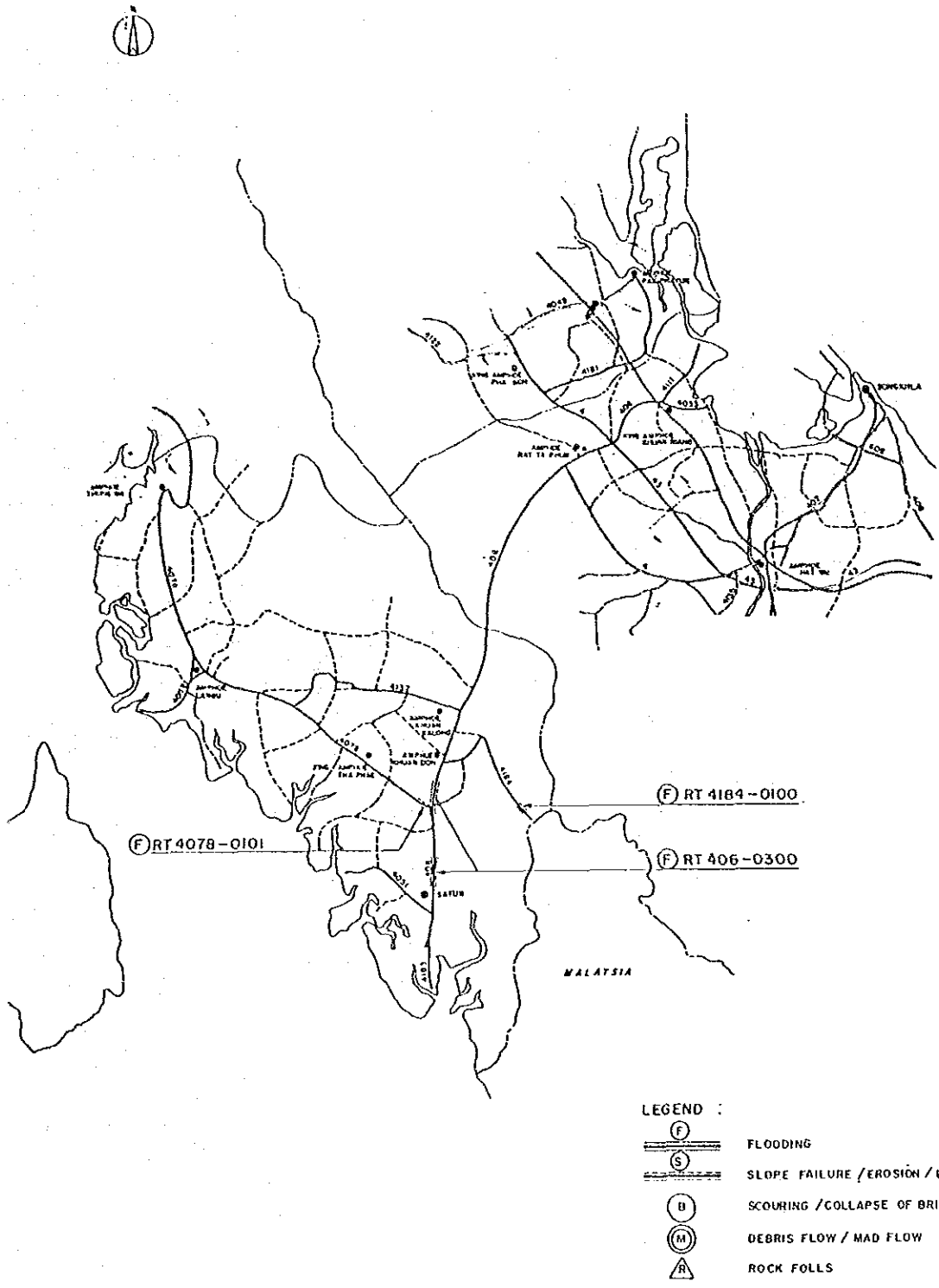
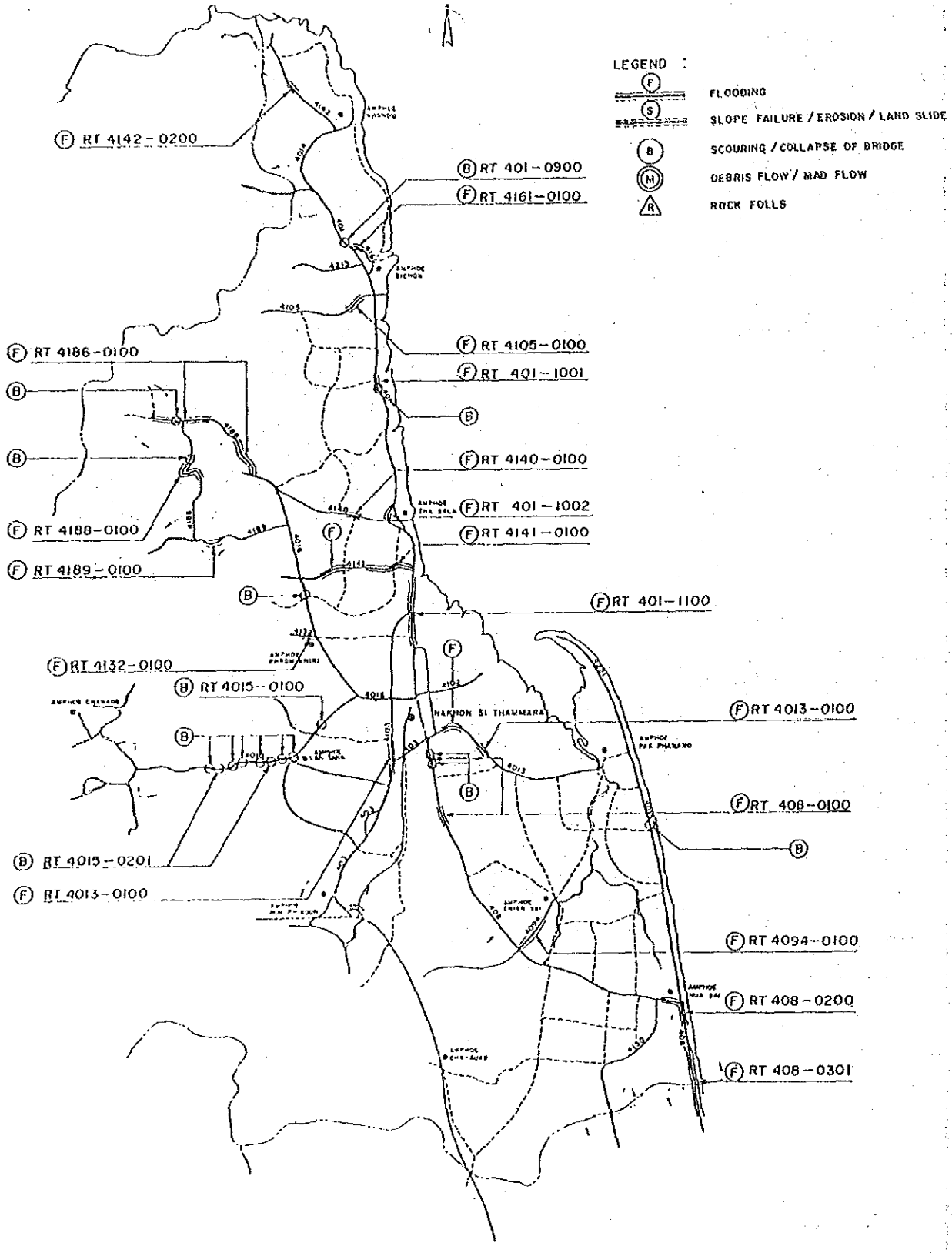


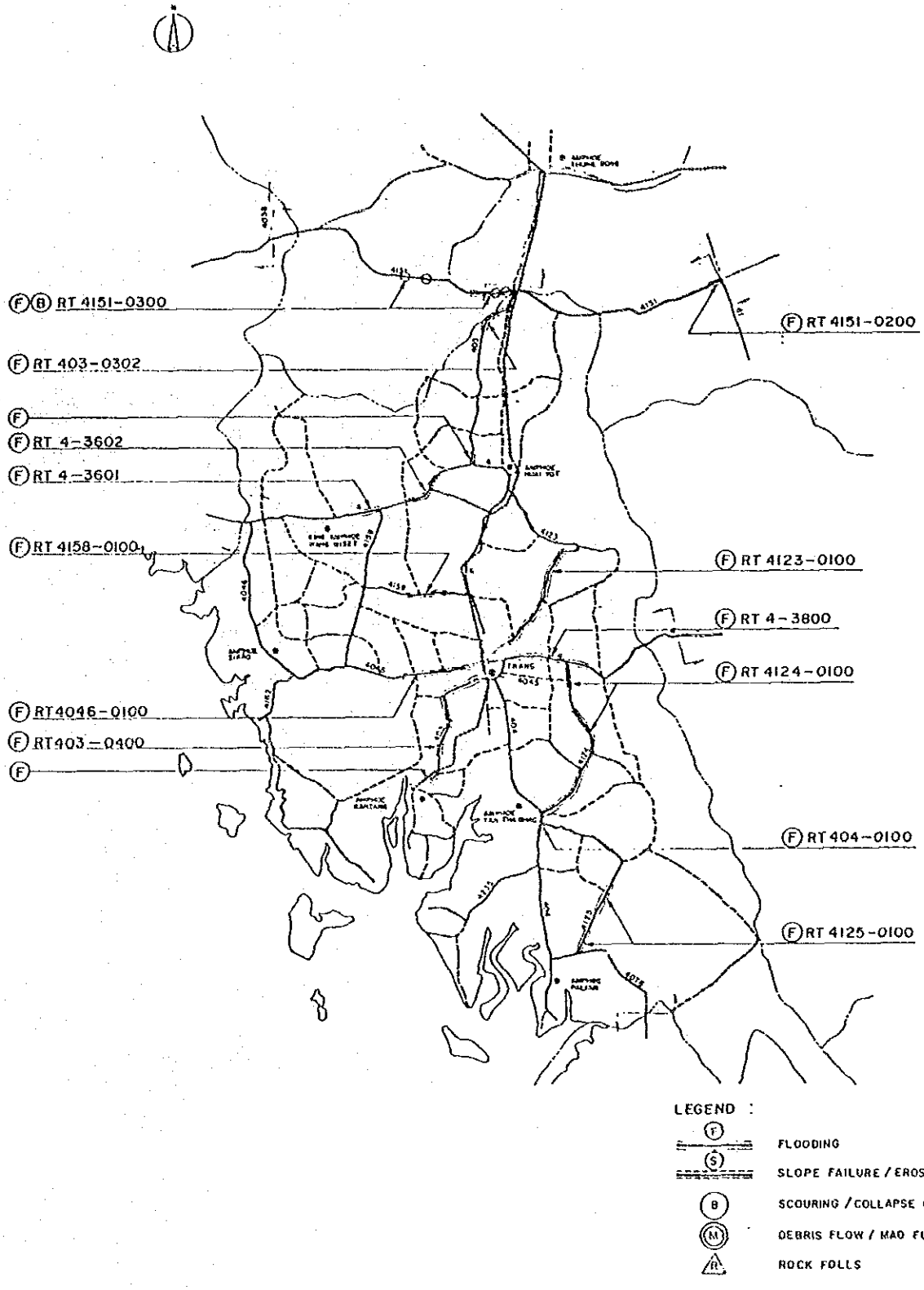
A.2.5.3 (6) Disaster History on DOH Highway

DISTRICT·SATUN



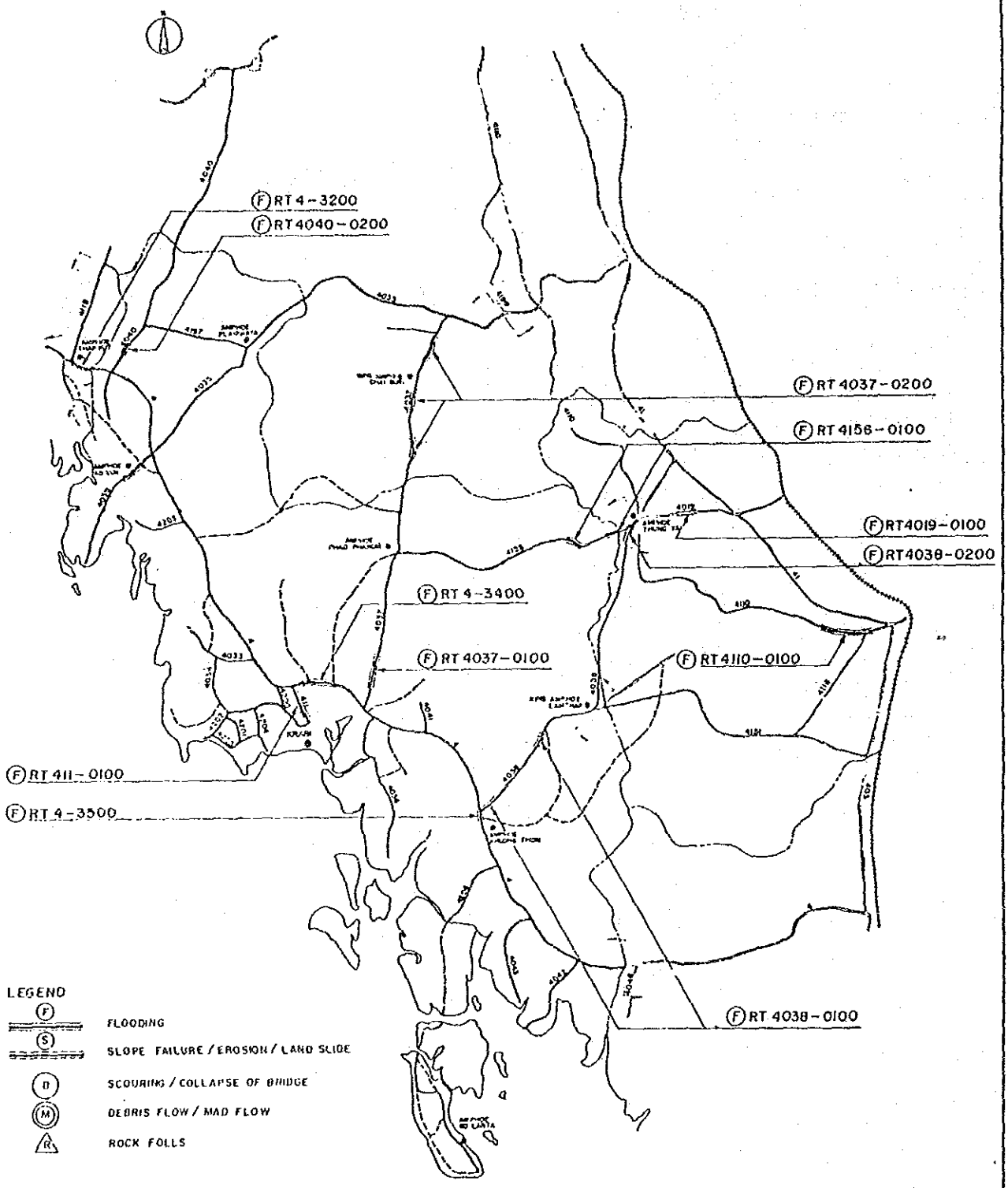
A.2.5.3 (7) Disaster History on DOH Highway

