastward passing through Ban Nong Maeng Thum, Amphoe Lam Plai Mat and Ban Nong Talao and ends at Ban Ka Sang. Its total length is 51.0 km. (Figure 30.5.2)

The terrain is almost flat. In the influence area, there exists several villages with total population of 40,200. There are three medical centers, and one secondary school along the proposed route.

There are 3 medical centers, and one secondary school along the proposed route.

The completion of the proposed route is expected to directly connect Changwat Nakhon Ratchasima to Changwat Buri Rum, thus forming the complete paved road from the former to Changwat Ubon Ratchathani.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 30.1.1.

The details are shown as the results of inventory survey in Table 30.1.2.

2. TRAFFIC

2.1 Method

Assigment Method was employed for traffic forecasting as considerable diverted and induced traffic are expected after improvement of the proposed road due to time savings of transportation.

2.2 Zoning and Road Links

The related area of proposed route was divided into five traffic zones and three Amphoe of Huai Thalang, Lam Plai Mat and Muang Buri Ram were chosen as the major destinations of transport demand originated in the area. The proposed route together with surrounding roads concerned were divided into five road links, four links in the proposed roads and one links in the surrounding roads.

Zoning map and characteristics of zone and links are shown in Figure 30.2.1, Table 30.2.1 and 30,2.2.

2.3 Transport Movement

1) Passenger

The transport demand in terms of trips per day by origin/destination pair in base year was estimated besing on the formula described in 7.3.3-1) of the Main Report, as shown below:

Zone	1	2	3	4	5	11
1	0	439	545	261	289	263
2	0	0	418	198	143	396
3	0	0	0	587	615	845
4	0	0	0	0	376	1215
5	0	0	0	0	0	0
11	0	0	0	0	0	0

Grand Total = 6585

The transport demand which can be obtained by assigning transport demand mentioned above to road links, are estiamted as shown in the following table:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	397
2	1240
3	2022
4	2775

2) Freight

The freight movement in terms of tonnage per day on proposed roate was estimated in accordance with the procedure described in 7.3.3-1) of the Main Report. The basis and results of the estimation of freight movement are shown in the following tables:

Ratios of Total/Non-Agricultural Freight Movement

Year	1987	1993	2001
Ratio	1.39	1.26	1.15

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	13	7	20
2	56	31	87
3	104	59	163
4	157	88	245

2.4 Future Growth of Transport Movement

The growth rate 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	1.9	1.6	1.4
PASSENGER MOVEMENT	5.9	6.0	6.0

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.6	7.7	7.8
AGRICULTURE	0.3	0.2	0.2
FREIGHT	6.0	6.5	7.1

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	93.3	95.5	97.4
DEVELOPED	0.0	0.3	0.3

2.6 Future Traffic

1) Traffic Composition

The movement 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
1-4	1982	3.1	53.1	0.0	43.8	0.0	12.5	18.8	59.3	9.4
	1987	6.0	50.2	4.2	37.4	2.2	13.7	18.1	52.9	15.3
	1993	9.4	46.8	9.2	29.7	4.9	15.1	17.2	45.2	22.5
	2001	14.0	42.2	15.8	19.5	8.5	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 30.2.3.

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	21	14	130	8	189	20	58	17	456	382	837
1993	46	45	145	24	249	24	63	31	626	426	1052
2001	107	121	149	65	357	33	72	65	970	458	1427

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by paddy fields. Kenaf and cassava are the major upland crops, followed by sugar cane, ground nut and beans.

Unused cultivable land for both paddy and upland fields remains mainly in Amphoe Lam Plai Mat area.

Land use and capability conditions in the area of influence are shown in Table 30.3.1 and Figure 30.3.1.

Typical cropping calendars in the Nakhon Ratchashima and Buri Ram areas are shown in Figure 30.3.2.

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 30.3.2.

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 30.3.3.

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 30.3.4. 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 concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link converned 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	19.8	4	0	0	18.0	1 (F4)	0
2	Flat	3.5	2B	0	0	7.0		0
3	Flat	15.0	2B	0	0	15.0		0
4	Flat	11.0	2B	3	0	11.0		0

/1 Road 1 : Paved Road
Road 2A : Laterite Road with good surface condition and alignment
Road 2B : Laterite Road with godd surface condition but poor alignment
Road 3 : Laterite Road with poor surface conditon 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)	10,877	17,416	32,098

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 30.5.1

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 30.5.2

Alignment of the route is shown in Figure 30.5.2.

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 30.5.1.

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

F4 Standard (DBST) L= 51.0 km

Financial Cost	$96.372 \cdot 10^3$ ₱
Economic Cost	$87.320 \cdot 10^3$ ₱

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 30.6.1.

The result indicated that the proposed project seems to be feasible in case of F4 Standard.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 30.7.1.

Table 30.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	A. Huai Thalaeng		
Destination	B. Kasang (J.R. 218)		
Length			
Total		51.0	km
Improvement Section		44.5	km
DOH Road	R. 2162	42.0	km
ARD Road		0	km
Others		2.5	km
New Alignment Section		6.5	km
Terrain	Flat		
Alignment (Hori./Vert.)	Fair, Poor/Fair		
Formation Width	3.0 m - 8.0 m, 6.6 m (Weighted average)		
Embankment Section			
Length		51.0	km
Height	0 m - 1.2 m		
Cut Section			
Length		0	km
Depth	m - m		
Surface Type and Condition			
SBST or DBST		0	km
Soil Aggregate	Good - Poor	11.5	km
Earth	Poor	39.5	km
Pipe Culvert	27 each		
Box Culvert	0 each	0	m
Bridge			
Permanent Bridge	1 each	45.0	m
Narrow Concrete Bridge	0 each	0	m (4m)
Wooden Bridge	3 each	50.3	m
Overflow Section	1 place	4.0	km

Table 30.1.2 ROAD INVENTORY (1)

PROPOSED ROUTE NO. IM-30 ROUTE NO. 2162 Rural 2166 A. HUAI THALAENG ~ B. KASANG (J.R. 218) BURI RAM/NAKHON RATCHASIMA L = 51.0 Km.

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. THA KHO KHAMAEN H = 100 P = 550	B. HOEY KHAEN H = 70 P = 340	B. NONG TAE H = 65 P = 325		B. NONG MAENG THUM H = 36 P = 120		B. NONG PHAONG H = 120 P = 600	B. YUOEY HOUNG H = 40 P = 200	B. PHAI NOI H = 40 P = 200	A. LAMPLAI MAT		B. BUTAWONG H = 300 P = 1500	
TERRAIN				Flat					Flat					Flat			
CROSS SECTION	Formation Width (m)	5.00	5.5	6.00	5.50	5.00			3.00	5.00			8.00			7.00	
	Embankment Height (m)	0.00		0.30		0.00	0.20		0.00			0.50	1.00	0.40	1.00	0.30	
	Cutting Depth (m)																
PAVEMENT	Type/Length	La.		Earth					Earth					Laterite			
	Condition	Fair		Poor					Poor					Good			
FLOODING	Overflow Length(Km)/Height(m)			L=4.0 H=0.4													
LAND USE	Left			Paddy					Paddy					Paddy			
	Right			Paddy					Paddy					Paddy			
PIPE CULVERT	Total Number													19 Pipes			
BOX CULVERT & BRIDGE	Station (Km)													23.0			
	Dimension													C-Br. 9.00 x 45.0			
RIGHT OF WAY (m)									—								
ALIGNMENT	Horizontal			Poor					Poor					Fair			
	Vertical			Fair					Fair					Fair			
ROUTE NO., AGENCIES				DOH 2162					Rural					DOH 2166		DOH 2162	

ROAD INVENTORY (2)

PROPOSED ROUTE NO. IM-30 ROUTE NO. 2162 Rural 2166 A. HUAI THALAENG ∿ B. KASANG (J.R. 218) (Cont'd) BURI RAM/NAKHON RATCHASIMA L = 51.0 Km.

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. SEELIAM YAI H = 170 P = 850 · B. NONG BUA KHOK · B. NONG TAIAI KHAY H = 95 P = 621 · B. SEELIAM NOI H = 236 P = 1262 · B. NONG TALAD H = 25 P = 125 · B. SAI YONG H = 56 P = 280 · B. MUANG H = 110 P = 550
TERRAIN		Flat
CROSS SECTION	Formation Width (m)	7.00 · 6.50 · 7.00 · 6.00 · 8.00
	Embankment Height (m)	0.30 · 0.50 · 0.80 · 0.30 · 0.50 · 0.60 · 0.80 · 0.50 · 1.20
	Cutting Depth (m)	
PAVEMENT	Type/Length	Laterite
	Condition	Good
FLOODING	Overflow Length(Km)/Height(m)	
LAND USE	Left	Paddy
	Right	Paddy
PIPE CULVERT	Total Number	8 Pipes
BOX CULVERT & BRIDGE	Station (Km)	42.6 · 46.5 · 46.9
	Dimension	W-Br. 4.50 x 20.30 · W-Br. 4.50 x 15.00 · W-Br. 4.50 x 15.00
RIGHT OF WAY (m)		
ALIGNMENT	Horizontal	Fair
	Vertical	Fair
ROUTE NO., AGENCIES		DOH 2162

Figure 30.2.1 ZONING AND ROAD NETWORK

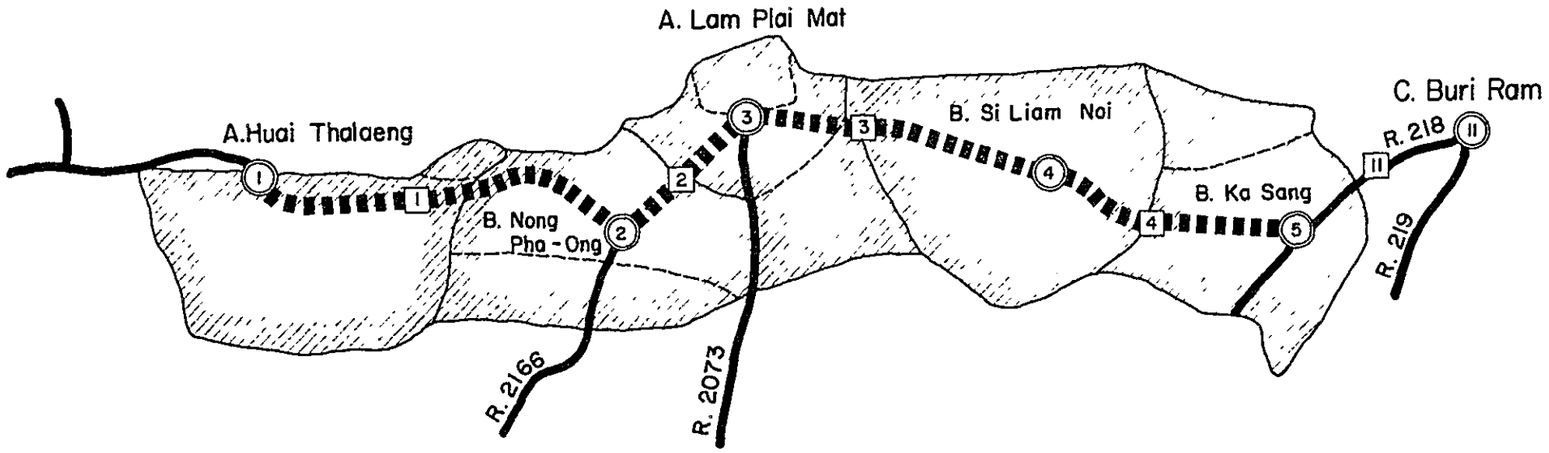


Table 30.2.1 ZONE CHARACTERISTICS

Zone	Administrative Division: Changwat	Amphoe	Tambon Code	Population: Tambon	%	Zone	Attraction
1	Nakhon Ratchasima	Huai Thalang	1	8,860	100	8.7	48.7
2	Buri Ram	Lam Plai Mat	6	4,750	100	4.8	
			14	5,624	60	3.4	
			Total			8.2	
3	Buri Ram	Lam Plai Mat	1	8,541	100	8.5	
			2	5,819	40	2.3	
			8	7,167	40	2.9	
			Total			13.7	43.9
4	Buri Ram	Lam Plai Mat	3	11,527	100	11.5	-
5	Buri Ram	Muang	4	14,623	100	14.6	
			14	8,125	30	2.4	
			Total			17.0	-
11	Buri Ram	Muang	1	25,719	100	25.7	
			2	16,773	10	1.7	
			Total			27.4	206.6

Table 30.2.2 LINK CHARACTERISTICS

Link No	Node Pair: Start Node	End Node	Length: $\bar{W}$	W	Grade: $\bar{W}$	W	Remark
1	1. A. Huai Thalaeng	2. B. Nong Pha-Ong	18.0	18.0	11	4	R.2162
2	2. B. Nong Pha-Ong	3. A. Lam Plai Mat	7.0	7.0	8	4	R.2166
3	3. A. Lam Plai Mat	4. B. Si Liam Noi	15.0	15.0	8	4	R.2162
4	4. B. Si Liam Noi	5. B. Ka Sang	11.0	11.0	8	4	R.2162
11	5. B. Ka Sang	11. C. Buri Ram	5.0	5.0	1	1	R.218

Table 30.2.3 TRAFFIC VOLUME ON ROUTE IM - 30

YEAR		1987					1993					2001				
LINK		1	2	3	4	AVR.	1	2	3	4	AVR.	1	2	3	4	AVR.
P/C	N+D	3	9	14	20	11	6	19	32	43	24	15	45	74	102	55
	I	10	9	11	10	10	22	20	25	21	22	51	46	57	50	52
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	13	18	25	29	21	28	39	56	65	46	66	92	132	152	107
L/B	N+D	2	6	10	14	7	6	19	31	42	23	16	51	83	114	62
	I	7	6	8	7	7	21	19	24	21	22	58	52	65	56	59
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	TOTAL	9	12	18	20	14	27	38	55	63	45	74	104	148	171	121
M/B	N+D	18	55	90	123	67	20	61	100	137	74	20	63	103	141	76
	I	62	56	70	60	63	69	62	77	67	70	71	64	80	69	72
	DV	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0
	TOTAL	80	111	159	183	130	89	124	177	205	145	91	128	183	211	149
H/B	N+D	1	3	5	7	4	3	10	17	23	12	9	28	45	62	33
	I	4	3	4	4	4	11	10	13	11	12	31	28	35	30	32
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	5	7	10	11	8	15	21	29	34	24	40	56	80	92	65
P/P&T	N+D	25	79	131	181	97	33	104	171	237	127	46	148	245	339	182
	I	89	81	102	89	92	117	107	134	117	121	168	155	194	170	174
	DV	0	0	0	0	0	0	1	1	1	1	1	1	1	2	1
	TOTAL	114	161	233	270	189	150	212	306	355	249	215	304	440	510	357
4/T	N+D	2	8	14	21	10	2	9	16	25	12	3	11	21	32	16
	I	7	8	11	10	9	10	10	14	13	12	14	15	20	19	17
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	9	16	25	32	20	12	19	31	38	24	16	26	42	51	33
6/T	N+D	5	22	41	62	30	5	23	43	65	32	6	25	47	70	34
	I	22	23	33	30	27	25	27	38	35	31	30	32	45	41	37
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	27	46	74	93	58	31	50	81	100	63	36	57	92	112	72
10/T	N+D	1	6	12	18	9	3	11	21	32	16	5	23	43	64	31
	I	6	7	9	9	8	13	13	19	17	15	27	29	41	38	34
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	8	13	22	27	17	15	25	40	50	31	33	52	84	102	65
ADT	N+D	57	189	318	447	236	78	256	431	604	320	120	394	660	924	490
	I	207	195	248	219	220	288	270	343	303	305	451	422	536	474	477
	DV	0	0	0	0	0	1	2	2	3	2	2	3	4	4	3
	TOTAL	264	383	565	665	456	367	528	776	910	626	572	819	1200	1402	970
M/C	N+D	107	246	333	392	254	135	295	386	440	297	182	369	451	478	351
	I	194	120	99	62	128	223	125	85	40	129	249	103	16	0	107
	DV	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	TOTAL	301	366	432	454	382	358	420	471	480	426	431	473	467	478	458
TOTAL	N+D	164	434	650	839	490	212	552	817	1044	616	302	763	1111	1401	840
	I	401	315	347	281	347	511	395	428	343	434	699	525	553	474	584
	DV	0	0	0	0	0	2	2	3	3	2	2	3	4	4	3
	TOTAL	565	749	997	1120	837	725	948	1247	1390	1052	1004	1291	1667	1879	1427

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

Figure 30.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – 30

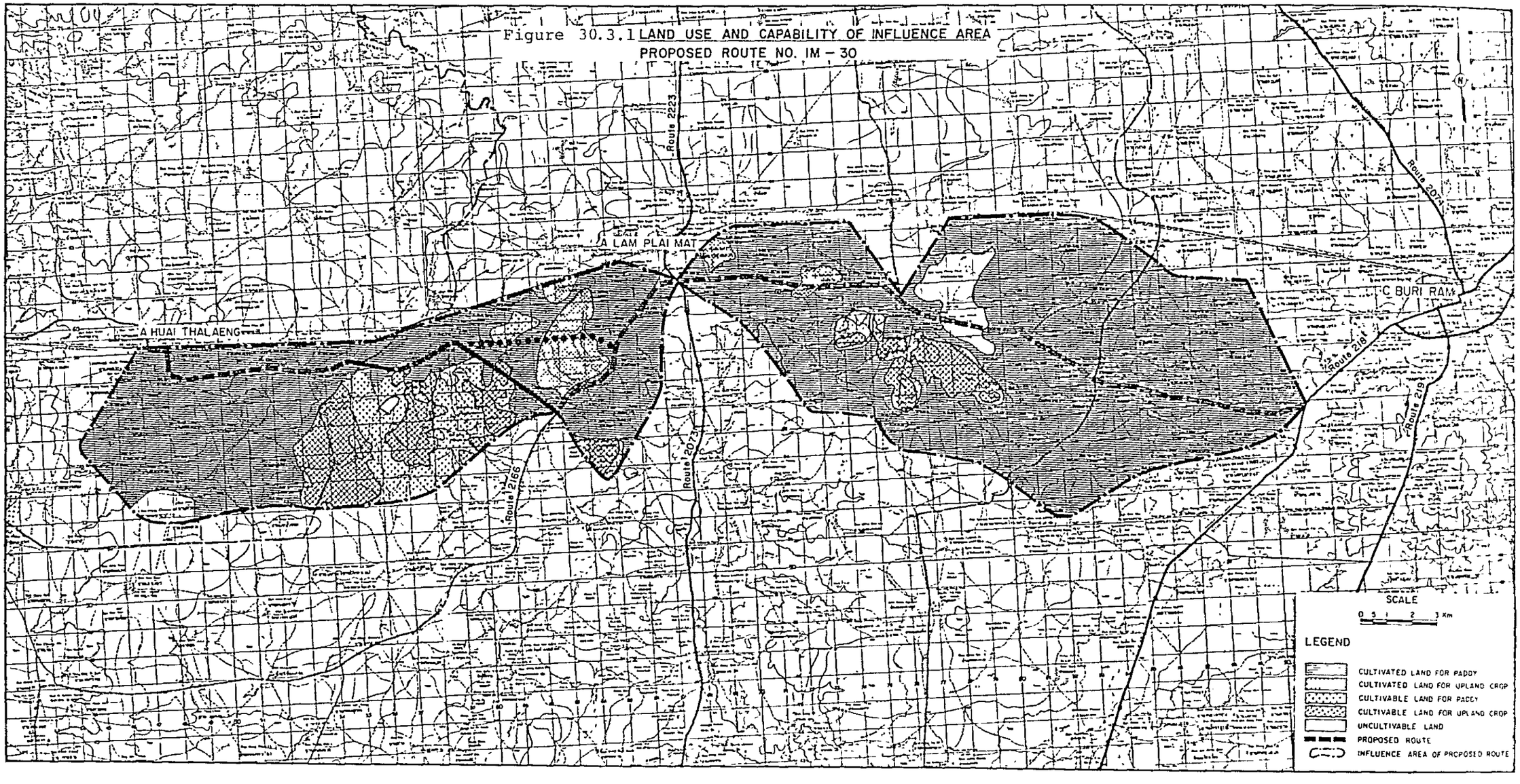
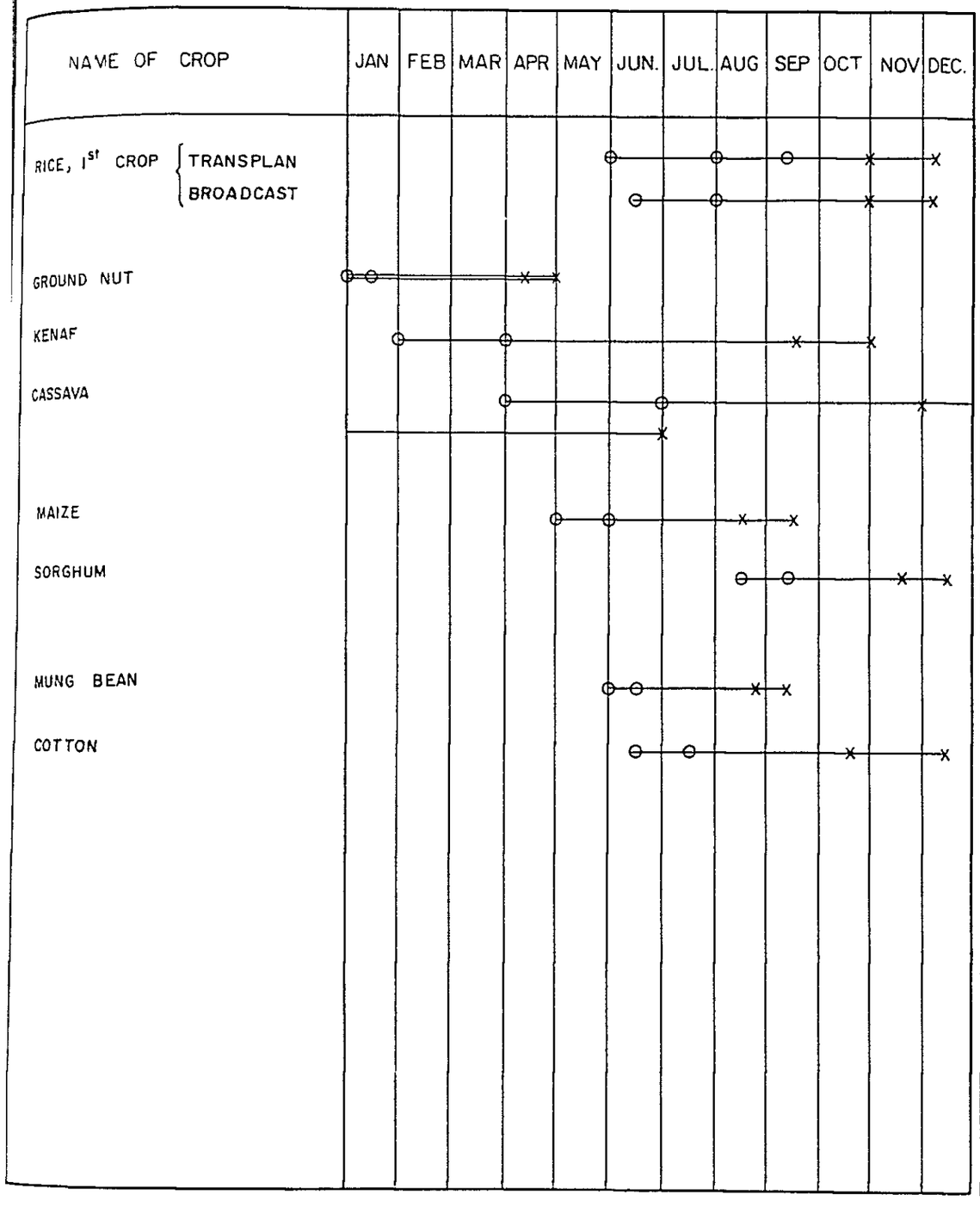


