Hong Kong Government
Territory Development Department
Urban Area Development Office

Central and Wan Chai Reclamation Development

Central Reclamation Phase II
Contract No. HK 4/94
Environmental Impact Assessment,
Final Report

Volume 1

Maunsell Consultants Asia Ltd

in association with

Balfours International (Asia)
MVA Asia Ltd
CES Consultants in Environmental Sciences (Asia) Ltd

Hong Kong Government
Territory Development Department
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Island Development Office

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1 INTRODUCTION

1.1 Purpose

CES (Asia) Ltd was commissioned by Maunsell Consultants Asia Ltd to undertake the Environmental Impact Assessment (EIA) for the Central Reclamation Phase II. The purpose of the assessment is to provide information on the nature and extent of potential environmental impacts associated with the proposed Central Reclamation Phase II in Central and Wanchai Reclamation Feasibility Study (CWRFS). This information will contribute to decisions on :-

(a) the acceptability of any adverse environmental consequences that are likely to arise from the construction and operation of the development and related facilities;

(b) conditions for the design, construction and operation of the project; and

(c) operation as public dump.

1.2 Study Objectives

The objectives of the assessment are as follows:

(a) to describe the proposed development and related facilities for their development;

(b) to identify and describe the elements of the community and environment likely to be affected by the proposed development;

(c) to minimise pollution and nuisance arising from the various stages of development and its operation and environmental disturbance during construction and operation of the project;

(d) to identify and evaluate the net environmental impacts and cumulative effects expected to arise during the construction and operation of the development in relation to the existing and planned community and neighbouring land uses;

(e) to identify methods, measures and standards to be included in the design, which may be necessary to mitigate these impacts and reduce them to acceptable levels;

(f) to recommend environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted.

A copy of the EIA Study Brief is included as Appendix 1.

2 PRINCIPAL FEATURES OF THE PROJECT

2.1 Description

The Central Reclamation Phase II consists of approximately 5 hectares of new reclamation and the associated infrastructure on the new reclamation and on the existing land to the east of the basin (Figure 2.1). An approximate 60 metre wide strip of reclamation to the north of Prince of Wales Building will be reclaimed in addition to the basin itself. This strip of new land will be used to provide an additional road link to Connaught Road via Edinburgh Place. The reclamation will be carried out from the east towards the west side of the basin.

There are three proposed options for the formation of the reclamation:

i) Use of marine based fill
ii) Operation as a public dump
iii) Formation using contractor sourced material

It is understood that land sourced materials, such as basement excavations, comprise a valuable and under-utilised source of fill material. The environmental implications of utilising land based and marine based fill are considered. Because of the relatively small amount of fill required for the reclamation, marine borrow areas would not be allocated to the project. However, the contractor can obtain marine sand from the marine borrow areas for other reclamation projects. On environmental grounds the latter would be preferable, because of the reduced truck movements and material handling operations on the site, and corresponding reductions in Air Quality impacts. There will be little difference between using public dump and contractor sourced fill, when compared to the marine based option, as both will require truck haulage on the site. The public dump option will require material of a suitable size only to be provided. There will be no on-site processing or stock piling of material because of site size constraints.

The basin contains a relatively thin layer of soft sediments, the great proportion of which appears to fall within the Class C category for contaminated sediments. The trace metal loading in the sediments are believed to be associated with the shipyard and vessel maintenance facilities located on the east side of the Tamar site, as there are no culverts discharging into the basin. The relatively thin layer of mud in the basin is attributable to the routine maintenance dredging carried out by the Navy. On the basis of the current programme, the shipyard maintenance facilities will be closed before commencement of the reclamation. The current proposals are to leave the mud in place, thus avoiding a potential disposal problem and limiting the opportunity for re-mobilisation of particulate bound contaminants.

There is no existing storm water discharge into the basin apart from one small diameter pipe immediately behind the seawall. There is one cooling water pumping station intake in the Tamar Basin, which serves the Prince of Wales Building. This facility will be relocated at the waterfront at the mouth of the basin. In addition a saltwater pump station is situated in the south-east corner of the basin, this will

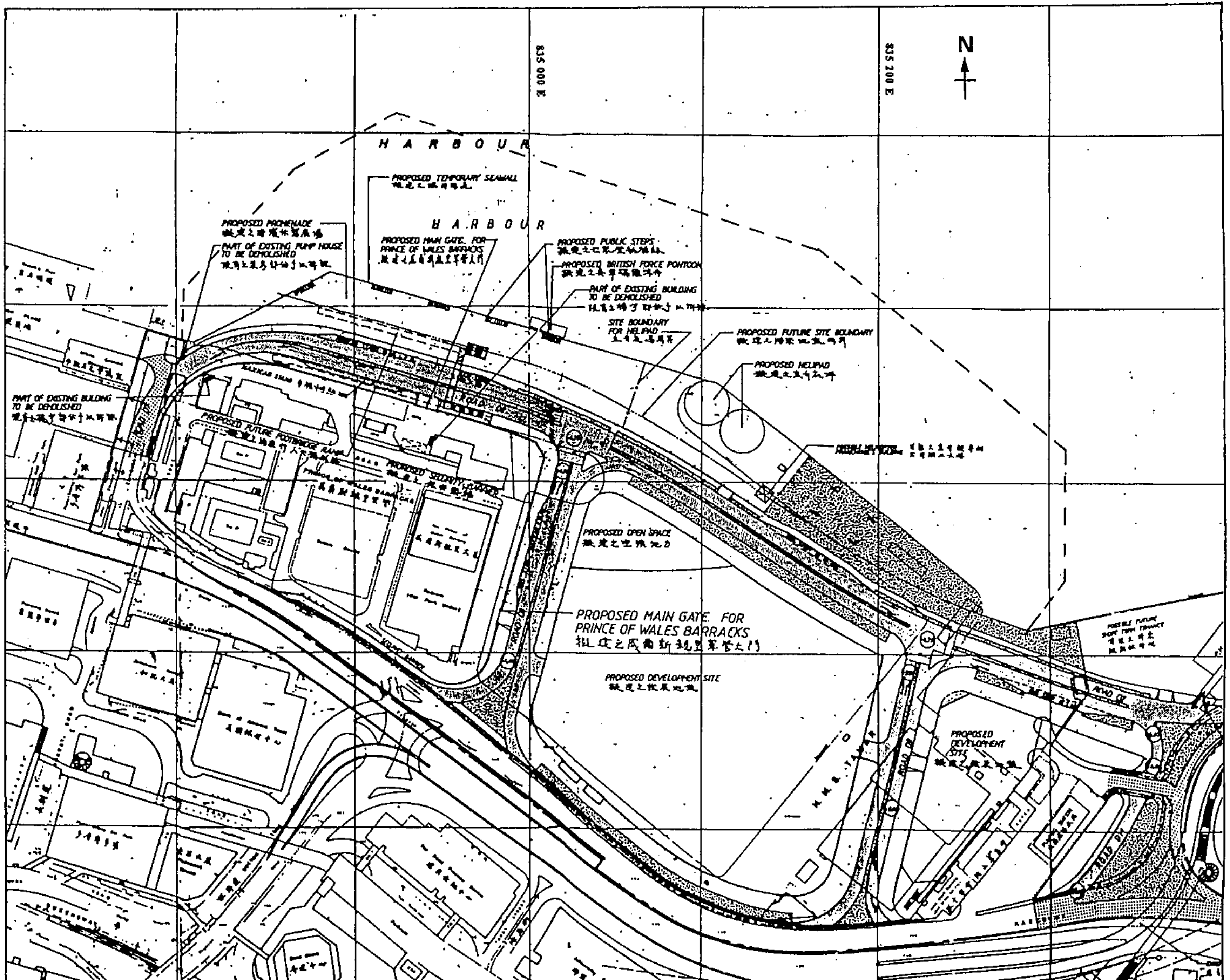


Figure 2.1 The Central Reclamation Phase II

remain in place until the submerged pumproom, to be constructed as part of the reclamation project, is completed.

2.2 Phasing

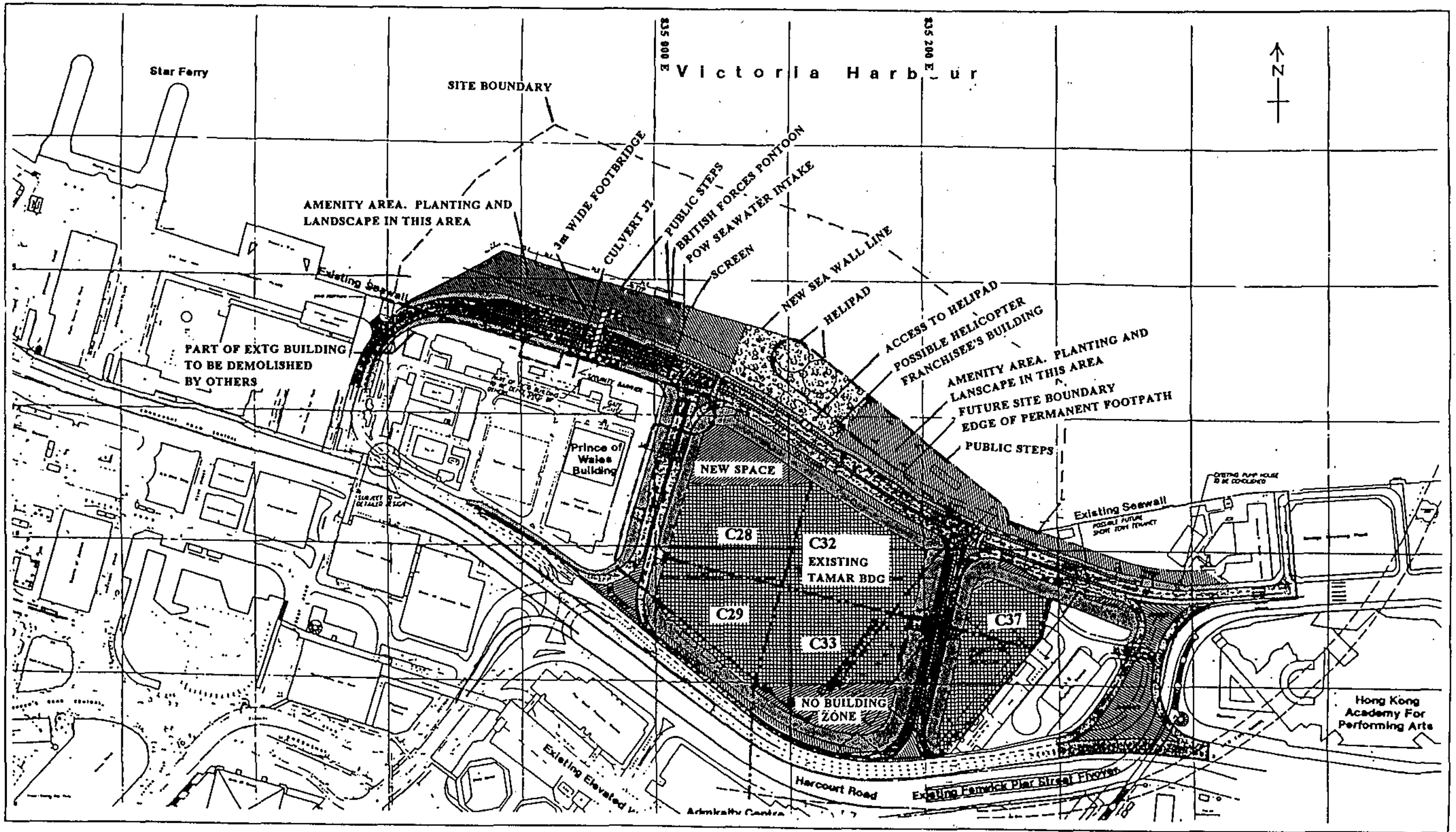
A proposed arrangement for the formation of reclamation is shown in Figure 2.2. Table 2.2.1 and the accompanying notes describe the timing and nature of works to be undertaken.

Table 2.2.1 Central Reclamation Phase II Proposed Sectional Completions

Section	Description	Date for Completion	
		Months	Days
1	Completion of Site C37 and provision of temporary 2-lane all weather accesses	6	180
2	Completion of POW south wall works and new traffic lane in Harcourt Road	12	365
3	Completion of Site C29 and provision of temporary 2-lane all weather accesses	14	425
4	Completion of Site C28 and provision of temporary 2-lane all weather accesses	20	610
5	Provision of all-weather 2-lane road access and pedestrian access to new Gatehouse, part of north seawall and access thereto	22	670
6	Remainder of works	27	850

Notes :

1. It is proposed that the Contractor will receive access to the old Gatehouse area (Site Area 3) 30 days after completion of Section 5.
2. Access to Site Area 2 (Bullnose area) is proposed to be at month 6, 180 days.
3. Section 2 early completion is intended to enable other works in Harcourt Road to commence as soon as possible.
4. Access to Site Area 4 (present helipad site) is proposed to be 10 days after the completion of the new helipad and access, except as in 5 below.
5. It is proposed that the core stores presently located in Site Area 5 are transferred to the western side of the old helipad site, and that contractor's access to the Site Area 4 for the purposes of this transfer be granted as soon as the helipad is transferred.
6. Completion of helipad site, paving, fencing and servicing and provision of all-weather 2-lane road access and pedestrian access thereto, would not appear to warrant a section.



Legend:

- Roads
- Ground Level Walkways
- Elevated Walkway (By Government)
- Amenity/Public Open Space
- Commercial Development
- Helipad
- Existing Seawall
- Elevated Walkways (By Developers)

Figure 2.2 Phasing Diagram for the Formation of Reclamation

2.3 Construction Activities

2.3.1 Reclamation and Seawalls

The limit of reclamation on the western side is determined by the desire to avoid interference with the existing pumphouse, and the Gazette limit (Figure 2.1). The details of the new seawall at the junction with the existing seawall have yet to be determined. These will be developed when site investigation information is available. Special construction measures may be required in this localised area, such as sheet piling.

On the north side, the seawall line has been determined by allowing for the future need to remove seawall blocks when further reclamation is carried out, without disturbing the roads and services built under this contract.

Preliminary site investigation results within the basin show depths of mud ranging between 1.5 and 4 m.

The seawalls will be designed to permanent standards, and so will require full dredging.

There will be roads and services on the basin reclamation. These will be required to be constructed early so that the new building development can be served as early as possible.

2.3.2 Roads

The proposed layout is shown in Figure 2.1. The proposed roads for Central Reclamation Phase II are Distributor Roads D2, D7 (Edinburgh Place), D8 and D9. Road D2 lies in an east-west direction along the proposed limit of reclamation, 150-200 m to the north of Harcourt Road. It connects Edinburgh Place in the west with Fenwick Pier Street in the east. Roads D7, D8 and D9 provide connections between Road D2 and Harcourt Road. The intersections of Road D7, D8 or D9 with Harcourt Road will comprise a left-in and left-out arrangement, whereas the intersections of Road D8 and D9 with Road D2 will be signalised. The typical configuration of Road D2/D8/D9 will be 2-lane 6.75 m carriageway.

2.3.3 Access

Access will be provided/maintained to Edinburgh Place, HMS Tamar, the new helipad, WSD pumping station, the former RSPCA building (to be used by the contractor for the extension to the Servicemen's Guild Building) and the Anne Black Building (Red Cross Society).

2.3.4 Pedestrian Facilities

The footpath layout and widths, including due allowances for planters and utility reserves, will be in accordance with the recommendations from the Development of Urban Design Parameter Investigation. A footbridge will be provided across Road D2 in the vicinity of the proposed public landing steps to the north of HMS Tamar, to serve passengers to and from the British Forces ferry. This grade-separated link is required by British Forces because of the particular personnel transport needs. It is proposed that a simple 3 m wide covered pedestrian bridge served by steps. Provision of future ramps have been made in the reclamation project. It is assumed that the necessary grade separated pedestrian crossing facilities over Harcourt Road will be provided as part of subsequent commercial development works, and not by this contract.

2.3.5 Berth Facilities

Currently the naval basin is used on a permanent basis for the berthing of defence vessels, and on a temporary basis for berthing of visiting warships (on the north and west arms). Suitable replacement facilities will be provided at the new naval base at Stonecutters Island prior to the Central Reclamation Phase II. Other small craft will also go to Stonecutters Island. No reprovisioning for these vessels is therefore needed.

British Forces ferries, which now ply between Tamar, Stonecutters Island and Kowloon Point, will continue to serve British Forces Headquarters (BFHQ). The ferries will be moored at Stonecutters Island by the start of contract works, and so will not require a permanent mooring at Tamar.

Steps in the new seawall will be provided for the reprovisioning of ferry berthing facilities. The BFHQ has requested a dedicated pontoon to be secured to one of the sets of steps for the use of RN ferries. It is proposed that the depth of the steps is 4.65 m below PD. This is acceptable to them provided that a public footbridge across road D2 is provided.

2.3.6 Buildings

All buildings to the east of the naval basin area will be demolished, as these are not compatible with the draft Outline Development Plan. The sites are required for future development. In the BFHQ area, two buildings are required to be demolished for construction of Road D2:

- the guardhouse. It is proposed to construct a new guardhouse along to the east of the present location beside the Amethyst Block, at the proposed new main entrance.

- annex to the Government pumphouse. This is on north-west side of the BFHQ area.

2.3.7 Access to BFHQ

After the Royal Navy facilities move to Stonecutters Island the BFHQ area will be surrounded by roads on four sides. One main and an alternative entrance are required. The proposed locations (on the north and east boundaries of the area respectively) have been agreed with BFHQ.

2.3.8 Drainage and Sewerage System

The existing storm drains, foul sewers and cooling water systems affected by the development proposals, and details of necessary diversion and extension works are described in Section 2.4.

2.4 Drainage and Sewerage

2.4.1 Drainage

There are two stormwater catchments J2 and K, as defined in the Central, Western and Wan Chai West Surface Water Drainage Systems Investigation, which will be affected by the reclamation works. A third catchment J1, overlaps the western boundary of the future development site, and although not directly affected by the reclamation, the discharge does have an impact on Victoria Harbour adjacent to the area and is therefore included in this Assessment.

Catchments J1 and K are entirely urban and each covers an area of less than 10 hectares within the Central and Wan Chai West areas. Catchment J2 differs considerably, collecting run-off from the rural Peak area down to the densely developed Wan Chai West District, a catchment size of about 140 hectares. The outfall inverts of the main culverts draining the three catchments are within the maximum tide level of 2.5 mPD and therefore, large sections of drainage within the low lying reclaimed areas are subject to tidal effects. Figure 2.3 shows the location of the outfalls for these catchments.

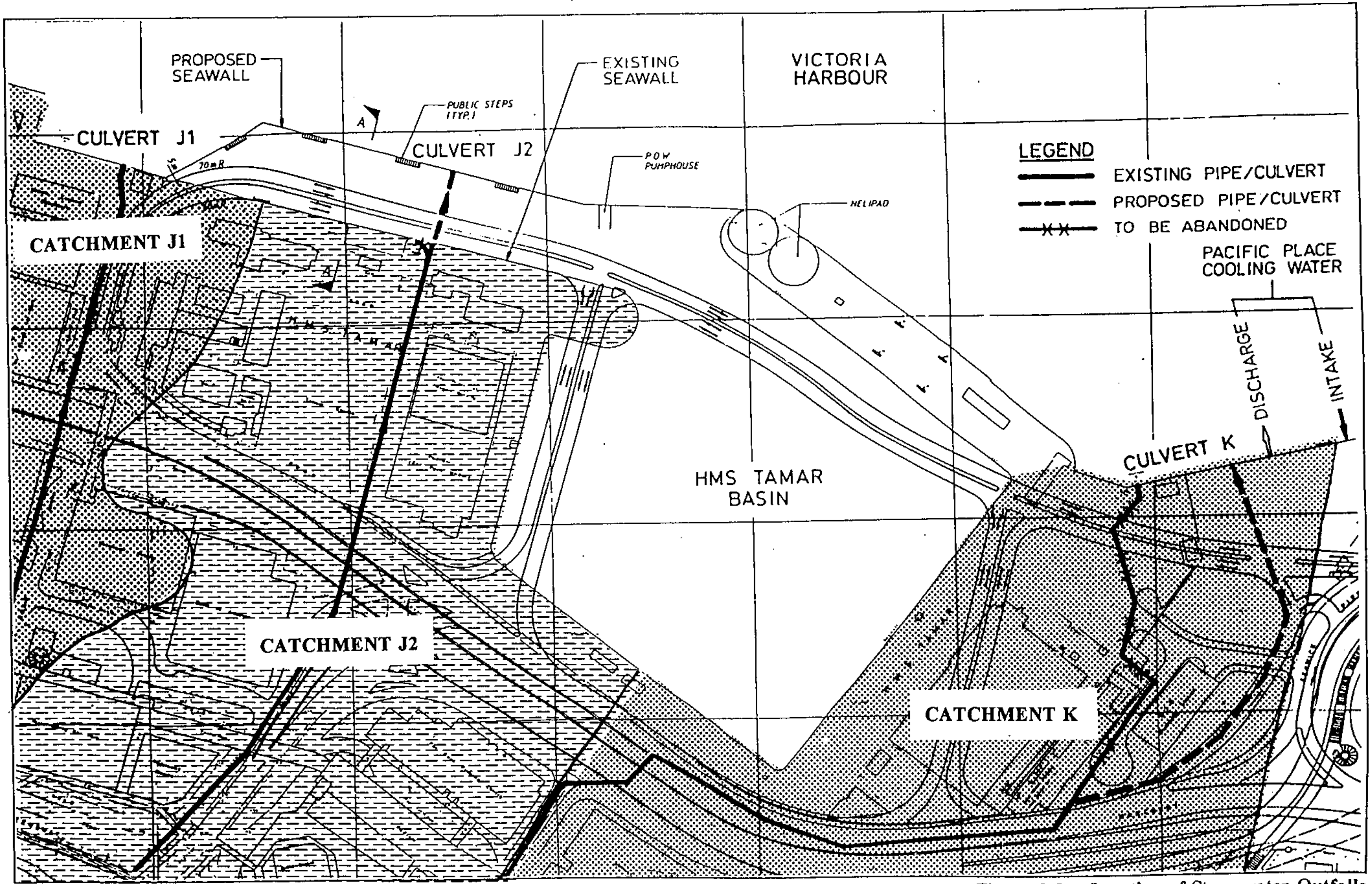


Figure 2.3 Location of Stormwater Outfalls

The Central, Western and Wan Chai West Sewerage Master Plan Study (CW3-SMP) showed that connections between foul and stormwater networks in the area have resulted in a partially combined system resulting in the significant pollution of stormwater discharges. Expedient connections also have been shown to contribute foul sewage to the stormwater system, and the problem is intensified by expedient connections within buildings and private sewers. In addition, the CW3-SMP identified pollution entering the stormwater system from direct effluent discharges to highway gullies from street markets, vendors and restaurants.

The pollution loadings surveyed during the Study confirms the occurrence of cross-connections between foul sewers and storm drains. In the area affecting Central Reclamation Phase II, only catchment J1 was observed to have significant pollution loads as shown in Table 2.4.1. A major expedient connection within the catchment was identified by the Study and has since been rectified by the Drainage Services Department (DSD). The Environmental Protection Department (EPD) has recently commissioned an Expedient Connection Survey which will cover catchment J1, as part of the continuing CW3-SMP Study. This should identify any further problems relating to pollution of stormwater by expedient connections.

The survey results for catchment J2 (see Table 2.4.1) indicate no potential pollution problems with the discharge, inferring that there are no significant expedient connections within the catchment, and no such connections were identified by other Study surveys either. However, the occurrence of a number of cross-connections between foul sewers and the main stormwater culvert around Cotton Tree Drive are thought to exist. These connections may be high level overflows or the sewers may be simply passing through the culvert due to conflicts in the available depth of construction. Although no significant pollution was detected at the time of the survey, there is still a potential for sewage discharging to the storm drain under overflow conditions if the former situation applies.

Although the pollution sampling point for J2 was located about 360 metres upstream of the outfall, the occurrence of expedient connections to the stormwater system between these two points is unlikely since this part of the network drains the relatively new finance centres adjacent to Cotton Tree Drive and parts of HMS Tamar. A relatively high Suspended Solids (SS) load was detected in the catchment J2 discharge, but this is not significant for the size and nature of the catchment area.

Sampling for pollution analysis of the stormwater discharges from catchment K was not carried out because of the problem of the entire drainage network being subject to tidal effects. However, the occurrence of expedient connections within this small system is again unlikely since it drains the area around the recently constructed Admiralty Centre and the Government land to the east of HMS Tamar. Therefore, the discharge from catchment K is probably not polluted by foul water.

Table 2.4.1 Pollutant Loads Measured in Stormwater Discharges in 1990

Outfall	Flow Rate (m^3/d)	SS (kg/d)	BOD (kg/d)	COD (kg/d)	NH_3-N (kg/d)	TKN (kg/d)	*E. coli* load (Count/100 ml)
J1	7430	980	2500	3750	290	410	3.1×10^{10}
J2[1]	31800	2330	79	575	10	36	3.7×10^{8}
K[2]	--	--	--	--	--	--	--

Notes

1. Source: Central, Western and Wan Chai West Sewerage Master Plan Study (1991)
2. Determinand values measured as a mean of duplicate spot samples taken during sewer survey in June - August 1990.
3. [1] Sampling point located 360 metres upstream of the outfall.
4. [2] No sampling carried out within this catchment.

The Central Reclamation Phase II will extend 60 metres beyond the existing seawall and outfall J2 will be extended to the new seawall line and enlarged to accept additional flows from the west and central areas of the development. A section of the main drain in catchment K will be abandoned and a new larger pipe will be constructed with the outfall K being relocated further east of its current position (see Figure 2.3). There should not be any additional pollution impact on sensitive receivers as a result of the J2 culvert extension and K culvert diversion works during the construction phase. Catchment J1 will not be affected by the reclamation.

The existing dry weather flow in catchment J2, attributable to run-off from the Peak area, will not be affected by the proposed storm drains to be connected to J2, but calculations show that during a design storm event of 1 in 200 years return period, the peak discharge from outfall J2 will increase by about 14% due to the additional run-off from the development. Similarly, the peak discharge from outfall K will increase by about 55% due to additional run-off. As a consequence, there is expected to be an increase in pollutant loading associated with run-off from the proposed road network.

2.4.2 Sewerage

The existing sewer reticulation in the area around the development will not be affected. The proposed sewerage layout for the Tamar Basin will be a simple system of gravity flow to a pumping station to be located on the eastern side of the reclamation, where the flow will be pumped through a rising main to the Wan Chai West Sewage Screening Plant for screening and disposal.

The peak flow from the development will be about 145 l/s. for a population equivalent of approximately 23,000. It is understood that the Wan Chai West Screening Plant has sufficient capacity to treat this additional flow. This would significantly increase the pollution load already entering the Harbour from the Plant.

2.4.3 Cooling Water Systems

Three cooling water pumping stations will be affected by the Central Reclamation Phase II and these will be catered for by either intake extension, or by station relocation. One of the intakes is located on the western edge of the reclamation and the quality of the intake water may be affected by the works.

To the east of the site are a number of cooling water pumping stations situated along the seawall which serve a number of major buildings in the Wan Chai area. The most significant of these is the Pacific Place intake and pumping station located between the Tamar Basin and the Wan Chai West Sewage Screening Plant. The reclamation works are probably too distant to have a significant impact on the intake water quality, but outfall K will be relocated closer to the intake for Pacific Place. The maximum allowable suspended solids concentration in cooling water is about 140 mg/l. The stormwater discharging from outfall K is unlikely to have a suspended solids content exceeding this value and therefore the closer proximity of the outfall should not cause any problems. In addition, the Pacific Place cooling water discharge outlet is located between outfall K and the intake, which will assist in dispersing the stormwater further out in to the Harbour so that any recirculation of suspended solids from the discharge to the intake water will be minimal.

2.4.4 Potential Improvement Measures

Improvement measures could be implemented to reduce the pollution entering the Harbour. The water quality around the reclamation area could be improved as a result, but it is acknowledged that the pollution problem cannot be completely eliminated.

The discharge from Catchment J1 has been identified as a significant source of contamination. The recently commissioned Expedient Connection Survey of this stormwater catchment will serve to identify major polluters and expedient connections to the system. Suitable remedial measures can therefore be carried out in order to reduce the pollution loading from this catchment. Similar surveys for catchments J2 and K have not been recommended under the CW3-SMP because the initial surveys showed no significant pollution problems. However, the type of cross-connections that exist between numerous foul sewers and Culvert J2 should be determined to assess their potential for contaminating the stormwater. High level overflows within the culvert should be eliminated.

The increase in sewage attributed to the future population of the development will cause a corresponding increase in pollution of the Harbour. This endorses the recommendations of the CW3-SMP to eventually phase out the Wan Chai West Screening Plant and convey the sewage to deep trunk sewers forming the Strategic Sewage Disposal Scheme for ultimate discharge to the Lema Channel.

2.5 Development and Landuse

The future landuse in the Tamar Basin will be a mixture of commercial, recreational and residential developments. As a worst case situation Site C24 is assumed to be residential. Table 2.5.1 shows the landuse for each site, and the locations are shown in Figure 2.4.

Table 2.5.1 Landuse for Development Sites

Site	Use
C23	Commercial
C24	Commercial
C28,C29,C37	Commercial
C32,C33	Commercial

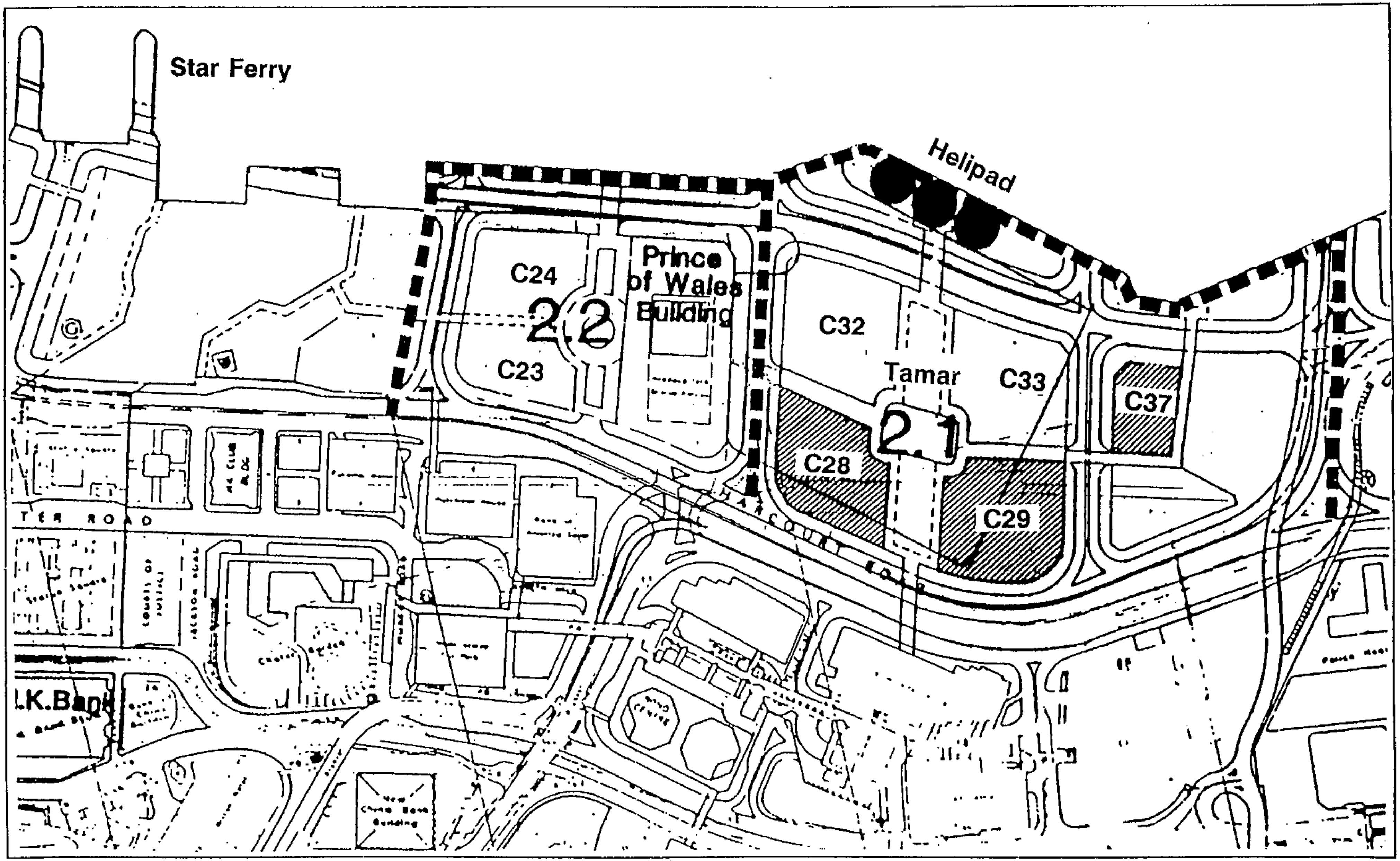


Figure 2.4 Future Landuse Development

3 WATER QUALITY

3.1 Overall Existing Water Quality

HMS Tamar is a relatively small basin with bed levels at approximately -9 mPD. Considering the typical tidal range in Hong Kong waters of around 1.3 m on representative semi-diurnal neap tides and 1.6m on representative diurnal spring tides, it is assumed that the basin is poorly flushed. In the wet season, when horizontal and vertical salinity gradients will increase, the flushing of the basin would also increase, but not substantially. As a result, water quality in the basin will be sensitive to any direct effluent discharges into the basin or ingress of poorly diluted effluents from any nearby sources such as the neighbouring sea wall outfalls all of which would generate a marked reduction in water quality in the basin. In order to examine existing water quality conditions, observations of salinity, temperature, dissolved oxygen, suspended solids and oxidation reduction potential were made at 6 stations within the basin and at 5 stations in Victoria Harbour (Figure 3.1). The observations consisted of non-simultaneous, single, vertical profiles at each Station. When comparing the data from the different Stations, it must be remembered that apparent differences in water quality conditions will include the effects of tidal variations during the time taken to visit each Station and will not simply be due to spatial variations between the Stations.

The observations, presented in Figures 3.2 to 3.12, were made in the dry season (March 1993) when the effects of the fresh water discharge from the Pearl Estuary should be minimal, conditions should be vertically well mixed for most parameters and salinities in general should be close to oceanic (35%). The observations made at Stations 7, 8, 10, 11 indicate high salinities in the range 33-34 kg/m^3 and vertically well mixed conditions as expected. The salinity at Station 9, however, close to the seawall, was vertically well mixed over the top 10 m of the water column at a concentration of 24kg/m^3 before increasing to approximately 28.5 mg/m^3 at the sea bed. It is likely that these depressed values were generated by the neighbouring discharges from the stormwater outfalls (Fig 2.3). This can be substantiated by the lower dissolved oxygen (DO) levels at this station compared to other stations outside the basin.

Within the basin, saline concentrations are comparatively lower than those outside the basin and the observations show salinity increases of 2-4% within the bottom 1-3 m from the sea bed. Salinities vary from 24.5-25 kg/m^3 at stations 1, 4 and 5 to 27-28 kg/m^3 at Stations 2 and 6. Such localised salinity variations over short distances can possibly be attributed to the poor mixing ability of the basin water. Similar localised variations on DO levels were also apparent.

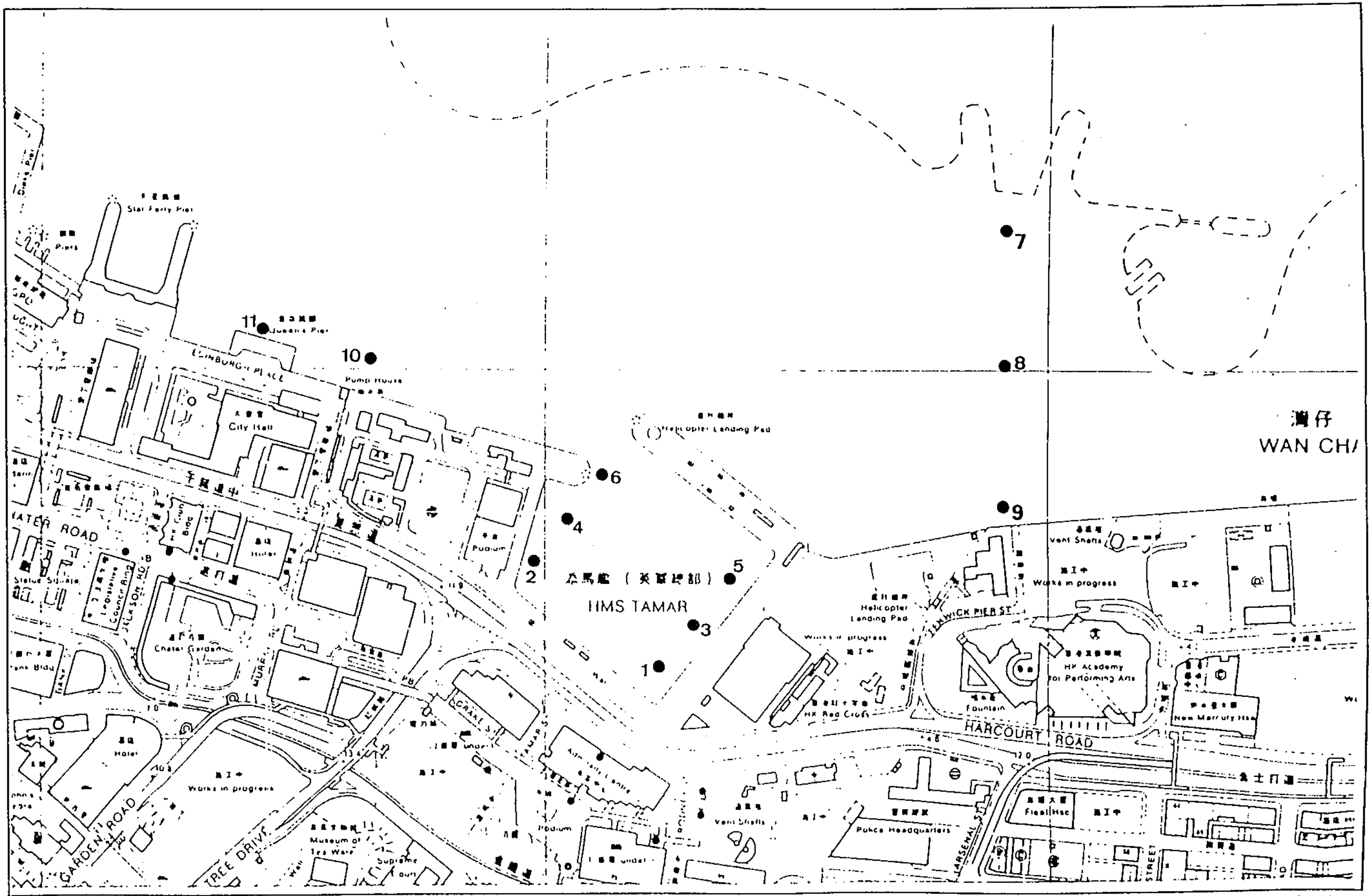


Figure 3.1 Location of Water Quality Monitoring Stations

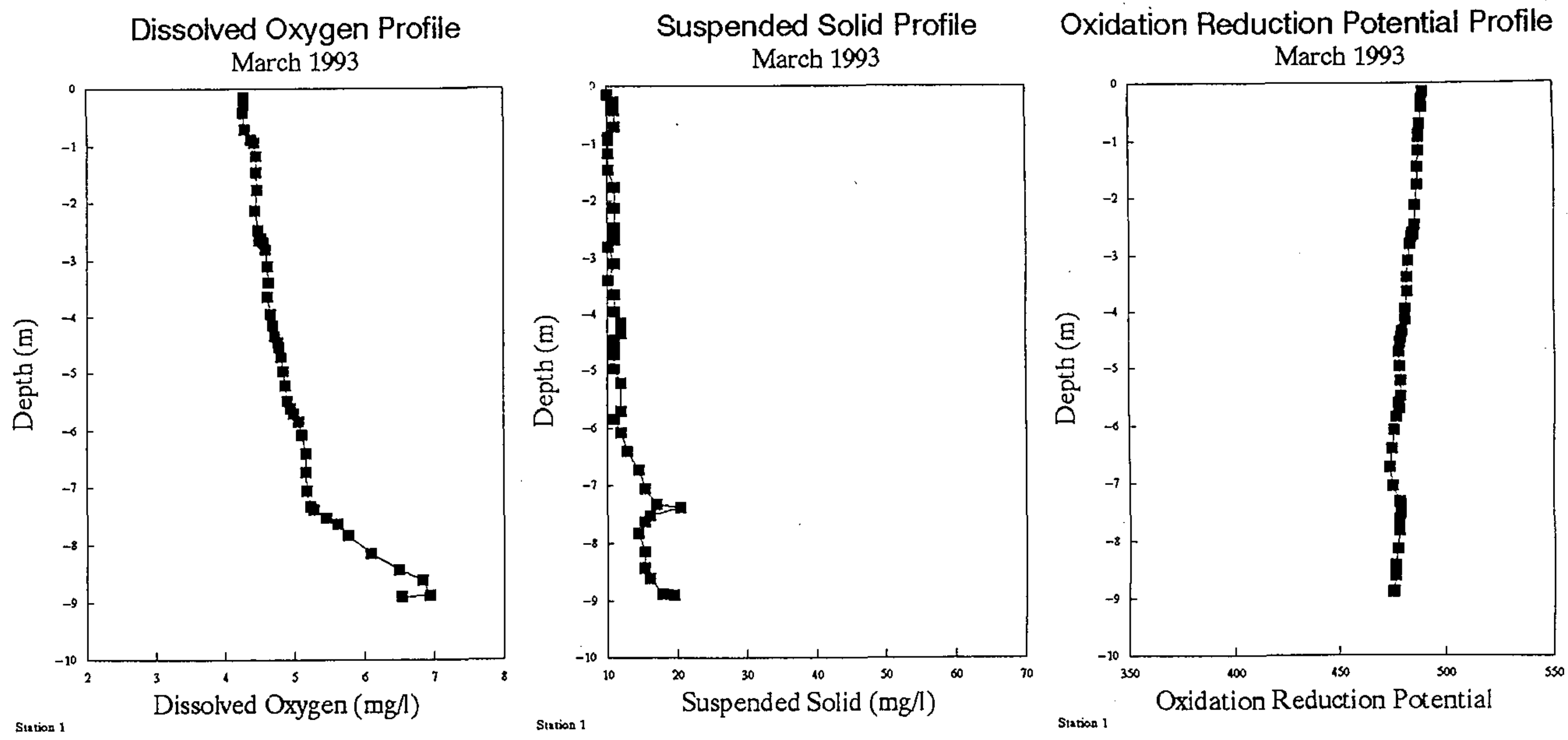
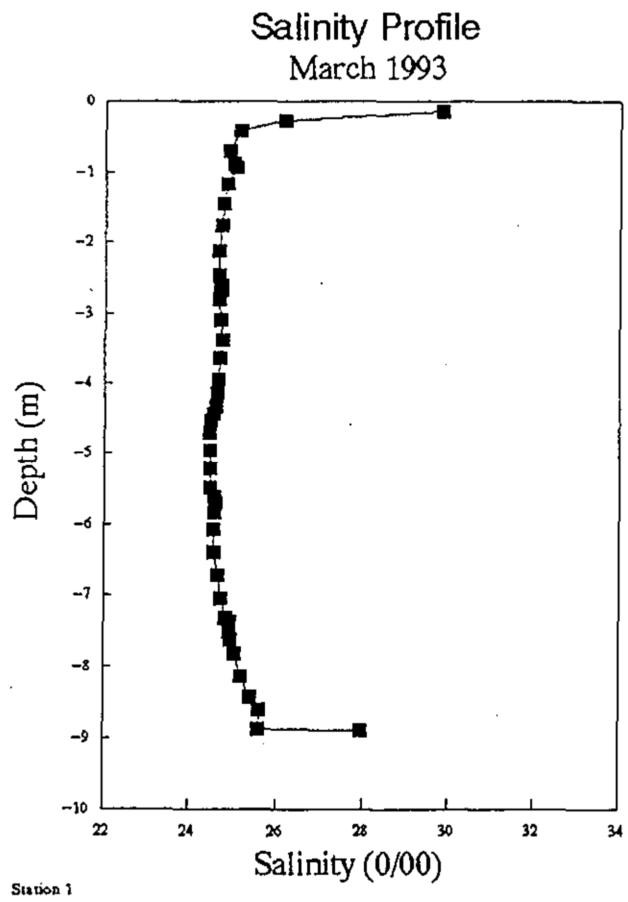


