

	PAGE
<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1 Purpose of the Manual .....	1
1.2 Background .....	1
1.3 Overview of the West Rail Environmental Protection System.....	2
1.4 Objectives of the Environmental Monitoring & Audit Programme .....	2
1.5 The Scope of the Environmental Monitoring and Audit Programme.....	3
1.6 Structure of The EM&A Manual .....	4
<b>2. THE ENVIRONMENTAL MANAGEMENT SYSTEM FOR THE CONSTRUCTION PHASE .....</b>	<b>7</b>
2.1 Introduction.....	7
2.2 The West Rail EIA.....	7
2.3 The West Rail EM&A Programme.....	7
2.4 Environmental Management Plans .....	8
2.5 Environmental Performance Reviews.....	8
2.6 Construction Method Statements.....	10
2.7 Contractual Documentation .....	10
2.8 Electronic Environmental Management System (EEMS) .....	11
<b>3. ORGANISATION AND STRUCTURE OF THE ENVIRONMENTAL TEAM..</b>	<b>13</b>
3.1 Project Organisation.....	13
<b>4. EM&amp;A GENERAL REQUIREMENTS .....</b>	<b>15</b>
4.1 Introduction.....	15
4.2 Summary of the EIA .....	15
4.3 Construction Phase EM&A .....	25
<b>5. NOISE MONITORING .....</b>	<b>31</b>
5.1 Introduction.....	31
5.2 Methodology and Noise Criteria.....	31
5.3 Monitoring Equipment.....	32
5.4 Monitoring Locations .....	33
5.5 Baseline Monitoring .....	35
5.6 Impact Monitoring .....	35
5.7 Compliance Assessment .....	35
5.8 Event Contingency Plan.....	36
<b>6. AIR QUALITY MONITORING .....</b>	<b>39</b>
6.1 Introduction.....	39
6.2 Methodology and Air Quality Criteria.....	39
6.3 Monitoring Equipment.....	40
6.4 Monitoring Locations .....	41
6.5 Baseline Monitoring .....	42

**Contents**

6.6 Impact Monitoring .....	43
6.7 Compliance Assessment .....	43
6.8 Event Contingency Plan.....	43
<b>7. WATER QUALITY MONITORING .....</b>	<b>45</b>
7.1 Introduction.....	45
7.2 Methodology and Criteria.....	45
7.3 Monitoring Equipment.....	46
7.4 Monitoring Locations .....	48
7.5 Baseline Monitoring .....	49
7.6 Impact Monitoring .....	50
7.7 Compliance Assessment .....	51
7.8 Event Contingency Plan.....	52
<b>8. LANDSCAPE AND VISUAL IMPACTS .....</b>	<b>55</b>
<b>9. HERITAGE RESOURCES .....</b>	<b>57</b>
<b>10. ECOLOGICAL RESOURCES .....</b>	<b>59</b>
<b>11. WASTE MANAGEMENT .....</b>	<b>61</b>
11.1 Introduction.....	61
11.2 Objectives of the Waste Audit .....	61
11.3 Methodology and Criteria .....	61
<b>12. LAND CONTAMINATION .....</b>	<b>65</b>
<b>13. ENVIRONMENTAL AUDITING.....</b>	<b>67</b>
13.1 Site Inspections .....	67
13.2 Compliance with Legal and Contractual Requirements .....	68
13.3 Environmental Complaints .....	68
<b>14. REPORTING .....</b>	<b>71</b>
14.1 Introduction.....	71
14.2 Baseline Monitoring Report.....	71
14.3 Monthly EM&A Reports .....	71
14.4 Annual and Bi-annual Reports.....	72
14.5 Data Keeping .....	72
14.6 Interim Notifications of Environmental Quality Limit Exceedances .....	72

**ANNEX A** Figures showing the Locations of Representative Air and Noise Monitoring Stations along the West Rail Alignment

**ANNEX B** List of Recommended Mitigation Measures and their Implementation Schedule

**Tables**

Table 4.3a Summary of Monitoring Programme.....	26
Table 5.2a Acceptable Noise Levels for Construction other than Percussive Piling.....	32
Table 5.3a Noise Monitoring Equipment.....	33
Table 5.4a EM&A Representative Noise Monitoring Locations.....	33
Table 5.7a Action and Limit Levels for Construction Noise dB(A).....	35
Table 5.8a Event Contingency Plan for Construction Noise .....	36
Table 6.3a TSP Recommended Monitoring Equipment.....	41
Table 6.4a EM&A Representative Air Quality Monitoring Stations .....	41
Table 6.7a Derivation of Action and Limit Levels for 24-Hour Air Quality Monitoring	43
Table 6.7b Derivation of Action and Limit Levels for 1-Hour Air Quality Monitoring ..	43
Table 6.8a Event Contingency Plan for Air Quality.....	44
Table 7.4a Locations of Marine Water Quality Monitoring Stations in Tsuen Wan Bay .	48
Table 7.4b Locations of River Water Quality Monitoring Stations along the West Rail Alignment .....	49
Table 7.5a Summary of Baseline Monitoring Programme for Water Quality.....	49
Table 7.7a Action and Limit Levels for Marine Water Quality.....	52
Table 7.8a Event Contingency Plan for Water Quality .....	52
Table 11.3a Recommended Waste Disposal Sites.....	62
Table 11.3b Waste Management Checklist .....	62

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### 1. INTRODUCTION

#### 1.1 Purpose of the Manual

This Environmental Monitoring and Audit (EM&A) Manual has been prepared as a supplementary document to the *West Rail Environmental Impact Assessment Final Assessment Report, ERM-Hong Kong, Ltd, January 1998*.

The purpose of the EM&A Manual is to provide information, guidance and instruction to personnel charged with environmental responsibilities and undertaking environmental monitoring work during the construction phase of West Rail. It provides systematic procedures for monitoring, auditing, and minimising environmental impacts that may arise from the works.

Broad EM&A requirements for the operational phase of West Rail have been identified in the Final Assessment Report (FAR) and these are referenced in this Manual. Full details of the Operational EM&A requirements, procedures and reporting systems will, however, be presented in a separate Operational EM&A Manual to be prepared prior to the commissioning of the new railway.

#### 1.2 Background

Since early 1991, the Kowloon-Canton Railway Corporation (KCRC) has been analysing ways to enhance its contribution to Hong Kong's transportation infrastructure and examining opportunities to expand its core business of rail transportation. The development of a new railway in the western part of Hong Kong provides such an opportunity, and is consistent with Government's strategic planning objective to create a modern urban and regional transportation system designed to serve both passenger and freight needs well into the next century.

In December 1994, the Hong Kong Government published the *Railway Development Strategy*, which provided an overall strategic planning framework for the future development of Hong Kong's railway network. In particular, the Strategy gave high priority to a Western Corridor Railway, calling for an in-service date of 2001. Subsequently, on 26th January 1995, the Government Secretariat, Transport Branch, invited KCRC to submit a proposal for the construction and operation of West Rail, consistent with the Railway Development Strategy.

In November 1995, KCRC submitted a full proposal to the Hong Kong Government which outlined a scheme for a new rail system which would include both domestic and through-train passenger services, a freight rail system terminating at the Kwai Chung container port facility (with a freight yard in the north of the New Territories), and connections and interchanges with existing and proposed rail systems in Hong Kong (such as KCRC's East Rail and the Mass Transit Railway Corporation's Lantau and Airport Railway). As part of the proposal submitted by KCRC, and in conformance with the Hong Kong Government's requirements, a Preliminary Environmental Investigation (PEI) was undertaken to identify the main environmental concerns associated with the Western Corridor Railway (formally and hereafter referred to as West Rail). The results

of the PEI have been reviewed and endorsed by a Study Management Group (SMG) comprising representatives of relevant Government Departments under the Chairmanship of the Environmental Protection Department (EPD).

Subsequently, in late 1996 the Government determined that only passenger train services and interchange facilities between West Kowloon and Tuen Mun should be built at this time and KCRC commissioned Environmental Resources Management Hong Kong Limited (ERM-Hong Kong) to undertake an Environmental Impact Assessment of West Rail.

The railway will include a number of new stations (Yen Chow Street, Mei Foo, Tsuen Wan West, Kam Tin, Yuen Long, Long Ping, Tin Shui Wai, Tuen Mun North and Tuen Mun Centre), and a major depot in the Kam Tin valley. It will not include the West Kowloon Passenger Terminal, the Port Rail Terminal, and most of the proposed Northern Section, which includes the Northern Freight Yard and the connections to Lok Ma Chau, Lo Wu and Sheung Shui. The West Rail alignment and station locations are shown in *Figures 1.2a-c*.

### **1.3 Overview of the West Rail Environmental Protection System**

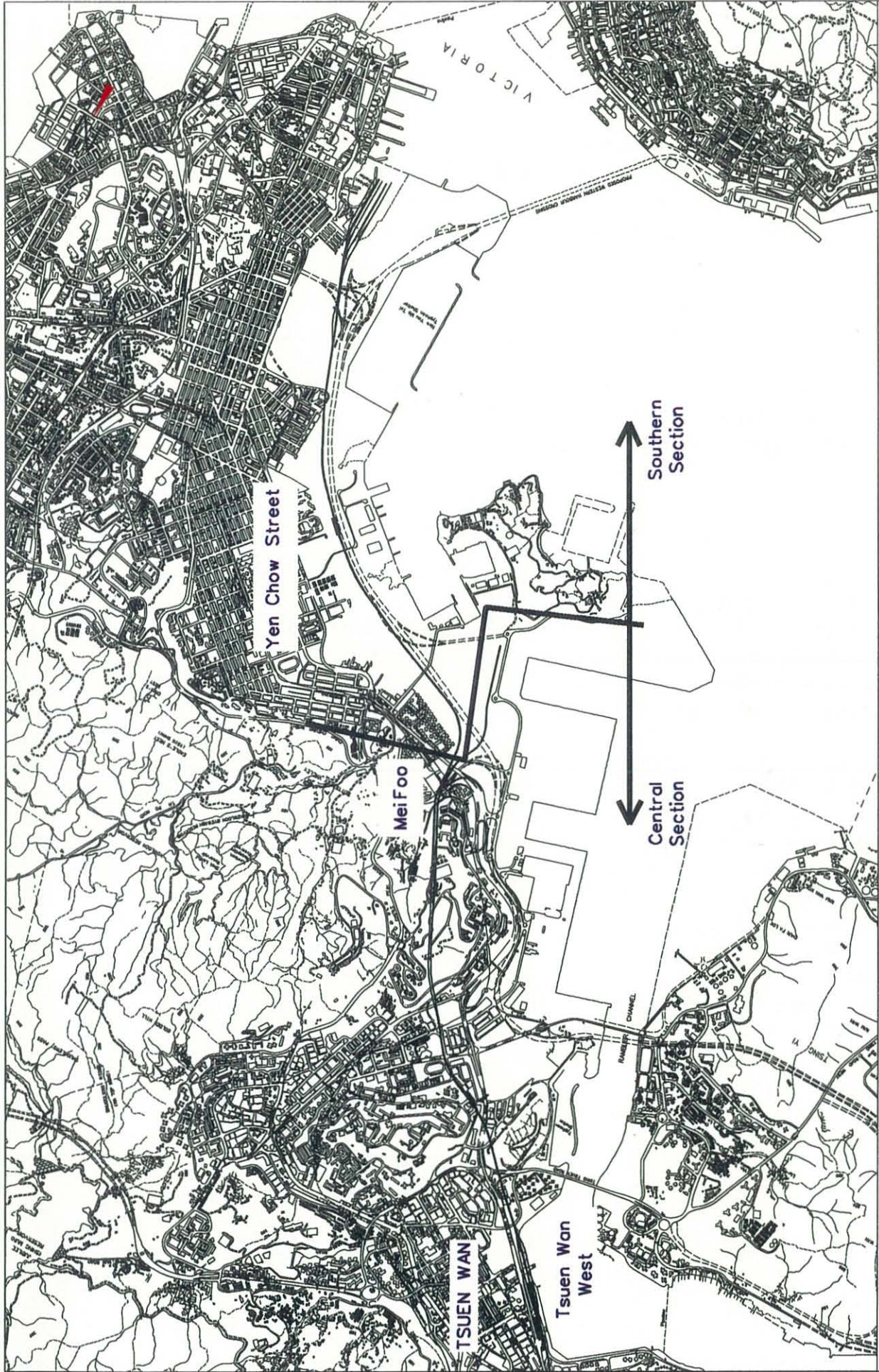
The overall West Rail environmental protection system, and the various elements of the scheme to be developed for the construction of West Rail, has evolved through discussion between the Consultants and the Corporation during the course of the West Rail EIA study. The key elements of the system are described within this Manual and are broadly based upon the criteria and standards established during the EIA Study and on the EIA mitigation measure recommendations.

However, a range of other mechanisms and procedural approaches, over and above that which will be achieved through the EM&A programme, have been pursued to address the mitigation of impacts required by the EIA Study. For example, the EIA Study also identified specific measures to be addressed during the ongoing detailed design of the new railway to ensure that environmental considerations continue to influence the design of the railway. Furthermore, the construction phase mitigation recommendations, the implementation and monitoring of which is addressed in this report, also form the basis of other Manuals, procedures, schedules, standards and contractual elements which, in one form or another, will be used by the Contractor's staff or by the Environmental Manager to identify, control, audit and verify that the environmental impact of the construction process is minimised.

The EM&A Manual, therefore, represents one element within a broader system of environmental controls to be employed by the Corporation during the construction of West Rail.

### **1.4 Objectives of the Environmental Monitoring & Audit Programme**

The West Rail EM&A Manual provides details of the environmental monitoring requirements arising from the West Rail EIA study including noise, air and water monitoring as well as audit recommendations for the noise, air, water, landscape and visual, heritage, ecological, waste, and land contamination issues and the relevant



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WEST RAIL: TS900 EIA STUDY

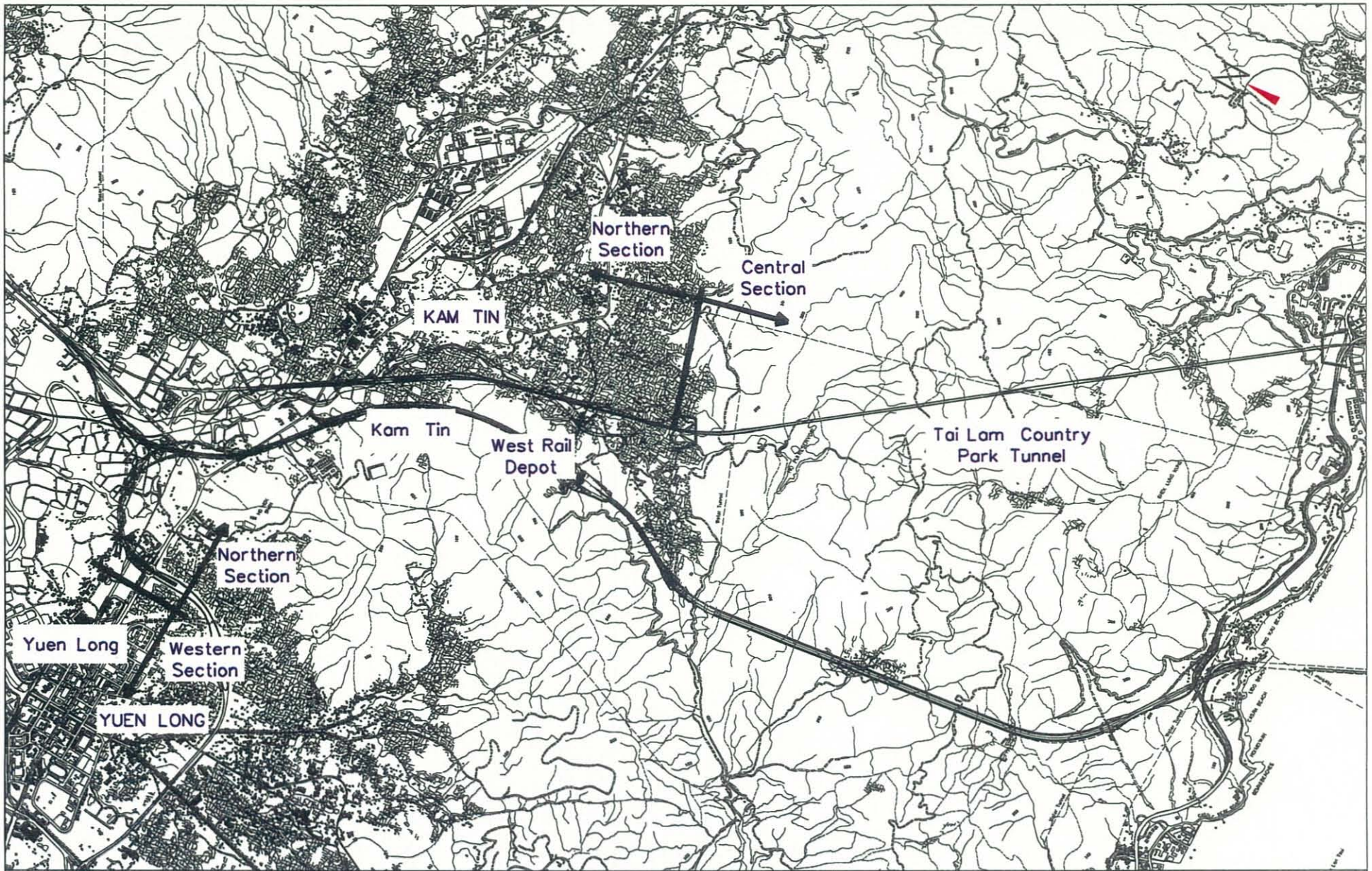


FIGURE 1.2a

WEST RAIL ALIGNMENT PLAN  
SCALE: 1/45,000

West-rail/report-ts/ma&v/1

LEGEND  
Station



LEGEND  
 ■ Station

WEST RAIL ALIGNMENT PLAN  
 SCALE: 1/45,000

FIGURE 1.2b

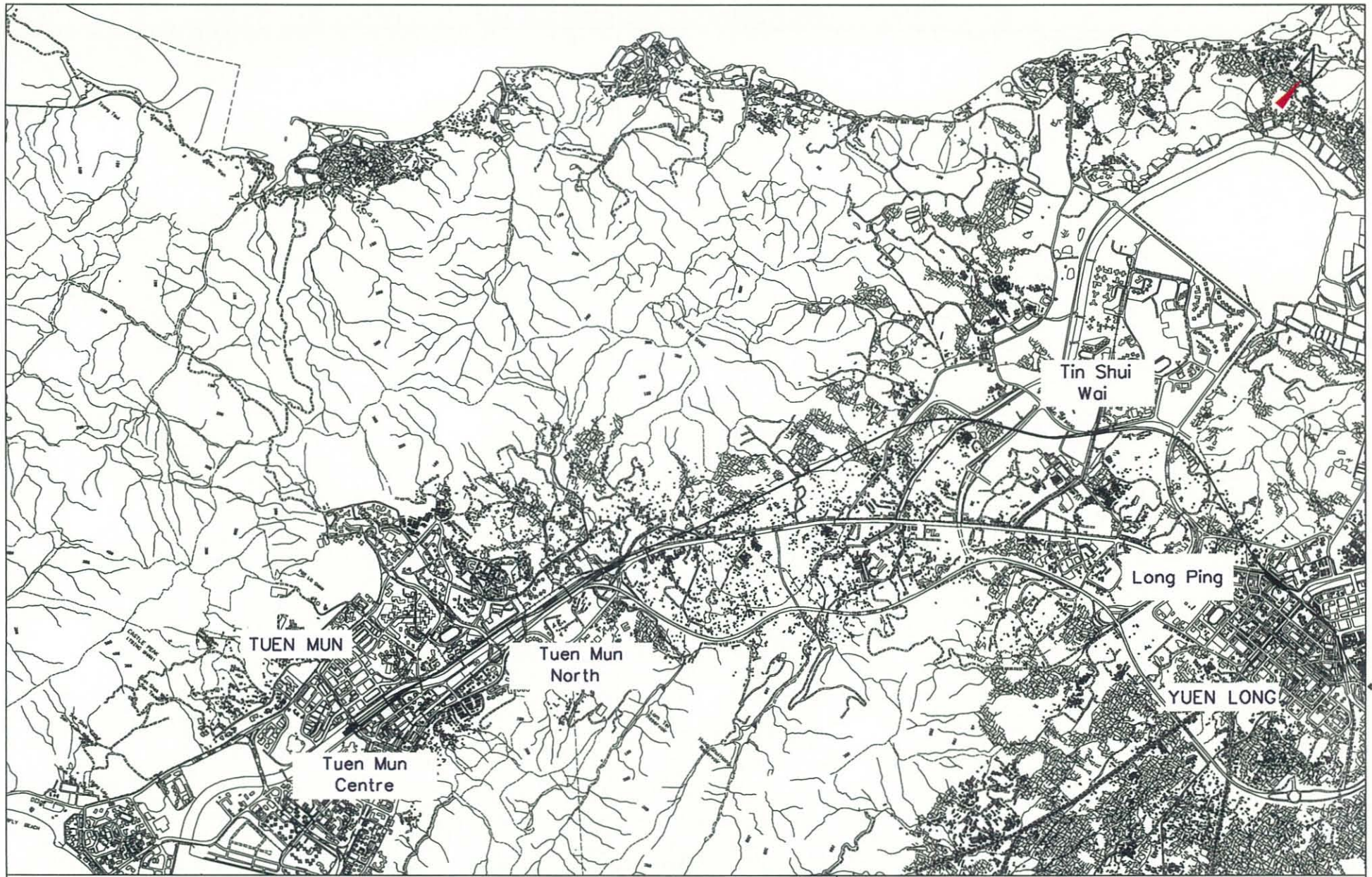
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LEGEND

■ Station

WEST RAIL ALIGNMENT PLAN  
SCALE: 1/45,000

FIGURE 1.2c

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WEST RAIL: TS900 EIA STUDY



measures are identified, designed and implemented, and to undertake additional *ad hoc* monitoring and auditing as required by special circumstances;

- Evaluate and interpret all environmental monitoring data to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards, and to verify the environmental impacts predicted in the EIA;
- Manage and liaise with other individuals or parties concerning any other environmental issues deemed to be relevant to the construction process;
- Conduct regular site audits of a formal or informal nature to assess:
  - the level of the Contractor's general environmental awareness,
  - the Contractor's implementation of the recommendations in the EIA,
  - the Contractor's performance as measured by the EM&A,
  - the need for specific mitigation measures to be implemented or the continued usage of those previously agreed,
  - to advise the site staff of any identified potential environmental issues;
- Submit monthly EM&A reports which summarise project monitoring and auditing data, with full interpretation illustrating the acceptability or otherwise of any environmental impacts and identification or assessment of the implementation status of agreed mitigation measures; and
- Produce an Operational Phase EM&A Manual, the content and need for which shall be the subject of discussions between KCRC and EPD at a later stage of the project.

## 1.6 Structure of The EM&A Manual

Following this introductory Section, the Manual is set out as follows:

- *Section 2* outlines the Environmental Management System to be employed during West Rail construction;
- *Section 3* presents the organisation and structure of the Environmental Team, outlines the various parties involved in the EM&A process, the responsibilities and contact details of key individuals;
- *Section 4* sets out the EM&A general requirements;
- *Section 5* details the requirements for baseline and impact monitoring for noise, and lists relevant monitoring equipment, locations, compliance criteria and event contingency plans (ECPs);
- *Section 6* details the requirements for baseline and impact monitoring for air quality, and lists relevant monitoring equipment, locations, compliance criteria and event contingency plans (ECPs);

- *Section 7* details the requirements for baseline and impact monitoring for water quality, and lists relevant monitoring equipment, locations, compliance criteria and event contingency plans (ECPs);
- *Section 8* details audit procedures and key locations with regard to landscape and visual issues;
- *Section 9* details audit procedures and key locations with regard to heritage issues;
- *Section 10* details sampling and audit procedures and key locations with regard to ecological issues;
- *Section 11* details audit procedures and key locations with regard to waste issues;
- *Section 12* details sampling and audit procedures and key locations with regard to land contamination issues;
- *Section 13* describes the scope and frequency of site auditing;
- *Section 14* details EM&A reporting requirements;
- *Annex A* presents representative monitoring locations for air and noise;
- *Annex B* presents a summary of the mitigation measures recommended in the EIA and their Implementation Schedule.

The EM&A Manual is an evolving document that shall be updated as necessary as the Project progresses and new information comes to light.

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### 2. THE ENVIRONMENTAL MANAGEMENT SYSTEM FOR THE CONSTRUCTION PHASE

#### 2.1 Introduction

The management of the construction phase of West Rail, in a manner which ensures that the Corporation fulfils the commitments and legal requirements associated with environmental protection, will be based upon a number of mechanisms, processes and organisational arrangements. The management system devised will draw upon the following:

- The West Rail EIA;
- The EM&A Programme;
- Environmental Management Plans;
- The Results of Environmental Performance Reviews;
- The Construction Method Statements; and
- Contractual Documentation relating to the civil works packages.

Each of these elements is further discussed below and its role in the environmental management function is described.

#### 2.2 The West Rail EIA

The West Rail EIA focused on the prediction and mitigation of impacts arising from the construction and operation of the railway. The findings and recommendations of the study constitute a formal commitment, on the part of the KCRC, to achieve the levels of environmental protection specified and form the basis upon which the Corporation's environmental performance will be judged during later stages of the project.

#### 2.3 The West Rail EM&A Programme

The EM&A Manual, this document, provides a description of the organisational arrangements required for the EM&A programme and stipulates the scope of construction monitoring (e.g. Noise, Air and Water), the parameters to be measured (e.g.  $L_{\text{aeq},30\text{min}}$ , Total Suspended Particulates, Suspended Solids, etc.), the frequency of monitoring and the actions to be taken in the event of exceedances of the environmental criteria being recorded. Additionally, audit requirements for landscape and visual, heritage, ecological, waste management and land contamination issues are presented. The EM&A programme also outlines guidelines for site auditing and reporting.

The EM&A programme provides the means by which feedback on the environmental impacts of the construction phase are provided (to the Contractor, the Corporation and, as the EM&A process is a requirement of the EIA process, the Environmental Protection Department) and the predictions made during the EIA can be tested.

The EM&A programme will also provide for an Implementation Schedule (see *Annex B*) for mitigation measures which ties the implementation of mitigation measures to the specific work activity for which it was prescribed thereby ensuring its timely installation.

## **2.4 Environmental Management Plans**

For the effective implementation of the mitigation, monitoring and remedial requirements presented in the EIA, EM&A and IS, an appropriate contractual and supervisory framework needs to be established.

The basis of the framework within which implementation will be managed is through the preparation of Environmental Management Plans (EMP) by the Contractor. KCRC will audit against the EMPs and advise the necessary remedial actions required which shall be enforced by the Engineer through contractual means.

The EMP is similar in nature to a safety or quality plan and will provide details of the means by which the Contractor (and all subcontractors working to the Contractor) will implement the recommended mitigation measures and achieve the environmental performance standards defined both in Hong Kong environmental legislation and in the EIA documentation. The primary reason for adopting the EMP approach is to make the Contractor aware of his environmental responsibilities and to ensure his commitment to achieving the standards specified.

The EMP approach is grounded on the principle that the Contractor shall define the means by which the environmental requirements of the EIA process, EM&A programme and contractual documentation shall be met. In the first instance, each Tenderer shall prepare a skeletal Environmental Management Plan for submission as part of the tendering process; the skeletal EMP will demonstrate the determination and commitment of the organisation and indicate how the environmental performance requirements laid out in the available EIA documentation will be met and, where appropriate, exceeded. It is recommended that this aspect be included as a specific criterion in the assessment of tender documents; this will act as a clear indication to all Tenderers of the Corporation's commitment to the minimisation and management of environmental impacts. Upon Contract Award, the successful Tenderer shall be required to submit a draft Environmental Management Plan for the approval of the Engineer and a final version prior to the commencement of the works.

## **2.5 Environmental Performance Reviews**

The environmental performance review programme comprises the regular assessment of the effectiveness of the EMPs, site practices and procedures to ensure that the required mitigation measures are routinely implemented and environmental standards are maintained.

The review of on-site environmental performance will be undertaken by KCRC on the basis of criteria and methodologies contained within a Review Protocol developed in advance of the commencement of construction works.

The criteria against which the reviews will be undertaken will be derived from:

- The approaches, procedures and commitments given by the Contractor in the Environmental Management Plan;
- The clauses contained within the Contractual Documentation; and
- Those parts of the Contractor's method statement which relate to the minimisation of environmental impacts or other specified environmental protection measures.

These reviews shall focus on the *effectiveness* of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented. In addition, the management systems established by the Corporation's on-site management team (i.e. the "Engineer") to monitor the Contractor's compliance with Contractual requirements will be included within the protocols.

The Review Protocols will be developed during the finalisation of the on-site procedures and will be incorporated in the revised EM&A Manual at that time. The likely protocols will include (but not be limited to) the auditing of the following activities:

- The allocation of responsibility for fulfilling environmental requirements and the effectiveness of lines of communication with regard to environmental issues;
- Compliance with procedures established to enable an effective response to environmental incidents, exceedances or non-compliances;
- The extent and accuracy of record-keeping related to environmental performance indicators;
- The effectiveness of staff training in ensuring high levels of awareness with regard to environmental requirements; and
- The effectiveness of environmental management activities, including:
  - The inspection, cleaning and maintenance of sediment traps and oil interceptors;
  - The management and disposal of on-site waste arisings;
  - The implementation of spill prevention measures;
  - The maintenance of site boundary fences to prevent incursions, tipping, vehicle movements and encroachment of personnel into surrounding areas;
  - The measures adopted to prevent the flow of pollutants, sediment and contaminated runoff into streams and water bodies within the work site boundary; and
  - The speed and effectiveness of responses to complaints.

The protocols will comprise checklists of environmental requirements and will be amended, throughout the construction phase as necessary, to focus on areas of frequent non-compliance and to reflect the potential impacts associated with specific activities within the construction programme.

## 2.6 Construction Method Statements

It is common practice for the Contractor to submit details of forthcoming works to the Engineer to seek approval for the commencement of the works as well as the methodology and equipment proposed to be used.

It is recommended that this process be expanded, in line with the adoption of the Contractor's EMP, to require the signature of the Contractor's Environmental Manager who shall comment on deviations of the specific works from that assumed in the project EIA and advise on the implications of the changes in construction methods for achieving the environmental performance criteria set out in the EIA documentation and the EMP.

This ongoing requirement for the Contractor to review proposed working methods, in terms of their potential to impact upon the environment, will reduce the time taken to implement the necessary environmental control measures and reduce the number of iterations a measure may have to go through before becoming effective.

Any changes in construction methods will need to be reflected in a revised EMP or the Contractor will be required to demonstrate the manner in which the existing EMP shall accommodate the proposed changes.

## 2.7 Contractual Documentation

The key element to be included in the contractual documentation is the requirement to prepare, implement and maintain an EMP (see above); the EMP places a contractual responsibility for on-site environmental management with the Contractor.

The EMP will, in part, be based upon the requirements contained within the contractual documentation. The contractual documentation would generally comprise appropriate extracts from (and references to) the EIA Report and EM&A Manual and include such typical elements as the relevant statutory environmental standards, general environmental control clauses and specific environmental management clauses, as well as an outline of the scope and content of the EMP. In drafting the documentation, due consideration shall be given to the predictive nature of the EIA process and the consequent need to manage and accommodate the actual impacts arising from the construction process. In particular, the Contractor must be placed under a clear obligation to identify and control any implications arising from changes from the EIA assumptions relating to work methods, progress rates and other estimates made during the preliminary design phase.

In addition, the contractual documentation shall define appropriate contractual mechanisms to ensure compliance with environmental requirements. The range of mechanisms available to the Engineer shall reflect the priority that the Corporation is to give environmental issues during the construction phase and may include provisions for suspending works pending the remediation of persistent environmental problems. Similarly, the inclusion of environmental performance milestones payments shall be considered by the Corporation as a means of enhancing the environmental performance and encouraging the Contractor to meet these contractual obligations.



## 2.8 Electronic Environmental Management System (EEMS)

An Electronic Environmental Management System (EEMS) will be implemented and maintained for each of the Civil Works Contracts throughout the construction phase of West Rail. The EEMS will function as a database for the entry of all recorded monitoring and audit information; in addition, EEMS will:

- automatically issue Notifications of Exceedance via E-mail;
- action Event Contingency Plans via E-mail;
- store details of complaints;
- store details of licenses/permits and notify forthcoming expiries via E-mail;
- store construction activity details and other relevant site information and link these to the Implementation Schedule; and
- allow retrieval of electronic versions of the EM&A Manual, FAR and other relevant documents.

The different users of the EEMS will have specific security clearance levels to determine extent of access.

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### 3. ORGANISATION AND STRUCTURE OF THE ENVIRONMENTAL TEAM

#### 3.1 Project Organisation

An Environmental Team shall be set up for the West Rail construction phase. The organisation and lines of communication with respect to environmental works are shown in *Figure 3.1a*. The following sub-sections outline the primary responsibilities and duties of the key EM&A programme participants.

##### 3.1.1 Environmental Manager

The Environmental Manager is responsible for:

- The broad supervision of the EM&A Study Programme, its members and the timely production and quality of the outputs;
- Managing the Independent Environmental Checker Team and providing guidance to KCRC personnel in their dealings with the Contractor's Environmental Team;
- Meeting the agreed objectives and deadlines as set out in this Manual; and
- Ensuring the quality of the deliverables.

