Agreement No. CE 42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun – Investigation

Environmental Impact Assessment Report

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1 INTRODUCTION

1.1 Background

In February 2006, Mott Connell Limited (MCL) was commissioned by Water Supplies Department under Agreement No. CE 42/2005(WS) to carry out the investigation and preliminary design for the "Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun" (The Project).

The need for the project has evolved from the requirement to provide security of water supply between Hong Kong and Kowloon. Specifically, it has been determined that 10 years' time, two of the existing four cross-harbour pipelines transferring portable supplies to Hong Kong Island will reach their design life of 50 years. There will be increasing risk of having one cross-harbour pipeline under maintenance while another pipeline has to be taken out of service without warning.

As cross-harbour pipelines are strategically important, it is necessary to lay a new cross-harbour pipeline on the western part of the harbour for maintaining the reliability of cross-harbour water transfer to Hong Kong Island.

The primary objective of this Assignment is to study the feasibility of providing laying of this additional submarine watermain and associated land mains. The Project and the Environmental Impact Assessment (EIA) is charged with identifying alternative sites and alignments if necessary as part of the EIA study for the Project, and obtaining an Environmental Permit (EP). This Assignment requires preliminary designs, contract strategy, programmes and cost estimates to be prepared to enable the detailed design to proceed. This Environmental Impact Assessment (EIA) Report is a key milestone of the Assignment and has been prepared in conjunction with other design teams.

The route of the proposed watermains is shown in **Figure 1.1**. The proposed Project is to construct and operate a new western cross harbour main and associated land mains.

The scope of the proposed Project comprises the following:

(i) approximately 2100-metre section of 1200mm nominal diameter of submarine watermain across Victoria Harbour from its connection at Lin Cheung Road in West Kowloon to the existing Sai Ying Pun Fresh Water Pumping Station in Sheung Wan (a designated project under EIA Ordinance);

(ii) approximately 2200-metre section of 1200mm nominal diameter of associated land watermains (Not a designated project under EIA Ordinance).

1.2 The Environmental Impact Assessment Study

The submarine watermain component (referred in Section 1.1(i) above) of the Project is a Designated Project under Schedule 2, Part 1(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project. An application (No. ESB-132/2005) for a EIA study brief under section 5(7)(a) of the EIAO was submitted by

Water Supplies Department on 30 August 2005 with a project profile No. PP-258/2005 (the Project Profile). The EPD issued an EIA Study Brief No. ESB-132/2005 on 13 October 2005, detailing the requirements for carrying out and reporting the EIA study.

The purpose of the EIA study is to provide information on the nature and extent of environmental impacts arising from the construction of the proposed designated project and related activities taking place concurrently, ultimately providing information on the following:

(i) the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed project;

(ii) the conditions and requirements for the detailed design, construction and operation of the proposed project to mitigate against adverse environmental consequences wherever practicable; and

(iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

The scope of the EIA covers the Project proposed in the Project Profile and the works and facilities mentioned in Section 1.1 above. The EIA study addresses the key issues described below, together with any other key issues identified during the course of the EIA study and the cumulative environmental impacts of the Project, through interaction or in combination with other existing, committed, and planned and known potential developments in the vicinity of the Project:

(i) the potential water quality and marine ecology impacts arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain.

(ii) the potential noise and dust impacts arising from the construction works of the Project.

(iii) the potential impacts on sites of cultural heritage of marine archaeological deposit likely to be affected by the construction works of the Project.

(iv) the potential fisheries impact arising from the Project.

The EIA study addressed all environmental aspects of the activities and has been based on the best and latest information available during the course of the EIA study. The cumulative environmental impacts from the Project with other interacting projects were assessed, including details of the construction programme and methodologies.

Previously approved studies or EIA reports which are relevant to the Project were reviewed and relevant information extracted for the purpose of this EIA study. The following study or EIA report has been referred to:

- Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Production Plant, Hong Kong

1.3 The Project Area

The proposed Project covers three main areas, namely: Victoria Harbour, West Kowloon and Sai Ying Pun.

The works for Victoria Harbour (a designated project under EIA Ordinance) is envisaged to comprise an approximately 50m wide corridor across Victoria Harbour linking West Kowloon with Sai Ying Pun.

The works in West Kowloon (Not a designated project under EIA Ordinance) generally comprise the West Kowloon Reclamation Area adjacent to the Western Harbour Tunnel Toll Plaza, and are bounded by Jordan Road to its north and Lin Cheung Road to its east. The land uses in this portion include the land reserved for the West Kowloon Cultural District, the Kowloon Station Development, the Wui Cheung Road Bus Terminus, the Yau Ma Tei Public Cargo Working Area, and the Western Harbour Tunnel Toll Plaza. The proposed 1200mm diameter fresh watermain will be laid in this portion for connection to the existing 1200mm diameter fresh watermain at the junction of Lin Cheung Road or Wui Cheung Road.

In Sai Ying Pun (Not a designated project under EIA Ordinance), the works comprise Sai Ying Pun area adjacent to Western Wholesale Food Market and is bounded by the approaches of Western Harbour Crossing Interchange. The proposed 1200mm diameter fresh watermain will be laid in this portion for connection to the existing Sai Ying Pun Fresh Water Pumping Station situated at the junction of Water Street/Fung Mat Road.

This EIA report covers the designated project component of the Project.

1.4 Environmental Impact Assessment Ordinance

As detailed in Section 1.2, the proposed submarine watermain is a Designated Project under Schedule 2, Part1(E3) of the EIAO (Cap. 499) and an EP issued under the EIAO is required for the construction and operation of the designated project.

To apply for an EP, an EIA must be undertaken in accordance with the requirements of the Study Brief issued by EPD on 13 October 2005, under reference No. ESB-132/2005. Reference can be made to the full requirements of the Study Brief which is contained in **Appendix A**.

The EIA has been conducted in accordance with the Study Brief, the Project Profile (No. PP-258/2005) and the criteria in the relevant sections of the Technical Memorandum on the EIA Process (Environmental Impact Assessment Ordinance) (EIAO-TM). The EIA has identified, described, predicted and evaluated potential environmental impacts, mitigation measures and will consider the impacts of any feasible alternatives.

The EIA Study assessed and discussed the alternative alignments and landing points of the proposed submarine watermain, alternative construction methods and sequences, and to compare their environmental benefits and dis-benefits with the view of selecting the preferred options from the environmental perspective.

The objectives of the EIA Study as detailed in the EIA Study Brief are as follows:

(i) to describe the Project and associated works together with the requirements for carrying out the Project;

(ii) to identify if there are other types of Designated Projects under Part I Schedule 2 of the EIAO to be covered in the Project;

(iii) to consider alternative alignment(s) and landing points of the submarine watermain, alternative construction method(s) and sequence(s), and to compare their environmental benefits and dis-benefits with the view of selecting the preferred options from the environmental perspective;

(iv) to identify and describe the elements of the community and environment likely to be affected by the proposed project and/or likely to cause adverse impacts to the proposed project, including both the natural and man-made environment;

(v) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(vi) to identify and quantify any potential losses or damage to flora, fauna and natural habitats and to propose measures to mitigate these impacts;

(vii) to identify any negative impacts on fisheries and to propose measures to mitigate these impacts;

(viii) to identify any negative impacts on sites of cultural heritage and to propose measures to mitigate these impacts;

(ix) to propose the provision of infrastructure or mitigation measures so as to minimize pollution, visually intrusive sediment plume dispersion, environmental disturbance and nuisance during construction of the project;

(x) to investigate the feasibility, practicability, effectiveness of the proposed mitigation measures.

(xi) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction phase of the project in relation to the sensitive receivers and potential affected uses;

(xii) to identify, assess and specify methods, measures and standards, to be included in the detailed design and construction of the project which are necessary to mitigate these environmental impacts and reducing them to acceptable levels;

(xiii) to investigate the extent of secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study as well as subsequent provision of necessary modifications;

(xiv) to design and specify the environmental monitoring and audit requirements, if required, to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.

1.5 Documents Reviewed

Particular attention has been given to the following document when undertaking this EIA Study:

- Final EIA Report, Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Production Plant, Hong Kong

2 CONSIDERATION OF ALTERNATIVES

2.1 Need for the Project

The need for the project has evolved from the requirement to provide security of water supply between Hong Kong and Kowloon. Specifically, it has been determined that 10 years' time, two of the existing four cross-harbour pipelines transferring portable supplies to Hong Kong Island will reach their design life of 50 years. There will be increasing risk of having one cross-harbour pipeline under maintenance while another pipeline has to be taken out of service without warning.

As cross-harbour pipelines are strategically important, it is necessary to lay a new cross-harbour pipeline on the western part of the harbour for maintaining the reliability of cross-harbour water transfer to Hong Kong Island.

2.2 Tentative Construction Programme

The construction of the proposed Project is scheduled to commence in September 2008 for completion by May 2011. The tentative project programme is given in **Appendix B**.

2.3 Consideration of Alternative Alignment Options

2.3.1 Physical Constraints to the Alignment

There are several major installations and underground structures within the study area which are considered to be physical constraints to the alignment of the proposed submarine watermain. These include:

- Kowloon South Salt Water Pumping Station and associated existing seawater intake culvert;
- Tunnel structure and Toll Plaza of the Western Harbour Crossing;
- DSD's drainage culvert next to Sai Ying Pun Fresh Water Pumping Station; and
- Proposed submarine gas main between West Kowloon and Sai Ying Pun.

The choice of landing points of the submarine watermain is limited by the locations of connection point to the existing water supply network in West Kowloon and the Fresh Water Pumping Station at Sai Ying Pun.

As shown on the **Figure 2.1**, the proposed submarine watermain is bounded by the Western Cross Harbour Tunnel and the proposed submarine gas main to the east. The existing seawater intake culvert for Kowloon South Salt Water Pumping Station, Yau Ma Tei Typhoon Shelter and proposed Western Kowloon Culture District development at West Kowloon and the Western AFCD Wholesale Food Market at Sai Ying Pun also affect the land availability for the landing point of the submarine watermain. By considering the physical constraints discussed above, the most feasible landing points are at the waterfront area next to the Kowloon South Salt Water Pumping Station at West Kowloon and the waterfront area next to the existing AFCD Western Wholesale Food Market at Fung Mat Road of Sai Ying Pun, which would lead to the shortest alignment across the Victoria Harbour with the least marine traffic impact.

2.3.2 Routing Constraints of the Alignment

The submarine watermain is proposed to be laid across the Victoria Harbour at a minimum depth of approximately 6m below the dredged seabed level and to interface with land mains at the landing points in West Kowloon and Sai Ying Pun. The proposed horizontal alignment will keep a minimum separation of 50m as far as practicable from the existing or planned marine installations. As the alignment of the submarine watermain is mainly dictated by the locations of the landing points, which constraints has been illustrated and discussed in section 2.3.1, therefore, the shortest and the most feasible route for this portion is straight between the dictated landing points such that the impact on water quality be minimized and impact on marine traffic is minimal. The alignment of submarine watermain is shown in **Figure 2.2**.

2.4 Consideration of Alternative Construction Methods and Works Sequences

The methods commonly used to install submarine watermain include dredging to form the trench followed by “bottom pull”, “lay barge” or “float and sink” followed by backfilling to protect the pipeline or, “horizontal directional drilling”.

For submarine watermain installations, dredging involves the removal of marine sediments from the seabed to form the trench, into which the submarine watermain are laid by possible methods including Bottom Pull, Lay Barge or the Float and Sink Method. Backfill material will be placed on top to protect the pipeline and minimize the cross section of dredging and backfilling works. The longitudinal profile and a typical cross section of the submarine watermain are provided in **Figure 2.3**. Design of the cross section and the resulting amount of marine sediments to be dredged from the seabed to form the trench will be the same no matter the Bottom Pull, Lay Barge or the Float and Sink Method is adopted for submarine watermain laying. Horizontal directional drilling involves taking the pipeline directly from the start to end point by underground drilling with no surface disturbance being necessary.

An analysis of different construction methods and techniques to minimise impacts on water quality, marine ecology, fisheries and waste was carried out. Details of the analysis are presented below.

2.4.1 Trench Excavation

Dredging

Many dredging techniques, such as grab dredging, cutter suction and trailer suction dredging are available and chosen depending on the engineering, environmental and risks conditions e.g. shear strength of marine deposits, marine traffic impact etc.. As the submarine watermain will be located across the Yau Ma Tei, Central and Southern Fairway, grab dredging is selected, as cutter suction and trailer suction dredging which requires a working area of over 150m in width will result in unacceptable impact on marine traffic and are thus not feasible. Dredging by suction dredging will also produce more marine sediment by volume (due to high water content) when compared with grab dredging. Grab dredging is therefore the best practicable and feasible method to minimize dredging and dumping requirements and demand for fill sources.

Dredging can be a comparatively fast way to construct a submarine watermain and is necessary in areas where extra watermain protection is required e.g. rock armour protection. However, the potential for impacts to water quality is higher than horizontal directional drilling (HDD). The excavated sediments would require disposal off-site at a designated disposal ground.

2.4.2 Submarine Pipeline Installation

Bottom Pull Method

In the bottom pull method (**Figure 2.4**), pipes are joined to form pipe strings which are progressively pulled from a landfall site into a pre-dredged trench underwater by a winch set up at the landfall site at the other side of the waters until the crossing is complete. Temporary structures are to be erected on both landfall points for launching the pipe strings in a vertical S-curve to avoid overstressing the pipe strings, and for accommodating the winch system throughout the pulling operation. This method is one of the most common method for installation of medium to large diameter pipelines.

Lay Barge Method

In the lay barge method (**Figure 2.5**), while the work barge moves along the pipeline, the pipes are progressively added to form a string, which are hung in a catenary from at the back of the barge, and are gradually lowered into the pre-dredged trench. Due to limited capacity of work barge, additional marine plants are required to transport pipes from the shore to the work barge throughout the mainlaying operation. As the lay barge method will introduce intolerable marine traffic impact due to its long suspended pipeline at sea during the installation, this method is considered not a feasible option.

Float and Sink Method

In the float and sink method (**Figure 2.6**), lengths of pipe are made up into strings at a fabrication yard and these strings are launched to seabed from one of the landfall sites. These prefabricated pipe strings are temporarily stored on the seabed before towed by work barge at or below the water surface to the pre-dredged trench. By removing or filling water to the supporting buoyancy tanks, the pipe strings are sunk to its final position. Underwater welding and bolting are required under this method. This method is one of the most common method for installation of medium to large diameter pipelines.

2.4.3 Backfilling

Cover of pipeline is required to provide adequate anchor protection and to satisfy the maintenance dredging requirements of CEDD. To satisfy the above criterion, the following backfilling material can be used for the submarine pipeline trench:-

- Marine deposit 8 m or deeper or;
- Sand filling 5 m or deeper or;
- Armour rock layer 4.5 m thick with a 0.3 m thick grade 75 bedding.

Pre-dredged trench is required for the pipe laying works, storage of dredged marine deposit for trench backfilling is considered not practicable. Moreover, the overall trench depth for marine deposit backfilling will be up to 9.5 m, this will also significantly increase the quantity of contaminated mud (>30% in volume) when compared with the armour rock option. Backfilling the trench with sand will induce significant disturbance on the existing marine environment and is considered environmentally unacceptable. Armour rock option is recommended as it can provide a strong protection to the pipeline away from the anchoring damage. This option also requires the smallest pre-dredged trench which can minimize the disposal of both contaminated and uncontaminated dredged marine mud.

2.4.4 Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) (**Figure 2.7**) is a method which takes the pipeline directly from start to end point by underground drilling with no surface disturbance being necessary. A pilot hole will be drilled with fluid pumping down the drill pipes for lubricating and stabilising the walls of the drillhole. After the full length pilot hole is complete, the drill is replaced with a reamer which is pulled back or pushed forward in several passes to enlarge the pilot hole to the required size. On completion of reaming, lengths of pipe are joined and pulled from one side of the landing point to the other using a bonded pull. Finally, the gap between the enlarged hole and the pipe string is grouted for fixing the pipe in position. The potential for impacts to water quality from HDD is lower than dredging as sediments on the seabed would not be disturbed. However, the drilling fluid would require treatment prior to discharge. As the risk and difficulty for recovery in the event of jamming is considered to be very high and HDD has not been used for constructing submarine watermain with size above 1200mm in diameter, this method is considered not a feasible option.

Figure 2.4 Bottom Pull Method

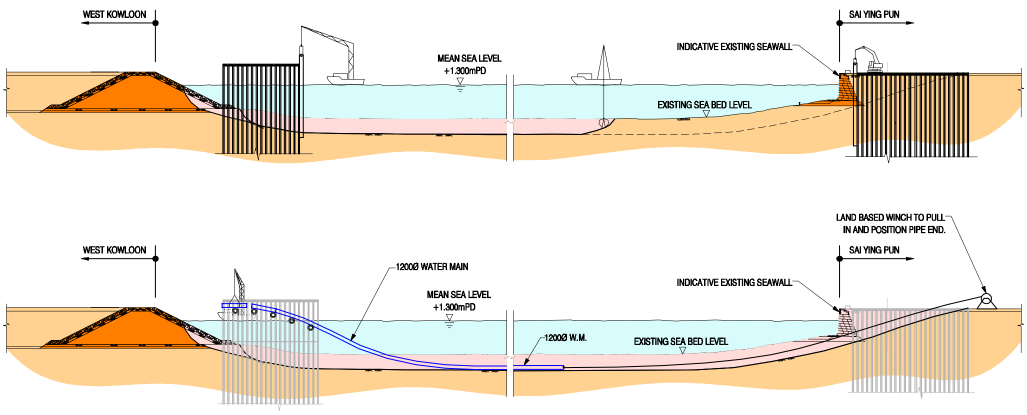


Figure 2.5 Lay Barge Method

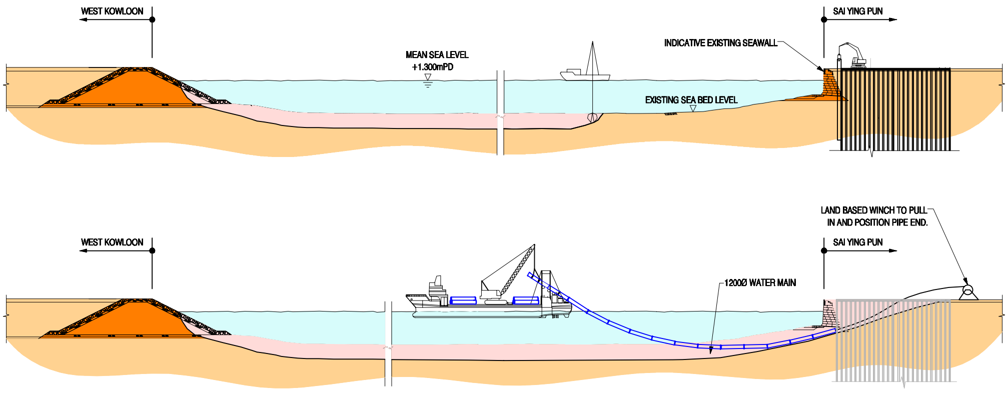


Figure 2.6 Float and Sink Method

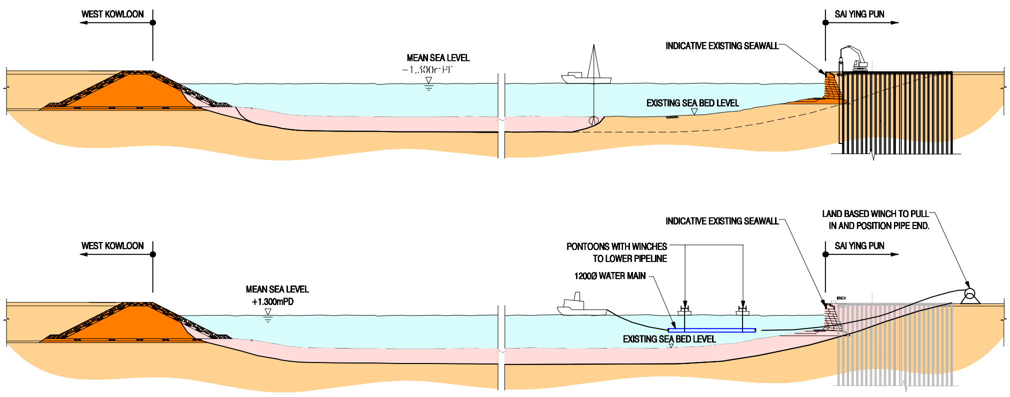
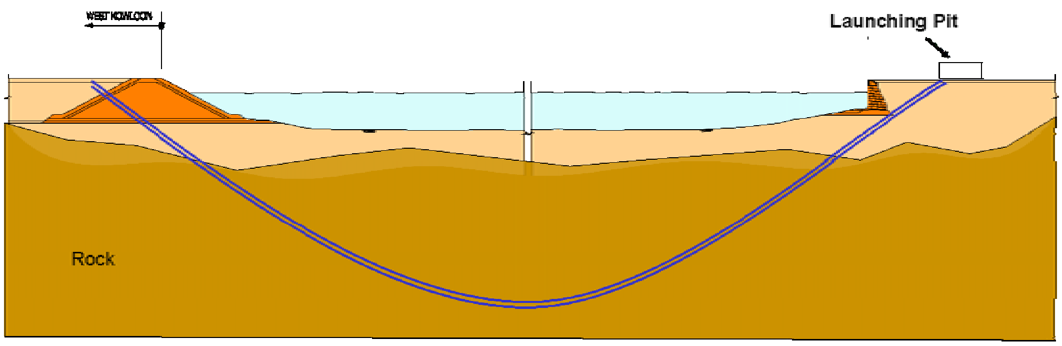


Figure 2.7 Horizontal Directional Drilling (HDD) Method



2.4.5 Best Practical Method

By comparing the pros and cons of the various construction methods as mentioned in Section 2.4.1 to 2.4.4, grab dredging and "bottom pull" method followed by protection of the submarine pipeline by backfilling with 4.5m thick armour rock layer with a 0.3m thick grade 75 bedding layer are the most practical construction method for the installation of the proposed submarine watermain. The assessment results, recommendations and conclusions have been addressed in this EIA report based on the proposed construction techniques or methods.

2.4.6 Sequencing and Timing

The issue of timing and sequencing has been analysed as part of the water quality impact assessment in Section 3. Modelling has examined the impacts on water quality of undertaking the work in either the dry or wet season. For the proposed dredging works, both seasons have been examined to be acceptable in the sense that water quality, marine ecology and fisheries criteria are complied with.

2.5 Selection of the Preferred Option

The discussions presented in Sections 2.3 and 2.4 have examined the rationale behind the selection of the preferred alignment, the preferred construction method and the issue of timing. The environmental and physical constraints have been presented along with the preferred alignment for the submarine watermain in **Figure 2.2**. As can be seen from the figure the submarine watermain alignment avoids direct impacts to the coral areas. The alignment presented on **Figure 2.2**, therefore, represents the preferred alignment for the submarine watermain taking into account ecological, water quality and marine traffic constraints. Taking into account the examination of different alignment options a preferred alignment is presented in **Figure 2.2**. By comparing the pros and cons of the various construction methods, grab dredging and "bottom pull" method followed by protection of the submarine pipeline by backfilling with 4.5m thick armour rock layer with a 0.3m thick grade 75 bedding layer are the most practical construction method for the installation of the proposed submarine watermain. This proposed alignment and construction methods for the submarine watermain have been studied in detail as part of this EIA Report. The selection of this position was taken after a holistic review of the environmental constraints (corals), physical constraints (navigation channel) and the results of the water quality modelling exercise.

3 WATER QUALITY IMPACT ASSESSMENT

3.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, construction and operation water quality impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain were assessed.

This section presents the findings of the assessment of potential water quality impacts associated with the construction and operation of the proposed submarine watermain specifically in terms of the effects in the vicinity of sensitive receivers in accordance with the requirements of the Study Brief and *Annexes 6 and 14* of the *Technical Memorandum on the Environmental Impact Assessment Process*. Suitable mitigation measures have been recommended to minimise potential adverse impacts and to ensure the acceptability of any residual impact (that is, after mitigation).

3.2 Environmental Legislation, Standards, Guidelines and Criteria

The criteria for evaluating water quality impacts in this EIA Study include:

- Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance) (EIAO-TM);
- Water Pollution Control Ordinance (WPCO);
- Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS);
- Hong Kong Planning Standards and Guidelines (HKPSG);
- Water Supplies Department (WSD) Water Quality Criteria; and
- Practice Note for Professional Persons (ProPECC), Construction Site Drainage (PN 1/94).

3.2.1 Environmental Impact Assessment Ordinance (EIAO)

The proposed submarine watermain is a Designated Project under Schedule 2, Part 1 (E3) of the EIAO (Cap.499). The EIAO-TM was issued by the EPD under Section 16 of the EIAO. It specifies the assessment method and criteria that have been followed in this EIA Study. Reference sections in the EIAO-TM provide the details of the assessment criteria and guidelines that are relevant to the water quality impact assessment, including:

- Annex 6 Criteria for Evaluating Water Pollution; and
- Annex 14 Guidelines for Assessment of Water Pollution.

3.2.2 Water Quality Objectives (WQOs)

The Water Pollution Control Ordinance (Cap. 358) provides the statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten Water Control Zones (WCZs). Water Quality Objectives (WQOs) are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in the WCZs based on their beneficial uses. The proposed submarine watermain is located within the Victoria Harbour (Phases Two and Three) WCZ. The corresponding WQOs of the assessment area including the Victoria Harbour and Western Buffer WCZs are listed in **Tables 3-1 and 3-2** respectively.

Table 3-1 Summary of Water Quality Objectives for the Victoria Harbour WCZ

Parameters	**Objectives**	**Sub-Zone**
Offensive Odour, Tints	Not to be present	Whole zone
Colour	Not to exceed 50 Hazen units, due to human activity	Inland waters
Visible foam, oil scum, litter	Not to be present	Whole zone
E. coli	Not to exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals between 7 and 21 days	Inland waters
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0 mg L^{-1} for 90% of samples	Marine waters
Depth-averaged DO	Not less than 4.0 mg L^{-1} for 90% of samples	Marine waters
Dissolved Oxygen	Not less than 4.0 mg L^{-1}	Inland waters
pH	To be in the range of 6.5 - 8.5, change due to human activity not to exceed 0.2	Marine waters
	Not to exceed the range of 6.0 - 9.0 due to human activity	Inland waters
Salinity	Change due to human activity not to exceed 10% of ambient	Whole zone
Temperature	Change due to human activity not to exceed 2 ^{o}C	Whole zone
Suspended solids	Not to raise the ambient level by 30% caused by human activity	Marine waters
	Annual median not to exceed 25 mg L^{-1} due to human activity	Inland waters
Ammonia	Annual mean not to exceed 0.021 mg L^{-1} as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4 mg L^{-1}	Marine waters
BOD_5	Not to exceed 5 mg L^{-1}	Inland waters
Chemical Oxygen	Not to exceed 30 mg L^{-1}	Inland waters

Parameters	Objectives	Sub-Zone
Demand		
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole zone
	Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Source: Statement of Water Quality Objectives (Victoria Harbour (Phases One, Two and Three) Water Control Zone).

Table 3-2 Summary of Water Quality Objectives for the Western Buffer WCZ

Parameters	Objectives	Sub-Zone
Offensive Odour, Tints	Not to be present	Whole zone
Colour	Not to exceed 30 Hazen units, due to human activity	Water gathering ground subzones
	Not to exceed 50 Hazen units, due to human activity	Inland waters
Visible foam, oil scum, litter	Not to be present	Whole zone
E. coli	Not to exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in a calendar year	Secondary contact recreation subzones and Fish culture subzones
	Not to exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in 1 calendar year. Samples should be taken at least 3 times in 1 calendar month at intervals of between 3 and 14 days.	Recreation subzones
	Less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals between 7 and 21 days	Water gathering ground subzones
	Not to exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals between 7 and 21 days	Other Inland waters
Depth-averaged DO	Not less than 4.0 mg L^{-1} for 90% of samples	Marine waters except Fish culture subzones
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0 mg L^{-1} for 90% of samples	Marine waters except Fish culture subzones
Depth-averaged DO	Not less than 5.0 mg L^{-1} for 90% of samples	Fish culture subzones
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0 mg L^{-1} for 90% of samples	Fish culture subzones

Parameters	Objectives	Sub-Zone
Dissolved Oxygen	Not less than 4.0 mg L^{-1}	Water gathering ground subzones and other inland waters
pH	To be in the range of 6.5 - 8.5, change due to human activity not to exceed 0.2	Marine waters
	Not to exceed the range of 6.0 – 8.5 due to human activity	Water gathering ground subzones
	Not to exceed the range of 6.0 - 9.0 due to human activity	Inland waters
Salinity	Change due to human activity not to exceed 10% of ambient	Whole zone
Temperature	Change due to human activity not to exceed 2 ^{o}C	Whole zone
Suspended solids	Not to raise the ambient level by 30% caused by human activity	Marine waters
	Annual median not to exceed 20 mg L^{-1} due to human activity	Water gathering ground subzones
	Annual median not to exceed 25 mg L^{-1} due to human activity	Inland waters
Ammonia	Annual mean not to exceed 0.021 mg L^{-1} as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4 mg L^{-1}	Marine waters
BOD_5	Not to exceed 3 mg L^{-1}	Water gathering ground subzones
	Not to exceed 5 mg L^{-1}	Inland waters
Chemical Oxygen Demand	Not to exceed 15 mg L^{-1}	Water gathering ground subzones
	Not to exceed 30 mg L^{-1}	Inland waters
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole zone
	Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Source: Statement of Water Quality Objectives (Western Buffer Water Control Zone).

3.2.3 Technical Memorandum

Besides setting the WQOs, the WPCO controls effluent discharging into the WCZ through a licensing system. A Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS) was issued under Section 21 of the WPCO that gives guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, storm water drains, inland and coastal waters). The limits control the physical, chemical and microbial quality of effluents. Sewage from the proposed construction activities should comply with the standards for effluent discharged into the foul sewers, inshore waters or marine waters of the Victoria Harbour WCZ, as shown in Table 1, Table 9a and Table 9b, respectively, of the TM-DSS.

3.2.4 Hong Kong Planning Standards and Guidelines (HKPSG)

The HKPSG, Chapter 9 (Environment), provides additional guidelines against water pollution for sensitive uses such as aquaculture and fisheries zones, bathing waters and other contact recreational waters.

3.2.5 Water Supplies Department (WSD) Water Quality Criteria

Besides the WQOs set under the WPCO, WSD have also specified a set of water quality criteria for flushing water at seawater intakes shown in **Table 3-3.**

Table 3-3 WSD's Water Quality Criteria for Flushing Water at Sea Water Intakes

Parameter (in mg/L unless otherwise stated)	Target Limit
Colour (HU)	< 20
Turbidity (NTU)	< 10
Threshold Odour Number (odour unit)	< 100
Ammonia Nitrogen (NH_3-N)	< 1
Suspended Solids (SS)	< 10
Dissolved Oxygen (DO)	> 2
5-day Biochemical Oxygen Demand (BOD_5)	< 10
Synthetic Detergents	< 5
E. coli (no. per 100 mL)	< 20,000

3.2.6 Practice Note

A practice note for professional persons was issued by the EPD to provide guidelines for handling and disposal of construction site discharges. The ProPECC PN 1/94 "Construction Site Drainage" provides good practice guidelines for dealing with ten types of discharge from a construction site. These include surface runoff, groundwater, boring and drilling water, bentonite slurry, water for testing and sterilisation of water retaining structures and water pipes, wastewater from building construction, acid cleaning, etching and pickling wastewater, and wastewater from site facilities. Practices given in the ProPECC PN 1/94 should be followed as far as possible during construction to minimise the water quality impact due to construction site drainage.

3.2.7 Suspended Solids Criterion for Fish Culture Zone

A general water quality protection guideline for suspended solids (SS) has been proposed by AFCD[(1)]. The guideline requires maximum SS levels remain below 50mgL^{-1}. This criterion has been adopted in the previous approved EIA [(2)],

([1]) City University of Hong Kong (2001), *Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment, Final Report,* For Agriculture, Fisheries and Conservation Department, Hong Kong SAR Government.

([2]) Maunsell Consultants Asia Ltd. (2001), *Environmental Impact Assessment for Tai Po Sewage Treatment Works – Stage V, Final EIA Report*, For Drainage Services Department, Hong Kong SAR Government.

3.2.8 Suspended Solids Criterion for Benthic Organisms

Benthic organisms, including corals, may be damaged by sediment deposition that blocks the respiratory and feeding organs of the corals. According to Hawker and Connell[1], the sedimentation rate higher than 0.1 kg m^{-2} per day would introduce moderate to severe impact upon corals. This was adopted as the assessment criterion for protecting the marine ecological sensitive receivers in this study. There are no established legislative criteria for water quality for corals. An elevation criterion of 10 mgL^{-1} in SS has been adopted as the critical value above which impacts to the habitat may occur, same as the previous approved EIA [2].

3.2.9 Sediment Quality

Dredged sediments destined for marine disposal are classified according to a set of regulatory guidelines with sediment quality criteria, which include organic pollutants and other toxic substances, for designation of sediments (Management of Dredged/Excavated Sediment, ETWB TCW No. 34/2002). Details on marine dredged sediment quality are presented in Section 6.

The requirements for the marine disposal of sediment is specified in the ETWB TCW No. 34/2002. Marine disposal of dredged materials is controlled under the Dumping at Sea Ordinance.

3.3 Description of the Environment

3.3.1 Marine Water Quality Monitored by EPD

For the purpose of this EIA, the EPD marine water quality monitoring data routinely collected in the vicinity of the site, which document the water quality in the Victoria Harbour WCZ were used. The EPD monitoring stations of most relevance (that is, in the vicinity of the location of the proposed submarine watermain) include VM5, 6, 7 and 8 as shown in **Figure 3.1**. A summary of the published marine water quality monitoring data from EPD in 2005 collected at these stations is presented in **Table 3-4** [3].

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(1) Hawker, D. W. and Connell, D. W. (1992). "Standards and Criteria for Pollution Control in Coral Reef Areas" in Connell, D. W and Hawker, D. W. (eds.), *Pollution in Tropical Aquatic Systems*, CRC Press, Inc.

(2) ERM Hong Kong Ltd. (2001), *Environmental Impact Assessment for the Proposed submarine Gas Pipeline from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong, Final EIA Report*, For the Hong Kong and China Gas Co., Ltd.

(3) EPD (2005). Marine Water Quality in Hong Kong in 2004.

Table 3-4 Marine Water Quality in Phases Two and Three of the Victoria Harbour Water Control Zone at Selected Stations in 2005

Determinand	VM6	VM7	VM5	VM8	WPCO WQOs (in marine waters)
Temperature (^oC)	23.0 (15.9 – 27.9)	23.1 (15.8 – 28.0)	23.0 (15.9 – 27.9)	23.1 (15.6 – 27.9)	natural daily level ± 2 ^oC
Salinity (psu)	31.3 (22.2 – 32.9)	30.9 (24.4 – 32.8)	31.4 (22.4 – 32.9)	31.1 (24.8 – 33.6)	natural ambient level ± 10 %
Dissolved Oxygen (mg/L)	5.5 (3.2 – 6.6)	5.6 (3.8 – 6.8)	5.5 (3.3 – 6.7)	5.8 (2.5 – 7.3)	≥ 4 mg L^{-1}
Dissolved Oxygen Bottom (mg/L)	5.3 (3.2 – 6.5)	5.4 (3.8 – 6.5)	5.3 (3.3 – 6.6)	5.6 (2.5 – 7.1)	≥ 2 mg L^{-1}
Dissolved Oxygen (% Saturation)	77 (45 – 97)	78 (54 – 104)	76 (46 – 99)	80 (35 – 110)	N/A
Dissolved Oxygen Bottom (% Saturation)	73 (45 – 94)	75 (54 – 94)	74 (46 – 99)	78 (35 – 108)	N/A
pH	8.0 (7.6 – 8.3)	8.0 (7.6 – 8.2)	8.0 (7.6 – 8.3)	8.1 (7.7 – 8.2)	6.5 - 8.5 (± 0.2 from natural range)
Secchi Disc Depth (m)	2.1 (1.2 – 3.3)	1.8 (0.9 – 3.2)	2.1 (1.3 – 3.1)	1.9 (1.2 – 2.5)	N/A
Turbidity (NTU)	9.8 (4.7 – 15.8)	10.8 (5.6 – 19.1)	9.8 (4.8 – 16.0)	11.9 (5.3 – 27.9)	N/A
Suspended Solids (mg/L)	3.7 (0.8 – 11.0)	4.1 (1.6 – 9.8)	3.4 (0.7 – 6.6)	5.2 (1.4 – 25.0)	≤ natural ambient level + 30%
5-day Biochemical Oxygen Demand (mg/L)	0.9 (0.3 – 1.6)	1.0 (0.6 – 1.9)	1.1 (0.6 – 2.4)	0.8 (0.4 – 1.7)	not applicable to marine waters
Ammonia Nitrogen (mg/L)	0.19 (0.05 – 0.27)	0.21 (0.10 – 0.41)	0.19 (0.06 – 0.30)	0.18 (0.06 – 0.56)	N/A
Unionized Ammonia (mg/L)	0.007 (0.003–0.014)	0.009 (0.004–0.023)	0.008 (0.003–0.015)	0.009 (0.002 – 0.040)	≤ 0.021 mg L^{-1}
Nitrite Nitrogen (mg/L)	0.03 (0.01 – 0.06)	0.03 (0.01 – 0.07)	0.03 (0.01 – 0.05)	0.04 (0.01 – 0.07)	N/A
Nitrate Nitrogen (mg/L)	0.16 (0.05 – 0.39)	0.19 (0.08 – 0.50)	0.15 (0.04 – 0.36)	0.18 (0.07 – 0.52)	N/A

Determinand	VM6	VM7	VM5	VM8	WPCO WQOs (in marine waters)
Total Inorganic Nitrogen (mg/L)	0.38 (0.11 – 0.68)	0.43 (0.28 – 0.93)	0.37 (0.11 – 0.65)	0.34 (0.18 – 0.92)	$\leq$ 0.4 mg L^{-1}
Total Kjeldahl Nitrogen (mg/L)	0.36 (0.21 – 0.48)	0.36 (0.23 – 0.51)	0.37 (0.22 – 0.63)	0.38 (0.15 – 1.40)	N/A
Total Nitrogen (mg/L)	0.55 (0.27 – 0.83)	0.58 (0.40 – 1.03)	0.55 (0.27 – 0.82)	0.59 (0.25 – 1.56)	N/A
Ortho-phosphate (mg/L)	0.04 (0.01 – 0.05)	0.04 (0.01 – 0.05)	0.04 (0.01 – 0.06)	0.03 (0.01 – 0.07)	N/A
Total-Phosphorus (mg/L)	0.05 (0.03 – 0.07)	0.05 (0.03 – 0.07)	0.05 (0.03 – 0.09)	0.05 (0.02 – 0.23)	N/A
Silica (as SiO_2) (mg/L)	0.9 (0.2 – 2.4)	1.0 (0.6 – 2.1)	0.9 (0.1 – 2.1)	1.0 (0.6 – 2.0)	N/A
Chlorophyll-α (μg/L)	2.7 (0.6 – 10.0)	2.2 (0.8 – 11.0)	2.8 (0.6 – 9.4)	2.0 (0.8 – 8.0)	N/A
E.coli (cfu/100mL)	5700 (840 – 38000)	9100 (800 – 49000)	7700 (360–57000)	4900 (220 – 190000)	not applicable to marine waters
Faecal Coliforms (cfu/100mL)	12500 (1700–91000)	20900 (2000–180000)	17000 (1100–90000)	12100 (930–730000)	N/A

Note:

1. Except as specified, data presented are depth-averaged results.
2. Depth-averaged results at each station are calculated as arithmetic means of measurements at all available depths (i.e. S, M, B) except for E.coli and faecal coliforms which are geometric means.
3. Data presented are annual arithmetic means except for E.coli and faecal coliforms which are annual geometric means.
4. Data enclosed in brackets indicate the ranges.
5. Shaded cells indicate non-compliance with the WQOs.

(Source: Adopted from *EPD Marine Water Quality Hong Kong in 2005*)

Full compliance with the WQO for depth-averaged (DA) and bottom dissolved oxygen (DO) and depth-averaged (DA) unionised ammonia (NH_3-N) was achieved at VM5, 6, 7 and 8 in 2005. VM5, 6 and 8 also achieved 100% compliance with the depth-averaged total inorganic nitrogen (TIN) of WQO.

3.3.2 Sediment Quality

The results of marine sediment quality analysis from the marine site investigation along the alignment of the proposed submarine watermain were presented in Section 6. The results indicated that Category H sediment was found at 9 out of 15 vibrocoring locations due to the high contaminant levels of copper (Cu), lead (Pb), mercury (Hg) and silver (Ag) that exceed the Upper Chemical Exceedance Level (UCEL) under the current sediment classification system (ETWB TCW No. 34/2002, Management of Dredged / Excavated Sediment).

3.3.3 Trend of Water Quality in Victoria Harbour

As reported in the “Marine Water Quality in Hong Kong in 2004” issued by EPD, significant decline in Total Kjeldahl Nitrogen (TKN) and Total Nitrogen (TN) was generally observed, except at the two stations VM5 and 8. On the other hand, an increase of nitrate nitrogen (NO_3-N) was detected in the western part of the harbour. An increase in DO, decreases in nutrients (TN, Total Phosphorus (TP)) and organics (5-day Biochemical Oxygen Demand (BOD_5)) were also evident in the north Rambler Channel (VM14).

3.4 Water Sensitive Receivers

Indicator points were selected within the Victoria Harbour and Western Buffer Water Control Zones, and all areas within 500m from the Project boundary to provide hydrodynamic and water quality outputs for evaluation of water quality impacts. The selected indicator points included water quality sensitive receivers and stormwater outfalls at the Western Harbour.

Water sensitive receivers that are potentially affected by the proposed Project are listed below:

- New Yau Ma Tei Typhoon Shelter
- Coral communities at Green Island
- 17 seawater intakes at the waterfront of Victoria Harbour

Locations of water sensitive receivers and stormwater outfalls at the Western Harbour are shown in **Figure 3.2**.

All the sensitive receivers and stormwater outfalls were defined as water quality monitoring points in the model to output the key water quality parameters for determination of water quality changes as a result of the construction and operation phase activities. The modelling results are presented in terms of contour plot, time series plot and table for both the dry and wet seasons in this section.

The indicator points with brief description are provided in **Table 3-5**.

Table 3-5 Water Quality Indicator Points

Location	Type	Assessment Point	Easting	Northing
New Yau Ma Tei Typhoon Shelter	Typhoon Shelter	R1	834 527.857	819 102.182
Green Island	Sensitive Receiver of Marine Ecology	R2	829 398.155	816 298.432
Green Island	Sensitive Receiver of Marine Ecology	R3	829 449.070	815 952.418
Green Island	Sensitive Receiver of Marine Ecology	R4	830 023.685	816 169.040
Green Island	Sensitive Receiver of Marine Ecology	R5	830 175.979	816 179.217
Prince Philip Dental Hospital	Seawater Intake	R6	833 437.625	816 747.640
Tsan Yuk Hospital	Seawater Intake	R7	833 461.092	816 744.773
Macau Ferry Terminal	Seawater Intake	R8	833 786.796	816 663.359
Munsey Street	Seawater Intake	R9	833 910.436	816 507.645
Harbour Building	Seawater Intake	R10	834 094.788	816 610.502
Reprovisioned Prince's Building Group at CRIII	Cooling Water Intake	R11	834 704.000	816 447.288
Reprovisioned Hong Kong Shanghai Bank at CRIII	Cooling Water Intake	R12	835 142.292	816 076.399
Reprovisioned Queensway Government Offices, Admiralty and Police Headquarters at CRIII	Cooling Water Intake	R13	835 212.354	816 057.961
WSD Cheung Sha Wan Salt Water Pumping Station	Seawater Intake	R14	833 545.427	820 678.020
WSD Kowloon South Salt Water Pumping Station	Seawater Intake	R15‡	833 982.630	818 282.101
Kowloon Government Offices Building	Seawater Intake	R16	834 335.800	817 769.145
Canton Road Government Offices Building	Seawater Intake	R17	834 364.658	817 802.847
MTRC Cooling Mains	Seawater Intake	R18	834 443.154	817 864.202
China Ferry Terminal	Seawater Intake	R19	835 227.714	817 832.283
Hong Kong Cultural Centre	Seawater Intake	R20	835 599.125	817 115.536
Western Harbour Crossing West Kowloon Outfall	Existing Stormwater Outfall	R21‡	833 941.469	817 988.659
Western Harbour Crossing West Kowloon Outfall	Existing Stormwater Outfall	R22	834 123.935	817 742.368
Sai Ying Pun Outfall	Existing Stormwater Outfall	R23‡	832 647.357	816 865.168
Sai Ying Pun Outfall	Existing Stormwater Outfall	R24‡	832 724.197	816 863.893
Sai Ying Pun Outfall	Existing Stormwater Outfall	R25‡	832 786.137	816 855.415
Sai Ying Pun Outfall	Existing Stormwater Outfall	R26	832 978.593	816 850.883
Shek Tong Tsui	Existing Stormwater Outfall	R27	831 581.898	816 516.015
WSD Kennedy Town Salt Water	Seawater Intake	R28	830 707	815 983

Location	Type	Assessment Point	Easting	Northing
Pumping Station				
WSD Sheung Wan Salt Water Pumping Station	Seawater Intake	R29	833 414	816 745

Note: ‡ These Assessment Points fall inside an area within 100m of the proposed water main.

All other Assessment Points fall outside this area.

The Green Island coral communities are located about 2.8 km west of the proposed submarine watermain. The coral communities may be potentially impacted during the construction of the submarine watermain due to the sedimentation of the suspended solids (SS) in the water column.

3.5 Assessment Methodology

To assess the potential water quality impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain, the sources and natures of effluent to be generated during construction were identified and their impacts were quantified where practicable.

3.5.1 Hydrodynamic and Water Quality Models

Set-up of Hydrodynamic Model

Computer modelling was employed to assess the potential impact on water quality in Victoria Harbour and Western Buffer Water Control Zones associated with the construction of the proposed submarine watermain for different tidal conditions. The hydrodynamic and water quality models were developed by Delft Hydraulics, namely Delft3D-FLOW and Delft3D-WAQ respectively.

In the present study, the basis for modelling of the harbour waters is the existing, validated Western Harbour Model. This model covers the relevant part of the Hong Kong waters, including the Pearl Estuary and the Dangan (Lema) Channel (**Figure 3.3**). The resolution of the model is between 100 and 200m in the project area (**Figure 3.4 and 3.5**). A locally refined domain in the project area was inserted to obtain the above-said resolution. The grid mesh was further modified to generate higher resolution (about 50 m x 100 m) in the vicinity of the proposed submarine watermain (**Figure 3.6**).

Coastlines and Bathymetry

The coastline configuration and bathymetry set up for the construction phase of the Project were shown in **Figures 3.7 and 3.8**, taking account of completed reclamation and the latest progress of the concurrent coastal developments.

Simulation Periods

The simulated periods cover a complete spring-neap tidal cycle. The actual simulation period is preceded by a spin-up period. Both the actual simulation period and the spin-up period originate from the Update Study and represent average tidal conditions. The simulation periods are specified below:

spin-up dry season: 2 February 13:00 - 9 February 12:00

dry season: 9 February 12:00 - 23 February 12:00

spin-up wet season: 19 July 04:00 - 26 July 04:00

wet season: 26 July 04:00 - 9 August 04:00

Boundary Conditions for Water Quality Models

The initial and boundary conditions are set to zero as the excess suspended solids concentrations are modelled.

3.5.2 Sediment Plume Modelling

General

Water quality impacts would arise from dredging activities of the proposed submarine watermain that would disturb the marine bottom sediment, elevate the SS concentrations of the water column and generate sediment plume along the tidal flows. The impact of sediment plume dispersion during the marine works was simulated by a three-dimensional Delft3D-WAQ Model. The WAQ model simulated suspended solids (SS, in mg/L), optionally subdivided over different fractions representing different sediment sources. The simulated SS represented the project related discharges only. The calculated concentrations were interpreted as excess concentrations on top of the background concentrations.

The Delft3D-WAQ model takes into account the sedimentation process by means of a settling velocity, while erosion of bed sediment, causing resuspension of sediment, is governed by a function of the bed shear stress. The parameters adopted in the present study are summarised in **Table 3-6**.

Table 3-6 Summary of Parameters for Sediment Plume Model (Delft3D-WAQ)

Sediment Plume Model Parameters	
Settling velocity	0.5mm/s
Critical shear stress for deposition	0.2N/m^2
Critical shear stress for erosion	0.3N/m^2
Minimum depth where deposition allowed	0.1m
Resuspension rate	30g/m^2/d

The impacts in terms of DO depletion, unionised ammonia (NH_3-N) and total inorganic nitrogen (TIN) would not be modelled explicitly, but estimated on the basis of the calculated sediment concentrations. This would lead to an estimated increase relative to the background of the concentrations of different contaminants, dependent on the quality of the released sediments. For TIN, it is assumed that the total nitrogen content, being ammonia content and Kjedahl-N of the sediment is transformed to TIN. For NH_3-N, it is assumed that the entire nitrogen content of the bottom is transformed to ammonium and unionised ammonia. The percentage unionised ammonia is estimated on the basis of temperature, salinity and pH on the basis of the formulations used in Delft3D-WAQ (Delft3D-WAQ Technical Reference Manual, September 2005, WL | Delft Hydraulics). The estimation of the factor is worst case and different for wet and dry season. Analogously, this would lead to an estimated decrease relative to the background of the concentrations of DO, dependent on the quality of the released sediments. For DO it is assumed that the entire COD content of the sediment is transformed to DO decrease. This can be expressed as follows:

$$\Delta TIN(x,y,z,t) = \Delta SS(x,y,z,t) \times (C_{SS,NH4} + C_{SS,Kj-N})$$

$$\Delta NH3(x,y,z,t) = \Delta SS(x,y,z,t) \times (C_{SS,NH4} + C_{SS,Kj-N}) \times f(sal,T,pH)$$

$$\Delta DO(x,y,z,t) = -\Delta SS(x,y,z,t) \times C_{SS,COD}$$

where

TIN	concentration of Total Inorganic Nitrogen (mgN/L)
SS	concentration of suspended solids (mg/L)
$C_{SS,NH4}$	concentration of ammonium in suspended matter (gN/gSS)
$C_{SS,Kj-N}$	concentration of Kjedahl-N in suspended matter (gN/gSS)
f(sal,temp,pH)	factor unionised ammonia (gNH3/(gNH4+gNH3)
sal	salinity (ppt)
T	temperature (Celsius)
pH	pH
DO	concentration of dissolved oxygen (mg/L)
$C_{SS,COD}$	concentration of COD in suspended matter (gO/gSS)

This approach relies on worst case assumptions. Any removal of pollutants from the water phase with the sedimentation of SS and any replenishment of DO from the atmosphere is neglected.

The values used in this assessment are based on the highest EPD routine marine sediment quality monitoring data recorded at VS5 in 2005 near the dredging area and are summarised in **Table 3-7**.

Table 3-7 Sediment Quality near the Dredging Area

Parameters	Dry season	Wet season
$C_{SS,NH4}$	41E-6	41E-6
$C_{SS,Kj-N}$	760E-6	760E-6
f(sal,temp,pH)	0.03	0.05
sal	28	28
T	20	27
pH	7.9	7.9
$C_{SS,COD}$	27E-3	27E-3

Modelling Scenario

The construction of the proposed submarine watermain from West Kowloon to Sai Ying Pun was scheduled to commence in September 2008 and complete in May 2010. Major marine works include dredging for the submarine watermain which was scheduled to be carried out from January to mid-May 2009, while backfilling was scheduled to be undertaken from December 2009 to February 2010.

Dredging works of the Project would be undertaken by a grab dredger. The assumptions made with regards to modelling grab dredging are as follows:

One grab dredger with a maximum production rate of 4,000 m^3 per day, 7 days per week, 24 hours per day equate to a maximum rate of 0.0463 $m^3\ s^{-1}$ during dredging operations.

For the dredging operation, a dry density of 1,300 kgm^{-3} has been assumed for the dredged material in deriving the figures. This figure was adopted in the Central Reclamation Phase III - Studies, Site Investigation, Design and Construction EIA study.

Spill loss during sediment dredging by a closed grab dredger was assumed to be continuous, 24 hours a day, 7 days per week.

With respect to the rate of sediment loss during dredging, the Contaminated Spoil Management Study[6] reviewed relevant literature and concluded that losses from closed-grab dredgers were estimated at 11 to 20 kg m^{-3} of mud removed. Taking the upper figure of 20 kg m^{-3} to be conservative, the loss rate in kg s^{-1} was calculated based on the daily volume rate of dredging. (Assuming a dry density for marine sediment of 1,300 kg m^{-3}, the sediment loss during dredging is equivalent to a spill amount of approximately 1.54%).

Spilling rates for sediment dredging by a closed grab dredger were assumed to take place uniformly over the water column.

Dredging of contaminated and uncontaminated sediment was assumed be carried out at the same rate.

Granular fill (either decomposed granite or armour rock) would be used as backfilling material after the cross harbour main laying works. As the granular fill does not contain fines material, there would be no sediment plume generation during the backfilling process and the marine water quality would not be affected. The contractor would follow the General Specification for Civil Engineering Works and the particle size distribution of fill material specified in Clause 6.07. The specifications for general fill material and granular fill material are reproduced in **Table 3-8**.

Table 3-8 Specifications for General Fill Material and Granular Fill Material

Type of fill material	Percentage by mass passing		
	Size	BS test sieve	
	200 mm	75 mm	600 μm
General fill material	100	75 – 100	N/A
Granular fill material	N/A	100	0 – 5

During dredging, a quantity of fine sediment will be lost to suspension that may be transported away from the works area, forming suspended sediment plumes. The formation and transport of sediment plumes from dredging are modelled in this Assignment.

To assess the water quality impact on the sensitive receivers during the entire duration of dredging works and along the entire alignment, load locations which represent the position

(6) Mott MacDonald (1991). Contaminated Spoil Management Study, Final Report, Volume 1.

of the dredger for one day was defined along the proposed alignment of the submarine watermain. The locations follow each other with a distance of 24m (with a working speed of 1m per hour) which result in 84 discharge locations along the alignment. Each location was active for one day. A simulation period of 90 days was thus given. Modelling was conducted for the complete simulation period for the dry and wet season and the spring neap cycle was repeated after every 14 days. This represents the worst case scenario as water quality impact on the sensitive receivers during the entire duration of dredging works and along the entire alignment was simulated with the maximum possible instantaneous working rate of $0.0463m^3s^{-1.}$ As a result, the highest possible elevation of suspended solids were predicted. This is a very conservative assumption as a grab dredger may, depending on the actual grab dredger and the sediment condition at the time of dredging, fill with water. A conservative assumption of loss rate for grab dredger of $20kgm^{-3}$ mud dredged with a corresponding sediment loss rate of $0.93kgs^{-1}$ was also adopted.

<u>Potential Cumulative Impact</u>

There may be other concurrent external dredging and filling projects that may impact the same areas. An analysis of external projects, which could occur at the same time as the installation of the Western Cross Harbour Main, has found that there will be three projects that could potentially contribute to cumulative impacts. These include reclamation for Central Reclamation Phase III, dredging works for proposed Cruise Terminal at Kai Tak and reclamation for Wan Chai Development Phase II and Central Wan Chai Bypass.

Reclamation for Central Reclamation Phase III would be constructed prior to the dredging works for the submarine watermain. Dredging works for proposed Cruise Terminal at Kai Tak is remote from the Western Cross Harbour Main and will be constructed after the dredging works for the submarine watermain. Reclamation for Wan Chai Development Phase II and Central Wan Chai Bypass at North Point is remote (over 5km away) from the Western Cross Harbour Main and thus is not anticipated to cause a cumulative impact. Reclamation for Wan Chai Development Phase II and Central Wan Chai Bypass at Wan Chai and Causeway Bay is scheduled to commence after the dredging works for the submarine watermain and consequently is not expected to overlap with the dredging works of the submarine watermain. At present, therefore, there are no planned marine construction projects that could have cumulative impacts with the installation of the Western Cross Harbour Main.

<u>Conservative Assumptions in Assessment Methodology</u>

Quantitative uncertainties in the sediment dispersion modelling should be considered when making an evaluation of the modelling predictions. Worst case conditions were adopted as model input to indicate the maximum extent of the potential environmental impacts. The input data tended to be conservative to provide a margin of tolerance. Some examples of the conservative nature of the input parameters are given below:

The dredging rate adopted for the sediment plume modelling represents the maximum production rate that could be achieved during construction. The actual dredging rate would be less as the shallow dredge option would be adopted and lesser quantity of mud would be dredged.

A conservative assumption of sediment loss from a closed grab dredger (that is, 20 kg m^{-3}) was adopted to generate the sediment loss rate for modelling. This loss rate would, however, be higher than the real situation.

<u>Contaminant Release during Dredging</u>

The loss of sediment to suspension during dredging may have chemical effects on the receiving waters. This is because the sediment would contain organic and chemical pollutants. As part of the marine site investigation works for this Project, laboratory testing of sediment samples was undertaken. A full description of the sediment quality testing and the classification of the sediment according to levels of contaminants are contained in Section 6.

An indication of the likelihood of release of heavy metals from the sediment during dredging is given by the results of the elutriate tests from the marine site investigation works. If the contaminant levels are higher in the elutriates in comparison with the blanks (marine water from the same site), it can be concluded that the contaminants are likely to be released into the marine waters during dredging activities. As there is no existing legislative standard or guideline for individual heavy metal contents in marine waters, the UK Water Quality Standards for Coastal Surface Water(7) were adopted as the assessment criteria.

3.5.3 Effluent, Sewage and Surface runoff

To assess the impact of the effluent from hydrostatic tests of the water mains system and sewage, wastewater and surface runoff from construction activities upon the nearby water bodies, the extent of hydrostatic tests and construction works associated with the proposed submarine watermain were reviewed and identified. Practical water pollution control measures or mitigation proposals were subsequently recommended to ensure effluent discharged from the construction site would comply with the WPCO criteria.

3.6 Identification of Environmental Impact

3.6.1 Construction Phase

<u>Dredging</u>

General

Dredging of marine sediment would be undertaken along the alignment of the proposed submarine watermain. The in-situ volume of dredged sediment for the Project was estimated to be approximately 362,000 m^3 (with a bulking factor of 1.5, bulked volume of dredged sediment was estimated to be approximately 543,000 m^3). The estimated volume of contaminated dredged sediment is approximately 141,333 m^3 (with a bulking factor of 1.5, bulked volume of dredged sediment was estimated to be approximately 212,000 m^3) (about 39% of the total dredged sediment).

(7) Environmental Quality Standards and Assessment Levels for Coastal Surface Water (from HMIP (1994) Environmental Economic and BPEO Assessment Principals for Integrated Pollution Control). *(Source: Environmental Impact Assessment Study for Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit, by ERM, January 1997).*

Key water quality concerns during dredging include (i) dredging works that would disturb the marine bottom sediment, causing an increase in SS concentrations in the water column and forming sediment plume along the tidal flows and (ii) construction runoff and drainage, with effluents potentially contaminated with silt, oil and grease.

Potential impacts on water quality from dredging include:

- increased suspension of sediment in the water column during dredging activities, with possible consequence of reducing DO levels and increasing nutrient levels;
- release of previously bound organic and inorganic constituents such as heavy metals, PAHs, polychlorinated biphenyls (PCBs) and nutrients into the water column, either via suspension or by disturbance as a result of dredging activities; and
- release of the same contaminants due to leakage and spillage as a result of poor handling and overflow from barges during dredging and transport.

Impacts would vary depending on the quantities and level of sediment contamination and the nature and locations of the WSRs. All of the above would result in deterioration of the receiving marine water quality and would have adverse effects on WSRs.

Impact of Suspended Sediment

As a result of dredging activities during the construction phase, fine sediment (less than 63 μm) would be lost to suspension. The suspended sediment would be transported by currents to form sediment plumes, which would gradually resettle. The impact from sediment plumes was to increase the suspended sediment concentrations, and caused non-compliance in WQO and other criteria for particular sensitive receivers.

The extent of elevation of ambient suspended sediment concentrations would determine whether or not the impact is adverse or not. The determination of the acceptability of any elevation is based on the WQOs. The WQO of SS is defined as being an allowable elevation of 30% above the background. As directed in a previous study of the environmental impacts of released SS[(8)], the ambient value is represented by the 90th percentile of reported concentrations.

The depth-averaged and surface SS levels in 90 percentiles during dry and wet seasons are summarised in **Table 3-9**. These values are derived from the marine water quality monitoring results of the four EPD's routine monitoring stations VM5, 6, 7 and 8 located near the dredging area. The SS levels recorded from 2003 to 2005 were used in this Assignment. As stipulated by the WQOs for the Victoria Harbour WCZ, the 30% allowable elevations of depth-averaged SS above the ambient were 2.6mgL^{-1} and 2.5mgL^{-1} for the dry and wet seasons, respectively. For surface SS, however, the allowable elevations were 2.6mgL^{-1} and 2.0mgL^{-1} for the dry and wet seasons, respectively. Since seawater intakes are generally located near the water surface, the ambient surface SS level of 8.6mgL^{-1} for dry season and 6.7 mgL^{-1} for wet season were added to the predicted SS elevations at these sensitive receivers for comparison against the relevant water quality criteria.

(8) ERM-Hong Kong Ltd (1997). *Environmental Impact Assessment for the Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit. Final EIA Report*, For Civil Engineering Department, Hong Kong SAR Government.

Table 3-9 Depth-averaged and Surface SS levels near the Dredging Area

Stations	**Dry Season**		**Wet Season**	
VM5, 6, 7 and 8	**Depth-averaged**	**Surface**	**Depth-averaged**	**Surface**
Average SS (mg L^{-1})	5.3	4.7	5.0	4.1
90 percentile (ambient level)	8.8	8.6	8.4	6.7
30% increase above the ambient level	2.6	2.6	2.5	2.0

Impact of Dissolved Oxygen, Total Inorganic Nitrogen and Unionised Ammonia

The extent of depletion of ambient DO concentration and elevation of ambient TIN and NH_3-N would determine or not the impact is adverse or not. The determination of the acceptability of any depletion or elevation is based on the WQOs. The WQO of DO, DO bottom, TIN and NH_3-N are defined as being larger than or equal to 4 mgL^{-1}, larger than or equal to 2 mgL^{-1}, less than or equal to 0.4 mgL^{-1} and less than or equal to 0.021 mgL^{-1} respectively.

An assessment of dissolved oxygen depletion and nutrient release during dredging was made in relation to the results of the sediment plume modelling of dredging activities and the sediment quality data of the Study Area. The predicted maximum elevations in tidal and depth-averaged SS concentrations at the construction site were used to estimate the effects of increased SS concentrations on DO, TIN and NH_3-N. The area in the vicinity of alignment of the proposed submarine pipeline was of particular concern. In the water quality model, it was assumed that all COD was exerted and that all TIN and NH_3-N in the sediment were released to the water. These were conservative assumptions and would likely result in an over-prediction of the potential impacts.

The depth-averaged DO, TIN and NH_3-N and bottom layer DO levels during dry and wet seasons are summarised in **Table 3-10**. To determine compliance with the water quality criteria, background water quality data were required. The average DO, TIN and NH_3-N values derived from the EPD's routine marine water quality monitoring data recorded from 2003 to 2005 at VM5, 6, 7 and 8 near the dredging area were used in the assessment. As presented in **Table 3-10**, the depth-averaged TIN concentration recorded during wet season does not comply with the WQO for TIN ($\geqq$0.4 mgL^{-1}).

Table 3-10 DO, TIN and NH_3-N levels near the Dredging Area

Stations	**Dry Season**		**Wet Season**	
VM5, 6, 7 and 8	**Depth-averaged**	**Bottom**	**Depth-averaged**	**Bottom**
Dissolved Oxygen (mg L^{-1})	6.0	6.0	5.0	4.1
Total Inorganic Nitrogen (mg L^{-1})	0.31	-	0.43	-
Unionised Ammonia (mg L^{-1})	0.006	-	0.010	-

<u>Hydrostatic Tests of the Water Mains System</u>

Hydrostatic tests would be undertaken in accordance with Section 23.73 and 23.77 of the *General Specification for Civil Engineering Works Volume 3, 1992 Edition* for sterilisation of pipeline and pressure pipeline test for the submarine watermain to check for leaks or flaws. For sterilisation of pipeline, the pipeline would be completely filled with water that has been dosed with a homogeneous solution of sterilising chemicals such that the final concentration of free chlorine in the water is at least 30ppm. The water will be left in the pipeline for at least 24 hours. After the 24 hour period, the pipeline will be drained down. For pressure pipeline testing, the pipeline would be filled with potable water or seawater (a nearly incompressible liquid) and examined for leaks or permanent changes in shape with a specified test pressure. The pipeline would be tested in sections. Pressure tests would not be carried out until the fill material has been deposited and compacted over the complete length of the pipeline to be tested. Effluent from the hydrostatic test of water supply pipeworks which the volume of discharge would be 2,500m^3 would be subjected to pre-treatment including dechlorination such as by physical process e.g. adsorption by activated carbon filter, or chemical process e.g. neutralisation by dechlorination agent dosing to ensure compliance with the discharge requirements stipulated in TM-DSS. Local and coastal waters may be impacted if the water for testing is allowed to discharge into the inshore waters or marine waters of the Victoria Harbour WCZ without mitigation.

<u>Surface Runoff, Sewage and Wastewater from Construction Activities</u>

Surface runoff from construction site may contain considerable loads of SS and contaminants during construction activities. Local and coastal waters may be impacted if the construction site run-off is allowed to discharge into the storm drains or natural drainage without mitigation. Potential water quality impact includes run-off and erosion of exposed bare soil and earth, and stockpiles.

Accumulation of solid and liquid waste such as packaging and construction materials, sewage effluent from the construction workforce, and spillage of oil, diesel or solvents by vessels and vehicles involved with the construction, if uncontrolled, would lead to deterioration in water quality. Increased nutrient level from contaminated discharges and sewage effluent would also lead to secondary water quality impacts including decrease in DO concentrations and localised increase in NH_3-N concentrations which would stimulate algal growth.

Sewage would arise from sanitary facilities provided for the on-site construction work force which would be characterised by high levels of BOD, NH_3-N and *E. coli*.

3.6.2 Operation Phase

No maintenance dredging is required for the future operation of the proposed submarine watermain. There would be no hydrodynamic impact as the operation of the submarine watermain would not involve reclamation or filling that would affect the flow volume within Victoria Harbour.

There would also be no water quality impact during the operation phase of the submarine watermain as no effluent would be discharged due to operation of the submarine watermain.

3.7 Prediction and Evaluation of Environmental Impacts

3.7.1 Suspended Solids

Water quality impact on the sensitive receivers during the entire duration of dredging works and along the entire alignment was simulated with the maximum possible instantaneous working rate of $0.0463 m^3 s^{-1}$ for two typical spring neap tidal cycles during dry and wet seasons in Hong Kong. Absolute maximum depth averaged and surface SS concentrations for the complete simulation period at each WSR, taking into account the ambient SS concentration, are presented for all scenarios.

The predicted suspended solids elevations and concentrations for all scenarios in dry and wet seasons at marine ecology sensitive receivers and the cooling and seawater intakes are presented in **Tables 3-11** to **3-14** respectively. The results indicated exceedance of WSD water quality (SS) criterion at WSD Seawater Intake at Kowloon South Salt Water Pumping Station. Mitigation measure is therefore required to minimise the impact.

The contours presented in FiguresC3.1b and 3.1c in **Appendix C** showed the extent of tidal averaged surface SS elevations over the complete simulation period during dry and wet seasons, respectively. As shown in these figures, the extent of SS impact appeared to be confined near the dredging location at West Kowloon and Sai Ying Pun. Temporal variations of surface SS elevations at various WSRs during dry and wet seasons are shown in FiguresC3.1e to t.

The contours presented in FigureC3.1d in Appendix C showed the predicted net sedimentation per metre square per day during dry and wet seasons, respectively. Both figures indicated that the sedimentation rates were highest at waters along the coast of West Kowloon and Sai Ying Pun. The sedimentation rate at Green Island, where coral communities are located, will be much lower than 0.1 kg m^{-2} per day. Thus, dredging works near West Kowloon and Sai Ying Pun will have negligible impact upon the coral communities at waters near Green Island.

Table 3-11 Predicted Suspended Solids Elevations at Marine Ecology Sensitive Receivers

Sensitive Receivers	**Assessment Point**	**SS Criterion (mgL^{-1})**	**Maximum SS Elevation**			
			Dry Season		**Wet Season**	
			Depth averaged (mgL^{-1})	**Surface layer (mgL^{-1})**	**Depth averaged (mgL^{-1})**	**Surface layer (mgL^{-1})**
Typhoon Shelter						
New Yau Ma Tei Typhoon Shelter	R1	-	0	0	0.1	0
Marine Ecology Sensitive Receivers						
Green Island	R2	Elevation <10	0.1	0.1	0	0
Green Island	R3	Elevation <10	0.1	0.1	0	0
Green Island	R4	Elevation <10	0.2	0.2	0	0
Green Island	R5	Elevation <10	0.2	0.2	0	0

- Values in **Bold** indicates exceedance of relevant criteria

Table 3-12 Predicted Suspended Solids Concentrations at Marine Ecology Sensitive Receivers

Sensitive Receivers	**Assessment Point**	**SS Criterion (mgL^{-1})**	**Maximum(1) SS Concentration**			
			Dry Season		**Wet Season**	
			Depth averaged (mgL^{-1})	**Surface layer (mgL^{-1})**	**Depth averaged (mgL^{-1})**	**Surface layer (mgL^{-1})**
Typhoon Shelter						
New Yau Ma Tei Typhoon Shelter	R1	-	8.8	8.6	8.5	6.8
Marine Ecology Sensitive Receivers						
Green Island	R2	-	8.9	8.7	8.4	6.7
Green Island	R3	-	8.9	8.7	8.4	6.7
Green Island	R4	-	9.0	8.8	8.4	6.7
Green Island	R5	-	9.0	8.7	8.4	6.7

- Values in **Bold** indicates exceedance of relevant criteria

(1) SS concentration include the ambient SS levels presented in Table 3.9 plus the SS elevation predicted in Table 3.11.

Table 3-13 Predicted Suspended Solids Elevations at Cooling and Sea Water Intakes

Sensitive Receivers	Maximum SS elevation in surface layer (mgL^{-1})			
	Assessment Point	**SS Criterion (mgL^{-1})**	**Dry Season**	**Wet Season**
Cooling Water Intakes				
Reprovisioned Prince's Building Group at CRIII	R11	-	0.8	0.4
Reprovisioned Hong Kong Shanghai Bank at CRIII	R12	-	0.2	0.1
Reprovisioned Queensway Government Offices, Admiralty and Police Headquarters at CRIII	R13	-	0.3	0.1
WSD Seawater Intakes				
Cheung Sha Wan Salt Water Pumping Station	R14	-	0	0
Kowloon South Salt Water Pumping Station	R15	-	**13.0**	**9.1**
Kennedy Town Salt Water Pumping Station	R28	-	0	0
Sheung Wan Salt Water Pumping Station	R29	-	1.2	1.4
Prince Philip Dental Hospital	R6	-	1.2	1.4
Tsan Yuk Hospital	R7	-	1.2	1.4
Macau Ferry Terminal	R8	-	1.1	1.1
Munsey Street	R9	-	1.0	0.7
Harbour Building	R10	-	0.9	0.6
Kowloon Government Offices Building	R16	-	1.2	0.4
Canton Road Government Offices Building	R17	-	1.0	0.3
MTRC Cooling Mains	R18	-	0.6	0.1
China Ferry Terminal	R19	-	0	0
Hong Kong Cultural Centre	R20	-	0.6	0.3

- Values in **Bold** indicates exceedance of relevant criteria.

Table 3-14 Predicted Suspended Solids Concentrations at Cooling and Sea Water Intakes

Sensitive Receivers	Maximum (1) SS concentration in surface layer (mgL^{-1})			
	Assessment Point	**SS Criterion (mgL^{-1})**	**Dry Season**	**Wet Season**
Cooling Water Intakes				
Reprovisioned Prince's Building Group at CRIII	R11	-	9.4	7.1
Reprovisioned Hong Kong Shanghai Bank at CRIII	R12	-	8.8	6.8
Reprovisioned Queensway Government Offices, Admiralty and Police Headquarters at CRIII	R13	<40	8.9	6.8
WSD Seawater Intakes				
Cheung Sha Wan Salt Water Pumping Station	R14	<10	8.6	6.7
Kowloon South Salt Water Pumping Station	R15	<10	**21.6**	**15.8**
Kennedy Town Salt Water Pumping Station	R28	<10	8.6	6.7
Sheung Wan Salt Water Pumping Station	R29	<10	9.8	8.1
Prince Philip Dental Hospital	R6	<10	9.8	8.1
Tsan Yuk Hospital	R7	<10	9.8	8.1
Macau Ferry Terminal	R8	<10	9.7	7.8
Munsey Street	R9	<10	9.6	7.4
Harbour Building	R10	<10	9.5	7.3
Kowloon Government Offices Building	R16	<10	9.8	7.1
Canton Road Government Offices Building	R17	<10	9.6	7.0
MTRC Cooling Mains	R18	<10	9.2	6.8
China Ferry Terminal	R19	<10	8.6	6.7
Hong Kong Cultural Centre	R20	<10	9.2	7.0

- Values in **Bold** indicates exceedance of relevant criteria.

(1) Absolute value of SS includes the ambient SS level presented in Table 3.9 plus the SS elevations predicted in Table 3.13.

3.7.2 Dissolved Oxygen, Total Inorganic Nitrogen and Unionised Ammonia

The predicted depth-averaged and bottom layer dissolved oxygen, total inorganic nitrogen and unionised ammonia elevations and concentrations for all scenarios in dry and wet seasons at marine ecology sensitive receivers and the cooling and seawater intakes are presented in **Tables 3-15 and 3-16**. The results in **Table 3-16** indicated that TIN exceedance was recorded at all assessment points during wet season. As discussed previously, the ambient TIN level near the dredging area during wet season did not comply with the WQO for TIN.

The contours presented in FiguresC3.2a, b and c, 3.3a and, 3.4a in **Appendix C** showed the extent of tidal and depth-averaged DO depletion, DO depletion at bottom layer and TIN and NH_3-N elevations over a spring-neap cycle during dry and wet seasons, respectively. As shown in these figures, the extent of DO, TIN and NH_3-N impact appeared to be confined near the dredging location at West Kowloon and Sai Ying Pun. Temporal variations of DO depletion, TIN and NH_3-N elevations at various WSRs during dry and wet seasons are shown in FiguresC3.2d to s, C3.3d to s and C3.4d to s respectively.

As presented in **Table 3-15**, with the maximum decrease in DO predicted to be 0.696mgL^{-1} at R15 during dry season and maximum increase in TIN and NH_3-N predicted to be 0.0166mgL^{-1} and 0.0017mgL^{-1} respectively at R15 during dry season, the impact of decrease in DO and increase in TIN and NH_3-N is considered trivial, Implication of algal bloom and red tide is therefore minimal and mitigation measure is therefore not required.

Table 3-15 Predicted Dissolved Oxygen, Total Inorganic Nitrogen and Unionised Ammonia Elevations

Sensitive Receivers	Assessment Point	Maximum Depth-averaged DO depletion (mgL^{-1})		Maximum DO depletion at bottom layer (mgL^{-1})		Maximum TIN elevation (mgL^{-1})		Maximum NH_3-N elevation (mgL^{-1})	
		Dry Season	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**
Typhoon Shelter									
New Yau Ma Tei Typhoon Shelter	R1	0	0	0	0.01	0	0.0001	0	0
Marine Ecology Sensitive Receivers									
Green Island	R2	0	0	0.01	0	0.0001	0	0	0
Green Island	R3	0	0	0	0	0.0001	0	0	0
Green Island	R4	0	0	0.01	0	0.0001	0	0	0
Green Island	R5	0.01	0	0.01	0	0.0002	0	0	0
Cooling Water Intakes									
Reprovisioned Prince's Building Group at CRIII	R11	0.03	0.02	0.04	0.03	0.0008	0.0005	0.0001	0
Reprovisioned Hong Kong Shanghai Bank at CRIII	R12	0.01	0.01	0.01	0.02	0.0003	0.0002	0	0
Reprovisioned Queensway Government Offices, Admiralty and Police Headquarters at CRIII	R13	0.01	0.01	0.01	0.02	0.0003	0.0002	0	0
WSD Seawater Intakes									
Cheung Sha Wan Salt Water Pumping Station	R14	0	0	0	0	0	0	0	0
Kowloon South Salt Water Pumping Station	R15	0.56	0.33	0.69	0.61	0.0166	0.0099	0.0017	0.0005
Kennedy Town Salt Water Pumping Station	R28	0	0	0	0	0	0	0	0

Sensitive Receivers	**Assessment Point**	**Maximum Depth-averaged DO depletion (mgL^{-1})**		**Maximum DO depletion at bottom layer (mgL^{-1})**		**Maximum TIN elevation (mgL^{-1})**		**Maximum NH_3-N elevation (mgL^{-1})**	
		Dry Season	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**
Sheung Wan Salt Water Pumping Station	R29	0.06	0.05	0.12	0.10	0.0019	0.0015	0.0002	0.0001
Other Seawater Intakes									
Prince Philip Dental Hospital	R6	0.06	0.05	0.12	0.10	0.0019	0.0015	0.0002	0.0001
Tsan Yuk Hospital	R7	0.06	0.05	0.12	0.10	0.0019	0.0015	0.0002	0.0001
Macau Ferry Terminal	R8	0.05	0.04	0.10	0.09	0.0016	0.0012	0.0002	0.0001
Munsey Street	R9	0.04	0.03	0.05	0.05	0.0011	0.0009	0.0001	0
Harbour Building	R10	0.04	0.03	0.06	0.06	0.0011	0.0010	0.0001	0
Kowloon Government Offices Building	R16	0.05	0.01	0.06	0.05	0.0014	0.0004	0.0001	0
Canton Road Government Offices Building	R17	0.04	0.01	0.05	0.03	0.0012	0.0003	0.0001	0
MTRC Cooling Mains	R18	0.03	0.01	0.04	0.02	0.0008	0.0003	0.0001	0
China Ferry Terminal	R19	0	0	0.01	0.01	0.0001	0.0001	0	0
Hong Kong Cultural Centre	R20	0.02	0.02	0.03	0.04	0.0007	0.0005	0.0001	0

- Values in **Bold** indicates exceedance of relevant criteria.

Table 3-16 Predicted Dissolved Oxygen, Total Inorganic Nitrogen and Unionised Ammonia Concentrations

Sensitive Receivers	**Assessment Point**	**Minimum Depth-averaged DO level (mgL^{-1})**		**Minimum DO level at bottom layer (mgL^{-1})**		**Maximum TIN concentration (mgL^{-1})**		**Maximum NH_3-N concentration (mgL^{-1})**	
		Dry Season	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**
Typhoon Shelter									
New Yau Ma Tei Typhoon Shelter	R1	6.00	5.10	6.00	4.69	0.3100	**0.4301**	0.0060	0.0100
Marine Ecology Sensitive Receivers									
Green Island	R2	6.00	5.10	5.99	4.70	0.3101	**0.4300**	0.0060	0.0100
Green Island	R3	6.00	5.10	6.00	4.70	0.3101	**0.4300**	0.0060	0.0100
Green Island	R4	6.00	5.10	5.99	4.70	0.3101	**0.4300**	0.0060	0.0100
Green Island	R5	5.99	5.10	5.99	4.70	0.3102	**0.4300**	0.0060	0.0100
Cooling Water Intakes									
Reprovisioned Prince's Building Group at CRIII	R11	5.97	5.08	5.96	4.67	0.3108	**0.4305**	0.0061	0.0100
Reprovisioned Hong Kong Shanghai Bank at CRIII	R12	5.99	5.09	5.99	4.68	0.3103	**0.4302**	0.0060	0.0100
Reprovisioned Queensway Government Offices, Admiralty and Police Headquarters at CRIII	R13	5.99	5.09	5.99	4.68	0.3103	**0.4302**	0.0060	0.0100
WSD Seawater Intakes									
Cheung Sha Wan Salt Water Pumping Station	R14	6.00	5.10	6.00	4.70	0.3100	**0.4300**	0.0060	0.0100
Kowloon South Salt Water Pumping Station	R15	5.44	4.77	5.31	4.09	0.3266	**0.4399**	0.0077	0.0105
Kennedy Town Salt Water Pumping Station	R28	6.00	5.10	6.00	4.70	0.3100	**0.4300**	0.0060	0.0100

Sensitive Receivers	**Assessment Point**	**Minimum Depth-averaged DO level (mgL^{-1})**		**Minimum DO level at bottom layer (mgL^{-1})**		**Maximum TIN concentration (mgL^{-1})**		**Maximum NH_3-N concentration (mgL^{-1})**	
		Dry Season	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**
Sheung Wan Salt Water Pumping Station	R29	5.94	5.05	5.88	4.60	0.3119	**0.4315**	0.0062	0.0101
Other Seawater Intakes									
Prince Philip Dental Hospital	R6	5.94	5.05	5.88	4.60	0.3119	**0.4315**	0.0062	0.0101
Tsan Yuk Hospital	R7	5.94	5.05	5.88	4.60	0.3119	**0.4315**	0.0062	0.0101
Macau Ferry Terminal	R8	5.95	5.06	5.90	4.61	0.3116	**0.4312**	0.0062	0.0101
Munsey Street	R9	5.96	5.07	5.95	4.65	0.3111	**0.4309**	0.0061	0.0100
Harbour Building	R10	5.96	5.07	5.94	4.64	0.3111	**0.4310**	0.0061	0.0100
Kowloon Government Offices Building	R16	5.95	5.09	5.94	4.65	0.3114	**0.4304**	0.0061	0.0100
Canton Road Government Offices Building	R17	5.96	5.09	5.95	4.67	0.3112	**0.4303**	0.0061	0.0100
MTRC Cooling Mains	R18	5.97	5.09	5.96	4.68	0.3108	**0.4303**	0.0061	0.0100
China Ferry Terminal	R19	6.00	5.10	5.99	4.69	0.3101	**0.4301**	0.0060	0.0100
Hong Kong Cultural Centre	R20	5.98	5.08	5.97	4.66	0.3107	**0.4305**	0.0061	0.0100

- Values in **Bold** indicate exceedance of relevant criteria.

(1) DO, TIN and NH_3-N concentrations include the ambient levels presented in Table 3.10 plus the DO and TIN and NH_3-N elevations predicted in Table 3.15.

3.7.3 Potential Contaminant Release During Dredging

The extent of marine sediment contamination along the alignment of the proposed cross harbour main was reported in Section 6. Fifteen vibrocore samples as shown in **Figure 6.1** were collected during the marine site investigation conducted in September 2006. The contaminant levels of vibrocore samples and their classifications under the definitions of ETWB TCW No. 34/2002 are presented in **Table 6-9**. The results indicated that high level of contamination in terms of arsenic (As), copper (Cu), lead (Pb), mercury (Hg), silver (Ag), polyaromatic hydrocarbons (PAHs) and polychlorinated biphenols (PCBs) were found essentially at a number of vibrocore samples.

These contaminants pose a higher risk of water quality impact as they would be released into the marine water when the sediment was disturbed during dredging. Thus, the elutriate tests of these parameters with sediment samples collected at all vibrocores were conducted. The tests provided an indication of the likelihood of release of heavy metals from the marine mud during dredging. The elutriate tests result was considered as rough estimation of the contaminant release at the point of dredging(9). The results are summarised in **Table 3-17**.

(9) Ludwig, D.D., Sherard, J. H. And Amende, R. A. (1988). An Evaluation of the Standard Elutriate Test as an Estimator of Contaminant Release at the Point of Dredging. Contract Report HL-88-1, prepared by Virginia Polytechnic Institute, Blacksburg VA, for the US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Table 3-17 Comparison of Marine Sediment Elutriate Test Results with Water Quality Standards

Vibrocore No.	Metal Content (μgL^{-1})					LMW PAHs (μgL^{-1})	HMW PAHs (μgL^{-1})	Total PCBs (μgL^{-1})
	As	**Cu**	**Pb**	**Hg**	**Ag**			
VC1a	**71**	<1	8.1	<0.1	<1	<0.2	<0.2	<0.01
VC2a	15	<1	1.1	<0.1	<1	<0.2	<0.2	<0.01
VC3a	**33**	1.1	1	<0.1	<1	<0.2	<0.2	<0.01
VC4a	1.1	2.9	<1	<0.1	<1	<0.2	<0.2	<0.01
VC5a	9.6	2.7	<1	<0.1	<1	<0.2	<0.2	<0.01
VC6a	<1	1	<1	<0.1	<1	<0.2	<0.2	<0.01
VC7a	15	1.6	1.9	<0.1	<1	<0.2	<0.2	<0.01
VC8a	4.1	1.2	<1	<0.1	<1	<0.2	<0.2	<0.01
VC9a	2.4	1.7	<1	<0.1	<1	<0.2	<0.2	<0.01
VC10a	1.7	3.1	<1	<0.1	<1	<0.2	<0.2	<0.01
VC11a	<1	1.1	<1	<0.1	<1	<0.2	<0.2	<0.01
VC12a	<1	<1	<1	<0.1	<1	<0.2	<0.2	<0.01
VC13a	1.6	4.9	1.8	<0.1	<1	<0.2	<0.2	<0.01
VC14a	3.9	<1	<1	<0.1	<1	<0.2	<0.2	<0.01
VC15a	6.3	<1	1.1	<0.1	**2.7**	<0.2	<0.2	<0.01
Water Quality Standard	25(3)	5(1)	25(1)	0.3(1)	2.3(1)	3.0(2)	3.0(2)	0.03(4)

Note: Values in **bold** indicates exceedance of Water Quality Standard

(1) UK Water Quality Standard

(2) Australian and New Zealand Guidelines for Fresh and Marine Waters

(3) Environmental Economic and BPEO Assessment Principals for Integrated Pollution Control

(4) USEPA Salt Water Criterion

As shown in **Table 3-17**, the As, Cu, Pb, Hg, Ag, PAHs and PCBs content in the elutriate samples fall within the UK Water Quality Standard, Australian and New Zealand Guidelines for Fresh and Marine Waters, Environmental Economic and BPEO Assessment Principals for Integrated Pollution Control and USEPA Salt Water Criterion respectively except for As at VC1a and 3a and Ag at VC15a.

Based on the detected highest concentrations for As, the required dilution to meet the relevant water quality standard was calculated to be 2.8. To estimate the extent of the mixing zone, conservative estimation of the required dilution factor was conducted. Although elevation of suspended solids in bottom layer is not a hundred percent representative of contaminant release, suspended solids in bottom layer represents a very conservative estimation of contaminant release. As shown in Figures C3.1b and c in Appendix C where the predicted maximum elevation of suspended solids in dry and wet seasons at the bottom layer were presented, about 3 times dilution could be achieved in a mixing zone of approximately 400m. As water quality sensitive receivers were not identified within the mixing zone of 400m, adverse water quality impacts are therefore not anticipated. Moreover, it is expected that any release of heavy metals during dredging will be quickly diluted by the large volume of marine water within the construction site. The release of pollutants will also be minimised by the use of closed grab dredger and the dispersion of pollutants will be confined within the construction site by the silt curtains (Section 3.8.1). Thus, it is considered that long-term off-site water quality impact is unlikely and any local water quality impact will be transient and localised.

3.7.4 Hydrostatic Tests of the Water Mains System

Effluent from the hydrostatic tests of water supply pipeworks which the volume of discharge would be 2,500m^3 would be subjected to pre-treatment including dechlorination such as by physical process e.g. adsorption by activated carbon filter, or chemical process e.g. neutralisation by dechlorination agent dosing to ensure compliance with the discharge requirements stipulated in TM-DSS . High SS concentration in marine water would lead to associated reduction in DO levels. Proper practice and good management should be strictly followed to prevent water with high level SS from entering the surrounding waters. With the implementation of appropriate measures to control water discharge from hydrostatic test, disturbance of water bodies would be localised and deterioration in water quality would be minimal. Effluent from hydrostatic tests would comply with the standards for effluent discharged into the inshore waters or marine waters of the Victoria Harbour WCZ as shown in Tables 9a and 9b of the TM-DSS and Sections 23.73 and 23.77 of the *General Specification for Civil Engineering Works Volume 3, 1992 Edition* provided the recommended mitigation measures detailed in Section 3.8 were properly implemented.

3.7.5 Surface Runoff, Sewage and Wastewater from Construction Activities

Construction run-off would cause physical, chemical and biological effects. The physical effects would arise from any increase in SS from the construction site that blocks drainage channels and causes local flooding when heavy rainfall occurs. High SS concentrations in marine water would also lead to associated reduction in DO levels.

Proper site practice and good site management should be strictly followed to prevent run-off water with high level of SS from entering the surrounding waters. With the implementation of appropriate measures to control run-off from the construction site, disturbance of water bodies would be localised and deterioration in water quality would be minimal. Unacceptable impacts on the water quality were not expected provided that the recommended measures described in Sections 3.8 were properly implemented.

Provided that good construction practices are observed to ensure that litter, fuels, and solvents are managed, stored and handled properly, effects on water quality from general construction activities would be minimal.

Based on the Sewerage Manual, Part I, 1995 of the Drainage Services Department (DSD), the global unit flow factor for employed population of 0.06 m^3 per worker per day and commercial activities in year 2012 of 0.29 m^3 per worker per day were used to estimate the sewage generation from the construction site. The total sewage production rate was estimated at 0.35 m^3 per worker per day. With every 100 construction workers working simultaneously at the construction site, a total of about 35 m^3 of sewage would be generated per day. The sewage should not be allowed to discharge directly into the surrounding water body without treatment. Chemical toilets and subsequently on-site sewer should be deployed at the construction site to collect and handle sewage from workers.

3.8 Mitigation of Adverse Environmental Impact

3.8.1 Construction Phase

Specific Mitigation Measures for dredging

Exceedances of WSD Seawater Intake criterion (10 mg L^{-1}) at Kowloon South Salt Water Pumping Station was predicted during both dry and wet seasons if dredging was undertaken near West Kowloon. To minimise the potential SS impact, implementation of the following mitigation measures is recommended:

- Dredging should be undertaken using one grab dredger only with a maximum production rate of 4,000m^3 per day;
- Deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress;
- Deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress.

The frame type silt curtain should be designed to enclose local pollution caused by the grab dredger and suspended by a steel frame mounted on the grab dredger and floating on water. This frame type silt curtain should be fabricated from permeable, durable, abrasion resistant membrane like geotextiles and be mounted on a floating boom structure. The frame type silt curtain should also extend to the seabed to cover the entire water column. Steel chain or ballast should be attached to the bottom of the silt curtain. Mid-ballast may be added as necessary. The structure of the silt curtain should be maintained by metal grids. The frame type silt curtain should be capable or reducing sediment loss to outside by a factor of 4 (or about 75%([10]). Silt screen is recommended for dredging near the seawater intake at Kowloon South Salt Water Pumping Station. The implementation of silt screen at the intake could

([10]) Maunsell Consultants Asia Ltd (2001), *Agreement No. CE 74/98, Wan Chai Development Phase II Comprehensive Feasibility Study, Final Environmental Impact Assessment Report,* for Territory Development Department..

reduce the SS level by a factor of 2.5 (or about 60%) (10). These SS reduction factors have been adopted in the Wan Chai Development Phase II Environmental Impact Assessment Study in 2001. An illustration of a typical configuration of frame type silt curtain and silt screen at seawater intake is shown in **Figure 3.9**.

Table 3-18 Predicted SS concentration at the WSD Seawater Intake after implementation of frame type silt curtain and silt screen at the intake

WSD Sea Water Intake	SS Criterion (mgL^{-1})	SS elevation in surface layer (mgL^{-1})		SS concentration in surface layer (mgL^{-1}) (1)	
		Dry Season	Wet Season	Dry Season	Wet Season
Kowloon South Salt Water Pumping Station	<10	1.3	0.9	9.9	7.6

(1) SS concentration includes the ambient SS level (8.6 mg L^{-1} for dry season and 6.7 mg L^{-1} for wet season) in the surface layer of water column

Table 3-18 summarises the predicted SS concentration at WSD Sea Water Intake at Kowloon South Salt Water Pumping Station after implementation of frame type silt curtain and silt screen at the sea water intake at Kowloon South Salt Water Pumping Station. With the implementation of frame type silt curtain and silt screen at sea water intake at Kowloon South Salt Water Pumping Station, the impacted WSD Seawater Intake at Kowloon South Salt Water Pumping Station will comply with the relevant SS criterion (10 mg L^{-1}) during both the dry and wet season. Further mitigation measures were considered not necessary.

Other Mitigation Measures for dredging

Good site practice that should be undertaken during dredging includes:

- Tight-closing grabs should be used to minimize the loss of sediment to suspension during dredging works. For dredging of any contaminated mud, closed watertight grabs must be used;
- all vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- the decks of all vessels should be kept tidy and free of oil or other substances that might be accidentally or otherwise washed overboard;
- adequate free board shall be maintained on barges to ensure that decks are not washed by wave action;
- all barges used for the transport of dredged materials should be fitted with tight bottom seals to prevent leakage of material during loading and transport;
- construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the site or dumping grounds;
- loading of barges should be controlled to prevent splashing of material into the surrounding waters. Barges should not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation;
- the speed of vessels should be controlled within the works area to prevent propeller wash from stirring up the seabed sediments; and

- before commencement of dredging works, the holder of the Environmental Permit should submit detailed proposal of the design and arrangement of the frame type silt curtain to EPD for approval.

Effluent from Hydrostatic Tests of the Water Mains System

To ensure compliance with the standards for effluent discharged into the inshore waters or marine waters of Victoria Harbour WCZ as shown in Tables 9a and 9b of the TM-DSS and Section 23.73 and 23.77 of the *General Specification for Civil Engineering Works Volume 3, 1992 Edition*, sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacities, are recommended as a general mitigation measure which can be used for settling the effluent prior to disposal. The system capacity should be flexible and suited to applications where the influent is pumped. Pre-treatment including dechlorination such as by physical process e.g. adsorption by activated carbon filter, or chemical process e.g. neutralisation by dechlorination agent dosing should be carried out to ensure compliance with the discharge requirements stipulated in TM-DSS.

Surface Runoff, Sewage and Wastewater from Construction Activities

Appropriate measures should be implemented to control runoff and prevent high loads of SS from entering the marine environment. Proper site management is essential to minimise surface runoff and sewage effluents.

Construction site runoff should be prevented or minimised in accordance with the guidelines stipulated in the EPD's Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94). All discharges from the construction site should be controlled to comply with the standards for effluents discharged into the Victoria Harbour WCZ under the TM-DSS. Good housekeeping and stormwater best management practices, as detailed below, should be implemented to ensure all construction runoff complies with WPCO standards and no unacceptable impact on the WSRs as a result of construction of the proposed submarine watermain.

Sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacities, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity should be flexible and able to handle multiple inputs from a variety of sources and suited to applications where the influent is pumped.

Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the storm runoff being directed into foul sewers.

All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and located wheel washing bay should be provided at every site exit, and wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfill toward the wheel-wash bay to prevent vehicle tracking of soil and silty water to public roads and drains.

Precautions should be taken at any time of year when rainstorms are likely. Actions should be taken when a rainstorm is imminent or forecast. Actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events, particularly for areas located near steep slopes.

Fuel tanks and storage areas should be provided with locks and be located on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank, to prevent spilled fuel oils from reaching the coastal waters of the Victoria Harbour and Western Harbour WCZs.

Portable chemical toilets would be used to handle construction workforce sewage prior to discharge to the existing trunk sewer. Sufficient numbers of portable toilets shall be provided by a licensed contractor to serve the construction workers. The Contractor shall also be responsible for waste disposal and maintenance practices.

3.9 Evaluation of Residual Impacts

Major water quality impact associated with dredging activities is the elevation of SS within the marine water column. Provided the recommended mitigation measures including the use of one grab dredger only with a maximum production rate of 4,000m^3 per day for dredging, deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress and deployment of silt screen at the seawater intake at Kowloon South Salt Water Pumping Station while dredging works are in progress are implemented, no unacceptable residual cumulative water quality impact due to construction of the cross harbour main as well as the other concurrent marine works is expected.

Hydrostatic test of the water mains system would lead to effluent containing elevated concentrations of SS that would enter into the surrounding water. It was however expected that the above water quality impact would be temporary and localised during construction only. Provided the recommended mitigation measure is implemented and the effluent discharge complied with the TM-DSS standards, no unacceptable residual water quality impact due to effluent arising from hydrostatic test is expected.

General construction activities associated with the construction of the submarine watermain would lead to construction site runoff containing elevated concentrations of SS and associated contaminants that would enter into the marine water. It was however expected that the above water quality impacts would be temporary and localised during construction only. Provided the recommended mitigation measures are implemented and all construction site/works area discharges complied with the TM-DSS standards, no unacceptable residual water quality impact due to construction of the submarine watermain is expected.

3.10 Environmental Monitoring and Audit

Based on the above assessment of the water quality impact, an environmental monitoring and audit (EM&A) programme was considered necessary to obtain a robust, defensible database of baseline information of water quality before construction, and thereafter, to monitor any variation of water quality from the baseline conditions and exceedances of

WQOs at sensitive receivers during construction. Details of the EM&A were presented in a stand-alone EM&A Manual.

3.11 Conclusions and Recommendations

3.11.1 Construction Phase

Water quality impact during the dredging works of the submarine watermain was quantitatively assessed using the Delft3D Model. Suspended sediment was identified as the key water quality parameter during dredging. Water quality impact on the sensitive receivers during the entire duration of the dredging works and along the entire alignment with the maximum possible instantaneous working rate of $0.0463m^3s^{-1.}$ (i.e. one grab dredger with a maximum production rate of $4,000m^3$ per day, 7 days per week, 24 hours per day) for the complete simulation period for the dry and wet seasons was assessed and it was predicted that potential water quality impact would occur at the WSD Sea Water Intake at Kowloon South Salt Water Pumping Station. With the implementation of the proposed mitigation measures including the use of one grab dredger only with a maximum production rate of $4,000m^3$ per day for dredging, deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress and deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress, the potential water quality impact upon the sea water intake would be effectively minimised and there would be no unacceptable residual cumulative water quality impact due to the dredging works of the submarine watermain as well as the other concurrent marine works. The assessment predicted that the dredging works would have negligible impact upon the coral communities near Green Island. An environmental monitoring and audit programme was recommended to ensure the effectiveness of the proposed water quality mitigation measures.

Minor potential water quality impacts from hydrostatic tests of the water mains systems and construction activities associated with the construction of the proposed submarine watermain were associated with effluent, sewage, wastewater and surface runoff. Impacts could be controlled to comply with the WPCO standards by implementing the recommended mitigation measure. No unacceptable residual impact on water quality was expected.

3.11.2 Operation Phase

No maintenance dredging is required for the future operation of the proposed submarine watermain. There would be no hydrodynamic impact as the operation of the submarine watermain would not involve reclamation or filling that affects the flow volume within the Victoria Harbour.

There would also be no water quality impact during the operation of the submarine watermain as no effluent would be discharged due to the operation of the submarine watermain.

4 MARINE ECOLOGICAL IMPACT ASSESSMENT

4.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, construction and operation marine ecological impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain were assessed.

This section presents the results of the assessment of ecological value of the habitat and marine resources of the Study Area for the proposed submarine watermain according to the EIA Study Brief No. ESB-132/2005. The potential impacts from the construction and operation of the Project on the existing ecological resources in the Study Area were assessed and evaluated according to the EIAO-TM Annex 8 and 16.

4.2 Environmental Legislation, Standards, Guidelines and Criteria

A number of international conventions, local legislations and guidelines provide the framework for the protection of species and habitats of ecological importance. Those related to the Project are:

- *Wild Animals Protection Ordinance* (Cap 170);
- *Protection of Endangered Species of Animals and Plants (Ordinance* (Cap 586);
- *Town Planning Ordinance* (Cap 131);
- *Hong Kong Planning Standards and Guidelines Chapter 10* (HKPSG);
- *The Technical Memorandum on Environmental Impact Assessment Process under the Environmental Impact Assessment Ordinance (EIAO TM)*;
- *EIAO Guidance Note No. 11/2004 Methodologies for Marine Ecological Baseline Surveys;*
- *United Nations Convention on Biodiversity* (1992);
- *Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);*
- *Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention);*
- *IUCN Red Data Books;* and

- *PRC Regulations and Guidelines*.

Under the ***Wild Animals Protection Ordinance***, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from destruction and removal. All birds and most mammals including all cetaceans are protected under this Ordinance, as well as certain reptiles, amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1992.

The ***Protection of Endangered Species of Animals and Plants Ordinance*** was gazetted on 10 March 2006 to replace the *Animals and Plants (Protection of Endangered Species) Ordinance*. The Ordinance will be effective on 1 December 2006, which aims at to regulate the import, introduction from the sea, export, re-export and possession or control of certain endangered species of animals and plants and parts and derivatives of those species; and to provide for incidental and connected matters.

The ***Town Planning Ordinance*** provides for the designation of areas such as “Coastal Protection Areas”, “Sites of Special Scientific Interest (SSSIs)”, “Green Belt” and "Conservation Area” to promote conservation or protection or protect significant habitat.

Chapter 10* of the *HKPSG covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong, and Government departments involved in conservation.

Annex 16* of the *EIAO TM sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating ecological impacts.

EIAO Guidance Note No. 11/2004 Methodologies for Marine Ecological Baseline Surveys elaborates on Annex 16 of the TM to provide information on the requirements of marine ecological baseline study. The note provides general guidelines for conducting a marine ecological baseline survey in order to fulfil the requirements stipulated in the TM in respect of marine ecological assessment for a proposed development.

The Peoples’ Republic of China (PRC) is a Contracting Party to the ***United Nations Convention on Biological Diversity*** of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The Government of the Hong Kong Special Administrative Region has stated that it will be “committed to meeting the environmental objectives” of the Convention (PELB 1996).

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between Governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The Convention on Migratory Species of Wild Animals (Bonn Convention) aims at to develop international cooperation with a view to the conservation of migratory species of wild animals. This includes the conserve of terrestrial, marine and avian migratory species throughout their range. Migratory species threatened with extinction are listed as Appendix I of the Convention. Migratory species that needs or would significantly benefit from international cooperation are listed in Appendix II of the Convention. Hong Kong was a Party of this Convention since 1985.

The PRC in 1988 ratified the ***Wild Animal Protection Law*** of the PRC, which lays down basic principles for protecting wild animals. The Law prohibits killing of protecting animals, controls hunting, and protects the habitats of wild animals, both protected and non-protected. The Law also provides for the creation of lists of animals protected at the state level, under Class I and Class II. There are 96 animal species in Class I and 156 in Class II. Class I provides a higher level of protection for animals considered to be more threatened.

4.3 Assessment Methodology

The Study Area was defined as the assessment area for Water Quality Impact Assessment, which is within 500 m from the site boundary, the Victoria Harbour and Western Buffer Water Control Zones. Area likely to be impacted by the Project including Green Island was also included in this assessment. A desktop literature review was conducted in order to establish the baseline conditions of the physical environment and to establish the general ecological profile for impact assessment. Information from the water quality assessment was also used to identify the effects of the change in water quality parameters on the marine ecology. The importance of marine ecological resources identified within the Study Area and the potential impacts due to the construction and operation of the Cross Harbour Main were assessed following the criteria and guidelines for evaluating and assessing ecological impact as stated in Annexes 8 and 16 of the *EIAO-TM* respectively.

The baseline information was gathered base on but not limited to the following publications and information:

- Environmental Resources Management (1998). *Environmental Impact Assessment: Dredging an Area of Kellett Bank for Reprovisioning of Six Government Mooring Buoys.* Civil Engineering Department Port Works Division.
- Scott Wilson Kirpatrick Consulting Engineering (1995). *Green Island Reclamation (Part) – Public Dump. Environmental and Traffic Impact Assessment, Final Report Vol. I. Environmental Impact Assessment.* Civil Engineering Department.
- Atkins China Ltd. (2001). *Central Reclamation, Phase III – Studies, Site Investigation, Design and Construction Environmental Impact Assessment Report.* Territory Development Department.
- Maunsell (2001). *Wan Chai Development Phase II Comprehensive Feasibility Study Environmental Impact Assessment.* Territory Development Department.
- Maunsell Consultants Asia Limited (2002). *Yau Tong Bay Development Reclamation of Yau Tong Bay Environmental Impact Assessment Study.*
- Morton, B.S. and Morton, J. (1983). *The Sea Shore Ecology of Hong Kong,* Hong Kong University Press, Hong Kong.

- Environmental Protection Department (2005). *Marine Water Quality in Hong Kong in 2004.*
- Tsim Sha Tsui Arial Photo date 5 October 2004 at 4,000 ft. Survey & Mapping Office, Lands Department HKSAR.
- Sai Wan and Green Island Arial Photos date 8 March 2005 at 4,000 ft. Survey & Mapping Office, Lands Department HKSAR.

4.4 Baseline Conditions & Marine Ecological Sensitive Receivers

The Study Area consists of several habitats, including the habitats in the intertidal zone (artificial seawalls and rocky shores), sub-tidal zone (soft-bottom and hard-bottom habitats) and the open sea (Victoria Harbour). The marine ecology around Green Island located approximately 2.8 km away from the proposed submarine watermain was also included in this study. **Figure 4.1** shows the Study Area for the marine ecological impact assessment.

4.4.1 Existing Condition of Victoria Harbour

The location of the proposed submarine watermain is at the west of Victoria Harbour, within the gazetted Victoria Harbour Water Control Zone under the Water Pollution Control Ordinance (Cap. 358). Victoria Harbour was described as unclean cesspits receiving effluent and every sort of rubbish[11]. The recent marine water quality monitoring results from Environmental Protection Department (2005)[12] showed that the water quality of the Victoria Harbour has been improved significantly after the implementation of the Harbour Area Treatment Scheme (HATS) in 2002. Only the total inorganic nitrogen (TIN) showed non-compliance to the Water Quality Objectives (WQO) in one monitoring station (with annual arithmetic means 0.20-0.57 mg/L) close to the alignment during 2004. Other key parameters such as dissolved oxygen and unionised ammonia were compliant with the WQO in both 2003 and 2004. The marine water quality sampling results at western Victoria Harbour in 2004[13] showed that the water was generally turbid (8.1 – 14.8 NTU), with increasing trend of nitrate nitrogen concentration (0.05 – 0.30 mg/L), *E. coli* (540 – 26000 cfu/100mL) and faecal coliforms (16000 – 95000 cfu/100mL) count. The recently conducted water quality monitoring results in August 2006 showed that the turbidity level within the study area has much improved, ranging from 3.71 – 12.02 mg/L. The nitrate nitrogen concentration approximates 0.16 mg/L and the *E. coli* count range from 2000 to 9000 cfu/100mL.

<u>Intertidal Zone</u>

Artificial Seawalls

The intertidal zone of the Project area consists of breakwaters and sloping artificial seawall formed by large boulders and rock armour during reclamation along West Kowloon Reclamation area (**Figure 4.2**). Vertical artificial seawalls along Sai Ying Pun shoreline and concrete embanked wharf piles close to the Western Wholesale Food Market are common habitats along the Victoria Harbour (**Figure 4.2**). Fouling organisms are commonly found in

[11] Morton, B. and Morton, J. (1983). *The Sea Shore Ecology of Hong Kong.* Hong Kong University Press.
[12] Environmental Protection Department (2005). Marine Water Quality in Hong Kong in 2004.
[13] *Ibid*

this kind of artificial structures. They include rock oysters, periwinkles and barnacles as well as algae, coelenterates, ascidians, bryozoans, sponges, crustaceans, other molluscs and polychaetes, which were tolerant to pollution[14 15 16]. No detail survey for these structures has been conducted, as much of the Harbour is ecologically degraded due to the smooth structures of the artificial seawall reduces the number of niches available for settlement and thus restricts the diversity of the flora and fauna that colonizes it[17]. Literatures within the Study Area and in vicinity have been reviewed and summarised in **Table 4-1** below.

Table 4-1 Typical Members of the Macrofauling Community in Wharf Piles of Hong Kong (Source: Morton, B. and Morton, J. 1983)

Zonation Commonly Recorded	Group	Species
Eulittoral zone	Bivalve	*Perna viridis* *Barbatia virescens* *Trapezium liratum* *Musculista senhausia* *Modiolus agripetus* *Ryenella cuprea* *Electroma japonica* *Saccostrea cucullata* *Chama* spp. *Striarca afra* *Claudiconcha japonica*
Eulittoral zone	Barnacles	*Balanus amphitrite* *Modiolus agripetus* *Ryenella cuprea* *Electroma japonica* *Balanus amphitrite* *Balanus reticulates* *Balanus variegates* *Balanus trigonus*
Sub-littoral fringe	Algae	*Ulva conglobata* *Enteromorpha prolifera* *Rhizoclonium riparium* *Codium cylindricum* *Colpomenia sinuosa*

[14] ERM (1998). *Dredging an Area of Kellett Bank for Reprovisioning of Six Government Mooring Buoys Environmental Impact Assessment.* Civil Engineering Department.
[15] Maunsell Consultants Asia Ltd. (2002). *Yau Tong Bay Development Reclamation of Yau Tong Bay Environmental Impact Assessment Study.*
[16] Morton, B. and Morton, J. (1983). *Op cit.*
[17] Morton, B. and Morton, J. (1983). *Op cit.*

Zonation Commonly Recorded	Group	Species
Sub-littoral fringe	Ascidians	*Ascidia sydneiensis* *Ciona intestinalis* *Styela plicata* *Styela canopus* *Herdmania momus*
Sub-littoral zone	Polychaete	*Pomatoceros triqueter* *Hydroides elegans* *Spirorbis foraminosus*
Sub-littoral zone	Polyzoa	*Pedicellina* (Genera) *Barentsia* (Genera) *Loxosomella* (Genera)

Natural Rocky Shores

Green Island was formed by granitic rocks with natural rocky shores at the coast[18]. The northern shores have a greater habitat variety than the southern shores, by having gentler slopes with sand and boulders at the coast[19].

Literature review showed that the species diversity at the intertidal zone of Green Island was similar on both northern and southern shores, but different assemblages of intertidal fauna were recorded. The species recorded in Green Island include the commonly found barnacle *Tetraclita squamosa*, topshells *Monodonta labio*, littorinids *nodilittorina trochoides*, chitons *Acanthopleura japonica,* the limpets *Cellana grata* and a rare species of nerite *Nerita undata*[20]. These species were found having a larger body size than the same species recorded at the northwestern shores of Hong Kong Island, which was probably the effect of limited human disturbance with food availability arising from the eutrophic water of the Victoria Harbour[21]. Apart from the fauna community, the mid-tidal zone of the rocky shores have an extensive bed of macroalgae *Porphyra* sp., *Ulva* sp., *Gelidium* sp. and encrusting cyanobacteria *Kyrtuthrix maculans.* The sea-lettuce *Ulva* sp. was described common upon nearly all shores in Hong Kong[22].

Baseline surveys of the coastal communities of Green Island, Little Green Island and a reference site in Hong Kong Island have been conducted by ERM in 1997[23]. In total 22 species of fauna and 8 species of algae were recorded, abstract of the most abundant species are listed in **Table 4-2** below.

The results showed that the most abundant species were grazing gastropods including Chiton and Limpets at the low shore, and Periwinkles at the high shore. Predatory

[18] Morton, B. and Morton, J. (1983). *Op cit.*
[19] Environmental Resources Management (1998). *Op cit.*
[20] *Ibid.*
[21] *Ibid.*
[22] Morton, B. and Morton, J. (1983). *Op cit.*
[23] *Ibid.*

gastropods such as the Dogwhelks *Thais clavigera* and *T. luteostoma* were also recorded in low density at the low shore. Sessile organisms including Stalked Barnacles and Acorn Barnacles were recorded in high abundances. Algae were sparsely distributed along the shore during summer, with Cyanobacteria *Pseudoulvella* spp. having the highest percentage cover[24].

By comparing the three survey locations, the overall species abundance and species diversity were highest at the reference Hong Kong sites, followed by the Little Green Island and Green Island. The findings displayed the intertidal community to be typical of semi-exposed rocky shores. No rare species or species of conservation value were recorded during the survey.

Table 4-2 Abstract of Coastal Flora and Fauna recorded in Green Island, Little Green Island and a reference site in Hong Kong Island. (Source: ERM, 1998)

Zonation Recorded	Group	Species
Low Shore	Herbivorous Molluscs	Chiton (*Acanthopleura japonica*) Limpets (*Cellana grata,C. toreuma, Patelloida pygmaea and P. saccharina)*
High Shore	Predatory Gastropods	*Periwinkles* (*Nodilittorina trochoides, N. radiate* and *N. vidua*)
Low Shore	Filter-feeding Barnacles	Dogwhelks (*Thais clavigera* and *T. luteostoma*)
Not Mentioned	Cyanobacteria	Stalked Barnacles (*Capitulum mitella*) Acorn Barnacles (*Tetraclita* sp.)
Not Mentioned		*Pseudoulvella* spp.

<u>Sub-tidal Zone</u>

Soft-bottom Benthos Assemblages

The sea bed sediment of Victoria Harbour was described as grey, clayey, very silty and very gravelly sand with shell fragments in 2002 sediment testing[25], which is similar to the recent sediment testing results conducted in September 2006. There were minimal seasonal changes in sediment characteristics for both summer and winter recorded around Victoria Harbour[26]. Vibrocore samples were collected in 15 locations (**Figure 4.1**), samples results showed that the seabed close to the Sai Ying Pun and along the proposed submarine watermain at the central are mainly composed of marine deposit with very soft, grey, silty

[24] Environmental Resources Management (1998). *Op cit.*
[25] Mouchel Asia Limited (2002). *Maintenance Dredging for Central Fairway Phases 1, 2 & 3 Sediment Quality Report.* Civil Engineering Department, Geotechnical Engineering Office HKSAR.
[26] CityU Professional Services Limited (2002). *Consultancy Study on Marine Benthic Communities in Hong Kong.* AFCD.

clay with trace of coarse sand and fine gravel size shell fragments. For the surface sediments close to the Yau Ma Tei New Typhoon Shelter, the marine deposit appeared dark grey, silty, fine sand with occasional coarse sand size shell fragments recorded. Sediments collected close to the central and southern fairway around 200m away from the proposed water main indicated that the surface deposit at around 1m depth from the seabed were anthropogenic, black sediment which oxidize to brown, slightly silty, fine to coarse sand with little subangular, fine to medium gravel of rocks were recorded. The different in sediments composition was the result of continuous seabed disturbance by the marine traffic at the Victoria Harbour.

In view of the similar composition of the sediment recorded between the literatures and this study, and low species diversity were recorded in the local region with references to difference studies, no benthic fauna survey was conducted. Benthic infauna and epifauna communities recorded within the Study Area and in vicinity have been reviewed, and the findings are summarised below.

Benthic Infauna

Benthic infauna can be studied by grab sampling, vibrocore survey and the use of sediment profile photography method named Remote Ecological Monitoring of the Seafloor (REMOTS). Grab sampling results showed that the particle size distribution of the benthos between Stonecutters Island and Kennedy Town had a mean silt content of 77% and an organic content of 2.2%[27]. The most abundant benthic fauna recorded is Polychaetes, which comprised of approximate 80% of the total infauna recorded. Other species include molluscs, crustaceans and echinoderms with abundance less than 10% of the total species recorded for each species group. The assemblages of the Victoria Harbour benthic infauna was characterised by low species diversity, evenness and low individual biomass[28 29]. The most abundant polychaete species recorded in the Western Harbour Area include the *Aglaophamus lyrochaeta*, *Nephtys* sp., *Paraprionospio pinnata, Tharys* sp., *Marphysa stragulum*, *Notomastus latericeus* and *Glycera chiori*[30]. *Paraprionospio pinnata* is known to be well adapted to organic pollution and is an indicator of the increase in TOM in sediments[31].

Grab samples along the Sulphur Channel between Green Island and Kennedy Town conducted in 1993 (**Figure 4.1**) showed that 92 macrobenthic organisms of 32 taxa were recorded, in which 69% of the total number of individuals were polychaetes, others include the molluscs and crustaceans[32]. The most abundant polychaetes comprised *Prionospio saccifera*, *Tharyx multifilis, Nephtys polybranchia, Sternespis sculata* and *Sigambra hanaokai*.

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[27] ERM (1998). *Op cit.*
[28] *Ibid.*
[29] CityU Professional Services Limited (2002). *Op cit.*
[30] ERM (1998). *Op cit.*
[31] CityU Professional Services Limited (2002). *Op cit.*
[32] Binnie Consultants Limited (1994). *South Cheung Chau & Sulphur Channel Seabed Ecology Pilot Survey by Grab Sample.* Civil Engineering Department.

Sediment sampling results in 1995 around the Central waterfront (**Figure 4.1**) recorded that no live benthic invertebrates were sampled[33]. Only empty gastropod shells were collected. The malodorous and anoxic sediment suggested that the marine lives were subject to pollution stress by the long term sewage discharge into the region.

Remote Ecological Monitoring of the Seafloor Studies (REMOTS) showed that benthic eutrophication occurs as a result of organic enrichment from the harbour (sampling locations see **Figure 4.1**) [34]. Only the pollution tolerant polychaetes species (Spionidae and Capitellidae) and crustaceans (crab larvae and small amphipods) in small size and low density were recorded on the near surface sediment. CityU (2002)[35] also indicated that the benthic fauna recorded in Victoria Harbour is characterized by species which can adapt to an eutrophic environment. The sediments in the study area appeared dark grey to black, reflecting the anoxic condition with high organic loading of the local region.

Benthic Epifauna

Trawl surveys were conducted by ERM in 1995[36] (see **Figure 4.1** for trawling location). There are total 15 species and 44 individuals recorded close to the Green Island (**Table 4-3**). The species diversity of the benthic epifauna was diverse, but low in abundance. The dominant species was anemones, which comprises of approximately 36% of the total number of organisms recorded in the region. Apart from the gorgonian soft corals and sea pen (*Pteroides esperi*) recorded were considered to be of ecological value, the fish diversity and macro-invertebrate communities around the Green Island were considered to be low comparing with other areas in Hong Kong[37].

Table 4-3 Benthic Epifauna Recorded around Green Island (Source: ERM, 1995)

Species	Abundance
Sponge	
Sclerobelemnon burgeri	6
Pteroides esperi	2
Virgularia gustaviana	2
Gorgonacea sp.	1
Anemones	
Unidentified anemones	16
Hydrozoa	
Unidentified hydroids	1
Bryozoan	

[33] ERM (1998). *Op cit.*
[34] ERM (1998). *Op cit.*
[35] CityU Professional Services Limited (2002). *Op cit.*
[36] ERM Hong Kong Ltd (1995). *Backfilling of South Tsing Yi and North of Lantau MBAs: Final Environmental Impact Assessment*. Civil Engineering Department.
[37] *Ibid.*

Species	Abundance
Unidentified bryozoan	2
Molluscs	
Callanailis hirascana	1
Shrimps & Mantis shrimp	
Alpheus bisincisus	5
Oratosquilla oratoria	3
Crabs	
Portunus hastatoides	1
Thalamita picta	1
Fish	
Paralichthys olivaceus	1
Oxyurichthys tentacularis	1
Unidentified Clupeidae	1
Total no. of species	**15**
Total no. of individuals	**44**

Hard-bottom Coral Assemblages

Remotely Operated Vehicle (ROV) was used to conduct coral survey around Green Island, Little Green Island and the Sulphur Channel close to the western Hong Kong Island (reference site) by ERM as part of the ecological surveys for the Green Island Development Studies in 1997[38]. Video were taken along three 10m wide belt transects at depths of -5, -10 and -15 mPD. Four species of soft coral and gorgonians were recorded in this study at Green Island and Little Green Island, including the Pink Soft Coral *Dendronnephthya* sp., Orange Sea Fan *Echinogorgia complexa*, White Sea Whip *Euplexaura curvata* and Purple Sea Whip *Ellisella gracilis*. No soft coral and gorgonian colonies was recorded in the western Hong Kong Island waters in this study. **Table 4-4** shows the frequency of soft coral and gorgonian colonies encountered during the study.

The seabed profile at the sub-tidal zone around Green Island is composed of rocky seabed with scattered boulders at -5 mPD[39], and become sandy offshore. Seabed profile around the western Hong Kong Island is a bit different from the Green Island, with sandy substrates in shallow region and becomes muddy with scattered shell fragments offshore. This may show the different in marine organism distribution among the sites.

[38] Babtie BMT (1997). *Green Island Development – Studies on Ecological, Water Quality and Marine Traffic Impacts. Initial Ecological and Water Quality Impacts Report.* TDD.
[39] ERM (1998). *Op cit.*

Table 4-4 Frequency of Soft Coral and Gorgonian Colonies Recorded around Green Island (Source: ERM, 1998)[40]

Survey Area and Transect No.	Level (-mPD	Species			
		Dendronephthya sp.	*Echinogorgia complexa*	*Euplexaura curvata*	*Ellisella gracilis*
Little Green Island					
T1.1	5	20	10	11	0
T1.2	10	18	9	15	0
T1.3	15	11	10	24	0
T2.1	5	17	4	5	2
T2.2	10	2	0	9	0
T2.3	15	11	2	8	0
Green Island					
T3.1	5	8	1	20	0
T3.2	10	3	0	57	0
T3.3	15	0	0	17	0
T4.1	5	20	0	0	0
T4.2	10	4	0	2	0
T4.3	15	18	0	13	0
Hong Kong Island					
T5.1	5	0	0	0	0
T5.2	10	0	0	0	0
T5.3	15	0	0	0	0
T6.1	5	0	0	0	0
T6.2	10	0	0	0	0
T6.3	15	0	0	0	0

The most frequently encountered (more than 40 colonies per transect) species in the Green Island was the White Sea Whip *Euplexaura curvata*, especially at the western side of the Green Island at depth -10 mPD, followed by the Pink Soft Coral *Dendronephthya* sp. which was common in both the Green Island and Little Green Island waters. The Orange Sea Fan *Echinogorgia complexa* was considered as rare in the Green Island region, but was common and evenly distributed at the three depths in Little Green Island. The Purple Sea Whip *Ellisella gracilis* was only encountered at the Little Green Island region at depth -5 mPD and considered as rare as less then 20 colonies were recorded in this transect.

<u>Open Sea</u>

Marine Mammals

All the marine mammals in Hong Kong are protected under the Wild Animals Protection Ordinance (Cap. 170) and the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). The Chinese White Dolphin *Sousa chinensis* and Finless Porpoise *Neophocaena phocaenoides* are the most common cetaceans recorded in Hong Kong. They

[40] ERM (1998). *Op cit.*

are listed as 'Data Deficient' in the IUCN Red list[41] and as 'highest protection' in CITES Appendix I[42].

The Chinese White Dolphin has limited distribution in Hong Kong waters, due to their preference for shallow, coastal estuarine habitats[43]. Their distribution range are mainly in the western waters, including outer Deep Bay, north, south, west and east Lantau, and west Lamma[44]. All of the areas with dolphin sightings recorded were influenced by freshwater discharge from the Pearl River[45]. While for the Finless Porpoise, they only occur in the southern and eastern waters, but not the northwestern waters which are influenced by the Pearl River[46]. The only sighting of the Chinese White Dolphin near the vicinity of the Study Area was in 1994, when the dolphin was sighted swimming towards the Lantau coast, away from the study area[47].

Marine Ecological Sensitive Receiver

There are no SSSIs, Fish Culture Zones, Marine Parks or Marine Reserves in the Study Area. The only marine ecological sensitive receiver is the established coral communities at Green Island, approximately 2.8 km to the west of the proposed cross harbour main. The Study Area is not the distribution range of the Chinese White Dolphin and Finless Porpoise, thus it is not considered to be an important habitat to the cetacean.

4.5 Ecological Importance

Based on the literatures review of the baseline conditions discussed above, the ecological assessment show that the marine ecological resources within the Study Area for the proposed marine cross harbour main are considered to be of low ecological value, due to their low species diversity and the present of pollution tolerant indicator species. Except for the sub-tidal and intertidal zone at Green Island, which are considered to be of moderate ecological value with the presents of soft corals and gorgonian species and the more diverse coastal communities compare with the species present on the artificial seawalls along the Victoria Harbour. The evaluation of the ecological importance of each habitat was determined on the basis of the criteria set in the EIAO-TM Annex 8 Table 2. **Table 4-5** and **Table 4-6** summarised the results of habitat evaluation.

[41] IUCN 2006. *2006 IUCN Red List of Threatened Species.* <www.iucnredlist.org>. Downloaded on 11 October 2006.

[42] UNEP-WCMC. 11 October, 2006. UNEP-WCMC Species Database: CITES-Listed Species http://www.unep-wcmc.org/isdb/CITES/Taxonomy/index.cfm
On the World Wide Web : http://www.unep-wcmc.org/isdb/CITES/Taxonomy/country_list.cfm?col=I&country=HK&source=animals&displaylanguage=eng

[43] Clarke, S.C., Jackson, A.P. and Neff, J. (2000). Development of a Risk Assessment Methodology for Evaluating Potential Impacts Associated with Contaminated Mud Disposal in the Marine Environment. *Chemosphere* 41:69-76.

[44] AFCD web page downloaded on 11 October 2006:
http://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/con_mar_chi_chi_dis_hk.html

[45] AFCD (2005). *Monitoring of Chinese White Dolphins (Sousa chinensis) in Hong Kong Waters.*

[46] *Ibid.*

[47] ERM (1998). *Op cit.*

Table 4-5 Evaluation of the Ecological Importance of the Inter-tidal Habitats

Criteria	Victoria Harbour	Green Island
Naturalness	Mainly composed of artificial seawall receiving extensive disturbance through high pollution load and wave action produced by marine traffic.	Natural rocky shores with little human disturbance.
Size	Approximate 660m of artificial shoreline was being studied.	The natural intertidal shoreline is approximately 2,000m.
Diversity	The species diversity is low.	The species diversity is low.
Rarity	The species recorded are commonly found on artificial seawalls in Hong Kong waters.	The species recorded are typical of other semi-exposed rocky shores in Hong Kong.
Re-creatability	The artificial seawall is recreatable.	The natural rocky shores cannot be recreated.
Fragmentation	Not applicable.	Not applicable.
Ecological Linkage	The existing habitats are not functionally linked to high ecological value habitats.	The rocky shores ecologically link with the sub-tidal habitats in the surrounding waters.
Potential Value	Unlikely to develop a nature conservation interest habitat.	Moderate potential to develop nature conservation interest habitat if water pollution and other human disturbances remove.
Nursery/Breeding Ground	Not identified.	Not identified.
Age	Not applicable.	Not applicable.
Abundance/Richness of Wildlife	The species abundance was low at vertical smooth structures but medium at wharf piles.	Compare to reference site at Hong Kong Island, the species abundance was low.
Summary	The inter-tidal assemblages along shoreline of Victoria Harbour are of low ecological value.	The inter-tidal assemblages along the natural rocky shores at Green Island are of low to medium ecological value.

Table 4-6 Evaluation of the Ecological Importance of the Sub-tidal Habitats

Criteria	Victoria Harbour	Green Island
Naturalness	The sub-tidal zone is composed of marine sediments receiving continuous disturbances.	The sub-tidal zone is composed of natural rocky seabed with scattered boulders and become sandy offshore.
Size	Approximate 7,000m² of sub-tidal zone was studied.	The study area of the sub-tidal zone is small.
Diversity	The species diversity of soft benthos is low.	The species diversity of benthic fauna and coral communities is moderate.
Rarity	The species recorded are common in Hong Kong.	The species recorded are not rare to Hong Kong.
Re-creatability	The disturbed seabed is recreatable.	The natural seabed can hardly recreate.
Fragmentation	Not applicable.	Not applicable.
Ecological Linkage	The existing habitats are not functionally linked to high ecological value habitats.	The sub-tidal habitats are ecologically link with the inter-tidal habitats in the surrounding waters.
Potential Value	Low potential to develop a nature conservation interest habitat.	Moderate potential to develop nature conservation interest habitat if water pollution and other human disturbances remove.

Criteria	Victoria Harbour	Green Island
Nursery/Breeding Ground	Not identified.	Not identified.
Age	Not applicable.	Not applicable.
Abundance/Richness of Wildlife	The soft benthos species abundance is low.	Compare to reference site at Hong Kong Island, the species abundance was higher.
Summary	The sub-tidal assemblages in Victoria Harbour are of low ecological value.	The sub-tidal assemblages at Green Island are of medium ecological value.

4.6 Identification and Prediction of Environmental Impacts

The proposed submarine watermain will be constructed approximately 6 m below the existing seabed level. The major impacts on the marine ecological resources will be the direct impacts of habitats loss from dredging and backfilling activities at the seabed and installation of submarine pipeline by "bottom pull" method during construction phase. There may be indirect impacts through the changes to water flow regime, and perturbations of the surrounding water quality. The potential marine ecological impacts arising from construction and operational phases are detailed below.

4.6.1 Construction Phase

Habitat Loss and Disturbances

The direct impacts from construction activities include the permanent loss of approximately 9.2ha of natural seabed resulting from dredging activities for the installation of the proposed submarine watermain and temporary disturbance of approximate 51.2ha of works area in the marine environment. Less than 90m of artificial shore at Yau Ma Tei Typhoon Shelter will be disturbed by the construction of temporary platform and approximate $2m^2$ on either side of the pipeline landing shores will be lost due to the installation of pipeline.

Direct and Indirect Impacts on Marine Fauna

The dredging activities will also directly remove the less mobile wildlife inhabiting the affected area and surrounding habitats, and indirectly affect the marine wildlife through associated impacts including, degradation of habitat quality, reduce sunlight penetrating the water column due to increase turbidity and reduce the food production ability of the photosynthesizing animals, as well as behaviour changing due to change in physical environment.

The dredging and backfilling activities will also increase the suspended solids (SS) concentration, decrease in dissolved oxygen (DO) level and the increase in nutrient levels in the water column. The high concentration of SS may cause clogging of gills or filaments of the marine organisms, increase energy consumption to expel the sediments by the filter feeding animals, and the reduction in DO level for consumption may eventually cause the marine organisms suffocate to die. The high concentration or deposition rate of SS may also form a blanket that smother the corals and reduce the ability of the associated photosynthesising zooxanthellae to undertake photosynthesis; coral bleaching may occur or even die if the corals cannot tolerate the stresses.

Release of previously bound organic and inorganic constituents such as heavy metals, PAHs and polychlorinated biphenyls (PCBs) into the water column via suspension or disturbance of seabed as a result of dredging may also cause lethal or sub-lethal effect to the marine fauna.

The physical disturbances to the surrounding waters by the construction activities include the increase in human activities, inappropriate storage or dumping of construction materials, increase in marine traffic and change in water flow regime may indirectly affect the marine wildlife at the local region.

4.6.2 Operational Phase

No post maintenance work is necessary for the proposed submarine watermain, and the potential impacts in operational phase are mainly the change in seabed profile and substrates along the 44m width alignment. The existing soft marine deposit with silt, sand and gravel will change to armour rock backfill with marine sediment naturally.

4.7 Evaluation of Environmental Impacts

4.7.1 Construction Phase

Habitat Loss and Disturbances

Habitat loss will occur at the sub-tidal zone and artificial seawalls at the inter-tidal zone along the Victoria Harbour. The seabed substrates are composed of marine sediments that receive continuous disturbances. Species recorded in this region were in low diversity and were dominated by common and pollution tolerant indicator marine benthos. Benthic fauna is expected to recolonize the seabed after the backfilling works and the deposition of sediment by natural process.

The permanent loss of artificial seawalls sections are very common structures along the seafronts in Hong Kong. The vertical surfaces of these structures support low species abundance of fouling organisms.

In view of the paucity of marine wildlife and low ecological value of the affected seabed and artificial seawalls, the direct impacts on permanent loss of approximately 9.2ha of natural seabed along Victoria Harbour and less than 90m of artificial shores at Yau Ma Tei Typhoon Shelter resulting from dredging activities for the installation of the proposed pipeline, the impacts are considered to be of low significant. Species are expected to recolonize after construction.

Direct and Indirect Impacts on Marine Fauna

From the baseline marine ecology results show that the marine benthos recorded within the construction area and in vicinity are of low ecological value and in low abundances. The impacts of the direct removal or indirect disturbances of these low importance species will be of low significance.

The potential impacts on the medium ecological value habitats (the sub-tidal and inter-tidal habitats with coral communities and natural rocky shores at Green Island) are the increase in

SS concentration and the associated deterioration of water quality at the Green Island waters due to the dredging and backfilling activities. According to the water modelling results presented in Section 3 **Table 3-11**, the predicted suspended solids concentrations for dredging undertaken near West Kowloon and near Sai Ying Pun in dry and wet seasons at marine ecological sensitive receivers (assessment points refer to **Table 3-5** in Section 3 and location refer to R2, R3, R4 and R5 in **Figure 3.2**) show that the predicted elevation of SS concentration during both dry and wet seasons at Green Island, will be less than 0.1 mgL^{-1} at depth average, top layer and bottom layer of the water column (Figure C3.1a to C3.1c in **Appendix C1**), and the net sedimentation rate is less than 0.001 kg m^{-2} per day (Figure C3.3e in **Appendix C1**). These results are much lower than the SS elevation limit and sedimentation rate set in Section 3.2.8 of 10mgL^{-1} and 0.1 kg m^{-2} per day respectively. Thus, dredging works near West Kowloon and Sai Ying Pun will have negligible impact upon the coral communities at waters near Green Island.