Figure 30.3.2

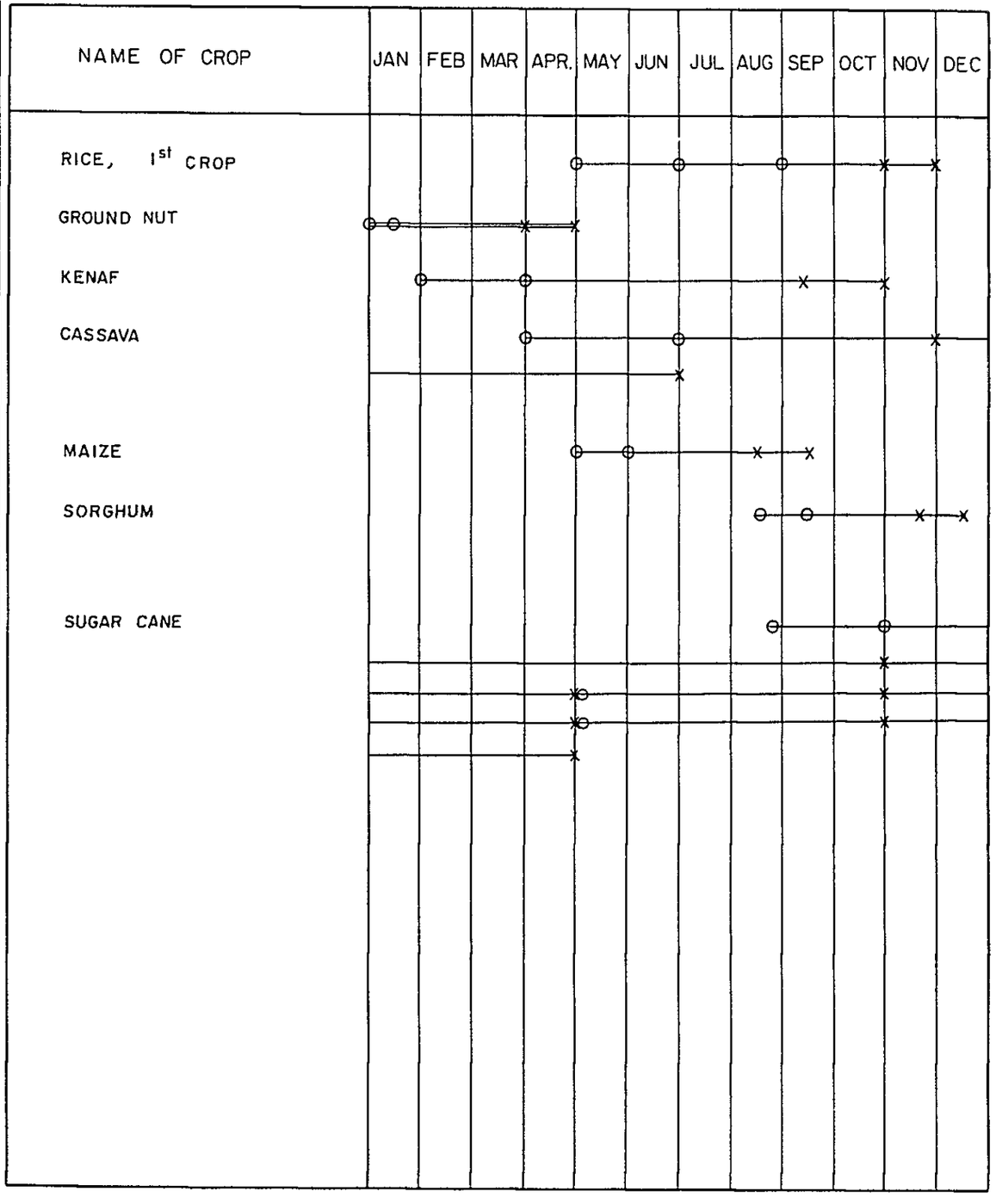
CROPPING CALENDAR (1)

1300 CHANGWAT NAKHON RATCHASIMA



CROPPING CALENDAR (2)

1400 CHANGWAT BURI RAM



Note

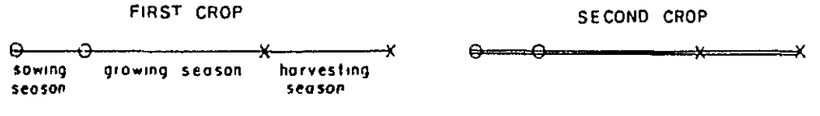


TABLE 30.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM'2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		135.625 (217.0)	5.000 (8.0)	140.625 (225.0)	10.125 (16.2)	12.813 (20.5)	22.938 (36.7)
1310	HUAI THALAENG	30.000 (48.0)	-	30.000 (48.0)	0.125 (0.2)	1.563 (2.5)	1.688 (2.7)
1401	M. BURI RAM	32.500 (52.0)	-	32.500 (52.0)	-	-	-
1406	LAM PLAI MAT	73.125 (117.0)	5.000 (8.0)	78.125 (125.0)	10.000 (16.0)	11.250 (18.0)	21.250 (34.0)

TABLE 30.3.2 CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)											
1981		117.86	-	0.08	0.23	1.90	0.17	2.28	-	5.13	123.00
1987		119.01	-	0.08	0.23	1.98	0.17	2.28	-	5.24	124.25
1993	WITHOUT PROJECT	119.01	-	0.08	0.23	2.07	0.17	2.28	-	5.35	124.36
	WITH PROJECT	119.01	-	0.08	0.24	2.37	0.18	2.28	-	5.71	124.72
2001	WITHOUT PROJECT	119.01	-	0.08	0.24	2.19	0.17	2.28	-	5.50	124.51
	WITH PROJECT	119.01	-	0.08	0.25	2.50	0.18	2.28	-	5.88	124.89
CROP YIELD (KG/RAI)											
1981		218.3	-	119.0	213.0	2422.5	6875.0	170.0	-		
1987		219.6	-	119.7	213.0	2422.5	6916.4	170.0	-		
1993	WITHOUT PROJECT	220.9	-	120.4	213.0	2422.5	6958.0	170.0	-		
	WITH PROJECT	223.6	-	121.9	214.3	2437.0	6999.8	170.0	-		
2001	WITHOUT PROJECT	222.7	-	121.4	213.0	2422.5	7013.8	170.0	-		
	WITH PROJECT	229.0	-	124.8	216.0	2456.6	7112.5	170.0	-		
CROP PRODUCTION (TON)											
1981		25,724	-	10	49	4,606	1,139	387	-	6,267	31,991
1987		26,132	-	10	49	4,803	1,146	387	-	6,476	32,607
1993	WITHOUT PROJECT	26,289	-	10	50	5,008	1,153	387	-	6,693	32,982
	WITH PROJECT	26,606	-	10	52	5,769	1,231	387	-	7,544	34,149
2001	WITHOUT PROJECT	26,500	-	10	51	5,295	1,162	387	-	6,997	33,497
	WITH PROJECT	27,251	-	10	54	6,149	1,251	387	-	7,954	35,205

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 30.3.3 FARMGATE PRICE AND PRODUCTION COST

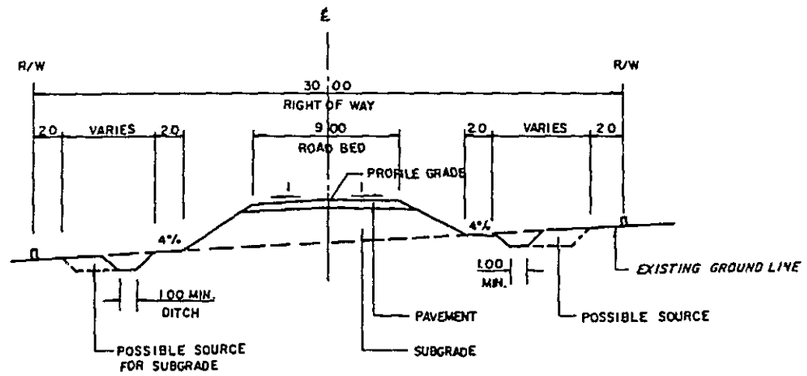
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,190	-	6,839	7,468	670	562	4,347	-
WITH PROJECT (1987 - 2001)	4,295	-	6,839	7,468	687	562	4,456	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	573	-	392	1,023	731	2,183	631	-
WITH PROJECT (1987 - 2001)	583	-	412	1,043	753	2,208	631	-

TABLE 30.3.4 NET PRODUCTION VALUE

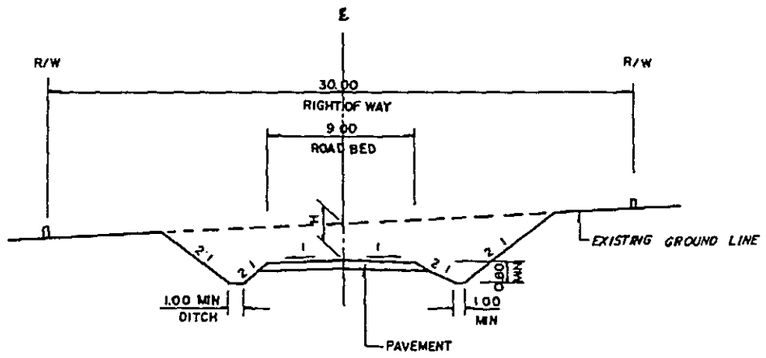
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	41,246	2,447	43,693	42,798	2,511	45,309
1993	41,904	2,529	44,433	44,834	2,927	47,761
2001	42,788	2,646	45,434	47,605	3,113	50,718

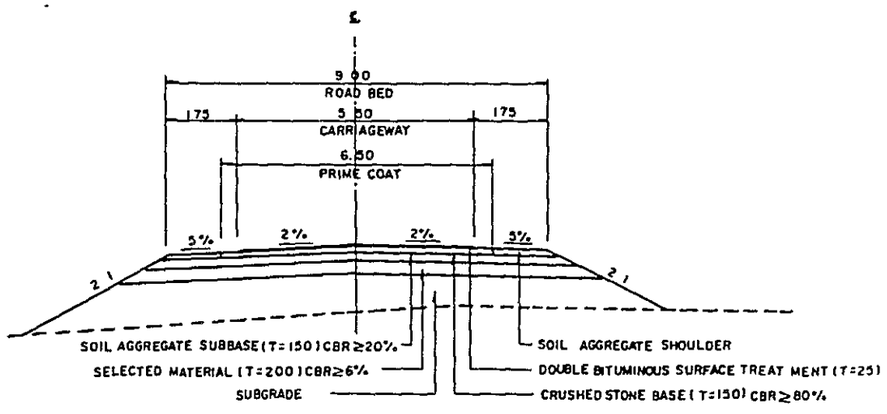
Figure 30.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



FILL SECTION

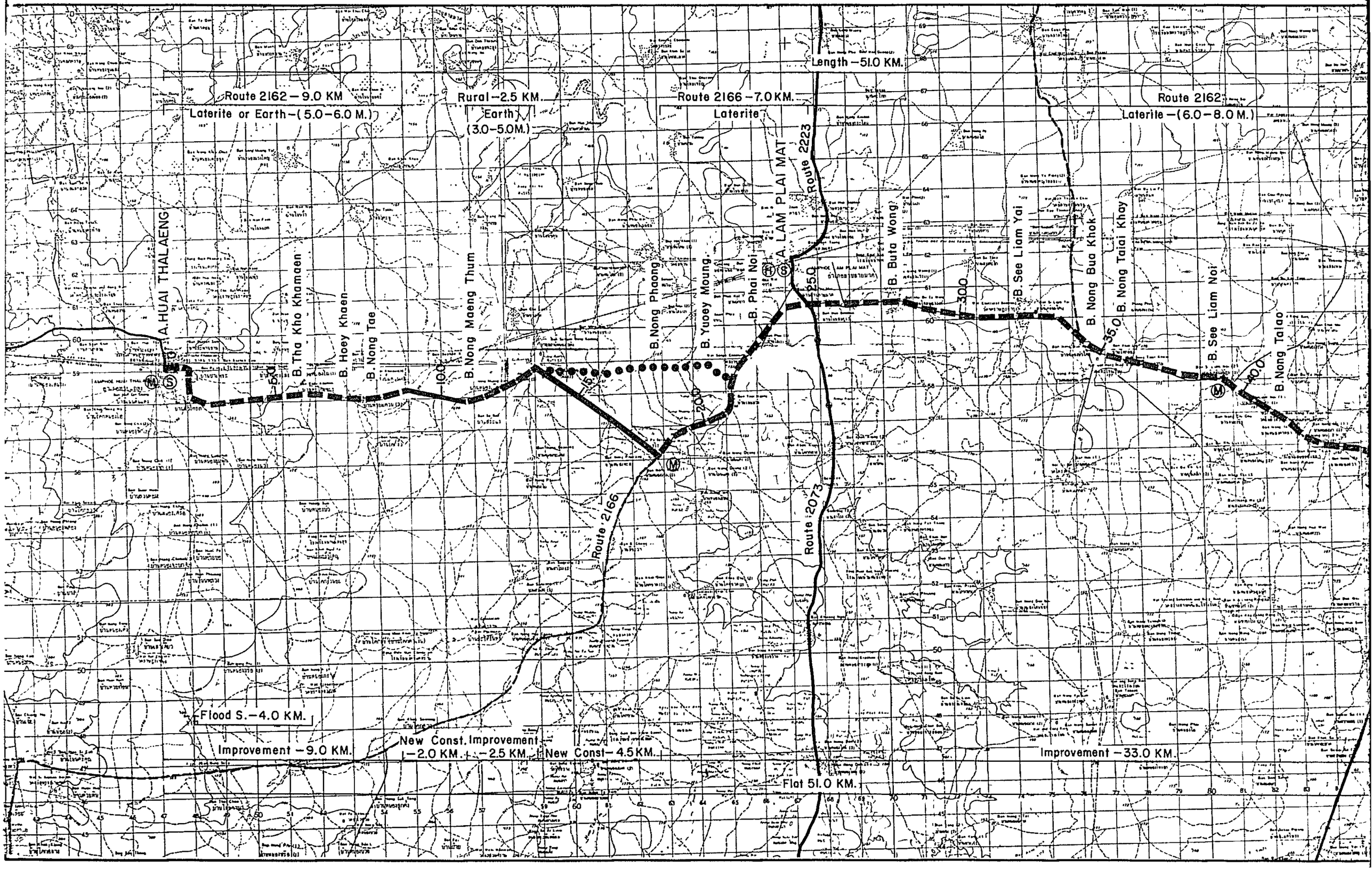


CUT SECTION



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

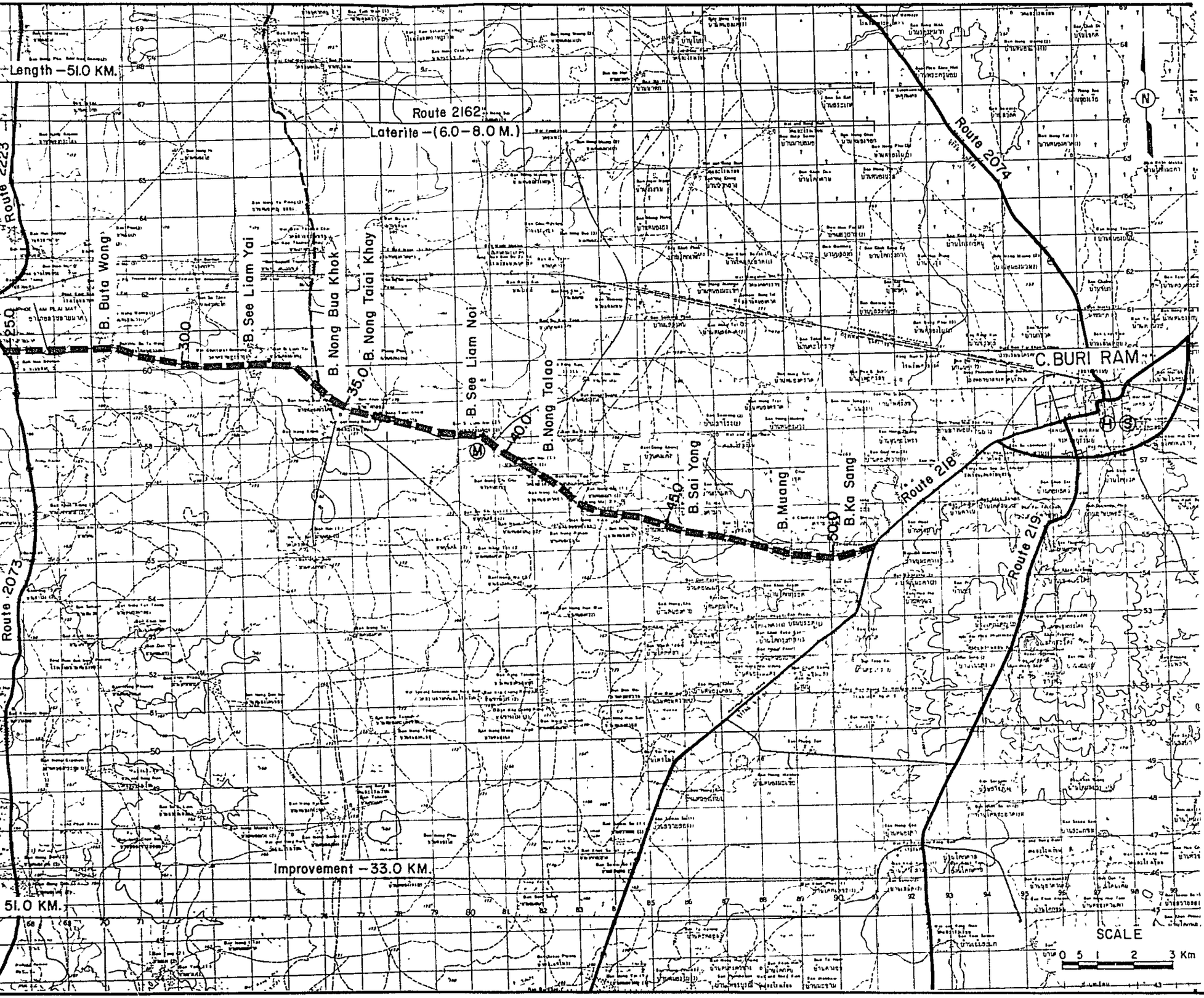
Figure 30.5.2 PROPOSED ROUTE NO. IM – 30 C. BURI RAM – NAKHON RATCHASIMA A. HUAI THALAENG – B. KA SANG (J.R. 218) ROUTE NO. 2162 + 2166 L = 51.0 Km.



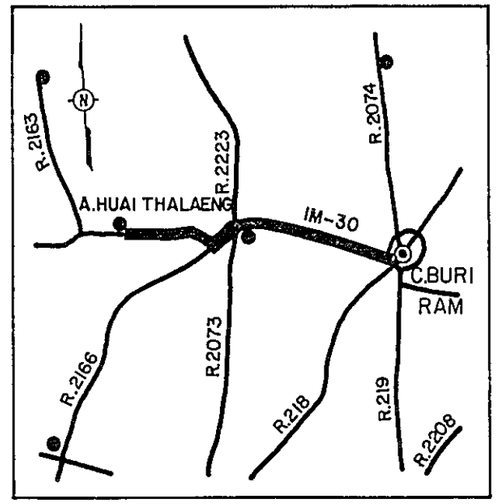
BURI RAM
NAKHON RATCHASIMA

A. HUAI THALAENG – B. KA SANG (J.R. 218)

ROUTE NO. 2162 + 2166 L = 51.0 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	23.0	—	C – 9.00 x 45.00
2	42.6	C – 7.00 x 24.00	W – 4.50 x 20.30
3	46.5	C – 7.00 x 18.00	W – 4.50 x 15.00
4	46.9	C – 7.00 x 18.00	W – 4.50 x 15.00

LEGEND

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

Table 30.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-30 (51.0 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	Financial Cost (10^3฿)	Economic Cost (10^3฿)
DIRECT CONSTRUCTION COST					
Clearing and Grubbing	ha	15,000	124	1,860	1,692
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	205,600	9,252	8,419
Selected Material	m^3	80	108,100	8,648	7,696
Soil Aggregate Surface or Subbase	m^3	105	75,700	7,948	7,074
Crushed Stone Base	m^3	370	49,200	18,204	16,747
Soil Aggregate Shoulder	m^3	105	21,400	2,247	1,999
Prime Coat and DBST	m^2	55	280,500	15,428	13,885
Pipe Culvert	m	2,100	2,380	4,998	4,598
Box Culvert	m	16,000	20	320	288
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	60	2,400	2,136
Sub Total (a)				71,306	64,538
Miscellaneous Works (a) x 7%				4,991	4,518
Total (b)				76,297	69,056
PHYSICAL CONTENGENCY (b) x 15%				11,445	10,358
ENGINEERING AND ADMINISTRATION (b) x 10%				7,630	6,906
Sub Total				19,075	17,264
LAND ACQUISITION					
Highly Developed Land	ha	50,000	20	1,000	1,000
Less Developed Land	ha	15,000	0	0	0
Sub Total				1,000	1,000
GRAND TOTAL				96,372	87,320

Table 30.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	17,464	0	0	0	0	24,536	0
1985	43,660	0	0	0	0	54,767	0
1986	26,196	0	0	0	0	29,340	0
1987	0	1,616	10,877	-33	12,460	0	11,125
1988	0	1,892	11,967	4	13,862	0	11,051
1989	0	2,168	13,057	41	15,265	0	10,866
1990	0	2,443	14,147	79	16,668	0	10,593
1991	0	2,719	15,237	116	18,071	0	10,254
1992	0	2,995	16,326	153	19,474	0	9,866
1993	0	3,271	17,416	190	20,877	0	9,444
1994	24,684	3,522	19,252	250	23,023	11,166	9,299
1995	0	3,773	21,087	309	25,169	0	9,076
1996	0	4,025	22,922	368	27,315	0	8,795
1997	0	4,276	24,757	427	29,461	0	8,469
1998	0	4,527	26,592	487	31,607	0	8,113
1999	0	4,779	28,428	546	33,752	0	7,735
2000	0	5,030	30,263	605	35,898	0	7,346
2001	-40,707	5,282	32,098	665	38,044	-7,437	6,951
TOTAL	71,297	52,317	304,424	4,206	360,948	112,371	138,981

DISCOUNTED ECONOMIC COSTS : 112,371

DISCOUNTED ECONOMIC BENEFITS : 138,981

AGRICULTURAL DEVELOPMENT BENEFIT	20,146
VOC SAVING	117,604
RMC SAVING	1,231

NET PRESENT VALUE : 26,610

BENEFIT COST RATIO : 1.24

INTERNAL RATE OF RETURN : 14.6 %

Table 30.7.1 SOCIAL INDICATORS

(Proposed Route IM-30)

