

**PROPOSED ROUTE NO. IM - 15**

Changwat : Nakhon Phanom

A.Renu Nakhon(J.R.2031) - B. Ku Ru Khu (J.R.22)

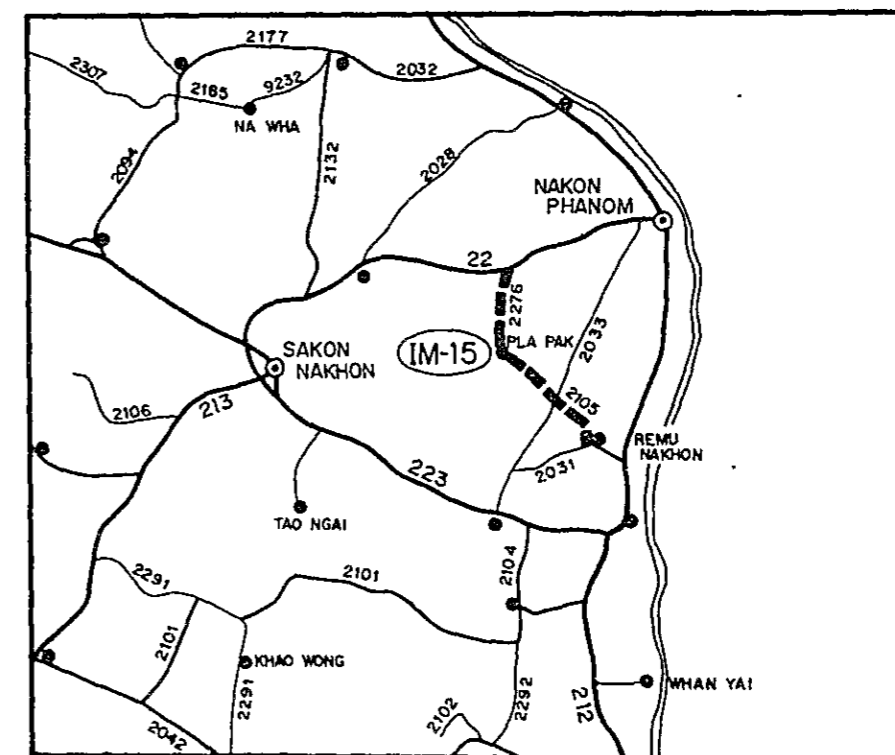
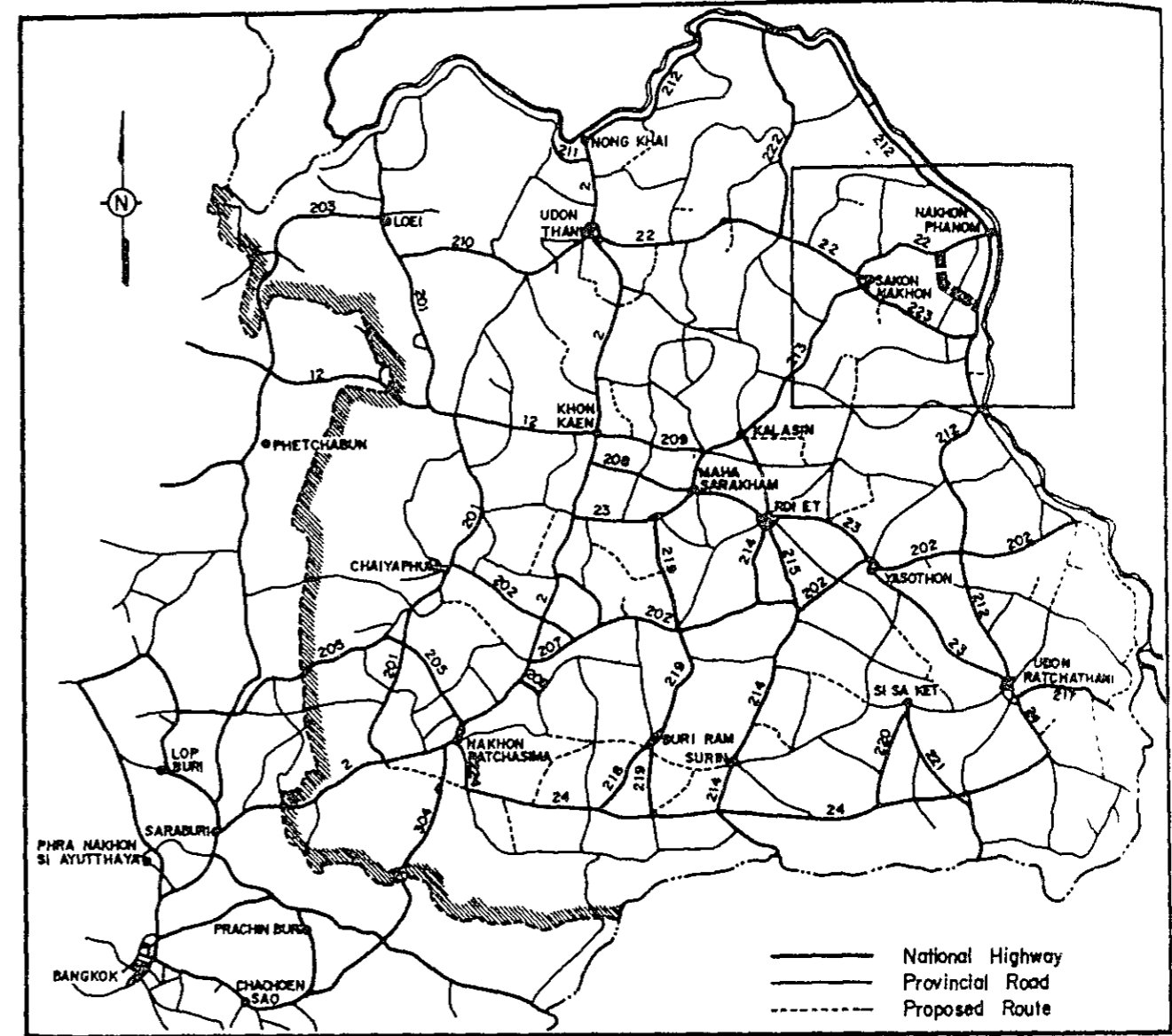
Length : 40.1 KM.

SUMMARY

PROPOSED ROUTE IM-15

Item	Description
Changwat	Nakhon Phanom
Origin	A. Renu Nakhon (J.R.2031)
Destination	B. Ku Ru Khu (J.R.22)
Length	
Total	40.1 km
Improvement Section	40.1 km
DOH Road	R.2105, R.2276 27.1 km
ARD Road	13.0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good - Poor
Terrain	Flat and Rolling
Influence Area	
Area	307 km <sup>2</sup>
Population (1982)	32,800
Principal Crops	Paddy
Traffic (ADT)	
Existing	95
1993	400
2001	534
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	75,443 . 10 <sup>3</sup> ฿
Economic	68,442 . 10 <sup>3</sup> ฿
IRR	5.1 %
B/C	0.51
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE



## 1. GENERAL

### 1.1 Characteristics of Route

The proposed route is located in the southwest part of Changwat Nakhon Phanom.

The route, starting at Amphoe Renu Nakhon on Route 2031, runs northward passing through Ban Hong Hi, King Amphoe Pla Pak and Ban Khok Klang and ends at Ban Ku Ru Khu on Route 22. Its total length is 40.1 km.

(Figure 15.5.2)

The terrain is almost rolling, while some sections are flat. In the influence area, there exists several villages with total population of 32,800. There are three medical centers and one secondary school along the proposed route but no hospital.

The proposed route, upon completion, will form an important part of road network to connect three highways, Route 2031, 2033 and 22 in the agriculturally developed area and also play vital role to connect King Amphoe Pla Pak with these highway.

### 1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 15.1.1. The details are shown as the result of inventory survey in Table 15.1.2.

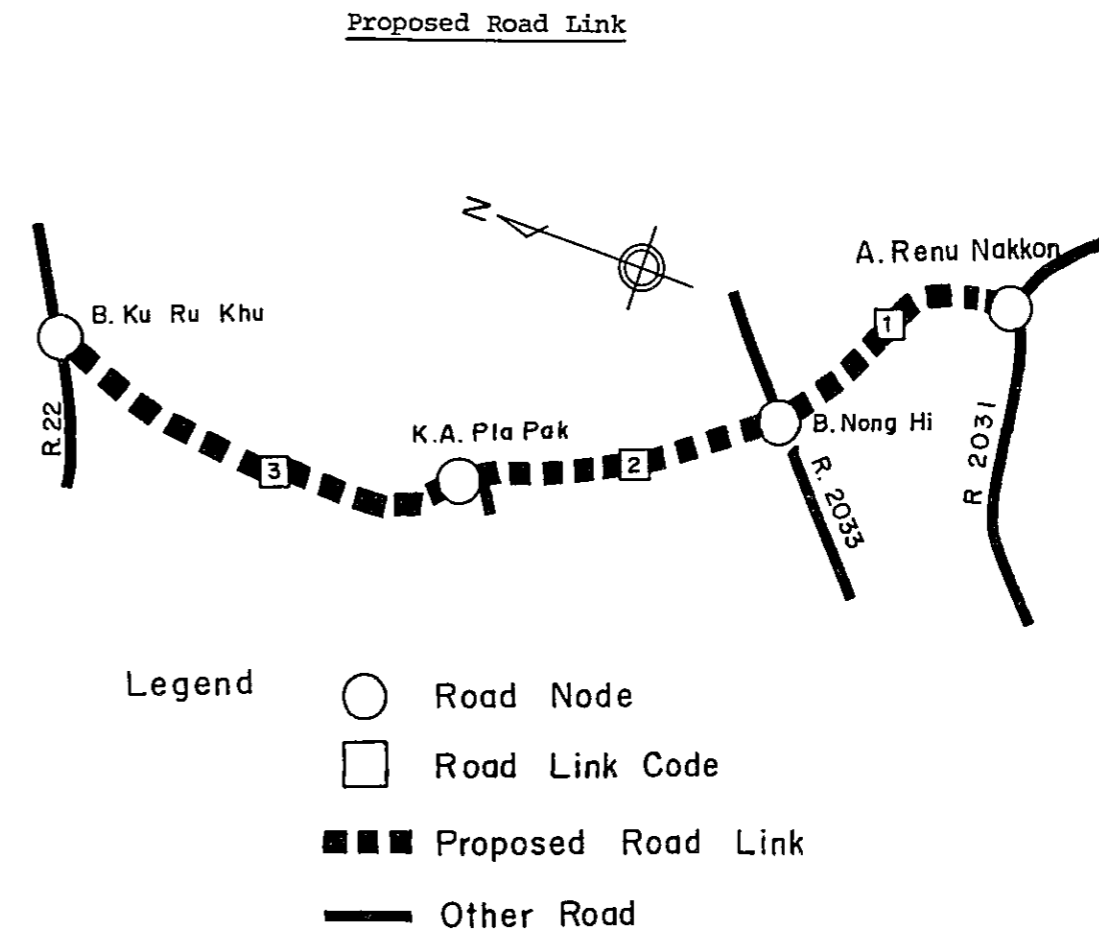
## 2. TRAFFIC

### 2.1 Method

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

### 2.2 Base Year Traffic

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



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 <sup>1/</sup>	19	22	16	19	2	4	10	20	3	115
	2	n.a.									
	3 <sup>2/</sup>	7	16	24	29	2	3	7	1	-	89
Manual Counts (1982)	1	3	72	3	-	-	8	17	22	2	127
	2	1	45	2	-	-	5	8	12	3	76
	3	n.a.									
Estimated	1	11	47	10	10	1	6	14	21	3	123
	2	1	45	2	-	-	5	8	12	3	76
	3	7	16	24	29	2	3	7	1	-	89

Note: <sup>1/</sup> Route 2105 Station 0100 Station Km 1+000  
<sup>2/</sup> Route 2276 Station 0100 Station Km 8+200

2.3 Transport Movement

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

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	601
2	203
3	1170

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONNAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	46	39	85
2	33	28	61
3	5	4	10

2.4 Future Growth of Transport Movement

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

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.2	1.0
PASSENGER MOVEMENT	5.5	5.6	5.7

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI. AGRICULTURE	7.1 0.5	7.2 0.1	7.3 0.1
FREIGHT	4.1	3.9	4.0

2.5 Induced and Developed Traffic

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

RATE OF INDUCED AND DEVELOPED TRAFFIC

ITEM	YEAR		
	( % )		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

2.6 Future Traffic

1) Traffic Composition

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

TRAFFIC COMPOSITION

LINK NO.	YEAR	(UNIT : %)									
		PASSENGER					FREIGHT				
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	
1	1982	13.9	59.5	12.7	12.7	1.3	13.6	31.8	47.7	6.8	
	1987	15.1	58.3	11.9	12.4	2.3	14.5	27.7	44.4	13.4	
	1993	16.5	56.9	10.9	12.2	3.5	15.6	22.7	40.4	21.4	
	2001	18.4	55.1	9.6	11.8	5.2	17.0	16.0	35.0	32.0	
2	1982	2.1	93.8	4.2	0.0	0.0	17.9	28.6	42.9	10.7	
	1987	7.8	88.0	3.5	0.5	0.2	17.6	25.3	40.8	16.3	
	1993	14.7	81.1	2.6	1.1	0.5	17.4	21.3	38.3	23.0	
	2001	24.0	71.9	1.5	1.9	0.8	17.0	16.0	35.0	32.0	
3	1982	9.0	20.5	30.8	37.2	2.6	27.3	63.6	9.1	0.0	
	1987	9.4	23.6	27.9	33.9	5.2	24.2	49.3	16.9	9.6	
	1993	9.7	26.7	25.1	30.6	7.9	21.1	35.1	24.6	19.2	
	2001	10.2	30.8	21.3	26.2	11.5	17.0	16.0	35.0	32.0	

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the following table and details by road link by traffic type are shown in Table 15.2.1.

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	11	18	20	3	56	8	12	4	133	194	327
1993	19	22	26	7	74	7	11	6	171	229	400
2001	35	28	35	15	109	5	11	10	248	286	534

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

The area of influence is divided into two parts: Amphoe Pla Pak side and Amphoe Renu Nakhon side. Almost all cultivated land is covered by paddy fields. Unused cultivable land for upland field remains in Amphoe Renu Nakhon side, but very few of new land is available for paddy field.

Land use and capability conditions in the area of influence are shown in Table 15.3.1 and Figure 15.3.1. A typical cropping calendar in the Nakhon Phanom area is shown in Figure 15.3.2.

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 15.3.2.

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 15.3.3.

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 15.3.4. 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				With Project		
		Length (Km)	<sup>1</sup> / <sub>1</sub> Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	Length (Km)	Road Class	Nos. of Wooden Narrow Bridge
1	Flat & Rolling	12.1	3	0	0	12.1	1(F4) } 2S(F5)	0
2	Rolling	13.0	3	0	8	13.0		0
3	Rolling	15.0	2B	4	1	15.0		0

<sup>1</sup>/<sub>1</sub> 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)	3,815	5,407	8,443
2A (F5)	2,367	3,552	5,786

#### 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 15.5.1.
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<sub>>20%</sub> : 15.0cm  
 Selected Material CBR<sub>> 6%</sub> : 20.0cm

Pipe Culvert

Standard Size :  $\phi$  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 15.5.2

Alignment of the route is shown in Figure 15.5.2.

## 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 15.5.1.

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

## Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10 <sup>3</sup> B)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	40.1	75,443	68,442	
F5 (Laterite)	40.1	45,160	40,896	

## 6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 15.6.1 and 15.6.2.

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 15.7.1.

Table 15.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	A. Renu Nakhon (J.R. 2031)	
Destination	B. Ku Ru Khu (J.R. 22)	
Length		
Total		40.1 km
Improvement Section		40.1 km
DOH Road	R.2105, R.2276	27.1 km
ARD Road		13.0 km
Others		0 km
New Alignment Section		0 km
Terrain	Flat and Rolling	
Alignment (Hori./Vert.)	Fair/Fair	
Formation Width	5.5 m - 9.0 m, 7.4 m (Weighted average)	
Embankment Section		
Length		40.1 km
Height	0.2 m - 1.5 m	
Cut Section		
Length		0 km
Depth	m - m	
Surface Type and Condition		
SBST or DBST	Good - Poor	5.1 km
Soil Aggregate	Good - Poor	35.0 km
Earth		0 km
Pipe Culvert	28 each	
Box Culvert	1 each	12.0 m
Bridge		
Permanent Bridge	1 each	21.0 m
Narrow Concrete Bridge	9 each	152.3 m (4m)
Wooden Bridge	4 each	50.8 m
Overflow Section	0 place	0 km



Table 15.1.2 ROAD INVENTORY (1)

PROPOSED ROUTE NO. IM-15

ROUTE NO. 2105  
ARD  
2276

A. RENU NAKHON (J.R. 2031) ~ B. KU RU KHU (J.R. 22)

L = 40.1 Km

NAKHON PHANO

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30							
VILLAGE																								
- Name																								
- Household (H)																								
- Population (P)																								
TERRAIN																								
CROSS SECTION	Formation Width (m)	6.50		9.00			7.50							6.50		7.00	7.50		6.50					
	Embankment Height (m)	0.30	1.50	0.30	0.50		0.20			0.30	0.20	1.00		0.40	0.20	0.40								
	Cutting Depth (m)																							
PAVEMENT	Type/Length	DT	Laterite										DT	La	DT	Laterite	DT	Laterite						
	Condition																							
FLOODING	Overflow Length(Km)/Height(m)																							
LAND USE	Left																							
	Right																							
PIPE CULVERT	Total Number	28 pipes																						
BOX CULVERT & BRIDGE	Station (Km)	3.4			11.4				14.8		18.4		20.2		21.0	21.5	22.6		22.9	23.2	25.7		30.0	
	Dimension	C-Br. 3.00 x 12.00			C-Br. 7.00 x 21.00				C-Br. 4.00 x 17.00		C-Br. 4.00 x 15.00		C-Br. 4.00 x 8.00		C-Br. 4.00 x 18.00	C-Br. 4.00 x 18.00	C-Br. 4.00 x 18.30	C-Br. 4.00 x 16.00	C-Br. 4.00 x 21.00	W-Br 4.00 x 9.00		W-Br 4.00 x 15.00		
RIGHT OF WAY (m)		15.0																						
ALIGNMENT	Horizontal	Fair																						
	Vertical	Fair																						
ROUTE NO., AGENCIES		DOH 2105							ARD										DOH 2276					

ROAD INVENTORY (2)

L = 40.1 Km.

A. RENU NAKHON (J.R. 2031) ~ B. KU RU KHU (J.R. 22) (Cont'd)

NAKHON PHANOM

STATION (Km)		30	32	34	36	38	40	
VILLAGE								B. KU RU KHU
- Name								
- Household (H)								
- Population (P)								
TERRAIN		Rolling						
CROSS SECTION	Formation Width (m)	7.50	7.00	5.50	5.50	7.30		
	Embankment Height (m)	0.80	0.20	0.40	0.20			
	Cutting Depth (m)							
PAVEMENT	Type/Length	Laterite DT		Laterite				
	Condition	Good						
FLOODING	Overflow Length(Km)/Height(m)							
LAND USE	Left	Bush	Paddy	Bush			Paddy	
	Right	Bush	Paddy	Bush			Paddy	
PIPE CULVERT	Total Number							
BOX CULVERT & BRIDGE	Station (Km)							
	Dimension							
RIGHT OF WAY (m)								
ALIGNMENT	Horizontal	Fair						
	Vertical	Fair						
ROUTE NO., AGENCIES		DOH 2276						

Table 15.2.1 TRAFFIC VOLUME ON ROUTE IM - 15

YEAR	1987				1993				2001				
	LINK	1	2	3	AVR.	1	2	3	AVR.	1	2	3	AVR.
P/C	N+D	15	5	10	10	22	13	14	16	37	31	23	30
	I	2	1	2	1	3	2	2	2	6	5	4	4
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	17	6	12	11	25	14	17	19	42	36	27	35
L/B	N+D	12	2	30	16	15	2	37	19	19	2	49	25
	I	2	0	5	2	2	0	6	3	3	0	7	4
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	14	2	35	18	17	3	43	22	22	2	56	28
M/B	N+D	12	0	36	18	16	1	45	22	24	2	60	30
	I	2	0	5	3	2	0	7	3	4	0	9	5
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	14	0	42	20	19	1	52	26	27	3	69	35
H/B	N+D	2	0	6	3	5	0	12	6	10	1	26	13
	I	0	0	1	0	1	0	2	1	2	0	4	2
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	3	0	6	3	5	0	13	7	12	1	30	15
P/P&T	N+D	65	60	27	49	83	75	41	65	118	100	71	95
	I	10	9	4	7	13	11	6	10	18	15	11	14
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	75	69	31	56	96	86	47	74	136	115	82	109
4/T	N+D	12	7	3	7	10	6	2	6	8	5	1	4
	I	2	1	1	1	2	1	0	1	1	1	0	1
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	14	8	4	8	12	7	2	7	9	6	1	5
6/T	N+D	19	12	1	10	18	12	1	10	17	12	2	10
	I	3	2	0	2	3	2	0	1	3	2	0	1
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	22	13	1	12	21	13	2	11	19	14	2	11
10/T	N+D	6	5	1	4	9	7	1	6	15	11	2	9
	I	1	1	0	1	1	1	0	1	2	2	0	1
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	7	5	1	4	11	8	1	6	18	13	2	10
ADT	N+D	144	91	114	116	179	116	154	149	248	165	234	216
	I	22	14	17	17	27	17	23	22	37	25	35	32
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	165	105	132	133	205	133	177	171	285	190	269	248
M/C	N+D	203	147	182	177	233	173	221	209	284	218	286	263
	I	19	15	18	17	21	17	21	20	23	20	24	22
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	222	162	200	194	254	190	243	229	307	238	310	286
TOTAL	N+D	346	238	297	293	412	289	375	358	532	383	520	479
	I	41	28	35	35	48	34	44	42	60	44	60	55
	DV	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	387	266	332	327	459	323	420	400	592	428	579	534

