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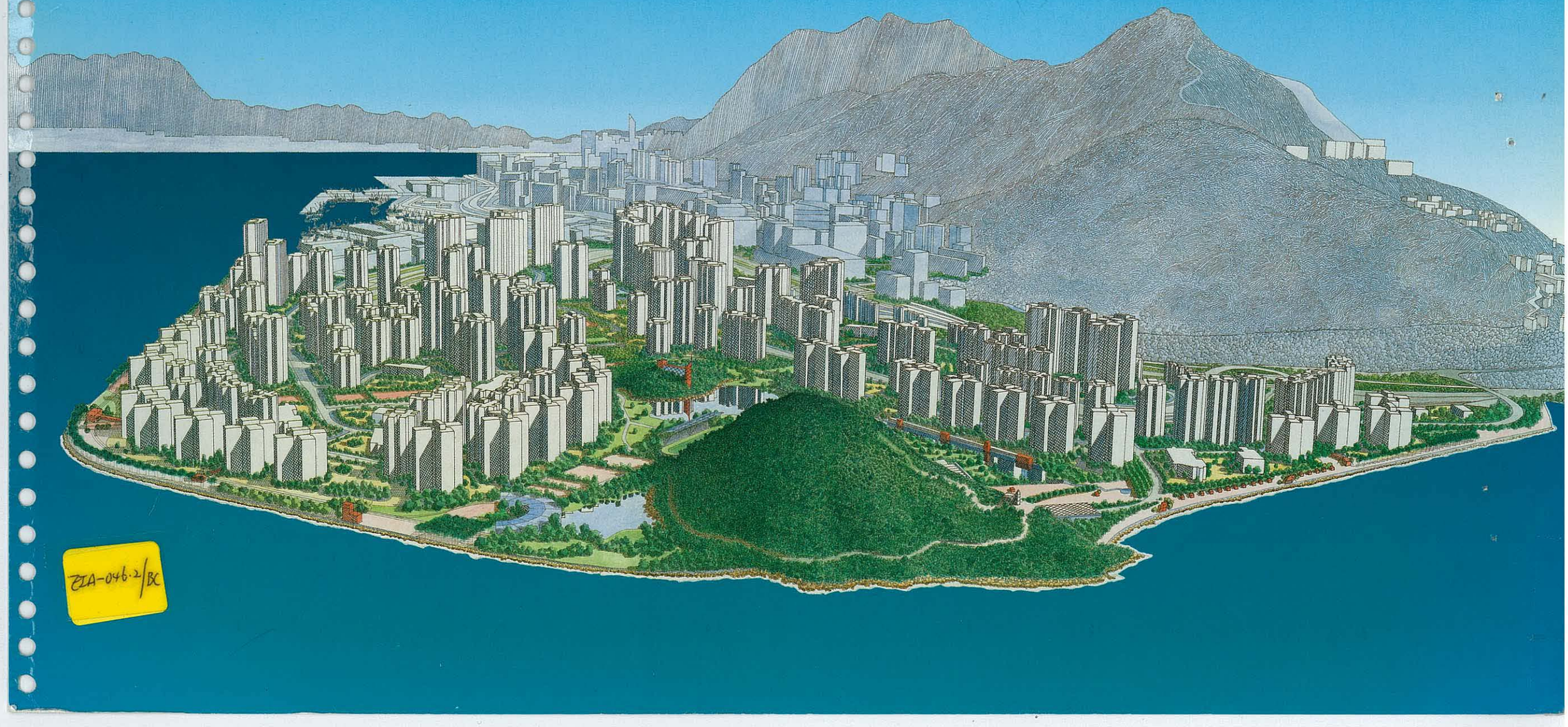
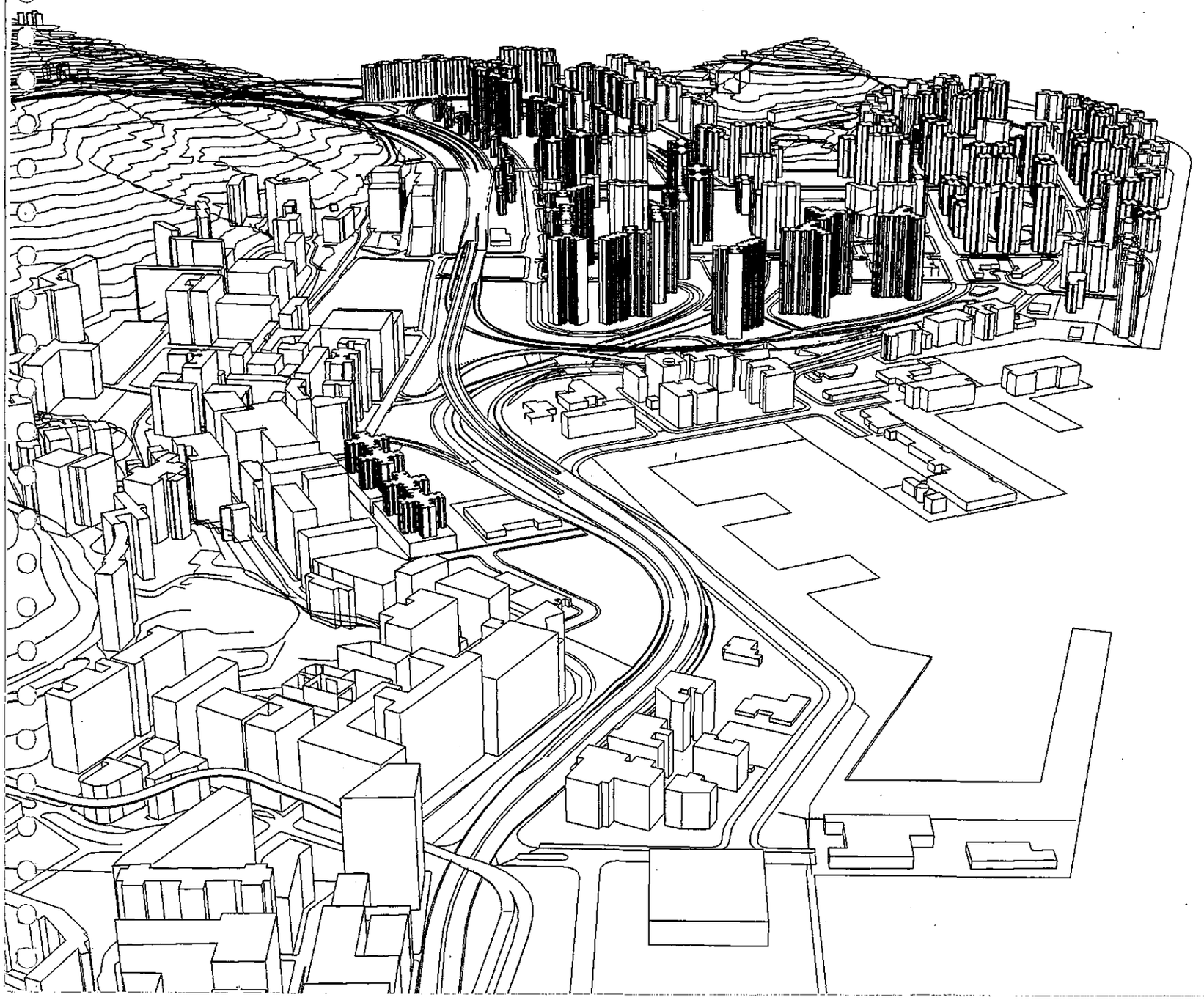
Draft Final Report
Volume 3

Transport, Route 7
and Engineering Studies

Territory Development Department
拓展署
Urban Area Development Office
市區拓展處

Green Island Reclamation Feasibility Study





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Transport, Route 7 & Engineering Studies

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1 Introduction

The Green Island Reclamation Feasibility Study has carried out specific studies of transport, traffic, Route 7, infrastructure associated with the development of the Study Area and the geotechnical aspects of the site and its reclamation. The outcome of these studies is embodied in the Recommended Outline Development Plan presented in Volume 1 of this Report. These engineering studies are presented here in more detail.

Traffic and transport aspects have been dealt with in a number of related study reports:

WP 1 Goals and Objectives and Strategic Context Options

TN 1 Review of Working Paper 1

TP 6 Review of MTR Extensions to Green Island

TP 14 Transport Model Development and Validation

TP 14 Addendum
Preparation of Reference Forecasts for 2011

TP 15 Strategic Network Studies

TP 16 Local Network Studies
Study Review (June 1990)
Major Road Layouts (Oct 1990)

The development of the study arising out of the Study Review Paper led to a preferred road layout associated with the Northern Option for the Green Island Link (GIL) and a Southern Option which assumed a southern GIL approach. Of these the Northern Option was chosen to be developed to RODP level whilst the Southern Option was developed to a lesser degree of detail. A decision to adopt 2011 as the design year in order to ensure compatibility with PADS was also made following the Study Review.

The other major transport infrastructure issue arising out of the Study Review was that of provision of the MTR. It was concluded that an MTR to the Green Island Reclamation would generate sufficient revenue to cover operating costs but would not cover construction costs. This was examined in the 'Review of MTR Extensions to Green Island' - TP6.

The local road network was developed in greater detail after decisions on the Strategic Network were taken. The aim was to minimise road area on the reclamation as far as possible, consistent with the likely traffic demand. This resulted in the adoption of a single spine road with secondary roads feeding onto it, basically a dendritic arrangement. This was detailed in the 'Local Network Studies' - TP16.

Chapter 2 presents the transport and traffic studies carried out.

The alignment of Route 7 from Central, through the Study Area and south to Aberdeen, has been reviewed. Alternative alignments across the reclamation were assessed and discussed in 'The Options Report' - WP2. The review of the previously proposed alignment and design of Route 7 from Kennedy Town to Aberdeen was presented in 'Route 7 Alignment' - TP17.

Drawings at a scale of 1:1000 have been prepared for the Route 7 alignment and reduced prints are presented as Appendix A of this Report.

Chapter 3 summarises the engineering aspects of the proposed Route 7.

The infrastructure proposals were discussed in 'Review of Infrastructure' - TP8. At the time of presenting that paper it was not known whether the Green Island Link or housing demands would require the triggering of the construction of the reclamation. Subsequently both have imposed time constraints on the reclamation implementation and these are discussed in Chapter 4 of this Volume.

The Engineering Feasibility Study required that a geotechnical study be carried out to identify all geotechnical problems and recommend solutions. A study of the available sources and types of appropriate fill material was carried out. Methods of reclamation were reviewed to overcome the deep waters and strong currents at Sulphur Channel to assess the feasibility of reclaiming the area around Green Island.

The following Technical Papers describe the work carried out to collate, assess, review and make recommendations for this part of the study :

TP1 Summary of Existing Geotechnical Information

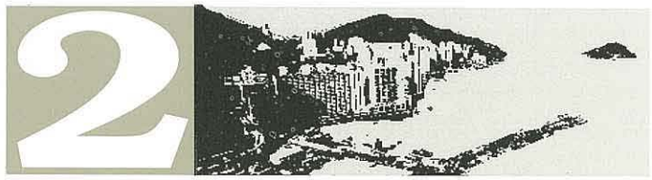
TP2 Availability of Fill Material

TP3 Site Investigation Report

TP4 Form of Seawalls

TP5 Reclamation Methods and Phasing

Chapter 5 presents the main issues coming from this geotechnical study. The recommendations for methods, phasing and programme for the reclamation are presented in Volume 1, Main Report, as part of the implementation of the Recommended Outline Development Plan.



2 Transport Studies

2.1 Background

Two levels of transport studies were required by the Study Brief.

- Study Area - the reclamation and Kennedy Town areas. A detailed assessment of traffic and transport demands and infrastructure was required within this area.

- Transport Study Area - included the Study Area together with the western part of Hong Kong Island between Western Street and the Wah Fu Estate. An assessment of the effects of the reclamation traffic on this adjacent area was required.

The Study Area and the Transport Study Boundary are shown in Figure 2.1.

Originally it was envisaged that the reclamation would be implemented in the period up to 2001 and so the two design years were identified as 1996 and 2001. Phasing of infrastructure during this period, in particular Route 7 between Rumsey Street and Aberdeen, was to be investigated. Base traffic data was to be taken from the Second Comprehensive Transport Study which was also using 1996 and 2001 as two of its design years.

During the early part of the study it became clear that the Port and Airport Development Strategy (PADS) was proposing options which could significantly change the transport infrastructure requirements on the reclamation. PADS had adopted 2001, 2006 and 2011 as its design years. The design years for this study were therefore changed to 2001 and 2011 to be compatible with PADS.

Full development of the reclamation by 2011 has been assumed for the design of the reclamation road networks, transport infrastructure and services. Design years 2001 and 2011 have been used for the Transport Study to examine conditions prior to the implementation of the reclamation development and after full development.

2.2 Existing Traffic and Transport Networks

The existing main road network in the Transport Study area is shown in Figure 2.2. The only major routes through the area are :

- northbound: Pok Fu Lam Road/Hill Road Flyover/ Connaught Road West

- southbound: Connaught Road West/Western Street/ High Street/Pok Fu Lam Road

- Victoria Road provides a lower standard, more circuitous route between Kennedy Town and parts of Pok Fu Lam. Other connections to Kennedy Town are provided by :

- Pokfield Road, a steep geometrically poor standard link to Pok Fu Lam Road

- Belcher Street and Kennedy Town Praya which carry the majority of the road based public transport and the tram.

The Study Area is served by China Motor Bus (CMB) / Kowloon Motor Bus (KMB) buses along Pok Fu Lam Road and through Kennedy Town, and CMB buses along Victoria Road. Red Public Light Buses (PLB's) and Green Minibus services operate along both Victoria Road and Pok Fu Lam Road, and through Kennedy Town. The tram runs from its terminus in Catchick Street, along Kennedy Town Praya through into Des Voeux Road West. The Kennedy Town section of the tram route is one of the most popular sections in the tram network.

2.3 Future Road and Transport Developments

The Western District Traffic Study (WDTS), undertaken for Highways Department, was completed in 1988. This study formulated a recommended Transport Plan for the District for design years 1991 and 1996. The key relevant recommendations were :

- construction of a new road link (the Belcher Bay Link) forming an extension of Connaught Road West to Kennedy Town, connecting into Sands Street and Smithfield. This link would be on new reclamation on Belcher Bay.

- a comprehensive traffic management scheme for Kennedy Town, incorporating improvements to Forbes Street and Rock Hill Street.

- an extension of Smithfield southbound to link with Pok Fu Lam Road (the Smithfield Extension).

The long term recommendation was for Route 7 to extend from Rumsey Street flyover, above Connaught Road West and Belcher Bay, round the coast to Aberdeen, with interchanges or slip roads serving Kennedy Town, Sandy Bay, Telegraph Bay and Victoria Road.

The Second Comprehensive Transport Study recommendations included the provision of the Western Harbour Crossing, from Sai Ying Pun to new reclamation at West Kowloon. It was recommended that this link be in place by 1996. The Metroplan Studies, undertaken by Lands and Works Branch, also advanced the planning of the proposed Green Island reclamation which led to the present study.

The recently completed Western Harbour Crossing Study has recommended that the elevated section of Route 7 between Rumsey Street and the Belcher Bay reclamation (west of Hill Road) and the Smithfield Extension should be completed at the same time as the Western Harbour Crossing. This will provide an additional route between the Western Harbour Crossing and Pok Fu Lam Road.

Longer term proposals from PADS include the Green Island Link which will connect the proposed Lantau Port Peninsula with Route 7. An interchange with Route 7 would be provided on the Green Island Reclamation.

Proposed road developments in the area are summarised in Figure 2.3. These committed and proposed schemes have been incorporated into the planning of the reclamation. Modifications to cater for the needs of the reclamation have been made where necessary.

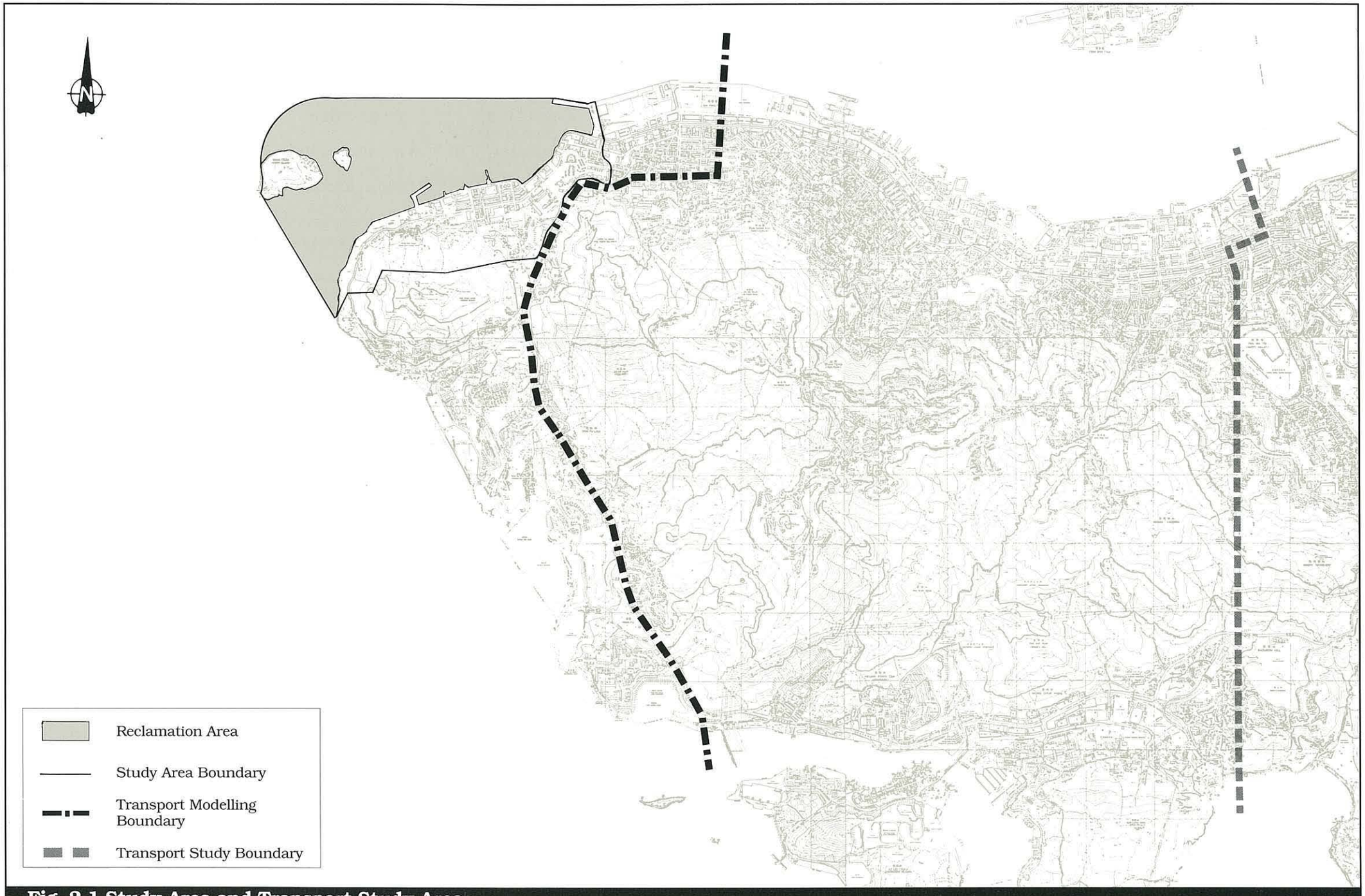


Fig. 2.1 Study Area and Transport Study Area

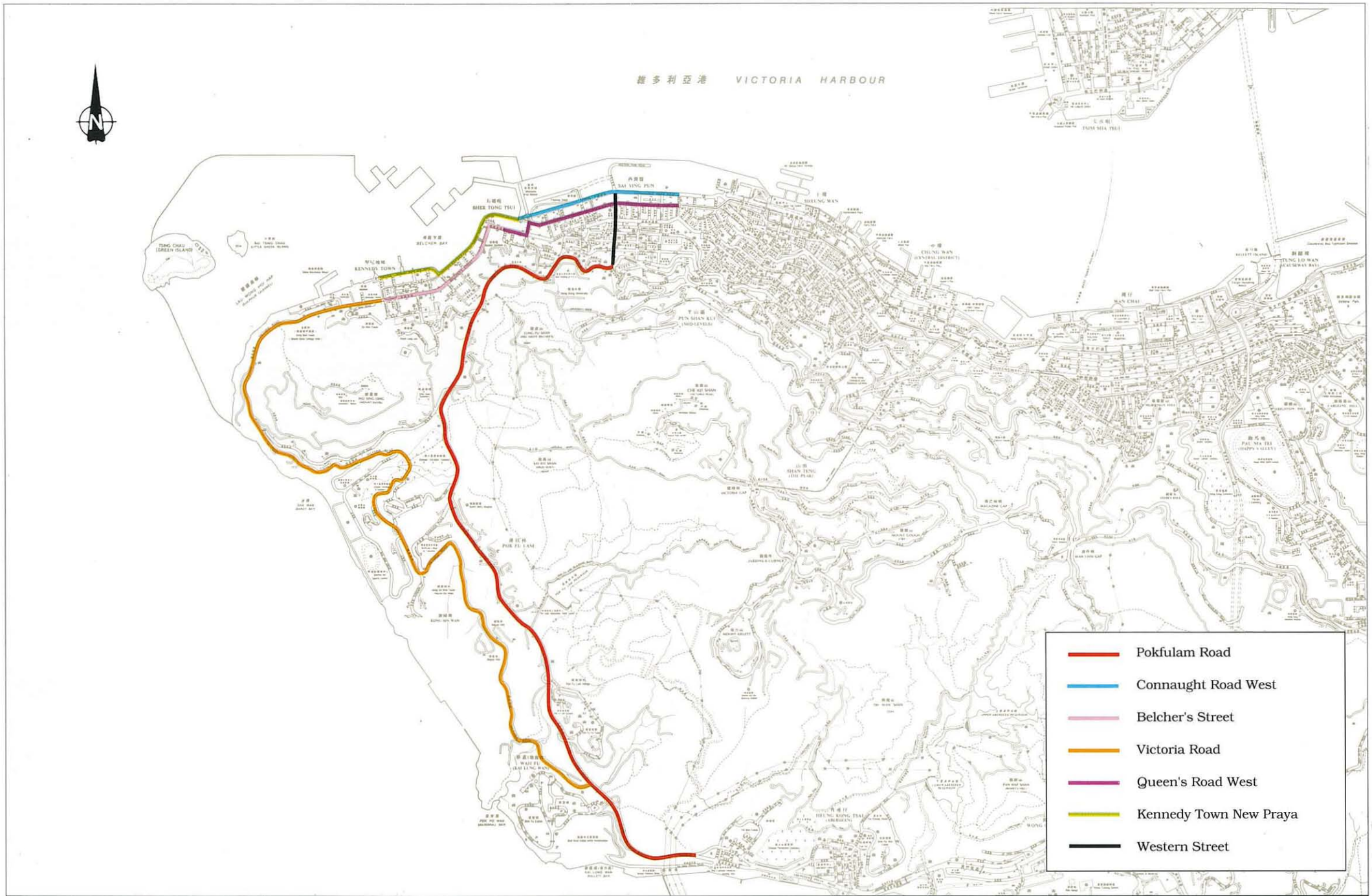


Fig. 2.2 Existing Roads

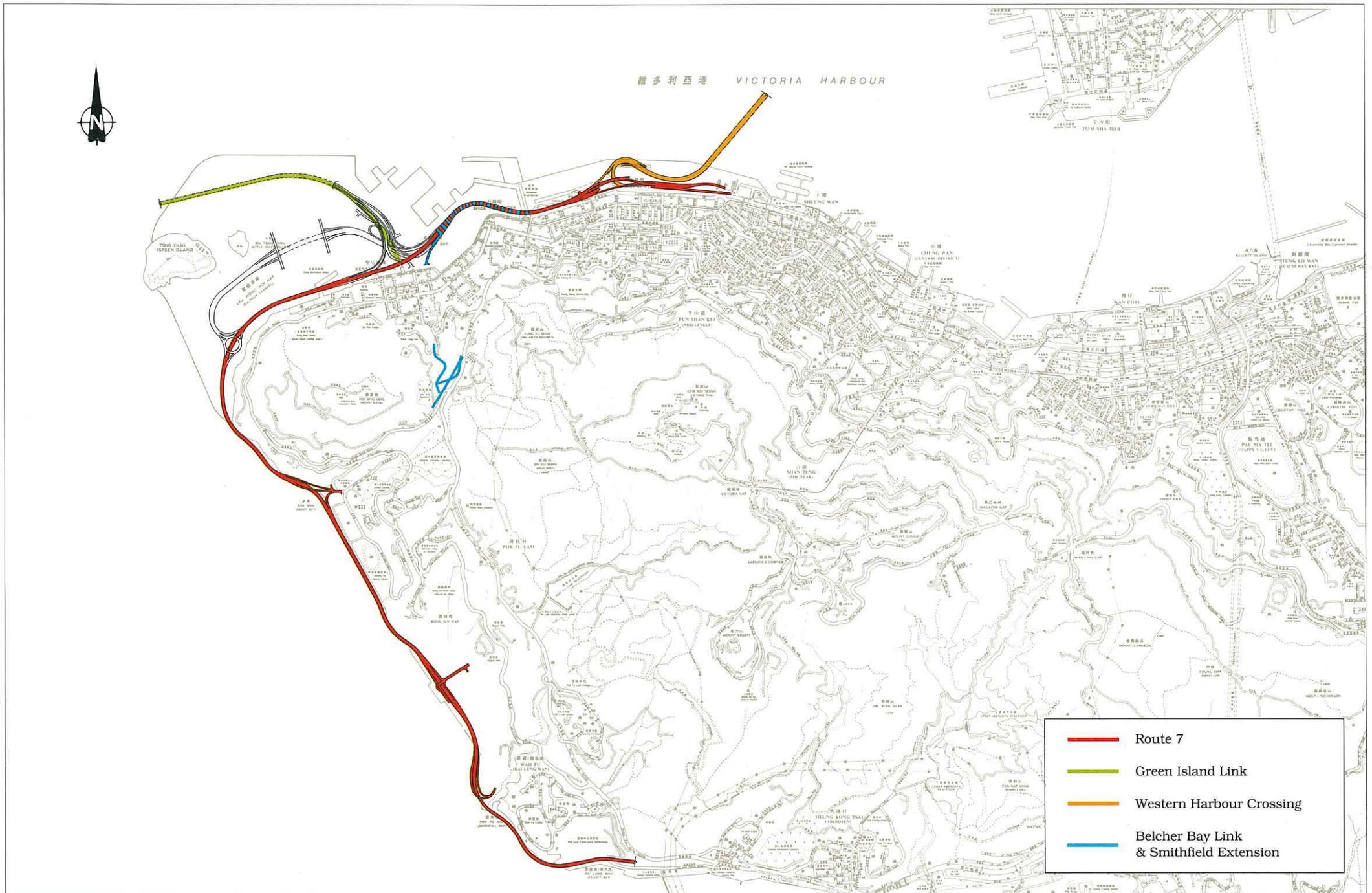


Fig. 2.3 Proposed New Roads

2.4 Future Travel Demands

During the study process there have been many changes to the planning parameters and associated travel demand estimates. By necessity, the study has been required to use different sets of data during the course of the transport studies. Four sets of data have been used :

- CTS-2 1996 and 2001 data for the initial model development reported in 'Transport Model Development and Validation' -TP14.

- unrestrained PADS estimates of 2001 and 2011 traffic demands, used in the draft of 'Strategic Network Studies' - TP15.

- restrained PADS estimates of 2001 and 2011 traffic demands. These incorporated restraint on goods vehicle and private car usage. These demands were used for the tests reported in the revised version of 'Strategic Network Studies' - TP15, and for the analysis of the 16 reclamation options reported in the 'Options Report' - WP2.

- Territory-wide data for 2001 and 2011 produced by the Territory Transport Planning Division of Transport Department in February/March 1990. This data incorporated the then-current land use development proposals both for the Port and Airport developments on Lantau and for the remainder of the Territory.

In all cases, the Territory-wide estimates were used to set the boundary conditions for all travel demands outside the Study Area (the reclamation and Kennedy Town). The estimates of land use development and associated travel demands were generated within the Study Area.

All of the analysis reported in subsequent sections of this report relates to the Transport Department data produced in February/March 1991. The main land use and trip data controls are reported below.

Table 2.1 Population and Employment Control Totals for 1986, 2001 and 2011

	Population			Employment		
Area	**1986**	**2001**	**2011**	**1986**	**2001**	**2011**
Green Island Reclamation	----	----	110,600	----	----	13,100
Kennedy Town	56,800	48,300	48,300	16,200	14,600	14,600
Sai Ying Pun/ Shek Tong Tsui (CTS zones 3, 4)	106,800	104,100	100,500	47,300	49,100	43,200
Sandy Bay (CTS zone 42)	16,600	23,800	22,100	5,200	2,800	2,600
Telegraph Bay (CTS zone 43)	7,500	25,100	22,500	1,700	5,100	4,800
Chi Fu (CTS zone 44)	22,400	30,100	26,400	3,500	6,200	5,700
Wah Fu (CTS zone 45)	45,900	43,800	43,600	3,300	8,800	9,300
Transport Study Area	302,500	275,200	374,000	77,200	86,600	93,300
Hong Kong Island Total	1,207,500	1,464,200	1,399,600	642,800	868,300	826,500
Territory Total	5,487,700	6,336,900	6,623,500	2,674,300	3,115,200	3,230,100

2.4.1 Population and Employment

The population and employment control values within the Transport Study Area (TSA) are given in Table 2.1. The population in the TSA is predicted to fall from approximately 300,000 in 1986, to 275,000 in 2001, and then rise to 374,000 in 2011, assuming full development on the reclamation. The corresponding figures for employment are 77,000 in 1986, 87,000 in 2001 and 93,000 in 2011. Excluding the reclamation, changes
in population and employment within the TSA are expected to be relatively small. These figures assume a continuation of the existing Pok Fu Lam Moratorium on development.

2.4.2 Travel Demands

The travel demands within the TSA are summarised in Table 2.2 for 1986, Table 2.3 for 2001 and Table 2.4 for 2011. There is expected to be a general rise in vehicular trip rates in the Territory, and this is reflected in the increasing numbers of private and goods vehicle trip ends per head of population and per employment place.

For areas outside the Study Area, the travel demands have been taken directly from Transport Department. Within the Study Area revised trip generation figures have been produced, using the trip rates shown in Table 2.5.

Table 2.2 Estimated Vehicular Trips from the TSA in 1986

	Private Trip				Goods Vehicle Trip			
	AM Peak		PM Peak		AM Peak		PM Peak	
Area	**G**	**A**	**G**	**A**	**G**	**A**	**G**	**A**
Green Island Reclamation	----	----	----	----	----	----	----	----
Kennedy Town	888	564	425	684	348	381	240	267
Sai Ying Pun/ Shek Tong Tsui (CTS zones 3, 4)	1804	1870	1410	1517	686	713	476	437
Sandy Bay (CTS zone 42)	648	384	414	528	80	100	59	59
Telegraph Bay (CTS zone 43)	630	89	167	345	63	45	53	23
Chi Fu (CTS zone 44)	625	277	241	434	95	115	66	82
Wah Fu (CTS zone 45)	627	330	233	444	169	166	124	101
Transport Study Area	5222	3514	2890	3952	1441	1520	1018	969
Territory Total	102,583	102,583	101,453	101,453	55,943	55,943	47,212	47,212

2.5 Road Traffic Studies in the Study Area

2.5.1 Background

Throughout the Study, many alternative infrastructure and land use development patterns have been examined. The 'Options Report' - WP2 - describes the 16 main options for the development of the reclamation. The preferred options incorporated a predominantly housing-led land use on the reclamation, and the strategic transport infrastructure has been governed by the decision to locate the replacement airport at Chek Lap Kok.

The strategic road network consists of Route 7 and the Green Island Link. An all movements grade separated intersection is required where the two roads meet on the reclamation. The major movements are east/west along Route 7, and between the Green Island Link and Route 7 from the east.

The reclamation will also require access to the strategic road network. Two junctions with Route 7 are proposed:

- A pair of on and off slip roads at Belcher Bay (because of the reduced level of development on the reclamation traffic flows are less than originally forecast during previous studies and the interchange previously proposed has been simplified).
- An all movements grade separated roundabout in the south-western corner of the reclamation.

The desirable minimum spacing between junctions, as specified in TPDM Volume 2 sections 4.2.11 and 6.3.6 are shown in Table 2.6.

Two alternative alignments for the Green Island Link - one to the north of Green Island and one to the south have been identified. The studies of Route 7 identified that the preferred location of Route 7 was at the southern part of the reclamation, as close to the existing coastline as possible. This reduced the land use and environmental impacts of the road on the area of development on the reclamation. The north and south alternative alignments for the Green Island Link have been developed to the level of an OZP for each option.

2.5.2 North Option

The Green Island Link would be aligned across the reclamation as far north as possible. It would then turn south on a radius of 600 metres to intersect with Route 7 in the south east of the reclamation. The visual impact of the two-level interchange would be on the main part of Kennedy Town.

The distance between the full roundabout interchange in the south and Green Island Link/Route 7 is 1250 metres in this option. The distance between the Belcher Bay slip roads and the Green Island Link is, however, only 850 metres.

The above junction locations do not meet expressway standards.If the 2km standard for expressways is retained, however, this would allow no junction west of the Green Island Link on Route 7 until Sandy Bay. The reclamation traffic would not be able to access Route 7 in the southerly direction or have access to the Green Island Link. This would not be sensible for the reclamation development.

The separation between the Green Island Link junction and the roundabout junction to the west has been made as great as possible. This has the result of reducing the distance between the Green Island Link junction and the junction at Belcher Bay. The junction at Belcher Bay comprises a slip road merging from the west and a slip road diverging from the east. Thus it is not a full all-movements interchange.

2.5.3 South Option

In this option the Green Island Link would be located as far west as possible so that the gradient in the tunnel between the sea wall and the portal would be 4%.

The distance between the full roundabout intersection in the south and the Green Island Link/Route 7 junction is 800 metres and the distance between the Belcher Bay junction and Green Island Link/Route 7 junction is 1300 metres.

Again the locations of these junctions do not meet the standards for expressways. The distance between the merging lane from the roundabout in the south of the reclamation and the diverging lane to the Green Island link is 300 metres. The traffic figures show that this distance is the minimum weaving length needed.

Table 2.3 Estimated Vehicular Trips from the TSA in 2001

	Private Trip				Goods Vehicle Trip			
	AM Peak		PM Peak		AM Peak		PM Peak	
Area	**G**	**A**	**G**	**A**	**G**	**A**	**G**	**A**
Green Island Reclamation	----	----	----	----	----	----	----	----
Kennedy Town	2176	1644	1458	1853	157	149	216	222
Sai Ying Pun/ Shek Tong Tsui (CTS zones 3, 4)	2130	2394	2145	2355	1136	1202	808	794
Sandy Bay (CTS zone 42)	1006	231	318	636	176	194	127	119
Telegraph Bay (CTS zone 43)	1394	341	445	898	279	301	194	198
Chi Fu (CTS zone 44)	715	456	470	613	355	339	256	229
Wah Fu (CTS zone 45)	768	529	577	746	465	480	333	313
Transport Study Area	8189	5595	5422	7101	2568	2665	1934	1875
Territory Total	136,901	136,901	145,660	145,660	140,630	140,630	117,701	117,701

2.5.4 Recommended Strategic Road Network

A northern approach of the Green Island Link is preferred for the following reasons:

- The North Option landtake is approximately 8 hectares compared with approximately 13 hectares for the South Option.
- In the North Option the Green Island Link creates a barrier to the area east of its junction with Route 7, this area is proposed as an industrial area next to the PCWA. The South Option, however, creates a physical and visual barrier between Kennedy Town and the reclamation thus increasing severance in both the north/south direction and the east/west direction.
- The Green Island Link to Route 7 westbound movements are considerably longer for the North Option. This, however, is the minor movement at the intersection.
- The locations of the portal and the ventilation building in the North Option are further from the existing and proposed development.
- The North Option, because of the location of the Green Island Link next to the proposed industrial area and PCWA, would affect a much smaller number of residential properties.
- The spacing of the junctions along Route 7 is better in the North Option. There is over 1km between the all movements roundabout intersection and the Green Island Link compared with the absolute minimum weaving length in the South Option. The distance between the Green Island Link junction and the slip roads at Belcher Bay is considerably shorter in the North Option but Belcher Bay is not now a full interchange.

The northern option was selected for study in detail. If the southern option were to be chosen subsequently, part of the local road network on the reclamation would require revision.

2.5.5 Local Road Network Options Design Considerations

• Design Flow

The permissible peak hour traffic flow for each type of carriageway was as specified in the Transport Planning and Design Manual, Volume 2, Chapter 2, Section 2.4. In some cases the additional allowances specified in para 2.4.12 have been incorporated to produce a balanced network design standard. The 2011 morning (am) and evening (pm) peak hour design flows are shown in Figure 2.4.

The details of the different road types used for the Green Island reclamation and their characteristics are shown in Table 2.7.

• Road Hierarchy

The following hierarchy has been identified for the reclamation, as shown in Figure 2.5.

- Primary distributor - this will form the interface between Route 7 and the local road network.
- District distributors - these will feed the traffic north/south through the reclamation to link with the primary distributor.
- Local distributors - these roads will link the district level road with the local access roads.
- Local roads - roads within development areas or connecting adjacent areas but not designed as through routes.

The junction spacing for the local road networks complies with the standards set out in TPDM Volume 2 section 2.4.11 and as shown in Table 2.8.

Table 2.4 Estimated Vehicular Trips from the TSA in 2011

	Private Trip				Goods Vehicle Trip			
	AM Peak		PM Peak		AM Peak		PM Peak	
Area	**G**	**A**	**G**	**A**	**G**	**A**	**G**	**A**
Green Island Reclamation	4062	2475	2414	3242	791	608	721	861
Kennedy Town	2291	1730	1535	1951	165	157	227	234
Sai Ying Pun/ Shek Tong Tsui (CTS zones 3, 4)	2093	2787	2496	2547	1231	1316	868	845
Sandy Bay (CTS zone 42)	926	268	338	613	182	200	136	121
Telegraph Bay (CTS zone 43)	1403	408	508	947	298	321	202	209
Chi Fu (CTS zone 44)	829	550	537	706	358	357	254	224
Wah Fu (CTS zone 45)	1104	615	761	1035	534	537	383	370
Transport Study Area	12,708	8,833	8,589	11,041	3,559	3,496	2,791	2,864
Territory Total	183,530	183,530	196,014	196,014	167,567	167,567	140,274	140,274

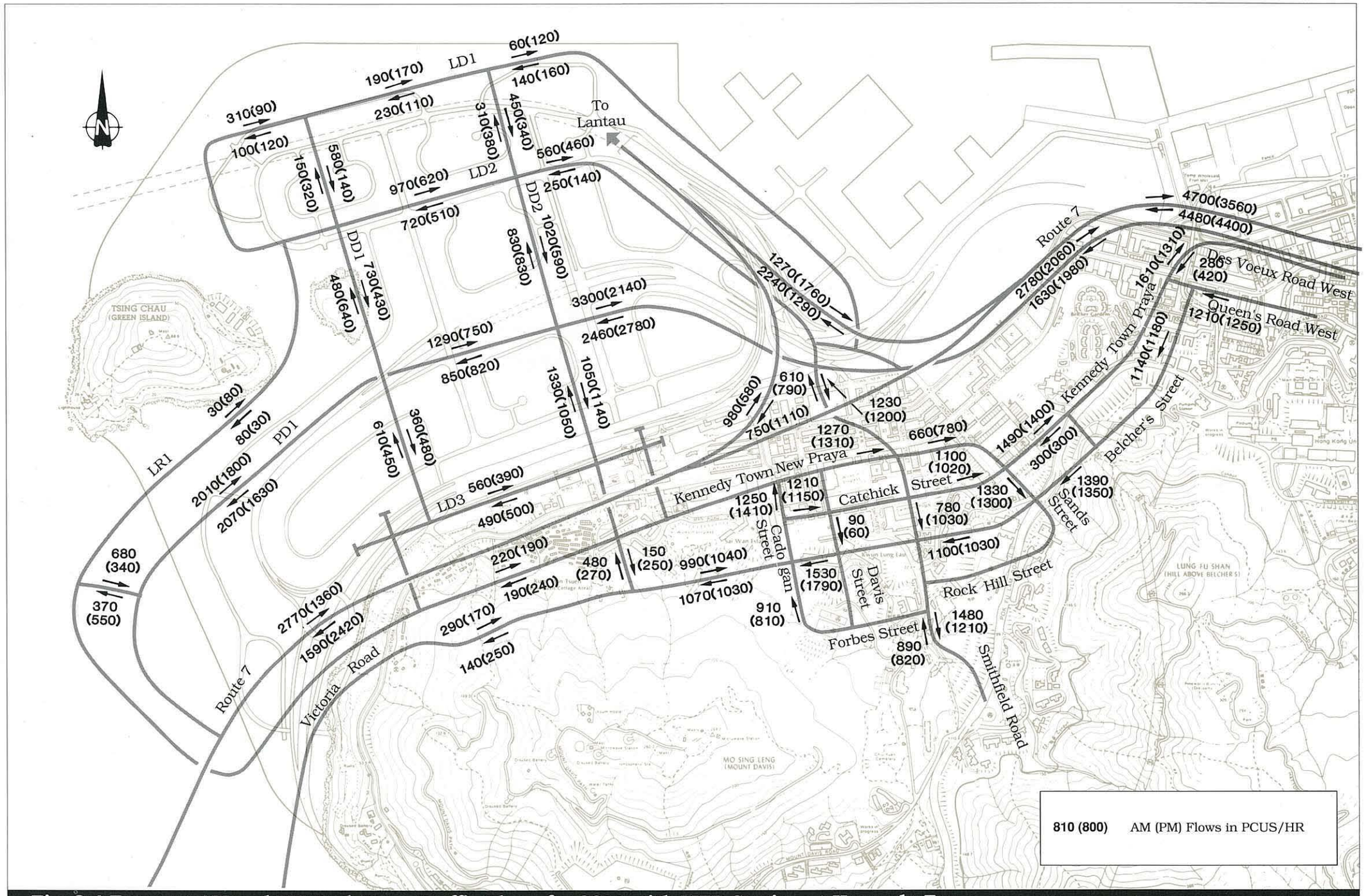


Fig. 2.4 Forecast AM and PM Peak Hour Traffic Flows for 2011 with MTR Station at Kennedy Town

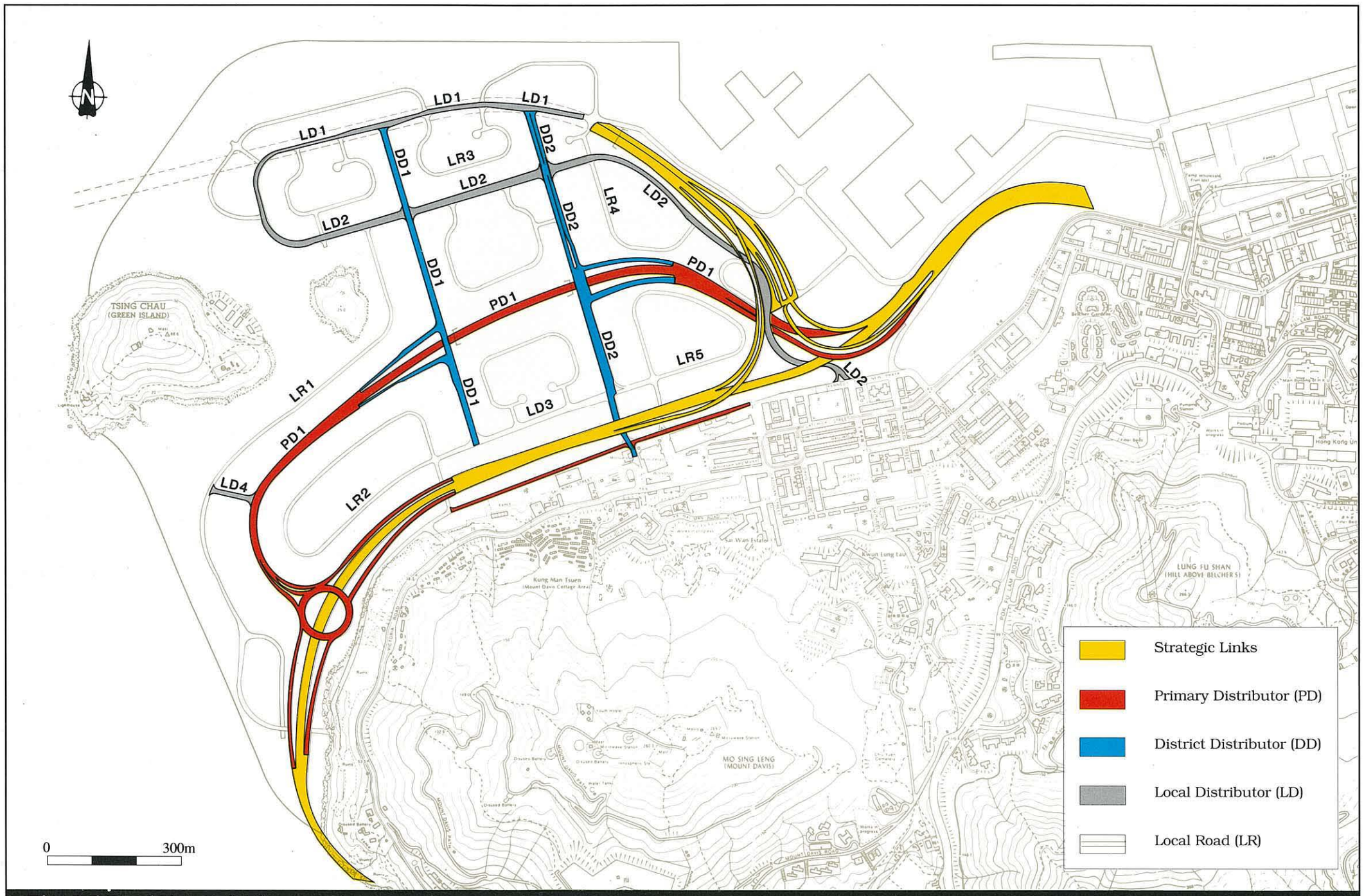


Fig. 2.5 Road Network Plan

• Primary Distributor

In the 'Options Report' - WP2 - it was anticipated that a population of 130,000 would be accommodated on the reclamation. This has subsequently been revised to 110,500 by Metroplan. As the reclamation will be predominantly residential, it is anticipated that only a single primary distributor will be required to feed the district road network.

Placing this primary distributor beneath Route 7, to reduce land taken, was investigated initially. Access to the reclamation from Belcher Bay Link would be from a right turn at a signal controlled junction. This junction would not have provided sufficient capacity.

The major movement at this junction would be the right turn to the reclamation and the left turn from it, a flyover in the vicinity of the existing abattoir was investigated. It was found that there was insufficient space for the deceleration lane and a third level would be necessary to pass over the primary distributor and also cross Route 7.

This proposal would allow very limited access to the reclamation at ground level and exacerbate severance between Kennedy Town and the reclamation.

Aligning the Primary Distributor (PD1) through the Central area of the reclamation gives a number of advantages:

- the Primary Distributor could be located away from Route 7, allowing a reduction in severance between Kennedy Town and the reclamation.
- junctions with strategic roads would be simplified whilst maintaining capacity by grade separating all movements.
- a dendritic network of roads within the reclamation would be possible thereby reducing the total road area required.

The connection between the PD1 and Route 7 in the east could be made via the previously proposed interchange on the Belcher Bay Reclamation. As traffic flows are less than expected from previous studies the interchange could be simplified by deleting the ramps westbound to Route 7 and eastbound from Route 7.

The connections between the PD1 and Route 7 in the west can be made by a roundabout which allows all movements, i.e. access to Route 7 to travel south and the north. Access to the north is required here to allow Green Island Reclamation traffic a connection to the Green Island Link.

• District Distributors

There are two district distributors (DD1 and DD2) which run north/south linking the various development areas on the reclamation to the Primary Distributor (PD1).

Originally all movement intersections between the two district distributors and the Primary Distributor were investigated. Because of the traffic volumes and the need to maintain urban trunk road status for the Primary Distributor all junctions are grade separated. It was found that there was not enough distance to enable all eight slip roads to join the district distributor. Various options were tested resulting in two one lane slip roads from DD1 to/from PD1 westwards andwo, two lane slip roads from DD2 to/from PD1 eastwards, as shown in Figure 2.6.
The section of the Primary Distributor between the two District Distributors would be in tunnel to maximise environmental benefits and land values.

• Local Distributors

Three local distributors are proposed (LD1, 2 and 3). The function of these roads is to link the two north/south district distributors (DD1 and DD2) to the local access roads within each of the development areas on the reclamation.

• Local Roads

Preliminary layouts for the local roads are as shown in Figure 2.6. During the detailed design of the development packages, the alignment of the local roads could change to conform to the development layout. However the proposed access points should be retained wherever possible.

Table 2.5 Trip Generation Rates Used for the Reclamation

	AM		PM	
	IN	OUT	IN	OUT
Commercial (per worker)				
office	0.048	0.033	0.045	0.047
retail	0.078	0.051	0.066	0.069
Residential (per person)				
PSPS/HOS	0.013	0.028	0.023	0.018
R1	0.026	0.043	0.033	0.022
Industrial (per worker)				
I(A)	0.025	0.013	0.041	0.038
I(C)	0.394	0.072	0.143	0.500
PCWA				
(per metre quay length)	0.130	0.221	0.206	0.138

Note: Rates give total vehicular trips (private and goods) in pcus.

