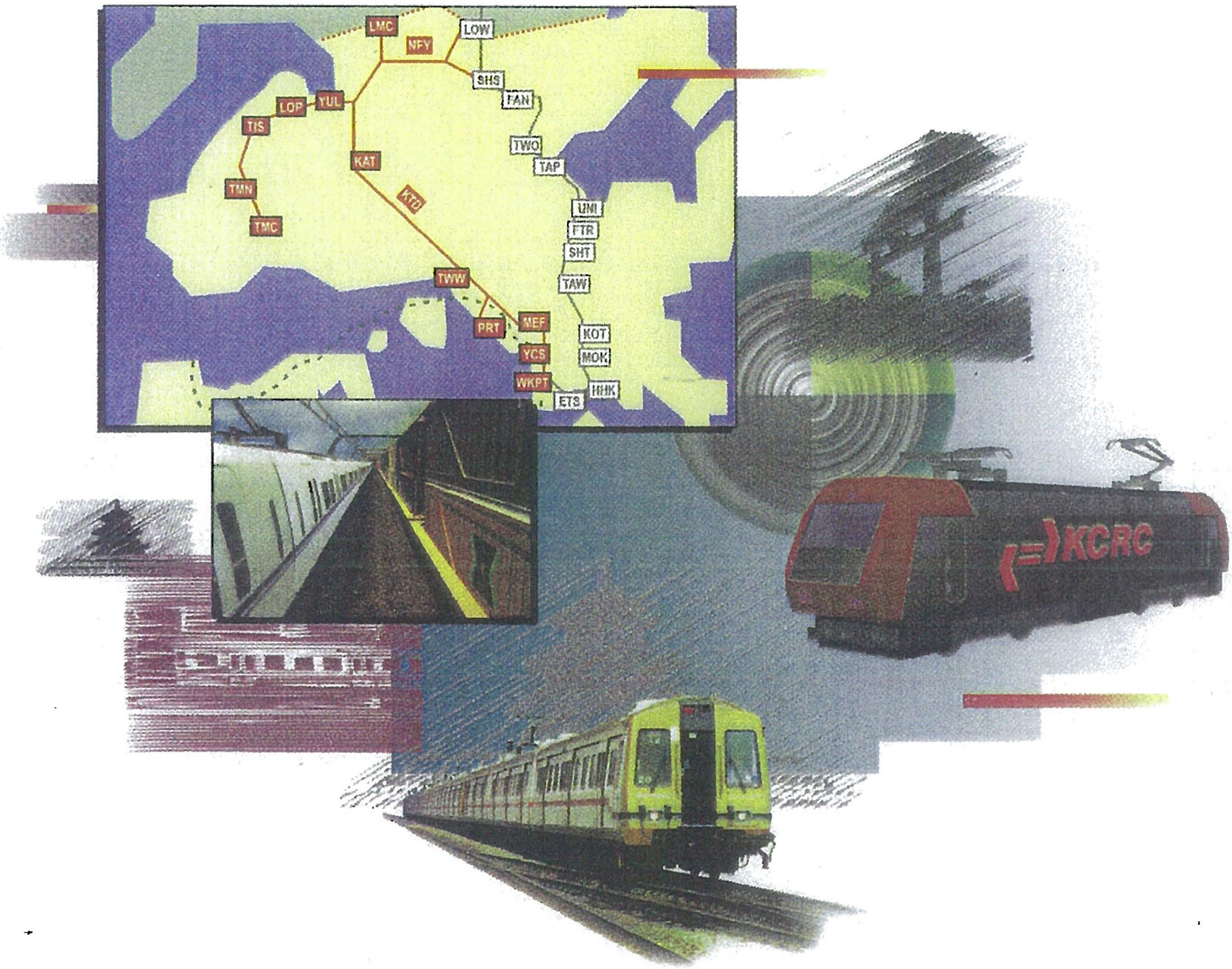
Kowloon-Canton Railway Corporation
West Rail



ERM

KCRC

Final Assessment Report
West Kowloon to Tuen Mun Centre
Contract No. TS-900
Environmental Impact Assessment

EIA - 149.1 /BC

KCRC-WEST RAIL
DCC#: TS0900-0045-1
REF: 064679

West Rail

Final Assessment Report
West Kowloon to Tuen Mun Centre

For and on behalf of ERM-Hong Kong, Ltd
Approved by: S.M. LAISTER
Signed: S M Laister
Position: Executive Director
Date: 11th February 1998

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REFERENCES

1. Ades, G. 1990. *Bats of Hong Kong. WWF/The Island House Conservation Studies Centre, 40pp.*
2. *AFD. 1994. Categorisation of Fish Ponds.*
3. *AFD. 1995. Categorisation of Agricultural Land. Revised 1995.*
4. *Anon. 1994. Valley Care: Bringing conservation and agriculture together in California's Central Valley. Ducks Unlimited, Inc., USA, 14pp.*
5. *Anon. 1995. Register of Sites of Special Scientific Interest (SSSIs). Loose-leaf document maintained by Planning Department.*
6. *Asahina, S. 1987. A revised list of the Odonata of Hong Kong. I. Zygoptera. Tombo, 30:7-24.*
7. *Babtie. 1996. Improvement to Kam Tin Road, Stage 1, Environmental Impact Assessment and Drainage Impact Assessment Studies. Environmental Impact Assessment (Final Report) Doc. No. BBL/96010/003, Issue No. 1.*
8. *Bascombe, M.J. 1993. Unpublished database on Hong Kong butterflies and food plants. Used with permission.*
9. *Belzer, W.R. and Lombardi, J.R. 1989. Cattle Egret symbiosis and heronry abandonment. Colonial Waterbirds 12(1): 115-117.*
10. *Berger, W.H. and F.L. Parker. 1970. Diversity of planktonic Foraminifera in deep sea sediments. Science 168:1345-7.*
11. *CES. 1995a. Supplementary Flora and Fauna Surveys for the Tai Lam Tunnel and Yuen Long Approach Road (TLT & YLA) of the Route 3 Highway Project. Final Survey Report Covering May 1993 through May 1995.*
12. *CES. 1995b. Route 3 Tai Lam Tunnel and Yuen Long Approach. Northern Section. Volume 1. Detailed Environmental Impact Assessment. Final Report. October 1995.*
13. *Chalmers, M.L. 1986. Annotated Checklist of the Birds of Hong Kong. Hong Kong Birdwatching Society, Hong Kong.*
14. *Cheng, T.H. 1987. A Synopsis of the Avifauna of China. Science Press, Beijing.*
15. *Chu, W.H. 1995. Fish ponds in the ecology of the inner Deep Bay wetlands of Hong Kong. Asian J. Env. Manage. 3(1):13-36.*
16. *Collar, N.J., M.J. Crosby, and A.J. Stattersfield. 1994. Birds to Watch 2. Birdlife Conservation Series No. 4, BirdLife International. Cambridge.*
17. *Cramp, S. and Simmons, K.E.L. (eds.) 1983. Birds of the Western Palearctic. Vol. III Waders to Gulls. OUP, London.*
18. *Dahmer, T. D. and H. K. Kwok. 1997. The sustainability of large- and small-scale developments in Kam Tin Valley. Hong Kong in relation to numbers of nesting herons and egrets. Asian J. Environmental Manage. 5(2):125-136.*
19. *del Hoyo, J., Elliott, A. and Sargatal, J. 1996. Handbook of the Birds of the World. Vol. III Hoatzin to Auks. Lynx Editions, Barcelona*
20. *EPD. 1996. River Water Quality in Hong Kong for 1995. Monitoring Section. Water Policy & Planning Group, Environmental Protection Dept., Hong Kong Government, 167pp.*
21. *ERM. 1995a. Yuen Long-Kam Tin-Ngau Tam Mei Main Drainage Channel Environmental Impact Assessment.*

22.ERM. 1995b. *Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin: Additional Avifauna Surveys.*

23.Fasola, M. and F. Barbieri. 1978. *Factors affecting the distribution of heronries in Northern Italy. Ibis 120:337-340.*

24.Fasola, M. and X. Ruiz. 1997. *The value of rice fields as substitutes for natural wetlands for waterbirds in the Mediterranean region. Colonial Waterbirds 19:122-128.*

25.Freeman Fox Maunsell. 1993a. *Route 3 Country Park Section and Ting Kau Bridge, Preliminary Design Stage 2, Country Park Section - Tai Lam Tunnel and Yuen Long Approach Road. Volume 3A, Environmental Assessment - Technical Report.*

26.Freeman Fox Maunsell. 1993b. *Route 3 Country Park Section and Ting Kau Bridge, Preliminary Design Stage 2, Country Park Section - Tai Lam Tunnel and Yuen Long Approach Road. Volume 3B, Environmental Assessment - Appendices.*

27.Freeman Fox Maunsell. 1995. *Supplementary Ecological Survey for Route 3 Project: Surveys Through Winter 1994-5.*

28.Hafner, H., P. Dugan, and V. Boy. 1987. *Herons and wetlands in the Mediterranean: development of indices for quality assessment and management of Mediterranean wetland ecosystems. Commission of the European Communities, Tour du Valat.*

29.Hayman, P., Marchant, J. and Prater, T. 1986. *Shorebirds: an identification guide to the waders of the world. Croom Helm, England.*

30.Hill, D.S. and K. Phillipps. 1981. *A colour Guide to Hong Kong Animals. Government Printer, Hong Kong, 281pp.*

31.Hua, H. L and J.W. Yin 1993. *Protected Animals in China. Shanghai Scientific and Technological Education Publishing House. (in Chinese.)*

32.Karsen, S.J., M.W. Lau, and A. Bogadek. 1986. *Hong Kong Amphibians and Reptiles. Urban Council, Hong Kong, 136pp.*

33.Krebs, C.J. 1985. *Ecology: The Experimental Analysis of Distribution and Abundance. Harper & Row, New York, xv + 800pp.*

34.Lau, C.K. 1997. *A challenge on the home front. South China Morning Post 10 March 1997.*

35.Maddock, M. and Baxter, G.S. 1991. *Breeding success of egrets related to rainfall: a six-year Australian study. Colonial Waterbirds 14(2): 133-139.*

36.Magurran, A. E. 1988. *Ecological Diversity and Its Measurement. Croom Helm Ltd., London, 179pp.*

37.Marchant, S. and Higgins, P.J. (eds.) 1993. *HANZAB Vol. II. Raptors to Lapwings, OUP Melbourne.*

38.Melville, D. S., L. Young, and P. J. Leader. 1994. *Fish ponds around Deep Bay: Their importance to wildlife, especially waterbirds. World Wide Fund for Nature Hong Kong. Unpublished Report.*

39.Mouchel. 1996. *Rural Drainage Rehabilitation Scheme: Environmental Impact Assessment, Final Assessment Report to Drainage Services Dept., Hong Kong Gov't.*

40.Pearson, S. 1993. *A comparison of the use of habitats for feeding by Chinese Pond Herons and Little Egrets in 1989, 1990 and 1993, with special emphasis on commercial fish ponds in Hong Kong. Extended essay, Li Po Chun UWC, Hong Kong.*

41. Pielou, E. C. 1966. *Shannon's formula as a measure of species diversity: its use and misuse. American Naturalist 100:463-465.*
42. Planning Department. 1995. *Hong Kong Planning Standards and Guidelines. Chapter 10 - Conservation. Government Printer, Hong Kong.*
43. Planning, Environment and Lands Branch (PELB), Government Secretariat. 1996. *Heading Toward Sustanibility: The Third Review of Progress on the 1989 White Paper Pollution in Hong Kong -- A Time to Act. March 1996. Government Printer. Hong Kong.*
44. Prosper, J. and H. Hafner. 1997. *Breeding aspects of the colonial Ardeidae in the Albufera de Valencia. Spain: Population changes, phenology, and reproductive success of the three most abundant species. Colonial Waterbirds 19:98-107.*
45. R3CC. 1996. *Route 3 Highway Project, Monthly Construction Stage Environmental Monitoring and Audit Reports. May and June 1996, Woodward-Clyde International. Inc., Hong Kong.*
46. R3CC. 1997. *Route 3 Highway Project, Monthly Construction Stage Environmental Monitoring and Audit Reports, May, 1997, Woodward-Clyde International, Inc.. Hong Kong.*
47. Romer, J.D. 1979. *Second revised annotated checklist with keys to the snakes of Hong Kong. Mem. Hong Kong Nat. Hist. Soc. 14:1-23.*
48. Shannon, C. E. and Weaver, W. 1963. *The Mathematical Theory of Communication. University of Illinois Press. Urbana, 117pp.*
49. Sharrock, J.T.R. 1976. *The Atlas of Breeding Birds in Britain and Ireland. Poyser, Berkhamstead.*
50. Thrower, S.L. 1984. *Hong Kong Country Parks. Hong Kong Government Publication. Hong Kong.*
51. Town Planning Board. 1994. *Town Planning Board Guidelines for Application for Developments Within Deep Bay Buffer Zones Under Section 16 of the Town Planning Ordinance. TPB PG-No. 12A (revised November 1994).*
52. Viney, C., K. Phillipps, and C.Y. Lam. 1994. *Birds of Hong Kong and South China. Government Printer, Hong Kong. 244pp.*
53. Walthew, G. *The status and Flight Periods of Hong Kong Butterflies. Porcupine! No. 16. July 1997.*
54. Wilson. K.D.P. 1995. *Hong Kong Dragonflies. The Urban Council of Hong Kong, Hong Kong. 211pp.*
55. Wong. F.K.O. 1991. *Habitat utilisation by Little Egrets breeding at Mai Po. Hong Kong Bird Report 1990: 185-190.*
56. Woodward Clyde International 1996. *Route 3 Highway: Monthly Environmental Monitoring & AuditReports to Hong Kong Government.*
57. Young, L. 1991. *Conservation of wildlife in the Deep Bay area: with particular reference to heron species.*
58. Young, L. 1993. *The Ecology of Hong Kong Ardeidae. Ph.D. thesis. Univ. Hong Kong. Faculty of Science.*
59. Young, L. and M.W. Cha. 1995. *The history and status of egretries in Hong Kong with notes on those in the Pearl River delta, Guangdong, China. Hong Kong Bird Report 1994: 196-215. Hong Kong Bird Watching Society, Hong Kong. Zhao, E.M.*

and K. Adler. 1993. Herpetology of China. Soc. for Study of Amphibians & Reptiles. Oxford, OH, 522pp.

ABBREVIATIONS

$\mu g\ m^{-3}$	micrograms per cubic metre
AAB	Antiquities Advisory Board
AFD	Agriculture & Fisheries Department
AFS	Accredited Farm Scheme
ALRS	Agricultural Land Rehabilitation Scheme
AMO	Antiquities and Monuments Office
ANL	Acceptable Noise Level
APCO	Air Pollution Control Ordinance
AQO	Air Quality Objectives
As	Arsenic
ASR	Air Sensitive Receiver
BNL	Basic Noise Level
BOD_5	5-day Biochemical oxygen demand
BRR	British Rail Research
Cd	Cadmium
CED	Civil Engineering Department
CNP	Construction Noise Permit
COD	Chemical Oxygen Demand
Cr	Chromium
CRN	Calculation of Rail Noise
CRTN	Calculation of Road Traffic Noise
CT9	Container Terminal No.9
Cu	Copper

CWTF	Chemical Waste Treatment Facility
dB	Decibels
DIA	Drainage Impact Assessment
DO	Dissolved Oxygen
DPA	Development Permission Area
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EM&A	Environmental Monitoring and Audit
EMU	Electric Multiple Unit
ERM	Environmental Resources Management Hong Kong Limited
EPD	Environmental Protection Department
EVA	Emergency Vehicle Access
FAR	Final Assessment Report
FMC	Fill Management Committee
FMG	Facilities Management Group
GEO	Geotechnical Engineering Office
GFA	Gross Floor Area
ha	hectare
Hg	Mercury
HKAS	Hong Kong Archaeology Society
HKBWS	Hong Kong Bird Watching Society
HKHA	Hong Kong Housing Authority
HKPSG	Hong Kong Planning and Standards Guidelines
Hz	Hertz
IAR	Initial Assessment Report

KAT	Kam Tin Station
KCRC	Kowloon-Canton Railway Corporation
km	kilometres
L_{MAX}	Maximum Noise Levels
LAR	Lantau and Airport Railway
LOP	Long Ping Station
LRT	Light Rail Transit
m	metres
m^3	cubic metres
MDC	Main Drainage Channel
MDC-NYK	Main Drainage Channels for Ngau Tam Mei, Yuen Long, Kam Tin
MEF	Mei Foo Station
MFSC	Mei Foo Sun Chuen
MTR	Mass Transit Railway
MTRC	Mass Transit Railway Corporation
NCA	Noise Control Authority
NCO	Noise Control Ordinance
NFY	Northern Freight Yard
Ni	Nickel
NSR	Noise Sensitive Receiver
ODP	Outline Development Plan
ONWG	Opertional Noise Working Group
OZP	Outline Zoning Plan
PAH	Poly-aromatic Hydrocarbons

Pb	Lead
PCB	Poly-Chlorinated Biphenol
PCW	Prescribed Construction Work
PCWA	Public Cargo Working Area
PEI	Preliminary Environmental Investigation
PELB	Planning, Environment and Lands Branch
PHI	Potentially Hazardous Installations
PME	Powered Mechanical Equipment
ppm	parts per million
ppv	Peak Particle Velocity
PRC	People's Republic of China
ProPECC	Professional Persons Environmental Consultative Committee
PTI	Public Transport Interchange
RAMSAR	RAMSAR Convention on the Preservation of Wetlands
RSD	Regional Services Department
RSP	Respirable Suspended Particulates
SEL	Sound Exposure Level
SENT	South-Eastern New Territories
SMG	Study Management Group
SMP	Sewage Master Plan
SPL	Sound Pressure Level
SR	Sensitive Receiver
SS	Suspended solids
SSC	Suspended Sediment Concentration
SSDS	Strategic Sewage Disposal Scheme

SSSI	Site of Special Scientific Interest
SWL	Sound Power Level
TDD	Territory Development Department
TIN	Tin Shui Wai Station
TKN	Total Kjeldahl nitrogen
TLCPT	Tai Lam Country Park Tunnel
TM	Technical Memorandum
TMC	Tuen Mun Centre Station
TMN	Tuen Mun North Station
TOC	Total Organic Carbon
TSP	Total Suspended Particulates
TWTP	Tsuen Wan Town Park
TWW	Tsuen Wan West Station
UPS	Uninterruptable Power Supply
USD	Urban Services Department
WBTC	Works Branch Technical Circular
WCO	Water Control Objectives
WCZ	Water Control Zone
WDO	Waste Disposal Ordinance
WQO	Water Quality Objective
WENT	Western New Territories
WIP	Works in Progress
WKDIS	West Kowloon Drainage Improvement Study
WKE/WKR	West Kowloon Expressway/West Kowloon Reclamation
WMATA	Washington Metropolitan Area Transit Authority

WPCO	Water Pollution Control Ordinance
WRD	West Rail Depot
WSD	Water Supplies Department
WSR	Water Sensitive Receivers
WTW	Water Treatment Works
YCS	Yen Chow Street Station
YUL	Yuen Long Station
Zn	Zinc
AP42	Compilation of Air Pollutant Emission Factors, Volume 1, 5 Ed, USEPA

1. INTRODUCTION

1.1 Scope of West Rail

The Kowloon-Canton Railway Corporation (KCRC) has commissioned Environmental Resources Management Hong Kong Limited (ERM-Hong Kong) to undertake an Environmental Impact Assessment (EIA) of the proposed Western Corridor Railway (more commonly referred to as *West Rail*).

The Full Proposal submitted to Government by the KCRC in 1995 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 MTRC's Lantau and Airport Railway).

The Government has determined that only passenger train services and interchange facilities between West Kowloon and Tuen Mun shall be built at this time. The railway would 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 would 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.

This Final Assessment Report (FAR) therefore, relates only to those parts of the overall scheme that the Government is determined to build at this time.

1.2 Scope and Objectives of the EIA

ERM-Hong Kong conducted a Preliminary Environmental Investigation (PEI) of the overall scheme in 1995, and the resulting report formed part of the KCRC's Full Proposal to Government. Responses to the PEI report and subsequent discussions have assisted in defining the scope of work that has been undertaken in this EIA Study. This scope includes the following key areas of assessment:

- Construction and Operational Noise;
- Air Quality;
- Water Quality;
- Landscape and Visual Issues;
- Landuse Issues;
- Archaeological & Cultural Resources;
- Ecology;

- Waste; and
- Land Contamination.

Separate Hazard Assessment Reports in relation to West Rail's potential interaction with the Au Tau water treatment works and the former Gin Drinkers Bay Landfill have been prepared, submitted and reviewed by the relevant Government departments prior to the FAR. A summary of the recommendations and/or proposed precautionary measures to be taken, resulting from these assessments, is provided in the relevant sections of the FAR.

Although the above key areas of assessment are listed separately, the EIA Study Team led by ERM-Hong Kong has maintained an overview across specialist areas to identify "cross-media" impacts (eg the visual impact of noise barriers), evaluate cumulative impacts, and illuminate possible trade-offs in resolving conflicts between the findings of different parts of the Study.

The objectives of the EIA Study were to:

- Describe the proposed railway and associated facilities including railway stations and the requirements for their development;
- Identify and describe the elements of the environment and existing and planned development that are likely to be affected by the proposed railway;
- Identify, predict, evaluate and (where possible) quantify sources of pollution and environmental impact and determine the significance of impacts on sensitive receivers and potentially affected uses;
- Minimise potential pollution and environmental disturbance arising from the construction and operation of the railway;
- Identify, predict, evaluate and quantify residual environmental impacts (ie after practicable mitigation) and cumulative effects (with other sources of impact) expected to arise during the construction and operational phases of the railway;
- Identify, assess and specify methods, measures and standards to be included in the design, construction and operation of the railway which are necessary to mitigate these impacts and reduce them to acceptable levels;
- Design and specify environmental monitoring and audit requirements necessary to ensure the effective implementation of the environmental protection and pollution control methods and measures adopted as a result of the Study;
- Investigate the extent of side effects of proposed mitigation measures that may lead to other forms of impact;
- Identify constraints associated with the mitigation measures recommended in the Study; and

- Identify any additional studies necessary to fulfil the objectives and requirements of the Study.

The KCRC has also engaged the services of engineering Design Consultants to develop design and engineering proposals for different Sections of the West Kowloon to Tuen Mun scheme. These engineering consultancy studies have been proceeding in parallel with the EIA Study. In addition to the many and varied tasks involved in undertaking the EIA, the EIA Study team has had the additional role of providing information to support and assist the engineering design process. The design objectives during the period of the EIA Study have related primarily to the following activities:

- Fixing an alignment that does not present insurmountable environmental problems;
- Identifying construction and operational phase land requirements;
- Developing detailed cost estimates; and
- Providing recommendations and specifications for the detailed design of the railway and associated facilities to ensure environmental compliance.

During the course of the EIA and engineering design studies, information, advice and other inputs have been passed between the engineering Design Consultants and the EIA specialists. Through this interface with the engineering design components of the project the EIA Study Team has been able to identify and maximise opportunities to resolve or "design out" potential environmental problems. The EIA Study Team has provided the following environmental inputs to the engineering design of West Rail:

- Information on key sensitive human and environmental receptors and on construction and operational performance requirements to mitigate potential impacts;
- Recommendations on environmental mitigation measures (eg advice on construction methods, and specifications of noise mitigation design and performance);
- Advice on the extent to which proposed design solutions will achieve the required environmental performance;
- Layout and design of fixed plant to achieve compliance with environmental regulations;
- Assessment of any proposed refinements to the alignment of the railway;
- Recommendations for track and train design to overcome noise-related impacts;
- Advice on landscape strategy, including design principles;
- Evaluation of the environmental implications and acceptability of proposed construction work sites; and

- Review of land acquisition maps in order to identify opportunities to conserve valued environmental resources.

The EIA study has been led by ERM-Hong Kong, and is being conducted with the assistance and support of its team of associated sub-consultants. This specialist sub-consultancy team comprises:

- **British Rail (BR) Research** (providing noise source term information and advice on rail and track technology issues);
- **Ecosystems Limited** (providing ecological input);
- **Hydraulics and Water Research (Asia) Limited** (providing hydrodynamic modelling expertise to supplement in house resources);
- **The Museum of London Archaeological Service** (providing archaeological evaluation and mitigation advice);
- **Wilson Ihrig & Associates** (providing technical input to the operational noise assessment); and
- **Urbis Limited** (providing input on the landscape strategy and on landscape, landuse and visual issues).

In addition, **Mr William Farrell** has provided advice to the Study Team on EIA strategy and the interpretation and presentation of study findings, and **Professor Siu Kwok-Kin** has provided input to the assessment of impacts to historic buildings.

1.3 The Initial Assessment Report

This FAR builds on and further develops the assessment and findings reported in the Initial Assessment Report (IAR), which was finalised in August 1997. In addition to defining the relevant and applicable standards and criteria for the EIA study and describing the methodologies that would be used for evaluating impacts and defining mitigation measures, the IAR provided an initial evaluation of potential environmental impacts and the measures available for their mitigation. The IAR also defined the work required to be undertaken as part of the final assessment that followed; the findings of this work are reported here.

The IAR identified a number of key environmental issues which would require more detailed assessment and, in most cases, special attention to the estimation of impacts and the definition and refinement of mitigation measures. These issues included:

- Train noise - the initial assessment identified unmitigated noise exceedances at many locations along the alignment in the Northern and Western Sections, and KCRC adopted a package of mitigation measures which offered the prospect of resolving these issues but required more definition and detailed assessment;
- Construction noise - a number of unacceptable residual impacts, mainly in the Northern and Western Sections, remained after the standard forms of

mitigation had been applied and evaluated, however the assessment had been based on notional site operations and worst case assumptions:

- Water quality - the initial assessment identified the importance of ensuring that relocation and diversion of culverts, drains and pipes would be undertaken with minimal additional impact on water quality, and that disturbance to flow, ingress of pollutants, siltation and flooding would be minimised at alignment intersections with rivers, nullahs and ponds, which required a careful assessment of detailed design and construction proposals;
- Tsuen Wan Bay reclamation - the initial assessment also identified need for detailed mathematical modelling of flow regimes in Rambler Channel and the transport and dispersion of fine sediments, and careful attention to the issue of dredging and disposal of contaminated marine muds;
- Landscape and visual impacts - impacts were predicted to be substantial to very substantial, especially during construction and even with the application of mitigation;
- Archaeological and cultural resources - the need for predictive modelling of potential impacts to buried archaeological resources was identified; and
- Ecological resources - a four-season ecological survey of the West Rail alignment was required and well underway but not completed when the IAR was finalised. The preliminary ecological assessment indicated that there would be a need to provide for the creation of compensatory habitat to offset the loss of ecologically important habitats.

1.4 The Final Assessment Report

The abovementioned key issues have been evaluated in more detail since the IAR, and the results of these further assessments are reported in this FAR.

Areas of uncertainty identified in the IAR have been resolved as far as possible during the detailed assessment phase of the EIA. The results of modelling and survey work have provided a better understanding of potential impacts, especially in the archaeological, ecological, water quality, waste and land contamination areas. More details of proposed construction sites, equipment deployment, works programmes and activities, and material requirements and arisings, have been available to assist in refining the construction impact assessments. Similarly, a better understanding of design proposals and options has facilitated more accurate assessments of operational impacts. A number of situations that may give rise to cumulative impacts have been examined in more detail, especially where simultaneous construction work is envisaged in the same geographical area. More confident and more refined proposals for mitigation have been investigated and developed and detailed proposals for post-project monitoring and audit will be prepared in the form of an Environmental Monitoring and Audit Report to be submitted subsequent to the finalisation of the FAR.

1.5 Structure of the Final Assessment Report

The remainder of the West Rail EIA Final Assessment Report is structured as follows:

- *Section 2* provides a detailed rationale and an up-to-date description of the West Rail elements assessed within this report;
- *Section 3* presents the environmental legislation and standards which form the context within which the KCRC's new railway is to be constructed and operated;
- *Section 4* describes the assessment methodology applied in undertaking the EIA of the construction and operation of West Rail;
- *Section 5* presents the findings of the EIA in relation to the construction and operation of the Southern Section of West Rail;
- *Section 6* presents the findings of the EIA in relation to the construction and operation of the Central Section of West Rail;
- *Section 7* presents the findings of the EIA in relation to the construction and operation of Northern Section and the West Rail Depot;
- *Section 8* presents the findings of the EIA in relation to the construction and operation of the Western Section of West Rail;
- *Section 9* presents an outline of the management approach to the construction process and describes the key attributes of the environmental monitoring and audit (EM&A) programme; and
- *Section 10* provides a summary and a set of conclusions arising from the EIA.

As a supplemental and separate volume of the FAR, the Technical Annexes comprise maps of the alignment and proposed work areas, lists and locations of sensitive receivers, figures showing the location of proposed mitigation measures, data streams and calculations primarily relating to ecology, noise and air pollution modelling. These have been prepared as supporting documentation for the FAR and should be read in parallel with this main report.

2. PROJECT DESCRIPTION

2.1 Development Rationale

The KCRC operates one of the most heavily used railways in the world with over 500 daily train trips, comprising both passenger and freight trains.

Since early 1991, the 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 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 to provide freight, through-train, cross-border and sub-regional services. 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 West Rail. The results of the PEI have been reviewed by a Study Management Group (SMG) comprising representatives of relevant Government Departments under the Chairmanship of the Environmental Protection Department (EPD).

The PEI and the comments provided by the SMG have provided useful background for the EIA Study and enabled the scope and contents of the detailed specialist studies for the EIA to be defined.

2.2 Description of the West Rail Alignment

2.2.1 Introduction

As outlined in *Section 1.1*, the Government has indicated that initial consideration should be limited to that part of the scheme comprising passenger train services and interchange facilities between West Kowloon and Tuen Mun, including domestic passenger lines and nine new stations as well as a major maintenance depot in the Kam Tin valley. It is these elements of the West Rail scheme which are the subject of this Final Assessment Report and which are described in fuller detail below.

2.2.2 *The West Rail Route Alignment*

The identification, selection and refinement of the West Rail alignment has been a continuous process since the planning of the railway commenced over three years ago. Commencing with the alignment presented in the EIA Inception report that initially formed the basis of Governments agreement that KCRC could proceed with the planning of the railway, and, throughout the EIA process, the alignment chosen for further assessment has been the result of a gradual process of evolution, optimisation, assessment and re-evaluation.

The outcome of this process was most evident during early 1997 when the engineering Design Consultants were commissioned and charged with the responsibility of optimising the 1994 PEI alignment with regard to operational, safety, environmental and engineering design requirements. Some sections of the alignment, such as the Southern Section, were more readily defined because of severe physical constraints and thus, these parts of the alignment differ very little from those investigated in the PEI. However, other sections of the alignment required substantial modification and parallel assessment of a number of options at varying levels of detail and indeed this was reflected by some of the uncertainties in the IAR assessment.

For this reason, the final assessment of the railway contained in this report, is able to focus on a single preferred alignment option in the knowledge that the optimisation process has carefully and continuously weighed environmental and other considerations in reaching an alignment preference.

The finalised West Rail alignment, as shown in *Figures 2.2a-2.2c* is considered to represent the "best achievable" alignment within the scope of the abovementioned parameters.

2.2.3 *Southern Section*

This Section is located on the West Kowloon Reclamation (WKR) and commences at a point approximately 500 m south-west of the proposed Yen Chow Street Station (YCS) near the proposed Prince Edward Road Roundabout. The area between this point and YCS will initially serve as overrun tunnels during the phase of railway development currently being assessed and will facilitate extension of the railway to the southern part of the WKR in the future.

From YCS, the alignment extends north-west to Lai Chi Kok and Mei Foo, passing under Hing Wah Street and the Lai Wan interchange. The alignment then turns east through Lai Chi Kok Park around the Mei Foo Sun Chuen residential development and ends just before the proposed Mei Foo (MEF) Station.

The entire rail alignment of the Southern Section will be constructed at grade, however, the alignment will be contained in a box structure constructed above ground and covered by a landscaped earth mound. In this connection, the Southern Section alignment is considered to be similar to a conventional tunnel.

LEGEND
- Station
- Cut & Cover
- Bored (Drill & Blast)
- Elevated Structure

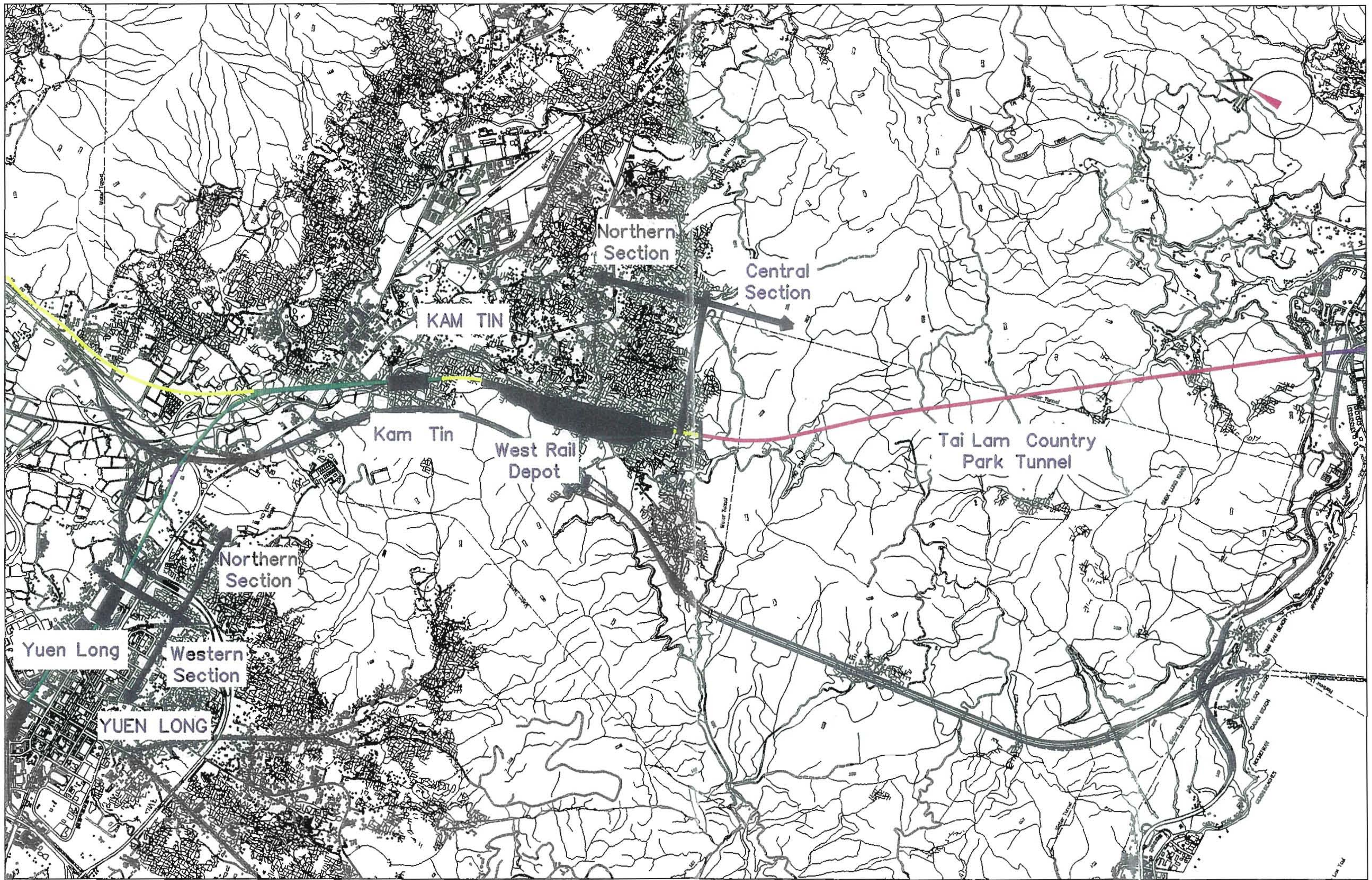
WEST RAIL ALIGNMENT PLAN
SCALE: 1/35,000

FIGURE 2.2a

Westrail/reports/Init_ass/1

ERM

KOWLOON - CANTON RAILWAY CORPORATION
WEST RAIL: TS900 EIA STUDY



LEGEND

- Station
- Cut & Cover
- Bored(Drill & Blast)
- Elevated Structure
- Embankment

WEST RAIL ALIGNMENT PLAN

SCALE: 1/35,000

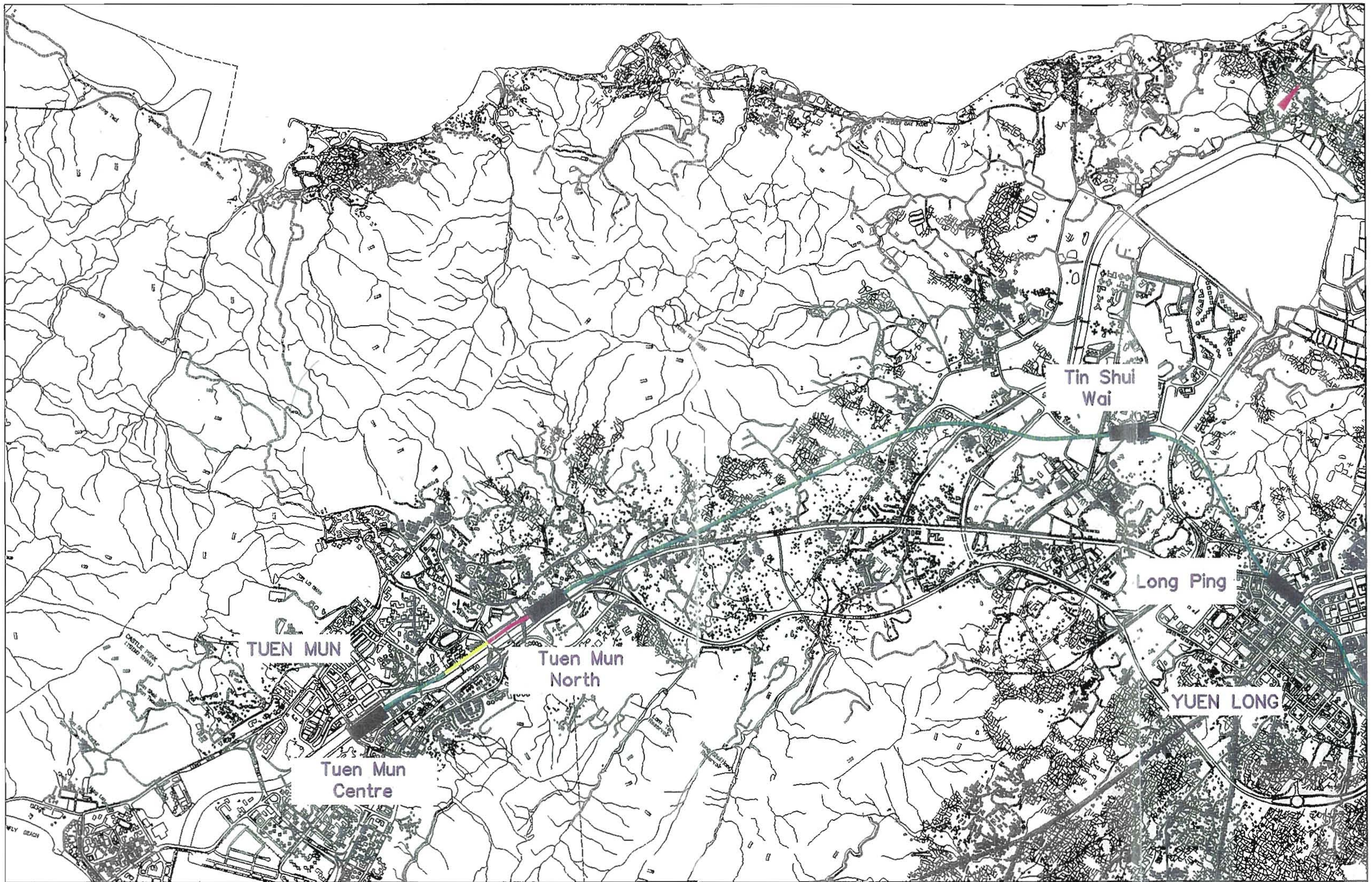
FIGURE 2.2b

Westrail/reports/init_aas/2

ERM

KOWLOON - CANTON
RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY



LEGEND

- Station
- Elevated Structure
- Embankment
- At Grade

WEST RAIL ALIGNMENT PLAN

SCALE: 1/35,000

FIGURE 2.2c

Westrail/reports/init_ass/3

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

The selection of a cut and cover construction approach for the Southern Section is based on a consideration of the location of the works. the material to be excavated and the shallow depth of excavation required. The construction activities will also involve diaphragm walling and bored piling activities at YCS. Along the alignment. construction will primarily involve site levelling and tunnel box construction activities, including steel fixing, formworking, concreting and general manual construction activities. Lifting equipment such as numerous tower and mobile cranes will also be required.

2.2.4 Central Section

This Section commences at the western end of the proposed MEF Station, and extends north-west under Kwai Chung Hospital in the Ha Kwai Chung Tunnels for approximately 1.5 km. These tunnels give way to the Kwai Fuk Road Tunnels for approximately 600m before entering the Tsing Tsuen Tunnels in the vicinity of Kwai Chung Park and Tsing Tsuen Road. The alignment continues north-west in the Tsing Tsuen Tunnels for approximately 1 km before exiting at the Tsuen Wan waterfront in the vicinity of the site of the proposed Tsuen Wan West (TWW) Station. From TWW, the alignment continues north-west and enters the southern portal of the Tai Lam Tunnel (TLT) at a point north of Tuen Mun Road at Tsuen Wan. The northern portal of the TLT is situated approximately 5 km north-west in the Kam Tin valley, where the railway extends for another 250m above ground before reaching the end of the Central Section.

The rail alignment of the Central Section will be contained entirely in soft ground or hard rock tunnels, except for that part north of the TLT northern portal, which will be constructed on embankment. MEF and TWW Stations will be constructed using cut-and-cover methods involving sheetpiling operations in the vicinity of road and bridge supports, hydraulic breaking plant, bored piling, excavation. concreting and building activities. In addition, at TWW, demolition of the existing Tsuen Wan Ferry Pier will be undertaken as well as reclamation of approximately 750,000m^3 of marine area in the south-east corner of Tsuen Wan Bay. Some excavation of seabed sediments may need to be undertaken before filling operations are commenced.

2.2.5 Northern Section and West Rail Depot

This Section commences approximately 250m north of the northern portal of the TLT. The alignment then heads generally north-west, passing through a new station to be constructed at Kam Tin (KAT). From Kam Tin, the alignment continues north-west until it reaches a junction at Au Tau between a north-bound section of the alignment (envisaged for the larger West Rail system and not part of this assessment) and the west-bound route to Tuen Mun. Two kilometres west of Au Tau along the Tuen Mun branch, the Northern Section comes to an end at the eastern endwall of the proposed Yuen Long Station (YUL).

The Northern Section also includes the West Rail Depot (WRD) which lies between the northern portal of TLT and Kam Tin Station. The WRD includes infrastructure such as rail and fleet maintenance facilities as well as buildings which in total occupy an area of approximately 22 hectares. The WRD facility also includes approximately 2.2 km of main line alignment.

The WRD and the section of alignment immediately north of Kam Tin Station will be constructed on embankment. The remainder will comprise elevated structure and a small cutting located near the Au Tau burial grounds. Following site clearance activities, embankment construction will require transport and placement of engineering fill and appropriate compaction and earthmoving machinery. These types of construction activities will predominate between Au Tau and the TLT. Depot facilities and buildings will be developed following completion of the earthworks. Viaduct construction will involve bored piling works followed by pilecap and column construction activities and superstructure works. A concrete batching plant and precasting yard may also be required.

2.2.6 *Western Section*

This Section of the alignment extends generally westward from Yuen Long Station (YUL) before heading south to the proposed Tuen Mun Centre (TMC) Station. The Western Section includes proposed intermediate stations at Long Ping (LOP), Tin Shui Wai (TIN) and Tuen Mun North (TMN). The entire Western Section alignment is to be constructed on elevated structure except approximately 500 m each of at grade and embankment between TMN and TMC stations.

Given the length and design of the Western Section, viaduct construction works will predominate. Initially, bored piling will be undertaken followed by pilecap and superstructure erection activities. A precasting yard and up to three concrete batching plants may be used to supply units for viaduct construction which will be launched using a sequential launching truss. Sheetpiling will also be required immediately adjacent to roads and the Tuen Mun nullah. A small proportion of embankment construction will also take place requiring the importation, placement and compaction of engineered fill and associated plant.

2.2.7 *Operations*

The West Kowloon to Tuen Mun passenger service is proposed to operate between 0500 and 0100 and, for the two peak periods, will run twenty trains per hour in each direction.

Train length will initially be six cars on start up, increasing to eight after two years as patronage rates increase, and finally 12 cars in the design year, post 2011. The maximum train speed will be 130 km/hr.

Predicted two-way peak hour passenger flows on the busiest sections of the line are approximately 40,000 in 2001 and 80,000 in 2011. Predicted two-way daily flows on these sections are 270,000 in 2001 and 570,000 in 2011.

The KCRC's proposed West Rail service will interface with Mass Transit Railway's services at Mei Foo (the Tsuen Wan Line) and Yen Chow Street (the Lantau line). It will also interchange with the Light Rail service at Yuen Long, Tin Shui Wai, Tuen Mun North and Tuen Mun Centre.

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3. ENVIRONMENTAL LEGISLATION AND STANDARDS

3.1 Introduction

This section describes the regulatory requirements and criteria against which the potential or predicted impacts of the construction and operation of the West Rail were evaluated.

Most of the relevant legislation, criteria or guidelines are those produced, adopted or accepted by the Hong Kong Government. In some cases, the provisions of international conventions and agreements may also apply; similarly, if a specific type of impact or issue is not addressed by Hong Kong Government requirements, or more stringent performance requirements are considered necessary or desirable, appropriate international standards, codes or practices may be adopted.

In addition to the standards and guidelines set out below, the Environmental Impact Assessment Ordinance and associated Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance, Cap 499, S16) provides guidance on the methodology to be used for undertaking environmental impact assessment in Hong Kong. Whilst the West Rail EIA has not been undertaken under the formal requirements of the Ordinance, the scope and depth of assessment reflects, in large part, that presented in the Ordinance and supporting TM.

3.2 Noise

3.2.1 Construction Phase

Control over the generation of construction noise in Hong Kong is governed primarily by the *Noise Control Ordinance* (NCO) and its subsidiary requirements. Technical Memoranda (TMs) produced under the NCO prescribe maximum permitted noise levels for the use of powered mechanical equipment (PME) and certain construction activities and processes, depending on the type of equipment or activity, the perceived noise climate of the area and the proposed hours of operation or usage. In addition to the NCO, a voluntary control on maximum permitted noise levels has been proposed by the Hong Kong Environmental Protection Department (EPD) and adopted by the KCRC. Percussive piling equipment is also addressed through the NCO and is the subject of a separate technical memorandum, the *Technical Memorandum on Noise from Percussive Piling (TM1).*

NCO requirements apply to all construction works undertaken between 0700 and 1900 on any day not being a general holiday. Guidelines for the control of construction noise from PME are given in the *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling* (TM2). An additional TM, the *Technical Memorandum on Noise from Construction Work in Designated Areas* (TM3), deals with the control of noise generated by specified powered mechanical equipment and prescribed construction work being carried out in certain areas. The prescribed construction activities include scaffolding, loading and unloading of materials and hammering, amongst others.

The NCO requires that the noise level resulting from construction work, as experienced by an affected Noise Sensitive Receiver (NSR), is less than a specified value, called the Acceptable Noise Level (ANL). The ANL is dependent on the area sensitivity rating (ASR) of the individual NSR, based on the perceived usage of the area and the presence of any influencing factors such as industrial areas, major roads and airports. The ANLs for construction work in designated areas set out in TM3 are more stringent than those given in TM2. ANLs applicable to West Rail construction work are given in *Table 3.2a.*

Table 3.2a ANLs for Construction Noise other than Percussive Piling

	$L_{Aeq, 5\,min}$ dB(A)		
Time Period	**ASR "A"**	**ASR "B"**	**ASR "C"**
All weekdays during the evening (1900-2300) and Sundays and General Holidays during the day and evening times	60 (45)	65 (50)	70 (55)
All days during the night-time (2300-0700) including Sundays and General Holidays	45 (30)	50 (35)	55 (40)

Note: Figures in brackets are ANLs for construction work in designated areas.

Although the NCO does not provide for the control of construction activities during daytime working hours (0700-1900), a limit of $L_{Aeq.\,30\,min}$ 75 dB for PME is recommended by the EPD in the *Practice Note for Professional Persons, Professional Persons Environmental Consultative Committee - Noise from Construction Activities - Non Statutory Controls, June 1993* (ProPECC PN2/93). This limit is generally accepted in Hong Kong and has been adopted by the KCRC for the West Rail assessment. For schools, ProPECC PN2/93 recommends noise levels during school days of $L_{Aeq.\,30min}$ 70 dB, lowered to 65 dB during examination periods, although this more stringent criterion is subject to specific investigations concerning noise insulation. Although a daytime construction noise limit for hospitals is not stated in PN2/93, it is suggested that 75 dB(A) is an appropriate assessment criterion for facades with air-conditioning and fixed glazing.

Subsidiary regulations of the NCO include *the Noise Control (Hand Held Percussive Breakers)* and *Noise Control (Air Compressors) Regulations*, which require compliance with relevant noise emission standards and the fixing of noise emission labels to specified plant and equipment. While these requirements are not directly relevant to the construction noise impact assessment, they must be met by Contractors during the construction phase of a project.

A Construction Noise Permit (CNP) is required by the regulations of the NCO for general construction work using PME or prescribed construction work in designated areas between 1900 and 0700 and at any time of a general holiday. The procedures set out in TM1 to TM3 are used by the Noise Control Authority (NCA) to determine whether or not a CNP should be issued. CNPs will not automatically be granted and will be assessed on a case by case basis by the Authority. The granting of a CNP is subject to conditions stated in the permit and it may be revoked at any time for failure to comply with the stated conditions.

Percussive piling between 0700 and 1900 on any day, not being a general holiday is only permitted where a CNP has been approved by the Authority. TM1 sets out the permitted hours of operation of percussive piling and ANL requirements, which are dependent on the architectural characteristics of the NSR. The ANL criteria for percussive piling are reproduced in *Table 3.2b*. ANLs for hospitals, schools, clinics, courts of law and other particularly sensitive receivers are 10 dB below the figures quoted in *Table 3.2b*.

Table 3.2b 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

Blasting activities during construction may give rise to impacts from noise and/or vibration and are therefore of interest to a number of government departments. In terms of statutory criteria however, neither noise or vibration from blasting are explicity regulated but are indirectly controlled through the need to protect receivers from excessive levels of impact.

Regarding vibration from blasting, Contractors adhere to contractural limits set by the developer based on advice from relevent government authorities and utility companies. The *KCRC Design Criteria Manual, Volume 1, Chapter 3, Section 9 - "Limiting Construction-Induced Vibrations at Existing Adjacent Structures"*, sets out the proposed limitations on vibration to be followed by Contractors for the West Rail project. The Manual also notes that other limitations may be imposed at existing adjacent structures such as hospitals, school buildings, telephone exchange structures, etc as specialist studies comissioned by KCRC may indicate. Methods of reducing vibration such as limiting the explosive charge per delay may be required. The adopted vibration critieria for the West Rail project are shown in *Table 3.2c* below.

Table 3.2c Maximum Allowable Peak Particle Velocities at Existing Adjacent Structures from Blasting

Adjacent Structure	Vibration (mm/sec)
Most structures in "good" condition	50
Most structures in "fair" condition	25
Most structures in "poor" condition	13
Water-supply structures	13
Underground railway strucutres	25

The administrative and procedural control of all blasting opertaions in Hong Kong is vested in the Mines and Quarries (M&Q) Division of the Civil Engineering Department

(CED). The M&Q Division require an assessment of blasting to be carried out by qualified blasting specialists and submitted to them for approval prior to commencement of blasting works at each site. Permits for the storage and use of explosives must be obtained from the M&Q Division which may also stipulate particular restrictions on blasting procedures, hence, a detailed assessment of blasting vibration is outside the scope of the West Rail EIA study. It should, however, be noted that the contractural controls on blasting will provide a degree of mitigation of the possible impacts on nearby sensitive landuses.

Similar to vibration, blasting noise is not directly controlled but indirectly regulated by the need to avoid "nuisance" to human recptors with the pertinent control authority being the Environmental Protection Department. However, in the absence of a statutory methodology or criteria to measure and assess blasting noise, opinions between the developer, the government and the community can vary widely. Mitigation measures such as not undertaking blasting during sensitive hours and publicising the proposed blasting schedule to reduce the "startle" factor among residents may be beneficial.

3.2.2 Operational Phase

3.2.2.1 Fixed Noise Sources

Noise from fixed sources will be evaluated in accordance with the HKPSG. Noise from sources such as electrical and mechanical plant will be assessed with reference to TM4. All fixed noise sources should be located and designed so that the noise level at the façade of the nearest NSR should be at least 5 dB(A) lower than the appropriate ANL stated in TM4.

3.2.2.2 Airborne Train Noise

Railway noise is controlled under the NCO by the *Technical Memorandum on Noise From Places Other Than Domestic Premises, Public Places or Construction Sites* (TM4), which specifies technical principles, assessment procedures and the applicable Acceptable Noise Levels (ANLs). ANLs are dependent on the ASR and the time of day. The ASR of an NSR is determined by the perceived usage of the area and the presence of any influencing factors such as industrial areas, major roads and airports. The ANLs from TM4 are reproduced in *Table 3.2d*.

Table 3.2d ANLs to be used as Operational Noise Criteria

	$L_{Aeq\ 30\ min}$ dB		
Time Period	ASR "A"	ASR "B"	ASR "C"
Daytime 0700-1900	60	65	70
Evening 1900-2300	60	65	70
Night-time 2300-0700	50	55	60

The Hong Kong Planning Standards and Guidelines (HKPSG) provide additional criteria for assessing railway noise. These criteria are specified in terms of the A-weighted maximum noise level and the daily railway noise exposure, as shown in *Table 3.2d*. For noise generated by West Rail to be within acceptable levels, the criteria given in both *Table 3.2d* and *Table 3.2e* must be met.

Table 3.2e HKPSG Railway Noise Criteria

Parameter	Noise level dB(A)
Maximum A-weighted sound pressure level, L_{max}	85
Equivalent continuous sound level, $L_{eq\ 24hrs}$	65

3.3 Air Quality

Air pollution impacts arising during the construction and operational phases of West Rail are subject to the *Air Pollution Control Ordinance* (APCO) and subsidiary legislation. The *Air Quality Objectives* (AQOs) stipulated in the APCO specify statutory limits on the quantities of particulate and certain gaseous pollutants in the atmosphere over specified averaging periods. These are given in *Table 3.3a*.

Table 3.3a APCO Air Quality Criteria

Pollutant	Air Quality Criteria (µg m^{-3})				
	1 hr(ii)	8 hrs(iii)	24 hrs(iii)	3 mths(iv)	1 year(iv)
Total Suspended Particulates (TSP)	500	-	260	-	80
Respirable Suspended Particulates (RSPs)(v)	-	-	180	-	55
Sulphur Dioxide	800	-	350	-	80
Nitrogen Dioxide	300	-	150	-	80
Carbon Monoxide	30000	10000	-	-	-
Ozone(vi)	240	-	-	-	-
Lead	-	-	-	1.5	-

Notes:

(i) All measured at 298 K and 101.3 kPa.

(ii) Not to be exceeded more than three times per year.

(iii) Not to be exceeded more than once per year.

(iv) Arithmetic means.

(v) RSPs are particles with a nominal aerodynamic diameter of 10 µm or less.

(vi) Photochemical oxidants are determined by measurement of ozone only.

The *Air Pollution Control (Restriction on Open Burning) Regulations* have been made under the APCO and, while these are not directly relevant to the impact assessment, they include requirements that may have to be to be met by Contractors during the construction of the project.

In addition to the APCO, a non-statutory hourly average level for particulate of 500µg m^{-3} is recommended by the EPD and is generally accepted in Hong Kong as appropriate for assessing construction dust impacts. This limit is able to be implemented through works contract clauses and has been adopted for this study.

3.4 Water Quality

The regulatory requirements and standards to protect water quality include the *Water Pollution Control Ordinance* (WPCO), its subsidiary technical memoranda, and various technical circulars issued by the Works Branch and the EPD as described below. Whilst the technical circulars are non-statutory, they are generally accepted as best practice guidelines in Hong Kong and have been adopted as relevant for this assessment.

3.4.1 Water Pollution Control Ordinance (WPCO)

Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQO). The standards to be met in each WCZ depend on the classification of the receiving waters (eg inland, inshore, marine or foul sewer). The standards are applied to effluents through licences issued by the EPD under Sections 15, 16 and 20 of the WPCO. The relevant standards are set out in the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

3.4.2 Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

This TM issued under Section 21 of the WPCO defines acceptable discharge limits to different types of receiving waters.

Effluents discharged into the inshore and marine waters of the Victoria Harbour WCZ are subject to standards stipulated in Tables 9a and 9b of the TM. The standards in Tables 10a and 10b of the TM apply to effluents discharged into the inshore and marine waters respectively of the North Western and Western Buffer WCZs. For the Deep Bay WCZ, the standards in Table 8 of the TM apply, although reference should also be made to *Section 3.4.3* below.

Relevant criteria for effluents discharged to inland waters depend on the classification of beneficial uses downstream. The majority of inland water bodies potentially affected by West Rail are used for agriculture (defined in the TM as Group B inland waters) and freshwater fish culture (Group C inland waters). Discharge standards for Group B and Group C inland waters are listed in Tables 4 and 5 of the TM respectively.

Discharges of effluents into the foul sewerage system need to comply with the standards listed in Tables 1 and 2 of the TM.

For cooling water discharges, in addition to the TM requirements (which only apply to discharges of up to 6,000 m^3 per day), the EPD has required that discharges of between

6,000 and 1,000,000 m^3 per day have a temperature of not more than 35 °C and not more than 10 °C above influent temperature, and contain not more than 0.2 mg/l of total residual chlorine.

3.4.3 The Deep Bay "Zero Discharge Policy"

In addition to Table 8 of the TM, this policy aims to limit the decline of water quality in Deep Bay and its catchments. It requires that major developments within Deep Bay catchments and all new developments in sensitive areas of the catchment, where a connection to public sewer system is not feasible, do not increase existing pollution loads.

3.4.4 Construction Site Drainage Guidelines

The *Practical Note for Professional Persons on Construction Site Drainage* (PN1/94) issued by the EPD provides basic environmental guidelines for the handling and disposal of construction site discharges to minimise impacts on water quality.

3.4.5 Guidelines for Cooling Water Intakes

Although there are no water quality objectives for cooling water intakes, the threshold criteria for suspended solids specified by a number of users (eg Queen Mary Hospital, Wah Fu estate, and Lamma and Tsing Yi Power stations) is 140 mg l^{-1}. This level should be used as a guide, and requirements could vary according for different cooling water users.

3.4.6 WSD Standards for Flushing Water

For the saltwater used for toilet flushing, the Water Supplies Department (WSD) has its own standards for water quality intake points of sea water pumping stations. The WSD standards for suspended solids and dissolved oxygen are <10 mg l^{-1} and >2 mg l^{-1} respectively. Other WSD standards apply for ammonical nitrogen (<1 mg l^{-1}), 5-day biological oxygen demand (<10 mg l^{-1}), *E.coli* (<20,000 per 100 ml), turbidity (<10 FTU) and synthetic detergents (<5 mg l^{-1}).

3.4.7 Marine Sediment Regulations

Marine disposal of dredged materials is controlled under the *Dumping at Sea Ordinance 1995*, which has recently replaced the *Dumping at Sea Act 1974 (Overseas Territories) Order 1975 (App. III, p.DK1)* in its application to Hong Kong.

Dredged sediments destined for marine disposal are classified according to their level of contamination by seven toxic metals, as stipulated in the EPD Technical Circular (EPDTC) No. 1-1-92, *Classification of Dredged Sediments for Marine Disposal.* These are shown in *Table 3.4a* below.

Table 3.4a EPD Classification of Contaminated Sediments by Metal Content

Classification	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-149
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-199
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

Note: All units are mg/kg dry weight.

The contamination levels presented in the Technical Circular serve as criteria for determining the disposal requirements of marine dredged sediments. Definition of the classification is as follows:

- Class A - Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with the Water Quality Objectives (WQOs), or for protection of sensitive receptors near the dredging or disposal areas;
- Class B - Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimises the loss of pollutants either into solution or by resuspension; and
- Class C - Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal grounds and which must be effectively isolated from the environment upon final disposal.

It should be noted that for sediments to be identified within a particular class, only the concentration of one metallic species needs to be exceeded. In cases of Class B or Class C contamination, the final determination of disposal options, routing and issue of a permit to dispose of material at the designated disposal site will be made by the EPD and Fill Management Committee (FMC) in accordance with Works Branch Technical Memoranda Nos. 22/92 and 6/92. In the absence of specific standards and requirements for river sediment disposal, it is assumed that river sediments will be regulated in accordance with the present classification scheme for marine sediments.

3.5 Landscape and Visual Issues

There is no legislation in Hong Kong that relates directly to the assessment of the landscape or visual impacts of new developments or construction sites. However, a degree of control is achieved through the requirement to address visual issues as part of an environmental review and assessment process.

The EPD Advice Note 2/90 relating to the *"Application of the EIA Process to Major Private Sector Projects"* and the Technical Memorandum of the EIA Ordinance identifies visual impact as being an issue of concern and provides guidelines for carrying out landscape and visual assessments in Hong Kong. In addition, *HKPSG Chapter 10: Landscape and Conservation* outlines those criteria that should be considered when planning in an urban environment, and the Planning Department has issued a set of guidelines entitled *"Guidelines for Landscape and Visual Impact Assessment"*. Government requirements on the preservation and felling of trees are detailed in *Government General Regulation 740.*

3.6 Landuse Issues

The landuse and planning information to be used in the assessment will be derived from the plans, documents and strategies prepared under the requirements of the HKPSG.

The land gazettal procedure to be applied in the temporary and permanent acquisition of land will be that established under the *Railways Ordinance*.

3.7 Archaeological and Cultural Resources

The *Antiquities and Monuments Ordinance (Cap. 53)*, provides powers for the designation of Antiquities and Monuments Sites or Declared Monuments in Hong Kong. The Ordinance provides statutory protection against the threat of development for gazetted monuments, historic buildings and archaeological sites which have been approved by the Antiquities Advisory Board (AAB) to enable rehabilitation and maintenance works and facilitate public visits.

Deemed Monuments have been identified by the Antiquities and Monuments Office (AMO) and agreement reached with the owners of the Monument to provide for specific measures to ensure preservation. Deemed Monuments have the potential to be upgraded to statutory Declared Monuments.

The AMO has also assigned gradings to buildings of historic interest ranging from the most valued buildings at Grade 1 down to Grade 3. This classification is for AMO internal reference and has no statutory protection power.

Although there are no statutory provisions for the protection of Sites of Historical Interest, Deemed Monuments and Graded Buildings in Hong Kong, the Government has administrative procedures which state that consideration must be given to protect listed and locally designated historic buildings and sites of cultural interest. However, the current record of archaeological sites is known to be incomplete as many areas are not yet surveyed. Although *Section 11* (and its relevant sub-sections) of the *Antiquities and Monuments Ordinance* require any person who discovers an antiquity or supposed antiquity to report the discovery to the Antiquities Authority, there is a need to ensure that procedures and mechanisms, which ensure the preservation or formal notification of previously unknown archaeological resources that may be revealed or discovered during project assessment or construction, are identified at an early stage in Project planning.

3.8 Ecology

3.8.1 Hong Kong Regulations and Guidelines

Hong Kong Government Ordinances and Regulations relevant to ecological and related issues arising from the present project include:

- *The Forests and Countryside Ordinance* (Cap. 96), which protects both natural and planted forests and prohibits burning in open areas of the countryside;
- *The Forestry Regulations* (subsidiary legislation of Cap. 96), which protect specified local wild plant species (but not their habitats);
- *The Wild Animals Protection Ordinance* (Cap. 170), which protects listed species of wild animals by prohibiting the hunting of protected animal species and the taking, removing, injuring, destroying or wilfully disturbing of their nests or eggs. The Ordinance also provides for the protection of habitat via restriction of human entry (e.g. the Restricted Areas of Yim Tso Ha fung shui woods and the Mai Po Marshes), although West Rail will not directly affect either of these sites; and
- *The Town Planning Ordinance* (Cap. 131), which provides for the drawing up of statutory plans to control development and the provision of land use zonings, including Sites of Special Scientific Interest (SSSIs), Conservation Areas and Coastal Protection Areas, to protect natural features.

In addition, the ecological impact assessments described in this report make reference to the following documents:

- *Planning, Environment & Lands Branch Technical Circular No. 1/97 - Works Branch Technical Circular No. 4/97*, "Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures". This Technical Circular sets out guidelines for the implementation of the Government's policy on off-site ecological mitigation measures, which states *inter alia* that, where such a measure is required, it would be provided to the extent that it is practicable, on a 'like for like' basis and within the boundaries of Hong Kong;

- *The Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance, Cap. 499, S. 16)*, which provides guidance on the methodology of environmental (including ecological) impact assessment in Hong Kong;

- *The Hong Kong Planning Standards and Guidelines* (HKPSG), Chapter 10, "Conservation", which provides guidelines on incorporating nature conservation objectives into landuse planning and new development; and

- *The Agriculture & Fisheries Department (AFD) Fish Pond Categories*, which segregate Hong Kong fish ponds into four grades depending on surface area, proximity to other ponds, quality of management, security from development, and access (AFD undated map). Although this system is not contained within any body of regulations relative to conservation or development, it is a useful guide for assessing the nature of fish ponds in specific areas within Hong Kong, and is the only available grading system available prior to the release of the results of the Fish Pond Study by Planning Department. Therefore, this classification scheme is used in this study.

Table 3.8a lists the 1995 revised AFD categories of agricultural lands, including fish ponds. It should be noted that conservation of native flora and fauna is not a criterion of the AFD fish pond classification. However, it is considered that there is a general relationship between the classification scheme and the potential for ponds to provide foraging areas for birds: the better managed, more secure ponds (Grade A) would be expected to provide more reliable foraging areas over a longer time period than would Grade C or D ponds, which are susceptible to conversion for other uses.

According to AFD (1994, 1995), the total surface area of Hong Kong fish ponds declined by about 19% between 1994 and 1995 (*Table 3.8b*). The decline from 1760 ha to 1430 ha in total pond area was attributable mainly to losses of 189 of 1330 ha of Class A ponds (14 %), and 201 of 245 ha of Class C ponds (82 %). Fish ponds at Ma On Kwong were upgraded from grade B to grade A (*Table 3.8c*). Losses of fish ponds and arable land as identified in the revised categorisation were taken into account in this assessment.

Table 3.8a AFD Categorisation of Agricultural Land and Fish Ponds

Grade	Classification Criteria for Categorisation of Agricultural Land (Revised 1995)
A	• Areas with well-established agricultural land and/or fish ponds. • Areas with over 50% of arable land being actively cultivated. • Physical conditions for crop farming and intensive agricultural development are excellent. • Agricultural infrastructures such as road access, irrigation, drainage and marketing facilities are available. Infrastructural improvement required to bring fallow land back to cultivation is fairly minor. • Areas in which implementation of agricultural development projects (e.g. Agricultural Land Rehabilitation Scheme (ALRS), Accredited Farm Scheme (AFS)) are being implemented. • Areas acting as a flood plain or buffer zone. • Fish ponds under active cultivation, well managed and with good potential for continued development and/or with high ecological value.
B	• Areas with established agricultural land/ fish pond. • Substantial amount of fallow arable land yet level and concentrated. • Agricultural infrastructures such as road access, irrigation, drainage and marketing facilities are basically available. Infrastructural improvement required to bring fallow land back to cultivation is moderate. • The majority of fish ponds are actively operated and well managed but further development for pond fish operation may be limited either by the remoteness of the site, availability of suitable land or vulnerability to flooding.
C	• With physical constraints for agricultural development such as remoteness, inconvenient accessibility, inadequate irrigation water. • Agricultural infrastructures such as road access, irrigation, drainage and marketing facilities are inadequate. Infrastructural improvement required to bring fallow land back to cultivation is large. • Scattered small fish ponds. • Under high development pressure and/or being stocked up by property developers as land bank.
D	• Agricultural infrastructures such as road access, irrigation, drainage and marketing facilities are lacking. Major input in infrastructural improvement will be required to bring fallow land back to cultivation. • A large part of the area had been converted for non-agricultural uses which is unlikely to return for agricultural development in the area. • Scattered small fish ponds, most of which are either idle or filled.

Source: AFD 1995

Table 3.8b Comparison of Areas of Fish Ponds in 1994 and 1995

Grade of Fish Pond	Estimated Area of Fish Pond (ha)	
	1994[a]	1995[b]
A	1330	1141
B	185	231
C	245	44
D	*	14
Total	1760	1430

a: Agriculture and Fisheries Department. 1994. Categorisation of Fish Ponds.

b: Agriculture and Fisheries Department. 1995. Categorisation of Agricultural Land.

*: In 1994, fish ponds were categorised into A, B and C grades only.

Table 3.8c Historical Grading of Fish Ponds Potentially Affected by West Rail

District on the Proposed West Rail Alignment	Locations of Affected Fish Ponds in District, by Village	Grading	
		1994	1995
Ma On Kong	Shek Wu Tong Tin Sum Tsuen North Ho Pui Ng Ka Tsuen	B	A
Fung Kat Heung	Sha Po Tsuen Wing Ki Tsuen Cheung Chun San Tsuen Au Tau North	B	B
Ping Shan	Ping Shan ha Mei San Tsuen	C	C

Source: AFD 1995

3.8.2 International Conventions

This study has considered the following relevant international agreements.

3.8.2.1 RAMSAR Convention

The United Kingdom extended application of The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the *Ramsar Convention*) to Hong Kong in 1979. The People's Republic of China (PRC) is a signatory of the Ramsar Convention, and the Sino-British Joint Liaison Group has approved the Convention's continued application to Hong Kong after 1 July 1997. The Mai Po Marshes and Inner Deep Bay wetland was designated as a Ramsar site, or "Wetland of International Importance", under the Convention in 1995.

Article 1 of the Ramsar Convention defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters." All aquatic habitats in, and downstream of, the study area, including streams and river, man-made fishponds, mudflats and mangroves, qualify as wetlands under this definition. For the purposes of this study, flood-irrigated agriculture is considered to be a type of wetland because it is important in terms of surface area and wildlife use in the study area. Hence, it is referred to as "agricultural wetland" habitat.

The Ramsar Convention also requires that contracting parties strive for "wise use" of wetlands in their development and planning strategies (Article 3.1). Annex 1 to Recommendation 3.3 of the 3rd Meeting of the Conference of the Contracting Parties to the Ramsar Convention (Regina, 1987), defines the "wise use" of wetlands as "their sustainable utilisation for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem", and "natural properties of the ecosystem" as "those physical, chemical and biological components, such as soil, water, plants, animals and nutrients, and the interactions between them".

The Ramsar Convention Guidelines for the Implementation of the Wise Use Concept state that, with regard to particular wetland sites, Contracting Parties should integrate "from the outset... environmental considerations in planning of projects which might affect the wetland (including full assessment of their environmental impact before approval, continuing evaluation during their execution, and full implementation of necessary environmental measures)" (Annex to Recommendation 4.10 of the 4th Meeting of the Conference of the Contracting Parties, Montreux, Switzerland, 1990). This applies to all wetlands within the territory of a Contracting Party to the Convention.

The ecological value of wetlands in the North West New Territories is high (Chu, 1995) and is the subject of an ongoing Fish Pond Ecology study commissioned by the Planning Department. Although fishponds are man-made wetlands, it is recommended that their natural properties be maintained.

3.8.2.2 Bonn Convention

Through the United Kingdom, Hong Kong was a Party to the Convention on the Conservation of Migratory Species of Wild Animals (the *Bonn Convention*). The PRC is not a signatory of the Bonn Convention. However, the Sino-British Joint Liaison Group approved its continued application to Hong Kong after 1st July 1997.

The Bonn Convention has two major objectives:

- To provide strict protection for species listed in Appendix I of the Convention (migratory species in danger of extinction throughout all or a significant portion of their range); and

- To encourage Range States for such species to conclude agreements for the conservation and management of Appendix II species (migratory species which have an unfavourable conservation status and require international agreements for their conservation, or which have a conservation status which would significantly benefit from international co-operation). At present no such agreements are relevant to Hong Kong.

The first objective above includes obligations to conserve and restore those habitats which are important in removing the species from danger of extinction, and to prevent, remove, compensate for or minimise the adverse effects of activities or obstacles that impede or prevent migration of the species. The five species listed below in *Table 3.8d* are listed in Appendix I of the Bonn Convention and occur in the Deep Bay area of Hong Kong, which lies downstream of the study area for this project. The Indus and Beas Rivers are tributaries of the Shenzhen River, which are a primary source of fresh water supply to Deep Bay. Therefore, habitats in the Indus and Beas watersheds, and any alterations to them, are directly relevant to the conservation management of Appendix I species occurring in the Deep Bay area.

Table 3.8d Endangered Species listed in Appendix 1 of the Bonn Convention

Species	Scientific Name
Dalmatian Pelican	*Pelecanus crispus*
Chinese Egret	*Egretta eulophotes*
Oriental White Stork	*Ciconia boyciana*
Relict Gull	*Larus relictus*
Saunders' Gull	*Larus saundersi*

3.8.2.3 United Nations Convention on Biodiversity

Both the UK and the PRC are Contracting Parties to the United Nations Convention on Biological Diversity of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. Article 8 of the Convention states (Paragraph (c)) that each Contracting Party shall "regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use." Paragraph (d) of Article 8 adds that each Contracting Party shall "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings, while paragraph (f) states the requirement to "rehabilitate and restore degraded ecosystems". Article 10 of the Convention requires signatories to integrate consideration of biodiversity conservation and sustainable use into decision-making, and adopt measures to avoid or minimise adverse impacts on biodiversity.

The UK did not extend application of the Convention to Hong Kong, nor has the PRC indicated whether it will extend application to Hong Kong. However, the Hong Kong Government has stated that it is "committed to meeting the environmental objectives" of the Convention (PELB, 1996).

3.8.3 Protected and Restricted Areas

3.8.3.1 Country Parks and Special Areas

No Country Parks or Special Areas will be directly affected by West Rail. The north tunnel portal will lie outside the boundaries of Tai Lam Country Park, while the tunnel itself will pass underneath the park.

3.8.3.2 Marine Parks and Marine Reserves

There are no Marine Parks or Reserves in the vicinity of the West Rail alignment.

3.8.3.3 Mai Po Marshes

Lying approximately 2.5 km northeast of Tin Shui Wai, the Mai Po Marshes and associated mangroves are a Restricted Area under the Wild Animals Protection Ordinance. This designation was made to protect waterbirds and other wildlife found within the marshes. Entry to the area is restricted to holders of AFD permits throughout the year, making it the best-protected nature conservation area in Hong Kong. This area lies downstream of the West Rail alignment, and thus is potentially subject to impacts arising from water quality or sediment quality degradation resulting from West Rail construction.

3.8.3.4 RAMSAR Site

In 1995 the Hong Kong Government declared Hong Kong's first Wetland of International Importance ("Ramsar Site") at Mai Po Marshes and Inner Deep Bay. As of 1 July 1997, it is the seventh Ramsar site of the PRC. On the landward side, the Ramsar Site covers the land area within Deep Bay Buffer Zone 1 (Town Planning Board, 1994), with the exception that most of the Mong Tseng Peninsula is excluded. On the seaward side, the Ramsar Site extends to the southern edge of the main navigation channel serving the Shenzhen River.

The Deep Bay Ramsar Site is downstream of the West Rail alignment and is, therefore, potentially subject to impacts arising from water quality or sediment quality degradation resulting from construction.

3.8.3.5 Sites of Special Scientific Interest (SSSIs)

The designation of SSSI is given in Hong Kong in order to mark sites of special biological or geological value. The designation has legal status under the Town Planning Ordinance, although the Ordinance has relevance to individual SSSIs only in cases where a designated SSSI has been zoned as such in a statutory town plan. This covers approximately a quarter of all designated SSSIs.

SSSIs near the study area are (in rough order of increasing distance from the site):

- Tsing Shan Tsuen (SSSI No. 8): the smallest SSSI in Hong Kong, established in 1975 to protect two *Cinnamomum cassia* trees, an introduced species;
- Castle Peak (SSSI No. 29): established in 1979 to protect plant species and ravine vegetation communities on Castle Peak;
- Inner Deep Bay (SSSI No. 46): the largest SSSI in Hong Kong, established in 1986. Key features are mangroves, mudflats essential for feeding of migrant birds, and habitat for species of economic value and scientific importance. Identified risks to the site include development projects within the Northwest New Territories, particularly at Tin Shui Wai, which may threaten the site through dredging, mangrove felling, or pollution;
- Tsim Bei Tsui (SSSI No. 41): established in 1984 to protect a mangrove community on the shores of Deep Bay;
- Tsim Bei Tsui Egretry (SSSI No. 47): established in 1988 to protect an egretry in fung shui woodlands at Tsim Bei Tsui; and
- Mai Po Marshes (SSSI No. 10): established in 1975 to protect Hong Kong's largest area of mangroves, gei wais, and bird feeding, wintering and nesting areas. The site is also, as noted above, a Restricted Area. Identified risks to the site include developments on the landward side of the site.

3.8.3.6 Other Planning Categories

Statutory landuse zones of Conservation Area and Green Belt occur in or near the study area. Like the SSSI designation, these categories derive their legal status from the *Town Planning Ordinance Cap. 131* and are indicated on Development Permission Area (DPA) plans or Outline Zoning Plans (OZPs).

The objective of the Conservation Area zoning is "to retain existing natural features and rural use", while Green Belt is intended "to define the limits of urban development area by conserving landscape features" (Planning Department, 1995). As such, the latter is not strictly an ecological category.

Outline Zoning Plans (OZPs) that cover the study area include:

- Kam Tin North OZP S/YL-KTN/1;
- Kam Tin South OZP S/YL-KTS/1;
- Yuen Long OZP S/YL/2;
- Lam Tei and Yick Yuen OZP S/TM/-LTYY/1;
- Ping Shan OZP S/YL-PS/1; and
- Tuen Mun OZP S/TM/8.

3.8.4 Government Policy on Assessment and Mitigation of Ecological Impacts

At present, the main guidelines on ecological assessment and mitigation available from Government are those contained in the *Technical Memorandum on Environmental Impact Assessment Process* (the "Technical Memorandum"). Annex 16, Appendix A, Note 2 of the Technical Memorandum sets forth a number of "important habitats which will need an ecological assessment". These include the following categories which occur on or near the West Rail alignment:

- Mature woodland of over 1 ha in area;
- Natural stream courses and rivers of over 100 m in length;
- Freshwater wetlands of over 0.5 ha in area; and
- Other wetlands (under the Ramsar Convention definition, which would include fishponds) of over 1 ha in area.

According to the Technical Memorandum, following assessment of the severity of impacts arising from a project, the policy for mitigating serious impacts on habitats and wildlife is to pursue impact avoidance, impact minimisation, and impact compensation in that order of priority (Technical Memorandum). Impact *avoidance* typically consists of modifications to the existing project design, but may in extreme cases require abandonment of the project (the "no-go" alternative). Impact *minimisation* includes any means of reducing the scope or severity of a given impact (e.g. through timing of construction works, modification in design, or ecological restoration of disturbed areas following the completion of works). Impact *compensation* assumes that an irreversible impact will occur upon a given habitat or species and attempts to compensate for it elsewhere (e.g. by enhancement or creation of suitable habitat). Compensation may take place on-site or off-site. The latter is defined as "off-site mitigation" for the purposes of this study.

According to the PELB/Works Branch Technical Circular on off-site mitigation of ecological impacts, off-site mitigation should be considered only if significant residual impacts remain after all on-site opportunities have been exhausted. Off-site mitigation proposals should be based on the "like for like" principle enshrined in the Technical Circular, and every attempt should be made to place mitigation sites as close as possible to the project site. The PELB/Works Branch Technical Circular was introduced after the commencement of the West Rail EIA. However, KCRC has indicated its willingness to comply with its provisions.

Finally, the Technical Memorandum and other Government documents recommend that cumulative impacts be considered in undertaking environmental impact assessments.

3.9 Waste

The following legislation relates to the handling, treatment and disposal of wastes in Hong Kong, and will be considered in assessing potential impacts and their avoidance or mitigation:

- *The Waste Disposal Ordinance (Cap 354);*
- *The Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);*
- The *Crown Land Ordinance (Cap 28);*
- The *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws;* and
- *Dumping At Sea Ordinance (Cap 466).*

The *Waste Disposal Ordinance* (WDO) prohibits the unauthorised disposal of wastes. Construction waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Under the WDO, wastes can only be disposed of at sites licensed by the EPD.

Under the *Waste Disposal (Chemical Waste) (General) Regulation* all producers of chemical wastes (including asbestos) must register with the EPD and treat their wastes, either utilising on-site plant licensed by the EPD, or arranging for a licensed collector to take the wastes to a licensed facility. The regulation also prescribes the storage facilities to be provided on site, including labelling and warning signs, and requires the preparation of written procedures and training to deal with emergencies such as spillages, leakages or accidents arising from the storage of chemical wastes.

Construction wastes which are wholly inert may be taken to public dumps. Public dumps usually form part of land reclamation schemes operated by the Civil Engineering Department (CED). The *Crown Land Ordinance* requires that dumping licences are obtained by individuals or companies who deliver suitable construction wastes to public dumps. The licences are issued by the CED under delegated powers from the Director of Lands.

The *Public Cleansing and Prevention of Nuisances By-Laws* provide further controls on the illegal tipping of wastes on unauthorised (unlicensed) sites.

The following documents and guidelines also relate to waste management and disposal in Hong Kong:

- *Waste Disposal Plan for Hong Kong (December 1989), Planning, Environment and Lands Branch, Hong Kong Government Secretariat;*
- *Environmental Guidelines for Planning In Hong Kong (1990), Hong Kong Planning and Standards Guidelines, Hong Kong Government;*

- *New Disposal Arrangements for Construction Waste (1992), Environmental Protection Department and Civil Engineering Department;*
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), Environmental Protection Department;*
- *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste, Environmental Protection Department;*
- *Works Branch Technical Circular No 2/93, Public Dumps;*
- *Works Branch Technical Circular No 16/96, Wet Soil in Public Dumps;*
- *Environmental Protection Department Technical Circular No. 1-1-92, Classification of Dredged Sediments for Marine Disposal; and*
- *Technical Circular No. 22/92, Marine Disposal of Dredged Mud, Works Branch.*

3.10 Land Contamination

There are currently no legislative standards or requirements for the assessment of contaminated land for development projects in Hong Kong. Assessment of land contamination and the potential impacts to particular development projects may have to be undertaken under the EPD's direction and oversight in accordance with the *Practice Note for Professional Persons ProPECC PN 3/94 "Contaminated Land Assessment and Remediation".*

The following legislation and guidelines are also relevant:

- *The WPCO*;
- *Technical Memorandum on the Standards for Effluents discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*;
- The *Waste Disposal Ordinance (Cap 354);*
- The *Waste Disposal (Chemical Waste)(General) Regulation (Cap 354)*;
- *A Guide to the Registration of Chemical Waste Producers*;
- *A Guide to the Chemical Waste Control Scheme; and*
- *Dutch Ministry of Public Housing, Landuse and Environment Guidelines (Dutch A, B, C guide Values)*, used as assessment criteria by EPD.

