

MALAYSIA
URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS
OF
GEORGE TOWN, BUTTERWORTH AND BUKIT MERTAJAM

FINAL REPORT

PHASE II - STAGE 1

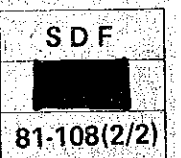
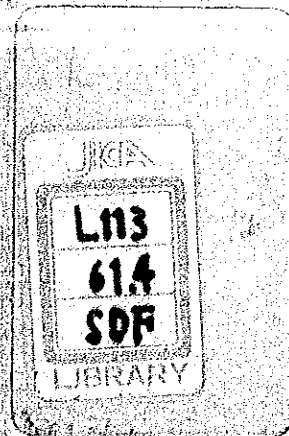
OUTER RING ROAD PROJECT

Preliminary Engineering Plans

May 1981

JAPAN INTERNATIONAL
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PRELIMINARY ENGINEERING DRAWINGS

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PRELIMINARY ENGINEERING DRAWINGS

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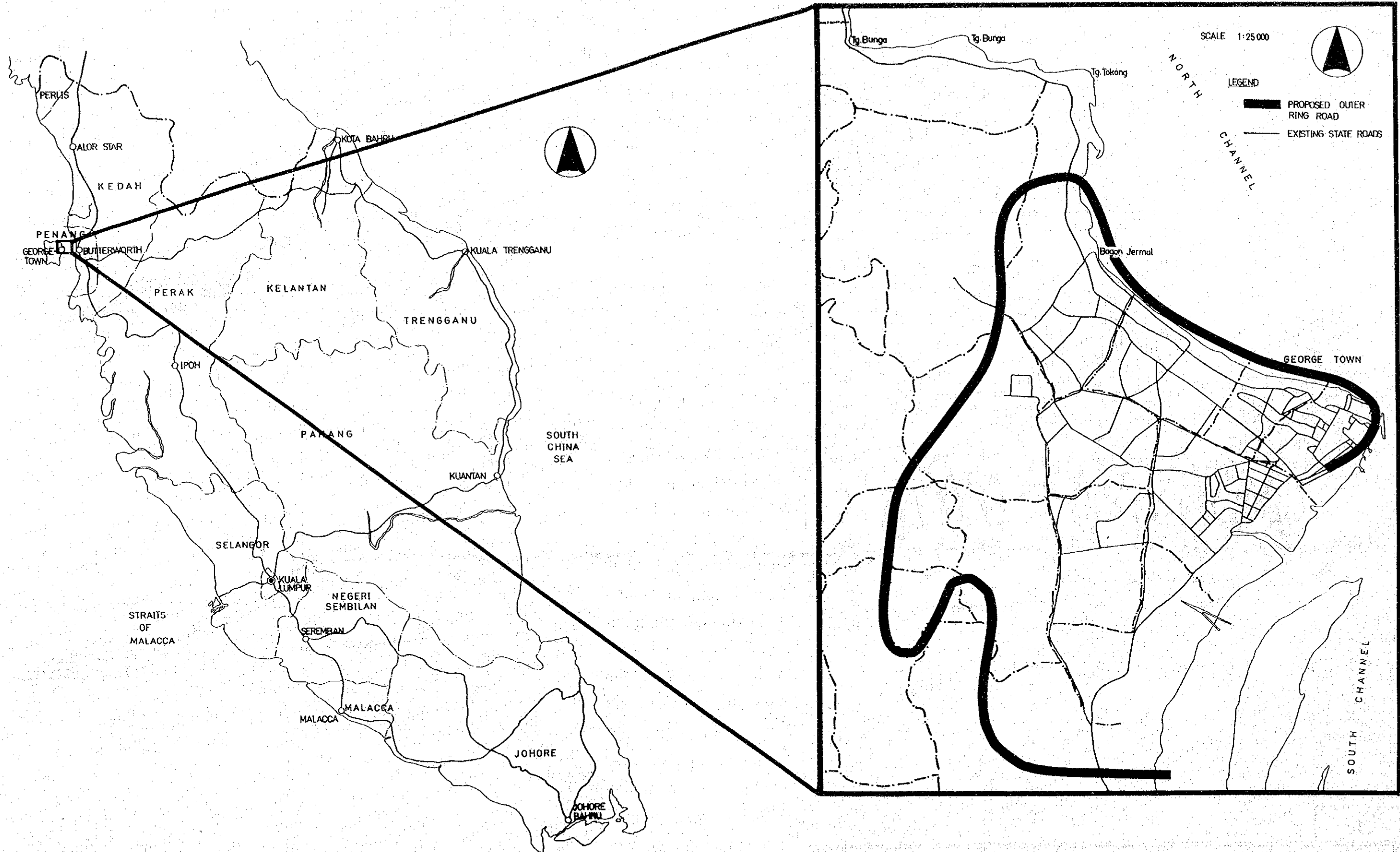
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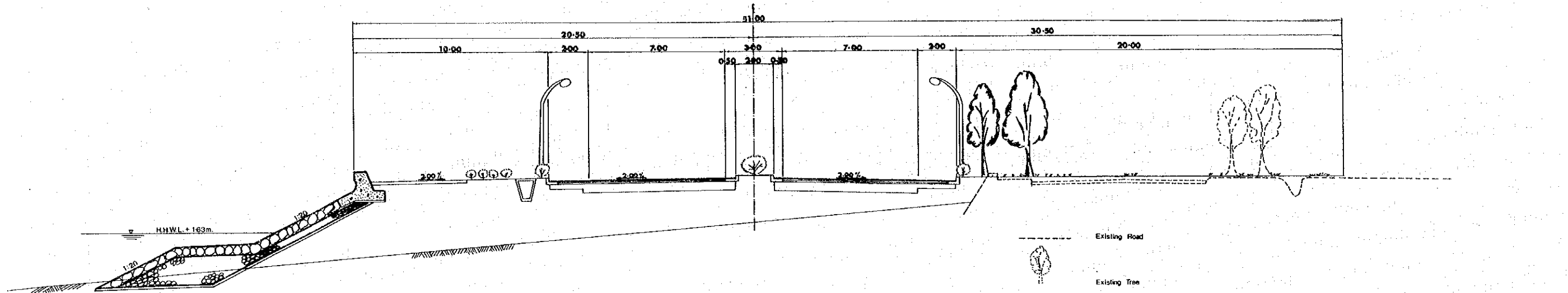
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LOCATION OF PENANG OUTER RING ROAD

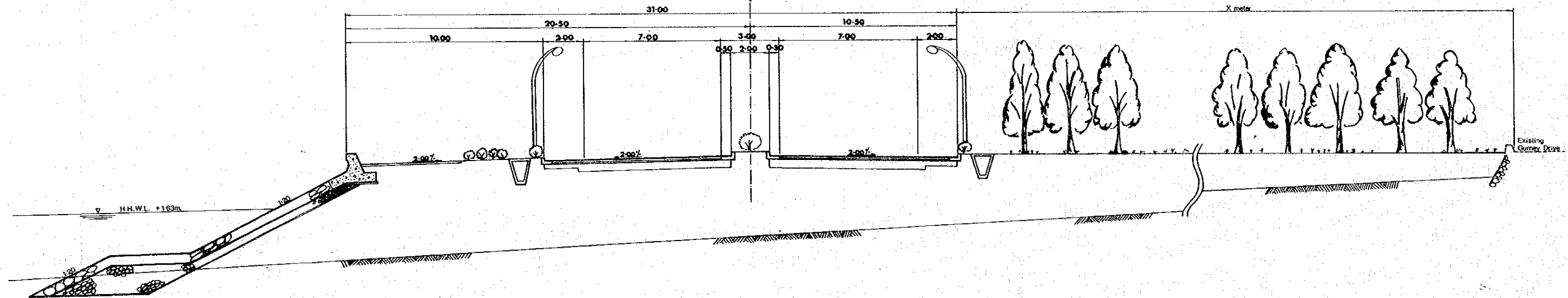


TYPICAL CROSS-SECTION

Improvement of existing GURNEY DRIVE (4-LANE)

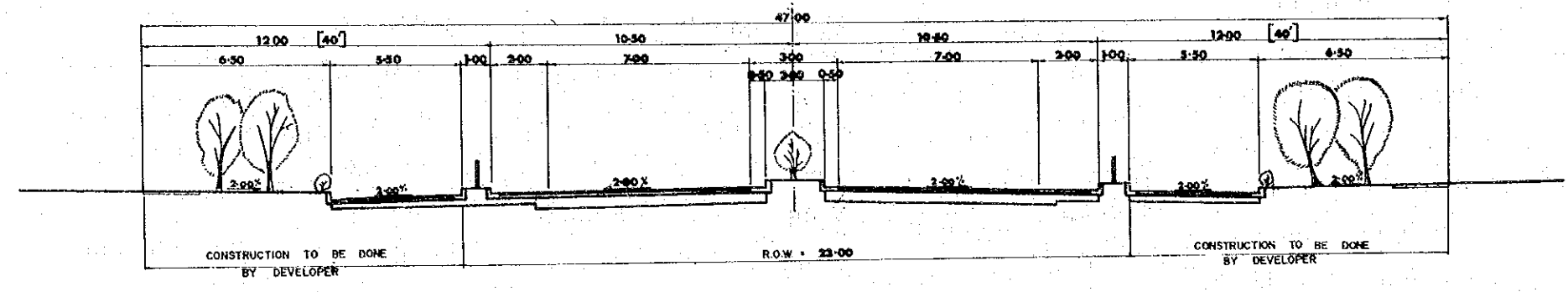


Extension of GURNEY DRIVE (4-LANE)

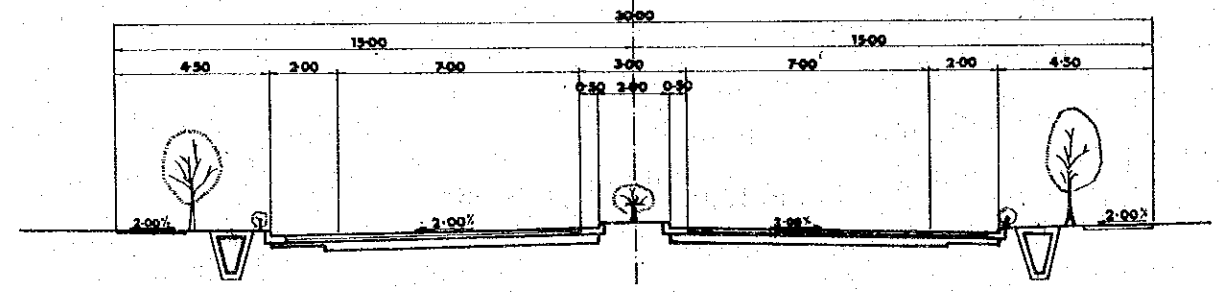


TYPICAL CROSS-SECTION

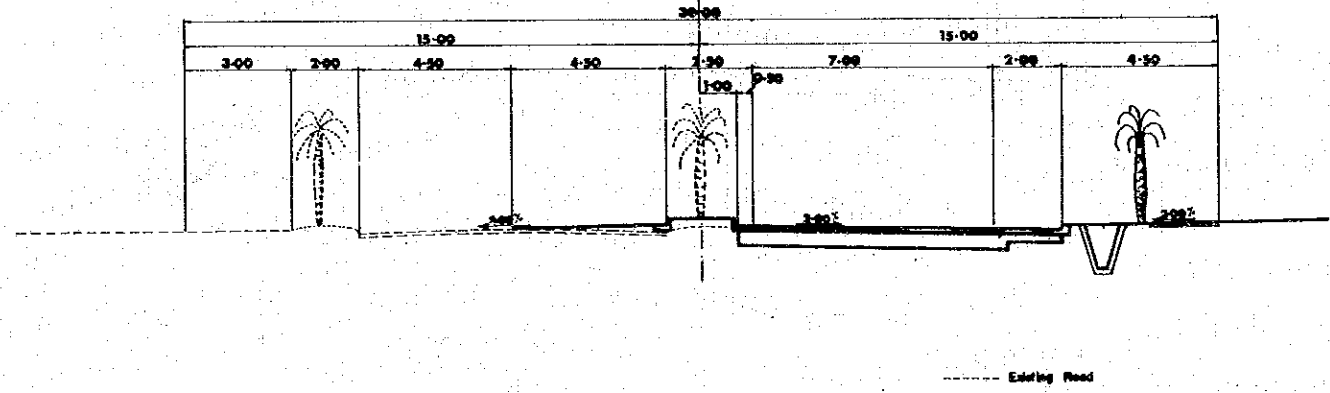
Residential Areas with Service Roads
(4-LANE)



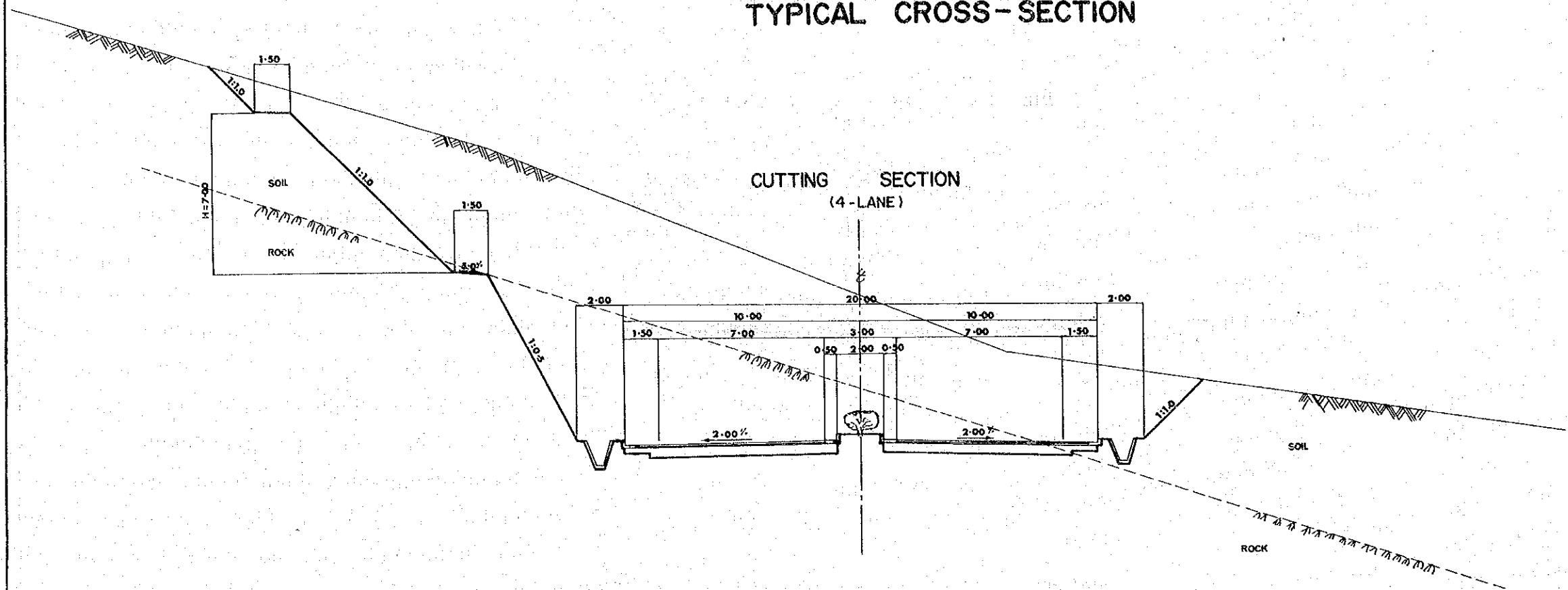
Residential Areas without Service Roads
(4-LANE)



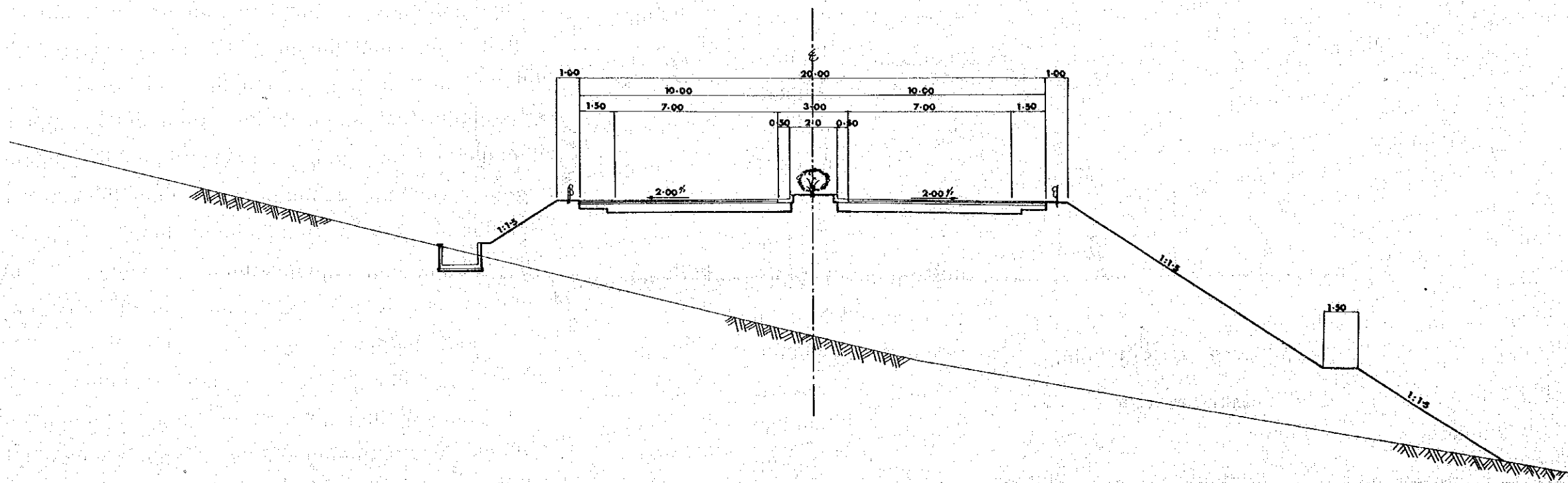
Improvement of existing JALAN GOTTLIEB & BAGAN JERMAL
(4-LANE)