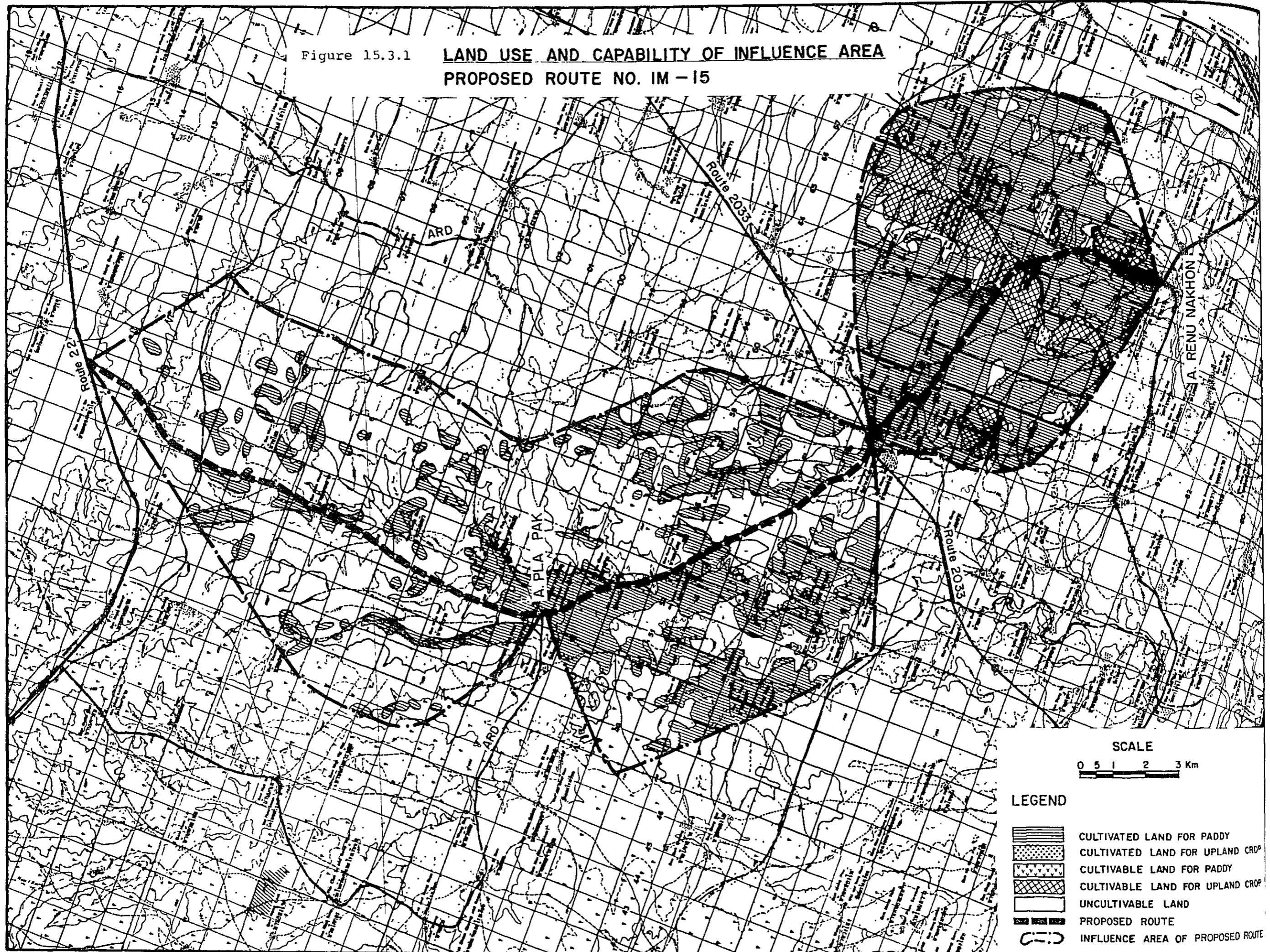
NOTE

N : NORMAL TRAFFIC  
DV : DEVELOPED TRAFFIC

D : DIVERTED TRAFFIC  
I : INDUCED TRAFFIC

Figure 15.3.1

**LAND USE AND CAPABILITY OF INFLUENCE AREA  
PROPOSED ROUTE NO. IM - 15**



SCALE  
0 5 1 2 3 Km

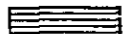

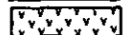

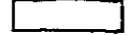


- LEGEND**
-  CULTIVATED LAND FOR PADDY
  -  CULTIVATED LAND FOR UPLAND CROP
  -  CULTIVABLE LAND FOR PADDY
  -  CULTIVABLE LAND FOR UPLAND CROP
  -  UNCULTIVABLE LAND
  -  PROPOSED ROUTE
  -  INFLUENCE AREA OF PROPOSED ROUTE



TABLE 15.3.1 CULTIVATED &amp; CULTIVABLE LAND

(1979)

[ UNIT : 1000 RAI (KM<sup>2</sup>) ]

AMPHOE	AMPHOE	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		75.813 (121.3)	-	75.813 (121.3)	1.438 ( 2.3)	8.313 ( 13.3)	9.750 ( 15.6)
0501	M. NAKHON PHANOM	0.188 ( 0.3)	-	0.188 ( 0.3)	-	-	-
0506	PLA PAK	30.625 ( 49.0)	-	30.625 ( 49.0)	0.938 ( 1.5)	0.188 ( 0.3)	1.125 ( 1.8)
0507	RENU NAKHON	45.000 ( 72.0)	-	45.000 ( 72.0)	0.500 ( 0.8)	8.125 ( 13.0)	8.625 ( 13.8)

TABLE 15.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	81.60	-	-	-	0.11	-	0.07	-	0.20	81.80
1987	83.65	-	-	-	0.12	-	0.07	-	0.21	83.87
1993	WITHOUT PROJECT	83.65	-	-	0.13	-	0.07	-	0.22	83.88
	WITH PROJECT	83.65	-	-	0.14	-	0.07	-	0.24	83.89
2001	WITHOUT PROJECT	83.65	-	-	0.14	-	0.07	-	0.24	83.90
	WITH PROJECT	83.65	-	-	0.16	-	0.07	-	0.26	83.91
CROP YIELD (KG/RAI)										
1981	205.0	-	-	-	2500.0	-	175.0	-	-	-
1987	206.2	-	-	-	2500.0	-	175.0	-	-	-
1993	WITHOUT PROJECT	207.5	-	-	2500.0	-	175.0	-	-	-
	WITH PROJECT	210.0	-	-	2515.0	-	175.0	-	-	-
2001	WITHOUT PROJECT	209.1	-	-	2500.0	-	175.0	-	-	-
	WITH PROJECT	215.1	-	-	2535.2	-	175.0	-	-	-
CROP PRODUCTION (TON)										
1981	16,729	-	-	-	267	-	12	-	389	17,118
1987	17,252	-	-	-	292	-	12	-	421	17,674
1993	WITHOUT PROJECT	17,356	-	-	320	-	12	-	456	17,813
	WITH PROJECT	17,565	-	-	351	-	12	-	489	18,054
2001	WITHOUT PROJECT	17,495	-	-	360	-	12	-	508	18,004
	WITH PROJECT	17,991	-	-	399	-	12	-	549	18,540

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 15.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,630	-	-	-	515	-	3,430	-
WITH PROJECT (1987 - 2001)	3,721	-	-	-	528	-	3,516	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	530	-	-	-	759	-	511	-
WITH PROJECT (1987 - 2001)	540	-	-	-	779	-	511	-

TABLE 15.3.4 NET PRODUCTION VALUE

YEAR	(1000 BAHT)					
	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	18,289	111	18,400	19,020	112	19,132
1993	18,666	119	18,785	20,184	129	20,313
2001	19,172	131	19,303	21,770	146	21,916

Figure 15. 5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

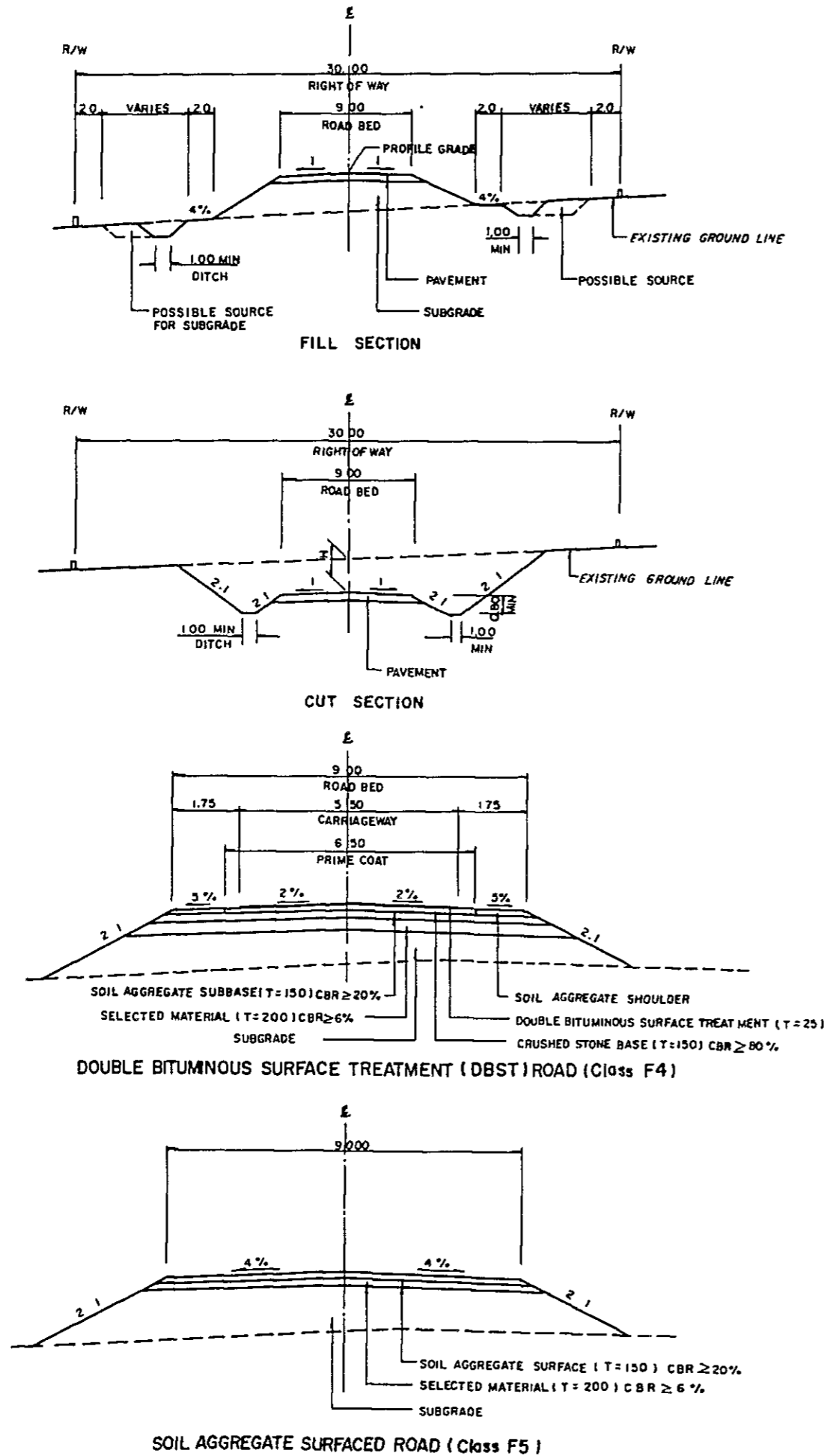
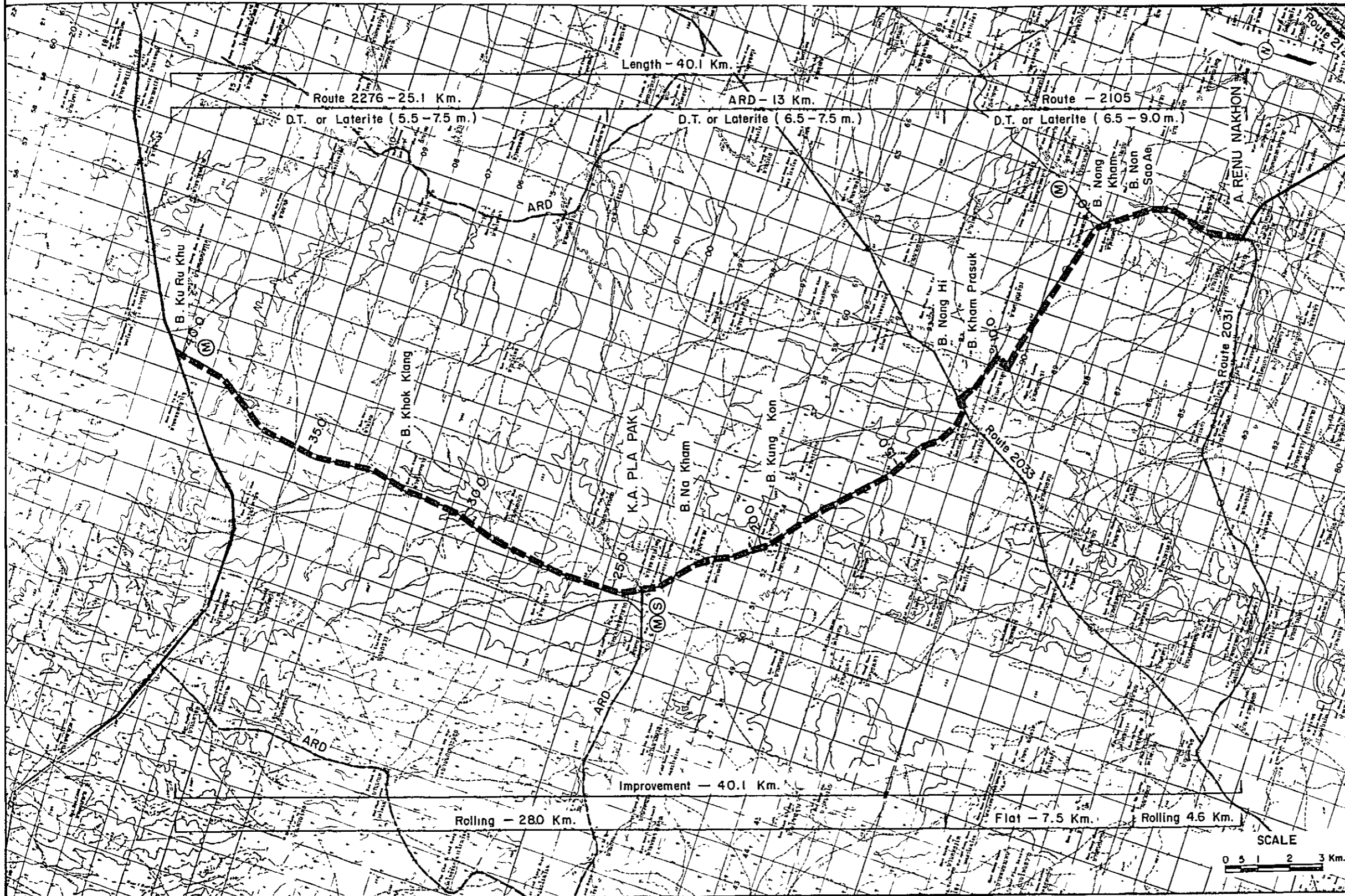
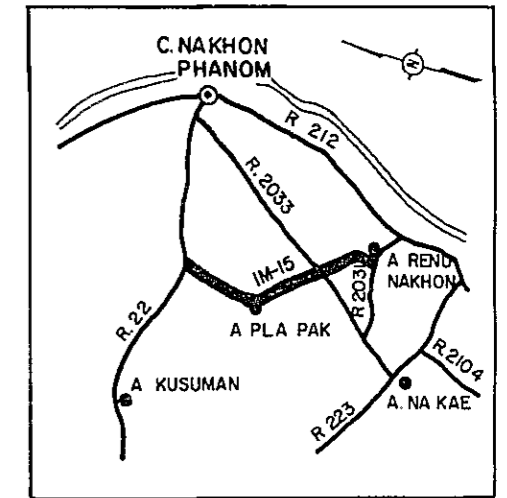




Figure 15.5.2 **PROPOSED ROUTE NO. 1M-15** C. NAKHON PHANOM A. RENU NAKHON (J.R. 2031) - B. KU RU KHU (J.R. 22)  
 ROUTE NO. R. 2105+ARD+R. 2276 L = 40.1 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	34	—	C - 3 00 x 12 00
2	11.4	—	C - 7 00 x 21 00
3	148	C - 7 00 x 17 00	C - 4 00 x 17 00
4	184	C - 7 00 x 15 00	C - 4 00 x 15 00
5	202	C - 7 00 x 8 00	C - 4 00 x 8 00
6	210	C - 7 00 x 18 00	C - 4 00 x 18 00
7	21.5	C - 7 00 x 18 00	C - 4 00 x 18.00
8	22.6	C - 7 00 x 18.30	C - 4 00 x 18 30
9	229	C - 7 00 x 16 00	C - 4 00 x 16 00
10	23.2	C - 7 00 x 21 00	C - 4 00 x 21 00
11	25.7	C - 7 00 x 21 00	C - 4 00 x 21 00
12	267	C - 7 00 x 12 00	W - 4 00 x 9 00
13	300	C - 7 00 x 18 00	W - 4 00 x 15 00
14	365	C - 7 00 x 18 00	W - 4 30 x 15 00
15	382	C - 7 00 x 14 00	W - 4 00 x 11 80

LEGEND

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



Table 15.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-15 (40.1 km)

Items	Unit of Q'ty	Financial Unit Rate ₪	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)	Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	91	1,365	1,242	91	1,365	1,242
Excavation - Soil	m <sup>3</sup>	20	0	0	0	0	0	0
Excavation - Hard Rock	m <sup>3</sup>	160	0	0	0	0	0	0
Embankment	m <sup>3</sup>	45	126,900	5,710	5,196	126,900	5,710	5,196
Selected Material	m <sup>3</sup>	80	72,100	5,768	5,133	72,100	5,768	5,133
Soil Aggregate Surface or Subbase	m <sup>3</sup>	105	50,500	5,302	4,719	50,500	5,302	4,719
Crushed Stone Base	m <sup>3</sup>	370	33,200	12,284	11,301	2,000	740	680
Soil Aggregate Shoulder	m <sup>3</sup>	105	14,300	1,501	1,336	800	84	74
Prime Coat and DBST	m <sup>2</sup>	55	187,000	10,285	9,257	11,000	605	545
Pipe Culvert	m	2,100	1,570	3,297	3,033	1,570	3,297	3,033
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	214	8,560	7,618	214	8,560	7,618
Sub Total (a)				54,073	48,838	31,432	28,244	
Miscellaneous Works (a) x 7%				3,785	3,419	2,200	1,977	
Total (b)				57,858	52,257	33,632	30,221	
PHYSICAL CONTEGENCY (b) x 15%				8,679	7,839	5,045	4,533	
ENGINEERING AND								
ADMINISTRATION (b) x 10%				5,786	5,226	3,363	3,022	
Sub Total				14,465	13,065	8,408	7,555	
LAND ACQUISITION								
Highly Developed Land	ha	50,000	60	3,000	3,000	60	3,000	3,000
Less Developed Land	ha	15,000	8	120	120	8	120	120
Sub Total				75,443	68,442	3,120	3,120	
GRAND TOTAL				75,443	68,442	45,160	40,896	

Table 15.6.1 COST AND BENEFITS  
(F4 STANDARD)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	13,688	0	0	0	0	19,231	0
1985	34,221	0	0	0	0	42,927	0
1986	20,533	0	0	0	0	22,997	0
1987	0	732	3,815	-163	4,383	0	3,914
1988	0	864	4,080	-154	4,790	0	3,819
1989	0	997	4,346	-145	5,198	0	3,700
1990	0	1,129	4,611	-135	5,605	0	3,562
1991	0	1,261	4,876	-126	6,012	0	3,411
1992	0	1,394	5,142	-117	6,419	0	3,252
1993	0	1,526	5,407	-107	6,826	0	3,088
1994	19,408	1,662	5,787	-93	7,355	8,779	2,971
1995	0	1,798	6,166	-79	7,885	0	2,843
1996	0	1,934	6,546	-65	8,414	0	2,709
1997	0	2,069	6,925	-52	8,943	0	2,571
1998	0	2,205	7,304	-38	9,472	0	2,431
1999	0	2,341	7,684	-24	10,001	0	2,292
2000	0	2,477	8,063	-10	10,530	0	2,155
2001	-33,168	2,613	8,443	4	11,060	-6,060	2,021
TOTAL	54,682	25,003	89,194	-1,304	112,893	87,874	44,738

DISCOUNTED ECONOMIC COSTS :	87,874
DISCOUNTED ECONOMIC BENEFITS :	44,738
AGRICULTURAL DEVELOPMENT BENEFIT	9,506
VOC SAVING	35,987
RMC SAVING	-755
NET PRESENT VALUE :	-43,136
BENEFIT COST RATIO :	0.51
INTERNAL RATE OF RETURN :	5.1 %

Table 15.6.2 COST AND BENEFITS  
(F5 STANDARD)

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	16,358	0	0	0	0	20,519	0
1986	24,538	0	0	0	0	27,483	0
1987	0	732	2,367	-18	3,081	0	2,751
1988	0	864	2,564	-13	3,416	0	2,723
1989	0	997	2,762	-8	3,751	0	2,670
1990	0	1,129	2,959	-3	4,085	0	2,596
1991	0	1,261	3,157	2	4,420	0	2,508
1992	0	1,394	3,355	7	4,755	0	2,409
1993	0	1,526	3,552	11	5,090	0	2,302
1994	968	1,662	3,831	18	5,512	438	2,226
1995	0	1,798	4,110	25	5,934	0	2,140
1996	0	1,934	4,390	33	6,356	0	2,046
1997	0	2,069	4,669	40	6,778	0	1,949
1998	0	2,205	4,948	47	7,200	0	1,848
1999	0	2,341	5,227	54	7,622	0	1,747
2000	0	2,477	5,507	61	8,044	0	1,646
2001	-20,497	2,613	5,786	68	8,466	-3,745	1,547
TOTAL	21,367	25,003	59,184	323	84,510	44,695	33,108

DISCOUNTED ECONOMIC COSTS :	44,695
DISCOUNTED ECONOMIC BENEFITS :	33,108
AGRICULTURAL DEVELOPMENT BENEFIT	9,506
VOC SAVING	23,539
RMC SAVING	64
NET PRESENT VALUE :	-11,587
BENEFIT COST RATIO :	0.74
INTERNAL RATE OF RETURN :	8.9 %

Table 15.7.1 SOCIAL INDICATORS  
(Proposed Route IM-15)

Population (1,000)		Education		Disparity		Note:
1982	: 32.8	Access to Secondary School		G.P.V. in 1993 (Mn B) <u>8/</u>		
1993	: 37.9	Number of Student in 1993 (1,000) <u>2/</u>	: 4.5	With project	: 65.7	
Average travelling speed, without (kph)	: 45	Average distance to school (km)	: 6.7	Without project	: 63.3	<u>2/</u> 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.
Isolation		Per capita time savings (10 <sup>-4</sup> )	: 0.124	Per capita G.P.V. in 1993 (B)		
Access to Amphoe		Score	: 64	With project (W)	: 1,734	<u>3/</u> Numbers of the sample areas
Average distance to Amphoe (km) <u>1/</u>	: 9.4	Teacher Intensity		Without project (w)	: 1,670	
Per capita time savings (10 <sup>-4</sup> )	: 0.020	Number of teachers <u>3/</u>		Degree of Disparity		<u>4/</u> (Number of University Graduate Teachers)/(Total Number of Student) x 1,000
Score	: 61	University graduate	: 2	(A/W) - (A/w) <u>9/</u>	: 0.07	
Access to Artery Highway		Total	: 16	Score	: 125	<u>5/</u> (Total of Teachers)/(Total Number of Student) x 1,000
Average distance to highway (km) <u>1/</u>	: 15	Number of Student	: 290	Total Score	: 531	
Per capita time savings (10 <sup>-4</sup> )	: 0.032	Indicators				<u>6/</u> Sum of <u>4/</u> and <u>5/</u>
Score	: 64	E1 <u>4/</u>	: 6.9			
Impassability		E2 <u>5/</u>	: (51.0)			<u>7/</u> 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
Impassable week a year	: -	E <u>6/</u>	: 57.9			
Impassability per year	: 0	Degree of Improvement <u>7/</u>	: 1.18			<u>8/</u> Estimated gross value of crop production in the areas of influence
Impassability per capita (10 <sup>-4</sup> )	: 0	Score	: 75			
Score	: 0					<u>9/</u> "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.
Health						
Access to Hospital						
Average distance to Hospital (km) <u>1/</u>	: 20.0					
Per capita time savings (10 <sup>-4</sup> )	: 0.044					
Score	: 102					
Access to Medical Facilities						
Average distance to facilities (km) <u>1/</u>	: 4.8					
Per capita time savings (10 <sup>-4</sup> )	: 0.010					
Score	: 40					

