STUDY ROUTE NO. 30

Rt. 1020 (B. Thung Ngiu)
– Rt. 1020 (B. Chumphu)
L = 47.8 Km
Changwat : Chiang Rai

1. GENERAL

1-1 Location of Route

The proposed road locates generally in parallel with the Ing at the northern end close to the border with Laos as shown in Figure 30-1-1.

The route originates at Rt. 1020 near A.Chiang Khong and runs south up to B. Chomphu which is located on the same Rt. 1020.

The route mostly passes low paddy area between the Ing and the foot of the mountains.

Major villages are mostly built-up along the road, with the population of about 33 thousand in the area of influence.

1-2 Conditions of Existing Road

Conditions of the existing road are given in Table 30-1-1, dividing it into 4 sections depending on its difference of conditions.

Figure 30-1-1 ROUTE LOCATION

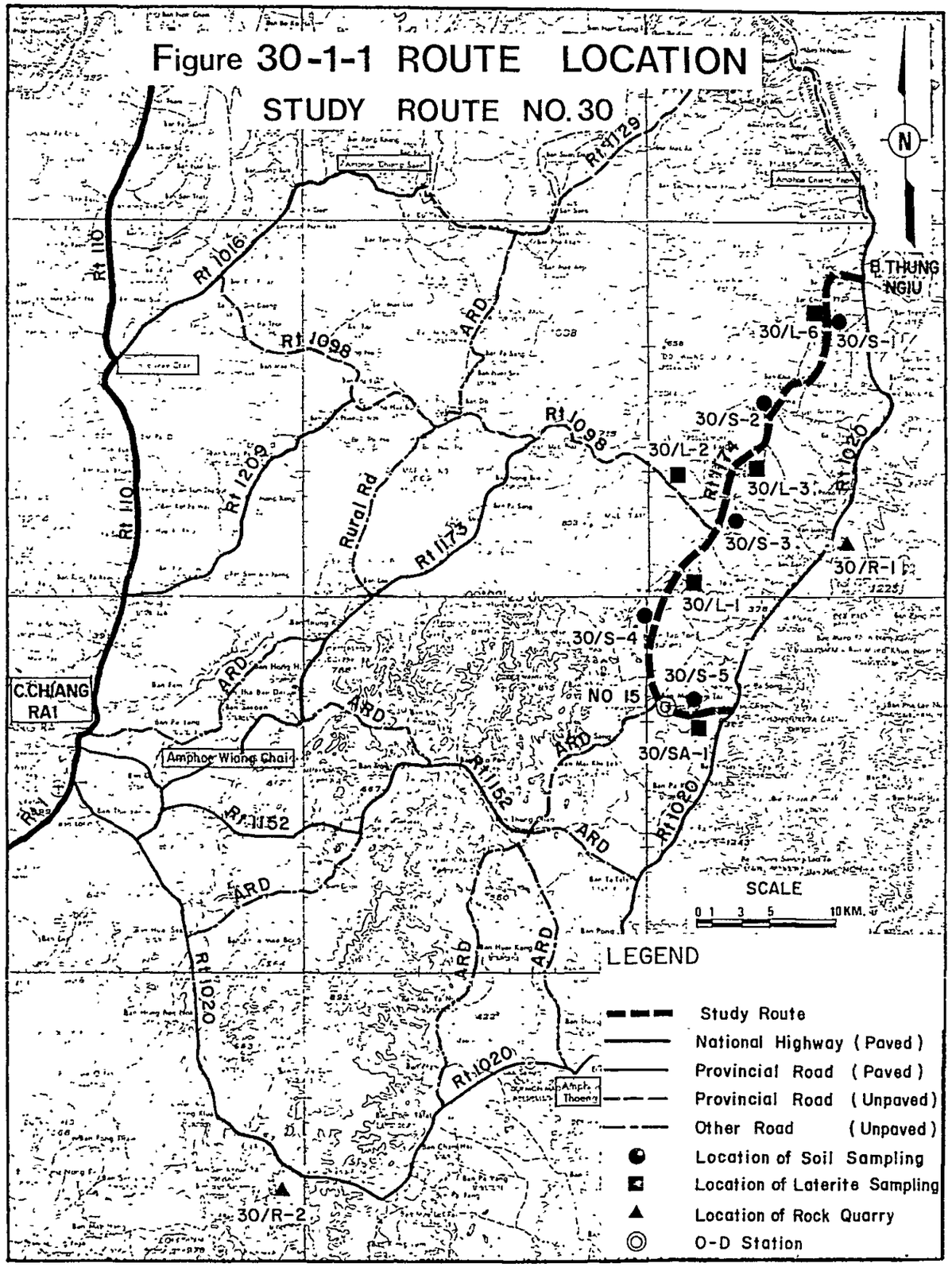


Table 30-1-1 SUMMARY OF ROAD INVENTORY

Segment	Changwat	Route Name	Route Section: Origin	Route Section: Destination	Length (km)	Terrain	Roadway Condition: Surface: Earth / Lat. / S.T.	Surface: Length (km)	Surface: Condition	Alignment: Horizontal	Alignment: Vertical	Road Cross Section: Width (m)	Road Cross Section: Emb. H. (m)	Road Cross Section: Cut D. (m)	Bridge: Nos.	Bridge: Width (m)	Bridge: ACC. Length (m)	Land Use	Overflow: Height X Length (m)
Seg. (a)	Chaing Rai	R.1174	R.1020 B. Thung Ngiu	B. Khita	12.1	Flat	L / S.T.	7.1 / 5.0	Fair / Good	Fair	Good	5.5 / 6.0	0.2 / 0.8	-	2 Timber	4.5	54.0	Paddy	0.3 x 400
Seg. (b)	Chaing Rai	R.1174	B. Khita	B. Kham	14.2	Flat	L / S.T.	10.0 / 4.2	Fair / Good	Fair	Good	4.5 / 6.0	0.2 / 0.75	-	4 Timber	4.5 / 6.5	51.0	Paddy Forest	-
Seg. (c)	Chaing Rai	R.1174	B. Kham	B. Mac Tam	11.9	Flat	L	11.9	Fair	Fair	Good	4.5 / 6.0	0.1 / 1.0	-	4 Timber	4.5 / 6.5	60.0	Paddy	0.1 x 1,000 0.2 x 3,000
Seg. (d)	Chaing Rai	R.1174	B. Mac Tam	R.1020 B. Chum Phu	9.6	Flat	L	9.6	Fair	Fair	Good	5.0 / 6.0	0.15 / 1.15	-	1 Timber 1 Concrete	4.3 10.0	8.5 12.4	Paddy Plantation	0.5 x 8,000

2. TRAFFIC

2-1 Traffic Zone and Road Links

Traffic zoning was made as shown in Figure 30-2-1

The area of influence was divided into 3 traffic zones, and total population in the area amounts approximately to 33200. The density in terms of population per unit Km of the proposed road length is 690. Annual rate of population increase in the area is 2.1% in the past 3 years, which is almost same as the average of 2.2% in the Northern Region.

As the major destinations of transport demands originated in the area, three Amphoe of Muang Chiang Rai, Chiang Khong and Thoeng were chosen based on the O/D survey. Characteristics of the traffic zones are shown in Table 30-2-1.

The existing and proposed roads in the area together with surrounding roads concerned were divided into totaling 21 road links, 4 links in the proposed roads and 17 links in the surrounding roads. The details are shown in Table 30-2-2.

2-2 Transportation Demands

a) Passenger

Passenger transportation demands by O/D pair in the opening year of the project were estimated in both cases of with and without project as follows:

Passenger O/D (without project)-1987

(trip/day)

	1	2	3	11	12	21	22	23
1	0	260	198	98	131	155	621	160
2	0	0	319	133	105	109	141	118
3	0	0	0	445	340	0	202	316
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0

Passenger O/D (with project)-1987

(trip/day)

	1	2	3	11	12	21	22	23
1	0	412	411	181	208	186	1057	231
2	0	0	401	277	169	118	263	167
3	0	0	0	445	475	0	293	392
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0

b) Agricultural Freight

The major destinations of agricultural freight originated in the influencial area were selected at A. Muang Chiang Rai, A. Chiang Khong and A. Thoeng, basing on the agro-economic survey results.

The estimated agricultural freight O/D volumes in 1987 for the both cases of with and without projects are as follows:

Agri. Freight O/D (without project)-1987

(1,000 ton/year)

	1	2	3	11	12	21	22	23
1	0.0	0.0	0.0	0.0	0.0	30.5	3.4	1.4
2	0.0	0.0	0.0	0.0	0.0	11.1	2.8	1.0
3	0.0	0.0	0.0	0.0	0.0	16.5	0.0	2.2
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 30-2-1 ZONING AND ROAD NETWORK