3.11 Hazards

The requirement to undertake the hazard assessments performed as part of the West Rail EIA for Potentially Hazardous Installations (PHIs) and landfill gas hazard assessments, respectively, are documented in Sections 11 and 6.5 of Chapter 9 of the HKPSG. These sections set out the requirement to perform a Hazard Assessment when a proposed development impacts an existing designated facility. The determination of whether an impact is sustained by the facility is made by delineating a "Consultation Zone" around the facility; any development which crosses into or borders the Consultation Zone requires a Hazard Assessment to be undertaken. In the cases of the Au Tau Water Treatment Works and the Gin Drinkers Bay landfill at Kwai Chung, which are the subject of the Hazard Assessments conducted for West Rail, these consultation zones are set at a radius of 1 km and 250 m respectively.

Results of the hazard assessments are compared with Government Risk Guidelines provided by the EPD in both cases.

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4.3 Impact Assessment Terminology

In evaluating and describing an impact, an EIA assessment team needs to take into account any standards or criteria (whether quantitative or qualitative) which are applicable to the project or which have been adopted for the EIA study. In some cases, especially where qualitative criteria are used or where no specific criteria exist, a consensus of professional judgement about the acceptability or significance of an impact may be sought.

However, the significance of an impact is not merely a measure of its compliance with a standard or criteria nor of its perceived acceptability. Significance may also involve questions of:

- The magnitude of the impact and the size of the exceedance;
- The number of people affected and their sensitivity;
- The scale or amount of the resources affected and their value and sensitivity; and
- The tractability of the issue or problem.

A number of different approaches are being taken in describing predicted impacts in this EIA study.

Firstly, for areas where quantified standards or criteria are used, an impact may be described as acceptable or in compliance (on the one hand) and unacceptable or failing to comply (on the other hand). Generally speaking, an impact which does not comply is considered as *significant*, and the measure of its significance will take into account the factors listed above. Impacts relating to air quality, water quality, noise, waste management and hazards are evaluated in this way.

Secondly, issues such as impacts on landscape and ecological resources (for which no quantitative criteria are applied), are described with terms indicating a *gradation* of significance. As outlined in the Inception Report:

- Landscape impacts are rated as "very slight", "slight", "moderate", "substantial" or "very substantial"; and ecological impacts are termed "minimal", "moderate" or "severe".

Finally, areas such as archaeology and culture, landuse and land contamination use no particular terminology for acceptability or significance, relying largely on professional judgement and common terms of speech to describe the importance and significance of impacts.

4.4 Noise

4.4.1 Construction Phase

4.4.1.1 Spatial Scope

The spatial scope of the assessment of airborne construction noise is defined by the distance from powered mechanical and percussive equipment within which the construction noise requirements or criteria described in *Section 3.2* are likely to be exceeded.

4.4.1.2 Prediction Methodology

The prediction of noise impacts undertaken for the Final Assessment Report is focussed on identifying all existing and committed landuses in the vicinty of the development, selecting representative receivers which are generally nearest to the alignment and, using specific information obtained from engineering Design Consultants concerning activity scheduling and plant teams and the methodology described below, performing an assessment of noise impacts at the receivers to quantify the level of impact expected. Mitigation measures are then evaluated and recommended where necessary to control the impacts at these receivers, while at other locations, the effects of construction noise is expected to be lower than the representative NSRs and with this, be adequately protected by the proposed measures.

The route has been divided into sections that match those defined for the individual engineering contracts setup by West Rail. The locations of representative and other receivers for assessment have been identified in consultation with the EPD and updated following comment by other Government departments. The consideration of committed development affects the noise sensitivity rating of the assessment areas during the West Rail construction programme. *Figures 2-18* in *Annex A* of the Technical Annexes show the proposed route alignment and location and identity of noise sensitive receivers (NSRs).

The technical methodology for assessing construction noise other than percussive piling is based on TM2 (described in *Section 3.2*). This methodology is as follows:

- Locate NSRs that may be affected;
- Calculate the distance (including geometric spreading and other absorption effects where relevant) and barrier attenuation (including effects of terrain) from a notional noise source point within the construction work site;
- Calculate the maximum total site sound power level (SWL) for construction activities using powered mechanical equipment (PME), using SWL data given in the TM. Where such data are not available for certain PME, the respective SWL will be obtained from other sources eg BS5228, manufacturer's data and actual monitoring data; and

- Predict construction noise levels at NSRs, with a facade correction, in the absence of any mitigation measures.

Where noise assessment criteria are exceeded at NSRs, appropriate mitigation measures have been evaluated and recommended. A systematic approach to the evaluation of mitigation measures has been adopted, including consideration of the three levels of mitigation (and combinations of each level) described in *Table 4.4a*.

Table 4.4a Primary Construction Noise Mitigation Strategy

Mitigation	Description
Level One	Selection of quiet plant and working methods
Level Two	Construction of temporary noise barriers
Level Three	Reduction of plant teams

In general, noise barriers of 3 to 5 metres located on site boundaries between noisy construction activities and NSRs can give up to 5 dB(A) reduction from screening. Barriers in the form of site hoardings can achieve this level of reduction although care in the location of site access needs to be taken to ensure effectiveness of the barriers. Certain types of PME, such as generators and compressors, can be completely enclosed to give a total reduction in SWL of 10 dB(A) or more. Movable barriers that can be located close to noisy plant can also be very effective at screening NSRs from particular plant.

Some models of plant are quieter than the standard types listed in TM2. Quiet plant is defined as PME whose actual SWL is less than the value specified in the TM for the same piece of equipment. The benefits achieved in using quiet plant will depend on the Contractor's chosen methods of working. Examples of SWLs and Sound Pressure Levels (SPLs) at a reference distance for specific silenced PME that may be used in the construction of West Rail are given in *Table 4.4b*.

Choice of the number and types of construction plant is usually left to the Contractor, allowing flexibility in devising working methodologies. However, in combination with the selection of quiet plant, limiting plant numbers may be needed to provide further mitigation of construction noise levels at source.

Table 4.4b Listing of Quiet Plant

Powered Mechanical Equipment (PME)	Maximum SWL dB(A)	Equivalent TM2 CNP Reference
Bored Piling Rig	110	CNP 165
Breaker	108	CNP 024
Bulldozer	110	CNP 030
Concrete Pump	105	CNP 047
Dump Truck	110	CNP 067

Powered Mechanical Equipment (PME)	Maximum SWL dB(A)	Equivalent TM2 CNP Reference
Excavator	105	CNP 081
Generator	100	CNP 101
Generator (silenced)	100	CNP 103
Loader	105	CNP 081
Lorry	105	CNP 141
Poker Vibrator	110	CNP 170
Mobile Crane	105	CNP 048
	SPL at 7 m	
Modern Breakers (mounted on demolition robot)	89-91	
Modern Saw (power wire saw, or modern wall saw)	76-81	
Kick Ripper, Saw and lift method	78-80	
Bursting System	70-72	
Crusher (hand held or mounted on demolition robot; hydraulic)	67-69	
Pipe Jacking	60-65	
Non explosive chemical agent	60-65	

4.4.2 Operational Phase

4.4.2.1 Introduction

This specialist component of the assessment evaluates airborne noise impacts from the operation of West Rail and its associated facilities. Operational airborne noise impacts for West Rail derive from three potential sources:

- Airborne noise from passenger rolling stock on West Rail and train induced vibration in elevated structures re-radiated as noise;
- Maintenance activities at the depot and along railway tracks; and
- Fixed electrical and mechanical plant (including ventilation systems), which are likely to be the dominant sources of noise within the vicinity of passenger stations, traction substations and ventilation buildings.

4.4.2.2 Spatial Scope

The spatial scope of the operational noise assessment is defined by the distance from the sources of airborne noise at which the operational noise criteria described in *Section 3.2* are likely to be exceeded.

4.4.2.3 Technical Scope

The technical scope of the operational noise study is described below.

4.4.2.3.1 Baseline Conditions

The assessment has considered existing and committed land uses in the study area and identified representative NSRs. Existing NSRs have been located through field visits. For committed developments, representative NSRs have been identified by reference to Outline Zoning Plans and Planning Department information, in accordance with the NCO and the Hong Kong Planning Standards and Guidelines (HKPSG).

4.4.2.3.2 Noise Assessment

For noise from operating trains, the assessment methodology uses an expected rolling stock design noise level, determined in consultation with the EPD, which allows for normal deterioration in rail and rolling stock conditions and takes account of the worst case operating scenario. Train noise predictions will be undertaken using the *UK Noise Advisory Council's* publication, *A Guide to the Measurement and Prediction of the Equivalent Continuous Sound Level.* The EPD has also agreed to the use of the UK methodology *Calculation of Rail Noise* (CRN) as a suitable platform for the railway noise propagation model.

This assessment presents results from the final noise calculations for rail noise at critical NSRs. Noise levels at identified NSRs are compared with the relevant noise standards and criteria to determine the required mitigation measures.

Noise levels from fixed plant and activities associated with the West Rail Depot have been calculated in detail. This is considered to represent the most important source of such noise, and specific mitigation measures are specified where required. Noise from other fixed plant locations has also been investigated, where these are currently known.

4.4.2.3.3 Noise Mitigation Measures

This report presents the specification for noise mitigation measures in detail. The required measures are the result of a six month intensive study period of the Operational Noise Working Group (ONWG), established by KCRC. The product of this study is an innovative system capable of outperforming noise barriers and thus, significantly improving the best practicable mitigation technology without resorting to wide scale use of full enclosures. The use of full noise enclosures has not been considered practicable owing to the safety and ventilation requirements that would render the use impractical other than in localised situations; as a consequence, the maximum length of enclosure permitted by these constraints is 230 m.

In addition, the ONWG has undertaken an integrated design approach to minimise reradiated noise from elevated structure through the design of trackform and structure and, in combination with airborne noise, control measures will provide the highest level of total noise control known for an elevated railway without full enclosure. Full details of the design specifications and generic design details are given in *Annex E.*

Provision of indirect mitigation mitigation measures on a limited scale will be necessary where best practice is insufficient to achieve the required criteria. The maximum extent identified in the IAR of some 80 properties will be reduced by the innovative mitigation measures developed for this project.

Stations are enclosed generally and therefore offer screening for train operational noise and station noise sources such as public address systems and passengers.

4.4.2.4 Prediction Methodology

4.4.2.4.1 Train Noise

Airborne train noise has been modelled using the detailed prediction methodology agreed with the EPD. This methodology is based on the *Calculation of Railway Noise* (CRN) methodology for calculation of $L_{Aeq(period)}$ in the reference time bands given by the HKPSG and NCO, and uses comparative source data for the electric multiple unit (EMU) proposed by KCRC. For the calculation of maximum noise levels (L_{Amax}), which is not allowed for in the CRN methodology, standard formulae have been used to convert Sound Exposure Level (SEL) values for individual train passbys to maximum noise levels.

The train noise source term of an EMU has been based on the MTRC Lantau Airport Railway specification of a maximum level (L_{max}) of 83 dB(A) at a distance of 25m and speed of 135 kph, for a disc braked EMU train travelling on ballasted track. This is equivalent to 82.5 dB(A) at 130 kph, the maximum line speed for West Rail. The SEL of a West Rail passenger train, which is 12 cars in length (300m) during the full development stage, is calculated to be 91.7 dB(A). A further 2 dB(A) is added for airborne noise from viaducts with slab track. A spectral profile is presented in detail in *Annex E*, and derived from empirical data from the MTRC Kwai Fong Viaduct.

As recommended by the EPD, a margin of 3 dB(A) has been added to predicted noise levels to account for the possibility of poor track conditions, wear in wheel treads, and other factors not accounted for in the base noise level predictions.

Because standard noise criteria as adopted for this project are related to the noise level at 1 metre from a facade, a correction of 2.5 dB has been added to account for facade reflection effects.

Principal Algorithims Adopted in Prediction Methodology

The following standard formulae have been used in the prediction methodology for alignment north of the West Rail Depot using a model developed by ERM and written in BASIC. Within the Depot and for the short section to the South of the tunnel portal, the train rolling noise has been evaluated using SoundPLAN and the CRN methodology. All calculations are based upon KCRC CAD design files giving track alignment and locations of points and crossings. Permanent way type and speed profiles are derived from KCRC design data.

- Attenuation due to geometric spreading (Lmax): 20 Log (25/d m)
- Angle of view correction: 10 Log (θ /180°)
- Airborne Speed Correction: 30 Log (V/130 kph)
- Structure-borne Speed Correction: 25 Log (V/130 kph)
- Barrier Correction: After Maekawa - see *Annex E*
- Sound Exposure Level: Lmax + 10 Log (l / V) + 10.5 - 10 Log ((4D/4D^2 +1) + 2 tan^{-1} (1 / 2D)), where l is train length (m), V is train speed (kph), d is distance from track, and D = d /l.
- Leq (calculated for each track individually and logarithmically summed): SEL + 10 Log N/T, where N is the number of trains in period T (1800 seconds under NCO)

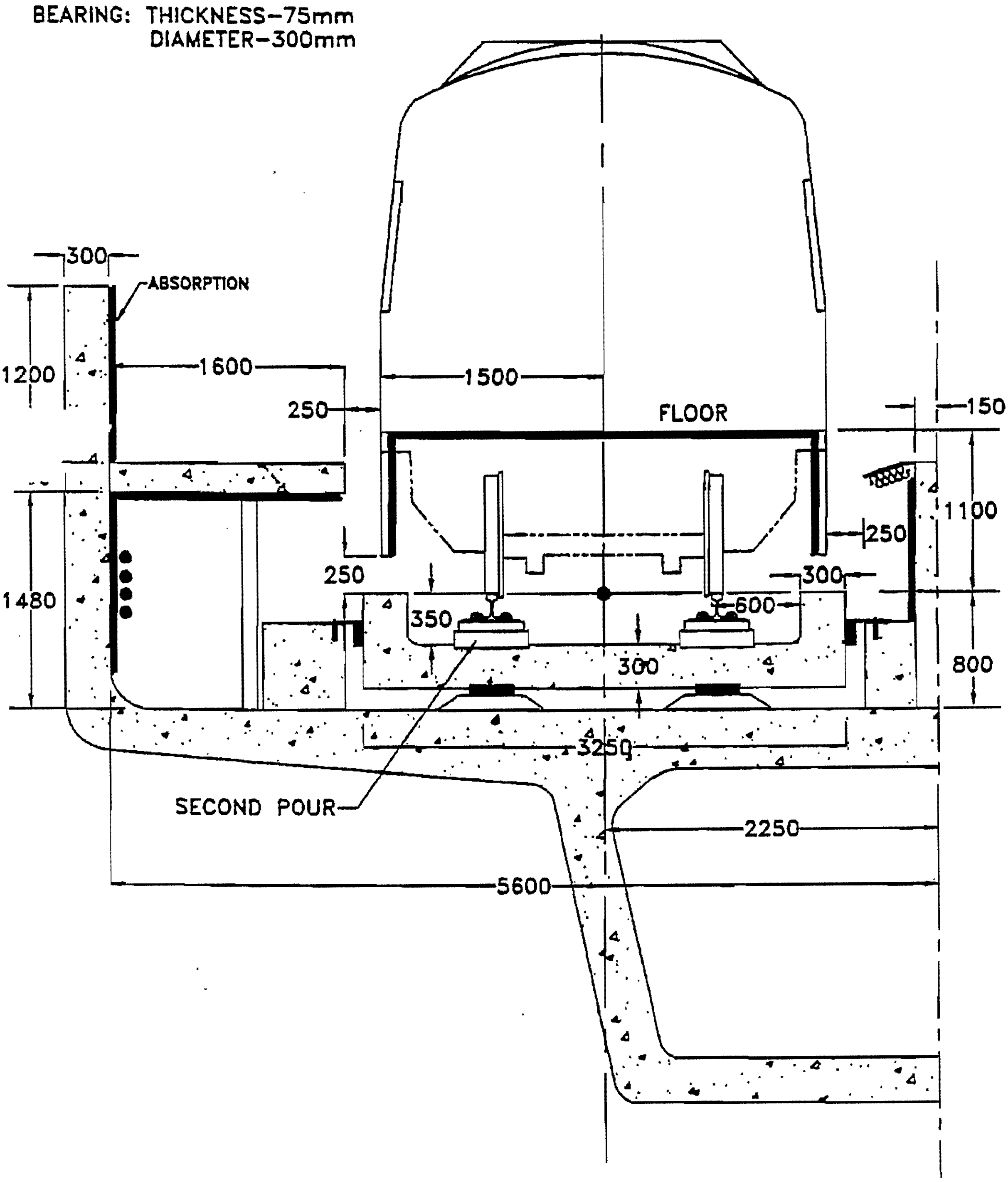
Calculation of Noise Levels After Mitigation

<u>Track-Form Noise Mitigation Measures</u>

Following the results presented in the Initial Assessment Report, it was determined that for all track sections which are not in tunnel, the design of the track form should incorporate specific measures to mitigate the significant noise impacts which had been identified. The four measures which were investigated are:

- The use of resilient rail baseplates for track on viaduct, to reduce vibration transmission to the viaduct structure and thereby reduce re-radiated noise from the structure;
- For track on viaduct, mounting the track on a floating slab system to further reduce vibration transmission to the viaduct structure;
- The use of extended wheel skirts and absorptive lining beneath the car, to create an acoustic plenum in the under-car area. In normal running, the skirts would extend to approximately 250 mm above the derailment containment upstand on the floating slab; and
- The creation of a second acoustic plenum on either side of the car, using either a walkway at the side of the track or a purpose-built construction. This would also incorporate absorptive lining in the area beneath the plenum. On tangent track, there would be a gap of approximately 250 mm between the edge of the plenum and the side of the car.

As shown in *Figure 4.4a*, the edge of the viaduct will extend to 1200 mm above the side of the walkway (approximately 2100 mm above top of rail) and will form an additional barrier for low-rise receivers. This will be lined with absorbing material to enhance its



NOT TO SCALE

CROSS SECTION OF KCRC WEST RAIL VIADUCT DESIGN - TANGENT TRACK

FIGURE 4.4a

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acoustic performance. Where required. this barrier can be extended upward to provide an additional 4 metres of barrier height and associated additional acoustic control.

Preliminary investigation revealed that in order to achieve the required noise criteria. all four of the above mitigation measures will be required to be incorporated in the basic track design, in addition to the use of higher edge barriers in some sections.

On non-viaduct track sections, it is assumed in this report that the same track-form as for viaduct structures would be used - that is, a non-ballasted track-form incorporating acoustic plena and a basic edge barrier as described above. Alternative designs are also possible for these sections, but any design used would need to provide acoustic performance at least matching that of the system described above.

Source Noise Levels After Mitigation - Air-Borne Noise

With the above double-plenum noise reduction system, the source of air-borne wheel/rail noise from the train can be considered to be the gaps at the top of the two plena on either side of the car. The effective sound power level radiated from these plena depends on the source level generated at the wheel/rail interface, the size of the plena, the extent and effectiveness of absorbing material in the plena and the size of the gap at the outlet of each plenum. For double-track viaduct sections, the effectiveness of the central plenum (referred to as the inboard plenum) is lower than that of the outboard plenum due to its smaller volume.

The noise level emanating from the top of each plenum was calculated by WIA, in terms of the maximum passby noise spectrum at 25 m from the train. The calculations and results are presented in *Annex E* and in *Figure 4.4b*. These calculations indicate an attenuation of approximately 18 dB(A) compared with the initial source noise level for the outboard plenum, and approximately 14 dB(A) for the inboard plenum.

An alternative calculation of plenum attenuation was performed independently by ERM. incorporating the assumption of a line source for direct noise generation and more conservative assumptions relating to low-frequency absorption. As shown in *Figure 4.4c*, the two procedures produce very similar results, with the ERM procedure predicting somewhat higher attenuations at high frequencies and lower at low frequencies. Overall. predicted attenuations are similar. In basic calculations of noise levels at NSRs, as reported below, the WIA values are used.

The variation in maximum train noise level with speed can be conservatively estimated to follow a 30 log(Speed) relationship, and this was assumed in detailed calculations at NSRs. Where the track curves, the gap at the top of the inboard and outboard plena will necessarily be wider than 250 mm, and can be up to approximately 350 mm. In these cases. the noise level generated is assumed to vary as 10 log(G/250), where G is the gap width in mm.

Source Noise Levels After Mitigation - Viaduct-Radiated Noise

Noise levels radiated from the viaduct due to structure-borne vibration were calculated by WIA, as reported in *Annex E*. Calculations used finite element analysis, and incorporated a detailed model of the rail, slab and viaduct system. They used conservatively high estimates of rail roughness, based on standard data which have been empirically verified. The final recommended vibration isolation system incorporates a floating slab tuned to 13 Hz (static) and rail baseplates with a stiffness of 21 kN/mm (static).

Figure 4.4d shows calculated noise emission from this source, in terms of the maximum passby noise level at 25 m for a train at 130 km/h. The figure shows the spectrum for a standard double viaduct structure. This spectrum gives a radiated noise level of 59 dB(A) at 130 km/h, 25 m from the track for a double viaduct construction.

The level from a single viaduct will be lower than shown in *Figure 4.4d*, as the structure is stiffer and has a smaller radiating area. However, in calculations it was conservatively assumed that the emission level shown in *Figure 4.4d* would apply for all viaduct structures along the route.

The variation in maximum structure-borne noise level with train speed was assumed to follow a 25 log(Speed) relationship.

Source Noise Levels - Points and Crossings

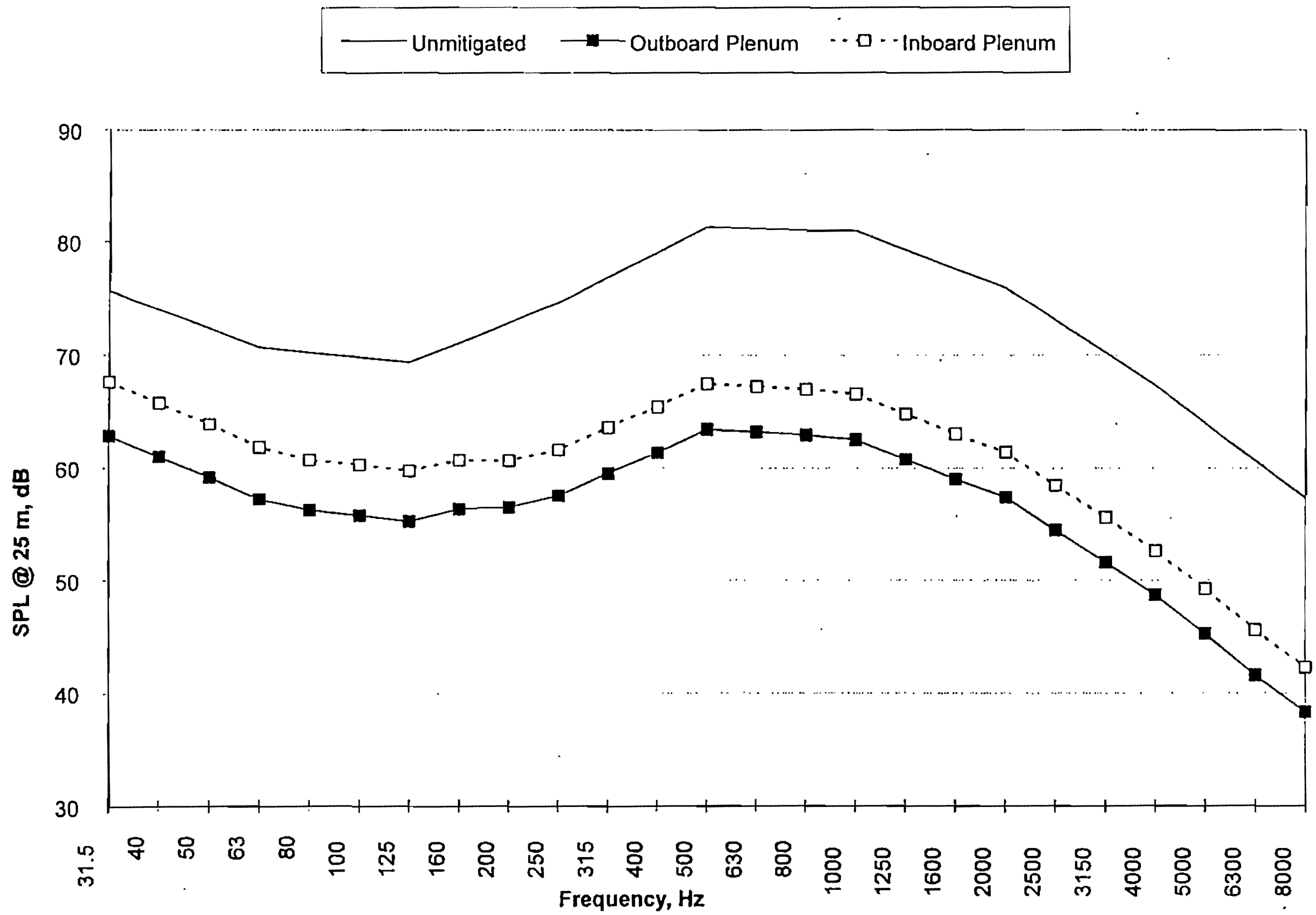
Maximum A-weighted noise levels likely generated at 25 m points and crossings, through air-borne and viaduct-radiated noise from a train at 130 km/h, are shown in *Table 4.4c*. Note that at these locations an inboard plenum cannot be provided, and the effectiveness of the under-car plenum may be reduced due to changing track alignment. Hence, the air-borne noise levels shown are without these mitigation measures. However, it is assumed that a vibration isolation system can be designed to provide equivalent performance in attenuating structure-borne noise to that described above for a standard track on viaduct.

Table 4.4c Maximum Noise Levels At Points And Crossings

	Maximum Noise Level at 25 m, 130 km/h - dB(A)	
	Air-borne Noise (Inboard Plenum)	Viaduct-Radiated Noise
Standard Viaduct	74	59
Points / Crossings	97	63

The same variation with train speed as described above for air-borne and structure-borne noise is assumed for noise from points and crossings.

Since here the source is effectively a point source rather than a line source, the conversion from maximum noise level to a sound exposure level, and the reduction in SEL with distance, is not as described previously for a train movement. The appropriate formula is



SOURCE NOISE LEVELS FROM PLENUM GAPS (130 kph, 250mm gap)

FIGURE 4.4b

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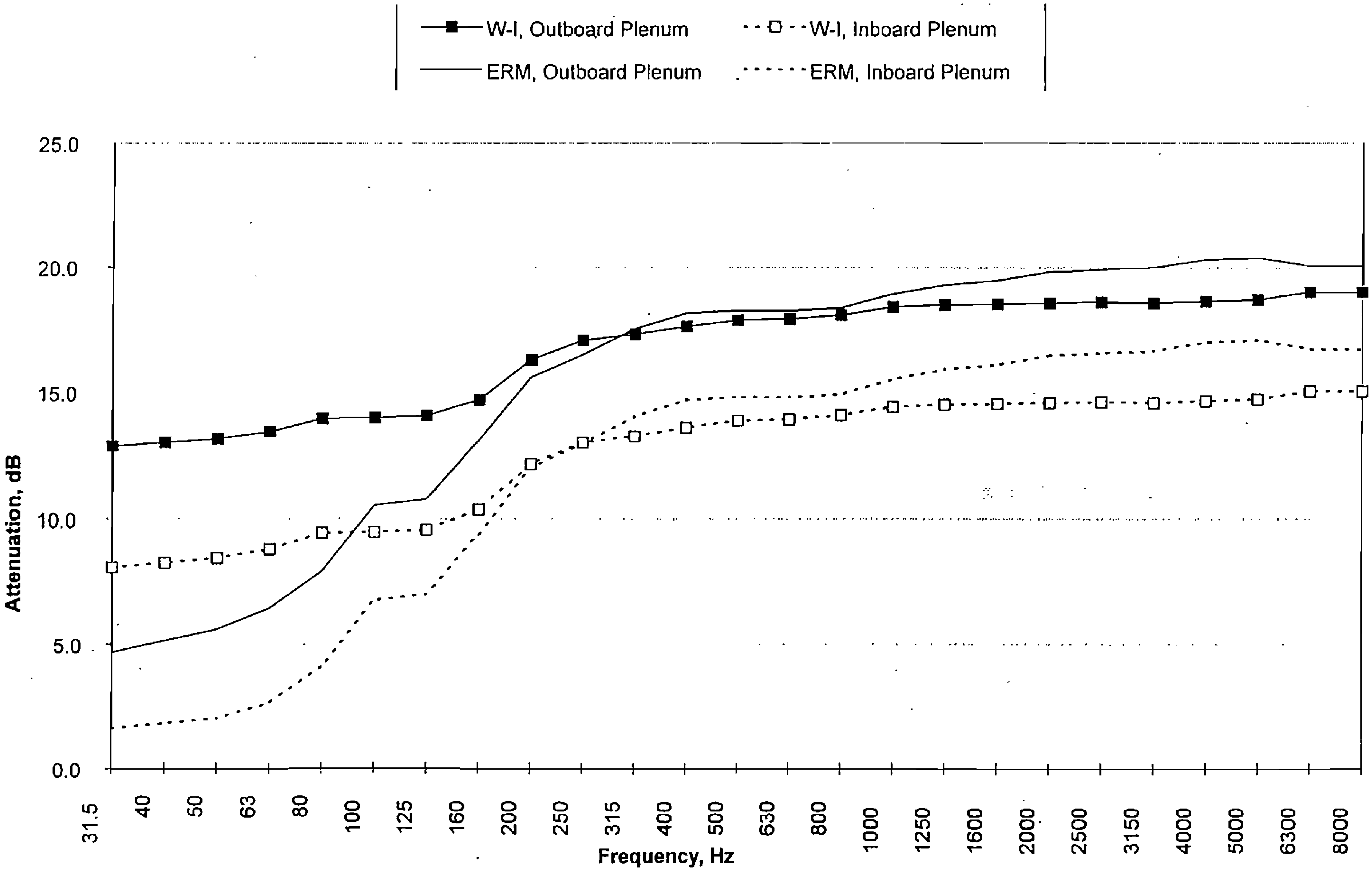

ATTENUATION DUE TO DOUBLE-PLENUM SYSTEM
- WILSON IHRIG AND ERM CALCULATION COMPARISON

FIGURE
4.4c

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CALCULATED NOISE LEVEL RADIATED FROM VIADUCT STRUCTURE
AFTER VIBRATION ISOLATION (TWIN VIADUCT)

FIGURE
4.4d

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$$SEL = L_{max,25m} + 10\log(l/V) - 20\log(r/25) + 5.6$$

where SEL is the sound exposure level at a distance r from the crossover, l is the train length in metres and V is the speed in km/h.

In most cases, the high air-borne noise levels generated near crossovers will require the track to be completely enclosed for a section around this location. The length of the enclosure will depend on train speeds, locations of NSRs and other variables, and is described for each case in the detailed assessment below.

Source Noise Levels - Other Structure-Borne Sources

Due to the large number of resilient elements introduced into the viaduct system in order to control structure-borne noise, various parts of the system will be excited into vibration and generate noise. In such a complex system, the level of noise generated in this way is not obvious, and requires calculation through finite element analysis, as it may be significant in comparison with the basic sources described above.

Figure 4.4e shows the noise level radiated by the floating slab below the train, in terms of the maximum noise level at 25 m from the train at 130 km/h with no additional mitigation. This is compared with the air-borne noise level generated by the wheel/rail interface at the same location. The slab-radiated noise adds only approximately 1 dB(A) to the total level generated beneath the car. However, as *Figure 4.4e* indicates, it is lower in frequency, and hence is attenuated less by the plena and barriers used as mitigation measures. For this reason, slab-radiated noise was added to the air-borne noise component before calculating total noise levels at NSRs.

Figure 4.4f shows calculated structure-radiated noise levels from a number of other sources which are at locations comparable to the plenum gaps in terms of subsequent mitigation. All these sources are at much lower levels than air-borne noise from the plenum gaps, and can be ignored in subsequent analysis.

Source Noise Levels - Other Air-Borne Sources

Noise from on-board systems such as condensers and other components of the air-conditioning system can contribute to the total noise level from a vehicle passby. This is particularly true if these components are located above the car, with noise not being mitigated by any of the systems described above.

However, we understand that specifications for all such systems to be located above the floor of the car will require that maximum noise levels should not exceed a level of at most 50 dB(A) at 15 metres. Given this specification, which we believe to be achievable, noise from these systems can be ignored in calculating total noise levels from train passbys.

4.4.2.4.2 Fixed Plant Noise

The operational noise impact assessment for fixed plant and other fixed noise sources including the West Rail Depot, traction sub-stations and ventilation buildings, has followed the *Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites* (TM4) issued under the NCO, and the requirements of the HKPSG.

The methodologies used in the prediction of noise emissions from moving and fixed sources within the Depot apply standard acoustic principles and are described in this section.

Train Rolling Noise

The rolling train noise assessment for the West Rail Depot is based on the **SoundPLAN** Modelling Package which implements the methodology in *Calculation of Railway Noise*, UK Department of Transport, 1995 (CRN). $L_{Aeq(30min)}$ noise levels were modelled to assess the operational train noise. The noise levels at selected NSRs were then calculated to assess the extent of mitigation required to protect the worst affected NSRs.

The calculations have taken into account the various noise propagation factors identified in CRN, namely noise attenuation due to distance, screening effects from barriers and intervening building structures, corrections for angle of view, façade reflections and track bed conditions. The noise levels include a 2.5 dB(A) façade correction and have been calculated for a 30-minute period as specified in the TM.

The alignment of the depot tracks was digitised into the model and the vertical and horizontal alignment were divided into segments, the length of the segments of the track being variable, determined by factors such as the train speed, curvature of the track, and gradient.

Points and Joints

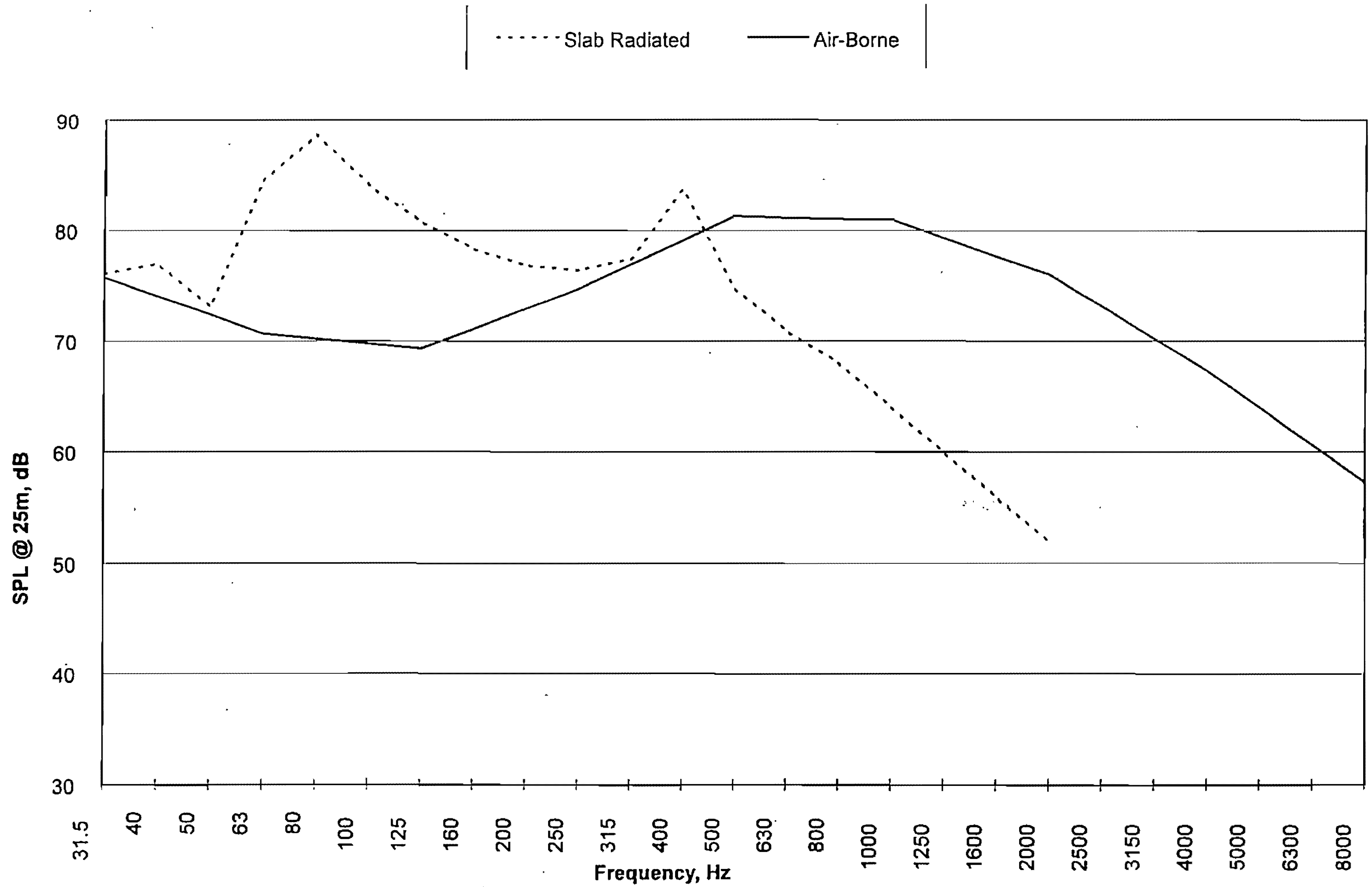
The contribution to the rolling noise at each NSR, generated by the points and joints within the WRD, were calculated separately based on the formula previously described in *Section 4.4.2.4.1.*

$$SEL = L_{max(25m)} + 10 \log ({}^{l}/_{v}) - 20 \log ({}^{r}/_{25}) + 5.6$$

These noise levels were then combined with the results of the SoundPlan modelling to provide the overall train rolling noise at each NSR.

Wheel Squeal

Wheel squeal is the term used to describe the intense, high pitched noise that can occur when trains traverse sharp curves. The mechanisms by which wheel squeal is produced are complex, but can be summarised as follows. At the heart of the phenomenon are the lateral forces between the train wheels and the tracks as the train is guided round a curved



CALCULATED NOISE LEVEL RADIATED FROM FLOATING SLAB BENEATH TRAIN

FIGURE 4.4e

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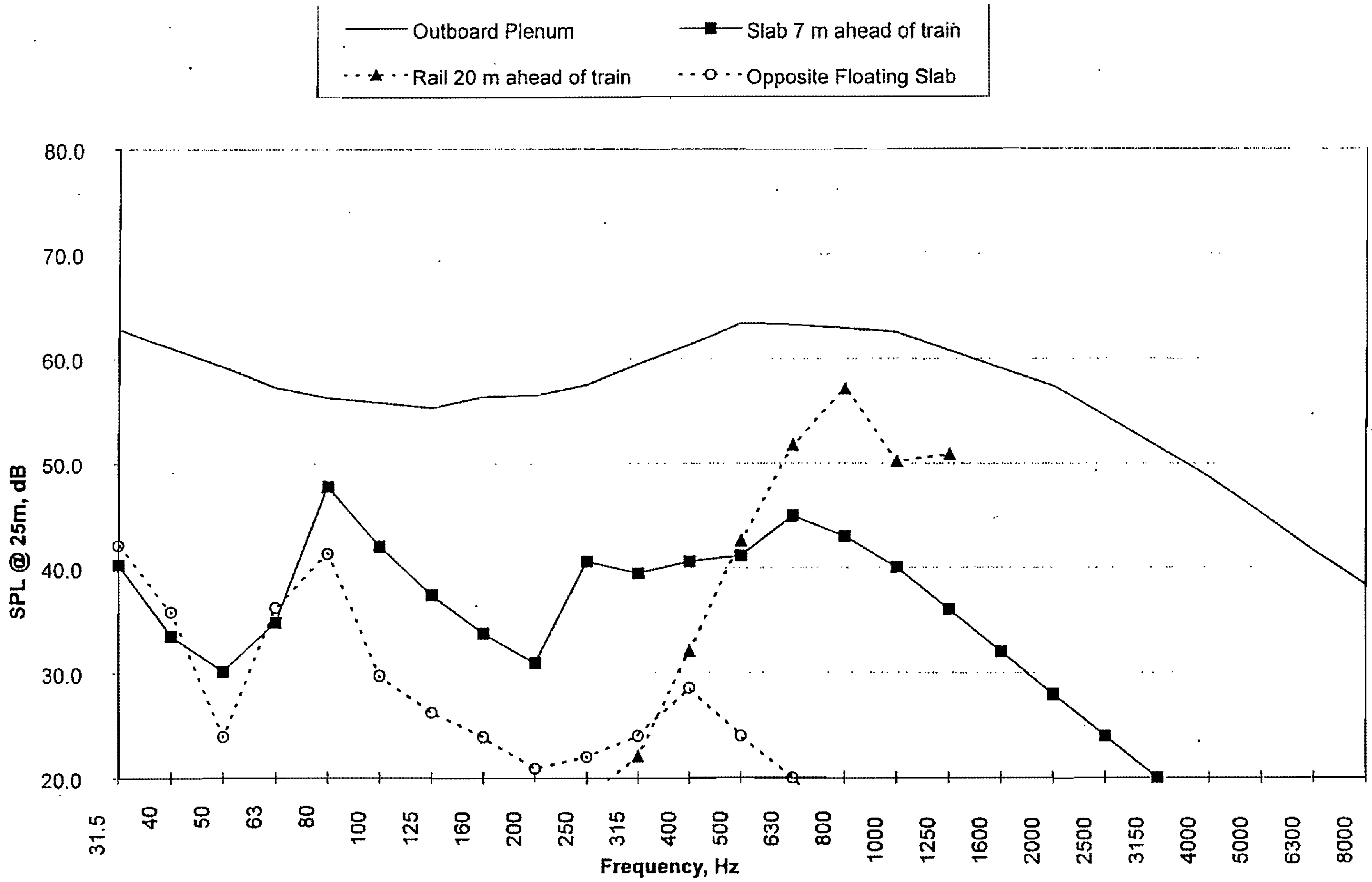

CALCULATED NOISE LEVELS FROM OUTBOARD PLENUM, FLOATING SLAB AND RAIL AHEAD OF TRAIN AND UNLOADED SLAB (TWIN VIADUCT)

FIGURE 4.4f

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route. These lateral forces act perpendicular to the plane of the wheels and in the same plane in which the wheels can radiate sound most efficiently.

For bogies with more than one set of wheels, as with the proposed KCRC EMU, wheel crabbing occurs whereby the wheels cannot remain parallel to the tracks and rotate at a slight angle to the direction of travel. Flange rubbing occurs when the wheel flange rubs against the outside rail, and differential slip can be produced because the fixed axles cannot allow different speeds of rotation for the outside and inside wheels. The combination of these forces gives rise to a stick-slip motion that excites resonances in the wheels that can radiate acoustic energy as squeal.

Several authors have reported on studies of wheel squeal. Some studies, such as that by R Lotz 1 give empirical methodologies for predicting wheel squeal. Others, such as MJ Rudd 2 derive theoretical models. More recently, in 1990, MA Staniano and G Sastry 3 derived a model for predicting the occurrence of wheel squeal based on predicting the lateral creep of the wheels across the track.

Lateral creep (defined as the ratio of the lateral and longitudinal velocities) is related to the angle between the wheel and the rail, which can be approximated as the ratio of the length of the bogie wheelbase (W) to the radius of the curve (R). The authors plot the coefficient of friction (between the wheel and rail) against lateral creep and report three regions of the curve that correspond to three 'squeal regimes'. The theory of lateral creep allows these regimes to be approximately delineated in terms of the track and bogie geometry as follows:

- No squeal $(W/R) < 0.01$;
- Intermediate squeal $0.01 < (W/R) < 0.03$; and
- Severe squeal $(W/R) > 0.03$.

The EMU's using the depot are expected to have a bogie wheelbase length of 2.5m. Hence no squeal is expected for curve radii greater than approximately 250m; the intermediate regime covers radii between about 83m and 250m; and for radii below about 83m severe squeal would be expected.

The authors report that the three regimes do not have discrete boundaries, and note that the regimes can only give an indication of the frequency of occurrence of wheel squeal. They go on to report a number of ways in which wheel squeal can be mitigated and their relative merits.

R Lotz also proposed three regions of squeal and suggested the following increases in noise level for three curve radii;

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1 R Lotz- Railroad and Transit Noise Sources, Journal of Sound and Vibration (1977) 51(3), pp 319-336.
2 MJ Rudd, Wheel/Rail Noise - Part 2: Wheel Squeal, Journal of Sound and Vibration (1976) 46(3), 381-394
3 MA Stiano and G Stastry, Control of Wheel Squeal Noise in Rail Transit Cars, (1990), Transportation Research Record No 1255, pp23-35

- R > 274m 0 dB(A):
- 180m < R <274m +10 dB(A); and
- R < 183 +20 dB(A).

The work of MJ Rudd is in agreement with MA Staniano and G Sastry in suggesting the onset of wheel squeal occurs approximately when (W/R) > 0.01.

Within the depot the majority of curves have radii greater than 250m but due to space restrictions a small number of curves have radii in the range 200m to 250m (ie within the intermediate squeal regime).

Wheel squeal not only gives rise to an elevation in rolling noise levels, but because of its tonal character it can be particularly annoying. Hence it is recommended that wheel squeal is avoided by suitable mitigation measures.

Six main forms of mitigation available for wheel squeal comprise:

- Water lubrication;
- Automatic all-rail grease lubrication;
- Rail facing;
- Barriers or enclosure;
- Wheel dampers; and
- Rail dampers.

Wheel squeal is also effected by train speed. MA Staniano and G Sastry report a reduction in wheel squeal of 6 dB(A) by reducing speed from 16 to 8km/hr. However, other techniques, in particular lubrication, produce better results. These authors report that water lubrication is highly effective, and gives results showing reductions of 18-23 dB(A). Most countries encounter problems with water freezing in winter conditions and cannot use water lubrication in sub-freezing conditions. In these conditions they tend to revert to grease lubrication which creates concerns over traction loss. Obviously, freezing conditions are not frequently recorded in Hong Kong.

MA Staniano and G Sastry give an overview of the effectiveness of water and grease combination lubrication in North America including Chicago, New York, Boston and Toronto. A detailed account of its effectiveness in a situation with R/W = 0.06 shows that the water or grease lubrication give similar results, but the combination of both is more effective. The addition of restraining rails can also effect squeal (generally reducing it) and their lubrication is also beneficial.

In 1987, the Washington Metropolitan Area Transit Authority (WMATA) carried out tests on a prototype rail facing treatment. Initially squeal was completely eliminated but within two years squeal had returned. Clearly this is an effective mitigation measure. It also demonstrates the importance of the rail head profile in determining if squeal occurs and hence its unpredictability for a new railway design.

The key concern in this case is whether squeal can be completely eliminated by such mitigation measures or whether provision should be made for barriers and/or damping of wheels and rails to reduce its level in case it does occur. Most of the case studies on wheel squeal mitigation relate to situations where squeal is common, and where the W/R ratio is far greater than 0.01.

Depot Fixed Plant

The noise levels generated at the closest NSRs by Depot sources other than rolling noise have been predicted using a modelling spreadsheet created in MS Excel 5.0. Features of this model are as follows:

- The model implements established calculating techniques, using source data entered in terms of SWL, internal SPL or L_{Aeq} ;
- The effects of air and ground absorption are calculated using guidance given in CRN;
- Where appropriate, the screening provided by barriers has been calculated using guidance given in CRN. Elsewhere a maximum attenuation of 10 dB has been used, based on the guidance given in BS 5228 and the EPD publication *A Practical Guide for the Reduction of Industrial Noise.*
- The results are presented in terms of $L_{Aeq\ (30min)}$ dB, as specified in the TM;
- 100% on-time has been assumed for all sources unless otherwise specified;
- A 2.5 dB façade correction has been included;
- Screening due to on-site buildings has been included;
- Screening due to topographical features has not been included;
- No angle of view correction has been included unless specifically mentioned; and
- Meteorological effects have been ignored.

Identification and details of the individual noise sources and assumptions made are described further in *Section 7.3.3.1.2.*

4.5 Air Quality

4.5.1 Spatial Scope

The spatial scope for the assessment of air quality impacts from construction works is defined as 300 metres from the boundary of worksites. In accordance with the HKPSG and the *Air Pollution Control Ordinance* (APCO), domestic premises, hotels, educational institutions, offices, factories, shops, shopping centres, places of public worship, libraries, courts of law, sports stadiums and performing arts centres are considered as air sensitive receivers. A review of both existing and committed landuses has been conducted to identify potential sensitive receivers, through site visits, reference to Outline Zoning Plans and a review of Planning Department information.

4.5.2 Construction Phase

4.5.2.1 Prediction Methodology

The likely type, sequence and duration of construction activities which may give rise to potential dust or other air pollution problems are identified and analysed. The Fugitive Dust Model (FDM) is used to predict the likely dust impacts from dust generating activities. Potential emission sources are identified based on the construction programme and the locations of works areas.

The particulate emission rates including particle size distribution are estimated, using the *Compilation of Air Pollutant Emission Factors* (AP42), USEPA, 5th edition, 1995. It is expected that dust generating activities will be carried out during daytime and worst case daytime meteorological conditions, neutral stability Class D with a wind speed of 1 ms^{-1}, are used for prediction purposes. Worst case wind directions (ie blowing from the construction site to the receiver) are used in the modelling exercise.

The impact of fugitive dust sources on air quality depends on the quantity 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 μm in diameter are likely to undergo impeded settling. These particles, depending on the extent of atmospheric turbulence, would probably settle within 100 m of the source. The main dust impact arises from particles less than 30 μm in diameter that disperse over greater distances from the sources.

Due to obstacles on the earth's surface, there is a retardation of the wind near the surface, known as "surface friction". Surface roughness length depends on the types of surface. For assessing dust impacts, the surface roughness length in urban areas with high rise buildings is assumed to be 200cm and in rural areas with low-rise village homes it is 60cm.

To evaluate the dust impact during the construction phase of the West Rail, 1-hour and 24-hour averaged dust levels are predicted with the worst case assumption of concurrent construction activities taking place at works sites, including stations, alignments and associated facilities. The background pollution levels are obtained from the EPD's monitoring data and included in the modelling prediction.

A maximum working period of twelve hours a day for the Southern Section is assumed, however, for the Central, Northern and Western Sections, the working period is 10 hours a day. For the Depot construction, the working period is 8 hours a day. For the Southern

Section the 24-hour average impact is estimated by multiplying the predicted 1-hour levels by a conversion factor of 0.5.

Pollution levels at sensitive receivers are reviewed and compared with the Air Quality Objectives (AQOs) and other criteria outlined in *Section 3.3*.

4.5.3 Operational Phase

4.5.3.1 Prediction Methodology

It is not anticipated that road traffic emissions associated with West Rail will be found to be of concern.

4.6 Water Quality

4.6.1 Spatial Scope

Land based impacts may comprise direct and indirect water quality impacts. Thus, the water quality assessment study area encompasses both local and directly affected waters, and water sensitive receivers (WSRs) located downstream and remote from the proposed works. Included in the study area is the highly sensitive Deep Bay catchment.

The marine based water quality impact assessment will be modelled as described below. The model coverage will comprise the area encompassing the entrance to the Ma Wan Channel and Kap Shui Mun Channel including the Rambler Channel, extending south to include the Victoria Harbour and the East and West Lamma Channels.

4.6.2 Construction Phase

4.6.2.1 Introduction

Potential water quality impacts during the construction phase comprise land-based and marine impacts. Drainage Impact Assessment (DIA) was conducted by the West Rail engineering Design Consultants to establish engineering solutions to reduce impacts of the West Rail construction on downstream drainage systems. The detailed water quality assessment in this Final Assessment Report has condensed the DIA findings and recommendations in terms of ensuring the adequacy of environmental protection of downstream water sensitive receivers (WSRs).

The water quality impact model was used to assess impacts of the reclamation (dredging and filling) in Tsuen Wan Bay required to form land for the Tsuen Wan West station. The modelling exercise compared the pre-construction baseline with the model prediction of the worst case dredging and filling activities for the West Rail reclamation. Recommendations had been suggested to reprovision the existing salt water intake in Tsuen Wan Bay to minimise the water quality impact of the intake.

4.6.2.2 Prediction Methodology

Present construction designs were reviewed to assess the proximity of the West Rail construction activities to existing and committed WSRs. All WSRs were identified in accordance with the guidance provided in the HKPSG and through detailed literature reviews, supplemented where necessary by field surveys and area appraisals.

Construction type, sequence and duration were reviewed to identify activities likely to impact upon identified freshwater and marine water bodies and WSRs (including Deep Bay and Rambler Channel), water courses, streams, ponds and wetland freshwater catchment areas.

Following the identification of WSRs and potential water quality impacts, the scale, extent and severity of potential net (ie unmitigated) construction impacts were evaluated, wherever possible quantitatively, taking into account all potential cumulative effects including those of adjacent projects, with reference to the WPCO criteria.

Where net water quality impacts were predicted to exceed the appropriate WPCO criteria, practical water pollution control measures/mitigation proposals were identified to ensure compliance with reference to the WPCO criteria for the beneficial uses of the marine water bodies and fresh water courses. Water quality monitoring and audit requirements will be subsequently developed to ensure the efficacy of the construction stage water pollution control measures and mitigation measures.

4.6.3 Operational Phase

4.6.3.1 Introduction

It is currently expected that water quality impacts during the operation of the railway will not be significant. In addition to the construction phase DIA, an operational phase DIA was conducted by the engineering Design Consultants to establish engineering solutions to reduce impacts of the West Rail operational drainage on downstream drainage systems. The assessment had considered the DIA findings and recommendations in terms of ensuring the adequacy of environmental protection of downstream WSRs.

The marine based water quality impact assessment have been modelled to assess the impact of the West Rail Tsuen Wan West station on tidal flows and volumes in isolation and in addition to a complete and partially complete Further Reclamation of Tsuen Wan Bay (Area 35). The modelling will compare pre-construction baseline tidal flows and volume conditions (i.e. before late 1998/early 1999) with the two potential final configurations scenarios (2002). The results of this assessment have been reported in *Section 6.5* below, along with the results of sediment plume modelling for the construction phase of the reclamation.

4.6.3.2 General Land and Marine Impacts

Present operational West Rail designs were reviewed to assess the proximity of the rail alignment or any associated operational facilities to existing and future committed WSRs, in accordance with the HKPSG.

All operational infrastructure proposals and activities were reviewed to identify activities likely to impact upon identified adjacent water bodies (including Deep Bay and the Rambler Channel), water courses, streams, ponds, wetland freshwater water catchment areas and marine WSRs.

Following the review of the West Rail operation, the potential adverse effects, scale, extent and severity of potential net (ie unmitigated) impacts were assessed and evaluated, wherever possible quantitatively, taking into account all potential cumulative effects, with reference to the WPCO criteria.

4.6.4 Water Quality Modelling

Water quality impacts arising from the construction and operation of the Tsuen Wan Bay reclamation were assessed as part of the Final Assessment by detailed mathematical flow modelling, as described below, and reported in the Final Assessment Report.

4.6.4.1 Water Quality Modelling Methodology

For the marine water quality assessment, initial inshore water quality modelling were undertaken using the TELEMAC 3D suite of models to assess the impacts of the proposed reclamation required to form land for the Tsuen Wan West Station and other Rambler Channel projects (including Tsing Yi and Ting Kau bridges and future projects including Tsuen Wan Bay Further Reclamation Area 35, CT9 and north Tsing Yi GIC facilities) on tidal flows and volumes. The model could be used to optimise the shape of the reclamation to minimise impacts on the flow regime. If no adverse flow regime impacts were identified, further sediment plume models, using the output data from the TELEMAC 3D model, would be employed to simulate the transport and dispersion of suspended sediment and address any associated impacts on dissolved oxygen and nutrients concentrations within the receiving waters. The modelling output was used to develop appropriate mitigation measures to minimise or eliminate exceedances of the statutory WPCO standards.

4.6.4.2 Tidal Flows

The proposed reclamation for the KCRC extension will be in the Rambler Channel which is a narrow body of water currently subject to high levels of pollution. Any changes to the coastline which may affect the tidal volumes flowing through the Rambler Channel will adversely affect water quality. This aspect is of particular concern because of the number of projects which have been carried out, resulting in restricted flows, such as the piers for the Tsing Yi South Bridges and the Ting Kau Bridge, and projects which are planned for the future, such as Container Terminal No 9, GIC facilities on north Tsing Yi and the Area 35 Tsuen Wan Bay Further Reclamation. The first phase of the modelling study will consider the impact of the proposed reclamation on tidal flows and determine any reduction in tidal volumes.

The impact of the proposed KCRC reclamation on tidal flows was modelled using the TELEMAC 3-dimensional model of tidal flows. The TELEMAC 3D model solves the characteristic equations of water movement using finite element techniques which employ an unstructured triangular mesh in the horizontal and five planes in the vertical with the water surface and sea bed being two of the planes. The unstructured triangular mesh means that the model is able to resolve small features in the coastline by fitting the mesh to the outline of the coast and by employing locally smaller elements.

The TELEMAC 3D model had been calibrated as part of the Tsuen Wan Bay Further Reclamation project and it is this model which was used to examine the KCRC reclamation. The flow modelling task for this project simulated two scenarios. These comprised one scenario investigating the implementation of the West Rail reclamation in Tsuen Wan Bay alone to assess the acceptability of the implementation in advance of the Further Reclamation of Tsuen Wan Bay Area 35. A second scenario assessed both the West Rail reclamation in Tsuen Wan Bay and the complete Further Reclamation of Tsuen Wan Bay Area 35. Comparison of a baseline case with these scenarios allowed the determination of the acceptability of possible effects of the KCRC reclamation on tidal flows and volume in the Rambler Channel.

4.6.4.3 Suspended Sediment Impacts

Sediments on the seabed in the vicinity of the proposed Tsuen Wan Bay reclamation was found to be contaminated and require special disposal in designated contained dumping areas. During construction, mud will be dredged from the seabed. Even if a "no-dredging" scenario is adopted for the reclamation work, some mud will have to be dredged along the line of the seawalls. Dredging will result in a proportion of the contaminated material being suspended in the water column and subsequently transported away from the reclamation site and possibly impacting upon marine WSRs.

The transport of fine sediment away from the site of the reclamation was simulated using the TELEMAC 3D sediment plume model. This model is developed from the WAHMO SEDPLUME model and uses the same random walk formulation. The TELEMAC 3D sediment plume model resolves the suspended sediment concentrations on a square grid which may be set as fine as necessary to resolve narrow plumes and uses the same layer structure as the TELEMAC 3D model of tidal flows. The impact analysis of the suspended sediment concentrations on dissolved oxygen and nutrient concentrations is carried out in the same way as for the WAHMO SEDPLUME model.

4.6.4.4 Water Pollution Control Measures

Where net impacts exceed the appropriate criteria, practical water pollution control measures and mitigation proposals were identified for inclusion in the design to ensure residual impact compliance with reference to the WPCO criteria for the beneficial uses of the marine water bodies and fresh water courses.

4.6.4.5 Water Quality Monitoring and Audit

Subject to the results of the assessment any operational water quality monitoring and audit requirements will subsequently be developed.

4.7 Landscape and Visual Issues

4.7.1 Spatial Scope

The study area for the impact assessment is generally defined by a distance of 500 metres from the railway alignment, but this study area will be expanded, where appropriate, to include other key sensitive receiver groups that are located beyond the primary study area.

4.7.2 Prediction Methodology

The assessment of the degree of significance of landscape and visual impacts is based on common perception and reasoned professional judgement.

The degree of significance of an impact depends primarily on the sensitivity of the receptor (whether this is a landscape element or a visual receiver) and the magnitude of the impact itself.

4.7.2.1 Sensitivity

The potential sensitivity of a landscape element as a receptor depends on several factors including:

- Whether the element is commonplace or rare (eg common tree species, or rare, protected tree species);
- Whether the element constitutes an area of particular landscape interest (eg a prominent ridgeline);
- Whether the element is of statutory importance (eg SSSIs, landscaped buffer zones); and
- Whether the element is of particular cultural interest (eg *fung shui* woodland).

The potential sensitivity of a visual receptor is primarily related to whether a person is at work, at play or at rest. Visual receptors may be broadly categorised into four groups as follows:

- Those who view the impact from their homes are considered highly sensitive as the attractiveness or otherwise of the outlook from their home will greatly affect their perception of the quality and acceptability of their home environment and their general quality of life;

- Those who view the impact from their workplace are considered only moderately sensitive as the attractiveness or otherwise of the outlook will have a less important, although still material, affect on their perception of their quality of life. The degree to which this applies depends on whether the workplace is industrial, retail or commercial;
- Those who view the impact whilst taking part in an outdoor leisure activity may display varying sensitivity depending on the type of leisure activity. Football players, for example, would be less concerned with the quality of their surroundings than hill walkers; and
- Those who view the impact whilst travelling on a public thoroughfare will also display varying sensitivity depending on the speed of travel and whether the view is continuous or occasionally glimpsed.

4.7.2.2 Magnitude

The magnitude of a landscape or visual impact will depend on several factors including:

- The nature of the development;
- The physical area of the impact, both in absolute terms and relative to it s landscape and visual context;
- The duration of the impact;
- The distance of the impact from the viewer;
- The number of viewers;
- The landscape context of the impact; and
- The visual context of the impact.

By synthesising the magnitude of the various impacts and the sensitivity of the various receptors, it is possible to categorise the degree of significance of the impacts in five classes: very substantial, substantial, moderate, slight and very slight (these may be positive or negative impacts).

4.8 Landuse Issues

The EIA assesses the implications of the construction and operation of West Rail for existing and planned land uses of the areas directly affected by the rail alignment and associated facilities. The assessment is based on landuse information collected during field visits, discussions with the Planning Department and from engineering Design Consultants. However, it is not intended to undertake an assessment of the planning or strategic implications of the new railway. Also, the planning of non-railway related property development, such as development above stations, falls outside the scope of this study.

The landuse assessment study area comprises the area of temporary and permanent landtake required for the construction and operation of West Rail and its associated facilities.

4.9 Archaeological and Cultural Issues

4.9.1 Spatial Scope

The potential impacts to the Archaeological, Historical and Cultural Resources within a corridor of 100 metres either side of the alignment centre line have been assessed. This corridor is considerably wider than the actual area of landtake required for the construction and operation of the new railway and has been defined in order to provide information regarding the context of features directly affected, to allow indirect impacts to be assessed and to help develop predictions on the scale of currently unknown archaeological resources.

The examination of this defined corridor also allows a more general appraisal of the archaeology, architectural history and historic landscapes of the areas that West Rail traverses.

The following heritage resources have been assessed:

- *Historic Buildings and Structures,* which include a variety of forms with a wide range of different functions including domestic, working and cultural uses. These include places of worship, houses, agricultural buildings, boundary and milestones and industrial buildings and workshops;
- *Landscape Features,* including sites of historical events, historic field patterns, tracks and fish ponds, and cultural elements such as *fung shui* woodlands and clan grave sites; and
- *Archaeological Remains,* including a variety of buried and upstanding forms dating from the prehistoric to historical times and comprising upstanding ruins, earthworks, finds scatters and evidence of landuse management, settlements and cultural attributes.

The West Rail development phase with the greatest potential direct impact to heritage features will be during the construction of the new railway. However, the study team has also assessed the indirect impacts associated with the operating railway.

4.9.2 Prediction Methodology

4.9.2.1 Known Heritage Features

Data gathering on known heritage resources has focused on the records held by the Antiquities and Monuments Office (AMO), supplemented by discussions with representatives of AMO, the Hong Kong Archaeological Society (HKAS) and appropriate academic sources. At the outset of the study, a review of existing AMO records established that no known archaeological sites or historic buildings will be directly impacted by West Rail. This preliminary review did identify a number of historic buildings located within 100 metres of the alignment and subsequent field survey has identified buildings previously unnoted in AMO's records.

An assessment of direct and indirect impacts upon identified buildings and structures has been undertaken in the EIA.

4.9.2.2 Identifying Historic and Cultural Resources

Culturally significant features such as clan grave sites, fung shui and temples have been identified through reference to the information collected by engineering Design Consultants, through consultations with and information from the Lands Department, District Offices and AMO and through field survey. Culturally significant features have been mapped and the impacts (both direct and indirect) from the construction and operation of the new railway have been assessed in the detailed EIA. Mitigation measures which may be recommended include relocation or reprovisioning and the shielding of features from visual and noise impacts.

4.9.2.3 Establishing Archaeological Potential

It is widely acknowledged that the existing archaeological sites and monuments record for Hong Kong does not provide comprehensive coverage of its archaeology, and that certain areas (primarily inland areas) remain largely uninvestigated. As a consequence, the lack of archaeological records relating to the West Rail alignment is likely to reflect a lack of investigation and perhaps a consequence of surface deposits having masked recognition, rather than the absence of sites and features.

The EIA Study team has evaluated the existing archaeological record and has established a methodology for assessing and establishing the archaeological potential of the route alignment.

Whilst no assessment strategy can guarantee absolute certainty as to the presence or otherwise of buried archaeological deposits, the development and implementation of a systematic desk top study, supplemented by a subsequent focused field evaluation of areas of potential, is likely to provide a sufficient level of certainty regarding archaeological potential to enable the planning of the railway to accommodate the preservation (in situ or by record) of archaeological deposits.

The desk top study has comprised the following steps:

- Review of Available Information: A review of available archaeological records and published and unpublished excavation reports has been undertaken in respect of the West Rail alignment. Any known areas of archaeological potential within 100 metres of the alignment have been noted and mapped.
- Discussions with Hong Kong Archaeological Practitioners: A series of consultations has been held with relevant Archaeological Practitioners to

establish an inventory of landforms, soil types and historical landuses which have high potential for revealing preserved archaeological deposits. A programme of field visits has been undertaken to verify the current status of known features through observation, field walking and, where appropriate, limited intrusive sampling.

- Mapping of Archaeological Potential: The outcome of the consultations and associated field visits has been summarised through the preparation of a series of maps indicating levels of archaeological potential. Land within the 100 metre study corridor has been classified as having the following levels of archaeological potential: "high", "medium", "low" or "none".
- Development of a Field Evaluation Programme & Protocols: The Desk Top Study has established a predictive model of archaeological potential within the study area. Field testing of the model is to be undertaken in early 1998 as the basis for determining the extent of field evaluation in advance of the construction of the new railway on the basis of an assessment of likely impacts. This archaeological impact assessment will be based upon the nature and extent of construction activities (*the level of impact*) and the predicted potential (*the predicted value of the resource*) of the area within which the activities are to take place. The field evaluation programme will identify the areas to be investigated and will produce field evaluation protocols determining the sampling technique (e.g. test pit or trench), the sample rationale to be applied (e.g. numbers of test pits, pit dimensions, sampling grid), and the site record forms to be used during the field evaluations. The evaluation protocols would be produced with reference to those established in Hong Kong and would be compatible with the best field practice and data capture requirements of AMO.

The results of the Field Evaluations will form the basis for the development of an archaeological action plan, detailing the measures to be adopted to provide appropriate mitigation of the impacts to buried archaeology. The adopted mitigation measures might include the minimisation of ground disturbance in archaeologically sensitive areas, excavation in advance of construction, and the provision of a watching brief during construction.

4.10 Ecology

4.10.1 Spatial Scope

The ecological study area is confined to a corridor along the railway alignment, generally defined by a distance of 500 metres from the centre of the proposed alignment.

4.10.2 Survey and Prediction Methodology

Impacts on ecological resources were evaluated in consultation with the Agriculture and Fisheries Department following submission of the Inception Report, an internal Key

Issues Report, and the Final Initial Assessment Report. Literature describing the project site and its vicinity was reviewed, and key ecological issues and sites of potential ecological interest were identified, investigated and surveyed. Findings from field surveys, estimates of areas of habitat losses, and appropriate impact mitigation measures are discussed in this report.

4.10.2.1 Baseline Ecological Resources

Habitat maps were prepared at 1:5000 scale based on 1996 aerial photos from the Government Map Office. Ground truthing was performed from February to October 1997 to update the habitat maps. Due to the highly urbanised nature of the Southern Section and southern half of the Central Section (from Mei Foo to the north tunnel portal), there are no sites of ecological conservation importance in these areas, so they are not discussed further in this assessment.

Based on inspection of Hong Kong Map Office aerial photography from the early 1970s onward, the Kam Tin valley land uses and habitats did not change substantially until the early to middle 1990s when construction of private housing and infrastructure projects accelerated, for example the on-going Route 3 which began construction in mid-1995. Therefore it should be acknowledged that the baseline condition is shifting and the baseline established in this study is mainly based on a survey of the existing conditions, taking into account future baseline with reference to the latest available planning information.

Literature describing the project site and the vicinity was reviewed. Key ecological issues and sites with potential ecological interest identified from the north tunnel portal to Tuen Mun were investigated and surveyed. Findings from field surveys are discussed. Areas of habitats to be affected by West Rail are estimated, and mitigation measures are proposed.

4.10.2.2 Flora and Habitat

Literature describing the flora and habitats within the study area was reviewed. Habitats within 500m and on each side of the alignment (i.e. within the study area) were drawn based on the 1996 aerial photos from the Government Map Office. Field surveys were performed in winter of 1996/7 and spring, summer and autumn of 1997 along the proposed alignment for ground truthing, description of habitats, and identification of any protected, rare or endangered species. A plant species list is shown in *Annex H* of the Technical Annexes.

Potential habitat loss was estimated by the grid method based on the proposed alignment as shown on the General Layout Sheet issued on 23 September 1997. The plan shows the boundary of the scheme, the alignment and associated features (permanent loss), as well as the areas marked for temporary works (temporary loss). Estimated habitat loss is comprised of both categories.

Within the study area three categories of fish ponds will potentially be affected by West Rail:

- Fish ponds to be affected by West Rail solely and included within the boundary of the scheme (category 1);
- Fish ponds to be affected by West Rail solely and *partially* included within the boundary of the scheme (category 2); and
- Fish ponds temporarily resumed for MDC-NYK (Main Drainage Channels for Ngau Tam Mei/Yuen Long/Kam Tin) but included within the boundary of the scheme (category 3).

Land resumption negotiations with Category 2 fish pond owners indicate that where partial inclusion occurs there is a preference for the entire fish pond to be resumed even when only part of the fish pond would be encroached. Category 3 fish ponds will be reinstated following completion of MDC-NYK, but will then be resumed and occupied by West Rail. Therefore, these ponds were included in the total area calculations for West Rail, but were totalled separately from the Category 1 and 2 ponds.

The methodology for estimating losses differs from that used in the Initial Assessment Report (IAR) for West Rail. In the IAR all fish ponds to be affected by both West Rail and MDC-NYK projects were not counted as West Rail losses, because those ponds were considered to be resumed by MDC-NYK in advance of West Rail works. For this Final Assessment Report ponds to be resumed by MDC-NYK, then reinstated on completion of those projects, and then again resumed for West Rail were counted as West Rail habitat losses. This change in calculation methodology was made because the reinstated ponds would be available as wetland habitats if West Rail is not built. Most of these situations occur in the Kam Tin Valley and at Au Tau. Because of overlapping construction programmes, some ponds which are intended to be reinstated by MDC-NYK and then re-occupied by West Rail would, in practice, not be reinstated by MDC-NYK. Rather, West Rail would simply take over the active works sites from MDC-NYK, thereby avoiding unnecessary restoration works.

The portion of the study area which supported fish ponds has been and continues to be subject to intense land use change due to urbanisation. This has caused losses of some fish ponds during the course of the West Rail EIA study, and also contributed to changes in the area estimates of fish pond losses between the IAR and this Final Assessment Report.

4.10.2.3 Invertebrate Fauna

Invertebrate fauna surveys were confined to the orders Lepidoptera and Odonata because within Hong Kong the field identification and taxonomy for these groups is better studied than for other invertebrates. Non-systematic surveys included use of photography and capture/release to identify individuals to the lowest possible taxon.

4.10.2.4 Avifauna

Literature was reviewed to identify sites known to be important for birds within the study area. Birds were then surveyed at those sites using both systematic and non-systematic methods.

The Western Section was surveyed non-systematically on 17 February and 5 March 1997 to determine whether any potentially important bird habitats existed in the study area. Surveys were carried out along the entire alignment between 0800-1600 hrs. Birds were recorded by species, number, and habitat.

Systematic surveys were carried out using point counts and egretry surveys.

4.10.2.4.1 Egretry Monitoring

Methods used in the winter, late winter, spring, summer and autumn surveys were similar to those used in September 1995 on the same site (CES, 1995a). Birds near Ho Pui egretry were sampled from the WSD catchwater road using a 25-60 power spotting scope and 10 power binoculars. Sampling was conducted at 15-minute intervals. At each sample point all birds in view were identified to species, counted, recorded by habitat and behaviour. Birds observed making head turns while perching or moving were assumed to be foraging. Birds observed standing still were assumed to be roosting. The winter survey in Ho Pui covered 149 sampling intervals on 10, 13, 14, 15, 19, 20 and 22 January 1997; the late winter survey covered 163 intervals on 18, 19, 20, 21, 25, 26 and 27 February 1997; the spring survey covered 50 intervals on 22 and 23 April 1997; the summer survey covered 45 intervals on 18 and 19 June 1997; and the autumn survey covered 60 intervals on 23 and 24 September 1997.

4.10.2.4.2 Bird Point Counts Along the West Rail Alignment

The area within 150 m of either side of the proposed railway centreline was considered as the affected zone and that outside 150 m from the proposed route as the control zone for this study of the importance of Kam Tin Valley agricultural habitats to birds. Six point count sites were set on the main types of habitats (active and abandoned agriculture) in the two zones - two on operating agriculture and one on abandoned agriculture in each zone. All points were set on the southern part of Ho Pui Valley because the agricultural habitats in the northern part only exist as small scattered patches. The points were surveyed on 20, 21, 25, 26 and 27 February (winter); 7, 8, 9 and 10 April (spring); 12, 18, 19 and 20 June (summer); and 11, 18, 22 September and 7 October (autumn). Ten minutes were spent counting birds at each point.

The bird communities of the two zones were compared qualitatively and quantitatively. A similarity index was used for qualitative comparisons, while Shannon's diversity index H', Pielou's index of evenness J', and Berger-Parker dominance were used for quantitative comparisons. Sampling was designed to enable monitoring of construction and operation impacts of the project, should such monitoring be required. The values of the indices for the two zones are used in this report for baseline descriptions, and may be used in future for comparisons of parameters before and after construction to monitor changes. Because the bird community is highly seasonal, it will only be appropriate to compare the indices within seasons and between years (eg. winter 1997 vs. winter 1998).

An index of similarity, Shannon's diversity index H', Pielou's index of evenness J' were calculated using the following formulae:

- Index of similarity = 2 x c / (a + b)

  (Krebs, 1985)

where c is the number of species common to both zones, a is the number of species in the affected zone, and b is the number of species outside the affected zone.

- $H' = -\sum_{i=1}^{s} p_i \ln (p_i)$

  (Shannon and Weaver, 1963)

- and $J' = H' / \ln (s)$

  (Pielou, 1966)

where s is the total number of species observed in a day and p_i is the percent of the total counted of the i th species.

Dominance was calculated using the Berger-Parker index d (Berger and Parker, 1970, in Magurran, 1988) which expresses the proportional importance of the single most abundant species.

Observations of bird breeding activity in Ho Pui Valley were recorded along with the point counts. The criteria used in the breeding bird survey are listed in *Table 4.10a.*

Table 4.10a Criteria used in the Bird Breeding Survey

Grades	Behaviours
A. Present	Species present at a site during breeding season
B. Possible breeding	Species present in potential breeding habitats
C. Probable breeding	Pair observed in suitable nesting habitat in breeding season, or showing territorial behaviour, such as intensive singing and calling for habitats, or chasing intruders out of territories, or species displaying or observed carrying nesting materials
D. Confirmed breeding	Nests found, or adults observed carrying food for juveniles, or recently fledged juveniles observed.

Adapted from Sharrock 1976

4.10.2.5 Reptiles and Amphibians

Non-systematic surveys for reptiles and amphibians were carried out at the same times as the flora and avifauna surveys during the winter of 1996/7. Additional surveys were carried out in spring and summer of 1997 when reptiles and amphibians were more active and thus more likely to be detected. Taxonomy follows Karsen *et al* (1986) except where updated by Zhao and Adler (1993).

4.10.2.6 Aquatic Fauna

The alignment crosses few aquatic habitats other than fish ponds. River crossings are found only in the Northern, Central and West Rail Depot Sections, and all affect the Kam Tin River. Locations of West Rail crossings occur in reaches of the Kam Tin River which will be channelled by the MDC-NYK project. The Kam Tin River is grossly polluted with effluents from livestock production and processing, residential sewage, and light industrial liquid wastes. The water quality in the river has been "very bad" since monitoring was instituted by EPD in 1984 (EPD, 1996). The fauna was dominated by oligochaetes, macrobenthos were absent, and only one species of catfish (probably *Silurus* spp.) was recorded by BCL (1992). Based on these results, and on the poor water quality in the Kam Tin River, no sampling of aquatic fauna was carried out.

4.10.2.7 Mammals

Mammals were surveyed non-systematically during other field work. Individuals seen were recorded by species, number, and habitat. Searches were carried out for burrows, dens, trails, rooting sites, or other signs of mammalian activity. Species identification was assigned to indirect evidence of mammal activity where possible.

4.10.2.8 Invertebrate fauna

Literature review on butterflies was performed using Bascombe's unpublished 1993 database. Field surveys were performed non-systematically with other field work to update his data. Individuals seen were recorded by species. Dragonflies and damselflies were surveyed with the same methodology. The status of butterfly species populations in Hong Kong was assessed following Walthew (1997). Dragonfly and damselfly population status was assessed following Wilson (1995).

4.10.3 Impact Prediction

Impact predictions were based on the design drawings and land resumption plans which indicated the total area and nature of surface disturbance. Habitat loss estimates may be subject to change if there are variations to the assumed alignment in the final design or land resumption plan, but such changes are not expected to be significant.

4.10.4 Impact Assessment

After collecting the necessary ecological information, the ecological and conservation importance of the key areas was established. This report follows the requirements of the Technical Memorandum (TM) on EIA Process. A habitat and species approach has been adopted for this assessment, as the overriding ecological concern of the project is habitat loss, especially of wetlands, natural woodlands, stream courses, and areas of designated ecological importance. A second key concern is impacts to species of particular importance, such as rare and protected species.

Impacts to species or groups which were assessed as 'minor' or 'minimal' were predicted to cause a slight and/or short-term reduction in the local population numbers or geographic distribution of a species or group, but the species or group was predicted to recover from the perturbation with no long-term adverse impacts. Habitat impacts were considered 'minor' or 'minimal' when no plant species of conservation or regulatory concern were found, and when the habitat in question was widely distributed locally.

Impacts to species or groups which were assessed as 'moderate' were predicted to cause local reduction of species or group population numbers. The reductions would be long-term, and probably not recoverable, but the species or groups in question are considered widely distributed or common, and abundant on a local, regional, or global scale. Habitat impacts were judged 'moderate' when the habitat in question was of limited local or regional distribution or declining in extent, and when the potential for the habitat to support fauna was considered of conservation or regulatory importance.

Impacts to species or groups were assessed as 'severe' when they were judged to adversely affect species or groups which are of conservation or regulatory concern locally, regionally, or globally due to scarcity or declining population or distribution trends. Impacts to habitats were considered 'severe' when the habitats were found to be limited or declining in geographic distribution, contained plant species of regulatory or conservation concern, or are generally considered by the scientific community to be of local, regional or global importance to the support of wild fauna.

4.10.5 Recommendation of Mitigation Measures

Measures recommended to mitigate the potential impacts to ecological resources follow the recommendations in the TM (see *Section 3.9.4*) and focus on:

- The avoidance of adverse impacts to ecologically important habitats, wherever practicable;
- The implementation of practical and effective measures to minimise habitat loss; and
- As a last resort, on-site or off-site compensatory restoration or re-creation of habitat.

Where avoidance or minimisation was insufficient to adequately reduce the severity of an impact, opportunities for compensatory habitat creation were investigated, subject to the availability of suitable land. Recommendations for compensatory habitat restoration or creation are accompanied by a rationale outlining the objectives, constraints and opportunities associated with the creation or restoration of habitat types.

4.11 Waste

The assessment of environmental impacts from waste generation from the construction and operation of West Rail is based on three factors:

- The type and nature of waste generated;
- The amounts and rates of principal waste types generated; and
- The proposed reuse, recycling, storage, collection, transport and disposal method, and the impacts of these methods.

4.11.1 Types and Nature of Waste Generated

4.11.1.1 Construction Phase

Construction activities will result in the generation of a variety of wastes that can be divided into distinct categories based on their constituents, as follows:

- Site clearance waste;
- Excess excavated material;
- General construction waste;
- Demolition waste;
- Chemical waste;
- General refuse; and
- Marine muds and sediment.

Site clearance waste is generated from site preparation work, and generally consists of a mixture of wood, metal and general refuse from the temporary structures.

Excess excavated material is defined as inert material removed from the ground and sub-surface which will not be reused on site. Considerable quantities of excavated material will be produced from the excavation of the bored, and cut and cover tunnels. Excavated material generated from cut and cover tunnelling is likely to contain a high proportion of soft material. Excavated material will also be generated at cut sections along the alignment and at some of the stations and depots. It can be re-used on-site or at other sections of West Rail.

General construction waste comprises unwanted materials generated during the construction works, including rejected structures and materials, materials which have been over ordered or are surplus to requirements and materials which have been used and discarded.

Demolition waste may be generated through the demolition of roads and permanent buildings prior to construction. Materials with high scrap value such as metals are normally recycled. The remaining materials should be separated into inert and non-inert material for disposal at public dump and landfill. When buildings are demolished, steel bars can be removed from reinforced concrete and recycled. Concrete beams, column and floor slabs can be broken down into manageable size for off site reuse or disposal. Buildings required to be demolished in the district of Tsuen Wan may contain asbestos. Should asbestos be suspected prior to demolition activities, then the requirements of the *Air Pollution Control (Amendment) Ordinance 1993* will be followed. For the disposal of asbestos waste, the *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste* will apply.