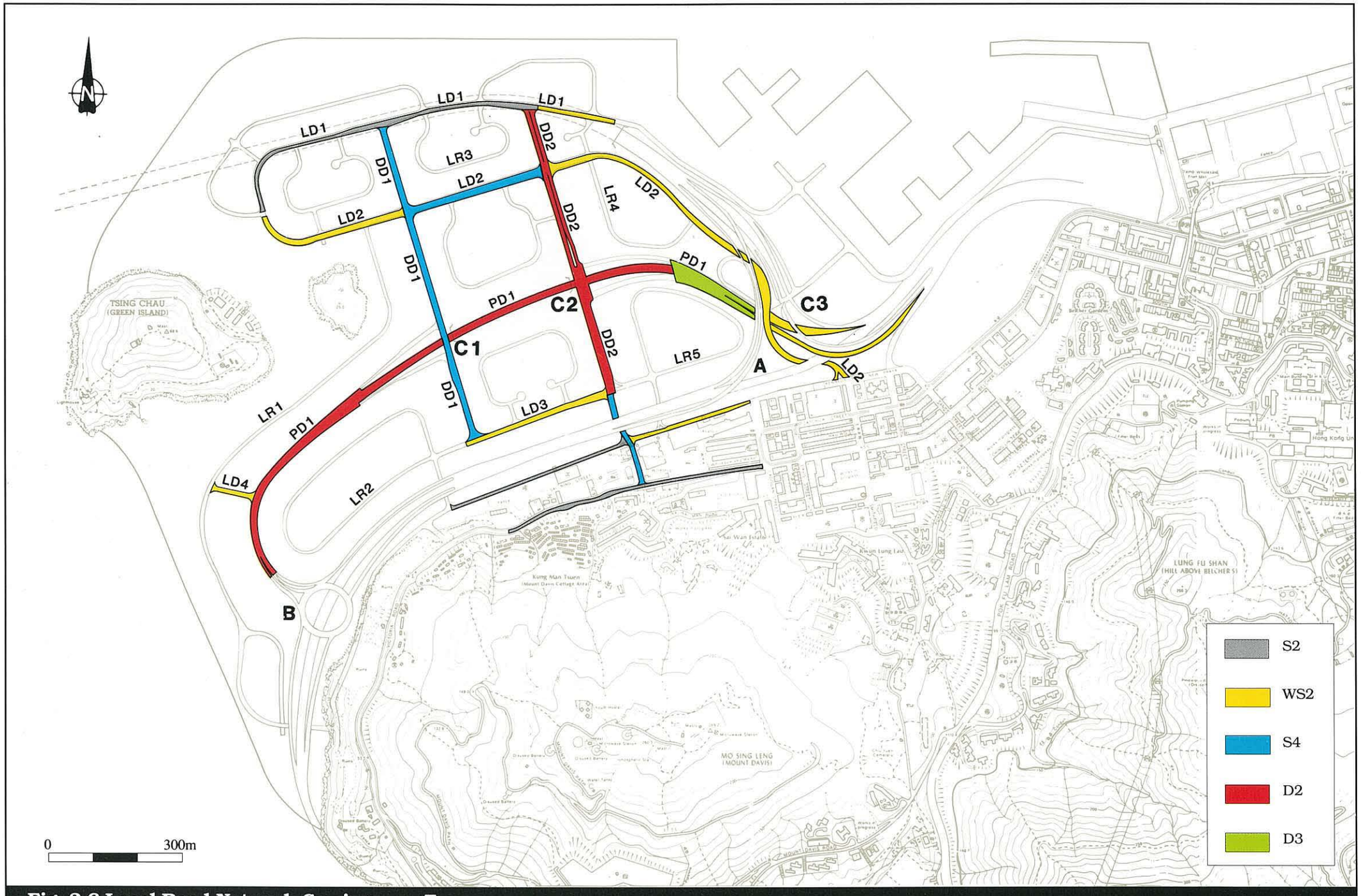


Fig. 2.6 Local Road Network Carriageway Types

• Belcher Bay

It is assumed that any local roads required on the southern part of the Belcher Bay reclamation (Figure 2.6 refers) would access directly from Kennedy Town Praya. There would be no direct connections to the Belcher Bay Link or Route 7.

• Network Performance

The network performance was examined in sufficient detail to confirm feasibility, and this is discussed in Section 2.7 below.

Table 2.6 Desirable Minimum Spacing Between Junctions

Road Type	Distance Between Junctions
Expressway	Desirable minimum - 5km Absolute minimum - 2km
Trunk Roads	Desirable minimum - 1km Absolute minimum - dictated by length of slip roads

Table 2.7 Road Types and Characteristics

Green Island Identification	Description	TPDM Standards	Peak Hour Design Flow (2 way)
S2	2 lane-single carriageway	7.3m	800vph
WS2	Wide 2 lane-single carriageway	10.3m	1200vph
S4	Urban 4 lane-single carriageway	13.5m	4800vph
D2	2 lane-dual carriageway	6.75mx2	5600vph
D3	3 lane-dual carriageway	10.0mx2	8400vph

Note: Carriageway widths do not include verges, bus laybys etc.

2.6 Public Transport Studies

2.6.1 Public Transport Demands

In the year 2011 the Reclamation and Kennedy Town is forecast to generate an estimated 242,000 daily public transport trips. Daily trip rates per head of population/ employment in 2011 are anticipated to be 36% higher than those existing in 1986. This assumption regarding trip rates has a significant effect on the demands for public transport throughout Hong Kong Island, not only on Green Island Reclamation.

Of these 242,000 daily trip ends, 29,000 will be during the peak hour and 23,000 will be in the peak direction, i.e. from the reclamation towards the East and Central in the a.m. peak and from the east to Green Island in the p.m. peak. This reflects the housing-led nature of the reclamation, as practically no employment is provided. It is anticipated that 20% of these trips will be internal Green Island and Kennedy Town trips with another 25% to and from the Sheung Wan, Central and Wan Chai areas. Trips to and from the east will comprise just over 10%, with less than 10% to and from Pok Fu Lam and the south. The remaining 35% of the trips will be between Green Island and Kowloon and the New Territories.

Table 2.8 Minimum Junction Spacing

Road Type	Distance
Primary Distributor (Urban Trunk Road)	300m
District Distributor	200m
Local Distributor	100m

The public transport systems examined to cater for these trips were :

- MTR
- Tram
- Franchised buses
- Green Mini-buses

No red PLB routes were considered in line with the PLB policy guidelines. TPDM Volume 9 Chapter 3 states that "Public light bus operations will be restricted to areas of activity within established patterns, by preventing extensions to new areas such as new towns and limited access roads. Green minibuses should be introduced in new towns where appropriate."

Two alternative extensions to the existing MTR Island Line were examined: to Kennedy Town and to the Reclamation. The tram options were extensions to the existing tram currently running to Kennedy Town. The MTR and tram extensions examined are shown in Figures 2.7 and 2.8 respectively. The purpose of the analysis of the MTR and tram systems was to examine the justification for providing reserves on the reclamation. Further studies would then be required if the initial analysis showed that there was expectation that the systems would be viable.

Fig. 2.7 Possible MTR Extensions

2.6.2 MTR Extension

Three possible MTR scenarios were examined:

- extension of the Island Line to Green Island Reclamation. (via Kennedy Town)
- extension of the Island Line only as far as Kennedy Town.
- no extension of the Island Line past Sheung Wan.

A full analysis of these three options and the expected revenue, and costs were reported in 'Review of MTR Extensions to Green Island - TP6'. For each option the boarding and alighting at each of the stations and an estimate of the likely increase in the system revenue were predicted. Many of the existing residents of Sai Ying Pun and Kennedy Town already use feeder services to the MTR and so it is the marginal changes in system boardings and revenues that are important. The estimated station patronage and marginal revenues for the two extensions to Kennedy Town and to Green Island for 2011 are given in Table 2.9.

Table 2.9 Estimated Daily Patronage and Marginal System Revenue for an MTR Extension to the Reclamation in 2011

	No Extension	Extension to Kennedy Town	Trips Extension to Green Island
Sheung Wan	174,000	116,300	118,900
Sai Ying Pun	0	61,800	64,600
Whitty	0	48,600	51,300
Kennedy Town	0	141,000	66,600
Green Island	0	0	100,200
Annual Daily Marginal System Revenue (*) HK$ millions (mid 1989 prices)		139	164
Daily Marginal System Boardings (*)		79,800	101,300

(*) Marginal revenues and boardings are the difference in values with and without MTR extensions from Sheung Wan to Kennedy Town and the Green Island

(*) Marginal revenues and boardings are the difference in values with and without MTR extensions from Sheung Wan to Kennedy Town and to Green Island.

The marginal revenues of an extension to Kennedy Town or onto the reclamation would cover the operating costs. However, the surplus revenue (after deduction of the operating costs) would be insufficient to finance the construction.

It was recommended that the reserve to Kennedy Town should be retained for long term planning purposes. In addition, a reserve would be retained across the reclamation to allow for a long term extension to Lantau Island. However, no station reserve would be retained on the reclamation, as an extension to Lantau would require a very deep track alignment across the reclamation.

2.6.3 Tram Options

Various tram options were looked into, these options consisted of:

- extending the existing tram onto the reclamation. This would complement any MTR extension;
- in the event that a MTR extension was not pursued, a tram feeder to Sheung Wan has been examined. The option of incorporating an upgraded tram, running on a revised alignment through Kennedy Town was examined.

The extension of the existing tram was investigated with three alternative assumptions regarding MTR infrastructure:

- MTR extended to the reclamation
- MTR extended to Kennedy Town
- No MTR extension from Sheung Wan

The operation of an upgraded tram from Sheung Wan to the reclamation was examined only in the event that there was no MTR extension.

During the study Transport Department, queried the assumption of retaining the tram in its existing form. The design year is 2011, and it is arguable that there may be improvements to the tram system which will enhance the overall operating characteristics. However, as the tram already operates to Kennedy Town, any extension must logically be operated by Hong Kong Tramways. The reclamation development is too small to justify its own separate rail based system. The base system must, therefore, be that operated by Hong Kong Tramways.

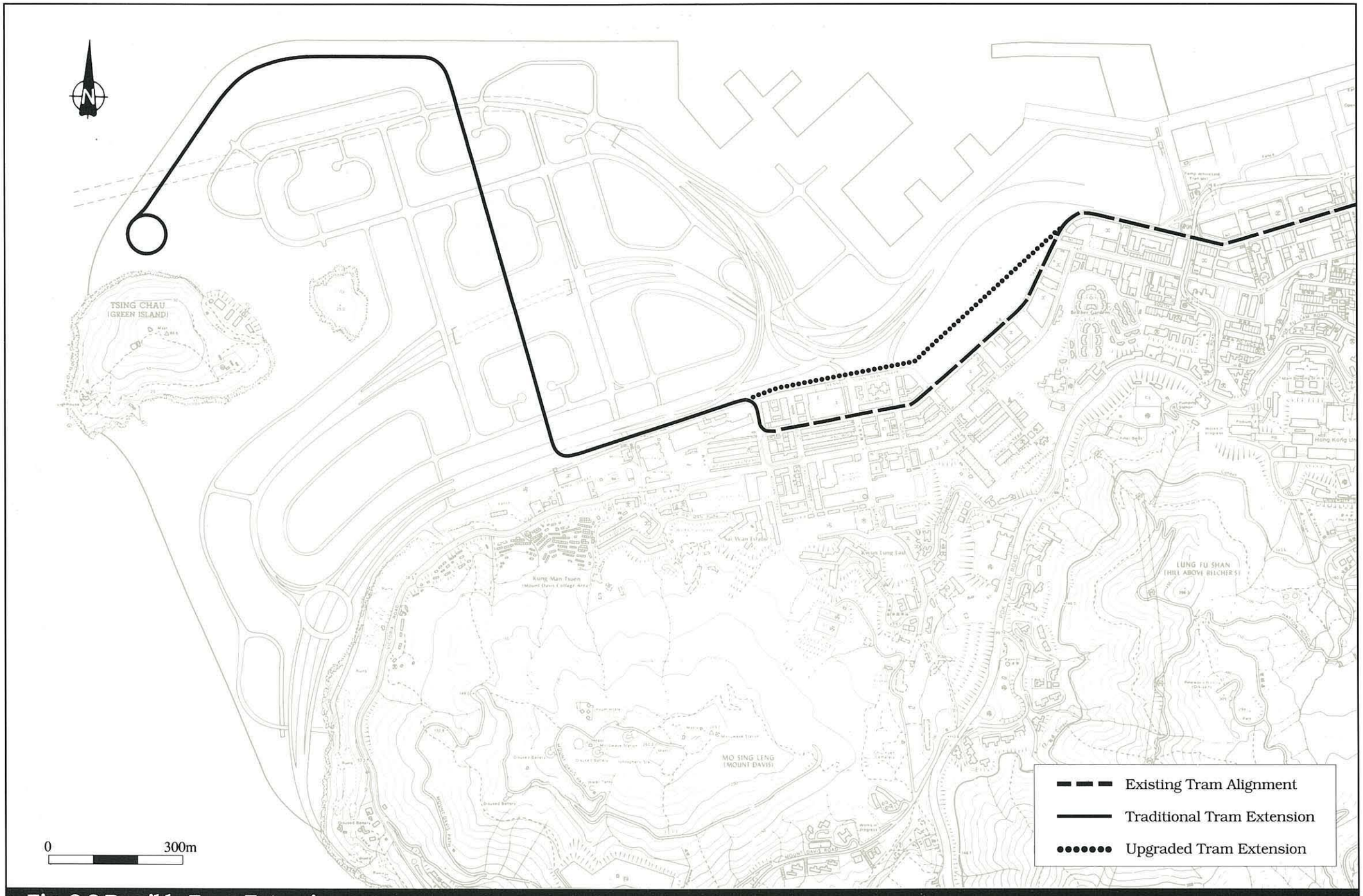


Fig. 2.8 Possible Tram Extensions

• Alignment

The alignment of the traditional or upgraded tram was assumed to be the same across the reclamation.

Running the tram on the reclamation in a loop along the district distributors was considered but in order for the junctions to have positive reserve capacity it was necessary to either ban most of the right turns or have major grade separation at each junction.

The option of the tram running along the main north/south open space corridor was then examined. In this alignment the tram extends westwards from Kennedy Town adjacent to
the Route 7 alignment as far as the existing China Merchant's Wharf where it would turn north. The alignment is then along the side of the green open space corridor passing over the primary distributor, three local distributors and three local access roads until it reaches the waterfront. It then turns along the waterfront to the Urban Fringe Park at Green Island.

• Existing Tram

The proposed tram extension would replace the existing turnaround at Catchick Street by extending the alignment from Catchick Street north along Cadogan Street to Kennedy New Town Praya and then to the west adjacent to Route 7. A turnaround facility would then be placed under Route 7 in the vicinity of the existing abattoir, where the tram would join the alignment across the reclamation described above. The new location for the tram turnaround has the advantage of reducing the conflict between the trams and other traffic on the road. The total length of the extension would be 2.5km. This alignment is shown in Figure 2.8.

The operation of the tram through the open space corridor would provide maximum accessibility. Along the waterfront the tram would run along the promenade, possibly segregated from pedestrians. For the purpose of costing the extension, tram stops have been assumed every 250 metres, although the exact spacings would depend on the detailed development layouts.

There is also the possibility that the vehicle length of the existing tram could be extended by 18 inches. Although this extension would not significantly increase the capacity of the vehicle it would enable the tram to become bi-directional. This would give the advantage of being able to use sidings instead of loops to reverse direction. A loop turnaround, if enough space can be provided, however, also gives stacking room for layover time at the terminus.

The tram fare considered for the extension to Green Island was a HK$1.00 (in 1989 prices) flat fare for each boarding anywhere on the Island-wide system. It was assumed that franchised bus services on Green Island would provide a similar level of service to that currently provided for Kennedy Town i.e. CMB buses within Hong Kong Island and cross harbour buses to Kowloon. Local GMB services were also assumed to link Green Island with Kennedy Town.

The loading on the extension and an estimate of the likely increase in system boardings and revenue were predicted and these are given in Table 2.10.

Table 2.10 Estimated Marginal Increase in Patronage and Marginal System Revenue for an Extensn of Tram Services to The Reclamation

	No Tram	Tram Extension to Kennedy Town	Tram Extension to The Reclamation
Marginal Daily Boardings	18,700	21,400	22,800
Annual Marginal System Revenue HK$ millions (1989 prices)	6.4	7.3	7.7

Note: Marginal revenues and boardings are the difference in values with and without the traditional tram extension from Kennedy Town to Green Island

The capital costs of an extension to the reclamation were estimated at HK$43 million and the operating costs HK$3 million per year (1989 prices), giving an annualised operating and capital cost of HK$7.2 millions. It has been estimated that 10 extra trams would be required to serve the extension with a 4 minute headway service. The existing depots belonging to Hong Kong Tramways would be able to cater for these extra trams.

The figures assume a zero land cost but it is anticipated that the land would be granted to Hong Kong Tramways in a similar manner to the LRT reserve in Tuen Mun. However, this would need to be considered in more detail by Government in the future.

The above figures do not included any passengers attracted by the Urban Fringe Park or the associated retail/tourist activities along the seafront. This indicates that the tram extension may well be viable and a more comprehensive study would be required during the detailed design of the
reclamation. A tram reserve has been provided in the Recommended Outline Development Plan.

• Upgraded Tram

An upgraded tram option was investigated. A more modern tram design could be based around two bogies. The vehicle would be longer, upto a length of 11.5m, and would have more entrance doors together with a redesigned lower deck allowing for greater freedom of movement from rear to front, with more standing space downstairs and maximum seating upstairs.

The twin bogies would provide a superior ride to that experienced on the present trams and modern control equipment would allow for smooth acceleration and braking. Maximum speeds would also increase.

Along the existing tram track from Sheung Wan Station to Hill Road, there is no alternative alignment and limited opportunities for improvement other than those identified during the Western District Traffic Study. From Hill Road to the west, along to Kennedy Town and then onto Green Island Reclamation there is room to provide a better level of service by upgrading the tram. The proposed upgraded tram alignment is shown in Figure 2.8.

Along the open space corridor and along the waterfront the tram would run along a fenced right of way; stops would be approximately 400 metres apart. Increasing the frequency of stops would add to the capital cost, and decrease system performance.

Two alternative fare structures for the upgraded tram were examined :

- HK$2.00 flat fare for each boarding of the system between Green Island and Sheung Wan.

- HK$3.00 flat fare for each boarding of the system between Green Island and Sheung Wan.

A fare higher than HK$3.00 was considered not to be feasible for a non- airconditioned service because of the competition from express bus MTR feeder services. The remainder of the tram service could retain the $1.00 fare, and a surcharge would be payable at Sheung Wan.

It was assumed that franchised bus services on Green Island would provide a similar level of service to that currently provided for Kennedy Town, i.e. CMB buses within Hong Kong Island and cross harbour buses to Kowloon. Local GMB services were also assumed to link Green Island with Kennedy Town.

Table 2.11 Estimated Patronage and Marginal System Revenue for an Upgraded Tram to the Reclamation

	HK$2.00 Fare	HK$3.00 Fare
Decrease in Traditional Tram Boardings	124,000	126,000
Upgraded Tram Boardings	77,000	54,000
***Annual Marginal Decrease Traditional Tram System Revenue**	-42.3	-43.0
***Annual Upgraded Tram System Revenue**	52.5	55.4
***Resultant Increase in Annual Revenue**	10.2	12.4

Note: * in HK$ millions (1989 prices)

The resultant drop in traditional tram trips and the number of trips on the upgraded tram system, along with the marginal revenues are shown in Table 2.11.

- The capital costs are estimated at HK$115 million and the operating costs HK$9 million per year (1989 prices). This represents a total annualised cost of HK$19.5 million. This assumes zero land costs and ignores depot requirements. Depot requirements are more important for the upgraded tram than for the traditional one as new equipment and technology will be needed. The existing depots could not cater for a significant number of longer trams. Additional investment would also be required in new equipment for repair and maintenance.

The analysis undertaken has indicated that a small system of upgraded tram service is unlikely to be profitable. A system wide upgrade, with an associated fare rise may occur between 1991 and 2011, but this will be dependent on Hong Kong Tramways. This will relate to their intended market, as currently they offer a cheap, relatively poor quality service which caters for a particular market segment.

A tram reserve across the reclamation has been retained on the RODP and OZP. It passes through the centre of the reclamation and along the waterfront to the Urban Fringe Park. The revised alignment across Belcher Bay has not been retained. It would remove the tram from much of its immediate catchment and the land use on the Belcher Bay reclamation will not generate a high demand for tram trips.

Table 2.12 Bus Routes and Frequencies with an MTR Extension to the Reclamation

Route No.	Capacity (passengers)	Max Load	Departures/Hour		Frequency (minutes)	
			Required	Assumed	Required	Assumed
Cross Harbour						
1	150	1550	11	10	5/6	6
2	150	1050	8	5	7/8	12
3	150	600	4	4	15	15
4	150	600	5	5	12	12
Pokfulam & South						
1	120	750	7	5	9	12
2	120	650	6	5	10	12
Central & East, Midlevels						
1	150	1550	10	8	6	7/8
2	120	1150	10	8	6	7/8
3	120	900	8	5	8	12
4	150	1450	10	8	6	7/8
Local						
1	120	1150	10	8	6	7/8
2	150	1500	10	8	6	7/8
3	150	1700	11	8	5/6	7/8
Feeders						
1	120	1300	11	8	5/6	7/8
2	120	1050	9	6	7	10
3	120	1250	11	8	5/7	7/8
Total of 16 Routes						

2.6.4 Bus Provision

To estimate the likely road based public transport flows, franchised bus service needs have been examined under the with- and without-MTR scenarios. A similar level of service as exists in Kennedy Town has been assumed.

Four destination areas were identified:

- Cross Harbour
- Central & Eastern
- Pokfulam and Southern
- Local, within Western District

It has been assumed that the buses within these designated areas are all new services. It is possible that some of these routes may be an extension to existing services currently serving Kennedy Town. To identify the routes in this much detail would require more detailed analysis which is beyond the scope of this feasibility study.

There is some concern that, although terminus facilities can be provided at the Green Island end of the routes, terminus facilities at the destination end, especially in the Central and Eastern Distict, will be a problem. This issue would have to be addressed at the stage of detailed design of the reclamation public transport provision. The purpose of this study is to ensure that the reclamation can be designed to cater for the maximum road based public transport demand.

The Cross Harbour routes have been designed to have as large a catchment as possible from Green Island, and then join the primary distributor where they would then have a limited number of stops before reaching the appropriate tunnel.

The Public Transport Corridor is currently eastbound along Kennedy Town Praya and Des Voeux Road West and westbound along Queen's Road West and Belcher Street. It has been assumed that this will continue. Thus the buses to Central and Eastern circulate around the Green Island reclamation and then travel along the main district distributors, through Kennedy Town, to a widened Kennedy Town Praya and then along Des Voeux Road West. Some of these buses for longer distance trips could become express routes, picking up in Green Island and then making use of the primary distributor to access Connaught Road West. It is assumed that feeder services to Sheung Wan MTR would operate this way if no MTR extension were to be constructed.

Although less than 10% of the trips from Green Island are to Pokfulam and the South, there are no alternative public modes except franchised buses and GMBs. Routes have been identified using both the Smithfield extension and Victoria Road.

The local routes designed for trips as far as Sheung Wan use a local distributor road which links to Smithfield and Kennedy Town Praya.

If the MTR is extended to either Kennedy Town or Green Island MTR feeder services will be required. These services pick up in the residential areas of the reclamation and terminate at the appropriate MTR station.

With an MTR station on Green Island Reclamation 16 bus routes have been identified: 4 cross harbour services; 4 to Central and Eastern; 2 to Pokfulam and the South; 3 local services; and 3 MTR feeders. More details of these routes are given in Table 2.12. The required numbers of departures are those that are calculated by assuming the full peak demand.

Table 2.13 Bus Routes and Frequencies with an MTR Extension to Kennedy Town

Route No.	Capacity (passengers)	Max Load	Departures/Hour		Frequency (minutes)	
			Required	Assumed	Required	Assumed
Cross Harbour						
1	150	1950	13	10	4/5	6
2	150	1350	9	6	7	10
3	150	750	5	5	12	12
4	150	1350	9	6	7	10
Pokfulam & South						
1	120	850	7	6	9	10
2	120	800	7	6	9	10
Central & East, Midlevels						
1	150	2050	14	10	4/5	6
2	120	1400	12	10	5	6
3	120	1050	9	5	7	12
4	150	2000	13	10	4/5	6
Local						
1	150	1800	12	10	5	6
2	120	1400	12	10	5	6
3	150	1950	13	10	4/5	6
Feeders						
1	120	1100	9	6	7	10
2	150	1400	9	6	7	10
3	150	2350	16	12	4	5
4	120	1100	9	5	7	12
Total of 16 Routes			178	133		

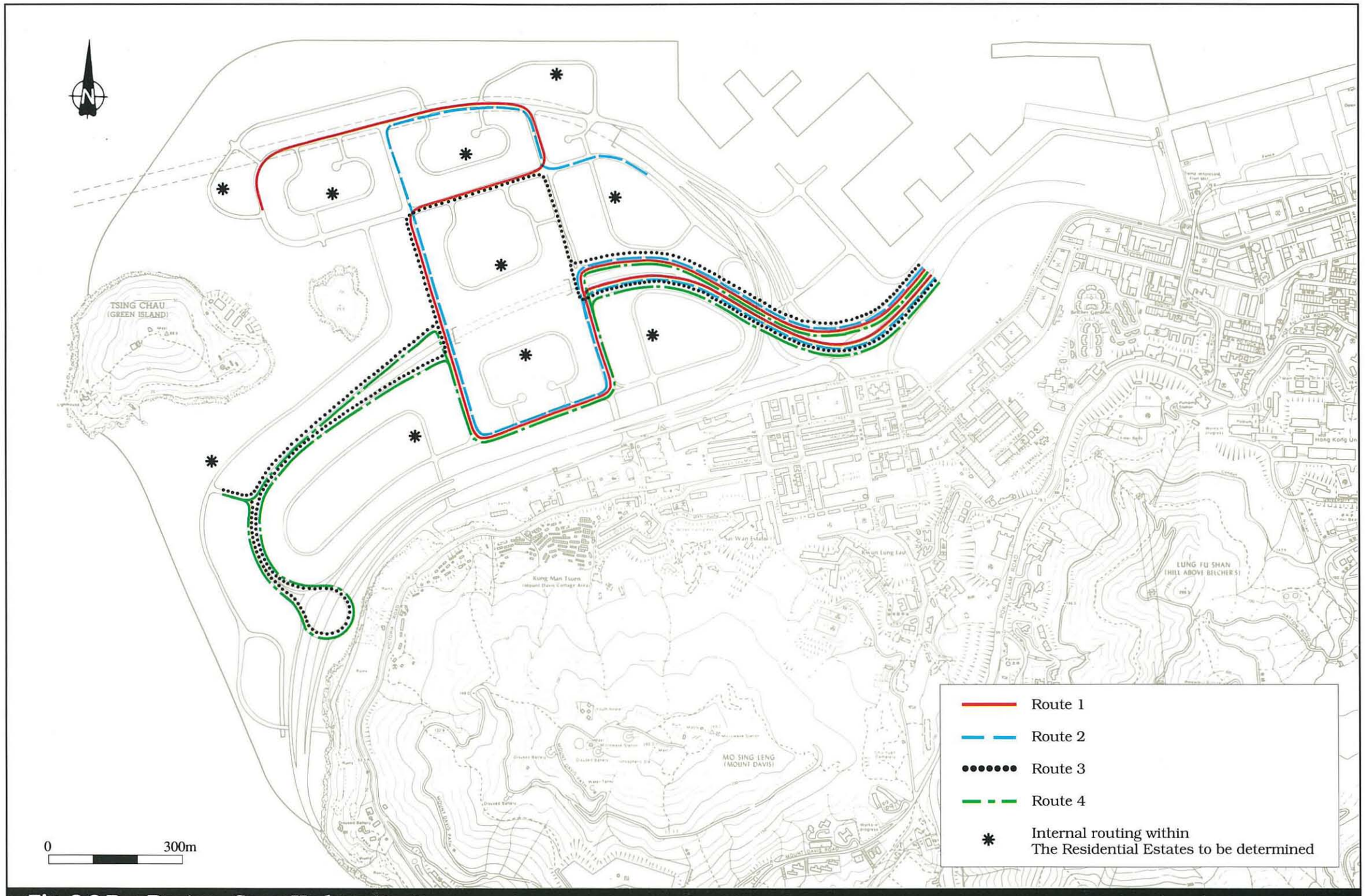


Fig. 2.9 Bus Routes - Cross Harbour Routes

The 'required' departures has been used for the purposes of sizing the road networks. In practice it is anticipated thatthe frequency would be reduced to represent a "flattening" of the peak, and to avoid over- supply of buses which would be redundant in the off-peak. The assumed departures provides for 75% of the maximum peak demand. In terms of pcus for highway design, the difference is not significant, but for sizing of bus termini etc., the difference is significant.

With an MTR station at Kennedy Town 17 bus routes have been identified: 4 cross harbour services; 4 to Central & Eastern; 2 to Pokfulam and the South; 3 local services; and 4 circular MTR feeder services. More details of these routes are given in Table 2.13 and Figures 2.9 to 2.13.

With no MTR extension beyond Sheung Wan, 17 bus routes have been identified: 4 cross harbour services; 4 to Central & Eastern, 2 to Pokfulam And Southern; 7 local services within Western District (these local services will also act as MTR feeder services). More details of these routes are given in Table 2.14.

2.6.5 Green Mini-buses

The Green Mini-bus guidelines, TPDM Volume 9, Chapter 3, recommend that Green Mini-buses be used only to fill in gaps in the network where franchised buses, railways and trams cannot physically or economically operate.

In view of this guideline it was assumed that only trips within Green Island were to be catered for with Green Mini-buses, i.e. 12,000 trips daily or 2,200 two-way trips in the peak hour.

Six routes with a 5 minute headway could cater for this level of demand. The exact routings within the estates on Green Island Reclamation would require more detailed analysis and would be dependent on the exact layout of the development areas.

2.7 Recommended Local Road Network Design

2.7.1 Road Network

The choice of carriageway type for the major routes was based on the forecast traffic flows. The traffic flows were the combination of the estimated private and goods flows and road based public transport demands. The proposed road network with the carriageway types was illustrated in Figure 2.6.

Road PD1, a Primary Distributor serving the reclamation, is a Dual-2 type carriageway except at the section east of Interchange C2 where it becomes Dual-3. The number of accesses to Road PD1 have been kept to a minimum and grade-separated to ensure a high grade, free-flowing route.

There are two District Distributors. Road DD1 and Road DD2 are both Single-4 type carriageways. Road DD1 acts as a north-south connection within the reclamation and Road DD2 links the reclamation to Victoria Road in Kennedy Town, at Sai Ning Street.

Four Local Distributors (LD1-4) are proposed and presented as shown in (Figure 2.5). Road LD2 serves the north and eastern side of the reclamation and east Kennedy Town. The Road intersects Kennedy Town New Praya at Smithfield to form a cross road. Forecast traffic demands along Road LD2 only required a WS2 type carriageway, but the relatively high flows in and out immediately north of the primary distributor and the area between the two district distributors made it necessary to upgrade the status of the section between Road DD1 and Road DD2 to a single 4 lane road.

Table 2.14 Bus Routes and Frequencies with No MTR Extension Beyond Sheung Wan

Route No.	Capacity (passengers)	Max Load	Departures/Hour		Frequency (minutes)	
			Required	Assumed	Required	Assumed
Cross Harbour						
1	150	2200	15	10	4	6
2	150	1500	10	10	6	6
3	150	850	6	5	10	12
4	150	1500	10	10	6	6
Pokfulam & South						
1	120	900	8	5	7/8	12
2	120	800	7	5	9	12
Central & East, Midlevels						
1	150	2550	17	12	3/4	5
2	150	1750	12	10	5	6
3	150	1300	9	6	6/7	10
4	150	2500	17	12	3/4	5
Local						
1	150	2000	13	10	4/5	6
2	150	1550	10	8	6	7/8
3	150	2150	14	10	4/5	6
4	120	1200	10	8	6	7/8
5	150	1550	10	8	6	7/8
6	150	2600	17	12	3/4	5
7	150	1200	8	6	7/8	10
Total Departures			193	145		

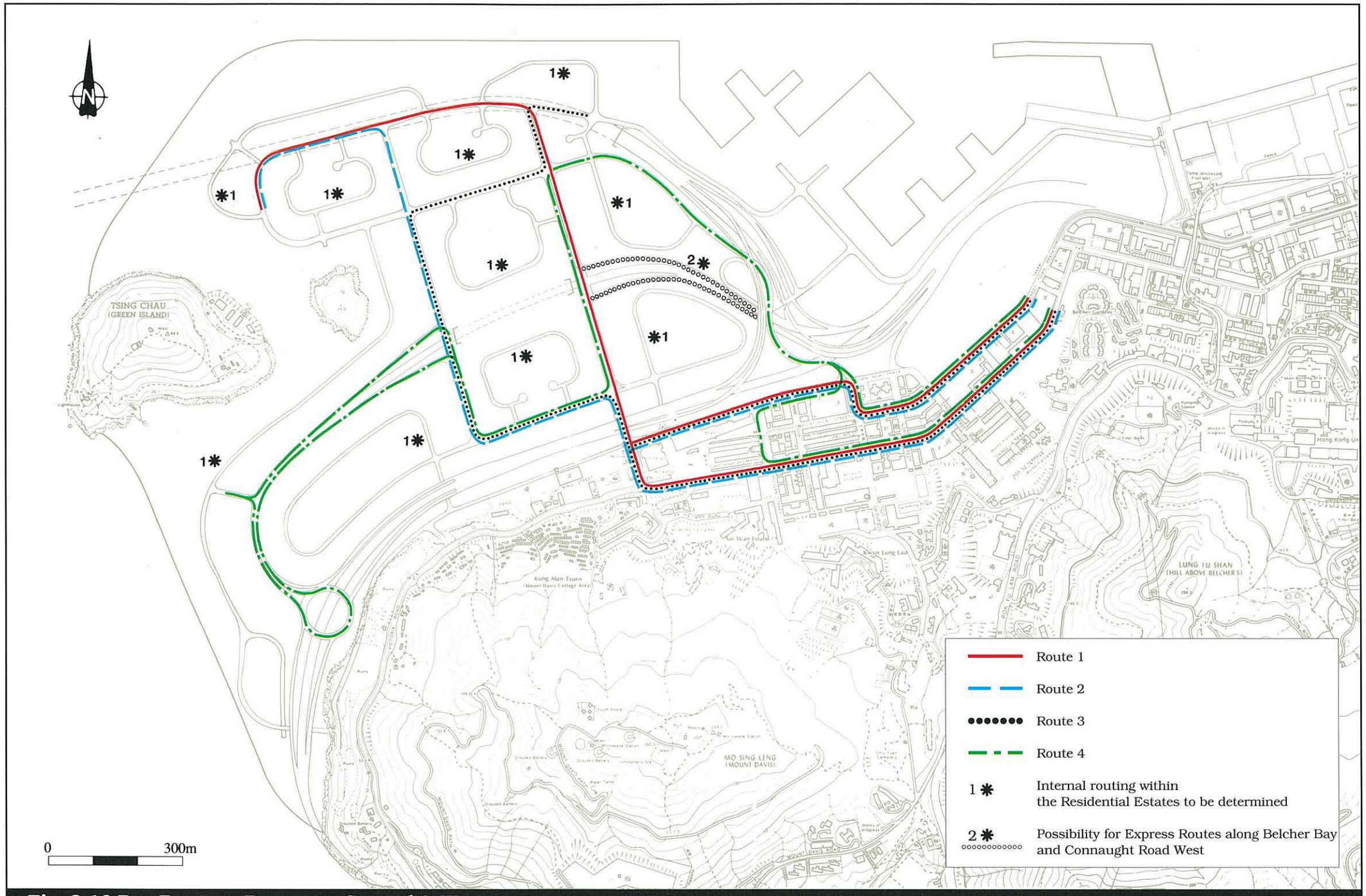


Fig. 2.10 Bus Routes - Routes to Central & Western

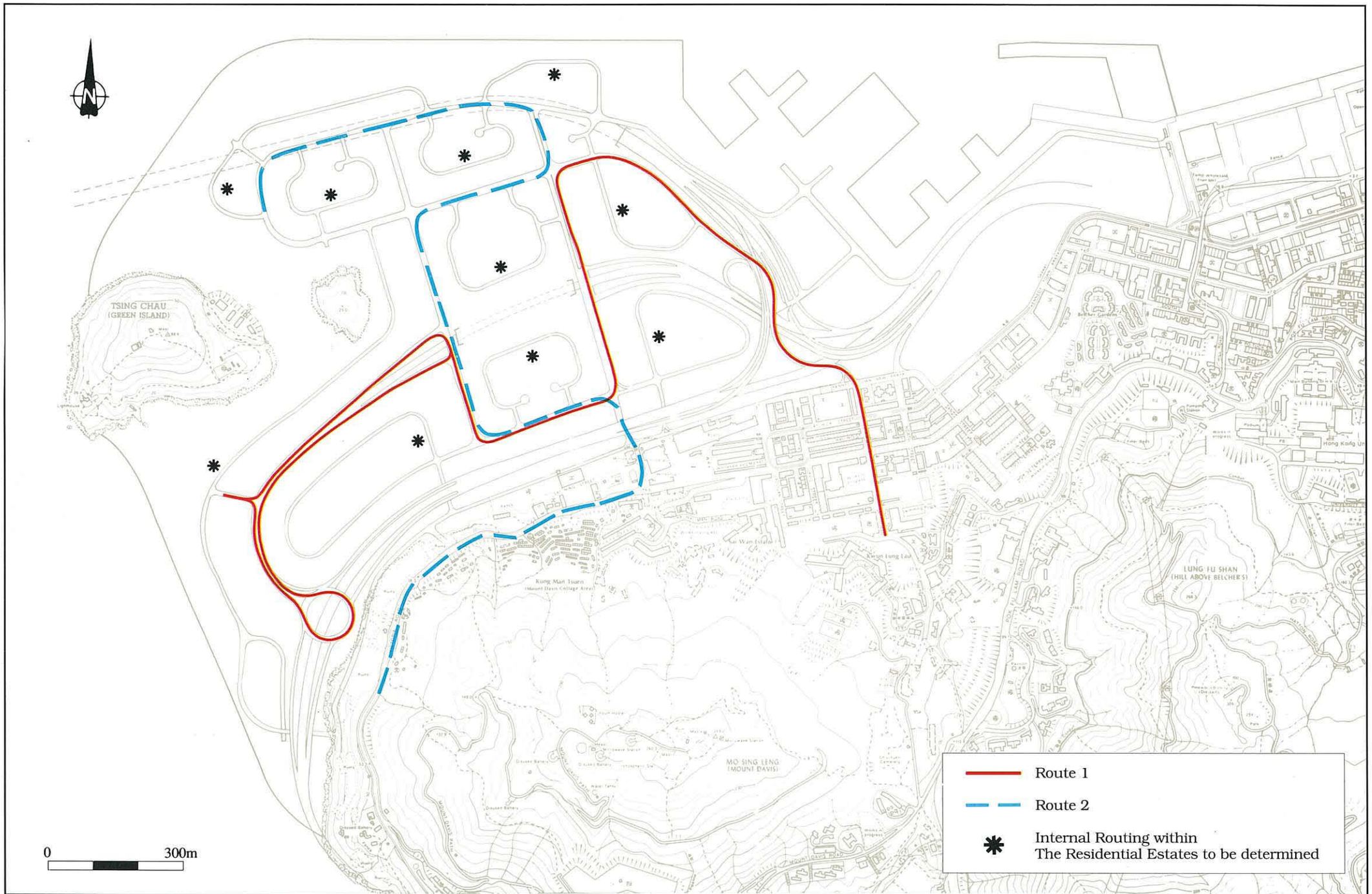


Fig. 2.11 Bus Routes - Pok Fu Lam and Southern District

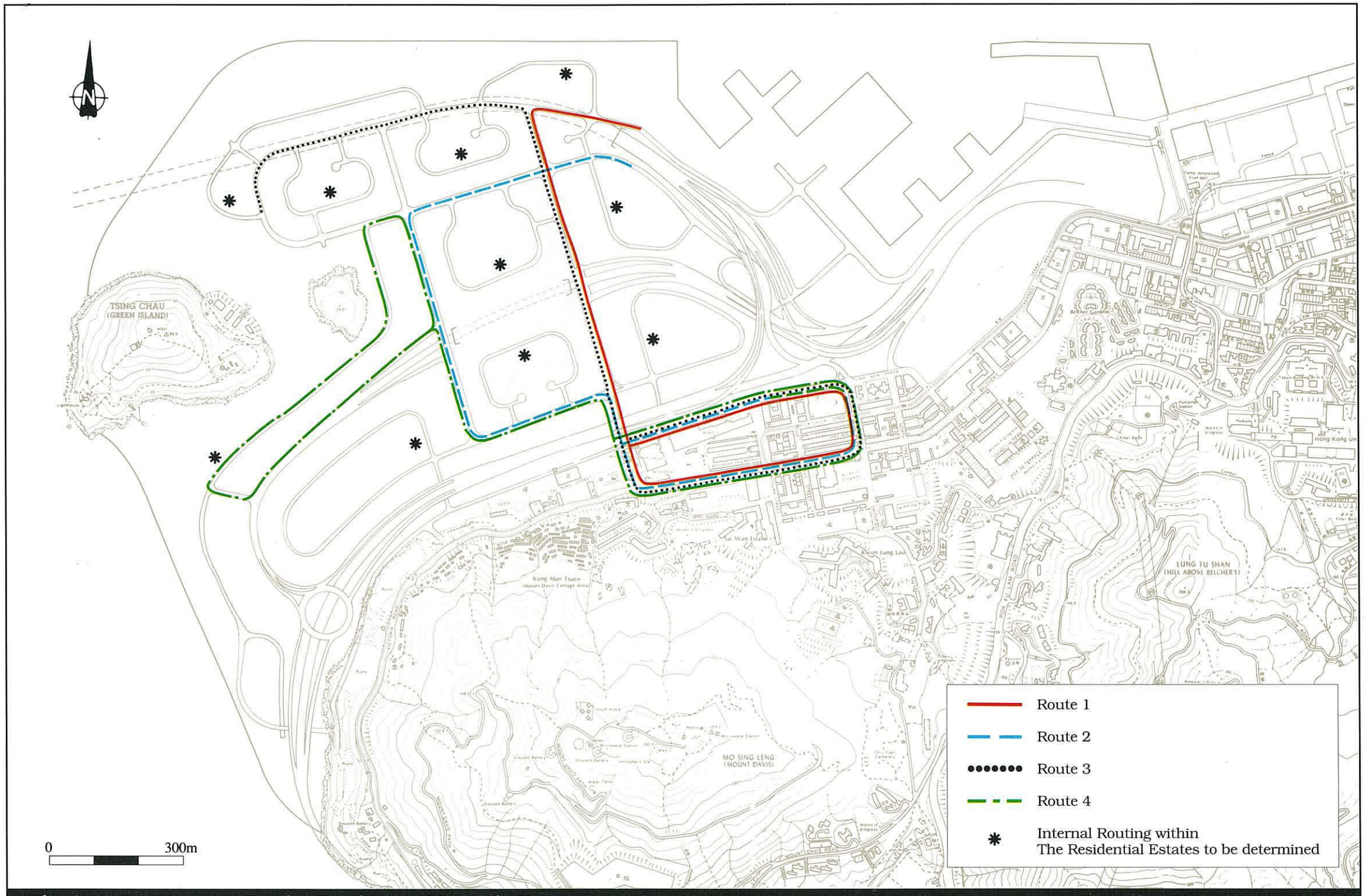


Fig. 2.12 Bus Routes - Feeder Services to Kennedy Town

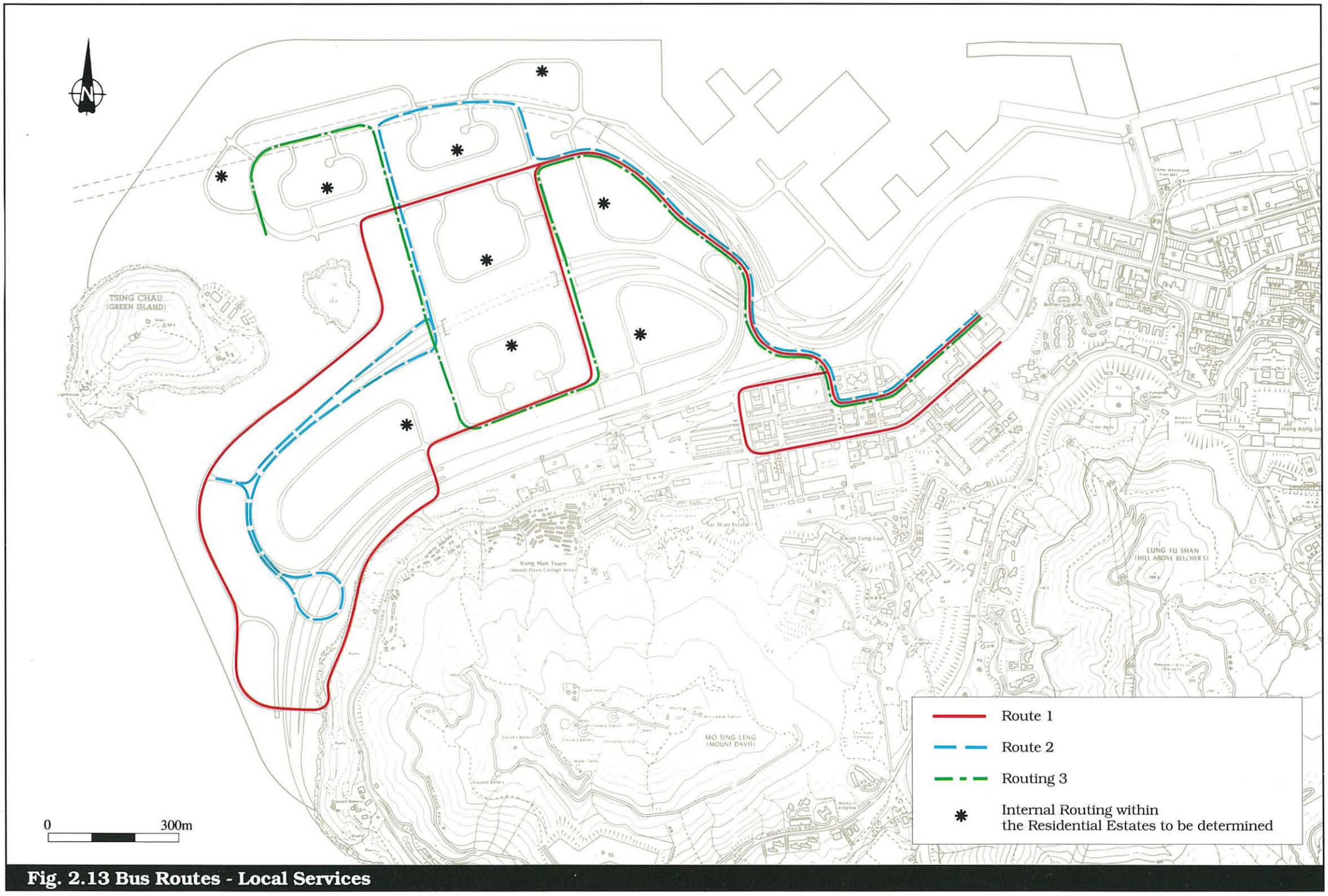


Fig. 2.13 Bus Routes - Local Services

Local Distributor LD4 links the local roads in the south west of the reclamation straight onto PD1. This junction is restricted to left in/left out movements only. To allow the right turns would require grade separation and there is no room for this. In order to turn right from LD4 westwards on PD1 a U-turn at Intersection C1 is required and to turn right from PD1 into LD4 a U-turn at Roundabout B is required.

The car and coach park for the Urban Fringe Park are located to the south of the park with easy access to Road LD4. The above arrangement has the added advantage that the traffic to the Park does not need to use the reclamation local road network. To access the park from the rest of Hong Kong, Route 7, Roundabout B and PD1 are used and from the park straight onto PD1 and then up to Route 7 at Belcher Bay.

Table 2.15 lists the major interchanges, which are all grade-separated to ensure unimpeded flow along the main links.

Spacing of junctions along the District Distributors have already been designed to a minimum as set out in the TPDM, with the exception of local roads to development areas. Access to the area immediately north of the Primary Distributor and between the two district distributors from Road DD2 has been restricted to left-in/left-out movements only. It was envisaged that any right turns would seriously hamper the adjoining junction operations.

Table 2.15 Inventory of Major Interchanges

Interchange	Description	Remark
A	Route 7/ Green Island Link	Grade Separated
B	Route 7/ Road PD1	Roundabout
C1	Road PD1/ Road DD1	Signalised
C2	Road PD1/ Road DD2	Signalised

2.7.2 Junction Capacity Assessment

•Methodology and Analysis

It was considered essential to assess the junction performance for all major road junctions. Capacity analysis was carried out for the morning and evening peak hour traffic conditions. See Figure 2.14. In general, three arm junctions were less critical, and therefore only contributed a minor part of the analysis. The computer program PICADY2 was used to evaluate the need for signalisation at the major intersections. Only the most critical peak was assessed and the results are shown in Table 2.16.
From the priority analysis, it was decided that traffic signals were required at the junctions of Road LD1/ Road DD1, Road LD1/Road DD2 and Road LR3/Road LD1.

A conservative method of reserve capacity calculation was adopted for the analysis of signalised intersections. The design for the junctions was intended to fulfil the requirement of a minimum reserve capacity of +25%. The design criteria was to operate each junction on a fixed cycle time of 60 seconds whenever possible.

A saturation flow of 1800 pcus/hr was taken for a straight on exit lane while a value of 1400 pcus/hr was adopted for each exclusive turning lane.

Table 2.16 Ratio of Flow To Capacity at Major Priority Junctions

Junction	Ratio of Flow to Capacity (RFC)
Road LR1/Road LD2	0.606
Road LR2/Road LD3	0.589
Road LR3/Road LD1	1.090
Road LD1/Road DD1	0.950
Road LD1/Road DD2	1.233
Road LD2/Road LR4	0.379
Road LD3/Road DD1	0.755

Signalised junctions in the vicinity of the reclamation, i.e. in Kennedy Town, were also examined to assess the impact on the existing road network.

The full set of traffic signal reserve capacity calculation results are shown in Table 2.17.

• Interchange B

The performance of the roundabout of Interchange B was investigated with the computer program ARCADY2. The layout requirements are summarised in the Table 2.18. With a 90m inscribed circle diameter for roundabout B, adequate capacities were obtained at all peaks, as shown in Table 2.18.

A roundabout is the most appropriate design at this location because of the need to allow the U-turn movement from the primary distributor.

• Interchanges C1 and C2

Due to the complexity of the 'diamond' arrangements at Interchanges C1 and C2, it was necessary to examine each interchange as two separate signalised junctions. Particular care on signal timing linking is required on such closely spaced junctions to avoid blockages caused by queueing back.

Interchange C1 has a 'half-diamond' arrangement for both options and was found to have sufficient reserve capacities if a four-lane bridge was to be constructed over Road PD1.