**PROPOSED ROUTE NO. IM - 16**

Changwat : Nakhon Phanom

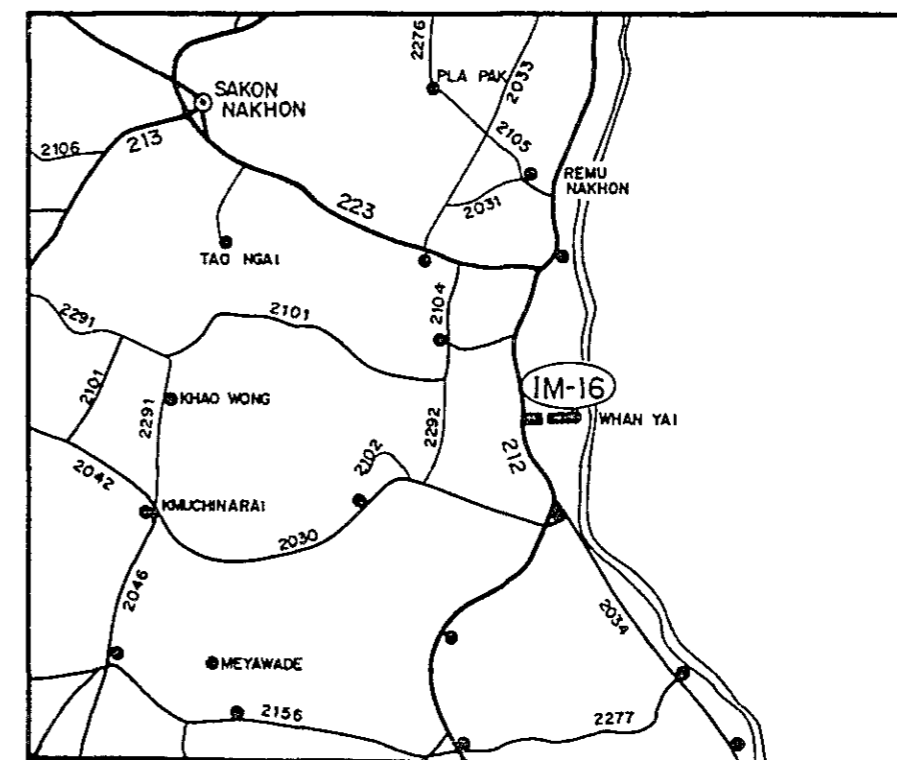
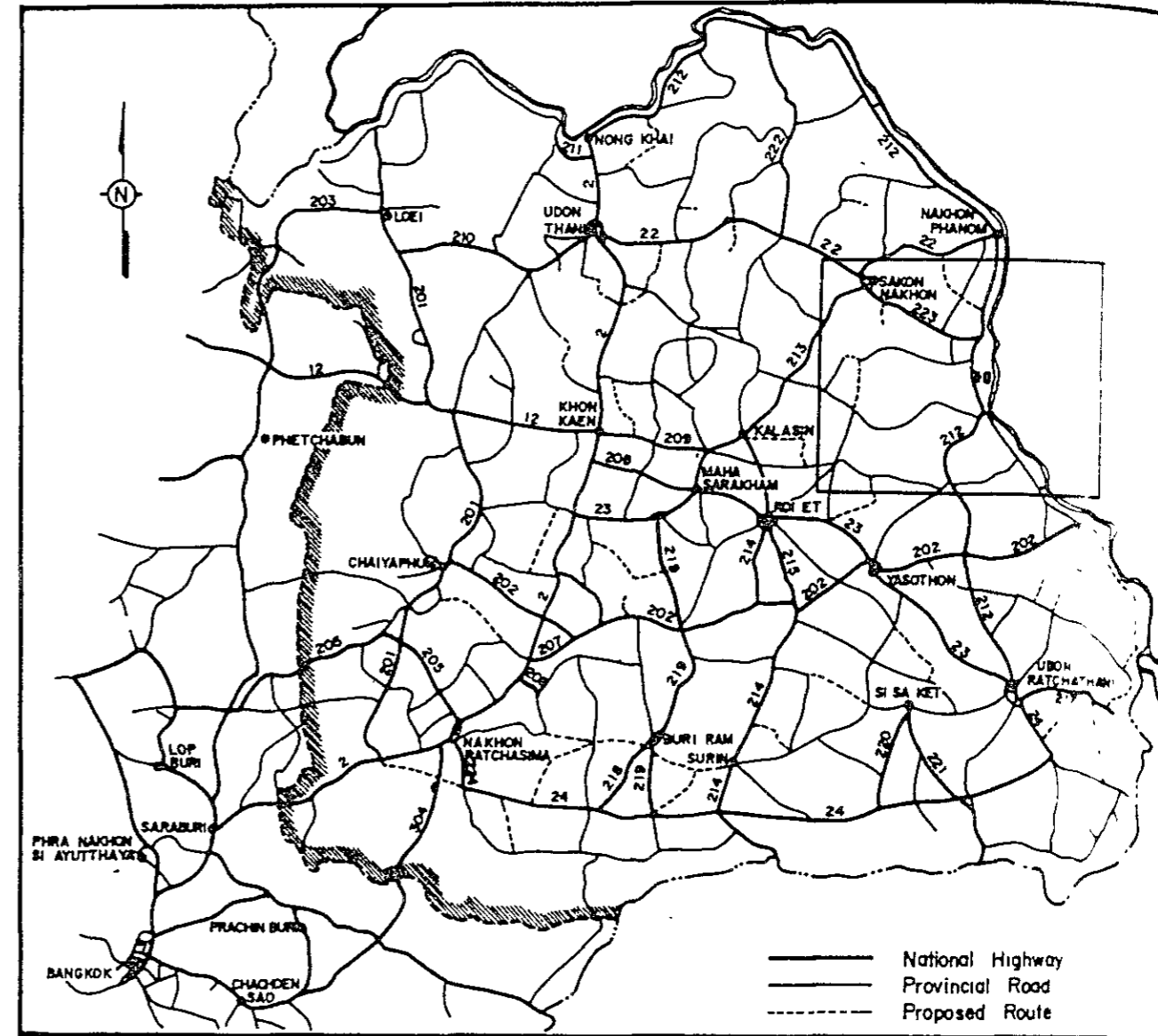
J.R. 212 - K.A. Whan Yai

Length : 9.1 KM.

SUMMARY  
PROPOSED ROUTE IM-16

Item	Description
Changwat	Nakhon Phanom
Origin	J.R.212
Destination	K.A. Whan Yai
Length	
Total	9.1 km
Improvement Section	9.1 km
DOH Road	0 km
ARD Road	0 km
Others	9.1 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Rolling
Influence Area	
Area	70 km <sup>2</sup>
Population (1982)	9,500
Principal Crops	Paddy
Traffic (ADT)	
Existing	67
1993	272
2001	347
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	15,224 . 10 <sup>3</sup> ฿
Economic	13,835 . 10 <sup>3</sup> ฿
IRR	3.0 %
B/C	0.40
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 part of Changwat Nakhon Phanom. The route starting at the intersection with Route 212, runs eastward and ends at King Amphoe Whan Yai. Its total length is 9.1 km (Figure 16.5.2).

The terrain is almost rolling. In the influence area, there exist a few village with total population of 9,500. There are one medical center, no hospital and one secondary school along the proposed route.

The proposed route, upon completion, will play vital role to connect King Amphoe Whan Yai closely located at the bank of the Mekong river with artery highway Route 212.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 16.1.1. The details are shown as the results of inventory survey in Table 16.1.2.

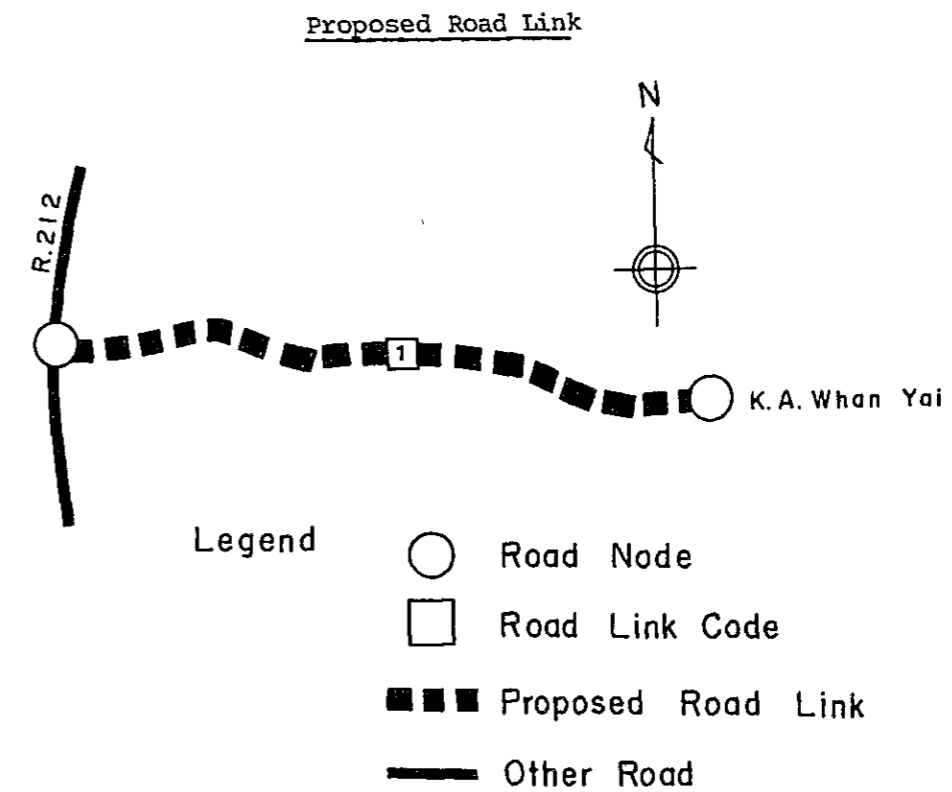
2. TRAFFIC

2.1 Method

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

2.2 Base Year Traffic

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



Traffic Volume in Base Year

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

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road 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	428

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	11	8	19

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	1993
	1987	1993	2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.6	1.3	1.1
PASSENGER MOVEMENT	5.6	5.7	5.8

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
NON-AGRI. AGRICULTURE	7.2	7.3	7.4
FREIGHT	4.4	4.5	4.5

2.5 Induced and Developed Traffic

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

RATE OF INDUCED AND DEVELOPED TRAFFIC

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.4	0.5

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

LINK NO.	YEAR	(UNIT : %)								
		PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	0.0	59.6	38.5	1.9	0.0	26.7	33.3	40.0	0.0
	1987	3.9	55.7	32.2	6.1	2.1	24.1	28.8	38.7	8.4
	1993	8.6	51.0	24.6	11.2	4.5	21.1	23.3	37.1	18.5
	2001	14.9	44.7	14.6	17.9	7.9	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road link is shown in the following table and details by road link by traffic type are shown in Table 16.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	3	23	4	1	44	4	5	1	86	145	232
1993	8	23	10	4	50	3	5	2	105	167	272
2001	19	19	23	10	60	2	5	4	142	205	347

### 3. AGRICULTURAL DEVELOPMENT

#### 3.1 Present Condition

Almost all cultivated land is covered by paddy field and very few by upland field of cassava, kenaf and sugar cane.

Unused cultivable land for both paddy and upland field still available in the area.

Land use and capability conditions in the area of influence are shown in Table 16.3.1 and Figure 16.3.1.

A typical cropping calendar in the Nakhon Phanom area is shown in Figure 16.3.2.

#### 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 16.3.2.

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 16.3.3.

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 16.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

### 4. VOC SAVINGS

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

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

#### Road Condition

Link	Without Project				With Project			Nos. of Wooden Narrow Bridge
	No. Terrain	Length (Km)	<sup>/1</sup> Nos. of Road Class	Nos. of Wooden Narrow C.Bridge	Length (Km)	<sup>/1</sup> Road Class	Nos. of Wooden Narrow Bridge	
1	Rolling	9.1	3	0	0	9.1	1(F4) 2A(F5)	0

<sup>/1</sup> 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:

<u>Vehicle Operating Cost Saving</u>			
(unit: 1,000 Baht)			
<u>Road Class</u>	<u>1987</u>	<u>1993</u>	<u>2001</u>
1 (F4)	472	669	1,030
2A (F5)	296	437	682

## 5. ENGINEERING

### 5.1 Preliminary Design

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

Design Standard	:	F4 (if not feasible, P5)
Geometric Design	:	AASHTO (Rural Highways)
Typical Cross Section	:	as shown in Figure 16.5.1
Minimum Height of Embankment		
Ordinary Section	:	1.0m
Approach of Bridge in Flat Area	:	2.0m
Flood Section	:	0.7m (above flood level)

#### Pavement Structure

In case of F4 Standard

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

In case of F5 Standard

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

#### Pipe Culvert

Standard Size	:	$\phi$ 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 16.5.2

Alignment of the route is shown in Figure 16.5.2.

### 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 16.5.1.

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

Total Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10 <sup>3</sup> B)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	9.1	15,224	13,835	
F5 (Laterite)	9.1	7,555	6,862	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 16.6.1 and 16.6.2.

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 16.7.1. Social impacts of the proposed route are considerably high.

Table 16.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	J.R. 212	
Destination	K.A. Whan Yai	
Length		
Total		9.1 km
Improvement Section		9.1 km
DOH Road		0 km
ARD Road		0 km
Others		9.1 km
New Alignment Section		0 km
Terrain	Rolling	
Alignment (Hori./Vert.)	Fair/Fair	
Formation Width	7.5 m - 9.0 m, 7.9 m (Weighted average)	
Embankment Section		
Length		9.1 km
Height	0.5 m -	1.0 m
Cut Section		
Length		0 km
Depth	m -	m
Surface Type and Condition		
SBST or DBST		0 km
Soil Aggregate	Poor	9.1 km
Earth		0 km
Pipe Culvert	3 each	
Box Culvert	1 each	9.0 m
Bridge		
Permanent Bridge	1 each	4.0 m
Narrow Concrete Bridge	0 each	0 m (4m)
Wooden Bridge	0 each	0 m
Overflow Section	0 place	0 km

Table 16.1.2 ROAD INVENTORY L = 9.1 Km.

J.R. 212 ~ K.A. WHAN YAI  
NAKHON PHANOM

PROPOSED ROUTE NO. IM-16

STATION (Km)		0	2	4	6	8	10	
VILLAGE								K.A. WHAN YAI
- Name								
- Household (H)								
- Population (P)								
TERRAIN		Rolling						
CROSS SECTION	Formation Width (m)	7.50	8.00	7.50	9.00	8.00	7.50	
	Embankment Height (m)	0.50	0.50	0.50	0.50	0.80	1.00	
	Cutting Depth (m)							
PAVEMENT	Type/Length	Laterite						
	Condition	Poor						
FLOODING	Overflow Length(Km)/Height(m)							
LAND USE	Left	Bush	Paddy					
	Right	Bush	Paddy					
PIPE CULVERT	Total Number	3 Pipes						
BOX CULVERT & BRIDGE	Station (Km)					6.9	8.8	
	Dimension					C-Br. 7.50 x 4.00	C-Box 1.00 x 0.50 x 9.00	
RIGHT OF WAY (m)		15.0						
ALIGNMENT	Horizontal	Fair						
	Vertical	Fair						
ROUTE NO., AGENCIES		Rural						

Table 16.2.1 TRAFFIC VOLUME ON ROUTE IM - 16

YEAR	1987		1993		2001		
LINK	1 AVR.		1 AVR.		1 AVR.		
P/C	N+D	2	2	7	7	17	17
	I	0	0	1	1	2	2
	DV	0	0	0	0	0	0
	TOTAL	3	3	8	8	19	19
L/B	N+D	20	20	20	20	16	16
	I	3	3	3	3	2	2
	DV	0	0	0	0	0	0
	TOTAL	23	23	23	23	19	19
M/B	N+D	4	4	9	9	20	20
	I	1	1	1	1	3	3
	DV	0	0	0	0	0	0
	TOTAL	4	4	10	10	23	23
H/B	N+D	1	1	4	4	9	9
	I	0	0	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	1	1	4	4	10	10
P/P&T	N+D	38	38	43	43	52	52
	I	6	6	6	6	8	8
	DV	0	0	0	0	0	0
	TOTAL	44	44	50	50	60	60
4/T	N+D	4	4	3	3	2	2
	I	1	1	0	0	0	0
	DV	0	0	0	0	0	0
	TOTAL	4	4	3	3	2	2
6/T	N+D	5	5	4	4	4	4
	I	1	1	1	1	1	1
	DV	0	0	0	0	0	0
	TOTAL	5	5	5	5	5	5
10/T	N+D	1	1	2	2	4	4
	I	0	0	0	0	1	1
	DV	0	0	0	0	0	0
	TOTAL	1	1	2	2	4	4
ADT	N+D	75	75	91	91	123	123
	I	11	11	14	14	18	18
	DV	0	0	0	0	1	1
	TOTAL	86	86	105	105	142	142
M/C	N+D	132	132	151	151	186	186
	I	14	14	15	15	18	18
	DV	0	0	0	0	1	1
	TOTAL	145	145	167	167	205	205
TOTAL	N+D	207	207	242	242	309	309
	I	25	25	29	29	37	37
	DV	0	0	1	1	1	1
	TOTAL	232	232	272	272	347	347

NOTE

N : NORMAL TRAFFIC  
DV : DEVELOPED TRAFFIC

D : DIVERTED TRAFFIC  
I : INDUCED TRAFFIC

Figure 16.3.1

**LAND USE AND CAPABILITY OF INFLUENCE AREA  
PROPOSED ROUTE NO. IM - 16**

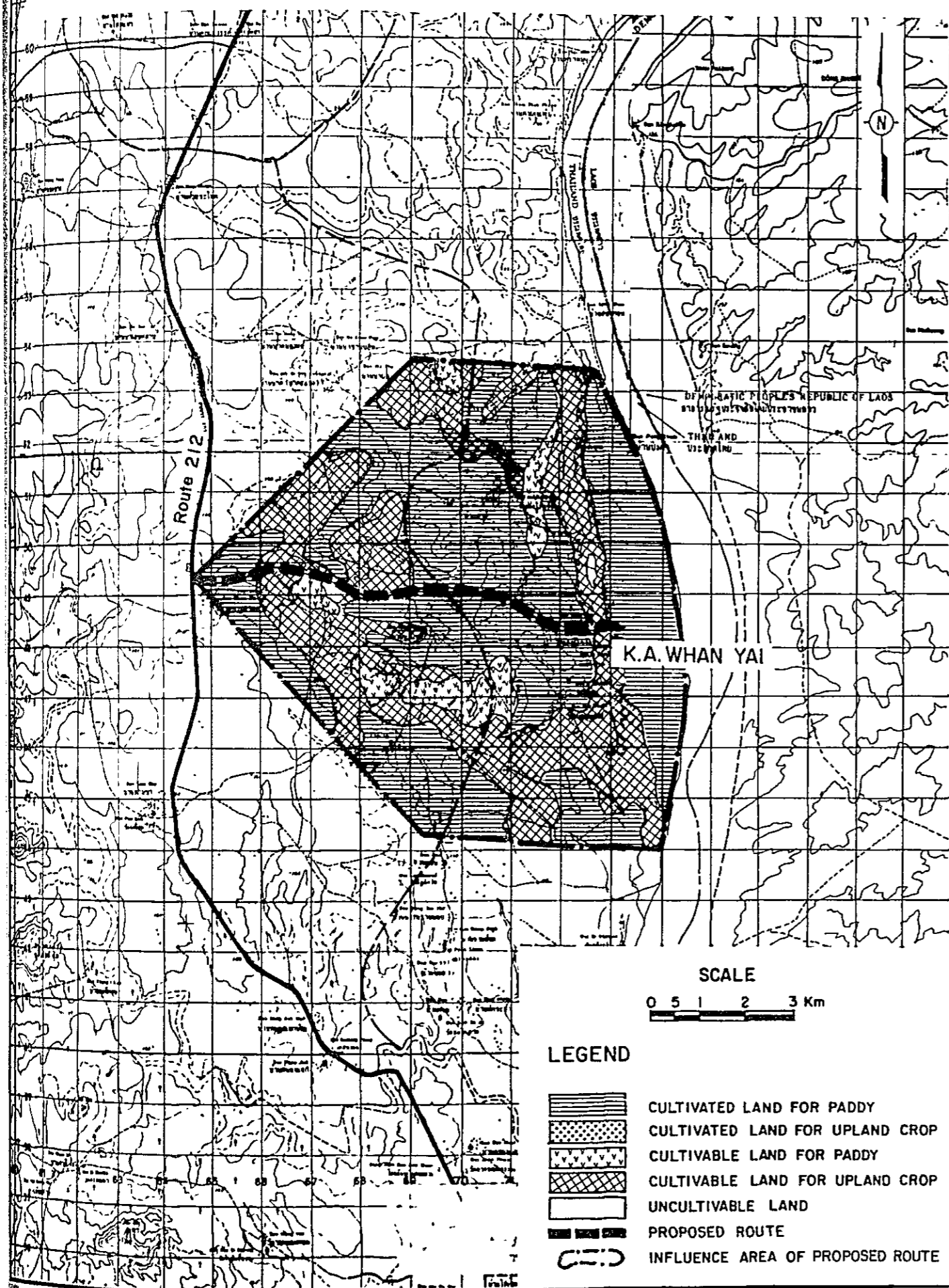


Figure 16.3.2 **CROPPING CALENDAR**

0500 CHANCWAT NAKHON PHANOM

NAME OF CROP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP.	OCT.	NOV	DEC
RICE , 1 <sup>st</sup> CROP				○	○	○	○	○	○	○	○	○
RICE , 2 <sup>nd</sup> CROP	○	○	○	○	○							
SUGAR CANE								○	○	○	○	○
TOBACCO (VIRGINIA & LOCAL)										○	○	○
KENAF		○	○	○	○	○	○	○	○	○	○	○
JUTE		○	○	○	○	○	○	○	○	○	○	○
CASSAVA				○	○	○	○	○	○	○	○	○
MAIZE				○	○	○	○	○	○	○	○	○
GROUND NUT { LESS-RAINY SEASON					○	○	○	○	○	○	○	○
{ MORE-DRY SEASON	○	○	○	○	○	○	○	○	○	○	○	○
COTTON							○	○	○	○	○	○

Note

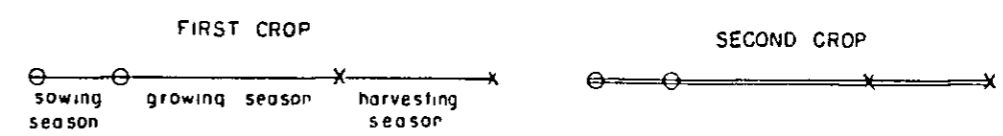


TABLE 16.3.1 CULTIVATED &amp; CULTIVABLE LAND

(1979)

[ UNIT : 1000 RAI (KM<sup>2</sup>) ]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		24.375 ( 39.0)	-	24.375 ( 39.0)	3.125 ( 5.0)	16.250 ( 26.0)	19.375 ( 31.0)
0512	MUKDAHAN	8.125 ( 13.0)	-	8.125 ( 13.0)	1.875 ( 3.0)	8.750 ( 14.0)	10.625 ( 17.0)
0513	WAN YAI	16.250 ( 26.0)	-	16.250 ( 26.0)	1.250 ( 2.0)	7.500 ( 12.0)	8.750 ( 14.0)

TABLE 16.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	23.36	-	-	-	0.45	0.14	0.33	-	1.00	24.36
1987	23.36	-	-	-	0.49	0.15	0.34	-	1.05	24.41
1993	23.36	-	-	-	0.53	0.16	0.34	-	1.11	24.47
	WITHOUT PROJECT	-	-	-	0.62	0.17	0.35	-	1.21	24.57
	WITH PROJECT	-	-	-	0.60	0.17	0.35	-	1.20	24.55
2001	23.36	-	-	-	0.69	0.18	0.35	-	1.31	24.67
	WITHOUT PROJECT	-	-	-	0.69	0.18	0.35	-	1.31	24.67
	WITH PROJECT	-	-	-	0.69	0.18	0.35	-	1.31	24.67
CROP YIELD (KG/RAI)										
1981	225.6	-	-	-	2500.0	6828.7	175.0	-	-	-
1987	227.0	-	-	-	2500.0	6869.8	175.0	-	-	-
1993	228.4	-	-	-	2500.0	6911.1	175.0	-	-	-
	WITHOUT PROJECT	-	-	-	2500.0	6911.1	175.0	-	-	-
	WITH PROJECT	-	-	-	2515.0	6952.7	175.0	-	-	-
2001	230.2	-	-	-	2500.0	6966.6	175.0	-	-	-
	WITHOUT PROJECT	-	-	-	2500.0	6966.6	175.0	-	-	-
	WITH PROJECT	-	-	-	2535.2	7064.7	175.0	-	-	-
CROP PRODUCTION (TON)										
1981	5,270	-	-	-	1,113	970	58	-	2,154	7,424
1987	5,302	-	-	-	1,216	1,036	59	-	2,324	7,626
1993	5,334	-	-	-	1,330	1,106	60	-	2,509	7,843
	WITHOUT PROJECT	-	-	-	1,548	1,180	61	-	2,803	8,234
	WITH PROJECT	-	-	-	1,498	1,207	61	-	2,780	8,156
2001	5,377	-	-	-	1,498	1,207	61	-	2,780	8,156
	WITHOUT PROJECT	-	-	-	1,758	1,299	62	-	3,132	8,739
	WITH PROJECT	-	-	-	1,758	1,299	62	-	3,132	8,739