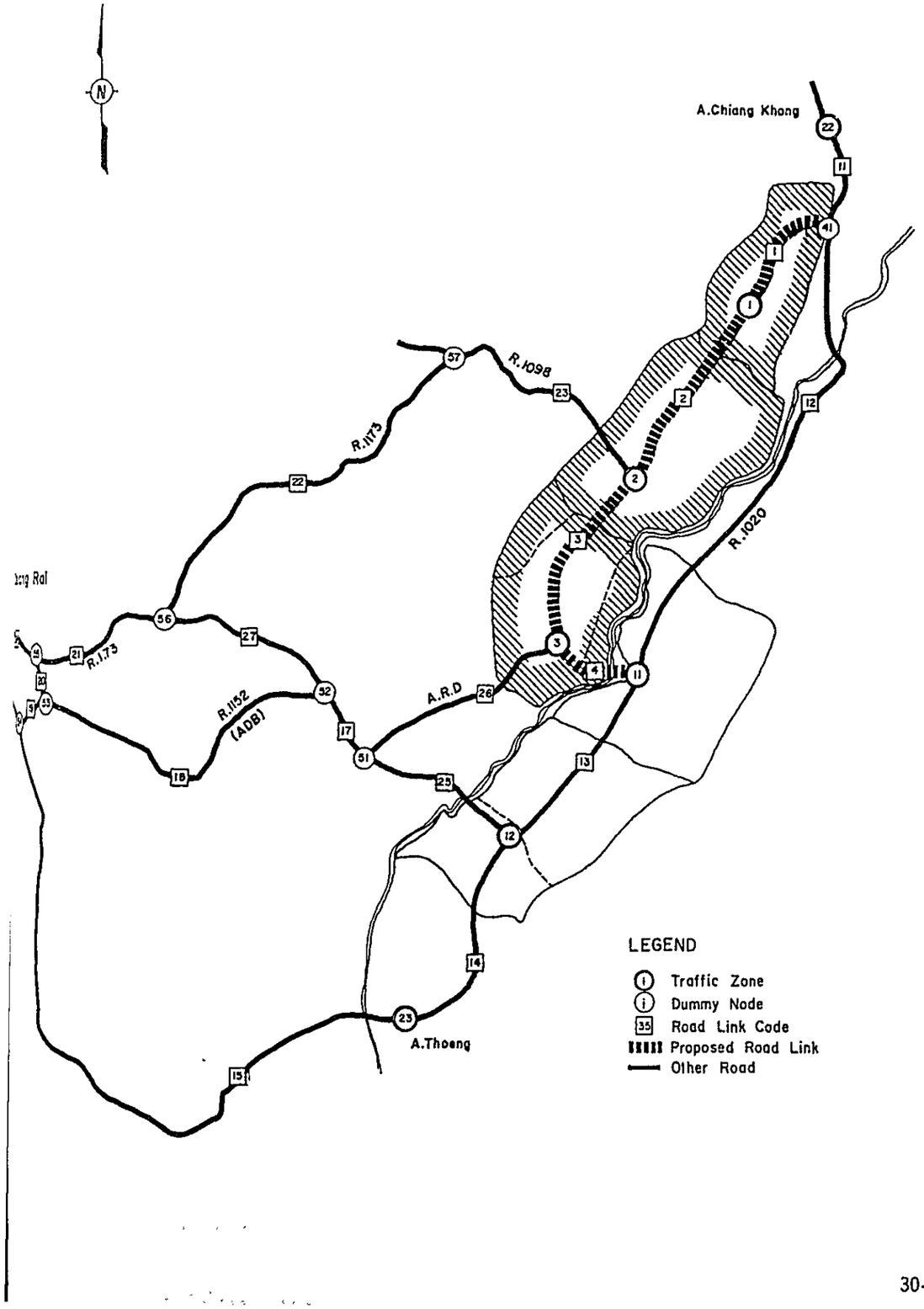


Table 30-2-1 ZONE CHARACTERISTICS

Traf. Zone	Relative Administrat. Div. Changwat	Amphoe	Tambon Code	% of Popul. in Traf. Zone	Popul. in 1981 (10^3)	Past Trend of Popul. Increase	Annual Rate of Increase 1981-1987	Projected Population in 1987 Generation	Attraction
1	C.R	Chiang Khong	090402	92	14.0	2.2	1.7	15.3	15.3
2	C.R	Chiang Khong	090405	100	7.3	4.5	2.4	8.1	8.1
3	C.R	Thoeng	090608(1)	11	1.2				
			090608(2)	10	1.1				
			090613	100	8.6				
		Wiang Chai	091105	28	2.1				
			Total	-	13.0	0.8	0.8	13.6	13.6
11	C.R	Thoeng	090608	79	8.6	0.8	0.8	9.0	9.0
12	C.R	Thoeng	090606	100	12.0				
			090607	100	7.7				
			Total	-	19.7	0.7	0.7	20.4	20.4
21	C.R	-	090000	100		0.9	0.9	-	977.4
22	C.R	Chiang Khong	090400	100	60.7	2.3	1.7	-	66.3
23	C.R	Thoeng	090600	100	130.8	1.3	1.2	-	140.2

Table 30-2-2 ROAD LINK CHARACTERISTICS

NO	SN	EN	LO	GOD	GOR	LW	GWD	GWR	TO	TW	REMARKS
1	1	41	12.1	8	11	12.1	4	4	18.2	10.4	R.1174
2	1	2	14.2	8	11	14.2	4	4	21.3	12.2	R.1174
3	2	3	11.9	8	11	11.9	4	4	17.9	10.2	R.1174
4	3	11	9.6	8	11	9.6	4	4	14.4	8.2	R.1174
11	22	41	6.0	4	4	6.0	4	4	5.1	5.1	R.1020
12	11	41	36.0	4	4	36.0	4	4	30.9	30.9	R.1020
13	11	12	15.0	4	4	15.0	4	4	12.9	12.9	R.1020
14	12	23	16.0	4	4	16.0	4	4	13.7	13.7	R.1020
15	23	54	57.0	4	4	57.0	4	4	48.9	48.9	R.1020
16	21	54	10.0	4	4	10.0	4	4	8.6	8.6	R.1020
17	51	52	10.0	5	5	10.0	5	5	10.0	10.0	R.1152(ADB)
18	52	53	25.0	5	5	25.0	5	5	25.0	25.0	R.1152(ADB)
19	53	54	3.5	5	5	3.5	5	5	3.5	3.5	R.1152(ADB)
20	53	55	2.0	5	5	2.0	5	5	2.0	2.0	R.1173(ADB)
21	55	56	14.0	5	5	14.0	5	5	14.0	14.0	R.1173
22	56	57	30.0	5	5	30.0	5	5	30.0	30.0	R.1173
23	2	57	19.2	9	12	19.2	9	12	38.6	38.6	R.1098
24	21	55	7.5	4	4	7.5	4	4	6.4	6.4	Rural
25	12	51	9.5	8	11	9.5	8	11	14.3	14.3	ARD
26	3	51	15.0	9	12	15.0	9	12	30.2	30.2	ARD
27	52	56	12.0	9	12	12.0	9	12	24.1	24.1	Rural

Note SN: Start Node, EN: End Node, LO: Link Length (W), GOD: Road Grade in Dry Season (W), GOR: Road Grade in Rainy Season (W), LW: Link Length (W), GWD: Road Grade in Dry Season (W), GWR: Road Grade in Rainy Season (W), TO: Time (W), TW: Time (W).

Agri. Freight O/D (with project)-1987

(1,000 ton/year)

	1	2	3	11	12	21	22	23
1	0.0	0.0	0.0	0.0	0.0	30.6	3.4	1.4
2	0.0	0.0	0.0	0.0	0.0	11.1	2.8	1.0
3	0.0	0.0	0.0	0.0	0.0	16.9	0.0	2.2
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

c) Non-agricultural Freight

The non-agricultural freight transportation demands are estimated based on the model described in 3-3-3 in the Summary Report. Their movements on each road link were obtained relating with the passenger movements which were derived from the assignment of the passenger O/D volumes shown in the above a).

2-3 Traffic Composition, Occupancy and Loading Ratio

a) Traffic Composition

In accordance with the examination of the classified traffic counts in the Phase I and II studies and DOH's traffic records, the traffic composition on the existing roads of the project area was estimated as follows:

Existing Traffic Composition

Survey Points and Source	Passenger Traffic						Freight Traffic				
	P/C	P/P	L/B	M/B	H/B	Total	P/T	4/T	6/T	10/T	Total
No.15(Phase II)	.00	.63	.04	.17	.17	1.00	.22	.17	.33	.27	1.00
R. 1174 (DOH)	.48	.04	.39		.08	1.00	.50		.35	.15	1.00
Estimated	.04	.57	.06	.25	.08	1.00	.30	.21	.34	.15	1.00

Changes in traffic composition due to income growth and road surface condition were predicted for the both cases of with and without projects as shown in the following tables:

Passenger Traffic Composition

Year	Without Project					With Project				
	P/C	P/P	L/B	M/B	H/B	P/C	P/P	L/B	M/B	H/B
1981	.04	.57	.06	.25	.08	.04	.57	.06	.25	.08
1987	.04	.58	.06	.24	.08	.09	.53	.06	.21	.11
1993	.04	.60	.05	.23	.08	.15	.49	.05	.17	.14
2001	.04	.61	.05	.22	.08	.22	.43	.05	.12	.18

Freight Traffic Composition

Year	Without Project				With Project			
	P/T	4/T	6/T	10/T	P/T	4/T	6/T	10/T
1981-2001	.30	.21	.34	.15	.34	.04	.45	.17

b) Occupancy

Occupancy by vehicle type and the average were determined as follows:

Occupancy

Vehicle Type	Person per Vehicle
P/C	3.1
P/P	4.4
L/B	10.9
M/B	16.2
H/B	38.3
Ave. (1993, $\bar{W}$)	10.1
(1993, W)	11.3

c) Loading Ratio

Loading ratio by vehicle type and the average were determined as follows:

Loading Ratio

Vehicle Type	Ave. Load of Loaded Truck	Rate of Loaded Trucks	Loading Ratio (ton)
P/T	0.65	.45	0.3
4/T	2.0	.50	1.0
6/T	4.1	.55	2.3
10/T	12.6	.60	7.6
Ave.($\bar{W}$)	-	-	2.2
(W)	-	-	2.5

2-4 Growth Rates of Transportation Demands

The growth rates of passenger, agricultural freight and non-agricultural freight transport demands for the periods of 1987-1993 and 1993-2001 were projected. The basis for the estimation of growth rate for passenger, and the projected rates are shown in the following tables:

The Basis for Estimation of Passenger Demands Growth

Indicator	Annual Growth Rate (%) 1987 - 1993	1993 - 2001	Elasticity
Per capita Income	5.7	5.5	1.08
Transportation price	3.6	3.6	-0.24
Population	1.4	1.1	1.00

Growth Rate of Transportation Demands

Type of Demand	Annual Growth Rate (%) 1987 - 1993	1993 - 2001	Index 1987=100 1993	2001
Passenger	6.7	6.2	148	240
Agri. Freight	0.1	0.1	100.7	101.7
Non-Agri. Freight	8.0	7.4	159	281