Table 2.18 Layout Requirements for Roundabout at Interchange B

From	Number of Approach Lanes Required	Remarks
Road PD1	2	Requires one exclusive lane to Route 7 eastbound
Route 7 Eastbound	2	Requires 2 approach lanes
Route 7 Westbound	2	2 Approach lanes flare to 3 at the Roundabout

Note: For Location see Figure 2.6

Table 2.17 Junction Reserve Capacities

Junction	Reserve Capacity					
	MTR to Sheung Wan		MTR to Kennedy Town		MTR to the Reclamation	
	AM	PM	AM	PM	AM	PM
C1 (North)	50%	55%	50%	60%	45%	30%
(South)	70%	160%	70%	165%	55%	115%
C2 (North)	25%	80%	30%	90%	70%	145%
(South)	20%	30%	25%	35%	35%	45%
Road DD2/ Road LD2	40%	100%	45%	105%	25%	65%
Road DD2/ Road LD1	100%	110%	105%	110%	40%	35%
Road DD1/ Road LD1	45%	95%	50%	105%	30%	45%
Road DD1/ Road LD2	30%	45%	30%	45%	25%	35%
Road DD2/ Road LD3 (Signals)	25%	40%	30%	45%	40%	75%
(Roundabout) (2)	0.80	0.78	0.77	0.76	0.56	0.56
Road LD1/ Road LR3	125%	130%	130%	135%	45%	30%
Kennedy Town New Praya/ Road DD2	30%	75%	30%	80%	50%	185%
Victoria Road/ Road DD2	40%	70%	40%	75%	30%	70%
Belcher's St/ Cadogan St/ Davis St	25%	30%	25%	30%	25%	35%
Kennedy Town New Praya/ Smithfield	30%	25%	30%	25%	30%	25%
Smithfield/ Catchick St	120%	110%	120%	110%	150%	140%
Smithfield/ Belcher's St/ North St	85%	100%	85%	100%	85%	90%
Smithfield/ Forbes St	55%	70%	55%	70%	45%	60%
Catchick St/ North St	195%	250%	200%	255%	210%	255%
Catchick St/ Sands St	25%	25%	25%	25%	25%	25%
Belcher's St/ Sands St	75%	80%	75%	80%	75%	80%
Road PD1/ Road LD2	50%	75%	50%	75%	40%	75%
Roundabout B (2)	0.80	0.68	0.80	0.68	0.82	0.76

Note : (1) Figures Show % Reserve Capacity to Nearest 5%
(2) For Roundabout Figures Show Ratio of Flow to Capacity

It was found necessary to provide a free-flow slip road for the left turn movement towards Road PD1 from Road DD1 northbound for Junction C1(South).

Two options were investigated for Interchange C2:

Option 1: 2 pairs of ramps creating a 'full diamond' arrangement, permitting all movements at the grade-separated junction.

Option 2: 1 pair of ramps only at Interchange C2, located eastwards of the junction to form a 'half-diamond' configuration with restricted access.

With preliminary traffic flows, the 'full-diamond' arrangement, as specified in Option 1, was found to require a six-lane bridge over Road PD1 in order to obtain marginally acceptable reserve capacities. The alternative of a roundabout of 70m inscribed circle diameter was also examined and was found to provide similar operational performances compared to the signalised control method.

The addition of bus preloads further worsened the reserve capacities and they became negative in all periods. It was therefore decided that Option 1 would not be feasible and all further work would be based on the Option 2 layout.

The 'half-diamond' layout of Option 2 demands a four-lane flyover above Road PD1 for Interchange C2. The ramps at Interchanges C1 and C2 require 1 and 2 lanes respectively.

• Junction Catchick St./Sands St.

With the forecast traffic distribution, it was necessary to provide two straight ahead lanes for the Catchick Street eastbound movement. Such a scheme would require the relocation, 30m east of a prospective eastbound tram stop as proposed in the Western District Traffic Study (WDTS).

• Junction Road DD2/Road LD3

The connection of Road DD2 to Road LD3 was found to be heavily trafficked. Although the provision of an overpass in the north-south direction gave respectable reserve capacities, the land take associated with such a structure was high and necessitated an alternative solution.

In view of the high proportion of turning vehicles at the intersection, the implementation of right turn bans and provision of left turn slip roads would be a possible solution.

Two right turns can be banned where reasonable alternative routes are available: Road LD3 eastbound and DD2 northbound. The former presents the problem of re-routing a significant amount of buses and other vehicles through a local road, making this an unsuitable alternative. So only the latter was imposed. Furthermore, left turn slip roads at the approaches of Road LD3 eastbound and Road DD2 northbound traffic were provided.

The combination of the above measures produced a satisfactory junction operation as verified by signal calculations.

A third option of a roundabout with a 45m inscribed circle diameter was also examined. This was found to yield favourable performances at all peak periods if two approach lanes were provided at each arm.

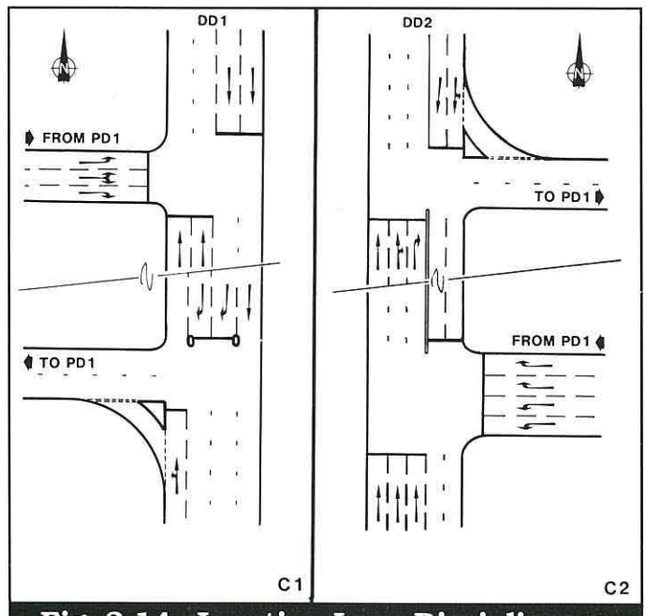


Fig. 2.14 Junction Lane Disciplines

Investigation of the possibility of a gyratory system in which vehicles travelled in a clockwise direction produced fair reserve capacities at the most critical peak period. The employment of a clockwise rather than anti-clockwise scheme depended mainly on safety considerations: it has a lower number of conflict points.

As each side of the gyratory system block is only approximately 300m in length, and taking the traffic distribution into account, the vehicle detours associated would be acceptable with the scheme. One minor drawback is the need for signal control at two junctions which previously were priority interchanges.

Acceptable reserve capacities, as shown in Table 2.19, were obtained for the four junctions involved in the scheme.

• Others

Local junctions in Kennedy Town adjacent to the reclamation have also been checked to ensure adequate capacity as a result of the additional traffic from the reclamation.

All other junctions examined were found to provide sufficient traffic capacities in all peaks.

• Layout of Junctions

Figures 2.14 - 2.19 show the recommended arrangements for each of the assessed junctions.

The general layout of the junctions in Kennedy Town have been based as far as possible on previous designs taken from the Stage 3 drawings of the WDTS.

2.8 Parking and Servicing in the Study Area

It has been assumed that all new developments will be provided with parking and servicing facilities in accordance with Hong Kong Planning Standards and Guidelines. These are summarised in Table 2.20 for the different types of development in the Study Area.

2.9 Traffic Study Area Analysis for 2001 and 2011

Within the traffic model boundary, the road traffic conditions have been examined for the two design years 2001 and 2011. The traffic situation in 2001 has been analysed assuming no reclamation at Green Island, except the committed Belcher Bay Reclamation. The following major road network assumptions were made for the traffic analysis in 2011:

- Belcher Bay Link and Smithfield Extension
- Kennedy Town Traffic Management Scheme (Stage 3 WDTS)
- Route 7 - Rumsey Street to Kennedy Town
- Western Harbour Crossing

All major junctions have been analysed, and the results are summarised in Table 2.21. Each area is described below.

Table 2.19 Gyratory System Junction Reserve Capacities

Junction	Reserve Capacity					
	MTR to Sheung Wan		MTR to Kennedy Town		MTR to the Reclamation	
	AM	PM	AM	PM	AM	PM
GA	25%	30%	30%	35%	45%	70%
GB	25%	30%	25%	35%	65%	150%
GC	80%	45%	80%	45%	85%	150%
GD	35%	35%	35%	35%	40%	70%

2001 - Sai Ying Pun

In 2001, assuming no development on the reclamation, most of the junctions in Sai Ying Pun will be operating with a satisfactory reserve capacity. Key junctions which will be operating over capacity are :

- Eastern Street/Connaught Road West
- Western Street/Bonham Road
- Third Street/Bonham Road

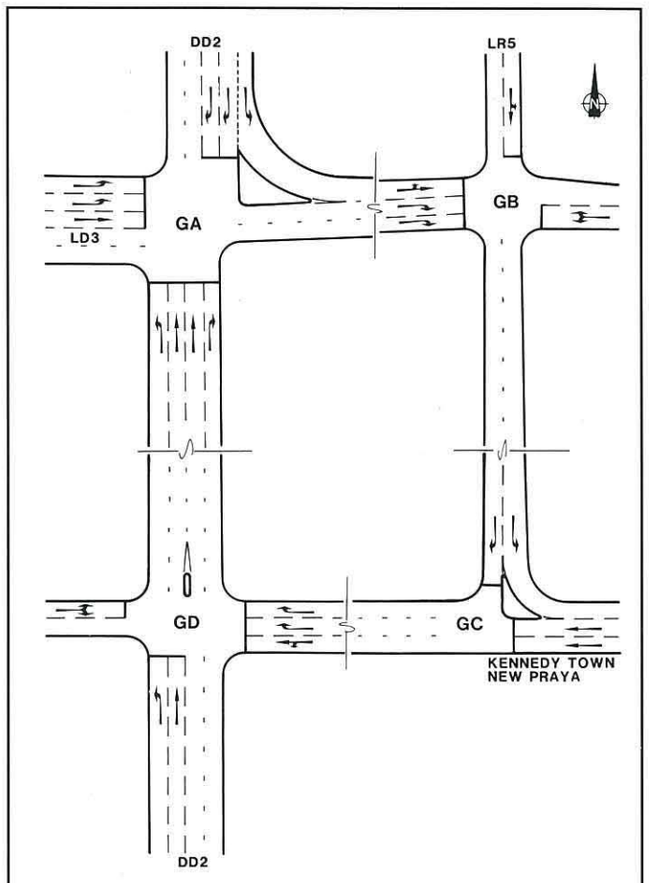


Fig. 2.15 Junction Layout of Gyratory System

2001 - Kennedy Town

Both the Catchick Street/Sands Street and Belcher Street/Sand Street junctions will be operating at capacity in 2001, but the remainder of the junctions will have a satisfactory level of capacity during the peaks.

2001 - Pok Fu Lam

The most heavily overloaded part of the Transport Study Area in 2001 will be the Pok Fu Lam Road corridor, south of the Smithfield Extension. In particular, the junctions of Pok Fu Lam Road with Sassoon Road and Bisney Road will be particularly bad. Partial relief can be provided at the Bisney Road junction by banning the right turn into Pok Fu Lam Road. However, the Sassoon junction is more difficult to improve because of the complications introduced by the access/egress to Queen Mary's Hospital.

The results of this analysis confirm that there is little scope for a relaxation of the Pok Fu Lam Moratorium up to 2001, unless Route 7 is constructed around to Aberdeen or Telegraph Bay before 2001.

Table 2.20 Planning Standards for Parking and Servicing Provision on the Reclamation

	Provision	
Type of Development	**Parking**	**Servicing/Loading/Unloading**
Residential PSPS/HOS	1 Space per 5 to 8 Flats	1 Space per 800 Flats or 1 Space per Block
Rental Estates	1 Space per 17 to 22 Flats	
R1	1 Space per 4 Flats	1 Space per 800 Flats or 1 Space per Block
R2	1 Space per Flat	1 Space per 800 Flats or 1 Space per Block
R3	Minimum 1.5 Space per Flat	1 Space per 800 Flats or 1 Space per Block
Office/Commercial	0 to 1 Space per 240sq.m	1 Loading/Unloading Space (11m x 3.5m) per 5000sq.m GFA
		1 Taxi layby for each 20,000sq.m for Buildings of 5000sq.m or more
Retail	1 Parking Space per 20-30sq.m of Gross Floor Area	1 Loading/ Unloading Space per 1000sq.m GFA
Educational Primary	4 to 6 Car Spaces per 24 room School	1 Car/Taxi Layby for every 2/3 Classrooms 3 School Bus Laybys
Secondary	6 to 8 Car Spaces for 24 room School	1 Car/Taxi Layby for every 3/5 Classrooms
Retail Markets	Nil Car Parking	1 Bay per 1000sq.m + 1 Bay for Refuse Collection Taxi/Car Laybys as Necessary

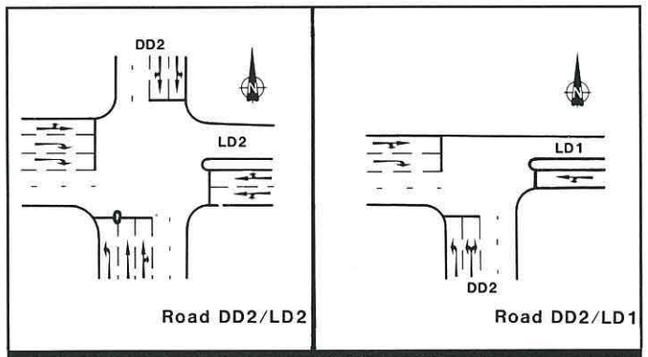


Fig. 2.16 Layout of Signalised Junctions

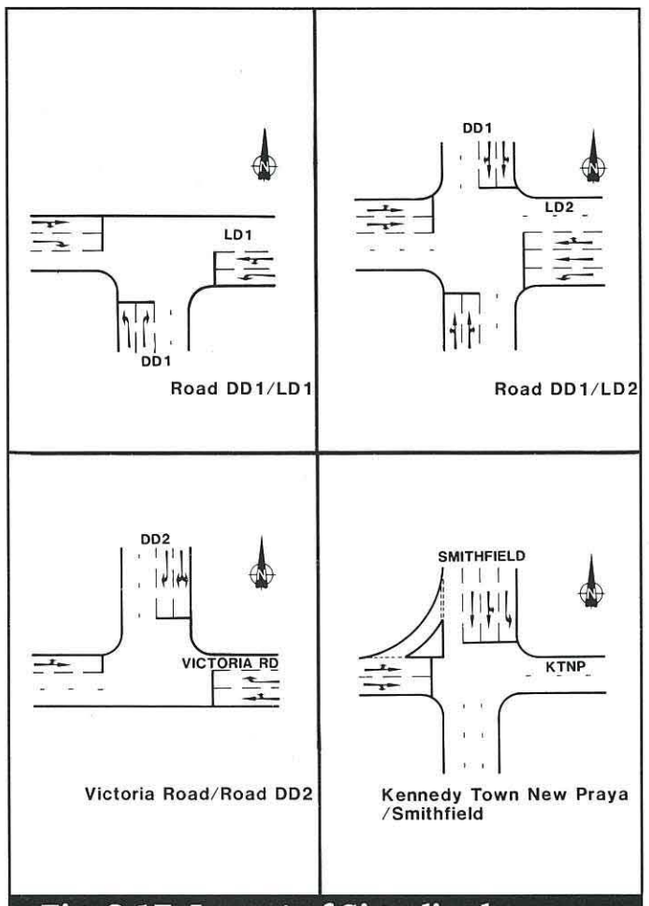


Fig. 2.17 Layout of Signalised Junctions

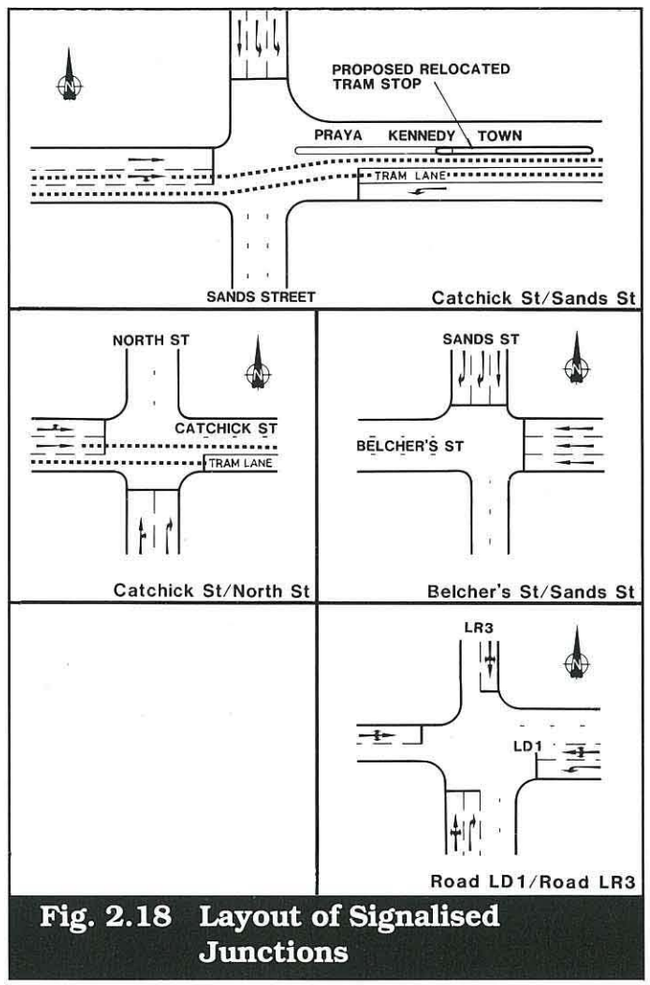


Fig. 2.18 Layout of Signalised Junctions

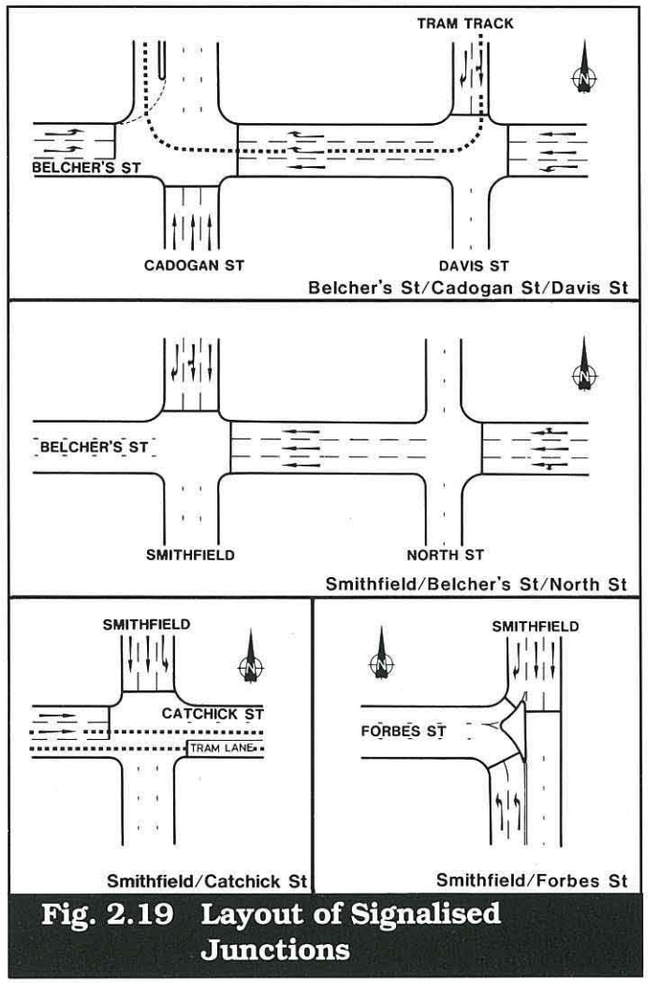


Fig. 2.19 Layout of Signalised Junctions

2011 - Sai Ying Pun

Assuming full development on the reclamation, most of the Sai Ying Pun road network would still have a satisfactory level of operation in 2011. A few of the junctions along Des Voeux Road West (at Eastern Street, Water Street, and Whitty Street) would be operating at capacity, but this is primarily because of the additional public transport flows. This could be partially alleviated by operating more limited stop services along Connaught Road West.

2011 - Kennedy Town

The design of the Kennedy Town road network has been integrated with that of the reclamation, and all junctions have adequate reserve capacities in the peaks.

2011 - Pok Fu Lam

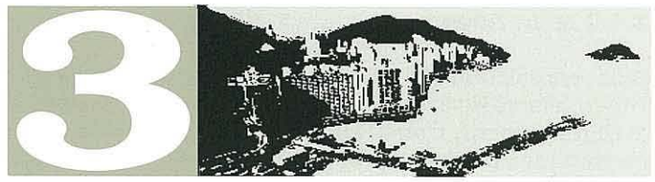
In 2011, the Pok Fu Lam Road/Sassoon Road junction will still be operating over-capacity in both peaks. An improvement to this junction would be required.

Table 2.21 Junction Reserve Capacities within the Area

Junction	Reserve Capacity 2001 AM	2001 PM	2011 AM	2011 PM
Sai Ying Pun Area				
A1 Eastern St/ Connaught Rd W	50%	0%	15%	5%
A2 Eastern St/ Des Voeux Rd W	5%	20%	-15%	20%
A3 Eastern St/ Queen's Rd W	25%	30%	15%	30%
A5 Centre St/ Des Voeux Rd W	130%	185%	75%	155%
A6 Centre St/ Queen's Rd W	80%	65%	55%	60%
A7 Western St/ Des Voeux Rd W	10%	20%	0%	15%
A8 Western St/ Queen's Rd W/ Pokfulam Rd	35%	25%	40%	30%
A9 Western St/ Bonham Rd	35%	0%	15%	0%
A10 Hill Rd/ Queen's Rd W	130%	95%	95%	70%
A11 Third St/ Pokfulam Rd	0%	-5%	-10%	-5%
A12 Water St/ Connaught Rd W	5%	60%	0%	25%
A13 Water St/ Des Voeux Rd W	15%	25%	-15%	0%
A14 Water St/ Queen's Rd W	65%	45%	55%	35%
A15 High St/ Pokfulam Rd	80%	70%	130%	35%
A16 Ka On St/ Connaught Rd W	175%	160%	40%	30%
A17 Des Voeux Rd W/ Ka On St	80%	80%	-5%	10%
A18 Des Voeux Rd W/ Whitty St	55%	45%	0%	10%
A19 Pokfulam Rd/ Bonham Rd	20%	10%	35%	5%
A20 Hill Rd/ Des Voeux Rd W/ Connaught Rd W	10%	105%	-10%	15%

Junction	Reserve Capacity 2001 AM	2001 PM	2011 AM	2011 PM
Kennedy Town Area				
B1 Kennedy Town Praya/Queen's Rd W	30%	150%	5%	25%
B2 Queen's Rd/ Belcher's St	270%	190%	110%	90%
B4 Catchick St/ Sands St	-15%	30%	25%	25%
B5 Belcher's St/ Sands St	5%	-15%	75%	80%
B6 Catchick St/ North St	15%	90%	200%	255%
B7 Belcher's St/ North St/ Smithfield	55%	30%	85%	100%
B8 Smithfield/ Kennedy Town New Praya	25%	110%	30%	25%
B9 Smithfield/ Catchick St	-10%	40%	120%	110%
B10 Belcher's St/ Davis St/ Cadogan St	-30%	10%	25%	30%
B11 Smithfield/ Forbes St	21%	0%	55%	70%
Pokfulam Area				
D1 Pokfulam Rd/ Pokfield Rd	-5%	5%	10%	5%
D3 Pokfulam Rd/ Sasson Rd	-50%	-45%	-20%	-20%
D4 Pokfulam Rd/ Outside No 131 & 137 (peds)	-5%	10%	20%	25%
D5 Pokfulam Rd/ Bisney Rd with Right-turn Ban from Bisney Road	0.90	0.84	0.87	0.71

Note : (1) Figures Show Reserve Capacity to Nearest 5%
(2) For Priority Intersection Figures Show Ratio of Flow to Capacity



Route 7

3.1 Introduction

The Route 7 Alignment Report - TP17 - reviewed the alignment of Route 7 from Kennedy Town to Aberdeen as proposed in the KMA Joint Venture Route 7 Preliminary Design Report of 1982 and takes into account the reports prepared by this Study and the Recommended Outline Development Plans for the area.

In 1982 KMA investigated a number of schemes for Route 7 and recommended an alignment on structure through the proposed Belcher Bay Reclamation and then a waterfront road along Kennedy New Town Praya. The proposed Green Island Reclamation necessitates a revised approach but allows greater flexibility in the Route 7 alignment across this area.

Numerous schemes from Kennedy Town were investigated involving tunnels and elevated structures. However, they were found to be unsuitable and a coastal alignment was recommended. This involved mainly seawall construction and two types were discussed in the KMA Report - vertical or rock mound. In addition the alignment took account of the completed reclamation in Sandy Bay, and the proposed reclamation being carried out in Kellet Bay. However, the seawall construction being undertaken in Kellet Bay at that time did not allow for road construction along it and it was therefore proposed that Route 7 followed the then existing shoreline around the Bay.

Due to revisions in the draft Outline Zoning Plans andRecommended Outline Development Plans and physical developments that took place after the KMA Report, a significant amount of re-design has been carried out. In addition, although Route 7 was proposed in the KMA Report as a limited access, high capacity road, it has since been designated an Expressway by Transport Department. Consequently, this has also necessitated re-design.

Lastly, the Study Review Paper (June 1990) and Major Roads Layout Paper (Oct 1990) recommended layouts for Route 7 and the associated roads on the Green Island Reclamation to suit two recommended options for the Green Island Link. Following the conclusion of those reports, this report concerns itself with the northern Green Island Link Option.

Drawings showing Route 7 are attached as Appendix A to this Volume

3.2 Traffic

The Route 7 alignment, junctions and interchanges have been designed for 2011 peak hour traffic forecasts as derived in 'Local Network Studies' - TP16 and discussed in Chapter 2. The forecasts indicate that the basic reasoning in the KMA Report remains valid and therefore the same movements have been accommodated in the present proposal. The only potential change would be the omission of sliproad "U" at Sandy Bay due to lack of traffic demand. As this is a low cost item however, and as alternative routes for this movement are long and tortuous, the slip road is retained in the current design. It can be regarded as optional however and this should be reviewed at the time of initiating detailed design.

3.3 Design Standards

3.3.1 Design Speed

Due to lack of space and interchange frequency, Route 7 betweenSai Ying Pun and Kennedy Town has been designed as a 70 kph All Purpose Road. West of Hill Road Flyover Route 7 is to be an Expressway. A large portion of Route 7 will be aligned along the west coast of Hong Kong Island and though it is a mainly rural environment the frequency of interchanges determines it as an urban road and thus a design speed of 85 kph has been adopted. The higher rural design speed of 100 kph would result in a significant escalation of cost with little or no associated benefit.

Another factor related to the design speed is the reduced Personal Injury Accidents per passenger kilometre associated with the lower speed.

3.3.2 Geometric Standards

While the longitudinal design factors are unlikely to be a problem, the road cross section is of significance. The main difference between a Trunk Road and an Expressway is the provision of hard shoulders. This results in larger landtake and hence higher costs, but the hard shoulders do accommodate stopped vehicles without disrupting flow and allow easier maintenance of both structure and carriageway. This is particularly important in the case of long distances between interchanges usually associated with Expressways.

KMA recommended a cross section including hard shoulders, so there is no major change in adopting this principle of an Expressway cross section. However, traffic figures do not justify dual three lanes and so dual two lanes have been adopted. This is considered to be an exceptional circumstance for Expressway standards to be retained.

3.3.3 Management of Conflicts

Expressways are intended to provide high speed alignments with as few conflict points as possible. Design standards therefore recommend minimum grade separated interchange spacings of about 5 kilometres and an absolute minimum spacing (regardless of speed) of 2 kilometres.

The interchange at Belcher Bay has been modified by limiting turning movements in order to take up a minimum length of Route 7. However, two further interchanges are still required along the remaining 2 kilometres of Route 7 across Green Island Reclamation, the Green Island Link connection and the PD1 interchange. This necessitates a departure from TPDM standards.

Along the western section of Route 7, KMA recommended three grade separated interchanges. The present study confirms that these remain the most effective locations for the interchanges. However, the spacing is below the absolute minimum and so, as in the Green Island Reclamation section, a departure from the Expressway standards would be required.

3.3.4 Alignment Standards

TPDM Chapter 6 sets out recommended and minimum values for curve radii, super-elevation, and K values for vertical sag and crest curves and these has been adopted in the design of Route 7.

3.4 Route 7 Across Green Island Reclamation

3.4.1 Interchange Design

The interchange at Belcher Bay was simplified to allow traffic to and from the west to access the elevated Route 7 whilst removing the facility for traffic to and from the east to access Route 7 at this point.

West of this junction and Belcher Bay is the major two level interchange with the Green Island Link allowing all movements between Route 7 and Green Island Link. Also passing through the junction area, though remaining separate will be the primary distributor (linking the road network on the reclamation to the Belcher Bay Link) and an extension of Smithfield to the reclamation. This arrangement replaces the Route 7 access facility referred to above as well as providing access to the reclamation itself.

Due to the layout of the interchange the area taken up is very sensitive to the radii of the slip roads. Thus, if Route 7 is to be an 85 kph Expressway, the slip roads should be designed to 70 kph with a desirable minimum radius of 175 metres. However, in order to meet population and other space requirements, a lower radius of 125 metres has been adopted for the slip roads.

A further advantage will be gained by using the same design standards for Route between Belcher Bay and the Green Island Link as for Route 7 to the east, i.e. 70 kph Trunk Road Standards. This will avoid a variation in standards along this part of Route 7 (eliminating changes in driver expectations) and the 125 metres radii for slip roads will then be in excess of absolute minimum requirements for slip roads between 70 kph Trunk Roads.

The third interchange on Route 7 will be at the western side of the reclamation where Route 7 descends to ground level. An all movements grade separated roundabout is proposed which minimises land take and also allows a possible future connection on its east side from proposed facilities to be located beneath Mount Davis. The interchange can be designed to any reasonable standards and there are a number of safety measures which can be implemented to assist its safe operation.

3.4.2 Main Alignment

Since completion of the KMA Report the proposal for the Green Island Reclamation has allowed more flexibility in the alignment. Constraints on the alignment are a 50 metre wide PCWA in the Belcher Bay Area, a maximum clearance to the widened Kennedy Town New Praya and a 20 metre wide storm drainage clearway adjacent to the existing seawall along the Kennedy Town New Praya.

In order to minimise wastage of land use at the roundabout location, by keeping the roundabout close to the existing shoreline, this storm drainage clearway has been diverted across Route 7 at its lowest point.

On structure, carriageway drainage will be achieved by casting gullies along the drainage channels in the deck. The runoff will be collected in hoppers and downspouts recessed in columns or abutments. Runoff collection on the at grade section will be by conventional side channels and then to cross culverts.

3.4.3 Construction Forms

Most of Route 7 across the reclamation will be an elevated structure. This allows for the interchange with Green Island Link and for the primary distributor to pass on to the reclamation. It also allows ground level links to the reclamation thereby reducing severance between Kennedy Town and the reclamation.

It is recommended that, in order to maintain continuity, the same shape and form be used for the structure, as was used for Rumsey Street Flyover and recommended for Route 7 Sai Ying Pun to Kennedy Town. In the same way, it is proposed to use the similar flared columns and foundations both for the main alignment and for the associated slip roads.

The structure will be founded on end bearing piles which avoid to need to dredge and replace marine deposits. Work can start as soon as the reclamation is in place. Careful placement of material will be needed to minimise lateral movement.

Wherever possible the major roads have been placed on earthworks. Advantages are increased scope for screening both visually and aurally and reduced costs compared with a piled structure. However, settlements may be significant and measures including the use of flexible pavement will need to be taken.

Road lighting will for the most part be designed by Highways Office and incorporated into the construction works. Exceptions to this will be the Green Island Link interchange and the roundabout.

3.44 Visual Impact

The extent of this problem depends on the planning of the adjacent land use. The road is aligned through new development so every opportunity has been taken to ensure compatibility between road and development as can be seen by reference to Chapter **. The use of elevated structure increases visual impact but this has to be measured against other environmental aspects such as severances. Visual separation, most noticeable towards the eastern end, would be minimised by adopting the structural form previously mentioned, which has a relatively slim deck and widely spaced columns.

3.4.5 Severance

The use of structure for Route 7 helps to minimise physical severance by allowing several at grade road connections as well as footpaths and other compatible uses beneath the structure. In addition the landscape treatment with woodland species would contribute to the screening of the interchange. The result of the design process has been to maintain as much continuity as possible between Kennedy Town and the new reclamation.

3.4.6 Traffic Noise

Traffic noise generated on Route 7 will be similar whether the road is at grade or on structure, and in either case some improvement can be made by using a porous wearing course. Road side noise barriers are of limited use and to be effective they would have to be high enough to keep the noise source out of the line of sight of receivers. This could only be achieved by totally enclosing the road which would be a largely untested solution with added maintenance problems. The most satisfactory solution has been to plan adjacent land uses in such a way as to minimise the length of road exposed to sensitive noise receivers.

Yes, but R(A)s sites have been placed along the strategic road corridors in the RODP.

3.4.7 Air Pollution

The proposed design allows traffic to flow freely on the main line, ground level roads and through the junctions. Reducing accelerations and decelerations reduces vehicle emission levels. In addition, Route 7 will be as far as possible from the existing Kennedy Town frontage thus relieving the effect on existing properties. In the reclamation area, careful planning of new developments will help minimise detrimental impacts.

3.5 Route 7 To The South Of The Green Island Reclamation

3.5.1 General

The proposed alignment follows generally the flowing alignment in the KMA Report, the lower levels in the bays helping to minimise visual obstruction. This has resulted from the need to provide adequate carriageway drainage together with balancing cuttings against marine fill works.

Differences from the KMA Report include a higher wave overtopping protection height of 5.8 metres to allow for the possible "Greenhouse Effect"; amended alignment across Telegraph Bay to take into account the revised Outline Development Plan; alignment on completed reclamation in Kellet Bay rather than on embankment.

3.5.2 Alignment Description

The alignment meets the desirable minimum TPDM standards for an 85 kph road and is generally similar to the KMA alignment. The Sandy Bay interchange remains essentially the same as in the KMA Report. The Route 7 northbound connection to Sandy Bay is omitted due to high costs, while the link to Route 7 southbound is included as an option, to be considered during detailed design.

At the time of the KMA Report, the reclamation in Telegraph Bay had only just commenced and the seawall was not considered suitable for the Route 7 alignment. The alignment therefore followed the coastline around the Bay to the Wah Fu Headland. Since that time, the reclamation has been completed and the Outline Development Plan shows an alignment following the edge of the reclamation with a grade separated roundabout at the mid- point of the reclamation and a half diamond interchange at the southern end.

In order to ensure continuity in planning, this report follows the ODP alignment, though the mini roundabout has been replaced by a safer signal controlled junction incorporating the waterfront access road and so avoiding a service access off the Expressway.

The southern Telegraph Bay interchange is limited access and is essentially as shown on the ODP. However, as the weaving length between the two interchanges in Telegraph Bay is the absolute minimum for only an 85 kph road, a departure from Expressway standards would be required. Further, it is recommended that, should planning in Telegraph Bay be re-assessed, this southern junction be replaced by a link between Victoria Road and the reclamation. In the meantime, it has been retained in order to preserve the ODP planning layout and CTS-2's recommendations.

The KMA Report envisaged Route 7 would be constructed prior to the reclamation in Kellet Bay. However, the reclamation is now complete and the draft ODP makes allowance for the Route 7 alignment along the seawall. Adoption of Expressway standards means this allowance would not be sufficient and so in order not to affect the newly constructed seawall, the proposed alignment would take slightly more land on the reclamation.

3.5.3 Construction Forms

Surface roads would be constructed almost entirely on new fill and reclamation and so it is recommended that flexible pavement structure be used, thus confirming KMA's findings.

Road lighting would be designed by Highways Office and incorporated into the construction works. Cut-off low pressure sodium lighting is recommended to reduce to a minimum glare visible from the sea.

Except where use is made of already completed reclamation, this section would require that Route 7 be constructed on a narrow band of reclamation. This would require protection by a seawall and for the majority of the route a rock mound seawall is considered the best solution (providing a suitable supply of armour stone can be found), again confirming KMA's findings.

Where the seabed slopes steeply or where interchanges require wider reclamation, such a seawall is likely to be impracticable. In such locations it is proposed to use sand filled caissons to provide a vertical wall. The KMA Report recommended a similar design, though modified here to rely on mass rather than rock anchors (a potential maintenance problem) to overcome imposed loads.

The principles of the calculations carried out by KMA for both stormwater and sewage outfalls remain valid though they would be re-evaluated when more detailed design is carried out.

3.5.4 Reprovisioning

The information contained in KMA's list of existing facilities and installations that would require reprovisioning remains valid. It would be re-evaluated at the time of detailed design.

3.5.5 Environmental Effects

Significant changes would not result from the adoption of Expressway standards so the environmental effects would be generally as discussed in the KMA Report. Some of the proposed development described has taken place and the area is now more urban. Construction of the Green Island Reclamation would change the west side of Hong Kong Island visually. The new shoreline would join the Mount Davis Headland to Green Island and the northern edge of the reclamation, and Route 7 would be confined to a corridor between the existing coast and reclamation development.

3.6 Costs

Table 3.1 shows cost estimates (presented in three sections for possible varying implementation programmes) for Route 7, its supporting structures and interchanges. It does not include ground level roads or the Green Island Link interchange.

3.7 Conclusion

The KMA Report generally remains valid. The main changes result from completion of the reclamations in Telegraph Bay and Kellet Bay, adoption of Expressway standards and the proposal of the Green Island Reclamation.

Table 3.1 Route 7 Cost Estimates

Route 7 - Hill Road Flyover to GIL Interchange

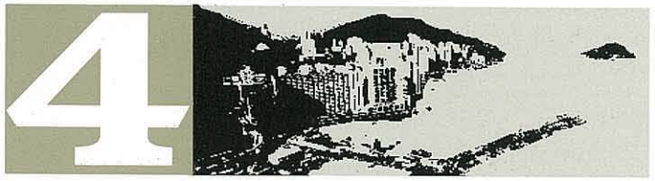
Item	
Roadworks	$0
Earthworks	$0
Culverts	$0
Structures	$289,521,500
Reinforced Earth Wall	$0
Sea Walls	$0
Sign Gantries	$700,000
Sub-total	$290,212,500
+15% Prelims	$43,531,875
Sub-total	$333,744,375
+15% Contingency	$50,061,656
Total	$383,806,031

Route 7 - GIL Interchange to GIR Interchange

Item	
Roadworks	$15,580,800
Earthworks	$26,624,000
Culverts	$12,800,000
Structures	$438,925,500
Reinforced Earth Wall	$18,920,000
Sea Walls	$0
Sign Gantries	$2,100,000
Sub-total	$514,950,300
+15% Prelims	$77,242,500
Sub-total	$592,192,800
+15% Contingency	$88,828,920
Total	$681,021,720

Route 7 - GIR Interchange to Aberdeen

Item	
Roadworks	$243,155,200
Earthworks	$28,200,000
Culverts	$2,270,000
Structures	$53,302,500
Reinforced Earth Wall	$33,862,500
Sea Walls	$602,140,000
Sign Gantries	$1,400,000
Sub-total	$964,330,200
+15% Prelims	$144,649,530
Sub-total	$1,108,979,730
+15% Contingency	$166,346,960
Total	$1,275,326,690
Total Route 7 Cost (1990 prices to nearest $100,000)	$2,340,200,000



Introduction

4.1 Introduction

The infrastructure and utility services for the Green Island reclamation have been considered at various stages during the progress of the Study. Other studies which influence the development of Green Island have been taken into account so that a comprehensive plan has evolved which provides properly serviced land when required by the development programme.

Two papers were presented during the Study. The first "Design Parameters for Infrastructure" - TP7 set the standards for which the infrastructure has been planned; the second "Review of Infrastructure" - TP8 presented the schemes on which the provision of serviced land have been based. These schemes have been developed in conjunction with the RODP. The strategic and local road networks and the identified plans for foul sewerage treatment and solid waste management.

4.2 Foul Sewerage

4.2.1 Related Studies

The design of the foul sewage system to serve the reclamation must also take into account proposals being developed under separate studies for adjacent areas and for the whole of Hong Kong island.
These include:-

- Central and Wan Chai Reclamation Study;
- Central, Western and Wan Chai West Sewerage Master Plan;
- Strategic Sewage Disposal Scheme (Site Investigations & Engineering Studies);
- Study of Potential Use of Space Underground (SPUN);
- Cavern Project.

These studies are now sufficiently well advanced for the impact of their proposals on Green Island reclamation to be summarised as follows:-

- There is no requirement for the Green Island foul sewerage system to accommodate any flow from the Central and Wan Chai reclamation area, as the latter will drain eastwards.
- Sewage treatment works will be constructed beneath Mount Davis as part of the strategic scheme. This will be designed with capacity to receive and treat the flow from Green Island reclamation, and there is thus no requirement for further treatment works on the reclamation.
- It would improve the performance of Kennedy Town sewerage if part of the flow could be diverted into the Green Island system, but the relative implementation dates might preclude it. Nevertheless a nominal provision has been made in the preliminary design of the Green Island foul sewerage to receive part of the Kennedy Town flow.

4.2.2 Outline Design of System

The layout of the proposed system is based on the following two main principles:-

- A collector sewer will run east-west along the approximate alignment of the existing seawall to receive flow from both the new reclamation and where necessary from Kennedy Town.
- The general direction of flow in the system should be from north to south to drain directly into the collector sewer without pumping, which would not be possible with radial or northward draining sewers.

Since the provision of sewage treatment beneath Mount Davis is now confirmed, the collector sewer should drain westwards to meet the proposed deep-tunnel strategic system near the south-west corner of the reclamation. It is likely that the pumping level at the inlet to the Mount Davis Works will be much higher than the Green Island sewerage system, and provision must therefore be made for a pumping station on the reclamation to deliver the flow to Mount Davis

The general layout proposed is shown on Figure 4.1 This is based on the northern approach of the Green Island Link (referred as N3 in the Major Road Layout Working Paper). Details of the system are given in Table 4.1.

Table 4.1 Sewerage System

Node	Proposed Invert Level (mPD)	Peak Flow (m /s)*	Capacity Provided (m /s)
Upstream of Eastern 975mm Sewer	+1.90	1.11	1.14
Junction 975/1200mm sewer	+0.10	2.16	2.20
Junction 1200/1350mm sewer	-1.75	2.52	2.60
Downstream 1650mm sewer	-2.80	3.47	3.50

* Based on 4 x Dry Weather Flow

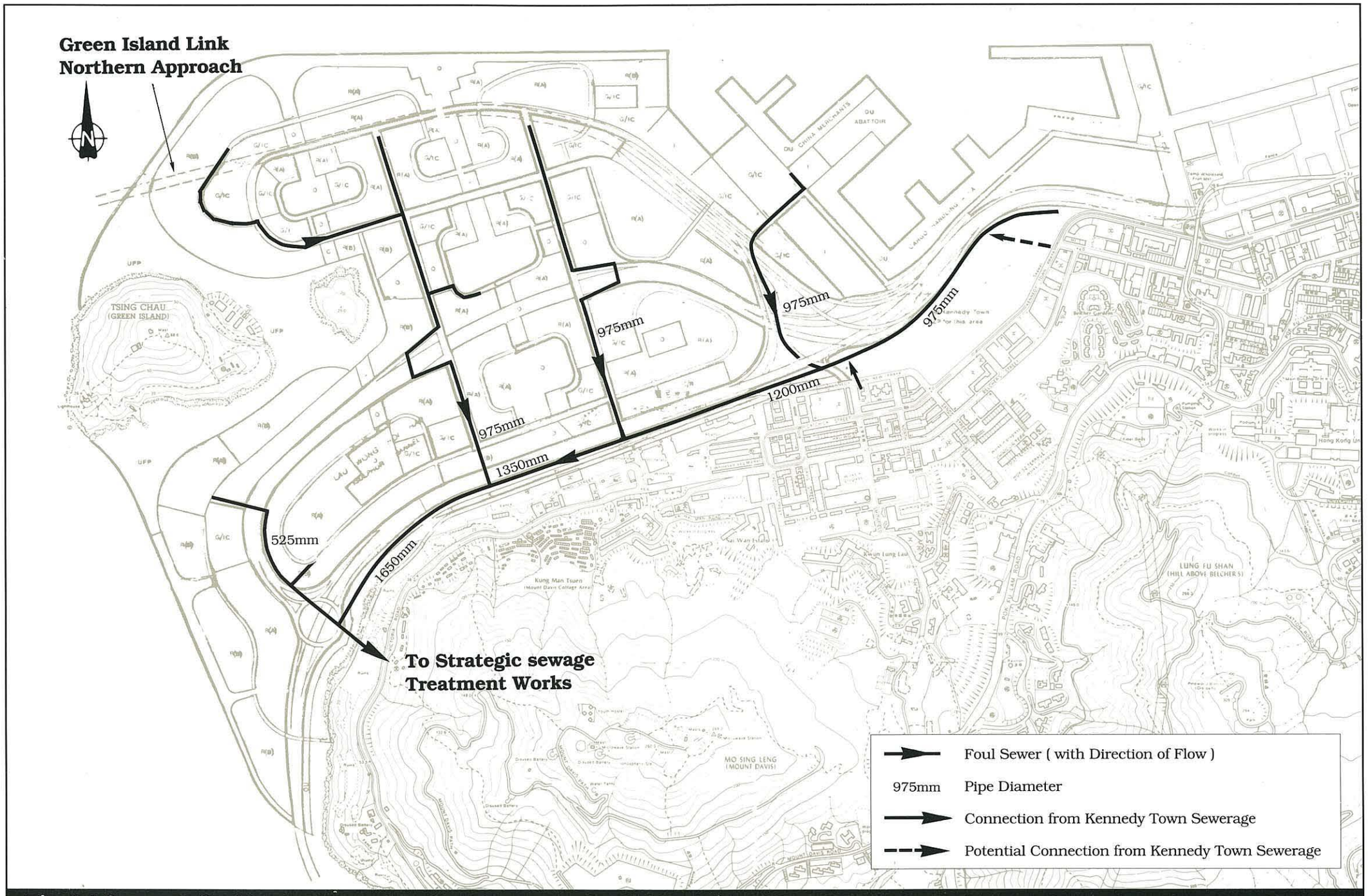


Fig. 4.1 Sewerage System

The two main north-south arterial sewers have to be aligned to avoid the central feeder road tunnel and pass under the approach road instead. As the reclamation is the tunnel, the sewer may be 6-8m deep for short lengths at the top of the slip roads.

The preliminary design of the system has been based on a per capita contribution of 300 litres/day, and a flow peaking factor of four times dry-weather flow in accordance with the Civil Engineering Design Manual. However, with the use of mathematical modelling techniques during the detailed design, it is recommended that more specific factors (from 6 for small-bore sewers to 2 for main trunk sewers) should be used in accordance with current international practice.

It has been assumed that a gravity flow of up to 260 litres/sec will be received from the Kennedy Town system in accordance with provisions of the Central and Western Sewerage Master Plan, although at the time of writing it was not established whether some of this would have to be pumped.

In the preliminary design, adequate gradients have been adopted to achieve self-cleansing velocities of flow and to avoid backfalls developing on the event of settlement. However, steeper gradients should be adopted if possible during detailed design when it has been established whether the strategic sewerage pumping system can be utilised.

Table 4.2 Storm Water System

Node/Outfall	Proposed Invert Level (mPD)	Catchment Area (ha)	Peak Discharge (m /s)*	Proposed Size Depth(m) x Width (m)
1	-0.96	59.23	18.06	Twin 2.5 x 3.0
2	-0.73	54.66	16.98	Twin 2.5 x 2.7
3	-0.55	51.06	16.34	Twin 2.5 x 2.7
4	-0.25	40.94	14.31	Twin 2.5 x 2.4
5	-0.14	31.40	11.57	Twin 2.5 x 2.0
5A	0.04	20.80	8.34	2.5 x 2.7
6	0.20	18.50	7.96	2.5 x 2.3
7	0.50	10.66	4.37	2.2 x 2.0
8	0.30	84.85	10.80	2.5 x 3.0
9	0.19	89.29	13.34	Twin 2.5 x 2.0
10	0.08	102.60	18.73	Twin 2.5 x 2.6
11	-0.06	108.50	21.26	Twin 2.5 x 2.8
12	-0.20	112.70	22.90	Twin 2.5 x 3.2
13	-0.27	115.80	24.40	Twin 2.5 x 3.2
14	-0.38	120.20	26.84	Triple 2.5 x 2.5
15	-0.49	123.90	28.90	Triple 2.5 x 2.5
16	-0.88	46.90	11.46	2.5 x 3.0
GS1	-1.50	70.23	24.71	Triple 2.5 x 2.6
GS2	-0.50	40.97	19.45	2.1 x 3.0
GS3	-0.50	34.97	17.28	2.0 x 3.0
GS6	-0.50	36.87	21.77	2.5 x 3.0
GS7	-1.00	173.00	42.74	4 no. 2.6 x 2.8

* Based on 200 Year Return Period Storm

4.3 Stormwater Drainage

4.3.1 Outline Design

The proposed layout of the stormwater drainage system is based on the following main principles:-

- a major collector system will be constructed along the approximate alignment of the existing seawall to pick up the sixteen existing stormwater discharges from Kennedy Town;

- drainage from the reclamation is generally radially from the central highest area as this minimises depth of sewers;

- the reclamation area has been divided into catchments in a pattern which remains unaffected by the position of the Green Island Link, although the alignment of the sewers has to be modified slightly to suit the tunnel approach, the hydraulic calculations thus remain unaffected.

- there should be no discharge of stormwater within the PCWA or any other confined water area.

The length of the existing seawall and the volume of existing discharges from Kennedy Town are such that it is necessary to divide the main collector system into separate catchments. These are shown on Figure 4.2 draining eastwards and westwards. The actual point of division can be varied if necessary during detailed engineering design to suit the existing invert levels of the drains to be collected. The location of the future Green Island Link would have little effect on this part of the storm water drainage layout.

Consideration was also given to introducing a third sector, draining northwards, but since discharge into the confined water of the port development was unacceptable this became uneconomic.
The preliminary design of the system has been based on a 200 year return-period storm in accordance with the C.E. Design Manual. However, it was reported "Development Parameters" - TP12 that highway drainage systems were unlikely to be able to conduct the run-off from such an extreme event into the drainage network, and some surface flooding is considered inevitable. This is particularly likely along the toe of the fairly steep slopes of Kennedy Town.

The concept of a "clearway" at a slightly lower finished level than the general reclamation was introduced in TP12. It will consist of an unobstructed corridor some 20 metres wide, finished at a level of probably 4mPD. This would accommodate initial surface flooding without affecting the developed area and would enable surface flooding to escape to the sea. The clearway will closely follow the existing seawall and will provide the corridor in which the main stormwater and foulwater collector sewers will be accommodated.

The gradients adopted in the design of the stormwater system vary from those of the foulwater since the sea level at the discharge is a limiting factor. Irrespective of the physically constructed gradient, the actual hydraulic gradients will be dictated by the sea level. Brief details of the system are given in Table 4.2.

4.3.2 Special Considerations

It will be necessary to relay the final length of some of the existing Kennedy Town storm sewers to enable them to be received by the new collector system. It has been established that the capacity would not be compromised in any of the affected sewers. These are numbered 5A, 6, 9 and 12 on Figure 4.2.