##### 3.1.2 Contractor's Environmental Team

The duties of the Contractor's Environmental Team are:

- To monitor the various environmental parameters as required by this EM&A Manual and to input the data into the EEMS database;
- To follow up and close out EEMS actions;
- To investigate and audit the Contractor's equipment and work methodologies with respect to pollution control and environmental mitigation, and to anticipate environmental issues that may require mitigation before the problem arises;
- To audit and prepare audit reports on the environmental monitoring data and the site environmental conditions; and
- To report the environmental monitoring and audit results to the Contractor and the Engineer.

##### 3.1.3 Engineer

The Engineer shall:

- Monitor the Contractor's compliance with contract specifications, including the effective implementation and operation of environmental mitigation measures;
- Instruct the Contractor to follow the agreed protocols or those in the Contract Specifications in the event of exceedances or complaints; and

- Comply with the agreed Event Contingency Plan in the event of any exceedance.

### **3.1.4 Contractor**

Reporting to the Engineer, the Contractor shall:

- Work within the scope of the construction contract and other tender conditions;
- Cooperate with the environmental performance review undertaken by the Independent Environmental Checker and undertake any corrective actions as instructed by the Engineer; and
- Operate and strictly adhere to the guidelines of the EMP developed by their project staff.

### **3.1.5 Independent Environmental Checker**

An Independent Environmental Checker shall be appointed by the Corporation to audit and verify the overall environmental performance of each the West Rail Contract sites and to assess the effectiveness of the Environmental Team in their duties. The main objectives will be to:

- Implement and maintain the EEMS to all contract packages;
- Arrange and conduct monthly general site inspections of the different works areas along the West Rail alignment;
- Review the programme of works, in order to anticipate any potential environmental impacts before they arise;
- Ensure that impact monitoring is conducted at the correct locations at the correct frequency as identified in the EM&A Manual;
- Check that mitigation measures that have been recommended in the EIA, the EM&A Manual and Contract documents, or as required, are correctly implemented, in a timely manner, when necessary; and
- Report the findings of site inspections and other environmental performance reviews to the Environmental Manager and the EPD.

## 4. EM&A GENERAL REQUIREMENTS

### 4.1 Introduction

In this Section, the general requirements of the EM&A programme are presented with reference to the relevant EIA findings that have formed the basis of the scope and content of the programme.

### 4.2 Summary of the EIA

A summary of the key findings of the EIA that have a bearing on the objectives, scope and content of the EM&A programme is presented below. The EIA recommended mitigation measures and their schedule for implementation are detailed in *Annex B*.

#### 4.2.1 Construction Noise

The main noisy activities during the construction of West Rail are expected to include portal construction, earthwork excavation, concreting, viaduct construction and removal of spoil. Unmitigated construction activities have been predicted to cause exceedances of the agreed daytime noise criteria of 75 dB(A) at many of the nearby noise sensitive receivers (NSRs). However, mitigation measures have been developed which shall reduce noise levels at NSRs to acceptable levels.

##### *Southern Section*

The construction noise assessment has shown that, in the main, the application of standard mitigation measures will reduce construction noise to within the established criteria. For those receivers where residual noise impacts are predicted, a reduction of plant numbers or the on-time of specific plant has been specified to reduce impacts to within acceptable levels.

If the measures recommended are fully implemented, the predicted noise levels at all NSRs, arising from the construction of the Southern Section, will comply with established noise criteria.

##### *Central Section*

The construction noise assessment has shown that, in the main, the application of standard mitigation measures will reduce construction noise to within the established criteria. For those receivers where residual noise impacts are predicted, a reduction of plant numbers or the on-time of plant has been specified to reduce impacts to within acceptable levels.

If tunnelling works were required to be conducted during restricted hours, a substantial amount of mitigation would be necessary in order that a Construction Noise Permit (CNP) could be obtained from the EPD. A purpose built noise enclosure around the tunnel portal may be adequate although parallel reductions in operational plant may also be required to meet established criteria.

If the measures recommended are fully implemented, the predicted noise levels at all NSRs, arising from the construction of the Central Section, will comply with established noise criteria.

*Northern Section and West Rail Depot*

The construction noise assessment has indicated that the application of standard noise mitigation measures will only be partially effective in controlling construction noise levels. To achieve compliance with agreed criteria, guidelines for limiting the on-time and number of active plant at any given time are presented in the EIA.

If the measures recommended are fully implemented, the predicted noise levels at all NSRs, arising from the construction of the Northern Section and the Depot, will comply with established noise criteria.

*Western Section*

The construction noise assessment has indicated that the application of standard mitigation measures has had limited success in reducing noise levels to within daytime criteria. Specifically, construction activities associated with viaduct and station construction lead to residual exceedances of up to 8 dB(A) and 16 dB(A) above the established criteria for residential and educational establishments respectively.

Reduction in the level of residual exceedance has been pursued by reducing the on-time of noisy plant and limiting the number of simultaneously operated plant, however, the predictions indicate that sensitive receivers are still impacted. It is suggested that remaining exceedances of the established criteria are reduced by the application of indirect mitigation measures which should result in compliance with construction noise levels.

If the measures recommended are fully implemented, the predicted noise levels at all NSRs, arising from the construction of the Western Section, will comply with established noise criteria.

*General*

Both general and specific mitigation measures have been recommended in the EIA for implementation during construction works in order to meet the agreed noise criteria. Mitigation measures including the use of quiet plant, on-site movable noise barriers and limiting both the total number and type of plant operating concurrently will be required. General best practice measures for the control of construction noise and specific measures which are to be implemented according to an indicated timeframe or which are linked to certain activities are listed in *Annex B*. Regular monitoring of noise at NSRs as detailed later in this document will also be required during construction.

**4.2.2 Air Quality**

Dust impacts generated from construction activities, including excavation, material handling and stockpiling, vehicular movement, wind erosion of unpaved works areas,

compressor and generator usage will be the major impact to air quality at Air Sensitive Receivers (ASRs).

#### *Southern Section*

The implementation of the EIA recommended dust mitigation measures will reduce dust levels such that the established criteria will be satisfied at all ASRs except for Nam Cheong Estate. If a speed limit of 15 kph is applied in works areas A and B, dust emissions from these sites will be further decreased and the 1-hour TSP level at Nam Cheong Estate will be reduced to acceptable levels. Lai Chi Kok Park is adjacent to the works area, and hoarding is recommended at the site boundary to further limit ground level fugitive dust dispersion into the park.

#### *Central Section*

With the application of the dust mitigation measures recommended in the EIA, the predicted 1-hour and 24-hour TSP levels at all ASRs will comply with established criteria.

#### *Northern Section and West Rail Depot*

The EIA predictions state that, with the implementation of the recommended dust control measures, the predicted 1-hour and 24-hour TSP levels are reduced to within the adopted criteria and no adverse residual impacts are anticipated during construction of the Depot and the Northern Section.

#### *Western Section*

The EIA indicates that, with the implementation of the recommended dust control measures, the predicted dust levels criteria will potentially still be above the 1-hour TSP and 24-hour TSP criterion in some areas. It should be noted that 24-hour TSP levels are predicted under worst wind conditions and for wind blowing directly towards the receivers for 24 hours. In reality, wind directions vary throughout the day and the dust levels at the ASR will be less than predicted. Nevertheless, further mitigation measures are recommended.

It is suggested that a speed limit of 15 kph should be applied at Long Ping and Tin Shui Wai stations, and a limit of 10 kph at Yuen Long and Tuen Mun Centre stations and the section of viaduct between Ping Ha Road and Castle Peak Road. Assuming that these measures are adopted there should be no unacceptable impacts at any ASRs.

#### *General*

Specific dust control measures have been recommended in the EIA to minimise dust impacts at sensitive receivers and to comply with the *Hong Kong Air Quality Objectives* (AQO). Air quality monitoring and audit requirements are detailed in *Section 6* while general and specific measures which are to be implemented according to an indicated timeframe or which are linked to certain activities are listed in *Annex B*.

### 4.2.3 Water Quality

Potential water quality impacts from West Rail construction activities may result from unmitigated land based construction activities including surface runoff and drainage, dewatering operations, sewage effluent, debris and spillages. The nearest sensitive water bodies to works which could be impacted include:

#### *Southern Section*

The only body of water along the alignment of the Southern Section will be Victoria Harbour Phase II Water Control Zone (WCZ). Sensitive uses that could be impacted include:

- Cheung Sha Wan salt water pumping station;
- Yau Ma Tei salt water pumping station; and
- Yau Ma Tei Typhoon Shelter.

The EIA water quality assessment has concluded that impacts can be controlled to within permitted standards by implementing the recommended mitigation measures.

#### *Central Section*

The major water bodies along the alignment of the Central Section are Victoria Harbour and Rambler Channel. Sensitive uses include:

- Gazetted beaches within the Western Buffer Zone WCZ;
- Rambler Channel Typhoon Shelter; and
- Water intakes along Rambler Channel.

Water quality impacts during the reclamation of Tsuen Wan Bay were quantitatively assessed using the TELEMAC-3D model. Suspended sediment is identified as the most problematic water quality parameter during the reclamation. The worst case scenario during reclamation was assessed and it was concluded that no significant water quality impacts will be experienced by WSRs along Ting Tau, Sham Tseng and Tsing Yi. However, the water quality at existing cooling water intakes and the Water Services Department (WSD) salt water intake at Tsuen Wan Bay would be substantially affected by the reclamation activities. Satisfactory temporary reprovisioning of these intakes is proposed for the construction stage on the basis of modelling results. Provided the recommended mitigation measures are implemented, water quality impacts of Tsuen Wan Bay reclamation will be reduced to acceptable levels.

Water quality impacts from land-based construction can be controlled to comply with standards by implementing the recommended mitigation measures. No unacceptable residual impact on water quality is anticipated.

#### *Northern Section and West Rail Depot*

The major water bodies along the alignment of the Northern Section are the Kam Tin River and its tributaries and numerous ponds. Sensitive uses include:



- Commercially farmed fish and duck ponds; and
- Deep Bay, where discharges are governed by the EPD “Zero Discharge” policy.

The EIA water quality assessment has determined that no insurmountable water quality impacts should result from the construction of the Northern Section and the Depot, provided that the mitigation measures outlined are implemented.

#### *Western Section*

The major water bodies along the alignment of the Western Section are Yuen Long Creek, Tin Shui Wai Nullah, Tuen Mun River and ponds near Yuen Long, Long Ping and Tin Shui Wai Stations. Sensitive uses include:

- Commercially farmed fish and duck ponds; and
- Tuen Mun typhoon shelter; and
- Gazetted beaches downstream of Tuen Mun River, in particular Castle Peak Beach.

With the implementation of proper site management and good construction practices it is considered that construction activities will present no unacceptable water quality impacts at any WSRs in the Western Section.

#### *General*

Specific water quality control measures have been recommended in the EIA to minimise impacts at sensitive receivers and to comply with the *Water Pollution Control Ordinance* (WPCO). Water quality monitoring and audit requirements are detailed in *Section 7* while general and specific measures which are to be implemented according to an indicated timeframe or which are linked to certain activities are listed in *Annex B*. Regular monitoring of water quality at WSRs as detailed later in this document will also be required during construction.

#### **4.2.4 Landscape and Visual**

##### *Southern Section*

The quality of the existing landscape in the Southern Section is generally poor. Only the open space developments at Nam Cheong Buffer Zone and Lai Chi Kok Park Stages 2 and 3 have a reasonably high quality of landscape character. Mitigation measures have been recommended in the EIA that will minimise potential visual and landscape impacts.

The construction of the railway will have significant negative but temporary impacts on the landscape resource and landscape character of both these open spaces through loss of amenity and semi-mature trees. However, comprehensive reinstatement of the parks above the railway tunnel is likely to result in an overall slight beneficial impact on the resource and character of the landscape.

In the short term, there will be significant negative impact on the character of road side areas on the reclamation through the introduction of large scale construction activity and the loss of recently planted trees. However replanting and additional landscape treatment along the rail corridor is likely to result in a long term slight beneficial impact on landscape resource and character in the operational phase.

There will be significant negative but temporary visual impacts during the construction of the Southern Section on existing residential developments and open spaces, as well as planned residential and community developments, depending on whether or not these developments are occupied before the completion of West Rail construction works.

#### *Central Section*

The alignment is either in cut and cover, or bored tunnel, throughout the Central Section except where the railway emerges from the North Portal within the Kam Tin Valley. As a result, landscape impacts will occur mainly during the construction period. Mitigation measures have been recommended in the EIA to minimise potential visual and landscape impacts during construction.

In the short term, the southern half of Lai Chi Kok Park Stage 1 will be temporarily disrupted with the loss of a number of sports pitches and mature planting, resulting in a very substantial negative landscape impact during construction. Facilities will be re-provisioned elsewhere within the park and the area will be landscaped for passive recreation, resulting in a slight beneficial landscape impact in the long term.

The route will also disturb planting in central reservation areas, roundabouts and embankments at Lai King Hill Road/Ching Cheung Road, Kwai Fuk Road roundabout and Hoi Hing Road, causing slight to very slight negative impact on the local landscape. Re-planting of these areas will effectively mitigate any impact on landscape resources or character.

Planting and park facilities within Tsuen Wan District Open Space Area 35, Phase 1 will be disrupted by the upgrading of two large drainage culverts required as part of the reclamation works, resulting in a slight to moderate negative impact on the landscape. Replanting and re-provisioning of facilities will effectively mitigate these impacts.

Reclamation works will result in a substantial negative impact on the landscape of waterfront promenade Phase 2 of the Open Space. Re-provisioning of the waterfront facilities within a comprehensive new development, however, will result in a moderate beneficial impact on the landscape resources and character of the area in the long term.

The route will have a very substantial negative short term impact on the character and resources of the Kam Tin valley during construction through disruption of the existing vegetation pattern and loss of mature vegetation. Planting along the shallow cuttings and embankments will mitigate the impact on landscape to some extent, although there is likely to be a moderate negative impact on the landscape in the long term.

There will be significant negative but temporary visual impacts during the construction of the Central Section on existing residential developments and open spaces.

*Northern Section and the West Rail Depot*

West Rail will be carried on elevated viaduct structures through this section, with the Depot being developed on embanked land. The alignment passes over the traditional farmed landscape of the Kam Tin flood plain that is of a high scenic quality at the southern end becoming progressively degraded to the north by infrastructural development, notably the Route 3 Highway, and container and open storage land uses. Mitigation measures have been recommended in the EIA to minimise potential visual and landscape impacts.

In the short term, the Depot will have significant negative impacts on the landscape resource and character of the Kam Tin valley close to the North Portal, just below the Country Park, which cannot be easily mitigated. Further to the north, however, the extent of natural landscape resources and scenic quality diminishes and viaduct construction will have progressively less impact.

Reinstatement of existing land uses beneath the viaducts will help to reduce landscape impacts, and large scale woodland planting on the embankments will provide a positive landscape and visual element that will tend to compensate for the impacts caused during construction.

There will be significant short term visual impacts caused by the construction of the Northern Section and Depot and these will be experienced to varying degrees over a wide geographical area due to the fact that the railway is elevated for most of the length of this Section.

*Western Section*

The new elevated railway structures running along the existing road and nullah corridors of both Yuen Long and Tuen Mun new towns will form dynamic new structures in the low quality urban environments. Construction activities will result in slight negative impacts on these streetscapes, but the innovative quality of the structures with associated planting and street improvements will result in a slight beneficial impact on the landscape in the long term.

The elevated structure is likely to have a slight to moderate negative impact on the landscape of the open low lying mixed agricultural / residential / storage areas between these two centres during construction. These will be mitigated to very slight beneficial impacts on landscape resources and slight negative impacts on landscape character during the operational phase through reinstatement of the existing land uses under the alignment to tone down the scale of the structure and strengthen the landscape pattern.

There will be substantial temporary visual impacts caused by the construction of the Western Section. These will be experienced to varying degrees over a wide geographical area due to the fact that the railway is elevated for most of the length of this Section, but they will be most intensely felt in the urban areas where the residential and community uses immediately adjacent to the railway will suffer temporary substantial negative visual impacts.

#### **4.2.5 Archaeology**

The ongoing interaction between the EIA Study Team and the engineering Design Consultants has ensured that the West Rail alignment can avoid directly impacting upon any known historic buildings or features.

The potential direct impacts to the temple at Cheung Po have been mitigated through the redesign of the Depot layout. Further mitigation to the setting of the temple will be provided through appropriate planting and screening.

It is recommended that direct impacts to the heritage value of the buildings of Lau's Residence at Tung Shing Lei be avoided through the adoption of a buffer zone of at least five metres between the building and the site boundary for the construction worksite.

Concerns have been raised regarding the potential impacts to the Tsui Shing Lau Pagoda, which is located some 40 metres to the south of the proposed Tin Shui Wai Station. It is recommended that the visual impact of the Station structure be mitigated through the adoption of sympathetic external design, which includes due consideration of the local preference for a traditional Chinese architectural style to be adopted for the design of the station.

The potential implications associated with the vibration impacts to the Pagoda, arising during construction and operation, have also been identified as an issue of concern. Whilst the predicted vibration levels will not cause any structural damage to the Pagoda, given the sensitivity of the structure and its associated heritage value, it is recommended that the structure is the subject of survey in advance, and following completion, of construction and that limits on vibration levels be imposed upon the Contractor.

The predictive modelling of potential impacts to buried archaeological resources is to be field tested during early 1998 and the findings and recommendations will be presented to the Antiquities & Monuments Office (AMO). The proposed approach to the evaluation of impacts to heritage resources has been presented to the Antiquities Advisory Board and, if appropriate, further presentations of progress will be provided during the course of the ongoing archaeological work.

#### **4.2.6 Ecology**

##### *Southern Section*

No resources of ecological value have been identified within the Southern Section of West Rail.

##### *Central Section*

In the Central Section no ecological resources are found in the southern part and ecological concerns in the northern part, between the north portal of the Tai Lam Tunnel and the West Rail Depot, are addressed together with the Northern Section and West Rail Depot.

*Northern Section and West Rail Depot (plus the northern region of the Central Section)*

The potential ecological impacts associated with West Rail construction have been assessed, and the available options of impact avoidance and mitigation investigated. The key impact associated with the 12 ha wetland habitat loss would be mitigated by the provision of at least 8.5 ha of high quality created wetlands with the benefits of long-term management to defined conservation objectives. The detailed specification for the provisioning of this compensatory habitat will be contained within a Habitat Creation and Management Plan to be prepared by experienced professionals and submitted to the Agriculture and Fisheries Department (AFD) for endorsement prior to the onset of construction. Strict construction control practices are also recommended to minimise the potential disturbance to the Painted Snipe roosting site near Kam Tin Road.

Fragmentation of remaining, undisturbed habitats will result from construction of the transport corridor through a predominantly agricultural area. Anticipated subsequent development of the area for residential and other purposes, arising from enhanced transport access and improved flood control, is expected to cause significant longer term impacts and will need to be addressed by the EIA or planning studies for those development proposals.

*Western Section*

Much of the Western Section alignment lies within a predominantly urbanised area interspersed with small agricultural plots, small fish ponds, isolated marshes and remnant, isolated stands of trees. The potential impacts of this section of West Rail are minor, and no mitigation is considered necessary by the EIA.

**4.2.7 Construction Waste Management**

No adverse impacts upon the environment, in terms of specified government regulations and guidelines, were identified in the EIA from the storage, handling, collection, transport and disposal of waste arisings during the construction phase of West Rail. In most cases, waste materials can be easily re-used on other fill sites or disposed of to Public Dumps. Mitigation measures recommended as good construction practices should be incorporated into Contract Specifications and applied to ensure that environmental nuisance does not arise from the storage, transport and disposal of the various types of waste arisings. These recommendations should form the basis of the site waste management plan to be developed by the Contractor at the detailed design stage.

Key issues from all Sections of West Rail include the need for effective waste management planning, effective management of chemical/industrial and other potentially hazardous wastes, proper handling and disposal of contaminated marine sediments, and the strong preference for reuse of clean surplus material rather than disposal at public filling areas. Waste management methods and practices and other mitigation measures have been recommended to ensure that potential impacts are avoided or controlled to acceptable levels.

#### **4.2.8 Land Contamination**

The EIA has assessed that the potential for soil and groundwater contamination exists in various areas along the alignment where current or historic land uses have impacted upon the land. Further review of subsurface conditions through geologic and hydrogeologic investigations may also be pertinent in assessing the potential for contamination impacts from areas adjacent to the development. The potential for impacts from land contamination exists where there will be an interface with the underlying soil either during construction or operation of West Rail.

##### *Southern Section*

Impacts from land contamination are not considered to represent a major concern during the construction of the Southern Section as there is no current or historical industrial usage. Health risks to site workers will be limited through the use of mechanised plant to perform the excavation and the saturated nature of any contaminated material found. Potential risks will be further reduced if good personal hygiene practises are encouraged. The main concern is the potential requirement to handle and dispose of minor quantities of contaminated sediments which may be present below the reclaimed area and the concurrent issue of potentially contaminated groundwater disposal.

##### *Central Section*

Land contamination impacts are not considered to represent a major concern during construction of the Central Section. The majority of works are likely to involve the use of plant and mechanical excavators. Any exposure to potential contaminants is likely to be for a relatively short period of time and can be controlled by implementing conventional personal protective and dust control measures. Good personal hygiene standards will further reduce the potential for human exposure.

The main impact relates to the potential requirement to handle and dispose of small isolated quantities of contaminated soils and groundwater based on historical industrial usage. This may be necessary if excavation takes place in the vicinity of the petrol filling station and factory in the Mei Foo Station development, and in the vicinity of the industrial buildings or any underground storage tanks associated with the bus terminus. At present these volumes are not determined.

##### *Northern Section and West Rail Depot*

Overall, land contamination impacts are not considered to represent a major concern during the construction of the Northern Section and the Depot, if recommended mitigation measures are implemented. Based on the results of the pond and river sediment sampling programme, it has been estimated that up to 30% of this material could be contaminated or unsuitable for reuse, and may require special handling and disposal. For the Kam Tin Station the KCRC has estimated the amount of contaminated mud to be 120,000 m<sup>3</sup>. However, from the limited initial sampling programme significant concentrations of heavy metals were detected in only one pond sample in the Kam Tin Station footprint, which indicated Class B or moderate contamination. This is based on the concentration of zinc detected (152 mg/kg, versus the standard of 150 to 199 mg/kg

for Class B). Therefore, the actual volume of material which is contaminated is likely to be much less than the earlier estimate.

Comparing the results against the EPD classification of sediment by metal content criteria, one pond sample and two river samples from within the Depot footprint are designated as Class C (seriously contaminated) which requires special handling and disposal. Copper and zinc were detected at concentrations of 159 and 428 mg/kg, respectively, more than twice the contamination level required for classification as Class C (65 mg/kg for copper, and 200 mg/kg for zinc). These data are from localised areas, and it is expected that the total amount of material which is contaminated and requiring special disposal will not be significant.

#### **4.2.9 Reprovisioning of Yuen Long Pond Fish Wholesale Market**

During construction works for the reprovisioning of Yuen Long Pond Fish Wholesale Market, it may become necessary to conduct noise and air quality monitoring at the committed residential development in the adjacent Comprehensive Development Area (CDA) to the west. This monitoring would only be required if any of the developments in the CDA site is inhabited at the time of the reprovisioning works and it would be sufficient for there to be just one representative monitoring station, sited at the closest of the inhabited premises.

#### **4.2.10 Gin Drinkers Bay Landfill Gas Risk Assessment**

The Draft qualitative Landfill Gas Assessment EIA, a complementary, stand alone document to the West Rail EIA has predicted risks from Gin Drinkers Bay Landfill during the operational phase of the railway. Various recommended measures were also outlined for the construction phase, but a detailed risk assessment should be conducted to assess and propose precautionary measures relevant to the specific construction methods and plant to be used (when known).

### **4.3 Construction Phase EM&A**

#### **4.3.1 General**

The issues associated with the construction phase of West Rail identified during the EIA process will be addressed through the employment of a range of specific mechanisms, procedures and controls.

Where significant uncertainty exists regarding the scale, severity or nature of a particular impacted resource or potential adverse effect (for example, the extent of land contamination or the presence of buried archaeological deposits), further investigations will be undertaken, in advance of construction, to provide sufficient information on which to base any subsequent required actions. The planning, execution and reporting of such investigations will be undertaken in consultation with relevant Government Departments and in accordance with established legislative and procedural requirements.

The mitigation of impacts to ecological resources, through the provision of compensatory habitat, will be detailed in a Habitat Creation and Management Plan, which will be agreed with the Agriculture and Fisheries Department (AFD) prior to implementation.

The monitoring of the effectiveness of mitigation measures relating to a range of other issues will be achieved through on-site auditing. Audit protocols will include within their scope; monitoring mechanisms to ensure that site tidiness, hoarding maintenance, waste management provisions, screen planting and the timely resolution of received complaints are managed and controlled in a manner consistent with the recommendations of the EIA. Further details regarding site auditing are provided in *Sections 4.3.5 and 13*.

The remaining construction phase issues of noise, dust and water pollution will be subject to monitoring regimes which have become common practice in Hong Kong in recent years. The broad description of the monitoring programme for these media is provided in *Section 4.3.2* below.

**4.3.2 Environmental Monitoring**

**4.3.2.1 Monitoring Programme**

The monitoring of environmental impacts shall be carried out by the Engineer's Environmental Team; the monitoring work will comprise noise, air and water quality impacts at representative sensitive receivers in the vicinity of the works. The monitoring programme for the Project is summarised in *Table 4.3a*.

**Table 4.3a Summary of Monitoring Programme**

	Noise	Air Quality	Water Quality
Parameters	<p>Restricted period: three consecutive <math>L_{Aeq}</math> 5 minutes;</p> <p>Unrestricted period: six consecutive readings <math>L_{Aeq}</math> 5 minutes.</p>	TSP 1-hour (baseline only) and 24-hour	<p>Dissolved oxygen (DO) (in <math>mg\ l^{-1}</math> and % saturation);</p> <p>Temperature (<math>^{\circ}C</math>)</p> <p>pH value;</p> <p>Turbidity (NTU);</p> <p>Water depth (m);</p> <p>Salinity (<math>mg\ l^{-1}</math>); and</p> <p>Total hardness (as <math>CaCO_3</math>) (<math>mg\ l^{-1}</math>).</p> <p>Suspended solids (<math>mg\ l^{-1}</math>)</p> <p>Sulphides (<math>mg\ l^{-1}</math>)</p>
Locations	See <i>Annex A</i>	See <i>Annex A</i>	See <i>Figures 7.4a-f</i>
Initial Baseline	Daily at 30 minute intervals for two weeks prior to construction.	24-hour TSP daily for two weeks prior to construction and three 1-hour TSP daily for two weeks. 1-hour sample should be conducted at least three times per day when the highest dust impact is expected.	3 times per week at surface, middle and bottom during mid-ebb and mid-flood tides (where appropriate) for a period of four weeks prior to construction



	Noise	Air Quality	Water Quality
Baseline Check	Every six months	Every six months	Not Applicable - control station approach used
Impact Monitoring	One set of measurement (three consecutive $L_{Aeq}$ 5 min) in restricted hours and one set of measurement (six consecutive $L_{Aeq}$ 5 min) in unrestricted periods every week when noise generating activities are underway.	One 24-hour TSP every six days	3 times per week at surface, middle and bottom during mid-ebb and mid-flood tides (where appropriate)
Additional Requirements	<i>Ad hoc</i> monitoring as required.	<i>Ad hoc</i> monitoring as required.	<i>Ad hoc</i> monitoring as required.

### 4.3.3 Action and Limit Levels

Action and Limit (A/L) Levels are defined levels of impact recorded by the environmental monitoring activities which represent levels at which a prescribed response is required. These levels are quantitatively defined later in the relevant sections of this manual and described in principle below:

- *Action Limits*: beyond which there is a clear indication of a deteriorating ambient environment for which appropriate remedial actions are likely to be necessary to prevent environmental quality from falling outside the *Limit Levels*, which would be unacceptable; and
- *Limit Levels*: Statutory and/or agreed contract limits stipulated in the relevant pollution control ordinances, *Hong Kong Planning Standards and Guidelines* (HKPSG) or Environmental Quality Objectives established by the EPD. If these are exceeded, works should not proceed without appropriate remedial action, including a critical review of plant and working methods.

### 4.3.4 Event Contingency Plans

The purpose of the Event Contingency Plans (ECPs) is to provide, in association with the monitoring and audit activities, procedures for ensuring that if any significant environmental incident (either accidental or through inadequate implementation of mitigation measures on the part of the Contractor) does occur, that the cause is quickly identified and remedied, and that the risk of a similar event recurring is reduced. This also applies to the exceedance of A/L criteria identified by the EM&A programme.

### 4.3.5 Environmental Auditing

As indicated in *Section 4.3.1* above, in addition to the monitoring of noise, air, and water quality levels as a means of assessing the ongoing performance of the Contractor, the Engineer's Environmental Team shall undertake regular audits of the Contractor's onsite practices and procedures. The primary objective of the audit programme will be to assess the effectiveness of the management systems established by the Contractor to implement the environmental mitigation measures recommended in the EIA for noise, air, and water

quality, landscape and visual impacts, archaeology, ecology, waste management and land contamination.

Whilst the audit programme will undoubtedly complement the monitoring activity with regard to the effectiveness of dust suppression, noise attenuation measures and water quality control, the criteria against which the audits will be undertaken shall be derived from the clauses within the Contract Document which seek to enforce the recommendations of the EIA and the established management systems.

The findings of site audits shall be made known to site staff at the time of the audit to enable the rapid resolution of identified non-compliances. Non-compliances, and the corrective actions undertaken, shall also be reported in the monthly EM&A Reports.

*Section 13* presents the scope and frequency of onsite audits and defines the range of issues the audit protocols shall be designed to address.

#### **4.3.6 Enquiries, Complaints and Requests for Information**

Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations including members of the public, Government departments, the press and television media and community groups. The vast majority of the correspondence is likely to be received directly by KCRC, although the other major receiver will be the site offices.

All enquiries concerning the environmental effects of the works, irrespective of how they are received, shall be reported to the Engineer's Environmental Team who shall set up procedures for the handling, investigation and storage of such information. The following steps shall then be followed:

- (1) The Engineer's Environmental Team shall notify the Engineer of the nature of the enquiry.
- (2) An investigation shall be initiated to determine the validity of the complaint and to identify the source of the problem.
- (3) The Engineer shall undertake the following steps, as necessary:
  - Investigate and identify the source of the problem (the Engineer may request additional dust or noise monitoring);
  - Liaise with the Environmental Manager to identify remedial measures;
  - Require the Contractor to take action to mitigate the situation;
  - Repeat monitoring to check compliance with A/L level criteria; and
  - If monitoring results show exceedances, repeat review procedures to identify further possible areas of improvement.
- (4) The outcome of the investigation and the action taken shall be documented on the complaints proforma. Where possible, a formal response to each

complaint received shall be prepared, within a maximum of seven days, in order to notify the concerned person(s) that action has been taken.

- (5) All enquiries which trigger this process shall be reported in the monthly reports which shall include results of inspections undertaken by site staff, and details of the measures taken, and additional monitoring results.

It should be noted that the receipt of complaints or enquiries will not, in itself, be sufficient reason to introduce additional mitigation measures. They, will however, initiate the ECP and this procedure may lead to the introduction of mitigation measures if they are considered necessary.

In all cases the complainant shall be notified of the findings of the ECP and audit procedures put in place to ensure that the problem does not recur.

#### **4.3.7 Reporting**

EM&A reporting will be annually, bi-annually and monthly. Monthly reports shall be prepared within 10 working days of the end of each calendar month by the Engineer's Environmental Team and provided to the client, the Contractor and the EPD. Further details are presented in *Section 14*.

#### **4.3.8 Cessation of the EM&A programme**

The construction of West Rail will be undertaken as a series of individual construction contracts with necessarily different construction programmes and completion dates. The EIA has outlined the adverse construction impacts to be expected from the different construction activities at each worksite for which mitigation and monitoring is required. The Environmental Manager shall maintain an overview of the 'impact causing potential' of each site, monitoring parameter or contract with a view to maintaining the most cost-effective use of the environmental resources dedicated to the Project.

Applications for the termination of monitoring should focus on the percentage contract completion status and on the basis of a history of benign environmental impact arising from the site over a representative period of monitoring. Justifiable application for termination of monitoring shall be put forward by the Environmental Manager, to the relevant Government Departments and the EPD, as necessary throughout the construction period.

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## 5. NOISE MONITORING

### 5.1 Introduction

In this section, the requirements, methodology, equipment, monitoring locations and mitigation measures for the monitoring and audit of noise impacts from the construction of West Rail are presented.

### 5.2 Methodology and Noise Criteria

Noise level measurements shall be carried out by suitably qualified members of the Engineer's Environmental Team using the methodology set out in Annexes of the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* and the *Technical Memorandum on Noise from Percussive Piling*.

The appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level ( $L_{Aeq}$ ) measured in decibels (dB). The two statistical sound levels  $L_{10}$  and  $L_{90}$ ; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The  $L_{90}$  may be considered as the ambient level into which the  $L_{10}$  as an average peak level intrudes.

The criterion against which the recorded noise levels shall be assessed refers to the noise level 1 m from the nearest part of the building façade and at a height approximately 1.2 m above the ground or at the height that has the least obstructed view of the construction activity in relation to the receiver.

Whilst the *Noise Control Ordinance* (NCO) does not provide for the statutory control of construction activities occurring on weekdays during normal working hours (i.e. Monday to Saturday inclusive 0700-1900), a voluntary daytime limit of  $L_{Aeq, 30 \text{ min}} 75 \text{ dB}$ , recommended in the *Practice Note for Professional Persons - Noise from Construction Activities - Non-statutory Controls*, EPD (ProPECC PN 2/93) was proposed in the EIA and agreed with EPD as the appropriate criterion for all residential premises. For educational establishments, a level of 70 dB(A) has been proposed and this shall be further reduced to 65 dB(A) during examination periods.