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 16.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,630	-	-	-	515	702	3,430	-
WITH PROJECT (1987 - 2001)	3,721	-	-	-	528	702	3,516	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	560	-	-	-	759	2,506	511	-
WITH PROJECT (1987 - 2001)	580	-	-	-	779	2,544	511	-

TABLE 16.3.4 NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	6,166	670	6,836	6,181	675	6,856
1993	6,282	721	7,003	6,660	805	7,465
2001	6,437	796	7,233	7,315	903	8,218

Figure 16.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

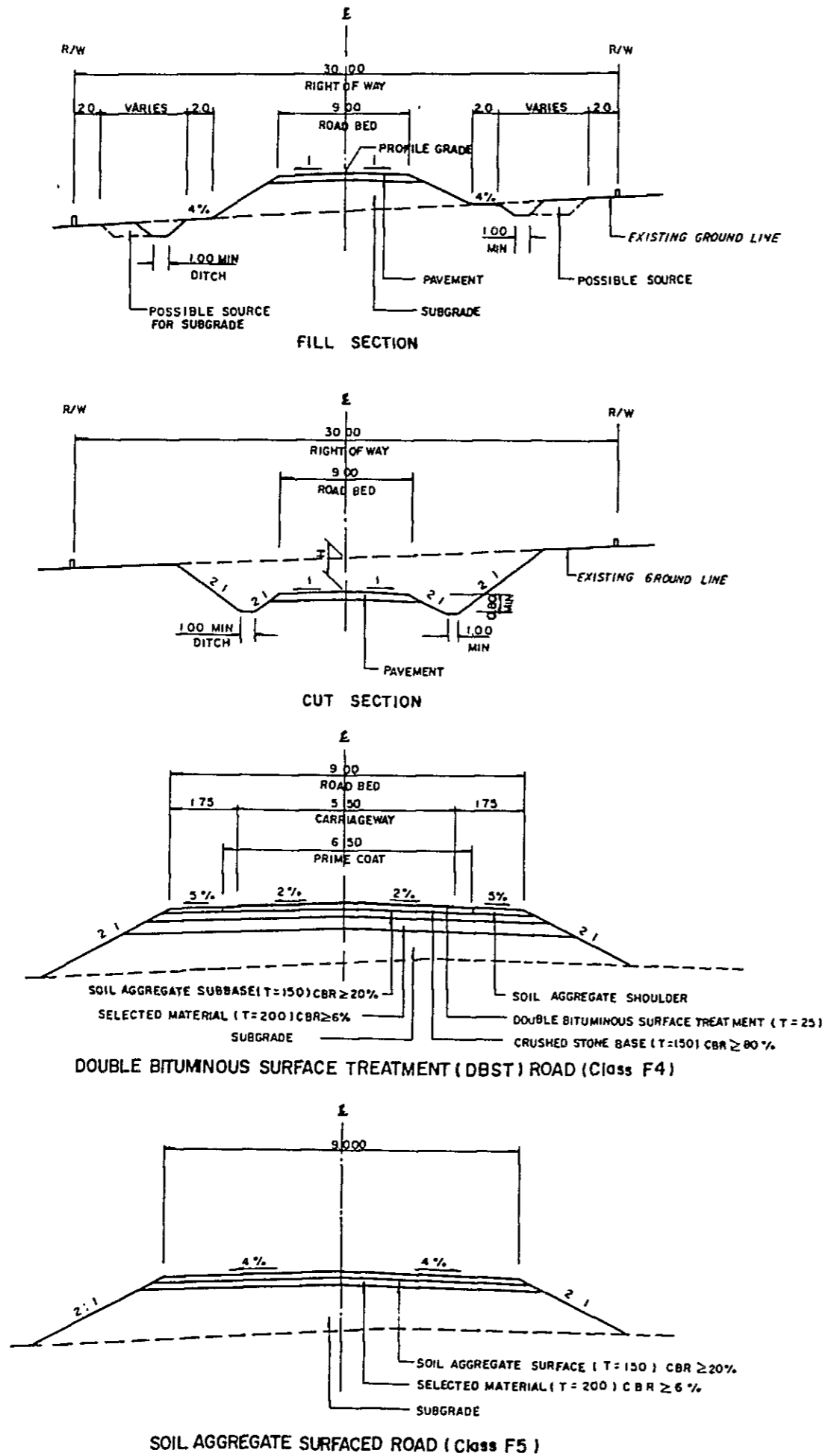
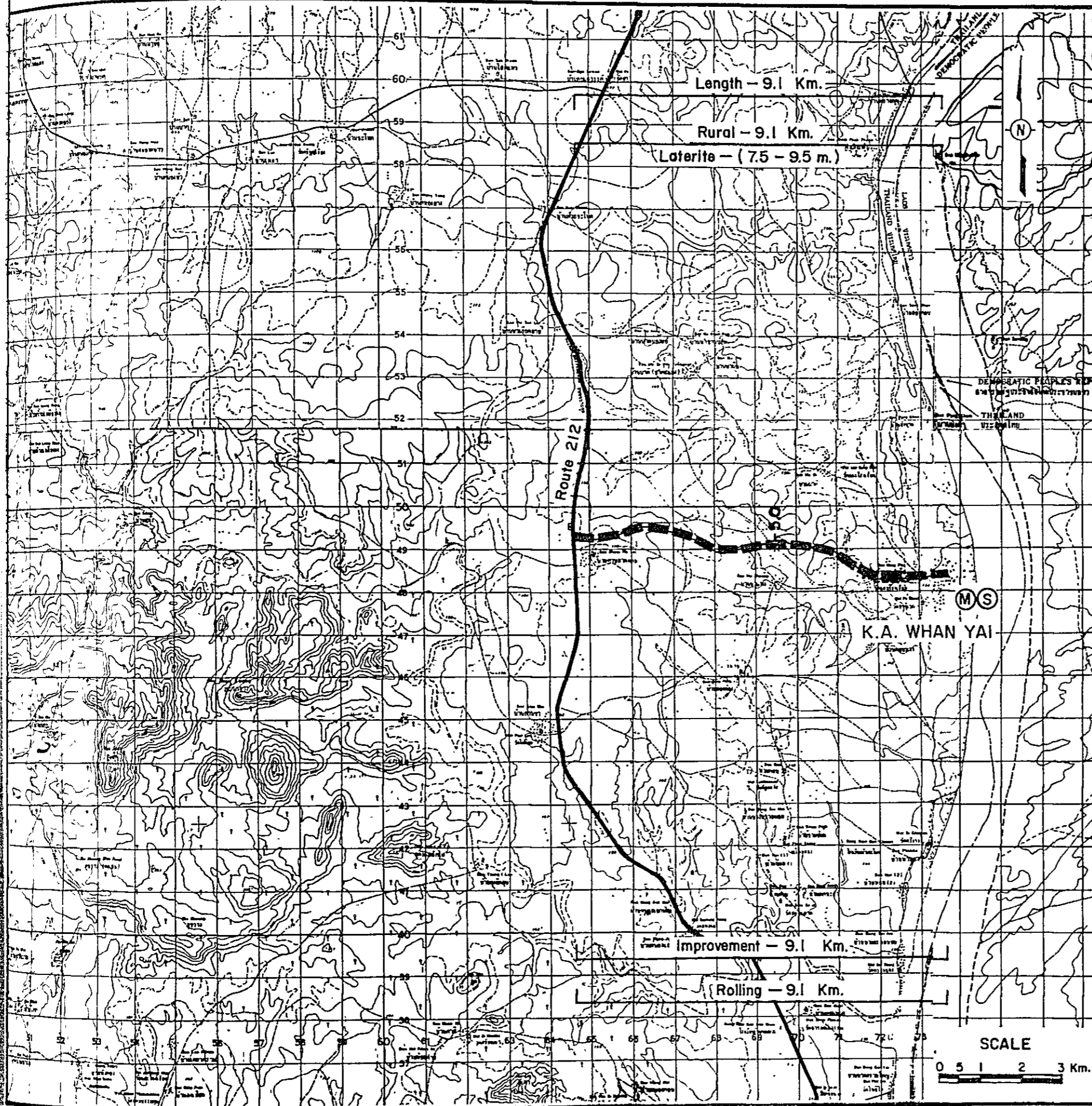


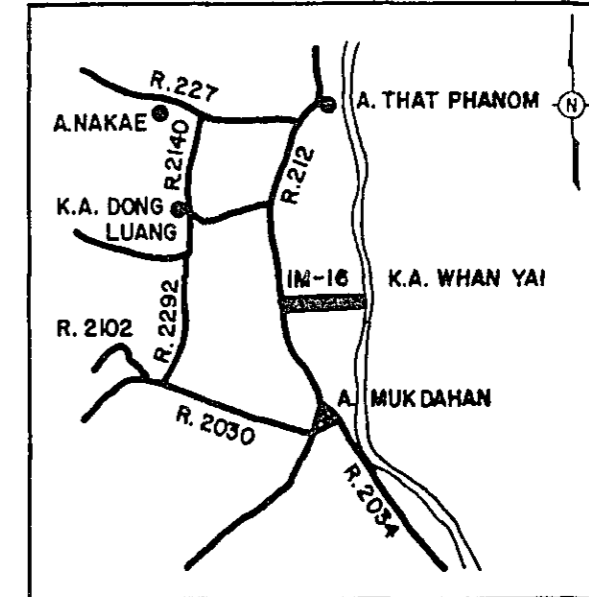


Figure 16.5.2

**PROPOSED ROUTE NO. IM-16 C.NAKHON PHANOM J.R. 212 - K.A. WHAN YAI**  
**ROUTE NO. Rural L=9.1 Km.**











LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	6.9	—	C - 7.50 x 4.00

LEGEND

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

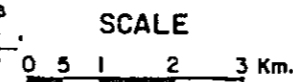


Table 16.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-16 (9.1 km)

Items	Unit of Q'ty	Financial Unit Rate ₪	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)	Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	20	300	273	20	300	273
Excavation - Soil	m <sup>3</sup>	20	0	0	0	0	0	0
Excavation - Hard Rock	m <sup>3</sup>	160	0	0	0	0	0	0
Embankment	m <sup>3</sup>	45	10,700	481	438	10,700	481	438
Selected Material	m <sup>3</sup>	80	19,300	1,544	1,374	19,300	1,544	1,374
Soil Aggregate Surface or Subbase	m <sup>3</sup>	105	13,500	1,417	1,261	13,500	1,417	1,261
Crushed Stone Base	m <sup>3</sup>	370	8,900	3,293	3,029	1,000	370	340
Soil Aggregate Shoulder	m <sup>3</sup>	105	3,800	399	355	400	42	37
Prime Coat and DBST	m <sup>2</sup>	55	50,100	2,756	2,480	5,500	303	273
Pipe Culvert	m	2,100	320	672	618	320	672	618
Box Culvert	m	16,000	3	48	43	3	48	43
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)				10,911	9,873		5,178	4,659
Miscellaneous Works (a) x 7%				764	691		362	326
Total (b)				11,675	10,564		5,540	4,985
PHYSICAL CONTINGENCY (b) x 15%				1,751	1,585		831	748
ENGINEERING AND ADMINISTRATION (b) x 10%				1,168	1,056		554	499
Sub Total				2,919	2,641		1,385	1,247
LAND ACQUISITION								
Highly Developed Land	ha	50,000	12	600	600	12	600	600
Less Developed Land	ha	15,000	2	30	30	2	30	30
Sub Total				630	630		630	630
GRAND TOTAL				15,224	13,835		7,555	6,862

Table 16.6.1 COST AND BENEFITS  
(F4 STANDARD)

YEAR	COST		BENEFITS		DISCOUNTED(12%)		
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	2,767	0	0	0	0	3,471	0
1986	11,068	0	0	0	0	12,396	0
1987	0	20	472	-61	431	0	385
1988	0	91	505	-59	537	0	428
1989	0	162	538	-56	644	0	458
1990	0	233	571	-54	750	0	477
1991	0	304	603	-51	857	0	486
1992	0	375	636	-48	963	0	488
1993	0	446	669	-46	1,070	0	484
1994	4,404	513	714	-42	1,186	1,992	479
1995	0	581	759	-38	1,302	0	469
1996	0	648	804	-34	1,418	0	457
1997	0	715	850	-30	1,534	0	441
1998	0	782	895	-26	1,650	0	424
1999	0	849	940	-23	1,767	0	405
2000	0	916	985	-19	1,883	0	385
2001	-6,704	984	1,030	-15	1,999	-1,225	365
TOTAL	11,535	7,620	10,972	-602	17,990	16,634	6,631

DISCOUNTED ECONOMIC COSTS :	16,634
DISCOUNTED ECONOMIC BENEFITS :	6,631
AGRICULTURAL DEVELOPMENT BENEFIT	2,512
VOC SAVING	4,438
RMC SAVING	-319
NET PRESENT VALUE :	-10,004
BENEFIT COST RATIO :	0.40
INTERNAL RATE OF RETURN :	3.0 %

Table 16.6.2 COST AND BENEFITS  
(F5 STANDARD)

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	1,372	0	0	0	0	1,721	0
1986	5,490	0	0	0	0	6,149	0
1987	0	20	296	-21	295	0	263
1988	0	91	319	-19	392	0	312
1989	0	162	343	-17	488	0	348
1990	0	233	366	-14	585	0	372
1991	0	304	390	-12	682	0	387
1992	0	375	413	-10	778	0	394
1993	0	446	437	-8	875	0	396
1994	484	513	468	-5	976	219	394
1995	0	581	498	-2	1,077	0	388
1996	0	648	529	1	1,178	0	379
1997	0	715	560	4	1,279	0	368
1998	0	782	590	8	1,380	0	354
1999	0	849	621	11	1,481	0	339
2000	0	916	652	14	1,582	0	324
2001	-3,496	984	682	17	1,683	-639	307
TOTAL	3,850	7,620	7,164	-53	14,731	7,450	5,326

DISCOUNTED ECONOMIC COSTS :	7,450
DISCOUNTED ECONOMIC BENEFITS :	5,326
AGRICULTURAL DEVELOPMENT BENEFIT	2,512
VOC SAVING	2,875
RMC SAVING	-61
NET PRESENT VALUE :	-2,124
BENEFIT COST RATIO :	0.71
INTERNAL RATE OF RETURN :	8.6 %

Table 16.7.1 SOCIAL INDICATORS  
(Proposed Route IM-16)

<b>Population (1,000)</b>		<b>Education</b>		<b>Note:</b>
1982	: 9.5	<b>Access to Secondary School</b>		
1993	: 11.1	Number of Student in 1993 (1,000) <sup>2/</sup>	: 1.8	
<b>Average travelling speed, without (kph)</b>		Average distance to school (km)	: 4.5	
: 40		Per capita time savings (10 <sup>-4</sup> )	: 0.278	
<b>Isolation</b>		Score	: 150	
<b>Access to Amphoe</b>		<b>Teacher Intensity</b>		
Average distance to Amphoe (km) <sup>1/</sup>	: 2.3	Number of teachers <sup>3/</sup>		
Per capita time savings (10 <sup>-4</sup> )	: 0.023	University graduate	: -	
Score	: 68	Total	: 13	
<b>Access to Artery Highway</b>		Number of Student	: 339	
Average distance to highway (km) <sup>1/</sup>	: 9	<b>Indicators</b>		
Per capita time savings (10 <sup>-4</sup> )	: 0.090	E1 <sup>4/</sup>	: -	
Score	: 196	E2 <sup>5/</sup>	: 38.3	
<b>Impassability</b>		E <sup>6/</sup>	: 38.3	
Impassable week a year	: -	Degree of Improvement <sup>7/</sup>	: 1.79	
Impassability per year	: 0	Score	: 114	
Impassability per capita (10 <sup>-4</sup> )	: 0	<b>Disparity</b>		
Score	: 0	G.P.V. in 1993 (Mn B) <sup>8/</sup>		
<b>Health</b>		With project	: 22.2	
<b>Access to Hospital</b>		Without project	: 21.1	
Average distance to Hospital (km) <sup>1/</sup>	: 4.5	Per capita G.P.V. in 1993 (B)		
Per capita time savings (10 <sup>-4</sup> )	: 0.045	With project (W)	: 2,000	
Score	: 105	Without project (w)	: 1,901	
<b>Access to Medical Facilities</b>		Degree of Disparity		
Average distance to facilities (km) <sup>1/</sup>	: 4.5	(A/W) - (A/w) <sup>9/</sup>	: 0.08	
Per capita time savings (10 <sup>-4</sup> )	: 0.045	Score	: 143	
Score	: 180	<b>Total Score</b>	: 956	

Note:

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

<sup>2/</sup> 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.

<sup>3/</sup> Numbers of the sample areas

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

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

<sup>6/</sup> Sum of <sup>4/</sup> and <sup>5/</sup>

<sup>7/</sup> 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

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

<sup>9/</sup> "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 - 17**

Changwat : Kalasin

A. Kuchinarai (J.R.2042,2030) - B.Na Khu

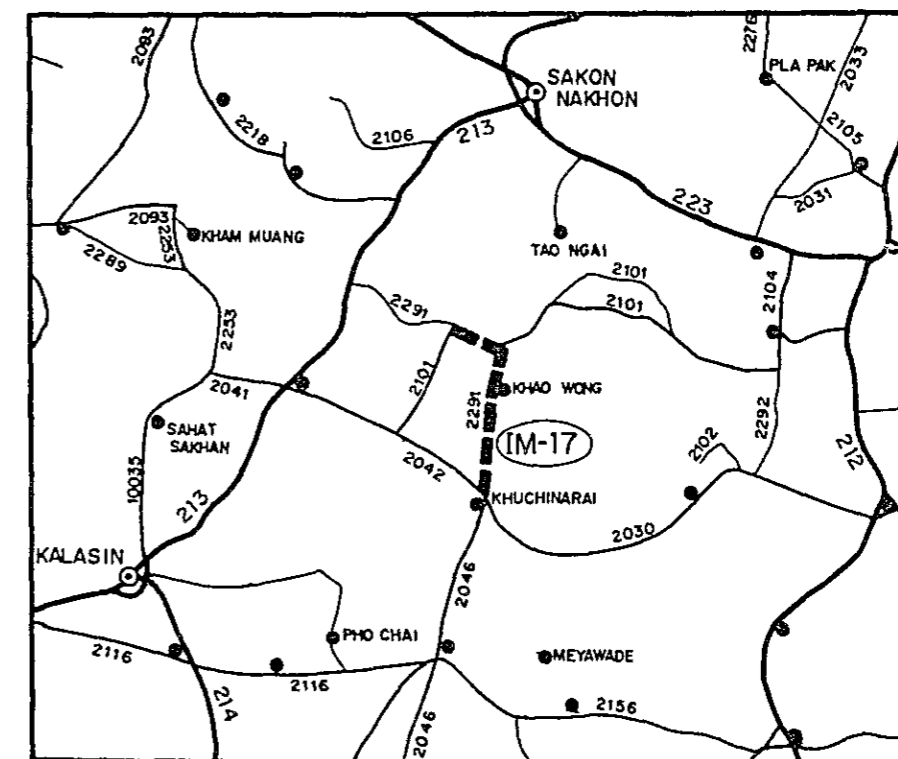
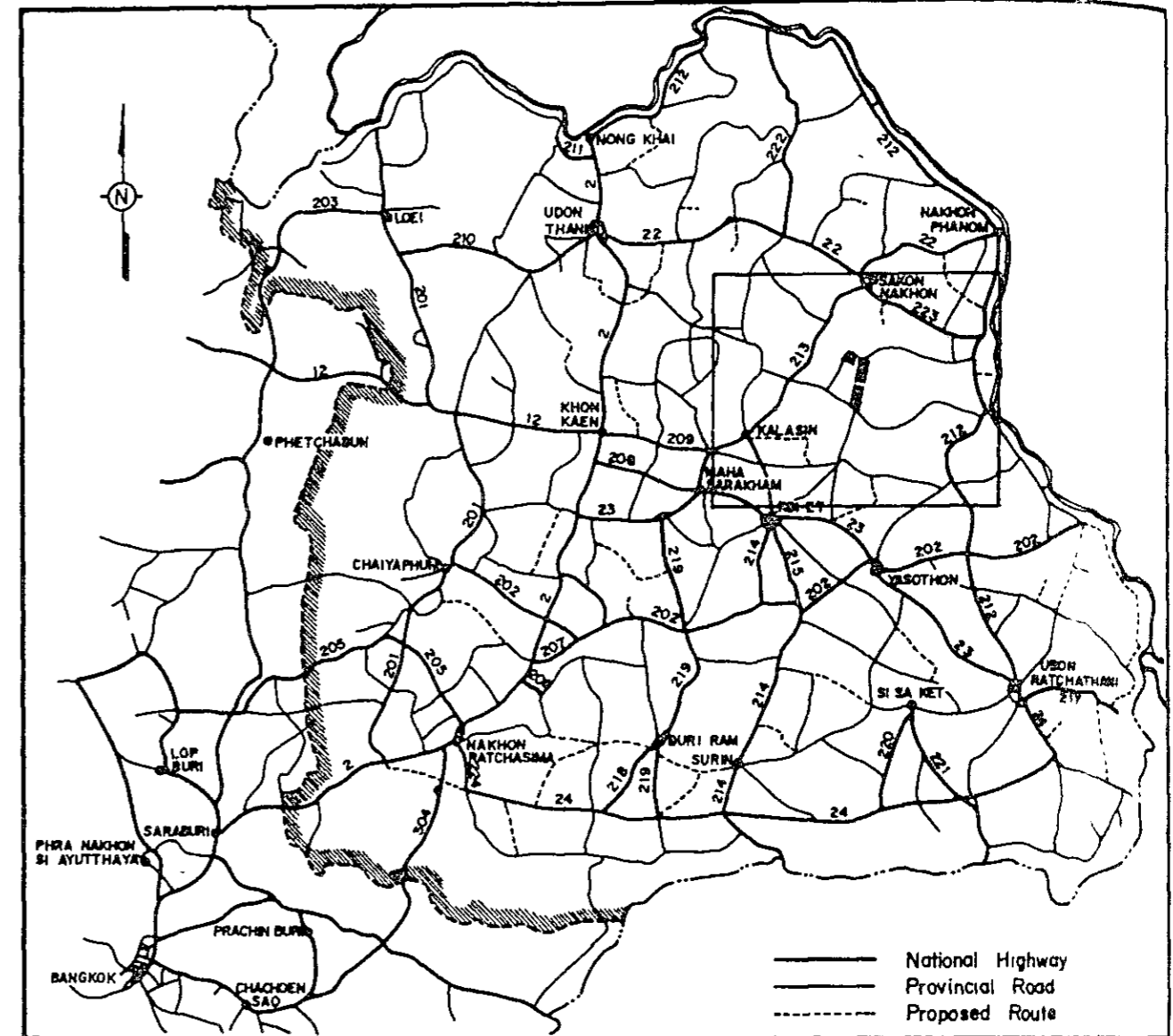
Length · 30.4 KM.

## LOCATION OF PROPOSED ROUTE

### SUMMARY

#### PROPOSED ROUTE IM-17

Item	Description
Changwat	Kalasin
Origin	A. Kuchinarai (J.R.2042, 2030)
Destination	B. Na Khu
Length	
Total	30.4 km
Improvement Section	30.4 km
DOH Road	R.2291      30.4 km
ARD Road	0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat and Rolling
Influence Area	
Area	175 km <sup>2</sup>
Population (1982)	25,300
Principal Crops	Paddy
Traffic (ADT)	
Existing	124
1993	469
2001	611
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	66,060 . 10 <sup>3</sup> ฿
Economic	59,650 . 10 <sup>3</sup> ฿
IRR	8.7 %
B/C	0.75
Recommendation	For further consideration



## 1. GENERAL

### 1.1 Characteristics of the Route

The proposed route is located in the south part of Changwat Kalasin. The route, starting at the intersection of Route 2042 with Route 2046, Amphoe Kuchinarai, runs northward passing through Ban Naka, Amphoe Khao Wong and Ban Nong Phu and ends at Ban Na Khu on Route 2101. Its total length is 30.4 km. (Figure 17.5.2)

The terrain is almost flat and rolling. In the influence area, there exists several villages with total population of 25,300. There are two medical centers, one hospital and three secondary schools along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect three highways, Route 2042, 2046 and 2101 in the agriculturally developed area and also play vital role to connect Amphoe Khao Wong.