TYPICAL CROSS-SECTION

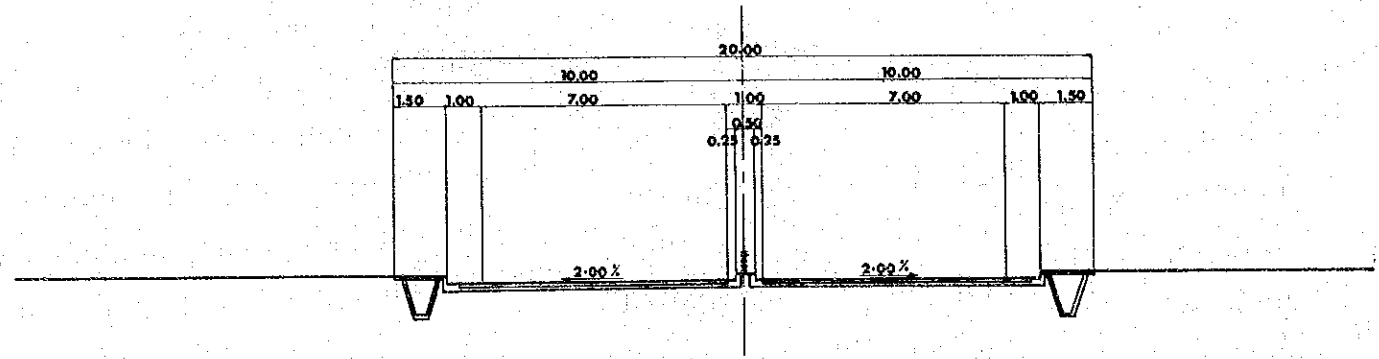


ENBANKMENT SECTION (4-LANE)



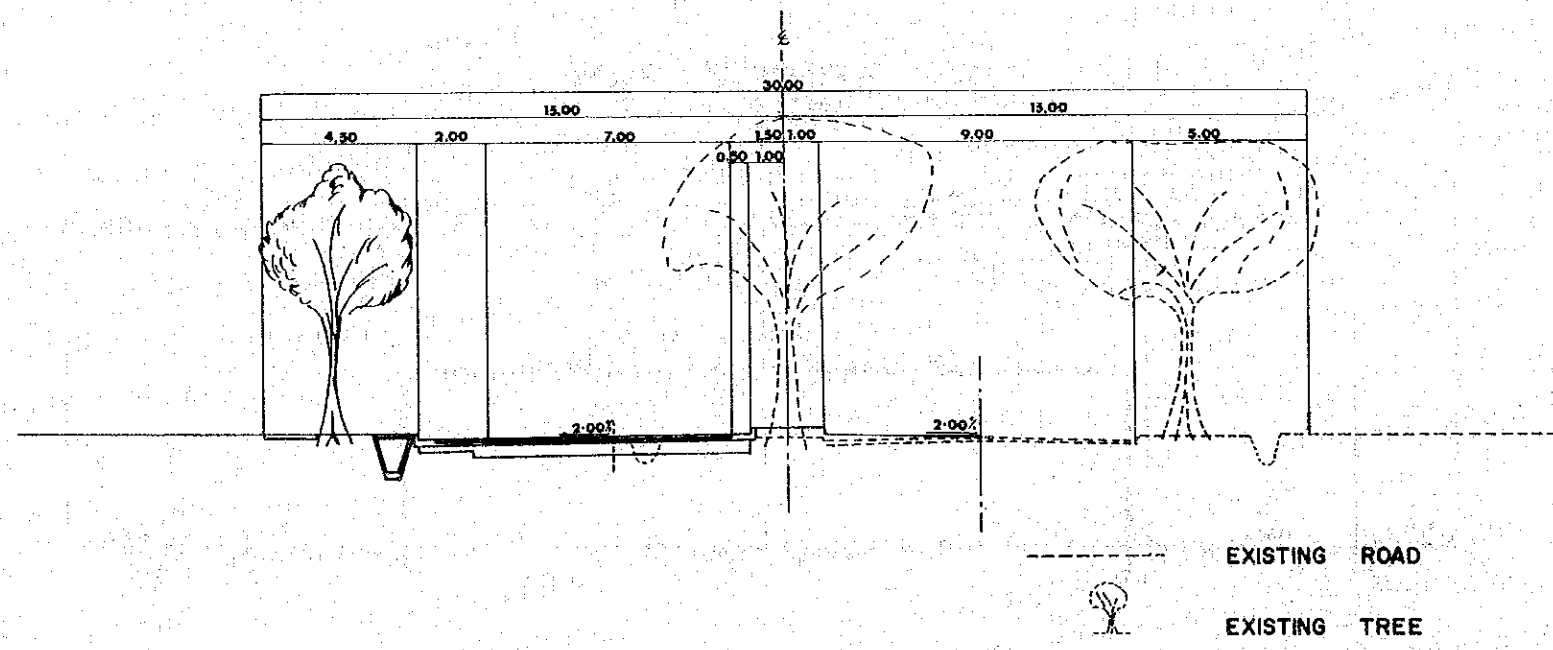
TYPICAL CROSS-SECTION

IMPROVEMENT OF EXISTING WELD QUAY
(4-LANE)



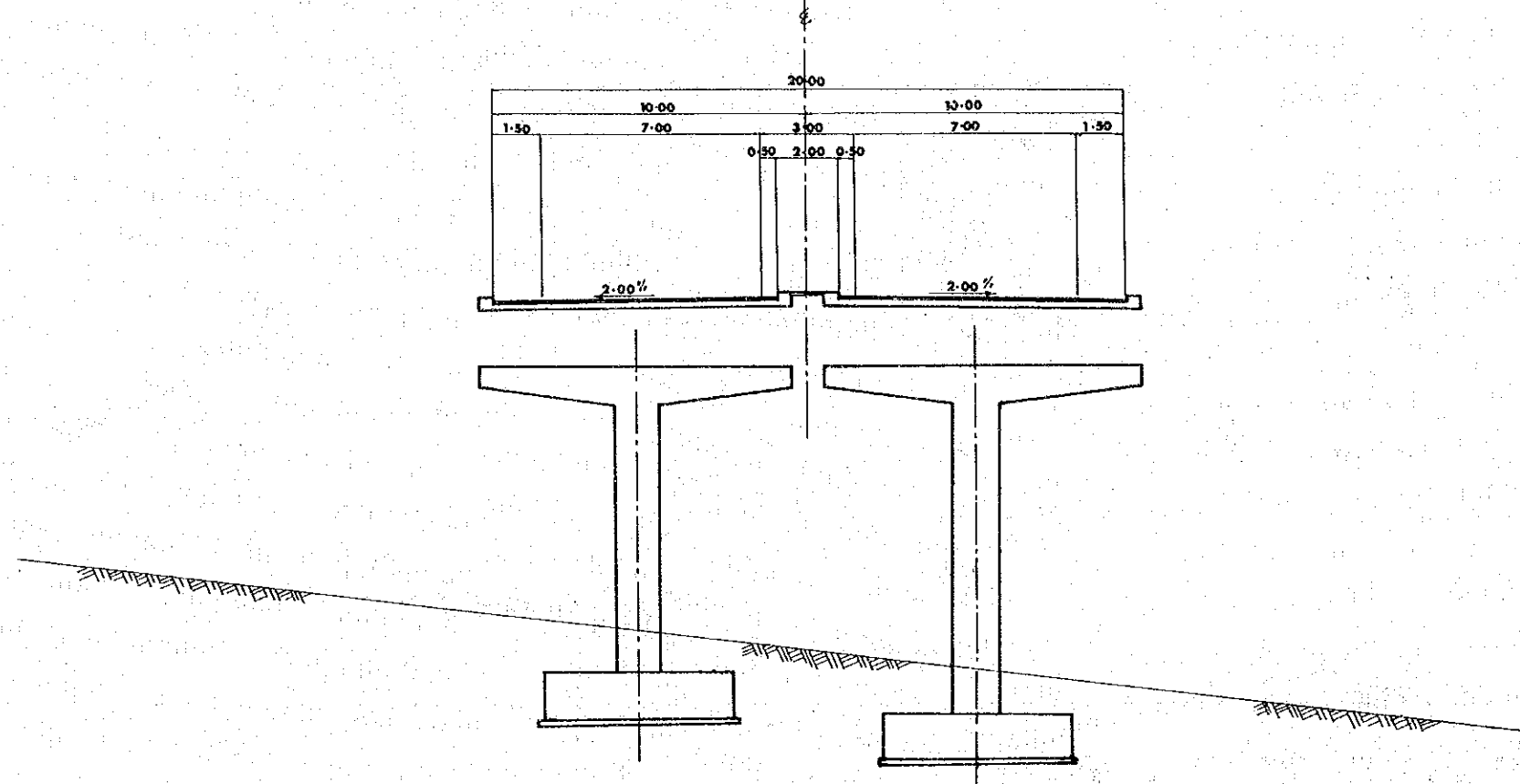
IMPROVEMENT OF EXISTING JALAN NORTHAM & KELAWEI

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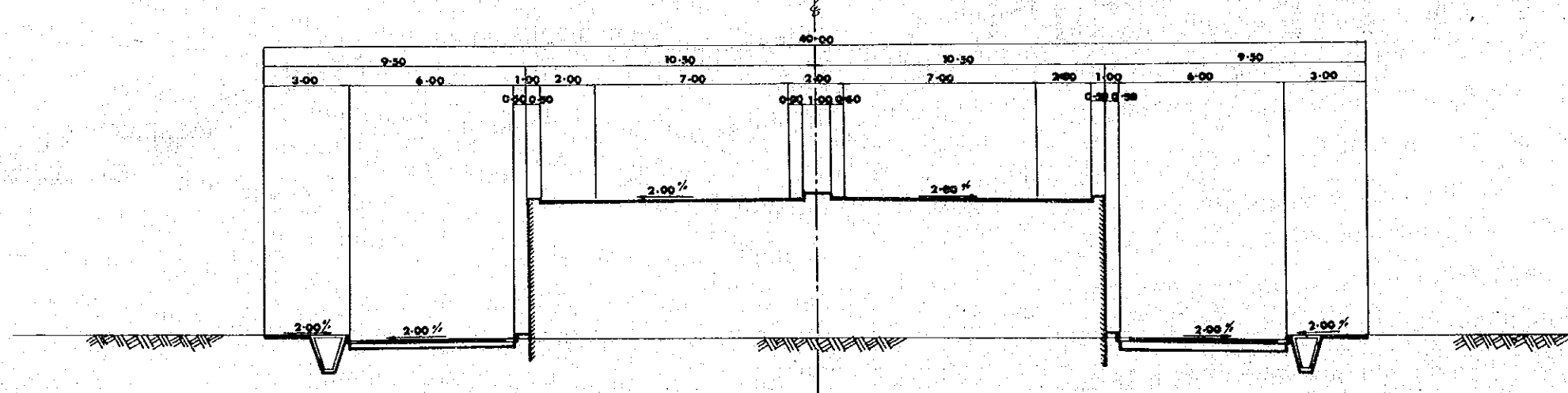


TYPICAL CROSS - SECTION

BRIDGE SECTION (4-LANE)

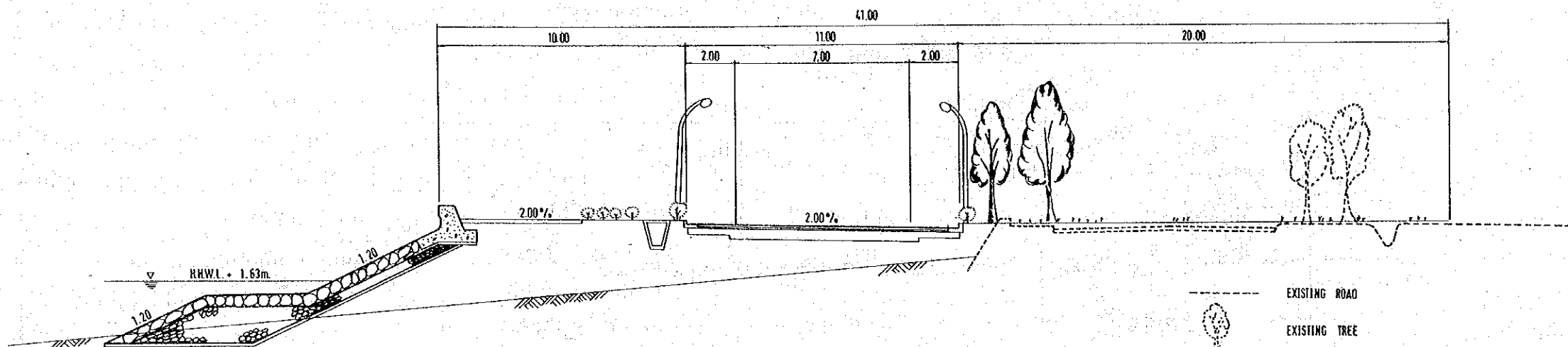


GRADE SEPARATION SECTION (4-LANE)

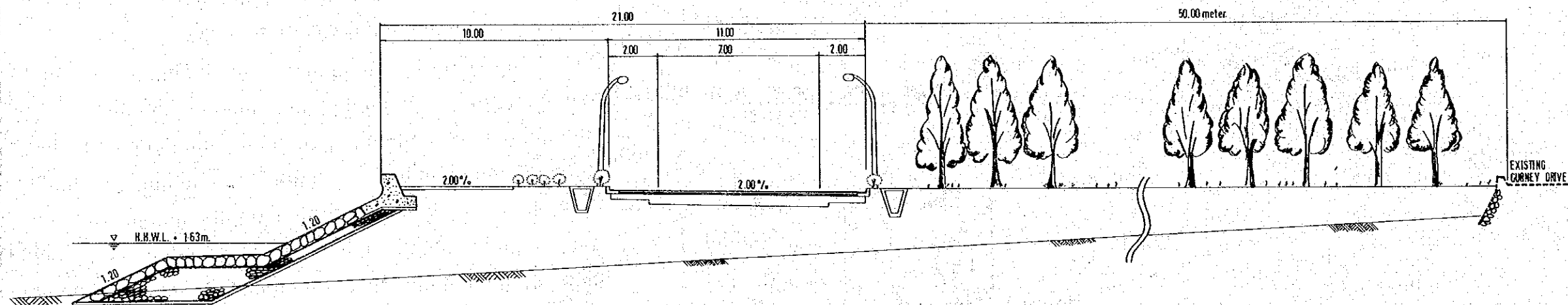


TYPICAL CROSS-SECTION

IMPROVEMENT OF EXISTING GURNEY DRIVE
(2 - LANE)

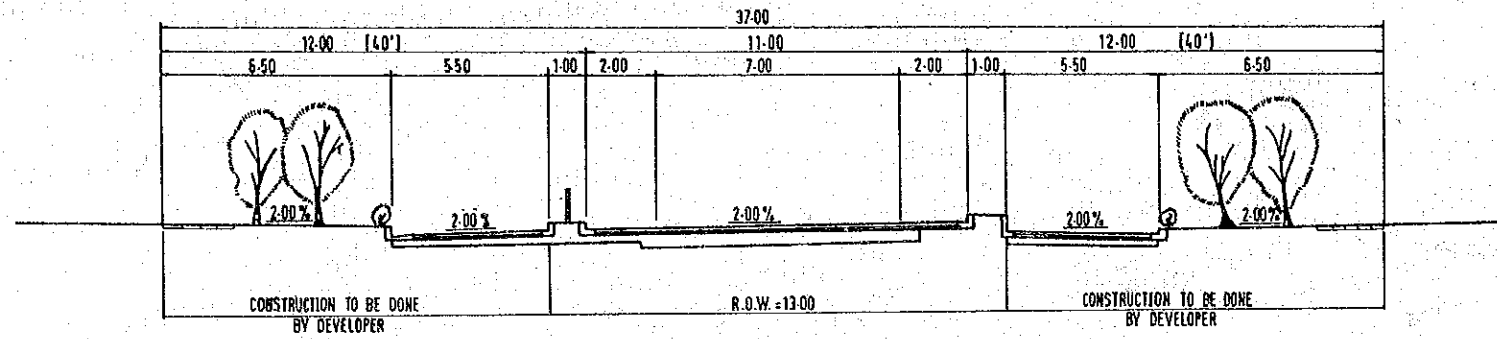


EXTENSION OF GURNEY DRIVE
(2 - LANE)

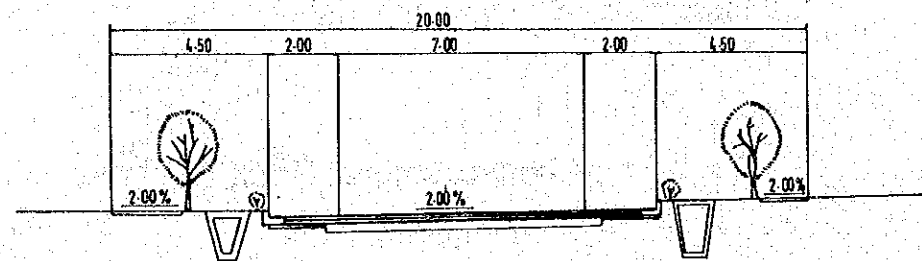


TYPICAL CROSS-SECTION

RESIDENTIAL AREAS WITH SERVICE ROADS (2-LANE)