Chemical waste likely to be generated from the construction of West Rail will, for the most part, arise from the maintenance of equipment, scrap batteries or spent acid/alkali, used engine oils and hydraulic fluids, chemical/oil based emulsions, spent mineral oils and cleaning fluids, and spent solvents.

General refuse includes any waste that does not fit into any of the categories previously described.

The reclamation of Tsuen Wan Bay may require dredging and disposal of marine muds and sediments. The dredged muds and sediments are classified according to their level of contamination as stipulated in the *EPD Technical Circular No. 1-1-92, Classification of Dredged Sediments for Marine Disposal.* The contamination levels presented in the Technical Circular serve as criteria for determining the disposal requirements of the dredged muds and sediments.

It should be noted that for muds or sediments to be identified within a particular class, only the concentration of one metallic species need be exceeded.

4.11.1.2 Operational Phase

During the operation of West Rail waste arisings will typically consist of the following:

- General refuse;
- Industrial waste; and
- Chemical waste.

The amount of waste arising from these sources will depend on the staffing levels and facilities available at the stations and depots and the nature of the maintenance activities.

General refuse will arise from the public, commercial operators within stations, and KCRC staff. Materials may include food waste, wood, plastic, office wastes, old tins/containers, cleaning materials and miscellaneous wastes produced during daily activities.

Industrial waste will arise from the maintenance activities of West Rail. The materials may include scrap materials from rail and carriage maintenance, cleaning materials and discarded electronic equipment.

The building facilities and railway maintenance activities at West Rail will generate industrial (and possibly some chemical) wastes from the servicing of heating, air conditioning and ventilation systems. These wastes may include freons, paints, lubricants and solvents.

4.11.2 Quantities of Principal Waste Types Generated

Estimates of the quantity of the principal waste types will be based on information obtained from the engineering Design Consultants and from KCRC records on waste generation rates for existing railway systems.

4.11.3 Proposed Waste Management Methods

The proposed re-use, recycling, storage, collection, transport and disposal methods for various wastes during the construction and operational stages for each section of West Rail and the environmental implications will be discussed in *Sections 5, 6, 7* and *8*.

4.12 Land Contamination

4.12.1 Overall Scope

The requirement for a specific and separate treatment of potential land contamination issues along the route of West Rail arose at the Study Management Group meeting to consider the West Rail EIA Inception Report. The initial study brief had originally indicated that land contamination issues would be addressed as part of the assessment of waste issues in this study.

The potential for soil and groundwater contamination exists in some areas along the alignment where current or historic land uses have impacted upon the land. The objective of this study is therefore to identify and evaluate any concerns with respect to potential soil and groundwater contamination where there may be an interface with the underlying soil. The survey of potential land contamination relates primarily to areas along the route where there are proposed excavation works for the station footprints and the West Rail Depot, all areas involving cut-and-cover, and the beginning and end of tunnels where there will be contact with soils.

Depending on the findings of this desktop study, there may be a need to conduct sampling programmes at certain sites to evaluate the extent of any contamination prior to commencement of the development programme. Based on the findings of a site investigation programme, there may be a need to develop remedial plans for dealing with any contaminated soil or groundwater identified.

Any contaminated soil or groundwater encountered during the development programme will need to be handled appropriately in accordance with Government requirements.

4.12.2 Impact Prediction

The assessment has been undertaken in accordance with *ProPECC PN/94 Practice Note for Professional Persons - Contaminated Land Assessment and Remediation*, and has included the following steps:

- Identification of sites along the alignment where excavation works are anticipated to take place;
- Review of the current and historical landuse of the sites to evaluate whether there is potential for any soil and ground contamination to have occurred;
- Evaluation of the nature of potential contamination associated with land uses identified along the alignment;
- Assessment of any potential environmental impacts or health concerns associated with the development of West Rail or future use of the land, arising as a result of exposure to any sources of potential contamination; and
- Development of preliminary mitigation measures and evaluation of residual impacts.

4.13 Hazards

4.13.1 Overall Scope

The requirement for a hazard assessment for the Au Tau Water Treatment Works (WTW) was specified by KCRC in the EIA tender documents whilst that for the assessment of potential landfill gas impacts at Kwai Chung arose during initial investigations of the route alignment.

4.13.2 Impact Prediction

The hazard assessment for Au Tau WTW was undertaken to a scope of study specified by KCRC. The methods of undertaking the Quantitative Risk Assessment are those derived from international best practice and agreed with officers of the EPD.

The procedures for undertaking the landfill gas risk assessment are stated in the Landfill Gas Hazard Assessment Guidance Note produced by EPD. In both cases, the hazard assessment reports are to be vetted seperately from the EIA by specialists agencies of the Hong Kong Government which provides an opportunity for peer review. Comments will be taken into account when these reports are finalised.

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5. THE SOUTHERN SECTION

5.1 Introduction

This section provides a brief description of the Southern Section of West Rail, and an assessment of the environmental implications of its construction and operation. This assessment is based on the best available information regarding the design and construction of West Rail at the time of the assessment, using the standards, criteria and assessment methods and techniques outlined in *Sections 3* and *4*.

5.2 Alignment Description

The Southern Section refers to that section of the rail alignment and associated development between Prince Edward Road at Tai Kok Tsui in the south and Mei Foo in the north.

The Section is located on the West Kowloon Reclamation (WKR), and commences at a point approximately 500m south-west of the proposed Yen Chow Street station (YCS) near the proposed Prince Edward Road Roundabout. The area between this point and YCS will initially serve as overrun tunnels during the current phase of railway development and will facilitate extension of the line to West Kowloon in the future. From YCS the alignment extends north-west to Lai Chi Kok and Mei Foo passing under Hing Wah Street and the Lai Wan interchange. The alignment then turns east through Lai Chi Kok Park around the Mei Foo Sun Chuen residential development and ends just before the proposed Mei Foo (MEF) station.

5.2.1 Construction Overview and Programme

The entire alignment of the Southern Section will be contained in tunnel on the WKR. While the alignment of the Southern Section is essentially at grade, it will be contained in a tunnel box constructed above ground which will be covered by a landscaped earth mound.

A cut-and-cover construction method has been proposed for YCS station and that part of the alignment below grade based on the location of the works, the material to be excavated and the shallow depth of excavation required. Construction will also involve diaphragm walling and bored piling activities at YCS. Along the alignment, construction will primarily involve site levelling and tunnel box construction activities including steel fixing, formworking, concreting and general manual construction activities (eg hammering, welding, bar bending). Lifting equipment such as tower and mobile cranes will also be required on a daily basis.

5.3 Noise

This section addresses the noise impacts arising from construction and operation of the Southern Section of West Rail. Potentially affected NSRs are identified, noise impacts are predicted and assessed, and appropriate mitigation measures are formulated, following the methodology outlined in *Section 4*.

5.3.1 Baseline Conditions

This section of the rail alignment will be enclosed in a box tunnel with earth mounding over the structure and the adjacent areas are either highly developed or committed to development. Major land uses are typically residential and industrial. Nearest residential developments include Tai Kok Tsui Centre, Nam Cheong Estate, Fat Cheung Street Temporary Housing Area (THA) and Mei Foo Sun Chuen. Although train noise impacts are unlikely by virtue of the design, the above residential areas with dense high-rise blocks may still be subject to noise impacts during construction, and fixed plant noise impacts during the operational phase. The noise climate is currently dominated by traffic noise from the West Kowloon Expressway and associated road networks on the West Kowloon Reclamation and will also be affected by the operation of the LAR in future. Identified noise sensitive receivers (NSRs) are shown in *Figures 2 to 4* of *Annex A*.

5.3.2 Construction Phase

5.3.2.1 Potential Sources of Impact

Station construction will take place at Yen Chow Street and Mei Foo. An earth-mounded, at-grade box tunnel will be constructed between them, with cut-and-cover construction and diaphram walling being used in the Lai Chi Kok Park area and the Lai Wan interchange, where some vibratory sheet piling will also be required.

Five construction work areas have been identified in the *Yen Chow Street - Mei Foo Construction Plan, Draft Technical Report, Atkins Hyder, Oct 1997*. They are:

- Site A: Prince Edward Roundabout to Yen Chow Street;
- Site B: Yen Chow Street Station;
- Site C: Yen Chow Street to Hing Wah Street;
- Site D: Hing Wah Street to Lai Wan Interchange; and
- Site E: Lai Wan Interchange to Mei Foo.

An additional work site, Mei Foo Station, has also been planned for the Southern Section.

Figures 2 to 4 in *Annex A* show the proposed route alignment, work areas and NSRs in the Southern Section. The construction works will generally be restricted to normal daytime working hours. The construction activities associated with these works have the potential to cause noise impacts on sensitive receivers in the surrounding area.

5.3.2.2 Prediction of Impacts

Details of the likely construction activities and the appropriate construction plant teams have been provided by the engineering Design Consultants. These have enabled an inventory of SWLs to be identified for each component of the various plant teams, from which the total SWL for each plant team has been calculated. Construction noise levels have been predicted using the methodology set out in the *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling* (TM1), and these are shown below in *Tables 5.3a-g*. Assumed plant team inventories are shown in *Annex B*. All noise levels are predicted at 1 m from the facade of the NSRs. Where a residential development is planned, but the site layout is unknown, a 40 m setback from facade to site boundary has been assumed.

Table 5.3a Predicted Noise Levels from Work Area A (Cut and Cover Tunnelling)

Fig/NSR No	NSR Name	Vibratory Sheet Piling	Bulk Excavation	Concreting Tunnel Slabs	Shotcreting (Tunnel lining)
2/12	Tai Lee Building	**76**	**77**	**80**	70
2/17	Chung Yew Building	71	72	75	65
2/c1	MTRC CDA Site D	**84**	**85**	**88**	**78**
2/24	Nam Cheong Estate	71	72	75	65

Notes: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3b Predicted Noise Levels from Work Area A (Ventilation Building)

Fig/NSR No	NSR Name	Site Clearance	Bored Piling	Concreting	Bulk Excavation	Building Structure Excavation	Building Structure Concreting
2/17	Chung Yew Building	69	73	82	80	76	80

Note: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30min) dB unless stated otherwise.

Table 5.3c Predicted Noise Levels from Work Area B

Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Construction	Column Construction	Station Construction
2/24	Nam Cheong Estate	71	72	73	72	73
3/4	Fat Tseung Street THA	**76**	**77**	**78**	**77**	**78**
3/c3	School/GIC	**77**	**78**	**79**	**78**	**79**

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70/dB(A) criterion for educational establishments are shown in bold font (65 dB(A) during examination periods).

All levels specified are LAeq (30min) dB unless stated otherwise.

Table 5.3d Predicted Noise Levels from Work Area C

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box and Vent Building Construction
3/4	Fat Tseung Street THA	74	76	77	79
3/c3	School/GIC	75	77	78	**80**

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70/dB(A) criterion for educational establishments are shown in bold font (65dB(A) during examination periods).

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3e Predicted Noise Levels from Work Area D

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box Construction
3/8	Haking Wong Technical Institute	68	70	71	73

Note: Exceedances of the 70 dB(A) criterion for educational establishments are shown in bold font (65 dB(A) during examination periods).

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3f Predicted Noise Levels from Work Area E

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box Construction
4/3	MFSC Community Centre	74	76	74	78
4/4	Mei Foo Sun Chuen	84	86	84	88

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

The MFSC community centre is assumed to contain educational facilities.

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3g Predicted Noise Levels from Construction of Mei Foo station

Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Construction	Column Construction	Station Construction
4/4	Mei Foo Sun Chuen	67	68	69	68	69

Notes: Exceedances of the 75 dB(A) criterion are shown in bold.

The plant teams used at Mei Foo involve a different number of plant items and different activities to those at Yen Chow Street.

All levels specified are LAeq (30min) dB unless stated otherwise

Noise impacts of the properties along Mount Sterling Mall are assessed in Central Section. Lai Chi Kok Park is not classified as a NSR under the NCO.

5.3.2.3 Evaluation of Impacts

Construction noise levels exceeding the recommended daytime noise limit have been predicted during most construction activities in the Southern Section. Exceedances of up to 13 dB(A) have been predicted at Mei Foo Sun Chuen and MTRC CDA Site D and 10 dB(A) at educational NSRs.

On the basis of the information available at this time, the MTRC CDA has been assumed to contain residential properties with openable windows and the MFSC Community Centre has been assumed to include educational facilities.

It should be noted that the noise levels shown in *Tables 5.3a-g* are worst case predictions. since the calculation assumes that all of the available plant items for a phase of works are in use for 100% of the time. In practice this is unlikely to be the case as a number of items of plant will operate sequentially and within the constraints of available space within the work site.

5.3.2.4 Recommended Mitigation

The predicted noise levels show that construction activities are likely to give rise to adverse daytime noise impacts at most NSRs. Substantial mitigation measures are therefore required which should including the following:

- Use of good site practices to limit noise emissions at source;
- Use of temporary noise barriers;
- Use of quiet plant and working methods (M1);
- Use of movable noise barriers (M2); and
- Reductions in the number of plant operating in critical areas close to NSRs (M3).

5.3.2.4.1 Good Site Practices and Noise Management Techniques

While the effects are not easily quantifiable, good site practice and noise management can considerably reduce the impact of construction activities on nearby NSRs. The following measures should be followed during each phase of construction:

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- 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;
- Plant known to emit noise strongly in one direction should, where possible, be orientated so that the noise is directed away from nearby NSRs;
- Silencers or mufflers on construction equipment should be properly fitted and maintained;
- Plant should be sited as far away from NSRs as possible; and
- Material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The noise benefits of these techniques can vary according to specific site conditions and operations, and while they would provide some attenuation, they cannot be assumed to guarantee a particular level of noise mitigation.

5.3.2.4.2 Purpose Built Temporary Noise Barriers

Purpose built temporary noise barriers 3 to 5 m high, located on the site boundaries between noisy construction activities and NSRs, could reduce noise levels by up to 5 dB(A) through partial screening. It should be possible for the Contractor to provide these in the form of site hoardings, which will achieve this attenuation effect provided that the barriers have no openings or gaps and have a superficial surface density of at least 20 kg m^{-2}.

However, as the geometry between the NSRs and the noise sources cannot yet be clearly defined, and designs of the hoarding and site boundary wall are not yet available, no screening has been assumed for these barriers. The potential benefits of site hoardings are not, therefore, assessed in this study.

5.3.2.4.3 Use of Quiet Plant and Working Methods

The Contractor should be able to obtain particular models of plant that are quieter than the noise levels given in TM1 and TM2. The benefits achievable will depend on the Contractor's chosen construction methods, and it is considered unnecessarily restrictive and contractually inappropriate to specify that the Contractor has to use specific models or items of plant for the construction operations. However, it is reasonable to set plant noise performance specifications for identified types of powered mechanical equipment (PME). In this way, plant teams could be chosen by the contractor to suit his preferred working methodology, while still meeting the identified total SWL.

Silenced plant and PME with a SWL less than the value specified in TM1 for the same item of plant are known to be available in Hong Kong and examples are provided in the plant team list shown in *Table 4.4b.*

It should be noted that EPD, when processing a construction noise permit (CNP) application for activities outside normal daytime hours, will apply the noise levels contained in the relevant TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

5.3.2.4.4 Portable Noise Barriers

Portable barriers that can be located close to noisy plant can be very effective at screening NSRs from individual items of PME. Movable barriers 3 m high, with skid footing and a small cantilevered upper portion, can be located close to static plant. Based on the NSR heights and preliminary site layouts, the noise screening benefit has been estimated to be up to 10 dB for PME such as air compressors and generators, and up to 5 dB for PME such as poker vibrators.

5.3.2.4.5 Reducing the Number of Plant Operating Close to NSRs

In combination with the selection of quiet plant and portable barriers, further reduction in the total SWL can be achieved through restrictions in the number of plant in operation at any one time. This can be most effective for activities associated with foundation work, station box and ventilation building construction and excavation activities in which a large number of PME are required on site, but not all of them need be utilised at the same time.

5.3.2.4.6 *Mitigated Noise Level Predictions*

Predictions of the mitigated noise levels presented in the following *Tables* assume that lorries will only generate significant amounts of noise whilst they are moving. When they are stationary the engine will be set to idle or switched off during loading. This will reduce unmitigated levels by up to 10 dB(A) for this activity.

The noise mitigation measures described above have been applied to the predicted noise levels given previously in *Tables 5.3a-g* and the mitigated noise levels, using mitigation measures M1, M2 and M3 are shown in *Tables 5.3h-m*.

Table 5.3h Mitigated Noise Levels from Work Area A (Cut and Cover Tunnelling)

Fig/NSR No	NSR Name	Vibratory Sheet Piling	Bulk Excavation	Concreting Tunnel Slabs	Shotcreting (tunnel lining)
2/12	Tai Lee Building	**76/76/73**	70/-/-	**76/75/-**	-/-/-
2/c1	MTRC CDA Site	**84/84/81**	**78/78/71**	**84/83/77**	74/-/-

Note: (1) Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown in bold font.

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3i Mitigated Noise Levels from Work Area A (Ventilation Building)

Fig/NSR No	NSR Name	Site Clearance	Bored Piling	Concreting	Bulk Excavation	Building Structure Excavation	Building Structure Concreting
2/17	Chung Yew Building	-	-	78/77/71	78/72/-	69/-/-	78/76/72

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown bold

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3j Mitigated Noise Levels from Work Area B

Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Construction	Column Construction	Station Construction
3/4	Fat Tseung Street THA	69/-/-	74/-/-	75/73/-	74/-/-	75/-/-
3/c3	School/GIC	70/ -/ -	75/74/67	76/74/64	78/73/67	76/73/67

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments shown in bold (65dB(A) during examination periods).

All levels specified are LAeq (30min) dB unless stated otherwise.

Table 5.3k Mitigated Noise Levels from Work Area C

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box and Vent Building Construction
3/4	Fat Tseung Street THA	-/-/-	69	77/77/72	75/-/-
3/c3	School/GIC	68/ -/ -	70/ -/ -	78/78/73	76/75/69

Note: (1) Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3l Mitigated Noise Levels from Work Area D

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box Construction
3/8	Haking Wong Technical Institute	-/ -/ -	63/ -/ -	71/71/66	69/ -/ -

Note: (1) Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 70 dB(A) criterion shown in bold.

All levels specified are LAeq (30min) dB unless stated otherwise

Table 5.3m Mitigated Noise Levels from Work Area E

Fig/NSR No	NSR Name	Site Clearance	Bulk Excavation	Sheet Piling	Tunnel Box Construction
4/3	MFSC Community Centre	67/ -/ -	69/ -/ -	**74/74/71**	**74/73/65**
4/4	Mei Foo Sun Chuen	**77/77/75**	**79/79/71**	**84/84/81**	**84/83/75**

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments shown in bold (65 dB(A) during examination periods).

The MFSC community centre is assumed to include educational facilities.

All levels specified are LAeq (30min) dB unless stated otherwise.

5.3.2.5 Cumulative Noise Impacts

In general, construction works on different sites will not give rise to cumulative impacts due to distance separation and the orientation of individual NSRs. However, there are a few NSRs close to the boundary of two worksites. Nam Cheong Estate. Mei Foo Sun Chuen Block 8 and the School/GIC site, which could be affected by cumulative impacts of noisy activities occurring simultaneously on both sites.

At Nam Cheong Estate, cumulative construction noise impacts from both Area A and B are expected. However, the mitigated noise levels from both sites are below

70 dB(A) and the cumulative noise impacts at the NSR will still comply with the noise criteria.

At Mei Foo Sun Chuen Block 8, construction noise from the works at both Area E and Mei Foo Station will affect the NSR. However, the predicted noise level from Area E is much higher than that of Mei Foo Station (more than 10 dB(A)), and therefore, the cumulative noise level at the NSR will be the same as the predicted noise levels from Area E.

Cumulative noise impacts from Areas B and C are expected at the School/GIC site. The predicted noise level would be increased by 3 dB(A), above the level in *Table 5.3k*, if construction works from both sites are running in parallel.

5.3.2.6 Residual Impacts

Application of the mitigation measures detailed above has reduced impacts to within the established criteria at all NSRs except for:

- The MTRC CDA site during vibratory sheet piling and tunnel slabs in work area A;
- The School/GIC facility during vibratory sheet piling in work area C; and
- Mei Foo Sun Chuen Block 8 during sheet piling and construction works for the box tunnel in work area E.

Worst case scenarios, as described above, have been assumed for plant team activities and, if necessary, the predicted noise level could be further reduced by limiting the period of use or number of items of noisy plant. Application of the following measures will reduce the noise impacts at all NSRs to within the established criteria.

Table 5.3n Additional Mitigation Measures

Work Area	Construction Activity	Percentage on-time in any 30 minute period	No of noisy plant
A	Sheet Piling	30%	-
	Tunnel Slab	-	restricted to one lorry operating at any time
C	Sheet Piling	70%	-
E (Section between Mei Foo Station and Mei Foo interchange)	Sheet Piling	25%	restricted to one lorry operating at any time
	Bulk Excavation	-	restricted to one lorry operating at any time
	Tunnel Box	-	restricted to one lorry operating at any time

A more stringent noise requirement is applied for educational institutions during examination periods, namely 65 dB(A). To avoid high noise impacts, especially noisy construction activity should be scheduled outside examination periods.

5.3.2.7 Conclusions

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, no serious noise impacts are expected from construction of the Southern Section.

5.3.3 Operational Phase

5.3.3.1 Fixed Plant Noise

5.3.3.1.1 Potential Sources of Impact

Fixed plant associated with the operation of West Rail may be a potential source of noise impacts. These noise sources will mainly be located at stations, ventilation structures and other ancillary buildings.

It is expected that the main contribution to fixed plant noise will come from the tunnel ventilation systems for underground or completely covered sections of the alignment, including underground stations. A complete ventilation system will normally comprise the following components:

- Tunnel ventilation plant and shafts;
- Tunnel impulse fans; and
- Trackway ventilation system.

In general, the proposed tunnel ventilation plant is a structure with three or four levels, with the first level as the fan room floor. The top level of the structure will be above-ground and will have air discharge and intake plenums with exterior louvres at the sides. Tunnel ventilation structures will normally be located near the ends of stations and at other locations along the tunnels. Tunnel impulse fans are required at strategic locations alongside the trackway to compensate for the possible effects of airflow short circuiting that could occur at a crossover. However, these fans are located within the tunnel and therefore their operation will not cause any noise impacts. Trackway ventilation is required at stations to remove heat emitted from the underframe and air-conditioning units of trains dwelling at these stations. Air extracted by the trackway ventilation system will be returned to the station air handling units or discharged directly to the ambient environment through the tunnel ventilation shafts.

In this assessment, only the tunnel ventilation structures are assessed for potential impact as their air discharge outlets and intakes will be the only above-ground noise sources with the potential to affect NSRs. The other components will be located underground and will not give rise to any noise impacts. It should also be noted that operation of the tunnel ventilation system is required under normal operation conditions owing to the limited piston effect produced by train movements within tunnels.

Additional contributions to fixed plant noise are expected from components of air-conditioning systems, including chillers and cooling water pumping stations. These have been considered in this assessment where information is available. Appropriate measures are also recommended to be included in the design of these facilities to ensure that no adverse impacts will arise from their operation.

Apart from ventilation buildings, noise may also be generated from other ancillary buildings. Examples of these include electric power sub-stations for the supply of station power and traction power. Noise is generated from transformers and associated cooling systems within these electric power sub-stations.

Station activities such as public announcements, train idling at platforms and passenger movements will also generate noise. However, none of these activities are considered likely to cause impacts beyond the station building structure and therefore assessment is not considered necessary.

As only limited information is currently available on fixed plant sources necessary for West Rail operation, it is not possible to accurately predict the noise impacts from every source for individual NSRs. Instead, appropriate noise specifications for the fixed plant to ensure compliance with relevant planning guidelines and statutory requirements have been identified, based on available information on the potential noise source and the nearest NSRs.

The alignment of the entire Southern Section is in tunnel and the largest number of ventilation facilities is found within this section.

- Four ventilation shafts approximately 500 m south of Yen Chow Street station at the southern end of the Nam Cheong Buffer Zone:
- Cooling water pumping station approximately 500 m south-west of Nam Cheong Estate; and
- Ventilation shaft structures at the northern and southern platform ends of Yen Chow Street station, which will form part of the station structure.

Information on the requirements for fans and chillers within the ventilation facilities has been provided by the engineering Design Consultants but no information is available so far on louvres and openings.

No traction power feeder station will be located within this section of the West Rail alignment.

5.3.3.1.2 Prediction of Impacts

The noise specifications for each potential source of fixed plant noise have been determined by considering the maximum allowable sound power level for each source to achieve compliance with the HKPSG criteria at the closest NSR, allowing a correction factor for distance, tonality and facade reflection. A further correction was applied if more than one fixed plant item was likely to cause a noise impact at an NSR.

The HKPSG suggests that noise criteria for fixed plant should be 5 dB below the appropriate Acceptable Noise Levels (ANL) specified in TM4. This level was therefore taken as the maximum allowable level at the NSR. Two NSRs in this area are likely to be exposed to noise from fixed plant. These are Tai Yick Building and Nam Cheong Estate; these represent the NSRs closest to the fixed plant items.

Nam Cheong Estate will be the NSR closest to two fixed plant installations: the ventilation shaft structures at the northern and southern platform ends of Yen Chow Street station and the cooling water pumping station approximately 500m south-west of Nam Cheong Estate. It is assumed that each of these facilities will contribute equal levels of noise at Nam Cheong Estate and therefore a 3 dB correction has been included when calculating the maximum allowable SWL to ensure that no cumulative impacts arise. Each of the three NSRs identified were assigned an Area Sensitivity Rating (ASR) of 'C'. The criterion adopted for these NSRs is therefore $L_{Aeq\ (30\ minutes)}$ 55 dB(A).

Table 5.3o below presents the maximum allowable sound power level for each of the fixed plant installations which will be required to meet the HKPSG criteria.

Table 5.3o Calculated Maximum Permissible Noise Levels of Fixed Plant

Fixed Plant Noise Source	Identity of Nearest NSR	Area Sensitivity Rating	Night-time Criteria $L_{Aeq\ (30\ minutes)}$ dB	Distance to NSR (m)	Maximum Allowable SWL of fixed plant, dB
Tunnel ventilation building in the vicinity of Cherry Street	Location not yet determined, therefore no preliminary predictions can be made				
Ventilation shafts approximately 500m south of Yen Chow Street station at the southern end of the Nam Cheong Buffer Zone	Figure 2 NSR13 Tai Yick Building	C	55	195	103[(1)]
Ventilation shaft structures at the northern and southern platform ends of Yen Chow Street station, which will form part of the station structure	Figure 2, NSR24 Nam Cheong Estate	C	55	170	99[(1)]
Cooling water pumping station approximately 500 m southwest of Nam Cheong Estate	Figure 2, NSR24 Nam Cheong Estate	C	55	400	102[(1)]

Notes:(1) This level includes a 3 dB correction to allow for potential cumulative impacts.

Provided that the above allowable sound power levels can be met, no impacts are likely.

5.3.3.1.3 Recommended Mitigation

Ventilation Fans, Vents and Buildings

Ventilation fan noise, and consequently vent noise, is characterised primarily by turbulent air flow noise and tonal noise. Turbulent air flow noise can be minimised by careful consideration of the fan positioning, avoiding areas where turbulence is likely to occur such as close to heaters/coolers or bends in the ductwork. Tonal noise can be minimised by optimising the fan speed and pitch of the blades. Where more than one fan is used, fan speeds should be selected to prevent low frequency noise being generated.

Fan noise can be reduced further by providing an acoustic enclosure and by fitting silencers. Noise emanating from vents can be reduced further by fitting attenuators.

All fans should be maintained in good mechanical condition to prevent unnecessary noise such as the high frequency whine that can be generated by worn bearings.

Chiller Plant

Chiller plant noise is characterised by intermittent compressor noise and low frequency air flow noise. Chiller plant noise can be minimised by enclosing the unit and fitting silencers to air inlets and outlets. All equipment should be maintained in good mechanical condition to prevent unnecessary noise which may result from loose panels or worn bearings.

Cooling Water Pumping Station

Calculations of maximum permissible noise levels have been made by considering the closest NSR, its sensitivity and the distance between the source and NSR.

Cooling water pumps have the potential to generate both tonal noise and structure borne noise. This noise can be minimised by installing an acoustic enclosure with silencers fitted to air inlets and outlets, and by ensuring that the pump is vibrationally isolated from any surface which may radiate noise. Equipment should be maintained in good mechanical condition.

Traction Sub-Stations

Noise from the traction sub-stations can be minimised by providing acoustic enclosures around transformers, particularly any cooling fans and ensuring that all equipment is maintained in good working condition.

Residual Impacts

Past experience suggests that conventional plant can achieve the noise performance requirements derived above, provided the mitigation measures outlined above are adopted. The plant specifications contained within contractual and procurement documentation shall include explicit reference to these performance criteria.

5.3.3.2 Train Operational Noise

In this section the effects of airborne noise from the railway will be limited due to the at-grade tunnel box that will enclose the track from Yen Chow Street station northwards to Mei Foo. All NSRs to the east and west of the alignment will be fully protected by the box structure. In order to demonstrate that airborne noise does not lead to impacts in this area a prediction of the airborne noise level at the nearest receptor, including the effect of the at-grade box tunnel section, has been carried out.

The closest NSR in this section is Mei Foo Sun Chuen which is about 23m from the alignment. Exact facade locations are not known at this stage. The predicted noise level due to airborne noise at a distance of 40m for a passenger train travelling at 100 kph, is 53 dB $L_{Aeq\ night}$. This assumes a conservative reduction in airborne noise of 25 dB(A) by the at-grade tunnel box. This is clearly below the most stringent operational noise criterion for receptors in this section, which vary from 55 to 60 dB(A) L_{Aeq}, for ASRs of B and C.

5.3.4 Conclusion

The assessment of Operational Noise for the Southern Section has concluded that noise levels will be well within the operational noise criteria.

5.4 Air Quality

5.4.1 Construction Phase

5.4.1.1 Baseline Conditions

The Southern Section of West Rail extends from the Prince Edward Road Roundabout in Tai Kok Tsui to Mei Foo Sun Chuen and is located on the West Kowloon Reclamation (WKR). A number of developments and facilities are currently under construction on the WKR, including the Lantau and Airport Railway (LAR) and housing estates. Air quality in the area is expected to be influenced by these construction works. Additionally, major roads, namely the West Kowloon Corridor and West Kowloon Expressway (WKE) also contribute to background air quality.

The nearest EPD air quality monitoring station is located on the roof top of Shamshuipo Police Station. The annual average TSP levels measured in 1996 was 91 $\mu g\ m^{-3}$.

5.4.1.2 Potential Sources of Impact

The principal potential source of air quality impacts arising from the construction of the alignment and stations will be fugitive dust. Although power mechanical equipment, such as air compressors and generators will be used, the number of equipment items required will be limited. There will be at most four generators and air compressors operating at any one time during the foundation works at Yen Chow Street station, and generally there will be 1 to 3 items operating simultaneously. Therefore, together with good house-keeping and regular maintenance, the gaseous exhaust emissions from the plant will be relatively small. According to the *Traffic Census 1996*, the annual average daily traffic flows at various counting stations on the West Kowloon Corridor are between 21510 and 104160. Additional traffic generated at the construction works sites will be relatively small (see *Table 5.4a* for details) and will not contribute significantly to air quality impacts in the area.

The alignment of the Southern Section and Yen Chow Street station will be at-grade within a box structure. Construction of the alignment and station will be by open cut and then box construction. There are five work sites spaced linearly along the alignment between Yen Chow Street station and the northern extent of the Southern Section at Mei Foo. The first site is located to the south of Yen Chow station and basically encompasses the overrun tunnel; the second is the station site itself and the third, fourth and fifth sites are approximately equally spaced between the Yen Chow Street and Mei Foo Station. These have been designated work site areas A to E and their locations are shown in

Figures 2 to 4 of *Annex A*. Potential fugitive dust sources from the Southern Section of West Rail are expected from the following activities:

- Excavation for the tunnel box and Yen Chow Street station;
- Material handling and stockpiling;
- Vehicular movement at the haul roads within the works areas; and
- Wind erosion of unpaved works areas.

The amount of traffic flow generated by construction of the station and alignment has been predicted in the *Draft Technical Report, Yen Chow Street - Mei Foo, Construction Plan, Atkins Hyder, October 1997*. The volume of spoil and materials to be transported to and from each site, and traffic volume generated by such activities area are list *in Table 5.4a*. The vehicle speed is assumed to be 35 kph, based on current practices on other construction sites. Calculated dust emission rates for each activity are based on AP42 and details are presented in *Annex F*.

Table 5.4a Estimate of Construction Traffic Flows

Works Area	Quantities of Materials Handled (m³)			Maximum Number of Trucks Required (veh/day)
	Spoil	Concrete	Steel	
A	21625	18500	1850	37
B	452142	265682	1010	420
C	52375	18500	1850	110
D	4000	18500	1850	17
E	25625	18500	1850	32

5.4.1.3 Prediction of Impacts

Air Sensitive Receivers (ASRs) along the West Rail alignment have been identified in accordance with the *Hong Kong Planning Standards and Guidelines* (HKPSG) and the *Air Pollution Control Ordinance* (APCO). Details of the ASRs are presented in *Annex A*. 1-hour and 24-hour TSP levels are predicted at the nearest ASRs. The cumulative 1-hour and 24-hour TSP levels arising from construction works for the Southern Section at the identified representative ASRs under the worst case wind conditions (including background levels) are shown in *Table 5.4b*. All of the work areas in the Southern Section have been included in the dust model to obtain the cumulative dust impacts at the ASRs. The annual TSP level measured at Sham Shui Po Police Station of 91 $\mu g\ m^{-3}$ were assumed as the background for the Southern Section.

Table 5.4b Predicted Cumulative 1-hour and 24-hour TSP Levels at Representative Air Sensitive Receivers

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Tai Kok Tsui (TKT)	2/c1	MTRC CDA Site D	**518**	**305**
	2/17	Chung Yew Building	**546**	**319**
	2/24	Nam Cheong Estate	**1397**	**744**
Cheung Sha Wan (CSW)	2/c1	CDA	443	**267**
	3/11	Wholesale Market	**823**	**457**
	3/4	Fat Tseung Street THA	476	**284**
	3/c3	Schools/GIC	486	**289**
	3/8	Haking Wong Technical Institute Workfront Annexe	226	159
	3/9	Hong Kong Telephone Sport Complex	201	146
Mei Foo (MEF)	4/1	Lai Chi Kok Park to the east of Mei Foo Sun Chuen	461	**276**
	4/3	Community Centre in Mei Foo Sun Chuen	186	139
	4/4	Mei Foo Sun Chuen	365	228

For location of ASRs refer to *Annex A*

Bold figures exceed TSP criteria

Includes background TSP Levels

Units are µg m^{-3}

5.4.1.4 Evaluation of Impacts

Dust emissions from the sites are high especially at site areas B and C where high materials handling rates and construction traffic flows are expected. The predicted 1-hour and 24-hour TSP levels at the representative ASRs along the southern section works area are in the range of 186-1397 µg m^{-3} and 139-744 µg m^{-3} respectively. The EPDs recommended hourly limit of 500 µg m^{-3} and 24-hour AQO of 260 µg m^{-3} are exceeded at the ASRs including MTRC CDA Site, Chung Yew Building, Nam Cheong Estate and Wholesale Market. The 24-hour AQO criteria will be exceeded in the CDA site in Cheung Sha Wan, Fat Tseung Street THA and School/GIC site and Lai Chi Kok park. Without implementation of dust control measures, these ASRs will be affected by dust impacts during construction.

5.4.1.5 Recommended Mitigation

The following mitigation measures are recommended for construction activities on all sites.

Materials Handling

- The heights from which excavated materials are dropped should be controlled to a minimum practical height to limit fugitive dust generation from unloading;
- All stockpiles of aggregate or spoil of more than 50 m^3 should be enclosed or covered and water applied in dry or windy conditions;

Excavation

- 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;

Vehicle Dust

- 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;
- Vehicles transporting materials that have the potential to generate dust should have properly fitting side and tail boards;
- Materials transported by vehicles should be covered, with the cover properly secured and extended over the edges of the side and tail boards;
- Materials should also be dampened, if necessary, before transportation;
- On-site vehicle speeds should be controlled to reduce dust re-suspension and dispersion; and
- 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.

Through the implementation of the above mitigation measures, dust emissions from materials handling and vehicle movement on haul roads will be reduced by 50% and 60 % respectively. The predicted mitigated 1-hour and 24-hour TSP levels are presented in *Table 5.4c*.

Table 5.4c Mitigated Cumulative 1-hour and 24-hour TSP Levels at Representative Air Sensitive Receivers

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Tai Kok Tsui (TKT)	2/c1	MTRC CDA Site D	275	163
	2/17	Chung Yew Building	279	154
	2/24	Nam Cheong Estate	620	256
Cheung Sha Wan (CSW)	3/c1	CDA	237	140
	3/11	Wholesale Market	389	187
	3/4	Fat Tseung Street THA	249	143
	3/c3	Schools/GIC	254	145
	3/8	Haking Wong Technical Institute Workfront Annexe	148	111
	3/9	Hong Kong Telecom Sport Complex	150	132
Mei Foo (MEF)	4/1	Lai Chi Kok Park to the east of Mei Foo Sun Chuen	249	150
	4/3	Community Centre in Mei Foo Sun Chuen	133	108
	4/4	Mei Foo Sun Chuen	210	137

For location of ASRs refer to *Annex A*

Includes background TSP Level

Units are $\mu g\ m^{-3}$

5.4.1.6 Residual Impacts

The implementation of the 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 256 $\mu g\ m^{-3}$. Lai Chi Kok Park is adjacent to the works area, and hoarding is also recommended at the site boundary to further limit ground level fugitive dust dispersion into the park.

5.4.2 Operational Phase

5.4.2.1 Baseline Conditions

The West Kowloon Corridor and West Kowloon Expressway (WKE) on the WKR have been identified as the main roads in the study area which will contribute to the background air quality. Reference to the *West Kowloon Reclamation Comprehensive*

Traffic Analysis Review and Environmental Impact Assessment Draft Final Report. Acer. September 1996 suggests that construction works in the area will take place until 2008. During the operation of West Rail, the background air quality will be influenced by construction dust from on-going construction works. The proposed developments will generate increased traffic flows in the area and air quality will also be affected by both construction dust and vehicular emissions. With the completion of construction works in the area, air quality will mainly be influenced by vehicular emissions.

5.4.2.2 Potential Sources of Impact

Potential air quality impacts during the normal operation of West Rail will be limited since electric trains will be used and no exhaust gas will be produced. However, low levels of dust may be created by the abrasion and wear of track, electrical pick-up gear and rolling stock during normal operation and maintenance activities. The amount of dust generated from such activities will be low and will have a negligible impact on the ASRs.

The used air inside the station and along the alignment will be emitted via the exhaust outlets or air ventilation systems. The pollutant levels of such emissions will be very low and adverse air quality impacts are therefore not expected.

Stations located underground or within box structure will need to be supplied with sufficient ventilation. Ventilation fans and louvers, or air ventilation systems, will be provided to ensure sufficient local air movement within the station concourse. Smoke extraction vents will also be provided in the event of fire. The design and orientation of vents will be such that discharges are directed away from the nearby sensitive receivers to avoid nuisance.

The public transport interchanges (PTI) are located more than 20 m from the ASRs, satisfying the Hong Kong Planning Standards and Guidelines (HKPSG) recommended buffer distances for trunk roads. Adverse air quality impacts from the transport interchanges is therefore unlikely.

5.4.2.3 Recommended Mitigation

The ventilation systems should be designed such that discharges are directed away from nearby sensitive receivers to avoid nuisance.

5.4.2.4 Residual Impacts

Air quality impacts during the operational phase of West Rail are not considered to be of concern as limited potential sources have been identified. No residual impacts are anticipated.

5.5 Water Quality

This section provides a detailed assessment of the potential water quality impacts associated with the construction and operation of the Southern Section of West Rail, based on the findings of the IAR and updated information provided by the engineering Design Consultants.

The key focus of this section of the FAR is to assess the potential generation and discharge of wastewaters, which may cause adverse water quality impacts on water sensitive receivers if not properly controlled. Where appropriate, mitigation measures have been proposed to control all potential water quality impacts so that residual (post-mitigation) discharge levels meet the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) standards.

5.5.1 Construction Phase

5.5.1.1 Water Sensitive Receivers (WSRs)

The receiving water body during the construction of the Southern Section will be the Victoria Harbour Phase II Water Control Zone, east of the West Kowloon Reclamation. Victoria Harbour is ecologically degraded. Major biological sensitive receivers such as mariculture zones and commercial fisheries are not found in the vicinity of the Southern Section construction area. Although water quality within the Victoria Harbour WCZ is poor, it is desirable to ensure that neither the construction nor operation of the Southern Section leads to further deterioration in water quality.

Owing to the highly urbanised nature of the Kowloon peninsula there are no natural streams located within the Southern Section construction area. There are, however, two WSD salt water pumping station intakes and a typhoon shelter along the West Kowloon coast line (see *Figure 5.5a*):

- Cheung Sha Wan salt water pumping station which is located at the waterfront of Tai Kok Tsui;
- Yau Ma Tei salt water pumping station which is located south of Yau Ma Tei Typhoon Shelter; and
- Yau Ma Tei Typhoon Shelter which is located along the edge of the West Kowloon reclamation area.

These three WSRs could be impacted by an increase in suspended solids and associated siltation problems during construction, particularly the salt water intakes of WSD sea water pumping stations. WSD has specified WQOs at intake points of salt water pumping stations for toilet flushing. The WSD standards for salt water for SS and DO are less than 10 mg/l and greater than 2 mg/l, respectively.

Although there are no specific water quality standards for typhoon shelters, adequate flushing and good water quality inside and outside the typhoon shelter is required to maintain the beneficial uses of these water bodies, with reference to the *Environmental Guidelines for Planning in Hong Kong*.

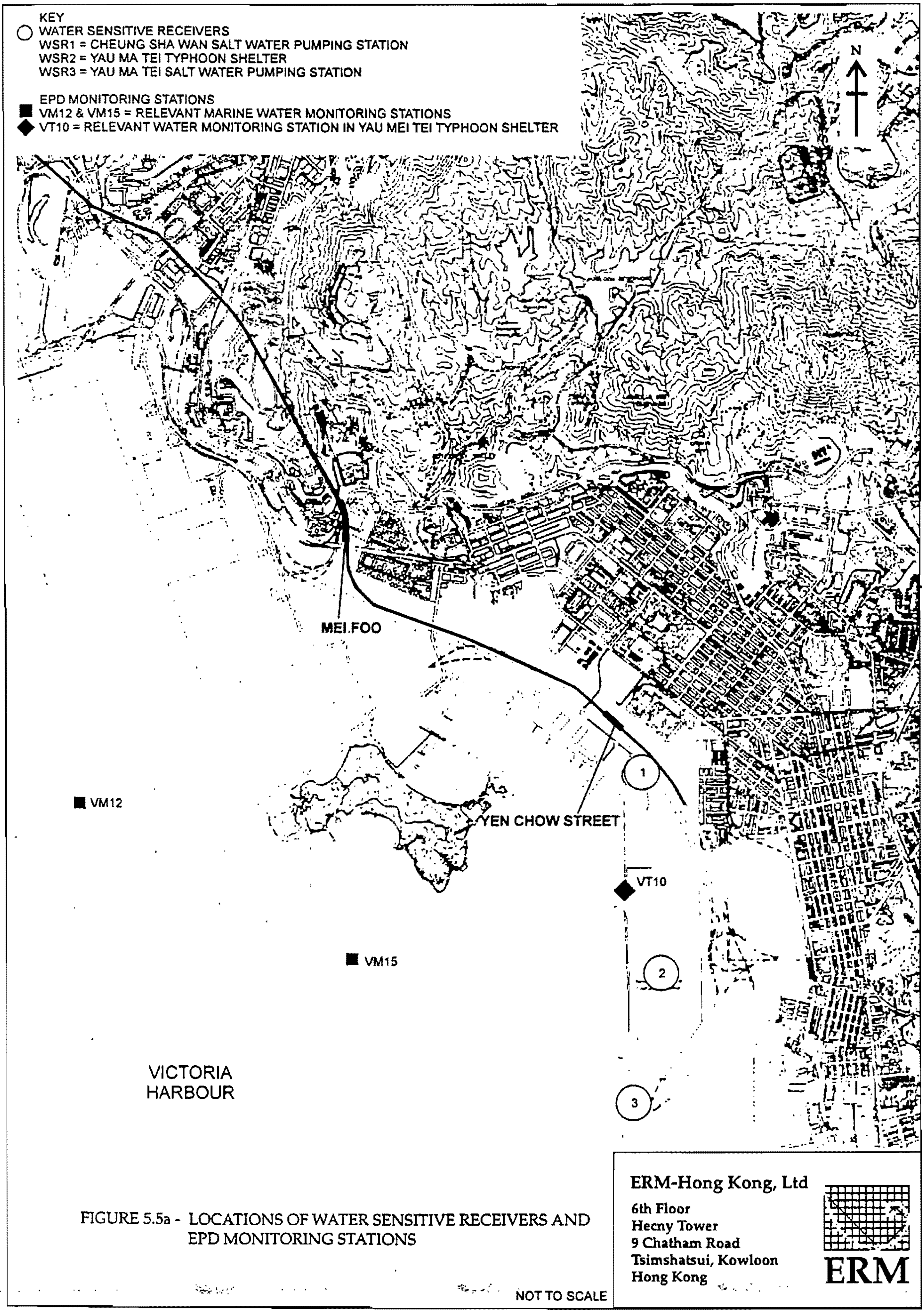

FIGURE 5.5a - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD MONITORING STATIONS

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6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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5.5.1.2 Baseline Conditions

5.5.1.2.1 Victoria Harbour

Water quality of the Victoria Harbour is well documented in the results of the EPD's routine marine water monitoring programme; the latest data available are for 1996. The nearest water quality monitoring stations to the Southern Section alignments are VM12 and VM15 (see *Figure 5.5a*), located south of Stonecutters' Island. A summary of the EPD's monitoring data (for 1996) for stations VM12 and VM15 is given in *Table 5.5a.*

The existing baseline condition of the Victoria Harbour is heavily polluted, as indicated by high nutrient levels (the annual means of total Kjeldahl nitrogen (TKN) of VM12 and VM15 are 0.42 mg/l and 0.46 mg/l, respectively), and faecal pollution in the form of high counts of *Escherichia coli (E. coli)* (ranging from 1,633 to 160,667 per 100 ml at VM12 and from 1,633 to 16,667 per 100 ml at VM15).

E. coli counts are high as a result of the discharge of untreated sewage from the West Kowloon area. This is substantiated by high 5-day biological oxygen demand (BOD_5) levels measured in 1996 at VM12 and VM15, which range from 0.5 mg/l to 1.4 mg/l, with an annual mean of 0.8 mg/l at each station. However, each of these two EPD monitoring stations is individually located close to sewage outfalls, with VM12 close to Tsing Yi and Kwai Chung sewage outfalls and VM15 close to Stonecutters' Island outfalls.

Table 5.5a Summary Statistics of 1996 Water Quality of Victoria Harbour

Determinant		Victoria Harbour EPD Monitoring Station No.	
		VM12	VM15
Temperature (°C)	Surface	23.3	23.8
		(18.4-27.9)	(18.8-28.5)
	Bottom	22.8	23.0
		(18.4-27.5)	(18.8-27.7)
Salinity (ppt)	Surface	30.7	31.2
		(26.1-34.0)	(25.7-34.1)
	Bottom	32.4	32.4
		(29.9-34.1)	(30.2-34.0)
DO (% saturation)	Surface	71.7	68.8
		(52.3-101.7)	(51.5-87.8)
	Bottom	62.9	64.7
		(53.5-74.9)	(50.5-81.4)

Determinant		Victoria Harbour EPD Monitoring Station No.	
		VM12	VM15
DO (mg/l)	Surface	5.1	4.9
		(4.0-6.9)	(3.6-5.9)
	Bottom	4.5	4.6
		(3.7-5.7)	(3.8-5.5)
pH value		7.9	7.8
		(7.7-8.1)	(7.5-8.1)
Suspended Solids (mg/l)		9.2	12.0
		(4.9-22.6)	(2.7-23.0)
Turbidity (NTU)		6.6	5.5
		(2.8-24.7)	(2.0-8.1)
BOD_5 (mg/l)		0.8	0.7
		(0.5-1.4)	(0.5-1.5)
Ammoniacal Nitrogen (mg/l)		0.25	0.26
		(0.10-0.36)	(0.11-0.39)
Total Kjeldahl Nitrogen (mg/l)		0.42	0.46
		(0.20-0.50)	(0.23-0.62)
Total Phosphorus (mg/l)		0.17	0.17
		(0.11-0.26)	(0.11-0.27)
E. coli (number per 100 ml)		6,423	3,665
		(1,633-160,667)	(1,633-16,667)

Notes:

1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for *E. coli* data which are geometric means.
3. Data enclosed in parentheses indicate the ranges.

Source: EPD

5.5.1.2.2 Yau Ma Tei Typhoon Shelter

Water quality in the Yau Ma Tei Typhoon Shelter is also well documented by the EPD routine marine water monitoring programme (monitoring station VT10), the latest available data being for the year 1995. A summary of EPD monitoring data (1995) for station VT10 is given in *Table 5.5b*.

Table 5.5b Summary Statistics of 1995 Water Quality of Yau Ma Tei Typhoon Shelter

Determinant		EPD Monitoring Station VT10
Temperature (°C)	Surface	23.2
		(18.5 - 27.2)
	Bottom	23.1
		(18.0 - 27.0)
Salinity (ppt)	Surface	30.9
		(27.6 - 32.9)
	Bottom	31.1
		(27.8 - 33.3)
DO (% Saturation)	Surface	34.0
		(14.9 - 46.7)
	Bottom	31.7
		(15.3 - 45.4)
DO (mg/l)	Surface	2.4
		(1.0 - 3.3)
	Bottom	2.3
		(1.1 - 3.2)
pH		7.6
		(7.4 - 7.7)
Suspended Solids (mg/l)		10.7
		(8.8 - 13.3)
Turbidity (NTU)		5.9
		(3.7 - 8.3)
BOD_5 (mg/l)		1.6
		(0.9 - 2.2)
Ammoniacal Nitrogen		0.63
(mg/l)		(0.38 - 0.99)
Total Kjeldahl Nitrogen		1.21
(mg/l)		(0.72 - 1.70)
Total Phosphorus (mg/l)		0.21
		(0.17 - 0.26)
E. coli (number per 100 ml)		24,354
		(8,000 - 37,333)

Determinant	EPD Monitoring Station VT10

Note:

1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for *E. coli* data which are geometric means.
3. Data enclosed in parentheses indicate the ranges

The existing baseline condition of the Yau Ma Tei Typhoon Shelter is heavily polluted, as indicated by the low dissolved oxygen level annual mean of 3.7 mg/l (surface), ranging from 1.4 mg/l to 5.2 mg/l. *E. coli* ranged from 3,800 to 159,000 counts per 100 ml, with an annual mean of 9,483 counts per 100 ml.

5.5.1.3 Potential Sources of Impact

Potential sources of impacts on water quality from the construction of the Southern Section include the following:

- Construction runoff and drainage including dewatering operations;
- Runoff from the cut-and-cover tunnelling and station construction works;
- Runoff from general construction activities; and
- Sewage effluents generated from the construction work force.

5.5.1.4 Prediction of Impacts

5.5.1.4.1 Construction Runoff and Drainage

Construction Runoff

Runoff from construction sites may contain increased loads of SS and contaminants. Potential sources of water pollution from site runoff include:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;
- Contaminated groundwater from dewatering activities;
- Bentonite slurries and other grouting materials;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

Construction runoff and drainage may cause both physical, chemical and biological effects. The physical effects could arise from any increase in SS from the site which could cause blockage of drainage channels and associated local flooding when heavy rainfall occurs, as well as local impacts on downstream water quality in Victoria Harbour.

Possible chemical and biological effects could arise as a result of construction runoff, depending upon the chemical and nutrient content of the runoff. Primary chemical effects may result from liquids containing significant quantities of concrete and cement-derived materials. These may include localised increases in turbidity and discoloration, localised elevations in pH, and accretion of pH solids. Bentonite slurry and other grouting material within runoff could also contribute to these chemical effects within the water column. A number of secondary effects may also result in toxic effects to marine biota due to elevated pH values, reduced decay rates of faecal micro-organisms due to decreased light penetration, and a localised increase in the proportion of unionised ammonia.

Stormwater Culvert Drainage

There are 13 existing culverts along the alignment of the Southern Section and their locations are shown in *Figure 5.5b*. The construction of the Southern Section alignments and stations will require reprovisioning of culverts HW1 and TS1; more detailed information on the diversions and realignments can be found in the *TS-100 Schematic Design Reports*. Other culverts, though may be affected by the construction of West Rail, will be restored in place. Outfalls for all of these culverts will not be affected. Details of the culvert modification and diversion are reported in the *Outline Design Report, Schematic Design Report and Drainage Impact Assessment Reports* concerning the Southern Section.

The *West Kowloon Stormwater Drainage Improvement Study* (WKDIS) was commissioned by the DSD in June 1994 to develop the Drainage Master Plan in West Kowloon. The WKDIS, which recommended two works Stages, was completed in December 1995. The Stage I implementation works are presently being designed while the Stage II works have not yet been commissioned. However, the drainage improvements proposed under WKDIS will not be in place before the commencement of construction of the Southern Section, according to the existing project schedule of the WKDIS.

Some West Kowloon area culverts are tidally affected and subject to sedimentation problems which cause a reduction in culvert capacities (e.g. 16% reduction in culvert WT1). Hence the culvert modification work due to construction of the Southern Section rail tracks and station could lead to local increases in sediment loading, exacerbate the existing sedimentation problems and further reduce the culvert capacity, which may lead to local flooding.

However, any modifications and diversions of the existing culverts due to Southern Section construction activities will maintain the drainage capacity and hydraulic performance of the culverts and drainage channels as any reduction in the internal depth of a culvert will be compensated by widening the culvert. Wherever a culvert cross-section has been modified, silt traps will be introduced immediately upstream and downstream of the expanded section. It is predicted that modification or diversion of existing culverts will not introduce any adverse deterioration of water quality of the receiving water bodies or local flooding.

Highway Drainage

Relocation of highway drainage pipes alongside the West Kowloon Expressway at the Yen Chow Street (YCS) Station will be required if the station structure or its associated temporary works encroach onto the drain. The discharge of the diverted pipes should comply with the TM standards.

5.5.1.4.2 Tunnelling and Station Construction

It is currently proposed that, for the section immediately north of the West Kowloon Station, the Southern Section alignment will be constructed in a cut-and-cover tunnel. During wet periods, rainfall and surface runoff entering exposed cut-and-cover tunnel sections or blown through entrances or ventilation shafts, and groundwater seepage through construction joints, could lead to construction runoff with high SS content. Thus mitigation should be designed to reduce the influx of rainwater into the exposed cut-and-cover works areas.

Bentonite will be required during cut-and-cover tunnelling for diaphragm walls, and as a result runoff may be contaminated with bentonite or other grouting materials. Therefore, bentonite use will require appropriate management, collection and disposal practices to ensure that no unacceptable water quality impacts arise as a result of the diaphragm wall construction works.

There is also potential for contamination of ground water depending on the depth of the cut-and-cover tunnel sections, the relationship with the water table height, and the geological features along the tunnel route. As the alignment is essentially constructed within the area of West Kowloon Reclamation, ground conditions encountered in the drill holes along the alignment generally comprise a sequence of marine sand fill overlying lenses of Alluvium and Marine deposits left in place during reclamation over completely decomposed granite (CDG). It is considered that only in areas where marine deposits have not been removed and 1 m above or below the marine deposits will there be the potential for groundwater to be polluted by the potentially heavy metal contaminated marine deposits left *in situ* during the West Kowloon Reclamation filling. However, heavy metals such as mercury, cadmium and copper are strongly chemically associated with the clay fraction and organic material in the sediments and thus do not readily enter the sediment pore water. Recorded Total Organic Carbon (TOC) contents of 0.2 - 9.0% represent a high amount of organic matter in the bottom sediment of Victoria Harbour. This organic matter plays an important role in binding of trace metals and organic micropollutants through sorption and/or complexation. Thus the high recorded TOC content would indicate that pollutants in any remaining marine deposits are likely to be less available to enter the sediment pore water. Therefore, in view of the relatively low levels of available contaminant in the pore waters, it is considered that the impact on the receiving waters from polluted groundwater will be minimal and expelled pore water contamination is not considered to be a key concern. However, it is considered prudent to assess the heavy metal pollution concentration of the groundwater within the range of 1 m above and 1 m below the layer of marine deposits, by on-site chemical testing. If it is

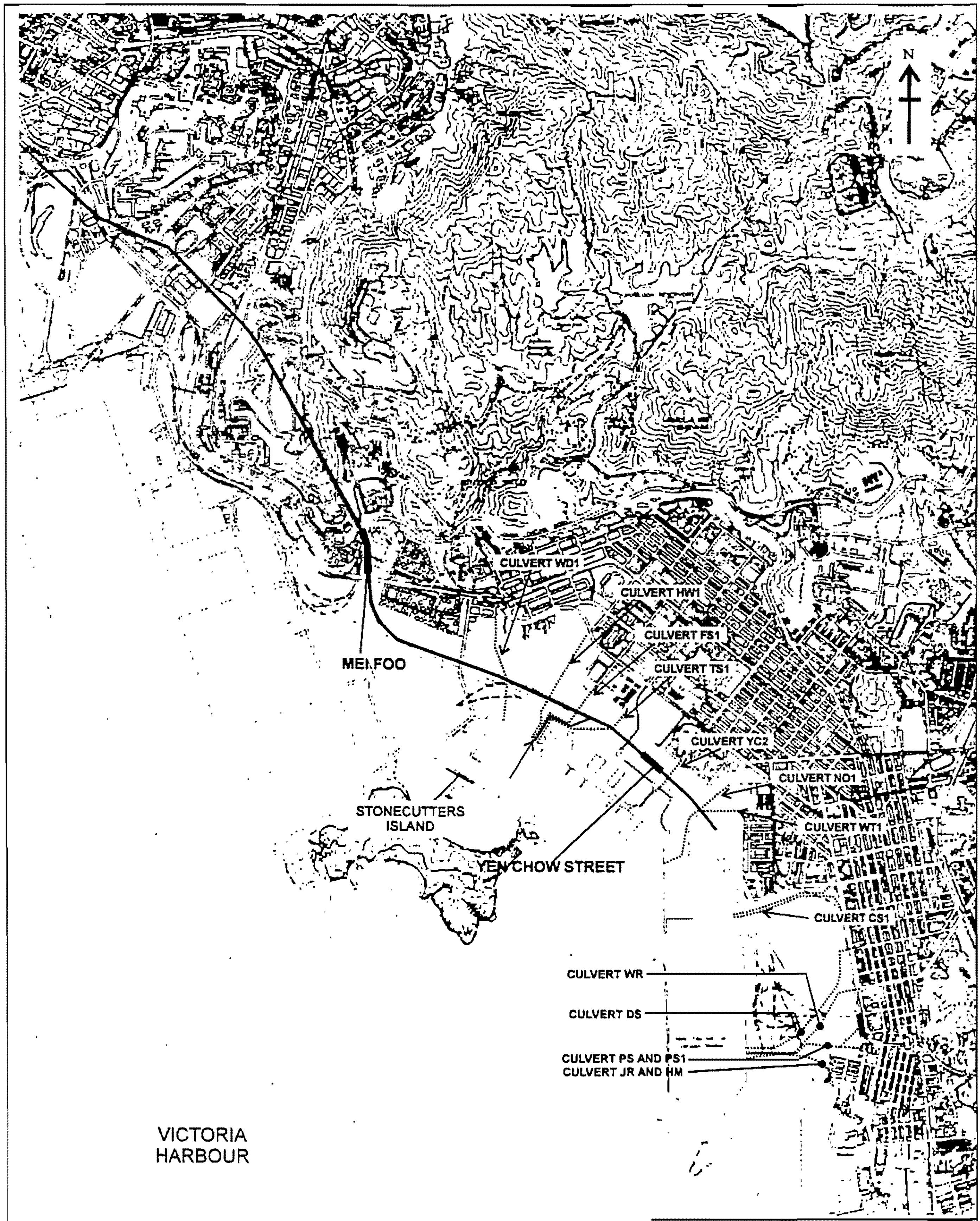

FIGURE 5.5b - LOCATIONS OF EXISTING DRAINAGE SYSTEM

NOT TO SCALE

ERM-Hong Kong, Ltd

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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determined to be polluted by heavy metals (other than by silt) it should only be discharged after appropriate treatment to achieve WPCO TM compliance.

Construction of the YCS Station will comprise the cut-and-cover excavation works. The station lies entirely on the West Kowloon Reclamation which was formed by marine sand fill. Site investigation to determine the ground water levels and the permeability of the sand is being conducted to determine the final design of platform level of the YCS Station and to avoid any future stormwater flooding.

Tunnelling and station construction works will generate materials requiring handling and disposal of the uncontaminated marine fill sands from the West Kowloon Reclamation area. Excavated material being used as backfill for the cut-and-cover works will require temporary storage on site. Runoff from the temporary storage area, without mitigation, could result in siltation or blockage of receiving drainage channels and localised deterioration in water quality.

5.5.1.4.3 General Construction Activities

General Southern Section construction activities have the potential to cause water pollution from debris and rubbish, such as packaging and used construction materials, entering the water column and resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of any receiving water body. Spillage of liquids stored on site, such as oil, diesel and solvents could also result in water quality impacts if they enter surrounding water bodies and soils.

The effects on water quality of these construction activities are likely to be minimal, provided that site boundaries are well maintained and good construction practice is observed to ensure that litter, fuels and solvents are managed, stored and handled properly.

5.5.1.4.4 Sewage Effluents

Sewage effluents will arise from sanitary facilities provided for the on-site construction work force for the Southern Section, and these have the potential to cause water pollution. Sewage is characterised by high levels of biochemical oxygen demand (BOD), ammonia and *E. coli* counts. It is estimated that about 300 construction workers will be working at the construction site during YCS Station construction. Owing to the lack of established guidelines for sewage generation rates for construction sites, the recommended design rate for offices, specified in the *Guidelines for the Design of Small Sewage Treatment Plants, EPD Solid Waste Control Group, March 1990*, has been used for this assessment. It is estimated that at least 16.5 m^3 of domestic sewage will be generated per day.

Construction work force sewage is expected to be connected to the existing trunk sewer or sewage treatment facilities. However, construction workers are likely to be dispersed along the alignment such that the installation of portable toilets and the proper disposal of sewage from construction work force may be necessary to ensure that TM standards are met.

5.5.1.5 Evaluation of Impacts

The net (unmitigated) water quality impacts on the WSRs include the runoff (from general construction activities associated with tunnelling and station construction) containing elevated concentrations of SS and associated contaminants, as well as the construction work force sewage discharges.

The WSD salt water pumping station intakes are particularly sensitive to levels of SS. The nearest WSD sea water intake is about 150 m from the Southern Section alignment. Therefore, the WSRs could be adversely impacted if mitigation measures are not implemented to reduce SS concentration of construction effluent.

5.5.1.6 Recommended Mitigation

It is important that appropriate measures are implemented to control runoff and drainage and thereby prevent high loading of SS from entering the Victoria Harbour. Proper site management is essential to minimise surface runoff, soil erosion and sewage effluents.

Construction site runoff and drainage should be prevented or minimised in accordance with the guidelines stipulated in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94). Good housekeeping and stormwater best management practices, detailed below, should be implemented to ensure that runoff from construction areas and any stored excavated material complies with the WPCO and no unacceptable impact on the WSRs arises due to the construction of West Rail. All discharges from the construction site should be controlled to comply with the standards for effluents discharged into the Victoria Harbour under the TM.

5.5.1.6.1 Construction Runoff and Drainage

Construction Runoff

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:

- Use of sediment traps; and
- Adequate maintenance of drainage systems to prevent flooding and overflow.

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.

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.

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

Open stockpiles of construction materials (e.g. aggregates, sand and fill material) of more than 50 m^3 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.

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.

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.

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.

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.

Drainage

It is recommended that interception of sediment before it enters the modified section of the culvert, in order not to exacerbate the sedimentation problem to the tidally affected culverts, will be necessary 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 will also be installed to provide continuous extraction of sediment within the modified section of the culvert.

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.

5.5.1.6.2 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, described in *Section 5.5.1.4.2*, 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.

5.5.1.6.3 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. On-site solid waste management requirements are described further in *Section 5.10* of this Report.

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 coastal waters of the Victoria Harbour.

5.5.1.6.4 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.

5.5.1.7 Residual Impacts

The general construction activities associated with the Southern Section tunnelling and station construction work could lead to site runoff containing elevated concentrations of SS and associated contaminants that may enter Victoria Harbour. However, it is anticipated that the above water quality impacts will generally be temporary and localised during construction. Therefore, no unacceptable residual water quality impacts are anticipated from the Southern Section construction phase, provided:

- Recommended mitigation measures including appropriate drainage and silty runoff collection facilities are incorporated into the construction area;
- Any diversions of drainage pipes or channels are constructed to allow the water flow to the discharge point or outfall without overflow or washout;
- All temporary drainage diversions are reinstated to the original condition after the completion of construction; and
- All construction site/works area discharges comply with the TM standards of the WPCO.

Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements. It is considered that controls on discharges from land-based construction activities and proper site management procedures, as referenced above, will minimise residual water quality impacts to acceptable levels.

5.5.2 Operational Phase

5.5.2.1 Baseline Conditions

Current baseline Conditions are described in *Section 5.5.1.2*.

The Victoria Harbour has been fully gazetted under the WPCO since April 1996. After the implementation of the WPCO, all effluent discharged into the Harbour has been under the statutory control provided by the Ordinance, and it is assumed that improvements in the baseline water quality of the Harbour will eventually occur. The water quality in north-west Kowloon is expected to improve by the time of the commissioning of West

Rail through implementation of Stage I of the SSDS and enforcement action associated with the gazettal of the Victoria Harbour WCZ.

5.5.2.2 Potential Sources of Impact

Potential sources of impact on water quality from the operation of the Southern Section could include the following:

- Runoff from rail track and operational tunnel drainage;
- Station runoff;
- Sewage generation at the YCS Station; and
- Cooling water discharge.

5.5.2.3 Prediction of Impacts

5.5.2.3.1 Runoff from Rail Track and Operational Tunnel Drainage

The proposed track bed drainage system comprises the open grated channel running alongside the railway track and the pumping units (e.g. the channel at the railway track section immediately to the south of YCS Station). These track drainage discharges will contain oil, grease, rail grindings and grit that may cause clogging of the pumping unit and downstream impacts on public stormwater drains.

5.5.2.3.2 Station Runoff

Rainwater runoff from the station structure is expected to be "clean" and therefore should have no impact on the WSRs.

5.5.2.3.3 Sewage Generation

Domestic sewage will be generated at the YCS Station. Uncontrolled discharge of sewage could cause unacceptable water quality impacts on the WSRs. However, toilet facilities will be provided at the YCS Station to serve both rail staff and passengers. According to design information, 55 m^3 per day of foul and surface water will be discharged into the sewers.

5.5.2.3.4 Cooling Water Discharge

An air-cooled design is currently preferred by KCRC for the Yen Chow Street Station. Thus, at this stage, marine water is not proposed for cooling and there will be no discharge of cooling water.

5.5.2.4 Evaluation of Impacts

The net (unmitigated) water quality impacts on the WSRs will arise from discharges from the station and rail track/tunnel. Impacts on water quality from operation of the Southern Section are evaluated below.

5.5.2.4.1 Runoff from Rail Tracks and Operational Drainage

Discharge from rail tracks via the pumping stations and tunnel drainage is expected to contain limited amounts of oil and grease. Where oils and lubricating fluids could be spilt, runoff should be diverted to silt and oil traps before discharged to the existing public stormwater drain system.

5.5.2.4.2 Sewage

Sewage effluents will be discharged directly to the existing sewerage infrastructure and therefore adverse water quality impacts are not expected. The Yen Chow Central sewage pumping station, located directly south of Yen Chow Street, has been redesigned and constructed recently, which will facilitate the collection and transportation of discharges from the Southern Section of the West Rail to the public foul sewerage facilities.

Provided the qualities of sewage and drainage effluents comply with the TM standards before discharge into foul sewers, it is predicted that there will be no further deterioration of the water quality in Victoria Harbour WCZ Phase II due to the operation of Southern Section.

5.5.2.5 Recommended Mitigation

The following measures should be incorporated, as appropriate, into the operation of the Southern Section:

- A surface water drainage system should be provided to collect operational tunnel seepage. Where oils and lubricating fluids could be spilt, the operational tunnel discharge and track runoff should pass through the oil and grit/silt interceptors/chambers to remove oil, grease and sediment before being pumped to the public stormwater drainage system via a rising main;
- Sewage effluents generated at the station are required to meet the TM standards prior to discharge. Sewage should be directed to the public foul sewer system and sewage treatment facility for treatment prior to discharge;
- The efficiency of silt traps and oil interceptors is dependent on regular cleaning and maintenance. These installations should be regularly cleaned and maintained in good working order;
- Oily contents of the oil interceptors should be collected for reuse, or transferred to an appropriate disposal facility; and

- The design of the sanitary fitments and drainage works should take into account the guidelines published in *Drainage Plans subject to Comment by the EPD, Practice Note for Professional Persons, Environmental Protection Department* (ProPECC PN 5/93).

5.5.2.6 Residual Impacts

With the adoption and incorporation of appropriate drainage and effluent collection systems (to be specified in the Drainage Impact Assessment prepared by the engineering Design Consultants), minimal residual operational water quality impact is expected.

5.5.3 Conclusion

5.5.3.1 Construction Phase

Water quality impacts from the Southern Section construction, without mitigation, could arise from the construction site runoff, groundwater discharge during cut and cover tunnelling works and sewage from on-site construction workers. However, the assessment has concluded that the impact could be controlled to within permitted standards by implementing the recommended mitigation measures. Thus, no residual adverse water quality is anticipated.

5.5.3.2 Operational Phase

Sewage effluent from the YCS Station will not introduce substantial adverse impact on the marine water quality as it will be collected by the sewer. Tunnel seepage and track runoff contaminated with SS and grease will not introduce adverse impacts provided they pass through silt and grease interceptors prior to discharge into stormwater culverts.

5.6 Landscape and Visual Issues

5.6.1 Existing Landscape Context

5.6.1.1 Landscape Character

Within the Southern Section, West Rail will start immediately north of the proposed West Kowloon Station and will run north / north west across the West Kowloon Reclamation to Mei Foo on a line broadly parallel, and frequently adjacent to the West Kowloon Expressway and the MTR Lantau and Airport Railway (LAR).

From there it will curve back to the north across the Mei Foo Buffer Zone / Lai Chi Kok Park (Stage 3) to the site of the proposed Mei Foo Station which will be located immediately west of the residential area of Mei Foo Sun Chuen and within Lai Chi Kok Park (Stages 1 and 2).

The Southern Section passes through two distinct landscape character areas. The first area is the main body of the West Kowloon Reclamation, the second is the area immediately south and west of Mei Foo Sun Chuen including Lai Chi Kok Park Stages 1.2 and 3.

The landscape of the West Kowloon Reclamation is flat and generally open and currently characterised by local and strategic transport corridors and un-developed or partly developed sites. The Reclamation is visually divided into two along a broad south to northwest line by the elevated structure of the West Kowloon Expressway. The West Kowloon Corridor elevated road separates the Reclamation site from the older mixed use urban zone to the west.

In the wider landscape the Reclamation lies to the west of the Kowloon Peninsula and is visually enclosed to the north by the distant hills of the Lion Rock and Ma On Shan Country Parks, and to the west by the Yau Ma Tei typhoon shelter and the former Stonecutters Island. To the south and southwest the reclamation is open to Victoria Harbour with distant views of Hong Kong Island and the Out-lying Islands.

There are virtually no areas of existing vegetation within the Reclamation site other than existing vegetation on Stonecutters Island and within the open spaces next to the alignment i.e. Lai Chi Kok Park, Nam Cheong Buffer Zone and Tung Chau Street Park at Sham Shui Po. There is however an extensive current programme of planting associated with the Reclamation, in particular the Buffer Zone at Nam Cheong but also along the West Kowloon Expressway, the LAR and the North and South WKR Roads developments, which should provide the long term landscape structure for the area. These will take several years to grow sufficiently to become important landscape features.

The existing land use of the area on the east side of the alignment is generally industrial however there are a number of low rise residential areas of Tai Kok Tsui and Yau Ma Tei close by.

Nam Cheong Buffer Zone is a 4.1 ha public open space created for passive recreation at Sham Shui Po, and is intended as a visual buffer between the residential area of Nam Cheong Estate and the West Kowloon Expressway. A further open space is planned for the area immediately to the West of the Nam Cheong Street Estate, but there is no programme for this with USD's current 5-year plan.

To the west of the alignment between the West Kowloon Expressway and the water edge there are several sites already constructed for cargo working and industrial and commercial storage, the remaining land is being developed for a variety of uses including container related activities. The areas to the east of the alignment are being developed more for residential / commercial and community use.

The scenic value of the area is low, and the areas are generally insensitive to change, due to the predominance of transport corridors and development sites. The Reclamation is likely to be characterised by progressive development and as the range of land uses and density of properties changes, the West Rail Corridor will become more enclosed, and less visible within it.

The second landscape character zone is centred on Lai Chi Kok Park (Stages 2 and 3) and is bound by the West Kowloon Expressway, the residential area of Mei Foo Sun Chuen and Ching Chung Road. The Park comprises a mixture of open active and passive recreational spaces and enclosed intimate areas set within a recently established soft landscape framework is an important district open space for residents.

The Park is also of high local scenic and landscape value and the area of Stage 3 (which has yet to be fully developed for recreation) was temporarily landscaped (Mei Foo Buffer Zone) as a visual screen between the residential area of Mei Foo Sun Chuen and the major transportation corridor comprising the West Kowloon Expressway and the Lantau and Airport Railway, and the industrial land beyond. It represents the only major open space in the district.

5.6.1.2 Visual Envelope

Within the Southern Section the railway will be constructed in a series of bored tunnels, earth mounded box tunnels and cut and cover tunnels. The physical profile of the tunnel will be visible at ground level from Road D7/Prince Edward Road to Mei Foo Station except for the section under Lai Wan Interchange. The extent of the visual envelope is illustrated in *Figure 5.6a, Annex G.*

The West Kowloon Expressway which runs parallel to the tunnel on the western side will restrict visual impacts upon properties and open space located to the west of the railway. The degree of visual impact in the area to the east of the railway will depend on the construction timing of the development of the adjacent urban areas and how this corresponds with the construction and completion of West Rail.

In the southern part of the Reclamation, West Rail will be visible from south-west facing residential properties, industrial units within the Reclamation site which face onto the West Kowloon Expressway, vehicular traffic on the West Kowloon Expressway (particularly traffic on slip roads) and rail passengers on the MTR Lantau and Airport Railway.

In the northern part of the Reclamation, long distance views of the site will be reduced due to the elevated roads and buildings surrounding the area. Localised views will be from Lai Chi Kok Park, the south and west facing residential blocks of Mei Foo Sun Chuen, vehicular traffic on Po Lun Street to the east, West Kowloon Expressway (from where the road and railway alignments split) and Ching Chung and Kwai Chung elevated roads.

There will also be middle distance views from Ching Lai Court and Princess Margaret hospital on Ha Kwai Chung to the west.

5.6.1.3 Visually Sensitive Receivers

Visually Sensitive Receivers for the Southern Section and the assessment of their sensitivity are as shown in *Table 5.6a, Annex G* and illustrated in *Figures 5.6a* and *b, Annex G*.

5.6.2 Sources of Impact

Potential sources of landscape and visual impact during the construction and operational phases are identified below.

5.6.2.1 Construction Phase

- Site access and haul routes, including traffic movements.
- Cut and fill, including storage of existing topsoil for reinstatement works.
- Materials stockpiling ,construction equipment and plant.
- Utilities, including water, drainage, power and lighting.
- Temporary parking and on site accommodation and working areas.

5.6.2.2 Operational Phase

- Station buildings, EVA's, car parks and service areas
- Earth mounding over box tunnels.
- Ventilation buildings and fan chambers.
- Boundary fencing.

5.6.3 Evaluation of Impacts

5.6.3.1 Construction Phase

5.6.3.1.1 Landscape Impact

Current information states that the construction period for the Southern Section of West Rail is programmed to be carried out in 2 phases commencing in February 1999 with completion estimated for July 2001. Relocation of utilities is scheduled to take place between November 1998 and July 1999.

Impact on Landscape Resources

The construction of West Rail will have an impact on the landscape resources of the Reclamation at Nam Cheong Buffer Zone. There will be an area of temporary alienation from the useable area of this space for the duration of the construction, resulting in a very substantial negative impact on the landscape resource. However, the impact will be temporary and confined to during the construction period.

There will be a high degree of landscape impact on Lai Chi Kok Park Stages 2 and 3. (impact on Stage 1 is assessed as part of the Central Section). Stage 2 of the Park comprises temporary facilities which will be wholly disrupted during the installation of the at-grade box tunnel. Stage 3 of the Park (currently the temporary Mei Foo Buffer Zone) will also be disrupted during the construction phase and the north west corner will be temporarily cut off from the remainder of the Park. This is considered to be a very substantial negative impact on the landscape resource but is temporary in nature as it is again confined to the construction phase.

The railway will pass at grade in an earth-mounded box through these areas, and the disrupted facilities could be reprovisioned by USD adjacent to and on top of the earth mound, and the whole area comprehensively re-landscaped. The section of tunnel box immediately adjacent to Mei Foo Station will pass close to the corner of Mei Foo Sun Chuen Estate and create an 8 m high physical barrier which will complicate internal park circulation. However the mound over the tunnel will help screen the West Kowloon Expressway from the Park and the change in level would add interest to the park. As a result there will be a slight negative effect on the resources of the park in the operational phase.

There will be no loss of mature vegetation from the area of the Reclamation, although there will be extensive loss of semi-mature ornamental trees from Lai Chi Kok Park Stages 2 and 3, Nam Cheong Buffer Zone, and some roadside areas. Unnecessary tree felling will be avoided and existing vegetation will be transplanted elsewhere within the park or to other sites to supplement planting of new good quality specimen trees.

Other than these areas there are no areas of vegetation or important landscape features within the route of West Rail in the Southern Section.

The construction of West Rail will also have an impact on topsoil reserves along the route particularly where the construction works will require the removal or temporary relocation of landscape resources i.e. Lai Chi Kok Stages 2 and 3 and Nam Cheong Buffer Zone. The impacts on topsoil removal can be minimised by storage of topsoil according to Government Standards. These comprise storage of topsoil in an area where it will not be disrupted by engineering works, storing heaps at a maximum height of 2 m, carrying out tests on nutrient and organic status, practising weed control, and turning the topsoil heaps to prevent anaerobic conditions occurring. Top soil should also be placed in its final position within 12 months of importation to site.

Impact on Landscape Character

Along the route of the Southern Section there is a space allowance of 10-15m either side of the railway corridor as a working width for the purposes of construction works during the excavation operations of installing the tunnel.

The existing quality of the landscape on the West Kowloon Reclamation is considered to be low, however it is expected that West Rail will result in a worsening of the current landscape quality of streetscapes during construction due to disruption of road side treatments and footpath surfaces and the loss of street trees and shrub planting in road side areas and a general intensification of development activity within the area associated with the installation of the tunnel. Generally there will be a very slight negative impact on the local landscape character of the Reclamation. However reinstatement of the existing land use pattern and planting of street trees and amenity areas will effectively mitigate these impacts and result in a slight beneficial impact on the local landscape character.

The railway alignment will cause temporary disruption to Nam Cheong Buffer Zone. Although it is likely to have reached only a semi-mature state by the commencement of the construction works, the significant temporary loss of useable area of the park and removal of the screen mounds and vegetation alongside the Expressway, is likely to result in a temporary substantial negative landscape impact on the character of the area during the construction period.

The permanent park facilities will be replaced directly after construction has finished and new planting will establish to a similar extent within two to three years time.

Similarly the railway alignment will cause temporary disruption to Lai Chi Kok Park Stages 2 and 3. Again the landscape in both sections of the park will have reached only a semi-mature state by the commencement of the construction works, but due to the scale of the park in the context of the residential and industrial setting, the landscape character is a more sensitive issue than at Nam Cheong Buffer Zone. The temporary loss of useable area of the park and removal of the screen mounds and vegetation alongside the Expressway, will result in a very substantial negative transient landscape impact on the character of the area during the construction period.

The permanent park facilities can be replaced directly after construction has finished and new planting will establish to a similar extent within two to three years time.

There are seven temporary works areas in the Southern Section, as shown on *Figure 5.6c*; two of the sites are major works areas and five are minor. One of the major works areas is located in between Roads D4 and D5. It is currently vacant and is zoned as a future urban development area and would be used for the storage of materials, plant, temporary accommodation, carparking etc. The other large site is located south of the alignment opposite Stage 3 of Mei Foo Buffer Zone and adjacent to the Container Port Terminal 7. This site is currently used for temporary storage of container freight and will be used for general track works associated with Phase 1 of West Rail. The five small areas are located between Nam Cheong Buffer Zone and the USD temporary sports fields. There are no areas of vegetation or landscape features on these sites which could be disrupted during the construction period.

5.6.3.1.2 Visual Impact

The degree and extent of the visual impacts that will result from the construction of West Rail is highly dependant upon the degree to which development of adjacent urban areas has progressed by that time. This is unclear at present but it is likely that committed development of currently vacant areas of land either side of the proposed West Rail route will occur simultaneously with West Rail construction and therefore dilute the overall visual impact of the railway works.

It is also unclear exactly what type of development will eventually occur as much of the current zoning is for industrial use which would seem unlikely in the context of the forecast lack of demand for industrial land and the continually increasing demand for residential land. The current assessment is based on the latest information available.

An assessment of the potential residual visual impacts during the construction phase is shown in *Table 5.6a, Annex G* and illustrated in *Figures 5.6b* and *c, Annex G.* This assessment assumes that the appropriate mitigation measures identified below have been implemented.

5.6.3.1.3 Mitigation Measures

Recommended mitigation measures for impacts caused during the construction process 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.

5.6.3.1.4 Residual Impacts

The mitigation measures will, to the maximum extent possible, reduce the potential negative visual impacts temporarily experienced by nearby sensitive receivers. However in the short term during the construction phase the residual temporary impacts will remain substantial. The residual impacts are tabulated in detail in *Table 5.6a, Annex G* and illustrated in *Figures 5.6b* and *c, Annex G.*

The key visual impacts will be in the vicinity of the cut and cover tunnels and earth mounded box tunnels.