### 1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 17.1.1. The details are shown as the results of inventory survey in Table 17.1.2.

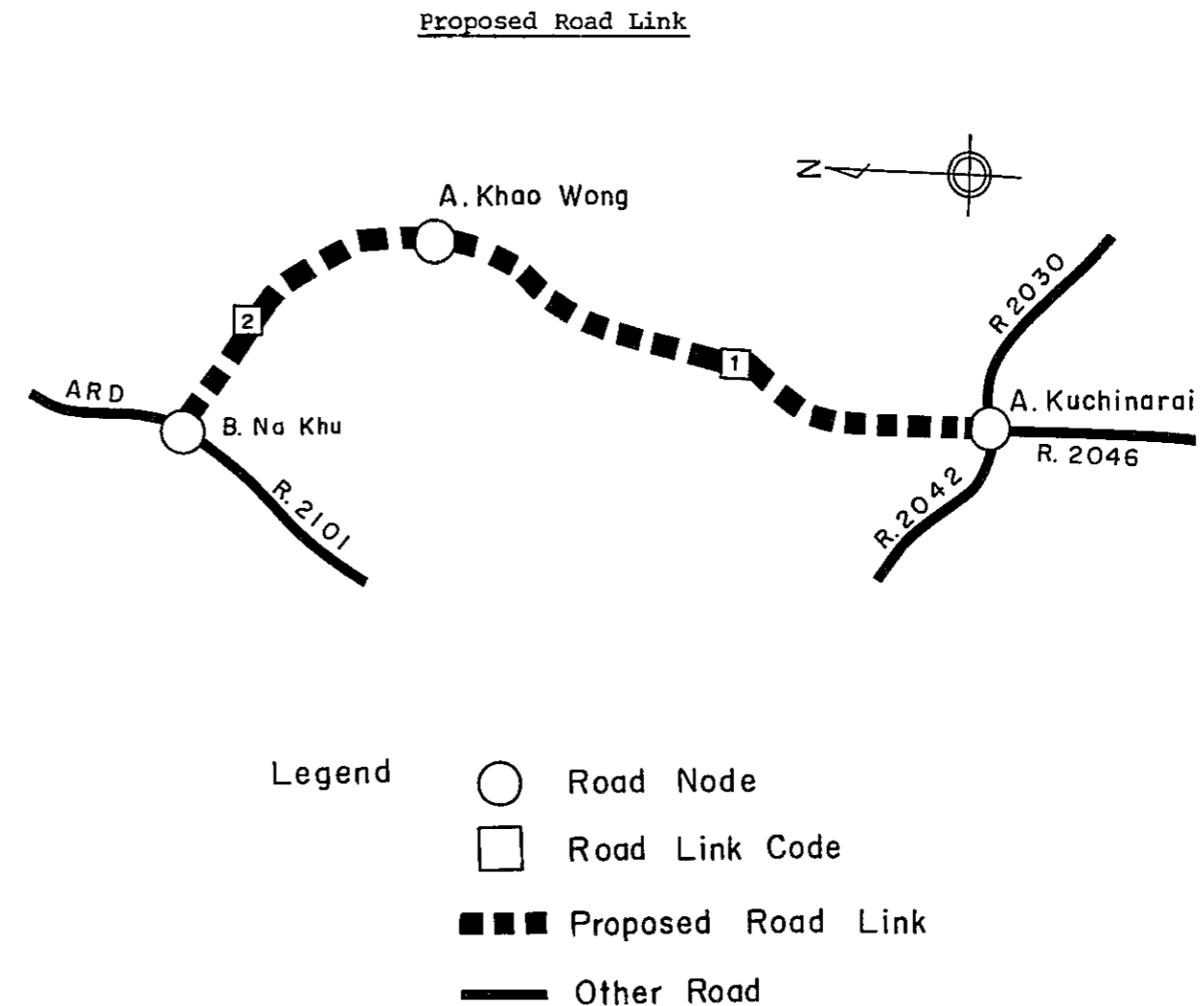
## 2. TRAFFIC

### 2.1 Method

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

### 2.2 Base Year Traffic

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



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 <sup>1/</sup>	26	21	17	20	5	4	10	25	8	136
	2	n.a.									
Manual Counts (1982)	1	n.a.									
	2	-	21	21	4	-	2	30	8	-	86
Estimated	1	26	21	17	20	5	4	10	25	8	136
	2	-	21	21	4	-	2	30	8	-	86

Note: 1/ Route 2291 Section 0100 Station Km 48+274

2.3 Transport Movement

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

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	1010
2	467

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE FER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	61	72	133
2	19	22	41

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	1993
	1987	1993	2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.6	1.3	1.1
PASSENGER MOVEMENT	5.6	5.7	5.8

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
NON-AGRI. AGRICULTURE	7.2 0.4	7.3 0.1	7.4 0.1
FREIGHT	3.5	3.4	3.5



## 2.5 Induced and Developed Traffic

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

### RATE OF INDUCED AND DEVELOPED TRAFFIC

ITEM	YEAR		
	( % )		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

## 2.6 Future Traffic

### 1) Traffic Composition

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

### TRAFFIC COMPOSITION

LINK NO.	YEAR	(UNIT : %)									
		PASSENGER					FREIGHT				
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	
1	1982	29.2	23.6	19.1	22.5	5.6	8.5	21.3	53.2	17.0	
	1987	24.4	28.4	18.5	22.0	6.7	11.1	19.7	47.7	21.5	
	1993	19.6	33.2	17.9	21.6	7.8	13.6	18.1	42.3	26.0	
	2001	13.2	39.6	17.0	21.0	9.2	17.0	16.0	35.0	32.0	
2	1982	0.0	45.7	45.7	8.7	0.0	5.0	75.0	20.0	0.0	
	1987	3.0	42.6	38.8	12.8	2.8	8.2	59.5	23.9	8.4	
	1993	6.6	39.0	30.6	17.6	6.1	11.9	40.8	28.7	18.5	
	2001	11.4	34.2	19.6	24.2	10.6	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 17.2.1.

### 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	25	24	24	7	40	13	23			
1993	28	30	33	12	60	12	23	14	211	258	469
2001	30	40	50	22	102	10	23	21	298	313	611

## 3. AGRICULTURAL DEVELOPMENT

### 3.1 Present Condition

Around 93% of the cultivated land in the influence area is covered by paddy fields. In the upland field, cassava, kenaf and ground nuts are grown.

Potential land remained is mostly for upland field.

Land use and capability conditions in the area of influence are shown in Table 17.3.1 and Figure 17.3.1.

A typical cropping calendar in the Kalasin area is shown in Figure 17.3.2.

### 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 17.3.2.

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 17.3.3.

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 17.3.4. 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.

		<u>Road Condition</u>						
Link		Without Project			With Project			
No.	Terrain	Length (Km)	<sup>/1</sup> Nos. of Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	Length (Km)	<sup>/1</sup> Nos. of Road Class	Nos. of Wooden Narrow Bridge
						Case 1	Case 2	
1	Flat & Rolling	23.0	3	4	1	23.0	} 1(F4) } 2A(F5)	0
2	Rolling	7.4	2B	4	2	7.4		0

- <sup>/1</sup> 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)	4,928	6,747	10,171
2A (F5)	3,400	4,782	7,335

#### 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 17.5.1
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 <sub>&gt;80%</sub> :	15.0cm

Soil Aggregate Subbase CBR $\geq$ 20% : 15.0cm

Selected Material CBR $\geq$  6% : 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR $\geq$ 20% : 15.0cm

Selected Material CBR $\geq$  6% : 20.0cm

Pipe Culvert

Standard Size :  $\phi$  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 17.5.2

Alignment of the route is shown in Figure 17.5.2.

## 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 17.5.1.

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

## Total Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10 <sup>3</sup> B)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	30.4	66,060	59,650	
F5 (Laterite)	30.4	40,628	36,519	

## 6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 17.6.1 and 17.6.2.

The result indicates that the proposed project seems to be not feasible in case of F4 Standard but feasible under F5 Standard.

## 7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 17.7.1.

Table 17.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	A. Kuchinarai (J.R. 2042, 2030)	
Destination	B. Na Khu	
Length		
Total		30.4 km
Improvement Section		30.4 km
DOH Road	R.2291	30.4 km
ARD Road		0 km
Others		0 km
New Alignment Section		0 km
Terrain	Flat and Rolling	
Alignment (Hori./Vert.)	Fair/Fair	
Formation Width	5.5 m - 8.5 m, 7.0 m (Weighted average)	
Embankment Section		
Length		30.4 km
Height	0.1 m -	1.0 m
Cut Section		
Length		0 km
Depth	m -	m
Surface Type and Condition		
SBST or DBST	Poor	7.6 km
Soil Aggregate	Poor	22.8 km
Earth		0 km
Pipe Culvert	24 each	
Box Culvert	0 each	0 m
Bridge		
Permanent Bridge	1 each	80.0 m
Narrow Concrete Bridge	3 each	56.1 m (4m)
Wooden Bridge	8 each	135.5 m
Overflow Section	2 places	0.9 km

Table 17.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-17

ROUTE NO. 2291

A. KUCHINARAI (J.R. 2042, 2030) ~ B. NA KHU

L = 30.4 Km

KALASIN

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30			
VILLAGE		A. KUCHINARAI																		
- Name																				
- Household (H)																				
- Population (P)		B. NA KHO H = 1050 P = 5000																		
TERRAIN		Rolling																		
CROSS SECTION	Formation Width (m)	7.50	5.50	8.00	8.50	6.50						8.50	8.00	6.00	7.00					
	Embankment Height (m)	0.40	0.20	0.10	0.50	1.00	0.30	0.50	0.20	0.80	1.00	0.20	0.40	0.30		0.20				
	Cutting Depth (m)																			
PAVEMENT	Type/Length	DT	Laterite	DT	Laterite						DT	Laterite								
	Condition	Poor																		
FLOODING	Overflow Length(Km)/Height(m)													L=0.3 H=0.8			L=0.6 H=0.6			
LAND USE	Left	Paddy	Bush											Paddy						
	Right	Paddy	Bush											Paddy						
PIPE CULVERT	Total Number	24 Pipes																		
BOX CULVERT & BRIDGE	Station (Km)																			
	Dimension	C-Br. 4.00 x 20.50    9.4 W-Br. 4.50 x 12.00    10.6  C-Br. 8.50 x 80.00    17.7 W-Br. 4.50 x 15.50    18.2  W-Br. 4.50 x 5.00    20.8  W-Br. 4.50 x 20.00    22.1  C-Br. 4.00 x 7.60    24.2 C-Br. 4.00 x 28.00    24.3 W-Br. 4.00 x 15.00    25.5  W-Br. 4.00 x 15.50    27.2 W-Br. 4.00 x 34.00    28.7 W-Br. 4.00 x 18.50    28.9																		
RIGHT OF WAY (m)																				
ALIGNMENT	Horizontal	Fair																		
	Vertical	Fair																		
ROUTE NO., AGENCIES		DOH 2291																		

Table 17.2.1 TRAFFIC VOLUME ON ROUTE IM - 17

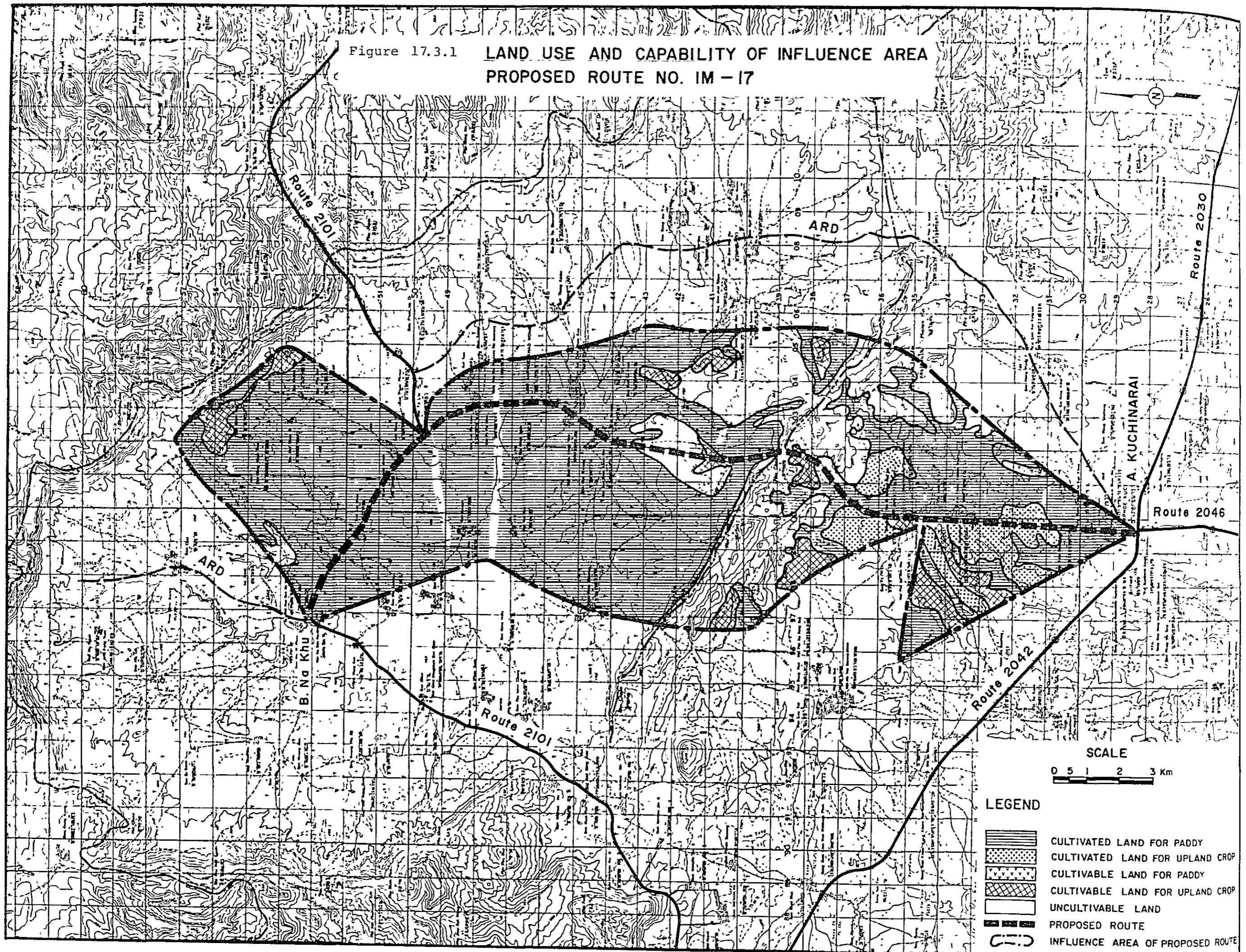
YEAR	1987			1993			2001			
	LINK	1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	28	2	21	30	5	24	31	11	26
	I	4	0	3	5	1	4	5	2	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	32	2	25	35	5	28	36	13	30
L/B	N+D	21	22	21	28	22	26	40	19	35
	I	3	3	3	4	3	4	6	3	5
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	24	25	24	32	25	30	46	22	40
M/B	N+D	25	7	21	34	12	28	50	24	43
	I	4	1	3	5	2	4	7	4	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	29	8	24	39	14	33	57	27	50
H/B	N+D	8	2	6	12	4	10	22	10	19
	I	1	0	1	2	1	2	3	2	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	9	2	7	14	5	12	25	12	22
P/F&T	N+D	38	26	35	59	30	52	105	37	89
	I	6	4	5	9	5	8	16	6	13
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	44	30	40	68	35	60	121	43	102
4/T	N+D	10	17	12	10	9	10	11	3	9
	I	2	2	2	2	1	2	2	1	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	12	19	13	12	11	12	13	4	10
6/T	N+D	24	7	20	24	7	20	24	7	20
	I	4	1	3	4	1	3	4	1	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	28	8	23	28	8	23	27	8	23
10/T	N+D	11	2	9	15	4	12	22	7	18
	I	2	0	1	2	1	2	3	1	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	13	3	10	17	5	14	25	8	21
ADT	N+D	165	83	145	213	93	184	304	119	259
	I	25	13	22	32	14	28	46	18	39
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	190	96	167	245	107	211	350	137	298
M/C	N+D	225	142	205	263	154	237	324	183	290
	I	21	15	19	23	16	21	25	18	23
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	245	157	224	286	170	258	348	201	313
TOTAL	N+D	390	226	350	476	248	421	628	303	549
	I	45	27	41	55	30	49	70	36	62
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	435	253	391	531	278	469	698	339	611

NOTE

N : NORMAL TRAFFIC  
 DV : DEVELOPED TRAFFIC

D : DIVERTED TRAFFIC  
 I : INDUCED TRAFFIC

Figure 17.3.1 **LAND USE AND CAPABILITY OF INFLUENCE AREA  
PROPOSED ROUTE NO. IM - 17**



**LEGEND**



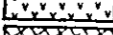
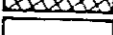

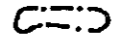

-  CULTIVATED LAND FOR PADDY
-  CULTIVATED LAND FOR UPLAND CROP
-  CULTIVABLE LAND FOR PADDY
-  CULTIVABLE LAND FOR UPLAND CROP
-  UNCULTIVABLE LAND
-  PROPOSED ROUTE
-  INFLUENCE AREA OF PROPOSED ROUTE





TABLE 17.3.1 CULTIVATED &amp; CULTIVABLE LAND

(1979)

[ UNIT : 1000 RAI (KM<sup>2</sup>) ]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		78.125 (125.0)	5.188 ( 8.3)	83.313 (133.3)	0.250 ( 0.4)	6.250 ( 10.0)	6.500 ( 10.4)
0808	KHAD WONG	63.125 (101.0)	-	63.125 (101.0)	-	2.500 ( 4.0)	2.500 ( 4.0)
0809	KUCHINARAI	15.000 ( 24.0)	5.188 ( 8.3)	20.188 ( 32.3)	0.250 ( 0.4)	3.750 ( 6.0)	4.000 ( 6.4)

TABLE 17.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	77.22	-	-	0.06	4.01	-	1.22	-	5.33	82.55
1987	79.30	-	-	0.06	4.04	-	1.19	-	5.33	84.64
1993	79.30	-	-	0.05	4.08	-	1.16	-	5.33	84.64
	79.30	-	-	0.05	4.15	-	1.09	-	5.33	84.64
2001	79.30	-	-	0.05	4.12	-	1.12	-	5.33	84.64
	79.30	-	-	0.05	4.20	-	1.05	-	5.33	84.64
CROP YIELD (KG/RAI)										
1981	258.1	-	-	189.7	2610.6	-	213.4	-	-	-
1987	259.6	-	-	189.7	2610.6	-	213.4	-	-	-
1993	261.2	-	-	189.7	2610.6	-	213.4	-	-	-
	264.3	-	-	190.8	2626.4	-	213.4	-	-	-
2001	263.3	-	-	189.7	2610.6	-	213.4	-	-	-
	270.7	-	-	192.3	2647.4	-	213.4	-	-	-
CROP PRODUCTION (TON)										
1981	19,927	-	-	11	10,461	-	261	-	10,970	30,896
1987	20,589	-	-	11	10,553	-	254	-	11,051	31,640
1993	20,712	-	-	10	10,644	-	247	-	11,132	31,844
	20,962	-	-	10	10,907	-	232	-	11,365	32,327
2001	20,879	-	-	10	10,763	-	238	-	11,236	32,115
	21,470	-	-	10	11,109	-	223	-	11,556	33,026

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 17.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,550	-	-	6,273	680	-	4,069	-
WITH PROJECT (1987 - 2001)	3,639	-	-	6,273	697	-	4,171	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	599	-	-	1,019	724	-	795	-
WITH PROJECT (1987 - 2001)	617	-	-	1,039	744	-	795	-

TABLE 17.3.4 NET PRODUCTION VALUE

YEAR	(1000 BAHT)					
	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	25,587	4,378	29,965	25,981	4,500	30,481
1993	26,026	4,414	30,440	27,340	4,655	31,995
2001	26,616	4,461	31,077	29,190	4,764	33,954