Figure 3.2a Water Quality Profiles at Station 1 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)



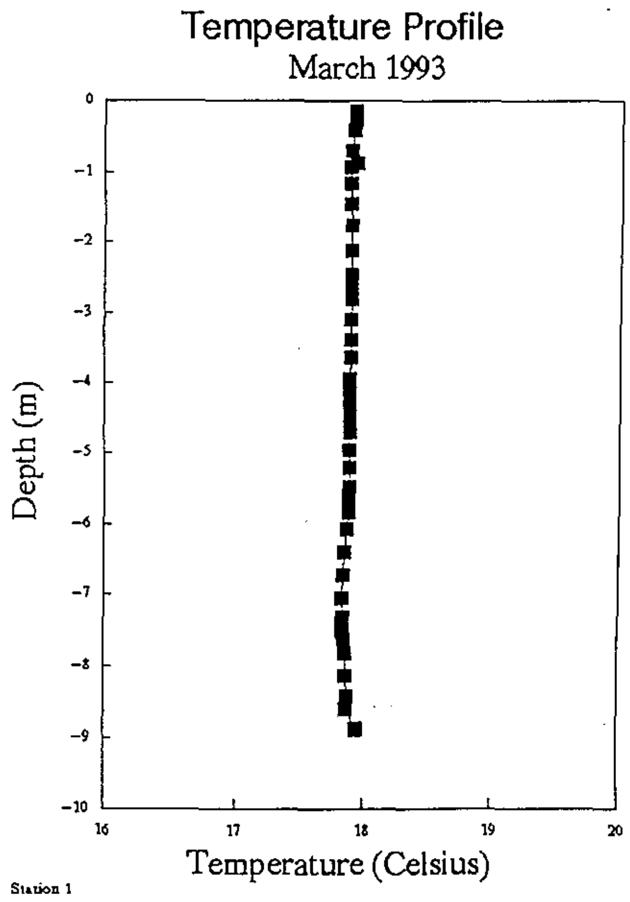


Figure 3.2b Water Quality Profiles at Station 1 (Salinity/Temperature)

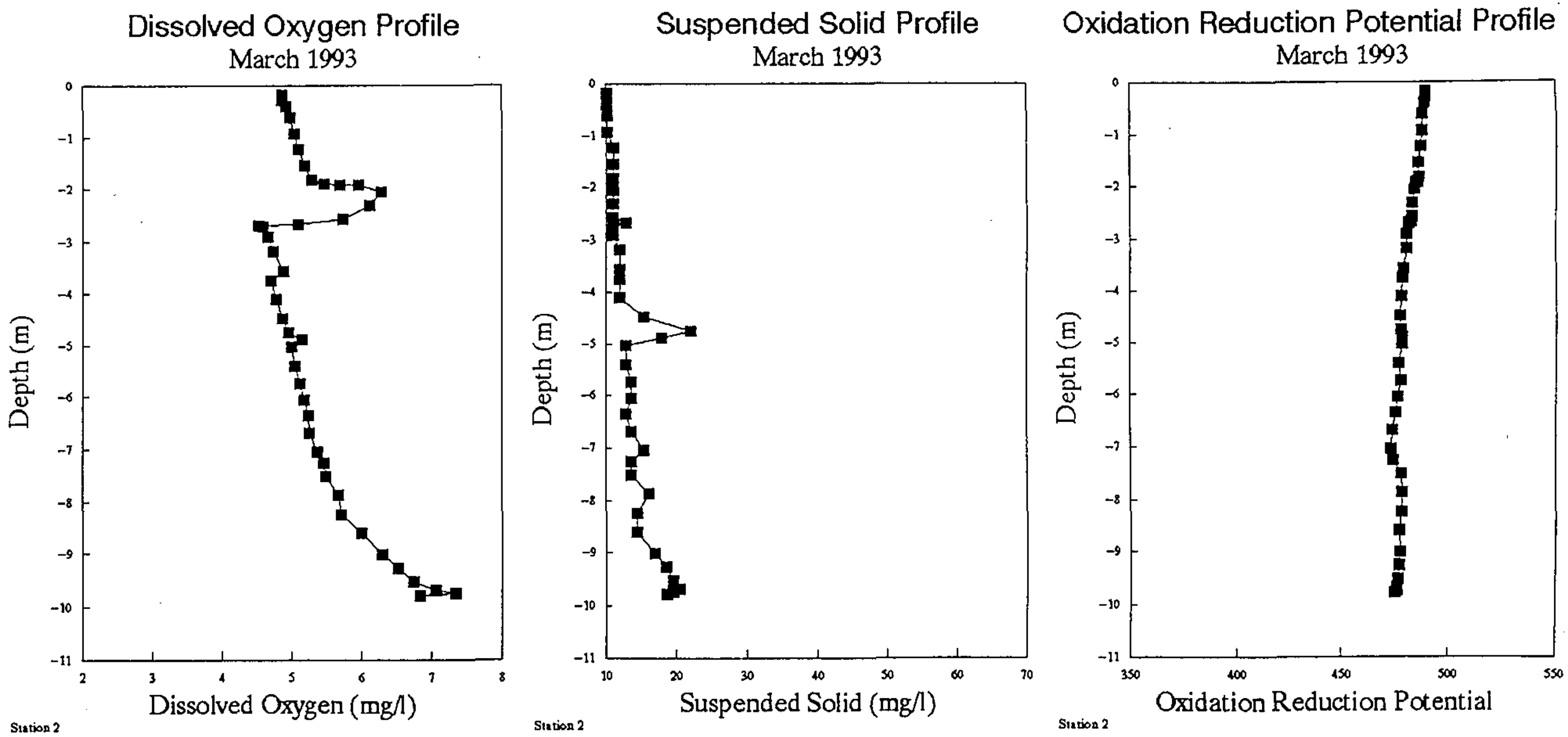


Figure 3.3a Water Quality Profiles at Station 2 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)

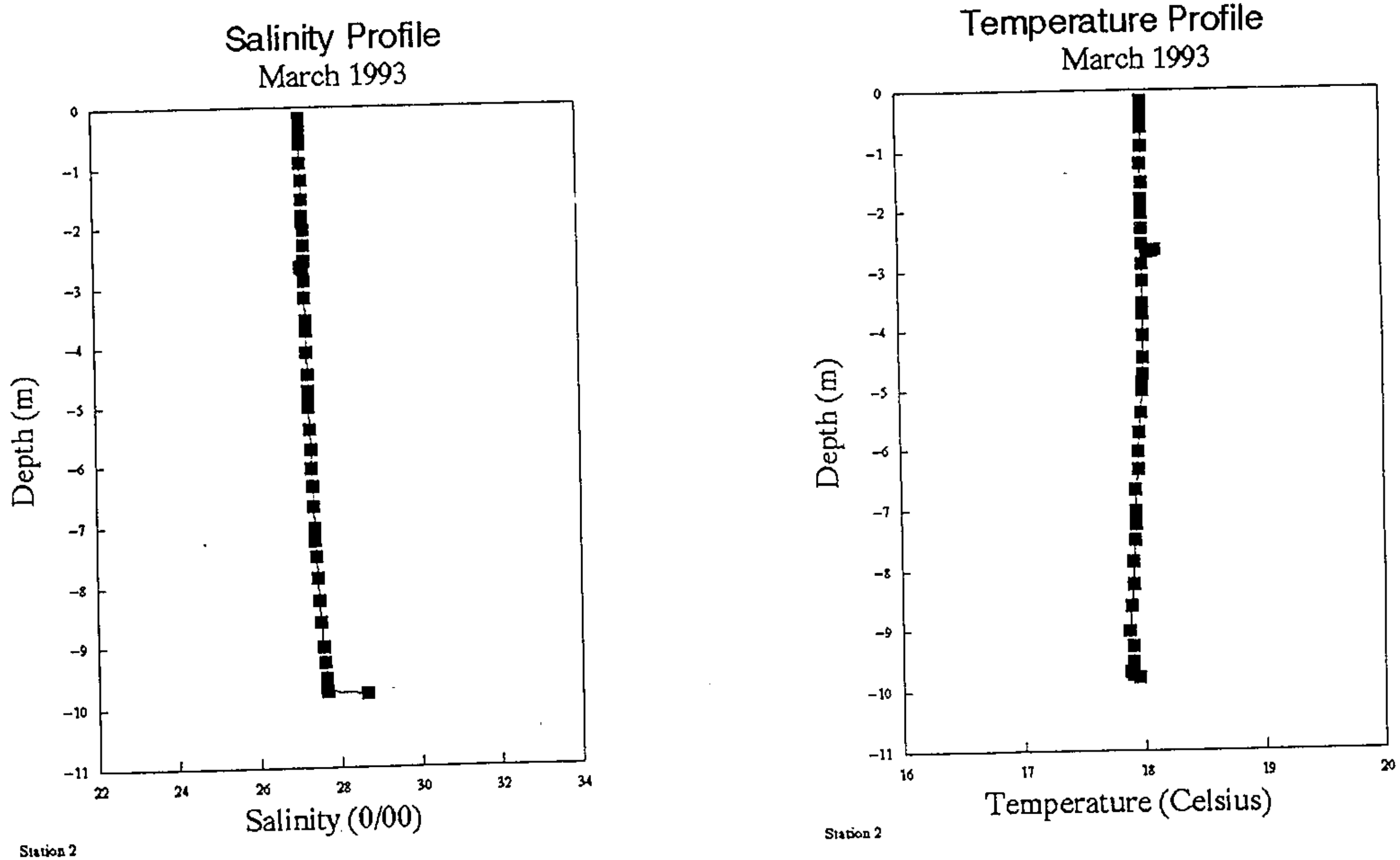


Figure 3.3b Water Quality Profiles at Station 2 (Salinity/Temperature)

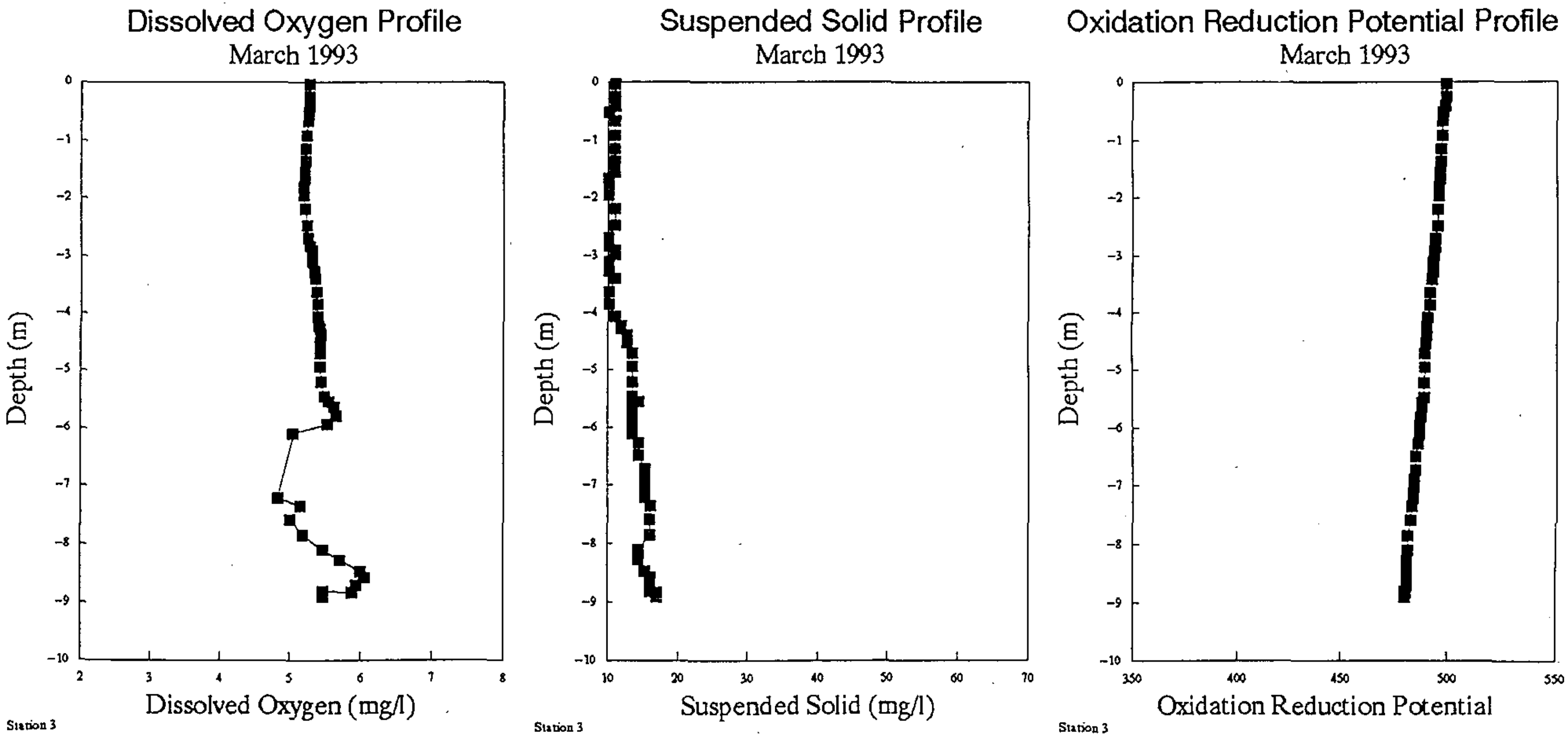


Figure 3.4a **Water Quality Profiles at Station 3 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)**

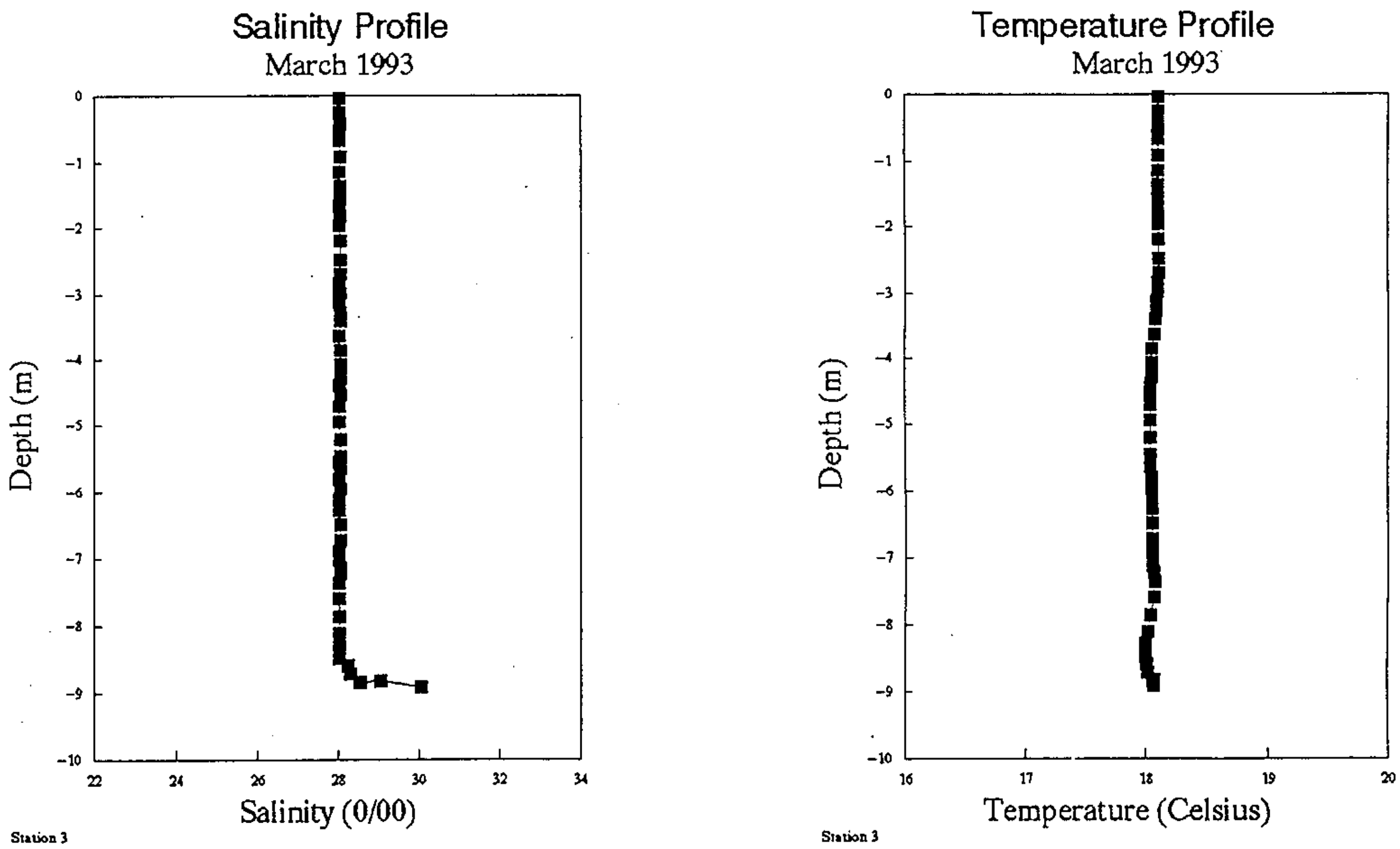


Figure 3.4b Water Quality Profiles at Station 3 (Salinity/Temperature)

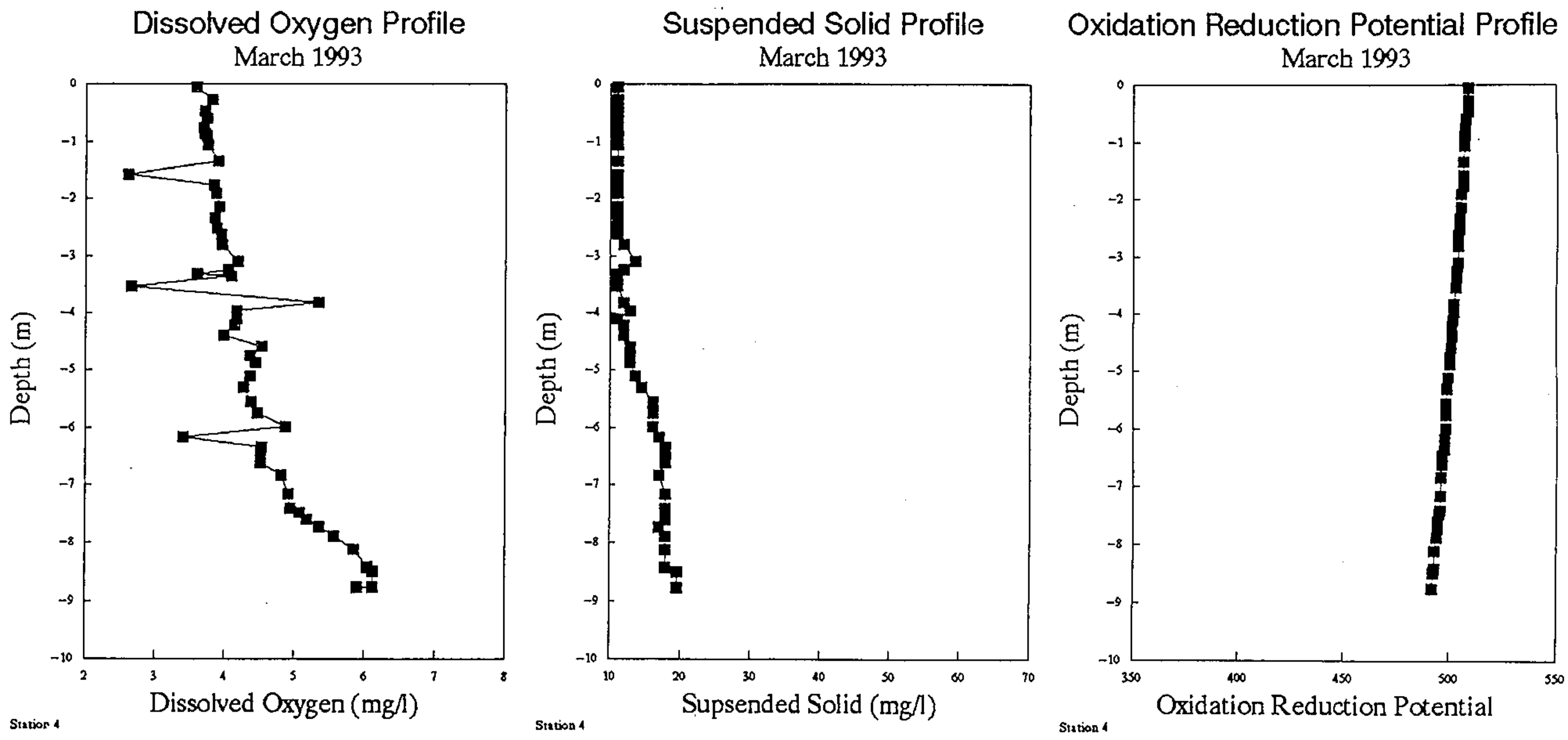


Figure 3.5a Water Quality Profiles at Station 4 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)

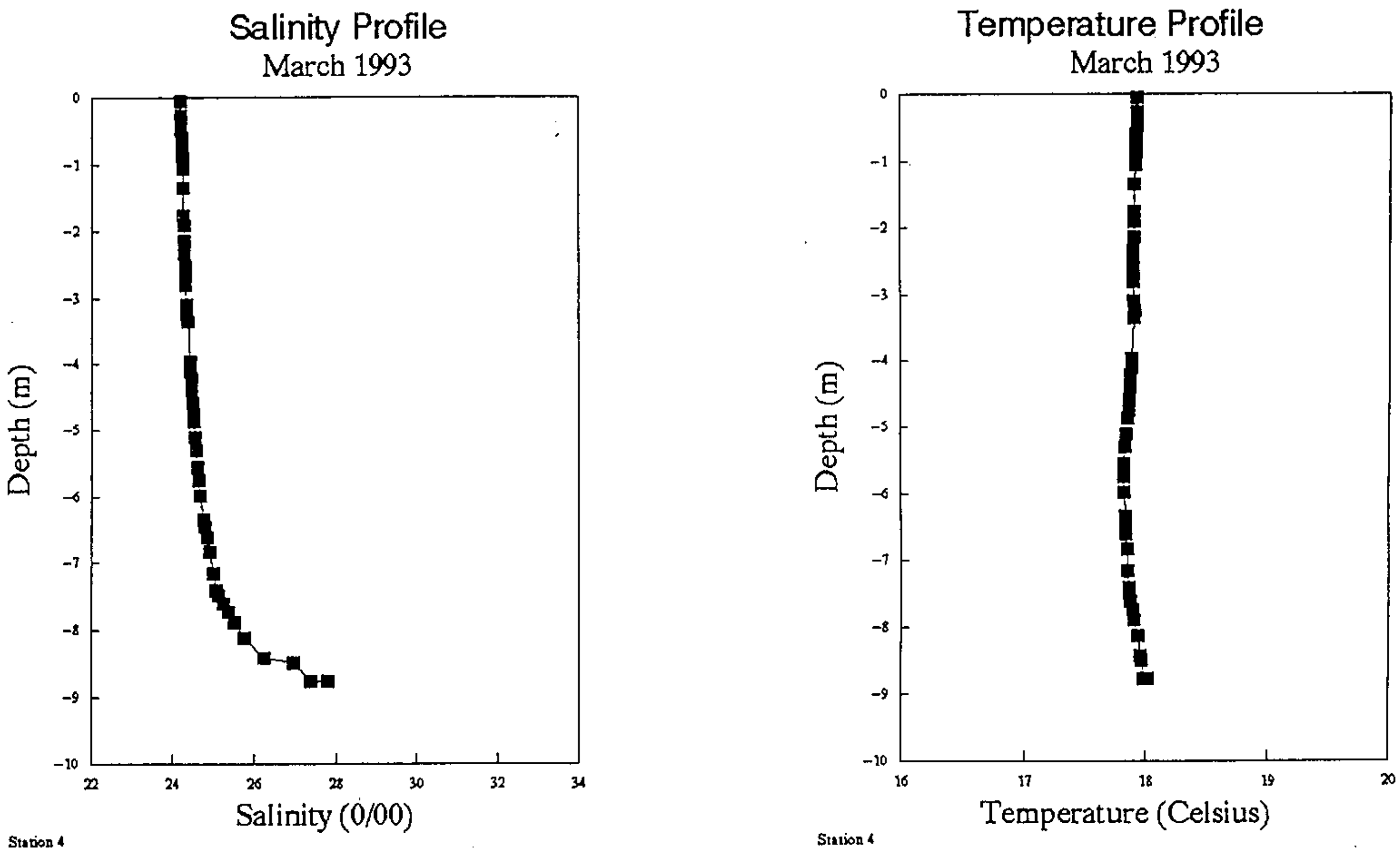


Figure 3.5b **Water Quality Profiles at Station 4 (Salinity/Temperature)**

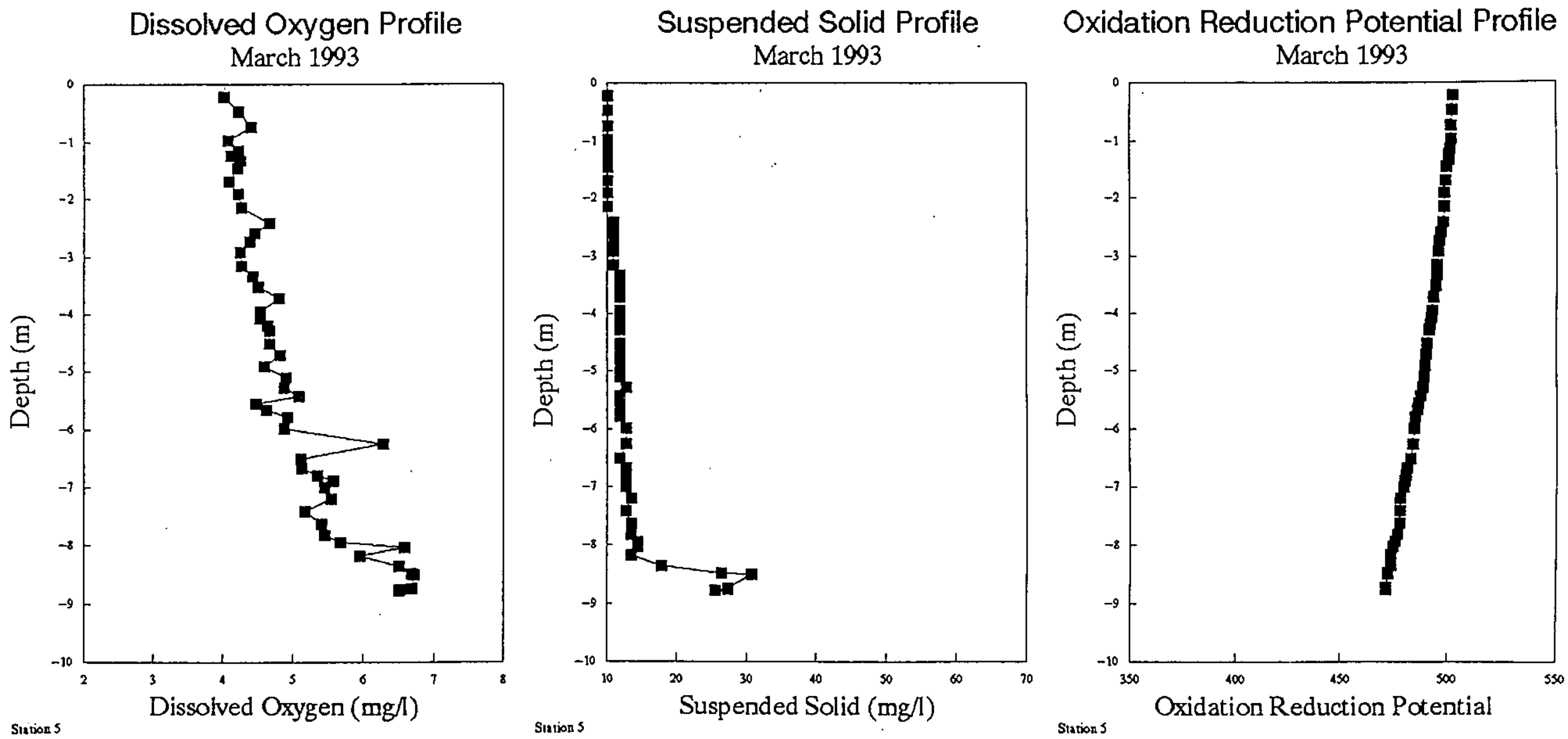
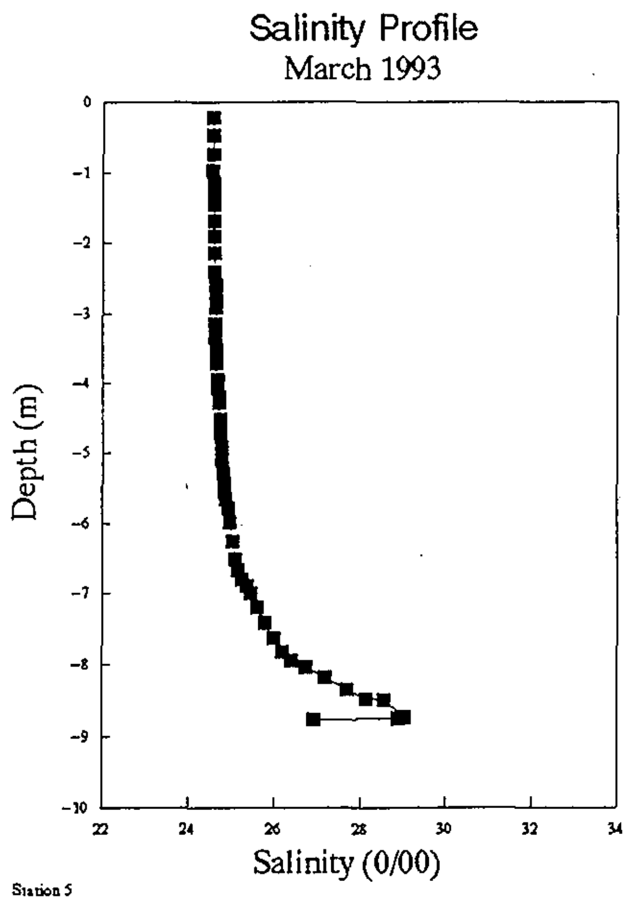


Figure 3.6a **Water Quality Profiles at Station 5 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)**



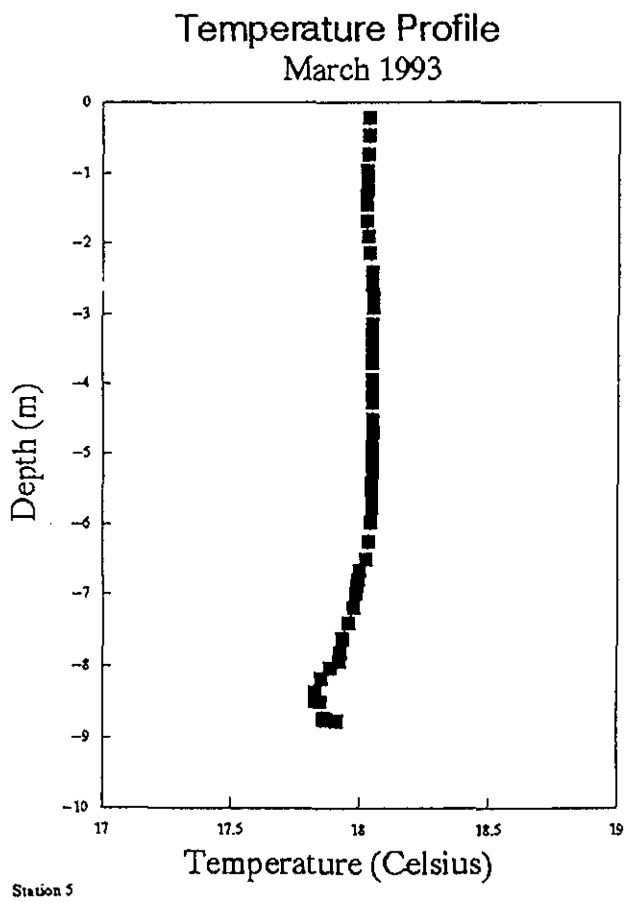


Figure 3.6b Water Quality Profiles at Station 5 (Salinity/Temperature)

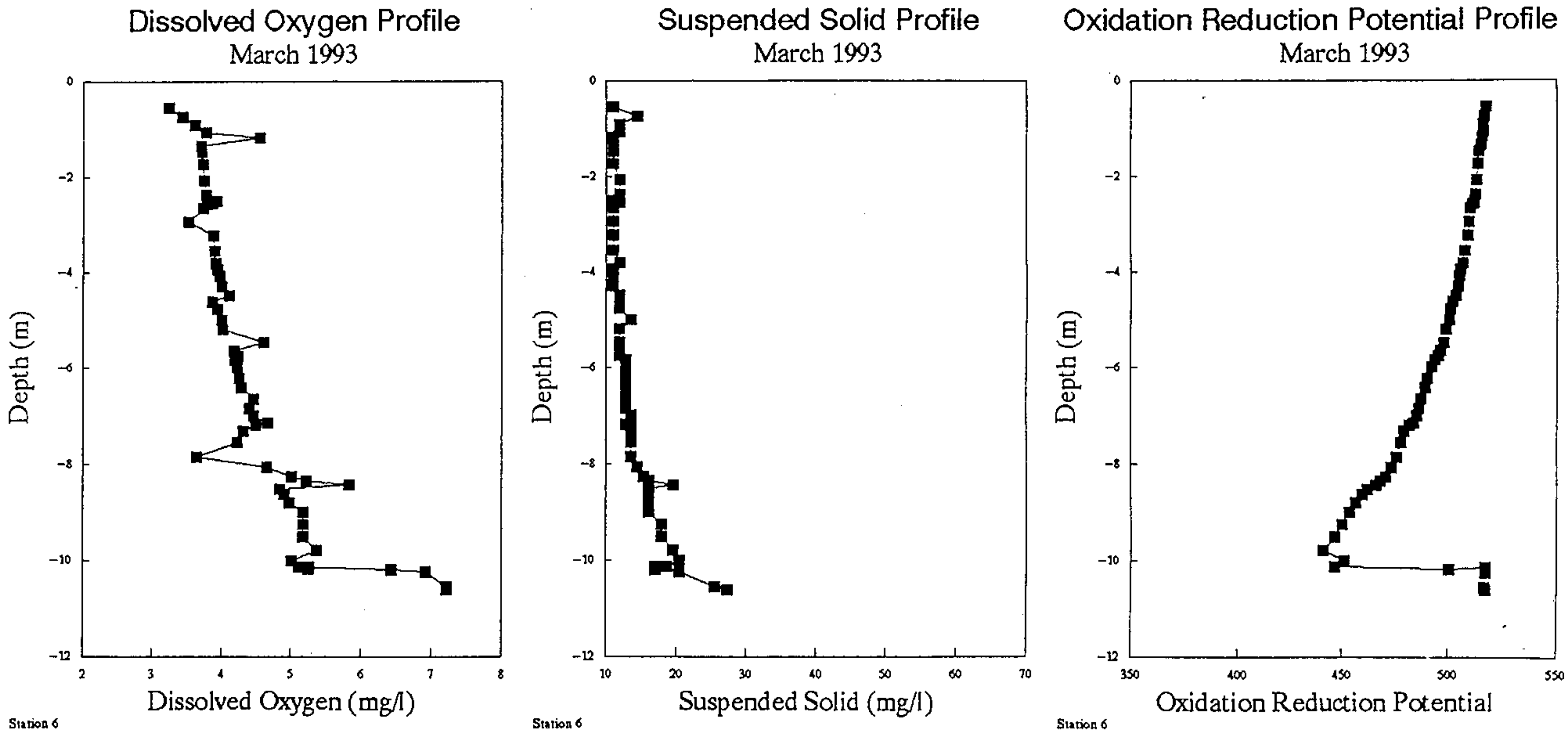
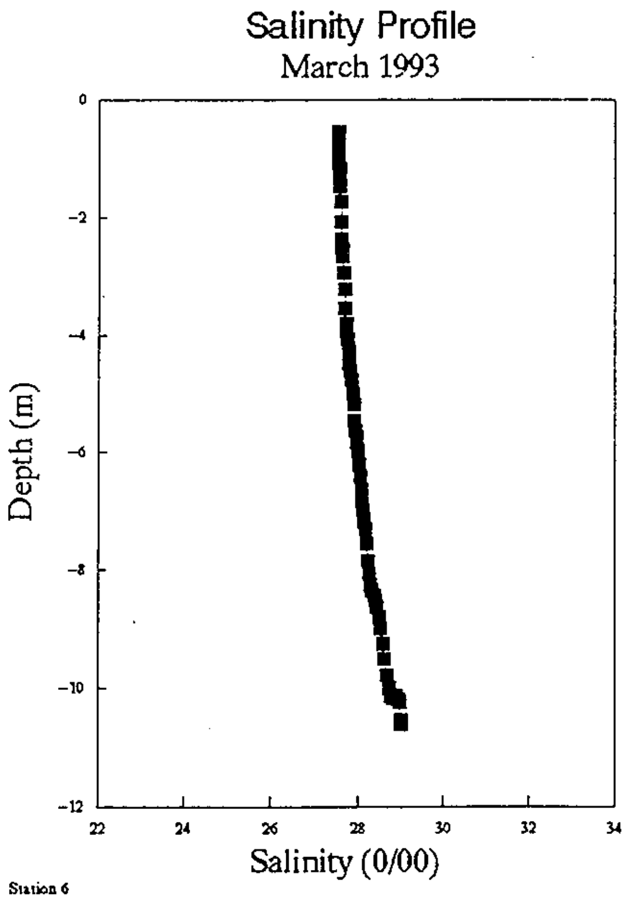


Figure 3.7a Water Quality Profiles at Station 6 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)



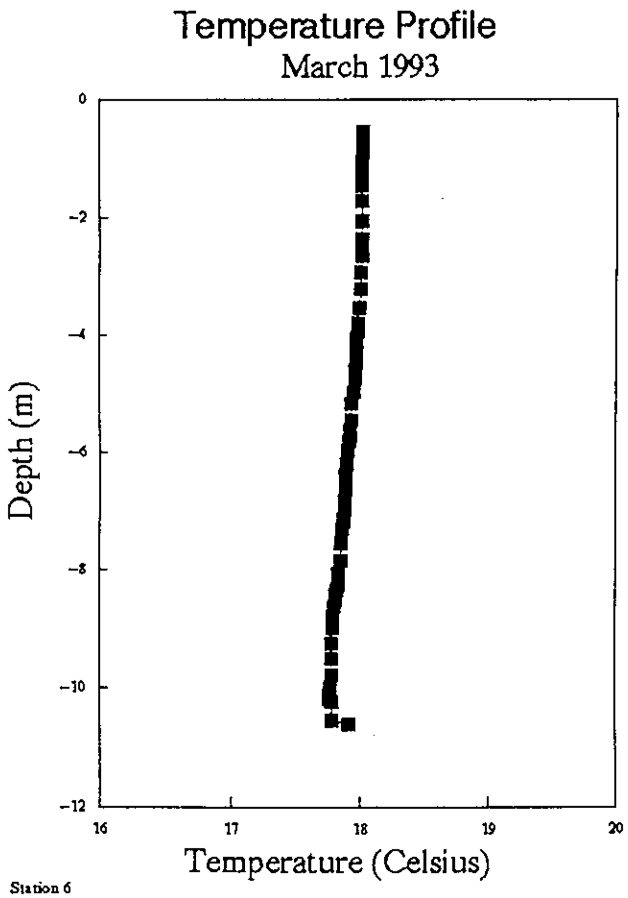


Figure 3.7b Water Quality Profiles at Station 6 (Salinity/Temperature)

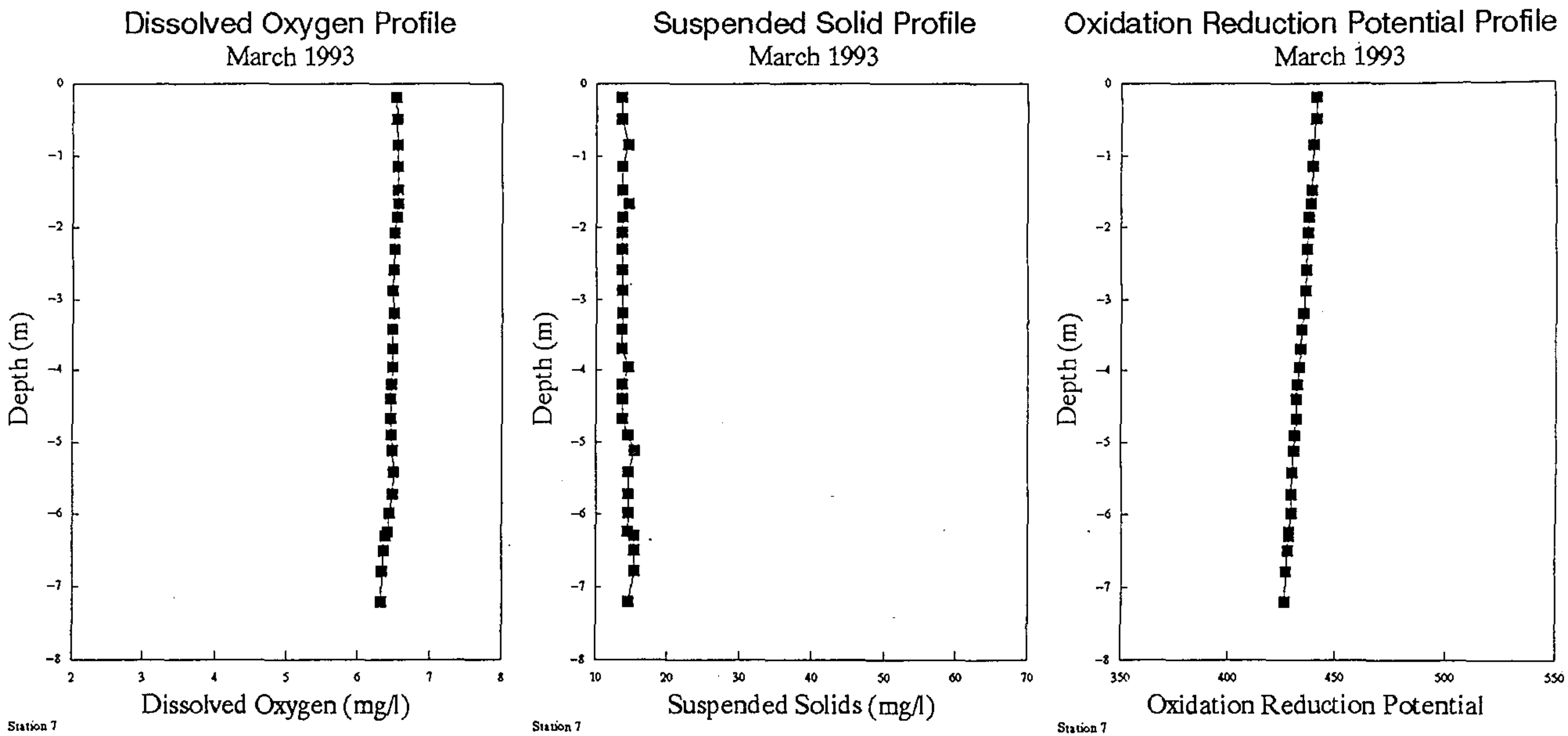


Figure 3.8a Water Quality Profiles at Station 7 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)