The properties in the vicinity of the cut and cover tunnel extending from West Kowloon Station to Yau Ma Tei Interchange will experience varying degrees of negative impact, from very substantial to moderate, depending on their proximity to the tunnel and to the many construction sites adjacent to the route and their relative sensitivity as receptors.

Similarly the properties in the vicinity of the cut and cover tunnel extending from Lai Wan Interchange to Mei Foo Station will experience varying degrees of negative impact.

from very substantial to very slight depending on their proximity to the tunnel and their relative sensitivity as receptors.

The most significant impacts are expected to be experienced by the residential properties on Man Cheong Street, Olympic Station hotel development, Nam Cheong Buffer Zone, Lai Chi Kok Park Stages 2 (Part) and 3 and Mei Foo Sun Chuen residential estate, all of which will experience temporary, but very substantial negative visual impacts, during the construction phase.

Current engineering information states that in the Southern Section four sites will be required for ventilation buildings or fan chambers. Currently three sites have been identified and are shown on *Figures 5.6b* and *c, Annex G.*

The construction of the ventilation building and fan chambers on the roadside embankments of the Yau Ma Tei Interchange will have slight negative visual impact on users of the adjacent GIC sites. Mitigation measures are required to screen the works area and the route of vehicular access to the sites from users of the GIC sites.

The siting of the temporary works area on Yuet Lun Street will result in moderate visual impact to the adjacent industrial property, to vehicles on the three surrounding roads and to those people using the bus depot on the west side of the area. Additionally there may be some visual impact to the residential properties on the extreme south east edge of Mei Foo Sun Chuen. Mitigation measures should aim to reduce over spill and night lighting and to screen the area with decorative screen hoarding.

Within Lai Chi Kok Park Stages 2 and 3 there will be temporary, but very substantial negative visual impact, at ground level during the construction period to those people using the park and residents of the south facing apartments of Mei Foo Sun Chuen. The use of advance planting for screening along the eastern and northern boundaries of the park is recommended where it can be incorporated within the permanent design of the park. Where this is not possible the use of decorative hoarding or excavated material as earth mounding for screening should be used. There will be strict control of overspill and night time lighting.

5.6.3.2 Operational Phase

5.6.3.2.1 Landscape Impact

The *Landscape Design Strategy Report* has proposed design principles for all landscape and visual aspects of West Rail as a guide for the detailed design by all the engineering Design Consultants. The Report recommends that the land over the railway tunnel in the Southern Section should be used for recreation purposes where possible.

The assessment of residual impacts during the operational phase of the railway is based on the effect of the landscape treatment after an establishment period of 5-8 years has lapsed e.g. when screen planting will have reached a height of approximately 6m.

From West Kowloon to Road D7 the landscape impact would be confined to soft landscape works around the sites of the ventilation buildings and fan chambers. There are no other works at ground level.

From Road D7 to Mei Foo Station the railway tunnel would be enclosed under an earth mound from north of Yen Chow Street to south of Mei Foo Sun Chuen. The earth mound will be planted to create a linear route linking Nam Cheong Buffer Zone to Lai Chi Kok Park. There are no ventilation buildings beyond Nam Cheong Buffer Zone and other than the earth mound there would be no sign of the presence of the railway within the landscape. The railway mound would be a planted back drop reducing the impact and scale of the adjacent West Kowloon Expressway and LAR corridor on the previous open landscape character.

Within the Southern Section there would in general be an overall positive improvement in the landscape quality of the environment due to the increase extent of landscaped area, resulting in a slight beneficial landscape impact in the long term.

The construction of the railway under Nam Cheong Buffer Zone would require the redesign of the current park area. However, it should be possible to conceal the earth mound of the tunnel underneath areas of the park and still provide all of the temporary facilities required, subject to agreement with the Provisional Urban Council. The resulting open space would be a more interesting diverse recreational area and have areas of undulating ground creating opportunities for view points and elevated features. The route of the railway would therefore ultimately have a positive landscape impact, resulting in a long term slight beneficial landscape impact in the operational phase.

Similarly at Mei Foo, the construction of the railway under Lai Chi Kok Park Stages 2 and 3 would require the redesign of the park. However, it will be possible to conceal the tunnel under mounding and re-provision the park and all of its facilities, subject to agreement from the Provisional Urban Council. The line of the tunnel box and covering mound through the park would limit the flexibility of the placement of park resources and would slightly complicate internal park circulation. However, this would be offset by the opportunity to create interesting landscape features using the changes in level and by the increased screening of the West Kowloon Expressway. The net overall effect would then be neutral.

5.6.3.2.2 Visual Impact

An assessment of the residual visual impacts during the operational phase is shown in *Table 5.6a, Annex G* and illustrated in *Figure 5.6d-e, Annex G*. This assessment assumes that the appropriate mitigation measures identified below have been implemented.

5.6.3.2.3 Mitigation Measures

The *Landscape Design Strategy Report* has proposed design principles for all landscape and visual aspects of West Rail as a guide to the detailed design by all design consultants.

These design principles form the essential basis of the mitigation measures which could be employed to minimise negative impacts and create the potential for positive impacts.

The principle design recommendations that are applicable to the Southern Section are listed below:

- Shape and plant earth mounds over box tunnels in order to integrate their landscape design with adjacent open spaces
- Site vent structures to minimise visual intrusion
- Integrate design of Vent Structures with surrounding architecture and urban context

5.6.3.2.4 Residual Impacts

Within the Southern Section, West Rail will be largely invisible during the operational phase. The only visible manifestations of the railway from residential areas to the east of the alignment will be the stations, vent structures and landscaped mounds located over some sections of tunnel.

Soft and hard landscape treatment around ventilation buildings and finishes to the surfaces of the structures will reduce their visual impact and should create visually attractive landscape features.

From Road D7 to Lai Wan Interchange the raised earth mound of the railway tunnel will screen the Lantau and Airport Railway line, the piers of the West Kowloon Expressway and industrial sites beyond from the properties on the north-eastern side of the track. This screening effect will have a positive visual impact upon the adjacent urban areas.

The integration of the raised earth mound of the railway within the redesign of Lai Chi Kok Park will have a positive visual impact. *Figures 5.6f* and *g* in *Annex G* shows the preliminary Nam Cheong Buffer Zone layout and cross sections, as provided by the engineering Design Consultants (see also *Figures 6.6f-k, Annex G*). The West Rail landscaped mound will screen the West Kowloon Expressway, the Lantau and Airport Railway line, the proposed Port Rail terminal and industrial sites beyond from the Park and from Mei Foo Sun Chuen. The mound will also provide opportunity for the creation of an interesting landscape design in the Park that exploits the design potential offered by changes in level. However, where the tunnel passes closest to (within 25 m of) Mei Foo Sun Chuen, at the end of Lai Wan Road, the tunnel box and associated mound will limit open views from the first 2 or 3 floors of the corner block. This visual impact can be mitigated by architectural and landscape treatment to the tunnel box walls.

5.6.4 Conclusion

The quality of the existing landscape 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 that will minimise to the maximum extent possible the 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 temporary 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 complete before the completion of West Rail.

During the operational phase, the Southern Section of West Rail will be screened by the earth mounding and the existing MTRC formation and the elevated structures of the Expressway. There will be positive visual impacts resulting mainly from the screening and visual enclosure offered by the landscaped mounds over the tunnels.

5.7 Landuse and Community Issues

The following section outlines the land use issues associated with West Rail between Jordan Road and Lai Chi Kok Park.

5.7.1 Landuse Context

The land use anticipated to be affected by the railway alignment, fall under the South West Kowloon Outline Development Plans (ODPs) Southern, Central and Northern Sections. It is understood that the Territory Development Department (TDD) is currently reviewing the land use zones of the northern section of the reclamation, given the recent Government initiative to identify sites to provide for additional housing.

The Draft South West Kowloon ODPs have been used as the base case land use scenario for the proposed West Rail alignment. The ODPs, however, have no statutory authority. Consideration has also been given, therefore, to the statutory Outline Zoning Plans for Lai Chi Kok (No. S/K16/4) and South West Kowloon (No. S/K20/3) to evaluate West Rail impacts on committed uses.

North of Yen Chow Street Station the proposed alignment passes near four sites zoned for Industrial (I) use. The sites are currently under review by the TDD in response to the

Government's initiative to provide additional land for housing. It is expected that the proposed West Rail alignment will have minimal impact on this zoning review.

A number of roads, both existing and proposed will be affected by the construction of West Rail. Anticipated impacts will be upon amenity, accessibility and ease of movement. Permanent diversion of roads will be required to minimise conflict with the railway. These issues have been addressed by the engineering Design Consultants in liaison with relevant Government departments.

5.8 Archaeological and Cultural Issues

The Southern Section of the West Rail alignment is to be constructed across recent reclamation. As a consequence, there are no historical buildings or features that are likely to be impacted by the new railway. Furthermore, the extent of ground disturbance is to be limited to fill material associated with the reclamation process and will not give rise to impacts to archaeological deposits.

The findings of the initial assessment of impacts to archaeological and cultural resources in the Southern Section are, therefore, that this section is considered to be scoped out of the EIA. Heritage issues have not be given further consideration in the Final Assessment Report.

5.9 Ecology

No ecologically valued resources have been identified within the Southern Section of West Rail, which is to be constructed across a highly urbanised area of recent reclamation.

5.10 Waste

5.10.1 Potential Sources and Prediction of Impacts

5.10.1.1 Construction Phase

5.10.1.1.1 General

Construction activities to be carried out for the Southern Section of West Rail will result in the generation of a variety of wastes which include:

- Site clearance waste;
- Excess excavated material/spoil;
- General construction waste;
- Demolition waste;
- Chemical waste;
- General refuse; and

- Contaminated marine sediments.

Environmental issues in connection with the generation, handling and disposal of contaminated sediments are discussed in *Section 5.11*. About 200,000 m^3 of sediment will be required to be excavated in the Southern Section, some of which may be contaminated and require special handling and disposal.

Assessments of the impacts of the other categories of waste are described below.

5.10.1.1.2 Site Clearance Waste

As this section of West Rail will be constructed on the recently reclaimed West Kowloon Reclamation, site clearance work will mainly involve the removal of grass and refuse.

5.10.1.1.3 Excess Excavated Material

Much of the excavation for the Yen Chow Street Station and the cut-and-cover tunnels of the Southern Section will take place on the West Kowloon Reclamation. The excavated material will therefore consist primarily of that used as fill for the reclamation. This will be largely alluvial in nature, but could also include rock from buried seawalls, completely decomposed granite, concrete rubble, and other materials. Excavated material will be generated from the following construction activities:

- Yen Chow Street Station: this will be constructed below ground;
- Prince Edward Roundabout to Hing Wah Street: construction of railway box structure towards the north. The rail tracks rise and the box structure surfaces about 200 m north of Prince Edward Interchange;
- Hing Wah Street to Mei Foo Interchange: construction of earth mound box structures at grade;
- Mei Foo Interchange to Mei Foo Station: construction of earth mound box structure at grade; and
- Modification of existing drainage box culverts.

The potential also exists for contaminated marine sediments to be excavated during construction of the station and overrun tunnels. Details of requirements for handling and disposal of sediment are discussed in *Section 6.10.3.2.3*.

5.10.1.1.4 General Construction Waste

In addition to wood waste from formwork and falsework, material and equipment wrappings, the following wastes may be generated from the construction activities:

- Surplus or rejected cement/bentonite and chemical grout which will be used for pre-treatment of ground before excavation;
- Surplus or rejected shotcrete which will be used for stabilisation of the cut surface; and

- Surplus or rejected concrete.

5.10.1.1.5 Demolition Waste

As the majority of the Southern Section will be constructed in the recently reclaimed West Kowloon Reclamation area, minimal demolition work is anticipated. Small amounts of demolition waste will be produced from the following activities:

- Removal of the eastern staircase of the footbridge at Hing Wah Street in order to allow for construction of railway box structures; and
- Demolition of the top slab of the existing box culverts in order to reduce the cell height and construct additional cells.

5.10.1.1.6 Chemical Waste

Substances likely to be generated by construction activities for the Southern Section will, for the most part, arise from the maintenance of equipment. These wastes may include, but may not be limited to, the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils and cleaning fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

Chemical waste may pose serious environmental, health and safety hazards if it is not properly managed. These hazards include:

- Toxic effects to workers;
- Adverse effects on water quality from spills;
- Fire hazards; and
- Disruption of sewage treatment works if chemical waste enters the sewerage system.

5.10.1.1.7 General Refuse

General refuse will be generated from the works sites for the Southern Section. The storage of general refuse has the potential to give rise to adverse impacts. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar impacts.

5.10.1.2 Operational Phase

5.10.1.2.1 General Refuse

General refuse will arise from the public, station employees and commercial operators within the Yen Chow Street Station. Materials may include food waste, paper, wood, plastic, office wastes, old tins/containers, cleaning materials and miscellaneous other waste produced during daily activities. As discussed for the construction phase, the storage of general refuse has the potential to give rise to adverse environmental impacts. These may include odour if waste is not collected frequently, litter, water quality impacts if waste enters storm water drains, visual impact and vermin problems if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

5.10.1.2.2 Industrial Waste

Industrial waste will arise from maintenance activities of the railway and stations of the Southern Section. The materials may include scrap materials from rail and carriage maintenance, used fluorescent tubes, used welding rods, cleaning materials and discarded electronic equipment.

5.10.1.2.3 Chemical Waste

Chemical waste will arise from maintenance activities of the railway and stations of the Southern Section. The waste may include lubricants, paints, used batteries, mineral oil, acids/alkalis, pesticides, coolants and solvents. As discussed in *Section 5.10.1.1.6*, these chemical wastes may pose significant environmental, health and safety hazards if they are not properly managed.

5.10.2 Evaluation of Impacts

The nature and amount of waste arising from the construction and operation of the Southern Section of West Rail and the potential environmental impacts from their handling, storage, transport and disposal are discussed below.

5.10.2.1 Construction Phase

5.10.2.1.1 Site Clearance Waste

As the site clearance works will mainly involve clearance of grass and refuse, the amount of site clearance waste is expected to be small. It is anticipated that the environmental impact due to the storage, handling, transport and disposal of the site clearance waste will be negligible.

5.10.2.1.2 Excess Excavated Material

As the majority of this section is located in the recently reclaimed West Kowloon Reclamation area, the material from excavation will be previously placed marine fill of medium to coarse sand and is expected to have a high moisture content. About 760,000m^3 (see *Table 5.10a, Annex N*) of excavated material will be generated from the construction of the Southern Section north of Prince Edward Roundabout. Most of the excavated material will be generated between October 1999 and December 2000 (see *Figure 5.10a*). About 192,000 m^3 of fill material will be required as structural fill between October 2000 and October 2001. Unless some of the excavated material could be stockpiled on site, the excess excavated materials have to be disposed of off-site at an expected rate of 1,800 m^3/day (Maximum).

The material excavated should comply with the public dumping licence requirements and therefore could be accepted at public filling areas (previously called public dumps). However, given the large amount of excess excavated material (about 178,000 m^3 and 246,000 m^3 for 1999 and 2000 respectively) that may require disposal at public filling areas, it may pose additional pressure on public filling capacity. About 5 million m^3 of surplus construction and demolition materials were delivered to public filling areas in 1996 and similar demand is expected for the next five years. With reference to the existing public filling programme, there is predicted to be a shortage of public filling capacity in 1999 unless additional public filling capacity can be secured. The delivery of 568,000 m^3 (about 10% of annual demand of public filling capacity) of excess excavated material to public filling areas could therefore have a significant impact on the public filling programme.

The potential air and water impacts from temporary on-site storage of excavation material are covered in *Sections 5.4 and 5.5* respectively.

5.10.2.1.3 General Construction Waste

The storage, handling, transport and disposal of general construction wastes have the potential to create visual, water, dust and associated traffic impacts. The quantity of general construction waste generated cannot be determined at this stage. General construction waste should be removed from site as soon as practicable in order to avoid adverse environmental impacts due to on-site storage of the material.

To conserve the capacities of landfill sites, general construction waste with more than 20% (by volume) inert material should not be disposed of at landfills. It is therefore good practice to segregate wastes at construction sites before disposing of the inert materials (concrete, soil, cement/bentonite, etc) at public filling areas and the degradable waste (wood, paper, plastic, etc) at landfills.

Construction and demolition wastes currently form approximately 35% of the annual take-up of the limited landfill void available in Hong Kong, although this proportion has varied widely over recent years. Therefore, it is important to minimise, wherever possible, the amount of wastes which must be disposed of to landfill.

5.10.2.1.4 Demolition Waste

Only the top slab of the drainage box culverts will be demolished for the construction of the Southern Section. The quantity of demolition waste to be generated cannot be determined at this stage but it is not likely to be large. Given the inert nature of the demolition waste, it can be delivered to the nearest public filling area. The small quantity of demolition waste to be disposed of at public dumps will not have a significant impact on the demand of the public filling capacity. The disposal of inert demolition waste at public filling areas is unlikely to raise any long term concerns because of its inert nature. The environmental impacts arising from their storage, handling and disposal will therefore be negligible.

5.10.2.1.5 Chemical Waste

It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the contractor's on-site maintenance activities and the numbers of plant and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oils and solvent, produced from plant maintenance will be small. These types of waste are readily accepted at the Chemical Waste Treatment Facility at Tsing Yi.

Storage, handling, transport and disposal of chemical waste should be arranged in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* published by the EPD. Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the environmental impacts arising from the storage, handling and disposal of a small amount of chemical waste generated from the construction activities will be negligible.

5.10.2.1.6 General Refuse

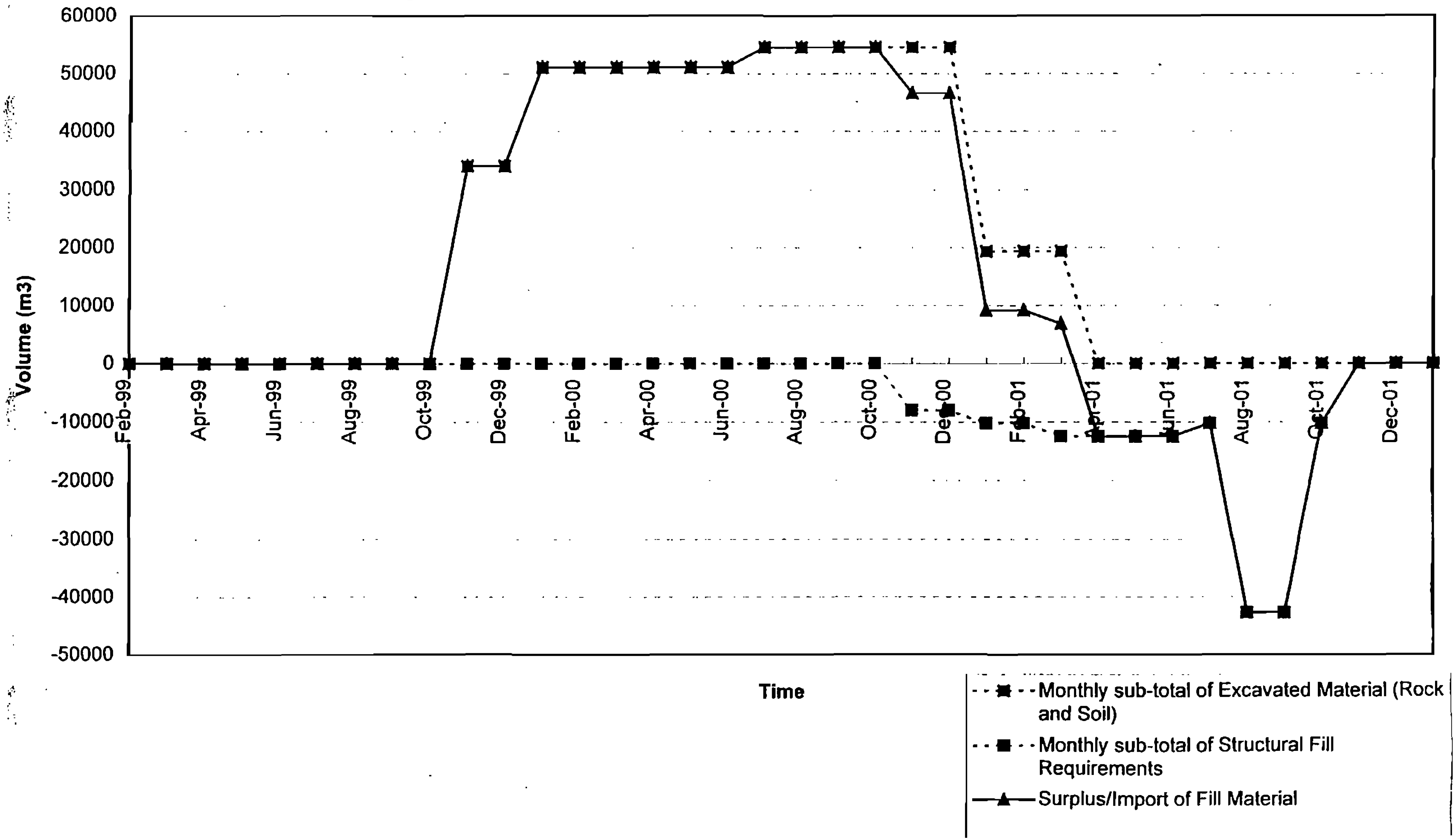
The construction sites of the Southern Section will employ a total of about 500 to 1,000 workers. Estimates of waste arisings based on these numbers of workers suggest that the amount of general refuse produced from the Southern Section will be in the range of 300 to 600 kg per day. Provided that the mitigation measures recommended in *Section 5.10.3* are adopted, the environmental impacts caused by storage, handling, transport and disposal of general refuse are expected to be minimal.

5.10.2.2 Operational Phase

5.10.2.2.1 General Refuse

The amounts of general refuse arising from the operations of the stations will depend on the number and types of retail outlets at the stations. Considering the operation of the existing railway, it is expected that the quantity of general refuse to be generated at each station (excluding the general refuse generated from shops) will be in the order of 500 kg per day. If good practice is adhered to with respect to storage, transport and disposal and

Figure 5.10a : Cut and Fill Requirements of Southern Section



all feasible avoidance, reuse and recycling opportunities are taken, including minimising over ordering, the potential environmental impacts will be minimal.

5.10.2.2.2 Industrial Waste

The amount of industrial waste which will be produced during the operational phase of the Southern Section cannot be determined at this stage but it is likely to be small. Metals and discarded electronic equipment have high scrap value and may be sold for recycling. Provided that the scrap materials are collected regularly, it is not expected that storage, handling, transport and disposal of industrial waste will cause any significant environmental impact. Other general industrial waste such as plastic, cloth and paper can be collected together with the general refuse and disposed of at licensed waste transfer or disposal facilities.

5.10.2.2.3 Chemical Waste

The amount of chemical waste generated during the operational phase of the Southern Section cannot be determined at this stage but it is also likely to be small. Chemical wastes should be stored, handled, transported and disposed of in accordance with the *Chemical Waste Regulations* and *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes*. They should be collected and transported to the Chemical Waste Treatment Facility (CWTF) at Tsing Yi or other licensed facility by a registered waste haulier. Provided that appropriate handling, storage and disposal procedures are followed, no unacceptable impacts associated with the management of chemical waste during the operational phase of the Southern Section are anticipated to occur.

5.10.3 Recommended Mitigation

5.10.3.1 Introduction

This section sets out the recycling, storage, transportation and disposal measures which are recommended to avoid or minimise potential adverse impacts associated with waste arising from the construction and operation of the Southern Section. For the construction phase, the contractor should incorporate these recommendations into a comprehensive on-site waste management plan. Such a management plan should incorporate site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. For the operational phase, it is recommended that KCRC should incorporate the recommendations into a comprehensive waste management plan for the operation of West Rail.

5.10.3.2 Construction Phase

5.10.3.2.1 Waste Management Hierarchy

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:

- Avoidance and minimisation (not generating waste through changing or improving practices and design);
- Reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- Treatment and disposal, according to relevant regulations, guidelines and good practice.

The contractor should consult the Waste Disposal Authority on the final disposal of wastes.

This hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs. Waste reduction measures should be introduced at the design stage and carried through to construction activities, wherever possible, by careful purchasing control, reuse of formwork and good site management. By reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing and in disposing of wastes.

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.

5.10.3.2.2 Storage, Collection and Transport of Waste

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:

- Handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution;
- Use waste hauliers authorised or licensed to collect the specific category of waste;
- Remove wastes in a timely manner;
- Maintain and clean waste storage areas regularly;
- Minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- 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.

5.10.3.2.3 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. If contaminated sediments are encountered, these should be disposed of as discussed in the relevant Land Contamination section of this report. Control measures should be taken at the stockpiling area in order to prevent the generation of dust and pollution of stormwater channels. Details of mitigation measures for dust and water pollution are discussed in *Sections 5.4 and 5.5*. Key mitigation measures are highlighted below:

Dust

- Wetting the surface of the stockpiled soil with water when necessary especially during the dry season;
- Covering the stockpiled soil with sheets;
- Minimising disturbance of the stockpiled soil; and
- Enclosure of the stockpiling area.

Water Quality

- Separating surface water drainage system for the stockpiling area;
- Installation of silt traps for the surface water drainage system; and
- Covering stockpiled material with tarpaulin during heavy rainstorm.

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.

As shown in *Figure 5.10b*, it is quite unlikely that other sections could accept the excess excavated material generated from the Southern Section. In order to increase the opportunity for the reuse of the surplus excavated material by other land formation or reclamation projects, it is recommended that the engineering Design Consultants should complete the Fill Management Committee (FMC)'s Questionnaire on Surplus and Fill Requirements and return it to FMC for inclusion into the Surplus and Fill Requirement Database.

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.

5.10.3.2.4 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.

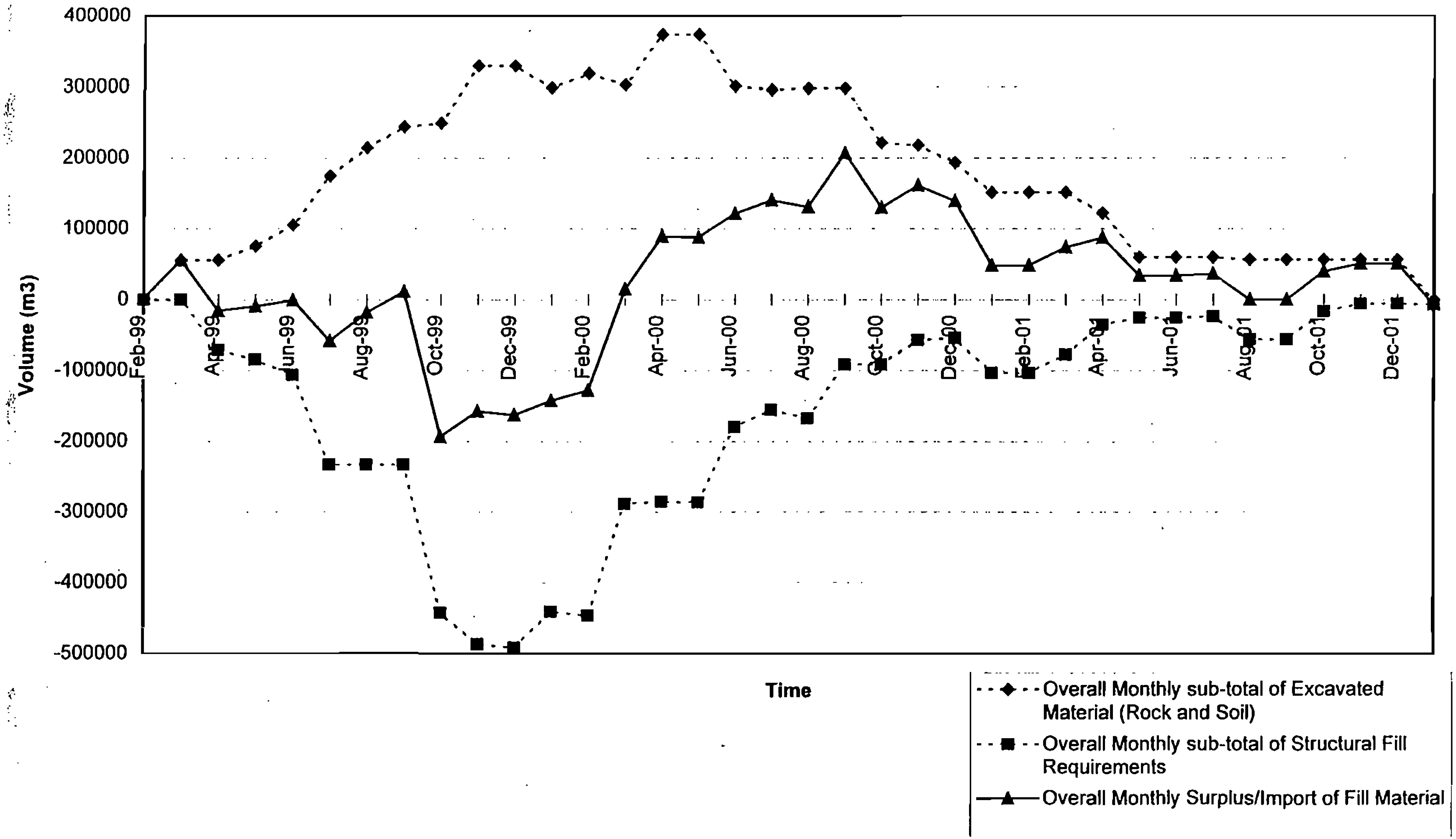
The contractor should recycle as much as possible of the construction waste on-site. Proper segregation of wastes on site will increase the feasibility of recycling certain components of the waste stream by recycling contractors. Concrete and masonry can be used as general fill and steel reinforcement bar can be used by scrap steel mills. Different areas should be designated for such segregation and storage wherever site conditions permit.

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.

Government has established a charging scheme for the disposal of waste to landfill. When it is implemented, it will provide additional incentive to reduce the volume of waste generated.

Figure 5.10b : Overall Cut and Fill Requirements



5.10.3.2.5 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;
- 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.

5.10.3.2.6 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.

5.10.3.3 Operational Phase

5.10.3.3.1 Storage, Collection and Transport of Waste

The mitigation measures recommended under the construction phase should also be applied during the operational phase.

5.10.3.3.2 General Refuse

General refuse will be generated largely by food service activities and shops at the stations. General refuse generated on-site should be stored in enclosed bins or compaction units separate from chemical wastes. The small quantity of industrial waste generated at the stations can be collected together with the general refuse. A reputable waste collector should be employed to remove general refuse and industrial waste from the stations, separately from chemical wastes, on a daily basis to minimise odour, pest and litter impacts.

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.

5.10.3.3.3 Chemical Waste

Chemical waste that is produced, as defined by *Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulations*, should be handled and disposed of in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. For mitigation measures, refer to the guidelines covered under construction phase mitigation of chemical wastes.

5.10.4 Conclusion

The potential impacts of waste arising from the construction and operational phases of the Southern Section of West Rail have been assessed. Key issues include the need for effective waste management planning during both of these phases, effective management of chemical/industrial and other potentially hazardous wastes, and the strong preference for reuse of clean surplus material rather than disposing of it 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.

5.11 Land Contamination

5.11.1 Background

The potential for soil and groundwater contamination exists in some 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. The following sections present the initial findings of the land contamination assessment.

5.11.1.1 Project Construction

In the Southern Section of the West Rail alignment, the main construction activities involve the construction of the Yen Chow Street Station and cut-and-cover tunnel along the alignment. A significant portion of the vertical alignment lies below the existing ground level of the West Kowloon Reclamation.

Excavated materials will be generated from the following construction activities:

- Yen Chow Street Station;
- Prince Edward Roundabout to Hing Wah Street: construction of railway box structure from Cherry Street towards the north. The rail tracks rise and the box structure surfaces about 200 metres north of the Prince Edward Interchange;
- Hing Wah Street to Mei Foo Interchange: construction of earth mound box structures at grade;
- Mei Foo Interchange to Mei Foo Station: construction of earth mounded tunnel box structures at grade; and
- Modification to an existing drainage box culvert.

5.11.1.2 Current and Historic Land Use

The West Kowloon Reclamation commenced at the beginning of 1990 and work is still in progress. For the reclamation the sea was progressively infilled with marine-dredged sand. Some of the marine sediments deposited in this area were dredged and removed from the sea bed prior to reclamation works, although the actual volumes of sediments, some of which may be contaminated, are unknown. The excavated material will therefore consist primarily of marine-dredged sand, and may also include alluvial material, potentially contaminated marine deposits, rock from buried seawalls, completely decomposed granite, concrete rubble and other materials. The main contamination issue is the need to excavate and remove potentially contaminated marine sediments that may lie under the reclamation.

There has been no historical industrial use of the Southern Section.

5.11.1.3 Geology and Hydrogeology

The *Hong Kong Geological Survey (HKGS) Sheet 11* covering Kowloon indicates that the subsurface area of the proposed alignment is composed mainly of Quaternary marine sands and some Quaternary alluvium which is described as well sorted to semi-sorted clay/silt, sand and gravel. Some of the marine sands constitute fill, which ranges in thickness up to 20 m in some locations. The alignment and offsets primarily lie within areas of reclamation made to the historical shoreline in 1904, 1924, 1945, 1964, 1982, 1985, and most recently in 1996.

Only one portion of the alignment, located east of the Yen Chow Street Station footprint, may potentially encounter bedrock, which consists of medium-grained granite of Upper Jurassic-Lower Cretaceous age.

Depth to groundwater is believed to be within one to two metres below ground level (m bgl), as the area constitutes reclaimed land.

5.11.2 Potential Sources of Impact

Impacts may potentially be sustained through land contamination issues associated with the construction and operation of the Southern Section. The likely areas of impact are:

- Health risks to site workers;
- Disposal of soils;
- Groundwater disposal; and
- Health risks to future users of the site.

These are discussed in the following sections.

5.11.2.1 Health Risks to Site Workers

Site construction workers may become exposed to contaminated soils and groundwater during earthmoving operations. The main exposure routes for site construction workers are inhalation of dusts and direct ingestion of contaminated materials, or through direct contact with potentially toxic or harmful contaminants in sediments or groundwater.

5.11.2.2 Disposal of Soils

During excavation contaminated soils may be encountered which will require off-site disposal at the East Sha Chau contaminated mud pits or a landfill site which is licensed to accept contaminated soils following agreement with the Waste Facilities Management Group of the EPD. Other soils should be suitable for reuse or for disposal at a public dump site.

5.11.2.3 Groundwater Disposal

Where excavations take place below the water table in areas of contamination, or there is a requirement to dewater any contaminated sediment encountered prior to disposal, there may be a need to handle and dispose of contaminated groundwater. Depending on the level of contamination encountered and subject to the agreement of the EPD, groundwater will need to be disposed of in accordance with the *Water Pollution Control Ordinance (WPCO)* to prevent potential contamination.

5.11.2.4 Health Risks to Future Users

Impacts to future users of the site may occur if there is an interface between contaminants and humans.

5.11.3 Prediction of Impacts

5.11.3.1 Health Risks to Site Workers

There is potential for contaminated marine sediments to be encountered at the interface of the marine fill and the seabed in the West Kowloon area. These are likely to be excavated during the development of the station and cut-and-cover tunnel works. The majority of excavation works are likely to involve the use of mechanical plant, and the underlying sediments at the base of the marine fill are expected to be saturated and therefore dust is not likely to be an issue. In dry conditions, any exposure to potentially contaminated dust is likely to be for a relatively short period of time and only if contaminated sediments are stockpiled on site. Good personal hygiene standards will further remove the potential for health risks.

5.11.3.2 Disposal of Soils

The majority of excavated material will comprise marine fill of medium to coarse sand which is suitable for disposal at public dump sites. Where appropriate, reuse or recycling of uncontaminated excavated material in other parts of the project which require fill materials will be considered. Some potentially contaminated sediment and fill interfaces are likely to be excavated from the southern portion of this Section, although the actual volume is not expected to be significant. Special precautions will, however, be needed to ensure safe handling and disposal in accordance with statutory obligations. The likely disposal point for this contaminated material will be the East Sha Chau contaminated mud pits or a landfill site, under the direction of the EPD's Facilities Management Group. 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.

5.11.3.3 Groundwater Disposal

There may be a requirement to dewater any contaminated sediments encountered prior to disposal, and any runoff should be handled in an appropriate manner to ensure that disposal is conducted in accordance with the requirements of the *Water Pollution Control Ordinance* (*WPCO*). Pumping of groundwater from excavations should also be conducted in accordance with the relevant Hong Kong Regulations. The potential contamination of surface waters during the use of any dust suppression equipment in dry conditions is not considered to represent a major concern as the underlying sediments are expected to be already saturated.

5.11.3.4 Health Risks to Future Users

During the operational phase of the development, impacts associated with the potential presence of contaminated sediments are likely to be minimal as there will normally be no interface between any residual contamination and human receptors. The only future impacts anticipated would result from utility maintenance work if excavation is conducted within areas that may be contaminated. However, both the likelihood of encountering contaminated material and the associated health risk are considered to be extremely low.

5.11.4 Evaluation of Impacts

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.

The handling, storage and disposal of contaminated sediments will need to be conducted in accordance with relevant regulations at a suitable disposal site which is able to accept contaminated materials. At present, the WENT landfill site is the only suitable landfill site in Hong Kong. The volumes of material requiring disposal should be minimised by dewatering prior to removal from site. The issue of disposal of non-contaminated material is discussed in *Section 5.10.*

Disposal of potentially contaminated groundwater is not considered to represent a major concern as there is no indication that major volumes of contaminated sediment would be encountered during the excavation programme. All groundwater disposal practises should ensure compliance with the *Water Pollution Control Ordinance*.

There is considered to be minimal impact associated with the potential presence of contaminated sediments which may remain *in situ* following development of the route, as there will be no direct interface with the sediment. Potential impacts to site maintenance workers can be minimised by ensuring minimal interaction with any potentially contaminated soils during utility service maintenance.

5.11.5 Recommended Mitigation

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;
- 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;
- 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.

5.11.6 Residual Impacts

Based on the limited information available at this stage, it is unlikely that there is a potential for major land contamination concerns along the Southern Section, provided the above measures are adopted.

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6. THE CENTRAL SECTION

6.1 Introduction

This section provides a brief description of the Central Section of West Rail, and an assessment of the environmental implications of its construction and operation. This assessment is based on the best available information regarding the design and construction of West Rail at the time of the assessment, using the standards, criteria and assessment methods and techniques outlined in *Sections 3* and *4*.

6.2 Alignment Description

The Central Section refers to that section of the rail alignment and associated development between the proposed KCRC Mei Foo (MEF) station and a point approximately 250m north of the northern portal of the Tai Lam Tunnel (TLT). The Section includes a proposed station at Tsuen Wan West (TWW) to be constructed on reclamation near the site of the existing Tsuen Wan Public Ferry Pier.

The Central Section commences at the western end of the proposed MEF station, and extends north-west under Kwai Chung Hospital in the Ha Kwai Chung Rock Tunnels for approximately 1.5 km. The Ha Kwai Chung Tunnels give way to the Kwai Fuk Road Tunnels for approximately 600 m before entering the Tsing Tsuen Tunnels in the vicinity of Kwai Chung Park and Tsing Tsuen Road. The alignment continues northwest in the Tsing Tsuen Tunnels for approximately 1 km before exiting at the Tsuen Wan Waterfront in the vicinity of the site of the proposed TWW station. From TWW, the alignment continues northwest and enters the southern portal of TLT at a point north of Tuen Mun Road at Tsuen Wan. The northern portal of TLT is situated approximately 5 km northwest in the Kam Tin valley where the railway extends for another 250m above ground before reaching the West Rail Depot and the interface with the adjoining section.

6.2.1 Construction Overview

The alignment of the Central Section will be contained entirely in soft ground or hard rock tunnels, except for that part which lies north of the northern portal of the TLT. which will be constructed on embankment.

MEF and TWW stations will be constructed by the cut and cover tunnelling techniques involving sheetpiling operations in the vicinity of roads and bridge supports, hydraulic breaking, bored piling, excavation. concreting and building activities. In addition. at TWW, demolition of the existing Tsuen Wan Ferry Pier will be undertaken as well as the reclamation of approximately 750,000 m^3 of marine area in the southeast corner of Tsuen Wan Bay.

The Ha Kwai Chung, Tsing Tsuen and Tai Lam Tunnels will be constructed using drill and blast methods. Soft ground at the tunnels portals will be excavated using a combination of excavation and breaking plant prior to commencement of blasting. A series of small blasts will establish the portal alignment and elevation before blasting of the actual tunnel can commence. Tunnelling operations will be supported by 24-hour operation of generator and ventilation plant.

6.3 Noise

This section addresses the noise impacts arising from construction and operation of the Central Section of West Rail. Potentially affected NSRs are identified, noise impacts are predicted and assessed, and appropriate mitigation measures are formulated, following the methodology outlined in *Section 4.*

6.3.1 Baseline Conditions

6.3.1.1 Mei Foo to Tsuen Wan West

The entire section from Mei Foo to Tsuen Wan West will be covered or within tunnel, including the Ha Kwai Chung Tunnel and the Tsing Tsuen Road Tunnel. Mei Foo station is located within Lai Chi Kok Park and the predominant land uses in the immediate vicinity are residential and recreational. Mei Foo Sun Chuen is situated further to the east of Lai Chi Kok Park. A smaller housing estate, Ching Lai Court, is located to the west of the station across Ching Cheung Road. The existing noise climate in this area is dominated by traffic noise from Ching Cheung Road, Kwai Chung Road and West Kowloon Expressway. The Container Terminals situated to the southwest of the station also contribute to the background noise in this area. In future, the Lantau and Airport Railway (LAR) is also expected to contribute to the baseline noise levels.

Areas along the alignment within Kwai Chung and Tsuen Wan are already heavily developed and severely affected by road traffic noise and industrial noise. The existing ambient noise levels in these areas are generally high.

Identified noise sensitive receivers (NSRs) are shown in *Figures 5-9* of *Annex A*. As this section of the alignment will either be within tunnels or covered, train noise impacts are not expected during the operational phase but construction of the railway and fixed plant noise from the operational railway may result in noise impacts on some of the identified NSRs.

6.3.1.2 Tsuen Wan West to Kam Tin

The major land use immediately adjacent to the alignment along the Tsuen Wan Bay waterfront is residential. Existing residential areas include Clague Garden Estate and Hing Shing Temporary Housing Area. The existing noise climate is dominated by traffic noise from Tsuen Wan Road and noise arising from the operation of the cargo handling area.

The alignment enters the Tai Lam Tunnel at Chai Wai Kok and emerges at the northern tunnel portal located within Kam Tin valley. From the portal, the alignment is either at-grade or on embankment and ends approximately 270m north of the northern portal of the TLT. The areas adjacent to the short section north of the tunnel portal is generally rural with low ambient noise levels. However, the drainage channel works to be carried out in the area during the period from 1998 to 2000 will contribute to the background noise. The nearest village settlement is found at Cheung Po. The identified Noise Sensitive Receivers (NSRs) are shown in *Figures 8* and *9* of *Annex A*.

6.3.2 Construction Phase

6.3.2.1 Potential Sources of Impact

Alignment construction work between Mei Foo and the southern portal of the Tai Lam Tunnel (TLT) has the potential to give rise to adverse noise impacts. This work essentially involves cut-and-cover tunnel construction for most of the alignment length at the following sections:

- South of Ha Kwai Chung Tunnel
- Kwai Fuk Road; and
- Tsing Tsuen Tunnel north portal to TLT south portal.

Sections through rock, including the Ha Kwai Chung Tunnel, Tsing Tsuen Tunnel and TLT, will be formed by drilling and blasting. The main worksites for tunnelling work are as follows:

Ha Kwai Chung Tunnel

- Southern works area located to the south of Lai Chi Kok Bay Garden along Lai King Hill Road; and
- Northern works area located to the north of Lingnam Dr Chung Wing Kwong Middle School between Kwai Chung Road and Lai King Hill Road.

Tsing Tsuen Tunnel

- Southern works area located to the east of Kwai Chung Park between Tsuen Wan Road and Kwai Hei Road; and
- Northern works area located at the junction of Tsuen Tsing Interchange adjacent to Wah Kei Industrial Centre.

Tai Lam Tunnel (TLT):

- Southern works area located at the footprint of Shun Kei Factory Estate along Tsuen Wan Road; and
- Northern works area located to the south of Cheung Po at the portal.

Locations of work sites are shown in *Annex A*.

The prediction of noise levels from blasting is not within the scope of this study. However, noise effects will reduce substantially as works proceed further into the tunnel.

It is expected that construction work will generally be restricted to normal daytime working hours, however tunnelling works and the removal of spoil from the tunnels may need to be carried out during restricted hours. For the latter activity, the spoil is assumed to be stockpiled during restricted hours to reduce noise levels. These construction activities have the potential to cause adverse noise impacts on sensitive receivers in the surrounding area.

A new area of reclamation will be required in Tsuen Wan Bay to accommodate the alignment to the south of Tsuen Wan West Station. Demolition of a pier and several industrial premises located at Hoi Hing Road and Hoi On Road will be a source of noise.

Sand filling of the Tsuen Wan Bay Reclamation area will be carried out by barge and a small number of trucks will be used for materials handling for other construction sites. The volume of construction traffic generated will be small compared with the background traffic flow. Piling works carried out for the proposed Mei Foo Station refer to bored piling activities and no percussive piling will be used.

6.3.2.2 Prediction of Impacts

Details of the likely construction activities and the appropriate construction plant teams have been provided by the engineering Design Consultants. These have enabled an inventory of SWLs to be identified for each component of the various plant teams, from which the total SWL for each plant team has been calculated. Construction noise levels have been predicted for each of the main construction activities, using the methodology set out in the TM (and *Section 4*) and these are shown below in *Tables 6.3a-g*. Noise impacts on properties along Mount Sterling Mall, located at Mei Foo Sun Chuen, by the subway construction have also been predicted.

Table 6.3a Predicted Noise Levels from Mei Foo Station Subway Construction

Fig/NSR No	NSR Name	Demolition	Piling	Excavation	Concreting
4/9	Mei Foo Sun Chuen Block 16	98	84	90	91
4/10	Mount Sterling Mall	98	84	90	91

Table 6.3b Predicted Noise Levels from Station Construction Activities

Fig/NSR No	NSR Name	Site Clearance	Piling	Pile cap Const'n	Column Const'n	Station Const'n
4/9	Mei Foo Sun Chuen Block 16	89	90	91	90	91
5/2	Ching Lai Court	**80**	**84**	**84**	**83**	**84**
7/3	Water Side Plaza	62	66	66	65	66
8/17	Clague Garden Estate	**80**	**84**	**84**	**83**	**84**
8/23	Hing Shing Temporary Housing Area	66	70	70	69	70

Note: Exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 6.3c Predicted Noise Levels from At-Grade Construction Works

Fig/NSR No	NSR Name	Site Clearance	Drainage Const'n	Excavation	Formation
5/2	Ching Lai Court	**80**	**78**	**82**	**77**

Note: Exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3d Predicted Noise Levels from Cut-and-Cover Tunnelling

Fig/NSR No	NSR Name	Vibratory Sheet Piling	Bulk Excavation	Concreting Tunnel Slabs	Shotcreting
5/2	Ching Lai Court	**84**	**85**	**88**	**78**
5/C1	HKHA Residential Development	74	75	**78**	68
5/3	Princess Margaret Hospital	**80**	**81**	**84**	74
5/8	Kau Wah Keng San Tsuen	65	66	69	59
5/15	Kwai Chung Methodist College	66	67	70	60
5/21	Lingnam CWK Middle School	**77**	**78**	**81**	71
6/4	Kwai Tsing Theatre	**86**	**87**	**90**	**80**
6/29	Lion Prevocational School	74	75	**78**	68

Fig/NSR No	NSR Name	Vibratory Sheet Piling	Bulk Excavation	Concreting Tunnel Slabs	Shotcreting
6/34	Lee I Yao Secondary School	69	70	**73**	63
6/53	Riviera Gardens	74	75	**78**	68
7/3	Water Side Plaza	**84**	**87**	**90**	**80**
8/17	Clague Garden Estate	75	**78**	**81**	71
8/23	Hing Shing Temporary Housing Area	**76**	**79**	**82**	72
8/35	The Panorama Site (WIP)	71	74	**77**	67
8/46	Allway Gardens	62	65	68	58

Note: Exceedances of the 75 dB(A) criterion for residential establishments and hospital, and the 70 dB(A) criterion for hospital and educational establishments are shown in bold (65 dB(A) during examination periods).

Bored pile will be used between Paul Y Building and Wing Shun Street.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3e Predicted Noise Levels from Rock Tunnelling Works

Fig/NSR No	NSR Name	Daytime Working	Restricted Hours Working
9/1	Cheung Po	65	**58**
5/c1	HKHA Residential Development	73	**66**
5/3	Princess Margaret Hospital	**79**	**72**
5/8	Kau Wah Keng San Tsuen	64	**57**
5/15	Kwai Chung Methodist College	65	-
5/21	Lingnam CWK Middle School	**76**	-
6/4	Kwai Tsing Theatre	69	62
6/29	Lion Prevocational School	**73**	-
6/34	Lee I Yao Secondary	68	-
6/53	Riviera Gardens	73	**66**
7/3	Water Side Plaza	**85**	**78**
8/35	The Panorama Site (WIP)	72	**65**
8/46	Allway Gardens	63	**56**

Note: Exceedances of the 75/70 dB(A) daytime criterion and the 50/55 dB(A) and 35/40 dB(A) criterion for evening and night-time are shown in bold.

It is assumed that the schools are not used during restricted hours.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3f Predicted Noise Levels from Sub Station/Pumping Station Construction

Fig/NSR No	NSR Name	Site Clearance	Bored Piling	Concreting	Bulk Excavation	Building Structure Excavation	Building Structure Concreting
5/21	Lingnam CWK Middle School	73	68	**77**	**76**	**72**	**76**
8/17	Clague Garden Estate	73	68	**77**	**76**	72	**76**
8/23	Hing Shing Temporary Housing Area	69	64	73	72	68	72
8/35	The Panorama Site (WIP)	72	67	**76**	75	71	75

Note: Exceedances of the 75 dB(A) criterion for residential establishments and hospital, and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 6.3g Predicted Noise Levels from Reclamation / New Pier Construction

Fig/NSR No	NSR Name	Reclamation				New Pier Construction	
		Seawall Construction	Sand Filling	Vibro compaction	Surcharging	Piling	Super-structure
7/3	Water Side Plaza	62	69	55	68	69	71
8/17	Clague Garden Estate	61	68	54	67	68	70
8/47	Gov't Office on Ferry Pier	61	68	60	73	74	**76**

Note: Exceedances of the 75 dB(A) criterion are shown in bold

All levels specified are LAeq (30 min) dB unless stated otherwise.

6.3.2.3 Evaluation of Impacts

Tables 6.3a-g above show that unmitigated construction noise impacts will exceed the noise criteria at virtually all NSRs during most phases of the construction. Exceedances of up to 15 dB(A) have been predicted at residential properties and educational establishments. Construction noise mitigation measures have been developed for this project and their effects on the predicted exceedances are discussed below.

It should be noted that the noise levels shown in *Tables 6.3a-g* are worst case predictions since the calculations assume that all the available plant items for a phase of works are in use for 100% of the time. In practice this is unlikely to be the case as a number of items of plant will operate sequentially and within the constraints of available space within the work site.

The control of all blasting operations in Hong Kong is vested in the Mines and Quarries Division of the Civil Engineering Department, who require an assessment of blasting vibration and its effects on nearby structures to be carried out by qualified blasting specialists, and submitted to them for approval. This assessment will be carried out by the specialist contractor prior to commencement of the works at each site. A detailed assessment of blasting vibration will not therefore be undertaken in the EIA. It should, however, be noted that the controls on blasting likely to be required to safeguard nearby structures will also provide mitigation of the possible impacts on nearby sensitive land uses.

6.3.2.4 Recommended Mitigation

The noise mitigation measures which could be applied to the construction works for the Southern Section have been described in detail in *Section 5.3*. These have been applied to the predicted noise levels in *Tables 6.3a-g* above and the mitigated noise levels, using mitigation options M1, M2 and M3, are shown in *Tables 6.3h-n* below.

In addition to the mitigation measures in M1, M2 and M3 it will be necessary to organise blasting activities to avoid sensitive times. Community liaison campaigns including publicity detailing the times at which blasting noise will be experienced can be an effective method of reducing the startle factor amongst the local population (and hence the likelihood of complaint).

Table 6.3h Mitigated Noise Levels from Mei Foo Station Subway Construction

Fig/NSR No	NSR Name	Demolition	Piling	Excavation	Concreting
4/9	Mei Foo Sun Chuen Block 16	**97/92/85**	**78/75/-**	**83/78/78**	**89/84/84**
4/10	Mount Sterling Mall	**97/92/85**	**78/75/-**	**83/78/78**	**89/84/84**

Table 6.3i Mitigated Noise Levels from Station Construction Activities

Fig/NSR No	NSR Name	Site Clearance	Piling	Pile cap Const'n	Column Const'n	Station Const'n
5/2	Ching Lai Court	73/ - / -	**83/82/79**	**81/79/ 75**	**80/78/75**	**81/78/75**
8/17	Clague Garden Estate	73/ - / -	**83/82/79**	**81/79/75**	**80/78/75**	**81/78/75**

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3j Mitigated Noise Levels from At grade Construction Works

Fig/NSR No	NSR Name	Site Clearance	Drainage Const'n	Excavation	Formation
5/2	Ching Lai Court	73/ - / -	73/ - / -	**78/76/75**	**77/77/77**

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3k Mitigated Noise Levels from Cut and Cover Tunnelling

Fig/NSR No	NSR Name	Vibratory Sheet Piling	Bulk Excavation	Concreting Tunnel Slabs	Shotcreting
5/2	Ching Lai Court	**84/84/81**	**78/78**/71	**84/82/76**	74/ - / -
5/C1	HKHA Residential Development	-/-/-	70/ - / -	74/-/ -	- / - / -
5/3	Princess Margaret Hospital	**80/80/77**	**74**/ 67/ -	**80/78**/72	-/ -/ -
5/15	Kwai Chung Methodist College	66/ -/ -	60/- / -	66/ -/ -	- / - / -
5/21	Lingnam CWK Middle School	**77/77/74**	**71/71**/64	**77/75**/69	67/65/ -
6/4	Kwai Tsing Theatre	**86/86/76**	**80/80/73**	86/84/78	**76/74**/ -
6/29	Lion Prevocational School	**74/74/71**	68/ -/ -	**74/72**/66	64/ - / -
6/34	Lee I Yao Secondary School	69/ -/ -	63/ - / -	69/ -/ -	- / - / -
6/53	Riviera Gardens	- / - / -	- / - / -	74/ - / -	- / - / -
7/3	Water Side Plaza	**78/78**/75	80/80/73	**86/84/78**	**76/74**/ -
8/17	Clague Garden Estate	-/-/-	71/ - / -	**77/75**/ -	- / - / -
8/23	Hing Shing Temporary Housing Area	70/-/-	72/ - / -	**78/76**/70	- / - / -
8/35	The Panorama Site (WIP)	- / - / -	- / - / -	**77**/73/ -	- / - / -

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for hospital and educational establishments shown in bold (65 dB(A) during examination periods).

Bored pile will be used between Paul Y Building and Wing Shun Street.

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 6.3l Mitigated Noise Levels from Tunnelling Works

Fig/NSR No	NSR Name	Daytime Working	Restricted Hours Working
9/1	Cheung Po	-/ -/ -	**54/54/51**
5/C1	HKHA Residential Development	- / - / -	**62/62/62**
5/3	Princess Margaret Hospital	**72/66-/-**	**68/68/66**
5/8	Kau Wah Keng San Tsuen	- / - / -	**53/53/53**
5/15	Kwai Chung Methodist College	- / - / -	-
5/21	Lingnam CWK Middle School	69/ - / -	-
6/29	Lion Prevocational School	66/ - / -	-
6/34	Lee I Yao Secondary School	- / - / -	-
6/53	Riviera Gardens	- / -/ -	**62/62/62**
7/3	Water Side Plaza	**78/78/**71	**74/74/74**
8/35	The Panorama Site (WIP)	- / - / -	**61/61/61**
8/46	Allway Gardens	- / - / -	**52/52/52**

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) daytime criterion for residential establishments and the 70 dB(A) daytime criterion for hospital and educational establishments shown in bold (65 dB(A) during examination periods).

Noise levels which exceed the restricted hours criteria are also shown in bold font. Evening criteria are 50 or 55 dB(A), depending on ASR.

It is assumed that schools are not used during restricted hours.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3m Mitigated Noise Levels from Sub Station/Pumping Station Construction

Fig/NSR No	NSR Name	Site Clearance	Bored Piling	Concreting	Bulk Excavation	Building Structure Excavation	Building Structure Concreting
5/21	Lingnam CWK Middle School	66/ -/ -	63/ - / -	**73/72**/65	**74**/68/ -	65/ - / -	**73/71**/65
8/17	Clague Garden Estate	- / - / -	- / - / -	73/ - / -	74/ - / -	- / - / -	73/ - / -
8/35	The Panorama Site (WIP)	- / - / -	- / - / -	72/ - / -	- / - / -	- / - / -	- / - / -

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 6.3n Mitigated Noise Levels from Reclamation / New Pier Construction

Fig/NSR No	NSR Name	Reclamation				New Pier Construction	
		Seawall Construction	Sand Filling	Vibro compaction	Surcharging	Piling	Super-structure
8/47	Gov't Office on Ferry Pier	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-	73/-/-

Note: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise.

6.3.2.5 Cumulative Noise Impacts

At Mei Foo Sun Chuen Block 16, cumulative noise impacts from both station and subway construction works are expected. The predicted noise level would be increased by 2 dB(A) above the levels in *Table 6.3i* if noisy construction works from both sites occur at the same time.

At Ching Lai Court, cumulative noise impacts from both station and at grade construction works are expected. The predicted noise level would be increased by 2 dB(A) above the levels in *Table 6.3i*, if noisy construction works from both sites occur at the same time. In addition, cumulative noise impacts from station and building construction are expected at Clague Garden Estate. Again, the predicted noise level would be increased by 2 dB(A) above the levels in *Table 6.3i*, if noisy construction works from both sites are simultaneous.

At Lingnam CWK Middle School, cumulative noise impacts from cut-and-cover tunnelling, tunnelling works and building construction are expected. However, the mitigated noise level from cut-and-cover tunnelling works is more than 9 dB(A) higher than the other activities and the cumulative noise levels at the NSR will, therefore, be the same as the predicted noise levels from the cut-and-cover tunnel worksite.

Due to the proximity of the cut-and-cover tunnel worksite and drill and blast tunnel worksite, cumulative noise impacts are expected at the closest NSRs. The affected receivers are Princess Margaret Hospital, Kwai Chung Methodist College, Ling Lam CWK Middle School, Lion Prevocational School, Lee I Yao Secondary School, Rivieria Gardens Water Side Plaza and the Panorama Site. However, the mitigated noise level from the cut-and-cover tunnel worksite is more than 10 dB(A) higher than the drill and blast tunnel worksite, so the cumulative noise level will be the same as the predicted level from the cut-and-cover worksite.

6.3.2.6 Residual Impacts

For Mei Foo Sun Chuen Block 16 and Mount Sterling Mall, hard solid hoarding will need to be incorporated with the proposed mitigation measures, in order to reduce noise impact to comply with the daytime criteria.

The proposed package of mitigation measures has proven largely successful in reducing the predicted noise levels to within the daytime criteria. However, during cut-and-cover tunnel works, noise levels are above the criteria for educational buildings at Lingnam CWK Middle School and Lion Prevocational School. Station construction also gives rise to adverse impacts at Clague Garden Estate during piling activities whilst piling and concreting activities give rise to adverse impacts during cut-and-cover tunnelling at Ching Lai Court, Princess Margaret Hospital and Waterside Plaza.

A 7 dB(A) exceedance of the daytime criterion has also been predicted at Princess Margaret Hospital during cut and cover tunnelling works. The hospital, however, is currently provided with fixed windows and air-conditioning, and as this will provide 10 dB(A) additional mitigation, no adverse impacts are expected.

Worst case scenarios, as described above, have been assumed for plant team activities and if necessary, the predicted noise level could be further reduced by limiting the on-time period or number of active items of noisy plant. If the additional mitigation measures shown in *Table 6.3o* are applied the noise impacts at the NSRs will be reduced to within the established criteria for day-time construction work.

Table 6.3o Additional Mitigation Measures

Construction Activities	Construction Activity	Percentage on-time in any 30 minute period	No of noisy plant
Mei Foo Station Subway Construction	Demolition		Limit to 1 PME, either 1 bulldozer or 1 compactor or 1 hand held breaker (50% on time)
	Concreting	35%	
Station Construction	Sheet Piling	40%	-
At grade Construction works	Formation	40%	-
Cut and Cover Tunnelling	Sheet Piling	25% for the section south of Ha Kwai Chung Tunnel 40% for other sections	-
	Concreting Tunnel Slabs	-	restricted to one lorry operating at any time

A more stringent noise requirement is applied for educational institutions during examination periods, 65 dB(A). To avoid high noise impacts, especially noisy construction activity should be scheduled outside examination periods.

Tunnelling works (including use of an excavator, rock drill and generator) undertaken during restricted hours will not be acceptable either during the evening or night-time unless considerable noise reductions of at least 10 to 20 dB(A) can be achieved. A purpose built noise enclosure around the tunnel portal could provide sufficient mitigation to gain a CNP for evening work, but night-time activities would also require large reductions in noise from operational plant. Allowances would also need to be made for noise from the tunnel ventilation system so that the overall noise from vent fans and other tunnelling works do not exceed relevant criteria. This would have to be clearly demonstrated in any CNP application.

6.3.2.7 Conclusions

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 CNP could be obtained from 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, no serious noise impacts are expected from construction of the Central Section.

6.3.3 Operational Phase

6.3.3.1 Fixed Plant Noise

6.3.3.1.1 Potential Sources of Impact

In general, the fixed plant noise sources will be similar to those already described in *Section 5.3.3* for the Southern Section. Information specific to the Central Section is discussed below.

The alignment of the Central Section is either covered or within tunnel and ventilation and air-conditioning facilities are required. These are listed as follows:

- Station ventilation shafts at the platform ends of Mei Foo station;
- Cooling water pumping station for Tsuen Wan West station; and
- Ventilation and cooling buildings at the south and north portal of the TLT.

One traction power sub-station will be provided within this section of the alignment, this will be contained within the combined Ventilation Building and Traction Power Feeder Substation known as the Kwai Fong Ancillary Building (KFAB). The KFAB will be located north of the cut-and-cover tunnel and south of Kwai Fuk Road. According to information supplied by KCRC in the *West Rail Operations & Maintenance Plan*, three 132/25kV transformers will be installed in the sub-station, but only two of these will be operational at any one time.

6.3.3.1.2 Prediction of Impacts

The noise specifications for each potential source of fixed plant noise have been determined by considering the maximum allowable sound power level for each source to achieve compliance with the HKPSG criteria at the closest NSR, allowing a correction factor for distance, tonality (3dB) and facade reflection. A further correction was applied if more than one fixed plant item was likely to cause a noise impact at an NSR.

The HKPSG recommends that for fixed plant, noise criteria should be 5 dB below the appropriate Acceptable Noise Levels (ANL) specified in TM4. This level was therefore taken as the maximum allowable level at the NSR. Of the six NSRs used in the predictions, five were assigned an Area Sensitivity Rating (ASR) of 'C'. These are Mei Foo, Riviera Gardens, Wheelock Site (residential development), Clague Garden Estate and Kwai Fong Terrace. The criterion adopted for these NSRs is therefore $L_{Aeq\ (30\ minutes)}$ 55 dB(A). For the remaining NSR, Cheung Po, an Area Sensitivity Rating of 'B' was assigned, and therefore a lower criterion of $L_{Aeq\ (30\ minutes)}$ 50 dB is used.

Cheung Po will be the closest NSR to the ventilation and cooling buildings at the northern portal of the Tai Lam Tunnel. This NSR will also be affected by noise from the West Rail Depot. It is assumed that each of the sources will contribute equal levels of noise, therefore a 3 dB correction has been included when calculating the maximum allowable SWL to ensure that no cumulative impacts arise.

Potential noise impacts from fixed plant has also been considered for the Kwai Tsing Theatre which is currently under construction. The KFAB will be the closest fixed plant installation to the Theatre. The Theatre is not however, the closest NSR to the KFAB and therefore has been considered further at this stage.

Table 6.3p below presents the maximum allowable sound power level for each of the sources which will be required to meet the HKPSG criteria.

Table 6.3p Calculated Maximum Permissible Noise Levels of Fixed Plant

Fixed Plant Noise Source	Nearest NSR	Area sensitivity Rating	Night-time Criteria $L_{Aeq\ (30\ minutes)}$ dB	Distance to NSR, m	Maximum Allowable SWL, of fixed source, dB
Station ventilation shafts at the platform ends of Mei Foo station	*Figure 4* , NSR4 Mei Foo Sun Cheun	C	55	130	100$^{(1)(3)}$
Ventilation/cooling buildings at the southern portal of the Tai Lam Tunnel	*Figure 8*, NSR34 Wheelock Site (WIP)	C	55	150	101$^{(1)}$
Ventilation/cooling buildings at the northern portal of the Tai Lam Tunnel	*Figure 10*, NSR1 Cheung Po	B	50	250	102$^{(1)}$
Cooling water pumping station for Tsuen Wan West station	*Figure 8*, NSR 17 Clague Garden Estate	C	55	200	101$^{(1)}$
KFAB	*Figure 6*, NSR 2 Kwai Fong Terrace	C	55	95	97$^{(1)}$

Notes:

(1) This level includes a 3 dB correction to allow for potential cumulative impacts.

(2) The location of the fixed plant are identified on the relevant figures in *Annex A*.

(3) Equates to 72dB(A) at a distance of 1m. Therefore no noise impacts are anticipated within Lai Chi Kok Park.

Provided that the above allowable sound power levels can be met, no mitigation will be required.

6.3.3.1.3 Recommended Mitigation

Ventilation Fans, Vents and Buildings

Ventilation fan noise, and consequently vent noise, is characterised primarily by turbulent air flow noise and tonal noise. Turbulent air flow noise can be minimised by careful consideration of the fan positioning, avoiding areas where turbulence is likely to occur such as close to heaters/coolers or bends in the ductwork. Tonal noise can be minimised by optimising the fan speed and pitch of the blades. Where more than one fan is used, fan speeds should be selected to prevent low frequency noise being generated.

Fan noise can be reduced further by providing an acoustic enclosure and by fitting silencers. Noise emanating from vents can be reduced further by fitting attenuators.

All fans should be maintained in good mechanical condition to prevent unnecessary noise such as high frequency whine that can be generated by worn bearings.

Chiller Plant

Chiller plant noise is characterised by intermittent compressor noise and low frequency air flow noise. Chiller plant noise can be minimised by enclosing the unit and fitting silencers to air inlets and outlets. All equipment should be maintained in good mechanical condition to prevent unnecessary noise which may result from loose panels or worn bearings.

Cooling Water Pumping Station

Cooling water pumps have the potential to generate both tonal noise and structure borne noise. This noise can be minimised by installing an acoustic enclosure with silencers fitted to air inlets and outlets, and by ensuring that the pump is vibrationally isolated from any surface which may radiate noise. Equipment should be maintained in good mechanical condition.

Traction Sub-Stations

Noise from the traction sub-stations can be minimised by providing acoustic enclosures around transformers, particularly any cooling fans and ensuring that all equipment is maintained in good working condition.

Residual Impacts

Past experience suggests that conventional plant can achieve the noise performance requirements derived above, provided the mitigation measures outlined above are adopted. The plant specifications contained within contractual and procurement documentation shall include explicit reference to these performance criteria.

6.3.3.2 Train Operational Noise

In this section no impact from airborne noise from the railway will arise since the trains will travel below ground in a tunnel.

6.4 Air Quality

6.4.1 Construction Phase

6.4.1.1 Baseline Conditions

In the Mei Foo and Lai King areas, the majority of land uses close to the alignment of the Central Section are residential and recreational uses. Industrial uses are also identified in the Kwai Fong and Tsuen Wan areas and construction works for the LAR and Route 3 are located in the Lai King area. However, civil engineering for the above infrastructure works have been largely completed and their dust impacts are diminishing. The main source of air quality impacts in the Mei Foo and Lai King areas is from existing traffic on Kwai Chung Road and the nearby local roads. In the Kwai Fong and Tsuen Wan areas air quality is influenced by both vehicular and industrial emissions.

The nearest EPD air quality monitoring stations along the Central Section is located on the roof top of Princess Alexandra Community Centre, Tsuen Wan. The annual average TSP level measured at this station in 1996 was 86 $\mu g\ m^{-3}$.

6.4.1.2 Potential Sources of Impact

The construction activities for the Central Section will involve drill and blast tunnelling for tunnel sections, cut-and-cover works for the underground section under Kwai Fuk Road, open cut excavation for the Mei Foo and Tsuen Wan West Stations, and reclamation for Tsuen Wan West Station. It is not envisaged that a concrete batching plant will form part of site activities.

During tunnel construction using drill and blast methods, blasting dust impacts can be expected during the initial excavation stage when blasting takes place near the surface and at the portals, but dust impacts will diminish as works move inside the tunnel. Blasting dust impacts will be further reduced by the adoption of current best practice for blasting works, including the erection of blasting nets and coverage of the blasting opening by canvas, as required by the Mines and Quarries Division (M&Q) of the CED. It has been assumed that there will be no more than one blast per hour and a blasting area of 25 m^2 has been assumed. This is a very conservative estimate as experience on the LAR in the Lai King tunnels suggests the maximum number of blasts that can be conducted in any 12 hour period is five.

Materials generated from blasting will be removed via the tunnel portals. There are two works areas for each tunnel section and their locations are listed in *Section 6.3*.

The works sites at the northern end of the Tsing Tsuen Road Tunnel and the southern end of the TLT are currently occupied by the Paul Y Industrial Building, Wah Kei Industrial Centre and Shun Kei Factory Estate. Demolition works will be required and are considered to be a potential source of dust. A specialist asbestos consultant will be employed to carry out a thorough survey of the industrial buildings and special procedures to demolish these buildings would be adopted if the buildings are found to contain asbestos.

The southern works site for the TLT is adjacent to Tuen Mun and Tsuen Wan Roads. The spoil removed from the TLT south portal work area will be by road and a high number of vehicle movements will be generated. Fugitive dust emissions from haul roads are, therefore, anticipated.

At the northern worksite, excavated materials will be transported by dump trucks and there will be potential for haul road dust impacts.

Construction of Mei Foo and Tsuen Wan West stations and the alignment under Kwai Fuk Road involve excavation. Excavated materials will be taken away from site by dump trucks and barges. Fugitive emissions are likely to be generated through handling of the spoil and vehicular movement over unpaved haul roads and work sites.

Tsuen Wan West Station and the reprovisioned Tsuen Wan Central Pumping Station will be built on the Tsuen Wan Reclamation area and potential dust impacts are anticipated from construction works associated with reclamation including dredging, rock and sand filling, and surcharging. Pier structure demolition and aggregate handling at the Tsuen Wan Ferry Pier will also be dusty.

An undredged method of construction with vertical drains installed for the reclamation works will be used as the primary method with a small amount of dredging required for the seawall construction. Rock and sand filling will also be undertaken during the reclamation period. These activities involve dropping materials onto a receiving surface and fugitive dust may be emitted. The Fill Management Committee has advised that marine sand should be used. Due to the high moisture content of marine sand, dust generation from the reclamation will be limited.

A substantial volume of fill is required to form the reclamation platform. It is expected that barges will be used to transfer marine sand to the site as fill material during reclamation and hence no haul road dust is expected. However, wind erosion over the exposed surfaces of the reclamation area could be a significant source of fugitive dust emissions. At the later stage of reclamation, excavated materials from the tunnel and station works may be used. Also, trucks will be required for the removal of surcharge materials from site.

The quantity of earthworks at each works area, and the number of dump trucks required for the disposal of excavated material off-site or the import of fill, have been estimated in the *Draft Technical Report, Tsuen Wan West Station and Approach Tunnels, Atkins China, October 1997* and *Draft Technical Report, Kwai Tsing Tunnels, Atkins China, October 1997* and are listed in *Table 6.4a*. The vehicle speed is assumed to be 35 kph, based on current practices on other construction sites. Calculated dust emission rates for each activity are based on AP42 and details are presented in *Annex F*.

Table 6.4a Estimated Earthwork Quantities and Volume of Truck Traffic

Construction Works Site	Maximum Number of Trucks required (trucks/day)
Mei Foo station	134
Ha Kwai Chung Tunnels	
• South Portal	60
• North Portal	50
Kwai Fuk Road	80
Tsing Tsuen Tunnel	
• South Portal	40
• North Portal	20
Tsuen Wan West station	170
Tai Lam Tunnel	
• South Portal	90
• North Portal	80

6.4.1.3 Prediction of Impacts

ASRs along the West Rail alignment have been identified in according to HKPSG and the APCO. Details of the ASRs are presented in *Annex A*. 1-hour and 24-hour TSP levels are predicted at representative ASRs. The cumulative 1-hour and 24-hour TSP levels arising from demolition, cut-and-cover and general construction works for the Central Section at the representative ASRs under the worst case wind conditions are shown in *Table 6.4b*. The predicted 1-hour TSP levels at various distances downwind of blasting are presented in *Table 6.4c*.

Table 6.4b Predicted Cumulative 1-hour and 24-hour TSP Levels from Construction Works

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Mei Foo (MEF)	4/5	Lai Chi Kok Park adjacent to Swimming Pool	496	291
	4/6	Lai Chi Kok Swimming Pool	364	225
	4/9	Mei Foo Sun Chuen	300	193
	4/10	Mount Sterling Mall	231	158
Lai King (LAK)	5/1	Ching Lai Commercial Centre	472	279
	5/2	Ching Lai Court	365	226
	5/c1	HK Housing Authority Residential Development	517	301

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
	5/3	Princess Margaret Hospital	310	198
	5/5	Lai Chi Kok Bay Garden	269	177
	5/6	Wah Fung Garden	198	142
	5/18	Tung Wah Group of Hospital Ko Ho Ning Memorial Primary School	147	116
	5/21	Lingnam Dr Chung Wing Kwong Memorial Middle School	265	176
Kwai Fong (KWF)	6/2	Kwai Fong Terrace	160	123
	6/1	Kwai Yi Road Playground	160	123
	6/4	Kwai Tsing Theatre (WIP)	122	104
	6/14	Kwai Chung Sport Ground	122	104
	6/26	Kwai Fuk Road Playground	120	103
	6/c1	Composite Industrial/Office at Kwai Hei Street	127	106
	6/47	Sunley Centre	219	153
	6/53	Riviera Gardens	234	160
Tsuen Wan (TWN)	7/3	Water Side Plaza	488	**287**
	7/c1	Proposed Recreational uses	258	172
	8/16	Clague Garden Estate Playground	290	188
	8/22	Shield Industrial Centre	304	195
Kam Tin (KAT)	9/1	Cheung Po (Church & Playground)	377	231
	8/23	Hing Shing Temporary Housing Area	410	248
	8/47	Offices on Pier Building	334	210

Note: (1)Exceedances of TSP criteria are shown in bold.

(2) For location of ASRs refer to *Annex A*

(3) Background TSP Level included in the predicted levels.

(4) Units are $\mu g\ m^{-3}$

Table 6.4c Predicted 1-hour TSP Levels arising from Blasting

Downwind Distance from the blasting site (m)	1-Hour TSP Level
5	**583**
10	286
15	157
20	98
25	67
30	49
35	37
40	29
45	24
50	19
100	6
200	2

Note: (1)Exceedance of TSP criteria are shown in bold.

(2) Does not include background level.

(3) Units are μg m^{-3}

6.4.1.4 Evaluation of Impacts

6.4.1.4.1 Cut-and-Cover Section

The predicted 1-hour and 24-hour TSP levels at the ASRs close to the cut-and-cover section in Kwai Fuk Road, namely Kwai Yi Road Playground, Kwai Fong Terrace, Kwai Tsing Theatre and Kwai Chung Sport Ground, are in the range of 122-160 μg m^{-3} and 104-123 μg m^{-3} respectively. The predicted 1-hour and 24-hour TSP levels are below both the EPD's recommended hourly limit of 500 μg m^{-3} and the 24-hour AQO. Dust impacts from alignment construction of this section would be low due to the limited extent of the works.

6.4.1.4.2 Demolition Works, Tunnel Section and Station

The predicted 1-hour and 24-hour TSP levels at some of the ASRs close to the demolition, station and tunnel portal works site exceed the EPD's recommended limit of 500 μg m^{-3} and 24-hour AQO and mitigation measures will be applied.

In Mei Foo, the highest 1-hour and 24-hour TSP levels of 496 μg m^{-3} and 291 μg m^{-3} are predicted at Lai Chi Kok Park due to the close proximity of the receiver to the site. In Lai King the HKHA Residential Development is predicted to experience 1-hour and 24-hour TSP levels of 517 μg m^{-3} and 301 μg m^{-3}. In Tsuen Wan, the highest 1-hour and 24-hour

TSP levels of 410 $\mu g\ m^{-3}$ and 248 $\mu g\ m^{-3}$ are predicted at Shing Hing Temporary Housing Area.

In Kwai Fong, the dust levels at all the ASRs will satisfy the established dust criteria.

The ASRs are most affected by the high volumes of construction traffic. Mitigation measures should aim at reducing the dust levels from material handling, erosion and most importantly from vehicle movement on unpaved haul roads.

The 1-hour TSP levels from blasting at the tunnel portals, as indicated from *Table 6.4c*, only exceed the EPD's recommended criterion very close to the source. The nearest representative ASRs are located at least 70 m from the tunnel portal and the contribution of dust from blasting towards the total TSP level will be about 20 $\mu g\ m^{-3}$ which will not result in adverse impacts. It should be noted that the extent of dust impact depends on the blasting area and techniques used. Best practice for the blasting works required by M&Q, including the erection of blasting nets and coverage of the blasting area with canvas, should be implemented to further reduce TSP levels. Dust mitigation measures for blasting are presented in the following section.

6.4.1.5 Recommended Mitigation

Dust mitigation measures which could be applied to the construction sites for material handling, excavation and vehicle dust have been described in *Section 5.4*. In addition, the following measures could be applied to the demolition, drilling and blasting works to reduce the dust emissions from the site:

Demolition Works

- Dust emissions should be reduced by covering the buildings and structures to be demolished with canvas and watering in worked areas;
- Special procedures to demolish buildings would be adopted if they are found to contain asbestos;

Drilling and Blasting

- 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;
- 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;
- 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
- Blast doors should be fitted at the portals to further contain dust and debris from tunnelling works.

With the implementation of the recommended dust mitigation measures. the 1-hour and 24-hour TSP levels will be reduced to the estimated levels shown in *Table 6.4d*.

Table 6.4d Mitigated 1-hour and 24-hour TSP Levels at Representative Air Sensitive Receivers

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Mei Foo	4/5	Lai Chi Kok Park adjacent to Swimming Pool	303	194
	4/6	Lai Chi Kok Swimming Pool	233	159
	4/9	Mei Foo Sun Chuen Block 16	202	144
	4/10	Mount Sterling Mall	163	125
Lai King	5/1	Ching Lai Commercial Centre	288	187
	5/2	Ching Lai Court	231	159
	5/c1	HK Housing Authority Residential Development	311	198
	5/3	Princess Margaret Hospital	204	145
	5/5	Lai Chi Kok Bay Garden	184	135
	5/6	Wah Fung Garden	145	116
	5/18	Tung Wah Group of Hospital Ko Ho Ning Memorial Primary School	118	102
	5/21	Lingnam Dr Chung Wing Kwong Memorial Middle School	177	131
Kwai Fong	6/2	Kwai Fong Terrace	124	105
	6/1	Kwai Yi Road Playground	124	105
	6/4	Kwai Tsing Theatre (WIP)	110	98
	6/14	Kwai Chung Sport Ground	108	97
	6/26	Kwai Fuk Road Playground	110	98
	6/c1	Composite Industrial/Office at Kwai Hei Street	108	97
	6/47	Sunley Centre	155	120
	6/53	Riviera Gardens	162	124
Tsuen Wan	7/3	Water Side Plaza	291	189
	7/c1	Proposed Recreational uses	178	132
	8/16	Clague Garden Estate Playground	193	140
	8/22	Shield Industrial Centre	199	142
	8/23	Hing Shing Temporary Housing Area	253	169
	8/47	Offices on Pier Building	224	155
Kam Tin (KAT)	9/1	Cheung Po (Church & Playground)	158	122

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level

Note: (1) For location of ASRs refer to *Annex A*

(2) Includes background TSP levels

(3) Units are $\mu g\ m^{-3}$

6.4.1.6 Residual Impacts

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

6.4.2 Operational Phase

6.4.2.1 Baseline Conditions

The Central Section of West Rail is located in the Mei Foo, Lai King, Kwai Fong and Tsuen Wan areas, which are largely developed. The only major construction works in the area are for the LAR and Route 3 in Lai King. However, it is anticipated that construction works will be finished during the operation of West Rail and background air quality will be influenced mainly by vehicular emissions from the main roads. In the Kwai Fong and Tsuen Wan areas, air quality will be influenced by both vehicular and industrial emissions.

6.4.2.2 Potential Sources of Impact

Potential air quality impacts during the normal operation of West Rail will be limited since electric trains will be used and no exhaust gas will be produced. However, low levels of dust may be created by the abrasion and wear of track, electrical pick-up gear and rolling stock during normal operation and from maintenance activities. The amount of dust generated from such activities will be low and will have a negligible impact on the ASRs.

The used air inside the station and along the alignment will be emitted via the exhaust outlets or air ventilation systems. The pollutant levels of such emissions will be limited and adverse air quality impacts are therefore not expected.

Stations located underground or within box structure will need to be supplied with sufficient ventilation. Ventilation fans and louvers, or air ventilation systems, will be provided to ensure sufficient local air movement within the station concourse. Smoke extraction vents will also be provided in the event of fire. The design and orientation of vents will be such that discharges are directed away from the nearby sensitive receivers to avoid nuisance.

The public transport interchanges (PTI) are located more than 20 m from the ASRs, satisfying the Hong Kong Planning Standards and Guidelines (HKPSG) recommended buffer distances for trunk roads. Also, the realigned Lai Wan Road is located at more than 5 m from the ASRs, satisfying the HKPSG's buffer distance of 5 m for local roads. Adverse air quality impacts from the transport interchanges and re-aligned Lai Wan Road are therefore unlikely.

For Lai Wan Road, Nassau Road and Broadway Road, the traffic flow is low, i.e., 1000-1200 vehicles at peak hours. The concentration of pollutants are expected low. Therefore, the adverse air quality impacts from traffic is unlikely.

The profile of the LCK Park will be raised to incorporate the West Rail alignment. As the buffer distances of the Kwai Chung Road bridge will be maintained, it is expected that the air quality of the park remain be acceptable.