DISTRICT NAKHON SI THAMMARAT



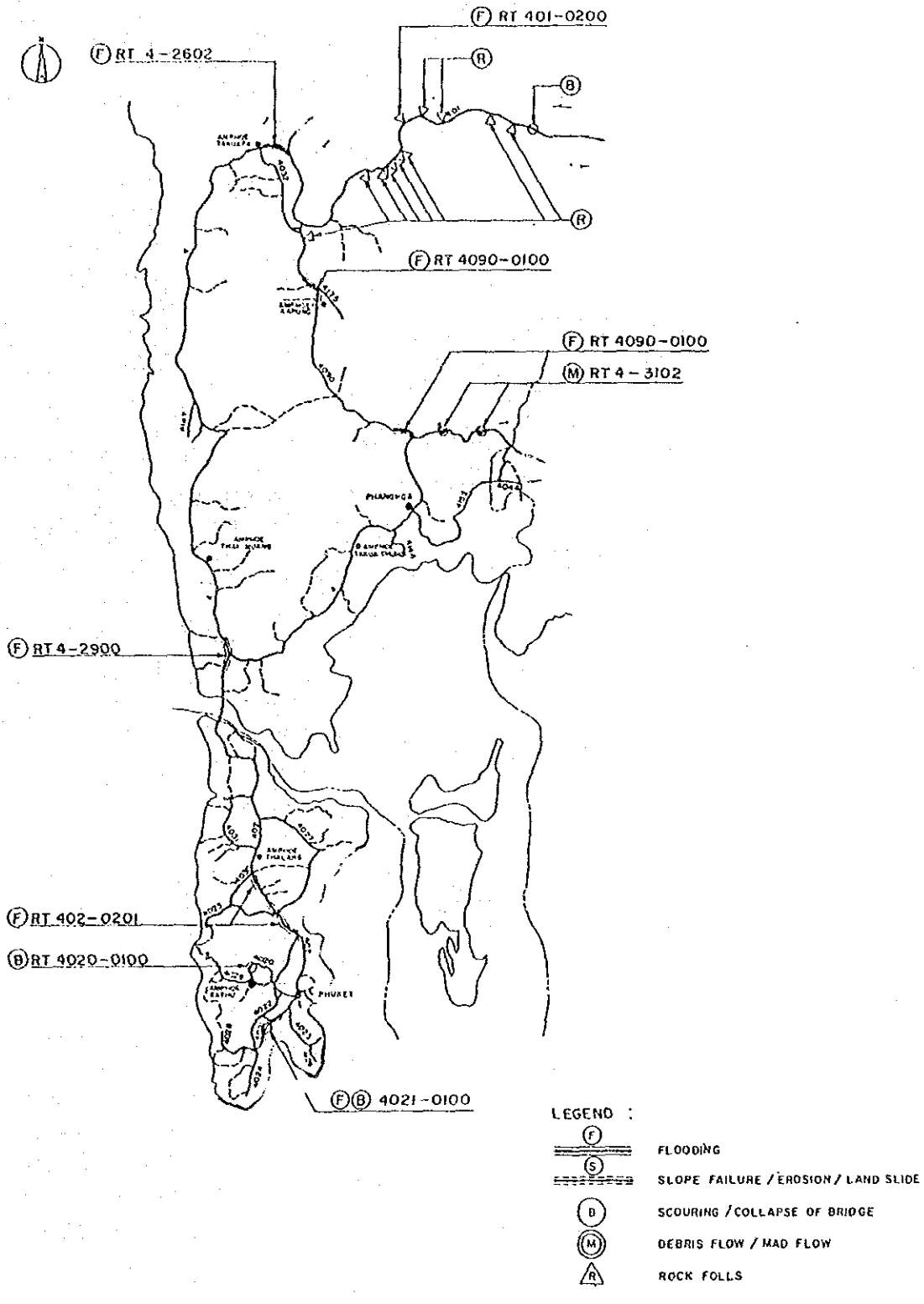
A12.5.3 (8) Disaster History on DOH Highway

DISTRICT TRANG



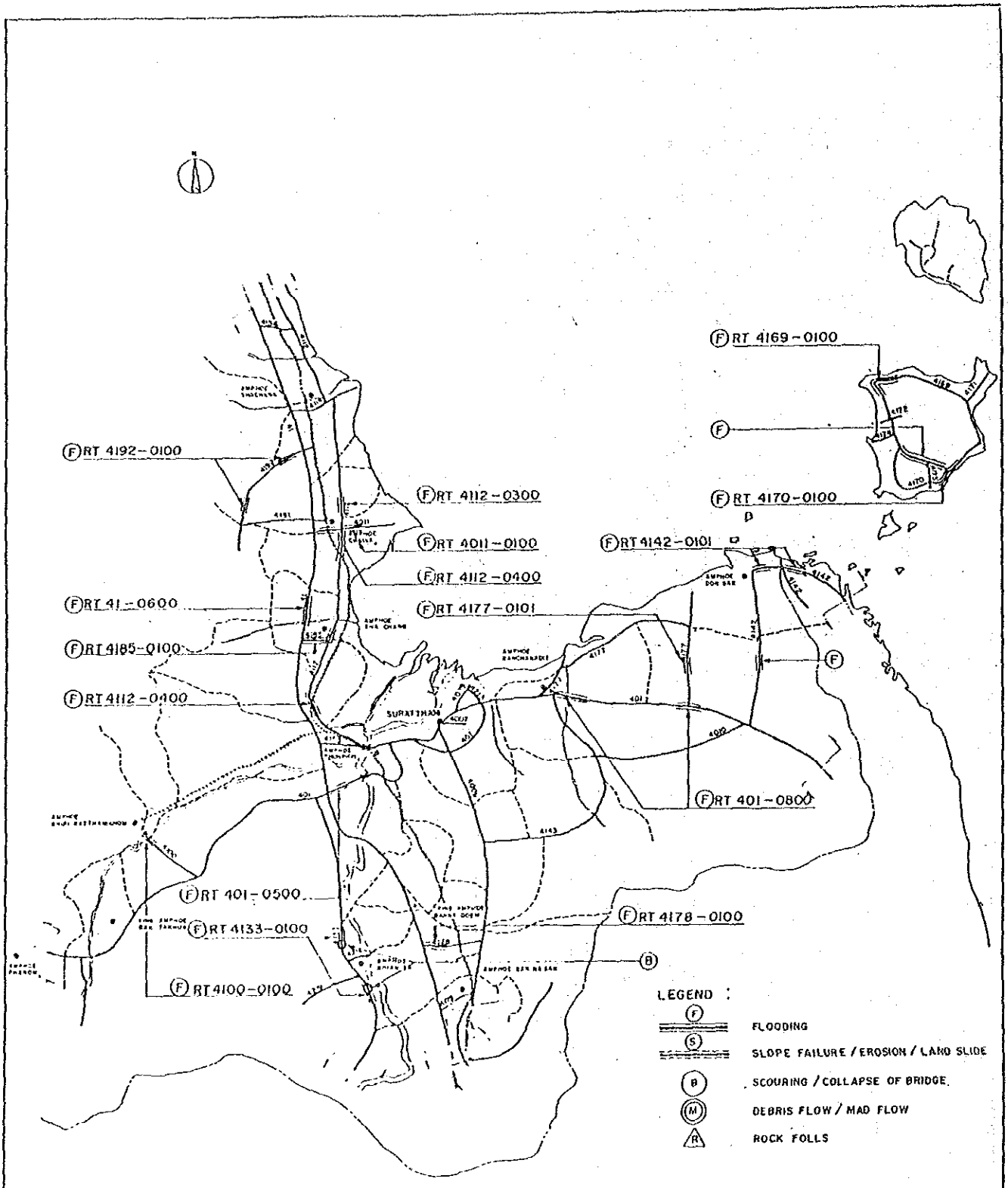
A.2.5.3 (9) Disaster History on DOH Highway

DISTRICT KRABI



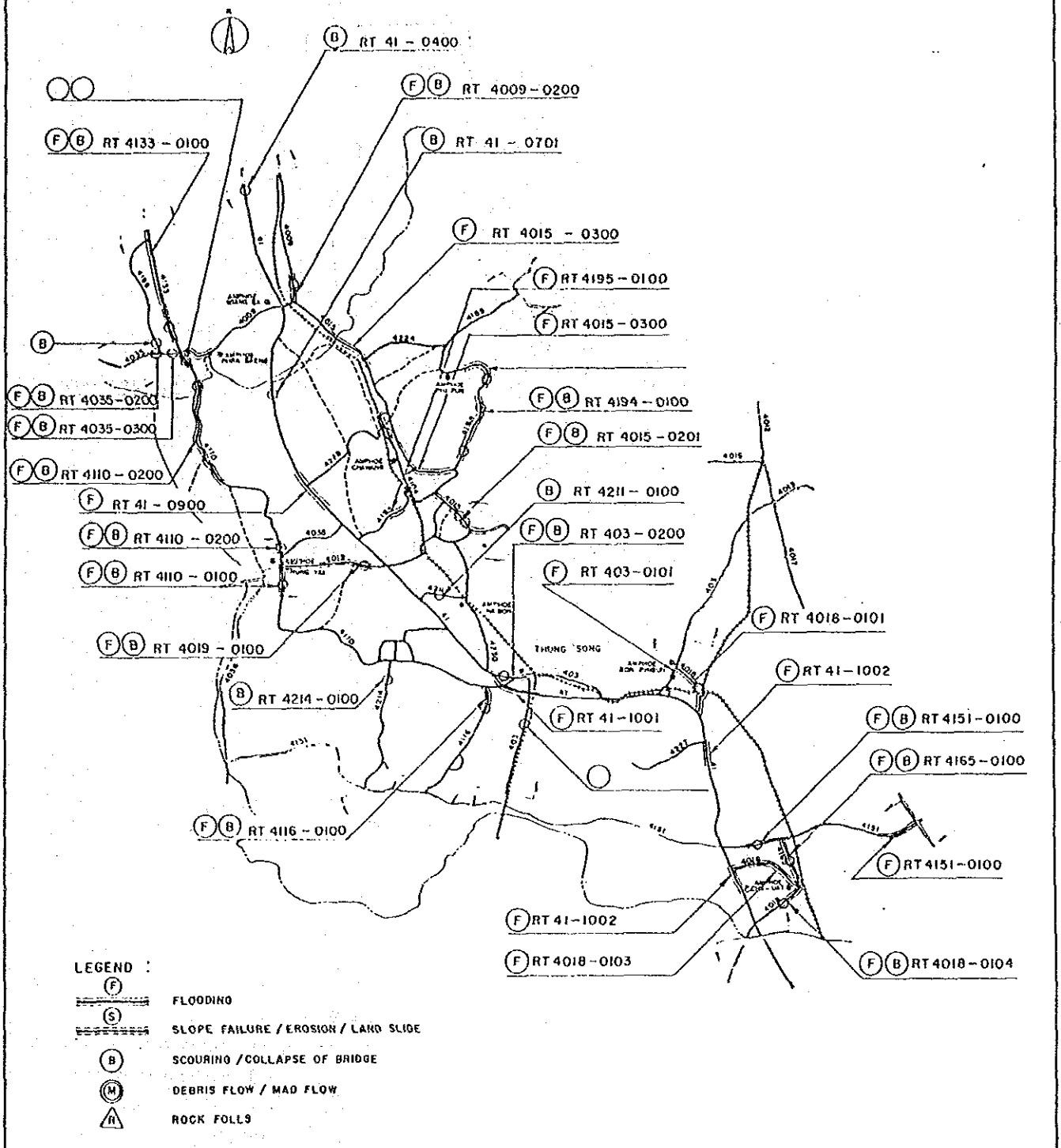
A.2.5.3 (10) Disaster History on DOH Highway

DISTRICT PHUKET



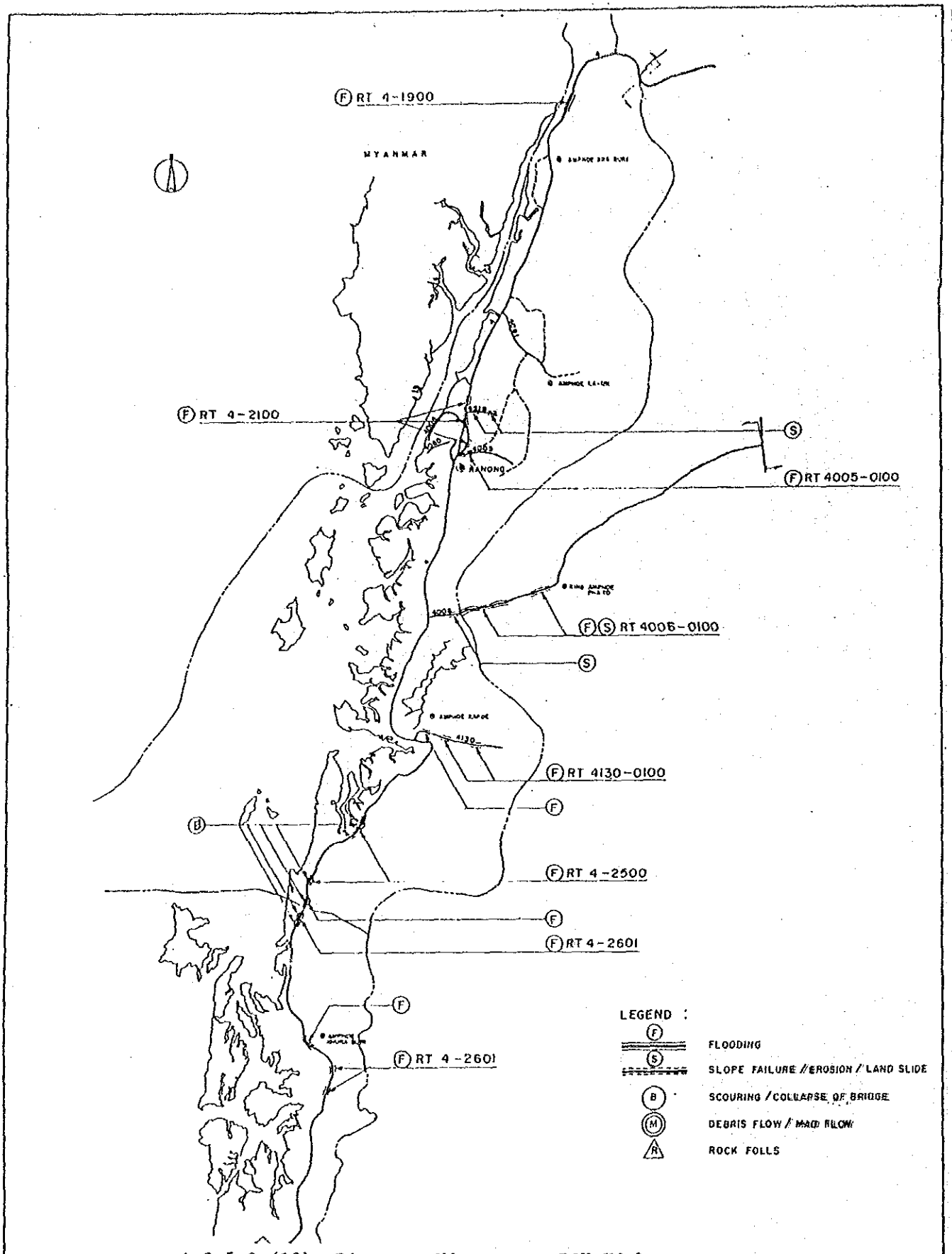
A.2.5.3 (11) Disaster History on DOH Highway