At present there are expedient industrial and residential connections discharging polluted water to the existing storm drains from Kennedy Town. These were identified in "Sampling Estimation and Analysis of Flows in Storm Sewers in Kennedy Town" - TP7A. They will be reconnected to the foulwater system during implementation of the Central, Western and Wan Chai West Sewerage Master Plan.

The existing storm drains from Kennedy Town will disrupt the reclamation process and temporary diversions will be necessary until the main collector system can be constructed. This will be addressed by the contractor appointed to undertake the reclamation.

4.4 Water Supply System

4.4.1 Potable Water

The Chief Planning Engineer in the Water Supplies Department has identified two possible sources of potable water for the Green Island development. One is the Sha Tin Treatment Works and Lion Rock High Level Service Reservoir. The other is the proposed treatment works at Pak Ngau Shek and the proposed reservoir at Butterfly Valley. The demand anticipated is in the range of 300-390 litres/hd/day in accordance with Departmental Instruction No. 1309 of the Water Supplies Department, plus an appropriate allowance for industrial use of up to 40 litres/hd/day depending on specific nature of the industry.

A new cross-harbour delivery main will be required in and a new reservoir will be required adjacent to the Green Island reclamation to service the development. This will occupy an area of some 10,000m2 and be sited at a level of 70-80m mPD. A site on the slopes of Mount Davis near Kung Man Tsuen has been identified by WSD to locate a reservoir to serve Western, and it might be possible to extend this to also serve Green Island.

The distribution network will generally follow the road network within the reclamation, or the open spaces and service reserves where necessary. The development of the network will be arranged to suit the phases of reclamation.

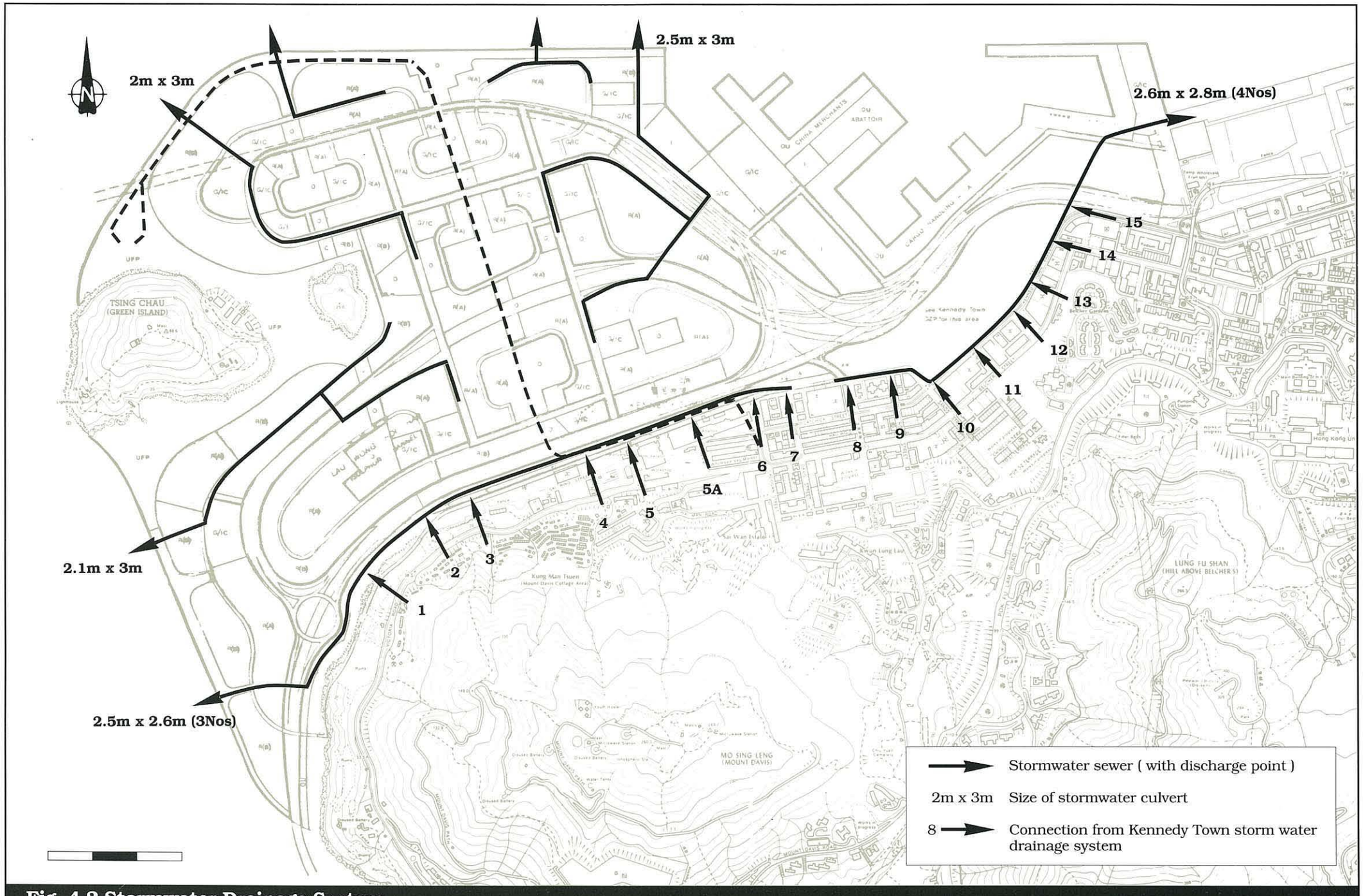


Fig. 4.2 Stormwater Drainage System

4.4.2 Flushing Water

The existing Kennedy Town Saltwater Pumping Station will have to be abandoned when the reclamation proceeds, and replaced by a new station requiring some 1500m² on the revised water front. The intake should be located about 100m from marine activities and stormwater discharges. The existing capacity of 3270m³/day will have to be increased to provide on additional 70 litres/hd/day for the reclamation including industrial use.

The new station will supply both the existing Kennedy Town system, and feed a new reservoir to service the Green Island reclamation development. The reservoir will be similar in level and location to the potable water reservoir, but will require an area of approximately 2500m².

The saltwater distribution system will generally follow the potable water distribution system.

Consideration must be given during the detailed engineering design to the requirement for disinfection of the flushing water supply, which will depend on water quality at the proposed intake. It is normal to chlorinate the water from Victoria Harbour.

4.4.3 Cooling Water

At present there is a pumping station on the existing sea front supplying cooling water to the abattoir. This will be relocated with the abattoir.

The requirement for further cooling water supplies will have to be assessed when the nature of specific industries within the development is established. The requirement for disinfection will also have to be considered.

4.5 Other Utilities

4.5.1 Electricity

The provision of power to the Green Island development by the Hong Kong Electricity Co. will be from the existing Mount Davis

- Sheung Wan circuit. Two sub-stations will probably be required on the reclamation, each occupying a plot of some 1600-2000m². One sub-station will be located in the east of the development, and one in the west.

Cables will follow roads and footpaths in accordance with standard practice, except for passage through open spaces and service corridors where necessary. They will generally have a cover of at least 1.2m beneath roads, and 0.6m beneath footpaths. Ducts will be required under major road crossings.

4.5.2 Gas

The gas supply to the new development will probably be from the North Point Depot of the Hong Kong & China Gas Company, and will require a new intermediate pressure main (240-700 kPa). The pressure will gradually reduce to medium (7.5-240 kPa) and low (2-7.5 kPa) within the distribution network, which will generally follow the alignment of the electricity and water.

Mains will be laid with a cover of 700-1100mm depending on working pressure and location.

There is a possibility that the gas supply will have to be brought from Tsuen Wan rather than North Point if the current demand in Central and Wanchai increases. This will require a new cross-harbour main and a pigging station at the landfall on Green Island. Provision has been made in the development plan for a plot of 1800m2. The station will require a clearance of at least 15m on three sides and 50m on the fourth side in compliance with statutory safety regulations. The 50m clearance has been arranged to face the sea.

4.5.3 Telephone

The Hong Kong Telephone Co Ltd has advised that two exchanges will probably be required to serve the reclamation, each requiring some 2000m². These need to be remote from electric rail or tram systems (at least 200m).

Provision has been made for one in the east of the development and one in the west.

4.5.4 Cable TV

At the time of detailed engineering design it will be appropriate to consider whether provision should also be made for Cable TV conduits.

4.6 Impact of Reclamation Phasing

The proposed phasing of the reclamation is shown in Figure 4.3. The progress of reclamation should be continual providing land for installation of services. This process is constrained by reprovisioning needs and the completion of the Sewage Treatment Works and Refuse Transfer Station at Mount Davis. These key constraints have been used to prepare the Programme within which the major infrastructure implementation is defined. Figure 4.4 presents the Programme and Fig 4.5 shows the sequencing of infrastructure to provide serviced land.

4.6.1 Stormwater Drainage

The first phase of stormwater drainage will be within the port areas in Phase 1b which accommodates the reprovisioning of CMC and the Western District PCWA. Most of this area falls within the catchment of the most easterly stormwater outlet through the north facing seawall. The programme for reclamation of Phase 2a allows this outlet to be constructed in line with the Phase 1b servicing. To the south at Belcher Bay the proposed major collector system to be constructed along the existing seawall should be in place. This will convey the existing praya stormwater outlets and the area to the south of Route 7 eastwards.

Progress with the next stage of reclamation from would enable the remainder of the outlets in the north facing seawall to be constructed. These would drain the catchments which are north of the centre of the reclamation.

Once the reprovisioning on Phase 1b reclamation is completed, construction of the remainder of the major collector system draining west and the outfalls through the west facing seawall will follow.

4.6.2 Foul Sewerage

In the long term sewage will be conveyed to the proposed treatment works at Mount Davis and major development on Green Island Reclamation is conditional on its completion. In the short term for the development of Phase 1b, an alternative disposal point is the Kennedy Town system which is due for upgrading under the implementation of the Central, Western and Wanchai West Sewerage Master Plan. This is expected to be available in mid 1998. Parts of the proposed permanent foul sewerage network could be constructed as part of this temporary disposal arrangement. Temporary pumping facilities to the upgraded Kennedy Town system might be necessary. Only sewage from Phase 1b for reprovisioning could be disposed of in thisway.

The reclamation phases and programme allow for construction of the permanent foul sewerage collector beginning on Phase 3a and proceeding upstream along the existing shoreline, after reprovision is complete, to the main sewer in road DD2 to serve the first development areas completed in 2006.

4.6.3 Water Supply

The water supply for Phase 1b may have to come from the existing Kennedy Town system if the new reservoir at Kung Man Tsuen is not complete. Part of the permanent distribution system could nevertheless be constructed. For further development beyond Phase 1 the Kung Man Tsuen reservoir should be operational. It would be possible to distribute water through the proposed system with no temporary arrangements.

4.6.4 Other Utilities

The electricity distribution system for Phase 1 forms part of the permanent network. It is necessary to accommodate a sub-station within the Phase 1b development. Thereafter arrangements will be made for electricity supply to the new developments and GIL from the sub-stations constructed during Phases 2 and 3 depending on the demand.

A gas supply if necessary for Phase 1b reprovisioning can be distributed through part of the permanent system if supply is from North Point. If the supply is from Tsuen Wan, however, provision will have to be made for the proposed Pigging Station, unless a temporary connection to Kennedy Town established. The permanent gas distribution system can be installed and utilised with development of the remainder of the reclamation irrespective of the source of gas.

One of the telephone exchanges necessary to serve the whole reclamation will be accommodated on Phase 1b to serve the port and reprovisioned developments. A second exchange will be required once development of the remainder of the reclamation takes place.

4.7 Conclusion

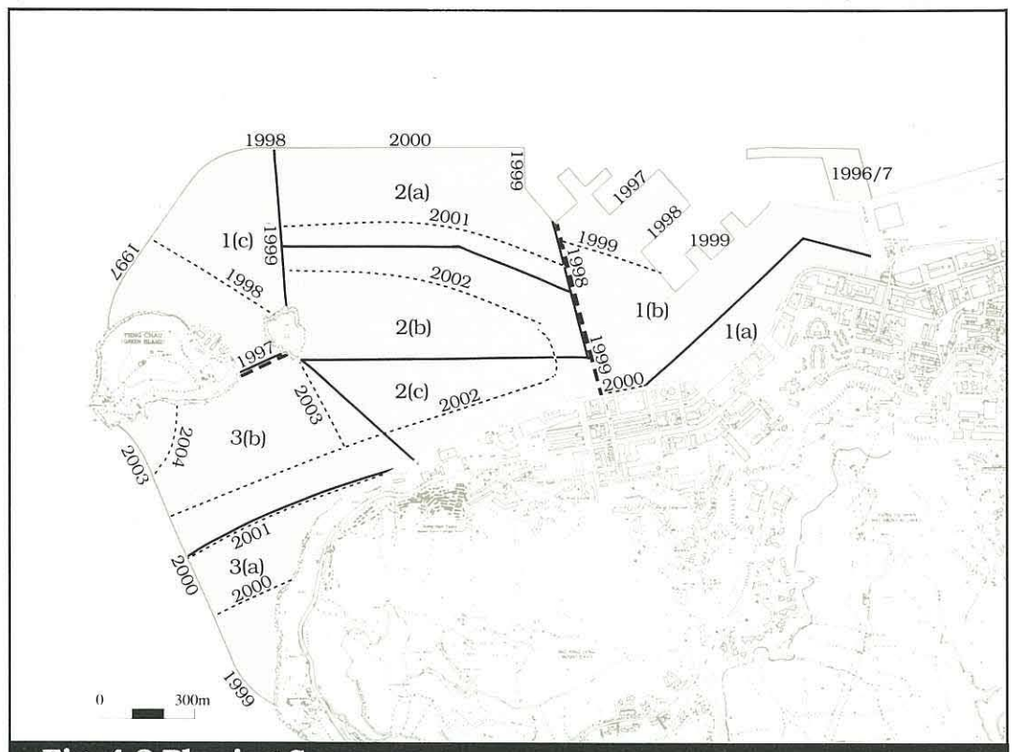
The most critical aspects of the reclamation in respect of utilities will be the provision of foul and surface water sewerage. The drainage of such a large, relatively flat area is likely to result in shallow gradients and/or deep pipework, with a possibility of a requirement for pumping. Any of these measures would lead to higher initial costs and greater maintenance commitments.

It will be important to ensure that the reclamation construction and consolidation methodology and the timing of subsequent development take the needs of infrastructure development into account. A degree of differential settlement can be accommodated by adopting flexible joints etc, but significant settlements will affect hydraulic performance, especially in the case of the foul sewer system.

The provision of other utilities, either dry or pressure, will be relatively straightforward, although the effects of settlement cannot be taken too lightly.

Activity	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1 Constraints																						
1.1 GIL Opening														1 Jan '05								
1.2 China Merchant's Reprovisioning											5 Jul '02											
1.3 Barge Point Reprovisioning (Interim RTS)											5 Jul '02											
1.4 Mount Davis Sewage Treatment Plant													4 Jun '04									
2 Reclamation Phases See Fig. 4.3																						
2.1 Belcher Bay Reclamation (Phase 1a)																						
2.2 Dredging Southern Fairway - Contract A																						
2.3 Phase 1b - Contract A																						
2.4 Phase 1c - Contract B																						
2.5 Phase 2a - Contract B																						
2.6 Phase 2b - Contract C2																						
2.7 Phase 2c - Contract C2																						
2.8 Phase 3a - Contract C1																						
2.9 Phase 3b - Contract C2																						

Fig. 4.4 Programme



Approximate Phasing Boundaries

Progress with Reclamation

Temporary seawall

Fig. 4.3 Phasing Sequence

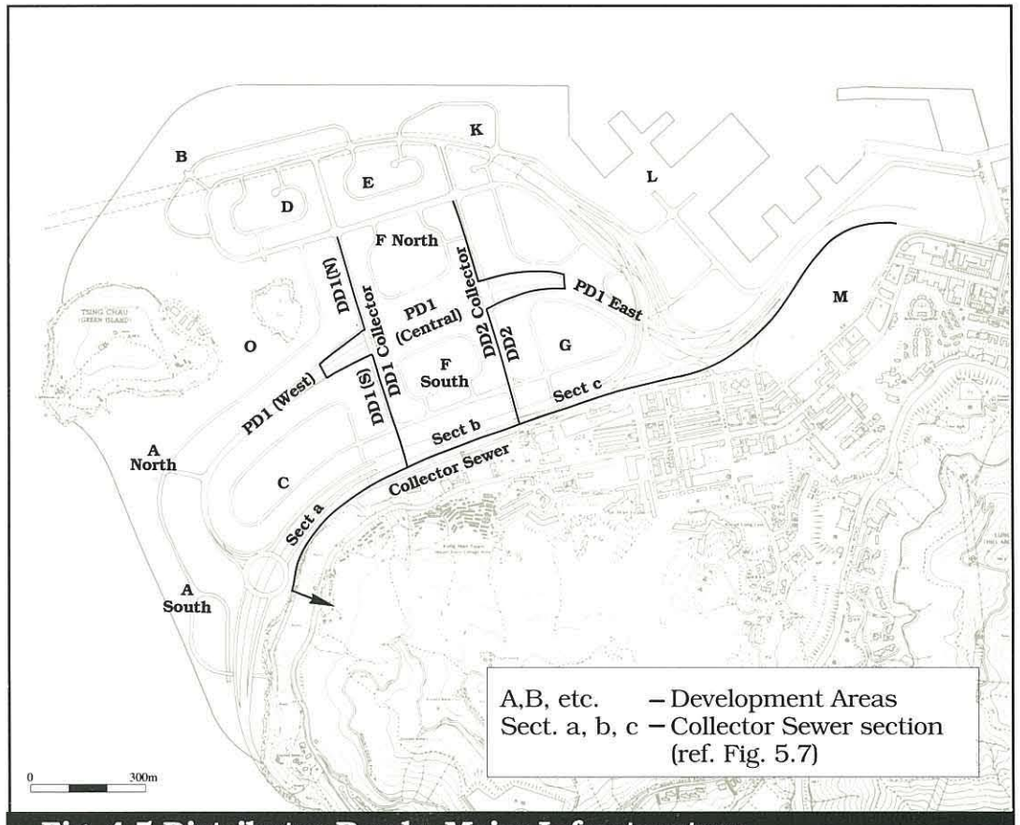


Fig. 4.5 Distributor Roads, Major Infrastructure and Development Areas

Activity	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
3 Highway Phases																						
3.1 Green Island Link																						
3.1.1 Casting Basin Construction																						
3.1.2 Produce Tube Units																						
3.1.3 Construct Vent Bldg (1c)																						
3.1.4 Approach Tunnels (2a)																						
3.1.5 Highway & Structures																						
3.2 Route 7																						
3.2.1 GIL Interchange																						
3.2.2 Central Section																						
3.2.3 Western Interchange																						
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3.3 Distributor Roads See Fig. 4.5																						
3.3.1 PD1 (East)																						
3.3.2 PD1 (Central)																						
3.3.3 PD1 (West)																						
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3.3.5 DD1 (North)																						
3.3.6 DD1 (South)																						
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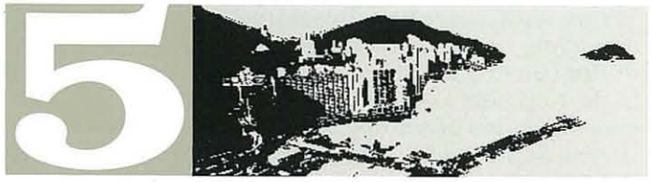
3.4.1 LD1																						
3.4.2 LD2 (North)																						
3.4.3 LD2 (East)																						
3.4.4 LD3																						
3.4.5 LR1																						
3.4.6 LR2																						
3.4.7 LR3																						
3.4.8 LR4																						
3.4.9 LR5																						
4 Major Infrastructure Phases See Fig. 4.5																						
4.1 Phase 1a & 1b (Kennedy Town Connection)																						
4.2 Collector Sewer (Sect a)																						
4.3 Collector Sewer (Sect b)																						
4.4 Collector Sewer (Sect c)																						
4.5 DD2 Collector																						
4.6 DD1 Collector																						
5 Development Areas See Fig. 4.5																						
5.1 Development Area A (South)																						
5.2 Development Area A (North)																						
5.3 Development Area B																						
5.3 Development Area C																						
5.3 Development Area D																						
5.3 Development Area E																						
5.3 Development Area F (North)																						
5.3 Development Area F (South)																						
5.3 Development Area G																						
5.3 Development Area H																						
5.3 Development Area K																						
5.3 Development Area L																						
5.3 Development Area M																						
5.3 Development Area O																						

Fig. 4.4 Programme (Continued)



Geotechnical Study

5.1 Existing Ground Conditions in the Study Area

A site investigation, comprising 13 marine boreholes, over 69 kilometres of geophysical survey and a laboratory testing programme, was carried out between September 1988 and January 1989 to identify the ground conditions and engineering properties of the geological strata in the area of reclamation. (Figure 22)

The figures referred to in this chapter are contained in Appendix A of this volume.

The purpose of the site investigation was to supplement the limited data existing at the time. Good information was available but only locally. These areas included Belcher's Bay along the Kennedy Town waterfront and on the coastline to the west. In the other parts of the area of reclamation a few ground profiles from widely spaced geophysical traverses, which happened to have entered the Study Area, had been drawn at the time of the SHRUG Study.

5.1.1 The Seabed (Figure 33)

The seabed is between 15 and 32 metres deep around Green Island and in the Sulphur Channel. Elsewhere it is generally less than 10 metres. There are strong tidal currents around Green Island and scour caused by these over time has shaped the seabed in what is now the Sulphur Channel. Locally the seabed contains dumped material and the Belcher's Bay is covered with a carpet of raw sewage.

Plans covering the Sulphur Channel note the presence of cables. The investigation failed to identify any cables or other existing subsea services. Some must exist as the Green Island Reception Centre for Vietnamese refugees and the Royal Observatory signal station both have a power supply, presumably a mains supply.

5.1.2 Geological Profile (Figures 34,35,36,37)

The geological sequence comprises marine deposits (mostly soft clays), alluvium (medium dense to dense sand and firm to stiff clay), soil weathered in situ from the bedrock and bedrock.

The marine deposits have a maximum thickness off up to 30 metres and are present to depths of 40 metres below principal datum (Figures 38 and 39). They are generally uniform in composition although some sand is present. Organic debris is present throughout. The decomposition of plant debris generating methane has resulted in gas being present in the marine deposits. The amount and distribution of the gas could not be determined. In other reclamations with marine deposits of similar composition no problems have arisen which could be attributed to the presence of gas bubbles.

The undrained shear strength of the clay i s reasonably well represented by the straight-line relationship Cu = 0.22p', representing a normally consolidated clay (Figure 40). Settlements of this highly compressible material reasonably be assessed from published data on the performance of other reclamation in Hong Kong.

The alluvial deposits have a maximum thickness in excess of 15 metres but are highly variable in composition containing both sand and clay (Figure 41). The alluvium is present to depths of 50 metres below datum (Figure 42). The variation in alluvial deposits is typical of other areas in Hong Kong. For clay Cu = 0.3p' is appropriate and a Ø of 33° for sand.

Rockhead is upto 75 metres below principal datum (Figure 43). The outcrop pattern in the area is not clear with granite, syenite and volcanic tuff all encountered. A NE/SW fault probably traverses the Sulphur Channel.

5.2 Fill and Reclamation

5.2.1 Volumes of Materials Required

A large volume of general fill material and processed stone is required for the reclamation. General fill requirements vary between 30 million m^3 and 50 million m^3 depending on whether the marine deposits are removed prior to filling. Processed stone requirements are approximately 5 million m^3 for sloping sea walls and 1 million m^3 for vertical sea walls. The requirements are for armour rock, underlayer, quarry spalls and pell mell.

5.2.2 Fill Material Sources

Several marine and land based sources were identified. The quantity of material available is in excess of that required for reclamation. However these sources are not exclusive and their availability depends on the demands of other projects. The Fill Management Committee has been set up in the Civil Engineering Department to coordinate the management of fill sources and requirements.

- **Marine Fill**

This generally consists of marine or alluvial sand obtained by dredging with the material transported to the reclamation by barge or in the hopper of the dredger. Marine fill has been used for land reclamation in Hong Kong since the 1950's.

In the 1980's a major co-ordinated search for suitable marine fill was carried out under the supervision of the Geotechnical Control Office. A summary of potentially workable sources of marine sand is shown in Figure 34.

- **Land Based Fill**

This traditionally has been obtained by stripping 'soft' material comprising colluvium and decomposed rock from surrounding hillsides to form platforms in areas with development potential.

A number of potential sites were considered as part of the study at Mount Davis and Pok Fu Lam. These sites would produce 'soft' decomposed material and volcanic rock. However because the volcanic rock tends to be closely jointed it is unlikely that blocks of suitable size could be processed for rock armour.

Alternative sources of land based fill include quarries and government borrow areas. Some of the quarries are located on islands within Chinese waters. The advantages of these alternative sources are that both processed stone and general fill material can be produced.

The location of potential land based fill sources are shown in Figure 45.

• Other Sources

A number of other sources were investigated. These included materials generated from the excavation of rock caverns and those associated with Mass Transit Railway Developments, Pulverised Fuel Ash (PFA) and Construction Waste. Processed stone could be generated from the first two of these and filling material from the latter two. The construction waste is unsuitable for general filling.

5.3 Reclamation Methods and Phasing

Construction of the Green Island reclamation will be more difficult than the majority of reclamations in Hong Kong because of :

• exceptionally thick marine deposite (Figure 38)

• strong tidal currents

• deep water in Sulphur Channel (Figure 33)

None of these is a new type of problem. The difficulty arises from the greater degree too which each exists at Green Island Compared to other reclamation sites. They can be overcome by carefully applying established construction techniques.

5.3.1 Marine Deposits

Traditionally in Hong Kong fill for reclamation has been placed by uncontrolled end tipping into the sea. This often leads to the creation of mud waves leading to a variation in marine clay thickness, slow rates of settlement and very large differential settlements. Even with careful placement of fill total settlements of up to 4.5m may be anticipated which may take up to 20 years (Figure 46). In the past a 5 year moratorium on development has been implemented which was sufficient time for most settlement to take place. Clearly this would not achieve the same result at Green Island nor would a similar moratorium time frame be acceptable today.

Various methods were evaluated which are available to reduce and accelerate settlements taking into account cost, programme, effectiveness and the likely eventual land use. These included removing all the marine deposits. This is not recommended. The recommended method is as follows :

• Remove marine clay at sea wall location.

• Instal wick drains throughout the reclamation followed by the careful placement of a 3 metre thick sand blanket on top of the marine clay. This provides a drainage medium for the wicks and prevents general disturbance of the clay during general filling.

The wicks do not reduce the total settlement, rather they accelerate the rate such that the majority takes place during construction, leaving an acceptable small amount to develop after completion of reclamation. The drain spacing varies according to land use. A spacing of 2 metres is proposed for areas to be subject to building development; 1.5 metres with a 5 metre soil surcharge in areas where the use is particularly sensitive to settlement and increased spacings for areas designated open space.

5.3.2 Preferred Filling Material

Fill obtained from both marine sources (sand) and land sources (soil and rock) are suitable for use as the general fill material for the reclamation, although the rock component of land-sources fill will have to be crushed to a size of 200mm or less before placing.

Marine source fill is, however, the preferred option based on cost, environmental reasons, greater speed of placement and for the easier construction of future piled foundations. Areas around North Lantau and the Brothers Islands provide adequate quantities where the haul distances are operationally and economically acceptable. However the availablity of these sources needs to be taken in consideration at the time because of the demands from other similar reclamation projects.

It is proposed that the marine fill be obtained by trailing suction hopper dredger and transported to Green Island in the hold of the dredger and then placed by bottom dumping to a level controlled by the draught requirements of the dredger. Thereafter the sand is pumped by a cutter suction dredger.

As the time of submitting the paper "Reclamation Methods and Phasing -TP5, the use of PFA as a general filling material below the water table could not be recommended due to ongoing trials which were examining the potential for heavy metals leaching into the waters. Recent trails appear to show that PFA is a feasible general fill material below and above the water table.

5.3.3 Phasing of Construction

The key constraints affecting phasing of the Green Island Reclamation are:

- the need to relocate twelve mooring buoys affected by realignment of the Southern Fairway, prior to dredging a new Southern Fairway and before reclamation within existing fairway limits;

- the need to retain marine access to the abattoir waterfront and the China Merchants Wharf until these operations can be transferred to new locations within the Study Area;

- the need to meet the construction programme for the Green Island Link;

- the need to provide the amount of housing as proposed by Metroplan for 2006.

The first constraint influences the start date for any reclamation.

Kellett Bank is no longer available to accommodate mooring buoys as the reclamations for Container Terminal No. 8 and the West Kowloon Reclamation have displaced buoys which will be relocated at Kellett Bank.

A suitable area for anchorage will need to be found in the Western Harbour to accommodate buoys displaced by realignment of the Southern Fairway. See Figure 5.1.

The reprovisioning requirement influences the sequencing of reclamation. The main waterfront operations presently carried out are located west of Sands Street and include:-

- the Green Island Cement Company

- the Wholesale Fruit & Vegetable Market

- the abattoir

- China Merchants Company

The Green Island Cement plant, although not recommended for reprovisioning within the Study Area, is a significant operation and access to its pier should be preserved for a period which allows sufficient time for alternative locations to be found.

The new Wholesale Market on the Western Reclamation area should be ready by 1993. Marine access should be retained until the time of relocation to avoid disruption to existing operations .

The abattoir and China Merchants Company (CMC) will be reprovisioned within the Study Area. Marine access is vital to CMC operations and this must be retained until relocation. Road access must also be maintained during the reclamation and construction stages.

The temperary RTS barging berth and rail facilities due to be complete in 1994 will also need to be reprovisioned and will influence later phases after of the reclamation.

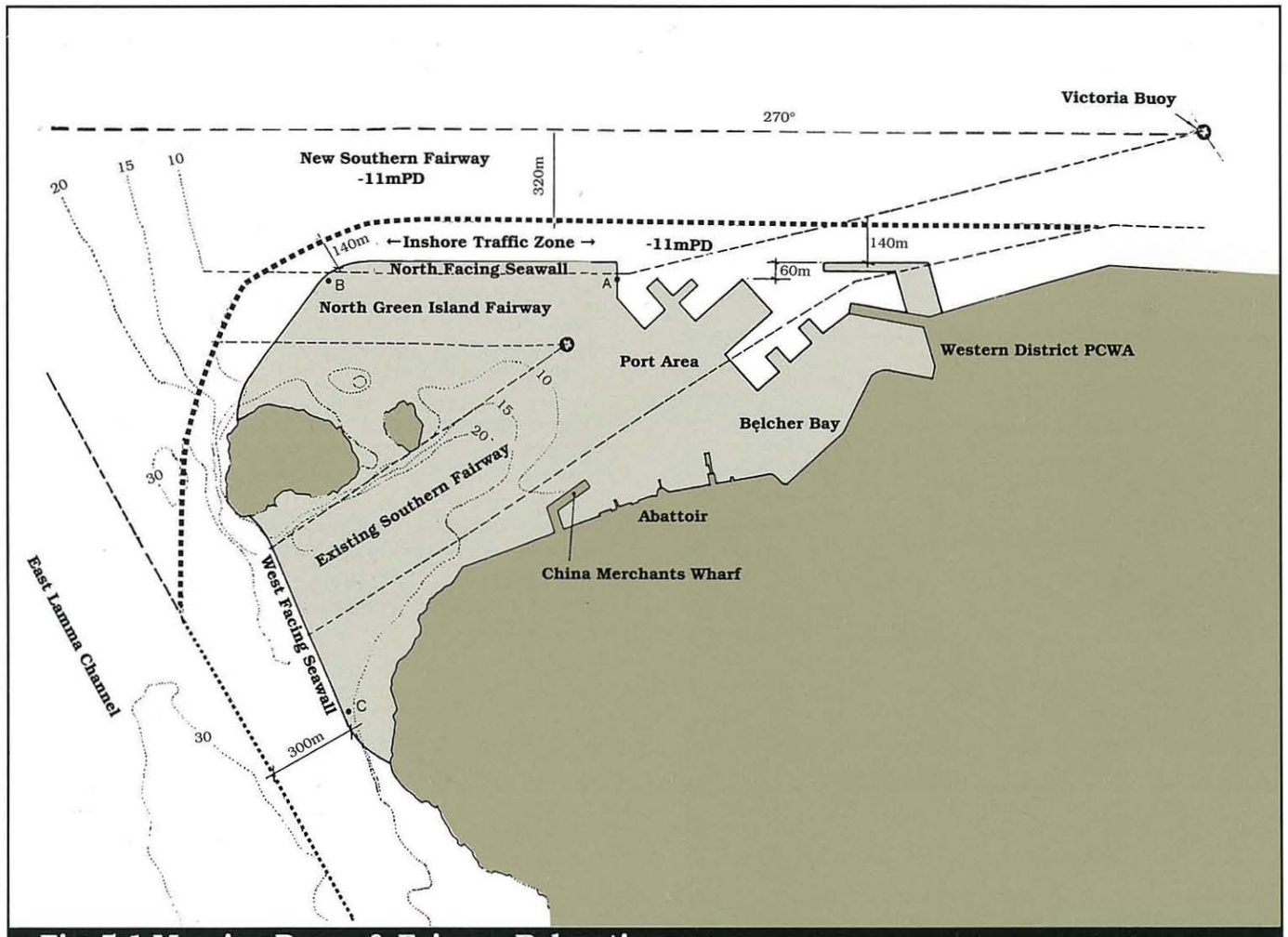


Fig. 5.1 Mooring Buoys & Fairway Relocation

Phase 1 of the Reclamation

The first phase of reclamation must:
- avoid disruption to existing formal waterfront activities;
- provide accommodation for those activities to be reprovisioned;
- be accessible by an established road system.

The reclamation for the Belcher Bay ground level link road (Phase 1a) meets these criteria and does not encroach into the existing Southern Fairway. It cannot accommodate all the reprovisioning needs within the Study Area.

There is an over-riding case for the first phase (Phase 1b) of the reclamation to extend the Belcher Bay Reclamation, see Figure 5.2. However, any viable extension of the Belcher Bay Reclamation encroaches into the Southern Fairway.

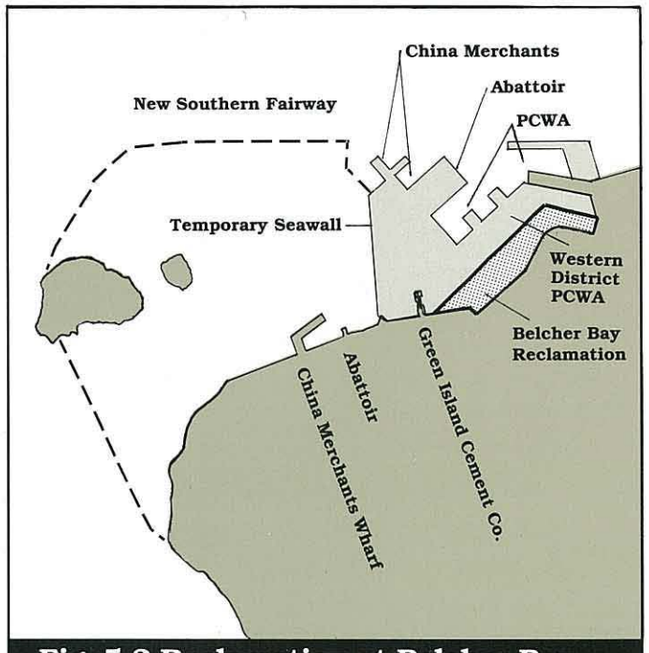


Fig. 5.2 Reclamation at Belcher Bay

The sequence of events are :

- relocate mooring buoys affected by the move northwards of the Southern Fairway.
- dredge the new Southern Fairway
- reclaim Phase 1b area - start reprovisioning development
- reclaim Phase 1c area - start GIL construction
- reprovision the formal waterfront activities

The phasing should emphasise the relocation of CMC to an acceptable site as soon as practical. Reclamation can then proceed together with the development of the local road network.

- **Closing Sulphur Channel**

Phase 1 reclamation will effectively reduce by half the cross- sectional area for tidal flow between Little Green Island and the Western District PCWA, see Figure 5.3.

This circumstance is unique to Green Island Reclamation and sets it apart from other urban reclamations, which have generally been aligned parallel to, rather than across, tidal channels.

The consequences of this reduction in flow area are expected to be an increase in current velocities and the erosion of seabed material from the Sulphur Channel.

The erosion of any contaminated seabed material in this way should be prevented by its removal to a designated dumping area. The area gazetted for dredging during Phase 1 should be extended to include this.

Second Phase Options

Two options are considered in the second phase of reclamation:

- CMC still operate from their existing wharf ;
- CMC have relocated to the new port area site and the existing wharf activities have ceased.

Three methods to close Sulphur Channel and stem the tidal flow have been considered. These are:

- construct the north facing seawall after reclamation of Phase 1C north of Green Island.
- construct a rubble mound between Little Green Island and the existing seawall at the end of Sai Ning Street.
- construct the west facing seawall.

Six sequences are possible and are shown in Figure 5.4.

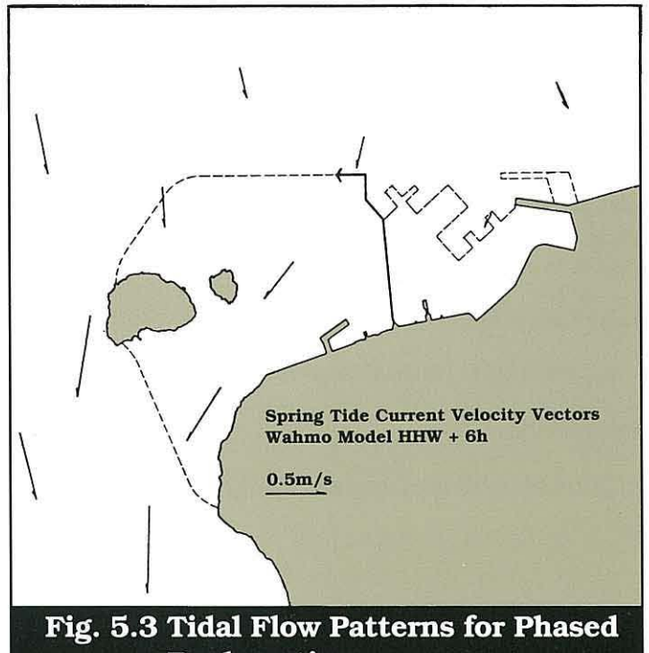


Fig. 5.3 Tidal Flow Patterns for Phased Reclamation

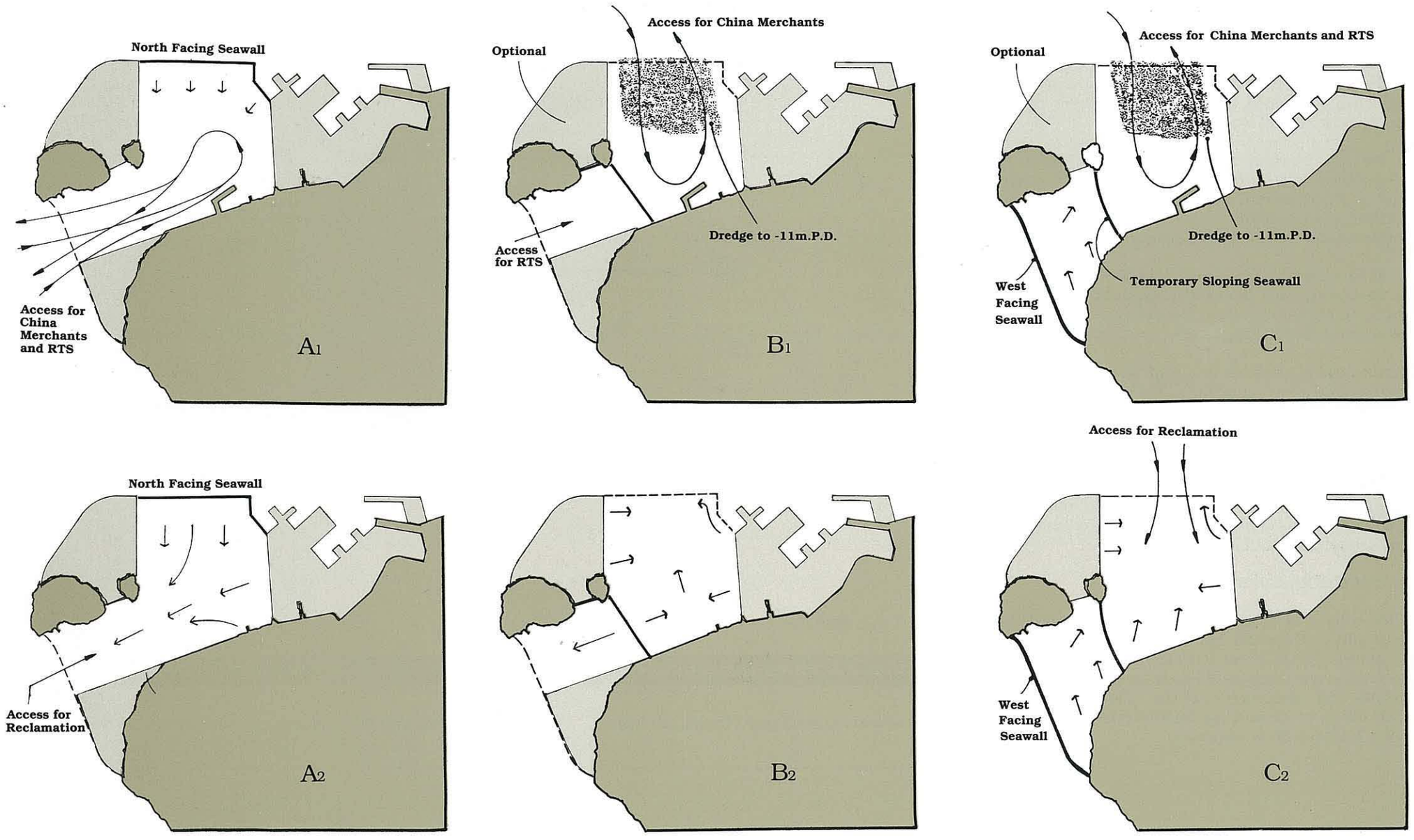


Fig. 5.4 Options for Phase 2 & 3

The Sulphur Channel is best closed by building up a wall uniformly along its length. Tidal currents over such a wall are expected to increase and then diminish as the tidal flow is stemmed. The accurate placing of seawall blocks, particularly for the north facing seawall, may prove to be too difficult during certain tides. Option B1 is an alternative which can be considered if further studies during detailed design favour a more direct approach to closure of Sulphur Channel.

If the Western Harbour Breakwater is completed it would substantially reduce locally generated wave heights in the Western Harbour. This would have benefits to the permanent design conditions and temporary protection required during reclamation.

Option C1 is less satisfactory than A1 in that reclamation in the west cannot proceed in conjunction with the development of strategic road links while CMC remain in operation at its existing wharf.

Options A_1 and A_2 perform best and benefit early construction of the Green Island Link. They have been used to formulate a programme for implementation of the reclamation.

The reclamation process for Phase 2 will follow the sequence shown in Figure 5.5. A continuing advance of the reclamation front in a southwestward direction will remove the need for construction of temporary seawalls and consequential reduction in costs.

Phase 3 of the Reclamation

The final stages of reclamation are also dictated by reprovisioning. Phase 3a must be reclaimed and the Refuse Barging Station constructed prior to reclamation in front of the temporary barge facilitiy. Phase 3a also allows and construction of the collector sewer to Mount Davis to processed and be linked to the Phase 2 areas while Phase 3b is underway.