6.4.2.3 Recommended Mitigation

The ventilation systems should be designed such that discharges are directed away from nearby sensitive receivers to avoid nuisance.

6.4.2.4 Residual Impacts

Air quality impacts during the operational phase of West Rail are not considered to be of concern as limited potential sources have been identified. No residual impacts are anticipated.

6.5 Water Quality

This section provides a detailed assessment of the potential water quality impacts associated with construction and operation of the Central Section of West Rail. The construction and operation of the Central Section will generate wastewater that may cause adverse water quality impacts if not controlled. Reclamation will be required to provide land in Tsuen Wan Bay for the construction of the Tsuen Wan West Station and adjacent railway tunnels. The marine mud dredging and reclamation filling works will result in potential water quality and movement impacts on the Rambler Channel during construction and operational phases. The results of quantitative hydrodynamic and sediment plume modelling are reported below.

6.5.1 Construction Phase

6.5.1.1 Water Sensitive Receivers (WSRs)

The major water bodies along the alignment of the Central Section are:

- Victoria Harbour;
- Rambler Channel;

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

The locations of the WSRs are shown in *Figure 6.5a*.

6.5.1.2 Baseline Conditions

6.5.1.2.1 Victoria Harbour

Part of the Central Section falls within the western part of the Victoria Harbour Phase I WCZ, which is located to the west and north of the West Kowloon Reclamation. The baseline conditions in Victoria Harbour have been discussed in *Section 5.5*.

6.5.1.2.2 Rambler Channel

The water quality in Rambler Channel is fairly polluted with high levels of nutrients and *E. coli*, as reported in *Marine Water Quality in Hong Kong for 1995*, EPD (1996). The nearest water quality monitoring stations to the Central Section alignment are VM12 to VM14, and WM4. Station VM12 is located south of Stonecutters' Island, and is influenced by both the Rambler Channel and Victoria Harbour. Stations VM13 and VM14 are located within the Rambler Channel, while station WM4 is located east of Ma Wan, where there are active mariculture activities.

A summary of monitoring data (for 1996) for these four stations is given in *Table 6.5a*. The data indicate that the annual mean water quality of the Rambler Channel is generally acceptable, except for *E. coli* (1,633 per 100 ml to 571,767 per 100 ml with an annual mean of 65,092 at VM13). Water quality within the Channel is comparatively worse than at the Stonecutters' Island and Ma Wan routine monitoring stations.

Table 6.5a Summary Statistics of 1996 Water Quality of Victoria Harbour, Rambler Channel and Ma Wan

Determinant		Victoria Harbour	Rambler Channel		Ma Wan
		EPD Monitoring Station Number			
		VM12	VM13	VM14	WM4
Temperature (°C)	Surface	23.3	23.2	23.2	23.4
		(18.4 - 27.9)	(18.5 - 27.5)	(18.4 - 27.8)	(16.8 - 28.3)
	Bottom	22.8	22.9	23.0	22.5
		(18.4 - 27.5)	(18.4 - 27.4)	(18.4 - 27.3)	(16.8 - 28.1)
Salinity (ppt)	Surface	30.7	30.5	29.7	29.2
		(26.1 - 34.0)	(26.1 - 33.9)	(24.1 - 33.8)	(18.9 - 34.2)
	Bottom	32.4	32.0	31.5	32.8
		(29.9 - 34.1)	(28.9 - 34.0)	(27.7 - 34.2)	(30.9 - 34.2)

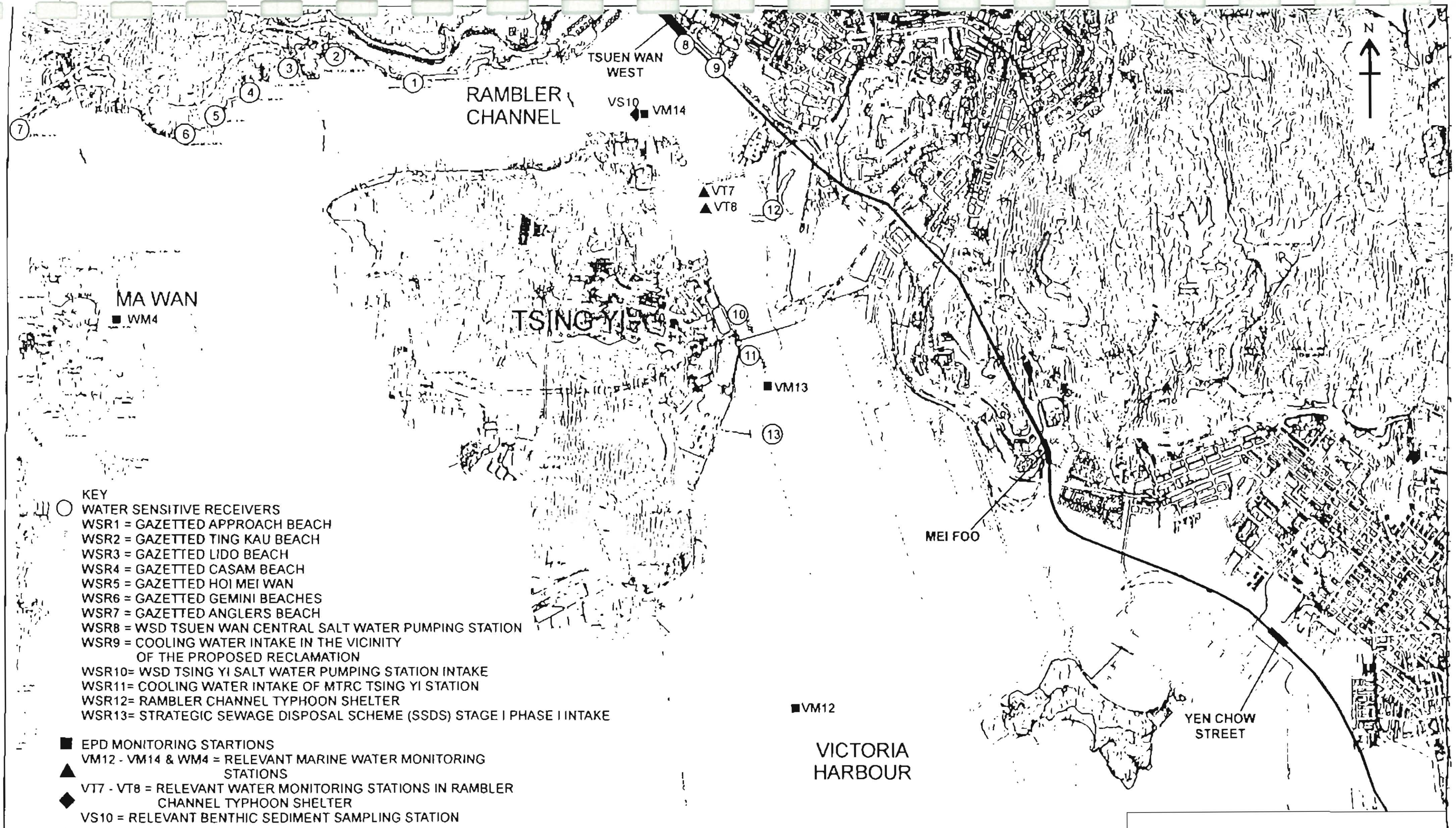

FIGURE 6.5a - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD MONITORING STATIONS

NOT TO SCALE

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Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
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Determinant		Victoria Harbour	Rambler Channel		Ma Wan
		EPD Monitoring Station Number			
		VM12	VM13	VM14	WM4
DO (% saturation)	Surface	71.7	68.0	70.0	81.2
		(52.3 - 101.7)	(46.2 - 81.2)	(51.7 - 94.3)	(60.4 - 100.2)
	Bottom	62.9	59.7	66.8	74.0
		(53.5 - 74.9)	(40.3 - 75.1)	(53.8 - 81.6)	(52.1 - 93.9)
DO (mg/l)	Surface	5.1	4.9	5.0	5.8
		(4.0 - 6.9)	(3.2 - 5.9)	(3.5 - 6.4)	(4.6 - 6.9)
	Bottom	4.5	4.3	4.9	5.3
		(3.7 - 5.7)	(2.8 - 5.6)	(3.6 - 5.9)	(3.6 - 6.8)
Suspended Solids (mg/l)		9.2	12.9	8.0	7.2
		(4.9 - 22.6)	(3.0 - 59.7)	(1.9 - 16.3)	(3.4 - 14.0)
Turbidity (NTU)		6.6	5.3	4.3	4.9
		(2.8 - 24.7)	(2.0 - 14.2)	(1.7 - 6.5)	(1.8 - 8.6)
pH value		7.9	7.9	7.9	8.1
		(7.7 - 8.1)	(7.7 - 8.0)	(7.8 - 8.1)	(7.8 - 8.3)
BOD_5 (mg/l)		0.8	1.2	0.9	0.4
		(0.5 - 1.4)	(0.6 - 2.7)	(0.5 - 2.5)	(0.2 - 1.0)
Ammonium N (mg/l)		0.25	0.30	0.21	0.09
		(0.10 - 0.36)	(0.04 - 0.75)	(0.03 - 0.43)	(0.01 - 0.17)
Total Kjeldahl N (mg/l)		0.42	0.67	0.35	0.26
		(0.20 - 0.50)	(0.29 - 1.50)	(0.15 - 0.46)	(0.11 - 0.34)
Total P (mg/l)		0.17	0.19	0.16	0.12
		(0.11 - 0.26)	(0.10 - 0.44)	(0.09 - 0.28)	(0.07 - 0.25)
E. coli (number per 100 ml)		6,423	10,650	5,189	160
		(1,633 - 160,667)	(1,633 - 571,767)	(697 - 42,033)	(30 - 1,133)

Notes:

1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for E. coli data which are geometric means.
3. Data enclosed in parentheses indicate ranges.

Source: EPD

6.5.1.2.3 Bathing Beaches

There are eight gazetted bathing beaches located within the Western Buffer WCZ including Anglers' Beach, Approach Beach, Casam Beach, Gemini Beach, Hoi Mei Wan Beach, Lido Beach, Ting Kau Beach and Tung Wan Beach, as shown in *Figure 6.5a*. A summary of EPD monitoring data (for 1996) of these gazetted bathing beaches in terms of *E. coli* count is given in *Table 6.5b*.

Table 6.5b Summary Statistics of 1996 Water Quality of Bathing Beaches within the Western Buffer Water Control Zone

Bathing Beaches	Turbidity	E. coli (number per 100 ml)
Anglers' Beach	6.8	485
	(1.3 - 27.0)	(8 - 6,928)
Approach Beach	10.7	1,097
	(2.6 - 50.0)	(130 - 9,798)
Casam Beach	10.8	376
	(4.5 - 25.0)	(30 - 5,000)
Gemini Beach	6.0	344
	(1.5 - 13.0)	(30 - 7,400)
Hoi Mei Wan Beach	4.9	306
	(1.5 - 10.0)	(67 - 1,960)
Lido Beach	12.3	426
	(3.2 - 33.0)	(23 - 2,670)
Tung Wan Beach, Ma Wan	6.8	48
	(1.2 - 20.0)	(4 - 632)
Ting Kau Beach	12.9	1,291
	(3 - 37)	(100 - 7,916)

Note:

1. Data presented for turbidity are annual arithmetic means, while those for *E. coli* are geometric means.
2. Data enclosed in parentheses indicate the ranges.

Source: EPD

The data indicate poor bacteriological water quality of the gazetted bathing beaches in the Western Buffer WCZ with very high *E. coli* counts, particularly at Approach and Ting Kau beaches. The annual means of the *E. coli* counts of the Approach and Ting Kau Beaches both exceeded the WPCO which stipulates an *E. coli* limit of 610 per 100 ml. Data for all other gazetted beaches in Western Buffer WCZ exceed the WPCO standards on occasions.

Although bathing beaches within the Western Buffer WCZ are located over 2 km from the west of the Tsuen Wan Bay reclamation area, potential water quality impacts on their beneficial uses for general amenity and secondary contact recreation are evaluated in the hydrodynamic and sediment plume modelling of the marine-based construction impact assessment.

The Ma Wan Fish Culture Zone (FCZ) is remote from the Central Section alignments (more than 5 km) so that impacts on it are not considered in the assessment.

6.5.1.2.4 Rambler Channel Typhoon Shelter

The Rambler Channel Typhoon Shelter is located between the Tsing Yi North Bridge and Tsing Yi Bridge over the Rambler Channel. The water quality of this typhoon shelter is well documented by routine EPD monitoring programmes at stations VT7 and VT8. A summary of EPD monitoring data for 1995 is given in *Table 6.5c*. The water quality of the Rambler Channel Typhoon Shelter is poor, with high BOD_5 levels and *E. coli* counts. The annual means of BOD_5 measured in 1995 at VT7 and VT8 were 2.4 mg l^{-1} and 1.4 mg l^{-1}, respectively, while the *E. coli* counts were 3,067 per 100 ml and 3,239 per 100 ml, respectively.

Table 6.5c Summary Statistics of 1995 Water Quality of Rambler Channel Typhoon Shelter

Determinant		Rambler Channel Typhoon Shelter	
		VT7	VT8
Number of samples		6	6
Temperature (°C)	Surface	23.1	23.1
		(18.2 - 26.9)	(18.1 - 27.0)
	Bottom	22.8	22.9
		(18.0 - 26.6)	(18.1 - 26.4)
Salinity (ppt)	Surface	30.9	30.7
		(25.3 - 33.7)	(23.7 - 33.7)
	Bottom	31.7	31.4
		(28.6 - 33.7)	(28.2 - 33.8)
DO (% Saturation)	Surface	56.3	57.8
		(41.9 - 67.6)	(43.9 - 73.8)
	Bottom	54.6	58.7
		(42.1 - 62.6)	(44.5 - 74.7)
DO (mg/l)	Surface	4.0	4.1
		(3.1 - 4.7)	(3.3 - 5.1)
	Bottom	3.9	4.2
		(3.1 - 4.6)	(3.4 - 5.2)
pH		7.9	7.8
		(7.8 - 8.0)	(7.8 - 8.0)
SS (mg/l)		12.7	15.8

Determinant	Rambler Channel Typhoon Shelter	
	VT7	VT8
Number of samples	6	6
	(6.6 - 24.0)	(7.2 - 26.0)
Turbidity (NTU)	5.3	5.9
	(2.5 - 8.4)	(2.4 - 10.8)
BOD_5 (mg/l)	2.2	1.1
	(0.7 - 5.8)	(0.9 - 1.3)
Ammoniacal Nitrogen	0.39	0.26
(mg/l)	(0.15 - 0.64)	(0.08 - 0.45)
Total Kjeldahl Nitrogen	1.18	0.84
(mg/l)	(0.71 - 2.30)	(0.60 - 1.23)
Total Phosphorus (mg/l)	0.23	0.18
	(0.15 - 0.48)	(0.11 - 0.22)
E. coli (number per 100 ml)	5,482	8,208
	(2,333 - 48,333)	(2,600 - 52,333)

Note:

1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for E. coli data which are geometric means.
3. Data enclosed in brackets indicate ranges.

Source: EPD (1996), Marine Water Quality in Hong Kong for 1995.

6.5.1.2.5 Water Intakes along the Rambler Channel

In the vicinity of the reclamation and the surrounding area of the Rambler Channel, there are a number of salt water pumping stations and associated cooling and flushing water intakes which supply coolant sea water to air conditioning systems and water-closet flushing water to the Tsuen Wan and Kwai Chung areas.

There is one WSD flushing water intake (the WSD Tsuen Wan Central Salt Water Pumping Station) and a cooling water intake located in the vicinity of the reclamation area. These will require relocation because of the West Rail development. Other more remote cooling water intakes along the Rambler Channel include an oil depot pump house located on the north shore of Tsing Yi Island and the Kwai Chung Incinerator.

The locations of these intakes are shown in *Figure 6.5a*.

These sea water intakes could be impacted by increases in SS and associated siltation problems, particularly the intakes of the WSD salt water pumping station used for toilet flushing. WSD has specified water quality standards at intake points of salt water pumping stations for toilet flushing. The standards for SS and DO are less than 10 mg/l and greater than 2 mg/l, respectively. Other relevant assessment criteria were described in *Section 3.4* of this report.

6.5.1.2.6 Marine Sediment Quality of Tsuen Wan Bay

Discharges from industrial activities, namely textile and printed circuit board manufacturers and electroplating industries in the Tsuen Wan and Kwai Chung area, have resulted in high levels of chromium, zinc and copper in marine sediments in Rambler Channel.

The marine sediment quality of the Rambler Channel is also well documented by the EPD's routine marine sediment monitoring programme. The nearest marine sediment monitoring location, VS10, is located in the vicinity of Tsuen Wan Bay where reclamation will be carried out for the construction of the Tsuen Wan West Station. A summary of the EPD's monitoring data (for 1996) for station VS10 and the levels of contamination are given in *Table 6.5d.*

The marine sediment quality data indicate that sediments in Tsuen Wan Bay are primarily classified as Class C and therefore are seriously contaminated. Appropriate marine sediment management and disposal arrangements will be required for any dredging activities to be conducted in Tsuen Wan Bay.

Table 6.5d Summary Statistics of 1996 Marine Sediment of Tsuen Wan Bay

Determinant	Tsuen Wan Bay in the Rambler Channel EPD Monitoring Station No. VS10	
	Bulk	<63 m
As (mg/kg)	4.7	9.6
	(1.8 - 8.5)	(7.3 - 12.0)
Cd (mg/kg)	0.6	0.9
	(0.1 - 1.5)	(0.2 - 1.5)
Cr (mg/kg)	***94***	***147***
	(31 - 220)	***(100 - 210)***
Cu (mg/kg)	***282***	***443***
	(70 - 680)	***(280 - 650)***
Hg (mg/kg)	0.08	0.20
	(0.03 - 0.18)	(0.01 - 0.55)
Ni (mg/kg)	***45***	***63***
	(12 - 110)	***(38 - 100)***
Pb (mg/kg)	37	73
	(17 - 64)	(69 - 81)
Zn (mg/kg)	***123***	***213***
	(49 - 290)	***(160 - 270)***

Determinant	Tsuen Wan Bay in the Rambler Channel	
	EPD Monitoring Station No. VS10	
	Bulk	<63 m
COD (mg/kg-O_2)	12,933	15,367
	(5,880 - 25,000)	(6,100 - 22,000)
PCBs (g/kg)	24	8
	(14 - 34)	(5 - 11)
PAHs (g/kg)	144	62
	(59 - 228)	(40 - 83)

Notes:

1. Data presented are annual arithmetic means.
2. Data enclosed in parentheses indicate the ranges.
3. Refer to the EPD's Technical Circular No. 1-1-92 metal contamination classification for sediment -

   Class A: Uncontaminated material — Normal

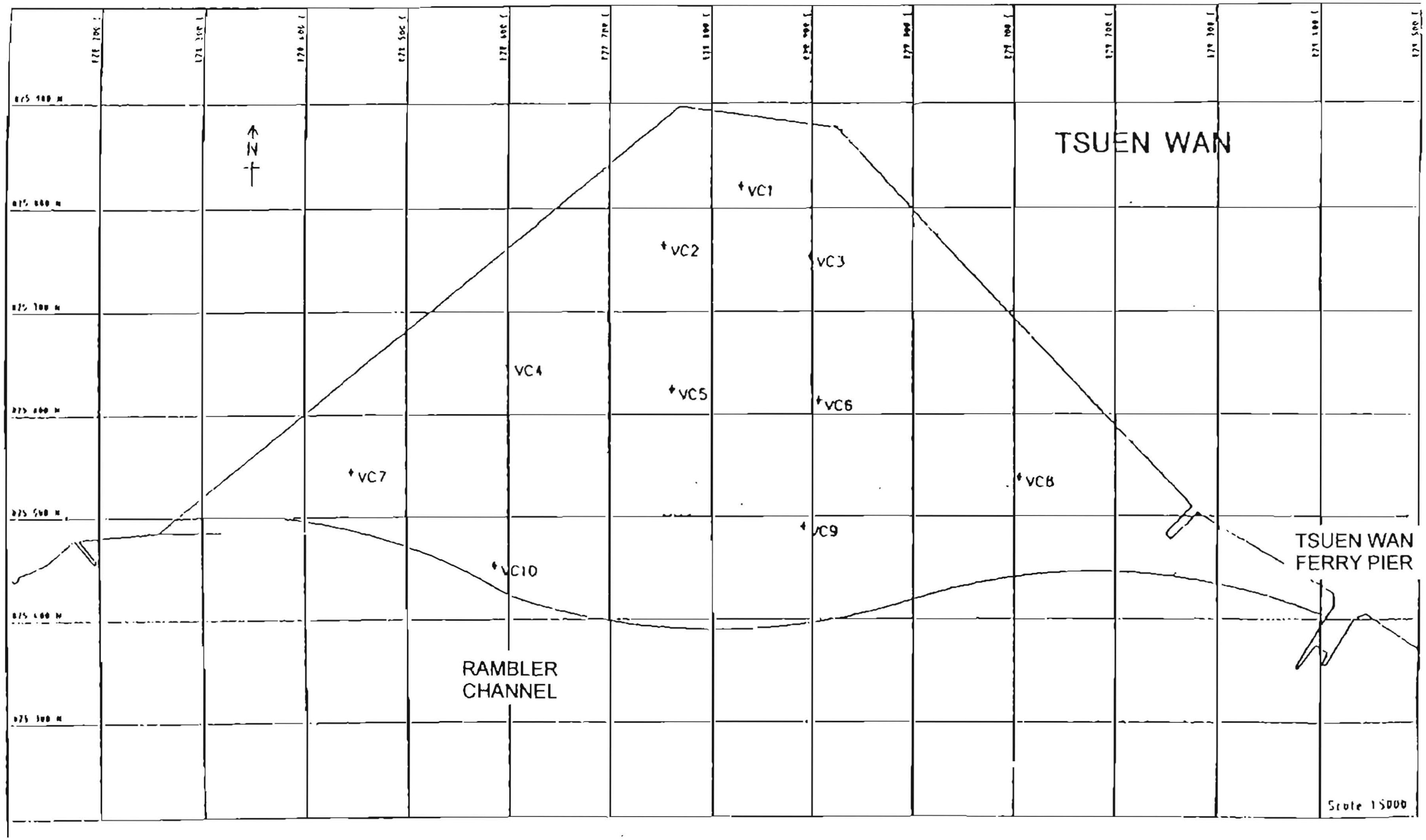
   Class B: Moderately contaminated material — Underlined

   Class C: Seriously contaminated material — Bold and Italics
4. No contamination classification criteria for As, PCBs, PAHs and COD.

Source: EPD

6.5.1.2.7 Sediment Testing for Tsuen Wan Bay Further Reclamation Area 35

The results of the heavy metal analysis for the Tsuen Wan Bay vibrocore samples are extracted from the *Tsuen Wan Bay Further Reclamation Area 35 Site* (TWBFR) *Investigation Report* and shown in *Table 6.5e*. Locations of the TWBFR vibrocore sampling stations are shown in *Figure 6.5b*. The TWBFR area, which is located adjacent to the West Rail reclamation site at Tsuen Wan Bay, was reported to have serious contamination with heavy metals (i.e. exceeding the Class C criteria) to depths of 2 to 3 m below the seabed on the coast of Tsuen Wan Bay.



KEY:
VC1 - VC10 VIBROCORE SEDIMENT SAMPLING LOCATION

FIGURE 6.5b - LOCATION OF SEDIMENT SAMPLING SITES FOR TSUEN WAN BAY FURTHER RECLAMATION, AREA 35

ERM-Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

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Table 6.5e Contamination of Marine Mud at Tsuen Wan Bay Further Reclamation Area 35

Vibrocore Location	Depth of Sampling below Seabed (m)	Contamination Classification Based on Heavy Metal Analysis							
		Cr	Cu	Ni	Pb	Zn	Hg	Cd	Overall Classification
VC1	0.0 - 0.1	C	C	C	C	C	A	C	C
	0.9 - 1.0	C	C	C	C	C	A	C	C
	1.9 - 2.0	C	B	A	C	C	A	C	C
	2.9 - 3.0	A	A	A	A	A	A	A	A
	5.9 - 6.0	A	A	A	A	A	A	A	A
	6.9 - 7.0	A	A	A	A	A	A	A	A
VC2	0.0 - 0.1	C	C	C	C	C	A	C	C
	0.9 - 1.0	C	C	C	C	C	A	B	C
	1.9 - 2.0	B	A	A	C	A	A	A	C
	2.9 - 3.0	C	B	A	C	C	A	C	C
	5.9 - 6.0	A	A	A	A	A	A	A	A
	8.9 - 9.0	A	A	A	C	A	A	A	C
	11.4 - 11.5	A	A	A	C	B	A	A	C
VC3	0.0 - 0.1	C	C	C	C	C	B	C	C
	0.9 - 1.0	C	C	A	C	C	C	C	C
	1.9 - 2.0	A	A	A	C	A	A	A	C
	2.9 - 3.0	A	A	A	A	A	A	A	A
	5.9 - 6.0	A	A	A	A	A	A	A	A
	8.9 - 9.0	A	A	A	C	A	A	A	C
VC4	0.0 - 0.1	C	C	C	C	C	A	B	C
	0.9 - 1.0	A	C	A	C	A	A	A	C
	1.9 - 2.0	C	C	C	C	C	A	B	C
	2.9 - 3.0	A	A	A	A	A	A	A	A
	5.9 - 6.0	A	A	A	A	A	A	A	A
	8.9 - 9.0	A	A	A	A	A	A	A	A
	0.0 - 0.1	C	C	C	A	C	A	B	C
	0.9 - 1.0	C	C	C	C	C	A	C	C

Vibrocore Location	Depth of Sampling below Seabed (m)	Contamination Classification Based on Heavy Metal Analysis							
		Cr	Cu	Ni	Pb	Zn	Hg	Cd	Overall Classification
VC5	1.9 - 2.0	C	C	C	C	C	A	B	C
	2.9 - 3.0	C	C	A	C	C	C	C	C
	5.9 - 6.0	A	A	A	A	A	A	A	A
	8.9 - 9.0	A	A	A	A	C	A	A	C
VC6	0.0 - 0.1	C	C	C	A	B	A	A	C
	0.9 - 1.0	C	C	C	B	C	A	C	C
	1.9 - 2.0	C	C	C	C	C	A	C	C
	2.9 - 3.0	C	C	A	A	A	A	A	C
	5.9 - 6.0	A	A	A	B	A	A	A	B
VC7	0.0 - 0.1	C	C	C	B	C	A	B	C
	0.9 - 1.0	A	A	A	A	A	A	A	A
	1.9 - 2.0	A	A	A	A	A	A	A	A
	2.9 - 3.0	A	A	A	C	A	A	A	C
	5.9 - 6.0	A	A	A	A	A	A	A	A
VC8	0.0 - 0.1	C	C	C	C	C	A	C	C
	0.9 - 1.0	C	C	C	C	C	A	C	C
	1.9 - 2.0	C	C	C	C	C	A	B	C
	2.9 - 3.0	A	A	A	A	A	A	A	A
	5.9 - 6.0	A	A	A	A	A	A	A	A
	8.9 - 9.0	A	A	A	A	A	A	A	A
VC9	0.0 - 0.1	A	A	A	C	A	A	A	C
	0.9 - 1.0	A	A	A	A	A	A	A	A
	1.9 - 2.0	A	A	A	A	A	A	A	A
	2.9 - 3.0	A	A	A	A	A	A	A	A
	5.9 - 6.0	A	A	A	B	A	A	A	B
VC10	0.0 - 0.1	C	C	C	C	C	A	B	C
	0.9 - 1.0	A	A	A	A	A	A	A	A
	1.9 - 2.0	A	A	A	A	A	A	A	A
	2.9 - 3.0	A	A	A	B	A	A	A	B

Vibrocore Location	Depth of Sampling below Seabed (m)	Contamination Classification Based on Heavy Metal Analysis							
		Cr	Cu	Ni	Pb	Zn	Hg	Cd	Overall Classification
	5.9 - 6.0	A	A	A	B	A	A	A	B

Notes:

1. Refer to the EPD's Technical Circular No. 1-1-92 metal contamination classification for sediment -

- Class A: Uncontaminated material — Normal
- Class B: Moderately contaminated material — Underlined
- Class C: Seriously contaminated material — Bold and Italics

Source: TDD (May 1995), Site Investigation Report Issue 1, Tsuen Wan Bay Further Reclamation Area 35.

6.5.1.2.8 Detailed Design Stage Sediment Testing for the West Rail Reclamation

Site investigations to collect vibrocore marine sediment samples (100 mm long sub-samples tested at seabed, 0.9 m, 1.9 m, 2.9 m and then every 3 m until the dredge depth is reached) will be conducted at the detailed design stage by the engineering Design Consultants, approximately every 100 m along the proposed seawall with reference to the *WBTC No. 22/92, Marine Disposal of Dredged Mud,* to determine the degree of heavy metal contamination of the sediment, to confine the dredging and filling operations, and to identify a suitable disposal site for the dredged material. Site specific sediment testing for the reclamation will be reported at the detailed design stage in the Sediment Quality Report to be produced by the engineering Design Consultants.

6.5.1.3 Potential Sources of Impact

6.5.1.3.1 Marine-based Construction Impact

Potential sources of impacts on water quality from the marine-based construction works of the Central Section are the disturbances to marine sediments at Tsuen Wan Bay during dredging, and elevated SS concentrations and associated impacts from reclamation filling activities.

If the majority of the contaminated marine sediments are left in situ undisturbed after dredging the seawall, they may still release contaminants into the water column. These may be contained in pore water being forced out of the sediments during site formation, sediment compaction and consolidation.

Following dredging work, fill material will be deposited. Since the fill material used during the reclamation filling works will meet the EPD criteria for uncontaminated material, the potential water quality impacts associated with sand filling will be limited to the temporary elevation of SS at the receiving water bodies.

6.5.1.3.2 Land-based Construction Impact

Potential sources of the land-based construction impact could include the following:

- Construction runoff and drainage including dewatering operations;
- Runoff from tunnelling works (cut-and-cover and drill-and-blast tunnelling);
- Runoff from station construction works;
- Runoff from general construction activities; and
- Sewage effluents generated from the construction work force.

6.5.1.4 Prediction of Impacts

6.5.1.4.1 Marine-based Construction Impact

The waterfront at the Tsuen Wan Ferry Pier will be reclaimed to provide land for the construction of the Tsuen Wan West Station. During site formation, prior to reclamation, dredging of marine sediments will be required in certain areas. Dredging will inevitably elevate levels of SS in areas immediately adjacent to the dredging. It may also lead to the potential release of heavy metals from the sediments as they are seriously contaminated.

The depth of the seabed within the proposed reclamation area is shallow, ranging from 2 to 8 m. Although it is presently envisaged that the majority of the contaminated mud may be left in place to minimise disturbance to the marine environment (only dredging for seawall construction is proposed) , it is likely that some marine mud will still be dredged along the line of the Tsuen Wan West Station seawalls for geotechnical stability purposes.

The level of oxygen saturation is of particular concern as elevated sediment suspension levels can lead to oxygen depletion in the water column. This arises as reduced light penetration reduces photosynthesis and thus the rate at which oxygen is produced in the water column. In addition, the associated decrease in primary production reduces the uptake of nutrients from the water column. Similarly, the increase in SS in the water column results in more energy from sunlight being retained, which increases the temperature. This also acts against oxygen levels as oxygen is more soluble in colder water. Therefore, special dredging practices, and handling and disposal methods, are necessary to reduce SS dispersion.

Potential impacts on water quality from dredging and disposal of marine mud will vary according to the quantities and level of contamination, as well as the nature and locations of the WSRs at or near the dredging and disposal sites. These impacts may include:

- Release of previously bound organic and inorganic constituents such as heavy metals, PAHs, PCBs, ammonia, sulphides and nutrients into the water column, either via suspension or by disturbance from turbulent flow or mud waves as a result of dredging activities, disposal of mud, or depositing fill materials;

- Release of contaminants from pore water and leachate forced out of sediments as a result of compaction or settlement during site formation;
- Release of the same contaminants due to leakage and spillage as a result of poor handling and overflow from barges during dredging and transport; and
- Suspension of solids in the water column during dredging activities and marine sediment dumping activities, with the likely consequence of reducing DO levels and increasing nutrient levels.

All of the above can result in deterioration of the receiving marine water quality and may have adverse effects on WSRs.

Uncontaminated marine sand will be used as filling materials, as discussed earlier in this section, so the potential water quality impact associated with sand filling will be limited to elevated SS levels.

Sediment Pore Water

In areas where marine sediments are not dredged and left in place, pore water may be forced out of the sediment matrix during compaction and consolidation, resulting in the release of contaminants into the water column.

Based on the results of the pore water analysis presented in *Central Reclamation Phase III* (CRIII), TDD (1997), pore water contains relatively much lower concentrations of heavy metals than marine mud. Heavy metals such as mercury, cadmium and copper are strongly chemically associated with the clay fraction and organic material in the sediments and thus do not readily enter the sediment pore water. It is therefore considered that the impact on the receiving waters from expelled pore water contamination is not a key concern, which will be subjected to further review at the detailed design stage when the Sediment Quality Report is available.

Temporary Relocation of Water Intakes

Two existing water intakes will be temporarily relocated during the construction phase, (*Figures 6.5d to 6.5f*) including:

- A cooling water pumping station intake located west of the existing Tsuen Wan Ferry Pier; and
- The WSD Tsuen Wan Central Salt Water Pumping Station intake.

The salt water intake systems are vulnerable to high SS concentrations in the water column, which may silt up the pipes and cause excessive wear to water pumps. Reprovisioning of the WSD's Tsuen Wan Central Pumping Station Intake and the cooling water intake in the vicinity of the West Rail reclamation is necessary. The schedule for reprovisioning of these intakes has not been finalised. It is anticipated that temporary salt water and cooling water intakes will begin to operate at Stage 2 of the reclamation (that is, between March 1999 and August 1999).

It is important that water quality at the intakes is maintained after temporary relocation. The final positions and lengths of the temporarily relocated intakes will be subject to the water modelling sensitivity analysis results reported in this section and the finalised reclamation layout plan.

Stormwater Culverts

There are two stormwater outfalls, Tai Ho box culvert and Ma Tau Pa box culvert, located in the vicinity of the West Rail reclamation area (*Figures 6.5d to 6.5f*). The Tai Ho box culvert is a four-cell concrete culvert with the outfall (*Figure 6.5f*) located at the semi-circular landing steps, while the Ma Tau Pa box culvert is a three-cell concrete culvert located to the east of the West Rail reclamation area. The existing stormwater outfalls at Tsuen Wan Bay, which will be affected by the West Rail reclamation works, will be reprovisioned and subsequently extended to the new seawall (*Figures 6.5d to 6.5f*). The relocations are currently expected to commence in November 1998.

Based on site visits since January 1997, the discharges from both stormwater culverts appear to be polluted with wastewater from the market, with the Ma Tau Pa box culvert apparently the more polluted. No identification of these contaminants has been attempted, but the discharge appears to be highly discoloured, with high SS, and was odorous, so that expedient connection of a polluted source is suspected. These stormwater culverts will be extended through the reclamation and must have temporary diversions during construction of the extensions.

Elimination of expedient connections to reduce the pollution loading on the stormwater system is described in the Tsuen Wan, Kwai Chung and Tsing Yi Sewerage Master Plan Study. The study recommended the provision of a system of gravity sewers and sewage pumping mains along the Castle Peak Road for sewage collection. As advised by the consultants undertaking sewerage improvement projects in the Tsuen Wan and Kwai Chung area, sewerage improvement works are scheduled to be completed by the end of 1997. Upon completion of these projects, more than 90% of the pollution loads should be removed from the stormwater drainage system.

Concurrent Projects

Other projects in the Rambler Channel area, including the construction of the Ting Kau bridge, CT9 and north Tsing Yi GIC facilities, may cause additional construction water quality impact on the WSRs, depending on project timing. Tsuen Wan Bay (Area 35) reclamation is scheduled to commence in 2002, that is, after the completion of reclamation for Tsuen Wan West Station.

6.5.1.4.2 Land-based Construction Impacts

Construction Runoff and Drainage

Construction Runoff

Runoff from construction sites may contain increased loads of SS and other contaminants. Potential sources of water pollution from site runoff include:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;
- Bentonite slurries and other grouting materials;
- Wastewater from concrete batching plants and dewatering activities;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

Construction runoff and drainage may cause physical and biological effects. The possible impacts on the WSRs arising from the construction runoff and drainage have been detailed in *Section 5.5*.

Drainage

Diversion and relocation of storm water drains are required in the alignment of Central Section, particularly the Tsing Tsuen Tunnels which will intersect the Kwai Chung Nullah at Kwai Chung Road. Any drainage modifications or relocation should ensure that the flow of the drainage channels is maintained and no reduction in the hydraulic capacity eventuates if construction work within the nullah or channel is required.

The Stormwater Drainage Master Plan Study in Tsuen Wan, Kwai Chung and Tsing Yi is currently being undertaken by DSD. Any drainage modifications arising from the Central Section will be incorporated into this Stormwater Drainage Master Plan, subject to the agreement of DSD.

Runoff from Tunnelling Works

Cut-and-Cover Tunnelling

It is currently proposed that the Central Section alignment will be constructed using both cut-and-cover and drill-and-blast tunnelling methods.

It is currently proposed that the Mei Foo Station, Kwai Fuk Road and Tsuen Wan West Station will be constructed using cut-and-cover methods. During wet periods, rainfall and surface runoff entering exposed cut-and-cover tunnel sections or blown through entrances or ventilation shafts, and ground water seepage through construction joints, could lead to construction runoff with high SS content. Thus mitigation should be designed to reduce the influx of rainwater into the exposed cut-and-cover works areas.

Bentonite will be required during cut-and-cover tunnelling for diaphragm walls, and as a result runoff may be contaminated with bentonite or other grouting materials. Therefore, bentonite use will require appropriate management, collection and disposal practices to ensure that no unacceptable impacts arise.

There is also potential for contamination of groundwater, depending on the depth of the cut-and-cover tunnel sections, the relationship with the water table height, and the geological features along the tunnel route. As the alignment will be constructed within the area of the West Kowloon Reclamation and in the vicinity of Tsuen Wan Bay (West Rail) Reclamation, it is considered that only in areas where marine deposits have not been removed and 1 m above or below the marine deposits will there be the potential for groundwater to be polluted by the potentially heavy metal contaminated marine deposits left *in situ* during the reclamation filling. However, heavy metals such as mercury, cadmium and copper are strongly chemically associated with the clay fraction and organic material in the sediments and thus do not readily enter the sediment pore water. Recorded TOC contents of 0.2 - 9.0% represent a high amount of organic matter in the bottom sediment of Victoria Harbour. This organic matter plays an important role in binding of trace metals and organic micropollutants through sorption and/or complexation. Thus the high recorded TOC content would indicate that pollutants in any remaining marine deposits are likely to be less available to enter the sediment pore water. Therefore, in view of the relatively low levels of available contaminant in the pore waters, it is considered that the impact on the receiving waters from polluted groundwater will be minimal and expelled pore water contamination is not considered to be a key concern. However, it is considered prudent to assess the heavy metal pollution concentration of the groundwater within the range of 1 m above and 1 m below the layer of marine deposits, by on-site chemical testing. If it is determined to be polluted (other than by silt) it should only be discharged after appropriate treatment to achieve compliance with the WPCO TM.

On-site groundwater monitoring has been undertaken at different locations of the Central Section and the complete results are not yet available. It is possible that weathered granite aquifers may be intersected by the advancing of the Tsing Tsuen Tunnel. In these areas, there is a potential for significant inflows into the tunnel in the absence of adequate advance ground treatment.

Excavated material being used as backfill for the cut-and-cover works will require temporary storage on site. Runoff from the temporary storage area may result in siltation or blockage of receiving drainage channels and localised deterioration in water quality.

Drill-and-Blast Tunnelling

Drill-and-blast tunnelling is presently proposed for the Ha Kwai Chung tunnels, Tsing Tsuen Tunnel and Tai Lam Tunnel (TLT). These tunnels would be entirely confined and isolated underground, and would have limited potential to cause water quality impacts. However, runoff could result from the few areas that are accessible to rainwater, including the plant access portals. At these locations silt traps will be required to prevent discharge of silty runoff from the construction areas.

The Ha Kwai Chung tunnels will be excavated under the Ha Kwai Chung Service Reservoir and Ha Kwai Chung nullah. The alignment beneath these facilities will pose a risk of water inflows to the tunnels from either the Service Reservoir or the ground water table if uncontrolled or improper blasting or drilling operations are used.

Water quality impacts from drill-and-blast tunnelling will include the discharge of water containing SS, so wastewater from drilling will require treatment to reduce SS loads, by settlement, prior to disposal.

The potential contamination of runoff and ground water during tunnelling activities, probing ahead and grouting will be similar to the cut-and cover tunnelling and would require appropriate collection and disposal methods to ensure that no unacceptable water quality impacts arise.

Runoff from Station Construction

Construction of the Mei Foo and Tsuen Wan West Stations will comprise cut-and-cover excavation works. The Tsuen Wan West Station will be constructed on the proposed reclamation area, so that there is potential to require removal of the seriously contaminated marine sediments which are left in place beneath the filled reclamation area, depending on the depth of the open cut excavation area.

Station construction works will generate materials requiring removal and disposal. Excavated material being used as backfill for the cut-and-cover works will require temporary storage on site. The potential water quality impact of runoff from the temporary storage area has been discussed above. Stockpiling of excavated contaminated sediments should not be allowed on-site. Special handling and disposal methods will be required.

Runoff from General Construction Activities

General construction activities have the potential to cause water pollution from debris and rubbish, such as packaging and used construction materials, entering the water column and resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of the receiving water body. Spillage of liquids stored on site, such as oil, diesel and solvents, could also result in water quality impacts if they enter surrounding water bodies and soils.

The effects on water quality from these construction activities are likely to be minimal, provided that site boundaries are well maintained and good construction practice is observed to ensure that litter, fuels and solvents are managed, stored and handled properly.

Sewage Effluents

Sewage effluents will arise from sanitary facilities provided for the on-site construction work force for the Central Section and these have the potential to cause water pollution. Sewage is characterised by high levels of biochemical oxygen demand (BOD), ammonia and *E. coli* counts.

Construction work force sewage is expected to be connected to the existing trunk sewer or sewage treatment facilities. However, the construction workers are likely to be dispersed along the Central Section alignment such that the installation of portable toilets and the proper disposal of construction work force sewage are necessary to ensure that discharge standards are met.

6.5.1.5 Evaluation of Impacts

The construction of West Rail should not be allowed to cause any further deterioration of the existing condition of the Victoria Harbour Phase I WCZ or Western Buffer WCZ, if beneficial uses are to be maintained.

6.5.1.5.1 Marine-based Construction Impact

Sediment Plume Model

The TELEMAC-3D sediment plume model was designed to simulate the processes of transport, deposition and re-erosion for narrow sediment plumes formed during dredging or filling activities and was therefore adopted for this study (*Figure 6.5c*).

Modelling Assumptions and Methodology

Based on the information given by the engineering Design Consultants, the likely time for worst case concurrent working would occur during Stage 2 of construction, when dredging would occur in Area A4(1) concurrently with filling in Areas A4(2) and A2 (*Figures 6.5d, e, and f*). At each of these locations, sediment was released into the sediment plume model and identified as release points (*Figure 6.5g*). The rate of filling was taken to be 15,000 m^3 per day and dredging was assumed to be 1,000 m^3 per day for the duration of the 16-hour working day. It was assumed that the dry density of sand filling material would be 1,700 kg/m^3 with a loss of fine sediment to suspension of 0.69%, leading to a loss rate for filling by bottom dumping of 3.05 kg/s. For dredging by grab dredger, assuming a dry density of 488 kg/m^3 and a loss rate of 5%, the loss rate for dredging was calculated to be 0.42 kg/s. These rates were incorporated into the model by representing each release point as a circular area of 20 m radius with a Gaussian distribution of loss to suspension over this area. The release of sediment into suspension was always at the surface so that settling of the sediment in the immediate vicinity of the release points was limited to provide a worst case simulation. The combined dredging and filling scenario was simulated for the dry season spring tide and the wet season neap tide.

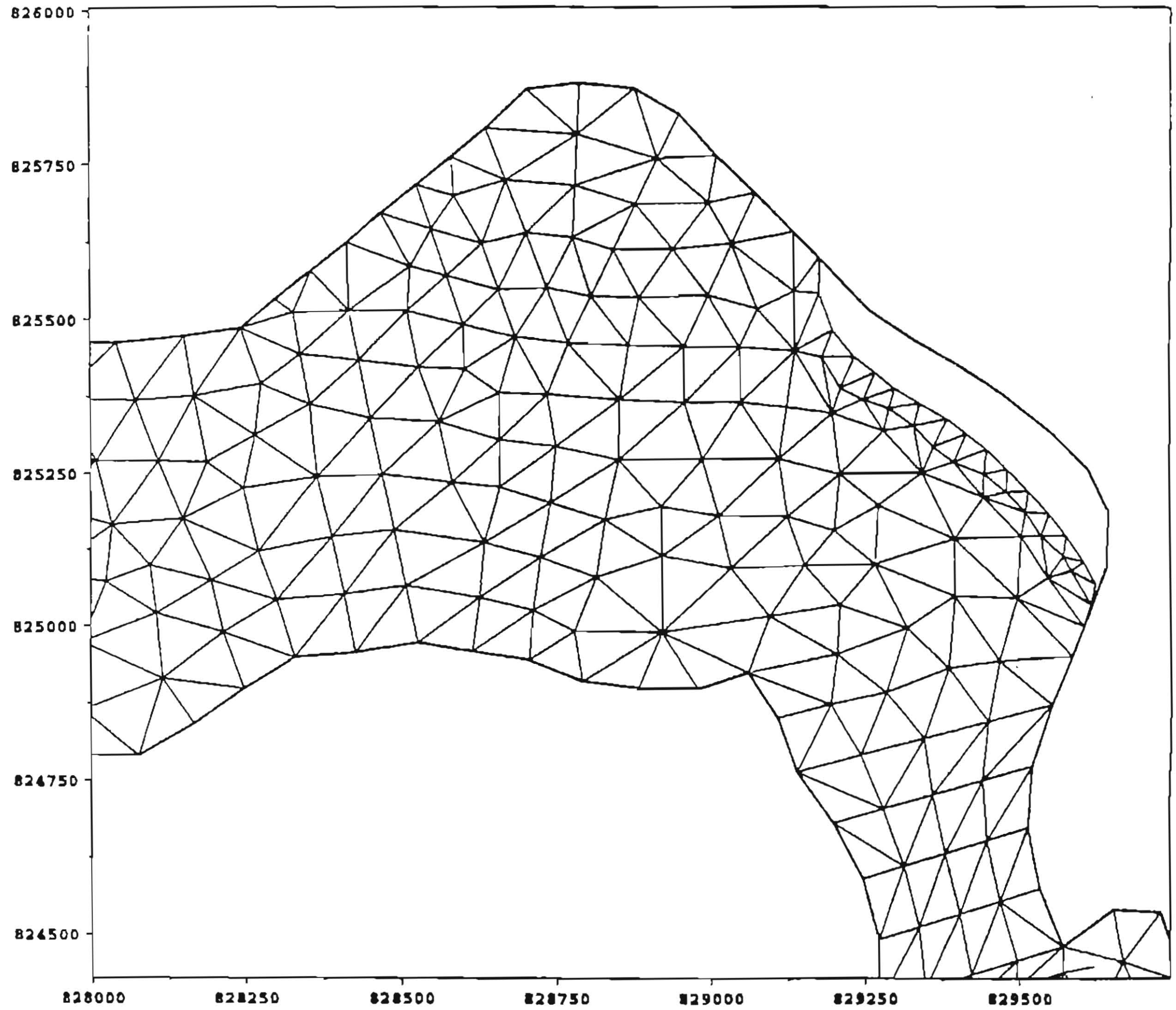

FIGURE 6.5c - USED SEDIMENT PLUME MODEL MESH IN AREA OF KCRC RECLAMATION

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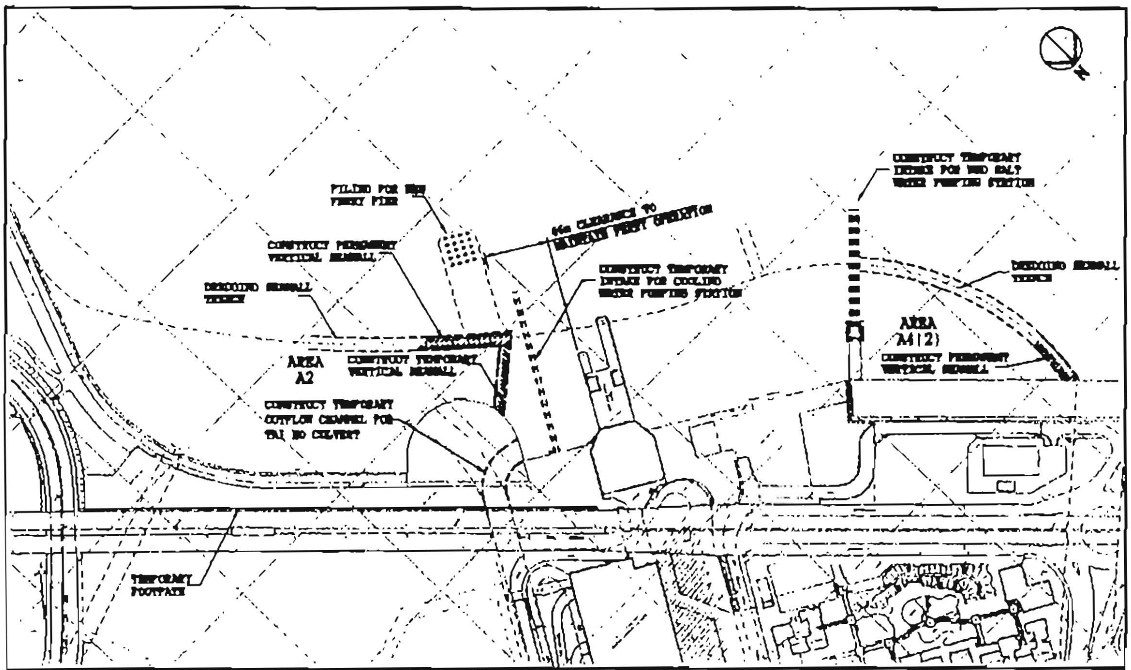
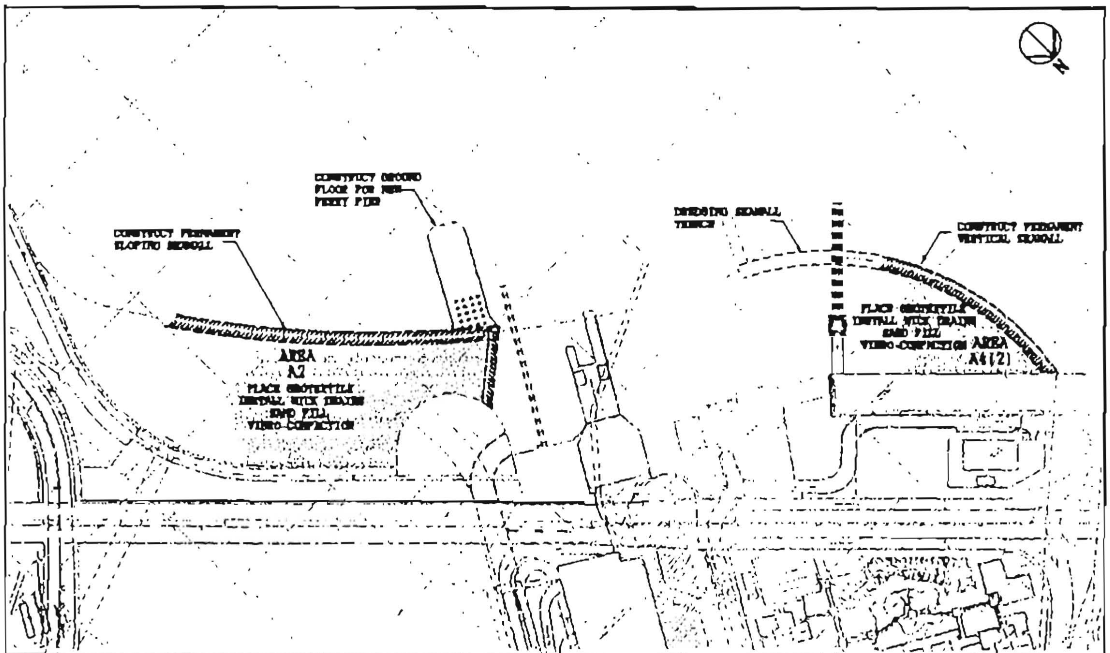


STAGE 1 OF TSUEN WAN BAY RECLAMATION



STAGE 2 OF TSUEN WAN BAY RECLAMATION

FIGURE 6.5d - STAGE 1 AND 2 OF TSUEN WAN BAY RECLAMATION

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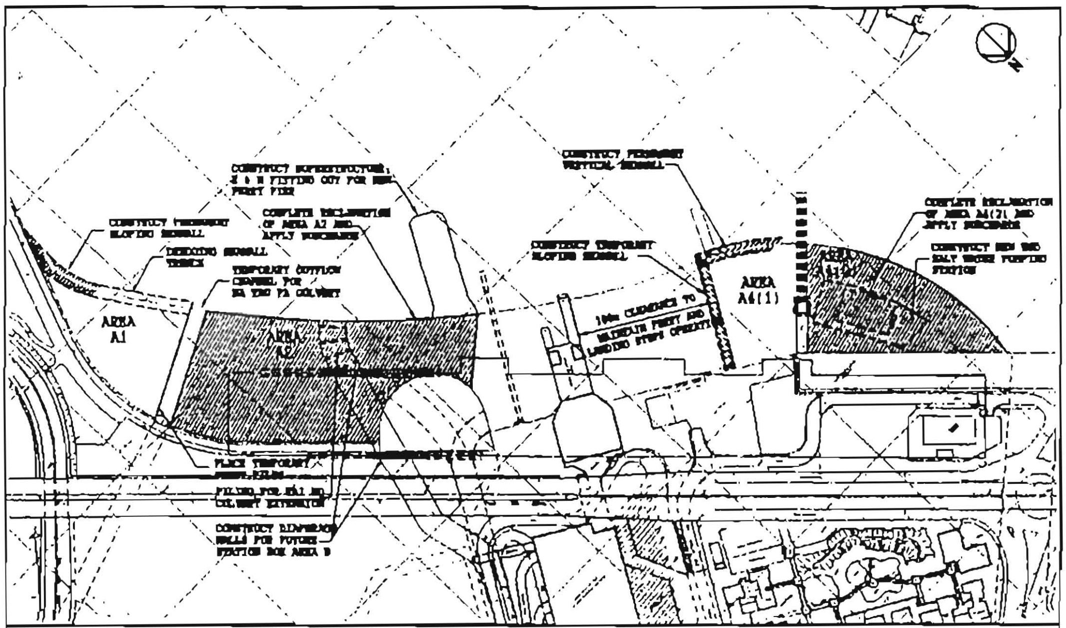
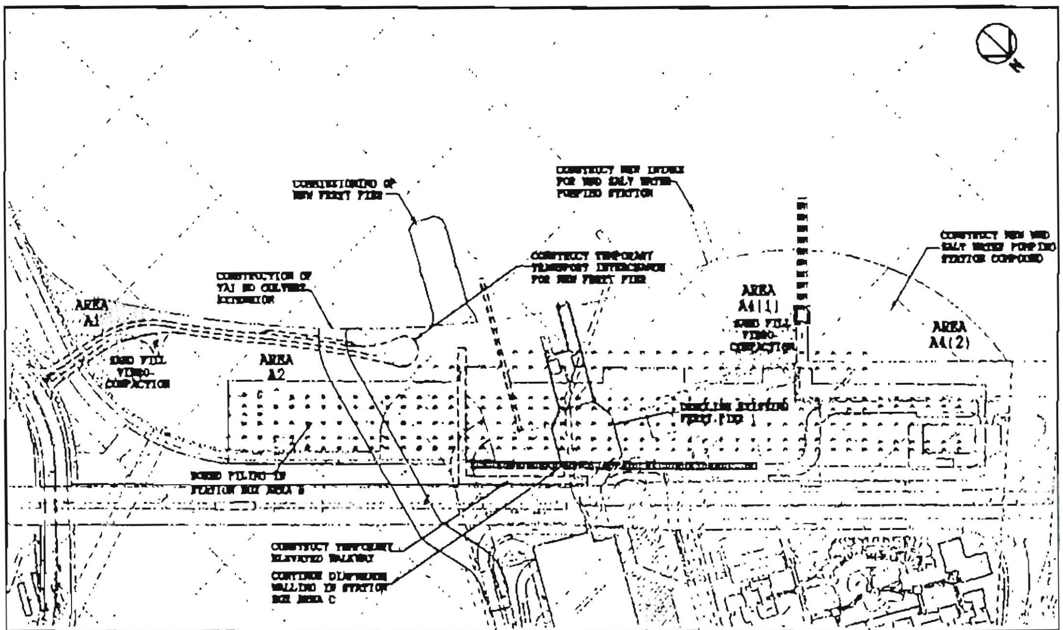


STAGE 3 OF TSUEN WAN BAY RECLAMATION



STAGE 4 OF TSUEN WAN BAY RECLAMATION

FIGURE 6.5e - STAGE 3 AND 4 OF TSUEN WAN BAY RECLAMATION

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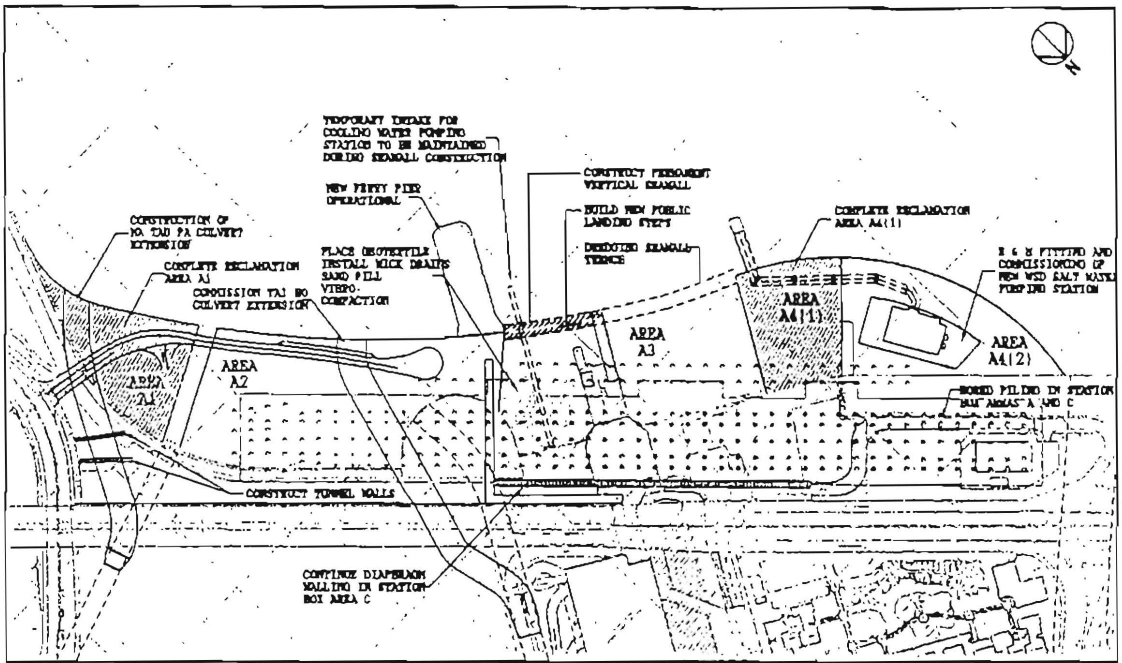
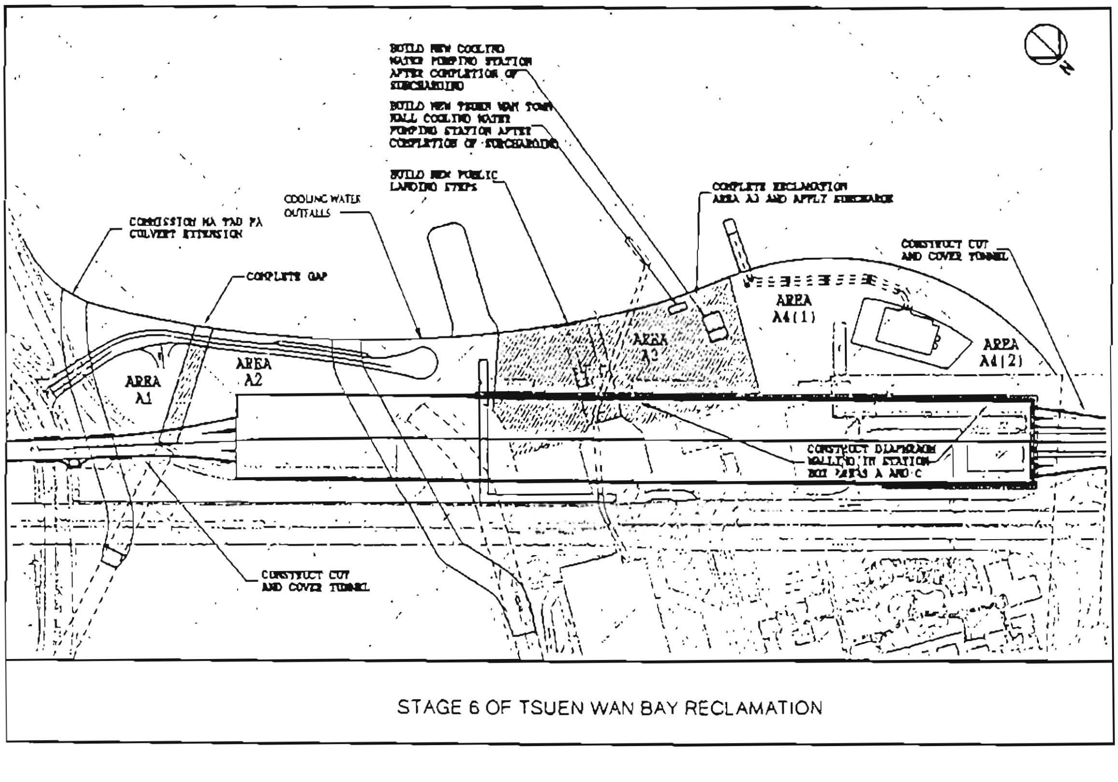


STAGE 5 OF TSUEN WAN BAY RECLAMATION



STAGE 6 OF TSUEN WAN BAY RECLAMATION

NOT TO SCALE

STAGE 5 AND 6 OF TSUEN WAN BAY RECLAMATION

FIGURE 6.5f

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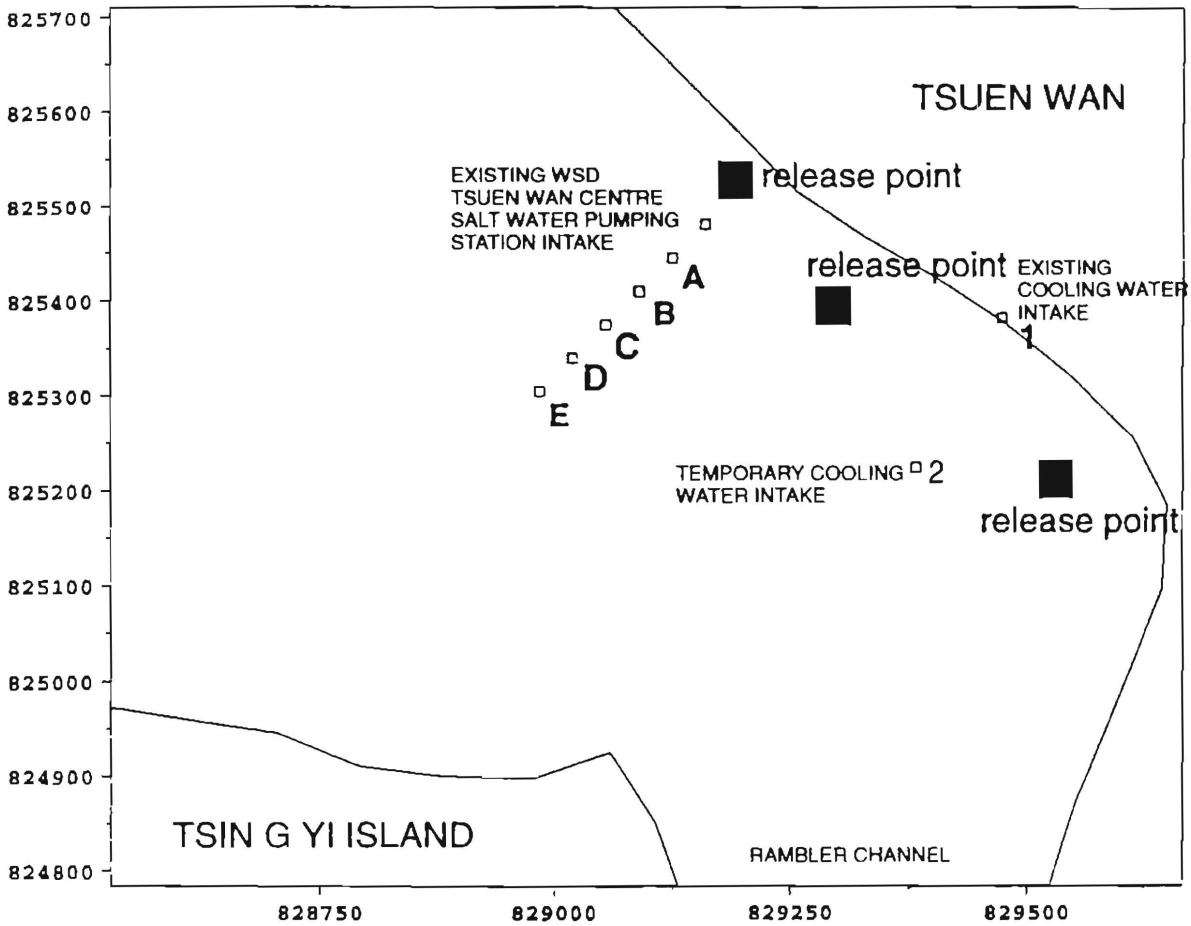

FIGURE 6.5g - LOCATION OF WATER SENSITIVE RECEIVERS AT TSUEN WAN BAY AND LOCATIONS OF SEDIMENT RELEASE POINTS OF SEDIMENT PLUME MODEL

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Locations A, B, C, D and E in *Figure 6.5g* represent the possible location of temporary salt water intakes for the WSD Tsuen Wan Central Salt Water Pumping Station during reclamation. These locations at 50 m intervals offshore, were modelled as a sensitivity analysis to ascertain an acceptable location for the temporary salt water intake to be determined, based upon the modelling results. Locations 1 and 2 represent the existing and temporary locations of cooling water intakes. The existing cooling water intake (Location 1) will be reprovisioned to the temporary intake (Location 2) during Stage 1 of construction.

The engineering Design Consultants indicate that the precise total dredging volume cannot be confirmed at this stage but will be available on completion of the Site Investigation Report. However, based on the schematic engineering design of Tsuen Wan West Station and approach tunnels, the total dredging volume is estimated to be more than 87,300 m^3 (to be confirmed by the Site Investigation Report) with a 2.5 m depth for dredging the seawall trenches using a single grab dredger. About 750,000 m^3 of marine sand fill material will possibly be used for reclamation. It is therefore considered that the relative impact of dredging will be smaller.

Water Quality Standards

Previous reclamation studies [(4)] have indicated that the concentrations of SS and DO in water are the two most sensitive parameters in assessing the water quality impacts of reclamations. Impacts on other parameters, including ammoniacal nitrogen, biochemical oxygen demand and *E. coli* are considered to be negligible and were therefore not considered in this assessment.

Suspended Sediment

To determine the WQOs for Suspended Sediment Concentration (SSC) in the study area, the data from EPD's VM13 and VM14 monitoring stations recorded in 1996 were used. As agreed with EPD in a previous study [(5)], the ambient value of marine water SSC has been defined as the 90th percentile of reported concentrations and was estimated to be 46.5 mg/l and 15.8 mg/l from VM13 and VM14 records, respectively. Comparison should then be made between the predicted SS elevations and the WQOs (within 30% elevation above the ambient SS level). The WQO compliance threshold is therefore set at 20.5 mg/l or 4.7 mg/l increase of SSC above the ambient level for VM13. For VM14, the WQOs compliance threshold is set at 60.4 mg/l or 14.0 mg/l elevation of SSC above the ambient level.

(4) Central Reclamation Phase III, Final EIA Report (February 1997) and Kowloon Point Development Feasibility Study Final EIA Report (September 1997).

(5) Backfilling of Marine Borrow Areas at East Tung Lung Chau, EIA, ERM-Hong Kong Ltd., November 1995.

Dissolved Oxygen

Based on the 1996 EPD's monitoring data, the DO concentration at VM14 ranged from 3.5 to 6.4 mg/l, with a mean value of 5.0 mg/l and a 10th percentile of 3.4 mg/l (ambient level). The DO concentration at VM13 was between 2.8 and 5.9 mg/l, with a mean value of 4.6 mg/l and a 10th percentile of 3.7 mg/l (ambient level). Comparison should be made between the predicted DO depletion and the EPD's WQOs allowance of DO below 4 mg/l for 90% of sampling occasions.

Water quality standards of salt water intakes for cooling and flushing should also be observed at the intakes. These standards are discussed in *Sections 3.4.5* and *3.4.6*. It should be noted that the existing ambient SSC is already well in excess of the WSD standards. Taking a pragmatic approach for the assessment, it is therefore recommended that current ambient level should be maintained, wherever practicable. In other words, significant elevation of SSC above the ambient level at the WSD's salt water intakes should not be allowed.

Modelling Results

Suspended Sediment

Figures 6.5h and *6.5i* show the instantaneous SSC at surface and bed layers for the dry spring and wet neap tides at the two different times in the tidal cycle where dispersion of the plume is at its greatest. For both scenarios the plume travels a greater distance on the ebb tide than on the flood tide, with the ebb plume travelling along the eastern side of the Rambler channel. The dry spring plume travels into the Northern Fairway while the wet neap plume merely reaches the Kwai Chung container terminal. The dry spring scenario shows a much greater excursion of the plume on the ebb tide than for the wet neap scenario. The behaviour of the plume on the flood tide is similar for both scenarios with the plume principally confined to the northerly part of Tsuen Wan Bay.

Figures 6.5j to *6.5o* show the time-history plots of elevations of SSC above the ambient level. The surface and bottom layers refer to the top and bottom 25% of the water column, respectively. Layers 1 and 2 refer to the 25% of the water column immediately below and above the surface and bottom layers, respectively. For the dry season spring tide scenario plume dispersion is the greatest at 2 hours before High Water (for the flood tide) and 7 hours after High Water (for the ebb tide). For the wet season neap tide scenario these times were found to be at 4 hours after High Water (for the flood tide) and 11 hours after High Water (for the ebb tide).