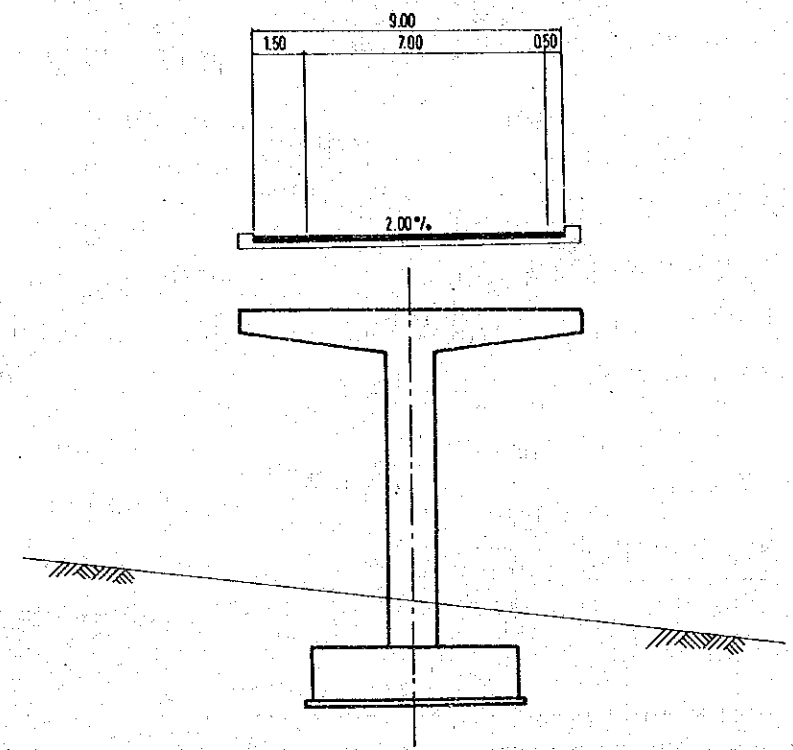


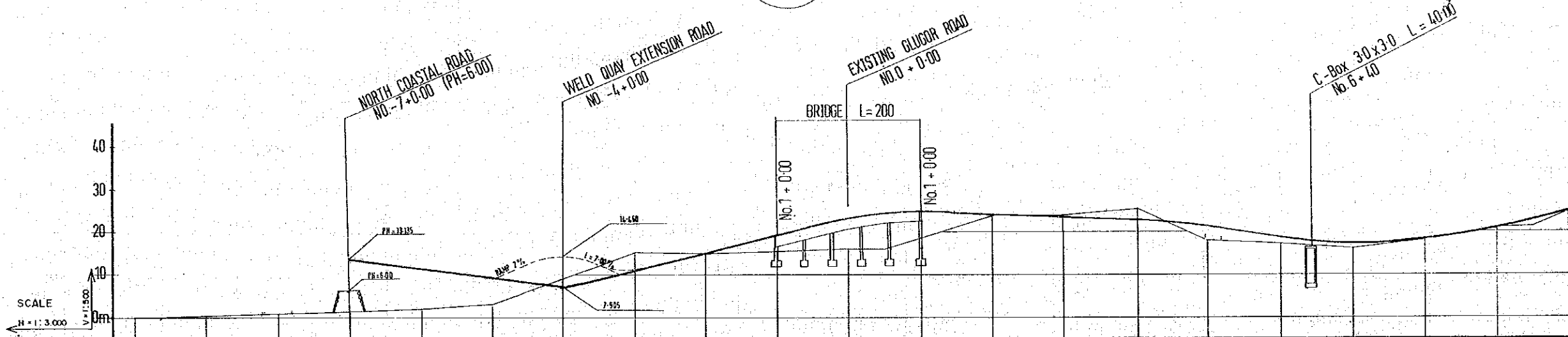
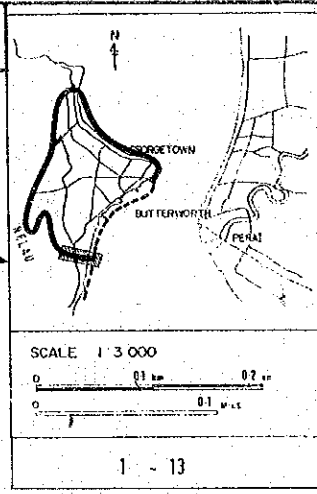
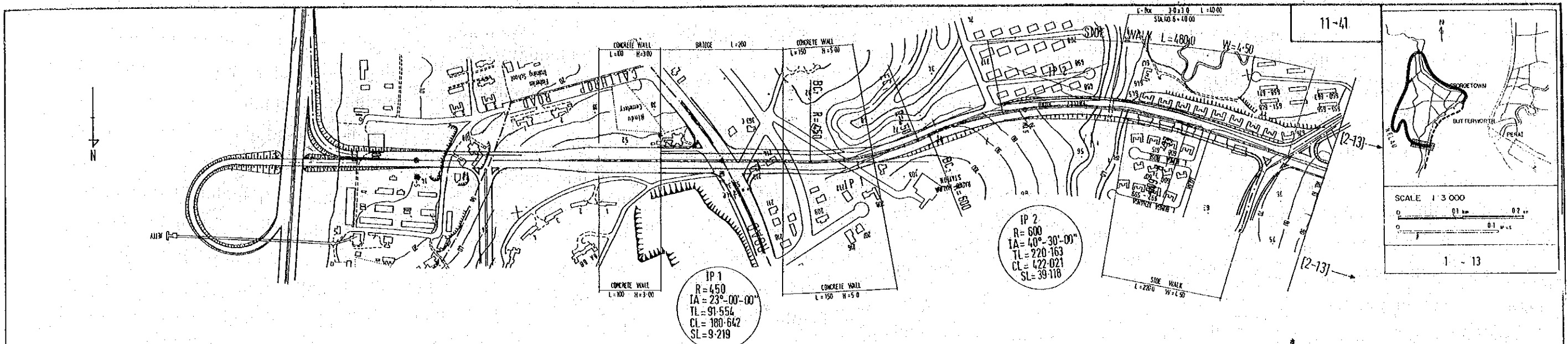
RESIDENTIAL AREAS WITHOUT SERVICE ROADS (2-LANE)



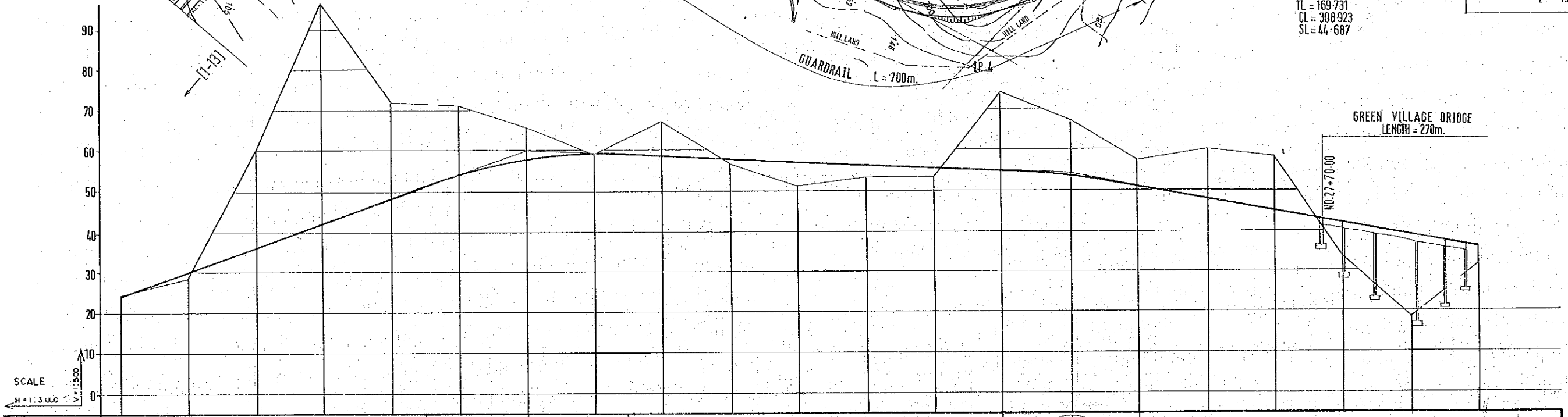
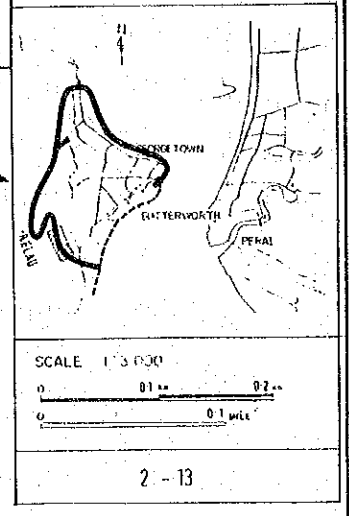
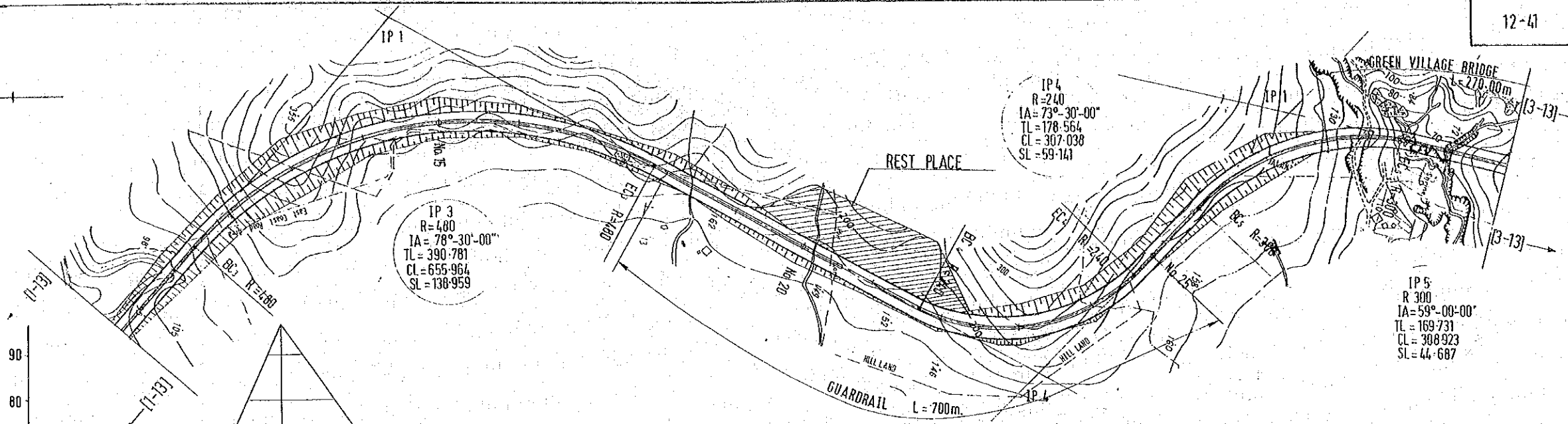
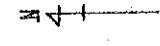
TYPICAL CROSS-SECTION

BRIDGE SECTION
(2-LANE)



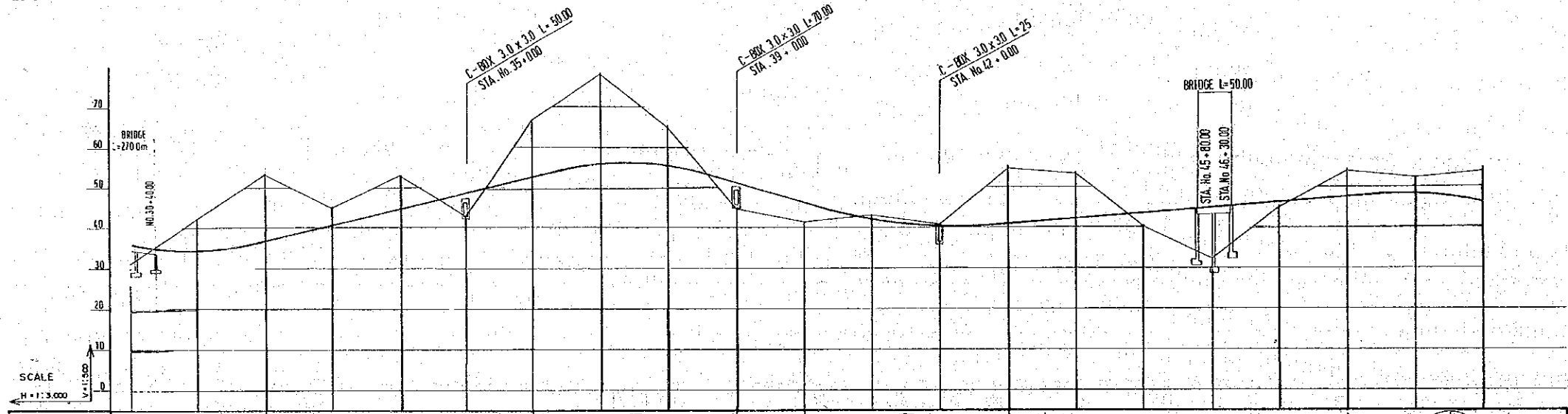
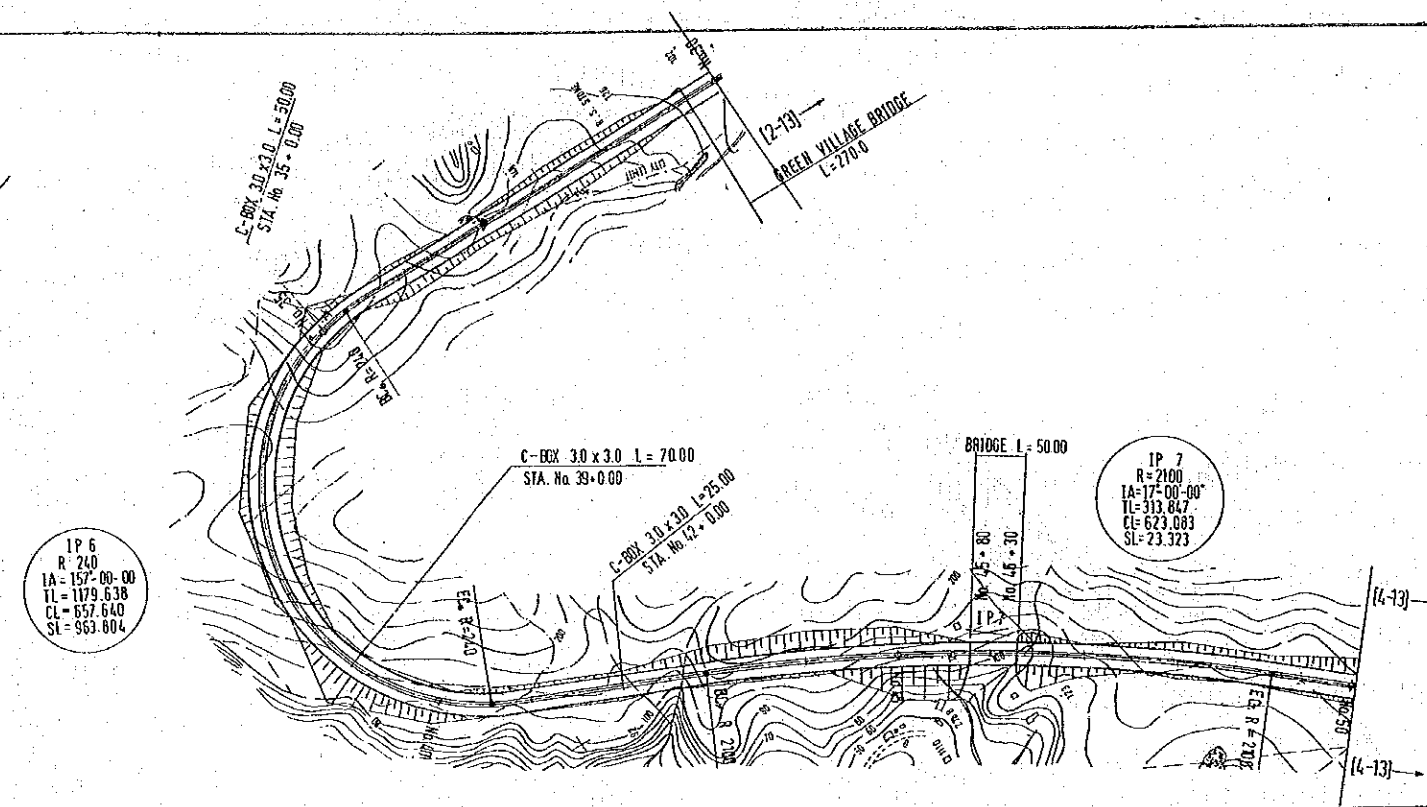
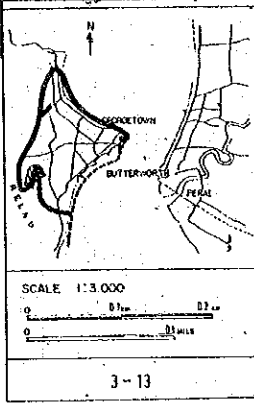