2-5 Forecasted Traffic

a) Forecasted Traffic by Vehicle Type

The forecasted traffic is summarized in the following table:

Forecasted Traffic

Year	P/C	L/B	M/B	H/B	P/P P/T	4/T	6/T	10/T	ADT	M/C
1987	18	12	43	22	138	3	39	15	291	196
1993	44	15	50	41	184	5	55	21	414	235
2001	98	22	53	80	258	8	89	33	642	302

b) Forecasted Traffic by Road Link

Details of the forecasted traffic by road link by traffic type are shown in the following table, taking a sample of the case of 1993:

Forecasted Traffic by Road Link

TRAFFIC VOLUME ON ROUTE 30 (1993)

LINK		1	2	3	4	AVR.
P/C	N+D	19	26	34	36	28
	I	13	16	18	14	15
	DV	0	0	0	0	0
	TOTAL	32	43	52	50	44
L/B	N+D	6	9	11	12	9
	I	4	5	6	5	5
	DV	0	0	0	0	0
	TOTAL	11	14	17	17	15
M/B	N+D	21	30	38	41	32
	I	14	19	20	16	17
	DV	0	0	0	0	0
	TOTAL	36	49	59	57	50
H/B	N+D	18	25	32	34	26
	I	12	15	17	13	14
	DV	0	0	0	0	0
	TOTAL	30	40	48	47	41
P/P&T	N+D	76	117	151	146	121
	I	52	68	74	57	63
	DV	0	0	0	0	0
	TOTAL	128	185	226	203	184
4/T	N+D	2	4	5	3	3
	I	1	2	2	1	2
	DV	0	0	0	0	0
	TOTAL	3	5	7	5	5
6/T	N+D	19	41	54	37	38
	I	13	18	21	16	17
	DV	0	0	0	0	0
	TOTAL	32	59	75	53	55
10/T	N+D	7	15	20	14	14
	I	5	7	8	6	7
	DV	0	0	0	0	0
	TOTAL	12	22	28	20	21
ADT	N+D	168	267	345	323	273
	I	115	151	166	127	141
	DV	0	0	0	0	0
	TOTAL	283	418	512	451	414
M/C	N+D	131	176	208	206	179
	I	57	61	58	47	56
	DV	0	0	0	0	0
	TOTAL	188	237	266	253	235
TOTAL	N+D	300	443	553	529	452
	I	172	212	225	174	197
	DV	0	0	0	0	0
	TOTAL	472	655	778	704	649

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

3. AGRICULTURAL DEVELOPMENT

3-1 Crop Production

The flat lands between the proposed road and Ing river are completely covered by paddy fields. More than 80% of rice grown in the area is glutinous rice with high yield. In the narrow hilly area in the western side of the area of influence, upland crops are planted. The major crops include maize followed by fruits, tobacco, vegetables and ground nuts.

Maize is assembled at Thoeng through Route 1020. Tobacco is sent to local drying places then shipped out to Chiang Rai. Most of paddy is milled at rice mills in Thoeng and Chian Khong and supplied for local consumption.

Land use and capability in the area of influence is illustrated in Figure 30-3-2. Typical cropping calendar in Chiang Rai area is also shown in Figure 30-3-1. Based on the estimated planted area and yields, the future crop production in the area of influence after opening of the proposed road is given in the following Table 30-3-1.

3-2 Net Value Added

In accordance with the concept discusses in Chapter 4 of Summary Report, net value added was calculated for both cases, with project and without project. The agricultural development benefit, indicated by the increment of net value added of crop production in the with project case, attributable to the project is estimated at 10.1, 11.1 and 12.5 in million Baht for 1987, 1993 and 2001 respectively.