Construction noise during restricted hours (1900-0700 for weekdays and all day on Sundays and Public Holidays) is controlled by the NCO and subsidiary technical memoranda, namely the *Technical Memorandum on Noise from Construction Work Other than Percussive Piling* (TM1). The control of percussive piling (at all times) is governed by the *Technical Memorandum on Noise from Percussive Piling* (TM2). These technical memoranda prescribe the permitted noise levels for construction work depending upon working hours and the existing noise climate.

A subsidiary technical memoranda the *Technical Memorandum on Noise from Construction Work in Designated Areas* (TM3), applies to construction works during restricted hour, within designated areas as defined by the *Noise Control (Construction Work Designated Areas) Notice, Legal Supplement No.2 to Gazette No.2/1996, 12 January 1996*. TM3 covers the use of the following specified powered mechanical

## Noise Monitoring

equipment: hand-held breakers, bulldozers, concrete mixer lorries, dump trucks, and hand-held poker vibrators. The prescribed construction works are: erection or dismantling of formwork or scaffolding, loading, unloading or handling of rubble, wooden boards, steel bars, wood or scaffolding material and hammering.

Construction works requiring the use of Powered Mechanical Equipment (PME) during restricted hours and percussive piling at any time require a Construction Noise Permit (CNP) and applicants will need to demonstrate that they can achieve the applicable Acceptable Noise Level (ANL). The ANLs for construction work other than percussive piling and for construction work in designated areas are shown in *Table 5.2a*.

**Table 5.2a Acceptable Noise Levels for Construction other than Percussive Piling**

Time Period	ASR "A"	ASR "B"	ASR "C"
All days during the evening (1900-2300) and general holidays (including Sundays) during the day and evening (0700-2300)	60(45)	65(50)	70(55)
All days during the night-time (2300-0700)	45(30)	50(35)	55(40)

Note: ASR - Area Sensitivity Rating

Levels in brackets are ANLs for construction work in designated areas

All noise levels are  $L_{Aeq,5min}$  dB

The ANLs for percussive piling are shown in *Table 5.2b* below.

**Table 5.2b ANLs for Percussive Piling**

Architectural Characteristics of NSR	ANL dB(A)
No windows or other openings	100
With central air conditioning	90
With windows or other openings but without central air conditioning	85

ANLs for hospitals, schools, clinics, courts of law, and other particularly sensitive receivers are 10dB below the figures quoted in *Table 5.2b*

### 5.3 Monitoring Equipment

Sound level meters and calibrators shall comply with the *International Electrotechnical Commission (IEC) Publication 651:1979 (Type 1) and 804:1985 (Type 1)* specification as referred to in the TM. The sound level meters shall be supplied and used with the manufacturers recommended wind shield and with a tripod.

The calibration of the sound level meters and their respective calibrators shall be carried out in accordance with the manufacturer's requirements. The sound level meters, including the calibrators, shall be verified by the manufacturers once every two years to ensure they perform to the same level of accuracy as stated in the manufacturers specifications. Calibrated hand-held anemometers shall also be supplied for the measurement of wind speeds during noise monitoring periods.

Sound level meters shall be calibrated using a portable calibrator before and after each measurement. The calibration levels shall be noted with the measurement results and where the difference between the calibration levels is greater than 1dB(A) the measurement shall be repeated.

The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.

Noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding  $5\text{ms}^{-1}$  or wind with gusts exceeding  $10\text{ms}^{-1}$ . The wind speed shall be checked with the hand-held anemometers capable of measuring the wind speed in  $\text{ms}^{-1}$ . *Table 5.3a* lists recommended quantities of noise monitoring equipment required for the Project.

Table 5.3a Noise Monitoring Equipment

Description	Quantity
Noise meter	40
Calibrator	40
Hand held anemometer	10

#### 5.4 Monitoring Locations

Representative noise monitoring stations have been identified along the West Rail alignment. Their locations are listed below in *Table 5.4a* and depicted in *Figures 1-18* in *Annex A*. Prior to the commencement of the EM&A Programme, the proposed noise monitoring locations will be discussed and agreed with the EPD.

Table 5.4a EM&amp;A Representative Noise Monitoring Locations

Works Area Location	Noise Sensitive Receiver
<b><i>Southern Section</i></b>	
A	2/c1 MTRC CDA Site
A - Vent Building	2/17 Chung Yew Building
B & C	3/C3 School
E	4/4 Mei Foo Sun Chuen
Mei Foo Station	4/9 Mei Foo Sun Chuen / Mount Sterling Mall
<b><i>Central Section</i></b>	
Mei Foo Station	5/2 Ching Lai Court
Cut & Cover Tunnel	5/3 Princess Margaret Hospital
Cut & Cover Tunnel	5/21 Lingnam CWK Middle School
Cut & Cover Tunnel	6/4 Kwai Tsing Theatre

## Noise Monitoring

Works Area Location	Noise Sensitive Receiver
Cut & Cover Tunnel	6/29 Lion Prevocational School
Tsuen Wan West Station	8/17 Clague Garden Estate
Tsuen Wan West Station	7/3 Waterside Plaza
<b>Northern Section And West Rail Depot</b>	
Tunnel Construction	9/1 Cheung Po
Depot Construction	9/4 Tai Kek Tsuen North Village House
Depot Construction	9/7 Kau Tsuen North Village House
Depot Construction	9/29 Kwan Tai Temple
Station and Viaduct	10/14 Kat Hing Gardens
Station and Viaduct	10/20 Kam Ting Mung Yueng Public School
Viaduct Construction	11/27 Tung Shing Lei
Viaduct Construction	12/3 Pok Oi Hospital
<b>Western Section</b>	
Yuen Long Station	12/13 Sun Yuen Long Centre
Yuen Long to Long Ping	12/29 Rainbow Mansion
Yuen Long to Long Ping	12/41 Morninglight School
Long Ping Station	13/60 Luen Fat House
Long Ping to Tin Shui Wai	13/68 Fung Chi Tsuen
Long Ping To Tin Shui Wai	13/70 Wing Ning Tsuen
Long Ping To Tin Shui Wai	13/72 Ha Mei San Tsuen
Tin Shui Wai Station	14/6 Kwok Yat Wai School
Tin Shui Wai to Tuen Mun North	15/5 Tin Sam Tsuen East Village Houses
Tin Shui Wai to Tuen Mun North	16/9 Siu Kwong Yuen
Tin Shui Wai to Tuen Mun North	16/23 Lee Ka Yuen Residential Area
Tin Shui Wai to Tuen Mun North	17/7 Tsing Lun Road Residential Area
Tuen Mun North Station	17/17 PLK Kindergarten
Tuen Mun North to Tuen Mun Centre	17/27 Tuen Mun Hospital
Tuen Mun North to Tuen Mun Centre	18/32 Tuen Mun Hospital Staff Quarters
Tuen Mun Centre Station	18/60 Ho King/Sun King/On Chuen Residential Building/Bit Hing Building

The first NSR number refers to the figure number it appears on in *Annex A*, the second number identifies the actual monitoring location on that figure.



### 5.5 Baseline Monitoring

To obtain fully satisfactory baseline results, a weatherproof logging sound level meter shall be used. Continuous baseline noise for the A-weighted levels  $L_{eq}$ ,  $L_{10}$  and  $L_{90}$  shall be measured over a period of two weeks in a sample period of 5 minutes or 30 minutes between 0700 and 1900, and 5 minutes between 1900 and 0700. The monitoring period shall be selected prior to the commencement of any construction activities and so as to avoid other atypical noise sources. The proper functioning of the logger shall be ensured during this period and shall be visited for a period not less than one hour every two days to ensure its continued operation and to detail specific noise sources audible at the monitoring location. Measurements shall be recorded to the nearest 0.1 dB.

Checking for changes in the baseline noise levels throughout West Rail construction shall be carried out by taking "sample" noise measurements every six months, when no noisy West Rail construction activities are in progress. If significant changes, that can be validated, are observed to have arisen, the baseline may be adjusted accordingly after consultation and agreement with the EPD.

### 5.6 Impact Monitoring

During normal construction working hours (0700-1900 Monday to Saturday), monitoring of  $L_{Aeq, 30min}$  noise levels (as six consecutive  $L_{Aeq, 5min}$  readings) shall be carried out at the agreed monitoring locations once every week in accordance with the methodology in the TM. If restricted hours works are undertaken, monitoring of  $L_{Aeq, 15min}$  noise levels (as three consecutive  $L_{Aeq, 5min}$  readings) shall be carried out at the agreed monitoring stations at the same frequency as specified for normal working hours.

In relation to the monitored noise levels, other noise sources such as road traffic may make a significant contribution to the overall noise environment. Therefore, the results of noise monitoring activities will take into account such influencing factors which were not present during the baseline monitoring period. All measurements shall be recorded to the nearest 0.1 dB.

### 5.7 Compliance Assessment

Action and Limit (A/L) Levels provide an appropriate framework for the interpretation of monitoring results. The noise impact monitoring data shall be checked against the agreed A/L Levels as listed in *Table 5.7a*.

Table 5.7a Action and Limit Levels for Construction Noise dB(A)

Time Period	Action	Limit
0700-1900 on normal weekdays;	When one or more documented complaints are received	75 dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days	When one or more documented complaints are received	50 or 55 dB(A) <sup>(1)</sup> 65 or 70 dB(A) <sup>(2)</sup>
2300-0700 of next day	When one or more documented complaints are received	35 or 40 dB(A) <sup>(1)</sup> 50 or 55 dB(A) <sup>(2)</sup>

Time Period	Action	Limit
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Note:

(2) for non-SPME and prescribed works

(1) for the SPME and prescribed works

To account for cases where ambient noise levels as identified by baseline monitoring approach or exceed the stipulated Limit Level prior to commencement of construction, a Maximum Acceptable Impact Level may be defined and agreed with EPD, which incorporates the baseline noise level and the identified construction noise Limit Level. This amended level will, therefore, be greater than 75 dB(A) and will represent the maximum acceptable noise level at a specific monitoring station. Correction factors for the effects of acoustic screening and/or architectural features of NSRs may also be applied for, from the EPD, as specified in the TM.

For the purposes of compliance checking, after taking into account any adjustments agreed with EPD, comparison with either the Limit or the Maximum Acceptable Impact Level shall represent the governing criteria for noise impact assessment during the West Rail EM&A.

### 5.8 Event Contingency Plan

The principle on which the ECP is based is the prescription of procedures and actions associated with the measurement of defined levels of noise impact recorded by the environmental monitoring process and defined in the tables above. In cases where exceedance of these criteria occurs, the Environmental Manager, Engineer and the Contractor shall strictly observe the relevant actions of the ECP shown in *Table 5.8a*.

Table 5.8a Event Contingency Plan for Construction Noise

Exceedance	Action: Engineer's Environmental Team	Action: Engineer	Action: Contractor
Action	Undertake measurement to establish validity of complaint.	Confirm receipt of notification of complaint and notify Contractor if proven.	Submit proposals for remedial actions to Engineer within three working days of notification.
	Identify the source(s) of the complaint.	Check monitoring data trends and Contractor's working methods.	Amend proposals if required by the Engineer.
	Inform Engineer in writing. Discuss remedial actions required with Engineer.	Remind the Contractor of his contractual obligations and discuss implementing remedial actions.	Implement the remedial actions immediately upon instruction from the CM.
	Increase monitoring frequency to assess efficacy of remedial measures.	Assess the efficacy of remedial actions and keep the Contractor informed.	Liaise with the Engineer to optimise the effectiveness of the agreed mitigation.
	If exceedance continues, meet with Engineer to review implementation of appropriate mitigation measures.	Inform complainant of actions taken.	

Exceedance	Action: Engineer's Environmental Team	Action: Engineer	Action: Contractor
	If exceedance stops, cease additional monitoring.		
Limit	Repeat measurement to confirm findings.	Confirm receipt of notification of exceedance and notify Contractor.	Take immediate action to avoid further exceedance.
	Identify the source(s) of impact.	Check monitoring data trends and Contractor's working methods.	Submit proposals for remedial actions to Engineer within three working days of notification.
	Inform Engineer and EPD in writing.	Discuss with Contractor the remedial actions to be implemented.	Amend proposals if required by the Engineer.
	Discuss remedial actions required with Engineer		
	Increase monitoring frequency to assess efficacy of remedial measures.	Assess the efficacy of remedial actions and keep the Contractor informed.	Implement remedial actions immediately upon instruction from the CM.
	If exceedance continues, meet with Engineer to identify appropriate mitigation measures.		Liaise with the Engineer to optimise the effectiveness of the agreed mitigation.
	If exceedance stops, cease additional monitoring.		

CM - Construction Manager

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## 6. AIR QUALITY MONITORING

### 6.1 Introduction

In this section, the requirements, methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of air quality impacts during the construction of West Rail are presented.

### 6.2 Methodology and Air Quality Criteria

The criteria against which air quality (measured as Total Suspended Particulates (TSP)) monitoring shall be assessed are:

- The Hong Kong *Air Quality Objectives* (AQO) for TSP, 24-hour TSP levels of  $260 \mu\text{g m}^{-3}$ ; and
- The EPD recommended 1-hour TSP limit of  $500 \mu\text{g m}^{-3}$ .

These levels are not to be exceeded at sensitive receivers.

The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and particles that are 30-100  $\mu\text{m}$  in diameter are likely to undergo impeded settling. These particles, depending on the extent of atmospheric turbulence, would settle within a distance of 100 m from the source. The main dust impact will arise from fine particles of a diameter less than 30  $\mu\text{m}$ , measured as Total Suspended Particulates (TSP), dispersed over greater distances from the sources. TSP levels will, therefore, be monitored to evaluate the dust impact during the construction phase of the Project.

TSP levels shall be measured by following the standard high volume sampling method as set out in *High Volume Method for Total Suspended Particulates, Part 50 Chapter 1 Appendix B, Title 40 of the Code of Federal Regulations of the USEPA*.

24-hour average TSP concentrations should be measured by drawing air through a high volume sampler (HVS), fitted with a conditioned, pre-weighed filter paper, at a controlled rate. After sampling, the filter paper with retained particles shall be collected and returned to the laboratory for drying in a desiccator followed by accurate weighing. TSP levels are calculated from the ratio of the mass of particulates retained on the filter paper to the total volume of air sampled. The drying and analysis process normally takes about two days to complete.

1-hour TSP levels may be monitored in response to complaints, exceedances or as directed by the Environmental Team Leader but will not be part of the regular EM&A programme for West Rail.

1-hour TSP concentrations can be measured either by the same monitoring method as 24-hour TSP sampling or real time airborne particulate measurement can be undertaken using a direct reading dust meter such as the MIE Data-Ram Portable Real Time Aerosol

Monitor (MIE). The MIE uses optical sensors to analyse the incoming airstream providing real time readout of particulate concentrations. Despite the advantages of using a real time monitor to measure particulate concentrations such as in response to dust complaints, results are not comparable with 24-hour HVS data. Therefore, if the use of a direct reading monitor is agreed for 1-hour TSP sampling both baseline and *ad hoc* monitoring must be carried out by the direct reading method.

No comparisons between direct reading and physically measured (HVS) data shall be attempted except that, where the direct reading method for 1-hour TSP sampling is used, the measured TSP concentrations shall be regarded as indicative of the 24-hour TSP results and the actions specified in this Manual shall be implemented.

### **6.3 Monitoring Equipment**

High volume sampler (HVS) in compliance with the following specifications shall be used for carrying out the 1-hr and 24-hr TSP monitoring:

- $1.7 \text{ m}^3 \text{ min}^{-1}$  (20-60 SCFM) adjustable flow range;
- equipped with a timing/control device with  $\pm 5$  minutes accuracy for 24 hours operation;
- installed with elapsed-time meter with  $\pm 2$  minutes accuracy for 24 hours operation;
- capable of providing a minimum exposed area of  $406 \text{ cm}^2$  ( $63 \text{ in}^2$ );
- flow control accuracy:  $\pm 2.5\%$  deviation over 24-hr sampling period;
- incorporated with an electronic mass flow rate controller or other equivalent devices;
- equipped with a flow recorder for continuous monitoring;
- provided with a peaked roof inlet;
- incorporated with a manometer;
- able to hold and seal the filter paper to the sampler housing at horizontal position;
- easy to change the filter; and
- capable of operating continuously for 24-hr period.

A hand-held direct reading dust meter, sampling in the range of  $0.1\text{-}100 \text{ mg m}^{-3}$  and capable of achieving results comparable to a high volume air sampler shall be used for 1-hr TSP sampling.

Equipment shall be maintained in calibration at all times and recalibration will be carried out in accordance with requirements stated in the manufacturers operating manual and as described below.

The flow rate of each high volume sampler with mass flow controller will be calibrated using an orifice calibrator. Initial calibration will be conducted upon installation and prior

to commissioning. One point flow rate calibration will be carried out every two months. Five point calibration will be carried out every six months.

The samplers shall be properly maintained. Prior to dust monitoring commencing, appropriate checks shall be made to ensure that all equipment and necessary power supply are in good working condition.

Table 6.3a presents the recommended types and quantities of TSP monitoring equipment.

Table 6.3a TSP Recommended Monitoring Equipment

Description	Quantity
High volume sampler	40
Hand-held direct reading dust meter	10

#### 6.4 Monitoring Locations

Thirty three air quality monitoring stations have been identified along the West Rail alignment. Locations of the monitoring stations are presented in Table 6.4a and depicted in Figures 1-18 in Annex A.

Prior to the commencement of the EM&A programme, the proposed air quality monitoring stations shall be discussed and agreed with the EPD.

Table 6.4a EM&A Representative Air Quality Monitoring Stations

Location	Air Sensitive Receiver
<b>Southern Section</b>	
Chung Yew Building	2/17
Nam Cheong Estate	2/24
Wholesale Market	3/11
Mei Foo Sun Chuen Community Centre	4/3
Schools/ GIC	3/C3
<b>Central Section</b>	
Mei Foo Sun Chuen Block 16	4/9
Ching Lai Commercial Centre	5/1
HK Housing Authority Residential Development	5/C1
Riviera Garden	6/53
Water Side Plaza	7/3
Hing Shing Temporary Housing Area	8/23
<b>Northern Section and West Rail Depot</b>	
Tai Kek Tsuen	9/2
Village Houses to the South of Cheung Po	9/3

## Air Quality Monitoring

Location	Air Sensitive Receiver
Village Houses to the South of Kam Cheq Garden	9/6
Village Houses to the South of Shek Wu Tong	10/8
Village Houses to the South of Proposed Kam Tin Station	10/11
Ko Po Tsuen	11/22
<b>Western Section</b>	
Sun Yuen Long Centre	12/13
Shung Tak School	12/15
Kwan Lok San Tsuen	12/18
Morninglight School	12/41
Fung Chi Tsuen	13/68
Ha Mei San Tsuen	13/72
Tin Yiu Estate	14/5
Shek Po Tsuen	15/1
Low-rise Residential Area South of Tin Sam Tsuen	15/8
Siu Kwong Yuen	16/9
Bank Adjacent to Fu Hong Home for the Aged	16/24
Chik Yuen Garden	17/1
Siu Hong Court	17/18
Tuen Mun Hospital Staff Quarters	18/32
Bit Hing Building	18/60
Tuen Mun Town Park	18/76

The first ASR number refers to the figure number it appears on in *Annex A*, the second number identifies the actual monitoring location on that figure.

### 6.5 Baseline Monitoring

Baseline monitoring shall be carried out to determine the ambient 1-hour and 24-hour TSP levels at the monitoring locations prior to the commencement of the construction works.

Baseline monitoring shall be carried out for a continuous period of at least two weeks under typical weather conditions with the 24-hour and three 1-hour ambient measurements taken daily at each monitoring location. As noted above, monitoring results of HVS and aerosol monitoring are not directly comparable and the same method must be used for baseline and impact monitoring. General meteorological conditions (wind speed and direction and precipitation) and notes regarding any significant adjacent dust producing sources shall also be recorded throughout the baseline monitoring period.

The baseline monitoring will provide data for the determination of the appropriate Action levels with the Limit levels set against statutory or otherwise agreed limits.



Baseline checking of ambient dust levels shall be carried out every six months at each monitoring location. The checking shall be carried out when dusty West Rail activities are not in operation and detailed notes shall be provided by the monitoring personnel as to any significant dust producing sources during the baseline checking.

## 6.6 Impact Monitoring

The monthly schedule of the compliance and impact monitoring programme shall be drawn up by the Environmental Team, one month prior to the commencement of the scheduled construction period. TSP monitoring shall include the following:

- One 24-hour sample every six days

Dust monitoring data shall be recorded on a standard record form developed for the Project.

## 6.7 Compliance Assessment

Environmental limits, termed Action and Limit (A/L) levels, provide an appropriate framework for the interpretation of monitoring results. The air quality monitoring data shall be checked against the agreed A/L levels as listed in *Tables 6.7a* and *6.7b*.

**Table 6.7a Derivation of Action and Limit Levels for 24-Hour Air Quality Monitoring**

Level	Total Suspended Particulates ( $\mu\text{g m}^{-3}$ )
Baseline	Derived from physical measurements prior to construction commencing
Action	For baseline $<108 \mu\text{g m}^{-3}$ , average of 130% of baseline and the Limit level For $108 < \text{baseline} > 154 \mu\text{g m}^{-3}$ , $200 \mu\text{g m}^{-3}$ For baseline $>154 \mu\text{g m}^{-3}$ , 130% of baseline level
Limit	AQO for TSP: $260 \mu\text{g m}^{-3}$ averaged over 24-hours

**Table 6.7b Derivation of Action and Limit Levels for 1-Hour Air Quality Monitoring**

Level	Total Suspended Particulates
Baseline	Derived from physical measurements prior to construction commencing
Action	For baseline $<154 \mu\text{g m}^{-3}$ , average of 130% of baseline and the Limit level For $154 < \text{baseline} > 269 \mu\text{g m}^{-3}$ , $350 \mu\text{g m}^{-3}$ For baseline $>269 \mu\text{g m}^{-3}$ , 130% of baseline level
Limit	$500 \mu\text{g m}^{-3}$

## 6.8 Event Contingency Plan

The principle upon which the ECP is based is the prescription of procedures and actions associated with the measurement of certain defined levels of air pollution (the Action and Limit levels), recorded by the environmental monitoring process, during the construction

**Air Quality Monitoring**

of West Rail. The ECP for exceedance of various levels and the responsibilities of relevant parties in the event of such an exceedance are given in *Table 6.8a* below.

**Table 6.8a Event Contingency Plan for Air Quality**

<b>Exceedance</b>	<b>Action: Environmental Team Leader</b>	<b>Action: Engineer</b>	<b>Action: Contractor</b>
<b>Action</b>	<p>Repeat measurement to confirm findings.</p> <p>Identify the source(s) of impact.</p> <p>Inform Engineer in writing.</p> <p>Discuss remedial actions required with Engineer.</p> <p>Increase monitoring frequency to assess efficacy of remedial measures.</p> <p>If exceedance continues, arrange meeting with Engineer to review implementation and identify further appropriate mitigation measures. If exceedance stops, cease additional monitoring.</p>	<p>Confirm receipt of notification of exceedance and notify Contractor.</p> <p>Check monitoring data trends and Contractor's working methods.</p> <p>Remind the Contractor of his contractual obligations and discuss remedial actions to be implemented.</p> <p>Assess the efficacy of remedial actions and keep the Contractor informed.</p>	<p>Submit proposals for remedial actions to Engineer within three working days of notification.</p> <p>Amend proposals if required by the Engineer</p> <p>Implement the remedial actions immediately upon instruction from the CM.</p> <p>Liaise with the Engineer to optimise the effectiveness of the agreed mitigation.</p>
<b>Limit</b>	<p>Repeat measurement to confirm findings.</p> <p>Identify the source(s) of impact. Inform Engineer and EPD in writing.</p> <p>Discuss remedial actions required with Engineer.</p> <p>Increase monitoring frequency to assess efficacy of remedial measures.</p> <p>If exceedance continues, arrange meeting with Engineer to identify further appropriate mitigation measures.</p> <p>If exceedance stops, cease additional monitoring.</p>	<p>Confirm receipt of notification of exceedance and notify Contractor.</p> <p>Check monitoring data trends and Contractor's working methods.</p> <p>Discuss with Contractor the remedial actions to be implemented.</p> <p>Assess the efficacy of remedial actions and keep the Contractor informed.</p>	<p>Take immediate action to avoid further exceedance.</p> <p>Submit proposals for remedial actions to Engineer within three working days of notification.</p> <p>Amend proposals if required by the Engineer.</p> <p>Implement remedial actions immediately upon instruction from the CM.</p> <p>Liaise with the Engineer to optimise the effectiveness of the agreed mitigation.</p>

CM - Construction Manager

## 7. WATER QUALITY MONITORING

### 7.1 Introduction

In this section, the requirements, methodology, equipment, monitoring locations and mitigation measures for the monitoring and audit of noise impacts from the construction of West Rail are presented.

### 7.2 Methodology and Criteria

#### 7.2.1 Marine Waters of Tsuen Wan Bay

Water quality monitoring shall be carried out by the Engineer's Environmental Team to ensure that any deteriorating water quality is readily detected and timely action taken to rectify the situation. Water quality monitoring parameters shall include:

- Dissolved oxygen (DO) (in  $\text{mg l}^{-1}$  and % saturation);
- Temperature ( $^{\circ}\text{C}$ );
- pH value;
- Turbidity (NTU);
- Water depth (m);
- Salinity ( $\text{mg l}^{-1}$ ); and
- Total hardness (as  $\text{CaCO}_3$ ) ( $\text{mg l}^{-1}$ ).

All of the above parameters shall be measured *in situ*.

- Suspended solids ( $\text{mg l}^{-1}$ )
- Sulphides ( $\text{mg l}^{-1}$ )

These parameters require laboratory analysis.

During West Rail construction, operation of cooling water pumping stations and intakes could be directly impacted by suspended solids (SS), turbidity, temperature, sulphides, pH value and total hardness (as calcium carbonate level) of sea water. Suspended solids concentration and turbidity should, therefore, be monitored to assess the background levels and the extent of impact during the construction. Sulphide, which may form corrosive substances with water and is discharged from the existing culverts, should also be monitored to assess its impact on the functioning of cooling water pumping stations before and during West Rail construction. Temperature of marine water is an important factor that determines the efficiency of impacted cooling water systems. The pH value indicates the corrosive impact of sea water. The hardness of water reflects the extent of the formation of insoluble precipitates that may accumulate as adhering deposits to surface of intake pipes and restrict the intake of sea water. Thus, these six parameters are the most sensitive parameters of the cooling water systems that require close monitoring. Dissolved oxygen (DO) will also be closely monitored.

### **7.2.2 River Water Quality Monitoring**

For river water quality; flow rate, suspended solid concentration, biochemical oxygen demand, chemical oxygen demand and dissolved oxygen shall be monitored.

### **7.2.3 Marine and River Water Monitoring**

Other relatively less sensitive parameters, including un-ionized ammoniacal nitrogen, *E. coli* and 5-day biochemical oxygen demand, will not be monitored in the EM&A programme.

In association with the water quality parameters, other relevant data shall also be measured, such as monitoring location / position, time, weather conditions, sea conditions (where appropriate), tidal stage (where appropriate), special phenomena and work activities at the construction site.

## **7.3 Monitoring Equipment**

For both marine and river water quality monitoring the following equipment shall be supplied by the Environmental Team and approved by the Engineer.

### **7.3.1 Dissolved Oxygen and Temperature Measuring Equipment**

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

- Dissolved oxygen levels in the range of 0 - 20 mg l<sup>-1</sup> and 0 - 200% saturation; and
- A temperature of 0-45 degrees Celsius.

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 25 m in length. Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary. (For example, YSI model 59 metre, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

### **7.3.2 Turbidity Measurement Equipment**

Turbidity within the water shall be measured in-situ by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring unit complete with cable, sensor and comprehensive operation manuals. The equipment shall be operated from a DC power source, it shall have a photoelectric sensor capable of measuring turbidity between 0 - 1000 NTU and shall be complete with a cable with at least 25 m in length (Hach 2100P or an approved similar instrument).

The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg l<sup>-1</sup>). After calibration, turbidity measurements shall be taken as a true representation of levels of suspended solids only before laboratory test results for suspended solids are known.

### **7.3.3 Suspended Solids**

A water sample shall be taken at the same time as the turbidity results are obtained using a Niskin Water Sampler (or a similar approved instrument) of at least 2.5 litre capacity with messenger and a 10 m line. Gravimetric suspended solid concentrations in each sample shall be determined in the laboratory according to Method No. 2540 D in APHA *Standard Methods for the Examination of Water and Wastewater, 19th edition*.

Water samples for SS measurements shall be collected in high density polythene bottles, packed in ice (cooled to 4 °C without being frozen), and delivered to a HOKLAS laboratory as soon as possible after collection.

### **7.3.4 Depth Gauge**

A portable, battery-operated echo sounder (Seafarer 700 or a similar approved instrument) shall be used for the determination of water depth at each designated monitoring station. This unit shall either be hand-held or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme.

### **7.3.5 Flow Rate Meter**

A portable, battery operated flow meter ( General Oceanics Mechanical Flowmeter Model 2030 or Flow Probe Hand Held Flowmeter) shall be used to determine river flow rate at each designated monitoring station. This unit should either be hand held or fitted to the bottom of the survey boat. Flow rate shall be measured in cubic meters per second.

### **7.3.6 Salinity Measurement Instrument**

A portable salinometer capable of measuring salinity in the range of 0 - 40 mg l<sup>-1</sup> shall be provided for measuring salinity of the water at each monitoring location.

### **7.3.7 Water Sampling Equipment**

A water sampler, consisting of a transparent PVC or glass cylinder of not less than two litres which can be effectively sealed with cups at both ends, shall be used (Kahlsico Water Sampler 13SWB203 or an approved similar instrument). The water sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth.

### **7.3.8 Positioning Device**

A hand-held or boat-fixed type digital Global Positioning System (GPS) shall be used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

All *in situ* monitoring instruments shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at bi-monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with

## Water Quality Monitoring

certified standard solutions before each use. Wet bulb calibration for a DO meter shall be carried out before measurement at each monitoring location.

For the on-site calibration of field equipment, the *BS 1427 : 1993, Guide to Field and On-Site Test Methods for the Analysis of Waters* shall be observed.

Sufficient stocks of spare parts shall be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when equipment is under maintenance or calibration.

### 7.3.9 Laboratory Analysis

All laboratory work shall be carried out in a HOKLAS accredited laboratory. Water samples of about 1,000 ml shall be collected at the monitoring stations for carrying out the laboratory SS determination. The SS determination work shall start within 24 hours after collection of the water samples. The analyses of SS and sulphides shall follow the standards described in *APHA Standard Methods for the Examination of Water and Wastewater*, 19th edition.

SS : 2540D standard method

Sulphides : 4500-S<sup>2-</sup> D

In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes.

### 7.4 Monitoring Locations

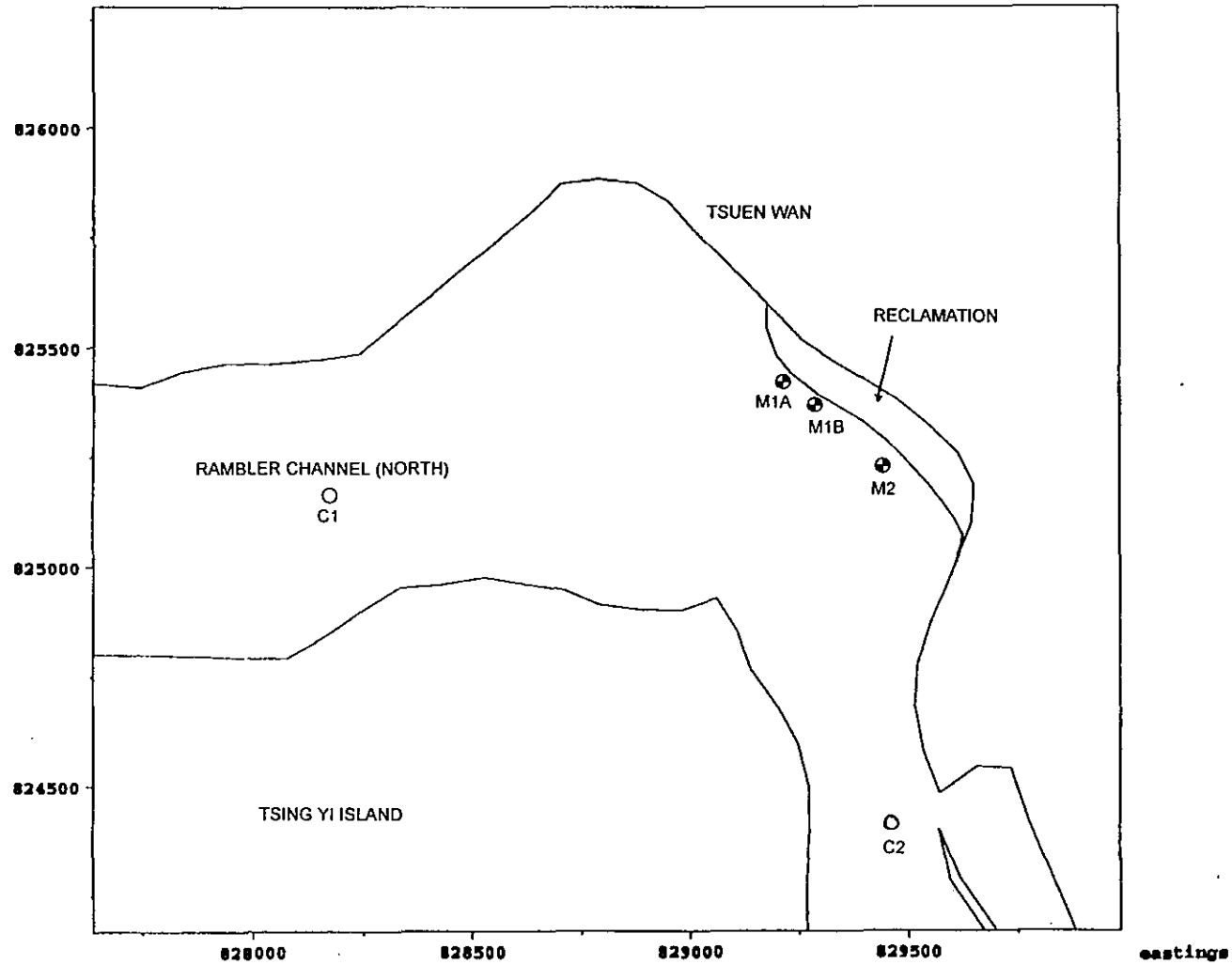
Thirty five water monitoring stations (16 impact monitoring, 19 control) have been identified along the West Rail alignment. Locations of the monitoring stations are presented in *Tables 7.4a* and *b* and depicted in *Figures 7.4a-f*

Prior to the commencement of the EM&A programme, the proposed water monitoring stations shall be discussed and agreed with the EPD.