The extent of marine sediment contamination along the alignment of the proposed submarine main was reported in Section 6. The results indicated that high level of contamination in terms of arsenic (As), copper (Cu), lead (Pb), mercury (Hg), silver (Ag) and polyaromatic hydrocarbons (PAHs) and polychlorinated biphenols (PCBs) were found essentially at a number of vibrocore samples. However, the elutriate tests results reported in Section 3 estimated that the release of the above contaminants to the water column at the point of dredging fall within the UK Water Quality Standard and no exceedances of standard was predicted. Therefore, long-term off-site marine ecological impact due to release of marine sediment with high contamination is negligible.

The physical disturbances to the surrounding waters by the construction activities include the increase in human activities, inappropriate storage or dumping of construction materials, increase in marine traffic and change in water flow regime may have negligible impact on the marine wildlife when good site practices and control of marine traffic speed are implemented during the construction phase.

The significance of impacts arising from this proposed works on the marine ecological resources mentioned above are evaluated using the criteria set in the EIAO-TM Annex 8 Table 1 and presented in **Table 4-7** below.

Table 4-7 Evaluation of the Significance of Ecological Impact

Criteria	Victoria Harbour	Green Island
Habitat Quality	The sub-tidal zone and artificial seawalls at inter-tidal zone being affected are of low ecological values.	No significant impact is anticipated to the moderate ecological valued natural rocky shores and soft bottom seabed.
Species	The species recorded in the dredging area are common and pollution tolerant.	No rare species were recorded within the study area, and coral communities of moderate conservation interest are not expected to be impacted by the construction at approximate 2.8km away from Green Island.
Size/Abundance	Approx. 9.2ha of low ecological value benthic assemblages will be loss, and approx. 51.2ha of works area may be temporary disturbed by	No direct impact is anticipated on the moderate abundance inter-tidal and sub-tidal region at Green Island.

Criteria	**Victoria Harbour**	**Green Island**
	construction activities. Around 2m² of artificial seawall at both landing points will also be loss permanently. The species abundance of the soft benthos and inter-tidal fouling organisms at vertical seawall is low.	
Duration	The lost of approx. 9.2ha of seabed and 2m² of artificial wall is permanent. The temporary affected area will last for approximate 1 year. The change in water quality in the water column around the dredging area is temporary and within environmental acceptable levels. Benthic communities within the dredging area are expected to recolonize after the backfilling of the seabed.	Change in water quality around the soft coral assemblages are expected to be temporary and short term.
Reversibility	Impacts to the benthic fauna within the working area will be long term. The seabed will be backfilled with armour rock and by natural sedimentation. Benthic fauna is expected to recolonize to the seabed after construction.	Soft coral assemblages are reversible if the stress is short term and in low magnitude. The change in water quality in the vicinity is anticipated to be in very low magnitude.
Magnitude	The impact to the habitats identified will be of low magnitude.	The impact to the habitats identified will be of very low magnitude.
Summary	The impacts to the low ecological valued marine benthos and artificial habitats within the dredging and works area are predicted to be of low significant.	The impacts to the coral communities and coastal communities at intertidal zone are predicted to be of negligible significant due to no works will be constructed in the vicinity, remote (2.8km) from the works boundary and the prediction of low elevation of SS concentration at the region.

In summary, the impacts of permanent habitat loss and temporary disturbances to marine ecological resources will be of low to negligible significance, due to no rare species recorded within the affected area and in vicinity and the low ecological value of the marine benthos and the re-creatable artificial structures along the Victoria Harbour. The indirect impacts on the medium ecological value habitats at Green Island are anticipated to be negligible, due to no works will be constructed in the vicinity, remote from the works boundary, the prediction of low elevation of SS concentration and receiving no effect on the release of contaminant during the dredging process.

4.8 Mitigation of Adverse Environmental Impact

The proposed dredging works will be confined in the works area within 25m at either side of the proposed alignment and the use of closed type grab dredger will reduce sediment and contaminants runoff to the water column. The trench will be backfilled with armour rock or decomposed granite and allow natural sedimentation on the substrates to provide protection of the pipeline from damage by ship anchors. Benthic fauna is expected to be recolonized to the seabed after construction. Other mitigation measures suggested in the water quality impacts assessment such as the use of one grab dredger only with a maximum production rate of 4,000m^3 per day for dredging, deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress, deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress. and good site practices to avoid silt runoff from construction works associated with the construction of the submarine watermain could also further reduce the impact on the marine ecology. No other specific mitigation measures for marine ecology are considered necessary, as no adverse impact was identified.

4.9 Evaluation of Residual Impacts

There will be loss of approximately 4m^2 of artificial seawall and change in approximately 9.2ha of seabed substrates along the alignment. Benthic fauna is expected to be recolonized to the seabed after construction. No adverse residual impact due to the construction and operation of the submarine watermain is expected after the implementation of the proposed mitigation measures.

4.10 Environmental Monitoring and Audit

The implementation of the ecological mitigation measures stated in Section 4.8 and water quality mitigation measures in Section 3 should be checked as part of the environmental monitoring and audit procedures during the construction period as presented in the separate *Environmental Monitoring and Audit Manual*. No other marine ecology-specific measures are considered necessary.

4.11 Conclusions and Recommendations

A review of the existing information showed that the marine ecological resources within the dredging area consist of pollution tolerant soft benthos in low diversity and typical to benthos recorded in poor quality sediments. Inter-tidal species along Victoria shorelines are common fouling organisms recorded at artificial seawall. Both the species diversity and abundance recorded are lower than those recorded in semi-exposed shore in Hong Kong. The marine ecology in Green Island is of moderate ecological value, with soft coral assemblages and larger size inter-tidal species recorded. However, the results of water quality modelling showed that the elevation of SS concentration and sedimentation rate around the Green Island waters is predicted to be less than 0.1mgL^{-1} and 0.001 kg m^{-2} per day respectively, which are much lower than the tolerant levels for corals communities. In addition, due to the remoteness from the works area, the impacts to the marine environment in vicinity to Green Island are anticipated to be negligible. The Study Area is not the distribution range of marine mammals and as low ecological value species are encountered in the region, the implementation of good site practices and mitigation measures for water quality impact are considered to be sufficiently minimize the impacts on the marine ecology. Thus, no special mitigation measures are necessary for ecological sensitive receivers.

In conclusion, the construction of the proposed submarine watermain along Victoria Harbour between Sai Ying Pun and West Kowloon is anticipated to be of low ecological impacts.

5 NOISE IMPACT ASSESSMENT

5.1 Introduction

A noise impact assessment has been undertaken to define the nature and scale of the potential noise impact to sensitive receivers associated with the proposed submarine watermain. The construction noise levels associated were predicted based on the plants to be used and the phasing of the construction programme was also considered.

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, construction noise impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain were assessed.

No noise impact is envisaged to arise from the operation phase of the proposed submarine watermain.

5.2 Environmental Legislation, Standards, Guidelines and Criteria

Noise impacts were assessed in accordance with the criteria and methodology given in the Technical Memoranda (TMs) issued under the Noise Control Ordinance (NCO) and the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

The Noise Control Ordinance provides the statutory framework for noise control. Assessment procedures and standards are set out in the following Technical Memoranda:

- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM); and
- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annexes 5 and 13.

5.2.1 Construction Noise

Noise impacts arise from construction works other than percussive piling using items of powered mechanical equipment (PME) during normal working hours (i.e. 0700 to 1900 hours on any day not being a Sunday or public holiday) to the noise sensitive buildings are assessed with reference to the NCO. The recommended noise standards in EIAO-TM are presented in **Table 5-1** below.

Table 5-1 EIAO-TM Daytime Construction Noise Standards (0700 to 1900 hours on any day not being a Sunday or public holiday) (Leq.30 min dB(A))

Uses	Acceptable Noise Standards
Domestic Premises	75
Educational institutions (normal periods)	70*
Educational institutions (during examination periods)	65*

Note: *For reference only, not used in this study.

The NCO also provides statutory controls on general construction works during the restricted hours (i.e. 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of items of powered mechanical equipment (PME) for carrying out construction works during the restricted hours would require a Construction Noise Permit (CNP). A CNP may be granted provided that the Acceptable Noise Level (ANL) for the noise sensitive receivers (NSRs) can be complied with. The Corrected Noise Levels CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed operations of items of PME are then compared to ANL. A CNP will be issued if the CNL is equal to or less than the ANL. The Noise Control Authority is guided by the GW-TM when assessing such an application.

The steps to determine the ANL for the sensitive receivers include determining the Basic Noise Level (BNL) and make correction according to the procedures stipulated in the GW-TM. The corresponding Basic Noise Levels (BNLs) for evening and night time periods are given in **Table 5-2**.

Table 5-2 Basic Noise Levels (BNL, Leq.30 min dB(A))

Time Period	Area Sensitivity Rating		
	A	B	C
All days during the evening (1900 – 2300 hours) and general holidays (including Sundays) during the day and evening (0700 – 2300) hours	60	65	70
All days during the night-time (2300 – 0700 hours)	45	50	55

5.2.2 *Area Sensitivity Ratings*

The Area Sensitivity Ratings assumed in this EIA Report (in **Section 5.4** below) are for indicative assessment only. Despite any description or assessment made in this EIA Report on construction noise aspects, there is no guarantee that a Construction Noise Permit (CNP) will be issued for the project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant Technical Memoranda issued under the Noise Control Ordinance. The Noise Control Authority will take into account of contemporary conditions/ situations of adjoining land uses and any previous complaints against construction activities at the site before making his decision in granting a CNP. Nothing in this EIA Report shall bind the Noise Control Authority in making his decision. If a CNP is to be issued, the Noise Control Authority shall include in it any condition he thinks fit. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.

In addition to the general controls on the use of items of PME during the restricted hours, the Noise Control Authority has implemented more stringent control mechanisms via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

Specified Powered Mechanical Equipment:
- Hand-held breaker
- Bulldozer
- Concrete lorry mixer
- Dump truck
- Hand-held vibratory poker

Prescribed Construction Work:
- Erection or dismantling of formwork or scaffolding
- Loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material
- Hammering

In an attempt to provide environmental additional protection carrying out of PCW is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB(A) more stringent than those listed in the GW-TM before a CNP would be issued.

It is worth noticing that the above SPME and PCW suggested will not be used during the construction of this Project (refer to the plant inventory listed in **Table 5-4**). Therefore, the above mentioned regulation in DA-TM would only serve as a reference only.

5.3 Noise Sensitive Receivers

Representative Noise Sensitive Receivers (NSRs) within 300m of the Project limit have been identified according to the criteria set out in the EIAO-TM and through site inspections and a review of land use plans. However, no NSR within 300m was found in West Kowloon, so the closest NSRs are considered. NSRs and their separate distance to the respective landfall sites have been obtained and are summarized in **Table 5-3**. Locations of the NSRs and the assessment area are shown in **Figures 5.1** and **5.2** at Sai Ying Pun and West Kowloon respectively. There is no planned development identified within the assessment areas hence no planned NSR was included in this assessment.

The landfall site at Sai Ying Pun is situated at the seafront area east of the Western Wholesale Food Market and next to the entrance of Western Harbour Crossing. **Figures 5.1 and 5.3** indicate the proposed works area for the landfall site at Sai Ying Pun with the extent of seawall construction works. The works in this area include pipe pulling by winch and seawall reinstatement. The nearest residential buildings along Connaught Road West are separated from the landfall site by the existing massive transport corridor.

The landfall site at West Kowloon is at the seafront area near the exit of the Western Harbour Crossing. **Figures 5.2 and 5.4** shows the works area in West Kowloon. Extent of seawall construction is also shown. The works in this area include construction of the temporary platform, pipe preparation, pipe laying and seawall reinstatement. The closest residential buildings are private developments above the Kowloon Station, including The

Union Square (KS6), The Arch (KS3b) and The Harbourside (KS4). These buildings are located far away from the construction site (>300m). They are included in this study for indicative purpose.

The Separation Distances (m) between the notional noise source and the NSRs are determined in accordance with the *TM on Noise from Construction Work other than Percussive Piling*. All items of PME are assumed to be located at a single notional source position. Since the items of PME will be close to the site of seawall reinstatement, the access roads are not considered when determining the geographical centre of the construction site. The Separation Distances established are shown in the **Table 5-3**.

Table 5-3 Representative Noise Sensitive Receivers

NSR ID	Description	Type of Use	Separation Distance (m)
West Kowloon			
WF1	The Waterfront	Residential	750
WF2			790
WF3a			830
KS2	Sorrento		760
KS3b	The Arch		810
KS4	The Harbourside		670
KS6	Union Square		580
Sai Ying Pun			
FSB	Fung Shing Building	Residential	360
VC	Viking Court		320
CLM	Cheong Ling Mansion		310
KY2	Kwan Yik Building Phase 2		400
KY3a	Kwan Yik Building Phase 3		245
KY3b			225
RWM	Richwealth Mansion		215
CG1	Connaught Garden		220
CG2			230
CG3			245
GB	General Building		270

Note: Noise Sensitive Receivers are representative and will be used in prediction calculations.

5.4 Assessment Methodology

5.4.1 Guidelines in GW-TM

A methodology for assessing construction noise other than percussive piling has followed the guidelines set out in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (GW-TM). The methodology is as follows:

- identify the likely type, sequence and duration of principal noisy construction activities required for the implementation of the proposed project;
- identify a list of plant inventory likely to be required for each construction activity;

- calculate the maximum total sound power level (SWL) for each construction activity using the plant list and SWL data given for each plant in the technical memorandum.
- representative NSRs as defined by the EIAO-TM have been identified, based on existing and committed land uses in the study area that may be affected by the worksite.
- calculate the distance attenuation and barrier corrections to NSRs from worksite notional noise source point;
- predict construction noise levels at NSRs in the absence of any mitigation measures; and
- include the +3 dB(A) facade correction to account for the facade effect at each NSR.

If the predicted noise levels at the NSRs exceed the noise assessment criteria, mitigation measures must be considered. A re-evaluation of the total SWL for each construction activity will be made assuming the use of practical mitigation measure such as quiet equipment and movable noise barriers. If the predicted noise levels still exceed the noise criteria, further mitigation measures such as reduction in noisy plant working simultaneously would be considered.

5.4.2 Area Sensitive Ratings (ASRs)

Determination of the Area Sensitivity Ratings for the NSRs in this study has been made with reference to relevant TMs.

Sai Ying Pun

The NSRs are residential developments located in urban area of Sai Ying Pun with an annual average daily traffic flow of 43,490 and 40,460 running through the nearby Connaught Road West and Western Harbour Crossing respectively (Source: Station no. 1006 and 1026, *Annual Traffic Census 2005* published by Transport Department). As the NSRs are located in urban area and are directly affected by this influencing factor, an Area Sensitivity Rating (ASR) of "C" is applied according to the GW-TM.

West Kowloon

In West Kowloon, the southwest facade of closest NSRs (KS4 & KS6) facing the landfall site is directly influenced by the traffic noise from the West Kowloon Highway with an annual average daily traffic flow of more than 38,410 (Source: Station no. 3502, *Annual Traffic Census 2005* published by Transport Department). As the NSRs are residential developments located in urban area with high-rise buildings and are directly affected by this influencing factor, an Area Sensitivity Rating (ASR) of "C" is applied according to the GW-TM.

Accordingly, the ANL would be 70 dB(A) in the evening and 55 dB(A) at night as detailed in **Table 5.2** for both Sai Ying Pun and West Kowloon.

5.4.3 Assessment for the Project

Using the methodology outlined in the TM, notional noise sources for different construction areas were assumed. All the items of powered mechanical equipment (PME) listed in **Table**

5-4 and **Table 5-5** for Sai Ying Pun and West Kowloon are assumed to be located at notional source.

Sound power levels (SWLs) of PME items are adopted from Table 3 of the GW-TM (No percussive piling is required for this Project). When no SWL is suggested in the TM, reference was made with *BS 5228: Part 1:1997 Noise Control on Construction and Open Sites*. Details of the items of PME and the total SWLs for various construction activities are listed in **Table 5-4** and **Table 5-5**.

The major tasks in the laying of the watermain are

- Trench dredging
- Laying of submarine watermain
- Backfilling

From the context of the programming of construction works, it is suggested that night-time dredging work could be required. The necessity of night-time dredging will depend on the progress of the project. For any construction works planned during restricted hours, it will be the responsibility of the Contractor to ensure compliance with the NCO and the relevant TMs. In such case, the Contractor will be required to submit CNP application to the Noise Control Authority and abide any condition stated in the CNP if it can be issued. An indicative assessment is undertaken at representative NSRs to identify any potential adverse noise impacts.

The construction programme in **Appendix B** sets out the time frame for the various tasks in the construction phase. It can be seen that the three major tasks mentioned will be performed consecutively (i.e. they are not concurrent). This important fact was noted in the assessment when the cumulative construction noise impact is considered.

A +3 dB(A) facade correction would be required to account for the facade effect at each NSR according to the GW-TM. It would be applicable to all PME items required for the construction activities in this Project.

5.5 Identification, Prediction and Evaluation of Environmental Impacts

5.5.1 Construction Phase

From the tentative project programme in **Appendix B**, the three major tasks in the construction of the proposed submarine watermain are expected to be carried out consecutively while other works including pipe preparation and seawall reinstatement will be concurrent with the other activities as shown.

Trench dredging will be carried out along the proposed alignment of the submarine watermain while the temporary platform is located at the seafront of West Kowloon. Pipe preparation will therefore be performed at West Kowloon landfall site and pipe laying by bottom pull method will be at Sai Ying Pun landfall site. Since the types and number of plants mobilized in Sai Ying Pun and West Kowloon landfall site are different, the noise emission inventories have been established independently and provided in **Tables 5-4** and **5-5**. The plant inventories established as shown in **Tables 5-4** and **5-5** are realistic, practical and valid for the completion of works within project programme as confirmed by the Project Proponent.

Table 5-4 Noise Emission Inventory (Sai Ying Pun)

Activity	Powered Mechanical Equipment	CNP Ref	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Trench Dredging	Grab dredgers+	CNP 063	2	112	115
	Hopper barges #	-	2	-	-
	Tug boats	CNP 221	2	110	113
	Crane, barge mounted	CNP 048	2	112	115
				Sub-SWL	**119**
Pipe laying	Generator	CNP 102	1	100	100
	Winch (pneumatic)	CNP 261	1	110	110
	Water pump (electric)	CNP 281	2	88	91
				Sub-SWL	**110**
Backfilling	Crane, barge mounted	CNP 048	2	112	115
	Hopper barges #	-	2	-	-
	Tug boats	CNP 221	2	110	113
				Sub-SWL	**117**
Seawall reinstatement	Crane, mobile/barge mounted	CNP 048	1	112	112
	Truck / lorry	CNP 141	2	112	115
	Piling machine	CNP 163	1	90	90
				Sub-SWL	**117**

Note: + One grab dredger will be used for dredging; while the other grab dredger will be used for trimming. Trimming will be carried out at the seawall at West Kowloon which would involve removal of armour rock for the set up of a temporary platform. Water quality impact arising from trimming activities is therefore not anticipated. Although dredging and trimming might be carried out simultaneously, cumulative water quality impact attributed to trimming activities is thus not anticipated.

No noise would be emitted from hopper barges.

* The marine piling vessel is assumed to be an oscillator piling plant.

Table 5-5 Noise Emission Inventory (West Kowloon)

Activity	Powered Mechanical Equipment	CNP Ref	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Trench Dredging	Grab dredgers+	CNP 063	2	112	115
	Hopper barges #	-	2	-	-
	Tug boats	CNP 221	2	110	113
	Crane, barge mounted	CNP 048	2	112	115
				Sub-SWL	**119**
Setting up of Temporary Platform	Marine piling vessel	CNP 165*	2	115	118
	Hopper barges #	-	4	-	-
	Tug boats	CNP 221	2	110	113
	Crane, barge mounted	CNP 048	2	112	115
				Sub-SWL	**121**
Pipe preparation	Truck/ lorry	CNP 141	2	112	115
	Crane, mobile/barge mounted (diesel)	CNP 048	2	112	115
				Sub-SWL	**118**
Pipe laying	Crane, mobile	CNP 048	1	112	112
	Generator	CNP 102	1	100	100
				Sub-SWL	**112**
Backfilling	Crane, barge mounted	CNP 048	2	112	115
	Hopper barges #	-	2	-	-
	Tug boats	CNP 221	2	110	113
				Sub-SWL	**117**
Seawall reinstatement	Crane, mobile/barge mounted	CNP 048	1	112	112
	Truck / lorry	CNP 141	2	112	115
	Piling machine	CNP 163	1	90	90
				Sub-SWL	**117**

Note: + One grab dredger will be used for dredging; while the other grab dredger will be used for trimming. Trimming will be carried out at the seawall at West Kowloon which would involve removal of armour rock for the set up of a temporary platform. Water quality impact arising from trimming activities is therefore not anticipated. Although dredging and trimming might be carried out simultaneously, cumulative water quality impact attributed to trimming activities is thus not anticipated.

No noise would be emitted from hopper barges.

* The marine piling vessel is assumed to be an oscillator piling plant.

5.5.2 Representative NSRs

Representative NSRs are chosen for assessment in both Sai Ying Pun and West Kowloon. In Sai Ying Pun, Richwealth Mansion (RWM) is used as it is closest to the landfall site and the north facade is facing the landfall site; In West Kowloon, the Union Square (KS6) which is closest to the landfall site is selected for indicative assessment although it does not fall into the 300m assessment boundary. With regard to the tentative project programme, noise generated affecting the NSRs were assessed.

Table 5-6 Selected NSRs for Noise Assessment

	Sai Ying Pun	**West Kowloon**
Representative Noise Sensitive Receivers (NSRs)	RWM	KS6
Separation distance of Representative NSRs to landfall sites	215m	580m

Detailed calculations are provided in Table E2 and E5 of **Appendix E**. Dredging work in the Victoria Harbour will be separated from the NSRs with a distance greater than those in **Table 5-3** and **Table 5-6**. However, to be conservative and to simplify the calculation, the trench dredging work is assumed to be carried out near the landfall site. Therefore, the distances used in **Appendix E** are taken as the distances in **Table 5-6**.

The noise impact from the possible night-time dredging is assessed. The construction noise level associated with the dredging is calculated and shown in Table E3 and E7 of **Appendix E**. Note that the noise levels assessed during Restricted Hours only include the proposed trench dredging work and are for indicative purpose only. It should be understood that despite any description or assessment made in this EIA Report on construction noise aspects, there is no guarantee that a Construction Noise Permit (CNP) will be granted for the proposed night-time works. *Section 5.3* and *5.4* should be referred to for information on the proposed night-time work and relevant regulations. The predicted noise levels are summarized in **Tables 5-7** and **5-8**.

Table 5-7 Summary of Unmitigated Construction Noise Levels during Normal Daytime Working Hours

Representative NSRs	**Predicted Unmitigated Construction Noise Levels during Normal Daytime Working Hour (0700 to 1900 on weekday) (dB(A))**	**Noise Criteria (dB(A))**
RWM (Sai Ying Pun)	59 – 68	75
KS6 (West Kowloon)	52 – 64	75

Table 5-8 Summary of Unmitigated Construction Noise Levels from dredging during Restricted Hours

Representative NSRs	**Predicted <u>Maximum</u> Construction Noise Levels (dB(A))**	**"Noise Criteria - All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the daytime and evening (0700 to 2300 hours)". (dB(A))**	**Noise Criteria – All days during Night time (2300 to 0700 hours) (dB(A))**
RWM (Sai Ying Pun)	68	70	55
KS6 (West Kowloon)	59	70	55

5.5.3 Evaluation of Noise Impact

During normal daytime working hours, noise generated from the construction works fully comply with the Noise Criteria set in the TM. Without mitigation, it can be concluded that there will not be any adverse noise impact from the marine construction work during daytime, the evening (1900 to 2300 hours) of all normal days and of general holidays (including Sundays).

The calculation is conservative in view of the close separation distance to the NSRs assumed for dredging work. Most of the dredging work will be carried out within the harbour and will be far from the landfall sites at most of the time.

However, the predicted noise level exceeds the Noise Criteria at night time for dredging work carried out close to the landfall sites. If the night-time work (2300 to 0700 hours) is carried out, there will possibly be certain level of noise nuisance at a short period of time.

5.6 Mitigation of Adverse Environmental Impacts

As shown in **Table 5-7**, the Noise Criteria at Daytime can be complied with at both Sai Ying Pun and West Kowloon. No mitigation measure is required but it is recommended that the Contractor shall take initiatives to further reduce the noise generated from the construction activities, including better arrangement of construction programme, the use of movable barriers, Quality PME and good site practices listed below.

The predicted noise level exceeds the Noise Criteria at night time for both Noise Sensitive Receivers KS6 and RWM but the Noise Criteria at evening time was complied with. It is therefore recommended that the dredging work should not be carried out as far as possible during night-time from the noise perspective. However, it is understood that due to the work programme and other constraints (e.g. the disturbance to the marine traffic during daytime), night-time dredging might be necessary. In case where night-time dredging is required and a Construction Noise Permit (CNP) can be granted, the noise at night time should be mitigated. The Contractor shall take into consideration the below recommendations prior to application of CNP and commencement of night-time work.

5.6.1 Work Schedule Rearrangement

Concurrent works should be such that necessary noisy works should be carried out at different time slots or spread around the construction sites. This will help to reduce the cumulative noise effect produced in the construction process.

If night-time (2300 to 0700 hours) dredging is required, the work shall be scheduled to carry out at a distance as far as possible to the NSRs. It is determined that the dredging work should be carried out at a location 750m away from the Sai Ying Pun landfall site and 450m from the West Kowloon landfall site along the trench as shown in the **Figure 5.5.** Under such condition, the separation distances to the NSRs (RWM & KS6) are increased to more than 900m. The night-time criteria of GW-TM can be complied because of the sufficient distance attenuation in noise level. The calculation is shown in the Table E4 and E8 in **Appendix E** while the results are summarised in the **Table 5-9** below. It is noteworthy that the resulting noise levels should be smaller during the dredging since the separation distance would be larger than 900m in the dredging zone. The contractor will be required to adhere to the restricted locations of dredging work at night-time to comply with relevant noise standard.

Table 5-9 Summary of Mitigated Construction Noise Levels from dredging during Night time (2300 to 0700 hours)

Representative NSRs	Predicted Maximum Construction Noise Levels (dB(A))	Noise Criteria – Night time (2300 to 0700 hours) (dB(A))
RWM (Sai Ying Pun)	55	55
KS6 (West Kowloon)	55	55

5.6.2 Using Quality PME

The use of Quality PME recognized by the Noise Control Authority for the purpose of CNP application can effectively reduce the noise generated from the construction plants. Quality PME are construction plants and equipments that are notably quieter, more environmental friendly and efficiently. The noise level reduction ranges from 5 – 10 dB(A) depending on the type of equipment used. The Contractor shall note the required procedures involved in application of the QPME.

5.6.3 Using Noise Barriers

Mobile or movable noise barriers to be erected near to the construction plants would reduce the noise levels for commonly 5 – 10 dB(A) depending on the types of items of PME and materials of the barriers. It is recommended that the Contractor shall screen noisy works and noise from stationary items of PME whenever practicable.

5.6.4 Good Site Practice

Good site practice and noise management can significantly reduce the impact of construction site activities on nearby NSRs. The following package of measures should be followed during construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from the NSRs;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

5.7 Evaluation of Residual Impacts

No residual impacts are predicted for the construction or operation of the Project.

5.8 Environmental Monitoring and Audit

Full compliance with the noise criteria will be achieved at all NSRs with the implementation of mitigation measures. Environmental monitoring and audit is recommended to ensure that the noise levels do not exceed the criteria during the construction phase as discussed in the EM&A Manual.

5.9 Conclusions and Recommendations

Construction noise impact to the NSRs has been assessed. It is predicted that major construction activities including dredging, laying of pipe and backfilling works would comply with the noise criteria stipulated in the EIAO-TM and NCO during daytime and evening (1900 to 2300 hours).

If night-time works (2300 to 0700 hours) are carried out, the location of dredging works should be restricted while there should be no work within the prohibited zones. With this measure being taken place, the night-time criteria during the dredging period can be complied with.

Work schedule rearrangement, quiet plants and mobile noise barriers are recommended to further suppress noise emissions from construction activities. Good site practices will be necessary to further reduce any potential impact to the noise sensitive receivers.

6 WASTE IMPACT ASSESSMENT

6.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, construction and operation waste management impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain were assessed.

This section identifies the types of solid wastes that are likely to be generated during the construction of the submarine watermain and evaluates the potential environmental impacts that may result from these wastes. The major solid waste would be dredged marine sediment from the construction of the proposed submarine watermain. Mitigation measures and good site practices, including waste handling, storage and disposal, are recommended with reference to the applicable waste legislation and guidelines.

6.2 Environmental Legislation, Standards, Guidelines and Criteria

6.2.1 General

The criteria and guidelines for assessing waste management implications are outlined in Annex 7 and Annex 15 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), respectively.

The following legislation relates to the handling, treatment and disposal of wastes in the Hong Kong SAR and has been used in assessing potential impacts:

- Waste Disposal Ordinance (Cap. 354)
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354)
- Public Health and Municipal Services Ordinance (Cap. 132) - Public Cleansing and Prevention of Nuisances Regulation
- Land (Miscellaneous Provisions) Ordinance (Cap. 28)
- Dumping at Sea Ordinance (Cap. 466)

6.2.2 Waste Management

The Waste Disposal Ordinance (WDO) prohibits the unauthorised disposal of wastes. Construction waste is defined as any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. Under the WDO, wastes can be disposed of only at designated waste disposal facilities.

Under the WDO, the Chemical Waste (General) Regulation 1992 provides regulations for chemical waste control, and administers the possession, storage, collection, transport and disposal of chemical wastes. The Environmental Protection Department (EPD) has also issued a ‘guideline’ document, the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), which details how the Contractor should comply with the regulations on chemical wastes.

The Public Cleansing and Prevention of Nuisances Regulation provides control on illegal tipping of wastes on unauthorised (unlicensed) sites.

6.2.3 Construction and Demolition (C&D) Materials

The current policy related to the dumping of C&D material is documented in the Works Branch Technical Circular No. 2/93, ‘Public Dumps’. Construction and demolition materials that are wholly inert, namely public fill, should not be disposed of to landfill, but taken to public filling areas, which usually form part of reclamation schemes. The Land (Miscellaneous Provisions) Ordinance requires that dumping licences be obtained by individuals or companies who deliver public fill to public filling areas. The Civil Engineering & Development Department (CEDD) issues the licences under delegated powers from the Director of Lands.

Under the Waste Disposal (Charges for Disposal of Construction Waste) Regulation, enacted in January 2006, construction waste delivered to a landfill for disposal must not contain more than 50% by weight of inert material. Construction waste delivered to a sorting facility for disposal must contain more than 50% by weight of inert material, and construction waste delivered to a public fill reception facility for disposal must consist entirely of inert material.

Measures have been introduced under Environment, Transport and Works Bureau (ETWB) TCW No. 33/2002, “Management of Construction and Demolition Material Including Rock” to enhance the management of construction and demolition material, and to minimize its generation at source. The enhancement measures include: (i) drawing up a Construction and Demolition Material Management Plan (C&DMMP) at the feasibility study or preliminary design stage to minimize C&D material generation and encourage proper management of such material; and (ii) providing the contractor with information from the C&DMMP in order to facilitate him in the preparation of the Waste Management Plan (WMP) and to minimize C&D material generation during construction. Projects generating C&D material less than 50,000m^3 or importing fill material less than 50,000m^3 are exempt from the C&DMMP. The new ETWB TCW No. 19/2005 “Environmental Management on Construction Sites” includes procedures on waste management requiring contractors to reduce the C&D material to be disposed of during the course of construction. A Waste Management Plan should be submitted by the contractor prior to the commencement of construction works.

6.2.4 Marine Dredged Sediment

ETWB TCW No. 34/2002, “Management of Dredged/Excavated Sediment” sets out the procedures for seeking approval to dredge/excavate sediment and the management framework for marine disposal of such sediment. Dredged marine sediment arising from the

Project will be managed in accordance with the requirements of ETWB TCW No. 34/2002. The sediment quality criteria for the classification of sediment are presented in **Table 6-5.**

In accordance with the Dumping at Sea Ordinance, application for dumping permits from EPD are required for marine disposal of dredged materials.

6.3 Assessment Methodology

6.3.1 General

The criteria for assessing waste management implications are outlined in Annex 7 of the EIAO-TM. The methods for assessing potential waste management impacts during the construction phase follow those presented in Annex 15 of the EIAO-TM and include the following:

- Estimation of the types and quantities of the wastes generated.
- Assessment of potential impacts from the management of solid waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and transport.
- Assessment of impacts on the capacity of waste collection, transfer and disposal facilities.

6.3.2 Marine Site Investigation

The chemical characteristics of the dredged material within the dredged trench area as shown in **Figure 2.3** include contaminated mud as indicated in the laboratory test results in the following reports

- Agreement No. GEO 01/2000, Environmental Chemical & Biological Testing for the New Sediment Classification Framework - Maintenance Dredging for Central Fairway Phases 1, 2 & 3 - Sediment Quality Report (Mouchel Asia Ltd, March 2002) - Phase I (West Area) - sampling location points a18 to g19 inclusive on which Tier II & III tests (as per ETWBTC (W) No. 34/2002) were undertaken; and
- CED Memo Ref. (35) in TS DF/NFYO/08 Pt.3 dated 16/5/2000 - Maintenance Dredging for Northern Fairway, Sediment Quality Report - Part of Contract No. CV/99/09 - Maintenance Dredging (2000-02) under Works Order No. MD/20/99 - sampling points R, S, T & U over lines 26 to 22. The assessment was based on the former classification system which has now been superseded by ETWBTC(W) No. 34/2002.

In this respect and with reference to ETWB TCW No. 34/2002, the marine investigations consist of vibrocore sampling on a 100m by 100m grid spacing with 100mm subsamples taken at seabed, 0.9m down, 1.9m down, 2.9m down, 5.9m down, 8.9m down and 11.9m down. As site investigation works are not permitted within the designated Fairways due to potential detrimental effects to marine traffic, the vibrocores are designed to be at an approximately 100m spacing taking into consideration offsets from areas outside the Fairways.

A total of 15 vibrocore pairs were taken at designated locations along the submarine watermain alignment to determine the vertical profile of sediment quality. Coordinates, type and depth of the vibrocores are summarised in **Table 6-1**. Locations of the vibrocore sampling points (given an ‘a’ suffix) are presented in **Figure 6.2**. Immediately adjacent to the ‘a’ vibrocores a second vibrocore denoted with a ‘b’ suffix was also taken. These vibrocores were used for logging purposes.

Table 6-1 Coordinates, Type and Depth of Vibrocores

Vibrocore No.	Coordinates		Material Type	Seabed level mPD	Length Recovered (m)
	Easting	Northing			
VC1a/b	832652	816956	Marine mud	-9.3	12.0
VC2a/b	833170	817533	Marine mud	-12.1	11.4
VC3a/b	833349	817640	Marine mud	-12.9	3.2
VC4a/b	833504	817790	Marine mud	-11.9	12.0
VC5a/b	833870	818135	Marine mud	-8.7	12.0
VC6a/b	833420	817709	Marine mud	-12.4	9.0
VC7a/b	833270	817569	Marine mud	-12.5	10.4
VC8a/b	832875	817045	Marine mud	-11.1	12.0
VC9a/b	832557	816917	Marine mud	-10.0	12.0
VC10a/b	832770	816999	Marine mud	-10.9	12.0
VC11a/b	832755	817329	Marine mud	-12.3	12.0
VC12a/b	833148	817065	Marine mud	-13.0	12.0
VC13a/b	833569	817850	Marine mud	-11.0	7.8
VC14a/b	833935	818214	Marine mud	-7.2	12.0
VC15a/b	833642	817911	Marine mud	-9.3	12.0

Note: Vibrocores denoted ’a’ & ’b’ were carried out in close proximity to each other, where ‘a’ vibrocores were laboratory testing samples while ‘b’ vibrocores were split for logging purposes.

6.3.3 Marine Dredged Sediment

General

Marine site investigation works of the Project were carried out in September 2006. Longitudinal geological profile of marine sediment along the proposed alignment of the submarine watermain is presented in **Figure 6.1**. Vibrocore records are presented in **Appendix F1**. The records indicated that the material along the proposed alignment of the submarine watermain consists mainly of marine deposits which are very soft, grey, sandy, silty clay with some gravel size shell fragments.

Laboratory testing of contaminants was included in the marine site investigation works to determine the level of contamination in the marine sediments at the existing seabed. The works included vibrocoring at 15 locations distributed along the proposed submarine watermain alignment as detailed in **Table 6-1**. Locations of the vibrocore sampling points (given an ‘a’ suffix) are presented in **Figure 6.2**

Chemical Testing

Sample Arrangement

Tier II chemical screening was carried out to determine whether the sediment is suitable for open sea disposal without further testing in accordance with the requirements of ETWB

TCW No. 34/2002. Sediment samples collected for chemical testing are presented in **Table 6-2**.

Table 6-2 Sample Arrangement for Chemical Testing

Vibrocore No.	Coordinates		Sample Depth	
	Easting	Northing	From (m)	To (m)
VC1a	832652	816956	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC2a	833170	817533	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.3
VC3a	833349	817640	0	0.9
			0.9	1.9
			1.9	2.9
VC4a	833504	817790	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC5a	833870	818135	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC6a	833420	817709	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
VC7a	833270	817569	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
VC8a	832875	817045	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC9a	832557	816917	0	0.9
			0.9	1.9
			1.9	2.9

Vibrocore No.	**Coordinates**		**Sample Depth**	
	Easting	**Northing**	**From (m)**	**To (m)**
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC10a	832770	816999	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC11a	832755	817329	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC12a	833148	817065	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC13a	833569	817850	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.7	8.7
VC14a	833935	818214	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9
VC15a	833642	817911	0	0.9
			0.9	1.9
			1.9	2.9
			4.9	5.9
			7.9	8.9
			10.9	11.9

Sample Preparation

Continuous samples were taken vertically from seabed down to the bottom of the proposed dredged layers. Vibrocoring was terminated in the alluvium layer below the marine mud deposit. On recovery, each vibrocore was cut into sub-samples. The top level of the sub-samples were at seabed, 0.9m down, 1.9m down, 2.9m down, 5.9m down, 8.9m down and 11.9m down or to the termination depth of the vibrocore.

Sections of vibrocore tube were cut, sealed and capped, labelled, stored in a dark environment in a cool box below 4^0C immediately after collection on site. On transfer from site to laboratory, samples were kept at below 4^0C, by regularly replacing the ice packs.

Determination Method and Reporting Limits

Chemical Testing was carried out for all vibrocores taken from the 15 locations. Each sub-sample recovered from vibrocoring was tested in the laboratory for the following parameters:

(i) Metals concentrations including cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), mercury (Hg), arsenic (As) and silver (Ag).
(ii) Concentrations of organic compounds including total polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and tributyltin (TBT).

Details of the determination methods and reporting limits are provided in **Tables 6-3** and **6-4** respectively.

Table 6-3 Testing Methods and Reporting Limits for Metals and Metalloids Analysis

Code	Test Parameter	Preparation Method USEPA Method	Determination Method USEPA Method	Reporting limits (mg/kg)
Cd	Cadmium	3050B	6020A	0.20
Cr	Chromium	3050B	6010C	8.0
Cu	Copper	3050B	6010C	7.0
Ni	Nickel	3050B	6010C	4.0
Pb	Lead	3050B	6010C	8.0
Zn	Zinc	3050B	6010C	20
Hg	Mercury	7471A	7471A	0.05
As	Arsenic	3050B	6020A	1.0
Ag	Silver	3050B	6020A	0.10

Table 6-4 Testing Methods and Reporting Limits for TBT, PAHs and PCBs Analysis

Parameter	Method Reference	Reporting limits
Total PCB	USEPA 3550B & 8082	3 μg/kg
PAHs	USEPA 3550B, 3630C & 8270C	55 ug/kg for LMW PAHs 170 ug/kg for HMW PAHs
TBT in interstitial water	UNEP/IOC/IAEA	15 ng TBT/L

Sediment Classification

Dredged sediment destined for marine disposal are classified according to their level of contamination by 13 contaminants as detailed in **Table 6-5**:

Table 6-5 Sediment Quality Criteria for the Classification of Sediment

Contaminants	LCEL	UCEL
Heavy Metal (mg/kg dry weight)		
Cadmium (Cd)	1.5	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.5	1

Contaminants	**LCEL**	**UCEL**
Nickel (Ni)	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (mg/kg dry weight)		
Arsenic	12	42
Organic-PAHs (µg/kg dry weight)		
PAHs (Low Molecular Weight)	550	3160
PAHs (High Molecular Weight)	1700	9600
Organic-non-PAHs (µg/kg dry weight)		
Total PCBs	23	180
Organometallics (µg-TBT L^{-1} in interstitial water)		
Tributyltin	0.15	0.15

Source: Appendix A of ETWB TCW No. 34/2002 Management of Dredged / Excavated Sediment

Note: LCEL – Lower Chemical Exceedance Level
UCEL – Upper Chemical Exceedance Level

Sediments are categorised with reference to the LCEL and UCEL, as follows:

Category L	Sediment with all contaminant levels not exceeding the LCEL. The material must be dredged, transported and disposed of in a manner that minimises the loss of contaminants either into solution or by suspension.
Category M	Sediment with any one or more contaminant levels exceeding the LCEL and none exceeding the UCEL. The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment
Category H	Sediment with any one or more contaminant levels exceeding the UCEL. The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.

In case of Category M and Category H contamination, the final determination of appropriate disposal options, routing and the allocation of a permit to dispose of material at a designated site will be made by EPD and the Marine Fill Committee (MFC) in accordance with the ETWB TCW No. 34/2002.

Biological Testing

For Category M sediment and Category H sediment with contaminant levels exceeding 10 times the LCEL, Tier III biological screening was carried out to determine the appropriate disposal methods in accordance with the requirements of ETWB TCW No. 34/2002.

Based on the results of the chemical testing and the estimated dredging depth of -8m for formation of the trench, the sediment samples presented in **Table 6-6** were subjected to biological testing, with a total of six test samples:

Table 6-6 Composite Sample Arrangement for Biological Testing

Composite Sample No.	Vibrocore No.	Coordinates		Sample Depth
		Easting	Northing	
2	VC7a	833270	817569	-0.9 to - 1.9m
4	VC11a	832755	817329	-0.9 to - 1.9m
5	VC12a	833148	817065	0.0 to - 0.9m
6	VC13a	833569	817850	0.0 to - 0.9m
7	VC13a	833569	817850	-4.9 to – 5.9m
8	VC14a	833935	818214	0.0 to - 0.9m

The following three toxicity tests (to be considered as one set) were conducted on each sample:

- a 10-day burrowing amphipod toxicity test ; and
- a 20-day burrowing polychaete toxicity test; and
- a 48-96 hour larvae (bivalve or echinoderm) toxicity test.

The species used for each type of biological test and the test conditions are listed in **Table 6-7** below.

Table 6-7 Test Species for Biological Testing

Test Types	Species	Reference Test Conditions*
10-day burrowing amphipod toxicity test	*Leptocheirus plumulosus*	USEPA (1994)
20-day burrowing polychaete toxicity test	*Neanthes arenaceodentata*	PSEP (1995)
48-96 hour bivalve larvae toxicity test	*Crassostrea gigas*	PSEP (1995)

Notes:*
(i) U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.
(ii) PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.

Sediment samples were characterized by the testing laboratory for ancillary testing parameters such as porewater salinity, ammonia, TOC, grain size and moisture content. This provided necessary information on the general characteristics of the sediment.

The test endpoints and decision criteria are summarized in **Table 6-8**. The sediment was deemed to have failed the biological testing if it failed in any one of the three toxicity tests.

Table 6-8 Test endpoints and decision criteria for biological testing

Toxicity test	Endpoints measured	Failure criteria
10-day amphipod	Survival	Mean survival in test sediment is significantly different ($p \leq 0.05$)[1] from mean survival in reference sediment **and** mean survival in test sediment < 80% of mean survival in reference sediment.
20-day polychaete	Dry Weight[2]	Mean dry weight in test sediment is significantly different ($p \leq 0.05$)[1] from mean dry weight in reference sediment **and** mean dry weight in test sediment < 90% of mean dry weight in reference sediment.
48-96 hour bivalve larvae	Normality Survival[3]	Mean normality survival in test sediment is significantly different ($p \leq 0.05$)[1] from mean normality survival in reference sediment **and** mean normality survival in test sediment < 80% of mean normality survival in reference sediment.

[1] Statistically significant differences should be determined using appropriate two-sample comparisons (e.g., *t-tests*) at a probability of $p \leq 0.05$.

[2] Dry weight means total dry weight after deducting dead and missing worms.

[3] Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

6.4 Baseline Condition of Marine Dredged Sediment

6.4.1 Chemical Screening

The marine sediment quality analysis results of chemical screening from the marine site investigation works are included as **Appendix F2**, as compared with the sediment quality criteria for the classification of sediment, are presented in **Table 6-9**.

The sediment chemical testing results indicate that Category L sediments were found at all depths at vibrocores VC2a and 3a. Category M sediment was found at vibrocores VC4a, 7a, 8a, 11a, 12a, 13a, 14a and 15a in terms of Cd, Cu, Pb, Zn, Hg, As, Ag, low molecular weight PAHs and high molecular weight PAHs. Category H sediment was found at vibrocores VC1a, 4a, 5a, 6a, 8a, 9a, 10a, 11a and 13a. The contamination is high in terms of Cu, Pb, Hg, and Ag. Sediment samples VC4a, 7a, 8a, 11a, 12a, 13a, 14a and 15a were required to proceed to Tier III biological screening.

Table 6-9 Contaminant Levels of Vibrocore Samples and Their Categories

Vibrocore No.	From (m)	To (m)	Material Type	LMW PAHs ug/kg	HMW PAHs ug/kg	Total PCBs ug/kg	Metals mg/kg									TBT ng/L	Overall Category	Disposal Type
							Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag			
VC1a	0	0.9	Clay	<55	<170	<3	<0.20	21	9.8	18	39	61	**1.2**	4.5	0.10	<0.015	H	2
VC1a	0.9	1.9	Clay	<55	<170	<3	<0.20	24	<7.0	19	18	52	0.06	3.3	<0.10	<0.015	L	1
VC1a	1.9	2.9	Clay	<55	<170	<3	<0.20	26	7.9	20	24	62	0.08	4.7	<0.10	<0.015	L	1
VC1a	4.9	5.9	Clay	<55	<170	<3	<0.20	27	10	19	30	59	0.09	7.1	<0.10	<0.015	L	1
VC1a	7.9	8.9	Clay	<55	<170	<3	<0.20	21	7.5	16	26	48	0.07	5.3	<0.10	<0.015	L	1
VC1a	10.9	11.9	Clay	<55	<170	<3	<0.20	27	12	20	37	63	0.08	10	<0.10	<0.015	L	1
VC2a	0	0.9	Clay	<55	<170	<3	<0.20	19	8.5	17	20	47	0.16	2.5	<0.10	<0.015	L	1
VC2a	0.9	1.9	Clay	<55	<170	<3	<0.20	16	<7.0	12	18	39	0.06	3.7	<0.10	<0.015	L	1
VC2a	1.9	2.9	Clay	<55	<170	<3	<0.20	22	7.4	18	20	50	0.07	3.9	<0.10	<0.015	L	1
VC2a	4.9	5.9	Clay	<55	<170	<3	<0.20	33	13	26	34	68	0.06	7.8	<0.10	<0.015	L	1
VC2a	7.9	8.9	Clay	<55	<170	<3	<0.20	28	11	17	30	51	0.08	11	<0.10	<0.015	L	1
VC2a	10.9	11.3	Clay	<55	<170	<3	<0.20	18	7.7	<4.0	48	37	0.05	7.4	<0.10	<0.015	L	1
VC3a	0	0.9	Clay	<55	<170	<3	<0.20	17	<7.0	14	17	45	0.07	4.2	<0.10	<0.015	L	1
VC3a	0.9	1.9	Clay	<55	<170	<3	<0.20	29	10	23	37	78	0.13	6.2	<0.10	<0.015	L	1
VC3a	1.9	2.9	Silt	<55	<170	<3	<0.20	29	12	25	33	68	0.09	10	0.11	<0.015	L	1
VC4a	0	0.9	Clay	<55	1000	<3	0.36	26	77	13	**130**	190	0.28	5.5	**2.1**	<0.015	H	2
VC4a	0.9	1.9	Clay	<55	<170	<3	<0.20	22	9.4	18	22	54	0.08	5.6	<0.10	<0.015	L	1
VC4a	1.9	2.9	Clay	<55	<170	<3	<0.20	18	<7.0	15	20	44	<0.05	3.4	<0.10	<0.015	L	1
VC4a	4.9	5.9	Clay	<55	<170	<3	<0.20	33	13	26	35	75	0.07	6.8	<0.10	<0.015	L	1
VC4a	7.9	8.9	Clay	<55	<170	<3	<0.20	21	10	15	26	50	0.14	7.2	<0.10	<0.015	L	1
VC4a	10.9	11.9	Clay	<55	<170	<3	<0.20	<8.0	<7.0	<4.0	62	<20	0.62	5.0	<0.10	<0.015	M	1D
VC5a	0	0.9	Clay	<55	<170	<3	0.38	45	**140**	22	38	110	0.30	7.3	1.4	<0.015	H	2
VC5a	0.9	1.9	Clay	<55	<170	<3	<0.20	25	8.3	18	46	54	0.09	4.4	<0.10	<0.015	L	1
VC5a	1.9	2.9	Clay	<55	<170	<3	<0.20	33	9.4	23	24	63	0.08	5.2	0.16	<0.015	L	1
VC5a	4.9	5.9	Clay	<55	<170	<3	<0.20	29	9.4	20	28	57	0.06	5.1	<0.10	<0.015	L	1

Vibrocore No.	From (m)	To (m)	Material Type	LMW PAHs ug/kg	HMW PAHs ug/kg	Total PCBs ug/kg	Metals mg/kg									TBT ng/L	Overall Category	Disposal Type
							Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag			
VC5a	7.9	8.9	Clay	<55	<170	<3	<0.20	21	7.6	15	22	49	0.08	3.7	<0.10	<0.015	L	1
VC5a	10.9	11.9	Clay	<55	<170	<3	<0.20	23	8.3	17	31	52	0.28	6.1	<0.10	<0.015	L	1
VC6a	0	0.9	Clay	690	<170	41	0.45	23	**360**	13	69	250	0.63	6.3	1.7	<0.015	H	2
VC6a	0.9	1.9	Clay	<55	<170	<3	<0.20	23	10	19	25	64	0.23	2.7	<0.10	<0.015	L	1
VC6a	1.9	2.9	Clay	<55	<170	<3	<0.20	26	10	21	30	56	0.11	5.4	<0.10	<0.015	L	1
VC6a	4.9	5.9	Clay	<55	<170	<3	<0.20	27	12	23	28	56	0.10	6.4	<0.10	<0.015	L	1
VC6a	7.9	8.9	Clay	<55	<170	<3	<0.20	29	17	22	40	68	0.15	7.6	0.11	<0.015	L	1
VC7a	0	0.9	Clay	<55	<170	<3	<0.2	16	11	13	38	46	0.17	4.2	0.15	<0.015	L	1
VC7a	0.9	1.9	Clay	780	9200	<3	<0.2	20	<7.0	17	17	42	0.08	3.0	<0.10	<0.015	M	2
VC7a	1.9	2.9	Clay	<55	<170	<3	<0.2	20	<7.0	18	17	49	0.09	3.9	<0.10	<0.015	L	1
VC7a	4.9	5.9	Clay	<55	<170	<3	<0.20	31	14	23	40	70	0.09	9.1	<0.10	<0.015	L	1
VC7a	7.9	8.9	Clay	<55	<170	<3	<0.20	12	<7.0	<4.0	10	<20	<0.05	2.3	<0.10	<0.015	L	1
VC8a	0	0.9	Silt	<55	<170	<3	0.69	55	**190**	22	84	180	0.92	7.6	**3.1**	<0.015	H	2
VC8a	0.9	1.9	Silt	<55	<170	<3	<0.20	24	9.0	19	33	62	0.26	3.8	<0.10	<0.015	L	1
VC8a	1.9	2.9	Clay	<55	<170	<3	<0.20	22	<7.0	17	19	52	0.07	4.4	<0.10	<0.015	L	1
VC8a	4.9	5.9	Clay	<55	<170	<3	<0.20	26	12	20	32	60	0.10	8.5	<0.10	<0.015	L	1
VC8a	7.9	8.9	Clay	<55	<170	<3	<0.20	26	12	19	38	60	0.11	9.4	<0.10	<0.015	L	1
VC8a	10.9	11.9	Clay	<55	<170	<3	<0.20	24	12	17	38	58	0.09	13	<0.10	<0.015	M	1D
VC9a	0	0.9	Clay	130	1100	5.2	0.40	26	65	15	100	120	**1.1**	8.2	1.8	<0.015	H	2
VC9a	0.9	1.9	Clay	<55	<170	<3	<0.20	22	<7.0	19	20	57	0.12	3.7	<0.10	<0.015	L	1
VC9a	1.9	2.9	Clay	<55	<170	18	<0.20	25	7.4	19	22	61	0.06	4.2	<0.10	<0.015	L	1
VC9a	4.9	5.9	Clay	<55	<170	<3	<0.20	28	12	20	30	60	0.08	8.0	<0.10	<0.015	L	1
VC9a	7.9	8.9	Clay	<55	<170	<3	<0.20	22	7.8	17	26	48	0.09	5.2	<0.10	<0.015	L	1
VC9a	10.9	11.9	Clay	<55	<170	<3	<0.20	23	11	17	30	56	0.07	9.4	<0.10	<0.015	L	1
VC10a	0	0.9	Clay	<55	420	6.0	0.69	52	**170**	21	78	190	0.99	7.3	**2.9**	<0.015	H	2
VC10a	0.9	1.9	Clay	<55	<170	<3	<0.20	23	7.6	17	20	50	0.10	5.0	<0.10	<0.015	L	1
VC10a	1.9	2.9	Clay	<55	<170	<3	<0.20	22	<7.0	16	20	46	0.07	4.9	<0.10	<0.015	L	1

Vibrocore No.	From (m)	To (m)	Material Type	LMW PAHs ug/kg	HMW PAHs ug/kg	Total PCBs ug/kg	Metals mg/kg									TBT ng/L	Overall Category	Disposal Type
							Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag			
VC10a	4.9	5.9	Clay	<55	<170	<3	<0.20	27	9.8	20	35	58	0.10	7.2	<0.10	<0.015	L	1
VC10a	7.9	8.9	Clay	<55	<170	<3	<0.20	27	10	20	28	59	0.10	7.4	<0.10	<0.015	L	1
VC10a	10.9	11.9	Clay	<55	<170	<3	<0.20	27	12	18	32	58	0.08	10	<0.10	<0.015	L	1
VC11a	0	0.9	Anthropogenic Deposit	<55	<170	<3	0.39	24	61	11	46	120	0.58	7.6	**2.4**	<0.015	H	2
VC11a	0.9	1.9	Clay	<55	<170	6.3	0.29	36	50	18	78	130	0.62	7.2	1.1	<0.015	M	1D
VC11a	1.9	2.9	Clay	<55	<170	<3	<0.20	23	7.1	19	18	53	0.06	5.6	<0.10	<0.015	L	1
VC11a	4.9	5.9	Clay	<55	<170	<3	<0.20	29	11	20	31	60	0.14	8.9	0.45	<0.015	L	1
VC11a	7.9	8.9	Clay	<55	<170	<3	<0.20	28	13	20	31	68	0.09	11	<0.10	<0.015	L	1
VC11a	10.9	11.9	Clay	<55	<170	<3	<0.20	18	8.5	10	24	37	0.06	12	<0.10	<0.015	L	1
VC12a	0	0.9	Anthropogenic Deposit	<55	<170	<3	<0.20	15	58	7.3	28	65	0.28	7.3	1.3	<0.015	M	2
VC12a	0.9	1.9	Gravel	<55	<170	<3	<0.20	32	14	23	38	69	0.19	10	0.14	<0.015	L	1
VC12a	1.9	2.9	Clay	<55	<170	<3	<0.20	20	7.2	15	23	43	0.12	4.3	<0.10	<0.015	L	1
VC12a	4.9	5.9	Clay	<55	<170	<3	<0.20	29	12	18	35	61	0.24	10	<0.10	<0.015	L	1
VC12a	7.9	8.9	Clay	<55	<170	<3	<0.20	28	12	18	38	60	0.12	9.4	<0.10	<0.015	L	1
VC12a	10.9	11.9	Silt	<55	<170	<3	<0.20	10	<7.0	6.1	16	22	0.07	4.9	<0.10	<0.015	L	1
VC13a	0	0.9	Clay	140	2600	<3	0.25	21	55	9.2	55	98	0.25	4.8	1.7	<0.015	M	1D
VC13a	0.9	1.9	Clay	180	1300	7.5	0.84	60	**270**	22	110	190	0.89	6.6	**2.4**	<0.015	H	2
VC13a	1.9	2.9	Clay	<55	<170	<3	<0.20	21	7.2	21	21	50	0.09	4.8	<0.10	<0.015	L	1
VC13a	4.9	5.9	Clay	<55	<170	<3	2.8	29	12	23	34	70	0.15	6.6	<0.10	<0.015	M	1D
VC13a	7.7	8.7	Clay	<55	<170	<3	<0.20	20	7.1	12	20	38	0.05	4.7	<0.10	<0.015	L	1
VC14a	0	0.9	Silt	<55	<170	<3	0.28	33	80	16	28	81	0.25	5.4	1.4	<0.015	M	2
VC14a	0.9	1.9	Silt	<55	<170	<3	<0.20	23	16	15	18	50	0.10	4.5	0.10	<0.015	L	1
VC14a	1.9	2.9	Clay	<55	<170	<3	<0.20	33	10	22	46	63	0.11	5.5	<0.10	<0.015	L	1
VC14a	4.9	5.9	Clay	<55	<170	<3	<0.20	32	9.0	21	30	59	0.09	4.6	<0.10	<0.015	L	1
VC14a	7.9	8.9	Clay	<55	<170	<3	<0.20	31	10	21	27	58	0.08	4.0	<0.10	<0.015	L	1
VC14a	10.9	11.9	Clay	<55	<170	<3	<0.20	36	13	21	44	63	0.28	8.9	<0.10	<0.015	L	1
VC15a	0	0.9	Clay	<55	<170	<3	<0.20	26	36	16	21	62	0.11	4.6	0.40	<0.015	L	1

Vibrocore No.	From (m)	To (m)	Material Type	LMW PAHs ug/kg	HMW PAHs ug/kg	Total PCBs ug/kg	Metals mg/kg									TBT ng/L	Overall Category	Disposal Type
							Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag			
VC15a	0.9	1.9	Clay	<55	<170	<3	<0.20	28	7.5	22	17	59	0.06	3.8	<0.10	<0.015	L	1
VC15a	1.9	2.9	Clay	<55	<170	<3	<0.20	27	7.7	20	19	59	0.06	4.7	<0.10	<0.015	L	1
VC15a	4.9	5.9	Clay	<55	<170	<3	<0.20	30	10	20	28	55	0.10	5.2	<0.10	<0.015	L	1
VC15a	7.9	8.9	Clay	<55	<170	<3	<0.20	30	10	20	32	57	0.06	6.2	0.10	<0.015	L	1
VC15a	10.9	11.9	Clay	<55	<170	<3	<0.20	29	11	15	27	50	0.07	<u>15</u>	<0.10	<0.015	M	2

Notes:
1. LMW = Low molecular weight PAHs, that is, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene and phenanthrene.
2. HMW = High molecular weight PAHs, that is, benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene.
3. Values <u>underlined</u> indicate Category M sediment under ETWB TCW No. 34/2002.
4. Values in **bold** indicate Category H sediment under ETWB TCW No. 34/2002.
5. Values in **bold** and <u>underlined</u> indicate Category H sediment under ETWB TCW No. 34/2002 and that the contaminant level exceeded the LCEL by 10 times.
6. Disposal Type 1 = Type 1 - Open Sea Disposal, Disposal Type 1D = Type 1 - Open Sea Disposal (Dedicated Sites) and Disposal Type 2 = Type 2 – Confined Marine Disposal

A summary of classification of the vibrocore samples is provided in **Table 6-10**. The majority of the sediment samples (78%) were classified as Category L.

Table 6-10 Summary of Classification of Vibrocore Samples

Category	Number of Vibrocore Samples
Category L	66
Category M	9
Category H	9
Category H (10 x > LCEL)	0

6.4.2 Biological Screening

The marine sediment quality analysis results of biological screening from the site investigation works were presented in a comprehensive laboratory testing report and is provided in **Appendix F3**.

The general characteristics of the marine sediment is provided in the ancillary tests results summarised in **Table 6-11.**

Table 6-11 Summary of Ancillary Tests Results

Composite Sample No.	**Vibrocore No.**	**Interstitial ammonia** ($mgNH_3/L$)	**Interstitial salinity** (ppt)	**Grain Size < 63mm** (%)	**Mositure Content** (%)	**TOC** (% Wet Weight)	**TOC** (% Dry Weight)
2	VC7a	See Note 1	29	44	51	0.49	0.74
4	VC11a	9.2	33	62	53	0.66	1.01
5	VC12a	16.4	33	18	40	0.40	0.56
6 & 7	VC13a	14.8	35	40	59	0.62	0.99
8	VC14a	4.3	30	83	93	0.70	1.35

Note: 1. Analysis was not performed due to insufficient amount of porewater obtained.

The sediment biological screening results indicated that composite sample no. 2, 5 and 8 failed the toxicity tests. The sediment was deemed to have failed the biological test if it fails in any one of the three toxicity tests. A summary of toxicity tests failure is provided in **Table 6-12**.

Table 6-12 Summary of Toxicity Test Failure

Toxicity Test	Test Failure (Composite Sample No.)
10-day amphipod	Nil
20-day polychaete	Nil
48-96 hour bivalve larvae	2, 5 and 8

6.5 Identification and Evaluation of Environmental Impacts

6.5.1 Construction Phase

The construction activities to be carried out for construction of the proposed submarine watermain would generate a variety of wastes that can be divided into distinct categories based on their composition and ultimate method of disposal. The identified waste types include:

- Construction and demolition (C&D) materials
- General refuse; and
- Chemical waste
- Marine dredged sediment

Each type of waste arising is described below, together with an evaluation of the potential environmental impacts associated with generation, handling, storage and transport of the waste.

Construction and Demolition (C&D) Materials

Excavated materials would arise from the excavation works for the landing points of the submarine watermain. It is anticipated that the volume of excavated material to be generated would be small and in the order of a few hundred cubic metres. In order to minimise the impact resulting from collection and transportation of C&D material for off-site disposal, the excavated material which comprise of reclamation fill material that could be reused on-site as fill material should be reused on-site as backfilling material for the construction of the associated landmains as far as practicable. The amount of C&D material to be generated would be quantified in the site Waste Management Plan to be prepared by the Contractor.

General Refuse

The construction workforce will generate refuse comprising food scraps, waste paper, empty containers, etc. Such refuse should be properly managed so intentional or accidental release to the surrounding environment does not occur. Disposal of refuse at sites other than approved waste transfer or disposal facilities shall be prohibited. Effective collection of site wastes will be required to prevent waste materials being blown around by wind, flushed or leached into the marine environment, or creating an odour nuisance or pest and vermin problem. Waste storage areas shall be well maintained and cleaned regularly. With the implementation of good waste management practices at the site, adverse environmental impacts are not expected to arise from the storage, handling and transportation of workforce wastes. The maximum number of construction workers to be employed is estimated to be about 100 workers. Based on a generation rate of 0.65 kg per worker per day, the maximum daily arising of general refuse during the construction period would be approximately 65 kg and this waste can be effectively controlled by normal measures.

Chemical Waste

The maintenance and servicing of construction plant and equipment may generate some chemical wastes such as cleaning fluids, solvents, lubrication oil and fuel. Maintenance of vehicles may also involve the use of a variety of chemicals, oil and lubricants. It is difficult to quantify the amount of chemical waste that will arise from the construction activities since it will be dependent on the Contractor’s on-site maintenance requirements and the amount of plant utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance, would be small and in the order of a few cubic metres per month. The amount of chemical waste to be generated will be quantified in the site Waste Management Plan to be prepared by the Contractor.

Chemical wastes arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. The potential hazards include:

- Toxic effects to workers
- Adverse impacts on water quality from spills and associated adverse impacts on marine biota; and
- Fire hazards.

Materials classified as chemical wastes would require special handling and storage arrangements before removal for appropriate treatment at the approved Chemical Waste Treatment Facility. Wherever possible opportunities should be taken to reuse and recycle materials. Mitigation and control requirements for chemical wastes are detailed in Section 6.6.5. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts are not expected.

Marine Dredged Sediment

In accordance with ETWB TC(W) No. 34/2002 - Managmeent of Dredged/Excavated Sediment, review of existing information for site contamination assessment (Tier I), chemical screening (Tier II) and biological screening (Tier III) were conducted along the trench to be dredged for submarine watermain installation to determine the sediment quality. Sediments were classified into Category L, M and H based on its contaminant levels identified from chemical screening. Sediment classified as Category M was then subjected to biological screening. The corresponding types of disposal required were thus identified and presented numerically in **Table 6-9** and graphically in **Figure 6.3**.

The existing seabed area would be dredged to lay the submarine watermain. According to **Figure 6.3**, the total volume of dredged sediment was estimated to be approximately 543,000 m^3. The estimated volume of contaminated dredged sediment was approximately 212,000 m^3. The potential environmental effects of the removal of these sediments on water quality have been assessed and presented in Section 3 of this Report.

To minimize any potential adverse impacts arising from the dredged marine sediment, the sediment shall be dredged, transported and disposed of in a manner that will minimise the loss of contaminants either into solution or by resuspension. Mitigation measures to minimise potential environmental impacts are described in Section 6.6.6. With the implementation of mitigation measures, no unacceptable impacts would be expected from the transportation and disposal of the dredged sediment.

6.5.2 Operation Phase

No solid wastes are anticipated to be generated during operation except for minor quantities of material collected during maintenance inspections.

6.6 Mitigation of Adverse Environmental Impacts

6.6.1 Good Site Practices

Adverse impacts related to waste management are not expected to arise, provided that good site practices are strictly followed. Recommendations for good site practices during the construction activities include:

- Nomination of an approved person, such as a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site
- Training of site personnel in proper waste management and chemical handling procedures
- Provision of sufficient waste disposal points and regular collection of waste
- Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers

6.6.2 Waste Reduction Measures

Good management and control can prevent the generation of a significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Sort C&D material from demolition and decommissioning of the existing facilities to recover recyclable portions such as metals
- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal
- Encourage collection of aluminium cans by providing separate labelled bins to enable this waste to be segregated from other general refuse generated by the work force
- Proper storage and site practices to minimise the potential for damage or contamination of construction materials
- Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste.

In addition to the above measures, specific mitigation measures are recommended below for the identified waste arising to minimise environmental impacts during handling, transportation and disposal of these wastes.

6.6.3 C&D Material

In order to minimise impacts resulting from collection and transportation of C&D material for off-site disposal, the excavated materials should be reused on-site as backfilling material and for landscaping works for the associated land mains as far as practicable. In addition, C&D material generated from excavation works should be disposed of at public fill reception facilities for other beneficial uses. Other mitigation requirements are listed below:

- A Waste Management Plan should be prepared.

- A recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed.
- In order to monitor the disposal of C&D material and solid wastes at public filling facilities and landfills, and to control fly-tipping, a trip-ticket system (e.g. ETWB TCW No. 31/2004) should be included.

6.6.4 General Refuse

General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D material. Preferably an enclosed and covered area should be provided to reduce the occurrence of 'wind blown' light material.

6.6.5 Chemical Waste

If chemical wastes are produced at the construction site, the Contractor would be required to register with the EPD as a chemical waste producer and to follow the guidelines stated in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately. Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as explosive, flammable, oxidizing, irritant, toxic, harmful, corrosive, etc. The Contractor shall use a licensed collector to transport and dispose of the chemical wastes, to either the approved Chemical Waste Treatment Centre, or another licensed facility, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.

6.6.6 Marine Dredged Sediment

The basic requirements and procedures for dredged mud disposal are specified under the ETWB TCW No. 34/2002. The management of the dredging, use and disposal of marine mud is monitored by the MFC, while the licensing of marine dumping is the responsibility of the Director of Environmental Protection (DEP).

The dredged marine sediments would be loaded onto barges and transported to designated disposal sites depending on their level of contamination. Based on the chemical and biological screening results and subsequently the corresponding types of disposal required as presented in **Table 6-9** and **Figure 6.3**, it was estimated that some 326,000m^3 of sediments would be suitable for open sea disposal (Type 1), some 5,000 m^3 of sediments would be suitable for open sea disposal (dedicated sites) (Type 1) and 212,000m^3 of sediments would require confined marine disposal (Type 2). Agreement from Marine Fill Committee for the dredging rationale was obtained as presented in **Appendix F4**. Moreover, Marine Fill Committee has no comment on the proposed disposal arrangements. In accordance with the ETWB TCW No. 34/2002, the contaminated material must be dredged and transported with great care, and the mitigation measures recommended in Section 3 of this Report should be strictly followed. Furthermore, the dredged contaminated sediment must be effectively isolated from the environment upon final disposal and shall be disposed of at the East Sha Chau Contaminated Mud Pits that is designated for the disposal of contaminated mud in Hong Kong.

During transportation and disposal of the dredged marine sediments, the following measures should be taken to minimise potential impacts on water quality:

- Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material. Excess material shall be cleaned from the decks and exposed fittings of barges and dredgers before the vessel is moved.
- Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self-monitoring devices as specified by the EPD.
- Barges or hopper barges shall not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation.

Table 6-13 provides a summary of the various waste types likely to be generated during the construction activities for the proposed submarine watermain, together with the recommended handling and disposal methods.

Table 6-13 Summary of Waste Handling Procedures and Disposal Routes

Waste Material Type	Generated from works item	Timing to be Generated	Total Quantity Generated	Quantity to be disposed off-site	Disposal	Handling
Marine Dredged Sediment (Uncontaminated)	Trench excavation	Sep 08 to Aug 09	331,000 m^3	331,000 m^3	MFC gazetted marine disposal ground – open sea disposal site	Minimise resuspension by use of closed grab, controlled loading and transfer
Marine Dredged Sediment (Contaminated)	Trench excavation	Sep 08 to Aug 09	212,000 m^3	212,000m^3	East Sha Chau contaminated mud pit	Minimise resuspension by use of closed grab, tight seal on barges, controlled loading and transfer
C&D Material	Excavation works	Sep 08 to May 11	Few hundred cubic meters (preliminary estimate)	Few hundred cubic meters (preliminary estimate)	To be reused on-site for construction of the associated landmains or To be disposed to public fill reception points for other beneficial uses or To be disposed to landfill	Segregate inert C&D material to avoid contamination from other waste arisings
General Refuse	Waste paper, discarded containers, etc. generated from workforce	Sep 08 to May 11	65 kg per day (preliminary estimate based on workforce of 100)	65 kg per day	Refuse station for compaction and containerisation and then to landfill	Provide on-site refuse collection points
Chemical Waste	Cleansing fluids, solvent, lubrication oil and fuel from construction plant and equipment	Sep 08 to May 11	Few cubic metres per month (preliminary estimate)	Few cubic metres per month (preliminary estimate)	Chemical Waste Treatment Centre	Recycle on-site or by licensed companies. Stored on-site within suitably designed containers

6.7 Evaluation of Residual Impacts

With the implementation of the recommended mitigation measures for the handling, transportation and disposal of the identified waste arising, no residual impact is expected to arise during the construction and operation of the proposed submarine watermain.

6.8 Environmental Monitoring and Audit

Waste management would be the contractor's responsibility to ensure that all wastes produced during the construction of the submarine watermain are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements. The recommended mitigation measures shall form the basis of the site Waste Management Plan to be developed by the Contractor in the construction stage.

Auditing of each waste stream should be carried out periodically to determine if wastes are being managed in accordance with approved procedures and the site Waste Management Plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and then to audit weekly thereafter.

6.9 Conclusions and Recommendations

A review of the sediment quality data from the marine site investigation indicated that the majority of the marine sediments to be dredged along the proposed submarine watermain were classified as Category L. The total dredged volume for the Project was estimated as 543,000 m^3, of which 212,000 m^3 of sediment was classified as requiring confined marine disposal. With the implementation of the recommended mitigation measures and management procedures in accordance with the requirements of ETWB TCW No. 34/2002, no residual impact was predicted.

Waste types generated by the construction activities are likely to include C&D material (from minor excavation works), general refuse from the workforce, and chemical waste from the maintenance of construction plant and equipment. Provided that these wastes are handled, transported and disposed of using approved methods and that the recommended good site practices are strictly followed, adverse environmental impacts is not expected during the construction phase.

7 AIR QUALITY IMPACT ASSESSMENT

7.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, construction air quality impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain was assessed.

An air quality impact assessment has been undertaken to define the nature and scale of potential environmental impacts associated with the construction of the submarine watermain specifically in terms of the effects of construction dust. Construction phase impacts have been assessed and mitigation measures have been identified to reduce any impact to acceptable levels.

7.2 Environmental Legislation, Standards, Guidelines and Criteria

Legislation, Standards, Guidelines and Criteria relevant to the consideration of air quality impacts under this Study include the following:

- Hong Kong Air Pollution Control Ordinance;
- Air Pollution Control (Construction Dust) Regulation; and
- Technical Memorandum on Environmental Impact Assessment Process.

7.2.1 Hong Kong Air Pollution Control Ordinance

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance (APCO) (Cap 311)*. The whole of the Hong Kong Special Administrative Region (HKSAR) is covered by the Hong Kong Air Quality Objectives (AQOs) which stipulate the statutory limits of some typical air pollutants and the maximum allowable number of exceedance over specific periods (refer to **Table 7-1**).

Table 7-1 Hong Kong Air Quality Objectives ($\mu g/m^3$)(i)

Pollutant	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates	500(vii)		260		80
Respirable Suspended Particulates (v)			180		55
Carbon Monoxide	30,000	10,000			
Nitrogen Dioxide	300		150		80
Photochemical Oxidants (as ozone) (vi)	240				
Lead				1.5	

Notes:
(i) Measured at 298K(25 ^{o}C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Yearly and three monthly figures calculated as arithmetic means.
(v) Respirable suspended particulates means suspended particles in air with nominal aerodynamic diameter of 10 micrometres and smaller.
(vi) Photochemical oxidants are determined by measurement of ozone only.
Air Pollution Control (Construction Dust) Regulation
(vii) This is not an AQO but a criterion for construction dust impact assessment under Annex 4 of the Technical Memorandum on Environmental Impact Assessment Process.

7.2.2 Air Pollution Control (Construction Dust) Regulation

Air Pollution Control (Construction Dust) Regulation stipulates the construction dust control requirements for both notifiable (e.g. site formation) and regulatory (e.g. road opening) Works to be carried out by the Contractor. The requirements for various notifiable and regulatory works are given in Parts 1 and 2 of the Regulation respectively. Part 3 of the Regulation stipulates the general control requirements (e.g. site boundary and entrance) for construction dust. The control requirements for individual activities (e.g. stockpiling of dusty material) are given in Part 4 of the Regulation.

7.2.3 Technical Memorandum on EIA Process (EIAO-TM), Annex 4 and 12

Criteria and guidelines for evaluating and assessing air quality impact as stated in Section 1 of Annex 4 and Annex 12 of the EIAO-TM are followed respectively. The EIAO-TM states that the hourly Total Suspended Particulate (TSP) level should not exceed 500μg/m^3 (measured at 25^{o}C and 1 atm.) for construction dust impact assessment.

7.3 Baseline Conditions & Air Sensitive Receivers

7.3.1 Baseline Conditions

The proposed landing point at West Kowloon is adjacent to the Western Harbour Tunnel Toll Plaza. The existing air quality at West Kowloon is mainly affected by vehicular emissions from the West Kowloon Expressway.

The proposed landing point at Sai Ying Pun is adjacent to the Western Wholesale Food Market. The existing air quality at Sai Ying Pun is mainly affected by emissions from vehicular traffic on Connaught Road West and Western Harbour Crossing.

The nearest EPD air quality monitoring stations (AQMS) are located at Sham Shui Po and Central/Western. The annual average air quality data monitored at these stations for the year 2004 are presented in **Table 7-2**.

Table 7-2 Background Air Quality (2001 – 2005)

Air Pollutant	Annual Average Concentration in ugm^{-3} (Average of year 2001 to 2005)	
	Sham Shui Po	Central/Western
Total Suspended Particulates (TSP)	79	73
Respirable Suspended Particulates (RSP)	55	52
Sulphur Dioxide (SO_2)	23	21
Nitrogen Dioxide (NO_2)	67	54

Source: Air Quality in Hong Kong, EPD

The annual average concentrations presented in **Table 7-2** have been used as the background air quality data for the following assessment.

7.3.2 Air Sensitive Receivers

Air Sensitive Receivers (ASRs) within 500m of the proposed submarine watermain alignment have been identified in accordance with the criteria set out in Annex 12 of the EIAO-TM by means of site inspections and reviews of land use plans. No ASR was identified within 500m of the proposed submarine watermain alignment at West Kowloon. ASRs were identified within 500m of the proposed submarine watermain alignment at Sai Ying Pun Identified ASRs with horizontal distances from the proposed watermain alignment are summarised in **Table 7-3**. The locations of the ASRs which are all located at Sai Ying Pun are shown in **Figure 7.1**.

Table 7-3 Representative Air Sensitive Receivers

ASR ID	Description	Type of Use	Separation Distance (m)
West Kowloon			
Nil			
Sai Ying Pun			
FSB	Fung Shing Building	Residential	360
VC	Viking Court		320
CLM	Cheong Ling Mansion		310
KY2	Kwan Yik Building Phase 2		400
KY3a	Kwan Yik Building Phase 3		245
KY3b			225
RWM	Richwealth Mansion		215
CG1	Connaught Garden		220
CG2			230
CG3			245
GB	General Building		270
TJB	Tianjin Building	Office	360
CMG	China Merchants Group, the Westpoint	Office	280
IPH	Island Pacific Hotel	Hotel and hostels	300
SCB	Singga Commercial Building	Office	310
AFCDMO	AFCD Market Office	GIC	220

ASR ID	Description	Type of Use	Separation Distance (m)
WWFM	Western Wholesale Food Market	GIC	340

7.4 Identification and Evaluation of Air Quality Impacts

7.4.1 Construction Phase

The likely air quality impacts arising from the construction of the proposed submarine watermain are dust nuisance and gaseous emission from construction plant, vehicles and barges. It is anticipated that dust would be generated from excavation, material handling and wind erosion from the site.

The construction of the cross harbour main would involve the following construction plants:

- two grab dredgers (one for dredging and one for trimming)
- four hopper barges
- two tug boats
- one winch
- one marine piling vessel
- two lorries
- two cranes

The submarine watermain laying activities such as trench dredging and pipe pulling as detailed in the construction programme are not dust generating and the gaseous emissions of SO_2 and NO_2 from one barge at anytime on site would be limited. Exceedance of AQOs from their operation is not anticipated.

The construction activities associated with the landing point would involve dust generating activities such as site clearance, minimal ground excavation, material handling and vehicle movements on haul roads. As the number of plants required on site would be limited, dust impact and SO_2 and NO_2 emissions from plants and site vehicles would be minimal. With the implementation of appropriate dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, together with proper maintenance of equipment, adverse air quality impacts are not anticipated.

7.4.2 Operation Phase

There will not be any operational phase emissions.

7.5 Mitigation of Adverse Environmental Impacts

7.5.1 Construction Phase

Construction dust impacts should be controlled within the 1-hour TSP criterion of 500 $\mu g/m^3$ and 24-hour TSP AQO of 260 $\mu g/m^3$. Therefore, effective control measures and good site practices should be implemented to meet the requirements of the *Air Pollution Control (Construction Dust) Regulation* and minimize construction dust impact.

During construction phase, the Contractor shall make reference, but not limit himself, to the following measures:

- any excavated dusty materials or stockpile of dusty materials should be covered entirely by impervious sheeting or sprayed with water so as to maintain the entire surface wet, and recovered or backfilled or reinstated within 24 hours of the excavation or unloading;
- the working area of excavation should be sprayed with water immediately before, during and immediately after the operations so as to maintain the entire surface wet;
- the load of dusty materials carried by vehicle leaving a construction site should be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle;
- where a site boundary adjoins a road, streets or other area accessible to the public, hoarding of not less than 2.4m high from ground level should be provided along the entire length except for a site entrance or exit;
- the area where vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;
- every main haul road should be scaled with concrete and kept clear of dusty materials or sprayed with water so as to maintain the entire road surface wet;
- the portion of road leading only to a construction site that is within 30m of a designated vehicle entrance or exit should be kept clear of dusty materials;
- all dusty materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty material wet;
- vehicle speed should be limited to 10 kph except on completed access roads; and
- every vehicle should be washed to remove any dusty materials from its body and wheels before leaving the construction sites.

7.5.2 Operation Phase

As impact from operation activities of the submarine watermain is not anticipated, air quality mitigation measures are not required.

7.6 Evaluation of Residual Air Quality Impacts

With the implementation of proposed dust suppression measures and good site practices, no residual air quality impacts associated with the construction and operation of the proposed submarine watermain is anticipated.

7.7 Environmental Monitoring and Audit

Dust monitoring during the construction of the submarine watermain is considered not necessary. Auditing on at least weekly basis during construction of the submarine watermain is required to ensure the proposed dust control measures are properly implemented.

7.8 Conclusions and Recommendations

Potential air quality impacts arising from the construction and operation of the submarine watermain have been evaluated.

As the number of construction plants involved in the submarine watermain laying activities at anytime on site would be limited, exceedance of AQOs emissions of gaseous pollutants from these construction plants is not anticipated. The number of plants required on site for the construction of the landing points would also be limited. Dust impact and SO_2 and NO_2 emissions from plants and site vehicles would be minimal. With the implementation of appropriate dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, together with proper maintenance of equipment, adverse air quality impact is not anticipated.

No air quality impact is anticipated at the operational phase since there will not have any operational phase emissions.

8 CULTURAL HERITAGE IMPACT ASSESSMENT

8.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, cultural heritage impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain was assessed.

A cultural heritage impact assessment has been undertaken to define the nature and scale of the potential impacts on cultural heritage resources associated with the construction of the submarine watermain, with a specific focus on the effects in the vicinity of sensitive receivers within the seabed that will be affected by the construction of the submarine watermain. Measures required to mitigate identified impacts are recommended, where appropriate, to reduce residual impacts to acceptable levels.

8.2 Environmental Legislation, Standards, Guidelines and Criteria

The following legislation and guidelines are applicable to the cultural heritage assessment in Hong Kong:

- Technical Memorandum on the EIA Process, Annex 10 and 19 (EIAO TM);
- Antiquities and Monuments Ordinance (Cap. 53);
- Hong Kong Planning Standards and Guidelines (HKPSG); and
- Marine Archaeological Investigation Guidelines.

8.2.1 Technical Memorandum on the EIA Process, Annex 10 and 19

The EIAO-TM outlines the approaches required in investigating and criteria for assessing the impacts on cultural heritage sites. The following Sections are applicable:

Annex 10 - "The criteria for evaluating impact on sites of cultural heritage includes: (a) The general presumption in favour of the protection and conservation of all sites of cultural heritage because they provide an essential, finite and irreplaceable link between the past and the future and are points of reference and identity for culture and tradition; (b) Adverse impacts on sites of cultural heritage shall be kept to the absolute minimum."

Annex 19 - "There is no quantitative standard in deciding the relative importance of these sites, but in general, sites of unique archaeological, historical or architectural value will be considered as highly significant. A baseline study shall be conducted: (a) to compile a comprehensive inventory of places, buildings, sites and structures of architectural, archaeological and historical value within the proposed project area; and (b) to identify possible threats of, and their physical extent, destruction in whole or in part of sites of cultural heritage arising from the proposed project."

The Memorandum also outlines the approach in regard to the preservation in totality, in part, and not at all of cultural resources:

Annex 19 - "Preservation in totality will be a beneficial impact and will enhance the cultural and socio-economical environment if suitable measures to integrate the sites of cultural heritage into the proposed project are carried out. If, due to site constraints and other factors, only preservation in part is possible, this must be fully justified with alternative proposals or layout designs, which confirm the impracticability of total preservation."

8.2.2 Antiquities and Monuments Ordinance (Cap.53)

The Antiquities and Monuments Ordinance (Cap. 53), provides power for the designation of Antiquities and Monuments Sites or Declared Monuments in Hong Kong, and provides statutory protection against the threat of development for declared monuments, historic buildings and archaeological sites on land and underwater which have been recommended by the Antiquities Advisory Board (AAB), approved by the Chief Executive and gazetted in the government gazette to enable their preservation for posterity.

The Antiquities Authority may, after consultation with the Antiquities Advisory Board (AAB) and with Government approval, gazette and protect any place, building, site or structure considered to be of public interest by reason of its historical, archaeological or palaentological significance. Once declared a site of public interest, no person may undertake acts that are prohibited under the Ordinance, such as demolishing or carrying out construction or other works, unless a permit is obtained from the Antiquities Authority.

For archaeological sites, all relics dated prior to 1800 AD belong to the Hong Kong Government. Archaeological sites are generally classified into two categories, as follows:

- Designated Monuments - those that have been gazetted in accordance with Cap. 53 by the Antiquities Authority; and
- Recorded Archaeological Sites – those which have not been declared but recorded by the AMO under administrative protection

The Legislation also sets out the procedures for the issuing of Licences to Excavate and Search for Antiquities, the effect of which is to forbid all such activities being undertaken without such a licence. It also provides for the penalties exacted for infringement of the Ordinance, including fines and imprisonment.

Although there are no statutory provisions for the protection of Sites of Cultural Heritage, Deemed Monuments and Graded Buildings in Hong Kong, the Government has administrative procedures which state that consideration must be given to protect them. However, at present, the record of sites of cultural heritage is incomplete as many areas have yet to be surveyed in detail.

Section 11 of the Antiquities and Monuments Ordinance requires any person who discovers an antiquity, or supposed antiquity, to report the discovery to the Antiquities Authority. Nevertheless it is prudent to ensure that procedures and mechanisms which ensure the preservation or formal notification of previously unknown archaeological resources that may be revealed or discovered during a project assessment or during construction are identified at an early stage in project planning.

8.2.3 Hong Kong Planning Standards and Guidelines

The HKPSG, Chapter 10 – Conservation covers planning considerations relevant to general guidelines and measures for conservation of historical buildings, archaeological sites and other antiquities.

8.2.4 Marine Archaeological Guidelines

The AMO have issued Guidelines for Marine Archaeological Investigation (MAI) which details the standard practice, procedures and methodology which must be undertaken in determining the marine archaeological potential, presence of archaeological artefacts and defining suitable mitigation measures.

8.3 Cultural Heritage Impact Assessment Methodology

8.3.1 Baseline Review

A baseline review was undertaken to compile a comprehensive inventory of cultural heritage resources of the Study Area. The Review established the historical profile and potential for cultural heritage sites and included:

- Marine charts records held in British Library and National Maritime Museum Library in London focus on cultural heritage features;
- Information held by the Antiquities and Monuments Office;
- Publications on local historical, architectural, anthropological, archaeological and other cultural studies;
- Unpublished papers, records, archival and historical documents held in local libraries and other government departments.

8.3.2 Geophysical Survey

The Geophysical Survey was undertaken to define the areas of greatest archaeological potential, assess the depth and nature of the seabed sediments to define which areas consist of suitable material to bury and preserve archaeological material and to map anomalies on the seabed which may be of archaeological potential.

IGGE (HK) Engineering Geophysical Company Limited undertook the Survey in August 2006, which covered a 200m corridor (100 m either side of the proposed centreline) along the length of the proposed submarine watermain route. This survey allowed for a comprehensive investigation of the seabed, and below the seabed.

8.3.3 Establishing Archaeological Potential

The data examined during the Baseline Review and Geophysical Survey were analysed to provide an indication of the likely character and extent of archaeological resources within the Study Area. The results are presented in the Marine Archaeological Investigation Report in **Appendix H** and summarised in Section 8.4.

8.4 Baseline Conditions

The submarine watermain is proposed to be located across Victoria Harbour from its connection at Lin Cheung Road in West Kowloon to the existing Sai Ying Pun Fresh Water Pumping Station in Sheung Wan. No evidence of any submerged cultural heritage sites including shipwrecks was identified from an examination of AMO records, archaeological and historical academic publications and all archives holding information on shipwrecks in Hong Kong waters. The detailed findings are presented in **Appendix H**. The associated landing point are proposed to be located at Sai Ying Pun and West Kowloon, which are on reclaimed land. As such, no land-based cultural heritage resources were identified within the Study Area.

IGGE (HK) Engineering Geophysical Company Limited undertook a Geophysical Survey in August 2006 which covered a 200m submarine watermain corridor to identify all forms of submerged marine archaeological deposits and objects. There are evidence of trawl marks, debris and dumped materials. The submarine watermain corridor and surrounds have been greatly affected by fishing trawlers and anchors and this will have resulted in impacts to the type and state of preservation of any submerged marine archaeological deposits. The seabed within the study area consists of mud or fine sand. Generally more than 10 m in thickness of marine deposits covered the study area. This would create a preservation environment for archaeological resources. Interpretation of the digital side scan sonar data revealed that there were no seabed anomalies within the dredging area of the Project as shown in **Figure 8.1**.

Although archaeological resources could be present on the seabed within the study area, the seabed has been subjected to previous substantial disturbance associated with dredging works for the construction of the western harbour crossing and new reclamation construction at Hong Kong Island and West Kowloon, construction of mooring buoys to the north of the Central Fairway and maintenance dredging of navigation channels within Victoria Harbour. These disturbed seabed areas cover most of the proposed dredging area for the submarine watermain. Further investigation was therefore not recommended.

8.5 Identification of Cultural Heritage Impact

The potential sources of impact may arise due to trench excavation by dredging and installation of the submarine pipeline by “bottom-pull” method.

8.6 Assessment of Cultural Heritage Impact

Preservation in totality is taken as the first priority and the assessment has taken into account the requirements as specified in the Section 2.1 of Annex 10 and Sections 2.6 to 2.14 of Annex 19 of the EIAO-TM.

As no land based cultural heritage resources were identified, no impacts are expected.

No indication of marine archaeological material was identified. As such, no impacts are expected from the installation of the cross harbour main.

8.7 Mitigation of Adverse Environmental Impact

No cultural heritage resources are identified within the Study Area and therefore, no mitigation measures are considered necessary.

8.8 Evaluation of Residual Cultural Heritage Impact

No cultural heritage resources are identified within the Study Area and therefore, no residual impacts are expected.

8.9 Environmental Monitoring and Audit

No cultural heritage resources are identified within the Study Area and therefore, no environmental monitoring and audit programme are recommended.

8.10 Conclusions and Recommendations

A comprehensive baseline review identified no land based or submerged cultural heritage resources within the Study Area.

A Geophysical Survey which covered a 200m submarine watermain corridor was conducted and no indication of marine archaeological material was identified. Therefore, no impacts are expected from the installation of the cross harbour main.

9 FISHERIES IMPACT ASSESSMENT

9.1 Introduction

The submarine watermain component of the Project across Victoria Harbour is a Designated Project under Schedule 2, Part 1I(E3) of the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) and an Environmental Permit (EP) issued under the EIAO is required for the construction and operation of the designated project.

In accordance with the EIA Study Brief No. ESB-132/2005, fisheries impact arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain was assessed.

This Section of the EIA Report presents the results of an assessment of the impact of construction and operation of the submarine watermain of the Project on existing fisheries resources, fishing operations and fish culture activities based on the findings of the Water Quality Impact Assessment.

9.2 Environmental Legislation, Standards, Guidelines and Criteria

The following legislations and guidelines are applicable to the fisheries impact assessment in Hong Kong:

- Technical Memorandum on the EIA Process, Annex 9 and 17 (EIAO-TM). Annex 17 of the EIAO-TM prescribes the general approach and methodology for the assessment of fisheries impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential impacts. EIAO-TM Annex 9 recommends the criteria that are to be used for evaluating fisheries impacts.
- Fisheries Protection Ordinance (Cap 171). This Ordinance provides for the conservation of fish and other aquatic life and regulates fishing practices.
- Marine Fish Culture Ordinance (Cap 353). This Ordinance regulates and protects marine fish culture and other related activities
- Water Pollution Control Ordinance (Cap 358). This Ordinance set limits to water quality parameters in various water control zones.

9.3 Fisheries Impact Assessment Methodology

A desktop literature review was conducted in order to establish the baseline conditions of the physical environment and fisheries importance of the area. Information from the water quality assessment was used to determine the size of the Study Area as that potentially affected by perturbations to water quality parameters. The importance of fisheries resources and fishing operations identified within the Study Area and the potential impacts due to the construction and operation of the cross harbour main were assessed following the criteria and guidelines for evaluating and assessing fisheries impact as stated in Annexes 9 and 17 of the *EIAO-TM*, respectively.

9.4 Baseline Conditions

This assessment of fisheries impacts focussed on the fisheries resources and fishing operations within the project area.

The availability of literature on the fisheries resources of the Study Area comes mainly from the AFCD 1996-1997 [(1)] and 2001-2002 [(2)] Port Survey. Other relevant reports from the Study Area have been reviewed. Updated mariculture information was obtained from the Agriculture, Fisheries and Conservation Department (AFCD).

In Hong Kong, the commercial marine fishing industry is divided into capture and culture fisheries. To assess the capture fishery within the Study Area, the most up-to-date information on the Hong Kong fishery was consulted. Information from other relevant studies within the Study Area were also reviewed in order to determine if the areas are important nursery and spawning grounds for commercial fisheries.

9.4.1 Capture Fisheries

General

The findings of fisheries surveys, fishermen's interviews and accompanying literature reviews [(3)] conducted for AFCD's *Fisheries Resources and Fishing Operations in Hong Kong Waters Study* have determined that commercial fish species reproduce throughout the year, though spawning for the majority of species appears to be concentrated during the period from June to September. The marine waters within the Study Area were not identified as a primary nursery ground for commercial fisheries as fish fry production density was less than or equal to 50 tails per hectare with reference to the AFCD's Port Survey 2001/2002.

In 2005, the estimated fisheries production in Hong Kong waters from capture fisheries amounted to 162,000 tonnes, valued at HK$1,600 million [(4)] . Within Hong Kong waters, the highest yields for local fisheries within Hong Kong waters were mainly derived from the eastern and northeastern coasts The five most abundant fish species landed by weight from the capture sector were golden thread (*Nemipterus virgatus* 14%), lizardfish (*Saurida* sp 9%), big-eyes (*Priacanthus* sp 5%), scads (*Decapterus* sp 5%) and yellow belly (*Nemipterus bathybius* 4%).

Based on the AFCD Port Survey 2001/2002 data, the highest range of fisheries production (i.e. 600 – 1000 kg ha^{-1}) was recorded near Cheung Chau, Penny's Bay, Kau Yi Chau, Po Toi, Ninepin Group and Tap Mun. The top 10 families captured in Hong Kong were rabbitfish (Sigdnidae), sardine (Clupeidae), croaker (Sciaenidae), scad (Carangidae), squid, shrimp, anchovy (Engraulidae), crab, seabream (Sparidae) and threadfin bream (Nemipteridae).

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(1) Agriculture, Fisheries and Conservation Department (1998) Port Survey 1996/1997.

(2) Agriculture, Fisheries and Conservation Department (2006) Port Survey 2001/2002, Web site www.afcd.gov.hk.

(3) ERM (1998) Fisheries Resources and Fishing Operations in Hong Kong Waters, Final Report, for Agriculture, Fisheries and Conservation Department, March 1998

(4) Agriculture, Fisheries and Conservation Department (2006) Web site www.afcd.gov.hk.

Up-to-date information from AFCD is available for use in this EIA and can be collated to allow an assessment be made of the importance of Fishing Zones in the Study Area to the Hong Kong fishery. The designated Fishing Zones within the Study Area have been identified and the importance of these zones is assessed and discussed below.

The Study Area interfaces with 5 Fishing Areas as identified in the AFCD Port Survey 1996/1997 Report (**Figure 9.1**). These Fishing Areas are identified as follows:

- Green Island
- Sai Ying Pun
- Central
- Yau Ma Tei
- Tsim Sha Tsui

Findings from Port Survey 1996/1997

The area and number of vessels operating during 1996-1997 in each of the Fishing Zones is presented in **Table 9-1**.

Table 9-1 Area (ha) and Number of Vessels Operating During 1996 - 1997 in Each AFCD Fishing Zone within the Study Area

Code	Fishery Area	Area (Ha)	Vessels < 15m	Vessels > 15m	All Vessels
089	**Green Island**	595.86	16.6	8.9	25.5
0151	**Sai Ying Pun**	655.76	5.0	0	5.0
0152	**Central**	265.10	6.1	0	6.1
0162	**Yau Ma Tei**	287.75	14.9	0	14.9
0163	**Tsim Sha Tsui**	181.76	2.6	0	2.6
Total		**1,986.23**	*	*	*
Total of all Fishing Zones in Hong Kong		**181,790.97**	**2,352.2**	**266.4**	**2,618.5**
Percentage of Hong Kong Total		**1.1 %**	*	*	*

*No values can be calculated for these parameters from the information provided, as it cannot be determined whether the vessels reported as operating within one zone are the same vessels that are reported for another zone.

The total number of vessels varies widely from 2.6 in Tsim Sha Tsui Fishing Area to 25.5 in Green Island Fishing Area. According to the AFCD Port Survey 1996/1997, the total fishing production in those fishing areas is mainly from vessels not exceeding 15m. Vessels exceeding 15m are only operated in the Green Island Fishing Area.

The overall fisheries production (adult fish and fish fry) ranged widely from approximately 4.96 kg ha^{-1} (Sai Ying Pun) to 134.3 kg ha^{-1} (Green Island) (**Table 9-2**). These values are not in the high range for production in Hong Kong.

Table 9-2 Fisheries Production Values from each AFCD Fishing Zone within the Study Area

Code	**0089**	**0151**	**0152**	**0162**	**0163**
Fishing Areas	**Green Island**	**Sai Ying Pun**	**Central**	**Yau Ma Tei**	**Tsim Sha Tsui**
Total Production					
Adult Fish (kg)	80,026.26	3,255.84	18,230.83	20,268.29	1,041.98
Fry (Tails)	-	-	-	-	-
Value (HKD)	760,154.46	106,666.67	400,357.14	719,309.53	30,857.14
Production (ha^{-1})					
Adult Fish (kg)	134.30	4.96	68.77	70.44	5.73
Fry (Tails)	-	-	-	,	-
Value (HKD)	1,275.74	162.66	1,510.22	2,499.77	169.77
Rank Production (Production, ha^{-1})					
Adult Fish (kg)	76	170	112	111	168
Fry (Tails)	-	-	-	-	-
Value (HKD)	130	169	124	96	168

Of the 5 fishing areas identified, one of the fishing zone recorded medium rank adult fish production (Green Island, 76th out of the 179 zones). Sai Ying Pun, Central, Yau Ma Tei and Tsim Sha Tsui recorded low ranked adult fish production (Sai Ying Pun 170th, Central 112th, Yau Ma Tei 111st and Tsim Sha Tsui 168th). No fish fry capture operations was recorded in the fishing areas within the Study Area.

According to the AFCD Port Survey data, the top five adult fish species caught in the sector Victoria Harbour (SE01) included the *Siganus Oramin* (Rabbitfish), *Leiognathus Brevirostris* (Pony Fish), *Mixed Species* (Mixed Fish), *Mixed Crab Species* (Crab) and *Argyrosomus Spp.* (Croaker). The main fish species reported in catches from the Study Area are of low commercial value (<HK$15/kg) including mixed species (juveniles of trash fish species such as *Caranx Kalla*, *Siganus canaliculatus* and *Leiognathus brevirostris*) (**Table 9-3**). Croaker and Flathead is regarded as of high commercial value (>HK $20/kg).

Table 9-3 Top Five Adult Fish (by weight) Caught in Each AFCD Fishing Zone within the waters of the Study Area

Code	**Fishing Area**	**Top Five Fish Caught (by weight)**	
		Species	**Common Name**
0089	Green Island	*Mixed Species*	Mixed Fish
		Mixed Prawn	Prawn
		Mixed Crab Species	Crab
		Leiognathus Brevirostris	Pony Fish
		Platycephalus Indicus	Flathead
0151	Sai Ying Pun	*Mixed Species*	Mixed Fish
		Mixed Prawn	Prawn
		Platycephalus Indicus	Flathead
		Oratosquilla Spp.	Mantis Shrimp

Code	Fishing Area	Top Five Fish Caught (by weight)	
		Species	**Common Name**
		Cynoglossus Spp.	Tongue Sole
0152	Central	*Caranx Kalla*	Shrimp Scad
		Siganus Oramin	Rabbitfish
		Stolephorus Spp.	Anchovy
		Mixed Crab Species	Crab
		Argyrosomus Spp.	Croaker
0162	Yau Ma Tei	*Siganus Oramin*	Rabbitfish
		Argyrosomus Spp.	Croaker
		Mixed Crab Species	Crab
		Clupanodon Punctatus	Gizzard Shad
		Leiognathus Brevirostris	Pony Fish
0163	Tsim Sha Tsui	*Leiognathus Brevirostris*	Pony Fish
		Siganus Oramin	Rabbitfish
		Argyrosomus Spp.	Croaker
		Mixed Crab Species	Crab
		Mixed Species	Mixed Fish

Findings from Port Survey 2001/2002

More recent data were extracted from the AFCD's Port Survey 2001/2002. In this Port Survey, a uniform grid of 720 ha cell size overlaid on Hong Kong waters and the fisheries related information (e.g. production, vessel number and catch value) was presented in the form of categories.

The results of Port Survey 2001/2002 shows that the waters within the Study Area are having low to medium adult fish production (>0 to 200kg/ha).

The catches from the direct impact grid cells as shown in **Figure 9.2** were at medium price in Hong Kong (HK$2000-5000/ha) in adult fish production.

Fishing vessels operated in this grid cell include shrimp trawler, gill netter, long liner, hand liner, miscellaneous craft and sampan. All fish vessels are less than 15m in length.

There is no fish fry collected within the direct impact grid cells.

Among the 10 species of major fisheries products in Port Survey 2001/2002, the most abundant species in the direct impact grid cells are crab and seabream with production of 20-40kg/ha and 10-20kg/ha respectively.

For the value of production, the direct impact grid cells are of low importance to capture fishing operations in Hong Kong.

9.4.2 Culture Fisheries

The closest AFCD designated Fish Culture Zone (FCZ) to the Study Area is located at Ma Wan which is approximately 10km away from the proposed cross harbour main. As of 30 September 2006, updated information from AFCD indicates that the Ma Wan FCZ consists of 108 licensed rafts with a total licensed area of 14,554m^2 (total gazetted area = 46,300m^2)

(5). The main species cultured are the spotted grouper (*Epinephelus chlorostigma*), gold-lined seabream (*Rhabdosargus sarba*), mangrove snapper (*Lutjanus argentimaculatus*) and the pompano (*Trachinotus blochii*). No figure is available for production at this FCZ, although the estimated production of marine culture fish in 2004 was about 1,540 tonnes valued at approximately $79 million (2).

9.4.3 Fisheries Importance

The importance of the fisheries within the Study Area is addressed based on the baseline information provided above. The Fishing Zones within the Study Area are characterised as mainly of medium to low value. The catches from these zones were composed of juvenile mixed fish species, which are used as fish feed in mariculture.

9.4.4 Sensitive Receivers

Based on the preceding review of the available information on the capture and culture fisheries of the waters of the Study Area and its immediate vicinity, no particular sensitive receiver may be affected by the proposed works associated with the Project.

9.5 Identification of Fisheries Impacts

9.5.1 Construction Phase

The cross harbour main with a length of approximately 2,100 metres will be submerged and embedded in a 6m deep trench in the seabed. The entire cross harbour main will be armoured with rockfill cover matching the original seabed level as shown in **Figure 2.3**.

Impact on future fishing operation is not anticipated as the armour rock will not protrude above the original seabed level. Impacts to fishing operations are expected to occur only during the installation of the cross harbour main. These impacts are predicted to be localised and small scale and may occur through the following mechanisms:

<u>Direct Impact</u>

Long term direct impacts are not expected to occur through the installation of the cross harbour main. Short term direct impacts are predicted to occur along the submarine pipeline trench with a length of approximately 2,100 metres and a width of approximately 44 metres to be formed at the seabed as shown in **Figure 2.3** as a result of the “bottom-pull” and dredging operations associated with the installation of the cross harbour main. Once these operations have ceased fisheries resources dependent on the affected area of seabed are expected to return due to recolonisation of the seabed by the supporting benthic fauna. The affected area of seabed will be reinstated in the following manner:

- Install the submarine pipeline by bottom-pull method upon completion of trench excavation;
- Cover the pipeline by a thin layer of grade 75 bedding (minimum 0.3m above the top of the pipeline) by hopper or crane barge;

(5) *ScottWilson (2001) Planning and Engineering Feasibility Study for Sham Tseng Development, EIA Final Report., for Civil Engineering Department.*

- Backfill the submarine pipeline by armour rock (approximately 4.5m) by hopper or crane barge;
- Monitor the armour rock level by chain or echo sounding during the course of rock placement. Trim the backfilled trench by crane barge to ensure the backfilled level match with the original seabed level without any rock armour protruding above the original seabed level; and
- Gaps between the backfilled armour rock and the edge of the submarine pipeline trench will be filled by marine sediment within the sea volume from natural movement of the top soft soil of existing seabed.

Indirect Impact

Indirect impacts to fisheries resources and fishing operations during the construction phase include sediment release associated with “bottom-pull” or dredging works. Potential impacts on water quality from sediment release are listed below:

- Increase concentrations of suspended solids (SS);
- A resulting decrease in dissolved oxygen (DO) concentrations; and
- An increase in nutrient concentrations in the water column.

Suspended Solids

Suspended sediment (SS) fluxes occur naturally in the marine environment, consequently fish have evolved behavioural adaptations to tolerate increased SS load (e.g., clearing their gills by flushing water over them). Where SS levels become excessive, fish will move to clearer waters. This level is defined as the tolerance threshold, which varies from species to species and at different stages of the life cycle. If SS levels exceed tolerance thresholds, fish are likely to become stressed, injured and may ultimately die. Susceptibility generally decreases with age, with eggs the most vulnerable and adults the least sensitive to effects from sediments. The rate, season and duration of SS elevations will influence the type and extent of impacts upon fish.

It is noted that, despite the very conservative nature of the assessment, the predicted increases in suspended solids concentrations did not exceed the guideline value recommended by AFCD which was identified for fisheries and selected marine ecological sensitive receivers that have been based on international marine water quality guidelines for the protection of ecosystems under the Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment (CSFMEC)[6] . The AFCD study recommends a maximum concentration of 50 mg L^{-1} (based on half of the no observable effect concentrations).

Dissolved Oxygen

The relationships between SS and DO are complex, with increased SS in the water column combining with a number of other effects to reduce DO concentrations. Elevated SS (and turbidity) reduces light penetration, lowers the rate of photosynthesis by phytoplankton

(6) *City University of Hong Kong (2001), Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment, Final Report, For Agriculture, Fisheries and Conservation Department, Hong Kong SAR Government..*

(primary productivity) and thus lowers the rate of oxygen production in the water column. Elevated SS can also cause increased energy retention from sunlight, resulting in higher temperatures, and thus the potential for lower oxygen levels as oxygen is more soluble in cold water. This has a particularly adverse effect on the eggs and larvae of fish, as at these stages of development high levels of oxygen in the water are required for growth to support high metabolic rates.

The assessment results of dissolved oxygen concentrations have shown that the predicted maximum decrease in dissolved oxygen concentrations are localised to within and around the submarine pipeline and restricted to the lower layers of the water column (i.e. close to the seabed). It is expected that the concentrations within the Study Area as a whole will be maintained at environmentally acceptable levels (i.e. compliant with the Water Quality Objectives as detailed in Section 3).

Nutrients

High levels of nutrients in seawater can cause rapid increases in phytoplankton, on occasions to the point where an algal bloom occurs. An intense bloom of algae can lead to sharp decreases in the levels of dissolved oxygen. This decrease will initially occur in the surface water, and then deepen as dead algae fall through the water column and decompose on the bottom. Anoxic conditions may result if DO concentrations are already low or are not replenished. This may result in mortality to fish, especially juveniles, due to oxygen deprivation.

The results of the water quality assessment sediment concentrations have shown that the predicted maximum sediment concentrations are localised to within and around the submarine pipeline and restricted to the lower layers of the water column (i.e. close to the seabed). It is expected that the concentrations within the Study Area as a whole will be maintained at environmentally acceptable levels (i.e. compliant with the Water Quality Objectives as detailed in Section 3).

Impacts to the sensitive receivers listed above are predicted, as a result of the construction of Project, to be within environmentally acceptable levels (as defined by compliance with the Water Quality Objectives).

9.5.2 Operation Phase

The only operation impacts from the submarine watermain would be if repair works were required. This includes maintenance and repairing work for any accidental damage of the pipeline. Since a protective armour rock layer has been provided to prevent or minimize the accidental damage, the repair works will not be significant during the design life of the submarine watermain. The impacts from this would be of reduced severity than those during the construction phase as the work would take place in a specific and confined small area. Therefore, unacceptable impacts to fisheries resources during the operation of the submarine watermain are not envisaged.

9.6 Assessment of Fisheries Impacts

From the information presented above, the fisheries impact associated with construction of the proposed submarine watermain is considered to be low. An evaluation of the impact in accordance with *Annex 9* of the *EIAO-TM* is presented below.

- *Nature of Impact*: Temporary, small scale and localised impact will occur to fisheries resources along submarine pipeline trench to be formed at the seabed as a result of the "bottom-pull" and dredging operations.
- *Size of Affected Area*: Although the submarine pipeline trench to be formed at the seabed as shown in **Figure 2.3** is long (approximately 2,100 metres in length), the affected area of fisheries resources is predicted to be very small and localised to the works involved in installation of the cross harbour main.
- *Size of fisheries resources/production*: The fisheries resources and production rates of the Study Area range from low to medium in terms of catch weight and value.
- *Destruction and disturbance of nursery and spawning grounds*: The marine waters within the Study Area were not identified as a primary nursery and spawning grounds for commercial fisheries. No destruction and disturbance of areas of fisheries importance is therefore expected due to the project works.
- *Impact on fishing activity*: The submarine pipeline pass through areas with low to medium fisheries production and activities. Impact to fishing activities in the area are not expected to be of concern due to the small area physically disrupted during the installation of the submarine pipeline and the short time frame of disturbance. Impact on future fishing operation is not anticipated as the armour rock will not protrude above the original seabed level.
- *Impact on aquaculture activity*: Based on the Water Quality Objectives and AFCD criteria, the closest AFCD gazetted Fish Culture Zone (FCZ) to the Study Area which is located at Ma Wan and is approximately 10km away from the proposed cross harbour main is not predicted to be impacted by either suspended solid elevation, dissolved oxygen depletion or nutrient elevation as a result of the Project.

9.7 Mitigation of Adverse Environmental Impacts

In accordance with the guidelines in the *EIAO-TM* on fisheries impact assessment the general policy for mitigating impacts to fisheries, in order of priority are avoidance, minimization and compensation.

Impacts to fisheries resources and fishing operations have largely been avoided during construction through constraints on the works operations for installation of the submarine watermain. Good construction practice and associated measures were recommended in Water Quality Assessment in *Section 3* to control water quality impacts to within acceptable levels and are also expected to control impacts to fisheries resources. Hence, no fisheries-specific mitigation measures are required during construction of the proposed submarine watermain.

9.8 Evaluation of Residual Fisheries Impacts

No adverse residual impact due to the construction and operation of the submarine watermain is expected after the implementation of the proposed mitigation measures to control water quality impacts.

9.9 Environmental Monitoring & Audit

The implementation of the water quality mitigation measures stated in the *Section 3* (Water Quality Impact Assessment) should be checked as part of the environmental monitoring and audit procedures during the construction phase as presented in the separate Environmental Monitoring and Audit Manual.

The dredging and “bottom pull” operations include constraints which act as appropriate mitigation measures to control environmental impacts to within acceptable levels. Actual water quality impacts from these activities will be monitored. Monitoring and audit activities designed to detect and mitigate any unacceptable impacts to water quality will serve to protect against unacceptable impacts to fisheries resources.

The water quality monitoring programme will provide management actions and supplemental mitigation measures to be employed should impacts arise, thereby ensuring the environmental acceptability of the project. No other fisheries-specific measures are considered necessary.

9.10 Conclusions and Recommendations

Review of existing information on fisheries resources and fishing operations located within the Study Area have been undertaken. Although the submarine pipeline trench to be formed at the seabed is relatively long, the affected area of fisheries resources is predicted to be temporary, small scale and localised to the works associated with formation of submarine pipeline trench at the seabed as a result of the “bottom-pull” and dredging operations. Although the submarine pipeline passes through areas with low to medium fisheries production and activities, impact to fishing activities in the area are not expected to be of concern due to the small area physically disrupted during the installation of the submarine pipeline and the short time frame of disturbance. Impact on future fishing operation is not anticipated as the armour rock will not protrude above the original seabed level. Ma Wan Fish Culture Zone which is the closest AFCD gazetted Fish Culture Zone to the Study Area is not predicted to be impacted by either suspended solids elevation, dissolved oxygen depletion or nutrient elevation as a result of the Project.

As potential impacts to fisheries resources and fishing operations arising from formation of the submarine pipeline trench at the seabed are predicted to be temporary, small scale and localised, they are not expected to cause adverse impacts to any fishing grounds or species of importance to the fishery. While no special mitigation measures are required for fisheries resources and fishing activities, mitigation measures recommended to control impacts to water quality to within acceptable levels are also expected to mitigate impacts to fisheries resources and fishing activities.

10 SUMMARY OF ENVIRONMENTAL OUTCOMES

10.1 Population and Environmental Sensitive Areas Protected

The EIA process has facilitated integration of environmental considerations into the design process for the Project. The principal measures identified are those achieved through careful routing of the watermain and the installation methodology or watermain design. Moreover, a number of mitigation measures have been identified to minimise the potential for adverse environmental impacts to occur. The mitigation measures are detailed in full in the Environmental Mitigation Implementation Schedule in Section 13. These measures will be implemented by WSD and, if appropriate, enforced by EPD by means of the EIAO.

One of the key environmental outcomes has been the ability to plan, design and ultimately construct the Project so that direct impacts to sensitive receivers are avoided, as far as practically possible. A detailed assessment of alternatives for routing the watermain was undertaken. A number of alternative watermain routes were studied and the preferred alignment avoids direct impacts to ecologically sensitive habitats and species such as corals fringing Green Island.

10.2 Environmental Friendly Designs Recommended and Problems Avoided

In preparing the design and installation method for the watermain, a key concern was to take steps so that indirect impacts to water quality sensitive receivers, through disturbance to the seabed, were avoided or minimised. Consequently, the following approaches were taken to achieve the above.

- Reduction in Indirect Impacts - The alignment chosen for the submarine watermain was located at a sufficient distance from ecological sensitive receivers so that the temporary dispersion of sediment from the installation works was not predicted to affect the receivers at levels of concern (as defined by the WQO and tolerance criteria).
- Installation Equipment - The use of grab dredging and “bottom-pull” along the entire route has minimised the severity of perturbations to water quality and hence allowed compliance with the WQOs at the sensitive receivers. This careful selection of installation equipment has helped avoid impacts to sensitive ecological receivers.
- Adoption of Acceptable Working Rates - The modelling work has demonstrated that the selected working rates for the dredging and “bottom-pull” works will not cause unacceptable impacts to water quality. Consequently, unacceptable indirect impacts to marine ecological resources have been avoided.

10.3 Environmental Benefits of the Project

The primary objective of this Project is to lay a new cross harbour main on the western part of the harbour for maintaining the reliability of cross harbour water transfer to Hong Kong Island as it was determined that 10 years’ time, two of the existing four cross harbour mains transferring portable supplies to Hong Kong Island will reach their design life of 50 years.

The new cross harbour main will reduce the risk of insufficient cross harbour transfer capacity in times of emergency in the next decade. With the proposed new cross harbour main, the risk of having one cross harbour main under maintenance while another watermain has to be taken out of service without warning. It will minimise the requirement of constructing new reservoirs and fresh water pumping stations in the highly congested urban areas with heavy traffic and congested underground utilities, and hence prevents associated environmental impacts arisen from those works.

11 ENVIRONMENTAL MONITORING AND AUDIT (EM&A) REQUIREMENTS

11.1 Water Quality

A marine water quality monitoring and audit programme is recommended during the dredging works to verify whether or not impact predictions are representative, and to ensure that the dredging works along the alignment of the proposed submarine watermain do not result in unacceptable impacts and the seawater quality at WSD's seawater intakes comply with the WSD's Water Quality Objectives (WQOs) of seawater for flushing supply. If monitoring shows unacceptable water quality impact, appropriate mitigation measures, such as changes in the operation of dredging works should be introduced.

Details of the environmental monitoring and audit programme are presented in the EM&A Manual. Water quality monitoring would be carried out at selected potentially affected sensitive receivers. The Manual includes site-specific monitoring and auditing protocols for baseline and impact monitoring of marine water quality. Such protocols include but are not limited to the locations of monitoring stations, parameters and frequencies for monitoring, monitoring equipment, and reporting of monitoring results.

As no adverse water quality impact was predicted from the operation of the Project, operational water quality monitoring and audit was not considered necessary.

11.2 Marine Ecology

The implementation of the ecological mitigation measures stated in *Section 4.8* and water quality mitigation measures in Section 3 should be checked as part of the environmental monitoring and audit procedures during the construction period as presented in the EM&A Manual. No other marine ecology-specific measures are considered necessary.

11.3 Noise

Full compliance with the noise criteria will be achieved at all NSRs with the implementation of mitigation measures. Environmental monitoring and audit is recommended to ensure that the noise levels do not exceed the criteria during the construction phase as discussed in the EM&A Manual.

11.4 Waste Management

It is recommended that auditing of each waste stream should be carried out periodically to determine if wastes are being managed in accordance with approved procedures and the site waste management plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and to audit weekly thereafter.

11.5 Air Quality

Full compliance with the air quality criteria will be achieved at all ASRs with the implementation of mitigation measures. Dust monitoring is considered not necessary but weekly site audits are required to ensure that the dust control measures are properly implemented.

11.6 Cultural Heritage

As discussed in Section 8, no indication of marine archaeological material was identified and no further investigation activities were recommended. As such, there would be no need for a cultural heritage monitoring programme during the construction phase of the submarine watermain.

11.7 Fisheries

The implementation of the water quality mitigation measures stated in the Section 3 (Water Quality Impact Assessment) should be checked as part of the environmental monitoring and audit procedures during the construction period as presented in the separate Environmental Monitoring and Audit Manual. No other fisheries-specific measures are considered necessary.

The dredging and “bottom pull” operations include constraints which act as appropriate mitigation measures to control environmental impacts to within acceptable levels. Actual water quality impacts from these activities will be monitored. Monitoring and audit activities designed to detect and mitigate any unacceptable impacts to water quality will serve to protect against unacceptable impacts to fisheries resources.

The water quality monitoring programme will provide management actions and supplemental mitigation measures to be employed should impacts arise, thereby ensuring the environmental acceptability of the project. No other fisheries-specific measures are considered necessary.

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 Water Quality

12.1.1 Construction Phase

Water quality impact during the dredging works of the submarine watermain was quantitatively assessed using the Delft3D Model. Suspended sediment was identified as the key water quality parameter during dredging. Water quality impact on the sensitive receivers during the entire duration of the dredging works and along the entire alignment with the maximum possible instantaneous working rate of $0.0463m^3s^{-1.}$ (i.e. one grab dredger with a maximum production rate of $4,000m^3$ per day, 7 days per week, 24 hours per day) for the complete simulation period for the dry and wet seasons was assessed and it was predicted that potential water quality impact would occur at the WSD Sea Water Intake at Kowloon South Salt Water Pumping Station. With the implementation of the proposed mitigation measures including the use of one grab dredger only with a maximum production rate of $4,000m^3$ per day for dredging, deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress and deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress (in a configuration as shown in **Figure 3.9**), the potential water quality impact upon the sea water intake would be effectively minimised and there would be no unacceptable residual cumulative water quality impact due to the dredging works of the submarine watermain as well as the other concurrent marine works. The assessment predicted that the dredging works would have negligible impact upon the coral communities near Green Island. An environmental monitoring and audit programme was recommended to ensure the effectiveness of the proposed water quality mitigation measures.

Minor potential water quality impacts from hydrostatic tests of the water mains systems and construction activities associated with the construction of the proposed submarine watermain were associated with effluent, sewage, wastewater and surface runoff. Impacts could be controlled to comply with the WPCO standards by implementing the recommended mitigation measure. No unacceptable residual impact on water quality was expected.

12.1.2 Operation Phase

No maintenance dredging is required for the future operation of the proposed submarine watermain. There would be no hydrodynamic impact as the operation of the submarine watermain would not involve reclamation or filling that affect the flow volume within the Victoria Harbour.

There would also be no water quality impact during the operation of the submarine watermain as no effluent would be discharged due to the operation of the submarine watermain.

12.2 Marine Ecology

A review of the existing information showed that the marine ecological resources within the dredging area consist of pollution tolerant soft benthos in low diversity and typical to benthos recorded in poor quality sediments. Inter-tidal species along Victoria shorelines are common fouling organisms recorded at artificial seawall. Both the species diversity and abundance recorded are lower than those recorded in semi-exposed shore in Hong Kong. The marine ecology in Green Island is of moderate ecological value, with soft coral assemblages and larger size inter-tidal species recorded. However, the results of water quality modelling showed that the elevation of SS concentration and sedimentation rate around the Green Island waters is predicted to be less than $0.1mgL^{-1}$ and 0.001 kg m^{-2} per day respectively, which are much lower than the tolerant levels for corals communities. In addition, due to the remoteness from the works area, the impacts to the marine environment in vicinity to Green Island are anticipated to be negligible. The Study Area is not the distribution range of marine mammals and as low ecological value species are encountered in the region, the implementation of good site practices and mitigation measures for water quality impact are considered to be sufficiently minimize the impacts on the marine ecology. Thus, no special mitigation measures are necessary for ecological sensitive receivers.

In conclusion, the construction of the proposed submarine watermain along Victoria Harbour between Sai Ying Pun and West Kowloon is anticipated to be of low ecological impacts.

12.3 Noise

Construction noise impact to the NSRs has been assessed. It is predicted that major construction activities including dredging, laying of pipe and backfilling works would comply with the noise criteria stipulated in the EIAO-TM and NCO during daytime and evening (1900 to 2300 hours).

If night-time works (2300 to 0700 hours) are carried out, the location of dredging works should be restricted while there should be no work within the prohibited zones. With this measure being taken place, the night-time criteria during the dredging period can be complied with.

Work schedule rearrangement, quiet plants and mobile noise barriers are recommended to further suppress noise emissions from construction activities. Good site practices will be necessary to further reduce any potential impact to the noise sensitive receivers.

12.4 Waste

A review of the sediment quality data from the marine site investigation indicated that the majority of the marine sediments to be dredged along the proposed submarine watermain were classified as Category L. The total dredged volume for the Project was estimated as 543,000 m^3, of which 212,000 m^3 of sediment was classified as requiring confined marine disposal. With the implementation of the recommended mitigation measures and management procedures in accordance with the requirements of ETWB TCW No. 34/2002, no residual impact was predicted.

Waste types generated by the construction activities are likely to include C&D material (from minor excavation works), general refuse from the workforce, and chemical waste from the maintenance of construction plant and equipment. Provided that these wastes are handled, transported and disposed of using approved methods and that the recommended good site practices are strictly followed, adverse environmental impacts is not expected during the construction phase.

12.5 Air Quality

Potential air quality impacts arising from the construction and operation of the submarine watermain have been evaluated.

As the number of construction plants involved in the submarine watermain laying activities at anytime on site would be limited, exceedance of AQOs emissions of gaseous pollutants from these construction plants is not anticipated. The number of plants required on site for the construction of the landing points would also be limited. Dust impact and SO_2 and NO_2 emissions from plants and site vehicles would be minimal. With the implementation of appropriate dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, together with proper maintenance of equipment, adverse air quality impact is not anticipated.

No air quality impact is anticipated at the operational phase since there will not have any operational phase emissions.

12.6 Cultural Heritage

A comprehensive baseline review identified no land based or submerged cultural heritage resources within the Study Area.

A Geophysical Survey which covered a 200m submarine watermain corridor was conducted and no indication of marine archaeological material was identified. Therefore, no impacts are expected from the installation of the cross harbour main.

12.7 Fisheries

Review of existing information on fisheries resources and fishing operations located within the Study Area have been undertaken. Although the submarine pipeline trench to be formed at the seabed is long, the affected area of fisheries resources is predicted to be temporary, small scale and localised to the works associated with formation of submarine pipeline trench at the seabed as a result of the “bottom-pull” and dredging operations. Although the submarine pipeline pass through areas with low to medium fisheries production and activities, impact to fishing activities in the area are not expected to be of concern due to the small area physically disrupted during the installation of the submarine pipeline and the short time frame of disturbance. Impact on future fishing operation is not anticipated as the armour rock will not protrude above the original seabed level. Ma Wan Fish Culture Zone which is the closest AFCD gazetted Fish Culture Zone to the Study Area is not predicted to be impacted by either suspended solids elevation, dissolved oxygen depletion or nutrient elevation as a result of the Project.

As potential impacts to fisheries resources and fishing operations arising from formation of the submarine pipeline trench at the seabed are predicted to be temporary, small scale and localised, they are not expected to cause adverse impacts to any fishing grounds or species of importance to the fishery. While no special mitigation measures are required for fisheries resources and fishing activities, mitigation measures recommended to control impacts to water quality to within acceptable levels are also expected to mitigate impacts to fisheries resources and fishing activities.

13 IMPLEMENTATION SCHEDULE

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
Water Quality						
3.8.1	2.9	**Specific Mitigation Measures for Dredging** Exceedances of WSD Seawater Intake criterion (10 mg L^{-1}) at Kowloon South Salt Water Pumping Station was predicted during both dry and wet seasons if dredging was undertaken near West Kowloon. To minimise the potential SS impact, implementation of the following mitigation measures is recommended: - Dredging should be undertaken using one grab dredger only with a maximum production rate of 4,000m^3 per day; - Deployment of frame type silt curtain to fully enclose the grab while dredging work are in progress. - Deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress. The frame type silt curtain should be designed to enclose local pollution caused by the grab dredger and suspended by a steel frame mounted on the grab dredger and floating on water. This frame type silt curtain should be fabricated from permeable, durable, abrasion resistant membrane like geotextiles and be mounted on a floating boom structure. The frame type silt curtain should also extend to the seabed to cover the entire water column. Steel chain or ballast should be attached to the bottom of the silt curtain. Mid-ballast may be added as necessary. The structure of the silt curtain should be maintained by metal grids. The frame type silt curtain should be capable or reducing sediment loss to outside by a factor of 4 (or about 75%). Silt screen is recommended for dredging near the seawater intake at Kowloon South Salt Water Pumping Station. The implementation of silt screen at the intake could reduce the SS level by a factor of 2.5 (or about 60%). These SS reduction factors have been adopted in the Wan Chai Development Phase II Environmental Impact Assessment Study in 2001. An illustration of a typical configuration of frame type silt curtain and silt screen at seawater intake is shown in Figure 3.9.	WSD's Contractor	Construction Work Sites (Along the alignment of dredging)	During Marine Construction works	Practice Note for Professional Persons with regard to site drainage (ProPECC PN 1/94) and WQO
3.8.1	2.9	**Other Mitigation Measures for Dredging** Good Site Practices are recommended to further reduce the potential water quality impacts from the construction works, especially during dredging.				