Population (1,000)	
1982	: 40.2
1993	: 48.6
Average travelling speed, without (kph)	: 42
Isolation	
Access to Amphoe	
Average distance to Amphoe (km) 1/	: 6.9
Per capita time savings (10^{-4})	: 0.014
Score	: 41
Access to Artery Highway	
Average distance to highway (km) 1/	: 25
Per capita time savings (10^{-4})	: 0.051
Score	: 111
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/	: 3.6 (4.6)
Per capita time savings (10^{-4})	: 0.012
Score	: 28
Access to Medical Facilities	
Average distance to facilities (km) 1/	: 3.5 (3.8)
Per capita time savings (10^{-4})	: 0.009
Score	: 36
Education	
Access to Secondary School	
Number of Student in 1993 (1,000) 2/	: 9.7
Average distance to school (km)	: 3.6 (4.6)
Per capita time savings (10^{-4})	: 0.061
Score	: 33
Teacher Intensity	
Number of teachers 3/	
University graduate	: -
Total	: 11
Number of Student	: 234
Indicators	
E1 4/	: -
E2 5/	: 47.0
E 6/	: 47.0
Degree of Improvement 7/	: 1.46
Score	: 93
Disparity	
G.P.V. in 1993 (Mn B) 8/	
With project	: 121.3
Without project	: 116.5
Per capita G.P.V. in 1993 (B)	
With project (W)	: 2,496
Without project (w)	: 2,397
Degree of Disparity	
(A/W) - (A/w) 9/	: 0.05
Score	: 89
Total Score	: 464

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 - 31

Changwat : Buri Ram

A. Lam Plai Mat (J.R.2073) - A. Nong Ki (J.R.24)

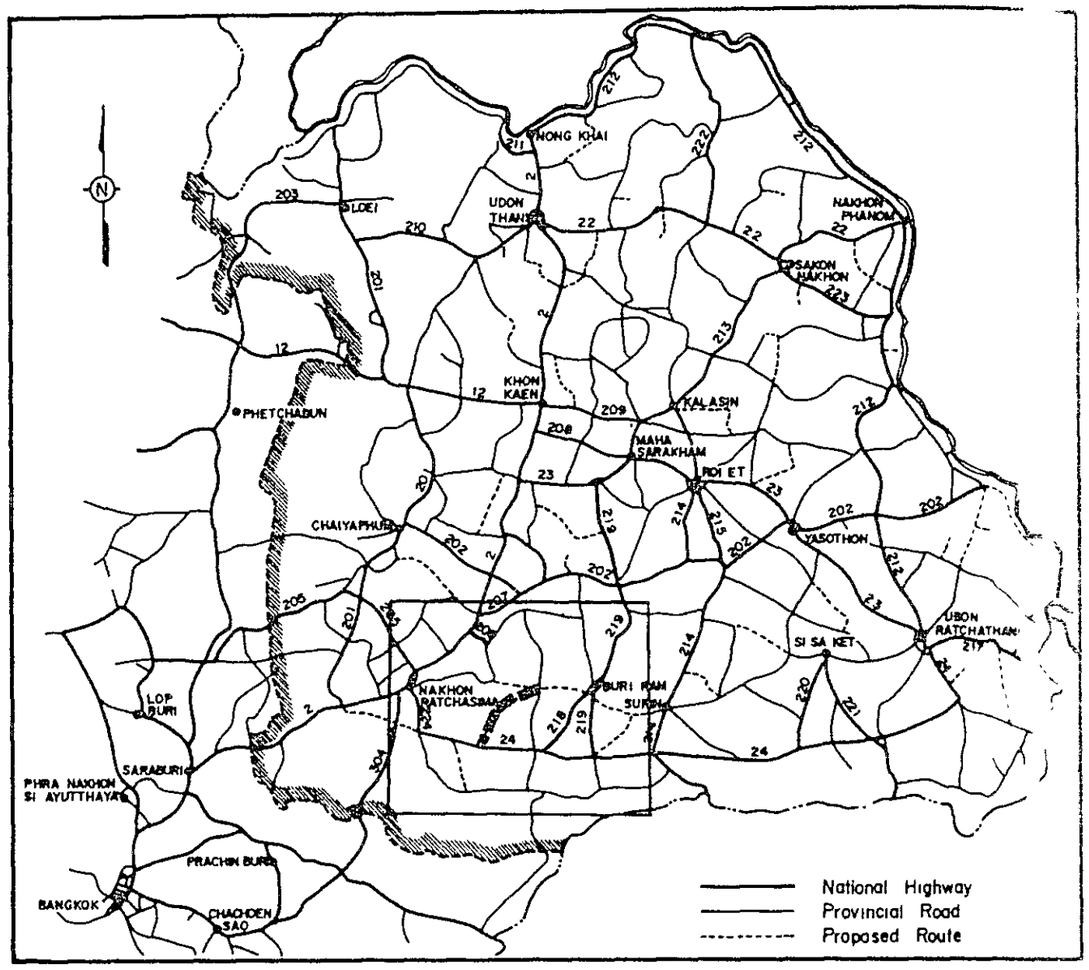
Length : 59.7 K M.

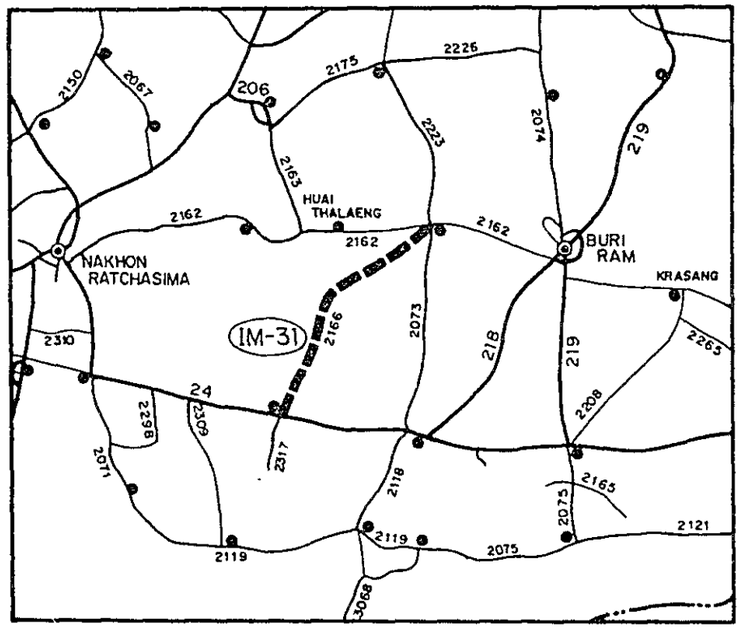
SUMMARY

PROPOSED ROUTE IM-31

Item	Description
Changwat	Buri Ram
Origin	A. Lam Plai Mat (J.R. 2073)
Destination	A. Nong Ki (J.R. 24)
Length	
Total	59.7 km
Improvement Section	59.7 km
DOH Road	R.2166 59.7 km
ARD Road	0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate and Earth, Poor
Terrain	Flat
Influence Area	
Area	353 km^2
Population (1982)	51,500
Principal Crops	Paddy
Traffic (ADT)	
Existing	183
1993	850
2001	659
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	93,083 · 10^3 ฿
Economic	84,259 · 10^3 ฿
IRR	15.1 %
B/C	1.28
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the southwest of Changwat Buri Ram.

The route, starting at the intersection with Route 2073, at Amphoe Lam Plai Mat, runs southwestward passing through Ban Si Chawa, Ban Non Si Khun and Ban Kham Yai and ends at Amphoe Nong Ki. Its total length is 59.7 km. (Figure 31.5.2)

The terrain is almost flat. In the influence area, there exists several villages with total population of 51,500. There are three medical centers, one hospital and two secondary schools along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 2073 and 24 in the agriculturally developed area.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 31.1.1.

The details are shown as the results of inventory survey in Table 31.1.2.

2. TRAFFIC

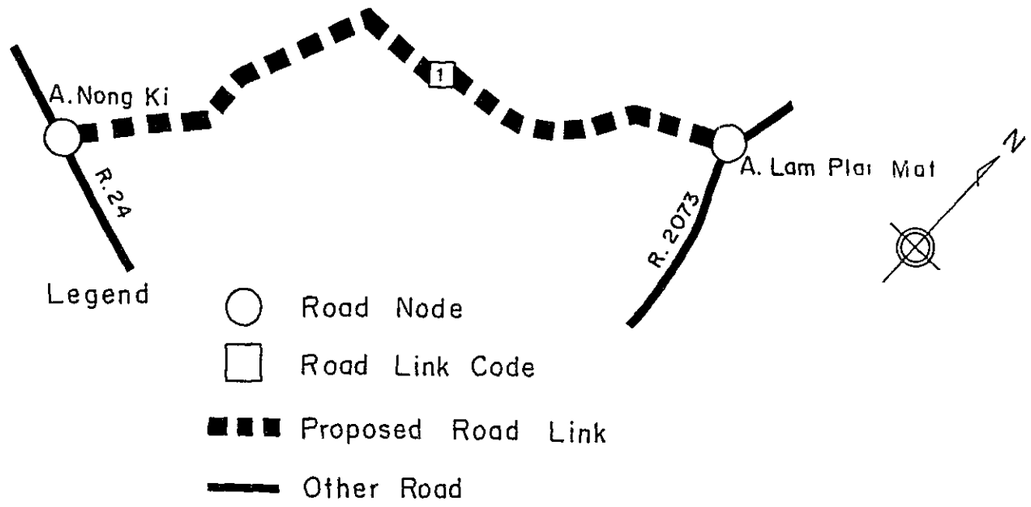
2.1 Method

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 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	H/B	P/T	4/T	6/T	10/T	ADT
DOH (1981)	1 1/	18	80	40	49	-	13	40	22	13	273
Manual Counts (1982)	1	-	20	47	10	-	2	-	10	-	89
Estimated	1	8	50	44	30	-	8	20	16	-	183

Note: 1/ Route 2166 Section 0100 Station Km 4+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 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	1470

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	64	50	115

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	1.9	1.6	1.4
PASSENGER MOVEMENT	5.9	6.0	6.0

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.6	7.7	7.8
AGRICULTURE	0.2	0.2	0.2
FREIGHT	4.4	4.4	4.5

2.5 Induced and Developed Trafric

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 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	6.1	37.9	33.3	22.7	0.0	15.7	39.2	31.4	13.7
	1987	7.4	36.6	29.9	23.3	2.9	16.0	33.1	32.3	18.5
	1993	8.9	35.0	25.8	24.0	6.3	16.4	25.8	33.5	24.3
	2001	11.0	33.0	20.2	24.9	10.9	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 31.2.1.

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	14	57	44	5	79	20	20	11	252	296	548
1993	22	65	61	16	100	18	23	17	321	338	659
2001	41	75	92	40	136	13	18	26	451	399	850

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

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

In the upland field, kenaf and cassava are the major crops.

Unused cultivable land for both paddy and upland field still remains.

Land use and capability conditions in the area of influence are shown in Table 31.3.1 and Figure 31.3.1.

A typical cropping calendar in the Buri Ram area is shown in Figure 31.3.2.

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 31.3.2.

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 31.3.3.

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 31.3.4. 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)	Road Class /1	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	With Project: Length (Km)	Road Class /1	Nos. of Wooden Narrow Bridge
1	Flat	59.7	3	2	0	59.7	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 alignment

Raod 3 : Laterite Road with poor surface condition and alignment

Raod 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)	12,075	17,467	28,069

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 31.5.1
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		:	ø100cm
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 31.5.2.

Alignment of the route is shown in Figure 31.5.2.

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 31.5.1.

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

F_4 Standard (DBST)		L = 59.7 km
	Financial Cost	93,083 · 10^3₱
	Economic Cost	84,259 · 10^3₱

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 31.6.1.

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 inpacts are tabulated in Table 31.7.1.

Table 31.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	A. Lam Plai Mat (J.R. 2073)		
Destination	A. Nang Ki (J.R. 24)		
Length			
Total		59.7	km
Improvement Section		59.7	km
DOH Road	R. 2166	59.7	km
ARD Road		0	km
Others		0	km
New Alignment Section		0	km
Terrain	Flat		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.5 m - 9.5 m	7.5 m	(Weighted average)
Embankment Section			
Length		59.7	km
Height	0.2 m - 1.0 m		
Cut Section			
Length		0	km
Depth	m - m		
Surface Type and Condition			
SBST or DBST	Poor	6.5	km
Soil Aggregate	Poor	48.2	km
Earth	Poor	5.0	km
Pipe Culvert	27 each		
Box Culvert	1 each	11.0	m
Bridge			
Permanent Bridge	1 each	45.0	m
Narrow Concrete Bridge	0 each	0	m (4m)
Wooden Bridge	2 each	23.7	m
Overflow Section	3 places	1.7	km

Table 31.1.2 ROAD INVENTORY (1)

PROPOSED ROUTE NO. IM-31 ROUTE NO. 2166 A. LAM PLAI MAT (J.R. 2073) ~ B. NONG KI (J.R. 24) L = 59.7 Km.

BURI RAM

STATION (Km)		0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
VILLAGE - Name - Household (H) - Population (P)		A. LAMPLAI MAT; B. PHAI NOI H = 40 P = 200; B. YUOEY MONG H = 40 P = 200; B. NONG PHAOENG H = 120 P = 600; B. SICHAWA H = 74 P = 225; B. NONG MA KHA H = 50 P = 225; B. NONG NUA CHANG H = 60 P = 400; B. KHOK SAWANG H = 60 P = 300; B. SISANGA H = 25 P = 125; B. NON KHLON H = 200 P = 1000; B. BUNG CHANG H = 170 P = 850
TERRAIN		Flat
CROSS SECTION	Formation Width (m)	8.00; 7.50; 6.50; 7.50
	Embankment Height (m)	0.50 0.70 1.00 0.50 0.80 0.30 0.20 0.80 0.50 1.00 0.80 0.40
	Cutting Depth (m)	
PAVEMENT	Type/Length	Laterite; Earth; Laterite
	Condition	Poor
FLOODING	Overflow Length(Km)/Height(m)	L=1.0 H=0.2; L=0.2 H=0.1
LAND USE	Left	Paddy; Forest; Jute; Paddy; Jute; Paddy; Forest; Paddy
	Right	Forest; Paddy; Forest; Jute; Paddy; Jute; Paddy; Forest; Paddy
PIPE CULVERT	Total Number	27 Pipes
BOX CULVERT & BRIDGE	Station (Km)	2.7; 11.6; 24.0
	Dimension	C-Br. 9.00 x 45.00; W-Br. 5.60 x 11.30; W-Br. 4.60 x 12.40
RIGHT OF WAY (m)		
ALIGNMENT	Horizontal	Fair
	Vertical	Fair
ROUTE NO., AGENCIES		DOH 2166

ROAD INVENTORY (2)

PROPOSED ROUTE NO. IM-31 ROUTE NO. 2166 A. LAM PLAI MAT (J.R. 2073) ∿ B. NONG KI (J.R. 24) (Cont'd) L = 59.7 Km.

BURI RAM

Item		Content (in order of station, Km 30 – 60)
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. NON SIK HUY H = 500 P = 2500; B. NON NGIU H = 50 P = 250; B. KHOK KLANG H = 380 P = 1900; B. NON SAMRAN H = 70 P = 350; B. SA DAOH WAN H = 100 P = 550; B. KHAM YAI H = 146 P = 830; B. KHAM NOI H = 120 P = 805; B. YOEI PRASAT H = 100 P = 750
TERRAIN		Flat
CROSS SECTION	Formation Width (m)	7.50 / 8.00 / 7.80 / 7.50 / 6.00 / 6.50 / 7.00 / 9.50 / 6.50 / 8.00 / 7.50 / 7.0) / 9.00
	Embankment Height (m)	0.40
	Cutting Depth (m)	
PAVEMENT	Type/Length	La. / DT / Laterite / DT / Laterite / DT / Laterite / DT
	Condition	Poor
FLOODING	Overflow Length(Km)/Height(m)	L=0.5 H=0.1
LAND USE	Left	Paddy / Cassava / Bush / Paddy / Marsh / Paddy
	Right	Paddy / Cassava / Paddy / Bush / Paddy
PIPE CULVERT	Total Number	
BOX CULVERT & BRIDGE	Station (Km)	57.2
	Dimension	C-Box 4.00 x 11.00
RIGHT OF WAY (m)		
ALIGNMENT	Horizontal	Fair
	Vertical	Fair
ROUTE NO., AGENCIES		DOH 2166

Table 31.2.1 TRAFFIC VOLUME ON ROUTE IM - 31

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	12	12	19	19	35	35
	I	2	2	3	3	5	5
	DV	0	0	0	0	0	0
	TOTAL	14	14	22	22	41	41
L/B	N+D	49	49	56	56	65	65
	I	7	7	8	8	10	10
	DV	0	0	0	0	0	0
	TOTAL	57	57	65	65	75	75
M/B	N+D	39	39	52	52	80	80
	I	6	6	8	8	12	12
	DV	0	0	0	0	0	0
	TOTAL	44	44	61	61	92	92
H/B	N+D	5	5	14	14	35	35
	I	1	1	2	2	5	5
	DV	0	0	0	0	0	0
	TOTAL	5	5	16	16	40	40
P/P&T	N+D	69	69	86	86	118	118
	I	10	10	13	13	18	18
	DV	0	0	0	0	0	0
	TOTAL	79	79	100	100	136	136
4/T	N+D	18	18	15	15	11	11
	I	3	3	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	20	20	18	18	13	13
6/T	N+D	17	17	20	20	24	24
	I	3	3	3	3	4	4
	DV	0	0	0	0	0	0
	TOTAL	20	20	23	23	28	28
10/T	N+D	10	10	14	14	22	22
	I	1	1	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	11	11	17	17	26	26
ADT	N+D	219	219	278	278	391	391
	I	33	33	42	42	59	59
	DV	0	0	1	1	1	1
	TOTAL	252	252	321	321	451	451
M/C	N+D	272	272	313	313	373	373
	I	24	24	25	25	25	25
	DV	0	0	1	1	1	1
	TOTAL	296	296	338	338	399	399
TOTAL	N+D	492	492	591	591	764	764
	I	56	56	67	67	84	84
	DV	0	0	2	2	2	2
	TOTAL	548	548	659	659	850	850

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

Figure 31.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – 31

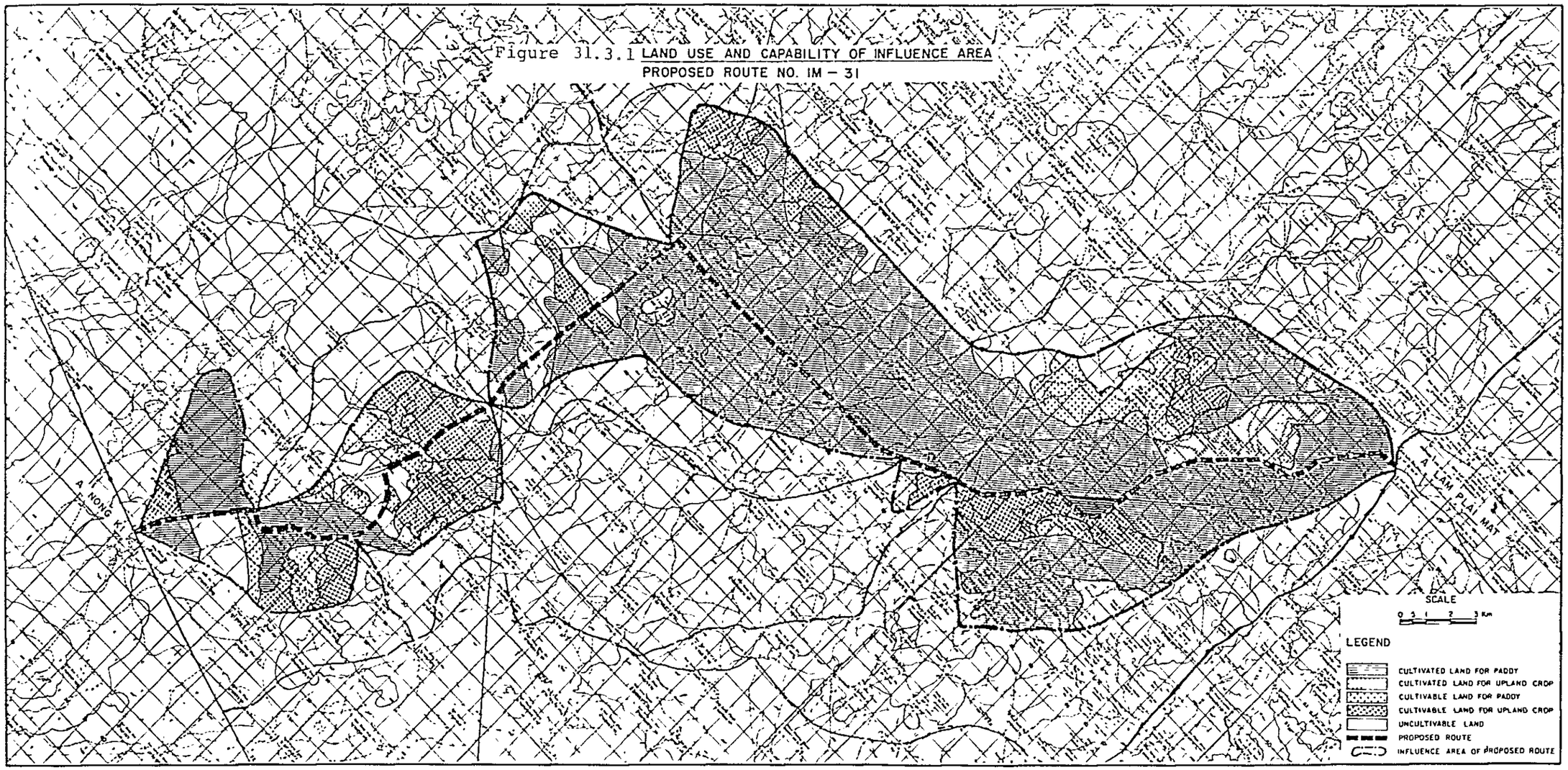


Figure 31.3.2 CROPPING CALENDAR

1400 CHANGWAT BURI RAM

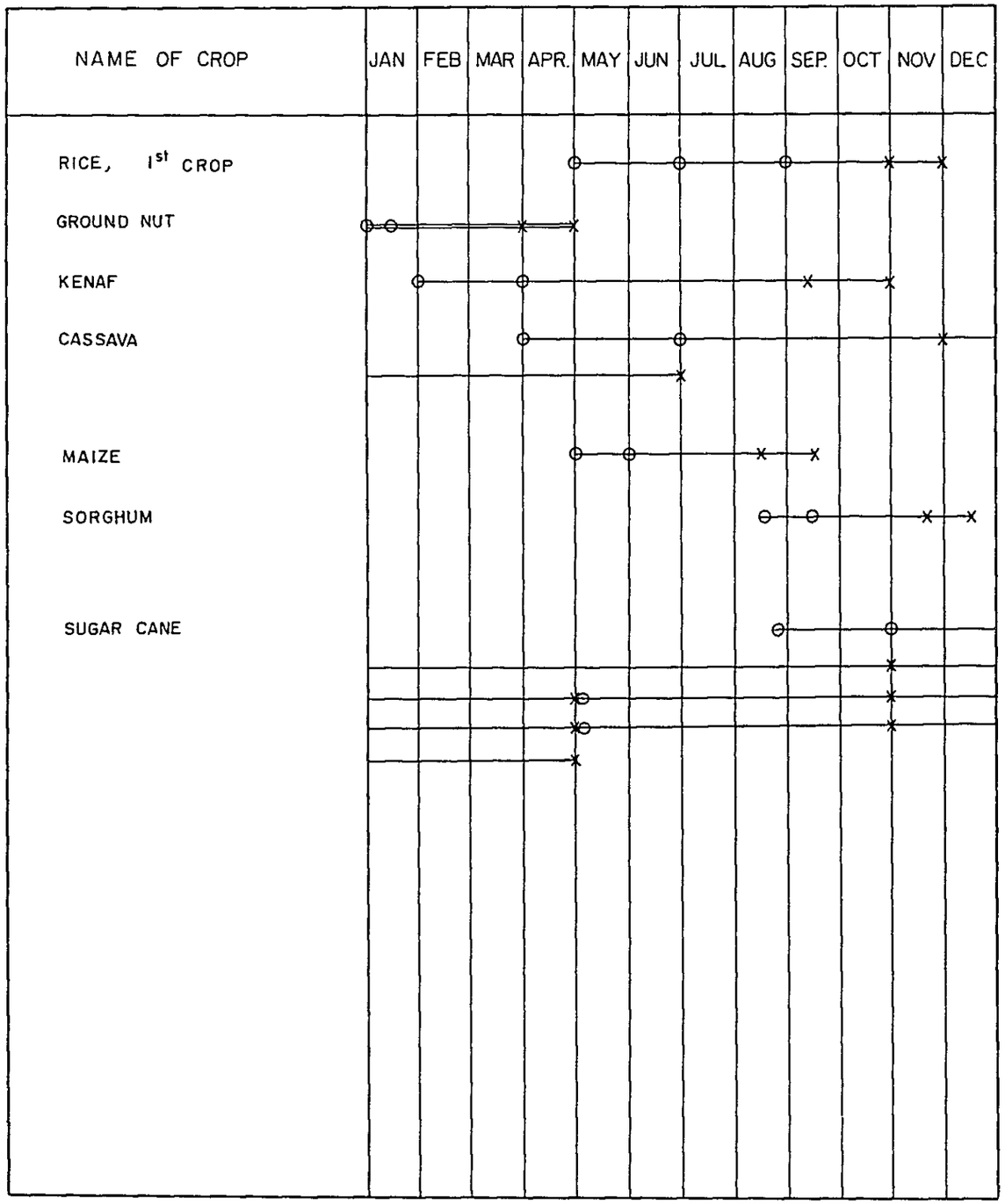


TABLE 31.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		155.000 (248.0)	6.875 (11.0)	161.875 (259.0)	16.875 (27.0)	26.875 (43.0)	43.750 (70.0)
1406	LAM PLAI MAT	131.875 (211.0)	6.875 (11.0)	138.750 (222.0)	9.375 (15.0)	12.500 (20.0)	21.875 (35.0)
1407	NONG KI	23.125 (37.0)	-	23.125 (37.0)	7.500 (12.0)	14.375 (23.0)	21.875 (35.0)