DISTRICT SURATTHANI

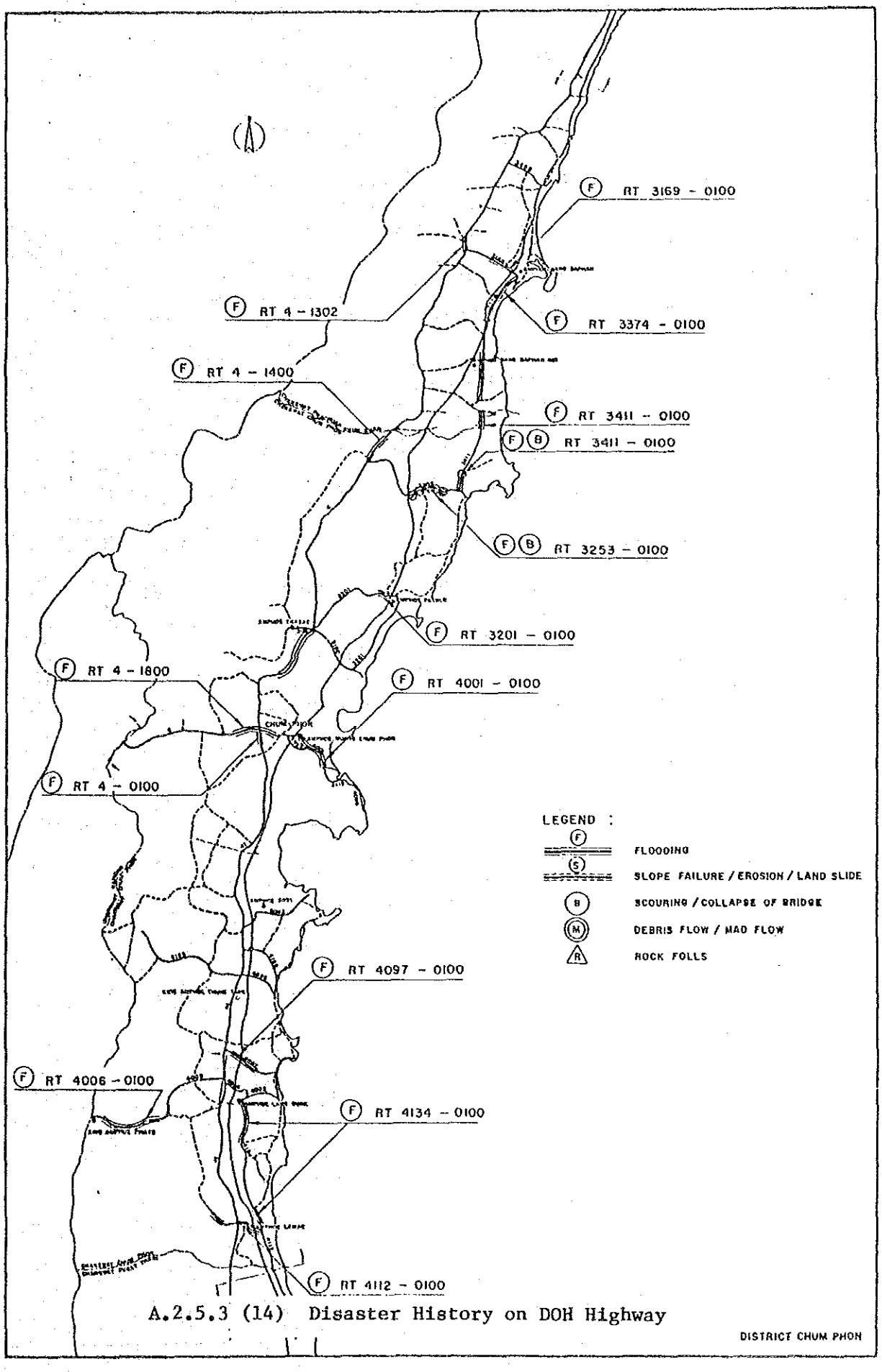


A.2.5.3 (12) Disaster History on DOH Highway

DISTRICT THUNG SONG



A.2.5.3 (13) Disaster History on DOH Highway



A.2.5.3 (14) Disaster History on DOH Highway

DISTRICT CHUM PHON

A.2.5.4 Results of CBR Test

ROUTES LIST

Route	Control Section	Road Name	Length (km)	Width of Pavment (m.)
4	4000	PHATTHALUNG MUNICIPAL - J. TO PAK PHA YUN (DIST. SATUN)	40.038	7.0
4	4100	J. TO PAK PHAYUN (DIST. PHATTHALUNG) - J. KHUHA	25.190	7.0
4	4200	J. KHUHA - J. THACHAMUANG (DIST. SONGKHLA)	7.025	7.0
42	0400	J. BAN NAKET - J. TASSABAN PATTANI	19.592	7.0
42	0601	J. TO A PANARE - I TO A. SAI BURI	17.778	7.0
42	0701	J. TO A. SAIBURI L - J. A. MUANG NARATHIWAT	44.527	7.0
406	0200	J. THACHAMUANG - J. TO NIKOM KHUAN KALONG (TUNG THAMSAO)	36.975	6.0
408	0100	DISTRICT BOUNDARY - INTERSECTION TO KHAU CHIANG YAI	33.637	6.0
408	0200	KHAU CHIANG YAI - HUA SAI	26.151	6.0
408	0302	DIST. NAKHON SI THAMMARAT - J. TO RANOT	17.113	6.0
408	0701	INTERSECTION THUNG WANG - R. 43	12.227	6.0
4009	0100	SURATTHANI MUNICIPAL - BAN NASAN MUNICIPAL	40.869	6.0
4009	0201	BAN NASAN - BANSONG	17.069	6.0
4035	0100	J. ROUTE 4 (AO LUK) - BAN PLAIPHARA YA	21.000	6.0
4035	0200	BAN PLAI PHARAYA - AMPHOE PHARA SAENG	44.500	6.0
4035	0300	DISTRICT KRABI - PHAR SAENG	4.968	6.0
4056	0201	A. SUNGAI PADI (RR) - A. SUNGAI KOLOK	16.148	6.0
4056	0202	JR 4056 0201 (KM 52+540) - MALAYSIA BORDER	2.630	6.0
4084	0100	C. NARATHIWAT - B. TABA	38.013	6.0
4112	0400	CHAI YA - THA CHANG - PHUN PHIN	36.400	5.0
4170	0100	J.R. 41 (NAM KLIANG) - R. 4009 (NONG DUK)	10.419	5.0

LOCATION FOR CBR SAMPLING

Route-Control Section	Kilo-post for Sampling (kilometers)	No. of Samples
4-4000	32, 39, 43, 54, 61	5
4-4100	13, 22	2
4-4200	13	1
42-0400	11, 16	2
42-0601	36, 52	2
42-0701	60, 76, 86, 96	4
406-0200	24, 37, 44	3
408-0100	7, 13, 33	3
408-0200	42, 59	2
408-0302	76	1
408-0701	17	1
4009-0100	6, 17, 24, 32	4
4009-0201	44, 47	2
4035-0100	9, 17	2
4035-0200	23, 35, 40, 50, 62	5
4035-0300	68	1
4056-0201	45	1
4056-0202	1	1
4084-0100	3, 18, 29, 37	4
4112-0400	3, 12, 26	3
4178-0100	6	1
	Total	50

SUMARY OF TEST RESULT

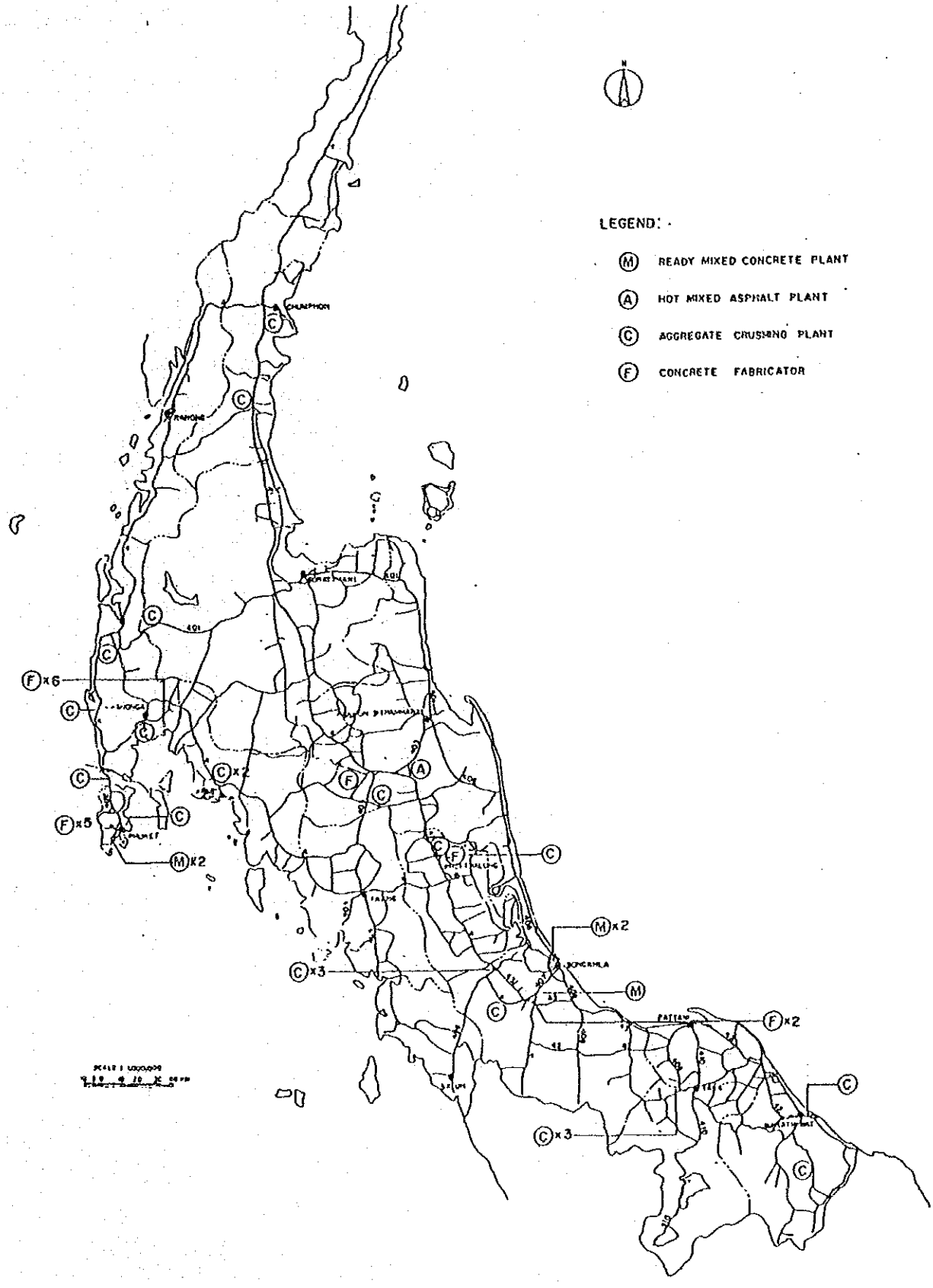
ROUTE - CONTROL SECTION	KM. No.	MATERIAL CESCRIPTION	PLASTICITY		GRADATION, % FINED					CLASSIFICATION		COMPACTION AASHTO T-99		SOAKED CBR %	
			LL	PI	3/8 in.	No. 4	No. 10	No. 40	No. 200	USCS	AASHTO	MAX.rd t/cu.m	OMC %	100% COMP.	95% COMP.
4+4000, RD - 4	32	Reddish Yellow, Silty Sand	26.40	5.25	72.54	53.24	38.81	32.02	23.83	SC - SM	A-1-b (0)	2.243	10.50	11.70	6.40
		Trace Clay													
RD - 4	39	Light Red (Reddish - Yellow),	39.50	14.34	100	93.12	89.00	87.76	84.58	CL	A-6 (11)	1.612	22.50	4.50	2.30
		Silty Clay													
RD - 4	43	Reddish Yellow, Silty Clay	44.10	22.15	100	89.56	85.89	84.80	81.52	CL	A-7-6 (16)	1.505	22.50	2.60	1.60
RD - 4	54	Reddish Yellow, Clayey Sand	35.75	13.40	81.24	68.65	55.16	50.12	41.20	SC	A-6 (2)	1.786	17.10	4.70	3.70
RD - 4	61	Light Yellowish Brown Silty Sand	22.90	6.52	86.10	79.46	62.13	44.07	30.74	SC - SM	A-2-4 (0)	2.142	8.70	22.85	18.40
		Trace Clay													
4+4100, RD - 4	13	Reddish Yellow Silty Sand Trace	24.00	6.48	100	95.48	88.62	66.07	34.18	SC - SM	A-2-4 (0)	1.968	11.00	7.10	5.00
		Clay.													
RD - 4	22	Very Pale Brown, Silty Sand	- N	P -	100	99.79	99.46	73.26	26.15	SM	A-2-4 (0)	1.870	9.60	18.40	11.20
4+4200, RD - 4	13	Reddish Brown Silty Sand	21.80	5.78	91.24	73.72	56.23	43.30	25.79	SC - SM	A-2-4 (0)	1.964	12.80	7.00	4.35
42+0400, RD - 42	11	Dark Greyish Brown Silt	51.00	16.70	100	100	99.90	98.56	96.42	OH - MH	A-7-5 (14)	1.468	25.40	2.55	2.00
		Trace Organic													
RD - 42	16	Ligh Yellowish Brown Silty Sand	- N	P -	100	99.88	99.74	98.67	9.22	SM - SM	A-3 (0)	1.635	15.50	17.90	11.20
42-0601, RD - 42	36	Very Pale Yellow Silty Sand,	29.75	8.75	96.46	92.10	75.36	39.31	23.47	SC - SM	A-2-4 (0)	1.927	11.00	23.40	16.80
		Trace Clay													
RD - 42	52	Reddish Yellow Clayey Sand	34.35	20.58	81.82	74.54	68.07	59.43	47.21	SC	A-6 (4)	1.829	12.60	16.50	11.40
42-0701, RD - 42	60	Yellow Silt Trace Organic	60.50	26.43	100	99.95	99.93	99.34	97.60	OH - MH	A-7-5 (19)	1.467	25.20	3.15	2.25
RD - 42	76	Light Brownish Grey, Silty Clay	34.90	14.64	100	99.58	97.43	75.58	53.70	CL	A-6 (6)	1.723	15.50	10.30	6.50
RD - 42	86	Greyish Brown, Silty Sand	28.85	7.12	98.42	95.24	90.15	75.14	42.48	SC - SM	A-4 (2)	1.827	13.40	6.75	3.10
		Trace Clay													
RD - 24	96	Very Pale Brown silty, Sand	32.75	7.38	84.80	72.45	58.19	36.34	20.18	SC - SM	A-2-4 (0)	1.887	11.00	13.90	8.00
		Trace Clay													

SUMARY OF TEST RESULT

ROUTE - CONTROL SECTION	KM. No.	MATERIAL CESCRIPTION	PLASTICITY		GRADATION, % FINED					CLASSIFICATION		COMPACTION AASHTO T-99		SOAKED CBR %	
			LL	PI	3/8 in.	No. 4	No. 10	No. 40	No. 200	USCS	AASHTO	MAX.rd t/cu.m	OMC %	100% COMP.	95% COMP.
406–0200, ED – 406	24	Very Pale Brown Silty Sand	31.00	7.67	98.40	87.80	84.31	79.48	47.63	SC – SM	A-4 (3)	1.755	14.60	5.40	2.80
		Trace Clay													
ED – 406	37	Light Reddish Brown Clayey Sand	29.15	9.00	85.10	78.38	62.58	39.56	28.75	SC	A-2-4 (0)	1.940	13.50	7.00	2.95
ED – 406	44	Reddish Yellow Clayey Sand	37.35	12.59	80.25	62.97	45.45	34.26	28.51	SC	A-2-6 (0)	1.965	14.90	7.50	2.70
408–0100, ED – 408	7	Reddish Yellow Silty Sand	19.20	–	99.50	85.78	74.38	36.77	16.29	SM	A-1-b (0)	2.067	9.50	11.30	7.30
ED – 408	13	Greyish Brown, Silty Sand	– NP –		100	98.91	98.31	48.86	4.78	SW – SP	A-1-b (0)	1.804	9.40	16.90	10.55
ED – 408	33	Reddish Brown Silty Sand	– NP –		100	94.72	89.53	72.42	16.65	SM	A-2-4 (0)	1.853	12.50	11.30	6.60
408–0200, ED – 408	42	Light Greyish Brown Silt	49.60	21.08	100	99.31	98.94	98.44	58.01	OL – ML	A-7-6 (14)	1.542	19.00	3.03	2.42
		Trace Organic													
ED – 408	59	Light Yellowish Brown Silty Sand	– NP –		100	99.06	97.94	88.68	46.95	SW – SM	A-4 (2)	1.894	10.70	13.60	7.70
408–0302, ED – 408	76	Light Brownish Grey, Silt	42.40	15.27	100	99.91	99.30	97.37	92.50	OL – ML	A-7-6 (12)	1.548	21.80	3.20	2.10
		Trace Organic													
408–0701, ED – 408	17	Reddish Brown Clayey Sand	30.15	10.93	100	89.77	58.29	29.97	19.71	SC	A-2-4 (0)	2.005	9.00	11.20	8.00
4009–100, ED – 4009	6	Reddish Brown Silty Sand	18.50	0.30	92.42	71.62	45.50	39.69	22.49	SM	A-1-b (0)	2.220	6.40	15.50	8.80
ED – 4009	17	Reddish Yellow Silty Sand	22.90	5.46	87.10	57.23	35.94	32.00	20.51	SC – SM	A-1-b (0)	2.221	9.10	16.20	6.40
		Trace Clay													
ED – 4009	24	Light Red Silty Sand Trace Clay	17.00	4.76	88.55	63.28	40.37	29.85	17.44	SC – SM	A-1-b (0)	2.247	6.20	30.20	14.10
ED – 4009	32	Reddish Brown Silty Sand	18.15	3.82	91.10	86.31	70.34	51.36	37.33	SM	A-4 (1)	2.023	9.50	9.30	6.80
4009–0201, ED – 4009	44	Reddish Yellow Silty Sand	18.65	1.18	95.78	82.64	63.27	28.38	15.25	SM	A-1-b (0)	2.136	7.20	22.80	14.60
ED – 4009	47	Reddish Grey Silty Sand	20.75	4.52	99.71	89.16	74.77	49.46	31.26	SM	A-2-4 (0)	2.174	8.10	20.30	9.50
4035–0100, ED – 4035	9	Reddish Yellow Silty Sand	15.00	2.94	100	91.04	85.49	73.91	43.00	SM	A-4 (2)	2.051	10.20	10.00	5.30
ED – 4035	17	Reddish Yellow Silty Sand	31.50	8.79	82.24	63.11	46.92	38.63	32.99	SC – SM	A-2-4 (0)	1.971	10.70	15.60	10.90
		Trace Clay													
4035–0200, ED – 4035	23	Reddish Yellow Silty Sand	22.10	5.00	89.10	72.24	55.58	42.35	32.00	SC – SM	A-2-4 (0)	1.947	9.50	13.60	8.60
		Trace Clay													