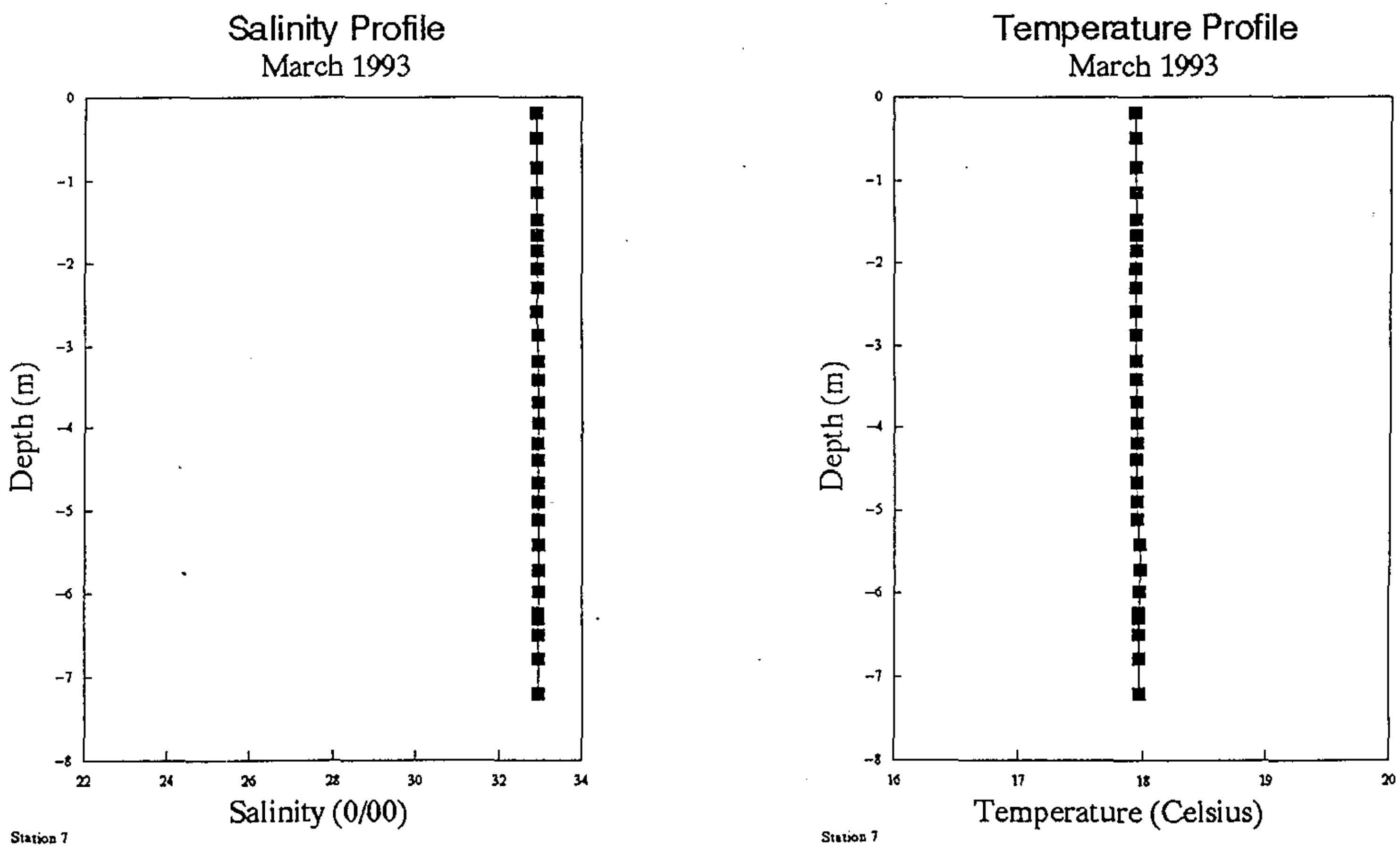


Figure 3.8b Water Quality Profiles at Station 7 (Salinity/Temperature)

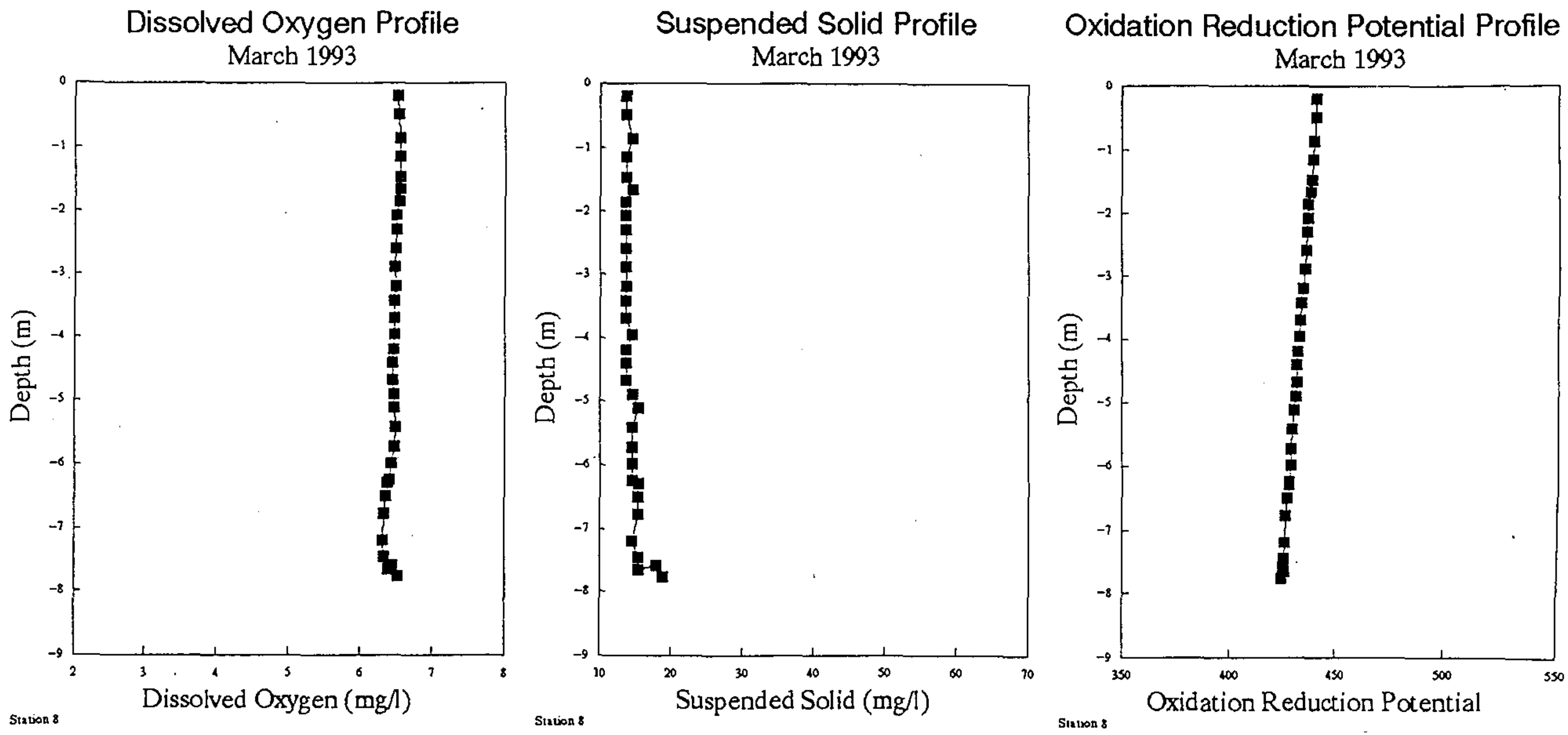
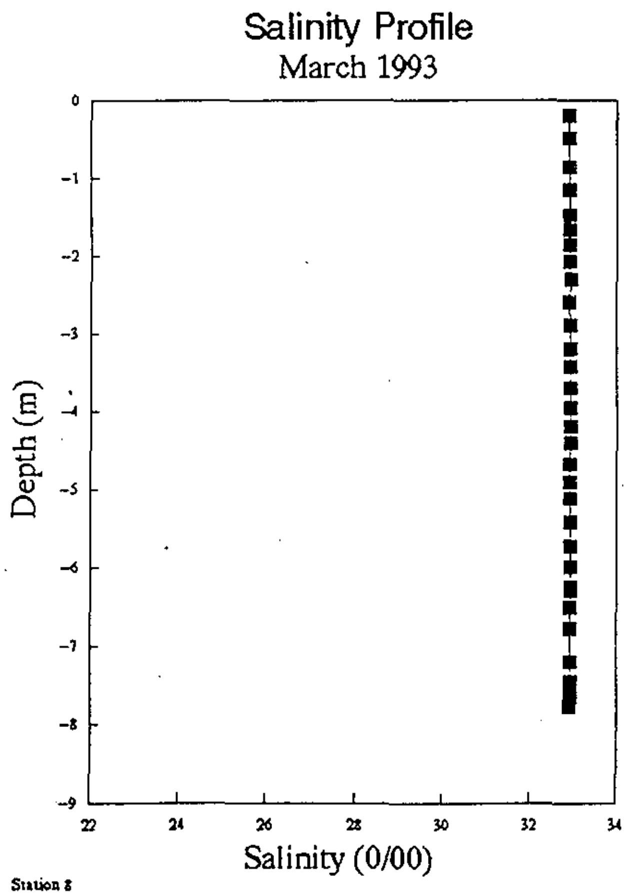


Figure 3.9a Water Quality Profiles at Station 8 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)



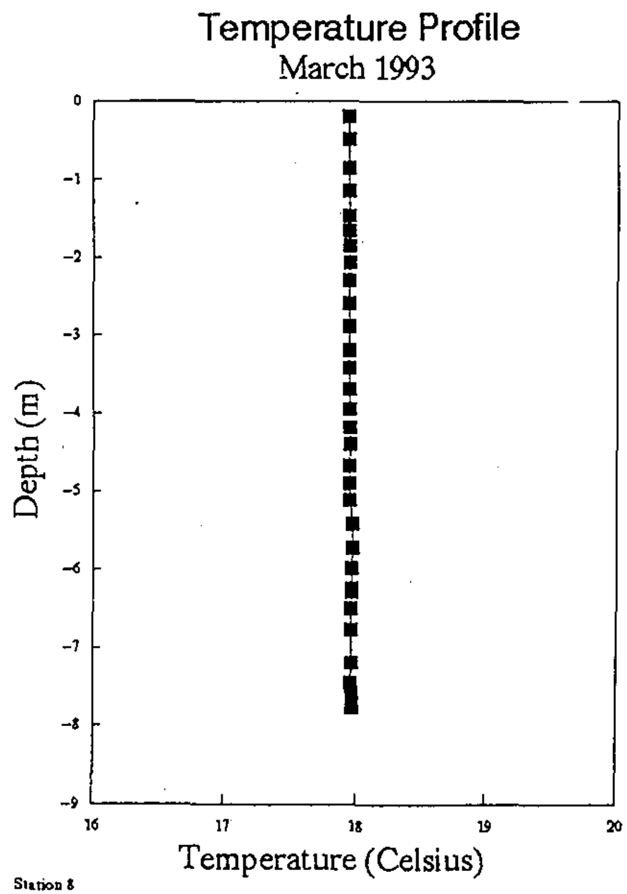


Figure 3.9b Water Quality Profiles at Station 8 (Salinity/Temperature)

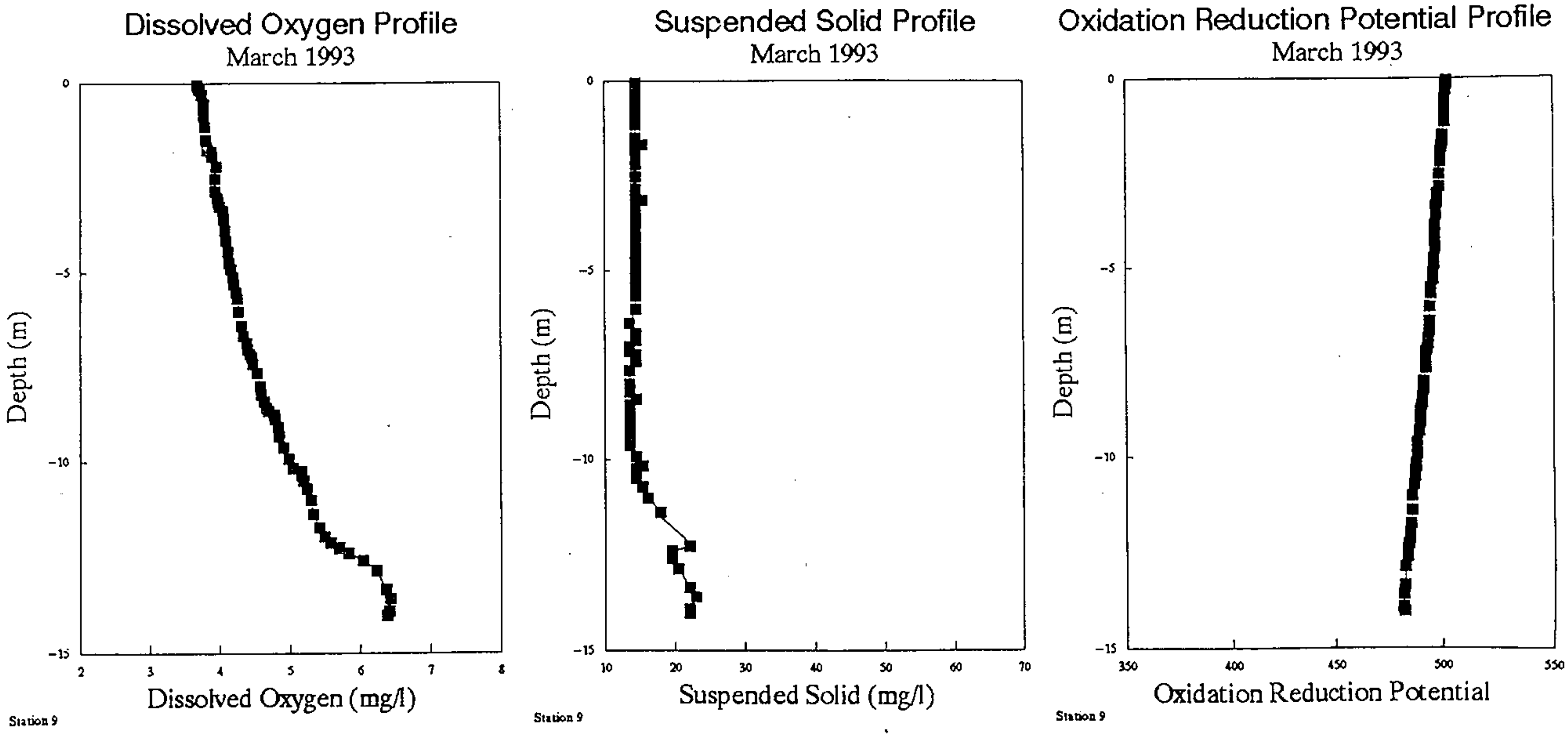
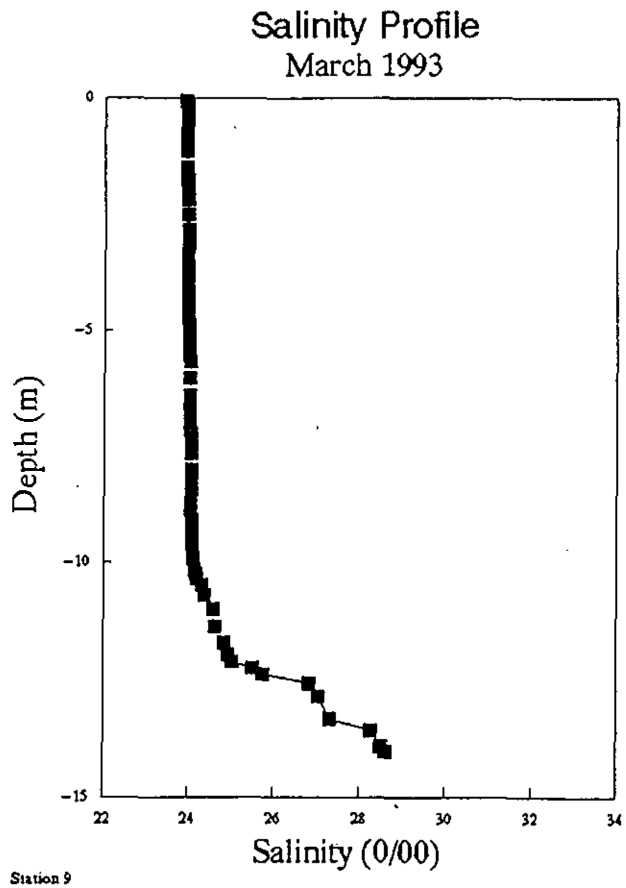


Figure 3.10a Water Quality Profiles at Station 9 (Dissolved Oxygen/Suspended Solid/Oxidation Reduction Potential)



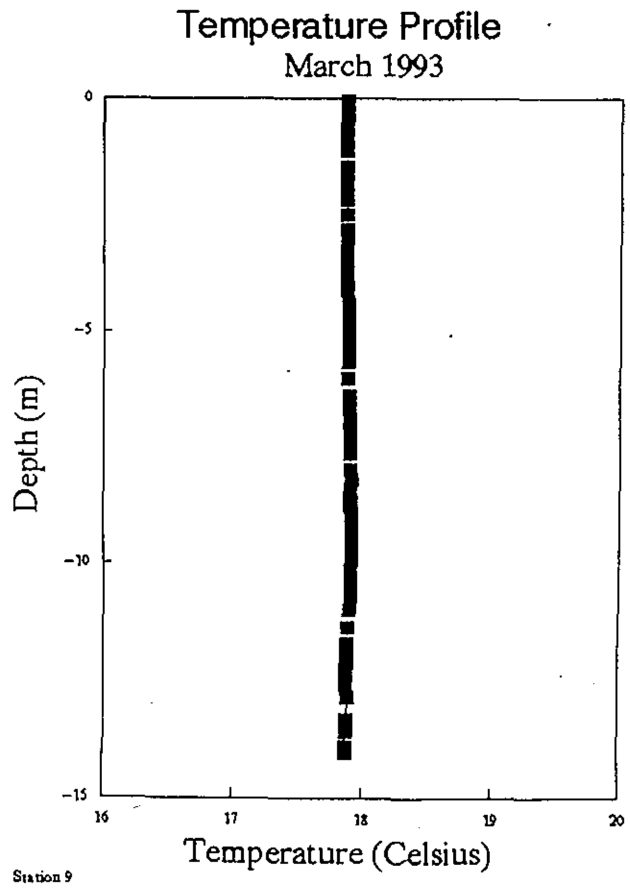


Figure 3.10b Water Quality Profiles at Station 9 (Salinity/Temperature)

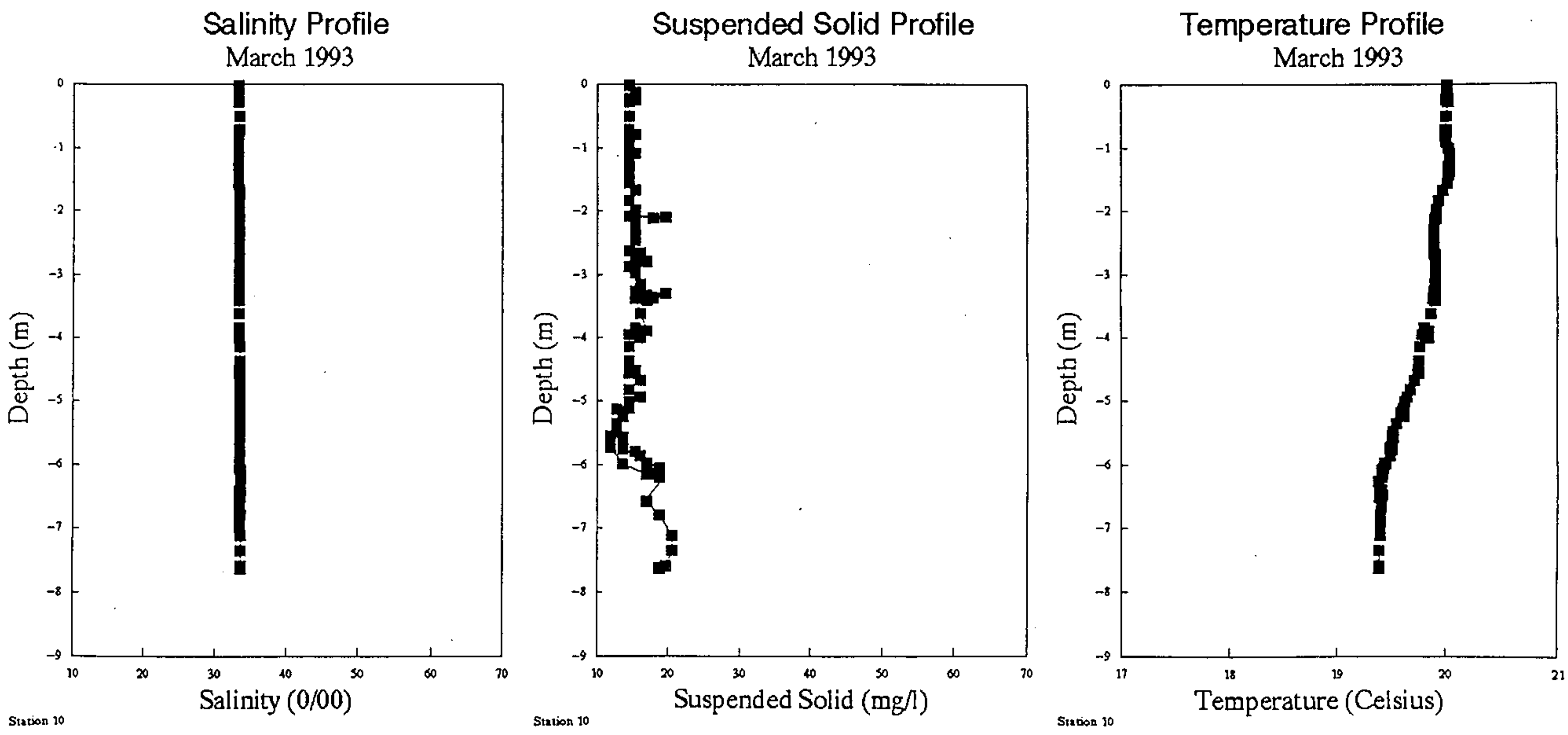


Figure 3.11 Water Quality Profiles at Station 10 (Salinity/Suspended Solid/Temperature)

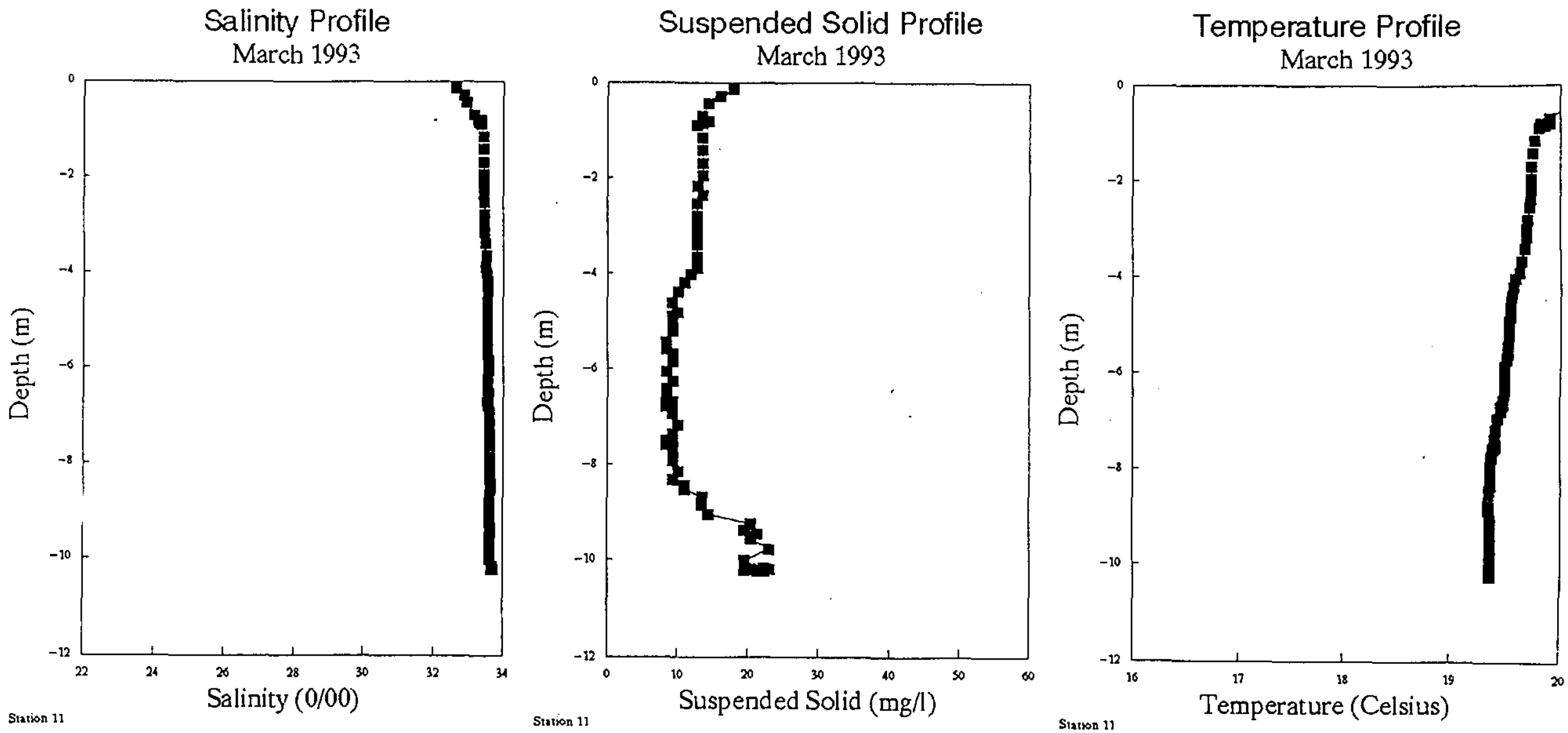


Figure 3.12 Water Quality Profiles at Station 11 (Salinity/Suspended Solid/Temperature)

Water temperatures at Stations 1 to 9 were almost uniform over the depth at approximately 18°C. At Stations 10 and 11 near some cooling water outfalls, water temperatures varied from 19.4°C near the sea bed to 20°C at the surface which represented an increase over the background temperatures indicated by the other Stations of +1.5° to +2°C. In the Central Reclamation Phase 1 Focused Environmental Impact Assessment Study, a three-dimensional model of tidal flows and cooling water discharges predicted surface layer water temperature increases of up to +2.0°C in the vicinity of Stations 10 and 11 when simulations of wet and dry season neap tides were carried out. The temperature increase observed at Stations 10 and 11 in the vicinity of the cooling water discharges will depend on the particular tidal conditions and the time during the tide when the observations were made. However, the higher temperatures found at these Stations compared to the background temperatures at the offshore Stations are not unexpected.

Suspended solids concentrations at all stations were similar, varying from approximately 10 mg/l near the surface to 20 mg/l near the sea bed. The SS data was very much as expected for Victoria Harbour waters based on many previous data sets including the routine EPD monitoring data. An important determinant of SS values currently recorded in Victoria Harbour is the distribution and scale of dredging and construction activities associated with a broad range of projects, and in particular, the large scale activities associated with the formation of West Kowloon Reclamation, and preliminary works associated with the Central-Wanchai Reclamation.

Dissolved oxygen (DO) concentrations at Stations 7 and 8 in the more open waters of the Harbour varied between approximately 83% saturation near the surface to approximately 80% near the sea bed. At Station 9 near the seawall and outfalls, the DO varied from 45% at the surface to 77% near the sea bed. Having the DO increase with depth is unusual but probably consistent with the polluted buoyant seawall discharges near this Station which would depress the DO in the surface waters - the variation in DO over the depth was also consistent with the salinity stratification at this station.

Within the basin, at Stations 1 to 6, DO concentrations varied rapidly over the short distances between the stations from a minimum of approximately 45% at the surface to 90% near the sea bed with localised variability between the Stations. It should be noted that the range of DO concentrations observed near the surface lie within the range of values found at Station 9 near the outfall but the higher bottom concentrations are unexpected. As with the salinity data, localised variations were apparent due to limited mixing within the basin.

E. coli data was available from an earlier survey involving water sampling at the Stations shown in Figure 3.1.1. From the data presented in Table 3.1.1, it can be seen that over most of the open water area sampled (Stations 7-11), *E. coli* concentrations were in the range $1.5x10^3$/100ml to $2.9x10^3$/100ml approximately. These concentrations are typical of those found in Victoria Harbour. Exceptions were at Station 9 where concentrations increased to $1.7x10^4$/100ml and at Station 7 where concentrations were only $2.7x10^2$/100ml.

Table 3.1.1 Results of *E.coli* Analysis

Station	*E.coli* count c.f.u/100ml
1	$3.9x10^2$
2	$4.1x10^2$
3	$1.9x10^2$
4	$3.3x10^2$
5	$3.4x10^2$
6	$4.9x10^2$
7	$2.7x10^2$
8	$2.8x10^3$
9	$1.7x10^4$
10	$1.5x10^3$
11	$2.9x10^3$

In Tamar basin, however, all the *E. coli* concentrations were uniformly lower lying in the range $1.9x10^2$/100ml to $4.9x10^2$/100ml. It is possible that the limited exchange between the basin and the Harbour and the mortality rate of the *E. coli* resulted in the lower concentrations found there.

3.2 Post Reclamation Conditions

The reclamation of the Tamar basin itself would have no measurable impact on tidal discharges through Victoria Harbour or on the magnitude of water movements in its vicinity. The existing seawall extends into the main flow (rather than being parallel to the neighbouring shoreline) and the additional reclamation to the West of the basin should not create any additional obstruction to the flow. Overall, therefore, the reclamation should have little impact on the large scale tidal flows or local water movements except perhaps in the area of the small embayment formed at the western extent of the reclamation where outfall J1 discharges.

The relocation of culvert J2 (Figure 2.3) at the new seawall should, in itself, have little impact on neighbouring water quality as noted in section 2.4.1. It is noted that the discharge from J2 (0.3-0.4 m^3/s) would increase by approximately 14% in the 1 in 200 year storm with additional pollutants associated with road runoff.

The predicted sewage flows for the Tamar development are 0.147 m^3/s for Stage 1 and 0.373 m^3/s for Stage II. These increases in discharge should be compared with the 1990 discharge from the screening plant of 0.313 m^3/s. Stage I would therefore increase the 1990 discharge by 47% while the total flow following Stage II would be 220% of the 1990 discharge. These increases are significant and there will be an impact on local water quality in the vicinity of the outfall. Compared to the total pollutant load into the harbour, however, the increase in the load from the Wanchai screening plant (for example, of the order of 5 tonnes BOD/day) is relatively small and large scale impacts of the development on water quality would be difficult to identify.

3.3 Construction Impacts

The construction of the seawall will involve dredging up to 101,000 m^3 of soft marine mud. The upper layers of mud have been found to be contaminated and it will be important to use appropriate dredging techniques, reinforced by contract specifications to minimise losses of sediment to the water column. It is proposed that grab dredgers will be used in order to minimise losses, and because of the reduced constraints on manoeuvrability of the smaller vessels in relation to trailer dredgers in this confined area. Based on a typical 6 m grab dredger, a work rate of between 12,000 and 30,000 m^3/week will be possible. On the basis of previous investigations near field loss of 1.0 to 3.0% are representative for this type of dredger.

From the hydraulic model studies carried out for the Central Reclamation, it was found that, during the main tidal flows, the simulated thermal plumes extended approximately 150 m offshore and that, over the tidal cycle, nearshore water speeds in the area affected would lie between 0 m/s and 0.2 m/s on neap tides. On spring tides, in the nearshore region, water speeds would be marginally larger than on neap tides. However, water speeds should be sufficiently low to allow the sediment to settle to the sea bed more or less throughout the tidal cycle. A typical lower limit for the settling velocity for low suspended sediment concentrations previously used in siltation studies in Hong Kong waters is 1 mm/s. Assuming the worst case where all sediment losses occur at the water surface and that nearshore water depths are of the order of 10 m, the bulk of the sediment losses would take approximately 3 hours to settle to the sea bed. In this time, assuming the tidal water speeds vary sinusoidally with a peak speed of 0.2 m/s on both east and west flowing tides, the sediment lost to suspension would resettle over an area estimated to be 4.0 km long. In practise, because the greatest proportion of sediment lost to suspension enters the water column close to the bed, localised resettlement will occur.

A reduced proportion of fine particulates lost during dredging will contribute to a limited visual impact in the vicinity of the site. Over a complete tidal cycle, assuming peak tidal speeds of 0.2 m/s, on the basis of theoretical calculations, particles may be transported up to 1 km east and west of the dredging site. Taking account of dispersion, it is estimated that any visible plume will occur only within the immediate vicinity of the dredging site, since material passing into suspension will remain largely within the lower layers. Without more detailed data it is not possible to refine the estimate of the extent of the visible sediment plume, particularly in view of the extensive existing discolouration associated with dredging and filling operations at West Kowloon Reclamation.

Sustained high suspended solids concentrations can impact on cooling water intakes by interference with pumping mechanisms. Previous reports by operators of cooling water intakes in Victoria Harbour have indicated an upper tolerance limit to pump specifications of 180mg/L suspended solids concentration. This is a theoretical value and it should be emphasised that there are no records of sustained SS values of this magnitude associated with construction activities occurring in Victoria Harbour. Very high suspended solids concentrations have been recorded during the ENPO programme in West Kowloon, but these have always been recorded in the immediate vicinity (10-50m) of working trailer dredgers or in the course of filling operations and have been of limited duration. Based on previous simulations of sediment plumes generated by dredging activities, the increase in suspended sediment concentrations would be expected to be less than 0.01 kg/m^3 and may be as low as 0.002 Kg m^3 within a few hundred meters of the dredging site - depending on tidal currents and time during the tide. Natural background suspended solid concentrations in Victoria Harbour are expected to lie in the range 0.01 kg/m^3 to 0.04 kg/m^3 most of the time and the field data set collected for this study lay at the lower end of this range. The impact of dredging, therefore, except in the immediate vicinity of the dredging site, would not generate suspended solids levels that exceeded the threshold or that fell outside the natural variability in concentration found in this area. As a result, and in view of the relatively short period during which dredging will be carried out, there is very limited evidence to suggest that the increase in suspended solids created by dredging would have a significant impact on any sensitive receivers.

A feature of the Brief for the present Study is the requirement to assess the potential increase in BOD, reduction in DO, and potential release of other pollutants to the water column in the course of dredging and disposal activities. It should be noted that the following estimates are based exclusively on a number of theoretical assumptions, including the physico-chemical characteristics of the material, the dispersive capacity and exchange rate of the water body, and the area over which suspended sediments are distributed. No previous physical monitoring of dredging activities in Hong Kong has demonstrated significant reductions in DO attributable exclusively to dredging activity.

If we assume a COD:BOD ratio of 2:1 then given a mean COD for sediments in Victoria Harbour of 14,200 we may assume a BOD of 7,100 mg/Kg. At a mean % fines of 54% for the area the potential loss of suspended solids to the water column may fall within the range of 0.5%-1.5%. For present purposes it is constructive to adopt the upper figure to obtain a worst case value. To determine the effect of BOD on DO levels we must also make assumptions regarding the volume through which the sediments disperse. For present purposes it is taken that a worst case scenario would represent a volume of approximately 376,991 m^3 based on the assumptions that there will be minimal dispersion, with the sediment plume confined to a cone of 200 m radius and 9 m depth. Adopting a simple mass balance approach as expressed in the relationship:

$r_R = [K_r(C_s - C) V] / 1000$

where r_R = reaeration rate (Kg O_2 day^{-1})
K_r = rate constant
C_s = DO concentration at saturation (assumed 7.4 mgl^{-1})
C = Steady state Dissolved Oxygen concentration (mgl^{-1})
V = Volume of the system in m^3 (376,991)

A value for K_r of 0.3 is derived from previous WAHMO studies, and a depth averaged DO % saturation of 60% (4.44 $mg.l^{-1}$) is based on EPD monitoring data from Victoria Harbour. Because it is assumed that the current reaeration rate is sufficient to meet the demand of the existing BOD loading, in turn resulting in the observed DO concentration, then substitution of the steady state oxygen concentration in the equation produces a figure for the reaeration rate of the volume of water affected by the plume. For the present case, the above equation results in a reaeration rate of 335 Kg O_2 day^{-1}.

In order to determine the future DO concentration under the projected scenario it is assumed that the additional BOD generated by resuspended sediments must be accommodated by the present reaeration rate. The projected DO change attributable to suspended materials may be determined from the expression:

$$C = C_s - [(1000 \times \{ r_R + BOD\}) / (K_r \times V)]$$

The BOD has been estimated as follows. The total mass of sediment to be removed is approximately 54,000 tonnes. Assuming 100 days of dredging gives a daily removal of 540 tonnes of sediment. Assuming a 3% loss of sediment mass into the water column yields a figure of 16.2 tonnes per day. BOD of the sediment is 7.1 kg per tonne (7,100 mg/kg) therefore the daily BOD load will be 115.02 kg O_2. Substituting in the above equation gives a new steady state for dissolved oxygen of 3.42 mg/l. This represents a decrease in dissolved oxygen due to the BOD demand of suspended sediment of 1.02 mg/l. As this is considered a worst case reduction affecting a limited volume of water, the real impact on dissolved oxygen from dredging activities is not expected to be a key issue. This view is supported by physical monitoring data recorded by the Consultants in a number of the Territories' dredging sites, which seldom demonstrate observable changes in dissolved oxygen associated with dredging-related sediment suspension. However, with proper control on dredging methods, e.g. closed grab dredging, a maximum dredging rate of 540 tonnes per day and an adequate monitoring programme as stated in the 'Environmental Monitoring & Audit Report (the Target, Action and Trigger (TAT) levels of which would provide advance warning before water quality deteriorated too much), the water quality impact is expected to be within an acceptable level. Should the TAT levels be exceeded, temporary cessation of dredging would be considered.

The potential release of other pollutants to the water column is not an issue that has been addressed quantitatively in the field. Although the primary concern would relate to trace metals in the surface sediments, under the prevailing reducing conditions at the sediment interface these trace contaminants are firmly immobilised and bound to the particulate phase. Factors that might influence the mobilisation of particulate bound contaminants include changes in the conditions that regulate pH, Eh, Salinity and temperature, although such changes would need to occur within a very specific range. For example, the most significant remobilisation of particulate bound Cd occurs only in the very low range of salinities 0-5mg/l^{1}. Corresponding changes in magnitude occuring at a higher range eg. 25-30mg/l^{-1} do not generate observable increases in contaminants entering the liquid phase. There is limited evidence of significant losses to the liquid phase of any commonly occuring trace metals under Hong Kong conditions.

Similarly in the case of nutrient losses associated with dredging activity and/or sediment resuspension, there are no known viable mechanisms for determining such losses under field conditions that would permit confidence limits to be attached to the conclusions. It is the view of the Study team that the dilution factors associated with the current velocities in the Study area would result in no observable increase in nutrient concentrations in the water column.

Water quality in the study area will be affected by reclamation and similar activities and impacts from Central Reclamation Phase I, Wanchai Reclamation Phase I, Western Harbour Crossing and possibly Central Reclamation Phase III. Dredging works for Central Reclamation Phase I are due to be completed by the end of 1994 and a considerable proportion of the 1,000,000 m^3 of marine sediment to be removed has already been dredged. Similarly, advanced dredging works are already underway at Wanchai Reclamation Phase I and the projected total of 500,000 m^3 of marine sediment is planned to be removed by autumn 1994. The Western Harbour Crossing requires 1,200,000 m^3 of marine sediment to be dredged and this is also currently underway. Central Reclamation Phase II is due to commence in August 1994 and a large proportion of dredging works relating to the other works will be completed by that time. Also, the volume of marine sediment to be removed from Central Reclamation Phase II is small by comparison (101,000 m^3), and should be of relatively short duration (approximately 3 months). Monitoring of suspended sediments and dissolved oxygen at the other dredging sites has demonstrated that these parameters have remained within acceptable limits. It is therefore concluded that the additional contribution to cumulative impacts arising from Central Reclamation Phase II dredging works should not result in exceedance of acceptable water quality criteria.

Marine fill is to be used for Central Reclamation Phase I (3,000,000 m^3) and Wanchai Reclamation Phase I (2,000,000 m^3) as well as Central Reclamation Phase II (750,000 m^3). Water quality impacts arising from the fill procedures can be minimised by pumping the fill material to the landward side of the site and maximising the distance over which the pumped material runs over the newly reclaimed land, allowing the particulate material to settle out. Central Reclamation Phase II constitutes 13% of the total fill for these three projects and its contribution to cumulative water quality impact due to reclamation activities should not exceed 13%.

Water quality modelling has been performed for much of the Central and Wanchai waterfront but cumulative impact of the developments has not been investigated using fine grid modelling. Following the implementation of Central, Western and Wanchai West Sewerage Master Plan, and Strategic Sewage Disposal Scheme (Stage III) around year 2000, it is expected that adequate sewerage and drainage systems will be built in the development area. Discharges of effluents, and illegal wastewater through stormwater drains to Victoria Harbour, will be eliminated. Sewage generated from the area will be collected and eventually discharged at an oceanic outfall. Thus ultimately, water quality in the harbour should improve. Of long term importance will be the location of cooling water intakes and outlets together with stormwater outfalls.

3.4 Control and Mitigation

Specific dredging methods and operational restrictions are contained within the contract conditions although short term increases in suspended solids are anticipated. It is unlikely that the dredging will have a significant impact on the cooling water intakes in the area. The performance specification states that it is the responsibility of the Contractor to keep turbidity within defined limits, and this will be regulated by the compliance monitoring programme.

3.5 Monitoring and Audit

The proposed monitoring locations are indicated on Figure 3.13. Sample specification clauses to assist in the regulation of operational practises during construction are detailed in Appendix 2.0. Monitoring and Audit guidelines are presented in Volume 2 of the present Report, and specify baseline and compliance monitoring requirements. The proposed monitoring programme for the baseline and compliance monitoring requirement will be included in the Environmental Monitoring and Audit Manual.

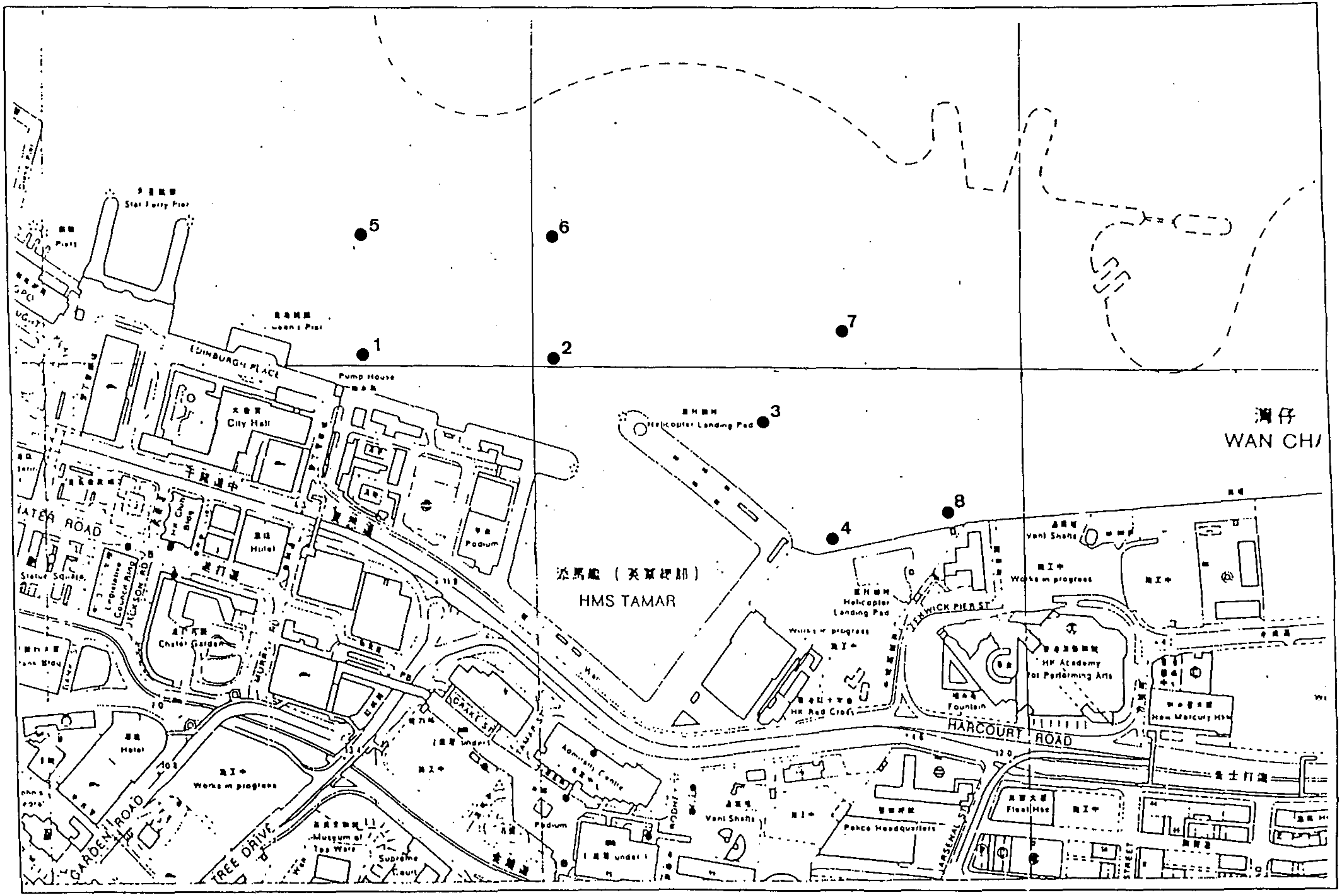


Figure 3.13 Locations of Water Quality Monitoring Stations

4 WASTE ARISING

4.1 Marine Mud

4.1.1 General

Prior to the reclamation of the proposed area it was recognised that some areas would require dredging of marine sediments. This section outlines those procedures undertaken to establish the contamination status of such material in order that disposal methods could be recommended.