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		• Tight-closing grabs should be used to minimize the loss of sediment to suspension during dredging works. For dredging of any contaminated mud, closed watertight grabs must be used;				
		• all vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;				
		• the decks of all vessels should be kept tidy and free of oil or other substances that might be accidentally or otherwise washed overboard;				
		• adequate free board shall be maintained on barges to ensure that decks are not washed by wave action;				
		• all barges used for the transport of dredged materials should be fitted with tight bottom seals to prevent leakage of material during loading and transport;				
		• construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the site or dumping grounds;				
		• loading of barges should be controlled to prevent splashing of material into the surrounding waters. Barges should not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation; • the speed of vessels should be controlled within the works area to prevent propeller wash from stirring up the seabed sediments; and				
		• before commencement of dredging works, the holder of the Environmental Permit should submit detailed proposal of the design and arrangement of the frame type silt curtain to EPD for approval.				
3.8.1	2.9	**Effluent from Hydrostatic Tests of the Water Mains System** To ensure compliance with the standards for effluent discharged into the inshore waters or marine waters of Victoria Harbour WCZ as shown in Tables 9a and 9b of the TM-DSS and Section 23.73 and 23.77 of the General Specification for Civil Engineering Works Volume 3, 1992 Edition, sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m3 capacities, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity should be flexible and suited to applications where the influent is pumped. Pre-treatment including dechlorination such as by physical process e.g. adsorption by activated carbon filter, or chemical process e.g. neutralisation by dechlorination agent dosing should be carried out to ensure compliance with the discharge requirements stipulated in TM-DSS.	WSD's Contractor	Construction Work Sites (General)	During Hydrostatic Tests	Practice Note for Professional Persons with regard to site drainage (ProPECC PN 1/94) and WQO

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
3.8.1	2.9	**Surface Runoff, Sewage and Wastewater from Construction Activities** Appropriate measures should be implemented to control runoff and prevent high loads of SS from entering the marine environment. Proper site management is essential to minimise surface runoff and sewage effluents. • Construction site runoff should be prevented or minimised in accordance with the guidelines stipulated in the EPD's Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94). All discharges from the construction site should be controlled to comply with the standards for effluents discharged into the Victoria Harbour WCZ under the TM-DSS. Good housekeeping and stormwater best management practices, as detailed below, should be implemented to ensure all construction runoff complies with WPCO standards and no unacceptable impact on the WSRs as a result of construction of the proposed submarine watermain;	WSD’s Contractor	Construction Work Sites (General)	During Construction works	Practice Note for Professional Persons with regard to site drainage (ProPECC PN 1/94) and WQO
		• Sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacities, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity should be flexible and able to handle multiple inputs from a variety of sources and suited to applications where the influent is pumped;				
		• Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the storm runoff being directed into foul sewers;				
		• All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and located wheel washing bay should be provided at every site exit, and wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfill toward the wheel-wash bay to prevent vehicle tracking of soil and silty water to public roads and drains;				
		• Precautions should be taken at any time of year when rainstorms are likely. Actions should be taken when a rainstorm is imminent or forecast. Actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events, particularly for areas located near steep slopes;				

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		• Fuel tanks and storage areas should be provided with locks and be located on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank, to prevent spilled fuel oils from reaching the coastal waters of the Victoria Harbour and Western Harbour WCZs; • Portable chemical toilets should be used to handle construction workforce sewage prior to discharge to the existing trunk sewer. Sufficient numbers of portable toilets shall be provided by a licensed contractor to serve the construction workers. The Contractor shall also be responsible for waste disposal and maintenance practices.				
Ecology						
4.8	3	Other mitigation measures suggested in the water quality impacts assessment such as the use of one grab dredger only with a maximum production rate of 4,000m^3 per day for dredging, deployment of frame type silt curtain to fully enclose the grab while dredging works are in progress, deployment of silt screen at the sea water intake at Kowloon South Salt Water Pumping Station while dredging works are in progress and good site practices to avoid silt runoff from construction works associated with the construction of the submarine watermain should be implemented to further reduce the impact on the marine ecology.	WSD's Contractor	Construction Work Sites (Along the alignment of dredging)	During Marine Construction works	EIAO
Noise						
5.6.1	4.8	**Work Schedule Rearrangement** Concurrent works should be such that necessary noisy works should be carried out at different time slots or spread around the construction sites. This will help to reduce the cumulative noise effect produced in the construction process. If night-time (2300 to 0700 hours) dredging is required, the work shall be scheduled to carry out at a distance as far as possible to the NSRs. It is determined that the dredging work should be carried out at a location 750m away from the Sai Ying Pun landfall site and 450m from the West Kowloon landfall site along the trench as shown in the Figure 5.5 of the EIA Report. The Contractor shall adhere to the restricted locations of dredging work at night-time to comply with relevant noise standard.	WSD's Contractor	Construction Work Sites (Along the alignment of dredging)	During Marine Construction works	PN 2/93 Noise from Construction Activities & EIAO

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
5.6.2	4.8	**Using Quality PME** The use of Quality PME recognized by the Noise Control Authority for the purpose of CNP application can effectively reduce the noise generated from the construction plants. Quality PME are construction plants and equipments that are notably quieter, more environmental friendly and efficiently. The noise level reduction ranges from 5 – 10 dB(A) depending on the type of equipment used. The Contractor shall note the required procedures involved in application of the QPME.				
5.6.3	4.8	**Using Noise Barriers** Mobile or movable noise barriers to be erected near to the construction plants would reduce the noise levels for commonly 5 – 10 dB(A) depending on the types of items of PME and materials of the barriers. It is recommended that the Contractor shall screen noisy works and noise from stationary items of PME whenever practicable.				
5.6.4	4.8	**Good Site Practices** Good site practice and noise management can significantly reduce the impact of construction site activities on nearby NSRs. The following package of measures should be followed during construction:				
		• only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;				
		• machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;				
		• plant known to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from the NSRs;				
		• mobile plant should be sited as far away from NSRs as possible; and				
		• material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.				
Waste Management						
6.6.1	5.3	**Good Site Practices** Adverse impacts related to waste management are not expected to arise, provided that good site practices are strictly followed. Recommendations for good site practices during the construction activities include:	WSD's Contractor	Construction Work Sites (General)	During Construction works	Waste Disposal Ordinance (Cap.354); Waste Disposal (Chemical Wastes) (General) Regulation

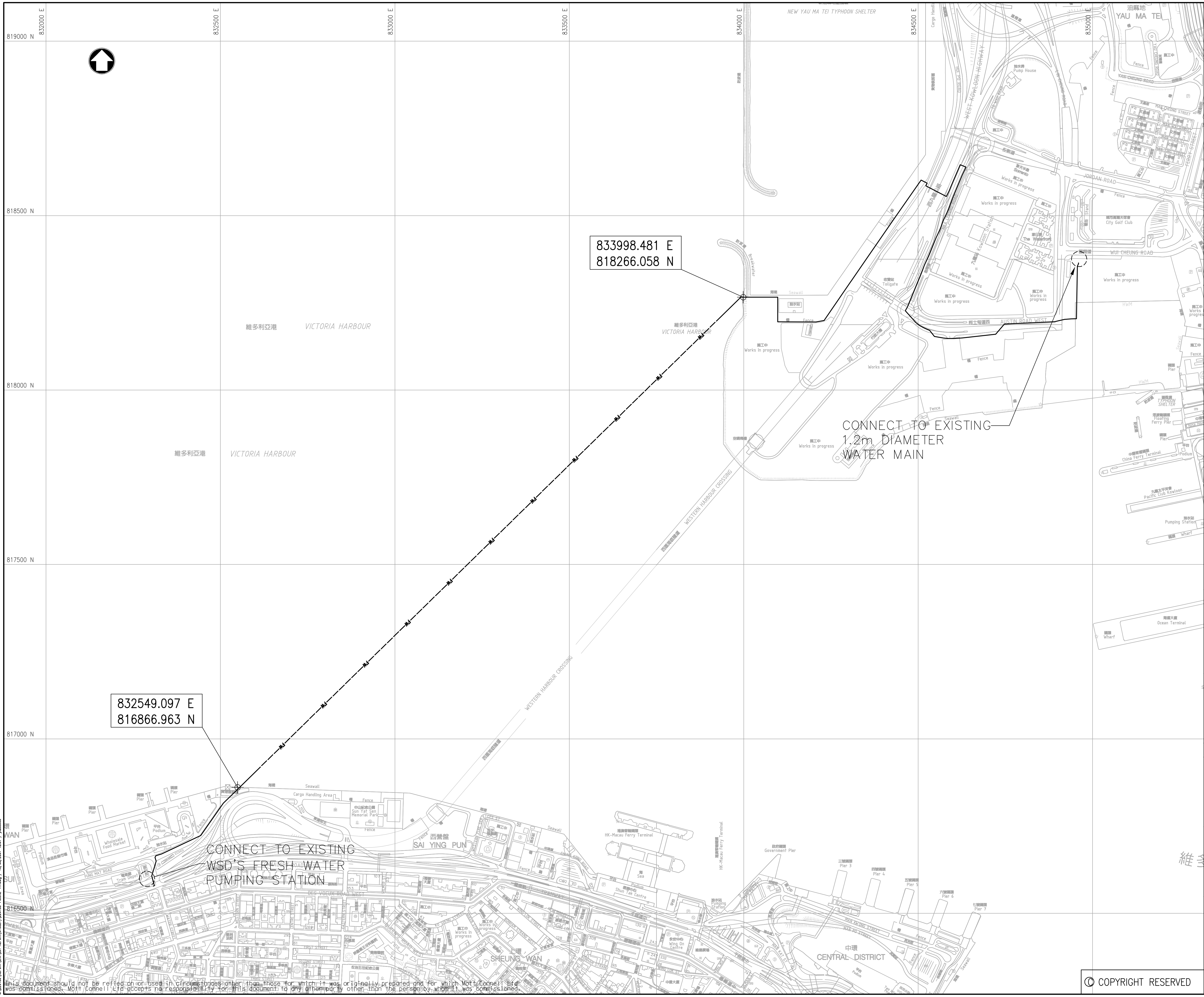
EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		• Nomination of an approved person, such as a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site; • Training of site personnel in proper waste management and chemical handling procedures; • Provision of sufficient waste disposal points and regular collection of waste; • Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers.				(Cap 354) and ETWBTC No. 15/2003, Waste Management on Construction Site
6.6.2	5.3	**Waste Reduction Measures** Good management and control can prevent the generation of a significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include: • Sort C&D material from demolition and decommissioning of the existing facilities to recover recyclable portions such as metals; • Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal; o Encourage collection of aluminium cans by providing separate labelled bins to enable this waste to be segregated from other general refuse generated by the work force; o Proper storage and site practices to minimise the potential for damage or contamination of construction materials; and o Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste.	WSD's Contractor	Construction Work Sites (General)	During Construction works	
6.6.3	5.3	**C&D Material** In order to minimise impacts resulting from collection and transportation of C&D material for off-site disposal, the excavated materials should be reused on-site as backfilling material and for landscaping works as far as practicable. In addition, C&D material generated from excavation works should be disposed of at public fill reception facilities for other beneficial uses. Other mitigation requirements are listed below: • A Waste Management Plan should be prepared; • A recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed; and	WSD's Contractor	Construction Work Sites (General)	During Construction works	ETWB TCW No. 31/2004

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		• In order to monitor the disposal of C&D material and solid wastes at public filling facilities and landfills, and to control fly-tipping, a trip-ticket system (e.g. ETWB TCW No. 31/2004) should be included.				
6.6.4	5.3	**General Refuse** General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D material. Preferably an enclosed and covered area should be provided to reduce the occurrence of 'wind blown' light material.	WSD's Contractor	Construction Work Sites (General)	During Construction works	
6.6.5	5.3	**Chemical Waste** Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately. Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as explosive, flammable, oxidizing, irritant, toxic, harmful, corrosive, etc. The Contractor shall use a licensed collector to transport and dispose of the chemical wastes, to either the approved Chemical Waste Treatment Centre, or another licensed facility.	WSD's Contractor	Construction Work Sites (General)	During Construction works	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes, Waste Disposal (Chemical Waste) (General) Regulation
6.6.6	5.3	**Marine Dredged Sediment** During transportation and disposal of the dredged marine sediments, the following measures should be taken to minimise potential impacts on water quality: • Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material. Excess material shall be cleaned from the decks and exposed fittings of barges and dredgers before the vessel is moved; • Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self-monitoring devices as specified by the EPD; and • Barges or hopper barges shall not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation.	WSD's Contractor	Construction Work Sites (Along the alignment of dredging)	During Marine Construction works	ETWB TCW No. 34/2002
Air Quality						

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
7.5.1	6.30	**Dust Control** Construction dust impacts should be controlled within the 1-hour TSP criterion of 500 g/m^3 and 24-hour TSP AQO of 260 g/m^3. Therefore, effective control measures and good site practices should be implemented :	WSD's Contractor	Construction Work Sites (General	During Construction works	EIAO-TM and Air Pollution Control (Construction Dust) Regulation
		• Any excavated dusty materials or stockpile of dusty materials should be covered entirely by impervious sheeting or sprayed with water so as to maintain the entire surface wet, and recovered or backfilled or reinstated within 24 hours of the excavation or unloading;				
		• The working area of excavation should be sprayed with water immediately before, during and immediately after the operations so as to maintain the entire surface wet;				
		• The load of dusty materials carried by vehicle leaving a construction site should be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle;				
		• Where a site boundary adjoins a road, streets or other area accessible to the public, hoarding of not less than 2.4m high from ground level should be provided along the entire length except for a site entrance or exit;				
		• The area where vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;				
		• Every main haul road should be scaled with concrete and kept clear of dusty materials or sprayed with water so as to maintain the entire road surface wet;				
		• The portion of road leading only to a construction site that is within 30m of a designated vehicle entrance or exit should be kept clear of dusty materials;				
		• All dusty materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty material wet;				
		• Vehicle speed should be limited to 10 kph except on completed access roads; and				
		• Every vehicle should be washed to remove any dusty materials from its body and wheels before leaving the construction sites.				
Cultural Heritage						
8.7	7	No cultural heritage resources are identified within the Study Area and therefore, no mitigation measures are considered necessary.				
Fisheries						

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
9.7	8	Impacts to fisheries resources and fishing operations have largely been avoided during construction through constraints on the works operations for installation of the submarine watermain. Good construction practice and associated measures recommended for Water Quality to control water quality impacts to within acceptable levels and are also expected to control impacts to fisheries resources.	WSD's Contractor	Construction Work Sites (General)	During Marine Construction works	EIAO-TM

FIGURES



LEGEND:

—FW— PROPOSED DN1200 SUBMARINE WATER MAIN

—— PROPOSED DN1200 LAND WATER MAIN (NOTE: THE ALIGNMENT IS SHOWN FOR REFERENCE ONLY AND IT IS NOT PART OF THE DESIGNATED PROJECT COVERED UNDER THIS EIA STUDY)

Rev	Date	Drawn	Description	Ch'k'd	App'd
P3	05/06	LYK	PRELIMINARY	CMH	RH
P2	04/06	LYK	PRELIMINARY	CMH	RH
P1	04/06	LYK	PRELIMINARY	CMH	RH

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

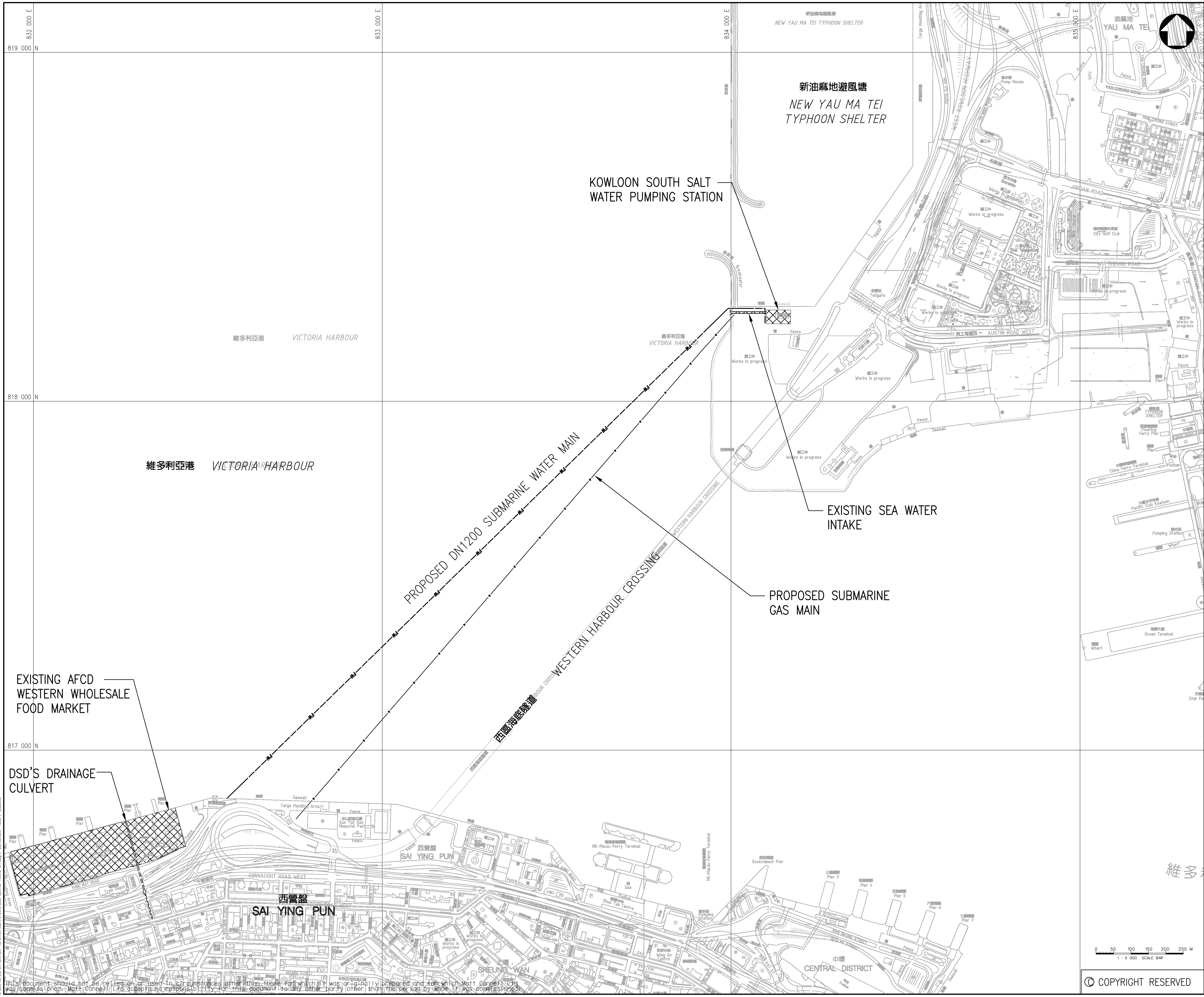
Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

INDICATIVE ROUTE OF THE PROPOSED WATERMAINS

Designed	RH	Eng.Chk.	CMH
Drawn	LYK	Coordination	----
Dwg.Chk.	----	Approved	
Scale	1 : 5000@A1	Project	226133
		CAD File	J:\226133\REPORT\ENV\EIA-REPORT(070327)\226133-FIGURE-1.1.dwg
Drawing No.	FIGURE 1.1	Rev	P3



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LEGEND:

- PROPOSED DN1200 SUBMARINE WATER MAIN
- PROPOSED DN1200 LAND WATER MAIN

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	08/06	LYK		CMH	RH

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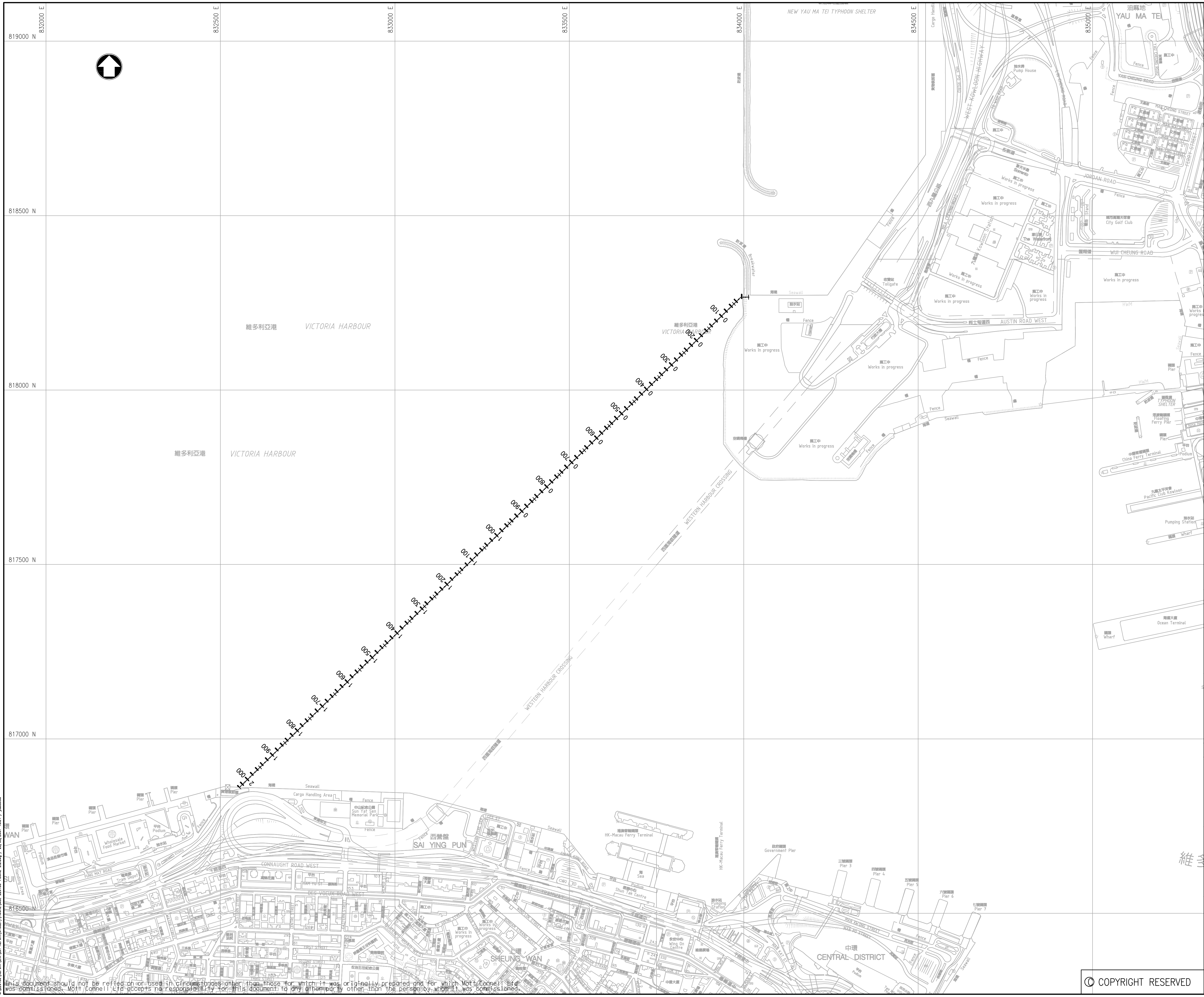
Contract No. CE42/2005(WS)

Project: LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title: PHYSICAL CONSTRAINTS TO THE PROPOSED SUBMARINE WATERMAINS

Designed	RH	Eng.Chk.	CMH
Drawn	LYK	Coordination	—
Dwg.Chk.	—	Approved	
Scale	1 : 5000@A1	Project	226133
Drawing No.	FIGURE 2.1	Rev	P1



J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\WCL-226133-FIGURE-2.2.dwg / 28/03/2007 10:54 / yk38608

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P1	10/06	LYK	PRELIMINARY	CMH	RH

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

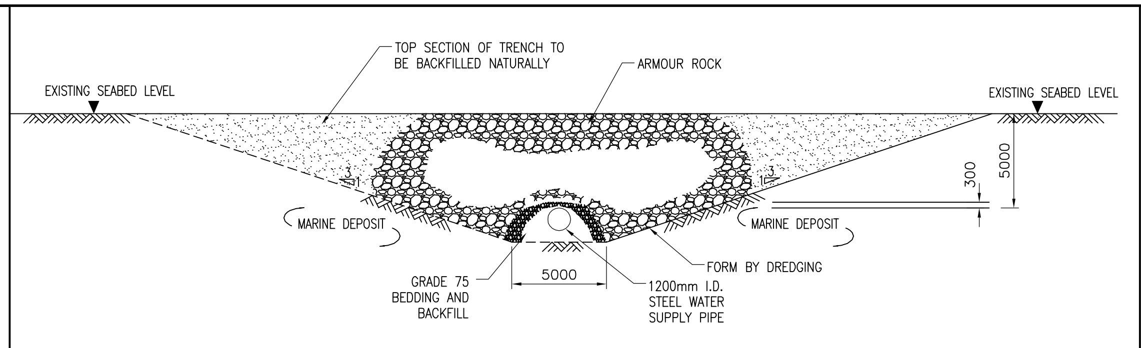
Contract No. CE42/2005(WS)

Project
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title
SELECTED ROUTE OF PROPOSED SUBMARINE WATERMAIN

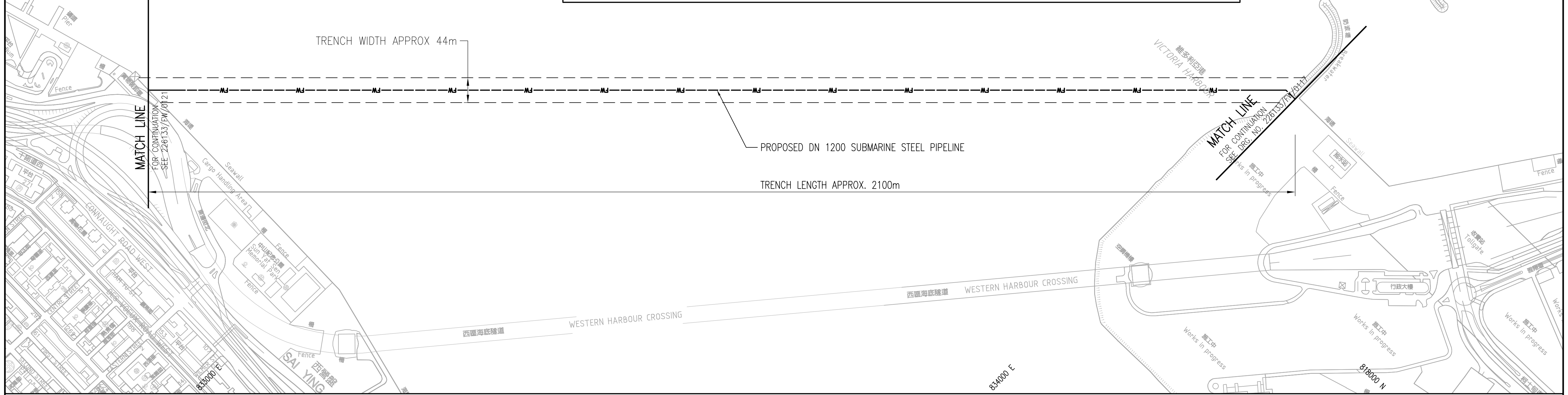
Designed	RH	Eng.Chk.	CMH
Drawn	LYK	Coordination	----
Dwg.Chk.	----	Approved	

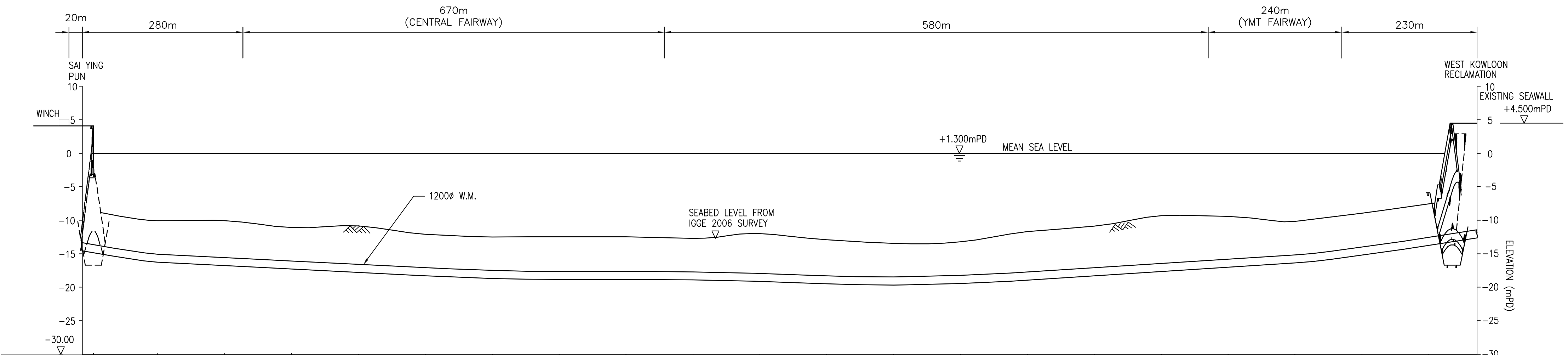
Scale 1 : 5000@A1
Project 226133
Status
CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\WCL-226133-FIGURE-2.2.dwg
Drawing No. FIGURE 2.2
Rev P3



TYPICAL SECTION OF SUBMARINE PIPELINE

N.T.S.





PIPE CHAINAGE (m)	GROUND LEVEL (mPD)	PIPE INVERT LEVEL (mPD)
CH-S 1996	4.09	-14.86
CH-S 1900	-10.07	-16.27
CH-S 1800	-10.06	-16.78
CH-S 1700	-11.08	-17.28
CH-S 1600	-10.85	-17.78
CH-S 1500	-12.08	-18.29
CH-S 1400	-12.48	-18.69
CH-S 1300	-112.47	-18.83
CH-S 1200	-12.47	-18.82
CH-S 1100	-12.71	-18.91
CH-S 1000	-12.00	-19.13
CH-S 0900	-12.91	-19.50
CH-S 0800	-13.47	-19.67
CH-S 0700	-13.23	-19.43
CH-S 0600	-11.70	-18.94
CH-S 0500	-10.89	-18.32
CH-S 0400	-9.33	-17.69
CH-S 0300	-9.42	-17.04
CH-S 0200	-10.18	-16.38
CH-S 0100	-8.94	-15.22
CH-S 0000	-7.55	-13.77

PIPE FITTINGS:

GRADIENT OF PIPE:

TYPE AND SIZE OF PIPES: DN1200 SUBMARINE STEEL PIPE WITH CONCRETE WEIPHT COAT

REMARK:

LEGEND:

---FW--- PROPOSED SUBMARINE WATER MAIN

— — — — EXTENT OF TRENCH DREDGING WORK

Rev	Date	Drawn	Description	Ch'k'd	App'd

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Contract No. CE42/2005(WS)

Project: LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title: PLAN VIEW PROFILE AND CROSS SECTION OF PROPOSED SUBMARINE WATERMAIN

Designed	JY	Eng.Chk.	MT
Drawn	LYK	Coordination	SHC
Dwg.Chk.	MT	Approved	SHC

Scale: 1 : 4000@A1
Project: 226133
Status: PRE
CAD File: J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\226133-figure-2.3.dwg
Drawing No.: FIGURE 2.3
Rev:

J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\226133-figure-2.3.dwg / 28/03/2007 10:27 / pls3908

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	06/06	LYK	PRELIMINARY		

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

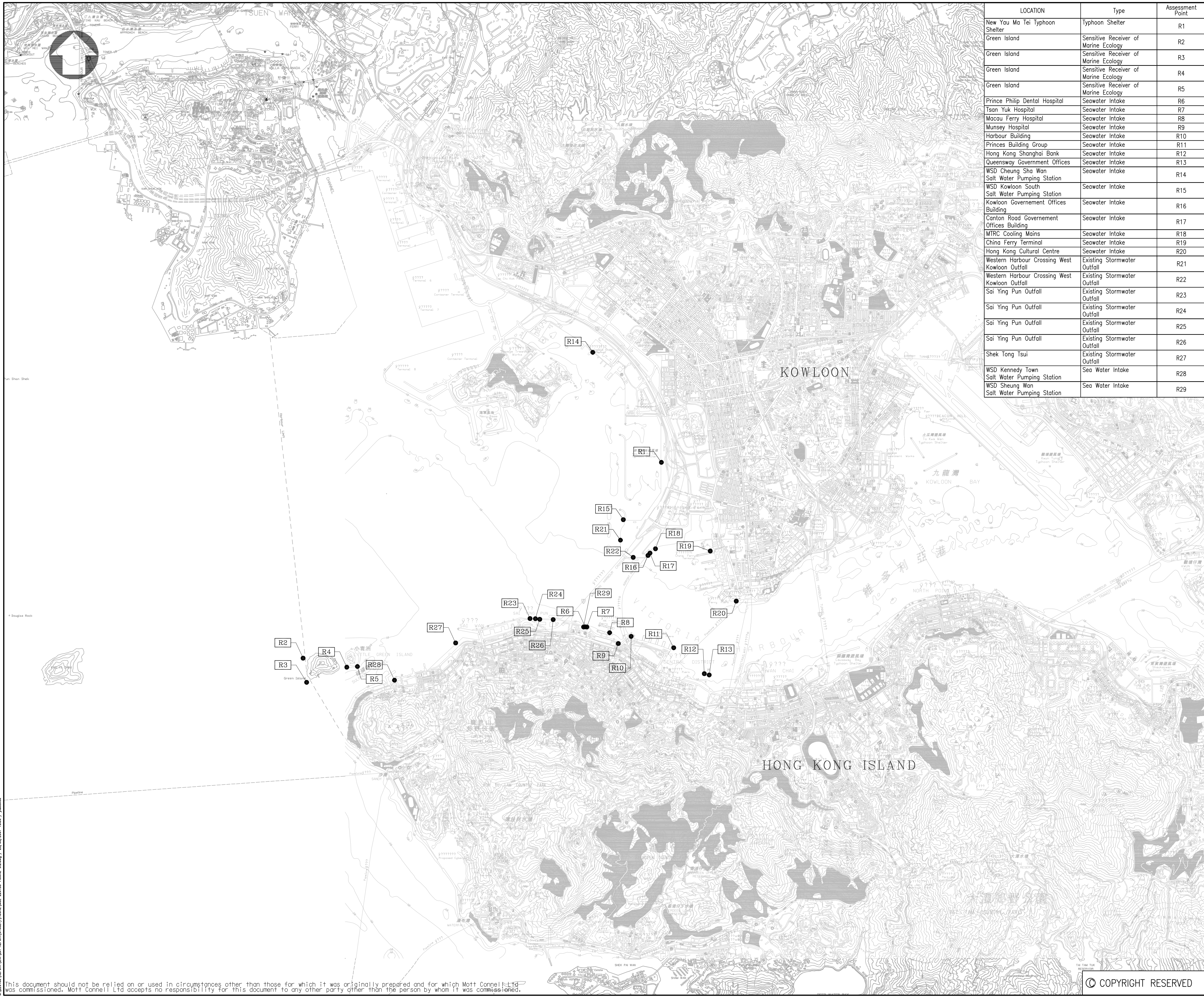
Project
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title
LOCATION OF EPD'S MARINE WATER QUALITY MONITORING STATIONS IN VICTORIA HARBOUR AND WESTERN BUFFER WATER CONTROL ZONES

Designed		Eng.Chk.	
Drawn	LYK	Coordination	–
Dwg.Chk.	—	Approved	

Scale	Project	Status
1 : 40000@A1	226133	
	CAD File	

Drawing No.	Rev
FIGURE 3.1	A



LOCATION	Type	Assessment Point
New Yau Ma Tei Typhoon Shelter	Typhoon Shelter	R1
Green Island	Sensitive Receiver of Marine Ecology	R2
Green Island	Sensitive Receiver of Marine Ecology	R3
Green Island	Sensitive Receiver of Marine Ecology	R4
Green Island	Sensitive Receiver of Marine Ecology	R5
Prince Philip Dental Hospital	Seawater Intake	R6
Tsan Yuk Hospital	Seawater Intake	R7
Macau Ferry Hospital	Seawater Intake	R8
Munsey Hospital	Seawater Intake	R9
Harbour Building	Seawater Intake	R10
Princes Building Group	Seawater Intake	R11
Hong Kong Shanghai Bank	Seawater Intake	R12
Queensway Government Offices	Seawater Intake	R13
WSD Cheung Sha Wan Salt Water Pumping Station	Seawater Intake	R14
WSD Kowloon South Salt Water Pumping Station	Seawater Intake	R15
Kowloon Governement Offices Building	Seawater Intake	R16
Canton Road Governement Offices Building	Seawater Intake	R17
MTRC Cooling Mains	Seawater Intake	R18
China Ferry Terminal	Seawater Intake	R19
Hong Kong Cultural Centre	Seawater Intake	R20
Western Harbour Crossing West Kowloon Outfall	Existing Stormwater Outfall	R21
Western Harbour Crossing West Kowloon Outfall	Existing Stormwater Outfall	R22
Sai Ying Pun Outfall	Existing Stormwater Outfall	R23
Sai Ying Pun Outfall	Existing Stormwater Outfall	R24
Sai Ying Pun Outfall	Existing Stormwater Outfall	R25
Sai Ying Pun Outfall	Existing Stormwater Outfall	R26
Shek Tong Tsui	Existing Stormwater Outfall	R27
WSD Kennedy Town Salt Water Pumping Station	Sea Water Intake	R28
WSD Sheung Wan Salt Water Pumping Station	Sea Water Intake	R29

Rev	Date	Drawn	Description	Ch'k'd	App'd
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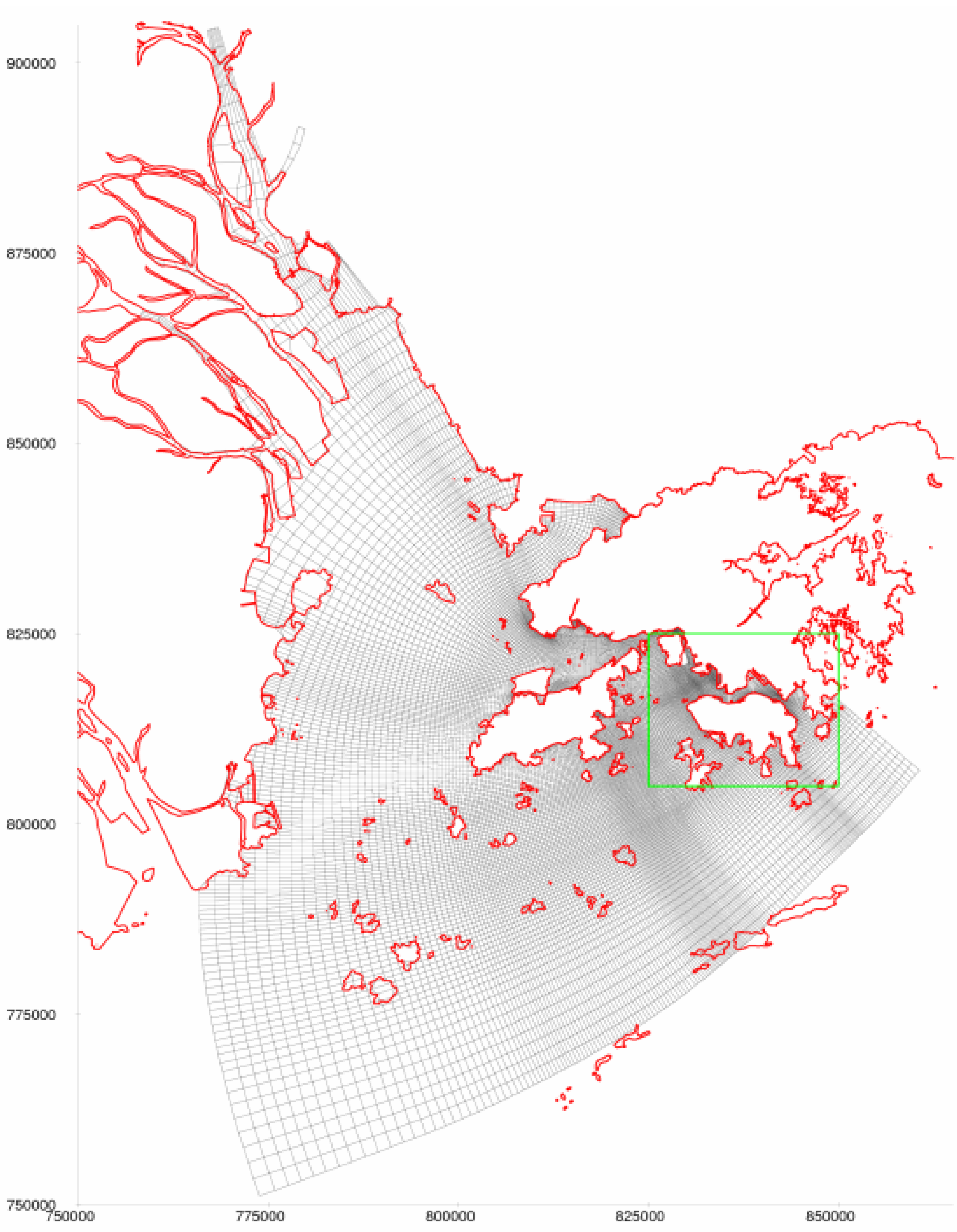
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

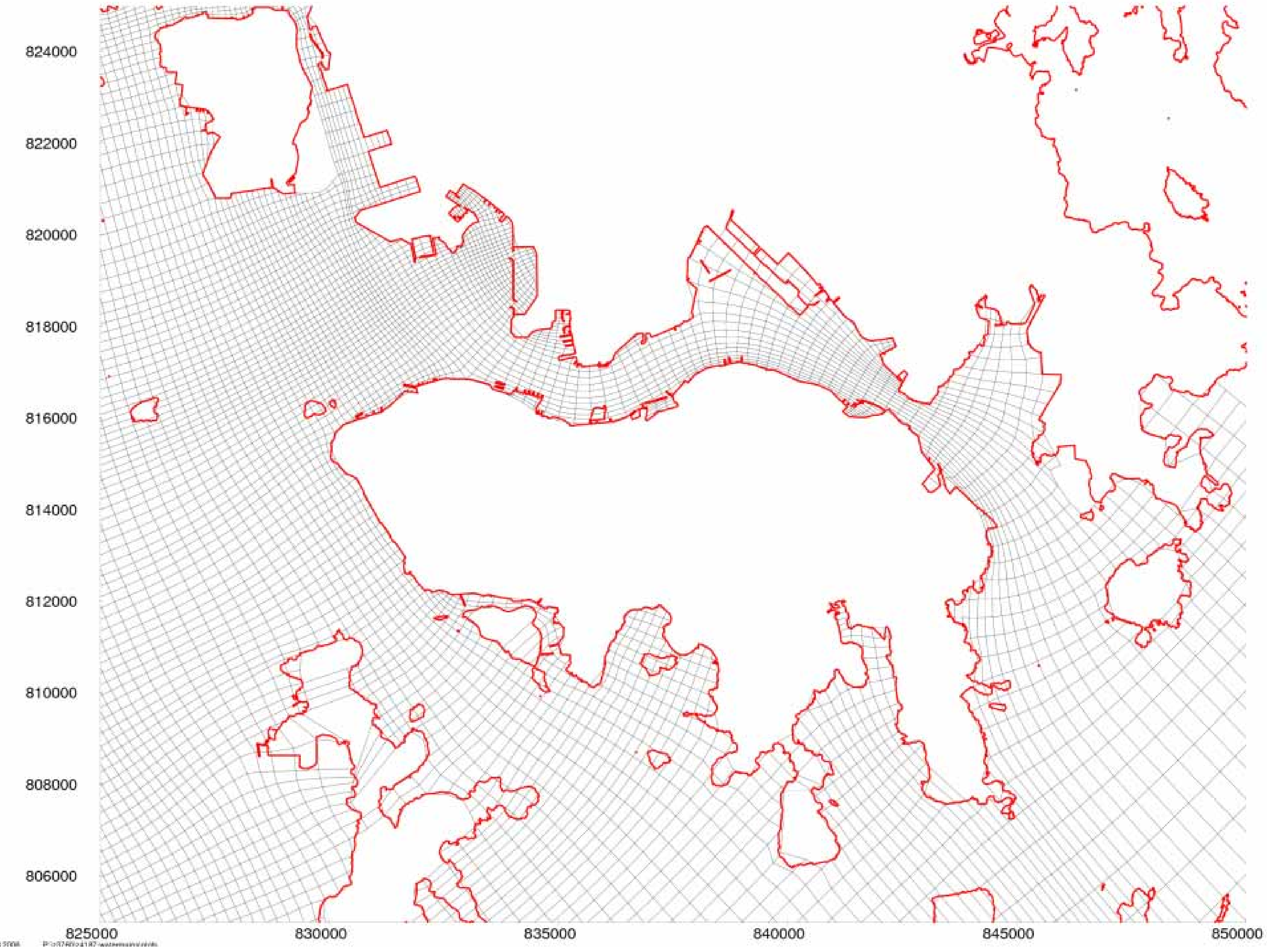
Project
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title
LOCATIONS OF WATER SENSITIVE RECEIVERS AND STORMWATER OUTFALLS AT WESTERN HARBOUR

Designed		Eng.Chk.	
Drawn	LYK	Coordination	–
Dwg.Chk.	–––	Approved	
Scale 1 : 25000@A1	Project 226133		Status
	CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\WCL-226133-FIGURE-3.2.dwg		
Drawing No.	FIGURE 3.2		Rev A



Water Supplies Department	Mott Connell	Laying of Western Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation	Title: Extent of the Western Harbour Model Grid Figure 3.3



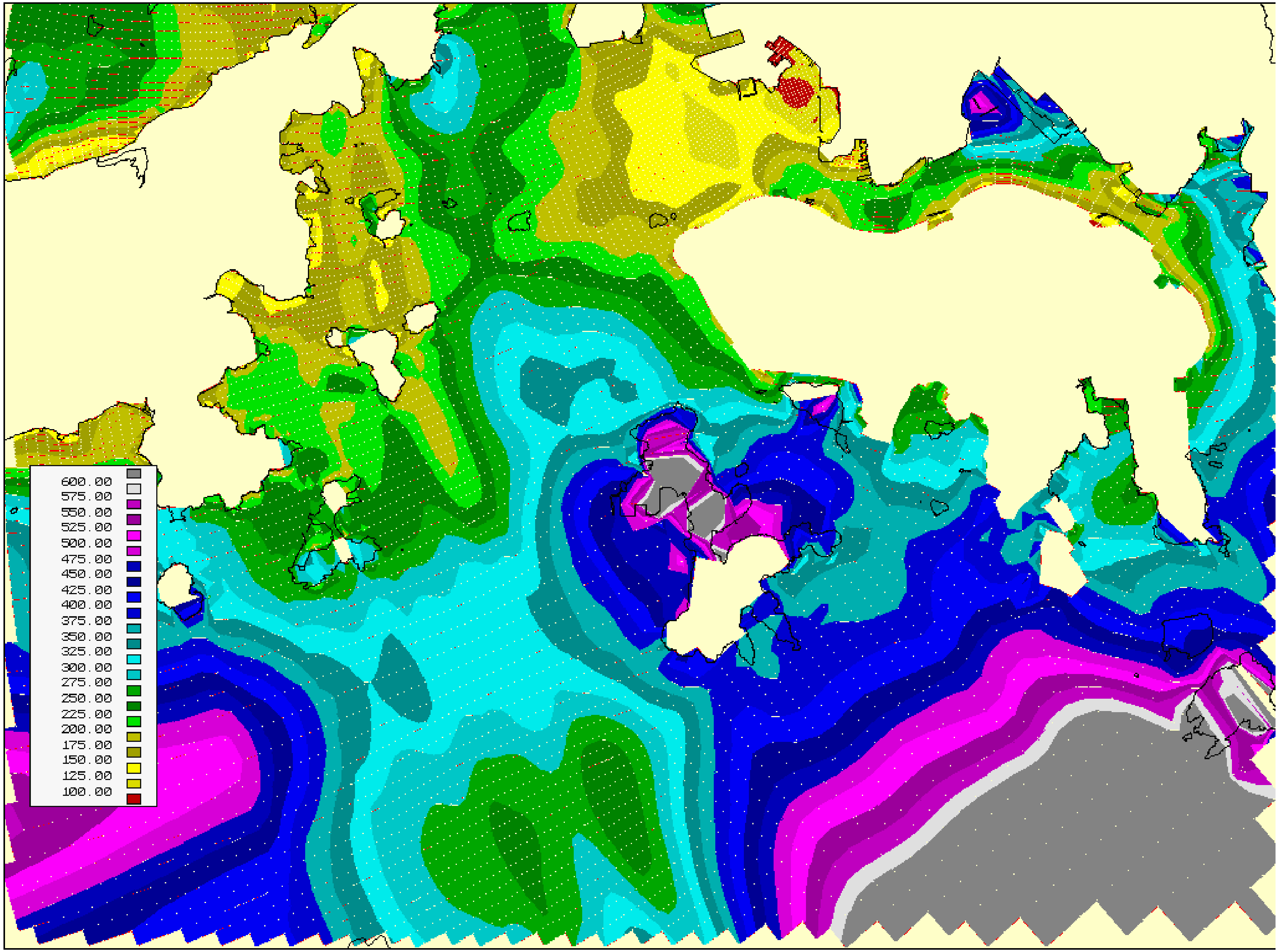
Water Supplies Department

Mott Connell

Laying of Western Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation

Title: Details of the Western Harbour Model Grid in the Project Area

Figure 3.4



Water Supplies Department

Mott Connell 萬徳

Laying of Western Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation

Title: Resolution of the Western Harbour Model Grid

Figure 3.5

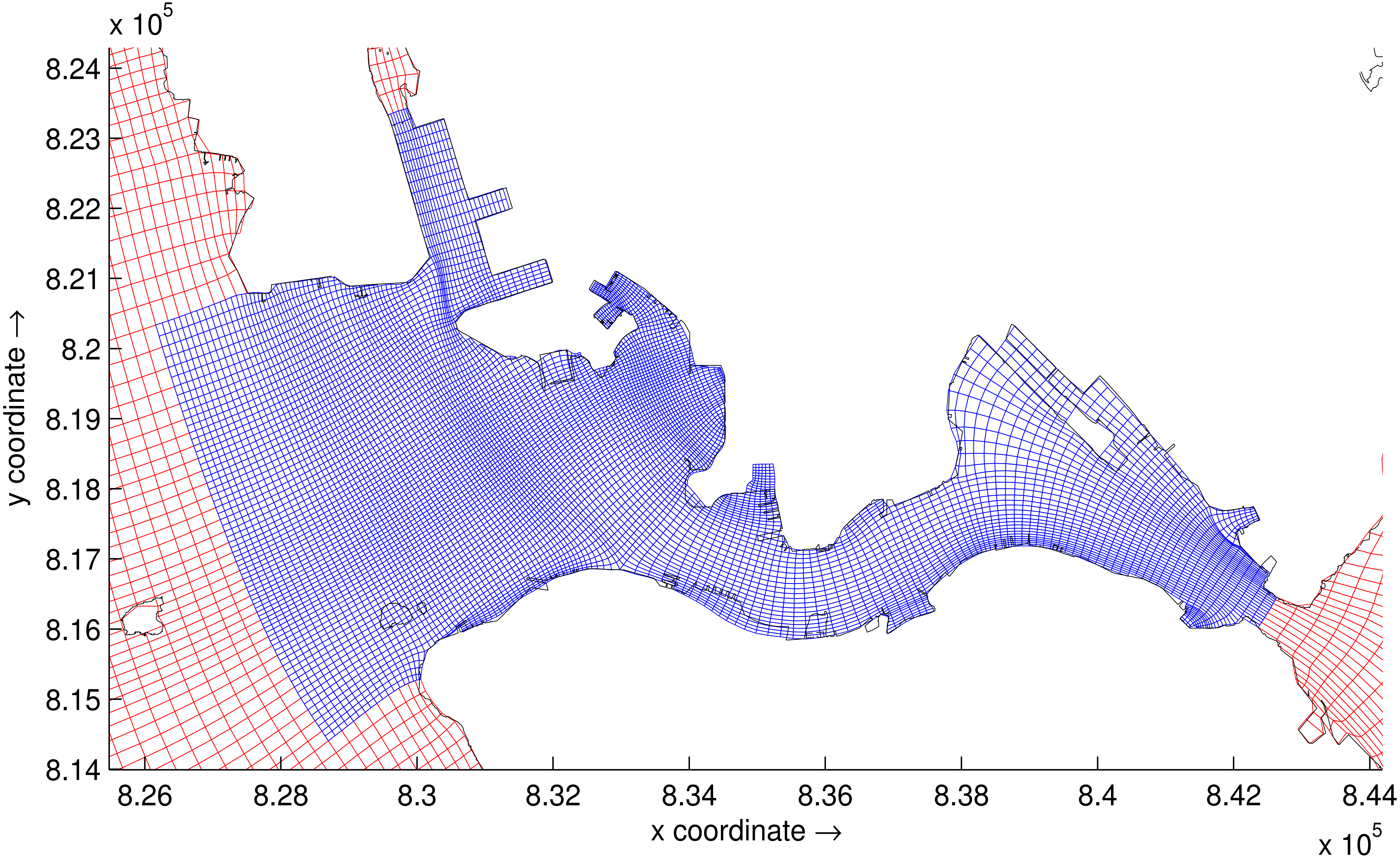


Figure 3.6 Grid Refinement of the Western Harbour Model Grid

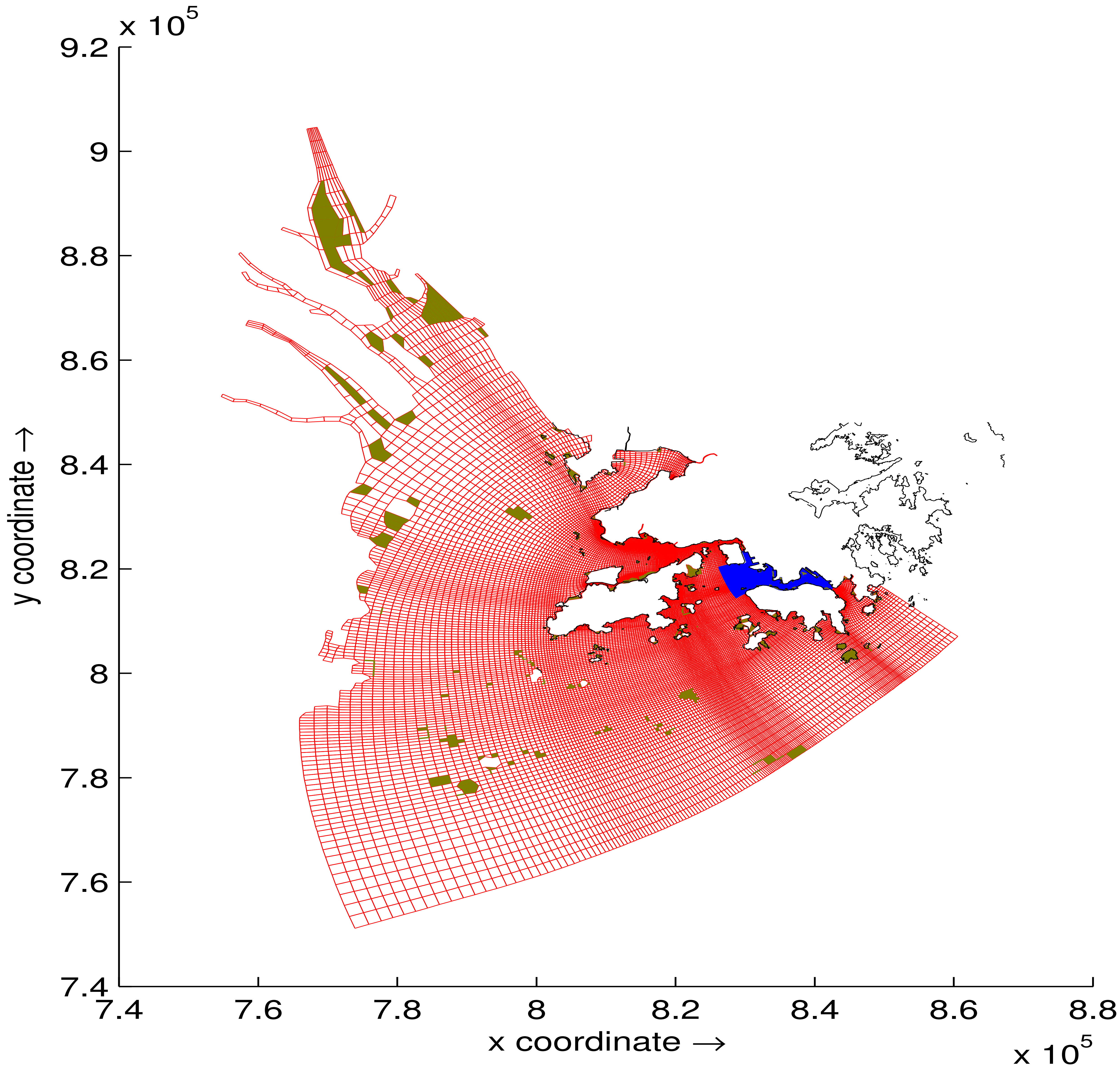


Figure 3.7a Coastline Configuration in the Project Area

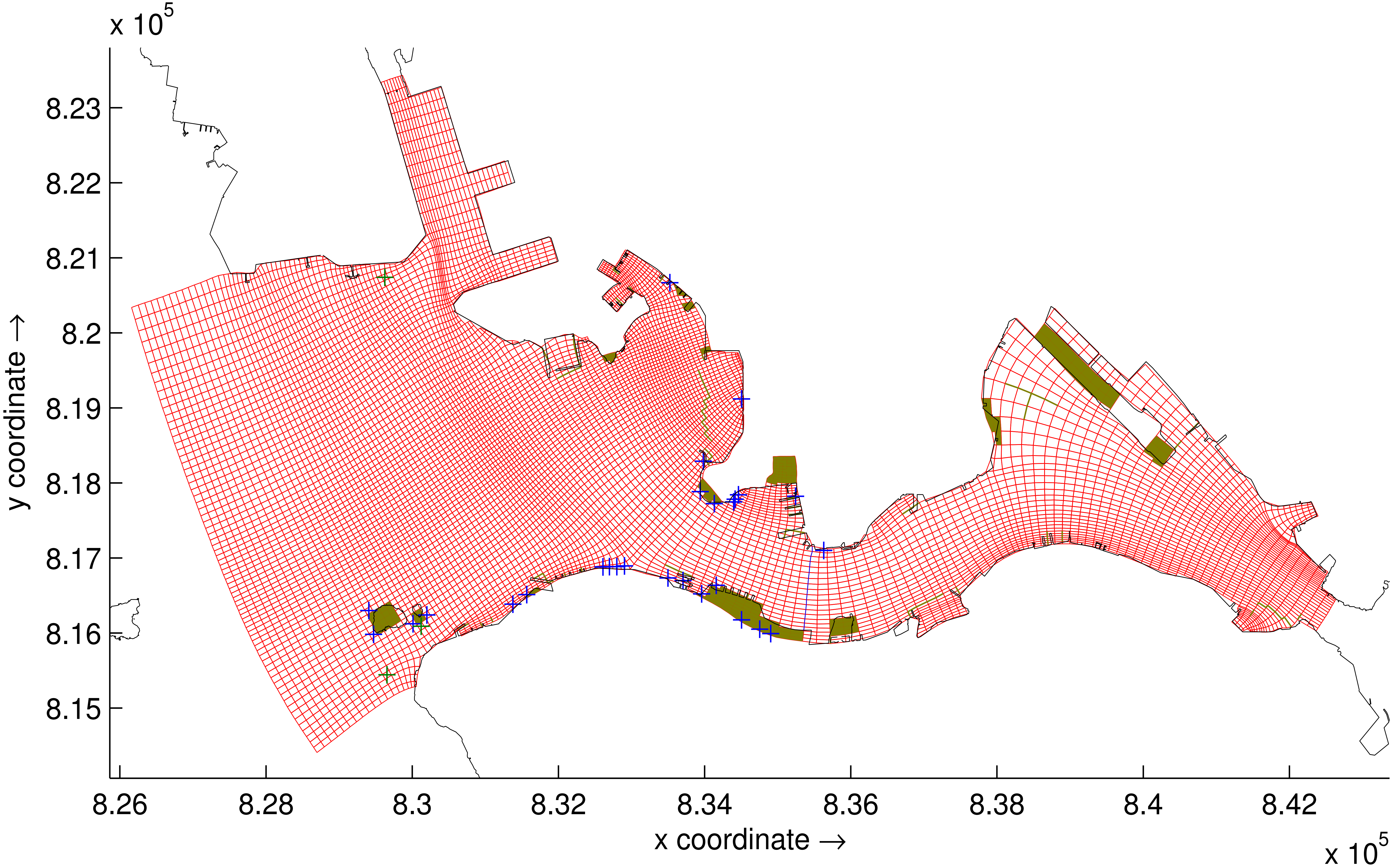


Figure 3.7b Coastline Configuration in the Victoria Harbour

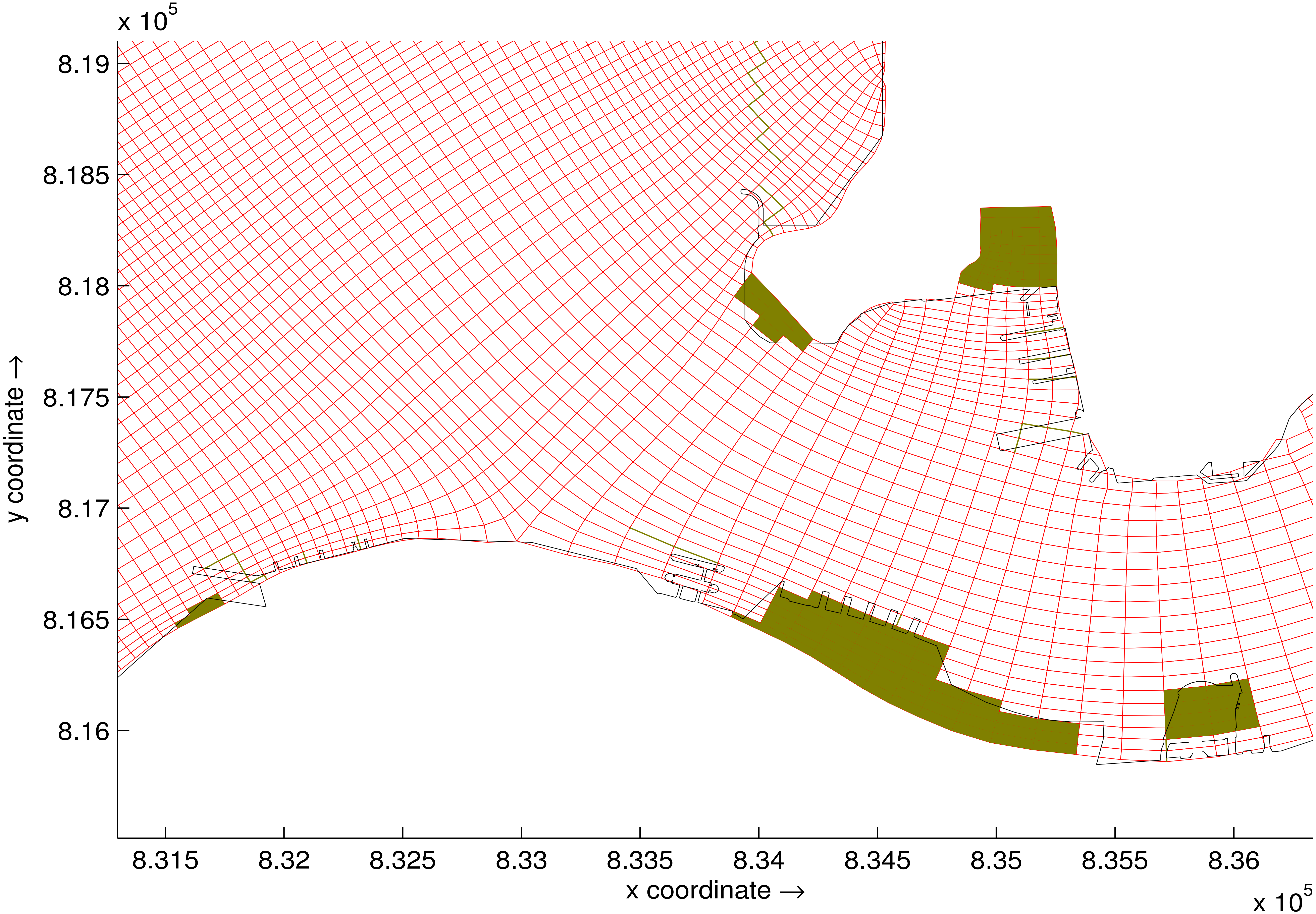


Figure 3.7c Coastline Configuration in the vicinity of the Alignment

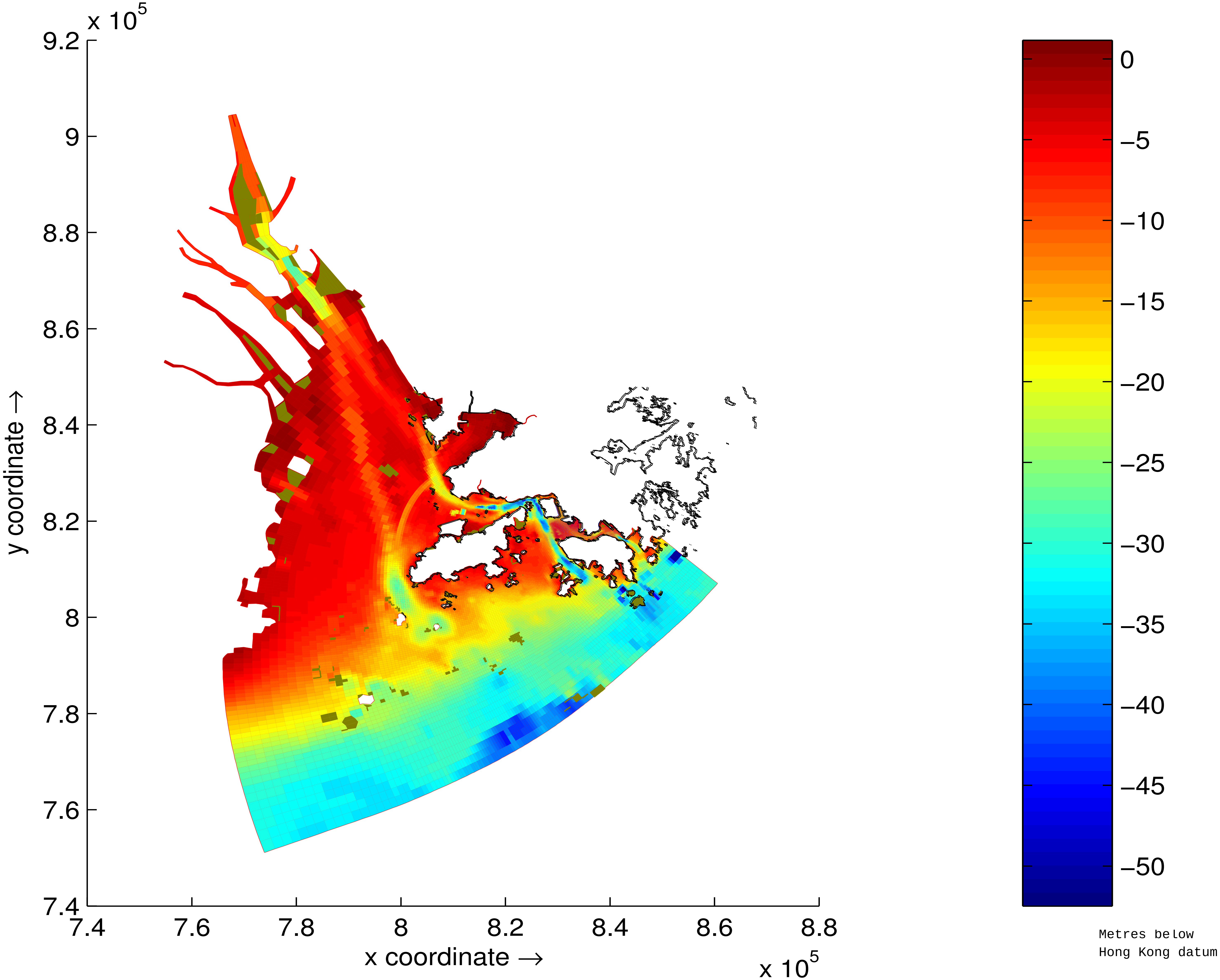


Figure 3.8a Bathymetry in the Project Area

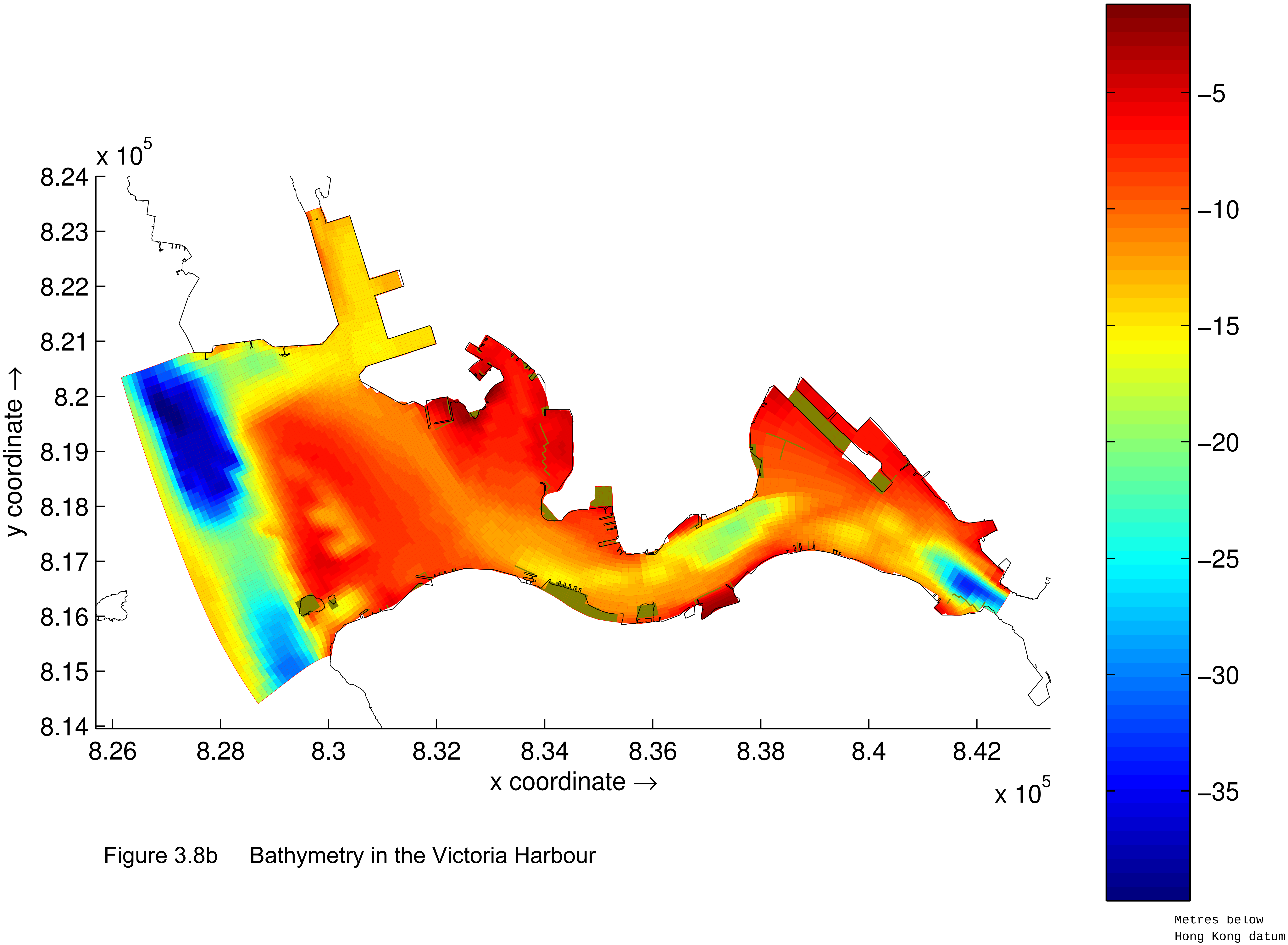


Figure 3.8b Bathymetry in the Victoria Harbour

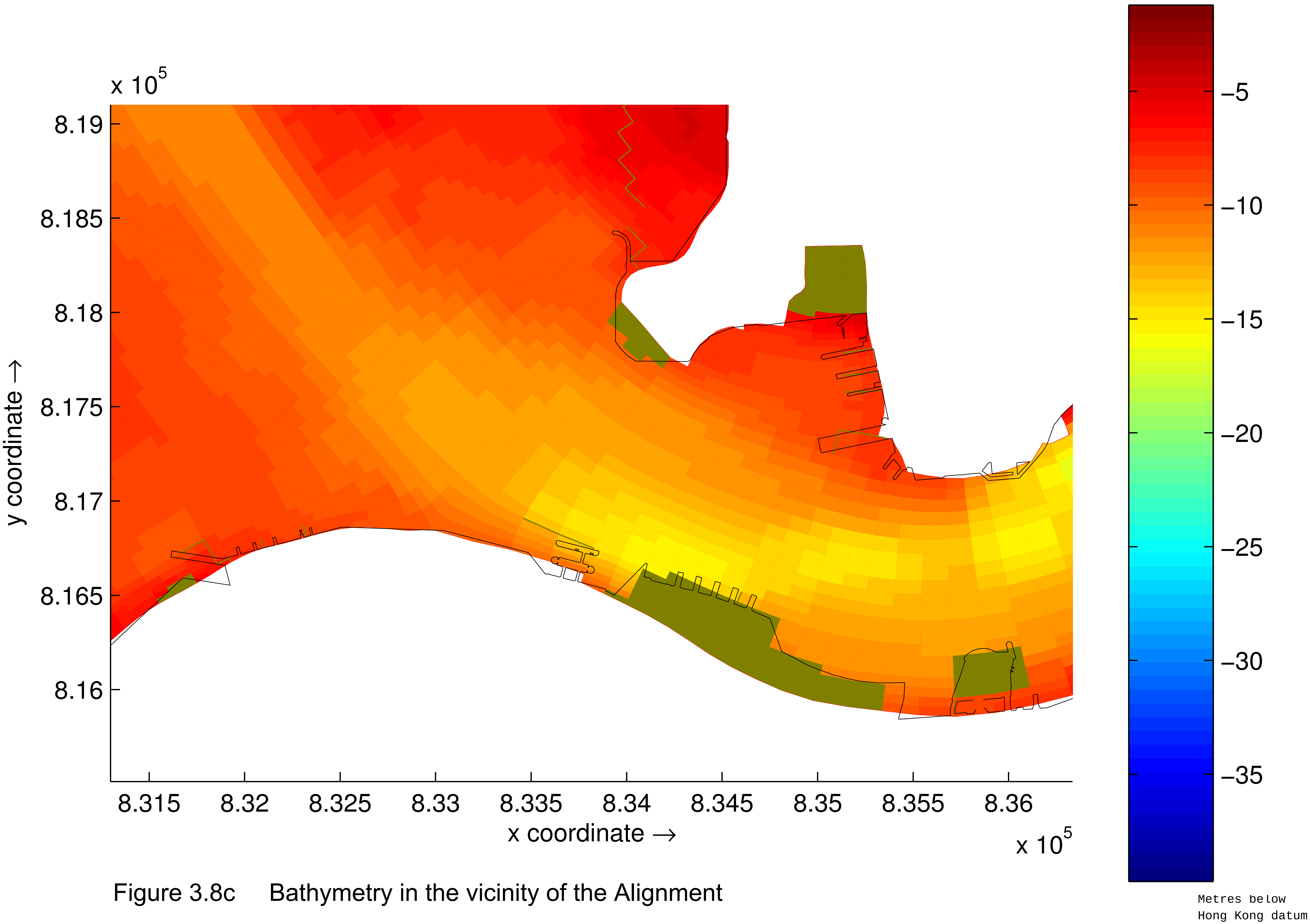
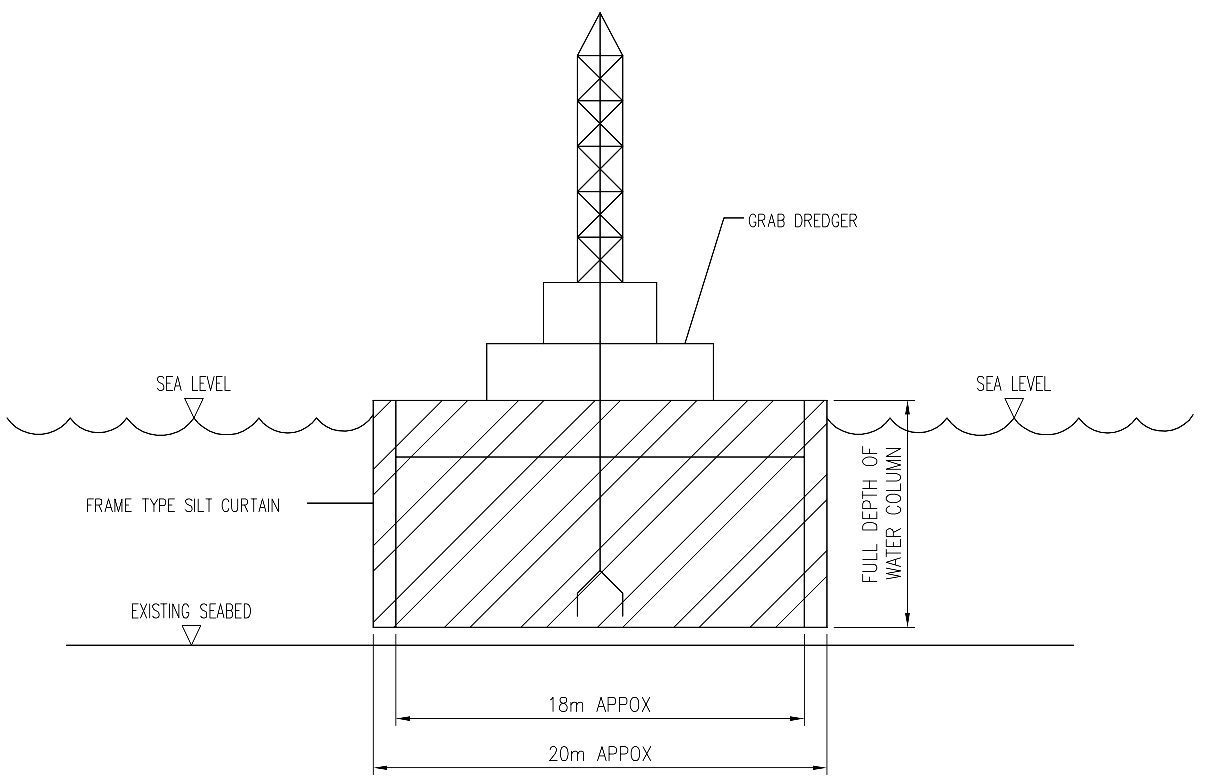
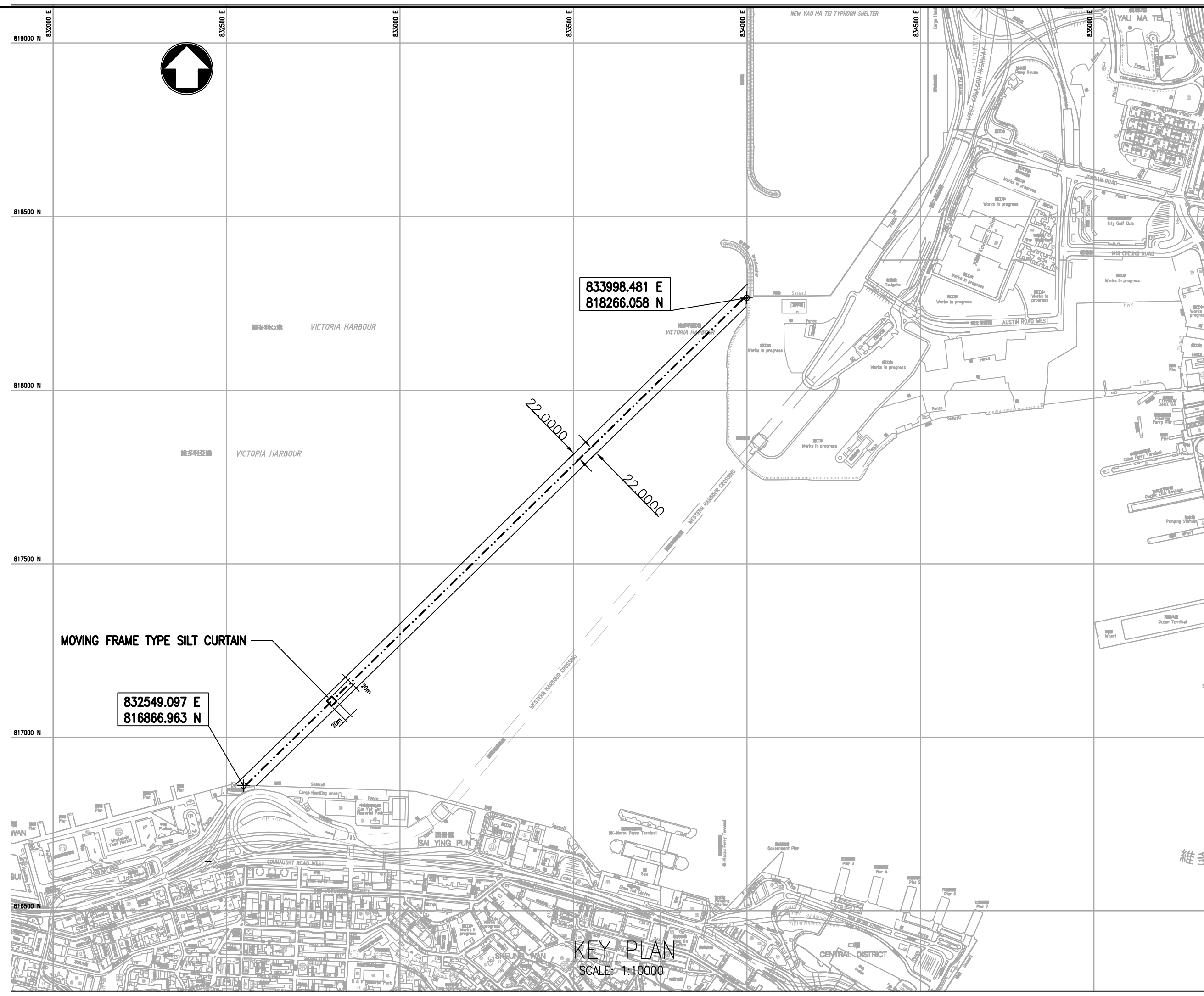


Figure 3.8c Bathymetry in the vicinity of the Alignment



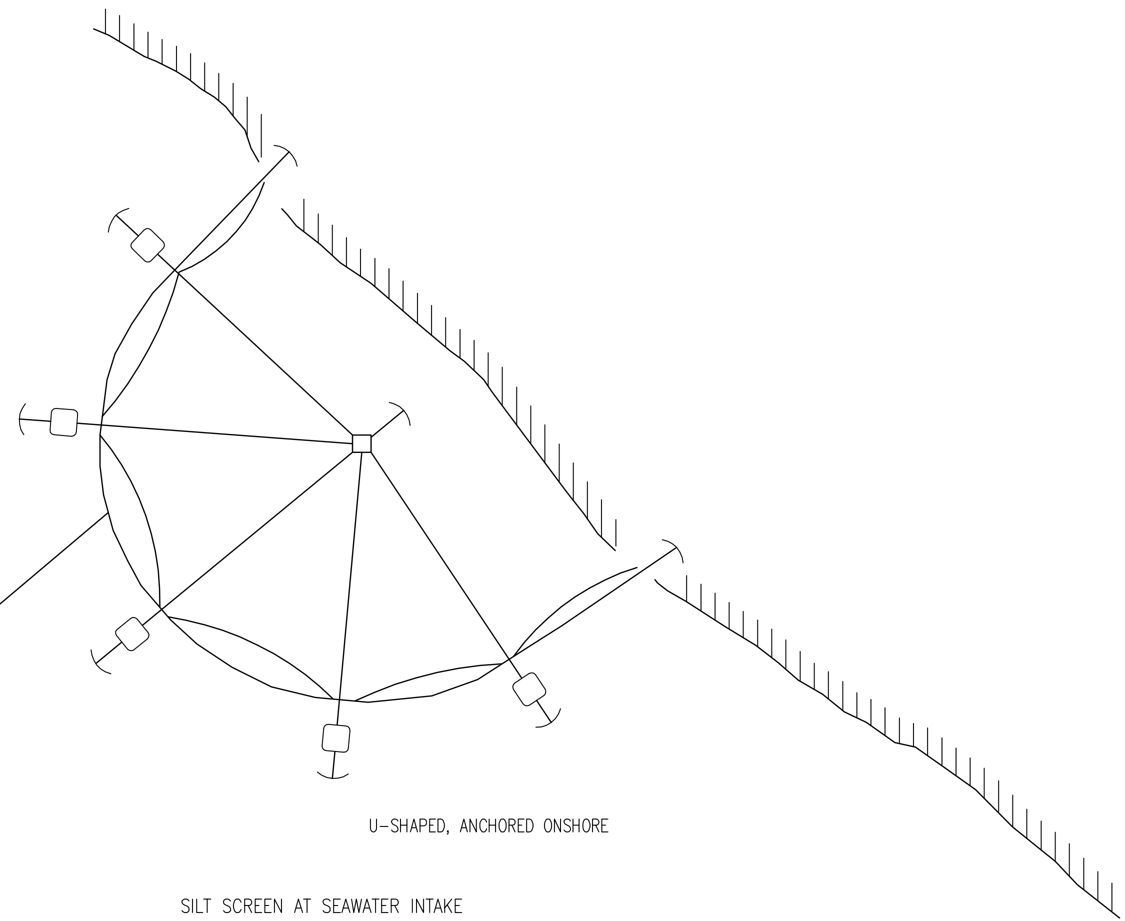
SILT CURTAIN ENCLOSING THE GRAB DREDGER
SECTION



LEGEND:

PROPOSED DN1200 SUBMARINE WATER MAIN

MOVING FRAME TYPE SILT CURTAIN



SILT SCREEN AT SEAWATER INTAKE

TYPICAL CONFIGURATION OF SILT CURTAINS AND SCREENS

Rev	Date	Drawn	Description	Ch'k'd	App'd
–	–	–	–	–	–

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION
WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

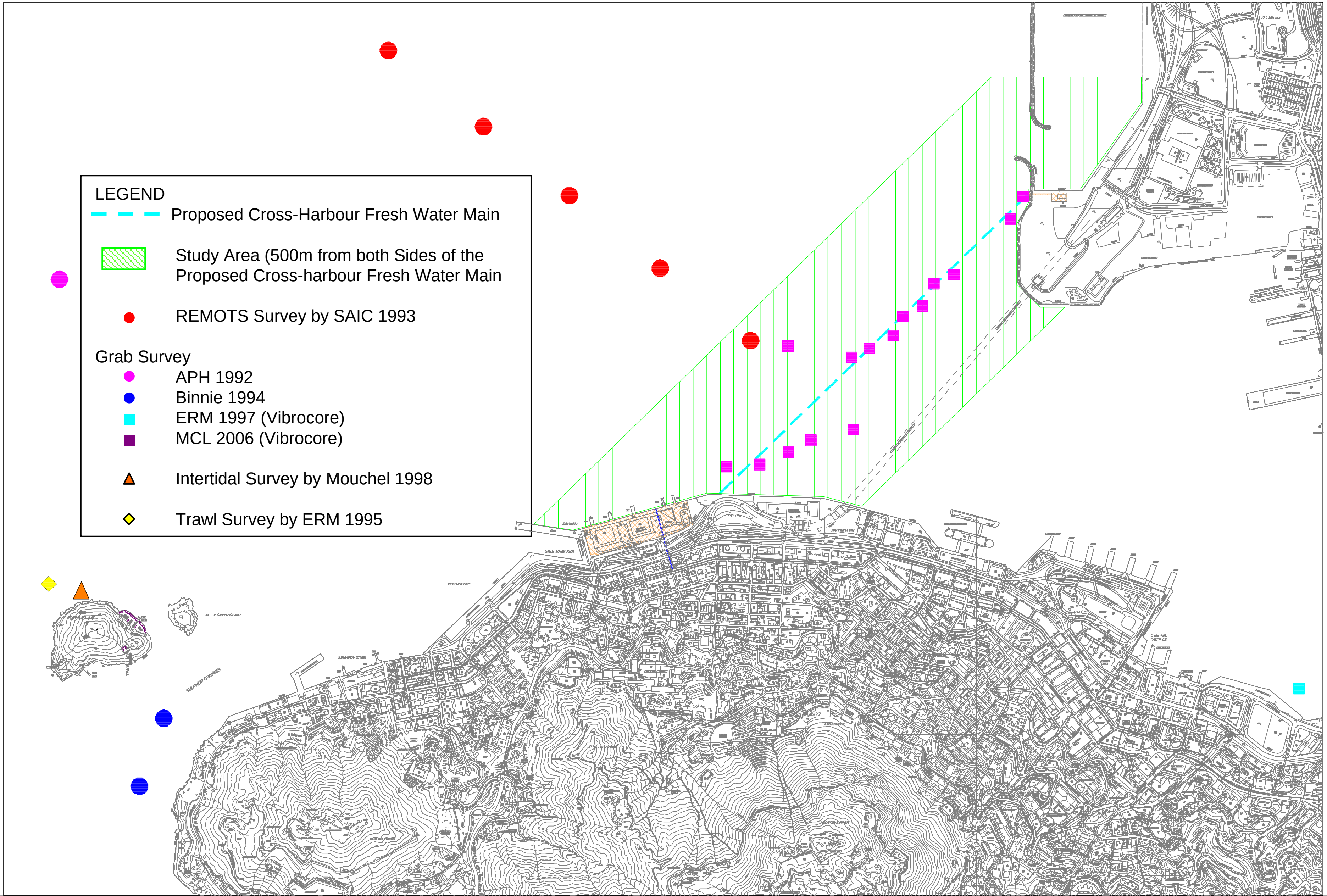
Title

TYPICAL CONFIGURATION OF SILT CURTAIN AND SILT SCREEN

Designed	RH		Eng.Chk.	CMH
Drawn	LYK		Coordination	----
Dwg.Chk.	----		Approved	

Scale 1 : 5000@A1
Project 226133
CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\MCL-226133-FIGURE-3.9.dwg
Status

Drawing No. FIGURE 3.9
Rev –

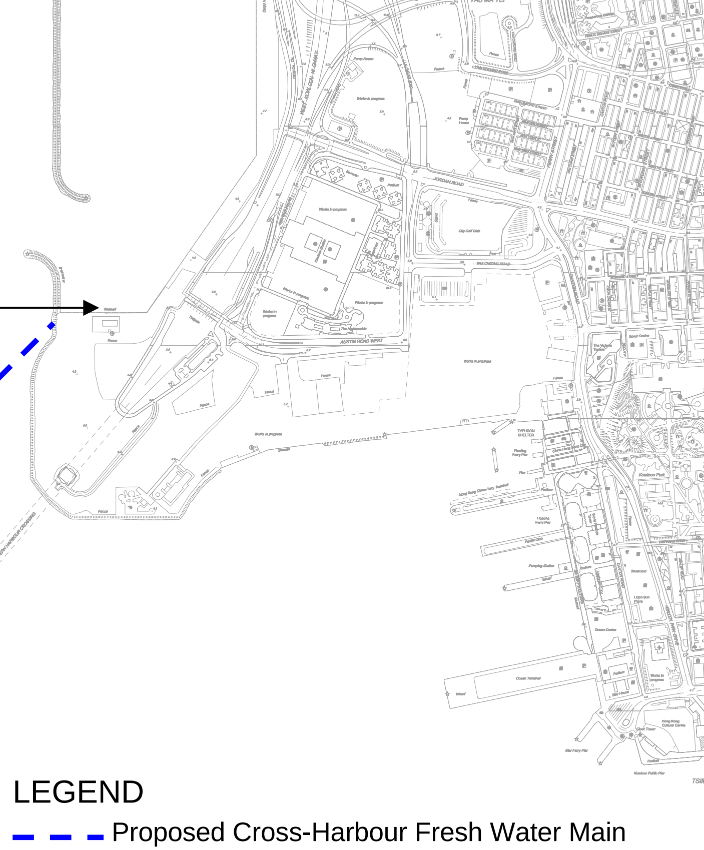


Project	Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun	Mott Connell
Title	Study Area and Sampling Locations for Marine Ecological Impact Assessment	Figure 4.1
Date Oct,2006		

Breakwaters made of rock armour at New Yau Ma Tei Typhoon Shelter.

New Yau Ma Tei Typhoon Shelter with vertical artificial seawall and breakwaters at the coast.

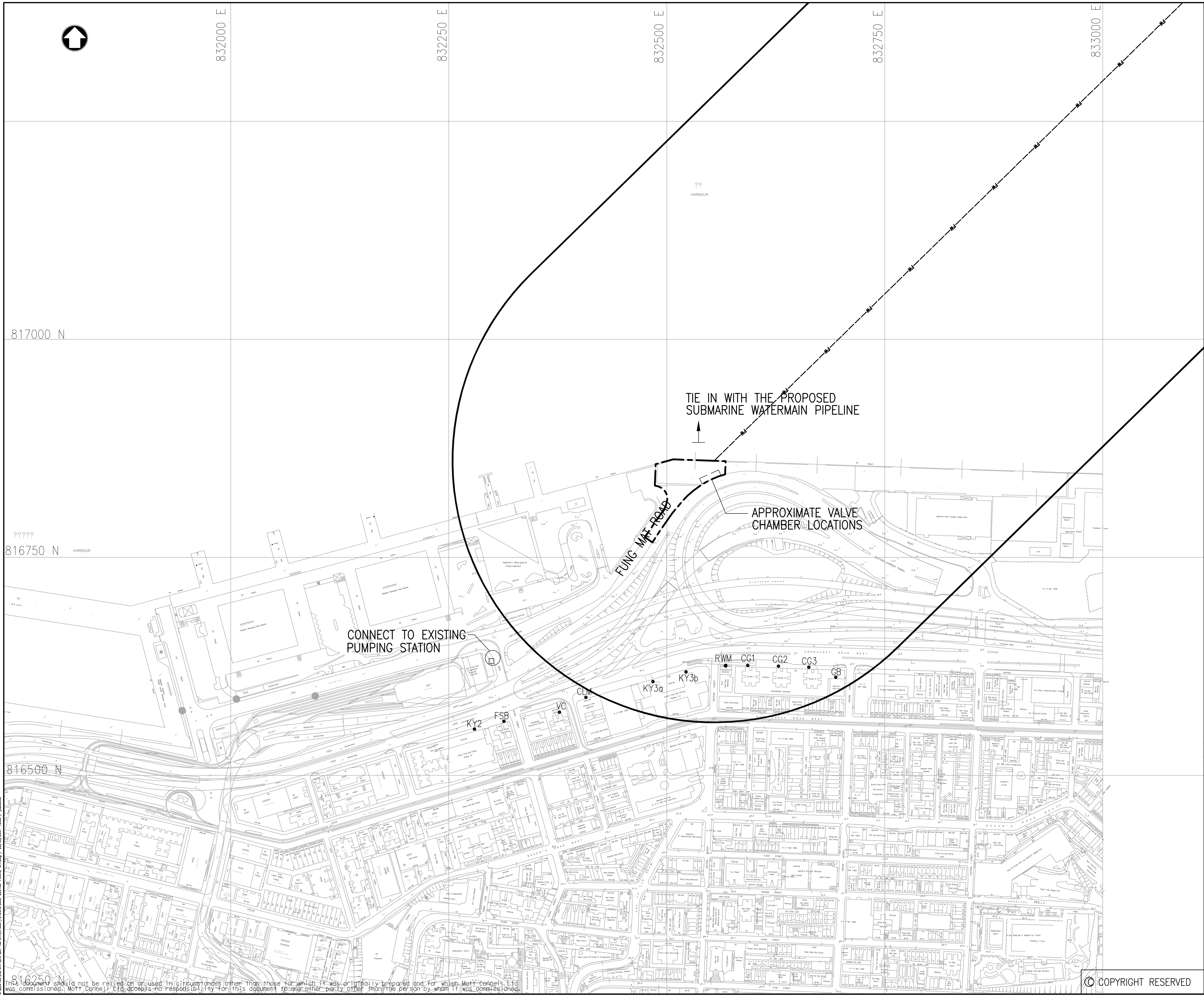
Wharf piles and vertical artificial seawall along the shore of Sai Ying Pun.



Project	Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun
Title	Intertidal Habitats within the Study Area
Date	Oct,2006

Mott Connell

Figure 4.2



LEGEND:

—FW—	PROPOSED ROUTE OF 1200ø FRESH WATER MAIN
•	NOISE SENSITIVE RECEIVERS
———	300m NOISE ASSESSMENT BOUNDARY
—— - ——	WORKS AREA BOUNDARY

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	06/06	LYK	PRELIMINARY		

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

Project
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title
LOCATIONS OF NOISE SENSITIVE RECEIVERS IN SAI YING PUN

Designed		Eng.Chk.	
Drawn	LYK	Coordination	
Dwg.Chk.		Approved	
Scale	1 : 2000@A1	Project	226133
		CAD File	J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\MCL-226133-FIGURE-5.1.dwg
Drawing No.	FIGURE 5.1	Rev	A

Status

LEGEND:

- PROPOSED ROUTE OF 1200ø FRESH WATER MAIN
- NOISE SENSITIVE RECEIVERS
- TEMPORARY PLATFORM
- 300m NOISE ASSESSMENT BOUNDARY
- WORKS AREA BOUNDARY

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	06/06	LYK	PRELIMINARY		

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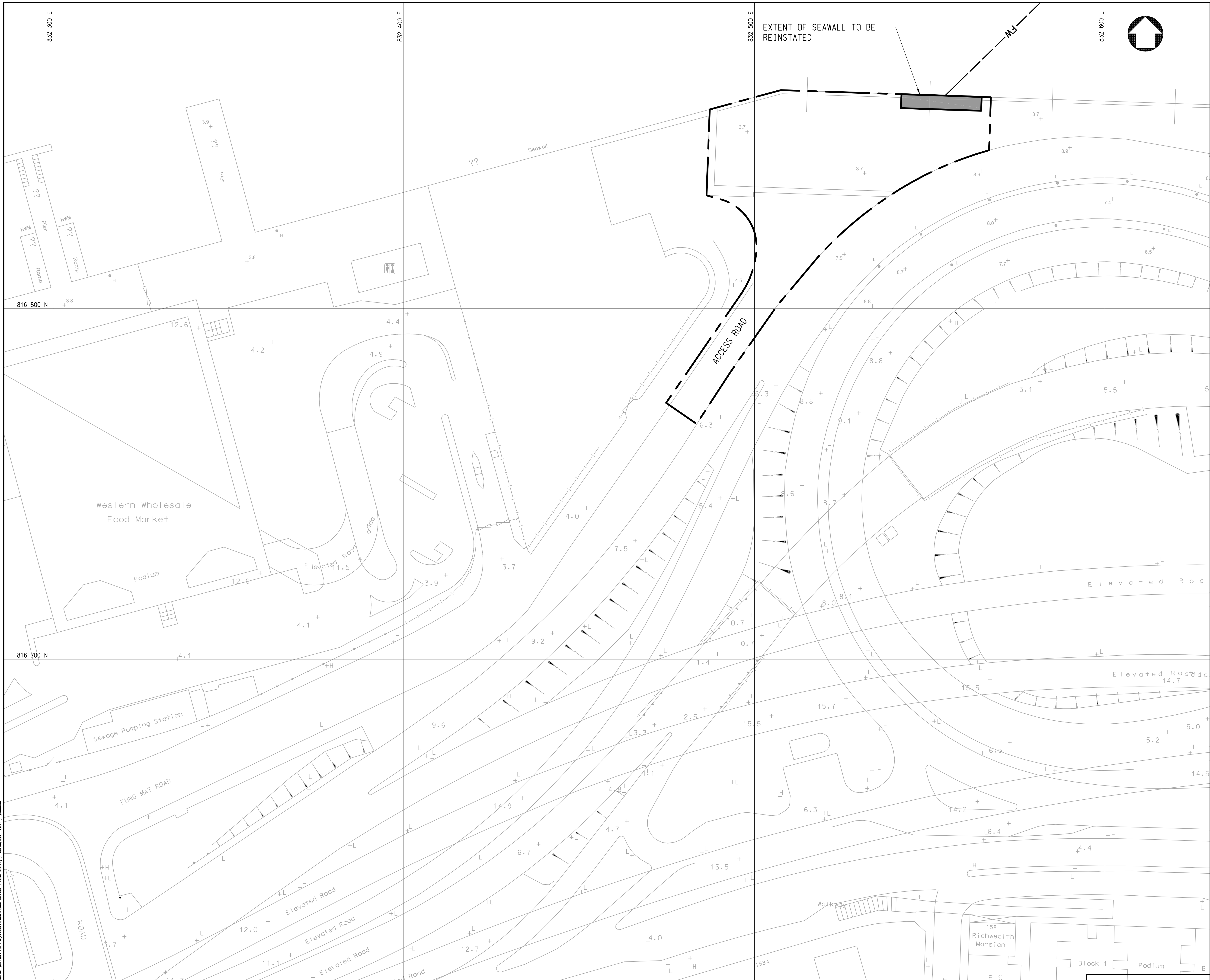
Contract No. CE42/2005(WS)

Project
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title
LOCATION OF NOISE SENSITIVE RECEIVERS IN WEST KOWLOON

Designed			Eng.Chk.		
Drawn	LYK		Coordination	–	
Dwg.Chk.			Approved		
Scale	1 : 4000@A1	Project	226133	Status	
		CAD File	J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\MCL-226133-FIGURE-5.2.dwg		
Drawing No.	FIGURE 5.2			Rev	A



LEGEND :

— · —	WORKS AREA FOR LANDFALL SITE AT SAI YING PUN
——FW——	PROPOSED 1200ø FRESH WATERMAIN

Rev	Date	Drawn	Description	Ch'k'd	App'd
--	--	--	--	--	--

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Contract No. CE42/2005(WS)

Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

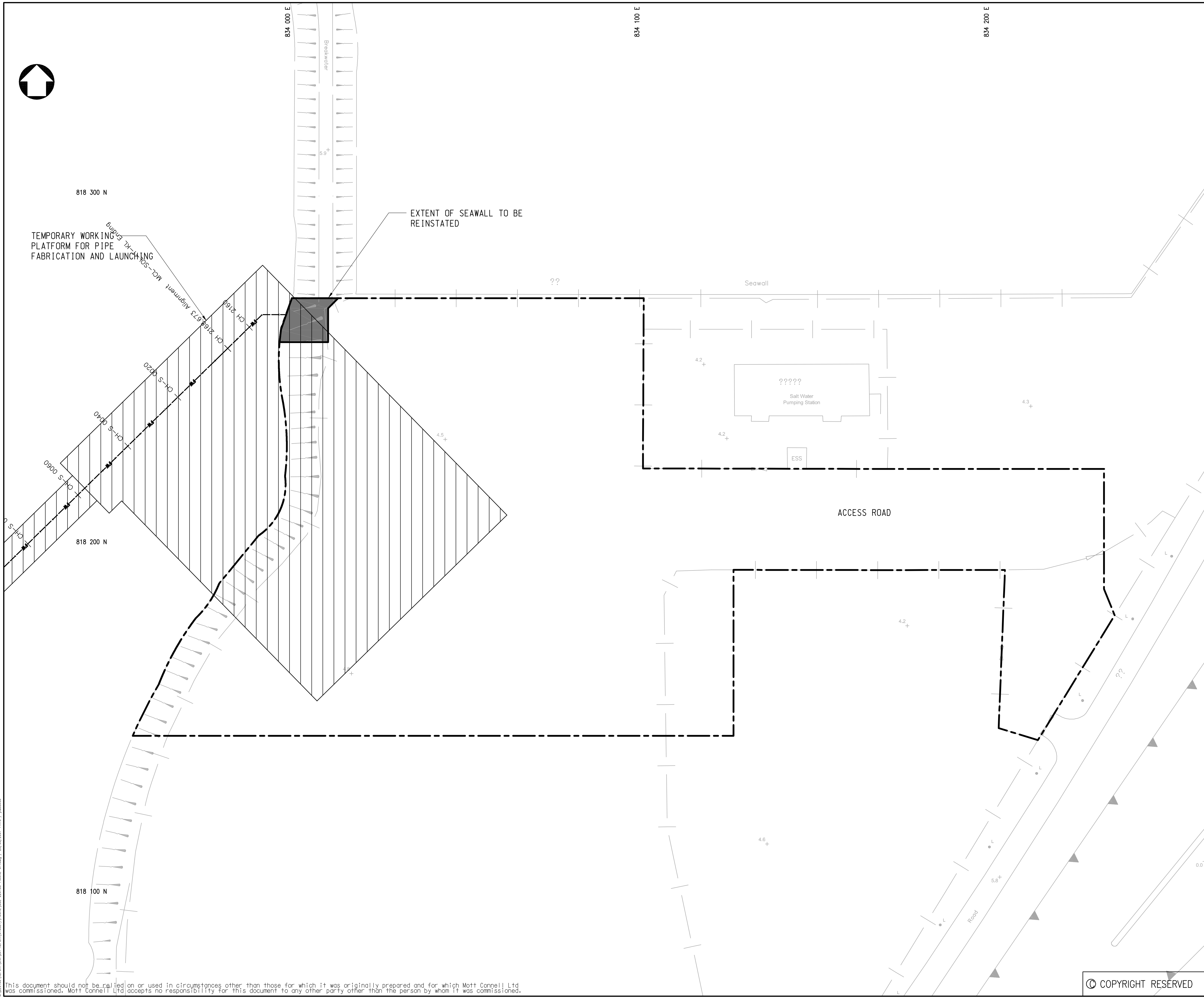
WORKS AREA – SAI YING PUN

Designed	CK	Eng.Chk.	MT
Drawn	LYK	Coordination	SHC
Dwg.Chk.	MT	Approved	SHC
Scale	1:500 @A1	Project	226133

Status

Drawing No. FIGURE 5.3

Rev



LEGEND :

WORKS AREA FOR LANDFALL SITE AT WEST KOWLOO

PROPOSED 1200ø FRESH WATERMAIN

Rev	Date	Drawn	Description	Ch'k'd	App'd
--	--	--	--	--	--

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Contract No. CE42/2005(WS)

Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

WORKS AREA – WEST KOWLOON

Designed	CK	Eng.Chk.	MT
Drawn	LYK	Coordination	SHC
Dwg.Chk.	MT	Approved	SHC

Scale 1:500 @A1

Project 226133

Status

Drawing No. FIGURE 5.4

Rev

LEGEND:

—FW— PROPOSED DN1200 SUBMARINE WATER MAIN

NIGHT-TIME DREDGING ZONE

Rev	Date	Drawn	Description	Ch'k'd	App'd

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

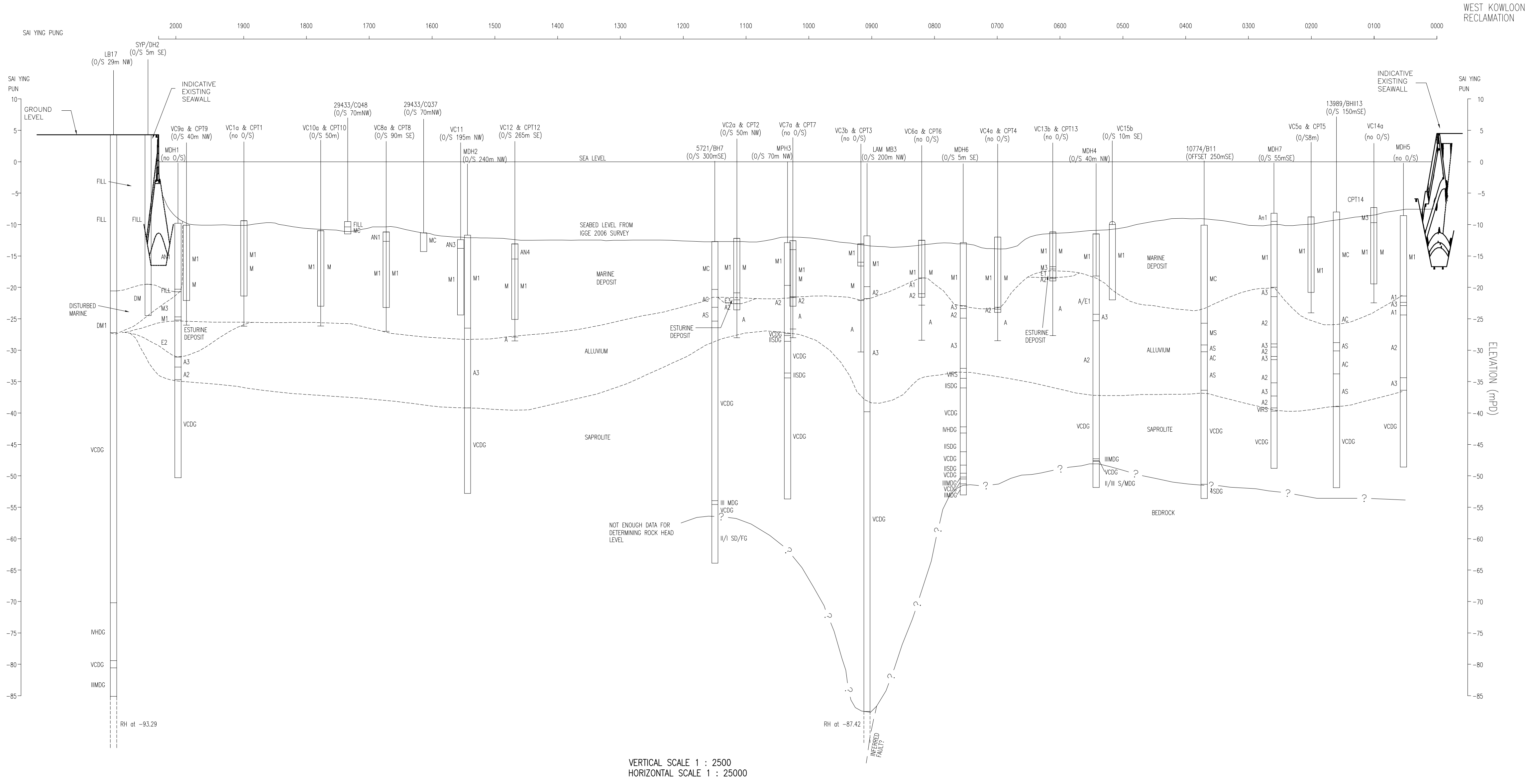
Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

LOCATION OF NIGHT-TIME DREDGING ZONE

Designed	RH	Eng.Chk.	CMH
Drawn	LYK	Coordination	——
Dwg.Chk.	——	Approved	
Scale 1 : 5000@A1	Project 226133	Status	
	CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\226133-FIGURE-5.5.dwg		
Drawing No.	FIGURE 5.5	Rev	



NOTE :

1. DATA TAKEN WITHIN 300m OFFSET ON EACH SIDE OF THE PROPOSED ALIGNMENT FROM THE CENTER LINE
2. THICKNESS OF ALLUVIUM MAY VARY CONSIDERABLY AT BURIED CHANNEL (SHEET II, SOLID AND SUPERFICIAL GEOLOGY, GCO, 1986)
3. DEEP ROCKHEAD AT SAI YING PUN AREA (LAU, 2004)

LEGEND:

AN – ANTHROPOGENIC DEPOSIT
DM – DISTURBED MARINE DEPOSIT
M – MARINE DEPOSIT
E – ESTURINE DEPOSIT
A – ALLUVIUM
IISDG – SLIGHTLY DECOMPOSED GRANITE
IIIMDG – MODERATEY DECOMPOSED GRANITE
IVCDG – COMPLETELY DECOMPOSED GRANITE
VCDG – COMPLETELY DECOMPOSED GRANITE
VIRS – RESIDUAL SOIL
1 – VERY SOFT TO SOFT CLAY OR SILT(C)
2 – FIRM TO VERY STIFF CLAY OR SILT(C)
3 – SAND (S)
4 – GRAVEL (G)
DRILLHOLE OR VIBROCORE
CPT

Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	--	--	PRELIMINARY	--	--
P1	--	--	PRELIMINARY	--	--

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Contract No. CE42/2005(WS)

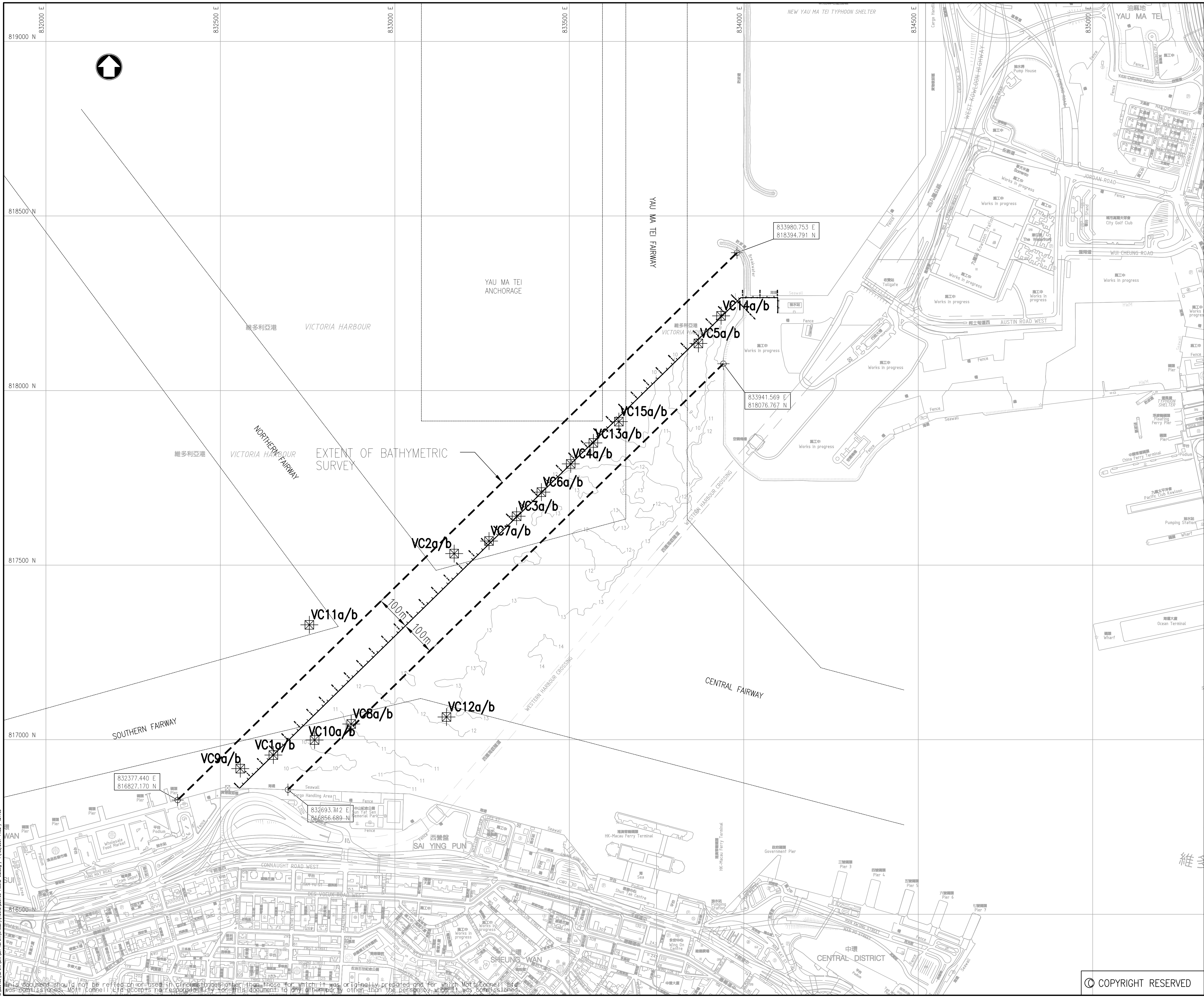
Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

LONGITUDINAL GEOLOGICAL PROFILE OF PROPOSED SUBMARINE WATER MAIN ALIGNMENT

Designed	RH	Eng.Chk.	CMH	
Drawn	LYK	Coordination	---	
Dwg.Chk.	---	Approved		
Scale	AS SHOWN@A1	Project 226133		Status
		CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\MCL-226133-FIGURE-6.1.dwg		
Drawing No.	FIGURE 6.1			Rev P2



LEGEND :

SEABED CONTOURS FROM PREVIOUS HYDROGRAPHIC & GEOPHYSICAL SURVEY

PROPOSED DN1200 SUBMARINE WATER MAIN

VC3/a/b VIBROCORE

MDH/VC/CPT NO.	MAIN GI LOCATIONS	
	EASTING (m)	NORTHING (m)
VC1a/b	832652	816956
VC2a/b	833170	817533
VC3a/b	833349	817640
VC4a/b	833504	817790
VC5a/b	833870	818135
VC6a/b	833420	817709
VC7a/b	833270	817569
VC8a/b	832875	817045
VC9a/b	832557	816917
VC10a/b	832770	816999
VC11a/b	832755	817329
VC12a/b	833148	817065
VC13a/b	833569	817850
VC14a/b	833935	818214
VC15a/b	833642	817911

Rev	Date	Drawn	Description	Ch'k'd	App'd
P3	05/06	LYK	PRELIMINARY	CMH	RH
P2	04/06	LYK	PRELIMINARY	CMH	RH
P1	04/06	LYK	PRELIMINARY	CMH	RH

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Contract No. CE42/2005(WS)

Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

LOCATION OF VIBROCORES

Designed	RH		Eng.Chk.	CMH	
Drawn	LYK		Coordination	–––	
Dwg.Chk.	–––		Approved		

Scale 1 : 5000@A1

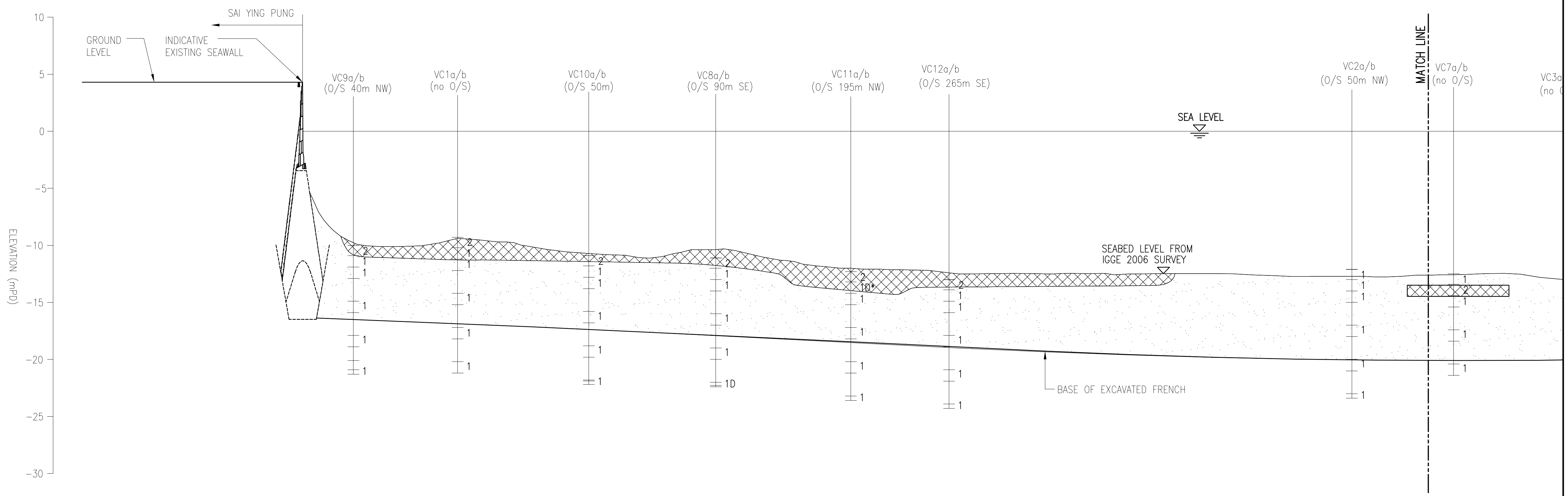
Project 226133

CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\226133-FIGURE-6.2.dwg

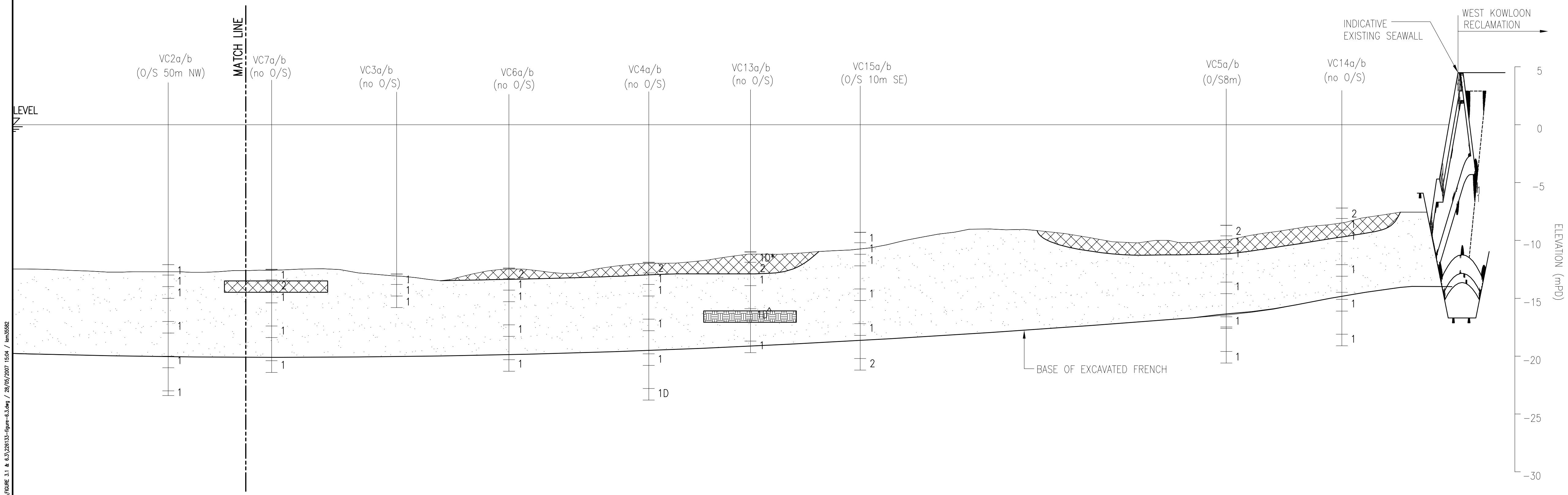
Status

Drawing No. FIGURE 6.2

Rev P3



VERTICAL SCALE 1 : 2000
HORIZONTAL SCALE 1 : 20000



VERTICAL SCALE 1 : 2000
HORIZONTAL SCALE 1 : 20000

NOTES :

1. DATA TAKEN WITHIN 300m OFFSET ON EACH SIDE OF THE PROPOSED ALIGNMENT FROM THE CENTER LINE
2. THICKNESS OF ALLUVIUM MAY VARY CONSIDERABLY AT BURIED CHANNEL (SHEET II, SOLID AND SUPERFICIAL GEOLOGY, GCO, 1986)
3. DEEP ROCKHEAD AT SAI YING PUN AREA (LAU, 2004)
4. SEABED LEVEL AS SHOWN IN THIS CROSS SECTION IS ALONG THE PROPOSED ALIGNMENT AND WAS PLOTTED BASED ON DATA GATHERED FROM IGGE2006 GEOPHYSICAL SURVEY. VIBROCORES AS SHOWN IN THIS FIGURE WERE TAKEN WITHIN 300m OFF SET ON EACH SIDE OF THE PROPOSED ALIGNMENT FROM THE CENTRE LINE.

LEGEND:

- TYPE 1 – OPEN SEA DISPOSAL
- TYPE 1D – OPEN SEA DISPOSAL (DEDICATED SITES)
- TYPE 2 – CONFINED MARINE DISPOSAL
- 1D* DUE TO DREDGING PRACTICALITY TYPE 1D IS CONSIDERED AS TYPE 2
- 1D$^{\Delta}$ DEPOSIT CONSIDERED AS TYPE 1D

Rev	Date	Drawn	Description	Ch'k'd	App'd

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Client: THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

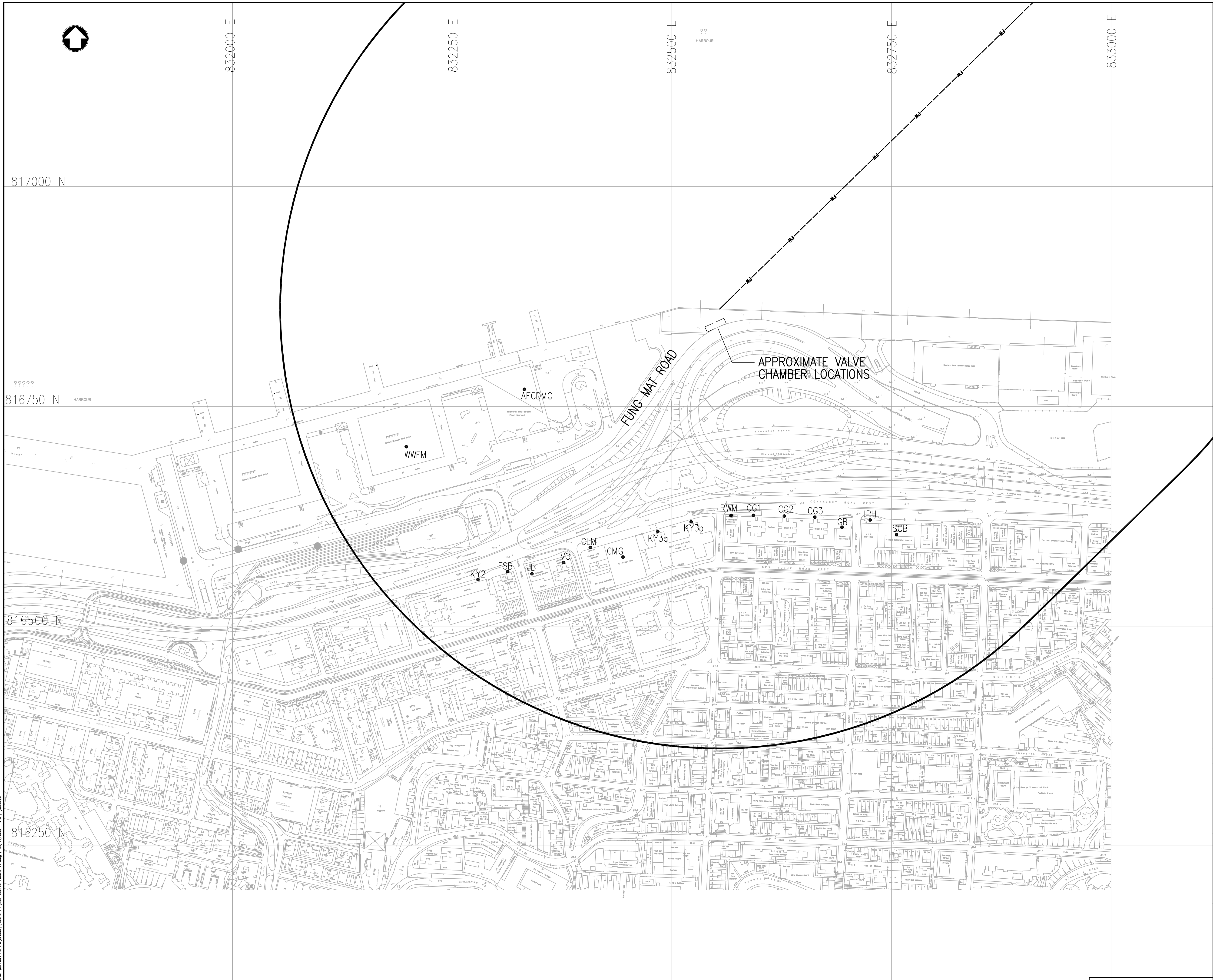
Project: LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title: SEDIMENT CLASSIFICATION PLAN

Designed	RH	Eng.Chk.	CMH
Drawn	LYK	Coordination	–––
Dwg.Chk.	–––	Approved	

Scale	Project	Status
AS SHOWN@A1	CAD File	PRE

Drawing No. FIGURE 6.3



LEGEND:

---FW---	PROPOSED ROUTE OF 1200ø FRESH WATER MAIN
•	AIR SENSITIVE RECEIVERS
——	500m AIR QUALITY ASSESSMENT BOUNDARY

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	06/06	LYK	PRELIMINARY		

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

Project

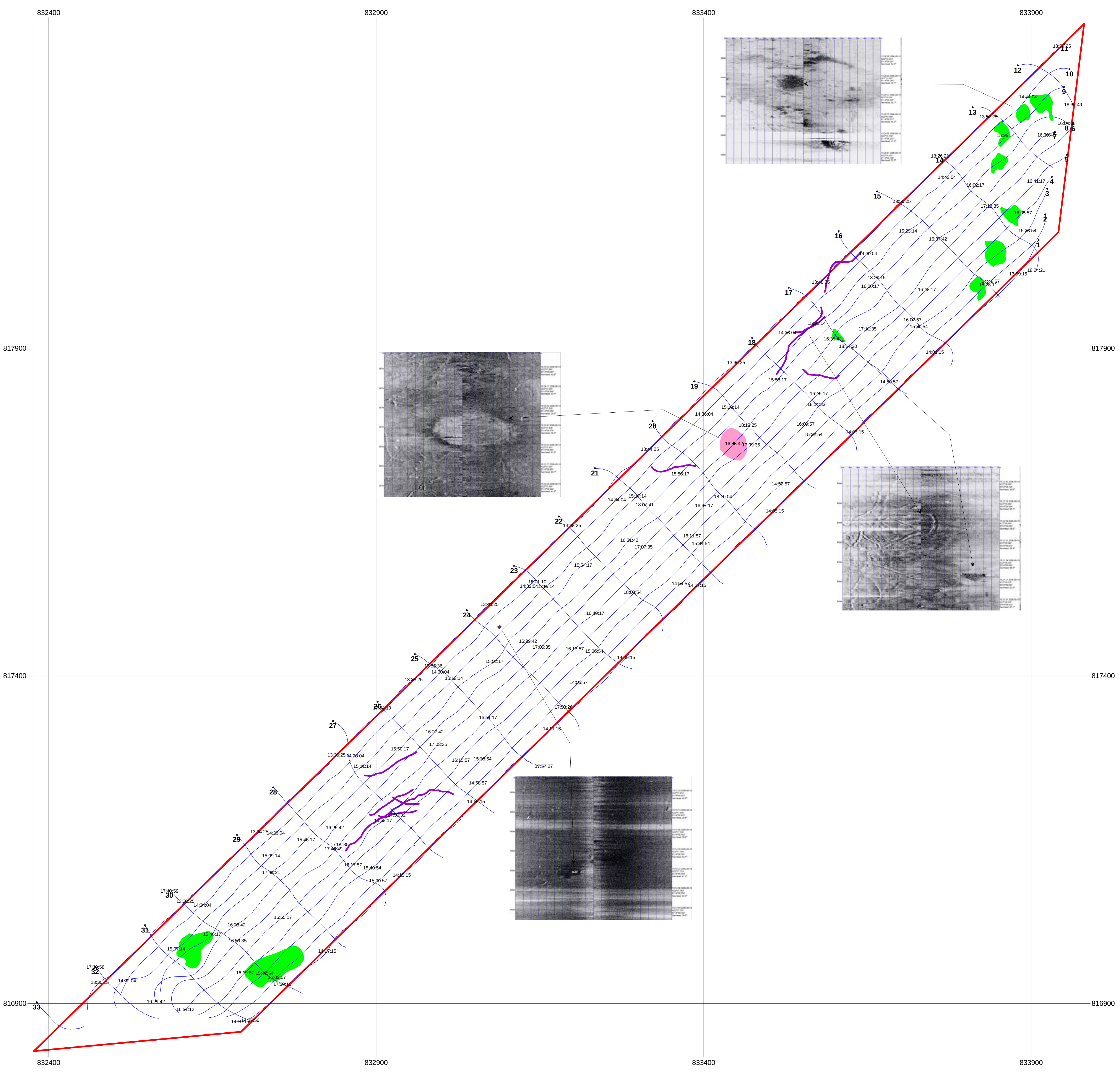
LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

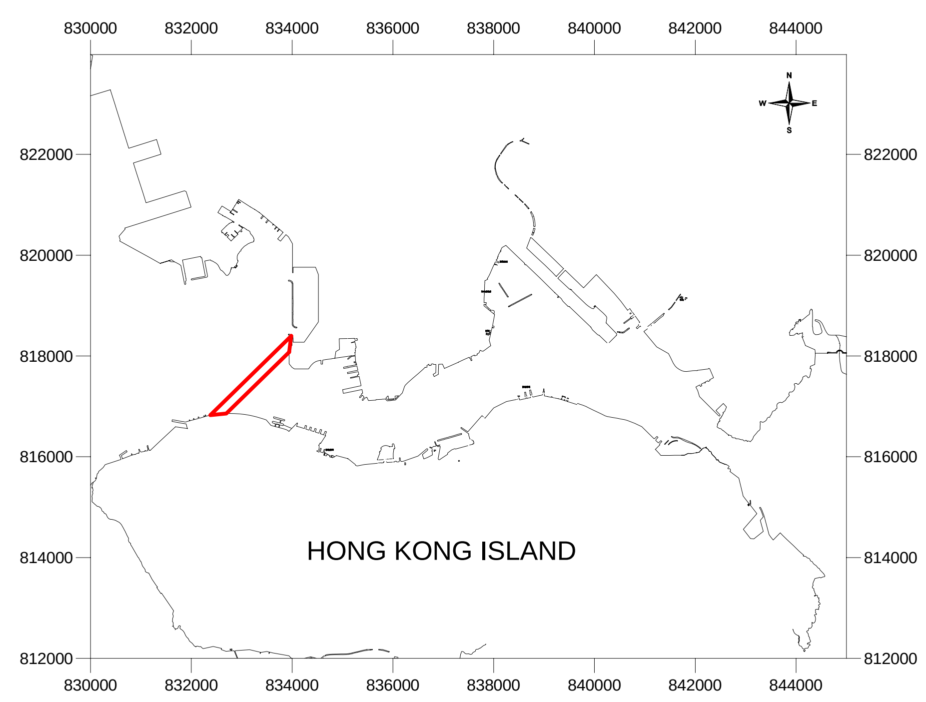
LOCATIONS OF AIR SENSITIVE RECEIVERS IN SAI YING PUN

Designed		Eng.Chk.	
Drawn	LYK	Coordination	
Dwg.Chk.		Approved	
Scale 1 : 2000@A1	Project 226133		Status
	CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE 7.1\WCL-226133-FIGURE-7.1.dwg		
Drawing No.	FIGURE 7.1		Rev A

J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE 7.1\WCL-226133-FIGURE-7.1.dwg / 28/03/2007 11:16 / zu38808



Location Plan:



Legend:

- Side Scan Sonar Survey Track with Fix Position
- Main Scar (Anchor Mark or Trawl Mark etc.)
- Boundary
- Granular Seabed/Dumped material (High Reflectivity)
- Debris/Boulder/Made Objects
- Pit
- Side Scan Sonar Image

AREA: West Kowloon to Sai Ying Pung

FIGURE NUMBER: SSS-2

Drawing Title:

SEABED FEATURES WITH SIDE SCAN SONAR TRACK

Notes:

1. Survey Date: August 18, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS EdgeTech 560 Sonar System

Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	09/09/2006	Liu Jianxun	Xiao Du	Preliminary

Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Metric Scale: 1:5,000

0m 100m 200m 300m 400m

Client: Civil Engineering and Development Department

Surveyor: IGGE (H. K.) Engineering Geophysical Co. Ltd.