SUMARY OF TEST RESULT

ROUTE - CONTROL SECTION	KM. No.	MATERIAL CESCRIPTION	PLASTICITY		GRADATION, % FINED					CLASSIFICATION		COMPACTION AASHTO T-99		SOAKED CBR %	
			LL	PI	3/8 in.	No. 4	No. 10	No. 40	No. 200	USCS	AASHTO	MAX.rd Ucu.m	OMC %	100% COMP.	95% COMP.
RD - 4035	35	Light Reddish Brown Clayed Sand	31.30	11.43	82.54	65.04	54.60	47.83	42.26	SC	A-6 (2)	1.850	8.40	17.50	11.00
RD - 4035	40	Reddish Yellow Clayey Sand	27.75	9.91	78.10	53.95	41.32	23.45	17.63	SC	A-2-4 (0)	1.921	10.40	21.70	12.00
RD - 4035	50	Light Reddish Brown Silty Sand	23.35	7.30	80.20	66.88	51.33	42.50	32.24	SC - SM	A-2-4 (0)	2.077	8.40	10.30	5.50
		Trace Clay													
R - 4035	62	Light Red Silty Sand Trace Clay	21.90	6.64	78.10	62.90	52.47	48.68	29.92	SC - SM	A-2-4 (0)	2.180	8.70	12.75	6.70
4035-0300, RD - 4035	68	Light Reddish Brown Clayey Sand	34.10	14.69	79.22	65.99	47.37	43.01	33.33	SC	A-2-6 (1)	2.086	11.10	10.70	5.65
4056-0201, R - 4056	45	Reddish Yellow Silty Sand	- N P -		87.66	77.77	72.00	49.19	25.59	SM	A-2-4 (0)	1.932	12.10	13.90	8.50
4056-0202, R - 4056	1	Reddish Yellow Clayey Sand	31.35	11.05	100	86.16	55.51	32.10	23.34	SC	A-2-6 (0)	1.958	9.50	8.50	5.20
4084-0100, R - 4084	3	Very Pale Brown Clayey Sand	37.50	13.33	100	98.98	82.06	42.44	25.76	SC	A-2-6 (0)	1.913	11.40	5.70	5.50
R - 4084	18	Light Grey Silty Sand	- N P -		99.61	99.53	99.27	59.06	4.66	SW - SP	A-3 (0)	1.659	11.10	5.30	5.20
R - 4084	29	Greyish Brown Silty Sand	- N P -		100	100	99.82	49.71	10.56	SW - SM	A-1-b (0)	1.830	12.00	20.50	13.50
R - 4084	37	Brownish Yellow Clayey Sand	28.75	11.01	99.71	98.08	94.85	78.20	40.73	SC	A-6 (1)	1.787	15.20	4.00	2.70
4112-0400, R - 4112	3	Red Silty Sand	17.35	0.93	100	90.89	82.43	54.94	25.93	SM	A-2-4 (0)	2.052	10.20	11.30	8.50
R - 4112	12	Light Red Silty Sand Trace Clay	27.20	4.79	92.10	79.56	70.01	61.61	45.97	SC - SM	A-4 (3)	1.930	14.70	7.10	3.40
4112-0300, RD - 4112	26	Light Red Silty Sand	18.35	3.59	85.42	60.35	48.33	40.14	30.97	SM	A-2-4 (0)	2.052	9.30	13.00	7.30
4178-0100, RD - 4178	6	Light Reddish Brown Silty Sand	- N P -		86.10	74.36	60.60	39.00	17.44	SM	A-1-b (0)	2.145	8.70	10.00	4.20



A.2.5.5 Location Map of Material Supply Facilities

APPENDIX; CHAPTER 3

A.3.4.1 Traffic Zone Code Table

Zone No.	RDSR Code	LTD Code (Toll Hwy. Study)	Zone Name
1	0201	8001	Chumphon
2	0202	8005, 8008	Tha Sae
3	0203	8006, 8007	Sawi
4	0204	8002, 8003, 8004	Lang Suan
5	1001	8101, 8102	Ranong
6	1002	8103, 8104	Kra Buri
7	1401	8201	Surat Thani
8	1402	8214	Phun Phin
9	1403	8208	Khian Sa
10	1404	8202, 8203	Ban Na San
11	1405	8213	Phrasaeng
12	1406	8218	Chai Buri
13	1407	8204, 8212	Phanom
14	1408	8209	Khiri Ratthananikh
15	1409	8205, 8215, 8216	Chaiya
16	1410	8207	Kanchanadit
17	1411	8206	Don Sak
18	1412	8217	Wiang Sa
19	1413	8210, 8211	Ko Samui
20	0701	8301, 8308	Phangnga
21	0702	8304	Khura Buri
22	0703	8305, 8303	Takua Pa
23	0704	8306, 8307	Takua Thung
24	1101	8601	Phuket
25	1102	8602	Kathu
26	1103	8603	Thalang
27	0101	8501, 8302	Krabi
28	0102	8502, 8506	Ao Luk
29	0103	8503	Khao Phanom
30	0104	8504, 8505, 8507	Khlong Thom
31	0401	8401, 8402, 8408	Nakhon Si Thammara
32	0402	8404, 8410, 8415, 8416	Chawang
33	0403	8412, 8413	Tha Sala
34	0404	8407	Khanom
35	0405	8405, 8406, 8409	Chian Yai
36	0406	8403, 8411	Cha-Uad
37	0407	8414, 8417	Thung Song
38	0301	9101	Trang
39	0302	9103	Kantang
40	0303	9105, 9107	Wang Wiset
41	0304	9102	Huai Yot
42	0305	9104, 9106	Palian
43	0601	9001	Phatthalung
44	0602	9005, 9007	Khuan Khanun
45	0603	9002, 9003, 9004	Khao Chaison
46	0604	9006, 9008, 9009	Pa Bon
47	1201	9201, 9214	Songkhla
48	1202	9205, 9209, 9211, 9215	Ranot
49	1203	9206, 9213	Rattaphum
50	1204	9203, 9212	Hat Yai
51	1205	9208	Sadao
52	1206	9202, 9204	Chana
53	1207	9207, 9210	Thepa
54	1301	9301, 9303	Satun
55	1302	9305, 9306	Langu
56	1303	9302, 9304	Khuan Ka Long

Zone No.	RDSR Code	LTD Code (Toll Hwy. Study)	Zone Name
57	0801	9401	Pattani
58	0802	9406,9407,9408,9410,9411	Yaring
59	0803	9403, 9409	Yarang
60	0804	9402, 9404, 9405	Khok Pho
61	0901	9501, 9505	Yala
62	0902	9506	Yaha
63	0903	9502, 9503, 9504	Betong
64	0501	9601	Narathiwat
65	0502	9606, 9607, 9608	Sungai Kolok
66	0503	9603, 9605, 9612	Rangae
67	0504	9602, 9604, 9611	Raso
68	0505	9609, 9610	Waeng
69	1500	70, 71, 73, 75, 76, 77	Western Region
70	1600	1, 16, 17, 18, 72, 74	BMR
71	1700	10-15	Central Region
72	1800	20-26, 9903	Eastern Region
73	1900	30-36, 40-49, 9902	Northeastern Regio
74	2000	50-57, 60-68, 9901	Northern Region
75	2100	9904	Malaysia

A.3.4.2 Population Framework of the Southern Region

(person)

ZONE NAME	CODE	ZONE NO.	1990	1996	2001	2006
Chumphon	0201	1	128952	145000	158100	172400
Tha Sae	0202	2	88010	96500	102700	108500
Sawi	0203	3	76934	84300	89800	94900
Lang Suan	0204	4	102360	112200	119400	126200
Ranong	1001	5	76649	93600	108500	125800
Kra Buri	1002	6	37799	43400	47500	52200
Surat Thani	1401	7	118394	139900	158200	179100
Phunphin	1402	8	91490	103200	112900	122400
Khian Sa	1403	9	25921	29200	32000	34700
Ban Na San	1404	10	90352	101900	111500	120900
Phrasaeng	1405	11	38930	43900	48100	52100
Chai Buri	1406	12	11690	13200	14400	15700
Phanom	1407	13	32207	36300	39800	43100
Khiri R'nikhom	1408	14	40444	45600	49900	54100
Chaiya	1409	15	96697	109100	119400	129400
Kanchanadit	1410	16	78140	88100	96300	104500
Don Sak	1411	17	29701	33500	36700	39800
Wiang Sa	1412	18	53558	60400	66100	71700
Ko Samui	1413	19	37001	41700	45700	49500
Phangnga	0701	20	65365	73500	80100	87400
Khura Buri	0702	21	20490	22700	24700	26400
Takua Pa	0703	22	51508	57200	62200	66200
Takua Thung	0704	23	76207	84600	92000	98000
Phuket	1101	24	96344	108300	118100	128900
Kathu	1102	25	16081	17800	19100	20100
Thalang	1103	26	48763	53900	57800	61000
Krabi	0101	27	121619	148500	172100	199500
Ao Luk	0102	28	69593	81300	92500	103500
Khao Phanom	0103	29	27671	32300	36800	41100
Khlong Thom	0104	30	78650	91900	104600	116900
Nakhon Si	0401	31	367161	399300	424800	452100
Chawang	0402	32	225955	238000	245900	250400
Tha Sala	0403	33	193575	203900	210700	214600
Khanom	0404	34	25277	26600	27500	28000
Chian Yai	0405	35	258821	272600	281700	286900
Cha-uat	0406	36	199310	209900	216900	220900
Thung Song	0407	37	156022	169700	180500	192100
Trang	0301	38	166404	190200	210000	231900
Kantang	0302	39	69216	76500	82300	87400
Wang Wiset	0303	40	51840	57300	61700	65500
Huai Yot	0304	41	113673	125600	135300	143600
Palian	0305	42	120728	133400	143700	152600
Phatthalung	0601	43	134674	144000	151400	159100
Khuan Khanum	0602	44	125785	131700	135100	137600
Khao Chaison	0603	45	114668	120100	123100	125400
Pa Bon	0604	46	81340	85200	87400	88900
Songkla	1201	47	254385	300500	340000	384700
Ranot	1202	48	149987	172600	193400	213300
Rattaphum	1203	49	88466	101800	114100	125800
Hat Yai	1204	50	305748	361200	408700	462300
Sadao	1205	51	91865	105700	118400	130600
Chana	1206	52	122598	141100	158000	174300
Thepha	1207	53	102645	118100	132400	146000
Satun	1301	54	110972	135500	157000	182000
Langu	1302	55	63928	72500	79600	86900
Ka Long	1303	56	49353	56000	61400	67100
Pattani	0801	57	95209	112500	127300	144000
Yaring	0802	58	166367	183400	197400	209900
Yarang	0803	59	129612	142900	153800	163600
Khok Pho	0804	60	146194	161200	173500	184500
Yala	0901	61	222516	267200	306100	350500
Yaha	0902	62	44023	48000	51300	53800
Betong	0903	63	89661	97800	104600	109700
Narathiwat	0501	64	92091	108800	123100	139300
Sungai Kolok	0502	65	160239	182300	201000	220000
Rangae	0503	66	135650	154400	170200	186300
Ruso	0504	67	120481	137100	151100	165500
Waeng	0505	68	53087	60400	66600	72900
TOTAL			7129190	7998000	8724000	9456000

A.3.4.3 GPP Framework of the Southern Region

(Million Baht)

ZONE NAME	CODE	ZONE NO.	1990	1996	2001	2006
Chumphon	0201	1	3518	5217	7420	10441
Tha Sae	0202	2	2401	3472	4820	6571
Sawi	0203	3	2099	3033	4214	5747
Lang Suan	0204	4	2793	4037	5603	7643
Ranong	1001	5	3459	4486	6648	9311
Kra Buri	1002	6	1705	2080	2910	3863
Surat Thani	1401	7	3315	5429	7871	11333
Phunphin	1402	8	2562	4005	5617	7745
Khian Sa	1403	9	725	1133	1592	2196
Ban Na San	1404	10	2529	3954	5548	7650
Phrasaeng	1405	11	1090	1703	2393	3297
Chai Buri	1406	12	327	512	716	993
Phanom	1407	13	902	1409	1980	2727
Khiri R'nikhom	1408	14	1132	1769	2483	3423
Chaiya	1409	15	2707	4233	5941	8188
Kanchanadit	1410	16	2188	3419	4791	6612
Don Sak	1411	17	831	1300	1826	2518
Wiang Sa	1412	18	1499	2344	3289	4537
Ko Samui	1413	19	1036	1618	2274	3132
Phangnga	0701	20	2656	3488	4775	6691
Khura Buri	0702	21	832	1077	1472	2021
Takua Pa	0703	22	2093	2714	3708	5068
Takua Thung	0704	23	3096	4014	5484	7501
Phuket	1101	24	4537	7269	10465	14929
Kathu	1102	25	757	1195	1692	2328
Thalang	1103	26	2296	3618	5121	7065
Krabi	0101	27	3307	5068	7480	10744
Ao Luk	0102	28	1893	2775	4020	5574
Khao Phanom	0103	29	753	1102	1599	2214
Khlong Thom	0104	30	2138	3136	4547	6296
Nakhon Si	0401	31	5927	9521	13671	19497
Chawang	0402	32	3648	5675	7912	10798
Tha Sala	0403	33	3125	4862	6780	9254
Khanom	0404	34	408	634	885	1207
Chian Yai	0405	35	4178	6500	9064	12372
Cha-uat	0406	36	3218	5005	6979	9526
Thung Song	0407	37	2519	4046	5808	8284
Trang	0301	38	3677	6083	8537	11906
Kantang	0302	39	1530	2447	3346	4487
Wang Wiset	0303	40	1145	1833	2508	3363
Huai Yot	0304	41	2512	4017	5500	7372
Palian	0305	42	2668	4267	5842	7834
Phatthalung	0601	43	2270	4089	5711	7415
Khuan Khanum	0602	44	2120	3739	5097	6413
Khao Chaison	0603	45	1933	3410	4644	5844
Pa Bon	0604	46	1371	2419	3297	4143
Songkla	1201	47	6759	10493	14758	20838
Ranot	1202	48	3985	6028	8395	11554
Rattaphum	1203	49	2351	3555	4953	6814
Hat Yai	1204	50	8125	12613	17740	25043
Sadao	1205	51	2441	3691	5144	7074
Chana	1206	52	3258	4928	6862	9441
Thepha	1207	53	2727	4124	5747	7909
Satun	1301	54	3028	4718	6587	9605
Langu	1302	55	1744	2524	3338	4587
Ka Long	1303	56	1346	1950	2574	3542
Pattani	0801	57	1575	3102	4307	6236
Yaring	0802	58	2751	5058	6678	9091
Yarang	0803	59	2143	3941	5203	7085
Khok Pho	0804	60	2417	4445	5869	7990
Yala	0901	61	5264	8666	12422	17622
Yaha	0902	62	1042	1557	2082	2705
Betong	0903	63	2121	3172	4245	5515
Narathiwat	0501	64	1813	3199	4640	6392
Sungai Kolok	0502	65	3155	5363	7576	10096
Rangae	0503	66	2671	4540	6415	8549
Ruso	0504	67	2372	4031	5695	7594
Waeng	0505	68	1045	1776	2510	3345
TOTAL			167753	262630	367620	506700

A.3.4.4 Framework of Other Regions

Table 1 Framework of Population in the Other Related Area
(thousand)

ZONE NAME	ZONE NO.	1990	1996	2001	2006
Western Region	69	3321	3602	3835	4120
BMR	70	8835	9655	10255	10910
Central Region	71	2812	2932	3134	3310
Eastern Region	72	3784	4294	4691	5114
Northeastern Region	73	20032	22039	23409	24780
Northern Region	74	11013	11783	12411	13203

Table 2 Framework of GRP in the Other Related Area
(Million Baht in 1988 prices)

ZONE NAME	ZONE NO.	1990	1996	2001	2006
Western Region	69	77340	101920	132980	177910
BMR	70	869420	1335120	1800510	2408820
Central Region	71	79280	91940	123040	165430
Eastern Region	72	137470	209990	298150	416070
Northeastern Region	73	194230	251350	324850	434600
Northern Region	74	173290	227050	294850	394470