4.1.2 Statutory Requirements and Guidelines

The procedures to be adopted in the dredging and disposal of marine sediments are detailed in Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud. The Circular outlines the steps that must be followed when applying for licensed disposal of dredged marine materials at sea. The criteria for the classification of sediments on the basis of their contamination status are contained in the EPD Technical Circular (TC) No 1-1-92, Classification of Dredged Sediments for Marine Disposal.

The methods adopted and procedures undertaken for the purpose of assessing the contamination status of sediments in and around Tamar Basin, have been based on the above Guidelines/Technical Circulars.

4.1.3 Methodology

A total of nine locations were chosen within Tamar Basin for assessing the Marine Sediment Quality in the area (Figure 4.1). These locations and corresponding sampling proposals were approved by DEP on 26.5.92. In accordance with standard procedures the vibrocore sub-samples were taken at the seabed, 0.9m down, 1.9m down, and 2.9m.

Chemical analysis of samples was undertaken in accordance with the methods outlined in WBTC 22/92, and were based on acid digestion followed by flame atomic absorption spectrophotometry for the priority trace metals; in the case of Hg the cold vapour generation method was adopted.

Results were subsequently categorised in accordance with the criteria in EPD Technical Circular 1-1-92 into Classes A, B or C according to the trace metal concentration. The criteria are presented in Table 4.1.1.

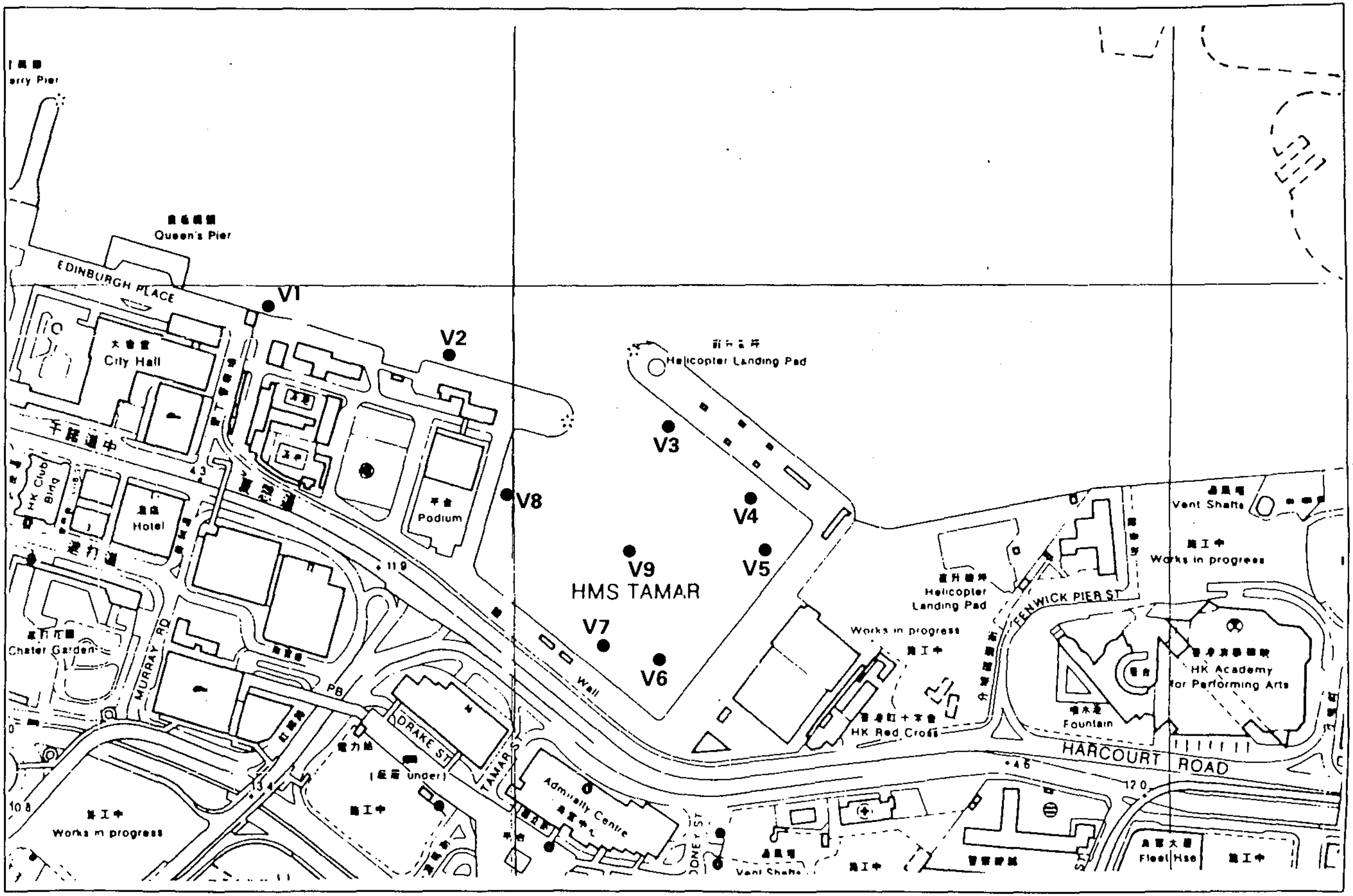


Figure 4.1 Location of Vibrocore Stations

Table 4.1.1 Classification of Sediments by Metal Content (mg/kg dry weight) in Hong Kong

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Background	0.05	7	7	0.07	10	19	40
Class A	0.40	25	20	0.20	20	35	75
Class B	1.00	50	55	0.80	35	65	150
Class C	1.50	80	65	1.00	40	75	100
Source : EPD Technical Circular 1-1-92							

These three classes are categorised as follows :

Class A Uncontaminated or mildly contaminated material for which no special dredging, transport or disposal methods are required except those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives, or for protection of sensitive receptors near the dredging or disposal areas.

Class B Moderately contaminated material which requires special care during dredging and transport, and which must be disposed of in a manner which ensures effective isolation and minimum loss of pollutants either by loss into solution or by resuspension.

Class C Highly contaminated material which must be dredged and transported with great care and which must be permanently isolated from the environment, and which should not be dumped in the Gazetted marine disposal grounds. Environmentally acceptable disposal methods and areas will be advised by EPD on a case by case basis.

4.1.4 Results

The results of trace metal analysis are shown in Table 4.1.2. These indicate significant levels of most metals particularly Copper and Zinc with Cu levels of up to 489 mg/kg in some upper layers. There is evidence of some localised contamination with particularly high levels of Lead, Zinc and Mercury in the lower sediment layers of Station V8. Although localised these very high levels are unrepresentative of the area and are at a concentration that exceeds values commonly recorded in Hong Kong. The results are not particularly surprising in view of the location of the reclamation site. Inshore sediments, particularly in the vicinity of marine outfalls throughout Victoria Harbour show high trace metal loadings. The activities at Tamar, in particular, ship painting and vessel maintenance, are significant potential sources of trace metals. The concentrations of metals released by these activities in conjunction with the absence of any flows to aid dispersion of contaminants, is expected to lead to the conditions identified at Tamar basin.

Table 4.1.2 Results of the Marine Mud Analysis for Tamar Basin

Sample Identification			Cadmium content mg/kg	Copper content mg/kg	Chromium content mg/kg	Lead content mg/kg	Nickel content mg/kg	Zinc content mg/kg	Mercury content mg/kg
Hole No.	Type	Depth							
V1	Bulk	0.0-0.1	1.1	438	70	89	23	270	0.76
V1	Bulk	0.9-1.0	0.87	269	68	91	22	289	0.71
V1	Bulk	1.9-2.0	0.51	173	70	102	22	238	0.75
V1	Bulk	2.9-3.0	0.65	119	62	122	20	284	0.94
V2	Bulk	0.0-0.1	0.87	402	69	84	22	237	0.60
V2	Bulk	0.9-1.0	1.3	422	73	185	24	402	1.1
V2	Bulk	1.9-2.0	0.12	20	10	24	3.2	35	0.08
V2	Bulk	2.9-3.0	<0.05	1.5	2.5	18	0.4	12	0.02
V3	Bulk	0.0-0.1	1.1	416	70	82	25	247	0.52
V3	Bulk	0.9-1.0	0.78	229	67	158	20	297	1.0
V3	Bulk	1.9-2.0	0.78	243	75	120	25	290	0.93
V4	Bulk	0.0-0.1	1.1	338	74	96	27	301	0.76
V4	Bulk	0.9-1.0	1.1	416	70	87	24	276	0.88
V5	Bulk	0.0-0.1	1.2	489	72	97	27	290	0.73
V5	Bulk	0.9-1.0	1.0	249	45	716	19	659	4.8
V6	Bulk	0.0-0.1	0.66	293	63	61	23	189	0.35
V6	Bulk	0.9-1.0	0.97	222	45	652	18	668	8.7
V7	Bulk	0.0-0.1	0.88	256	74	136	27	304	0.94
V7	Bulk	0.9-1.0	0.86	157	65	181	22	355	1.5
V7	Bulk	1.5-1.7	<0.05	8.8	2.2	28	1.5	51	0.04
V8	Bulk	0.0-0.1	1.1	488	75	132	26	323	0.79
V8	Bulk	0.9-1.0	0.50	275	59	122	20	405	0.69
V8	Bulk	1.9-2.0	0.73	465	35	148	14	313	3.1
V8	Bulk	2.8-3.0	1.5	302	33	2300	17	1630	39
V9	Bulk	0.0-0.1	0.49	238	56	51	21	165	0.35
V9	Bulk	0.9-1.0	0.36	225	35	80	12	152	0.60
V9	Bulk	1.9-2.0	0.72	228	65	103	20	259	0.73
V9	Bulk	2.9-3.0	0.99	183	56	612	20	723	11

The above results were classified in accordance with the sediment quality criteria (SQC) in Table 4.1.1. The exceedance of only one metal within a sample is required for a sample to be placed in a particular class. The classification of these samples is shown in Table 4.1.3. Almost all samples are of Class C with only several non-contaminated samples from the lower layers of Stations V2 and V7.

4.1.5 Proposed Disposal Routes

It was originally proposed to dredge the entire reclamation area of Tamar prior to construction of the reclamation. However, in view of the widespread distribution of Class C material in Tamar basin and the associated environmental and economic constraints, it is now proposed to restrict dredging of marine sediments to the sea wall area, and to leave remaining material inside the basin *in situ*. The proposed dredging area illustrated in Figure 4.2 will generate approximately 101,000 m^3 of dredged material, of which an estimated 44,000 m^3 will be contaminated Class C material, and 57,000 m^3 will be uncontaminated material. Separate sites will be allocated for the disposal of contaminated and uncontaminated mud, and it is provisionally anticipated that these will be located at East Sha Chau and South Cheung Chau disposal sites respectively.

The Brief for the present Study specifies a requirement for qualitative assessments of off-site operations including borrow areas and mud disposal sites. This presents some difficulties since no borrow area has been allocated to the project at this stage. It is none the less noted that in the event that a borrow area is allocated to the project, DEP will require an EIA to be carried out on the prospective site, or to have been previously completed. In the case of disposal sites, extensive monitoring has been carried out over the past 12 months at both East Sha Chau and South Cheung Chau. In the case of contaminated sediments, the Contained disposal methods adopted at the East Sha Chau site are designed to minimise the potential for mobilisation of particulate bound contaminants. It is understood that in the course of mud disposal operations at East Sha Chau, the appointed contractor will be required to initiate a pit-specific monitoring programme to ensure compliance with the current disposal procedures.

4.2 Construction Waste

4.2.1 General

The formation of this phase of the reclamation will generate solid waste in the form of demolition and general construction wastes. There will be a significant amount of demolition as the buildings to the east of the basin will be removed. This Section reviews current guidelines and policies regarding the disposal of construction wastes, and discusses the disposal options available.

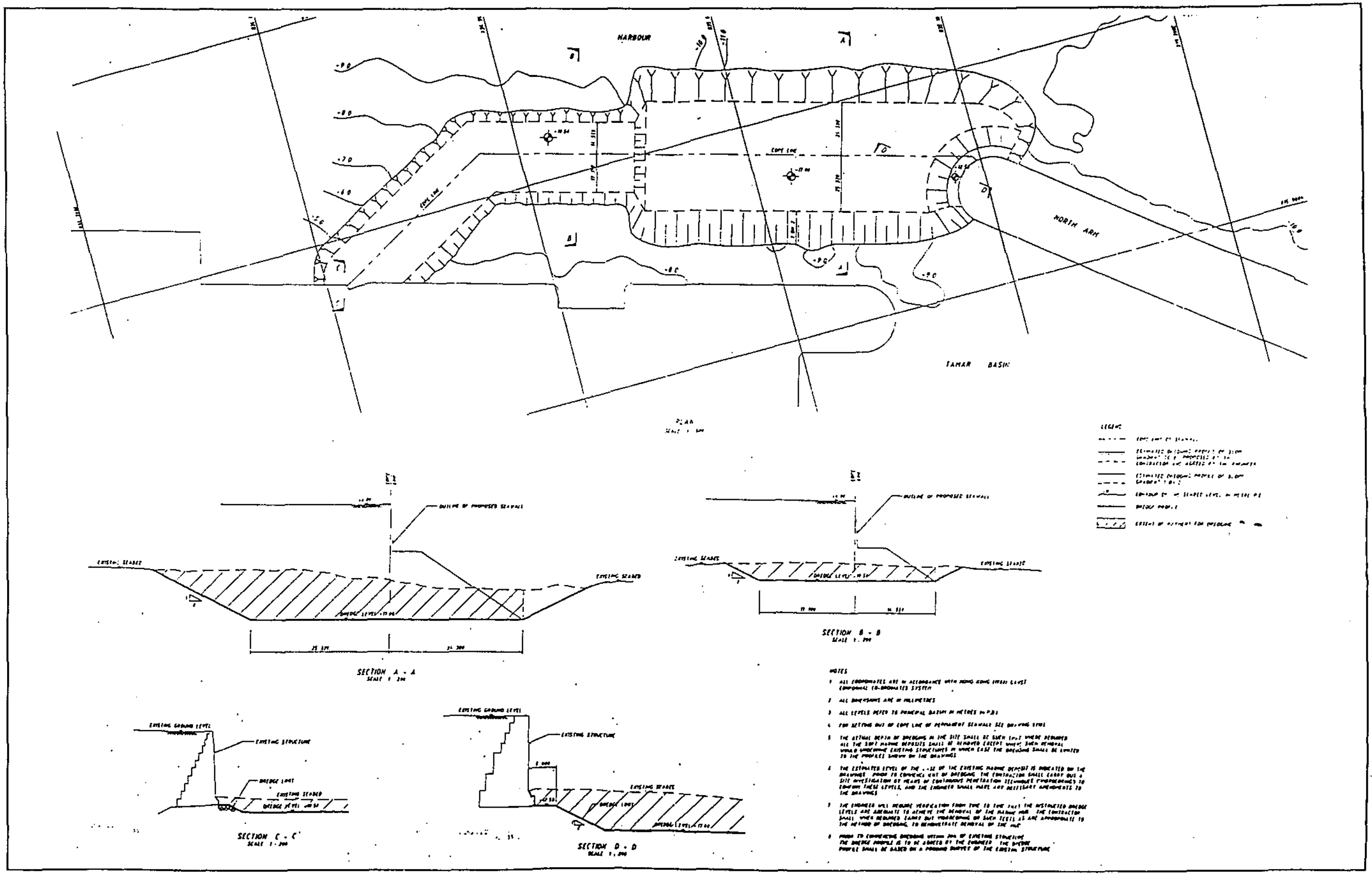


Figure 4.2 Proposed Dredging Plan

4.2.2 Current Legislation

The current policy relating to public dumps and the dumping of waste is documented in the Works Branch Technical Circular No. 2/93, `Public Dumps'. In order to dispose of waste in a public dump, a license is required which is issued by the Civil Engineering Department (CED). The Works Branch Circular states that construction waste suitable for dumping should not be disposed of to landfill, but placed in public dumps on reclamation and land formation projects. The Public Dumping Sub-Committee (PDSC) together with Project Departments are responsible for considering the suitability of a site as a public dump.

In addition to the Works Branch Circular, EPD and CED have produced a leaflet titled `New Disposal Arrangements for Construction Waste' which states that construction waste with less than 20% by volume of inert material will be accepted at landfill. If the material contains more than 20% inert material, the waste must be sorted with suitable material sent to public dump and non-inert waste sent to landfill for final disposal. Consideration is being given to the use of the Tamar Basin as a public dump site.

4.2.3 Disposal Routes

Building demolition wastes typically consist of concrete (20%), reinforced concrete (33%), dirt/soil/mud (12%), rock rubble (12%), ferrous metal (3.5%), and other miscellaneous components. Currently the only recycled material is ferrous scrap, usually in the form of reinforcement bars which has a secondary market in Hong Kong. There are no existing markets, or facilities for separation. If the Tamar Basin is operated as a public dump, most of the waste generated can be disposed of on-site. This would remove the requirement for off-site haulage and capacity at other public dumps.

There will be no crushing or mineral processing on site due to the lack of space for such facilities. Material arriving on site will have to be preprocessed or sorted to a suitable size, ie. less than 250 mm. This may reduce the demand for the public dump, with waste producers preferring to dump at alternative sites where the requirements are less stringent.

If the site is not designated as a public dump, fill material will come from marine based or land-based sources. The latter is more likely as a surplus of material has been identified. Sources include demolition waste, basement excavations etc. If the site is not public dump, it is unlikely that the material generated on site will be used as fill material and off-site haulage will be necessary.

Table 4.1.3 Contamination Status of Marine Mud Samples from Tamar Basin

Sample Identification			Contaminated (Y/N)	Contamination Class
Hole No.	Type	Depth		
V1	BULK	0.0-0.1	Y	C
V1	BULK	0.9-1.0	Y	C
V1	BULK	1.9-2.0	Y	C
V1	BULK	2.9-3.0	Y	C
V2	BULK	0.0-0.1	Y	C
V2	BULK	0.9-1.0	Y	C
V2	BULK	1.9-2.0	N	A
V2	BULK	2.9-3.0	N	A
V3	BULK	0.0-0.1	Y	C
V3	BULK	0.9-1.0	Y	C
V3	BULK	1.9-2.0	Y	C
V4	BULK	0.0-0.1	Y	C
V4	BULK	0.9-1.0	Y	C
V5	BULK	0.0-0.1	Y	C
V5	BULK	0.9-1.0	Y	C
V6	BULK	0.0-0.1	Y	C
V6	BULK	0.9-1.0	Y	C
V7	BULK	0.0-0.1	Y	C
V7	BULK	0.9-1.0	Y	C
V7	BULK	1.5-1.7	N	A
V8	BULK	0.0-0.1	Y	C
V8	BULK	0.9-1.0	Y	C
V8	BULK	1.9-2.0	Y	C
V8	BULK	2.8-3.0	Y	C
V9	BULK	0.0-0.1	Y	C
V9	BULK	0.9-1.0	Y	C
V9	BULK	1.9-2.0	Y	C
V9	BULK	2.9-3.0	Y	C

The potential air quality and noise impacts generated from waste disposal are discussed in Sections 5 and 6. If all or most of the fill material will be brought over land, the major advantage of creating a public dump is that the removal of material created on site would not be necessary. Regarding the waste disposal aspect, the creation of a public dump meets with current policy and enables waste materials to be utilised as a valuable source of fill material rather than requiring disposal as a waste product. If marine fill is utilised, the potential environmental impacts during site formation would be significantly reduced in terms of air quality and noise although site generated waste would require disposal elsewhere.

Utilisation of the Tamar site as a public dump does impose some constraints from an environmental perspective. Central to this is the difficulty of exercising control over the flow of materials into the site. Without strict control the truck operators may purposefully or through lack of understanding attempt to dispose of non-construction waste. This may lead to the disposal of non-suitable putrescible waste into the reclamation and potential problems associated with contaminated leachate and floatable material leaving the site. Floatable material is controlled within the contract clauses which places the responsibility for collecting all floatable material with the Contractor. The intermittent availability of public dump materials/construction waste suggests that the estimated peak flows of up to 1000 vehicles per day, based on 750,000 m^3 fill within 8 month period, would generate handling and quality control problems; current experience at public dumps elsewhere in Hong Kong such as Aldrich Bay suggests however, that throughput volumes may be no more than 500 vehicles per day. Determination of available fill supplies from construction/demolition sites is complex due to the variability in quality and volumes of material available at any one time. It is assumed that Contractor sourcing would permit improved regulation of material flows and quality control. Experience elsewhere suggests that the size grading requirements of materials deteriorates as the volume increases. This in turn presents difficulties to the contractors in meeting their own contractual and programming requirements.

Correspondingly the possible intermittent high volumes of stockpiled materials that may occur if the site is utilised as a public dump, may promote some further deterioration in dust generation. Contractor sourced material, retains the benefits of utilising construction waste through:

- saving limited available waste disposal capacity in the Territory.
- Preserving limited offshore fill resources and the impacts associated with their retrieval.

The Consultants conclude that the use of marine fill still represents the preferred option to land based sources and, in the case of the latter, contractor sourced material is preferable to general public dump access. This is due to the improved opportunity for managing the flows of materials and vehicles entering the site, and for exercising improved quality control over the construction materials utilised. In the event that marine fill was utilised, reduced noise and air quality impacts and reduced traffic congestion would bring positive benefits to the construction programme.

4.3 Contaminated Land

The Consultant (CES) was appointed by Territory Development Department to carry out a preliminary site inspection of the East Tamar Workshop site to check the likelihood of finding contamination and to provide information from which an effective investigation can be designed, if necessary. Since the site has been used for vessel building and repair, fuel refilling and hazardous substances storage for more than 70 years, it is possible that the land is contaminated. Potential contaminants include fuel oil, lubrication oil, paints, resins and solvent from ship repair and maintenance. The site visit was conducted on May 26, 1994 by CES. The eastside of the site was walked over, potentially contaminated areas were noted and personnel familiar with the operations of the site were interviewed.

The site is situated adjacent to the Tamar basin in Victoria harbour. Most of the site surface in the open space is paved with a concrete layer which appears relatively well maintained and free from apparent contamination. There are two main workshops at the site. According to the workshop manager, one of the two workshops was constructed in 1984 and the other has been there for more than sixty years. Processes carried out in the two workshops are similar, and generally comprised: woodworking and metalworking for vessel parts and paint and coating application and removal. Hazardous materials used or produced include petroleum hydrocarbons, cleaning solvents, thinners, resins, battery acid, paints, hydrogen peroxide, mercury and finely divided metal wastes. The Consultant was told that asbestos had not been used deliberately, although sources such as the removal of insulation parts from vessels or building materials may contain asbestos. EMSD confirmed that all the asbestos used for wire cable insulation at the site had been removed. Appendix 4 contains the questionnaire reply from the site safety officer. The new workshop appears relatively well maintained but potential ground contamination is likely to exist for the old workshop judging by its appearance. Next to the main workshops, there is a GRP plant used for fibreglass hull manufacturing using a GRP resin mixing process.

Besides the workshop, there is a hazardous material storage area which was used for storing various forms of substances in separate rooms including acetylene, radioactive materials and B.F.M (fire extinguisher). Most of the hazardous substances have been removed. No evidence of significant contamination could be detected. Some of the materials were said to be used directly in the workshops while others were used by the Radio and Weapon Division of the British Force. Figure 4.3 presents a conceptual site plan for reference as no formal site plan has been made available.

Waste disposal practice used at the site was such that hazardous substances were temporarily stored in a chemical waste storage tank opposite to the old workshop, to be eventually removed by a licensed chemical waste collector (Enviropace). According to the workshop manager, it is possible that some spillage/leakage and deliberate discharge of such waste into the drains inside the workshop has historically taken place, causing potential land contamination.

As almost all of the hazardous substances and machinery have been removed, no evidence has been found for any significant safety chemical hazard associated with above-ground decommissioning, provided that normal safety measures are adopted by the contractor and removal of any remaining hazardous substances is handled by a licensed party. Similarly, the underground oil storage tanks at the refilling station should be emptied and the oil disposed of appropriately.

Based on the visual appearance of the old workshop and the nature of the activities/materials historically used at the site, it is the opinion of the Consultant that some potential land contamination exists. In view of this land history and proposed sensitive land use, EPD require the project proponent to undertake a contamination assessment in the form of sub-surface sampling and analysis of soil and groundwater to determine the degree and extent of the possible contamination and to carry out any necessary site remediation contingent to the findings of the assessment before commencement of any construction works for the site.

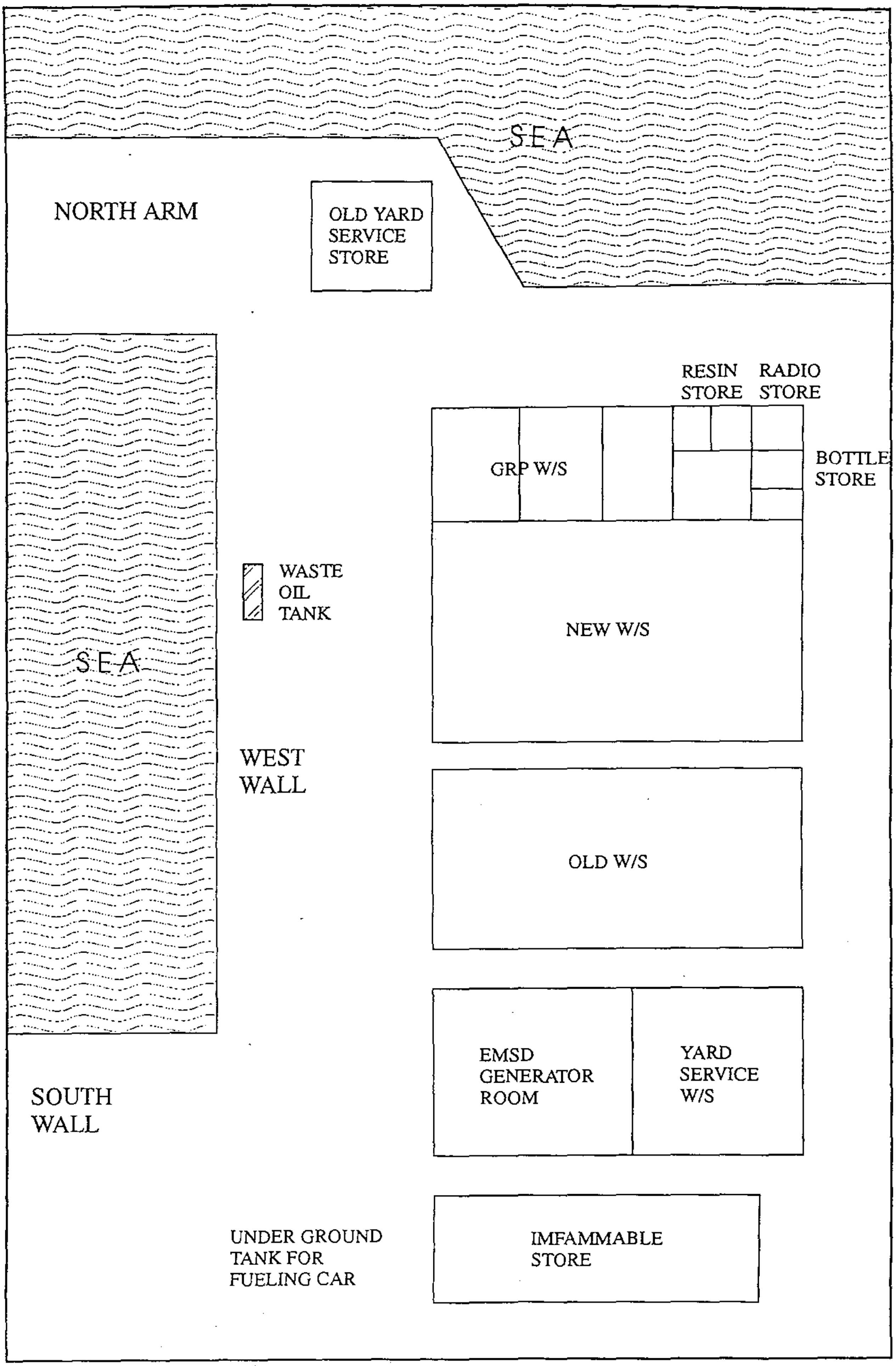


Figure 4.3 **Conceptual Site Plan of East Tamar**

5 AIR QUALITY

5.1 Legislation and Guideline Controls

The Air Pollution Control Ordinance (APCO) provides powers for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites. It encompasses a number of Air Quality Objectives (AQO) which stipulate concentrations for a range of pollutants. Those that are relevant to this study are listed in Table 5.1.1.

Table 5.1.1 Hong Kong Air Quality Objectives

Air Pollutant	Concentration in microgram per cubic metre			
	Averaging Time			
	1-Hour*	8-Hour	24-Hour**	Annual
CO	30000	10000		
NO_2	300		150	80
TSP	500+		260	80
RSP	346#		180	55

* Not to be exceeded more than once per year.

** Not to be exceeded more than three times per year.

\+ In addition to the above established legislative controls, it is generally accepted that an hourly average total suspended particulate (TSP) concentration of 500 μgm^{-3} should not be exceeded. Such a control limit is particularly relevant to construction work and has been imposed on a number of construction projects in Hong Kong in the form of contract clauses.

\# No specific 1-hour average criterion or guideline exists for respirable suspended particulate (RSP). However, a previous study adopted 346 μgm^{-3} as a criterion, based on the 500 μgm^{-3} guideline for TSP multiplied by the ratio of the RSP/TSP 24-hour AQOs.

5.2 Existing Environment

Estimation of background pollutant levels for the area in the future is not possible. However, an indication of the existing conditions is available from the monitoring programme undertaken by EPD. The closest Air Quality Monitoring Station is located in Central/Western district. Results for 1991 show that there were no exceedances of the annual average pollutant concentrations for NO_2 and TSP but exceedance of RSP. There were no exceedances of the 24-hour average AQOs.

5.3 Sensitive Receivers

The representative air quality sensitive receivers adopted for the purposes of assessment are the same for both construction and operational phases. Twenty two receivers were identified, these are the existing buildings located around the site and inside the Prince of Wales Barracks. These are shown in Figure 5.1 (and listed in Table 5.4.2). The height used for the analysis was based on the ground floor level for buildings with the exception that several above-ground receivers were located in the residential floors of the buildings within the Prince of Wales Barracks. As the reclamation is flat, this would represent a worst-case situation.

5.4 Construction Phase

5.4.1 Assessment Methodology

The major potential air quality impact during the construction phase will result from dust arising from the formation of the reclamation and other construction work. Vehicle and plant exhaust emissions from the site are not considered to constitute a significant source of air pollutants. For the formation of the reclamation, marine or land based fill material will be used. There will be three possible sources of fill material:

a) marine sand; or

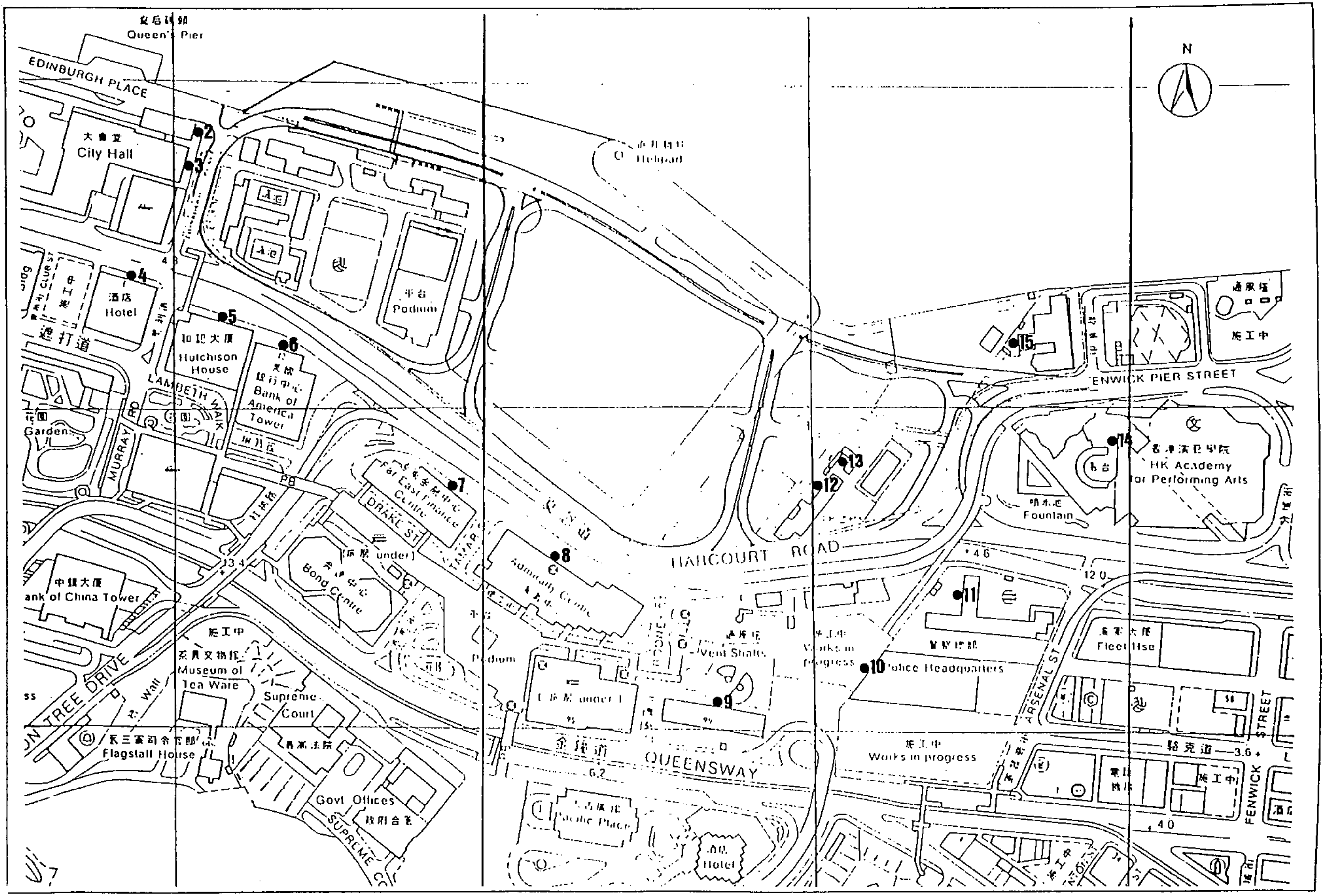
b) contractor sourced material; or

c) public dump material.

One function of this assessment is to determine the difference between the impacts from the different fill options. However, as option b) and c) will involve land sourced material with similar characteristics, as opposed to marine based fill material, the differences will be limited regarding the emission of fill material. Besides, there will be no on-site size reduction for public dump material due to site size constraints. Hence, for the purposes of the air quality assessment, these two working methods will generate similar air quality impacts. Central differences between option b) and c) rest on the frequency and distribution of vehicles entering the site, and the possible variation in volumes of stockpiled materials. These aspects were discussed in greater detail in Section 4.2.3.

The major dust producing activities will be:

- site preparation;
- demolition of existing buildings and removal of top portion of existing seawalls;



● Air Sensitive Receivers

Figure 5.1 Air Quality Sensitive Receivers

- excavations, particularly those associated with construction of foundations;
- wind erosion of stockpiled materials and working areas;
- vehicle/plant movements on unpaved roads and over the site; and
- material transfer from trucks.

A number of assumptions were made in order to undertake the analysis. The Basin will require approximately 1 million cubic metres of fill over a period of 18 months. For the land-based fill material option, based on 450 working days of 12 hours, an average of nearly 50 trucks per hour will be entering the site was estimated. Trucks were assumed to travel at 20 $kmhr^{-1}$ in the site area. The silt content for both marine and land based fill materials was assumed to be 5%. Moisture content is difficult to estimate and a conservative estimate of 0.5% was used.

Basic dust emissions were estimated using USEPA Compilation of Air Pollutant Emission Factors (AP-42). The ISCST dispersion model was used for the modelling of dust emissions from the site. The modelling assumed that the whole area would be worked simultaneously with maximum dust emission rates from each part of the site during the whole construction phase. It was assumed that 60% of the site would be reclamation and 40% would have general construction. Worst-case meteorological conditions (Pasquill stability class D and mixing height 500 m) were adopted for the calculation of 1-hour average TSP concentrations at the sensitive receivers. For erosion of open sites, dust emission becomes significant at higher wind speed (in accordance with AP-42, greater than or equal to 5.4 ms^{-1}). Dispersion modelling was undertaken for both wind speeds of 2.0 ms^{-1} and 5.4 ms^{-1}. The predicted dust emissions from the construction and reclamation activities for both marine and land based fill material options are shown in Table 5.4.1.

No specific assessment was undertaken to calculate RSP concentrations. Previous studies indicate that the maximum RSP generation is approximately 50% of the TSP.

Table 5.4.1 Predicted Dust Emissions for Reclamation and Construction Activities

Activity	Dust (TSP) level ($kgday^{-1}$)			
	Land based fill material		Marine based fill material	
	Wind speed		Wind speed	
	2.0 ms^{-1}	5.4 ms^{-1}	2.0 ms^{-1}	5.4 ms^{-1}
Truck movement to dump area on unpaved road	502.1	502.1	0	0
Tipping fill material	62.0	167.3	0	0
Truck movement off dump area on unpaved road	406.9	406.9	0	0
Erosion of open site area	0	304.9	0	145.3
General construction operations	248.5	248.5	463.8	463.8
Total	1219.5	1629.7	463.8	609.1

5.4.2 Impacts on Sensitive Receivers

For marine and land based fill material options, Table 5.4.2 shows the worst-case 1-hour average TSP concentrations at the sensitive receivers for wind speed 2.0 ms^{-1} and 5.4 ms^{-1}. As can be seen, there will be severe impact at most of the sensitive receivers for both low and high wind speed. With no mitigation, the predicted TSP concentrations may exceed the acceptable limit of 500 μgm^{-3} especially for land based fill material option.

Table 5.4.2 Worst-case 1-hour Average TSP Concentration at Sensitive Receivers, Without Dust Suppression Measures

Receiver	Location	TSP (μgm^{-3})			
		Land based fill material		Marine based fill material	
		Wind speed		Wind speed	
		2.0 ms^{-1}	5.4 ms^{-1}	2.0 ms^{-1}	5.4 ms^{-1}
ASR 1A	The Prince of Wales Building, G/F	2488*	1154*	885*	336
ASR 1B	The Prince of Wales Building, 2/F	2307*	1070*	814*	310
ASR 1C	The Prince of Wales Building, 16/F	370	163	111	55
ASR 1D	The Prince of Wales Building, 28/F	51	21	33	13
ASR 1E	Amethyst Block, G/F	2230*	1019*	957*	355
ASR 1F	Amethyst Block, 5/F	1699*	778*	643*	240
ASR 1G	Blake Block, G/F	1708*	799*	740*	274
ASR 1H	Blake Block, 4/F	1232*	564*	561*	208
ASR 2	Urban Council Chambers	1750*	784*	958*	355
ASR 3	City Hall	956*	436	480	178
ASR 4	Furama Hotel	866*	393	263	113
ASR 5	Hutchison House	1094*	503*	325	140
ASR 6	Bank of American Tower	1339*	613*	396	172
ASR 7	Far East Finance Centre	1957*	890*	697*	289
ASR 8	Admiralty Centre	2035*	935*	797*	305
ASR 9	New Rodney Building	1427*	652*	484	199
ASR 10	May House	1357*	607*	523*	220
ASR 11	Police Headquarters	1281*	568*	519*	222
ASR 12	Anne Black Building	2379*	1041*	1360*	522*
ASR 13	RSPCA	2895*	1219*	1598*	653*
ASR 14	Hong Kong Academy For Performing Arts	912*	405	361	147
ASR 15	Servicemen's Guides Association	1164*	518*	447	182

* Exceedance of 500 μgm^{-3} guideline 1-hour average concentration

Table 5.4.2 clearly indicates that dust suppression will be required. Taking dust suppression measures into account, Table 5.4.3 shows the effectiveness of practical dust reduction measures. The predicted TSP concentrations for marine and land based fill material options may be reduced by approximately 47% and 69% respectively if dust suppression measures are adopted.

Table 5.4.3 Effectiveness of Dust Suppression Measures

Dust suppression measure	Average dust (TSP) reduction level (%)	
	Land based fill material	Marine based fill material
Speed control of dump trucks in site area (reduce from 20 $kmhr^{-1}$ to 10 $kmhr^{-1}$)	34.2	0
Twice daily watering with complete coverage	45.8	46.8
Spraying the fill material with water before tipping to achieve 1% moisture content	13.5	0
TOTAL CUMULATIVE REDUCTION	69	47

Table 5.4.4 shows the worst-case 1-hour average TSP concentrations at the sensitive receivers for downwind wind speed 2.0 ms^{-1} and 5.4 ms^{-1} with adoption of dust suppression measures. With the dust suppression measures taken into account, the TSP concentration at all receivers will be within the acceptable limit at high wind speed. The TSP concentration may exceed 500 μgm^{-3} at some receivers under low wind speed.

Table 5.4.4 Worst-case 1-hour Average TSP Concentrations at Sensitive Receivers, with Dust Suppression Measures

Receiver	Location	TSP (μgm^{-3})			
		Land based fill material		Marine based fill material	
		Wind speed		Wind speed	
		2.0 ms^{-1}	5.4 ms^{-1}	2.0 ms^{-1}	5.4 ms^{-1}
ASR 1A	The Prince of Wales Building, G/F	656*	335	440	191
ASR 1B	The Prince of Wales Building, 2/F	611*	311	405	177
ASR 1C	The Prince of Wales Building, 16/F	118	54	55	35
ASR 1D	The Prince of Wales Building, 28/F	21	8	16	7
ASR 1E	Amethyst Block, G/F	628*	309	476	187
ASR 1F	Amethyst Block, 5/F	475	234	320	139
ASR 1G	Blake Block, G/F	434	227	368	136
ASR 1H	Blake Block, 4/F	344	170	279	105
ASR 2	Urban Council Chambers	531*	250	477	177
ASR 3	City Hall	272	133	239	89
ASR 4	Furama Hotel	251	121	131	71
ASR 5	Hutchison House	321	154	162	91
ASR 6	Bank of American Tower	388	185	197	111
ASR 7	Far East Finance Centre	562*	273	347	168
ASR 8	Admiralty Centre	560*	279	397	171
ASR 9	New Rodney Building	402	198	241	120
ASR 10	May House	414	195	260	124
ASR 11	Police Headquarters	403	186	258	125
ASR 12	Anne Black Building	809*	359	677*	269
ASR 13	RSPCA	1074*	456	795*	355
ASR 14	Hong Kong Academy For Performing Arts	287	133	180	87
ASR 15	Servicemen's Guides Association	362	168	222	108

* Exceedance of 500 μgm^{-3} guideline 1-hour average concentration

The modelling assumed construction activity over the whole site and all dump trucks for land based fill material were assumed to travel over the whole fill area at the same time, which are conservative predictions. Maximum emission rates over the whole construction phase were assumed which is also conservative. The probability of maximum dust generating activity coinciding with worst-case meteorological conditions is low. The dust levels predicted in Table 5.4.4 should occur only very rarely.