TABLE 31.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			135.75	-	0.11	0.32	2.55	0.23	3.15	-	7.02	142.77
1987			135.75	-	0.11	0.32	2.66	0.23	3.15	-	7.16	142.91
1993	WITHOUT	PROJECT	135.75	-	0.11	0.32	2.77	0.23	3.15	-	7.31	143.06
	WITH	PROJECT	135.75	-	0.11	0.34	3.17	0.24	3.15	-	7.74	143.49
2001	WITHOUT	PROJECT	135.75	-	0.11	0.33	2.93	0.23	3.15	-	7.51	143.27
	WITH	PROJECT	135.75	-	0.11	0.34	3.36	0.24	3.15	-	7.97	143.72
CROP YIELD (KG/RAI)												
1981			226.1	-	119.0	213.0	2500.0	6875.0	170.0	-		
1987			227.5	-	119.7	213.0	2500.0	6916.4	170.0	-		
1993	WITHOUT	PROJECT	228.9	-	120.4	213.0	2500.0	6958.0	170.0	-		
	WITH	PROJECT	231.6	-	121.9	214.3	2515.0	6999.8	170.0	-		
2001	WITHOUT	PROJECT	230.7	-	121.4	213.0	2500.0	7013.8	170.0	-		
	WITH	PROJECT	237.2	-	124.8	216.0	2535.2	7112.5	170.0	-		
CROP PRODUCTION (TON)												
1981			30,698	-	14	67	6,373	1,566	535	-	8,662	39,360
1987			30,883	-	14	68	6,646	1,576	535	-	8,951	39,833
1993	WITHOUT	PROJECT	31,068	-	14	69	6,930	1,585	535	-	9,251	40,320
	WITH	PROJECT	31,443	-	14	73	7,983	1,693	535	-	10,418	41,861
2001	WITHOUT	PROJECT	31,318	-	14	70	7,327	1,598	535	-	9,672	40,990
	WITH	PROJECT	32,205	-	14	74	8,509	1,720	535	-	10,986	43,191

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 31.3.3 FARMGATE PRICE AND PRODUCTION COST

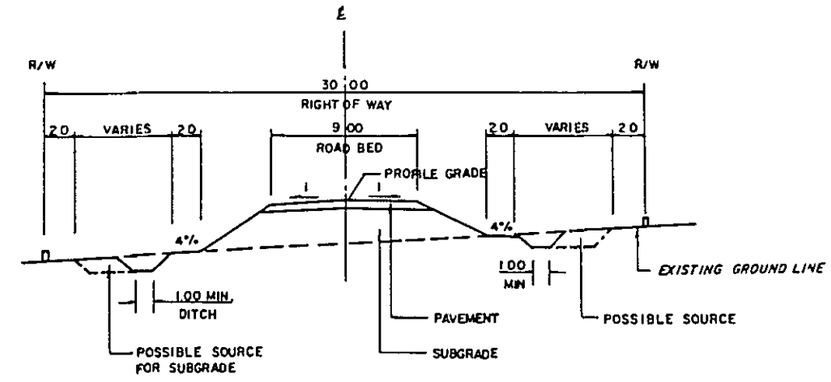
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,144	-	6,839	7,468	670	562	4,347	-
WITH PROJECT (1987 - 2001)	4,248	-	6,839	7,468	687	562	4,456	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	573	-	392	1,023	734	2,183	631	-
WITH PROJECT (1987 - 2001)	583	-	412	1,043	754	2,208	631	-

TABLE 31.3.4 NET PRODUCTION VALUE

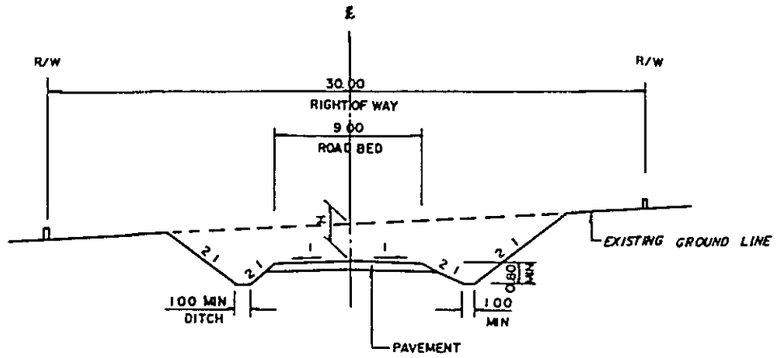
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	50,193	3,437	53,630	52,046	3,534	55,580
1993	50,962	3,553	54,515	54,426	4,120	58,546
2001	51,996	3,719	55,715	57,665	4,381	62,046

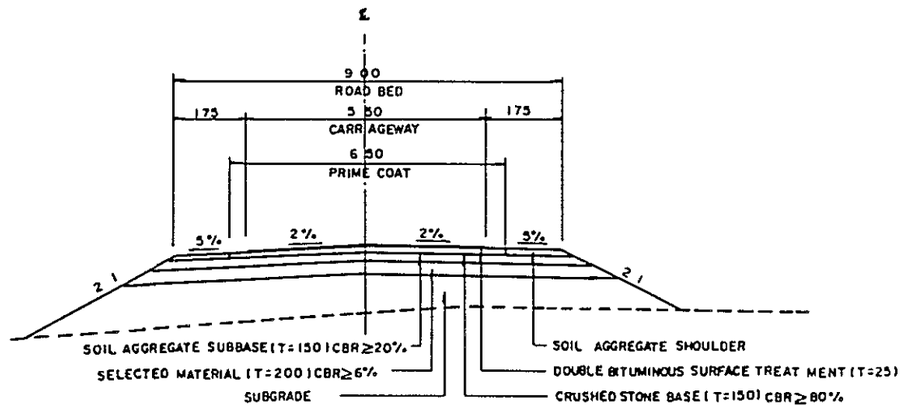
Figure 31.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



FILL SECTION



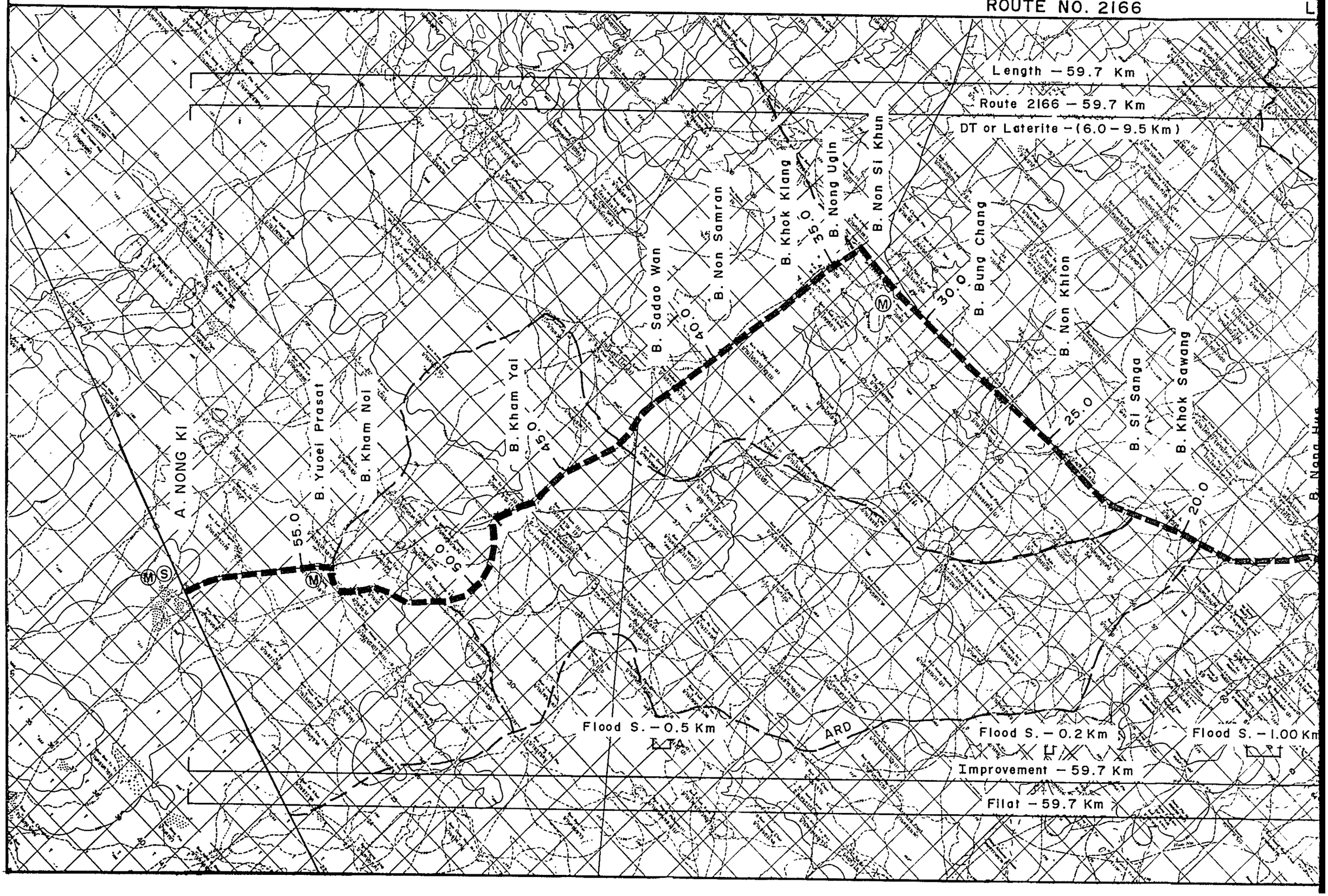
CUT SECTION



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

Figure 31.5.2 **PROPOSED ROUTE NO. IM – 31** **C. BURI RAM** **A. LAM PLAI MAT (J.R. 2073) – A**

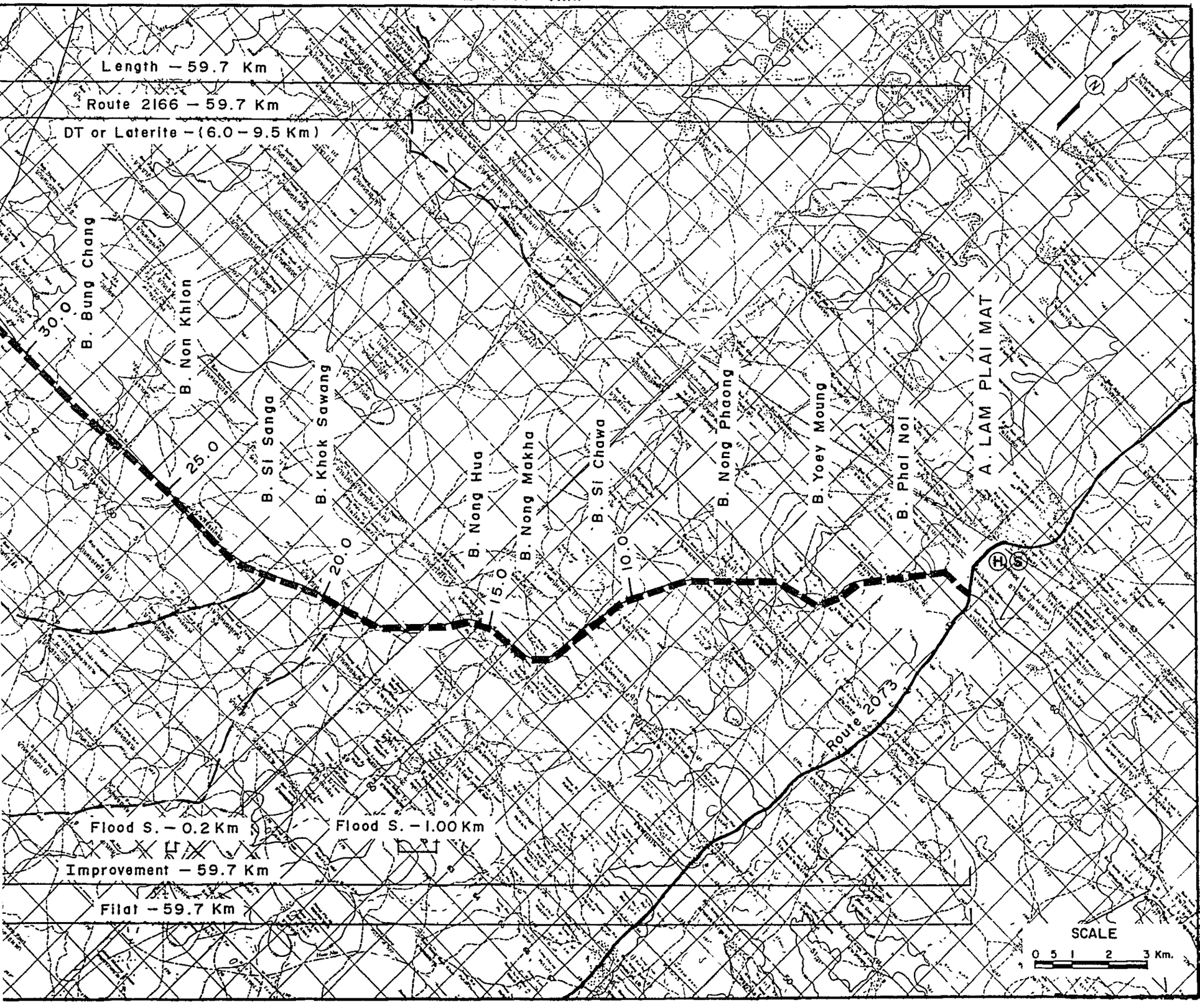
ROUTE NO. 2166 L



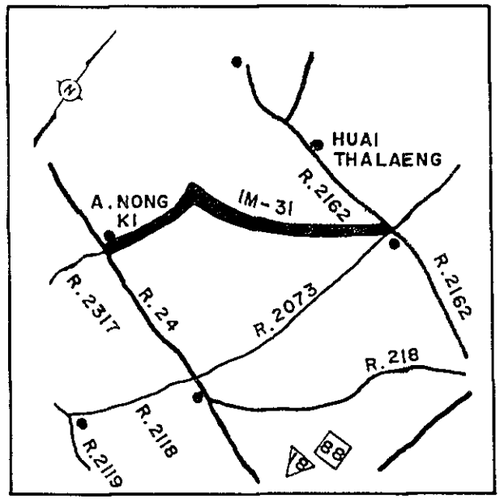
RAM

A. LAM PLAI MAT (J.R. 2073) — A. NONG KI (J.R. 24)

ROUTE NO. 2166 L=59.7 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	2.7	C — 7.00 x 14.00	C — 9.00 x 45.00
2	11.6	C — 7.00 x 14.00	W — 5.60 x 11.30
3	24 0	—	W — 4.60 x 12.40

LEGEND

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

Table 31.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-31 (59.7 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	134	2,010	1,829
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	142,200	6,399	5,823
Selected Material	m^3	80	112,800	9,024	8,031
Soil Aggregate Surface or Subbase	m^3	105	79,000	8,295	7,382
Crushed Stone Base	m^3	370	51,900	19,203	17,666
Soil Aggregate Shoulder	m^3	105	22,300	2,341	2,083
Prime Coat and DBST	m^2	55	292,600	16,093	14,484
Pipe Culvert	m	2,100	2,410	5,061	4,656
Box Culvert	m	16,000	3	48	43
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	28	1,120	996
Sub Total (a)				69,594	62,997
Miscellaneous Works (a) x 7%				4,872	4,410
Total (b)				74,466	67,407
PHYSICAL CONTENGENCY (b) x 15%				11,170	10,111
ENGINEERING AND ADMINISTRATION (b) x 10%				7,447	6,741
Sub Total				18,617	16,852
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				93,083	84,259

Table 31.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	16,852	0	0	0	0	23,676	0
1985	42,129	0	0	0	0	52,847	0
1986	25,278	0	0	0	0	28,311	0
1987	0	1,950	12,075	-52	13,973	0	12,476
1988	0	2,285	12,974	-30	15,230	0	12,141
1989	0	2,621	13,873	-7	16,487	0	11,735
1990	0	2,956	14,771	16	17,744	0	11,276
1991	0	3,292	15,670	39	19,001	0	10,781
1992	0	3,627	16,569	62	20,257	0	10,263
1993	0	3,963	17,467	84	21,514	0	9,732
1994	28,895	4,258	18,793	119	23,170	13,071	9,358
1995	0	4,554	20,118	153	24,825	0	8,952
1996	0	4,850	21,443	187	26,480	0	8,526
1997	0	5,145	22,768	222	28,135	0	8,088
1998	0	5,441	24,094	256	29,791	0	7,647
1999	0	5,737	25,419	290	31,446	0	7,207
2000	0	6,033	26,744	325	33,101	0	6,773
2001	-38,759	6,328	28,069	359	34,757	-7,081	6,350
TOTAL	74,395	63,040	290,846	2,024	355,910	110,823	141,305

DISCOUNTED ECONOMIC COSTS :	110,823
DISCOUNTED ECONOMIC BENEFITS :	141,305
AGRICULTURAL DEVELOPMENT BENEFIT	24,310
VOC SAVING	116,477
RMC SAVING	518
NET PRESENT VALUE :	30,482
BENEFIT COST RATIO :	1.28
INTERNAL RATE OF RETURN :	15.1 %

Table 31.7.1 SOCIAL INDICATORS

(Proposed Route IM-31)

Population (1,000)	
1982	: 51.5
1993	: 62.2
Average travelling speed, without (kph)	: 48
Isolation	
Access to Amphoe	
Average distance to Amphoe (km)1/	: 17.4
Per capita time savings (10^{-4})	: 0.019
Score	: 56
Access to Artery Highway	
Average distance to highway (km)1/	: 0
Per capita time savings (10^{-4})	: 0
Score	: 0
Impassability	
Impassable week a year	: 2
Impassability per year	: 0.038
Impassability per capita (10^{-4})	: 0.006
Score	: 50
Health	
Access to Hospital	
Average distance to Hospital (km)1/	: 15.0
Per capita time savings (10^{-4})	: 0.017
Score	: 40
Access to Medical Facilities	
Average distance to facilities (km)1/	: 7.3
Per capita time savings (10^{-4})	: 0.008
Score	: 32
Education	
Access to Secondary School	
Number of Student in 1993 (1,000)2/	: 15.6
Average distance to school (km)	: 15.0
Per capita time savings (10^{-4})	: 0.067
Score	: 36
Teacher Intensity	
Number of teachers3/	
University graduate	: -
Total	: 17
Number of Student	: 494
Indicators	
E1 4/	: -
E2 5/	: 34.4
E 6/	: 34.4
Degree of Improvement7/	: 1.99
Score	: 127
Disparity	
G.P.V. in 1993 (Mn B)8/	
With project	: 143.3
Without project	: 137.5
Per capita G.P.V. in 1993 (B)	
With project (W)	: 2,304
Without project (w)	: 2,211
Degree of Disparity	
(A/W) - (A/w)9/	: 0.05
Score	: 89
Total Score	: 430

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 - 32

Changwat · Nakhon Ratchasima / Buri Ram

B. Yok Kham (J.R.2309) - A. Soeng Sang (J.R.2119)

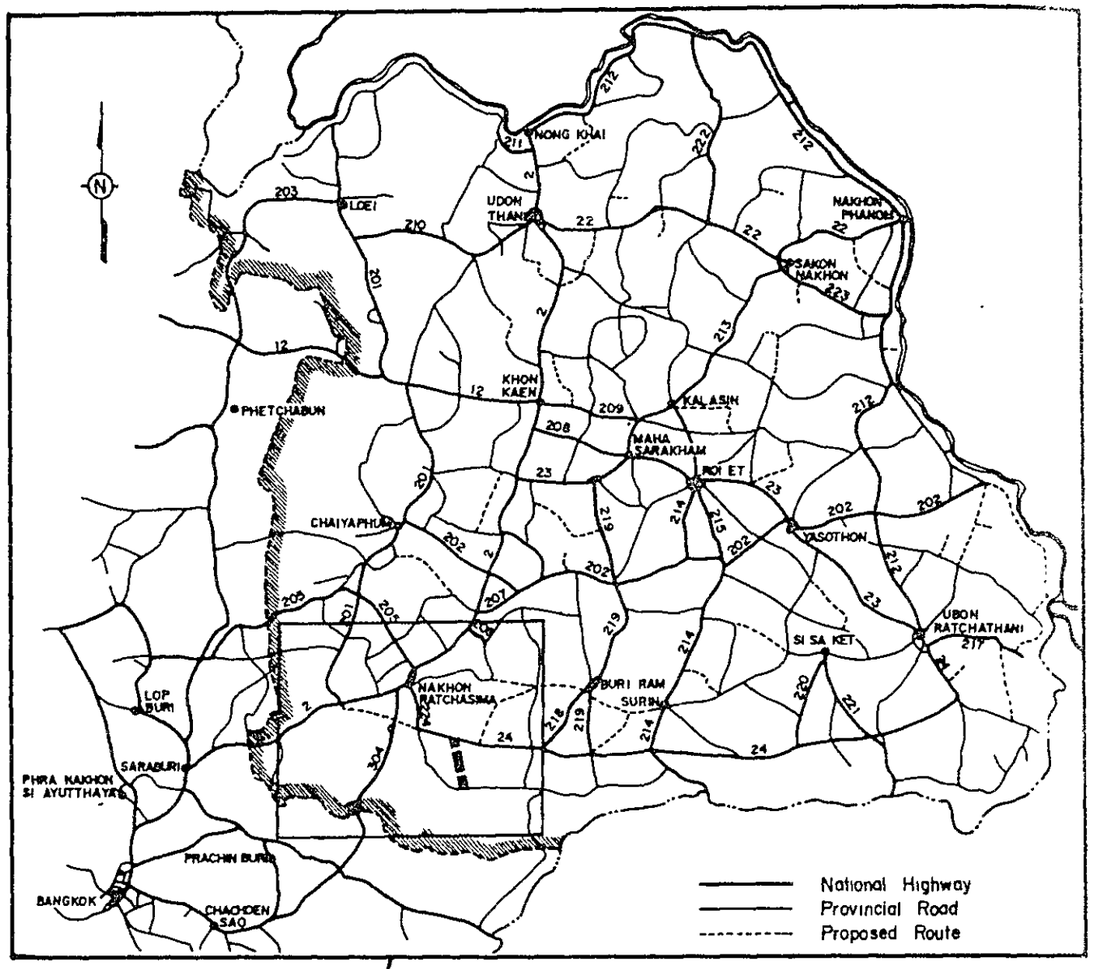
Length · 29.0 KM.