A.3.4.5 Estimated Trip Generation and Attraction by Zone

- Car -

Year	1990		1996		2001		2006	
Zone	Gen.	Att.	Gen.	Att.	Gen.	Att.	Gen.	Att.
1	648	628	1322	1280	2033	1968	2972	2874
2	259	355	515	706	773	1059	1095	1498
3	205	186	408	369	612	555	867	785
4	377	242	750	481	1125	721	1594	1021
5	470	312	1041	691	1703	1129	2646	1753
6	154	148	321	308	495	475	730	700
7	1209	1136	2592	2434	4134	3879	6274	5882
8	230	245	471	501	726	773	1056	1122
9	26	28	53	57	82	88	119	128
10	223	231	456	472	704	728	1024	1058
11	61	69	125	141	193	218	280	316
12	22	18	45	37	69	57	101	83
13	41	56	84	114	130	177	188	257
14	28	39	57	80	88	123	128	179
15	125	162	256	331	395	511	574	742
16	135	109	276	223	426	343	619	499
17	186	165	381	337	588	521	855	757
18	167	177	342	362	527	558	767	811
19	111	110	227	225	351	347	509	504
20	460	529	938	1078	1443	1657	2110	2421
21	27	65	54	131	83	200	119	287
22	123	227	248	457	380	700	542	999
23	205	246	413	495	633	759	904	1083
24	1126	1117	2297	2276	3532	3499	5168	5115
25	598	588	1201	1180	1818	1785	2564	2516
26	405	360	812	721	1229	1090	1738	1541
27	640	557	1418	1233	2318	2014	3601	3127
28	202	205	428	434	687	696	1031	1044
29	11	12	23	25	37	41	56	61
30	109	122	231	258	371	415	556	621
31	1046	973	2064	1918	3097	2877	4418	4101
32	399	387	763	739	1111	1076	1517	1468
33	382	386	730	737	1064	1074	1453	1465
34	199	180	380	343	554	500	756	682
35	382	132	730	252	1064	367	1453	501
36	103	109	197	208	287	303	392	414
37	453	461	894	909	1341	1363	1913	1943
38	1147	1260	2379	2611	3705	4063	5483	6010
39	413	446	828	894	1257	1355	1789	1928
40	62	42	124	84	189	128	269	182
41	344	318	690	637	1048	967	1491	1375
42	273	285	547	571	832	867	1184	1233
43	768	834	1490	1617	2210	2396	3112	3372
44	67	98	127	186	184	269	251	367
45	85	116	162	220	234	318	319	434
46	81	67	154	127	223	184	304	251
47	1736	1818	3721	3893	5938	6209	9005	9411
48	116	318	242	663	383	1048	566	1548
49	108	64	225	134	356	211	527	312
50	3121	2948	6690	6314	10677	10070	16187	15257
51	344	347	718	724	1135	1143	1678	1689
52	725	746	1514	1557	2391	2457	3536	3630
53	682	724	1424	1510	2251	2386	3328	3525
54	640	744	1418	1647	2317	2690	3600	4177
55	231	209	475	430	736	665	1077	972
56	229	233	471	479	729	741	1068	1084
57	1723	1749	3694	3747	5896	5976	8939	9055
58	1027	919	2054	1837	3119	2786	4445	3969
59	280	184	560	368	850	558	1212	795
60	319	274	638	548	969	831	1381	1184
61	1487	1672	3240	3640	5235	5878	8035	9015
62	291	284	576	561	868	846	1220	1188
63	531	528	1051	1044	1585	1574	2229	2211
64	650	713	1393	1527	2224	2435	3373	3692
65	124	151	256	311	398	484	584	710
66	67	76	138	157	215	244	316	357
67	526	566	1086	1168	1688	1814	2478	2661
68	65	64	134	132	209	205	306	301
69	419	377	825	742	1238	1112	1783	1601
70	418	450	829	892	1242	1335	1771	1902
71	5	8	9	15	14	23	20	32
72	37	22	76	45	117	70	172	102
73	31	32	62	64	93	96	132	135
74	35	16	68	31	101	46	144	66
75	28	8	57	16	86	25	123	35
Total	30782	30782	63688	63686	99145	99151	146126	146126

- Bus -

Year	1990		1996		2001		2006	
Zone	Gen.	Att.	Gen.	Att.	Gen.	Att.	Gen.	Att.
1	267	255	440	420	625	596	870	830
2	4	8	6	13	9	18	12	24
3	19	10	31	16	42	22	57	30
4	96	56	154	90	214	124	289	168
5	103	122	184	218	278	329	412	487
6	32	37	54	62	77	89	108	124
7	490	621	849	1075	1249	1581	1807	2286
8	312	318	516	526	735	748	1018	1035
9	20	20	33	33	47	47	65	65
10	53	48	88	79	125	113	173	156
11	28	33	46	55	66	78	91	107
12	8	8	13	13	19	19	26	26
13	0	4	0	7	0	9	0	13
14	12	12	20	20	28	28	39	39
15	20	16	33	26	47	38	65	52
16	71	62	117	102	167	146	232	202
17	37	36	61	59	87	85	121	117
18	46	57	76	94	108	134	150	186
19	31	29	51	48	73	68	101	94
20	150	83	247	137	351	194	489	270
21	33	32	54	52	76	74	104	100
22	110	63	179	103	253	145	345	197
23	28	21	46	34	64	48	88	66
24	534	601	880	990	1249	1404	1742	1957
25	637	633	1034	1027	1444	1433	1941	1926
26	317	327	514	530	717	739	967	996
27	123	105	220	188	332	283	492	419
28	37	38	63	65	94	96	134	138
29	8	12	14	21	20	30	29	43
30	22	11	38	19	56	28	80	40
31	628	633	1001	1009	1386	1396	1886	1897
32	501	498	774	769	1040	1033	1354	1343
33	187	199	289	307	388	413	506	537
34	46	28	71	43	95	58	124	75
35	82	82	127	127	170	170	222	221
36	71	57	110	88	147	118	192	154
37	196	201	313	320	433	443	588	602
38	219	137	367	229	527	329	744	465
39	32	32	52	52	73	73	99	98
40	68	69	110	112	154	157	210	212
41	145	155	235	251	329	352	447	477
42	37	33	60	53	84	75	114	102
43	126	156	198	244	270	334	363	449
44	12	22	18	34	25	45	32	59
45	4	9	6	14	8	18	11	24
46	8	3	12	5	16	6	21	8
47	660	664	1143	1149	1683	1691	2434	2444
48	39	39	66	66	96	96	135	135
49	127	116	214	196	313	285	440	401
50	836	837	1448	1449	2132	2132	3082	3080
51	177	178	299	300	435	437	614	616
52	142	141	240	238	349	346	492	488
53	43	46	73	78	106	113	149	159
54	587	612	1051	1095	1585	1650	2347	2443
55	87	87	145	145	207	206	288	288
56	472	479	785	796	1120	1136	1565	1585
57	327	343	567	594	834	874	1206	1263
58	173	199	280	321	392	450	532	611
59	80	52	129	84	181	118	246	160
60	45	46	73	74	102	104	138	141
61	267	270	470	475	701	708	1026	1035
62	129	127	206	203	287	282	384	378
63	170	171	272	273	378	380	507	509
64	268	250	464	433	684	637	989	920
65	78	72	130	120	187	172	261	241
66	17	17	28	28	41	41	57	57
67	172	160	287	267	412	382	576	535
68	17	17	28	28	41	41	57	57
69	151	136	240	216	333	299	457	411
70	232	244	372	391	514	540	699	733
71	0	0	0	0	0	0	0	0
72	6	9	10	15	14	21	20	30
73	3	11	5	18	7	24	9	33
74	2	5	3	8	4	11	6	15
75	9	6	15	10	21	14	28	19
Total	11326	11326	18847	18849	26956	26956	37704	37703

- Truck -

Year / Zone	1990 Gen.	1990 Att.	1996 Gen.	1996 Att.	2001 Gen.	2001 Att.	2006 Gen.	2006 Att.
1	583	636	1173	1278	1869	2035	2816	3060
2	242	268	475	525	738	816	1078	1189
3	49	42	96	82	149	128	218	186
4	211	238	414	466	643	724	940	1056
5	304	475	535	835	888	1385	1332	2073
6	78	102	129	169	202	264	288	375
7	1220	1150	2711	2553	4403	4143	6790	6375
8	527	529	1118	1121	1756	1760	2594	2593
9	199	201	422	426	664	669	981	987
10	397	448	842	949	1324	1491	1955	2197
11	263	263	558	557	878	876	1295	1290
12	32	26	68	55	106	86	158	128
13	93	113	197	239	310	376	458	554
14	95	95	201	201	317	316	467	466
15	154	172	327	365	514	573	758	844
16	287	283	609	599	955	940	1412	1387
17	100	133	212	282	334	443	493	653
18	244	245	518	519	813	815	1202	1202
19	69	74	146	157	230	246	340	363
20	529	364	943	648	1446	993	2169	1487
21	100	76	176	133	269	204	395	299
22	222	270	391	475	598	726	875	1060
23	255	198	449	348	687	532	1006	778
24	1073	1101	2333	2391	3762	3853	5747	5874
25	728	715	1560	1530	2474	2425	3645	3566
26	428	457	915	976	1451	1546	2144	2280
27	417	444	867	922	1434	1524	2205	2339
28	220	203	438	403	710	654	1055	969
29	81	86	161	171	261	277	388	410
30	130	170	259	338	420	548	623	812
31	753	1137	1641	2475	2640	3978	4032	6064
32	473	459	998	968	1559	1510	2279	2203
33	469	411	990	867	1546	1353	2261	1973
34	137	93	289	196	452	306	660	446
35	143	348	302	734	471	1145	689	1671
36	133	198	281	417	438	652	641	950
37	533	562	1162	1223	1868	1966	2853	2997
38	683	700	1533	1569	2410	2466	3600	3675
39	527	540	1144	1171	1752	1792	2516	2568
40	69	51	150	111	230	169	330	243
41	485	399	1052	865	1614	1325	2317	1899
42	280	297	608	644	932	987	1338	1414
43	656	448	1603	1094	2508	1710	3487	2372
44	124	95	297	227	453	346	610	466
45	58	47	139	112	212	171	285	230
46	87	24	208	57	318	88	428	118
47	1317	1070	2774	2251	4371	3544	6609	5349
48	417	222	856	455	1335	709	1968	1043
49	149	138	306	283	477	441	703	649
50	1978	1849	4166	3890	6564	6125	9924	9240
51	707	708	1450	1451	2264	2263	3335	3326
52	1261	1222	2588	2505	4037	3905	5948	5742
53	1000	969	2052	1986	3203	3098	4721	4556
54	286	313	605	661	946	1033	1477	1610
55	121	100	238	196	352	290	518	426
56	130	101	255	198	378	293	557	431
57	548	807	1465	2155	2278	3349	3533	5182
58	154	208	384	518	568	766	828	1114
59	102	84	255	209	376	309	549	450
60	58	64	145	160	214	236	312	343
61	347	594	775	1325	1245	2127	1891	3224
62	234	233	475	472	711	707	989	981
63	204	237	414	480	620	720	863	999
64	874	602	2093	1440	3400	2338	5017	3442
65	394	310	909	714	1438	1129	2052	1608
66	104	106	240	244	380	386	542	550
67	397	325	915	748	1449	1184	2069	1687
68	110	104	254	239	401	379	573	540
69	615	434	1100	775	1607	1132	2303	1619
70	772	987	1609	2054	2430	3101	3482	4434
71	71	27	112	42	167	64	241	91
72	84	128	174	265	277	421	414	628
73	13	43	23	75	33	109	47	156
74	37	47	66	83	96	121	137	173
75	3	9	5	15	7	21	9	27
Total	27427	27427	58343	58332	91632	91632	135764	135761

- Motorcycle -

Year / Zone	1990 Gen.	1990 Att.	1996 Gen.	1996 Att.	2001 Gen.	2001 Att.	2006 Gen.	2006 Att.
1	2157	2157	4398	4398	6790	6790	10006	10006
2	1785	1785	3549	3549	5348	5348	7636	7636
3	1345	1345	2672	2672	4031	4031	5757	5757
4	1430	1430	2842	2842	4283	4283	6118	6118
5	1019	1019	2256	2256	3703	3703	5803	5803
6	964	964	2007	2007	3110	3110	4619	4619
7	1667	1667	3572	3572	5719	5719	8750	8750
8	1486	1486	3040	3040	4708	4708	6898	6898
9	879	879	1796	1796	2786	2786	4083	4083
10	1228	1228	2511	2511	3891	3891	5702	5702
11	1745	1745	3568	3568	5535	5535	8103	8103
12	464	464	950	950	1467	1467	2162	2162
13	1128	1128	2305	2305	3579	3579	5238	5238
14	251	251	513	513	795	795	1165	1165
15	534	534	1093	1093	1693	1693	2480	2480
16	1470	1470	3005	3005	4651	4651	6821	6821
17	1225	1225	2505	2505	3886	3886	5696	5696
18	2013	2013	4117	4117	6379	6379	9351	9351
19	2	2	4	4	6	6	9	9
20	1221	1221	2490	2490	3842	3842	5665	5665
21	1269	1269	2549	2549	3928	3928	5673	5673
22	3060	3060	6162	6162	9487	9487	13647	13647
23	1186	1186	2388	2388	3676	3676	5292	5292
24	2568	2568	5235	5235	8082	8082	11922	11922
25	3821	3821	7669	7669	11652	11652	16572	16572
26	3472	3472	6959	6959	10566	10566	15071	15071
27	1397	1397	3093	3093	5075	5075	7952	7952
28	1570	1570	3326	3326	5358	5358	8102	8102
29	414	414	876	876	1414	1414	2134	2134
30	1317	1317	2791	2791	4497	4497	6792	6792
31	2137	2137	4214	4214	6348	6348	9131	9131
32	2396	2396	4576	4576	6695	6695	9213	9213
33	2175	2175	4154	4154	6078	6078	8367	8367
34	281	281	536	536	785	785	1080	1080
35	335	335	640	640	936	936	1289	1289
36	1023	1023	1954	1954	2858	2858	3934	3934
37	2735	2735	5394	5394	8124	8124	11685	11685
38	1986	1986	4116	4116	6435	6435	9604	9604
39	1826	1826	3660	3660	5574	5574	8001	8001
40	1845	1845	3698	3698	5638	5638	8089	8089
41	2224	2224	4456	4456	6796	6796	9749	9749
42	1231	1231	2467	2467	3762	3762	5399	5399
43	1033	1033	2003	2003	2982	2982	4234	4234
44	1513	1513	2873	2873	4172	4172	5743	5743
45	831	831	1578	1578	2290	2290	3153	3153
46	907	907	1723	1723	2502	2502	3440	3440
47	2241	2241	4800	4800	7690	7690	11760	11760
48	1231	1231	2569	2569	4075	4075	6075	6075
49	1018	1018	2124	2124	3371	3371	5023	5023
50	2573	2573	5512	5512	8830	8830	13499	13499
51	2660	2660	5550	5550	8802	8802	13122	13122
52	2140	2140	4466	4466	7081	7081	10557	10557
53	1240	1240	2587	2587	4107	4107	6120	6120
54	4389	4389	9718	9718	15942	15942	24977	24977
55	1923	1923	3955	3955	6148	6148	9070	9070
56	4587	4587	9438	9438	14652	14652	21640	21640
57	3777	3777	8093	8093	12966	12966	19822	19822
58	4004	4004	8004	8004	12198	12198	17529	17529
59	3127	3127	6252	6252	9527	9527	13696	13696
60	3179	3179	6356	6356	9686	9686	13921	13921
61	3313	3313	7214	7214	11701	11701	18108	18108
62	1653	1653	3268	3268	4946	4946	7010	7010
63	0	0	0	0	0	0	0	0
64	3559	3559	7625	7625	12214	12214	18680	18680
65	1819	1819	3753	3753	5858	5858	8666	8666
66	469	469	968	968	1511	1511	2235	2235
67	1744	1744	3599	3599	5616	5616	8313	8313
68	469	469	968	968	1511	1511	2235	2235
69	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
Total	119680	119680	245102	245102	380344	380344	559388	559388

A.3.4.6 Transport Demand on Other Modes of Transport

Transport demand on the other modes of transport was incorporated into the OD tables by creating traffic centroids representing major airports, ports and railway stations. Sea, air and railway transport are discussed here to estimate future trip generation and attraction of such traffic centroids.

1) Present Situations

(1) Sea Transport

Total freight volume passes through the major coastal ports (customs ports only) in Thailand were 3.07 million tons in 1985 and 4.56 million tons in 1987. The annual growth rate is calculated at 22 percent for the period.

OD tables of freight passed through the coastal ports in Thailand were prepared in 1985 by the Harbour Department. Table 3.4.6.1 shows the origin and destination of cargoes handled at the ports in the Southern Region.

Most of coastal ports in the Southern Region accommodate both domestic and international cargoes. Songkhla Port handled the biggest volume of almost 800 thousand tons for both inbound and outbound, followed by Nakhon Si Thammarat(Sichon and Pak Phanang ports) of about 600 thousand tons. The both ports had a similar tendency that they received freight from the ports in the Southern Region and dispatched them to overseas countries. Surat Thani Port including Ko Samui handled about 400 thousand tons mainly to and from Bangkok. Trang (Yongsata and Kantang ports) handled almost 300 thousand tons which were mainly to and from overseas countries.

(2) Air Transport

Total number of air passengers in the Southern Region increased to 1.56 million in 1988 from 0.77 million in 1984 as shown in Table 3.4.6.2. An average annual growth rate was 19.3 percent, which was higher than the national average by 3.2 percent.