However, background dust levels in the Central/Western area are high according to EPD measurements. Every practical effort should be adopted to ensure minimal additional dust generation from the Tamar Basin.

It should be noted that the marine based fill material option may result in less dust nuisance at all the sensitive receivers as compared with the land based fill material option. For marine based fill material option, modelling indicates that dust concentrations will be below 500 μgm^{-3} at most sensitive receivers. The RSPCA and the Anne Black Building are very close to the site. Adverse dust impacts may arise for both marine and land based fill material options, even with tight controls in place. However, these two receivers are air conditioned buildings and should not be adversely affected by dust nuisance. For land based fill material option, modelling indicates that dust concentrations will be above 500 μgm^{-3} at 8 receivers when at low wind speed. Those receivers may experience adverse dust nuisance even with major dust suppression measures.

RSP concentrations are also likely to be high in the area, particularly in view of the existing high levels monitored in the Central/Western area. The mitigation proposals for TSP will also lead to a corresponding reduction in the RSP generated.

5.4.3 Control and Mitigation Measures

In view of the potential high levels of dust arising from the formation of the reclamation and related construction activities, it will be necessary to adopt control and mitigation measures wherever practical.

The following measures should be adopted where applicable:

- use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads. Up to 50% reduction in dry dust emissions can be achieved by twice daily watering with complete coverage;

- use of frequent watering for particularly dusty static construction areas and areas close to ASR 12, ASR 13 and the Prince of Wales Barracks where construction operations are to take place;

- side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be employed to aggregate fines;

- where possible, prevent placing dusty material storage piles and locating site exit points near ASR 12, ASR 13 and the Prince of Wales Barracks;
- paving of frequently used site roads can reduce emissions by up to 85%. Alternatively geotextiles should be used to form flexible road surfaces;
- tarpaulin covering of all dusty vehicle loads transported to, from and between site locations;
- imposition of speed controls for vehicles on unpaved site roads. 10 $kmhr^{-1}$ is the recommended limit;
- where feasible, routing of vehicles and positioning of construction plant at maximum possible separation distance from sensitive receivers especially ASR 12, ASR 13 and the Prince of Wales Barracks;
- provision of a fixed spray bar system to wet loads prior to dumping on site;
- establishment and use of vehicle wheel and body washing stations at the exit point of the site, combined with cleaning of public roads where necessary; and
- instigation of a control program to monitor the construction process in order to enforce controls and modify methods of work if dusty conditions arise.

Specimen contract clauses for dust minimisation are included in Appendix 2.

5.4.4 Dust Monitoring and Audit

TSP monitoring should be carried out by the Engineer or Contractor throughout the construction period. Two high volume air samplers and associated equipment and shelters should be provided. Location of monitoring stations should be close to site boundary, free from local obstructions or shelters and one of them should be nearest to the Prince of Wales Barracks and the other should nearest to ASR 12 and ASR 13. The exact locations should be reviewed in relation to practical site constraints.

Baseline monitoring should be carried out by the Engineer prior to the commencement of the construction work to determine the ambient dust (TSP) levels at specified monitoring stations. The baseline monitoring should be carried out for a period of at least two weeks with measurements to be taken every 24-hour at each monitoring station.

Impact monitoring during the course of the reclamation and construction should be undertaken at a frequency not lower than one 24-hour measurement per six days at each monitoring station. Should the monitoring results indicate a deteriorating situation, closer monitoring may be undertaken by the Engineer until the monitoring results indicate an improving and acceptable level of air quality.

When it is determined that the recorded dust (TSP) level is significantly greater than the baseline levels, the Engineer may direct the Contractor to take mitigation measures concerning potential dust sources and working procedures.

The levels of RSP as monitored in the Central/Western district during 1991 showed exceedance of the annual average AQO. Therefore it is recommended that RSP is monitored in parallel with TSP.

5.5 Operational Phase

5.5.1 Assessment Methodology

Impacts following development may result from traffic pollutants arising from vehicles on the new road network. There are no proposals for industrial landuse.

The air quality assessment of operational phase impact was undertaken for the traffic flow composition of the two stages:

a) Central Reclamation Phase II only, design year 2001;

b) Full reclamation development, design year 2011.

The CALINE4 dispersion model was used for this study. Pollutants NO_2, CO and RSP were investigated. Vehicle emissions were calculated in accordance with the methodology given in USEPA Compilation of Air Pollutant Emission Factors (AP-42) with the following assumptions:

- By 2001 all light petrol vehicles will be fitted with catalytic converters. Estimated average mileage is 50000 miles. A basic NO_x emission level of 1.02 $gveh^{-1}mile^{-1}$ was used for vehicles fitted with catalytic converters.

- Light diesel vehicles will be on average 7 years old with an average mileage of 50000 miles. 1985+ data were used.

- Heavy diesel vehicles will be on average 10 years old with an average mileage of 200000 miles. 1987-92 and 1997+ figures were used for 2001 and 2011 respectively.

- Only speed correction was applied. No other adjustments were made, e.g. extra load, humidity etc due to lack of available data.

- 20% NO_x to NO_2 conversion was assumed.

In the dispersion modelling, meteorological conditions of wind speed 1 ms^{-1}, Pasquill stability class D, mixing height of 500 m, horizontal wind direction standard deviation of 12 degrees and worst-case wind direction were considered to represent realistic worst-case 1-hour average conditions. Peak hour traffic flow predictions (vehicles per hour) for the two development stages were used (Figure 5.2). Traffic composition of 40% light petrol, 40% light diesel and 20% heavy diesel was adopted, based on data from the Design Memorandum for the reclamation road tunnel. Table 5.5.1 shows emission factors for this traffic composition with an assumed speed of 50 $kmhr^{-1}$.

Table 5.5.1 Vehicle Emission Factors

Year	CO (g veh^{-1} $mile^{-1}$)	NO_x (g veh^{-1} $mile^{-1}$)	RSP (g veh^{-1} $mile^{-1}$)
2001	4.63 [2.88]	2.94 [1.83]	0.77 [0.48]
2011	4.08 [2.54]	2.85 [1.77]	0.77 [0.48]

[ ] Emission in g veh^{-1} km^{-1}

The dispersion modelling also included traffic on Queensway, Queen's Road East, Garden Road, Cotton Tree Drive and Justice Drive in order to provide an indication of likely overall pollutant concentrations (i.e. inclusive of background). Data were obtained from the Central and Wanchai, North South Links Study. Only mobile sources were considered in the analysis, although it is appreciated that there may be a small background contribution from local stationary sources.

5.5.2 Impacts on Sensitive Receivers

Worst-case 1-hour concentrations (inclusive of background concentrations) of CO, NO_2 and RSP at the sensitive receivers for the two stages are shown in Table 5.5.2. All predicted concentrations for CO are compliant with statutory Air Quality Objectives. Modelling indicates that the 1-hour average concentrations for NO_2 and RSP will exceed the AQO of 300 μgm^{-3} and the acceptable limit of 346 μgm^{-3} respectively at ASR 7 and ASR 8 in both development stages. Assuming that the peak hour traffic volume consists of 7% of the daily traffic flow, according to the predicted 1-hour average RSP values and considering that worst case meteorological conditions rarely persisted in a day, exceedance of the RSP 24-hour AQO at ASR 7 and ASR 8 is not expected.

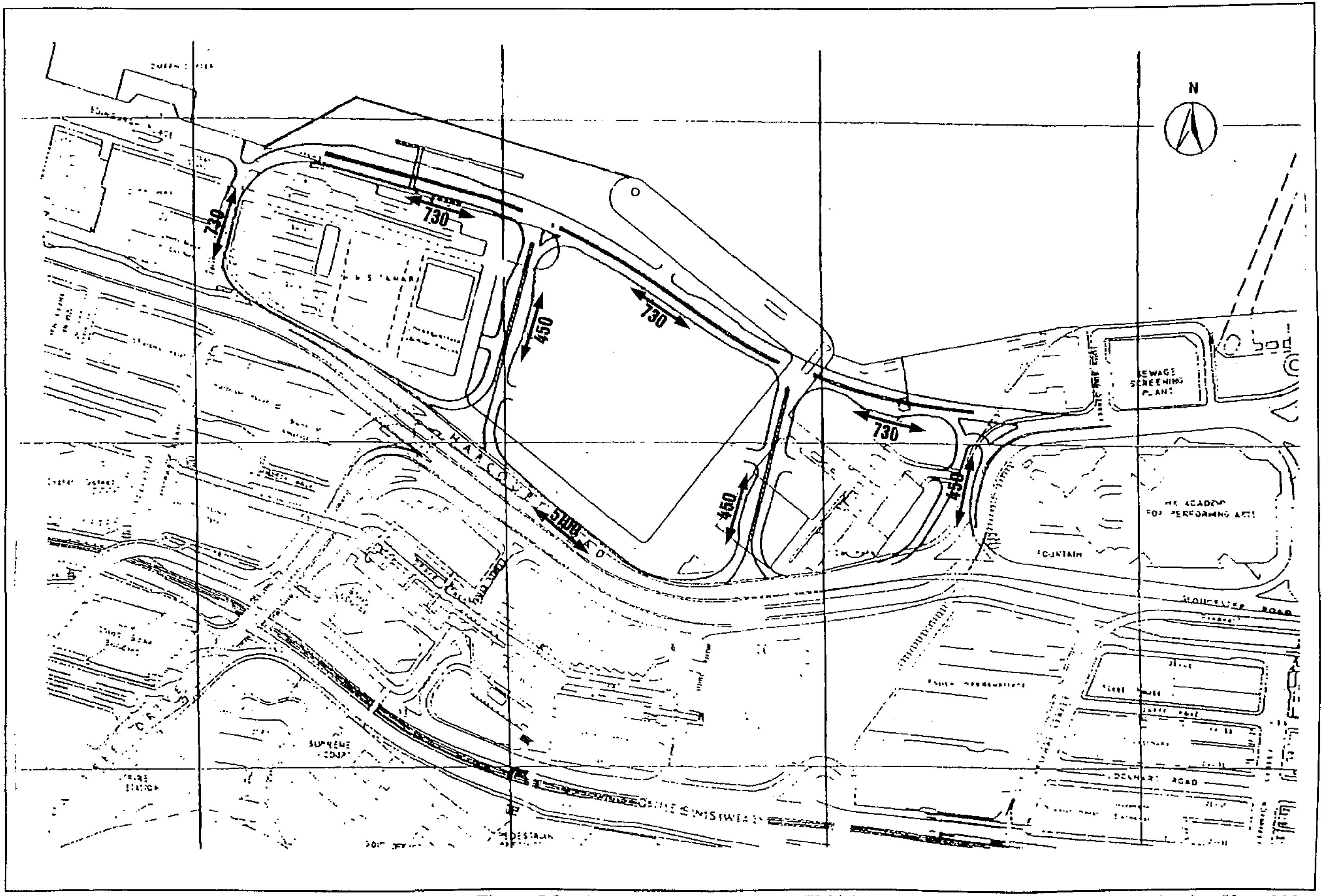


Figure 5.2 Peak Hour Traffic Flows (Vehicles per hour) - Development Stage 1 (Design Year 2001)

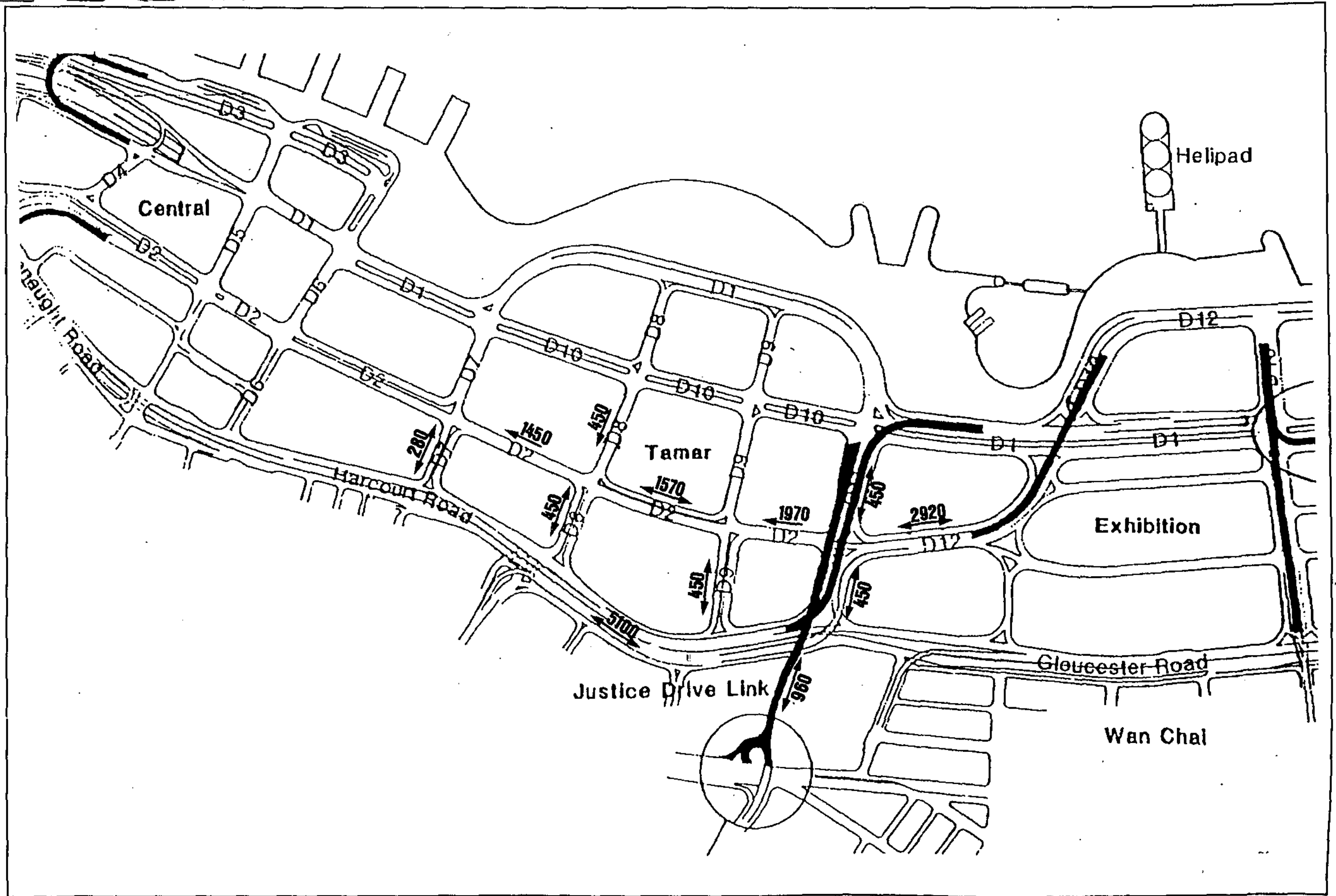


Figure 5.3 Peak Hour Traffic Flows (Vehicles per hour) - Development Stage 2 (Design Year 2011)

Table 5.5.2 Worst-case 1-hour Pollutant Concentrations at Sensitive Receivers (μgm^{-3})

Receiver	2001			2011		
	CO	NO_2	RSP	CO	NO_2	RSP
1A	935	160	156	793	150	150
1B	905	155	150	768	145	145
1C	303	52	50	255	48	48
1D	127	22	21	103	20	20
1E	704	121	117	593	112	112
1F	616	106	102	520	98	98
1G	715	123	119	608	115	115
1H	670	115	111	570	107	108
2	923	158	154	697	132	132
3	1110	190	185	836	158	158
4	1619	278	269	1400	264	264
5	1410	242	234	1212	229	229
6	1386	238	230	1191	225	225
7	2140	367*	356	1851	349*	349
8	2170	372*	361	1871	353*	353
9	1498	257	249	1214	229	229
10	1382	237	230	1206	227	228
11	1450	249	241	1311	247	247
12	1462	251	243	1259	238	238
13	1201	206	200	995	188	188
14	1462	251	243	1259	238	238
15	1212	208	202	997	188	188

* Exceedance of AQOs acceptable 1-hour average level

5.5.3 Control and Mitigation Measures

The 1-hour average concentrations for CO under worst-case conditions are in compliance with the Air Quality Objectives. Modelling indicates that the 1-hour average concentrations for NO_2 will be exceeded at ASR 7 and ASR 8 in both development stages. However, these two receptors are fitted with central air conditioning and the air intakes are installed at podium levels. The NO_2 levels at the height of air intakes will be reduced by approximate 30% and therefore unacceptable air quality impact due to road traffic is not expected.

It should be noted that mitigation for reduction of impacts from traffic air pollutants can only be achieved through control at source, ie. reduction in individual vehicle emissions, reduction in trips through provision of additional public transport facilities, or through traffic management schemes.

5.6 Odour Impact

Odour impact from the associated infrastructural facilities of the development may arise from the pumping station of the sewerage system located immediately north of the existing WSD pumping station. Malodourous gases are normally formed in the wet-well area of pumping stations, principally due to the bacterial reduction of the sulphate ion in wastewater causing hydrogen sulphide odour nuisance. The rate of hydrogen sulphide generation depends on retention time in pipes, sulphate concentration, BOD and the temperature of the wastewater. As seawater flushing is proposed for the development, the sulphate concentration will be higher than in normal wastewaters and therefore the rate of hydrogen sulphide formation will be increased.

There are no statutory Air Quality Objectives or endorsed guidelines for odour, the evaluation and measurement of this parameter are subjective and constrained by technical difficulties. For general considerations, two odour units should not be exceeded at the site boundary of the emitter. This limit is adopted so that the existing ambient odour level is not incremented, although it is widely accepted that recognition and complaints of odour do not occur until a dilution factor of about five is reached.

In order to control odour and meet current EPD requirements, an odour removal system will be incorporated into the pumping station ventilation system using activated carbon filters. 99.9% H_2S removal on 10 ppm inlet concentration is required. The responsibility for provision, maintenance and monitoring odour from this source rests with Drainage Services Department (DSD), and was included within the Strategic Sewage Disposal Strategy (SSDS) Study. This should be referenced for further information on odour impact assessment.

6 NOISE

6.1 General

Receivers will be affected by the noise generated from construction activities, traffic, and from helicopter movements. Impacts on the sensitive receivers were assessed for each of these sources, in accordance with statutory procedures and guidelines.

6.2 Legislation and Guideline Controls

The Noise Control Ordinance (NCO) provides the statutory framework for noise control and defines statutory limits that will apply to the construction of the Central Reclamation Phase II. In addition, EPD has stated that for better planning and in order not to contravene the NCO, consideration should be taken of the Hong Kong Planning Standards and Guidelines (HKPSG), although the environmental related guidelines included in this publication have no statutory basis. As well as setting out guidelines for planning practice with respect to noise, the HKPSG presents the only published limits on traffic and helicopter noise in Hong Kong.

Noise from construction activities will be generated from powered mechanical equipment (PME) on site, but there will be no percussive piling. Assessment of noise levels from PME at the Noise Sensitive Receivers (NSRs) was, therefore, carried out in accordance with the procedures in the Technical Memorandum (TM) on Noise from Construction Work other than Percussive Piling.

Under this TM, noise from PME is not restricted during the hours 0700 - 1900 (except Sundays and Public Holidays). However, a non-statutory guideline limit of 75 dB(A) is frequently adopted for day-time construction noise whenever practical. Consequently, EPD has suggested a day-time general construction noise limit of 75 dB(A) in $L_{eq\ (30\ min)}$. While this limit has no statutory significance with respect to Construction Noise Permits, it has been included in a number of contract specifications together with the requirement that appropriate noise mitigation measures should be considered once this limit is exceeded.

Between 1900 and 0700 and all day on Sundays and public holidays, construction activities are restricted unless a permit is obtained. A permit will be granted only if the Acceptable Noise Level (ANL) for the noise sensitive receiver can be met. Basic Noise Levels (BNLs) are assigned depending upon the Area Sensitivity Rating (ASR). As the NSRs in the vicinity of the development area are situated in an urban area, NSRs are likely to be assigned an ASR of either B or C. The BNLs for the respective ASRs are presented in Table 6.2.1.

Since `Correction for the Duration of the Construction Noise Permit' and `Correction for Multiple Site Situation' would not be applied in the assessment, BNLs as shown in Table 6.2.1 are directly equal to the ANLs for the corresponding noise sensitive receivers.

Table 6.2.1 Basic Noise Levels (BNLs)

Time Period	Basic Noise Level $L_{eq\ (5\ min)}$, dB(A)	
	ASR `B'	ASR `C'
All days during the evening (1900 to 2300), and general holidays (including Sundays) during the day-time and evening (0700 to 2300)	65	70
All days during the night-time (2300 to 0700)	50	55

There are currently no statutory controls to limit the impacts from road traffic noise and helicopter noise, however, the HKPSG provide criteria which are shown in Table 6.2.2. A helipad should not be located in such a way that the day-time operational maximum noise levels at receivers, as listed in Table 6.2.2, will be exceeded.

Table 6.2.2 HKPSG Limits for Traffic and Helicopter Noise

Receiver	Road Traffic $L_{A10\ (Peak\ Hour)}$, dB(A)	Helicopter Noise L_{max}, dB(A)
Dwelling	70	85
Hotel and Hostels	70	85
Offices	70	90
Technical Institute or School	65	85
Hospital	55	85

Note : These standards apply to receivers that rely on open windows for ventilation

6.3 Construction Phase

6.3.1 Sensitive Receivers

Ten NSRs which may be affected by the construction works for the Central Reclamation Phase II were identified. These are listed in Table 6.3.1 and shown in Figure 6.1. For the purposes of assessment, ASRs were also assigned to the respective NSRs in accordance with the TM. The Open Air Theatre of The Hong Kong Academy for Performing Arts is rarely used for performances because of traffic noise and unpredictable weather. It is proposed that the Open Air Theatre will be closed when work of Central Reclamation Phase II commences. Therefore, this Open Air Theatre will not be regarded as a sensitive receiver.

Table 6.3.1 Locations and ASRs of NSRs

Noise Sensitive Receiver	Location	ASR*
NSR1	Lower Block of City Hall	C
NSR2	Furama Hotel	C
NSR3	Supreme Court	C
NSR4	Marriott Hotel	C
NSR5	HK Academy for Performing Arts	C
NSR6	Northern Facade at 16/F - 28/F, The Prince of Wales Building	B
NSR7	Eastern Facade at 16/F - 28/F, The Prince of Wales Building	C
NSR8	Amethyst Block	B
NSR9	Blake Block	B
NSR10	Medical and Dental Centre	C

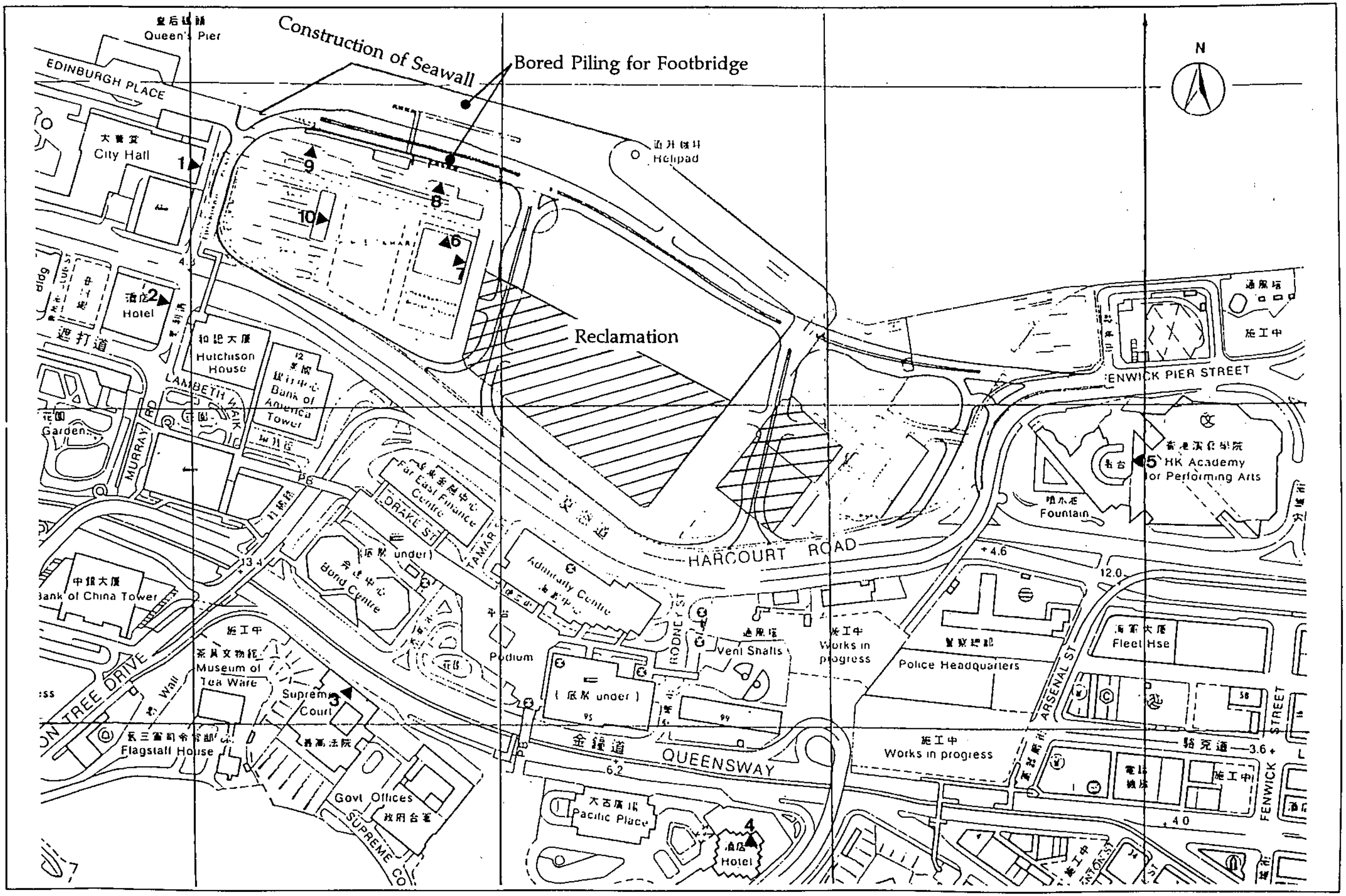
* Assumed for assessment purposes only. The selection of an appropriate ASR is at the discretion of the Authority during the Noise Permit application procedure. These may be subject to change depending on future conditions.

6.3.2 Existing Conditions

There is no construction work being undertaken in the vicinity of Tamar area and therefore the sensitive receivers are not affected by existing construction noise. The receivers are subject to high noise levels from existing traffic in the area (see Section 6.4.2).

6.3.3 Assessment Methodology

The construction of Central Reclamation Phase II is divided into 2 phases: (i) reclamation and commercial development - the reclamation works are at present scheduled from December 1994 until March 1997; and (ii) the development works executed from early 1995 until early 1998. The assessment has taken account of both options for reclamation: (i) public dump or use contractor sourced material, and (ii) marine fill.



▲ **Noise Sensitive Receivers**

▨ **Commercial Development Sites**

Figure 6.1 Construction Noise Sensitive Receivers

Plant schedules and sound power levels of the proposed equipment are given in Tables 6.3.2, 6.3.3 and 6.3.4. The assessment followed the procedures given in the TM on Noise from Construction Work other than Percussive Piling. Attenuation for distances over 300 m is not provided in the TM.

For the purpose of assessment of noise arising from PME, the distance attenuation was calculated using the standard formula (2.1):

$$\textit{Distance Attenuation in } dB(A) = 20 \log D + 8 \qquad (2.1)$$

where D is the distance in metres.

All PME, except the bored piling rigs engaged in reclamation work, were assumed to be located at notional source positions (NSP), selected in accordance with the procedures in the TM. The bored piling rigs for reclamation work were assumed to be located at fixed positions as shown in Figure 6.1.

Table 6.3.2 Plant Schedule 1 - Reclamation Contract (Public Dump or Contractor Sourced Material)

Number of Items of Equipment in Operation (Total Sound Power Level, dB(A))

Equipment	1993		1994												1995												1996											
	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling																																						
Mobile Crane	1 (112)	1 (112)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	1 (112)											
Track Crane															1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)														
Concreting																																						
Ready-mix Trunk		1 (109)	1 (109)	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	1 (109)											
Concrete Pump			1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)														
Excavation and Filling																																						
Dump Truck		5 (124)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)						15 (129)	15 (129)	15 (129)	15 (129)	15 (129)	15 (129)															
Dozer		1 (115)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)				2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)															
Backhoe	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)											
Lorry	2 (115)	2 (115)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)											
Marine																																						
Tug Boat	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)				1 (110)	1 (110)	1 (110)																		
Barge	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)	2 (107)				1 (104)	1 (104)	1 (104)																		
Grab Dregder	2 (121)	2 (121)	2 (121)	2 (121)	2 (121)	2 (121)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)				1 (118)	1 (118)	1 (118)																		
Piling																																						
Bored Piling Rig																		1 (115)	1 (115)	1 (115)	1 (115)																	
Auxiliary																																						
Compressor	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)											
Generators	1 (108)	1 (108)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)											
Hydraulic Impact Breaker	2 (125)	2 (125)	2 (125)	2 (125)	2 (125)	2 (125)																																

Table 6.3.3 Plant Schedule 2 - Commercial Development (Public Dump or Contractor Sourced Material)

Equipment	Number of Items of Equipment in Operation (Total Sound Power Level, dB(A))																																					
	1993		1994												1995												1996											
	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling																																						
Tower Crane						1 (95)	1 (95)	1 (95)	1 (95)	1 (95)	1 (95)	1 (95)	1 (95)	1 (95)	2 (98)	2 (98)	2 (98)	2 (98)	2 (98)	2 (98)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	3 (100)	2 (98)	2 (98)
Mobile Crane						1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	2 (115)	2 (115)
Track Crane															2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)												
Concreting																																						
Ready-mix Trunk						3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	5 (116)	5 (116)	5 (116)	5 (116)	5 (116)	5 (116)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	7 (117)	5 (116)	5 (116)
Concrete Pump						2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	3 (114)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	3 (114)	3 (114)
Excavation and Filling																																						
Dump Truck						1 (117)	1 (117)	1 (117)	1 (117)	1 (117)	1 (117)	1 (117)	1 (117)	1 (117)	2 (120)	2 (120)	2 (120)	2 (120)	2 (120)	2 (120)	3 (122)	3 (122)	3 (122)	3 (122)	3 (122)	3 (122)												
Dozer						1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)				1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)	1 (115)												
Backhoe						1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)
Lorry						2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)
Piling																																						
Bored Piling Rig						2 (118)	2 (118)	2 (118)	2 (118)						2 (118)	2 (118)	2 (118)	2 (118)			2 (118)	2 (118)	2 (118)	2 (118)														
Diaphragm Walling Rig						2 (108)	2 (108)	2 (108)	2 (108)						2 (108)	2 (108)	2 (108)	2 (108)			2 (108)	2 (108)	2 (108)	2 (108)														
Auxiliary																																						
Compressor					2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)	4 (115)
Generators					2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	3 (113)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)	4 (114)
Hydraulic Impact Breaker																																						

Table 6.3.4 Plant Schedule 1 - Reclamation Contract - Marine Sand Fill

Equipment	Number of Items of Equipment in Operation (Total Sound Power Level, dB(A))													
	1993		1994											
	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling														
Mobile Crane	1 (112)	1 (112)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)
Track Crane														
Concreting														
Ready-mix Trunk		1 (109)	1 (109)	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)
Concrete Pump			1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)	1 (109)
Excavation and Filling														
Dump Truck								4 (123)	4 (123)	4 (123)	4 (123)	4 (123)		
Dozer		1 (115)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)
Backhoe	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)
Lorry	2 (115)	2 (115)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)
Marine														
Tug Boat	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)	1 (110)
Barge	3 (109)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)	4 (110)
Grab Dregder	2 (121)	2 (121)	2 (121)	2 (121)	2 (121)	2 (121)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)	1 (118)
Lighter	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)	1 (104)
Piling														
Bored Piling Rig														
Auxiliary														
Compressor	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)
Generators	1 (108)	1 (108)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)
Hydraulic Impact Breaker	2 (125)	2 (125)	2 (125)	2 (125)	2 (125)	2 (125)								

Equipment	1995												1996											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Material Handling																								
Mobile Crane	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	1 (112)											
Track Crane	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)	1 (112)														
Concreting																								
Ready-mix Trunk	2 (112)	2 (112)	2 (112)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	3 (114)	1 (109)											
Concrete Pump	1 (109)	1 (109)	1 (109)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)														
Excavation and Filling																								
Dump Truck							4 (123)	4 (123)	4 (123)															
Dozer				2 (118)	2 (118)	2 (118)	2 (118)	2 (118)	2 (118)															
Backhoe	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)	2 (115)											
Lorry	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)	3 (117)											
Marine																								
Tug Boat				1 (110)	1 (110)	1 (110)																		
Barge				2 (110)	2 (110)	2 (110)																		
Grab Dregder				1 (118)	1 (118)	1 (118)																		
Lighter				1 (104)	1 (104)	1 (104)																		
Piling																								
Bored Piling Rig				1 (115)	1 (115)	1 (115)	1 (115)																	
Auxiliary																								
Compressor	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)	2 (112)											
Generators	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)	2 (111)											
Hydraulic Impact Breaker																								

6.3.4 Impact on Receivers

The distance of each NSR to each corresponding NSP and the respective distance attenuation are given in Table 6.3.5.

Table 6.3.5 Distances from NSRs to Notional Source Positions and Respective Distance Attenuation

Noise Sensitive Receiver	Reclamation Work		Bored Piling		Commercial Development	
	Distance m	Distance Attenuation dB(A)	Distance m	Distance Attenuation dB(A)	Distance m	Distance Attenuation dB(A)
NSR1	230	55	160	52	365	57
NSR2	235	55	205	54	255	56
NSR3	240	56	350	59	225	55
NSR4	265	57	470	61	240	56
NSR5	285	57	495	61	280	57
NSR6	117	49	100	48	200	54
NSR7	104	48	110	49	181	53
NSR8	260	52	45	41	220	55
NSR9	140	51	120	50	280	57
NSR10	130	50	210	54	240	56

The construction noise level at each NSR was calculated and presented in Tables 6.3.6 and 6.3.7.

Table 6.3.6 Noise Impacts on Sensitive Receivers (Public Dump or Contractor Sourced Material)

NSR	Activity	1993		1994												1995												1996											
		11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
NSR1	Reclamation Work	75	77	80	80	80	80	78	78	78	78	78	78	73	73	71	71	71	78	78	78	78	78	78	71	70	70	69											
	Bored Piling																		66	66	66	66																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	75	77	80	80	80	80	79	79	79	79	79	79	74	74	75	75	75	80	79	79	80	79	79	75	75	75	73	70	70	70	70	70	70	70	70	70	69	69
NSR2	Reclamation Work	75	77	80	80	80	80	78	78	78	78	78	78	73	73	71	71	71	78	78	78	78	78	78	71	70	70	69											
	Bored Piling																		64	64	64	64																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	75	77	80	80	80	80	79	79	79	79	79	79	75	75	75	75	75	80	80	80	80	80	80	76	75	75	73	71	71	71	71	71	71	71	71	71	70	70
NSR3	Reclamation Work	74	76	79	79	79	79	77	77	77	77	77	77	72	72	70	70	70	77	77	77	77	77	77	70	69	69	68											
	Bored Piling																		59	59	59	59																	
	Commercial Development					63	73	73	73	73	71	71	71	71	71	74	74	74	74	74	74	75	75	75	75	75	75	72	72	72	72	72	72	72	72	72	72	71	71
	Total Noise Level, dB(A)	74	76	79	79	79	80	79	79	79	78	78	78	74	74	76	76	76	79	79	79	79	79	79	76	76	76	73	72	72	72	72	72	72	72	72	72	71	71
NSR4	Reclamation Work	73	75	78	78	78	78	76	76	76	76	76	76	71	71	69	69	69	76	76	76	76	76	76	69	68	68	67											
	Bored Piling																		57	57	57	57																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	73	75	78	78	78	79	78	78	78	77	77	77	73	73	75	75	75	78	78	78	78	78	78	75	75	75	72	71	71	71	71	71	71	71	71	71	70	70
NSR5	Reclamation Work	73	75	78	78	78	78	76	76	76	76	76	76	71	71	69	69	69	76	76	76	76	76	76	69	68	68	67											
	Bored Piling																		57	57	57	57																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	73	75	78	78	78	78	77	77	77	77	77	77	73	73	74	74	74	78	78	78	78	78	78	75	74	74	72	70	70	70	70	70	70	70	70	70	69	69
NSR6	Reclamation Work	81	83	86	86	86	86	84	84	84	84	84	84	79	79	77	77	77	84	84	84	84	84	84	77	76	76	75											
	Bored Piling																		70	70	70	70																	
	Commercial Development					64	74	74	74	74	72	72	72	72	72	75	75	75	75	75	75	76	76	76	76	76	76	73	73	73	73	73	73	73	73	73	73	72	72
	Total Noise Level, dB(A)	81	83	86	86	86	86	85	85	85	85	85	84	80	80	79	79	79	85	85	85	85	85	85	80	79	79	77	73	73	73	73	73	73	73	73	73	72	72
NSR7	Reclamation Work	82	84	87	87	87	87	85	85	85	85	85	85	80	80	78	78	78	85	85	85	85	85	85	78	77	77	76											
	Bored Piling																		69	69	69	69																	
	Commercial Development					65	75	75	75	75	73	73	73	73	73	76	76	76	76	76	76	77	77	77	77	77	77	74	74	74	74	74	74	74	74	74	74	73	73
	Total Noise Level, dB(A)	83	84	87	87	87	87	86	86	86	86	86	85	81	81	80	80	80	86	86	86	86	86	86	81	80	80	78	74	74	74	74	74	74	74	74	74	73	73
NSR8	Reclamation Work	78	80	83	83	83	83	81	81	81	81	81	81	76	76	74	74	74	81	81	81	81	81	81	74	73	73	72											
	Bored Piling																		77	77	77	77																	
	Commercial Development					63	73	73	73	73	71	71	71	71	71	74	74	74	74	74	74	75	75	75	75	75	75	72	72	72	72	72	72	72	72	72	72	71	71
	Total Noise Level, dB(A)	78	80	83	83	83	83	82	82	82	82	82	82	77	77	77	77	77	83	83	83	83	82	82	78	77	77	75	72	72	72	72	72	72	72	72	72	71	71
NSR9	Reclamation Work	79	81	84	84	84	84	82	82	82	82	82	82	77	77	75	75	75	82	82	82	82	82	82	75	74	74	73											
	Bored Piling																		68	68	68	68																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	79	81	84	84	84	84	83	83	83	82	82	82	77	77	77	77	77	83	83	83	83	83	83	77	76	76	75	70	70	70	70	70	70	70	70	70	69	69
NSR10	Reclamation Work	80	82	85	85	85	85	83	83	83	83	83	83	78	78	76	76	76	83	83	83	83	83	83	76	75	75	74											
	Bored Piling																		64	64	64	64																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	80	83	85	85	85	85	84	84	84	83	83	83	78	78	78	78	78	84	84	84	84	84	84	78	77	77	76	71	71	71	71	71	71	71	71	71	70	70

Note: (a) 3 dB(A) facade effect was included.
(b) Bored Piling was one of the activities in reclamation work.

Table 6.3.7 Noise Impacts on Sensitive Receivers (Marine Sand Fill)

NSR	Activity	1993		1994												1995												1996											
		11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
NSR1	Reclamation Work	75	76	76	76	76	76	73	75	75	75	75	75	73	73	71	71	71	74	74	74	75	75	75	71	70	70	69											
	Bored Piling																		66	66	66	66																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	75	76	76	76	76	77	75	76	76	76	76	76	74	74	75	75	75	77	76	76	78	77	77	75	75	75	73	70	70	70	70	70	70	70	70	70	69	69
NSR2	Reclamation Work	75	76	76	76	76	76	73	75	75	75	75	75	73	73	71	71	71	74	74	74	75	75	75	71	70	70	69											
	Bored Piling																		64	64	64	64																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	75	76	76	76	76	78	75	77	77	76	76	76	75	75	75	75	75	77	76	76	78	77	77	76	75	75	73	71	71	71	71	71	71	71	71	71	70	70
NSR3	Reclamation Work	74	75	75	75	75	75	72	74	74	74	74	74	72	72	70	70	70	73	73	73	74	74	74	70	69	69	68											
	Bored Piling																		59	59	59	59																	
	Commercial Development					63	73	73	73	73	71	71	71	71	71	74	74	74	74	74	74	75	75	75	75	75	75	72	72	72	72	72	72	72	72	72	72	71	71
	Total Noise Level, dB(A)	74	75	75	75	76	77	75	76	76	76	76	76	74	74	76	76	76	77	76	76	78	78	78	76	76	76	73	72	72	72	72	72	72	72	72	72	71	71
NSR4	Reclamation Work	73	74	74	74	74	74	71	73	73	73	73	73	71	71	69	69	69	72	72	72	73	73	73	69	68	68	67											
	Bored Piling																		57	57	57	57																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	73	74	74	74	75	76	74	75	75	75	75	75	73	73	75	75	75	76	75	75	77	77	77	75	75	75	72	71	71	71	71	71	71	71	71	71	70	70
NSR5	Reclamation Work	73	74	74	74	74	74	71	73	73	73	73	73	71	71	69	69	69	72	72	72	73	73	73	69	68	68	67											
	Bored Piling																		57	57	57	57																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	73	74	74	74	75	76	74	75	75	75	75	74	73	73	74	74	74	75	75	75	76	76	76	75	74	74	72	70	70	70	70	70	70	70	70	70	69	69
NSR6	Reclamation Work	81	82	82	82	82	82	79	81	81	81	81	81	79	79	77	77	77	80	80	80	81	81	81	77	76	76	75											
	Bored Piling																		70	70	70	70																	
	Commercial Development					64	74	74	74	74	72	72	72	72	72	75	75	75	75	75	75	76	76	76	76	76	76	73	73	73	73	73	73	73	73	73	73	72	72
	Total Noise Level, dB(A)	81	82	82	82	82	83	80	82	82	82	82	82	80	80	79	79	79	81	81	81	82	82	82	80	79	79	77	73	73	73	73	73	73	73	73	73	72	72
NSR7	Reclamation Work	82	83	83	83	83	83	80	82	82	82	82	82	80	80	78	78	78	81	81	81	82	82	82	78	77	77	76											
	Bored Piling																		69	69	69	69																	
	Commercial Development					65	75	75	75	75	73	73	73	73	73	76	76	76	76	76	76	77	77	77	77	77	77	74	74	74	74	74	74	74	74	74	74	73	73
	Total Noise Level, dB(A)	82	83	83	83	83	84	81	83	83	83	83	83	81	81	80	80	80	82	82	82	83	83	83	81	80	80	78	74	74	74	74	74	74	74	74	74	73	73
NSR8	Reclamation Work	78	79	79	79	79	79	76	78	78	78	78	78	76	76	74	74	74	77	77	77	78	78	78	74	73	73	72											
	Bored Piling																		77	77	77	77																	
	Commercial Development					63	73	73	73	73	71	71	71	71	71	74	74	74	74	74	74	75	75	75	75	75	75	72	72	72	72	72	72	72	72	72	72	71	71
	Total Noise Level, dB(A)	78	79	79	79	79	80	78	79	79	79	79	79	77	77	77	77	77	81	81	81	82	80	80	78	77	77	75	72	72	72	72	72	72	72	72	72	71	71
NSR9	Reclamation Work	79	80	80	80	80	80	77	79	79	79	79	79	77	77	75	75	75	78	78	78	79	79	79	75	74	74	73											
	Bored Piling																		68	68	68	68																	
	Commercial Development					61	71	71	71	71	69	69	69	69	69	72	72	72	72	72	72	73	73	73	73	73	73	70	70	70	70	70	70	70	70	70	70	69	69
	Total Noise Level, dB(A)	79	80	80	80	80	81	78	80	80	80	80	79	78	78	77	77	77	79	79	79	80	80	80	77	76	76	75	70	70	70	70	70	70	70	70	70	69	69
NSR10	Reclamation Work	80	77	81	77	77	77	74	76	76	76	76	76	74	74	76	72	72	75	75	75	76	76	76	72	71	71	74											
	Bored Piling																		64	64	64	64																	
	Commercial Development					62	72	72	72	72	70	70	70	70	70	73	73	73	73	73	73	74	74	74	74	74	74	71	71	71	71	71	71	71	71	71	71	70	70
	Total Noise Level, dB(A)	80	77	81	77	77	78	76	77	77	77	77	77	75	75	76	76	76	77	77	77	78	78	78	76	76	76	76	71	71	71	71	71	71	71	71	71	70	70

Note: (a) 3 dB(A) facade effect was included.
(b) Bored Piling was one of the activities in reclamation work.