Figure 17.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

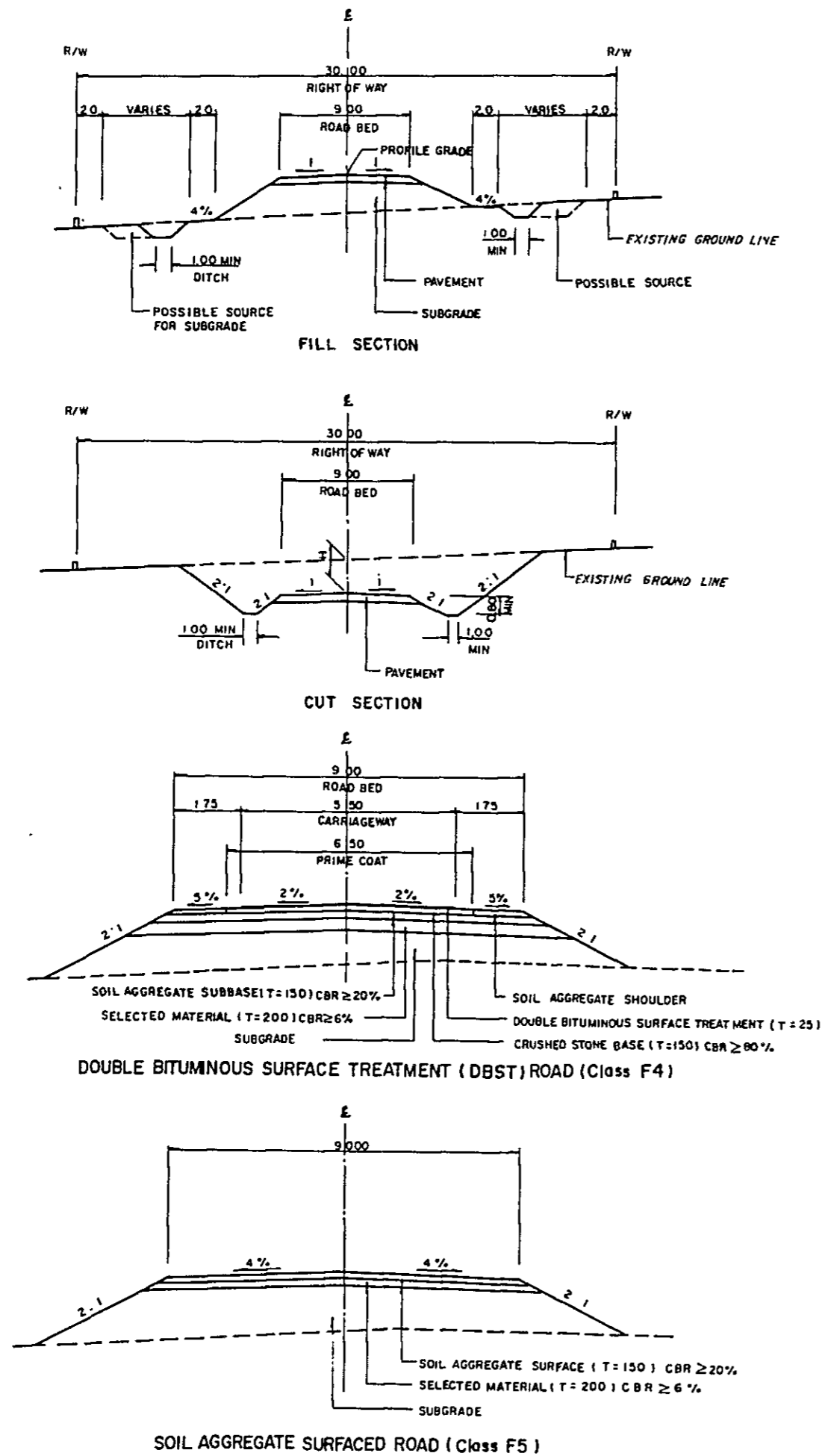
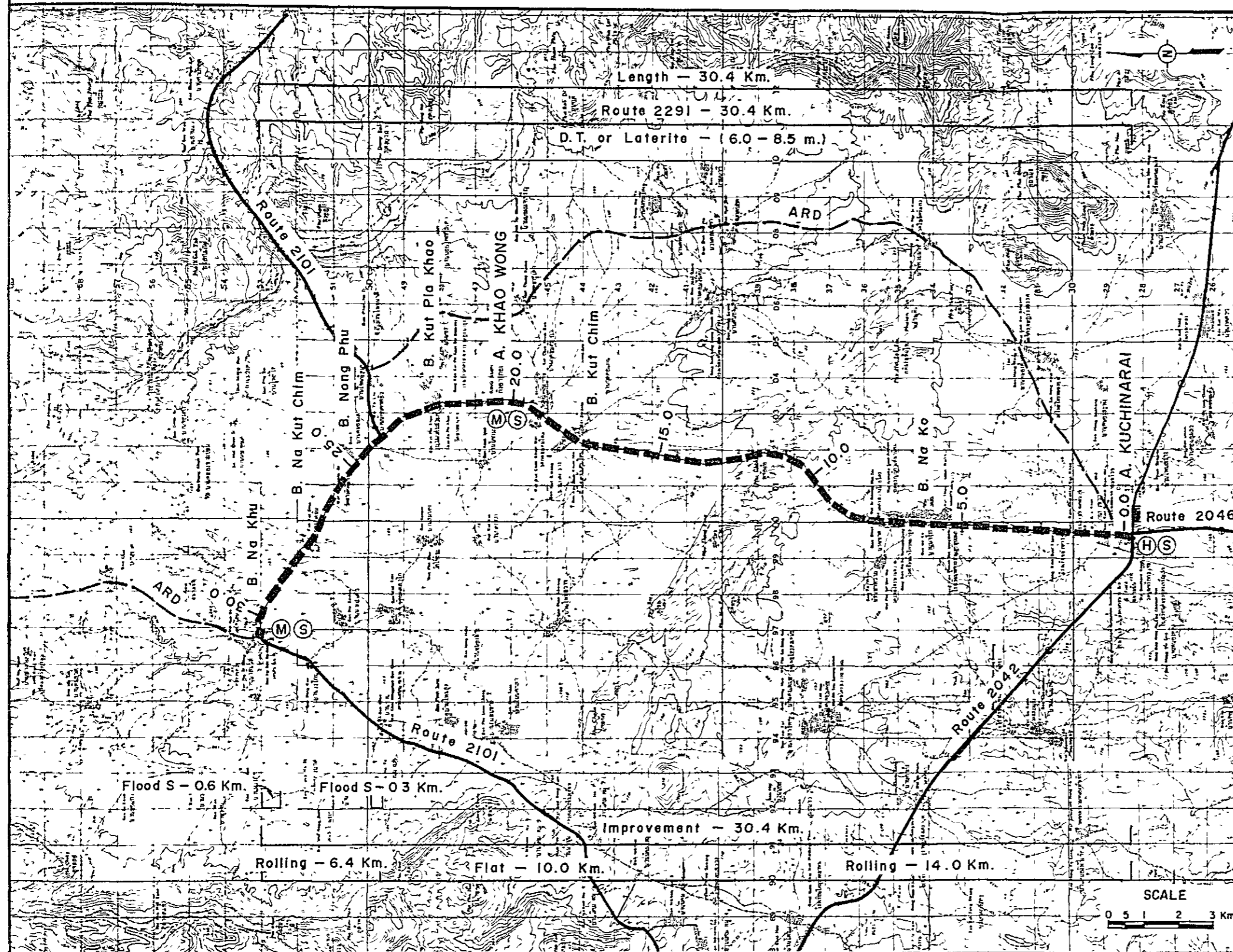
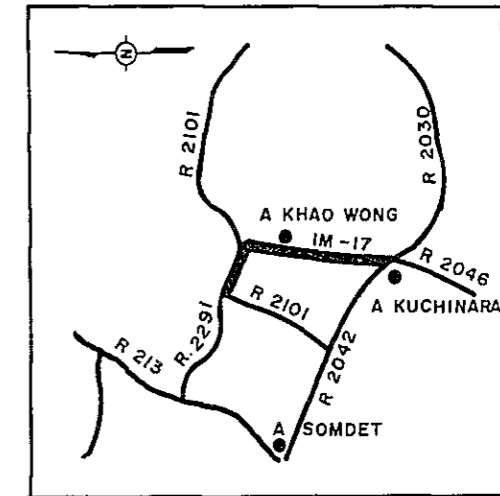


Figure 17.5.2 **PROPOSED ROUTE NO. IM - 17** C. KALASIN A. KUCHINARAI (J.R. 2042, 2030) - B. NA KHU  
 ROUTE NO. 2291 L = 30.4 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km	Proposed Bridge	Existing Bridge
1	9.4	C-7.00 x 20.50	C-4.00 x 20.50
2	10.6	C-7.00 x 14.00	W-4.50 x 12.00
3	17.7	-	C-8.50 x 80.00
4	18.2	C-7.00 x 18.00	W-4.50 x 15.50
5	20.8	C-7.00 x 7.00	W-4.50 x 5.00
6	22.1	C-7.00 x 22.00	W-4.50 x 20.00
7	24.2	C-7.00 x 7.60	C-4.00 x 7.60
8	24.3	C-7.00 x 28.00	C-4.00 x 28.00
9	25.5	C-7.00 x 18.00	W-4.00 x 15.00
10	27.2	C-7.00 x 18.00	W-4.00 x 15.50
11	28.7	C-7.00 x 36.00	W-4.00 x 34.00
12	28.9	C-7.00 x 21.00	W-4.00 x 18.50

LEGEND

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

Table 17.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-17 (30.4 km)

Items	Unit of Q'ty	Financial Unit Rate ₪	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)	Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)
<b>DIRECT CONSTRUCTION COST</b>								
Clearing and Grubbing	ha	15,000	70	1,050	955	70	1,050	955
Excavation - Soil	m <sup>3</sup>	20	0	0	0	0	0	0
Excavation - Hard Rock	m <sup>3</sup>	160	0	0	0	0	0	0
Embankment	m <sup>3</sup>	45	126,900	5,710	5,196	126,900	5,710	5,196
Selected Material	m <sup>3</sup>	80	64,500	5,160	4,592	64,500	5,160	4,592
Soil Aggregate Surface or Subbase	m <sup>3</sup>	105	45,200	4,746	4,223	45,200	4,746	4,223
Crushed Stone Base	m <sup>3</sup>	370	29,600	10,952	10,075	3,400	1,258	1,157
Soil Aggregate Shoulder	m <sup>3</sup>	105	12,800	1,344	1,196	1,500	157	140
Prime Coat and DBST	m <sup>2</sup>	55	167,200	9,196	8,276	19,300	1,062	956
Pipe Culvert	m	2,100	1,330	2,793	2,569	1,330	2,793	2,569
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	211	8,440	7,511	211	8,440	7,511
Sub Total (a)				49,391	44,598	30,377	27,304	
Miscellaneous Works (a) x 7%				3,457	3,122	2,126	1,911	
Total (b)				52,848	47,720	32,503	29,215	
PHYSICAL CONTINGENCY (b) x 15%				7,927	7,158	4,875	4,382	
<b>ENGINEERING AND ADMINISTRATION (b) x 10%</b>								
ADMINISTRATION (b) x 10%				5,285	4,772	3,250	2,922	
Sub Total				13,212	11,930	8,125	7,304	
<b>LAND ACQUISITION</b>								
Highly Developed Land	ha	50,000	0	0	0	0	0	0
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				0	0	0	0	
<b>GRAND TOTAL</b>				66,060	59,650	40,628	36,519	

Table 17.6.1 COST AND BENEFITS  
(F4 STANDARD)

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	23,860	0	0	0	0	29,930	0
1986	35,790	0	0	0	0	40,085	0
1987	0	516	4,928	-105	5,339	0	4,767
1988	0	689	5,231	-91	5,829	0	4,647
1989	0	862	5,534	-78	6,319	0	4,498
1990	0	1,036	5,838	-64	6,809	0	4,327
1991	0	1,209	6,141	-51	7,299	0	4,141
1992	0	1,382	6,444	-37	7,788	0	3,946
1993	0	1,555	6,747	-24	8,278	0	3,745
1994	14,713	1,720	7,175	-4	8,891	6,655	3,591
1995	0	1,886	7,603	15	9,504	0	3,427
1996	0	2,051	8,031	35	10,116	0	3,257
1997	0	2,216	8,459	54	10,729	0	3,084
1998	0	2,381	8,887	74	11,342	0	2,911
1999	0	2,547	9,315	93	11,955	0	2,740
2000	0	2,712	9,743	113	12,567	0	2,572
2001	-27,439	2,877	10,171	132	13,180	-5,013	2,408
TOTAL	46,924	25,638	110,246	62	135,945	71,657	54,061

DISCOUNTED ECONOMIC COSTS :	71,657
DISCOUNTED ECONOMIC BENEFITS :	54,061
AGRICULTURAL DEVELOPMENT BENEFIT	9,319
VOC SAVING	44,945
RMC SAVING	-203
NET PRESENT VALUE :	-17,596
BENEFIT COST RATIO :	0.75
INTERNAL RATE OF RETURN :	8.7 %

Table 17.6.2 COST AND BENEFITS  
(F5 STANDARD)

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	14,607	0	0	0	0	18,323	0
1986	21,912	0	0	0	0	24,541	0
1987	0	516	3,400	-12	3,904	0	3,486
1988	0	689	3,631	-3	4,317	0	3,441
1989	0	862	3,861	7	4,730	0	3,367
1990	0	1,036	4,091	16	5,143	0	3,268
1991	0	1,209	4,321	26	5,556	0	3,152
1992	0	1,382	4,551	35	5,968	0	3,024
1993	0	1,555	4,782	45	6,381	0	2,887
1994	1,694	1,720	5,101	58	6,879	766	2,778
1995	0	1,886	5,420	72	7,377	0	2,660
1996	0	2,051	5,739	85	7,875	0	2,536
1997	0	2,216	6,058	99	8,374	0	2,407
1998	0	2,381	6,378	113	8,872	0	2,277
1999	0	2,547	6,697	126	9,370	0	2,147
2000	0	2,712	7,016	140	9,868	0	2,019
2001	-16,799	2,877	7,335	154	10,366	-3,069	1,894
TOTAL	21,414	25,638	78,382	960	104,979	40,562	41,344

DISCOUNTED ECONOMIC COSTS :	40,562
DISCOUNTED ECONOMIC BENEFITS :	41,344
AGRICULTURAL DEVELOPMENT BENEFIT	9,319
VOC SAVING	31,751
RMC SAVING	274
NET PRESENT VALUE :	782
BENEFIT COST RATIO :	1.02
INTERNAL RATE OF RETURN :	12.2 %

Table 17.7.1 SOCIAL INDICATORS  
(Proposed Route IM-17)

Population (1,000)		Education	
1982	: 25.3	Access to Secondary School	
1993	: 29.5	Number of Student in 1993 (1,000) <sup>2/</sup>	: 4.4
Average travelling speed, without (kph)	: 40	Average distance to school (km)	: 5.2
Isolation		Per capita time savings (10 <sup>-4</sup> )	: 0.131
Access to Amphoe		Score	: 71
Average distance to Amphoe (km) <sup>1/</sup>	: 5.2	Teacher Intensity	
Per capita time savings (10 <sup>-4</sup> )	: 0.020	Number of teachers <sup>3/</sup>	
Score	: 59	University graduate	: 2
Access to Artery Highway		Total	: 9
Average distance to highway (km) <sup>1/</sup>	: 23	Number of Student	: 188
Per capita time savings (10 <sup>-4</sup> )	: 0.087	Indicators	
Score	: 189	E1 <sup>4/</sup>	: 10.6
Impassability		E2 <sup>5/</sup>	: 47.9
Impassable week a year	: 2	E <sup>6/</sup>	: 58.5
Impassability per year	: 0.038	Degree of Improvement <sup>7/</sup>	: 1.17
Impassability per capita (10 <sup>-4</sup> )	: 0	Score	: 74
Score	: 0	Disparity	
Health		G.P.V. in 1993 (Mn B) <sup>8/</sup>	
Access to Hospital		With project	: 85.1
Average distance to Hospital (km) <sup>1/</sup>	: 15.0	Without project	: 82.0
Per capita time savings (10 <sup>-4</sup> )	: 0.057	Per capita G.P.V. in 1993 (B)	
Score	: 133	With project (W)	: 2,885
Access to Medical Facilities		Without project (w)	: 2,780
Average distance to facilities (km) <sup>1/</sup>	: 5.5	Degree of Disparity	
Per capita time savings (10 <sup>-4</sup> )	: 0.021	(A/W) - (A/w) <sup>9/</sup>	: 0.04
Score	: 84	Score	: 71
		Total Score	: 681

Note:

- <sup>1/</sup> ( ) shows the length or distance in without project case. Unless otherwise, lengths are same both in with project case and without project case.
- <sup>2/</sup> 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.
- <sup>3/</sup> Numbers of the sample areas
- <sup>4/</sup> (Number of University Graduate Teachers)/(Total Number of Student) x 1,000
- <sup>5/</sup> (Total of Teachers)/(Total Number of Student) x 1,000
- <sup>6/</sup> Sum of <sup>4/</sup> and <sup>5/</sup>
- <sup>7/</sup> 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
- <sup>8/</sup> Estimated gross value of crop production in the areas of influence
- <sup>9/</sup> "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 - 18**

Changwat : Kalasin / Roi Et

C. Kalasin - B. Khok Nong Bua (J R 2116)

Length · 50.7 KM.

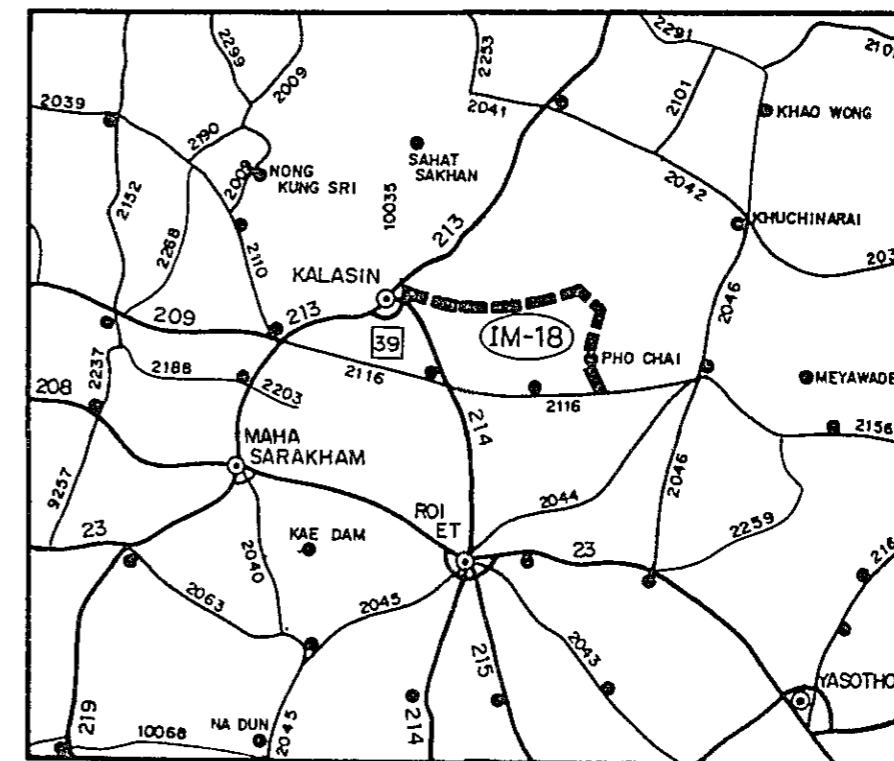
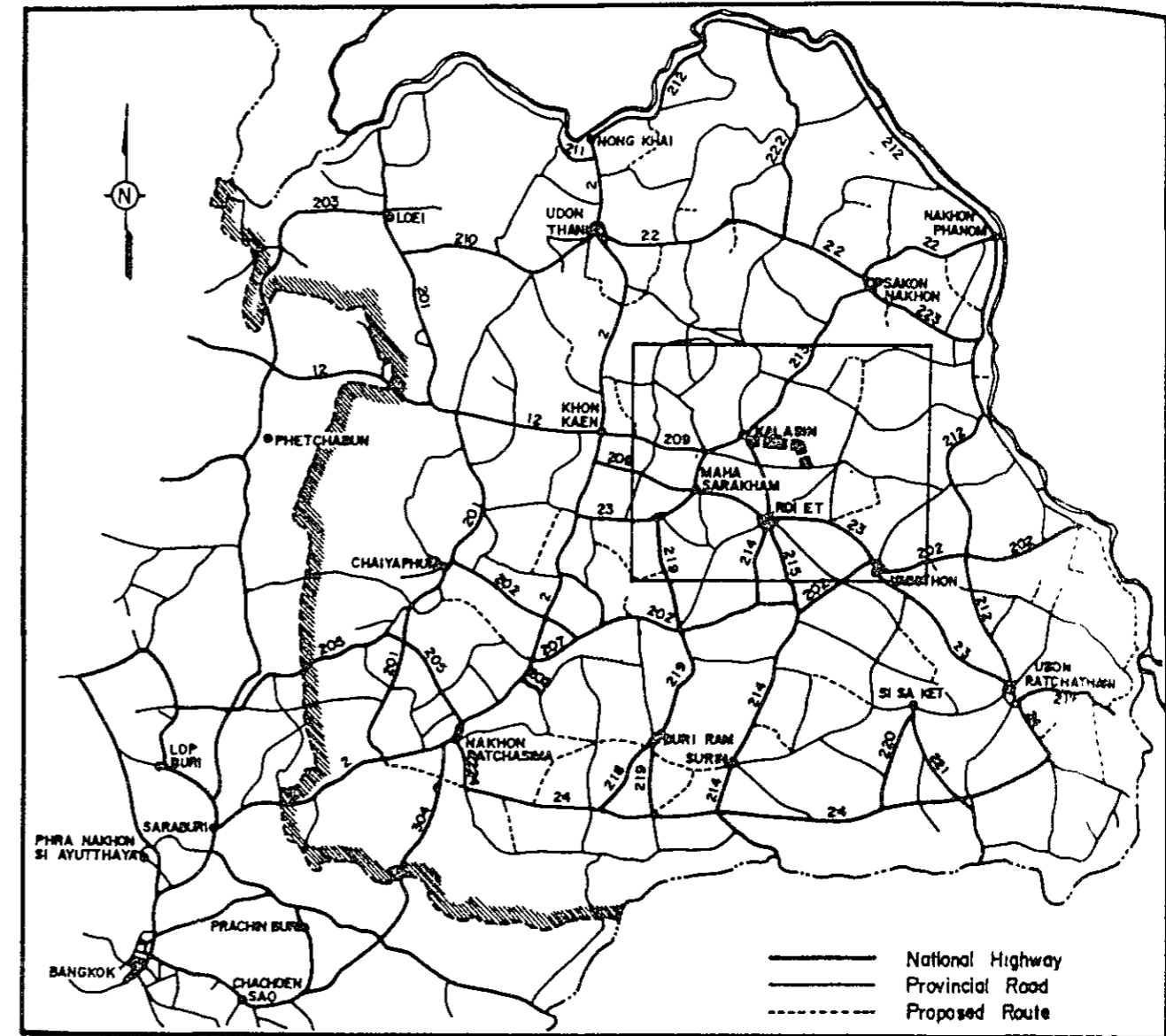


SUMMARY

PROPOSED ROUTE IM-18

Item	Description
Changwat	Kalasin/Roi Et
Origin	C. Kalasin
Destination	B. Khok Nong Bua (J.R.2116)
Length	
Total	50.7 km
Improvement Section	50.7 km
DOH Road	0 km
ARD Road	50.7 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good - Poor
Terrain	Flat and Partially Rolling
Influence Area	
Area	366 km <sup>2</sup>
Population (1982)	52,500
Principal Crops	Paddy
Traffic (ADT)	
Existing	117
1993	431
2001	557
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	98,245 . 10 <sup>3</sup> ฿
Economic	89,203 . 10 <sup>3</sup> ฿
IRR	7.5 %
B/C	0.65
Recommendation	For further consideration

LOCATION OF PROPOSED ROUTE



1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two Changwats of Kalasin and Roi Et.

The route starting at Changwat Kalasin, runs southeastward passing through Ban Kae Pae, Ban Nong Pok and Amphoe Pho Chai and ends at Ban Khok Nong Bua on Route 2116. Its total length is 50.7 km. (Figure 18.5.2)

The terrain is almost flat, while some sections are rolling. In the influence area, there exists several villages with total population of 52,500. There are one medical center, 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 the agriculturally developed area with Changwat Kalasin and also play vital role to connect Amphoe Pho Chai with artery highway.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 18.1.1. The details are shown as the results of inventory survey in Table 18.1.2.

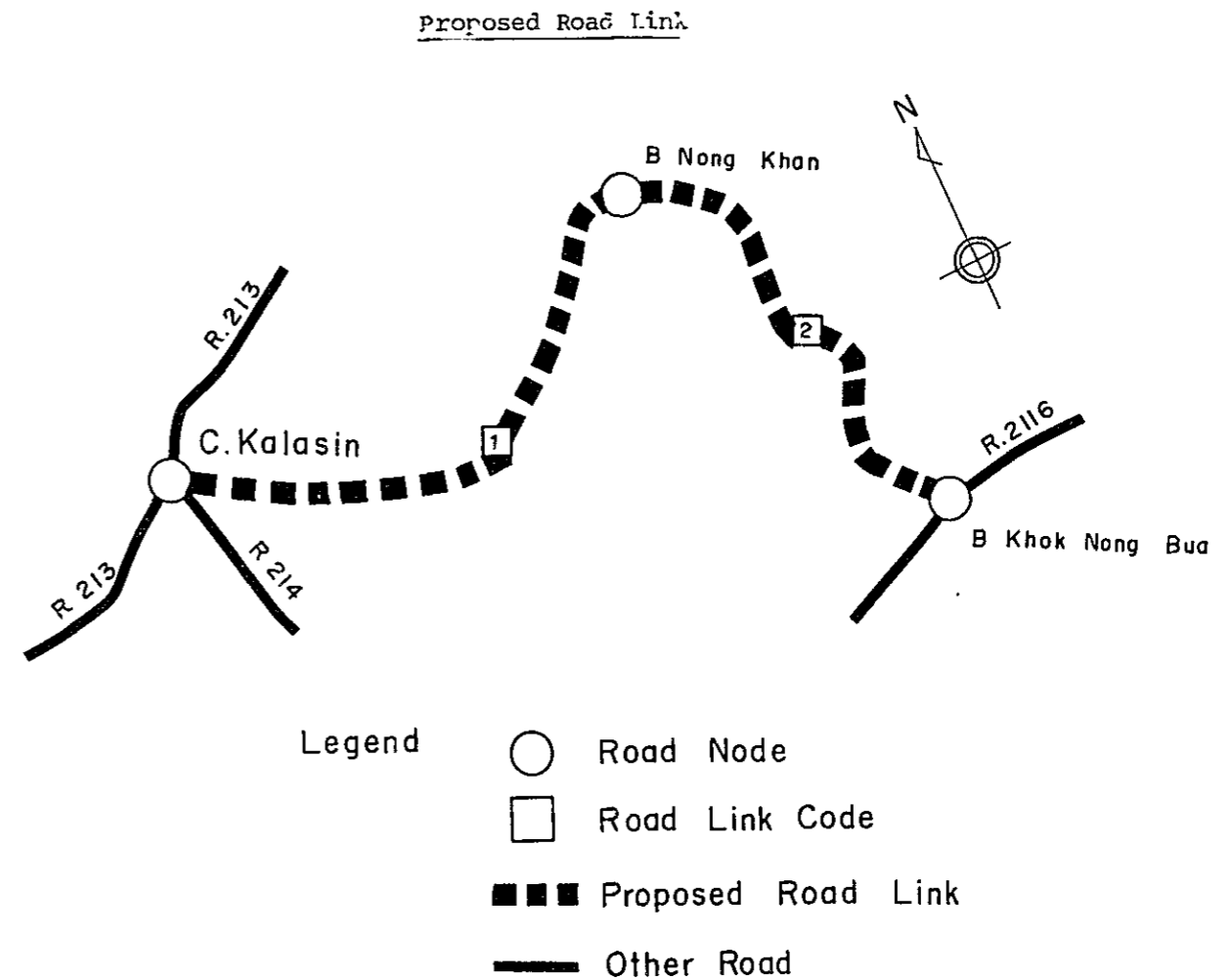
2. TRAFFIC

2.1 Method

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

2.2 Base Year Traffic

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



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	-	16	35	21	-	2	24	42	-	140
	2	6	54	6	2	-	6	5	11	3	93

2.3 Transport Movement

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

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	1001
2	351

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	21	39	110
2	11	46	57

2.4 Future Growth of Transport Movement

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

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981-1987	1987-1993	1993-2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.3	1.2
PASSENGER MOVEMENT	5.5	5.7	5.8

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981-1987	1987-1993	1993-2001
NON-AGRI. AGRICULTURE	7.1	7.4	7.5
FREIGHT	1.9	1.9	1.9

2.5 Induced and Developed Traffic

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

RATE OF INDUCED AND DEVELOPED TRAFFIC

ITEM	YEAR (%)		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	3.4	3.4

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	0.0	22.2	48.6	29.2	0.0	2.9	35.3	61.8	0.0
	1987	2.7	24.5	41.4	28.4	3.0	6.6	30.2	54.7	8.4
	1993	5.9	27.2	32.8	27.5	6.6	11.1	24.1	46.3	18.5
	2001	10.2	30.8	21.3	26.2	11.5	17.0	16.0	35.0	32.0
2	1982	8.8	79.4	8.8	2.9	0.0	24.0	20.0	44.0	12.0
	1987	12.3	75.9	7.6	3.5	0.6	22.2	18.9	41.6	17.3
	1993	16.5	71.7	6.2	4.3	1.3	19.9	17.7	38.8	23.6
	2001	22.1	66.2	4.2	5.2	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 traffic type are shown in Table 18.2.1.