Table 7.4a Locations of Marine Water Quality Monitoring Stations in Tsuen Wan Bay

Stations	Northing	Easting
M1A	825406	829218
M1B	825369	829263
M2	825250	829428
M3	823441	829547
M4	823132	829635
M5	822162	829898
C1	825170	828180
C2	824428	829445

northings



KEY

● MONITORING STATION

○ CONTROL STATION

LOCATIONS OF WATER QUALITY MONITORING STATIONS NEAR  
TSUEN WAN BAY

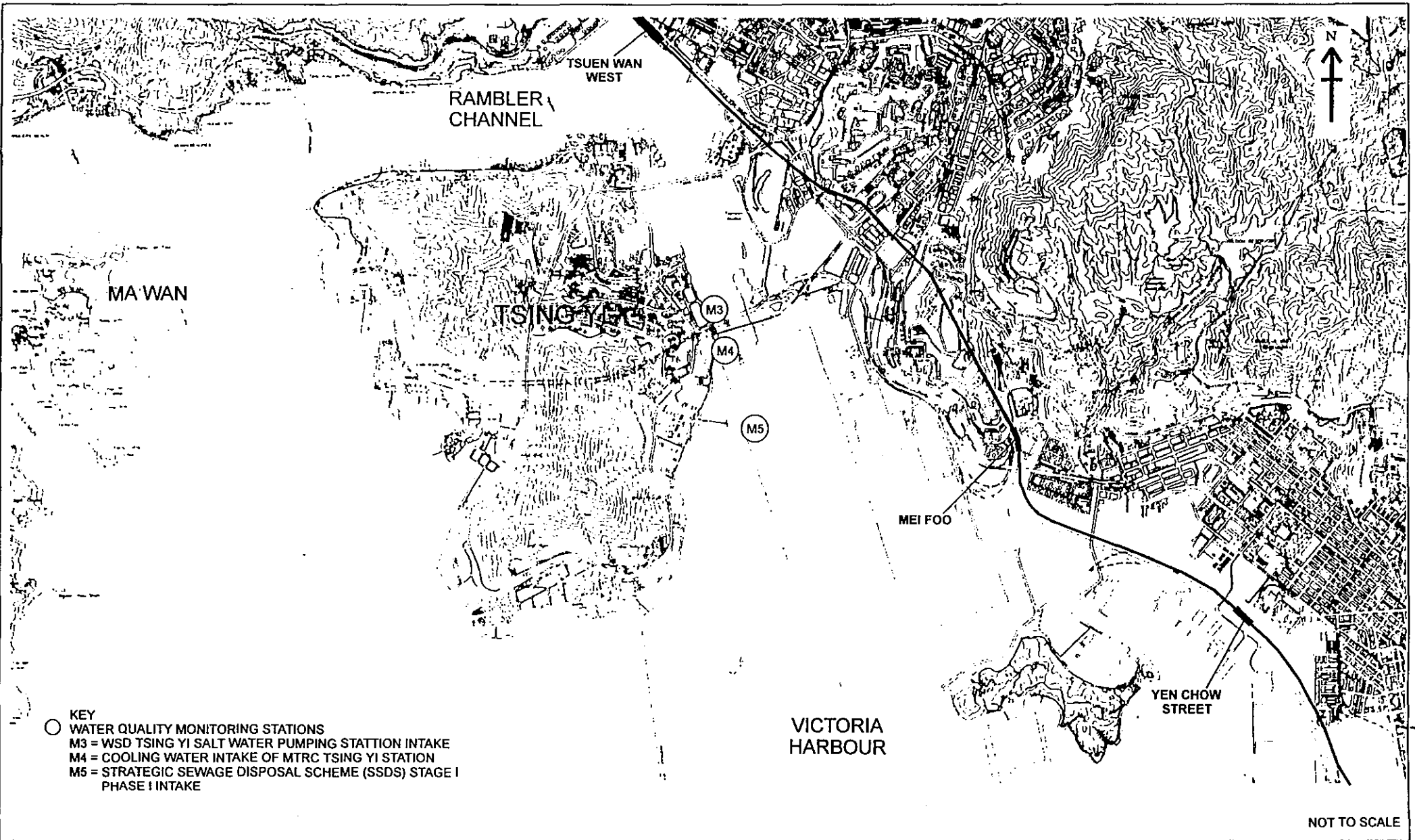
FIGURE  
7.4a

Contract/C1588/C1588\_91



KOWLOON - CANTON  
RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY





LOCATIONS OF WATER QUALITY MONITORING STATIONS ALONG RAMBLER CHANNEL EAST OF TSING YI ISLAND

FIGURE 7.4b

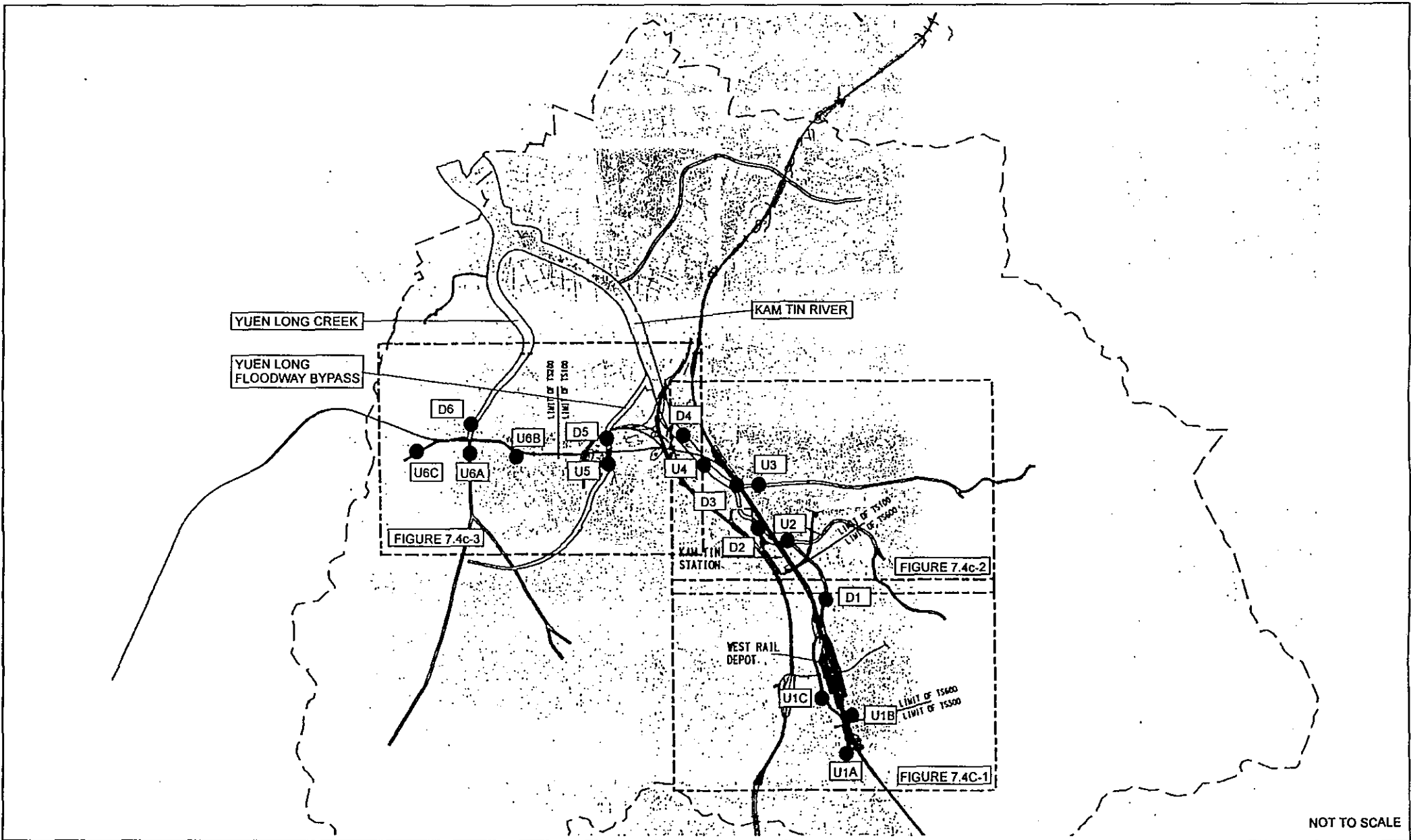
Contract/C1588/C1588\_90



KOWLOON - CANTON RAILWAY CORPORATION  
 WEST RAIL: TS900 EIA STUDY







NOT TO SCALE

**LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS ALONG WEST RAIL ALIGNMENT (NORTHERN SECTION PHASE I AND PART OF WESTERN SECTION)**

**FIGURE 7.4c**

Contract/C1588/C1588z50



**KOWLOON - CANTON RAILWAY CORPORATION**  
**WEST RAIL: TS900 EIA STUDY**





KOWLOON - CANTON  
RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY

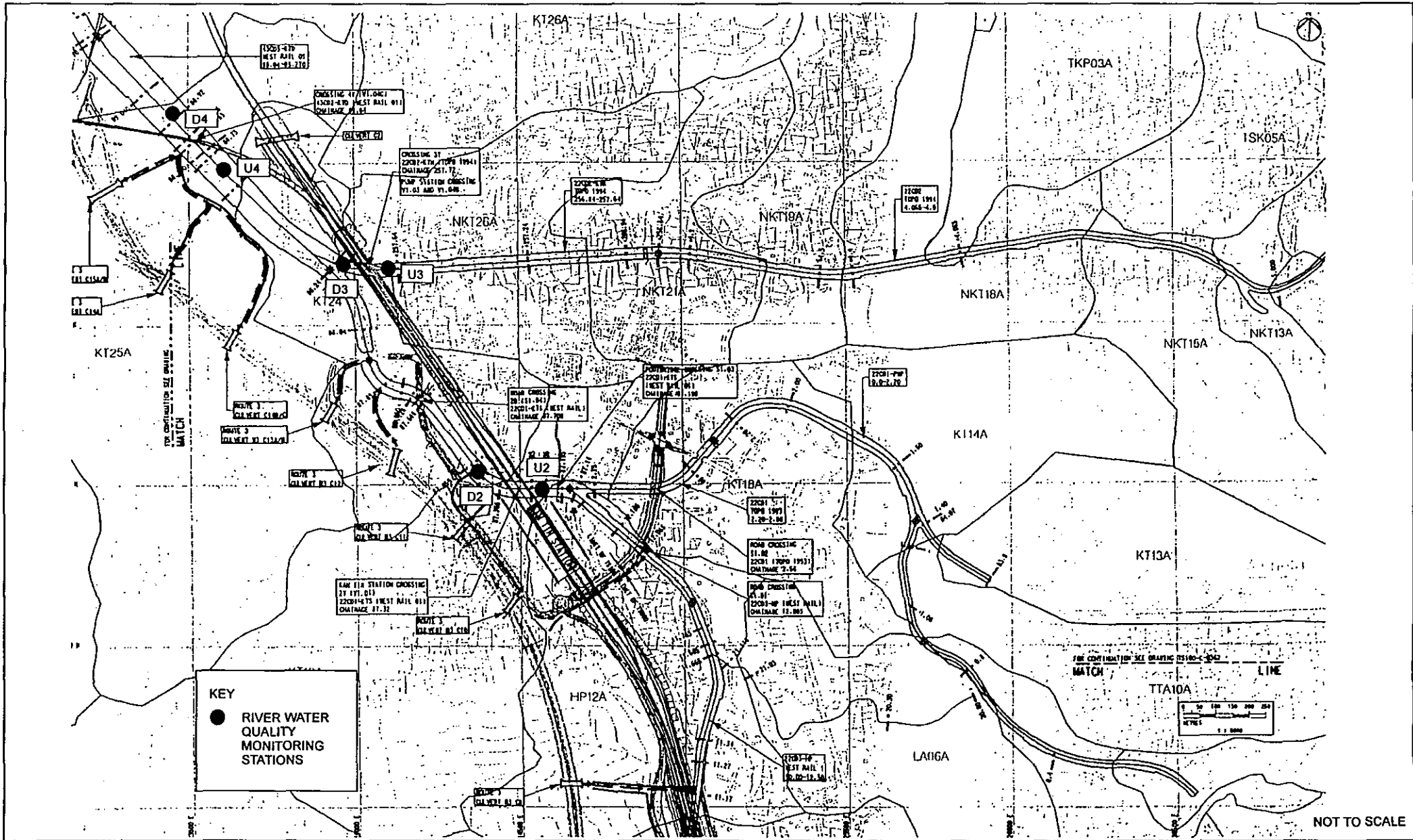


FIGURE  
7.4C-1

Contract/C1558/C1558B249

LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS ALONG  
WEST RAIL ALIGNMENT (WEST RAIL DEPOT)





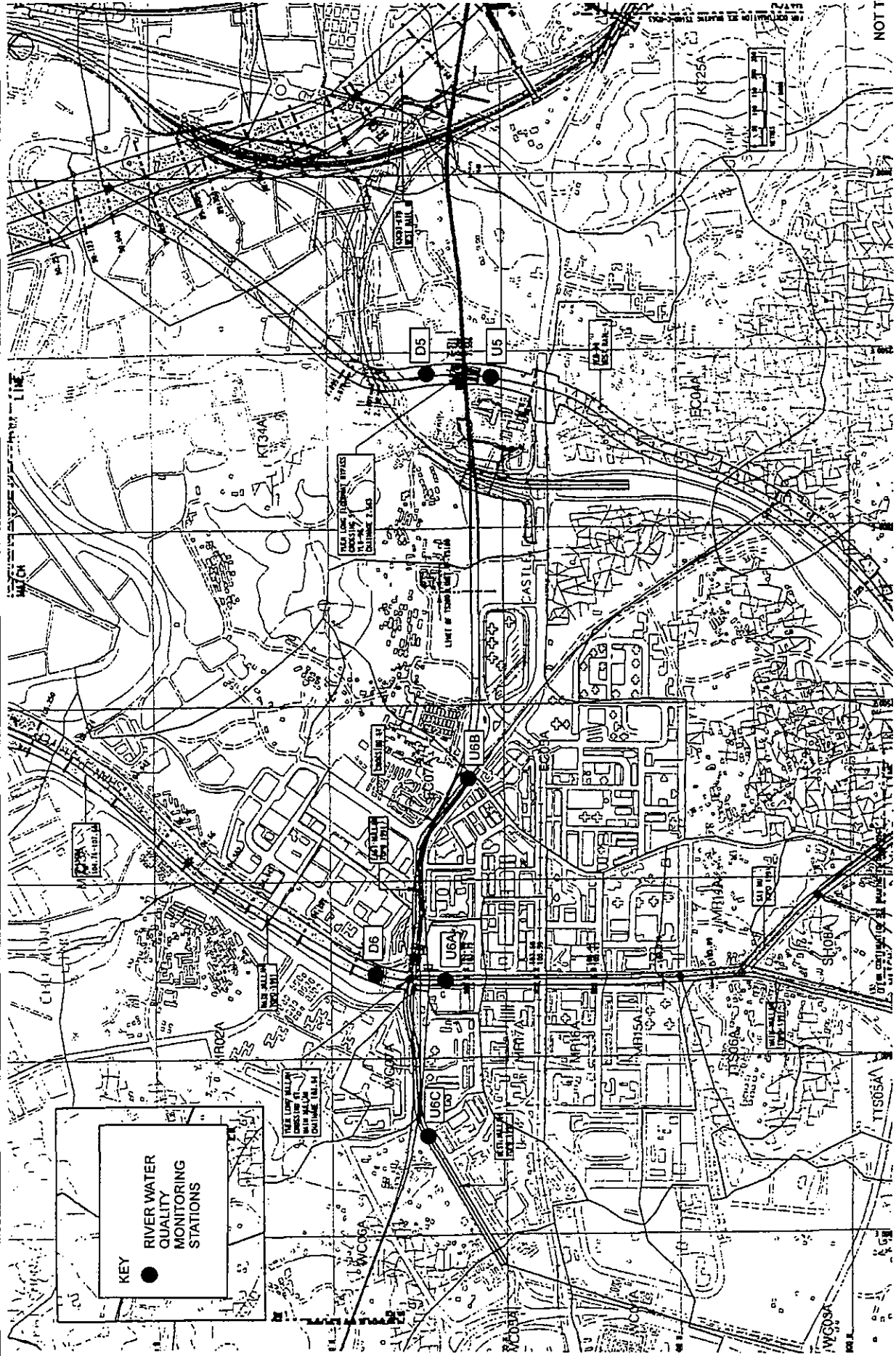
LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS ALONG WEST RAIL ALIGNMENT (NORTHERN SECTION)

FIGURE 7.4c-2  
Contract/C1588/C1588z48



KOWLOON - CANTON RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY





NOT TO SCALE

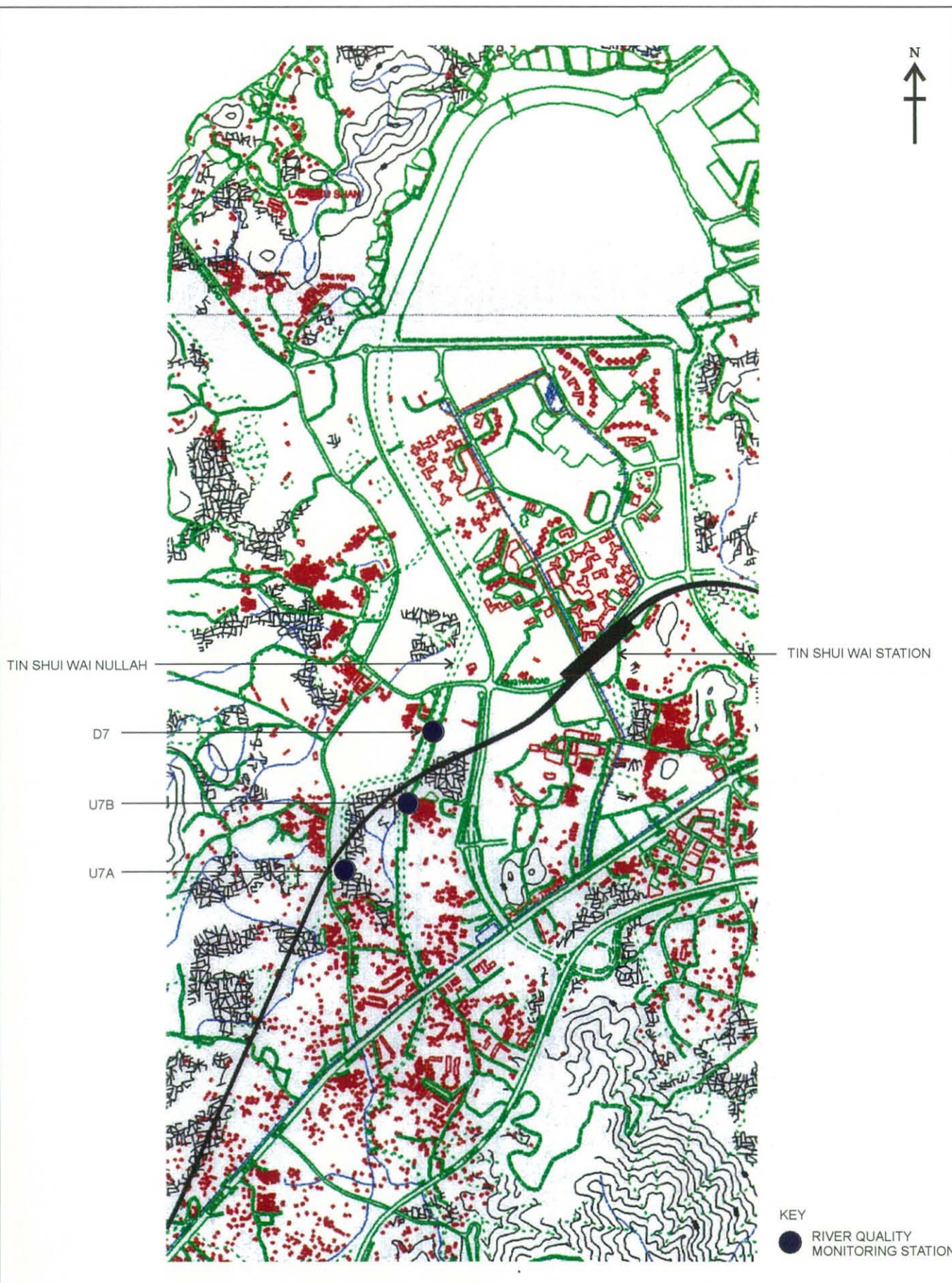


KOWLOON - CANTON  
RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY

FIGURE  
7.4C-3

Contract/C1588/C1588-47

LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS ALONG  
WEST RAIL ALIGNMENT (NORTHERN SECTION AND WESTERN SECTION)



LOCATIONS OF RIVER QUALITY MONITORING STATIONS AT TIN SHUI WAI NULLAH

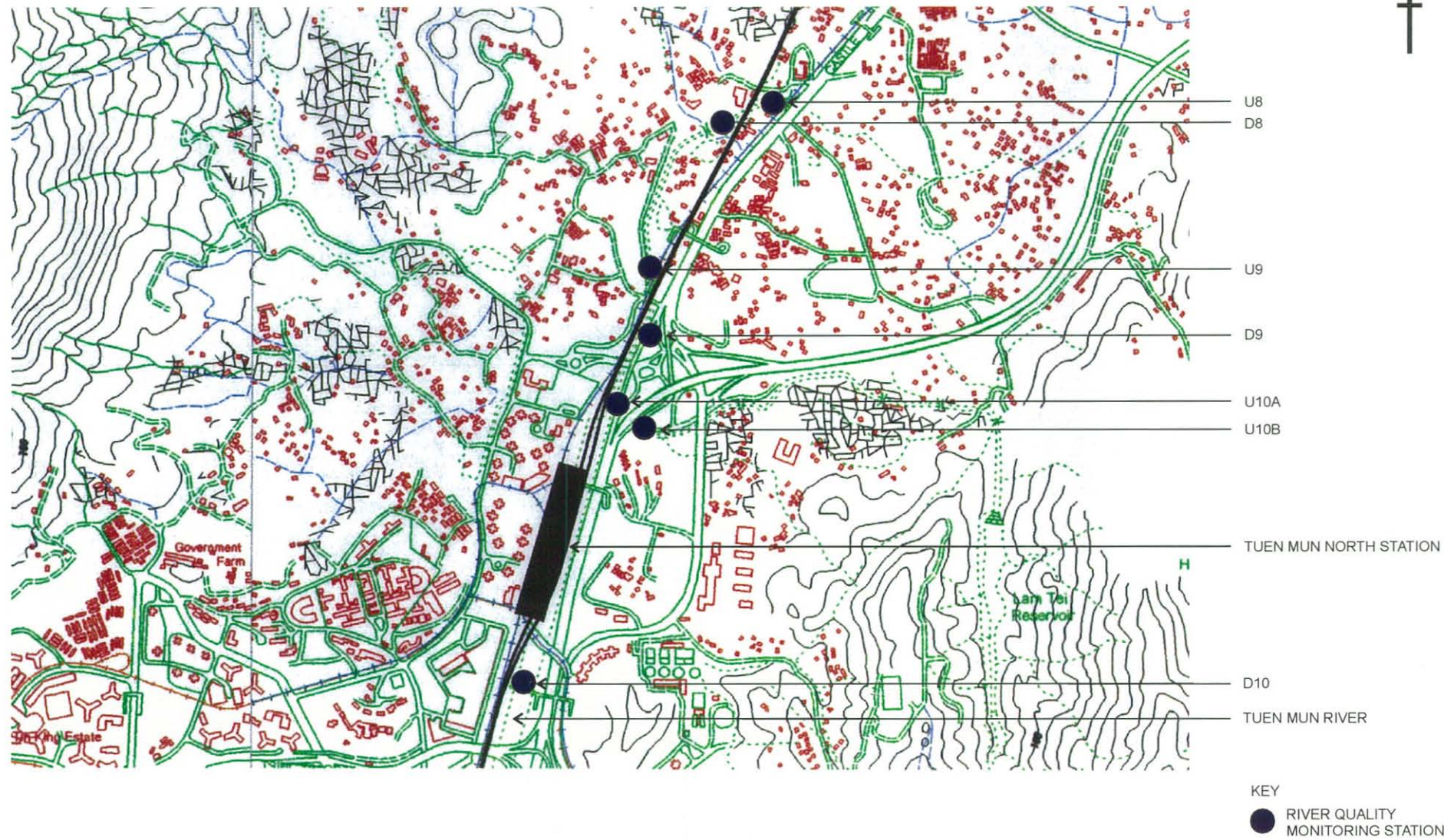
FIGURE 7.4d

Contract/C1588/EM&A/EM&A\_1



KOWLOON - CANTON RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY





LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS NEAR  
TUEN MUN NORTH STATION

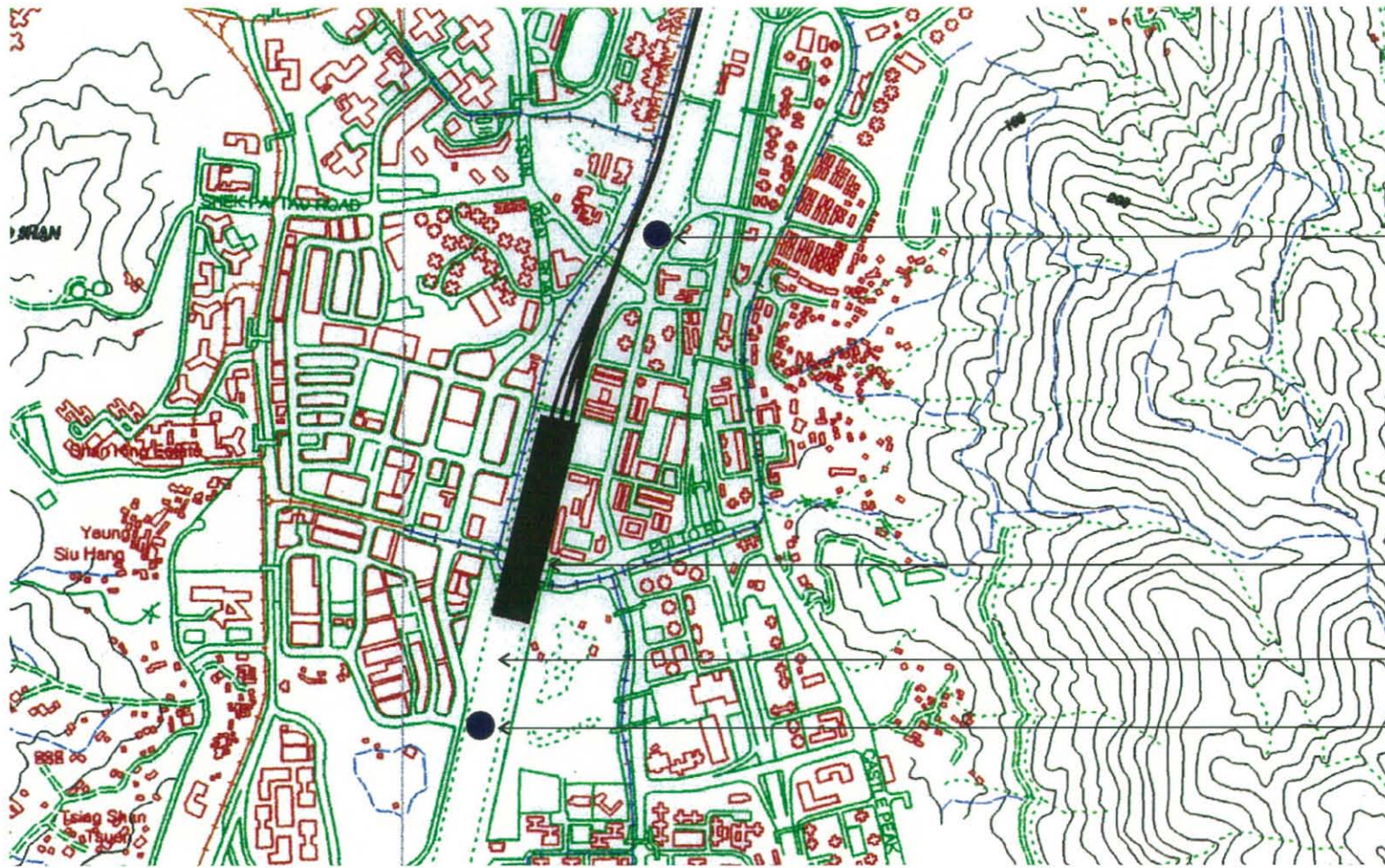
FIGURE  
7.4e

Contract/C1588/EM&A/EM&A\_2



KOWLOON - CANTON  
RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY





U11

TUEN MUN CENTRE STATION

TUEN MUN RIVER

D11

KEY

● RIVER QUALITY MONITORING STATION

LOCATIONS OF RIVER WATER QUALITY MONITORING STATIONS NEAR  
TUEN MUN CENTRE STATION

FIGURE  
7.4f

Contract/C1588/EM&A/EM&A\_3



KOWLOON - CANTON  
RAILWAY CORPORATION  
WEST RAIL: TS900 EIA STUDY



Table 7.4b Locations of River Water Quality Monitoring Stations along the West Rail Alignment

Alignment Section	Monitoring Stations
West Rail Depot	Upstream: U1A, U1B, U1C Downstream: D1
Northern Section (Phase I)	Upstream: U2, U3, U4 and U5 Downstream: D2, D3, D4 and D5
Western Section	Upstream: U6A, U6B, U6C, U7A, U7B, U8, U9, U10A, U10B, U11 Downstream: D7, D8, D9, D10, D11

### 7.5 Baseline Monitoring

Baseline conditions for water quality shall be established and agreed with the EPD prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact and control monitoring stations. The baseline conditions shall be established by measuring the water quality parameters specified above. The measurements shall be taken at all designated impact monitoring stations, at mid-flood and mid-ebb tides (where appropriate) on the sampling day.

In view of the number of cooling water intakes and other sensitive receivers that may be impacted by West Rail construction, it is considered essential to fully characterise the water quality conditions under which cooling water pumping station operators have been operating immediately prior to any West Rail construction. Therefore, a period of 4 consecutive weeks of baseline monitoring prior to the commencement of construction is recommended. The baseline monitoring will provide a database of water quality data which shall be used as the reference for subsequent impact monitoring during the West Rail construction phase. As such, the Contractor shall be compelled to accept the results/findings of the baseline monitoring carried out by others.

As it is proposed that the baseline monitoring programme should last for 4 weeks, it is considered that three sampling days per week will be sufficient to set up the database cost-effectively.

Table 7.5a summarises the baseline monitoring programme for each parameter.

Table 7.5a Summary of Baseline Monitoring Programme for Water Quality

Parameters	Monitoring Stations	Frequency	Total Number of Sampling Days
Dissolved Oxygen	All	Three days per week at each monitoring station	12
pH	All	Three days per week at each monitoring station	12



## Water Quality Monitoring

Temperature	All	Three days per week at each monitoring station	12
Turbidity	All	Three days per week at each monitoring station	12
Salinity	Marine water quality monitoring stations only	Three days per week at each monitoring station	12
Total hardness	All	Three days per week at each monitoring station	12
Suspended Solids	All	Three days per week at each monitoring station	12
Sulphides	Marine water quality monitoring stations only	Three days per week at each monitoring station	12

All measurements shall be carried out at three water depths, namely, 1 m below water surface, mid-water depth, and 1 m above sea bed (where appropriate). Water samples for suspended solids and sulphides analyses shall be taken at the same three depths. If the water depth is less than 6 m, the mid-depth measurement may be omitted subject to the approval of the Engineer. If the depth is less than 3 m, only the mid-depth measurement needs to be taken subject to the approval of the Engineer. There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring.

All parameters should be measured at the control stations on each monitoring day.

## 7.6 Impact Monitoring

### 7.6.1 On-Site Monitoring

During the course of the marine/riverine works, impact monitoring shall be undertaken on three working days per week. Monitoring at each station shall be undertaken at both mid-ebb and mid-flood tides (for tidal sections) on the same day. The interval between two sets of monitoring shall not be less than 36 hours. Two consecutive measurements of turbidity (marine water quality only), DO, dissolved oxygen saturation at each depth of each station shall be taken. The probes shall be retrieved out of water after the first measurement and then redeployed for the second measurement. Where the difference in value between the first and second readings of each set is more than 25% of the value of the first reading, the reading shall be discarded and further readings shall be taken. One sample for suspended solids measurement shall be taken at each depth at each water quality monitoring/control station.