A commencement date for construction work was originally assumed as November 1993 for noise calculations. However, the current start date is August 1994. Applying a ten month correction to the dates shown in Table 6.3.6, it may be inferred that for public dump or use of contractor sourced material, the maximum noise level at the City Hall is estimated to be a maximum of 80 dB(A) during October 1994 to January 1995 and January 1996. The Furama Hotel may experience maximum noise levels up to 80 dB(A) during October 1994 to January 1995 and January to June 1996. The maximum noise level at the Supreme Court is estimated to be 80 dB(A) in January of 1995. However, this is likely to be an overestimate because the commercial buildings located above the Admiralty MTR station provide shielding from the site. The maximum noise level at the Marriott Hotel is estimated to be 79 dB(A) in January 1995. At the HK Academy for Performing Arts, the maximum noise level may reach 78 dB(A) from October 1994 to January 1995 and January to June 1996. The maximum noise levels at the northern and western facades above 16/F of Prince of Wales Building are estimated to be 86 and 87 dB(A) respectively from October 1994 to January 1995. However, these are likely to be an overestimate because part of the site is screened from direct view of the receivers. The maximum noise levels at Amethyst Block is estimated to be 83 dB(A) from October 1994 to January 1995 and from January to April 1996. The maximum noise levels at Blake Block and Medical and Dental Centre are estimated to be 84 and 85 dB(A) respectively from October 1994 to January 1995. Similarly, these are likely to be overestimate because part of the site is screened from direct view of the receivers.

From Table 6.3.7 for marine sand fill option, the maximum noise level at the City Hall is estimated to be a maximum of 78 dB(A) during February to April 1996. The Furama Hotel may experience maximum noise levels up to 77 dB(A) during March and April 1994, January, May and June 1996. The maximum noise levels at the Supreme Court and Marriott Hotel are estimated to be 78 dB(A) and 77 dB(A) respectively from April to June of 1996. At the HK Academy for Performing Arts, the maximum noise level may reach 76 dB(A) from January to June 1996. The maximum noise levels at the northern and western facades above 16/F of Prince of Wales Building are estimated to be 82 and 83 dB(A) respectively from January to June 1996. The maximum noise level at Amethyst Block may reach 82 dB(A) during April 1996. The maximum noise levels at Blake Block and Medical and Dental Centre are estimated to be 80 and 78 dB(A) respectively from April to June 1996. The noise levels at Supreme Court, northern and western facades above 16/F of Prince of Wales Building, Amethyst Block, Blake Block and Medical and Dental Centre are likely to be overestimate because part of the site is screened from direct view of the receivers.

It is observed that noise level generated from the activities of marine sand fill is lower than the option of public dump or contractor sourced material. Therefore, the marine sand fill for reclamation is preferred.

All NSRs may be exposed to maximum noise levels which exceed the 75 dB(A) non-statutory day-time limit in some periods during the construction phase. However, all NSRs except the blocks inside Prince of Wales Barracks are fitted with high quality glazing and central air conditioning which will attenuate received noise levels inside the building. Mitigation measures are required for the blocks inside Prince of Wales

Barracks if a 75 dB(A) non-statutory day-time limit is enforced. It is evident that mitigation would also be necessary for evening and night time work if required for public dump or contractor sourced material option.

Although potentially exposed to high construction noise levels, the noise environment at NSRs 2 to 4 in particular will be dominated by traffic noise from Connaught Road and Queensway.

The analysis presented in this section corresponds to a worst case scenario because it is assumed that plant would be working simultaneously at a single Notional Source Position for each stage of work (except boring piling equipment). In reality, this would not be the case and it is therefore unlikely that such high levels will occur.

6.3.5 Control and Mitigation

The current NCO and its subsidiary regulations such as Noise Control (Hand Held Pneumatic Breakers) Regulations and Noise Control (Air Compressors) Regulations should be strictly complied with. If construction works are carried out in the evening (1900 - 2300) and during the night time (2300 - 0700) or any time on general holidays (including Sundays). Construction Noise Permits (CNPs) will have to be obtained from the EPD. Mitigation measures will be required to reduce the noise levels to acceptable limits. Possible measures including erection of substantial noise barriers to screen out the stationary plant which should be designed in accordance with BS5228:1984 or `A Practical Guide for the Reduction of Noise from Construction Works' published by EPD.

Noise levels at the blocks inside Prince of Wales Barracks can be reduced by providing noise barriers of practical height to shield the direct line of sight to the construction activities from the blocks inside Prince of Wales Barracks.

All plant and equipment used on the construction works should be routinely maintained in good working condition and effectively `sound-reduced' by means of silencers, mufflers or acoustic linings to avoid disturbance to any nearby noise sensitive receivers. Operational aspects should be considered, such as limiting number of trucks at any place at the same time, where these conditions are practical and may be reasonably enforced. In the case of site operation as a public dump, such controls would be difficult to implement. However, a time restriction on the hours for operating the public dump should be required.

The above requirement should be incorporated into the contract documentation. The inclusion of a 75 dB(A) daytime construction noise limit, as measured at NSRs, in the contract documentation is recommended.

6.3.6 Monitoring and Audit Requirements

It is recommended that a programme of regular monitoring is undertaken by the Engineer or Contractor. Noise monitoring should be carried out at noise sensitive receivers that are likely to be affected. If it is impractical or impossible to carry out the noise monitoring at the NSRs, it should be undertaken at an appropriate location, adjusting the noise level to the NSR using standard acoustic principles. One $L_{eq\,(30\,min)}$ should be taken during day-time on a basis of three normal weekdays per week for each receiver during the construction stage. Three consecutive 5 minute L_{eq} measurements per week should be employed in the evening or during night-time where CNP apply.

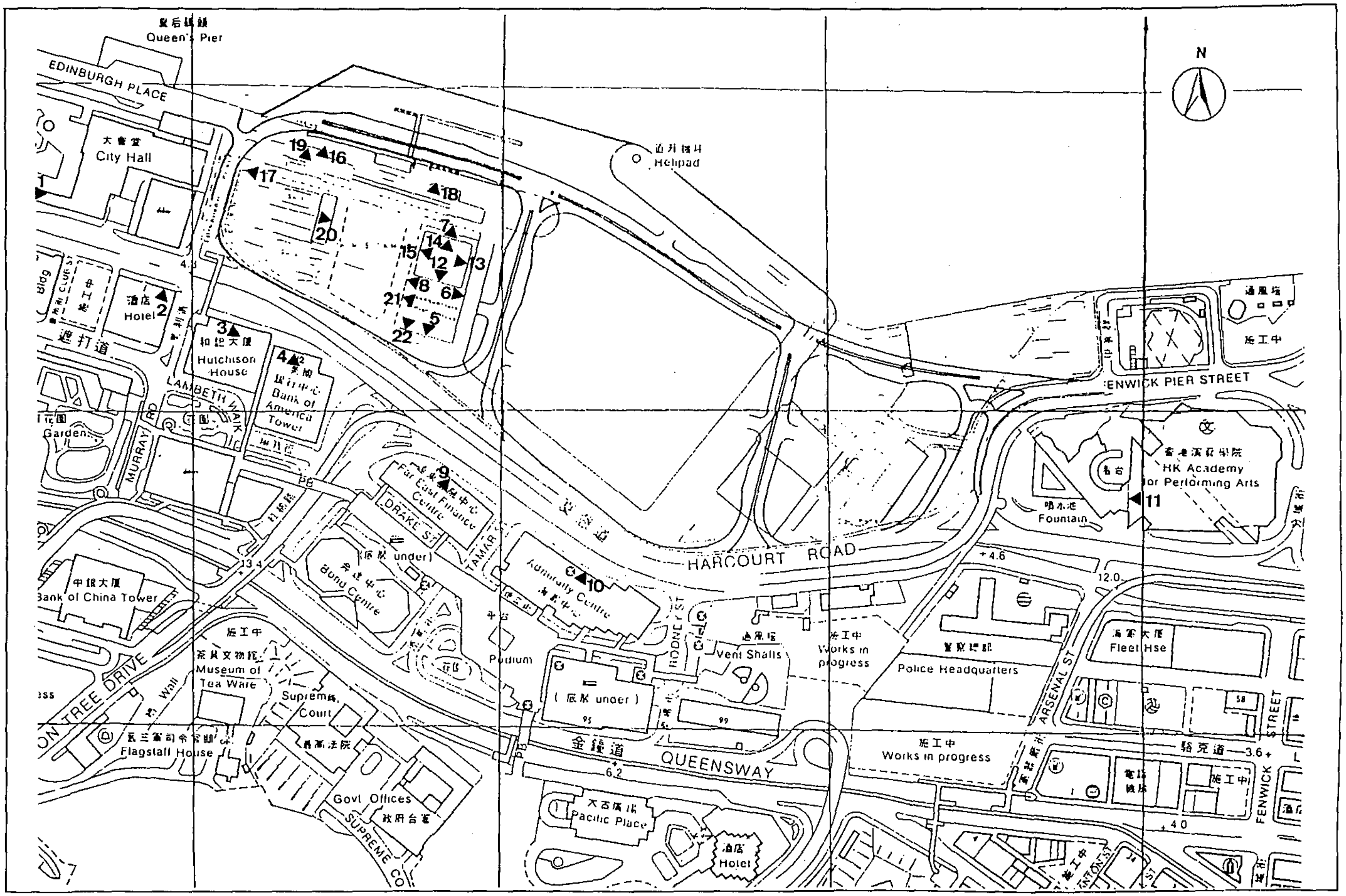
The instrumentation and procedures adopted for the measurements should comply with the requirements of the `Technical Memorandum on Noise from Construction Work other than Percussive Piling'.

The results should be audited by the Engineer immediately on receipt and if monitoring indicates potential exceedance of statutory limits, or an action level determined in accordance with the baseline noise monitoring results and agreed with EPD, the Contractor should be required to instigate remedial measures and review working practices in order to reduce noise levels.

6.4 Traffic Noise

6.4.1 Sensitive Receivers

Twenty-two existing and future sensitive facades in the Study area were identified. These are shown in Figure 6.2 and described in Table 6.4.1. As mentioned in section 6.3.1, the Open Air Theatre of The Hong Kong Academy for Performing Arts will not be regarded as a sensitive receiver.



▲ Noise Sensitive Facades

Figure 6.2 Traffic and Helicopter Noise Sensitive Facades

Table 6.4.1 Location of Sensitive Facades

Sensitive Facade	Location
1	City Hall
2	Furama Hotel
3	Hutchison House
4	Bank of America Tower
5	Southern Facade, British Forces Headquarters
6	Eastern Facade, British Forces Headquarters
7	Northern Facade, British Forces Headquarters
8	Western Facade, British Forces Headquarters
9	Far East Finance Centre
10	Admiralty Centre
11	HK Academy for Performing Arts
12	Southern Facade at 16/F, Prince of Wales Building
13	Eastern Facade at 16/F, Prince of Wales Building
14	Northern Facade at 16/F, Prince of Wales Building
15	Western Facade at 16/F, Prince of Wales Building
16	Future Commercial Development
17	Future Commercial Development
18	Amethyst Block
19	Blake Block
20	Medical and Dental Centre
21	Western Facade of Education Centre
22	Southern Facade of Education Centre

The lowest levels of the sensitive facades, where sensitive uses are located, were adopted for the assessment of road traffic noise.

6.4.2 Existing Conditions

The existing environment is dominated by traffic noise from Connaught Road Central, Harcourt Road and Queensway. An estimate of noise from these sources was made using traffic figures taken from the Annual Traffic Census 1990, Transport Department. Seven percent of the daily traffic flow was taken to represent peak hour flows. The percentage of heavy good vehicles was calculated from the vehicle classification data for Core Stations 1001 and 1007. Calculations were carried out using the UK Department of Transport `Calculation of Road Traffic Noise', 1988 (CRTN). This methodology was adopted in the Final Report on `Central Reclamation, Phase 1, Focused Environmental Impact Assessment Study'.

This assumes a distance of 10 m or less to the sensitive receivers. There are sensitive receivers on Connaught Road Central, Harcourt Road and Queensway and therefore an additional correction for distance is not considered necessary.

The existing traffic noise levels at the facades of the buildings at lower floor levels on these roads are estimated as shown in Table 6.4.2. At higher floors, noise levels will be reduced because of distance attenuation.

Table 6.4.2 Calculation of Existing Road Traffic Noise Levels (L_{10})

	Connaught Road	Harcourt Road	Queensway
Daily vehicle flow 1990	115,330	126,530	79,560
7% (peak hour flow)	8,070	8,860	5,570
Basic Noise Level, dB(A)	82.5	83	79.5
% of HGVs	15.8	15.8	24.8
Correction for speed and % of HGVs, dB(A)	+0.5 @ 40 km/hr & +3.5 @ 80 km/hr	+0.5 @ 40 km/hr & +3.5 @ 80 km/hr	+2.6 @ 40 km/hr & +4.5 @ 80 km/hr
Facade effect, dB(A)	+2.5	+2.5	+2.5
Corrected Noise Level, dB(A)	**85.5 to 88.5**	**86 to 89**	**82.1 to 84**

Note: Traffic noise is described in terms of L_{10} in accordance with the standard CRTN calculation methodology.

An empirical relationship between L_{10} and L_{eq}, i.e. $L_{10} = L_{eq} + 3$ dB(A), is given in the publication `Road Traffic Noise' (Alexandre, A. *et al*, 1975). This equation holds for vehicle flows of more than or equal to about 100 vehicles per hour and thus it can be applied in these circumstances. Therefore, the L_{eq} of the traffic noise levels generated from the road traffic from these roads can be estimated approximately as follows:

Connaught Road : 82.3 to 85.5 dB(A)
Harcourt Road : 83 to 86 dB(A)
Queensway : 82.1 to 84 dB(A)

6.4.3 Assessment Methodology

The traffic noise levels at the facades of receivers were predicted using the UK Department of Transport `Calculation of Road Traffic Noise' 1988 (CRTN). Sensitive facades were selected in accordance with the definition laid down in HKPSG. Assumptions for the assessment were:

(a) design year of 2001 for roads constructed as part of the Central Reclamation Phase II contract, and design year of 2011 for roads constructed as part of the full Central and Wanchai Reclamation;

(b) predicted peak hour flow (vehicles per hour) for the roads for design years 2001 and 2011 are shown in Figure 5.2 respectively with 20% heavy goods vehicles (HGVs) as given in the Design Memorandum.

(c) the CRTN methodology states that vehicles over 1,525 kg unladen weight should be considered as HGVs, which includes the Public Light Bus (PLB) category of vehicles;

(d) traffic speed was taken as 50 km/hr;

(e) the road surface was assumed to be impervious bitumen/concrete;

(f) the security barrier around HMS Tamar was considered to act as a noise barrier.

6.4.4 Impacts on Receivers

The impacts on sensitive facades 12 to 17, 22 and 22 and the first four levels of sensitive facades 1 to 11 and 18 to 20 are shown in Table 6.4.3. Noise impacts on higher levels would be reduced due to distance attenuation.

Table 6.4.3 Noise Impacts on the Sensitive Facades

Sensitive Facade	Existing Noise Level				Design year of 2001				Design year of 2011			
	1/F	2/F	3/F	4/F	1/F	2/F	3/F	4/F	1/F	2/F	3/F	4/F
1	85.4	84.8	84.1	83.4	85.6	85.0	84.3	83.6	85.6	85.0	84.3	83.6
2	82.2	82.0	81.8	81.6	82.4	82.2	82.0	81.8	82.4	82.2	82.0	81.8
3	79.9	79.8	79.7	79.6	79.8	79.7	79.6	79.5	79.7	79.7	79.6	79.5
4	81.0	80.9	80.7	80.6	80.7	80.6	80.4	80.2	80.7	80.5	80.4	80.2
5	83.2	83.2	82.9	82.6	83.1	83.1	82.9	82.6	83.1	83.1	82.9	82.6
6	70.8	71.1	71.4	71.9	73.7	74.4	74.7	75.0	73.6	74.4	74.7	74.9
7	N/A	N/A	N/A	N/A	67.9	68.5	69.4	70.0	67.9	69	70.3	71.1
8	71.3	71.6	71.9	72.4	71.4	71.9	72.2	72.7	71.3	71.7	72.1	72.7
9	79.6	79.5	79.5	79.4	80.4	80.3	80.3	80.2	80.4	80.3	80.3	80.2
10	79.7	79.6	79.5	79.3	81.0	80.8	80.7	80.6	81.0	80.8	80.7	80.6
11	75.0	75.0	75.0	74.9	77..0	77.0	77.0	77.0	77.0	77.0	77.0	76.9
12 (16/F)	76.2				76.8				76.8			
13 (16/F)	71.7				74.3				74.3			
14 (16/F)	N/A				69.1				70.2			
15 (16/F)	73.3				73.6				73.5			
16 (1/F)	N/A				74.0				74.9			
17 (1/F)	72.1				74.2				72.2			
18	N/A	N/A	N/A	N/A	69.8	72.9	73.0	72.8	71.4	74.7	74.8	74.6
19	N/A	N/A	N/A	N/A	71.4	72.1	72.1	72.1	72.3	72.7	72.7	72.6
20	73.8	78.3	N/A	N/A	73.6	78.0	N/A	N/A	73.6	78.0	N/A	N/A
21 (4/F)	73.7				73.5				73.6			
22 (4/F)	78.1				77.7				77.7			

N/A: Facades only affected by future roads - i.e. no existing noise levels.

It was observed that noise levels at most sensitive facades may potentially exceed the HKPSG limits. The predicted noise levels at all sensitive facades are higher than for the existing traffic noise environment by not more than 3.3 dB(A). This is because the predicted peak hour traffic flows for the design years of 2001 and 2011 are higher than the existing peak hourly traffic flows on Connaught Road and Harcourt Road. For the extreme cases, facades 6, 11 and 17 will be affected by roads on the reclamation or Justice Drive and hence will be subject to a future increase of greater than 2 dB(A).

For the reclamation, approximately 50 trucks per hour will be required to provide the fill material. This will apply whether the reclamation is public dump or uses contractor sourced material. The advantage of the latter option would be to enable control of delivery routes through the contract specifications. For public dump material, there would be no control measures available to prevent trucks using local or minor roads, which may cause nuisance to residents.

6.4.5 Control and Mitigation

All sensitive buildings are provided with central air-conditioning (except residential units in The Prince of Wales Building which have individually controlled units, Amethyst Block and Blake Block) and high quality glazing. This effectively means that the facades are non-sensitive to traffic noise, and hence that the requirements of the HKPSG can be met.

Due to the elevation of the residential units in The Prince of Wales Building, a high and substantial noise barrier would be required for noise mitigation. This is considered impractical. Traffic noise at these sensitive facades is mainly caused by the traffic on Harcourt Road in the vicinity of the junction between Harcourt Road and Cotton Tree Drive. This is a grade-separated structure which would be extremely difficult to shield with barriers or covers.

New sensitive buildings on the reclamation should be of a self protecting design (ie. a blank facade facing the major noise source) or be provided with ventilation and glazing to the standard required by the HKPSG.

6.4.6 Monitoring and Audit Requirements

As traffic noise impact is a long term issue, monitoring and audit are not applicable.

6.5 Helicopter Noise

6.5.1 Sensitive Receivers

Sensitive facades 4, 6, 7, 9, 10, 11, 13, 14, 18, 19 and 20 used for the assessment of traffic noise and shown in Figure 6.2, were selected for this assessment. As mentioned in section 6.3.1, the Open Air Theatre of The Hong Kong Academy for Performing Arts will not be regarded as a sensitive receiver. These sensitive facades are all located in multi-storey buildings and may be mainly affected by the noise from both level flight and take off.

6.5.2 Existing Conditions

There are currently two types of helicopters using Fenwick Pier Street helipads. These are the Aerospatiale AS305BA Squirrel (VR-HJF) from Heliservices (Hong Kong) Ltd and the Sikorsky S76 (HKG16) from Royal Hong Kong Auxiliary Air Force. Two other types of helicopter: The Scout from Army Air Force and the Wessex from Royal Air Force are currently using the HMS Tamar helipads.

The noise levels recorded during the helicopter noise monitoring programme at Fenwick Pier Street and HMS Tamar helipads, and the corresponding Sound Power Levels (SWL) calculated in accordance with acoustical principles, are presented in Table 6.5.1. Measurements indicate that the noise levels during take off are higher than approach for all types of helicopter. The Scout Helicopter from the Army Air Force has the highest SWL. Therefore, L_{max} values for the Scout at 20 m during take off was adopted for the assessment as a conservative case.

Table 6.5.1 Helicopter Noise Levels

Monitoring Station	Type of Helicopter	Shortest Distance from Noise Source	Take Off L_{max}, dB(A)	Max. SWL, dB(A)	Approach L_{max}, dB(A)	Max. SWL, dB(A)
Fenwick Pier Street	(1)	15m	100.9	132.4	98.2	129.7
			102.5	134.0	98.3	129.8
			101.2	132.7	98.9	130.4
	(2)	25m	91.2	127.2	96.1*	132.1
			100.0	136.0	97.0	133.0
			99.3	135.3		
HMS Tamar	(3)	20m	104.3	138.3	98.1	132.1
	(4)	20m	101.9	135.9	101.1	135.1

Note: (1) Aerospatiale AS305BA Squirrel (VR-HJF) from Heliservices (Hong Kong) Ltd
(2) Sikorsky S76 (HKG16) from Royal Hong Kong Auxiliary Air Force
(3) Scout from Army Air Force
(4) Wessex from Royal Air Force

* For this type of helicopter, the approach was measured to be louder than take off.

6.5.3 Assessment Methodology

Although the Royal Hong Kong Air Auxiliary Force has been dismissed and reorganized as the Government Flying Services, the same helicopters will be used in the future. Helicopters from these four corporations will use the proposed helipads after 1996. The type of helicopter to be used by Heliservices (Hong Kong) Ltd will be the Aerospatiale AS305BA Squirrel. The flight frequency will double from the present number, but there is no set flight schedule as the service is `on demand' only. The Government Flying Services will use the Sikorsky S76. Movements in and out of the new helipad are expected to be five per hour from 0700 - 1700 and one per hour from

1700 - 0700. The types of helicopters and flight frequency for the Army Air Force and the Royal Air Force will be approximately the same as present.

Direct measurements of existing helicopter noise levels were undertaken and the results were used for the prediction of future noise impacts on the receivers.

The sound level meter used was a Bruel & Kjaer Type 2231 installed with a Statistical Analysis Module BZ7115 which conforms to IEC 651:1979 (Type 1) and IEC 804:1985 (Type 1).

The meter was calibrated by a Sound Level Calibrator Type 4230 with calibration sound pressure level 93.85 dB at 1 kHz before and after each measurement. Measurements were accepted as valid only if the calibration levels from before and after the noise measurement agreed to within 1.0 dB. The sound level meter was set at frontal, fast response and A-weighted.

In accordance with BS5727:1979, the microphone was placed so that the centre of its diaphragm was 1.2 m above an unobstructed flat and reflecting ground surface, and a wind shield was used. In compliance with the HKPSG requirement, L_{max} was recorded during the measurement.

Due to practical constraints during noise monitoring, the measurements could only be performed for the take off and approach of a helicopter at the helipads at HMS Tamar and Fenwick Pier Street. From the experience of the helicopter operators, the operating rotor-blade tip-speed is constant for different types of helicopter, but the take-off or approach will be noisier than level flight due to ground reflection. Although the noise levels at level flight could not be recorded during the measurement, prediction of the noise levels at the sensitive receivers during level flight was approximated using the L_{max} value in take off or approach. This is considered to be a conservative approach to the assessment.

The receivers wili be affected by noise from level flight, approach or take off of the helicopter. Noise levels at the facades of receivers from level flight were calculated using Formula (2.2).

$$L_{max}P = L_{max}M - 20 \log \frac{Distance\ (receiver\ to\ source)}{Distance\ (monitoring\ station\ to\ source)} \qquad (2.2)$$

where $L_{max}P$ is the Predicted Maximum Noise Level in dB(A); and
$L_{max}M$ is the Measured Maximum Noise Level in dB(A) at take off or approach.

Noise levels at facades of receivers generated during take off or approach were calculated using Formula (2.3).

Suppliers' and manufacturers' noise data for helicopters were not made available for the assessment. Therefore, predictions were based on the monitoring data.

$$L_{max}P = L_{max}M - 20 \log \frac{Distance\ (receiver\ to\ source)}{Distance\ (monitoring\ station\ to\ source)} + 3 \qquad (2.3)$$

6.5.4 Impacts on Receivers

The arrangement of helipads will be changed during the construction phase and can be summarised into four stages. The first stage is same as the current situation which will exist during the first three or four months of the construction period. Therefore the noise impacts on the sensitive receivers will be the same as at present. The locations of helipads at the second stage are shown in Figure 6.3 which will exist from the 4th month to the 12th month of the construction period. Stage 3 will be similar to Stage 4 in terms of noise which will apply after a year from the commencement of construction and still exist during the operational phase. These two stages will be regarded as the final stage in this assessment and the respective locations of helipads are shown in Figure 6.4.

All helicopters were assumed to fly over Victoria Harbour, and the future routes will follow a similar path to the existing one. Thus the helicopters stationing on the helipads should be at the closest distance to the sensitive facades throughout the whole flight path. To be conservative, the shortest distances from all levels of sensitive buildings to the flight path of level flight was assumed to be equal to the horizontal distances from helipads to the sensitive buildings. In predicting the noise impacts using the measured data, it is observed from formulae (2.2) and (2.3) that noise generated from take off is 3 dB(A) higher than that from level flight because the noise generated from level flight is assumed to be equal to that during take off (refer to Section 6.5.3). Therefore, the calculation using measured data only concentrates on the prediction of noise impacts on these sensitive facades caused by take off.

The distances used for calculating the existing impacts are presented in Table 6.5.2. and the distances used for calculating the impacts during Stage 2 and the final stage are presented in Tables 6.5.3 and 6.5.4 respectively. The existing and predicted noise levels at sensitive facades for all stages are given in Table 6.5.5.

Sensitive facades 13 and 14 are at the 16th floor or above of The Prince of Wales Building. Therefore, the noise levels from both level flight and take off were taken into consideration and are shown in Table 6.5.5.

Table 6.5.2 Distances from Sensitive Facades to Noise Sources during Existing Condition

	Sensitive Facade											
	3	4	6	7	9	10	11	13	14	18	19	20
Shortest Distance for Take Off, m	260 540	250	140	123	210	210	120	148	148	145	240	24 0
Shortest Distance to Level Flight, m								128	128			

Table 6.5.3 Distances from Sensitive Facades to Noise Sources during Stage 2

	Sensitive Facade											
	3	4	6	7	9	10	11	13	14	18	19	20
Shortest Distance for Take Off, m	540	490	360	380	380	310	150	370	387	400	500	48 0
Shortest Distance to Level Flight, m								360	380			

Table 6.5.4 Distances from Sensitive Facades to Noise Sources during Final Stage

	Sensitive Facade											
	3	4	6	7	9	10	11	13	14	18	19	20
Shortest Distance for Take Off, m	260	250	140	123	210	210	270	148	148	145	240	24 0
Shortest Distance to Level Flight, m								128	128			

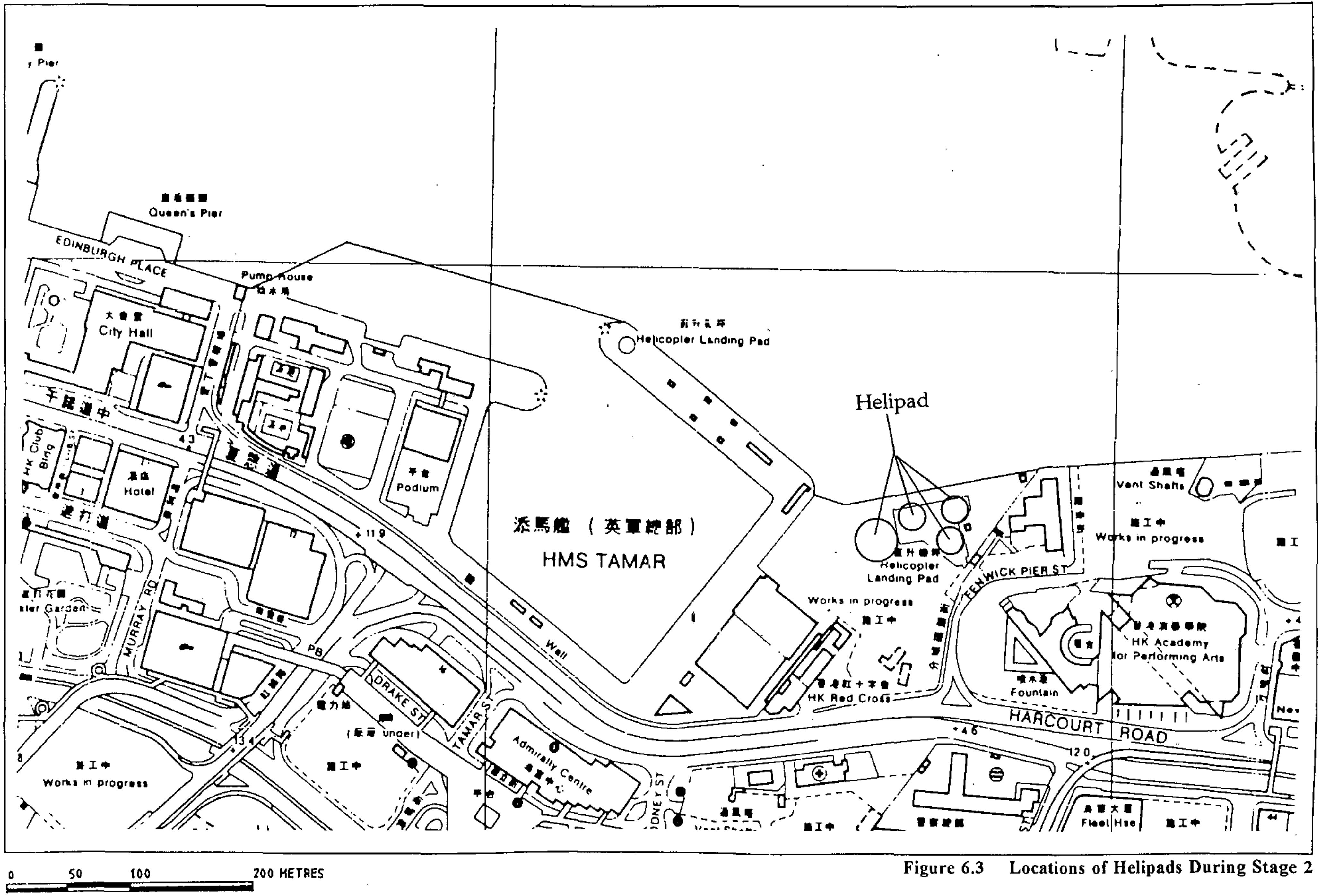


Figure 6.3 Locations of Helipads During Stage 2

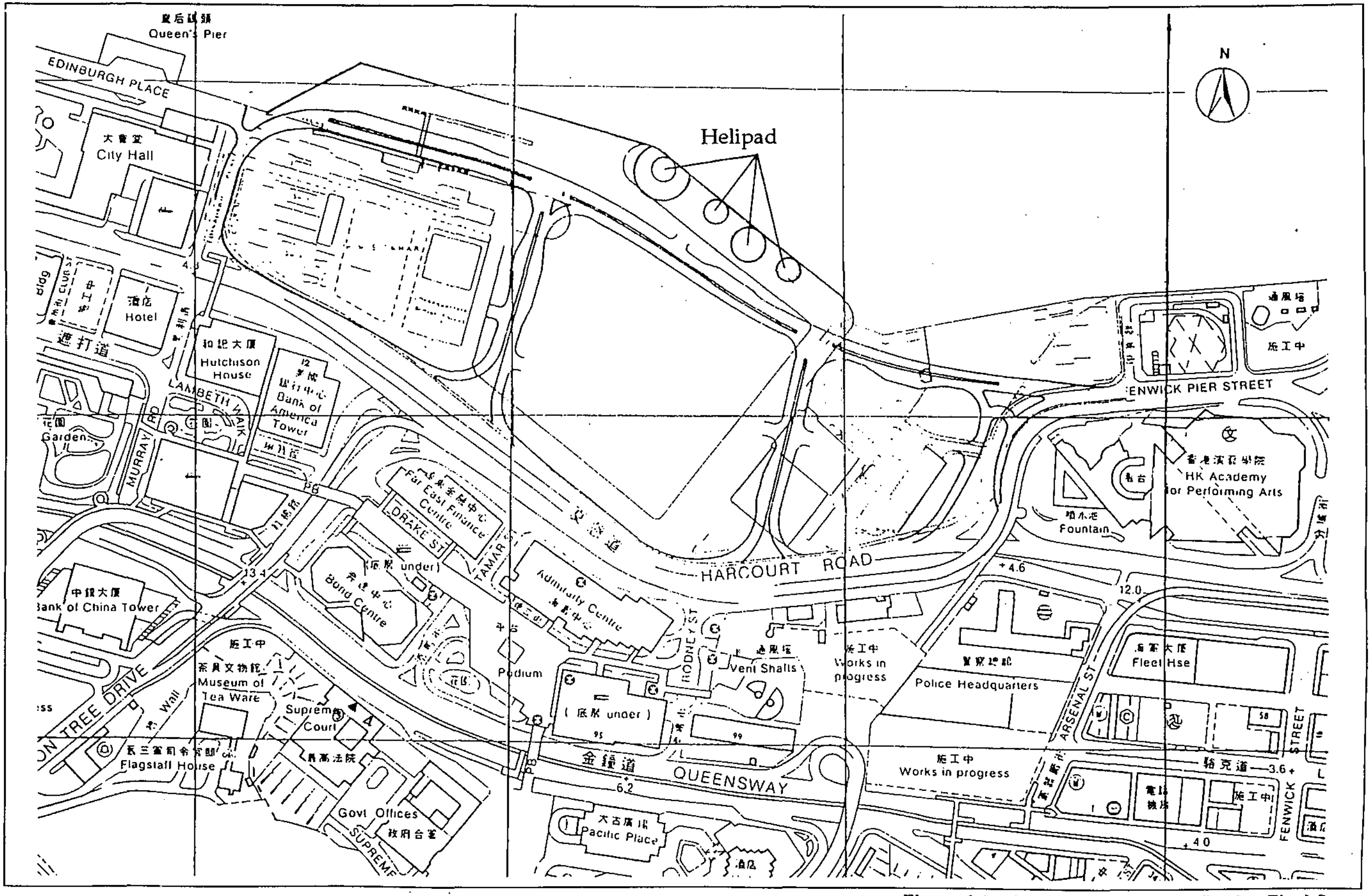


Figure 6.4 Locations of Helipads During Final Stage

Table 6.5.5 Predicted L_{max} at Sensitive Facades from Measured Noise Levels of Scout Helicopter during Take Off

Sensitive Facades	Scout from Army Air Force					
	Existing		Stage 2		Final Stage	
	L_{max} during Take Off, dB(A)	L_{max} in Level Flight, dB(A)	L_{max} during Take Off, dB(A)	L_{max} in Level Flight, dB(A)	L_{max} during Take Off, dB(A)	L_{max} in Level Flight, dB(A)
3	85.0		78.7		85.0	
4	85.4		79.5		85.4	
6	90.4		82.2		90.4	
7	91.5		81.7		91.5	
9	86.9		81.7		86.9	
10	86.9		83.5		86.9	
11	89.4		89.5		84.7	
13	90.8	88.2	82.0	79.2	90.8	88.2
14	90.8	88.2	81.6	78.7	90.8	88.2
18	90.3		81.3		90.3	
19	85.7		79.3		85.7	
20	85.7		79.7		85.7	

Note: The existing noise level at sensitive facade 11 was estimated based on the measured noise level of Sikorsky S76 because there is no Scout helicopter is presently being operated at Fenwick Pier Street helipad.

Predicted L_{max} at all sensitive facades during the Stage 2 helipad arrangements are within the HKPSG limit except sensitive facade 11. However, the predicted noise level at sensitive facade 11 during Stage 2 shows an approximately similar figure to existing conditions. Moreover, the sensitive receivers in the vicinity of the Fenwick Pier Street helipad are fitted with good quality windows and central air-conditioning system. Therefore, the helipad arrangement at Stage 2 will not cause any additional impacts on the sensitive facades.

Predicted L_{max} at sensitive facades 3, 4, 9, 10 and 11 during the final stage are within the HKPSG limit, but the L_{max} at sensitive facades 6, 7, 13, 14, 18, 19 and 20 exceed the guideline limit. However, the existing helicopter noise levels at the facades of 6, 7, 13, 14, 18, 19 and 20 were calculated to be the same as future levels. Noise at sensitive facade 11 is calculated to be marginally below the guideline limit. Comparing the distances of existing and proposed helipads to the facade, the predicted noise level should be lower than the existing helicopter noise because of the greater distance. It is concluded that the relocated helipads during the final stage will cause no additional impact when compared with the existing location.

6.5.5 Control and Mitigation

All sensitive facades have high quality glazing and air conditioning. In accordance with the HKPSG, these receivers are not considered to be sensitive to helicopter noise.

The flight path for the helicopter should be clearly defined to maximise the distance from sensitive facades. A minimum distance of 185 m should be maintained between the helicopters and sensitive receivers during level flight, in order to meet the HKPSG requirements. Obviously during the approach or take off this distance cannot be maintained. Noise from other types of helicopters should be assessed before being operated close to the affected area. Other mitigation measures are limited to use of quieter, or silenced helicopters. Such recommendations for operational changes are not controllable within the framework of this study.

6.5.6 Monitoring and Audit Requirements

Monitoring of helicopter noise should be undertaken if there are complaints. A monitoring station should be set up at the location where the complaint arises, as far as is practical. Otherwise, the assessment point should be in line with the sensitive facade and the location of the helipad. The monitoring results can then be adjusted to represent noise levels at the sensitive facade by means of standard acoustical principles and practice. However, it should be noted that future complaints with regard to noise would be directed at the helipad operators, with the subsequent responsibility for mitigation action falling to them.

7 CONCLUSIONS

7.1 Water Quality

The planned reclamation should not in itself have any impact on tidal water movements and overall water quality. The effluent arising from the increased population associated with Stages I and II of the development will be discharged via the Wanchai West Screening Plant and the increased discharge would have a localised effect on water quality characteristics in the immediate vicinity of the outfall. However, the increased discharge should not have a significant or observable impact on overall water quality in the harbour.

The construction of the new seawall will require the dredging of 101,000 m^3 of marine mud and this would increase suspended solid concentrations locally for the duration of the dredging period. A sediment plume may be generated and this could extend some distance either side of the dredging site, although the visual impact is expected to be limited due to the reduced concentrations high in the water column. With appropriate dredging practice, increases in suspended solid concentrations are expected to remain below approximately 0.01 kg/m^3 over most of the area affected. In view of the variability in the naturally occurring suspended solid concentrations and the short duration of the dredging exercise, it is not thought that the dredging would affect any local sensitive receivers such as cooling water intakes. Similarly, projected increases in BOD and corresponding reductions in Dissolved Oxygen concentrations are not considered to be significant in the present case. A monitoring and audit programme should be carried out during the dredging period to confirm this assessment, and appropriate mitigation/action plans developed on the basis of TAT levels to minimise any adverse impacts on intakes.

In terms of fill options, there will be little difference on water quality grounds since the area to be filled is contained. Although the potential for dispersion of materials is very limited it is likely that marine sand would be preferable for the purpose of exercising quality control over the materials entering the site and potential introduction of pollutants. If the site were to be utilised as a public dump it would be necessary to impose strict control on vehicles entering the site to ensure that putrescible material does not enter the site or the reclamation.

7.2 Waste Arising

Waste will be generated from the demolition of existing buildings and the sea walls in the Study area. Other waste will be generated as a result of general construction activity on the site. Utilising most of this material within the development, preferably in an area where oversized material can be accommodated without further processing, offers an opportunity to minimize the environmental impact arising from disposal of this material off-site.

Although utilisation of construction waste as fill material represents a useful opportunity for disposal of on-site generated material, on-site processing of materials to ensure compliance with the quality and size grading criteria will promote additional dust and noise sources. Of the disposal route options the use of marine fill is favoured on environmental grounds since it limits the number of on-site activities and the number of trucks accessing the site. In terms of land based sources the use of contractor sourced material is preferable for two reasons. First, regulation of the flow of vehicles and materials is more easily accomplished with contractor sourcing. Secondly, quality control becomes more difficult with intermittent supplies and extended stockpiling. Both have implications for noise and air quality.

The major proportion of dredged material removed for the formation of the seawalls is contaminated by trace metals and corresponds to Class C material suitable for Contained Disposal. It is proposed that this material will be disposed of at East Sha Chau Contained Disposal Facility and/or any alternative site specified by FMC/EPD. Dredging operations will be regulated by contract performance specifications and a monitoring and audit programme.

7.3 Air Quality

For both marine and land based fill material options, predicted dust levels during the construction phase will be high at some sensitive receivers, and dust suppression measures will be required to minimise this impact. Dispersion modelling indicates that less dust nuisance will occur with the marine based fill material option at all the sensitive receivers. Therefore, marine based fill material would be the preferable option in terms of air quality. For land based fill material, there will be no on-site size reduction and the only difference in the quantity of dust generated between operation as public dump, or the use of contractor sourced fill, will be determined by the frequency and distribution of vehicles and materials entering the site.

Dust suppression measures and their effectiveness were assessed, and specimen Contract Specifications are presented that provide a mechanism for implementation and control.

For the operational phase, all predicted concentrations for CO are compliant with statutory Air Quality Objectives. Modelling indicates that the 1-hour average concentrations for NO_2 and RSP will exceed the AQO of 300 μgm^{-3} and the acceptable limit of 346 μgm^{-3} respectively at ASR 7 and ASR 8 in both development stages. However, these two receptors are fitted with central air conditioning and the air intakes are installed at podium levels. The NO_2 levels at the height of air intakes will be reduced by approximate 30% and unacceptable air quality impact due to road traffic is not therefore expected. Assuming that the peak hour traffic volume consists of 7% of the daily traffic flow, according to the predicted 1-hour average RSP values and considering that worst case meteorological conditions rarely persisted in a day, exceedance of the RSP 24-hour AQO at ASR 7 and ASR 8 is not expected.

Odour impact that may arise from the pumping station of the sewerage system is considered within the Strategic Sewage Disposal Strategy Study. In order to control odour and meet current EPD requirements, an odour removal system will be incorporated into the pumping station ventilation system using activated carbon filters.

7.4 Noise

The construction noise assessment showed that the maximum noise levels at the buildings in the vicinity of the site would be between 78 - 87 dB(A) if public dump and contractor sourced materials were used for reclamation. However, the maximum noise levels at the sensitive receivers will be reduced to 76 - 84 dB(A) if marine fill is adopted for reclamation. Therefore, reclamation by using marine fill is recommended to minimise the noise impact. Buildings except those inside the Prince of Wales Barracks are not particularly sensitive to noise and have high quality glazing and air-conditioning which will attenuate received noise levels inside the building. Noise levels at the blocks inside Prince of Wales Barracks can be reduced by providing noise barriers of practical height to shield the direct line of sight to the construction activities from the blocks inside Prince of Wales Barracks.

Specific measures for noise mitigation are included in the Report, and specimen Contract Clauses are provided. A contractually binding day-time noise limit (normally 75 dB(A)) is recommended. Provision of such a requirement would severely limit the number of trucks allowed on site at any time. This may considerably lengthen the time period for formation of the reclamation.

From a noise perspective there is little difference between forming the reclamation from contractor sourced material, in comparison with the public dump option. However, there is a slight benefit in that the delivery routes of trucks can be controlled through the contract, thus preventing trucks using local roads or unsuitable routes for access to the site.