Table 3.4.6.1 Cargo O&D by Coastal Port in 1985 (Aggregated by Province in the South)

unit : ton/year

O\D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1. Bangkok	326990	100296	0	313356	139032	0	0	40205	8037	464166	0	10920	0	89422	1492424
2. Chumphon	330	0	0	4003	18068	0	0	0	0	0	0	0	0	0	22401
3. Ranong	0	0	0	0	0	0	0	0	0	0	0	0	0	1007	1007
4. Suratthani	50581	2350	0	150	28011	0	0	0	0	5293	0	0	0	0	86385
5. Nakhon Si	11344	0	0	1900	7243	0	0	0	0	0	0	0	0	352680	373167
6. Krabi	0	0	0	0	0	0	66	0	647	0	0	0	0	58692	59405
7. Phangnga	0	0	0	0	0	30	0	0	40	0	0	0	0	0	70
8. Phuket	0	0	0	0	0	0	0	0	0	0	0	0	0	60577	60577
9. Trang	0	0	0	0	0	0	0	1810	1108	0	0	0	0	147362	150280
10. Songkhla	1177	900	0	6280	2110	0	0	0	0	0	0	870	0	267559	278896
11. Satun	0	0	0	0	0	0	0	0	44	0	0	0	0	43335	43379
12. Pattani	0	0	0	0	0	0	0	0	0	1075	0	0	0	9988	11063
13. Narathiwat	0	0	0	0	0	0	0	0	0	0	0	0	0	5049	5049
14. Oth Countries	270661	0	11817	459	0	60	6824	45017	127822	28055	15	84	18	0	490832
Total	661083	103546	11817	326148	194464	90	6890	87032	137698	498589	15	11874	18	1035671	3074935

Source : The Harbour Department, 1985

Phuket Airport handled the largest number of passengers of 1,007 thousand person in 1988, which was next to Bangkok Airport of 10,552 thousand passengers, followed by Hat Yai Airport of 390 thousand passengers and Surat Thani Airport of 142 thousand passengers. Nakhon Si Thammarat Airport showed the highest annual growth rate of 34.5 percent during 1984 - 1988, followed by Phuket Airport of 31.5 percent and Surat Thani Airport of 27.4 percent. Hat Yai Airport had a stagnant annual growth rate of 2.4 percent while the other small airports had negative growth rates of 10 - 24 percent.

Table 3.4.6.2 Air Passenger Traffic at Regional Airports, 1984-1988

unit: 1,000 persons

Airport\Year	1984	1985	1986	1987	1988	1984-1988 (% p.a.)
Hat Yai	354.9	363.8	349.8	362.9	390.3	2.4
Nakhon Si	2.5	5.4	11.0	7.9	8.1	34.2
Narathiwat	6.0	5.1	4.5	4.1	3.8	(10.8)
Pattani	1.5	1.1	1.1	0.5	0.5	(24.0)
Phuket	336.2	385.1	520.2	764.5	1,006.5	31.5
Surat Thani	54.2	66.9	85.0	101.8	142.8	27.4
Trang	17.0	13.6	11.9	11.7	11.3	(9.7)
South Total	772.3	841.0	983.5	1,253.4	1,563.3	19.3
Chiang Mai	491.7	554.1	622.8	777.3	915.6	16.8
Others	316.0	341.3	362.1	370.6	396.2	5.8
Grand Total	1,580.0	1,736.4	1,968.4	2,401.3	2,875.1	16.1

Source : 1988 Air Transport Statistic, Department of Aviation
Note : Number with parenthesis shows negative value.

Table 3.4.6.3 shows air freight transport in the Southern Region. Cargo volume of the Southern Region in 1988 was 7.94 thousand tons or 61.7 percent of the national total excluding Bangkok Airport. An average annual growth rate of air freight transport in the Southern Region was 39.4 percent during the same period, 10.9 percent higher than that of the national total. The cargoes handled at the airports in the Southern Region were mainly frozen fishery products and fruits, destined for both domestic and international markets.

Hat Yai airport had the largest number of cargo of 3.9 thousand tons in 1988, followed by Phuket airport of 3.4 thousand tons. Nakhon Si Thammarat airport showed the highest annual growth rate of 96.8 percent for the same period, followed by Surat Thani airport of 55.4 percent, Phuket airport of 52.4 percent and Hat Yai airport of 32.4 percent. Pattani and Narathiwat airports showed sluggish growth rates of minus 11 percent and 3 percent respectively.

Table 3.4.6.3 Air Freight Traffic at Regional Airports, 1984-1988

unit: 1,000 kg

Airport\Year	1984	1985	1986	1987	1988	1984-1988 (%p.a.)
Hat Yai	1,251.9	1,262.9	1,186.9	2,098.8	3,852.1	32.4
Nakhon Si	4.7	16.7	26.6	50.1	70.0	96.4
Narathiwat	25.8	28.8	20.8	30.5	29.0	3.0
Pattani	34.2	33.7	24.2	28.3	21.7	(10.7)
Phuket	626.3	723.9	898.6	1,428.9	3,381.4	52.4
Surat Thani	78.0	125.1	215.1	292.3	454.5	55.4
Trang	82.2	79.0	78.6	98.3	134.8	13.2
South Total	2,103.1	2,270.1	2,450.8	4,027.2	7,943.5	39.4
Chiang Mai	1,549.7	1,870.3	2,725.4	2,475.9	3,636.1	23.8
Others	1,074.3	989.5	1,113.9	1,208.7	1,298.7	4.9
Grand Total	4,727.1	5,129.9	6,290.1	7,711.8	12,878.3	28.5

Source : 1988 Air Transport Statistic, Department of Aviation
Note : Number with parenthesis shows negative value.

(3) Railway

Passenger traffic on the SRT system remains in the order of 80 million passengers per annum: 78.8 million in 1981, 78.0 million in 1985, and 81.6 million in 1988. Freight traffic shows a similar static tendency with passenger traffic, remaining in the order of 6.1 million tons per annum: 6.0 million tons in 1981, 5.6 million tons in 1985, and 6.2 million tons in 1988.

Table 3.4.6.4 shows passenger traffic among regions. The Southern Region had 14.49 million departing passengers and 14.54 million arriving passengers, which were approximately 18 percent of the total railway passengers of the country. Intra-regional traffic in the Region accounted for as high as 88 percent of the departing and arriving passengers. About 1.3 million passengers used the SRT system from the Southern Region to Bangkok and vice versa.

Table 3.4.6.4 SRT Passenger Traffic among Regions

unit : million psn

O\D	Bangkok	North	Northeast	Central	South	Total
Bangkok	7.45	1.74	2.01	5.37	1.28	17.85
North	1.70	12.19	0.01	0.81	-	14.70
Northeast	2.08	0.01	12.24	0.41	-	14.74
Central	5.04	0.80	0.47	12.98	0.42	19.72
South	1.25	-	-	0.40	12.83	14.49
Total	17.51	14.74	14.73	19.98	14.54	81.50

Source : Annual Transport Statistics, 1984

Table 3.4.6.5 shows freight traffic among regions. The Southern Region sent 0.7 million tons of cargo and received 1.2 million tons by railway. 0.45 million tons were carried within the region, accounting for 60 percent of departing cargo and 38 percent of arriving cargo. Main commodities carried within the region were such resource based products as rubber and gypsum. The Region received cargoes from various regions by railway such as petroleum products, cement and rice.

Table 3.4.6.5 SRT Freight Traffic among Regions
unit : 1,000 tons

O\D	Bangkok	North	Northeast	Central	South	Total
Bangkok	8	738	604	237	254	1,840
North	344	58	3	255	209	870
Northeast	20	1	21	21	97	160
Central	1,327	52	71	72	174	1,697
South	179	10	12	88	450	739
Total	1,878	859	711	673	1,184	5,306

Source : Annual Transport Statistics, 1984

Table 3.4.6.6 and 3.4.6.7 show the passenger and freight movements in FY 1989 (October 1988 to September 1989) at major railway stations in the South; Surat Thani, Thungsong and Hat Yai. Hat Yai station handled the largest number of passengers of 1.2 million for both ways, followed by Surat Thani of 0.6 million passengers and Thungsong of 0.5 million passengers. Surat Thani handled the largest volume of cargo of 56 thousand tons(outbound only), followed by Hat Yai of 42 thousand tons and Thungsong of 23 thousand tons.

Table 3.4.6.6 Passenger Movements by Railway at Major Stations in FY 1989 (Oct. 1988 - Sept. 1989)

unit: person

Station	From				To			
	Bangkok	South*	Others	Total	Bangkok	South*	Others	Total
Suratthani	270586	444008	50672	765266	264003	308339	43036	615378
Thungsong	116114	340951	22464	479529	107269	323424	20407	451100
Hat Yai	391190	753761	48290	1193241	410413	745054	63891	1219358

Table 3.4.6.7 Cargo Movements by Railway at Major Stations in FY 1989 (Oct. 1988 - Sept. 1989)

unit : tons

Station	To			
	Bangkok	South*	Others	Total
Surat Thani	46,648	1,457	7,803	55,908
Thungsong	20,948	1,736	242	22,926
Hat Yai	37,961	1,811	1,998	41,770

Note : * Southern Provinces within the study area

2) Future Transport Demand on Other Modes of Transport

(1) Sea Transport

According to the Harbour Department, total freight handled at all ports in Thailand increased from 3,075 thousand tons in 1985 to 4,563 thousand tons in 1987. GRP in the Southern Region increased from 394 million baht to 446 million baht during the same period. The elasticity of cargo handling volume at coastal ports with regard to GRP of the Southern Region was calculated at 1.31.

Using this elasticity and the future GRP, total cargo volume by sea transport was estimated for the region. A cargo OD table of sea transport, which is shown in Table 3.4.6.1, was used to forecast future cargo generation and attraction by port together with the future socio-economic indicators by Changwat. The forecasted cargo volume handled at ports in the Southern Region is shown in Table 3.4.6.8 by the target years.

(2) Air Transport

Air passengers by airport were classified into two groups according to their growth rates. A group of high growth rate comprises Phuket, Hat Yai, Nakhon Si Thammarat and Surat Thani airports, while a group of low growth rate consists of Narathiwat, Trang and Pattani airports.

Table 3.4.6.8 Estimated Cargo Handling Volume at Ports in the South

(unit: thousand ton/year)

Province	Port	Node	1996		2001		2006	
			Unloaded	Loaded	Unloaded	Loaded	Unloaded	Loaded
Chumphon	Paknam Chumphon	401	184	182	395	388	771	762
Ranong	Kra Buri	421	12	0	27	0	54	0
	Ranong	420	61	66	145	160	288	320
Suratthani	Ko Samui	405	4	5	8	9	14	18
	Ban Don	402	489	479	959	938	1798	1762
Nakhon Si	Sichon	406	18	847	30	1425	51	2435
Thammarat	Pak Phanang	408	848	4	1421	7	2417	11
Krabi	Krabi	416	92	219	264	414	493	756
Phangnga	Phangnga	417	63	56	147	137	310	290
	Takua Pa	419	39	36	93	86	195	182
Phuket	Phuket	418	218	199	407	381	756	709
Trang	Yongsata	414	1	1	2	2	4	3
	Kantang	415	451	409	733	685	1237	1162
Songkhla	Songkhla	409	949	897	1639	1574	2899	2799
Satun	Pakbara	413	0	17	0	29	0	54
	Satun	412	0	146	0	257	0	477
Pattani	Pattani	410	249	242	457	440	860	827
Narathiwat	Takbai	411	0	264	0	532	0	968
Total			3678	4069	6727	7464	12147	13535

A linear regression model was developed based on the analysis of the relationship between the number of air passengers and population in the Southern Region. Total number of air passengers of the region in the future was estimated based on the regression model. The growth rates calculated for the future were applied to the airports of high growth rate. The following growth rates were assumed to the airports of low growth rate:

1990 - 1996	8 % p.a.
1996 - 2001	5 % p.a.
2001 - 2006	5 % p.a.

Air cargo in the Region was also analyzed in the similar way. The estimated air transport demand of passengers and cargoes are shown in Table 3.4.6.9.

(3) Railway Transport

As examined in the above, railway passengers and cargo have no clear trend of increase. But, it would not mean that railway passengers and cargo will not increase at all in the future. Future improvement of the system might attract patronage to the railway. It was assumed in this study that railway passengers would increase in proportion to the increase of Changwat population where railway station are located and that railway cargo would increase in proportion to the increase of Changwat GRP where railway stations are also located.

Forecasted railway passengers and cargo in the target years are shown in Table 3.4.6.10 and 3.4.6.11 respectively.

Table 3.4.6.9 Estimated Air Transport Demand

Year		Phuket	Hat Yai	Narathiwat	Nakhon Si Thammarat	Trang	Pattani	Suratthani	Total	Growth % p.a.
1988	Passenger (1,000)	1,006	390	4	8	11	0.50	143	1,563	
1996		2,710	1,051	4	22	12	0.50	384	4,184	13.09
2001		4,036	1,565	5	32	15	0.60	572	6,226	8.28
2006		5,652	2,192	6	45	18	0.80	802	8,716	6.96
1988	Freight (ton)	3,381	3,852	29	70	135	22	454	7,943	
1996		9,181	10,458	55	190	255	41	1,234	21,414	13.20
2001		14,333	16,328	78	297	363	58	1,926	33,383	9.29
2006		21,155	24,099	110	438	511	82	2,843	49,238	8.08

Table 3.4.6.10 Forecasted Railway Passenger

(person per day)

Passenger	1990	1996	2001	2006
Surat Thani	3,783	4,299	4,730	5,167
Thungsong	2,550	2,718	2,839	2,941
Hat Yai	6,610	7,708	8,679	9,699

Note : Arriving and departing passengers

Table 3.4.6.11 Forecasted Railway Cargo

(ton per day)

Passenger	1990	1996	2001	2006
Surat Thani	415	654	922	1,281
Thungsong	171	269	380	527
Hat Yai	309	474	663	924

Note : Loading and unloading cargo

A.3.4.7 Inter-Changwat Vehicle Trip OD Table in 1990

(Car) (per day)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1 Chumphon	290	220	401	24	6	8	44	7	3	32	0	5	0	4	445	0	1489
2 Ranong	279	26	52	121	37	6	8	4	2	7	3	2	3	0	74	0	624
3 Surat Thani	298	60	964	4	16	67	868	76	11	67	1	4	1	6	120	1	2564
4 Phangnga	6	48	14	28	490	176	14	16	1	5	0	0	0	1	16	0	815
5 Phuket	9	20	37	633	1164	120	37	12	7	21	0	5	1	0	62	1	2129
6 Krabi	8	5	88	198	139	26	117	313	18	39	0	1	0	0	10	0	962
7 Nakhon Si Thammarat	42	10	784	12	32	81	738	257	186	701	7	31	21	5	57	0	2964
8 Trang	5	3	37	10	61	340	263	990	300	213	0	2	3	5	6	1	2239
9 Patthalung	3	0	10	4	13	28	113	372	4	403	21	3	10	6	11	0	1001
10 Songkhla	9	10	56	12	35	25	327	275	546	4316	550	315	182	97	76	1	6832
11 Satun	1	0	1	0	0	0	4	0	26	468	584	6	5	1	4	0	1100
12 Pattan	0	0	4	0	4	0	16	3	6	471	4	1804	737	292	8	0	3349
13 Yala	0	0	1	0	1	4	9	3	0	6	0	818	1452	9	6	0	2309
14 Narathiwat	1	0	5	0	3	0	4	0	1	104	0	110	56	1138	10	0	1432
15 Other Thailand	460	57	90	21	63	15	65	22	4	99	16	10	13	6	0	4	945
16 Malaysia	0	1	1	0	1	0	1	1	0	13	0	10	0	0	0	0	28
Total	1411	460	2545	1067	2065	896	2628	2351	1115	6965	1186	3126	2484	1570	905	8	30782

Estimated by the study team

(Bus) (per day)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1 Chumphon	24	63	73	0	0	0	6	0	0	8	0	0	0	0	212	0	386
2 Ranong	53	18	30	14	8	0	0	0	0	0	0	0	0	0	12	0	135
3 Surat Thani	54	23	850	0	3	34	112	4	0	14	0	0	0	0	30	4	1128
4 Phangnga	0	26	2	76	163	43	2	1	0	2	0	0	0	0	6	0	321
5 Phuket	0	4	16	101	1264	13	13	9	0	15	0	0	0	0	53	0	1488
6 Krabi	0	0	62	0	40	30	6	27	0	10	0	0	0	0	15	0	190
7 Nakhon Si Thammarat	4	0	150	0	9	2	1312	62	46	100	0	4	3	2	17	0	1711
8 Trang	0	0	5	0	23	14	88	254	53	56	0	0	0	0	8	0	501
9 Patthalung	0	0	0	0	0	2	41	21	18	57	3	0	2	2	4	0	150
10 Songkhla	8	6	26	2	22	19	93	41	65	1580	88	31	6	8	29	0	2024
11 Satun	0	0	0	0	0	0	0	0	1	59	1084	0	0	0	2	0	1146
12 Pattan	0	0	0	0	0	0	0	0	0	46	0	330	180	69	0	0	625
13 Yala	0	0	0	0	0	0	0	0	0	6	0	182	366	6	6	0	566
14 Narathiwat	0	0	0	0	0	0	3	0	0	21	0	93	6	420	9	0	552
15 Other Thailand	186	19	59	6	29	9	22	7	6	41	3	0	5	9	0	2	394
16 Malaysia	0	0	0	0	0	0	0	0	1	6	0	0	0	0	2	0	9
Total	329	159	1264	199	1561	166	1698	426	190	2021	1178	640	568	516	405	6	11326