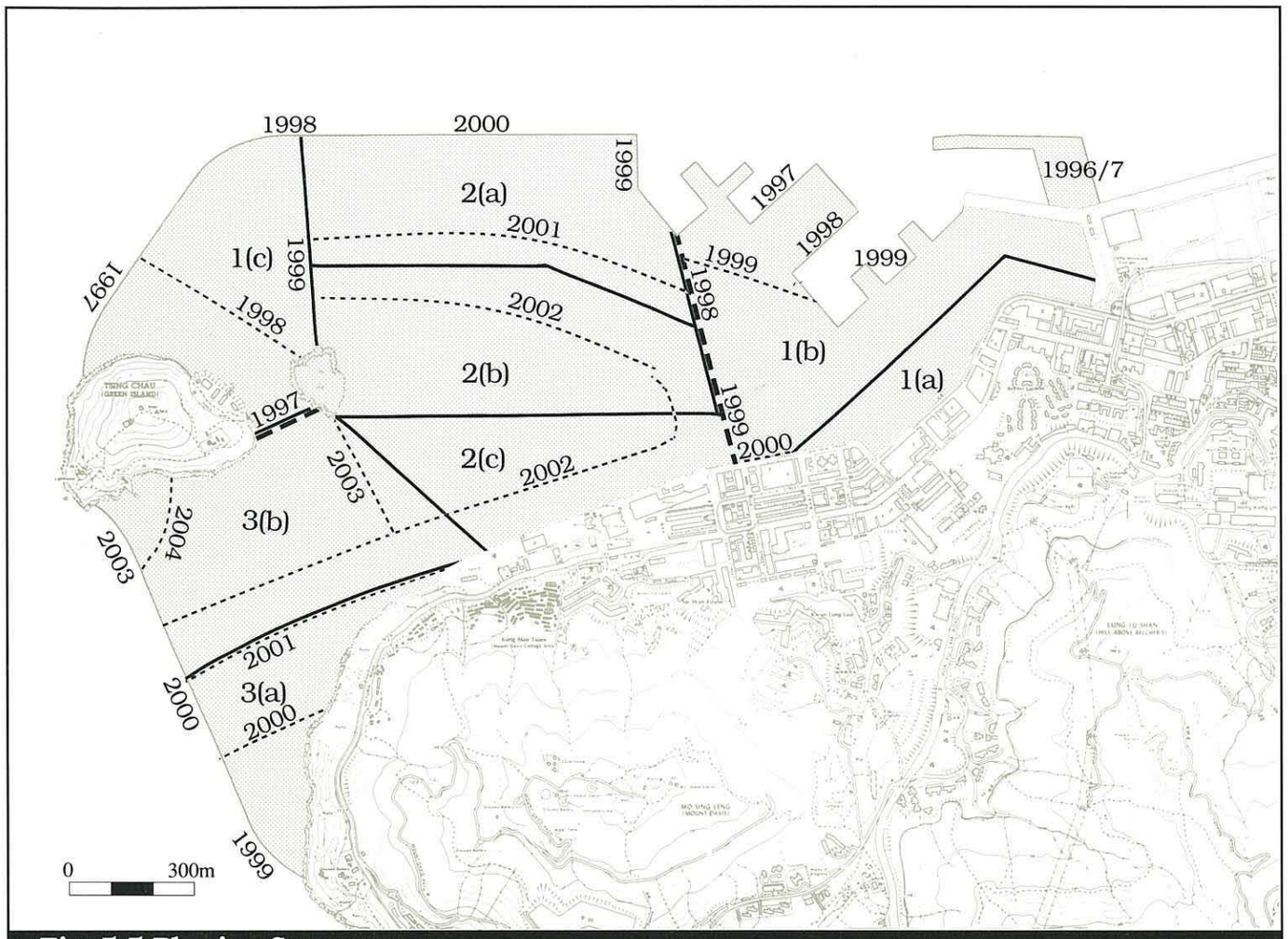


Fig. 5.5 Phasing Sequence

Approximate Phasing Boundaries Progress with Reclamation Temporary seawall

Appendix A
Drawings

List of Drawings

1 Route 7 Key Plan
2 Road Layout Sheet 1
3 Road Layout Sheet 2
4 Road Layout Sheet 3
5 Road Layout Sheet 4
6 Road Layout Sheet 5
7 Road Layout Sheet 6
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10 Road Layout Sheet 9
11 Road Layout Sheet 10
12 Road Layout Sheet 11
13 Road Layout Sheet 12
14 Road Layout Sheet 13
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16 Vertical Alignment Sheet 2
17 Vertical Alignment Sheet 3
18 Vertical Alignment Sheet 4
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21 Vertical Alignment Sheet 7
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31 South Option
32 Location of Site Investigation
33 Map of Seabed
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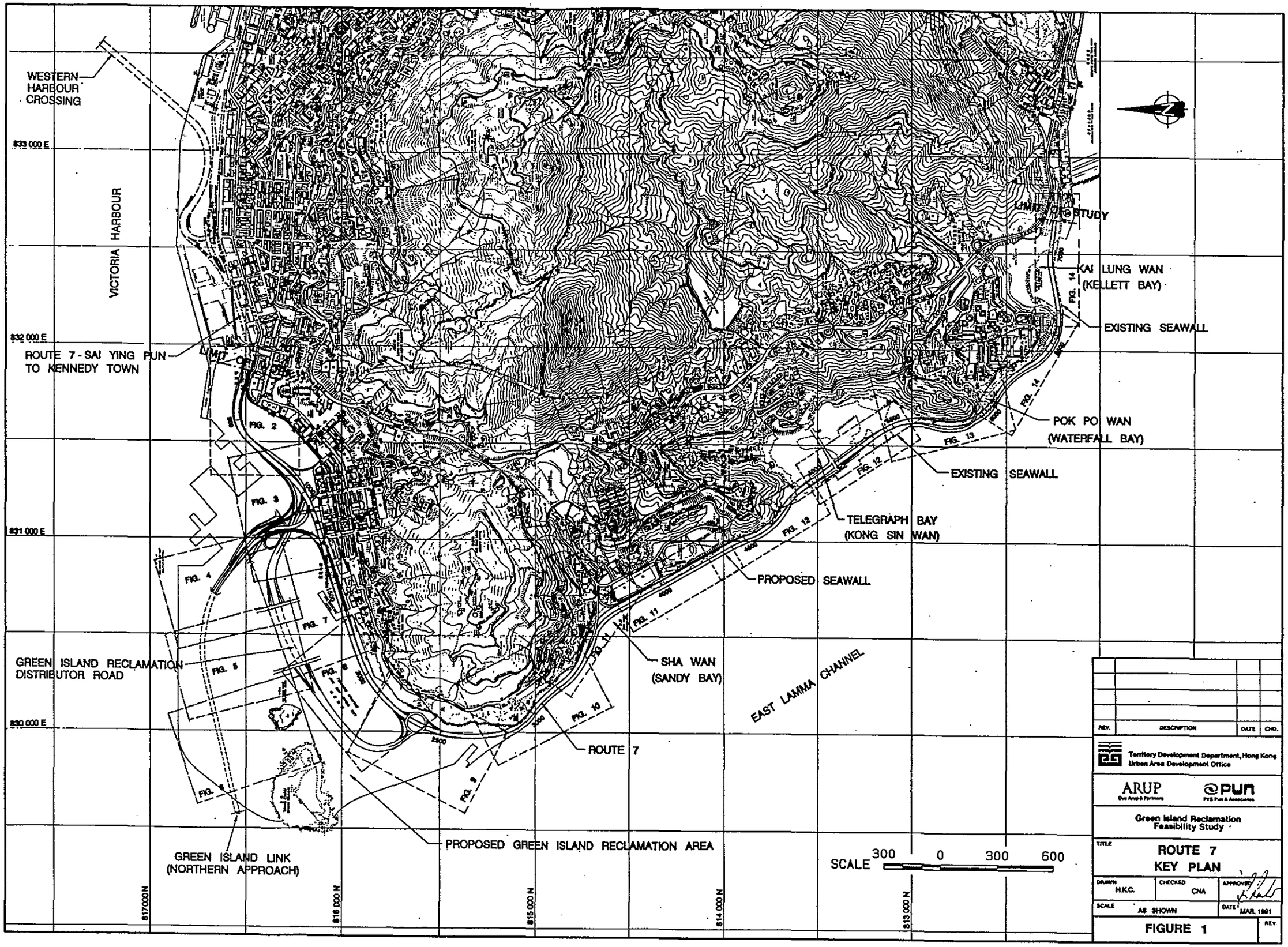
35 Geological Sections
36 Geological Sections
37 Geological Sections
38 Marine Deposit Thickness
39 Base of Marine Deposits
40 Properties of Marine Clay
41 Thickness of Alluvium
42 Base of Alluvium
43 Rockhead Level
44 Potential Areas of Marine Fill
45 Potential Areas of Land Fill
46 Consolidation Settlement



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TITLE
ROUTE 7
KEY PLAN

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FIGURE 1

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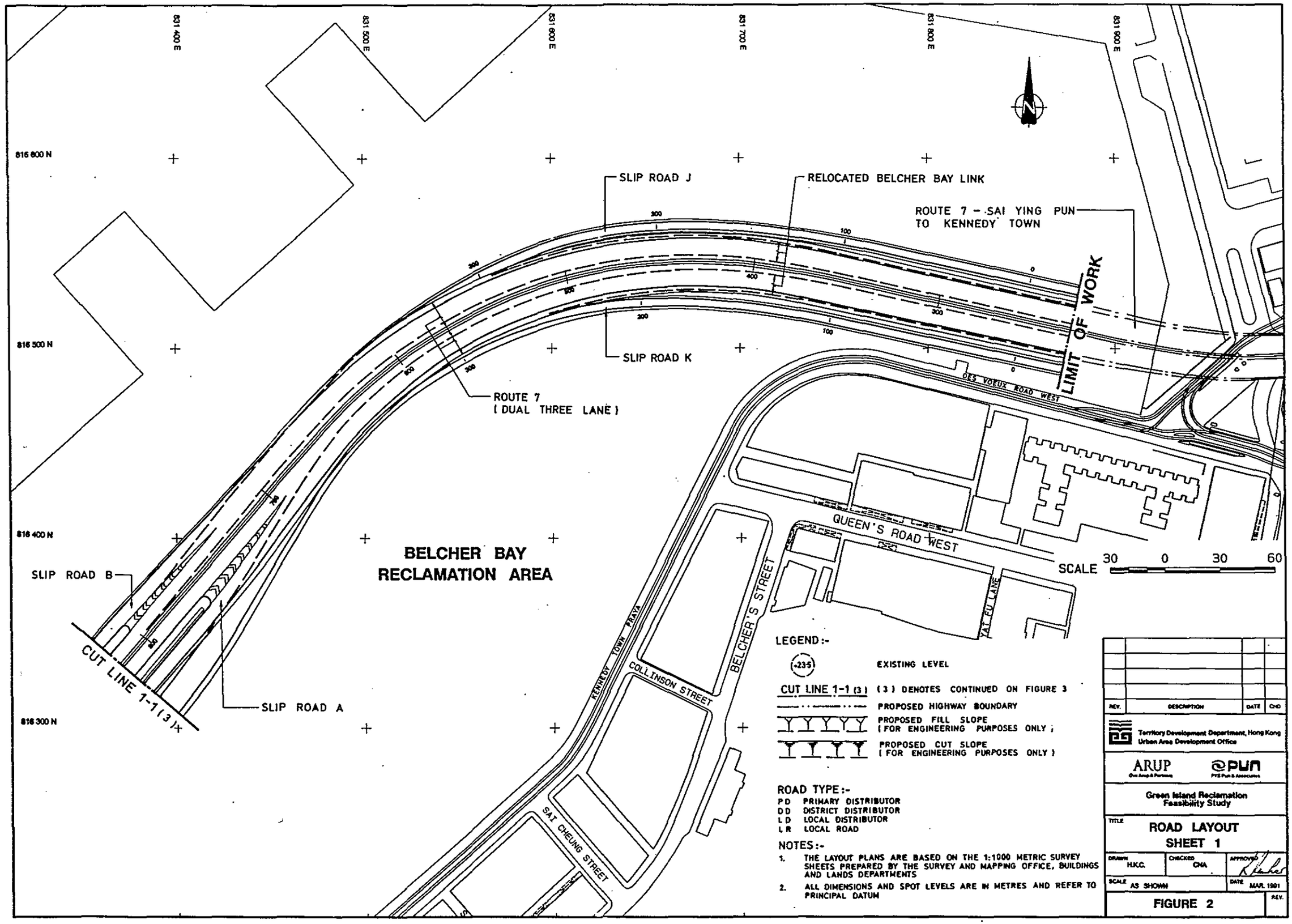

LEGEND :-

(-235) EXISTING LEVEL

CUT LINE 1-1 (3) (3) DENOTES CONTINUED ON FIGURE 3

PROPOSED HIGHWAY BOUNDARY

PROPOSED FILL SLOPE
(FOR ENGINEERING PURPOSES ONLY)

PROPOSED CUT SLOPE
(FOR ENGINEERING PURPOSES ONLY)

ROAD TYPE :-

PD PRIMARY DISTRIBUTOR
DD DISTRICT DISTRIBUTOR
LD LOCAL DISTRIBUTOR
LR LOCAL ROAD

NOTES :-

1. THE LAYOUT PLANS ARE BASED ON THE 1:1000 METRIC SURVEY SHEETS PREPARED BY THE SURVEY AND MAPPING OFFICE, BUILDINGS AND LANDS DEPARTMENTS
2. ALL DIMENSIONS AND SPOT LEVELS ARE IN METRES AND REFER TO PRINCIPAL DATUM

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TITLE
ROAD LAYOUT
SHEET 1

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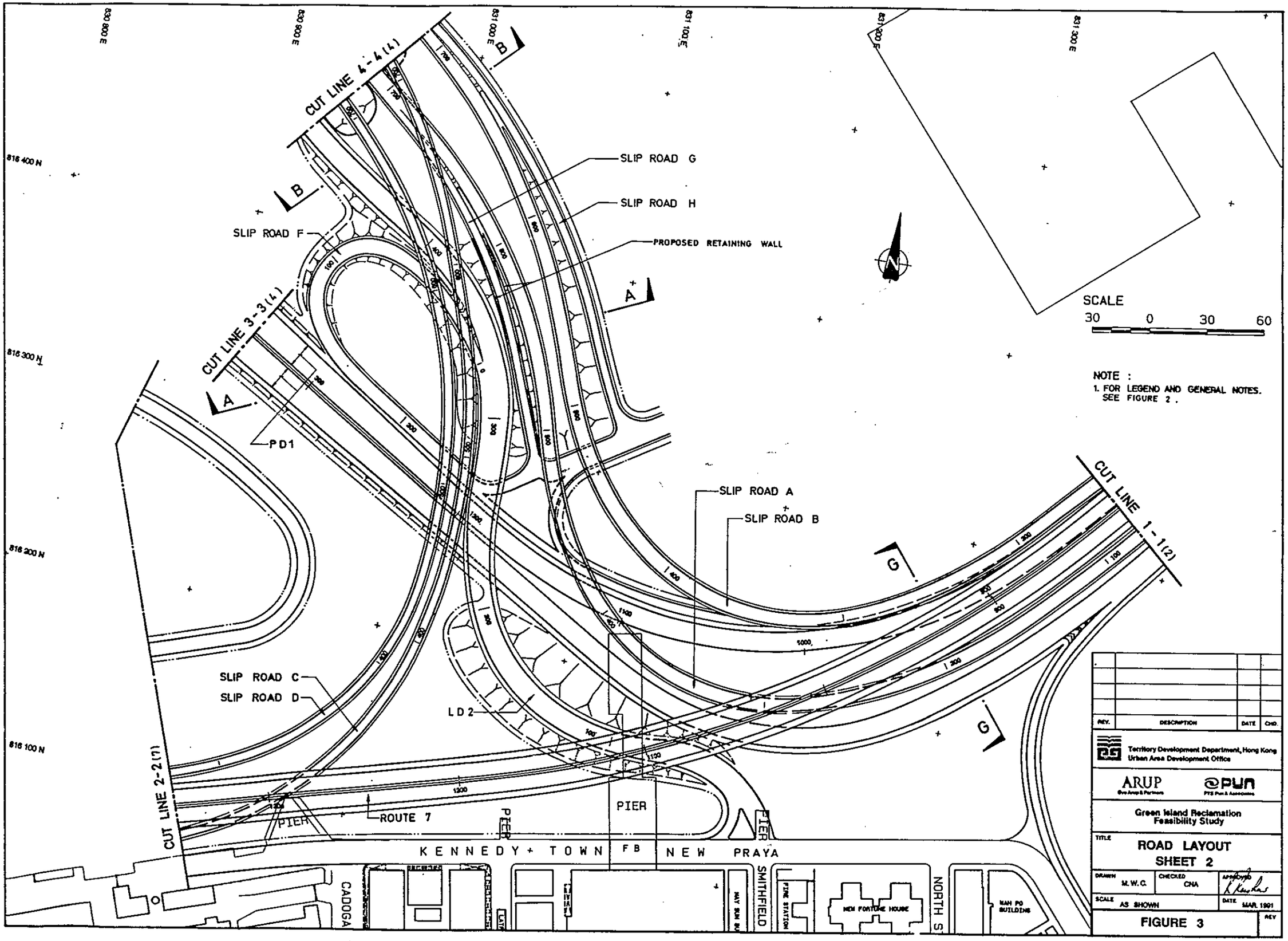
FIGURE 2 REV.


830 800 E
830 900 E
831 000 E
831 100 E
831 200 E
831 300 E
816 400 N
816 300 N
816 200 N
816 100 N
CUT LINE 4-4(4)
CUT LINE 3-3(4)
CUT LINE 2-2(7)
CUT LINE 1-1(2)
SLIP ROAD F
SLIP ROAD G
SLIP ROAD H
PROPOSED RETAINING WALL
SLIP ROAD A
SLIP ROAD B
SLIP ROAD C
SLIP ROAD D
PD1
LD2
ROUTE 7
PIER
KENNEDY TOWN
FB
NEW PRAYA
SMITHFIELD
CADOGA
NEW FORTUNE HOUSE
NORTH
MAN PO BUILDING
FIRE STATION
SCALE
30 0 30 60
NOTE :
1. FOR LEGEND AND GENERAL NOTES. SEE FIGURE 2 .
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ROAD LAYOUT
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FIGURE 3
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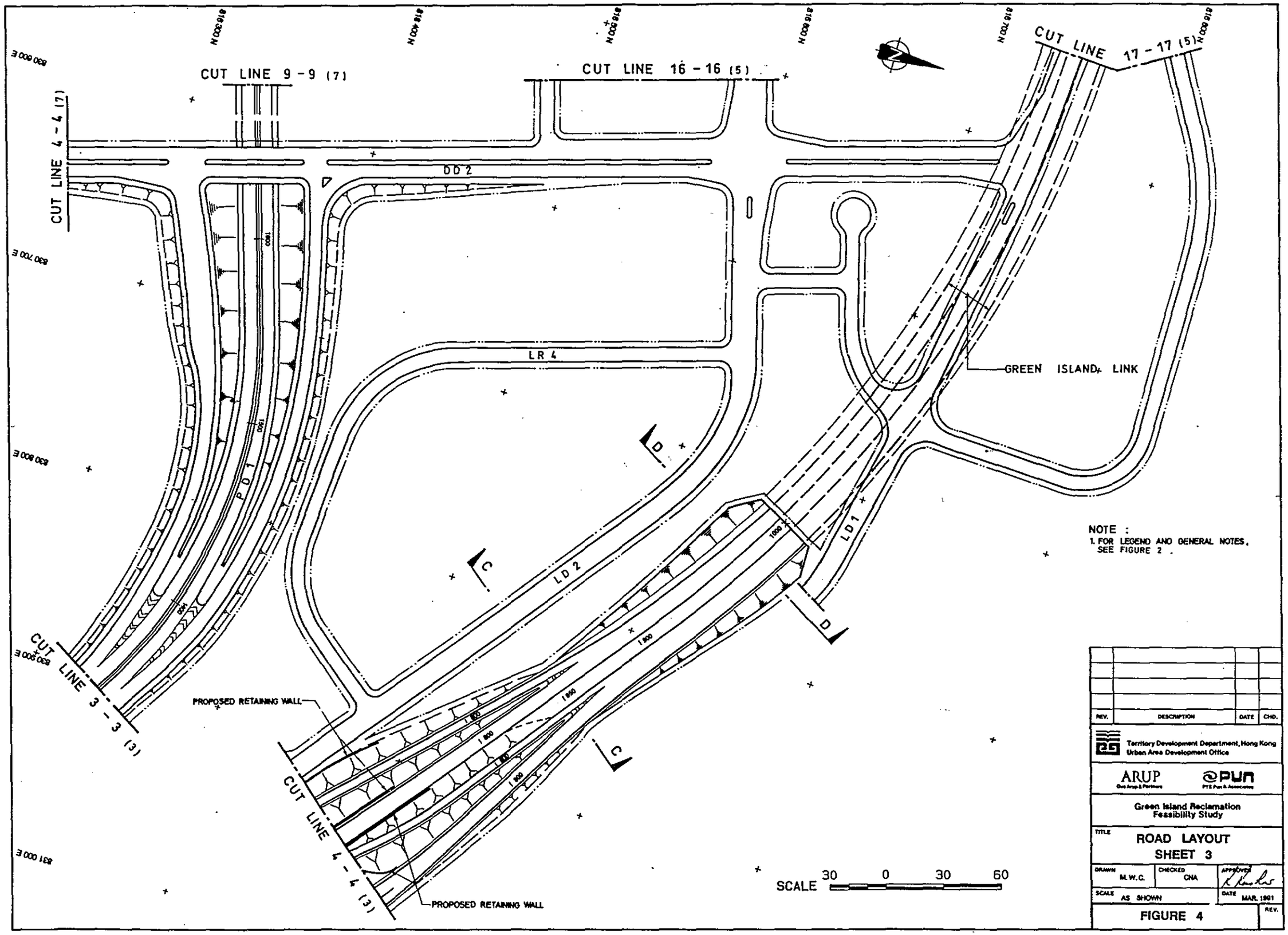

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FIGURE 4 — REV.

GREEN ISLAND RECLAMATION AREA

CUT LINE 13-13 (8)

CUT LINE 18-18 (6)

LR 1 (S2)

LD 2 (WS2)

CUT LINE 19-19 (6)

GREEN ISLAND LINK

CUT LINE 14-14 (8)

DD1 (S4)

DD1 (S4)

LR6 (S2)

LR10 (S2)

LD2 (S4)

LR 3 (S2)

LD1 (S2P)

LR8 (S2)

CUT LINE 17-17 (4)

CUT LINE 16-16 (4)

VICTORIA HARBOUR

NOTE :
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2.

SCALE 30 0 30 60 METRES

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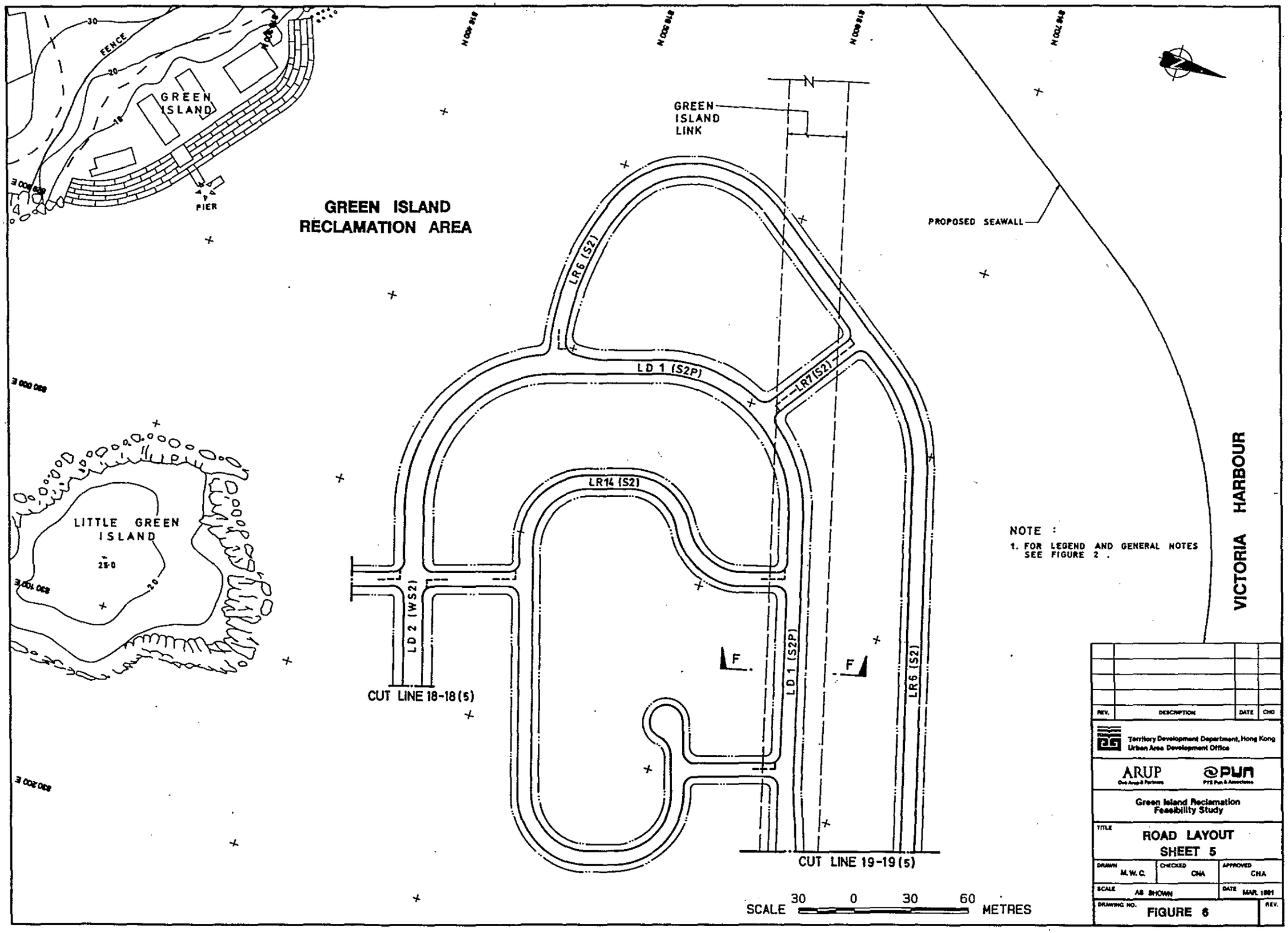

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ROAD LAYOUT
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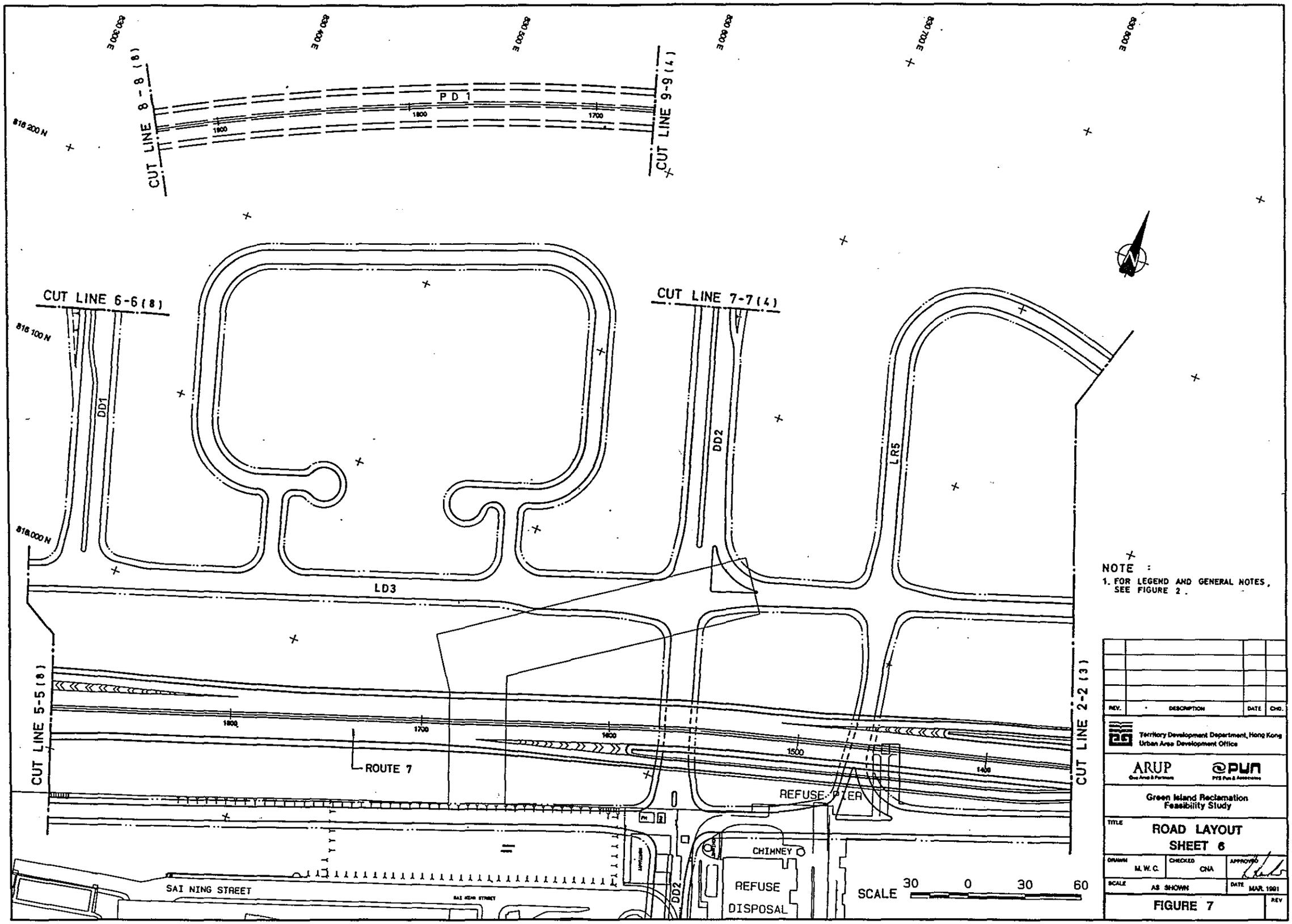

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TITLE: ROAD LAYOUT
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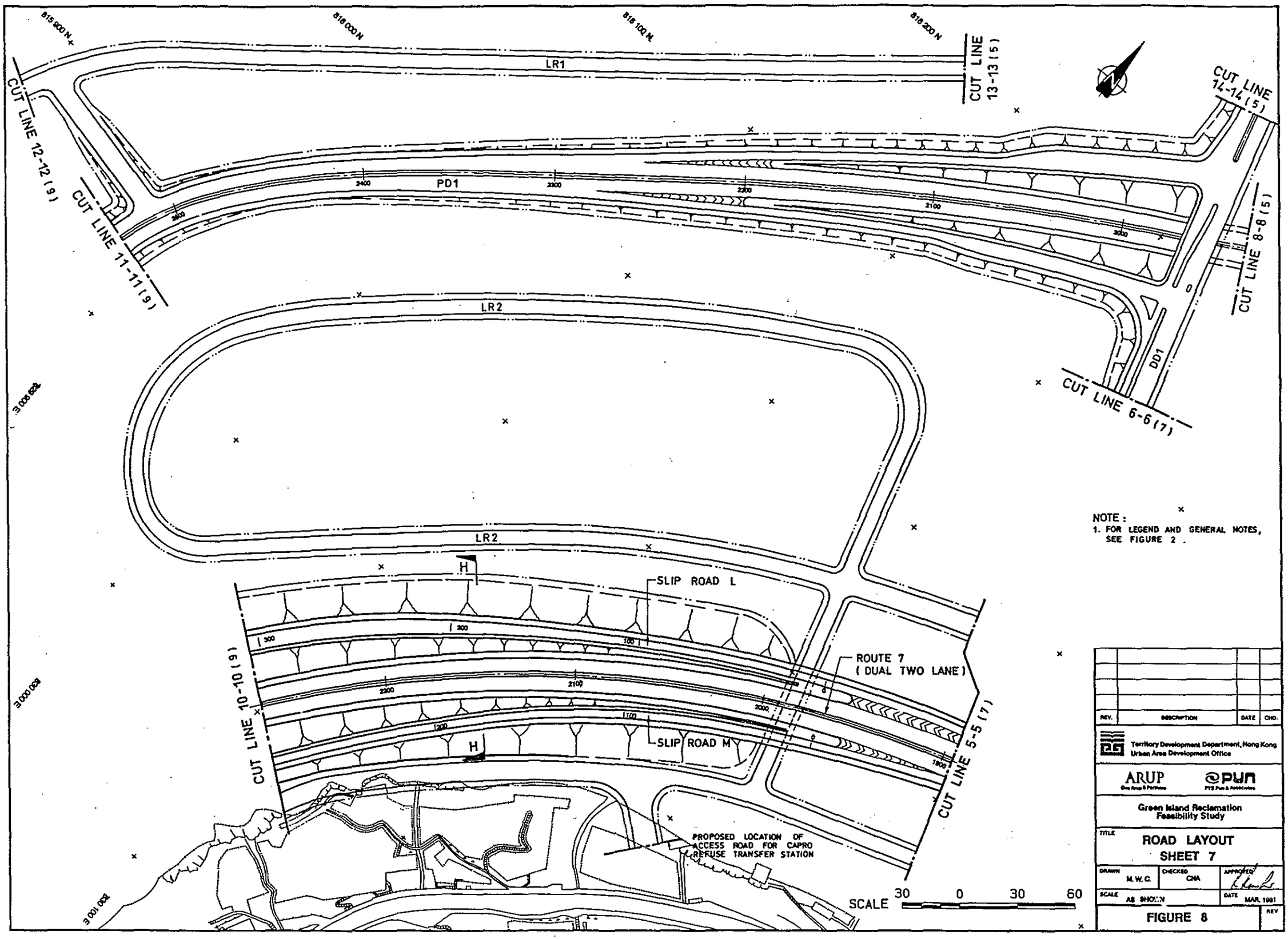
FIGURE 7 — REV



NOTE :
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2 .

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TITLE
ROAD LAYOUT
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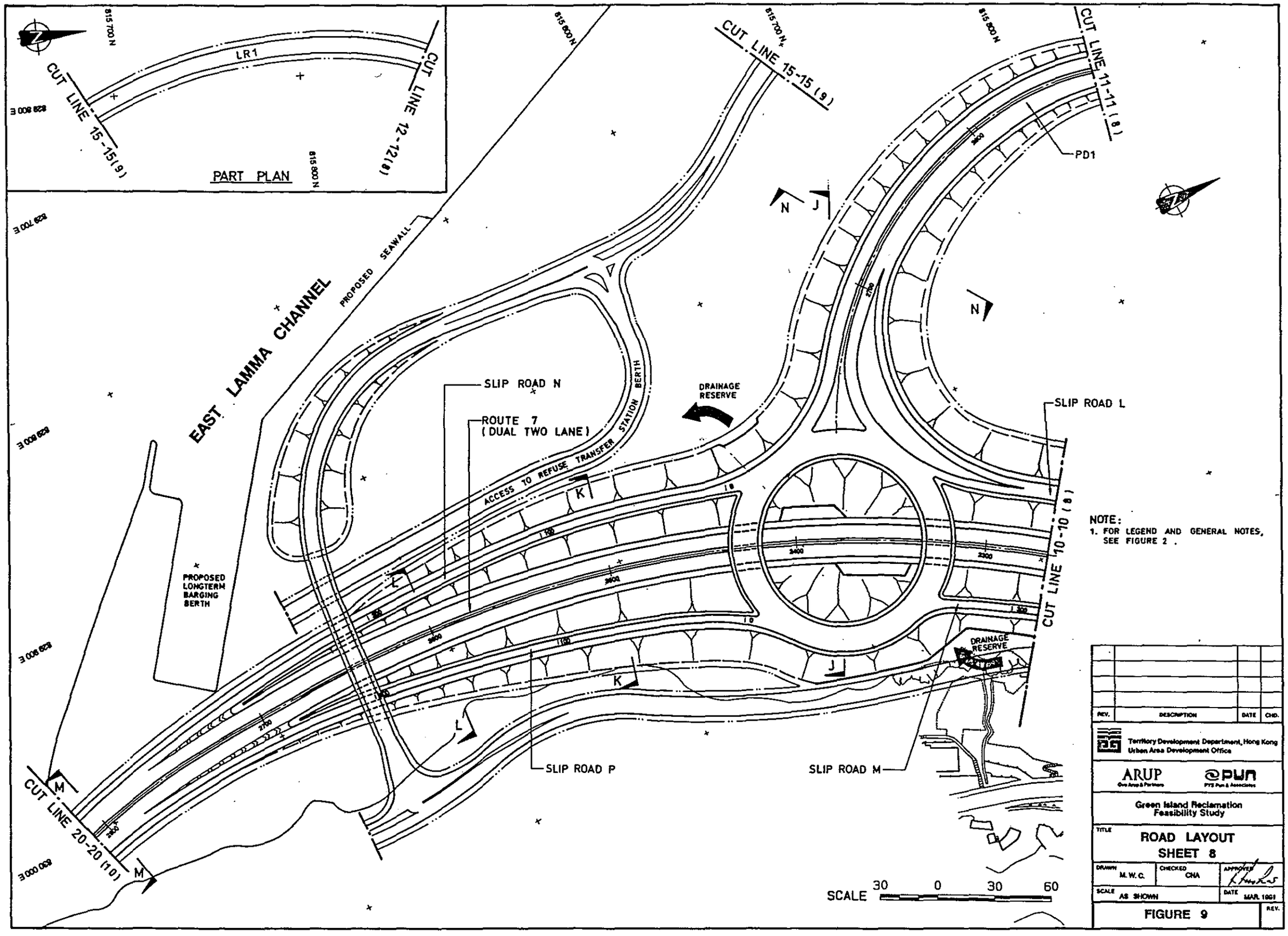
FIGURE 8 — REV



NOTE:
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2 .

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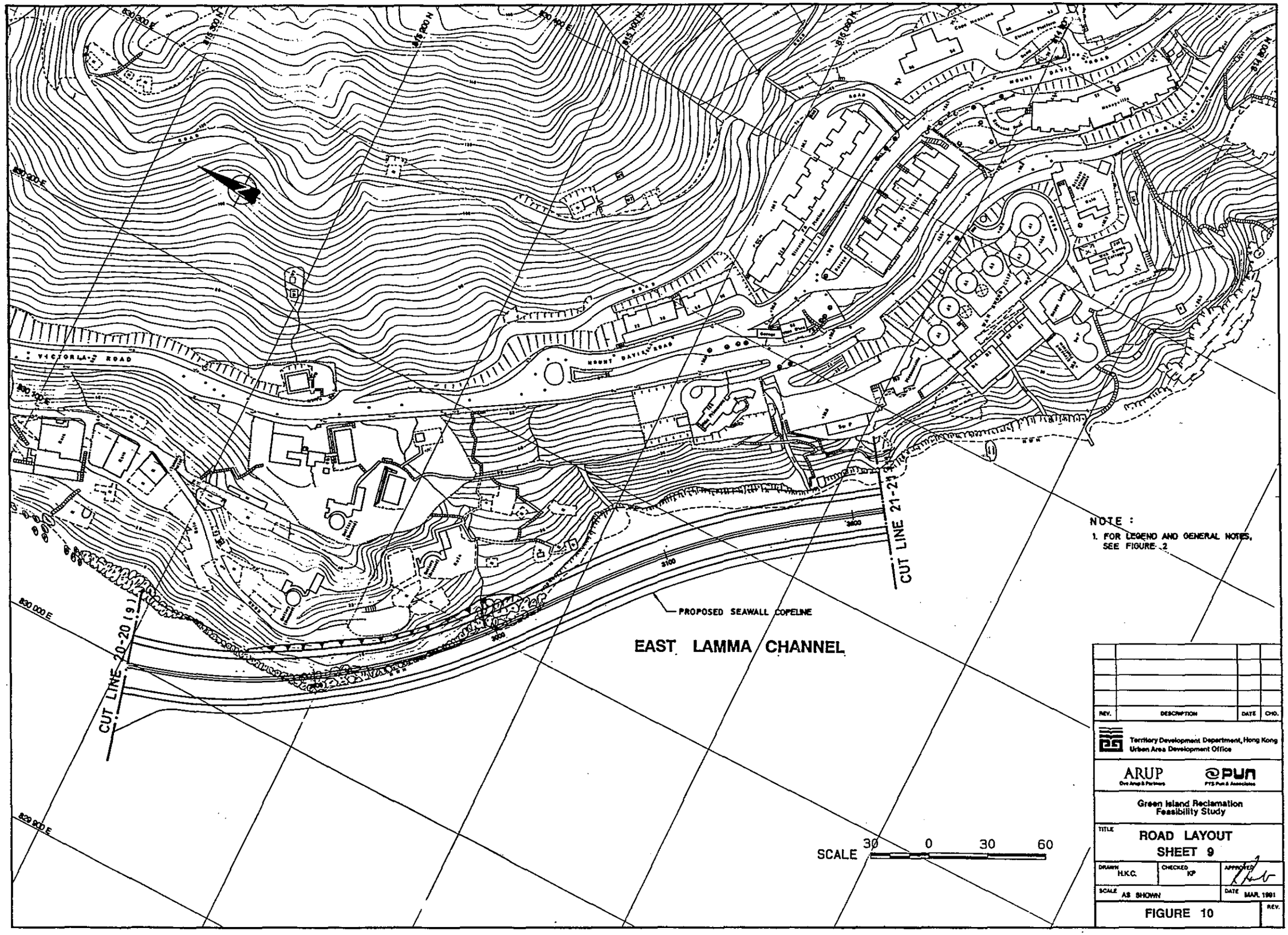
Green Island Reclamation
Feasibility Study

TITLE
ROAD LAYOUT
SHEET 8

DRAWN	CHECKED	APPROVED
M. W. C.	CHA	
SCALE AS SHOWN		DATE MAR. 1991

FIGURE 9 REV.



NOTE :

1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
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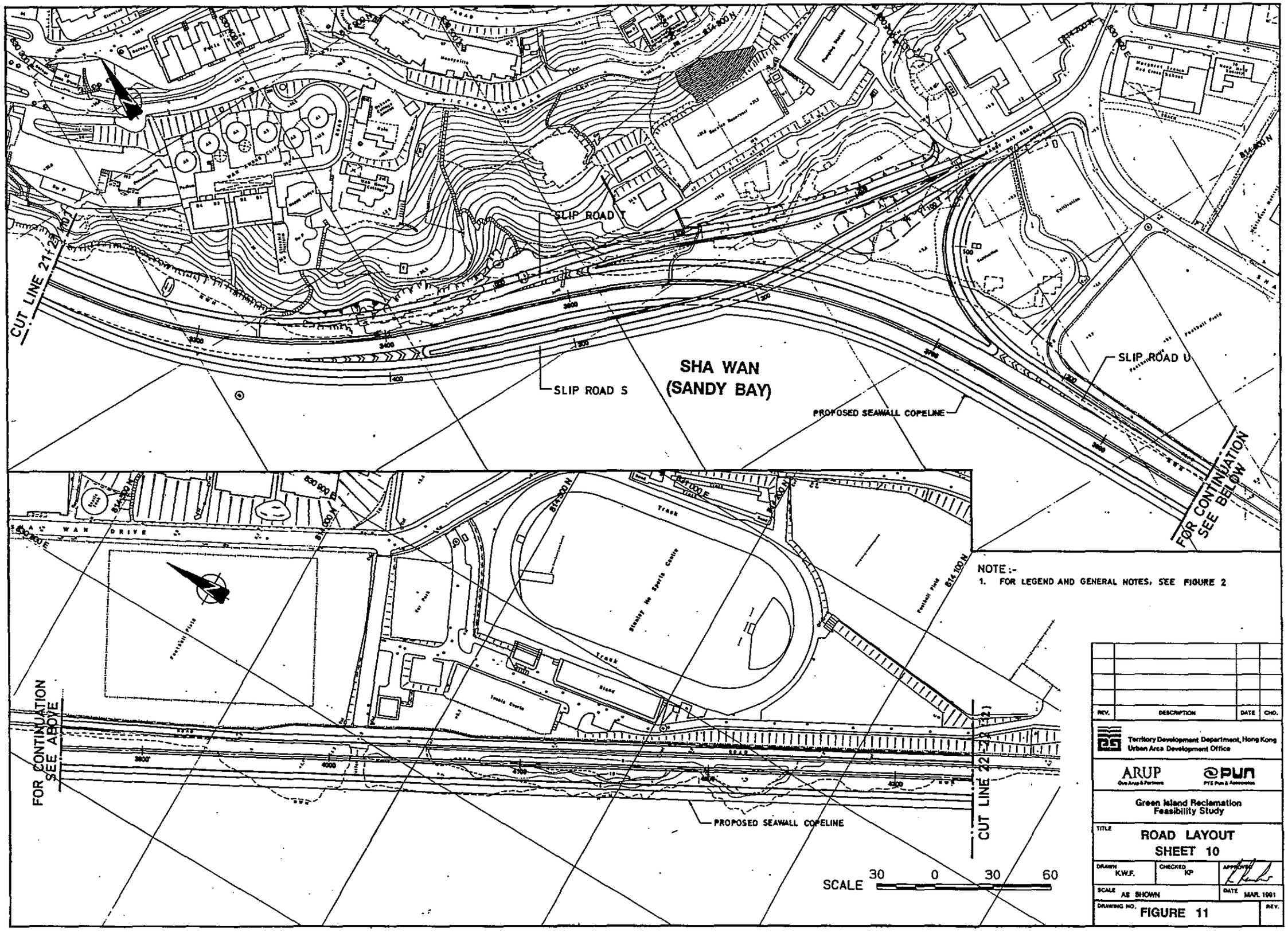
Green Island Reclamation
Feasibility Study

TITLE
ROAD LAYOUT
SHEET 9

DRAWN	CHECKED	APPROVED
H.K.C.	KP	
SCALE AS SHOWN		DATE MAR. 1991

FIGURE 10 — REV.



NOTE :-

1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
Urban Area Development Office

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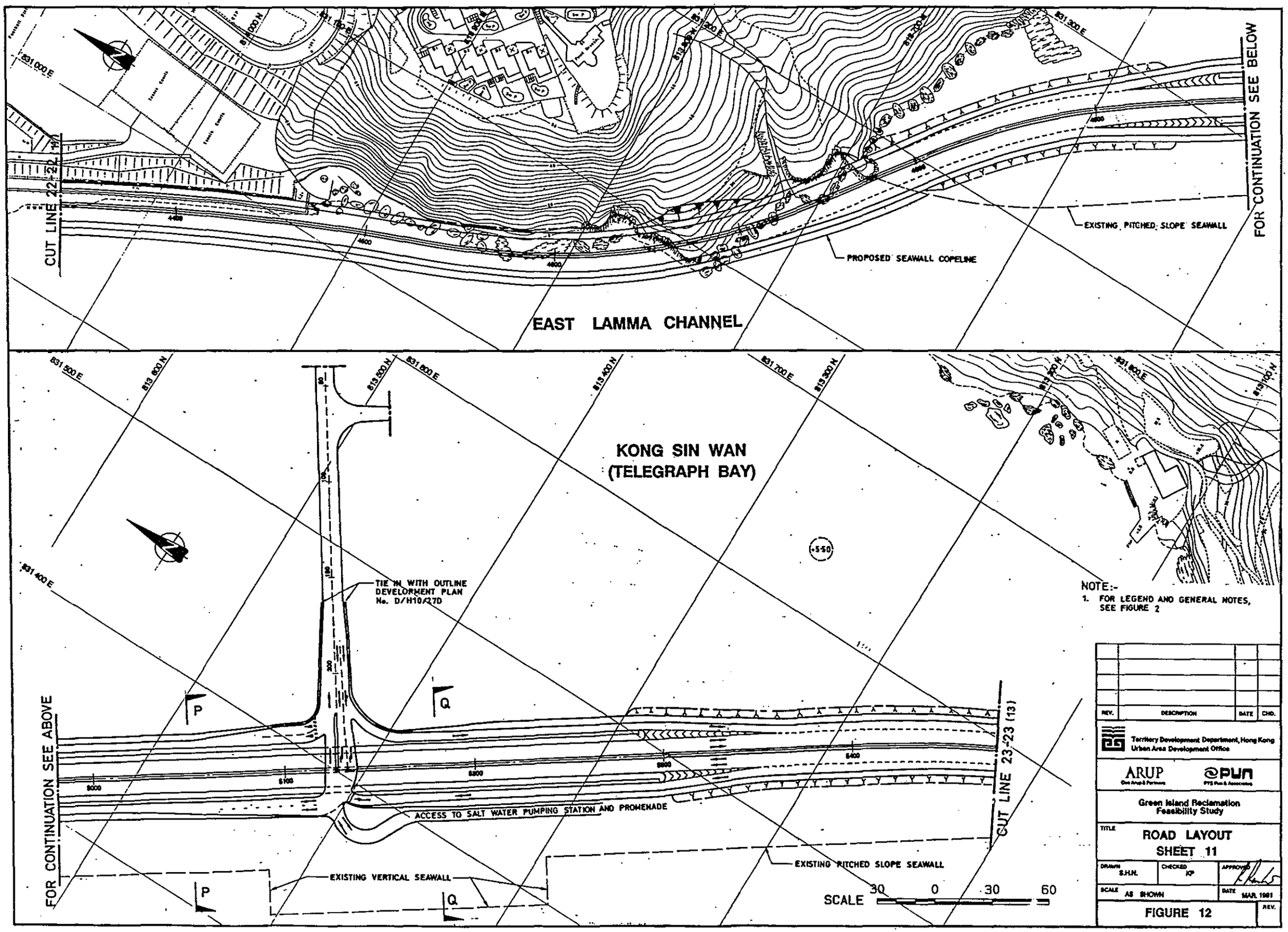
Feasibility Study

TITLE
ROAD LAYOUT
SHEET 10

DRAWN	CHECKED	APPROVED
K.W.F.	KP	
SCALE AS SHOWN		DATE MAR. 1991

DRAWING NO. FIGURE 11 REV.



NOTE:-

1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD.

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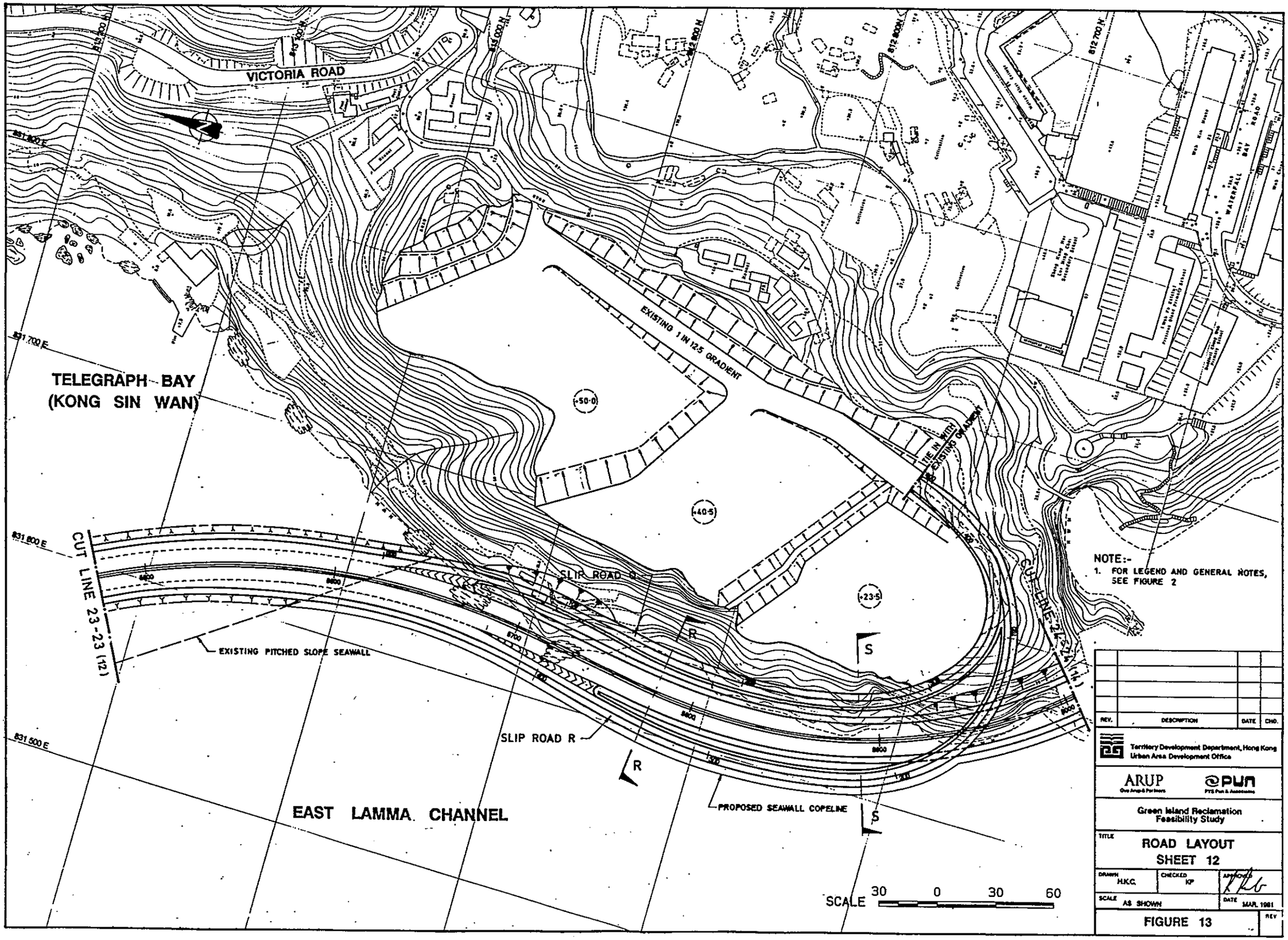
Feasibility Study

TITLE
ROAD LAYOUT
SHEET 11

DRAWN	CHECKED	APPROVED
S.H.N.	KP	
SCALE AS SHOWN		DATE MAR. 1981

FIGURE 12 — REV.



NOTE:-
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD.

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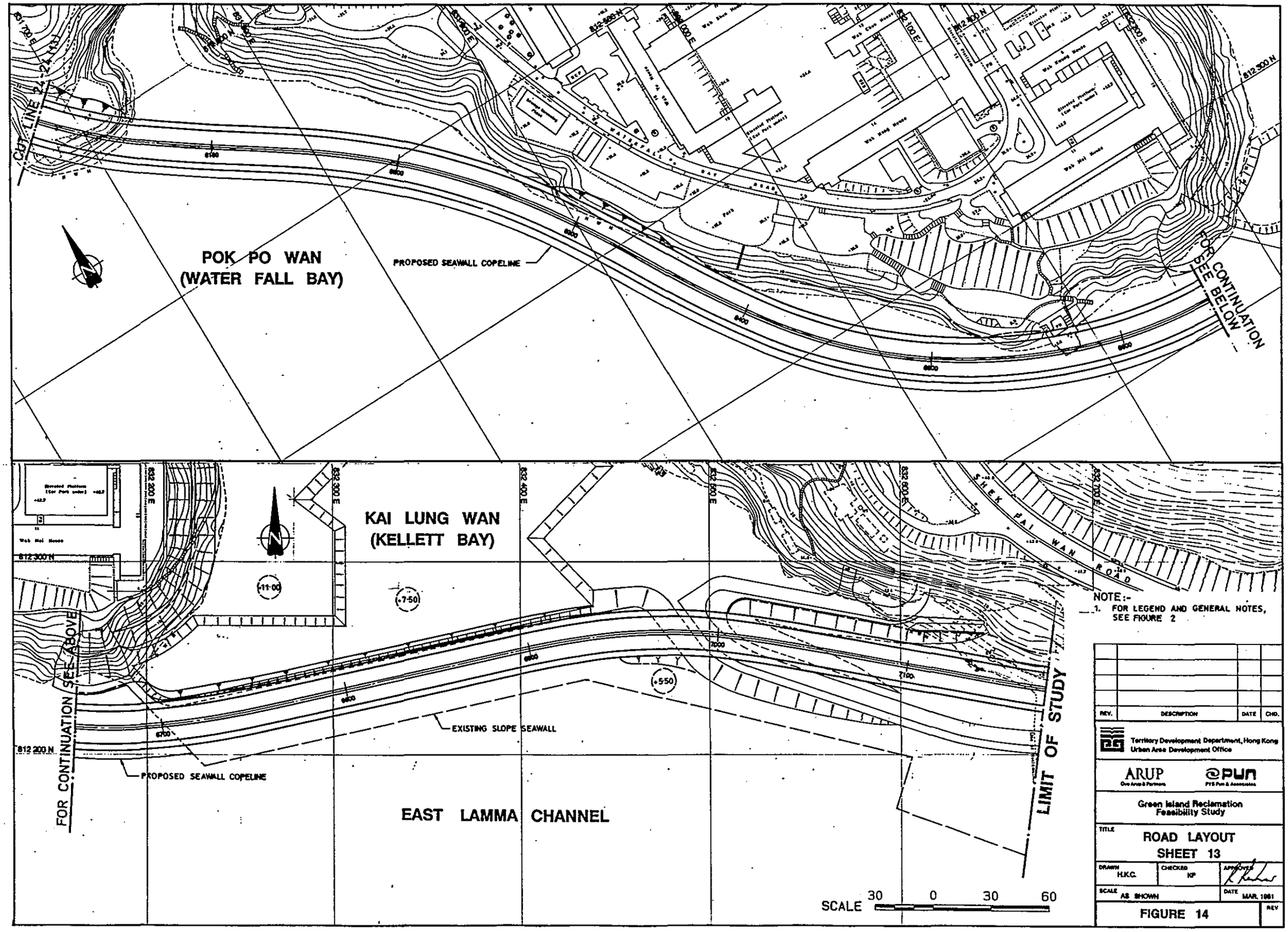
TITLE
ROAD LAYOUT SHEET 12

DRAWN	CHECKED	APPROVED
H.K.C.	KP	
SCALE AS SHOWN		DATE MAR. 1981

FIGURE 13 REV



NOTE:-

1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD.