PROPOSED HEIGHT (m)	EMBANKMENT HEIGHT (m)	CUTTING DEPTH (m)	EXISTING GROUND HEIGHT (m)	ACCUMULATE DISTANCE (m)	DISTANCE (m)	STATION	CURVE (m)
13.135	11.135		2.0	700	100.00	NO.-8	
11.135	8.635		2.5	600	100.00	NO.-7	
9.135	6.935		3.0	500	100.00	NO.-6	
7.905		1.095	9.0	400	100.00	NO.-5	
11.295		3.705	15.0	300	100.00	NO.-4	
15.455	0.455		15.0	200	100.00	NO.-3	
25.461	9.461		16.0	100	100.00	NO.-2	
25.105	9.105		16.0	0	100.00	NO.-1	
24.547	0.545		24.0	100	100.00	NO.0	
23.675		0.325	24.0	200	100.00	NO.1	
22.803		2.689	25.5	300	100.00	NO.2	
21.080	3.080		18.0	400	100.00	NO.3	
18.540	1.040		17.5	500	100.00	NO.4	
17.125	0.929		16.2	600	100.00	NO.5	
17.994		0.006	18.0	700	100.00	NO.6	
20.000		0.400	20.4	800	100.00	NO.7	
24.000		0.600	24.6	900	100.00	NO.8	
				1000	100.00	NO.9	
					100.00	NO.10	

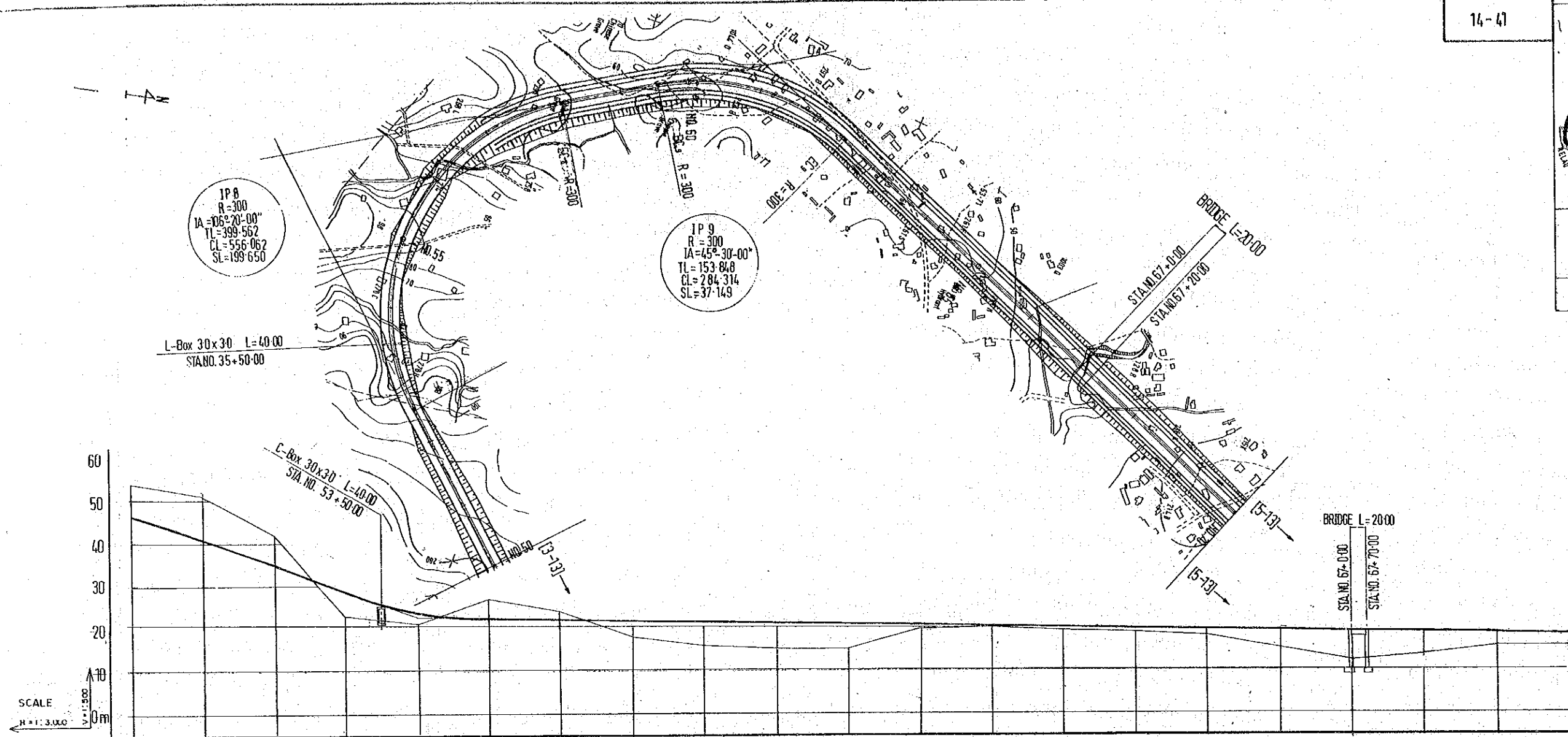
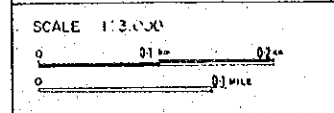
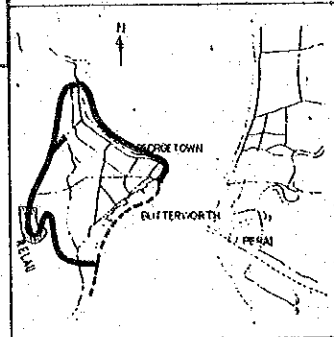


	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
PROPOSED HEIGHT (m)	24.00	30.00	36.00	42.00	48.00	53.719	57.469	58.969	58.50	57.75	57.0	56.25	55.50	54.75	53.439	51.00	48.00	45.00	42.00	39.00	36.00
EMBANKMENT HEIGHT (m)		1.5								0.95	6.0	3.05	2.3						8.0	20.6	4.5
CUTTING DEPTH (m)	0.6		24.00	54.5	24.0	17.281	8.431	0.031	9.0					19.25	14.063	6.5	12.0	13.4			
EXISTING GROUND HEIGHT (m)	24.6	28.5	60.0	96.5	72.0	71.0	65.9	59.0	67.5	56.9	51.0	53.2	53.2	74.0	67.5	57.5	60.0	58.4	34.0	18.4	31.5
ACCUMULATE DISTANCE (m)	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	No.10	No.11	No.12	No.13	No.14	No.15	No.16	No.17	No.18	No.19	No.20	No.21	No.22	No.23	No.24	No.25	No.26	No.27	No.28	No.29	No.30
CURVE (m)																					

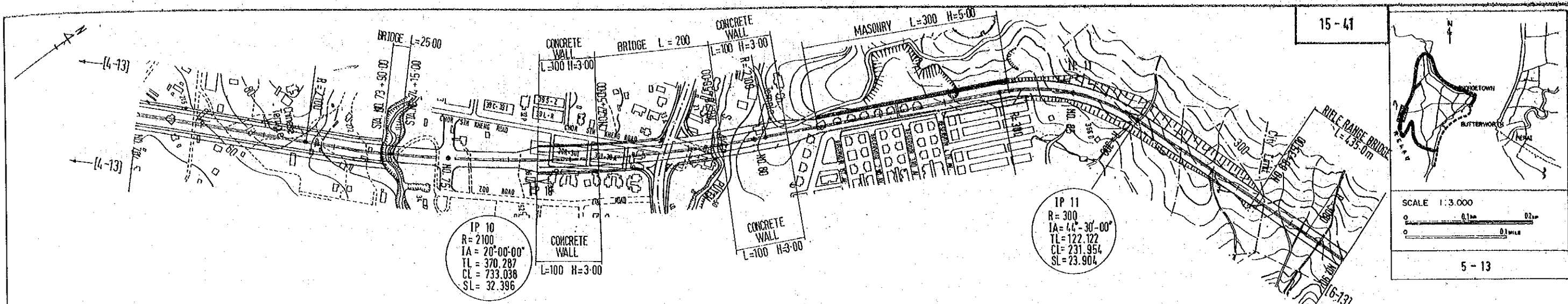
URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM.
JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.



	No. 30	No. 31	No. 32	No. 33	No. 34	No. 35	No. 36	No. 37	No. 38	No. 39	No. 40	No. 41	No. 42	No. 43	No. 44	No. 45	No. 46	No. 47	No. 48	No. 49	No. 50
PROPOSED HEIGHT (m)	36.00	33.00	37.00	41.00	45.00	49.00	53.00	55.50	55.00	51.50	46.50	42.50	40.75	41.02	42.37	43.72	45.07	46.42	47.78	47.89	45.57
EMBANKMENT HEIGHT (m)	4.5					6.0				6.5	4.9					3.222	2.671	1.42			
CUTTING DEPTH (m)		9.0	16.5	4.5	8.3		14.0	22.3	9.8			0.5	0.267	13.576	11.27				6.231	4.909	8.429
EXISTING GROUND HEIGHT (m)	31.5	42.0	53.5	45.0	53.3	43.0	37.0	77.8	64.8	45.0	41.6	43.2	41.0	54.6	53.5	40.5	32.4	45.0	54.0	52.5	54.0
ACCUMULATE DISTANCE (m)	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000	4100	4200	4300	4400	4500	4600	4700	4800	4900	5000
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	No. 30	No. 31	No. 32	No. 33	No. 34	No. 35	No. 36	No. 37	No. 38	No. 39	No. 40	No. 41	No. 42	No. 43	No. 44	No. 45	No. 46	No. 47	No. 48	No. 49	No. 50
CURVE (m)																					



PROPOSED HEIGHT (m.)	45.571	40.795	34.795	28.795	24.22	22.495	22.195	21.895	21.595	21.295	20.995	20.695	20.395	20.095	19.795	19.495	19.195	18.895	18.595	18.295	17.995	
EMBANKMENT HEIGHT (m.)				5.695	3.220			3.895	5.695	5.995	5.295	0.895	0.595	0.895	1.195	1.495	4.195	6.895	5.095	2.995	2.695	
CUTTING DEPTH (m.)	8.429	10.205	7.205			4.505	1.805															
EXISTING GROUND HEIGHT (m.)	54.0	51.0	42.0	23.1	21.0	27.0	24.0	18.0	15.9	15.3	15.0	19.8	19.8	19.2	18.6	18.0	15.0	12.0	13.5	15.3	15.3	
ACCUMULATE DISTANCE (m)	500	5100	5200	5300	5400	5500	5600	5700	5800	5900	6000	6100	6200	6300	6400	6500	6600	6700	6800	6900	7000	
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
STATION	NO. 50	NO. 51	NO. 52	NO. 53	NO. 54	NO. 55	NO. 56	NO. 57	NO. 58	NO. 59	NO. 60	NO. 61	NO. 62	NO. 63	NO. 64	NO. 65	NO. 66	NO. 67	NO. 68	NO. 69	NO. 70	
CURVE (m)																						



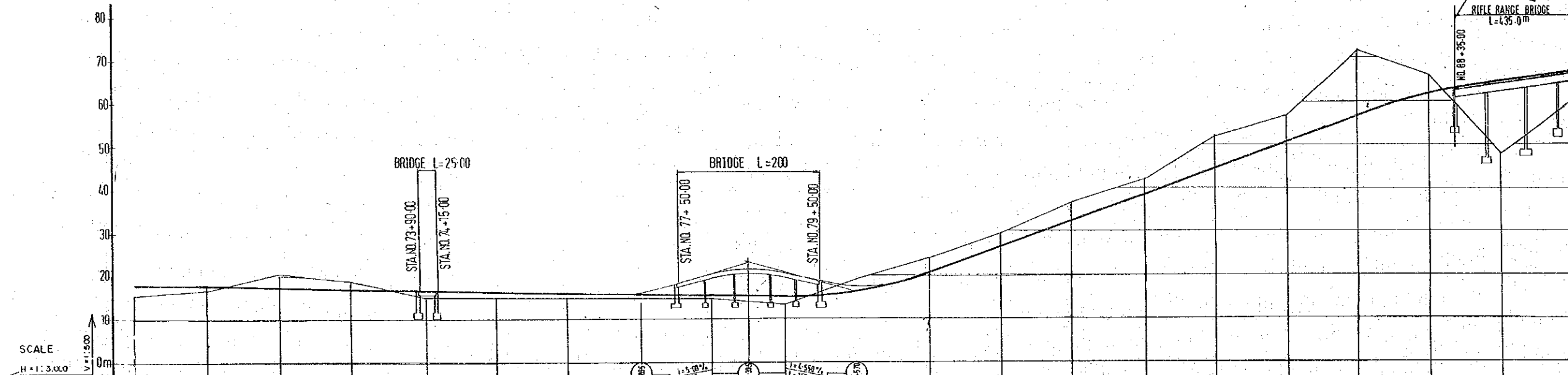
15-41

SCALE 1:3,000

0 0.1km 0.2km

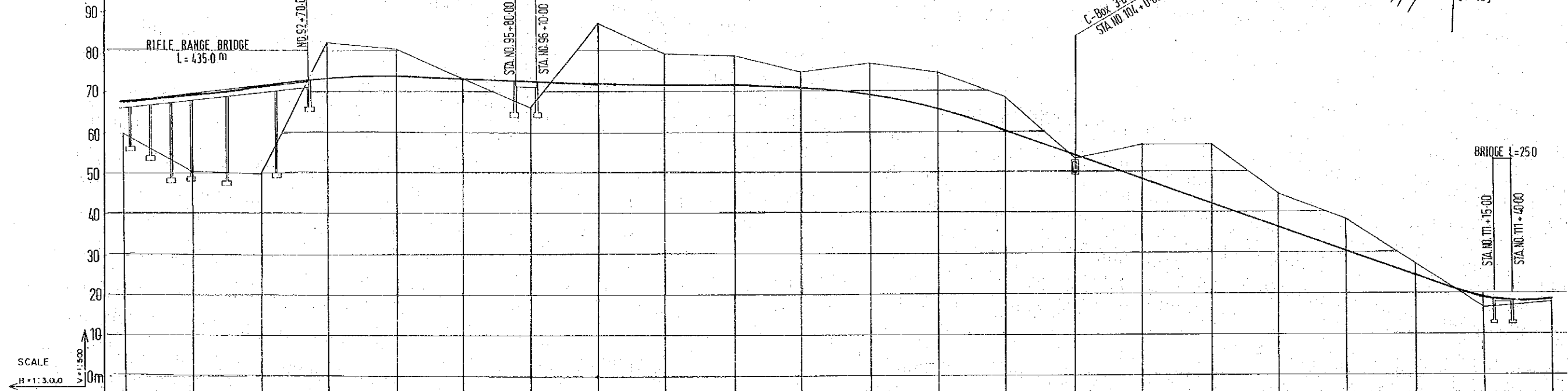
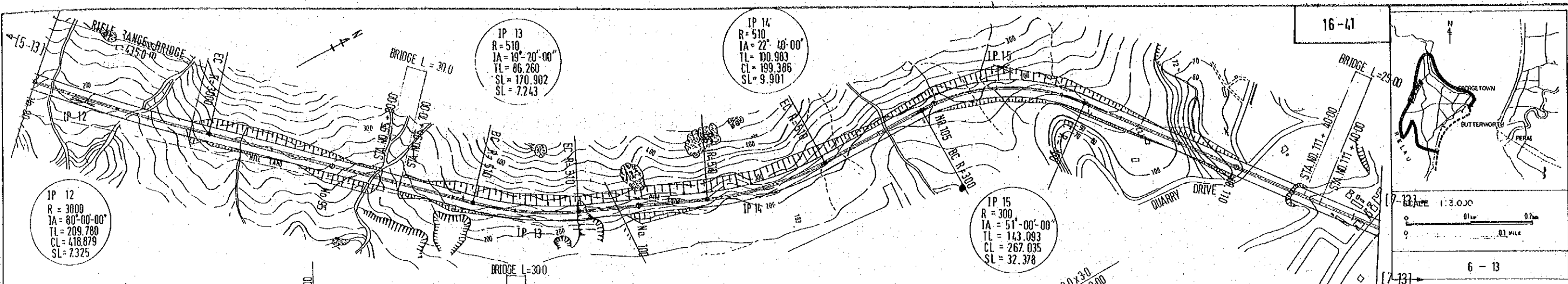
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5-13