No SSC elevation is predicted at Gemini Beaches, Ho Mei Wan, Casam Beach and Lido Beach under dry spring and wet neap conditions. For MTRC and SSDS Stage 1 Phase I c cooling water intakes, the suspended sediment concentrations are small and remain below 2.5 mg/l on the spring tide and 1 mg/l on the neap tide (*Figures 6.5j* and *6.5k*). The predicted SSC at these cooling water intakes are within the recommended threshold of 140 mg l^{-1} (*Section 3.4.5*), and no adverse impact is expected. For the WSD Tsing Yi Salt

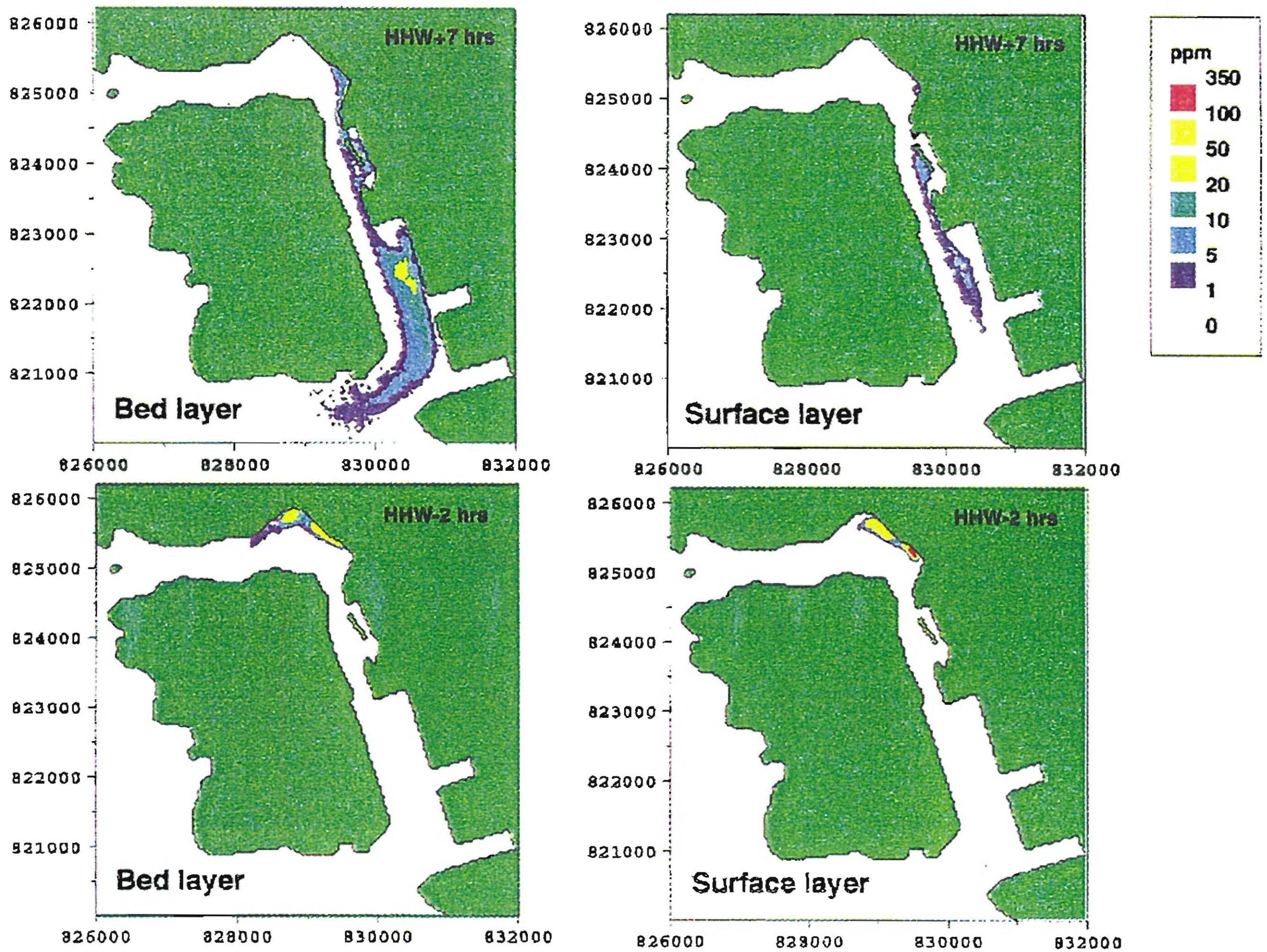

FIGURE 6.5h - SEDIMENT PLUME MODELLING OF STAGE 2 (SAND FILLING AND DREDGING) CONSTRUCTION OF TSUEN WAN BAY RECLAMATION DURING DRY SEASON SPRING TIDE

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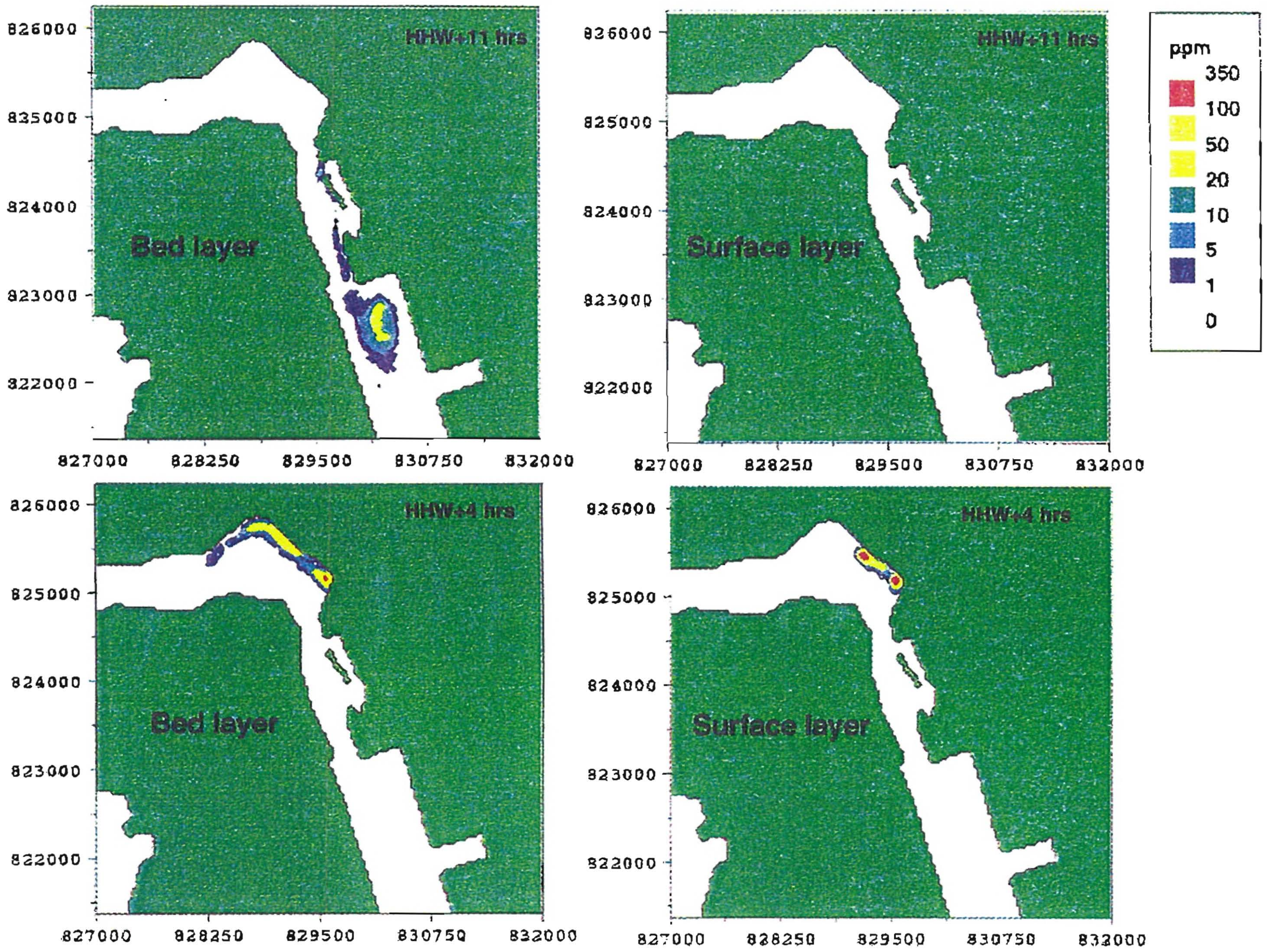

FIGURE 6.5i - SEDIMENT PLUME MODELLING OF STAGE 2 (SAND FILLING AND DREDGING) CONSTRUCTION OF TSUEN WAN BAY RECLAMATION DURING WET SEASON NEAP TIDE

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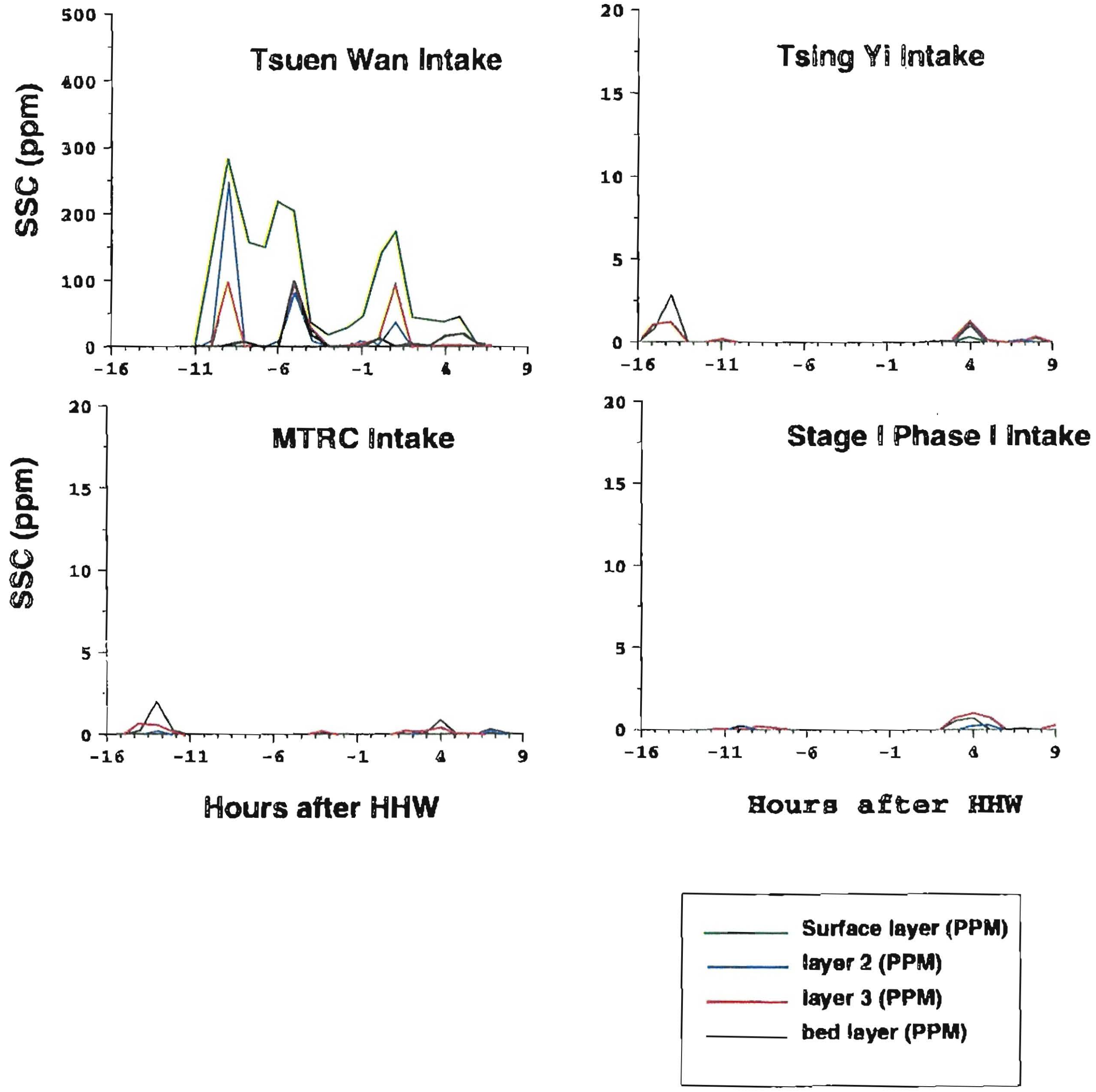

Suspended sediment concentrations at sensitive receivers
Spring Tide Dry Conditions

FIGURE 6.5j - ELEVATION OF SUSPERED SEDIMENT CONCENTRATION (SSC) AT DIFFERENT WATER SENSITIVE RECEIVERS ALONG RAMBLER CHANNEL DURING DRY SEASON SPRING TIDE OF STAGE 2 TSUEN WAN BAY RECLAMATION

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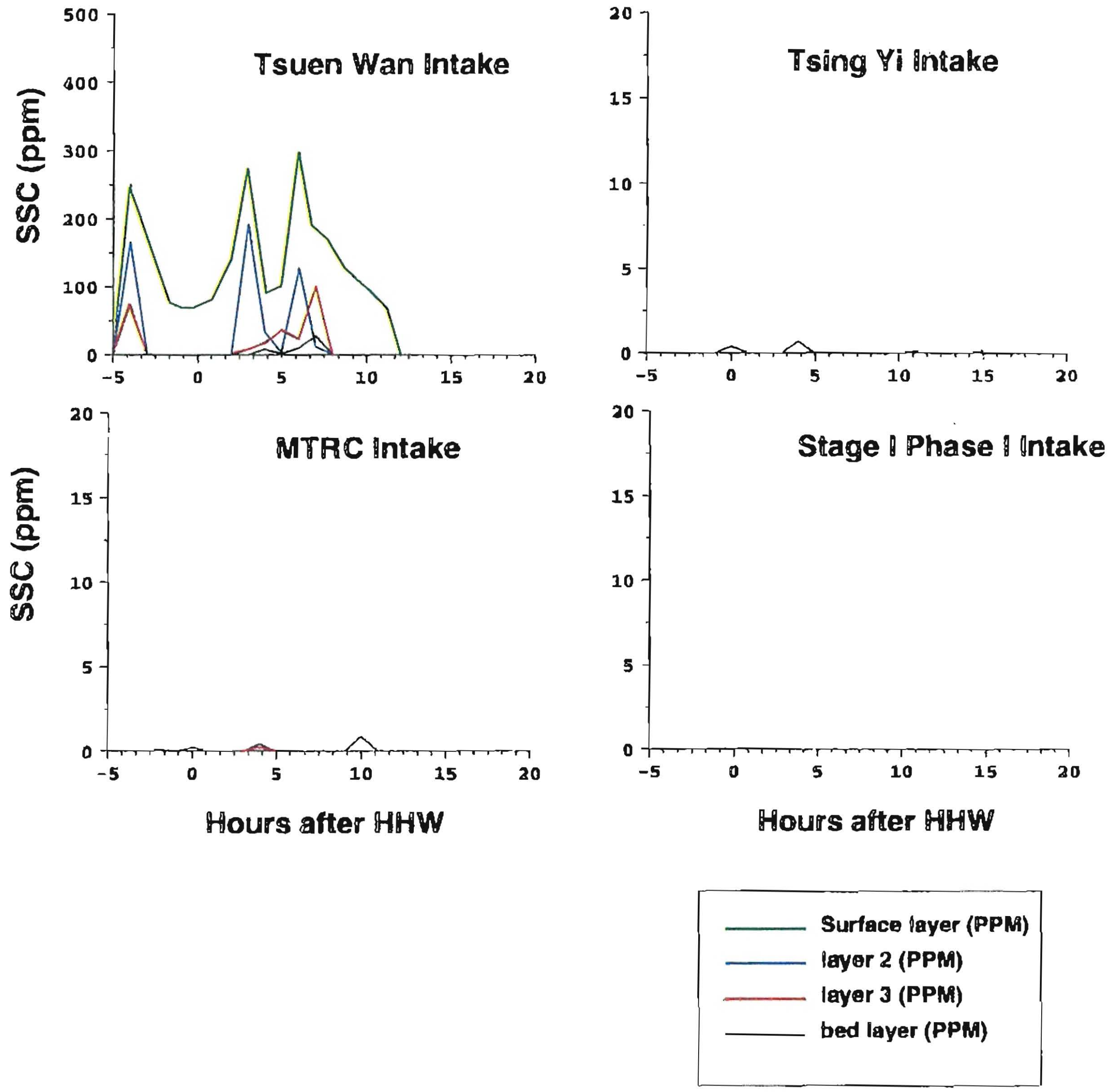

Suspended sediment concentrations at sensitive receivers
Neap Tide Wet Conditions

FIGURE 6.5k - ELEVATION OF SUSPERED SEDIMENT CONCENTRATION (SSC) AT DIFFERENT WATER SENSITIVE RECEIVERS ALONG RAMBLER CHANNEL DURING WET SEASON NEAP TIDE OF STAGE 2 TSUEN WAN BAY RECLAMATION

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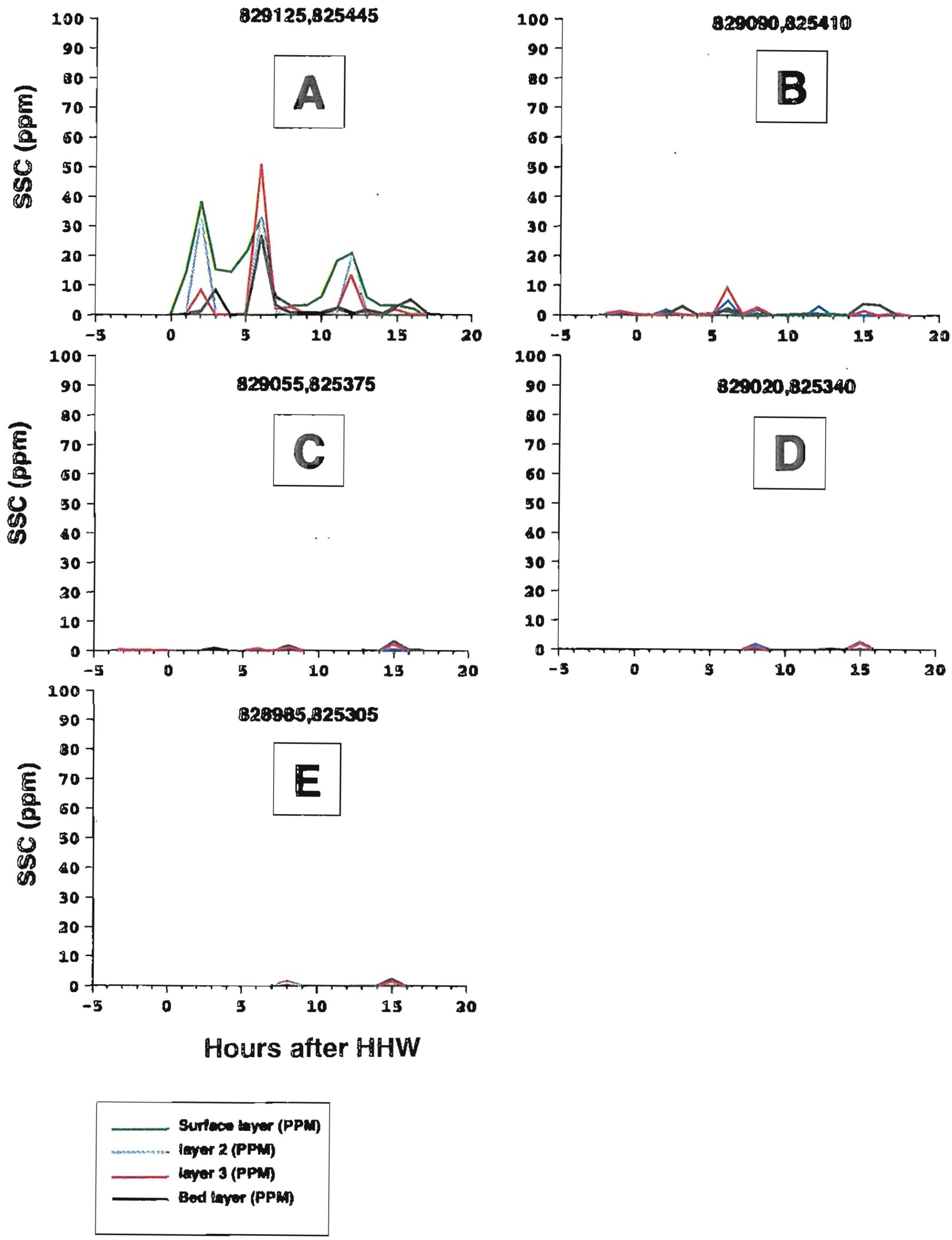

FIGURE 6.51 - ELEVATION OF SUSPENDED SEDIMENT CONCENTRATION (SSC) AT PROVISIONAL LOCATIONS OF TEMPORARY SALT WATER INTAKE DURING DRY SEASON SPRING TIDE OF STAGE 2 TSUEN WAN BAY RECLAMATION

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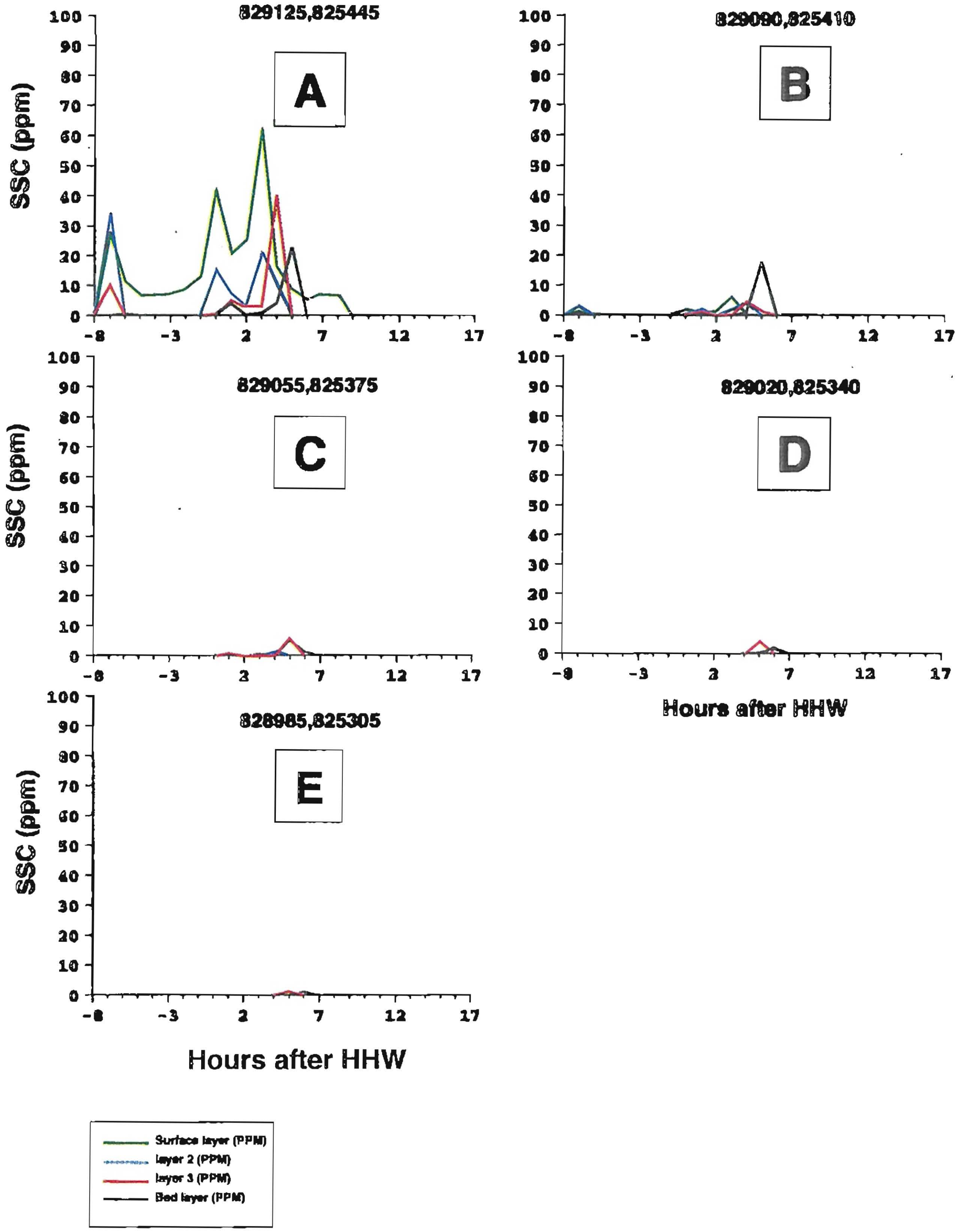

FIGURE 6.5m - ELEVATION OF SUSPENDED SEDIMENT CONCENTRATION (SSC) AT PROVISIONAL LOCATIONS OF TEMPORARY SALT WATER INTAKE DURING WET SEASON NEAP TIDE OF STAGE 2 TSUEN WAN BAY RECLAMAITION

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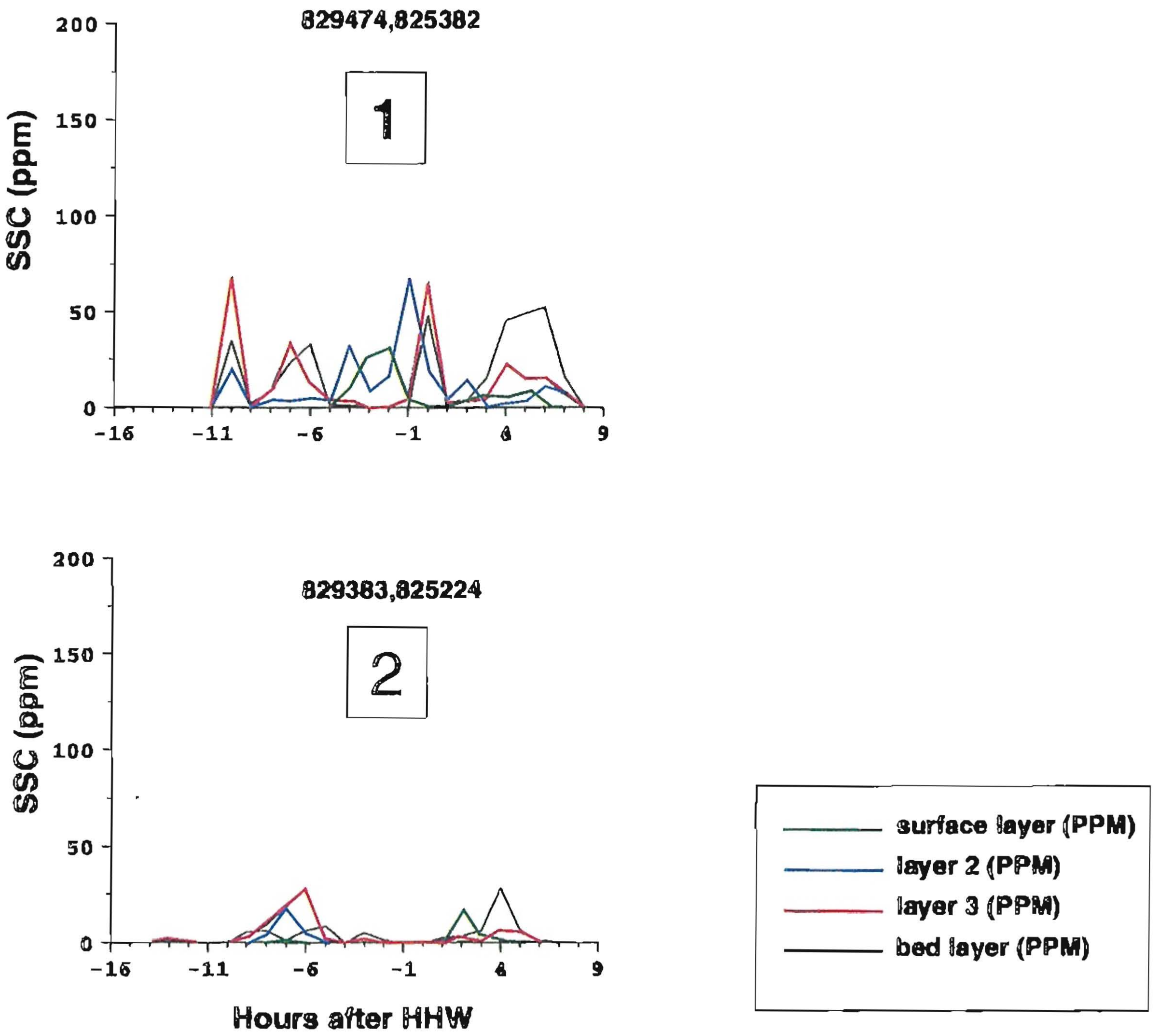

FIGURE 6.5n - ELEVATION OF SUSPENED SEDIMENT CONCENTRATION (SSC) AT THE EXISTING (LOCATION 1) AND TEMPORARY (LOCATION 2) COOLING WATER INTAKES DURING DRY SEASON SPRING TIDE OF STAGE 2 TSUEN WAN BAY RECLAMATION

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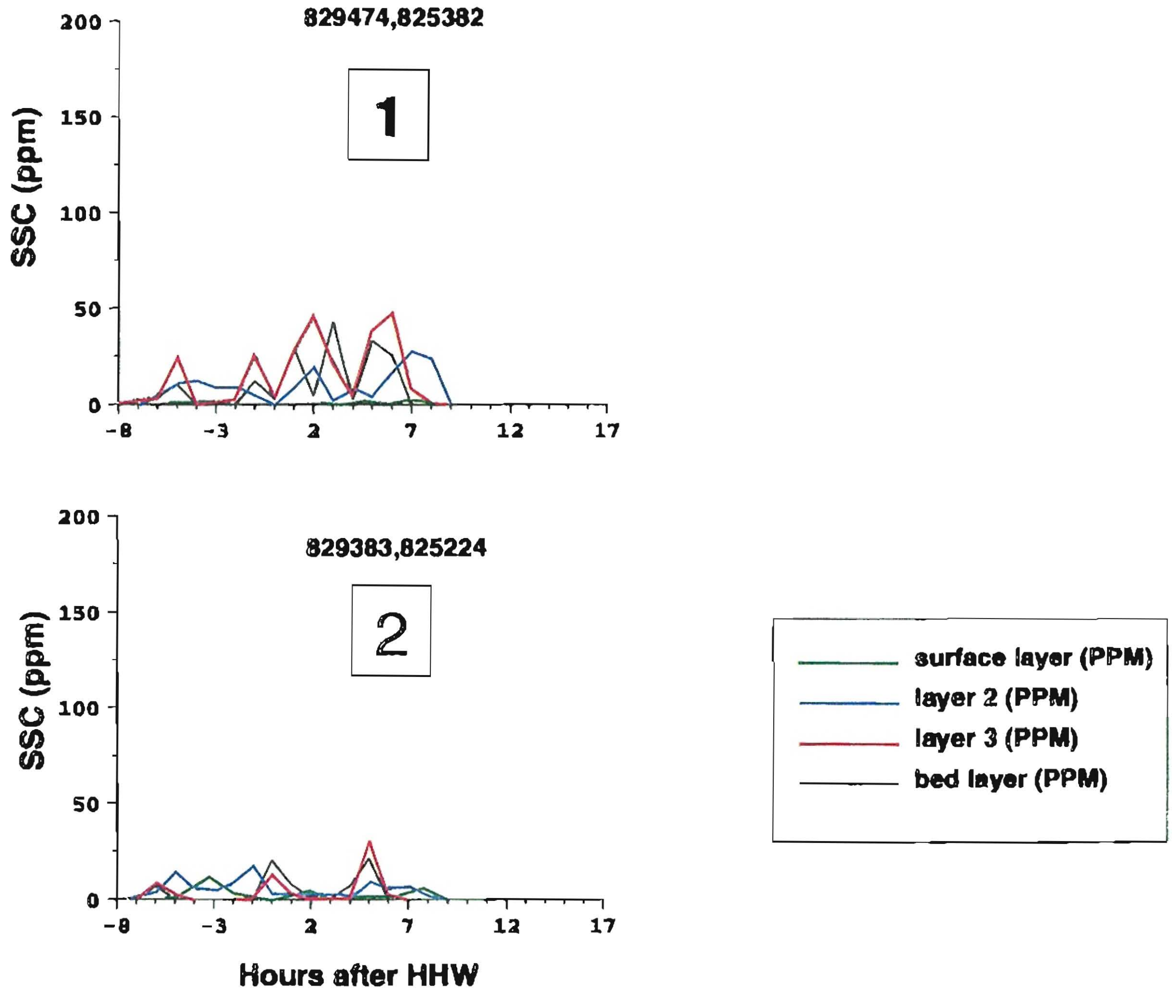

FIGURE 6.5o - ELEVATION OF SUSPENED SEDIMENT CONCENTRATION (SSC) AT THE EXISTING (LOCATION 1) AND TEMPORARY (LOCATION 2) COOLING WATER INTAKES DURING WET SEASON NEAP TIDE OF STAGE 2 TSUEN WAN BAY RECLAMATION

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Water Pumping Station intake, the elevation of SSC is minimal and varies from 2.5 mg/l (dry spring, *Figure 6.5j*) to 1 mg/l (wet neap, *Figure 6.5k*).

In both dry spring and wet neap scenarios, a maximum SSC of 300 mg/l occurs at the existing Tsuen Wan Central Salt Water Pumping Station intake, which is located 50 m from the most northerly release point (*Figure 6.5g* and *Figures 6.5j* and *6.5k*). Locations further offshore (locations A to E, *Figure 6.5g*) show a rapid decline in maximum SSC, with location A experiencing maximum concentrations of 50 mg/l (dry spring) and 70 mg/l (wet neap), and SSC of less than 10 mg/l (dry spring) and 20 mg/l (wet neap) at location B (*Figures 6.5l* and *6.5m*). With respect to compliance with the WSD's WQOs for salt water flushing, the location of the extended Tsuen Wan Central Salt Water Pumping Station intake, without any mitigation facilities, should be approximately 200 m (location C) away from the most northerly release points to avoid exceedance of the criteria. However, if a silt curtain is deployed to contain the dispersion of suspended sediments from the dredging and filling areas, the extent of impact could be reduced by a factor of 2.5 [6]. This measure should not only ensure the acceptability of temporary salt water intakes at locations C, D or E, but also reduce the extent of impact from suspended sediments at location B to an acceptable level. In summary, the existing Tsuen Wan Central Salt Water Pumping Station intake will be subject to unacceptable impacts in terms of elevated SSC during reclamation. A temporary intake should be relocated to location B (with silt curtain mitigation around dredging and filling areas) or locations C, D or E (without any mitigation measures) to ensure acceptable salt water for flushing.

The existing and future temporary cooling water intakes (Locations 1 and 2, respectively, in *Figure 6.5g*) would experience different extents of impact during West Rail reclamation in Tsuen Wan Bay. Without relocation, an elevation of more than 70 mg/l of SSC would be experienced at the existing cooling water intake during dry spring tide (*Figure 6.5n*), while the impact would be less under the wet neap tide (*Figure 6.5o*). For the future temporary intake, Location 2, a maximum of about 30 mg/l elevation of SSC is predicted under dry spring and wet neap tides. For both intakes, the predicted SSCs are not greater than the recommended limit of 140 mg/l for cooling water intakes and thus the reclamation will not have a significant impact on the operation of the temporary cooling water intake.

Dissolved Oxygen

The predicted tidally averaged DO depletions were calculated based on the values for sediment oxygen demand of 2100 mg-O/kg which was derived from elutriate testing of sediment samples from Tsuen Wan Bay [7]. The area affected by DO depletion is more extensive for the dry spring scenario than for the wet neap scenario, and more extensive at the bed than at the surface. For both scenarios the highest level of DO depletion of 0.20

(6) Pak Shek Kok Reclamation - Public Dump, Environmental Impact Assessment Study, Final Report, Mouchel Asia Limited, May 1994.

(7) Tsuen Wan Bay Further Reclamation Area 35, Environmental Impact Assessment, Final Assessment Report (Draft), Manusell Consultants Asia Ltd., August 1997.

mg/l occurs at the surface in the vicinity of the release points, whereas a relatively lower level of DO depletion of 0.10 mg/l is predicted at the bed layer. The DO depletion is well within the WQO allowance. The projected impact on DO due to suspended sediments is therefore negligible and there is virtually no DO impact at the WSRs.

6.5.1.5.2 Land-based Construction Impact

The net unmitigated water quality impacts on the WSRs include the runoff from general construction activities associated with tunnelling and station construction containing elevated concentrations of SS and associated contaminants, as well as the construction work force sewage discharges.

According to the engineering Design Consultants, high groundwater inflows within the hard rock tunnelling are predicted to be localised and associated with linear faults and shears which may cut across the tunnels. Where these inflows are not connected with a significant water source, they typically decay with time. However, where sufficient storage is provided by adjacent aquifers, prolonged inflows can occur.

The risk of problematic inflows can occur if the saprolite below the groundwater table or weathered granite aquifer is directly intersected by the advancing tunnel. In these areas, there is a potential for significant inflows in the absence of adequate advance ground treatment.

Conclusion

There will be no adverse water quality impact arising from the reprovisioning of WSD Tsuen Wan Central Salt Water Pumping Station, provided that the following suggested mitigation measures are implemented.

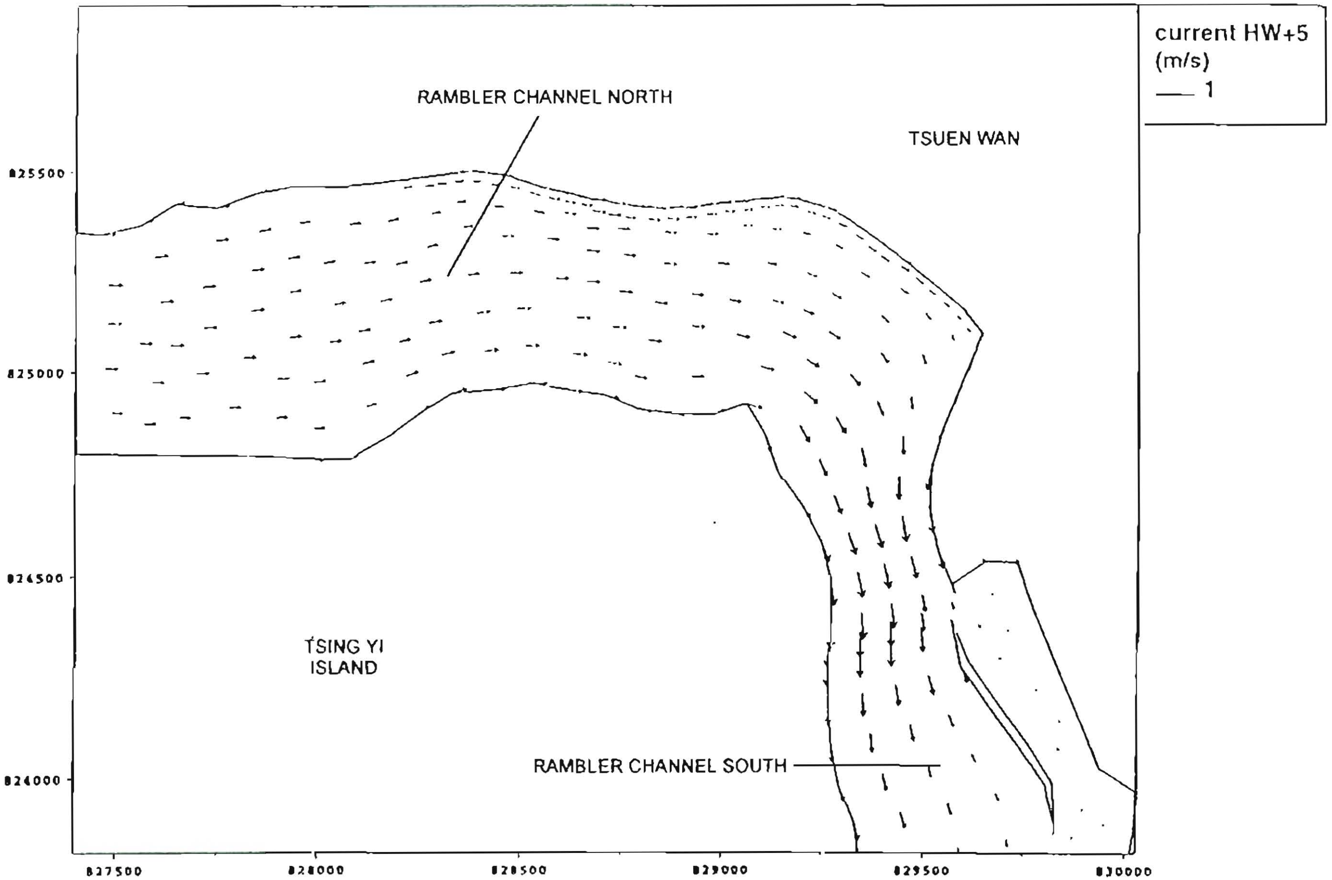
6.5.1.6 Recommended Mitigation

6.5.1.6.1 Marine-based Construction Impact

A minimum-dredge option during construction has been considered by the engineering Design Consultants to minimise the amount of contaminant release. Although the reclamation only involves marine dredging of about 79,000 m^3 of marine sediment for seawall construction, 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.

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:

N



2004 KCRC and Tsuen Wan Bay Further Reclamation, Area 35

NOT TO SCALE

TIDAL FLOW MODEL WITH AND WITHOUT RAMBLER CHANNEL RECLAMATION IN YEAR 2004

FIGURE 6.5p -1

Contract/C1588/C1588Z33

ERM

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WEST RAIL: TS900 EIA STUDY

- 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;
- Silt curtains should be deployed around the dredging areas without jeopardising the navigation of ships and ferries along the navigation channels;
- 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;
- 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;
- 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
- Additional consideration should be given to the transportation and disposal of the dredged material, as discussed in *Section 6.10.*

Additionally, as predicted by sediment plume modelling, the existing Tsuen Wan Central Salt Water Pumping Station intake should be relocated temporarily during Stage 1 of construction to location B, assuming the adopting of silt curtain mitigation around dredging or to location C, assuming no further at-source mitigation measures. The cooling water intake should also be relocated during Stage 1 of the construction to temporary Location 2 to ensure compliance with recommended standards.

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 (*Figures 6.5d to 6.5f*).

As advised by the consultants undertaking sewerage improvement projects in Tsuen Wan and Kwai Chung area, sewerage improvement works will be completed by the end of 1997. Upon completion of these projects, more than 90% of the pollution loads will be removed from the stormwater drainage system. The expedient connections and poor water quality discharges from the two existing stormwater culverts along the Rambler Channel are therefore expected to be largely eliminated.

6.5.1.6.2 Land-based Construction Impact

It is important that appropriate measures are implemented to control runoff and drainage and prevent high loading of SS from entering the marine environment. Proper site management is essential to minimise surface water runoff, soil erosion and sewage effluents.

Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements in order to ensure the adequate hydraulic capacity of all drains.

Construction site runoff and drainage should be prevented or minimised in accordance with the guidelines stipulated in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94). Good housekeeping and stormwater best management practices, as detailed in *Section 5.5.1.6* of this Report, should be implemented to ensure that all construction runoff complies with WPCO standards and no unacceptable impact on the WSRs arises due to construction of the Central Section. All discharges from the construction site should be controlled to comply with the standards for effluents discharged into the Victoria Harbour Phase I and Western Buffer WCZs under the TM.

Inflows of groundwater during tunnelling should be adequately controlled by advance ground treatment works. Probing ahead and grouting techniques should be applied to control any prolonged inflows of groundwater.

The contaminated excavated materials from station construction work will require special handling and disposal methods to minimise any potential impact on the WSRs, as discussed in *Section 6.10*.

The cut-and-cover tunnelling work should be conducted segment by segment to limit the amount of construction runoff generated 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 to the drainage system via appropriate sediment traps.

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, described in *Section 6.5.1.4.2*, 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.

6.5.1.7 Residual Impacts

6.5.1.7.1 Marine-based Construction Impact

Provided a minimum-dredging approach and appropriate dredging and handling techniques are adopted, and recommended mitigation measures (including cooling and flushing water intake temporary relocations and at-source silt curtain mitigation of dredging and filling activities) are used, water quality impacts on cooling water intake and WSD's salt water (flushing) intakes should be maintained at acceptable levels. Dredging and placement of fill will not generate unacceptable residual impacts at the beaches along Ting Kau and Sham Tseng, or the salt water and cooling water intakes along Rambler Channel.

6.5.1.7.2 Land-based Construction Impact

General construction activities associated with tunnelling and station construction could lead to site runoff containing elevated concentrations of SS and associated contaminants that may enter the marine water. However, it is anticipated that the above water quality impacts will generally be temporary and localised during construction. Therefore, no unacceptable residual water quality impacts are anticipated from the Central Section construction phase, provided all of the recommended mitigation measures are implemented and all construction site/works area discharges comply with the TM standards.

6.5.1.7.3 Overall

In summary, the assessment indicates that, provided recommended mitigation measures are implemented and discharges meet the TM standards, both land-based and marine-based construction works are not expected to generate any unacceptable residual water quality impacts on the identified WSRs.

6.5.2 Operational Phase

6.5.2.1 Baseline Conditions

A description of current water quality conditions in the study area is given *in Section 6.5.1.2*. Water quality in the Rambler Channel near Tsuen Wan and Kwai Chung is expected to improve with enforcement actions associated with the declaration of the Victoria Harbour Phase I and Western Buffer WCZs, as well as enforcement of the *Water Pollution Control Ordinance* (WPCO) and the *Waste Disposal (Chemical Waste)(General) Regulation.*

Long-term water quality improvement measures for the Western Buffer WCZ were recommended in the Tsuen Wan, Kwai Chung and Tsing Yi Sewerage Master Plan Study. In particular, the study recommended the provision of a system of gravity sewers and sewage pumping mains along the Castle Peak Road for sewage collection.

As advised by the consultants undertaking sewerage improvement projects in the Tsuen Wan and Kwai Chung area, sewerage improvement works will be completed by the end of 1997. Upon completion of these projects, more than 90% of the pollution loads should be removed from the stormwater drainage system. Local improvements in water quality are therefore expected.

6.5.2.2 Potential Sources of Impact

6.5.2.2.1 Marine-based Operational Impact

Marine-based operational impacts will arise from any adverse changes in tidal flow or increases in discharge volumes at Tsuen Wan Bay after the formation of a new coastline configuration.

6.5.2.2.2 Land-based Operational Impact

Potential sources of impact on water quality from the operation of the Central Section could include the following:

- Cooling water discharges;
- Runoff from operational tunnel drainage;
- Station runoff; and
- Sewage generation at stations.

6.5.2.3 Prediction of Impacts

6.5.2.3.1 Marine-based Operational Impact

The reclamation will fill up part of Tsuen Wan Bay and may affect the water quality near the shore due to changes in marine flow regimes (i.e. water movement patterns and tidal flushing) in the Rambler Channel. However, as the reclamation will be located away from the major tidal flow path along the Rambler Channel, it is anticipated that hydrodynamic changes of water movement and tidal flows will be minimal.

6.5.2.3.2 Land-based Operational Impact

Cooling Water Discharge

An air-cooled engineering design will be adopted in the Mei Foo Station. Cooling water will be discharged from Tsuen Wan West Station and tunnels along Central Section (*Figure 6.5f*). The maximum rate of the cooling water discharge is about 892 litres per second for 18 hours per day (or a worst case of 57,800 m^3 per day), with a maximum cooling water discharge temperature of 32 °C and an average temperature of about 29 °C. The collected cooling water will be discharged directly to the Western Buffer WCZ via two water discharge points. The depth of the cooling water discharge point is about -2.6 mPD.

Runoff from Operational Drainage

The operational tunnel drainage may be contaminated with oil, grease and SS arising from track grindings and corrosion of rolling stock, which may cause downstream impacts on the public stormwater drains and the WSRs.

The tunnels will be underground, so the volume of operational tunnel drainage is expected to be minimal. Appropriate measures to minimise potential sources of contamination should still be taken to ensure compliance with the TM.

Runoff from Stations

Rainwater runoff from the station structure, such as the station roofs, is expected to be "clean" and should therefore have no adverse impact on the WSRs.

Sewage Generation

Domestic sewage will be generated at the Mei Foo and Tsuen Wan West Stations. Uncontrolled discharge of sewage will cause unacceptable water quality impacts on the WSRs. Toilet facilities will be provided to serve not only the rail staff but also passengers. According to *Section 10.4.3* of the *TS-300 MEF Station and KCR/MTR Interchange Final Technical Report - Volume 1*, foul flows from Mei Foo Station will be approximately 6 l s^{-1}. With reference to *Section 9.2.3* of *Tsuen Wan West Station and Approach Tunnels Final Technical Report - Volume 1* (TWW FTR), approximately 7 l s^{-1} of sewage will be discharged from Tsuen Wan West Station.

6.5.2.4 Evaluation of Impacts

6.5.2.4.1 Marine-based Operational Impact

A flow model (*Figures 6.5p* and *6.5p-1*) was used to identify the impacts on tidal flows of the Rambler Channel Reclamation. Flow model scenario comparison was made between the expected coastline in year 2004 with and without the reclamation. Information including types and slope of sea wall along the edge of the reclamation were added to enhance the accuracy of the results. The results from the flow model simulations have been analysed to give total discharges across the major flow channels into and out of the Rambler Channel.

A small area of speed increase was predicted along the face of the reclamation where the reclamation reduces the cross-section of the flow area. However, all of the predicted changes are small compared to current speeds through the main Rambler Channel. The tidal discharge calculations (*Table 6.5f*) show that the Rambler Channel tidal discharges reduce by about 0.89% on the ebb tide at Rambler Channel (S) section. The reductions at the Rambler Channel (N) section are not as great in the Rambler Channel (S) section and on the flood tide this is because the tidal volume, which the reclamation occupies, now flows through the channel. These changes are all very small indeed and considered to be within resolution of the model and the procedures used to calculate the discharge volumes.

Table 6.5f Discharge Volumes in Rambler Channel -2004 Baseline + Rambler Channel Reclamation

Discharge Section	Discharge Volume (* 10^6 m^3)		Percentage Change from Baseline	
	Ebb	Flood	Ebb	Flood
Rambler Channel (N)[1]	51.60 (51.98)[3]	29.39 (29.52)[3]	-0.73	-0.44
Rambler Channel (S)[1]	56.45 (56.77)[3]	34.32 (34.63)[3]	-0.56	-0.89
Rambler Channel (N)[2]	41.24 (41.29)[3]	10.22 (10.27)[3]	-0.12	-0.49
Rambler Channel (S)[2]	43.04 (43.16)[3]	11.79 (11.87)[3]	-0.27	-0.67

Notes:

(1) represent results obtained from dry season spring tide

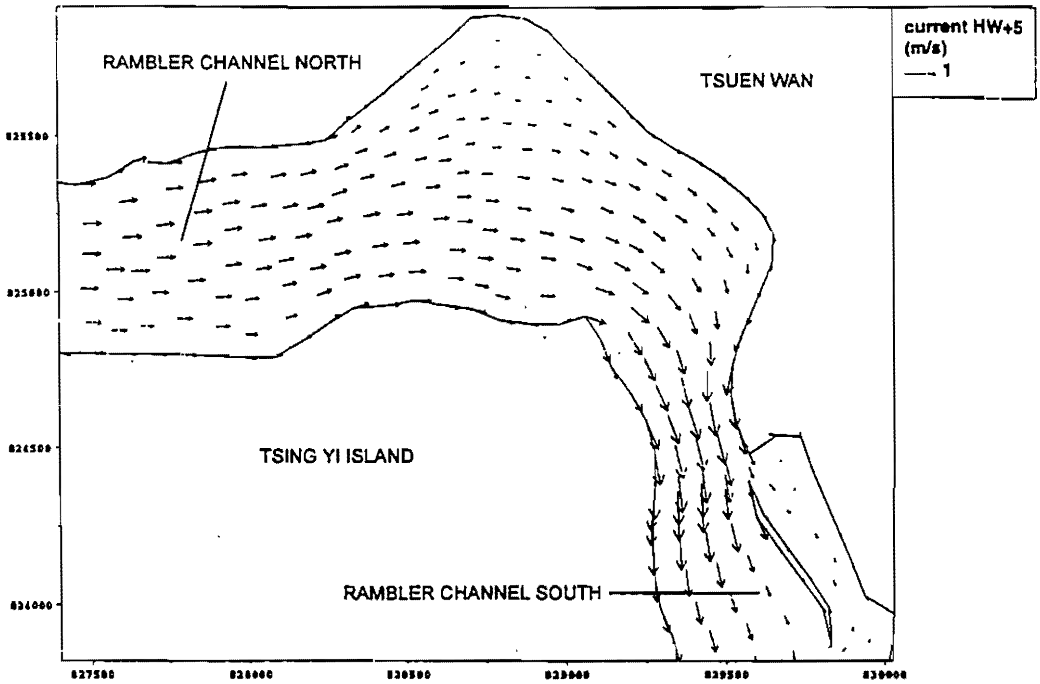
(2) represent results obtained from wet season neap tide

(3) numbers in blankets are discharge volume in 2004 without reclamation

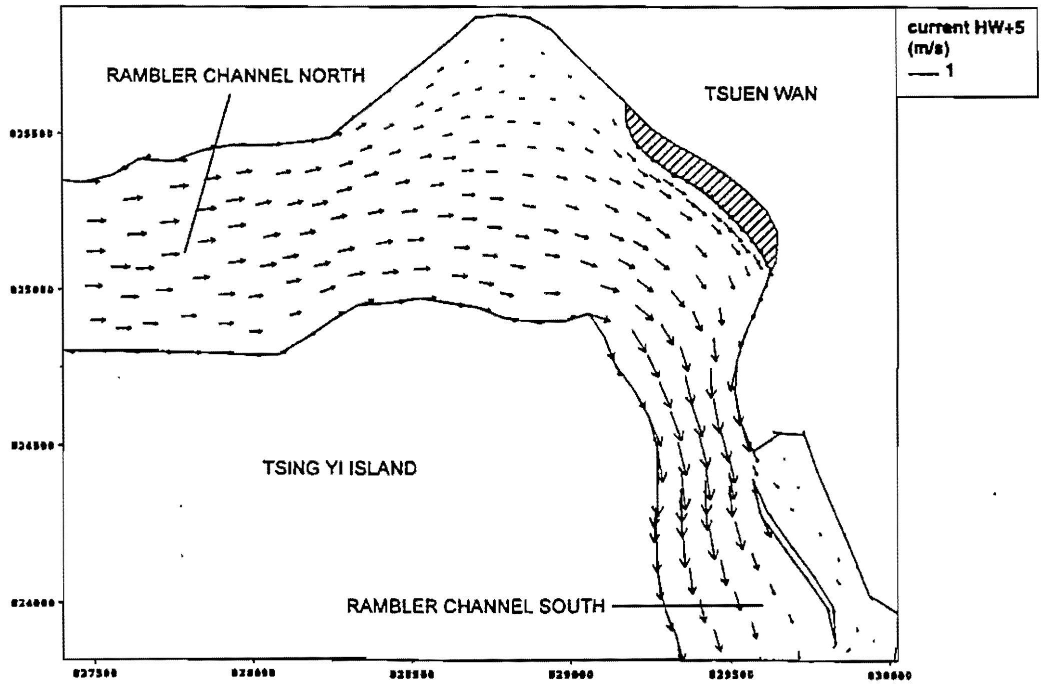
Results with and without the West Rail Reclamation (2004) and Tsuen Wan Bay Further Reclamation (Area 35) are shown in *Figures 6.5p* and *6.5p-1*. It was found that current speeds at the southern end of the reclamation will be reduced following construction of the reclamation. As shown in *Figure 6.5q*, flow along the new coastline will be increased by between 0.05 and 0.30 m/s, while flow at areas adjacent to the edges of reclamation will decrease by between 0.05 and 0.10 m/s. In the location where there is a slight reduction in speed, a relocated stormwater drain will discharge and concern was expressed as to whether the reduction in current speed in the area of the new stormwater discharge would result in reduction of discharge dispersion rates. In order to assess this concern a float track (drogue) model simulation was run with drogues released at times of peak ebb and flood tidal flows and then the drogues were tracked for the duration of one tidal cycle in both scenarios.

In general the simulated drogue releases (*Figure 6.5r*) show similar behaviour for both the ebb and flood releases in that the excursions of the drogues for the baseline and completed reclamation scenarios are similar. On the flood release the extent of the drogue travel is slightly greater in the flood direction being carried further around the Tuen Wan Bay for the baseline showing the effect of the decreased speed but later in the tidal cycle, during the subsequent ebb, the drogue excursions are very similar for the two scenarios. This shows that the reduction in speed at peak flood has little effect once the pollutants are transported away from the immediate vicinity of the outfall. Results of the wet neap ebb drogue release show better dispersion with the reclamation in place, because the outfall discharges closer to the main Rambler Channel flow areas.

Based on the results from TELEMAC 3D tidal flow modelling and consideration of the physical layout, the location of the proposed West Rail reclamation and the results of tidal flow modelling, it is considered that there will be no adverse impact to the main tidal flow along the Rambler Channel and consequent water quality impacts on Rambler Channel will be minimal.



2004 baseline - peak ebb currents - surface



2004 KCRC - peak ebb currents - surface

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TIDAL FLOW MODEL WITH AND WITHOUT RAMBLER CHANNEL RECLAMATION IN YEAR 2004	FIGURE 6.5p Contract/C1588/C1588Z23	ERM	KOWLOON - CANTON RAILWAY CORPORATION WEST RAIL: TS900 EIA STUDY

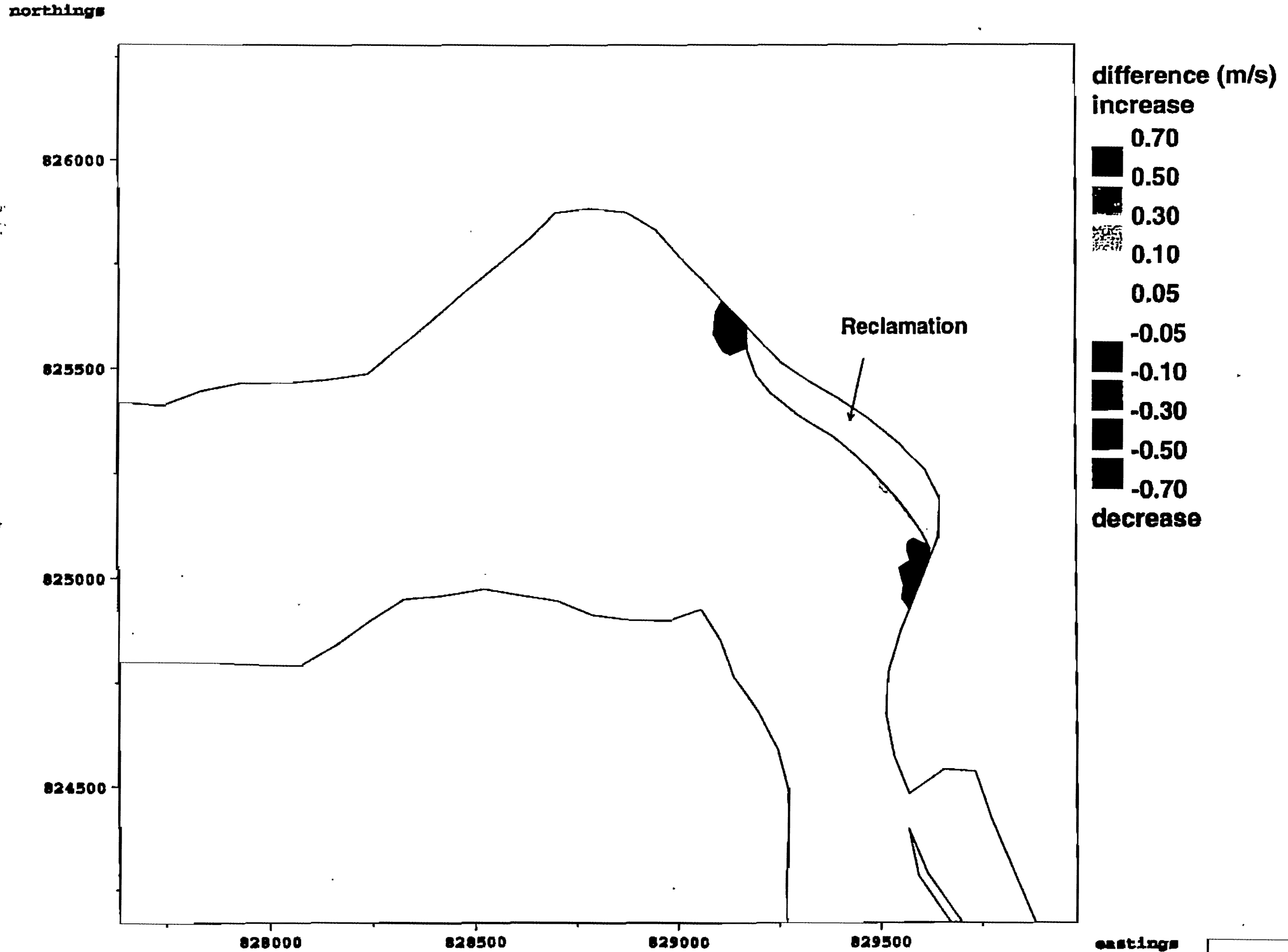

FIGURE 6.5q - CURRENT SPEED DIFFERENCE IN DEPTH-MEAN CURRENT MAGNITUDE - PEAK EBB

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Tsimshatsui, Kowloon
Hong Kong

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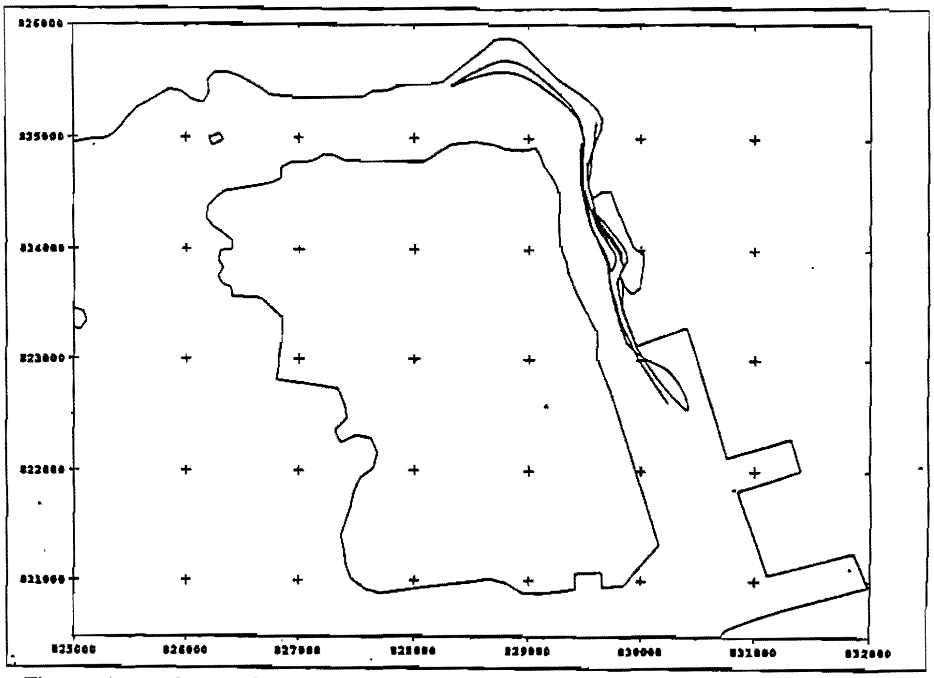
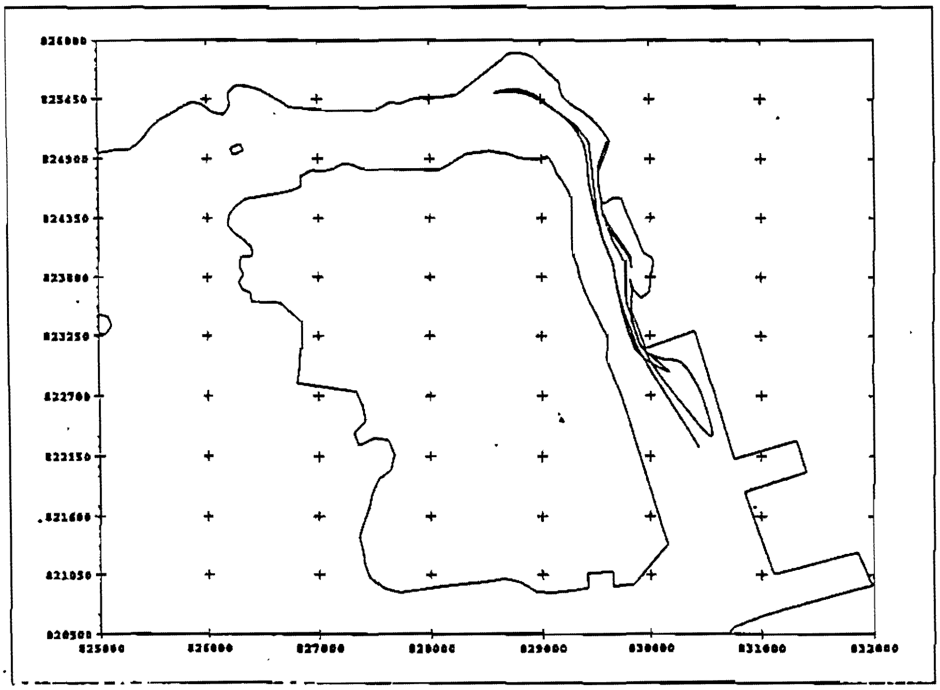


Float released at outfall - Peak Ebb, Baseline



Float released at outfall - Peak Ebb, KCRC reclamation

FIGURE 6.5r - SIMULATED DROGUE RELEASE MODEL WITH AND WITHOUT RAMBLER CHANNEL RECLAMATION IN YEAR 2004

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Hong Kong

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6.5.2.4.2 Land-based Operational Impact

The net (unmitigated) water quality impacts on the WSRs may arise from the discharge from the stations and tunnel. The evaluation of impacts on water quality from the operation of the Central Section is provided below.

Cooling Water Discharge

Cooling water from tunnels and the Tsuen Wan West (TWW) Station will be collected and discharged directly to the Victoria Harbour WCZ Phase I / Western Buffer WCZ. The temperature standard stipulated in the TM is 40 °C for a flow rate ranging from 10 m^3 per day to 6,000 m^3 per day. The estimated cooling water discharge rate of the Tsuen Wan West Station is 892 litres per second (a maximum of 57,800 m^3 per day), so the TM standard is not applicable. The EPD has advised that, for discharges with flow rates between 6,000 and 1,000,000 m^3 per day, the discharge temperature should not be more than (i) 35 °C and (ii) 10 °C above the influent temperature, and the discharge should not contain more than 0.2 mg/l of total residual chlorine.

When compared with the thermal water modelling and assessment in the endorsed EIA for the Central Reclamation Phase III (CR III), the discharge volume for TWW Station is much smaller than the combined discharge from the four cooling towers of CR III. Also, the total heat loading will be very much smaller (less than 10%) for TWW Station. Furthermore, the West Rail discharge will be subject to tidal currents of about 0.25 m/s, which is a dispersive environment. As the thermal modelling for CR III indicated that the standard of no more than 2° C elevation would be met in receiving waters, it is considered that the West Rail discharge will not lead to any unacceptable thermal impact on waters in Tsuen Wan Bay.

Runoff from Stations and Operational Drainage

Rainwater runoff from "clean" station areas is not expected to have an adverse water quality impact. Discharge from rail tracks via the pumping stations is expected to contain limited amounts of oil and grease discharged to the existing public stormwater drain system.

Sewage

Sewage effluents will be discharged directly to the existing sewerage infrastructure. For the foul flows from Mei Foo Station, adverse water quality impacts are not expected (and EPD have no objection to the additional flow). For the additional flow from Tsuen Wan West Station, it was reported in TWW FTR that the flow would be offset by the flow reduction from the existing government offices above the ferry pier, which would be relocated elsewhere. EPD have confirmed that there is sufficient spare capacity at the pumping station, to accommodate the additional flows.

6.5.2.5 Recommended Mitigation

The following recommendations should be incorporated, where appropriate, into the operation of the Central Section:

- A surface water drainage system should be provided to collect operational tunnel seepage, tunnel drainage and track runoff. The discharge should pass through oil and grit interceptors/chambers to remove any oil, grease and sediment before being pumped to the public stormwater drainage system;
- Sewage effluents are required to meet standards stipulated in the TM. Sewage should be directed to the public foul sewer system and sewage treatment facilities for treatment prior to discharge;
- The efficiency of silt traps and oil interceptors is dependent on regular cleaning and maintenance. These installations should therefore be regularly cleaned and maintained in good working condition; and
- Oily contents of the oil interceptors should be collected and reused, or transferred to an appropriate disposal facility.

6.5.2.6 Residual Impacts

With the adoption and incorporation of appropriate drainage and effluent collection systems (to be specified in the Drainage Impact Assessment prepared by the engineering Design Consultants), minimal residual operational water quality impacts are expected, since the effluent discharge standards in the TM must be followed. Requirements for tunnel and station cooling water discharge should be obtained from the EPD and DSD after the discharge volume is finalised.

6.5.3 Conclusion

6.5.3.1 Construction Phase

6.5.3.1.1 Marine-based Construction Impact

The water quality impact during the reclamation of Tsuen Wan Bay was quantitatively assessed using the TELEMAC-3D model. Suspended sediment is identified as the most significant 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. The water quality at the existing cooling water intake and WSD salt water intake at Tsuen Wan Bay would be substantially affected by the reclamation activities. Satisfactory temporary locations of these intakes are proposed for the construction stage on the basis of modelling results. Provided the recommended mitigation measures are implemented, water quality impacts of the West Rail Tsuen Wan Bay reclamation can be maintained at acceptable levels.

EM&A Programme

Based on the above assessment, an EM&A programme is considered necessary to obtain a robust, defensible database of baseline information of water quality before construction, and thereafter, to monitor any variation in water quality from the baseline conditions during reclamation. This is particularly the case during Stage 2 of construction when dredging and filling are carried out simultaneously. The EM&A Manual for this Project will be produced as a separate stand-alone document.

6.5.3.1.2 Land-based Construction Impact

Water quality impacts from land-based construction are associated with the surface discharge from the site, groundwater discharge during tunnelling works and sewage from on-site construction workers. Impacts can be controlled to comply with standards by implementing the recommended mitigation measures. No unacceptable residual impact on water quality is anticipated.

6.5.3.2 Operational Phase

The key concern during the operation of Central Section will be the discharge of cooling water from tunnels and Tsuen Wan West Station into Tsuen Wan Bay. The current estimated volume of cooling water discharge will exceed the TM volume standards, but will be subject to further revision when the engineering designs are finalised. Specific requirements for cooling water discharge should then be obtained from the EPD and DSD. Sewage effluent from the stations will not cause adverse impacts on marine water quality as it will be collected by the sewer. Tunnel seepage and track runoff contaminated with SS and grease will not introduce adverse impacts, provided they pass through silt and grease interceptors prior to discharge into stormwater culverts.

6.6 Landscape and Visual Issues

6.6.1 Existing Landscape Context

6.6.1.1 Landscape Character

In the Central Section West Rail starts at the southern wall of the proposed Mei Foo Station and passes in a north westerly direction through the high rock plateau at Cho Yiu Chuen, under Kwai Fuk Road, under ground along the shoreline east of Tsuen Wan Bay and into Tai Lam Country Park. The railway emerges from the tunnel under Tai Lam Country Park through the North Portal into the Kam Tin valley, and the interface with the West Rail Depot.

In the Central Section West Rail runs through 6 character zones: Lai Chi Kok Park, Kwai Chung rock area, from Kwai Ching Road to Wing Shun Street, Tsuen Wan Bay, Tai Lam Country Park and Kam Tin valley.

The first landscape character zone is centred on Lai Chi Kok Park, Stages 1 and 2 and is bounded by the Kwai Chung Road, Ching Chung Road and the northern part of the residential area of Mei Foo Sun Chuen. The Park is well established and comprises a mixture of open active and passive recreational spaces and enclosed intimate areas set within a soft landscape framework. It is an important district open space for residents and is of high local scenic and landscape value and is of relatively high sensitivity to change.

Kwai Chung rock area is a plateau upon which areas of mixed residential and community land use have been established within mature hillside vegetation. It forms the southern part of a ridge which overlooks the lower Kwai Chung area including Lai King to the west, the container related developments along the water edge of the Rambler Channel to the south, Mei Foo district and the Butterfly valley to the west. The mature vegetation and rocky outcrops of Kwai Chung Rock ridge give it local scenic value however as it extends north into the much higher hills of the Kam Shan Country Park the district scenic value becomes greater.

From Kwai Cheung Road to Wing Shun Street the landscape is a mix of commercial, industrial and residential use set within undulating land form. There are several major transportation routes within this area some of which are elevated which increase the sense of scale of development at ground level. Although the slopes of Kam Shan Country Park form a green back drop on the south west side of this area the landscape is in general of low scenic value due to the dominance of industrial buildings and elevated roads, and of low sensitivity to change.

The landscape in Tsuen Wan Bay area is flat and industrial in character and of low scenic value. The Bay area is dominated by the elevated structure of Tsuen Wan Road which runs in a north-westerly direction parallel to the water edge. There is public access across the southern edge of the bay along the promenade linking Riviera Gardens residential area with Tsuen Wan Park (currently under construction). However, the China Ferry terminal and the Public Cargo Works area restrict public access in the northern part.

On a wider scale the Bay area is surrounded by the hills of Tai Lam Country Park to the north, Shing Mun Country Park to the east, Kam Shan Country Park to the south and Tsing Yi island to the west. The combined skyline of the surrounding land form creates a sense of distant enclosure within the Bay area.

Tai Lam Country Park is an area of rural uplands of high scenic and landscape value. It is dominated by the mature vegetated slopes, the streams and reservoirs and a mix of natural and man-made landscape features of high recreational interest. The land form of Tai Lam Country Park separates the Kam Tin valley to the north from Tsuen Wan Bay area to the south.

The area of the Kam Tin valley immediately around the North Portal is of relatively high scenic value, the valley floor is wide and relatively flat and is characterised by an attractive mixture of woodland, pockets of farmland, streams and fishponds and several rural villages. The valley is partly enclosed in this location by the wooded hills of the Tai Lam Country Park.

6.6.1.2 Visual Envelope

Within the Central Section West Rail will be constructed in a series of bored tunnels, earth mounded box tunnels and cut and cover tunnels. The visual envelope is shown on *Figure 6.6a.*

The construction of West Rail will generally be visible from the following locations: Lai Chi Kok Park Stage 1, Ha Kwai Chung, Kwai Fong, Kwai Shing, Tsuen Wan Bay and Kam Tin valley.

In Kwai Fong, the scale of the buildings and elevated roads which extend beyond the limit of the construction site on either side will result in the railway corridor having a strictly localised visual impact.

West Rail will be within bored tunnel under Tai Lam Country Park and views within the park will not be affected. However, developments associated with the construction of the North Portal i.e. the ventilation buildings currently to be positioned on top of the tunnel Portal and its associated ramped access road will be visible from the Kam Tin valley and from the surrounding hillsides of the Tai Lam Country Park.

West Rail emerges from the Northern Portal and runs in a series of shallow cuttings and embankments towards the West Rail Depot at the interface of the Northern and Central section

The landscape and visual impacts of West Rail in Kam Tin valley are dealt with in *Section 7.6.*

6.6.1.3 Visually Sensitive Receivers

Visual Sensitive Receivers for the Central Section and the assessment of their sensitivity are as listed in *Table 6.6a, Annex G* and illustrated in *Figures 6.6a* and *b, Annex G.* (Visually Sensitive Receivers in Kam Tin valley are dealt with in *Section 7.6*)

6.6.2 Sources of Impact

Potential sources of landscape and visual impact during the construction and operational phases are identified below.

6.6.2.1 Construction Phase

- Site access and haul routes, including traffic movements.
- Cut and fill, including storage of existing topsoil for reinstatement works.
- Materials stockpiling ,construction equipment and plant .
- Utilities, including water, drainage, power and lighting.
- Temporary parking and on site accommodation and working areas.

6.6.2.2 Operational Phase

- Station buildings, EVA's, car parks and service areas
- Earth mounding over box tunnels.
- Ventilation buildings and fan chambers.
- Boundary fencing.

6.6.3 Evaluation of Impacts

6.6.3.1 Construction Phase

6.6.3.1.1 Landscape Impact

Current information indicates that the construction period for the Central Section of West Rail is currently programmed to commence in August 1998 with completion estimated for 2002. Relocation of utilities is scheduled to take place prior to the main construction works of each area.

Impact on Landscape Resources

In general the landscape impacts during the construction phase are greatest at the south and north ends of the Central Section in areas where the landscape quality is highest and where the route of the railway is visible at ground level.

In the short term, within Lai Chi Kok Park (Stage 1) there will be a very substantial negative impact to the landscape resources of the park through the disruption to the recreational facilities resulting from the construction of the proposed station and at grade box tunnel, and from the loss of existing mature trees. Use of the sports pitches in the southern half of the Stage 1 area will be lost for the duration of the works. These will need to be re-provisioned, after completion of the railway, to some location within Stage 3, (Phase 2) of the overall Lai Chi Kok Park Development. The station box within the Stage 1 Park will be mounded over and landscaped as a passive amenity area.

During the construction phase of the works associated with the underground pedestrian link from the Station to Mei Foo MTRC Station will result in a temporary, but substantial negative impact, to the landscape resources due to disruption of the existing paved area with a slight change in ground level (+0.5m) particularly outside Mount Sterling Mall. However, the change in ground level will be mounded over and landscaped as part of the reprovisioning of the park. Construction of the underground link will comprise the temporary removal of pedestrian facilities up to a distance of approximately 55m inside the Mall from Lai Wan Road. However, there will be no disruption to a 2m wide width of paving surface directly outside the shops on either side of the Mall hence no obstruction to the shop entrances. Upon completion of the underground link the disrupted Mall area will be redesigned as a civic space with new facilities including sitting areas with shade structures, a new water feature, new lighting, attractive shrub planting around the MTR/Station entrances and a new grand archway at the Mall entrance. Ground level at the centre of the Mall will be raised by +0.5m as a result of the underground link and will be finished with new high quality paving material. Access to the raised area will be from shallow ramps and short flights of steps (3 steps).

From Lai Chi Kok Park to Lai King Hill Road, West Rail passes under Ching Cheung Road in cut and cover tunnel. The construction works will result in loss of existing vegetation from the road embankments. This is considered to be a slight negative impact on the local landscape resources of the area. Replanting after completion of the railway will effectively mitigate this impact.

The construction of Ha Kwai Chung Ventilation Building within the wooded hillside overlooking Kau Wa Keng San Tsuen will require in the removal of existing vegetation resulting in a slight negative impact on the local landscape resources. Replanting around the Building upon completion of the construction process will help mitigate this impact.

From Lai King Hill road to Kwai Chung Road the railway will be in bored tunnel and there will be no landscape impact at ground level.

Kwai Fong Ventilation Building will be construction just north of where the railway emerges from rock tunnel at Kwai Chung Road. The Ventilation Building will be constructed on disused ground and there will be no landscape impact.

The route then proceeds north in cut and cover tunnel following the route of Kwai Fuk Road. The construction of the tunnel will result in the removal of the existing planting in Kwai Fuk Road roundabout and central reservation. This is considered to be a slight negative impact on the local landscape resources of the area. Replanting after completion of the railway will effectively mitigate this impact.

From Shing Fuk Street the railway enters bored tunnel and there will be no landscape impacts at street level.

The railway passes from bored tunnel into cut and cover tunnel approximately 200m north of Tsing Tsuen Road, beneath the Wah Kai and Paul Y buildings then through an unused section of land next to Waterside Plaza residential area. This piece of land has been reserved for a future squash centre however regional Services Department currently have no programme for the development of this facility in this location. The construction of the railway along this section will not disrupt any existing landscape features or pedestrian circulation.

The cut and cover tunnel passes under Wing Shun Street where there will be temporary traffic measures affecting the road and footpath during the construction period. From Wing Shun Street the route enters into Tsuen Wan Bay area and will run underground in cut and cover tunnel in between the elevated Tsuen Wan Road and the water edge.

At Tsuen Wan the route will run across new reclamation area alongside the Tsuen Wan District Open Space Area 35. Phase 1 of the Open Space is currently under construction and will not be directly affected by the proposed railway corridor. The new reclamation will, however require the upgrading of two large drainage culverts beneath the park which will result in some temporary alienation and loss of semi-mature trees. This will constitute only a slight negative impact on landscape resources during construction. Replanting after completion of the railway will effectively mitigate this impact.

Phase 2 of the Open Space area is currently a water edge promenade linking the recreational area of Riverside Plaza residential area with the China Ferry terminal. Although this route could be maintained in part during the construction period for access there would be a loss of amenity due to temporary pedestrian diversions where it crosses the railway corridor, and in the landscape setting of the promenade, as a result of the reclamation activities. This will constitute only a moderate negative impact on landscape resources during construction. Restoration over the railway corridor will comprise reprovisioning of the waterfront promenade and the integration of Phase 2 of the Open Space with the design of Phase 1 within a comprehensive new development. This will result in a moderate beneficial impact on the landscape resources of the area in the operational phase.

From the proposed Tsuen Wan Station to Castle Peak Road West Rail will run under ground in cut and cover tunnel. Currently the land is used as a Public Cargo Working Area (PCWA). The PCWA will be relocated to Stonecutters Island as part of Tsuen Wan Bay Further Reclamation however there is no programme for the development of this facility and it is unclear if this will occur before the West Rail construction process will commence. There are no landscape features or public walkways through the PCWA and there will be no impact on landscape resources during construction.

There will be disruption to the footpath, road and central reservation planting on Hoi Hing Road for the construction of West Rail resulting in diversion of traffic and pedestrian circulation. This will result in a slight negative impact on landscape resources within this area. Replanting after completion of the railway will effectively mitigate this impact.

There will be no impact on the landscape features within Tsuen Wan District Open Space at Area 2 (Tsuen Wan RC Project 244LS) although there will be disruption to surrounding footpaths and roads on Hoi On Road during the construction of the South Portal resulting in a slight negative impact on landscape resources within this immediate area.

There will be disruption at ground level to the rock face and existing vegetation within Proposed Tsuen Wan District Open Space Area 3, Tsuen Wan RC Project 245 LS from the construction of the cut and cover tunnel and removal of excavated material from the adjacent bored tunnel. This will result in a moderate negative impact on resources of the eastern section of the Park. However, there will be no impact on the resources within the most useable sections of this park as the railway would be within bored tunnel.

From Castle Peak Road/Tsuen Mun Road to the North Portal, West Rail will be in bored tunnel under Tai Lam Country Park and there will be no impacts on the landscape at ground level.

The construction of the North Portal and railway connection to the Depot site within the Kam Tin Valley will incur a temporary very substantial negative impact on landscape resources, through the Removal of areas of woodland, fishponds, agricultural land, diversion of a tributary of the Kam Tin river and disruption to burial sites. Planting of the embankment slopes and reinstatement of the landscape pattern to either side is likely to partly mitigate the impact on resources, however there will still be a long term moderate negative impact on landscape resources in the operational phase.

The construction of West Rail will also have an impact on topsoil reserves along the route particularly where the construction works will require the removal or temporary relocation of landscape resources i.e. Lai Chi Kok Park Stages 1, Tsuen Wan Open Space Area 35 and around the North Portal. The impacts on topsoil removal can be minimised by storage of topsoil according to Government Standards. These comprise storage of topsoil in an area where it will not be disrupted by engineering works, storing heaps at a maximum height of 2 m, carrying out tests on nutrient and organic status, practising weed control, and turning the topsoil heaps to prevent anaerobic conditions occurring. Top soil should also be placed in its final position within 12 months of importation to site.

Impact on Landscape Character

Within Lai Chi Kok Park (Stage 1) there will be a temporary, but very substantial negative impact on the landscape character of the park during construction due to the replacement of existing park landscape by activity associated with the construction of the proposed station and at grade box tunnel, and from the loss of existing mature trees. This will be reinstated as passive landscape upon completion of the railway, increasing visual enclosure and screening from surrounding developments. In the long term this will result in a slight beneficial impact on the landscape character.

The loss of existing vegetation from the road embankments at Lai King Hill Road and Ching Cheung Road and for the construction of Ha Kwai Chung Ventilation Building will result in a slight impact on the character of these areas. Reinstatement planting after construction will in time grow to replace the vegetation lost and there will be no long term impact on the landscape character.

The removal of the existing planting in Kwai Fuk Road roundabout and central reservation. As a result of the construction of the tunnel will result in a very slight negative impact on the character of the landscape of the road corridor. Replacement planting at the end of the construction work will in time restore the landscape to its present condition and there will be no long term impact on landscape character.

At Tsuen Wan there is likely to be a moderate negative impact on the character of Tsuen Wan District Open Space Area 35, Phase 1 from the loss of trees and landscape setting caused by the construction of the two drainage culverts beneath the park. This will be replaced in time and there will be no long term impact on landscape character.

There is likely to be a substantial negative impact on the character of Phase 2 of the Open Space during construction as the character of the water front promenade is dependent on its relationship to the water. Reprovisioning of the waterfront promenade within a comprehensive new development, however, will result in a moderate beneficial impact on the landscape character of the area in the long term.

The removal of the existing planting in Hoi Hing Road, as a result of the construction of the tunnel, will result in a very slight negative impact on the character of the landscape of the road corridor. Replacement planting at the end of the construction work will in time restore the landscape to its present condition and there will be no long term impact on landscape character.

The disruption to surrounding footpaths and roads on Hoi On Road during the construction of the tunnel and the South Portal will result in a slight negative impact on the landscape character of Tsuen Wan District Open Space at Area 2 (Tsuen Wan RC Project 244LS). However, restoration on the completion of the works will ensure that there will be no long term impacts on the landscape character.

The construction of the cut and cover tunnel and the bored tunnel within proposed Tsuen Wan District Open Space Area 3 (Tsuen Wan RC Project 245LS) will disrupt existing landscape features within the steep slopes of the area but will have a limited affect on the character of the flat more useable part of the park. The overall impact on the landscape character will be moderate negative however the works will not affect the character of the adjacent Tai Lam Country Park. Replanting and restoration of the rock face will minimise long term impacts on the landscape character of the area.

The construction of West Rail within the southern portion of the Kam Tin valley will cause disturbance of existing landscape features and drainage patterns, and involve the large scale removal of rock from the northern half of the bored tunnel to the West Rail Depot site, as well as the construction of the North Portal and associated ventilation building and ramped access road. These will cause severe disruption to the scenic quality and intimate landscape character of the valley floor and result in a very substantial negative impact.

Planting of the perimeter embankment slopes will provide a positive woodland feature within the valley which will provide a strong edge to the surrounding landscape pattern, and will be compensation in part for the loss of the existing landscape character, however there will still be a long term moderate negative impact on landscape character in the operational phase.

There are seven temporary works areas in the Central Section, as shown on *Figures 6.6a-b* and *7.6b*; three of the sites are major works areas and four are minor. One of the major works areas is located in between Kwai Chung Methodist College and Kwai Fuk Road. It is currently vacant and is zoned as a future urban development area and will be used for the storage of materials, plant, temporary accommodation and carparking associated with the construction of Kwai Fong Ventilation Building. There are no areas of vegetation or landscape features on these sites which could be disrupted during the construction period.

The second large site is the future reclamation area at Tsuen Wan Bay. The northern part of this site is currently the Public Cargo Works Area which will be relocated to Stonecutters Island. The southern part is the pedestrian promenade from Riviera Gardens residential area to the China Ferry Terminal. This site will be used for the construction of Tsuen Wan West station and for the new water edge promenade area. There will be disruption to the planting and pedestrian access of the existing promenade during the construction period however, the planting is not yet mature, is not of ecological importance and could be relocated else where at the start of the construction period.

The third major temporary works area is around the site for the North Portal in the Kam Tin Valley. There will be disruption to mature vegetation, agricultural land, wetland of ecological importance and pedestrian and vehicular accesses, resulting in a substantial impact on the landscape character of the area.

The four minor sites are located between Lai Chi Kok Park (Stage 1) and Clague Gardens in Tsuen Wan Bay. There are no areas of vegetation or landscape features on these sites which could be disrupted during the construction period.

6.6.3.1.2 Visual Impact

An assessment of the potential residual visual impacts during the construction phase is shown in *Table 6.6a, Annex G* and illustrated in *Figures 6.6a-b, Annex G.* This assessment assumes that the appropriate mitigation measures identified below have been implemented.

6.6.3.1.3 Mitigation Measures

Recommended mitigation measures for impacts caused during the construction process 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.

6.6.3.1.4 Residual Impacts

The mitigation measures will, to the maximum extent possible, reduce the potential negative visual impacts temporarily experienced by nearby sensitive receivers. However the residual impacts will remain substantial, but only in the short term during the construction phase. The residual impacts are tabulated in detail in *Table 6.6a, Annex G* and illustrated in *Figures 6.6a* and *b, Annex G.*

The key visual impacts will be in the vicinity of Mei Foo Station, the sections of cut and cover tunnel in Kwai Fong and Tsuen Wan and in the vicinity of the North Portal.

In the short term the construction of Mei Foo Station will result in a very substantial negative visual impact for the nearby residents in the north west facing apartments of Mei Foo Sun Chuen, users of Lai Chi Kok Park Stage 1 and Lai Chi Kok Pool. During the construction period the works associated with the underground pedestrian link from the Station to Mei Foo MTRC Station would result in a substantial negative visual impact within Mount Sterling Mall. These impacts will however be temporary in nature and will be minimised by the mitigation measures applied. Short term substantial negative impact will be experienced by residents of Ching Lai Court during construction and a slight negative impact by staff and patients in Princess Margaret Hospital. Vehicular traffic on Ching Cheung and Kwai Chung Roads will also experience a very slight negative visual impact from the works in the Park.

The construction of Ha Kwai Chung Ventilation Building within the wooded hillside overlooking Kau Wa Keng San Tsuen will result in a moderate negative visual impact on residents of this village area and for staff of the WSD reservoir and land allocation adjacent to the site due to the disruption to existing hillside vegetation. Very slight negative visual impacts will also be experienced by patients and staff of Kwai Fung Hospital to the south.

The construction of Kwai Fong Ventilation Building will cause a medium negative visual impact for users of Kwai Chung Methodist College and Lai King Catholic Secondary School.

The construction of the cut and cover tunnel between Kwai Chung Road and Kwai Shing Estate will cause very substantial negative temporary impacts on both the Civic Centre currently under construction next to Metroplaza and the adjacent recreational open space. Short term substantial impacts will be experienced by Kwai Fong Court. Moderate impacts will be experienced by south-east facing residential properties of Kwai Shing Estate West and Hibiscus park on the higher ground to the north, and the industrial properties along Kwai Fuk Road. Slight impacts will be experienced by Lai Yiu Estate on higher ground to the east.

In the short term the construction of the cut and cover tunnel along Tsuen Wan waterfront will cause very substantial negative impacts on Clague Gardens and Waterside Plaza during the construction phase. Substantial temporary impacts will be experienced by Tsuen Wan Park, Riviera Garden and the recreational open space alongside. Very slight impacts will be felt by the bus terminus next to Clague Gardens and the industrial properties at the north-west end of the Bay.

The construction of the South Portal ventilation building will have a slight negative impact on the industrial properties on Hoi Shing road, Chai Wan Kok Street and Hoi On Road and on Tsuen Wan District Open Space at Area 2.

Villages in the southern end of the Kam Tin valley will experience very substantial negative temporary visual impacts from the construction of the North Portal and associated developments.

6.6.3.2 Operational Phase

6.6.3.2.1 Landscape Impact

The re-provisioning of facilities from Lai Chi Kok Park (Stage 1) after completion of the railway, to some location within Stage 3, Phase 2 of the overall park development will effectively mitigate impacts on the landscape resources and character of the park, and the reorganisation of the park facilities into a more co-ordinated structure and the introduction of a landscaped passive amenity area on mounding over the station and tunnels should result in a moderate beneficial impact on landscape resources, and a moderate beneficial impact on the character of the surrounding landscape in the operational phase.

The section of Lai Chi Kok Park on top of the Northern Section of Mei Foo Station will be +18.2 mPD i.e. 6m above Kwai Chung Road/ Lai Chi Kok Bridge. Substantial screen planting along the southern boundary of this section of the park will screen the road for users of the park. This will therefore be an improvement on the existing situation where the road is clearly visible. The ground level of the Park on top of the Southern Section of the Station will be +12.2 mPD i.e. the same height as the road level. Views of the bridge will be obscured by the station concourse connection structure and by tree planting along the edge of the roof.

The redesign of the western section of Mount Sterling Mall will in the long term result in a beneficial impact on the landscape resources due to the upgrading of pedestrian facilities and the general enhancement to the localised environment and have a slight positive visual impact for users of the Mall. The presence of the raised area (+0.5m) in the centre of the Mall will not obstruct views across the space and the area will continue to be a public through route to the eastern section of the Mall.

The reinstatement of vegetation from Central reservation areas, roundabouts and embankments at Lai King Hill Road /Ching Cheung Road, Kwai Fuk Road roundabout and Hoi Hing Road will effectively mitigate any impact on landscape resources or character.

Reinstatement of planting and park facilities within Tsuen Wan District Open Space Area 35, Phase 1 that would disrupted by the upgrading of two large drainage culverts would effectively mitigate any impact on landscape resources or character. Reprovisioning of the waterfront promenade Phase 2 of the Open Space 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.

Planting along the shallow cuttings and embankments to the route within the Kam Tin valley will only mitigate the impact on landscape resources and character in part, but there will be a moderate negative impact on the landscape even when the planting has become fully established.

6.6.3.2.2 Visual Impact

An assessment of the residual visual impacts during the operational phase is shown in *Table 6.6a, Annex G* and illustrated in *Figures 6.6c-d, Annex G*. This assessment assumes that the appropriate mitigation measures identified below have been implemented.

6.6.3.2.3 Mitigation Measures

The *Landscape Design Strategy Report* has proposed design principles for all landscape and visual aspects of West Rail, as a guide for the detailed design by all engineering Design Consultants. These design principles form the essential basis of the mitigation measures which will be employed to minimise negative impacts and create the potential for positive impacts.

The principle design recommendations that are applicable to the Central Section are listed below:

- Shape and plant earth mounds over box tunnels in order to integrate their landscape design with adjacent open spaces
- Site vent structures to minimise visual intrusion
- Integrate design of Vent Structures with surrounding architecture and urban context

6.6.3.2.4 Residual Impacts

Within the Central Section, West Rail will be largely invisible during the operational phase. The only visible manifestations of the railway will be the stations, vent structures located over some sections of tunnel, and northern tunnel portal area at Kam Tin valley. Implementation of the recommendations of the *Landscape Design Strategy Report* where possible will result in an overall slightly positive visual impact.