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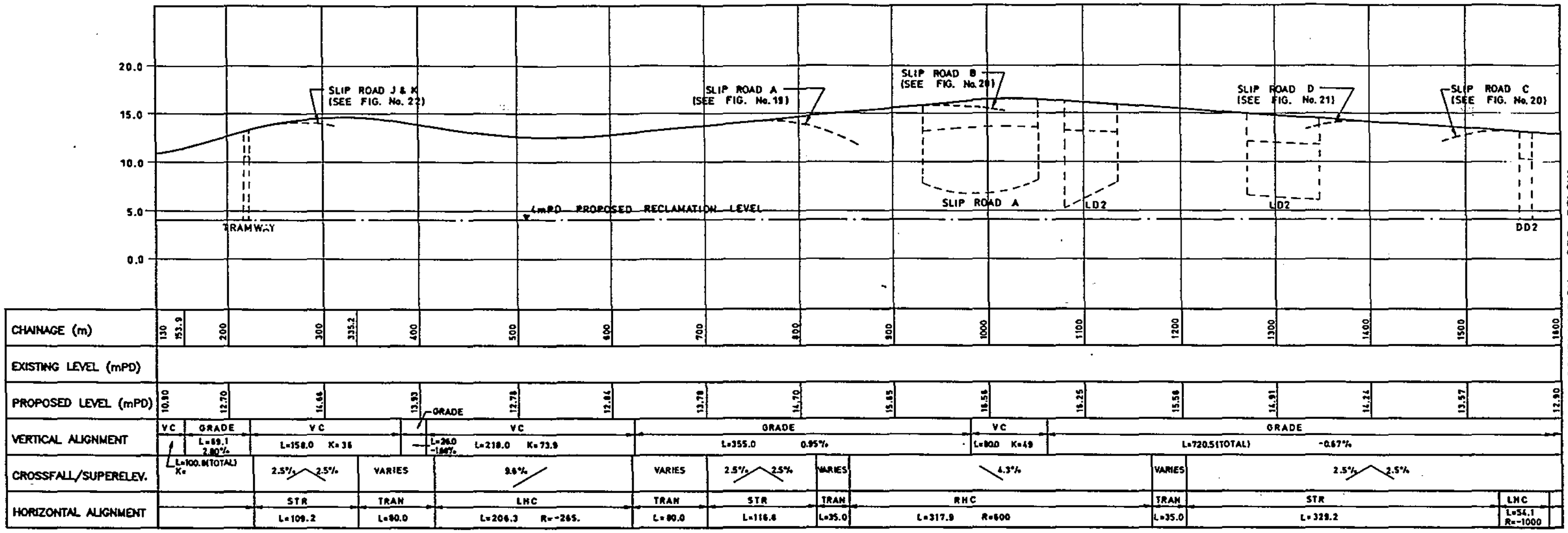
TITLE
ROAD LAYOUT
SHEET 13

DRAWN	CHECKED	APPROVED
H.K.C.	KP	

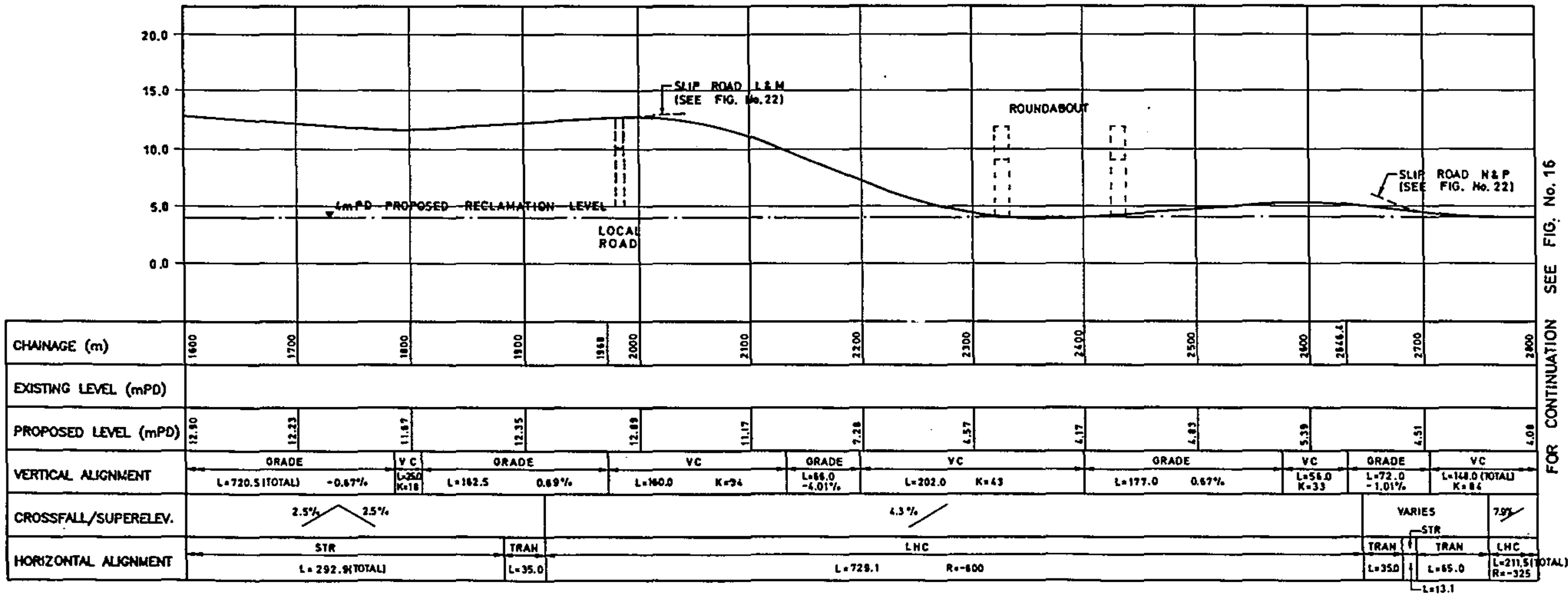
SCALE AS SHOWN — DATE MAR. 1981

FIGURE 14 — REV



ROUTE 7

FOR CONTINUATION SEE BELOW



ROUTE 7

FOR CONTINUATION SEE FIG. No. 16

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

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PYS Pun & Associates

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TITLE **VERTICAL ALIGNMENT. SHEET 1**

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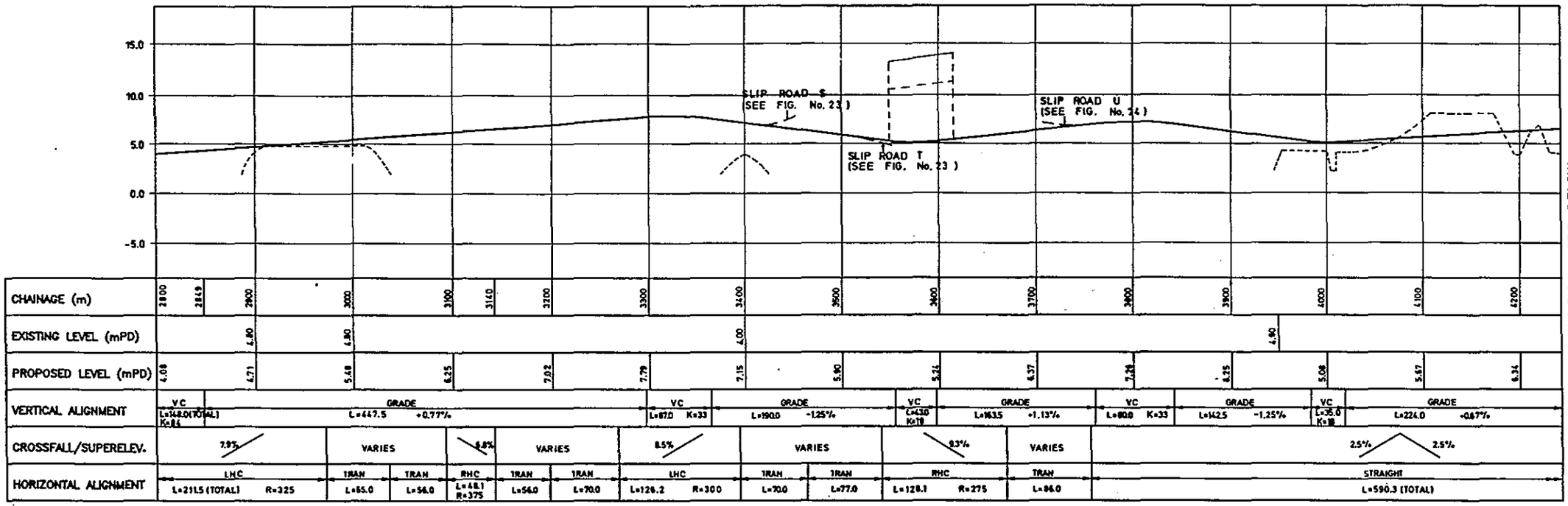
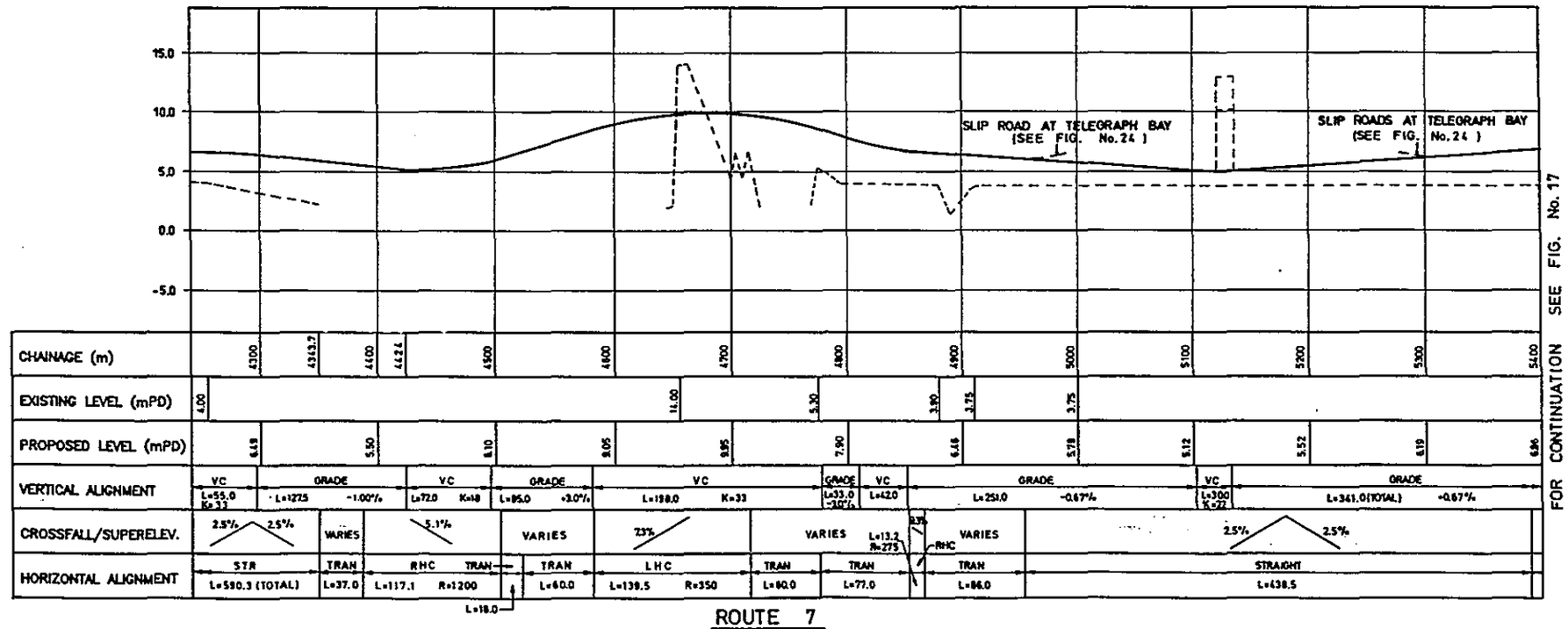
SCALE AS SHOWN		DATE MAR. 1991

FIGURE 15 REV



ROUTE 7



ROUTE 7

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

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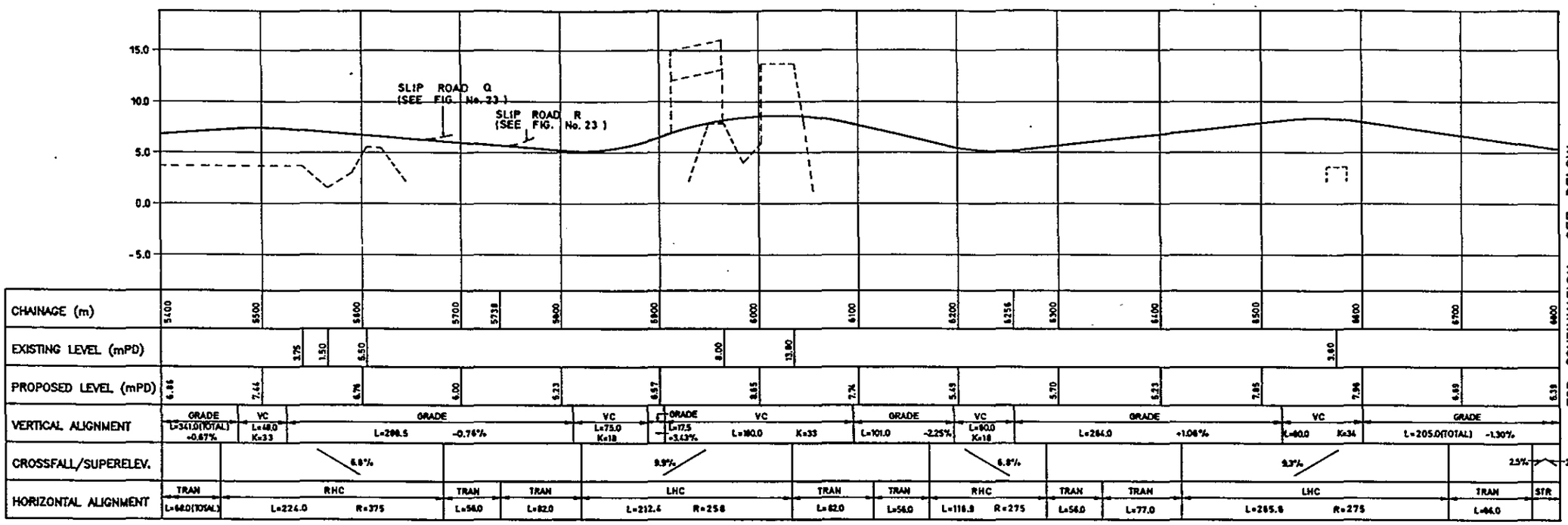
Feasibility Study

TITLE: VERTICAL ALIGNMENT SHEET 2

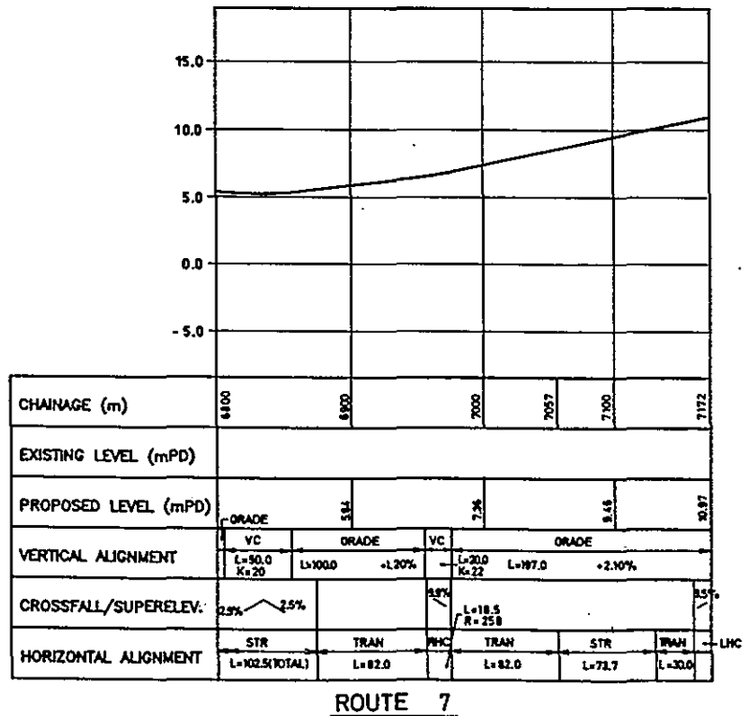
DRAWN	CHECKED	APPROVED
S.H.N.	KP	

SCALE AS SHOWN — DATE MAR. 1991

FIGURE 16 — REV.



ROUTE 7



ROUTE 7

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

FOR CONTINUATION SEE BELOW

REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
Urban Area Development Office

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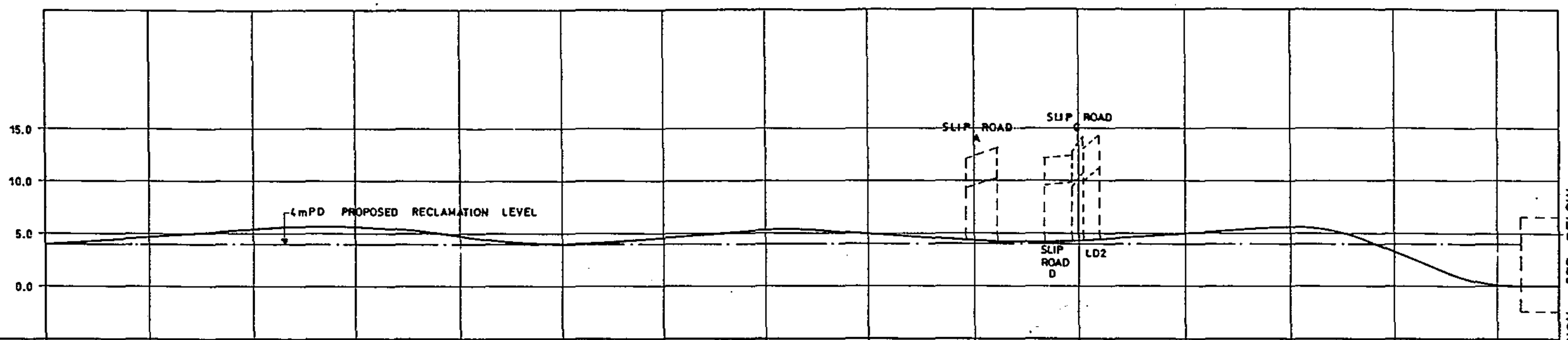
Feasibility Study

TITLE VERTICAL ALIGNMENT SHEET 3

DRAWN	CHECKED	APPROVED
S.H.N.	KP	
SCALE AS SHOWN		DATE MAR. 1991

FIGURE 17 REV



FOR CONTINUATION SEE BELOW

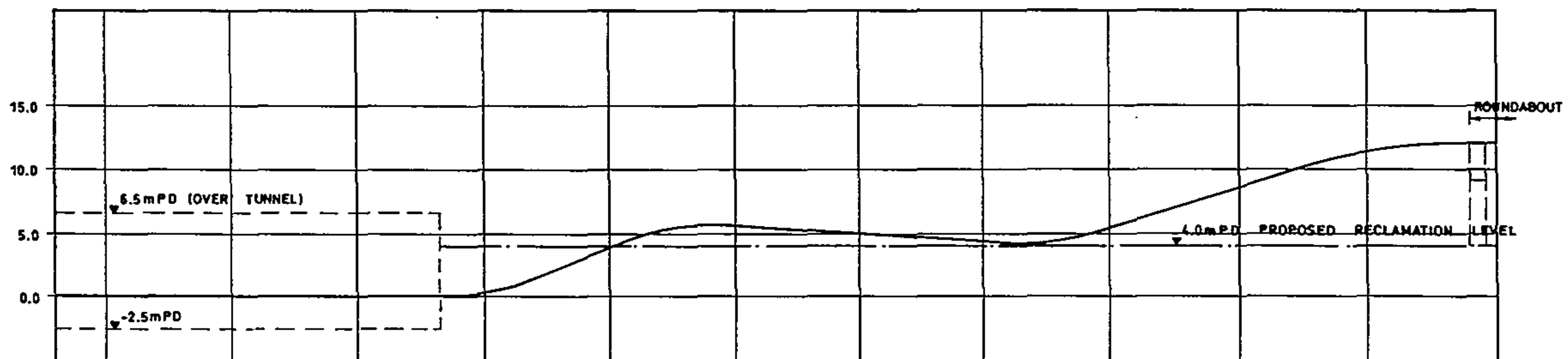
CHAINAGE (m)	200	300	400	500	600	700	752	800	900	1000	1100	1200	1300	1400	1500	1600	1624	1680
EXISTING LEVEL (mPD)																		
PROPOSED LEVEL (mPD)	4.12	4.79	5.45	5.59	4.80	4.04		4.81	5.36	5.01	4.35	4.35	5.01	5.86	3.36	0.14		0.00

VERTICAL ALIGNMENT		
GRADE	L=192.0	0.67%
V C	L=220.0	K=108
V C	L=140.0	K=70
GRADE	L=130.0	0.78%
V C	L=76.0	K=52
GRADE	L=127.0	-0.67%
V C	L=130.0	K=97
GRADE	L=176.5	0.67%
V C	L=89.0	K=19
GRADE	L=63.5	-4.0%
V C	L=80.0	K=20
GRADE		0.00%

CROSSFALL/SUPERELEV.

HORIZONTAL ALIGNMENT

P D 1



CHAINAGE (m)	1680	1700	1800	1900	1984	2000	2100	2200	2300	2400	2500	2600	2700	2780	2800
EXISTING LEVEL (mPD)															
PROPOSED LEVEL (mPD)	0.00	0.00	0.00	0.00		0.32	3.84	5.60	4.93	4.25	5.38	8.47	11.25	12.00	12.00

VERTICAL ALIGNMENT		
GRADE	L=340.0 (TOTAL)	0.00%
V C	L=80.0	K=20
GRADE	L=63.5	4.00%
V C	L=89.0	K=19
GRADE	L=215.5	-0.67%
V C	L=84.0	K=22
GRADE	L=154.0	3.09%
V C	L=132.0	K=41
GRADE		0.0%

CROSSFALL/SUPERELEV.

HORIZONTAL ALIGNMENT

P D 1

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

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Urban Area Development Office

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PUN — P&T Pun & Associates

Green Island Reclamation Feasibility Study

TITLE VERTICAL ALIGNMENT SHEET 4

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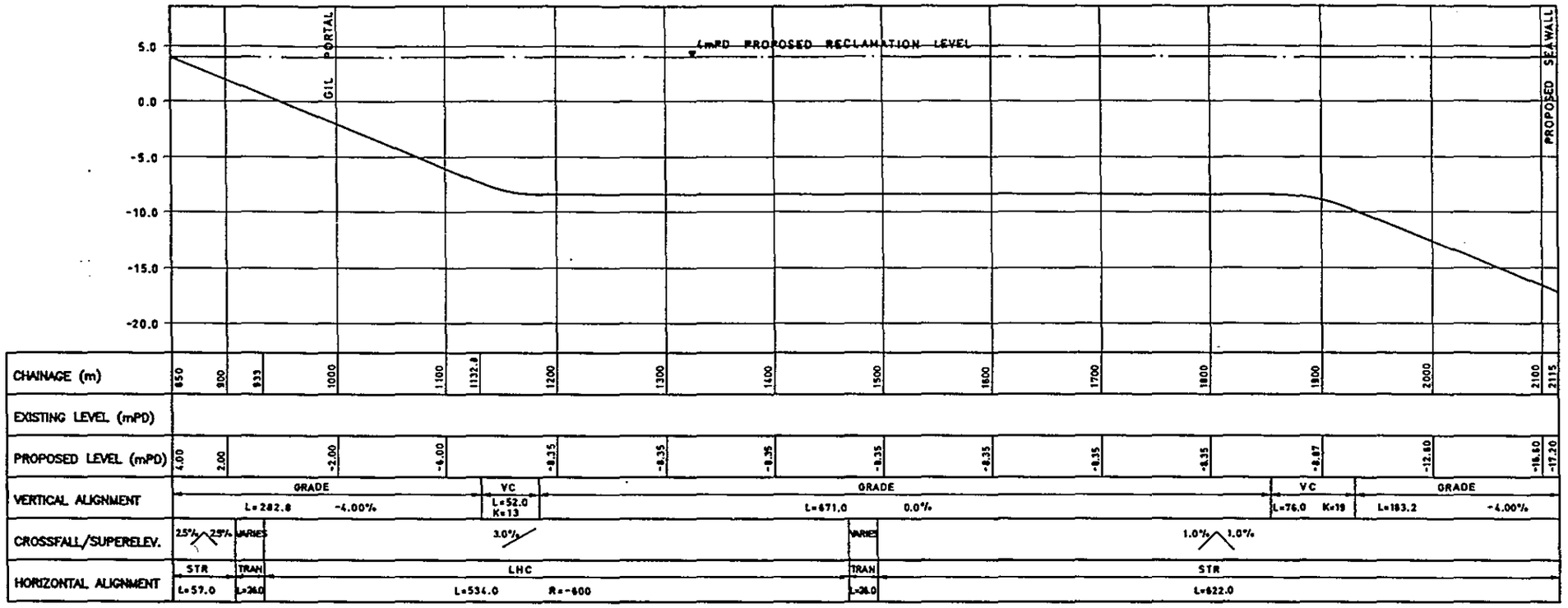
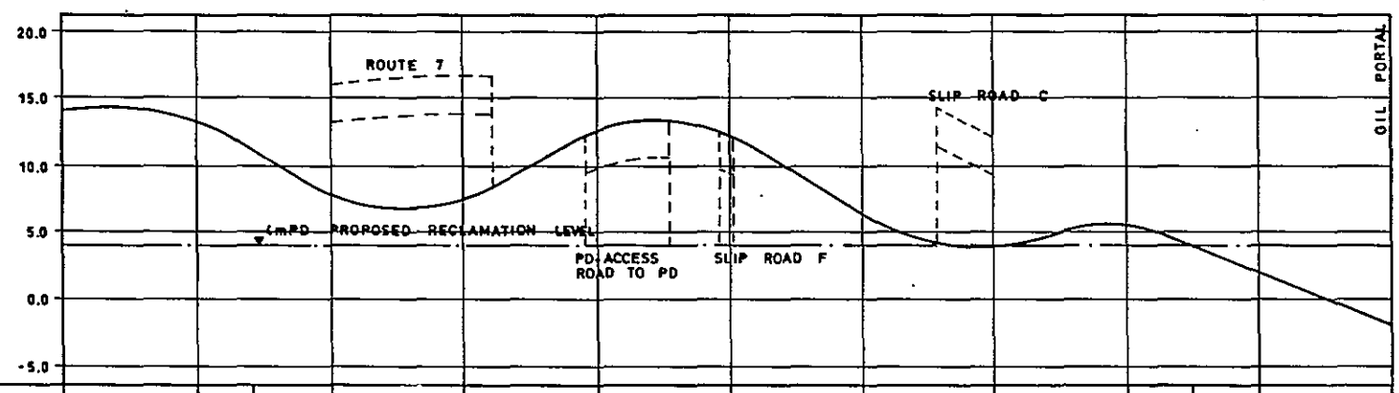
SCALE AS SHOWN | DATE MAR. 1991

FIGURE 18 | REV



GREEN ISLAND LINK



SLIP ROAD A

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

Territory Development Department, Hong Kong
Urban Area Development Office

ARUP Ove Arup & Partners — PYS Pun & Associates

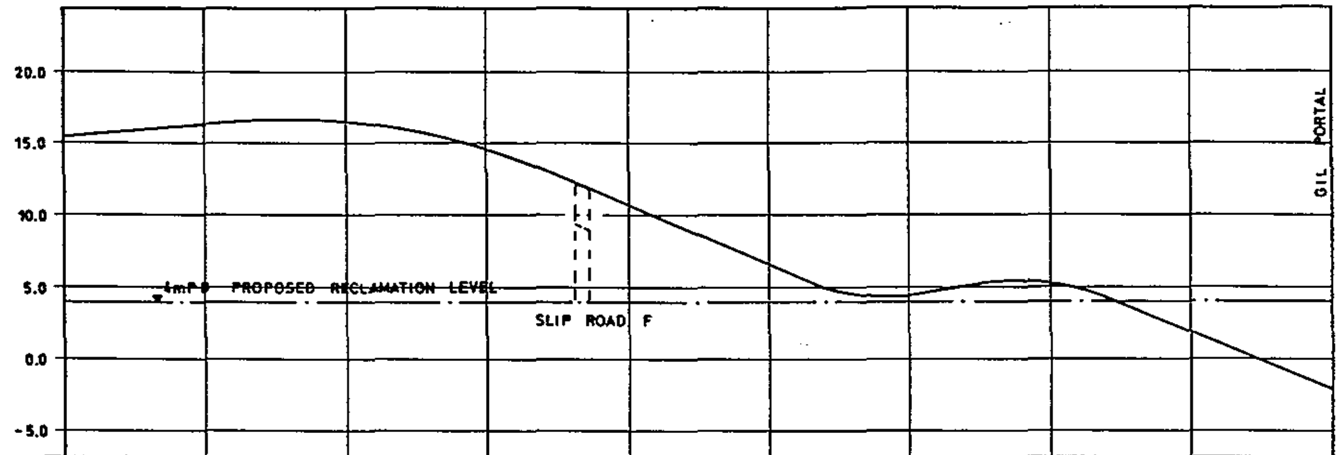
Green Island Reclamation
Feasibility Study

TITLE: VERTICAL ALIGNMENT SHEET 5

DRAWN	CHECKED	APPROVED
S.H.N.	CNA	

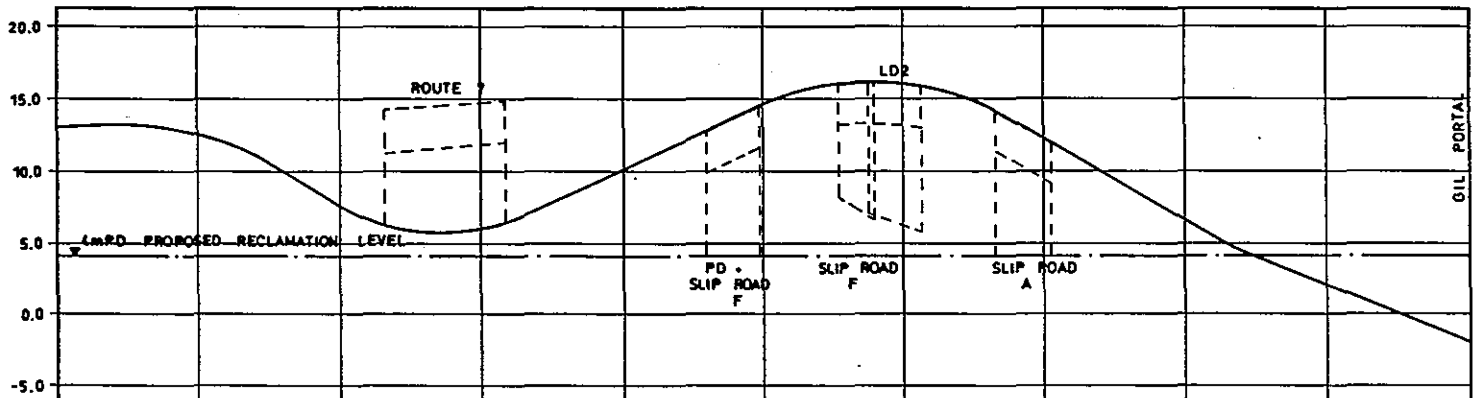
SCALE	DATE	REV
AS SHOWN	MAR 1991	

FIGURE 19



CHAINAGE (m)	100 / 200 / 221 / 300 / 400 / 500 / 600 / 700 / 800 / 850 / 900 / 1000
EXISTING LEVEL (mPD)	
PROPOSED LEVEL (mPD)	15.40 / 16.35 / 16.81 / 14.88 / 10.80 / 6.63 / 4.56 / 5.35 / 2.00 / -2.00
VERTICAL ALIGNMENT	GRADE L=121.0 0.95% / VC L=230.0 K=45 / GRADE L=175.0 -4.17% / VC L=74.0 K=13 / GRADE L=50.0 1.5% / VC L=98.0 K=17.8 / GRADE L=152.0 -4.00%
CROSSFALL/SUPERELEV.	VARIES / VARIES / 10% / VARIES / 5.1% / VARIES / 2.5% 2.5% / 2.5%
HORIZONTAL ALIGNMENT	OFFSET FROM ROUTE 7 / TRAN L=152.0 / RHC L=55.0 R=125 / TRAN L=138.0 / LHC L=210.0 R=-340 / TRAN L=38.0 / STR L=70.0 / OFFSET FROM GIL

SLIP ROAD B



CHAINAGE (m)	0.0 / 38 / 100 / 200 / 300 / 400 / 500 / 600 / 700 / 800 / 850 / 900 / 1000
EXISTING LEVEL (mPD)	
PROPOSED LEVEL (mPD)	12.97 / 12.61 / 7.65 / 5.87 / 10.06 / 14.64 / 16.14 / 12.38 / 6.61 / 2.00 / -2.00
VERTICAL ALIGNMENT	GRADE L=38.0 0.67% / VC L=124.0 K=18.6 / GRADE L=33.0 -6.0% / VC L=138.0 K=13 / GRADE L=159.0 4.60% / VC L=194.0 K=18.7 / GRADE L=136.0 -5.75% / VC L=26.0 K=15 / GRADE L=152.0 -4.00%
CROSSFALL/SUPERELEV.	2.5% / VARIES / 10.0% / VARIES / 8.3% / VARIES / VARIES / 6.9% / VARIES / 2.5%
HORIZONTAL ALIGNMENT	OFFSET FROM ROUTE 7 / TRAN L=100.0 / LHC L=144.0 R=-180 / TRAN L=110.0 / LHC L=37.0 R=-210 / TRAN L=74.0 / TRAN L=40.0 / LHC L=66.0 R=-250 / TRAN L=72.0 / OFFSET FROM GIL

SLIP ROAD C

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
Urban Area Development Office

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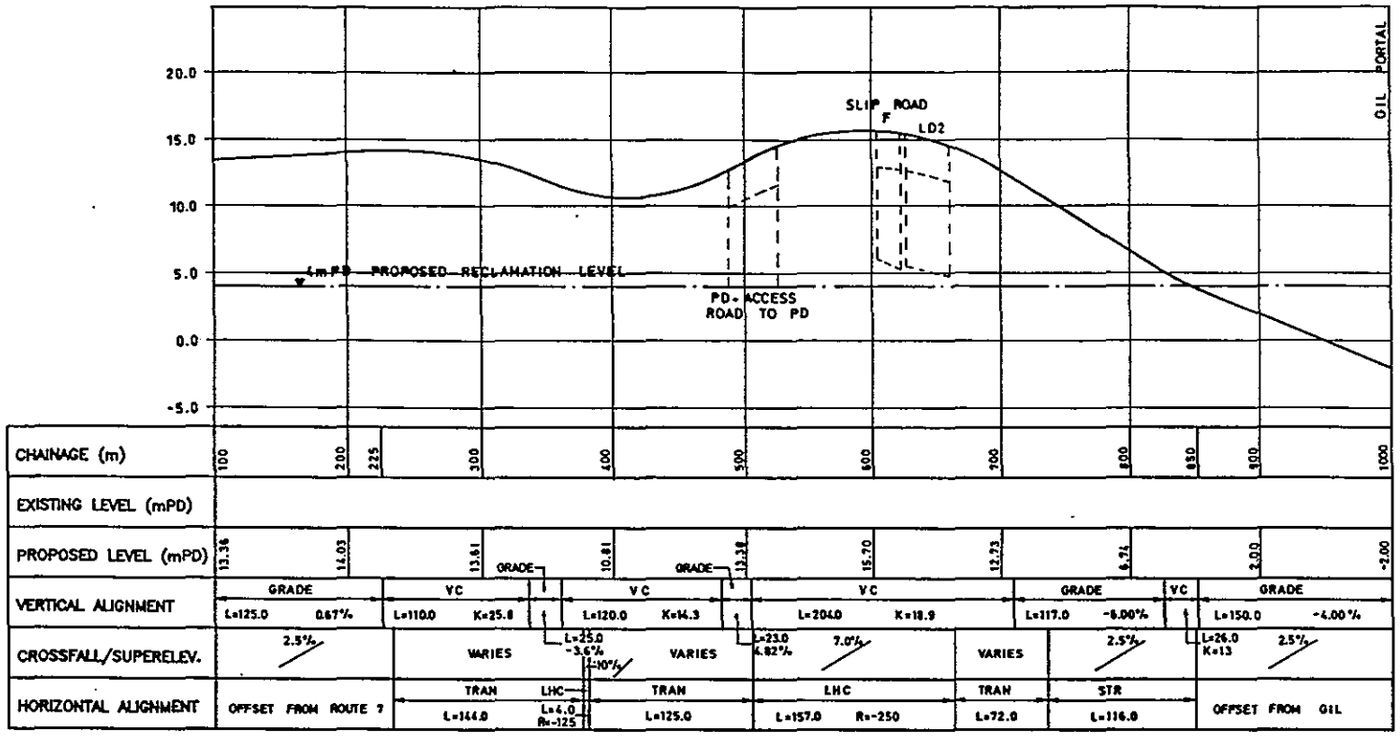
Green Island Reclamation Feasibility Study

TITLE VERTICAL ALIGNMENT SHEET 6

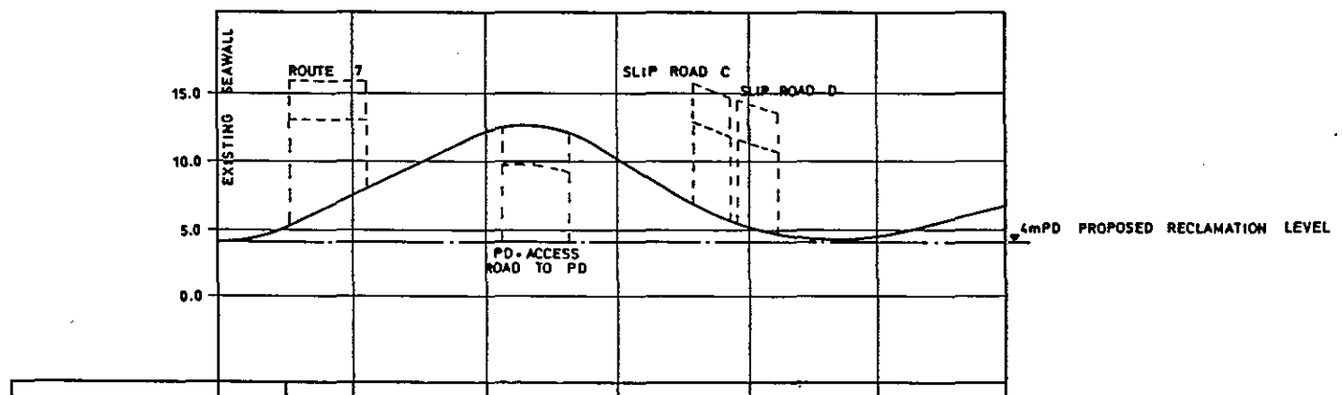
DRAWN S.H.N. CHECKED CHA APPROVED

SCALE AS SHOWN DATE MAR. 1991

FIGURE 20 REV



SLIP ROAD D



SLIP ROAD E

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

Territory Development Department, Hong Kong
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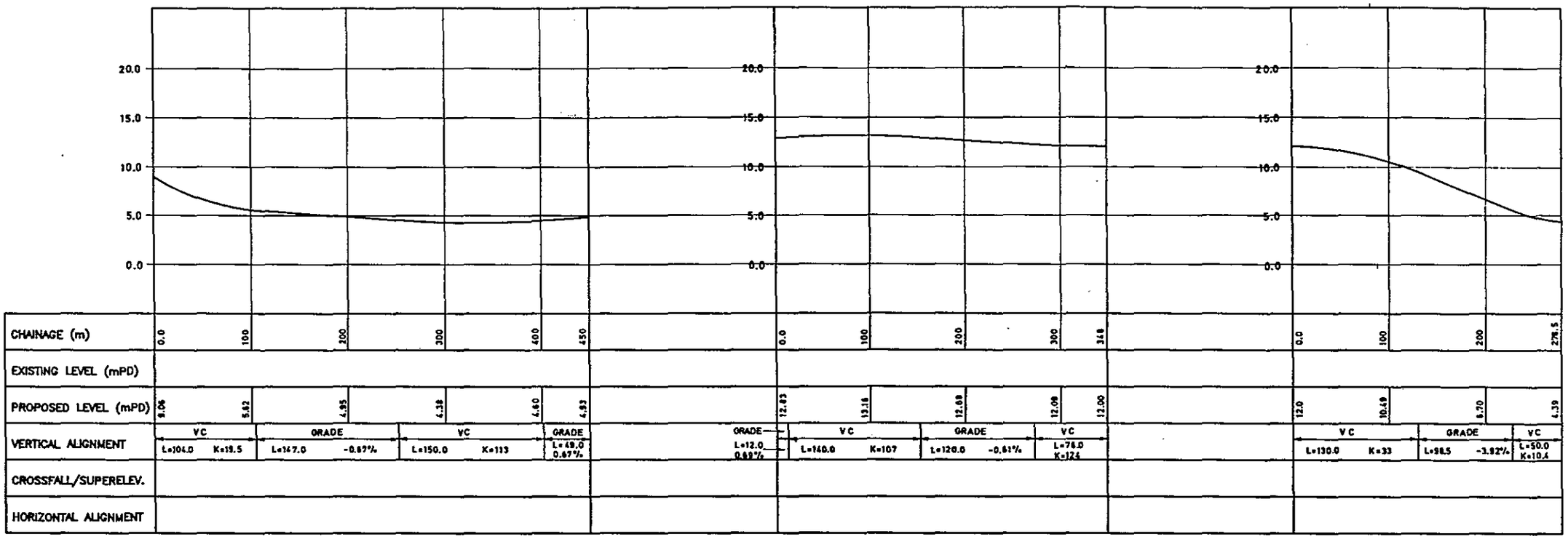
Green Island Reclamation
Feasibility Study

TITLE VERTICAL ALIGNMENT
SHEET 7

DRAWN	CHECKED	APPROVED
S.H.N.	CNA	

SCALE AS SHOWN DATE MAR. 1981 REV.

FIGURE 21



REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
Urban Area Development Office

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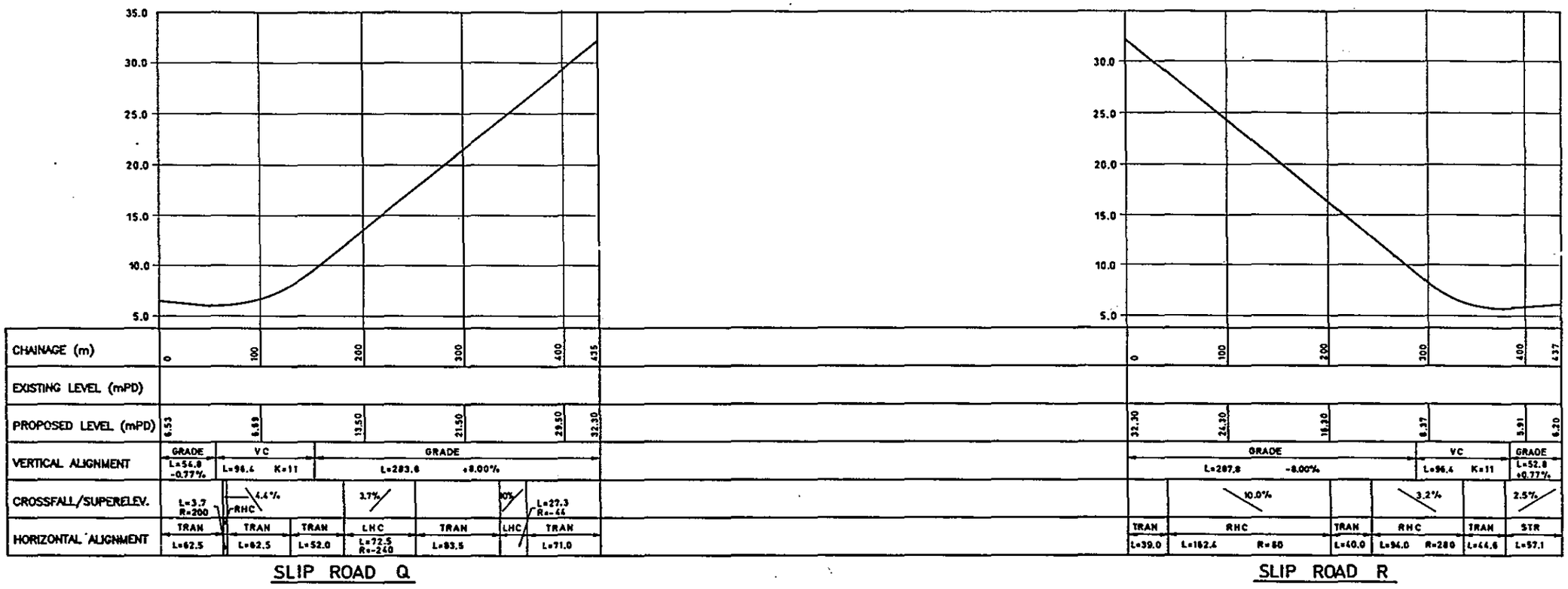
Green Island Reclamation
Feasibility Study

TITLE: VERTICAL ALIGNMENT
SHEET 8

DRAWN	CHECKED	APPROVED
S.H.N.	CNA	
SCALE AS SHOWN		DATE MAR. 1991

FIGURE 22 — REV



VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD.