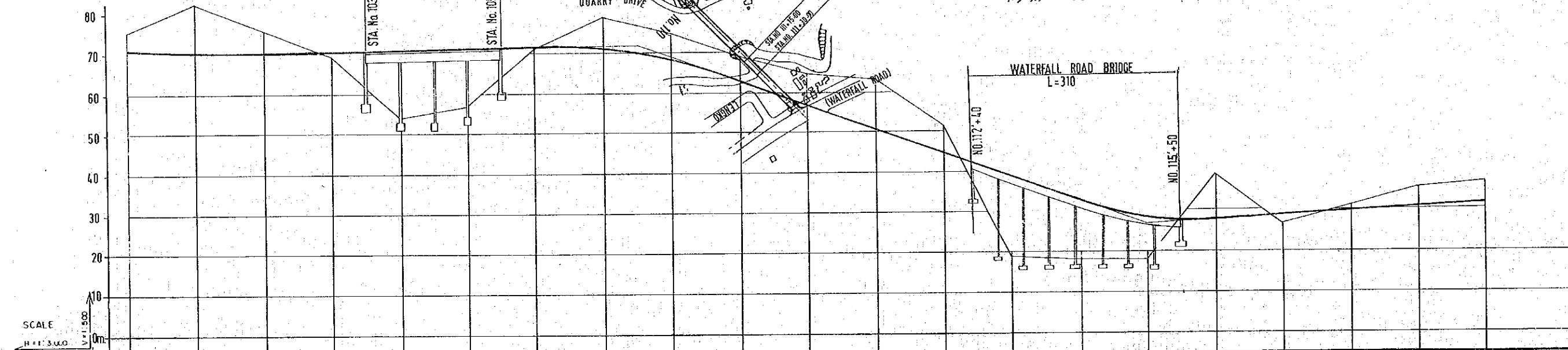
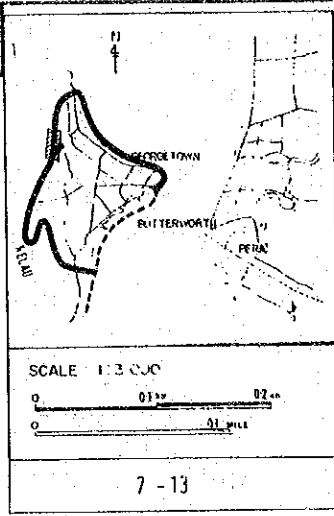
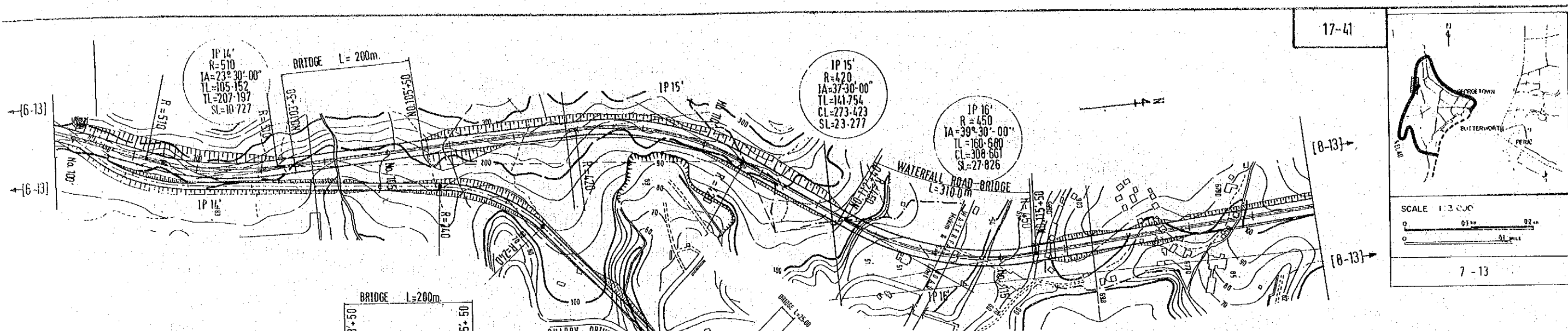
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PROPOSED HEIGHT (m)	17.995	17.695	17.395	17.095	16.795	16.495	16.195	15.895	15.595	15.295	16.570	20.995	26.995	32.995	38.995	44.995	50.995	56.995	62.995	68.235	67.475
EMBANKMENT HEIGHT (m)	2.885	0.885			1.795	1.495	1.195	0.895	0.595	1.795										17.235	7.000
CUTTING DEPTH (m)			3.205	1.705							2.930	3.005	3.005	4.005	3.005	7.505	6.005	15.005	3.005		
EXISTING GROUND HEIGHT (m)	15.3	16.8	20.6	18.8	15.0	15.0	15.0	15.0	15.0	13.5	19.5	24.0	30.0	37.0	42.0	52.5	57.0	72.0	66.0	48.0	60.0
ACCUMULATE DISTANCE (m)	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890	900
DISTANCE (m)	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
STATION	NO. 70	NO. 71	NO. 72	NO. 73	NO. 74	NO. 75	NO. 76	NO. 77	NO. 78	NO. 79	NO. 80	NO. 81	NO. 82	NO. 83	NO. 84	NO. 85	NO. 86	NO. 87	NO. 88	NO. 89	NO. 90
CURVE (m)																					

URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM.
 JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.



PROPOSED HEIGHT (m)	67.475	69.715	71.955	73.510	73.695	73.195	72.895	71.695	71.195	70.695	70.195	66.945	60.945	54.945	48.945	42.945	36.945	30.945	24.945	18.945	18.645
EMBANKMENT HEIGHT (m)	7.475	18.915	21.755		64.95								0.945						2.545	2.445	
CUTTING DEPTH (m)				8.999	7.105	0.105	14.905	7.905	8.205	4.305	7.205	8.055	8.055	8.055	8.055	14.055	8.055	7.655			
EXISTING GROUND HEIGHT (m)	60.0	50.8	50.2	82.5	80.8	73.3	66.2	87.1	79.6	79.4	75.0	77.4	75.0	69.0	54.0	57.0	57.0	45.0	38.6	27.0	16.5
ACCUMULATE DISTANCE (m)	9000	9100	9200	9300	9400	9500	9600	9700	9800	9900	10000	10100	10200	10300	10400	10500	10600	10700	10800	10900	11000
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	NO.90	NO.91	NO.92	NO.93	NO.94	NO.95	NO.96	NO.97	NO.98	NO.99	NO.100	NO.101	NO.102	NO.103	NO.104	NO.105	NO.106	NO.107	NO.108	NO.109	NO.110
CURVE (m)																					

URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM.
 JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.



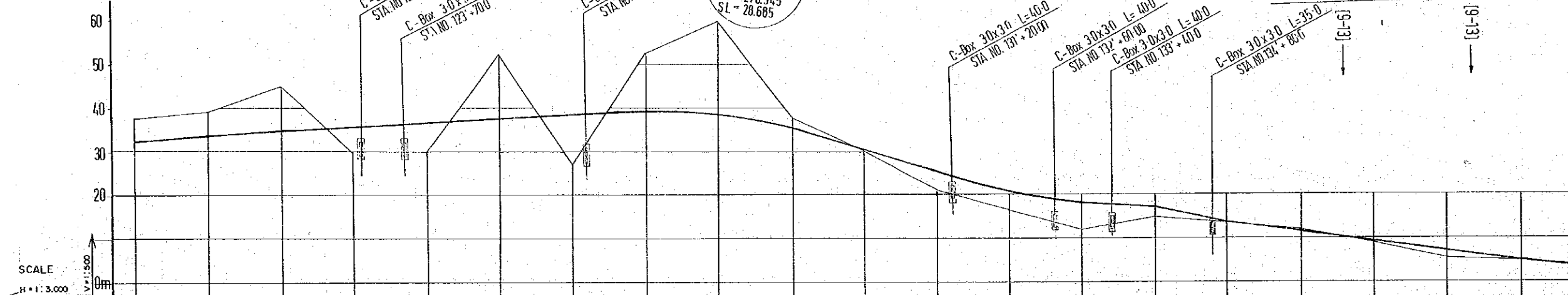
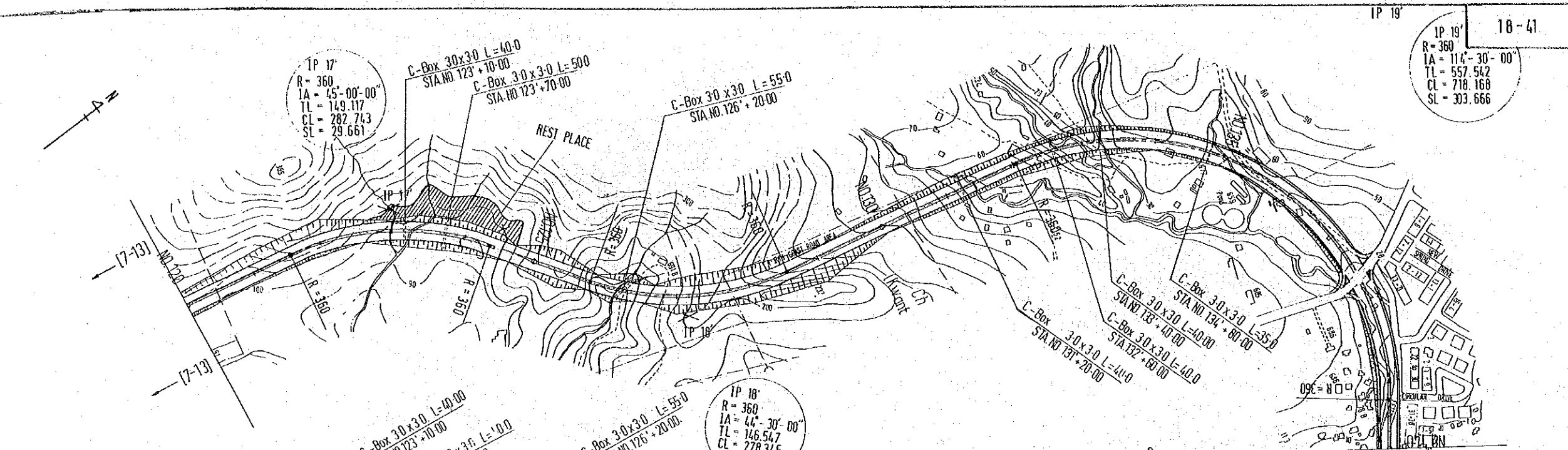
PROPOSED HEIGHT (m)	70.695	70.195	70.12	70.47	70.82	71.17	71.52	71.87	68.790	63.045	57.045	51.045	45.045	38.045	33.045	27.045	28.115	25.165	30.255	31.325	32.395
EMBANKMENT HEIGHT (m)				0.87	16.82	14.17	0.52							19.845	14.845	8.845		2.165			
CUTTING DEPTH (m)	4.305	11.805	4.88					7.13	6.220	6.155	7.755	12.555	6.955				10.885		1.245	4.675	5.105
EXISTING GROUND HEIGHT (m)	75.0	82.0	75.0	69.6	54.0	57.0	71.0	79.0	75.0	69.2	64.8	63.6	52.0	19.2	18.2	18.2	39.0	27.0	31.5	36.0	37.5
ACCUMULATE DISTANCE (m)	10000	10100	10200	10300	10400	10500	10600	10700	10800	10900	11000	11100	11200	11300	11400	11500	11600	11700	11800	11900	12000
LI-DISTANCE (m)	0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	No.100	No.101	No.102	No.103	No.104	No.105	No.106	No.107	No.108	No.109	No.110	No.111	No.112	No.113	No.114	No.115	No.116	No.117	No.118	No.119	No.120
CURVE (m)																					

URBAN TRANSPORT STUDY IN CERTAIN METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND RUKIT MERTAJAM.
 JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.

IP 19'
 R = 360
 IA = 114° 30' 00"
 TL = 557.542
 CL = 718.168
 SL = 303.666

SCALE 1:3,000
 0 0.1 0.2 Miles
 0 0.1 0.2 Kilometers

8-13



	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
PROPOSED HEIGHT (m)	32.395	33.455	34.535	35.605	36.675	37.745	38.815	39.824	38.674	35.494	30.555	25.355	20.919	18.011	17.275	13.723	11.579	9.435	7.291	5.147	3.536
EMBANKMENT HEIGHT (m)				5.605	6.675		11.815				0.555	4.355	4.419	6.011	2.275	0.223		0.435	4.291	0.147	0.636
CUTTING DEPTH (m)	5.105	5.535	10.455			14.755		12.876	21.366	2.006							0.421				
EXISTING GROUND HEIGHT (m)	37.5	39.0	45.0	30.0	30.0	52.5	27.0	52.5	60.0	37.5	30.0	21.0	16.5	12.0	15.0	13.5	12.0	9.0	5.5	5.0	3.0
ACCUMULATE DISTANCE (m)	200	700	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	NO. 120	NO. 121	NO. 122	NO. 123	NO. 124	NO. 125	NO. 126	NO. 127	NO. 128	NO. 129	NO. 130	NO. 131	NO. 132	NO. 133	NO. 134	NO. 135	NO. 136	NO. 137	NO. 138	NO. 139	NO. 140
CURVE (m)																					

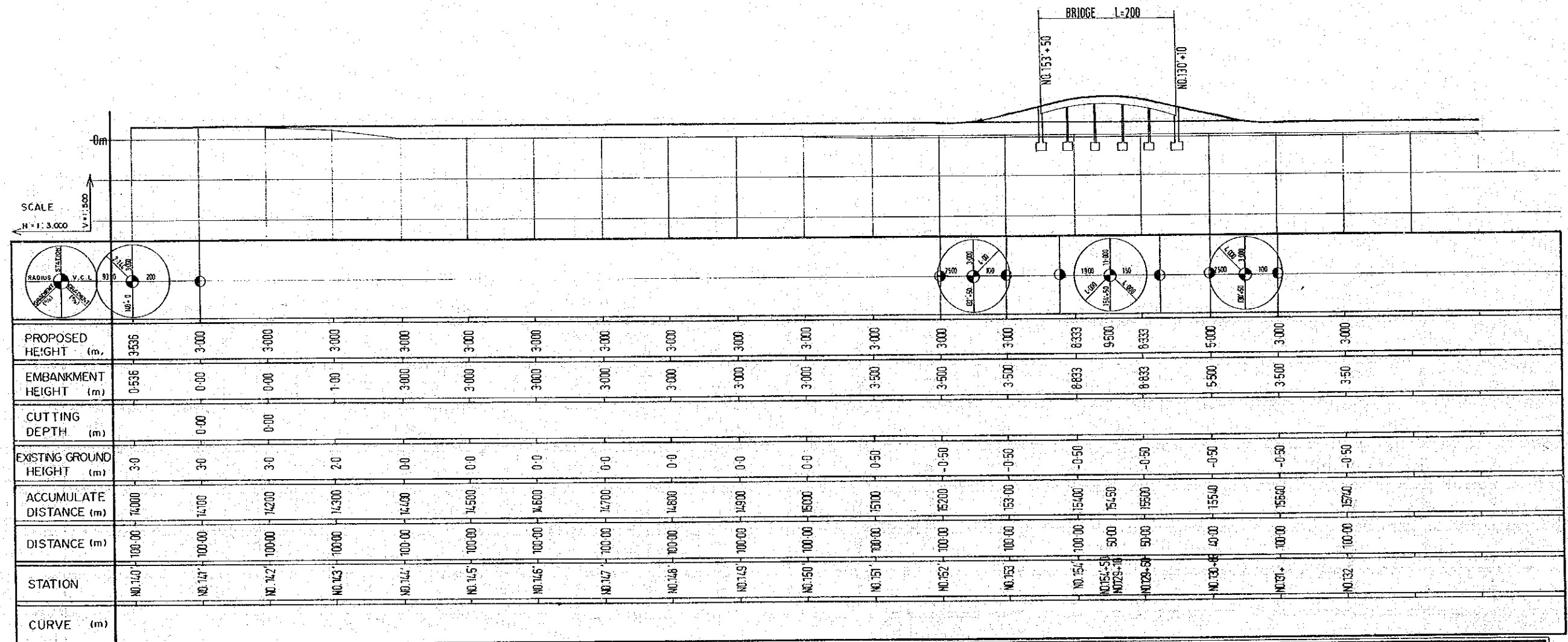
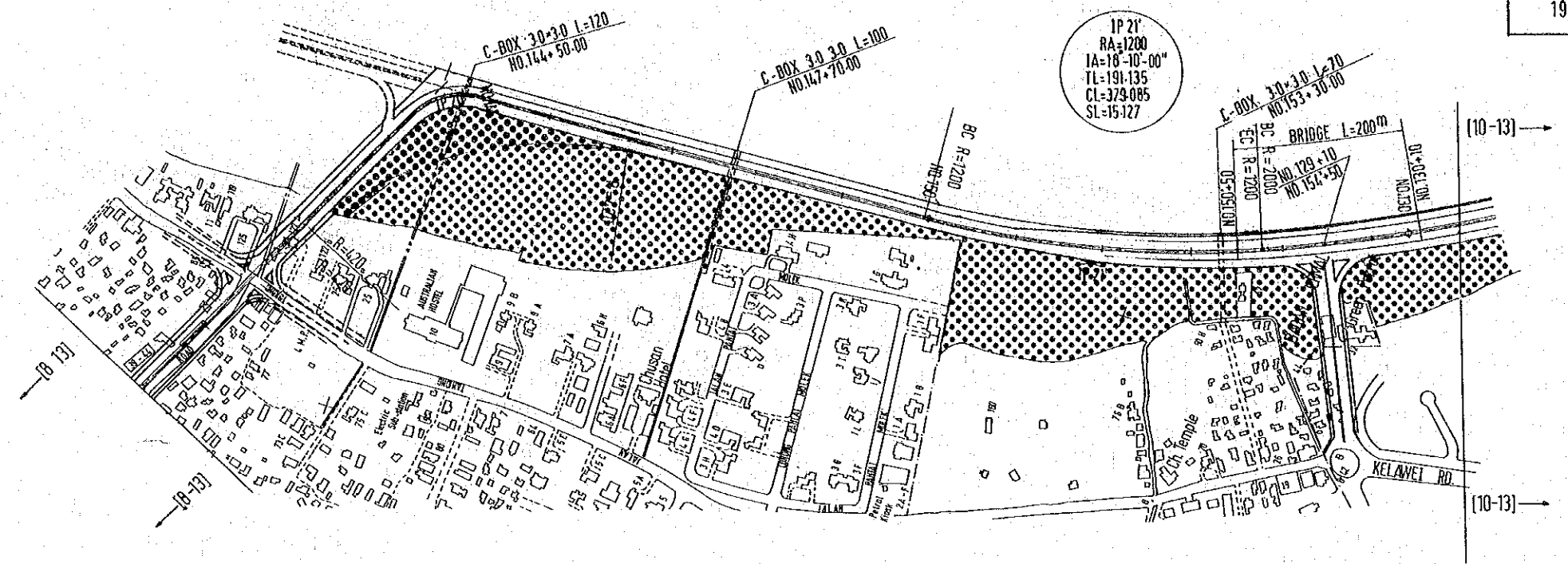
URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM
 JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.