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	8	26	17	2	56	12	23	5	149	210	359
1993	16	30	24	6	76	9	18	8	188	243	431
2001	35	30	37	16	11	6	13	12	262	295	557

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

In the area of influence, around 88% of cultivated land is covered by paddy fields. In the upland field, cassava ranks first followed by ground nuts

and kenaf. Potential land for future cultivation is available mostly for upland field, especially in Amphoe Pho Chai.

Land use and capability conditions in the area of influence are shown in Table 18.3.1 and Figure 18.3.1.

Typical cropping calendars in the Kalasin and Roi Et areas are shown in Figure 18.3.2.

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 18.3.2.

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 18.3.3.

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 18.3.4. 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			With Project			
		Length (Km)	<sup>/1</sup> Nos. of Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	Length (Km)	<sup>/1</sup> Road Class Case 1 Case 2	Nos. of Wooden Narrow Bridge
1	Flat	25.5	2B	4	0	25.5	} 1(F4) } 2A(F5)	0
2	Flat & Rolling	25.2	3	2	2	25.2		0

<sup>/1</sup>

- 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)	4,693	6,458	9,515
2A (F5)	2,576	3,904	5,996

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 18.5.1
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 <sub>&gt;</sub> 80%	:	15.0cm
Soil Aggregate Subbase CBR <sub>&gt;</sub> 20%	:	15.0cm
Selected Material CBR <sub>&gt;</sub> 6%	:	20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR <sub>&gt;</sub> 20%	:	15.0cm
Selected Material CBR <sub>&gt;</sub> 6%	:	20.0cm

Pipe Culvert

Standard Size	:	∅ 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 18.5.2

Alignment of the route is shown in Figure 18.5.2.

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 18.5.1.

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

Total Financial and Economic Construction Cost

Road Class	Length (Km)	Construction Cost (10 <sup>3</sup> B)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	50.7	98,245	89,203	
F5 (Laterite)	50.7	59,599	54,020	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 18.6.1 and 18.6.2.

The result indicates that the proposed project seems to be not feasible in case of F4 Standard but feasible under F5 Standard.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 18.7.1.

Table 18.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	C. Kalasin	
Destination	B. Khok Nong Bua (J.R. 2116)	
Length		
Total	50.7 km	
Improvement Section	50.7 km	
DOH Road	0 km	
ARD Road	50.7 km	
Others	0 km	
New Alignment Section	0 km	
Terrain	Flat and Partially Rolling	
Alignment (Hori./Vert.)	Fair / Fair	
Formation Width	5.5 m - 7.0 m, 6.6m (Weighted average)	
Embankment Section		
Length	50.7 km	
Height	0.2 m - 1.0 m	
Cut Section		
Length	0 km	
Depth	m - m	
Surface Type and Condition		
SBST or DBST	Good	0.7 km
Soil Aggregate	Good - Poor	50.0 km
Earth		0 km
Pipe Culvert	47 each	
Box Culvert	1 each	6.0 m
Bridge		
Permanent Bridge	3 each	114.0 m
Narrow Concrete Bridge	2 each	34.0 m (4m)
Wooden Bridge	6 each	116.7 m
Overflow Section	2 places	2.0 km

Table 18.1.2 ROAD INVENTORY(1)

PROPOSED ROUTE NO. IM-18

ROUTE NO. ARD

C. KALASIN ~ B. KHOK NONG BUA (J.R. 2116)

L = 50.7

KALASIN/ROI ET

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30		
VILLAGE - Name - Household (H) - Population (P)		B. THUNG SI H = 200 P = 1200		B. KHOK H = 50 P = 300		B. LEK H = 200 P = 1800		B. SA-AT SOMSI H = 100		B. KAE PAE H = 600 P = 4000		B. KUT KHLONG H = 350 P = 2500		B. NONG KWANG H = 210 P = 126 B. NONG KHAN H = 300 P = 2500		B. NONG POK H = 170 P = 1000			
TERRAIN		Flat																	
CROSS SECTION	Formation Width (m)	7.00	8.00	7.00	6.50	6.00	6.50		6.00		7.00	6.50	6.00		5.50				
	Embankment Height (m)	0.20	0.30	0.50	1.00	0.50	0.50	0.30	0.40	0.20	0.60		0.40		0.30	0.80	0.30		
	Cutting Depth (m)																		
PAVEMENT	Type/Length	DT		Laterite															
	Condition	Good														Poor			
FLOODING	Overflow Length(Km)/Height(m)											L=1.0 H=0.5							
LAND USE	Left	Paddy																	
	Right	Paddy																	
PIPE CULVERT	Total Number	47 Pipes																	
BOX CULVERT & BRIDGE	Station (Km)			3.2	4.7	5.8			13.7		16.4				27.1		29.3		
	Dimension			W-Br. 4.30 x 25.00	W-Br. 4.50 x 12.00	C-Br. 7.00 x 27.00			W-Br. 4.00 x 60.00		W-Br. 4.50 x 6.20				W-Br. 4.00 x 5.00		C-Br. 4.50 x 18.00		
RIGHT OF WAY (m)		15.0																	
ALIGNMENT	Horizontal	Fair																	
	Vertical	Fair																	
ROUTE NO., AGENCIES		ARD																	



ROAD INVENTORY (2)

PROPOSED ROUTE NO. IM-18 ROUTE No. ARD

C. KALASIN ~ B. KHOK NONG BUA (J.R. 2116) (Cont'd)

L = 50.7 Km.

KALASIN/ROI ET

STATION (Km)		30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60		
VILLAGE			B. SA AT CHAI SI H = 120 P = 900		B. NA LAO H = 200 P = 1800			B. NONG NATHO H = 40 P = 300		B. PHO CHAI H = 500 P = 4000		B. KHOK KUNG H = 50 P = 400							
TERRAIN		Flat						Rolling											
CROSS SECTION	Formation Width (m)	7.30	7.00	6.00	7.00	6.00	6.50		6.00										
	Embankment Height (m)	0.50	1.00		0.60	0.4	0.60	0.80	1.00		0.80		0.30						
	Cutting Depth (m)																		
PAVEMENT	Type/Length	Laterite																	
	Condition	Poor																	
FLOODING	Overflow Length(Km)/Height(m)			L=1.0 H=0.2															
LAND USE	Left	Paddy						Bush		Paddy		Cassava							
	Right	Paddy						Cassava		Paddy		Cassava							
PIPE CULVERT	Total Number																		
BOX CULVERT & BRIDGE	Station (Km)			33.2			36.5					46.3			48.5				
	Dimension			C-Box 7.50 x 6.00			C-Br. 4.50 x 16.00					C-Br. 8.30 x 81.00			W-Br. 4.50 x 8.50				
RIGHT OF WAY (m)								15.0											
ALIGNMENT	Horizontal	Fair																	
	Vertical	Fair																	
ROUTE NO., AGENCIES		ARD																	

Table 18.2.1 TRAFFIC VOLUME ON ROUTE IM -18

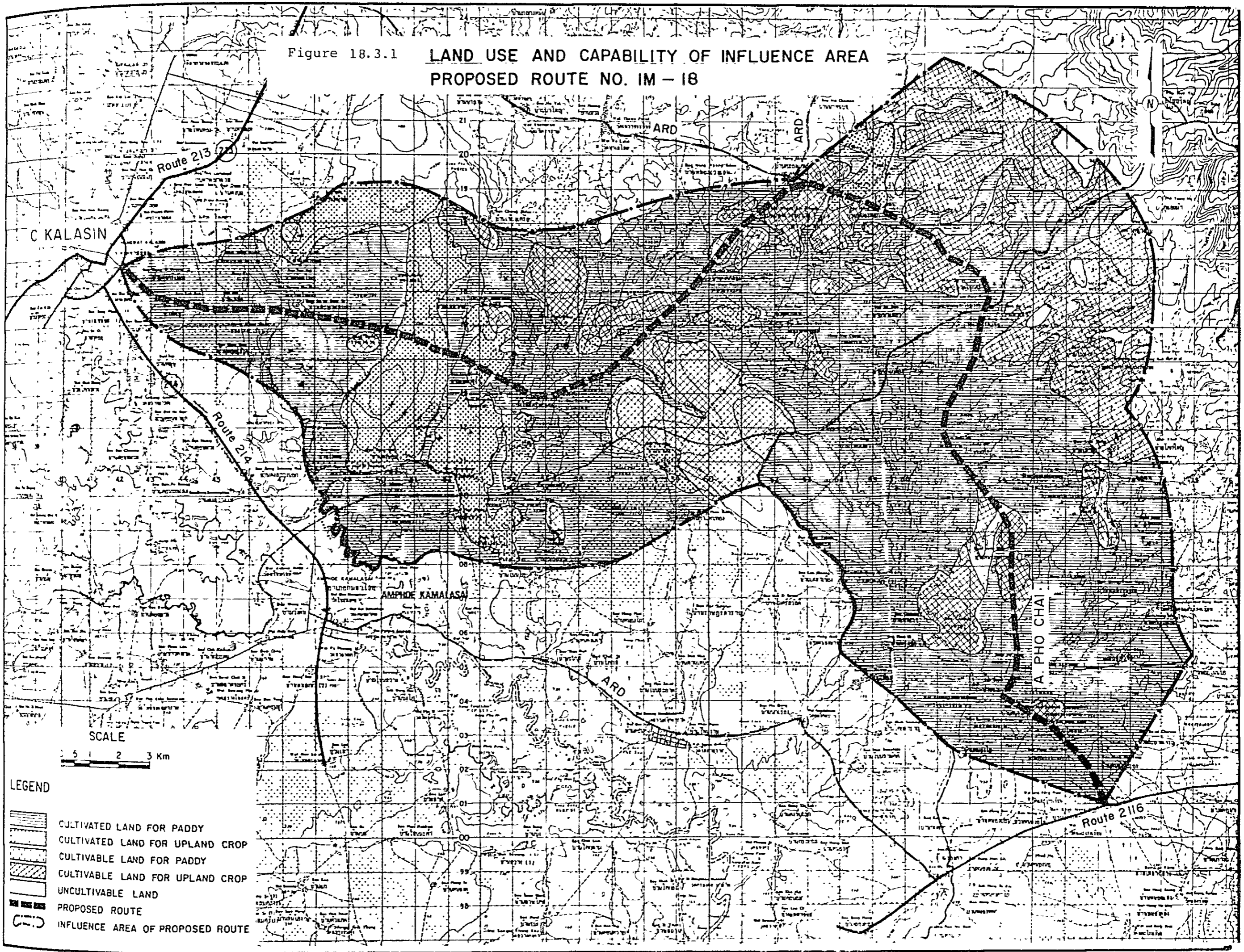
YEAR	1987			1993			2001		
LINK	1	2	AVR.	1	2	AVR.	1	2	AVR.
N+D	3	11	7	8	19	13	20	39	30
P/C I	0	2	1	1	3	2	3	6	4
DV	0	0	0	0	1	1	1	2	1
TOTAL	3	12	8	9	23	16	24	46	35
N+D	39	7	23	42	7	25	43	7	25
L/B I	6	1	3	6	1	4	6	1	4
DV	0	0	0	2	0	1	2	0	1
TOTAL	44	8	26	50	9	30	51	9	30
N+D	27	3	15	35	5	20	52	9	31
M/B I	4	0	2	5	1	3	8	1	5
DV	0	0	0	1	0	1	2	0	1
TOTAL	30	4	17	42	6	24	62	11	37
N+D	3	1	2	9	2	5	23	4	14
H/B I	0	0	0	1	0	1	3	1	2
DV	0	0	0	0	0	0	1	0	1
TOTAL	3	1	2	10	2	6	27	5	16
N+D	27	71	49	40	88	64	69	120	94
P/P&T I	4	11	7	6	13	10	10	18	14
DV	0	0	0	2	3	3	3	5	4
TOTAL	31	81	56	48	105	76	82	143	112
N+D	17	4	11	11	4	8	7	3	5
4/T I	3	1	2	2	1	1	1	1	1
DV	0	0	0	0	0	0	0	0	0
TOTAL	19	5	12	14	5	9	8	4	6
N+D	30	10	20	22	9	15	15	8	11
6/T I	5	1	3	3	1	2	2	1	2
DV	0	0	0	1	0	1	1	0	0
TOTAL	35	11	23	26	10	18	18	9	13
N+D	5	4	4	9	5	7	13	7	10
10/T I	1	1	1	1	1	1	2	1	2
DV	0	0	0	0	0	0	1	0	0
TOTAL	5	5	5	10	6	8	16	8	12
N+D	149	110	129	177	139	158	242	198	220
ADT I	22	16	19	26	21	24	36	30	33
DV	0	0	0	7	5	6	10	8	9
TOTAL	171	126	149	210	166	188	288	235	262
N+D	214	168	191	239	197	218	289	245	267
M/C I	20	17	18	22	19	20	24	21	23
DV	0	0	0	5	5	5	6	5	6
TOTAL	235	185	210	267	220	243	319	272	295
N+D	363	278	321	416	336	376	531	443	487
TOTAL I	43	33	38	48	39	44	61	51	56
DV	0	0	0	12	10	11	16	13	14
TOTAL	406	311	359	477	385	431	607	507	557

NOTE

N : NORMAL TRAFFIC  
 DV : DEVELOPED TRAFFIC

D : DIVERTED TRAFFIC  
 I : INDUCED TRAFFIC

Figure 18.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA  
PROPOSED ROUTE NO. IM - 18



SCALE  
0 1 2 3 Km

LEGEND








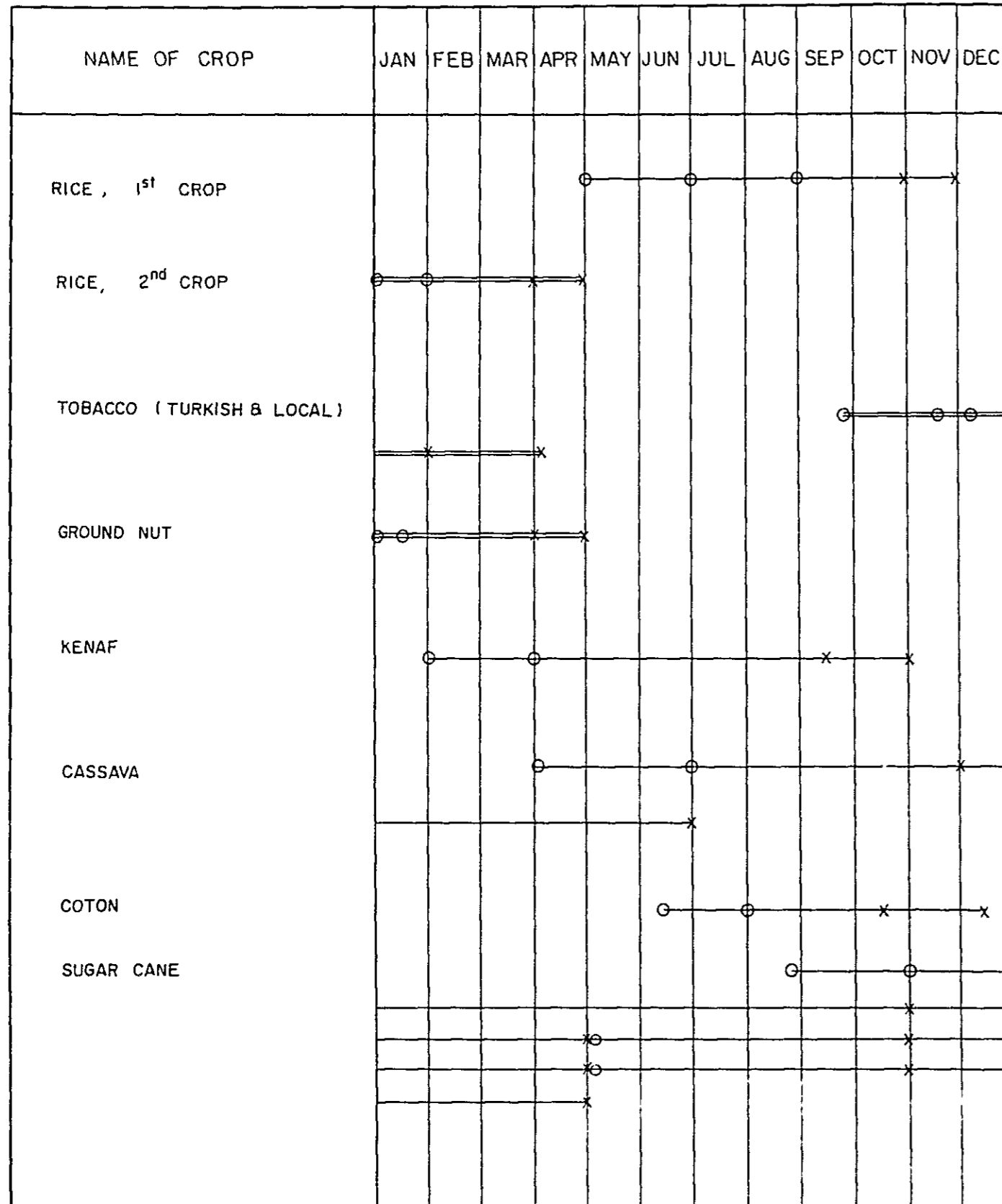
-  CULTIVATED LAND FOR PADDY
-  CULTIVATED LAND FOR UPLAND CROP
-  CULTIVABLE LAND FOR PADDY
-  CULTIVABLE LAND FOR UPLAND CROP
-  UNCULTIVABLE LAND
-  PROPOSED ROUTE
-  INFLUENCE AREA OF PROPOSED ROUTE

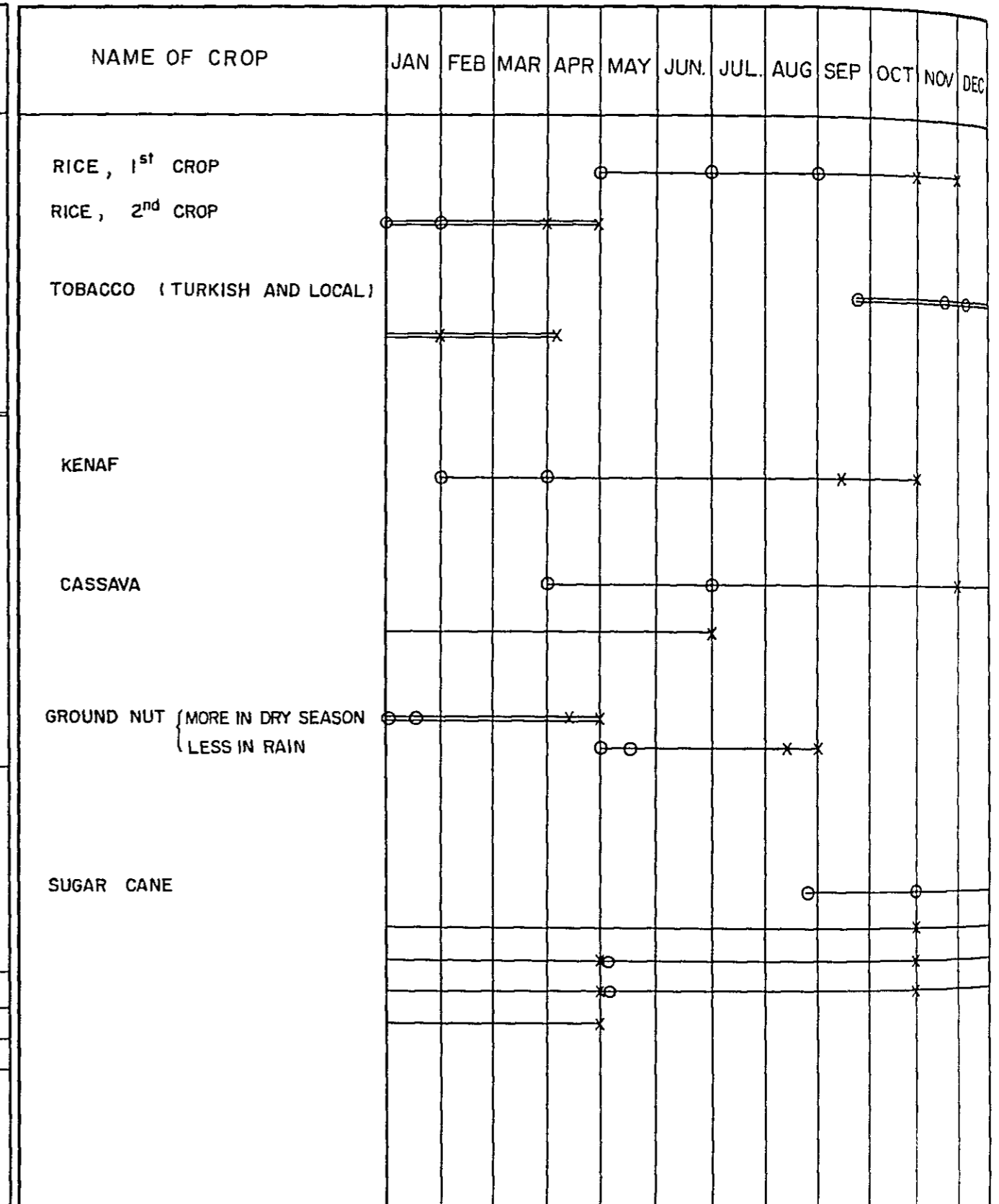
Figure 18.3.2 CROPPING CALENDAR(1)

0800 CHANGWAT KALASIN



CROPPING CALENDAR (2)

0900 CHANGWAT ROIET



Note

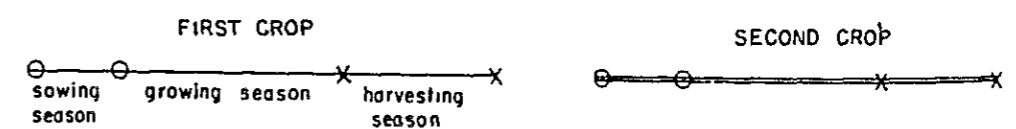


TABLE 18.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[ UNIT : 1000 RAI (KM<sup>2</sup>) ]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		153.125 (245.0)	21.125 ( 33.8)	174.250 (278.8)	0.750 ( 1.2)	49.375 ( 79.0)	50.125 ( 80.2)
0801	M. KALASIN	71.250 (114.0)	20.000 ( 32.0)	91.250 (146.0)	-	28.125 ( 45.0)	28.125 ( 45.0)
0812	KAMALASAI	13.750 ( 22.0)	1.125 ( 1.8)	14.875 ( 23.8)	-	3.750 ( 6.0)	3.750 ( 6.0)
0902	PHO CHAI	68.125 (109.0)	-	68.125 (109.0)	0.750 ( 1.2)	17.500 ( 28.0)	18.250 ( 29.2)