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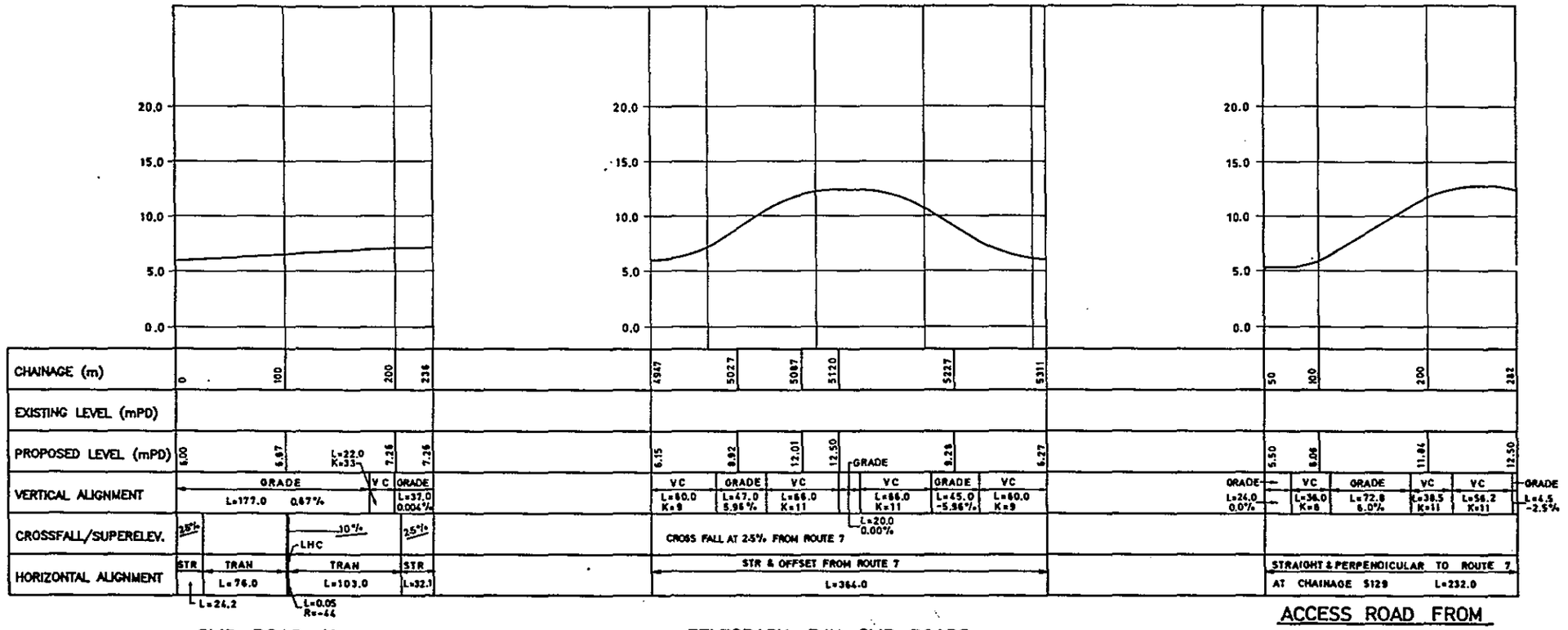
Feasibility Study

TITLE: VERTICAL ALIGNMENT
SHEET 9

DRAWN	CHECKED	APPROVED
S.H.M.	KP	

SCALE AS SHOWN | DATE MAR. 1991

FIGURE 23 | REV



SLIP ROAD U

TELEGRAPH BAY SLIP ROADS

ACCESS ROAD FROM TELEGRAPH BAY DEVELOPMENT

CHAINAGE (m)	
EXISTING LEVEL (mPD)	
PROPOSED LEVEL (mPD)	
VERTICAL ALIGNMENT	
CROSSFALL/SUPERELEV.	
HORIZONTAL ALIGNMENT	

VERT. SCALE 5 0 5 10

HORI. SCALE 50 0 50 100

REV.	DESCRIPTION	DATE	CHD

Territory Development Department, Hong Kong
Urban Area Development Office

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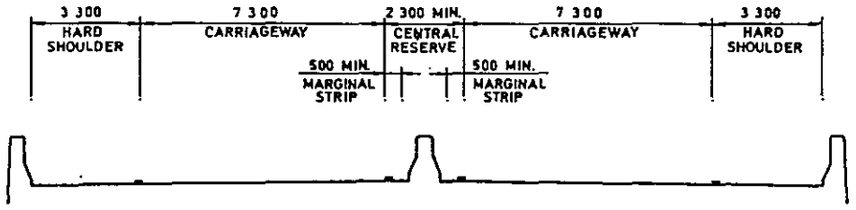
PYS PYS Pun & Associates

Green Island Reclamation Feasibility Study

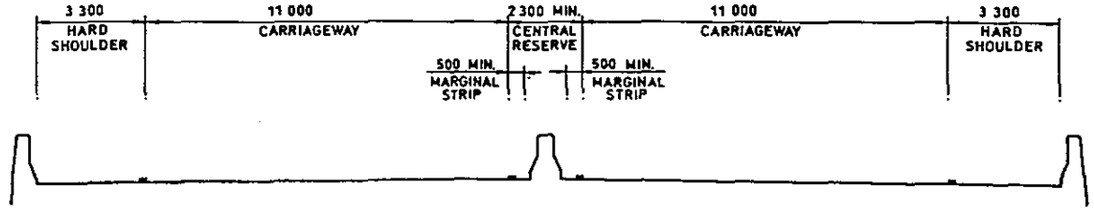
TITLE VERTICAL ALIGNMENT SHEET 10

DRAWN	CHECKED	APPROVED
S.H.N.	KP	
SCALE AS SHOWN		DATE MAR. 1991

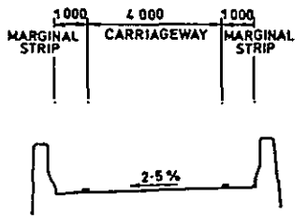
FIGURE 24 REV



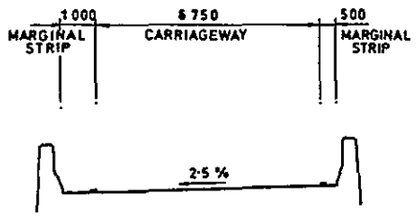
ELEVATED EXPRESSWAY — DUAL TWO LANE
(ROUTE 7)



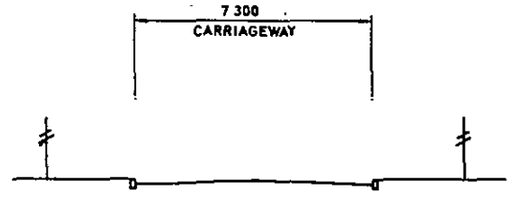
ELEVATED EXPRESSWAY — DUAL THREE LANE
(ROUTE 7)



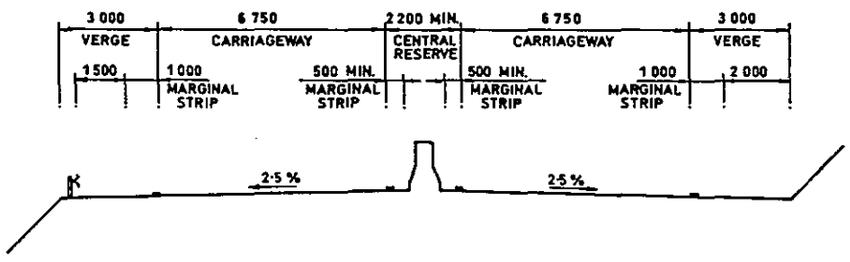
ELEVATED SINGLE CARRIAGEWAY ROAD — ONE LANE
(SLIP ROAD C & D)



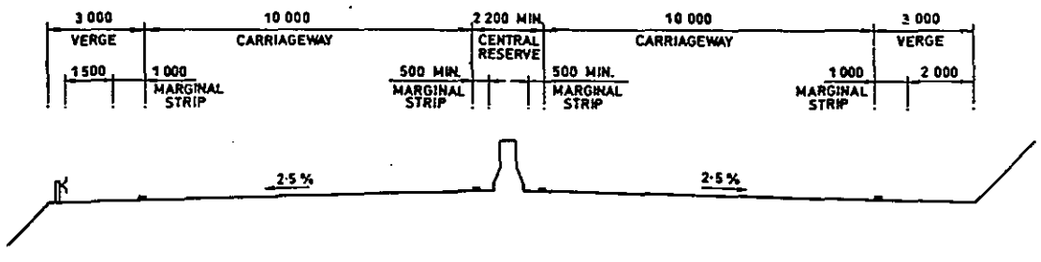
ELEVATED SINGLE CARRIAGEWAY ROAD — TWO LANE
(SLIP ROAD A & B)



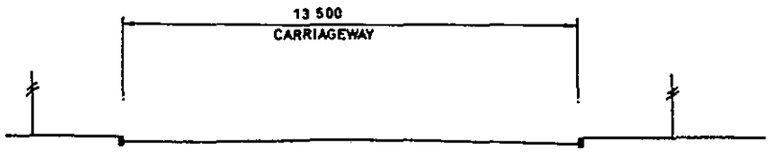
LOCAL DISTRIBUTOR ROAD — SINGLE TWO LANE
(LR1, LR2, LR3, LR4 & LR5)



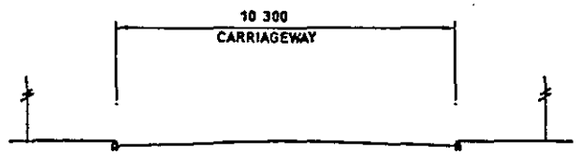
PRIMARY DISTRIBUTOR ROAD —
DUAL TWO LANE
(PD 1 , DD 1 & DD 2)



PRIMARY DISTRIBUTOR ROAD —
DUAL THREE LANE
(PD 1)



DISTRICT DISTRIBUTOR ROAD —
SINGLE FOUR LANE
(LD 2)



DISTRICT DISTRIBUTOR ROAD —
WIDE SINGLE TWO LANE
(LD1, LD2, LD3 & LD4)

SCALE
3 0 3 6 METRES

REV.	DESCRIPTION	DATE	CHD.

Territory Development Department, Hong Kong
Urban Area Development Office

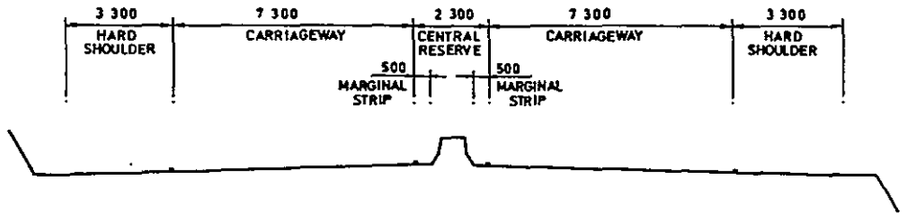
ARUP — Ove Arup & Partners
PYS — PYS Pun & Associates

Green Island Reclamation
Feasibility Study

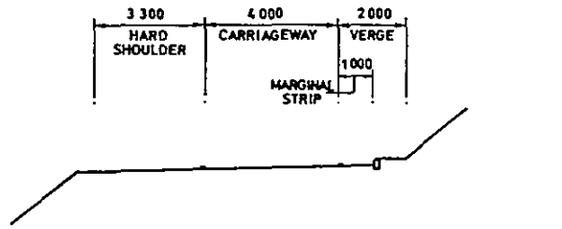
TITLE
TYPICAL CROSS SECTIONS
SHEET 1

DRAWN	CHECKED	APPROVED
K.W.F.	CNA	
SCALE AS SHOWN		DATE MAR. 1981

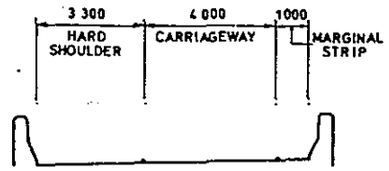
FIGURE 25 — REV



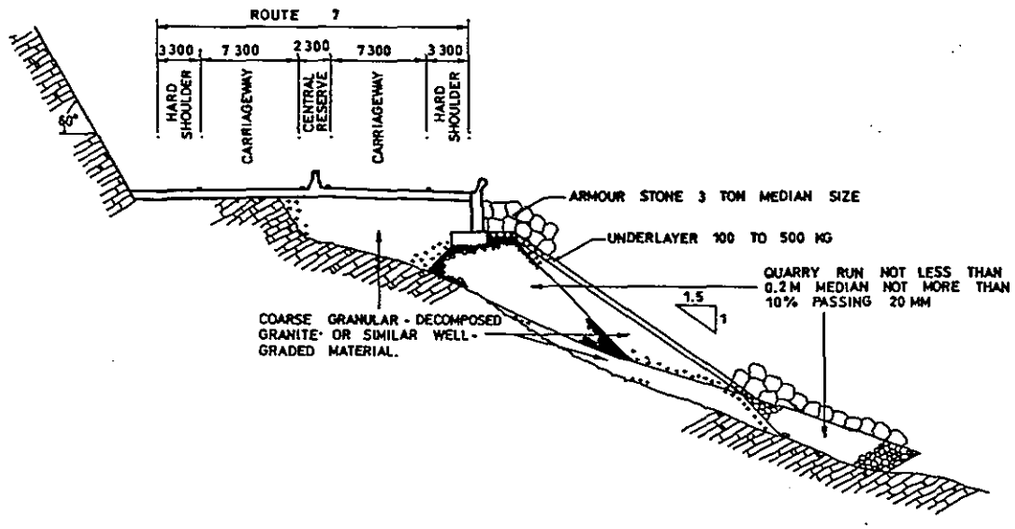
DUAL TWO LANE EXPRESSWAY
(ROUTE 7)



EXPRESSWAY SLIP ROAD
(SLIP ROADS Q, T, U, TELEGRAPH BAY)



EXPRESSWAY ELEVATED SLIP ROAD
(SLIP ROADS R & S)



ROCK MOUND SEAWALL

REV.	DESCRIPTION	DATE	CHD.

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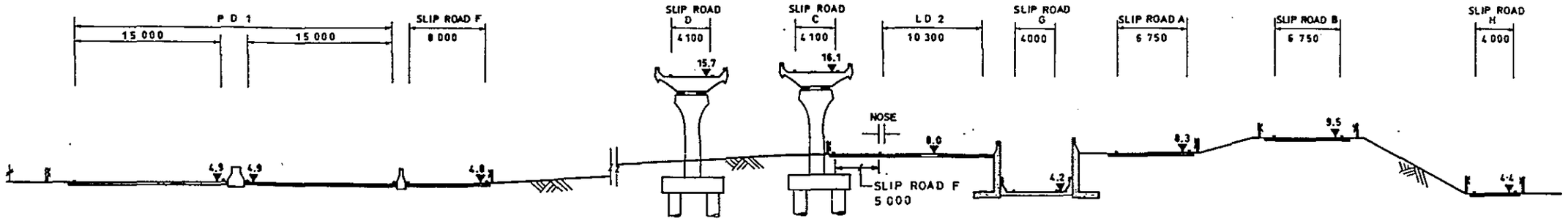
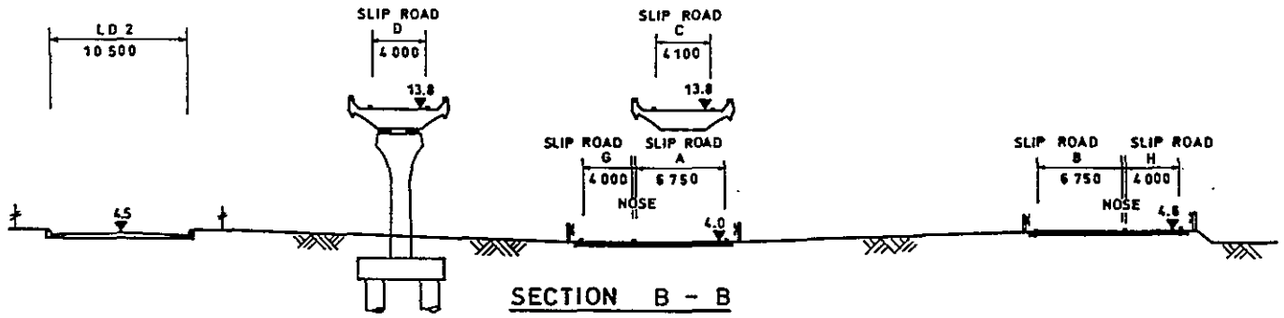
TITLE
TYPICAL CROSS SECTIONS
SHEET 2

DRAWN	CHECKED	APPROVED
S.H.N.	KP	
SCALE AS SHOWN		DATE MAR. 1981

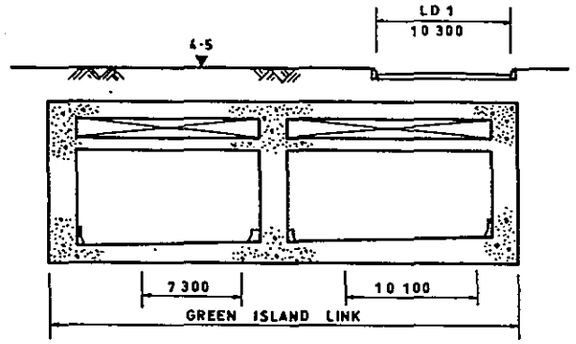
FIGURE 26 — REV



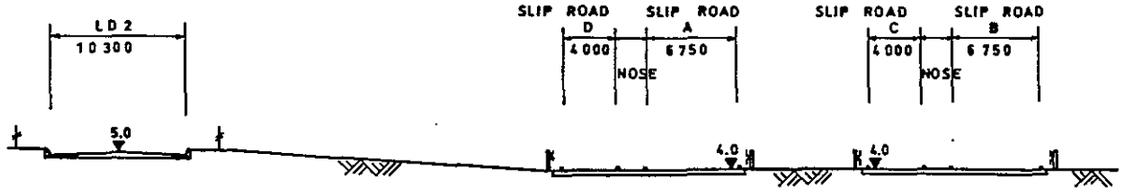
SECTION A - A



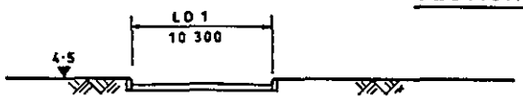
SECTION B - B

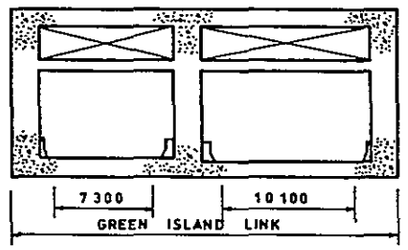


SECTION E - E (TYPICAL)

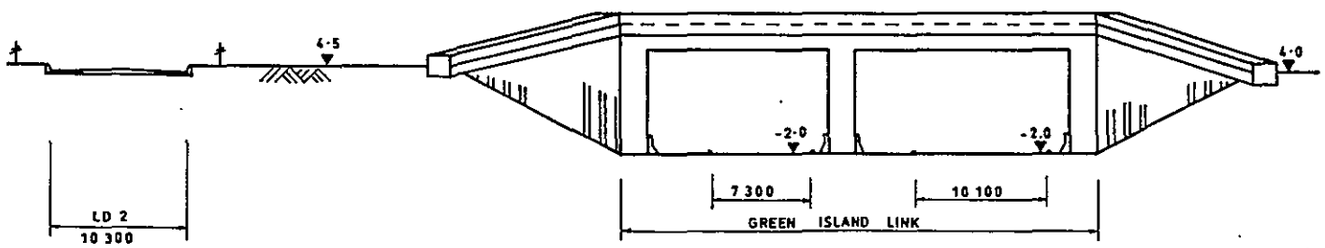


SECTION C - C





SECTION F - F (TYPICAL)



SECTIONAL ELEVATION D - D

SCALE 5 0 5 10 15

REV.	DESCRIPTION	DATE	CHD.

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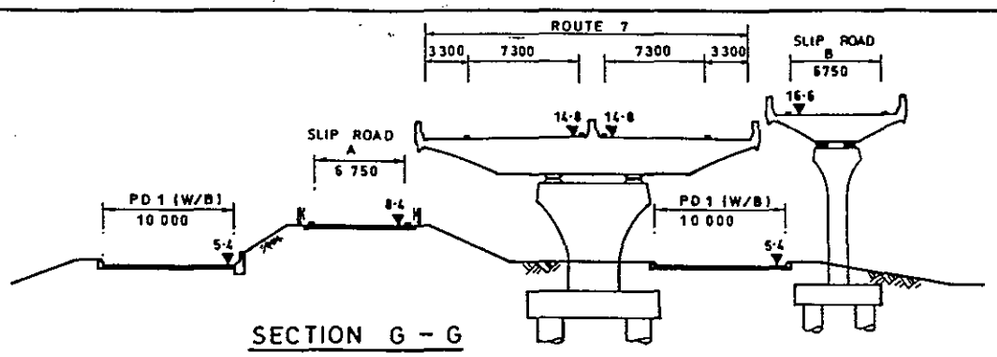
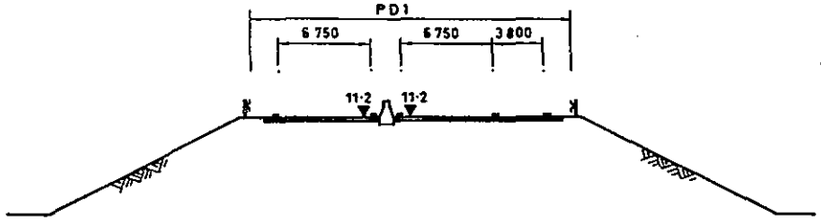
TITLE
CROSS SECTIONS
SHEET 1

DRAWN	CHECKED	APPROVED
M. W. C.	CHA	
SCALE AS SHOWN		DATE MAR. 1991

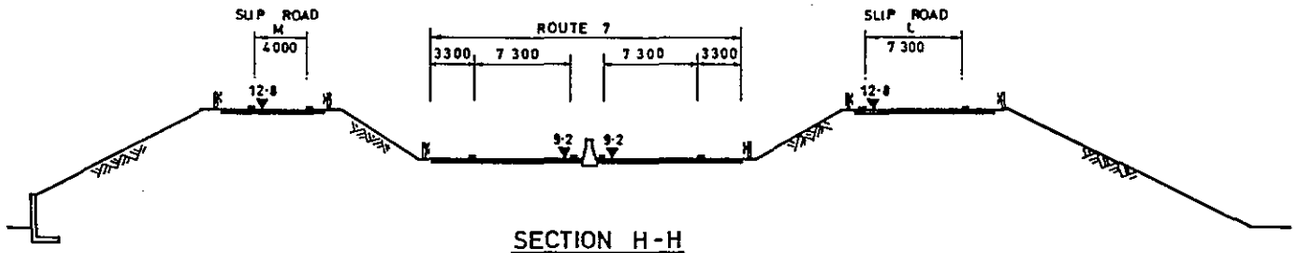
FIGURE 27 — REV.



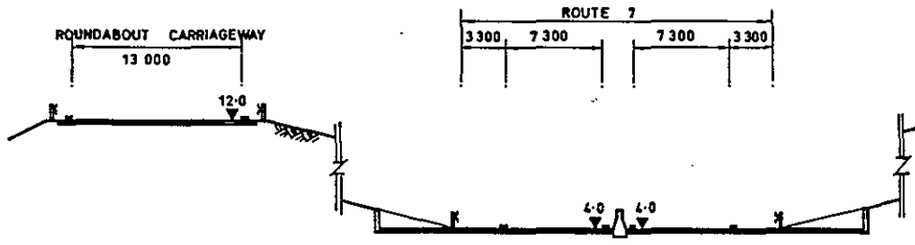
SECTION G - G

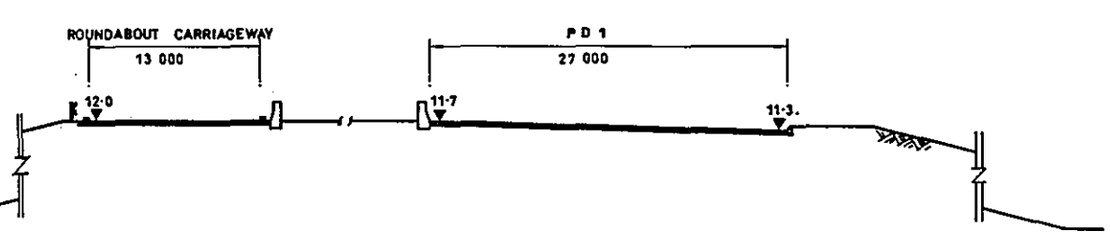


SECTION N-N

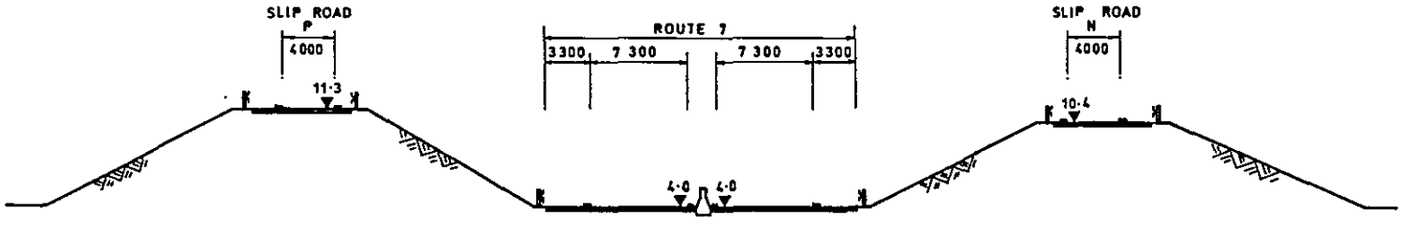


SECTION H-H

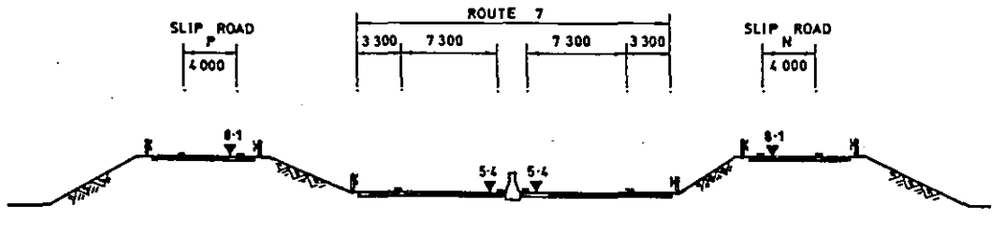




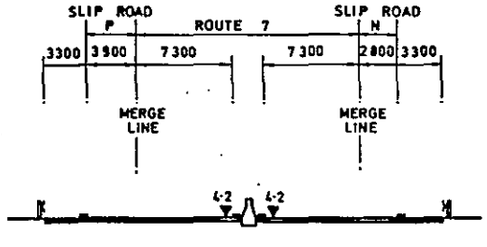
SECTION J - J



SECTION K-K



SECTION L-L



SECTION M-M

SCALE 5 0 5 10 15

REV.	DESCRIPTION	DATE	CHD

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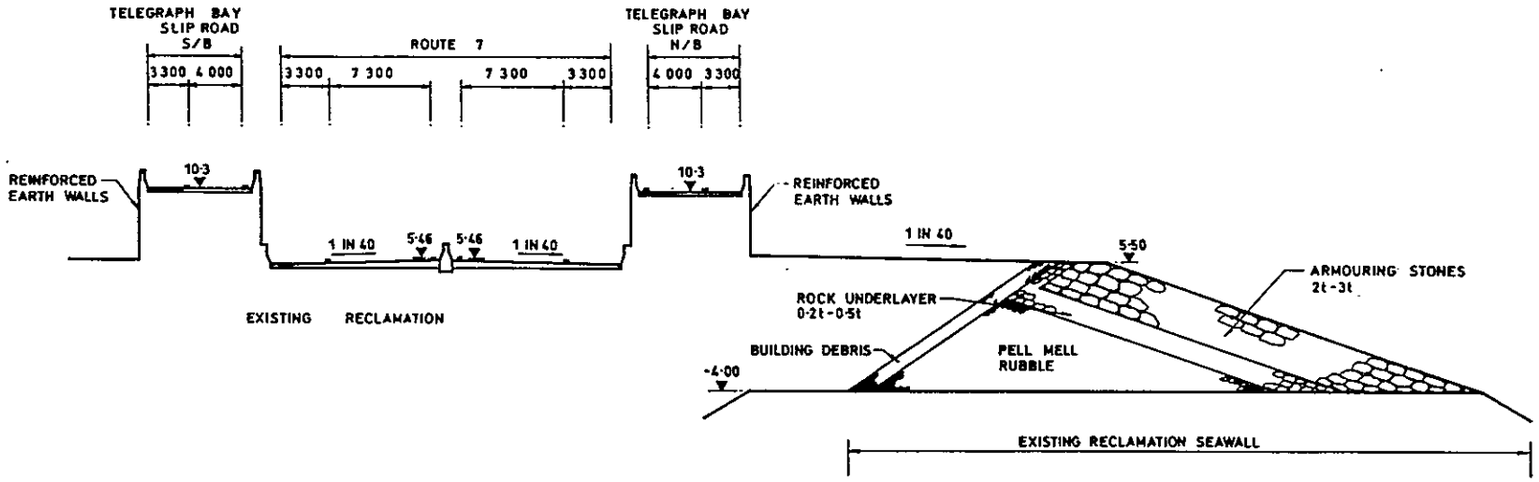
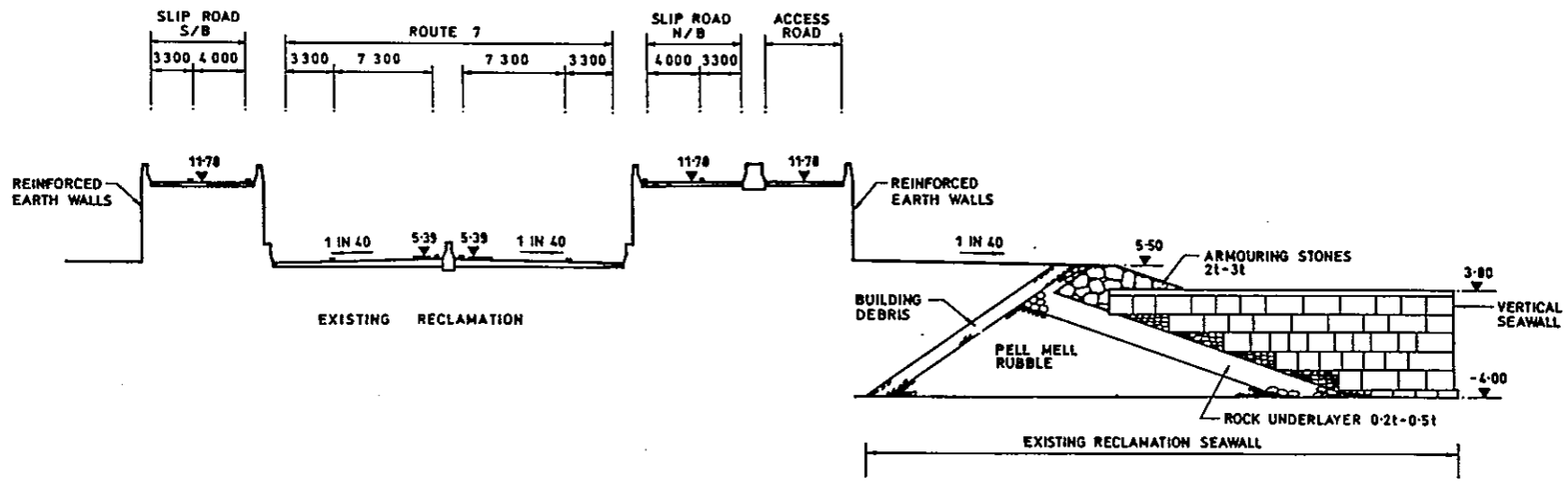
TITLE
CROSS SECTIONS
SHEET 2

DRAWN	CHECKED	APPROVED
M. W. C.	CHA	
SCALE AS SHOWN		DATE MAR. 1981

FIGURE 28 — REV



SECTION P-P



SECTION Q-Q

SCALE 5 0 5 10 15

NOTE :-
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2

REV.	DESCRIPTION	DATE	CHD

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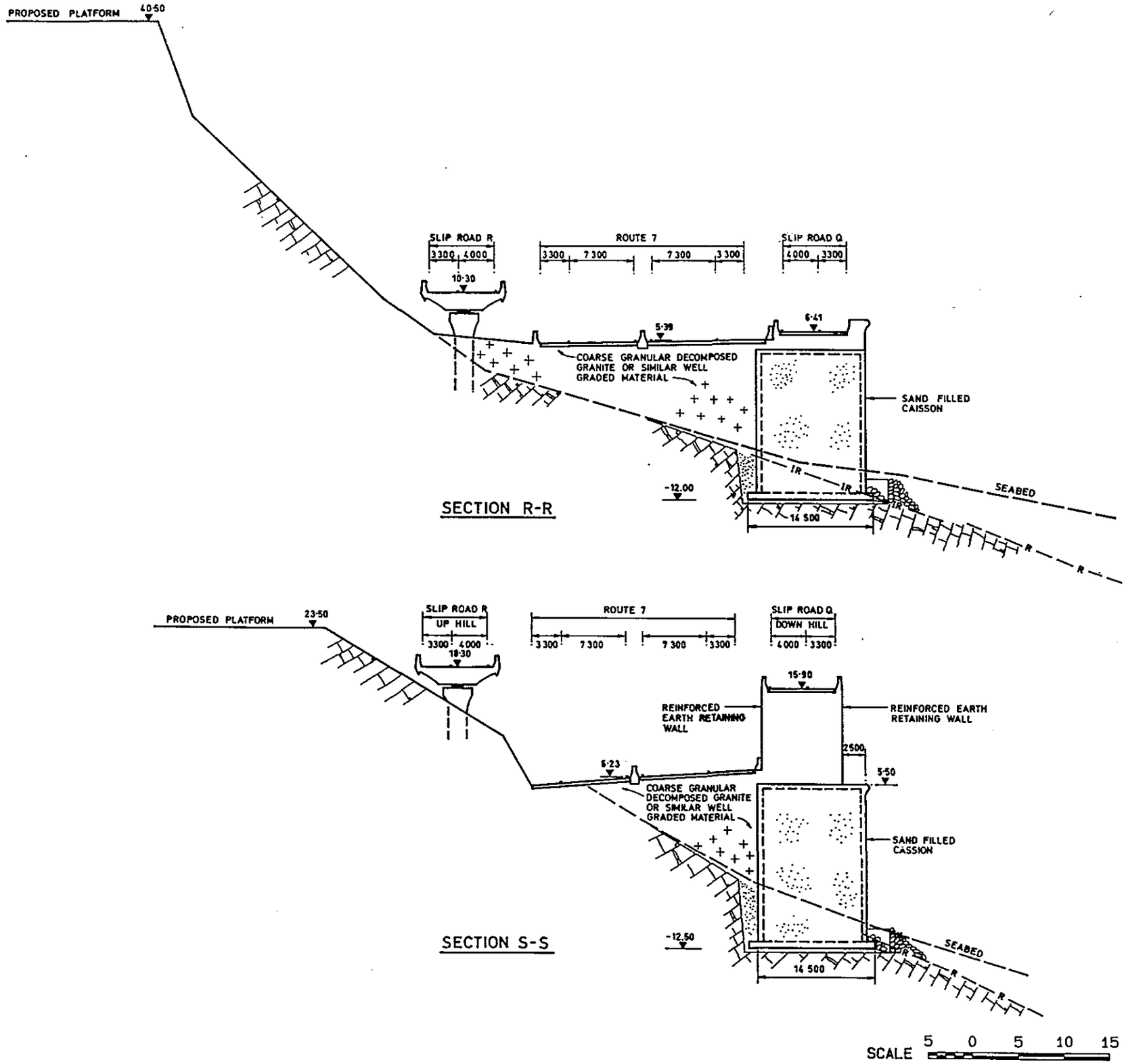
TITLE
CROSS SECTIONS
SHEET 3

DRAWN	CHECKED	APPROVED
M. W. C.	CNA	
SCALE AS SHOWN	DATE MAR. 1991	

FIGURE 29 — REV.



NOTE:-
1. FOR LEGEND AND GENERAL NOTES, SEE FIGURE 2.

REV.	DESCRIPTION	DATE	CHQ

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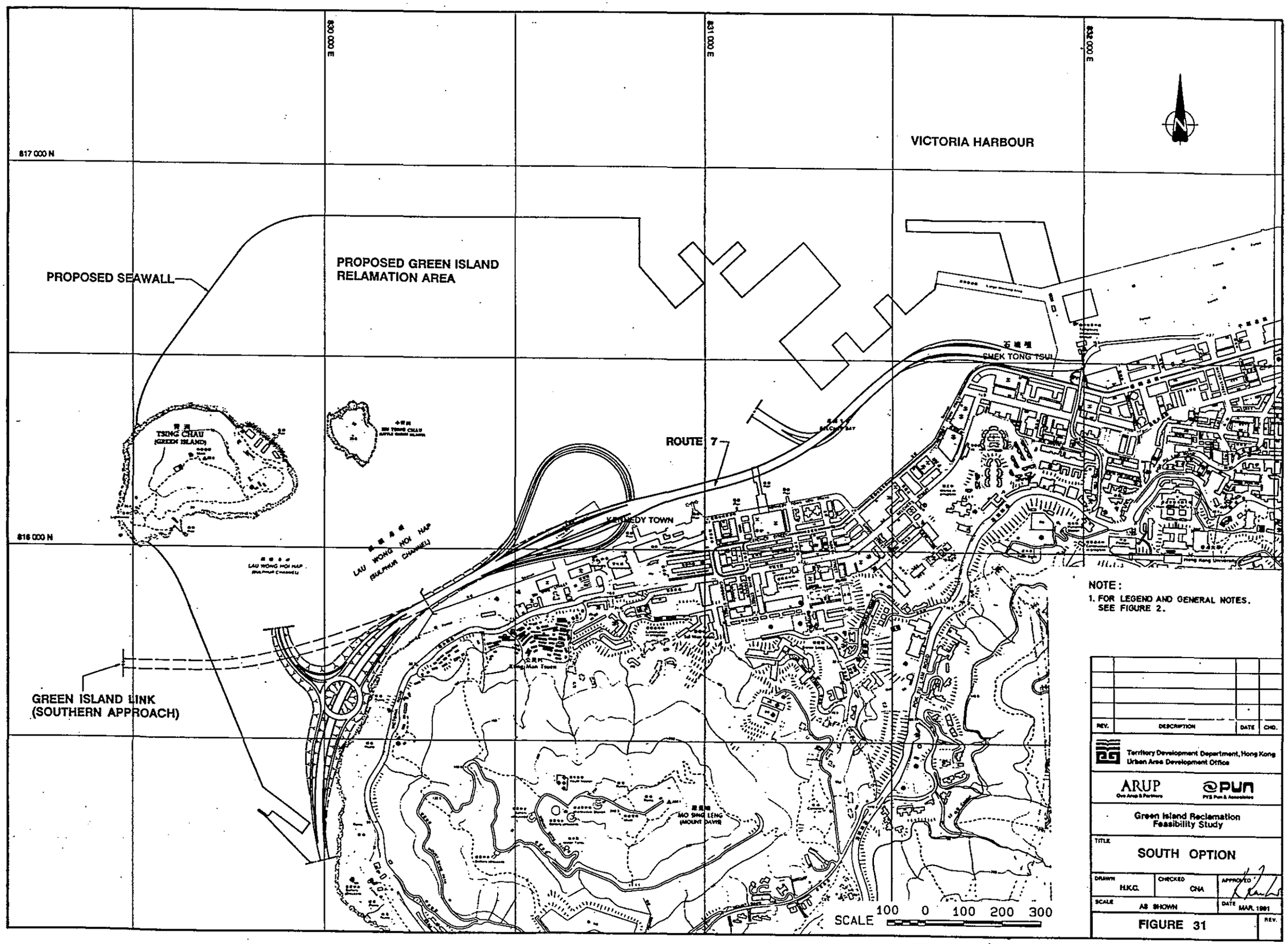
TITLE
CROSS SECTIONS
SHEET 4

DRAWN	CHECKED	APPROVED
K.W.F.	KP	

SCALE AS SHOWN — DATE MAR. 1991

FIGURE 30 — REV.



NOTE:

1. FOR LEGEND AND GENERAL NOTES. SEE FIGURE 2.

REV.	DESCRIPTION	DATE	CHD.

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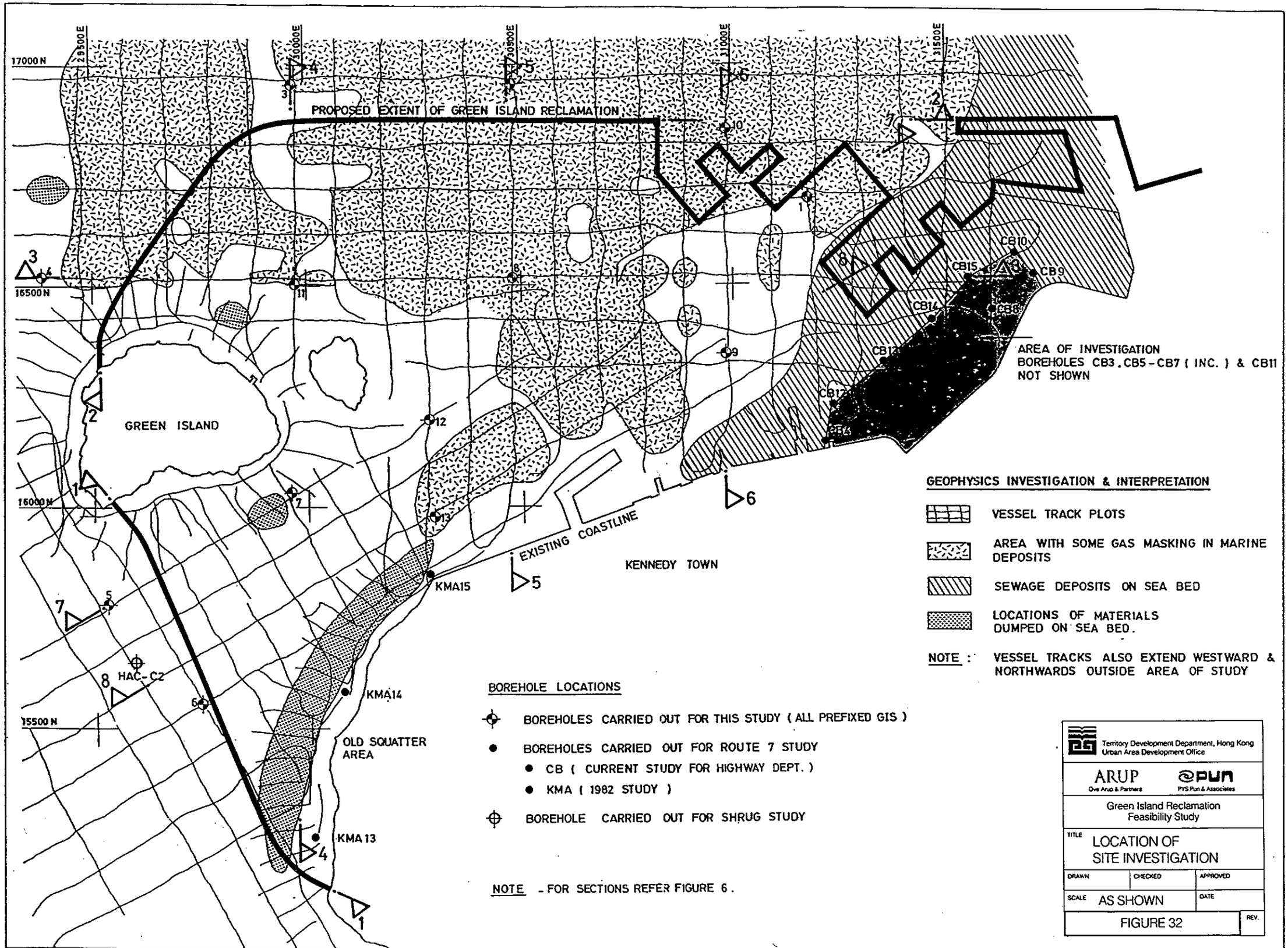
TITLE
SOUTH OPTION

DRAWN	CHECKED	APPROVED
H.K.C.	CNA	
SCALE		DATE
AS SHOWN		MAR. 1991

FIGURE 31 REV.


29500E
30000E
30500E
31000E
31500E
17000N
16500N
16000N
15500N
PROPOSED EXTENT OF GREEN ISLAND RECLAMATION
GREEN ISLAND
EXISTING COASTLINE
KENNEDY TOWN
OLD SQUATTER AREA
HAC-C2
KMA15
KMA14
KMA13
CB10
CB15
CB9
CB14
CB8
CB13
CB12
CB4
AREA OF INVESTIGATION
BOREHOLES CB3, CB5-CB7 (INC.) & CB11
NOT SHOWN
GEOPHYSICS INVESTIGATION & INTERPRETATION
VESSEL TRACK PLOTS
AREA WITH SOME GAS MASKING IN MARINE DEPOSITS
SEWAGE DEPOSITS ON SEA BED
LOCATIONS OF MATERIALS DUMPED ON SEA BED.
NOTE : VESSEL TRACKS ALSO EXTEND WESTWARD & NORTHWARDS OUTSIDE AREA OF STUDY
BOREHOLE LOCATIONS
BOREHOLES CARRIED OUT FOR THIS STUDY (ALL PREFIXED GIS)
BOREHOLES CARRIED OUT FOR ROUTE 7 STUDY
CB (CURRENT STUDY FOR HIGHWAY DEPT.)
KMA (1982 STUDY)
BOREHOLE CARRIED OUT FOR SHRUG STUDY
NOTE - FOR SECTIONS REFER FIGURE 6.
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PYS Pun & Associates
Green Island Reclamation
Feasibility Study
TITLE
LOCATION OF
SITE INVESTIGATION
DRAWN
CHECKED
APPROVED
SCALE AS SHOWN
DATE
FIGURE 32
REV.

29500 E
30000 E
30500 E
31000 E
31500 E
32000 E
17000 N
16500 N
16000 N

N

PROPOSED EXTENT OF GREEN ISLAND RECLAMATION

GREEN ISLAND

EXISTING COASTLINE

KENNEDY TOWN

LEGEND

LEVELS GREATER THAN 20m BELOW DATUM

CONTOURS REPRESENT LEVELS (m) BELOW DATUM .

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PYS
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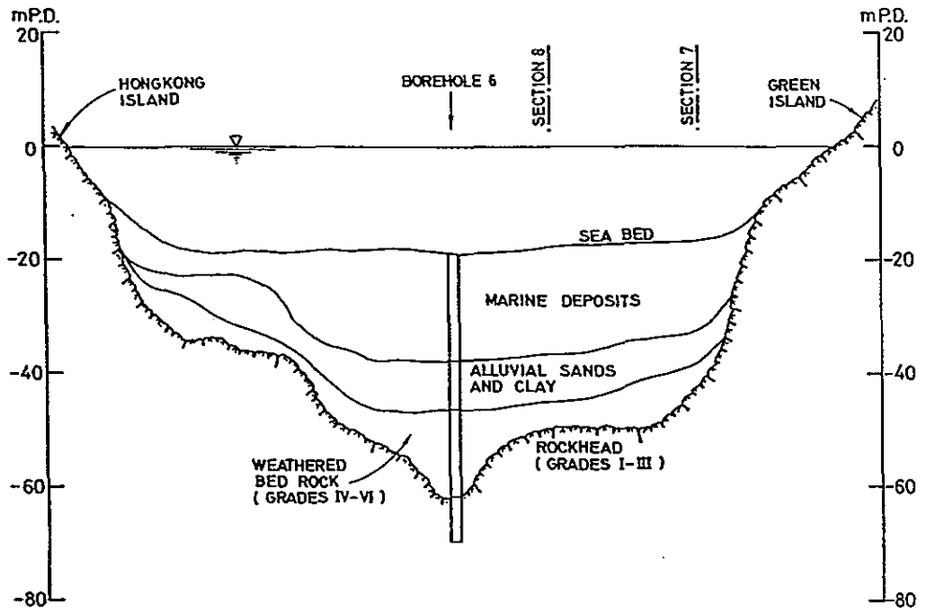
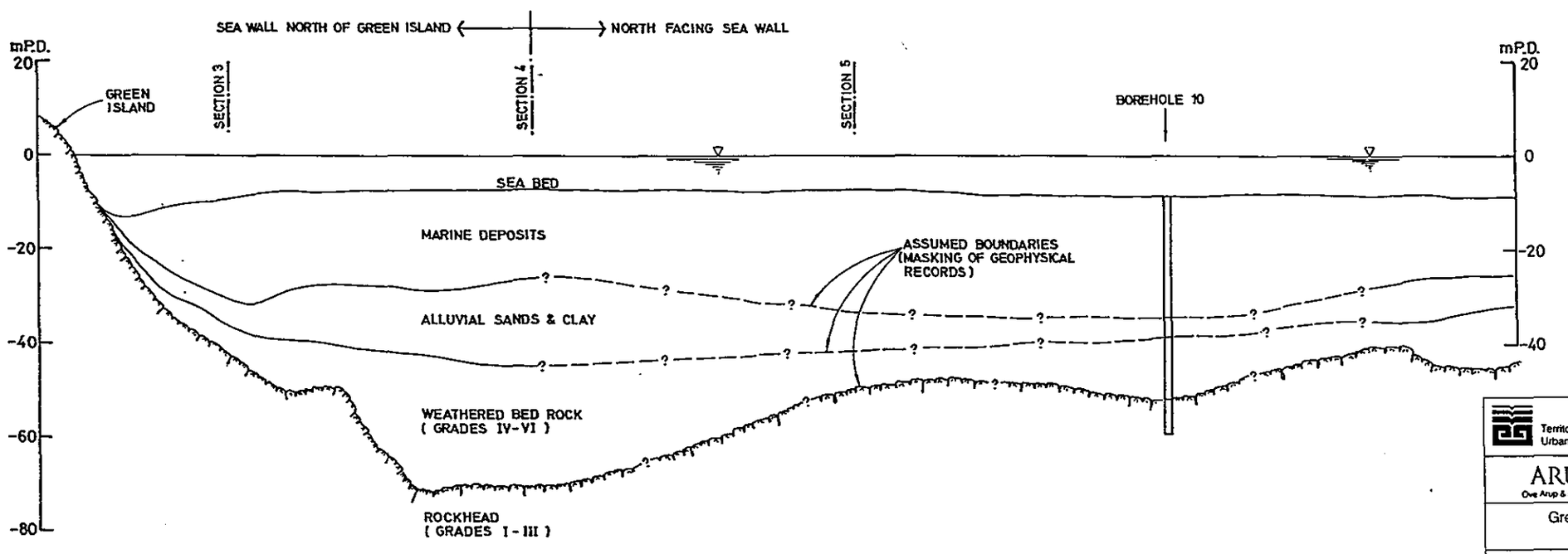
TITLE
MAP OF SEABED

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE

FIGURE 33 REV



SECTION 1-1 (WEST FACING SEA WALL)



SECTION 2-2 (NORTHERN SEA WALL)

NOTES

- BOREHOLES ARE ALL PREFIXED GIS.
- REFER FIGURE 1 FOR POSITION OF SECTIONS.

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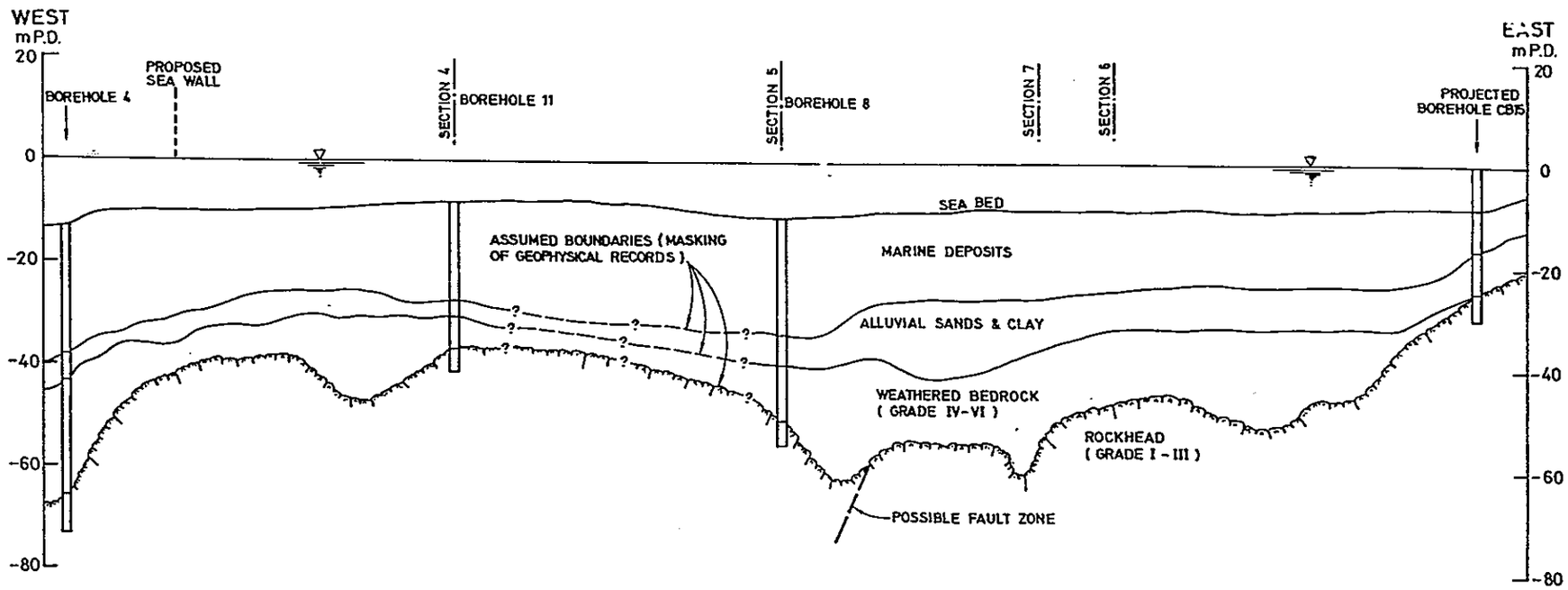
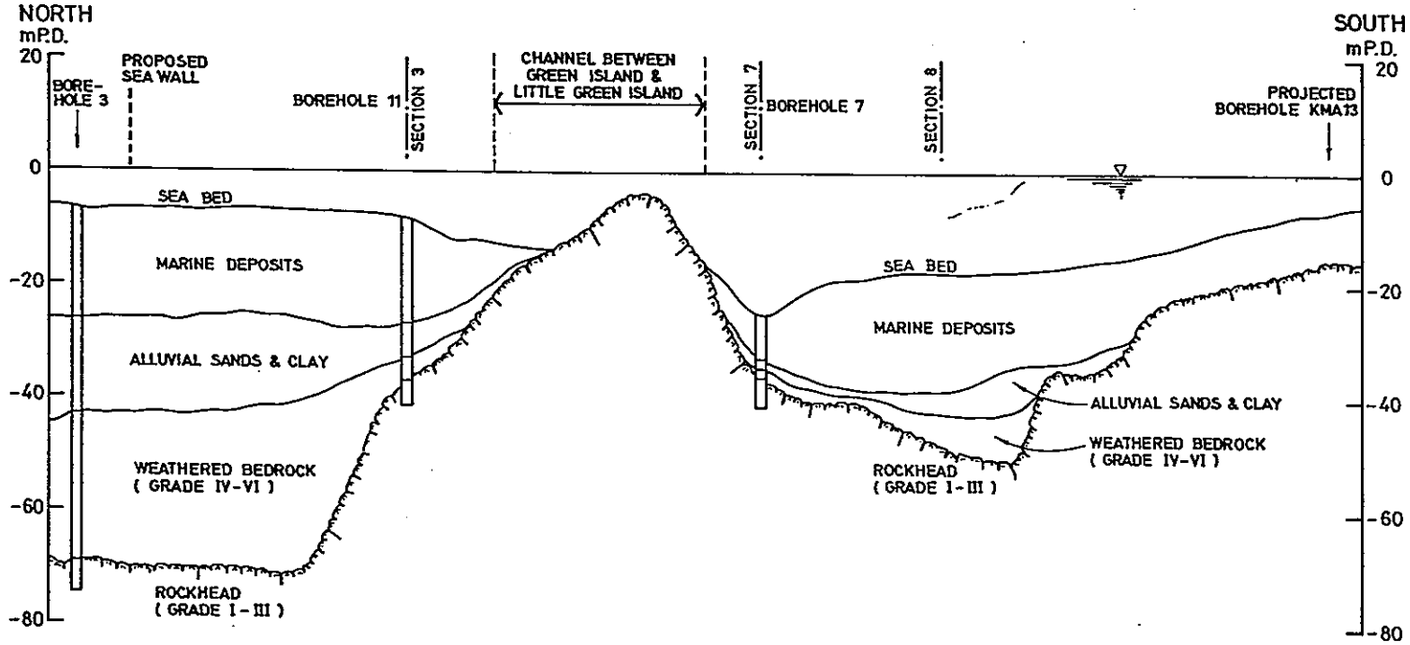
TITLE
GEOLOGICAL SECTIONS

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 34		REV



SECTION 3 - 3 (NORTH OF GREEN ISLAND)



SECTION 4 - 4 (BETWEEN GREEN & LITTLE GREEN ISLAND)

NOTES

- BOREHOLES ARE ALL PREFIXED G1S.
- REFER FIGURE 1 FOR POSITION OF SECTIONS.