Figure 8.1 Geophysical Survey Area and Seabed Features with Side Scan Sonar Track

LEGEND:

PROPOSED DN1200 SUBMARINE WATER MAIN

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	06/06	LYK	PRELIMINARY		

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THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION WATER SUPPLIES DEPARTMENT

Contract No. CE42/2005(WS)

Project

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS FROM WEST KOWLOON TO SAI YING PUN – INVESTIGATION

Title

LOCATION OF AFCD FISHING ZONE IN THE VICINITY OF THE PROPOSED WATERMAINS

Designed		Eng.Chk.	
Drawn	LYK	Coordination	–
Dwg.Chk.	–––	Approved	

Scale 1 : 25000@A1

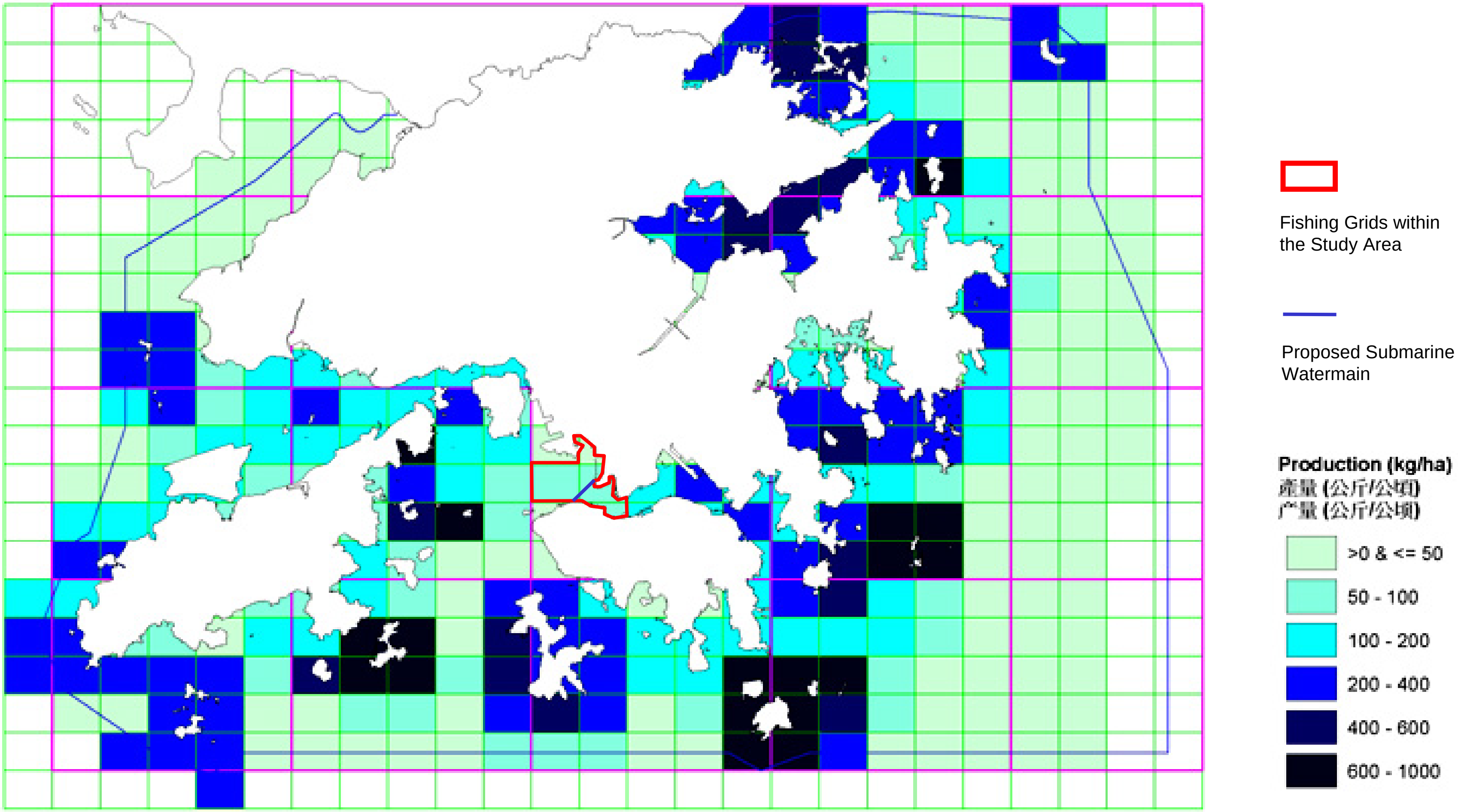
Project 226133

Status

CAD File J:\226133\REPORT\ENV\EIA-REPORT(070327)\FIGURE\226133-FIGURE-9.1.dwg

Drawing No. FIGURE 9.1

Rev A



Water Supplies Department

Mott Connell

Laying of Western Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation

Title: Fishing Grids within the Study Area

Figure 9.2

APPENDICES

APPENDIX A

EIA Study Brief No. ESB-132/2005

Environmental Impact Assessment Ordinance (Cap. 499) Section 5 (7)
Environmental Impact Assessment Study Brief No. ESB-132/2005

Project Title: Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun
(hereinafter known as the "Project")

Name of Applicant: Water Supplies Department
(hereinafter known as the "Applicant")

1. BACKGROUND

1.1 An application (No. ESB-132/2005) for an Environmental Impact Assessment (EIA) study brief under section 5(1) of the Environmental Impact Assessment Ordinance (EIAO) was submitted by the captioned Applicant on 30 August 2005 with a project profile No. PP-258/2005 (the Project Profile).

1.2 The proposed Project is to construct and operate a new western cross harbour main and associated land mains. The indicative route of the proposed water mains is shown in the Project Profile and is reproduced in Annex A of this study brief. The proposed Project will comprise the following:

(i) an approximately 2100 meter of 1200mm nominal diameter of submarine watermain across Victoria Harbour from its connection at Lin Cheung Road in West Kowloon to the existing Sai Ying Pun Fresh Water Pumping Station in Sheung Wan;
(ii) an approximately 2200 meter of 1200mm nominal diameter of associated land watermains.

1.3 Based on the scope of the Project Profile, the submarine watermain component of the Project is identified as a Designated Project as defined under Item E.3 of Part 1 Schedule 2 of the EIAO

1.4 Pursuant to section 5(7)(a) of the EIAO, the Director of Environmental Protection (the Director) issues this Environmental Impact Assessment (EIA) study brief to the Applicant to carry out an EIA study.

1.5 The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction of the proposed designated project and related activities taking place concurrently. This information will contribute to decisions by the Director on:

(i) the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed project;

(ii) the conditions and requirements for the detailed design, construction and operation of the proposed project to mitigate against adverse environmental consequences wherever practicable; and

(iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

2. OBJECTIVES OF THE EIA STUDY

2.1 The objectives of the EIA study are as follows:

(i) to describe the proposed project and associated works together with the requirements for carrying out the proposed project;

(ii) to identify if there are other types of Designated Projects under Part I Schedule 2 of the EIAO to be covered in the Project;

(iii) to consider alternative alignment(s) and landing points of the submarine watermain, alternative construction method(s) and sequence(s), and to compare their environmental benefits and dis-benefits with the view of selecting the perferred options from the environmental perspective;

(iv) to identify and describe the elements of the community and environment likely to be affected by the proposed project and/or likely to cause adverse impacts to the proposed project, including both the natural and man-made environment;

(v) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(vi) to identify and quantify any potential losses or damage to flora, fauna and natural habitats and to propose measures to mitigate these impacts;

(vii) to identify any negative impacts on fisheries and to propose measures to mitigate these impacts;

(viii) to identify any negative impacts on sites of cultural heritage and to propose measures to mitigate these impacts;

(ix) to propose the provision of infrastructure or mitigation measures so as to minimize pollution, visually intrusive sediment plume dispersion, environmental disturbance and nuisance during construction of the project;

(x) to investigate the feasibility, practicability, effectiveness of the proposed mitigation measures.

(xi) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction phase of the project in relation to the sensitive receivers and potential affected uses;

(xii) to identify, assess and specify methods, measures and standards, to be included in the detailed design and construction of the project which are necessary to mitigate these environmental impacts and reducing them to acceptable levels;

(xiii) to investigate the extent of secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study as well as subsequent provision of necessary modifications;

(xiv) to design and specify the environmental monitoring and audit requirements, if required, to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.

3. DETAILED REQUIREMENTS OF THE EIA STUDY

3.1 The Purpose

The purpose of this study brief is to scope the key issues of the EIA study and to specify the environmental issues that are required to be reviewed and assessed in the EIA report. The Applicant has to demonstrate in the EIA report that the criteria in the relevant sections of the Technical Memorandum on the Environmental Impact Assessment Process of the Environmental Impact Assessment Ordinance (hereinafter referred to as "the TM"), are fully complied with.

3.2 The Scope

The scope of this EIA study shall cover the Project proposed in the Project Profile and the works and facilities mentioned in Section 1.2 above. The EIA study shall address the key issues described below, together with any other key issues identified during the course of the EIA study and the cumulative environmental impacts of the Project, through interaction or in combination with other existing, committed, and planned and known potential developments in the vicinity of the Project:

i) the potential water quality impacts arising from the dredging, laying of pipe and backfilling works for the construction of the submarine watermain.

ii) the potential noise and dust impacts arising from the construction works of the Project.

iii) the potential impacts on sites of cultural heritage of marine archaeological deposit likely to be affected by the construction works of the Project.

iv) the potential fisheries impact arising from the Project.

3.3 Consideration of Alternative Alignment Options and Construction Methods

3.3.1 Need for the Project

The Applicant shall present in the EIA the information on the need for the Project and the Project's implementation programme.

3.3.2 Consideration of Different Alignment Options

The Applicant shall consider any other feasible watermain alignment options for the project, taking into account of other planned projects in the vicinity, including the Western Harbour Submarine Gas Pipeline. Alternative locations of landing points for connecting to land mains shall also be investigated. The Applicant shall compare the environmental benefits and dis-benefits of each of the possible alignment options and locations of landing point and provide reasons for selecting the final preferred option including the environmental factors played in the selection.

3.3.3. Consideration of Other Construction Methods and Sequences of Works

Having regard to the cumulative effects of the construction period and the severity of the construction impacts to the affected sensitive receivers, the Applicant shall explore other alternative construction methods (including those indicated in the Project Profile, i.e. the closed grab dredger method, and other possible methods to be investigated during the course of the EIA study) and sequences of works for the Project, with a view to proposing the best practical method to avoid prolonged adverse environmental impacts to the maximum practicable extent. A comparison of the environmental benefits and dis-benefits of applying different construction methods and sequence of works shall be made to demonstrate the role played by environmental factors in the selection of the preferred option.

3.3.4 Need for Maintenance Dredging

The Applicant shall investigate whether there would be any need for maintenance dredging during the operation stage. If such a need is identified, the Applicant shall assess and quantify the frequency as well as the likely extent of maintenance dredging required, and the associated potential water quality impact. It is also necessary to assess and quantify such water quality impacts if the maintenance dredging is expected to deploy dredging method and sequence different from the watermains laying activities.

Technical Requirements

3.4 The Applicant shall conduct the EIA study to address all environmental aspects of the activities as described in Sections 3.2 and 3.3 above. The assessment shall be based on the best and latest information available during the course of the EIA study. The Applicant shall assess the cumulative environmental impacts from the Project with other interacting projects. The Applicant shall include in the EIA report details of the construction programme and methodologies.

3.5 The Applicant shall review previously approved studies or EIA reports which are relevant to the Project and extract relevant information for the purpose of this EIA study. The following studies or EIA reports shall be referred to:

- Western Harbour Submarine Gas Pipeline and Associated Station
- Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Production Plant, Hong Kong

3.6 The EIA study shall meet the following technical requirements on specific impacts, unless otherwise approved by the Director specifically in writing:

3.6.1 Water Quality Impact

3.6.1.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing water pollution as stated in Annexes 6 and 14 of the TM respectively.

3.6.1.2 The assessment area for the water quality impact assessment shall include the Victoria Harbour and Western Buffer Water Control Zones stipulated under the Water Pollution Control Ordinance (WPCO, Cap. 358); and all areas within 500m from the Project boundary. This assessment area could be extended to include existing and new drainage system; and any associated water system(s) affected by the construction or operation of the Project during the course of the EIA study including Green Island.

3.6.1.3 The Applicant shall identify and analyse physical, chemical and biological disruptions of marine, estuarine or fresh water system(s), drainage system, catchment area(s), stormwater channel(s) and coastal water(s) arising from the construction and operation of the Project.

3.6.1.4 The Applicant shall predict, quantify and assess any water quality impacts arising from the Project on the affected water system(s) and their sensitive receivers by proposing appropriate techniques approved by the Director. Potential impacts shall include, but are not limited to, those arising from: the dredging and backfilling for the laying of the submarine pipeline; hydrostatic tests of the water mains system; sewage, wastewater and surface runoff from construction activities.

3.6.1.5 The Applicant shall address water quality impacts due to the construction phase and operational phase of the Project. Essentially, the assessment shall address the following :

(i). Collect and review background information on affected existing and planned water systems, their respective catchments and sensitive receivers which might be affected by the Project;

(ii). Characterize water and sediment quality of the water systems and sensitive receivers, which might be affected by the Project based on existing best available information or through appropriate site survey and tests;

(iii). Identify and analyse relevant existing and planned future activities, beneficial uses and water sensitive receivers related to the affected water system(s). The Applicant should refer to those uses specified in the relevant Outline Zoning Plan, Outline Development Plans and Layout Plans, and any other relevant published landuse plans;

(iv). Identify pertinent water and sediment quality objectives, criteria or standards for the water system(s) and the sensitive receivers identified in (i), (ii) & (iii) above, including ecologic and fisheries sensitive receivers for the assessments covered in Sections 3.6.2 and 3.6.7.

(v). Review construction methods and sequence of the Project to identify any alteration of existing shoreline or bathymetry, flow regimes, ground water levels and catchment types or areas.

(vi). Review the specific construction sequence and methods of the Project, such as,-the dredging and filling methods; dredging rates; handling, treatment and disposal of effluent arising from hydrostatic test.

(vii). Identify and quantify existing and likely future water and sediment pollution sources and loading (to include maintenance dredging, if found necessary, during operational phase of the Project). An emission inventory on the quantities and characteristics of these existing and likely future pollution sources in the study area shall also be provided. Field investigation and laboratory test, shall be conducted as appropriate to fill relevant information gaps.

(viii). Predict and quantify, by mathematical modelling or other technique approved by th Director, the impacts due to the Project on the water system(s) and their sensitiv receivers. The mathematical modelling requirements are set out in Annex B of thi Study Brief. Possible impacts include change in hydrology, flow regime, sedimen erosion or deposition, water and sediment quality and the effects on the marine o aquatic organisms or fisheries due to such changes in the affected water bodies. Th prediction shall take into account and include possible different construction stages o the Project.

(ix) Assess the cumulative impacts due to other related concurrent and planned projects activities or pollution sources along the selected watermains alignment that may hav a bearing on the environmental acceptability of the Project. This shall includ assessing the potential cumulative water quality impacts arising from, the associate works of the Project, and other activities and planned projects to be approved by th Director.

(x) Identify and quantify dredging, fill extraction, back filling, mud/ sedimen transportation and disposal activities and requirements. Potential fill source an dumping ground to be involved shall also be identified. Field investigation, samplin and laboratory tests to characterize the sediment/mud concerned shall be conducted a: appropriate. The potential release of contaminants during dredging and other marin works shall be addressed using the chemical testing results derived from sediment an marine water samples collected on site and relevant historical data. Appropriat laboratory tests such as elutriate tests in accordance with the USACE method an sediment pore water (interstitial water) analyses shall be performed on the sedimen samples to simulate and quantify the degree of mobilization of various contaminant such as metals, oxygen demand, ammonia, nutrients, trace organic contaminant (including PCBs, PAHs, TBT and chlorinated pesticides) into the water column durin dredging. The ranges of parameters to be analyzed; the number, location, depth o sediment, type and methods of sampling; sample preservation; and chemica laboratory test methods to be used shall be subject to the approval of the Director. Th Applicant shall also assess the pattern of the sediment deposition and the potentia increase in turbidity and suspended solid levels in the water column and at th sensitive receivers due to the disturbance of sediments during dredging, back fillin and dumping.

(xi) Predict, quantify and assess impacts on the hydrodynamic regime, water an sediment quality of the water system(s) and the sensitive receivers due to the activitie identified above. The prediction and quantification of impacts caused by sediment re suspension and contaminants release shall be carried out by mathematical modellin requirements as set out in Annex B of this Study Brief) or other techniques to b approved by the Director.

(xii) Evaluate the impacts of dredging, back filling and dumping, in particular sedimen re-suspension and contaminants release, and their effects on ecological sensitiv receivers at Green Island as identified in Section 3.6.2.

(xiii) Review, evaluate and identify best practicable dredging and backfilling methods t minimize, to the maximum extent, marine mud disturbance, the need for dumping an any demand for fill sources. The Applicant shall work on the presumption tha existing marine mud shall be left in place and not be disturbed as far as possible. Th selected method shall take into consideration the need to protect ecological sensitiv receivers identified at Green Island as required under Section 3.6.2. The selecte method shall also take into consideration the need to reduce to the maximum exten the creation of visually intrusive sediment plume to key vantage points, such a commercial buildings fronting the harbour. Where appropriate, the effectiveness o mitigation measures to reduce the size of such plumes shall be included.

(xiv) The Applicant shall devise mitigation measures to avoid or minimize the impact identified. The residual impacts on the water system(s) and the sensitive receiver with regard to the relevant water and sediment quality objective, criteria, standards o guidelines shall be assessed and quantified using appropriate mathematical modellin as set out in Annex B to this Study Brief or other techniques to be approved by th Director.

(xv) The Applicant shall assess the potential impact to the marine, coastal or lan environment when applying the hydrostatic tests. The chemicals and their respectiv concentrations to be used for the tests, the potential for their escape into th environment during the testing and their secondary impact on the receivin environment, the effectiveness of any proposed mitigations shall be covered. I necessary, the dispersion of these chemicals shall be assessed and quantified usin appropriate mathematically modelling as set out in Annex B to this Study Brief o other techniques to be approved by the Director

3.6.2 Marine Ecological Impact

3.6.2.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing ecological impact as stated in Annexes 8 and 16 of the TM, respectively.

3.6.2.2 The assessment area for the purpose of this ecological impact assessment shall be the same as the assessment area for Water Quality Impact Assessment, and to include any other area likely to be impacted by the Project, such as Green Island.

3.6.2.3 In the ecological impact assessment, the Applicant shall examine the flora, fauna and other components of the ecological habitats within the assessment area. The aim shall be to protect, maintain or rehabilitate the natural environment. The assessment shall identify and quantify the potential ecological impacts associated with the Project.

3.6.2.4 The assessment shall include the following major tasks:

(i) review the findings of relevant studies and collate the available information regarding the ecological characters of the assessment area;

(ii) evaluate information collected and identify any information gap relating to the assessment of potential ecological impacts to coastal and aquatic environment;

(iii) carry out necessary field surveys and investigations to verify the information collected, fill the information gaps identified and fulfil the objectives of the EIA study;

(iv) establish the general ecological profile and describe the characteristics of each habitat found; major information to be provided shall include :

- (a) description of the physical environment;
- (b) habitat maps of suitable scale showing the types and locations of habitats in the assessment area;
- (c) ecological characteristics of each habitat type such as size, vegetation and/or substrate type, species present, dominant species found, species diversity and abundance, community structure, seasonal patterns, inter-dependence of the habitats and species, and presence of any features of ecological importance;
- (d) representative colour photos of each habitat type and any important ecological features identified;
- (e) species found that are rare, endangered and/or listed under local legislation, international conventions for conservation of wildlife / habitats or red data books;

(v) investigate and describe the existing wildlife uses of various habitats;

(vi) describe recognized sites of conservation importance in the assessment area, and assess whether these sites will be affected by the Project or not;

(vii) using suitable methodology, identify and quantify any direct, indirect, on-site, primary, secondary and cumulative ecological impacts such as destruction of habitats, reduction of species abundance/diversity, loss of feeding and breeding grounds, reduction of ecological carrying capacity and habitat fragmentation.;

(viii) identify ecological sensitive receivers including sensitive elements of marine, subtidal, and intertidal communities/ habitats which would be potentially affected directly or indirectly by the Project. The corals at Green Island shall be included as one of the major sensitive receivers;

(ix) evaluate the significance and acceptability of the ecological impacts identified using well-defined criteria;

Ecological Mitigation

(x) consider, evaluate and recommend possible alternatives and practicable mitigation measures to avoid, minimize, and/or compensate for the adverse ecological impacts identified.

(xi) evaluate the feasibility and effectiveness of the recommended mitigation measures and define the scope, type, location, implementation arrangement, subsequent management and maintenance of such measures;

(xii) determine and quantify the residual ecological impacts after implementation of the proposed mitigation measures;

(xiii) evaluate the severity and acceptability of the residual ecological impacts using well-defined criteria and determine if off-site mitigation measures are necessary to mitigate the residual impacts; and

(xiv) review and recommend any ecological monitoring programme required.

3.6.3 Noise Impact (Construction Stage)

3.6.3.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing the construction noise impacts arising from the Project as stated in Annexes 5 and 13 of the TM respectively. In response to Section 4.4.2(h) of the TM, the Applicant shall review and consider any lessons learnt from other similar projects for incorporation in the current proposal to avoid in the first instance or minimize potential noise impacts.

3.6.3.2 The noise impact assessment shall include the following:

(i) <u>Determination of Assessment Area</u>

The study area shall include all areas within a distance of 300m from the Project boundary. The study area may be reduced accordingly if the first layer of noise sensitive receivers (NSRs), closer than 300m from the outer project limit, provides acoustic shielding to those receivers located further away. In this case, the study area shall be agreed with the Director. Subject to the agreement of the Director, the assessment area shall be expanded to include NSRs at greater distance which would be affected by the construction of the Project.

(ii) <u>Provision of Background Information and Existing Noise Levels</u>

The Applicant shall provide background information relevant to the Project, e.g. relevant previous or current studies. Unless involved in the planning standards, e.g. those for planning of fixed noise sources, no existing noise levels are particularly required.

(iii) Identification of Noise Sensitive Receivers

(a) The Applicant shall refer to Annex 13 of the TM when identifying the NSRs. The NSRs shall include existing NSRs and planned/ committed noise sensitive developments and uses earmarked on the relevant Outline Zoning Plans, Outline Development Plans and Layout Plans, and other relevant published land use plans.

(b) The Applicant shall select assessment points to represent all identified NSRs for carrying out quantitative noise assessment as described below. The assessment points shall be agreed with the Director prior to the quantitative noise assessment. A map shall be given showing the location of each and every selected assessment points.

(iv) Provision of an Emission Inventory of the Noise Sources

The Applicant shall provide inventory of noise sources including representative construction equipment assumed for assessing construction noise associated with the dredging, laying of pipe and backfilling works. Confirmation of the validity of the inventory shall be obtained from the relevant government departments or authorities.

(v) Construction Noise Assessment

(a) Based on best information, the assessment shall cover the cumulative noise impacts due to the construction works of the Project and other projects and works in the vicinity.

(b) The Applicant shall carry out assessment of noise impact from construction (excluding percussive piling) of the project during day time, i.e. 7 a.m. to 7 p.m., on weekdays other than general holidays in accordance with the methodology stipulated in paragraphs 5.3. and 5.4 of Annex 13 of the TM. The criteria in Table 1B of Annex 5 of the TM shall be adopted in the assessment.

(c) If the unmitigated construction noise levels are found exceeding the relevant criteria, the Applicant shall propose practicable direct mitigation measures (including movable barriers, enclosures, quieter alternative methods, re-scheduling and restricting hours of operation of noisy task) to minimize the impact. If the mitigated noise levels still exceed the relevant criteria, the duration of the noise exceedance shall be given.

(d) In case the Applicant would like to evaluate whether construction works in restricted hours as defined under the Noise Control Ordinance (NCO) are feasible or not in the context of programming construction works, reference should be made to the relevant technical memoranda issued under the NCO. Regardless of the results of the construction noise impact assessment for restricted hours, the Noise Control Authority will process the Construction Noise Permit (CNP) application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the contemporary conditions/situations. This aspect should be explicitly stated in the noise chapter and the conclusions and recommendations chapter in the EIA report.

(vi) Assessment of Side Effects and Constraints

The Applicant shall identify, assess and propose means to minimise any side effects and to resolve any potential constraints due to the inclusion of any recommended direct technical remedies.

3.6.4 **Waste Management Implications**

3.6.4.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing waste management implications as stated in Annexes 7 and 15 of the TM

3.6.4.2 The assessment of waste management implications shall cover the following :

(i) Analysis of Activities and Waste Generation

The Applicant shall identify the quantity, quality and timing of the waste arising as a result of the construction and operation activities, based on the sequence and duration of these activities.

(ii) Proposal for Waste Management

(a) Prior to considering the disposal options for various types of wastes, opportunities for reducing waste generation and on-site or off-site reuse shall be fully evaluated. Measures which can be taken in the planning and design stages e.g. by modifying the design approach and in the construction stage for maximising waste reduction shall be separately considered.

(b) Having taken into account the opportunities for reducing waste generation and maximizing reuse, the types and quantities of the wastes required to be disposed of as a consequence shall be estimated and the disposal options for each type of waste described in detail. The disposal method recommended for each type of wastes shall take into account the result of the assessment set out in (c) below.

(c) The impact caused by handling (including labelling, packaging and storage), collection, and disposal of wastes shall be addressed in detail and appropriate mitigation measures proposed. This assessment shall cover the following areas:

- potential hazard;
- air & odour emissions;
- noise;
- wastewater discharge; and
- public transport.

(iii) Dredging, Filling and Dumping

(a) identification and quantification of dredging, fill extraction, filling, mud/sediment transportation and disposal activities and requirements. Potential fill source and dumping ground to be involved shall also be identified. Field investigation, sampling and chemical and biological laboratory tests to characterize the sediment/mud concerned shall be conducted as appropriate. The ranges of parameters to be analyzed; the number, type and methods of sampling; sample preservation; chemical and biological laboratory test method; and the laboratory to be used shall be subject to the approval of the Director. Any seriously contaminated sediment which requires special treatment and/or disposal arrangement in accordance with WBTC No.34/2002 shall be identified by both chemical and biological tests. If the presence of such sediment is confirmed, the Applicant shall identify the most appropriate treatment and/or disposal arrangement and demonstrate its feasibility.

(b) Identification and evaluation of the best practicable dredging methods to minimize dredging and dumping requirements and demand for fill sources based on the criterion that existing marine mud shall be left in place and not to be disturbed as far as possible.

3.6.5 **Air Quality Impact**

3.6.5.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing air quality impact as stated in section 1 of Annex 4 and Annex 12 of the TM respectively.

3.6.5.2 The assessment area for air quality impact shall general be defined by a distance of 500m from the proposed project boundary.

3.6.5.3 The Applicant shall review the constructional dust impact arising from land based work of the project with respect to the following:

Background and analysis of activities

(i) provide background information relating to air quality issues relevant to the project, e.g. description of the types of activities of the projects.

(ii) give an account of the considerations/ measures that had been considered in the planning of the project to abate the air pollution impact. That is, the Applicant should consider alternative construction methods/ phasing programmes to minimize the constructional air quality impact.

(iii) present the background air quality levels in the assessment area for the purpose of evaluating the cumulative constructional air quality impacts.

Identification of ASRs

(iv) identify and describe representative existing and planned/committed air sensitive receivers (ASRs) that would likely be affected by the project. The Applicant shall select the assessment points of the identified ASRs such that they represent the worst impact point of these ASRs. A map showing the location and a description including the name of the buildings, their uses and height of the selected assessment points shall be given. The separation distances of these ASRs from the nearest emission sources should also be given.

(v) provide an exhaustive list of air pollutant emission sources, including any nearby emission sources, which are likely to have impact on the project. Examples of constructional stage emission sources include stock piling, concrete batching and vehicular movements on unpaved haul roads on site, etc.

Mitigation Measures

(vi) The Applicant shall follow the requirements of the Air Pollutant Control (Construction Dust) Regulation and propose any other remedies or mitigation measures in dust control to ensure construction dust impacts are controlled within the relevant standards as stipulated in section 1 of Annex 4 of the TM.

3.6.6 **Cultural Heritage Impact**

The Applicant shall engage a qualified marine archaeologist to review available information to identify whether there is any possible existence of sites or objects of cultural heritage, for example shipwreck, within the seabed that will be affected by the marine works of the Project. The result of the review shall be presented as a written report and charts. If possible existence of sites or objects of cultural heritage are found, a Marine Archaeological Investigation (MAI) shall be required. The MAI shall be carried out by a qualified marine archaeologist who shall obtain a Licence from the Antiquities Authority under the provision of the Antiquities and Monuments Ordinance (Cap. 53). The requirements of the MAI are set out in Annex C of this EIA study brief.

3.6.7 Fisheries Impact

The Applicant shall investigate the fishing activities within the coastal and marine areas affected by the Project, and assess the potential of any fisheries impact that might arise from the construction and operation of the Project. If there is potential for fishery impact, the Applicant shall follow the criteria and guidelines contained in Annexes 9 and 17 of the TM for evaluating and assessing fisheries impact.

3.6.8 Summary of Environmental Outcomes

The EIA report shall contain a summary of the key environmental outcomes arising from the EIA study, including the population and environmentally sensitive areas protected, environmentally friendly designs recommended, key environmental problems avoided, and the environmental benefits of environmental protection measures recommended.

4. ENVIRONMENTAL MONITORING & AUDIT (EM&A) REQUIREMENTS

4.1 The Applicant shall identify in the EIA study whether there is any need for EM&A activities during the construction phase of the project and, if affirmative, to define the scope of the EM&A requirements for the project in the EIA study.

4.2 Subject to the confirmation of the EIA study findings, the Applicant shall comply with the requirements as stipulated in Annex 21 of the TM.

4.3 The Applicant shall prepare a project implementation schedule (in the form of a checklist) containing all the EIA study recommendations and mitigation measures with reference to the implementation programme.

5. DURATION OF VALIDITY

5.1 The Applicant shall notify the Director of the commencement of the EIA study. If the EIA study does not commence within 36 months after the date of issue of this EIA study brief, the Applicant shall apply to the Director for a fresh EIA study brief before commencement of the EIA study.

6. REPORT REQUIREMENTS

6.1 In preparing the EIA report, the Applicant shall refer to Annex 11 of the TM for the contents of an EIA report. The Applicant shall also refer to Annex 20 of the TM, which stipulates the guidelines for the review of an EIA report.

6.2 The Applicant shall supply the Director with the following number of copies of the EIA report and the executive summary:

(i) 40 copies of the EIA report in English and 50 copies of the executive summary (each bilingual in both English and Chinese) as required under section 6(2) of the EIAO to be supplied at the time of application for approval of the EIA report.

(ii) when necessary, addendum to the EIA report and the executive summary submitted in (i) above as required under section 7(1) of the EIAO, to be supplied upon advice by the Director for public inspection.

(iii) 20 copies of the EIA report in English and 50 copies of the executive summary (each bilingual in both English and Chinese) with or without Addendum as required under section 7(5) of the EIAO, to be supplied upon advice by the Director for consultation with the Advisory Council on the Environment.

6.3 In addition, to facilitate the public inspection of the EIA Report via the EIAO Internet Website, the applicant shall provide electronic copies of both the EIA Report and the Executive Summary Report prepared in HyperText Markup Language (HTML) (version 4.0 or later) and in DynaDoc Format (version 3.0 or later) [for Chinese documents] and in Portable Document Format (PDF version 3.0 or later) [for English documents], unless otherwise agreed by the Director. For the HTML version, a content page capable of providing hyperlink to each section and sub-section of the EIA Report and the Executive Summary Report shall be included in the beginning of the document, and all graphics in the report shall be in interlaced GIF format.

6.4 The electronic copies of the EIA report and the Executive Summary shall be submitted to the Director at the time of application for approval of the EIA Report.

6.5 When the EIA Report and the Executive Summary are made available for public inspection under section 7(1) of the EIA Ordinance, the content of the electronic copies of the EIA Report and the Executive Summary must be the same as the hard copies and the Director shall be provided with the most updated electronic copies.

7. OTHER PROCEDURAL REQUIREMENTS

7.1 During the EIA study, if there is any change in the name of the Applicant for this EIA study brief, the Applicant mentioned in this study brief must notify the Director immediately.

7.2 If there is any key change in the scope of the project mentioned in Section 1.2 of this EIA study brief and in Project Profile No. PP-258/2005, the Applicant must seek confirmation from the Director in writing on whether or not the scope of issues covered by this EIA study brief can still cover the key changes, and the additional issues, if any, that the EIA study must also address. If the changes to the project fundamentally alter the key scope of this EIA study brief, the Applicant shall apply to the Director for another EIA study brief afresh.

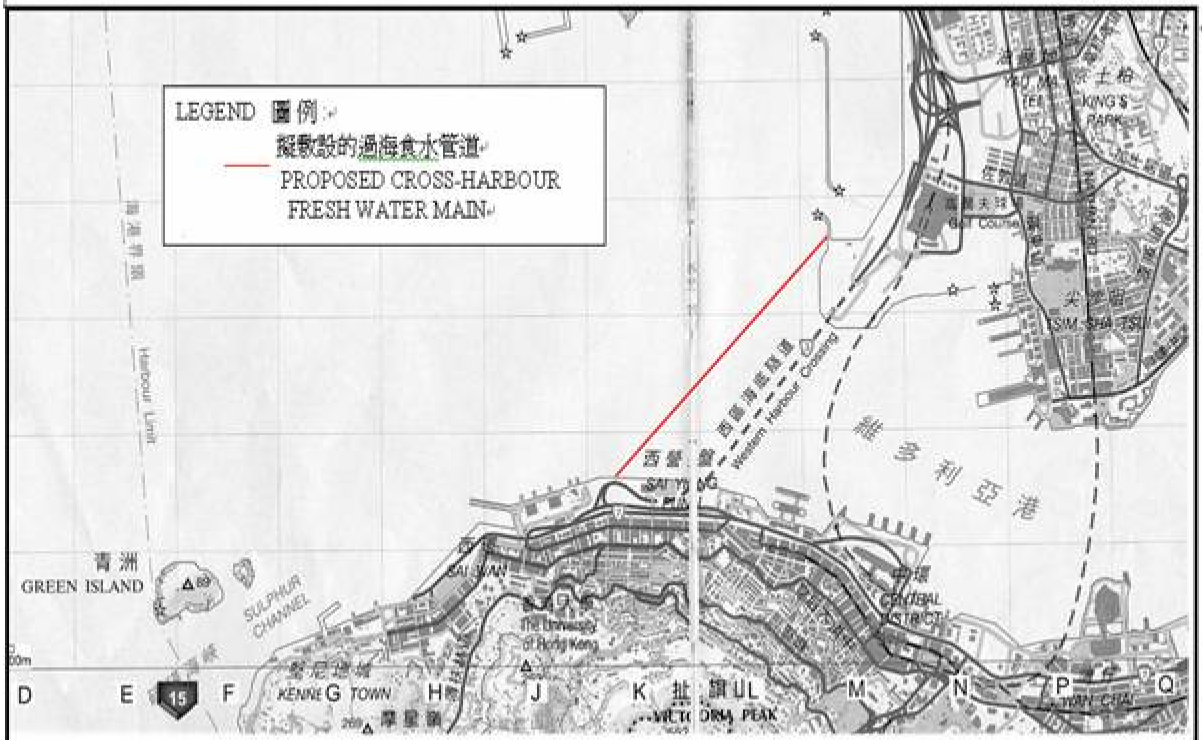
--- END OF EIA STUDY BRIEF ---

October 2005
Environmental Assessment Division,
Environmental Protection Department

Annex A

Project Title: **Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun**	**Annex A** **EIA Study Brief No. ESB-132/2005** Note: Reproduced from Sketch No SK 2005/025 in Project Profile PP-258/2005

Annex A 1



Project Title: **Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun**	**Annex A 1** EIA Study Brief No. ESB-132/2005	

Annex B

Environmental Impact Assessment Study Brief No. ESB-132/2005

Project Title: <u>Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun</u>

<u>Hydrodynamic and Water Quality Modelling Requirements</u>

Modelling Software General

1. The modelling software shall be fully 3-dimensional capable of accurately simulating the stratified condition, salinity transport, and effect of wind and tide on the water body within the model area.

2. The modelling software shall consist of hydrodynamic, water quality, sediment transport and particle dispersion modules. The hydrodynamic, water quality, sediment modules shall have been proven with successful applications locally and overseas.

3. The models shall be strictly mass conserved at all levels.

4. An initial dilution model may be used to characterize the initial mixing of the hydrostatic test effluent discharge, and to feed the terminal level and size of the plume into the far field water quality modules where necessary. The initial dilution model shall have been proven with successful applications locally and overseas.

Model Details – Calibration & Validation

1. No field data collection is required for model calibration for this study. However, the models shall be properly calibrated and validated before its use in this study in the Hong Kong waters, the Pearl Estuary and the Dangan (Lema) Channel with the relevant field data collected from:

    - Hydraulic and Water Quality Studies in Victoria Harbour (1987)
    - Port and Airport Development Strategy - Enhancement of WAHMO Mathematical Models (1990)
    - Strategic Sewage Disposal Scheme Stage II - Oceanic Outfall, Oceanographic Surveys and Modelling (1992)
    - Update on Cumulative Water Quality and Hydrological Effect of Coastal Development and Upgrading of Assessment Tool (1998)
    - EPD's routine monitoring data
    - Tidal data from HK Observatory, Macau and relevant Mainland Authorities.

2. Tidal data shall be calibrated and validated in both frequency and time domain manner.
3. For the purpose of calibration and validation, the model shall run for not less than 15 days of real sequence of tide (excluding model spin up) in both dry and wet seasons with due consideration of the time required to establish initial conditions.

4. In general the hydrodynamic models shall be calibrated to the following criteria :

Criteria	Level of fitness with field data
• tidal elevation (rms)	<8%
• maximum phase error at HW and LW	<20 minutes
• maximum current speed deviation	<30%
• maximum phase error at peak speed	<20 minutes
• maximum direction error at peak speed	<15 degrees

- maximum salinity deviation <2.5 ppt

<u>Model Details – Simulation</u>

1. The water quality modelling results shall be qualitatively explainable and any identifiable trend and variations in water quality shall be reproduced by the model. The water quality model shall be able to simulate and take account of the interaction of dissolved oxygen, phytoplankton, organic and inorganic nitrogen, phosphorus, silicate, BOD, temperature, suspended solids, air-water exchange, *E. coli.*, contaminant release of dredged and disposed material, and benthic processes. It shall also be able to simulate salinity. Salinity results simulated by hydrodynamic models and water quality models shall be demonstrated to be consistent.

2. The sediment transport module for assessing impacts of sediment loss due to marine works shall include the processes of settling, deposition and re-erosion. The values of the modelling parameters shall be agreed with the Director. Contaminants release and DO depletion during dredging and dumping shall be simulated by the model.

3. The models shall at least cover the Hong Kong waters, the Pearl Estuary, and Dangan (Lema) Channel to incorporate all major influences and hydrodynamic and water quality. A fine grid model may be used for detailed assessment of this study. It shall either be dynamically linked to a far field model or form part of a larger model by gradual grid refinement. The coverage of the proposed model shall be properly designed such that it is remote enough so that the boundary conditions would not be affected by the Project. The model coverage area shall be agreed with EPD.

4. In general, grid size at the area affected by the project shall be less than 400m in open waters and less than 75m around sensitive receivers. The grid schematisation shall be agreed with EPD.

<u>Modelling assessment</u>

1. Scenarios to be assessed shall cover the baseline condition and scenarios with various different options proposed by the Applicant in order to quantify the environmental impacts and improvements that will be brought about by these options. Corresponding pollution load, bathymetry and coastline shall be adopted in the model set up.

2. Hydrodynamic, water quality, sediment transport and particle dispersion modules, where appropriate, shall be run for (with proper model spin up) for at least a real sequence of 15 days spring-neap tidal cycle in both dry season and the wet season.

3. The modelled results shall be assessed for compliance of Water Quality Objectives. Any changes in hydrodynamic regime shall be assessed. Daily erosion/ sedimentation rate shall be computed and its ecological impact shall be assessed.

4. The impact on all sensitive receivers shall be assessed.

5. Cumulative impacts due to other projects, activities or pollution sources within a boundary to the agreement of EPD shall also be predicted and quantified.

6. All modelling input data and results shall be submitted in digital media to EPD.

Annex C

Environmental Impact Assessment Study Brief No. ESB-132/2005

Project Title: Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun

Guidelines for Marine Archaeological Investigation (MAI)

The standard practice for MAI should consist of four separate tasks, i.e. (1) Baseline

Review, (2) Geophysical Survey, (3) Establishing Archaeological Potential, and (4) Remote Operated Vehicle (ROV)/ Visual Diver Survey/ Watching Brief.

1. Baseline Review

1.1 A baseline review should be conducted to collate the existing information in order to identify the potential for archaeological resources and, if identified, their likely character, extent, quality and value.

1.2 The baseline review will focus on known sources of archive data. It will include:

a. Geotechnical Engineering Office (GEO) - the Department holds extensive seabed survey data collected from previous geological research.

b. Marine Department, Hydrographic Office - the Department holds a substantial archive of hydrographic data and charts.

c. The Royal Naval Hydrographic Department in the UK - the Department maintains an archive of all survey data collected by naval hydrographers.

1.3 The above data sources will provide historical records and more detailed geological analysis of submarine features which may have been subsequently masked by more recent sediment deposits and accumulated debris.

2. Geophysical Survey

2.1 Extensive geophysical survey of the study area should deploy high resolution boomer, side scan sonar and an echo sounder. The data received from the survey would be analyzed in detail to provide:

a. Exact definition of the areas of greatest archaeological potential.
b. Assessment of the depth and nature of the seabed sediments to define which areas consist of suitable material to bury and preserve archaeological material.
c. Detailed examination of the boomer and side scan sonar records to map anomalies on the seabed which may be archaeological material.

3. Establishing Archaeological Potential

3.1 The data examined during Tasks 1 and 2 will be analysed to provide an indication of the likely character and extent of archaeological resources within the study area. This would facilitate formulation of a strategy for investigation.

3.2 The results would be presented as a written report and charts. If there is no indication of archaeological material there would be no need for further work.

4. Remote Operated Vehicle (ROV)/ Visual Diver Survey/ Watching Brief

4.1 Subject to the outcome of Task 1, 2 and 3, accepted marine archaeological practice would be to plan a field evaluation programme to acquire more detailed data on areas identified as having archaeological potential. The areas of archaeological interest can be inspected by ROV or divers. ROV or a team of divers with both still and video cameras would be used to record all seabed features of archaeological interest.

4.2 Owing to the heavy marine traffic in Hong Kong, the ROV/visual diver survey may not be feasible to achieve the target. If that is the case, an archaeological watching brief is the most appropriate way to monitor the dredging operations in areas of identified high potential to obtain physical archaeological information.

4.3 A sampling strategy for an archaeological watching brief would be prepared based on the results of Task 1, 2 and 3 to focus work on the areas of greatest archaeological potential. Careful monitoring of the dredging operations would enable immediate identification and salvage of archaeological material. If archaeological material is found, the Antiquities and Monuments Office (AMO) should be contacted immediately to seek guidance on its significance and appropriate mitigation measures would be prepared.

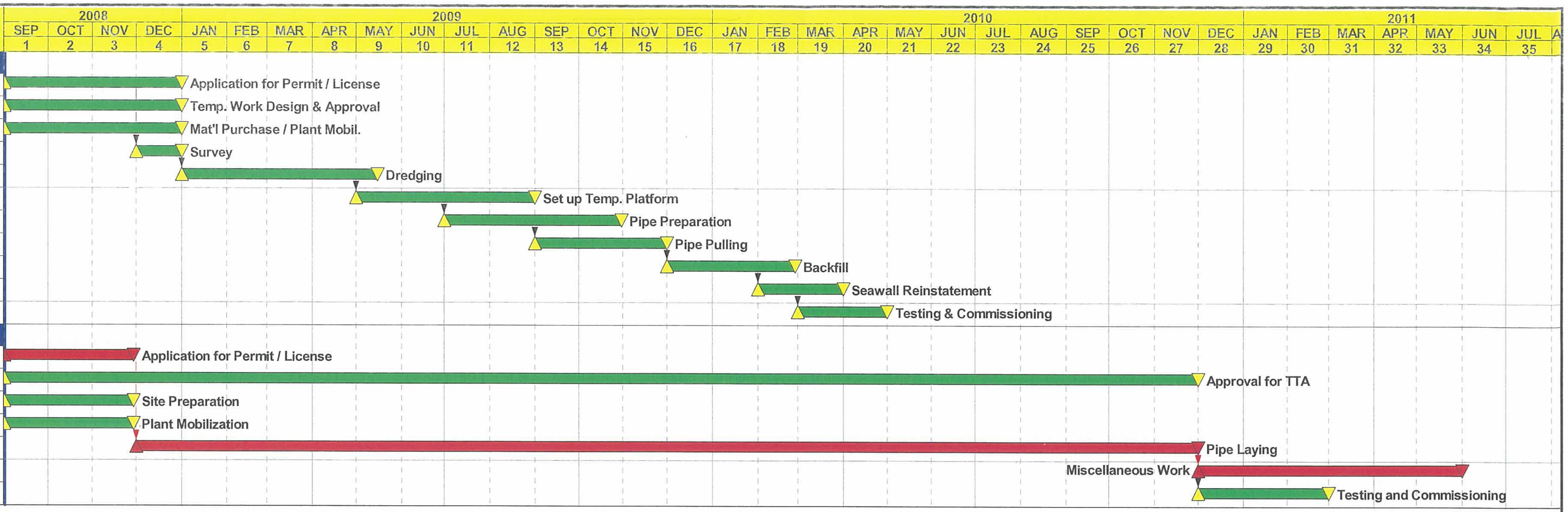
4.4 If Task 4 is undertaken, the results would be presented in a written report with charts

~ End ~

Appendix B

Tentative Project Programme

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
Submarine Main				
0001	Application for Permit / License	88	01SEP08	31DEC08
0002	Temp. Work Design & Approval	88	01SEP08	31DEC08
0003	Mat'l Purchase / Plant Mobil.	88	01SEP08	31DEC08
0004	Survey	23	01DEC08	31DEC08
0005	Dredging	97	01JAN09	15MAY09
0006	Set up Temp. Platform	87	01MAY09	31AUG09
0007	Pipe Preparation	88	01JUL09	30OCT09
0008	Pipe Pulling	65	01SEP09	30NOV09
0009	Backfill	64	01DEC09	26FEB10
0010	Seawall Reinstatement	43	01FEB10	31MAR10
0011	Testing & Commissioning	45	01MAR10	30APR10
Land Mains				
0014	Application for Permit / License	65	01SEP08	28NOV08
0015	Approval for TTA	587	01SEP08	30NOV10
0012	Site Preparation	65	01SEP08	28NOV08
0013	Plant Mobilization	65	01SEP08	28NOV08
0016	Pipe Laying	522	01DEC08	30NOV10
0018	Miscellaneous Work	130	01DEC10	31MAY11
0017	Testing and Commissioning	64	01DEC10	28FEB11



Start Date	01SEP08
Finish Date	31MAY11
Data Date	01SEP08
Run Date	30MAR07 16:15

Early Bar
Progress Bar
Critical Activity

Tentative Project Programme
Agreement No. CE42/2005 (WS)
Laying of Western Cross Harbour Main and Associated Land Mains
from West Kowloon to Sai Ying Pun
- Investigation

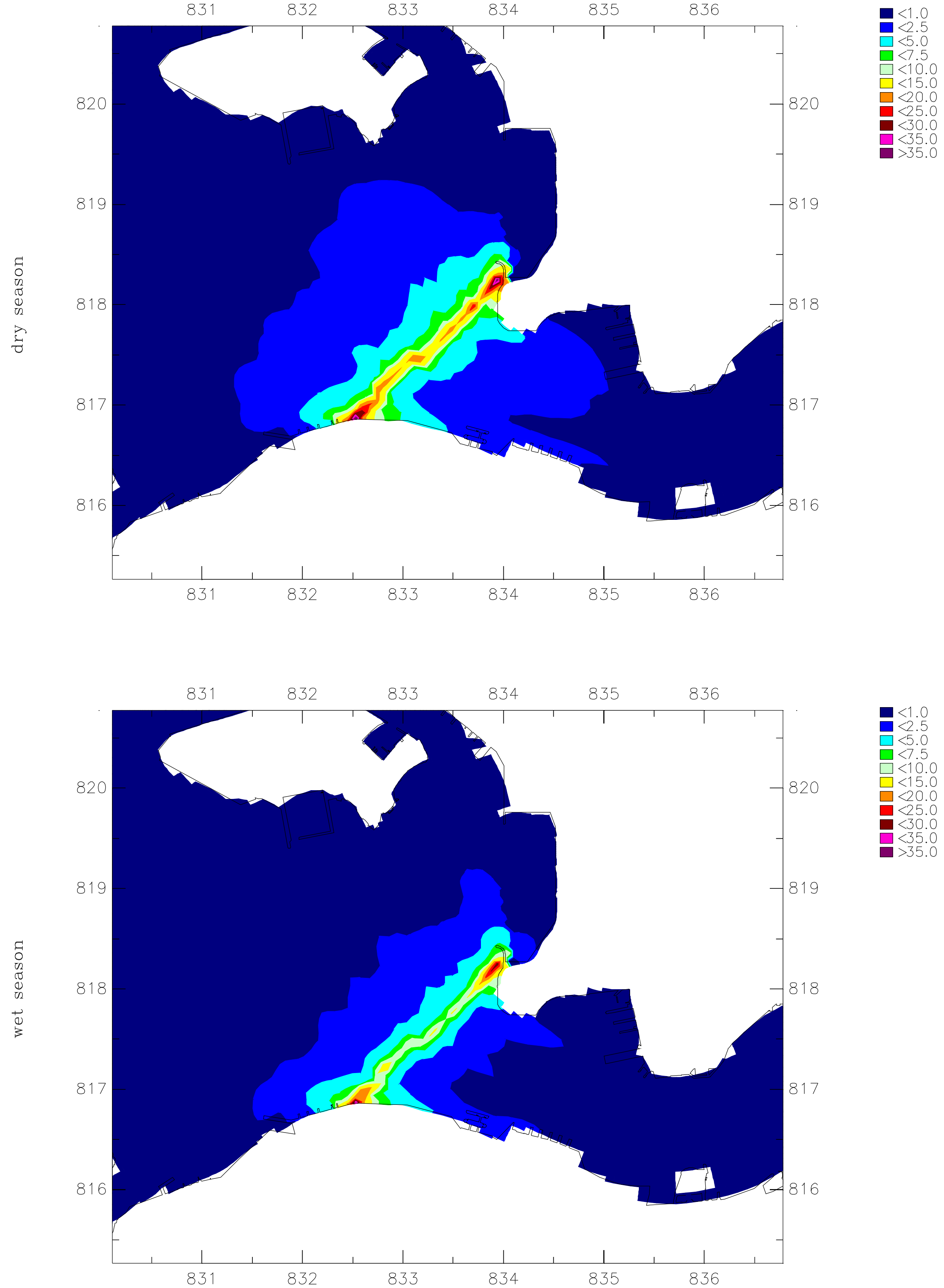
Sheet 1 of 1

Figure 4.1

Tentative Project Programme

Appendix C1

Water Quality Modelling Results



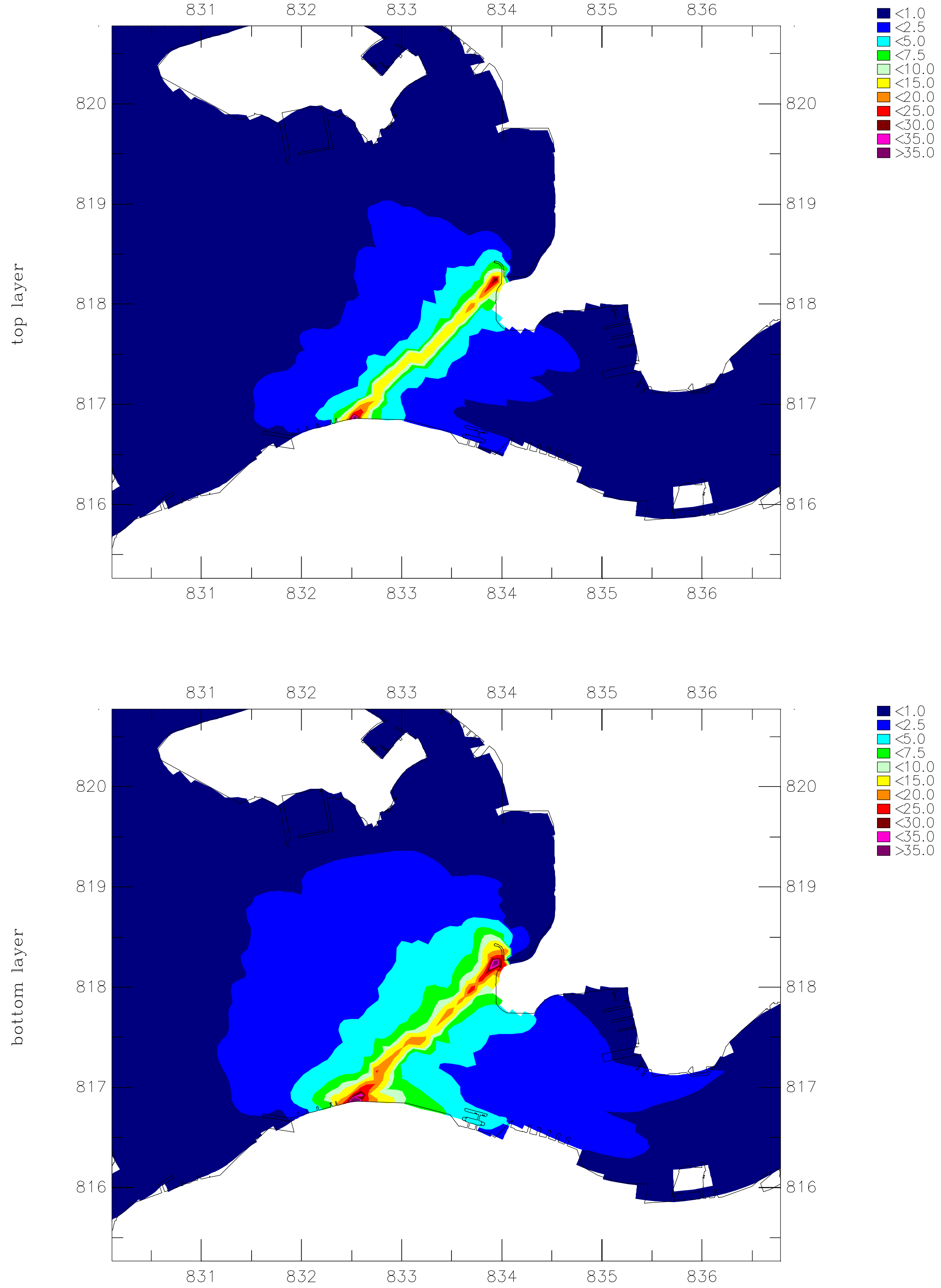
Depth averaged suspended sediment (mg/l)
Upper: Dry season maximum elevation
Lower: Wet season maximum elevation

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.1a



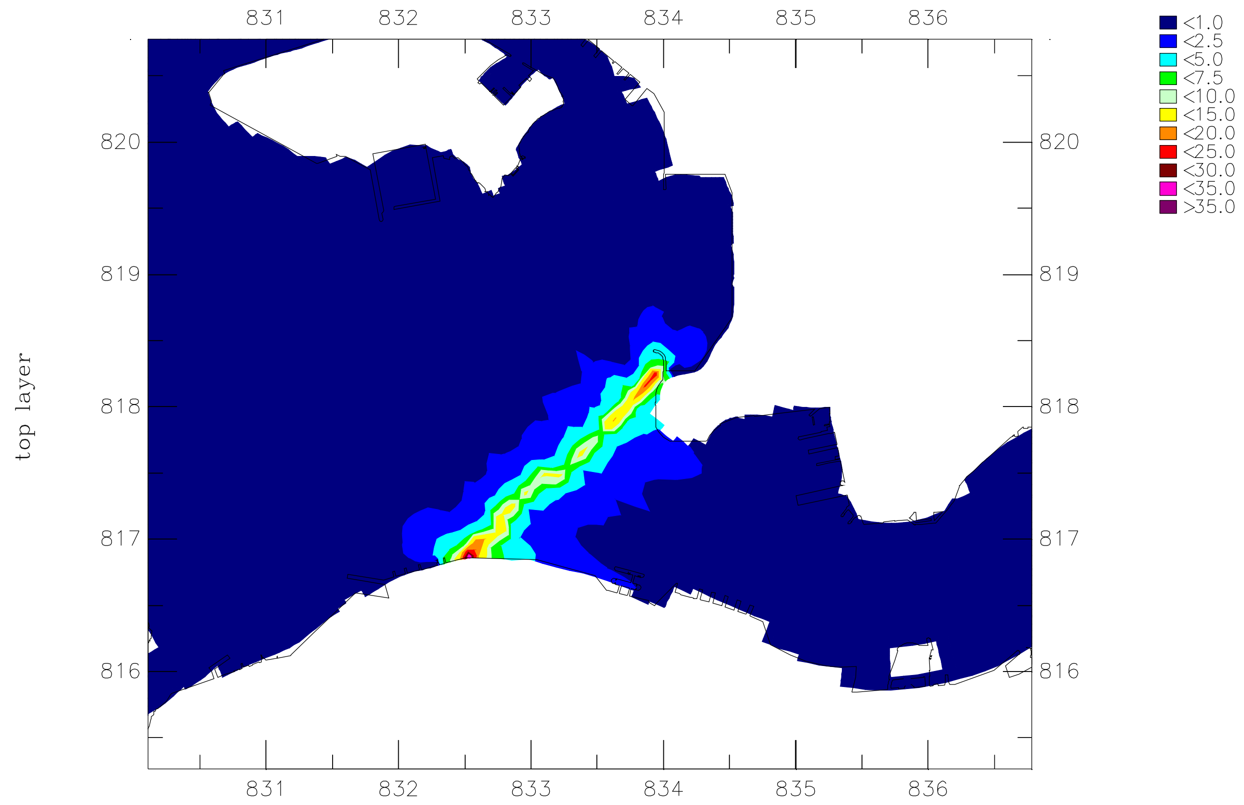
Suspended Sediment (mg/l)
Upper: Dry season maximum elevation top layer
Lower: Dry season maximum elevation bottom layer

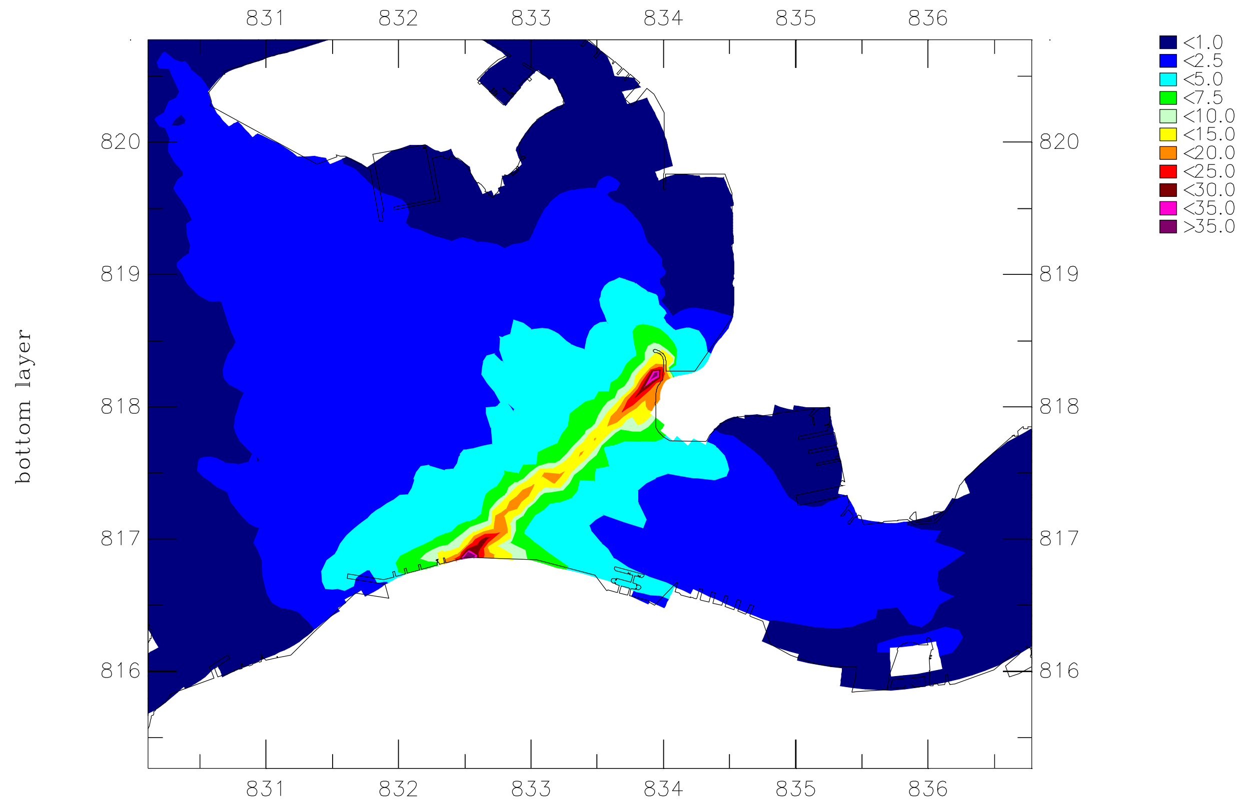
Z4187

Cross Harbour Water Mains

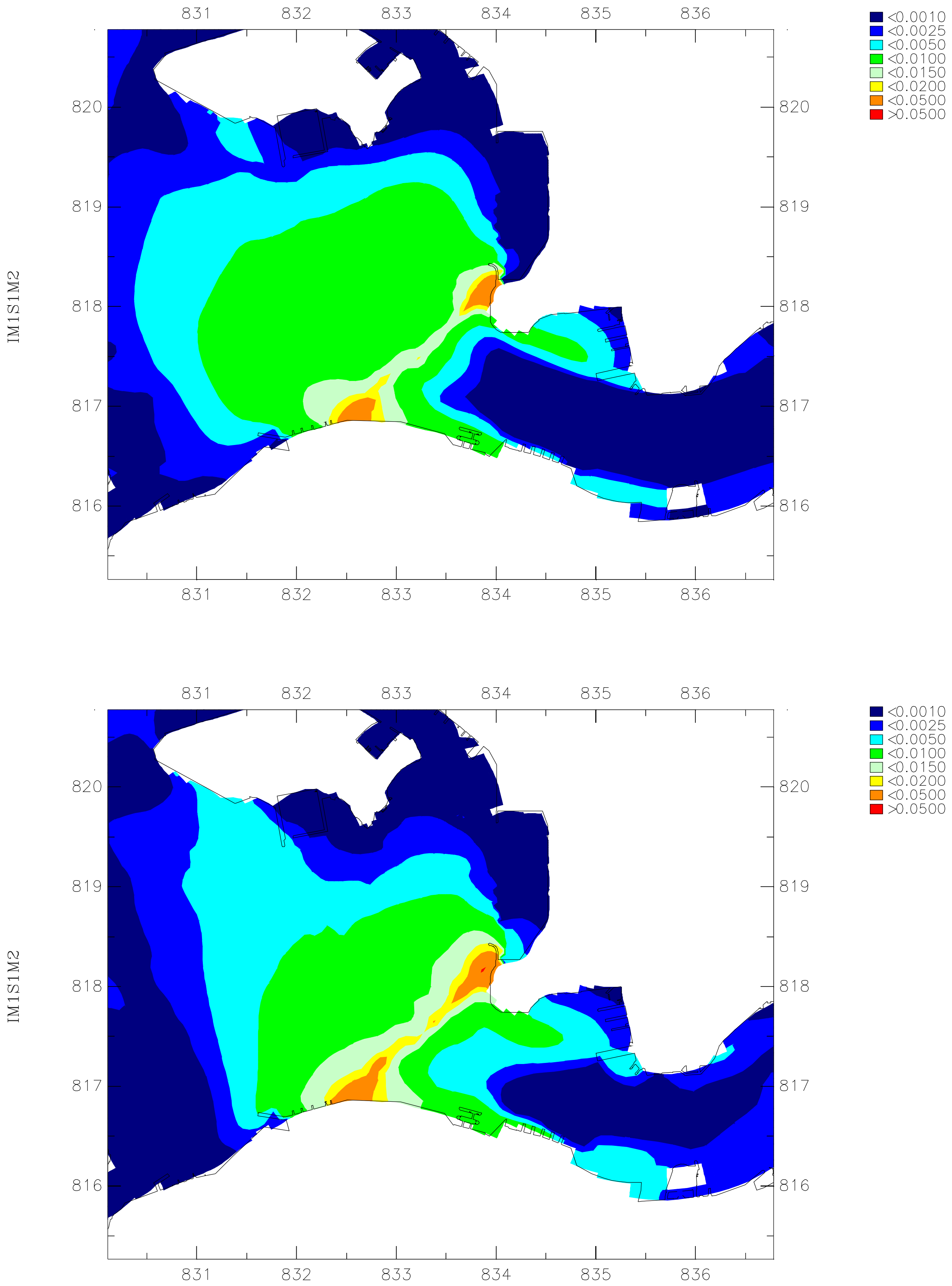
WL | Delft Hydraulics

Figure C3.1b





Suspended Sediment (mg/l) Upper: Wet season maximum elevation top layer Lower: Wet season maximum elevation bottom layer	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	**Figure C3.1c**	



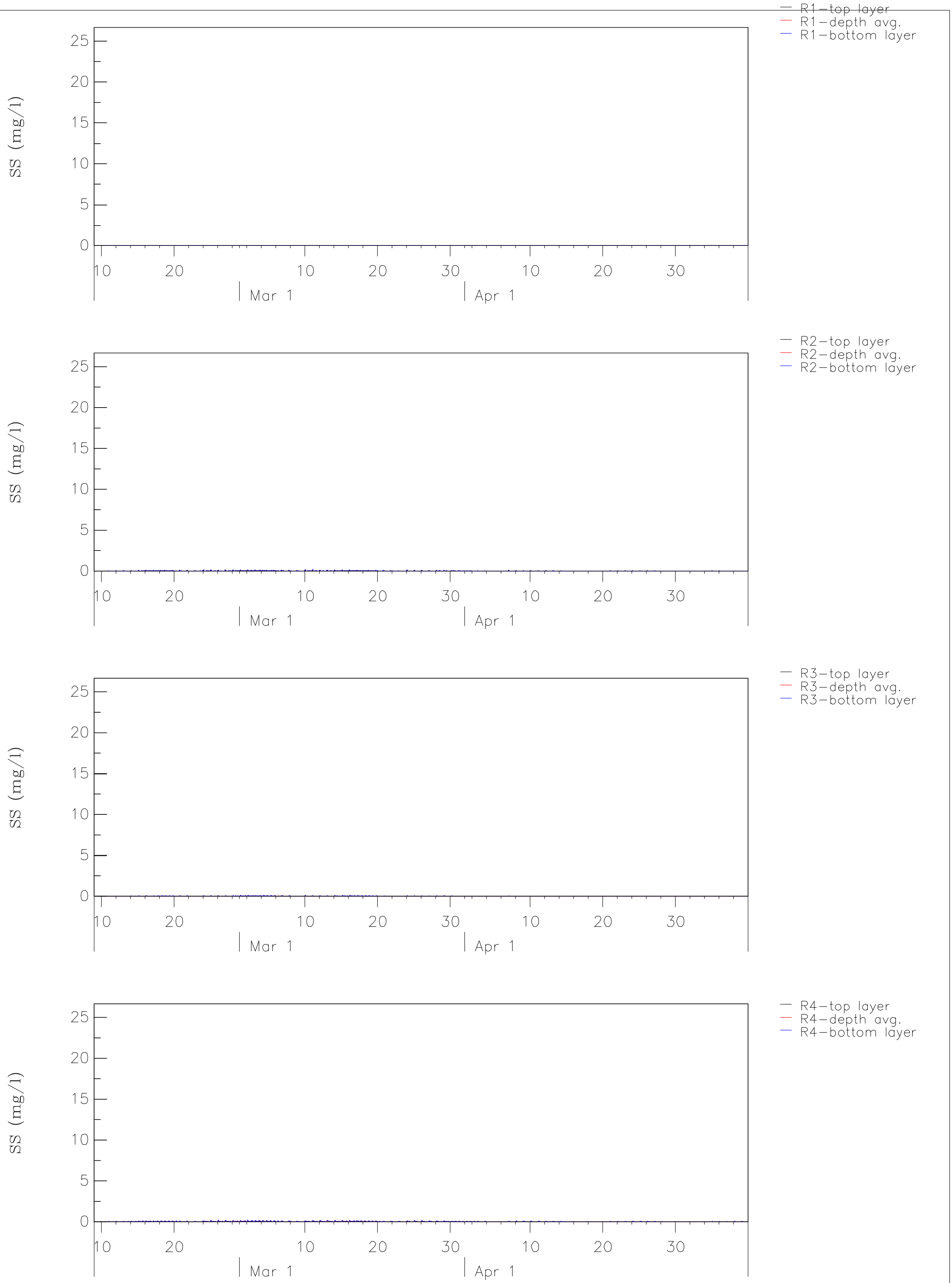
Nett sedimenation (kg/m2/d)
Upper: Dry season
Lower: Wet season

Z4187

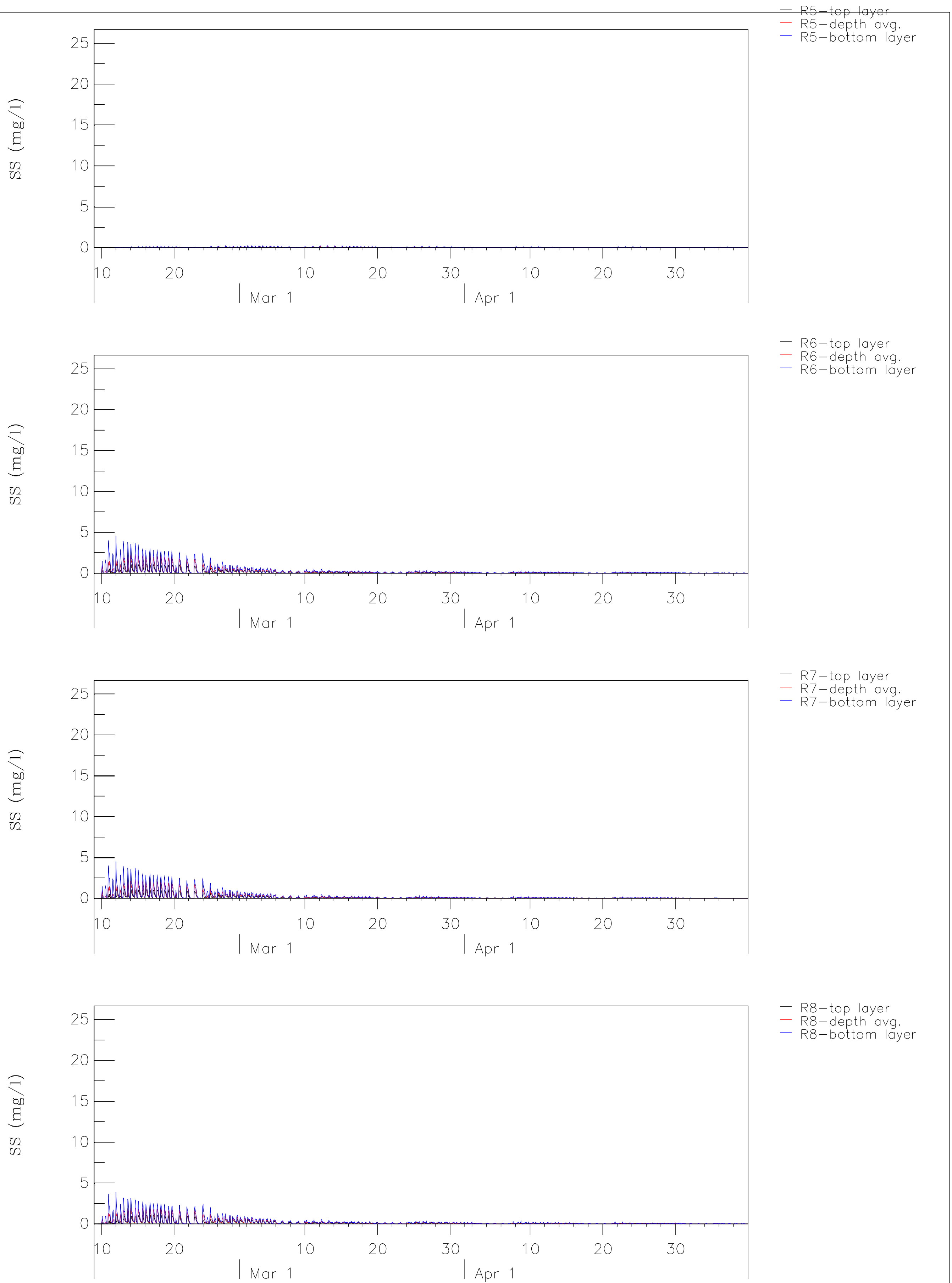
Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.1d



Suspended Sediment (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R1, R2, R3, R4	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	**Figure C3.1e**	



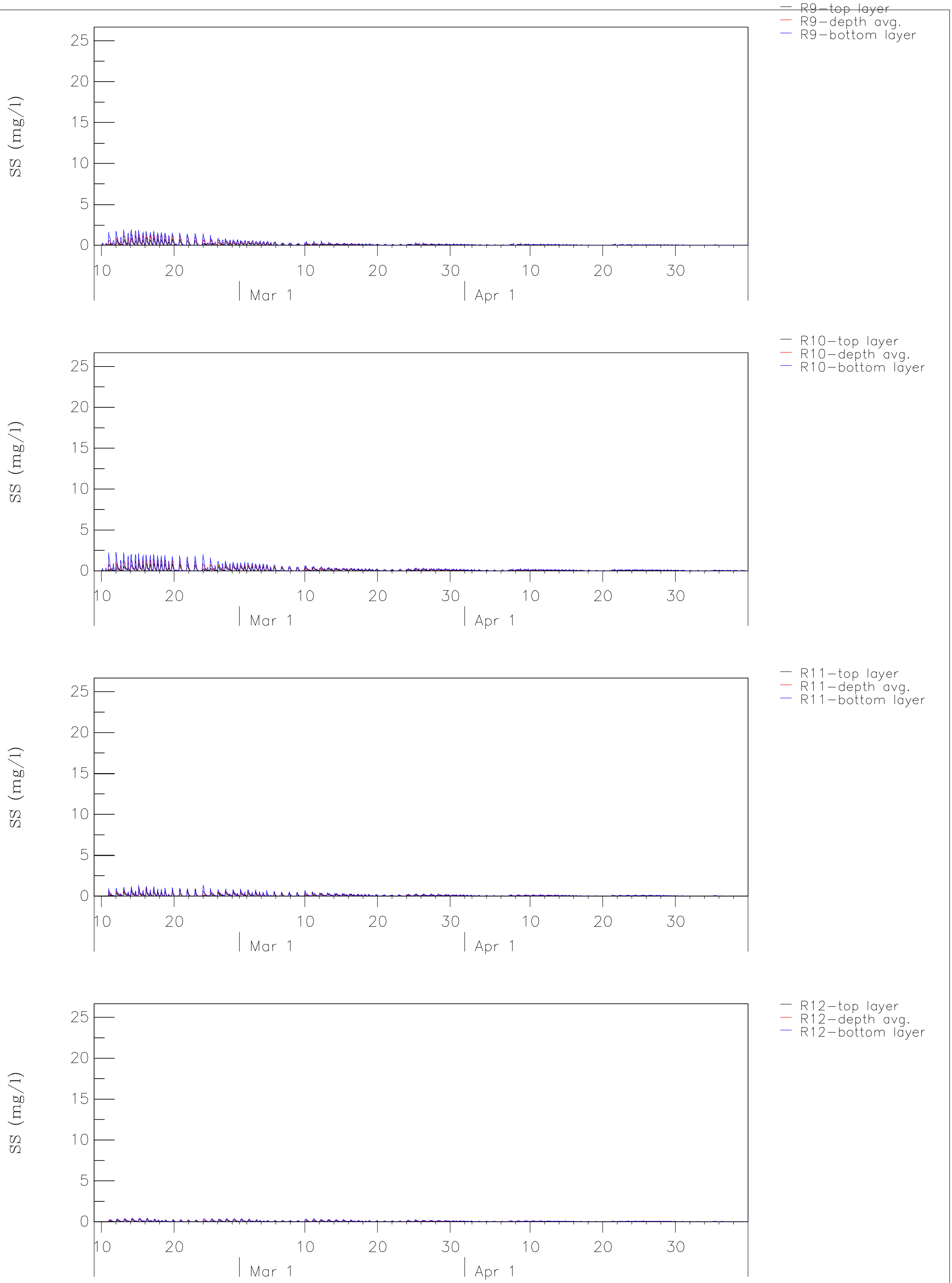
Suspended Sediment (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.1f



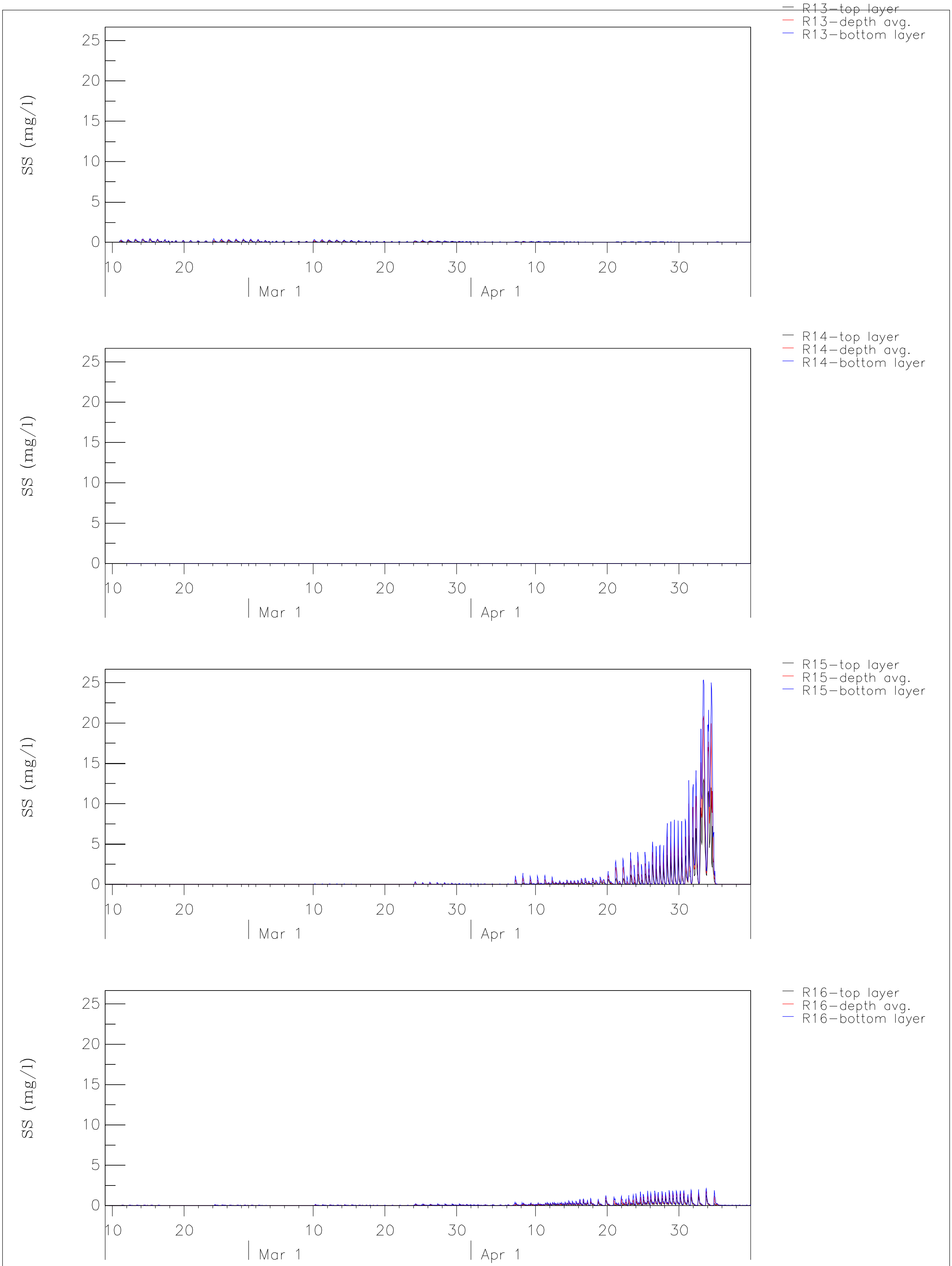
Suspended Sediment (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R9, R10, R11, R12

Z4187

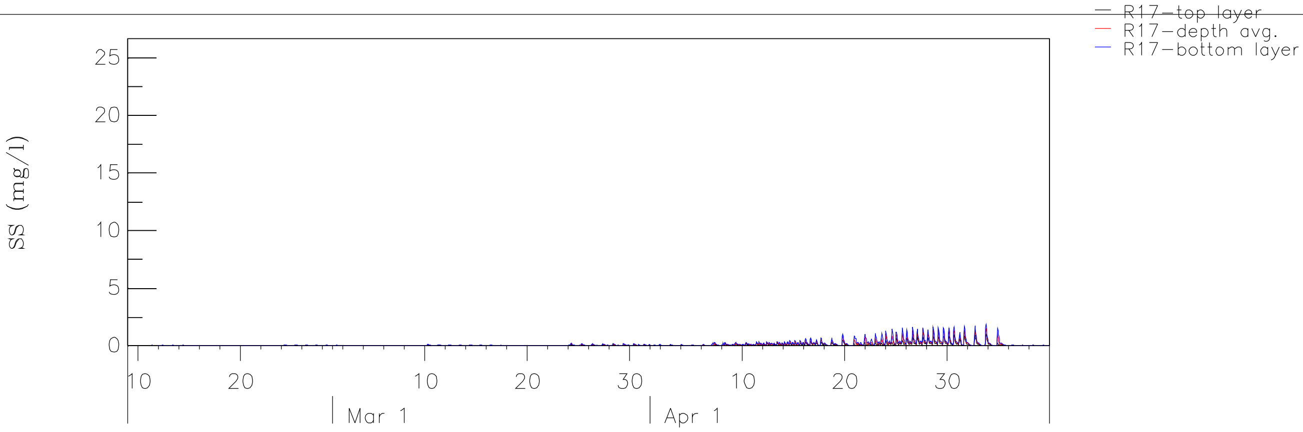
Cross Harbour Water Mains

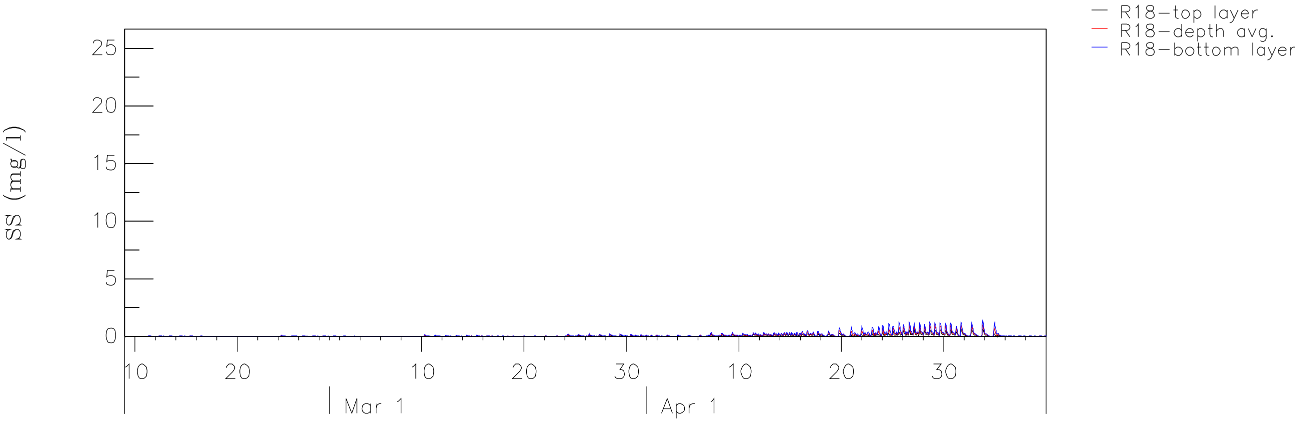
WL | Delft Hydraulics

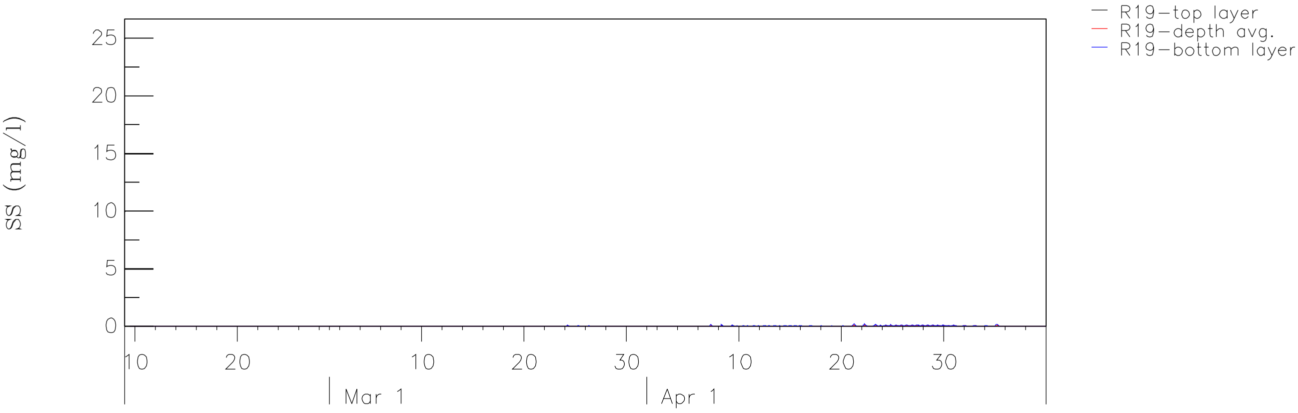
Figure C3.1g

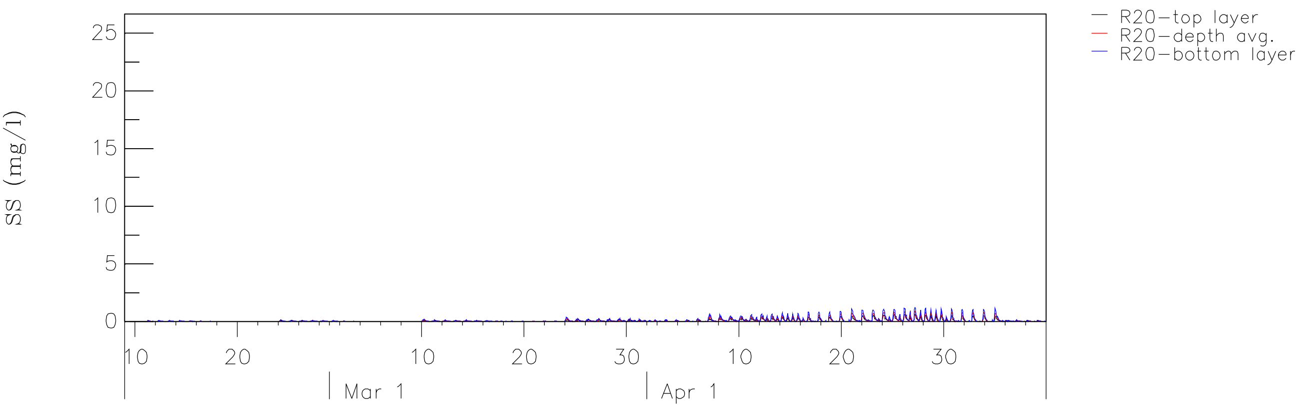


Suspended Sediment (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R13, R14, R15, R16	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	**Figure C3.1h**









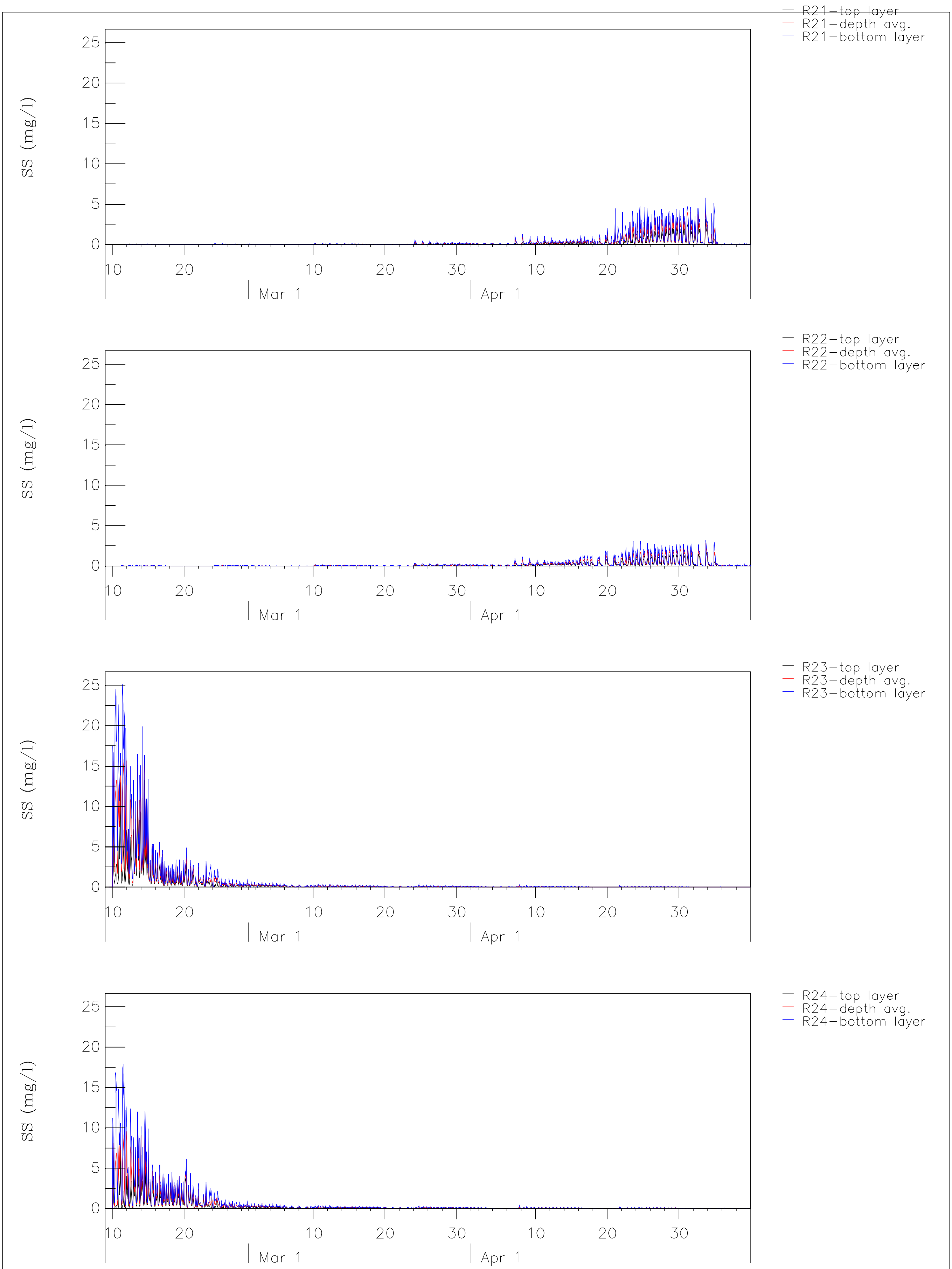
Suspended Sediment (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R17, R18, R19, R20

Z4187

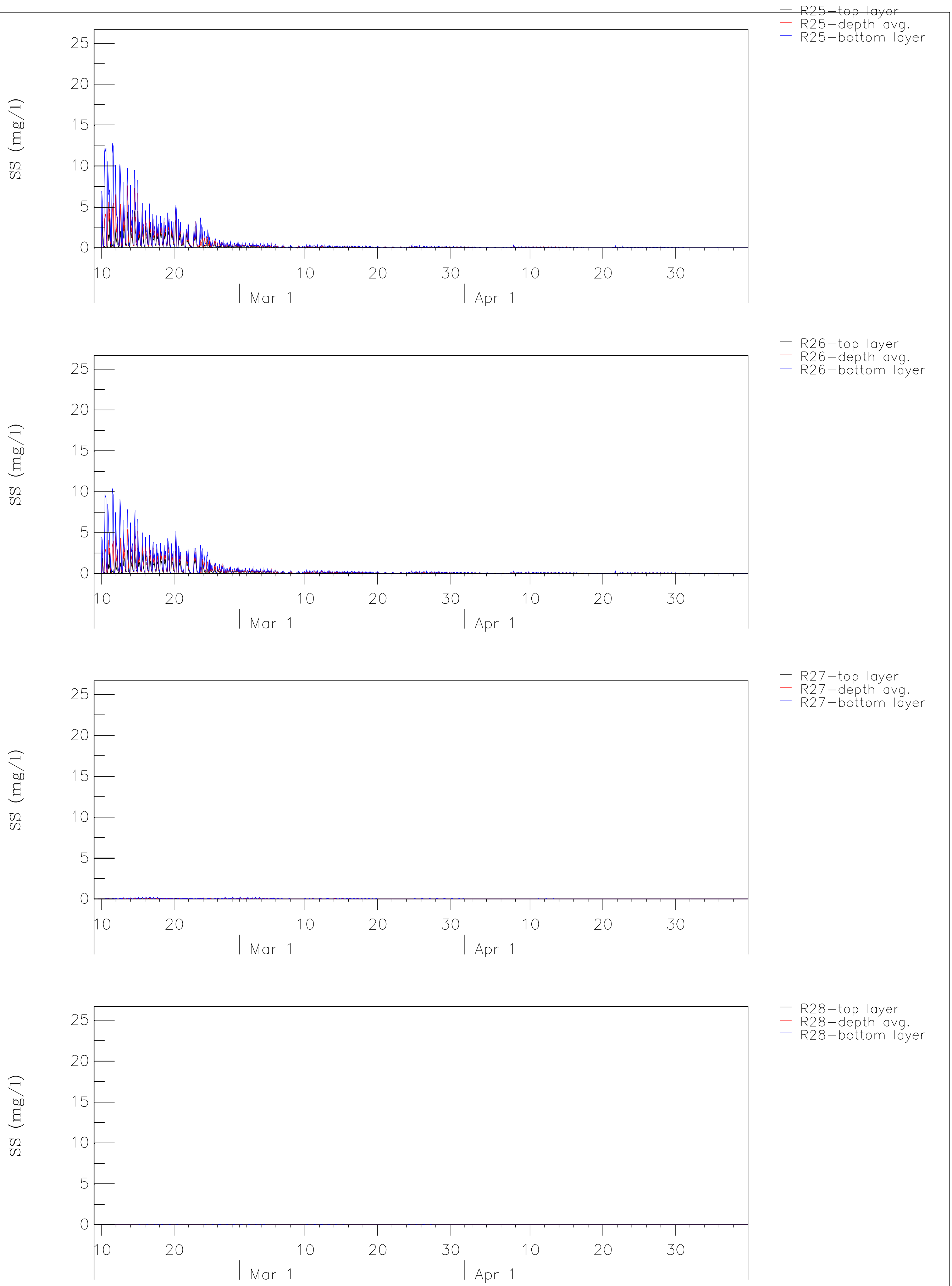
Cross Harbour Water Mains

WL | Delft Hydraulics

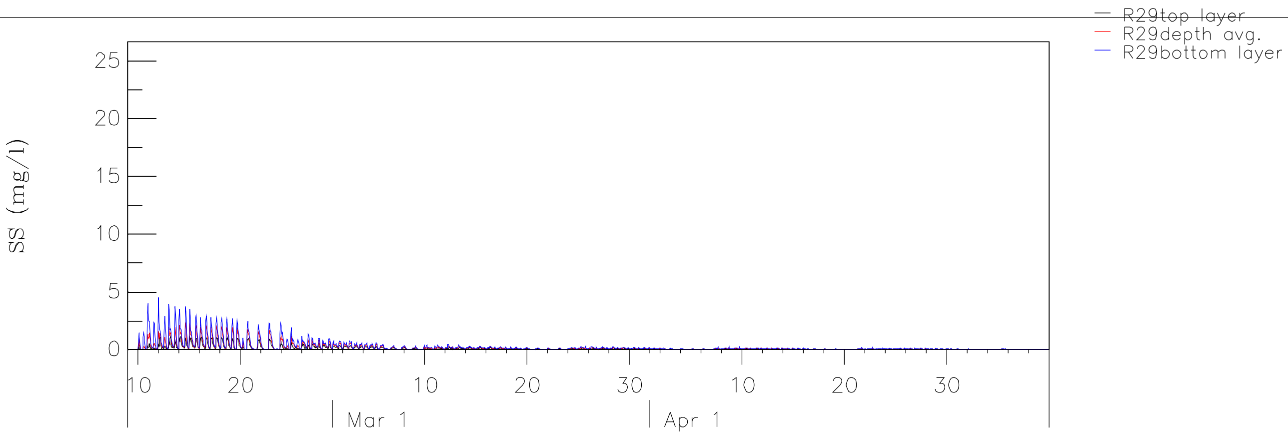
Figure C3.1i



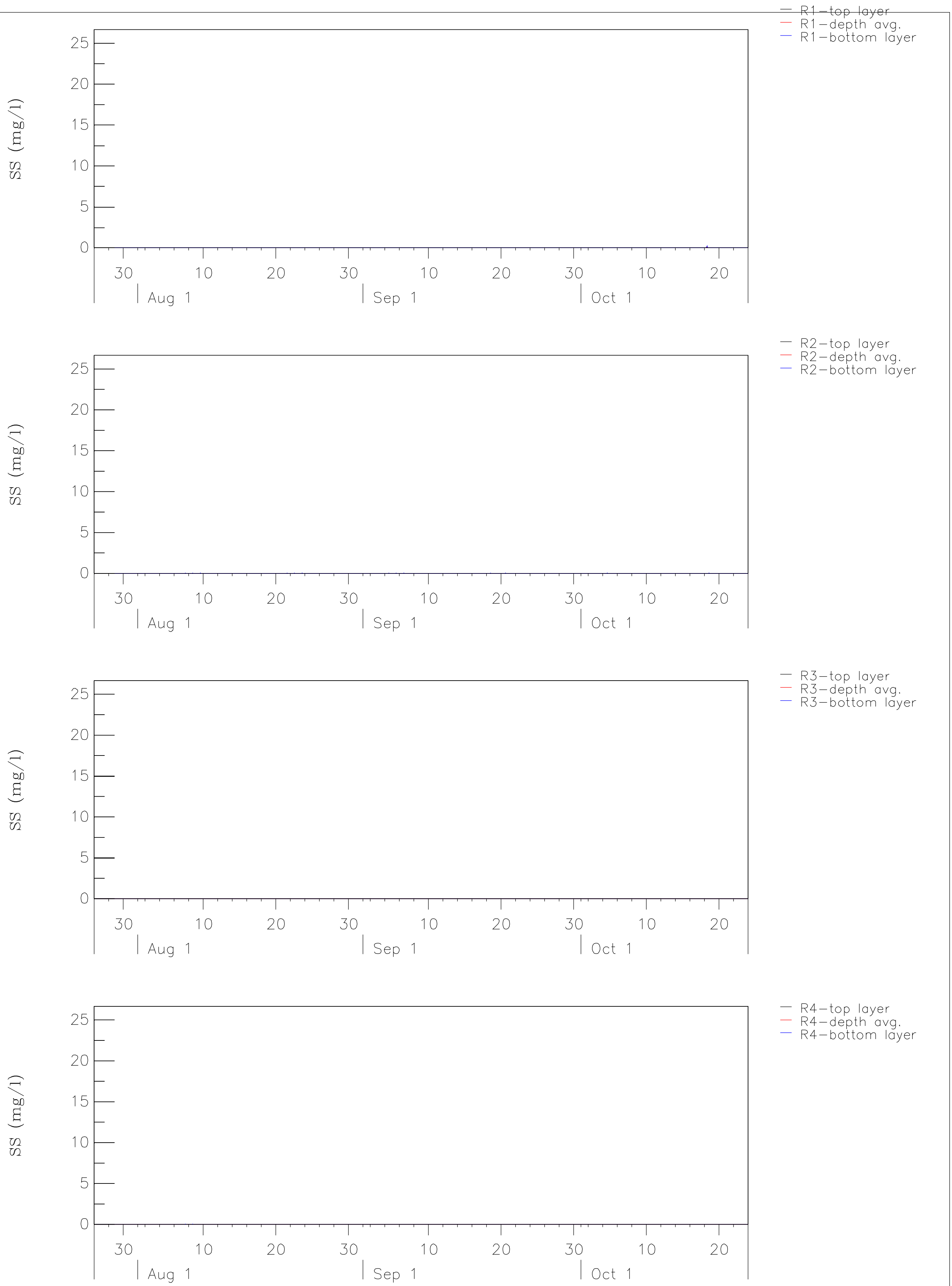
Suspended Sediment (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.1j



Suspended Sediment (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R25, R26, R27, R28	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	**Figure C3.1k**



Suspended Sediment (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R29	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure C3.1l	



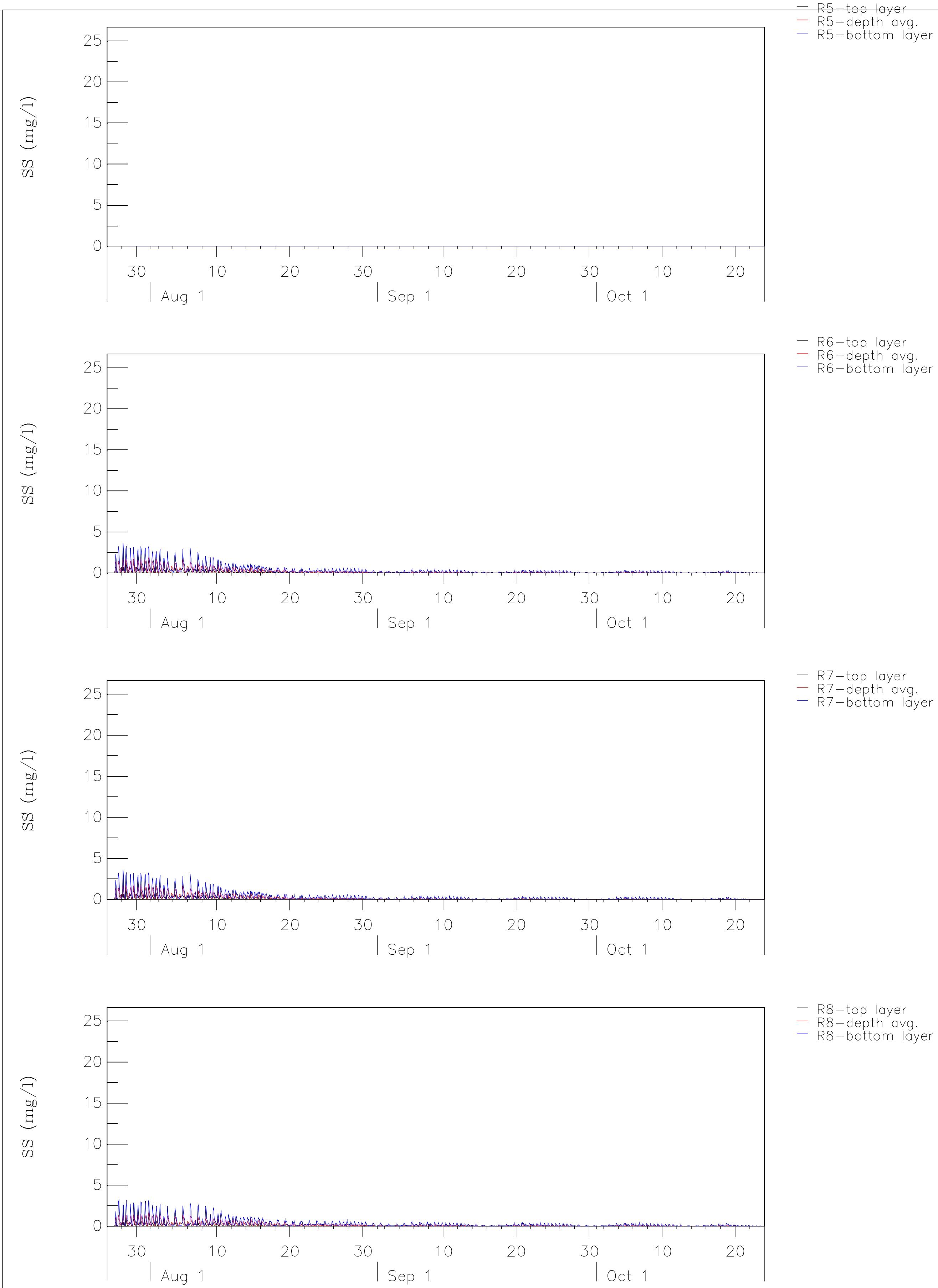
Suspended Sediment (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R1, R2, R3, R4

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.1m



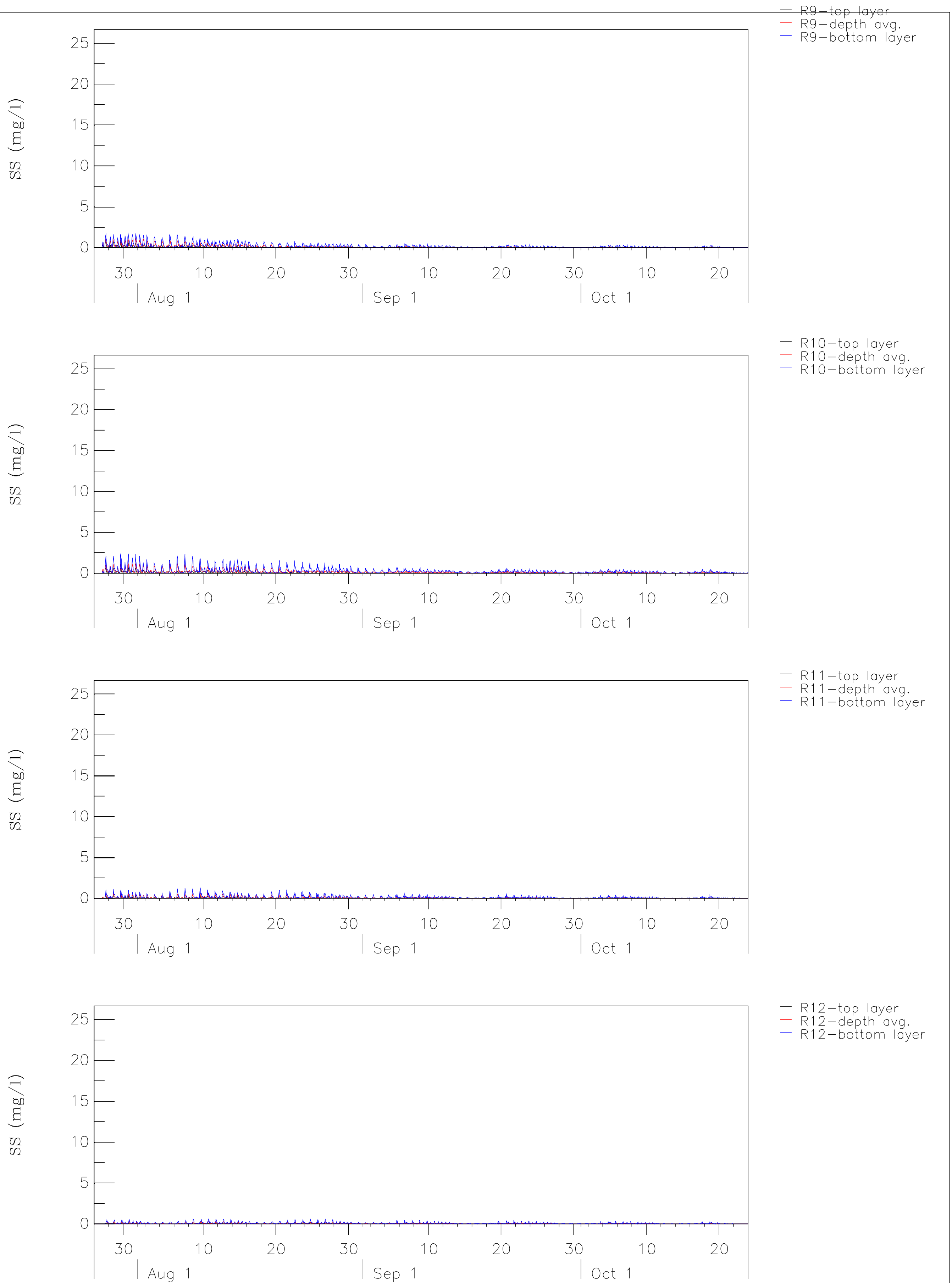
Suspended Sediment (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

Z4187

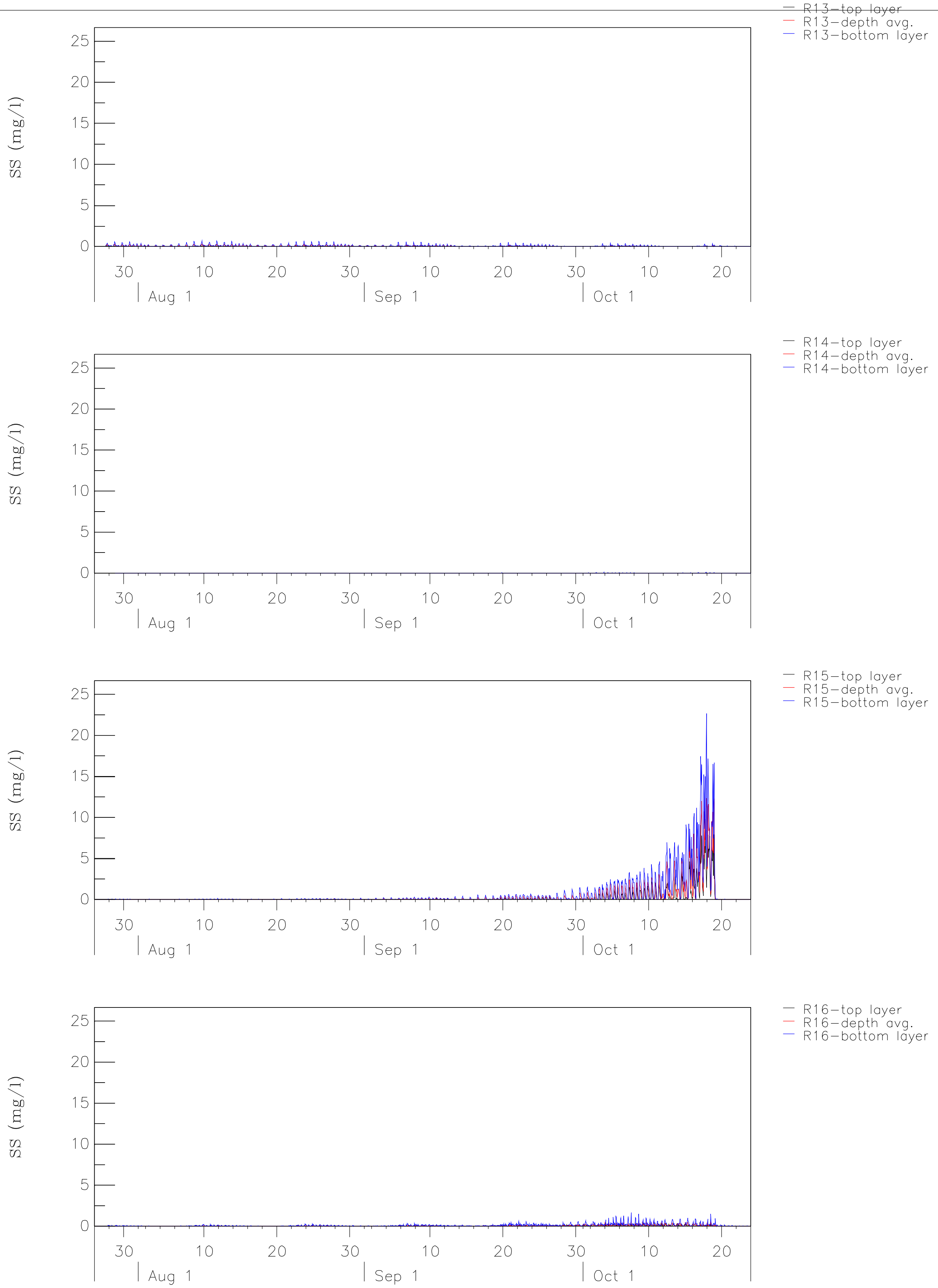
Cross Harbour Water Mains

WL | Delft Hydraulics

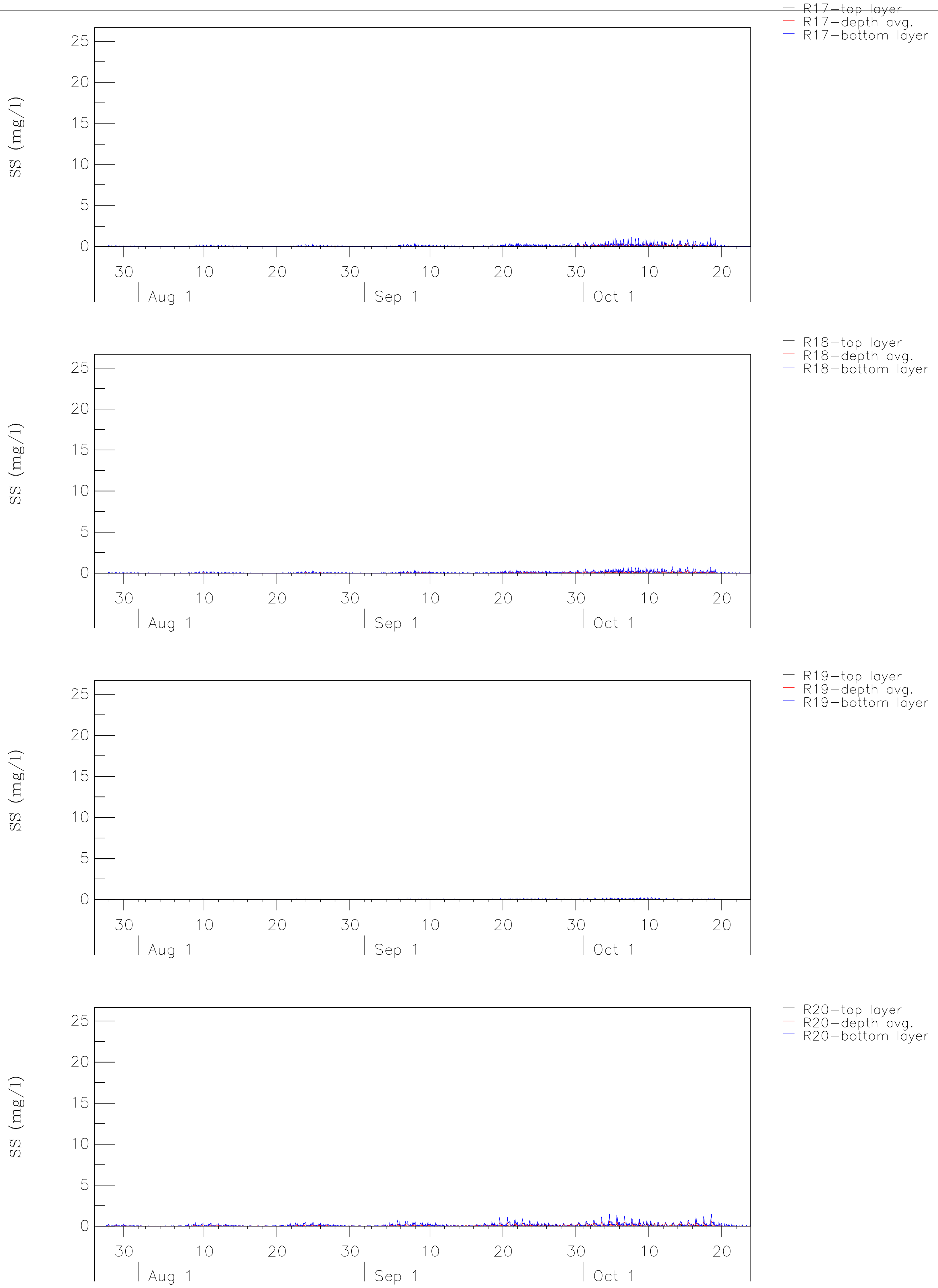
Figure 3.1n



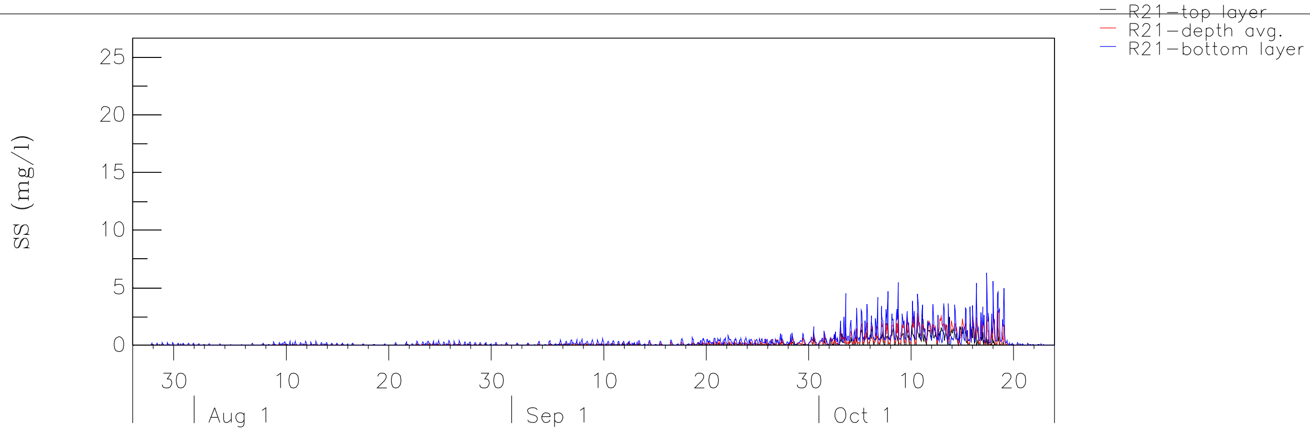
Suspended Sediment (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R9, R10, R11, R12	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure 3.1o	

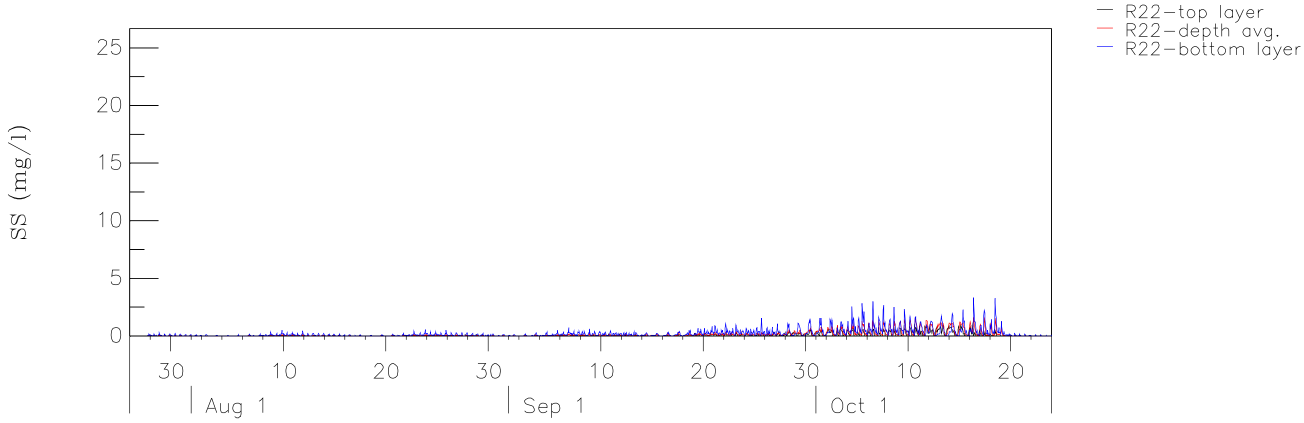


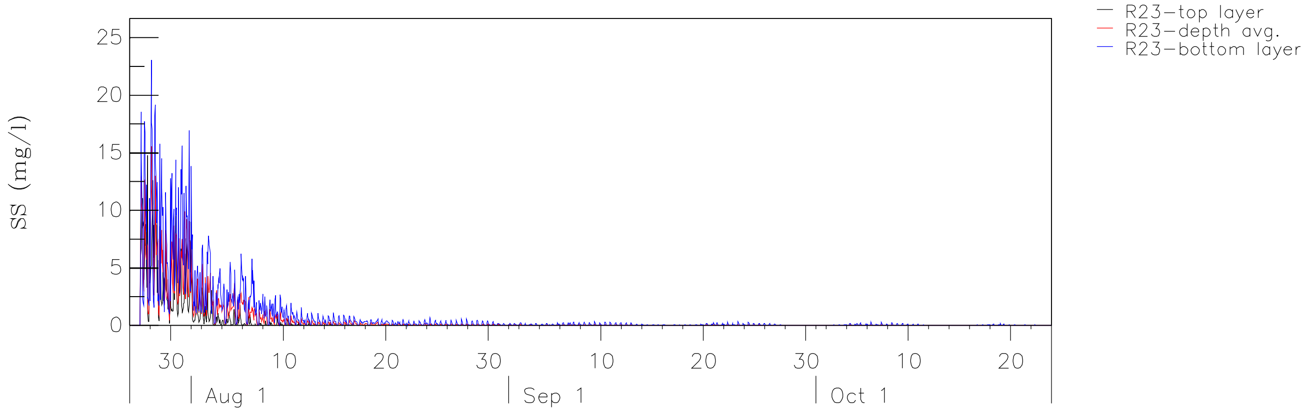
Suspended Sediment (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R13, R14, R15, R16	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	**Figure C3.1p**

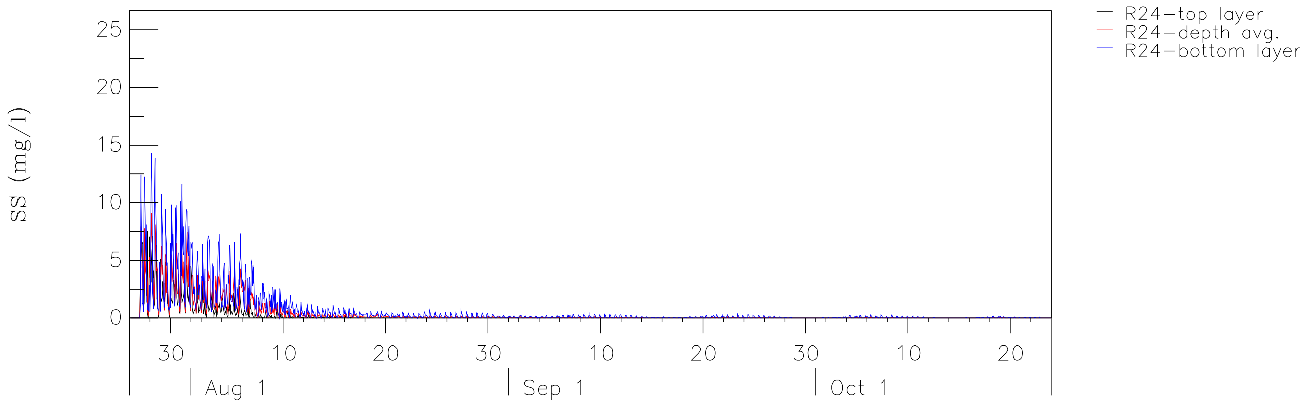


Suspended Sediment (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R17, R18, R19, R20	Z4187
	Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.1q

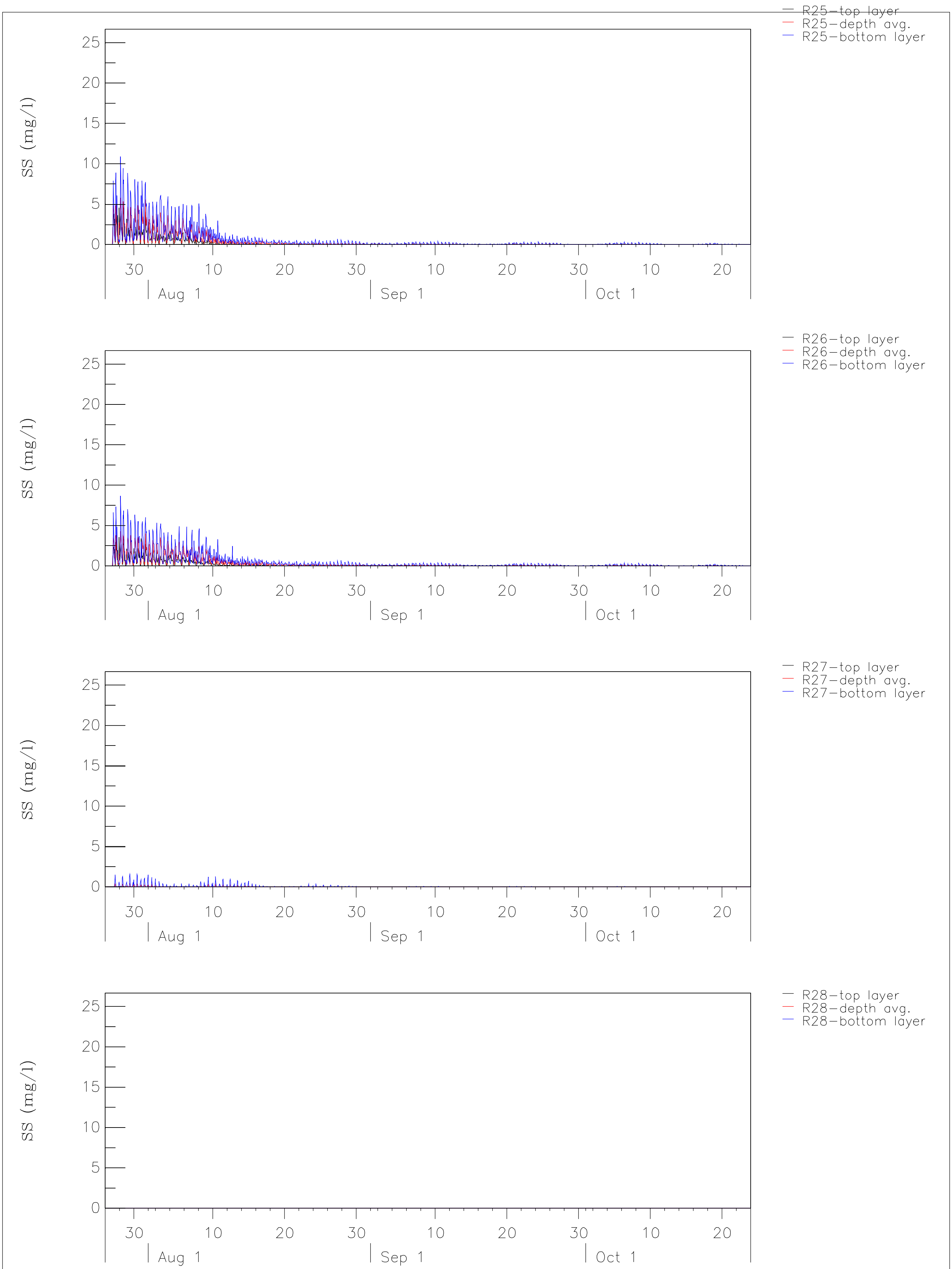




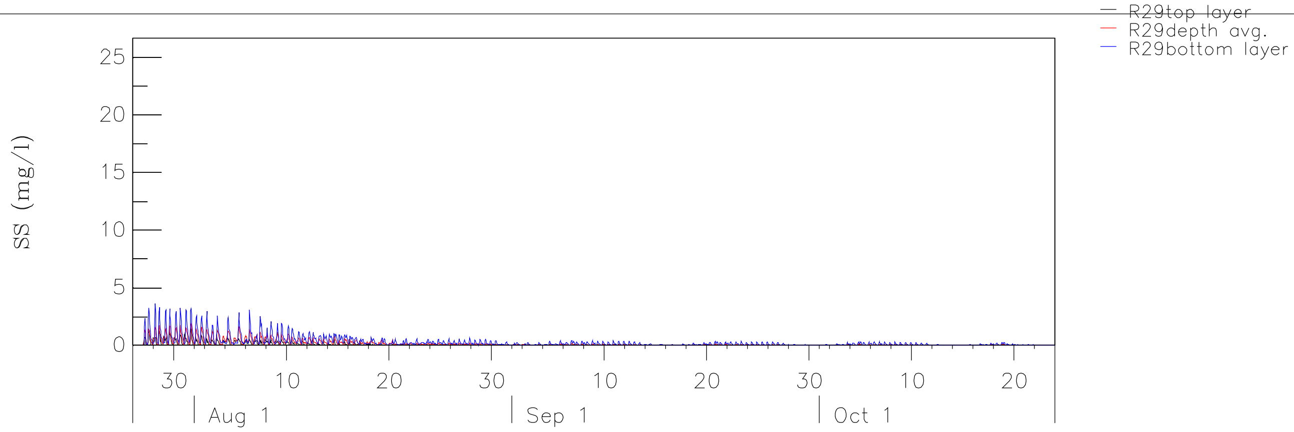




Suspended Sediment (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.1r



Suspended Sediment (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R25, R26, R27, R28	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	**Figure C3.1s**



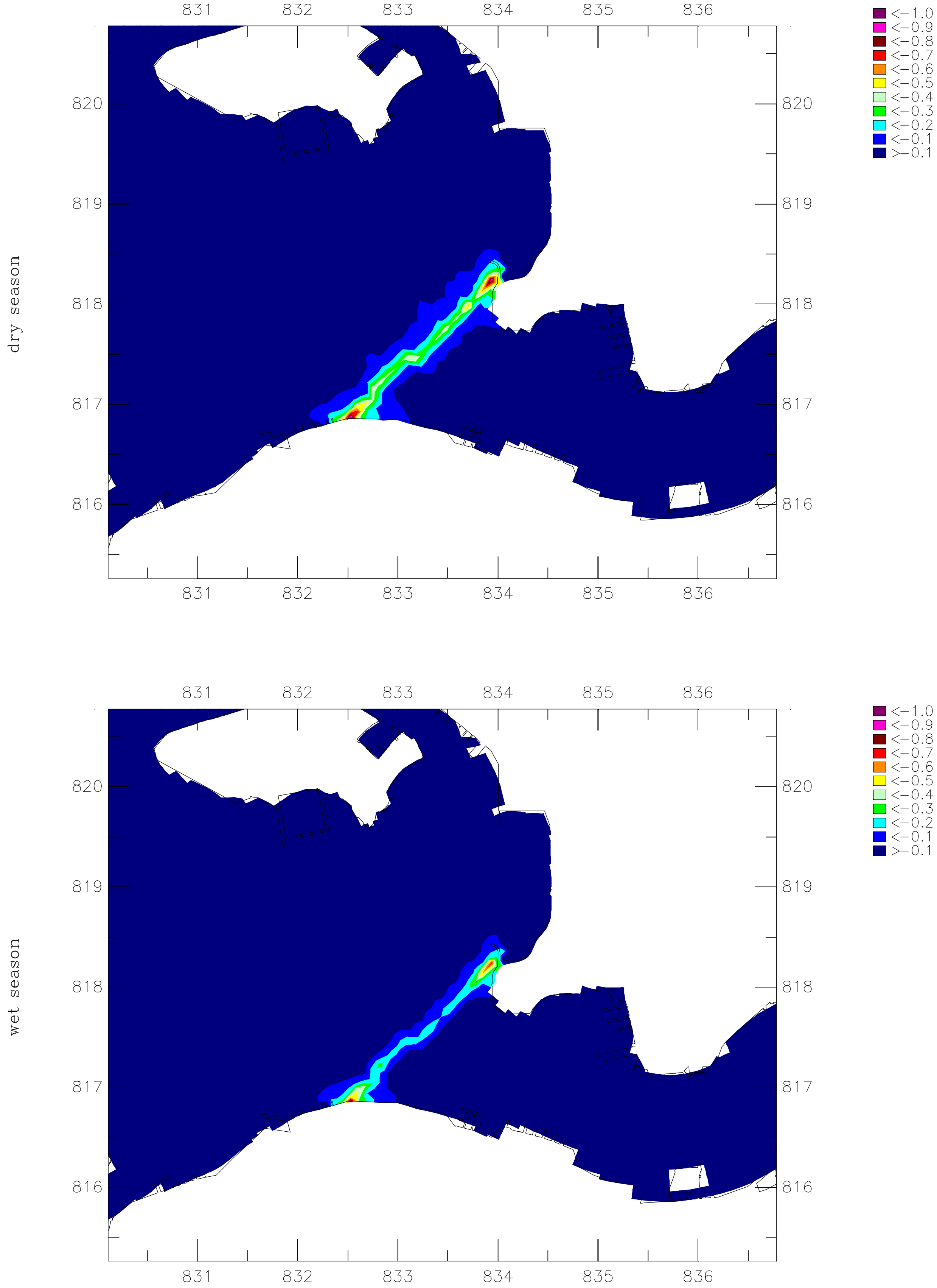
Suspended Sediment (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R29