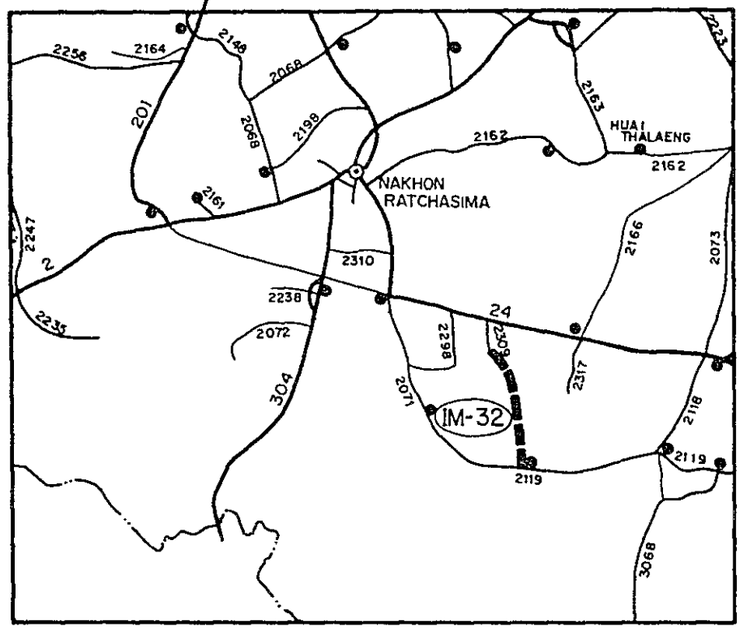
SUMMARY

PROPOSED ROUTE IM-32

Item	Description
Changwat	Nakhon Ratchasima/Buri Ram
Origin	B. Yok Kham (J.R. 2309)
Destination	A. Soeng Sang (J.R. 2119)
Length	
Total	29.0 km
Improvement Section	29.0 km
DOH Road	0 km
ARD Road	16.0 km
Others	13.0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate and Earth, Poor
Terrain	Flat and Rolling
Influence Area	
Area	175 km^2
Population (1982)	19,200
Principal Crops	Cassava
Traffic (ADT)	
Existing	67
1993	228
2001	319
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	49,461 . 10^3 ฿
Economic	44,938 . 10^3 ฿
IRR	4.5 %
B/C	0.51
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE





1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two Changwat of Nakhon Ratchasima and Buri Ram.

The route, starting at Ban Yok Kham, runs southward passing through Ban Nong Yai Thiam, Ban Don Kwaen and Ban Khok Na Keong and ends at the intersection with Route 2119 at Amphoe Soeng Sang. Its total length is 29.0 km. (Figure 32.5.2)

The terrain is flat and flat/rolling. In the influence area, there exists several villages with total population of 19,200.
There are one medical center, one hospital and one secondary school along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 24 and 2119 in the agriculturally developed area.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 32.1.1.
The details are shown at the results of inventory survey in Table 32.1.2.

2. TRAFFIC

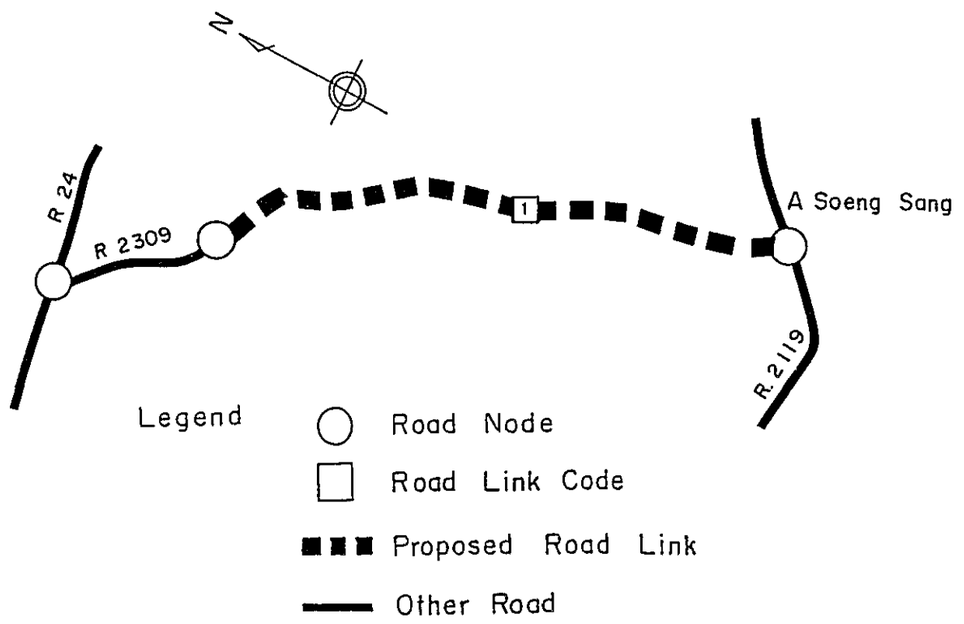
2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffice 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	2	20	-	1	2	2	36	2	2	67

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	180

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	1	48	49

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	2.3	1.9	1.6
PASSENGER MOVEMENT	6.3	6.3	6.3

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	8.2	8.1	8.1
AGRICULTURE	0.7	0.1	0.0
FREIGHT	0.9	0.3	0.3

2.5 Induced and Developed Traffice

The following ratios are used for the estimation of induced and developed traffic described in 7.3.3-3) of 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	8.0	80.0	0.0	4.0	8.0	4.8	85.7	4.8	4.8
	1987	11.7	76.3	1.1	4.4	6.5	8.0	67.4	12.7	11.9
	1993	16.1	71.9	2.5	4.8	4.7	11.8	45.4	22.3	20.5
	2001	22.0	66.0	4.3	5.3	2.3	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 traffice type are shown Table 32.2.1.

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	0	2	3	34	22	4	4	73	126	199
1993	10	2	3	3	48	10	5	5	86	142	228
2001	25	5	6	3	78	3	6	5	130	188	319

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all cultivated land in the influence area is covered by upland fields, mainly of cassava, maize, kenaf and ground nut. Beans and cotton are also planted in the area. Cassava root shipped to the cassava pellet or flour factories near by Nakhon Ratchasima via Route 24.

Unused cultivable land for only upland field remains in southern part of the area.

Land use and capability conditions in the area of influence are shown in Table 32.3.1 and Figure 32.3.1.

Typical cropping calendars in the Nakhon Ratchasima areas are shown in Figure 32.3.2.

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 32.3.2.

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 32.3.3.

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 32.3.4. 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)	Road Class [1]	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	With Project: Length (Km)	Road Class [1] Class 1	Class 2	Nos. of Wooden Narrow Bridge
1	Flat	9.0	4	0	0	9.0	1(F4)	2A(F5)	0
1	Flat & Rolling	20.0	3	0	0	20.0	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)	2,210	2,672	3,185
2A (F5)	1,658	2,071	2,400

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 32.5.1

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 32.5.2

Alignment of the route is shown in Figure 32.5.2.

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 32.5.1.

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

Totaled financial and economic construction cost derived from Table 32.5.1 are shown below by the applied road class.

Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10^3₱)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	29.0	49,461	44,938	
F5 (Soil Aggregate)	29.0	29,097	26,415	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 32.6.1 and 32.6.2.

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 32.7.1.

Table 32.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	B. Yok Kham (J.R. 2309)		
Destination	A. Soeng Sang (J.R. 2119)		
Length			
Total			29.0 km
Improvement Section			29.0 km
DOH Road			0 km
ARD Road			16.0 km
Others			13.0 km
New Alignment Section			0 km
Terrain	Flat and Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	5.5 m - 7.0 m, 6.3 m (Weighted average)		
Embankment Section			
Length			29.0 km
Height	0.2 m - 0.8 m		
Cut Section			
Length			0 km
Depth	m - m		
Surface Type and Condition			
SBST or DBST	Poor		1.0 km
Soil Aggregate	Poor		19.0 km
Earth	Poor		9.0 km
Pipe Culvert	7 each		
Box Culvert	0 each		0 m
Bridge			
Permanent Bridge	2 each		60.0 m
Narrow Concrete Bridge	0 each		0 m (4m)
Wooden Bridge	0 each		0 m
Overflow Section	0 place		0 km

Table 32.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-32 ROUTE NO. Rural ARD 2309 B. YOK KHAM (JR 2309) ~ A. SOENG SANG (J.R. 2119) NAKHON RATCHASIMA L = 29.0 Km.

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. YOK KHAM H = 128 P = 762			B. NONG YAI THIAM H = 220 P = 1100		B. HAUTHA UNOP H = 370 P = 1650		B. DON KWAEN H = 200 P = 1000			B. KHOK NA KLONG H = 50 P = 250				B. PHAI NOI H = 150 P = 900	
TERRAIN		Flat							Flat/Rolling								
CROSS SECTION	Formation Width (m)	6.00			6.50		5.50		6.50	6.00	7.00	6.50	7.00		6.50		
	Embankment Height (m)	0.20			0.40		0.30		0.50	0.80	0.40	0.50	0.30	0.50	0.30	0.50	
	Cutting Depth (m)																
PAVEMENT	Type/Length	Laterite			Earth				Laterite							DT	
	Condition	Fair			Poor												
FLOODING	Overflow Length(Km)/Height(m)																
LAND USE	Left	Cassava			Paddy		Cassava									Cane	
	Right	Cassava			Marsh		Cassava										
PIPE CULVERT	Total Number	7 Pipes															
BOX CULVERT & BRIDGE	Station (Km)	3.2			5.6												
	Dimension	C-Br. 10.00 x 20.00			C-Br. 10.00 x 40.00												
RIGHT OF WAY (m)		14.0							20.0								
ALIGNMENT	Horizontal	Fair															
	Vertical	Fair															
ROUTE NO., AGENCIES		Rural Road							ARD								

Table 32.2.1 TRAFFIC VOLUME ON ROUTE IM - 32

YEAR		1987		1993		2001	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	4	4	9	9	22	22
	I	1	1	1	1	3	3
	DV	0	0	0	0	0	0
	TOTAL	5	5	10	10	25	25
L/B	N+D	0	0	1	1	4	4
	I	0	0	0	0	1	1
	DV	0	0	0	0	0	0
	TOTAL	0	0	2	2	5	5
M/B	N+D	2	2	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
H/B	N+D	2	2	3	3	2	2
	I	0	0	0	0	0	0
	DV	0	0	0	0	0	0
	TOTAL	3	3	3	3	3	3
P/P&T	N+D	30	30	42	42	68	68
	I	4	4	6	6	10	10
	DV	0	0	0	0	0	0
	TOTAL	34	34	48	48	78	78
4/T	N+D	19	19	9	9	2	2
	I	3	3	1	1	0	0
	DV	0	0	0	0	0	0
	TOTAL	22	22	10	10	3	3
6/T	N+D	4	4	4	4	5	5
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	4	4	5	5	6	6
10/T	N+D	3	3	4	4	5	5
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	4	4	5	5	5	5
ADT	N+D	64	64	75	75	113	113
	I	10	10	11	11	17	17
	DV	0	0	0	0	0	0
	TOTAL	73	73	86	86	130	130
M/C	N+D	114	114	128	128	172	172
	I	12	12	13	13	17	17
	DV	0	0	0	0	0	0
	TOTAL	126	126	142	142	188	188
TOTAL	N+D	178	178	204	204	285	285
	I	22	22	25	25	34	34
	DV	0	0	0	0	0	0
	TOTAL	199	199	228	228	319	319

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

Figure 32.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – 32

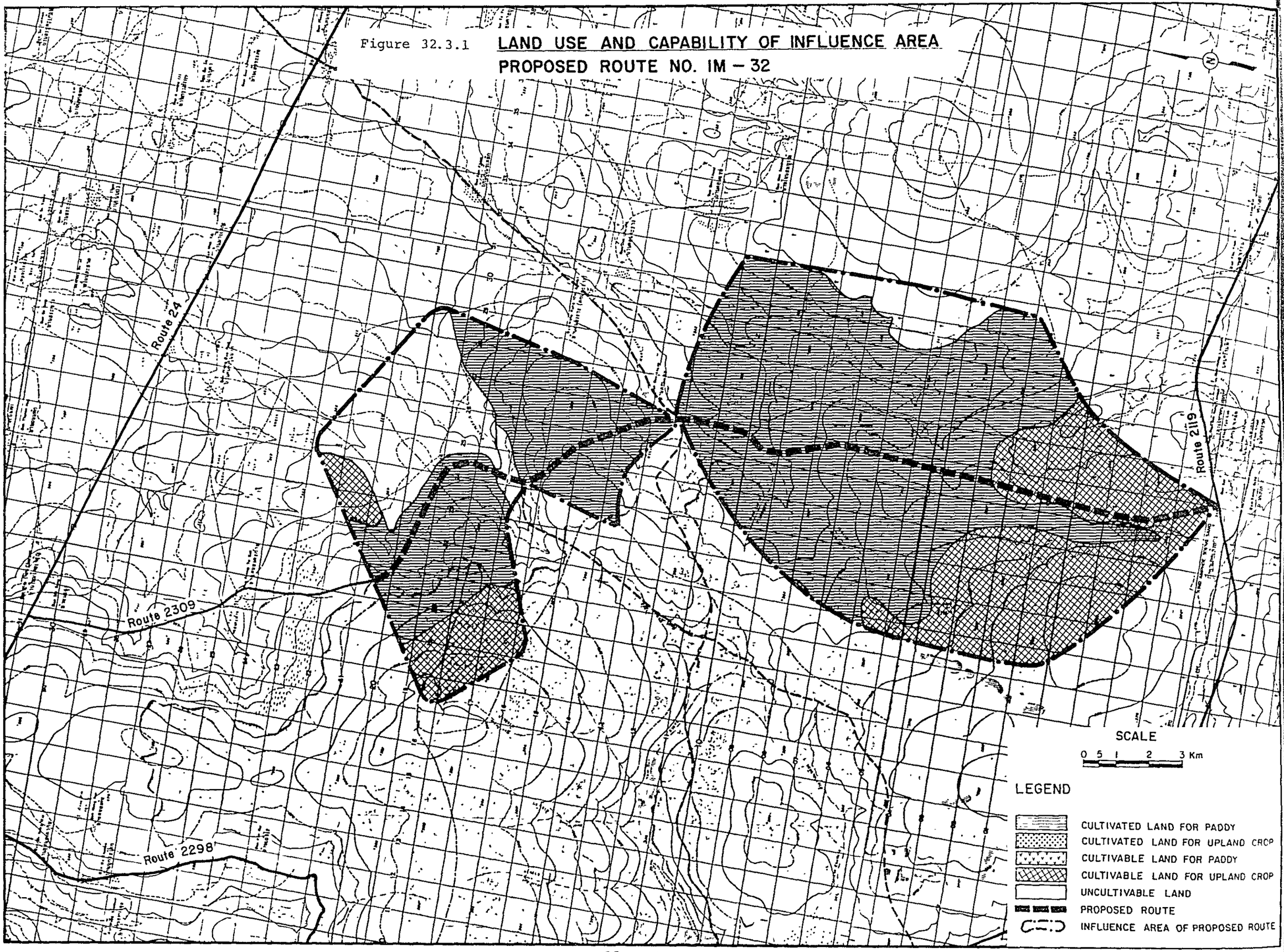
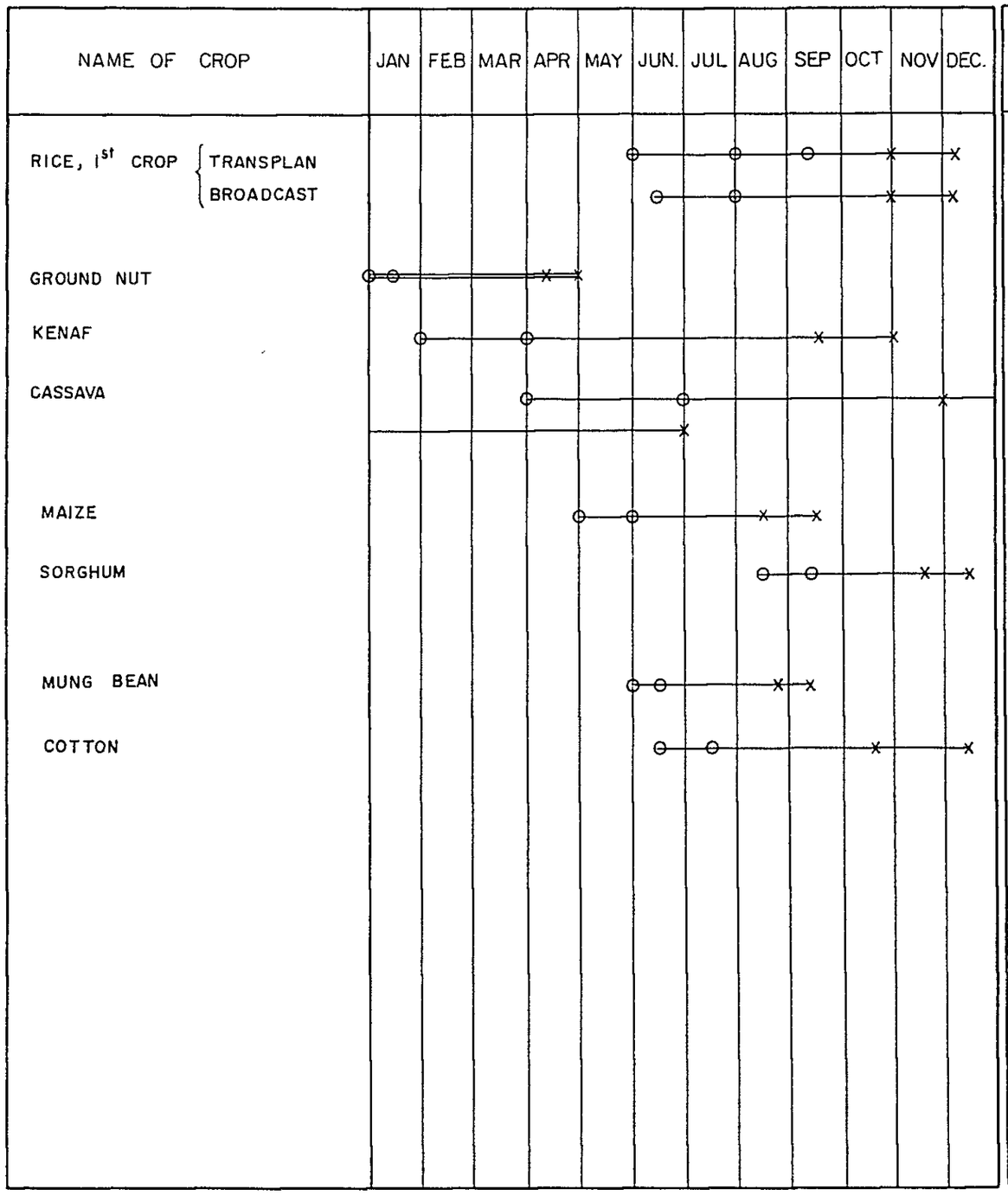


Figure 32.3.2

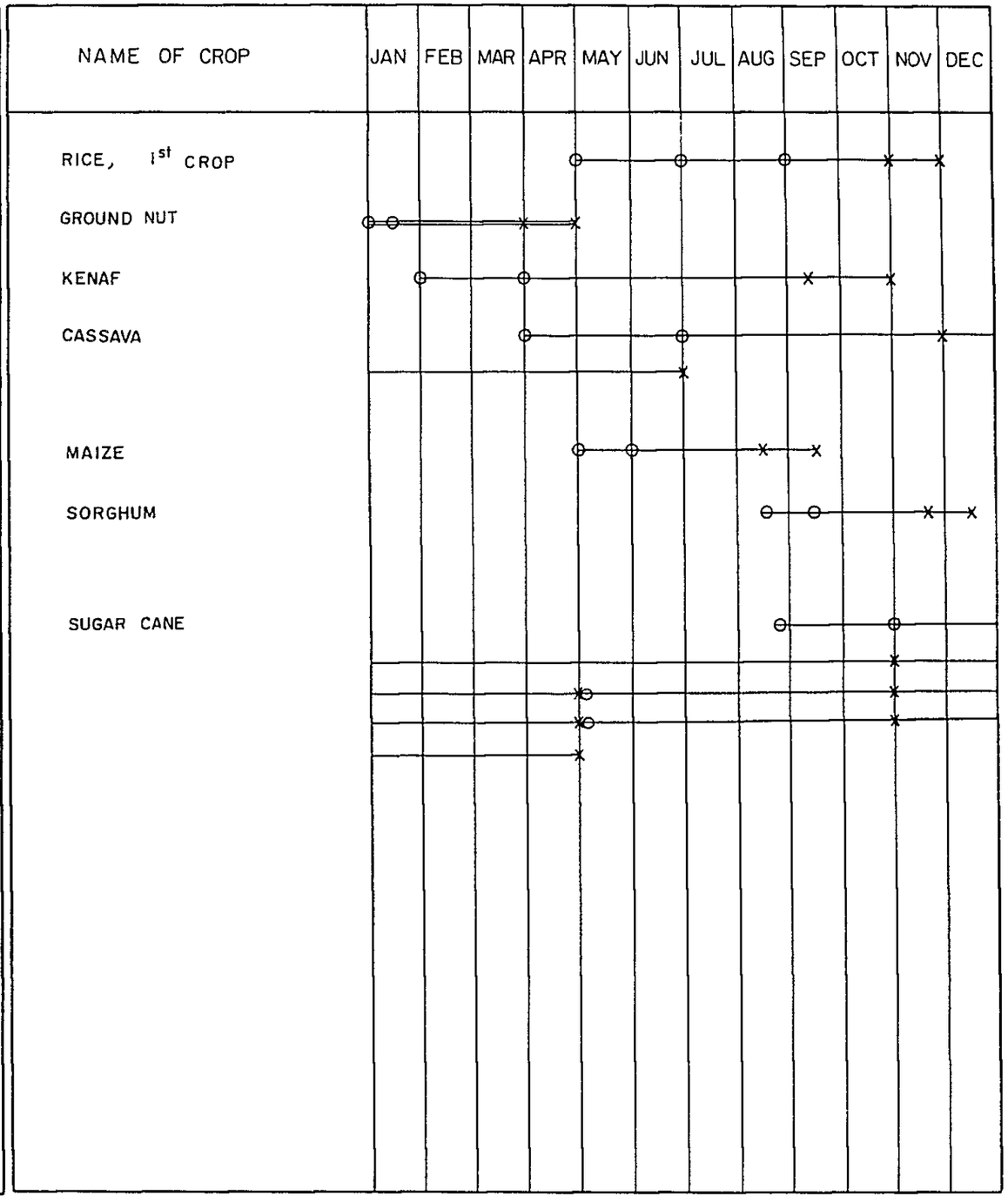
CROPPING CALENDAR (1)