Figure 30-3-1 TYPICAL CROPPING CALENDAR - Route 30

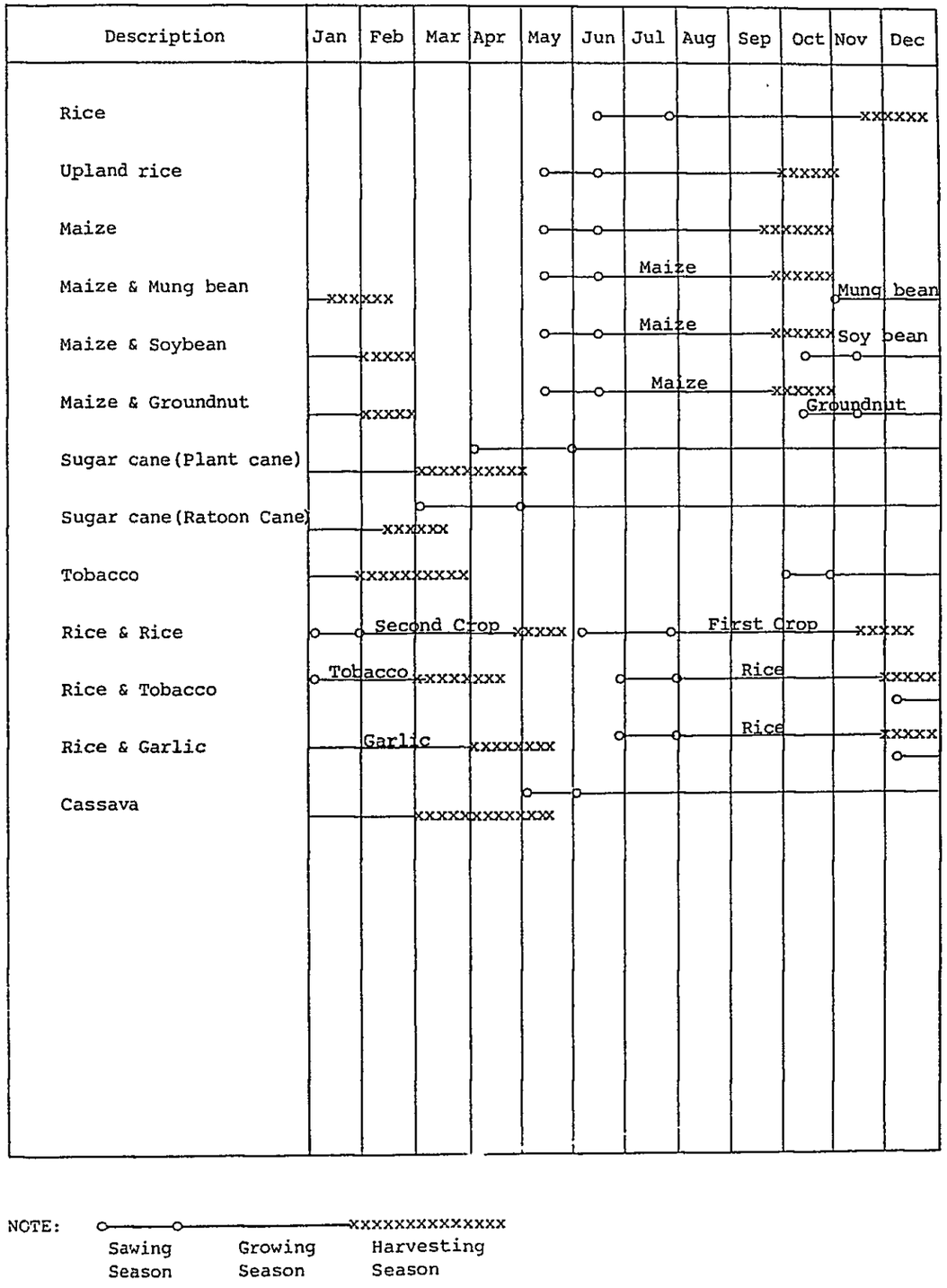


Figure 30-3-2 LAND USE AND CAPABILITY OF INFLUENCE AREA STUDY ROUTE NO. 30

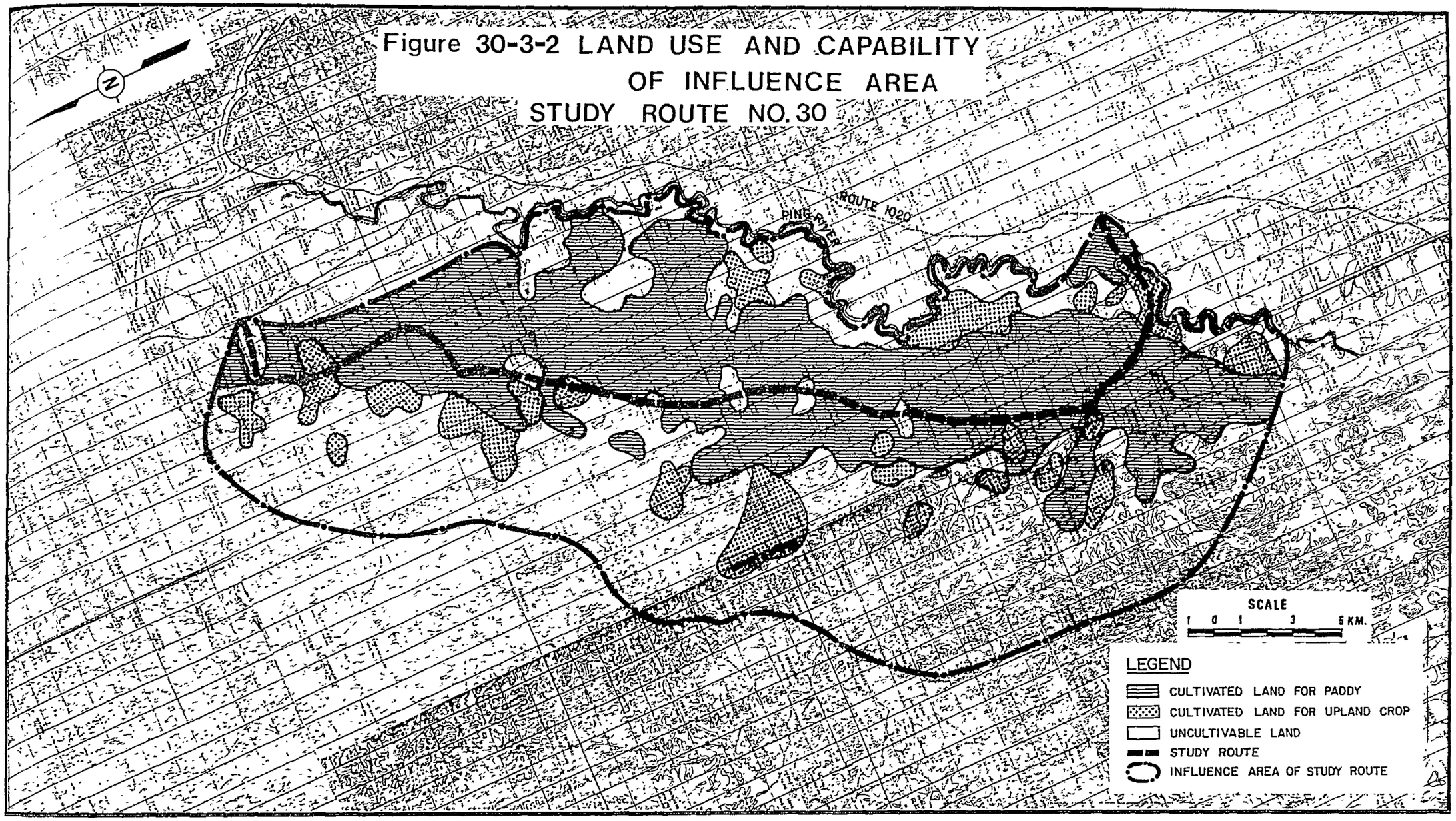


Table 30-3-1 CROP PRODUCTION - Route 30

(1000 TON)

CROP	1987		1993		2001	
	W/O	W	W/O	W	W/O	W
PADDY	56.0	56.1	56.1	56.6	56.1	57.2
MAIZE	4.1	4.6	4.1	4.6	4.1	4.7
MUNG BEAN	0.1	0.1	0.1	0.1	0.1	0.1
SOY BEAN	0.0	0.0	0.0	0.0	0.0	0.0
GROUND NUTS	0.5	0.6	0.5	0.6	0.5	0.6
SORGHUM	0.0	0.0	0.0	0.0	0.0	0.0
CASSAVA	0.0	0.0	0.0	0.0	0.0	0.0
SUGAR CANE	0.0	0.0	0.0	0.0	0.0	0.0
TOBACCO	1.2	1.2	1.2	1.2	1.2	1.2
COTTON	0.0	0.0	0.0	0.0	0.0	0.0
GARLIC	0.0	0.0	0.0	0.0	0.0	0.0
CHILLI	0.0	0.0	0.0	0.0	0.0	0.0
SESAME	0.0	0.0	0.0	0.0	0.0	0.0
VEGETABLES	1.1	1.1	1.1	1.1	1.1	1.1
FRUITS	5.5	5.5	5.5	5.5	5.5	5.5
OTHERS	0.4	0.4	0.4	0.4	0.4	0.4

4. ROAD USERS COST SAVINGS

In accordance with the concept and basic data described in Chapter 5 of Summary Report, sums of VOC on each road link concerned were calculated in both cases of with project and without project.

Road users cost savings, defined as the difference of total link VOC in the case of with project and that in the without project case, were estimated at 12.8, 17.4 and 26.5 in million Baht for 1987, 1993 and 2001 respectively.

5. ENGINEERING

5-1 Soils and Materials

Test results of subgrade soil, materials for subbase and shoulders and crushed rocks along the route or in the vicinity of the project area are shown in Table 30-5-1.

Location of samplings for the soil test done in this study are shown in the Location Map of 30-1-1.

5-1-1 Subgrade Soils

Subgrade soils along the study route consist mainly of clay of medium plasticity index ranging from 10 to 20%. They were classified as A-4 and A-7 in the AASHTO Classification. CBR values were from 3.0 to 7.0 %.

5-1-2 Subbase and Shoulder Materials

Test results of laterite done by DOH itself along the study route indicated that the plasticity-index of the portion passing the No. 4 sieve was from 10% to 20% and the soaked CBR was from 20% to 40%.

Most of laterites along the study route are not suitable for use in subbase and shoulder layer, because of this high plasticity-index, DOH made the mixture of the laterite and the river sand with N.P. obtained from the adjacent river and tested them. This mixture has low plasticity-index and satisfy the specification of subbase in DOH.

5-1-3 Rock Material

The rock quarry available for the proposed road is the source 30/R-2 located along Rt. 1020, about 50 km far from Chiang Rai. The fine aggregates passing #40 sieve is non-plastic and Los Angeles abrasion loss was around 30%.

One test result indicated that the CBR value is 98%.

5-2 Preliminary Design

Engineering studies on the proposed road are described, dividing the route into four Segments ((a), (b), (c) and (d)), due to its topographic differences.

Segment-(a)	:	Rt. 1021, B. Thung Ngiu - B. Khita	(12.1 km, flat)
Segment-(b)	:	B. Khita - B. Kham	(14.2 km, flat)
Segment-(c)	:	B. Kham - B. Mae Tam	(11.9 km, flat)
Segment-(d)	:	B. Mae Tam - Rt. 1020, B. Chum Phu	(9.6 km, flat)

Design speed employed in the studies is 80 km/hr according to F4 class of DOH Design Standard.

5-2-1 Alignment and Earthwork

As the horizontal and vertical alignments are fair condition along the proposed road, no major improvements to the existing road were required. The widening width and the raising height vary from 3.0 m to 4.5 m and 0.5 m to 1.5 m, respectively.

The bypass (0.25 Km) is planned to avoid B. Huai So.

5-2-2 Pavement Design (F4 Class)

1) Design Traffic Number (DTN)

The basic data on traffic volume for DTN calculation are as follows:

	Heavy Truck	Medium Truck	Heavy Bus	Total	Remarks
Average Number of Heavy Vehicles	15	39	23	77	ADT in 1987

Table 30-5-1 TEST RESULTS OF SOILS AND MATERIALS

Description	Sample No.	Location of Source (KM)	Depth (m)	Description of Sample	AASHO Classification	Sieve Analysis (% Passing) 50.0	25.0	19.0	9.5	#4	#10	#40	#200	Plasticity LL (%)	PI (%)	Compaction DH-T STD. Opt. Mc.(%)	γd gm/cc.	Lab. CBR CBR (%)	Swell (%)	Moisture Content (After Soaked) (%)	Abrasion (%)
Subgrade Soil	30/S-1	KM. 5+000 (L]] m)		Clay	A-6	-	-	-	100	95.6	86.2	75.8	68.8	38.0	]4.]8	20.0	1.760	4.9	0.18		
	30/S-2	KM.15+000 (R.7)		Clay	A-7-6	-	-	-	-	100	99.6	98.0	95.0	45.7	20.81	18.6	1.757	5.10	0.96		
	30/5-3	KM.25+000 (L.6)		Clay	A-4	-	-	-	-	100	99.8	98.8	98.0	33.5	10.1	20.4	1.605	7.00	0.73		
	30/5-4	KM.35+000 (R.6)		Clay	A-7-6	-	-	-	-	100	99.6	97.2	94.0	45.2	22.0	19.4	1.631	3.40	0.35		
	30/S-5	KM.45+000 (L.]2)		silty sand	A-6	-	-	-	-	-	100	99.2	95.4	38.3	15.6	22.2	1.579	4.2	1.67		
Subbase/ Shoulder Material	30/L-1	KM.32+700 (L.30)			A-6	-	100	99.3	94.2	86.8	79.0	58.7	45.7	36.36	17.27	9.1	2.182	19.8	0.84		59.2
	30/L-2	KM 26+800 (R.5.4KM)		laterite	A-2-6	100	99.0	96.2	81.8	64.4	47.9	24.2	13.0	32.25	17.10						
	30/SA-1	KM 45+800 (R.150)		sand Ing Rv.	A-1-b	-	-	-	-	100	95.0	21.0	1.0	N - P							
		30/L-2 mixed with 30/L-2 in]:]			A-2-4	-	100	98.0	90.5	82.0	71.5	22.0	7.0	22.00	9.10	10.4*	2.044*	66.0	-		40.7
	30/L-3	KM 20+000			A-2-6	100	74.4	66.0	60.6	45.9	30.5	16.5	9.6	32.25	13.65						
		30/L-3mixed with 30/SA-] in 4:]			A-1-a	-	-	100	69.0	56.0	42.0	18.0	7.0	18.90	5.40	10.4*	2.235*	50.2	-		54.2
	30/L-4	KM 98+200			A-2-4	100	81.9	76.7	62.7	50.1	41.3	23.5	11.7	24.71	9.85	8.5*	2.138*	44.0	-		57.0
	30/L-5	KM 95+700 (R.200) mixed with 30/SA-] in 2:3			A-2-7	100	96.9	93.5	79.3	58.4	44.3	36.2	35.3	44.49	17.83						
					A-2-4	-	100	97.0	91.5	83.0	74.5	28.0	14.5	25.00	10.00	13.3*	2.006*	47.5	0.94		65.2
	30/L-6	KM. 5+400			A-7-5	100	95.2	91.2	73.0	55.4	47.1	41.2	37.8	61.50	23.09						
		30/L-6 mixed with 30/SA-] in 3:7			A-2-4	-	100	97.5	91.5	86.0	80.5	27.5	12.5	28.00	1070	10.9*	2.154*	50.0	1.04		39.4

Table 30-5-1 TEST RESULTS OF SOILS AND MATERIALS (Cont'd)

Description	Sample No.	Location of Source (KM)	Depth (m)	Description of Sample	AASHO Classification	Sieve Analysis (% Passing)								Plasticity		Compaction DH-T STD.		Lab. CBR		Moisture Content (After Soaked) (%)	Abrasion (%)
						50.0	25.0	19.0	9.5	#4	#10	#40	#200	LL (%)	PI (%)	Opt. Mc. (%)	γd gm/cc.	CBR (%)	Swell (%)		
Crushed Rock	30/R-1	KM. Post 117+000 Rt. 1020																			19.4
	30/R-2	Km. Post 42 from C. Rai 6km from Rt. 1020				100	90.7	81.3	66.8	56.1	39.6	20.4	7.9	N - P		7.0*	2.259*	98.0	-		29.1

Note: * Compaction by DH-T-MOD

Using the traffic analysis chart, DTN obtained for DTN7 (7 years design period) and DTN15 (15 years) were 4.5 and 12.0, respectively.