Z4187

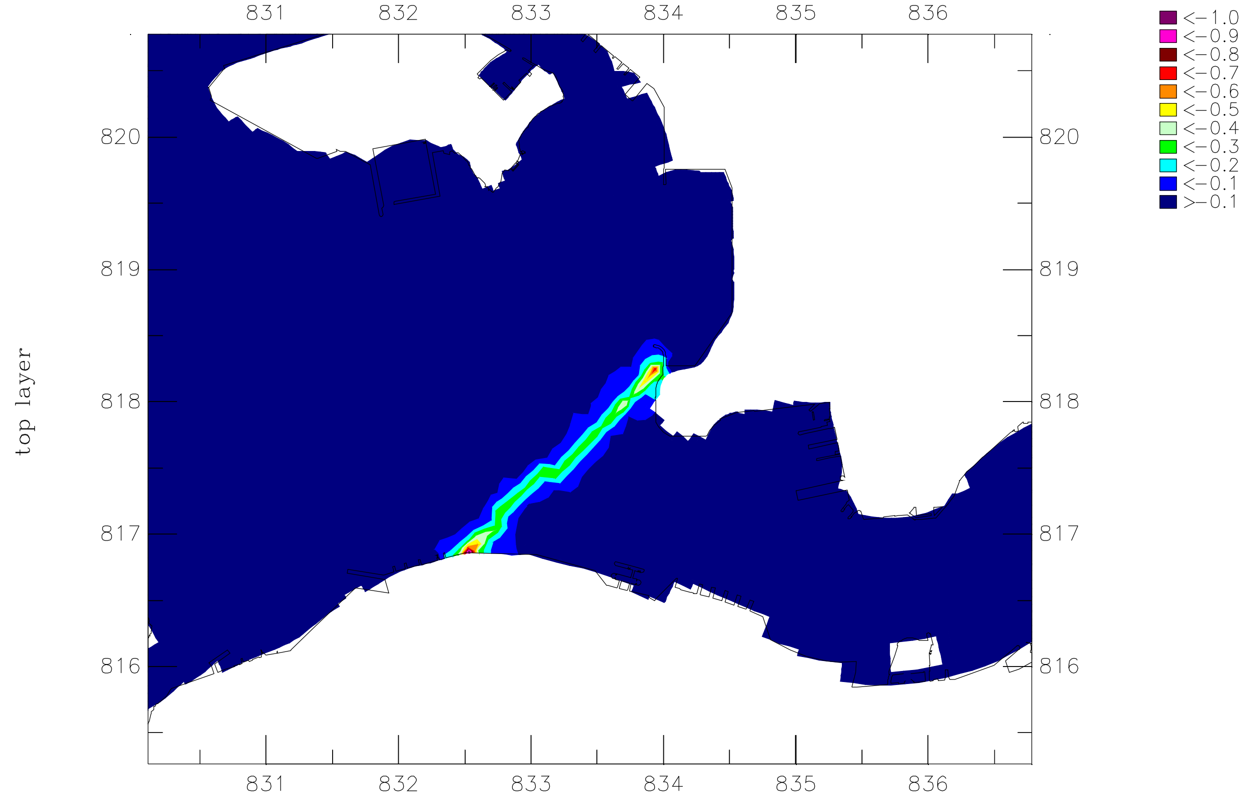
Cross Harbour Water Mains

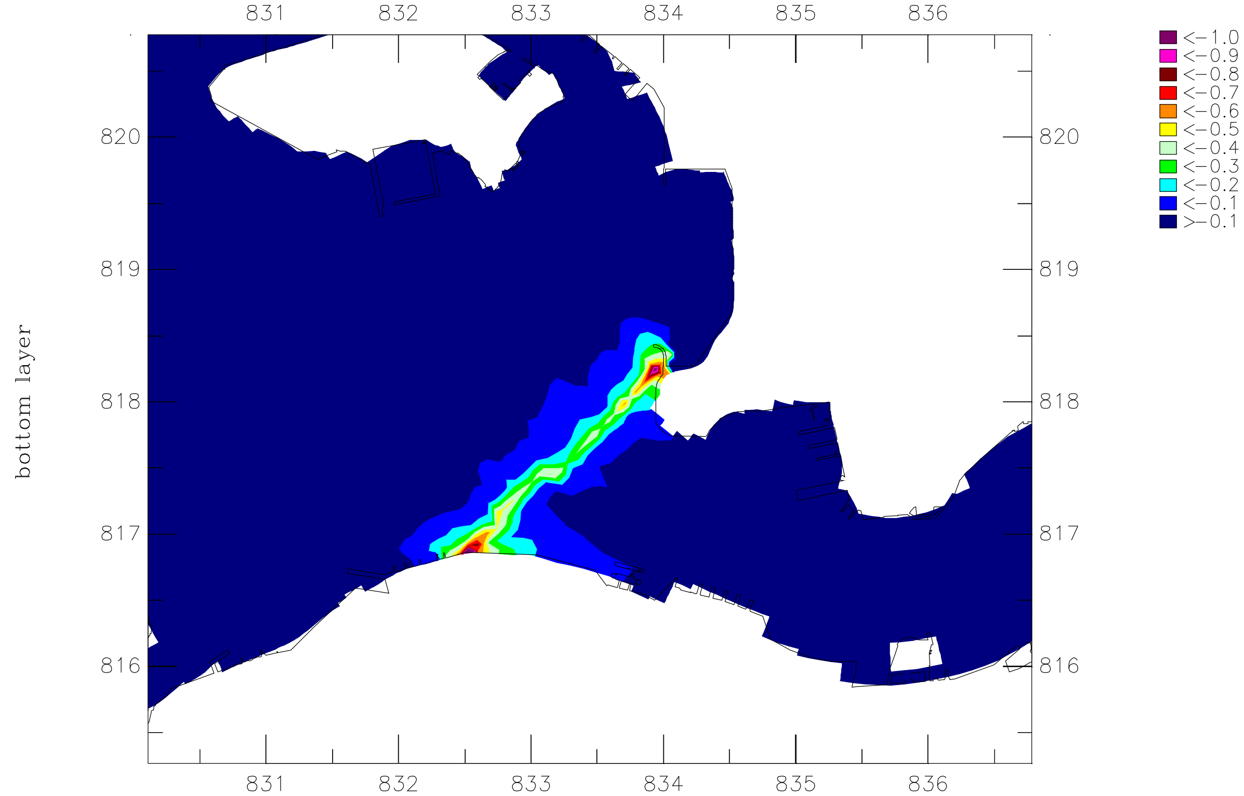
WL | Delft Hydraulics

Figure C3.1t



Depth averaged Dissolved Oxygen (mg/l) Upper: Dry season maximum decrease Lower: Wet season maximum decrease	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2a





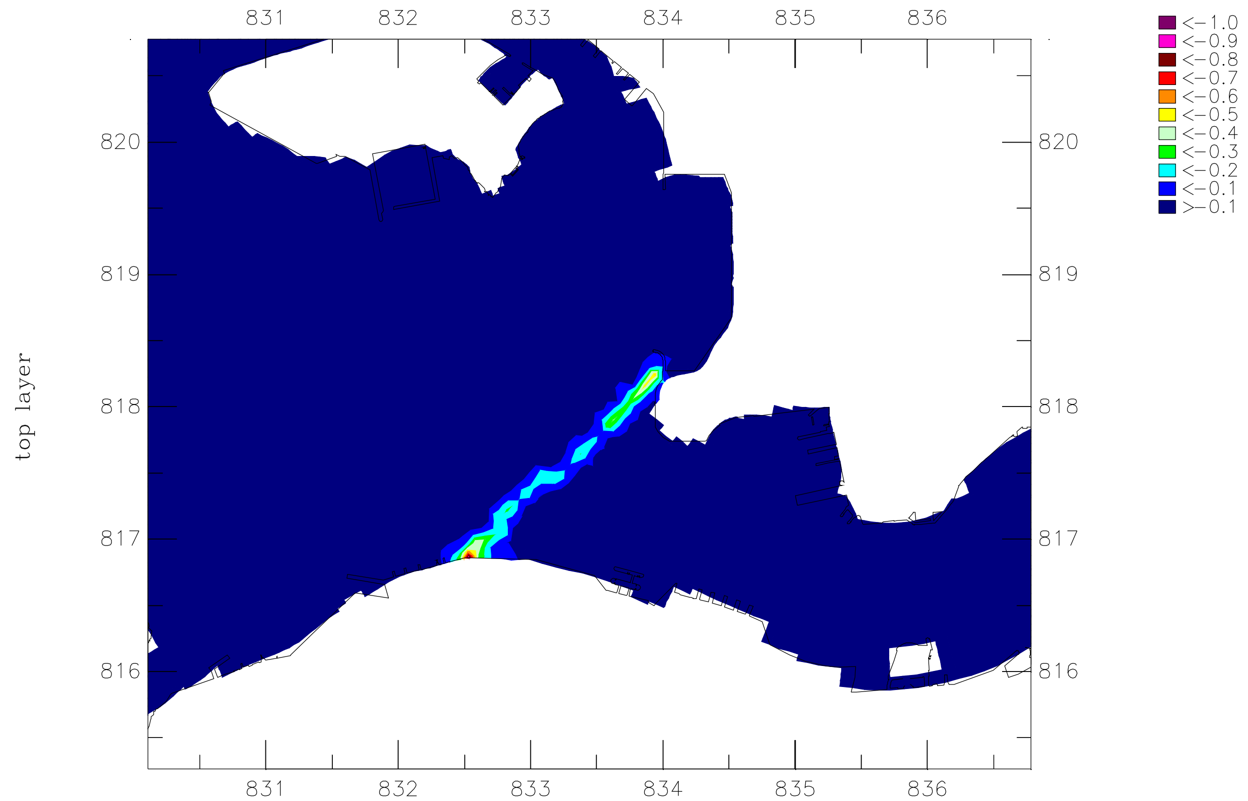
Dissolved Oxygen (mg/l)
Upper: Dry season maximum decrease top layer
Lower: Dry season maximum decrease bottom layer

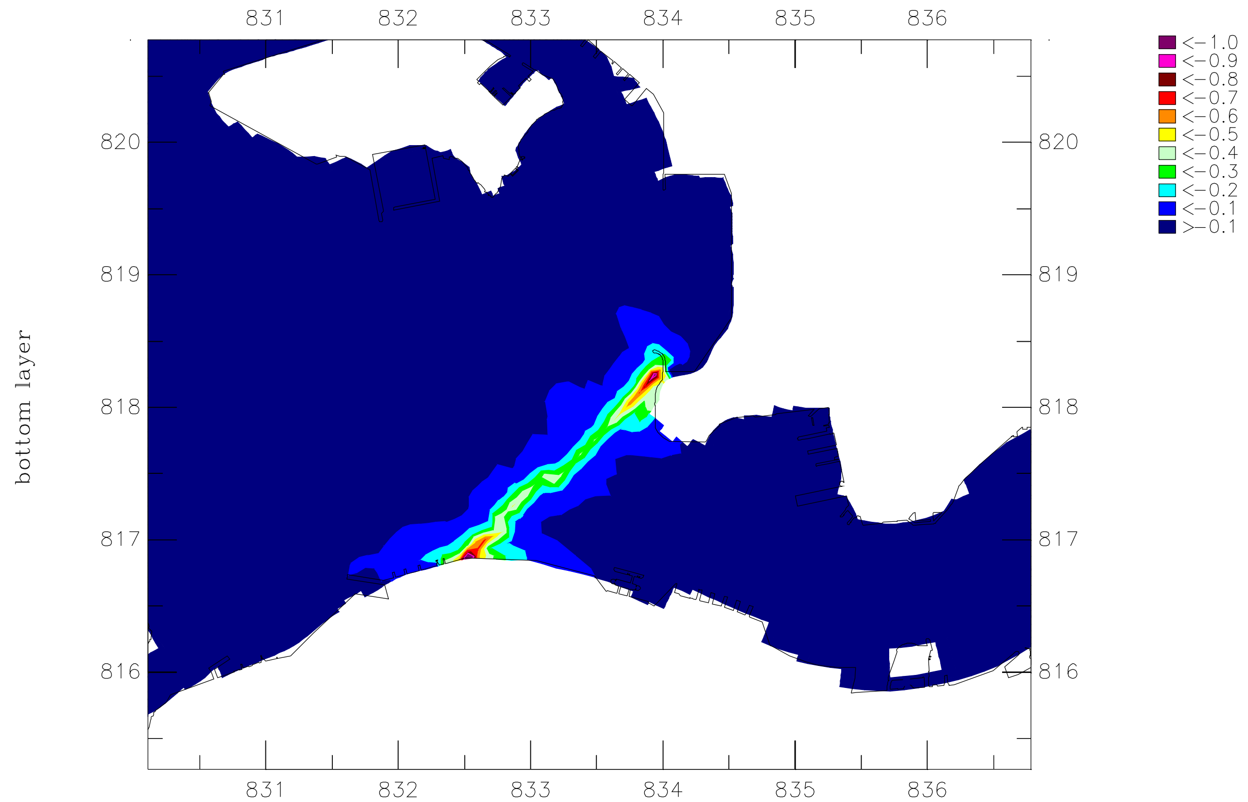
Z4187

Cross Harbour Water Mains

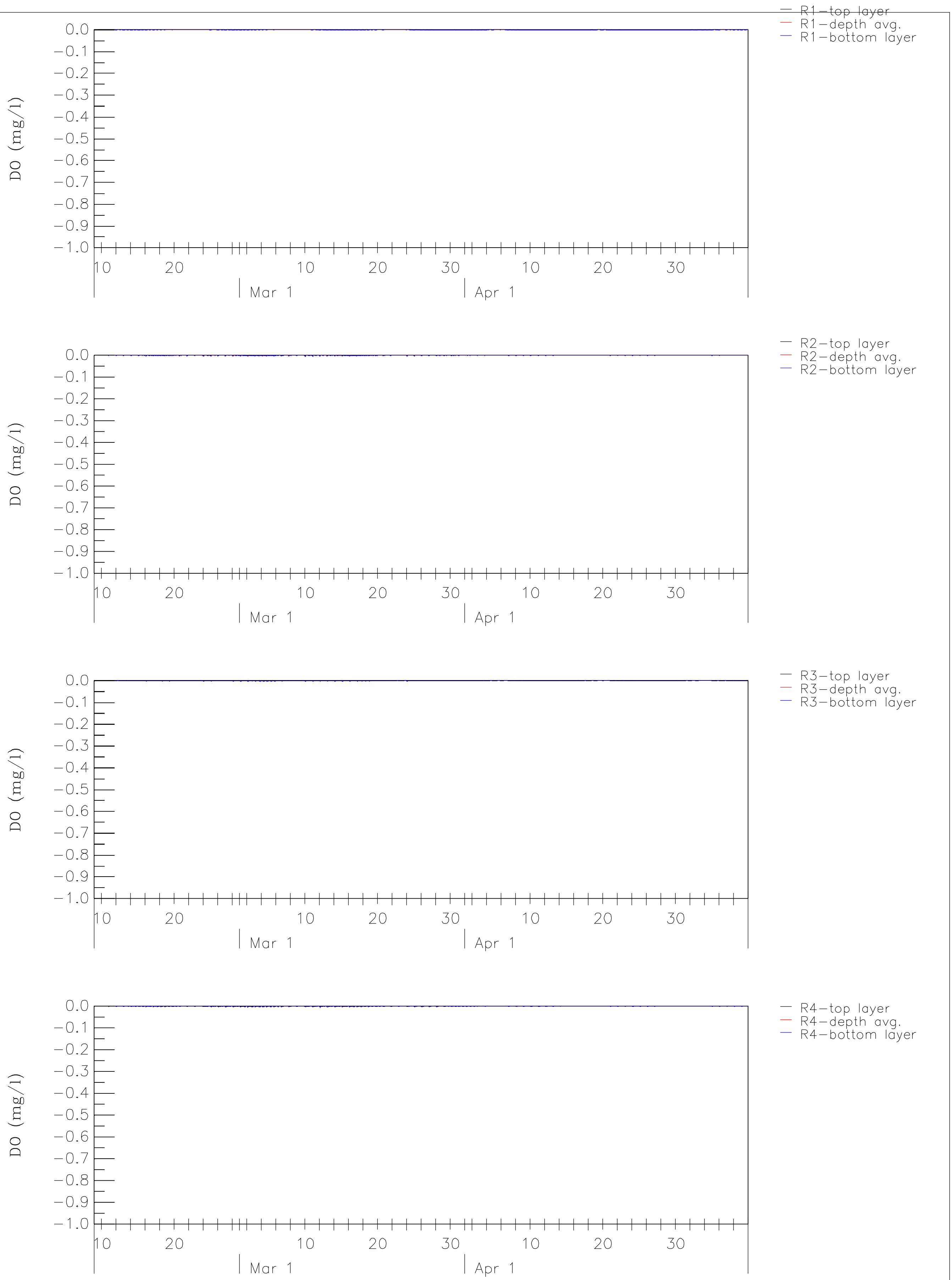
WL | Delft Hydraulics

Figure C3.2b

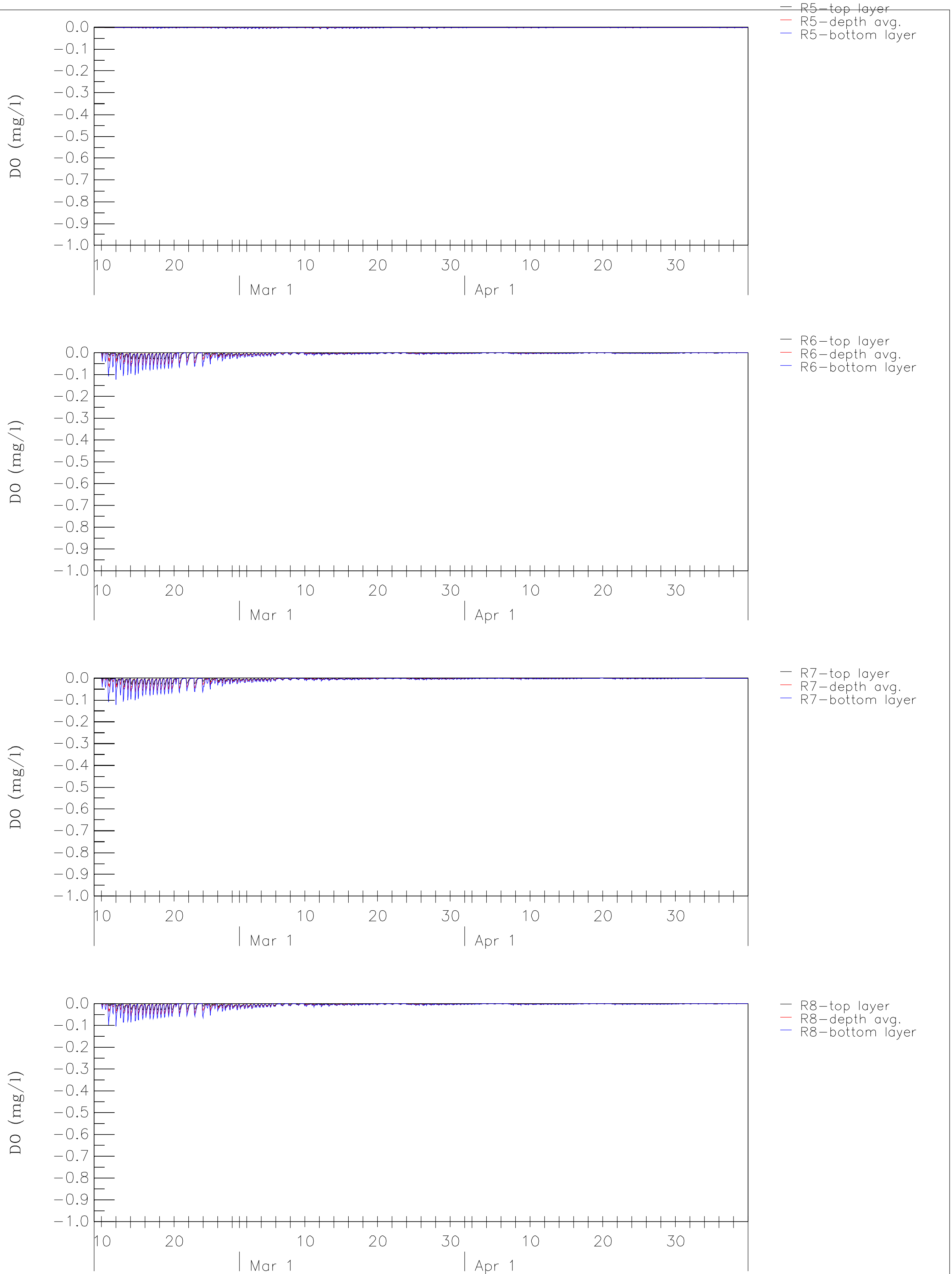




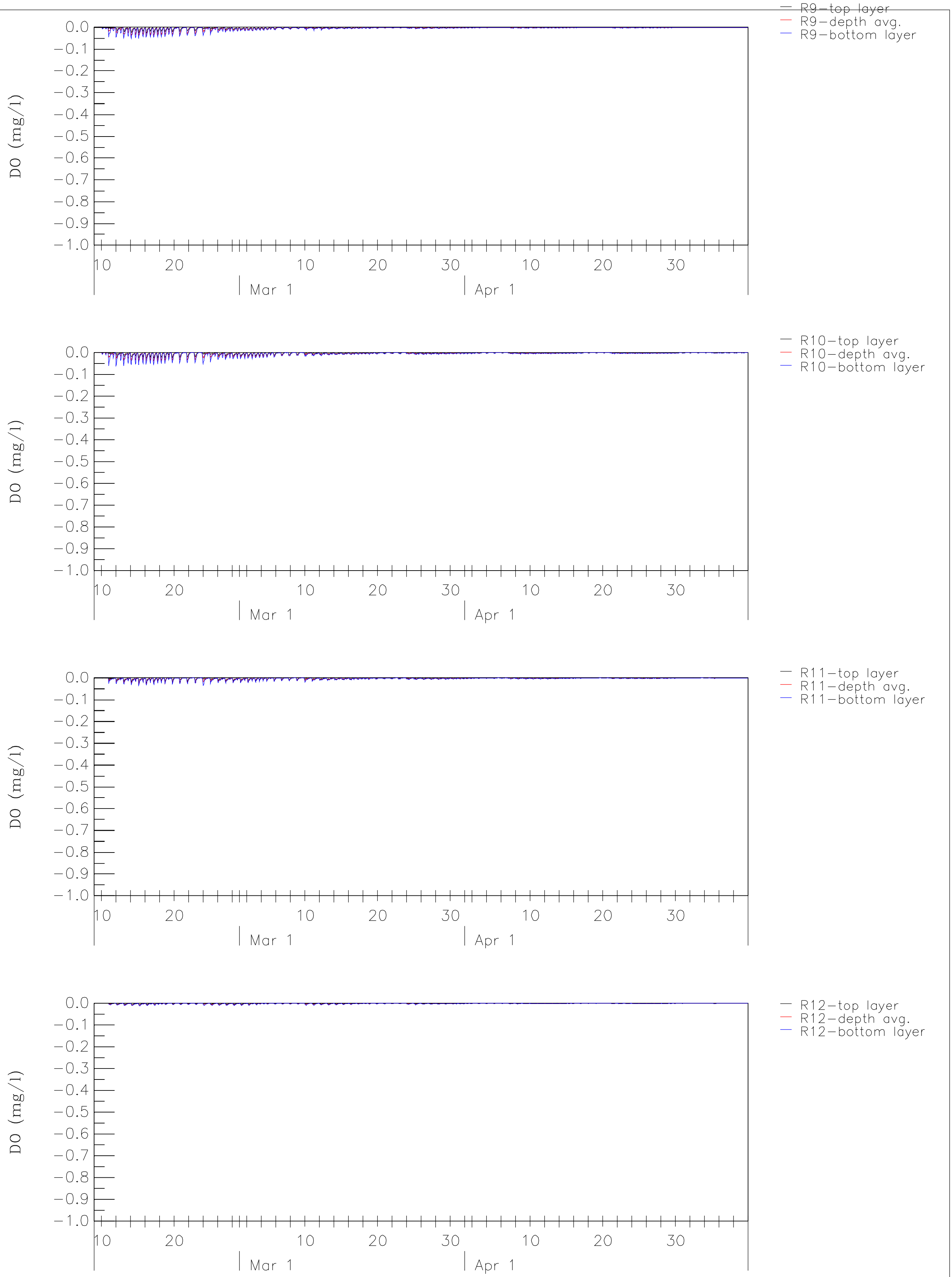
Dissolved Oxygen (mg/l) Upper: Wet season maximum decrease top layer Lower: Wet season maximum decrease bottom layer	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2c



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R1, R2, R3, R4	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2d



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R5, R6, R7, R8	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure C3.2e	



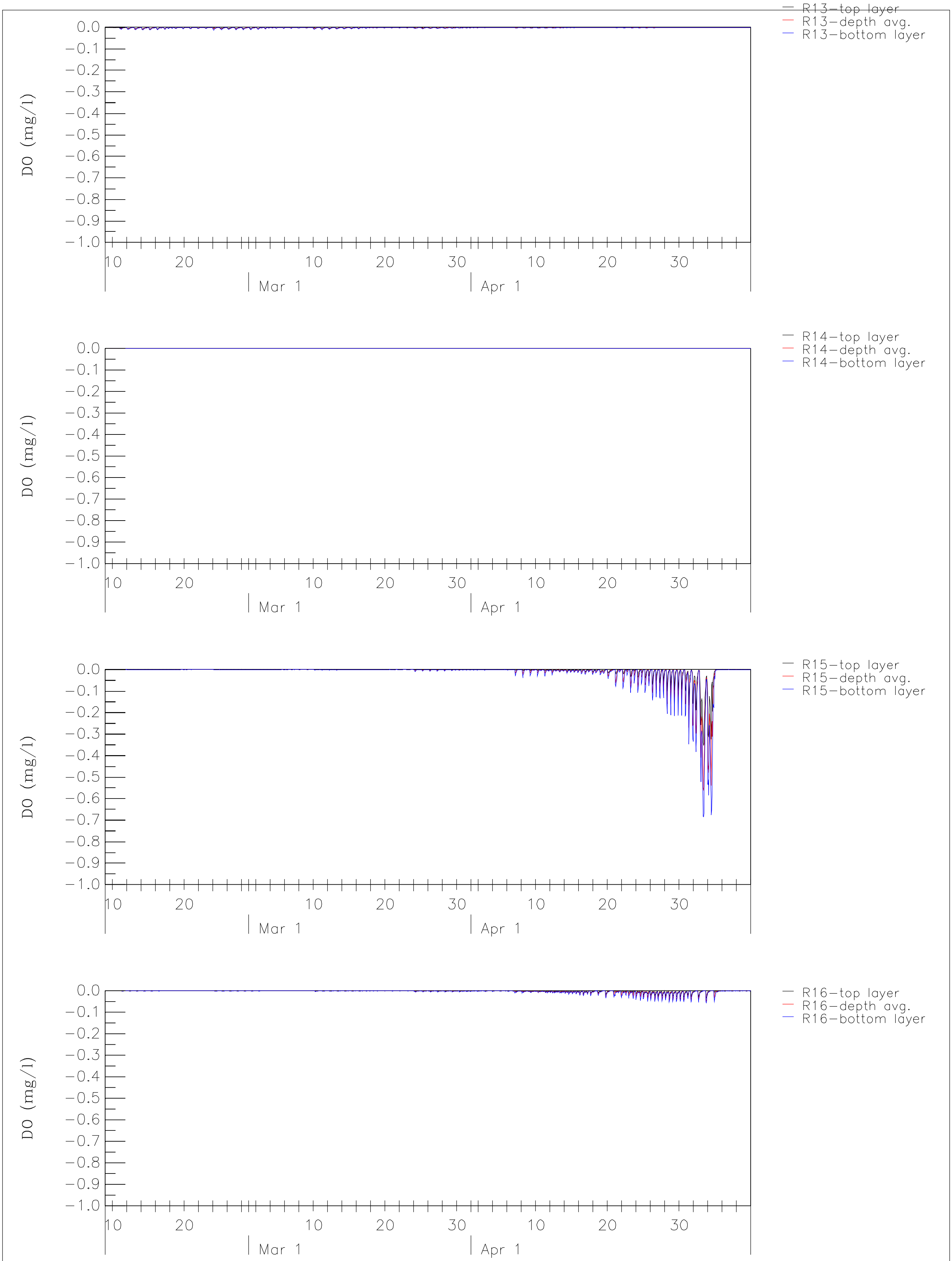
Dissolved Oxygen decrease (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R9, R10, R11, R12

Z4187

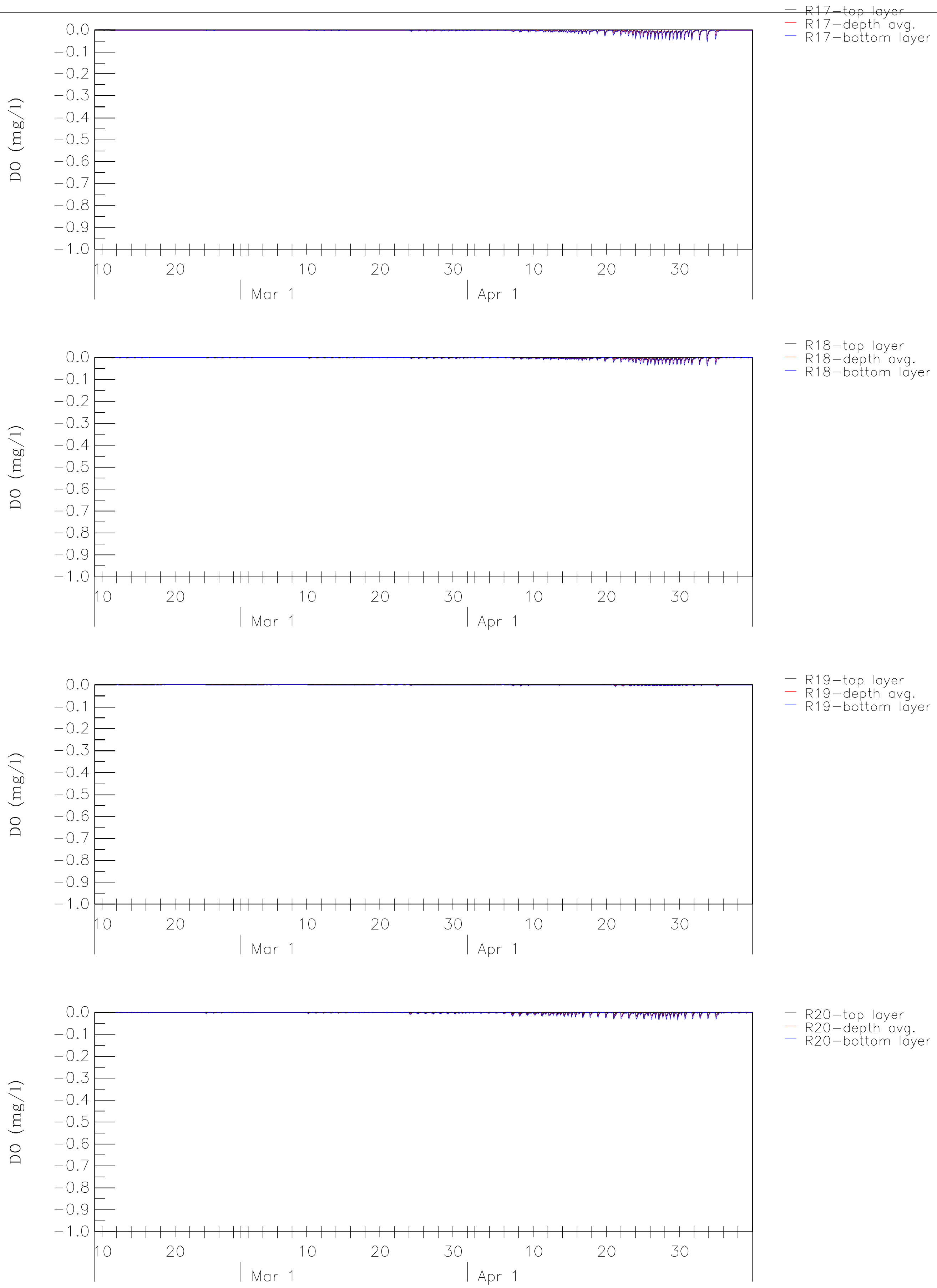
Cross Harbour Water Mains

WL | Delft Hydraulics

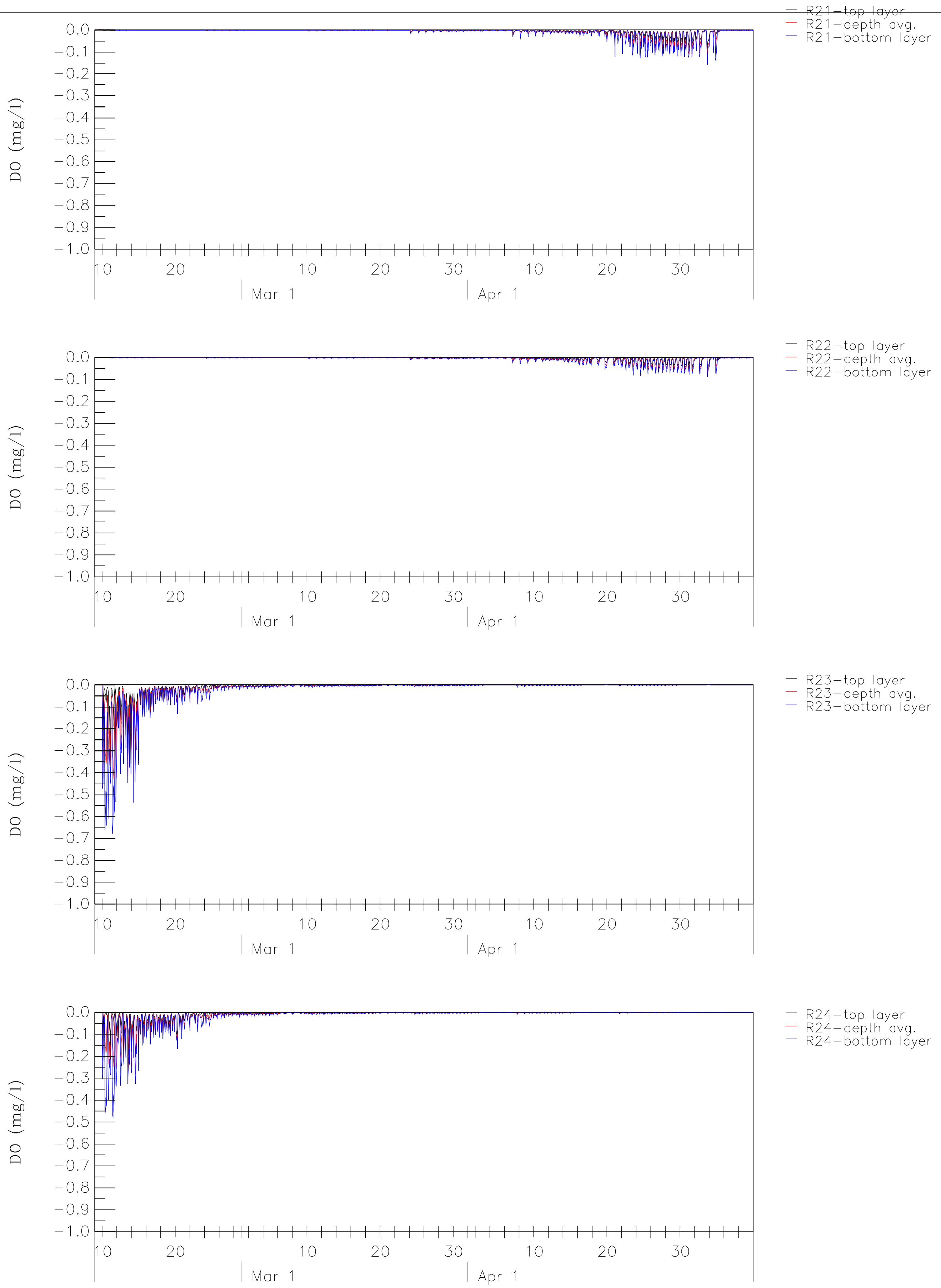
Figure C3.2f



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R13, R14, R15, R16	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure C3.2g	



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R17, R18, R19, R20	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2h



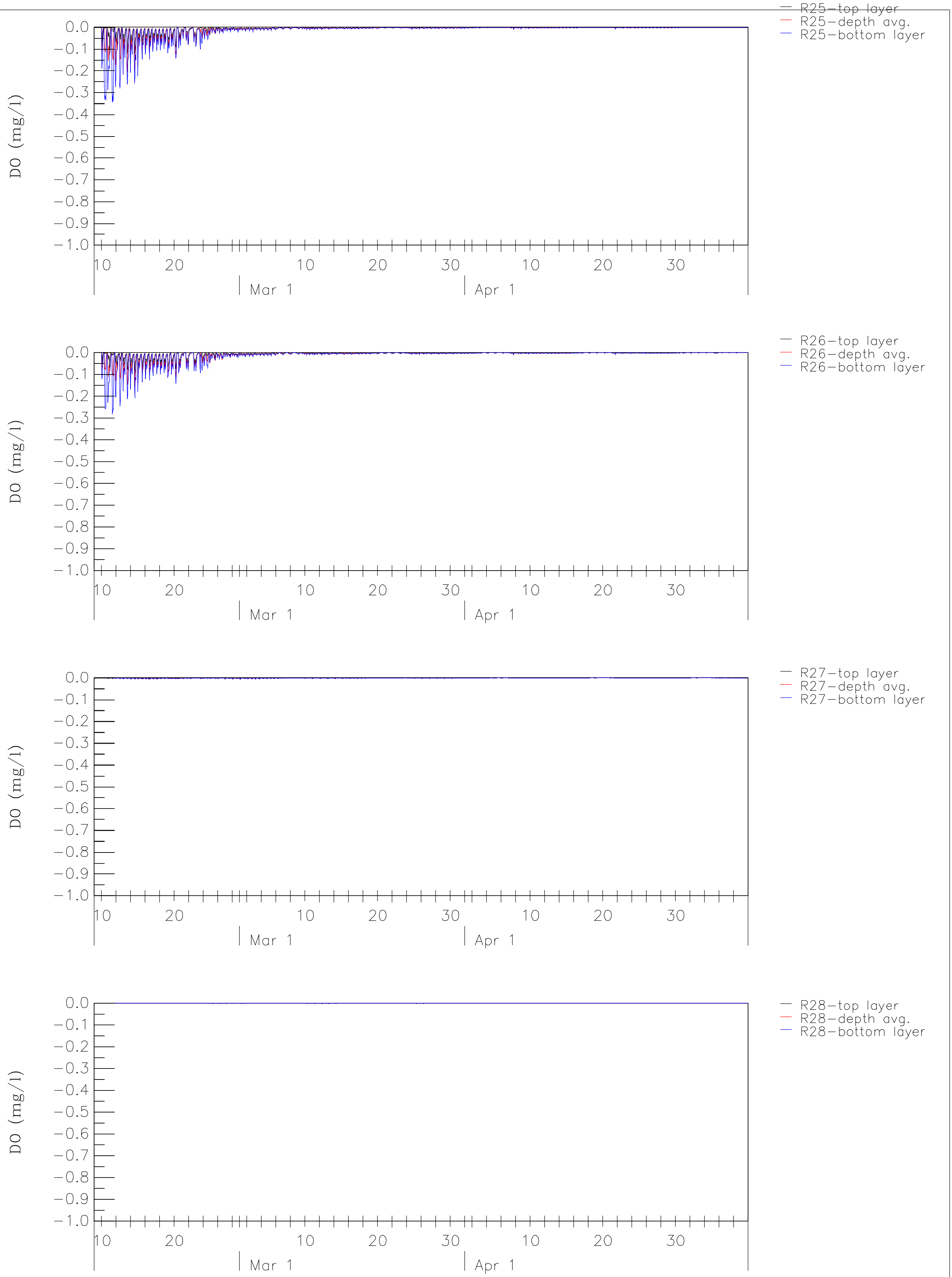
Dissolved Oxygen decrease (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R21, R22, R23, R24

Z4187

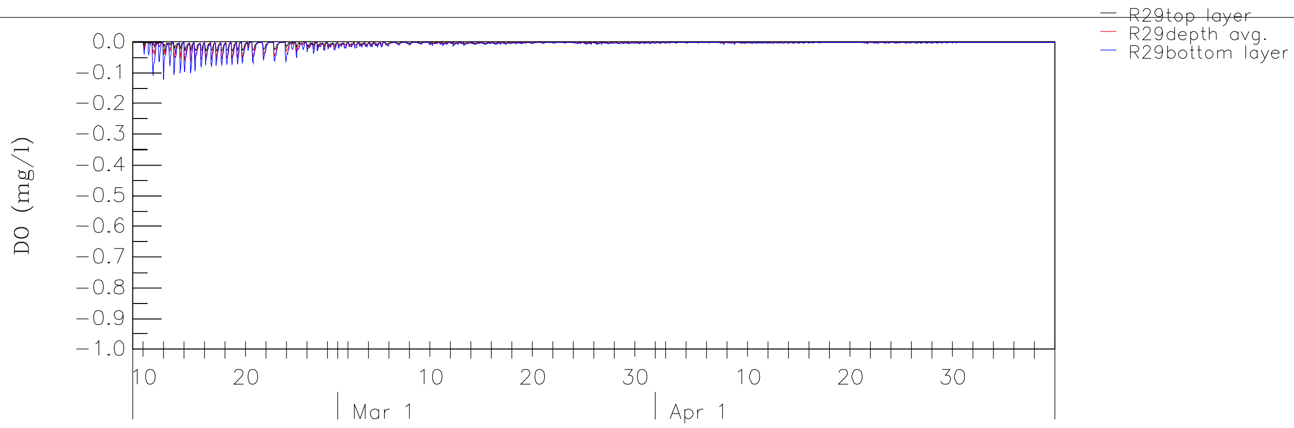
Cross Harbour Water Mains

WL | Delft Hydraulics

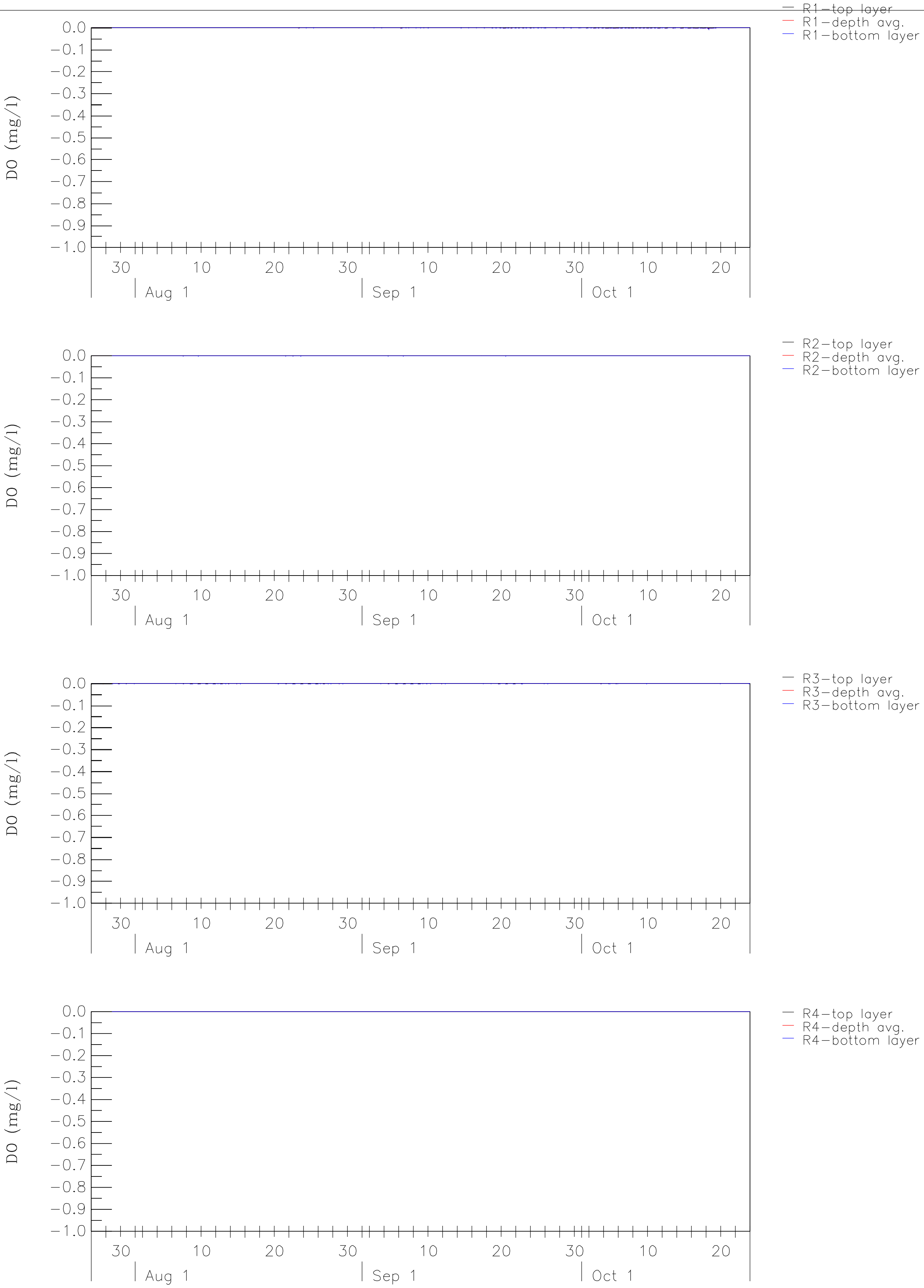
Figure C3.2i



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R25, R26, R27, R28	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2j



Dissolved Oxygen decrease (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R29	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure C3.2k	



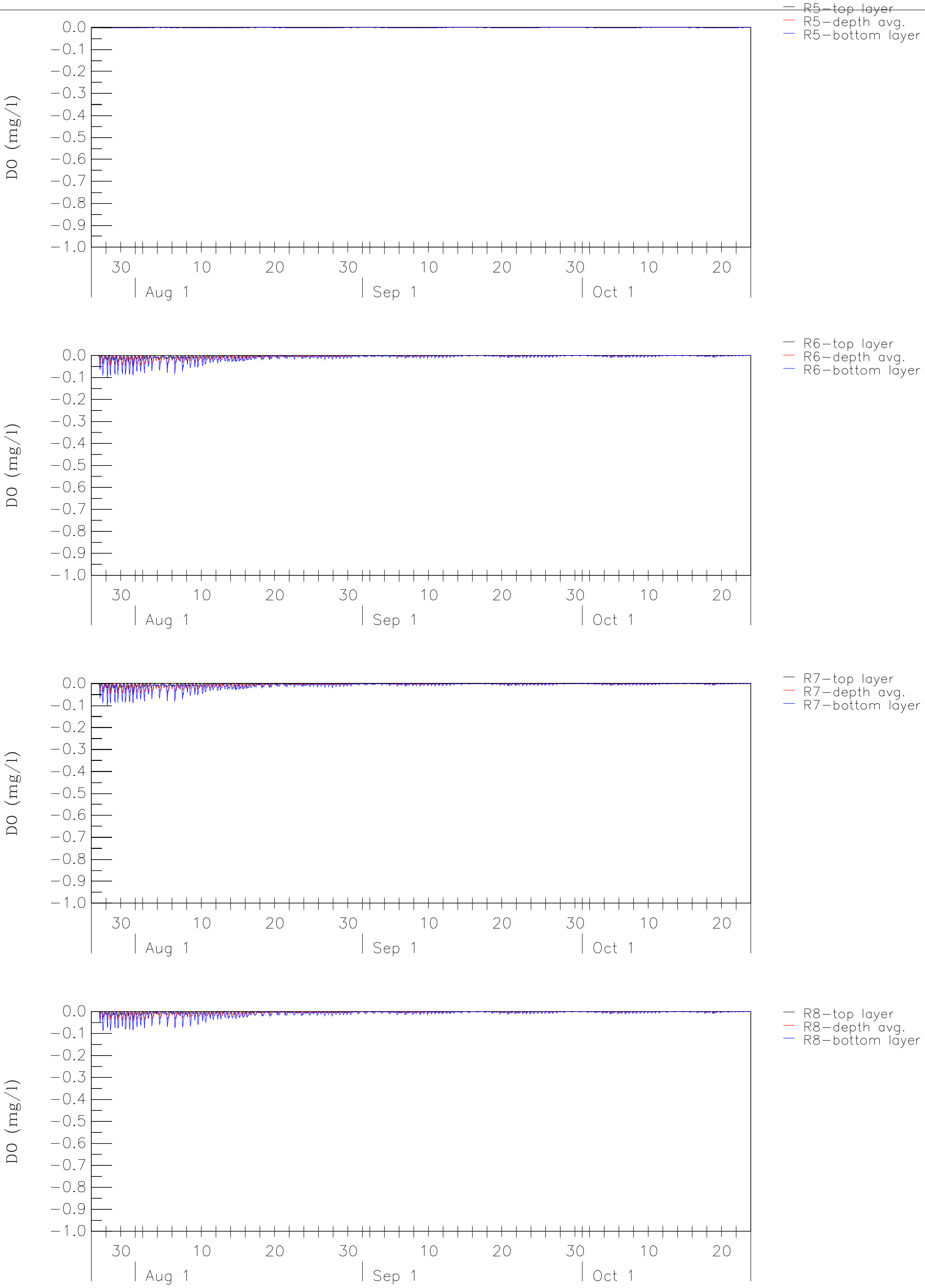
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R1, R2, R3, R4

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2l



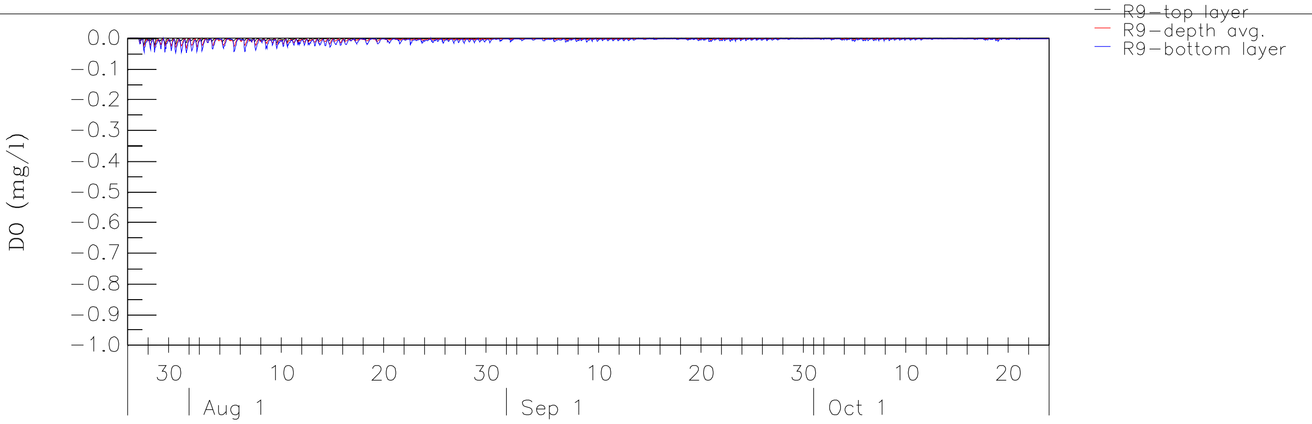
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

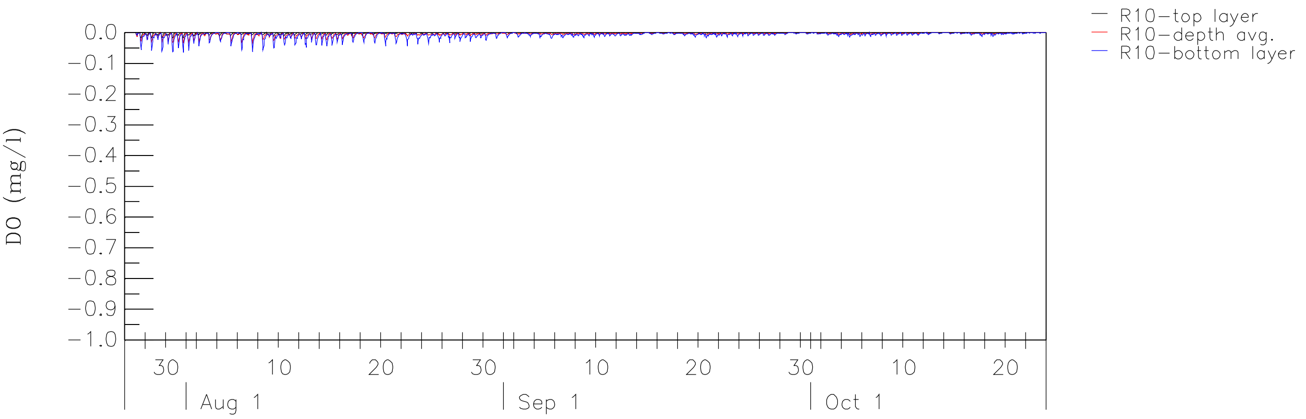
Z4187

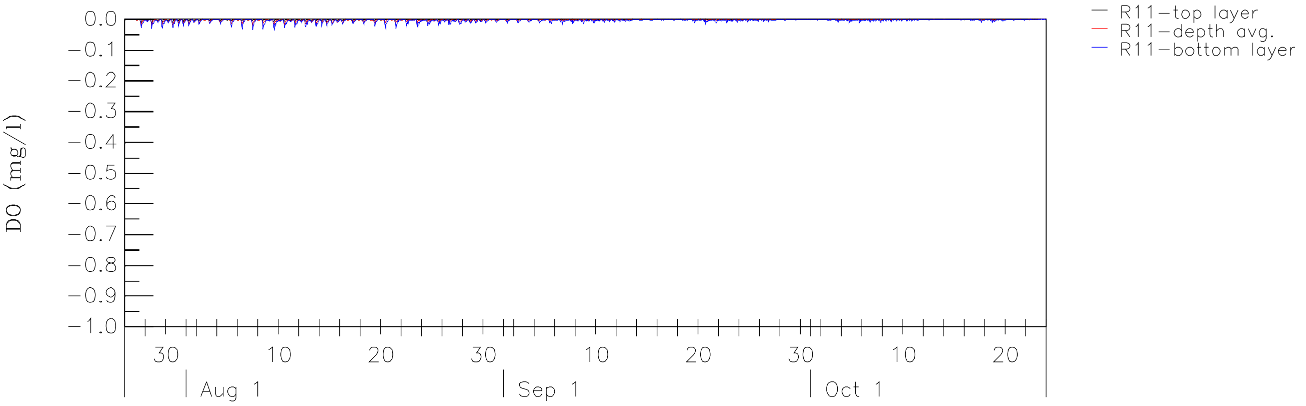
Cross Harbour Water Mains

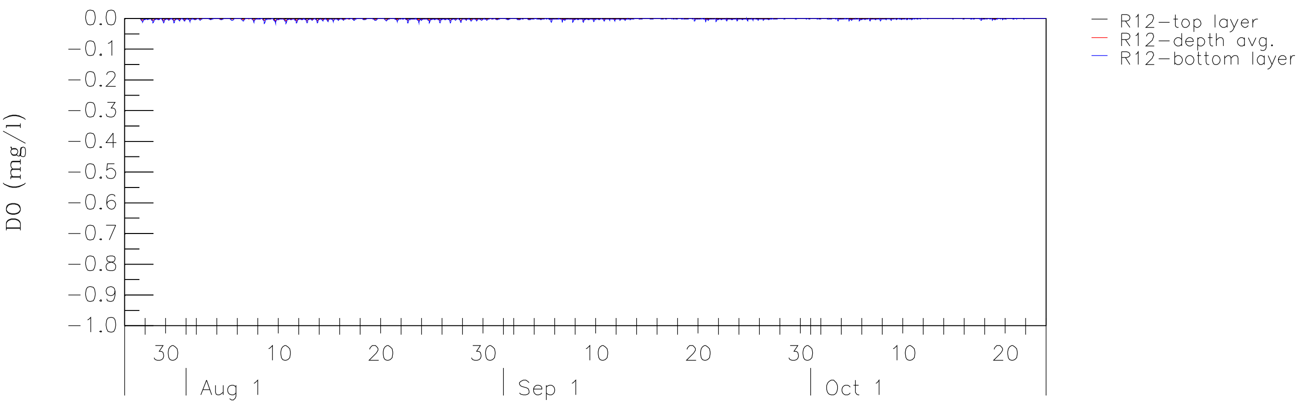
WL | Delft Hydraulics

Figure C3.2m

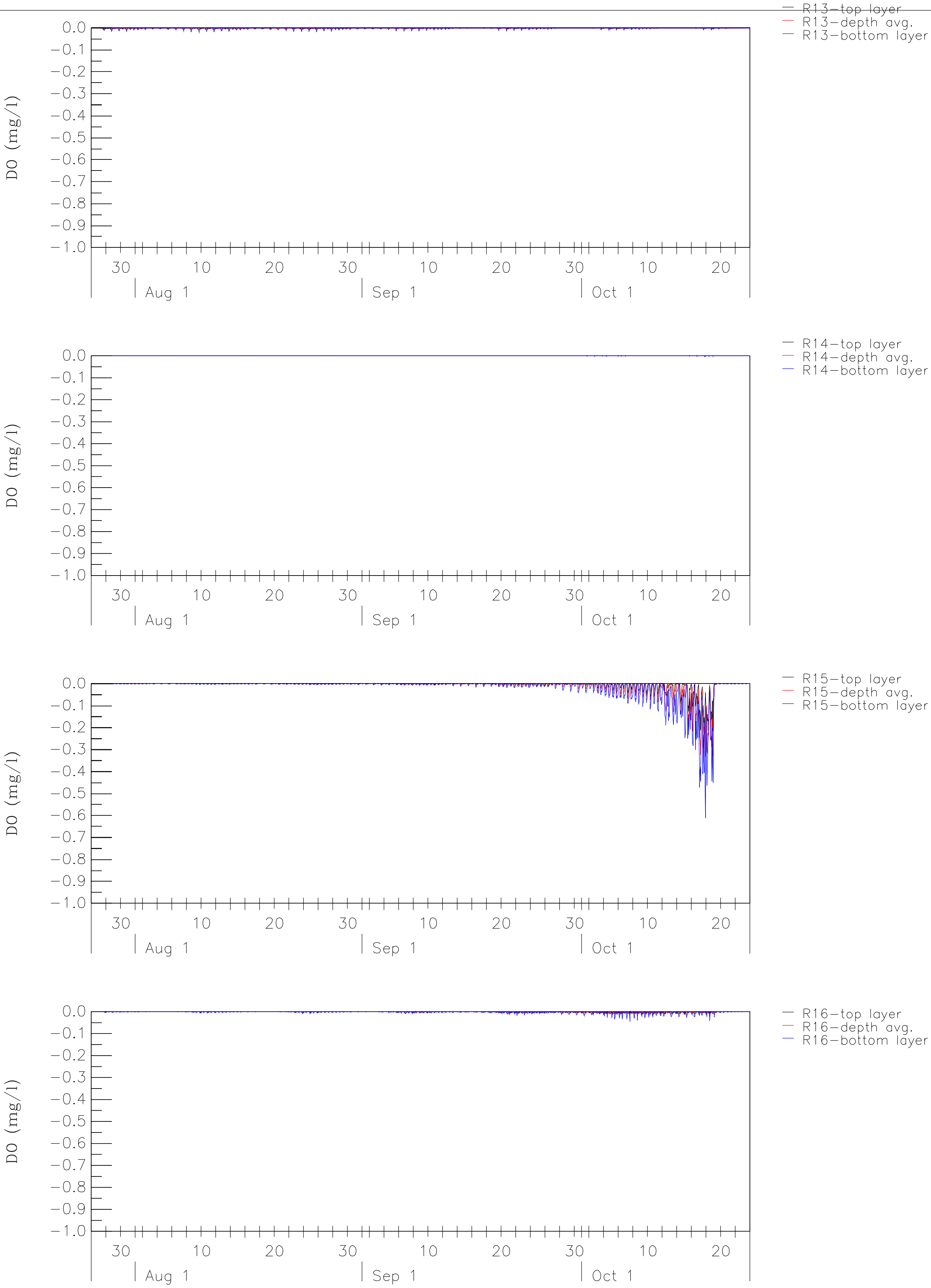








Dissolved Oxygen decrease (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R9, R10, R11, R12	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.2n



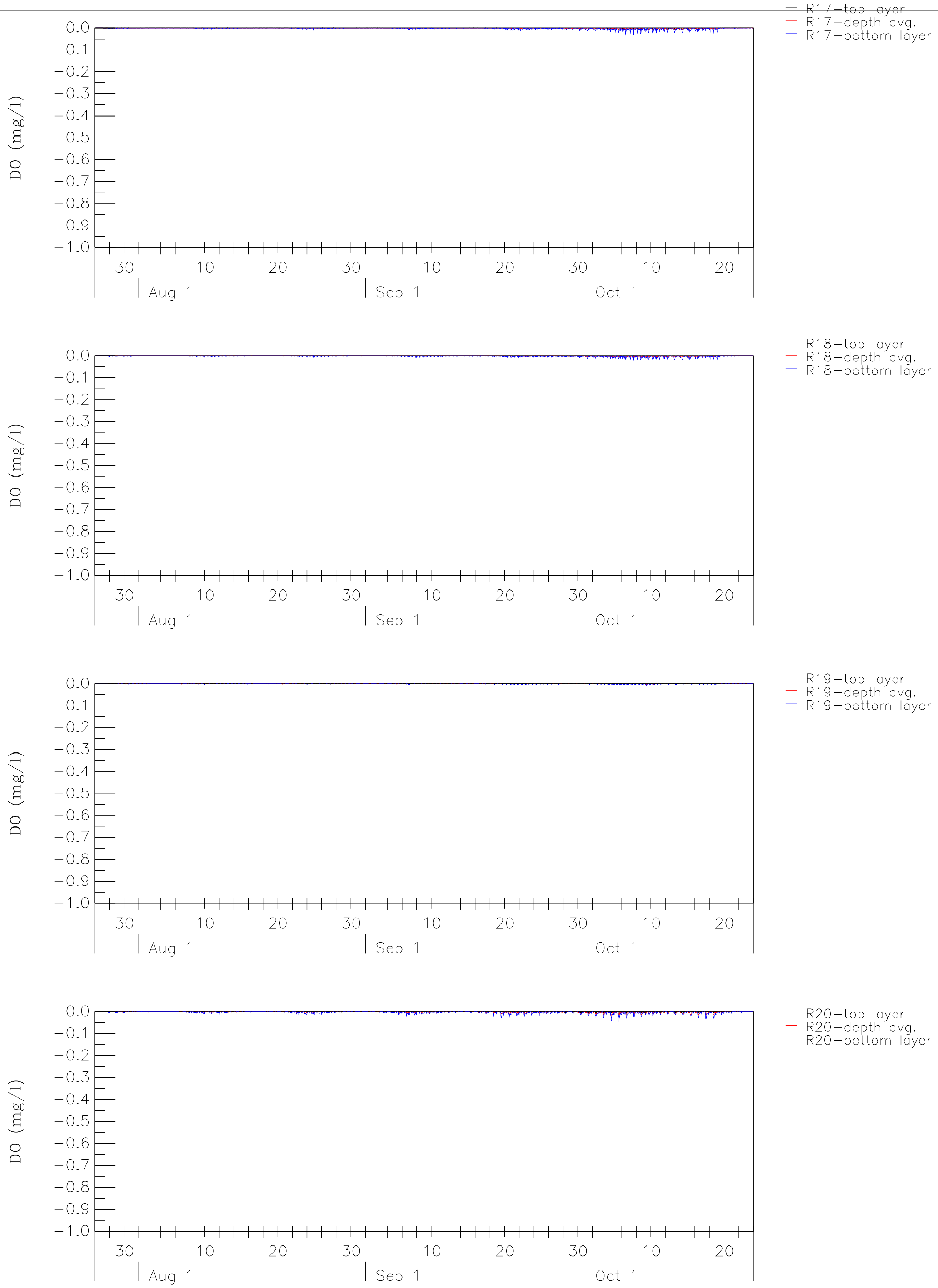
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R13, R14, R15, R16

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2o



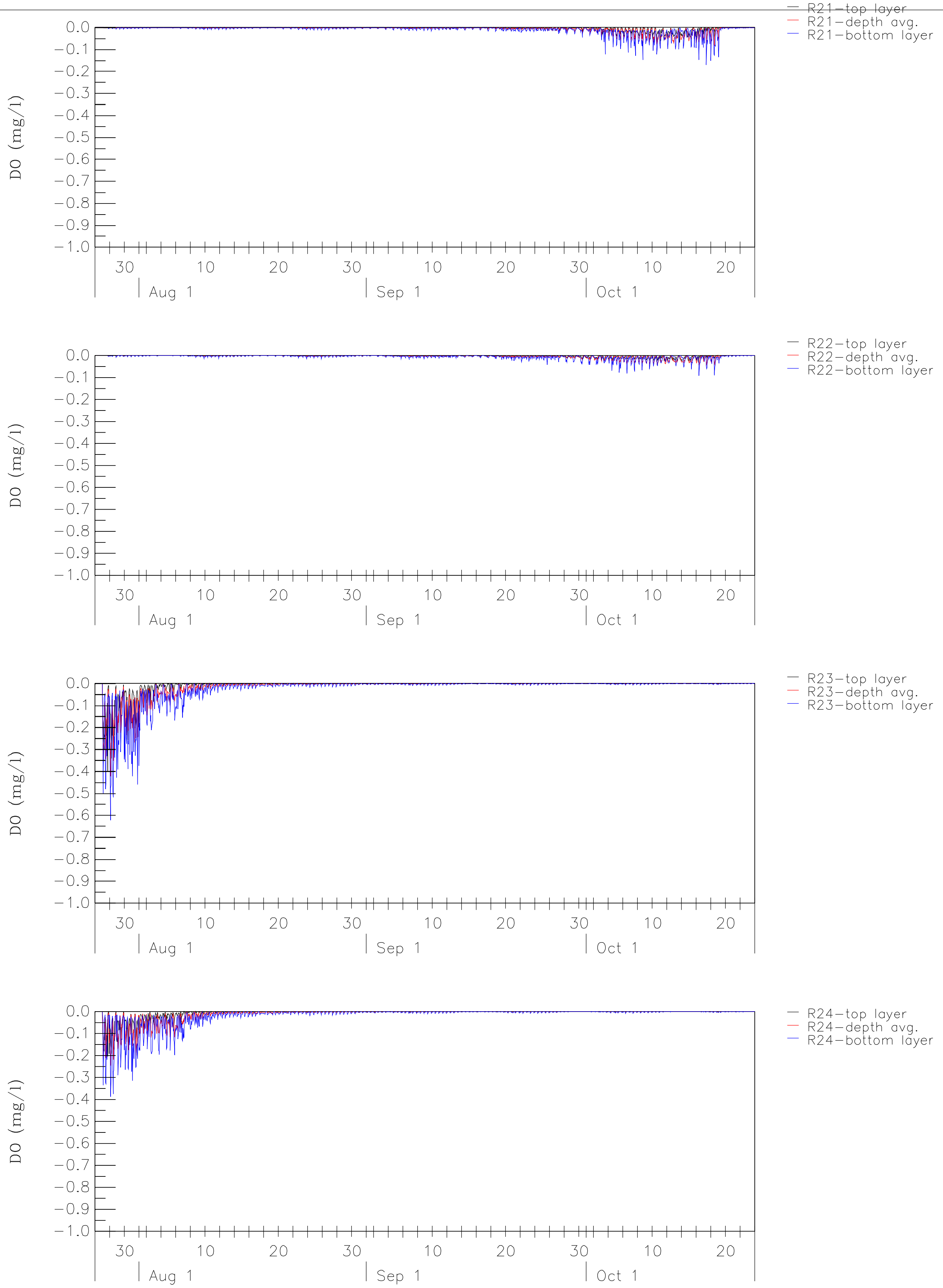
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R17, R18, R19, R20

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2p



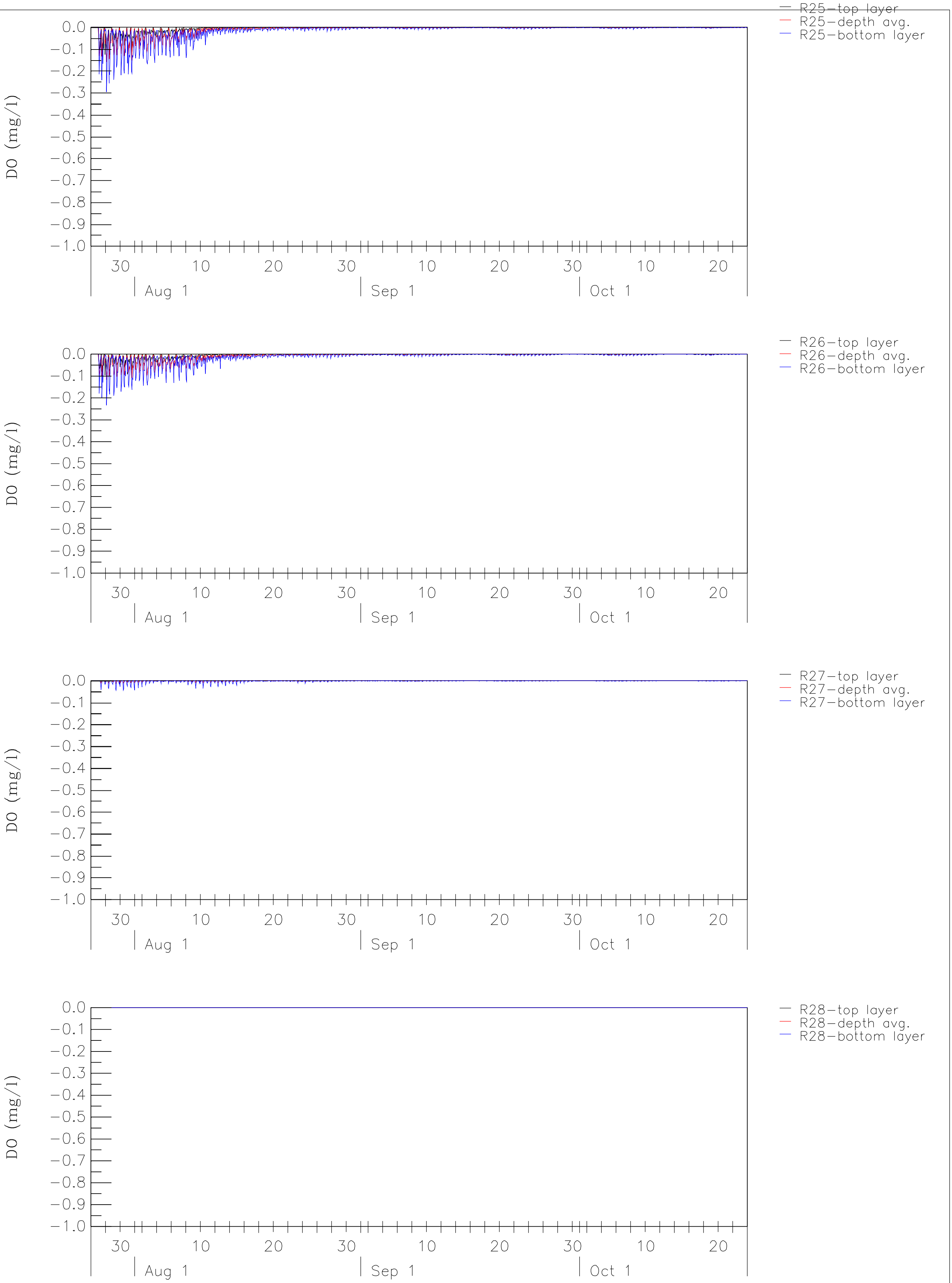
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R21, R22, R23, R24

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2q



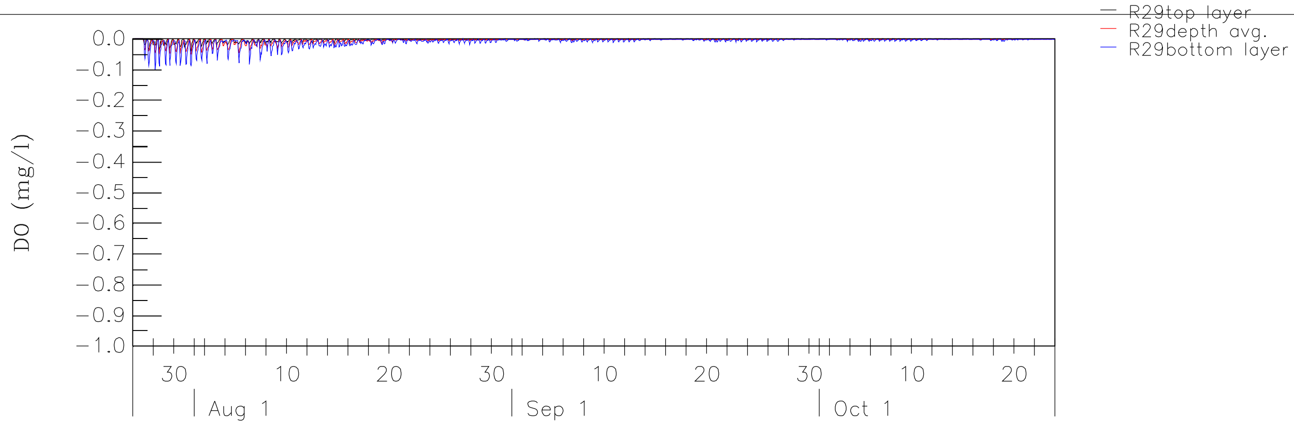
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R25, R26, R27, R28

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2r



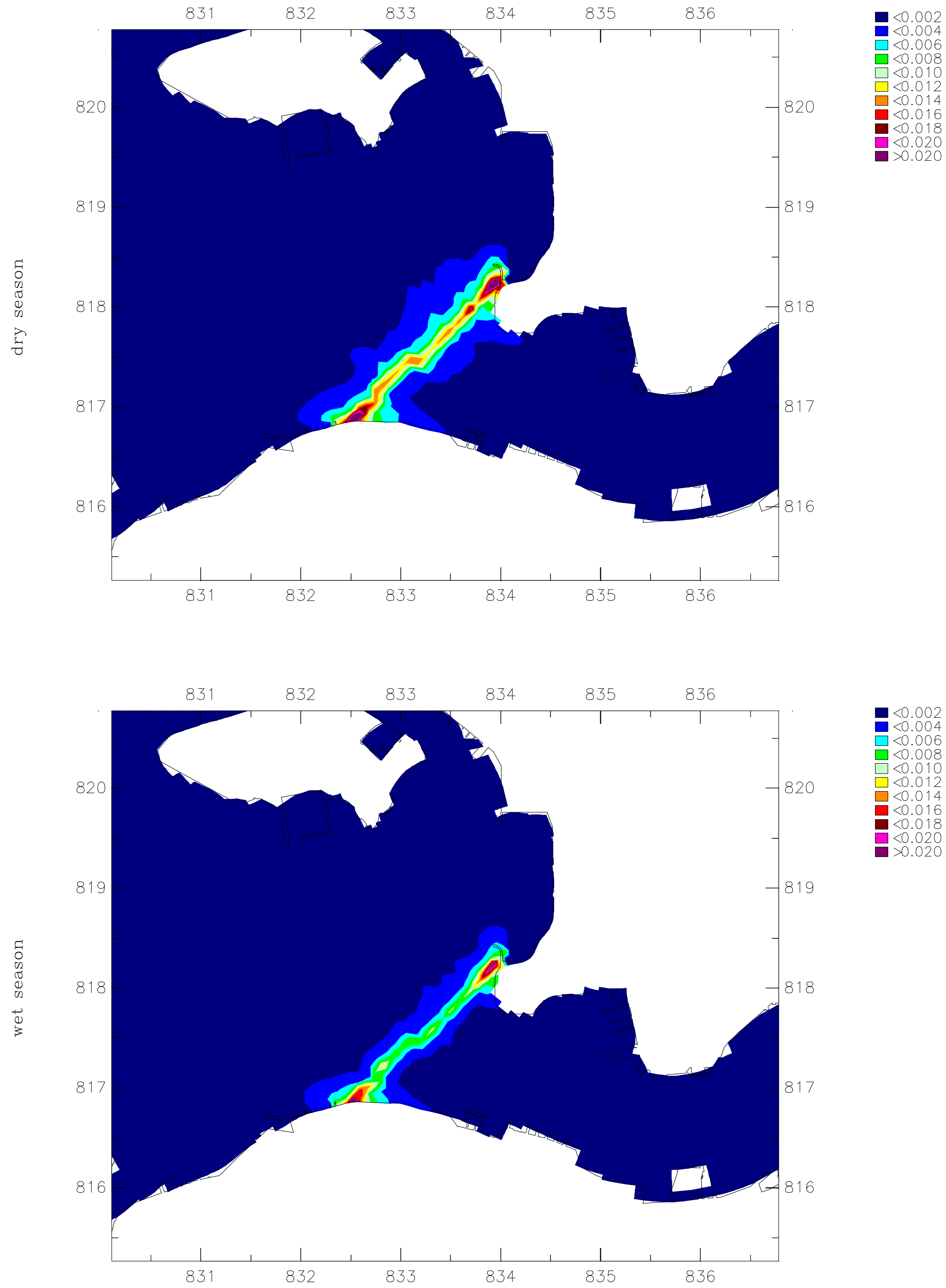
Dissolved Oxygen decrease (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R29

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.2s



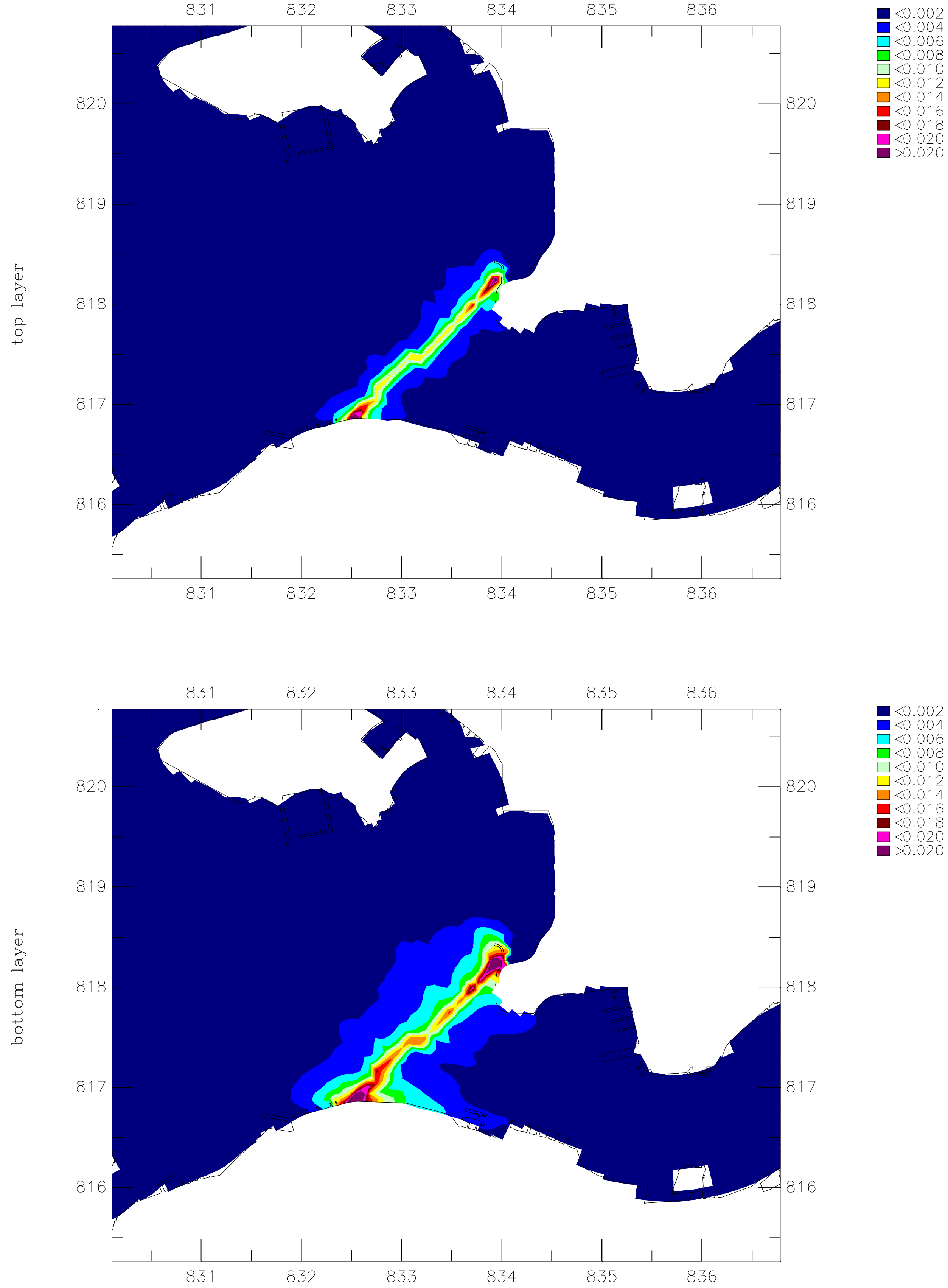
Depth averaged Total Inorganic Nitrogen (TIN) (mg/l)
Upper: Dry season maximum elevation
Lower: Wet season maximum elevation

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3a

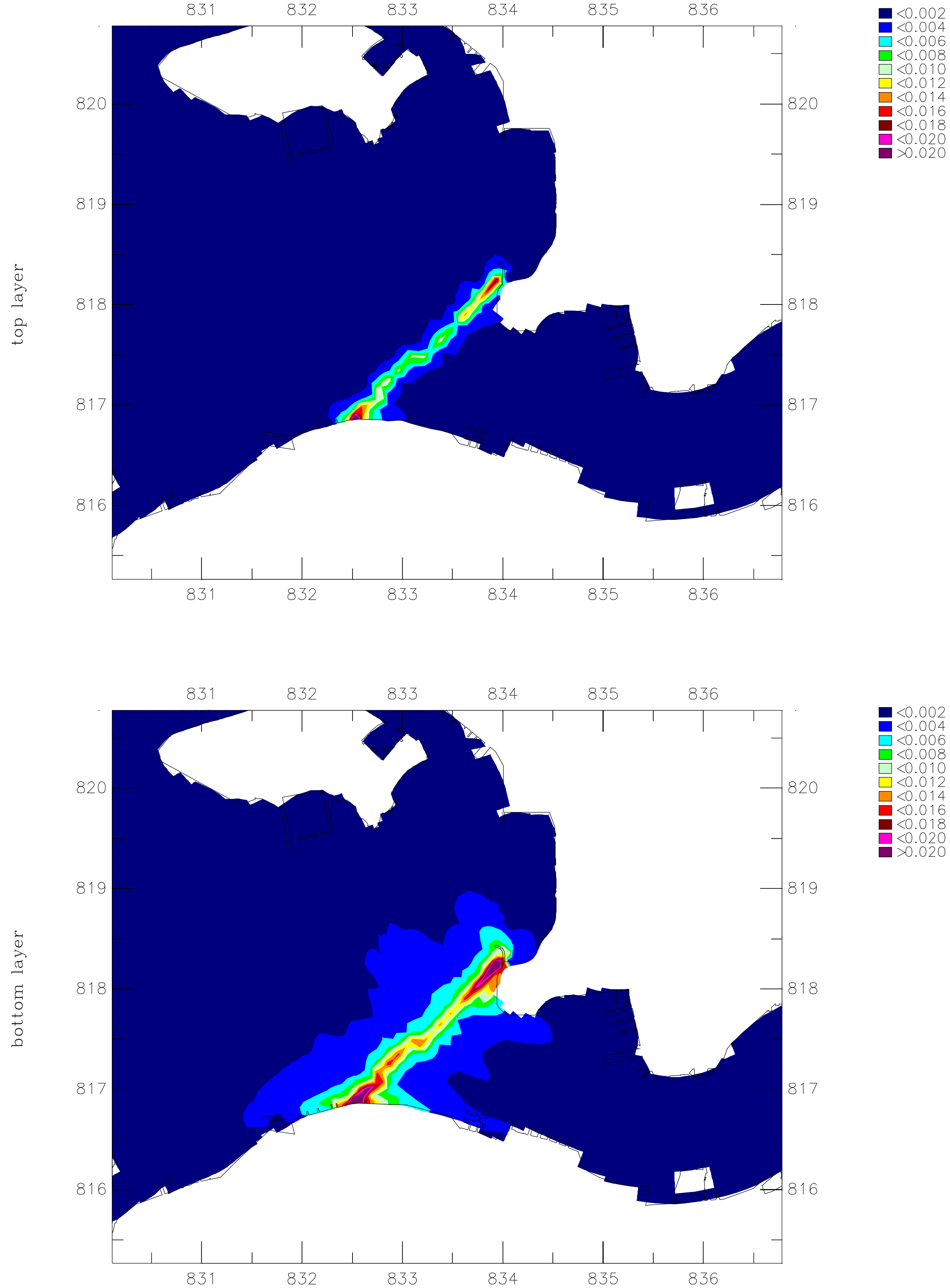


Total Inorganic Nitrogen (TIN) (mg/l)
Upper: Dry season maximum elevation top layer
Lower: Dry season maximum elevation bottom layer

Z4187	
Cross Harbour Water Mains	

WL | Delft Hydraulics

Figure C3.3b



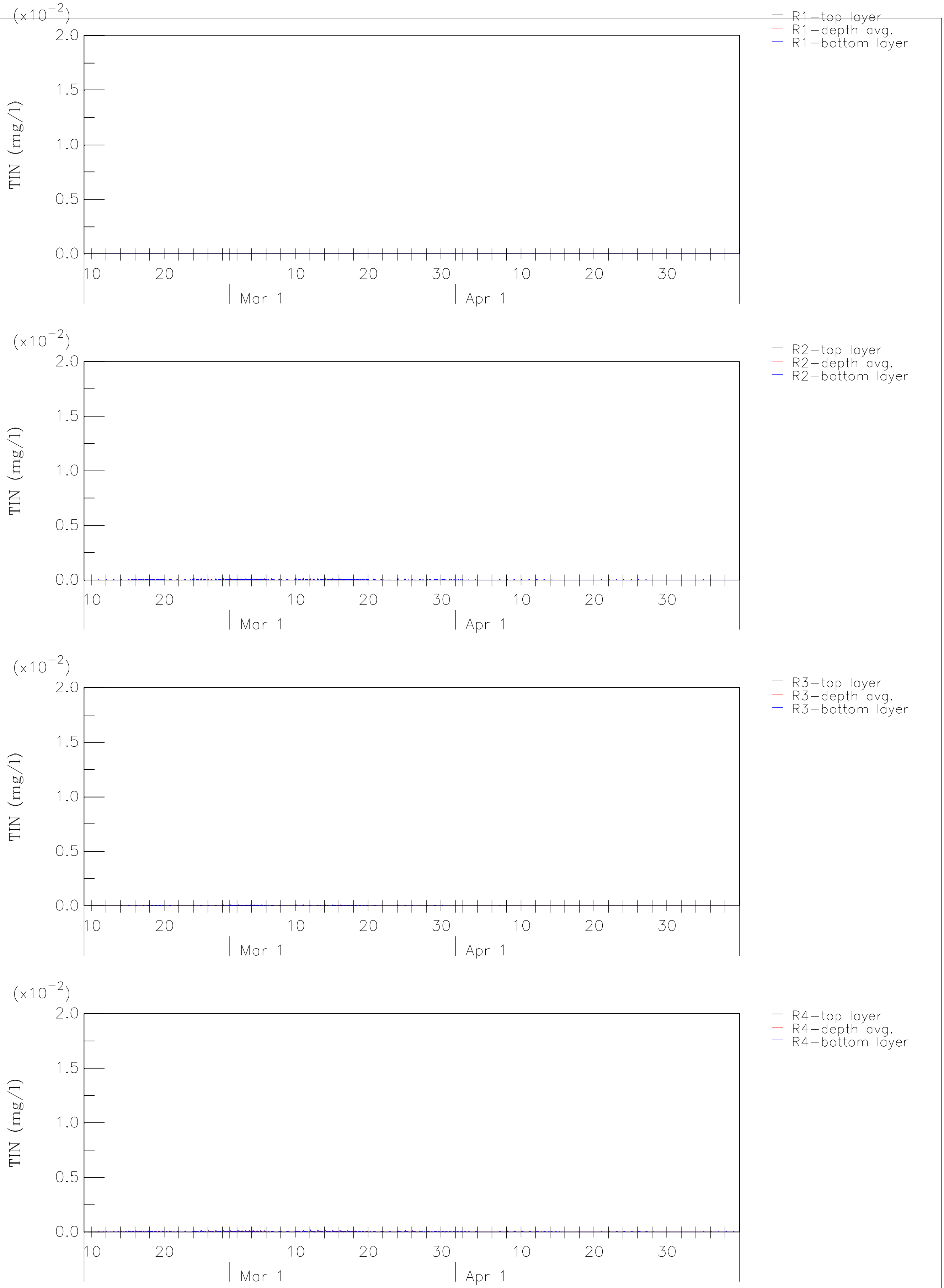
Total Inorganic Nitrogen (TIN) (mg/l)
Upper: Wet season maximum elevation top layer
Lower: Wet season maximum elevation bottom layer

Z4187

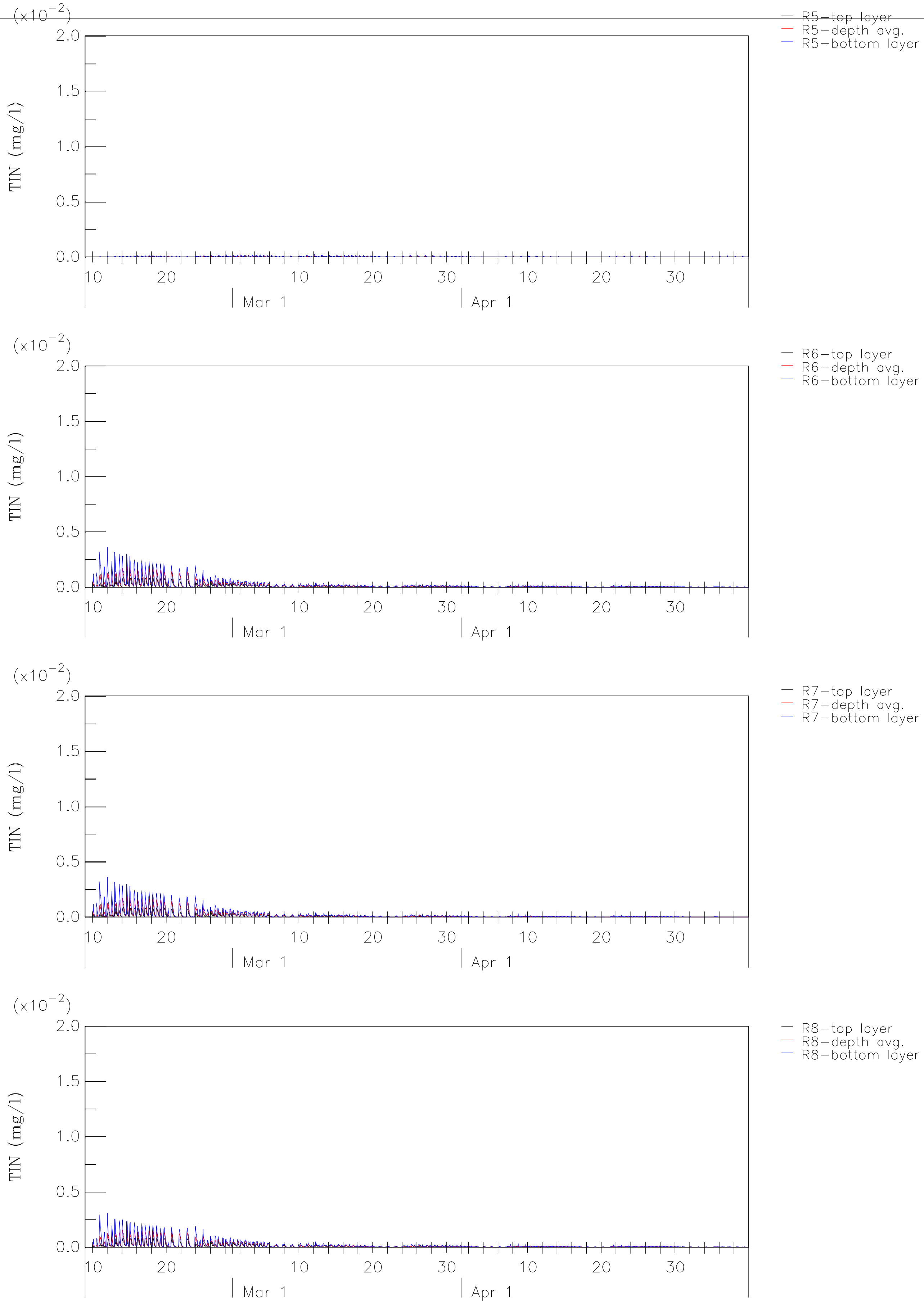
Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3c



Total Inorganic Nitrogen elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R1, R2, R3, R4	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3d



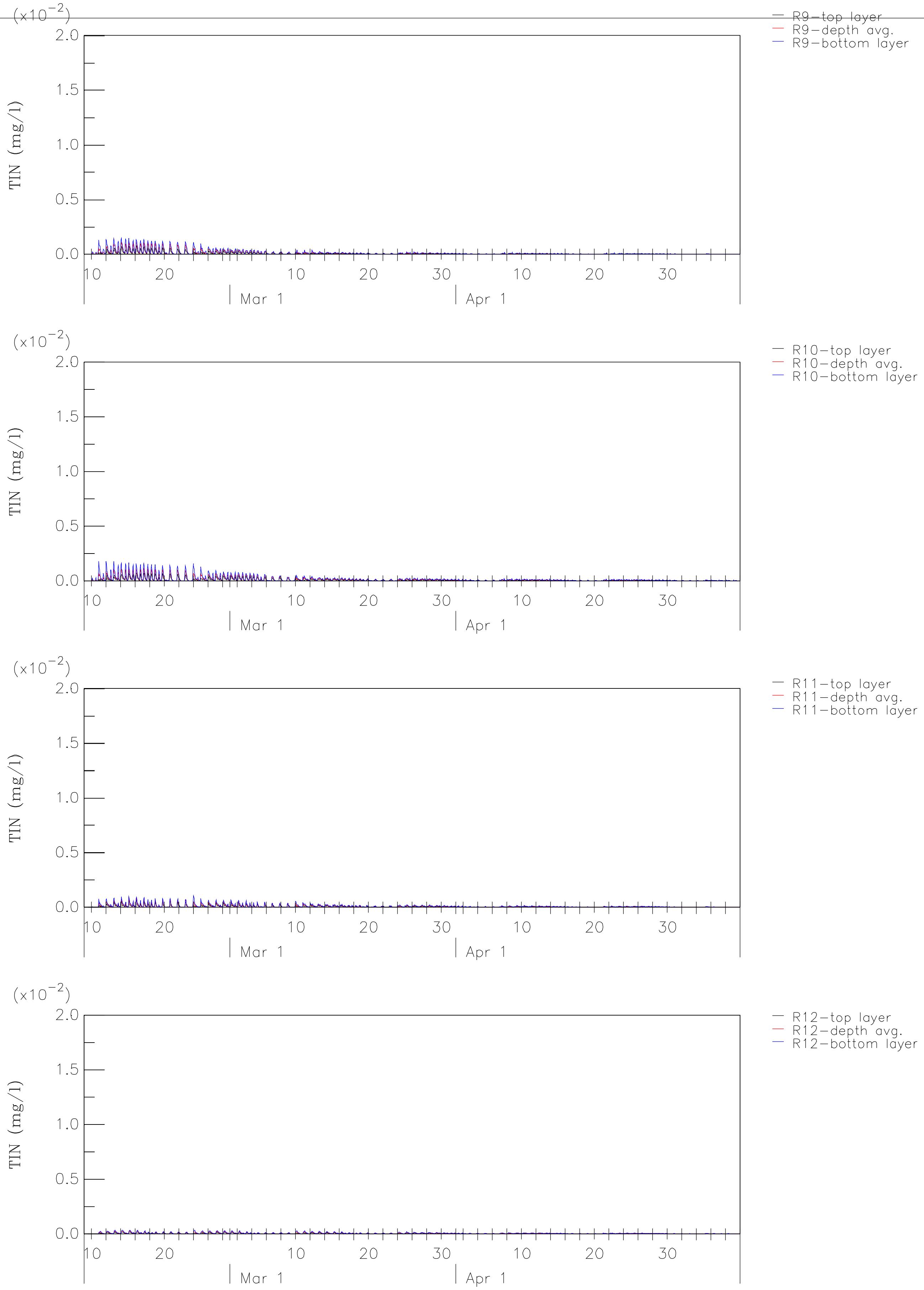
Total Inorganic Nitrogen elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

Z4187

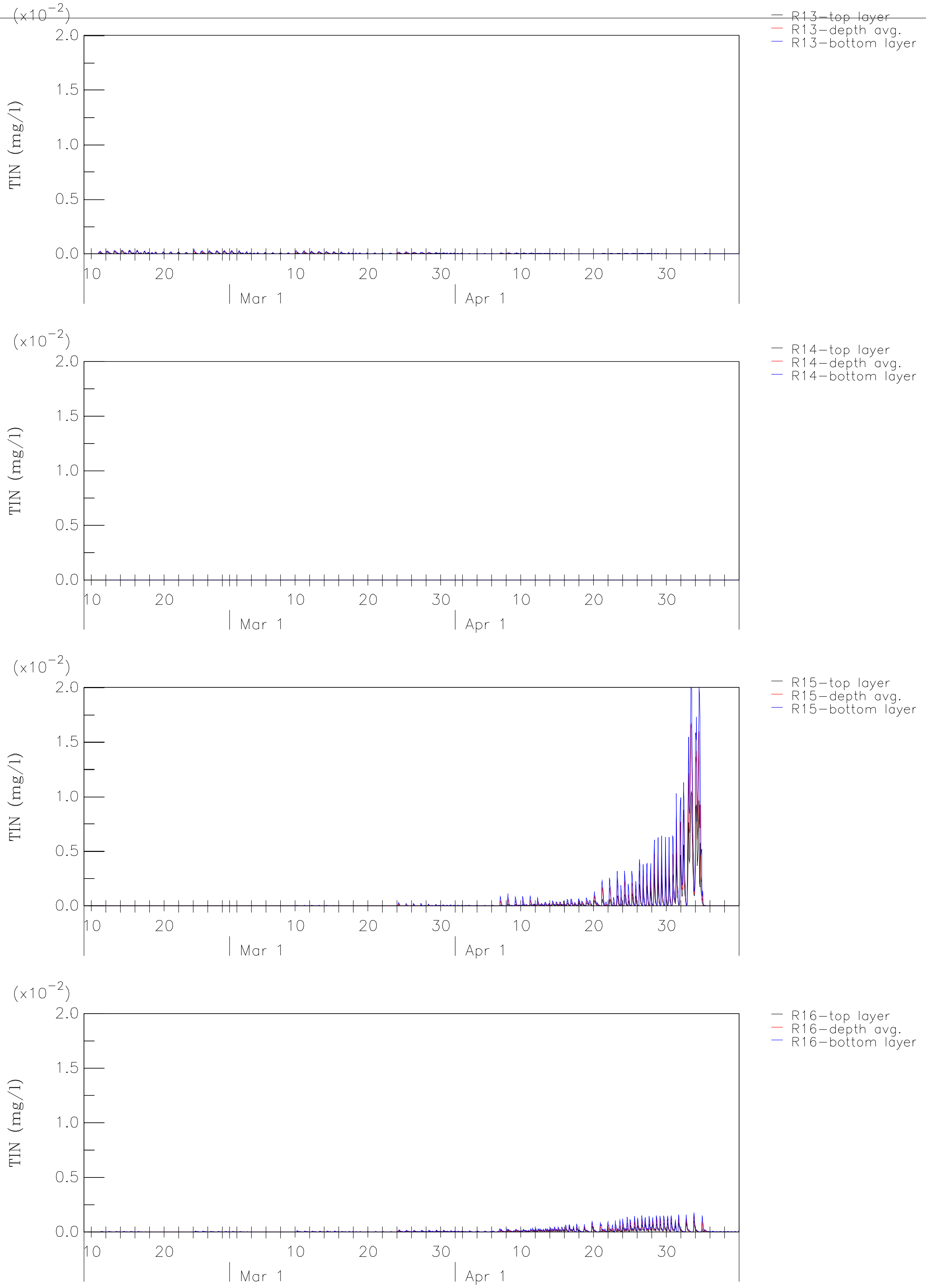
Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3e



Total Inorganic Nitrogen elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R9, R10, R11, R12	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3f



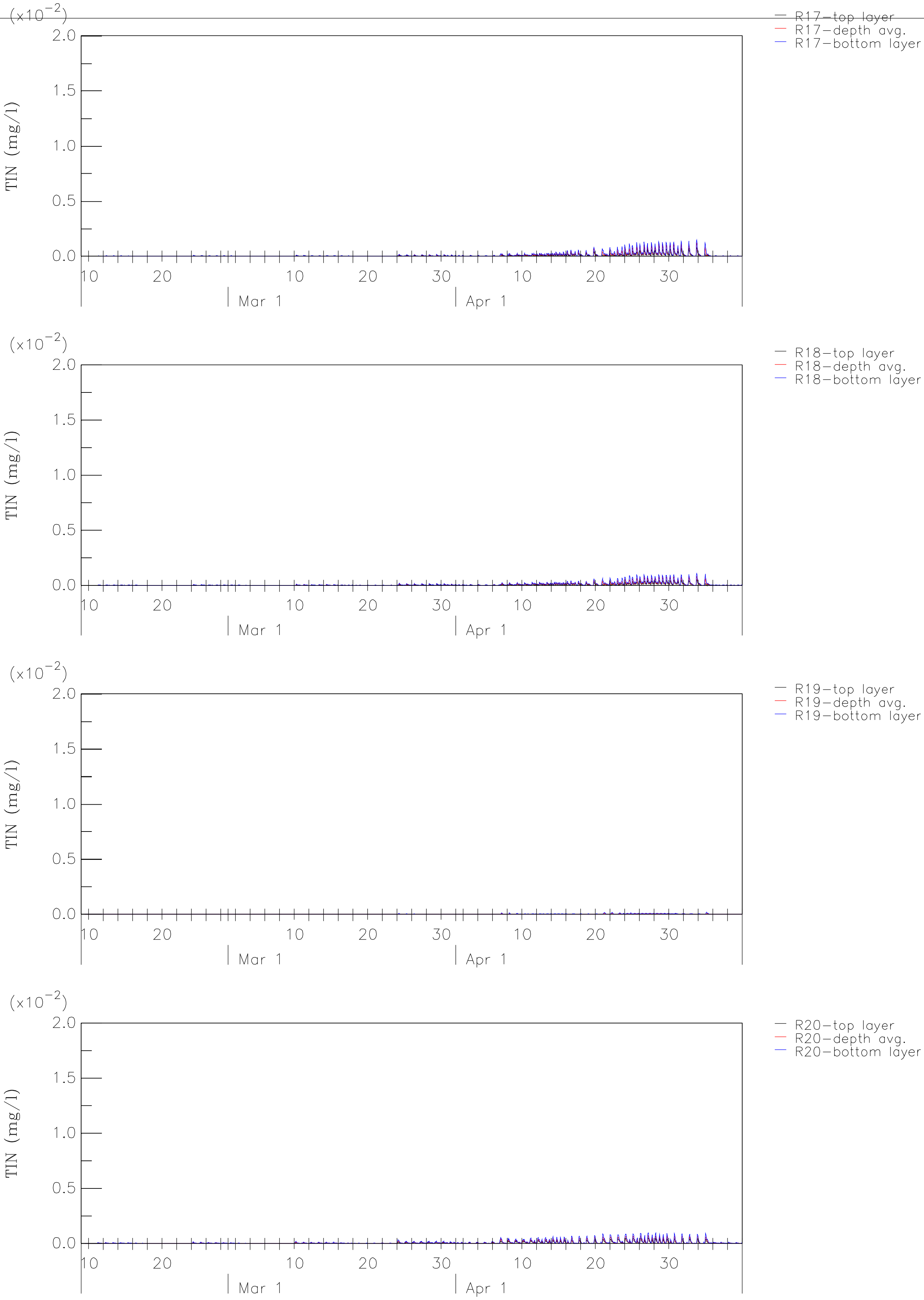
Total Inorganic Nitrogen elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R13, R14, R15, R16

Z4187

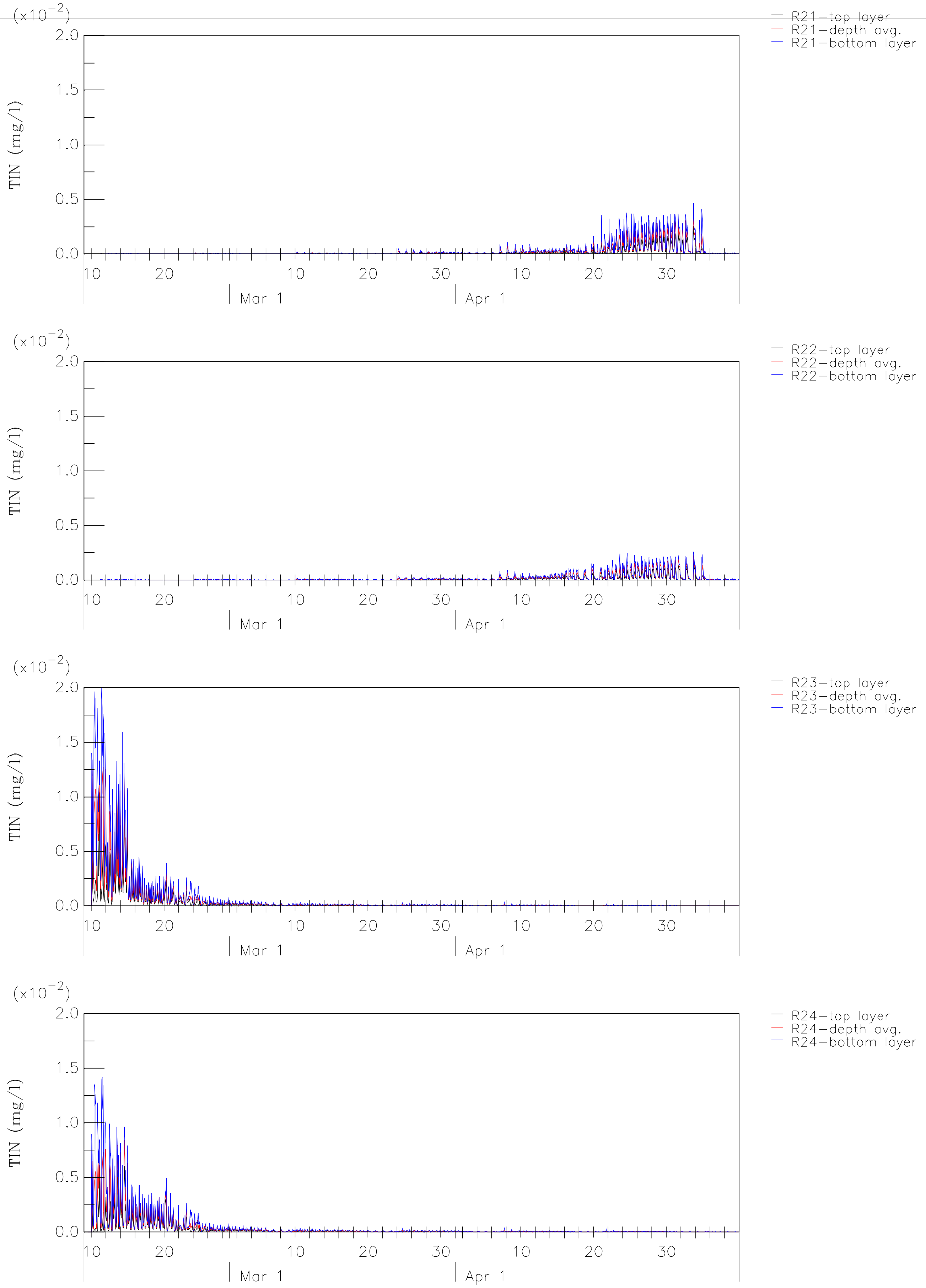
Cross Harbour Water Mains

WL | Delft Hydraulics

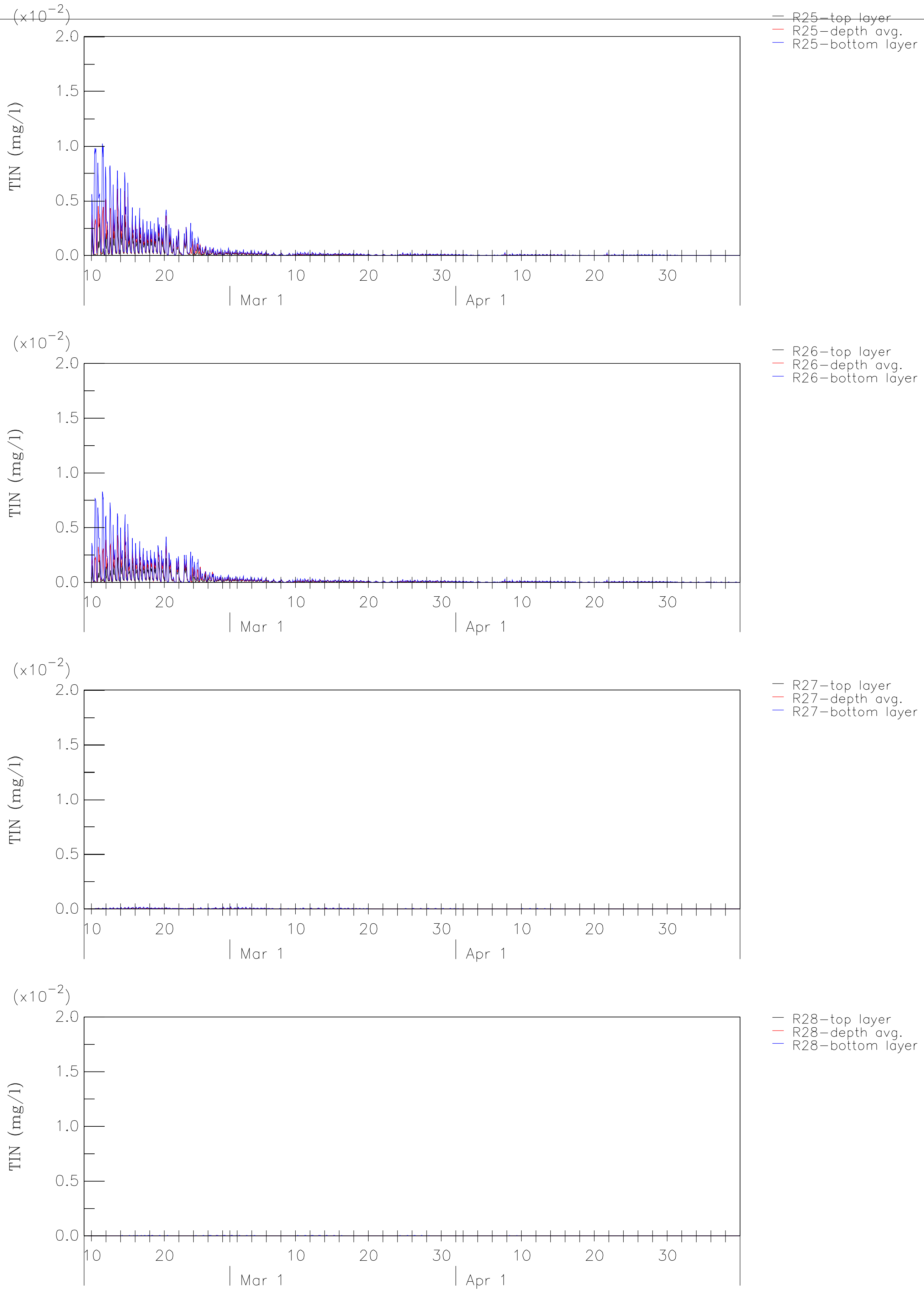
Figure C3.3g



Total Inorganic Nitrogen elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R17, R18, R19, R20	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3h



Total Inorganic Nitrogen elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3i



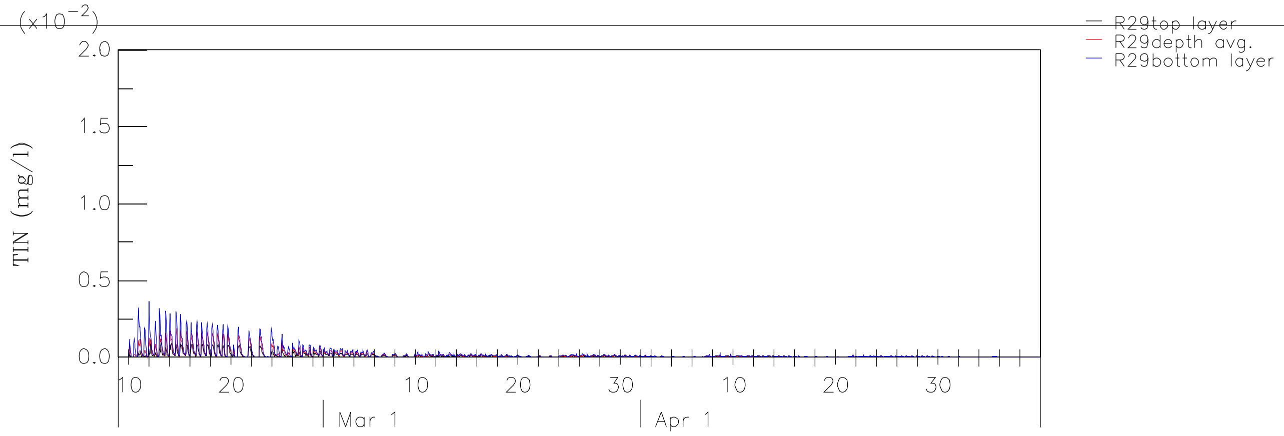
Total Inorganic Nitrogen elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R25, R26, R27, R28

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3j



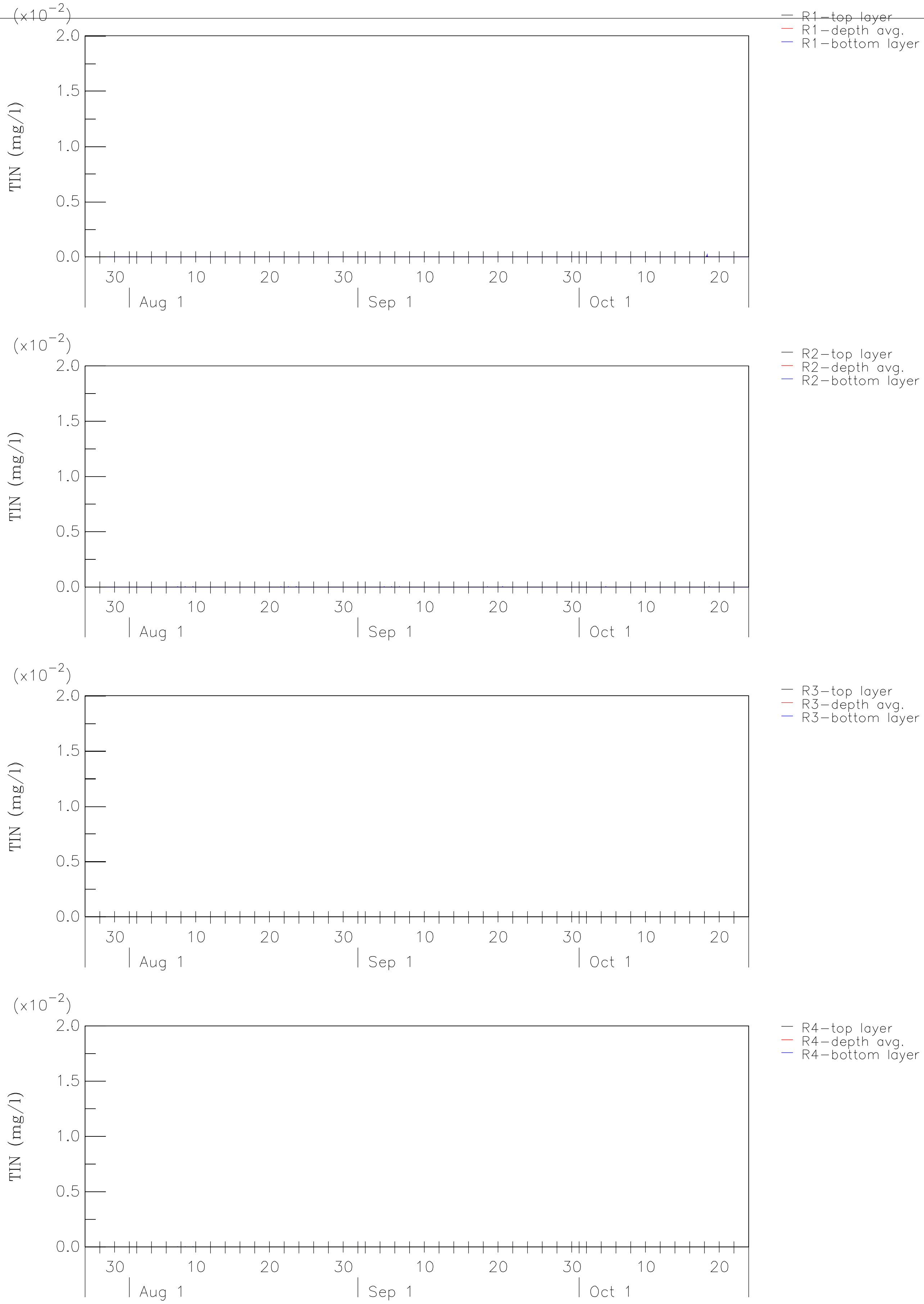
Total Inorganic Nitrogen elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R29

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3k



Total Inorganic Nitrogen elevation (mg/l) Wet season

Top layer, Depth averaged, Bottom layer

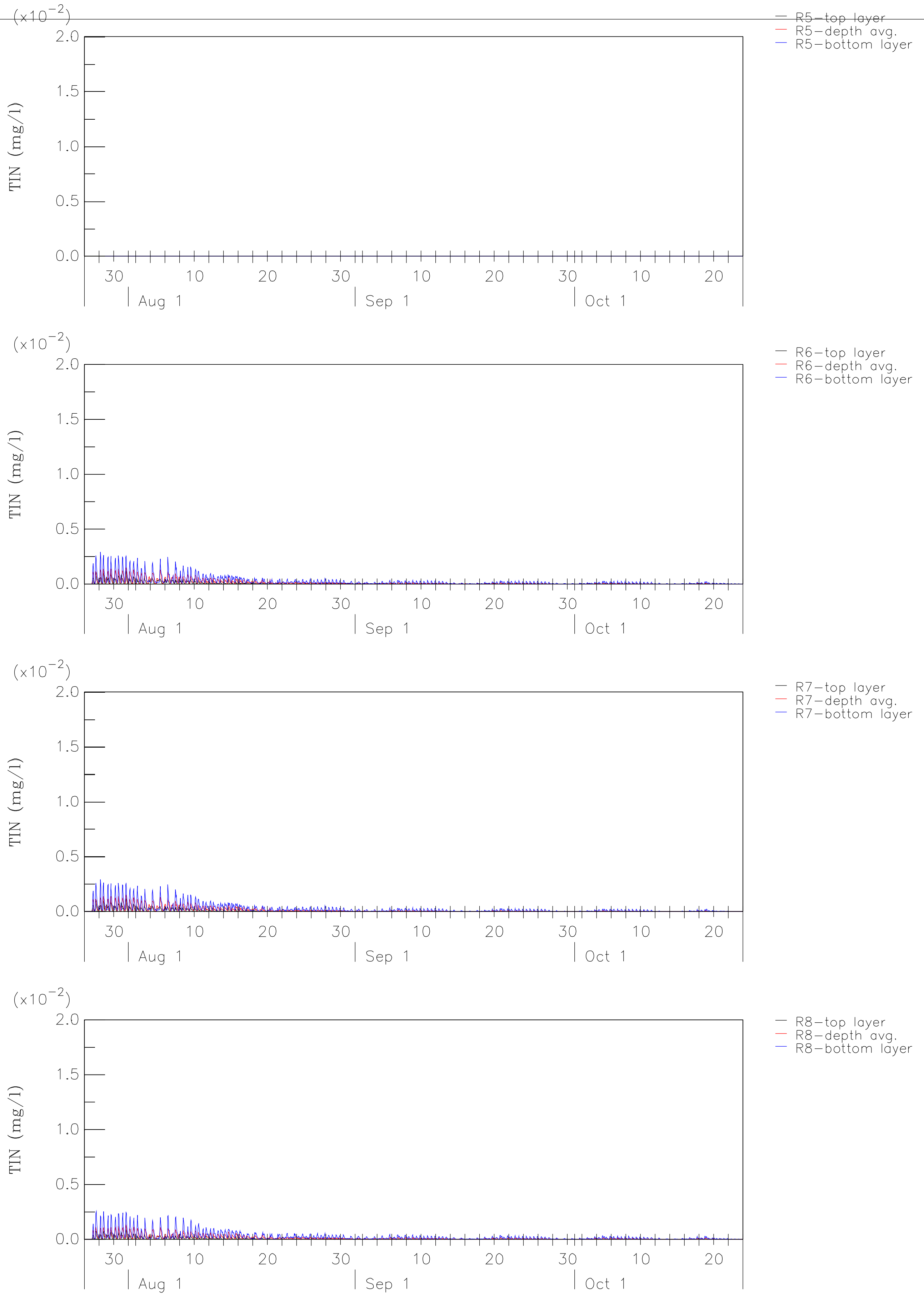
Stations R1, R2, R3, R4

Z4187

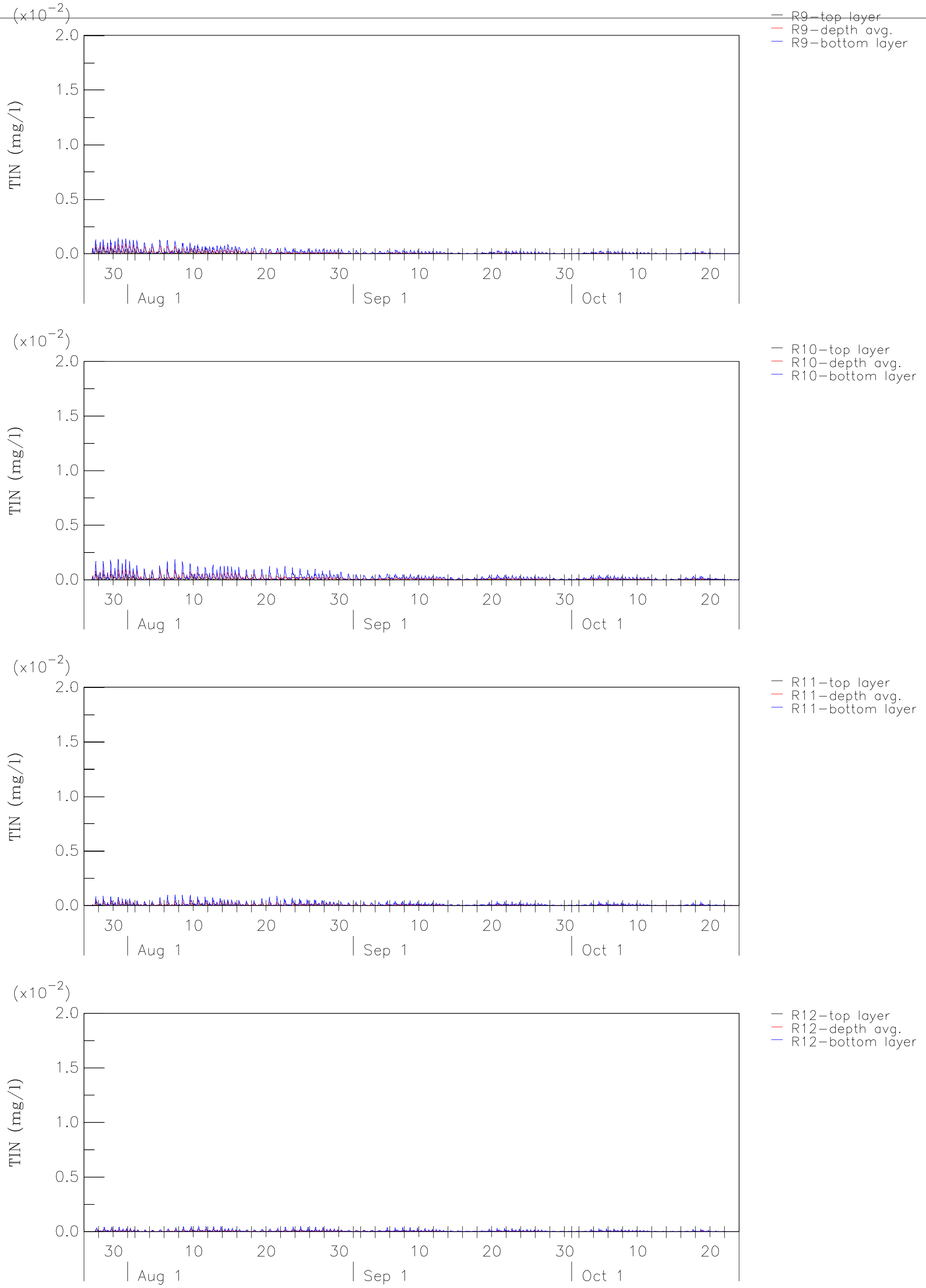
Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3l



Total Inorganic Nitrogen elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R5, R6, R7, R8	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3m



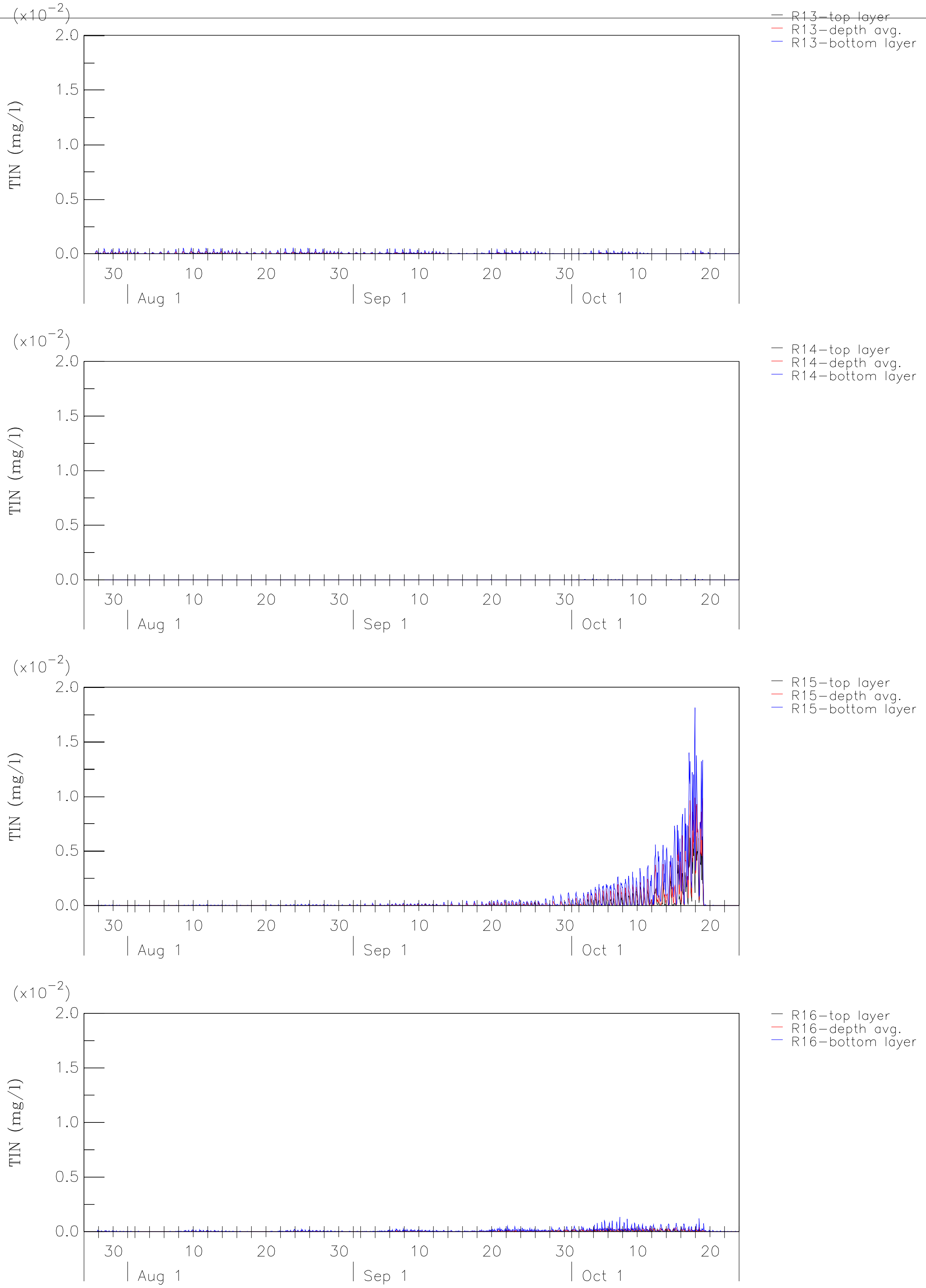
Total Inorganic Nitrogen elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R9, R10, R11, R12

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3n



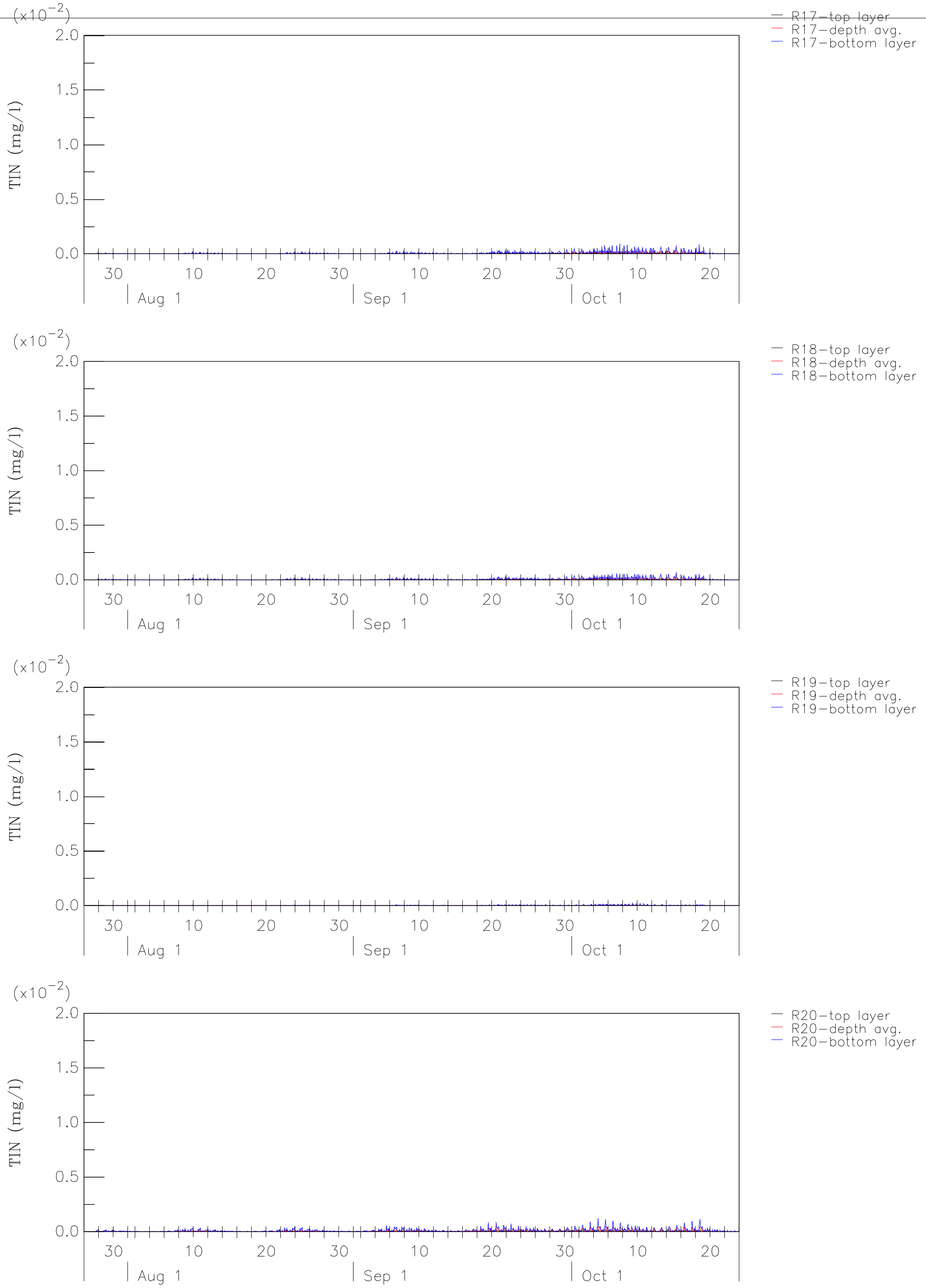
Total Inorganic Nitrogen elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R13, R14, R15, R16