Marine water samples shall be taken at 1 m below the surface, mid-water depth and 1 m above the seabed at both mid-flood and mid-ebb tide. If the water depth is less than 6 m, the mid-depth measurement may be omitted subject to the approval of the Engineer. If the depth is less than 3 m, only the mid-depth measurement need be taken subject to the approval of the Engineer. For river water quality impact monitoring, the same sampling methodology should be adopted as for baseline monitoring.

The marine water monitoring station M1a will be relocated to M1b, when the temporary WSD Tsuen Wan Central Pumping Station salt water intake is relocated to the new permanent position. Should the monitoring record levels of turbidity, suspended solids, sulphides, temperature or dissolved oxygen that exceed Action and/or Limit levels or the statutory standards of the *Water Pollution Control Ordinance*, increased monitoring shall be required. The Engineer may direct that monitoring shall be undertaken daily at each designated monitoring station until the recorded depth averaged values of these parameters indicate, to the satisfaction of the Engineer, an improving and acceptable level of water quality.

#### **7.6.2 Off-Site Monitoring (Marine Water Quality only)**

The same marine water impact monitoring procedures should be carried out near the mud disposal grounds of Class A uncontaminated material and Class B moderately contaminated material for off-site mud disposal impact monitoring, when the disposal site(s) for them is finalised by FMC/EPD. Measurements of turbidity, DO, temperature and SS shall be the same as specified for on-site monitoring and shall be undertaken on three working days per week at each off-site monitoring and control station.

#### **7.7 Compliance Assessment**

Monitoring data collected during the period of the construction works shall be assessed for SS and DO with regard to the Action and Limit Levels as shown in *Table 7.7a*. For all other parameters, Action and Limit Levels shall be proposed by the Engineer's Environmental Team for agreement with the EPD following the completion of the baseline monitoring. River water impact monitoring at Kam Tin river, Yuen Long Floodway Bypass, Yuen Long creek and Tin Shui Wai shall observe the EPD Deep Bay "Zero Discharge" Policy.

Table 7.7a Action and Limit Levels for Marine Water Quality

Parameters	Action	Limit
DO in mg l <sup>-1</sup> (Surface, Middle & Bottom)	<u>Surface &amp; Middle</u> 1 percentile of baseline data for surface and middle layer, or midway between 5 percentile of baseline data and Limit Levels	<u>Surface &amp; Middle</u> 4 mg l <sup>-1</sup>
	<u>Bottom</u> 1 percentile of baseline data for bottom layer, or midway between 5 percentile of baseline data and Limit Levels	<u>Bottom</u> 2 mg l <sup>-1</sup>
SS in mg l <sup>-1</sup>	95 percentile of baseline data and 120% of upstream control station's SS at the same tide of the same day	99 percentile of baseline data and 130% of upstream control station's SS at the same tide of the same day

Notes: For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.

For SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.

All the figures given in the table are used for reference only and the EPD may amend the figures whenever it considered as necessary.

### 7.8 Event Contingency Plan

Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are exceeded, the actions in accordance with the Event Contingency Plan in *Table 7.8a* shall be carried out.

Table 7.8a Event Contingency Plan for Water Quality

Event	Engineer's Environmental Team	Contractor	Engineer
Action level exceeded on one sampling day	Repeat in-situ measurement to confirm findings; Identify source(s) of impact; Inform Contractor and EPD; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with Engineer and Contractor; Repeat measurement on next day of exceedance.	Inform the Engineer and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Propose mitigation measures to Engineer and discuss with ET and Engineer; Implement the agreed mitigation measures.	Discuss with ET and Contractor on the proposed mitigation measures; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures.
Action level exceeded on more than two consecutive sampling days	Repeat in-situ measurements to confirm findings; Identify source(s) of impact; Inform Contractor and EPD; Check monitoring data, all plant,	Inform the Engineer and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods;	Discuss with ET and Contractor on the proposed mitigation measures; Make agreement on the mitigation measures to

**Water Quality Monitoring**

Event	Engineer's Environmental Team	Contractor	Engineer
	<p>equipment and Contractor's working methods;</p> <p>Discuss mitigation measure with Engineer and Contractor;</p> <p>Ensure mitigation measures are implemented;</p> <p>Prepare to increase the monitoring frequency to daily;</p> <p>Repeat measurement on next day of exceedance.</p>	<p>Propose mitigation measures to Engineer within 3 working days and discuss with ET and Engineer;</p> <p>Implement the agreed mitigation measures.</p>	<p>be implemented;</p> <p>Assess the effectiveness of the implemented mitigation measures.</p>
Limit level exceeded on one sampling day	<p>Repeat in-situ measurement to confirm findings;</p> <p>Identify source(s) of impact;</p> <p>Inform Contractor and EPD;</p> <p>Check monitoring data, all plant, equipment and Contractor's working methods;</p> <p>Discuss mitigation measure with Engineer and Contractor;</p> <p>Ensure mitigation measures are implemented;</p> <p>Increase the monitoring frequency to daily until no exceedance of Limit level.</p>	<p>Inform the Engineer and confirm notification of the non-compliance in writing;</p> <p>Rectify unacceptable practice;</p> <p>Check all plant and equipment; Consider changes of working methods;</p> <p>Propose mitigation measures to Engineer within 3 working days and discuss with ET and Engineer;</p> <p>Implement the agreed mitigation measures.</p>	<p>Discuss with ET and Contractor on the proposed mitigation measures;</p> <p>Request Contractor to critically review the working methods;</p> <p>Make agreement on the mitigation measures to be implemented;</p> <p>Assess the effectiveness of the implemented mitigation measures.</p>
Limit level exceeded on more than two consecutive sampling days	<p>Repeat in-situ measurement to confirm findings;</p> <p>Identify source(s) of impact;</p> <p>Inform Contractor and EPD;</p> <p>Check monitoring data, all plant, equipment and Contractor's working methods;</p> <p>Discuss mitigation measure with Engineer and Contractor;</p> <p>Ensure mitigation measures are implemented;</p> <p>Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days.</p>	<p>Inform the Engineer and confirm notification of the non-compliance in writing;</p> <p>Rectify unacceptable practice;</p> <p>Check all plant and equipment; Consider changes of working methods;</p> <p>Propose mitigation measures to Engineer within 3 working days and discuss with ET and Engineer;</p> <p>Implement the agreed mitigation measures;</p> <p>As directed by the Engineer, to slow down or to stop all or part of the marine work or construction activities.</p>	<p>Discuss with ET and Contractor on the proposed mitigation measures;</p> <p>Request Contractor to critically review the working methods;</p> <p>Make agreement on the mitigation measures to be implemented;</p> <p>Assess the effectiveness of the implemented mitigation measures;</p> <p>Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the marine work until no exceedance of Limit Level.</p>

ET - Engineer's Environmental Team

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## 8. LANDSCAPE AND VISUAL IMPACTS

The West Rail EIA Final Assessment Report identifies a range of measures to mitigate the landscape and visual impacts associated with the West Rail construction phase. The major recommended measures are as follows:

- Control of night time lighting;
- Erection of decorative screen hoarding;
- Advance planting for screening;
- Use of stripped excavated material /earth mounding for screening;
- Minimising height of temporary buildings; and
- Careful positioning of construction plant.

As part of the contractual requirements placed upon the Contractor, an Environmental Management Plan (EMP) for the works will be submitted to the Engineer for approval. The EMP shall detail the Contractor's plans for implementing the required landscape and visual mitigation measures. This information will be entered into the revised Implementation Schedule for submittal to the EPD, and the effectiveness of the Contractor's implementation and maintenance of these mitigation measures will be monitored as part of the ongoing site audit programme.

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## 9. HERITAGE RESOURCES

The provisions and requirements for safeguarding significant archaeological deposits will be the subject of an Archaeological Action Plan to be submitted to the Antiquities and Monuments Office for approval.

During the construction phase the following specific EIA recommendations apply:

- It is recommended that direct impacts to the heritage value of the buildings of Lau's residence at Tung Shing Lei be avoided through the adoption of a buffer zone of at least five metres between the building and the site boundary for the construction worksite; and
- During the construction phase, the adjacent works will include site clearance, foundation construction using non-percussive piling techniques and superstructure construction. With the distance separation between these works and the Pagoda, no impacts are likely during the construction phase. However, given the sensitivity and heritage importance of this structure, it is recommended that a condition survey is undertaken prior to and following the completion of the works and that sample vibration monitoring is undertaken by the Contractor during site operations. A vibration limit of 2 mm/s peak particle velocity should be applied to all construction related activities.

As part of the contractual requirements placed upon the Contractor, an Environmental Management Plan (EMP) for the works will be submitted to the Engineer for approval. The EMP shall detail the Contractor's plans for implementing the required heritage resource mitigation measures. This information will be entered into the revised Implementation Schedule for submittal to the EPD, and the effectiveness of the Contractor's implementation and maintenance of these mitigation measures will be monitored as part of the ongoing site audit programme.



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### 10. ECOLOGICAL RESOURCES

The West Rail EIA has recommended that the length of railway easement corridor between Kam Tin Station and the Au Tau Intersection will provide the key focus of mitigating habitat provision. The corridor will provide for land under the high viaducts, the footprint of which occupies an area which extends up to a width of 60 metres, plus a 3 metre maintenance strip on each side of the viaducts. It is estimated that some 8 ha of land will be available from this area for restoration to suitable freshwater wetlands. In addition there is a small pocket of land approximately 0.5 ha in size next to the tunnel portal that will be restored after the completion of construction works. These potential sites are considered suitable in view of being in close ecological linkage to impacted areas. Appropriate principles and designs for wetland restoration which have been practised elsewhere will be adopted for the implementation of the ecological mitigation measures, as outlined in the EIA.

Further studies will be undertaken by the Corporation at the Detailed Design stage to develop these into specific wetland habitat restoration or enhancement plans, including engineering specifications for marsh and pond locations, size, self-perpetuating hydrological regime (where practicable), bathymetry, drainage, revegetation and maintenance. The outcome of these further studies will be presented in an Habitat Creation and Management Plan which will be submitted to AFD for endorsement.

Establishment and management of these sites within the railway corridor shall be undertaken by the Corporation.

Following completion of wetland restoration an ecological monitoring programme should be carried out to ensure that the set conservation objectives are achieved, details of which shall be reported in the Habitat Creation and Management Plan. Generally monitoring should be undertaken over a 5-year period to quantify and document the following parameters of flora and fauna colonisation:

- Vegetation species presence, abundance, dominance (annual monitoring);
- Odonate species presence (twice annual monitoring in summer to early autumn);
- Reptile & amphibian species presence (twice annual monitoring in summer to early autumn); and
- Avifauna species presence, abundance, and diversity (quarterly monitoring).

Results should be compared against EIA data, and management action should be taken in the event that the wetlands do not perform as intended in the audited final design specifications.

*Ho Pui and Toll Plaza Egrettries*

Both egrettries should be monitored during construction of West Rail on an annual basis. Three counts should be made of the total number of ardeids occupying each egrettry during the months of April, May, and June during each year of project construction, and for the first 3 years following commencement of operation. Should either egrettry be abandoned or if there is a decline in nest numbers, assessment should begin immediately under the direction of a qualified ornithologist to determine the following:

- Causation of the abandonment/nest decline;
- Prospects for management action to remove the cause of abandonment/ nest decline;
- Potential for West Rail involvement in corrective management if abandonment is attributed to West Rail construction or operation; and
- Appropriate management response.

Prescribed management responses should be implemented as soon as possible, and results should be monitored to determine efficacy.

*Ho Pui Bat Roost*

The bat roost southwest of the north tunnel portal should be monitored bi-weekly during the construction phase of the northern part of the tunnel to determine the impact of tunnel blasting/boring and associated activities on bat roost occupancy. Monitoring should be carried out by an ecologist. Data to be recorded shall include species presence and estimates of bat abundance.

Should roosting bat numbers decline during the construction period, or should the roost be abandoned, immediate action should be taken in concert with the AFD.

*General*

As part of the contractual requirements placed upon the Contractor, an Environmental Management Plan (EMP) for the works will be submitted to the Engineer for approval. The EMP shall detail the Contractor's plans for implementing the required ecological mitigation measures. This information will be entered into the revised Implementation Schedule for submittal to the EPD, and the effectiveness of the Contractor's implementation and maintenance of these mitigation measures will be monitored as part of the ongoing site audit programme.

## 11. WASTE MANAGEMENT

### 11.1 Introduction

The effective management of waste arisings during the construction phase of West Rail will be monitored through the site audit programme. The scope of that part of the programme relating to waste management is presented below.

### 11.2 Objectives of the Waste Audit

The aims of the waste audit are:

- To ensure that the waste arising from works are handled, stored, collected, transferred and disposed of in an environmentally acceptable manner;
- To ensure that the handling, storage, collection and disposal of waste arising from the demolition works comply with the relevant requirements under the Waste Disposal Ordinance and its regulations; and
- To encourage the reuse and recycling of materials.

### 11.3 Methodology and Criteria

The Engineer's Environmental Team should ensure that the Contractor has obtained from appropriate authorities the necessary waste disposal permits or licences in accordance with the various ordinances:

- Chemical waste permits/licences under the *Waste Disposal Ordinance* (Cap 354);
- Public Dumping Licence under the *Crown Land Ordinance* (Cap 28); and
- Marine Dumping Permit under the *Dumping at Sea Ordinance* (Cap 466).

The storage, handling and disposal of chemical waste should be audited with reference to the requirements of the *Code of Practice on the Package, Labelling and Storage of Chemical Wastes* published by the EPD.

The storage, handling and disposal of asbestos waste should be monitoring and audit with reference to the requirements of the *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste* published by the EPD.

The recommended disposal sites for different types of waste are shown below in *Table 11.3a*.

Table 11.3a Recommended Waste Disposal Sites

Type of Waste	Disposal Site
Steel (including steel mesh, reinforcement bars, window frame, railings, banisters, etc.)	<ul style="list-style-type: none"> <li>•Licensed steel mills in Hong Kong; or</li> <li>•Overseas steel mills.</li> </ul>
Inert demolition material (reinforced concrete, asphaltic concrete, dirt/soil, bricks, masonry, mortar, plastic, ceramic/ceiling tiles, etc.) which comply with the requirements of the Public Dumping Licence	<ul style="list-style-type: none"> <li>•Construction sites which require fill material;</li> <li>•Public filling areas;</li> <li>•Public filling barging points; and</li> <li>•Public filling sorting facility (if available).</li> </ul>
Demolition waste (plastics, glass, wood, bamboo scaffolding, etc.) which consist less than 20% (by volume) of inert material	<ul style="list-style-type: none"> <li>•Licensed landfill sites.</li> </ul>
Chemical waste as defined under <i>Schedule 1 of the Waste Disposal (Chemical Waste) Regulation</i>	<ul style="list-style-type: none"> <li>•Chemical Waste Treatment Facility at Tsing Yi; or</li> <li>•Other facilities approved by the EPD.</li> </ul>
Asbestos waste	<ul style="list-style-type: none"> <li>•Licensed landfill designated by the EPD.</li> </ul>
General Refuse	<ul style="list-style-type: none"> <li>•Licensed landfill sites; or</li> <li>•Refuse transfer stations.</li> </ul>

The Contractor's waste management practices should be audited with reference to *Table 11.3b*.

Table 11.3b Waste Management Checklist

Activities	When	Monitoring Frequency	If non-compliance, Corrective Action Required
All necessary waste disposal permits or licences have been obtained.	Before the commencement of demolition works	Once	Apply for the necessary permits/licences prior to disposal of the waste. The ET Leader shall ensure that corrective action has been taken.
Only licensed waste haulier are used for waste collection.	Throughout the works	Weekly	The ET should instruct the Contractor to use a licensed waste haulier. Waste collection of that particular waste should be temporarily suspended until a licensed waste haulier is used. Corrective action should be undertaken within 48 hours.
Records of quantities of wastes generated, recycled and disposed are properly kept. For demolition material/waste, the number of loads for each day should be recorded (quantity of waste can then be estimated based on average truck load. Should landfill charging be implemented, the receipts of the charge could be used for estimating the quantity).	Throughout the works	Weekly	Estimate the missing data based on previous records and the activities carried out.

**Waste Management**

Activities	When	Monitoring Frequency	If non-compliance, Corrective Action Required
Wastes are removed from site in a timely manner. General refuse is collected on a daily basis.	Throughout the works	Weekly	The ET should instruct the Contractor to remove waste accordingly.
Waste storage areas are properly cleaned and do not cause windblown litter and dust nuisance.	Throughout the works	Weekly	The ET should instruct the Contractor to clean the storage area and/or cover the waste.
Different types of waste are segregated in different containers or skip to enhance recycling of material and proper disposal of waste.	Throughout the works	Weekly	The ET should instruct the Contractor to provide separate skips/containers. The Contractor should ensure the workers place the waste in the appropriate containers.
Chemical wastes are stored, handled and disposed of in accordance with the <i>Code of Practice on the Packaging, Handling and Storage of Chemical Wastes</i> , published by the EPD	Throughout the works	Weekly	The ET should instruct the Contractor to rectify the problems immediately. Warning should be given to the Contractor if corrective actions are not taken within 24 hrs and the Waste Control Group of the EPD should be notified.
Asbestos waste is stored, handled and disposed of in accordance with the <i>Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste</i> .	During the Asbestos Abatement Works	Weekly	The ET should instruct the Contractor to rectify the problem immediately. Warning should be given to the Contractor if corrective actions are not taken within 24 hrs and the Air Management Group of EPD should be notified.
Demolition material/waste in dump trucks are properly covered before leaving the site.	Throughout the works	Weekly	Trucks should not be allowed to leave the site until the waste are properly covered.
Wastes are disposed of at licensed sites.	Throughout the works	Weekly	The ET should warn the Contractor and instruct the Contractor to ensure the wastes are disposed of at the licensed sites. Should it involve chemical waste, the Waste Control Group of EPD should be notified.

ET - Engineer's Environmental Team

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## 12. LAND CONTAMINATION

The effective management of land contamination during the construction phase of West Rail will be monitored through the site audit programme.

Potential impacts associated with the handling and disposal of contaminated soils and groundwater, though not expected, can be mitigated by adopting the following measures:

- The use of bulk earth-moving equipment should minimise the potential interface of contaminated materials with site construction workers;
- Exposure to any contaminated materials should be minimised by the wearing of appropriate clothing and personal protective gear such as gloves when interacting directly with contaminated material, providing adequate hygiene and washing facilities, and preventing smoking and eating during such activities;
- Where excavated material is suspected to be contaminated, preliminary analysis of representative samples should be performed to enable options for disposal of contaminated materials to be properly evaluated (based on the soil classification) and to allow the volume of such materials to be estimated before agreement or approval is sought from the relevant authorities;
- Contaminated soils should not be stockpiled on site. However, in the event that this is necessary in the short-term, any stockpiled contaminated sediments should be covered with plastic sheeting or tarpaulin, especially during heavy rainstorms;
- Waste hauliers which are authorised or licensed to collect contaminated soils should be used, and these waste hauliers should be used to transport and dispose of contaminated soils to an appropriate disposal site licensed to accept the waste;
- Vehicles containing contaminated materials should be suitably covered to limit potential dust emissions and the tailgates sealed to prevent contaminated wastewater runoff during transport;
- Prior agreement should be sought with the appropriate authorities regarding the acceptability of disposal of contaminated sediments to East Sha Chau or to landfill, following any sampling and analysis programme conducted. Although not officially designated, the only landfill site in Hong Kong that is likely to be able to accept small amounts of contaminated sediment is the WENT landfill;
- The necessary waste disposal permits should be obtained from the appropriate authorities, in accordance with the *Waste Disposal Ordinance* (Cap 354), *Waste Disposal (Chemical Waste) (General) Regulation* (Cap 354), as required;
- Procedures should be developed to ensure that illegal disposal of wastes does not occur;



## Land Contamination

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- Records of the quantities of wastes generated and disposed of should be maintained;

In accordance with good construction practice, silt traps should be used to reduce the level of suspended solids arising from particles of disturbed ground and soil;

- Groundwater should be disposed of in accordance with the *Water Pollution Control Ordinance (WPCO)*;
- Surface waters should be diverted around any areas currently being worked, or materials being stockpiled, to minimise potential runoff into excavations, as runoff would increase the volume of contaminated groundwater requiring disposal and suspended solids in the wastewater stream; and
- Potential impacts on future site maintenance and utility workers should be minimised by developing services in concrete culverts and service ducts.

As part of the contractual requirements placed upon the Contractor, an Environmental Management Plan (EMP) for the works will be submitted to the Engineer for approval. The EMP shall detail the Contractor's plans for implementing the required land contamination mitigation measures. This information will be entered into the revised Implementation Schedule for submittal to the EPD, and the effectiveness of the Contractor's implementation and maintenance of these mitigation measures will be monitored as part of the ongoing site audit programme.

### 13. ENVIRONMENTAL AUDITING

#### 13.1 Site Inspections

Site inspections provide a direct means to trigger and enforce the specified environmental protection and pollution control measures. They shall be undertaken routinely to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented. With well defined pollution control and mitigation specifications and a well established site inspection, deficiency and action reporting system, the site inspection is one of the most effective tools used to enforce the environmental protection requirements on the construction site.

The Environmental Manager is responsible for formulation of the environmental site inspection, deficiency and action reporting system, and for carrying out the site inspection works.

Regular site inspections shall be carried out at least once per week. The areas of inspection shall not be limited to the environmental situation, pollution control and mitigation measures within the site; it should also review the environmental situation outside the site area which is likely to be affected, directly or indirectly, by the site activities. The Environmental Manager shall make reference to the following information in conducting the inspection:

- The EIA recommendations on environmental protection and pollution control mitigation measures;
- Works progress and programme;
- Individual works methodology proposals (which shall include proposal on associated pollution control measures);
- The contract specifications on environmental protection;
- The relevant environmental protection and pollution control laws; and
- Previous site inspection results.

The Contractor shall update the Environmental Manager with all relevant information of the construction contract for him to carry out the site inspections. The inspection results and its associated recommendations on improvements to the environmental protection and pollution control works shall be submitted to the Engineer and the Contractor within 24 hours, for reference and for taking immediate action. The Contractor shall follow the procedures and time-frame as stipulated in the environmental site inspection, deficiency and action reporting system formulated by the Environmental Manager to report on any remedial measures subsequent to the site inspections.

*Ad hoc* site inspections shall also be carried out if significant environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified in Action Plan for environmental monitoring and audit.

### 13.2 Compliance with Legal and Contractual Requirements

There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong which the construction activities shall comply with.

In order that the works are in compliance with the contractual requirements, all the works method statements submitted by the Contractor to the Engineer for approval shall be sent to Environmental Manager for vetting to see whether sufficient environmental protection and pollution control measures have been included.

The Environmental Manager shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that the any foreseeable potential for violating the laws can be prevented.

The Contractor shall regularly copy relevant documents to the Environmental Manager so that the checking work can be carried out. The document shall at least include the updated Work Progress Reports, the updated Works Programme, the application letters for different licence/permits under the environmental protection laws, and all the valid licence/permit. The site diary shall also be available for the Environmental Manager's inspection upon his request.

After reviewing the document, the Environmental Manager shall advise the Engineer and the Contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the Environmental Manager's review concludes that the current status on licence/permit application and any environmental protection and pollution control preparation works may not cope with the works programme or may result in potential violation of environmental protection and pollution control requirements by the works in due course, he shall also advise the Contractor and the Engineer accordingly.

Upon receipt of the advice, the Contractor shall undertake immediate action to remedy the situation. The Engineer shall follow up to ensure that appropriate action has been taken by the Contractor in order that the environmental protection and pollution control requirements are fulfilled.

### 13.3 Environmental Complaints

Complaints shall be referred to the Environmental Manager and passed on to the Environmental Team for carrying out complaint investigation procedures. The Environmental Team shall undertake the following procedures upon receipt of the complaints:

- Log complaint and date of receipt onto the complaint database;
- Investigate the complain to determine its validity, and to assess whether the source of the problem is due to works activities;
- If a complaint is valid and due to works, identify mitigation measures;
- If mitigation measures are required, advise the Contractor accordingly;

- Review the Contractor's response on the identified mitigation measures, and the updated situation;
- If the complaint is transferred from the EPD, submit interim report to the EPD on status of the complaint investigation and follow-up action within the time frame assigned by the EPD;
- Undertake additional monitoring and audit to verify the situation if necessary, and review that any valid reason for complaint does not recur;
- Report the investigation results and the subsequent actions to the source of complaint for responding to complainant (If the source of complaint is EPD, the results should be reported within the time frame assigned by EPD); and
- Record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports.

During the complaint investigation work, the Contractor and Engineer shall cooperate with the Environmental Manager in providing all the necessary information and assistance for completion of the investigation. If mitigation measures are identified in the investigation, the Contractor shall promptly carry out the mitigation. The Engineer shall ensure that the measures have been carried out by the Contractor.

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## **14. REPORTING**

### **14.1 Introduction**

The primary reporting function, undertaken within the EM&A programme will be the issuance of formal exceedance notifications, corrective actions and ongoing feedback between the Environmental Team and the Corporation. Reporting will be driven by the results of the monitoring and audit programme and will be recorded through written correspondence, audit reports and minutes and notes of meetings.

In addition, periodic reviews of the EM&A process will be prepared and circulated to relevant personnel within the Corporation's Project Team as a means of gauging site staff and contractor performance. The periodic reviews will comprise Monthly, Biannual and Annual EM&A Reports; these Reports will be copied to the EPD for comment. The exact details of the frequency, distribution and deadlines shall be agreed with EPD prior to the commencement of the works.

### **14.2 Baseline Monitoring Report**

The baseline monitoring results, their interpretation and proposals for the A/L level parameters will be presented in the form of a draft report which will be submitted to the EPD for agreement. The draft report will be supported by the baseline monitoring data in electronic format, along with information from the covering monitoring locations, equipment and protocols.

The agreed baseline report will then be reissued as a stand alone report.

### **14.3 Monthly EM&A Reports**

Monthly EM&A Reports shall be prepared and submitted to the Environmental Manager and copied to the EPD within 10 working days of the end of each calendar month, the first report will be submitted in the month after construction works commence. The report shall include (but not be limited to) the following elements:

- Executive Summary highlighting breaches of agreed criteria, complaints, reporting changes and future key issues;
- Basic project information (e.g. current permits and licences);
- Brief account of construction activities;
- Monitoring results together with details of locations, dates, times, parameters monitored, etc.;
- Interpretation of the significance of monitoring results and explanation of influencing factors;
- Graphical plots of monitored trends over the past four reporting periods;
- Description of recommendations and/or actions taken, or outstanding, in the event of non-compliances or deficiencies, including site inspections and audits;

## **Environmental Auditing**

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- Review of the implementation status and effectiveness of environmental protection works in relation to non-compliances and deficiencies and the mitigation measures recommended in the EIA report;
- Summary of complaints, results of investigations and follow-up actions; and
- Future key issues.

### **14.4 Annual and Bi-annual Reports**

In addition to the Monthly Reports, Bi-annual and Annual Reports will be issued which will provide a general overview of the progress of the Project EM&A to date.

The Bi-annual and Annual Reports will document the findings of the audit of noise, air and water quality monitoring results by contract, referring first to baseline conditions and then impact results. Graphs of the monitoring trends will be included to indicate the performance for impact control for each media over the reporting period. The audit findings of visual, archaeology, ecology, waste management and land contamination issues shall also be included.

A performance evaluation of the period monitoring results will review the roles of site staff, both KCRC and the Contractors, to the environment, based on Notice of Exceedance (NOE) communications and enacted mitigation measures.

A summation of the main findings and recommendations to further improve the environmental performance of the Project will be included, as appropriate, in the conclusions.

### **14.5 Data Keeping**

All documents and records, in both paper and electronic format, pertaining to the West Rail EM&A will be retained as part of the Project files and will be subject to appropriate data handling procedures.

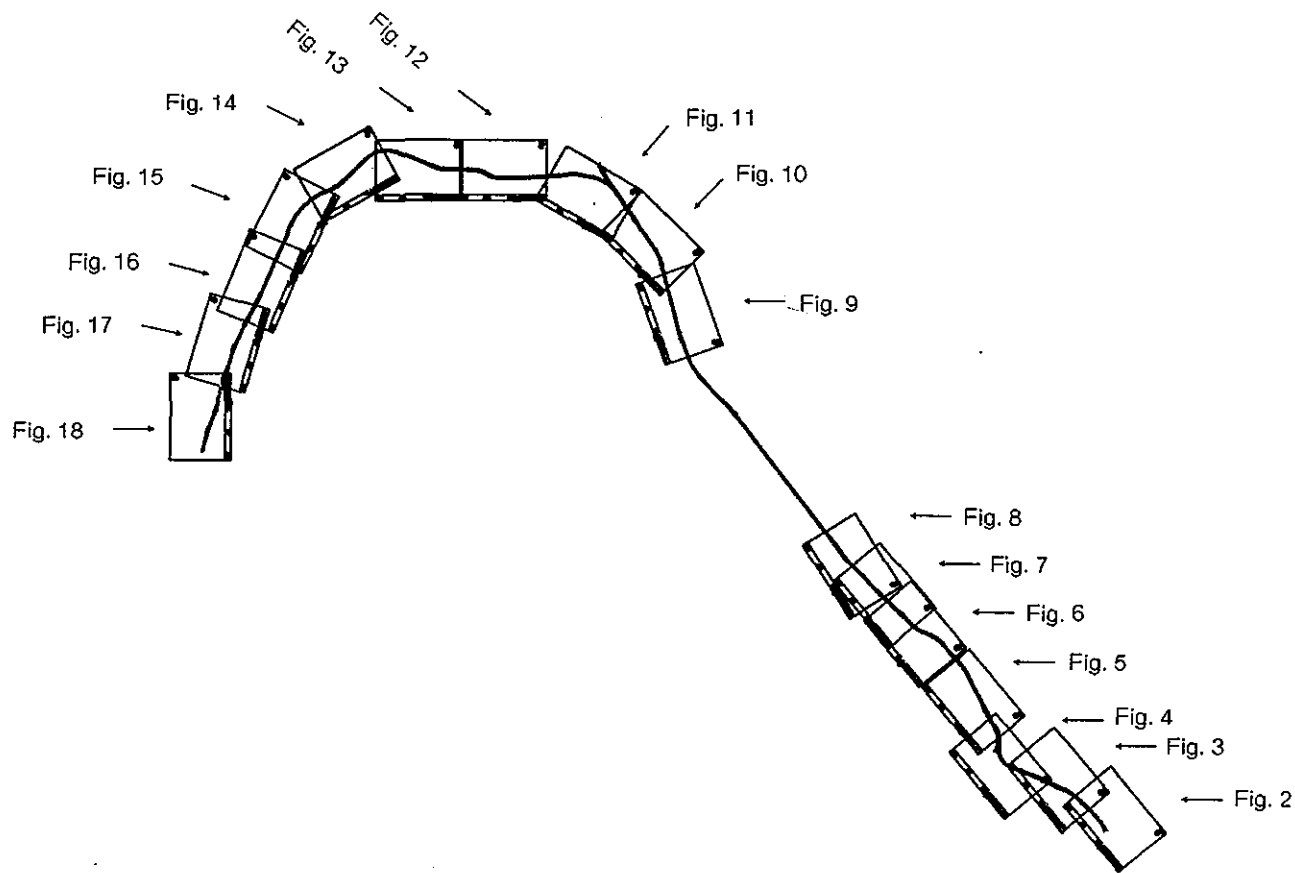
### **14.6 Interim Notifications of Environmental Quality Limit Exceedances**

Interim notifications of exceedances of Limit Levels will be issued to the EPD within 24 hours of the identification of an exceedance. The Monthly Reports will contain all available details concerning measured exceedances and complaints, their causes and those steps taken to control impacts and prevent their recurrence.