2) Design CBR

Design CBR of 30 percentile value was calculated at 4.2 percent from the following testing results.

Sample No.	1	2	3	4	5	Design CBR
CBR Testing Value (%)	4.9	5.1	5.4	3.4	4.2	4.2

3) Thickness of Pavement

Thickness of full-depth asphaltic concrete were obtained from the Thickness Design Chart as 170 mm and 190 mm for TA7 (7 years design period) and TA15 (15 years), respectively.

Thickness of pavement structures of SBST was determined from calculated TA7 170 mm full-depth asphaltic concrete as follows:

SBST		12 mm
Crushed stone base	CBR $\geq$ 80	150 mm
Soil aggregate subbase	CBR $\geq$ 20	260 mm

Thickness of overlay required at 7th year is 20 mm (TA15-TA7) in case of asphaltic concrete. If it is planned with SBST, the layer composition is as follows:

SBST		12 mm
Crushed stone base	CBR $\geq$ 80	40 mm

5-2-3 Drainage

1) Pipe Culvert

Segment-(a)

Pipe culverts (ø 1.0 m) are installed at intervals of 200 m for the sections where the land is used for paddy fields, 5.5 km long in total and at intervals of 500 m for the remainder.

Segment-(b)

Pipe culverts (ø 1.0 m) are installed at intervals of 200 m for the sections where the land is used for paddy fileds, 8.1 km long in total and at intervlas of 500 m for the remainder.

Segment-(c)

Pipe culverts (ø 1.0 m) are installed at intervals of 200 m for the sections where the land is used for paddy fields, 3.0 km long in total and at intervals of 500 m for the remainder.

Segment-(d)

As the land along Segment-(d) is used almost for paddy fields, pipe culverts (ø 1.0 m) are installed at intervals of 200 m uniformly all along Segment-(d).

2) Box Culverts

Box culverts were not planned.

5-2-4 Bridge

Short span concrete bridge was planned where the river is relatively narrow and shallow. The length of bridges was determined by the comparing discharge with flow capacity of bridge opening.

List of Bridge

Station	Existing Structure	Catchment Area (km^2)	Intensity (mm/h)	Discharge (m^3/sec)	Proposed Structure 1/	Capacity (m^3/sec)
1+300	BR-T(4.5x24.0)	33	58	266	BR-C-24.0	270
4+800	BR-T(4.5x30.0)	20	66	190	BR-C-30.0	240
12+850	BR-T(4.5x23.5)	14	82	172	BR-C-24.0	186
15+850	BR-T(5.0x10.0)	10	64	93	BR-C-18.0	103
16+400	BR-T(5.0x10.0)	11	76	123	BR-C-12.0	146
25+750	BR-T(6.5x9.5)	18	40	109	BR-C-20.0	117
27+200	BR-T(6.5x19.5)	25	57	206	BR-C-20.0	217
31+050	BR-T(5.0x15.0)	35	48	233	BR-C-16.0	116 } 249
31+500	BR-T(6.0x18.0)				BR-C-18.0	133
34+700	BR-T(4.5x7.5)	11	64	102	BR-C-10.0	114
44+800	BR-T(4.3x8.5)	10	70	99	BR-C-10.0	114

Total length = 202.0 m

Note: 1/ Carriageway width of bridge is 7.0 m.

6. CONSTRUCTION COST

Construction costs were obtained by applying the unit rates to the respective work quantities calculated on the basis of the engineering studies.

Rock materials used for SBST, base course and structure works were supposed to be transported from rock quarry 30/R-2 with a hauling distance of 88 km. The transportation cost for this hauling distance was reflected to each unit rate.

The construction cost together with land acquisition cost are given in Table 30-6-1.

The construction period for the proposed road was estimated to be 3 years. Yearly disbursements of construction cost togetner with price contingency are shown in the following table.

YEARLY COST DISBURSEMENT - Route 30

(Million Baht)

	1984		1985		1986		Total		
	L/C[1/]	F/C[2/]	L/C	F/C	L/C	F/C	L/C	F/C	Total
Construction Cost	11.4	10.6	28.6	26.4	17.2	15.9	57.2	52.9	110.1
Price Contingency[3/]	3.7	1.6	13.0	6.1	10.3	4.9	27.0	12.6	39.6
Total	15.1	12.2	41.6	32.5	27.5	20.8	84.2	65.5	149.7
							(3.67)	(2.85)	(6.52)

Note: 1/ Local Currency

2/ Foreign Currency

3/ At assumed annual escalation rates as follows (% p.a.):

	Local C.	Foreign C.
1981 - 1983	15	7.5
1983 - 1987	10	6.5

( ) Million US$ Equivalent (1 US$ = 22.63 Baht)

Table 30-6-1 CONSTRUCTION COST - Route 30 (F-4 / 47.8 Km)

Description	Unit of Quantity	Financial Unit Rate (Baht)	Quantity	Economic Cost (10^3 ฿)
Clearing & Grubbing	ha	17,000	102	1,578
Roadway Excavation-Classified Earth	m^3	36	0	0
Roadway Excavation-Classified Soft Rock	m^3	80	0	0
Embankment-Side Borrow	m^3	45	448,300	18,358
Embankment-Borrow Pit	m^3	60	0	0
Embankment-Selected Material	m^3	80	0	0
Subbase-Soil Aggregate	m^3	106	125,800	11,868
Base-Crushed Rock	m^3	399	46,600	17,106
Shoulder-Soil Aggregate	m^3	170	20,100	3,041
Asphaltic Prime Coat	m^2	11.3	310,700	3,230
Single Bituminous Surface Treatment	m^2	28.5	262,900	6,744
R.C. Pipe Culvert	m	2,700	2,100	5,216
R.C. Box Culvert	m	18,700	0	0
R.C. Bridge-Short Span	m	41,400	202	7,443
P.C. Bridge-Long Span	m	71,600	0	0
Sub-Total				74,584
Miscellaneous Works[1/]				5,221
Total Direct Construction Cost				79,805
PHYSICAL CONTINGENCY[2/]				11,971
DESIGN AND CONSTRUCTION SUPERVISION[3/]				7,981
Total				99,757
Land Acquisition				
Highly Devel'd Land	ha	50,000	0	0
Less Devel'd Land	ha	15,000	0	0
Grand Total				99,757
FINANCIAL COST (10^3 Baht)				(110,063)

NOTE: 1/ 7% Of direct construction cost of major work items.

2/ 15% Of direct construction cost.

3/ 10% Of direct construction cost.

7. EVALUATION

In accordance with the basic conditions of economic evaluation discussed in Chapter 8 of Summary Report and economic costs and benefits estimated as in the foregoing sections, internal rate of return of the proposed road project was calculated at 17.4%. This implies that the proposed project is economically viable, assuming that the opportunity cost of capital is 12%.

Details of costs and benefits stream are given in Table 30-7-1.

Table 30-7-1 COSTS AND BENEFITS STATEMENT - Route 30

(1000 BAHT)

	COST	BENEFITS				DISCOUNTED(12%)	
YEAR	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1983	0	0	0	0	0	0	0
1984	19,950	0	0	0	0	28,028	0
1985	49,880	0	0	0	0	62,569	0
1986	29,927	0	0	0	0	33,518	0
1987	0	10,100	12,827	-119	22,808	0	20,364
1988	0	10,273	13,585	-105	23,753	0	18,936
1989	0	10,447	14,343	-91	24,699	0	17,580
1990	0	10,620	15,101	-77	25,645	0	16,298
1991	0	10,793	15,860	-62	26,591	0	15,088
1992	0	10,967	16,618	-48	27,536	0	13,951
1993	0	11,140	17,376	-34	28,482	0	12,884
1994	31,756	11,314	18,513	-13	29,814	14,365	12,041
1995	0	11,488	19,650	9	31,146	0	11,232
1996	0	11,661	20,787	30	32,478	0	10,457
1997	0	11,835	21,924	51	33,811	0	9,720
1998	0	12,009	23,061	73	35,143	0	9,020
1999	0	12,183	24,198	94	36,475	0	8,359
2000	0	12,356	25,335	115	37,807	0	7,735
2001	-45,888	12,530	26,472	137	39,139	-8,384	7,151
TOTAL	85,625	169,715	285,651	-39	455,327	130,097	190,817