Z4187

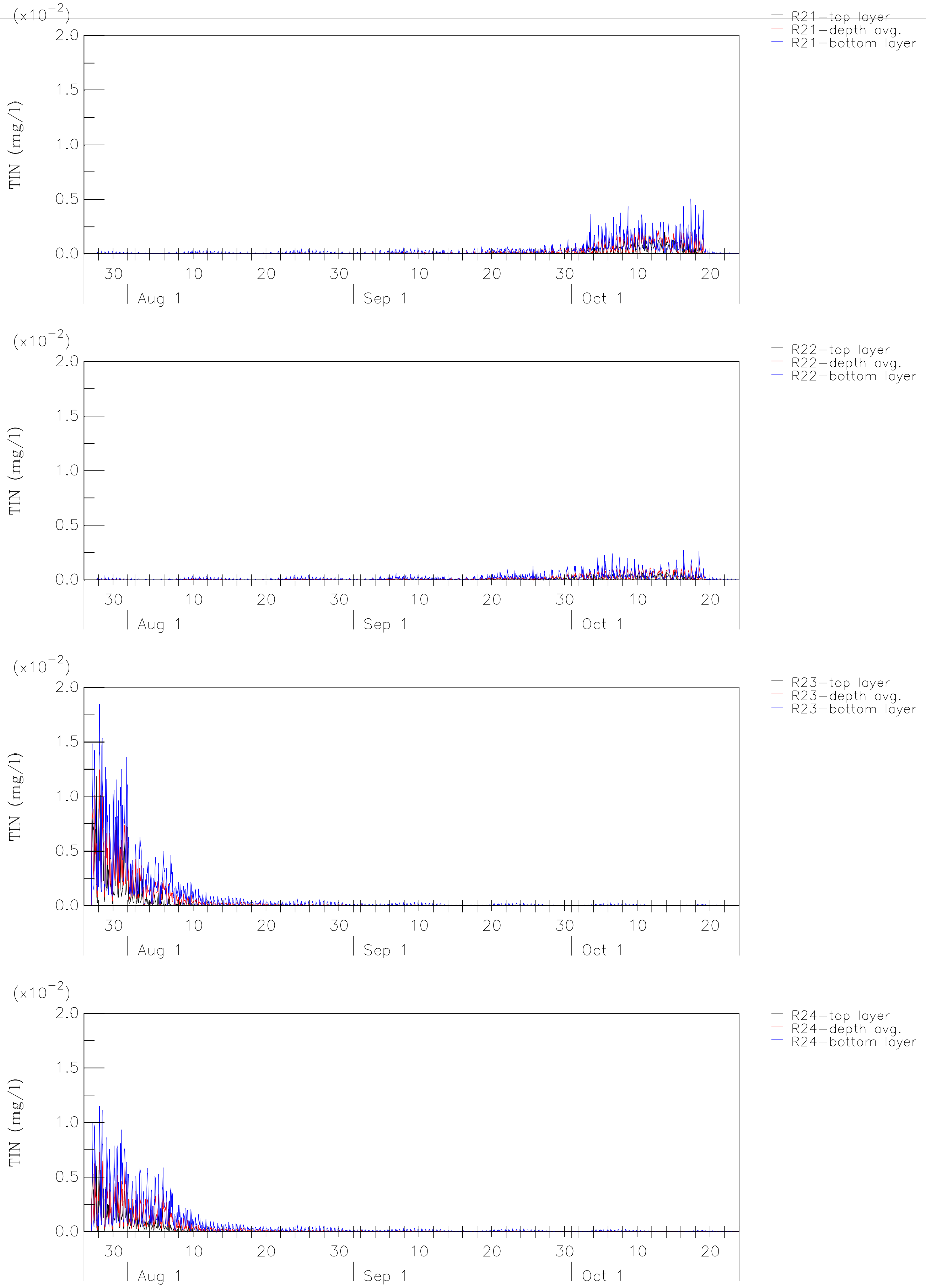
Cross Harbour Water Mains

WL | Delft Hydraulics

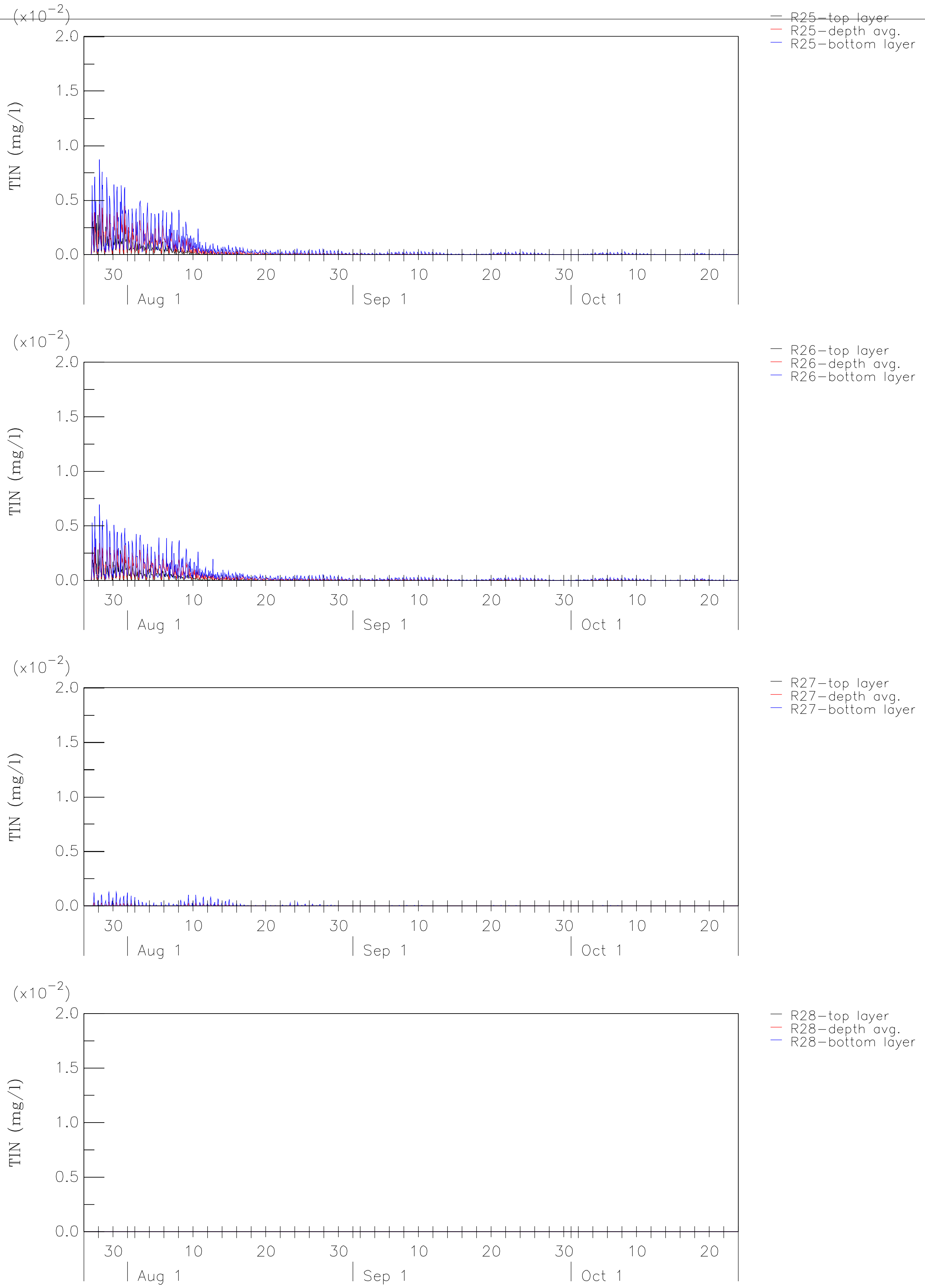
Figure C3.3o



Total Inorganic Nitrogen elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R17, R18, R19, R20	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.3p



Total Inorganic Nitrogen elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	**Figure C3.3q**



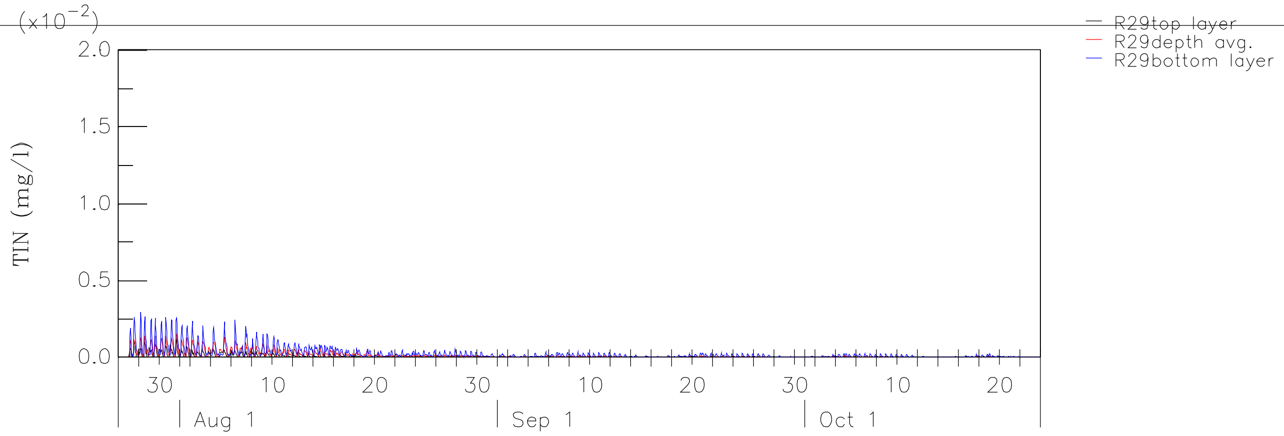
Total Inorganic Nitrogen elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R25, R26, R27, R28

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.3r



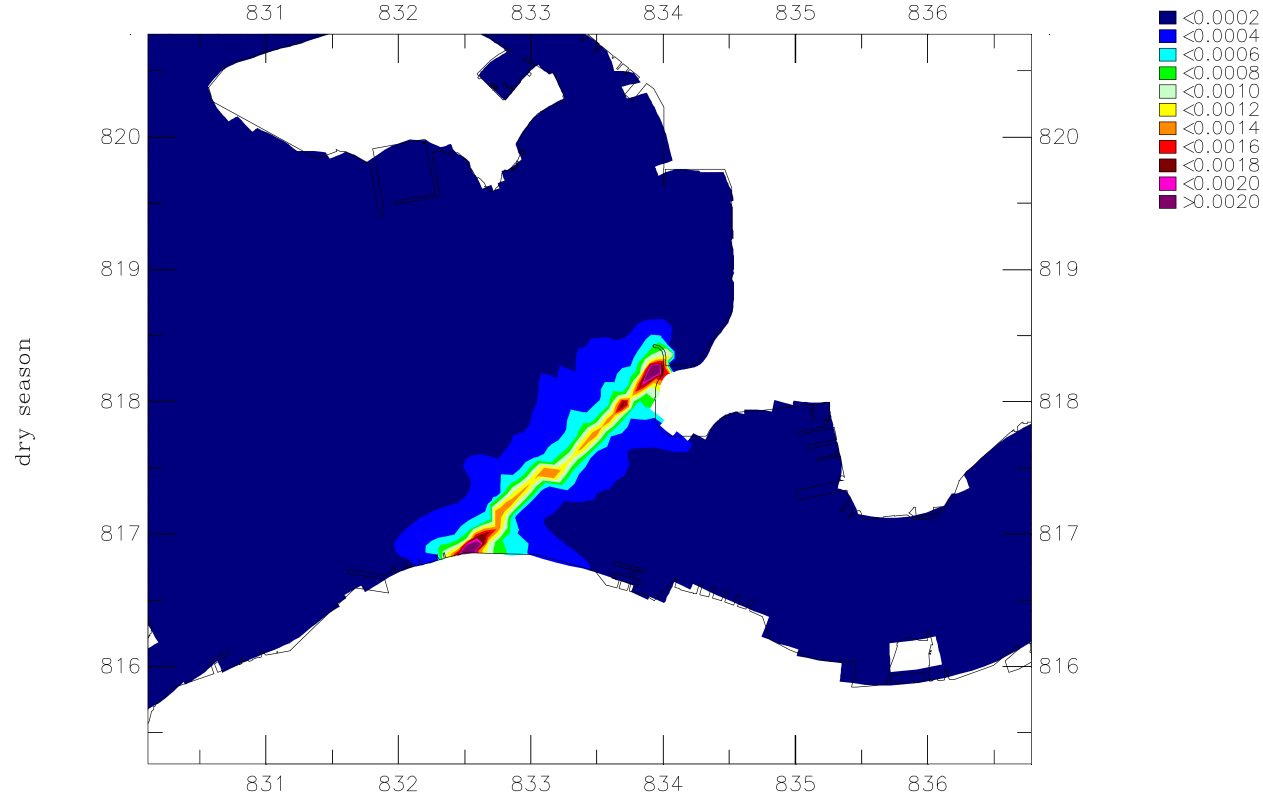
Total Inorganic Nitrogen elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R29

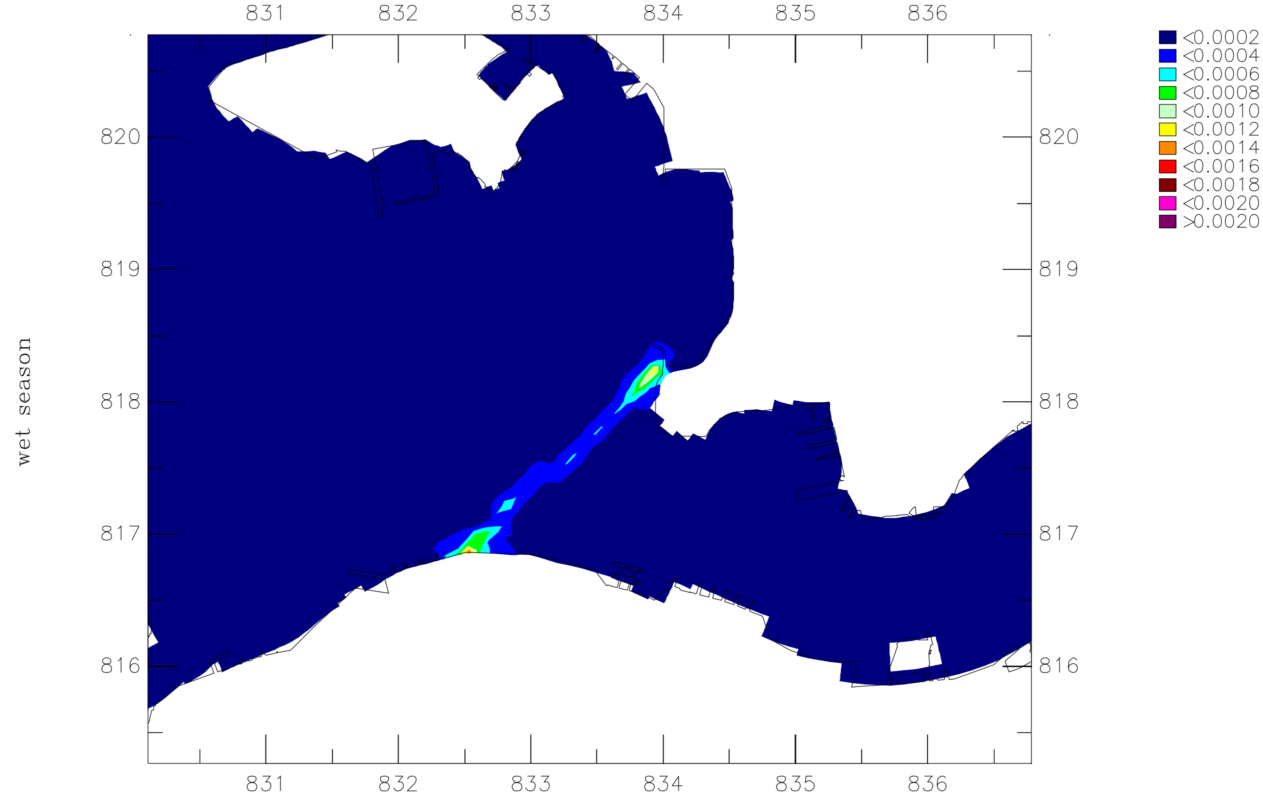
Z4187

Cross Harbour Water Mains

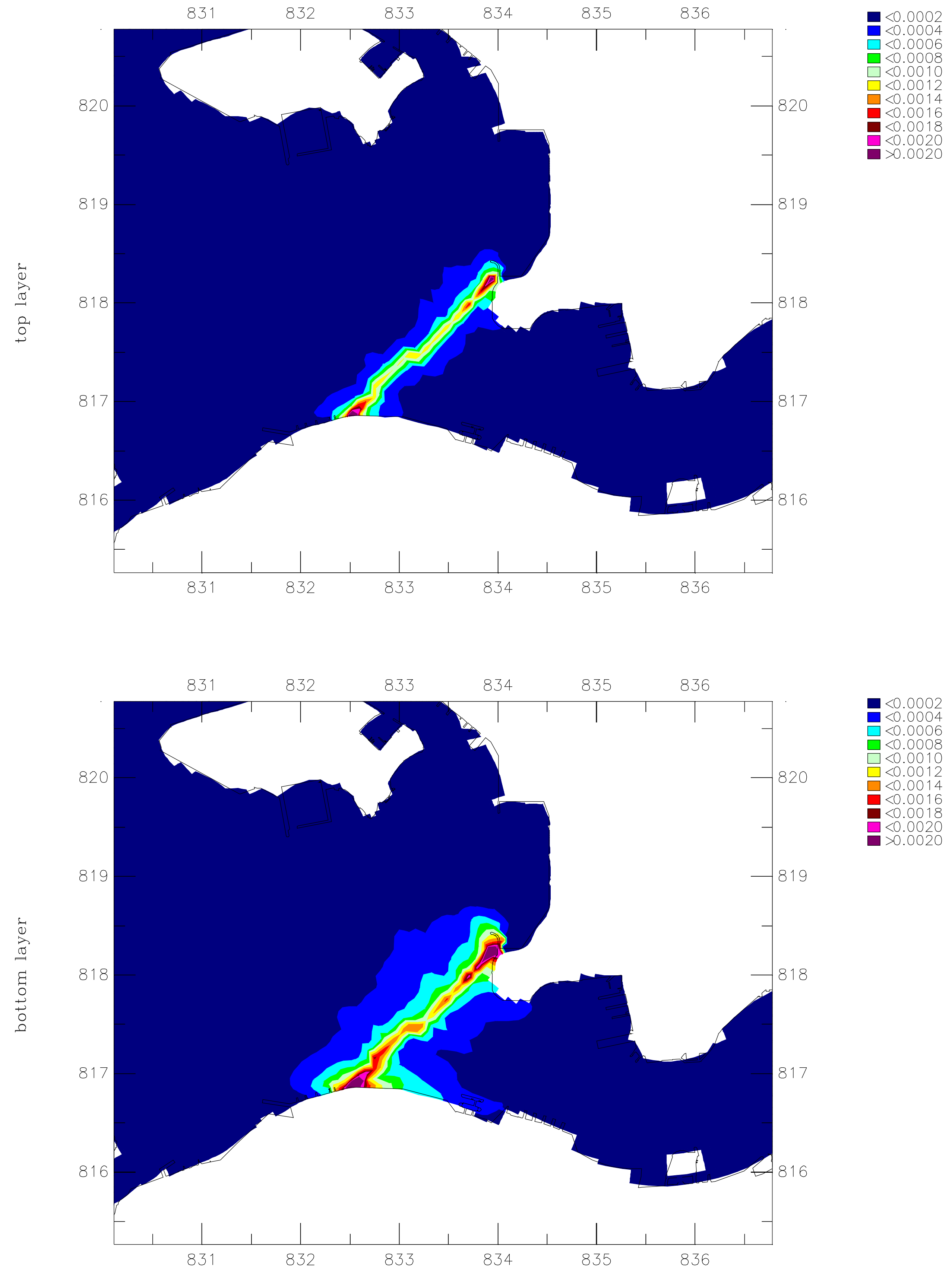
WL | Delft Hydraulics

Figure C3.3s

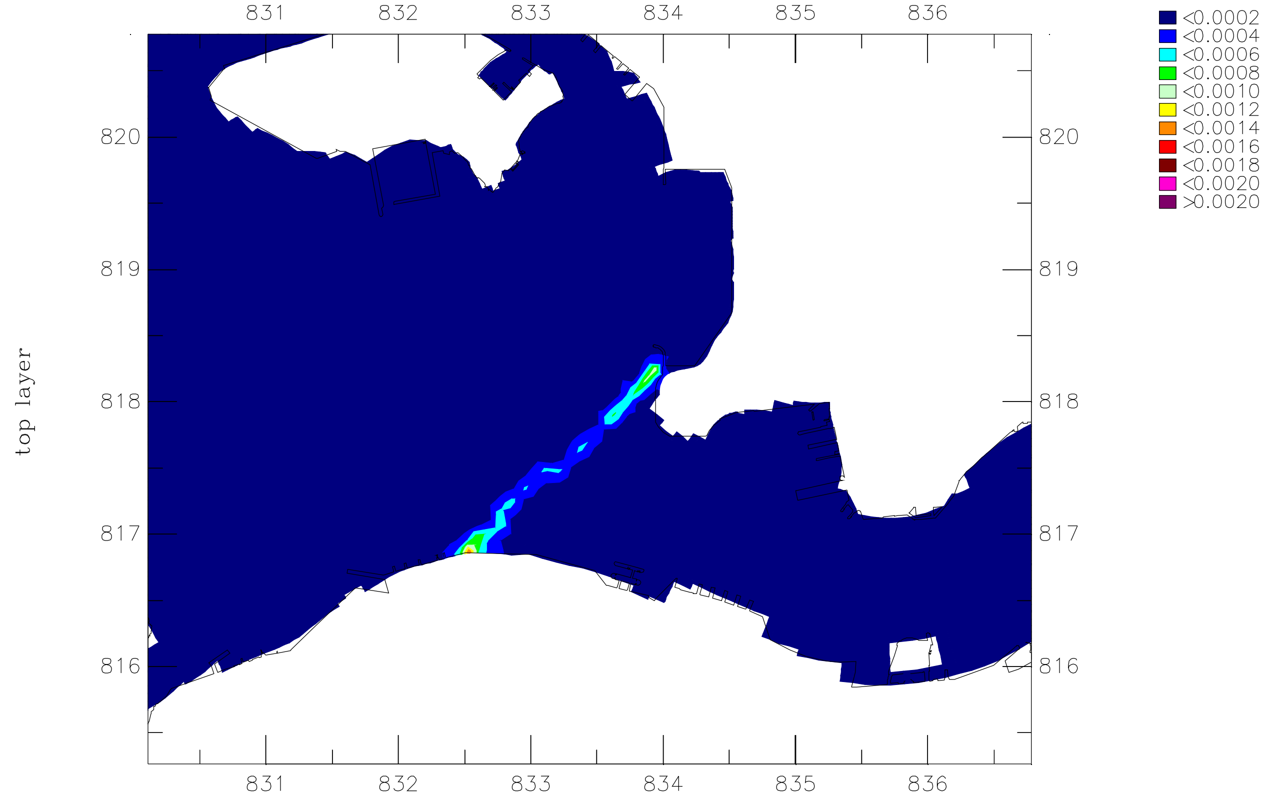


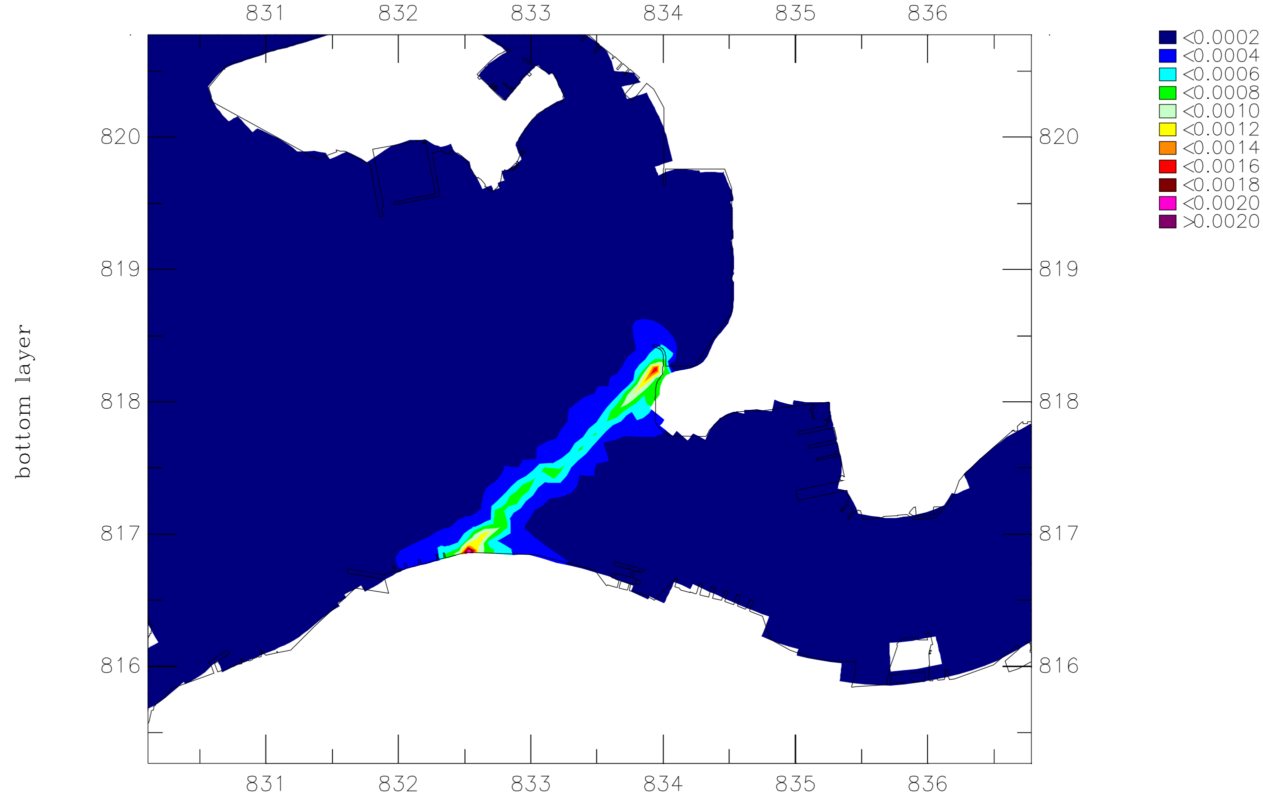


Depth averaged Unionised Ammonia (NH3) (mg/l) Upper: Dry season maximum elevation Lower: Wet season maximum elevation	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4a

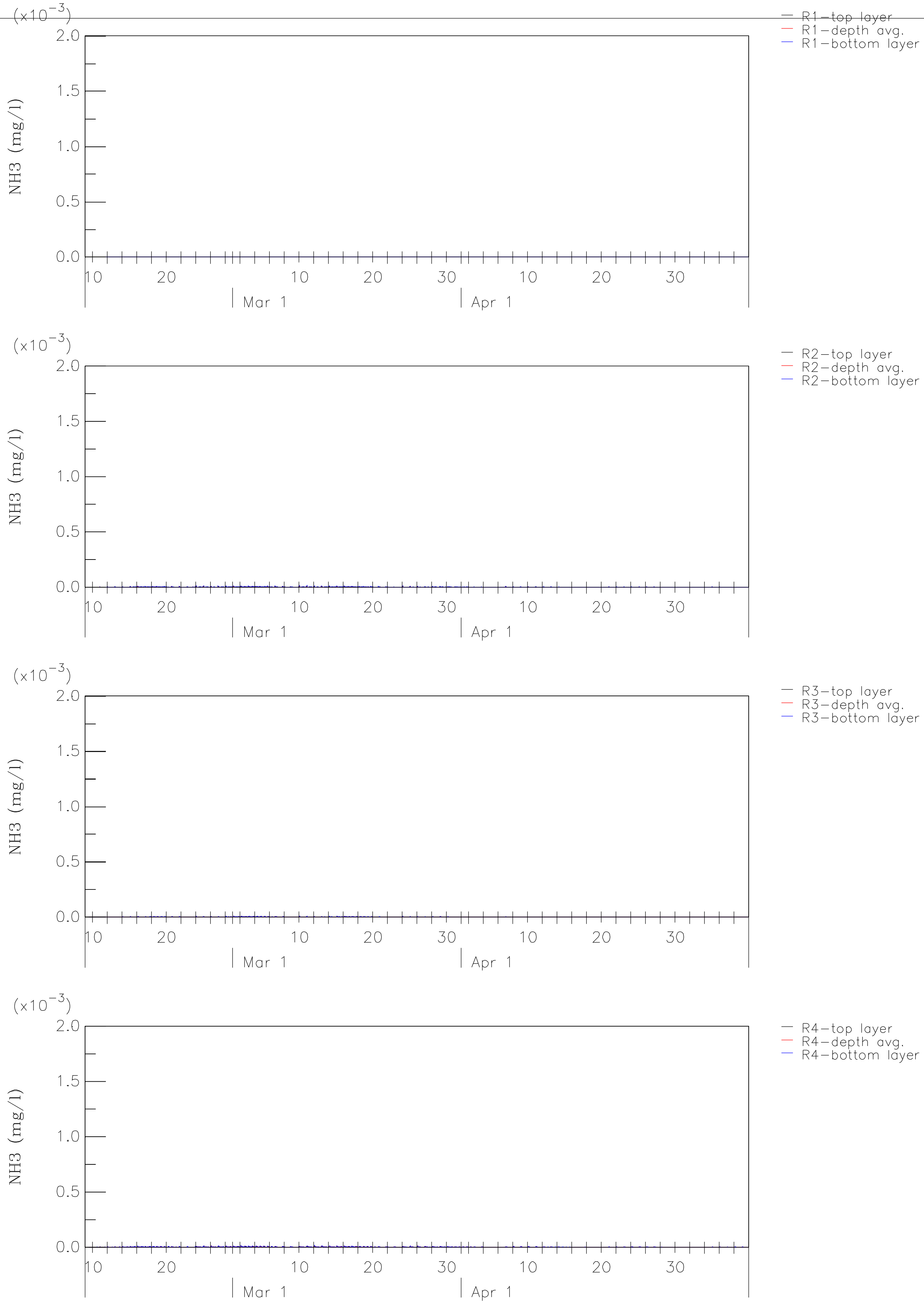


Unionised Ammonia (NH3) (mg/l) Upper: Dry season maximum elevation top layer Lower: Dry season maximum elevation bottom layer	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	**Figure C3.4b**	

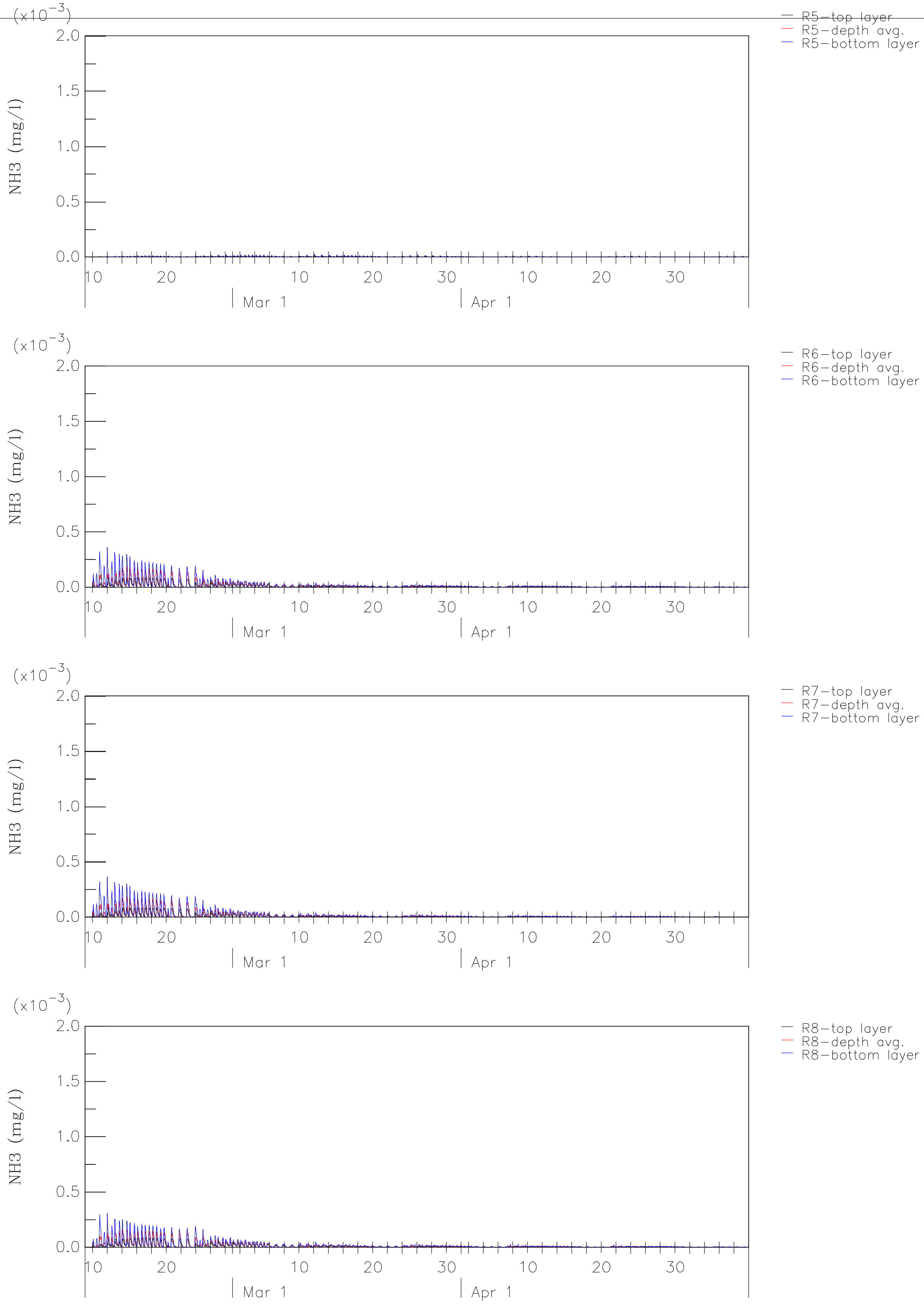




Unionised Ammonia (NH3) (mg/l) Upper: Wet season maximum elevation top layer Lower: Wet season maximum elevation bottom layer	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	**Figure C3.4c**	



Unionised Ammonia elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R1, R2, R3, R4	Z4187
	Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4d



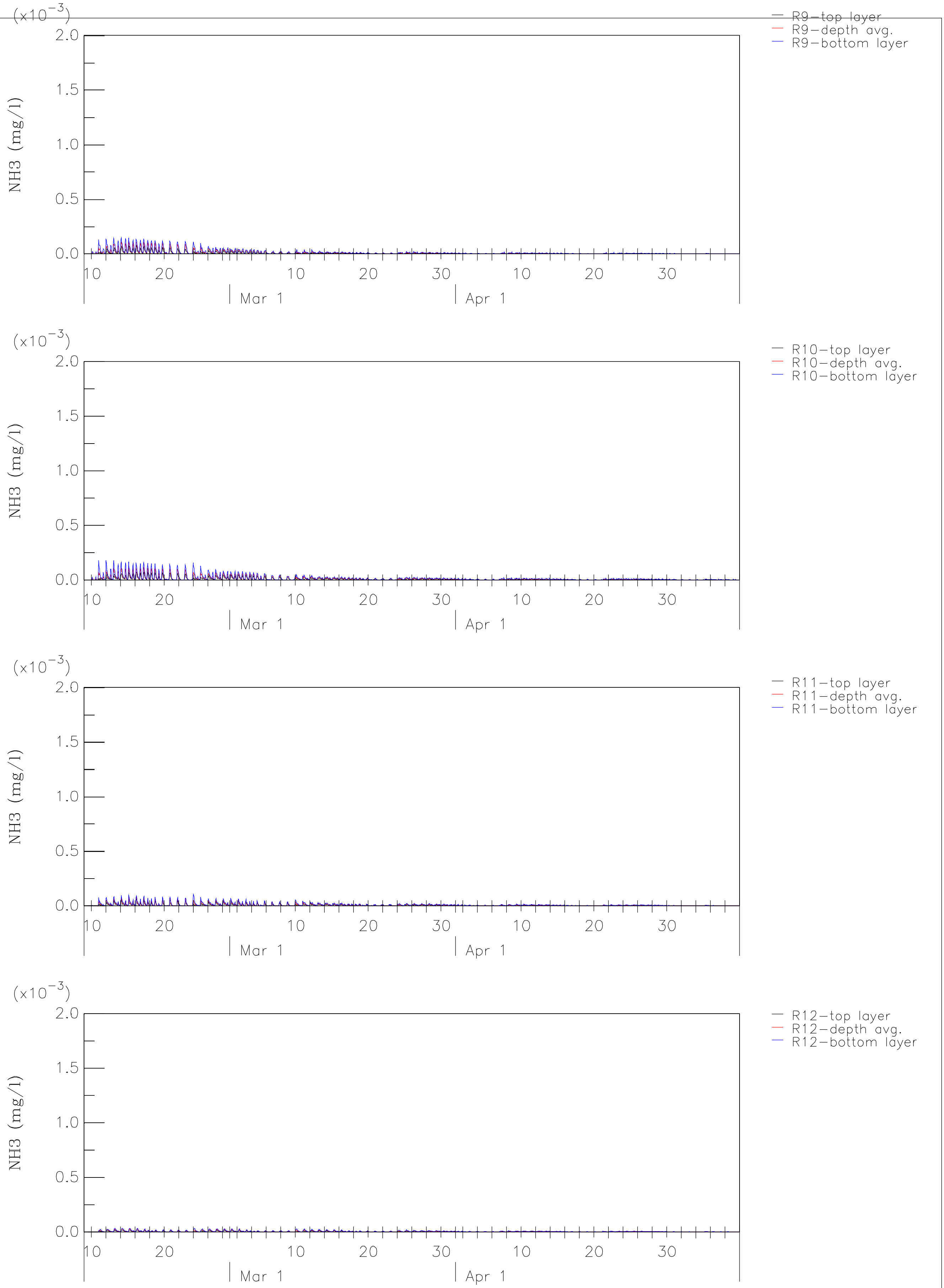
Unionised Ammonia elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.4e



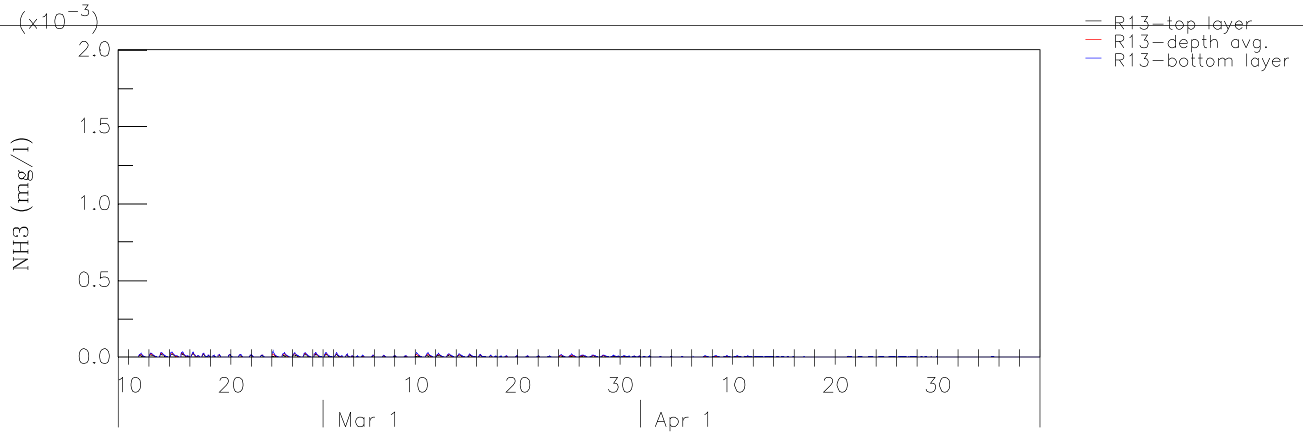
Unionised Ammonia elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R9, R10, R11, R12

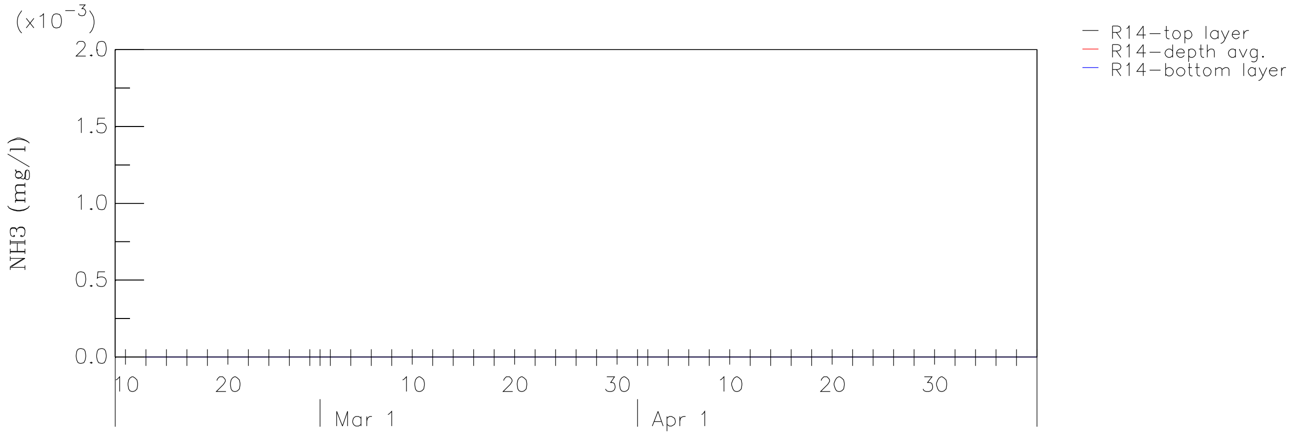
Z4187

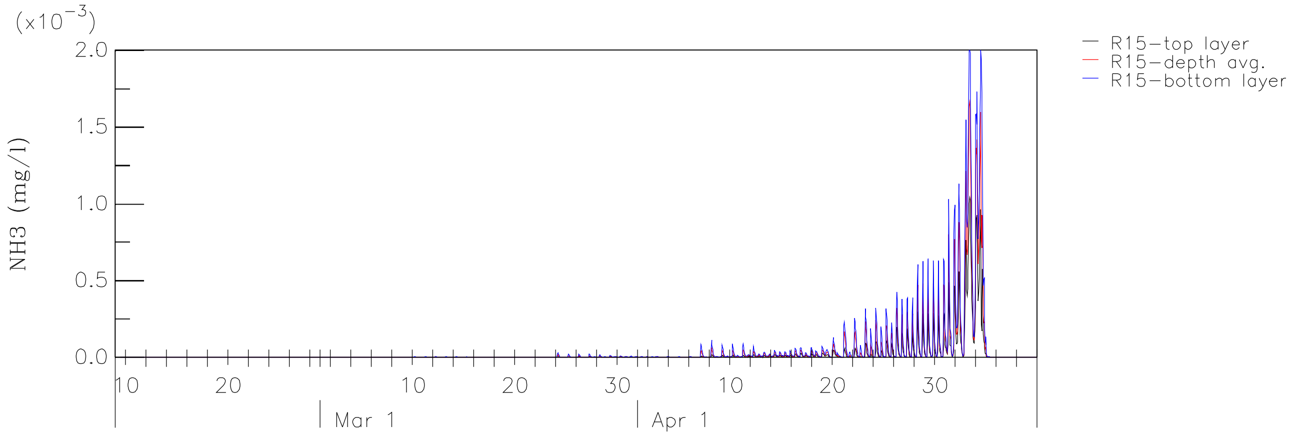
Cross Harbour Water Mains

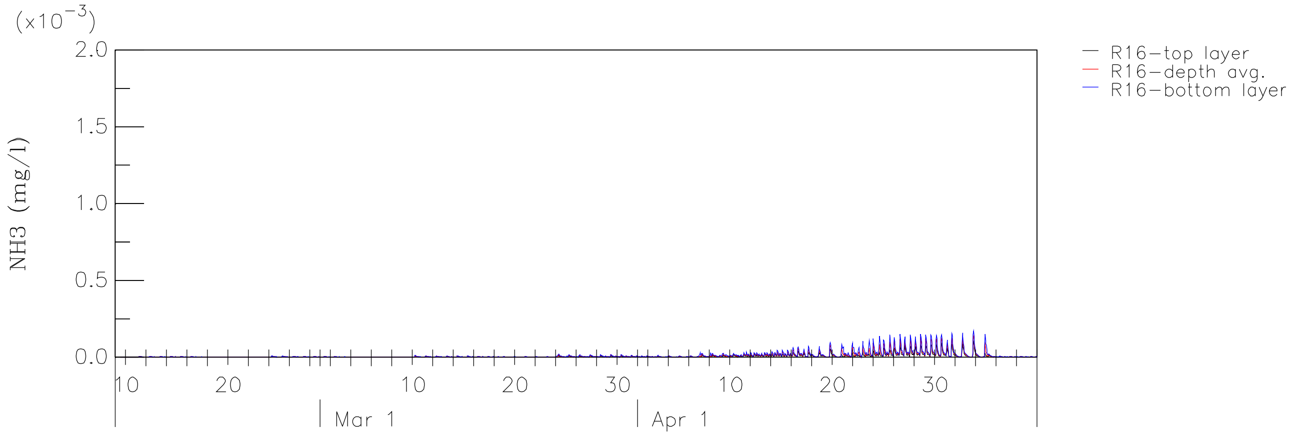
WL | Delft Hydraulics

Figure C3.4f









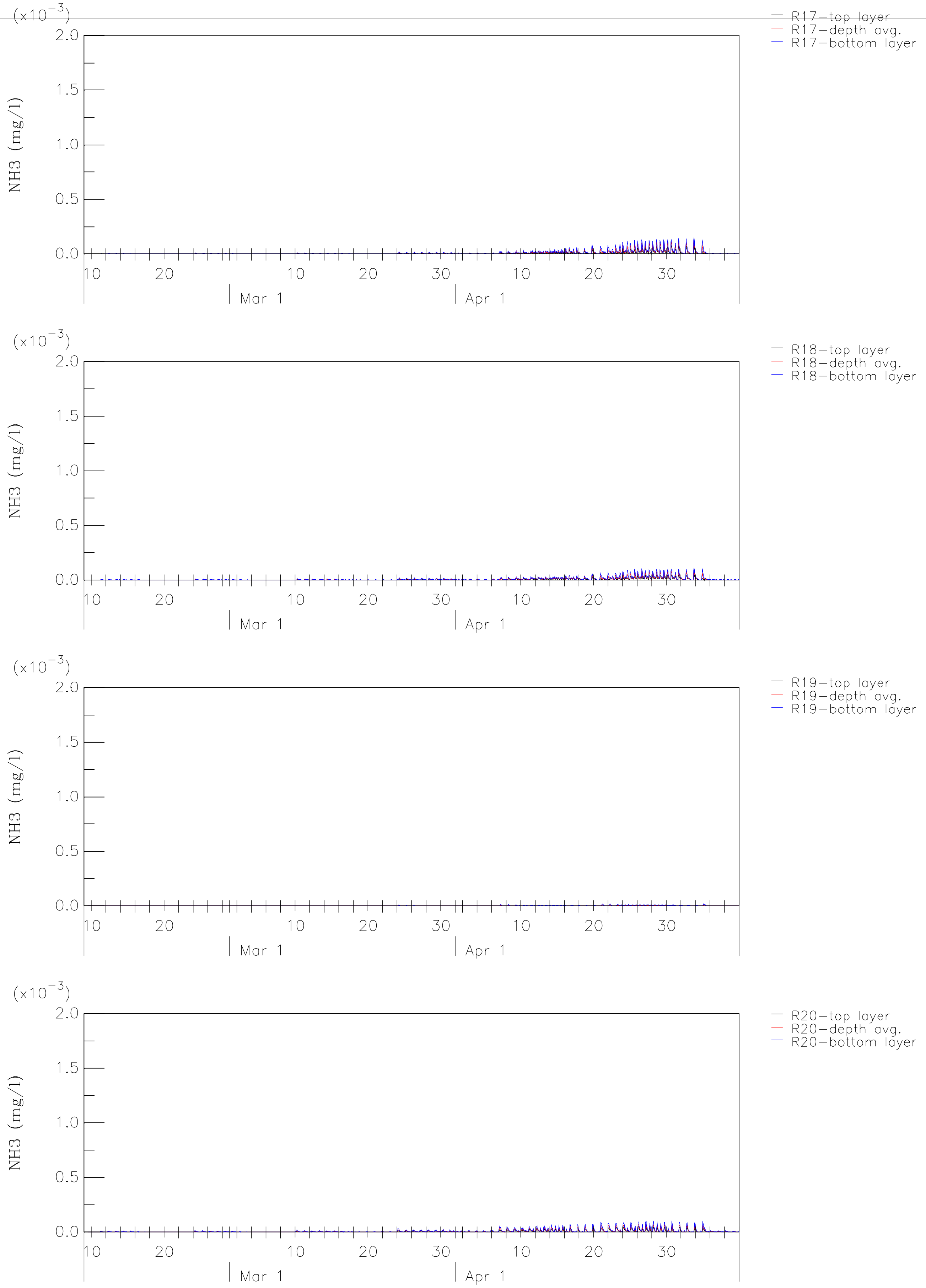
Unionised Ammonia elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R13, R14, R15, R16

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.4g



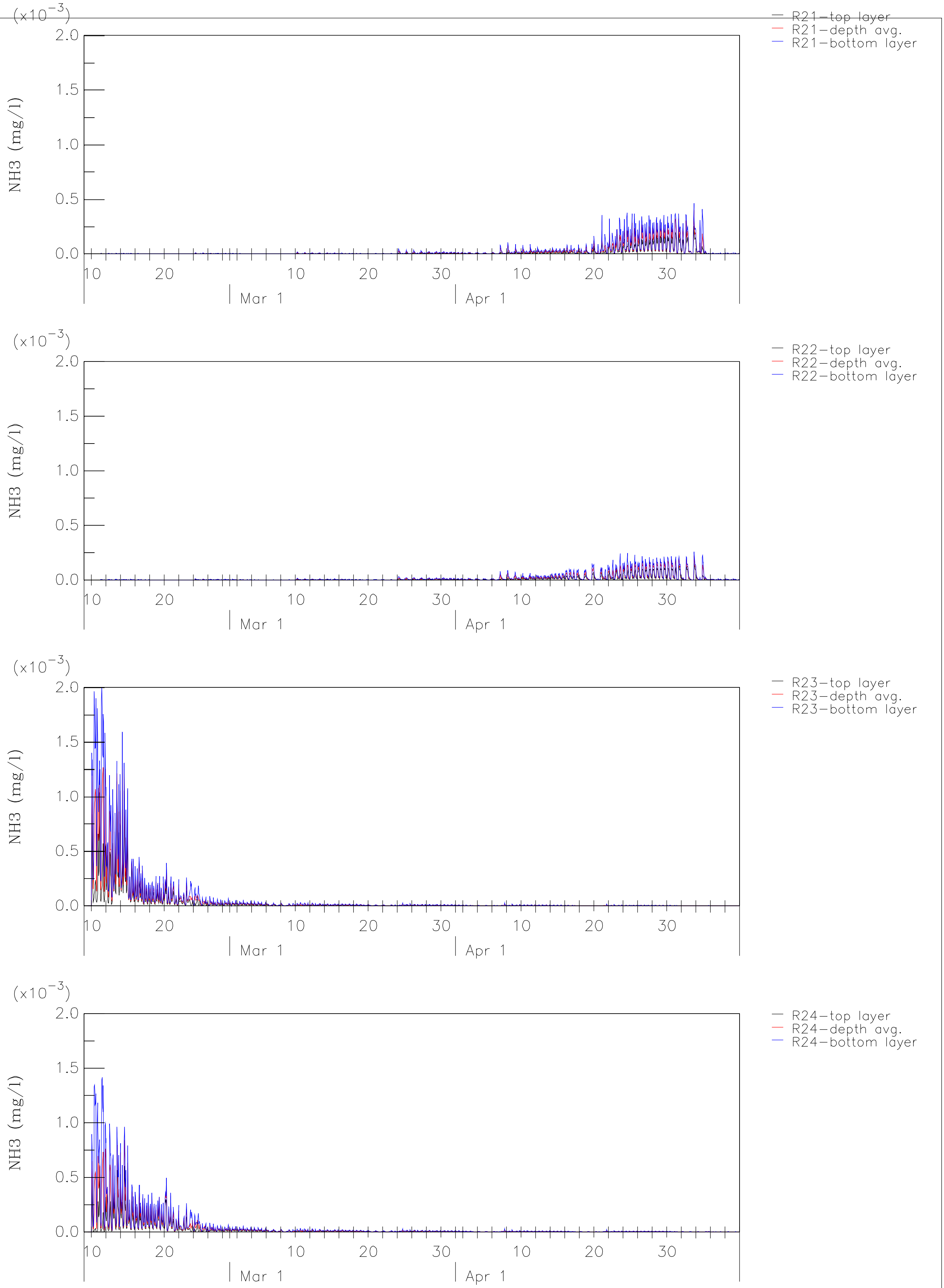
Unionised Ammonia elevation (mg/l) Dry season
Top layer, Depth averaged, Bottom layer
Stations R17, R18, R19, R20

Z4187

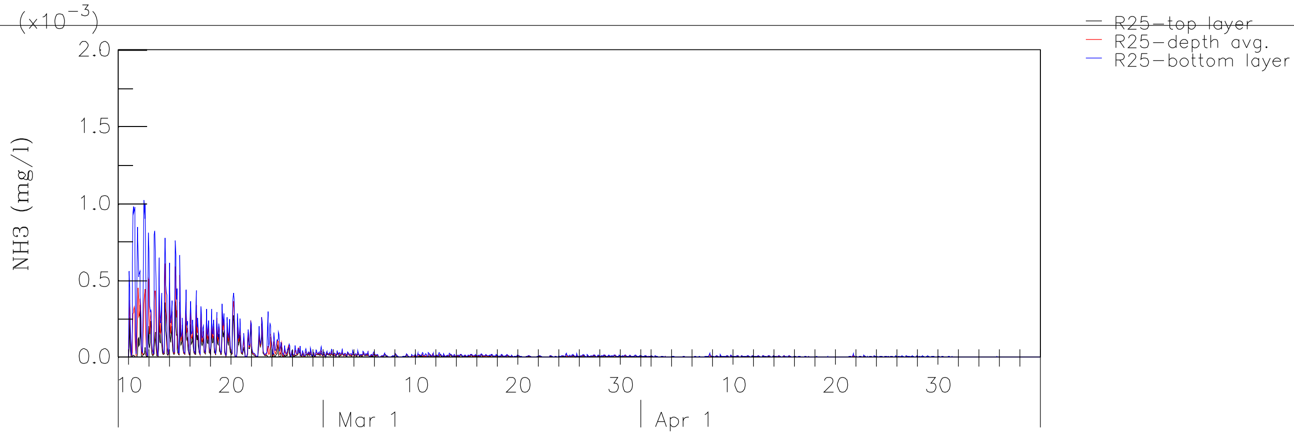
Cross Harbour Water Mains

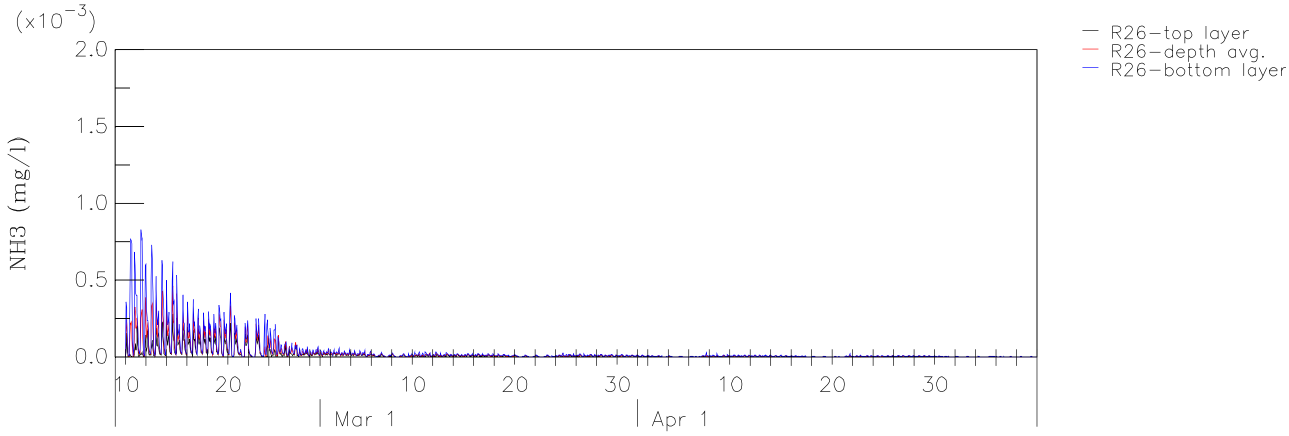
WL | Delft Hydraulics

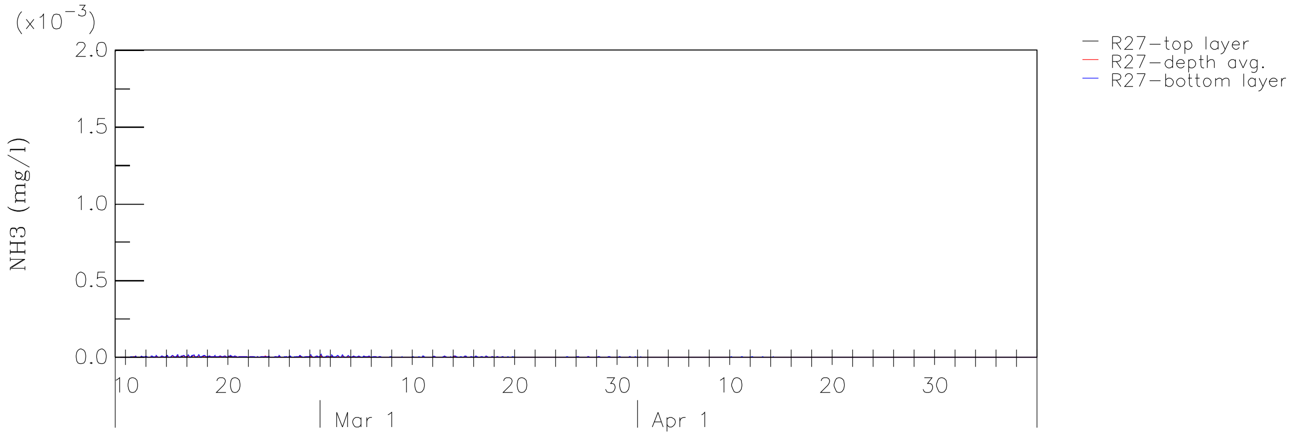
Figure C3.4h

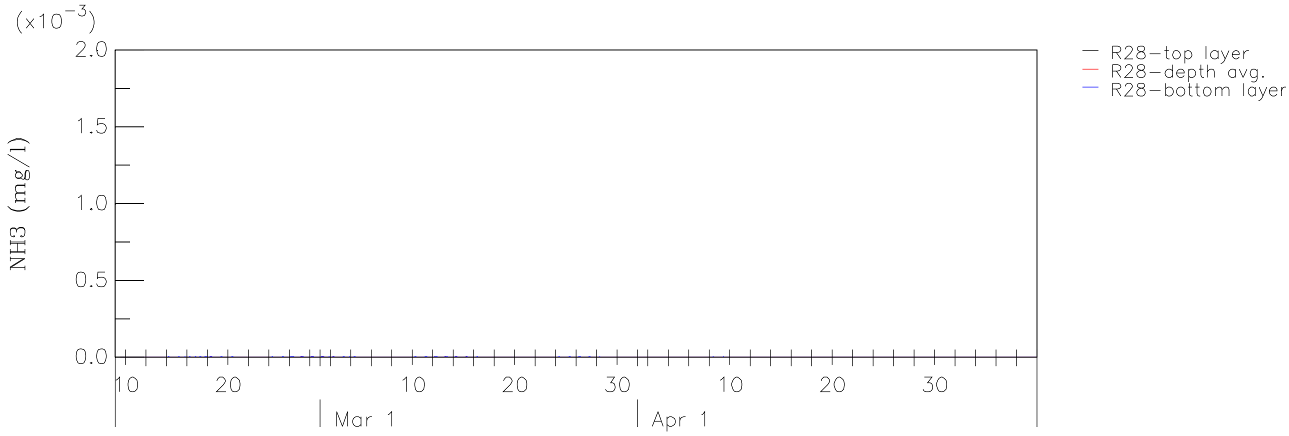


Unionised Ammonia elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4i

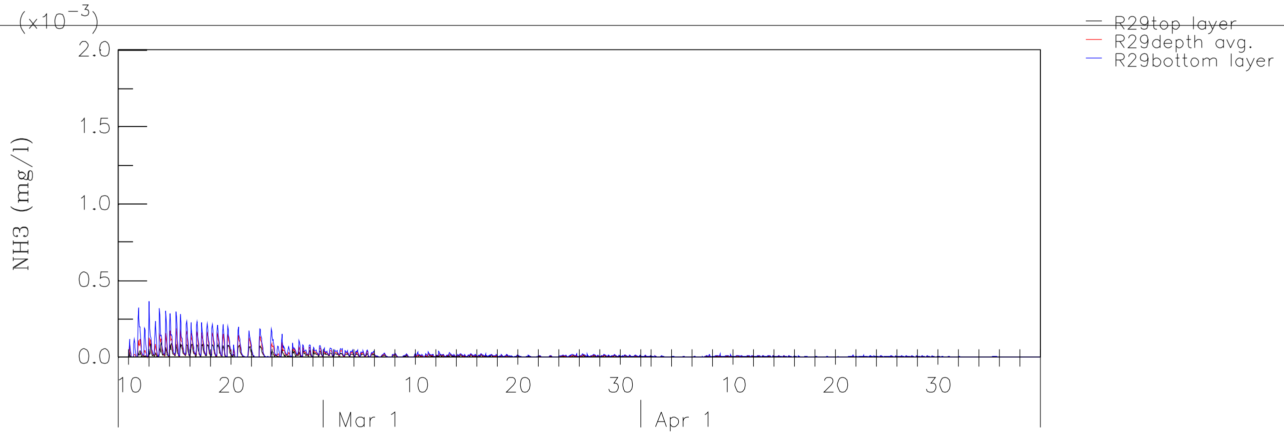




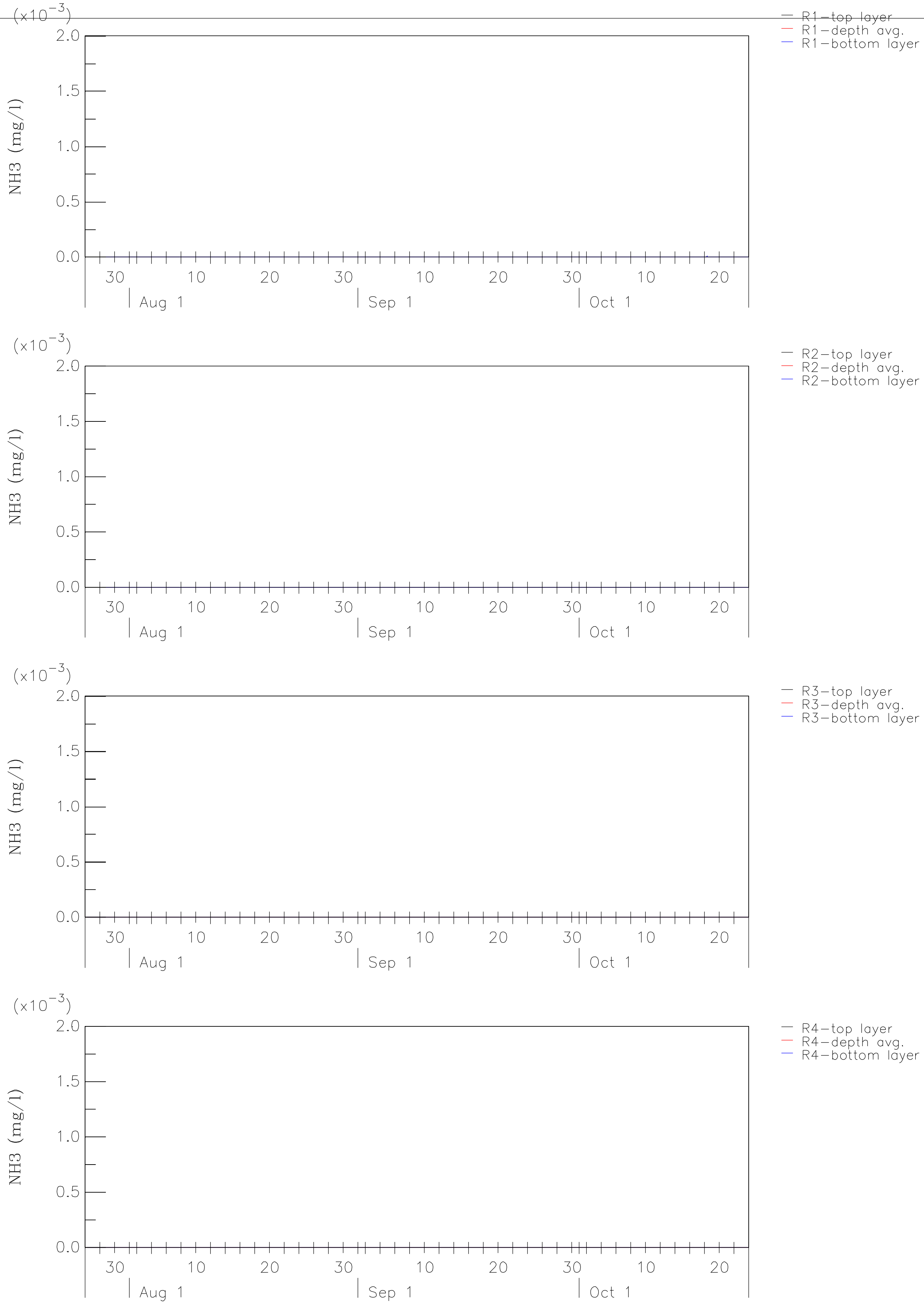




Unionised Ammonia elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R25, R26, R27, R28	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4j



Unionised Ammonia elevation (mg/l) Dry season Top layer, Depth averaged, Bottom layer Stations R29	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	Figure C3.4k	



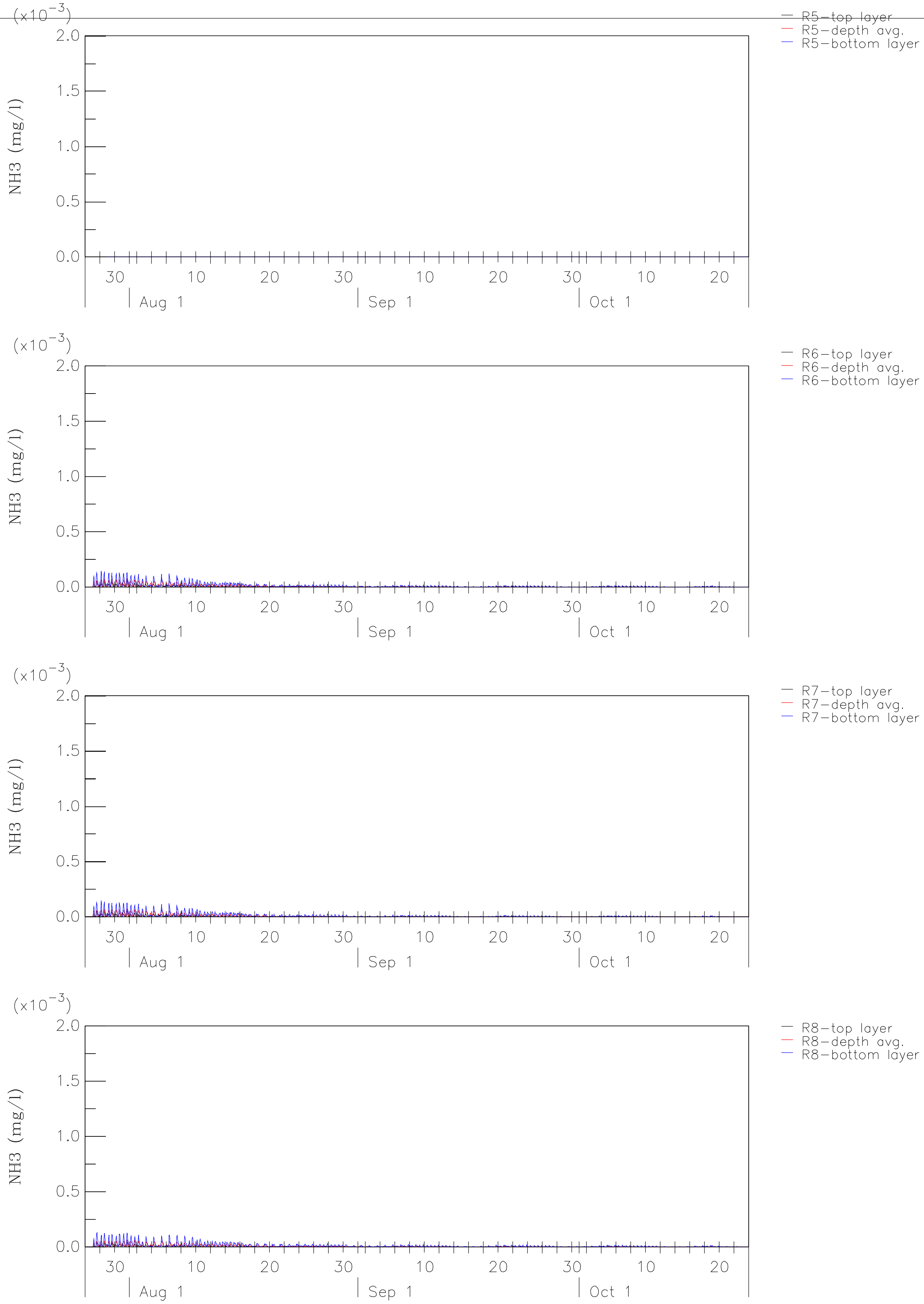
Unionised Ammonia elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R1, R2, R3, R4

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.4l



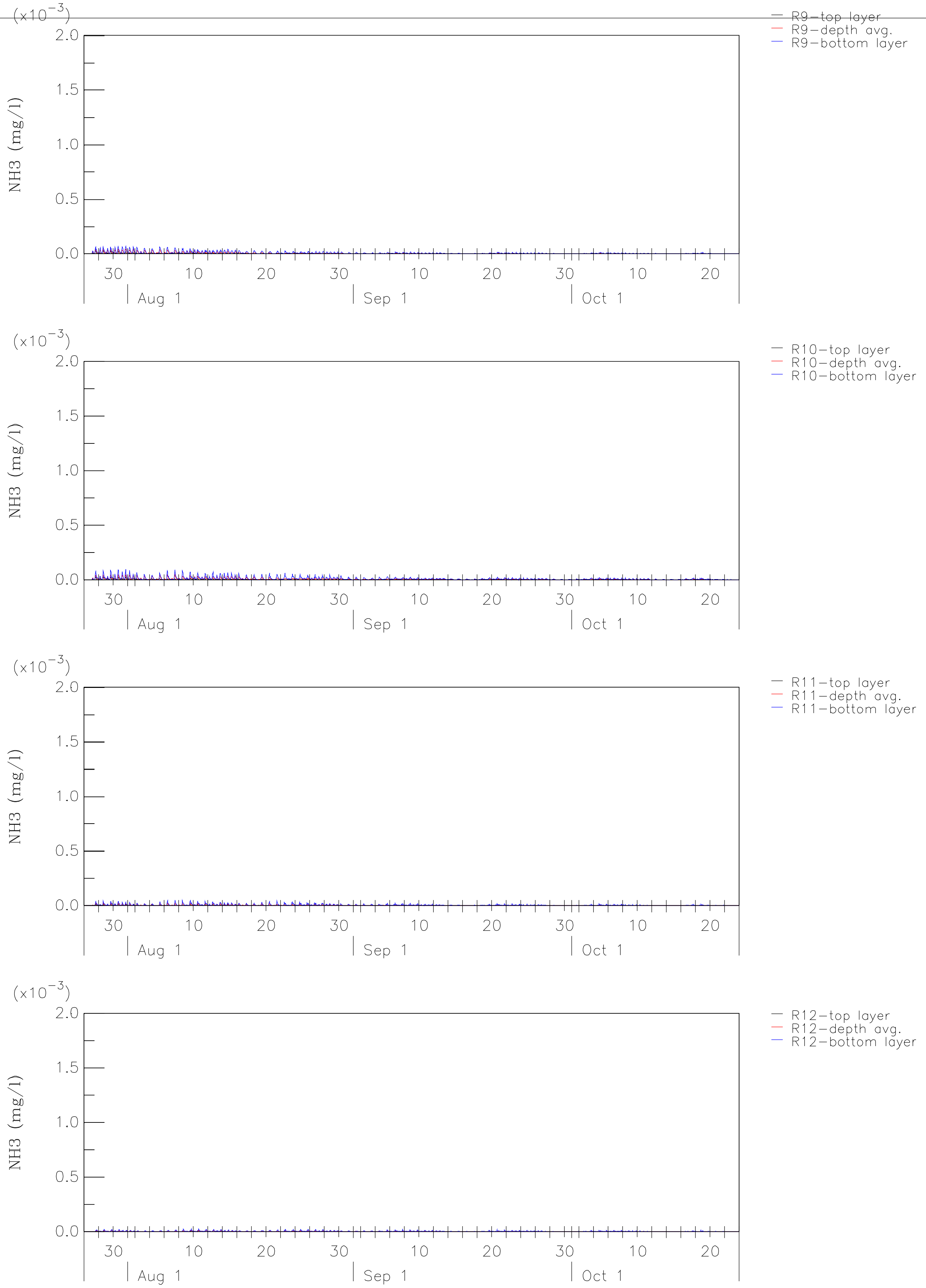
Unionised Ammonia elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R5, R6, R7, R8

Z4187

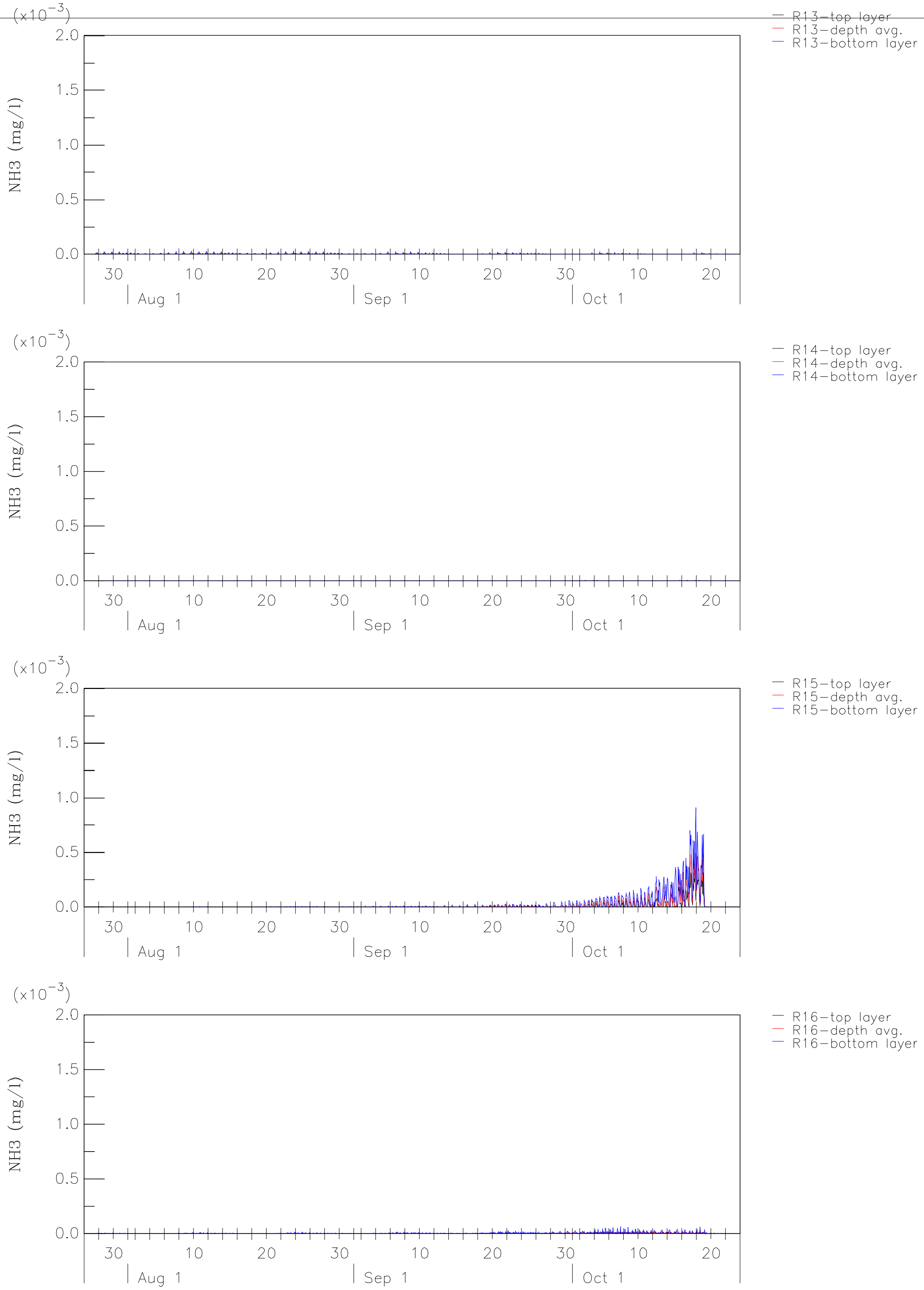
Cross Harbour Water Mains

WL | Delft Hydraulics

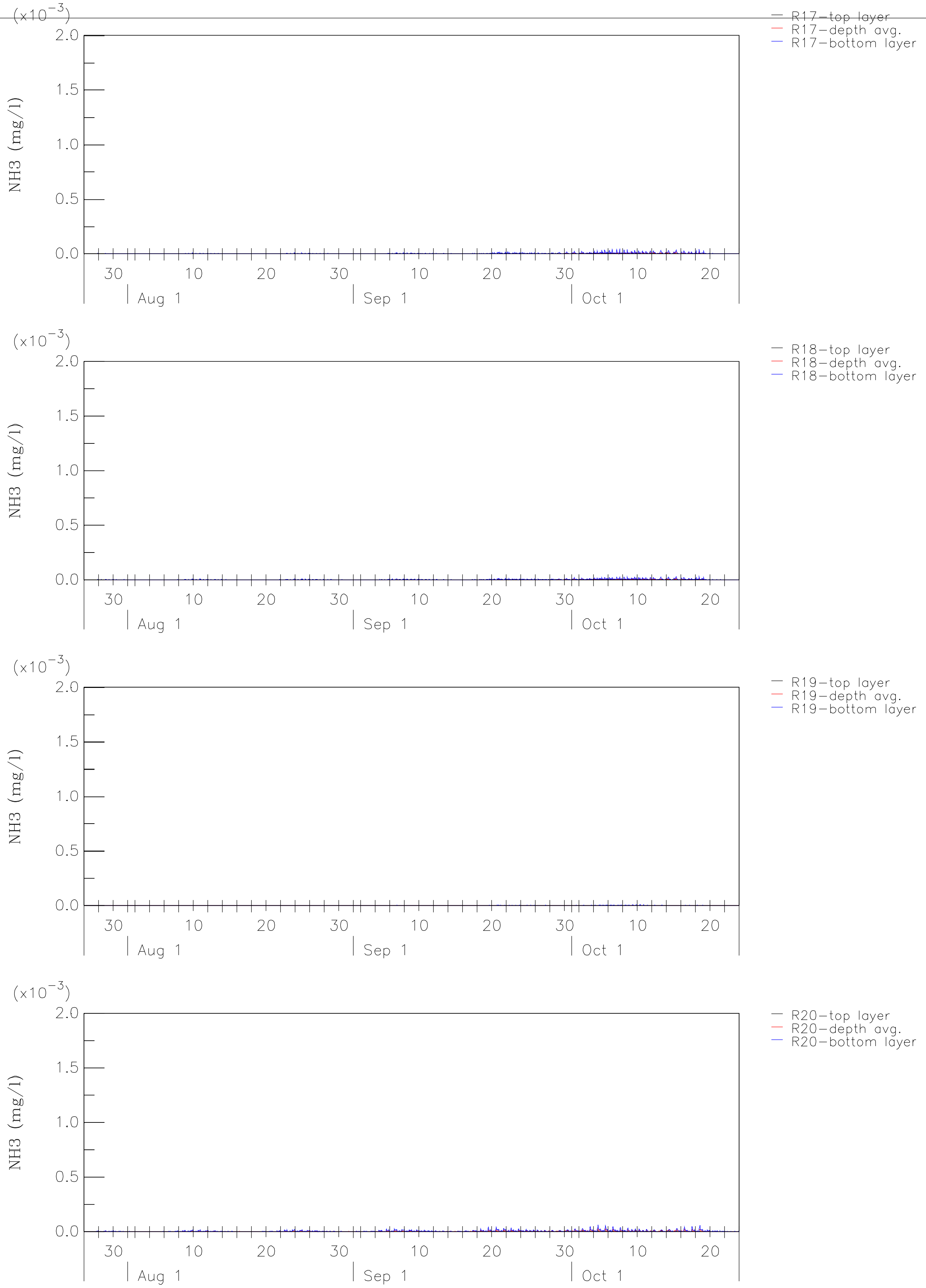
Figure C3.4m



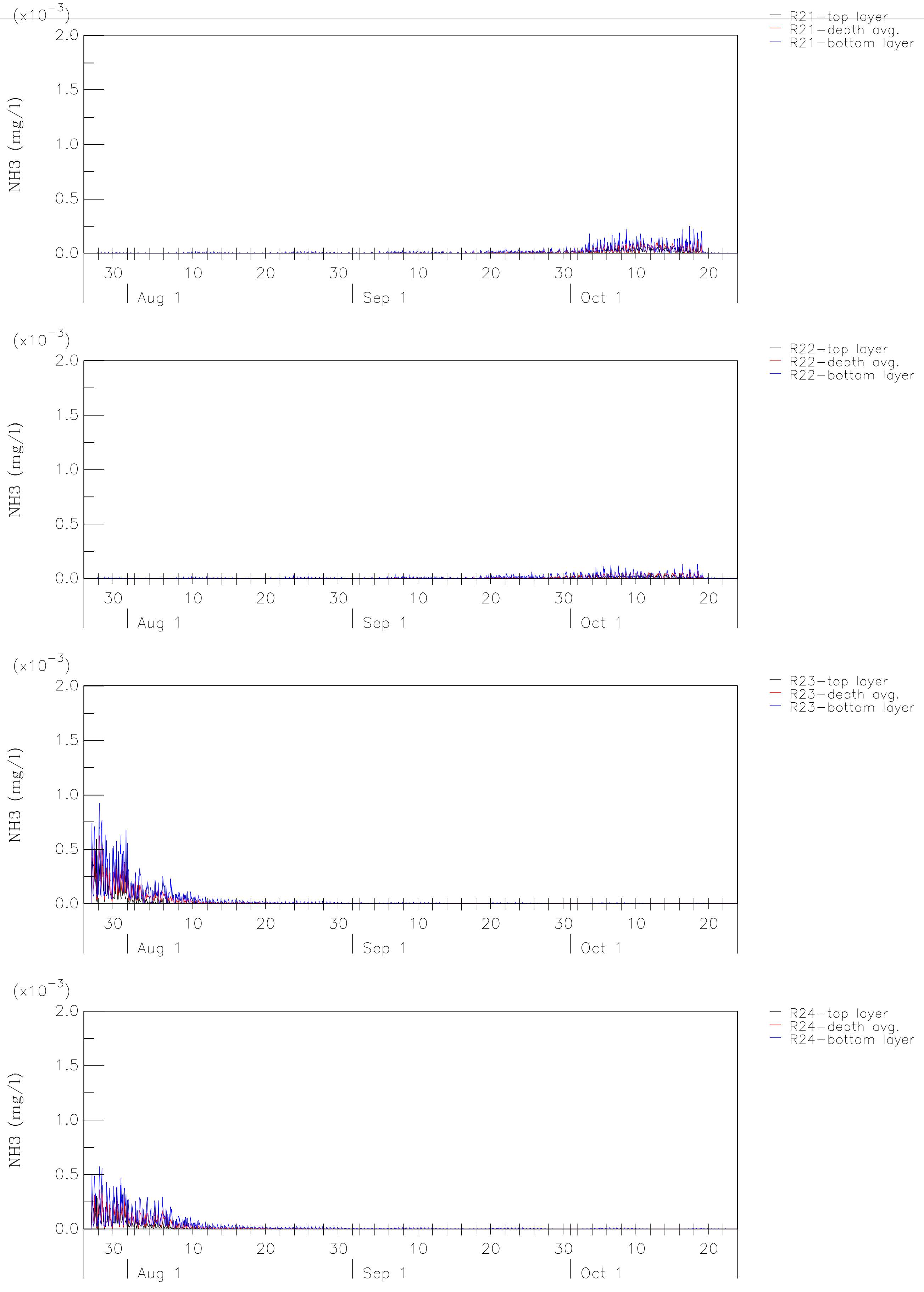
Unionised Ammonia elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R9, R10, R11, R12	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4n



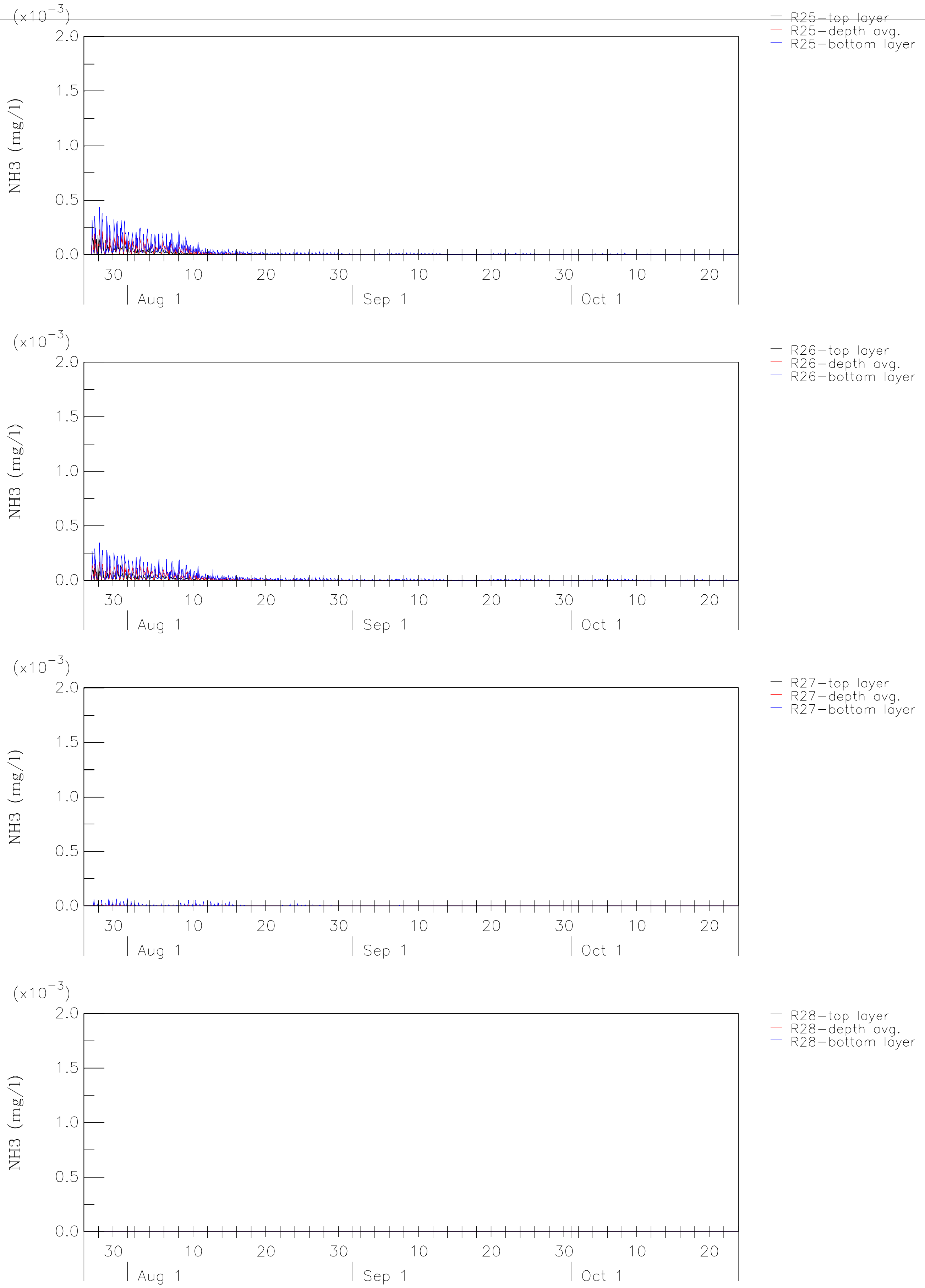
Unionised Ammonia elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R13, R14, R15, R16	Z4187	
	Cross Harbour Water Mains	
WL | Delft Hydraulics	**Figure C3.4o**	



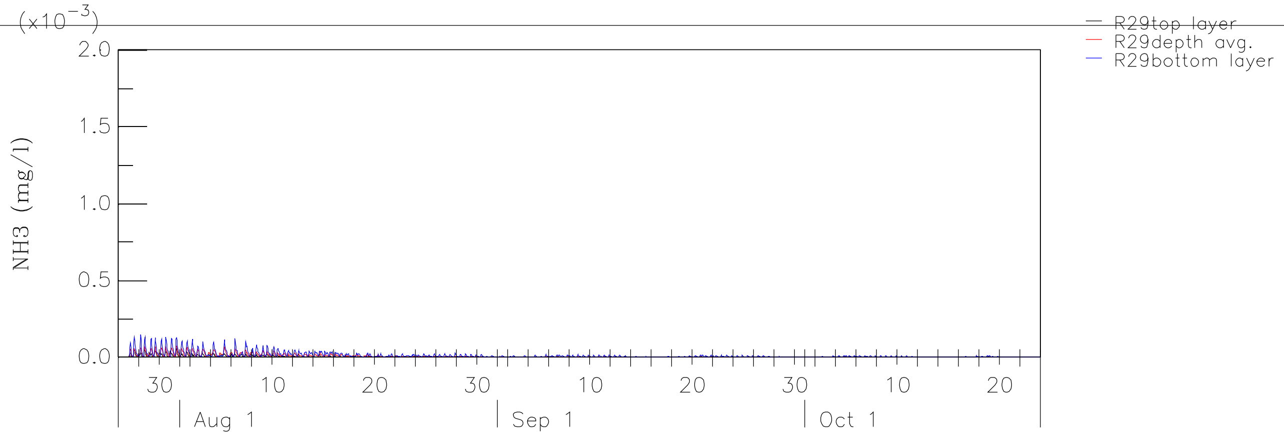
Unionised Ammonia elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R17, R18, R19, R20	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4p



Unionised Ammonia elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R21, R22, R23, R24	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4q



Unionised Ammonia elevation (mg/l) Wet season Top layer, Depth averaged, Bottom layer Stations R25, R26, R27, R28	Z4187 Cross Harbour Water Mains
WL | Delft Hydraulics	Figure C3.4r



Unionised Ammonia elevation (mg/l) Wet season
Top layer, Depth averaged, Bottom layer
Stations R29

Z4187

Cross Harbour Water Mains

WL | Delft Hydraulics

Figure C3.4s

Appendix C2

Laboratory Test Report on Elutriate Tests

Elutriate

Metals

Australian Government

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN574343

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG		Job No.	: LAML01/060914
			Quote No.	: QT-00441
			Order No.	:
			Date Sampled	:
			Date Received	: 14-SEP-2006
Attention	: WONG YAU TIM		Sampled By	: CLIENT
Project Name	:			
Your Client Services Manager	: BRIAN WOODWARD		Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/04836	VC14A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04837	VC14A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04838	VC5A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04839	VC5A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999

Lab Reg No.		NQ06/04836	NQ06/04837	NQ06/04838	NQ06/04839	
Sample Reference	Units	VC14A	VC14A	VC5A	VC5A	Method
Trace Elements						
Arsenic-Total	ug/L	3.9	57	9.6	69	NT247_251
Copper-Total	ug/L	<1	<1	2.7	2.9	NT2_47
Mercury-Total	ug/L	<0.1	<0.1	<0.1	<0.1	NT2_47_244

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

28-SEP-2006

REPORT OF ANALYSIS

Report No. RN574343

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	Job No.	: LAML01/060914
		Quote No.	: QT-00441
		Order No.	:
		Date Sampled	:
		Date Received	: 14-SEP-2006
Attention	: WONG YAU TIM	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	Phone	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/04840	VC15A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04841	VC15A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04842	VC13A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04843	VC13A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999

Lab Reg No.		NQ06/04840	NQ06/04841	NQ06/04842	NQ06/04843	
Sample Reference	Units	VC15A	VC15A	VC13A	VC13A	Method
Trace Elements						
Arsenic-Total	ug/L	6.3	76	1.6	9.2	NT247_251
Copper-Total	ug/L	<1	<1	4.9	3.6	NT2_47
Mercury-Total	ug/L	<0.1	<0.1	<0.1	<0.1	NT2_47_244

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

28-SEP-2006

Total = Acid extractable trace elements.

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This report is issued in accordance with NATA's accreditation requirements.
Accreditated for compliance with ISO/IEC 17025.
This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

REPORT OF ANALYSIS

This Report supersedes reports: *RN573672*

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: LAM LABORATORIES

NMI QA Report No: LAML01/060914T1 **Sample Matrix:** Water

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ug/L	ug/L	ug/L	ug/L	%	%	%
Inorganics Section				NQ06/04843				NQ06/04843
Arsenic	NT2.47/2.51	1	<1	9.3	9.1	2.2	98	79
Copper	NT2.47	1	<1	3.7	3.6	2.7	90	99
Mercury	NT2.47/2.44	0.1	<0.1	<0.1	<0.1	ND	90	86

Filename = K:\ICPMS\Trace\QAR2006\Water\

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Honway Louie
Inorganics Manager, NMI-Pymble

Date: 27/09/2006

Australian Government
National Measurement Institute

REPORT OF ANALYSIS

Report No. RN576797

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.**	: LAML01/060914
		Quote No.	: QT-00441
		Order No.	:
		Date Sampled	:
		Date Received	: 14-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/04836/1	VC14A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04837/1	VC14A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04838/1	VC5A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999

Lab Reg No.			NQ06/04836/1	NQ06/04837/1	NQ06/04838/1	
Sample Reference	Units	LOR	VC14A	VC14A	VC5A	Method
Trace Elements						
Lead-Total	ug/L	1	<1	1.7	<1	NT2_47
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

REPORT OF ANALYSIS

Report No. RN576797

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/060914 : QT-00441 : : : 14-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/04839/1	VC5A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04840/1	VC15A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04841/1	VC15A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999

Lab Reg No.			**NQ06/04839/1**	**NQ06/04840/1**	**NQ06/04841/1**	
Sample Reference	**Units**	**LOR**	**VC5A**	**VC15A**	**VC15A**	**Method**
Trace Elements						
Lead-Total	ug/L	1	2.8	1.1	1.3	NT2_47
Silver-Total	ug/L	1	<1	2.7	1.1	NT2_47

NQ06/04840/1
Silver result has been confirmed by repeat analysis.

NQ06/04841/1
Silver result has been confirmed by repeat analysis.

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

REPORT OF ANALYSIS

Report No. RN576797

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.**	: LAML01/060914
		Quote No.	: QT-00441
		Order No.	:
		Date Sampled	:
		Date Received	: 14-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/04842/1	VC13A	MARINE WATER 0.0-0.9M GE/2005/047 JOB J469 SO19-17986,17999
NQ06/04843/1	VC13A	MARINE WATER 0.9-1.9M GE/2005/047 JOB J469 SO19-17986,17999

Lab Reg No.			NQ06/04842/1	NQ06/04843/1		
Sample Reference	**Units**	**LOR**	**VC13A**	**VC13A**		**Method**
Trace Elements						
Lead-Total	ug/L	1	1.8	2.6		NT2_47
Silver-Total	ug/L	1	<1	<1		NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

Total = Acid extractable trace elements.

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Results relate only to the sample(s) tested.

This Report supersedes reports: *RN576545*

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: LAM LABORATORIES

NMI QA Report No: LAML01/060914T1 **Sample Matrix:** Water

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ug/L	ug/L	ug/L	ug/L	%	%	%
Inorganics Section				NQ06/04843				NQ06/04843
Arsenic	NT2.47/2.51	1	<1	9.3	9.1	2.2	98	79
Copper	NT2.47	1	<1	3.7	3.6	2.7	90	99
Mercury	NT2.47/2.44	0.1	<0.1	<0.1	<0.1	ND	90	86
Silver	NT2.47	1	<1	<1	<1	ND	96	98
Lead	NT2.47	1	<1	2.7	2.4	12	96	97

Filename = \\S212PPFILE\Home\jh2005\

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Honway Louie
Inorganics Manager, NMI-Pymble

Date: 27/09/2006

REPORT OF ANALYSIS

Report No. RN576852

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.**	: LAML01/060925
		Quote No.	: QT-00441
		Order No.	:
		Date Sampled	:
		Date Received	: 25-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: Brian Woodward	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/05281	VC2A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M
NQ06/05282	VC2A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M
NQ06/05283	VC3A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M

Lab Reg No.			NQ06/05281	NQ06/05282	NQ06/05283	
Sample Reference	**Units**	**LOR**	**VC2A**	**VC2A**	**VC3A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	15	48	33	NT247_251
Copper-Total	ug/L	1	<1	<1	1.1	NT2_47
Lead-Total	ug/L	1	1.1	1.2	1	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

REPORT OF ANALYSIS

Report No. RN576852

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/060925 : QT-00441 : : : 25-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: Brian Woodward	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/05284	VC3A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M
NQ06/05285	VC4A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M
NQ06/05286	VC4A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M

Lab Reg No.			**NQ06/05284**	**NQ06/05285**	**NQ06/05286**	
Sample Reference	**Units**	**LOR**	**VC3A**	**VC4A**	**VC4A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	16	1.1	100	NT247_251
Copper-Total	ug/L	1	2.4	2.9	2	NT2_47
Lead-Total	ug/L	1	3.4	<1	1	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

REPORT OF ANALYSIS

Report No. RN576852

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.**	: LAML01/060925
		Quote No.	: QT-00441
		Order No.	:
		Date Sampled	:
		Date Received	: 25-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: Brian Woodward	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/05287	VC6A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M
NQ06/05288	VC6A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M
NQ06/05289	VC7A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M

Lab Reg No.			NQ06/05287	NQ06/05288	NQ06/05289	
Sample Reference	**Units**	**LOR**	**VC6A**	**VC6A**	**VC7A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	<1	4.5	15	NT247_251
Copper-Total	ug/L	1	1	2.2	1.6	NT2_47
Lead-Total	ug/L	1	<1	2.8	1.9	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

REPORT OF ANALYSIS

Report No. RN576852

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/060925 : QT-00441 : : : 25-SEP-2006
Attention	: WONG YAU TIM	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: Brian Woodward	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/05290	VC7A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M
NQ06/05291	VC11A	MARINE WATER GE/2005/047 JOB J469 SO19 0.0-0.9M
NQ06/05292	VC11A	MARINE WATER GE/2005/047 JOB J469 SO19 0.9-1.9M

Lab Reg No.			**NQ06/05290**	**NQ06/05291**	**NQ06/05292**	
Sample Reference	**Units**	**LOR**	**VC7A**	**VC11A**	**VC11A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	37	<1	16	NT247_251
Copper-Total	ug/L	1	<1	1.1	1.8	NT2_47
Lead-Total	ug/L	1	<1	<1	1.9	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

12-OCT-2006

Total = Acid extractable trace elements.

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REPORT OF ANALYSIS

This Report supersedes reports: *RN576283*

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: LAM GEOTECHNICS LTD

NMI QA Report No: LAML01/060925T1 **Sample Matrix:** Water

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ug/L	ug/L	ug/L	ug/L	%	%	%
Inorganics Section				NQ06/05292				NQ06/05292
Arsenic	NT2.47/2.51	1	<1	16	16	0	94	99
Copper	NT2.47	1	<1	1.8	1.8	0	100	102
Lead	NT2.47	1	<1	1.7	2.2	26	100	104
Mercury	NT2.47/2.44	0.1	<0.1	<0.1	<0.1	ND	108	98
Silver	NT2.47	1	<1	<1	<1	ND	101	104

Filename = K:\ICPMS\Trace\QAR2006\Water\

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Honway Louie
Inorganics Manager, NMI-Pymble

Date: 10/10/2006

REPORT OF ANALYSIS

Report No. RN577441

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/061003 : QT-00441 : : : 3-OCT-2006
Attention	: TIM WONG	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/06145	VC1A	MARINE WATER GE/2005/047 JOB J469-SO19 0.0-0.9M
NQ06/06146	VC1A	MARINE WATER GE/2005/047 JOB J469-SO19 0.9-1.9M
NQ06/06147	VC8A	MARINE WATER GE/2005/047 JOB J469-SO19 0.0-0.9M

Lab Reg No.			NQ06/06145	NQ06/06146	NQ06/06147	
Sample Reference	Units	LOR	VC1A	VC1A	VC8A	Method
Trace Elements						
Arsenic-Total	ug/L	1	71	69	4.1	NT247_251
Copper-Total	ug/L	1	<1	1.4	1.2	NT2_47
Lead-Total	ug/L	1	8.1	<1	<1	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

17-OCT-2006

REPORT OF ANALYSIS

Report No. RN577441

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/061003 : QT-00441 : : : 3-OCT-2006
Attention	: TIM WONG	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/06148	VC8A	MARINE WATER GE/2005/047 JOB J469-SO19 0.9-1.9M
NQ06/06149	VC9A	MARINE WATER GE/2005/047 JOB J469-SO19 0.0-0.9M
NQ06/06150	VC9A	MARINE WATER GE/2005/047 JOB J469-SO19 0.9-1.9M

Lab Reg No.			**NQ06/06148**	**NQ06/06149**	**NQ06/06150**	
Sample Reference	**Units**	**LOR**	**VC8A**	**VC9A**	**VC9A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	59	2.4	53	NT247_251
Copper-Total	ug/L	1	<1	1.7	<1	NT2_47
Lead-Total	ug/L	1	1.3	<1	<1	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

17-OCT-2006

REPORT OF ANALYSIS

Report No. RN577441

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/061003 : QT-00441 : : : 3-OCT-2006
Attention	: TIM WONG	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/06151	VC10A	MARINE WATER GE/2005/047 JOB J469-SO19 0.0-0.9M
NQ06/06152	VC10A	MARINE WATER GE/2005/047 JOB J469-SO19 0.9-1.9M
NQ06/06153	VC12A	MARINE WATER GE/2005/047 JOB J469-SO19 0.0-0.9M

Lab Reg No.			NQ06/06151	NQ06/06152	NQ06/06153	
Sample Reference	**Units**	**LOR**	**VC10A**	**VC10A**	**VC12A**	**Method**
Trace Elements						
Arsenic-Total	ug/L	1	1.7	93	<1	NT247_251
Copper-Total	ug/L	1	3.1	2	<1	NT2_47
Lead-Total	ug/L	1	<1	1.4	<1	NT2_47
Mercury-Total	ug/L	0.1	<0.1	<0.1	<0.1	NT2_47_244
Silver-Total	ug/L	1	<1	<1	<1	NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

17-OCT-2006

REPORT OF ANALYSIS

Report No. RN577441

Client	: LAM LABORATORIES LTD 1412 - 1416 HONOUR IND CENTRE 6 SUN YIP STREET CHAI WAN HONG KONG	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: LAML01/061003 : QT-00441 : : : 3-OCT-2006
Attention	: TIM WONG	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
NQ06/06154	VC12A	MARINE WATER GE/2005/047 JOB J469-SO19 0.9-1.9M

Lab Reg No.			NQ06/06154			
Sample Reference	**Units**	**LOR**	**VC12A**			**Method**
Trace Elements						
Arsenic-Total	ug/L	1	14			NT247_251
Copper-Total	ug/L	1	<1			NT2_47
Lead-Total	ug/L	1	<1			NT2_47
Mercury-Total	ug/L	0.1	<0.1			NT2_47_244
Silver-Total	ug/L	1	<1			NT2_47

Dr. Honway Louie, Section Manager
Inorganics - NSW (Accreditation No. 198)

17-OCT-2006

Total = Acid extractable trace elements.

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

This report is issued in accordance with NATA's accreditation requirements.
Accreditated for compliance with ISO/IEC 17025.
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Results relate only to the sample(s) tested.

This Report supersedes reports: *RN576933*

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: LAM LABORATORIES

NMI QA Report No: LAML01/061003T1 **Sample Matrix:** Water

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ug/L	ug/L	ug/L	ug/L	%	%	%
Inorganics Section				NQ06/06154				NQ06/06154
Arsenic	NT2.47/2.51	1	<1	14	14	0.0	104	107
Copper	NT2.47	1	<1	<1	<1	ND	106	100
Mercury	NT2.47/2.44	0.1	<0.1	<0.1	<0.1	ND	120	108
Silver	NT2.47	1	<1	<1	<1	ND	103	101
Lead	NT2.47	1	<1	<1	<1	ND	109	99

Filename = \\S212PPFILE\Home\jh2005\

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting
RPD = Relative Percent Difference
LCS = Laboratory Control Sample.
ND = Not Determined
NA = Not Applicable
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed: Dr Honway Louie
Inorganics Manager, NMI-Pymble

Date: 13/10/2006

PAH

TEST REPORT

Report No.	:	100971N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122
Sample Description	:	30 elutriate samples said to be saline water
Sample Receipt Date	:	09 September 2006 - 27 September 2006
Test Period	:	10 September 2006 - 09 October 2006

Test Information

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

CODE	Test Parameter	Reporting Limit ug/L	Test Procedure
NAP	Naphthalene	0.2	W/O/PAH
ANY	Acenaphthylene	0.2	W/O/PAH
ANA	Acenaphthene	0.2	W/O/PAH
FLU	Fluorene	0.2	W/O/PAH
PHE	Phenanthrene	0.2	W/O/PAH
ANT	Anthracene	0.2	W/O/PAH

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

CODE	Test Parameter	Reporting Limit ug/L	Test Procedure
CHR	Chrysene	0.2	W/O/PAH
BaA	Benzo(a)anthracene	0.2	W/O/PAH
BbF	Benzo(b)fluoranthene	0.2	W/O/PAH
BkF	Benzo(k)fluoranthene	0.2	W/O/PAH
BaP	Benzo(a)pyrene	0.2	W/O/PAH
DBA	Dibenz(ah)anthracene	0.2	W/O/PAH
FLT	Fluoranthene	0.2	W/O/PAH
IPY	Indeno(1,2,3-cd)pyrene	0.2	W/O/PAH
PYR	Pyrene	0.2	W/O/PAH
BPE	Benzo(ghi)perylene	0.2	W/O/PAH

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. Results relate to samples as received.
3. < = less than
4. N/A = Not applicable
5. Test results satisfy all in-house QA/QC protocols as attached.
6. Test description (for in-house methods) as follows:
   W/O/PAH: Solvent extraction and GC-MS Quantification.
7. The elutriate samples were prepared according to contract agreed procedure.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

TEST REPORT

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Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

1. **Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs**

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	NAP ug/L	ANY ug/L	ANA ug/L	FLU ug/L	PHE ug/L	ANT ug/L
Elutriate VC14a(0.0-0.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC14a(0.9-1.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC5a(0.0-0.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC5a(0.9-1.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC15a(0.0-0.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC15a(0.9-1.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC13a(0.0-0.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC13a(0.9-1.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC4a(0.0-0.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC4a(0.9-1.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC6a(0.0-0.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC6a(0.9-1.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC3a(0.0-0.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC3a(0.9-1.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC7a(0.0-0.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC7a(0.9-1.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC2a(0.0-0.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC2a(0.9-1.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC11a(0.0-0.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC11a(0.9-1.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

TEST REPORT

Report No. : 100971N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref.	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC14a(0.0-0.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC14a(0.9-1.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC5a(0.0-0.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC5a(0.9-1.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC15a(0.0-0.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC15a(0.9-1.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC13a(0.0-0.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC13a(0.9-1.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC4a(0.0-0.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC4a(0.9-1.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC6a(0.0-0.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC6a(0.9-1.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC3a(0.0-0.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC3a(0.9-1.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC7a(0.0-0.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC7a(0.9-1.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC2a(0.0-0.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC2a(0.9-1.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC11a(0.0-0.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC11a(0.9-1.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

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TEST REPORT

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Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Customer Ref.	Sample					NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen						
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC12a(0.0-0.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC12a(0.9-1.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC8a(0.0-0.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC8a(0.9-1.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC10a(0.0-0.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC10a(0.9-1.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC1a(0.0-0.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC1a(0.9-1.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC9a(0.0-0.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC9a(0.9-1.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

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Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref.	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC12a(0.0-0.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC12a(0.9-1.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC8a(0.0-0.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC8a(0.9-1.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC10a(0.0-0.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC10a(0.9-1.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC1a(0.0-0.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC1a(0.9-1.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC9a(0.0-0.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Elutriate VC9a(0.9-1.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

------------------------End of Report------------------------

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QUALITY CONTROL REPORT

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Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.1 Sample Duplicate

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	NAP %	ANY %	ANA %	FLU %	PHE %	ANT %
18011/1	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*
Elutriate VC3a(0.0-0.9m) (VC3a)	N/A	N/A	N/A		N/A	2	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean					

1.2 Sample Spike (Spike Level = 5 ug)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	NAP %	ANY %	ANA %	FLU %	PHE %	ANT %
18011/2	N/A	N/A	N/A		N/A	1	94	94	87	83	98	83
Elutriate VC3a(0.9-1.9m) (VC3a)	N/A	N/A	N/A		N/A	2	87	95	90	86	97	90
Control Limits							70 - 130 %					

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

QUALITY CONTROL REPORT

Report No. : 100971N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.1 Sample Duplicate

Customer Ref.	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
18011/1	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Elutriate VC3a(0.0-0.9m) (VC3a)	N/A	N/A	N/A		N/A	2	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean									

2.2 Sample Spike (Spike Level = 5 ug)

Customer Ref.	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
18011/2	N/A	N/A	N/A		N/A	1	87	95	82	88	93	89	83	89	100	107
Elutriate VC3a(0.9-1.9m) (VC3a)	N/A	N/A	N/A		N/A	2	85	99	99	96	106	109	84	103	99	91
Control Limits							70 - 130 %									

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

QUALITY CONTROL REPORT

Report No. : 100971N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.3 QC Sample (Spike Level = 5 ug)

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
MB Spike	N/A	N/A	N/A		N/A	1	91	95	86	83	101	90
MB Spike	N/A	N/A	N/A		N/A	2	95	91	86	81	95	90
Control Limits							70 - 130 %					

1.4 Method Blank

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
N/A	N/A	N/A	N/A		N/A	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
N/A	N/A	N/A	N/A		N/A	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Control Limits							Less than reporting limit					

QUALITY CONTROL REPORT

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Customer : Geotechnical Projects Division, Geotechnical Engineering office,
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Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.3 QC Sample (Spike Level = 5 ug)

Customer Ref.	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
MB Spike	N/A	N/A	N/A		N/A	1	97	103	101	106	108	84	97	85	102	105
MB Spike	N/A	N/A	N/A		N/A	2	88	101	103	99	111	93	84	95	102	97
Control Limits							70 - 130 %									

2.4 Method Blank

Customer Ref.	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
N/A	N/A	N/A	N/A		N/A	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
N/A	N/A	N/A	N/A		N/A	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Control Limits							Less than reporting limit									

PCBs

TEST REPORT

Report No.	:	100972N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122
Sample Description	:	30 elutriate samples said to be saline water
Sample Receipt Date	:	09 September 2006 - 27 September 2006
Test Period	:	10 September 2006 - 09 October 2006

Test Information

CODE	Test Parameter	Reporting Limit ug/L	Test Procedure
8	2,4' dichlorobiphenyl	0.01	W/O/PCB
18	2,2',5 trichlorobiphenyl	0.01	W/O/PCB
28	2,4,4' trichlorobiphenyl	0.01	W/O/PCB
44	2,2',3,5' tetrachlorobiphenyl	0.01	W/O/PCB
52	2,2',5,5' tetrachlorobiphenyl	0.01	W/O/PCB
66	2,3',4,4' tetrachlorobiphenyl	0.01	W/O/PCB
77	3,3',4,4' tetrachlorobiphenyl	0.01	W/O/PCB
101	2,2',4,5,5' pentachlorobiphenyl	0.01	W/O/PCB
105	2,3,3',4,4' pentachlorobiphenyl	0.01	W/O/PCB
118	2,3',4,4',5 pentachlorobiphenyl	0.01	W/O/PCB
126	3,3',4,4',5 pentachlorobiphenyl	0.01	W/O/PCB
128	2,2',3,3',4,4' hexachlorobiphenyl	0.01	W/O/PCB
138	2,2',3,4,4',5' hexachlorobiphenyl	0.01	W/O/PCB
153	2,2',4,4',5,5' hexachlorobiphenyl	0.01	W/O/PCB
169	3,3',4,4',5,5' hexachlorobiphenyl	0.01	W/O/PCB
170	2,2',3,3',4,4',5 heptachlorobiphenyl	0.01	W/O/PCB
180	2,2',3,4,4',5,5' heptachlorobiphenyl	0.01	W/O/PCB
187	2,2',3,4',5,5',6 heptachlorobiphenyl	0.01	W/O/PCB

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. Results relate to samples as received.
3. < = less than
4. N/A = Not applicable
5. Test results satisfy all in-house QA/QC protocols as attached.
6. Test description (for in-house methods) as follows:
   W/O/PCB: Solvent extraction and GC-MS Quantification.
7. The elutriate samples were prepared according to contract agreed procedure.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

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TEST REPORT

Report No. : 100972N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	8 ug/L	18 ug/L	28 ug/L	44 ug/L	52 ug/L	66 ug/L	77 ug/L	101 ug/L	105 ug/L
Elutriate VC14a(0.0-0.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC14a(0.9-1.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC5a(0.0-0.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC5a(0.9-1.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.01	0.01	0.01
Elutriate VC15a(0.0-0.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC15a(0.9-1.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC13a(0.0-0.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC13a(0.9-1.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC4a(0.0-0.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC4a(0.9-1.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC6a(0.0-0.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC6a(0.9-1.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC3a(0.0-0.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC3a(0.9-1.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC7a(0.0-0.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC7a(0.9-1.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC2a(0.0-0.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC2a(0.9-1.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC11a(0.0-0.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC11a(0.9-1.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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TEST REPORT

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Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

Customer Ref.	Sample					118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC14a(0.0-0.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC14a(0.9-1.9m)(VC14a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC5a(0.0-0.9m)(VC5a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC5a(0.9-1.9m)(VC5a)	N/A	N/A	N/A		N/A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Elutriate VC15a(0.0-0.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC15a(0.9-1.9m)(VC15a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC13a(0.0-0.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC13a(0.9-1.9m)(VC13a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC4a(0.0-0.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC4a(0.9-1.9m)(VC4a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC6a(0.0-0.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC6a(0.9-1.9m)(VC6a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC3a(0.0-0.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC3a(0.9-1.9m)(VC3a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC7a(0.0-0.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC7a(0.9-1.9m)(VC7a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC2a(0.0-0.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC2a(0.9-1.9m)(VC2a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC11a(0.0-0.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC11a(0.9-1.9m)(VC11a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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TEST REPORT

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Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC12a(0.0-0.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC12a(0.9-1.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC8a(0.0-0.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC8a(0.9-1.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.01	0.01	0.01
Elutriate VC10a(0.0-0.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC10a(0.9-1.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC1a(0.0-0.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC1a(0.9-1.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC9a(0.0-0.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC9a(0.9-1.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TEST REPORT

Report No. : 100972N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

Customer Ref.	Sample					118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Elutriate VC12a(0.0-0.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC12a(0.9-1.9m)(VC12a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC8a(0.0-0.9m)(VC8a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC8a(0.9-1.9m)(VC8a)	N/A	N/A	N/A		N/A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Elutriate VC10a(0.0-0.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC10a(0.9-1.9m)(VC10a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC1a(0.0-0.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC1a(0.9-1.9m)(VC1a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC9a(0.0-0.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Elutriate VC9a(0.9-1.9m)(VC9a)	N/A	N/A	N/A		N/A	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

------------End of Report------------

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

QUALITY CONTROL REPORT

Report No. : 100972N

Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469

Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

1.1 Sample Duplicate

Customer Ref.	Sample						8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen	Batch									
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
18011/1	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*
Elutriate VC3a(0.0-0.9m) (VC3a)	N/A	N/A	N/A		N/A	2	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

1.2 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample						8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen	Batch									
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
18011/2	N/A	N/A	N/A		N/A	1	84	83	80	86	97	89	75	94	75
Elutriate VC3a(0.9-1.9m) (VC3a)	N/A	N/A	N/A		N/A	2	79	95	88	92	92	94	80	105	105
Control Limit							70-130 %								

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

QUALITY CONTROL REPORT

Report No.	:	100972N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

2.1 Sample Duplicate

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m.		%	%	%	%	%	%	%	%	%
18011/1	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*
Elutriate VC3a(0.0-0.9m) (VC3a)	N/A	N/A	N/A		N/A	2	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

2.2 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
18011/2	N/A	N/A	N/A		N/A	1	76	83	83	95	81	77	83	85	101
Elutriate VC3a(0.9-1.9m) (VC3a)	N/A	N/A	N/A		N/A	2	91	92	95	99	87	98	91	97	90
Control Limit							70-130 %								

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100972N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122

Test Results

1.3 QC Sample (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
Method Blank	N/A	N/A	N/A		N/A	1	84	97	80	99	103	89	74	96	81
Method Blank	N/A	N/A	N/A		N/A	2	88	106	87	101	102	92	89	106	103
Control Limit							70-130 %								

1.4 Method Blank

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
N/A	N/A	N/A	N/A		N/A	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N/A	N/A	N/A	N/A		N/A	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Control Limit							Less than reporting limit								

QUALITY CONTROL REPORT

Report No. : 100972N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17986,17999,18015,18026,18044,18071,18079,18105,18122
Test Results

2.3 QC Sample (Spike Level = 1 ug)

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	118 %	126 %	128 %	138 %	153 %	169 %	170 %	180 %	187 %
Method Blank	N/A	N/A	N/A		N/A	1	82	92	87	89	80	77	91	83	90
Method Blank	N/A	N/A	N/A		N/A	2	89	92	97	100	84	99	99	95	91
Control Limit							70-130 %								

2.4 Method Blank

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	118 ug/L	126 ug/L	128 ug/L	138 ug/L	153 ug/L	169 ug/L	170 ug/L	180 ug/L	187 ug/L
N/A	N/A	N/A	N/A		N/A	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N/A	N/A	N/A	N/A		N/A	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Control Limit							Less than reporting limit								

Appendix D

Not Used

Appendix E

Detailed Calculations of Construction Noise Levels

Appendix E

Table E1 Plant Inventory for Different Construction Tasks in Sai Ying Pun

A. Trench Dredging

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Grab dredgers	CNP 063	2	112	115
Hopper barges #	-	2	-	-
Tug boats	CNP 221	2	110	113
Crane, barge mounted	CNP 048	2	112	115
			Total SWL	**119**

B. Setting up of Temporary Platform

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Marine piling vessel	CNP 165*	-	-	-
Hopper barges #	-	-	-	-
Tug boats	CNP 221	-	-	-
Crane, barge mounted	CNP 048	-	-	-
			Total SWL	**-**

C. Pipe preparation

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Truck/ lorry	CNP 141	-	-	-
Crane, mobile/barge mounted (diesel)	CNP 048	-	-	-
			Total SWL	**-**

D. Pipe Laying - Bottom Pull

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, mobile	CNP 048	-	-	-
Generator	CNP 102	1	100	100
Winch (pneumatic)	CNP 261	1	110	110
Water pump (electric)	CNP 281	2	88	91
			Total SWL	**110**

E. Backfilling

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, barge mounted	CNP 048	2	112	115
Hopper barges #	-	2	-	-
Tug boats	CNP 221	2	110	113
			Total SWL	**117**

F. Seawall Reinstatement

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, mobile/barge mounted	CNP 048	1	112	112
Truck / lorry	CNP 141	2	112	115
Piling machine	CNP 163	1	90	90
			Total SWL	**117**

Note:
No noise is emitted from hopper barges.
* The Marine piling vessel is assumed to be an oscillator piling plant.

Appendix E

Table E2 Calculation of Construction Noise Levels in Sai Ying Pun (RWM) during Normal Daytime Working Hour (0700 to 1900 on weekday) (Unmitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities														
					Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10
					Trench Dredging														
									Set up Temporary Platform										
											Pipe Preparation								
													Pipe laying						
																Backfiling			
																		Seawall Reinstatement	
Trench Dredging	119	215	-55	3	68	68	68	68	68	68	68	68	-	-	-	-	-	-	-
Set up Temporary Platform	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pipe Preparation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pipe laying	110	215	-55	3	-	-	-	-	-	-	-	-	59	59	59	-	-	-	-
Backfilling	117	215	-55	3	-	-	-	-	-	-	-	-	-	-	-	65	65	65	-
Seawall Reinstatement	117	215	-55	3	-	-	-	-	-	-	-	-	-	-	-	-	-	65	65
			Total dB(A)		68	68	68	68	68	68	68	68	59	59	59	65	65	68	65
			Criteria dB(A)		75	75	75	75	75	75	75	75	75	75	75	75	75	75	75

Table E3 Calculation of Construction Noise Levels during evening (1900 to 2300 hours) and night-time (2300 to 0700 hours) in Sai Ying Pun (RWM) (Mitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities				
					Jan-09	Feb-09	Mar-09	Apr-09	May-09
					Trench Dredging				
Trench Dredging	119	215	-55	3	68	68	68	68	68
			Total dB(A)		68	68	68	68	68
			Criteria (evening) dB(A)		70	70	70	70	70
			Criteria (night-time) dB(A)		**55**	**55**	**55**	**55**	**55**

Note: Bold Characters indicate that the predicted noise level exceeds the Noise Criteria

Table E4 Calculation of Construction Noise Levels during evening (1900 to 2300 hours) and night-time (2300 to 0700 hours) in Sai Ying Pun (RWM) (Mitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities				
					Jan-09	Feb-09	Mar-09	Apr-09	May-09
					Trench Dredging				
Trench Dredging	119	900	-67	3	55	55	55	55	55
			Total dB(A)		55	55	55	55	55
			Criteria (evening) dB(A)		70	70	70	70	70
			Criteria (night-time) dB(A)		55	55	55	55	55

Table E5 Plant Inventory for Different Construction Tasks in West Kowloon

A. Trench Dredging

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Grab dredgers	CNP 063	2	112	115
Hopper barges #	-	2	-	-
Tug boats	CNP 221	2	110	113
Crane, barge mounted	CNP 048	2	112	115
			Total SWL	**119**

B. Setting up of Temporary Platform

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Marine piling vessel	CNP 165*	2	115	118
Hopper barges #	-	4	-	-
Tug boats	CNP 221	2	110	113
Crane, barge mounted	CNP 048	2	112	115
			Total SWL	**121**

C. Pipe preparation

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Truck/ lorry	CNP 141	2	112	115
Crane, mobile/barge mounted (diesel)	CNP 048	2	112	115
			Total SWL	**118**

D. Pipe Laying - Bottom Pull

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, mobile	CNP 048	1	112	112
Generator	CNP 102	1	100	100
Winch (pneumatic)	CNP 261	-	-	-
Water pump (electric)	CNP 281	-	-	-
			Total SWL	**112**

E. Backfilling

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, barge mounted	CNP 048	2	112	115
Hopper barges #	-	2	-	-
Tug boats	CNP 221	2	110	113
			Total SWL	**117**

F. Seawall Reinstatement

Powered Mechanical Equipment (PME)	CNP	No. of Plants	SWL/Unit, dB(A)	SWL, dB(A)
Crane, mobile/barge mounted	CNP 048	1	112	112
Truck / lorry	CNP 141	2	112	115
Piling machine	CNP 163	1	90	90
			Total SWL	**117**

Note:
No noise is emitted from hopper barges.
* The Marine piling vessel is assumed to be an oscillator piling plant.