Estimated by the study team

(Truck) (per day)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1 Chumphon	60	179	167	13	0	13	14	7	0	14	0	7	0	0	611	0	1085
2 Ranong	182	8	21	42	5	0	3	4	0	21	3	3	0	2	88	0	382
3 Surat Thani	275	50	2502	10	14	170	374	27	16	56	2	2	0	2	180	0	3680
4 Phangnga	19	105	16	136	682	114	14	3	0	0	0	0	0	0	17	0	1106
5 Phuket	15	39	41	514	1408	69	53	15	0	6	0	0	0	2	67	0	2229
6 Krabi	0	9	206	131	40	260	60	108	5	11	0	0	0	0	18	0	848
7 Nakhon Si Thammarat	23	9	459	7	20	85	896	336	305	331	4	13	17	12	122	2	2641
8 Trang	3	3	45	1	5	140	382	1248	70	87	0	5	4	2	49	0	2044
9 Patthalung	2	4	32	6	2	10	383	114	8	322	11	9	7	6	9	0	925
10 Songkhla	15	35	82	10	12	24	743	78	173	4526	228	429	177	108	187	2	6829
11 Satun	0	0	6	0	0	0	20	0	7	237	220	4	5	1	37	0	537
12 Pattan	0	0	4	0	0	2	33	6	0	245	2	72	255	171	72	0	862
13 Yala	0	0	2	2	0	0	36	4	1	9	0	182	472	2	75	0	785
14 Narathiwat	2	2	2	2	0	0	20	2	20	144	7	397	83	1066	132	0	1879
15 Other Thailand	588	134	147	34	85	16	177	35	8	169	37	40	44	73	0	5	1592
16 Malaysia	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	3
Total	1184	577	3732	908	2273	903	3208	1987	614	6178	514	1163	1064	1447	1666	9	27427

Estimated by the study team

(Motorcycle) (per day)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1 Chumphon	5518	658	541	0	0	0	0	0	0	0	0	0	0	0	0	0	6717
2 Ranong	658	614	0	711	0	0	0	0	0	0	0	0	0	0	0	0	1983
3 Surat Thani	541	0	8288	403	0	1245	3340	275	0	0	0	0	0	0	0	0	14092
4 Phangnga	0	711	403	2190	3078	354	0	0	0	0	0	0	0	0	0	0	6736
5 Phuket	0	0	0	3078	6706	77	0	0	0	0	0	0	0	0	0	0	9861
6 Krabi	0	0	1245	354	77	2568	72	382	0	0	0	0	0	0	0	0	4698
7 Nakhon Si Thammarat	0	0	3340	0	0	72	5106	1354	919	291	0	0	0	0	0	0	11082
8 Trang	0	0	275	0	0	382	1354	4830	1828	0	443	0	0	0	0	0	9112
9 Patthalung	0	0	0	0	0	0	919	1828	770	698	69	0	0	0	0	0	4284
10 Songkhla	0	0	0	0	0	0	291	0	698	9764	365	1273	671	41	0	0	13103
11 Satun	0	0	0	0	0	0	0	443	69	365	10022	0	0	0	0	0	10899
12 Pattan	0	0	0	0	0	0	0	0	0	1273	0	7050	3520	2244	0	0	14087
13 Yala	0	0	0	0	0	0	0	0	0	671	0	3520	416	359	0	0	4966
14 Narathiwat	0	0	0	0	0	0	0	0	0	41	0	2244	359	5416	0	0	8060
15 Other Thailand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Malaysia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	6717	1983	14092	6736	9861	4698	11082	9112	4284	13103	10899	14087	4966	8060	0	0	119680

Estimated by the study team

A.3.4.8 Average Loaded Factors

OD Type	Vehicle Type	Total Vehicle	Avg. Load 1/ (person)	Avg. Load 2/ (person)	Avg. Load (tons)
Car	Passenger Car	7,875	3.6	2.6	-
	Pickup(pass)	9,380	3.7	2.7	-
	Total		3.7	2.7	
Bus	Light Bus	1,410	7.9	5.9	-
	Medium Bus	317	15.8	13.8	-
	Heavy Bus	1,971	46.9	44.5	-
	Total		29.4	27.2	
Truck	Pickup(cargo)	6,287	-	-	0.76
	Light Truck	393	-	-	1.59
	Medium Truck	2,858	-	-	3.53
	Heavy Truck	5,008	-	-	10.54
	Total				4.69
Motorcycle 3/		-	1.5	0.5	-

Source: Survey results of the Toll Highway Development Study, 1990
Note: 1/ The figures are included driver and assistance.
Note: 2/ The figures are excluded driver and assistance.
Note: 3/ Assumed by Study Team.

A.3.4.9 Q-V Formula

Road Code	Highest Running Speed	Lowest Running Speed	Traffic Volume at Highest Running Speed	Traffic Volume at Lowest Running Speed
1	80	10	14,000	3,700
2	75	10	13,000	3,500
3	70	10	12,000	3,200
4	60	10	9,600	2,400
5	55	10	8,000	2,000
6	45	10	6,000	1,500
7	90	20	64,000	16,000
8	90	20	78,000	20,850
9	50	10	10,000	2,700
10	60	20	44,000	11,700
11	40	10	6,000	1,500
12	30	10	4,800	1,200
13	20	10	6,000	1,600
14	120	20	72,000	18,000
15	30	30	10,000	10,000
16	20	20	10,000	10,000

APPENDIX; CHAPTER 4

A.4.3.1 Ongoing Construction and Rehabilitation Projects in the Southern Region

NATIONAL HIGHWAY PLAN — As of July 1990

ROAD NO.	STANDARD ROAD	ROAD NAME	FROM	DISTANCE (KM)	COST (million)	PERIOD	PROGRESS (%)	REMARK
MAIN ROAD CONSTRUCTION								
4	PDP1	A.Sadao - Ban Klong Pruan Section 1 (Songkhla)	70+000-84+112	14.113	99.2	Mar.10,'89 - Feb.17,'91	71.1	
4	PDP1	(A.Hat Yai - A.Sadao) A.Hat Yai - Ban Khlong Ngae	29+453-55+000	25.545	340.6	Jun.01,'90 - Aug.08,'92	1.9	
4	PDP1	(A.Hat Yai - A.Sadao) Ban Klong Ngae - A.Sadao	55+000-70+100	15.000	203.5	Mar.19,'90 - Feb.07,'92	5.5	
			Total	54.658	643.3			
MAIN ROAD IMPROVEMENT								
4	P 2	A. Kok Kloy - A.Takua Thung	0+000-19+891	19.891	29.2	Jul.18,'88 - Jul.07,'90	75.3	Too much rain
4	P2PD	Ban Tha Chamuang - A.Hat Yai	2+000-34+223	32.224	78.2	Dec.28,'87 - Nov.26,'92	-	Finish Nov.'89
4	P 3	Junction Krabi - Junction A.Lamtap	-	36.000	-			Under design
42	P 3	Junction A.Taepha - Ban Na Ket	-	23.000	-			Under design
4	P 1	A.Haui Yod - Trang	-	25.000	-			Under design
			Total	136.115	107.4			
MAIN BRIDGE AND TUNNEL CONSTRUCTION								
4	-	Junction A.Thung Song - Ban Khuan Kun - A.Thap Phut	0+984-10+619	0.170	11.3			Waiting for price approval
			Total	0.170	11.3			
SECOND ROAD CONSTRUCTION								
414	S1SD	Songkhla - A.Hat Yai Section 1 Junction A.Hat Yai to Airport	0+000-24+309	28.231	389.4	Jan.01,'89 - Jun.19,'91	67.8	
414	S D	Songkhla - A.Hat Yai Section 2 Junction A.Hat Yai to Airport	4+103-10+638	6.353	68.6	Mar.01,'90 - Dec.20,'91	-	Adjust for new plan
414	S D	Junction Highway No. 4 - Krabi	-	4.000	-			Under design
401	S D	A.Phunphin - Surat Thani	0+000-12+359	12.395	42.7	Oct.'88 - Sep.'89	89.1	Waiting for surface
			Total	50.979	500.7			

NATIONAL HIGHWAY PLAN — As of July 1990

ROAD NO.	STANDARD ROAD	ROAD NAME	FROM	DISTANCE (KM)	COST (million)	PERIOD	PROGRESS (%)	REMARK
SECOND ROAD IMPROVEMENT								
401	S 1	A.Tha Sala - Ban Tha Pae	0+000-19+466	19.466	45.4	Mar.22,'88 - Jul.29,'90	-	Finish May 90
410	S 2	Pattani - Yala	2+665-37+544	34.875	138.8	Jan.01,'88 - Jan.20,'91	88.6	
403	S 3	Junction Highway No. 41 - A.Thung Song	-	10.000	-			Under design
410	S 4	Ban Km. 32 - A.Be Tong	-	31.000	-			Under design
410	S 4	Junction A.Bannang Sata - Ban Bo Hin (Km.7)	-	36.000				Under design
			Total	131.341	184.2			
SECOND BRIDGE AND TUNNEL CONSTRUCTION								
402	-	Ban Kok Kloi - Phuket Municipality (Tha Nun - Tha Chat Chai)	7+466-8+378	5.020	301.8	Oct.08,'89 - Oct.11,'90	2.0	Adjust for new plan
408	2	Songkhla - A.Na Tha Wi	29+315-30+315	0.100	5.7	Sep.28,'89 - Jun.25,'90	-	Finish April 90
4	P 2	A.Kura Buri - Junction Surat Thani	728+95-776+85	47.900	-			New bidding
41	P 2	Surat Thani - A.Thung Song Junction Ban Nam Kleing - A.Vieng Sra	-	16.099	-			Under design
41	P 2	Surat Thani - A.Thung Song Junction Highway No. 401 - A.Nam Kleing	-	39.000	-			Under design
4	P 3	(Krabi - A.Thap Phut) Krabi - Ban Klang	108+00-139+60	29.600	-			Bidding Sept. 90
4	P 3	(Krabi - A.Thap Phut) Ban Klang - A.Thap Phut	137+60-168+50	30.900	-			Bidding Sept. 90
418	S 3	Yala - A.Bannang Sata	5+300-43+000	37.700	-			Bidding Sept. 90
			Total	206.220	307.5			

PROVINCIAL HIGHWAY PLAN — As of July 1990

ROAD NO.	STANDARD ROAD	ROAD NAME	FROM	DISTANCE (KM)	COST (million)	PERIOD	PROGRESS (%)	REMARK
PROVINCIAL HIGHWAY CONSTRUCTION								
4042	F 4	Junction Highway No. 4 (Ban Sai Khao) - Ban Bo Muang	0+000-13+340	13.340	33.0	Jan.09,'89 - Feb17,'91	62.1	
4139	F 4	Junction Highway No. 41 (Ban Na Nue) - Ban Kao Talu	0+000-23+309	23.314	42.9	Dec.25,'88 - Nov.24,'90	92.3	
4182	F 4	Junction Highway 41 - Ban Laem Tanod	0+000-12+097	12.097				New bidding
4123	F 4	Trang - Highway No. 4 (Ban Pak Jam)	2+547-33+279	30.732	62.9	Jan.09,'89 - Sep.30,'90	81.7	
4013	F 3	East Pak Phanang - West Pak Phanang	0+000-9+386	9.386	-			New bidding
4203	F 4	Ban Sai Thai - Shell Graveyard - Ao Pranang - Had Nopparat Tara	0+000-8+455	14.970	28.1	Nov.09,'89 - Apr.12,'91	53.2	
4054	F 4	A.Sadao - A.Padang Besa	0+000-12+471	12.403	62.5	Jan.07,'89 - Mar.17,'91	20.3	Adjust for new plan
4059	F 4	Ban Tha Rue - Ban Batong (include bridge 300 m)		3.000	-			DOH assign Songkhla to do
4234	F 4	Entrance to A.Pak Panang Fish Port	0+000-3+412	3.303	69.1			Wait for sign
4038	F 4	K.A.Lamtap - A.Thung Yai	26+025-53+806	27.753	59.1	Aug.01,'90 - May 11,'92		
4055	F 4	Ban Dusongyo - Ban Kato	0+000-12+150	12.150	69.2			Wait for price approval
			Total	162.448	426.8			
4232	F 4	A.Sichol - A.Kanom	0+000-25+000	26.980	40.0	Oct.'89 - Sep.'90	64.3	
4006	F 4	Ban Ratchagrude - A.Phato - A.Lang Suan	39+000-64+700	25.700	40.0	Oct.'89 - Sep.'90	21.6	
4151	F 4	Ban Kuan Nong Hong - Ban Ka Pang	28+172-39+350	11.718	15.0	Oct.'89 - Sep.'90	44.3	Slow work by contractor
4191	F 4	A.Chaiya - Ban Thung Nang Pao	0+000-8+600	4.900	10.0	Oct.'89 - Sep.'90	9.7	Slow work by contractor
4158	F 4	Ban Klong Teng - Ban Kao Vises	0+000-6+500	5.000	10.0	Oct.'89 - Sep.'90	60.2	
4169	F 4	Improve Roadside round Ko Samui	0+000-50+195	50.195	5.0	Oct.'89 - Sep.'90	4.0	Lack of material
4169	F 4	Improve Roadside round Ko Samui	0+000-50+195	50.195	5.0	Oct.'89 - Sep.'90	-	
4122	F 4	K.A.Ba Born Nue - Ban Lo Jan Kra	18+000-32+250	14.220	20.0	Oct.'89 - Sep.'90	51.3	Lack of material
4121	F 4	Junction No.4 (Ban Mae Kree) - Ban Lo Jan Kra	-	-	30.0	Oct.'89 - Sep.'90	-	Finish
4095	F 4	A.Saba Yoi - T.Kao Daeng	0+000-20+670	20.671	39.0	Oct.'89 - Sep.'90	4.3	Slow work by contractor
4181	F 4	Junction No.4 - A. Pak Phayun	0+000-16+000	16.000	14.5	Oct.'89 - Sep.'90	87.4	
4163	F 4	Junction No.4 (Kuan Din So) - Ban Kao Poo	0+000-7+700	7.700	10.0	Oct.'89 - Sep.'90	72.2	Slow work by contractor
4193	F 4	A.Sungai Padi - A.Waeng	11+800-15+799	3.911	10.0	Oct.'89 - Sep.'90	25.9	Too much rain
4111	F 4	A.Kuan Nieng - Ban Pak Cha	6+700-8+800	2.100	3.1	Oct.'89 - Sep.'90	57.5	Wait for surface material
			Total	239.290	251.6			

PROVINCIAL HIGHWAY PLAN — As of July 1990

ROAD NO.	STANDARD ROAD	ROAD NAME	FROM	DISTANCE (KM)	COST (million)	PERIOD	PROGRESS (%)	REMARK
IMPROVE ROAD								
4013	F 3	N. Si Thammarat - A.Pak Panang	0+050-28+650	28.600	78.8	Dec.18,'87 - Dec.05,'89	-	Finish Apr.'90
4055	F 2	Narathiwat - B.Tan Yong Mas	104+72-122+29	17.564	67.8	Jul.25,'88 - Dec.11,'90	19.7	Few machine
4057	F 2	A.Tak Bai - A. Sungai Kolok	0+000-32+308	32.308	158.0	Mar.01,'88 - Jan.24,'91	93.4	
4001	F 2	Chumporn Municipality Chumporn River Mouth	1+000-14+712	13.172	9.1		-	Wait for sign
4020	F 4	Junction Sala Ket Ho - Junction Pa Tong	-	5.000	-		-	Bidding Jun.22,'90
4002	F 4	A.Lang Suan-Lang Suan River Mouth	-	8.000	-		-	Bidding Jul.31,'90
4144	F 4	Junction No.4 - Ao Pangnga	0+000-3+875	3.875	-		-	Wait for approval
			Total	108.519	313.7			
CONSTRUCTION BRIDGE								
4022	1	Phuket - Sala Ket Ho	6+894-11+388	0.088	4.2	Apr.21,'89 - Dec.16,'89	60.9	Adjust new plan
4163		Kuan Din So - Kao Poo - Pa Pha Yom	28+270-46+660	0.084	4.0	Dec.14,'89 - Sep.09,'90	52.5	
4021	1	Phuket Municipality - T Junction Naborn	14+466	0.030	1.8	Jan.22,'90 - Aug.22,'90	76.4	
4001	2	Chumporn - Chumporn River Mouth	1+613-2+284	0.034	4.4	Jan.22,'90 - Sep.18,'90	19.0	
4206	5	Ban Huai Nam Kao - A.Klong Yao	10+427	0.038	2.2	Oct.27,'89 - May 23,'90	-	
4193	4	A.Sungai Padi - Ban Sam Yaek	6+521-10+918	0.077	3.9	Aug.17,'89 - Apr.13,'90	42.3	
4116		A.Thung Song - Ban Bo Nam Ron	0+782-8+347	0.053	7.4	Sep.29,'89 - Apr.26,'90	99.2	
4192	3	Ban Ko Muk - Ban Thung Nang Pao	3+310-6+852	0.064	3.3	Sep.29,'89 - Apr.26,'90	-	Finish June '90
4047	2	Ban Ba Sang - Pattalung	2+502-6+692	0.054	7.8	Mar.23,'90 - Oct.18,'90	53.4	
4231	1	A.Pak Nam - Laem Talumpuk	14+376	0.030	2.6	May 28,'90 - Dec.29,'90	13.2	
4015	3	Ban Kuan Mai Daeng - Ban Na Ban at 4015	9+481-19+443	0.074	5.6	May 28,'90 - Feb.21,'91	19.9	
43	1	A.Hat Yai - A.Chana	32+515	0.100	6.8	Jul.18,'90 - Mar.14,'91	-	
			Total	0.726	54.0			