Soft and hard landscape treatment around ventilation buildings and the tunnel portal will reduce their visual impact and should create visually attractive landscape features. *Figure 6.6e* in *Annex G* shows an artist's impression of the tunnel portal area at Kam Tin valley, as provided by the engineering Design Consultants.

At Mei Foo the station design will include an extensive roof garden facility which will provide attractive views from Mei Foo Sun Chuen, Ching Lai Court and Lai Chi Kok Pool. The landscape associated with the station will also screen the ugly concrete slopes of Ching Cheung Road when viewed from Lai Chi Kok Park Stage 1. Consequently there will be a slight positive residual visual impact to these visual receptors. Substantial screen planting adjacent to Kwai Chung Road/Lai Chi Kok Bridge will screen views of the road for users of the park. This will therefore be an improvement on the existing situation where the road is clearly visible. *Figure 6.6f-k* in *Annex G* show the preliminary master landscape plan and cross section of the Lai Chi Kok Park, as provided by the engineering Design Consultants.

At Tsuen Wan Bay, Tsuen Wan Park Phase II will be constructed at grade over the cut and cover tunnel. This will create a landscape link connecting Tsuen Wan Park with the waterfront and will also improve the views from Waterside Plaza, Riviera Garden and Clague Gardens, resulting in a positive residual impact. Additionally the construction of the South Portal in Tsuen Wan Bay will screen the industrial buildings on Hoi On Road resulting in a slight positive residual visual impact to the visual receptors on the east of Tsuen Wan Road.

6.6.4 Conclusion

The route is either in cut and cover, or bored tunnel almost 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 to the maximum extent possible 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 alienated with the loss of a number of sports pitches and mature planting from within the park resulting in a very substantial negative landscape impact during construction. Facilities would be reprovisioned 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 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 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 reprovisioning 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. Reprovisioning of the waterfront facilities Open Space 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 space.

During the operational phase the Central Section of West Rail will be virtually invisible. However there will be positive visual impacts resulting from the landscape roof deck over Mei Foo Station and the landscaped area over the tunnel in Tsuen Wan.

6.7 Landuse Issues

The following section outlines the land use issues associated with West Rail between Lai Chi Kok Park and the Kam Tin Valley. A detailed appraisal of the land use impacts of the railway in this section has been studied by the engineering Design Consultants; the findings of these studies, and recommended mitigation options, have been developed in liaison with the relevant Government departments and affected bodies and have been reported, in detail, elsewhere.

6.7.1 Landuse Context

6.7.1.1 Lai Chi Kok Park to Tsuen Wan

The planning framework for the urban areas abutting the West Rail Central Section alignment (from south to north) is addressed by the Lai Chi Kok OZP (No. D/K16/1C), the Kwai Chung ODP (No. D/KC/A), the Tsuen Wan Central ODP (No. D/TWC/2), and the Tsuen Wan North ODP (No. D/TWN/2). A number of privately owned sites have been identified for resumption to facilitate the introduction of West Rail. It is anticipated that resumption will be conducted under the *Railways Ordinance.*

Lai Chi Kok (LCK) Park facilities (shown as OS2 and OS3 in *Figures 5.6c* and *6.6a* in *Annex G*), will be disrupted during construction of the West Rail Mei Foo Station. The engineering Design Consultants have examined interfaces between the park and railway. It is anticipated that those park facilities affected by West Rail will be reprovisioned within the park and that there will be no net loss of existing facilities in the park.

The proposed West Rail alignment through the Central Section has three proposed tunnels. These are Ha Kwai Chung Tunnel, Tsing Tsuen Road Tunnel and Tai Lam Tunnel. These tunnels in themselves are not anticipated to create any planning impacts. However, land will be required for the associated ventilation buildings and cut and cover works, and may influence the future use of adjacent land.

A tunnel ventilation building and traction power substation are proposed to be accommodated on an area in Kwai Fong zoned 'Other Uses (OU) Container Related Uses', currently occupied by lorry parking. The lorry parking will require reprovisioning within the container port area.

Resumption and demolition of the Paul Y and Wah Kei Industrial buildings are required for the construction of the portion of cut and cover tunnel in the Tsuen Wan Bay area. Compensation for the industrial buildings affected will be provided.

A number of footbridges will require reprovisioning, construction or extension to provide connectivity to the proposed West Rail stations. Pedestrians are anticipated to experience temporary loss of amenity, accessibility and ease of movement. Continued pedestrian movement, however, will need to be maintained during the construction period.

A salt water pumping station lies within the proposed West Rail alignment in Tsuen Wan. A reprovisioning site has been proposed within the West Rail related reclamation in Tsuen Wan Bay.

Tsuen Wan Town Park (TWTP) Phase 2, shown as OS6 in *Figure 6.6b (Annex G)*, was originally programmed by Government to be developed and completed by late 1997. TWTP Phase 2 falls within the proposed West Rail alignment and temporary loss and disruption of the proposed open space areas are anticipated. The Consultants of the town park have prepared proposals to replan and redevelop the park extension and waterfront area, ensuring that full reprovisioning of affected park land is observed and that connectivity to the envisaged waterfront promenade is maintained.

Construction of the railway through Tsuen Wan will cause temporary severance of access to a number of areas. Temporary alternative access will be provided until such time restitution or alternative circulation systems are completed.

6.7.1.2 Kam Tin Valley

As stated above the Tai Lam Tunnel (TLT) runs from Tsuen Wan to the Kam Tin Valley. The TLT will not have any land use impacts upon the Country Park. The planning framework for the southern Kam Tin Valley is covered by Kam Tin South OZP (No. S/ KTS/ 1). The area to the north of the northern portal of the TLT comprises mainly high quality farmland, fishponds and villages.

The principal impacts generated by West Rail in this area are likely to be cultural. A number of grave sites and other traditional/cultural artefacts will be affected and compensation is under liaison.

West Rail is also anticipated to impact upon an area of 'Agricultural' and 'Conservation Area' zonings north of the Tai Lam Country Park in the vicinity of the northern portal. The boundaries of Tai Tek and Cheung Po villages, zoned 'V' and shown as R21 and R22 respectively in *Figure 7.6b (Annex G)*, may require slight adjustment if minimal loss of village land is to be achieved.

6.7.2 Community Context

Likely areas of community concern in the Kam Tin Valley include land and property rights, community facilities, visual amenity and the loss of grave sites; these are under continuous liaison. A footbridge will be provided over West Rail to ensure that access between villages is not lost.

6.7.3 Conclusion

According to the 1996 By-census there were 374,688 people living in the Tsuen Wan area. The residential demographics in Tsuen Wan are expected to change with the introduction of West Rail.

The loss of the factories in Tsuen Wan will mean the loss of employment for factory workers. The potential development of commercial properties will increase the opportunities for white collar workers. These two changes will impact on the population within Tsuen Wan.

The Central Section of West Rail is mainly in tunnel which produces few land use impacts. The primary areas of concern in this section are Lai Chi Kok Park, the Tsuen Wan Area and land surrounding the Northern Portal of the TLT. The Tsuen Wan area presents a variety of reprovisioning issues that have been addressed individually by the engineering Design Consultants to mitigate identified impacts.

6.8 Archaeological and Cultural Issues

6.8.1 Existing Conditions

South of the Kam Tin valley, the Central Section of the West Rail alignment is to be constructed across recent or historical reclamation and in bored tunnel. Field visits have confirmed that, there are no historical buildings or features that are likely to be impacted by the new railway. Furthermore, the extent of ground disturbance is to be limited to fill material associated with the reclamation process and to tunnelling; this ground disturbance will not give rise to impacts to archaeological deposits. For the purposes of the EIA, therefore, that part of the Central Section that is south of the Kam Tin valley portal of the TLT is considered to be scoped out of the EIA and has not be given further consideration in the Final Assessment Report.

Literature review and field surveys conducted by Professor Siu Kwok-kin of the Hin Chiu Institute have confirmed that there are no historic structures or buildings which are likely to be impacted by the construction or operation of West Rail in this section.

The alignment north of the TLT, however, is considered to have potentially high levels of archaeological survival.

6.8.2 Potential Sources of Impact

The area to the north of the northern portal to the Tai Lam Tunnel will potentially be impacted by activities associated with the construction, permanent landtake and operation of West Rail.

Both temporary and permanent landtake may result in damage to, or loss of, archaeological remains and deposits due to the following activities.

- Disturbance through excavations at or near the site, topsoil stripping and the passage of heavy machinery on exposed deposits;
- Disturbance by machinery working on the present surface where there are extant earthworks;
- The burial of sites resulting in a limitation on accessibility for future archaeological investigations (including surface survey and remote sensing techniques) and obscuring visible surface evidence; and
- The introduction of archaeological material with spoil from other sites.

In addition, severance and "islanding" may result from permanent landtake required for the West Rail alignment and associated permanent features and from temporary landtake required during construction to accommodate haul roads and construction sites. Areas of historic and cultural interest may be severed, thereby altering or destroying their integrity.

Ground compaction due to construction activities or the weight of permanent embankments may cause damage or distortion to buried archaeological remains, especially in soft alluvial deposits.

6.8.3 Prediction & Evaluation of Impacts

6.8.3.1 Historic Buildings

No buildings or structures of known historical interest are to be impacted by the West Rail alignment in this Section.

6.8.3.2 Archaeological Resources

Preliminary data gathering has shown that no known archaeological sites will be directly affected by the West Rail alignment. The assessment of archaeological potential has, however, identified the portal area as having a high potential. The evaluation of likely impacts in this area is currently underway and will inform the development of the Field Evaluation Programme. The AMO will continue to be consulted regarding the direction and progress of the heritage assessment.

In developing the predictive model of likely impact to archaeological resources, the Study Team has undertaken a number of activities in support of the predictive assessment including the evaluation of information revealed by borehole logs and the planning of a programme of direct observations of geotechnical investigations, particularly the excavation of test pits.

Validation of this predictive model of archaeological potential is scheduled to be undertaken in early 1998. This will take the form of a series of Trial Pits and Auger Transects designed to test the accuracy of the maps of archaeological potential prepared on the basis of the Desk Top Study. The findings of the field testing will be formally reported to the AMO.

The completion of these ongoing tasks will enable the final predictive modelling to be completed. The model will then provide a basis for an assessment of the likely impact to archaeology along the alignment of the new railway. This archaeological impact assessment will be based upon the nature and extent of construction activities (*the level of impact*) and the predicted potential (*the predicted value of the resource*) of the area within which the activities are to take place.

The archaeological impact assessment will provide a basis for determining the need for field evaluation in advance of the construction of the new railway which will be advanced through the development (in consultation with the AMO) of a specification and programme for field evaluation (or trial work). This will be reported in the Field Evaluation Programme and Protocols which will identify the significant impacts likely to arise during construction and operation and will formulate of a plan for the mitigation of identified impacts.

The first level of field evaluation will comprise non-intrusive surface examination of potentially impacted areas. If identified areas are clear of vegetation then a systematic surface collection will be made by walking parallel lines; if concealed by vegetation then any exposed areas will be searched. Densely vegetated land may be excluded from this stage of field evaluation, due to the time and cost of evaluation, and will be evaluated once Land Acquisition powers have been gained by the KCRC and clearance effected.

The field evaluation programme will identify the areas to be investigated and will produce field evaluation protocols determining the sampling technique (for example, test pit or trench), the sample rationale to be applied (numbers of required test pits; dimensions of pits, sampling grid, etc.) and the site record forms to be used during the field evaluations. The evaluation protocols would be produced with reference to those established in Hong Kong and would be compatible with the best field practice and data capture requirements of the AMO.

Whilst the Field Evaluations fall outside the scope of the EIA Study, they would form part of the ongoing West Rail Project and their commencement would be subject to the KCRC gaining powers of access to the identified areas within the study corridor.

The results of the Field Evaluations would form the basis for the development of an archaeological action plan detailing the measures to be adopted to provide appropriate mitigation of the impacts to buried archaeology. Although there are no standard criteria against which to assess the severity of impacts to cultural heritage, the appropriate actions will be defined and recommended based upon the following factors:

- The proportion of the feature affected and whether its key characteristics would be affected by the West Rail works;
- A consideration of the type, survival or condition, fragility or vulnerability, potential and amenity value of the feature affected; and

- Guidelines or criteria on noise, visual intrusion, etc. either in general or site specific terms, provided by other West Rail specialist teams.

The adopted mitigation measures might include the minimisation of ground disturbance in archaeologically sensitive areas, excavation in advance of construction and the provision of a watching brief during construction.

6.8.4 Recommended Mitigation

The mitigation of impacts to archaeological resources will be reported via the field evaluation programme and through ongoing discussions with the AMO's archaeological curators.

6.9 Ecology

Ecological concerns are only relevant to the northern part of this section from the north portal of the TLT to the West Rail Depot. This represents an alignment length of about 270m. The potential ecological impact associated with this short section is addressed under *Section 7.9.* together with the Depot and Northern Section that fall within the Kam Tin Valley.

6.10 Waste

6.10.1 Potential Sources and Prediction of Impacts

6.10.1.1 Construction Phase

6.10.1.1.1 General

Construction activities to be carried out for the Central Section of West Rail will result in the generation of a variety of wastes which include:

- Site clearance waste;
- Excess excavated material/spoil;
- General construction waste;
- Demolition waste;
- Chemical waste;
- General refuse; and
- Contaminated marine sediments.

These are discussed in the following sections.

6.10.1.1.2 Site Clearance Waste

As most of the Central Section will be constructed underground, little site clearance waste is anticipated. A small amount of vegetation and timber waste will be generated from the clearance of a small piece of woodland at the northern portal of the TLT.

6.10.1.1.3 Excess Excavated Material

The construction of a series of bored and cut and cover tunnels and two underground stations will produce a considerable amount of surplus excavated rock and soft material. Excavated material will be generated from the following construction activities:

- Construction of the 300 m long, underground Mei Foo Station at Lai Chi Kok Park using the cut-and-cover method;
- Construction of a 100 m long cut-and-cover tunnel to the north of Mei Foo Station;
- Construction of the 1,690 m long Ha Kwai Chung Tunnel using drill and blast methods;
- Construction of a 600 m long cut-and-cover tunnel underneath the Kwai Fuk Road;
- Construction of the 1,200 m long Tsing Tsuen Tunnel using drill and blast;
- Construction of a 300 m long cut-and-cover tunnel to the north of Tsing Tsuen Tunnel;
- Construction of the 340 m long Tsuen Wan West Station in the Tsuen Wan Bay Reclamation using the cut-and-cover method;
- Construction of a 1,050 m long cut-and-cover tunnel to the north of Tsuen Wan West Station; and
- Construction of the 5,420 m long TLT using drill and blast.

6.10.1.1.4 General Construction Waste

About 73,900 m^2 and 55,700 m^2 of gross floor area will be constructed at Mei Foo and Tsuen Wan West Stations respectively. General construction waste generated from these construction works will consist of wood waste from formwork and falsework, material and equipment wrappings, and surplus or rejected construction material.

If general construction wastes are not removed from site regularly, they may hinder construction and present a safety hazard, in addition to causing potential water quality impacts from runoff. The storage and disposal of construction wastes also have the potential to create visual and dust nuisances.

6.10.1.1.5 Demolition Waste

Although the majority of the Central Section will be constructed below ground level using drill and blast tunnelling methods, certain areas of the Central Section will be constructed using the cut-and-cover method. Some existing buildings or facilities will be demolished for the construction of the cut-and-cover tunnels. In addition, the reclamation of a portion of Tsuen Wan Bay for the construction of Tsuen Wan West Station will necessitate the demolition and relocation of the existing Tsuen Wan Ferry Pier. Demolition waste will be generated from the following activities:

- Relocation of the footbridge across Ching Cheung Road to the Ching Lai Commercial Centre;
- Relocation of some of the recreational facilities of the Lai Chi Kok Park;
- Demolition of Paul Y Industrial Building, Shun Kei Flatted Factory and Wah Kei Building, which may contain asbestos;
- Relocation of the Water Services Department (WSD) Salt Water Pumping Station which will involve the demolition of the existing pumping compound and associated facilities; and
- Demolition of the existing HYF ferry pier which is a four-storey building.

6.10.1.1.6 Chemical Waste

Substances likely to be generated by construction activities for the Central Section will, for the most part, arise from the maintenance of equipment. These may include, but may not be limited to, the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Shutter release agents (chemical/oil based emulsions);
- Waste explosive from the tunnelling works;
- Spent mineral oils and cleaning fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

In addition, the demolition of the Paul Y Industrial Building, Shun Kei Flatted Factory and Wah Kei Building may produce asbestos waste.

Chemical waste may pose serious environmental, health and safety hazards if not properly managed. These hazards include:

- Toxic effects to workers;
- Adverse effects on water quality from spills;
- Fire hazards; and

- Disruption of sewage treatment works if chemical waste enters the sewerage system.

6.10.1.1.7 General Refuse

General refuse will be generated from the works sites for the Central Section. The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

6.10.1.1.8 Marine Sediment

The reclamation of a portion of Tsuen Wan Bay for the construction of Tsuen Wan West Station may require dredging of marine sediment. Government has a standing policy of minimising mud dredging as far as possible in order to conserve the finite fill resources and minimise the requirement for mud disposal. With respect to this policy, the engineering Design Consultant has reviewed various reclamation methods. However, it is considered that dredging of marine sediment along the line of seawall could not be avoided. The settlement rate of the reclaimed area behind the seawall can be increased by surcharging and installation of wick drains and therefore dredging in this area will not be required.

It is very likely that marine sediments in Tsuen Wan Bay area are contaminated with heavy metals and will be classified as either Class B or Class C contaminated mud as indicated in *Section 6.5.1.2.6*. The dredged sediment will have to be disposed of in an environmentally secure manner. Special handling, transport and disposal methods have to be followed. FMC should be consulted to determine the location of an appropriate disposal site.

6.10.1.2 Operational Phase

6.10.1.2.1 General Refuse

General refuse will arise from the public, station employees and commercial operators within the Mei Foo and Tsuen Wan West Stations. Materials may include food waste, wood, plastic, office wastes, old tins/containers, cleaning materials and miscellaneous other waste produced during daily activities. As discussed for the construction phase, the storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, litter, water quality impacts if waste enters storm water drains, visual impact and vermin problems if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of general refuse at sites other than approved waste transfer or disposal facilities can also lead to similar adverse impacts at those sites.

6.10.1.2.2 Industrial Waste

Industrial waste will arise from maintenance activities of the railway and the two stations of the Central Section. The materials may include scrap materials from rail and carriage maintenance, used fluorescent tubes, used welding rods, cleaning materials and discarded electronic equipment.

6.10.1.2.3 Chemical Waste

Chemical waste will arise from maintenance activities of the railway and stations of the Central Section. The waste may include lubricants, paints, acids/alkalis, mineral oil, batteries, coolants and solvents. As discussed in *Section 6.10.1.1.6*, these chemical wastes may pose significant environmental, health and safety hazards if they are not properly managed.

6.10.2 Evaluation of Impacts

The nature and amount of the waste arising from the construction and operation of the Central Section and the potential environmental impacts which may arise from their handling, storage, transport and disposal are discussed in detail below.

6.10.2.1 Construction Phase

6.10.2.1.1 Site Clearance Waste

As little site clearance work apart from the northern portal of the TLT will be required for the construction of the Central Section, it is anticipated that there will be negligible environmental impact due to the storage, handling, transport and disposal of site clearance waste. The contractor should liaise with the AFD for the possibility of reusing suitable wood generated from site clearance works for the construction of country park facilities.

6.10.2.1.2 Excess Excavated Material

The total volume of excavated material (including soil and rock) produced from the construction of the Central Section will amount to approximately 4 million m^3 (of which about 1.3 million m^3 will be generated from TLT) (see *Table 5.10a, Annex N*). The reclamation of the Tsuen Wan Bay will require about 847,000 m^3 and 145,000 m^3 of sand fill and rock respectively. The Engineering Design Consultants propose to use natural sand fill for the reclamation. Sand would probably be imported from the Pearl River Delta by barge. With respect to the construction programme, and the cut and fill requirements of the Central Section (see *Figure 6.10a*), it may be possible for the soil and rock excavated from the South Portal cut-and-cover tunnels to be used for the reclamation if the materials have the required engineering properties. This will minimise the amount of sand fill to be imported and the amount of excess excavated material to be disposed of at the public filling areas. As shown in *Figure 6.10a* and *Table 5.10a (Annex N)*, there will be a surplus of about 2.5 million m^3 of excavated materials from the Central Section. During the peak period (September 2000), an average of 6,600 m^3/day excess excavated materials (about 55.2% are rock) will need to be disposed of (see *Table 5.10a Annex N*). About 47.5% of the excess excavated material exported in 2000 are rock from the construction of tunnels.

The local construction industry has a large demand for good quality rock, and it is anticipated that most of the rock generated could be absorbed by that industry. Assuming all the excess rock can be reused by the local construction industry, there may still be a large quantity (in the order of 1,400 m^3/day in December 1999 to 2,800 m^3/day in September 2000) of excess excavated material (mainly soil material) requiring off-site disposal.

The excess excavated material can also be used for site formation of other sections of West Rail. Site formation of the Depot will require the import of about 1.46 million m^3 of structural and embankment fill (see *Table 5.10a, Annex N*). From January 2000 to August 2000, the formation of West Rail Depot will need to import about 1,000 m^3/day to 3,200 m^3/day of fill material. It is likely that all the excess excavated rock arising from the northern portal of TLT (about 770 m^3/day) could be used for the Depot earthwork. However, the excavated rock will need to be crushed before it can be used for site formation. Transport of the excess excavated materials from other parts of the Central Section to West Rail Depot should also be considered. Integration of construction programmes will help to ensure that full use is made of the excess excavated material. A stockpile area is being provided within the Depot construction development plan. It is understood that stockpiling of excess excavated material required for the Depot earthworks will be possible within the Depot area.

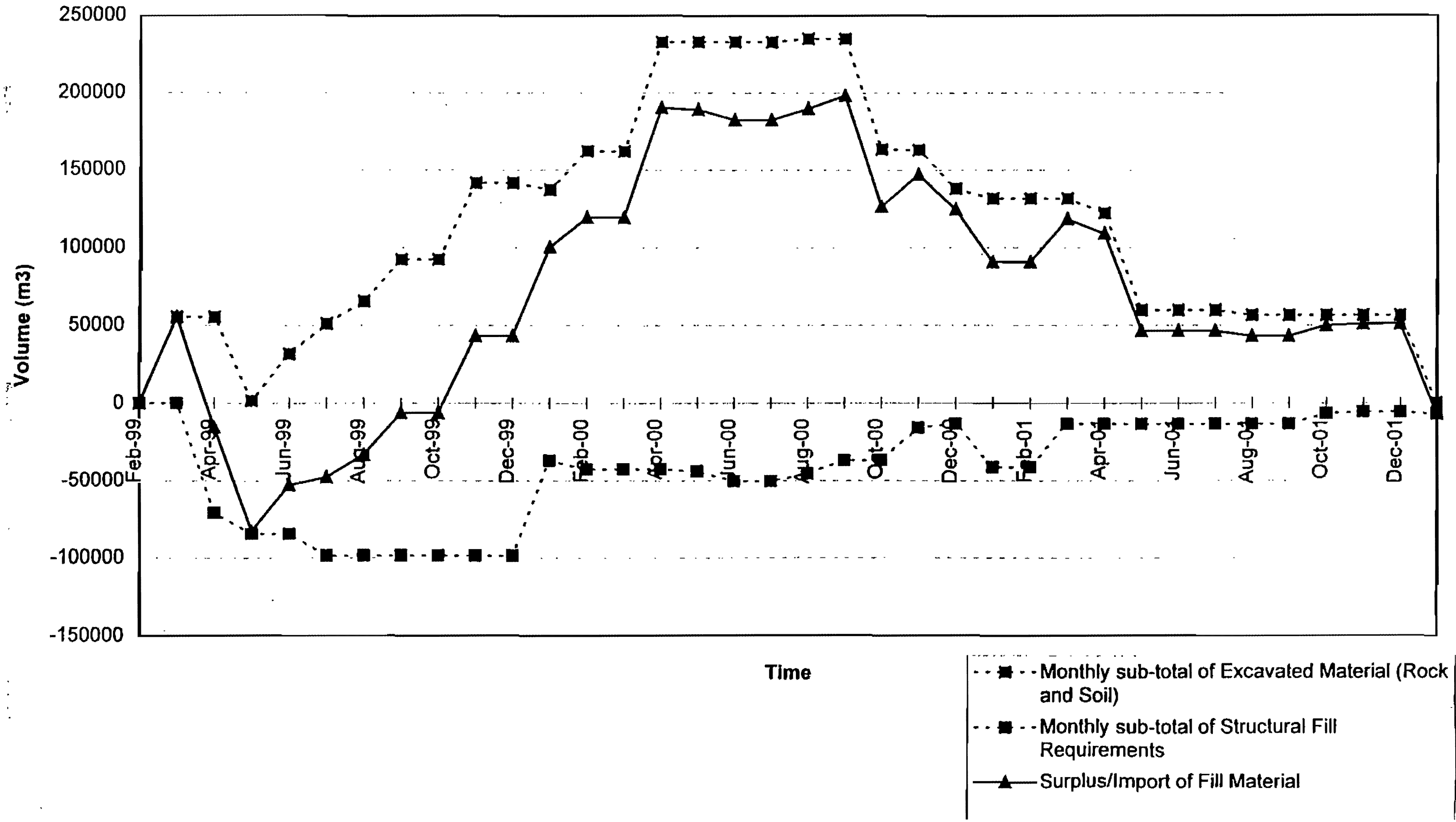
About 15,000 m^3/day of public fill is currently being delivered to public filling areas. If all of the 2,800 m^3/day of excess excavated materials (worst scenario) generated from the Central Section were delivered to public filling areas, it will have a significant impact on public filling capacity.

The potential air and water impacts from the storage, handling, transport and disposal of excavation material are covered in *Sections 6.4 and 6.5* respectively.

6.10.2.1.3 General Construction Waste

The storage, handling, transport and disposal of general construction wastes have the potential to create visual, water, dust and associated traffic impacts. About 73,900 m^2 and 55,700 m^2 of gross floor area (GFA) will be constructed at Mei Foo and Tsuen Wan West Stations respectively. Based on a waste generation rate of 0.1 m^3/m^2 of GFA to be constructed, approximately 12,960 m^3 of general construction waste will be generated. The quantity of general construction waste arising from other construction works such as roads and associated facilities cannot be determined at this stage. General construction waste should be removed from site as soon as practicable in order to avoid adverse environmental impacts due to on-site storage of the material.

Figure 6.10a : Cut and Fill Requirements for Central Section



To conserve void space at landfill sites, general construction waste with more than 20% (by volume) inert material should not be disposed of at landfills. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials (concrete, soil, cement, etc) at public filling areas and the degradable wastes (wood, paper, plastic, etc) at landfills. The production of general construction wastes should be minimised by the careful control of ordering procedures which can result in surplus materials. The avoidance of over-ordering and the segregation of materials will minimise waste arisings requiring landfill disposal.

Construction and demolition wastes currently form approximately 35% of the annual take-up of the limited landfill void available in Hong Kong, although this proportion has varied widely over recent years. Therefore, it is important to minimise, wherever possible, the amount of wastes which must be disposed of by landfill.

6.10.2.1.4 Demolition Waste

A number of structures will be removed or demolished for the construction of the Central Section. As information on GFA or building plans of the Paul Y Industrial Building, Shun Kei Flatted Factory and Wah Kei Building is not available, the exact quantity of the demolition waste generated from demolition of these building cannot be determined at this stage. It is expected that the daily generation rate of the demolition waste should be small comparing with the daily quantity of public fill arising in Hong Kong and it will not have a significant impact on the demand for the public filling capacity.

The demolition contractor should adopt the selective demolition method so that reusable material, like wood and metal, can be segregated and recycled, degradable waste can be disposed of at landfills, and inert demolition material can be reused on site or delivered to public filling areas. The disposal of demolition wastes at public filling areas is unlikely to raise any long term environmental concerns because of their inert nature. The environmental impacts arising from the storage, handling and disposal of demolition waste will therefore be negligible.

6.10.2.1.5 Chemical Waste

It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the Contractor's on-site maintenance activities and the numbers of plant and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oils and solvent, produced from plant maintenance will be small.

The explosive used for blasting of rocks is classified as Category 1 Dangerous Goods and the handling of it is under the supervision of the Mine and Quarry Division of Geotechnical Engineering Office (GEO). Unperfected blasting may generate explosive residuals or un-ignited detonators which require special handling and disposal by a licensed shotfirer under the supervision of the GEO. However, it is anticipated that the amount of explosive residual or un-ignited detonator will be small as a specialist contractor will likely be used. Explosive waste should be handled and disposed of separately from other wastes including chemical waste.

An asbestos investigation of the flatted factories in Tsuen Wan is being undertaken. If the quantity of asbestos waste to be generated exceeds 250 m^3, a programme for the removal works and the estimated asbestos waste arisings must be provided to the EPD so that suitable disposal arrangements can be made. Although all of the results are not yet available, the expected arisings are much smaller than the above figure. The disposal of asbestos waste requires the waste producer to given notification to the EPD, and disposal has to follow EPD's direction. The directions issued by the EPD would specify the appropriate disposal facility for the asbestos waste and the date and time when the delivery of asbestos waste should be made. Additional requirements on the handling and transport arrangements and any other special precautions may also included.

Storage, handling, transport and disposal of chemical waste should be arranged in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. In addition, the storage, handling, transport and disposal of asbestos waste should be arranged in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the environmental impacts due to storage, handling, transport and disposal of chemical waste will be negligible.

6.10.2.1.6 General Refuse

The construction sites for the Central Section will employ a total of about 300 to 500 workers. Estimates of waste arisings based on these numbers of workers suggest that the amount of general refuse produced at the Central Section will be in the range of 170 to 300 kg per day. Provided that the mitigation measures recommended in *Section 5.10* are adopted, the environmental impacts caused by storage, handling, transport and disposal of general refuse are expected to be minimal.

6.10.2.1.7 Marine Sediment

It is estimated that about 79,000 m^3 of marine sediment will be dredged for construction of the seawall for the Tsuen Wan Bay reclamation (see *Table 5.10a, Annex N*), and another 211,000 m^3 will be excavated for the cut-and-cover tunnels in this Section. The dredged sediments from the Tsuen Wan Bay reclamation are known to be heavily contaminated, especially in the top layers of the seabed, and will require special handling and disposal. It is also expected that some of the material excavated from beneath the West Kowloon reclamation will be contaminated. Details of requirements for the handling and disposal of contaminated sediments are discussed in *Section 6.10.3.2.3*.

Provided that the contractor follows the recommended procedures for dredging and transportation of sediment, adverse impacts on marine water quality due to dredging are not anticipated. The only disposal sites at present designated for the disposal of contaminated sediment are the East Sha Chau Contaminated Mud Pits. The disposal of contaminated sediment at East Sha Chau is under the strict control of the CED. The environmental monitoring results obtained so far indicate that the disposal operation has not caused adverse environmental impacts in the area. It is therefore expected that the disposal of a relatively small amount of contaminated mud at East Sha Chau will not cause any additional adverse environmental impact.

Moderately contaminated or uncontaminated marine mud should be disposed of at designated marine dumping grounds. The construction contractor should consult FMC for the location of the appropriate marine dumping ground and must obtain a marine dumping licence from the EPD.

6.10.2.2 Operational Phase

6.10.2.2.1 General Refuse

The amount of general refuse arising from the operations of the Mei Foo and Tsuen Wan West Stations will depend on the number and types of retail outlets at the stations. Based on the operation of the existing railway, it is anticipated that in the order of 500 kg per day of general refuse will be generated at each station. The amount of general refuse arising from the operation of the shops cannot be determined at this stage. General refuse collected at the Mei Foo and Tsuen Wan West Stations can be delivered to the West Kowloon Transfer Station. If good practice is adhered to and all feasible avoidance, reuse and recycling opportunities are taken, including minimising of over-ordering, there should be minimal impact.

6.10.2.2.2 Industrial Waste

The amount of industrial waste to be generated from the operation of the Central Section cannot be determined at this stage but it is expected to be small. Metals and discarded electronic equipment have high scrap value and may be sold for recycling. Provided that the scrap materials are collected regularly, it is not expected that storage, handling, transport and disposal of industrial waste will cause any significant environmental impact. Other general industrial waste such as used fluorescent tubes, plastic, cloth and paper can be collected together with general refuse and disposed of at licensed waste transfer or disposal facilities.

6.10.2.2.3 Chemical Waste

The amount of chemical waste to be generated from the operation of the Central Section cannot be determined at this stage but it is expected to be small. Chemical wastes should be stored, handled, transported and disposed of in accordance with the *Chemical Waste Regulations* and *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes*. They should be collected and transported to the CWTF or other licensed facility by a registered waste haulier. Provided that appropriate handling, storage and disposal procedures are followed, no unacceptable impacts associated with the management of chemical waste during the operational phase of the Central Section are anticipated.

6.10.3 Recommended Mitigation

6.10.3.1 Introduction

Section 5.10.3 has recommended the recycling, storage, transport and disposal measures to avoid or minimise potential adverse impacts associated with waste arising from the construction and operation of the Southern Section under each category of waste type. The majority of these recommendations will also be applicable to the Central Section. For the construction phase, the contractors should incorporate these recommendations into a comprehensive on-site waste management plan for the construction of the Central Section. Such a management plan should incorporate site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. For the operational phase, it is recommended that the KCRC should incorporate the recommendations into a comprehensive waste management plan for the operation of West Rail.

6.10.3.2 Construction Phase

6.10.3.2.1 Excess Excavated Material

A considerable amount of surplus rock and soft material will be generated from the construction of the Central Section. It is important that appropriate measures are taken by the contractor in order to minimise the impact on public filling capacity and avoid the disposal of inert material to landfill. To optimise the cut and fill balance of West Rail and minimise the amount of excess excavated material to be delivered to public filling areas, 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 sites.

In order to increase the opportunity for re-use of the excess excavated material by other land formation or reclamation projects, it is recommended that the engineering Design Consultants should complete the FMC's Questionnaire on Surplus and Fill Requirements and return it to FMC for inclusion into the Surplus and Fill Requirement Database.

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. It is also recommended that the contractor should liaise with the Port Works Division of Civil Engineering Department (CED) for the anticipated quantity of excavated material to be delivered to public filling areas so that any impact on the planning of public filling capacity could be considered at the earliest possible time.

Excavation at the Lai Chi Kok park will need to remove the top soil. It is recommended that the excavated top soil should be reused for the landscape works of the existing East Rail or other parks of the Regional Council parks.

6.10.3.2.2 Construction and Demolition Waste

In order to minimise waste arisings and keep environmental impacts within acceptable levels, the mitigation measures described in *Section 5.10* should be adopted.

6.10.3.2.3 Marine Sediment

Marine sediment arising from the reclamation of Tsuen Wan Bay should be transported and disposed of in approved special dumping grounds in accordance with *EPD Technical Circular No 1-1-92*. To minimise the loss of contaminated material to the water column, the following measures should be taken:

- Dredging of contaminated marine mud should be undertaken by a suitable grab dredger using a closed watertight grab;
- Transport of contaminated marine mud should be by split barge of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site;
- All barges and hopper dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;
- Mud should be placed in the disposal site by bottom dumping, at a location within the pit specified by FMC;
- Discharge should be undertaken rapidly and the hoppers should then immediately be closed, material adhering to the sides of the hopper should not be washed out of the hopper, and the hopper should remain closed until the barge next returns to the disposal site;
- The dumping vessel should be stationary throughout the dumping operation;
- Barge loading should be monitored to ensure that loss of material does not take place during transportation; and
- Transport barges or vessels should be equipped with automatic self monitoring devices as specified by the EPD.

6.10.3.2.4 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* (see *Section 5.10*). In addition, any asbestos waste should be handled in accordance with *the Code of Practice on the Handling, Transport and Disposal of Asbestos Waste.*

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

6.10.3.2.5 General Refuse

General refuse will be generated from 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.

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.

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.

6.10.3.3 Operational Phase

6.10.3.3.1 Storage, Collection and Transport of Waste

The mitigation measures recommended under the construction phase should also be applied during the operational phase.

6.10.3.3.2 General Refuse and Industrial Waste

General refuse will be generated largely from the passengers, station employees and commercial operators. General refuse generated on-site should be stored in enclosed bins or compaction units separate from chemical wastes. The small quantity of industrial waste generated at the stations can be collected together with the general refuse. A reputable waste collector should be employed to remove general refuse and industrial waste from the stations, separately from chemical wastes, on a daily basis to minimise odour, pest and litter impacts.

Scrap metals and other recyclable materials should be stored separately and collected by contractor for recycling.

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.

6.10.3.3.3 Chemical Waste

Chemical waste that is produced, as defined by Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation, should be handled and disposed of in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (see Section 5.10).*

6.10.4 Conclusion

The potential impacts of waste arising from the construction and operational phases of the Central Section of West Rail have been assessed. Key issues include the need for effective waste management planning during both of these phases, 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 disposing of it 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.

6.11 Land Contamination

6.11.1 Background

The potential for soil and groundwater contamination exists in some areas along the alignment where current or historic land uses have impacted upon the land. The potential for impacts from land contamination exists primarily where there will be an interface with the underlying soil either during construction or operation of West Rail. The following sections present the findings of the land contamination assessment conducted by the EIA Study team.

6.11.1.1 Project Construction

In the Central Section, the main construction activities involve Mei Foo Station, Tsuen Wan West Station, and the development of bored and cut-and-cover tunnels.

Excavated materials, which may give rise land contamination concerns, will be generated from the following construction activities:

- Construction of the 300m long underground Mei Foo Station at Lai Chi Kok Park, and a 60m long cut-and-cover tunnel to the north of the station;
- Construction of a 600m long cut-and-cover tunnel underneath the Kwai Fuk Road;
- Construction of a 300m long cut-and-cover tunnel to the north of Tsing Tsuen Tunnel (Tsuen Wan Station);
- Construction of the 340m long Tsuen Wan West Station using cut-and-cover; and

- Construction of a 1,050m long cut-and-cover tunnel to the north of Tsuen Wan West Station.

Issues concerned with the dredging, handling and disposal of contaminated marine muds arising from the formation of the Tsuen Wan reclamation are addressed in *Section 6.10*, as they relate to seabed rather than land contamination.

During construction the main potential sources of impact relate to the excavation of soils at the two portals. The impact associated with the southern portal of the tunnel is considered under the Tsuen Wan Station discussion. As the northern entrance is in a predominantly rural area, the potential for contaminated land impacts is considered to be minimal and is not discussed further in this assessment.

6.11.1.2 Current and Historic Land Use

A review of historical maps of the key sites along the route and a selected review of historical aerial photos indicate that the majority of the proposed Central Section is to be developed along land which has primarily been used for commercial purposes, car parking, a bus terminus, refuse collection points and recreation areas. Some land, notably the former Lai Chi Kok Bay, has been reclaimed. The available information does not indicate that there has been any major industrial usage along the alignment, although some industrial buildings and an oil depot to the east of the alignment have been identified. These are discussed below.

The current and previous land uses of the key sites along the route are shown in *Tables 6.11a-c Mei Foo Station Area.*

Table 6.11a Historic Land Use of Mei Foo Station and 60m Cut-and-Cover Section

Year	Site Usage
1963/1964/1968	Harbour, Lai Chi Kok Bay, beach, large oil depot immediately to the east of the station footprint
1974	Harbour, Lai Chi Kok Bay, beach, CIP for MFSC commercial complex in the location of former oil depot immediately to the east of the station, reclamation in progress
1976	Harbour, Lai Chi Kok Bay, beach, CIP for MFSC commercial complex, reclamation in progress, flyover, electric transformer
1978	Harbour, Lai Chi Kok Bay, elevated platform, car park, reclamation in progress, flyover, CIP for ferry pier, electric transformer
1981/1982	Harbour, reclaimed land, podium, car park, flyover, ferry pier, CIP on further reclamation of Lai Chi Kok Bay
1984/1985/1986	Harbour, reclaimed land, podium, commercial complex, flyover, CIP on reclamation, footpath, refuse collection point
1987/1989	Harbour, reclaimed land, podium, commercial complex, flyover, CIP on reclamation, footpath, refuse collection point, playground, reclamation in progress

Year	Site Usage
1990	Reclaimed land, podium, commercial complex, football field, tennis court, playground, bus terminus, refuse collection point, WIP, CIP
1997	Roads, garden, Lai Chi Kok Park and recreational area, shopping mall footbridge, residential WSD site

CIP - Construction in progress, WIP - Works in progress, MFSC - Mei Foo Sun Chuen.

Information obtained by reference to *Hong Kong Ordinance Survey* maps (1:1000 scale, reference 11-NW-7a, 7b, 7c & 7d and 1:1200 scale, reference 161-SE-A, B, & D).

A review of the current and historic land use of the area within the footprint for Mei Foo Station indicates that the area was primarily reclaimed from Lai Chi Kok Bay, and that there have been no major contaminating land uses along this part of the alignment. The potential for soil and groundwater contamination to have occurred in this area is therefore considered to be low, particularly as the former oil depot is located outside the proposed station footprint and was redeveloped in the early 1970s. The area that is to be developed for cut-and-cover to the north of this area does not have any contamination concerns.

Kwai Fuk Road Area

Table 6.11b Historic Land Use of Kwai Fuk Road Cut-and-Cover Area

Year	Site usage
1970/72/73	Open area
1976	Open area, temporary structures, culvert, latrine, road
1977/1978	Godowns, temporary structures, road, open area, CIP
1980	Open area, CIP, road, **electric transformer**
1982/1983	Open area, temporary structures, open sided structures, road, electric transformer, **factory**
1984/1985	Car parks, open sided structures, open storage, road, electric transformer, factory
1987/1988	Car parks, open storage, road, electric transformer, factory, **petrol filling station** (just outside the boundary of the alignment)
1997	Roads, nullah, Landscaping, footbridges, residential, car park

CIP - Construction in progress.

Hong Kong Ordinance Survey maps (1:1000 scale, reference 11-NW-1b & 7-SW-21d and 1:1200 scale, reference 161-NE-A and C)

The main landuses of concern along this part of the alignment relate to the presence of a petrol service station, one unnamed factory and two electric transformers along the alignment.

The petrol filling station was developed after 1985, and the main concern relates to the potential for leakage or spillage of fuel to have occurred from the presence of underground storage tanks at the site, and contamination with petroleum hydrocarbons.

Petrol filling stations are one of the landuses described in the *Technical Memorandum on Environmental Impact Assessment Process* as being Potential Contaminated Land Uses, for which a Contamination Assessment Plan is required to be prepared as part of the evaluation and (if necessary) remediation of the site. In this case, the petrol station is located outside the proposed West Rail alignment, but at least a preliminary investigation of the site is warranted to establish whether any leakage of petroleum hydrocarbons might have occurred, and whether it is possible or likely that these contaminants could have migrated into the vicinity of the West Rail footprint.

The factory was constructed between 1980 and 1982, and reference to aerial photographs indicates that the factory comprises a flatted factory building. However, the actual use of the building and the nature of activities undertaken within this building are unknown at this stage. The main concern associated with the factory would be the potential for contamination of soils at the surface of the site, where any spillages or leakages may have occurred from previous site operations or storage of oils and chemicals at ground or basement levels. However, the site is located outside the cut-and-cover, and is therefore not anticipated to be of concern.

The electrical transformers have been on the site from at least 1980, and there are unlikely to be any contamination issues unless there have been spillages or leakages of transformer oil containing polychlorinated biphenyls (PCBs).

Tsuen Wan West Station Area

Table 6.11c Historic Land Use of Tsuen Wan West Station

Year	Site Usage
1960	Harbour, **oil depot**, small textile factory, other small industrial premises
1961	Harbour, oil depot, **small factories**, road (unchanged)
1976	Harbour, godown, road, factories, oil depot, reclamation in progress
1980	Harbour, godown, road, sports centre, partial reclamation in progress, oil depot being decommissioned, construction of Wah Kai Industrial building
1985	Harbour, Tsuen Wan Road and bridge built, **Tsuen Wan Cargo area**, CIP on reclamation, Tsuen Wan **transport complex**, ferry pier, sports centre converted to Shun Kei Factory estate. Only four tanks remain at the oil depot, industrial building next to Wah Kai removed
1992	Sea, **industrial buildings**, culverts, road, footpath, bus terminus, Tsuen Wan transport complex, podium, ferry pier, Tsuen Wan cargo working area, pumping station, latrine, refuse collection points, WIP, electric substation
1997	Industrial buildings, roads, ferry prier, pumping station, cargo working area, temporary housing area, flatted factories

Year	Site Usage

WIP - Works in progress.

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-SE-20a, 20b, 20c, 25b; 7-SW-21a; 6-SE-25b, and 1:1200 scale, reference 144-SW-C; 144-SW-D)

The main landuses of concern along this part of the alignment are four industrial buildings, the Tsuen Wan transport bus complex and a cargo working area along the station footprint and alignment, and some small factories and an oil depot in the vicinity of the alignment south-east of the station.

The four industrial buildings were constructed between 1980 and 1985, and reference to aerial photographs indicates that the industrial buildings comprise flatted factories. However, their actual use and the nature of activities undertaken within them are unknown at this stage. The main concern associated with these buildings would be the potential for contamination of soils at the surface of the site where any spillages or leakages may have occurred from previous site operations at ground or basement levels.

The issue with the bus station complex is whether any refuelling is or has been conducted on site, and hence the potential presence of underground fuel storage and possible contamination from petroleum hydrocarbon leakages. As indicated above, a Contamination Assessment Plan will be required if underground storage tanks are present.

The cargo working area is presently paved with hardstanding and a review of aerial photographs indicates that the area was used primarily for parking of goods vehicles during loading and unloading of containers. The area was built between 1983 and 1985, along with reclamation and construction of the Tsuen Wan Road.

The cut-and-cover area and bored section to the south-east of Tsuen Wan Road West Station are next to land that was formerly used as the Caltex (Asia) Ltd Tsuen Wan oil depot prior to the 1940s and until the mid-1980s. The facility operated at least five warehouses and godowns with up to 20 above-ground storage tanks. Following removal of the depot, this land was developed as the Riviera Gardens Housing Estate by 1989, and is not expected to be a contamination concern as excavation would likely have taken place prior to development of the apartment buildings for foundations and basement areas.

In addition, a number of small factories (identified on maps as weaving and enamel factories) were located along the former access road between the oil depot and the former Gin Drinkers Bay Road, to the south-east. This may also fall within the area to be bored. These factories are also not a major contamination concern, as they were small operations and all were removed by the mid-1980s. However, no previous assessments of these sites have been conducted.

As indicated in the previous section the presence of an electrical transformer station is not likely to represent a major concern, provided that no spillages or leakages from the transformers have taken place.

6.11.1.3 Geology and Hydrogeology

The *Hong Kong Geological Survey* (HKGS) Sheet 11 indicates that the area of the cut-and-cover/bored alignment in the vicinity of Mei Foo Station is comprised mainly of fine grained or coarse grained granite of Upper Jurassic - Lower Cretaceous age. Some dykes of feldsparphyric and quartzphyric rhyolite are known to occur locally in the granite in this area. Quaternary deposits, where encountered, consist of surficial sands, silts, and marine muds and sand.

An alluvial deposit of well sorted to semi-sorted clay/silt, sand and gravel overlying coarse grained granite is located in the vicinity of the proposed Mei Foo Station footprint, to the east of Kwai Chung Hospital.

The bored area immediately east of the Rambler Channel Typhoon Shelter cuts through fine to medium grained-granite with dykes. The subsurface in this area also contains some granodiorite.

The cut-and-cover portions of the alignment immediately along the shoreline at Tsuen Wan will consist of undivided Holocene sands and mud of the Hang Hau Formation. Underlying these surficial deposits is fine-grained granodiorite and dacite of Jurassic-Cretaceous age.

The bored section to the north of Tsuen Wan to the Kam Tin valley will cut through Upper Jurassic tuff-breccias of the Shing Mun Formation, and coarse ash crystal tuff of the Yim Tin Tsai Formation, which were both deposited around an older plutonic body made up of fine to medium-grained granodiorite of Jurassic-Cretaceous age.

6.11.2 Potential Sources of Impact

The main sources of potential impacts are the same as those presented in *Section 5.11.2*. The prediction, evaluation and recommendation of appropriate mitigation concerning the land contamination impacts in the Central Section are discussed below.

6.11.3 Prediction of Impacts

6.11.3.1 Disposal of Soils

During the development programme contaminated soils may be encountered if excavation is conducted in the vicinity of the petrol filling station in the Mei Foo Station development, the industrial buildings, the cargo working area, and any underground storage tanks associated with the bus terminus in the vicinity of Tsuen Wan West Station. Potentially contaminated soils will require an assessment to determine final disposal volumes and requirements. An assessment of the impact of any potential contamination and any consequent remediation requirements can only be determined following performance of detailed investigations at the identified properties during the detailed design stage. Such investigations would normally involve a baseline intrusive investigation with minimum soil sample collection and analysis, with analytical results used for development of the Contamination Assessment Plan (where underground tanks are involved) and for the ultimate determination of disposal options. The main sites of concern in terms of potential contamination of underlying soils would be the petrol filling station and the Tsuen Wan bus terminus.

6.11.3.2 Groundwater Disposal

The main concern in this respect is likely to be the potential presence of contaminated groundwater, especially if leakages from any underground fuel tanks have occurred. The issue of disposal of contaminated groundwater is discussed in *Section 5.11.3*.

6.11.4 Evaluation of Impacts

Land contamination impacts are not considered to represent a major concern during the construction of the Central Section. The majority of the 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 undetermined.

At present there is no designated landfill site in Hong Kong for the disposal of contaminated soil. The Facilities Management Group (FMG) of the EPD would need to be approached for approval to dispose of contaminated soils to one of the strategic landfill sites in Hong Kong, which is most likely to be the WENT landfill. There may also be restrictions on the volumes that can be received and therefore dewatering of the soils prior to disposal is recommended.

The potential contamination of surface waters from the use of any dust suppression equipment during dry conditions may be an issue. However, this can be mitigated by applying the measures described in the following section. Pumping and disposal of groundwater from excavations and excess surface water considered to be contaminated should be conducted in accordance with the Water Pollution Control Ordinance. This is likely to be of most concern in the vicinity of any underground fuel storage tanks if any leakages have occurred historically. During the operational phase of the development, impacts associated with the potential presence of contaminated soil are likely to be minimal as there will be no interface between any residual contamination and human receptors. Potential impacts on site maintenance workers can be minimised by ensuring minimal interaction with any potentially contaminated soils during utility service maintenance.

6.11.5 Recommended Mitigation

Specific further investigations of the petrol filling station, industrial buildings, cargo working area and bus terminus should be undertaken by KCRC prior to construction to determine/confirm whether there is or has been underground storage and whether it is likely that spillage, leakage or other forms of contamination have occurred in the past.

If underground storage is confirmed, preparation of a Contamination Assessment Plan is required. The Assessment Plan should include provision for a visual identification of the presence of any underground tanks.

If site inspections, interviews, reviews of site history, inventory reconciliation or other investigation techniques suggest that contamination is likely, targeted on-site sampling and analysis may be required to define the extent of the problem and develop remediation plans.

Where investigations indicate the possibility of site contamination, a minimum of three soil borings should be advanced at the site in accessible locations to the groundwater table, with a minimum of two soil samples and one groundwater grab sample collected from each boring and analysed for total petroleum hydrocarbons. Additional consideration should be given to installing temporary groundwater monitoring wells. This will ensure that any contaminated soil or groundwater resulting from contaminant releases are identified and appropriate mitigation measures are able to be defined, including proper site treatment and/or waste disposal in consultation with the EPD. If disused storage tanks are encountered, they should be decommissioned, cleaned out and removed prior to any construction work.

The potential exposure to contaminated materials can be minimised by implementing the measures described in *Section 5.11.5*.

6.11.6 Residual Impacts

Based on the limited information available at this stage, it is unlikely that there is a potential for major land contamination concerns along the Central Section, provided the prescribed investigation and mitigation measures are adopted. Requirements for the disposal of potentially contaminated soils and groundwater from two identified potential sites of concern will be developed, if necessary, following detailed investigations of the sites.

6.12 Hazards

6.12.1 Background

The West Rail alignment in the Central Section at Kwai Chung passes within 250 m of the former Gin Drinkers Bay Landfill. Specifically, the northern portion of the Kwai Fuk Road cut and cover tunnel and the southern portion of the Tsing Tsuen bored tunnel, including the FSD emergency access adit and proposed construction worksite, shown in

Figure 6.12a, are being assessed in terms of their sensitivity to landfill gas ingress and the resulting risk to West Rail users. The Hazard Assessment is being carried out under the requirements of the HKPSG and the EPD Guidance Note on Landfill Gas Assessment; the latter of which sets out the guidelines for carrying out such assessments.

The detailed hazard assessment report has been submitted and endorsed by Government as a separate report and only a summary of the study, its findings and recommendations are presented in this section.

6.12.2 Overview of the Gin Drinkers Bay Landfill Hazard Assessment

The Gin Drinkers Bay Landfill was thoroughly researched, primarily with reference to EPDs Restoration of Urban Landfills Study documents which were updated earlier this year in regard to the Gin Drinkers Bay site. Consultants' estimates of landfill gas production rates from these studies varied between 490 and 900 $m^3 hr^{-1}$ for 1997.

Geological information along the proposed alignment was provided by the engineering Design Consultants and revealed no significant geological features between the landfill site and West Rail which would act as a direct pathway for the transmission of landfill gas. However, it is noted that there are several complicated networks of utilities adjacent to both the landfill and West Rail and in the ground between the two. Results of historical landfill gas monitoring in service voids around the perimeter of the landfill have previously indicated the presence of gas as did the results of monitoring conducted during December 1997 at two purposely installed monitoring wells along the West Rail alignment route.

On the basis of the desk top and field investigations, five specific features of the railway infrastructure were assessed for their sensitivity to landfill gas:

- The northern portion of the Kwai Fuk Road cut and cover tunnel and the southern portion of the Tsing Tsuen bored tunnel;
- The tunnels interface;
- The emergency access adit which will extend to the ground surface; and
- The telecommunications equipment room located off this access adit housing, amongst other items, a transformer room and an uninterruptable power supply (UPS).

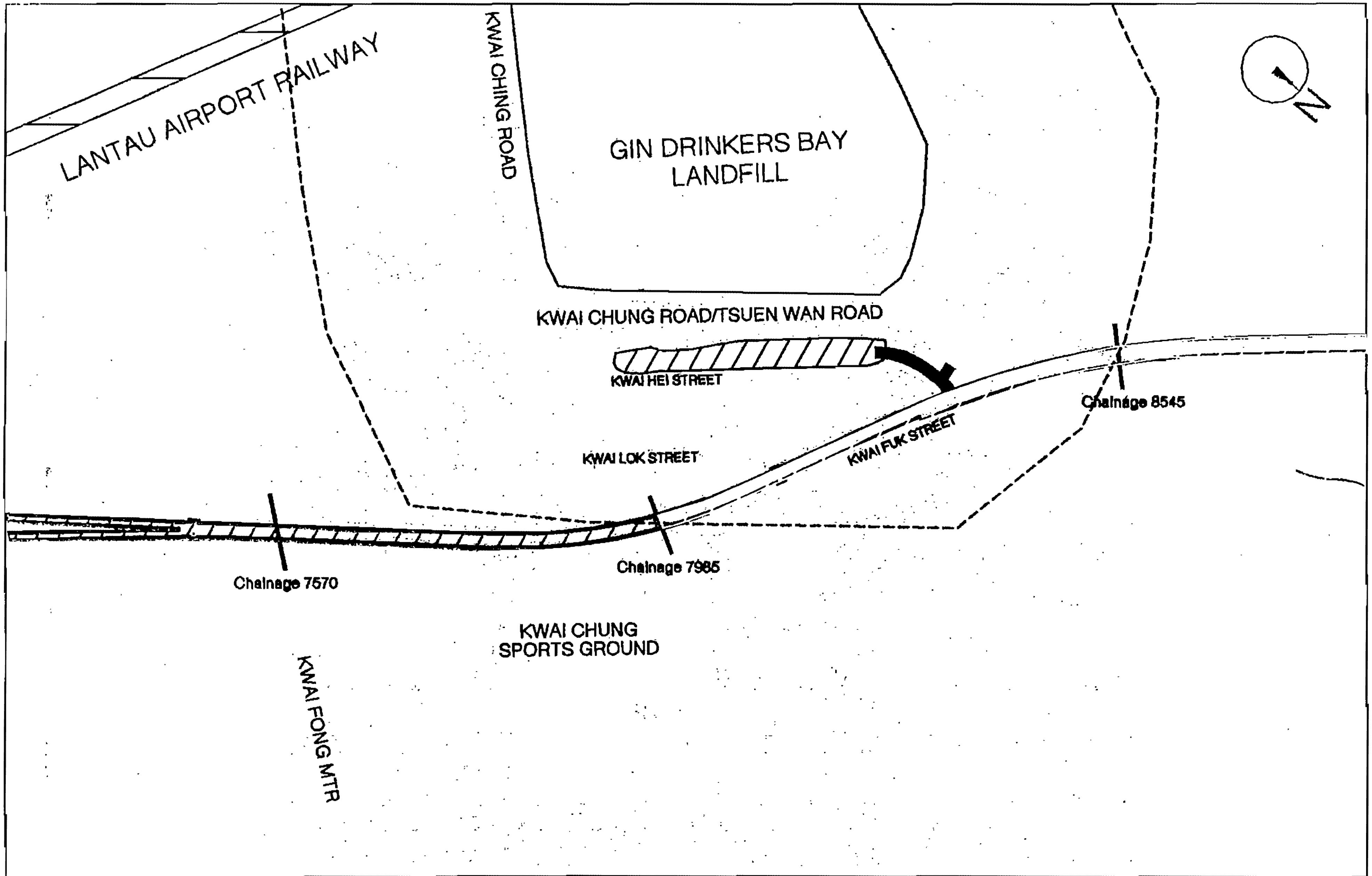
It was recommended that a detailed risk assessment be conducted prior to work commencing at the construction worksite adjacent to Kwai Hei Street when uncertainties over the actual activities which will ultimately take place here are resolved. A risk assessment conducted prior to the availability of detailed information on site layout and works schedule would be too general in nature to be of benefit.

The results of the Source-Pathway-Target qualitative risk assessment indicated a medium to high risk of landfill gas effecting the normal operation of the railway; the tunnel sections and adit attracting the medium risk rating and the tunnel interface and telecommunication and equipment rooms the high risk rating, largely because of uncertainties regarding the routing of power supplies and ventilation arrangements and the likely presence of multiple ignition sources.

The recommended protection and precautionary measures specified covered all aspects of the construction, maintenance and operation of the railway. Construction precautions include strict supervision and inspection of the supply, placement and application of the tunnel membrane and lining systems to ensure that their ability to reduce landfill gas ingress is maximised. Consideration of additional internal joint sealants and/or regular in service grouting of the tunnel interface may also be considered to further reduce the likelihood of gas ingress.

During maintenance as well as operation, an "assumed presence" of landfill gas is to be adopted for all activities in the tunnels and training in the symptoms and signs of landfill gas is to be provided to maintenance workers. A strict no smoking policy and good ventilation is also to be adopted at all times within the tunnels and the tunnel ventilation system is to be automatically run in the half hour leading up to the first train entering the tunnel. Monitoring for methane, carbon dioxide and oxygen is to be carried out continuously during normal operation by installation of a gas detection system (with power backup) in the tunnels and telecommunications and equipment rooms and also during maintenance activities. The gas detection system is to be linked to visual alarms at the station controllers office and emergency ventilation system.

Provided that the full range of protection and precautionary measures documented in the Hazard Assessment report are implemented, it is considered that the West Rail tunnels may be operated without undue risk from landfill gas.



LEGEND

- Assumed Boundary of Waste
- 250m Consultation Zone
- Kwai Fuk Road Tunnel
- Tsing Tsuen Road Tunnel
- Telecommunications Room
- FSD Emergency Act
- Temporary Construction Worksite

LOCATION OF WEST RAIL INFRASTRUCTURE IN RELATION TO GIN DRINKERS BAY LANDFILL

FIGURE 6.12a

ermhk/c1688/vol4/612.dgn

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

7. THE NORTHERN SECTION AND WEST RAIL DEPOT

7.1 Introduction

This section provides a brief description of the Northern Section of West Rail and the West Rail Depot, and an assessment of the environmental implications of its construction and operation. This assessment is based on the best information available regarding the design and construction of West Rail at the time of the assessment, using the standards, criteria and assessment methods and techniques outlined in *Sections 3* and *4*.

7.2 Alignment Description

The Northern Section commences at the interface with the Central Section approximately 270m north of the northern portal of the TLT. The alignment then heads generally north-west, passing through a new station to be constructed at Kam Tin (KAT). From KAT, the alignment continues north-west until it reaches a junction at Au Tau between a north-bound section of the alignment envisaged for the larger West Rail system and a west-bound route to Tuen Mun. Two kilometres west of Au Tau on the Tuen Mun line, the Northern Section comes to an end at the eastern end of the proposed Yuen Long Station (YUL).

The Northern Section also includes the West Rail Depot (WRD) which lies between the TLT and Kam Tin Station. The Depot includes infrastructure such as rail and fleet maintenance facilities and buildings occupying an area of about 22 ha as well as approximately 2.2 km of main line alignment. The WRD will primarily be constructed at grade and on embankment while the section of alignment from approximately 100 m south of KAT to YUL will be built on elevated structure.

7.2.1 Construction Overview and Programme

The majority of the Northern Section is to be built on viaduct with a small section, approximately 130 m, of cut and cover tunnel near Tung Shing Lei at Au Tau. Following site clearance activities, Depot construction will require transport and placement of engineering fill and appropriate compaction and earthmoving machinery. It is currently expected that fill material required for the Depot will be sourced from the TLT and crushed on site and also from China. Depot facilities and buildings will be developed following the completion of earthworks.

Viaduct construction will involve bored piling works followed by pilecap and column construction activities, and then superstructure works. A batching plant and precasting yard may also be required.

7.3 Noise

This section addresses the noise impacts arising from the construction and operation of the Northern Section and Depot of West Rail. Potentially affected NSRs are identified, noise impacts are predicted and assessed, and appropriate mitigation measures are formulated, following the methodology outlined in *Section 4.*

7.3.1 Baseline Conditions

7.3.1.1 Kam Tin

The majority of land occupied in the Kam Tin area is used for agricultural purposes, fish ponds, open space and isolated villages. Kam Tin and Kam Sheung Roads are the two main access roads, which are considered to be the dominant contributors of background noise. Route 3 is located in the vicinity of the proposed West Rail alignment and the Depot, and will start operation in mid-1998. Traffic noise from Route 3 will also contribute to the background noise level in this area.

The nearest sensitive uses are village developments in Cheung Po, Tai Kek Tsuen and Shek Wu Tong, which are likely to be impacted during the construction and operational phases of the Depot and the rail alignment. The West Rail Construction sites and identified NSRs are shown in *Figures 9* and *10* of *Annex A.*

7.3.1.2 Kam Tin to Yuen Long

The region surrounding Kam Tin station and the proposed alignment between Kam Tin and Yuen Long consists mainly of village-type developments. Vehicles on Kam Tin Road, Kam Sheung Road and Castle Peak Road are the dominant noise sources in the area. Traffic on Route 3, which is located closed to the proposed alignment, will also contribute to the background noise level during the construction and operational phase.

Low-rise village developments in Kam Tin, Ko Po Tsuen and Tung Shing Lei would be the nearest NSRs likely to be impacted in the construction and operational phases. In addition, village houses located to the north-east of Yuen Long town centre would also be affected. *Figures 11* and *12* of *Annex A* show the West Rail work sites and the identified NSRs in this area.

7.3.2 Construction Phase

7.3.2.1 Potential Sources of Impact

The Northern Section runs through the Kam Tin valley from the Depot north of the TLT northern portal towards Yuen Long Station. The alignment will be constructed at-grade, on a slight embankment and then on viaduct as it proceeds from Kam Tin station to Yuen Long. *Figures 9 to 12* of *Annex A* show the proposed route alignment and sensitive receivers in this Section.

Various works sites have been identified along the alignment and it is expected that the contractors will probably work in parallel with each other. The identified work sites are shown *in Figure 9 to 12* in *Annex A* and are listed below:

- Tai Lam Tunnel (TLT) at tunnel portal;
- Area 1: Kam Tin Station;
- Area 2A: Kam Tin Station to Kam Tin Road;
- Area 2B: Kam Tin Road to the Pumping Station;
- Area 3: Pumping station to the Main Drainage Channel;
- Area 4: The Main Drainage Channel to Route 3 Crossing;
- Area 5: Route 3 Crossing to Yuen Long;
- Area 6: Yuen Long By-pass Crossing to Yuen Long Station; and
- West Rail Depot.

It is expected that construction works will generally be restricted to normal daytime working hours. However, the transport of spoil from the northern portal to the Depot may need to be carried out during restricted hours, subject to the granting of noise permits.

7.3.2.2 Prediction Of Impacts

Details of the likely construction activities and appropriate construction plant teams have been based on information supplied by the engineering Design Consultants. These have enabled an inventory of SWLs to be identified for each component of the various plant teams, from which the total SWL for each plant team has been calculated. The information also indicates that off-site traffic from Depot construction, mainly via Route 3 CPS, is less than 430 pcu/hour. The traffic flow of Route 3 CPS will be 9821 pcu/hour, and contribution of construction traffic noise will therefore be low. Construction noise levels have been predicted, using the methodology set out in *the Technical Memorandum on Noise from Construction Site other than Percussive Piling* (TM2) and *Section 4,* and these are shown below in *Tables 7.3a-f.*

Table 7.3a Predicted Noise Levels from Work Area 1 (Station Construction)

Fig/NSR No	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Station Const'n	Roof Erection
10\14	Kat Hing Garden	68	72	72	71	72	67

Note: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3b Predicted Noise Levels from Work Area 1 (At Grade Construction)

Fig/NSR No	NSR Name	Site Clearance	Access Const'n	Ground Treatment and Fill	Track Formation
10\14	Kat Hing Garden	**76**	75	**78**	73
10/16	Village Houses to the East of Ko Po San Tsuen	68	67	70	65
10\20	Kam Tin Mung Yeung Public School	**74**	**73**	**76**	**71**

.Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 7.3c Predicted Noise Levels from Work Areas 2a - 6 (Viaduct Construction)

Fig/NSR No	Site	NSR Name	Site Clearance	Piling	Pile cap Const'n	Column Const'n	Beam Erection
10\14	Area 2a	Kat Hing Garden	**82**	**83**	**86**	**85**	**82**
10/16	Area 2a	Village Houses to the east of Ko Po San Tsuen	70	71	74	73	70
10\20	Area 2a	Kam Tin Mung Yeung Public School	**73**	**74**	**77**	**76**	**73**
11/22	Area 3	Ko Po Tsuen	72	73	**76**	75	72
11/24	Area 3	Village Houses Between Cheung chun San Tsuen and Ha Ko Po Tsuen	72	73	**76**	75	72
11/26	Area 4	Village Houses to the north of Au Tau	72	73	**76**	75	72
11\27	Area 5	Village Houses in Tung Shing Lei	**84**	**85**	**88**	**87**	**84**
12/2	Area 5	Small Traders New Village Public School	**77**	**78**	**81**	**80**	**77**
12/3	Area 5	Pok Oi Hospital	**88**	**89**	**92**	**91**	**88**
12/6	Area 5	Small Traders New Village	**82**	**83**	**86**	**85**	**82**
12/8	Area 6	Tai Wai Tseun	**76**	**77**	**80**	**79**	**76**

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for hospital and educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 7.3d Predicted Noise Levels from West Rail Depot (Depot Construction)

Fig/NSR No	NSR Name	Site Clearance and Earthworks	Depot Const'n	Railway Systems Installation
9\1	Cheung Po	**82**	72	**79**
9\4	Tai Kek Tsuen North Village House	**85**	**84**	**81**
9\29	Kwan Tai Temple	**89**	**77**	**84**
9\7	Kau Tsuen North Village House	**86**	**81**	**82**
9\2	Tai Kek Tsuen	**89**	**77**	**84**

Note: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3e Predicted Noise Levels from West Rail Depot (At Grade Construction)

Fig/NSR No	NSR Name	Site Clearance	Ground Treatment and Fill	Access Const'n	Drainage Const'n
9\1	Cheung Po	62	64	61	60
10\11	Village House to the south of Kam Tin station	**80**	**82**	**79**	**78**

Note: Exceedances of the 75 dB(A) criterion are shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3f Predicted Noise Levels from Tunnel Construction

Fig/NSR No	NSR Name	Daytime Working	Restricted Hours Working
9\1	Cheung Po	65	**58**

Note: Exceedances of the 75 dB(A) daytime and 50 dB(A) night-time criterion are shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

7.3.2.3 Evaluation of Impacts

Tables 7.3a-f show that unmitigated construction noise impacts will exceed the assessment criteria at virtually all NSRs during most phases of the construction works for the depot, at-grade alignment and viaduct, by up to 14 dB(A) at residential and 22 dB(A) at hospital. A series of construction noise mitigation measures have been developed for this project and their effects on the predicted exceedances are discussed below.

It should be noted that the above predicted noise are worst case predictions, since the calculation assumes that all of the available plant items for a phase of works are in use for 100% of the time. In practice this is unlikely to be the case as a number of items of plant will operate sequentially and within the constraints of available space within the work site.

7.3.2.4 Recommended Mitigation

The noise mitigation measures which could be applied to the construction works have been described in detail in *Section 5.3*. These have been applied to the predicted noise levels given in *Tables 7.3a-f* and the mitigated noise levels using mitigation options M1. M2 and M3 are shown in *Tables 7.3g - k* below.

Table 7.3g Mitigated Noise Levels from Work Area 1 (At Grade Construction)

Fig/NSR No	NSR Name	Site Clearance	Assess Const'n	Ground Treatment and Fill	Track Formation
10\14	Kat Hing Garden	69/-/-	-/-/-	73/-/-	-/-/-
10\20	Kam Tin Mung Yeung Public School	67/-/-	68/-/-	71/71/70	71/66/-

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 7.3h Mitigated Noise Levels from Work Areas 2a-6 (Viaduct Construction)

Fig/NSR No	Site Area	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erection
10\14	Area 2a	Kat Hing Garden	75/ -/ -	81/78/76	83/80/77	82/78/77	77/77/77
10/16	Area 2a	Village Houses to the east of Ko Po San Tsuen	-/-/-	-/-/-/	-/-/-	-/-/-	-/-/-
10\20	Area 2a	Kam Tin Mung Yeung Public School	66/ -/ -	72/69/ -	74/71/68	73/69/ -	68/ -/ -
11/22	Area 3	Ko Po Tsuen	-/-/-	-/-/-	73/-/-	-/-/-	-/-/-
11/24	Area 3	Village Houses Between Cheung Chun San Tsuen and Ha Ko Po Tsuen	-/-/-	-/-/-	73/-/-	-/-/-	-/-/-
11/26	Area 4	Village Houses to the north of Au Tau	-/-/-	-/-/-	73/-/-	-/-/-	-/-/-
11\27	Area 5	Village Houses in Tung Shing Lei	77/77/72	83/80/78	85/82/79	84/80/79	79/79/79
12/2	Area 5	Small Traders New Village Public School	70/ -/ -	76/73/71	78/75/72	77/73/72	72/72/72
12/3	Area 5	Pok Oi Hospital	81/81/76	87/84/82	89/86/83	88/84/83	83/83/83
12/6	Area 5	Small Traders New Village	75/ -/ -	81/78/76	83/80/77	82/78/77	77/77/77
12/8	Area 6	Tai Wai Tseun	69/ -/ -	75/ -/ -	77/74/ -	76/72/ -	71/ -/ -

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for hospital and educational establishments shown in bold (65 dB(A) during examination periods).

Fig/NSR No	Site Area	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erection

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3i Mitigated Noise Levels from West Rail Depot (Depot Construction)

Fig/NSR No	NSR Name	Site Clearance and Earthworks	Depot Const'n	Railway Systems Installation
9\1	Cheung Po	**80/80/75**	-/ -/ -	**77/76/76**
9\4	Tai Kek Tsuen North Village House	**83/83/78**	**78/77/**75	**79/78/78**
9\29	Kwan Tai Temple	**87/87/82**	71/ -/ -	**82/81/80**
9\7	Kau Tsuen North Village House	**84/84/79**	75/ -/ -	**80/79/78**
9\2	Tai Kek Tsuen	**87/87/82**	71/ -/ -	**82/81/80**

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3j Mitigated Noise Levels from West Rail Depot (At Grade Construction)

Fig/NSR No	NSR Name	Site Clearance	Ground Treatment and Fill	Assess Const'n	Drainage Const'n
9\1	Cheung Po	-/ -/ -	-/ -/ -	-/ -/ -	-/ -/ -
10\11	Village House south of Kam Tin station	73/ -/ -	**77/**73/-	74/73/-	73/ -/ -

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 75 dB(A) criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 7.3k Mitigated Noise Levels from Tunnel Construction

Fig/NSR No	NSR Name	Daytime Working	Restricted Hours Working
9\1	Cheung Po	-/ -/ -	54/54/51

Note: Noise levels are shown for mitigation measures M1/M2/M3, with exceedances of the 50 dB(A) nighttime criterion shown in bold.

All levels specified are LAeq (30 min) dB unless stated otherwise.

7.3.2.5 Cumulative Noise Impacts

In general, construction works on different sites will not give rise to cumulative impacts due to distance separation and the orientation of individual NSRs. However, there are a few NSRs, close to the boundary of two worksites. The Kat Hing Garden, Kam Tin Mung Yeung Public School and Cheung Po could be affected by cumulative impacts if noisy activities occur simultaneously on both sites.

At the Kat Hing Garden and Kam Tin Mung Yeung Public School, cumulative construction noise impacts from both Area 1 and Area 2A are expected. The mitigated noise level from Area 2A is higher than that of Area 1 by 7 dB(A) and the predicted cumulative noise level would therefore be increased by 1 dB(A) above the level in *Table 7.3h*, if construction works from both sites are running in parallel.

At Cheung Po, construction noise from the tunnel construction, at-grade and Depot construction works at the West Rail Depot will affect this NSR. However, the mitigated noise level from the at grade construction works for the West Rail Depot is higher than other work areas by more than 10 dB(A), and therefore, the cumulative noise level at Cheung Po will be the same as the predicted noise levels from *Table 7.3i*.

7.3.2.6 Residual Impacts

The proposed package of mitigation measures will reduce noise levels to within the daytime criteria for about 50% of the NSRs. However, there remain a number of exceedances 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.

A 13 dB(A) exceedance of the daytime criterion has also been predicted at the Pok Oi Hospital during viaduct construction. The hospital, however, will be provided with secondary glazing and air conditioning as part of the Route 3 indirect mitigation measures and, as this will provide 15 dB(A) additional mitigation, no adverse impacts are expected.

Worst case scenarios have been assumed for plant team activities. If necessary, the predicted noise levels could be further reduced by limiting the on-time period or number of items of noisy plant. Application of the following measures will reduce the noise impacts at all NSRs to within the established criteria.

Table 7.3l Additional Mitigation Measures

Work Area	Construction Activity	Percentage on-time in any 30 minute period	No of noisy plant
Area 2a	Piling	80%	-
	Pilecap Const'n	-	restricted to one lorry operating at any time
	Column Const'n	75%	-
	Beam Erection	65%	-
Area 5	Piling	50%	-
	Pilecap Const'n	80%	-
	Column Const'n	75%	-
	Beam Erection	40%	-

Work Area	Construction Activity	Percentage on-time in any 30 minute period	No of noisy plant
Depot Const'n	Earth work	50% for bulldozer and roller	scraper and grader should not be operated together with other PME
(At Grade Const'n)	Railway Systems Installation	-	Loco and wagons should not be operated together with other PMEs.
	Excavation and Drainage	85% PME	

A more stringent noise requirement is applied for educational institutes during examination period, 65 dB(A). Where necessary, noisy construction activity should be scheduled outside the examination period or other mitigation measures applied, to ensure that the noise criteria is not exceeded.

The night-time noise levels exceed the residential criterion for Cheung Po by 1 dB(A) as a result of tunnelling works, which could be reduced by limiting the on-time period of noisy plants and good management. A CNP is required for construction works during restricted hours. Options to control residual noise impact from night-time tunnel construction activities have been outlined in *Section 6.3.2.6*.

7.3.2.7 Conclusions

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 suggested. If these measures are fully implemented, no serious are expected in the Northern Section or West Rail Depot.

7.3.3 Operational Phase

7.3.3.1 Fixed Plant Noise

7.3.3.1.1 Potential Sources of Impact

The majority of fixed noise sources along this section of the West Rail alignment will be located in the West Rail Depot. Additionally, train rolling noise for the section of mainline track which runs through the Depot and is affected by other sources of noise emanating from the Depot is considered in this section. The balance of operational train noise from the remaining section of mainline track is considered separately in *Section 7.3.3.2*. The traction power substation at Au Tau is located beyond the portion of Northern Section under consideration in this assessment, and will be assessed in a separate submission as required.

A number of potential noise sources within the Depot have been identified and divided into two categories for assessment. They are:

- Sources of rolling noise; and
- Fixed noise sources.

A third category, consisting of the cumulative impact from train rolling noise and fixed noise will also be evaluated.

Train rolling noise will be generated on both the main line, which follows an alignment between the two groups of stabling sidings of the Depot and the track fan and siding areas. Trains travelling along the mainline will do so typically at speeds of 130 kph while those travelling in the train fan area and siding tracks will travel at speeds of 25 kph. Wheel squeal may also be generated from trains moving through sharp bends. Wheel squeal is considered as a source of rolling noise for the track fan areas within the depot owing to the necessity to use a number of curves with small radii (200m) because of spatial constraints.

Fixed noise sources will include all other noise sources generated from within the Depot such as idling trains, noise from train washing, train mounted ancillary equipment eg air conditioners, noise emanating from train maintenance activities such as wheel lathes, from workshops and stores and from public address systems, human noise and train horns.

The West Rail Depot will operate 24 hours a day. Noise emissions will be dependent on the activities which occur at any particular time, but also the sensitivity of the period during which they are generated. Therefore, in order to determine the periods during which impacts are likely to be greatest, it is necessary to consider the activity schedule for the Depot, as shown in *Table 7.3m*.

Table 7.3m Depot Activities Schedule - Periods Most Likely Prone to Noise Impacts

	Time Period			
Activity	06:00-07:00	07:00-08:00	16:00-17:00	23:00-24:00
EMUs using main line (per hour)	30	40	28	24
Locomotives using Siding tracks (per hour)	0	0	0	1
EMUs using siding tracks (per hour)	12	12	15	6
EMU Workshop	n	n	y	n
EMU Running Maintenance	y	y	y	y
Locomotive Maintenance	n	n	y	y
Infrastructure Maintenance Building	n	n	y	y
Stabled Trains	y	y	y	y
Train Washes	y	y	y	y

Notes: 'y' and 'n' indicate plant operating and not operating, respectively

In general, the nighttime period is most noise sensitive. This assumption is supported by the NCO which sets night time noise compliance levels as the most stringent standards, some 10 dB below daytime levels. Preliminary calculations also indicate that train rolling noise will dominate noise emissions from the Depot, therefore, based on the above reasoning, it is considered that the noise impact will be greatest between the hours of 0600 and 0700. Hence, if the noise criteria can be met during this period, they can be met at all other times. Noise levels have therefore been predicted and assessed with reference to the activities being conducted in this period.

7.3.3.1.2 Prediction of Impacts

Noise predictions have been made at the top floor level for a total of 13 NSRs identified in the vicinity of the Depot. Nine of the NSRs are residential and one a place of worship. The NSRs are shown in *Table 7.3n* below. An Area Sensitivity Rating of 'B' has been proposed for all 13 NSRs whose locations are shown in *Figures 9* and *10* of *Annex A*.

Table 7.3n NSRs Potentially Affected by Operational Noise from West Rail Depot

Fig/NSR No	NSR Name	Area Sensitivity Rating
9/1	Cheung Po (Church and Playground)	B
9/2	Tai Kek Tsuen	B
9/3	Village houses south of Cheung Po	B
9/4	Village houses north of Tai Kek Tsuen	B
9/5	Kam Cheq Garden	B
9/6	Village houses south of Kam Cheq Garden	B
9/7	Village house north of Kau Tsuen	B
10/8	Village houses south of Shek Wu Tong	B
10/9	Shek Wu Tong	B
9/29	Kwan Tai Temple	B
9/30	Sites for which building licences have been approved	B
10/10	Village houses along Kam Sheung Road	B
10/11	Village houses to the south of the proposed Kam Tin Station	B

The methodologies and assumptions used to predict the noise impacts from each type of noise source and the results are given below.

Rolling Noise

Train rolling noise generated within the Depot has been predicted using the CRN methodology. The model includes trains travelling along the mainline through the Depot (130 kph) as well as trains travelling along siding tracks (25 kph).

The CRN methodology is valid for speeds of 20 km/hr and above, and is thus a valid method in this situation. CRN also recommends that modelling should assume a speed of 20 km/hr where speeds drop below 20 km/hr. Hence, the low speed of trains within the depot requires no modification to the general modelling method for rolling noise. The worst case results of modelling train rolling noise are given in *Table 7.3o* below.

Wheel squeal is a function of the ratio between the length of the bogie wheel base (W) and the track curve radius (R). Mitigation is generally required where W/R is much greater than 0.01. For the tightest bends in the West Rail Depot, the W/R ratio is expected to be no higher than 0.0125. Hence it is reasonable to assume that if squeal does occur, it will be occasional, and more importantly, it will be relatively easy to mitigate. Water or grease lubrication will probably be sufficient for a complete solution, but it may be necessary to consider modification to restraining rails and rail head profiles in order to completely eliminate squeal noise.

For the purpose of this assessment, point noise has been included within rolling noise. It was however, calculated independently of the SoundPlan Model using the formula described in the assessment methodology *Section 4.4.2.4.1*. The L_{AMAX} values used in the calculations includes a -3dB(A) correction to allow for undercar absorption and vehicle skirts. A further 2 dB(A) was also applied for points within the Depot to allow for ballast track. This further correction was not included for the points along the viaduct section approaching Kam Tin Station.