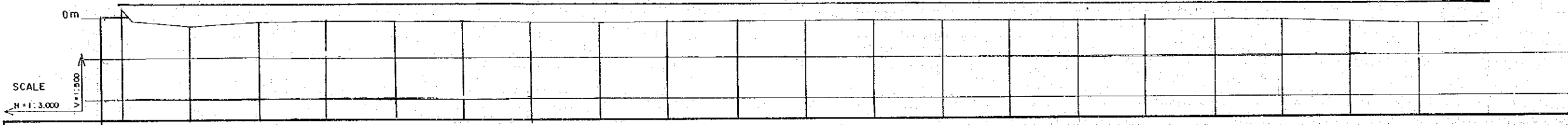
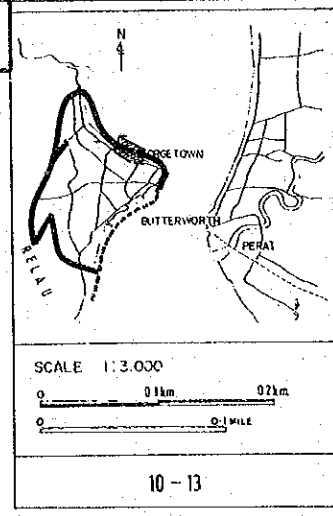
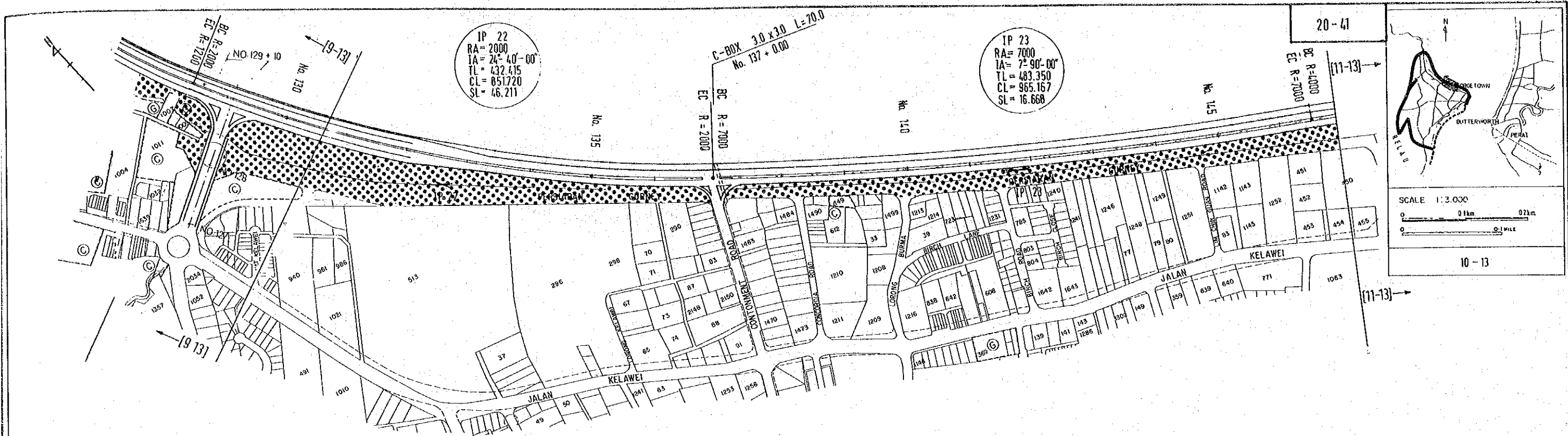
SCALE: 1:3,000

0 0.1 km 0.2 km

0 0.1 mile 0.2 mile

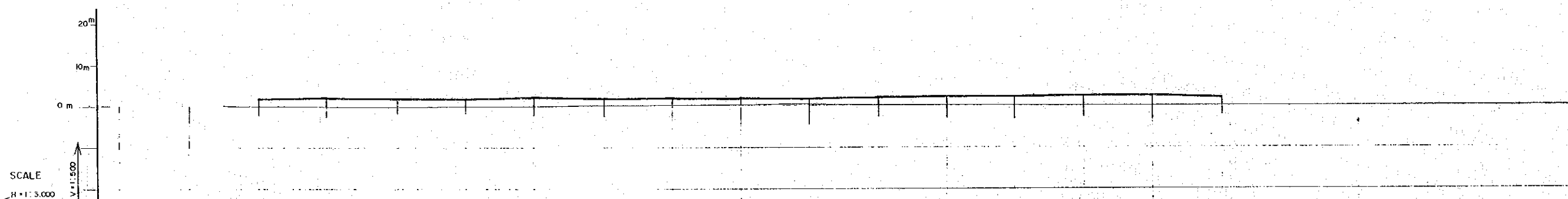
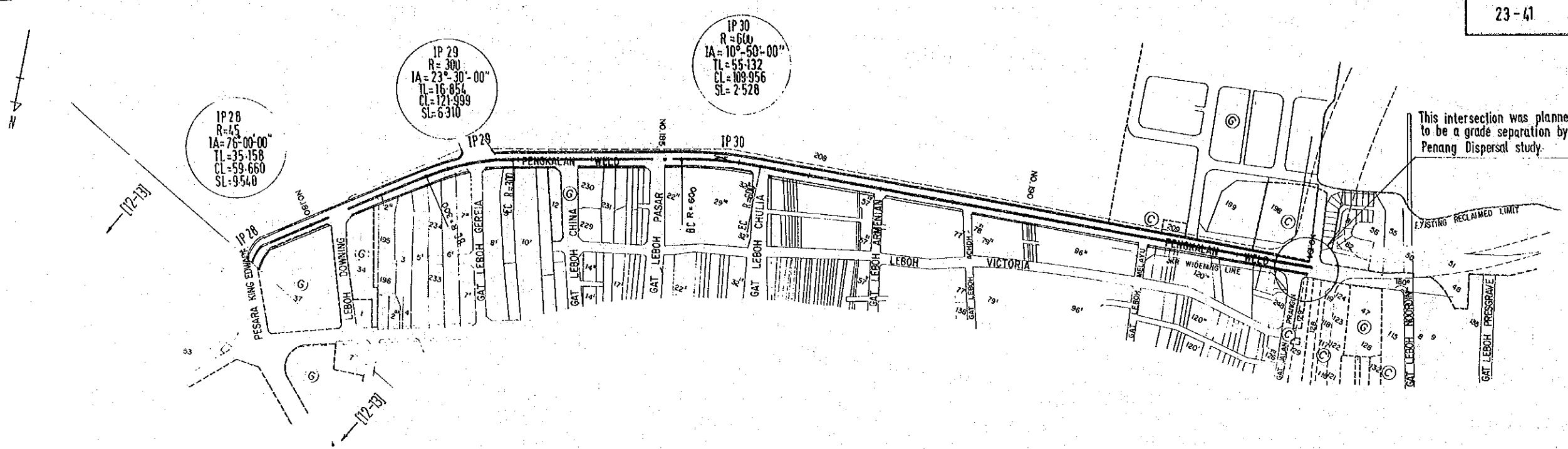
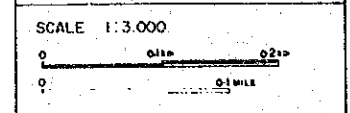
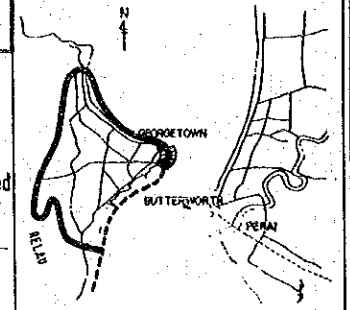
9-13





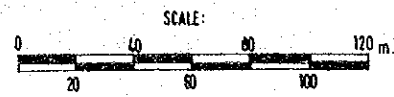
	NO.130	NO.131	NO.132	NO.133	NO.134	NO.135	NO.136	NO.137	NO.138	NO.139	NO.140	NO.141	NO.142	NO.143	NO.144	NO.145	NO.146	NO.147	NO.148
PROPOSED HEIGHT (m)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
EMBANKMENT HEIGHT (m)	4.000	4.000	4.000	4.000	4.150	4.300	4.200	4.100	4.100	4.100	4.100	4.100	4.100	4.100	4.100	4.100	4.500	5.000	5.000
CUTTING DEPTH (m)																			
EXISTING GROUND HEIGHT (m)	-1.00	-1.00	-1.00	-1.00	-1.15	-1.30	-1.20	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	-1.50	-2.00	-2.00
ACCUMULATE DISTANCE (m)	154.00	156.40	157.40	158.40	159.40	160.40	161.40	162.40	163.40	164.40	165.40	166.40	167.40	168.40	169.40	170.40	171.40	172.40	173.40
DISTANCE (m)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
STATION	NO.130	NO.131	NO.132	NO.133	NO.134	NO.135	NO.136	NO.137	NO.138	NO.139	NO.140	NO.141	NO.142	NO.143	NO.144	NO.145	NO.146	NO.147	NO.148
CURVE (m)																			

URBAN TRANSPORT STUDY IN GREATER METROPOLITAN AREAS OF GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM.
 JAPAN INTERNATIONAL COOPERATION AGENCY. GOVERNMENT OF MALAYSIA.



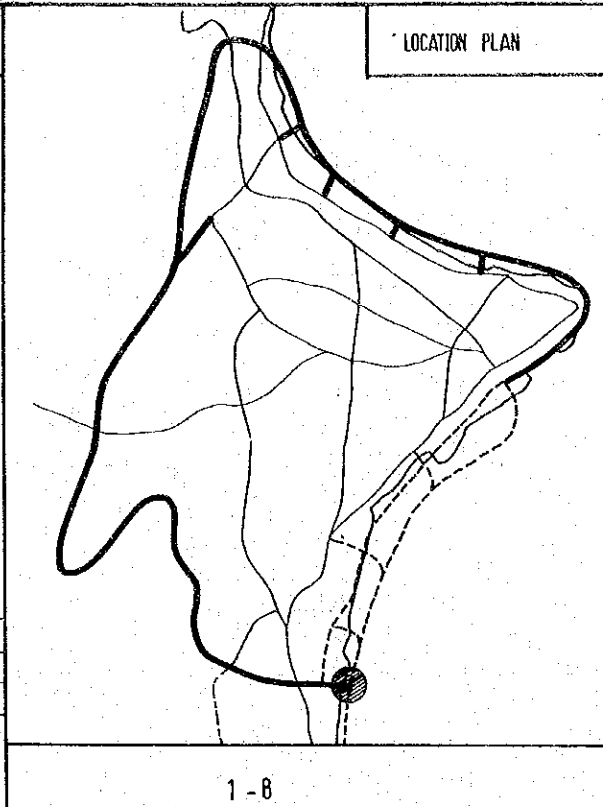
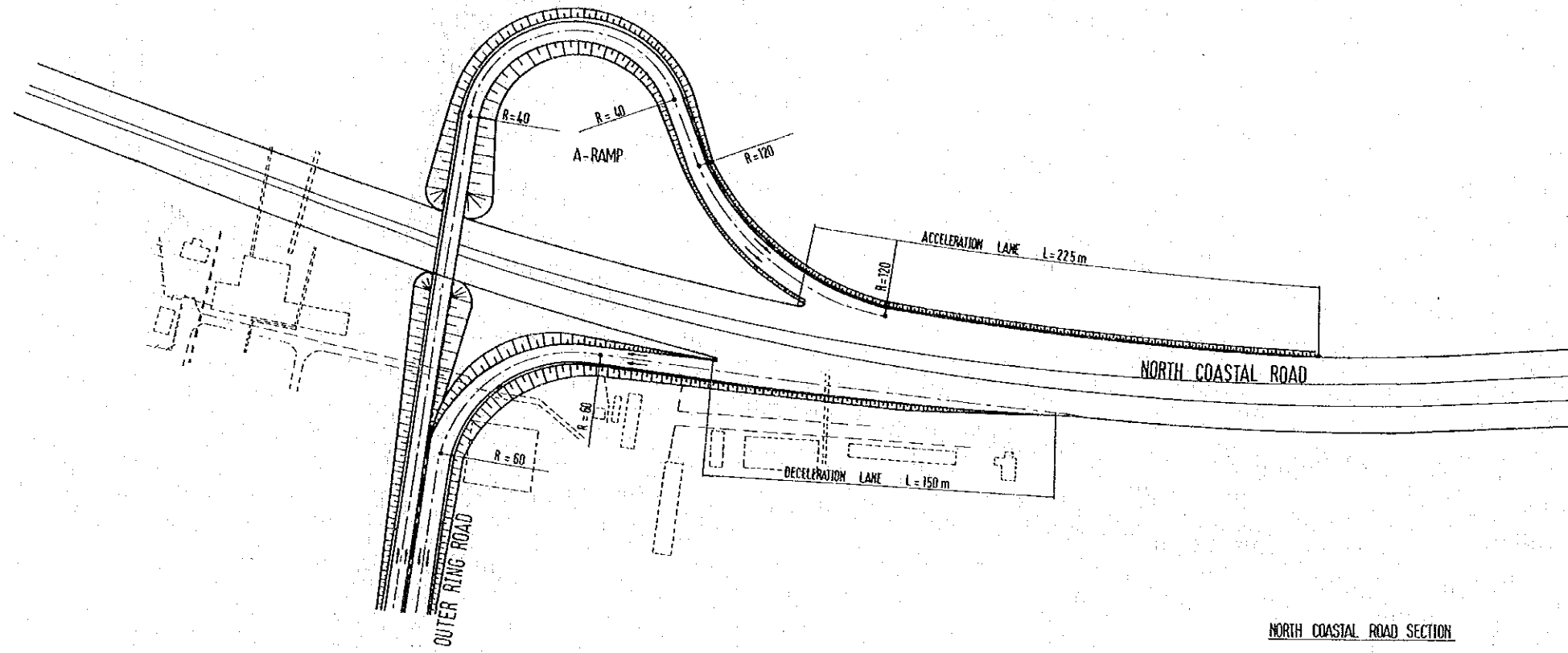
PROPOSED HEIGHT (m)	EMBANKMENT HEIGHT (m)	CUTTING DEPTH (m)	EXISTING GROUND HEIGHT (m)	ACCUMULATE DISTANCE (m)	DISTANCE (m)	STATION	CURVE (m)
2.021	0.02		2.0	20.540	100.00	NO.180	
2.000	0.03		1.97	20.640	100.00	NO.181	
2.000	0.07		1.93	20.740	100.00	NO.182	
2.000			2.0	20.840	100.00	NO.183	
2.000		0.07	2.07	20.940	100.00	NO.184	
2.000			2.0	21.040	100.00	NO.185	
2.000			1.93	21.140	100.00	NO.186	
2.000	0.05		1.95	21.240	100.00	NO.187	
2.013	0.043		1.97	21.340	100.00	NO.188	
2.000		0.1	2.1	21.440	100.00	NO.189	
2.000		0.23	2.23	21.540	100.00	NO.190	
2.000		0.23	2.23	21.640	100.00	NO.191	
2.365	0.03		2.35	21.740	100.00	NO.192	
2.400	0.24		2.16	21.840	100.00	NO.193	
2.000	0.03		1.97	21.940	100.00	NO.194	

GLUGOR INTERCHANGE PLAN
(ALTERNATIVE A)