Appendix E

Table E6 Calculation of Construction Noise Levels in West Kowloon (KS6) during Normal Daytime Working Hour (0700 to 1900 on weekday) (Unmitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities														
					Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10
					Trench Dredging														
									Set up Temporary Platform										
											Pipe Preparation								
													Pipe laying						
																Backfiling			
																		Seawall Reinstatement	
Trench Dredging	119	580	-63	3	59	59	59	59	59	59	59	59	-	-	-	-	-	-	-
Set up Temporary Platform	121	580	-63	3	-	-	-	-	60	60	60	60	-	-	-	-	-	-	-
Pipe Preparation	118	580	-63	3	-	-	-	-	-	-	58	58	58	58	-	-	-	-	-
Pipe laying	112	580	-63	3	-	-	-	-	-	-	-	-	52	52	52	-	-	-	-
Backfilling	117	580	-63	3	-	-	-	-	-	-	-	-	-	-	-	57	57	57	-
Seawall Reinstatement	117	580	-63	3	-	-	-	-	-	-	-	-	-	-	-	-	-	57	57
			Total dB(A)		59	59	59	59	63	63	64	64	59	59	52	57	57	60	57
			Criteria dB(A)		75	75	75	75	75	75	75	75	75	75	75	75	75	75	75

Table E7 Calculation of Construction Noise Levels during evening (1900 to 2300 hours) and night-time (2300 to 0700 hours) in West Kowloon (KS6) (Mitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities				
					Jan-09	Feb-09	Mar-09	Apr-09	May-09
					Trench Dredging				
Trench Dredging	119	580	-63	3	59	59	59	59	59
			Total dB(A)		59	59	59	59	59
			Criteria (evening) dB(A)		70	70	70	70	70
			Criteria (night-time) dB(A)		**55**	**55**	**55**	**55**	**55**

Note: Bold Characters indicate that the predicted noise level exceeds the Noise Criteria

Table E8 Calculation of Construction Noise Levels during evening (1900 to 2300 hours) and night-time (2300 to 0700 hours) in West Kowloon (KS6) (Mitigated)

	Sub-SWL, dB(A)	Distance (m)	Distnce Attenuation, dB(A)	Facade correction dB(A)	Month / Activities				
					Jan-09	Feb-09	Mar-09	Apr-09	May-09
					Trench Dredging				
Trench Dredging	119	900	-67	3	55	55	55	55	55
			Total dB(A)		55	55	55	55	55
			Criteria (evening) dB(A)		70	70	70	70	70
			Criteria (night-time) dB(A)		55	55	55	55	55

Appendix F1

Vibrocore Records

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. **VC1a**

CONTRACT No.: **GE/2005/28**

SHEET: 1 of 2

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES: E **832652.40** N **816956.50**	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**		DATE from: **25/09/2006** to **25/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-9.30** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
25/09/2006	SW			97					1		0.00	-9.30	0.00			
												-9.48	0.18			No recovery, assumed to be MARINE DEPOSIT.
																Very soft to soft, greensih grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	VIOO	2.90					
4									5		3.90					
5									6		4.90					
6	SW 6.00			99					7		5.90	-15.30	6.00			
									8		6.00	-15.46	6.16			6.00 - 6.16m: With some lenses (<5mm) of silty clayey, fine to coarse sand and a gravel size ceramic fragment.
7									9		7.00					
8									10	VIOO	7.90					
9									11		8.90					
												-18.60	9.30			9.30 - 12.00m: Soft to firm.
10									12		9.90	-19.30	10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED **W.S. Tsang**
DATE **26/09/2006**
CHECKED **S.C. Wong**
DATE **28/09/2006**

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC1a	
CONTRACT No.: GE/2005/28	SHEET: 2 of 2	
PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation		
METHOD: Vibrocoring	CO-ORDINATES: E 832652.40 N 816956.50	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 25/09/2006 to 25/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.30 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-19.30	10.00			As sheet 1 of 2.
									13	V100	10.90	-20.20	10.90			Below 10.90m: Soft.
25/09/2006									14		11.90 12.00	-21.30	12.00			End of investigation hole at 12.00m.
													20.00			

Small Disturbed Sample; Piston sample; U76 Undisturbed Sample; Vibrocore sample; Vibrocore sub-sample; SPT Liner Sample; Water Sample

Standard Penetration Test; In-situ Vane Shear Test; Permeability Test; Impression Packer Test; Packer Test; Piezometer Tip; Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

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FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC1b	CONTRACT No.: GE/2005/28	SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832653.90 N 816957.10	DATE from: 25/09/2006 to 25/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.40 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
25/09/2006	SW			94					1		0.00	-9.40	0.00			No recovery, assumed to be ANTHROPOGENIC MUD / MARINE DEPOSIT.
												-9.76	0.36			Very soft to soft, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional angular, fine to coarse gravel. Strong organic odour. (ANTHROPOGENIC MUD / MARINE DEPOSIT)
												-10.10	0.70			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with trace fine gravel size shell and shell fragments. (MARINE DEPOSIT)
									2		0.90					
									3		1.90					
									4	VIOO	2.90					
									5		3.90					
									6		4.90					
	SW 6.00								7		5.90					
				98					8		6.00	-15.40	6.00			At 6.00m: With occasional organic debris.
												-15.65	6.25			At 6.25m: With an angular, coarse gravel size brick fragment.
												-15.74	6.34			At 6.34m: With a subrounded to rounded cobble of moderately strong rock.
									9		7.00	-16.52	7.12			At 7.12m: With a gravel size ceramic fragment.
									10	VIOO	7.90					
									11		8.90					
									12		9.90	-19.40	10.00			

Legend			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No.	VC1b
	CONTRACT No.: GE/2005/28	SHEET:	2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 832653.90 N 816957.10	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 25/09/2006 to 25/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.40 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-19.40	10.00			As sheet 1 of 2.
11									13	VIOO	10.90					
25/09/2006 12									14		11.90 12.00	-21.40	12.00			End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key		Logging	REMARKS
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC2a
CONTRACT No.: GE/2005/28	SHEET: 1 of 2

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E 833170.70 N 817533.80	DATE from: **18/09/2006** to **18/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-12.10** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
18/09/2006	SW			91					1		0.00	-12.10	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-12.64	0.54			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy to sandy (fine to medium), silty CLAY with some gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	V100	2.90	-15.00	2.90			2.90 - 3.30m: Slightly sandy (fine).
												-15.25	3.15			3.15 - 3.30m: An oyster shell.
												-15.40	3.30			Soft, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT)
4									5		3.90					
5									6		4.90					
6	SW 6.00			100					7 8		5.90 6.00					
7									9		7.00	-19.10	7.00			Soft to firm, grey (10YR/6/1), slightly sandy, clayey SILT with occasional wood and plant fragments. (ESTUARINE DEPOSIT)
8									10	V100	7.90					
9									11		8.90					
												-21.90	9.80			
10									12		9.90	-22.10	10.00			Grey (10YR/6/1), clayey silty, fine to medium

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	1. 7.5L of water samples were collected.
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	2. Two 4L grab samples were collected.
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.30m.
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

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VIBROCORE RECORD

HOLE No.	VC2a		
CONTRACT No.: GE/2005/28	SHEET: 2 of 2		

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E **833170.70** N **817533.80**	DATE from: **18/09/2006** to **18/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-12.10** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level (-22.10)	Depth (m) (10.00)	Legend	Grade	Description
																SAND. (ESTUARINE DEPOSIT)
11									13	VIOO	10.90					Stiff, light grey (10YR/7/1), mottled yellowish brown and occasional reddish brown, silty CLAY with occasional black organic debris. (ALLUVIUM)
18/09/2006									14		11.30 11.40	-23.50	11.40			
12																End of investigation hole at 11.40m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key		
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong
Vibrocore sample	Impression Packer Test	DATE 28/09/2006
Vibrocore sub-sample	Packer Test	
SPT Liner Sample	Piezometer Tip	
Water Sample	Standpipe	

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC2b
	CONTRACT No.: GE/2005/28	SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833169.10 N 817534.10	DATE from: 18/09/2006 to 18/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.20 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
18/09/2006	SW			85					1		0.00	-12.20	0.00			No recovery, assumed to be ANTHROPOGENIC MUD.
												-12.95	0.75			Very soft, dark grey (10YR/4/1) and black (10YR/2/1), SILT / CLAY with occasional shell fragments and angular, fine to coarse gravel. Strong organic odour. (ANTHROPOGENIC MUD)
1									2		0.90	-13.10	0.90			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy (fine to medium), silty CLAY with some gravel size shell fragments. (MARINE DEPOSIT)
2									3		1.90					
												-14.60	2.40			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional shell fragments. (MARINE DEPOSIT)
3									4	VIOO	2.90	-15.30	3.10			3.10 - 4.95m: Soft to firm.
4									5		3.90					
5									6		4.90	-17.15	4.95			Soft to firm, grey (10YR/6/1), SILT / CLAY with occasional plant and shell fragments. (ESTUARINE DEPOSIT / MARINE DEPOSIT?)
6	SW 6.00			100					7 8		5.90 6.00					
7									9		7.00					
8									10	VIOO	7.90					
9									11		8.90	-21.45	9.25			Soft to firm, dark grey (10YR/4/1), silty CLAY with occasional black organic debris. (ESTUARINE DEPOSIT)
10									12		9.90	-22.20	10.00			

Key		Logging	REMARKS
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC2b
	CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833169.10 N 817534.10	DATE from: 18/09/2006 to 18/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.20 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-22.20	10.00			As sheet 1 of 2.
												-22.66	10.46			Soft to firm, light grey (10YR/7/1), sandy clayey SILT with occasional wood fragment. (ESTUARINE DEPOSIT / ALLUVIUM)
										V100		-22.93	10.73			Stiff to firm, light grey (10YR/7/1), mottled brown and occasional reddish brown, silty CLAY with some black organic debris. (ALLUVIUM)
11									13		10.90					
18/09/2006									14		11.30 11.40	-23.60	11.40			End of investigation hole at 11.40m.
12																
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC3a
CONTRACT No.: GE/2005/28	SHEET: 1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833349.30 N 817640.10	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 15/09/2006 to 15/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-12.90	0.00			
15/09/2006				100					1	VIOO	0.00					Very soft to soft, grey (10YR/6/1), slightly sandy (fine), silty CLAY with occasional shell and shell fragments. (MARINE DEPOSIT)
									2		0.90					
									3		1.90					
												-15.30	2.40			Firm, pale grey (10YR/6/2), mottled orange brown, sandy clayey SILT with occasional subangular, fine gravel of quartz. (ALLUVIUM)
									4		2.90	-15.90	3.00			Yellowish brown (10YR/5/6), mottled grey, silty clayey, fine to coarse SAND. (ALLUVIUM)
15/09/2006									5		3.10 3.20	-16.10	3.20			End of investigation hole at 3.20m.
													10.00			

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	1. 7.5L of water samples were collected.
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	2. One 4L grab sample was collected.
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m and 1.90 - 2.90m.
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC3b

CONTRACT No.: GE/2005/28

SHEET: 1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring

MACHINE & No.: LAM - 4

FLUSHING MEDIUM: Water

CO-ORDINATES: E 833349.90 N 817641.60

ORIENTATION: Vertical

WORKS ORDER No. GE/2005/28.7

DATE from: 15/09/2006 to 15/09/2006

SEABED LEVEL -13.00 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
15/09/2006				100					1	VIOO	0.00	-13.00	0.00			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy (fine), silty CLAY with occasional shell and shell fragments. (MARINE DEPOSIT)
									2		0.90					
									3		1.90					
									4		2.90	-15.90	2.90			Firm, light grey (10YR/7/1), mottled brown to pink, slightly sandy, clayey SILT. (ALLUVIUM)
											3.40	-16.38	3.38			Firm, pale grey (10YR/6/2), mottled orange brown, clayey silty, fine to coarse SAND with occasional subangular, fine gravel of quartz. (ALLUVIUM)
15/09/2006									5		3.50	-16.50	3.50			End of investigation hole at 3.50m.
													10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC4a

CONTRACT No.: GE/2005/28

SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring

CO-ORDINATES: E 833504.30 N 817790.70

WORKS ORDER No. GE/2005/28.7

MACHINE & No.: LAM - 4

DATE from: 12/09/2006 to 12/09/2006

FLUSHING MEDIUM: Water

ORIENTATION: Vertical

SEABED LEVEL -11.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
12/09/2006	ZW			83							0.00	-11.90	0.00			No recovery, assumed to be MARINE DEPOSIT.
1									1		0.90	-12.92	1.02			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy silty CLAY with occasional coarse sand size shell fragments. (MARINE DEPOSIT)
2									2		1.90					
3									3	VIOO	2.90					
4									4		3.90	-15.90	4.00			4.00 - 4.60m: Soft to firm.
												-16.30	4.40			At 4.40m: With a fragment of wood.
												-16.50	4.60			
5									5		4.90					
6				99					6		5.90					
									7		6.00					
7									8		7.00	-19.10	7.20			7.20 - 7.90m: Soft to firm.
8									9	VIOO	7.90	-19.80	7.90			
												-20.50	8.60			8.60 - 10.20m: Soft to firm.
9									10		8.90					
10									11		9.90	-21.90	10.00			

Symbol	Symbol
Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang

DATE 15/09/2006

CHECKED S.C. Wong

DATE 20/09/2006

REMARKS

1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC4a

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring

CO-ORDINATES: E 833504.30 N 817790.70

WORKS ORDER No. GE/2005/28.7

MACHINE & No.: LAM - 4

DATE from: 12/09/2006 to 12/09/2006

FLUSHING MEDIUM: Water

ORIENTATION: Vertical

SEABED LEVEL -11.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-21.90	10.00			
												-22.10	10.20			As sheet 1 of 2.
									12	VIOO	10.90	-23.40	11.50			Firm, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional to some wood fragments. (ESTUARINE DEPOSIT)
12/09/2006	ZW 12.00								13		11.90 12.00	-23.90	12.00			Firm, pale grey (10YR/6/2), sandy (fine), silty CLAY with occasional subangular, fine gravel of quartz. (ALLUVIUM)
																End of investigation hole at 12.00m.
													20.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC4b	CONTRACT No.: GE/2005/28	SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833505.60 N 817789.80	DATE from: 12/09/2006 to 12/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.70 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Sample No.	Sample Type	Sample Depth	Reduced Level	Depth (m)	Legend	Grade	Description
12/09/2006	ZW			90					1		0.00	-11.70	0.00			No recovery, assumed to be ANTHROPOGENIC MUD / MARINE DEPOSIT.
												-12.30	0.60			Very soft to soft, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional shell fragments. (ANTHROPOGENIC MUD / MARINE DEPOSIT)
												-12.50	0.80			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy (fine) silty CLAY with occasional coarse sand size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	V100	2.90					
4									5		3.90	-15.60	3.90			3.90 - 4.80m: Locally firm.
												-16.50	4.80			
5									6		4.90					
6									7		5.90	-17.70	6.00			6.00 - 6.18m: No recovery, assumed to be MARINE DEPOSIT.
				97					8		6.00	-17.88	6.18			
7									9		7.00					
8									10	V100	7.90					
9									11		8.90	-20.60	8.90			8.90 - 9.80m: Brownish grey (10YR/5/2).
												-21.50	9.80			
10									12		9.90	-21.70	10.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

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VIBROCORE RECORD

HOLE No. **VC4b**

CONTRACT No.: **GE/2005/28**

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES: E **833505.60** N **817789.80**
MACHINE & No.: **LAM - 4**	WORKS ORDER No. **GE/2005/28.7**
FLUSHING MEDIUM: **Water**	DATE from: **12/09/2006** to **12/09/2006**
ORIENTATION: **Vertical**	SEABED LEVEL **-11.70** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level (-21.70)	Depth (m) (10.00)	Legend	Grade	Description
																As sheet 1 of 2.
												-22.25	10.55			Soft to firm, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional plant and wood fragments. (MARINE DEPOSIT / ESTUARINE DEPOSIT)
11									13	VI00	10.90					
												-23.15	11.45			11.45 - 11.90m: With many wood fragments.
											11.90	-23.60	11.90			
12/09/2006 12	ZW 12.00								14		12.00	-23.70	12.00			Firm, pale grey (10YR/6/2), mottled yellowish brown, clayey silty, medium to coarse SAND with much subangular, fine gravel of quartz. (ALLUVIUM)
																End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample

Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC5a

CONTRACT No.: GE/2005/28

SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring

CO-ORDINATES: E 833870.60 N 818135.20

WORKS ORDER No. GE/2005/28.7

MACHINE & No.: LAM - 4

DATE from: 07/09/2006 to 07/09/2006

FLUSHING MEDIUM: Water

ORIENTATION: Vertical

SEABED LEVEL -8.70 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
07/09/2006	ZW			90					1		0.00	-8.70	0.00			No recovery, assumed to be ANTHROPOGENIC MUD / FILL.
												-9.30	0.60			Very soft to soft, grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	VIOO	2.90					
4									5		3.90					
5									6		4.90	-13.60	4.90			4.90 - 6.00m: Soft.
6				85					7 8		5.90 6.00	-14.70	6.00			6.00 - 6.85m: No recovery, assumed to be MARINE DEPOSIT.
												-15.55	6.85			
7									9		7.00	-15.70	7.00			At 7.00m: Soft, slightly sandy (medium to coarse).
												-15.97	7.27			Grey (10YR/6/1), slightly silty, slightly clayey, fine to medium SAND. (MARINE DEPOSIT)
												-16.17	7.47			Yellowish brown (10YR/5/6), slightly silty, slightly clayey, fine to coarse SAND with occasional pockets (<100mm) of soft, grey, silt / clay. (MARINE DEPOSIT)
												-16.50	7.80			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/7/1), slightly sandy SILT / CLAY with occasional shell fragments. (MARINE DEPOSIT)
8									10	VIOO	7.90					
9									11		8.90					
10									12		9.90	-18.70	10.00			

Small Disturbed Sample; Piston sample; U76 Undisturbed Sample; Vibrocore sample; Vibrocore sub-sample; SPT Liner Sample; Water Sample; Standard Penetration Test; In-situ Vane Shear Test; Permeability Test; Impression Packer Test; Packer Test; Piezometer Tip; Standpipe

LOGGED W.S. Tsang

DATE 15/09/2006

CHECKED S.C. Wong

DATE 20/09/2006

REMARKS

1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

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VIBROCORE RECORD

HOLE No.	VC5a
CONTRACT No.:	GE/2005/28
SHEET:	2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833870.60 N 818135.20	DATE from: 07/09/2006 to 07/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -8.70 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level (-18.70)	Depth (m) (10.00)	Legend	Grade	Description
	ZW 10.50															As sheet 1 of 2.
									13	VIOO	10.90					
07/09/2006									14		11.90 / 12.00	-20.70	12.00			End of investigation hole at 12.00m.
													20.00			

Symbol	Symbol
Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

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VIBROCORE RECORD

HOLE No. **VC5b**

CONTRACT No.: **GE/2005/28**

SHEET: 1 of 2

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E **833870.30** N **818136.50**	DATE from: **08/09/2006** to **08/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-8.70** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
08/09/2006	ZW			81							0.00	-8.70	0.00			No recovery, assumed to be ANTHROPOGENIC MUD / FILL.
									1		0.90	-9.84	1.14			Grey (10YR/6/1), spotted white, silty, fine to coarse SAND with occasional pockets (<130mm) of very soft, black, slightly sandy silt / clay. (FILL?)
												-10.42	1.72			1.72 - 1.84m: Yellowish brown (10YR/5/6).
									2		1.90	-10.54 -10.60	1.84 1.90			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
									3	VIOO	2.90					
									4		3.90					
									5		4.90	-13.60	4.90			4.90 - 12.00m: Soft to firm.
				83					6		5.90 6.00	-14.70	6.00			6.00 - 7.02m: No recovery, assumed to be MARINE DEPOSIT.
									7		7.00	-15.72	7.02			
									8	VIOO	7.90					
									9		8.90					
									10		9.90	-18.70	10.00			

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Key		Key	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC5b
CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833870.30 N 818136.50	DATE from: 08/09/2006 to 08/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -8.70 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-18.70	10.00			As sheet 1 of 2.
	ZW 10.70															
11									11	VC00	10.90					
												-19.85	11.15			11.15 - 11.85m: With occasional wood fragments.
												-20.55	11.85			
08/09/2006 12									12		11.90 12.00	-20.70	12.00			End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC6a
	CONTRACT No.: GE/2005/28	SHEET: 1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833420.60 N 817709.70	DATE from: 14/09/2006 to 14/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.40 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
14/09/2006	SW			85							0.00	-12.40	0.00			No recovery, assumed to be MARINE DEPOSIT.
									1	VI00	0.90	-13.30	0.90			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional subangular, fine gravel size shell fragments. (MARINE DEPOSIT)
									2		1.90	-14.30	1.90			At 1.90m: Slightly (fine) sandy.
									3		2.90					
									4		3.90	-16.30	3.90			3.90 - 6.12m: Soft to firm.
									5		4.90					
	SW 6.00			100					6 7		5.90 6.00	-18.52	6.12			Soft, grey (10YR/6/1), slightly sandy SILT / CLAY with occasional lenses (<2mm) of grey, fine to medium sand and occasional wood fragments. (ESTUARINE DEPOSIT)
									8	VI00	7.00	-18.83	6.43			Soft to firm, yellowish brown (10YR/5/6), mottled pale grey, slightly sandy (fine), silty CLAY with occasional subangular to subrounded, fine to coarse gravel. (ALLUVIUM?)
									9		7.90	-19.88	7.48			Firm to stiff, light grey (10YR/7/1), mottled brown, spotted white, sandy (fine), very silty CLAY. (ALLUVIUM)
14/09/2006									10 11		8.90 9.00 9.10	-21.50	9.10			End of investigation hole at 9.10m.
													10.00			

Key		Logged/Checked	REMARKS
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	1. 7.5L of water samples were collected.
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	2. Two 4L grab samples were collected.
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	3. Vibrocore sub-samples were taken for toxicity testing from 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m and 7.90 - 8.90m.
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. **VC6b**

CONTRACT No.: **GE/2005/28**

SHEET: **1** of **1**

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E **833421.70** N **817710.30**	DATE from: **14/09/2006** to **14/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-12.50** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level (-12.50)	Depth (m) (0.00)	Legend	Grade	Description
14/09/2006	SW			85							0.00					No recovery, assumed to be MARINE DEPOSIT.
									1		0.90	-13.40	0.90			Very soft to soft, grey (10YR/6/1), silty CLAY with occasional subangular, fine gravel size shell fragments. (MARINE DEPOSIT)
									2		1.90	-14.40	1.90			At 1.90m: Slightly (fine) sandy.
									3	VI00	2.90					
									4		3.90	-16.40	3.90			3.90 - 5.57m: Soft to firm.
									5		4.90					
												-18.07	5.57			Soft to firm, yellowish brown (10YR/5/6), mottled pale grey, slightly sandy silty CLAY. (ALLUVIUM?)
	SW 6.00			97					6 7		5.90 6.00	-18.40	5.90			Very soft to soft, grey (10YR/6/1), silty CLAY with occasional subangular, fine gravel size shell fragments. (MARINE DEPOSIT)
												-19.35	6.85			Soft to firm, light brown (7.5YR/6/3), mottled pale grey, slightly sandy (fine), silty CLAY. (ALLUVIUM?)
									8	VI00	7.00					
												-20.22	7.72			Firm, yellowish brown (10YR/5/6), mottled pale grey, sandy (fine), very silty CLAY. (ALLUVIUM)
									9		7.90					
												-21.06	8.56			Firm, yellowish brown (10YR/5/6), mottled light grey, very sandy (fine to coarse), silty CLAY. (ALLUVIUM)
14/09/2006									10		8.90 9.69	-21.50	9.00			End of investigation hole at 9.00m.
													10.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FGS Job No.: 05 0460 05 007

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. **VC7a**

CONTRACT No.: **GE/2005/28**

SHEET: 1 of 2

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E **833270.50** N **817569.60**	DATE from: **16/09/2006** to **16/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-12.50** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
16/09/2006	SW			93					1		0.00	-12.50	0.00			No recovery, assumed to be MARINE DEPOSIT.
									2		0.90	-12.98	0.48			Grey (10YR/6/1), silty clayey, fine to medium SAND with some coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
									3		1.90	-13.90	1.40			Soft, grey (10YR/6/1), sandy (fine to medium), silty CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT)
									4	VIOO	2.90	-14.90	2.40			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT)
									5		3.90					
									6		4.90					
	SW 6.00			100					7 8		5.90 6.00	-18.50	6.00			At 6.00m: With some partings of greyish brown, silty fine to medium sand.
									9		7.00	-19.10	6.60			Very soft, grey (10YR/6/1), slightly sandy (fine), silty CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT / ESTUARINE DEPOSIT?)
												-19.88	7.38			At 7.38m: With a piece of wood fragment.
									10	VIOO	7.90	-20.05	7.55			Soft, light bluish grey (10B/7/1), sandy clayey SILT with occasional lenses (<3mm) of silty clayey fine to medium sand and occasional wood fragments. (ESTUARINE DEPOSIT)
																Soft, brownish grey (10YR/5/2), slightly sandy, clayey SILT with much wood fragments. (ESTUARINE DEPOSIT)
									11		8.90	-21.50	9.00			Soft to firm, yellowish brown (10YR/5/6), mottled grey, slightly sandy clayey SILT with occasional plant and wood fragments.
												-22.00	9.50			(ALLUVIUM)
									12		9.90		10.00			Firm to stiff, light grey (10YR/7/1), dappled

Small Disturbed Sample; Piston sample; U76 Undisturbed Sample; Vibrocore sample; Vibrocore sub-sample; SPT Liner Sample; Water Sample; Standard Penetration Test; In-situ Vane Shear Test; Permeability Test; Impression Packer Test; Packer Test; Piezometer Tip; Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m and 7.90 - 8.90m.

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VIBROCORE RECORD

HOLE No. VC7a

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833270.50 N 817569.60	DATE from: 16/09/2006 to 16/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.50 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-22.50	10.00			
16/09/2006									13	VIOO	10.30 10.40	-22.90	10.40			brown and reddish brown, slightly sandy clayey SILT. (ALLUVIUM)
																End of investigation hole at 10.40m.
11																
12																
13																
14																
15																
16																
17																
18																
19																
20														20.00		

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC7b
CONTRACT No.:	GE/2005/28
SHEET:	1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833271.80 N 817570.80	DATE from: 16/09/2006 to 16/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.50 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
16/09/2006	SW			89					1		0.00	-12.50	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-13.16	0.66			Soft to firm, grey (10YR/6/1), sandy (fine to medium), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
									2		0.90	-13.26	0.76			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand size shell fragments. (MARINE DEPOSIT)
									3		1.90					
									4	VI00	2.90					
									5		3.90					
									6		4.90	-17.65	5.15			Soft, greyish brown (10YR/5/2), sandy to very sandy (fine), silty CLAY with occasional organic debris. (ALLUVIUM)
	SW 6.00								7		5.90	-18.50	6.00			6.00 - 6.17m: No recovery, assumed to be ALLUVIUM.
				94					8		6.00	-18.67	6.17			6.17 - 7.40m: With some lenses (<6mm) of brown, silty clayey, fine to medium sand.
									9	VI00	7.00	-19.90	7.40			Firm, greyish brown (10YR/5/2), mottled grey, sandy (fine), silty CLAY with occasional root. (ALLUVIUM)
									10		7.90	-20.45	7.95			Stiff, yellowish brown (10YR/5/6), mottled grey, slightly sandy (fine), silty CLAY with occasional subangular, fine to coarse quartz gravel. (ALLUVIUM)
												-20.86	8.36			7.95 - 8.36m: Light grey (10YR/7/1), mottled brown.
16/09/2006									11		8.80 / 8.90	-21.40	8.90			End of investigation hole at 8.90m.
													10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

FUGRO
FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC8a
CONTRACT No.:	GE/2005/28
SHEET:	1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832875.80 N 817045.20	DATE from: 22/09/2006 to 22/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.10 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
22/09/2006	SW			93					1		0.00	-11.10	0.00			No recovery, assumed to be ANTHROPOGENIC MUD.
												-11.52	0.42			Very soft, grey (10YR/6/1), sandy (fine), clayey SILT with some subangular to subrounded gravel and much shell fragments. (ANTHROPOGENIC MUD)
1									2		0.90					
												-12.60	1.50			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional gravel size shell fragments. (MARINE DEPOSIT)
2									3		1.90					
3									4	VIOO	2.90					
4									5		3.90					
5									6		4.90					
6	SW 6.00			99					7		5.90					
									8		6.00	-17.20	6.10			At 6.10m: With a fragment of wood.
7									9		7.00					
8									10	VIOO	7.90					
9									11		8.90	-20.00	8.90			8.90 - 9.40m: Soft to firm.
												-20.50	9.40			9.40 - 12.00m: Firm.
10									12		9.90	-21.10	10.00			

Key	
Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

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VIBROCORE RECORD

HOLE No.	VC8a	
CONTRACT No.: GE/2005/28	SHEET: 2 of 2	
PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation		
METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832875.80 N 817045.20	DATE from: 22/09/2006 to 22/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.10 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR%	SCR%	RQD%	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-21.10	10.00			As sheet 1 of 2.
									13	V100	10.90					
22/09/2006									14		11.90 12.00	-23.10	12.00			At 12.00m: Occasional organic debris.
																End of investigation hole at 12.00m.
													20.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong
Vibrocore sample	Impression Packer Test	DATE 28/09/2006
Vibrocore sub-sample	Packer Test	
SPT Liner Sample	Piezometer Tip	
Water Sample	Standpipe	

REMARKS

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC8b	SHEET:	1 of 2
CONTRACT No.:	GE/2005/28		

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4	E 832876.70 N 817046.60	DATE from: 22/09/2006	to 22/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.20 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
22/09/2006	SW			91					1		0.00	-11.20	0.00			No recovery, assumed to be ANTHROPOGENIC MUD.
												-11.74	0.54			Very soft, dark grey (10YR/4/1) to black (10YR/2/1), slightly sandy (fine), silty CLAY. (ANTHROPOGENIC MUD)
									2		0.90	-12.10	0.90			0.90 - 1.75m: With some subangular, coarse gravel of rock, red brick / tile and shell fragments.
												-12.95	1.75			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional gravel size shell fragments. (MARINE DEPOSIT)
									3		1.90					
									4	VIOO	2.90					
									5		3.90					
									6		4.90					
	SW 6.00								7		5.90					
				90					8		6.00	-17.20	6.00			6.00 - 6.60m: No recovery, assumed to be MARINE DEPOSIT.
												-17.80	6.60			
												-18.00	6.80			At 6.80m: With a subangular, coarse cobble.
												-18.10	6.90			At 6.90m: With a circular ceramic fragment.
									9		7.00	-18.20	7.00			7.00 - 12.00m: Soft.
									10	VIOO	7.90					
									11		8.90					
									12		9.90	-21.20	10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC8b
	CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832876.70 N 817046.60	DATE from: 22/09/2006 to 22/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.20 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-21.20	10.00			As sheet 1 of 2.
11									13	VIOO	10.90					
22/09/2006									14		11.90 12.00	-23.20	12.00			End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

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VIBROCORE RECORD

HOLE No. **VC9a**

CONTRACT No.: **GE/2005/28**

SHEET: **1** of **2**

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E **832557.70** N **816917.50**	DATE from: **26/09/2006** to **26/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-10.00** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
26/09/2006	SW			87					1		0.00	-10.00	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-10.78	0.78			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	V100	2.90					
4									5		3.90					
5									6		4.90					
6	SW 6.00			91					7 8		5.90 6.00	-16.00	6.00			6.00 - 6.54m: No recovery, assumed to be MARINE DEPOSIT.
												-16.54	6.54			
7									9		7.00					
8									10	V100	7.90					
9									11		8.90					
10									12		9.90	-20.00	10.00			

Symbol	Symbol
Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC9a
	CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832557.70 N 816917.50	DATE from: 26/09/2006 to 26/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -10.00 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level -20.00	Depth (m) 10.00	Legend	Grade	Description
																As sheet 1 of 2.
												-20.75	10.75			10.75 - 10.83m: With a pocket (<80mm) of very soft, grey, slightly sandy silt / clay.
												-20.83	10.83			
11									13	VIOO	10.90	-20.90	10.90			10.90 - 12.00m: Soft.
12 26/09/2006									14		11.90 12.00	-22.00	12.00			
																End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

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FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC9b
CONTRACT No.:	GE/2005/28
SHEET:	1 of 2
PROJECT:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation
METHOD:	Vibrocoring
MACHINE & No.:	LAM - 4
FLUSHING MEDIUM:	Water
CO-ORDINATES:	E 832559.50 N 816918.90
ORIENTATION:	Vertical
WORKS ORDER No.	GE/2005/28.7
DATE from:	26/09/2006 to 27/09/2006
SEABED LEVEL	-9.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-9.90	0.00			
26/09/2006	SW			95					1		0.00					No recovery, assumed to be ANTHROPOGENIC MUD.
												-10.20	0.30			Very soft, dark grey (10YR/4/1) to black (10YR/2/1), SILT / CLAY with organic ordour. (ANTHROPOGENIC MUD)
												-10.36	0.46			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90					
3									4	V100	2.90					
4									5		3.90	-13.80	3.90			3.90 - 12.00m: Soft.
5									6		4.90					
26/09/2006 6	SW 6.00								7		5.90	-15.90	6.00			
27/09/2006				97					8		6.00	-16.02	6.12			6.00 - 6.12m: No recovery, assumed to be MARINE DEPOSIT.
7									9		7.00					
8									10	V100	7.90					
9									11		8.90					
10									12		9.90	-19.90	10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 27/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC9b
CONTRACT No.:	GE/2005/28
SHEET:	2 of 2
PROJECT:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation
METHOD:	Vibrocoring
MACHINE & No.:	LAM - 4
FLUSHING MEDIUM:	Water
CO-ORDINATES:	E 832559.50, N 816918.90
ORIENTATION:	Vertical
WORKS ORDER No.	GE/2005/28.7
DATE from:	26/09/2006 to 27/09/2006
SEABED LEVEL	-9.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-19.90	10.00			As sheet 1 of 2.
									13	VI00	10.90					
												-21.30	11.40			11.40 -12.00m: With occasional wood fragments.
27/09/2006									14		11.90 12.00	-21.90	12.00			End of investigation hole at 12.00m.
													20.00			

Key		Key	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang

DATE 27/09/2006

CHECKED S.C. Wong

DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC10a	SHEET:	1 of 2
CONTRACT No.:	GE/2005/28		

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 832770.70 N 816999.80	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 23/09/2006 to 23/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -10.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
23/09/2006	SW			99					1		0.00	-10.90	0.00			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
1									2		0.90	-11.90	1.00			At 1.00m: Slightly sandy (fine).
2									3		1.90					
3									4	VI00	2.90					
4									5		3.90					
5									6		4.90					
6	SW 6.00			100					7 / 8		5.90 / 6.00					
7									9		7.00	-18.40 / -18.50	7.50 / 7.60			7.50 - 7.60m: With occasional wood fragments.
8									10	VI00	7.90					
9									11		8.90					
10									12		9.90	-20.80	9.90 / 10.00			

Legend		Tests	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

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VIBROCORE RECORD

HOLE No. VC10a

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 832770.70 N 816999.80	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4		DATE from: 23/09/2006 to 23/09/2006	
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -10.90 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level -20.90	Depth (m) 10.00	Legend	Grade	Description
11									13	VIOO	10.90					9.90 - 12.00m: Soft to firm.
23/09/2006 12									14		11.90 12.00	-22.90	12.00			At 12.00m: Occasional organic debris.
13																End of investigation hole at 12.00m.
14																
15																
16																
17																
18																
19																
20													20.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC10b	
CONTRACT No.: GE/2005/28	SHEET: 1 of 2	

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 832772.10 N 817001.10	DATE from: 23/09/2006 to 23/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.00 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
23/09/2006	SW			93					1		0.00	-11.00	0.00			No recovery, assumed to be ANTHROPOGENIC MUD.
												-11.42	0.42			Very soft to soft, grey (10YR/6/1), sandy SILT / CLAY with occasional angular to subangular, fine to coarse gravel of rock and brick fragments. (ANTHROPOGENIC MUD)
									2		0.90					
												-12.40	1.40			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand and fine gravel size shell fragments. (MARINE DEPOSIT)
									3		1.90					
									4	VI00	2.90					
									5		3.90					
									6		4.90	-15.90	4.90			4.90 - 9.90m: Soft to firm.
	SW 6.00								7		5.90	-17.00	6.00			
				97					8		6.00	-17.12	6.12			6.00 - 6.12m: No recovery, assumed to be MARINE DEPOSIT.
									9		7.00					
									10	VI00	7.90					
									11		8.90					
									12		9.90	-20.90	9.90 10.00			

Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang

DATE 26/09/2006

CHECKED S.C. Wong

DATE 28/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

FUGRO
FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC10b
CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: **Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation**

METHOD: **Vibrocoring**	CO-ORDINATES:	WORKS ORDER No. **GE/2005/28.7**
MACHINE & No.: **LAM - 4**	E 832772.10 N 817001.10	DATE from: **23/09/2006** to **23/09/2006**
FLUSHING MEDIUM: **Water**	ORIENTATION: **Vertical**	SEABED LEVEL **-11.00** mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level -21.00	Depth (m) 10.00	Legend	Grade	Description
									13	VIOO	10.90					9.90 - 12.00m: Firm, with occasional wood fragments.
23/09/2006									14		11.90 12.00	-23.00	12.00			
																End of investigation hole at 12.00m.

Key	
Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED	W.S. Tsang
DATE	26/09/2006
CHECKED	S.C. Wong
DATE	28/09/2006

REMARKS

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC11a	SHEET:	1 of 2
CONTRACT No.:	GE/2005/28		

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 832755.30 N 817329.40	WORKS ORDER No.	GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 19/09/2006	to 20/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL	-12.30 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-12.30	0.00			
19/09/2006	SW			87					1		0.00					No recovery, assumed to be ANTHROPOGENIC MUD.
												-13.08	0.78			
									2		0.90					Black (oxidize to brown) (10YR/2/2), slightly silty, fine to coarse SAND with some subangular, fine to medium gravel of moderately strong rock. (ANTHROPOGENIC MUD)
												-13.70	1.40			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand size shell fragments. (MARINE DEPOSIT)
									3		1.90	-14.20	1.90			At 1.90m: Slightly sandy (fine).
									4	V100	2.90					
									5		3.90					
									6		4.90					
19/09/2006	SW 6.00								7		5.90					
20/09/2006				100					8		6.00	-18.30	6.00			6.00 - 6.20m: Black (10YR/2/1), silty, clayey, fine to coarse SAND with occasional cobble size wood fragments.
												-18.50	6.20			
									9		7.00					
												-19.80	7.50			7.50 - 12.00m: Soft to firm.
									10	V100	7.90					
									11		8.90					
									12		9.90	-22.30	10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC11a

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4	E 832755.30 N 817329.40	DATE from: 19/09/2006 to 20/09/2006	
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.30 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Samples Type	Samples Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-22.30	10.00			As sheet 1 of 2.
									13	V100	10.80					
20/09/2006									14		11.90 12.00	-24.30	12.00			At 12.00m: Firm to soft, with some organic debris.
																End of investigation hole at 12.00m.
													20.00			

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Key		
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong
Vibrocore sample	Impression Packer Test	DATE 28/09/2006
Vibrocore sub-sample	Packer Test	
SPT Liner Sample	Piezometer Tip	
Water Sample	Standpipe	

REMARKS

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD	HOLE No.	VC11b
CONTRACT No.: GE/2005/28	SHEET:	1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 832756.70 N 817334.60	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 20/09/2006 to 20/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.70 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-12.70	0.00			
20/09/2006	SW			93					1		0.00					No recovery, assumed to be ANTHROPOGENIC MUD.
												-13.12	0.42			Very soft to soft, grey (10YR/6/1) and black (10YR/2/1), slightly sandy SILT / CLAY with occasional shell fragments. (ANTHROPOGENIC MUD)
									2		0.90					
												-14.07	1.37			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional shell fragments. (MARINE DEPOSIT)
									3		1.90					
									4	VIOO	2.90					
												-16.30	3.60			3.60 - 9.90m: Soft to firm.
									5		3.90					
									6		4.90					
												-18.45	5.75			5.75 - 10.65m: With occasional pockets (<60mm) of stiff, light grey, clayey silt.
	SW 6.00								7		5.90					
				90					8		6.00	-18.70	6.00			6.00 - 6.60m: No recovery, assumed to be MARINE DEPOSIT.
												-19.30	6.60			6.60 - 7.20m: Soft, grey (10YR/6/1), slightly sandy SILT / CLAY with some shell fragments and a subangular cobble of reddish brown coral fragments.
									9		7.00	-19.90	7.20			
									10	VIOO	7.90					
									11		8.90					
									12		9.90	-22.60	9.90			
													10.00			

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Key		Key	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang

DATE 26/09/2006

CHECKED S.C. Wong

DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC11b

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4	E 832756.70 N 817334.60	DATE from: 20/09/2006 to 20/09/2006	
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.70 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR%	SCR%	RQD%	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-22.70	10.00			9.90 - 10.65m: Firm to stiff.
												-23.35	10.65			Firm, grey (10YR/6/1), SILT / CLAY with some wood fragments. (MARINE DEPOSIT / ESTUARINE DEPOSIT)
11									13	V100	10.90					
20/09/2006 12									14		11.90 12.00	-24.70	12.00			End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC12a

CONTRACT No.: GE/2005/28

SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:		WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833148.60	N 817065.20	DATE from: 21/09/2006 to 21/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical		SEABED LEVEL -13.00 mPD

Drilling Progress: 21/09/2006. Casing depth/size: SW; SW 6.00. TCR %: 81 (0.00–4.80 m); 100 (6.00 m onwards).

Samples (No. / Type / Depth): 1 – 0.90; 2 – 1.90; 3 VIOO 2.90; 4 – 3.90; 5 – 4.90; 6 – 5.90; 7 – 6.00; 8 – 7.00; 9 VIOO 7.90; 10 – 8.90; 11 – 9.90

Reduced Level	Depth (m)	Description
-13.00	0.00	No recovery, assumed to be ANTHROPOGENIC MUD.
-14.00	1.00	Grey (10YR/6/1), coarse sand and fine GRAVEL of shells and occasional coral in a matrix of grey, sandy (fine) silt. (ANTHROPOGENIC DEPOSIT? / SUBMERGED RELIC REEF)
-15.40	2.40	Very soft to soft, grey (10YR/6/1), silty CLAY with occasional fine gravel size shell fragments. (MARINE DEPOSIT)
-22.60	9.60	9.60 - 9.80m: With occasional lenses (<3mm) of grey, silty clayey, fine to medium sand.
-22.80	9.80	
	10.00	

Key:
- Small Disturbed Sample
- Piston sample
- U76 Undisturbed Sample
- Vibrocore sample
- Vibrocore sub-sample
- SPT Liner Sample
- Water Sample
- Standard Penetration Test
- In-situ Vane Shear Test
- Permeability Test
- Impression Packer Test
- Packer Test
- Piezometer Tip
- Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC12a

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833148.60 N 817065.20	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4		DATE from: 21/09/2006 to 21/09/2006	
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -13.00 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level (-23.00)	Depth (m) (10.00)	Legend	Grade	Description
												-23.20	10.20			Soft, grey (10YR/6/1), slightly sandy, clayey SILT with occasional coarse sand sized quartz. (MARINE DEPOSIT?) 9.80 - 10.20m: Sandy. 10.20 - 12.00m: With some lenses (<10mm) of grey, silty clayey, fine to coarse sand.
									12	V100	10.90					
21/09/2006									13		11.90 12.00	-25.00	12.00			At 12.00m: Sandy (fine to coarse), some subrounded, fine gravel and some organic debris. End of investigation hole at 12.00m.
													20.00			

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

FUGRO
FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC12b

CONTRACT No.: GE/2005/28

SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833149.30 N 817063.70	DATE from: 21/09/2006 to 21/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -12.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
21/09/2006	SW			94					1		0.00	-12.90	0.00			No recovery, assumed to be ANTHROPOGENIC MUD.
												-13.26	0.36			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), slightly sandy SILT / CLAY with much shell fragments and coral fragments. (DISTURBED MARINE DEPOSIT)
												-13.60	0.70			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with some fine gravel and coarse sand size shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90	-14.80	1.90			At 1.90m: Sandy (fine) with cobble sized oyster shell fragments.
3									4	VIOO	2.90					
												-16.10	3.20			3.20 - 6.55m: Firm.
4									5		3.90					
5									6		4.90					
6	SW 6.00			100					7 8		5.90 6.00					
												-19.45	6.55			Very soft to soft, grey (10YR/6/1), SILT / CLAY with occasional shell fragments. (MARINE DEPOSIT)
7									9		7.00					
8									10	VIOO	7.90					
9									11		8.90					
												-22.40	9.50			9.50 - 10.00m: With occasional pockets (<50mm) of grey, silty clayey, fine to coarse sand.
10									12		9.90	-22.80 -22.90	9.90 10.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 26/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 28/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO
FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC12b

CONTRACT No.: GE/2005/28

SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	E 833149.30	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		N 817063.70	DATE from: 21/09/2006 to 21/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical		SEABED LEVEL -12.90 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level -22.90	Depth (m) 10.00	Legend	Grade	Description
																At 9.90m: Parting of grey, silty fine SAND.
												-23.50	10.60			Grey (10YR/6/1), silty clayey, fine to coarse SAND with much pockets (<50mm) of soft to firm, grey, slightly sandy, silt / clay. (MARINE DEPOSIT)
									13	V100	10.90	-23.80	10.90			Firm, grey (10YR/6/1), slightly sandy SILT / CLAY. (MARINE DEPOSIT)
												-24.00	11.10			10.60 - 11.10m: With some pockets or lenses (<30mm) of grey, silty clayey, fine to coarse sand.
												-24.65	11.75			At 10.90m: Very sandy (fine to coarse)
21/09/2006									14		11.90 12.00	-24.90	12.00			11.75 - 12.00m: With occasional wood fragments.
																End of investigation hole at 12.00m.
													20.00			

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Key		Key	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang
DATE 26/09/2006
CHECKED S.C. Wong
DATE 28/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC13a
	CONTRACT No.: GE/2005/28	SHEET: 1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833569.30 N 817850.00	DATE from: 11/09/2006 to 11/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.00 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
11/09/2006	ZW			88					1		0.00	-11.00	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-11.72	0.72			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand size shell fragments. (MARINE DEPOSIT)
									2		0.90					
									3		1.90					
									4	VIOO	2.90					
									5		3.90					
									6		4.90					
												-16.50	5.50			Grey (10YR/6/1), silty, fine to coarse SAND with occasional lenses of soft, grey, silty clay. (MARINE DEPOSIT?)
									7		5.90					
				99					8		6.00	-17.00	6.00			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY. (MARINE DEPOSIT)
												-17.50	6.50			At 6.50m: With a piece of pottery.
									9		6.70					
										VIOO						
									10		7.70	-18.70	7.70			At 7.70m: Occasional fine gravel sized shell fragments.
												-19.25	8.25			Firm to soft, yellowish brown (10YR/5/6), mottled pale grey, silty CLAY. (ALLUVIUM)
11/09/2006	ZW 8.80								11		8.70 8.80	-19.80	8.80			End of investigation hole at 8.80m.
													10.00			

Key			
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	1. 7.5L of water samples were collected.
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	2. Two 4L grab samples were collected.
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m and 7.70 - 8.70m.
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC13b
CONTRACT No.:	GE/2005/28
SHEET:	1 of 1

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833570.90 N 817850.10	DATE from: 11/09/2006 to 11/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -11.10 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
11/09/2006	ZW			95					1		0.00	-11.10	0.00			
												-11.40	0.30			No recovery, assumed to be ANTHROPOGENIC MUD.
												-11.65	0.55			Very soft to soft, black (10YR/2/1), slightly sandy SILT / CLAY. (ANTHROPOGENIC MUD)
												-11.95	0.85			Very soft to soft, grey (10YR/6/1), sandy SILT / CLAY with occasional shell fragments. (MARINE DEPOSIT / ANTHROPOGENIC MUD)
									2		0.90					Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional coarse sand sized shell fragments. (MARINE DEPOSIT)
									3		1.90					
									4	VC100	2.90					
									5		3.90					
												-15.30	4.20			4.20 - 5.90m: Soft to firm.
									6		4.90					
									7		5.90	-17.00	5.90			Grey (10YR/6/1), silty, fine to coarse SAND with occasional subangular, fine gravel. (MARINE DEPOSIT)
				95					8		6.00	-17.20	6.10			Soft, grey (10YR/6/1), silty CLAY. (MARINE DEPOSIT)
									9	VC100	6.70					
												-18.20	7.10			Yellowish brown (10YR/5/6), silty clayey, fine to coarse SAND. (ALLUVIUM)
												-18.30	7.20			Very stiff, yellowish brown (10YR/5/6), mottled pale grey, silty CLAY. (ALLUVIUM)
11/09/2006	ZW 7.80								10		7.70 7.80	-18.90	7.80			End of investigation hole at 7.80m.
													10.00			

Legend		Legend	
Small Disturbed Sample		Standard Penetration Test	
Piston sample		In-situ Vane Shear Test	
U76 Undisturbed Sample		Permeability Test	
Vibrocore sample		Impression Packer Test	
Vibrocore sub-sample		Packer Test	
SPT Liner Sample		Piezometer Tip	
Water Sample		Standpipe	

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC14a
	CONTRACT No.: GE/2005/28	SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833935.40 N 818214.70	DATE from: 06/09/2006 to 06/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -7.20 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
06/09/2006	ZW			92					1		0.00	-7.20	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-7.68	0.48			Dark grey (2.5Y/4/1), silty, fine SAND with some coarse sand size shell fragments. (MARINE DEPOSIT)
									2		0.90					
									3		1.90					
												-9.60	2.40			Very soft to soft, greenish grey (10GY/5/1) to dark grey (2.5Y/4/1), silty CLAY with occasional coarse sand and fine gravel sized shells and shell fragments. (MARINE DEPOSIT)
									4	V100	2.90					
									5		3.90					
									6		4.90					
									7		5.90	-13.10	5.90			At 5.90m: Soft to firm.
				95					8		6.00	-13.20	6.00			6.00 - 6.30m: No recovery, assumed to be MARINE DEPOSIT.
												-13.50	6.30			
									9		7.00					
									10	V100	7.90					
									11		8.90	-16.10	8.90			8.90 - 12.00m: Soft to firm.
	ZW 10.00								12		9.90	-17.20	10.00			

Legend		Logged / Checked	REMARKS
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	1. 7.5L of water samples were collected.
Piston sample	In-situ Vane Shear Test	DATE 07/09/2006	2. Two 4L grab samples were collected.
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.
Vibrocore sample	Impression Packer Test	DATE 11/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC14a
CONTRACT No.:	GE/2005/28
SHEET:	2 of 2
PROJECT:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation
METHOD:	Vibrocoring
MACHINE & No.:	LAM - 4
FLUSHING MEDIUM:	Water
CO-ORDINATES:	E 833935.40 N 818214.70
ORIENTATION:	Vertical
WORKS ORDER No.	GE/2005/28.7
DATE from:	06/09/2006 to 06/09/2006
SEABED LEVEL	-7.20 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-17.20	10.00			As sheet 1 of 2.
									13	VIOO	10.90					
06/09/2006									14		11.90 12.00	-19.20	12.00			At 12.00m: Soft to firm with occasional organic debris. End of investigation hole at 12.00m.
													20.00			

Legend			
Small Disturbed Sample	Standard Penetration Test	LOGGED	W.S. Tsang
Piston sample	In-situ Vane Shear Test	DATE	07/09/2006
U76 Undisturbed Sample	Permeability Test	CHECKED	S.C. Wong
Vibrocore sample	Impression Packer Test	DATE	11/09/2006
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

REMARKS

FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No. VC14b

CONTRACT No.: GE/2005/28

SHEET: 1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833933.70 N 818216.30	WORKS ORDER No. GE/2005/28.7	
MACHINE & No.: LAM - 4		DATE from: 06/09/2006	to 06/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -7.10 mPD	

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level (-7.10)	Depth (m) (0.00)	Legend	Grade	Description
06/09/2006	ZW			69					1		0.00					No recovery, assumed to be ANTHROPOGENIC MUD.
												-7.76	0.66			Very soft to soft, dark grey (10YR/4/1), slightly sandy SILT / CLAY with organic ordour. (ANTHROPOGENIC MUD)
												-7.90	0.80			
									2		0.90	-8.05	0.95			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional fine gravel sized shells and shell fragments. (DISTURBED MARINE DEPOSIT) 0.80 - 0.95m: With occasional lenses (<3mm) of grey, silty, fine sand. 1.60 - 1.90m: With occasional pockets (<30mm) of very soft, dark grey and black, slightly sandy silt / clay with much shell fragments.
												-8.70	1.60			
									3		1.90	-9.00	1.90			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), SILT / CLAY with occasional shell fragments. (MARINE DEPOSIT) At 1.90m: Slightly sandy (fine).
									4	VIOO	2.90					
									5		3.90					
									6		4.90					
									7		5.90	-13.10	6.00			
				92					8		6.00					6.00 - 6.48m: No recovery, assumed to be MARINE DEPOSIT.
												-13.58	6.48			
									9		7.00					
	ZW 7.80								10	VIOO	7.90					
									11		8.90					
10									12		9.90	-17.10	10.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 07/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 11/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC14b
	CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833933.70 N 818216.30	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 06/09/2006 to 06/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -7.10 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-17.10	10.00			As sheet 1 of 2.
11									13	VIOO	10.90					11.05 - 12.00m: With some organic debris including highly decomposed rootlets and timber fragments.
06/09/2006 12									14		11.90 12.00	-19.10	12.00			
																End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20													20.00			

Key	Key		
Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 07/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 11/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

FUGRO
FUGRO GEOTECHNICAL SERVICES LTD

VIBROCORE RECORD

HOLE No.	VC15a	
CONTRACT No.: GE/2005/28	SHEET: 1 of 2	

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES:	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4	E 833642.30 N 817911.70	DATE from: 09/09/2006 to 09/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.30 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
09/09/2006	ZW			88					1		0.00	-9.30	0.00			No recovery, assumed to be MARINE DEPOSIT.
												-10.02	0.72			Very soft to soft, greenish grey (10GY/5/1) to grey (10YR/6/1), silty CLAY with occasional fine sand and fine gravel sized shell fragments. (MARINE DEPOSIT)
1									2		0.90					
2									3		1.90	-11.20	1.90			1.90 - 4.90m: Slightly sandy (fine).
3									4	VIOO	2.90					
4									5		3.90					
5									6		4.90	-14.20	4.90			
6									7		5.90	-15.30	6.00			6.00 - 6.42m: No recovery, assumed to be MARINE DEPOSIT.
				93					8		6.00	-15.72	6.42			
7									9		7.00					
8									10	VIOO	7.90					
9									11		8.90	-18.65	9.35			9.35 - 12.00m: Soft to firm.
10									12		9.90	-19.30	10.00			

Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS
1. 7.5L of water samples were collected.
2. Two 4L grab samples were collected.
3. Vibrocore sub-samples were taken for toxicity testing from 0.00 - 0.90m, 0.90 - 1.90m, 1.90 - 2.90m, 4.90 - 5.90m, 7.90 - 8.90m and 10.90 - 11.90m.

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC15a		
CONTRACT No.: GE/2005/28	SHEET: 2 of 2		

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833642.30 N 817911.70	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 09/09/2006 to 09/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.30 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level	Depth (m)	Legend	Grade	Description
												-19.30	10.00			As sheet 1 of 2.
									13	VIOO	10.90					
	ZW 11.80										11.90					
09/09/2006									14		12.00	-21.30	12.00			End of investigation hole at 12.00m.
													20.00			

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Small Disturbed Sample	Standard Penetration Test
Piston sample	In-situ Vane Shear Test
U76 Undisturbed Sample	Permeability Test
Vibrocore sample	Impression Packer Test
Vibrocore sub-sample	Packer Test
SPT Liner Sample	Piezometer Tip
Water Sample	Standpipe

LOGGED W.S. Tsang

DATE 15/09/2006

CHECKED S.C. Wong

DATE 20/09/2006

REMARKS

VIBROCORE RECORD

FUGRO GEOTECHNICAL SERVICES LTD

HOLE No.	VC15b
CONTRACT No.:	GE/2005/28
SHEET:	1 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833641.50 N 817913.00	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 09/09/2006 to 09/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.40 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/end	Water Return %	TCR %	SCR %	RQD %	FI	Tests	Samples No.	Type	Depth	Reduced Level (-9.40)	Depth (m) (0.00)	Legend	Grade	Description
09/09/2006	ZW			93					1		0.00	-9.82	0.42			No recovery, assumed to be ANTHROPOGENIC MUD.
									2		0.90	-10.30	0.90			Very soft to soft, dark grey (10YR/4/1), slightly sandy SILT / CLAY with occasional shell fragments and organic ordour. (ANTHROPOGENIC MUD)
												-10.50	1.10			At 0.90m: Slightly sandy (fine) with occasional coarse gravel sized clam shell.
									3		1.90	-11.30	1.90			Very soft to soft, grey (10YR/6/1), silty CLAY with occasional fine sand and fine gravel sized shell fragments. (MARINE DEPOSIT) At 1.90m: Slightly sandy (fine).
									4	V100	2.90					
									5		3.90					
									6		4.90					
									7		5.90	-15.40	6.00			
				96					8		6.00	-15.64	6.24			6.00 - 6.24m: No recovery, assumed to be MARINE DEPOSIT.
									9		6.90					
									10	V100	7.90					
									11		8.90					
									12		9.90	-19.40	10.00			

Small Disturbed Sample
Piston sample
U76 Undisturbed Sample
Vibrocore sample
Vibrocore sub-sample
SPT Liner Sample
Water Sample
Standard Penetration Test
In-situ Vane Shear Test
Permeability Test
Impression Packer Test
Packer Test
Piezometer Tip
Standpipe

LOGGED W.S. Tsang
DATE 15/09/2006
CHECKED S.C. Wong
DATE 20/09/2006

REMARKS

FGS Job No.: 05 0460 05 007

FUGRO GEOTECHNICAL SERVICES LTD	VIBROCORE RECORD	HOLE No. VC15b
	CONTRACT No.: GE/2005/28	SHEET: 2 of 2

PROJECT: Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun - Investigation

METHOD: Vibrocoring	CO-ORDINATES: E 833641.50 N 817913.00	WORKS ORDER No. GE/2005/28.7
MACHINE & No.: LAM - 4		DATE from: 09/09/2006 to 09/09/2006
FLUSHING MEDIUM: Water	ORIENTATION: Vertical	SEABED LEVEL -9.40 mPD

Drilling Progress	Casing depth/size	Water Level (m) Shift start/ end	Water Return %	T C R %	S C R %	R Q D %	F I	Tests	Samples No.	Type	Depth	Reduced Level -19.40	Depth (m) 10.00	Legend	Grade	Description
																As sheet 1 of 2.
11									13	V100	10.90	-20.30	10.90			10.90 - 12.00m: Soft to firm, with occasional wood fragments.
	ZW 11.60															
09/09/2006 12									14		11.90 12.00	-21.40	12.00			End of investigation hole at 12.00m.
13																
14																
15																
16																
17																
18																
19																
20														20.00			

Small Disturbed Sample	Standard Penetration Test	LOGGED W.S. Tsang	REMARKS
Piston sample	In-situ Vane Shear Test	DATE 15/09/2006	
U76 Undisturbed Sample	Permeability Test	CHECKED S.C. Wong	
Vibrocore sample	Impression Packer Test	DATE 20/09/2006	
Vibrocore sub-sample	Packer Test		
SPT Liner Sample	Piezometer Tip		
Water Sample	Standpipe		

Appendix F2

Laboratory Test Report on Chemical Screening

Sediment

Metals

TEST REPORT

Report No.	: 100976N
Project Name	: Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	: Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Address	: 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No.	: J469
Lab Sample No.	: 17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053, 18060,18073,18087,18089,18096,18107,18019
Sample Description	: 85 samples said to be sediment
Sample Receipt Date	: 6 September 2006 - 26 September 2006
Test Period	: 7 September 2006 - 9 October 2006

Test Information

Code	Test Parameter	Reporting Limits Sediment/Soil mg/kg	Test Procedure
Cd	Cadmium	0.20	S/M/DIG-RAR & M/ICP-MS
Cr	Chromium	8.0	S/M/DIG-RAR & M/ICP-MS
Cu	Copper	7.0	S/M/DIG-RAR & M/ICP-MS
Ni	Nickel	4.0	S/M/DIG-RAR & M/ICP-MS
Pb	Lead	8.0	S/M/DIG-RAR & M/ICP-MS
Zn	Zinc	20	S/M/DIG-RAR & M/ICP-MS
Hg	Mercury	0.05	S/M/DIG-RAR & M/ICP-MS
As	Arsenic	1.0	S/M/DIG-RAR & M/ICP-MS
Ag	Silver	0.10	S/M/DIG-RAR & M/ICP-MS

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. Results related to samples as received.
3. Results are based on dry sample weight.
4. < = less than
5. N/A = Not applicable
6. Test results satisfy all in-house QA/QC protocols as attached.
7. Test description (for in-house methods) as follows:
   S/M/DIG-RAR: Acid digestion.
   M/ICP-MS: ICP-MS Quantification.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

Lam Laboratories Limited Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

TEST REPORT

Report No. : 100976N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053,
18060,18073,18087,18089,18096,18107,18019

Test Result

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth, m	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Ag mg/kg
VC14a	NA	0.00	0.90		NA	0.28	33	80	16	28	81	0.25	5.4	1.4
VC14a	NA	0.90	1.90		NA	<0.20	23	16	15	18	50	0.10	4.5	0.10
VC14a	NA	1.90	2.90		NA	<0.20	33	10	22	46	63	0.11	5.5	<0.10
VC14a	NA	4.90	5.90		NA	<0.20	32	9.3	21	30	59	0.09	4.6	<0.10
VC14a	NA	7.90	8.90		NA	<0.20	31	10	21	27	58	0.08	4.0	<0.10
VC14a	NA	10.90	11.90		NA	<0.20	36	13	21	44	63	0.28	8.9	<0.10
VC5-a	NA	0.00	0.90		NA	0.38	45	140	22	38	110	0.30	7.3	1.4
VC5-a	NA	0.90	1.90		NA	<0.20	25	8.3	18	46	54	0.09	4.4	<0.10
VC5-a	NA	1.90	2.90		NA	<0.20	33	9.4	23	24	63	0.08	5.2	0.16
VC5-a	NA	4.90	5.90		NA	<0.20	29	9.4	20	28	57	0.06	5.1	<0.10
VC15a	NA	0.00	0.90		NA	<0.20	26	36	16	21	62	0.11	4.6	0.40
VC15a	NA	0.90	1.90		NA	<0.20	28	7.5	22	17	59	0.06	3.8	<0.10
VC15a	NA	1.90	2.90		NA	<0.20	27	7.7	20	19	59	0.06	4.7	<0.10
VC15a	NA	4.90	5.90		NA	<0.20	30	10	20	28	55	0.10	5.2	<0.10
VC15a	NA	7.90	8.90		NA	<0.20	30	10	20	32	57	0.06	6.2	0.10
VC15a	NA	10.90	11.90		NA	<0.20	29	11	15	27	50	0.07	15	<0.10
VC5a	NA	7.90	8.90		NA	<0.20	21	7.6	15	22	49	0.08	3.7	<0.10
VC5a	NA	10.90	11.90		NA	<0.20	23	8.3	17	31	52	0.28	6.1	<0.10
VC13a	NA	0.00	0.90		NA	0.25	21	55	9.2	55	98	0.25	4.8	1.7
VC13a	NA	0.90	1.90		NA	0.84	60	270	22	110	190	0.89	6.6	2.4

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
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TEST REPORT

Report No. : 100976N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053,
18060,18073,18087,18089,18096,18107,18019

Test Result

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth, m	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Ag mg/kg
VC13a	NA	1.90	2.90		NA	<0.20	21	7.2	21	21	50	0.09	4.8	<0.10
VC13a	NA	4.90	5.90		NA	2.8	29	12	23	34	70	0.15	6.6	<0.10
VC13a	NA	7.70	8.70		NA	<0.20	20	7.1	12	20	38	0.05	4.7	<0.10
VC4a	NA	0.00	0.90		NA	0.36	26	77	13	130	190	0.28	5.5	2.1
VC4a	NA	0.90	1.90		NA	<0.20	22	9.4	18	22	54	0.08	5.6	<0.10
VC4a	NA	1.90	2.90		NA	<0.20	18	<7.0	15	20	44	<0.05	3.4	<0.10
VC4a	NA	4.90	5.90		NA	<0.20	33	13	26	35	75	0.07	6.8	<0.10
VC4a	NA	7.90	8.90		NA	<0.20	21	9.5	15	26	50	0.14	7.2	<0.10
VC4a	NA	10.90	11.90		NA	<0.20	<8.0	<7.0	<4.0	62	<20	0.62	5.0	<0.10
VC6a	NA	0.00	0.90		NA	0.45	23	360	13	69	250	0.63	6.3	1.70
VC6a	NA	0.90	1.90		NA	<0.20	23	10	19	25	64	0.23	2.7	<0.10
VC6a	NA	1.90	2.90		NA	<0.20	26	9.6	21	30	56	0.11	5.4	<0.10
VC6a	NA	4.90	5.90		NA	<0.20	27	12	23	28	56	0.10	6.4	<0.10
VC6a	NA	7.90	8.90		NA	<0.20	29	17	22	40	68	0.15	7.6	0.11
VC3a	NA	0.00	0.90		NA	<0.20	17	<7.0	14	17	45	0.07	4.2	<0.10
VC3a	NA	0.90	1.90		NA	<0.20	29	10	23	37	78	0.13	6.2	<0.10
VC3a	NA	1.90	2.90		NA	<0.20	29	12	25	33	68	0.09	10	0.11
VC7a	NA	0.00	0.90		NA	<0.20	16	11	13	38	46	0.17	4.2	0.15
VC7a	NA	0.90	1.90		NA	<0.20	20	<7.0	17	17	42	0.08	3.0	<0.10
VC7a	NA	1.90	2.90		NA	<0.20	20	<7.0	18	17	49	0.09	3.9	<0.10

TEST REPORT

Report No.	:	100976N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053, 18060,18073,18087,18089,18096,18107,18019

Test Result

Customer Ref.	Sample					Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag
Drillhole No.		Depth, m		Type	Specimen									
	No.	From	To		Depth, m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
VC7a	NA	4.90	5.90		NA	<0.20	31	14	23	40	70	0.09	9.1	<0.10
VC7a	NA	7.90	8.90		NA	<0.20	12	<7.0	<4.0	10	<20	<0.05	2.3	<0.10
VC2a	NA	0.00	0.90		NA	<0.20	19	8.5	17	20	47	0.16	2.5	<0.10
VC2a	NA	0.90	1.90		NA	<0.20	16	<7.0	12	18	39	0.06	3.7	<0.10
VC2a	NA	1.90	2.90		NA	<0.20	22	7.4	18	20	50	0.07	3.9	<0.10
VC2a	NA	4.90	5.90		NA	<0.20	33	13	26	34	68	0.09	7.8	<0.10
VC2a	NA	7.90	8.90		NA	<0.20	28	11	17	30	51	0.08	11	<0.10
VC2a	NA	10.90	11.30		NA	<0.20	18	7.7	<4.0	48	37	0.05	7.4	<0.10
Ref. Sediment	NA	NA	NA		NA	<0.20	24	12	17	32	64	0.07	5.2	0.11
VC11a	NA	0.00	0.90		NA	0.39	24	61	11	46	120	0.58	7.6	2.4
VC11a	NA	0.90	1.90		NA	0.29	36	50	18	78	130	0.62	7.2	1.1
VC11a	NA	1.90	2.90		NA	<0.20	23	7.1	19	18	53	0.06	5.6	<0.10
VC11a	NA	4.90	5.90		NA	<0.20	29	11	20	31	60	0.14	8.9	0.45
VC11a	NA	7.90	8.90		NA	<0.20	28	13	20	31	68	0.09	11	<0.10
VC11a	NA	10.90	11.90		NA	<0.20	18	8.5	10	24	37	0.06	12	<0.10
VC12a	NA	0.00	0.90		NA	<0.20	15	58	7.3	28	65	0.28	7.3	1.3
VC12a	NA	0.90	1.90		NA	<0.20	32	14	23	38	69	0.19	10	0.14
VC12a	NA	1.90	2.90		NA	<0.20	20	7.2	15	23	43	0.12	4.3	<0.10
VC12a	NA	4.90	5.90		NA	<0.20	29	12	18	35	61	0.24	9.6	<0.10
VC12a	NA	7.90	8.90		NA	<0.20	28	12	18	38	60	0.12	9.4	<0.10

TEST REPORT

Report No.	:	100976N
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Test Result

Customer Ref.	Sample					Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth, m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
VC12a	NA	10.90	11.90		NA	<0.20	9.5	<7.0	6.1	16	22	0.07	4.9	<0.10
VC8a	NA	0.00	0.90		NA	0.69	55	190	22	84	180	0.92	7.6	3.1
VC8a	NA	0.90	1.90		NA	<0.20	24	9.0	19	33	62	0.26	3.8	<0.10
VC8a	NA	1.90	2.90		NA	<0.20	22	<7.0	17	19	52	0.07	4.4	<0.10
VC8a	NA	4.90	5.90		NA	<0.20	26	12	20	32	60	0.10	8.5	<0.10
VC8a	NA	7.90	8.90		NA	<0.20	26	12	19	38	60	0.11	9.4	<0.10
VC8a	NA	10.90	11.90		NA	<0.20	24	12	17	38	58	0.09	13	<0.10
VC10a	NA	0.00	0.90		NA	0.69	52	170	21	78	190	0.99	7.3	2.9
VC10a	NA	0.90	1.90		NA	<0.20	23	7.6	17	20	50	0.10	5.0	<0.10
VC10a	NA	1.90	2.90		NA	<0.20	22	<7.0	16	20	46	0.07	4.9	<0.10
VC10a	NA	4.90	5.90		NA	<0.20	27	9.8	20	35	58	0.10	7.2	<0.10
VC10a	NA	7.90	8.90		NA	<0.20	27	10	20	28	59	0.10	7.4	<0.10
VC10a	NA	10.90	11.90		NA	<0.20	27	12	18	32	58	0.08	9.7	<0.10
VC1a	NA	0.00	0.90		NA	<0.20	21	9.8	18	39	61	1.2	4.5	0.10
VC1a	NA	0.90	1.90		NA	<0.20	24	<7.0	19	18	52	0.06	3.3	<0.10
VC1a	NA	1.90	2.90		NA	<0.20	26	7.9	20	24	62	0.08	4.7	<0.10
VC1a	NA	4.90	5.90		NA	<0.20	27	10	19	30	59	0.09	7.1	<0.10
VC1a	NA	7.90	8.90		NA	<0.20	21	7.5	16	26	48	0.07	5.3	<0.10
VC1a	NA	10.90	11.90		NA	<0.20	27	12	20	37	63	0.08	10	<0.10
VC9a	NA	0.00	0.90		NA	0.40	26	65	15	100	120	1.1	8.2	1.8

TEST REPORT

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Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053, 18060,18073,18087,18089,18096,18107,18019

Test Result

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth, m	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Ag mg/kg
VC9a	NA	0.90	1.90		NA	<0.20	22	<7.0	19	20	57	0.12	3.7	<0.10
VC9a	NA	1.90	2.90		NA	<0.20	25	7.4	19	22	61	0.06	4.2	<0.10
VC9a	NA	4.90	5.90		NA	<0.20	28	12	20	30	60	0.08	8.0	<0.10
VC9a	NA	7.90	8.90		NA	<0.20	22	7.8	17	26	48	0.09	5.2	<0.10
VC9a	NA	10.90	11.90		NA	<0.20	23	11	17	30	56	0.07	9.4	<0.10

-----End of Report----

QUALITY CONTROL REPORT

Report No.	:	100976N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053, 18060,18073,18087,18089,18096,18107,18019

Test Results

1.1 Sample Duplicate (Relative deviation)

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	Cd %	Cr %	Cu %	Ni %	Pb %	Zn %	Hg %	As %	Ag %
VC14a	NA	10.90	11.90		NA	1	*na	2.8	0.0	4.3	25	1.0	9.3	3.9	*na
VC13a	NA	0.00	0.90		NA	2	20	1.3	15	6.3	21	25	3	4.8	25
VC2a	NA	0.90	1.90		NA	3	*na	18	*na	17	2.2	18	12	14	*na
Ref. Sediment	NA	NA	NA		NA	4	*na	1.9	2.5	1.7	2	4.3	15	2.6	1.1
VC10a	NA	0.00	0.90		NA	5	0.6	19	7.2	5.2	14	6.7	9.8	7.1	13
Control Limits							+/- 30 % of the mean								

1.2 Method Spike (Standard Addition)

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	Cd %	Cr %	Cu %	Ni %	Pb %	Zn %	Hg %	As %	Ag %
VC14a	NA	10.90	11.90		NA	1	98	99	89	93	108	95	99	89	97
VC13a	NA	0.00	0.90		NA	2	99	89	113	94	114	98	110	91	84
VC2a	NA	0.90	1.90		NA	3	101	101	98	110	108	107	107	91	90
Ref. Sediment	NA	NA	NA		NA	4	101	105	99	101	97	106	103	105	102
VC10a	NA	0.00	0.90		NA	5	105	90	83	95	98	99	108	110	113
Control Limits							75 - 125 %								

Note: 1. *na = Relative deviation(RD) for duplicates cannot be evaluated as the value determined is lower than reporting limits.
2. Results are based on dry sample weight
3. < = less than

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

QUALITY CONTROL REPORT

Report No. : 100976N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,18041,18053, 18060,18073,18087,18089,18096,18107,18019

Test Results

1.3 Sample Reference Material (ISE 2005.3.1)

Reference	Sample					Batch	Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag
	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
ISE 2005.3.1	N/A	N/A	N/A		N/A	1	98	109	90	100	85	86	95	83	92
ISE 2005.3.1	N/A	N/A	N/A		N/A	2	104	94	82	81	103	83	120	85	93
ISE 2005.3.1	N/A	N/A	N/A		N/A	3	101	77	76	86	101	76	100	89	121
ISE 2005.3.1	N/A	N/A	N/A		N/A	4	102	98	80	88	93	77	106	85	101
ISE 2005.3.1	N/A	N/A	N/A		N/A	5	105	98	88	93	106	84	119	94	103
Control Limits							75 - 125% of nominal value								

1.4 Method Blank

Reference	Sample					Batch	Cd	Cr	Cu	Ni	Pb	Zn	Hg	As	Ag
	Depth, m			Type	Specimen										
	No.	From	To		Depth m		mg/kg								
N/A	N/A	N/A	N/A		N/A	1	<0.20	<8.0	<7.0	<4.0	<8.0	<20	<0.05	<1.0	<0.10
N/A	N/A	N/A	N/A		N/A	2	<0.20	<8.0	<7.0	<4.0	<8.0	<20	<0.05	<1.0	<0.10
N/A	N/A	N/A	N/A		N/A	3	<0.20	<8.0	<7.0	<4.0	<8.0	<20	<0.05	<1.0	<0.10
N/A	N/A	N/A	N/A		N/A	4	<0.20	<8.0	<7.0	<4.0	<8.0	<20	<0.05	<1.0	<0.10
N/A	N/A	N/A	N/A		N/A	5	<0.20	<8.0	<7.0	<4.0	<8.0	<20	<0.05	<1.0	<0.10
Control Limits							Less than reporting limit								

Note: 1. Results are based on dry sample weight
2. < = less than

PAHs

TEST REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Address : 8/F Civil Engineering and Development Building, 101 Princess Margaret Road,
Kowloon, Hong Kong

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019
Sample Description : 85 samples said to be sediment
Sample Receipt Date : 06 September 2006 - 26 September 2006
Test Period : 07 September 2006 - 09 October 2006

Test Information

1. **Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs**

CODE	Test Parameter	Reporting Limit ug/kg	Test Procedure
NAP	Naphthalene	55	S/O/PAH
ANY	Acenaphthylene	55	S/O/PAH
ANA	Acenaphthene	55	S/O/PAH
FLU	Fluorene	55	S/O/PAH
PHE	Phenanthrene	55	S/O/PAH
ANT	Anthracene	55	S/O/PAH
LMW PAH	Total LMW PAH	55	S/O/PAH

2. **High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs**

CODE	Test Parameter	Reporting Limit ug/kg	Test Procedure
CHR	Chrysene	170	S/O/PAH
BaA	Benzo(a)anthracene	170	S/O/PAH
BbF	Benzo(b)fluoranthene	170	S/O/PAH
BkF	Benzo(k)fluoranthene	170	S/O/PAH
BaP	Benzo(a)pyrene	170	S/O/PAH
DBA	Dibenz(ah)anthracene	170	S/O/PAH
FLT	Fluoranthene	170	S/O/PAH
IPY	Indeno(1,2,3-cd)pyrene	170	S/O/PAH
PYR	Pyrene	170	S/O/PAH
BPE	Benzo(ghi)perylene	170	S/O/PAH
HMW PAH	Total HMW PAH	170	S/O/PAH

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. Results relate to samples as received.
3. Results are based on dry sample weight.
4. < = less than
5. N/A = Not applicable
6. Test results satisfy all in-house QA/QC protocols as attached.
7. Test description (for in-house methods only) as follows:
S/O/PAH:Ultra-Sonic extraction and GC-MS Quantification.
8. Total LMW PAH Equals to the summary of NAP,ANY,ANA,FLU,PHE,ANT.
9. Total HMW PAH Equals to the summary of CHR,BaA,BbF,BkF,BaP,DBA,FLT,IPY,PYR,BPE.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

TEST REPORT

Report No. : 100973N
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Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. **Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs**

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	NAP ug/kg	ANY ug/kg	ANA ug/kg	FLU ug/kg	PHE ug/kg	ANT ug/kg	LMW PAH ug/kg
VC14a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC14a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC14a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC14a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC14a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC14a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5-a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5-a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5-a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5-a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC15a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC5a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC13a	NA	0.00	0.90		NA	<55	<55	<55	<55	95	<55	140
VC13a	NA	0.90	1.90		NA	<55	<55	<55	<55	110	69	180

TEST REPORT

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Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref.	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE	HMW
Drillhole No.	Depth, m			Type	Specimen											PAH
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC14a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC14a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC14a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC14a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC14a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC14a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5-a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5-a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5-a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5-a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC15a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC5a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC13a	NA	0.00	0.90		NA	250	320	280	340	340	<170	390	<170	640	<170	2600
VC13a	NA	0.90	1.90		NA	<170	190	210	<170	210	<170	<170	<170	370	<170	1300

TEST REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Customer Ref.	Sample					NAP	ANY	ANA	FLU	PHE	ANT	LMW PAH
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC13a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC13a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC13a	NA	7.70	8.70		NA	<55	<55	<55	<55	<55	<55	<55
VC4a	NA	0.00	0.90		NA	<55	<55	<55	<55	65	<55	99
VC4a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC4a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC4a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC4a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC4a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC6a	NA	0.00	0.90		NA	330	<55	<55	<55	250	<55	690
VC6a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC6a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC6a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC6a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC3a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC3a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC3a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC7a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC7a	NA	0.90	1.90		NA	<55	150	<55	<55	430	200	780
VC7a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55

TEST REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	CHR ug/kg	BaA ug/kg	BbF ug/kg	BkF ug/kg	BaP ug/kg	DBA ug/kg	FLT ug/kg	IPY ug/kg	PYR ug/kg	BPE ug/kg	HMW PAH ug/kg
VC13a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC13a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC13a	NA	7.70	8.70		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC4a	NA	0.00	0.90		NA	<170	<170	210	<170	190	<170	<170	<170	200	<170	1000
VC4a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC4a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC4a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC4a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC4a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC6a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC6a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC6a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC6a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC6a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC3a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC3a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC3a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC7a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC7a	NA	0.90	1.90		NA	770	1200	1700	480	1200	<170	1300	340	1600	670	9200
VC7a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170

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TEST REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	NAP ug/kg	ANY ug/kg	ANA ug/kg	FLU ug/kg	PHE ug/kg	ANT ug/kg	LMW PAH ug/kg
VC7a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC7a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC2a	NA	10.90	11.30		NA	<55	<55	<55	<55	<55	<55	<55
Ref. Sediment	NA	NA	NA		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC11a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC12a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC12a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC12a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC12a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC12a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55

TEST REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref.	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE	HMW PAH
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC7a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC7a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC2a	NA	10.90	11.30		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
Ref. Sediment	NA	NA	NA		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC11a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC12a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC12a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC12a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC12a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC12a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170

TEST REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
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Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	NAP ug/kg	ANY ug/kg	ANA ug/kg	FLU ug/kg	PHE ug/kg	ANT ug/kg	LMW PAH ug/kg
VC12a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC8a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC10a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC1a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55
VC9a	NA	0.00	0.90		NA	<55	<55	<55	<55	<55	<55	130

TEST REPORT

Report No. : 100973N
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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref.	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE	HMW PAH
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC12a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC8a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC10a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	420
VC10a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC10a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC10a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC10a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC10a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC1a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC9a	NA	0.00	0.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	1100

TEST REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Customer Ref.	Sample					NAP	ANY	ANA	FLU	PHE	ANT	LMW PAH
Drillhole No.	Depth, m			Type	Specimen Depth m							
	No.	From	To			ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC9a	NA	0.90	1.90		NA	<55	<55	<55	<55	<55	<55	<55
VC9a	NA	1.90	2.90		NA	<55	<55	<55	<55	<55	<55	<55
VC9a	NA	4.90	5.90		NA	<55	<55	<55	<55	<55	<55	<55
VC9a	NA	7.90	8.90		NA	<55	<55	<55	<55	<55	<55	<55
VC9a	NA	10.90	11.90		NA	<55	<55	<55	<55	<55	<55	<55

TEST REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	CHR ug/kg	BaA ug/kg	BbF ug/kg	BkF ug/kg	BaP ug/kg	DBA ug/kg	FLT ug/kg	IPY ug/kg	PYR ug/kg	BPE ug/kg	HMW PAH ug/kg
VC9a	NA	0.90	1.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC9a	NA	1.90	2.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC9a	NA	4.90	5.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC9a	NA	7.90	8.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
VC9a	NA	10.90	11.90		NA	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170

-----------End of Report-----------

QUALITY CONTROL REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.1 Sample Duplicate

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	na*	na*	na*	na*	na*	na*
VC13a	N/A	0.00	0.90		N/A	2	na*	na*	na*	na*	3.6	na*
Ref. Sediment	N/A	N/A	N/A		N/A	3	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean					

1.2 Sample Spike (Spike Level = 5 ug)

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	102	109	107	98	99	103
VC13a	N/A	0.00	0.90		N/A	2	105	107	105	90	113	114
Ref. Sediment	N/A	N/A	N/A		N/A	3	109	108	111	98	110	95
Control Limits							70 - 130 %					

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: : 27 Dec. 2006

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

QUALITY CONTROL REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.1 Sample Duplicate

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
VC14a	N/A	0.00	0.90		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
VC13a	N/A	0.00	0.90		N/A	2	7.1	15	9.0	8.6	3.7	na*	8.0	na*	8.1	na*
Ref. Sediment	N/A	N/A	N/A		N/A	3	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean									

2.2 Sample Spike (Spike Level = 5 ug)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
VC14a	N/A	0.00	0.90		N/A	1	90	102	113	99	98	85	99	87	106	83
VC13a	N/A	0.00	0.90		N/A	2	90	83	87	89	94	87	76	90	93	92
Ref. Sediment	N/A	N/A	N/A		N/A	3	96	107	81	94	95	87	81	91	93	86
Control Limits							70 - 130 %									

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.3 QC Sample (SETOC 2002.3.3)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	NAP %	ANY %	ANA %	FLU %	PHE %	ANT %
SETOC 2002.3.3	N/A	N/A	N/A		N/A	1	92	95	108	75	99	94
SETOC 2002.3.3	N/A	N/A	N/A		N/A	2	96	100	96	92	93	102
SETOC 2002.3.3	N/A	N/A	N/A		N/A	3	92	95	108	100	85	104
Control Limits							70 - 130 % of nominal value					

1.4 Method Blank

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	NAP ug/kg	ANY ug/kg	ANA ug/kg	FLU ug/kg	PHE ug/kg	ANT ug/kg
N/A	N/A	N/A	N/A		N/A	1	<55	<55	<55	<55	<55	<55
N/A	N/A	N/A	N/A		N/A	2	<55	<55	<55	<55	<55	<55
N/A	N/A	N/A	N/A		N/A	3	<55	<55	<55	<55	<55	<55
Control Limits							Less than reporting limit					

QUALITY CONTROL REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.3 QC Sample (SETOC 2002.3.3)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
SETOC 2002.3.3	N/A	N/A	N/A		N/A	1	91	93	93	87	98	92	97	83	101	89
SETOC 2002.3.3	N/A	N/A	N/A		N/A	2	90	87	84	102	84	98	106	91	115	90
SETOC 2002.3.3	N/A	N/A	N/A		N/A	3	89	100	81	99	93	98	100	82	118	97
Control Limits							70 - 130% of nominal value									

2.4 Method Blank

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR ug/kg	BaA ug/kg	BbF ug/kg	BkF ug/kg	BaP ug/kg	DBA ug/kg	FLT ug/kg	IPY ug/kg	PYR ug/kg	BPE ug/kg
N/A	N/A	N/A	N/A		N/A	1	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
N/A	N/A	N/A	N/A		N/A	2	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
N/A	N/A	N/A	N/A		N/A	3	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
Control Limits							Less than reporting limit									

QUALITY CONTROL REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.5 Sample Duplicate

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	NAP %	ANY %	ANA %	FLU %	PHE %	ANT %
VC2a	N/A	0.00	0.90		N/A	4	na*	na*	na*	na*	na*	na*
18072/1	N/A	N/A	N/A		N/A	5	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean					

1.6 Sample Spike (Spike Level = 5 ug)

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	NAP %	ANY %	ANA %	FLU %	PHE %	ANT %
VC2a	N/A	0.00	0.90		N/A	4	101	111	111	95	103	99
18072/1	N/A	N/A	N/A		N/A	5	110	93	109	102	110	113
Control Limits							70 - 130 %					

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100973N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
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Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department
Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.5 Sample Duplicate

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
VC2a	N/A	0.00	0.90		N/A	4	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
18072/1	N/A	N/A	N/A		N/A	5	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean									

2.6 Sample Spike (Spike Level = 5 ug)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
VC2a	N/A	0.00	0.90		N/A	4	89	91	94	99	96	89	84	88	97	98
18072/1	N/A	N/A	N/A		N/A	5	100	101	103	107	97	95	96	101	105	101
Control Limits							70 - 130 %									

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100973N

Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
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Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469

Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.7 QC Sample (SETOC 2002.3.3)

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
SETOC 2002.3.3	N/A	N/A	N/A		N/A	4	100	90	96	75	98	101
SETOC 2002.3.3	N/A	N/A	N/A		N/A	5	86	99	96	117	97	101
Control Limits							70 - 130 % of nominal value					

1.8 Method Blank

Customer Ref.	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
N/A	N/A	N/A	N/A		N/A	4	<55	<55	<55	<55	<55	<55
N/A	N/A	N/A	N/A		N/A	5	<55	<55	<55	<55	<55	<55
Control Limits							Less than reporting limit					

QUALITY CONTROL REPORT

Report No.	:	100973N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.7 QC Sample (SETOC 2002.3.3)

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	CHR %	BaA %	BbF %	BkF %	BaP %	DBA %	FLT %	IPY %	PYR %	BPE %
SETOC 2002.3.3	N/A	N/A	N/A		N/A	4	84	85	102	87	84	86	84	79	111	103
SETOC 2002.3.3	N/A	N/A	N/A		N/A	5	85	105	92	102	93	92	90	79	101	84
Control Limits							70 - 130% of nominal value									

2.8 Method Blank

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	Batch	CHR ug/kg	BaA ug/kg	BbF ug/kg	BkF ug/kg	BaP ug/kg	DBA ug/kg	FLT ug/kg	IPY ug/kg	PYR ug/kg	BPE ug/kg
N/A	N/A	N/A	N/A		N/A	4	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
N/A	N/A	N/A	N/A		N/A	5	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
Control Limits							Less than reporting limit									

PCBs

TEST REPORT

Report No.	: 100974N
Project Name	: Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	: Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Address	: 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No.	: J469
Lab Sample No.	: 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019
Sample Description	: 85 samples said to be sediment
Sample Receipt Date	: 06 September 2006 - 26 September 2006
Test Period	: 07 September 2006 - 09 October 2006

Test Information

CODE	Test Parameter	Reporting Limit ug/kg	Test Procedure
8	2,4' dichlorobiphenyl	3.0	S/O/PCB
18	2,2',5 trichlorobiphenyl	3.0	S/O/PCB
28	2,4,4' trichlorobiphenyl	3.0	S/O/PCB
44	2,2',3,5' tetrachlorobiphenyl	3.0	S/O/PCB
52	2,2',5,5' tetrachlorobiphenyl	3.0	S/O/PCB
66	2,3',4,4' tetrachlorobiphenyl	3.0	S/O/PCB
77	3,3',4,4' tetrachlorobiphenyl	3.0	S/O/PCB
101	2,2',4,5,5' pentachlorobiphenyl	3.0	S/O/PCB
105	2,3,3',4,4' pentachlorobiphenyl	3.0	S/O/PCB
118	2,3',4,4',5 pentachlorobiphenyl	3.0	S/O/PCB
126	3,3',4,4',5 pentachlorobiphenyl	3.0	S/O/PCB
128	2,2',3,3',4,4' hexachlorobiphenyl	3.0	S/O/PCB
138	2,2',3,4,4',5' hexachlorobiphenyl	3.0	S/O/PCB
153	2,2',4,4',5,5' hexachlorobiphenyl	3.0	S/O/PCB
169	3,3',4,4',5,5' hexachlorobiphenyl	3.0	S/O/PCB
170	2,2',3,3',4,4',5 heptachlorobiphenyl	3.0	S/O/PCB
180	2,2',3,4,4',5,5' heptachlorobiphenyl	3.0	S/O/PCB
187	2,2',3,4',5,5',6 heptachlorobiphenyl	3.0	S/O/PCB
Total PCB	Total PCB	3.0	S/O/PCB

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. Results relate to samples as received.
3. Results are based on dry sample weight.
4. < = less than
5. N/A = Not applicable
6. Test results satisfy all in-house QA/QC protocols as attached.
7. Test description (for in-house methods only) as follows:
   S/O/PCB:Ultra-Sonic extraction and GC-MS Quantification.
8. Total PCB Equals to the summary of individual reported PCBs.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

TEST REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC14a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
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TEST REPORT

Report No. : 100974N

Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469

Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	118 ug/kg	126 ug/kg	128 ug/kg	138 ug/kg	153 ug/kg	169 ug/kg	170 ug/kg	180 ug/kg	187 ug/kg	Total PCB ug/kg
VC14a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC14a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5-a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC15a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC5a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	7.5

TEST REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.	No.	Depth, m From	Depth, m To	Type	Specimen Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC13a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	7.70	8.70		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.4	<3.0
VC6a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

TEST REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					118	126	128	138	153	169	170	180	187	Total
Drillhole No.	Depth, m			Type	Specimen										PCB
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC13a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC13a	NA	7.70	8.70		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC4a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	12	12	<3.0	3.0	6.6	<3.0	41
VC6a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC6a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC3a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

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TEST REPORT

Report No. : 100974N

Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

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Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen									
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC7a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	10.90	11.30		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Ref. Sediment	NA	NA	NA		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

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TEST REPORT

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Test Results

Customer Ref.	Sample					118	126	128	138	153	169	170	180	187	Total
Drillhole No.	Depth, m			Type	Specimen										PCB
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC7a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC7a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC2a	NA	10.90	11.30		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Ref. Sediment	NA	NA	NA		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	6.3
VC11a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC11a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC12a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

TEST REPORT

Report No. : 100974N

Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469

Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.		Depth, m		Type	Specimen									
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC12a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

TEST REPORT

Report No. : 100974N

Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469

Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref. Drillhole No.	Sample No.	Depth, m From	Depth, m To	Type	Specimen Depth m	118 ug/kg	126 ug/kg	128 ug/kg	138 ug/kg	153 ug/kg	169 ug/kg	170 ug/kg	180 ug/kg	187 ug/kg	Total PCB ug/kg
VC12a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC8a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	6.0
VC10a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC10a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC1a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	0.00	0.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	5.2

Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

TEST REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					8	18	28	44	52	66	77	101	105
Drillhole No.		Depth, m		Type	Specimen									
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC9a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

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TEST REPORT

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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					118	126	128	138	153	169	170	180	187	Total
Drillhole No.		Depth, m		Type	Specimen										PCB
	No.	From	To		Depth m	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
VC9a	NA	0.90	1.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	1.90	2.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	18
VC9a	NA	4.90	5.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	7.90	8.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
VC9a	NA	10.90	11.90		NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

-----------End of Report-----------

QUALITY CONTROL REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation
Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer : Geotechnical Projects Division, Geotechnical Engineering office,
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Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1.1 Sample Duplicate

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*
VC13a	N/A	0.00	0.90		N/A	2	na*	na*	na*	na*	na*	na*	na*	na*	na*
Ref. Sediment	N/A	N/A	N/A		N/A	3	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

1.2 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	78	90	92	94	94	91	95	98	89
VC13a	N/A	0.00	0.90		N/A	2	90	111	95	97	107	79	108	81	78
Ref. Sediment	N/A	N/A	N/A		N/A	3	91	97	83	100	95	88	85	94	76
Control Limit							70-130 %								

Notes :
1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: : 27 Dec. 2006

QUALITY CONTROL REPORT

Report No.	:	100974N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1.3 Sample Duplicate

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*
VC13a	N/A	0.00	0.90		N/A	2	na*	na*	na*	na*	na*	na*	na*	na*	na*
Ref. Sediment	N/A	N/A	N/A		N/A	3	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

1.4 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC14a	N/A	0.00	0.90		N/A	1	103	94	87	81	85	96	96	95	79
VC13a	N/A	0.00	0.90		N/A	2	86	86	96	88	92	87	91	87	92
Ref. Sediment	N/A	N/A	N/A		N/A	3	86	96	85	90	96	79	94	91	91
Control Limit							70-130 %								

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100974N
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Lab Job No. : J469
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Test Results

2.1 QC Sample (SETOC 2002.4.4)

Customer Ref. Drillhole No.	Batch	28 %	52 %	101 %	105 %	118 %	128 %	138 %	153 %	180 %
SETOC 2002.4.4	1	114	116	89	113	99	104	97	90	105
SETOC 2002.4.4	2	104	93	88	92	98	99	106	80	105
SETOC 2002.4.4	3	117	97	84	106	106	83	85	84	87
Control Limit		70 - 130% of nominal value								

2.2 Method Blank

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
N/A	N/A	N/A	N/A		N/A	1	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	2	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Control Limit							less than reporting limit								

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
N/A	N/A	N/A	N/A		N/A	1	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	2	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Control Limit							less than reporting limit								

QUALITY CONTROL REPORT

Report No.	:	100974N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1.5 Sample Duplicate

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC2a	N/A	0.00	0.90		N/A	4	na*	na*	na*	na*	na*	na*	na*	na*	na*
18072/1	N/A	N/A	N/A		N/A	5	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

1.6 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	8	18	28	44	52	66	77	101	105
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC2a	N/A	0.00	0.90		N/A	4	85	99	79	92	95	95	92	97	97
18072/1	N/A	N/A	N/A		N/A	5	84	100	99	90	98	99	95	88	91
Control Limit							70-130 %								

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100974N
Project Name : Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
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Test Results

1.7 Sample Duplicate

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC2a	N/A	0.00	0.90		N/A	4	na*	na*	na*	na*	na*	na*	na*	na*	na*
18072/1	N/A	N/A	N/A		N/A	5	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limit							+/- 30% of the mean								

1.8 Sample Spike (Spike Level = 1 ug)

Customer Ref.	Sample					Batch	118	126	128	138	153	169	170	180	187
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%
VC2a	N/A	0.00	0.90		N/A	4	87	94	91	91	85	89	99	94	101
18072/1	N/A	N/A	N/A		N/A	5	84	76	85	94	91	82	101	85	92
Control Limit							70-130 %								

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No.	:	100974N
Project Name	:	Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
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Test Results

2.3 QC Sample (SETOC 2002.4.4)

Customer Ref. Drillhole No.	Batch	28 %	52 %	101 %	105 %	118 %	128 %	138 %	153 %	180 %
SETOC 2002.4.4	4	103	99	88	94	81	85	94	80	90
SETOC 2002.4.4	5	106	102	97	87	106	91	122	97	106
Control Limit		70 - 130% of nominal value								

2.4 Method Blank

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	8 ug/kg	18 ug/kg	28 ug/kg	44 ug/kg	52 ug/kg	66 ug/kg	77 ug/kg	101 ug/kg	105 ug/kg
N/A	N/A	N/A	N/A		N/A	4	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	5	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Control Limit							less than reporting limit								

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	118 ug/kg	126 ug/kg	128 ug/kg	138 ug/kg	153 ug/kg	169 ug/kg	170 ug/kg	180 ug/kg	187 ug/kg
N/A	N/A	N/A	N/A		N/A	4	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
N/A	N/A	N/A	N/A		N/A	5	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Control Limit							less than reporting limit								

TBT

TEST REPORT

Report No.	: 100975N
Project Name	: Chemical and Biological Testing of Sediment (Service Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon To Sai Ying Pung - Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer	: Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Address	: 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No.	: J469
Lab Sample No.	: 17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019
Sample Description	: 85 samples said to be water
Sample Receipt Date	: 06 September 2006 - 26 September 2006
Test Period	: 07 September 2006 - 09 October 2006

Test Information

CODE	Test Parameter	Reporting Limit ug/L	Test Procedure
TBT	Tri-Butyl Tin	0.015	W/O/TBT

Notes :
1. This report shall not be reproduced, except in full, without prior approval from Lam Laboratories Ltd.
2. < = less than
3. N/A = Not applicable
4. Test results satisfy all in-house QA/QC protocols as attached.
5. Test description (for in-house methods) as follows:
   W/O/TBT: Solvent extraction and GC-MS Quantification.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

Lam Laboratories Limited Unit 12, 14/F., Honour Industrial Centre, 6 Sun Yip Street, Chai Wan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 e-mail: info@lamlab.com

TEST REPORT

Report No. : 100975N
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Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main
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Customer : Geotechnical Projects Division, Geotechnical Engineering office,
Civil Engineering and Development Department

Lab Job No. : J469
Lab Sample No. : 17970,17980,17985,17991,17996,18003,18022,18028,18036,
18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					TBT
Drillhole No.	Depth, m			Type	Specimen Depth m	ug TBT / L
	No.	From	To			
VC14a	NA	0.00	0.90		NA	<0.015
VC14a	NA	0.90	1.90		NA	<0.015
VC14a	NA	1.90	2.90		NA	<0.015
VC14a	NA	4.90	5.90		NA	<0.015
VC14a	NA	7.90	8.90		NA	<0.015
VC14a	NA	10.90	11.90		NA	<0.015
VC5-a	NA	0.00	0.90		NA	<0.015
VC5-a	NA	0.90	1.90		NA	<0.015
VC5-a	NA	1.90	2.90		NA	<0.015
VC5-a	NA	4.90	5.90		NA	<0.015
VC15a	NA	0.00	0.90		NA	<0.015
VC15a	NA	0.90	1.90		NA	<0.015
VC15a	NA	1.90	2.90		NA	<0.015
VC15a	NA	4.90	5.90		NA	<0.015
VC15a	NA	7.90	8.90		NA	<0.015
VC15a	NA	10.90	11.90		NA	<0.015
VC5a	NA	7.90	8.90		NA	<0.015
VC5a	NA	10.90	11.90		NA	<0.015
VC13a	NA	0.00	0.90		NA	<0.015
VC13a	NA	0.90	1.90		NA	<0.015

TEST REPORT

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Test Results

Customer Ref. Drillhole No.	Sample					TBT
	Depth, m			Type	Specimen	
	No.	From	To		Depth m	ug TBT / L
VC13a	NA	1.90	2.90		NA	<0.015
VC13a	NA	4.90	5.90		NA	<0.015
VC13a	NA	7.70	8.70		NA	<0.015
VC4a	NA	0.00	0.90		NA	<0.015
VC4a	NA	0.90	1.90		NA	<0.015
VC4a	NA	1.90	2.90		NA	<0.015
VC4a	NA	4.90	5.90		NA	<0.015
VC4a	NA	7.90	8.90		NA	<0.015
VC4a	NA	10.90	11.90		NA	<0.015
VC6a	NA	0.00	0.90		NA	<0.015
VC6a	NA	0.90	1.90		NA	<0.015
VC6a	NA	1.90	2.90		NA	<0.015
VC6a	NA	4.90	5.90		NA	<0.015
VC6a	NA	7.90	8.90		NA	<0.015
VC3a	NA	0.00	0.90		NA	<0.015
VC3a	NA	0.90	1.90		NA	<0.015
VC3a	NA	1.90	2.90		NA	<0.015
VC7a	NA	0.00	0.90		NA	<0.015
VC7a	NA	0.90	1.90		NA	<0.015
VC7a	NA	1.90	2.90		NA	<0.015

TEST REPORT

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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					TBT
Drillhole No.	Depth, m			Type	Specimen	
	No.	From	To		Depth m	ug TBT / L
VC7a	NA	4.90	5.90		NA	<0.015
VC7a	NA	7.90	8.90		NA	<0.015
VC2a	NA	0.00	0.90		NA	<0.015
VC2a	NA	0.90	1.90		NA	<0.015
VC2a	NA	1.90	2.90		NA	<0.015
VC2a	NA	4.90	5.90		NA	<0.015
VC2a	NA	7.90	8.90		NA	<0.015
VC2a	NA	10.90	11.30		NA	<0.015
Ref. Sediment	NA	NA	NA		NA	<0.015
VC11a	NA	0.00	0.90		NA	<0.015
VC11a	NA	0.90	1.90		NA	<0.015
VC11a	NA	1.90	2.90		NA	<0.015
VC11a	NA	4.90	5.90		NA	<0.015
VC11a	NA	7.90	8.90		NA	<0.015
VC11a	NA	10.90	11.90		NA	<0.015
VC12a	NA	0.00	0.90		NA	<0.015
VC12a	NA	0.90	1.90		NA	<0.015
VC12a	NA	1.90	2.90		NA	<0.015
VC12a	NA	4.90	5.90		NA	<0.015
VC12a	NA	7.90	8.90		NA	<0.015

TEST REPORT

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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref. Drillhole No.	Sample					TBT
	Depth, m			Type	Specimen Depth m	
	No.	From	To			ug TBT / L
VC12a	NA	10.90	11.90		NA	<0.015
VC8a	NA	0.00	0.90		NA	<0.015
VC8a	NA	0.90	1.90		NA	<0.015
VC8a	NA	1.90	2.90		NA	<0.015
VC8a	NA	4.90	5.90		NA	<0.015
VC8a	NA	7.90	8.90		NA	<0.015
VC8a	NA	10.90	11.90		NA	<0.015
VC10a	NA	0.00	0.90		NA	<0.015
VC10a	NA	0.90	1.90		NA	<0.015
VC10a	NA	1.90	2.90		NA	<0.015
VC10a	NA	4.90	5.90		NA	<0.015
VC10a	NA	7.90	8.90		NA	<0.015
VC10a	NA	10.90	11.90		NA	<0.015
VC1a	NA	0.00	0.90		NA	<0.015
VC1a	NA	0.90	1.90		NA	<0.015
VC1a	NA	1.90	2.90		NA	<0.015
VC1a	NA	4.90	5.90		NA	<0.015
VC1a	NA	7.90	8.90		NA	<0.015
VC1a	NA	10.90	11.90		NA	<0.015
VC9a	NA	0.00	0.90		NA	<0.015

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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

Customer Ref.	Sample					TBT
Drillhole No.	Depth, m			Type	Specimen	
	No.	From	To		Depth m	ug TBT / L
VC9a	NA	0.90	1.90		NA	<0.015
VC9a	NA	1.90	2.90		NA	<0.015
VC9a	NA	4.90	5.90		NA	<0.015
VC9a	NA	7.90	8.90		NA	<0.015
VC9a	NA	10.90	11.90		NA	<0.015

---------------End of report---------------

QUALITY CONTROL REPORT

Report No.	:	100975N
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Test Results

1.1 Sample Duplicate (Relative deviation)

Customer Ref.	Sample					Batch	TBT
Drillhole No.	Depth, m			Type	Specimen		
	No.	From	To		Depth m		%
17965/1	N/A	N/A	N/A		N/A	1	na*
17998/1	N/A	N/A	N/A		N/A	2	na*
17986/1	N/A	N/A	N/A		N/A	3	na*
Control Limit							+/- 30% of the mean

1.2 Sample Spike (Spike Level = 50 ng)

Customer Ref.	Sample					Batch	TBT
Drillhole No.	Depth, m			Type	Specimen		
	No.	From	To		Depth m		%
17965/1	N/A	N/A	N/A		N/A	1	89
17998/1	N/A	N/A	N/A		N/A	2	108
17986/1	N/A	N/A	N/A		N/A	3	104
Control Limit							70-130 %

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Authorized Signatory :

Wong Yau Tim
(Operations Manager)

Issue Date: 27 Dec. 2006

QUALITY CONTROL REPORT

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18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1.3 QC Sample (Spike level = 50 ng)

Customer Ref.	Sample						TBT
Drillhole No.	Depth, m			Type	Specimen	Batch	
	No.	From	To		Depth m		%
MB Spike	N/A	N/A	N/A		N/A	1	98
MB Spike	N/A	N/A	N/A		N/A	2	110
MB Spike	N/A	N/A	N/A		N/A	3	103
Control Limit							70 - 130 %

1.4 Method Blank

Customer Ref.	Sample						TBT
Drillhole No.	Depth, m			Type	Specimen	Batch	
	No.	From	To		Depth m		ug TBT / L
N/A	N/A	N/A	N/A		N/A	1	<0.015
N/A	N/A	N/A	N/A		N/A	2	<0.015
N/A	N/A	N/A	N/A		N/A	3	<0.015
Control Limit							Less than reporting limit

QUALITY CONTROL REPORT

Report No.	:	100975N
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Customer	:	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
Lab Job No.	:	J469
Lab Sample No.	:	17970,17980,17985,17991,17996,18003,18022,18028,18036, 18041,18053,18060,18073,18087,18089,18096,18107,18019

Test Results

1.5 Sample Duplicate (Relative deviation)

Customer Ref.	Sample					Batch	TBT
Drillhole No.	Depth, m			Type	Specimen Depth m		
	No.	From	To				%
17999/1	N/A	N/A	N/A		N/A	4	na*
VC12a	N/A	0.00	0.90		N/A	5	na*
Control Limit							+/- 30% of the mean

1.6 Sample Spike (Spike Level = 50 ng)

Customer Ref.	Sample					Batch	TBT
Drillhole No.	Depth, m			Type	Specimen Depth m		
	No.	From	To				%
17999/1	N/A	N/A	N/A		N/A	4	95
VC8a	N/A	0.00	0.90		N/A	5	81
Control Limit							70-130 %

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

QUALITY CONTROL REPORT

Report No. : 100975N
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Test Results

1.7 QC Sample (Spike level = 50 ng)

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	TBT %
MB Spike	N/A	N/A	N/A		N/A	4	91
MB Spike	N/A	N/A	N/A		N/A	5	108
Control Limit							70 - 130 %

1.8 Method Blank

Customer Ref. Drillhole No.	Sample Depth, m No.	From	To	Type	Specimen Depth m	Batch	TBT ug TBT / L
N/A	N/A	N/A	N/A		N/A	4	<0.015
N/A	N/A	N/A	N/A		N/A	5	<0.015
Control Limit							Less than reporting limit

Appendix F3

Laboratory Test Report on Biological Screening

Biological Testing

Amphipod Test

Test report

Report No.	:	101864N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s) & Description	:	10 no. of samples stated as sediment were received on chilled condition 9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	29 Oct - 8 Nov, 2006

Test Parameter

Parameter	Test Method
Amphipod Sediment Bioassay	USEPA 1994

Note(s):
1. Uncertainty is calculated as 2 SD.
2. Standard Method: Methods for Assessing Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods. EPA/600/R-94/025, USEPA, 1994.
3. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: **Date:** 22-Dec-2006

Yi Zhang
(Ecotoxicologist)

Lam Laboratories Limited Room 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong.
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Report no.: 101864N

1. Method

This 10-day toxicity test with Leptocheirus plumulosus was conducted using the USEPA method (1994) "Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods". Leptocheirus plumulosus is exposed to the test sediment overlaid with seawater for a 10-day test period and survival rate is determined as the primary endpoint.

2. Sample storage and pretreatment

All samples were homogenized thoroughly. Debris and indigenous organisms present in the sediment were removed and the sediment samples were stored at 4°C in dark until analyzed.

3. Test organism

Species:	*Leptocheirus plumulosus*
Source:	Purchased from research organism supplier from USA, mortality during shipping was 0.79%
Size/age:	3-4 mm in length
Acclimation:	under test conditions with feeding provided, as per USEPA 1994, mortality during acclimation was 4.35%
Health condition:	healthy

4. Summary of test particulars

Type of test:	static
Duration:	29 Oct - 8 Nov, 2006
Control sediment:	mud and sand collected from a clean area on the eastern coast of the New Territories and Hong Kong Island respectively, shipped to the laboratory on the same day, sieved through 425 micrometer mesh sieve, mixed and stored at 4°C in dark dark until use
Control seawater:	reconstituted seawater prepared with the Instant Ocean salt at 20 ppt, aerated for two days after preparation
Test temperature:	25±1°C
Lighting:	continuous
Aeration:	provided (around 100 bubbles/min)
Test vessel:	1000ml glass jars
Volume of sediment:	175ml
Volume of overlying water:	775 ml
No. of replicates:	5
No. of organisms/replicate:	20
Feeding:	none
Monitoring:	temperature, DO, pH and salinity in overlying water everyday, ammonia in overlying water at test initiation and termination
Reference toxicant test:	96 hour water only test with $CdCl_2$

Test report

Report no.: 101864N

5. Summary of test results

Table 1. Survival of amphipods on Day 10

Sample ID	Number of living amphipod on Day 10						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative Control with sediment	20	19	19	19	20	19.4	0.5
VC4a (0.9m - 1.9m)	16	16	15	12	15	14.8	1.6
VC7a (0.9m - 1.9m)	16	14	14	14	19	15.4	2.2
VC8a (10.9m - 11.9m)	15	17	19	16	14	16.2	1.9
VC11a (0.9m - 1.9m)	15	14	15	11	15	14.0	1.7
VC12a (0.0m - 0.9m)	17	18	18	14	14	16.2	2.0
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	14	12	16	15	14	14.2	1.5
VC14a (0.0m - 0.9m)	15	18	14	19	17	16.6	2.1
VC15a (10.9m - 11.9m)	9	7	10	11	12	9.8	1.9
Reference sediment	16	19	16	17	17	17.0	1.2

Table 2. Survival percentage of amphipods on Day 10

Sample ID	Survival percentage of amphipod on Day 10 (%)						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative Control with sediment	100	95	95	95	100	97.0	2.7
VC4a (0.9m - 1.9m)	80	80	75	60	75.0	74.0	8.2
VC7a (0.9m - 1.9m)	80	70	70	70	95.0	77.0	11.0
VC8a (10.9m - 11.9m)	75	85	95	80	70.0	81.0	9.6
VC11a (0.9m - 1.9m)	75	70	75	55	75.0	70.0	8.7
VC12a (0.0m - 0.9m)	85	90	90	70	70.0	81.0	10.2
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	70	60	80	75	70.0	71.0	7.4
VC14a (0.0m - 0.9m)	75	90	70	95	85.0	83.0	10.4
VC15a (10.9m - 11.9m)	45	35	50	55	60.0	49.0	9.6
Reference sediment	80	95	80	85	85	85.0	6.1

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Table 3. Summary of the amphipod survival in relation to the reference sediment

Sample ID	Survival in relation to reference site (%)	Difference between sample and reference sediment (t-test)
VC4a (0.9m - 1.9m)	87.1	NA[1]
VC7a (0.9m - 1.9m)	90.6	NA[1]
VC8a (10.9m - 11.9m)	95.3	NA[1]
VC11a (0.9m - 1.9m)	82.4	NA[1]
VC12a (0.0m - 0.9m)	95.3	NA[1]
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	83.5	NA[1]
VC14a (0.0m - 0.9m)	97.6	NA[1]
VC15a (10.9m - 11.9m)	57.6	Significantly different, t critical=1.86, t stat=-7.060, $p<0.05$ (one tail)
NA [1]. As the average survival of the amphipods for the test sediment was no less than 80% of that of the reference sediment, statistical analysis is not required.		

Report no.: 101864N

6. Test validity

Table 3. Test validity criteria and water quality ranges in the amphipod test

Parameter	Minimum during the test period	Maximum during the test period	Acceptable Range in USEPA 1994
Overlying salinity	19 ppt	21 ppt	19-21 ppt
Dissolved oxygen	6.4 mg/L	7.7 mg/L	>4.7 mg/L [1]
Overlying pH	7.3	8.1	NA [2]
Temperature	24.2 °C	25.4 °C	22.0-28.0 °C time-average 24.0-26.0 °C
Total ammonia in overlying water (initiation / termination)	0.06 mg/L	2.31 mg/L	<60 mg/L [3]
Interstitial salinity (initiation)	27 ppt	32 ppt	1.5-32 ppt [4]
Interstitial pH (initiation)	7.1	8.1	NA [2]
Amphipod survival in the negative control	95-100% , averagely 97.0 %		≥ 90% average ≥ 80% in any individual replicate
96-h LC_{50} obtained from the reference toxicant test	0.72 mg/L		0.95±0.35 mg/L

1. 60% of saturation level at 20 ppt
2. pH is not adjusted or controlled
3. The acceptance level for overlying ammonia was < 20 mg/L in ETWB TCW 34/2002. When this level is exceeded, additional set of amphipod test is conducted with purging of sediment.
4. VC4a(10.9m - 11.9m), VC8a(10.9m -11.9m), VC11a(0.9m - 1.9m), VC12a(0.0m - 0.9m) and VC13a(0.0m - 0.9m) + VC13a(4.9m - 5.9m) were pre-mixed with 20 ppt reconstituted seawater, so that interstitial salinity was below 32 ppt at test initiation.

As shown in Table 3, the water quality parameters during the test period ranged within acceptable limits: temperature ranged from 24.2 to 25.4 °C, the dissolved oxygen level ranged from 6.4 to 7.7 mg/L, pH ranged from 7.3 to 8.1, the salinity ranged from 19 to 21 ppt. As a result, the data are interpretable.

The tests were validated by acceptable survival of control organisms. The average survival rate in controls was greater than 90% and survival rate in any control replicates greater than 80%.

The organisms also demonstrated comparable sensitivity to the reference toxicant (cadmium). The 96-hr LC_{50} for *Leptocheirus plumulosus* obtained was 0.72 mgCd/L and found within the laboratory control limits (Mean±2STD, i.e., 0.95± 0.35 mgCd/L). Therefore, the data are acceptable.

End of report

Data entry checked by: [illegible]
Y.~~M. Choy~~/ W.K. Cheuk

Polychaete Test

TEST REPORT

Report No.	:	101866N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s) & Description	:	10 no. of samples stated as sediment were received on chilled condition 9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	26 Oct - 15 Nov, 2006

Test Parameter

Parameter	Test Method
Polychaete Sediment Bioassay	PSEP 1995

Note(s):

1. Results related to sample(s) as received.
2. NA = Not applicable.
3. Uncertainty is calculated as 2 SD.
4. Standard method: Puget Sound Estuary Program Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments, USEPA, Revised July 1995.
5. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: ______________________ **Date:** 22-Dec-2006

Yi Zhang
(Ecotoxicologist)

Test report

Report No.: 101866N

1. Method

This 20-day toxicity test on sediment with Neanthes arenaceodentata was conducted using the PSEP method (1995) "Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments". *Neanthes arenaceodentata* is exposed to the test sediment overlaid with seawater for a 20-day test period. The endpoints are survival and growth.

2. Sample storage and pretreatment

All samples were homogenized thoroughly. Debris and indigenous organisms present in the sediment were removed and the sediment samples were stored at 4oC in dark until analyzed.

3. Test organism

Species:	*Neanthes arenaceodentata*
Source:	Purchased from research organism supplier from USA, mortality during shipping was 0%
Age/size:	2-3 weeks post emergence
Acclimation:	under test conditions with feeding provided, as per USEPA 1994, mortality during acclimation was 0%
Health condition:	healthy
Mean initial dry weight:	0.63 mg/worm

4. Summary of test particulars

Type of test:	renewal every three days
Duration:	26 Oct - 15 Nov, 2006
Control sediment:	mud and sand collected from a clean area on the eastern coast of the New Territories and Hong Kong Island respectively, shipped to the laboratory on the same day, sieved through 425 micrometer mesh sieve, mixed and stored at 4°C in dark dark until use
Control seawater:	reconstituted seawater prepared with the Instant Ocean salt at 28 ppt, aerated for two days after preparation
Test temperature:	20±1°C
Lighting:	continuous
Aeration:	provided (around 100 bubbles/min)
Test vessel:	1000ml glass jars
Volume of sediment:	175ml
Volume of overlying water:	775 ml
No. of replicates:	5
No. of organisms/replicate:	5
Feeding:	Tetramarin powder, 8 mg per worm each time, once every two days
Monitoring:	temperature, DO, pH and salinity in overlying water everyday, ammonia in overlying water at test initiation and termination
Reference toxicant test:	96 hour water only test with $CdCl_2$

Test report

Report No.: 101866N

5. Summary of test results

Table 1. Survival of polychaetes on Day 20

Sample ID	Number of living polychaete on Day 20						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative control with sediment	5	5	5	5	5	5.0	0.0
VC4a (0.9m - 1.9m)	5	5	5	5	5	5.0	0.0
VC7a (0.9m - 1.9m)	4	4	5	5	5	4.6	0.5
VC8a (10.9m - 11.9m)	2	5	5	5	3	4.0	1.4
VC11a (0.9m - 1.9m)	5	5	5	5	5	5.0	0.0
VC12a (0.0m - 0.9m)	4	5	5	5	4	4.6	0.5
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	5	5	5	5	5	5.0	0.0
VC14a (0.0m - 0.9m)	5	5	5	5	5	5.0	0.0
VC15a (10.9m - 11.9m)	5	5	4	5	5	4.8	0.4
Reference sediment	5	5	5	5	3	4.6	0.9

Table 2. Survival percentage of polychaetes on Day 20

Sample ID	Survival percentage of polychaete on Day 20 (%)						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative control with sediment	100	100	100	100	100	100.0	0.0
VC4a (0.9m - 1.9m)	100	100	100	100	100	100.0	0.0
VC7a (0.9m - 1.9m)	80	80	100	100	100	92.0	11.0
VC8a (10.9m - 11.9m)	40	100	100	100	60	80.0	28.3
VC11a (0.9m - 1.9m)	100	100	100	100	100	100.0	0.0
VC12a (0.0m - 0.9m)	80	100	100	100	80	92.0	11.0
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	100	100	100	100	100	100.0	0.0
VC14a (0.0m - 0.9m)	100	100	100	100	100	100.0	0.0
VC15a (10.9m - 11.9m)	100	100	80	100	100	96.0	8.9
Reference sediment	100	100	100	100	60	92.0	17.9

Table 3. Total dry weight of polychaetes on Day 20

Sample ID	Total dry weight of polychaete on Day 20 (mg)						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative control with sediment	40.14	73.51	63.54	64.96	77.05	63.8	14.4
VC4a (0.9m - 1.9m)	63.66	60.28	47.74	48.75	46.89	53.5	7.9
VC7a (0.9m - 1.9m)	54.36	63.03	53.78	76.16	56.06	60.7	9.4
VC8a (10.9m - 11.9m)	33.21	70.69	65.63	51.66	41.49	52.5	15.8
VC11a (0.9m - 1.9m)	65.03	64.89	59.30	60.05	50.38	59.9	6.0
VC12a (0.0m - 0.9m)	40.82	47.24	24.56	55.57	53.64	44.4	12.5
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	67.49	63.49	71.87	55.23	55.99	62.8	7.2
VC14a (0.0m - 0.9m)	60.45	53.08	49.84	56.45	62.14	56.4	5.1
VC15a (10.9m - 11.9m)	62.97	58.20	62.03	48.32	70.17	60.3	8.0
Reference sediment	58.07	51.14	2.16	78.82	61.06	50.3	28.8

Test report

Report No.: 101866N

Table 4. Summary of the total dry weight of polychaetes in relation to the reference sediments

Sample ID	Total dry weight in relation to reference site (%)	Difference between sample and reference sediment (t-test)
VC4a (0.9m - 1.9m)	106.4	NA[1]
VC7a (0.9m - 1.9m)	120.8	NA[1]
VC8a (10.9m - 11.9m)	104.5	NA[1]
VC11a (0.9m - 1.9m)	119.3	NA[1]
VC12a (0.0m - 0.9m)	88.3	Insignificantly different, t critical=1.86, t stat=-0.420, p=0.3429 (one tail)
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	125.0	NA[1]
VC14a (0.0m - 0.9m)	112.2	NA[1]
VC15a (10.9m - 11.9m)	120.1	NA[1]
NA[1] - As the average total dry weight for the test sediment was no less than 90% of that of the reference sediment, statistical analysis is not required.		

Report No.: 101866N

6. Test validity

Table 5. Test validity criteria and water quality ranges in the polychaete test

Parameter	Minimum during the test period	Maximum during the test period	Control Limit
Overlying salinity	26 ppt	30 ppt	26-30 ppt
Dissolved oxygen	6.3 mg/L	7.4 mg/L	not specified
Overlying pH	7.1	8.3	NA [1]
Temperature	19.2 °C	20.4 °C	19-21°C
Unionized ammonia in overlying water (initiation/termination)	<0.002 mg/L	0.287 mg/L	NA [2]
Interstitial salinity (initiation/termination)	26 ppt	30 ppt	>20ppt
Interstitial pH (initiation/termination)	7.0	8.1	NA [1]
Polychaete survival in the negative control	All 100% , averagely 100.0%		≥ 90% average ≥ 80% in any individual replicate
96-h LC_{50} obtained from the reference toxicant test	9.96 mg/L		10.10±2.95 mg/L

1. pH is not adjusted or controlled
2. Overlying ammonia is not controlled. Results could be qualified as possible false positive when unionized ammonia greater than 0.7 mg/L

As shown in Table 5, the water quality parameters during the test period ranged within acceptable limits: temperature ranged from 19.2 to 20.4 °C, the salinity ranged from 26 to 30 ppt. As a result, the data are interpretable.

The tests were validated by acceptable survival of control organisms. The average survival rate in controls was greater than 90% and survival rate in any control replicates greater than 80%.

The organisms also demonstrated comparable sensitivity to the reference toxicant (cadmium). The 96-hr LC_{50} for *Neanthes arenaceodentata* obtained was 9.96 mgCd/L and found within the laboratory control limits (Mean±2STD, i.e., 10.10±2.95 mgCd/L). Therefore, the data are acceptable.

End of report

Data entry checked by: Fanny Cheuk
~~Y.M.Choy~~ /W.K.Cheuk

Bivalve Test

TEST REPORT

Report No.	:	101865N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s) & Description	:	10 no. of samples stated as sediment were received on chilled condition 9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	31 Oct - 2 Nov, 2006

Test Parameter

Parameter	Test Method
Bivalve Larvae Sediment Bioassay	PSEP 1995

Note(s):

1. Results related to sample(s) as received.
2. NA = Not applicable.
3. Uncertainty is calculated as 2 SD.
4. Standard method: Puget Sound Estuary Program Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments, USEPA, Revised July 1995.
5. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: ______________________ Date: 22-Dec-2006

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Test report

Report No.: 101865N

1. Method

This bivalve larvae test with Crassostrea gigas was conducted using the PSEP method (1995) "Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments". Bivalve adults are induced to spawn and gametes are fertilized. After fertilization the embryos are immediately exposed to the test sediment overlaid with seawater and allowed to develop for 48-60 hours. The normality survival of larvae is determined as endpoint.

2. Sample storage and pretreatment

All samples were homogenized thoroughly. Debris and indigenous organisms present in the sediment were removed and the sediment samples were stored at 4oC in dark until analyzed.

3. Test organism

Species:	*Crassostrea gigas*
Source:	purchased from a research organism supplier in UK .
Acclimation:	24 hours under test conditions, as per PSEP 1995, mortality during acclimation was 0 %
Conditions of eggs:	mature and clean
Conditions of sperms:	active
Fertilization rate:	90.8%
Mean initial stocking:	27434 fertilized eggs per test chamber

4. Summary of test particulars

Type of test:	static and non-renewal
Duration:	31 October - 2 November, 2006, 48 hours in total
Control seawater:	collected from a clean area on the eastern coast of the Hong Kong Island, filtered through 0.45 mm filter paper, adjusted to 28 ppt, aerated for two days after preparation
Test temperature:	20±1°C
Lighting:	14h light : 10h dark cycle
Aeration:	provided (around 100 bubbles/min)
Test vessel:	1000ml glass jars
Volume of sediment:	18g
Volume of overlying water:	900 ml
No. of replicates:	5
Feeding:	none
Monitoring:	temperature, DO, pH and salinity in overlying water everyday, and termination ammonia in overlying water at test initiation
Reference toxicant test:	48 hour water only test with $CdCl_2$

Report No.: 101865N

5. *Summary of test results*

Table 1. Total number of normal larvae in each test chamber at test termination

Sample ID	Number of normal larvae in each test chamber at test termination						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative Control with Seawater I	19400	17800	20100	21400	19900	19720	1302.7
Negative Control with Seawater II	19700	19800	20100	21100	20900	20320	641.9
VC4a (0.9m - 1.9m)	16000	17400	18100	15400	17000	16780	1082.6
VC7a (0.9m - 1.9m)	12400	11600	10100	10100	9800	10800	1138.0
VC8a (10.9m - 11.9m)	17100	17000	17600	16900	17500	17220	311.4
VC11a (0.9m - 1.9m)	16100	15200	17000	17900	17000	16640	1026.2
VC12a (0.0m - 0.9m)	11500	9600	10200	11000	10600	10580	729.4
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	17000	18800	17700	16800	18000	17660	805.0
VC14a (0.0m - 0.9m)	14000	15800	15200	15300	14000	14860	817.3
VC15a (10.9m - 11.9m)	17000	16500	18100	17000	17100	17140	585.7
Reference sediment	19100	16800	20700	19400	18400	18880	1430.7

Table 2. Combined normality/survival of the bivalve larvae at test termination

Sample ID	Normality survival of bivalve larvae at test termination (%)						
	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Mean	SD
Negative Control with Seawater I	70.7	64.9	73.3	78.0	72.5	71.9	4.7
Negative.Control with Seawater II	71.8	72.2	73.3	76.9	76.2	74.1	2.3
VC4a (0.9m - 1.9m)	58.3	63.4	66.0	56.1	62.0	61.2	3.9
VC7a (0.9m - 1.9m)	45.2	42.3	36.8	36.8	35.7	39.4	4.1
VC8a (10.9m - 11.9m)	62.3	62.0	64.2	61.6	63.8	62.8	1.1
VC11a (0.9m - 1.9m)	58.7	55.4	62.0	65.2	62.0	60.7	3.7
VC12a (0.0m - 0.9m)	41.9	35.0	37.2	40.1	38.6	38.6	2.7
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	62.0	68.5	64.5	61.2	65.6	64.4	2.9
VC14a (0.0m - 0.9m)	51.0	57.6	55.4	55.8	51.0	54.2	3.0
VC15a (10.9m - 11.9m)	62.0	60.1	66.0	62.0	62.3	62.5	2.1
Reference sediment	69.6	61.2	75.5	70.7	67.1	68.8	5.2

End of Page

Report No.: 101865N

Table 3. Summary of the normality survival of bivalve larvae in relation to the reference sediments

Sample ID	Normality survival in relation to reference site (%)	Difference between sample and reference sediment (t-test)
VC4a (0.9m - 1.9m)	88.9	NA [1]
VC7a (0.9m - 1.9m)	57.2	Significantly different, t critical=1.86, t stat=-9.883, p<0.05 (one tail)
VC8a (10.9m - 11.9m)	91.2	NA [1]
VC11a (0.9m - 1.9m)	88.1	NA [1]
VC12a (0.0m -0.9m)	56.0	Significantly different, t critical=1.86, t stat=-11.557 p<0.05 (one tail)
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	93.5	NA [1]
VC14a (0.0m - 0.9m)	78.7	Significantly different, t critical=1.86, t stat=-5.455, p<0.05 (one tail)
VC 15a (10.9m - 11.9m)	90.8	NA [1]

NA[1] - As the average normality survival of the bivalve larvae for the test sediment was no less than 80% of that of the reference sediment, statistical analysis is not required.

End of Page

Report No.: 101865N

6. Test validity

Table 4. Test validity criteria and water quality ranges in the bivalve test

Parameter	Minimum during the test period	Maximum during the test period	Control Limit
Overlying salinity	27 ppt	29 ppt	27-29ppt
Dissolved oxygen	6.5 mg/L	7.3 mg/L	>4.5mg/L [1]
Overlying pH	6.8	7.9	NA [2]
Temperature	19.2 °C	20.6 °C	19.0-21.0°C
Unionized ammonia in overlying water (initiation/termination)	<0.002 mg/L	0.008 mg/L	NA [3]
Larvae normality survival in the negative control	64.9 - 78.0% , averagely 73.4%		≥ 70% averagely
48-h EC_{50} obtained from the reference toxicant test	1.39 mg/L		1.44 ± 0.52 mg/L

1. 60% of saturation level at 28 ppt
2. pH is not adjusted or controlled
3. Overlying ammonia is not controlled. Results could be qualified as possible false positive when ammonia (unionized) is greater than 0.13 mg/L

As shown in Table 4, the water quality parameters during the test period ranged within control limits: temperature ranged from 19.2 to 20.6 °C, the dissolved oxygen level ranged from 6.5 to 7.3 mg/L, pH ranged from 6.8 to 7.9, the salinity ranged from 27 to 29 ppt. As a result, the data are interpretable.

The tests were validated by acceptable normality survival of control organisms. The average normality survival rate in controls was greater than 70%.

The organisms also demonstrated comparable sensitivity to the reference toxicant (cadmium). The 48-hr EC_{50} for *Crassostrea gigas* obtained was 1.39 mgCd/L and found within the laboratory control limits (Mean±2STD, i.e., 1.44±0.52 mgCd/L). Therefore, the data are acceptable.

End of Report

Data entry checked by: [illegible]
Y.~~M.C~~hoy /W.K.Cheuk

Ancillary Tests

Interstitial Ammonia

TEST REPORT

Report No.	:	101867N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s) & Description	:	10 no. of samples stated as sediment were received on chilled condition 9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	21-Oct-06

Test Parameter

Parameter	Test Method
Interstitial ammonia	APHA 4500-NH3 F. Phenate Method

Note(s):
1. Results related to sample(s) as received.
2. NA = Not applicable.
3. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: Yi Zhang (Ecotoxicologist) **Date:** 22-Dec-2006

Test report

Report no.: 101867N

Sample ID	Interstitial ammonia ($mgNH_3/L$)
VC4a (0.9m - 1.9m)	See Note 1
VC7a (0.9m - 1.9m)	See Note 1
VC8a (10.9m - 11.9m)	21.9
VC11a (0.9m - 1.9m)	9.2
VC12a (0.0m - 0.9m)	16.4
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	14.8
VC14a (0.0m - 0.9m)	4.3
VC15a (10.9m - 11.9m)	4.1
Reference sediment	4.2
Detection limit	0.03
Note 1 - Analysis was not performed due to insufficient amount of porewater obtained.	

Sample duplicate

Sample ID	Relative deviation (%)
Reference Sediment	-5.3
Control limits	±20% from the mean

Sample Spike

Sample ID	Spike recovery (%)
Reference Sediment	-89.9
Control limits	80-120% from the nominal value

End of Report

Data entry checked by: Tommy Cheuk
W.K. Cheuk / Y. ~~M. Choy~~

Interstitial Salinity

TEST REPORT

Report No.	:	101868N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s) & Description	:	10 no. of samples stated as sediment were received on chilled condition 9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	17-Oct-06

Test Parameter

Parameter	Test Method
Interstitial salinity	APHA 2502 B

Note(s):
1. Results related to sample(s) as received.
2. NA = Not applicable.
3. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: Yi Zhang (Ecotoxicologist) **Date:** 22-Dec-2006

Lam Laboratories Limited

Test report

Report no.: 101868N

Sample ID	Interstitial salinity (ppt)
VC4a (0.9m - 1.9m)	35
VC7a (0.9m - 1.9m)	29
VC8a (10.9m - 11.9m)	34
VC11a (0.9m - 1.9m)	33
VC12a (0.0m - 0.9m)	33
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	35
VC14a (0.0m - 0.9m)	30
VC15a (10.9m - 11.9m)	31
Reference Sediment	30
Detection limit	NA

Sample duplicate

Sample ID	Relative deviation (%)
Reference sediment	-11.2
Control limits	±20% from the mean

Standard check

Sample ID	Recovery (%)
Reference standard	100.6
Control limits	80-120% from the nominal value

End of Report

Data entry checked by: Harry Cheuk
W.K. Cheuk / ~~Y.M. Choy~~

TOC, Grains Size & Moisture Content

TEST REPORT

Report No.	:	101869N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Customer Address	:	8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Job No.	:	J469
Lab. Sample Ref. No.	:	18263/1-9
No. of Sample(s)	:	10 no. of samples stated as sediment were received on chilled condition
& Decription	:	9 no. of samples were tested including VC4a (10.9m - 11.9m), VC7a (0.9m - 1.9m), VC8a (10.9m - 11.9m), VC11a (0.9m - 1.9m), VC12a (0.0m - 0.9m), VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m), VC14a (0.0m - 0.9m), VC15a (10.9m - 11.9m) & Reference Sediment as per customer's instruction
Sample Receive Date	:	6 -22 Sept, 2006
Test Date	:	17-Oct-06

Parameter	Test Method
Grain size	Geospec 3: Test 8.1
Moisture content	Geospec 3: Test 5.2
Total Organic Carbon	ALS Method Code EP-009

Note(s):
1. Results related to sample(s) as received.
2. NA = Not applicable.
3. The TOC samples were subcontracted to ALS Technichem (HK) Pty Ltd.
4. This is the final report and supersedes the draft report with the same report number.