DISCOUNTED ECONOMIC COSTS : 130,097

DISCOUNTED ECONOMIC BENEFITS : 190,817

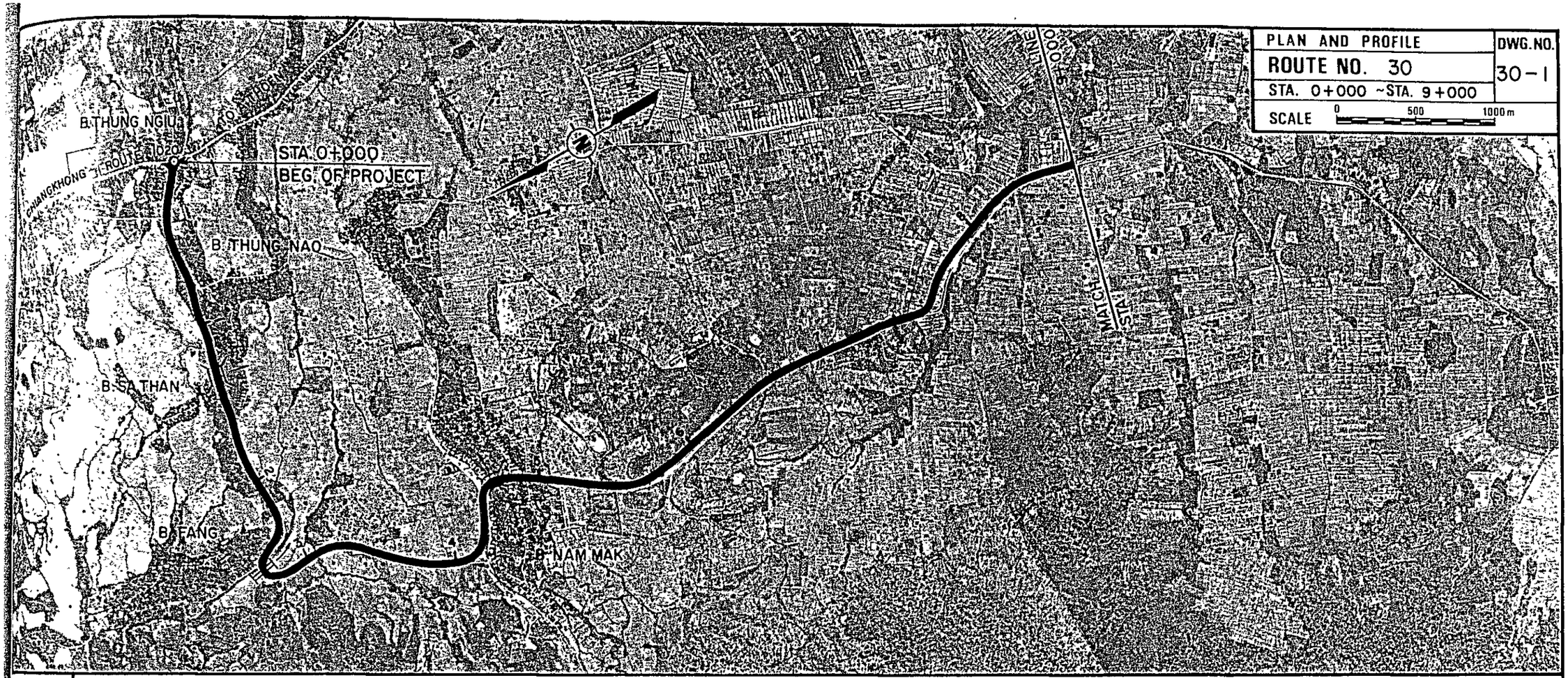
AGRICULTURAL DEVELOPMENT BENEFIT	74,673
VOC SAVING	116,411
RMC SAVING	-267

NET PRESENT VALUE : 60,720

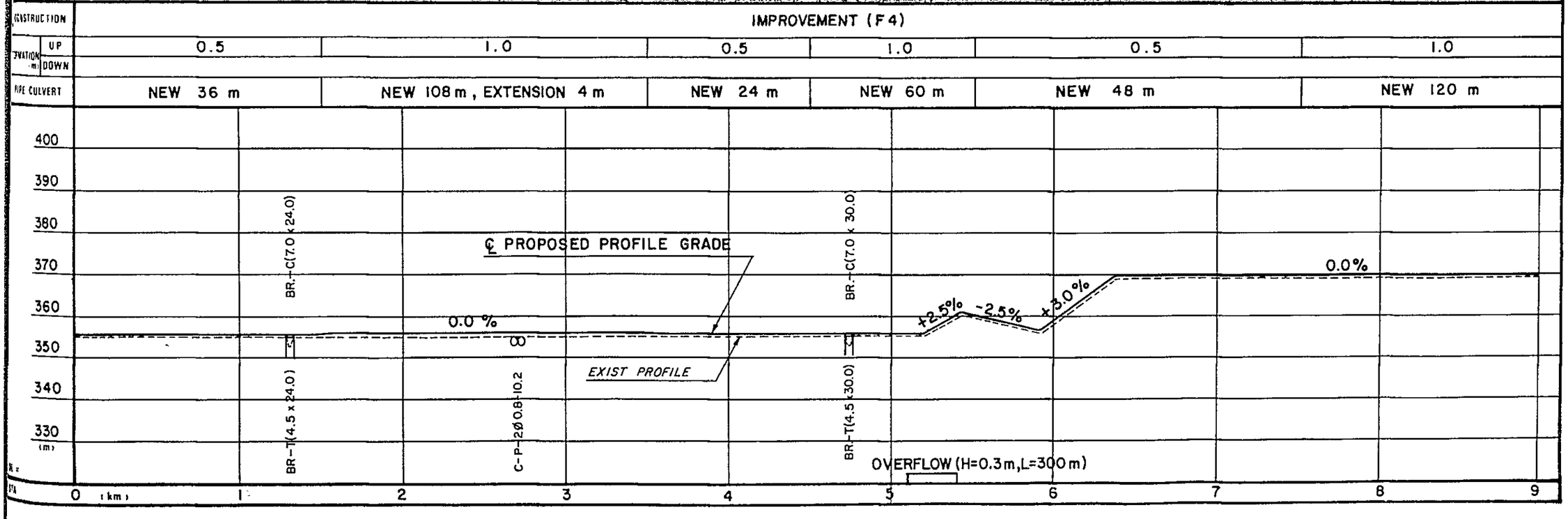
BENEFIT COST RATIO : 1.47

INTERNAL RATE OF RETURN : 17.4 %

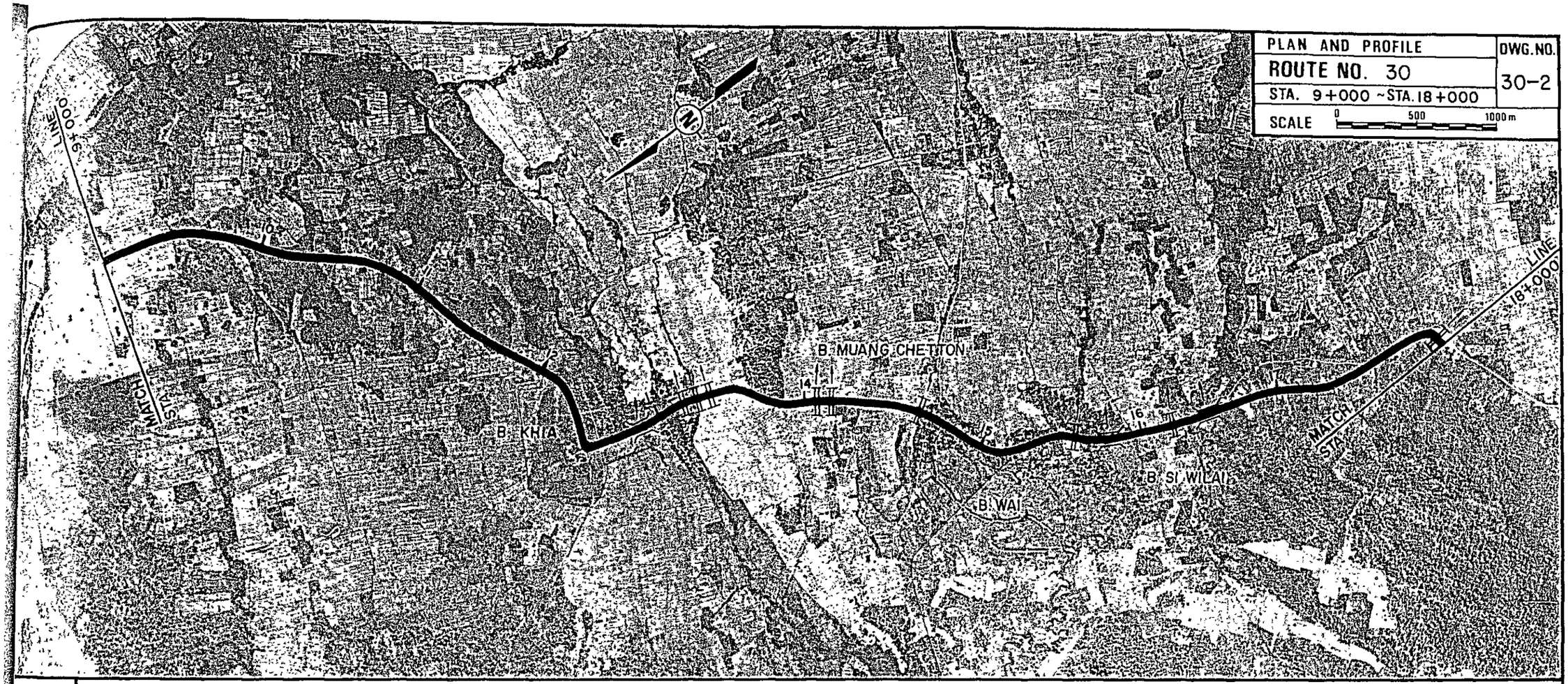
PLAN AND PROFILE	DWG. NO.
ROUTE NO. 30	30-1
STA. 0+000 ~STA. 9+000	
SCALE 0 500 1000 m	



CONSTRUCTION	IMPROVEMENT (F4)					
ELEVATION (m) UP	0.5	1.0	0.5	1.0	0.5	1.0
ELEVATION (m) DOWN						
PIPE CULVERT	NEW 36 m	NEW 108 m, EXTENSION 4 m	NEW 24 m	NEW 60 m	NEW 48 m	NEW 120 m



PLAN AND PROFILE	DWG.NO.
ROUTE NO. 30	30-2
STA. 9+000 ~ STA. 18+000	
SCALE 0 500 1000 m	



CONSTRUCTION		IMPROVEMENT (F4)								
ELEVATION (m)	UP	1.0	0.5	1.0	0.5	1.0	0.5			1.0
	DOWN									
PIPE CULVERT		NEW 24 m	NEW 40 m	NEW 36 m, EXTENSION 1m		EXT 2m	NEW 84 m, EXTENSION 14 m			NEW 216 m, EXTENSION 4 m