1300 CHANGWAT NAKHON RATCHASIMA



CROPPING CALENDAR (2)

1400 CHANGWAT BURI RAM



Note

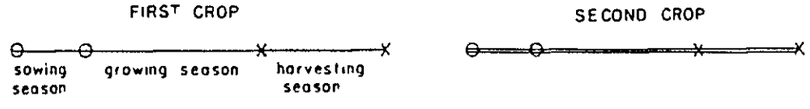


TABLE 32.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		0.938 (1.5)	64.375 (103.0)	65.313 (104.5)	-	33.750 (54.0)	33.750 (54.0)
1319	CHOK CHAI	-	6.250 (10.0)	6.250 (10.0)	-	1.875 (3.0)	1.875 (3.0)
1320	KHON BURI	-	33.125 (53.0)	33.125 (53.0)	-	15.000 (24.0)	15.000 (24.0)
1407	NONG KI	0.938 (1.5)	25.000 (40.0)	25.938 (41.5)	-	16.875 (27.0)	16.875 (27.0)

TABLE 32.3.2 CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)											
1981		0.74	18.87	0.19	0.97	41.76	-	3.39	0.09	65.27	66.01
1987		0.74	20.03	0.19	0.98	43.29	-	3.39	0.10	67.98	68.72
1993	WITHOUT PROJECT	0.74	20.47	0.19	0.95	43.20	-	3.26	0.11	68.19	68.93
	WITH PROJECT	0.74	20.74	0.17	0.88	43.28	-	3.01	0.10	68.19	68.93
2001	WITHOUT PROJECT	0.74	20.98	0.18	0.92	42.89	-	3.09	0.13	68.19	68.93
	WITH PROJECT	0.74	21.25	0.16	0.85	42.96	-	2.84	0.12	68.19	68.93
CROP YIELD (KG/RAI)											
1981		227.0	321.3	120.0	208.1	2522.7	-	169.9	250.0		
1987		228.4	321.3	120.7	208.1	2537.9	-	169.9	250.0		
1993	WITHOUT PROJECT	229.7	321.3	121.4	208.1	2553.1	-	169.9	250.0		
	WITH PROJECT	232.5	323.2	122.9	209.3	2568.5	-	169.9	250.0		
2001	WITHOUT PROJECT	231.6	321.3	122.4	208.1	2573.6	-	169.9	250.0		
	WITH PROJECT	238.1	325.8	125.9	211.0	2609.9	-	169.9	250.0		
CROP PRODUCTION (TON)											
1981		169	6,063	23	201	105,356	-	575	22	112,243	112,412
1987		170	6,436	23	204	109,863	-	575	25	117,129	117,299
1993	WITHOUT PROJECT	171	6,577	23	199	110,295	-	554	28	117,679	117,849
	WITH PROJECT	173	6,705	21	184	111,162	-	511	26	118,612	118,784
2001	WITHOUT PROJECT	172	6,741	22	191	110,392	-	524	32	117,905	118,077
	WITH PROJECT	177	6,925	21	179	112,115	-	483	30	119,755	119,932

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 32.3.3 FARMGATE PRICE AND PRODUCTION COST

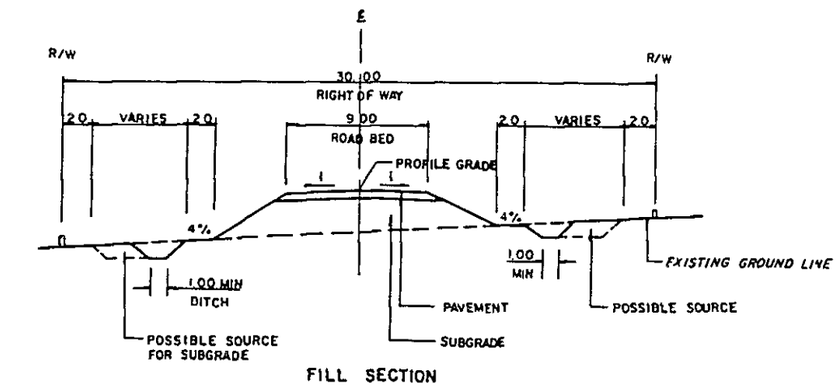
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,144	2,567	6,906	7,118	675	-	4,356	11,995
WITH PROJECT (1987 - 2001)	4,248	2,631	6,906	7,118	692	-	4,465	11,995
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	573	481	402	1,051	768	-	632	2,116
WITH PROJECT (1987 - 2001)	583	485	422	1,071	793	-	632	2,116

TABLE 32.3.4 NET PRODUCTION VALUE

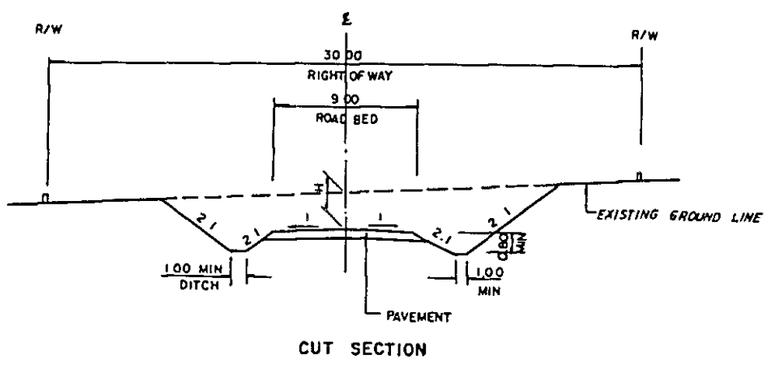
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	278	48,758	49,036	287	49,902	50,189
1993	282	49,254	49,536	300	51,088	51,388
2001	287	49,707	49,994	318	52,323	52,641

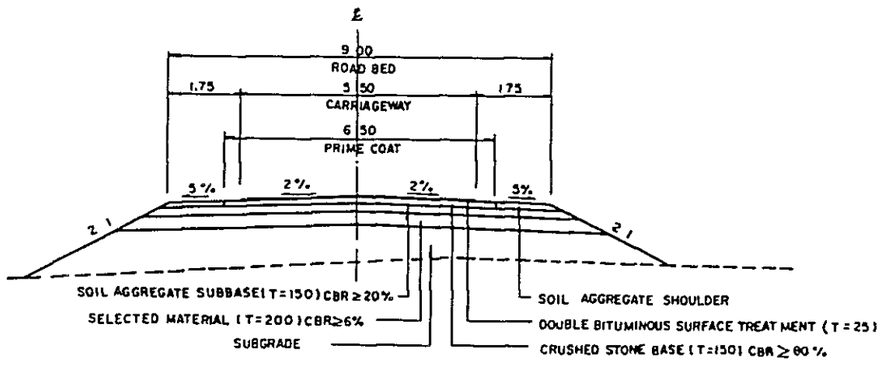
Figure 32.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



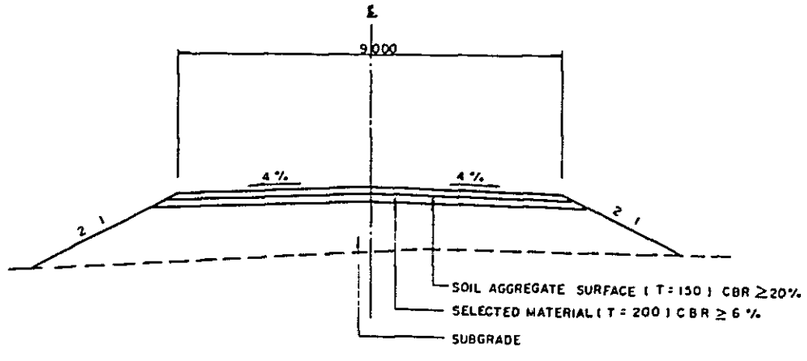
FILL SECTION



CUT SECTION



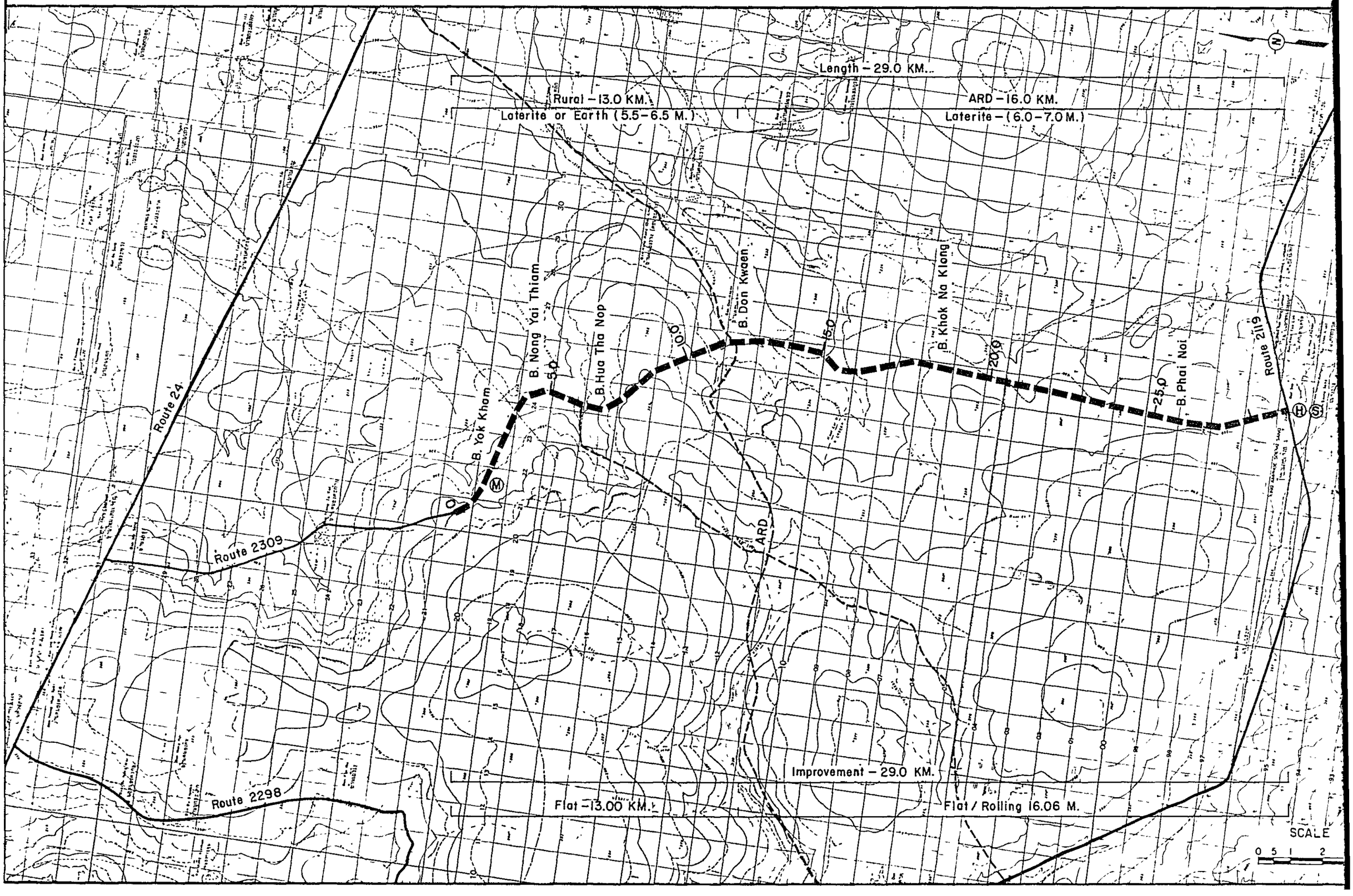
DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)



SOIL AGGREGATE SURFACED ROAD (Class F5)

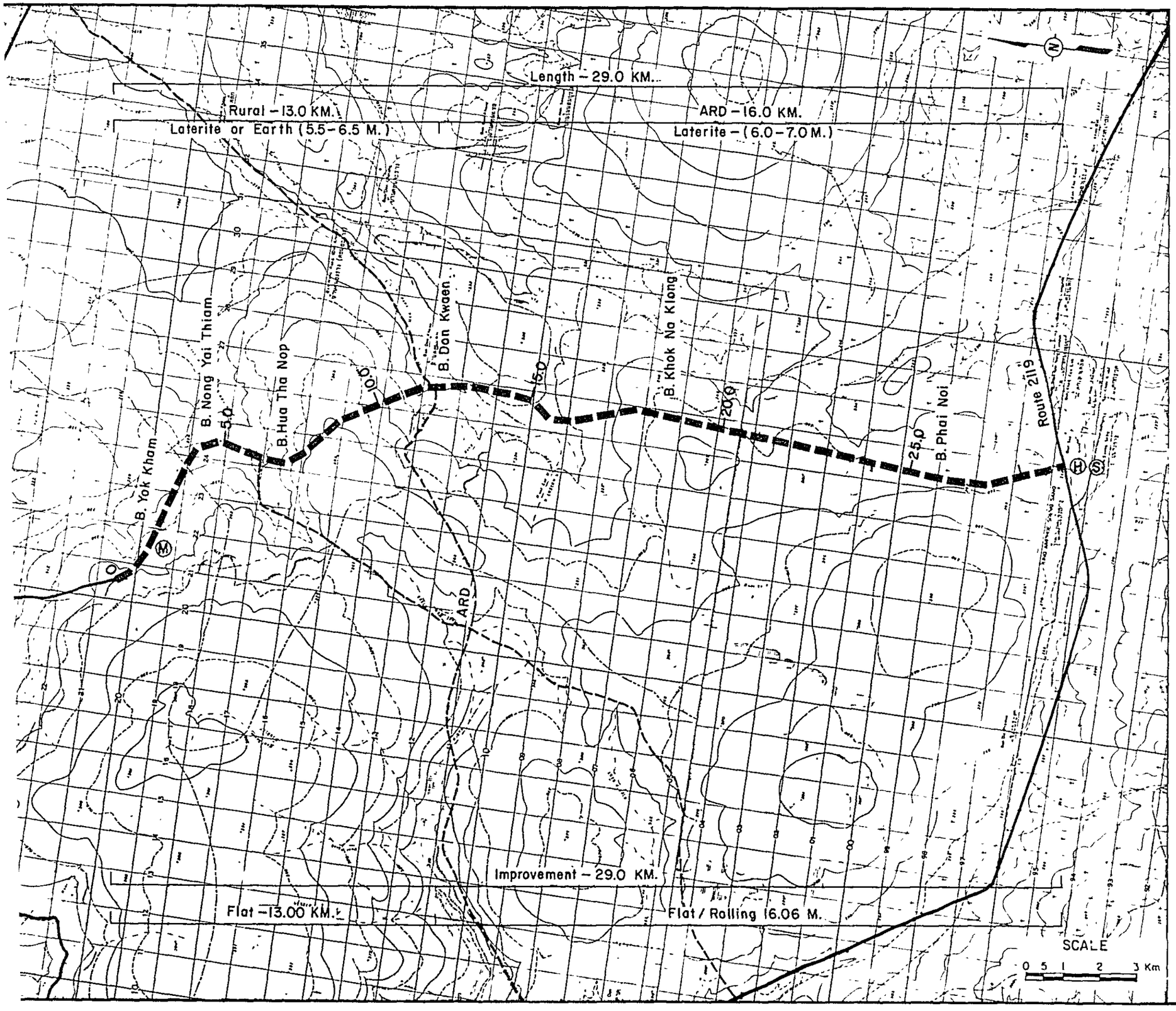
Figure 32.5.2 PROPOSED ROUTE NO. IM-32 C. NAKHON RATCHASIMA / C. BURI RAM — B. YOK KHAM (J.R. 2309) — A. SOENG SANG (J.R. 2119)

ROUTE NO. RURAL + ARD — L = 29.0 Km.

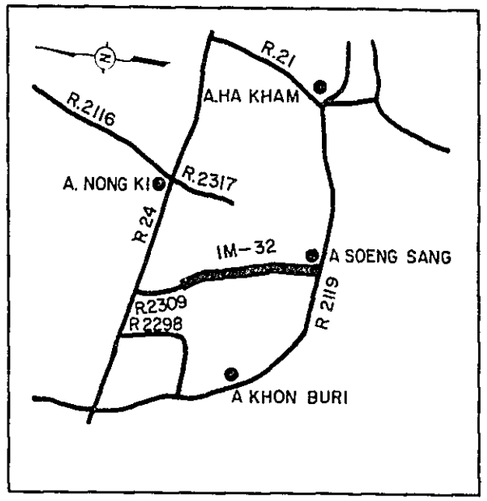


TE NO. IM-32 C. NAKHON RATCHASIMA
C. BURI RAM

B. YOK KHAM (J.R. 2309) — A. SOENG SANG (J.R. 2119)
ROUTE NO. RURAL + ARD L = 29.0 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	3.2	–	C-1000 x 2000
2	5.6	–	C-7000 x 4000

LEGEND

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

Table 32.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-32 (29.0 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	69	1,035	941	69	1,035	941
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	96,700	4,351	3,959	96,700	4,351	3,959
Selected Material	m^3	80	59,400	4,752	4,229	59,400	4,752	4,229
Soil Aggregate Surface or Subbase	m^3	105	41,600	4,368	3,887	41,600	4,368	3,887
Crushed Stone Base	m^3	370	27,300	10,101	9,292	6,300	2,331	2,144
Soil Aggregate Shoulder	m^3	105	11,800	1,239	1,102	2,700	283	252
Prime Coat and DBST	m^2	55	154,000	8,470	7,623	35,800	1,969	1,772
Pipe Culvert	m	2,100	610	1,281	1,178	610	1,281	1,178
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	0	0	0	0	0	0
Sub Total (a)				35,597	32,215		20,371	18,366
Miscellaneous Works (a) x 7%				2,492	2,255		1,426	1,286
Total (b)				38,089	34,470		21,797	19,652
PHYSICAL CONTENGENCY (b) x 15%				5,713	5,171		3,270	2,948
ENGINEERING AND ADMINISTRATION (b) x 10%				3,809	3,447		2,180	1,965
Sub Total				9,522	8,618		5,450	4,913
LAND ACQUISITION								
Highly Developed Land	ha	50,000	37	1,850	1,850	37	1,850	1,850
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				1,850	1,850		1,850	1,850
GRAND TOTAL				49,461	44,938		29,097	26,415

Table 32.6.1 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	17,975	0	0	0	0	22,548	0
1986	26,963	0	0	0	0	30,199	0
1987	0	1,153	2,210	-170	3,193	0	2,851
1988	0	1,270	2,287	-167	3,390	0	2,702
1989	0	1,386	2,364	-164	3,586	0	2,552
1990	0	1,503	2,441	-161	3,782	0	2,404
1991	0	1,619	2,518	-158	3,979	0	2,258
1992	0	1,736	2,595	-155	4,175	0	2,115
1993	0	1,852	2,672	-152	4,371	0	1,977
1994	14,036	1,951	2,736	-148	4,539	6,349	1,833
1995	0	2,051	2,800	-145	4,706	0	1,697
1996	0	2,150	2,864	-141	4,873	0	1,569
1997	0	2,250	2,928	-137	5,041	0	1,449
1998	0	2,349	2,992	-133	5,208	0	1,337
1999	0	2,448	3,057	-129	5,375	0	1,232
2000	0	2,548	3,121	-126	5,543	0	1,134
2001	-21,670	2,647	3,185	-122	5,710	-3,959	1,043
TOTAL	37,304	28,911	40,769	-2,208	67,472	55,137	28,154

DISCOUNTED ECONOMIC COSTS :	55,137
DISCOUNTED ECONOMIC BENEFITS :	28,154
AGRICULTURAL DEVELOPMENT BENEFIT	11,654
VOC SAVING	17,550
RMC SAVING	-1,050
NET PRESENT VALUE :	-26,982
BENEFIT COST RATIO :	0.51
INTERNAL RATE OF RETURN :	4.5 %

Table 32.6.2 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	10,566	0	0	0	0	13,254	0
1986	15,849	0	0	0	0	17,751	0
1987	0	1,153	1,658	-34	2,777	0	2,480
1988	0	1,270	1,727	-32	2,964	0	2,363
1989	0	1,386	1,796	-30	3,152	0	2,243
1990	0	1,503	1,864	-28	3,339	0	2,122
1991	0	1,619	1,933	-26	3,526	0	2,001
1992	0	1,736	2,002	-24	3,713	0	1,881
1993	0	1,852	2,071	-23	3,900	0	1,764
1994	3,146	1,951	2,112	-22	4,041	1,423	1,632
1995	0	2,051	2,153	-21	4,183	0	1,508
1996	0	2,150	2,194	-20	4,324	0	1,392
1997	0	2,250	2,235	-19	4,466	0	1,284
1998	0	2,349	2,276	-18	4,607	0	1,183
1999	0	2,448	2,318	-17	4,749	0	1,088
2000	0	2,548	2,359	-16	4,890	0	1,001
2001	-13,150	2,647	2,400	-15	5,032	-2,402	919
TOTAL	16,411	28,911	31,097	-344	59,664	30,025	24,862

DISCOUNTED ECONOMIC COSTS :	30,025
DISCOUNTED ECONOMIC BENEFITS :	24,862
AGRICULTURAL DEVELOPMENT BENEFIT	11,654
VOC SAVING	13,383
RMC SAVING	-175
NET PRESENT VALUE :	-5,164
BENEFIT COST RATIO :	0.83
INTERNAL RATE OF RETURN :	9.8 %

Table 32.7.1 SOCIAL INDICATORS

(Proposed Route IM-32)

Population (1,000)	
1982	: 19.2
1993	: 24.1
Average travelling speed, without (kph)	: 43
Isolation	
Access to Amphoe	
Average distance to Amphoe (km) 1/	: 7.2
Per capita time savings (10^{-4})	: 0.028
Score	: 82
Access to Artery Highway	
Average distance to highway (km) 1/	: -
Per capita time savings (10^{-4})	: -
Score	: 100
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/	: 14.5
Per capita time savings (10^{-4})	: 0.056
Score	: 130
Access to Medical Facilities	
Average distance to facilities (km) 1/	: 8.4
Per capita time savings (10^{-4})	: 0.033
Score	: 132
Education	
Access to Secondary School	
Number of Student in 1993 (1,000) 2/	: 3.9
Average distance to school (km)	: 14.5
Per capita time savings (10^{-4})	: 0.348
Score	: 188
Teacher Intensity	
Number of teachers 3/	
University graduate	: -
Total	: 7
Number of Student	: 179
Indicators	
E1 4/	: -
E2 5/	: 39.1
E 6/	: 39.1
Degree of Improvement 7/	: 1.75
Score	: 111
Disparity	
G.P.V. in 1993 (Mn B) 8/	
With project	: 99.3
Without project	: 96.4
Per capita G.P.V. in 1993 (B)	
With project (W)	: 4,120
Without project (w)	: 4,000
Degree of Disparity	
(A/W) - (A/w) 9/	: 0
Score	: 0
Total Score	: 743