TABLE 18.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	153.03	-	-	1.94	19.34	-	0.17	-	21.45	174.48
1987	157.68	-	-	1.94	20.05	-	0.17	-	22.16	179.84
1993	WITHOUT PROJECT	-	-	1.94	20.78	-	0.17	-	22.89	185.36
	WITH PROJECT	-	-	2.18	23.94	-	0.17	-	26.30	191.70
2001	WITHOUT PROJECT	-	-	1.94	21.80	-	0.17	-	23.91	192.99
	WITH PROJECT	-	-	2.18	25.11	-	0.17	-	27.47	199.61
CROP YIELD (KG/RAI)										
1981	209.4	-	-	185.9	2669.5	-	189.6	-	-	-
1987	212.0	-	-	185.9	2669.5	-	189.6	-	-	-
1993	WITHOUT PROJECT	-	-	185.9	2669.5	-	189.6	-	-	-
	WITH PROJECT	-	-	187.0	2685.6	-	189.6	-	-	-
2001	WITHOUT PROJECT	-	-	185.9	2669.5	-	189.6	-	-	-
	WITH PROJECT	-	-	188.5	2707.1	-	189.6	-	-	-
CROP PRODUCTION (TON)										
1981	32,049	-	-	360	51,633	-	32	-	52,035	84,084
1987	33,420	-	-	360	53,520	-	32	-	53,922	87,343
1993	WITHOUT PROJECT	-	-	360	55,475	-	32	-	55,878	90,729
	WITH PROJECT	-	-	408	64,290	-	33	-	64,742	100,863
2001	WITHOUT PROJECT	-	-	360	58,195	-	32	-	58,598	95,452
	WITH PROJECT	-	-	411	67,982	-	33	-	68,438	107,561

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 18.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,505	-	-	6,276	679	-	4,069	-
WITH PROJECT (1987 - 2001)	3,593	-	-	6,276	696	-	4,171	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	507	-	-	1,019	724	-	725	-
WITH PROJECT (1987 - 2001)	527	-	-	1,039	744	-	725	-

TABLE 18.3.4 NET PRODUCTION VALUE

YEAR	(1000 BAHT)					
	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	37,160	22,119	59,279	36,948	22,593	59,541
1993	39,745	22,917	62,662	42,583	27,242	69,825
2001	43,410	24,026	67,436	49,815	28,959	78,774

Figure 18.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

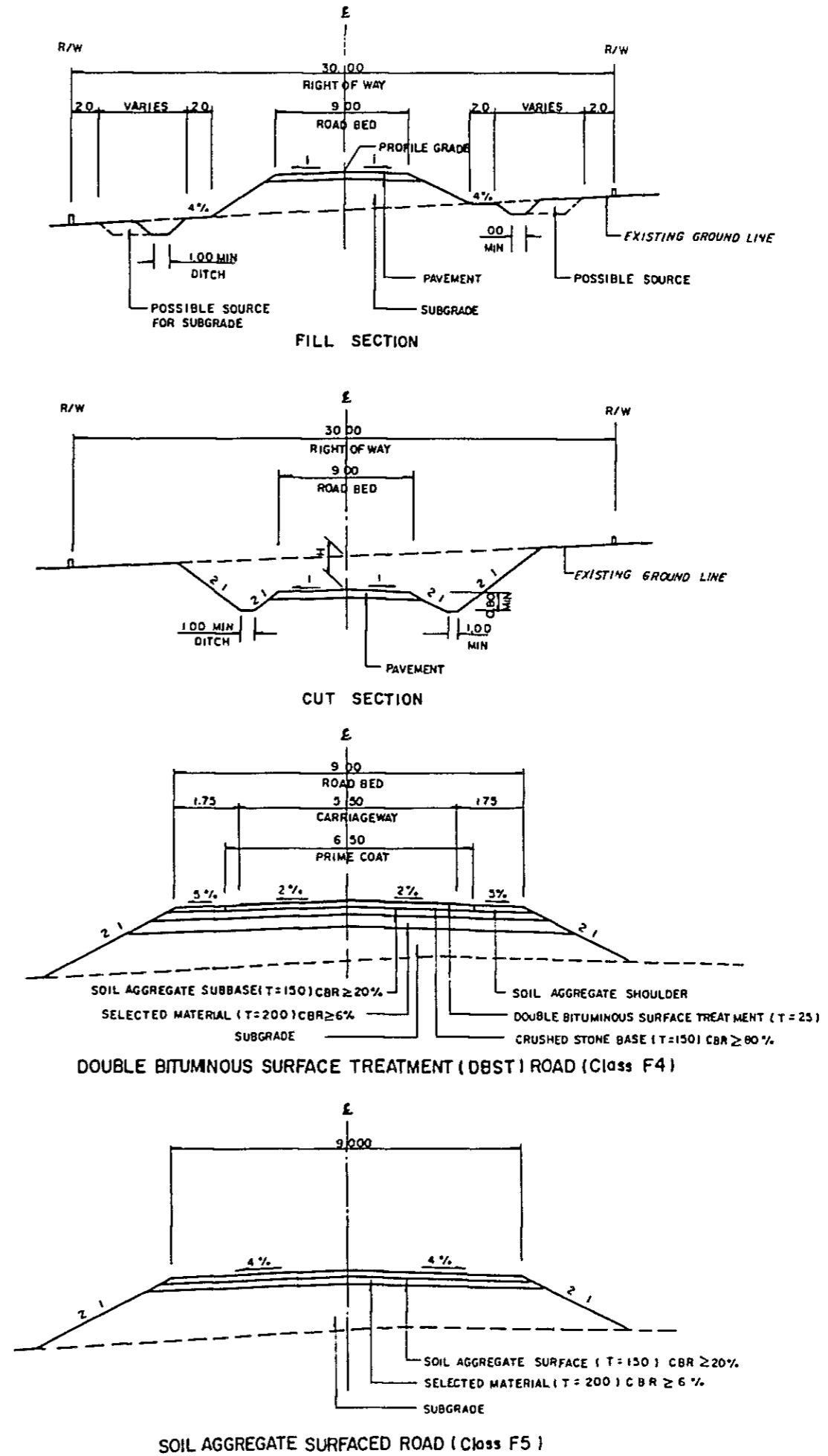
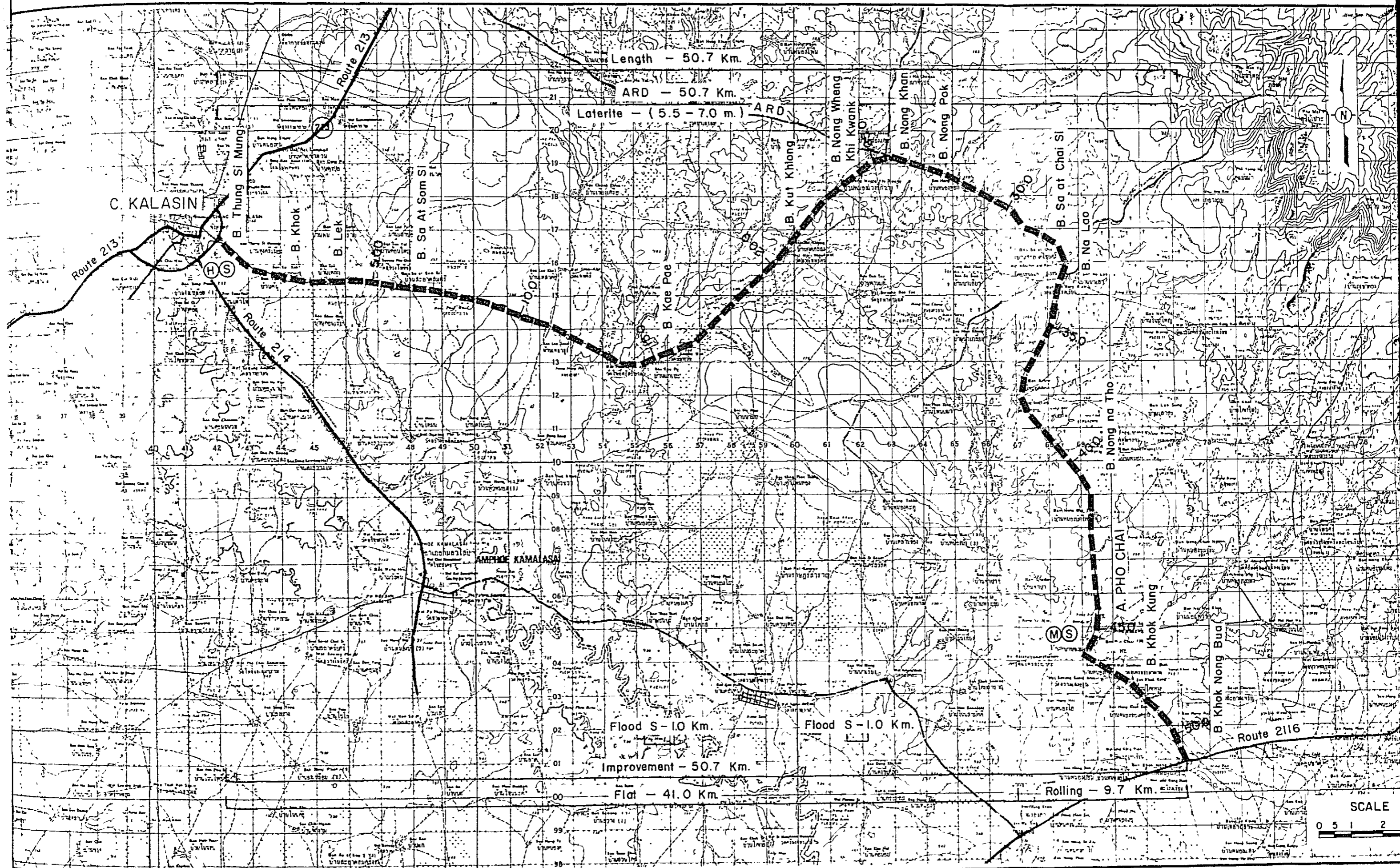




Figure 18.5.2 PROPOSED ROUTE NO. IM - 18

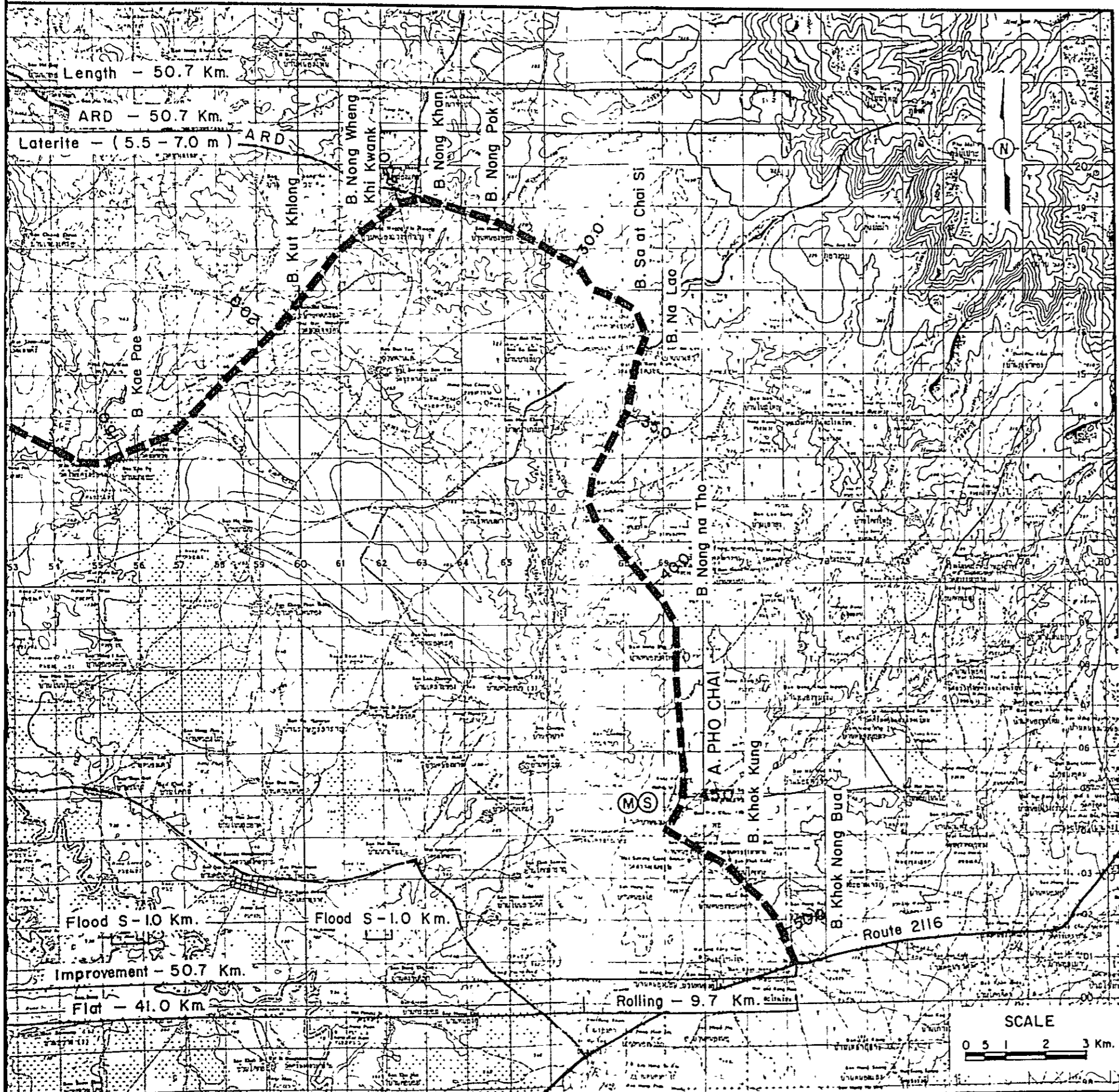
C. KALASIN  
ROI ET

C. KALASIN - B. KHOK NONG BUA (J.R. 2116)  
ROUTE NO. ARD  
L = 50.7 Km.

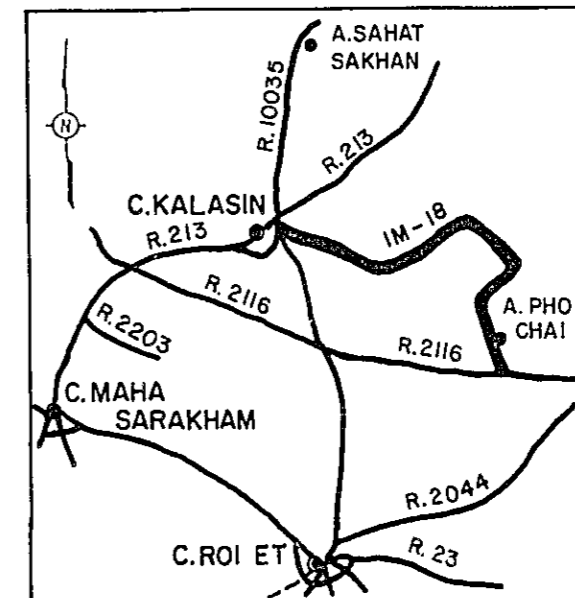




**C. KALASIN ROI ET**      **C. KALASIN — B. KHOK NONG BUA (J.R. 2116)**  
**ROUTE NO. ARD**      **L = 50.7 Km.**



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	3.2	C - 7 00 x 27 00	W - 4 30 x 25 00
2	4.7	C - 7 00 x 14 00	W - 4 50 x 12 00
3	5 8	—	C - 7 00 x 27 00
4	13.7	C - 7 00 x 62.00	W - 4 00 x 60.00
5	16.4	C - 7 00 x 9 00	W - 4 50 x 620
6	27 1	C - 7 00 x 7 00	W - 4 00 x 5 00
7	29 3	C - 7 00 x 18.00	C - 4 00 x 18.00
8	33 2	—	C - 7 50 x 6 00
9	36.5	C - 7 00 x 16 00	C - 4.50 x 16 00
10	46 3	—	C - 8.50 x 8 100
11	48.5	C - 7 00 x 12.00	W - 4.50 x 8.50

LEGEND

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

SCALE



Table 18.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-18 (50.7 km)

Items	Unit of Q'ty	Financial Unit Rate ₪	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)	Q'ty	Financial Cost (10 <sup>3</sup> ₪)	Economic Cost (10 <sup>3</sup> ₪)
<b>DIRECT CONSTRUCTION COST</b>								
Clearing and Grubbing	ha	15,000	119	1,785	1,624	119	1,785	1,624
Excavation - Soil	m <sup>3</sup>	20	0	0	0	0	0	0
Excavation - Hard Rock	m <sup>3</sup>	160	0	0	0	0	0	0
Embankment	m <sup>3</sup>	45	163,800	7,371	6,707	163,800	7,371	6,707
Selected Material	m <sup>3</sup>	80	106,000	8,480	7,547	106,000	8,480	7,547
Soil Aggregate Surface or Subbase	m <sup>3</sup>	105	74,300	7,801	6,943	74,300	7,801	6,943
Crushed Stone Base	m <sup>3</sup>	370	48,800	18,056	16,611	7,300	2,701	2,484
Soil Aggregate Shoulder	m <sup>3</sup>	105	21,000	2,205	1,962	3,200	336	299
Prime Coat and DBST	m <sup>2</sup>	55	275,000	15,125	13,613	41,000	2,255	2,030
Pipe Culvert	m	2,100	2,060	4,326	3,979	2,060	4,326	3,979
Box Culvert	m	16,000	4	64	57	4	64	57
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	135	5,400	4,806	165	6,600	5,874
Sub Total (a)				70,613	63,853		41,719	37,548
Miscellaneous Works (a) x 7%				4,943	4,470		2,920	2,628
Total (b)				75,556	68,323		44,639	40,176
PHYSICAL CONTINGENCY (b) x 15%				11,333	10,248		6,696	6,026
ENGINEERING AND ADMINISTRATION (b) x 10%				7,556	6,832		4,464	4,018
Sub Total				18,889	17,080		11,160	10,044
<b>LAND ACQUISITION</b>								
Highly Developed Land	ha	50,000	76	3,800	3,800	76	3,800	3,800
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				3,800	3,800		3,800	3,800
<b>GRAND TOTAL</b>				<b>98,245</b>	<b>89,203</b>		<b>59,599</b>	<b>54,020</b>

Table 18.6.1 COST AND BENEFITS  
(F4 STANDARD)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	17,841	0	0	0	0	25,065	0
1985	44,601	0	0	0	0	55,947	0
1986	26,761	0	0	0	0	29,972	0
1987	0	262	4,693	-192	4,763	0	4,253
1988	0	1,245	4,987	-177	6,055	0	4,827
1989	0	2,228	5,281	-163	7,346	0	5,229
1990	0	3,211	5,575	-148	8,638	0	5,490
1991	0	4,194	5,870	-134	9,930	0	5,634
1992	0	5,176	6,164	-119	11,221	0	5,685
1993	0	6,159	6,458	-105	12,513	0	5,660
1994	24,539	6,803	6,840	-83	13,560	11,100	5,477
1995	0	7,446	7,223	-61	14,607	0	5,268
1996	0	8,089	7,605	-39	15,654	0	5,040
1997	0	8,732	7,987	-18	16,702	0	4,801
1998	0	9,376	8,369	4	17,749	0	4,556
1999	0	10,019	8,751	26	18,796	0	4,308
2000	0	10,662	9,133	48	19,843	0	4,060
2001	-43,086	11,305	9,515	69	20,890	-7,872	3,817
TOTAL	70,656	94,907	104,450	-1,090	198,267	114,214	74,103

DISCOUNTED ECONOMIC COSTS :	114,214
DISCOUNTED ECONOMIC BENEFITS :	74,103
AGRICULTURAL DEVELOPMENT BENEFIT	32,138
VOC SAVING	42,715
RMC SAVING	-749
NET PRESENT VALUE :	-40,110
BENEFIT COST RATIO :	0.65
INTERNAL RATE OF RETURN :	7.5 %

Table 18.6.2 COST AND BENEFITS  
(F5 STANDARD)

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	21,608	0	0	0	0	27,105	0
1986	32,412	0	0	0	0	36,301	0
1987	0	262	2,576	-22	2,816	0	2,514
1988	0	1,245	2,797	-12	4,030	0	3,213
1989	0	2,228	3,018	-2	5,244	0	3,732
1990	0	3,211	3,240	7	6,458	0	4,104
1991	0	4,194	3,461	17	7,672	0	4,353
1992	0	5,176	3,683	26	8,886	0	4,502
1993	0	6,159	3,904	36	10,100	0	4,569
1994	3,630	6,803	4,166	50	11,018	1,642	4,450
1995	0	7,446	4,427	64	11,937	0	4,304
1996	0	8,089	4,689	77	12,855	0	4,139
1997	0	8,732	4,950	91	13,773	0	3,960
1998	0	9,376	5,211	105	14,692	0	3,771
1999	0	10,019	5,473	118	15,610	0	3,577
2000	0	10,662	5,734	132	16,528	0	3,382
2001	-26,901	11,305	5,996	146	17,447	-4,915	3,187
TOTAL	30,749	94,907	63,325	833	159,065	60,134	57,758

DISCOUNTED ECONOMIC COSTS :	60,134
DISCOUNTED ECONOMIC BENEFITS :	57,758
AGRICULTURAL DEVELOPMENT BENEFIT	32,138
VOC SAVING	25,405
RMC SAVING	215
NET PRESENT VALUE :	-2,376
BENEFIT COST RATIO :	0.96
INTERNAL RATE OF RETURN :	11.6 %

Table 18.7.1 SOCIAL INDICATORS  
(Proposed Route IM-18)

Population (1,000)		Education	
1982	: 52.5	Access to Secondary School	
1993	: 61.3	Number of Student in 1993 (1,000) <sup>2/</sup>	: 13.5
Average travelling speed, without (kph)		Average distance to school (km)	: 10.3
	: 44	Per capita time savings (10 <sup>-4</sup> )	: 0.067
Isolation		Score	: 36
Access to Amphoe		Teacher Intensity	
Average distance to Amphoe (km) <sup>1/</sup>	: 13.9	Number of teachers <sup>3/</sup>	
Per capita time savings (10 <sup>-4</sup> )	: 0.020	University graduate	: -
Score	: 59	Total	: 6
Access to Artery Highway		Number of Student	: 140
Average distance to highway (km) <sup>1/</sup>	: 5	Indicators	
Per capita time savings (10 <sup>-4</sup> )	: 0.007	E1 <sup>4/</sup>	: -
Score	: 15	E2 <sup>5/</sup>	: 42.9
Impassability		E <sup>6/</sup>	: 42.9
Impassable week a year	: 4	Degree of Improvement <sup>7/</sup>	: 1.59
Impassability per year	: 0.077	Score	: 102
Impassability per capita (10 <sup>-4</sup> )	: 0.013	Disparity	
Score	: 108	G.P.V. in 1993 (Mn B) <sup>8/</sup>	
Health		With project	: 177.2
Access to Hospital		Without project	: 162.2
Average distance to Hospital (km) <sup>1/</sup>	: 15.0	Per capita G.P.V. in 1993 (B)	
Per capita time savings (10 <sup>-4</sup> )	: 0.022	With project (W)	: 2,891
Score	: 51	Without project (w)	: 2,646
Access to Medical Facilities		Degree of Disparity	
Average distance to facilities (km) <sup>1/</sup>	: 10.5	(A/W) - (A/w) <sup>9/</sup>	: 0.10
Per capita time savings (10 <sup>-4</sup> )	: 0.015	Score	: 179
Score	: 60	Total Score	: 610

Note:

- <sup>1/</sup> ( ) shows the length or distance in without project case. Unless otherwise, lengths are same both in with project case and without project case.
- <sup>2/</sup> 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.
- <sup>3/</sup> Numbers of the sample areas
- <sup>4/</sup> (Number of University Graduate Teachers)/(Total Number of Student) x 1,000
- <sup>5/</sup> (Total of Teachers)/(Total Number of Student) x 1,000
- <sup>6/</sup> Sum of <sup>4/</sup> and <sup>5/</sup>
- <sup>7/</sup> 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
- <sup>8/</sup> Estimated gross value of crop production in the areas of influence
- <sup>9/</sup> "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.