Annex A

Locations of Representative Air and  
Noise Monitoring Stations along West  
Rail Alignment





WEST RAIL NOISE AND AIR  
MONITORING LOCATIONS KEY PLAN

SCALE: 1/160,000

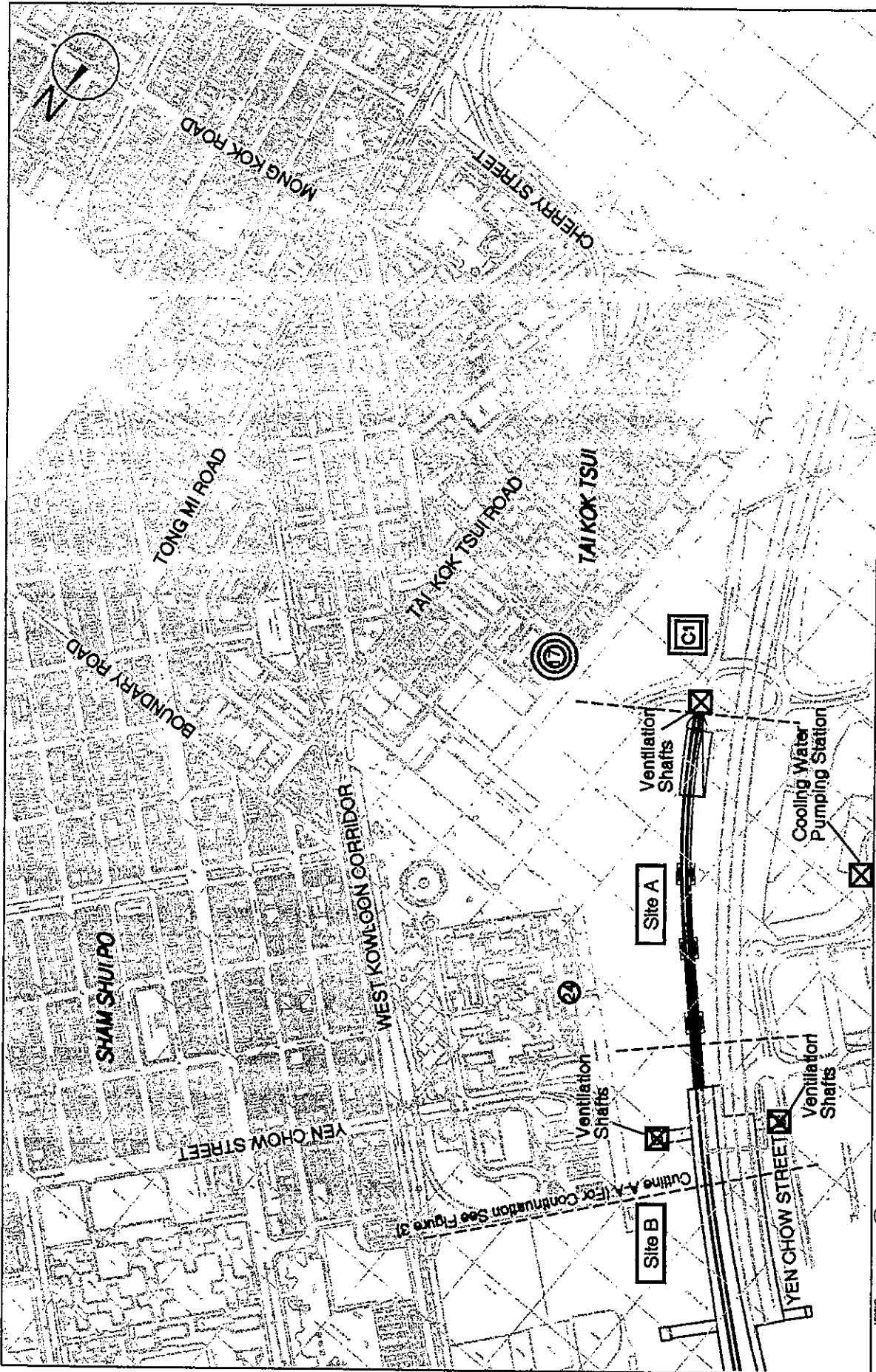
FIGURE 1

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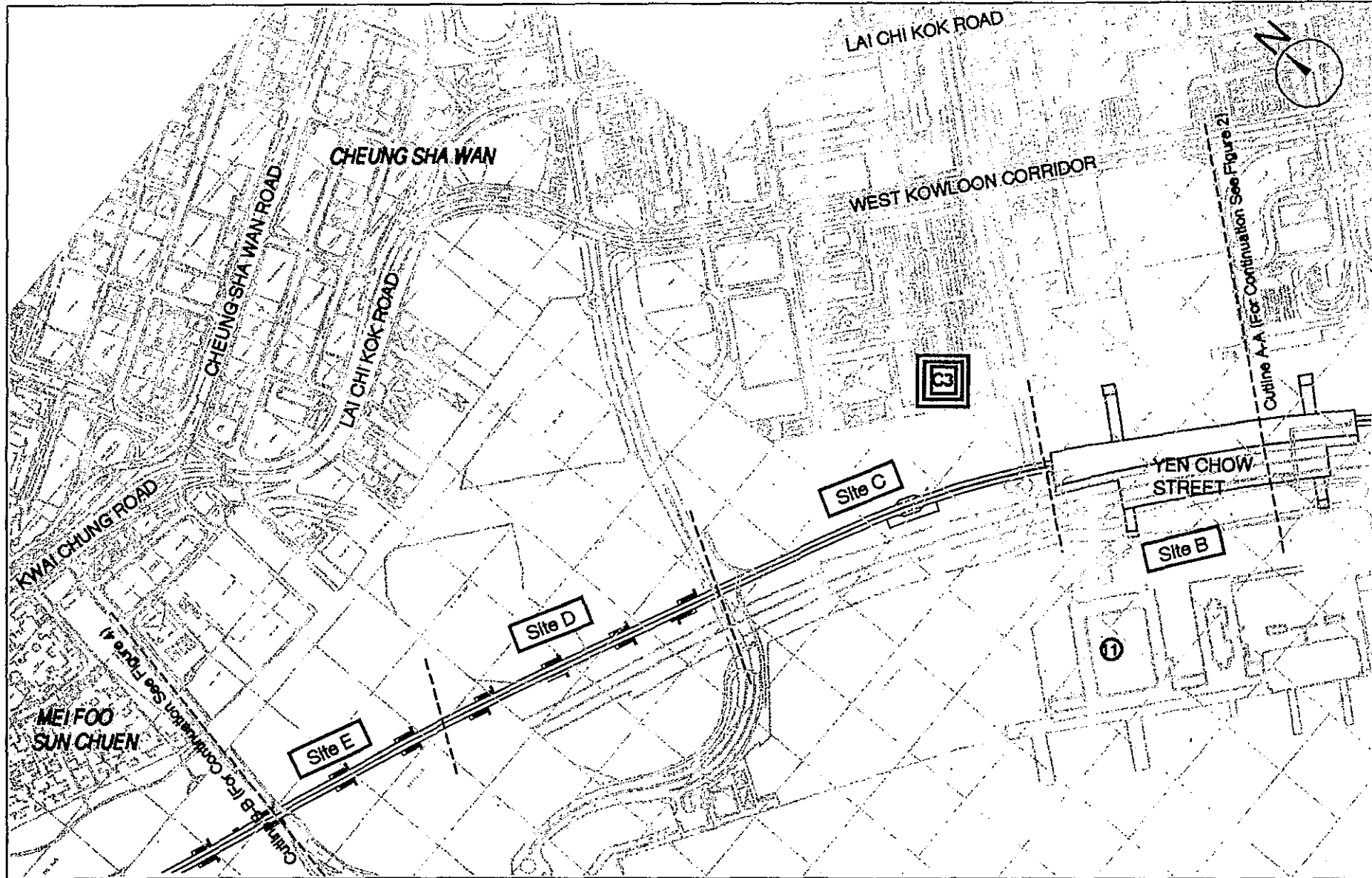


FIGURE 2  
REPRESENTATIVE NOISE AND AIR  
MONITORING LOCATIONS - TAI KOK TSUI (TKT)

SCALE: 1:17,600

- LEGEND
- ① Representative Air Monitoring Location
  - ② Representative Noise Monitoring Location
  - ③ Representative Air Monitoring Location
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|---|--|
| <ul style="list-style-type: none"> <li>① Representative Air Monitoring Location</li> <li>② Representative Noise Monitoring Location</li> <li>③ Representative Combined Air &amp; Noise Monitoring Location</li> <li>④ Representative Combined Air Monitoring Location</li> <li>⑤ Representative Combined Noise Monitoring Location</li> </ul> | <ul style="list-style-type: none"> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Combined Air &amp; Noise Monitoring Location</li> <li>④ Representative Combined Air &amp; Noise Monitoring Location</li> <li>④ Representative Combined Air Monitoring Location</li> <li>④ Representative Combined Noise Monitoring Location</li> </ul> |
| <ul style="list-style-type: none"> <li>④ Representative Combined Air &amp; Noise Monitoring Location</li> <li>④ Representative Combined Air Monitoring Location</li> <li>④ Representative Combined Noise Monitoring Location</li> </ul>   | <ul style="list-style-type: none"> <li>④ Representative Combined Air &amp; Noise Monitoring Location</li> <li>④ Representative Combined Air Monitoring Location</li> <li>④ Representative Combined Noise Monitoring Location</li> </ul>  |

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - CHEUNG SHA WAN (CSW)** FIGURE 3

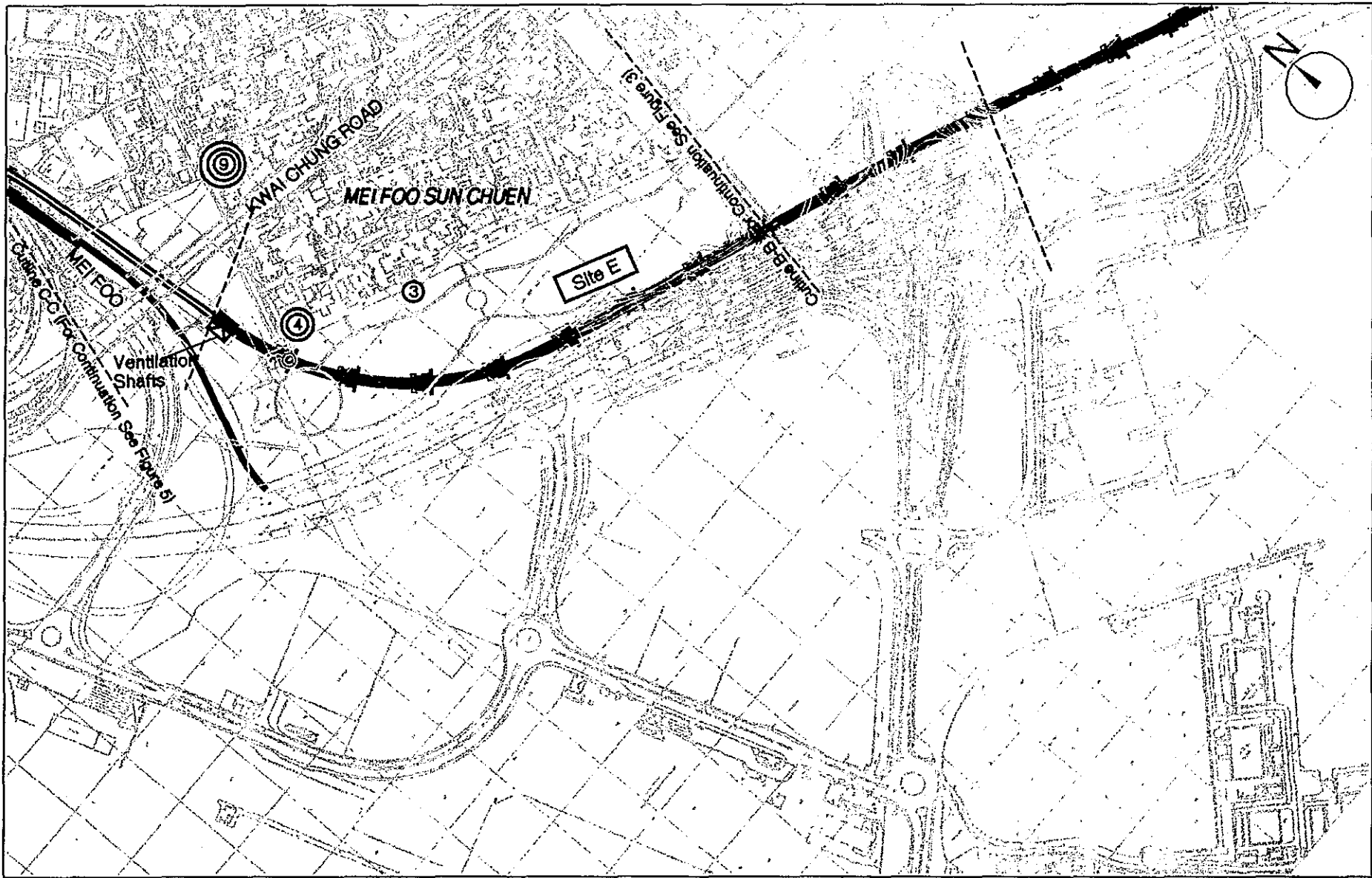
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LEGEND	
	Representative Air Monitoring Location
	Representative Noise Monitoring Location
	Representative Consultant Air Monitoring Location
	Representative Consultant Noise Monitoring Location
	Representative Air & Noise Monitoring Location
	Representative Consultant Air & Noise Monitoring Location
	Work Site
	Work Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - MEI FOO (MEF)**

**FIGURE 4**

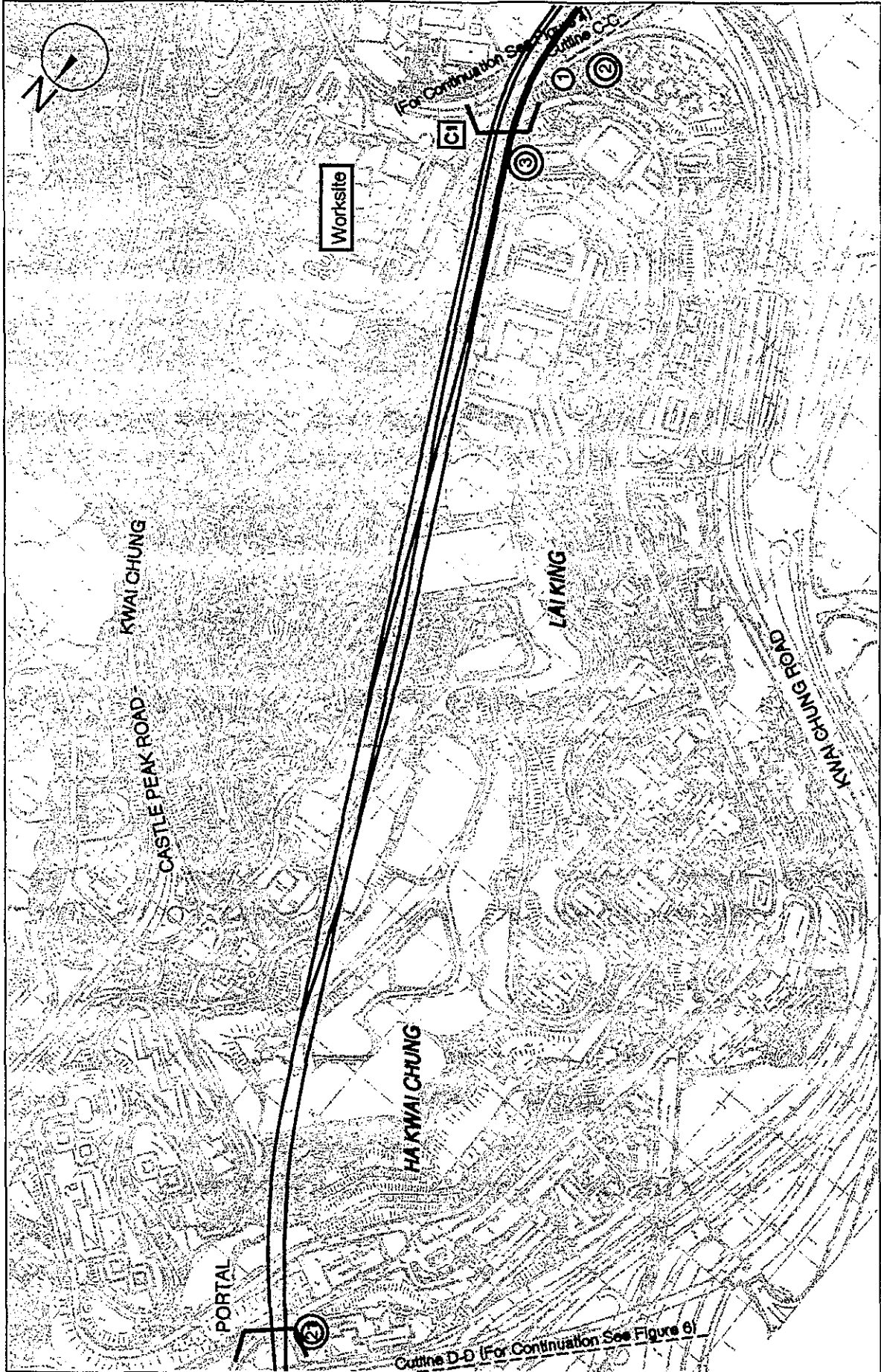
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**FIGURE 5**  
**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - LAI KING (LAK)**

SCALE: 1:7,500

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 WEST RAIL: TS900 EIA STUDY

**ERM**

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<p><b>LEGEND</b></p> <ul style="list-style-type: none"> <li>○ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> </ul>	<ul style="list-style-type: none"> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> <li>⊙ Representative Air &amp; Noise Monitoring Location</li> <li>⊙ Representative Noise Monitoring Location</li> </ul>
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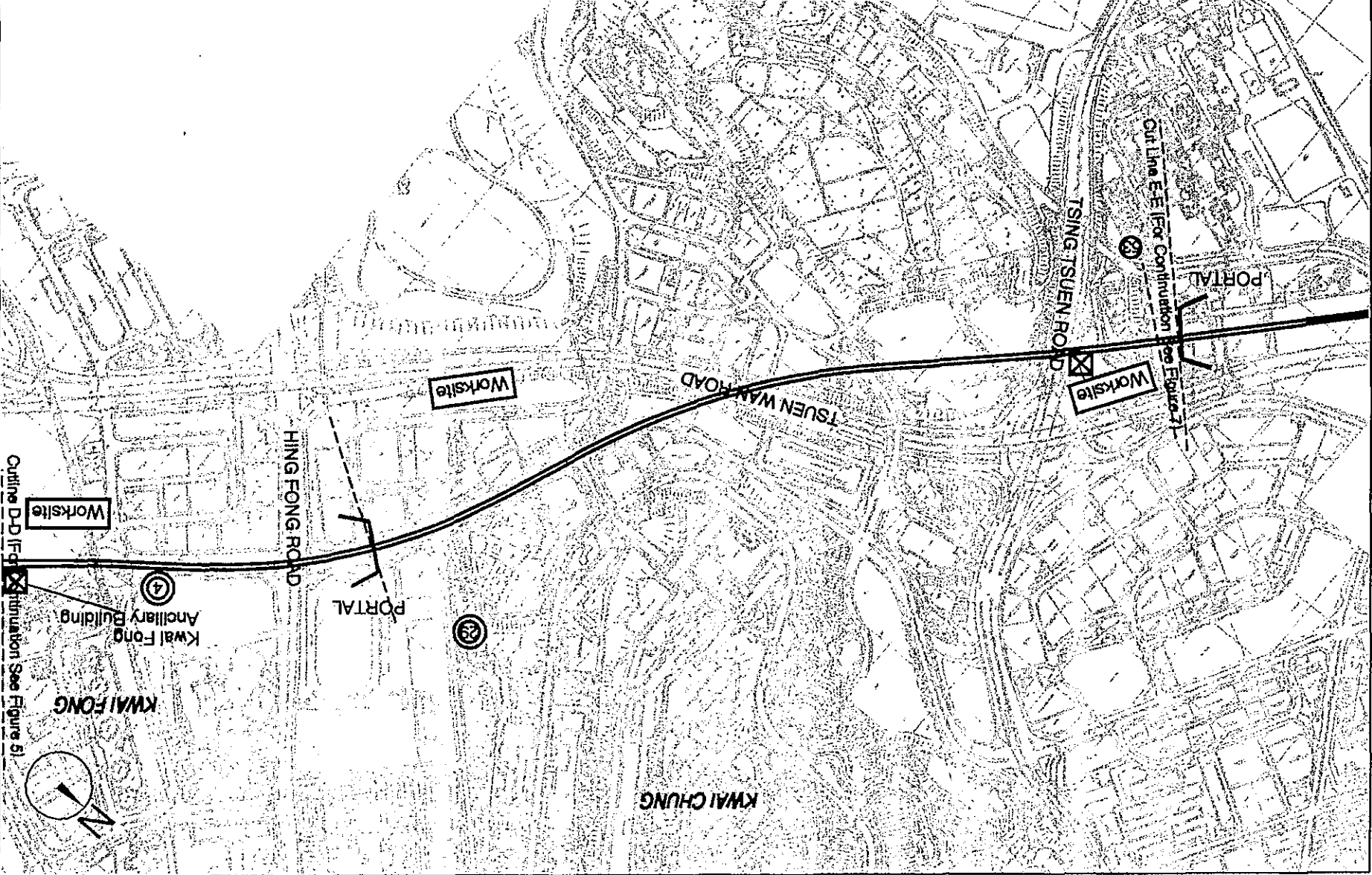


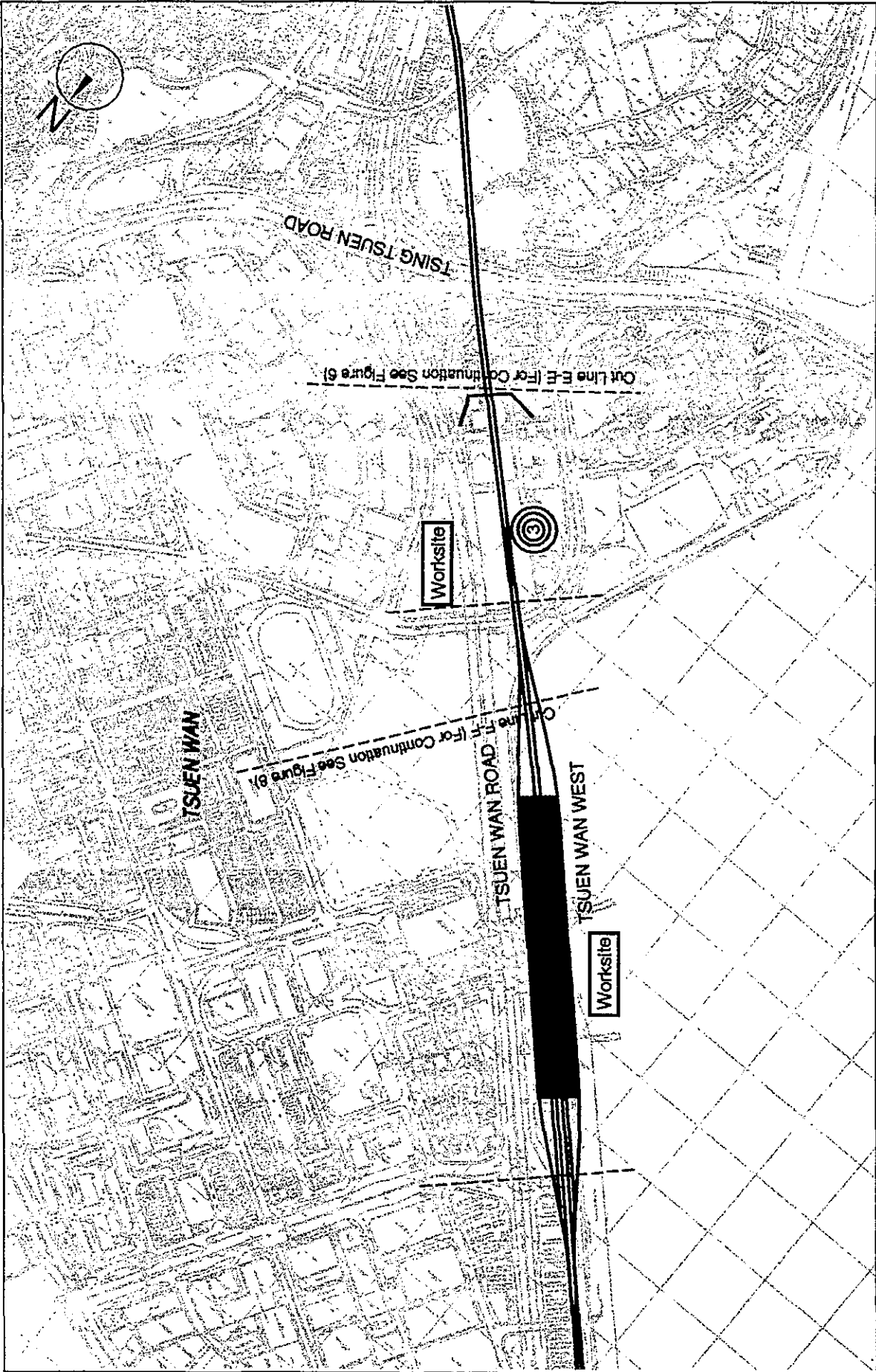
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RAILWAY CORPORATION  
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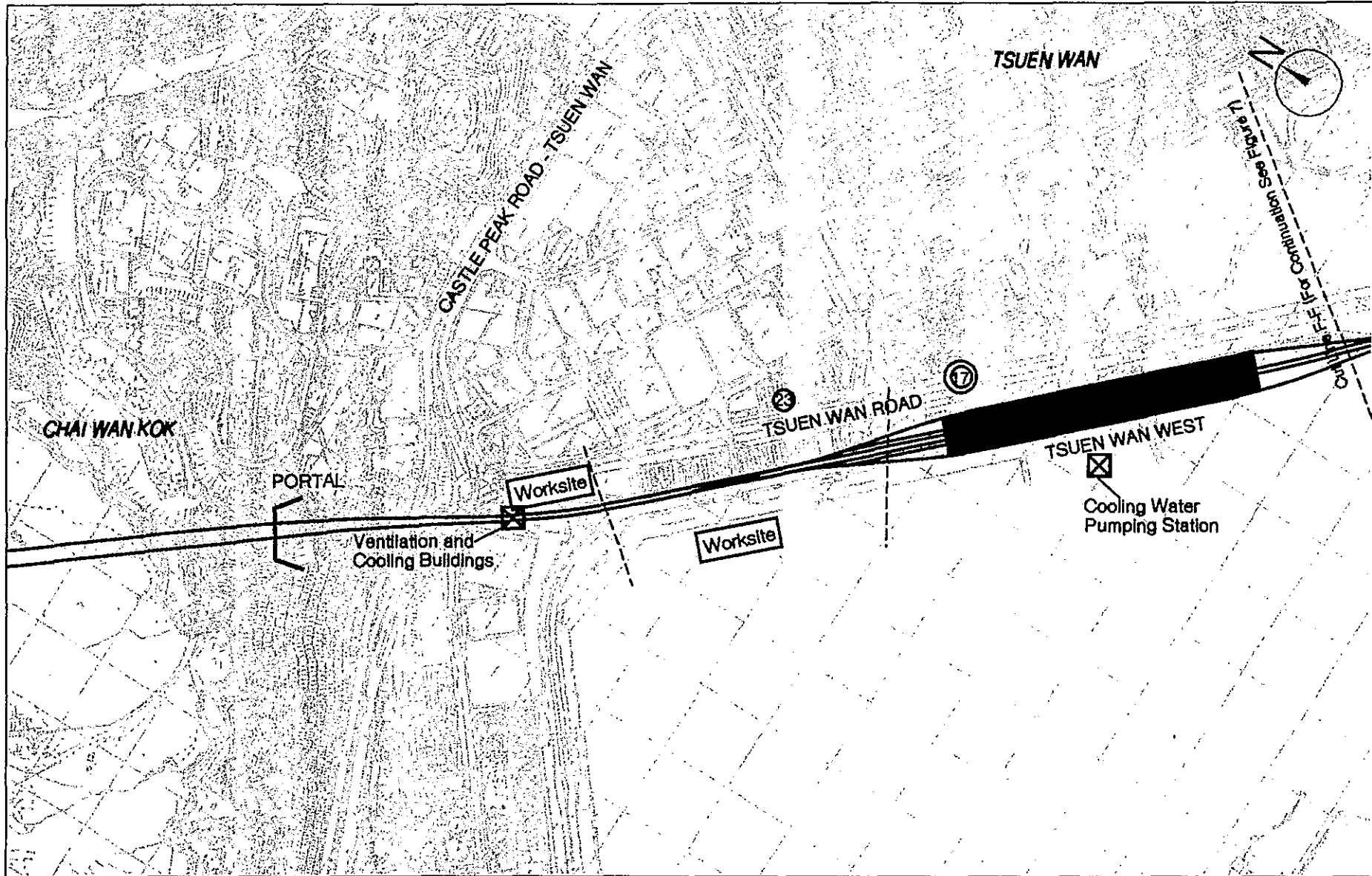
FIGURE 6  
MONITORING LOCATIONS-KWAI FONG (KWF)

SCALE: 1/7,500





<p>LEGEND</p> <ul style="list-style-type: none"> <li>○ Monitoring Point</li> <li>□ Monitoring Location</li> <li>○ Proposed Station</li> <li>○ Existing Station</li> <li>○ Proposed Overhead</li> <li>○ Proposed Underpass</li> <li>○ Proposed Tunnel</li> <li>○ Proposed Viaduct</li> <li>○ Proposed Bridge</li> <li>○ Proposed Road</li> <li>○ Proposed Footpath</li> <li>○ Proposed Drainage</li> <li>○ Proposed Utility</li> <li>○ Proposed Boundary</li> </ul>	<p>Representative Noise and Air Monitoring Locations</p> <p>Proposed Station</p> <p>Existing Station</p> <p>Proposed Overhead</p> <p>Proposed Underpass</p> <p>Proposed Tunnel</p> <p>Proposed Viaduct</p> <p>Proposed Bridge</p> <p>Proposed Road</p> <p>Proposed Footpath</p> <p>Proposed Drainage</p> <p>Proposed Utility</p> <p>Proposed Boundary</p>	<p>FIGURE 7</p> <p>REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TSUEN WAN (TWN)(1 OF 2)</p> <p>SCALE: 1:7,500</p>	<p>KOWLOON - CANTON RAILWAY CORPORATION</p> <p>WEST RAIL: TS900 EIA STUDY</p> <p>ERM</p>
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**LEGEND**

	Representative Air Monitoring Location		Representative Air & Noise Monitoring Location
	Representative Noise Monitoring Location		Representative Combined Air & Noise Monitoring Location
	Representative Combined Air Monitoring Location		Work Sites
	Representative Combined Noise Monitoring Location		Work Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TSUEN WAN(TWN)(2 OF 2)**

FIGURE 8

SCALE: 1/7,500

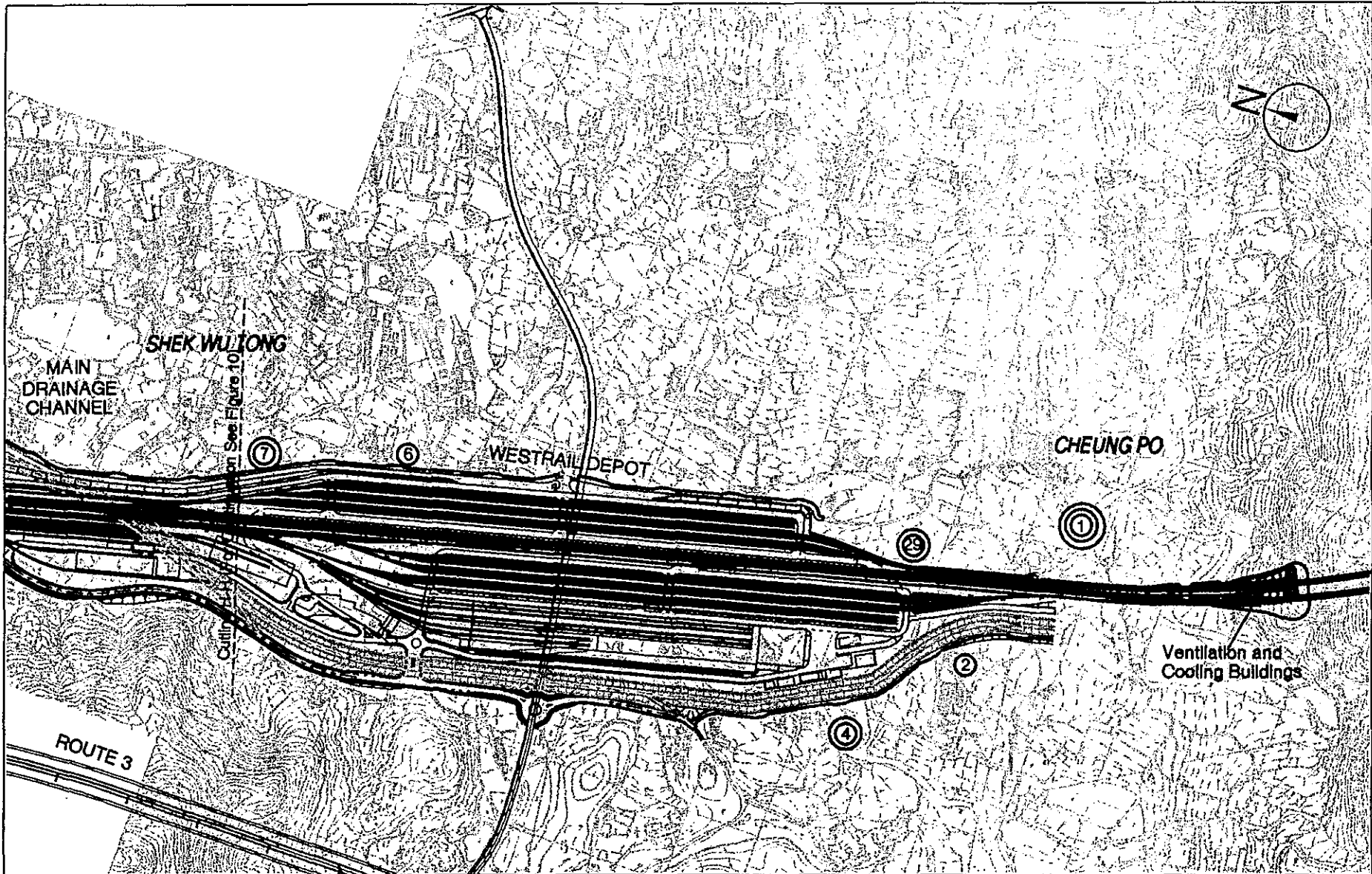
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**LEGEND**



Representative Air Monitoring Location	Representative Air & Noise Monitoring Location
Representative Noise Monitoring Location	Representative Combined Air & Noise Monitoring Location
Representative Combined Air Monitoring Location	Water Pipe
Representative Combined Noise Monitoring Location	Work Site Boundary