Authorized signatory: ______________________ Date: 22-Dec-2006

Yi Zhang
(Ecotoxicologist)

Lam Laboratories Limited Room 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong.
Tel: (852) 2897 3282 Fax: (852) 2897 5509 Email: info@lamlab.com

Test report

Report No.	:	101869N
Project Name	:	Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pun - Investigation
Customer Name	:	Geotechnical Projects Division, Geotechnical Engineering Office, Civil Engineering and Development Department
Contract No.	:	GE/2005/47
Works Order No.	:	GE/2005/47.19
Lab. Sample Ref. No.	:	18263/1-9

Sample ID	Grain Size < 63 mm (%)	Moisture Content [1] (%)	TOC (% Wet Weight)	TOC (% Dry Weight) [2]
VC4a(10.9m - 11.9m)	37	22	0.65	0.79
VC7a (0.9m - 1.9m)	44	51	0.49	0.74
VC8a (10.9m - 11.9m)	95	57	0.60	0.94
VC11a (0.9m - 1.9m)	62	53	0.66	1.01
VC12a (0.0m -0.9m)	18	40	0.40	0.56
VC13a (0.0m - 0.9m) + VC13a (4.9m - 5.9m)	40	59	0.62	0.99
VC14a (0.0m - 0.9m)	83	93	0.70	1.35
VC 15a (10.9m - 11.9m)	87	54	0.35	0.54
Reference Sediment	69	98	0.64	1.27
Detection Limit	NA	NA	0.05	0.10
Note 1. Moisture content is calculated as: (Sample Wet Weight – Sample Dry Weight) / Sample Dry Weight x 100%				

End of Report

Data entry checked by: [signature]
W. K. Cheuk / ~~Y.M.Choy~~

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract)

Report No: 101887N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/1

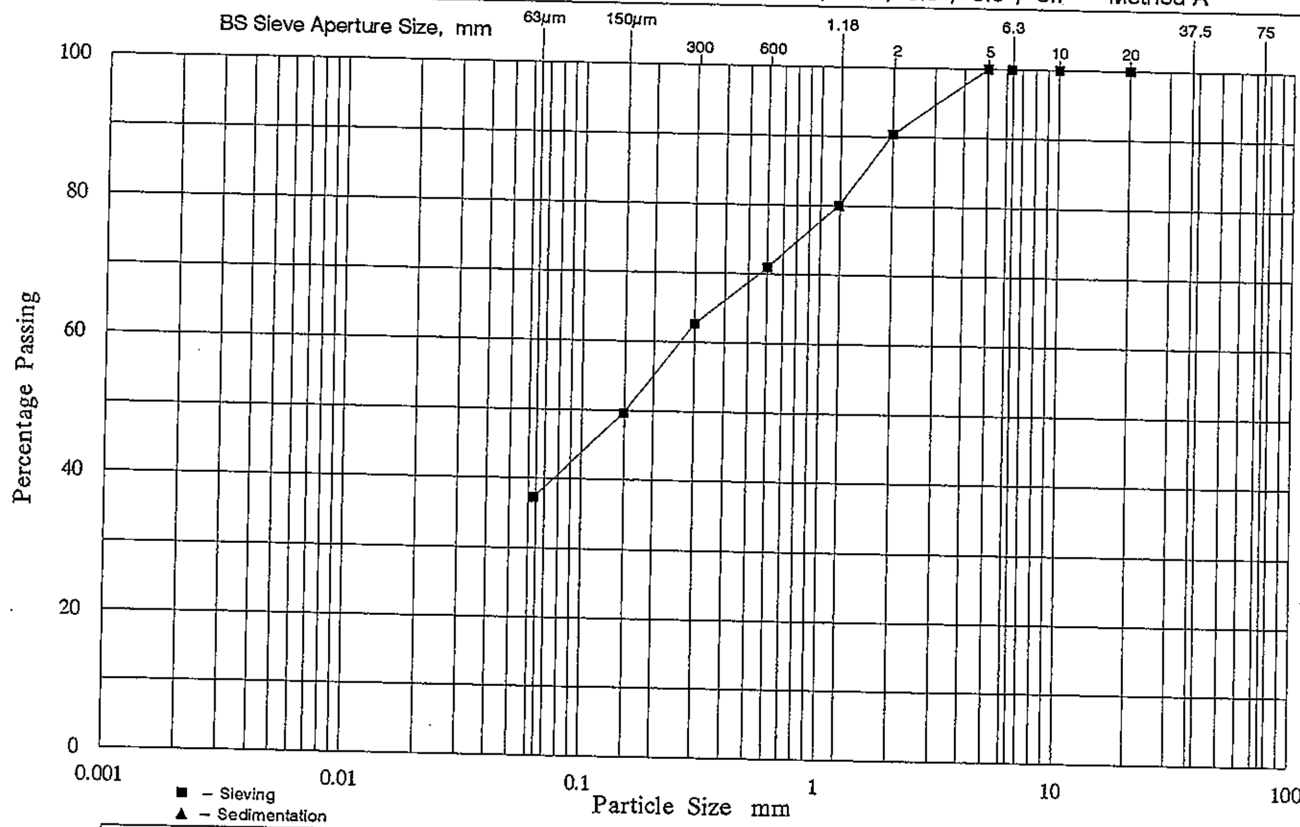
Composite Sample No. : VC4a **Sample No:** **Depth m:** 10.90 – 11.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, gravelly, silty, very clayey SAND

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/06 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COB-BLES
	SILT			SAND			GRAVEL			

Remarks:

SUMMARY :

GRAVEL	10 %
SAND	53 %
SILT & CLAY	37 %

Approved Signatory: Lo Kam chuen

Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Report No: 101887N

Project :	Chemical and Biological Testing of Sediment(Term Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples
Customer & Address :	Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong
Lab Job No :	J469
Works Order No:	GE/2005/47.19
Lab. Sample Ref. No:	18263/1
Composite Sample No. :	VC4a
Sample No:	
Depth m:	10.90 – 11.90
Specimen Depth m:	
Sample Type:	Bulk
Spec. Ref:	
Geological Origin:	Sediment
Description :	Grey, gravelly, silty, very clayey SAND
Date Sample Received:	13/10/2006
Date Tested:	21/10/06
Tested By:	H. W. Chu
Tested in Accordance With:	GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 103.07

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	103.07	*cum. mass ret. + m2 =*		*103.07*
Riffled m3 20.0	103.07	*difference from m1 % =*		*0.00*
Washed m4	64.84	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3		0.00	0.0	100.0
Passing m5 6.3	64.84	*cum. mass ret. + m5 =*		*64.84*
Riffled m6 6.3	64.84	*difference from m4 % =*		*0.00*
5.00		0.00	0.0	100.0
2.00	9.93	9.93	9.6	90.4
1.18	10.72	10.72	10.4	80.0
0.600	9.30	9.30	9.0	70.9
0.300	8.50	8.50	8.2	62.7
0.150	13.48	13.48	13.1	49.6
0.063	12.67	12.67	12.3	37.3
Pan mE	0.17			
		cum. mass ret. + mE =		*64.77*
		difference from m6 % =		*0.11*

Approved Signatory: Lo Kam chuen

Lo Kam–chuen

Date: 27–11–2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101888N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/2

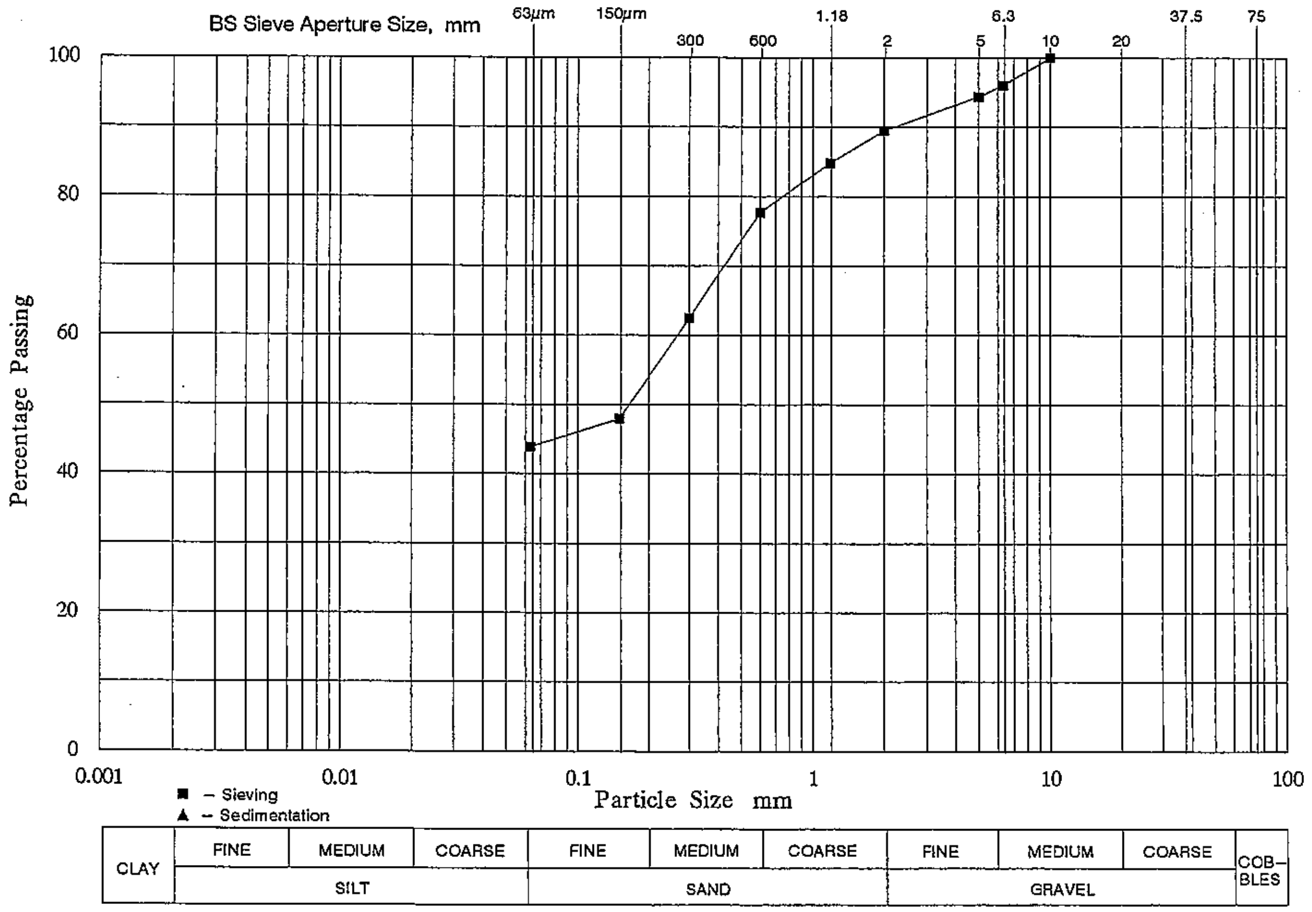
Composite Sample No. : VC7a **Sample No:** **Depth m:** 0.90 – 1.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, sandy CLAY with some shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :

GRAVEL	11 %
SAND	45 %
SILT & CLAY	44 %

Approved Signatory: Lo Kam Chuen
Lo Kam–chuen

Date: 27–11–2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

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Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Report No: 101888N

Project : Chemical and Biological Testing of Sediment(Term Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/2

Composite Sample No. : VC7a **Sample No:** **Depth m:** 0.90 – 1.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, sandy CLAY with some shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 101.55

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	101.55	*cum. mass ret. + m2 =*		*101.55*
Riffled m3 20.0	101.55	*difference from m1 % =*		*0.00*
Washed m4	57.04	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3	4.00	4.00	3.9	96.1
Passing m5 6.3	53.04	*cum. mass ret. + m5 =*		*57.04*
Riffled m6 6.3	53.04	*difference from m4 % =*		*0.00*
5.00	1.71	1.71	1.7	94.4
2.00	5.03	5.03	5.0	89.4
1.18	4.72	4.72	4.6	84.8
0.600	7.20	7.20	7.1	77.7
0.300	15.42	15.42	15.2	62.5
0.150	14.79	14.79	14.6	47.9
0.063	4.11	4.11	4.0	43.8
Pan mE	0.01			
		cum. mass ret. + mE =		*52.99*
		difference from m6 % =		*0.09*

Approved Signatory: Lo Kam Chuen
Lo Kam – chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101889N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/3

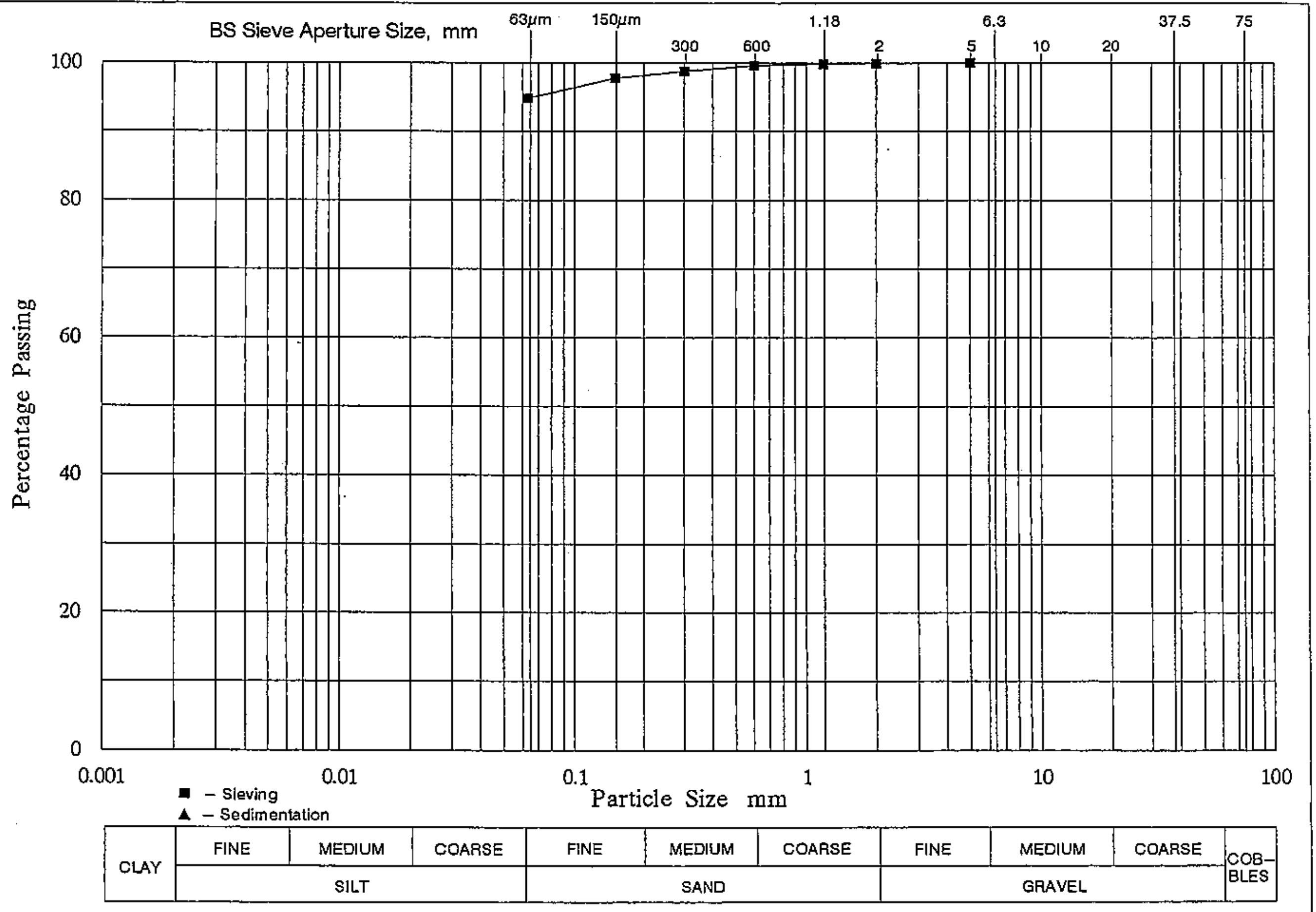
Composite Sample No. : VC8a **Sample No:** **Depth m:** 10.90 – 11.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :	GRAVEL	0 %
	SAND	5 %
	SILT & CLAY	95 %

Approved Signatory: Lo Kam Chuen
Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Report No: 101889N

Project : Chemical and Biological Testing of Sediment(Term Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/3

Composite Sample No. : VC8a **Sample No:** **Depth m:** 10.90 – 11.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 102.85

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	102.85	*cum. mass ret. + m2 =*		*102.85*
Riffled m3 20.0	102.85	*difference from m1 % =*		*0.00*
Washed m4	5.37	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3		0.00	0.0	100.0
Passing m5 6.3	5.37	*cum. mass ret. + m5 =*		*5.37*
Riffled m6 6.3	5.37	*difference from m4 % =*		*0.00*
5.00		0.00	0.0	100.0
2.00	0.07	0.07	0.1	99.9
1.18	0.09	0.09	0.1	99.8
0.600	0.27	0.27	0.3	99.6
0.300	0.82	0.82	0.8	98.8
0.150	0.99	0.99	1.0	97.8
0.063	3.10	3.10	3.0	94.8
Pan mE	0.01			
		cum. mass ret. + mE =		*5.35*
		difference from m6 % =		*0.37*

Approved Signatory: Lo Kam-chuen
Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101891N

Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to

Project : Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/4

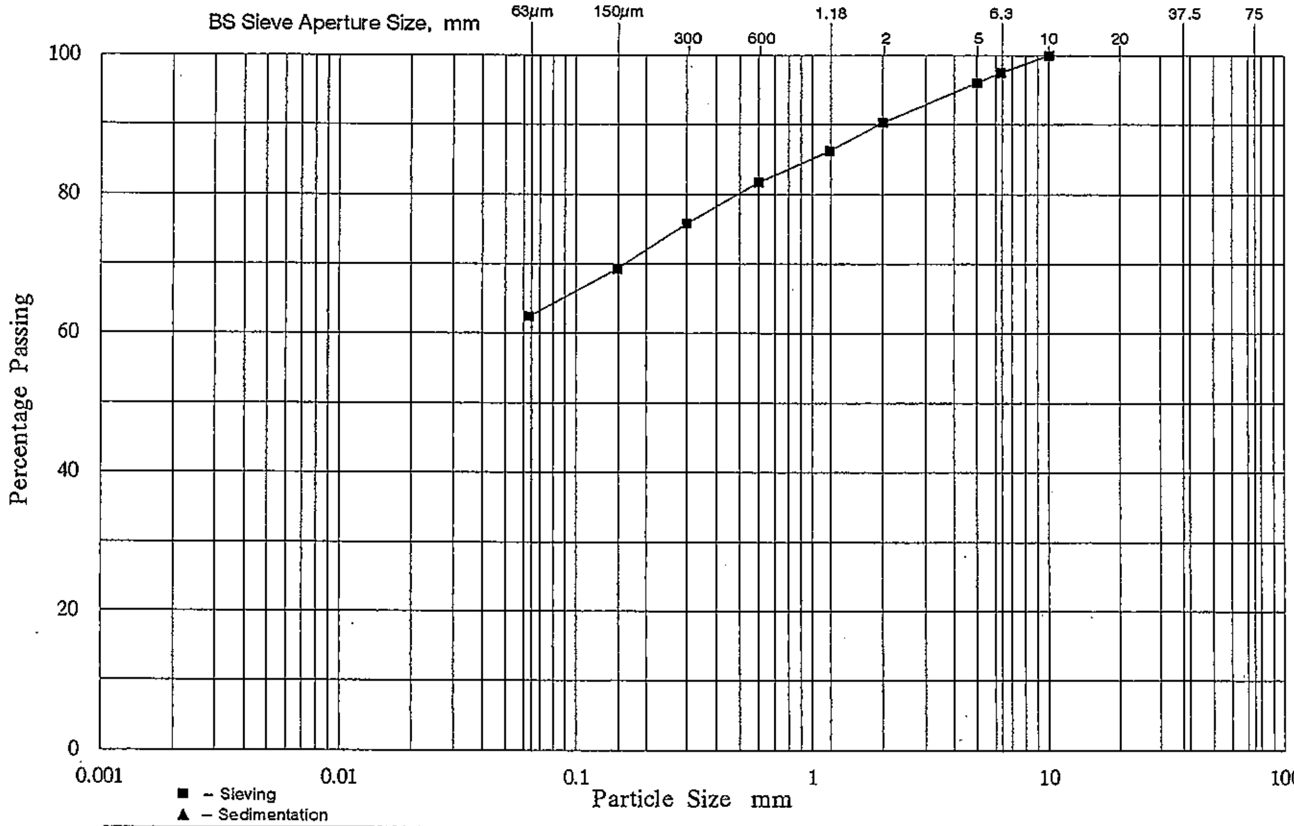
Composite Sample No. : VC11a **Sample No:** **Depth m:** 0.90 – 1.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly gravelly, slightly sandy CLAY with occasional shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COB-BLES
	SILT			SAND			GRAVEL			

Remarks:

SUMMARY :

GRAVEL	10 %
SAND	28 %
SILT & CLAY	62 %

Approved Signatory: Lo Kam chuen

Lo Kam – chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

TEST\GEO36\PSDA (19970811)

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) — Report No: 101891N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 Works Order No: GE/2005/47.19 Lab. Sample Ref. No: 18263/4

Composite Sample No. : VC11a Sample No: Depth m: 0.90 – 1.90 Specimen Depth m:

Sample Type: Bulk Spec. Ref: Geological Origin: Sediment

Description : Grey, slightly gravelly, slightly sandy CLAY with occasional shell fragments

Date Sample Received: 13/10/2006 Date Tested: 21/10/2006 Tested By: H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 104.73

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	104.73	*cum. mass ret. + m2 =*		*104.73*
Riffled m3 20.0	104.73	*difference from m1 % =*		*0.00*
Washed m4	39.33	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3	2.60	2.60	2.5	97.5
Passing m5 6.3	36.73	*cum. mass ret. + m5 =*		*39.33*
Riffled m6 6.3	36.73	*difference from m4 % =*		*0.00*
5.00	1.55	1.55	1.5	96.0
2.00	6.03	6.03	5.8	90.3
1.18	4.25	4.25	4.1	86.2
0.600	4.74	4.74	4.5	81.7
0.300	6.15	6.15	5.9	75.8
0.150	6.87	6.87	6.6	69.3
0.063	7.04	7.04	6.7	62.5
Pan mE	0.01			
		cum. mass ret. + mE =		*36.64*
		difference from m6 % =		*0.25*

Approved Signatory: Lo Kam chuen (signature) Lo Kam–chuen Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

(Page 1 of 2)

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101892N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/5

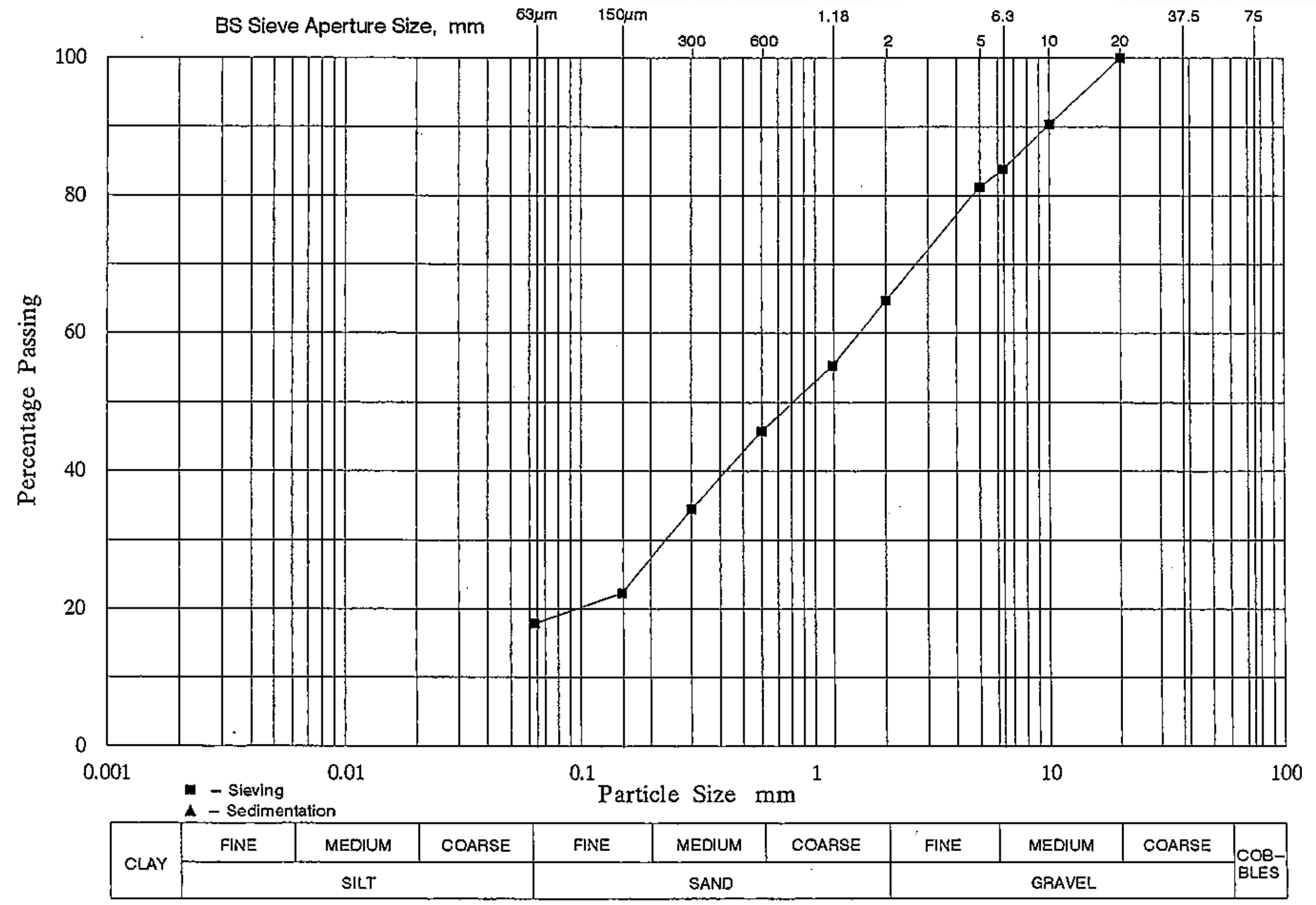
Composite Sample No. : VC12a **Sample No:** **Depth m:** 0.00 – 0.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Black, grey, clayey, gravelly SAND with some shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :

GRAVEL	35 %
SAND	47 %
SILT & CLAY	18 %

Approved Signatory: Lo Kam chuen
Lo Kam-chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

TEST\GEO36\PSDA (19970811)

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Report No: 101892N

Project : Chemical and Biological Testing of Sediment(Term Contract) Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 Works Order No: GE/2005/47.19 Lab. Sample Ref. No: 18263/5

Composite Sample No. : VC12a Sample No: Depth m: 0.00 – 0.90 Specimen Depth m:

Sample Type: Bulk Spec. Ref: Geological Origin: Sediment

Description : Black, grey, clayey, gravelly SAND with some shell fragments

Date Sample Received: 13/10/2006 Date Tested: 21/10/2006 Tested By: H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS				
Initial Dry Mass of Soil m1 g:	126.20			
BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	126.20	*cum. mass ret. + m2 =*		*126.20*
Riffled m3 20.0	126.20	*difference from m1 % =*		*0.00*
Washed m4	103.71	Note: m4 = mass >63um		
10.0	12.09	12.09	9.6	90.4
6.3	8.33	8.33	6.6	83.8
Passing m5 6.3	83.29	*cum. mass ret. + m5 =*		*103.71*
Riffled m6 6.3	83.29	*difference from m4 % =*		*0.00*
5.00	3.19	3.19	2.5	81.3
2.00	20.90	20.90	16.6	64.7
1.18	11.82	11.82	9.4	55.4
0.600	12.07	12.07	9.6	45.8
0.300	14.25	14.25	11.3	34.5
0.150	15.43	15.43	12.2	22.3
0.063	5.45	5.45	4.3	17.9
Pan mE	0.09			
		cum. mass ret. + mE =		*83.20*
		difference from m6 % =		*0.11*

Approved Signatory: Lo Kam chuen
Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101893N

Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to

Project : Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/6

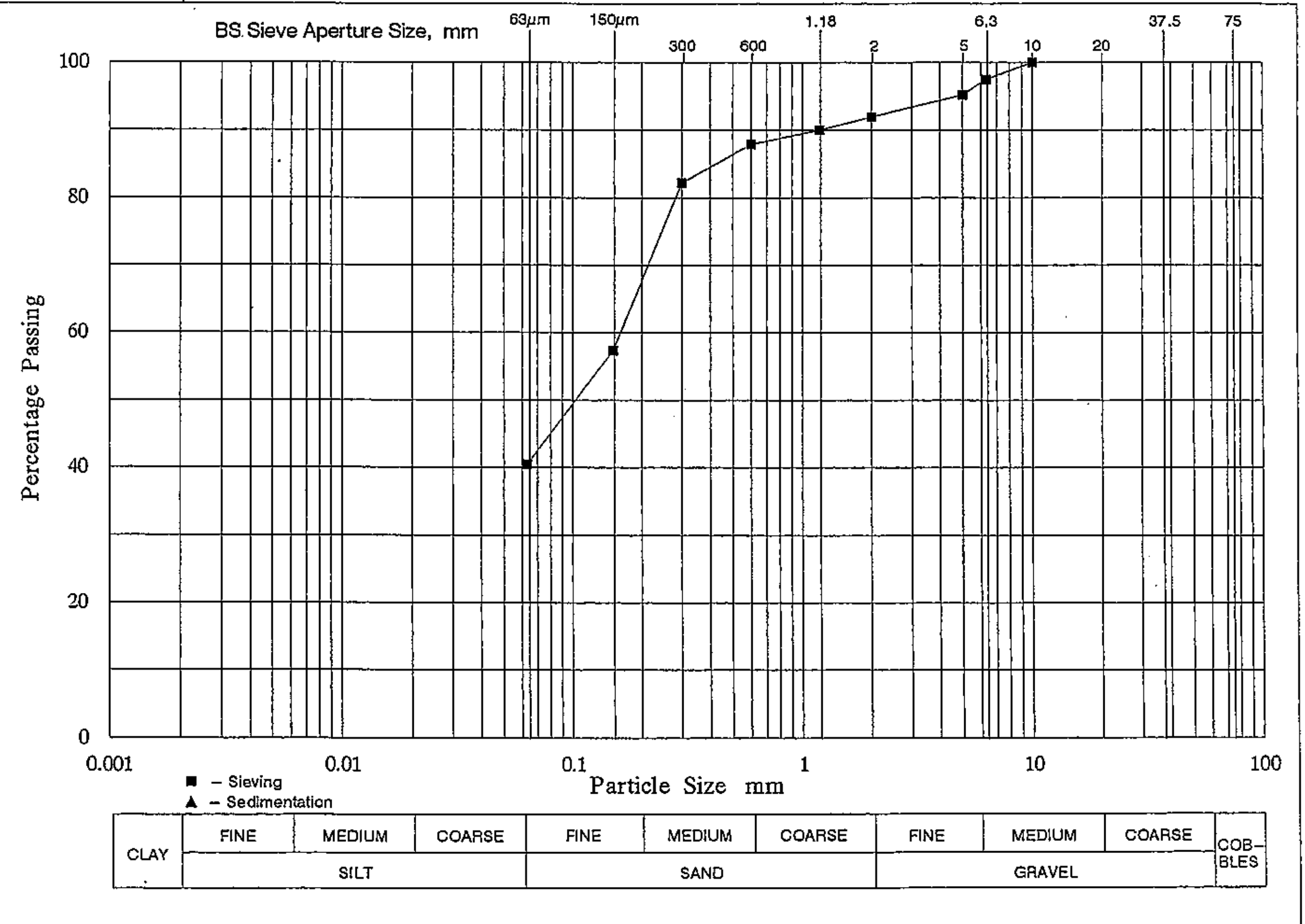
Composite Sample No. : VC13a **Sample No:** **Depth m:** 0.00 & 4.90 – 0.90 5.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Dark grey, slightly gravelly, silty, very clayey SAND with occasional shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :		
	GRAVEL	8 %
	SAND	52 %
	SILT & CLAY	40 %

Approved Signatory: Lo Kam chuen
Lo Kam-chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101893N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/6

Composite Sample No. : VC13a **Sample No:** **Depth m:** 0.00 – 0.90 & 4.90 5.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Dark grey, slightly gravelly, silty, very clayey SAND with occasional shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 107.02

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	107.02	*cum. mass ret. + m2 =*		*107.02*
Riffled m3 20.0	107.02	*difference from m1 % =*		*0.00*
Washed m4	63.76	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3	2.63	2.63	2.5	97.5
Passing m5 6.3	61.13	*cum. mass ret. + m5 =*		*63.76*
Riffled m6 6.3	61.13	*difference from m4 % =*		*0.00*
5.00	2.47	2.47	2.3	95.2
2.00	3.53	3.53	3.3	91.9
1.18	2.08	2.08	1.9	90.0
0.600	2.28	2.28	2.1	87.9
0.300	6.11	6.11	5.7	82.2
0.150	26.55	26.55	24.8	57.3
0.063	17.98	17.98	16.8	40.5
Pan mE	0.04			
		cum. mass ret. + mE =		*61.04*
		difference from m6 % =		*0.15*

Approved Signatory: Lo Kam chuen
Lo Kam – chuen

Date: 27-11-2006

TEST\GEO36\PSDA (19970811)

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101894N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/7

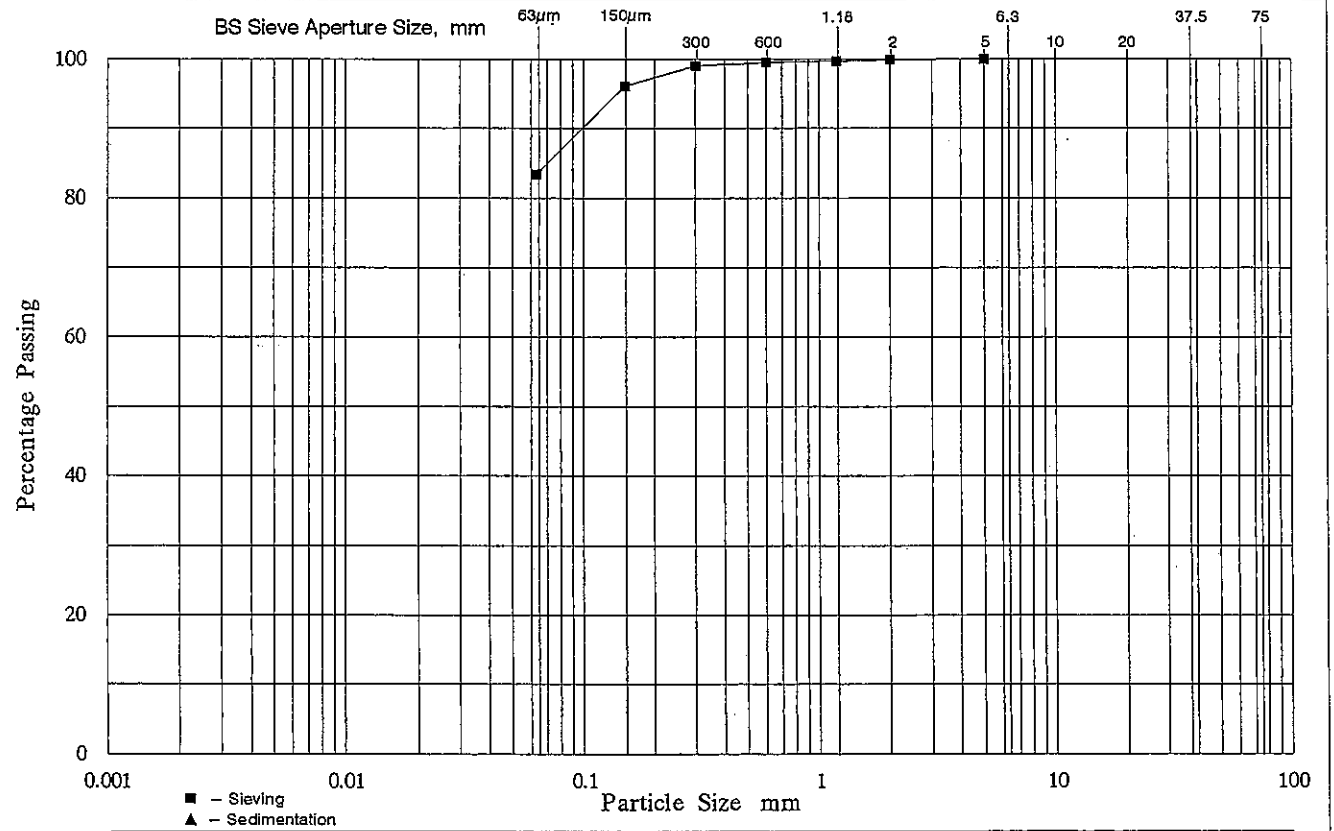
Composite Sample No. : VC14a **Sample No:** **Depth m:** 0.00 – 0.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COB-BLES
	SILT			SAND			GRAVEL			

Remarks:

SUMMARY :

GRAVEL	0 %
SAND	17 %
SILT & CLAY	83 %

Approved Signatory: Lo Kam-chuen

Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

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Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101894N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/7

Composite Sample No. : VC14a **Sample No:** **Depth m:** 0.00 – 0.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 106.12

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	106.12	*cum. mass ret. + m2 =*		*106.12*
Riffled m3 20.0	106.12	*difference from m1 % =*		*0.00*
Washed m4	17.73	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3		0.00	0.0	100.0
Passing m5 6.3	17.73	*cum. mass ret. + m5 =*		*17.73*
Riffled m6 6.3	17.73	*difference from m4 % =*		*0.00*
5.00		0.00	0.0	100.0
2.00	0.10	0.10	0.1	99.9
1.18	0.23	0.23	0.2	99.7
0.600	0.21	0.21	0.2	99.5
0.300	0.40	0.40	0.4	99.1
0.150	3.20	3.20	3.0	96.1
0.063	13.49	13.49	12.7	83.3
Pan mE	0.05			
		cum. mass ret. + mE =		*17.68*
		difference from m6 % =		*0.28*

Approved Signatory: Lo Kam Chuen
Lo Kam – chuen

Date: 27-11-2006

TEST|GEO36|PSDA (19970811)

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101890N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/8

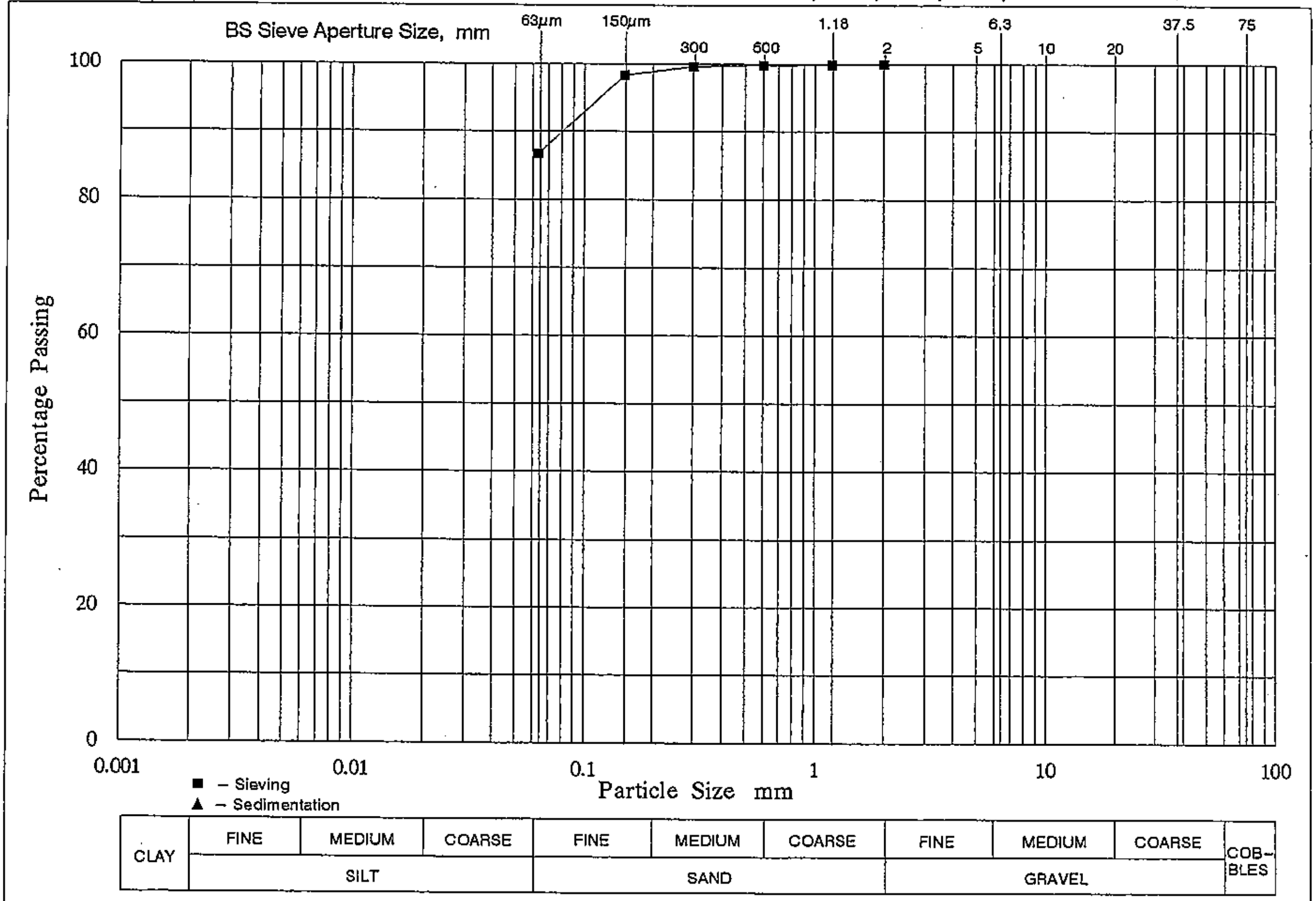
Composite Sample No. : VC15a **Sample No:** **Depth m:** 10.90 – 11.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :

GRAVEL	0 %
SAND	13 %
SILT & CLAY	87 %

Approved Signatory: Lo Kam-chuen

Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Report No: 101890N

Project : Chemical and Biological Testing of Sediment(Term Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/8

Composite Sample No. : VC15a **Sample No:** **Depth m:** 10.90 – 11.90 **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 100.64

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	100.64	*cum. mass ret. + m2 =*		*100.64*
Riffled m3 20.0	100.64	*difference from m1 % =*		*0.00*
Washed m4	13.48	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3		0.00	0.0	100.0
Passing m5 6.3	13.48	*cum. mass ret. + m5 =*		*13.48*
Riffled m6 6.3	13.48	*difference from m4 % =*		*0.00*
5.00		0.00	0.0	100.0
2.00		0.00	0.0	100.0
1.18	0.07	0.07	0.1	99.9
0.600	0.09	0.09	0.1	99.8
0.300	0.20	0.20	0.2	99.6
0.150	1.29	1.29	1.3	98.4
0.063	11.64	11.64	11.6	86.7
Pan mE	0.10			
		cum. mass ret. + mE =		*13.39*
		difference from m6 % =		*0.67*

Approved Signatory: Lo Kam chuen
Lo Kam–chuen

Date: 27-11-2006

TEST\GEO36\PSDA (19970811)

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101895N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Client Name & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/9

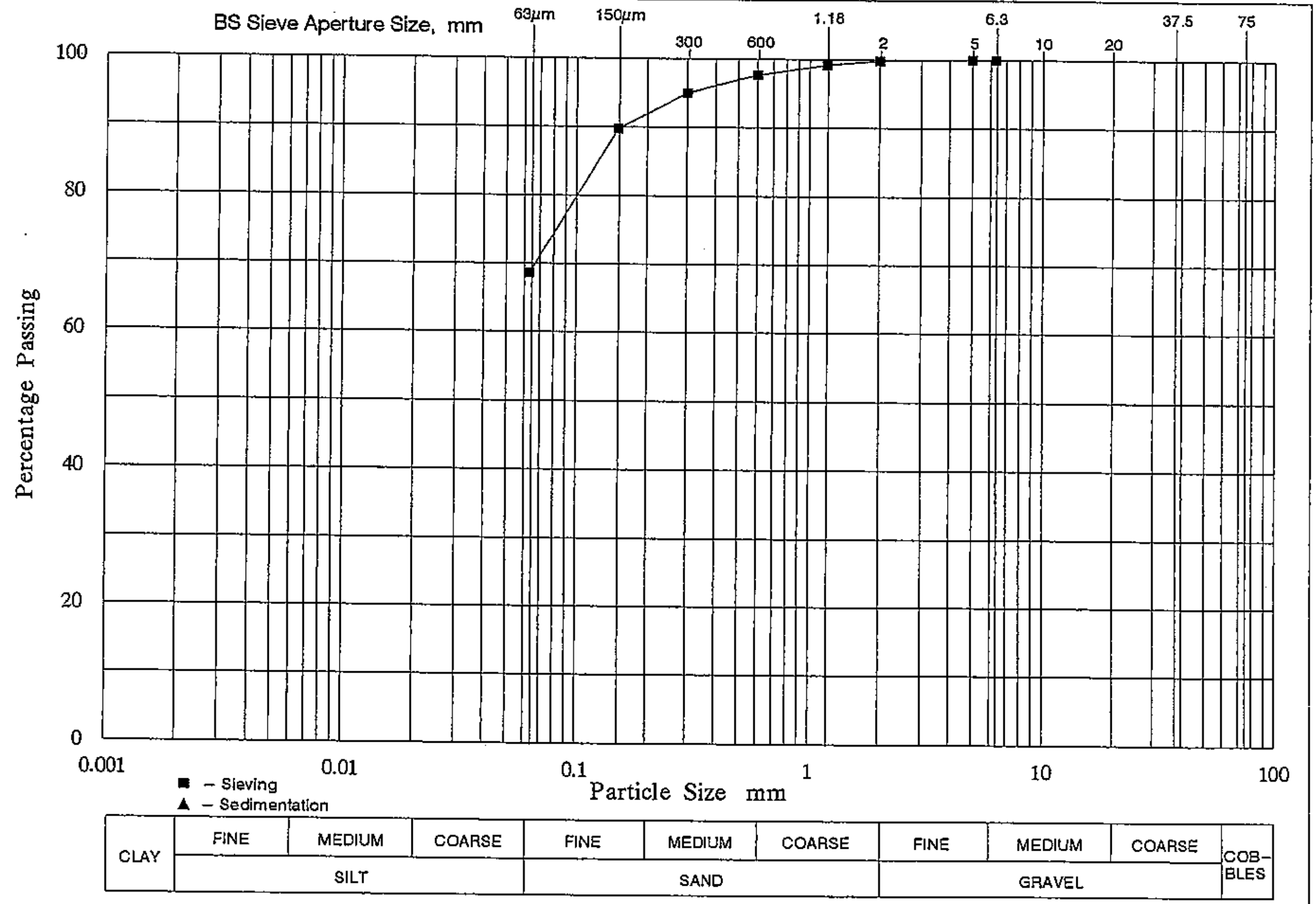
Composite Sample No. : Reference Sediment **Sample No:** **Depth m:** – **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY with occasional shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A



Remarks:

SUMMARY :

GRAVEL	0 %
SAND	31 %
SILT & CLAY	69 %

Approved Signatory: Lo Kam-chuen

Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 28973282

Lam Laboratories Limited

TEST REPORT ON DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Chemical and Biological Testing of Sediment(Term Contract) Report No: 101895N

Project : Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department 8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No:** GE/2005/47.19 **Lab. Sample Ref. No:** 18263/9

Composite Sample No. : Reference Sediment **Sample No:** **Depth m:** – **Specimen Depth m:**

Sample Type: Bulk **Spec. Ref:** **Geological Origin:** Sediment

Description : Grey, slightly sandy CLAY with occasional shell fragments

Date Sample Received: 13/10/2006 **Date Tested:** 21/10/2006 **Tested By:** H. W. Chu

Tested in Accordance With: GEOSPEC 3:2001 Test 8.1 / ~~8.2 / 8.5 / 8.6 / 8.7~~ Method A

SIEVE ANALYSIS

Initial Dry Mass of Soil m1 g: 104.98

BS Test Sieve mm	Mass Retained g	Corr. Mass Retained g	Percent Retained %	Percent Passing %
75.0			0.0	100.0
37.5			0.0	100.0
20.0			0.0	100.0
Passing m2 20.0	104.98	*cum. mass ret. + m2 =*		*104.98*
Riffled m3 20.0	104.98	*difference from m1 % =*		*0.00*
Washed m4	33.01	Note: m4 = mass >63um		
10.0		0.00	0.0	100.0
6.3		0.00	0.0	100.0
Passing m5 6.3	33.01	*cum. mass ret. + m5 =*		*33.01*
Riffled m6 6.3	33.01	*difference from m4 % =*		*0.00*
5.00	0.02	0.02	0.0	100.0
2.00	0.22	0.22	0.2	99.8
1.18	0.62	0.62	0.6	99.2
0.600	1.53	1.53	1.5	97.7
0.300	2.82	2.82	2.7	95.0
0.150	5.60	5.60	5.3	89.7
0.063	22.12	22.12	21.1	68.6
Pan mE	0.03			
		cum. mass ret. + mE =		*32.96*
		difference from m6 % =		*0.15*

Approved Signatory: Lo Kam-chuen Lo Kam – chuen Date: 27-11-2006

TEST REPORT ON DETERMINATION OF MOISTURE CONTENT

(By oven drying at 105°C ± 5°C)

Report No: 101896N

Project : Chemical and Biological Testing of Sediment(Term Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No** : GE/2005/47.19

Date Samples Received : 13/10/2006

Tested in Accordance With : GEOSPEC 3: 2001 Test 5.2

Composite Sample No.	Sample				Lab. Sample Ref. No.	Date Tested	Tested By	Description	Geological Origin	Moisture Content %
	No.	Depth m	Type	Specimen Depth m						
VC4a		10.90–11.90	Bulk		18263/1	13/10/06	HWC	Grey, gravelly, silty, very clayey SAND	Sediment	22
VC7a		0.90–1.90	Bulk		18263/2	13/10/06	HWC	Grey, sandy CLAY with some shell fragments	Sediment	51
VC8a		10.90–11.90	Bulk		18263/3	13/10/06	HWC	Grey, slightly sandy CLAY	Sediment	57
VC11a		0.90–1.90	Bulk		18263/4	13/10/06	HWC	Grey, slightly gravelly, slightly sandy CLAY with occasional shell fragments	Sediment	53
VC12a		0.00–0.90	Bulk		18263/5	13/10/06	HWC	Black, grey, clayey, gravelly SAND with some shell fragments	Sediment	40
VC13a		0.00–0.90 & 4.90–5.90	Bulk		18263/6	13/10/06	HWC	Dark grey, slightly gravelly, silty, very clayey SAND with occasional shell fragments	Sediment	59
VC14a		0.00–0.90	Bulk		18263/7	13/10/06	HWC	Grey, slightly sandy CLAY	Sediment	93
VC15a		10.90–11.90	Bulk		18263/8	13/10/06	HWC	Grey, slightly sandy CLAY	Sediment	54

Remarks:

Approved Signatory: Lo Kam chuen
Lo Kam–chuen

Date: 27-11-2006

Lam Laboratories Limited

TEST REPORT ON
DETERMINATION OF MOISTURE CONTENT

(By oven drying at 105°C ± 5°C)

Report No: 101897N

Project : Chemical and Biological Testing of Sediment(Term Contract)
Agreement No. CE 42/2005 (WS) Laying of Western Cross Harbour Main and Associated Land Mains West Kowloon to Sai Ying Pung – Investigation Chemical, Elutriate and Biological Testing of Marine Sediment and Seawater Samples

Customer & Address : Geotechnical Projects Division, Geotechnical Engineering office, Civil Engineering and Development Department
8/F Civil Engineering and Development Building, 101 Princess Margaret Road, Kowloon, Hong Kong

Lab Job No : J469 **Works Order No :** GE/2005/47.19

Date Samples Received : 13/10/2006

Tested in Accordance With : GEOSPEC 3: 2001 Test 5.2

Composite Sample No.	Sample No.	Sample Depth m	Sample Type	Sample Specimen Depth m	Lab. Sample Ref. No.	Date Tested	Tested By	Description	Geological Origin	Moisture Content %
Reference Sediment			Bulk		18263/9	13/10/06	HWC	Grey, slightly sandy CLAY with occasional shell fragments	Sediment	98

Remarks:

Approved Signatory: Lo Kam chuen
Lo Kam – chuen

Date: 27-11-2006

Lam Laboratories Limited Rm 1412, Honour Industrial Centre, 6 Sun Yip Street, Chaiwan, Hong Kong Tel: 2897 3282

TEST\GEO36\MC105 (19970224)

ALS Technichem (HK) Pty Ltd

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

CERTIFICATE OF ANALYSIS

Client	: LAM LABORATORIES LIMITED	*Laboratory*	: ALS Technichem (HK) Pty Ltd	*Page*	: 1 of 6
Contact	: MS MAUREEN CHANG	*Contact*	: Alice Wong / Ivan Leung	*Work Order*	: **HK0605630**
Address	: RM 1412-16, HONOUR INDUSTRIAL CENTRE, 6 SUN YIP STREET, CHAI WAN, HONG KONG	*Address*	: 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T. Hong Kong		
E-mail	: maureenchang@lamlab.com	*E-mail*	: alice.wong@alsenviro.com		
Telephone	: +852 2975 3372	*Telephone*	: +852 2610 1044		
Facsimile	: +852 2897 5509	*Facsimile*	: +852 2610 2021	*Date received*	: 31 Oct 2006
Project	: J469 SO19	*Quote number*	: ----	*Date of issue*	: 7 Nov 2006
Order number	: ----			*No. of samples*	- *Received* : 10
C-O-C number	: ----				*Analysed* : 9
Site	: ----				

Report Comments

This report for ALS Technichem (HK) Py Ltd work order reference HK0605630 supersedes any previous reports with this reference. The completion date of analysis is 3 Nov 2006. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

Specific comments for Work Order HK0605630 : **Sample(s) analysed and reported on an as received basis.**
Samples were received in an ambient condition.

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in the 'Electronic Transactions Ordinance' of Hong Kong, Chapter 553, Section 6.

Signatory	*Position*	*Authorised results for:-*
Fung Lim Chee, Richard	**General Manager**	**Inorganics**

Client : LAM LABORATORIES LIMITED
Work Order HK0605630

Analytical Results

Submatrix: SOIL

Method: Analysis Description	CAS number	LOR	Units	18263/1	18263/2	18263/3	18263/4	18263/5
Laboratory Sample ID:				HK0605630-001	HK0605630-002	HK0605630-003	HK0605630-004	HK0605630-005
Sample Date / Time:				[31 Oct 2006]	[31 Oct 2006]	[31 Oct 2006]	[31 Oct 2006]	[31 Oct 2006]
EP: Aggregate Organics								
EP009: Total Organic Carbon	----	0.05	%	**0.65**	**0.49**	**0.60**	**0.66**	**0.40**

Client : LAM LABORATORIES LIMITED
Work Order HK0605630

Analytical Results

Submatrix: SOIL

Method: Analysis Description	CAS number	LOR	Units					
			Client Sample ID :	18263/6	18263/7	18263/8	18263/9	
			Laboratory Sample ID :	HK0605630-006	HK0605630-008	HK0605630-009	HK0605630-010	
			Sample Date / Time :	[31 Oct 2006]	[31 Oct 2006]	[31 Oct 2006]	[31 Oct 2006]	
EP: Aggregate Organics								
EP009: Total Organic Carbon	----	0.05	%	**0.62**	**0.70**	**0.35**	**0.64**	

Client : LAM LABORATORIES LIMITED
Work Order HK0605630

Quality Control - Laboratory Duplicate (DUP) Results

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Duplicate (DUP) Results				
				LOR	Units	Original Result	Duplicate Result	RPD (%)
EP: Aggregate Organics (QC Lot: 300680)								
HK0605629-001	Anonymous	EP009: Total Organic Carbon	----	0.05	%	0.26	0.25	0.0
HK0605629-003	Anonymous	EP009: Total Organic Carbon	----	0.05	%	0.93	1.07	13.8

Quality Control - Method Blank (MB), Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results

Matrix Type: SOIL		Method Blank (MB) Results			Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results						
					Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EP: Aggregate Organics (QCLot: 300680)											
EP009: Total Organic Carbon	----	0.05	%	<0.05	40 %	102	----	85	115	----	----

Client : LAM LABORATORIES LIMITED
Work Order HK0605630

Quality Control - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results

Matrix Type: SOIL

Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results						
				Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
				Concentration	MS	MSD	Low	High	Value	Control Limit
EP: Aggregate Organics (QCLot: 300680)										
HK0605630-001	18263/1	EP009: Total Organic Carbon	----	40 %	101	----	75	125	----	----

Appendix F4

Approval Letter from MFC on Dredging Rationale

CED

土木工程拓展署
CEDD Civil Engineering and Development Department

土木工程處
Civil Engineering Office

Web site 網址 : http://www.cedd.gov.hk
E-mail 電子郵件: winghongchung@cedd.gov.hk
Telephone 電話 : 2762 5540
Facsimile 傳真 ; 2714 0113
Our reference 本署檔號: (2) in FM DS/DIS/20 Pt. 8
Your reference 來函檔號: KMY/SHC/GAJ/MT/RLI/CKT/mc/226133/08.03/L-0126

香港九龍公主道 101 號
土木工程拓展署大樓
Civil Engineering and
Development Building,
101 Princess Margaret Road,
Kowloon, Hong Kong

BY FAX (Fax No. 2827 1823)
21 July 2006

Mott Connell Limited
40/F., Hopewell Centre, 183 Queen's Road East,
Wanchai, Hong Kong.
(Attention: Mr. S.H. CHING)

Dear Sirs,

Agreement No. CE 42/2005(WS)
Laying of Western Cross Harbour Main and Associated Land Mains
From West Kowloon to Sai Ying Pun – Investigation

Dredging Rationale

I refer to your submission dated 20 July 2006 and would like to advise you that your Rationale for Sediment Removal submitted for this project is agreed with.

Yours faithfully,

(W.H. CHUNG)
for Secretary, Marine Fill Committee
Civil Engineering Office
Civil Engineering and Development Department

c.c. WSD/CM – Attn: Ms Candy WONG (fax no.: 2634 1770)

WHC/whc

Appendix G

Not Used

Appendix H

Marine Archaeological Investigation Report

AGREEMENT NO. CE 42/2005 (WS)

LAYING OF WESTERN CROSS HARBOUR MAIN AND ASSOCIATED LAND MAINS

FROM WEST KOWLOON TO SAI YING PUN

MARINE ARCHAEOLOGICAL INVESTIGATION

Yau Ma Tei typhoon shelter in 1906 after a bad storm

PREPARED FOR MOTT CONNELL LIMITED

BY SDA MARINE LTD

REPORT NUMBER: HKSDA00610
JANUARY 2007

SDA MARINE LTD
1604 Kinwick Centre
32 Hollywood Road
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CONTENTS

FIGURES

CHART FIGURES

1 SUMMARY

In accordance with the 1998 EIA Ordinance (Cap. 499, S16), the Antiquities and Monuments Office (AMO) requested a Marine Archaeological Investigation (MAI) for the Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun. The requirement is set out in the Water Supplies Department Draft Brief issued 24th October, Appendix III, Annex C (EIA Study Brief ESB-132/2005).

The project will comprise an approximately 2.1Km x 1200mm-diameter submarine water main, buried at 5m depth across Victoria Harbour: from its existing connection at Lin Cheung Road in West Kowloon to the existing Sai Ying Pun Fresh Water Pumping Station in Sheung Wan.

The aim of the investigation was to locate and assess underwater archaeological resources which may be damaged by the installation of the cross harbour mains. In accordance with AMO Guidelines, the MAI consisted of a Baseline Review and Geophysical Survey.

The desk top Baseline Review indicated a high potential for marine archaeological material within the study area. The area around Yau Ma Tei has been the focus for intense maritime activity throughout the whole of Hong Kong's history. The potential is reduced because of the seabed disturbance associated with numerous reclamations and construction of the Western harbour crossing.

The combination of the Baseline Review and Geophysical Survey combine to provide 100% coverage of the study area. The geophysical survey provided very detailed information about features on the seabed. Within the study area, the seabed is characterised by the presence of dumped materials, trawl marks, scars and other evidence of previous disturbance. There was no indication of any archaeological resources.

It is therefore concluded that there are no marine archaeological resources within the study area. It follows that there are no related constraints on the proposed development.

There is no need for any further archaeological investigation or mitigation measures.

2 INTRODUCTION

In accordance with the 1998 EIA Ordinance (Cap. 499, S16), the Antiquities and Monuments Office (AMO) requested a Marine Archaeological Investigation (MAI) for the Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun. The requirement is set out in the Water Supplies Department Draft Brief issued 24th October, Appendix III, Annex C (EIA Study Brief ESB-132/2005).

The project will comprise an approximately 2.1Km x 1200mm-diameter submarine water main, buried at 5m across Victoria Harbour: from its existing connection at Lin Cheung Road in West Kowloon to the existing Sai Ying Pun Fresh Water Pumping Station in Sheung Wan. The location of the study area is shown in Figure 1.

The aim of the investigation was to locate and assess underwater archaeological resources which may be damaged by the installation of the cross harbour mains. In accordance with AMO Guidelines, the MAI consisted of a Baseline Review and Geophysical Survey.

3 LEGISLATIVE FRAMEWORK FOR MARINE ARCHAEOLOGICAL INVESTIGATIONS IN HONG KONG

Since the introduction of the 1998 Environmental Impact Assessment (EIA) Ordinance CAP. 499, S16, (Hong Kong Environmental Protection Department, 1977), the Antiquities and Monuments Office (AMO) have the power to request a MAI for developments affecting the seabed. The EIA Ordinance stipulates that consideration must be given to issues associated with cultural heritage and archaeology as part of the EIA process. Annexes 10 and 19 of the EIA Technical Memoranda (TM) outline the criteria for evaluating the impacts on sites of cultural heritage and guidelines for impact assessment, respectively. The EIA TM identifies a general presumption in favour of the protection and conservation of all sites of cultural heritage and requires impacts upon sites of cultural heritage to be '*kept to a minimum*'. There is no quantitative standard for determining the relative importance of sites of cultural heritage, but in general sites of unique, archaeological, historical or architectural value should be considered as highly significant.

3.1 THE ANTIQUITIES AND MONUMENTS ORDINANCE

Legislation relating to antiquities is set out in the Antiquities and Monuments Ordinance (Chapter 53 of the Laws of Hong Kong), which came into force on January 1st 1976. The AM Ordinance provides statutory protection against the threat of development on Declared Monuments, historical buildings and archaeological sites to enable their preservation for posterity. The legislation applies equally to sites on land and underwater. The purpose of the Ordinance is to prescribe controls for the discovery and protection of antiquities in Hong Kong. A summary of the key aspects of the legislation relevant to the current study is presented below:

- Human artefacts, relics and built structures may be gazetted and protected as monuments. The Antiquities Authority may, after consultation with the Antiquities Advisory Board (AAB) and with the Chief Executive's approval, declare any place, building, site or structure which the Antiquities Authority considers to be of public interest by reason of its historical, archaeological or palaentological significance, to be a monument, historical building, archaeological or palaentological site or structure.

- Once declared a site of public interest, no person may undertake acts which are prohibited under the Ordinance, such as to demolish or carry on building or other works, unless a permit is obtained from the Antiquities Authority.

- The Ordinance defines an antiquity as a relic (a moveable object made before 1800) and a place, building, site or structure erected, formed or built by human agency before the year 1800. Archaeological sites are classified into three categories, as follows:
  Declared Monument – those that are gazetted in accordance with Cap. 53 by the Antiquities Authority and are to be protected and conserved at all costs;
  Recorded Archaeological Sites – those which are considered to be of significant value but which are not yet declared as monuments and should be either protected, or if found not possible to protect these sites then salvaged

- The Legislation sets out the procedures for the issuing of Licenses to Excavate and Search for Antiquities, the effect of which is to forbid all such activities being undertaken without such a License. It also provides for the penalties exacted for infringement of the Ordinance, including fines and imprisonment.

4 METHODOLOGY

The study was undertaken using standard MAI techniques described below which follow the Guidelines issued by the Antiquities and Monuments Office.

4.1 BASELINE REVIEW

A comprehensive review was carried out to determine the archaeological potential of the study area. This included archaeological and historical publications.

4.2 ARCHIVE SEARCH

All archives holding information on shipwrecks in Hong Kong were explored for relevant data.

4.3 GEOPHYSICAL SURVEY

The survey aim was to locate any possible marine archaeological resources on the seabed. On the instructions of the Geotechnical Engineering Office (GEO) of Civil Engineering & Development Department (CEDD), Works Order No. GE/2005/26, a geophysical survey was conducted by IGGE. The full data set was passed to SDA Marine Ltd for analysis and interpretation.

4.3.1 SURVEY PERIOD AND LOCATION

The survey area is defined by four co-ordinated boundary points shown on each of the charts attached to this report. The survey was conducted on August 17th to 24th 2006. The survey line spacing and cross survey line spacing were set out by Mott Connell as followl:

SURVEY TYPE	MAIN SURVEY LINE SPACING	CROSS SURVEY LINE SPACING
Multi beam sounding	20m	100m
Seismic Profiler	20m	100m
Side scan sonar	20m	N/a

The track plot for each type of survey is also shown on each of the ChartFigures accompanying this report.

4.3.2 SITE SAFETY

Safety conditions on board were good and were checked by the officials of GEO and the IGGE safety officer. The crew working on the survey vessel held safety training certificates. The survey vessel stayed in contact with Port Control via marine radio during the survey. This was vital as the study area is in a very busy section of Victoria Harbour.

4.3.3 EQUIPMENT

Listed below is the equipment relevant to the archaeological assessment and not the total equipment deployed.

EQUIPMENT	MODEL
Multi beam echo sounder	Seabeam 1185
Automatic water level recorder	Valeport VLR740
Positioning system	NT-300D DGPS differential signal receiver
Marine seismic profiler	DELPH II – including power pack, boomer and hydrophone streamer
Dual channel side scan sonar	Edge Tech 560A
Computerised navigation system	Season TRACKER Navigation System
Depth measurement	Echo sounder - Hummingbird

4.3.4 EQUIPMENT CALIBRATION AND CHECK

4.3.5 TIDE GAUGE

The Valeport VLR 740 Automatic Tide Logger was calibrated at the beginning of each survey day at Tuen Mun Pier to ensure the accuracy of +/- 0.02m.

4.3.6 POSITIONING SYSTEM

The accuracy check was completed prior to commencement of the survey. The DGPS was installed and checked at a co-ordinated station at North Point. Data were 95% reliable within a 2m radius.

4.3.6 MULTI BEAM ECHO SOUNDING

Calibrations of the vessel motion sensor and the time delay of the positioning system are vital to the quality of the data collected. The calibrations were performed on August 16th, 2006. The calibration of the ELAC SEA BEAM 1185 multi beam system comprise three items: roll, pitch and yaw offset.

4.3.7 SEISMIC PROFILER

The seismic profiler comprise: Control Unit, Power Pack, Hydrophone and Boomer. It is not calibrated by the user but at the time of manufacture. However, it was checked during the survey parameter configuration test and was in good working condition.

4.3.8 SIDE SCAN SONAR

As above, the Edge Tech side scan sonar is pre-set by the manufacturers. Calibration by manual adjustment is not possible. It was checked before the survey commenced.

4.3.9 FIELD PROCEDURE

4.3.10 MULTI BEAM ECHO SOUNDER PARAMETERS

The parameters for the Multi Beam echo sounding were as follows:

Vessel speed:	4-5 knots
Source frequency:	180 kHz
Fan Subtends:	131º

4.3.11 SEISMIC PROFILER PARAMETERS

Fix interval:	1 second
Source:	Boomer
Vessel Speed:	2-4 knots
Energy source:	200J
Ping rate:	2 per second

4.3.12 SIDE SCAN SONAR PARAMETERS

Fix interval:	1 second
Scan width:	50m

Vessel speed: 3-5 knots
Source frequency 500 kHz

4.3.13 DATA PROCESSING AND ANAYLSIS

4.3.14 MULTI BEAM ECHO SOUNDING

4.3.15 TIDAL CORRECTION

The permanent tide gauge station was set up on Cheung Chau pier with co-ordinates of 807428N, 820447E at elevation +3.66mPD. The tide gauge station elevation was measured by ET-02 distometer and ND3000 theodolite based on a known government trigonometric station with HK1980 grid co ordinates.

The data from the geophysical survey were corrected to Hong Kong Principal Datum (HKPD) by using a bench mark with known level in mPD. The tide data in mPD was the water column height referred to Principal Datum. The tidal correction of the geophysical data was calculated according to the corresponding time by the following formula:

Corrected depth Datum = Survey reading – Tide Datum

The seabed levels were calculated from the corrected multi beam data. The data was processed and presented as a contour plan.

4.3.16 SEISMIC PROIFLER DATA

The following processing was applied to the data:

- Seismic processing software was applied to get clearer reflection interfaces by adjusting post-processing parameters
- Analysis and definition of the geological horizons
- Digitising of the reflection interfaces to get the two-way travel time profiles
- Conversion of the two-way travel time profiles into seismic-geological depth profiles
- Combining of bathymetric data and seismic data to define the elevation of each horizon
- Process with Surfer software to generate required drawings

5. RESULTS

5.1 BASELINE REVIEW

5.1.1 SHIPWRECK DATA

Practically nothing is known about the archaeological potential of the seabed deposits in Hong Kong. The only marine archaeological discovery is that of a late Sung/early Ming Dynasty (1368-1644) boat uncovered during the construction of the High Island Reservoir, near Sai Kung (Frost, 1974). Since then, no other historic shipwreck has been found. However, this is probably because there were no dedicated marine archaeological surveys until the introduction of the 1998 EIA Ordinance. Marine archaeology is therefore a relatively new area of study in Hong Kong with very little data to draw upon.

Formation of archaeological sites underwater is mainly due to shipwrecks (Muckelroy, 1978). Since these are random and haphazard events it is difficult to predict their exact location if no written references survive. The aim of this review is to examine the evidence for maritime activity within the study area to predict the shipwreck potential.

5.1.2 ARCHIVE SEARCH

The UK Hydrographic Office (UKHO) at Taunton holds a database of surveyed shipwrecks in Hong Kong, including many not shown on Admiralty Charts. The database does not contain any records of shipwrecks within the study area.

However, the Hydrographic Office only charts wrecks, which are a potential hazard to navigation. It is therefore possible that within the study area there are partially or totally buried wrecks, which are not recorded.

The Hydrographic Office also holds unpublished historical charts of the Hong Kong SAR's waters. British Admiralty Charts from 1853 and 1888 are presented as Figures 2 and 3.

5.1.3 VICTORIA HARBOUR IN PRE-BRITISH TIMES

The first reference to the sea passage and waters in what later became called Victoria Harbour are found in Cheng Ho's navigation map of the China coast dated c.1425 AD. This map was published in a book called *Mo Pei Chi* (Notes on Military Preparation), published in 1621 (Empson, 1992). The map indicates the routes taken by vessels of a 15th century Imperial Chinese fleet under the command of Admiral Cheng Ho.

Victoria Harbour is charted in a 1553 coastal map of Kwangtung appearing in a book by Ying Ka called *Chong Ng Chung Tuk Kwan Mun Chi*. It is also represented in "*Map of the entire coastline*" by Chan Lun Kwing in his book *Hoi Kwok Man Kin Luk* printed in 1744 (Figure 4). The Kang Hsi Emperor commissioned the Jesuit Fathers to produce a detailed map of China, which was reprinted in part in 1737. The Jesuit map is largely a compilation of pre-existing Chinese maps of the coast. Hong Kong waters are charted in his map, found in *Nouvelle Atlas de la Chine*, published in Paris. A further reference appears in the San On Yuen Chi, a cartogram from the directory of San On County (Figure 5).

The first map depicting Hong Kong's harbour in detail is an 1810 marine chart (Figure 6). Daniel Ross and Philip Maughan, Lieutenants of the Bombay Marine prepared this chart for the East India Company.

Together the aforementioned maps are particularly important; indicating that Victoria Harbour was established as a known coastal settlement from at least the 15th century. Although there is no documentary material that records what exactly took place within the harbour, the fact it merited mapping is significant.

5.1.4 1841-1860

On the signing of the Treaty of Chuen-pi in 1841, H.M.S. *Sulphur*, commanded by Captain Sir Edward Belcher, was commissioned to undertake a hydrographic survey of Hong Kong Island and the surrounding waters. Produced in the meticulous style typical of the Royal Navy, this chart is remarkable for its accuracy and detail. It takes into account depth soundings in a number of areas, and these actually form the basis of today's charts in unchanged areas (Figure 7).

5.1.5 SAI YING PUN

Sai Ying Pun was laid out in the 1860's, immediately west of Tai Ping Shan. The name means 'Western Military Camp" and was so called because the first British troops were stationed there. However, this derivation of the name is the subject of controversy; some scholars argue that the term Sai Ying Poon was originally a name used by the Ching Dynasty pirate Cheung Po Tsai from 1806. There was another area at Tsat Tsz Mui, on the eastern end of Hong Kong Island near Quarry Bay, which was known as Tung Ying Poon or "Eastern Military Camp". In both places there are no physical reminders of the 19th Century buildings, but the suitability of both sites with commanding views and strategic locations at both ends of the harbour is unquestioned (Lo, 1963).

When the British landed in 1841, there was already a narrow bridle path along the northern shore of Hong Kong Island extending from West Point to a hamlet near Causeway Bay known as Kwantailou. When the winds and tide were unfavourable, this track was used as a towpath by the crews of coastal trading junks (Eitel, 1895). By February 1841, the Royal Navy laid claim to Navy Bay (Belcher's Creek), and a number of storehouses were constructed. However, within a short time the Navy found the position too exposed to the seasonal typhoon winds and moved to the Central area where they remained for the next century and a half (Lau, 1995).

Riots in southern China in the 1850s brought an influx of mainland Chinese into Hong Kong. In order to accommodate the thousands of new immigrants, the Government had to develop the Sai Ying Pun area. Streets were opened up on the slope to the south of Queen's Road West. A market was built between First and Second Streets. Upon completion of the development project, Sai Ying Pun became a major residential area.

5.1.6 YAU MA TEI

The name “Yau Ma Tei” means Oil Sesame Ground, and at some time sesame was cultivated in the vicinity. The settlement at Yau Ma Tei grew up at the foot of a curving hill, the arms of which extended into the sea as headlands both on the north (Mong Kok Tsui, near today’s Dundas Street) and in the south (the southern headland was near what is now Battery Street). There was an old Chinese fort on this hill from about 1800, which was rebuilt in 1839 and designed to protect vessels sheltering in the anchorage. Between the two headlands, the line of the hill ran close to what is now Nathan Road, and the old excavated face of the hill can still be seen near Cliff Street. Between the two headlands was a beach opening at the southern end to the anchorage creek. On either side of a small stream a tiny agricultural village of two or three houses stood.

It was this beach and creek which attracted the boat population, who used it to repair their vessels and as a shelter against storms. In 1882, this creek was described as:

> “ *a sort of mud dock which dries at half ebb or a little later. This is occupied by many boats, some of which are too leaky or old to go out, and lie here permanently being used as dwellings. This causes serious nuisance*”.

In 1883, the Sanitary Board condemned this creek as a nuisance. By about 1885 it had disappeared, as a consequence of reclamation in the area. After that date, it seems likely that there was no shelter for small boats in West Kowloon until the typhoon shelter opened in 1915. Figure 8 shows the layout of Yau Ma Tei in 1875.

To the north of the Mong Kok Tsui headland a stream flowed into the sea (near the present Soy Street). On either side of this stream there were cultivated fields belonging to the village of Mongkok, already over a 100 years old in 1860. Mongkok village stood to the north of the stream under what today are Mongkok Road and Fife Street.

To the south of the Battery Street Headland was another stream, which entered the sea near today’s Waterloo Road. Like the stream to the north, it had cultivated fields on both sides. In 1864, the Hong Kong Government offered land along the Yau Ma Tei shore to villagers whose homes in Tim Sha Tsiu had been removed for redevelopment. The dispossessed villagers also received “Squatters Licences” for the lots they were given. Many took advantage of the opportunity and within months a thriving new market village had developed.

The first detailed evidence that provides information regarding the settlement at Yau Ma Tei is the first Rates Schedule for British Kowloon dated 1873. It lists the premises, occupants and use of property. A detailed examination of this list with succeeding Rate Valuation Lists, makes it is possible to build an idea of the layout of the settlement and the nature of its occupants.

At that time Yau Ma Tei possessed a good, safe anchorage for sampans in a shallow, but substantial creek six acres in area. The creek ran inland for some three hundred yards, in two branches. One went as far as the junction of today's Jordan Road and Parks Street, the other to the eastern side of today's Nathan Road, near Saigon Street. A breakwater protected the outer part of both branches. The present Pak Hoi Street runs close to where the northern shore of the creek used to be, and doubtless takes its name from this fact. A military post from 1800 protected it. The anchorage was thus in use well before 1860 but the growth of this anchorage into somewhere that could be called a market town began only in 1864.

It is evident from the first valuation of Yau Ma Tei that its economy was primarily dependent on the sea. Boat building yards and their auxiliary businesses such as rope-works, oar makers, blacksmiths and marine stores dominated the market society. There is no way to determine the exact extent of the floating population, but boat building, repairing and provisioning were the principal business activities. It is evident that a substantial floating population was present. The presence of the temple dedicated to Tin Hau the Queen of Heaven, the principal deity of the sea-going population of southern China is also evidence of the importance of the sea-going population to the settlement at Yau Ma Tei. Some of the Yau Ma Tei residents were boat people and fishermen, and newspaper reports of the time particularly mention shrimp fishers.

As noted above, the land was occupied principally by boat-builders and associated trades, but other general traders had moved in by the mid 1870s. In October 1876, the Surveyor General called the town a "*rising and flourishing village*", and in February 1877, the Register General, in commenting on the recent Census stated that:

> "*Yau Ma Tei in Kowloon has become a new town within the last few months, and it will continue to increase if facilities are afforded to the boat builders and the junk people, who will repair thither to careen and repair their vessels, for on those the trade of the place depends*".

Over the years a number of small industries were established at Yau Ma Tei, with many of the products being for the export market. By the 1870s soap and bean curd were being manufactured and exported. In 1880, a match factory was opened, employing around fifty women and children as workers.

Almost inevitably, the Hong Kong Government soon became concerned with the lack of sanitation and associated issues and in 1876 the Yau Ma Tei area was completely cleared. It was extensively redeveloped and replaced with a modern town plan the outline of which remains in the pattern of modern streets.

By the turn of the century a large number of sites on the new reclamation and development areas became available for industrial use. Subsequently the number of factories in Yau Ma Tei grew very quickly. By 1910, factories in the area were producing preserved ginger, matches, walking canes, feather products, peanut oil and rice wine. The range of industries in the area continued to grow steadily until the coming of the Japanese in 1941.

By no means was all of the business activity in Yau Ma Tei lawful, and a not inconsiderable fraction of the shipping through the port was for the purpose of smuggling. Salt smuggling was particularly important and the area became a centre for transiting the goods into the Chinese mainland.

In China, salt production was a government monopoly and to avoid payment of the taxes, it was imported into Hong Kong from the salt producing areas to the west and north east of Hong Kong. It was then transferred to specially designed junks, and under an armed crew, transported up the Canton delta. In the early period of Hong Kong's history this trade flourished at East Point, later shifting to the Sai Ying Pun waterfront. By 1876, the salt merchants opened up business in Yau Ma Tei. When the new premises in the redeveloped town became available in 1978, the salt merchants moved to the new main sea front Praya.

This activity brought a criminal element to Yau Ma Tei. Some of the crews of the salt smuggling junks were alleged to have engaged in piracy on their home runs after disposing of the salt. Yau Ma Tei also had a 'thieves market'. Reported cases mention stolen coal, sandalwood, copper nails and wire being brought there for sale.

Yau Ma Tei was also the distribution point for the overland smuggling of opium. The opium was landed at Yau Ma Tei where porters conveyed it across the Sino-British border and over the Kowloon hills, eventually to Sham Chun and Wai Chow. The trick was to avoid the enforcement officers of the Chinese Customs at the border at Customs Pass where the road crossed the hills. At times informers would warn the Customs Officers of a shipment. In and around Yau Ma Tei the Chinese Customs agents tried to monitor these illegal activities.

The redevelopment of Yau Ma Tei market in 1876 and the piecemeal sale of Crown Leases from 1876 to 1900 had little impact on the character of the town. In 1900, Yau Ma Tei was still a busy and prosperous market town and anchorage. It was almost entirely enclosed within Station Street and Temple Street, close to the Tin Hau temple. It remained physically distinct from and to a degree economically independent of the City. This changed within a few years after 1900.

In 1900, a major reclamation project started in West Kowloon, from the existing waterfront to the eastern edge of Ferry Street and from near today's Jordan Road to Mongkok Road. This reclamation was completed in 1904. Down the centre of the new reclamation two major roads were laid, Reclamation Street and Canton Road, with numerous transverse streets running from the new waterfront back to Station Street.

The available land for development increased at least five fold. The northern part of this area was being distinguished from Yau Ma Tei and called Mongkok. Dozens of new streets were laid down and the first Crown Leases were sold in 1910. While the First World War slowed the development (one third was still vacant in 1924) by the late 1930s, the whole area was more or less fully developed.

At the same time communication with the rest of Hong Kong was greatly improved. In 1990, the only access to Yau Ma Tei was along Station Street from Austin Road. By 1902, it had been agreed that Nathan Road should be extended to Boundary Street. The essential work of cutting back the hill behind Yau Ma Tei was only completed in 1917. Almost as soon as the road was opened, buses were running on it. A regular ferry service was started which linked the new reclamation with Hong Kong Island.

By the First World War, the prosperous market town of 1900 had become an essential part of the main urban area. By the 1930's, the whole of West Kowloon from Tsim Sha Tsui to Yen Chow Street was approaching full development. After the Second World War, the heart of the old market town (Shanghai Street and Temple Street) was cleared by Government, as the 1876 buildings were old and dangerous. These were replaced with Yau Ma Tei Government Offices and a car park.

5.1.7 TIN HAU TEMPLE

The famous Tin Hau Temple at Yau Ma Tei has a long history, dating from well before the cession of Kowloon to Britain in 1860. An 1870 memorial tablet, which is still preserved in the temple, describes the building that stood in 1870 as "ancient". This would indicate that it had stood for at least two generations and had probably been on the same site, albeit in a smaller form than in 1870, since at least the early 1840s. The temple tablet goes on to state that while the temple was built onshore, there was very little in the area surrounding it when it was built. It must therefore have been a small temple located a little above the anchorage (Hayes, 1966).

5.1.8 TYPHOON SHELTER

In 1900, a severe storm caused a great deal of damage in Hong Kong. Following the storm, and in the years 1901 to 1902 many demands were made that the government should act to protect the boat people in Hong Kong during the typhoon season. At that time, there were none of the sophisticated techniques for plotting the course of a typhoon prior to it making landfall. The nature of the storms was not understood and in the early days of the twentieth century, typhoons would effectively strike without warning, causing extensive damage and loss of life. In Hong Kong there was only one small artificial typhoon shelter, which was constructed in 1883 at Causeway Bay.

Therefore, on the 14th December 1903, the Hon. Gershom Stewart, an Unofficial Member of the Legislative Council, rose to move the following motion:

> *"That in the opinion of the Council it is advisable to increase if possible the means of shelter for cargo boats and sampans during the typhoon season. The harbour is after all the reason for our existence here, from the harbour we, either directly or indirectly, all of us depend on our subsistence. We are now in the happy position of having an abundant revenue, and I have not put in a plea for a humble and hard-working section of the sea-faring population who have no means of advocating their own cause."*

Mr Stewart's resolution was seconded by the Hon. C. W. Dickson, Deputy Chairman of the Hong Kong and Shanghai Banking Corporation and a partner at Jardine Matheson & Co. The Acting Colonial Secretary's response was that the government was fully aware of the problem and it was only the lack of funds that had delayed construction of a typhoon shelter. However, the subject was not mentioned again in the Legislative Council until the following September when the Finance Committee was advised that the Government regretted that it had not been possible to allocate monies for the construction of a typhoon for the coming year.

Thus, all of 1904 and most of 1905 passed without any action on the proposed shelter until Governor Sir Matthew Nathan delivered a long speech to the Legislative Council which gave an estimate of the Colony's financial position as at 31st December 1905. In his statement he listed a large number of proposed projects including the provision of a typhoon shelter for the increasing number of junks, which had to leave their work early to ensure not being shut out of the limited accommodation in Causeway Bay. Members welcomed the reference to the typhoon shelter at a subsequent meeting. However, by the early part of 1906 it was clear that the project remained on hold.

Events then took a tragic turn, and on The 20th November 1906, the Governor informed the members of the Legislative Council that:

> *"Hong Kong has just suffered from a calamity as calamitous, it not more so than any which had previously befallen the Colony. The loss of life and property between the hours of 9 and 11 on Tuesday morning (18th September) were, as far as can at present be judged, greater than those incurred in the great typhoon of 1874".*

He went on to say:

> *"None of us are likely to forget the scenes of that morning. First of all we saw, when the typhoon gun was fired at about 9 o'clock, crowds of helpless shipping, then the whole scene was wiped out by the blowing sheets of rain, and an hour later, the atmosphere being again clear, we saw that the junks and small craft had disappeared, that that may of the larger junks were aground or in distress. What had happened to the Chinese boats was evidenced by the appalling scenes of desolation along the Praya of the Kowloon shore."*

Figure 9 shows the damage at the Police Station following the typhoon. The typhoon occurred just after the budget for 1907 had been presented, and before the Council had an opportunity to comment on the proposed expenditure at the next sitting. The Governor suggested that construction of a typhoon shelter could not be started unless it was financed out of increased light dues.

Two months later in November 1906 the Director of Public Works presented to the Legislative Council the Report of the Proceedings of a Committee, together with a chart showing five possible locations, including Yau Mau Tei. In the following months there was much debate and dispute over the funding and location of the proposed typhoon shelter.

No works had started when another disaster struck. On the 17th July 1908, a typhoon struck Hong Kong that was more powerful than that of 19th September 1906, which had then become known as the Great Typhoon. This storm was a turning point in the long debate over construction of the typhoon shelter; on the 6th August 1908 the Governor submitted for the acceptance of the Council the following resolution:

> *"Be is resolved that on and from the 1st January 1909, the owner, agent or master of every ship entering the waters of the Colony shall pay the following dues to such officer as the Governor may from time to time appoint: for all river steamers 5/6ths of a cent per ton register; all other ships entering the waters of the Colony, 2 cents were ton register."*

The typhoon shelter was therefore to be financed by a tax placed on shipping entering Hong Kong, thereby resolving the debates of the preceding years. Nearly a year later, in October 1910, the Director of Public Works advised Members of the Legislative Council that a contract worth just over two million dollars had been let for the construction of the detached breakwater and that completion of the work was expected within five years.

During the period 1911 to 1914, as the papers tabled in the Legislative Council show, work on the typhoon shelter continued steadily. Europe was engulfed in the First World War, but life in Hong Kong remained largely unaffected, and work continued on the typhoon shelter without any break. Finally, on the 16th December 1915, twelve and a half years after the Hon. Gershom Stewart had proposed the project; the completion of the typhoon shelter was commemorated in the laying of a stone by Sir Francis May – the third Governor to have been involved in the project.

Fifty years later the inexorable pressure of population growth in Hong Kong, and especially the need to relieve traffic congestion in West Kowloon, led to demands for more reclamation. The first strip of reclamation was to allow Tong Mei Road to be built, closing off the direct contact between the typhoon shelter and the heart of Yau Ma Tei. This took place in the 1960s. This reclamation and the new road helped ease the traffic congestion in West Kowloon but could only give 25 years life to the old typhoon shelter. As soon as it was agreed (during 1990) that the new airport would be built on Lantau, the shelter was doomed as the new Cross Harbour Tunnel and the new Airport Railway could only be built across its site. A new typhoon shelter was therefore constructed, well seaward of the 1915 one. When it was opened on the 23rd October 1992 the old shelter was closed and quickly filled in.

5.2 GEOPHYSICAL SURVEY

5.2.1 SIDE SCAN SONAR SURVEY

The digital side scan sonar data was analysed. It showed that the seabed within the study area is mud or fine sand. There is also evidence of trawl marks, debris and dumped materials. The location and size of all these features were marked and shown on Chart Figure 2 attached. Below are examples of the actual data collected. The exact location of each of these examples is shown on ChartFigure2 attached.

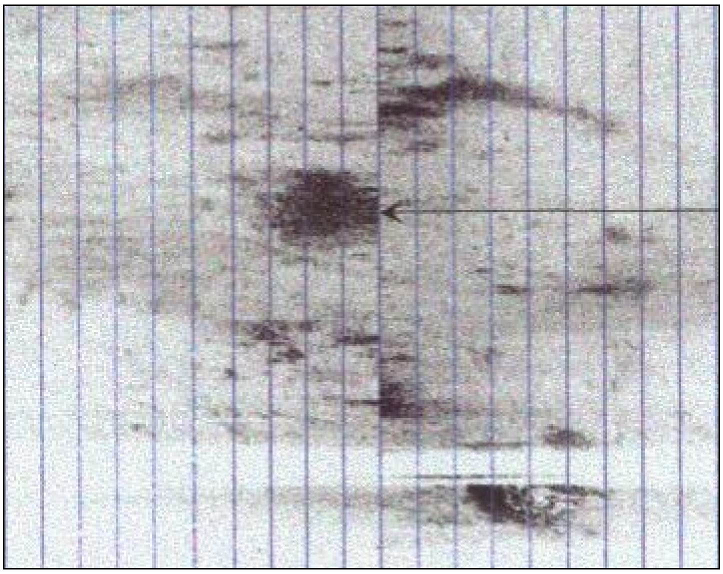

Figure 10: Side scan sonar data showing modern dumped material

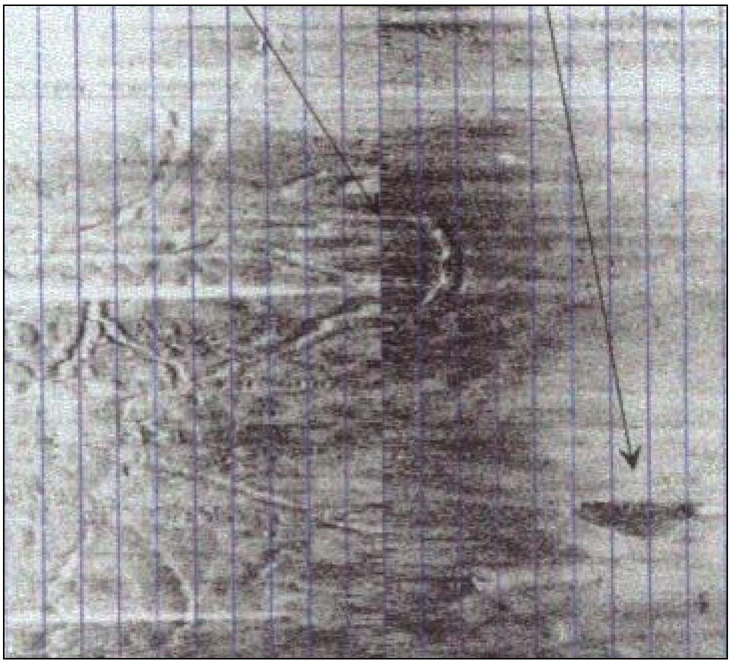

Figure 11: Side scan sonar data showing deeply incised trawl marks

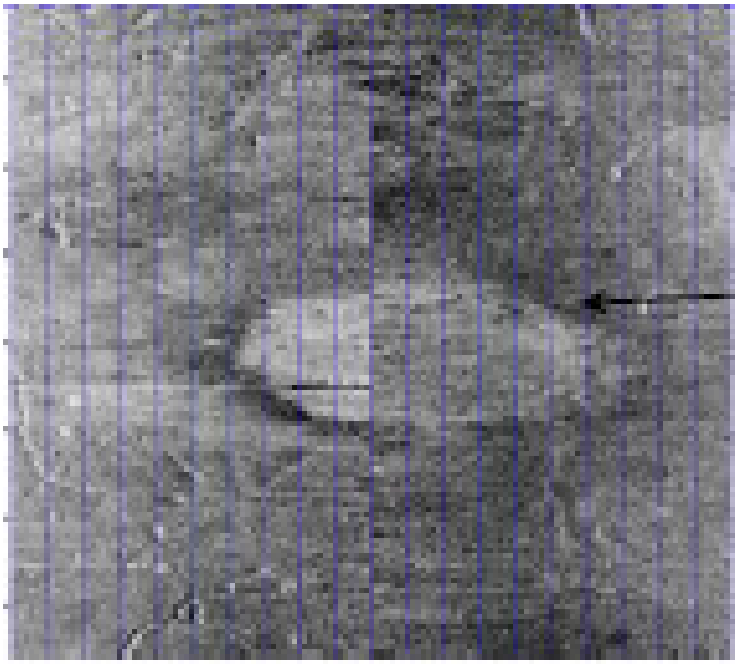

Figure 12: Side scan sonar data showing a large pit on the seabed.

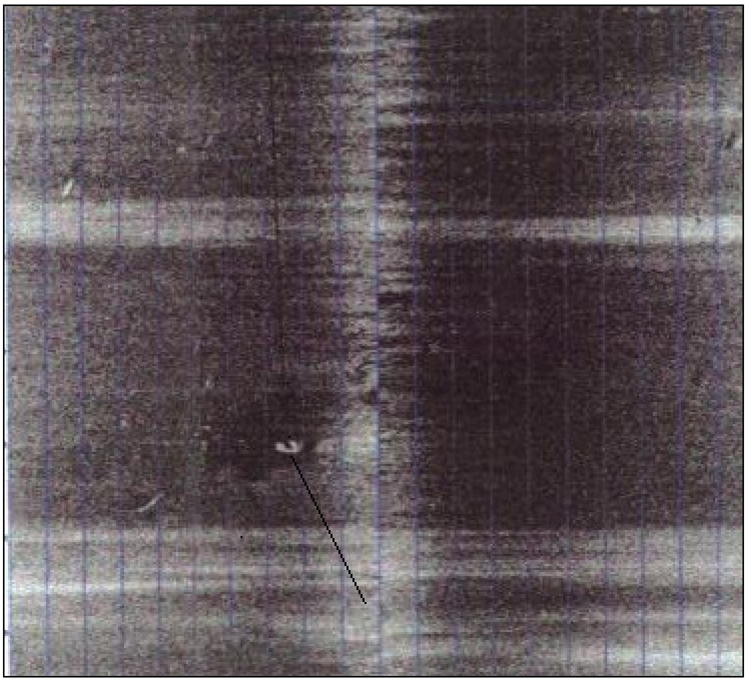

Figure 13: Side scan sonar data showing a boulder on the seabed

5.2.2 DATA OUTPUT

The side scan sonar data is summarised in the following drawings attached at the end of the report:

- Side scan sonar track plot (ChartFigure1 – SSS-1)
- Seabed features combined with side scan sonar track plot (Chart Figure 2 – SSS-2)

5.2.3 MULTI BEAM ECHO SOUNDER

The results are presented as two drawings:

- Multi beam bathymetry track plot (ChartFigure3 – MB-1)
- Contour plan of multi beam bathymetry (ChartFigure4 – MB2)

5.2.4 SEISMIC PROFILER DATA

5.2.5 DEFINITION OF SEISMIC WAVE VELOCITY

As seven drill hole logs were collected as part of the geotechnical survey, it was possible to accurately define the seismic wave velocity. The drill hole logs were made available to the engineer to calibrate the seismic data during interpretation.

The average velocity of seismic energy penetrating each layer was as follows:

- Marine deposits: 1620 m/s
- Alluvium: 1800 m/s
- Decomposed Rock (Grade V_IV): 2150m/s

5.2.6 SEISMIC PROFILER DATA OUTPUT

Following data processing, the seismic profiler data were presented in the following drawings:

- Seismic hydrophone track plot (ChartFigure 5 – S-1)
- Contour plan of interfaces between each layer (ChartFigure 6 – S-2)

5.2.7 SEABED STRATIGRAPHY

Across the study area the seabed were defined into three layers:

- Marine deposit with some mud
- Alluvium with some estuarine deposits
- Decomposed rock

Across the study are the Marine Deposit is more than 10m thick at a minimum. The pipe installation will therefore not affect any other sediment layers.
These soft sediments are assigned to the Hang Hau Formation. The formation consists of relatively homogenous very soft to soft, greenish grey silty clay (Fyfe et al., 1997) and has high moisture content. Therefore, the Hang Hau Formation sediments potentially provide an excellent substrate for the preservation of archaeological material. Additionally, the soft nature of the sediments would make it possible for archaeological material to be buried within the formation, where it would have greater protection than if it were exposed on the seabed. Additional analysis of the lower rock strata was provided but this is not relevant to the archaeological investigation and therefore excluded from this study.

5.2.8 ACCURACY OF THE GEOPHYSICAL SURVEY

The accuracy of the survey was as follows:

- Position fixing — better than 2m
- Seabed level — < 0.5m

6. CONCLUSION

6.1 BASELINE REVIEW

The Baseline Review indicates a high potential for marine archaeological material within the study area due to the long history of shipping activity in and around Yau Ma Tei. However, the total potential resource is reduced because of the seabed disturbance associated with numerous extensive reclamations, cable laying and construction of the western harbour crossing.

6.2 GEOPHYSICAL SURVEY

Detailed examination of the geophysical survey data enabled accurate assessment of the seabed within the study area. The area is characterised by extensive disturbance as evidence by trawl marks and modern dumped material. This is compatible with its location within one of the busiest sections of Victoria Harbour and adjacent to existing reclamation and engineering works. These activities would have a negative impact on the seabed thereby reducing its archaeological potential. It is therefore concluded that there are no archaeological resources within the study area.

7 RECOMMENDATION

Since there is no archaeological material present within the study area, it follows that there are no related constraints on the proposed reclamation work. There is no need for any further archaeological investigation or mitigation measures.

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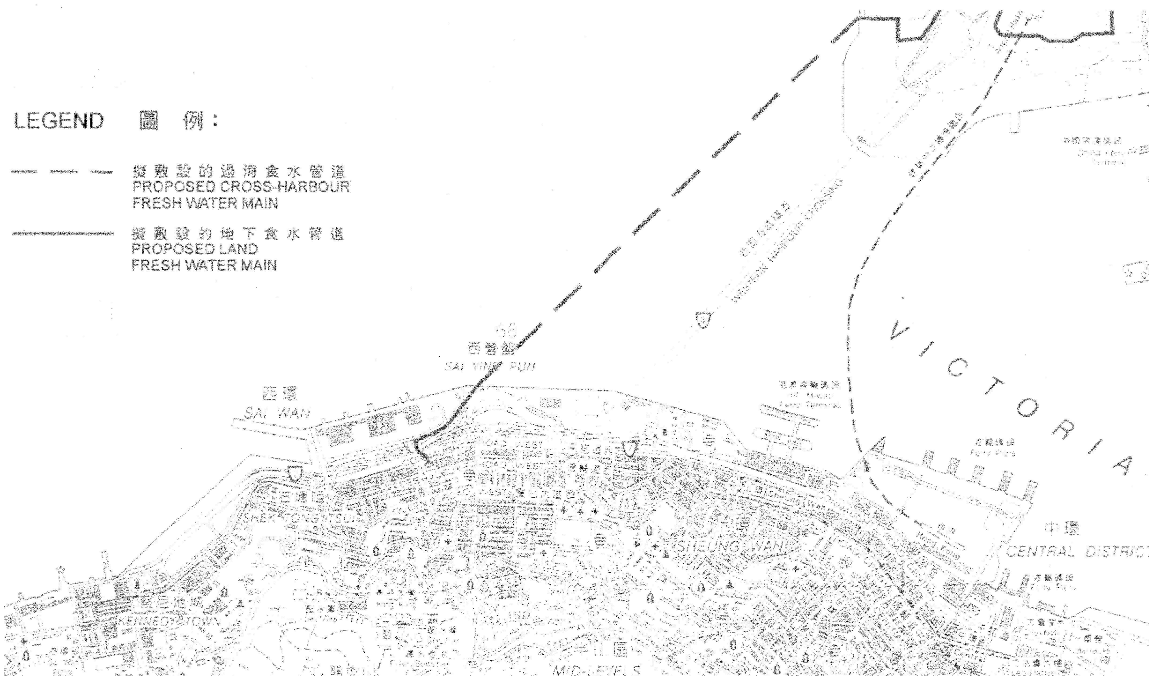


Figure 1: Location of the study area

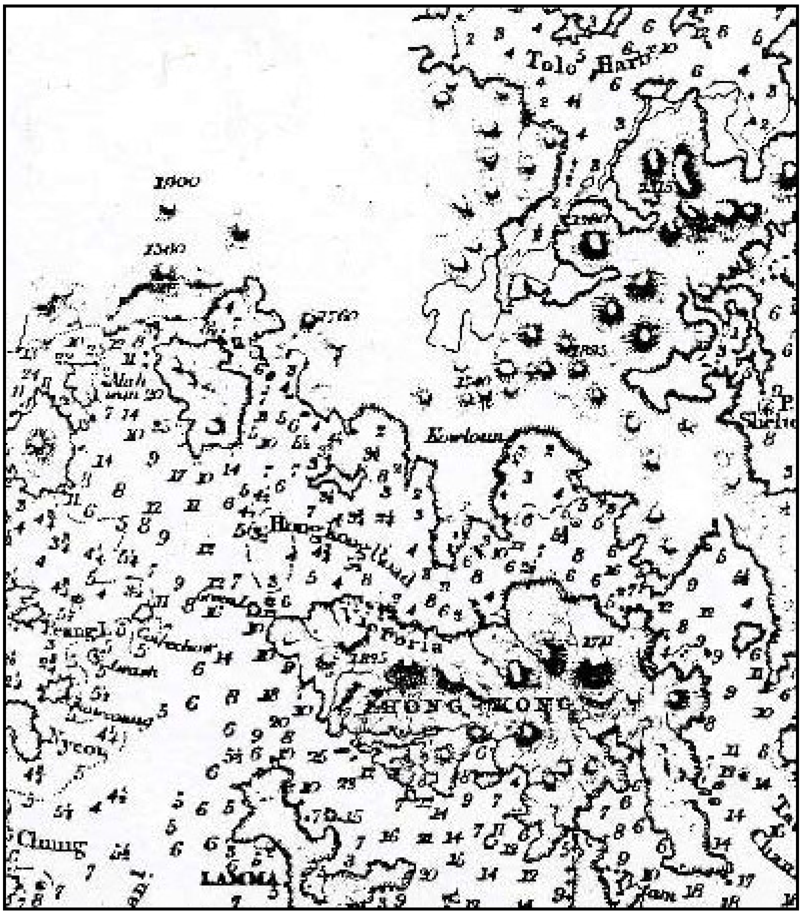


Figure 2: British Admiralty Chart 1853

Figure 3: British Admiralty Chart 1888

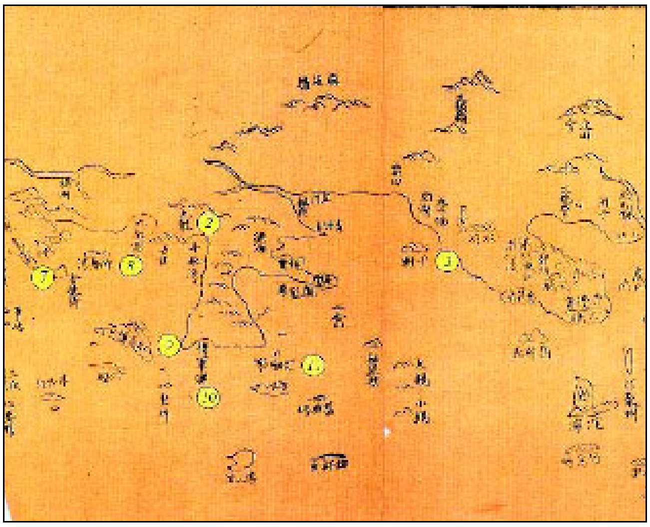


Figure 4: Section of the Map of the Entire Coastline by Chan Lun Kwing in Hoi Kwok Man Kin Luk (Record of the Countries of the Sea) printed by Ngai Hoi Chu Chan.

Key to place names

2 Kowloon

3 Ping Chau

7 Kap Shui Mun

8 Ngong Shue Chau (Stonecutters Island)

9 Red Incence Burner Hill (Hong Kong Island)

10 Tseung Kwan O

11 Fat Ton Mun

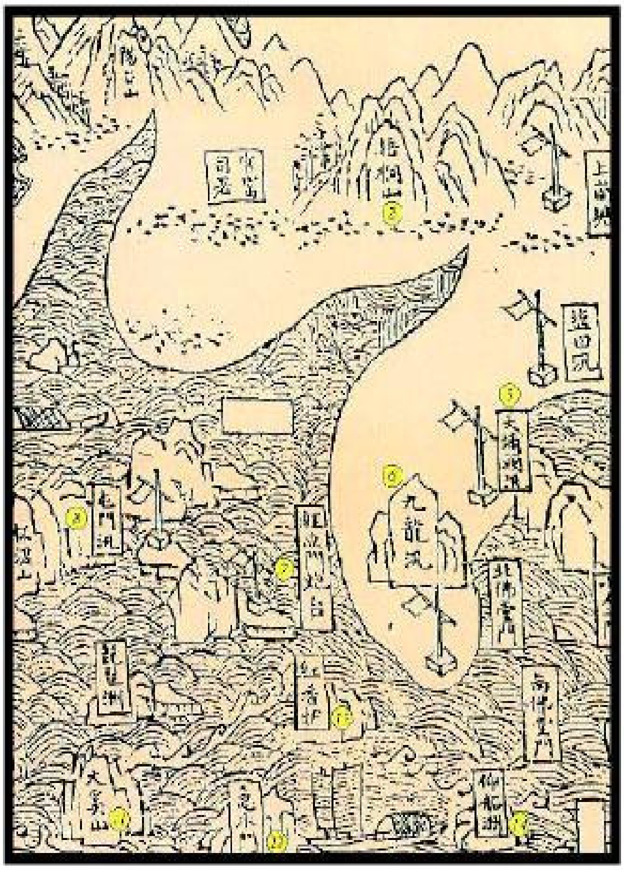


Figure 5: 1819 San On Yuen cartogram from the Directory of San On County

Key to play names

2	Wung Tung City
5	Tai Po Tai (Tai Po)
6	Kowloon
7	Lei Yue Mun
8	Tuen Mun
11	Tai Hai/Kai Shan (Lantau)
12	Kap Shui Mun
13	Red Incence Burner (Hong Kong)
14	Ngong Shuen Chan (Stonecutters Island)

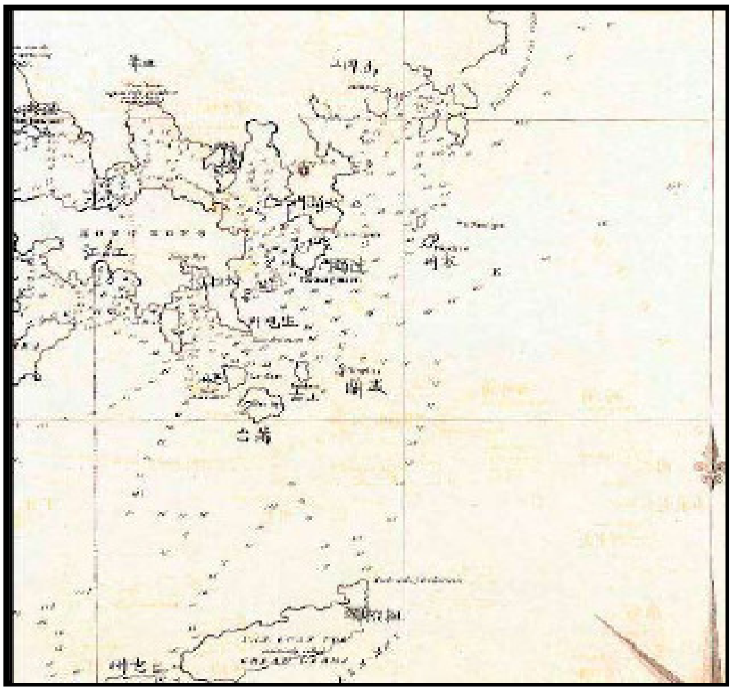


Figure 6: Section of a Marine Chart of Macau Roads prepared for the East India Company by Daniel Ross and Philip Maughan, Lieutenants of the Bombay Marine

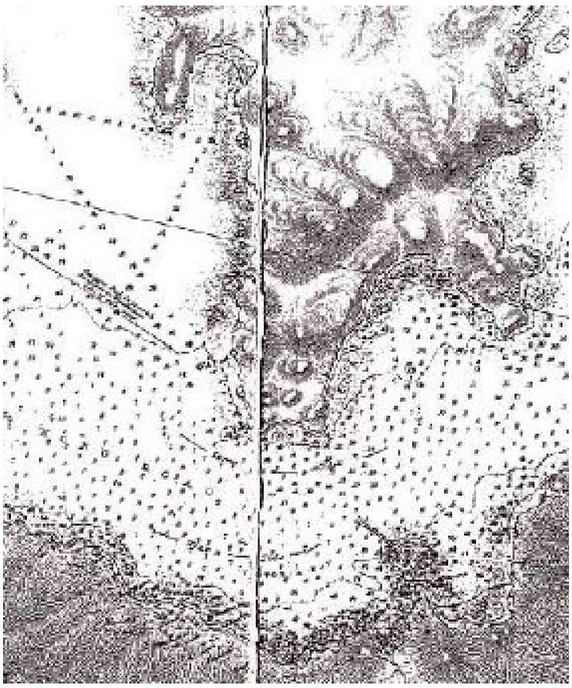


Figure 7: British Admiralty Chart Prepared following hydrographic surveys by Sir Edward Belcher in 1841

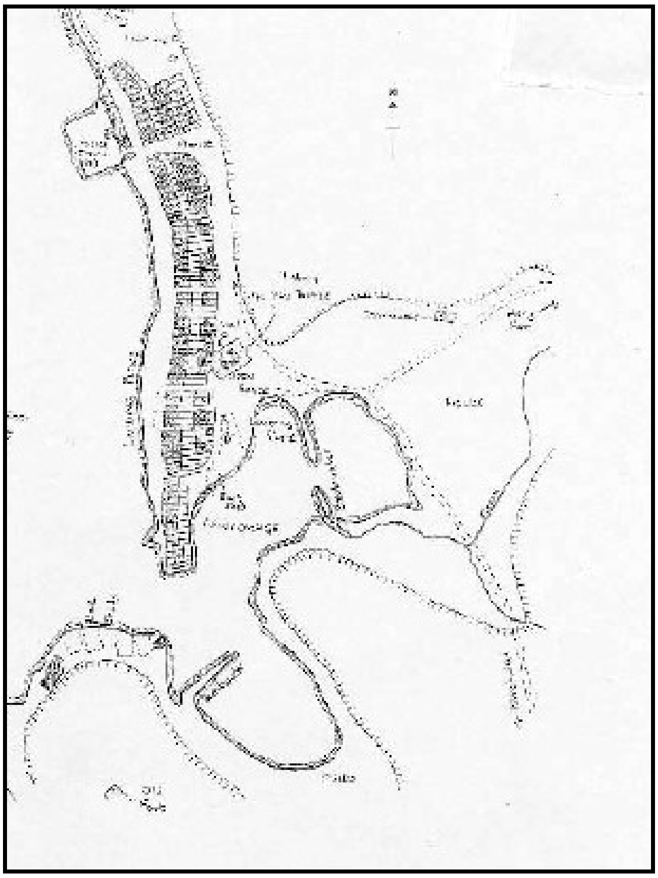
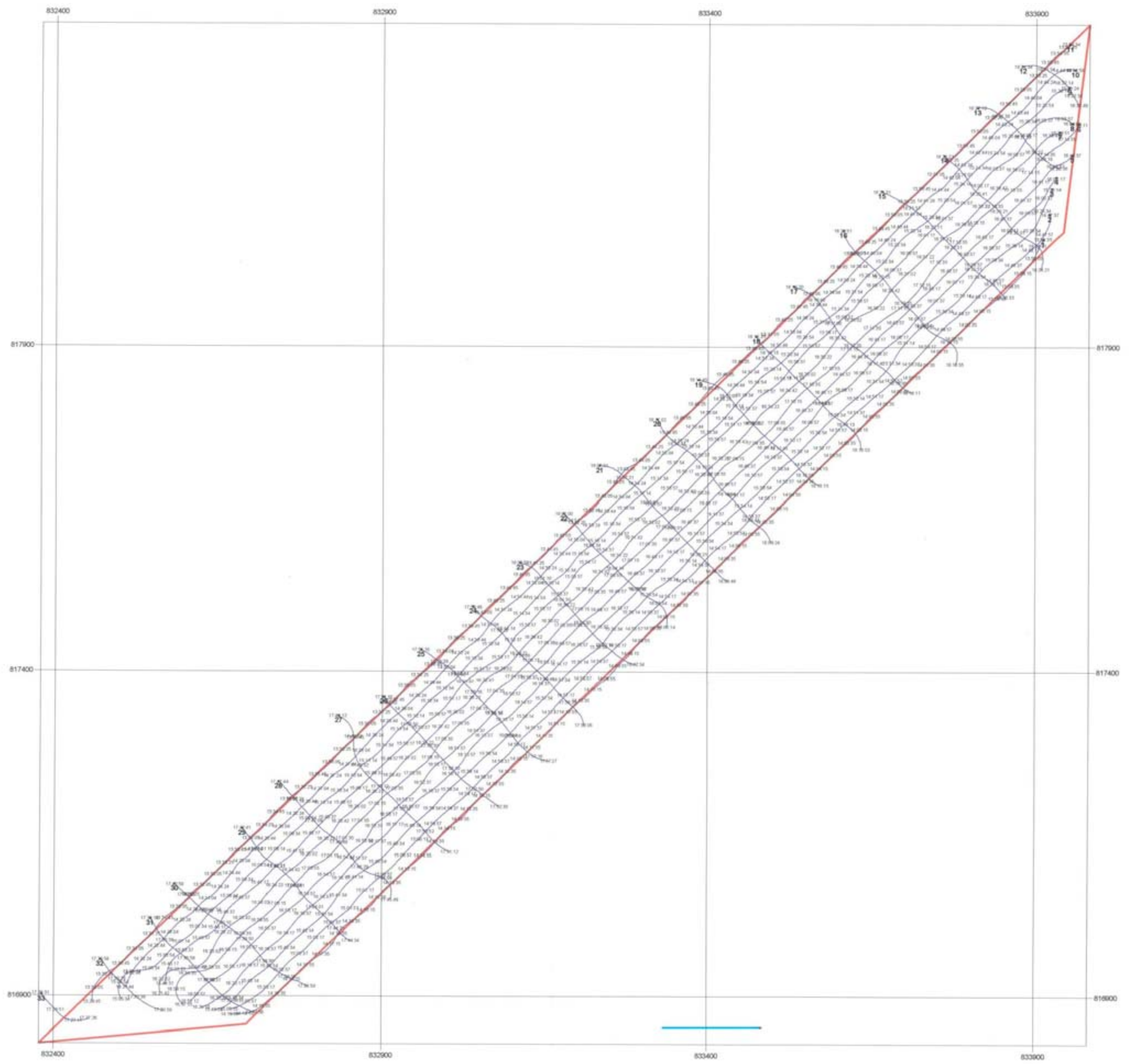
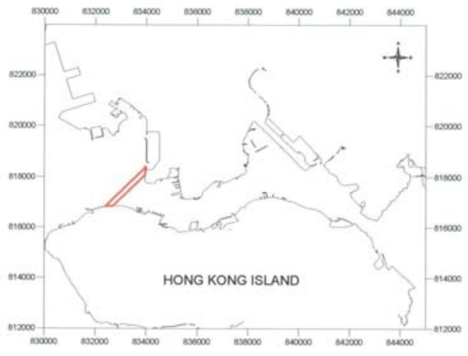


Figure 8: the layout of Yau Ma Tei in 1875

Figure 9: Yau Ma Tei typhoon shelter in 1906 after a storm



Location Plan:



Legend:

Side Scan Sonar Survey Track with Fix Position

Boundary

Area: West Kowloon to Sai Ying Pung

Drawing No.: SSS-1

Drawing Title: SIDE SCAN SONAR TRACKS PLAN

Notes:

1. Survey Date: August 18, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS
   EdgeTech 560 Sonar System

Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	09/09/2006	Liu Jianxun	Xiao Du	Preliminary

Metric Scale: 1:5,000

0m 100m 200m 300m 400m

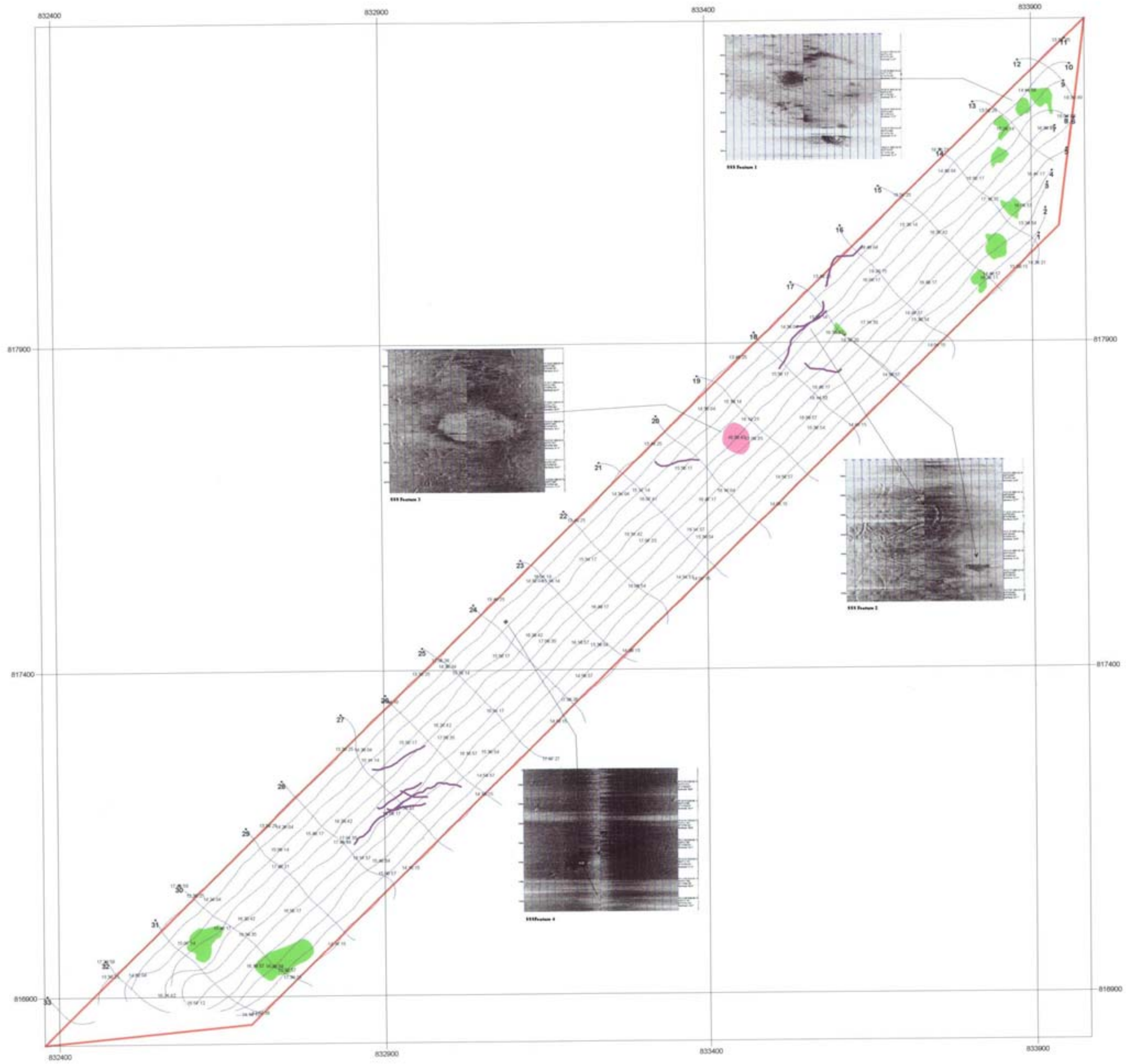
Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

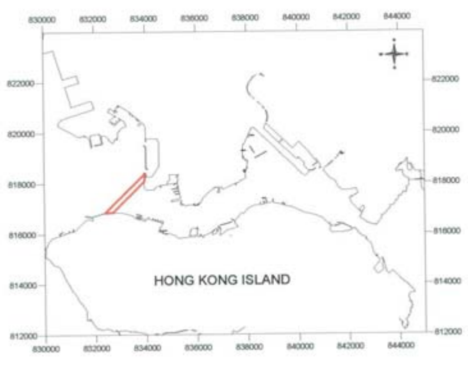
Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Client: CEDD Civil Engineering and Development Department

Surveyor: IGGE (H. K.) Engineering Geophysical Co. Ltd.



Location Plan:



Legend:

- Side Scan Sonar Survey Track with Fix Position
- Main Scar (Anchor Mark or Trawl Mark etc.)
- Boundary
- Granular Seabed/Dumped material (High Reflectivity)
- Debris/Boulder/Made Objects
- Pit
- Side Scan Sonar Image

Area: West Kowloon to Sai Ying Pung

Drawing No.: SSS-2

Drawing Title:

SEABED FEATURES WITH SIDE SCAN SONAR TRACKS

Notes:

1. Survey Date: August 18, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS
   EdgeTech 560 Sonar System

Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	09/09/2006	Liu Jianxun	Xiao Du	Preliminary

Metric Scale: 1:5,000

0m 100m 200m 300m 400m

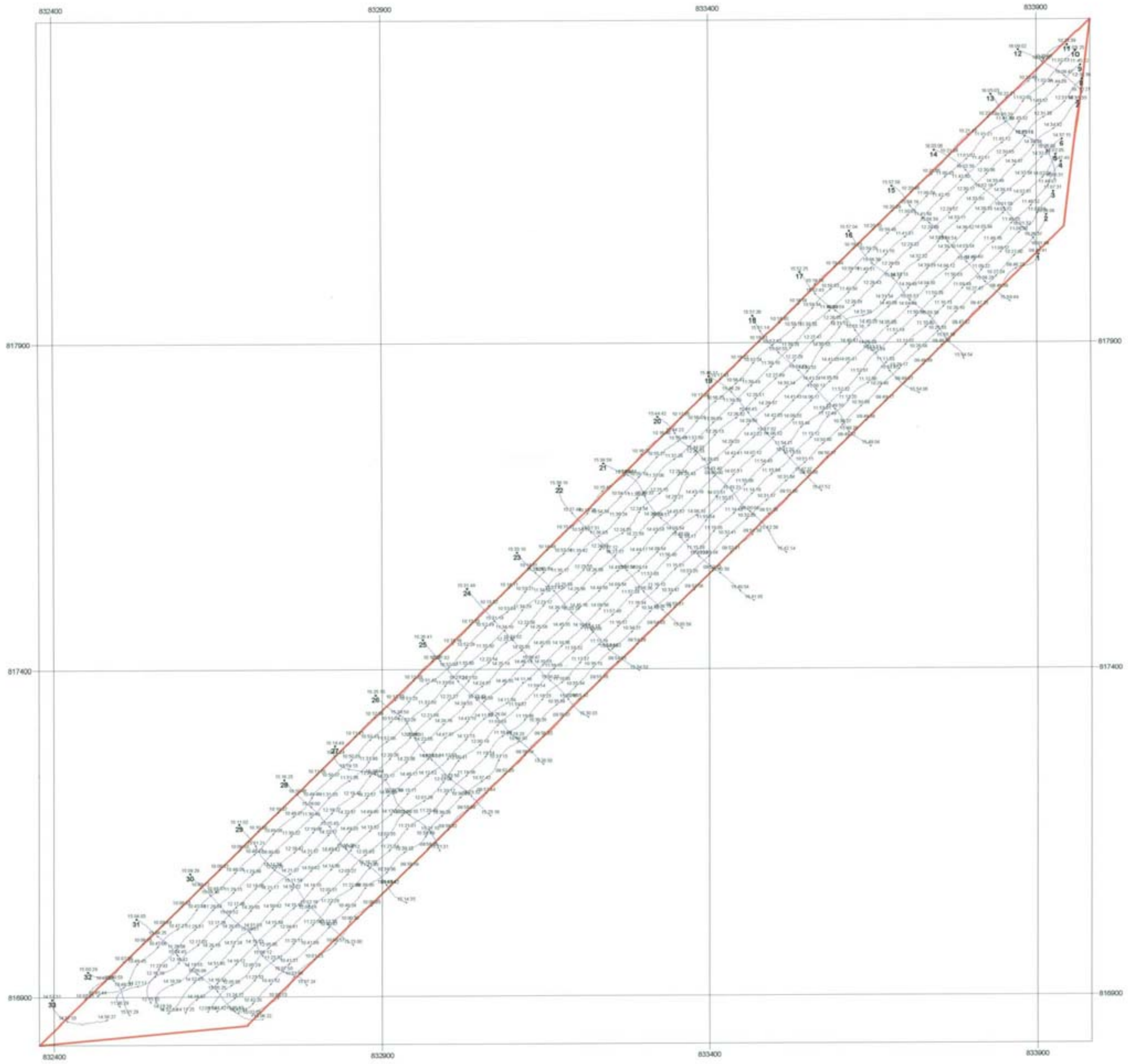
Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

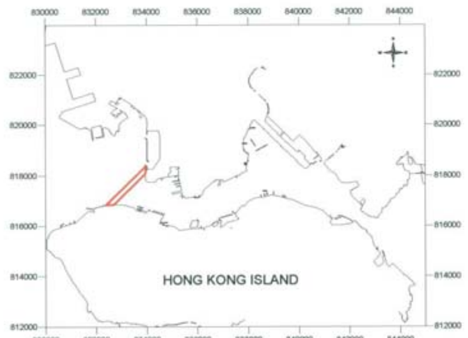
Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Client: Civil Engineering and Development Department

Surveyor: IGGE (H. K.) Engineering Geophysical Co. Ltd.



Location Plan:



Legend:

16:43:21 — Multi-Beam Bathymetry Track with Fix Position

Survey Boundary

Area: West Kowloon to Sai Ying Pung

Drawing No.: MB-1

Drawing Title:

MULTI-BEAM BATHYMETRY TRACKS PLAN

Notes:

1. Survey Date: August 17, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS SeaBeam 1000(1185)

Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	09/09/2006	Mei Yanhui	Xiao Du	Preliminary

Metric Scale: 1:5,000

0m 100m 200m 300m 400m

Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

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Client: CEDD Civil Engineering and Development Department

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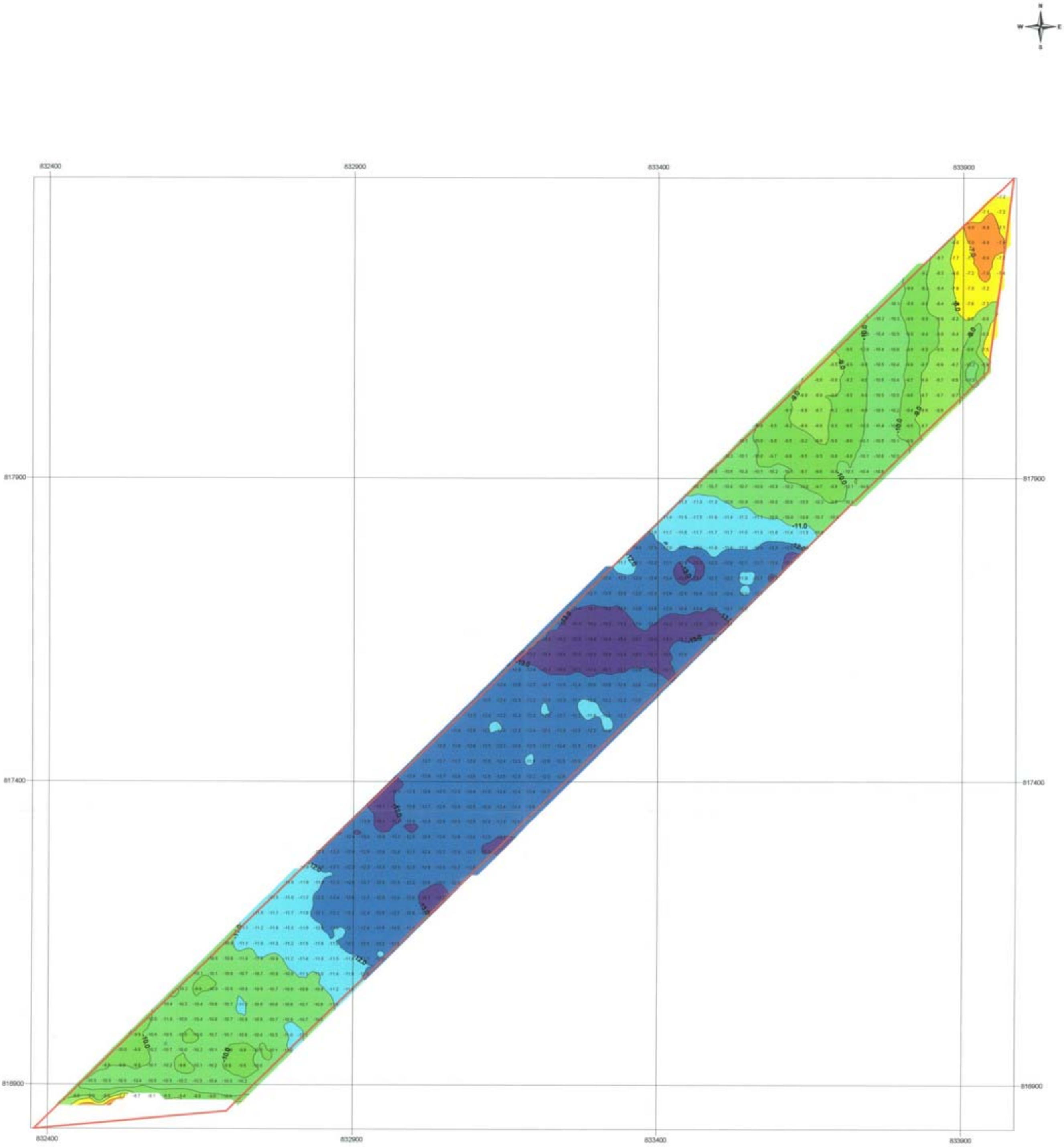
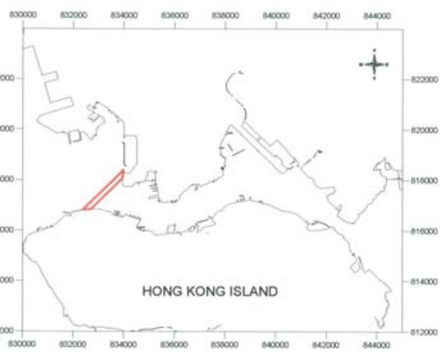


Location Plan:



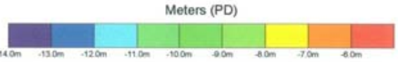
Legend:

Boundary

-10.5 Contour at 1 meter intervals

-10.5 Sounding value in meters (PD)

Meters (PD)



Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Area: West Kowloon to Sai Ying Pung

Drawing No.: MB-2

Drawing Title:

CONTOUR PLAN OF MULTI-BEAM BATHYMETRY

Notes:

1. Survey Date: August 17, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS SeaBeam 1000(1185)

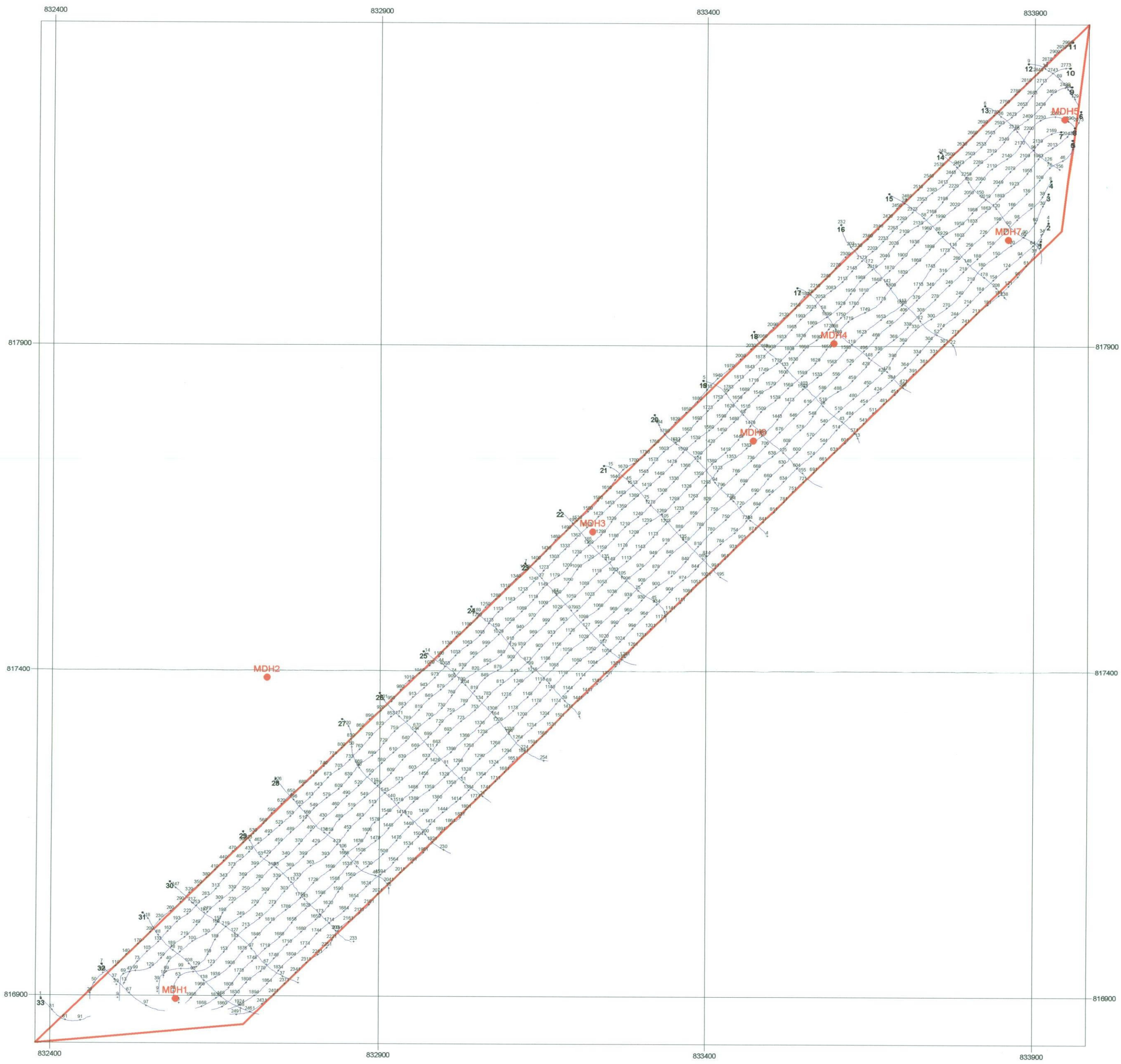
Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	09/09/2006	Mei Yanhui	Xiao Du	Preliminary

Metric Scale: 1:5,000

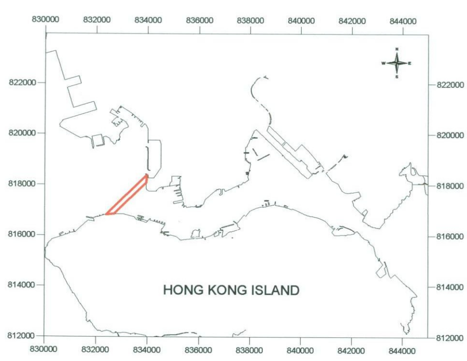
0m 100m 200m 300m 400m

Client: CEDD Civil Engineering and Development Department

Surveyor: IGGE (H. K.) Engineering Geophysical Co. Ltd.



Location Plan:



Legend:

Symbol	Description
220	Seismic Track with Fix Position
	Survey Boundary
MDH1	Drillhole Record

Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Area: West Kowloon to Sai Ying Pung

Drawing No.: S-1

Drawing Title:

SEISMIC HYDROPHONE TRACKS PLAN

Notes:

1. Survey Date: August 18, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS DELPH II

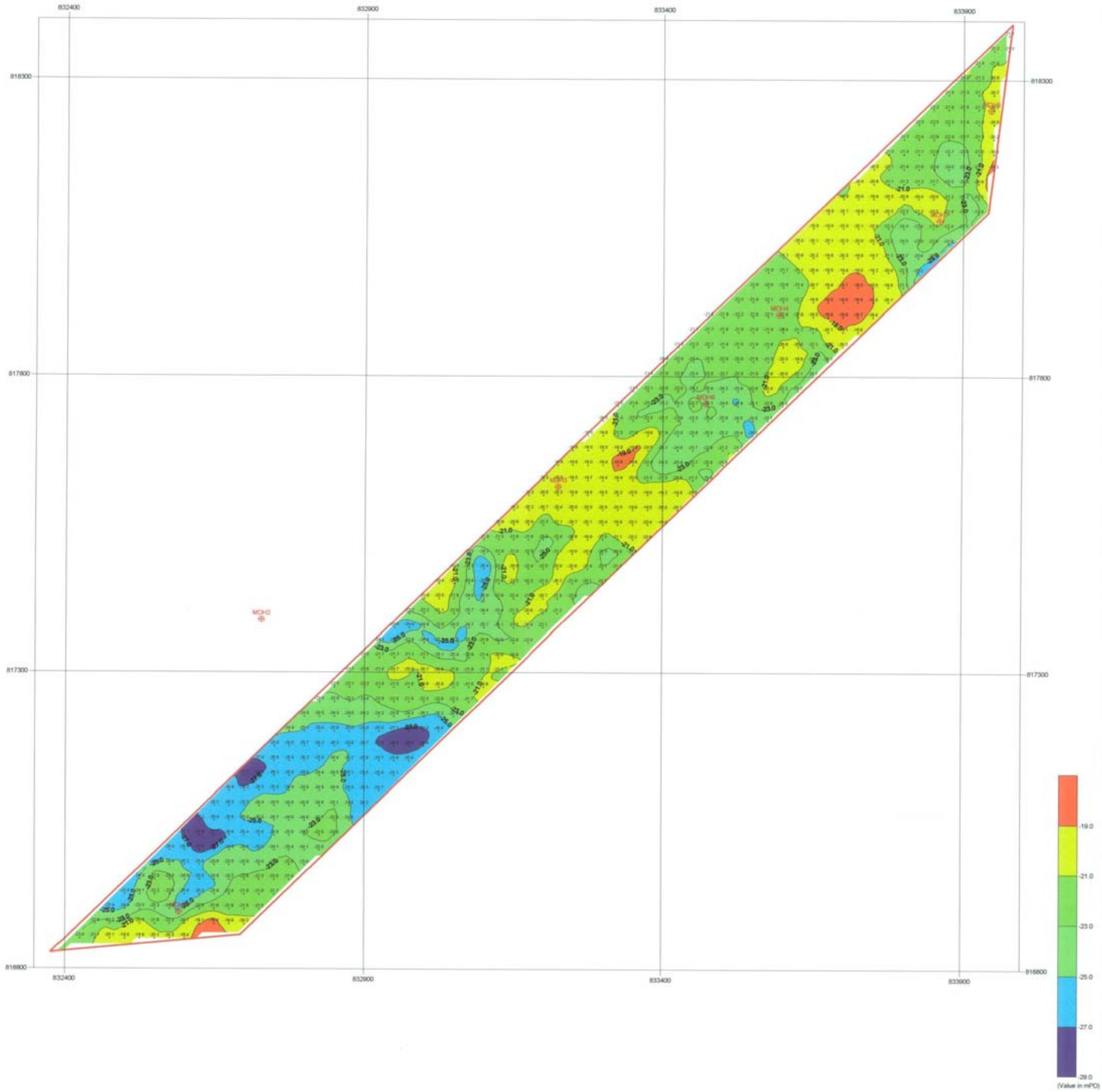
Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	08/12/2006	Mei Yanhui	Xiao Du	Preliminary

Metric Scale: 1:5,000

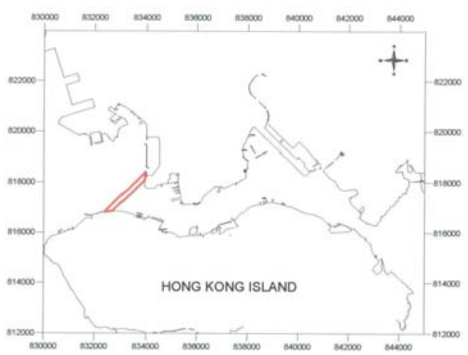
0m 100m 200m 300m 400m

Client: CEDD Civil Engineering and Development Department

Surveyor: IGGE (H. K.) Engineering Geophysical Co. Ltd.



Location Plan:



Legend:

-14.0 Contoured Levels in mPD

-14.3 Depth Value in Meters

Survey Boundary

MDH1 Drillhole Record

Project:

CEDD CONTRACT NO. GE/2005/26
WORKS ORDER NO. GE/2005/26.18

Agreement No. CE42/2005(WS) Laying of Western Cross Harbour Main and Associated Land Mains From West Kowloon to Sai Ying Pung - Marine Geophysical Surveys

Area: West Kowloon to Sai Ying Pung

Drawing No.: S-2

Drawing Title:

Contour Plan of Base of Marine Deposit

Notes:

1. Survey Date: August 18, 2006
2. Survey Grid: Hong Kong Metric Grid
3. Survey Datum: Hong Kong Principal Datum
4. Survey Vessel: Hung Kuk
5. Equipment: Trimble DGPS DELPH II

Revision No.	Date(D/M/Y)	Drawn by	Checked & Approved by	Remarks
0	08/12/2006	Mei Yanhui	Xiao Du	Preliminary

Metric Scale: 1:5,000

0m 100m 200m 300m 400m

Client: CEDD Civil Engineering and Development Department

Surveyor: IGGE IGGE (H. K.) Engineering Geophysical Co. Ltd.