Road traffic noise assessment indicated that most of the sensitive facades in the vicinity of the proposed development were subjected to external facade noise levels higher than 70 dB(A).

Predicted traffic flows (and hence noise levels) for the design years will be lower than existing levels. Therefore, future traffic noise would not cause any additional noise impacts on these sensitive facades.

Existing buildings are not especially sensitive to traffic noise impacts, however, mitigation should be incorporated into the designs of future buildings.

The helicopter noise assessment indicates that the maximum noise levels at some sensitive facades close to the proposed helipads may exceed the HKPSG limits. However, the relocated helipads during the intermediate and final stages will not cause any additional impact on the receivers. Mitigation measures are limited, and would rely on changes to the helipad operations.

7.5 General

The Consultants conclude that on the basis of the predicted impacts, the use of marine sand for site formation poses fewer adverse environmental effects than the alternative contractor sourced fill or public dump options. The reduction of potential adverse air, noise and water impacts for this option results directly from reduced truck movements and on-site handling. The primary benefit of contractor sourcing is that it offers the opportunity to utilise valuable surplus materials. In view of the relatively small amount of fill required for the reclamation, the contractor can obtain marine sand from the approved marine borrow areas for other reclamation projects. It may none the less be concluded that from the perspective of the residents and adjacent buildings, noise and air quality deterioration would be a feature of both contractor sourcing and utilisation of public dump material, and it is therefore recommended that the preferred choice of marine fill is selected.

APPENDIX 1

CENTRAL AND WAN CHAI RECLAMATION DEVELOPMENT

Agreement No. CE 33/92

Tamar Basin Development

ENVIRONMENTAL ASSESSMENT

SCOPE OF WORK

1. Purpose of the Environmental Assessment

1.1 The purpose of the assessment is to provide information on the nature and extent of potential environmental impacts associated with the proposed Tamar Basin Development in CWRFS. This information will contribute to decisions on:

(i) the acceptability of any adverse environmental consequences that are likely to arise from the construction and operation of the development and related facilities and

(ii) conditions for the design, construction and operation of the project.

2. Objective of the Environmental Assessment

2.1 The objectives of the assessment are as follows:

(i) to describe the proposed development and related facilities for their development;

(ii) to identify and describe the elements of the community and environment likely to be affected by the proposed development;

(iii) to minimise pollution and nuisance arising from the various stages of development and its operation and environmental disturbance during construction and operation of the project;

(iv) to identify and evaluate the net environmental impacts and cumulative effects expected to arise during the construction and operation of the development in relation to the existing and planned community and neighbouring land uses;

(v) to identify methods, measures and standards to be included in the design, which may be necessary to mitigate these impacts and reduce them to acceptable levels;

(vi) to recommend environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted;

3. Technical Requirements of the Environmental Assessment Study

The Environmental Assessment Study shall include, but shall not necessarily be limited to the following tasks :-

3.1 Construction Phase Assessment

3.1.1 Noise Impact Study

(a) Identify interactions between noise sensitive receivers and construction activities to determine the extent of potentially unacceptable construction noise impacts. The assessment should follow the requirements contained in all ordinances & their Regulations governing the control of construction noise currently in force in Hong Kong and follow guidelines advised by the Director of Environmental Protection.

(b) Formulate appropriate noise control measures for inclusion in contract documentation.

3.1.2 Air Pollution Study

(a) Identify those construction activities likely to cause potential dust (or other air pollutant) problems to receptors.

(b) Recommend appropriate air pollution control measures for consideration in the design.

3.1.3 Water Quality Impact Study

(a) From a knowledge of the likely type, sequences and duration of construction activities required for project implementation, identify those activities likely to have an impact on the affected watercourse/water bodies. Such activities should include both on-site operations such as dredging and reclamation (e.g. by public dumping), etc and off-site operations such as borrowing and mud disposal.

(b) identify interactions between sensitive receivers and various pollutant sources from construction activities and sewerage discharge to determine the adverse effects (if any) of construction on water quality of watercourse/water bodies. In particular, assess the potential increase in turbidity levels, bacteria counts and biochemical oxygen demand and any subsequent decrease in dissolved oxygen level in the water column due to disturbance of bed sediments during dredging and arising from placement of ill, and the potential for release of metals, sulphides, ammonia or organics during dredging.

(c) Recommend appropriate mitigation and control measures for inclusion in contract documentation. Where appropriate, make suggestions for practical mitigation measures and monitoring for compliance.

3.1.4 Construction Waste Impact Study

(a) Identify the quantity, quality and timing of the waste, contaminated spoil/dredged materials, construction and demolition wastes, and surplus excavated material arisings as a result of the construction activities.

(b) Recommend suitable waste handling and disposal measures including considerations fro the reuse/recycling of surplus excavated materials and construction wastes for constrcution purpose so as to minimise the amount of wastes to be disposed of at landfills. Recommend suitable handling and disposal measuers for any contaminated spoils generated as a result of dredging and reclamation.

3.2 Operational Phase Assessment

3.2.1 Noise Impact Study

(a) Assess traffic noise impact to the identified noise sensitive receivers and proposed traffic noise amelioration measures if the predicted traffic noise level exceeds the HKPSG criteria.

(b) Assess Helipad operating noise impact and propose noise amelioration measures with respect to HKPSG criteria.

3.2.2 Air Pollution Modelling Study

(a) Assess the air pollutant levels at the receptors due to the proposed projects using dispersion model to be agreed with the Director of Environmental Protection.

(b) Assess odour impact due to the associated infrastructural facilities (e.g. sewerage systems).

(c) Proposed cost effective amelioration measures in situations where the predicted air pollution levels exceed the Hong Kong Air Quality Objectives.

3.2.3 Water Quality Impact Study

(a) Assess the adverse effects, if any, of the proposed infrastructures and facilities; marine deposits generated as a result of reclamation, existing storm drains and the sewage outfalls on the water quality of the waterhouse/water bodies. Assessment methodology shall be agreed with EPD.

(b) Determine qualitatively whether the presence of the reclamation will affect the hydraulics and water quality in the harbour.

(c) Recommend appropriate cost effective amelioration measures to minimise any adverse affects identified.

3.2.4 Sewerage Impact Study

(a) Identify the impact of reclamation and also the proposed development on the existing sewerage, screening plants and outfalls.

(b) Recommend appropriate cost effective amelioration measures/improvement works to minimise any adverse impacts identified.

3.3 Monitoring and Post-Project Audit Requirements

3.3.1 Environmental Monitoring

Define environmental monitoring requirements including any necessary programme for baseline, construction impact and compliance monitoring.

3.3.2 Post-Project Audit

Formulate environmental audit requirements including any necessary compliance and post-project audit programmes to review the environmental monitoring data. Assess compliance with regulatory requirements, policies and standards and identify and remedial works required to redress unacceptable consequential or unanticipated environmental impacts.

4. Reporting

The output of the assessment shall consist of an EIA study report which satisfies the requirements of this Brief in respect of the prediction and assessment of impacts, identification of necessary mitigation measures and specification of environmental monitoring and audit requirements. The report shall take into account any revisions and supplements as might be required by the Director of Environmental Protection.

APPENDIX 2

SAMPLE SPECIFICATION CLAUSES FOR

ENVIRONMENTAL PROTECTION

1. AVOIDANCE OF NUISANCE

(i) The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private rights of way as a result of his operations, including any deposits arising from the movement of plant or vehicles. The Contractor shall provide a vehicle cleaning facility at the exits from the works areas where excavated material is hauled, to the approval of the Engineer and to the requirements of the Commissioner of Police.

(ii) The Contractor shall ensure that existing stream courses and drains within and adjacent to works areas are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.

(iii) Water and waste products arising on works areas shall be collected, removed from works areas via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.

(iv) The Contractor shall construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the Works. He shall also provide adequate precautions to ensure that no spill or debris of any kind is allowed to be pushed, washed down, fall or be deposited on land or the seabed adjacent to works areas.

(v) In the event of any spoil or debris from construction works being deposited on adjacent land or seabed or any silt washed down to any area, then such spoil, debris or material and silt shall be immediately removed and the affected land or seabed and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.

Air Quality

2. GENERAL REQUIREMENTS

(i) The Contractor shall undertake measures to prevent dust nuisance as a result of his activities. Any air pollution control system installed shall be operated whenever the plant is in operation.

(ii) The Contractor shall not install any furnace, boiler or other similar plant or equipment using any fuel that may produce air pollutants without the prior written consent of the Director of Environmental Protection (DEP) pursuant to the Air Pollution Control Ordinance.

(iii) The Contractor shall not burn debris or other material on the works areas.

(iv) The Contractor shall implement dust suppression measures which shall include, but not limited, to the following:

(a) Stockpiles of sand and aggregate greater than 20 m^3 for use in concrete manufacture shall be enclosed on three sides, with walls extending above the pile and 2 m beyond the front of the pile.

(b) Effective water sprays shall be used during the delivery and handing of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen stored materials during dry and windy weather.

(c) Areas where there is a regular movement of vehicles shall have all-weather surfaces to a standard agreed with the Engineer and be kept clear of loose surface material.

(d) If used, conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimise dust emission. Conveyors carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

(e) Cement and other such fine grained material delivered in bulk shall be stored in closed silos fitted with a high level alarm indicator. The high level alarm indicators shall be interlocked with the filling line so that in the event of the hopper approaching an overfull condition, an audible alarm will operate and the pneumatic line to the filling tanker will close.

(f) Air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms. The fabric area shall be determined using an air-cloth ration (filtering velocity) of 0.01 - 0.03 m/s.

(g) Weigh hoppers shall be vented to a suitable filter.

(h) The filter bags in the cement silo dust collector must be thoroughly shaken after cement is blown into the silo to ensure adequate dust collection for subsequent loading.

(i) The provision of adequate dust suppression plant including water bowers with spray bars or means of applying surface chemical treatment. The details of which shall be submitted to an approved by the Engineer.

(j) Areas of reclamation shall be completed, including final compaction, as quickly as possible consistent with good practice to limit the creation of wind blown dust.

(k) Unless otherwise approved by the Engineer, the Contractor shall restrict all motorised vehicles on the work areas to a maximum speed appropriate to the quality of the haul roads and confine haulage and delivery vehicles to designed roadways inside the work areas.

(l) If applicable, the Contractor shall arrange blasting techniques so as to minimise dust generation.

(v) At any concrete batching plant or crushing plant being operated on the work areas the following additional conditions shall be complied with:

(a) Where dusty materials are being discharged to vehicles from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented through a suitable fabric filter system.

(b) Any vehicle with an open load carrying area used for moving potentially dust producing materials shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin in good condition. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

3. OPERATING MINERAL WORKS (CRUSHING PLANTS) ON WORK AREAS

The Contractor will not be allowed to operate Mineral Works (Crushing Plant) on the works areas.

4. MONITORING OF DUST (TSP) LEVELS

General Requirements

(i) The Contractor shall carry out the Works in such a manner as to minimise dust emissions during execution of the Works.

(ii) The Engineer may require equipment intended to be used on the Works to be made available for inspection and approval to ensure that it is suitable for the project.

(iii) The Contractor shall devise and arrange methods of working to minimise dust emissions, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(iv) Before the commencement of the Works, the Contractor shall submit to the engineer the proposed methods of working.

(v) After commencement of the Works if the equipment or work methods are believed by the Engineer to be causing serious air pollution impacts, remedial proposals shall be drawn up by the Contractor and, once approved by the engineer, implemented. In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to the pollution impacts. Where such remedial measures include the use of additional or alternative equipment such equipment shall not be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved equipment such equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(vi) If the Engineer finds the approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

(vii) The Contractor shall provide two high volume air samplers and associated equipment and consumables and shelters in accordance with Part 50 of Chapter 1 Appendix B of Title 40 of the Code of Federal Regulations of the USA within one week of the commencement of the Works. The samplers, equipment and shelters shall be constructed so as to be transferable between monitoring stations.

(viii) The Contractor shall construct suitable access, at each monitoring station in areas to be directed by the Engineer. Alternative locations may be necessary if difficulties arise in obtaining access, or if the locations become unsuitable.

The exact location and direction of the monitoring equipment at each monitoring station shall be agreed with the Engineer. Monitoring stations points shall be free from local obstructions or sheltering, subject to practical consideration.

(ix) The dust (TSP) levels will be measured by the "High Volume Method for the total suspended particulars" as described by the United States Environmental Protection Agency in 40 CFR Part 50.

(x) The Engineer will carry out baseline monitoring prior to the commencement of major construction works to determine and agree with the Contractor ambient dust (TSP) levels at each specified monitoring station. The baseline monitoring will be carried out for a period of at least two weeks, with measurements to be taken every day at each monitoring station.

(xi) Should the impact monitoring record dust levels which are indicative of a deteriorating situation so that closer monitoring is reasonably indicated, then the Engineer may instruct the Contractor to undertake daily impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

5. ACTION OF CONSTRUCTION DUST (TSP) LEVELS

(i) Where the Engineer determines that the recorded dust (TSP) level is significantly greater than the levels established in the baseline survey, the Engineer will direct the Contractor to take effective remedial measures including, but not limited to, reviewing dust source and modifying working procedures.

(ii) The Contractor shall inform the Engineer of all steps taken. Written reports and proposals for action shall be passed to the Engineer by the Contractor whenever the Engineer determines that air quality monitoring shows that the recorded dust (TSP) level is significantly greater than the levels established in the baseline survey or breaching the Air Quality Objectives, or accepted guidelines.

(iii) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

Water Pollution Control and Water Quality Monitoring

6. GENERAL REQUIREMENTS

(i) The Contactor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during the execution of the Works. In particular he shall arrange his method of working to minimise the effects on the water quality within the works areas, adjacent to the works areas, on the transport routes to and from the works areas and at the loading, and dumping areas.

(ii) If marine plant is used on the Works, it shall be inspected by the Engineer to ensure that the plant is suitable for the project and can be operated to achieve the water quality requirements (WQRs) detailed in Clause 8 of this appendix. The Contractor shall provide facilities to the Engineer for inspecting or checking such vessels and shall not use such vessels or plant for the Works without the approval of the Engineer. The Engineer may require the Contractor to carry out trials of any plant or vessels to prove their suitability.

(iii) The Contractor shall devise and arrange methods of working to minimise water pollution and to meet the WQRs and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(iv) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods of working.

(v) After commencement of the Works, if the plant or work methods are believed by the Engineer to be causing serious water pollution impacts, the Contractor shall propose remedial measures which may include, but not be limited to, the pollution avoidance measures outlined in clause 10 of this appendix. Where such remedial measures include the use of additional or alternative plant such plant shall not be used on the works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved plant, such plant shall not be used on the works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(vi) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

7. **DEFINITIONS**

(i) For use in this contract only, the following definition is used:-

(a) unsuitable material - material taken from the area of the Works. (including borrow areas), which is unsuitable for use as fill material. The material may include builders debris, spoil and hard material dumped by others.

8. **WATER QUALITY REQUIREMENTS - APPLICABLE IF THERE IS TO BE RECLAMATION FORMATION AS PART OF THE WORKS**

The Contractor shall minimise adverse impacts resulting from the dumping operations on water quality. To achieve these requirements the Contractor shall design and implement methods of working that:-

(a) minimise loss of material during transport of fill material;

(b) prevent discharge of fill material except at approved locations;

(c) prevent the avoidable reduction, due to the Works, of the dissolved oxygen content of the water adjacent to the Works;

9. **WATER QUALITY MONITORING EQUIPMENT - APPLICABLE IF THERE IS TO BE RECLAMATION FORMATION AS PART OF THE WORKS**

(i) The Contractor shall provide the following equipment within one week of the commencement of the Contract:-

(a) Dissolved oxygen and temperature measuring equipment

The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a DC power source. It shall be capable of measuring:-

* a dissolved oxygen level in the range of 0-20 mg/L and 0-200% saturation; and

* a temperature of 0-45 degree Celsius

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 30 m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary. (YSI model 58 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or similar approved).

(b) Turbidity Measurement Instrument

A portable, weatherproof turbidity-measuring instrument complete with cable, sensor and comprehensive operation manuals. The equipment shall be operable form a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-100 NTU and be complete with a cable at least 30 m long. (Partech Turbidimeter Model 7000 3RP mark 2 or similar approved).

(c) Suspended Solids Sampling Equipment

A 12 volt DC powered peristaltic pump equipped with a Tygon tubing of at least 30 m length.

(d) Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degree Celsius.

(e) Water depth Detector

A portable, battery-operated echo sounder. This unit can either be handheld or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme. (Seafarer 700 or similar approved).

(ii) Monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently re-calibrated at 3-month intervals throughout all stages of the water quality monitoring. Response of sensors an electrodes should be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg/L).

10. GENERAL PROCEDURES FOR THE AVOIDANCE OF POLLUTION DURING TRANSPORTING, AND DUMPING

(i) The Contractors' equipment shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

(ii) Pollution avoidance measures shall include but are not limited to the following:-

(a) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;

(b) vessels shall be sized so that adequate clearance is maintained between vessels and the sea bed at all sates of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

(c) pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;

(d) the marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the work areas or dumping grounds;

(e) barges shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

(f) excess material shall be cleaned from the decks and exposed fittings of barges before the vessel is moved;

The engineer may monitor vessels transporting material to ensure that no dumping outside the approved location takes place and that loss of material does not take place during transportation. The Contractor shall provided all reasonable assistance to the Engineer for these purposes.

(iii) The Contractor shall ensure that material is disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with conditions of a licence issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floatable and certain contaminated material (as defined by DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal.

11. REMOVAL OF WASTE MATERIAL

(i) Notwithstanding the provisions of the GCC the Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the works areas onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the works areas or onto any adjoining land and shall have all such matter removed from the works areas.

(ii) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(iii) The Contractor shall submit any proposed stream course and nullah temporary diversions to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition when the temporary diversion is no longer required.

(iv) The Contractor shall segregate inert construction waste material suitable for reclamation or land formation and shall dispose of such material at a public dumping area(s).

(v) Non-inert construction waste material deemed unsuitable for reclamation or land formation and other waste materials shall be disposed at a public landfill.

(vi) The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance.

12. DISCHARGE INTO SEWERS AND DRAINS

(I) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling or hot water without the prior consent of the relevant Authority who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.

(ii) If any office, site canteen or toilet facilities is erected, foul water effluent shall, subject to paragraph 12(i) above, be directed to a foul sewer or to a sewage treatment facility.

(iii) The Contractor's attention is drawn to the Buildings Ordinance, the Water Pollution Control Ordinance and the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters."

13 NOISE POLLUTION CONTROL

(i) The Contractor shall comply with and observe the Noise Control Ordinance and its subsidiary regulations in force in Hong Kong.

(ii) The Contractor shall provide an approved integrating sound level meter to IEC 651:1979 (Type 1) and 804:1985 (Type 1) for the exclusive use of the Engineer at all times. The Contractor shall maintain the meter in proper working order and provide a substitute when the meter is out of order or otherwise not available.

(iii) The addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday (including Sunday), the following requirements shall also be complied with:

(a) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A).

(b) The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A) [65 dB(A) during school examination periods].

The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

(c) Should the limits stated in the above sub-clauses (i) and (ii) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented.

(iv) Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

(v) The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(vi) The Contractor shall ensure that all plants and equipment to be used on site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers.

(vii) Notwithstanding the requirements and limitations set out in clause 3 above and subject to compliance with clauses 5 and 6 above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any durations provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

(viii) No excavator mounted breaker shall be used within 125 m from any nearby noise sensitive receivers. The Contractor shall use hydraulic concrete crusher whenever applicable.

(ix) The only equipment that shall be allowed on the Site for rock drilling works will be quiet drilling rigs with a sound power level not exceeding 110 dB(A). Conventional pneumatically driven drilling rigs are specifically prohibited.

(x) For the purposes of the above clauses, any domestic premises, hotels, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered a noise sensitive receiver.

(xi) The Contractor shall, when necessary, apply as soon as possible for a construction noise permit in accordance with the Noise Control (General) Regulations, display the permit as required an copy to the Engineer. The Contractor is to note that neither the Authority nor its employees can influence the issue or terms of a construction noise permit.

APPENDIX 3

Tamar Basin EIA
Station: 1
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
125	62	27.9671	8.952	8.896	17.9522	11.23	6.533	8.007	475.685	19.6525
126	62.5	25.6115	8.943	8.887	17.9593	10.26	6.94	8.094	476.29	17.955
127	63	25.5944	8.673	8.619	17.8748	9.28	6.843	8.066	476.894	16.24
128	63.5	25.4007	8.475	8.422	17.8803	8.79	6.49	8.048	476.894	15.3825
129	64	25.1935	8.196	8.145	17.8724	8.79	6.088	8.117	477.499	15.3825
130	64.5	25.0523	7.872	7.823	17.8732	8.3	5.762	8.112	478.103	14.525
131	65	24.9423	7.674	7.627	17.8568	8.79	5.607	8.094	478.103	15.3825
132	65.5	24.9072	7.558	7.51	17.8466	9.28	5.448	8.076	478.707	16.24
133	66	24.909	7.414	7.367	17.8521	11.72	5.264	8.066	478.707	20.51
134	66.5	24.8399	7.36	7.314	17.849	9.77	5.221	8.053	478.103	17.0975
135	67	24.7131	7.099	7.054	17.8411	8.79	5.177	8.044	475.081	15.3825
136	67.5	24.6398	6.757	6.715	17.8474	8.3	5.164	8.025	473.872	14.525
137	68	24.5748	6.442	6.402	17.8591	7.33	5.165	8.011	474.477	12.8275
138	68.5	24.5755	6.118	6.08	17.8818	6.84	5.101	8.002	475.685	11.97
139	69	24.5502	5.875	5.839	17.8897	6.35	5.054	7.993	476.894	11.1125
140	69.5	24.5946	5.731	5.695	17.8865	6.84	4.991	7.984	478.103	11.97
141	70	24.5558	5.65	5.615	17.8912	34.68	4.938	7.975	477.499	
142	70.5	24.4745	5.524	5.49	17.8959	15.14	4.897	7.965	478.707	
143	71	24.4853	5.255	5.222	17.8951	6.84	4.86	7.961	478.707	11.97
144	71.5	24.4716	4.994	4.963	17.8967	6.35	4.838	7.952	478.103	11.1125
145	72	24.4553	4.733	4.703	17.8983	6.35	4.812	7.947	477.499	11.1125
146	72.5	24.4763	4.562	4.534	17.8998	6.35	4.782	7.943	478.103	11.1125
147	73	24.5428	4.472	4.444	17.9006	6.35	4.756	7.943	478.707	11.1125
148	73.5	24.6055	4.355	4.328	17.8991	6.84	4.714	7.938	479.312	11.97
149	74	24.6314	4.157	4.131	17.8991	6.84	4.684	7.938	480.52	11.97
150	74.5	24.6409	3.96	3.935	17.8983	6.35	4.653	7.933	480.52	11.1125
151	75	24.6954	3.663	3.64	17.9084	6.35	4.618	7.933	481.729	11.1125
152	75.5	24.7285	3.402	3.381	17.9092	5.86	4.625	7.929	481.729	10.255
153	76	24.6935	3.105	3.086	17.9077	6.35	4.612	7.929	482.334	11.1125
154	76.5	24.6651	2.818	2.8	17.91	5.86	4.579	7.929	482.938	10.255
155	77	24.712	2.701	2.684	17.9092	6.35	4.559	7.924	483.542	11.1125
156	77.5	24.7242	2.629	2.612	17.9061	6.35	4.522	7.924	484.147	11.1125
157	78	24.676	2.656	2.639	17.9069	6.35	4.498	7.924	484.751	11.1125
158	78.5	24.6516	2.485	2.469	17.9069	6.35	4.473	7.92	485.356	11.1125
159	79	24.6615	2.134	2.121	17.9077	6.35	4.438	7.92	485.356	11.1125
160	79.5	24.7003	1.766	1.755	17.9077	6.35	4.46	7.92	485.96	11.1125
161	80	24.7517	1.46	1.451	17.9037	5.86	4.454	7.92	485.96	10.255
162	80.5	24.8349	1.173	1.165	17.9006	5.86	4.452	7.92	486.564	10.255
163	81	25.0336	0.939	0.933	17.9006	5.86	4.412	7.92	487.169	10.255
164	81.5	24.9779	0.894	0.888	17.9475	5.86	4.368	7.919	487.169	10.255
165	82	24.9	0.705	0.701	17.9147	6.35	4.285	7.915	487.773	11.1125
166	82.5	25.1301	0.427	0.424	17.9288	6.35	4.252	7.92	488.378	11.1125
167	83	26.1557	0.274	0.272	17.9382	6.35	4.275	7.915	488.378	11.1125
168	83.5	29.8081	0.139	0.138	17.9436	5.86	4.264	7.915	488.982	10.255

Tamar Basin EIA
Station: 2
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
218	108.5	28.6576	9.843	9.782	17.9521	10.74	6.835	3.594	475.6766	18.795
219	109	27.6577	9.816	9.755	17.9008	11.23	7.349	3.589	476.4817	19.6525
220	109.5	27.6352	9.753	9.692	17.8831	11.72	7.057	3.588	476.8266	20.51
221	110	27.6396	9.591	9.531	17.9015	11.23	6.739	3.593	476.9605	19.6525
222	110.5	27.5975	9.321	9.263	17.8995	10.74	6.519	3.593	477.6151	18.795
223	111	27.5751	9.078	9.022	17.8661	9.77	6.301	3.593	478.0459	17.0975
224	111.5	27.5137	8.646	8.592	17.8908	8.3	5.997	3.593	477.9252	14.525
225	112	27.476	8.295	8.244	17.9115	8.3	5.709	3.593	478.4816	14.525
226	112.5	27.4625	7.926	7.877	17.9119	9.28	5.661	3.593	478.8437	16.24
227	113	27.4188	7.567	7.519	17.928	7.81	5.482	3.593	478.0958	13.6675
228	113.5	27.3974	7.297	7.251	17.9362	7.81	5.465	3.594	474.8552	13.6675
229	114	27.3922	7.09	7.045	17.9357	8.79	5.379	3.594	473.7195	15.3825
230	114.5	27.3782	6.73	6.688	17.9408	7.81	5.247	3.594	474.3447	13.6675
231	115	27.3529	6.388	6.348	17.9725	7.33	5.243	3.594	475.759	12.8275
232	115.5	27.3472	6.1	6.062	17.969	7.81	5.183	3.594	476.657	13.6675
233	116	27.3353	5.776	5.74	17.9826	7.81	5.119	3.594	478.1118	13.6675
234	116.5	27.3156	5.425	5.392	17.9963	7.33	5.047	3.594	477.3779	12.8275
235	117	27.2929	5.057	5.025	18.0084	7.33	5.003	3.594	478.8281	12.8275
236	117.5	27.2843	4.913	4.882	18.0112	10.26	5.144	3.594	478.8697	17.955
237	118	27.2726	4.778	4.748	18.0147	12.7	4.95	3.594	478.1073	22.225
238	118.5	27.2643	4.499	4.471	18.015	8.79	4.862	3.594	477.6059	15.3825
239	119	27.2535	4.112	4.087	18.0193	6.84	4.772	3.594	478.0193	11.97
240	119.5	27.2476	3.771	3.747	18.022	6.84	4.7	3.595	478.6794	11.97
241	120	27.2393	3.591	3.568	18.0224	6.84	4.878	3.595	479.1249	11.97
242	120.5	27.2323	3.213	3.193	18.0227	6.84	4.732	3.595	480.611	11.97
243	121	27.2303	2.926	2.907	18.0215	6.35	4.658	3.595	480.6502	11.1125
244	121.5	27.1986	2.728	2.711	18.0587	6.35	4.59	3.595	481.5499	11.1125
245	122	27.167	2.701	2.684	18.0959	6.35	4.528	3.595	481.5593	11.1125
246	122.5	27.1354	2.692	2.675	18.1331	7.33	5.094	3.596	482.5262	12.8275
247	123	27.2118	2.593	2.577	18.0195	6.35	5.732	3.594	482.9194	11.1125
248	123.5	27.2059	2.332	2.318	18.0227	6.35	6.125	3.595	483.378	11.1125
249	124	27.2026	2.062	2.05	18.0219	6.35	6.284	3.595	484.355	11.1125
250	124.5	27.1995	1.937	1.925	18.0227	6.35	5.962	3.595	484.8201	11.1125
251	125	27.1937	1.928	1.916	18.0235	6.35	5.69	3.595	485.5268	11.1125
252	125.5	27.189	1.91	1.898	18.0227	6.35	5.457	3.595	485.4007	11.1125
253	126	27.1846	1.829	1.817	18.0235	6.35	5.282	3.595	486.0338	11.1125
254	126.5	27.1797	1.559	1.549	18.025	6.35	5.183	3.595	485.8097	11.1125
255	127	27.1777	1.244	1.237	18.0242	6.35	5.092	3.595	486.6343	11.1125
256	127.5	27.1716	0.93	0.924	18.0258	5.86	5.03	3.595	487.019	10.255
257	128	27.1667	0.624	0.62	18.0274	5.86	4.969	3.595	487.3851	10.255
258	128.5	27.1655	0.4	0.397	18.0274	5.86	4.91	3.595	487.9374	10.255
259	129	27.161	0.283	0.281	18.0282	5.86	4.848	3.595	488.5261	10.255
260	129.5	27.1572	0.184	0.183	18.0282	5.86	4.855	3.595	488.4744	10.255

Tamar Basin EIA
Station: 3
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
153	76	30.04764	8.979	8.923	18.0724	9.77	5.471	7.937	480.52	17.0975
154	76.5	29.04016	8.88	8.825	18.0716	9.28	5.483	7.937	480.52	16.24
155	77	28.54033	8.898	8.843	18.0591	9.77	5.884	7.937	481.125	17.0975
156	77.5	28.30307	8.763	8.709	18.0232	9.28	5.94	7.938	481.729	16.24
157	78	28.23535	8.646	8.592	18.0068	9.28	6.062	7.938	481.729	16.24
158	78.5	28.03941	8.529	8.476	17.9951	8.79	6.006	7.938	481.729	15.3825
159	79	28.03793	8.349	8.297	18.0036	8.3	5.713	7.938	481.729	14.525
160	79.5	28.03609	8.16	8.109	18.0193	8.3	5.484	7.938	482.334	14.525
161	80	28.02933	7.899	7.85	18.0435	9.28	5.198	7.933	482.334	16.24
162	80.5	28.03961	7.639	7.591	18.0638	9.28	5.019	7.933	482.938	16.24
163	81	28.03031	7.405	7.358	18.0747	9.28	5.144	7.933	483.542	16.24
164	81.5	28.04451	7.261	7.215	18.0646	8.79	4.831	7.928	484.147	15.3825
165	82	28.04518	7.171	7.126	18.0622	8.79		7.928	484.147	15.3825
166	82.5	28.02898	7.063	7.019	18.0614	8.79		7.928	484.751	15.3825
167	83	28.03447	6.937	6.893	18.063	8.79		7.928	484.751	15.3825
168	83.5	28.05022	6.766	6.724	18.0622	8.79		7.928	485.356	15.3825
169	84	28.04614	6.532	6.491	18.0599	8.3		7.928	485.356	14.525
170	84.5	28.03979	6.316	6.277	18.0544	8.3		7.928	485.96	14.525
171	85	28.02784	6.145	6.107	18.056	7.81	5.051	7.928	486.564	13.6675
172	85.5	28.04551	5.992	5.955	18.056	7.81	5.542	7.928	486.564	13.6675
173	86	28.0312	5.839	5.803	18.0552	7.81	5.663	7.933	487.169	13.6675
174	86.5	28.04266	5.686	5.651	18.0536	7.81	5.626	7.933	487.773	13.6675
175	87	28.03088	5.587	5.552	18.0528	8.3	5.558	7.933	487.773	14.525
176	87.5	28.05335	5.497	5.463	18.0528	7.81	5.495	7.933	488.378	13.6675
177	88	28.04229	5.246	5.213	18.0521	7.81	5.442	7.933	488.378	13.6675
178	88.5	28.03743	4.985	4.954	18.0521	7.81	5.427	7.933	488.982	13.6675
179	89	28.02738	4.742	4.712	18.0521	7.81	5.429	7.933	488.982	13.6675
180	89.5	28.05235	4.562	4.534	18.0528	7.33	5.439	7.933	489.586	12.8275
181	90	28.02761	4.418	4.391	18.0528	7.33	5.444	7.933	490.191	12.8275
182	90.5	28.04201	4.31	4.283	18.0544	6.84	5.437	7.933	490.191	11.97
183	91	28.05099	4.256	4.23	18.056	6.84	5.411	7.933	490.191	11.97
184	91.5	28.04663	4.094	4.069	18.0575	6.35	5.4	7.933	490.795	11.1125
185	92	28.04958	3.879	3.854	18.0591	5.86	5.399	7.933	491.4	10.255
186	92.5	28.02774	3.663	3.64	18.0786	5.86	5.383	7.928	491.4	10.255
187	93	28.05428	3.42	3.399	18.0934	6.35	5.359	7.928	492.004	11.1125
188	93.5	28.04467	3.285	3.265	18.0997	5.86	5.339	7.924	492.608	10.255
189	94	28.03444	3.123	3.104	18.102	5.86	5.315	7.924	492.608	10.255
190	94.5	28.0526	2.997	2.979	18.1036	6.35	5.315	7.919	493.213	11.1125
191	95	28.03325	2.926	2.907	18.109	6.35	5.308	7.919	493.213	11.1125
192	95.5	28.03913	2.863	2.845	18.1106	5.86	5.283	7.919	493.817	10.255
193	96	28.0475	2.71	2.693	18.1145	5.86	5.259	7.919	493.817	10.255
194	96.5	28.05204	2.503	2.487	18.1168	6.35	5.244	7.914	494.422	11.1125
195	97	28.04672	2.206	2.193	18.1184	6.35	5.215	7.914	494.422	11.1125
196	97.5	28.04059	1.973	1.96	18.1207	5.86	5.198	7.914	495.026	10.255
197	98	28.0415	1.82	1.808	18.1215	5.86	5.194	7.914	495.026	10.255
198	98.5	28.04021	1.694	1.683	18.1199	5.86	5.205	7.914	495.63	10.255
199	99	28.04711	1.568	1.558	18.1207	6.35	5.214	7.914	495.63	11.1125
200	99.5	28.05488	1.37	1.362	18.1207	6.35	5.225	7.914	496.235	11.1125
201	100	28.04022	1.164	1.156	18.1207	6.35	5.23	7.914	496.235	11.1125
202	100.5	28.05266	0.921	0.915	18.1199	6.35	5.233	7.914	496.839	11.1125
203	101	28.02736	0.678	0.674	18.1192	6.35	5.25	7.914	496.839	11.1125
204	101.5	28.03648	0.525	0.522	18.1192	5.86	5.253	7.91	496.839	10.255
205	102	28.05442	0.418	0.415	18.1192	6.35	5.265	7.914	497.444	11.1125
206	102.5	28.03672	0.247	0.245	18.1199	6.35	5.265	7.91	498.048	11.1125
207	103	28.03835	0.04	0.04	18.1192	6.35	5.271	7.91	498.048	11.1125

Tamar Basin EIA
Station: 4
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
158	78.5	27.7959	8.835	8.78	18.0136	11.23	5.898	7.97	492.608	19.6525
159	79	27.3622	8.826	8.771	17.987	11.23	6.125	8.103	492.608	19.6525
160	79.5	26.9449	8.547	8.494	17.9659	11.23	6.122	8.089	493.213	19.6525
161	80	26.2367	8.475	8.422	17.9558	10.26	6.04	8.144	493.817	17.955
162	80.5	25.7717	8.178	8.127	17.937	10.26	5.852	8.19	493.817	17.955
163	81	25.5187	7.935	7.886	17.9112	10.26	5.566	8.195	494.422	17.955
164	81.5	25.3594	7.773	7.725	17.8948	9.77	5.36	8.185	495.026	17.0975
165	82	25.2365	7.657	7.609	17.8846	10.26	5.182	8.167	495.026	17.955
166	82.5	25.1381	7.522	7.475	17.8744	10.26	5.068	8.149	495.63	17.955
167	83	25.0671	7.45	7.403	17.8658	10.26	4.941	8.135	496.235	17.955
168	83.5	25.0074	7.198	7.153	17.858	10.26	4.914	8.121	496.235	17.955
169	84	24.9188	6.883	6.84	17.8572	9.77	4.808	8.103	496.235	17.0975
170	84.5	24.8593	6.649	6.607	17.8533	10.26	4.502	8.076	496.839	17.955
171	85	24.807	6.505	6.464	17.8501	10.26	4.515	8.057	496.839	17.955
172	85.5	24.7676	6.388	6.348	17.847	10.26	4.517	8.044	497.444	17.955
174	86.5	24.6862	6.028	5.99	17.8431	9.28	4.866	8.021	498.048	16.24
175	87	24.6542	5.794	5.758	17.8408	9.28	4.456	8.012	498.048	16.24
176	87.5	24.6297	5.587	5.552	17.8408	9.28	4.371	8.007	498.048	16.24
177	88	24.6019	5.336	5.302	17.8486	8.3	4.275	7.998	498.652	14.525
178	88.5	24.5691	5.138	5.106	17.8603	7.81	4.358	7.989	499.257	13.6675
179	89	24.5441	4.895	4.864	17.8721	7.33	4.44	7.984	499.861	12.8275
180	89.5	24.5202	4.778	4.748	17.8775	7.33	4.36	7.979	499.861	12.8275
181	90	24.5055	4.607	4.578	17.8807	7.33	4.517	7.975	500.466	12.8275
182	90.5	24.4796	4.418	4.391	17.8854	6.84	3.992	7.966	501.07	11.97
183	91	24.463	4.238	4.212	17.8916	6.84	4.141	7.961	501.07	11.97
184	91.5	24.44	4.121	4.096	17.8979	6.35	4.159	7.956	501.674	11.1125
185	92	24.4279	3.987	3.962	17.901	7.33	4.163	7.952	502.279	12.8275
186	92.5		3.834	3.81	7.7994	6.84	5.35	7.986	502.279	11.97
188	93.5	24.3797	3.366	3.345	17.9175	6.35	4.094	7.942	503.488	11.1125
190	94.5	24.3499	3.258	3.238	17.9331	6.84	4.04	7.938	503.488	11.97
191	95	24.3457	3.114	3.095	17.9229	7.81	4.183	7.938	504.092	13.6675
192	95.5	24.3355	2.818	2.8	17.9229	6.84	3.96	7.938	504.092	11.97
193	96	24.3273	2.647	2.63	17.9237	6.35	3.934	7.933	504.092	11.1125
194	96.5	24.3171	2.53	2.514	17.9237	6.35	3.886	7.933	504.696	11.1125
195	97	24.309	2.35	2.335	17.9245	6.35	3.847	7.933	504.696	11.1125
196	97.5	24.2974	2.152	2.139	17.9268	6.35	3.913	7.933	505.301	11.1125
197	98	24.2849	1.919	1.907	17.9284	6.35	3.861	7.929	505.301	11.1125
198	98.5	24.2733	1.775	1.764	17.9308	6.35	3.843	7.933	505.905	11.1125
200	99.5	24.2579	1.352	1.344	17.9331	6.35	3.898	7.929	505.905	11.1125
201	100	24.2505	1.074	1.067	17.937	6.35	3.751	7.929	506.51	11.1125
202	100.5	24.2527	0.912	0.906	17.9378	6.35	3.736	7.929	506.51	11.1125
203	101	24.2453	0.876	0.871	17.9394	6.35	3.706	7.929	507.114	11.1125
204	101.5	24.2345	0.768	0.763	17.9425	6.35	3.686	7.929	507.114	11.1125
205	102	24.2251	0.606	0.603	17.9433	6.35	3.728	7.929	507.718	11.1125
206	102.5	24.2169	0.472	0.469	17.9464	6.35	3.702	7.929	508.323	11.1125
207	103	24.2109	0.274	0.272	17.948	6.35	3.809	7.929	508.323	11.1125
208	103.5	24.2087	0.049	0.049	17.9495	6.35	3.579	7.929	508.323	11.1125

Tamar Basin EIA
Station: 5
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
126	62.5	26.9327	8.826	8.771	17.9115	14.65	6.505	7.979	472.059	25.6375
127	63	28.9026	8.817	8.762	17.8685	15.63	6.529	7.988	472.059	27.3525
128	63.5	29.0503	8.79	8.735	17.8591	15.63	6.686	7.989	472.059	27.3525
129	64	28.5532	8.565	8.512	17.845	17.58	6.716	7.993	473.268	30.765
130	64.5	28.1481	8.538	8.485	17.8262	15.14	6.68	7.993	473.268	26.495
131	65	27.6942	8.412	8.36	17.8262	10.26	6.511	7.993	474.477	17.955
132	65.5	27.1971	8.223	8.172	17.8473	7.81	5.961	7.993	474.477	13.6675
133	66	26.75	8.088	8.038	17.8865	8.3	6.576	7.993	475.685	14.525
134	66.5	26.4018	7.989	7.94	17.9178	8.3	5.68	7.988	476.894	14.525
135	67	26.1911	7.863	7.814	17.9225	7.81	5.458	7.984	477.499	13.6675
136	67.5	25.9808	7.674	7.627	17.935	7.81	5.424	7.979	478.707	13.6675
137	68	25.7763	7.459	7.412	17.9616	7.33	5.18	7.974	478.707	12.8275
138	68.5	25.5988	7.243	7.197	17.9788	7.81	5.548	7.97	478.707	13.6675
139	69	25.451	7.045	7.001	17.9881	7.33	5.459	7.965	479.916	12.8275
140	69.5	25.3582	6.937	6.893	17.992	7.33	5.576	7.965	480.52	12.8275
141	70	25.2525	6.838	6.795	17.9983	7.33	5.36	7.961	481.125	12.8275
142	70.5	25.171	6.712	6.67	18.003	7.33	5.141	7.961	481.729	12.8275
143	71	25.0952	6.55	6.509	18.028	6.84	5.119	7.956	482.938	11.97
144	71.5	25.028	6.298	6.259	18.0413	7.33	6.287	7.951	484.147	12.8275
145	72	24.9604	6.019	5.982	18.0467	7.33	4.887	7.947	484.751	12.8275
146	72.5	24.9161	5.821	5.785	18.0498	6.84	4.926	7.942	485.356	11.97
147	73	24.8702	5.704	5.669	18.0514	6.84	4.629	7.942	485.96	11.97
148	73.5	24.8458	5.587	5.552	18.0514	6.84	4.482	7.937	486.564	11.97
149	74	24.8245	5.461	5.427	18.0506	6.84	5.084	7.933	487.773	11.97
150	74.5	24.8005	5.327	5.293	18.0522	7.33	4.889	7.933	488.378	12.8275
151	75	24.7841	5.147	5.115	18.0537	6.84	4.918	7.928	488.982	11.97
152	75.5	24.7589	4.94	4.909	18.0553	6.84	4.597	7.928	489.586	11.97
153	76	24.7485	4.742	4.712	18.0576	6.84	4.819	7.928	490.191	11.97
154	76.5	24.7288	4.535	4.507	18.0584	6.84	4.676	7.924	490.795	11.97
155	77	24.7122	4.31	4.283	18.0584	6.84	4.667	7.924	491.4	11.97
156	77.5	24.6986	4.211	4.185	18.0576	6.84	4.649	7.924	492.004	11.97
157	78	24.6853	4.085	4.06	18.0584	6.84	4.532	7.924	492.608	11.97
158	78.5	24.6798	3.96	3.935	18.0569	6.84	4.542	7.924	493.213	11.97
159	79	24.6589	3.726	3.702	18.0576	6.84	4.801	7.919	493.817	11.97
160	79.5	24.649	3.528	3.506	18.0592	6.84	4.515	7.919	494.422	11.97
161	80	24.6353	3.357	3.336	18.0608	6.84	4.438	7.919	495.026	11.97
162	80.5	24.6272	3.168	3.149	18.0615	6.35	4.268	7.919	495.026	11.1125
163	81	24.6218	2.935	2.916	18.06	6.35	4.258	7.919	495.63	11.1125
164	81.5	24.6171	2.755	2.738	18.0592	6.35	4.385	7.919	496.235	11.1125
165	82	24.6118	2.611	2.595	18.0553	6.35	4.468	7.919	496.839	11.1125
166	82.5	24.6046	2.422	2.407	18.0545	6.35	4.667	7.919	497.444	11.1125
167	83	24.6055	2.161	2.148	18.0467	5.86	4.271	7.919	498.048	10.255
168	83.5	24.6017	1.919	1.907	18.0381	5.86	4.221	7.919	498.048	10.255
169	84	24.5955	1.703	1.692	18.0358	5.86	4.086	7.919	498.652	10.255
170	84.5	24.5904	1.469	1.46	18.0358	5.86	4.205	7.919	499.257	10.255
171	85	24.5853	1.334	1.326	18.0358	5.86	4.256	7.919	499.861	10.255
172	85.5	24.581	1.244	1.237	18.0366	5.86	4.116	7.919	499.861	10.255
173	86	24.5776	1.164	1.156	18.0381	5.86	4.222	7.919	500.466	10.255
174	86.5	24.5759	0.984	0.978	18.0389	5.86	4.083	7.919	501.07	10.255
175	87	24.5689	0.75	0.745	18.042	5.86	4.398	7.919	501.07	10.255
176	87.5	24.5647	0.472	0.469	18.0428	5.86	4.224	7.919	501.674	10.255
177	88	24.5566	0.229	0.227	18.0436	5.86	4.022	7.919	502.279	10.255