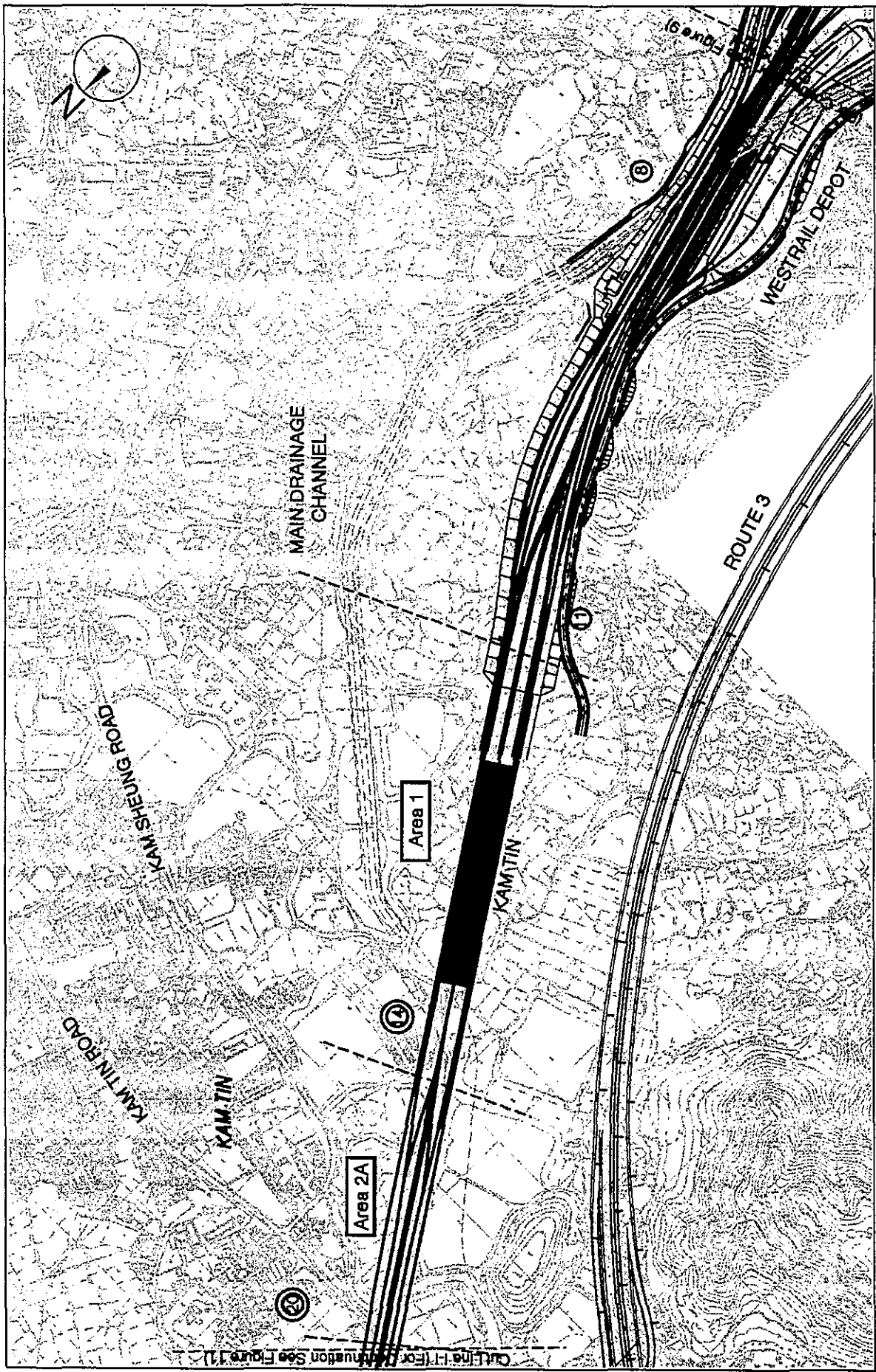
**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - KAM TIN (KAT) (1 OF 3)**

FIGURE 9

SCALE: 1/7,500

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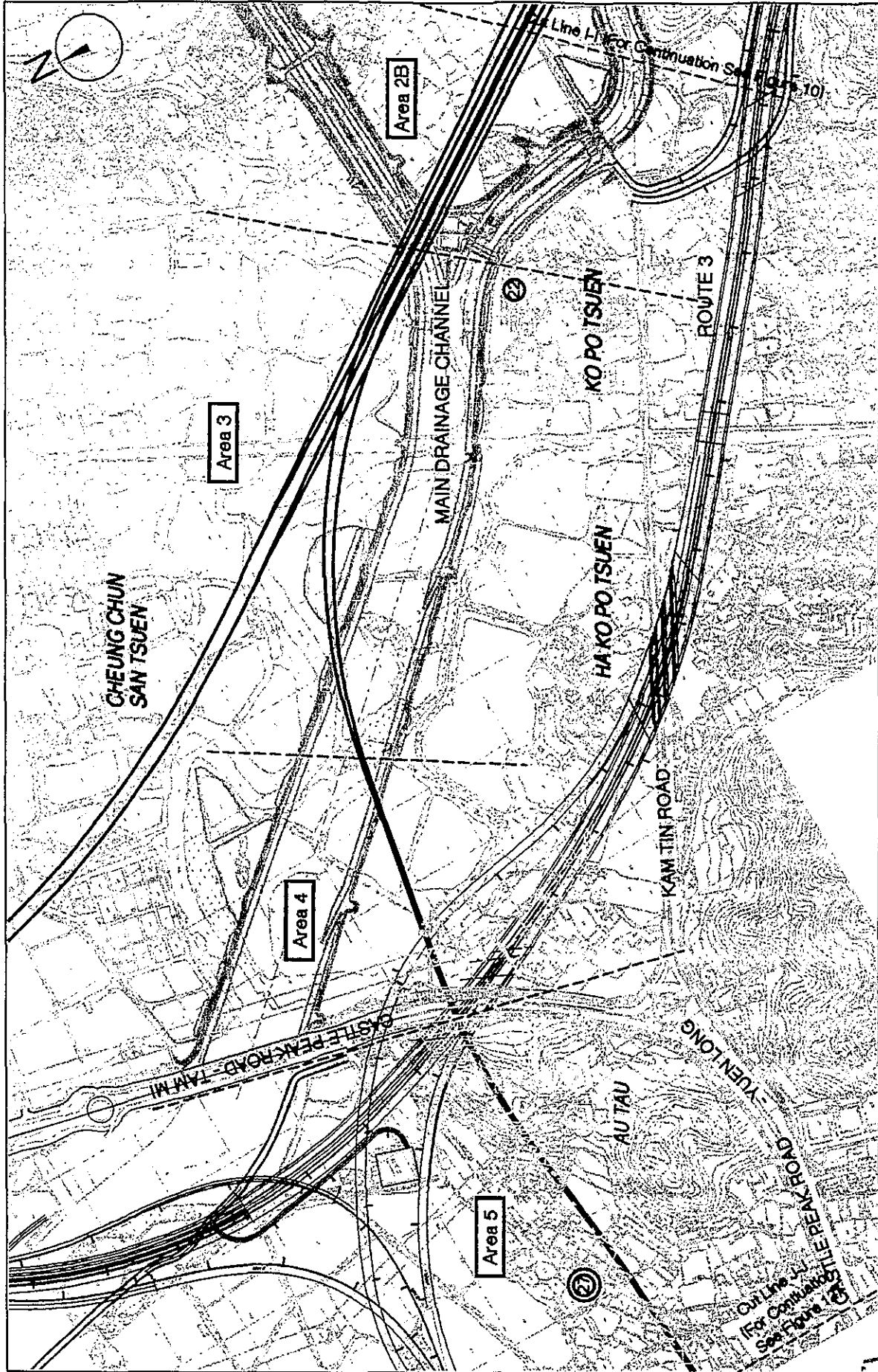
LEGEND

- Representing Air Monitoring Location
- ⊙ Representing Noise Monitoring Location
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- ⊞ Representing Noise Monitoring Location

Scale: 1:7,500

REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - KAM TIN (KAT) (2 OF 3)

FIGURE 10



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FIGURE 11

REPRESENTATIVE NOISE AND AIR  
MONITORING LOCATIONS - KAM TIN (KAT) (3 OF 3)

- LEGEND
- ① Monitoring Point
  - ② Monitoring Station
  - ③ Monitoring Location
  - ④ Monitoring Location
  - ⑤ Monitoring Location
  - ⑥ Monitoring Location

SCALE: 1:7,500

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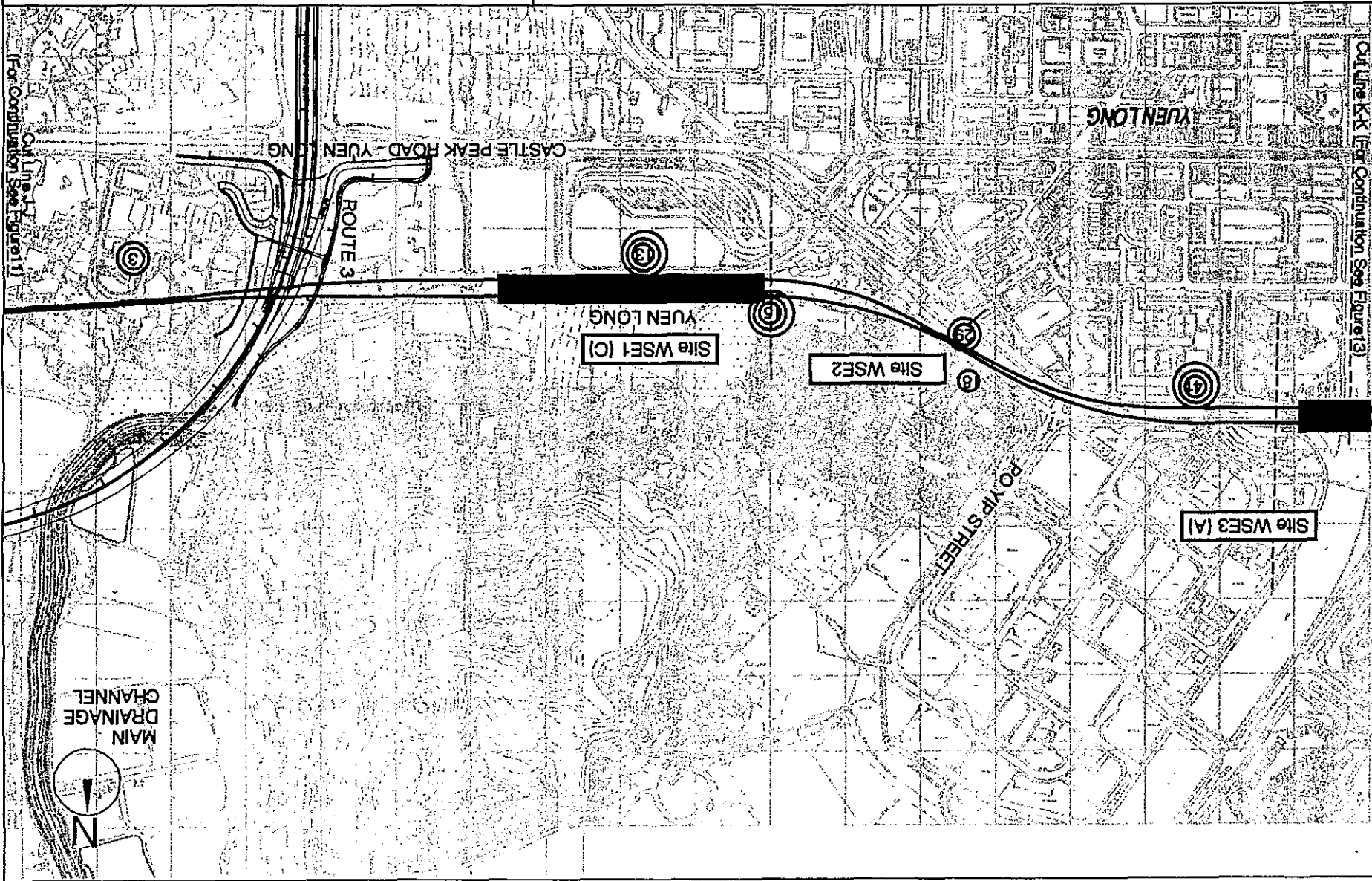
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WEST RAIL: TS900 EIA STUDY



FIGURE 12  
MONITORING LOCATIONS - YUEN LONG (1) OF 2)

SCALE: 1/7,500

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Outline K-K (For Continuation See Figure 13)



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RAILWAY CORPORATION  
WEST RAIL, TS900 EIA STUDY

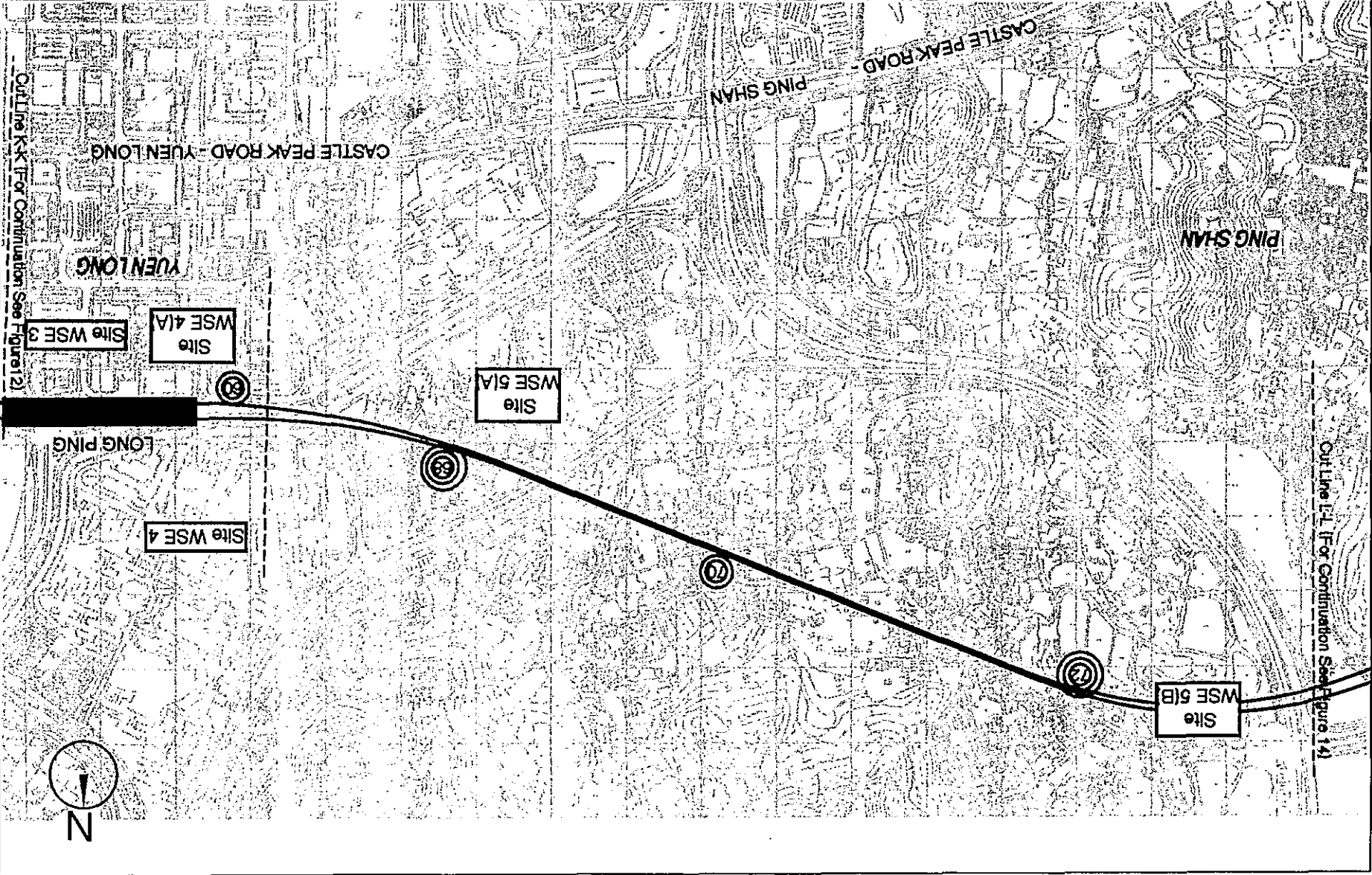


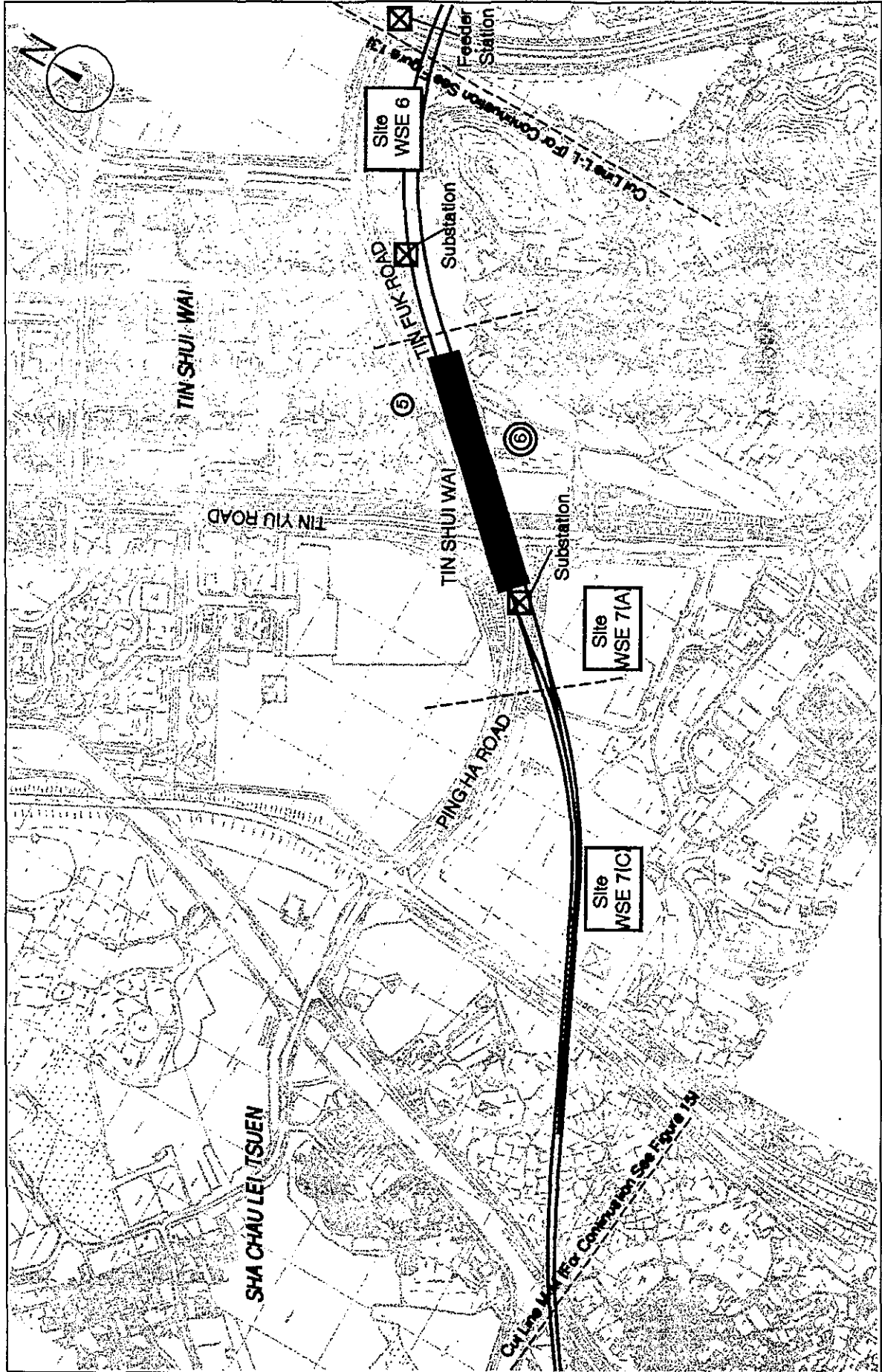
FIGURE 13  
MONITORING LOCATIONS - YUEN LONG (YUL#2 OF 2)

SCALE: 1/7,500

LEGEND

①	Monitoring Location
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REPRESENTATIVE NOISE AND AIR  
MONITORING LOCATIONS - TIN SHUI WAI (TIS)

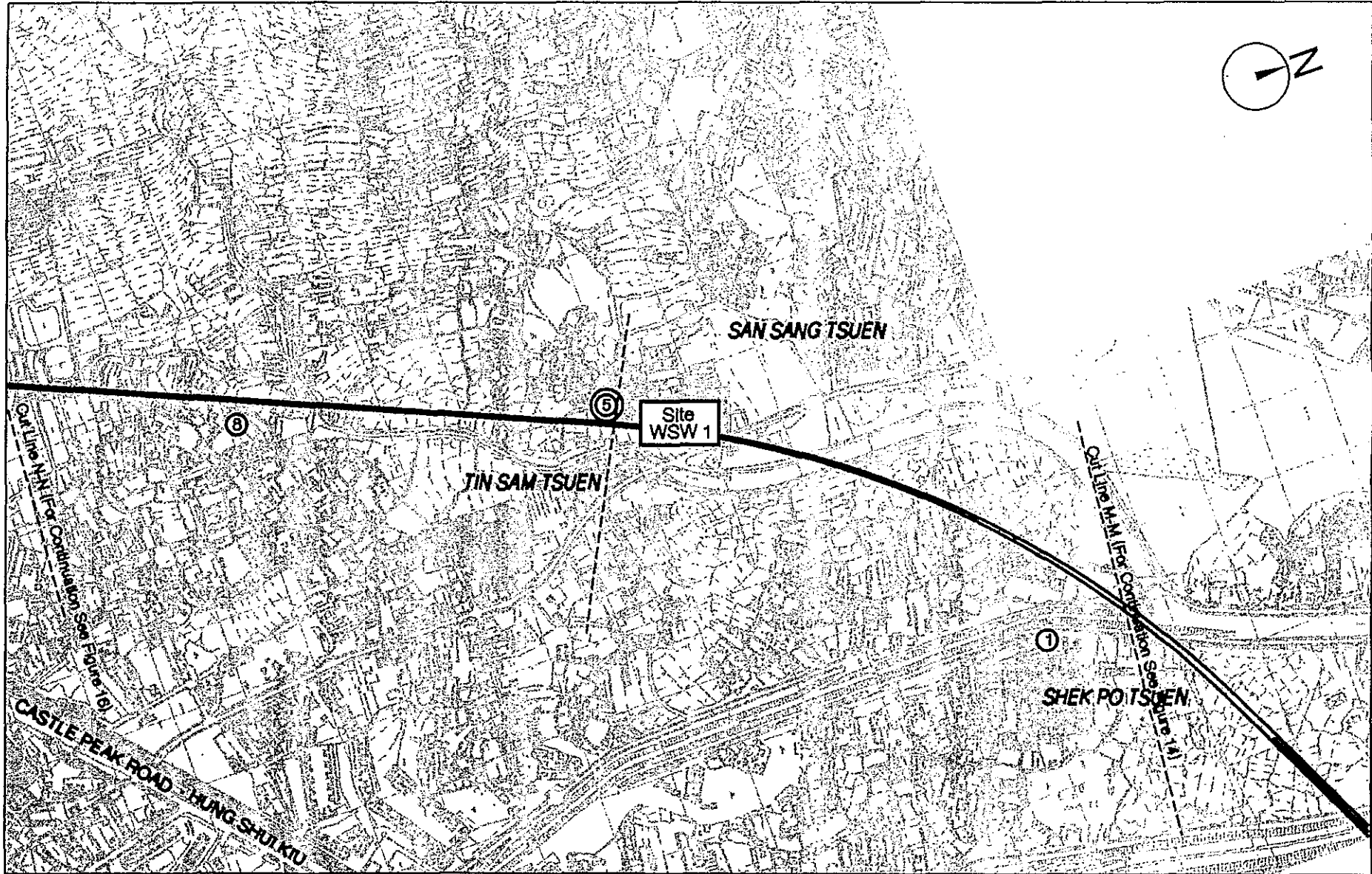
FIGURE 14

SCALE: 1/7 500

LEGEND

- ① Monitoring Location
- ② Representative Noise Monitoring Location
- ③ Representative Air Monitoring Location
- ④ Representative Noise Monitoring Location
- ⑤ Representative Air Monitoring Location

Proposed Air & Noise Monitoring Location  
 Proposed Noise Monitoring Location  
 Proposed Air Monitoring Location  
 Proposed Noise Monitoring Location




- LEGEND**
- Representative Air Monitoring Location
  - Representative Noise Monitoring Location
  - Representative Committed Air & Noise Monitoring Location
  - Representative Committed Air Monitoring Location
  - Representative Committed Noise Monitoring Location
  - Representative Air & Noise Monitoring Location
  - Representative Committed Air & Noise Monitoring Location
  - Water Sites
  - Water Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TUEN MUN NORTH (TMN) (1 OF 2)**


SCALE: 1/7,500

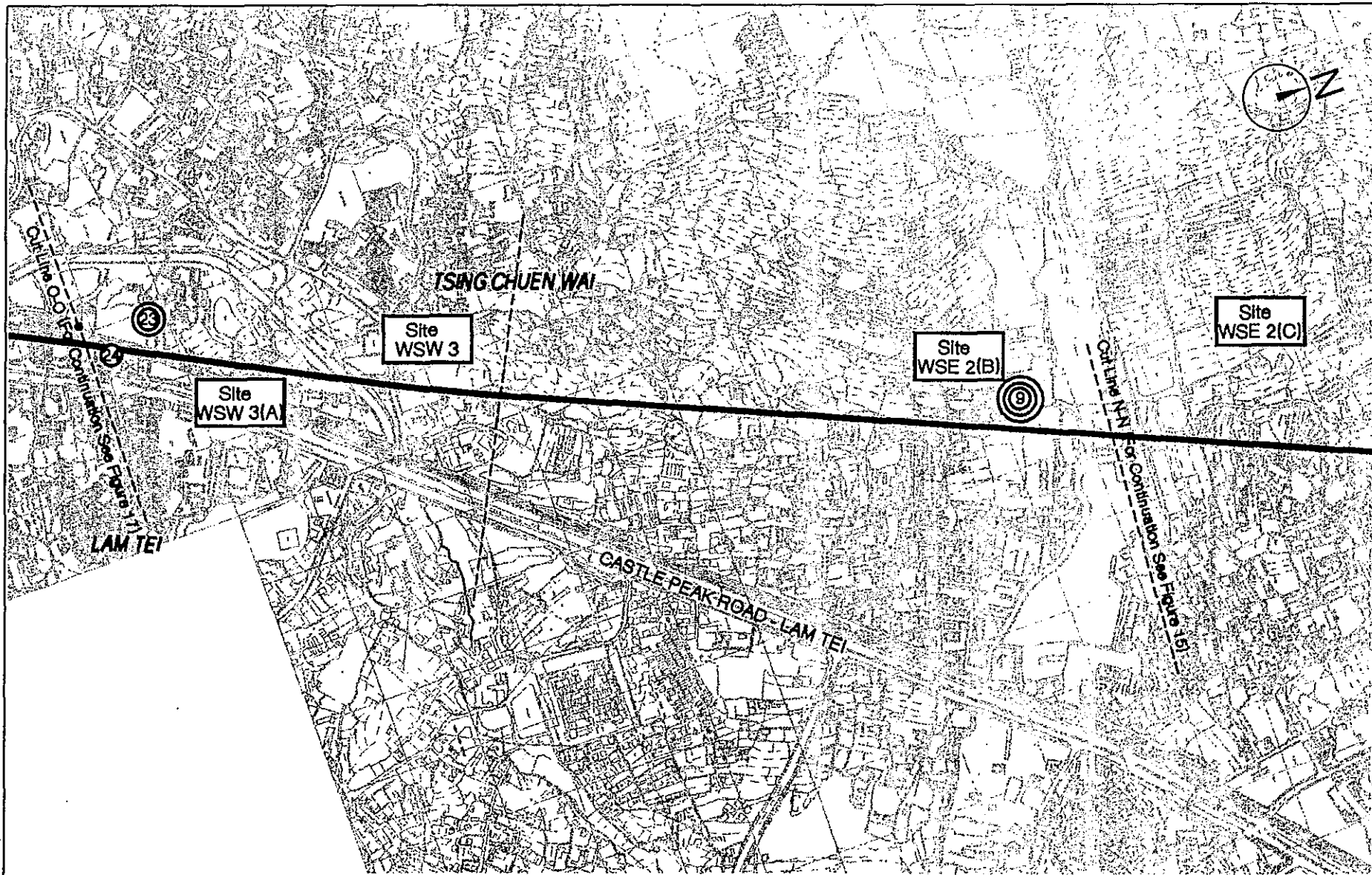
FIGURE 15



**KOWLOON - CANTON RAILWAY CORPORATION**

WEST RAIL: TS900 EIA STUDY





- LEGEND**
- Representative Air Monitoring Location
  - Representative Noise Monitoring Location
  - Representative Air & Noise Monitoring Location
  - Work Site
  - Work Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TUEN MUN NORTH (TMN) (2 OF 2)**

FIGURE 16

SCALE: 1/7,500

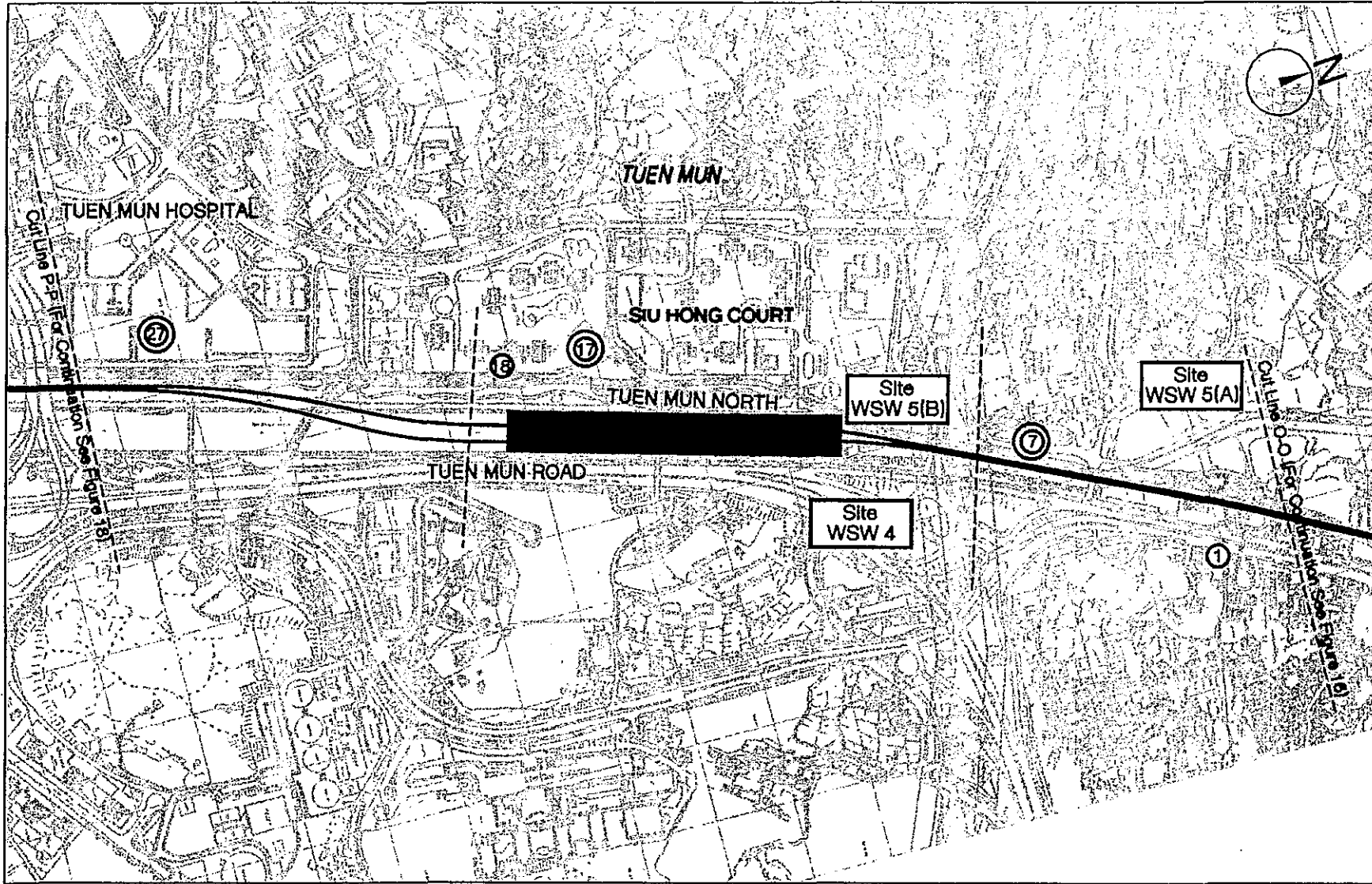
www.kcr1000/vol1/16\_01.jpg



**KOWLOON - CANTON RAILWAY CORPORATION**  
WEST RAIL: TSS900 EIA STUDY







**LEGEND**

- Representative Air Monitoring Location
- Representative Noise Monitoring Location
- Representative Council Air Monitoring Location
- Representative Council Noise Monitoring Location
- Representative Air & Noise Monitoring Location
- Representative Council Air & Noise Monitoring Location
- Work Site
- Work Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TUEN MUN CENTRE (TMC) (1 OF 2)**