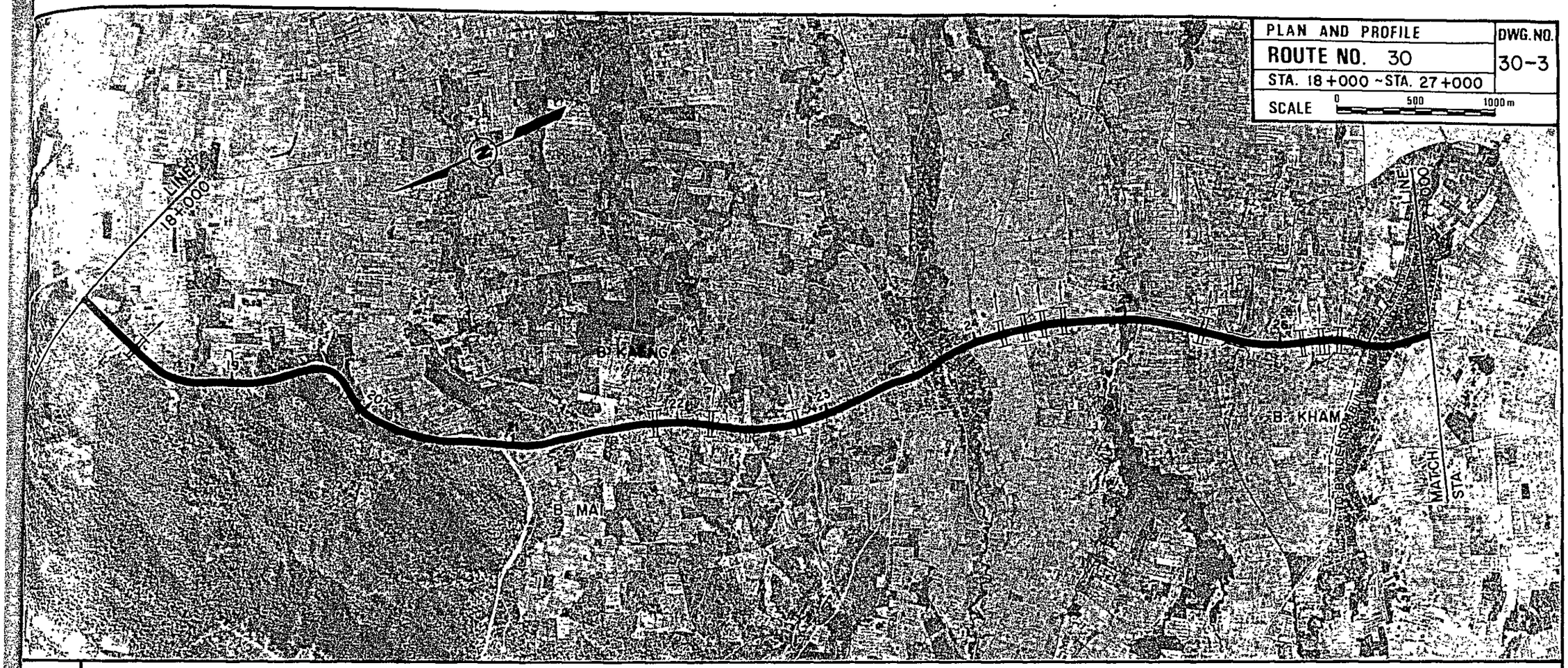
410
400
390
380
370
360
350
340
(m)

℄ PROPOSED PROFILE GRADE
EXIST. PROFILE
0.0%
+4.0%
-2.0%
0.0 %
OVERFLOW (H=0.3m, L=100m)

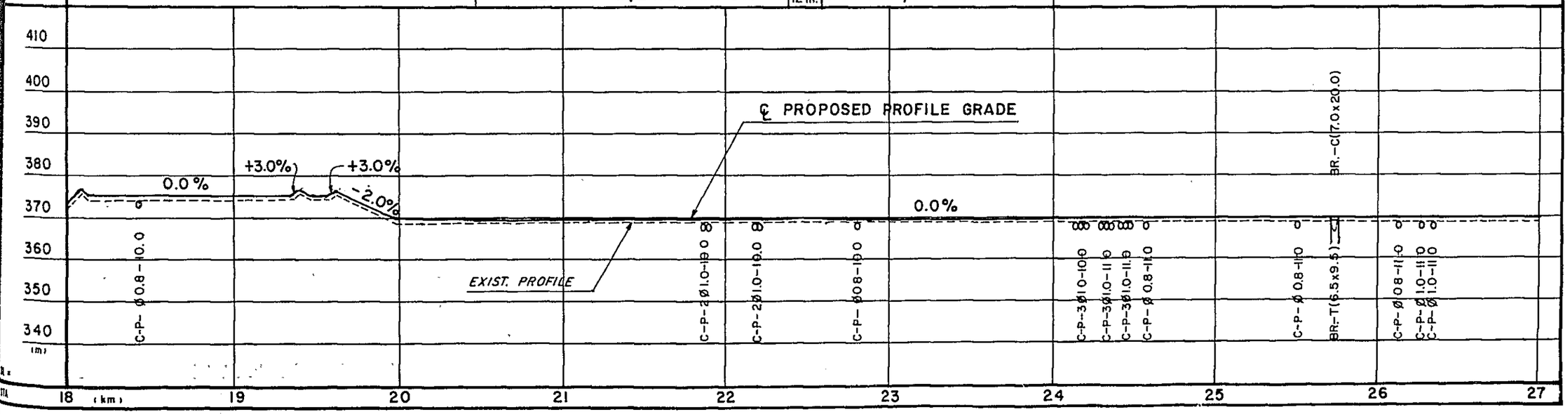
BR.-C(7.0x24.0)
BR.-C(7.0x8.0)
BR.-C(7.0x2.0)
BR-T(4.5x23.5)
C-P-4Ø1.0-10.0
C-P-Ø1.0-10.0
C-P-Ø0.8-10.0
C-P-Ø0.8-10.0
C-P-Ø0.8-10.0
C-P-3Ø0.8-10.0
C-P-Ø0.8-10.0
BR.-T(6.0x8.0)
C-P-Ø0.8-10.0
BR.-T(5.0x10.0)
C-P-Ø0.8-10.0

STA. 9 (km) 10 11 12 13 14 15 16 17 18

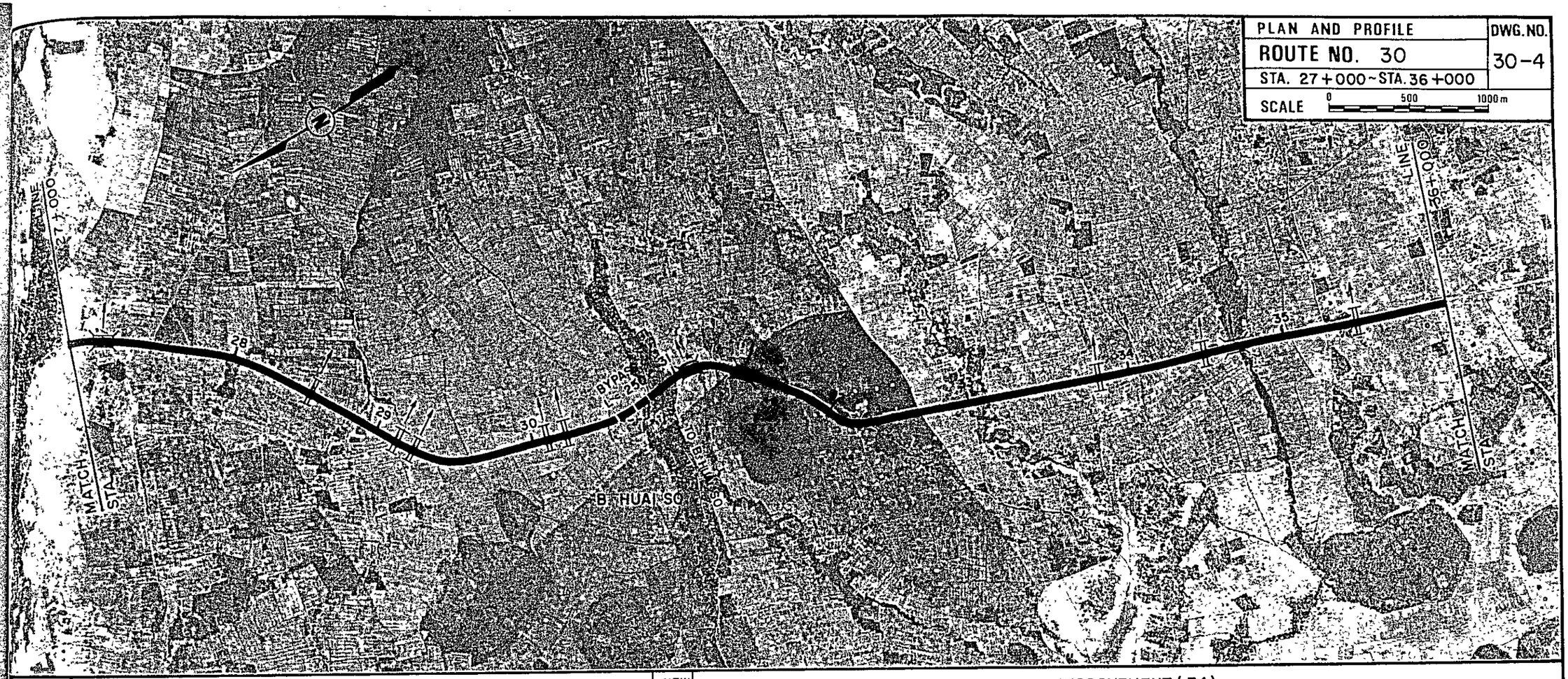
PLAN AND PROFILE	DWG. NO.
ROUTE NO. 30	30-3
STA. 18+000 ~ STA. 27+000	
SCALE 0 500 1000 m	