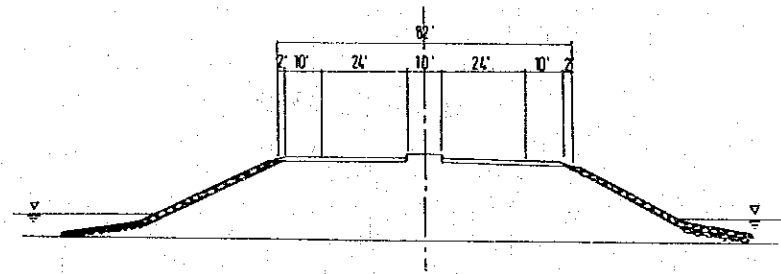


24-41

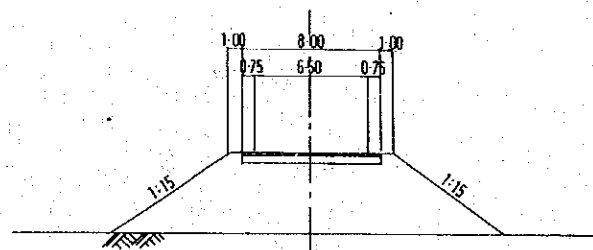
LOCATION PLAN



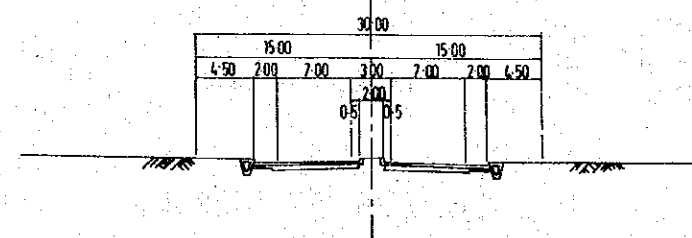
NORTH COASTAL ROAD SECTION



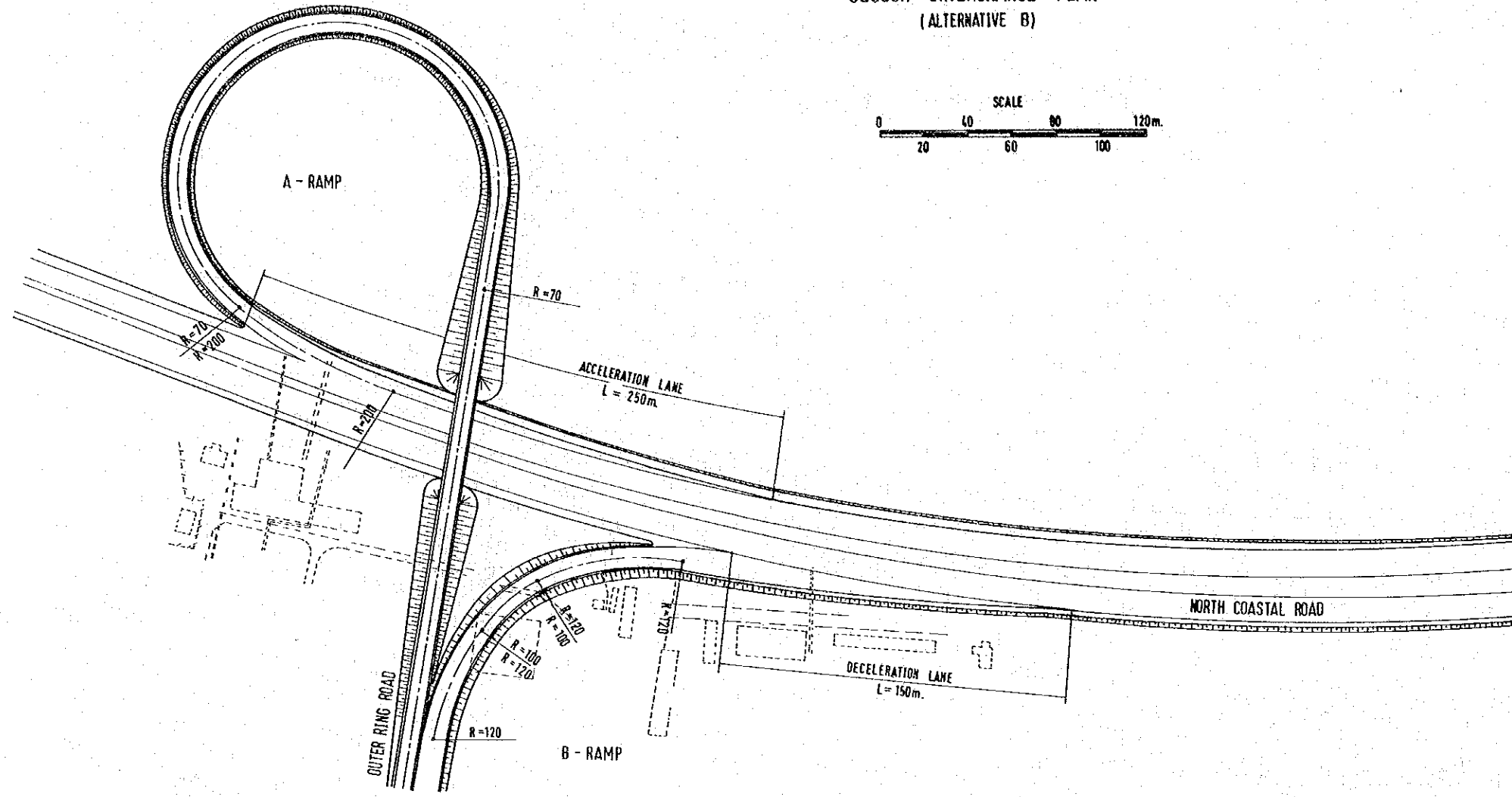
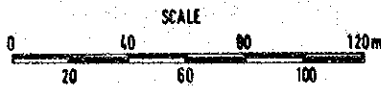
RAMP - SECTION



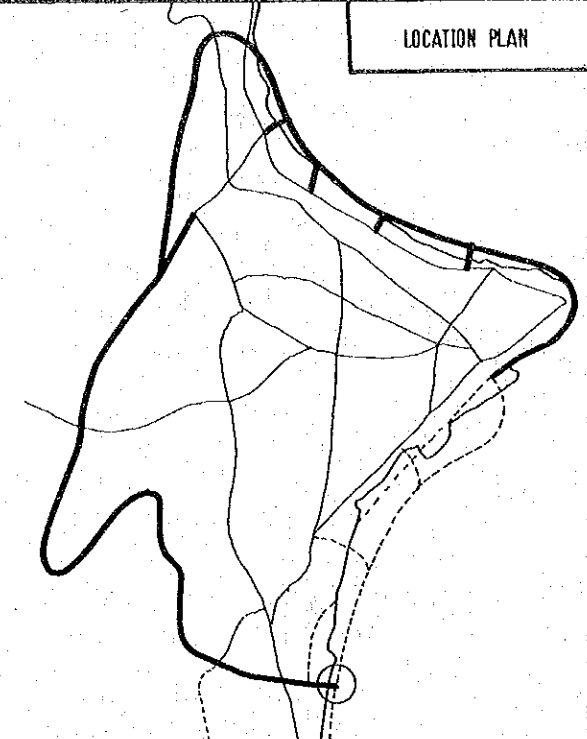
OUTER RING ROAD SECTION



GLUGOR INTERCHANGE PLAN (ALTERNATIVE B)

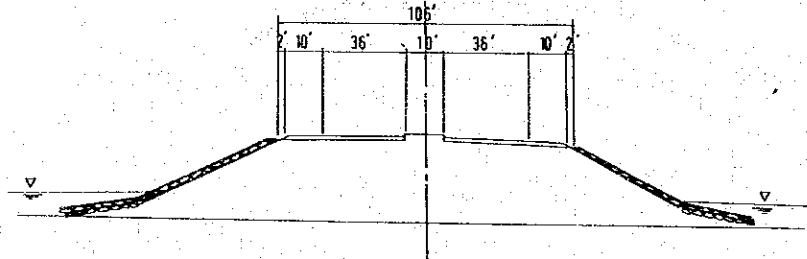


LOCATION PLAN

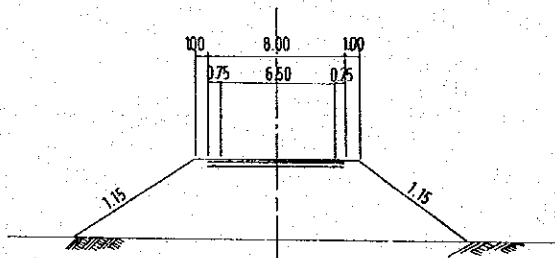


2-8

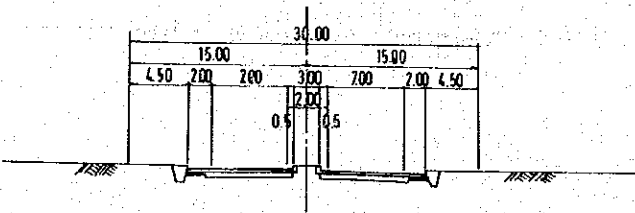
NORTH COASTAL ROAD SECTION



RAMP SECTION



OUTER RING ROAD SECTION

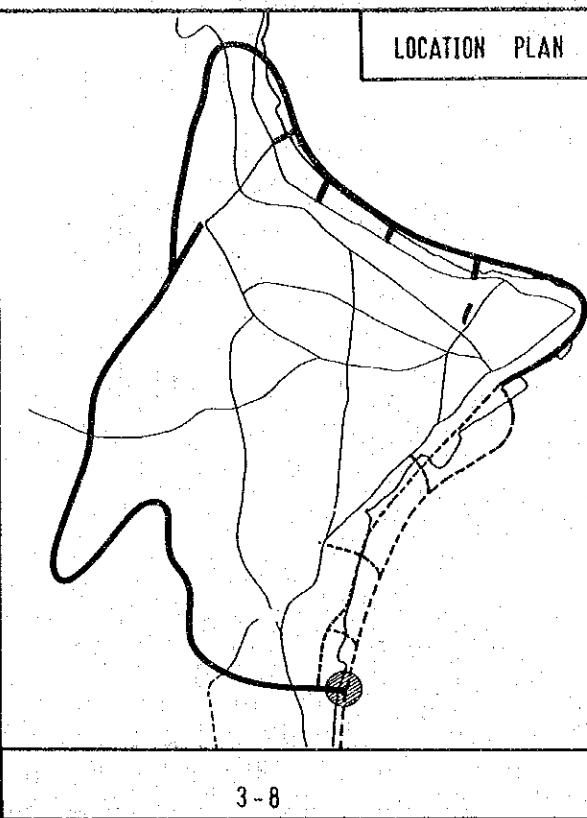
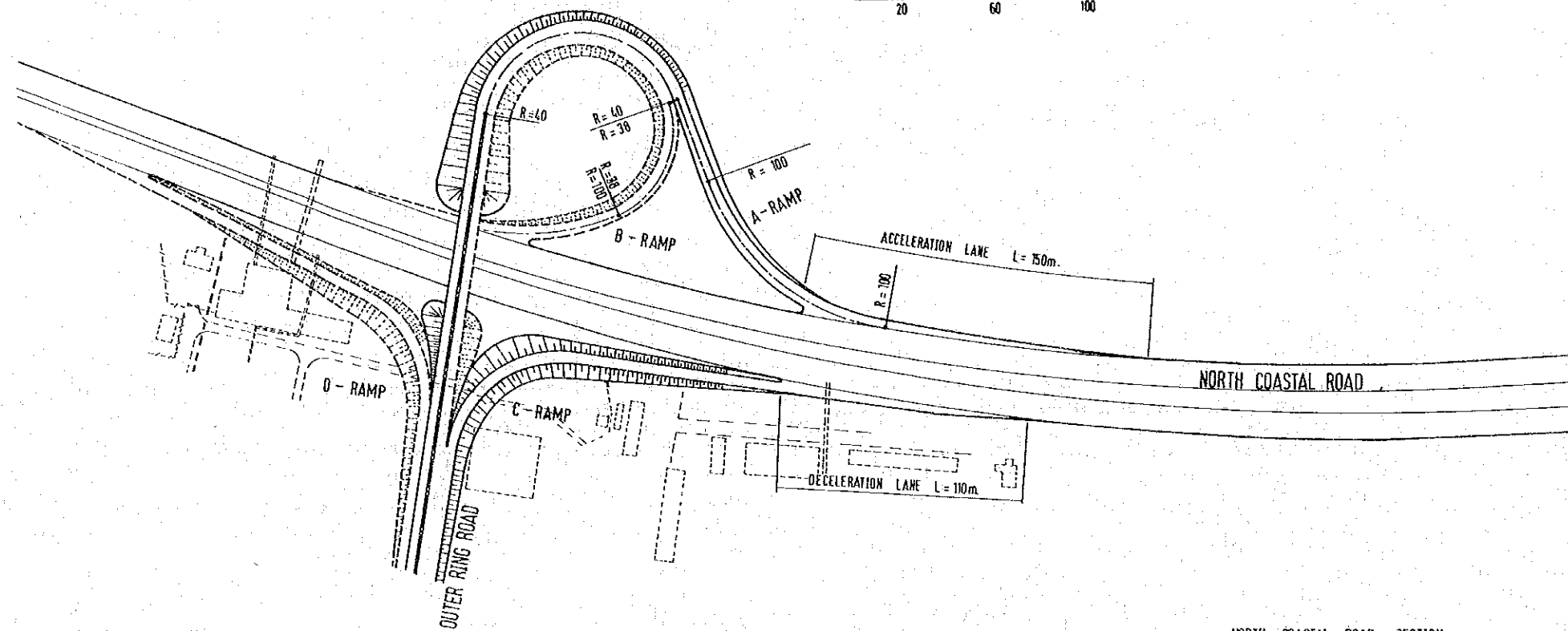
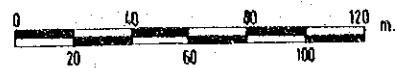


GLUGOR INTERCHANGE PLAN
(ALTERNATIVE C)

26-41

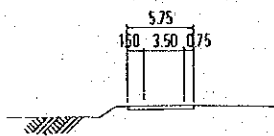
LOCATION PLAN

SCALE

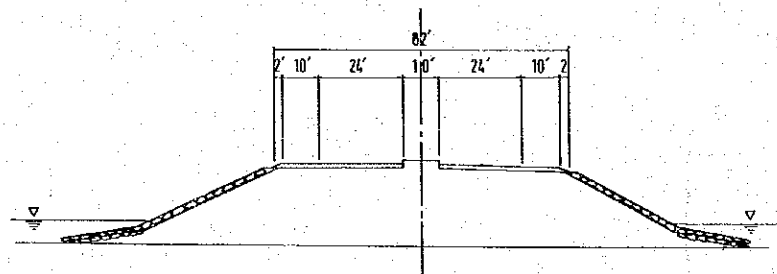


3-8

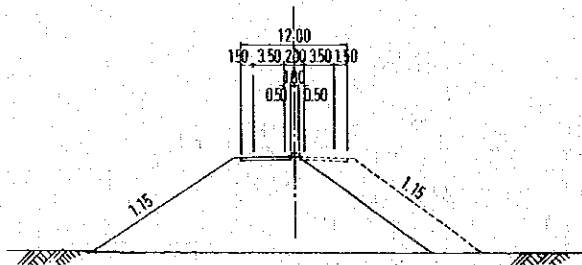
B, D - RAMP SECTION



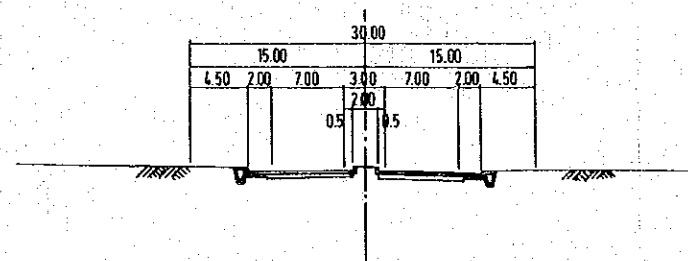
NORTH COASTAL ROAD SECTION



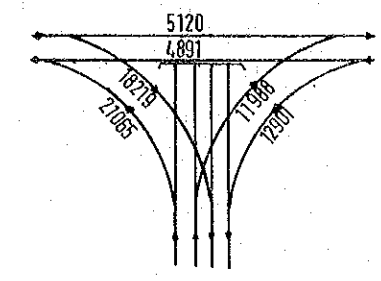
A, C - RAMP SECTION



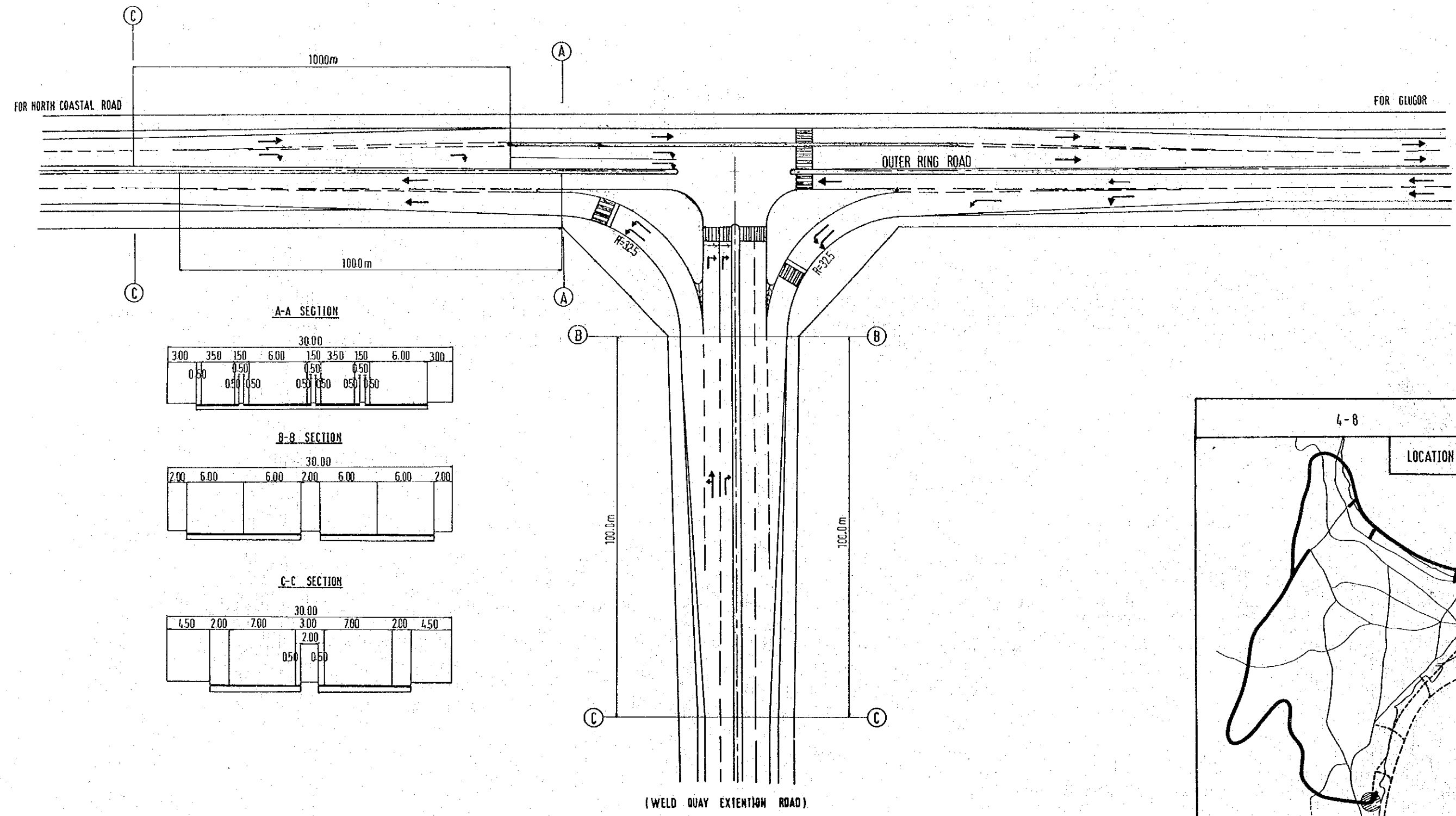
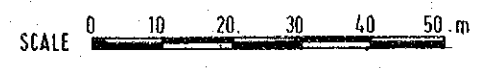
OUTER RING ROAD SECTION