SCALE: 1/7,500

FIGURE 17

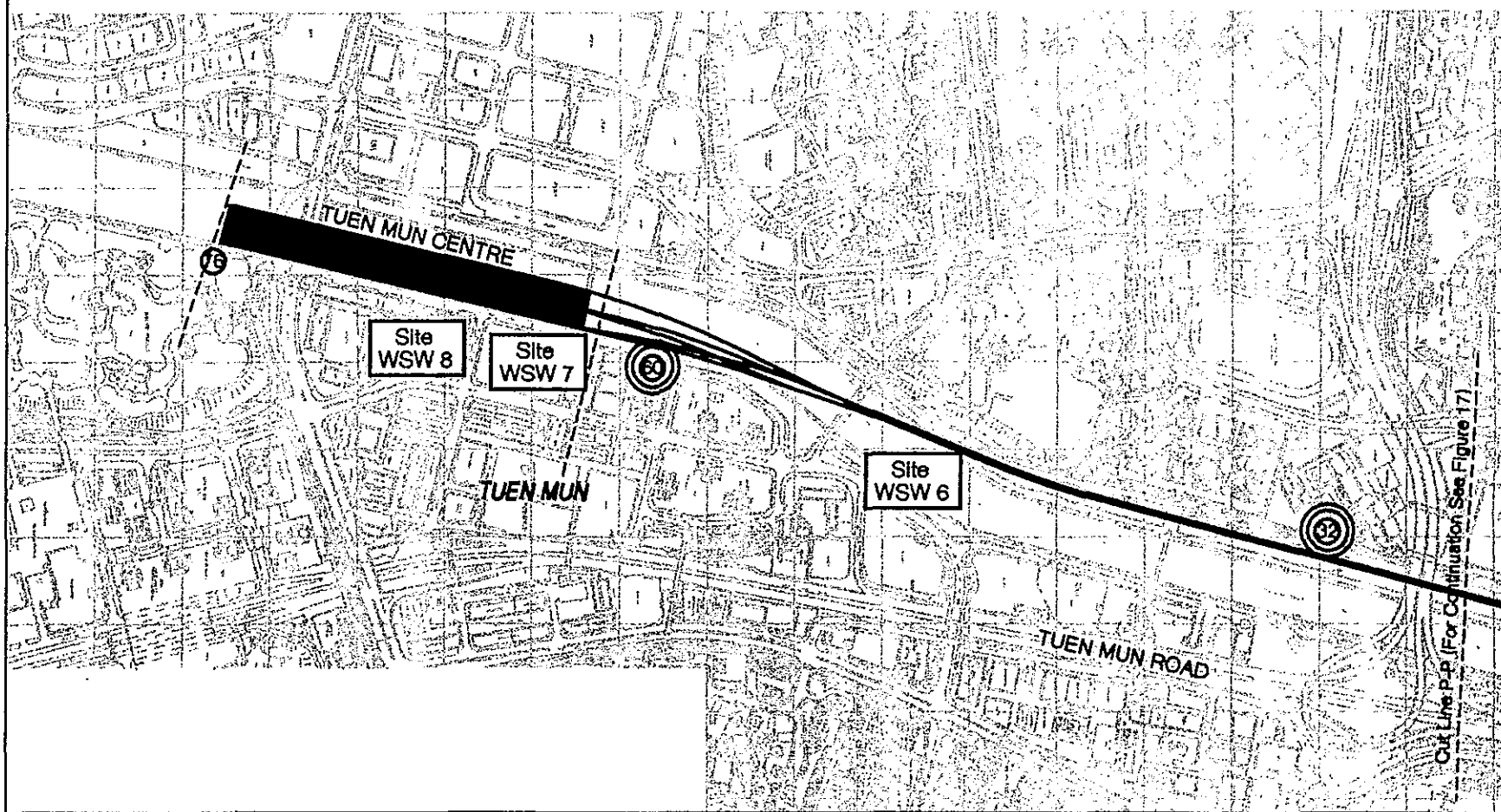
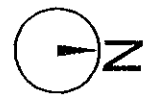


**ERM**

**KOWLOON - CANTON RAILWAY CORPORATION**

WEST RAIL: TS900 EIA STUDY





- LEGEND**
- Representative Air Monitoring Location
  - Representative Noise Monitoring Location
  - Representative Combined Air & Noise Monitoring Location
  - Representative Combined Air Monitoring Location
  - Representative Combined Noise Monitoring Location
  - Representative Air & Noise Monitoring Location
  - Representative Combined Air & Noise Monitoring Location
  - Work Site
  - Work Site Boundary

**REPRESENTATIVE NOISE AND AIR MONITORING LOCATIONS - TUEN MUN CENTRE (TMC) (2 OF 2)**

FIGURE 18

SCALE: 1:7,500

erm/ci/999/vr/183.dgn



**KOWLOON - CANTON RAILWAY CORPORATION**  
WEST RAIL: TS900 EIA STUDY



Annex B

Recommended Mitigation Measures  
and their Implementation Schedule

### Recommended Mitigation Measures and their Implementation

Parameter	Mitigation Measure	Implementation
Noise - general	<ul style="list-style-type: none"> <li>• Use of good site practices to limit noise emissions at source, for example;                             <ul style="list-style-type: none"> <li>• Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;</li> <li>• Machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;</li> <li>• Plant known to emit noise strongly in one direction should, where possible, be orientated so that the noise is directed away from nearby NSRs;</li> <li>• Silencers or mufflers on construction equipment should be properly fitted and maintained;</li> <li>• Plant should be sited as far away from NSRs as possible; and</li> <li>• Material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.</li> </ul> </li> <li>• Use of portable noise barriers;</li> <li>• Use of quiet plant and working methods; and</li> <li>• Reductions in the number of plant operating in critical areas close to NSRs.</li> </ul>	General noise mitigation measures shall be employed at all work sites throughout the construction phase.
Noise - specific	<p><i>Southern Section:</i></p> <ul style="list-style-type: none"> <li>• To mitigate for MTRC CDA site during vibratory sheet piling and tunnel slab work, only one lorry should be in operation in works area A;</li> <li>• To mitigate for the School/GIC facility during vibratory sheet piling, only one lorry should be in operation in works area C; and</li> <li>• To mitigate for Mei Foo Sun Chuen Block 8 during sheet piling and construction works for the box tunnel in work area E, only one lorry should be in operation.</li> </ul> <p><i>Central Section:</i></p> <ul style="list-style-type: none"> <li>• To mitigate for Mei Foo Sun Chuen Block 16 and Mount Sterling Mall, hard solid hoarding will need to be incorporated as well as other recommended measures to comply with daytime criteria; and</li> <li>• Tunnelling works during restricted hours will not meet statutory criteria unless a noise enclosure is constructed around the tunnel portal.</li> </ul> <p><i>Northern Section and West Rail Depot:</i></p> <p>During viaduct and Depot at-grade construction, at Kat Hing, village houses in Tung Shing Lei, Small Traders New Village Public School, Pok Oi Hospital, Small Traders New Village, Cheung Po, Tai Kek Tsuen South Village House, Kwan Tai Temple, Kau Tsuen North Village House and Tai Kek Tsuen there may be the requirement for plant number reduction, eg. have only one lorry in</p>	<p>During vibratory sheet piling and tunnel slab works.</p> <p>During vibratory sheet piling activities.</p> <p>During sheet piling and construction works for the box tunnel in work area E</p> <p>At commencement of construction works.</p> <p>If restricted hour tunnelling is expected a noise enclosure will need to be erected in advance.</p> <p>During viaduct and Depot at-grade construction.</p>

Parameter	Mitigation Measure	Implementation
	<p>use, or plant on-time reduction. The exact requirements should be determined through feedback from the Environmental Team and the results of the impact monitoring programme.</p>	
	<p><i>Western Section:</i></p> <p>Numerous exceedances remain in the Western Section even after implementation of the general mitigation measure packages, therefore it is suggested that the number of mixer lorries per plant team is limited to one, with a portable noise barrier at the loading /unloading area during pilecap and column construction.</p>	<p>Throughout construction.</p>
	<p>The affected facades of Shung Tak School and Chun Kwong School should be provided with secondary glazing and air conditioning (if not already provided) to satisfy noise criteria.</p>	<p>Prior to construction activity commencement.</p>
<p>Air Quality - general</p>	<p><i>Materials Handling</i></p> <ul style="list-style-type: none"> <li>• The heights from which excavated materials are dropped should be controlled to a minimum practical height to limit fugitive dust generation from loading/unloading;</li> <li>• All stockpiles of aggregate or spoil of more than 50 m<sup>3</sup> should be enclosed or covered and water applied in dry or windy conditions;</li> </ul>	<p>General air quality mitigation measures shall be employed at all work sites throughout the construction phase.</p>
	<p><i>Excavation</i></p> <ul style="list-style-type: none"> <li>• To minimise dust emissions, the amount of soil exposed and the dust generation potential should be kept as low as possible. This can be accomplished by water sprays, surface compaction, temporary fabric covers, minimising the extent of exposed soil, and prompt re-vegetation of completed earthworks;</li> </ul>	
	<p><i>Vehicle Dust</i></p> <ul style="list-style-type: none"> <li>• Effective water sprays should be used on the site to dampen potential dust emission sources such as unpaved areas used by site traffic and active construction areas;</li> <li>• Vehicles transporting materials that have the potential to generate dust should have properly fitting side and tail boards;</li> <li>• Materials transported by vehicles should be covered, with the cover properly secured and extended over the edges of the side and tail boards;</li> <li>• Materials should also be dampened, if necessary, before transportation;</li> <li>• On-site vehicle speeds should be controlled to reduce dust re-suspension and dispersion; and</li> <li>• Wheel washing facilities should be provided at the exit of the site to prevent dusty material from being carried off-site on vehicles and deposited on public roads.</li> </ul>	
	<p><i>Demolition Works</i></p> <ul style="list-style-type: none"> <li>• Dust emissions should be reduced by covering the buildings and structures to be demolished with canvas and watering in worked areas;</li> <li>• Special procedures to demolish buildings should be adopted if they are found to contain asbestos;</li> </ul>	<p>Prior to demolition.</p>

Parameter	Mitigation Measure	Implementation
	<i>Drilling and Blasting</i>	
	<ul style="list-style-type: none"> <li>• Where breaking of rock/concrete is required, watering should be undertaken to control dust. Water sprays should be used during the handling of excavated material at the site and at active cuts, excavation and fill sites where dust is likely to be generated;</li> <li>• Wire mesh, gunny sack and sandbag should be used on top of the blast area on each shot for preventing flying rock and reduce fugitive dust generation;</li> <li>• Blasting operations should be well arranged and take appropriate precautions to minimise dust generation, such as the use of blast nets, canvas covers and watering; and</li> <li>• Blast doors should be fitted at the portals to further contain dust and debris from tunnelling works.</li> </ul>	Prior to drilling and blasting
Air Quality - specific	<p><i>Southern Section:</i></p> <p>To mitigate for Nam Cheong Estate a speed limit of 15kph shall be employed in work areas A and B.</p> <p><i>Northern Section and West Rail Depot:</i></p> <p>At the West Rail Depot specific measures should be adopted along with general mitigation, such as:</p> <ul style="list-style-type: none"> <li>• Locate the haul roads away from all ASRs;</li> <li>• Haul roads should be paved; and</li> <li>• Vehicle speeds should be limited to 15 kph within the depot work site.</li> </ul> <p><i>Western Section:</i></p> <p>A speed limit of 15kph should be applied at Long Ping and Tin Shui Wai Stations and a limit of 10kph at Yuen Long and Tuen Mun Centre Stations and the section of viaduct between Ping Ha Road and Castle Peak Road.</p>	<p>Throughout the construction period.</p> <p>Prior to construction.</p> <p>Throughout construction.</p> <p>Throughout construction.</p>
Water Quality - general	<p><i>Construction Runoff</i></p> <p>Exposed soil areas should be minimised to reduce the potential for increased siltation, contamination of runoff, and erosion. Construction runoff related impacts associated with tunnelling and above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:</p> <ul style="list-style-type: none"> <li>• Use of sediment traps; and</li> <li>• Adequate maintenance of drainage systems to prevent flooding and overflow.</li> </ul> <p>The boundaries of critical areas of earthworks should be marked and surrounded by dykes or embankments for flood protection. Temporary ditches should be provided to facilitate runoff discharge into the appropriate watercourses, via a silt retention pond. Permanent drainage channels should incorporate sediment basins or traps and baffles to enhance deposition rates. The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94.</p>	General air quality mitigation measures shall be employed at all work sites throughout the construction phase.

Parameter	Mitigation Measure	Implementation
	<p>Ideally, construction works should be programmed to minimise surface excavation works during the rainy season (April to September). All exposed earth areas should be completed as soon as possible after earthworks have been completed, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means.</p>	
	<p>Sediment tanks of sufficient capacity 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 particularly suited to applications where the influent is pumped.</p>	
	<p>Open stockpiles of construction materials (e.g. aggregates, sand and fill material) of more than 50 m<sup>3</sup> should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.</p>	
	<p>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 drainage system and storm runoff being directed into foul sewers.</p>	
	<p>Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and 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, especially for areas located near steep slopes.</p>	
	<p>Oil interceptors should be provided in the drainage system and regularly cleaned to prevent the release of oils and grease into the storm water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain.</p>	
	<p>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.</p>	
	<p><i>Drainage</i></p>	
	<p>All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. All sediment control measures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rain storms. The temporarily diverted drainage should be reinstated to its original condition when the construction work has finished or the temporary diversion is no longer required.</p>	

Parameter	Mitigation Measure	Implementation
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*Tunnelling and Station Construction*

The cut-and-cover tunnelling work should be conducted segment by segment to limit the amount of construction runoff generated in the areas during the wet season (April to September). Temporary open storage of excavated materials used for backfill on site should be covered with tarpaulin or similar fabric during rainstorms. Any washout of construction or excavated materials should be diverted through appropriate sediment traps before discharge to stormwater drainage system.

Ground water pumped out of tunnels should be discharged into the drainage channels which incorporate sediment traps to enhance deposition rates and to remove silt. Any contaminated groundwater identified by on-site chemical testing within 1 m above and 1 m below the layer of marine deposits should be dealt with according to the requirements of the WPCO and only discharged after appropriate treatment to ensure WPCO compliance.

Spent bentonite slurries or other grouts used in diaphragm wall construction should be collected in a separate slurry collection system, reconditioned and reused wherever practicable. The disposal of used bentonite slurry will only be permitted if it is treated to the TM standards before discharge to the storm drains or disposal to landfill.

*General Construction Activities*

Debris and rubbish on site should be collected, handled and disposed of properly to avoid entering the water column to cause water quality impacts.

All 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 WSRs.

Discharge and surface runoff contaminated by materials from concrete batching plants should be diverted to neutralisation tank to reduce acidity. Alkaline chemicals such as sodium hydroxide (NaOH) is suggested to be used as neutralising agent. However, lime should not be utilised in the neutralisation tank as considerable amount of SS would be produced during the process. Treated discharge should be connected to silt trap to remove SS before disposing to sewage system.

*Sewage Effluent*

Construction work force sewage discharges on site are expected to be connected to the existing trunk sewer or sewage treatment facilities. The construction sewage may need to be handled by portable chemical toilets if construction workers are likely to be dispersed along the alignment. Appropriate numbers of portable toilets should be provided by a licensed contractor to serve the large number of construction workers dispersed along the alignment. The Contractor will also be responsible for waste disposal and maintenance practices.



Parameter	Mitigation Measure	Implementation
	<p data-bbox="387 304 735 333"><i>Marine-based Construction Impact</i></p> <p data-bbox="387 353 1174 472">A minimum-dredge option during construction has been considered to minimise the amount of contaminant release. Most of the dredged material is likely to be seriously contaminated. It is important that appropriate measures are taken to ensure that impacts are kept to a minimum.</p> <p data-bbox="387 495 1174 613">Depending on the type of dredgers employed, careful consideration of dredging methods may be necessary. With the small scale nature of the dredging, it is most likely that a closed grab dredger will be employed. The following mitigation measures are recommended:</p> <ul data-bbox="387 636 1185 1245" style="list-style-type: none"> <li data-bbox="387 636 1150 725">• Mechanical grabs, if used, should be designed and maintained to avoid spillage and sealed tightly while being lifted. For dredging of contaminated mud, closed watertight grabs must be used;</li> <li data-bbox="387 748 1177 808">• Silt curtains should be deployed around the dredging areas without jeopardising the navigation of ships and ferries along the navigation channels;</li> <li data-bbox="387 831 1182 913">• 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;</li> <li data-bbox="387 936 1182 1019">• Construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or dumping grounds;</li> <li data-bbox="387 1041 1185 1167">• Loading of barges and hoppers should be controlled to prevent splashing of dredged material into the surrounding water. Barges or hoppers should not be filled to a level which will cause the overflow of materials or polluted water during loading or transportation; and</li> <li data-bbox="387 1189 1174 1245">• Additional consideration should be given to the transportation and disposal of the dredged material.</li> </ul>	
Water Quality - specific	<p data-bbox="387 1312 571 1341"><i>Southern Section:</i></p> <p data-bbox="387 1361 1182 1570">Interception of sediment is required before it enters modified sections of the culvert, in order not to exacerbate the sedimentation problem of tidally affected culverts and to prevent local flooding problems during construction. Sediment traps should be installed both upstream and downstream of the modified culvert sections in order to minimise the sediment loading in these sensitive culverts. Vortex tube site traps shall also be installed to provide continuous extraction of sediment within the modified section of the culvert.</p> <p data-bbox="387 1592 555 1621"><i>Central Section:</i></p> <ul data-bbox="387 1641 1182 1805" style="list-style-type: none"> <li data-bbox="387 1641 1182 1702">• The existing Tsuen Wan Central Salt Water Pumping Station intake should be relocated temporarily during Stage 1 of construction; and</li> <li data-bbox="387 1724 1182 1805">• The relocation of polluted stormwater culverts, including Tai Ho and Ma Tau Pa Culverts, along the existing coastline before dredging and reclamation filling should be undertaken in order to avoid serious water quality impacts.</li> </ul>	<p data-bbox="1217 1361 1417 1391">Prior to construction</p> <p data-bbox="1217 1641 1422 1671">Prior to construction.</p> <p data-bbox="1217 1731 1469 1760">Before reclamation works</p>

Parameter	Mitigation Measure	Implementation
	<i>Western Section:</i>	
	To minimise impact to hydraulic capacity of nullahs elevated rail structure columns should be located outside nullahs wherever possible or the nullah realigned.	Design process.
	Any Yuen Long elevated rail structure construction activities that may require partial blocking of the nullah will need to be scheduled during the dry season.	Works schedule development.
Landscape and Visual - general	<p>Mitigation measures to mitigate the unsightly visual appearance of works during construction include the:</p> <ul style="list-style-type: none"> <li>• Control of night time lighting;</li> <li>• Erection of decorative screen hoarding;</li> <li>• Advance planting for screening;</li> <li>• Use of stripped excavated material/earth mounding for screening;</li> <li>• Minimising height of temporary buildings; and</li> <li>• Careful positioning of construction plant.</li> </ul> <p>Landscape resources shall be mitigated through planting of slopes and reinstatement of landscape pattern.</p>	General landscape and visual mitigation measures shall be employed at all work sites throughout the construction phase. Some consideration should be given to the work sites layout prior to construction.
Landscape and Visual - specific	<i>Southern Section:</i>	
	Unnecessary tree felling shall be avoided from Lai Chi Kok Park and the Nam Cheong Buffer Zone. Any trees that must be removed should be transplanted to elsewhere in the park or to other suitable sites.	Site Clearance.
	Topsoil removed from Lai Chi Kok Park or the Nam Cheong Buffer Zone shall be stored according to Government Standards and replaced or reused elsewhere.	During topsoil removal.
	<i>Northern Section and West Rail Depot:</i>	
	Topsoil removed by works in this Section, especially Kam Tin Valley shall be stored according to Government Standards and replaced or reused elsewhere.	During topsoil removal.
	<i>Western Section:</i>	
	Unnecessary tree felling shall be avoided at Kwan Lok San Tsuen and between Tung Tau Tsuen and Sun Yuen Long Plaza near Kau Tui Village. Any trees that must be removed should be transplanted to elsewhere in the vicinity or to other suitable sites.	Site Clearance.
	Topsoil removed by works in this Section, eg. the rural areas between Yuen long, Tin Shui Wai and Tuen Mun, shall be stored according to Government Standards and replaced or reused elsewhere.	During topsoil removal.
Heritage - general	The measures for mitigation of impacts to heritage sites will be reported via the field evaluation programme and through ongoing discussions with the AMO's archaeological curators.	During the field evaluation programme.

Parameter	Mitigation Measure	Implementation
Heritage - specific	<i>Northern Section and West Rail Depot:</i> Lau's Residence at Tung Hing Lei shall be protected through implementation of a five metre buffer zone between the southwesternmost house and the site boundary for the construction worksite.	During design phase.
	<i>Western Section:</i> At Tsui Shing Lau Pagoda a condition survey shall be undertaken prior to and following the completion of the works, sample vibration monitoring shall be undertaken by the Contractor during site operations and a vibration limit of 2 mm/s peak particle velocity shall be applied to all contraction related activities.	Prior to, and throughout construction works.
Ecology - general	Ecological damage control will be achieved to a certain extent through noise, air, water and waste control measure implementation. Non-disturbance of floral and wetland habitats, other than those already determined for landtake, should be strictly controlled.	General ecological mitigation measures shall be employed throughout the construction phase.
Ecology - specific	The EIA has indicated that approximately 12 ha of the important Kam Tin valley wetland habitats would be lost to West Rail. Thus, there is a need to mitigate the habitat losses and consequent adverse impacts to wildlife, through the restoration, enhancement or creation of habitats that would provide similar breeding, nesting and foraging functions. A key focus for mitigation measures would be the provision of habitats for the Painted Snipe, herons and egrets, Narrow-mouthed Frogs and dragonflies.	During construction.
	Further studies will be undertaken by the Corporation at the Detailed Design stage to develop specific wetland habitat restoration/enhancement plans. The outcome will be presented in an Habitat Creation and Management Plan which will be submitted to AFD for endorsement. Design principles: <ul style="list-style-type: none"> <li>• The outline of ponds should be irregular with spits and bays. This increases the length of the shoreline for the growth of emergent and rooted aquatic plants, and provides more locations for birds for feeding and sheltered places suitable for roosting and nesting. The vegetation can also provide landing platform for amphibians and dragonflies to lay eggs into the water;</li> <li>• Islands of irregular shape within the pond are also recommended, which not only serve the same functions as mentioned above but also provide protection to wildlife from disturbance;</li> <li>• Ponds should reach a depth of at least 2 m and preferably more to prevent the spread of emergent vegetation and ensure an area of permanent open water. This also reduces the likelihood of the pond drying out during dry weather;</li> </ul>	Detailed design phase.

Parameter	Mitigation Measure	Implementation
	<ul style="list-style-type: none"> <li>• The profile of ponds should have a gentle side-slope and variation in depth to allow access of wildlife and establishment of different wetland plants;</li> <li>• Shallow, sloping pond edges can be extended to create flat marshlands that blend into the ponds;</li> <li>• Water of the marshland areas should have varying depths (eg. not exceeding 100 mm in depth over the site for Painted Snipe, simulating the situation at the existing Kam Tin School marsh);</li> </ul>	
	<p>Marsh vegetation similar to that found at the existing Kam Tin School marsh such as the herbs <i>Rumex maritimus</i> and <i>Wedelia trilobata</i> should be planted;</p> <ul style="list-style-type: none"> <li>• Scattered, small islands (10-15 m<sup>2</sup> in area) rising some 10-20 cm above maximum water levels should be provided in the marshland areas;</li> <li>• Appropriate soil texture and composition to promote growth of marsh vegetation should be provided.</li> </ul>	
	<p>Establishment and management of these sites within the railway corridor would be undertaken by the Corporation. Following successful establishment of stabilised habitats, annual management requirements are expected to be minimal, consisting primarily of rubbish removal and weedy plant removal.</p> <p>With regard to the potential impacts on the Painted Snipe habitat, in addition to the habitat creation or enhancement outlined above, the following mitigation measures during construction are recommended:</p>	
	<ul style="list-style-type: none"> <li>• It would not be practicable to interrupt construction works to accommodate nesting seasons for Painted Snipe because existing records indicate nesting may occur between April and October (a seven month time span). The preferred approach would be to build the section of the alignment near the marsh as quickly as possible (without interruption), and then immediately restore the affected marshland to pre-existing condition.</li> <li>• The water level of the remaining marsh habitat should be maintained. De-watering of the construction site could adversely affect the entire marsh if not carefully controlled. This potential impact could be minimised by bunding and sheet-piling of the works boundary, followed by removal of the sheet piling on completion of construction.</li> <li>• The works boundary should be strictly controlled, through secure and robust fencing, to ensure that no disturbance to the remaining marsh habitat occurs. The site boundary should be regularly inspected and necessary maintenance undertaken within 24 hours.</li> <li>• As the rail alignment would not be at ground level, much of the affected marsh habitat could be reinstated following completion of construction. Painted Snipe would then be able to re-occupy marsh habitat beneath the railway. The only areas of marsh to be permanently lost would be those sites occupied by the support columns for the railway.</li> </ul>	

Parameter	Mitigation Measure	Implementation
	<p>The drill and blast operation of the Tai Lam Tunnel will strictly follow the existing Government vibration criteria to minimise the potential vibration impact on the nearby bat roost. The status of the roost cave during construction will be monitored through the environmental monitoring and audit programme. If tunnel blasting or drilling were to cause physical damage to the cave, mitigation through restoration of the cave will be undertaken without delay.</p> <p>Revegetation on the finished cut slope and lineside planting using native species is recommended. Native species suitable for planting on the cut slope include <i>Gordonia axillaris</i>, <i>Rhodomyrtus tomentosa</i>, <i>Schima superba</i> and <i>Rhaphiolepis indica</i>.</p>	
Waste - general	<p>The various waste management options can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:</p> <ul style="list-style-type: none"> <li>• Avoidance and minimisation (not generating waste through changing or improving practices and design);</li> <li>• Reuse of materials, thus avoiding disposal (generally with only limited reprocessing);</li> <li>• Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and</li> <li>• Treatment and disposal, according to relevant regulations, guidelines and good practice.</li> </ul> <p>The contractor should consult the Waste Disposal Authority on the final disposal of wastes.</p> <p>Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. Training requirements should be included in the site waste management plan.</p> <p><i>Storage, Collection and Transport of Waste</i></p> <p>Permitted waste hauliers should be used to collect and transport wastes to the appropriate disposal points. The following measures to minimise adverse should be instigated:</p> <ul style="list-style-type: none"> <li>• Handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution;</li> <li>• Use waste hauliers authorised or licensed to collect the specific category of waste;</li> <li>• Remove wastes in a timely manner;</li> <li>• Maintain and clean waste storage areas regularly;</li> <li>• Minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;</li> </ul>	General waste management mitigation measures shall be employed throughout the construction phase.

Parameter	Mitigation Measure	Implementation
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- Obtain the necessary waste disposal permits from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance* (Cap 354), *Waste Disposal (Chemical Waste) (General) Regulation* (Cap 354), the *Crown Land Ordinance* (Cap 28), *Dumping At Sea Ordinance* (Cap 466) and *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud*;
- Dispose of waste at licensed sites;
- Develop procedures such as a ticketing system to facilitate tracking of loads, particularly for chemical waste, and to ensure that illegal disposal of wastes does not occur; and
- Maintain records of the quantities of wastes generated, recycled and disposed.

*Excess Excavated Material*

Some of the material excavated from cut-and-cover tunnels will be reused to cover the tunnels. This material will be temporarily stockpiled and reused on site if space is available.

In order to minimise the amount of excess excavated material to be delivered to public filling areas and optimise the overall cut and fill balance of West Rail, the priority for off-site disposal of excess excavated material should be as follows:

- Transport to other Sections of West Rail for reuse;
- Transport to other land formation sites for reuse; and

Transport to public filling areas.

It is also recommended that the contractor should liaise with other contractors who will require fill material during that period. This will minimise the amount of inert excavated material to be delivered to public filling areas.

*Construction and Demolition Waste*

In order to minimise waste arisings and keep environmental impacts within acceptable levels, the mitigation measures described below should be adopted:

- Careful design, planning and good site management can minimise over-ordering and waste of materials such as concrete, mortars and cement grouts. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse;
- The contractor should recycle as much as possible of the construction waste on-site. Proper segregation of wastes on site will increase the feasibility of recycling certain components of the waste stream by recycling contractors. Concrete and masonry can be used as general fill and steel reinforcement bar can be used by scrap steel mills. Different areas should be designated for such segregation and storage wherever site conditions permit;

Parameter	Mitigation Measure	Implementation
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- The handling and disposal of bentonite slurries should be undertaken in accordance with the *Practice Note For Professional Persons, Construction Site Drainage, Professional Persons Consultative Committee, 1994 (ProPECC PN 1/94)*.
- In order to maximise landfill life, Government policy restricts the disposal of construction and demolition waste with more than 20% (by volume) of inert material at landfills. Public filling areas will only accept inert construction and demolition waste (ie earth, building debris, and broken rock and concrete) which is free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter. The Government plans to establish a number of construction and demolition material sorting facilities at strategic locations to process mixed construction and demolition waste, however it is unlikely that these facilities will be available during the early stages of West Rail construction. It is therefore desirable for West Rail to adopt on-site segregation of waste so that the segregated waste can either be recycled and reused or disposed of at landfills or public filling areas.

#### *Chemical Waste*

For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

Chemical waste that is produced, as defined by *Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation*, should be handled in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* as follows:

Containers used for the storage of chemical wastes should:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- Have a capacity of less than 450 l unless the specifications have been approved by the EPD; and
- Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

- Be clearly labelled and used solely for the storage of chemical waste;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding of sufficient capacity to accommodate 110% of the volume of the largest container or 20% of the total volume of waste stored in that area, whichever is the greatest;

Parameter	Mitigation Measure	Implementation
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- Have adequate ventilation;
- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- Be arranged so that incompatible materials are adequately separated.

Disposal of chemical waste should:

- Be via a licensed waste collector; and
- Be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or
- Be to a reuser of the waste, under approval from the EPD.

The Centre for Environmental Technology operates a Waste Exchange Scheme which can assist in finding receivers or buyers for the chemical wastes.

*General Refuse*

General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

General refuse will be generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate labelled bins for their deposit should be provided wherever feasible.

Office wastes can be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

Land Contamination - general

Potential impacts associated with the handling and disposal of contaminated soils and groundwater can be mitigated by adopting the following measures:

- The use of bulk earth-moving equipment should minimise the potential interface of contaminated materials with site construction workers;
- Exposure to any contaminated materials should be minimised by the wearing of appropriate clothing and personal protective gear such as gloves when interacting directly with contaminated material, providing adequate hygiene and washing facilities, and preventing smoking and eating during such activities;

General land contamination mitigation measures shall be employed throughout the construction phase, particularly during excavation works.



Parameter	Mitigation Measure	Implementation
	<ul style="list-style-type: none"> <li>• Where excavated material is suspected to be contaminated, preliminary analysis of representative samples should be performed to enable options for disposal of contaminated materials to be properly evaluated (based on the soil classification) and to allow the volume of such materials to be estimated before agreement or approval is sought from the relevant authorities;</li> <li>• Contaminated soils should not be stockpiled on site. However, in the event that this is necessary in the short-term, any stockpiled contaminated sediments should be covered with plastic sheeting or tarpaulin, especially during heavy rainstorms;</li> <li>• Waste hauliers which are authorised or licensed to collect contaminated soils should be used, and these waste hauliers should be used to transport and dispose of contaminated soils to an appropriate disposal site licensed to accept the waste;</li> <li>• Vehicles containing contaminated materials should be suitably covered to limit potential dust emissions and the tailgates sealed to prevent contaminated wastewater runoff during transport;</li> <li>• Prior agreement should be sought with the appropriate authorities regarding the acceptability of disposal of contaminated sediments to East Sha Chau or to landfill, following any sampling and analysis programme conducted. Although not officially designated, the only landfill site in Hong Kong that is likely to be able to accept small amounts of contaminated sediment is the WENT landfill;</li> <li>• The necessary waste disposal permits should be obtained from the appropriate authorities, in accordance with the <i>Waste Disposal Ordinance</i> (Cap 354), <i>Waste Disposal (Chemical Waste) (General) Regulation</i> (Cap 354), as required;</li> <li>• Procedures should be developed to ensure that illegal disposal of wastes does not occur;</li> <li>• Records of the quantities of wastes generated and disposed of should be maintained;</li> <li>• In accordance with good construction practice, silt traps should be used to reduce the level of suspended solids arising from particles of disturbed ground and soil;</li> <li>• Groundwater should be disposed of in accordance with the <i>Water Pollution Control Ordinance</i> (WPCO);</li> <li>• Surface waters should be diverted around any areas currently being worked, or materials being stockpiled, to minimise potential runoff into excavations, as runoff would increase the volume of contaminated groundwater requiring disposal and suspended solids in the wastewater stream; and</li> <li>• Potential impacts on future site maintenance and utility workers should be minimised by developing services in concrete culverts and service ducts.</li> </ul>	

Parameter	Mitigation Measure	Implementation
Land Contamination - specific	<p><i>Central Section:</i></p> <p>Further investigation of the petrol filling station, industrial buildings, cargo working area and bus terminal should be undertaken to determine any contamination potential. If contamination is confirmed preparation of a Contamination Assessment Plan is required.</p> <p><i>Western Section:</i></p> <p>Further investigation of the petrol filling station that existed at Yuen Long should be undertaken to determine any contamination potential. If contamination is confirmed preparation of a Contamination Assessment Plan is required.</p>	<p>Prior to excavation of these areas.</p> <p>Prior to excavation of the area.</p>