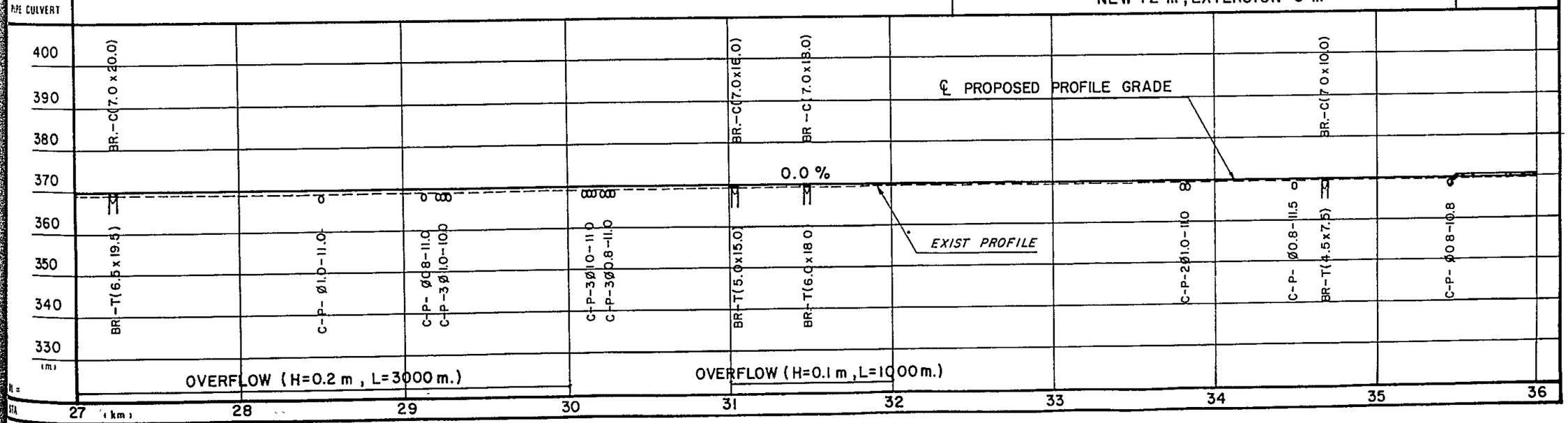
CONSTRUCTION																		
		IMPROVEMENT (F4)																
ELEVATION (m)	UP	1.0				0.5			1.0	0.5					1.0			
	DOWN																	
TYPE CULVERT						NEW 48 m, EXTENSION 8 m			NEW 12 m.	NEW 36 m, EXTENSION 2 m					NEW 516 m, EXTENSION 41 m			



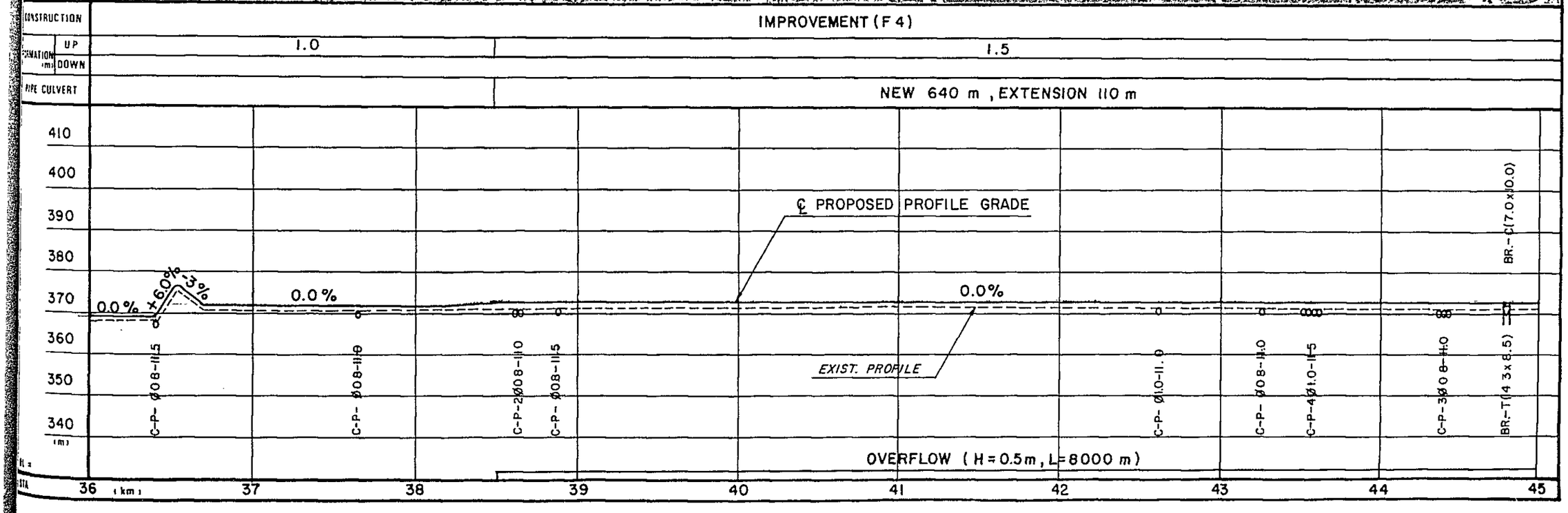
PLAN AND PROFILE	DWG.NO.
ROUTE NO. 30	30-4
STA. 27+000 ~ STA. 36+000	
SCALE 0 500 1000 m	



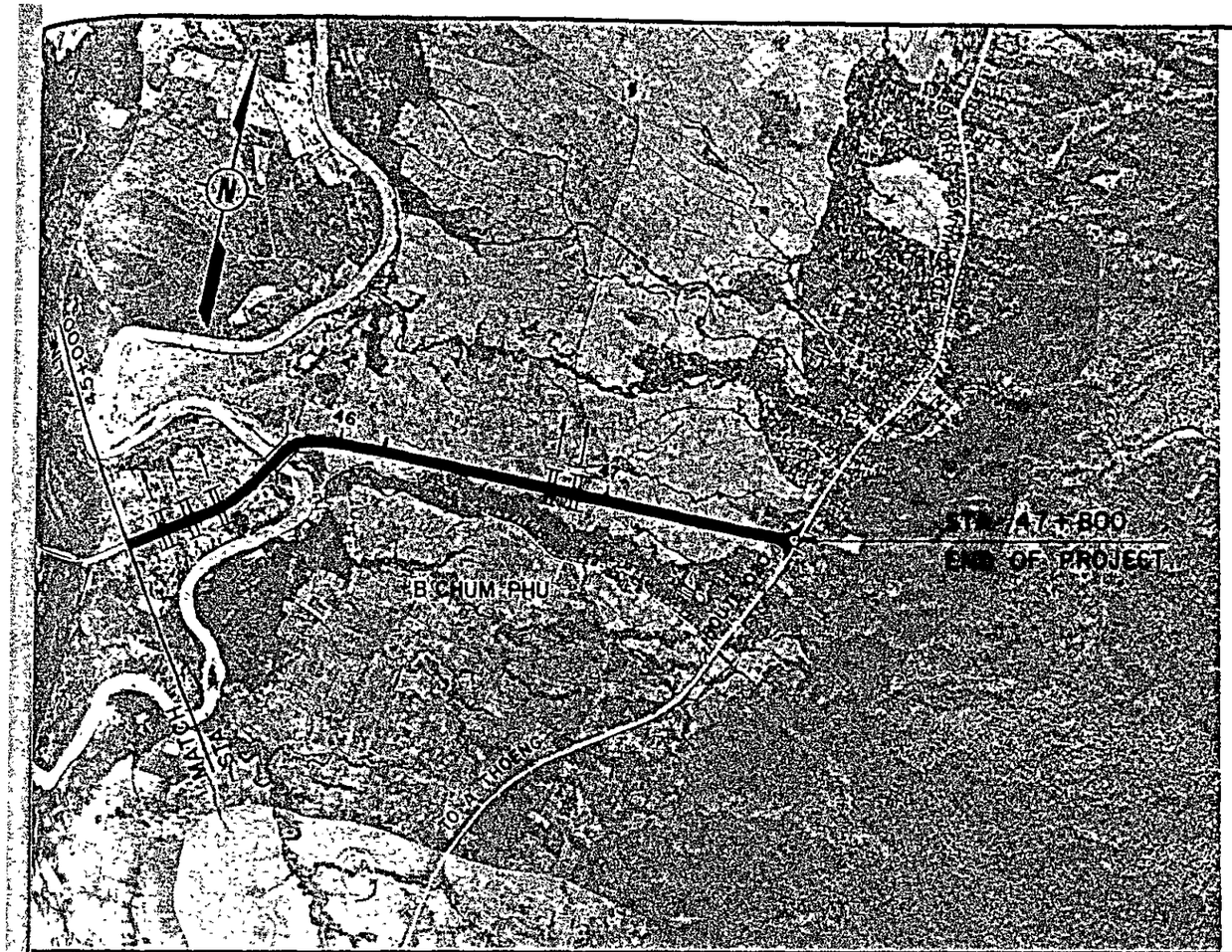
CONSTRUCTION		IMPROVEMENT (F4)	NEW (F4)	IMPROVEMENT (F4)	
ELEVATION (m)	UP	1.0		0.5	1.0
	DOWN				
PIPE CULVERT				NEW 72 m, EXTENSION 3 m	



PLAN AND PROFILE	DWG. NO.
ROUTE NO. 30	30-5
STA. 36+000 ~ STA. 45+000	
SCALE 0 500 1000 m	



PLAN AND PROFILE	DWG. NO.
ROUTE NO. 30	30-6
STA. 45+000 ~ STA. 47+800	
SCALE 0 500 1000 m	



CONSTRUCTION: IMPROVEMENT (F4)

ELEVATION (m) UP: 1.5 | 1.0

ELEVATION (m) DOWN:

PIPE CULVERT: NEW 98 m, EXTENSION 6 m