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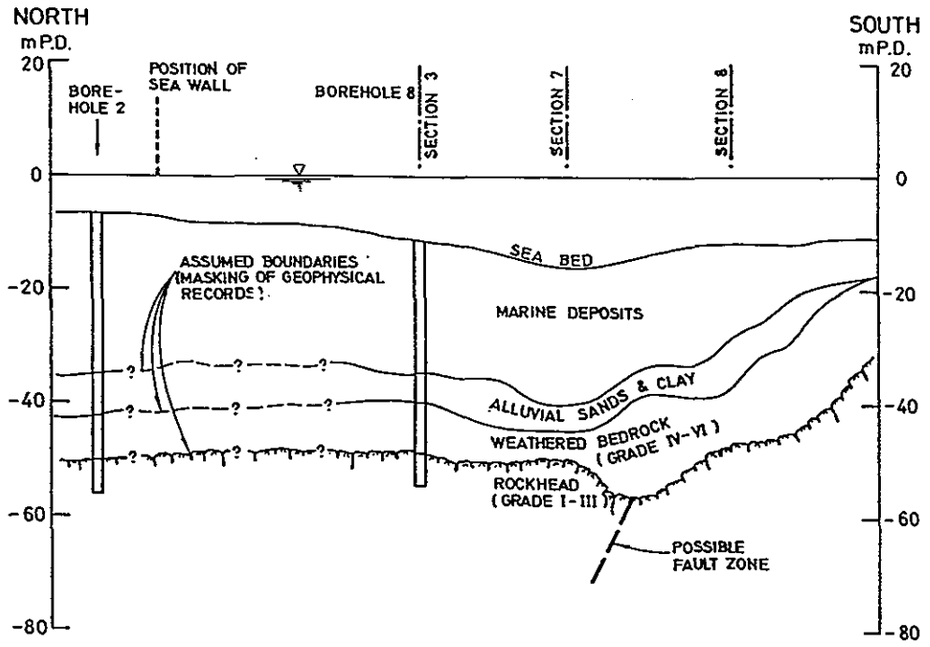
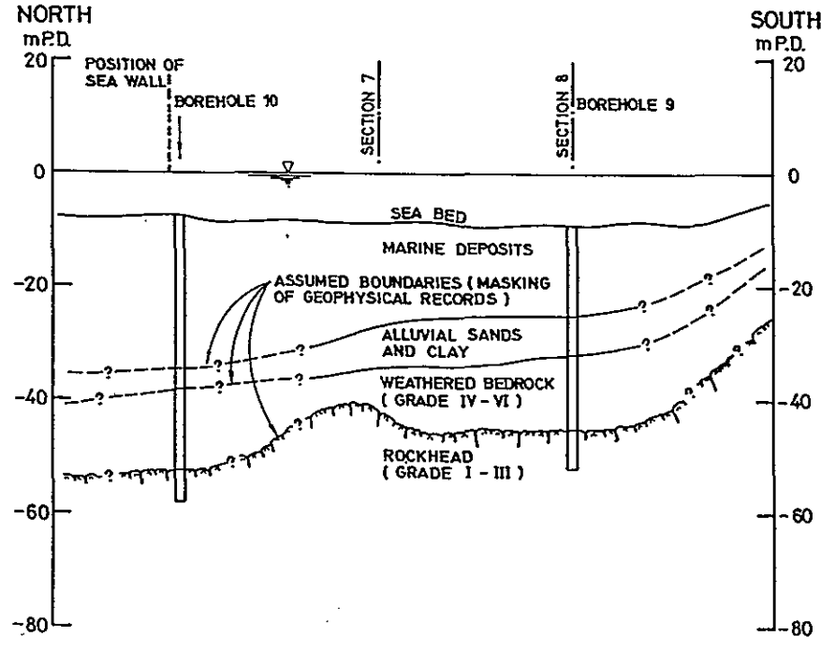
TITLE
GEOLOGICAL SECTIONS

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 35		REV



SECTION 5 - 5 (CENTRAL PART OF RECLAMATION)



SECTION 6 - 6 (EASTERN PART OF RECLAMATION)

NOTES

- BOREHOLES ARE ALL PREFIXED GIS.
- REFER FIGURE 1 FOR POSITION OF SECTIONS.

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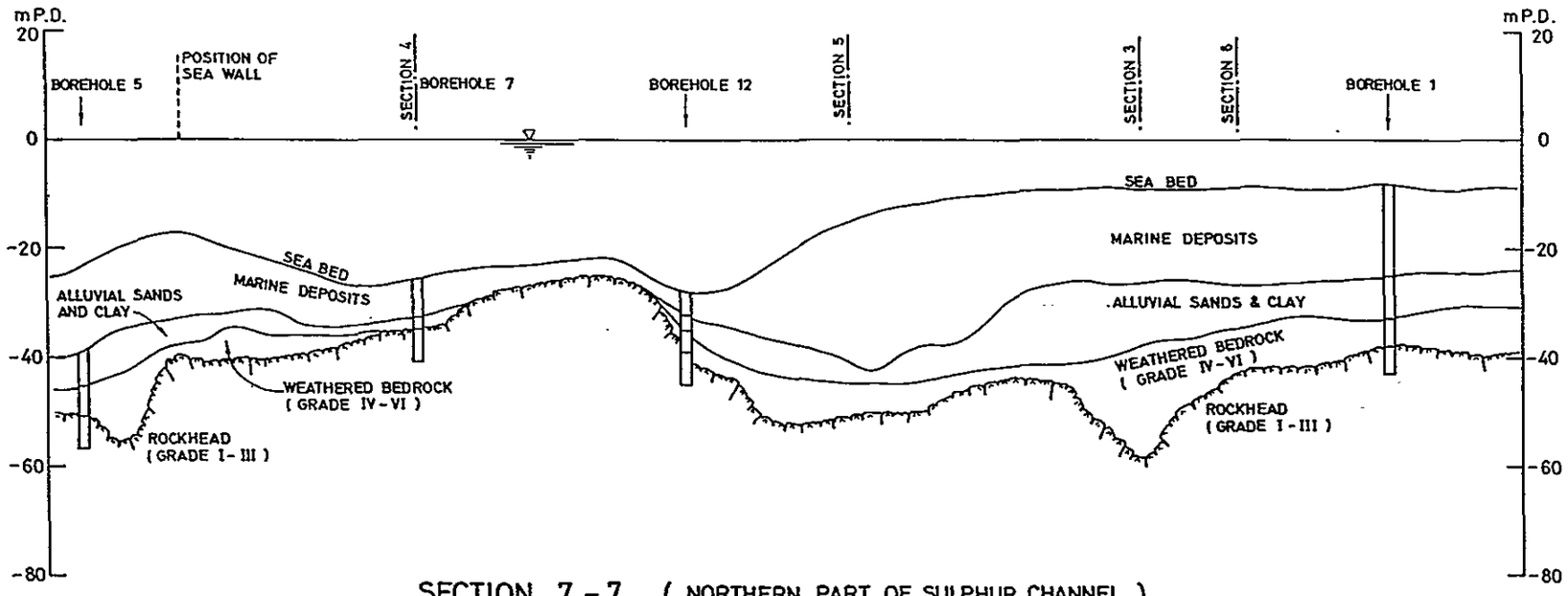
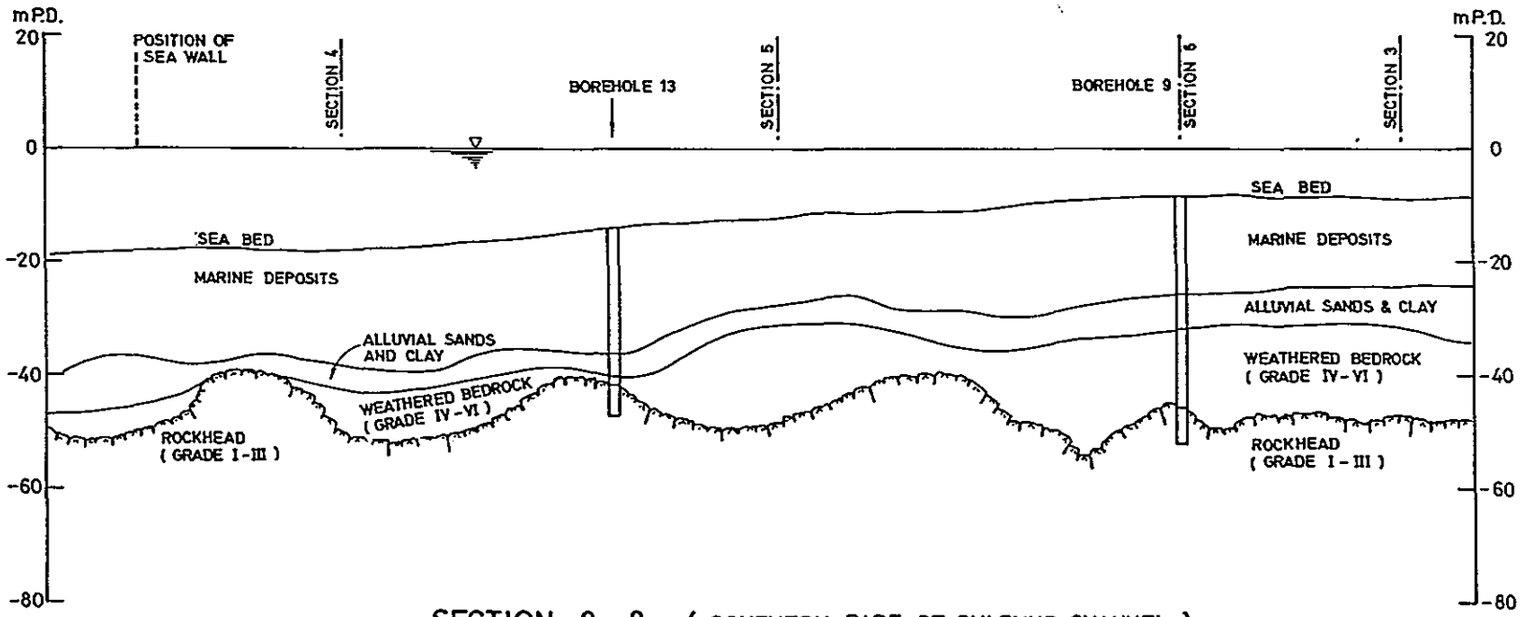
TITLE
GEOLOGICAL SECTIONS

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 36		REV.



SECTION 7 - 7 (NORTHERN PART OF SULPHUR CHANNEL)



SECTION 8 - 8 (SOUTHERN PART OF SULPHUR CHANNEL)

NOTES

- BOREHOLES ARE ALL PREFIXED GIS.
- REFER FIGURE 1 FOR POSITION OF SECTIONS.

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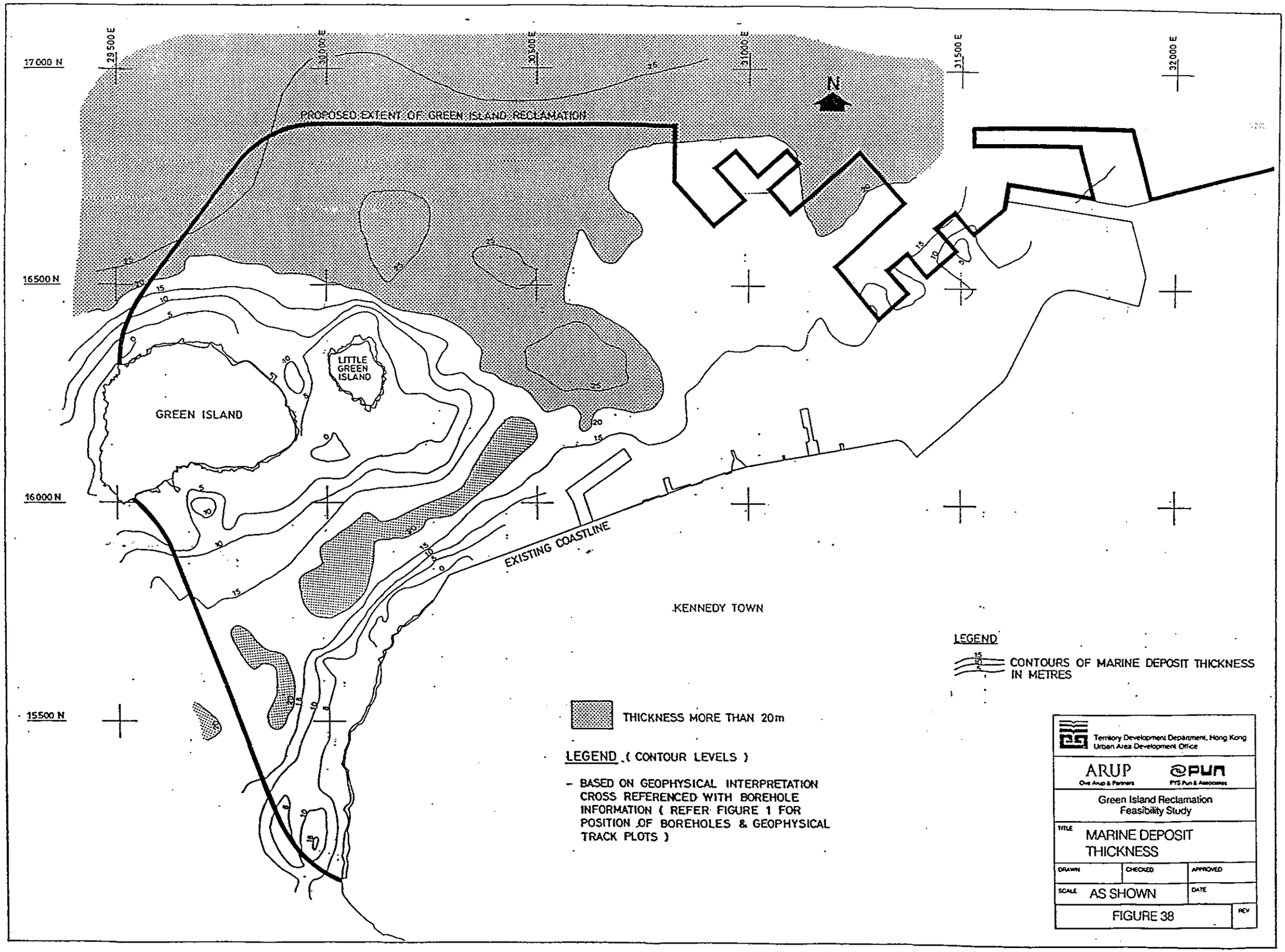
TITLE
GEOLOGICAL SECTIONS

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 37		REV


17000 N
16500 N
16000 N
15500 N
29500 E
30000 E
30500 E
31000 E
31500 E
32000 E
N
PROPOSED EXTENT OF GREEN ISLAND RECLAMATION
LITTLE GREEN ISLAND
GREEN ISLAND
EXISTING COASTLINE
KENNEDY TOWN
THICKNESS MORE THAN 20m
LEGEND (CONTOUR LEVELS)
- BASED ON GEOPHYSICAL INTERPRETATION CROSS REFERENCED WITH BOREHOLE INFORMATION (REFER FIGURE 1 FOR POSITION OF BOREHOLES & GEOPHYSICAL TRACK PLOTS)
LEGEND
CONTOURS OF MARINE DEPOSIT THICKNESS IN METRES
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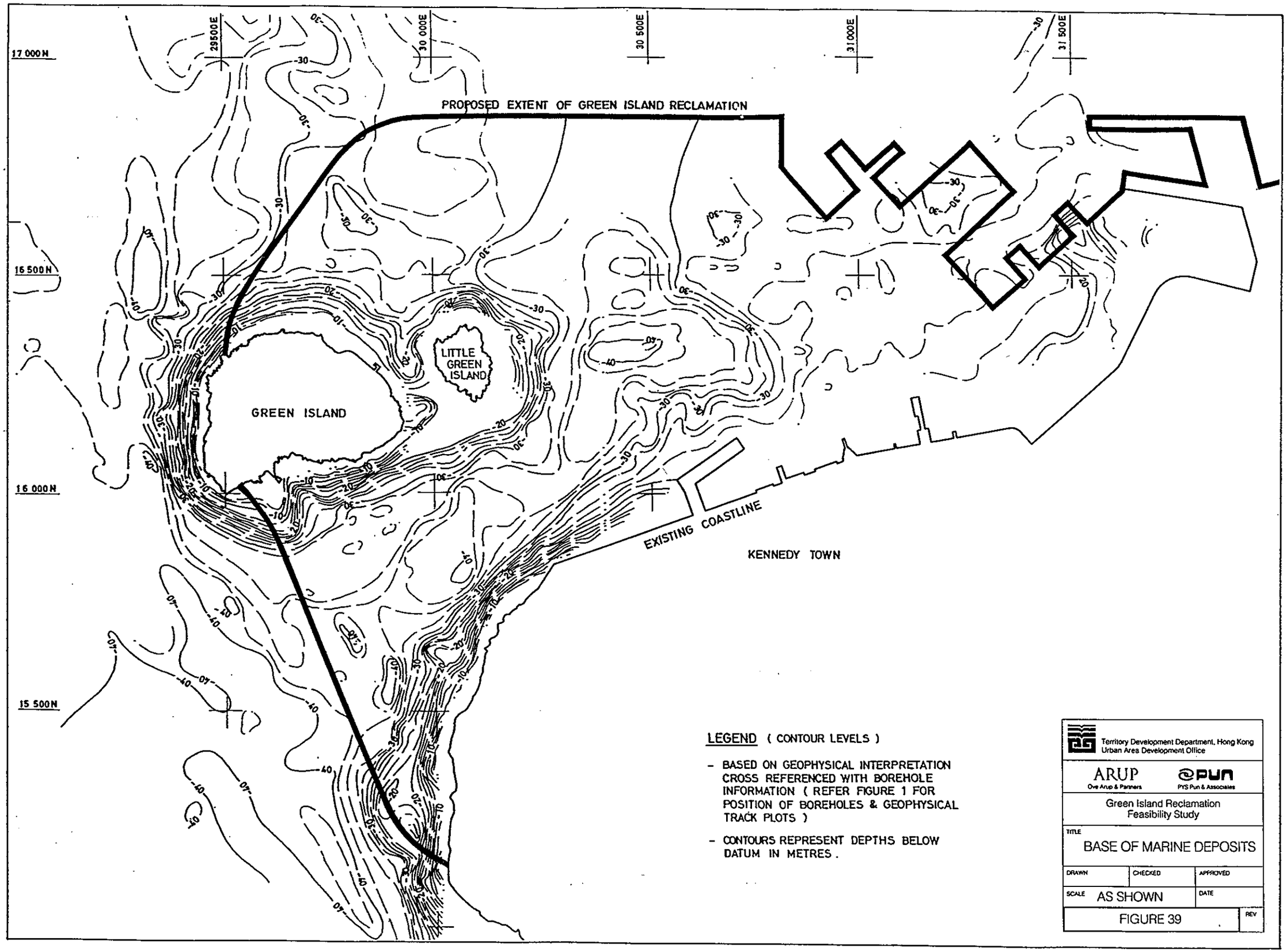
Urban Area Development Office
ARUP
Ove Arup & Partners
PYS Pun & Associates
Green Island Reclamation
Feasibility Study
TITLE
MARINE DEPOSIT
THICKNESS
DRAWN
CHECKED
APPROVED
SCALE
AS SHOWN
DATE
FIGURE 38
REV



LEGEND (CONTOUR LEVELS)

- BASED ON GEOPHYSICAL INTERPRETATION CROSS REFERENCED WITH BOREHOLE INFORMATION (REFER FIGURE 1 FOR POSITION OF BOREHOLES & GEOPHYSICAL TRACK PLOTS)
- CONTOURS REPRESENT DEPTHS BELOW DATUM IN METRES .

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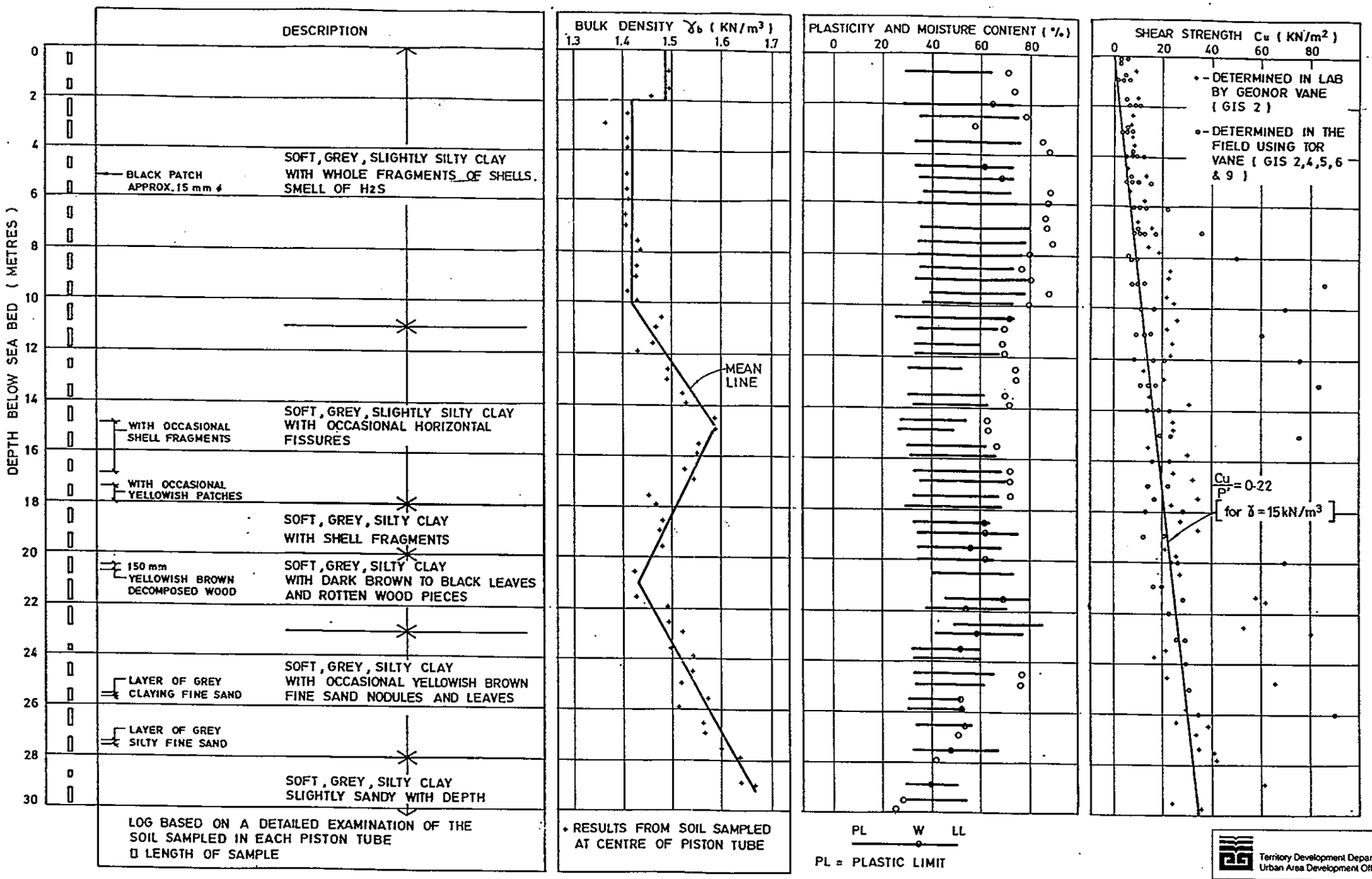
TITLE
BASE OF MARINE DEPOSITS

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE

FIGURE 39 REV



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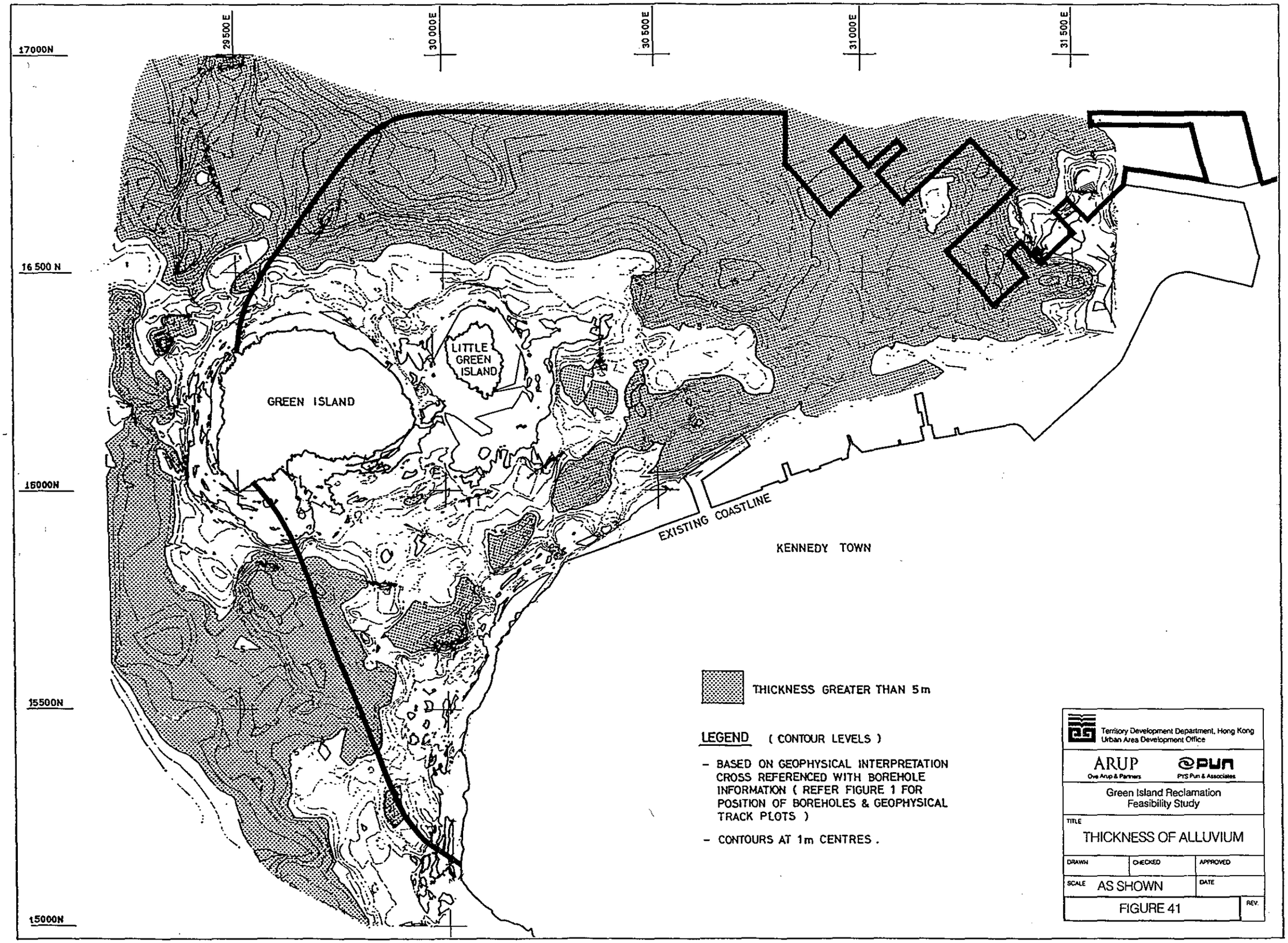
TITLE: PROPERTIES OF MARINE CLAY

DRAWN	CHECKED	APPROVED
SCALE: AS SHOWN		DATE

FIGURE 40 — REV.


17000N
16 500 N
16000N
15500N
15000N
29 500 E
30 000 E
30 500 E
31 000 E
31 500 E
GREEN ISLAND
LITTLE GREEN ISLAND
EXISTING COASTLINE
KENNEDY TOWN
THICKNESS GREATER THAN 5m
LEGEND (CONTOUR LEVELS)
- BASED ON GEOPHYSICAL INTERPRETATION CROSS REFERENCED WITH BOREHOLE INFORMATION (REFER FIGURE 1 FOR POSITION OF BOREHOLES & GEOPHYSICAL TRACK PLOTS)
- CONTOURS AT 1m CENTRES .
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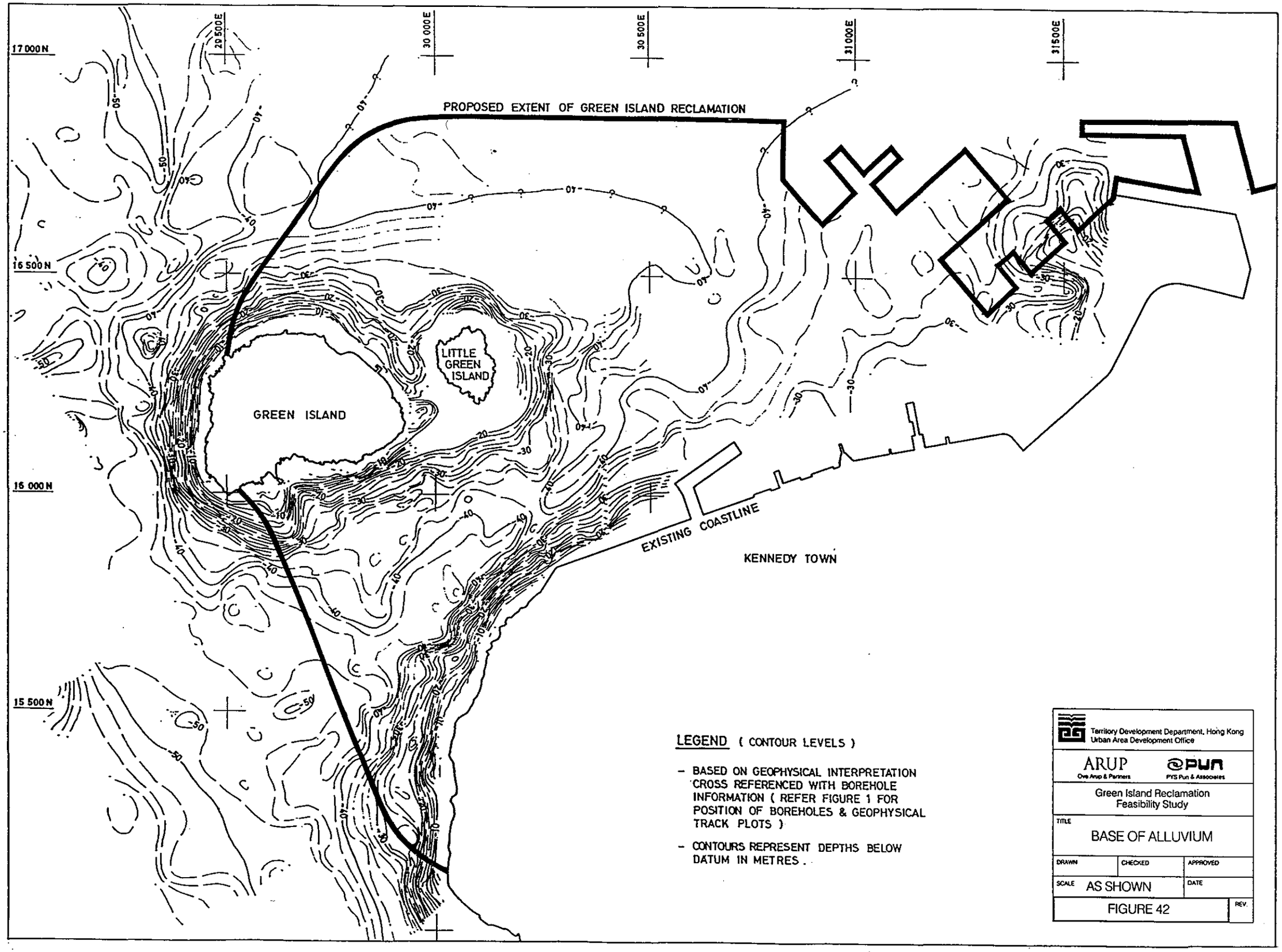
Urban Area Development Office
ARUP
Ove Arup & Partners
PYS Pun & Associates
Green Island Reclamation
Feasibility Study
TITLE
THICKNESS OF ALLUVIUM
DRAWN
CHECKED
APPROVED
SCALE AS SHOWN
DATE
FIGURE 41
REV.



LEGEND (CONTOUR LEVELS)

- BASED ON GEOPHYSICAL INTERPRETATION CROSS REFERENCED WITH BOREHOLE INFORMATION (REFER FIGURE 1 FOR POSITION OF BOREHOLES & GEOPHYSICAL TRACK PLOTS)
- CONTOURS REPRESENT DEPTHS BELOW DATUM IN METRES.

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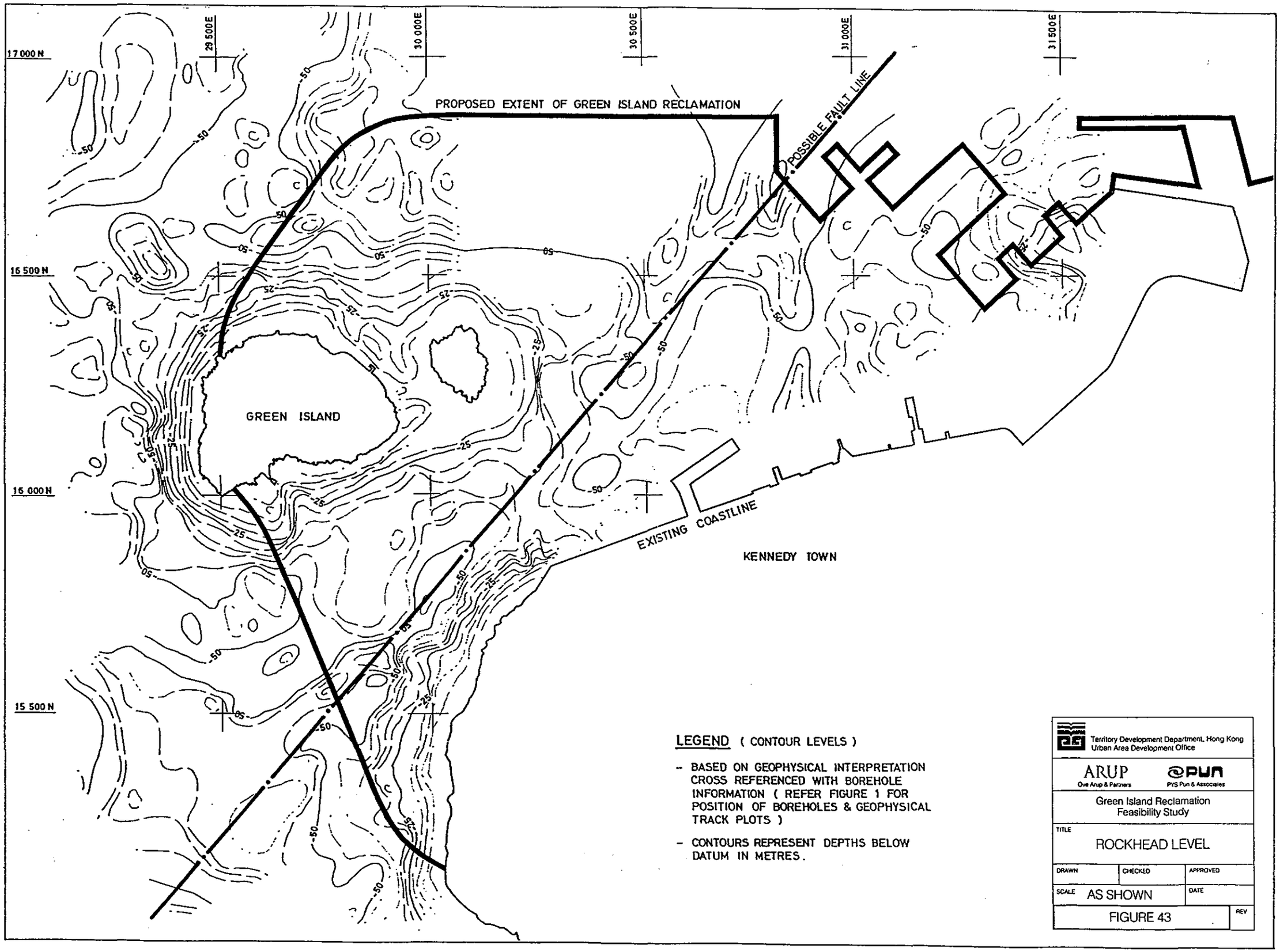
TITLE
BASE OF ALLUVIUM

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 42		REV.



LEGEND (CONTOUR LEVELS)

- BASED ON GEOPHYSICAL INTERPRETATION CROSS REFERENCED WITH BOREHOLE INFORMATION (REFER FIGURE 1 FOR POSITION OF BOREHOLES & GEOPHYSICAL TRACK PLOTS)
- CONTOURS REPRESENT DEPTHS BELOW DATUM IN METRES.

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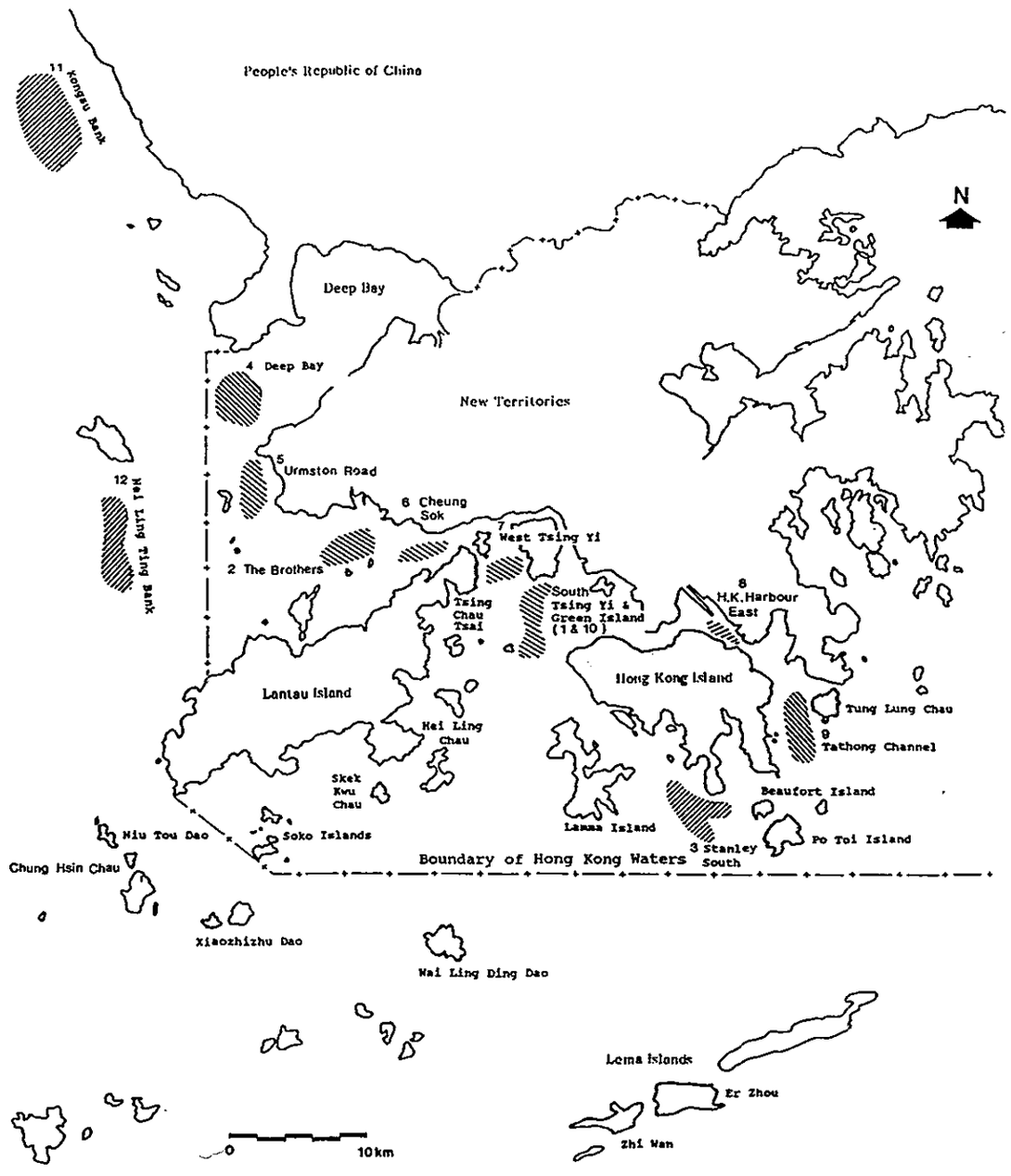
TITLE
ROCKHEAD LEVEL

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE
FIGURE 43		REV



KEY:

POTENTIAL MARINE FILL SOURCES

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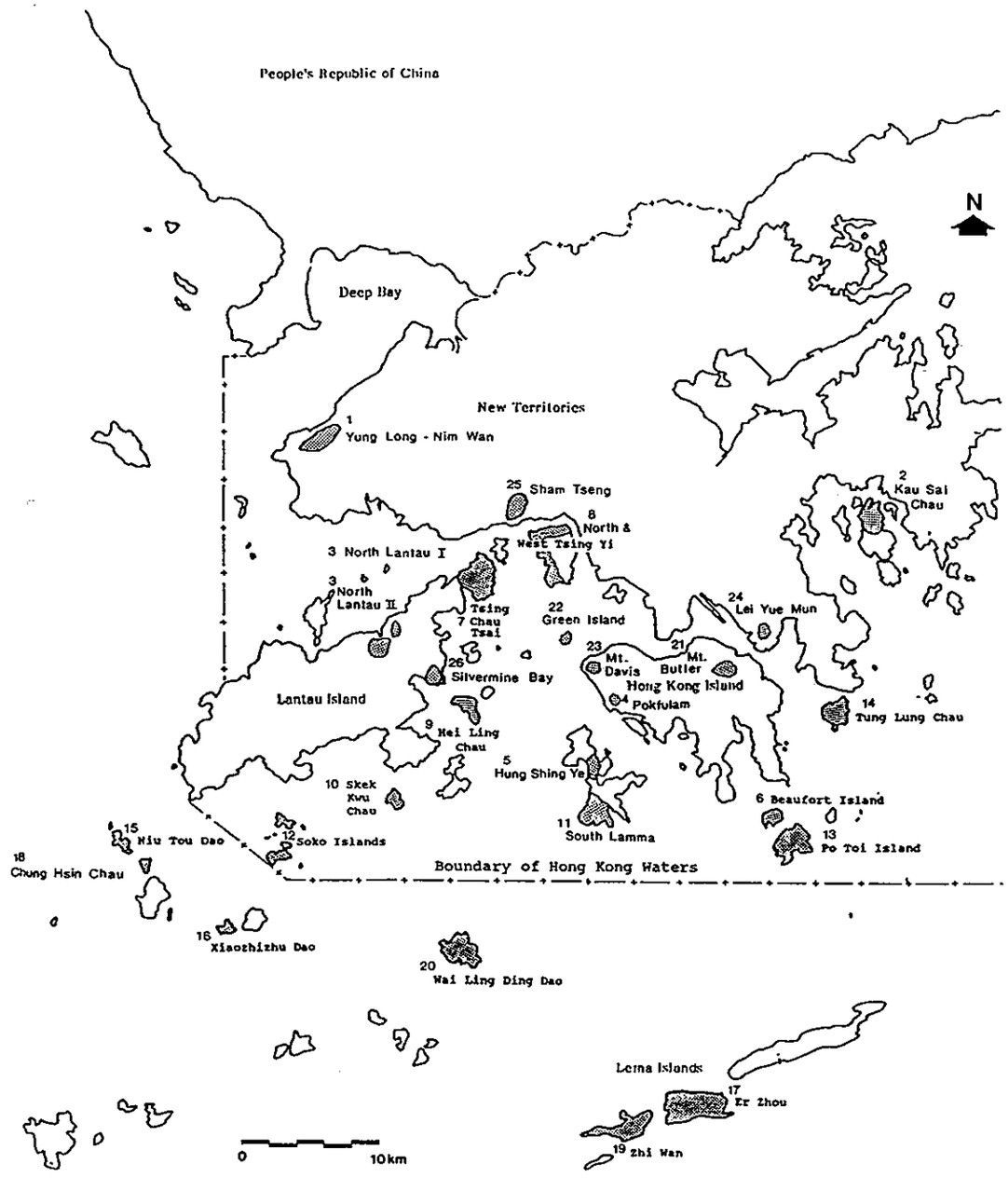
TITLE
POTENTIAL AREAS
OF MARINE FILL

DRAWN	CHECKED	APPROVED
SCALE AS SHOWN		DATE

FIGURE 44 REV



KEY :

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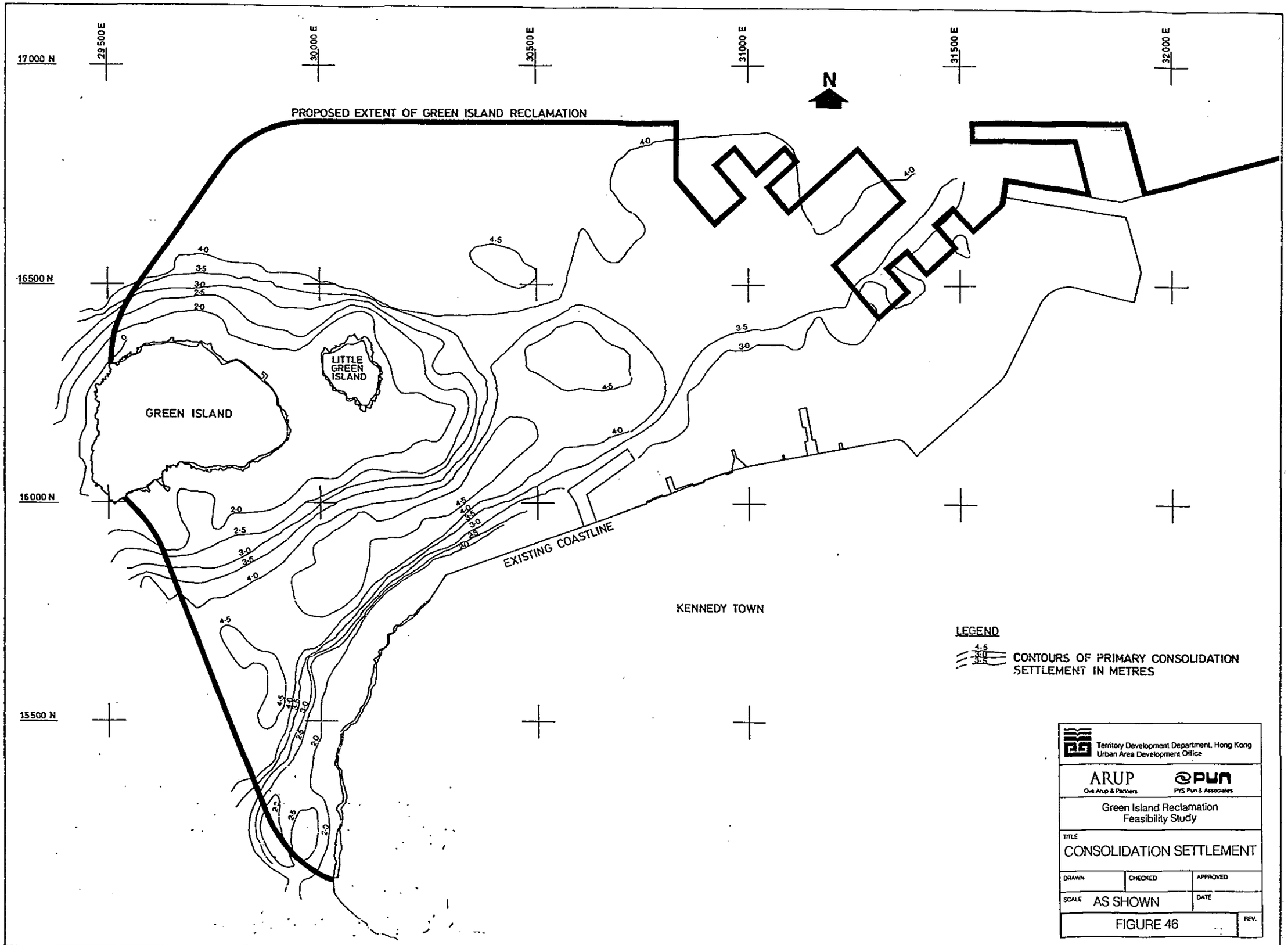
SCALE: AS SHOWN		DATE

FIGURE 45 — REV.


17000 N
16500 N
16000 N
15500 N
29500 E
30000 E
30500 E
31000 E
31500 E
32000 E
N
PROPOSED EXTENT OF GREEN ISLAND RECLAMATION
GREEN ISLAND
LITTLE GREEN ISLAND
EXISTING COASTLINE
KENNEDY TOWN
4·0
3·5
3·0
2·5
2·0
4·5
LEGEND
CONTOURS OF PRIMARY CONSOLIDATION SETTLEMENT IN METRES
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Green Island Reclamation
Feasibility Study
TITLE
CONSOLIDATION SETTLEMENT
DRAWN
CHECKED
APPROVED
SCALE AS SHOWN
DATE
FIGURE 46
REV.

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