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 - 33

Changwat · Nakhon Ratchasima

J R. 2 – A. Chok Chai (J.R. 24)

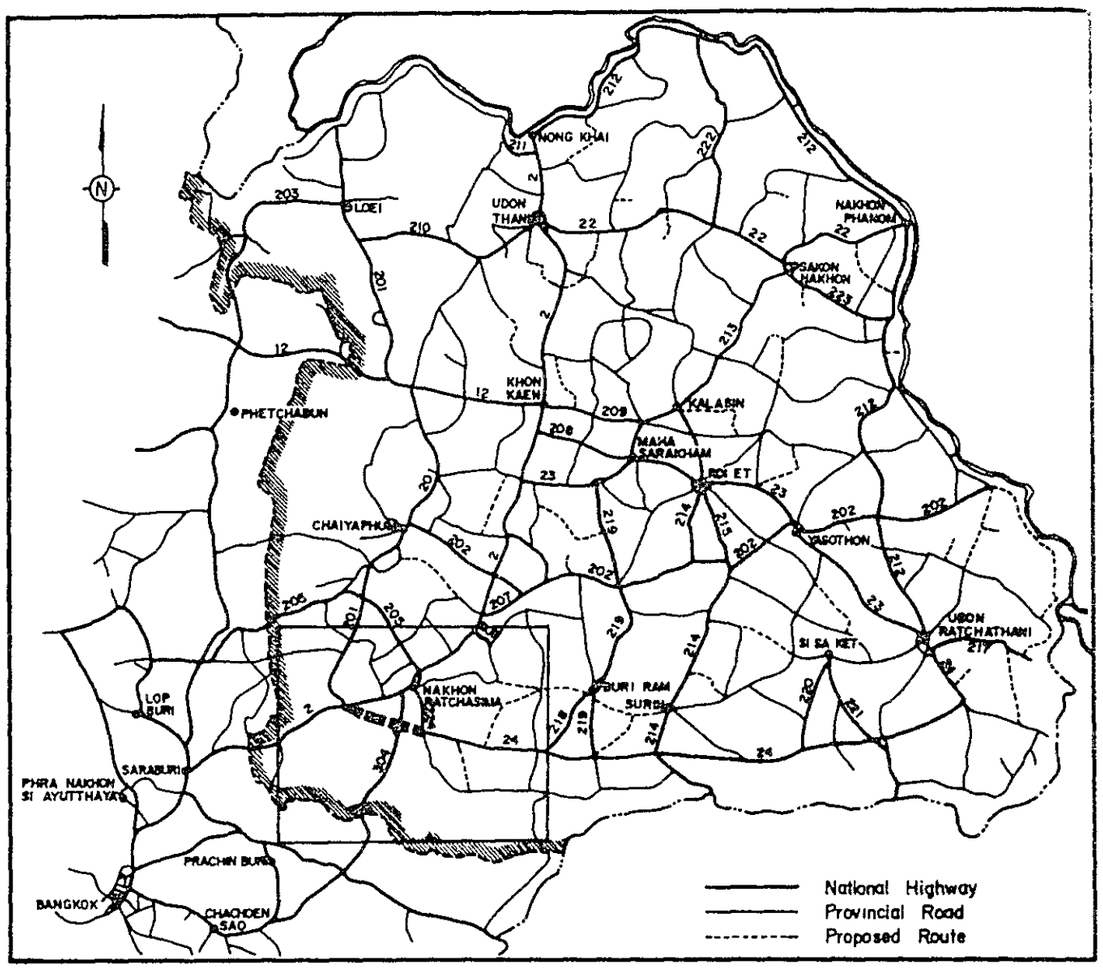
Length · 51.5 KM.

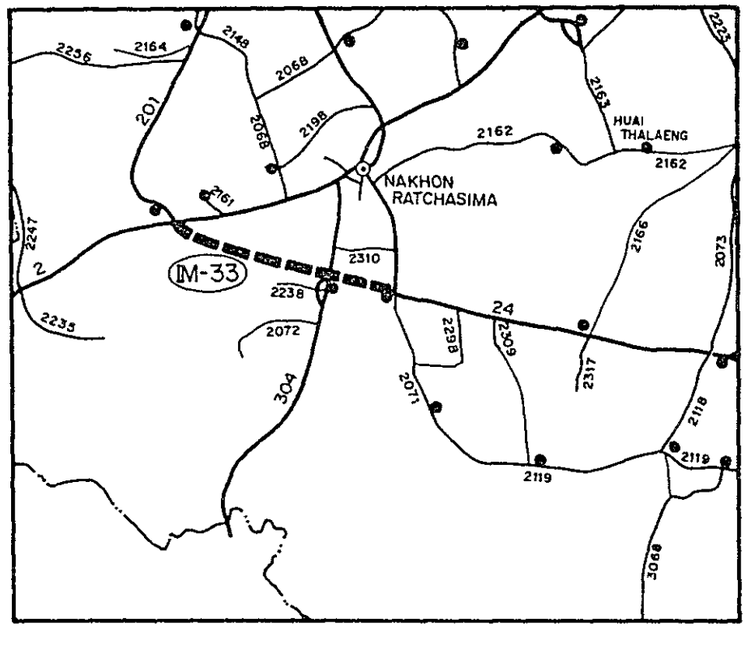
SUMMARY

PROPOSED ROUTE IM-33

Item	Description
Changwat	Nakhon Ratchasima
Origin	J.R. 2
Destination	A. Chok Chai (J.R.24)
Length	
Total	51.5 km
Improvement Section	0 km
DOH Road	0 km
ARD Road	0 km
Others	0 km
New Alignment Section	51.5 km
Surface Type and Condition	
Terrain	
Influence Area	
Area	372 km^2
Population (1982)	18,900
Principal Crops	Paddy
Traffic (ADT)	66
Existing	1,652
1993	2,150
2001	F4 (DBST)
Proposed Standard	
Construction Cost	
Financial	108,627 . 10^3 ฿
Economic	99,100 . 10^3 ฿
IRR	21.6 %
B/C	1.99
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 south of Changwat Nakhon Ratchasima . The route, starting at the intersection of Route 24 with 224 at Amphoe Chok Chai, runs westward passing through Amphoe Pak Thong Chai and ends at the intersection with Route 21 at Amphoe Si Khiu. Its total length is 51.5 km. (Figure 33.5.2)

The terrain is almost flat and rolling. In the influence area, there exists several villages with total population of 18,900. There are one medical center, one hospital and two secondary schools along the proposed route.

The proposed route is the extension of Route 24 which is presently connected with Route 2 passing Changwat Nakhon Ratchacima.

Therefore, it will provided, upon the completion, the short cut to connect Route 24 to 2.

1.2 Condition of Existing Road

There is no existing road which can be utilizes for the proposed route. The fields reconaisance was made instead of the invontory survey.

2. TRAFFIC

2.1 Method

Assigment Method was employed for traffic forecasting as considerable diverted and induced traffic are expected after improvement of the proposed road due to time savings of transportation.

In this particular case, much diverted traffic from R.2 and R.224 to Proposed Route is expected. Therefore diverted traffic was estimated based on the result of O/D survey on R.224, additionaly.

2.2 Zoning and Road Links

The related area of proposed route was divided into four traffic zones and four Amphoe of Si Khuen, Sing Noen, Pak Thong Chai and Chok Chai were chosen as the major destinations of transport demand originated in the area. The proposed route together with surrounding roads concerned were divided into six road links, three links in the proposed roads and three links in the surrounding roads.

Zoning map and characteristics of zone and links are shown in Figure 33.2.1, Table 33.2.1 and 33.2.2.

2.3 Transport Movement

1) Passenger

The transport demand in terms of trips per day by origin/destination pair in base year was estimated basing on the formula described in 7.3.3-1) of the Main Report, as shown below:

Zone	1	2	3	4
1	0	360	1142	631
2	0	0	518	288
3	0	0	0	1441
4	0	0	0	0

Grand Total = 4379

The transport demand which can be obtained by assigning demand mentioned above to road links, are estimated as shown in the following table:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	0
2	372
3	1023

2) Freight

The freight movement in terms of tonnage per day on proposed route was estimated in accordance with the procedure described in 7.3.3-1) of the Main Report. The basis and results of the estimation of freight movement are shown in the following tables:

Ratios of Total/Non-Agricultural Freight Movement

Year	1987	1993	2001
Ratio	2.64	2.32	1.79

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	0	0	0
2	12	23	35
3	43	86	129

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 below 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	1.9	1.6	1.4
PASSENGER MOVEMENT	5.9	6.0	6.0

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.6	7.7	7.8
AGRICULTURE	0.9	0.9	0.9
FREIGHT	2.8	3.2	4.3

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	79.8	85.2	93.0
DEVELOPED	0.0	10.9	10.9

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
1-3	1982	3.6	44.0	23.1	28.4	0.9	19.5	57.6	14.9	8.0
	1987	5.8	41.8	22.0	27.1	3.3	18.8	46.7	20.2	14.3
	1993	8.4	39.2	20.7	25.4	6.3	18.1	33.5	26.5	21.9
	2001	11.9	35.7	18.9	23.3	10.2	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 33.2.3.

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	73	59	115	58	310	86	120	108	928	375	1304
1993	106	83	156	87	402	79	159	148	1221	431	1652
2001	168	114	213	143	539	62	226	213	1677	473	2150

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Paddy and upland fields are mixed in the area of influence. Around 75% of the cultivated land is covered by paddy. As many cassava plants stand near by the area, cassava ranks first in the upland field followed by maize, ground nut, beans and cotton.

Large ares of unused cultivable land for upland field still remains in the area.

Land use and capability conditions in the area of influence are shown in Table 33.3.1 and Figure 33.3.1.

A typical cropping calendar in the Nakhon Ratchasima area is shown in Figure 33.3.2.

3.2 Develpment 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 as shown in Table 33.3.2.

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 Tabl3 33.3.3.

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 33.3.4. 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 converned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calcualtion 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	31.0	4	0	0	22.0	1 (F4)	0	
2	Flat & Rolling	5.0	1	0	0	4.0		0	
2	Flat & Rolling	4.0	2B	0	0	3.0		0	
2	Flat	10.0	4	0	0	8.0		0	
3	Flat	21.0	1	0	0	14.5		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)	25,839	35,627	55,556

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 33.5.1

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 33.5.2

Alignment of the route is shown in Figure 33.5.2.

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 33.5.1.

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

F4 Standard (DBST) L = 51.5 km

Financial Cost $108,627 \cdot 10^3$ ¥

Economic Cost $99,100 \cdot 10^3$ ¥

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 33.6.1.

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

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 33.7.1. Social impacts of the proposed route are considerably high.

Figure 33.2.1 ZONING AND ROAD NETWORK

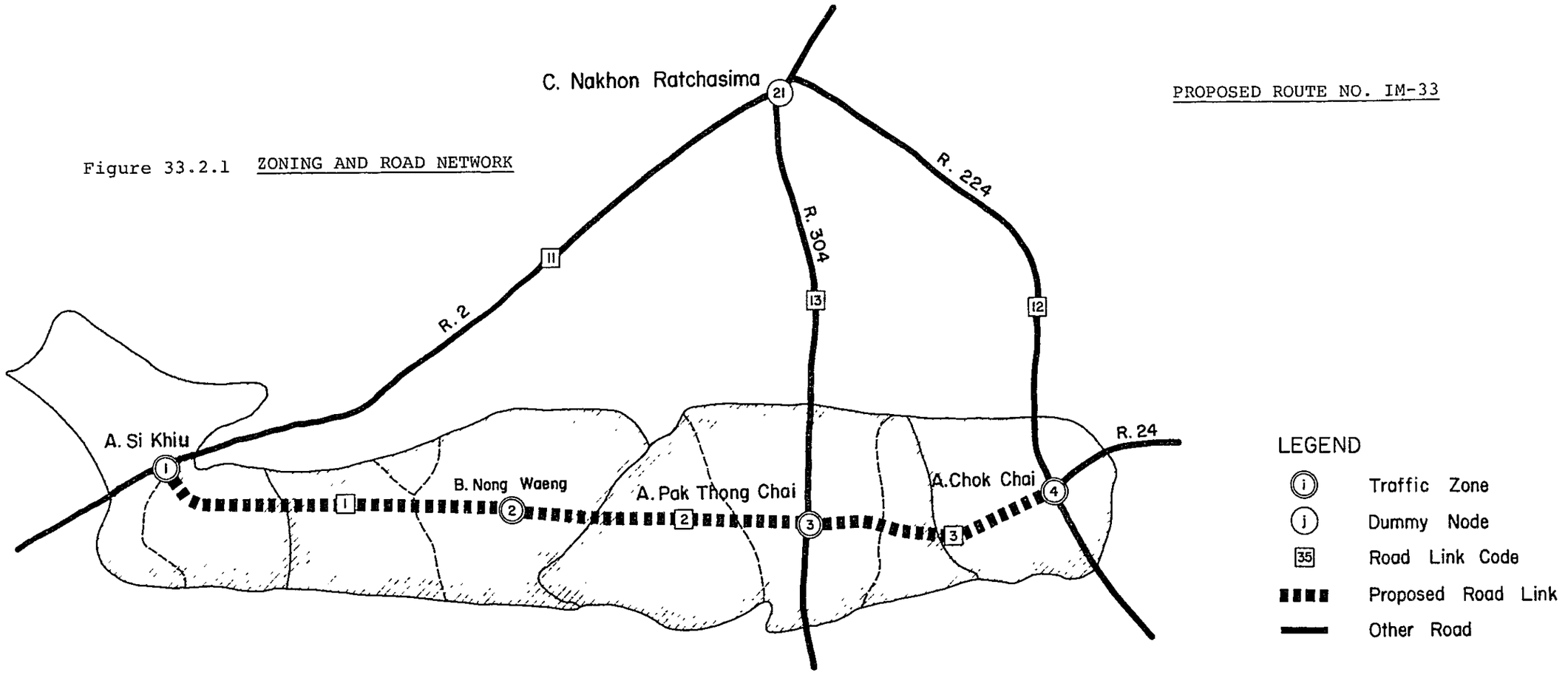


Table 33.2.1 ZONE CHARACTERISTICS

Zone	Administrative Division: Changwat	Amphoe	Tambon Code	Population: Tambon	%	Zone	Attraction
1	Nakhon Ratchasima	Sikhiiu	1	23,090	100	23.1	
			7	4,220	50	2.1	
			Total			25.2	70.0
2	Nakhon Ratchasima	Sing Noen	1	4,707	5	0.2	
			8	6,919	40	2.8	
			10	4,120	70	2.9	
			Total			5.9	53.7
3	Nakhon Ratchasima	Pak Thong Chai	1	20,081	80	16.1	
			2	9,608	80	7.7	
			3	3,641	100	3.6	
			Total			27.4	139.6
4	Nakhon Ratchasima	Chok Chai	1	22,407	50	11.2	
			2	6,463	80	5.2	
			Total			16.4	91.7

Table 33.2.2 LINK CHARACTERISTICS

Link No	Node Pair: Start Node	End Node	Length: $\bar{W}$	W	Grade: $\bar{W}$	W	Remark
1	1. A. Sikhuieu	2. B. Nong Waeng	31.0	22.0	10	1	Rural
2	2. B. Nong Waeng	3. A. Pak Thong Chai	19.0	15.0	9	1	Rural
3	3. A. Pak Thong Chai	4. A. Chok Chai	21.0	14.5	6	1	ARD
11	1. A. Sikhieu	21. C. Nakhon Ratchasima	38.0	38.0	2	2	R.2
12	4. A. Chok Chai	21. C. Nakhon Ratchasima	35.0	35.0	2	2	R.224
13	3. A. Pak Thong Chai	21. C. Nakhon Ratchasima	23.0	23.0	3	3	R.304

Table 33.2.3 TRAFFIC VOLUME ON ROUTE IM - 33

YEAR		1987				1993				2001			
LINK		1	2	3	AVR.	1	2	3	AVR.	1	2	3	AVR.
P/C	N+D	64	66	67	66	85	89	91	88	124	132	137	130
	I	8	9	6	8	15	17	12	15	32	37	25	31
	DV	0	0	0	0	3	4	3	3	6	8	7	7
	TOTAL	72	75	73	73	103	110	107	106	162	176	169	168
L/B	N+D	25	32	37	30	32	41	47	39	43	55	64	53
	I	29	33	23	29	37	42	29	36	51	58	40	50
	DV	0	0	0	0	7	9	8	8	10	12	11	11
	TOTAL	54	65	60	59	77	92	84	83	104	126	115	114
M/B	N+D	73	82	88	80	93	104	112	101	126	141	152	138
	I	36	41	28	35	46	52	36	45	63	72	49	62
	DV	0	0	0	0	9	11	10	10	12	15	14	13
	TOTAL	109	123	116	115	148	167	157	156	201	227	215	213
H/B	N+D	53	54	54	53	71	74	76	73	105	112	117	110
	I	4	5	3	4	11	13	9	11	27	31	22	27
	DV	0	0	0	0	2	3	2	2	5	7	6	6
	TOTAL	57	59	58	58	85	89	87	87	138	150	144	143
P/P&T	N+D	232	250	264	246	288	309	326	304	385	412	433	406
	I	65	75	51	64	81	93	64	80	110	127	87	108
	DV	0	0	0	0	16	20	18	18	22	27	24	24
	TOTAL	296	324	315	310	384	422	407	402	516	566	544	539
4/T	N+D	52	65	75	63	47	56	64	55	42	47	50	46
	I	23	28	19	23	19	24	16	20	13	16	11	13
	DV	0	0	0	0	4	6	5	5	3	4	3	3
	TOTAL	75	93	94	86	71	86	85	79	57	66	64	62
6/T	N+D	105	111	115	110	134	141	147	140	182	192	201	190
	I	10	12	8	10	15	19	13	16	28	34	23	28
	DV	0	0	0	0	3	4	4	4	6	8	7	7
	TOTAL	115	123	124	120	153	164	164	159	216	234	231	226
10/T	N+D	98	102	105	101	127	134	139	132	173	183	191	181
	I	7	9	6	7	13	15	11	13	26	31	21	26
	DV	0	0	0	0	3	4	3	3	6	7	6	6
	TOTAL	105	111	111	108	143	153	152	148	205	221	219	213
ADT	N+D	702	761	806	748	877	947	1002	933	1180	1274	1345	1254
	I	182	212	145	180	237	276	189	235	349	406	278	346
	DV	0	0	0	0	48	59	54	53	71	87	79	78
	TOTAL	884	972	951	928	1162	1283	1244	1221	1600	1766	1702	1677
M/C	N+D	237	281	311	271	270	316	346	304	321	369	398	357
	I	119	113	74	104	128	117	77	110	131	106	69	106
	DV	0	0	0	0	17	15	15	16	13	7	9	10
	TOTAL	356	394	385	375	415	448	438	431	465	482	476	473
TOTAL	N+D	940	1042	1117	1019	1147	1263	1347	1237	1501	1643	1743	1611
	I	300	324	219	284	365	393	265	345	480	512	347	452
	DV	0	0	0	0	66	74	69	69	84	94	88	88
	TOTAL	1240	1366	1335	1304	1578	1730	1682	1652	2065	2248	2178	2150

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

Figure 33.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA : PROPOSED ROUTE NO. IM – 33