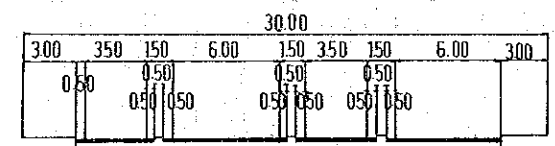
TRAFFIC VOLUME



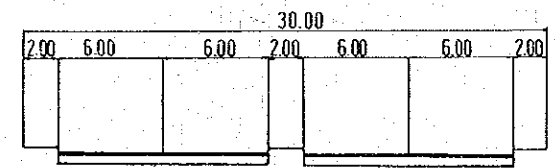
AT-GRADE INTERSECTION PLAN



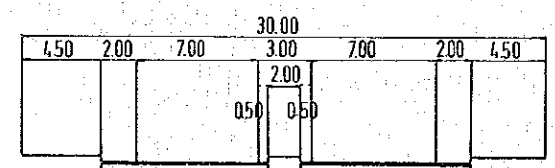
A-A SECTION



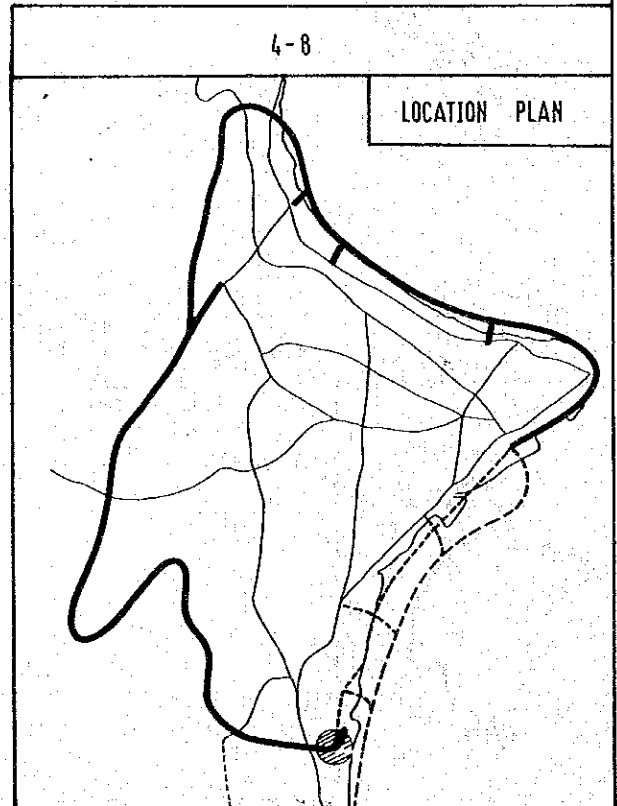
B-B SECTION



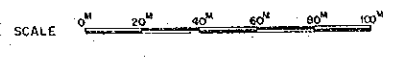
C-C SECTION



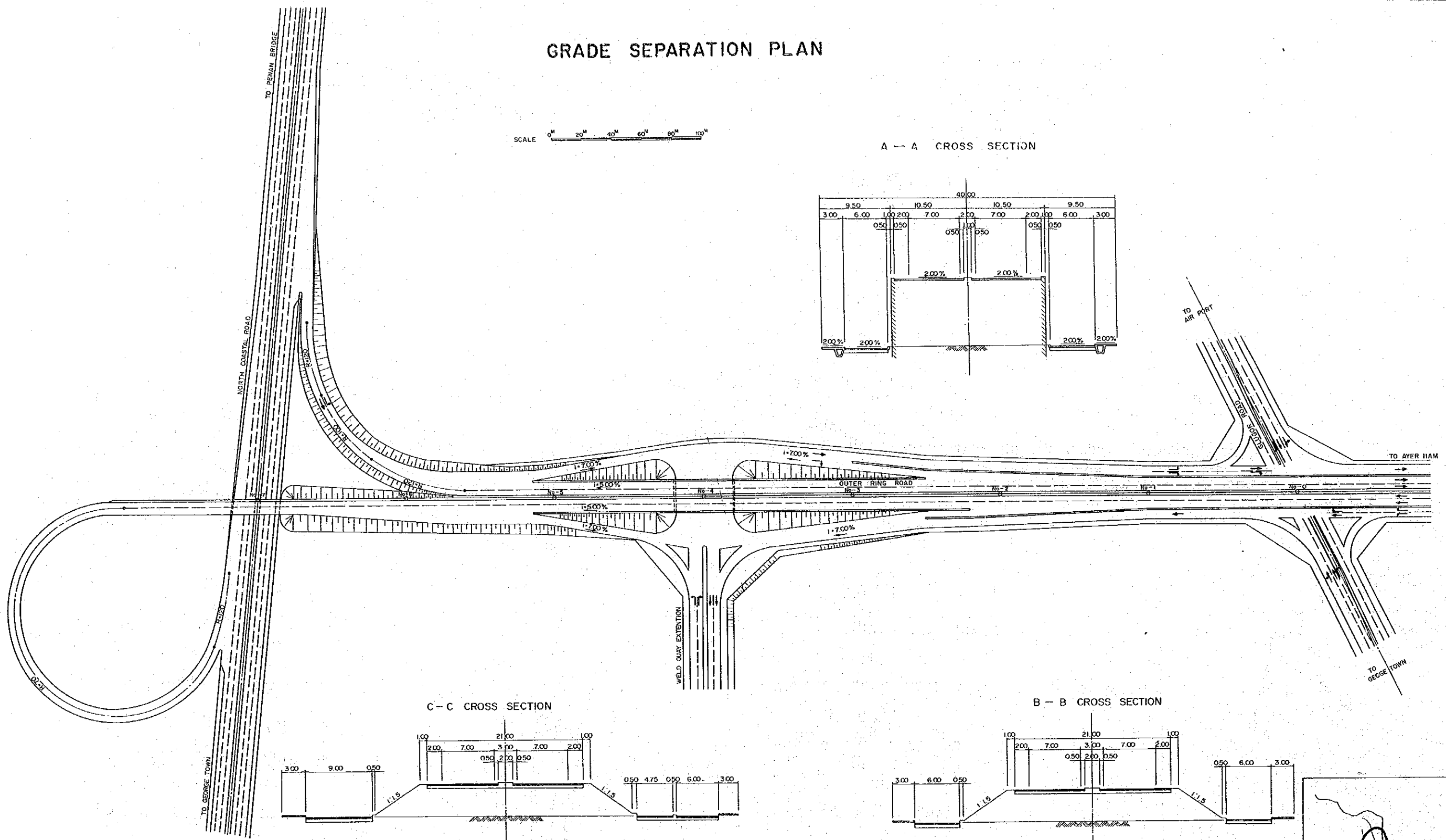
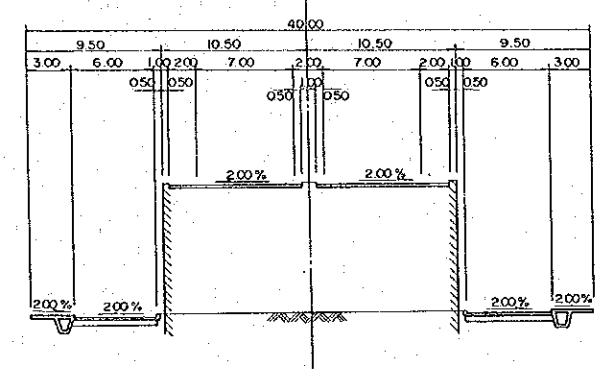
LOCATION PLAN



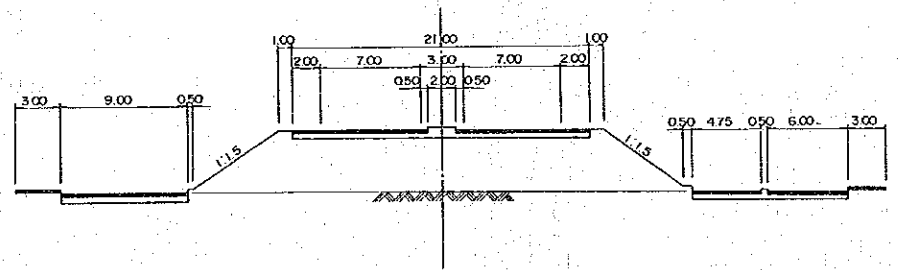
GRADE SEPARATION PLAN



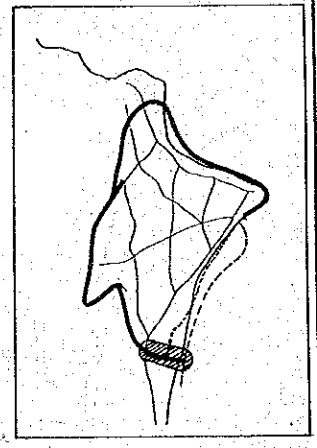
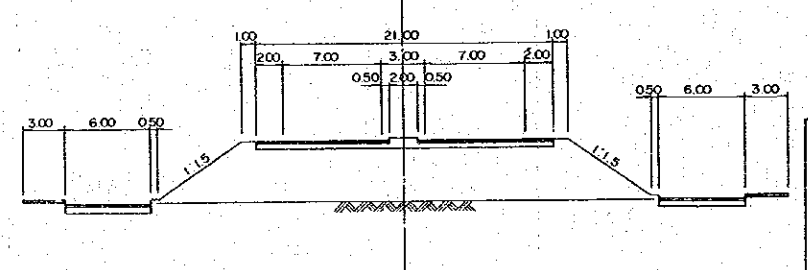
A - A CROSS SECTION



C - C CROSS SECTION



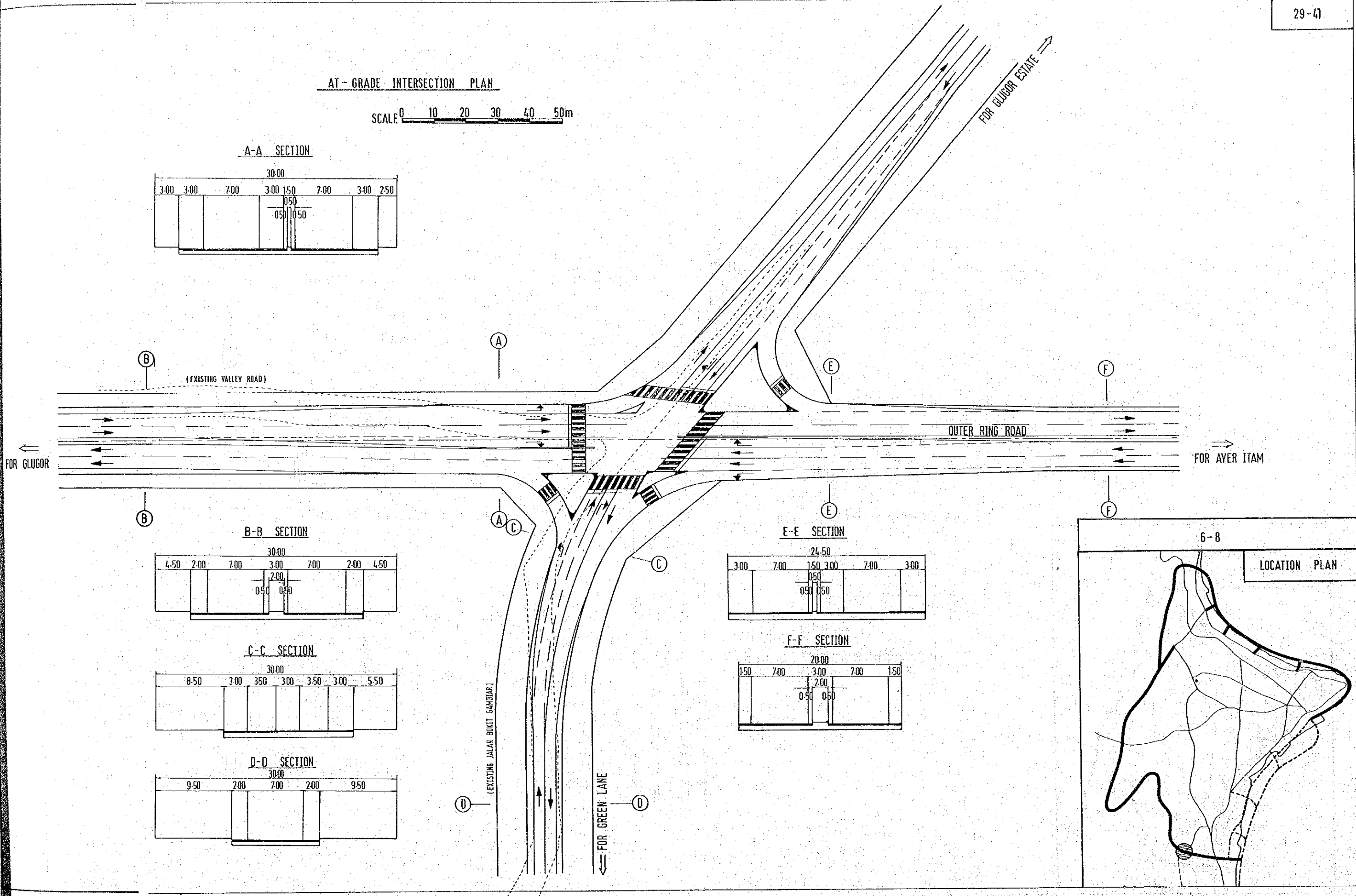
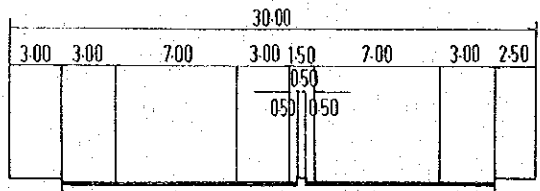
B - B CROSS SECTION



AT-GRADE INTERSECTION PLAN



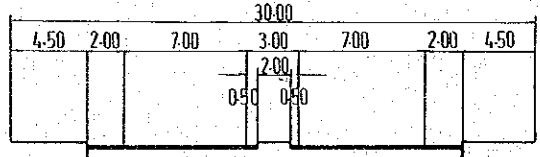
A-A SECTION



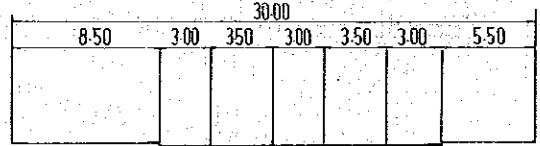
(EXISTING VALLEY ROAD)

OUTER RING ROAD

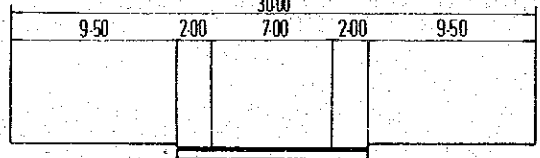
B-B SECTION



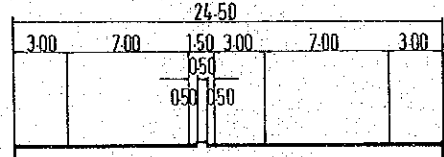
C-C SECTION



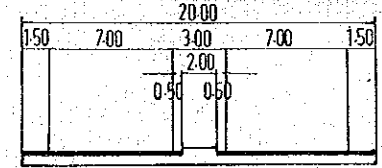
D-D SECTION



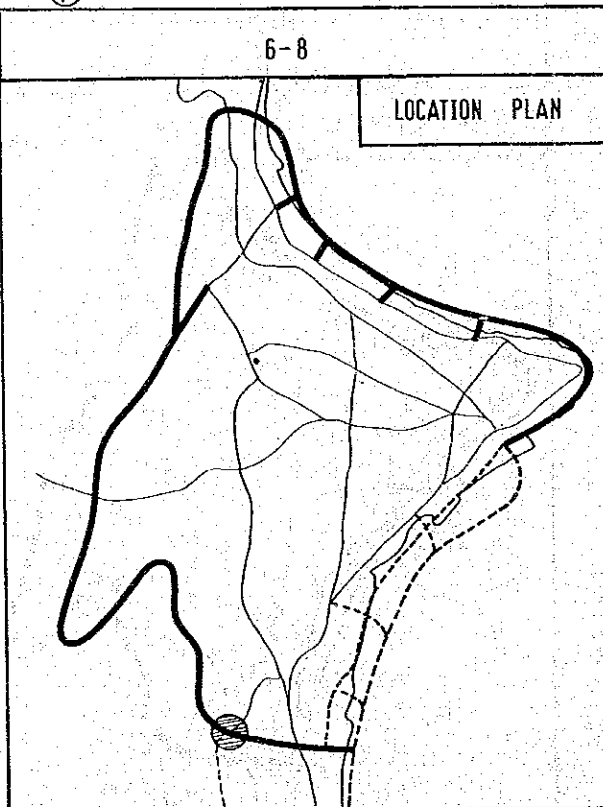
E-E SECTION



F-F SECTION



LOCATION PLAN



AT-GRADE INTERSECTION PLAN

SCALE 0 10 20 30 40 50 m

TRAFFIC VOLUME