ROAD NO.	STANDARD ROAD	ROAD NAME	FROM	DISTANCE (KM)	COST (million)	PERIOD	PROGRESS (%)	REMARK
LOAN PROJECT								
4133	F 4	A.Kien Sa - A.Pra Saeng	-	33.000	-			Under design
43	S 1	A.Chana - A.The Pha - Junction Pattan	-	52.000	-			Under design
4034	F 4	Krabi River Mouth - Ban Kao Thong	0+000-25+565	25.565	37.5	Nov.15,'89 - Jul.14,'91	13.5	
4124	F 4	Ban Na Yong Nue - A.Yan Ta Kao	1+700-23+785	22.579	41.9	Oct.01,'89 - Apr.30,'91	55.0	
4151	F 4	Ban Bo Lo - Ban Kuan Nong Hong	0+000-28+800	28.800	-			Bidding Sep.'90
4038	F 4	A.Klong Tom - A.Lam Tap	0+000-26+000	26.000	-			Bidding Sep.'90
4159	F 4	Ban Ton Chod - A.Na Wong	0+000-22+500	22.500	-			Bidding Sep.'90
4009	F 3	Ban Song - A.Pra Saeng	16+600-35+500	18.900	-			Bidding Sep.'90
4022	F 3	Ban Ra Ngae - Junction Phuket Port	0+000-4+051	6.075	-			Bidding Nov.'90
4037	F 3	Junction No.4 (Ban Nue Klong) - A.Kao Phanom	-	25.000	-			Under design
			Total	260.419	79.4			
SECURITY ROAD CONSTRUCTION								
4062	F45/	Ban Be Tong - Ban Poo Kao Thong	4+000-7+000	1.000	20.0	Oct.'89 - Sep.'90	94.0	
4227	F 6	Ban Nai Ao - Ban Nue Klong	0+000-6+500	6.500	6.9	Oct.'89 - Sep.'90	55.9	Arrange land ownership
4227	F 6	Ban Nai Ao - Ban Nue Klong	-	-	6.9	Oct.'89 - Sep.'90	15.2	
4228	F 4	Tan Po Railway Station - Road No.41 (Phanara Cave)	4+300-17+700	13.400	17.9	Oct.'89 - Sep.'90	85.9	Company sent material slow
4228	F 4	Tan Po Railway Station - Road No.41 (Phanara Cave)	-	-	23.3	Oct.'89 - Sep.'90	25.4	Contractor sent material slow
	F 4	Ban Kra Pang - Ban Lam Tap	-	40.200	5.0	Oct.'89 - Sep.'90	10.6	
	F 4	A.Ya Ring - Ban Pa Na Rae	-	14.500	5.0	Oct.'89 - Sep.'90	3.0	Arrange land ownership
			Total	75.600	85.0			
TOURIST PROMOTION PROGRAM								
4040	F 2	A.Phanom - Ban Kao To - A.Thap Phut	0+000-48+161	48.161	-			Bidding Dec.'90
4233	F 4	Ravai Beach - Surin Beach (Round Phuket)	0+000-19+188	34.060	-			Bidding Dec.'90
			Total	82.221	-			
			Grand Total	1,508.708	2,964.9			

Source : Planning Div. of DOH

APPENDIX: CHAPTER 5

A.5.3.1 Vehicle Operating Cost (VOC) and Time Value

1) Economic Vehicle Operating Costs

(unit; Baht/km)

Speed (Kph.)	Paved in Good Condition	Paved in Poor Condition	Laterite	Paved in Good Condition	Paved in Poor Condition	Laterite
	Motorcycle			Heavy Truck		
20	1.0321	1.2109	1.6189	9.5903	10.8743	13.4481
30	0.9857	1.1601	1.5557	8.8694	10.0990	12.5735
40	0.9481	1.1192	1.5033	8.3260	9.4921	11.9150
50	0.9219	1.0901	1.4720	8.0822	9.2567	11.6721
60	0.9082	1.0798		8.0204	9.2467	
70	0.9041	1.0831		8.0768	9.3772	
80	0.9101	1.0918		8.1789		
90	0.9262			8.3372		
100	0.9775			8.5228		
	Passenger Car			Light Bus		
20	3.5874	4.7520	6.1615	4.2048	4.6320	5.7530
30	3.3836	4.3010	6.3814	3.7949	4.1946	5.2437
40	3.2143	4.0193	5.5587	3.5308	3.9127	4.9126
50	3.0814	3.8134	5.3691	3.3364	3.7026	4.6728
60	2.9853	3.6707		3.1768	3.5314	
70	2.9178	3.5553		3.0604	3.4198	
80	2.8782	3.4744		2.9754		
90	2.8660			2.9099		
100	2.9338			3.0180		
	Light Truck			Heavy Bus		
20	3.2600	3.7585	5.1125	7.7352	8.9302	11.4743
30	2.9269	3.3943	4.6618	7.2673	8.4178	10.9092
40	2.7283	3.1744	4.3799	6.8815	7.9960	10.4577
50	2.5905	3.0176	4.1817	6.7485	7.8706	10.3310
60	2.4801	2.8927		6.7669	7.9306	
70	2.4067	2.8217		6.8802	8.0931	
80	2.3599			7.0264		
90	2.3285			7.2029		
100	2.4671			7.3989		
	Medium Truck					
20	6.2050	7.0669	8.5728			
30	5.7262	6.5228	7.9742			
40	5.4137	6.1791	7.6092			
50	5.2686	5.2557	7.4675			
60	5.1738	5.9705				
70	5.1372	5.9606				
80	5.2102	0.8727				
90	5.2419					
100	5.3167					

Increase of Minimum Wage Rate

Year	Increase Rate
1988	3.0 %
1989	3.0 %
1990	3.0 %

Source; Quarterly Bulletin,
December 1989, Bank of Thailand.

Wages of Vehicle Crew

Vehicle Type	Monthly Wage (Baht)	Working Hours (Month)	Wage/Hour (Baht)
Motorcycle	3,193	240	13.3
Passenger Car	3,193	185	17.3
Light Bus	8,013	200	40.1
Medium Bus	8,013	200	40.1
Heavy Bus	8,013	200	40.1
Light Truck	6,407	220	29.1
Medium Truck	6,407	220	29.1
Heavy Truck	6,407	220	29.1

Source; Road Development Study in the Central Region,
March 1989, JICA
"Monthly Wage" and "Wage/Hour" were up-dated by the Team.

Time Values

Vehicle Type	Vehicle Occupancy *	Busi. & Work Trip Ratio (%)	Business & Work Pass. Wage (Baht/hr)	Calculation	Time Value (Baht/hr)
Motorcycle	1.5	15	13.4	1.5*(0.15*13.4+(1-0.15) *5.44)	10.0
Passenger Car	2.7 Passengers	45.5	51.3	2.7*(0.455*51.3 +(1-0.455)*5.44	71.0
Light Bus	2 Crew + 5.9 Passengers	35.2	22.5	5.9*(0.352*22.5 +(1-0.352)*5.44)	67.5
Medium Bus	2 Crews + 13.8 Passengers	35.2	22.5	13.8*(0.352*22.5 +(1-0.352)*5.44)	157.9
Heavy Bus	2 Crew + 38.0 Passengers	35.2	22.5	38.0*(0.352*22.5 +(1-0.352)*5.44)	434.9
Light Truck	Crew	100	29.1	1.0*29.1	29.1
Medium Truck	Crew	100	-	0	0.0
Heavy Truck	Crew	100	-	0	0.0

Source; Road Development Study in the Central Region, March, 1989, 1989.
* "Vehicle Occupancy" is calculated by the Study Team based on the original data sheets of the Roadside Interview Survey conducted by the Toll Highway Development Study, JICA, 1990.

A.5.3.2 Benefit Estimation for Ko Lanta Link

Amphoe Ko Lanta has about 20,000 population. The Ko Lanta Island is now isolated from the main land, lacking of direct road link to the DOH highway network. Sea transport services are provided between the amphoe center and Bor Muang on the main land with a distance of about 20 kilometers.

The island is left behind the economic development of the Southern Region, mainly dependent on traditional agriculture and fishery. The island, however, is endowed with natural beauty, clean ocean in particular. The island is expected to be developed as a beach resort in close relationship with the Phi Phi Island in Phuket Tourism Cluster.

It is likely that the benefit of the Ko Lanta Link will primarily rely on the tourism development of the island instead of savings on vehicle operating cost and travel time of the local resident as in the case of other projects.

To assess the economic benefit of the Ko Lanta Link, it was assumed that tourism development of the island will progress at a pace of 300 hotel rooms in 1996, 600 rooms in 2001 and 1,200 rooms in 2006. The number of tourist arrival is estimated at about 19,700 persons in 1996, 39,400 persons in 2001 and 78,800 persons in 2006 on the following assumptions:

- Double Occupancy Rate 1.5;
- Room Occupancy Rate 0.6; and
- Length of Stay 5.0.

Tourist expenditure is estimated 271 million baht in 1996, 680 million baht in 2001 and 1,724 million baht in 2006 on the following assumptions:

	Expenditure per Tourist (baht)		Total Expenditure (million baht)		
	Foreign	Domestic	Foreign	Domestic	Total
1996	20,000	8,600	177.4	93.1	270.5
2001	23,700	12,000	420.2	260.0	680.2
2006	28,100	16,800	996.4	728.1	1,724.5

On top of foreign exchange earnings, tourism will contribute to create employment opportunities for local people, generate new business opportunities, and so on.

Opening of a new highway to connect the island with the main land including inter island bridges will surely contribute to boost the tourism business in the island. Tourism development, however, is not solely dependent on highway connection but also investments in hotels, tourism facilities and the like. Only some part of these benefits, therefore, can be attributed to tourism development.

Indicators of economic evaluation of the project are calculated as shown below on an assumption that some part of foreign exchange expenditure by international tourists is attributable to the highway development.

Benefit: Expenditures by International Tourist

	EIRR (%)
100 % of Expenditures	32 %
Cost Up by 20 %	29 %
Benefit Down by 20 %	29 %
50 % of Expenditures	22 %
20 % of Expenditures	12 %

Viability of the project will largely depend on the progress of future tourism development in the island as well as the assessment that how many percent of international tourist expenditures can be attributable to the project. The EIRR of the project will be in the range to 12 - 22 % with a little influence of cost up and benefit down.

Ko Lanta Link

unit: 1,000 baht

		1) 100 % of Expenditures					2) 50 % of Expenditures			5) 20 % of Expemditures		
			Cost		Benefit	Balance						
		(1)	(2)	(3)	(4)	(5)						
No.	Year	Const.	Maint.	Total			Cost	Benefit	Balance	Cost	Benefit	Balance
1	1990	0	0	0	0	0	0	0	0	0	0	0
2	1991	0	0	0	0	0	0	0	0	0	0	0
3	1992	119181	0	119181	0	-119181	119181	0	-119181	119181	0	-119181
4	1993	216541	0	216541	0	-216541	216541	0	-216541	216541	0	-216541
5	1994	205976	0	205976	0	-205976	205976	0	-205976	205976	0	-205976
6	1995	127315	0	127315	0	-127315	127315	0	-127315	127315	0	-127315
7	1996	0	-56	-56	177400	177456	-56	88700	88756	-56	35480	35536
8	1997	0	-56	-56	210800	210856	-56	105400	105456	-56	42160	42216
9	1998	0	-56	-56	250500	250556	-56	125250	125306	-56	50100	50156
10	1999	0	-56	-56	297600	297656	-56	148800	148856	-56	59520	59576
11	2000	0	-56	-56	353600	353656	-56	176800	176856	-56	70720	70776
12	2001	0	-56	-56	420200	420256	-56	210100	210156	-56	84040	84096
13	2002	0	-56	-56	499400	499456	-56	249700	249756	-56	99880	99936
14	2003	0	-56	-56	593500	593556	-56	296750	296806	-56	118700	118756
15	2004	0	-56	-56	705400	705456	-56	352700	352756	-56	141080	141136
16	2005	0	-56	-56	838400	838456	-56	419200	419256	-56	167680	167736
17	2006	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
18	2007	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
19	2008	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
20	2009	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
21	2010	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
22	2011	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
23	2012	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
24	2013	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
25	2014	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
26	2015	0	-56	-56	996400	996456	-56	498200	498256	-56	199280	199336
	Total	669013	-1120	667893	14310800	13642907	667893	2862160	2194267	667893	2862160	2194267
	EIRR					32.12			21.97			11.82
	NPV(12%)			403613	1980926		403613	990463		403613	396185	
	B/C(12%)					4.91			2.45			0.98

NC-1

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
				Significant Effects		
			01 No Significant Effects	02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses	○			
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	○			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	○			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	○			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	○			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			○			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	○			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds	○			
- Other construction hazards	As applicable	As applicable	○			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

AD1-1 TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
				Significant Effects		
			01 No Significant Effects	02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses	○			
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	○			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	○			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	○			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	○			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			○			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	○			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds	○			
- Other construction hazards	As applicable	As applicable	○			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

AD1-2 TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		○		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	○			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses		○		
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	○			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	○			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			○			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	○			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds	○			
- Other construction hazards	As applicable	As applicable	○			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

AD2-1 TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses	◯			
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	◯			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	◯			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds	◯			
- Other construction hazards	As applicable	As applicable		◯		
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

AD2-2

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		◯		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas		◯		
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses		◯		
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds		◯		
- Other construction hazards	As applicable	As applicable		◯		
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

NC-3

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		◯		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas		◯		
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	◯			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream-water quality and land values	Careful construction planning including use of ponds	◯			
- Other construction hazards	As applicable	As applicable	◯			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

WD74-1 TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses	◯			
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	◯			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	◯			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream-water quality and land values	Careful construction planning including use of ponds	◯			
- Other construction hazards	As applicable	As applicable	◯			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

WD74-2 TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses	○			
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	○			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	○			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas	○			
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	○			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			○			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	○			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds	○			
- Other construction hazards	As applicable	As applicable	○			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

WD6-1

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		○		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	○			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	○			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas		○		
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	○			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			○			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	○			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds		○		
- Other construction hazards	As applicable	As applicable	○			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

NC-5

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		◯		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas		◯		
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses	◯			
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds		◯		
- Other construction hazards	As applicable	As applicable	◯			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program				

RW7-1

TABLE ENVIRONMENTAL PARAMETERS CHECKLIST FOR PROJECT IN HIGHWAYS AND ROADS

Action Affecting Environmental Resources and Values (A)	Damage to Environmental (B)	Recommended Feasible Projection Measuring (C)	IEE (D)			
			01 No Significant Effects	Significant Effects 02 Small	03 Moderate	04 Major
ENVIRONMENTAL PROBLEMS FOR MAJOR HIGHWAY PROJECTS						
(1) Encroachment on precious ecology	Loss of precious ecology	Careful planning to minimize and offset losses		◯		
(2) Encroachment on historical/cultural/ monument areas	Loss of these values	Careful planning to minimize and offset losses	◯			
(3) Impairment of fisheries/aquatic ecology and of others beneficial uses	Impairment of downstream beneficial water uses	Careful planning to minimize and offset losses	◯			
(4) Erosion and siltation	Excessive soil erosion and impairment of downstream water quality	Careful resurfacing or replanting of exposed areas		◯		
(5) Environmental Aesthetics	Loss of scenic values	Careful planning to minimize and offset losses		◯		
(6) Noise and vibrations	Nuisances to travelers and neighbors	Careful planning to minimize and offset losses				
(7) Air pollution hazards	Nuisances and health hazards to travelers/workers	Control of motor vehicle emission				
(8) Highway runoff pollution			◯			
(9) Highway spills of hazardous materials	Serious health/safety hazards to travelers and neighbors	Careful planning and O&M and competent emergency clean up	◯			
(10) Construction stage problems						
- Erosion and silt runoff	Impairment of downstream water quality and land values	Careful construction planning including use of ponds		◯		
- Other construction hazards	As applicable	As applicable	◯			
- Monitoring	Needed to ensure contractor compliance with constraints	Competent construction stage monitoring				
(11) Post construction monitoring	Needed to assess adequacy to project design/O&M	Competent post construction monitoring program