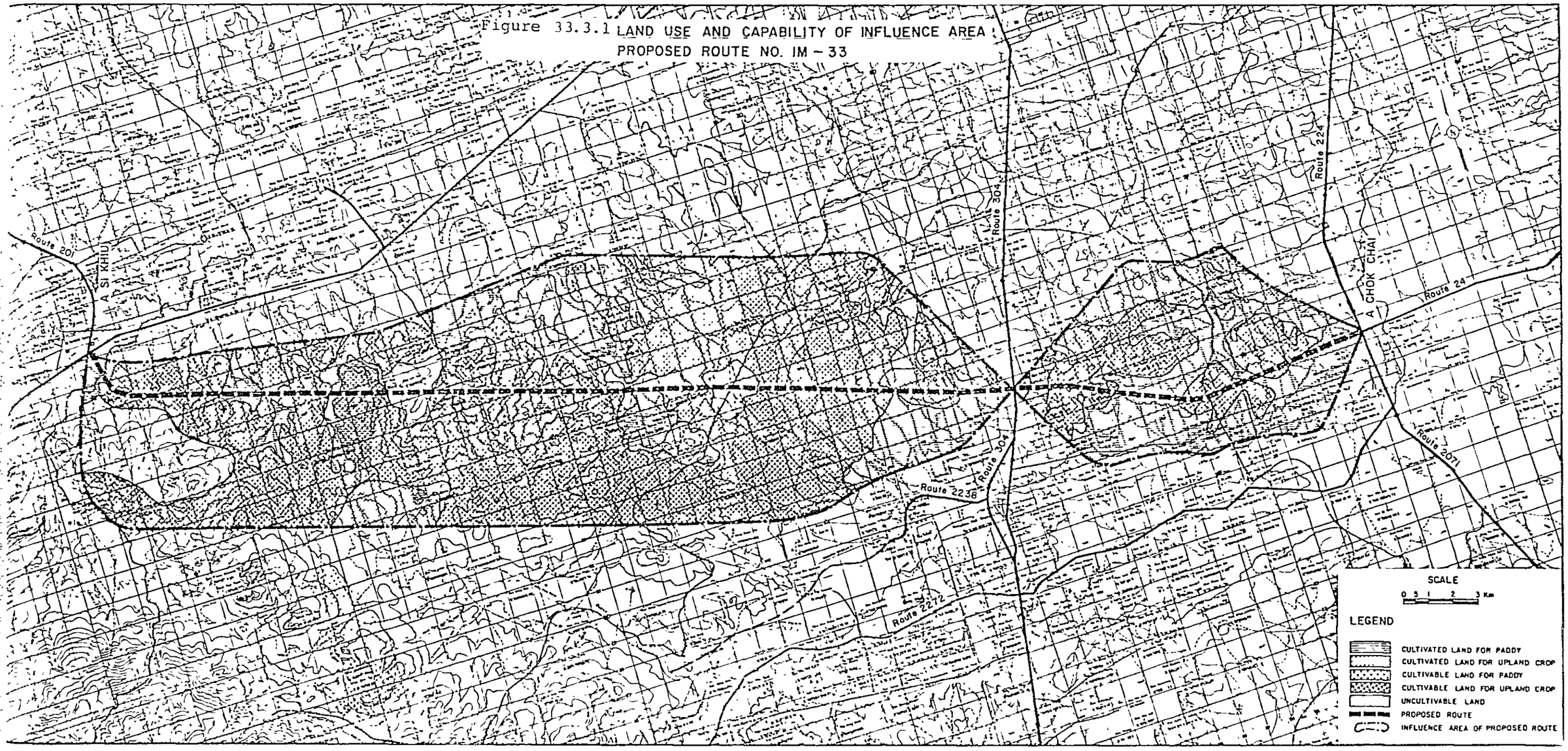


Figure 33.3.2 CROPPING CALENDAR

1300 CHANGWAT NAKHON RATCHASIMA

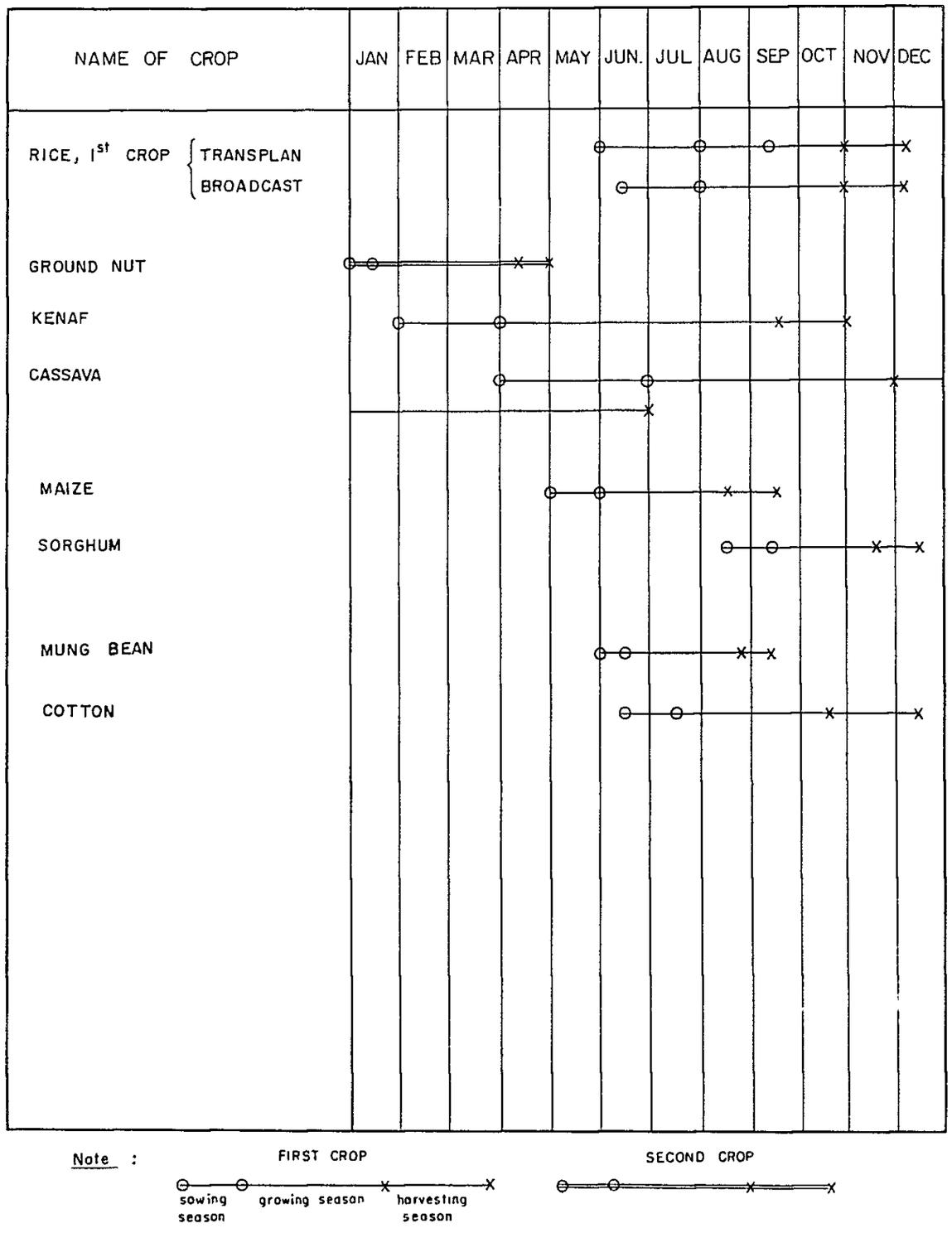


TABLE 33.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		52.500 (84.0)	17.500 (28.0)	70.000 (112.0)	13.375 (21.4)	139.375 (223.0)	152.750 (244.4)
1315	SUNG NOEN	18.125 (29.0)	5.625 (9.0)	23.750 (38.0)	8.750 (14.0)	94.375 (151.0)	103.125 (165.0)
1318	PAK THONG CHAI	21.250 (34.0)	8.750 (14.0)	30.000 (48.0)	4.375 (7.0)	45.000 (72.0)	49.375 (79.0)
1319	CHOK CHAI	13.125 (21.0)	3.125 (5.0)	16.250 (26.0)	0.250 (0.4)	-	0.250 (0.4)

TABLE 33.3.2 CROP PRODUCTION

ITEM			PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)												
1981			35.94	1.45	0.37	0.60	15.01	-	-	0.17	17.68	53.62
1987			38.16	1.54	0.37	0.60	15.56	-	-	0.19	18.34	56.50
1993	WITHOUT	PROJECT	40.50	1.63	0.37	0.60	16.13	-	-	0.22	19.04	59.54
	WITH	PROJECT	42.97	2.06	0.42	0.60	19.68	-	-	0.24	23.09	66.06
2001	WITHOUT	PROJECT	43.86	1.77	0.38	0.60	16.92	-	-	0.27	20.02	63.87
	WITH	PROJECT	46.53	2.23	0.42	0.60	20.65	-	-	0.30	24.28	70.81
CROP YIELD (KG/RAI)												
1981			207.5	348.6	75.0	188.1	1531.5	-	-	190.5		
1987			210.0	348.6	78.7	188.1	1550.0	-	-	190.5		
1993	WITHOUT	PROJECT	212.5	348.6	82.6	188.1	1568.7	-	-	190.5		
	WITH	PROJECT	216.4	350.7	83.6	189.2	1587.6	-	-	190.5		
2001	WITHOUT	PROJECT	216.0	348.6	88.0	188.1	1594.0	-	-	190.5		
	WITH	PROJECT	225.2	353.6	90.5	190.8	1639.1	-	-	190.5		
CROP PRODUCTION (TON)												
1981			7,459	505	28	113	22,986	-	-	31	23,844	31,303
1987			8,013	536	29	113	24,113	-	-	37	25,012	33,025
1993	WITHOUT	PROJECT	8,609	569	31	113	25,296	-	-	42	26,239	34,847
	WITH	PROJECT	9,298	722	35	114	31,251	-	-	46	32,356	41,655
2001	WITHOUT	PROJECT	9,472	616	33	113	26,963	-	-	52	27,969	37,441
	WITH	PROJECT	10,478	788	38	115	33,846	-	-	56	35,038	45,517

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 33.3.3 FARMGATE PRICE AND PRODUCTION COST

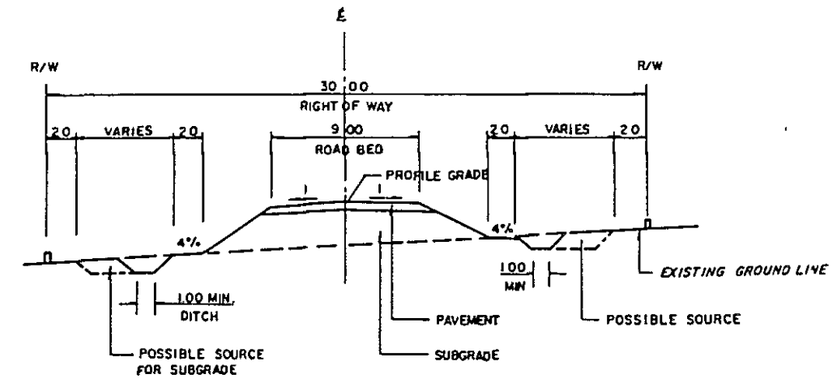
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,355	2,606	7,550	6,510	680	-	-	11,995
WITH PROJECT (1987 - 2001)	4,464	2,671	7,550	6,510	697	-	-	11,995
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	559	493	498	1,068	802	-	-	1,571
WITH PROJECT (1987 - 2001)	575	498	518	1,088	841	-	-	1,571

TABLE 33.3.4 NET PRODUCTION VALUE

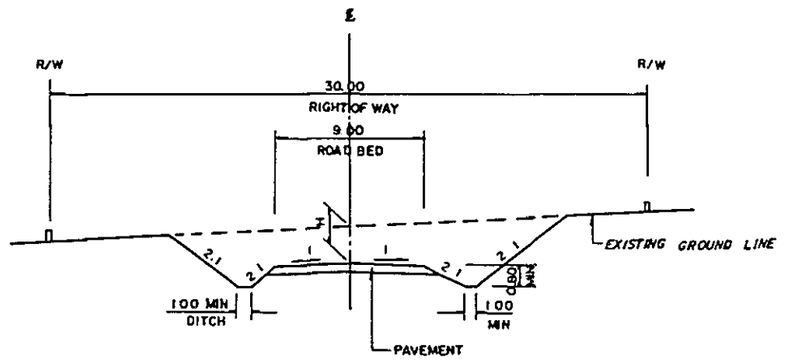
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	13,564	4,860	18,424	13,849	4,667	18,516
1993	14,845	5,281	20,126	16,821	6,471	23,292
2001	16,729	5,888	22,617	20,043	7,627	27,670

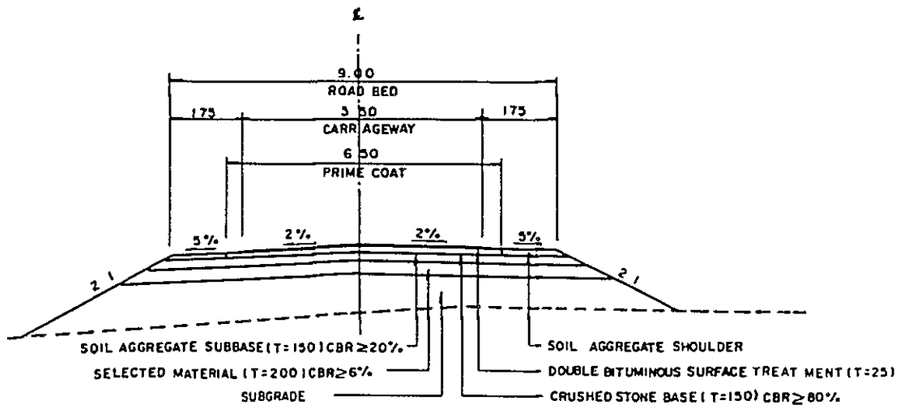
Figure 33.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



FILL SECTION



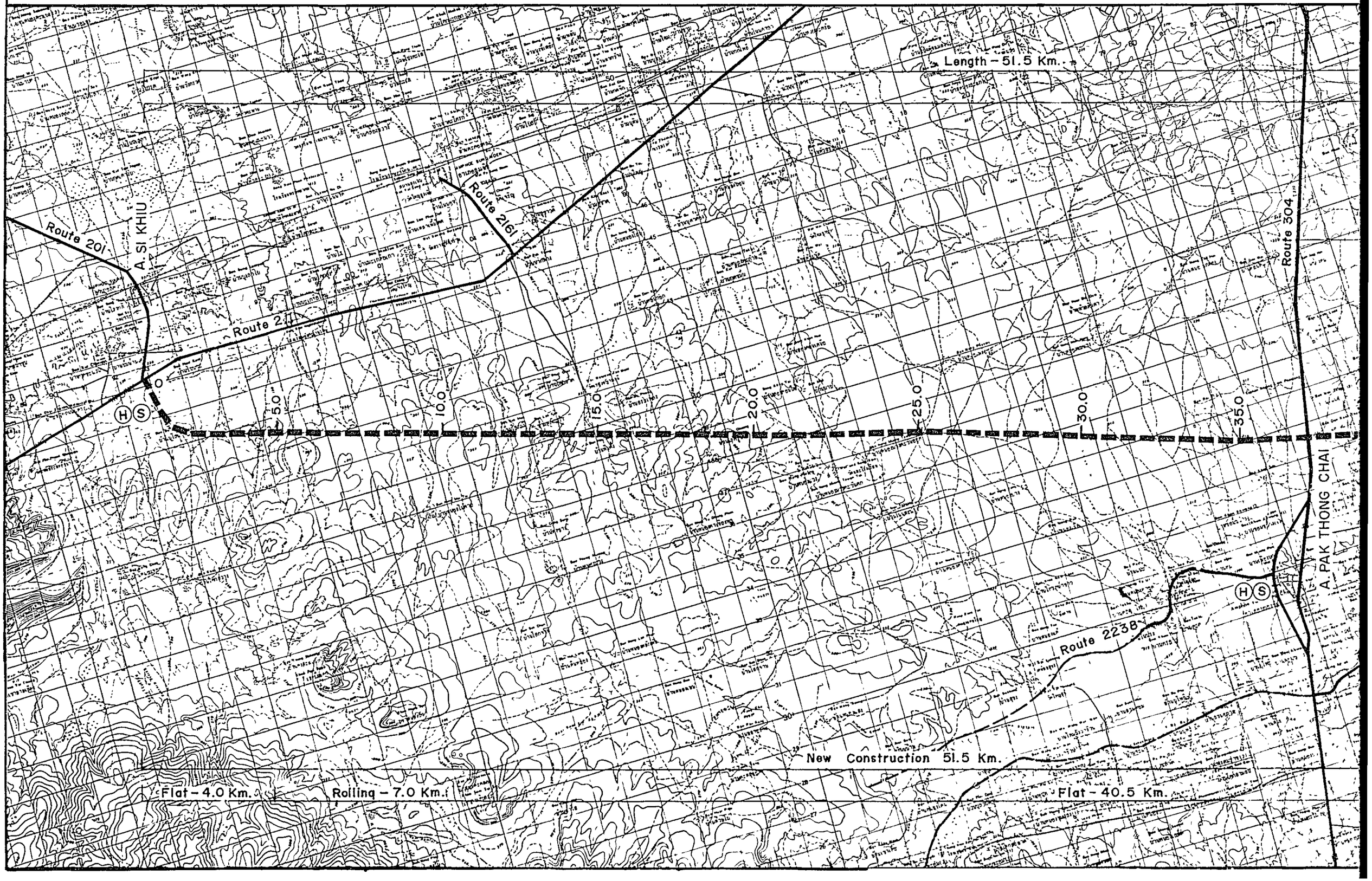
CUT SECTION



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

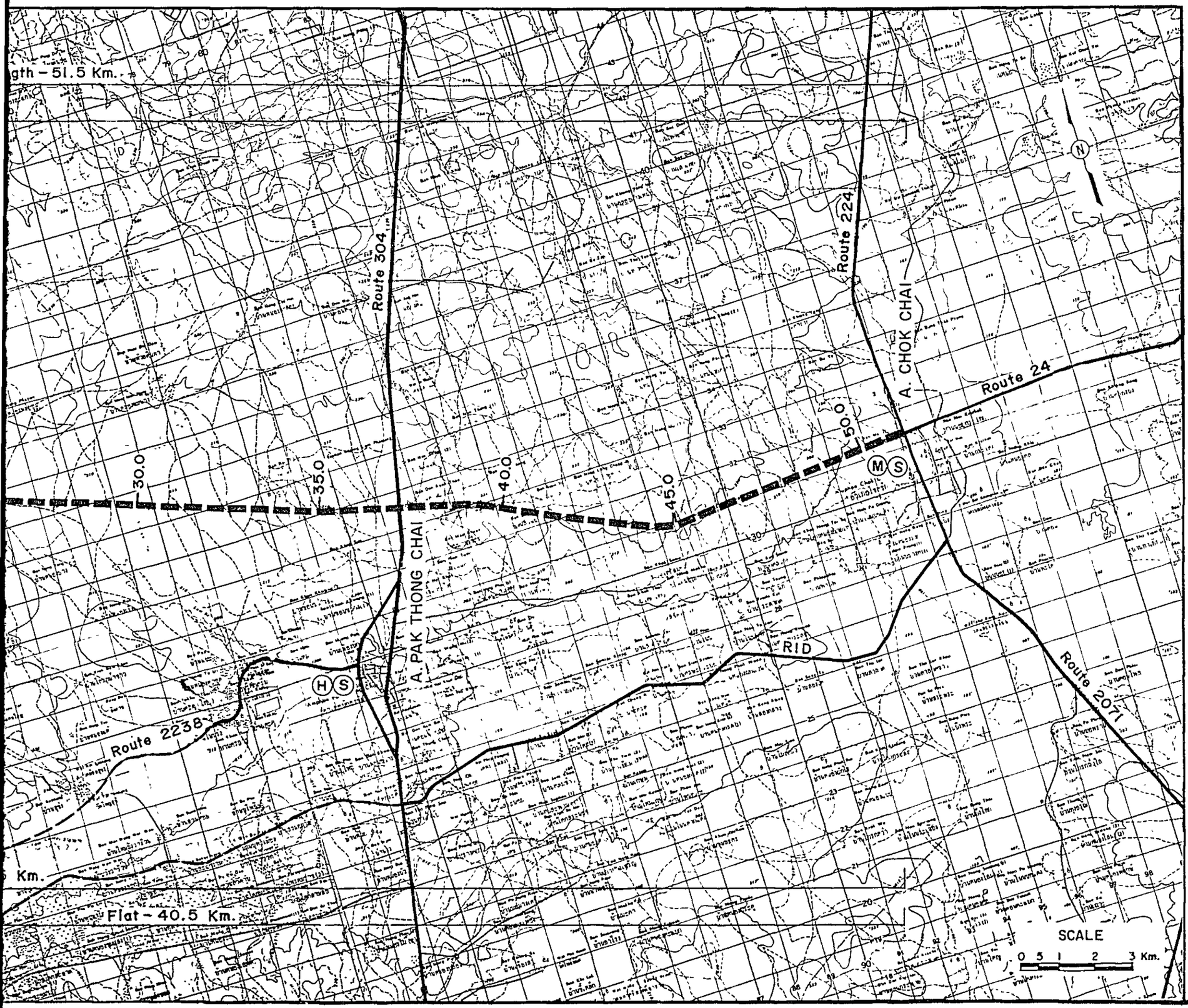
Figure 33.5.2 **PROPOSED ROUTE NO. IM-33 C.NAKHON RATCHASIMA** J.R. 2 — A. CH

ROUTE NO. EXTENSION O

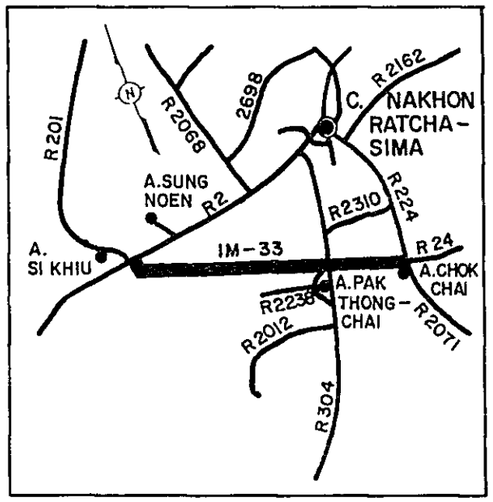


ON RATCHASIMA — J.R. 2 — A. CHOK CHAI (J.R. 24)

ROUTE NO. EXTENSION OF R 24 L = 51.5 Km.



LOCATION MAP



LEGEND

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

Table 33.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-33 (51.5 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	155	2,325	2,115
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	309,000	13,905	12,653
Selected Material	m^3	80	109,200	8,736	7,775
Soil Aggregate Surface or Subbase	m^3	105	76,500	8,032	7,148
Crushed Stone Base	m^3	370	50,200	18,574	17,088
Soil Aggregate Shoulder	m^3	105	21,600	2,268	2,018
Prime Coat and DBST	m^2	55	283,300	15,582	14,024
Pipe Culvert	m	2,100	1,790	3,759	3,458
Box Culvert	m	16,000	140	2,240	2,016
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	0	0	0
Sub Total (a)				75,422	68,299
Miscellaneous Works (a) x 7%				5,280	4,781
Total (b)				80,702	73,080
PHYSICAL CONTENGENCY (b) x 15%				12,105	10,962
ENGINEERING AND ADMINISTRATION (b) x 10%				8,070	7,308
Sub Total				20,175	18,270
LAND ACQUISITION					
Highly Developed Land	ha	50,000	155	7,750	7,750
Less Developed Land	ha	15,000	0	0	0
Sub Total				7,750	7,750
GRAND TOTAL				108,627	99,100

Table 33.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	19,820	0	0	0	0	27,846	0
1985	49,550	0	0	0	0	62,156	0
1986	29,730	0	0	0	0	33,298	0
1987	0	92	25,839	-168	25,763	0	23,003
1988	0	432	27,470	-163	27,739	0	22,113
1989	0	773	29,102	-159	29,715	0	21,150
1990	0	1,113	30,733	-155	31,691	0	20,140
1991	0	1,453	32,364	-151	33,666	0	19,103
1992	0	1,794	33,995	-147	35,642	0	18,057
1993	0	2,134	35,627	-143	37,618	0	17,016
1994	24,926	2,493	38,118	-134	40,477	11,275	16,348
1995	0	2,851	40,609	-124	43,336	0	15,627
1996	0	3,210	43,100	-115	46,195	0	14,874
1997	0	3,569	45,591	-106	49,054	0	14,102
1998	0	3,927	48,083	-97	51,913	0	13,325
1999	0	4,286	50,574	-87	54,772	0	12,552
2000	0	4,645	53,065	-78	57,632	0	11,793
2001	-49,771	5,003	55,556	-69	60,491	-9,093	11,051
TOTAL	74,255	37,774	589,827	-1,896	625,705	125,481	250,256

DISCOUNTED ECONOMIC COSTS :	125,481
DISCOUNTED ECONOMIC BENEFITS :	250,256
AGRICULTURAL DEVELOPMENT BENEFIT	12,332
VOC SAVING	238,881
RMC SAVING	-956
NET PRESENT VALUE :	124,775
BENEFIT COST RATIO :	1.99
INTERNAL RATE OF RETURN :	21.6 %

Table 33.7.1 SOCIAL INDICATORS

(Proposed Route IM-33)

Population (1,000)	
1982	: 18.9
1993	: 22.8
Average travelling speed, without (kph)	: 48
Isolation	
Access to Amphoe	
Average distance to Amphoe (km) 1/	: 8.5 (11.8)
Per capita time savings (10^{-4})	: 0.056
Score	: 165
Access to Artery Highway	
Average distance to highway (km) 1/	: 15 (21)
Per capita time savings (10^{-4})	: 0.101
Score	: 220
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/	: 8.7 (11.9)
Per capita time savings (10^{-4})	: 0.056
Score	: 130
Access to Medical Facilities	
Average distance to facilities (km) 1/	: 7.8 (10.6)
Per capita time savings (10^{-4})	: 0.049
Score	: 196
Education	
Access to Secondary School	
Number of Student in 1993 (1,000) 2/	: 3.6
Average distance to school (km)	: 7.8 (10.4)
Per capita time savings (10^{-4})	: 0.301
Score	: 163
Teacher Intensity	
Number of teachers 3/	
University graduate	: -
Total	: 5
Number of Student	: 112
Indicators	
E1 4/	: -
E2 5/	: 44.6
E 6/	: 44.6
Degree of Improvement 7/	: 1.53
Score	: 98
Disparity	
G.P.V. in 1993 (Mn B) 8/	
With project	: 66.9
Without project	: 57.8
Per capita G.P.V. in 1993 (B)	
With project (W)	: 2,934
Without project (w)	: 2,535
Degree of Disparity	
(A/W) - (A/w) 9/	: 0.16
Score	: 286
Total Score	: 1,258

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.

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