Tamar Basin EIA
Station: 6
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
151	75	29.0034	10.681	10.614	17.9218	15.63	7.223	7.993	517.389	27.3525
152	75.5	29.0015	10.609	10.542	17.7887	14.65	7.222	7.975	516.784	25.6375
153	76	28.9837	10.311	10.247	17.7934	11.72	6.93	7.938	517.389	20.51
154	76.5	28.9373	10.266	10.202	17.777	9.77	6.428	7.915	517.389	17.0975
155	77	28.8869	10.212	10.149	17.7699	9.77	5.115	7.915	517.389	17.0975
156	77.5	28.8335	10.239	10.175	17.7707	9.77	5.255	7.929	500.466	17.0975
157	78	28.7799	10.212	10.149	17.7738	10.74	5.276	7.938	446.674	18.795
158	78.5	28.7299	10.068	10.005	17.7793	11.72	5.016	7.948	451.51	20.51
159	79	28.6709	9.843	9.782	17.7864	11.23	5.368	7.957	441.235	19.6525
160	79.5	28.6179	9.564	9.505	17.7887	10.26	5.175	7.961	446.674	17.955
161	80	28.5798	9.303	9.245	17.7887	10.26	5.172	7.97	450.301	17.955
162	80.5	28.5394	9.042	8.986	17.7958	9.28	5.182	7.975	453.927	16.24
163	81	28.4945	8.862	8.807	17.8036	9.28	4.98	7.98	456.949	16.24
164	81.5	28.4504	8.691	8.637	17.8122	9.28	4.918	7.98	459.971	16.24
165	82	28.41	8.583	8.53	17.8193	9.28	4.858	7.984	462.389	16.24
166	82.5	28.372	8.484	8.431	17.8248	11.23	5.84	7.984	466.015	19.6525
167	83	28.334	8.394	8.342	17.8303	9.28	5.221	7.984	468.433	16.24
168	83.5	28.3008	8.304	8.252	17.8365	8.79	5.008	7.989	470.85	15.3825
169	84	28.2715	8.115	8.065	17.8428	8.3	4.657	7.989	473.268	14.525
170	84.5	28.2411	7.908	7.859	17.8545	7.81	3.648	7.989	475.685	13.6675
171	85	28.2103	7.603	7.555	17.8631	7.81	4.223	7.989	477.499	13.6675
172	85.5	28.1806	7.369	7.323	17.8702	7.81	4.316	7.988	479.312	13.6675
173	86	28.1559	7.225	7.179	17.8757	7.33	4.494	7.988	481.729	12.8275
174	86.5	28.1327	7.18	7.135	17.8827	7.81	4.676	7.984	483.542	13.6675
175	87	28.108	7.045	7.001	17.8882	7.81	4.457	7.979	485.356	13.6675
176	87.5	28.0896	6.874	6.831	17.8921	7.33	4.407	7.979	485.96	12.8275
177	88	28.0699	6.676	6.634	17.896	7.33	4.46	7.975	487.169	12.8275
178	88.5	28.0503	6.451	6.411	17.8999	7.33	4.277	7.97	488.982	12.8275
179	89	28.0282	6.253	6.214	17.9093	7.33	4.261	7.97	490.191	12.8275
180	89.5	28.0024	6.01	5.973	17.9203	7.33	4.223	7.965	492.004	12.8275
181	90	27.9758	5.866	5.83	17.9343	7.33	4.199	7.965	493.817	12.8275
182	90.5	27.9543	5.776	5.74	17.939	6.84	4.234	7.961	495.026	11.97
183	91	27.9373	5.668	5.633	17.9429	6.84	4.177	7.961	496.235	11.97
184	91.5	27.914	5.497	5.463	17.9484	6.84	4.605	7.956	497.444	11.97
185	92	27.8941	5.21	5.177	17.9508	6.84	4.013	7.956	498.652	11.97
186	92.5	27.8642	5.021	4.989	17.968	7.81	4.008	7.956	499.861	13.6675
187	93	27.8351	4.778	4.748	17.9781	6.84	3.934	7.951	500.466	11.97
188	93.5	27.8124	4.616	4.587	17.9828	6.84	3.868	7.951	501.674	11.97
189	94	27.7901	4.49	4.462	17.9867	6.84	4.103	7.951	502.883	11.97
190	94.5	27.7745	4.301	4.274	17.9906	6.35	3.999	7.951	504.092	11.1125
191	95	27.757	4.085	4.06	17.9914	6.35	3.963	7.951	504.696	11.1125
192	95.5	27.7351	3.96	3.935	17.9969	6.35	3.942	7.951	505.301	11.1125
193	96	27.721	3.816	3.792	18.0024	6.84	3.917	7.951	505.905	11.97
194	96.5	27.7074	3.555	3.533	18.007	6.35	3.901	7.947	507.114	11.1125
195	97	27.6887	3.24	3.22	18.0156	6.35	3.885	7.947	508.323	11.1125
196	97.5	27.6673	2.961	2.943	18.0203	6.35	3.527	7.947	508.927	11.1125
197	98	27.6501	2.683	2.666	18.0266	6.35	3.738	7.947	509.531	11.1125
198	98.5	27.634	2.584	2.568	18.0274	6.35	3.797	7.942	510.74	11.1125
199	99	27.6238	2.566	2.55	18.0289	6.84	3.867	7.942	511.345	11.97
200	99.5	27.6163	2.512	2.496	18.0305	6.35	3.932	7.942	511.345	11.1125
201	100	27.6105	2.386	2.371	18.0313	6.84	3.775	7.942	511.949	11.97
202	100.5	27.6023	2.08	2.067	18.032	6.84	3.745	7.938	512.553	11.97
203	101	27.5946	1.73	1.719	18.032	6.35	3.731	7.938	513.158	11.1125
204	101.5	27.5868	1.469	1.46	18.032	6.35	3.713	7.938	513.762	11.1125
205	102	27.5759	1.343	1.335	18.0328	6.35	3.705	7.938	514.367	11.1125
206	102.5	27.5637	1.182	1.174	18.0336	6.35	4.551	7.938	514.971	11.1125
207	103	27.5538	1.056	1.049	18.0328	6.84	3.775	7.938	515.575	11.97
208	103.5	27.5458	0.921	0.915	18.0352	6.84	3.617	7.938	515.575	11.97
209	104	27.5388	0.75	0.745	18.0359	8.3	3.427	7.938	516.18	14.525
210	104.5	27.532	0.552	0.549	18.0383	6.35	3.245	7.938	516.784	11.1125

Tamar Basin EIA
Station: 7
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
119	59	32.9283	7.252	7.206	17.971	8.3	6.326	7.901	426.729	14.525
120	59.5	32.9304	6.829	6.786	17.9733	8.79	6.34	7.919	427.334	15.3825
121	60	32.9351	6.541	6.5	17.974	8.79	6.357	7.938	427.938	15.3825
122	60.5	32.9443	6.334	6.294	17.9724	8.79	6.381	7.951	428.542	15.3825
123	61	32.9436	6.28	6.241	17.9747	8.3	6.407	7.961	428.542	14.525
124	61.5	32.938	6.019	5.982	17.9783	8.3	6.441	7.965	429.751	14.525
125	62	32.9324	5.767	5.731	17.9819	8.3	6.476	7.97	429.751	14.525
126	62.5	32.9268	5.461	5.427	17.9855	8.3	6.49	7.974	430.356	14.525
127	63	32.9396	5.147	5.115	17.9699	8.79	6.484	7.979	430.96	15.3825
128	63.5	32.9369	4.94	4.909	17.9699	8.3	6.467	7.984	431.564	14.525
129	64	32.9377	4.706	4.677	17.9691	7.81	6.454	7.984	432.169	13.6675
130	64.5	32.9357	4.436	4.408	17.9683	7.81	6.46	7.984	432.169	13.6675
131	65	32.9298	4.22	4.194	17.9691	7.81	6.463	7.984	432.773	13.6675
132	65.5	32.9298	3.978	3.953	17.9676	8.3	6.475	7.988	433.378	14.525
133	66	32.9304	3.717	3.694	17.9652	7.81	6.487	7.988	433.982	13.6675
134	66.5	32.9278	3.438	3.417	17.9652	7.81	6.484	7.988	434.586	13.6675
135	67	32.9278	3.213	3.193	17.9637	7.81	6.494	7.988	435.191	13.6675
136	67.5	32.9266	2.89	2.872	17.9637	7.81	6.488	7.988	435.795	13.6675
137	68	32.9254	2.611	2.595	17.9637	7.81	6.495	7.988	436.4	13.6675
138	68.5	32.9255	2.314	2.3	17.9637	7.81	6.507	7.993	437.004	13.6675
139	69	32.9249	2.08	2.067	17.9629	7.81	6.516	7.988	437.608	13.6675
140	69.5	32.9243	1.874	1.862	17.9637	7.81	6.54	7.993	437.608	13.6675
141	70	32.9237	1.685	1.674	17.9644	8.3	6.549	7.993	438.213	14.525
142	70.5	32.9218	1.487	1.478	17.9652	7.81	6.556	7.993	438.817	13.6675
143	71	32.9206	1.155	1.147	17.9652	7.81	6.56	7.988	439.422	13.6675
144	71.5	32.92	0.858	0.853	17.9644	8.3	6.549	7.993	440.026	14.525
145	72	32.9196	0.49	0.486	17.9668	7.81	6.54	7.993	440.63	13.6675
146	72.5	32.9177	0.193	0.192	17.9676	7.81	6.519	7.993	440.63	13.6675
147	73	32.9166	−0.122	−0.121	17.9691	8.3	6.511	7.993	441.235	14.525
148	73.5	32.9206	−0.229	−0.228	17.9676	259.83	6.511	7.993	1236.015	454.7025
149	74	32.9235	−0.238	−0.237	17.9605	735.53	6.527	7.988	1236.015	1287.178
150	74.5	4.623	−0.086	−0.085	17.9433	526.5	7.775	7.993	1236.015	921.375
151	75	3.1715	−0.382	−0.38	17.8345	515.26	7.578	7.989	1236.015	901.705
152	75.5	3.6739	−0.4	−0.398	17.7507	1996.58	7.927	7.989	1236.015	3494.015
153	76	17.0624	−0.355	−0.353	17.6761	2000	7.431	7.989	1236.015	3500

Tamar Basin EIA
Station: 8
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
115	57	32.9228	7.818	7.77	17.9721	10.74	6.527	7.984	424.916	18.795
116	57.5	32.9354	7.63	7.582	17.9712	10.26	6.459	7.965	425.52	17.955
117	58	32.9298	7.701	7.653	17.9712	8.79	6.394	7.929	426.125	15.3825
118	58.5	32.9431	7.513	7.466	17.9695	8.79	6.339	7.901	426.125	15.3825
119	59	32.9283	7.252	7.206	17.971	8.3	6.326	7.901	426.729	14.525
120	59.5	32.9304	6.829	6.786	17.9733	8.79	6.34	7.919	427.334	15.3825
121	60	32.9351	6.541	6.5	17.974	8.79	6.357	7.938	427.938	15.3825
122	60.5	32.9443	6.334	6.294	17.9724	8.79	6.381	7.951	428.542	15.3825
123	61	32.9436	6.28	6.241	17.9747	8.3	6.407	7.961	428.542	14.525
124	61.5	32.938	6.019	5.982	17.9783	8.3	6.441	7.965	429.751	14.525
125	62	32.9324	5.767	5.731	17.9819	8.3	6.476	7.97	429.751	14.525
126	62.5	32.9268	5.461	5.427	17.9855	8.3	6.49	7.974	430.356	14.525
127	63	32.9396	5.147	5.115	17.9699	8.79	6.484	7.979	430.96	15.3825
128	63.5	32.9369	4.94	4.909	17.9699	8.3	6.467	7.984	431.564	14.525
129	64	32.9377	4.706	4.677	17.9691	7.81	6.454	7.984	432.169	13.6675
130	64.5	32.9357	4.436	4.408	17.9683	7.81	6.46	7.984	432.169	13.6675
131	65	32.9298	4.22	4.194	17.9691	7.81	6.463	7.984	432.773	13.6675
132	65.5	32.9298	3.978	3.953	17.9676	8.3	6.475	7.988	433.378	14.525
133	66	32.9304	3.717	3.694	17.9652	7.81	6.487	7.988	433.982	13.6675
134	66.5	32.9278	3.438	3.417	17.9652	7.81	6.484	7.988	434.586	13.6675
135	67	32.9278	3.213	3.193	17.9637	7.81	6.494	7.988	435.191	13.6675
136	67.5	32.9266	2.89	2.872	17.9637	7.81	6.488	7.988	435.795	13.6675
137	68	32.9254	2.611	2.595	17.9637	7.81	6.495	7.988	436.4	13.6675
138	68.5	32.9255	2.314	2.3	17.9637	7.81	6.507	7.993	437.004	13.6675
139	69	32.9249	2.08	2.067	17.9629	7.81	6.516	7.988	437.608	13.6675
140	69.5	32.9243	1.874	1.862	17.9637	7.81	6.54	7.993	437.608	13.6675
141	70	32.9237	1.685	1.674	17.9644	8.3	6.549	7.993	438.213	14.525
142	70.5	32.9218	1.487	1.478	17.9652	7.81	6.556	7.993	438.817	13.6675
143	71	32.9206	1.155	1.147	17.9652	7.81	6.56	7.988	439.422	13.6675
144	71.5	32.92	0.858	0.853	17.9644	8.3	6.549	7.993	440.026	14.525
145	72	32.9196	0.49	0.486	17.9668	7.81	6.54	7.993	440.63	13.6675
146	72.5	32.9177	0.193	0.192	17.9676	7.81	6.519	7.993	440.63	13.6675

Tamar Basin EIA
Station: 9
Instrument ID: E

Scan	Times	Sal	Pr	DepS	TO	Obs	Oxg Mg/L	pH	Orp	S.S
143	71	28.6162	14.111	14.023	17.8821	12.7	6.385	8.011	482.334	22.225
144	71.5	28.4888	14.012	13.925	17.8805	12.7	6.416	8.011	481.729	22.225
145	72	28.2742	13.688	13.602	17.8813	13.19	6.434	8.011	481.729	23.0825
146	72.5	27.305	13.418	13.334	17.8836	12.7	6.376	8.011	482.334	22.225
147	73	27.0406	12.941	12.86	17.8891	11.72	6.234	8.011	482.334	20.51
148	73.5	26.8234	12.679	12.6	17.8844	11.23	6.043	8.011	482.938	19.6525
149	74	25.7628	12.472	12.394	17.8813	11.23	5.84	8.011	482.938	19.6525
150	74.5	25.5128	12.337	12.26	17.8805	12.7	5.695	8.011	483.542	22.225
151	75	25.0382	12.211	12.135	17.886	21	5.579	8.011	484.147	
152	75.5	24.9405	12.058	11.983	17.8891	31.75	5.49	8.011	484.147	
153	76	24.8552	11.797	11.723	17.8883	14.65	5.425	8.011	484.751	
154	76.5	24.6672	11.446	11.374	17.9032	10.26	5.328	8.011	485.356	17.955
155	77	24.5973	11.059	10.989	17.9126	9.28	5.295	8.011	485.356	16.24
156	77.5	24.3968	10.762	10.694	17.9188	8.79	5.243	8.011	485.96	15.3825
157	78	24.3274	10.546	10.48	17.9188	8.3	5.195	8.011	486.564	14.525
158	78.5	24.2161	10.419	10.354	17.9181	8.3	5.158	8.011	486.564	14.525
159	79	24.1638	10.302	10.238	17.9196	8.3	5.158	8.011	487.169	14.525
160	79.5	24.1376	10.221	10.158	17.9227	8.79	5.051	8.011	487.169	15.3825
161	80	24.1256	9.978	9.916	17.9259	8.3	4.984	8.011	487.773	14.525
162	80.5	24.0974	9.681	9.621	17.9259	7.81	4.914	8.011	487.773	13.6675
163	81	24.0889	9.375	9.317	17.9274	7.81	4.857	8.011	488.378	13.6675
164	81.5	24.071	9.159	9.102	17.9274	7.81	4.843	8.011	488.982	13.6675
165	82	24.066	8.925	8.87	17.9251	7.81	4.794	8.011	488.982	13.6675
166	82.5	24.0626	8.826	8.771	17.9243	7.81	4.782	8.011	488.982	13.6675
167	83	24.0605	8.718	8.664	17.9259	7.81	4.707	8.011	489.586	13.6675
168	83.5	24.0563	8.628	8.574	17.9243	7.81	4.67	8.011	490.191	13.6675
169	84	24.0563	8.466	8.413	17.9243	8.3	4.636	8.011	490.191	14.525
170	84.5	24.0546	8.286	8.235	17.9251	7.81	4.598	8.011	490.795	13.6675
171	85	24.0522	8.061	8.011	17.9227	7.81	4.578	8.011	490.795	13.6675
172	85.5	24.0511	7.719	7.671	17.9204	7.81	4.535	8.016	491.4	13.6675
173	86	24.0444	7.477	7.43	17.9188	8.3	4.48	8.011	491.4	14.525
174	86.5	24.0428	7.261	7.215	17.9173	8.3	4.46	8.016	491.4	14.525
175	87	24.0364	7.18	7.135	17.9173	7.81	4.435	8.016	492.004	13.6675
176	87.5	24.0347	7.054	7.01	17.9181	7.81	4.411	8.016	492.608	13.6675
177	88	24.0292	6.901	6.858	17.9165	8.3	4.384	8.016	492.608	14.525
178	88.5	24.0275	6.712	6.67	17.9173	8.3	4.342	8.016	493.213	14.525
179	89	24.026	6.442	6.402	17.9157	7.81	4.319	8.016	493.213	13.6675
180	89.5	24.0173	6.055	6.017	17.911	8.3	4.274	8.016	493.213	14.525
181	90	24.0157	5.713	5.678	17.9095	8.3	4.261	8.016	493.817	14.525
182	90.5	24.0029	5.533	5.499	17.9095	8.3	4.241	8.016	493.817	14.525
183	91	24.0009	5.318	5.284	17.9087	8.3	4.218	8.016	494.422	14.525
184	91.5	23.9919	5.138	5.106	17.9087	8.3	4.198	8.016	494.422	14.525
185	92	23.9856	4.913	4.882	17.9087	8.3	4.164	8.016	495.026	14.525
186	92.5	23.9788	4.76	4.73	17.9071	8.3	4.136	8.016	495.026	14.525
187	93	23.979	4.454	4.426	17.9048	8.3	4.12	8.016	495.63	14.525
188	93.5	23.9774	4.157	4.131	17.9032	8.3	4.094	8.016	495.63	14.525
189	94	23.9741	3.879	3.854	17.9024	8.3	4.078	8.016	495.63	14.525
190	94.5	23.9729	3.582	3.56	17.9024	8.3	4.063	8.016	496.235	14.525
191	95	23.9708	3.366	3.345	17.9016	8.3	4.044	8.016	496.235	14.525
192	95.5	23.9687	3.258	3.238	17.9032	8.3	4.002	8.016	496.839	14.525
193	96	23.9687	3.159	3.14	17.9032	8.79	3.988	8.016	496.839	15.3825
194	96.5	23.9679	3.042	3.023	17.9024	8.3	3.969	8.016	496.839	14.525
195	97	23.9692	2.845	2.827	17.9024	8.3	3.94	8.016	497.444	14.525
196	97.5	23.9671	2.53	2.514	17.904	8.3	3.937	8.016	497.444	14.525
197	98	23.966	2.206	2.193	17.9016	8.3	3.952	8.016	498.048	14.525
198	98.5	23.9639	1.928	1.916	17.9032	8.3	3.903	8.02	498.048	14.525
199	99	23.9537	1.829	1.817	17.9032	8.3	3.876	8.016	498.652	14.525
200	99.5	23.9541	1.766	1.755	17.9024	8.3	3.84	8.016	498.652	14.525
201	100	23.9455	1.775	1.764	17.904	8.3	3.823	8.02	498.652	14.525
202	100.5	23.9473	1.685	1.674	17.9032	8.79	3.821	8.016	499.257	15.3825
203	101	23.9461	1.487	1.478	17.9032	8.3	3.8	8.02	499.257	14.525
204	101.5	23.9419	1.146	1.138	17.9016	8.3	3.788	8.02	499.861	14.525
205	102	23.939	0.84	0.835	17.9024	8.3	3.777	8.02	499.861	14.525
206	102.5	23.9305	0.534	0.531	17.9016	8.3	3.771	8.016	499.861	14.525
207	103	23.928	0.31	0.308	17.9016	8.3	3.75	8.016	500.466	14.525
208	103.5	23.9229	0.166	0.165	17.9016	8.3	3.72	8.02	500.466	14.525
209	104	23.9208	0.139	0.138	17.9008	8.3	3.702	8.016	501.07	14.525
210	104.5	23.9166	0.058	0.058	17.9016	8.3	3.691	8.02	501.07	14.525

Tamar Basin EIA
Station: 10
Instrument ID: 1A

Scan	TimeS	Sal	Pr	DepS	To	Obs	SS
102	50.5	33.6491	7.674	7.62	19.4014	10.74	18.795
103	51	33.6533	7.647	7.593	19.4006	11.23	19.6525
104	51.5	33.6455	7.397	7.345	19.4045	11.72	20.51
105	52	33.5788	7.155	7.105	19.406	11.72	20.51
106	52.5	33.5884	6.833	6.785	19.406	10.74	18.795
107	53	33.4875	6.627	6.58	19.4176	9.77	17.0975
108	53.5	33.5177	6.708	6.66	19.4199	137.73	
109	54	33.5202	6.878	6.829	19.4137	160.2	
110	54.5	33.5502	6.994	6.945	19.406	55.19	
111	55	33.5507	7.03	6.98	19.4083	63.49	
112	55.5	33.5495	6.94	6.891	19.4098	126.98	
113	56	33.5724	6.726	6.678	19.4199	104.52	
114	56.5	33.5656	6.52	6.474	19.4299	63	
115	57	33.578	6.439	6.394	19.416	63.98	
116	57.5	33.5731	6.466	6.42	19.4175	54.7	
117	58	33.592	6.529	6.483	19.4044	21.49	
118	58.5	33.6017	6.565	6.518	19.3982	29.3	
119	59	33.5856	6.565	6.518	19.399	25.89	
120	59.5	33.5682	6.457	6.412	19.4028	26.86	
121	60	33.5906	6.314	6.269	19.3943	20.02	
122	60.5	33.5873	6.135	6.092	19.4221	15.63	
123	61	33.5467	6.028	5.985	19.4623	9.77	17.0975
124	61.5	33.5584	6.019	5.976	19.4497	9.77	17.0975
125	62	33.5702	6.108	6.065	19.437	10.74	18.795
126	62.5	33.5819	6.198	6.154	19.4244	10.26	17.955
127	63	33.588	6.242	6.198	19.4198	10.74	18.795
128	63.5	33.5916	6.198	6.154	19.4214	9.77	17.0975
129	64	33.5726	6.028	5.985	19.4569	7.81	13.6675
130	64.5	33.5531	5.777	5.736	19.4932	6.84	11.97
131	65	33.519	5.598	5.559	19.5209	6.84	11.97
132	65.5	33.5159	5.536	5.496	19.5263	7.33	12.8275
133	66	33.5298	5.652	5.612	19.5194	7.81	13.6675
134	66.5	33.5244	5.813	5.772	19.5202	7.81	13.6675
135	67	33.5465	5.911	5.87	19.4971	9.28	16.24
136	67.5	33.5465	5.831	5.79	19.5002	8.79	15.3825
137	68	33.5376	5.607	5.568	19.5218	7.81	13.6675
138	68.5	33.5246	5.392	5.354	19.5588	7.33	12.8275
139	69	33.4761	5.24	5.203	19.5973	7.81	13.6675
140	69.5	33.4674	5.169	5.132	19.6112	7.33	12.8275
141	70	33.4927	5.222	5.186	19.6004	7.81	13.6675
142	70.5	33.4736	5.285	5.248	19.6243	7.81	13.6675
143	71	33.4784	5.267	5.23	19.6243	7.81	13.6675
144	71.5	33.492	5.16	5.123	19.6251	8.3	14.525
145	72	33.4836	5.061	5.026	19.6313	8.3	14.525
146	72.5	33.4902	4.981	4.946	19.6513	9.28	16.24
147	73	33.4763	4.865	4.83	19.6836	8.3	14.525
148	73.5	33.4646	4.722	4.688	19.7205	9.28	16.24
149	74	33.4101	4.605	4.573	19.7475	8.3	14.525
150	74.5	33.3898	4.552	4.52	19.7582	8.3	14.525
151	75	33.4166	4.552	4.52	19.7498	8.3	14.525
152	75.5	33.4111	4.587	4.555	19.7582	8.3	14.525
153	76	33.4075	4.596	4.564	19.7598	8.3	14.525
154	76.5	33.4348	4.543	4.511	19.7598	8.79	15.3825
155	77	33.459	4.409	4.377	19.7636	8.3	14.525
156	77.5	33.4629	4.176	4.147	19.7736	8.3	14.525
157	78	33.4277	3.979	3.951	19.7913	8.3	14.525
158	78.5	33.4084	3.872	3.845	19.8067	8.79	15.3825
159	79	33.4256	3.908	3.88	19.8059	8.79	15.3825
160	79.5	33.4012	3.997	3.969	19.8336	9.28	16.24
161	80	33.3897	4.033	4.005	19.8451	9.28	16.24
162	80.5	33.4139	3.917	3.889	19.8474	9.77	17.0975
163	81	33.4082	3.64	3.614	19.8666	9.28	16.24
164	81.5	33.3801	3.389	3.365	19.8873	8.79	15.3825
165	82	33.361	3.273	3.25	19.8996	8.79	15.3825
166	82.5	33.3706	3.309	3.285	19.892	11.23	19.6525
167	83	33.3552	3.398	3.374	19.8981	10.26	17.955
168	83.5	33.3532	3.434	3.41	19.905	9.77	17.0975
169	84	33.3786	3.345	3.321	19.9043	9.77	17.0975
170	84.5	33.3804	3.166	3.143	19.9066	9.28	16.24
171	85	33.3752	2.987	2.966	19.9073	8.79	15.3825

172	85.5	33.3547	2.889	2.868	19.9066	8.3	14.525
173	86	33.3542	2.853	2.833	19.9043	8.79	15.3825
174	86.5	33.366	2.808	2.788	19.9028	9.77	17.0975
175	87	33.3673	2.737	2.717	19.9028	8.79	15.3825
176	87.5	33.3532	2.692	2.673	19.9013	8.79	15.3825
177	88	33.361	2.674	2.655	19.899	9.28	16.24
178	88.5	33.3763	2.638	2.62	19.899	8.3	14.525
179	89	33.3799	2.486	2.469	19.899	8.79	15.3825
180	89.5	33.3795	2.299	2.282	19.8982	8.79	15.3825
181	90	33.3605	2.129	2.114	19.9044	8.79	15.3825
182	90.5	33.3521	2.093	2.078	19.9136	8.3	14.525
183	91	33.3527	2.102	2.087	19.9128	11.23	19.6525
184	91.5	33.3497	2.12	2.105	19.9167	10.26	17.955
185	92	33.3603	2.093	2.078	19.9182	8.79	15.3825
186	92.5	33.3633	1.995	1.981	19.919	8.79	15.3825
187	93	33.3454	1.843	1.83	19.9328	8.3	14.525
188	93.5	33.3027	1.682	1.67	19.975	8.79	15.3825
189	94	33.266	1.566	1.555	20.0125	8.3	14.525
190	94.5	33.2535	1.459	1.448	20.0255	8.3	14.525
191	95	33.2469	1.396	1.386	20.0309	8.3	14.525
192	95.5	33.2501	1.307	1.297	20.0255	8.3	14.525
193	96	33.2477	1.235	1.226	20.0301	8.3	14.525
194	96.5	33.243	1.173	1.164	20.0302	8.3	14.525
195	97	33.2441	1.101	1.093	20.0348	8.79	15.3825
196	97.5	33.2549	1.012	1.005	20.0271	8.3	14.525
197	98	33.2808	0.914	0.907	20.0019	8.3	14.525
198	98.5	33.2804	0.815	0.81	19.998	8.3	14.525
199	99	33.2669	0.744	0.739	19.9973	8.3	14.525
200	99.5	33.2716	0.762	0.756	20.0019	8.3	14.525
201	100	33.2686	0.797	0.792	20.0057	8.79	15.3825
202	100.5	33.284	0.797	0.792	19.9996	8.3	14.525
203	101	33.2905	0.726	0.721	20.0019	8.3	14.525
204	101.5	33.2888	0.512	0.508	20.0027	8.3	14.525
205	102	33.2721	0.235	0.233	20.0195	8.3	14.525
206	102.5	33.272	0.288	0.286	20.0211	8.3	14.525
207	103	33.2824	0.252	0.251	20.005	8.79	15.3825
208	103.5	33.2801	0.127	0.126	20.0081	8.79	15.3825
209	104	33.2747	0.02	0.02	20.0135	8.3	14.525

Tamar Basin EIA
Station: 11
Instrument ID: 1A

Scan	TimeS	Sal	Pr	DepS	To	Obs	SS
369	184	33.6749	10.262	10.189	19.3562	13.19	23.0825
370	184.5	33.6743	10.244	10.172	19.357	12.7	22.225
371	185	33.6784	10.262	10.189	19.3578	11.72	20.51
372	185.5	33.685	10.307	10.234	19.357	12.7	22.225
373	186	33.6904	10.307	10 234	19.3562	12.7	22.225
374	186.5	33.694	10.316	10.243	19.3562	12.21	21.3675
375	187	33.6659	10.289	10.216	19.357	11.23	19.6525
376	187.5	33.6117	10.092	10.02	19.3578	11.23	19.6525
377	188	33.6172	9.85	9.78	19.3554	13.19	23.0825
378	188.5	33.6221	9.626	9.558	19.3554	11.72	20.51
379	189	33.643	9.519	9.451	19.3547	12.21	21.3675
380	189.5	33.64	9.438	9.371	19.3554	11.23	19.6525
381	190	33.6162	9.313	9.247	19.3554	11.72	20.51
382	190.5	33.6157	9.116	9.051	19.3547	8.3	14.525
383	191	33.6158	8.919	8.856	19.3531	7.81	13.6675
384	191.5	33.6153	8.749	8.687	19.3523	7.81	13.6675
385	192	33.6339	8.587	8.527	19.3516	6.35	11.1125
386	192.5	33.6351	8.498	8.438	19.3531	6.35	11.1125
387	193	33.6267	8.399	8.34	19.3547	5.37	9.3975
388	193.5	33.6231	8.229	8.171	19.3562	5.86	10.255
389	194	33.6182	8.014	7.958	19.3639	5.37	9.3975
390	194.5	33.6155	7.8	7.744	19.3732	5.37	9.3975
391	195	33.6135	7.656	7.602	19.3817	4.88	8.54
392	195.5	33.6037	7.612	7.558	19.3894	5.37	9.3975
393	196	33.601	7.612	7.558	19.4003	5.37	9.3975
394	196.5	33.5961	7.576	7.522	19.4049	4.88	8.54
395	197	33.5991	7.442	7.389	19.4041	5.37	9.3975
396	197.5	33.605	7.245	7.193	19.4088	5.86	10.255
397	198	33.5996	7.003	6.954	19.4288	5.37	9.3975
398	198.5	33.5659	6.851	6.802	19.4589	4.88	8.54
399	199	33.5652	6.77	6.722	19.4628	5.37	9.3975
400	199.5	33.5627	6.743	6.696	19.4674	5.37	9.3975
401	200	33.5619	6.69	6.643	19.4744	4.88	8.54
402	200.5	33.5666	6.6	6.554	19.4775	4.88	8.54
403	201	33.5652	6.484	6.438	19.4852	4.88	8.54
404	201.5	33.5543	6.314	6.269	19.4929	5.37	9.3975
405	202	33.5657	6.108	6.065	19.4906	4.88	8.54
406	202.5	33.5669	5.902	5.861	19.4937	5.37	9.3975
407	203	33.5451	5.777	5.736	19.5091	5.37	9.3975
408	203.5	33.5438	5.715	5.674	19.5122	5.37	9.3975
409	204	33.5454	5.643	5.603	19.5176	4.88	8.54
410	204.5	33.5537	5.482	5.443	19.5191	4.88	8.54
411	205	33.5494	5.24	5.203	19.5261	5.37	9.3975
412	205.5	33.5374	5.044	5.008	19.5322	5.37	9.3975
413	206	33.5363	4.936	4.901	19.5322	5.37	9.3975
414	206.5	33.5374	4.847	4.813	19.5353	5.86	10.255
415	207	33.5475	4.659	4.626	19.5361	5.37	9.3975
416	207.5	33.5461	4.418	4.386	19.5453	5.86	10.255
417	208	33.5375	4.212	4.182	19.5577	6.35	11.1125
418	208.5	33.5143	4.042	4.013	19.5823	6.84	11.97
419	209	33.502	3.917	3.889	19.6155	7.33	12.8275
420	209.5	33.5078	3.684	3.658	19.6409	7.33	12.8275
421	210	33.4871	3.416	3.392	19.6655	7.33	12.8275
422	210.5	33.4688	3.175	3.152	19.684	7.33	12.8275
423	211	33.4628	2.996	2.975	19.6917	7.33	12.8275
424	211.5	33.4674	2.799	2.779	19.6978	7.33	12.8275
425	212	33.451	2.558	2.54	19.7155	7.33	12.8275
426	212.5	33.4419	2.37	2.353	19.7255	7.81	13.6675
427	213	33.4419	2.174	2.158	19.727	7.33	12.8275
428	213.5	33.4443	1.959	1.945	19.7286	7.81	13.6675
429	214	33.4419	1.7	1.688	19.7316	7.81	13.6675
430	214.5	33.4323	1.423	1.413	19.7409	7.81	13.6675
431	215	33.4179	1.146	1.138	19.7532	7.81	13.6675
432	215.5	33.3666	0.896	0.889	19.797	7.33	12.8275
433	216	33.3601	0.815	0.81	19.82	7.81	13.6675
434	216.5	33.3205	0.842	0.836	19.8461	7.81	13.6675
435	217	33.271	0.815	0.81	19.8952	8.3	14.525
436	217.5	33.1733	0.708	0.703	19.8998	7.81	13.6675
437	218	32.9465	0.449	0.446	20.0721	8.3	14.525
438	218.5	32.8602	0.297	0.295	20.2189	9.28	16.24
439	219	32.6205	0.145	0.144	20.2166	10.26	17.955

APPENDIX 4

BASE ENGINEERING DEPARTMENT
HMS TAMAR
BFPO 1

CLASSIFICATION	UNCLASSIFIED

Transmission Details		Document Details
Serial Number BE /94	DTG of Tx:	Reference: 95065/FNK 4060602
From: MR. SIMON YIU	Fax N°. 010 852 7460320	Subject: SITE HAZARD WORKSHOPS
To: MR. MATTHEW KO	Fax N°. 891 0305	Number of pages: 2

AUTHORISING OFFICER	Transmit Operator
Rank, Name & Appointment: WOMEA PEARSON SSO.	Rank/Grade & Name: LWTR C M CLEARY
Signature:	Signature:

DATE 7.6.94

ACTION/REPLY/COMMENT

PROJECT ☐ PROPOSAL ☐
FINANCIAL ☐ BOX FILE ☐
NUMBER ~~2586~~ 95065

BASE ENGINEERING DEPARTMENT
HMS TAMAR
BFPO 1

CLASSIFICATION	U\C

[illegible]		[illegible] Document De[illegible]
Serial Number	DTG of Tx:	Reference: CES (ASIA) LTD FAX DATED 30 MAY 94
From: WOMEA PEARSON SSO	Fax N°. 010852 7460320	Subject: SITE HAZARD WORKSHOPS EAST TAMAR
To: MATTHEW KO	Fax N°. 8910305	Number of pages: 3
[illegible]		[illegible] Op[illegible]
Rank, Name & Appointment: WOMEA(P) R PEARSON		Rank/Grade & Name:
Signature: [signature]		Signature:

Message/Remarks:
In reply to your request, the following list of hazardous substances were used in old Tamar, to the best of our knowledge.

- hydraulic oil om 33
- Engine oil om 113
- diesel fuel oil
- Anti freeze al 39
- Shellex
- Greases various
- Carbon cleaner
- Oil om 15
- Oil om 65
- Oil oep 70
- Px 10 cleaner
- Px 24 cleaner
- Hydrogen peroxide
- Mercury
- Sanding Sealer
- Cellulose thinners
- Bostik thinners
- Cellulose finish
- Varnish
- White spirit
- Bostic Glue
- Epoxy resin
- GRP resin
- Wood primer
- Paints various
- Acetone
- Battery acid

All hazardous substances were disposed of either in the original containers or sullage tank before being disposed of by contracters.

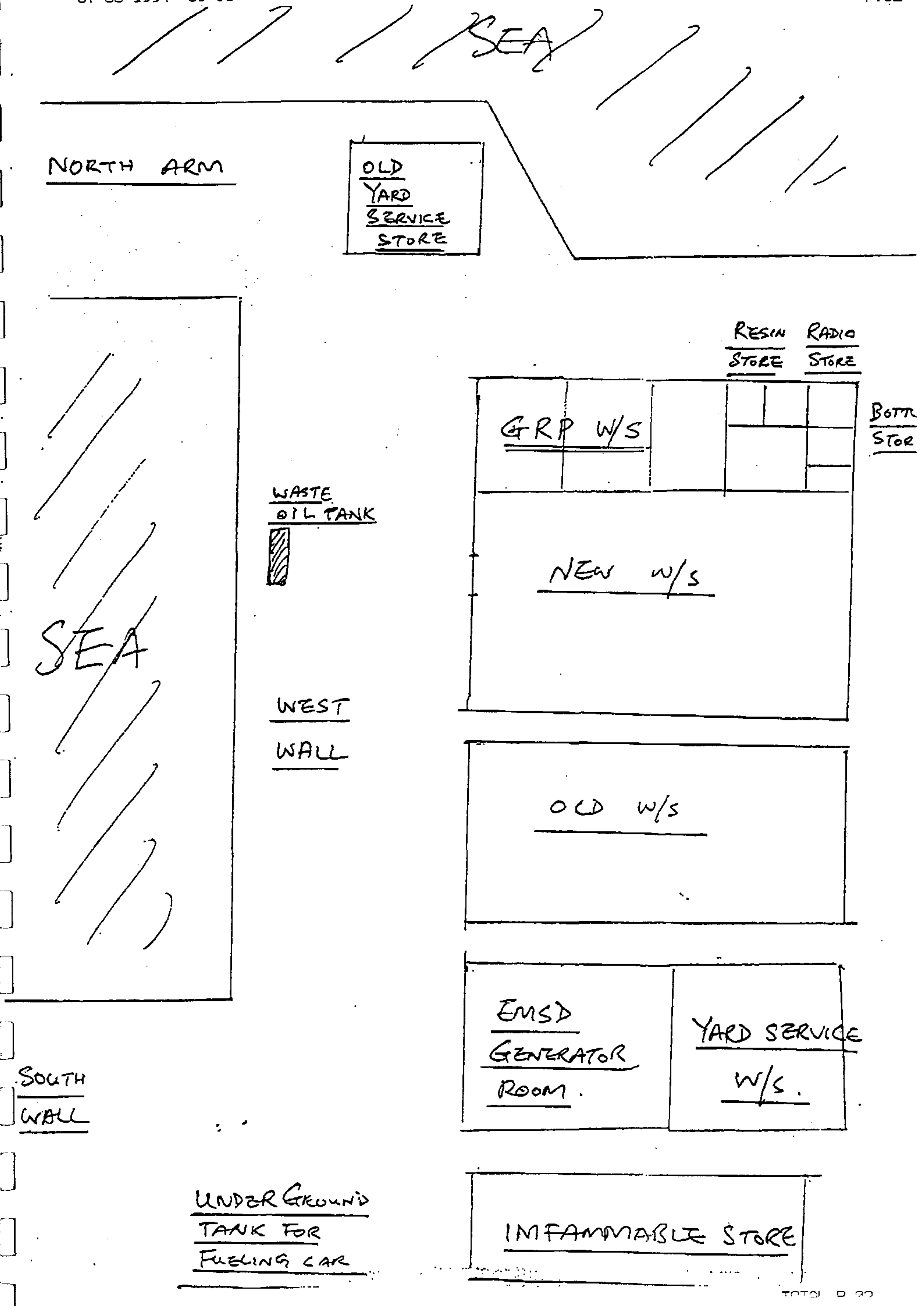
[illegible] [illegible] [illegible]

Please indicate whether the following materials have been used or stored at the workshop/depot

請指出以下材料是否曾在工廠應用

Material 材料	Possible Source 可能性來源	YES 是	NO 否
Fuels, lubricating oils, hydraulic fluid 燃油、潤滑油、水壓液體	Spillages, maintenance and dismantling of equipment. Scrapping tanks and pipeworks. 機械維修或拆卸所溢出。油缸及喉管清理	USED AND STORED	
Anticorrosive Paints, thinners 防銹油漆、溶劑	Application of anticorrosive coatings. 使用防銹塗層	USED AND STORED	
Antifouling Paint/coatings 防腐油漆/塗料	Application of antifouling coatings. 使用防腐塗層		NONE
Cleaning solvents 清洗溶劑	Engine room and equipment maintenance. 機房及機械維修	USED AND STORED	
Acids 酸液	Treating steel plate to remove millscale (historical). 清除鋼板上之污垢	BATTERY ACIDS USED & STORED	
Asbestos 石棉	Application and removal of engine room insulation. 使用及清除機房之隔熱材料		NONE
Transformer Oil (PCB) 變壓器油	Scrapping electrical equipment. 拆毀電動機械		NOT KNOWN

Material 材料	Possible Source 可能性来源	YES 是	NO 否
Blasting grit 打砂磨石	Treating steel plate to remove millscale. Removing old coatings, especially anti-foulings. 清除鋼板上之污垢 清除舊塗層,特別在防腐用途。		NOT USED
Coal, ash, oily tank and bilge sludges 煤、煤灰、油缸及積泥	Boiler room/engine room maintenance. Tank cleaning. 爐房/機房之維修 清理油缸。		ALWAYS REMOVED FROM SITE
Finely divided metal wastes 微細金屬廢料	Grinding and milling operations, especially weld joints. 打磨操作,特別在燒焊接合處	MINIMUM SWARF REMOVED FROM SITE REGULARLY	
Electrical wiring 電線	Electrical installation, maintenance scrapping electrical equipment. 電器安裝、維修及清理電力設備	USED AND STORED	
Low-level radioactive waste 低放射性廢料	Scrapped instruments. 清理儀器		NOT STORED OR USED
Polyurethane foam 聚氨酯泡沫	Hull manufacture/maintenance 船身製造及維修		NONE USED
Wood preservatives 木材防腐劑	Timber treatments 木材處理	USED AND STORED	


SEA
NORTH ARM
OLD YARD SERVICE STORE
RESIN STORE
RADIO STORE
BOTT STOR
GRP W/S
WASTE OIL TANK
NEW W/S
SEA
WEST WALL
OLD W/S
EMSD GENERATOR ROOM.
YARD SERVICE W/S.
SOUTH WALL
UNDERGROUND TANK FOR FUELING CAR
INFLAMMABLE STORE