Table 7.3o Predicted Noise Levels from Depot Train Rolling Noise

Fig/NSR No	NSR Name	Main Line	Siding Track	Total
9/1	Cheung Po (Church and Playground)	63	50	63
9/2	Tai Kek Tsuen	67	59	67
9/3	Village houses south of Cheung Po	67	56	68
9/4	Village houses north of Tai Kek Tsuen	64	56	65
9/5	Kam Cheq Garden	62	53	63
9/6	Village houses south of Kam Cheq Garden	66	57	66
9/7	Village house north of Kau Tsuen	66	59	66
10/8	Village houses south of Shek Wu Tong	70	55	70
10/9	Shek Wu Tong	62	50	62
9/29	Kwan Tai Temple	74	60	74
9/30	Sites for which building licences have been approved	68	56	69
10/10	Village houses along Kam Sheung Road	69	-	69
10/11	Village houses to the south of the proposed Kam Tin Station	72	-	72

All levels specified are $L_{Aeq\ (30\ min)}$ dB unless stated otherwise

Fixed Plant

From currently available information from the engineering Design Consultants, it has been assumed that the EMU running maintenance, heavy repair facilities, workshops and stores will be contained by an appropriately designed building envelope. Additionally, although wheel turning on the underfloor wheel lathes can potentially give rise to major noise impacts, the engineering Design Consultants have advised that an acoustic enclosure will be provided for this activity and therefore these impacts have been considered no further in this assessment.

Potential impacts from public announcement, human noise and train whistles would be regulated by common sense controls, in particular during the night-time.

Stabled Trains

It is proposed that EMU trains will be stabled overnight within the West Rail Depot. There will be provision for a total of 32 trains at the depot in the form of 16 tracks each capable of stabling two EMU trains.

The stabling tracks will be split into two separate sections (8 tracks each) located on either side of the main track running through the depot. Trains stabled along these tracks are likely to generate noise only during start up and shut down periods as well as during daily cleaning. During these periods the main noise source will be the train-mounted plant such as compressors for the control of doors and air conditioning units.

KCRC have advised that the use of EMU roof-mounted air conditioning units will be prohibited within the Depot. Since this represents the main noise source associated with trains within the stabling areas, no impacts from stabled trains are likely. This type of noise has therefore not been considered any further in this assessment.

EMU Heavy Cleaning Facility

The heavy cleaning facility will consist of two berths each capable of accommodating a 12 car train. No more impacts are likely to be generated by this facility therefore this type of noise has not been considered any further in this assessment.

Train Wash

Noise impacts from two train washes installed within each group of stabling sidings, including the pump rooms, water jets and brush sets, were considered in this assessment. The first washer is assumed to be located approximately 75 m east of the EMU maintenance building and the other approximately 100 m north of the West Rail Headquarters Building. It is assumed that trains will be washed every second day. The predictions assume operation of the washers for 100% of the time during the period of assessment.

A noise level of approximately 70 dB(A) at 5m from the train wash is anticipated. If it is assumed that this measurement is typical of levels measured on a cylindrical conformal area of radius 7m and that the train wash will be 50m long, the approximate SWL of the washer can be estimated as 70 dB(A) plus 10 x log (conformal area) - ie 100 dB(A). The train wash has therefore been modelled as a 100 dB(A) point source.

Electricity Sub-Station

An electricity sub-station will be provided at the Depot. It is assumed that appropriate mitigation measures will be incorporated into the installation design, with particular regard to the tonal character of the noise. This item has therefore not been considered further in this assessment.

Storage Facilities

Several storage facilities will be provided at the Depot. It is assumed that noise from storage associated activities will be minimal, therefore they are not considered further in this assessment.

Workshops and Maintenance Areas

Several workshops and maintenance areas will be located within the Depot. These include locomotive workshops (electrical and diesel), welding plant, infrastructure and building maintenance workshop and the EMU Running Maintenance Building. Operations within these areas are likely to comprise mainly the use of hand tools (electrical and pneumatic), electric forklifts, and doors opening and shutting to allow trains to enter and exit.

Noise levels within the workshops and maintenance areas should not exceed NC75[(8)]. which is approximately equivalent to an overall noise level of 80 dB(A). It is assumed that the building heights are 8 m and that the building envelope will ensure a minimum transmission loss of 20 dB(A). It will be necessary to employ good operating procedures to achieve this value, including:

- Avoiding running equipment when not in use;
- Minimising the period of time that doors are left open; and
- Appropriate design and use of any audible alarm systems which may be required.

The Running Maintenance Building will be of considerable size (385m long x 50m wide) therefore it is necessary to include a correction for the angle of view that each NSR has with respect to this structure.

(8) Source: West Rail Design Criteria Volume II/Chapter 6 - Mechanical/Section 2 - Stations , Stations Sites and Maintenance Depot Rev2 March 1997

The worst case noise levels generated by fixed noise sources other than rolling noise have been predicted using a modelling spreadsheet created in MS Excel 5.0. The results are presented in *Annex C* and reproduced below in *Table 7.3p*.

Table 7.3p Predicted Noise Levels from Depot Fixed Plant

Fig/NSR No	NSR Name	Predicted Noise Level
9/1	Cheung Po (Church and Playground)	37
9/2	Tai Kek Tsuen	43
9/3	Village houses south of Cheung Po	50
9/4	Village houses north of Tai Kek Tsuen	49
9/5	Kam Cheq Garden	41
9/6	Village houses south of Kam Cheq Garden	43
9/7	Village house north of Kau Tsuen	44
10/8	Village houses south of Shek Wu Tong	49
10/9	Shek Wu Tong	43
9/29	Kwan Tai Temple[1]	45
9/30	Sites for which building licences have been approved	49
10/10	Village houses along Kam Sheung Road	-
10/11	Village houses to the south of the proposed Kam Tin Station	-

Notes: (1) This property is not night sensitive therefore the daytime criteria applies

All levels specified are $L_{Aeq\,(30\,min)}$ dB unless stated otherwise

7.3.3.1.3 Evaluation of Impacts

Noise impacts for the West Rail Depot have been assessed in three categories; train rolling noise (combined mainline, siding track noise and point/joint noise), fixed plant noise and the combined impact of rolling and fixed plant noise. The discussion in preceding sections has determined that the nighttime noise period, specifically the hour between 0600 and 0700 will be the most crucial, and that if predicted noise levels are acceptable within this period, then noise levels during other periods will also be acceptable.

The criteria to be met for all categories of the Depot noise assessment are shown in *Table 7.3q* below.

Table 7.3q Summary of Evaluation Criteria for Depot Noise Sources

Source Type	Criteria	
	Daytime	Nighttime
Train Rolling Noise[1]	65	55
Fixed Plant[2]	60	50
Combined Sources (rolling noise + fixed plant) [3]	65	55

Notes (1) Based on NCO Criteria

(2) Based on HKPSG criteria

(3) Based on NCO criteria, although HKPSG criteria for fixed plant must be concurrently met

All levels specified are LAeq (30 min) dB unless stated otherwise

The results indicate that all NSRs will be impacted by exceedances of the noise criteria caused by train rolling noise and that the criteria will only be met at Shek Wu Tong for fixed plant sources. Consequently, for the combined case, exceedances will be sustained at all NSRs.

7.3.3.1.4 Recommended Mitigation

Several mitigation measures have been considered in this assessment which can be implemented to minimise noise impacts resulting from the operation of the West Rail Depot. These measures include control of noise at source, provision of noise barriers and operations scheduling.

Control of Noise at Source

The most effective method of controlling the noise at source is in the selection of the quietest plant and techniques available to allow a task to be completed. Other methods include adopting policies of good operating practice, such as ensuring that all equipment is maintained in a good working condition, used only as intended by the manufacturer and turned off, whenever practicable, when not in use. This will be of particular importance for activities which take place out of doors such as heavy cleaning and train washing.

Noise Barriers

It is proposed that trackside noise barriers are used to control the main line rolling noise. These barriers cannot be continuous along the entire length of the track as openings will be necessary where there are points leading to maintenance areas, heavy cleaning, lifting and siding tracks. The length of openings in the barriers should be minimised to ensure maximum effect of the barriers. The barriers should be absorptive and located as close to the track as practicable (assume to be 3 m). It is also proposed that trackside barriers are used to control noise from points and joints.

The locations and the extent of the proposed barriers are shown in *Annex D*.

7.3.3.1.5 Residual Impacts

Table 7.3r shows that the mitigated noise levels expected at each NSR which result from train rolling noise, fixed plant and a combination of the noise sources will comply with the TM4 and HKPSG criteria respectively and that there will be no residual impacts.

Table 7.3r Mitigated Noise Levels from the Depot

Fig/NSR No	NSR Name	Rolling Noise	Fixed Plant	Combined
9/1	Cheung Po (Church and Playground)	55	37	55
9/2	Tai Kek Tsuen	54	43	54
9/3	Village houses south of Cheung Po	54	50	55
9/4	Village houses south of Tai Kek Tsuen	54	49	55
9/5	Kam Cheq Garden	45	41	46-
9/6	Village houses south of Kam Cheq Garden	53	43	54
9/7	Village house north of Kau Tsuen	53	44	54
10/8	Village houses south of Shek Wu Tong	54	49	55
10/9	Shek Wu Tong	53	42	53
9/29	Kwan Tai Temple	60	45	60
9/30	Sites for which building licences have been approved	54	49	55
10/10	Village houses along Kam Sheung Road	55	-	55
10/11	Village houses to the south of the proposed Kam Tin Station	55	-	55

All levels specified are $L_{Aeq\ (30\ min)}$ dB unless stated otherwise

It is worth noting that various safety margins have been incorporated within the model, such as assuming a 100% on-time for all fixed plant, using conservative levels of screening due to the buildings within the depot, ignoring any possible screening effects from buildings outside the depot boundary, excluding angle of view corrections (in most cases) and, when calculating noise levels from large area sources, assuming that the noise source is at the point closest to each NSR. The noise levels presented in this assessment are therefore considered to be *worst case*.

7.3.3.2 Train Noise

7.3.3.2.1 Introduction

For receivers which are located close to the West Rail Depot, noise impacts will result from both through trains and sources within the Depot. In these cases, noise from through trains has been considered together with other sources in *Section 7.3.3.1*, and mitigation measures have been designed to reduce the total noise level from all sources. This section considers train noise impacts to receivers which are not significantly affected by noise from the West Rail Depot, north of Kam Tin Station.

The criteria for the assessment of noise from normal train operations are discussed in *Section 3.2.2.* In using criteria based on the Technical Memorandum (TM), the relevant criterion noise level depends on the time of day and the Area Sensitivity Rating (ASR) of the NSR. For this track section, based on the proposed timetable for years 2006-2011, it is proposed that up to 20 trains per hour would operate in each direction. However, the most critical time period for assessment is the hour 0600-0700, when it is proposed that 15 trains per hour would operate in each direction (ie 30 'train movements'). This period falls within the "night-time" period specified in the TM, and as a consequence has a lower specified noise level criteria.

The criteria which are required to be met in this period are 55 dB(A) $L_{eq,30\text{-}min}$ for areas with a ASR of B and 60 dB(A) $L_{eq,30\text{-}min}$ for ASR C.

An additional criterion is that the maximum level of a train passby should not exceed 85 dB(A). L_{max} levels were also calculated as described in *Section 4.4.2.4.1* and compared with this criterion. However, as demonstrated in the Initial Assessment Report, in all cases the relevant criterion in terms of $L_{eq,30\text{-}min}$ will be the more stringent, such that if this was met, the L_{max} criterion will also be met.

7.3.3.2.2 ***Prediction of Impacts***

In the Northern Section, a total of 93 NSRs have been identified as potentially being affected by noise from train operations. A complete listing of modelling locations is given in *Annex D* and these are shown on *Figures D11, D12* and *D13* together with the boundary of West Rail.

A computer model of the track was constructed in order to provide accurate calculation of noise levels at each of these NSRs. The model incorporates the entire length of both the up and down tracks, using co-ordinates of the track centres provided by KCRC at 20 m intervals. From these co-ordinates, the alignments of noise sources representing the inboard and outboard plena and the structure-radiated noise from the viaduct were generated. In addition, barrier alignments were generated at the position of the top of the standard walkway barrier. Horizontal offsets from the track centres and vertical offsets from the top of rail were used in generating these alignments are shown in *Table 7.3s* below.

Table 7.3s Offsets from Track Centre Used to Generate Noise Source and Barrier Alignments

Alignment	Horizontal Offset, m*	Vertical Offset, m
Outboard plenum gap	1.625	0.98
Inboard plenum gap	-1.625	0.98
Viaduct radiated noise	0	-2
Standard barrier, double track	3.35	2.08
Standard barrier, single track	3.15 and -3.15	2.08

*Positive offset refers to the outboard side

For each 20-metre section of each noise source, information supplied by KCRC was used to determine the train speed (which differs for the up and down tracks) and the track curvature, which determines the width of the plenum gap. These values were then used to determine a correction to the basic noise spectrum for that source, as described in *Section 4.4.2.4.1*.

The present analysis does not include noise from freight or passenger rolling stock associated with Phase 2. Development of these lines represents a separate stage of the project, and would be subject to a separate environmental impact assessment process.

For each identified NSR, the model calculates the contribution of each section of each noise source to the total L_{eq} noise level, taking account of the noise emission level, distance and, for the plenum gap sources, attenuation due to any barriers which break line-of-sight to the source. Barrier attenuation is calculated using the standard Maekawa point-source formula, with correction for a line source effectively being carried out through the numerical integration which is implicit in the modelling process. Conversion from maximum noise levels to L_{eq} levels is carried out as described in *Section 4.4.2.4.1*. To provide a conservative assessment, attenuation due to atmospheric absorption and the ground effect are neglected.

Finally, total L_{eq} noise levels are calculated by summing the levels from the outboard plenum gap, inboard plenum gap and viaduct radiated noise, and compared with the relevant criterion for each NSR.

Where NSRs represent high-rise buildings, it is not obvious which level will be most affected by noise, since at higher levels the barrier attenuation decreases, but the distance from the source increases. For this reason, where the maximum height of an NSR is greater than 40 m above the ground, calculations were carried out at 20 metre intervals down from the top of the building to determine the most-affected location.

Annex D shows results of the above analysis, incorporating all mitigation measures described in *Section 4.4.2.4.1*, with the edge barriers being the basic barrier at 1.2 m above the walkway on each side of the viaduct.

7.3.3.2.3 Recommended Mitigation

From *Annex D,* there are a total of three NSRs at which the calculated L_{eq} noise level exceeds the relevant criterion. These are all located in the section, where the track passes through a village development east of Yuen Long station and Pok Oi Hospital as shown by *Figure 7.3a.* Exceedances here are due to the close proximity of residences to the line, combined with relatively high train speed and are only predicted to occur in the design year with a twelve car train operating.

At these NSRs - identified as locations 303, 304 and 306 (East of Pok Oi Hospital - NSR 3, Figure 12) - calculated structure-borne noise is above the criterion. These NSRs are all located within 14 m of the nearest track, and would not be possible to provide mitigation which would reduce noise levels at these locations to within the criterion. The extent of exceedance at these three properties is a maximum of 1.6 dB(A), and will not occur until full build out in the design year when a 12 car train is operated: noise levels on year of opening are 1.8 dB(A) lower (*see Section 7.3.3.2.4)*, as the train length is four cars less.

Annex E, Concept Specification and Structure Radiated Noise Evaluation of the KCRC Viaduct, Sections 5 and *6,* conclude that the extent of structure-borne noise reduction can be optimised in the detailed design and identifies that by increasing the impedance below the floating slabs by changing from a one to three cell deck section, a further 3 dB(A) noise reduction is predicted.

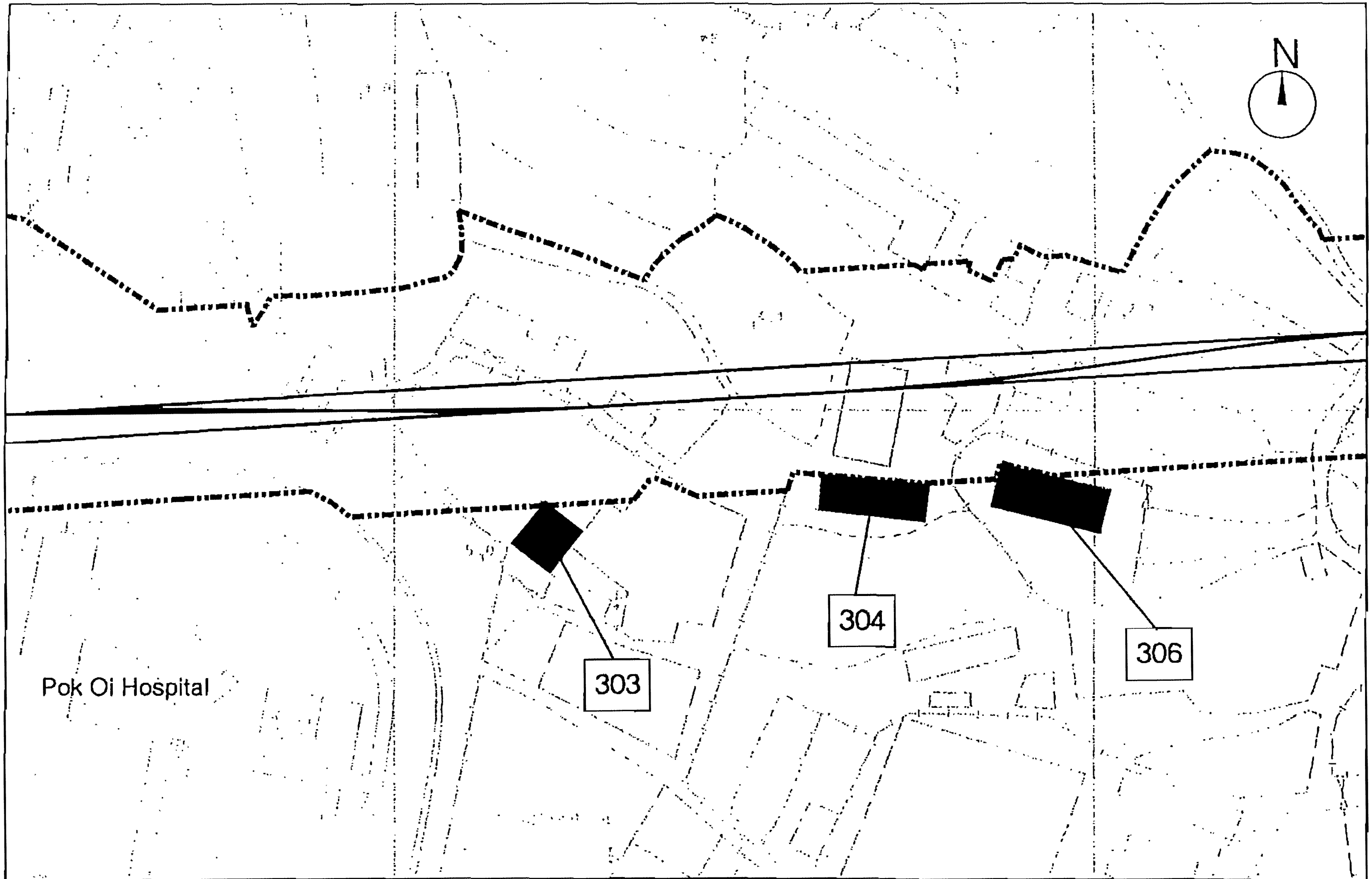
It is therefore recommended that full consideration of this 'at-source' treatment is given before 'at-receiver' measures are implemented.

The package of 'at-receiver' mitigation measures to which KCRC are committed to provide if found necessary and includes, inter alia, noise barriers outside affected dwellings and a range of building modifications.

It should be noted that the provision of 'at-receiver' mitigation applied to a maximum of 15 properties in the Northern section as identified in the IAR. Having extensively researched structure-borne and airborne noise control measures since the IAR, the result of this focussed six month study is the detailed specification of the noise barriers, the Multi-plenum system, resilient baseplates, floating slab track and structural enhancement and only three properties with residual exceedances of less than 2 dB(A) in the design year with a twelve car train operating.

It is understood that future development is proposed at Sz Tsz Uk (NSR 5, Figure 12). The degree of mitigation required to protect this development will depend on the layout and height of the development. As a guide, the typical requirements for set back and building height based on the maximum practicable extent of additional barrier heights that can be applied to West Rail viaducts are presented in *Section 7.3.3.2.5* below.

The above analysis does not take account of noise associated with crossovers. On this section of the line, two locations have been identified where this noise source requires additional amelioration. Due to the potential for airborne noise radiation from these



Boundary of the Scheme

Operational Noise Modelling Locations

RESIDUAL NOISE EXCEEDANCES AT THREE NOISE SENSITIVE RECEIVERS EAST OF POK OI HOSPITAL

FIGURE 7.3a

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

locations, it is generally necessary to fully enclose the track for some distance around them, using absorptive lining in the enclosed section. A lining of 45 mm Pyrok, as recommended for lining of the under-walkway plenum, has been assumed.

Noise levels at the nearest NSR were calculated as described in *Section 4.4.2.4.1*, taking account of train speed and distance. The extent of enclosure required to meet the relevant criterion at this NSR was then calculated. Results are shown in *Table 7.3t* below.

Table 7.3t Enclosures Required for Crossovers

Crossover Location	Extent of Enclosure
Approx ch. 18950-19050	To 50 m each side of crossover, and to ensure the minimum distance between enclosure end and NSR is not less than 30 m.
Approx ch. 19150-19250	To 20 m each side of crossover
Approx ch. 21550-21650	To 50 m each side of crossover, and to ensure the minimum distance between enclosure end and NSR is not less than 30 m.

7.3.3.2.4 Mitigation Required Immediately On Start-Up

The above mitigation measures are designed to ensure that noise levels are within the relevant criteria at full predicted usage of the rail system - that is, 15 twelve-car train movements in each direction between 6 am - 7 am, which represents the most critical time period. Immediately on opening the systems, it is proposed to use the same timetable as for full operations, but to use only eight-car trains. This has the effect of reducing the L_{eq} noise level by 1.8 dB(A), although maximum noise levels close to the track would be almost unaffected.

Enclosures of approximately the same size as those described in *Table 7.3t* above would still be required to protect adjacent NSRs. Given the difficulties involved in adding additional length to such structures, it would appear more appropriate to construct them to the full required length from the beginning of operations.

7.3.3.2.5 Mitigation for Future NSRs

While the above mitigation measures will ensure that noise levels are within relevant criteria at all existing NSRs, the possibility of future noise-sensitive development close to the track has also been considered. The requirements for noise mitigation for such future development cannot be set out precisely, as they depend on the location of the development, its height and the ASR that would be assigned under the NCO.

To assess the potential for operational noise from the railway to affect possible future potential developments, three locations were selected along the track, representing the range of track speeds and other operational conditions which exist in this section. At each location, noise levels were calculated at hypothetical NSRs with various heights, situated at various distances from the track. These levels were then used to determine the minimum distance from the track at which an NSR could be located in order to comply with criteria of 55 dB(A) L_{eq} (ASR B) and 60 dB(A) L_{eq} (ASR C) for the hour 0600-

0700. Calculations were then repeated with additional edge barrier heights of 2 m and 4 m, to determine the effect of these barriers on the minimum allowable distance. Results from this analysis are presented in *Tables 7.3u* and *7.3v* below.

Table 7.3u Minimum Distance from Nearest Track to new NSR to meet criterion of 55 dB(A) L_{eq}

Chainage	Description	Building Height, m	Additional Edge Barrier Height, m 0	2	4
21000	Twin Viaduct	10	10	10	10
		50	90	60	40
		90	110	80	65
		130	110	80	65
18000	Near West Rail Depot	10	12	10	10
		50	60	20	15
		90	85	30	15
		130	85	30	15
16500	Near Tunnel Portal	10	15	10	10
		50	55	20	10
		90	85	30	10
		130	85	30	10

Table 7.3v Minimum Distance from Nearest Track to new NSR to meet criterion of 60 dB(A) L_{eq}

Chainage	Description	Building Height, m	Additional Edge Barrier Height, m 0	2	4
21000	Twin Viaduct	10	10	10	10
		50	35	30	20
		90	35	30	20
		130	35	30	20
18000	Near West Rail Depot	10	10	10	10
		50	10	10	10
		90	10	10	10
		130	10	10	10
16500	Near Tunnel Portal	10	10	10	10
		50	10	10	10
		90	10	10	10
		130	10	10	10

From *Table 7.3v* above, it is clear that if the ASR for a new development is C, then in most cases buildings of any height could be located quite close to the track. With the addition of 4 m edge barriers, buildings of any height could be located up to 20 m from the track at any of the selected locations.

On the other hand, to meet the noise requirements for ASR B, relatively tall buildings may need to be set back up to 110 m from the track. Even with 4 m additional edge barriers, this required setback may be reduced only to 65 m. Low-rise buildings, however, could be located up to 10 m of the track after the provision of 2 m high edge barriers.

The structural design of the viaduct has been specified to accommodate high sided barriers and sections of full enclosure of a limited length upto 230 m. The length of any enclosure required is limited by safety and ventilation requirements.

The Multi-plenum System will always provide greater attenuation than a mitigation solution based solely on noise barriers and, as such, the application of the System will effectively reduce overall barrier heights and consequent visual intrusion. In line with the commitment given to Government by the Corporation, the Multi-plenum System provides the flexibility for future enhancement as edge wall barrier heights can be incrementally extended for increased noise attenuation from 1.2 m upto full enclosure. This will provide Government with greater flexibility in the long term land use planning of the areas through which West Rail passes and will facilitate, as yet uncommitted, development to be considered in much closer proximity to the railway than would otherwise be the case.

7.3.3.2.6 Conclusions

Based on the package of mitigation measures specifically designed for West Rail, there will be no residual exceedances on start up of operations in the Northern Section. Predicted noise levels are not in excess of the NCO criteria with an eight car train operating with 15 movements each way in the last hour of the night-time period between 0600 and 0700. For a future twelve car train service, at-receiver mitigation will be required to reduce noise levels by around 2 dB(A) at three properties east of Pok Oi Hospital. However, during the detailed design process of the viaduct structure, consideration will be given to a three-cell viaduct which may reduce noise levels by 3 dB(A). This would result in no at-receiver mitigation being required.

For future development close to West Rail, additional barriers can be applied to minimise, as far as practicable, the set back. At the indicative locations considered in this assessment for future high rise development, a maximum set back distance of 20 m and 65 m for ASR C and ASR B respectively would be required with a maximum practicable additional barrier height of 4 m.

The package of mitigation measures incorporating the multi-plenum system and structure-borne noise control is considered to present the maximum practicable noise reduction for West Rail.

7.4 Air Quality

7.4.1 Construction Phase

7.4.1.1 Baseline Conditions

In the Kam Tin area the main land uses are for agricultural purposes, fish ponds and scattered villages. Kam Tin Road and Kam Sheung Road are the two main access roads. According to the *Traffic Census 1996*, the averaged annual daily traffic flows on Kam Tin Road and Kam Sheung Road are 8700 and 22360 respectively. The air quality in Kam Tin is influenced by emissions from vehicles using these roads. Route 3 is located in the vicinity of the West Rail alignment and is currently under construction and due to be opened by mid-1998. During its operation, traffic will be one of the main sources of air quality impact to the area.

As there are no existing EPD air quality monitoring stations in the area near Kam Tin, monitoring results at the nearest comparable air monitoring station located in Tai Po are referenced. The annual averaged TSP level measured at the Tai Po air quality monitoring station in 1996 was 73 $\mu g\ m^{-3}$.

7.4.1.2 Potential Sources of Impact

The principal potential source of air quality impact arising from the construction of West Rail will be fugitive dust. Although powered mechanical equipment, such as air compressors and generators will be used, the number of items required will be limited. Therefore, together with good house-keeping and regular maintenance, the gaseous exhaust emissions from the plant will be small and should not result in adverse impacts.

7.4.1.2.1 Northern Section

The Northern Section of West Rail is to be constructed mainly on viaduct with one section located in a cut and cover tunnel to the north of Au Tau Interchange. The work sites of the Northern Section were described in *Section 7.3*. Construction activities for viaduct sections involve excavation during site preparation, construction of foundations and viaduct deck. Major excavation is expected in Area 2 for the diversion of the river. It is likely that the excavated materials will be disposed of off-site by dump truck and hence impacts from haul road dust are anticipated. During the foundation and viaduct deck construction, excavated materials from bored piling will have a high moisture content and the viaduct deck will be pre-cast. Therefore, dust impacts from materials handling will be limited. Construction of stations and the cut and cover tunnel will also require materials handling which would be likely to cause air quality impacts on the surrounding environment.

A precasting yard and concrete batching plant may be required for the construction of the Northern Section and West Rail Depot. Storage of raw materials and materials handling at the precasting yard and concrete batching plant are potential fugitive dust sources. however a site for the infrastructure has not been identified and may be left up to the Contractor. Concrete batching is a specified process under the APCO and a licence is required for the operation of the plant.

The volume of cut and fill for the Northern Section and the traffic flows generated for each work site have been predicted and are summarised in *Table 7.4a.*

Table 7.4a Estimates of Construction Traffic Flows

Site Area	Cut (m^3)	Fill (m^3)	Traffic Flow (veh./day) (1)
Area 1	2,000	270,000	153
Area 2A	75,000	150,000	43
Area 2B	14,000	15,000	1
Area 3	23,000	648,000	356
Area 4	16,000	14,000	2
Area 5	10,000	19,000	5
Area 6	12,000	3,000	5

(1) based on assumed working day of 10 hours and 254 working days a year.

7.4.1.2.2 West Rail Depot

Construction activities for the West Rail Depot will mainly be foundation work and building construction. The preparation of the Depot site will require major earthworks which, in association with other construction work on the site, could generate considerable dust impacts. The construction of the West Rail main line and excavation for the DSD drainage channel could also generate dust impacts. It is envisaged that a total of 1,300,000 m^3 of fill material will need to be brought to the site, of which 579,000 m^3 will be obtained from the Central Section. It is expected that the highest traffic flow (215 vehicles per hour) would be generated in the site formation phase for the spoil transfer activities.

7.4.1.3 Prediction of Impacts

ASRs have been identified according to HKPSG and the APCO guidelines. Details of the ASRs list are presented in *Annex A*. The predicted cumulative 1-hour and 24-hour TSP levels arising from the construction works for the Northern Section and the West Rail Depot at the nearby representative ASRs under worst case meteorological conditions are shown in *Table 7.4b*. As discussed in *Section 7.3*, the off-site traffic for the Depot will mainly use Route 3 CPS. The contribution of West Rail construction trucks to the traffic volume of Route 3 is less than 5% and any air impacts on air quality will be minimal. The annual TSP level measured at Tai Po air quality monitoring station of 73 $\mu g\ m^{-3}$ was assumed as the background for the Northern Section and the Depot.

Table 7.4b Predicted Cumulative 1-hour and 24-hour TSP Levels

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Kam Tin (KAT)	9/2	Tai Kek Tsuen	7863	3345
	9/4	Village houses to the south of Tai Kek Tsuen	3536	1527
	9/3	Village houses to the south of Cheung Po	3647	1574
	9/6	Village Houses to the south of Kam Cheq Garden	5588	2389
	9/7	Village House to the North of Kau Tsuen	4738	2032
	10/8	Village houses to the south of Shek Wu Tong	7003	2894
	10/11	Village house to south of the proposed Kam Tin Station	6495	2770
	10/10	Village houses along Kam Sheung Road	3433	1484
	10/14	Kat Hing Garden	3411	1475
	10/9	Shek Wu Tong	780	370
	10/16	Village houses to the east of Ko Po San Tsuen	2708	1180
	11/22	Ko Po Tsuen	2518	1100
	11/24	Village house between Cheung Chun San Tsuen & Ha Ko Po Tsuen	1074	493
	11/C1	Retail complex in DD 107, Sha Po	2057	904
	11/26	Village houses to the north of au Tau	573	283
	11/27	Village houses in Tung Shing Lei	535	267

Exceedances of TSP criteria are shown in bold

Location of ASR refer to *Annex A*

Includes background TSP levels

Units are $\mu g\ m^{-3}$

7.4.1.4 Evaluation of Impacts

The predicted 1-hour and 24-hour TSP levels at the ASRs along the Northern Section and near the Depot are in the range of 535-7863 $\mu g\ m^{-3}$ and 267-3345 $\mu g\ m^{-3}$ respectively. The EPD's recommended hourly limit of 500 $\mu g\ m^{-3}$ and 24-hour AQO of 260 $\mu g\ m^{-3}$ are exceeded at all ASRs. The high volume of haul road traffic during the formation of Depot is the major dust source. Effective mitigation measures should be adopted in order to reduce the dust level to within the statutory guidelines.

7.4.1.5 Recommended Mitigation

Dust mitigation measures which could be applied to the construction sites for material handling, excavation and vehicle dust have been described in *Section 5.4*. In addition, the following measures should be applied to the haul roads to further reduce the dust emissions from the Depot.

- Locate the haul roads away from all ASRs;
- Haul roads should be paved; and
- Vehicle speeds should be limited to 15 kph within the depot work site.

Through the implementation of the above mitigation measures, dust emission from material handling will be reduced by 50 %. Paving the haul road will reduce dust generation by 85%, in accordance with *Control Techniques for Particulate Emissions From Stationary Sources, Volume 2, US Environmental Protection Agency 1982*. Emissions could be further reduced up to 97% by controlling vehicle speeds within the site to 15 kph and maintaining the regular watering programme. The predicted 1-hour and 24-hour TSP levels are presented in *Table 7.4c*.

Table 7.4c Predicted Mitigated Cumulative 1-hour and 24-hour TSP Levels

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
Kam Tin (KAT)	9/2	Tai Kek Tsuen	213	132
	9/4	Village houses to the south of Tai Kek Tsuen	138	100
	9/3	Village houses to the south of Cheung Po	139	101
	9/6	Village Houses to the south of Kam Cheq Garden	185	120
	9/7	Village House to the North of Kau Tsuen	159	109
	10/8	Village houses to the south of Shek Wu Tong	212	131
	10/11	Village house to south of the proposed Kam Tin Station	209	130
	10/10	Village houses along Kam Sheung Road	172	115
	10/14	Kat Hing Garden	168	113
	10/9	Shek Wu Tong	115	91
	10/16	Village houses to the east of Ko Po San Tsuen	130	97
	11/22	Ko Po Tsuen	245	145
	11/24	Village house between Cheung Chun San Tsuen & Ha Ko Po Tsuen	116	91
	11/C1	Retail complex in DD 107, Sha Po	177	117
	11/26	Village houses to the north of au Tau	99	84

Area	Fig/ASR No	ASR Name	1-Hour TSP Level	24-Hour TSP Level
	11/27	Village houses in Tung Shing Lei	213	132

Exceedance of TSP criteria are shown in bold

Location of ASR refer to *Annex A*

Includes background TSP levels

Units are µg m^{-3}

7.4.1.6 Residual Impacts

As indicated in *Table 7.4 c*, 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.

7.4.2 Operational Phase

7.4.2.1 Baseline Conditions

In the Kam Tin area the majority of land is used for agriculture, fish ponds and scattered villages. Kam Tin Road and Kam Sheung Road are the two main existing access roads. Route 3 is under construction and will commence operation in mid-1998. During the operation of West Rail, traffic on these existing and proposed roads will be the main sources of air quality impact to the area.

7.4.2.2 Potential Sources of Impact

Potential air quality impacts during the normal operation of West Rail will be limited since electric trains will be used and no exhaust gas will be produced. However, low levels of dust may be created by the abrasion and wear of track, electrical pick-up gear and rolling stock during normal operation and from maintenance activities. The amount of dust generated from such activities will be low and will have a negligible impact on the ASRs.

The used air inside the station will be emitted via the exhaust outlets or air ventilation systems. The pollutant levels of such emissions will be limited and adverse air quality impacts are therefore not expected.

The public transport interchanges (PTI) are enclosed and located further than 20 m from the ASRs. If the air quality controls installed at the interchanges satisfy the requirements outlined in the *Practice Note on Control of Air Pollution in Semi-confined Public Transport Interchanges*, adverse air quality impacts from the transport interchanges are unlikely.

During the operation of the Depot, there may be fugitive dust from welding and ballast handling. Fugitive emissions are also anticipated from paint spraying. It is anticipated that control measures will be implemented to meet occupational health requirements, and such measures will assist in controlling air quality impacts. There will also be odorous emissions from refuse storage. However, it has been recommended in *Section 7.10* that general refuse generated on-site should be stored in enclosed bins or compaction units and a reputable waste collector should be employed to remove general refuse and industrial waste on a daily basis. Therefore, odour and litter impacts could be minimised.

7.4.2.3 Recommended Mitigation

Adequate mechanical ventilation should be provided to ensure that the air quality inside PTI meet the standards stated in the Practice Note specified above.

7.4.2.4 Residual Impacts

Air quality impacts during the operational phase of West Rail are not considered to be of concern as limited potential sources have been identified. No adverse residual impacts are anticipated.

7.5 Water Quality

This section provides a detailed assessment of potential water quality impacts, including impacts on river water quality and drainage, associated with the construction and operation of the Northern Section and the West Rail Depot (WRD). The Northern Section comprises rail tracks on embankment and elevated structures and the proposed Kam Tin Station. Maintenance and routine cleaning of trains would be undertaken at the WRD.

The key issue addressed in this section is the generation of wastewater which may cause adverse water quality impacts on water sensitive receivers. Where appropriate, mitigation measures are recommended to minimise potential impacts so that residual (post- mitigation) discharge levels meet the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) standards.

7.5.1 Construction Phase

7.5.1.1 Water Sensitive Receivers (WSRs)

The Northern Section and WRD are located close to a number of fish/duck ponds, agricultural lands and the Kam Tin River. The WSRs likely to be affected by the construction of the Northern Section and the WRD include:

- Ponds and tributaries of Kam Tin River in Kam Tin valley;
- Ponds and agricultural land south of Kam Tin Station;

- Ponds near WRD;
- The Kam Tin River; and
- Ponds in the Kam Tin lowlands.

The locations of these WSRs are shown on *Figure 7.5a.*

7.5.1.2 Baseline Conditions

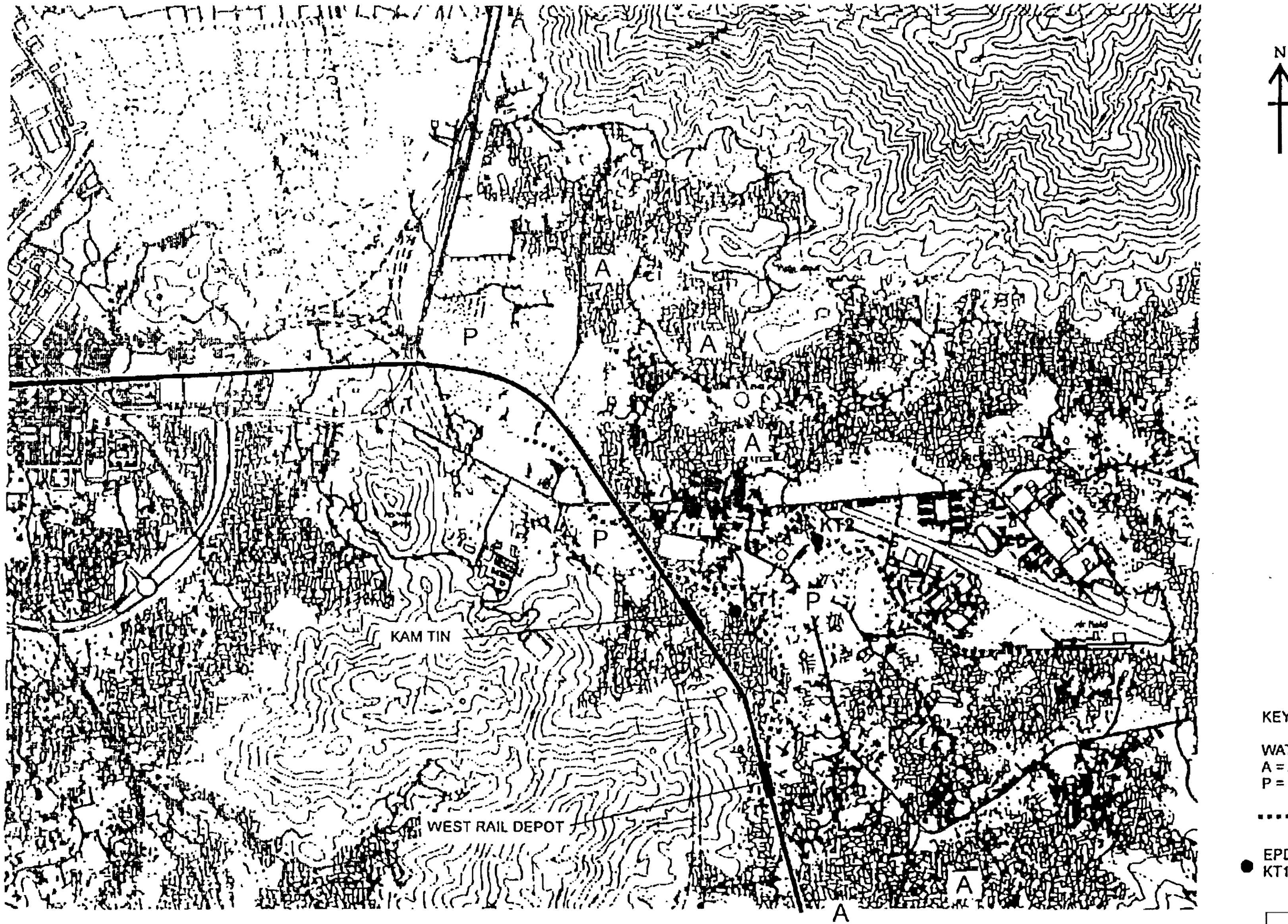
7.5.1.2.1 Kam Tin River

Kam Tin River is one of the larger catchment areas in the North West New Territories and meanders across the flood plain of the Kam Tin valley. The Kam Tin River and its tributaries are the major surface water bodies in the area of the Northern Section and WRD, and are prone to flooding.

Kam Tin River water quality is regularly monitored by the EPD's river water monitoring programme and the relevant monitoring stations are KT1 and KT2, as shown in *Figure 7.5a.* A summary of the EPD monitoring data (for 1996) for stations KT1 and KT2 is given in *Table 7.5a.*

Table 7.5a Summary Statistics of 1996 Water Quality for Kam Tin River

Parameter	KT1	KT2	WQOs for inland waters of Deep Bay WCZ
DO (% Saturation)	17.6	12.2	n.a.
	(5.8 - 41.7)	(1.5 - 36.6)	
DO (mg/l)	1.3	0.9	4 mg/l
	(0.4 - 12.5)	(0.1 - 3.1)	
BOD_5 (mgl/)	25.0	42.0	3 mg/l
	(12.0 - 110.0)	(15.0 - 210.0)	
COD (mg/l)	39.0	42.0	15 mg/l
	(20.0 - 230.0)	(17.0 - 320.0)	
Oil and Grease (mg/l)	0.9	1.5	n.a.
	(0.5 - 22.0)	(0.5 - 43.0)	
Suspended Solids (mg/l)	35.0	56.0	Annual median 20 mg/l
	(16.0 - 130.0)	(14.0 - 180.0)	
Turbidity (NTU)	36.7	37.7	n.a.
	(14.0 - 65.0)	(12.0 - 100.0)	
Ammoniacal Nitrogen (mg/l)	15.50	22.00	n.a.
	(8.20 - 30.00)	(9.60 - 50.00)	
Total Kjeldahl Nitrogen (mg/l)	21.50	28.50	n.a.
	(10.00 - 43.00)	(11.00 - 74.00)	



KEY:

WATER SENSITIVE RECEIVERS
A = AGRICULTURAL LAND
P = FISH/DUCK PONDS

KAM TIN RIVER

EPD MONITORING STATIONS
KT1 & KT2 = RELEVANT RIVER MONITORING STATION IN KAM TIN RIVER

FIGURE 7.5a - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD WATER QUALITY MONITORING STATIONS

NOT TO SCALE

ERM-Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

Parameter	KT1	KT2	WQOs for inland waters of Deep Bay WCZ
Total Phosphorus (mg/l)	3.80	6.35	n.a.
	(2.00 - 9.40)	(1.90 - 15.00)	
pH	7.0	7.0	6.5 - 8.5
	(6.7 - 7.3)	(6.8 - 7.2)	
Flow (l/s)	330	154	n.a.
	(363 - 840)	(35 - 86)	

Note:

1. Data presented are annual arithmetic means, except where otherwise indicated.
2. Data enclosed in brackets indicate ranges.
3. n.a. = not available

The Kam Tin River has been badly affected by discharges of livestock waste. EPD monitoring data for 1996 show that water quality at the two monitoring stations was very bad. Low DO levels, high BOD_5 and COD content and high SS levels were observed throughout the year.

The Kam Tin River and its tributaries have been designated for channel improvement works by TDD/DSD to alleviate recurrent flooding in the area. The modified channel will be aligned immediately adjacent to the western edge of the WRD site.

7.5.1.2.2 Fish/Duck Ponds

Some fish/duck ponds along the alignment are commercially active. However, the number of active ponds has gradually declined with increasing urbanisation. In recent years large numbers of agricultural land and fish ponds, particularly those located along Kam Tin Road and Kam Sheung Road, have been filled in and converted into open storage uses. The existing ecological value of the identified fish and duck ponds is discussed in the *Section 7.9* of this Report.

7.5.1.2.3 Deep Bay

The watershed of the Kam Tin River is predominantly draining from south to north and forms a part of the Deep Bay catchment. The EPD's "zero discharge" policy proposes no net increase of pollutant loadings into Deep Bay WCZ to protect the environmental resources of the catchment.

7.5.1.3 Potential Sources of Impact

7.5.1.3.1 Northern Section

Potential sources of impacts to water quality from the construction of the Northern Section include the following:

- Construction runoff and drainage;
- Dredging of river and ponds in the viaduct section;
- Runoff from station construction works;
- Runoff from general construction activities and the concrete batching plant; and
- Sewage effluents generated from the construction work force.

Of particular concern will be the flow of silt laden construction site runoff into fish ponds and the Kam Tin tributaries. In Au Tau and Kam Tin, cumulative impacts may arise from concurrent river training works of the Kam Tin River and the construction of Route 3.

7.5.1.3.2 The Depot

Potential sources of impacts to water quality from the construction of the WRD include the following:

- Runoff from WRD construction sites and possible, the concrete batching plant; and
- Sewage effluents generated from the construction work force.

Of particular concern will be the temporary disturbance to the flow of the Kam Tin River due to construction activities within or adjacent to the Kam Tin River or its tributaries. Additional potential impacts from river training work and Route 3 construction are also a concern.

7.5.1.4 Prediction of Impacts

7.5.1.4.1 Northern Section

Construction Runoff and Drainage

Runoff from construction sites may contain increased loads of SS and other contaminants. Potential sources of water pollution from site runoff include:

- Runoff and erosion from site surfaces, earth working area and stockpiles;
- Wastewater from dewatering activities during site formation;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

Construction runoff and drainage may cause physical, chemical and biological effects. The possible impacts on the WSRs from construction runoff and drainage have been described in *Section 5.5*.

The major drainage impacts on WSRs would be the construction of the railway crossing (viaduct) of the Kam Tin River, as this may modify water flow in the channel. According to the TS-100 Drainage Impact Assessment, changes to peak flow rates in the main channel will be associated with the following:

- Increases in sub-catchment impermeability associated with the development of major West Rail Infrastructure, including Kam Tim Station and the West Rail Depot; and
- Changes in the distribution of channel inflows due to sub-catchment flow path modifications.

Dredging of River and Ponds

Approximately 1.7 km of the rail alignment from the Au Tau junction heading west to the Yuen Long Station will be built on viaduct. The construction of support structures for the viaduct would require minimal dredging within water courses or ponds in certain areas. Although the dredging areas are expected to be small, dredging will inevitably elevate levels of SS in areas immediately adjacent to the dredging plant. Dredging may also lead to the potential release of contaminants if they are found to be present in the sediment.

Station Construction

Station construction works will generate materials requiring handling and disposal, as well as temporary storage on site. The potential water quality impact of runoff from the temporary storage area may result in localised deterioration in water quality that may affect downstream WSRs, if they are not controlled properly to meet TM requirements and the "zero discharge" policy.

General Construction Activities

General Northern Section construction activities have the potential to cause water pollution from debris and rubbish, such as packaging and used construction materials, entering water bodies and resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of any receiving water body. Spillages of liquids stored on site, such as oil, diesel and solvents, could also result in water quality impacts if they enter surrounding water bodies and soils. However, the effects on water quality from construction activities are likely to be minimal, provided that site boundaries are well maintained and good construction practices are observed to ensure that litter, fuels and solvents are managed, stored and handled properly.

A concrete batching plant is required for the construction of the Northern Section and the West Rail Depot. Surface runoff contaminated by materials in a concrete batching plant would contain high SS concentrations and acidity which could lead to both physical and chemical water quality impacts. Wastewater generated from the washing of mixer trucks should be treated and recycled on site to remove the SS, reduce the acidity and minimise the discharges into stormwater drains.

Sewage Effluents

Domestic sewage effluents will arise from sanitary facilities provided for the on-site construction work force for the Northern Section, and these have the potential to cause water pollution. Sewage is characterised by high levels of BOD, ammonia and *E. coli* counts.

There are no public sewers within the Northern Section and the construction workforce are expected to be dispersed along the alignment. A site sewerage system is currently proposed to divert sewage from Kam Tin Station to WRD temporary sewage facilities. Before the commission of the proposed sewerage system, adequate and proper sewage collection and disposal facilities (e.g. portable toilets or sewage holding tanks with regular emptying services by licensed contractors) should be installed to ensure that the discharge standards stipulated in the TM are met and there is no net increase in pollutant loading to Deep Bay.

Cumulative Impacts

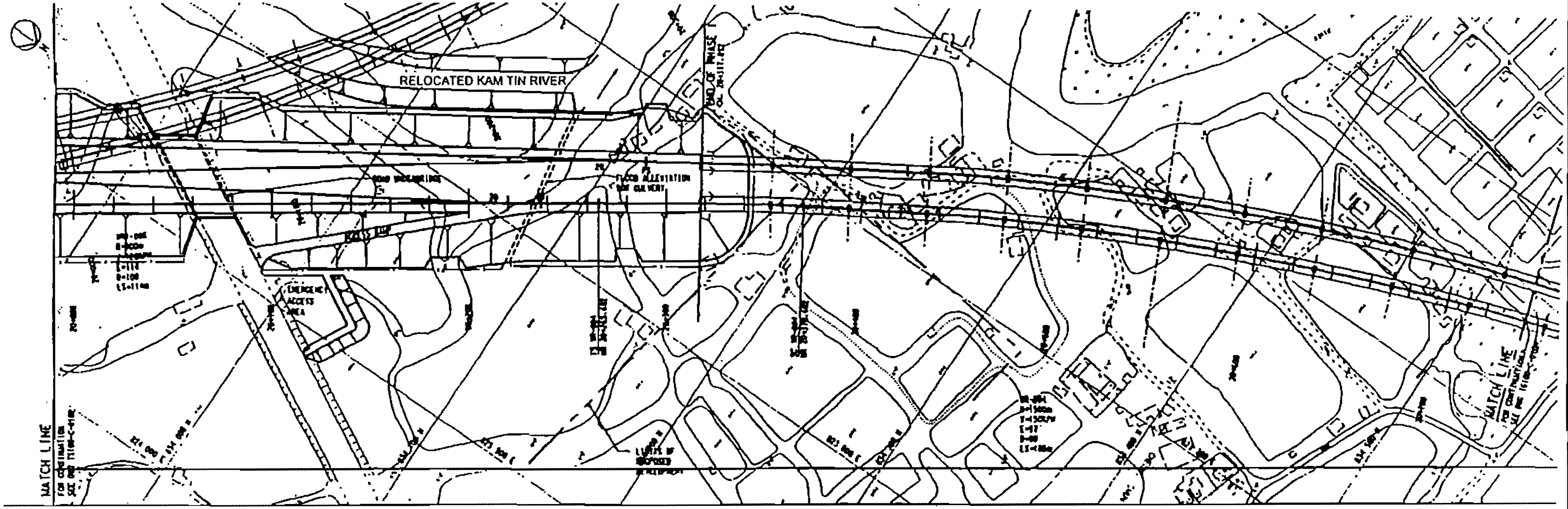
The construction of Route 3 and the proposed TDD/DSD Kam Tin River training works have the potential to contribute to cumulative construction impacts. Both of these projects are currently under construction and scheduled for completion in early and mid-1998 respectively, while West Rail construction is scheduled to commence in late 1998 or early 1999. Cumulative impacts are therefore not expected.

The Kam Tin area is prone to flooding due to its low lying nature. The Kam Tin River training work (43CD) has been proposed by TDD/DSD to form a drainage channel to alleviate recurrent flooding and provide a flood mitigation scheme. The construction work of 43CD was scheduled to be completed in July 1998 in accordance with the *Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin, EIA Study for Kam Tin Section (43CD) and Village Flood Protection Works (30CD) EIA, TDD (1995).* The potential cumulative construction impact will depend on the precise timing of the WRD construction work and the Kam Tin River training work. Although DSD are not prepared to entrust the drainage works at the Railway Crossing of Channel at Kam Tin Station to KCRC, it is considered that diversion of the river is viable and the best option for the crossing of the river. Moving the river alignment approximately 40 m to the south-west of the railway alignment (*Figure 7.5b*) would achieve acceptable viaduct/station structure interface, widen the channel and negate the disturbance of the columns on the river channels. Further discussion between DSD and KCRC is required to determine the best construction strategy.

7.5.1.4.2 The Depot

Runoff from Depot Construction

Construction methods may involve piling, channel excavation, formation of embankments, infilling of fish ponds, and temporary and permanent diversion of water courses. These activities may lead to scouring and deposition of sediment which will



NOT TO SCALE

RAILWAY ALIGNMENT OF NORTHERN SECTION NEAR AU TAU JUNCTION AND THE PROPOSED REALIGNMENT OF KAM TIN RIVER

FIGURE 7.5b

Contract/C1588/C1588Z34

ERM

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WEST RAIL: TS900 EIA STUDY

increase SS levels and turbidity in the receiving water bodies. Increases in downstream siltation may directly affect downstream water sensitive uses, such as active fish ponds, and indirectly impact on WSRs located remote from the proposed construction work sites, such as the Deep Bay catchment. The prediction of impact from the possible location of the concrete batching plant at the Depot is included under the Northern Section.

Potential water quality impacts on WSRs anticipated during the construction of the WRD include:

- Loss and disturbance of ecological resources such as fish/duck ponds, as well as effects on groundwater quality during piling, where potential water quality impacts will depend on the depth of the piles and the relative height of the water table;
- Deterioration in water quality from increased sediment loads; and
- Runoff from spoil stockpiles.

Channel excavation work within the water courses will inevitably elevate levels of SS in areas immediately adjacent to the dredging plant (e.g. excavator or backhoe). Dredging may also lead to the release of sediment contaminants. Channel excavation work may therefore cause both disturbance to the flow regime and adverse impacts on water quality. However, the extent of impacts will depend on the precise timing relationship between the WRD construction work and the Kam Tin River training work.

Sewage Effluents

During the construction stage, it will be necessary to provide a temporary means of sewage collection and disposal as the existing area is unsewered. A proposed site sewerage system will be built from Kam Tin Station to WRD temporary sewage treatment facilities. However, the provision of the temporary sewage treatment facilities is under investigation as possible advance works. The alignments of the sewers are chosen to follow access road/footpath to facilitate future maintenance work. All the site sewers are gravity systems and no intermediate pumping station is expected. All the sewers are designed to be 225 mm, the minimum size as specified in the Sewerage Manual. Before the proposed sewerage system is available, temporary sewage collection and disposal facilities should be made available, such as sewage holding tanks or portable toilets. Such facilities should be installed and regularly emptied by licensed contractors.

Local Flooding

The WRD is located in the Kam Tin valley along the alignment of the Ho Pui watercourse. The area is relatively low-lying and has a history of flooding during the wet season. Any change in flow regime of the water course may cause local flooding of the flood fringe area.

The DSD has envisaged that the construction of the WRD will not have a significant effect on the current estimated flood levels. The DIA[9] also indicated that although changes in sub-catchment impermeability will result in increased peak discharges, modifications to inflow points will delay the inflow to the channel. In some areas, the net result will be a reduction of peak discharges in the channel, such as the area directly upstream of the Kam Tin Depot. However, in most instances, a slight increase in peak discharge is anticipated over all adjacent channel systems.

Cumulative Impacts

The main potential cumulative impact will be an increase in sedimentation from simultaneous WRD construction activities and drainage channel training works. However, the construction of WRD will not induce significant sedimentation as all embankments will be protected against erosion. Minor deposition may occur around bridge piers. These would be transient and would not affect the channel hydraulics. Sediment may be washed from the site and regular monitoring and clearance are required.

7.5.1.5 Evaluation of Impacts

The water quality of the polluted Kam Tin River and its tributaries will further deteriorate if unmitigated construction activities are conducted. The net water quality impacts, include construction runoff from general construction activities and the concrete batching plant containing elevated concentrations of SS and associated contaminants as well as the construction work force sewage discharges. These may directly affect the water quality of the WSRs and downstream water quality within the Deep Bay catchment unless mitigated.

All discharges from construction sites should comply with limits stipulated in the TM. Site management and good housekeeping practices, including measures recommended in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94) to control the construction site runoff and drainage, should be adopted to minimise the net (unmitigated) water quality impacts on WSRs.

It is likely that the material volumes associated with any dredging of rivers or fish ponds will be minimal. Proper dredged sediment handling and disposal methods should be implemented to minimise any potential water quality impacts on the downstream WSRs, especially where material to be dredged is found to be contaminated.

The construction of Route 3 is scheduled to be completed in April 1998, while the Kam Tin River Training works is likely to be undertaken simultaneously with the construction of the Northern Section and WRD. The key impact of the construction of West Rail and river training works will be the increase in SS from the site runoff, which may cause some

(9) Schematic Design Report, Volume 6, Draft Drainage Impact Assessment, Construction Phase I, Northern Section, KCRC West Rail, October 1997.

deterioration in river water quality without control. Other potential impacts include the depletion of DO and elevation of organic contaminants in the river water.

7.5.1.6 Recommended Mitigation

The main purpose of construction mitigation measures should be to minimise the flow of pollutants and sediments into adjacent Kam Tin River tributaries and fish/duck ponds from work sites. Any infilling activities which cause the loss of wetland should be minimised. All fish ponds which are temporarily occupied during construction phase should be restored to commercial operation, as appropriate.

Both the Northern Section and WRD are located within the Deep Bay WCZ such that all discharges from the construction sites are subject to TM requirements and "zero discharge" policy. The development should therefore not result in any net additional pollution loads to Deep Bay. It is important that appropriate measures are implemented to control runoff and drainage and prevent SS loadings from adversely impacting downstream WSRs. Proper site management will be essential to minimise surface water runoff, soil erosion and sewage effluent impacts.

Construction site runoff and drainage should be prevented or minimised in accordance with the guidelines stipulated in the ProPECC PN1/94. Good housekeeping and stormwater best management practices, as detailed below, should be implemented to ensure that runoff from construction areas and any stored excavated material comply with the WPCO, so that no unacceptable impact on the WSRs arises due to the construction of West Rail. All discharges from the construction site should be controlled to comply with effluent standards.

7.5.1.6.1 Construction Runoff and Drainage

Exposed soil areas should be minimised to reduce the potential for increased siltation, contamination of runoff and erosion. Construction runoff impacts associated with above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:

- The use of sediment traps; and
- Adequate maintenance of drainage systems to prevent flooding and overflow.

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 appropriate watercourses, via a silt retention pond. Permanent drainage channels should incorporate sediment basins or traps and baffles to enhance deposition rates.

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 traps should be regularly cleaned and maintained. 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.

Sand and silt in wash water from wheel washing facilities should be settled out and removed before discharge into storm drains. A section of the road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site runoff from entering public road drains.

Oil interceptors should be provided in the drainage system downstream of any significant oil and grease sources and regularly emptied 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, as specified in the ProPECC PN 1/94.

7.5.1.6.2 Station and Depot Construction

Temporary on-site storage of excavated materials from station and depot construction works should be covered with tarpaulin or similar fabric during rainstorms. Any washout of construction or excavated materials should be diverted to the drainage system via appropriate sediment traps. Concrete washing contains high level of SS and acidity and should be created by appropriate neutralisation tanks and diverted through sediment traps prior to disposal (see *Section 6.5.1.6.2*).

7.5.1.6.3 General Construction Activities

Debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts. Requirements for solid waste management are detailed in *Section 7.10* of this Report.

All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching the WSRs.

Discharge and surface runoff contaminated by materials from the concrete batching plant should be diverted to neutralisation tank to reduce acidity. Alkaline chemical 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.

7.5.1.6.4 Sewage Effluent

Construction work force sewage is expected to be handled by portable chemical toilets or sewage holding tanks along the alignment of the Northern Section. Appropriate and adequate portable toilets should be provided by licensed contractors who will be responsible for appropriate disposal and maintenance of these facilities. All site sewage produced should be diverted to the sewer system for handling by the temporary sewage treatment facilities at WRD. However, the provision of the temporary sewage treatment facilities is subject to an investigation as possible advance works. If the treatment facilities is not feasible in the construction stage, temporary sewage collection and disposal facilities should be made available, such as sewage holding tanks or portable toilets. Such facilities should be installed and regularly emptied by licensed contractors. Information on the size of the on-site construction workforce is not available at this stage.

7.5.1.7 Residual Impacts

General construction activities associated with the Northern Section and WRD could lead to site runoff containing elevated concentrations of SS and associated contaminants that may enter the WSRs. However, it is anticipated that water quality impacts will generally be temporary and localised during construction. Therefore, no unacceptable residual water quality impacts are anticipated from the Northern Section and WRD construction phase, provided that:

- All of the recommended mitigation measures, including appropriate drainage and silty runoff collection facilities, are adopted;
- Any diversion of drainage pipes or channels is constructed to allow flow to the discharge point or outfall without overflow or washout;
- All temporary drainage diversions are reinstated to their original condition after the construction works are completed. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements; and
- All construction site discharges comply with the TM standards of the WPCO.
- All the site sewage are dealt by adequate temporary sewage collection and disposal facilities, as well as temporary treatment facilities (if feasible).

7.5.2 Operational Phase

7.5.2.1 Baseline Conditions

The potential WSRs will be broadly the same as those identified for the construction stage, including fish/duck ponds, agricultural lands and the Kam Tin River and its tributaries.

Although the Kam Tin River and its tributaries are graded "bad" to "very bad" with respect to water quality, the implementation of the Livestock Waste Control Scheme in 1989 under the *Waste Disposal Ordinance* and the *Water Pollution Control Ordinance*, and construction of the *Stage III of the Yuen Long and Kam Tin Sewerage Master Plan* (scheduled to commence in 1999), are expected to produce significant improvements in water quality.

7.5.2.2 Potential Sources of Impact

7.5.2.2.1 Northern Section

Potential sources of impact on water quality from the operation of the Northern Section include the following:

- Cooling water discharge;
- Runoff from rail track;
- Station runoff;
- Sewage generation at the Kam Tin Station; and
- Local flooding.

7.5.2.2.2 The Depot

Potential sources of impact on water quality from the operation of the WRD include the following:

- Operational runoff, particularly from polluted/contaminated surfaces;
- Wastewater from train cleaning, and heavy cleansing and maintenance facilities;
- Sewage generation from the lavatories, showers and kitchen areas of the WRD; and
- Local flooding.

7.5.2.3 Prediction of Impacts

7.5.2.3.1 Northern Section

Cooling Water Discharge

Five units of packaged air-cooled chillers with condensing fans will be used in Kam Tin Station. No cooling water discharge will be produced under normal operation of the chillers. However, the quantity of the chiller water has not been specified by the Engineering Consultant. The frequency of chiller water generation has also not been specified but is likely to be discharged only under emergency conditions. The chiller water will then be discharged into the site sewerage system which diverts effluent to the sewage treatment facilities at WRD. The Engineering Consultant will review this issue subsequently, cognizant that any discharge of chiller water should comply with the limits stipulated in the TM.

Runoff from Rail Track

Track drainage discharges may contain oil, grease, rail grindings and grit that could cause blockage of the pumping units and downstream impacts on WSRs. However, limited amounts of oil and grease in the stormwater runoff from rail tracks are expected.

Station Runoff

Rainwater runoff from the station is expected to be "clean", and therefore should have no impact on the WSRs.

A section of the Kam Tin Station will be located within the drainage channel so that the channel may need to be retrained locally to prevent overflow. The station drainage system will take account of the roof and car park drainage and flood protection requirements. Flood control at the station will follow the KCRC Design Criteria to take account of three flood levels (50, 200 and 1000 year).

Sewage Generation

Sewage will be generated at the Kam Tin Station. Uncontrolled discharge of sewage will cause unacceptable water quality impacts on the WSRs. According to the latest programme of the Preliminary Project Feasibility Study Report of the Yuen Long and Kam Tin Sewerage and Sewage Treatment Requirement Study, trunk sewer will be provided in 2005 to the area near the proposed Kam Tin Station. Sewage generated from Kam Tin Station will ultimately be diverted to the trunk sewer to transfer sewage to sewage treatment facilities in 2005.

In the interim period (2002 to 2005), it is proposed that the sewage generated in Kam Tin Station will be transferred to a treatment plant at the WRD, with the ultimate intention of connecting with the sewerage system after its completion under the Sewerage Master Plan Study for the Kam Tin and Yuen Long area (SMP) in 2005.

The SMP has recommended the construction of a rising main from Ho Pui connecting to a gravity sewer at Shek Wu Tong which extends to Kam Tin, from where it would be pumped by rising main to the proposed Yuen Long sewerage system.

Local Flooding

The risk of local flooding in the Northern Section may be increased by runoff from catchments which are modified by development of the Northern Section, surface runoff from West Rail facilities in the Northern Section, and losses of flood plain. These factors, together with changes in hydrographs for 2, 10, 50 and 200 year return period flood events, will be modelled by the engineering Design Consultants as part of the design of detailed layout plans for the Northern Section. To date, only findings for Kam Tin and Yuen Long Stations are available in the Schematic Design Report, Construction Phase I, Drainage Impact Assessment of Contract No. TS-100, Northern Section.

There are four Route 3 culverts which outfall along the proposed western boundary of Kam Tin Station. These culverts are shown to be connected to the Main Kam Tin Drainage Channels. In addition there are two new proposed outfalls serving the station area which discharge into the main drainage channels. Findings from Local Drainage Impact Assessment show that the proposed route for the main Kam Tin Channel (PWP81CD) and proposed rail alignment are in conflict, and this matter is currently subject to discussion between KCRC and the DSD. Based on the proposed trained drainage channel, the increase run-off from the Northern Section will not cause additional flooding during operation.

Cumulative Impact

The Kam Tin Main Channel profile for the 200 year event shows a dramatic rise in water level upstream of the Route 3 and NTCR crossing, however the water level associated with the Northern Section is minimal.

The provision of the Trunk Sewer may become a critical issue because of the substantial amount of sewage generation in the development area. In the interim period, discharge from the WRD sewage treatment works should comply with the "zero discharge" policy.

*7.5.2.3.2 **The Depot***

Operational WRD Runoff

The routine operational activities of the WRD could give rise to the release of oil and grease residues. These oily and greasy residues can be dripped, washed or spilled onto the ground surface within a working area. In areas such as the maintenance facilities where runoff could be contaminated by oil and grease, oil interceptors are recommended for separating oil from water prior to discharge.

Wastewater

Wastewater generated by locomotive train washing, heavy cleaning and maintenance facilities may be contaminated with oil, grease and detergent. This wastewater should be treated on-site prior to discharge. On-site wastewater treatment facilities should be provided to treat wastewater discharges collected from these facilities and any leachate from the solid waste storage and handling area. Recycled wastewater should have on-site treatment to remove grit and oil.

Effluent from the Maintenance Facility

Effluent produced from maintenance works has the potential to be heavily contaminated with oils, greases and other hydrocarbon-based products. In addition, the washing of batteries during the maintenance process can produce an effluent contaminated with heavy metals, such as lead and nickel. All of these effluents should be regarded as chemical wastes. Special handling, storage and treatment methods are specified in *Section 7.10.*

Any effluent contaminated with hydrocarbons, heavy metals or other potentially hazardous chemicals must be segregated and controlled to prevent the effluent from contaminating "clean" stormwater runoff. Therefore, drainage on-site must identify areas where contaminated effluent may arise and provide for segregation of clean and contaminated effluent.

Effluent from Train Washing Facilities

Effluents from the acid wash plant will have low pH values so waste water should be neutralised prior to discharge. The volume of liquid effluents from the water and detergent wash plant should be minimised to meet TM requirements. Bio-degradable detergents should be used to cause minimum impact on water courses and associated ecology at the receiving water bodies.

The existing WRD site is unsewered. However, wastewater can be discharged and treated at the Government treatment plants after the implementation of the SMP, as discussed above. The depot is located upstream of the proposed Ho Pui rising main. The design and construction stages of the SMP are scheduled for 2001 - 2002 and 2003 - 2005 respectively, while the operation of the WRD is proposed to commence in the year of 2000. During the interim period, all wastewater should be discharged to an on-site treatment facility and subsequently discharged to the Kam Tin drainage channel after passing through grit and oil removal units, such as silt traps and oil interceptors.

Sewage

Lavatories, showers and kitchen areas will be located within the WRD and effluents will arise from the workforce employed at the Depot. Sewage from trains will be controlled such that it is not to be discharged at the WRD. It is anticipated that this will be a controlled station-specific activity. As mentioned in *Section 7.5.2.3.1*, a Trunk Sewer is proposed and estimated to be completed in mid-2005, which will be able to handle sewage generated by 60,000 residents in Kam Tin and Yuen Long area. Within this estimation, this Trunk Sewer will convey sewage generated from WRD, Kam Tin Station, HQ Building and the 30,000 residents in the Depot development for treatment and disposal under the Yuen Long and Kam Tin SMP.

A temporary sewage treatment plant is proposed at the WRD to comply with the "zero discharge" requirement to Deep Bay in the interim period (2002 to 2005). The proposed temporary treatment work will provide secondary treatment to sewage from the WRD, Kam Tin Station and KCRC HQ building and the treated effluent will be temporarily discharged via the Kam Tin Main Channel into the Deep Bay before the commission of the Trunk Sewer. Because of the zero discharge requirement to the Deep Bay, no new discharge of organic wasteload to the Kam Tin channel will be permitted. However, due to the temporary nature of discharge, it is considered acceptable to intercept and treat part of the polluted water in the Kam Tin River to ensure there will be no net pollution to Kam Tin River during the interim period. It is anticipated that the treated effluent quality standards for BOD_5 is 20 mg l^{-1} and total SS is 30 mg l^{-1}, which will follow those for the conventional secondary treatment plant.

A Sequencing Batch Reactor (SBR), which is a suspended growth system is recommended by the Engineering Consultant for the secondary sewage treatment. The design flow rate of 154 m^3 per day, with BOD loading average of 49.4 kg per day and total SS average of 49.4 kg per day, are adopted to treat a total population of 1,200. This total population includes workers employed in the three main shifts and HQ Building

The 154 m^3 per day comprises 65 m^3 per day of Kam Tin channel water (BOD loading 3.12 kg per day), sewage from WRD and KCRC HQ Building 72 m^3 per day (300 loading 40.8 kg per day) WRD train wash water 8 m^3 per day (BOD loading 0.4 kg per day) and Kam Tin Station wastewater 9 m^3 per day (BOD loading 5.1 kg per day). Details of the design is described in the *West Rail Depot Final Technical Report,* dated 19 December 1997.

Flooding Hazard

The depot is situated in a flood fringe area where there are flood hazards to the nearby villages, such as Yuen Kong San Tsuen, Tin Sam Tsuen, Shek Wu Tong, Cheung Po and Tai Wo to the east of the depot and Tai Kek, Ma On Kong and Ho Pui to the west of the depot. According to the findings of the Drainage Impact Assessment supplied by the engineering Design Consultants, the local rise in water level through the culvert and transition length is not significant to the overall channel hydraulics. However, the engineering Design Consultants recommend that flood retention walls are constructed over the transition length and box section.

Fish/duck ponds can act as water detention ponds which help to reduce the water flow and associated flooding hazard to the adjacent flood prone villages. Their presence may reduce pollutants such as suspended solids from entering the Sham Chun River and ultimately Deep Bay during storm events. Therefore, the alignment should be chosen to minimise the loss of fish/duck ponds, wherever possible.

Cumulative Impacts

Hydrographs from the Drainage Impact Assessment show that for most sub-catchments the WRD does not increase the surface runoff, provided that maintenance mitigation measures are implemented, where applicable.

As described in *Section 7.5.2.3.2*, the provision of the Trunk Sewer may become a critical issue for water quality because of the substantial quantity of sewage generation in the development area.

7.5.2.4 Evaluation of Impacts

7.5.2.4.1 Northern Section

Net (unmitigated) water quality impacts on the WSRs may arise from discharges from station and rail track. Impacts from the operation of the Northern Section may arise from disposal of replaced water in chilled water system (if any) of the air-cooled chiller in Kam Tin Station, rainwater runoff from station areas, and sewage generated from the Kam Tin Station. All of these discharges should comply with the TM standards and conform with the "zero discharge" policy.

7.5.2.4.2 The Depot

The WRD design aims to avoid any deterioration of local flooding hazard due to the development. Net water quality impacts on WSRs may arise from discharges from the WRD facilities. With the temporary sewage treatment facility, the Deep Bay water quality impact will be minimal. After the commissioning of the SMP, the proposed depot sewerage system will provide a main gravity sewer to connect all sewage and wash discharges to the proposed trunk sewer via a sewage pumping station to be located at the eastern side of the Kam Tin River Main Drainage Channel.

7.5.2.5 Recommended Mitigation

7.5.2.5.1 Northern Section

The following measures should be adopted, where appropriate, for the operation of the Northern Section:

- A surface water drainage system should be provided to collect track runoff. Where oils and lubricating fluids could be spilt, including those from operations at the maintenance depot, the track drainage channels discharge will pass through oil interceptors and sediment traps to remove oil, grease and sediment before being pumped to the public stormwater drainage system via a rising main;
- Sewage effluents generated at the maintenance depot and station must meet the standards stipulated in the TM prior to discharge. Sewage should be directed to an appropriate sewage treatment facility for treatment prior to discharge;
- Silt traps, sediment basins and oil interceptors should be regularly cleaned and maintained in good working order. The efficiency of these installations is dependent on regular cleaning and maintenance; and
- Oily contents of the oil interceptors should be collected for reuse, or transferred to an appropriate disposal facility.

7.5.2.5.2 The Depot

The following measures should be adopted, where appropriate, for the operation of the WRD:

- Hard standing surfaces should be provided for areas which may potentially give rise to contamination of storm water by oil and grease. Runoff and spillage prevention measures should conform with relevant engineering and design standards; schematic layout of the WRD can be found in *TS-600 Milestone 7 Engineering Design Concept Report*;
- The acid washing facilities should be designed to achieve effective neutralisation of acids to TM requirements prior to discharge (e.g.

neutralisation tanks). Prudent management practices should be adopted to minimise the amount of acid used;

- Any opportunities for the recycling of water within the automatic washing facilities should be sought to minimise discharge requirements. Bio-degradable detergents should be selected to minimise the impact on water quality and associated ecosystems of the receiving water bodies;
- On-site drainage must focus on the areas where contaminated effluent may be generated and provide a clear segregation of clean and contaminated effluents;
- All plant maintenance areas should be bunded and constructed on a hard standing, and provided with sediment traps and petrol interceptors. Traps and interceptors should be regularly cleaned and maintained, especially after any accidental spillages. Each petrol interceptor should have a bypass to prevent flushing during periods of heavy rains. Layers of sawdust, sand or equivalent material should be laid underneath and around any plant and equipment that may possibly leak oil;
- An emergency spillage action plan should be developed for the WRD to ensure that any accidental spillage event is treated immediately and does not impact on any water bodies;
- The disposal of waste oil and other chemicals is controlled by the *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*. Waste oil and other chemicals must be disposed of at the Government Chemical Waste Treatment Centre at Tsing Yi; and
- Appropriate drainage and effluent collection and treatment systems should be specified to meet the discharge limits as stipulated in the *Technical Memorandum of Standards for Effluents into Drainage and Coastal Waters* at the detailed design stage.

7.5.2.6 Residual Impacts

7.5.2.6.1 Northern Section

With the adoption and incorporation of appropriate drainage and effluent collection systems (to be specified in the Drainage Impact Assessment prepared by the engineering Design Consultants), minimal residual operational impacts are expected.

7.5.2.6.2 The Depot

The design of the WRD should locate major activities using oils and similar materials within areas where exposure to rain is unlikely. Oil/water interceptors should be provided within the drainage system. Assuming the adoption of these measures and the other mitigation measures described above, all WRD discharges should comply with the TM.

7.5.3 Conclusion

This qualitative water quality assessment has determined that no insurmountable water quality impacts should result from the construction and operation of the Northern Section and WRD, provided that the mitigation measures outlined above are implemented.

7.6 Landscape and Visual Issues

7.6.1 Existing Landscape Context

7.6.1.1 Landscape Character

The Depot is situated in the Kam Tin valley at the northern end of the Central Section. From this point the railway passes north through the Kam Tin valley to Kam Tin Station, and then turns west to Yuen Long.

The area of the Depot site is at the southern limit of the Kam Tin flood plan is an area of high scenic value immediately below the wooded hills of the Tai Lam Country Park. The valley floor is wide and relatively flat and comprises an attractive mixture of woodland, pockets of farmland, streams, fishponds and several rural villages which have largely been undisturbed by the infixing with container and open storage areas. As such the area still has a relatively high sensitivity to change.

West Rail will run on embankment from the Depot Site to Kam Tin Station roughly parallel to the Alignment of Route 3. Kam Tin valley is enclosed by the wooded hills of the Tai Lam Country Park. However the scenic quality of this landscape has been reduced by the removal of vegetation and earthworks as part of the construction of Route 3 along the foothills of the western slopes, and by the progressive infilling of farm land with container and open storage areas. The valley floor is wide and relatively flat and comprises an attractive mixture of woodland, pockets of farmland, streams, fishponds and several rural villages. The sensitivity of the valley landscape to change diminishes progressively to the north as the extent of infrastructure and new development increases.

In the section from Kam Tin Station to the Au Tau Interchange, West Rail will be on viaduct across the Kam Tin Road and Route 3 corridors. The land form is generally low lying rising to the low foothills of the Tai Lam Country Park to the west, and with occasional knolls around Au Tau. The traditional landscape pattern was one of agricultural land and fish ponds, with scattered village settlements, but is now largely characterised by container and open storage land uses transport corridors and power lines. The area is consequently of low scenic value and of low sensitivity to change.

At Au Tau the route heads west to Yuen Long where it joins the Western Section. In this length, West Rail will run in on viaduct at approx. 15 -23 m above existing ground level across rural residential and farming land either side of Route 3 and the Castle Peak Road. It would be in short cutting as it traverses the hillside near Castle Peak Road. The land is generally flat and is used for arable and duck/fish farming with scattered village settlements, some container and open storage land uses and a number of transportation and flood relief corridor the hills of the Tai Lam and Lam Tsuen Country Parks providing a distant enclosing element to the south and east respectively.

The Au Tau fish ponds within this section are classified as areas of ecological interest. There are several ancestral buildings which are classified as sites of historical and cultural interest on the north and south sides of the railway : Poon Uk Hakka Mansion (AMO Grade 1) and Clan Houses (AMO Ungraded).

7.6.1.2 Visual Envelope

The visual envelope of the Northern Section and Depot, and the Western Section is shown in *Figure 7.6a, Annex G.*

Due to the size and open nature of the West Rail Depot in the Kam Tin valley there will be disruptions to existing long distance views from the surrounding hillsides and from the view points along the Catchwater Road and other hiking trails in the Country Park. The construction of the West Rail Depot will also disrupt short to middle distant views from the countryside and villages of the valley floor surrounding the site.

From the West Rail Depot to Kam Tin Station, West Rail will be on embankment, and from Kam Tin Station to Yuen Long Station, it will be on viaduct (apart from a short section of cutting near Castle Peak Road) and will be highly visible from the low-lying rural land and agricultural areas on either side.

7.6.1.3 Visually Sensitive Receivers

Visually Sensitive Receivers for the Northern Section and Depot are listed in *Table 7.6a, Annex G* and shown on *Figures 7.6b-e, Annex G.*

7.6.2 Sources of Impact

Potential sources of landscape and visual impact during the construction and operational phases are identified below.

7.6.2.1 Construction Phase

- Site access and haul routes, including traffic movements;
- Cut and fill, including storage of existing topsoil for reinstatement works;
- Concrete Falsework;
- Cranes and lifting gear for constructing viaducts;
- Materials stockpiling ,construction equipment and plant;
- Utilities, including water, drainage, power and lighting; and
- Temporary parking and on site accommodation and working areas.

7.6.2.2 Operational Phase

- West Rail Depot;
- New elevated road crossing the Depot from west to east;
- Station buildings, EVA's, car parks and service areas;
- Viaducts;
- Noise Barriers;
- Noise Enclosures;
- Cuttings;
- Embankments;
- Tunnel Portal;
- Ventilation Buildings and Fan Chambers at Tunnel Portal; and
- Boundary fencing, signage.

7.6.3 Evaluation of Impacts

7.6.3.1 Construction Phase

7.6.3.1.1 Landscape Impact

Impact on Landscape Resources

The construction of the extensive Depot site, will result in the loss of a substantial area of existing farmland with complementary loss of marginal woodland, streams, fishponds and rural settlements. The scale of the disruption is likely to result in a very substantial negative impact on the landscape resource of the Kam Tin valley during construction. Planting of the perimeter embankment slopes and reinstatement of the landscape pattern to either side is likely to partly mitigate the impact on resources. However there will still be a long term moderate negative impact on landscape resources in the operational phase.

The construction of the embankments from the Depot site to the Kam Tin Station, will also result in the loss of a substantial area of existing farmland with complementary loss of marginal woodland, streams, fishponds and rural settlements. The landscape is less sensitive than the Depot site, but the scale of the disruption is likely to result in a short term substantial negative impact on the landscape resource of the Kam Tin valley during construction. Planting of the embankment slopes and reinstatement of the landscape pattern to either side of the route is likely to mitigate the impact on resources to a large extent. However there will still be a slight negative impact on landscape resources in the long term.

Between Kam Tin Station to the Au Tau Interchange, construction of the elevated structures will result in the temporary loss of some landscape resources including agricultural land and fish ponds and marginal vegetation. These tend to be more scarce landscape resources than further south within the Kam Tin valley due to previous development and their loss will constitute a moderate negative impact. Reinstatement of land uses under the elevated structure including the large construction and temporary works areas will result in a neutral effect on the overall quality of the landscape resources.

In the section from Au Tau to Yuen Long the construction of the viaduct structure will result in the temporary disruption of some agricultural land, fish ponds and marginal vegetation. The creation of the short section of cutting near Castle Peak Road will also result in disruption of scrub vegetation on the hillside. The route is not likely to have a direct impact on the ecological value of the fish ponds the construction works may have indirect effects on the water balance of the area. Given the lack of landscape resources due to previous infrastructural and site formation developments this loss is considered to be a moderate negative impact on the landscape resources of the area. The reinstatement of the agricultural land, fish ponds and marginal vegetation beneath the route and on cutting slopes will in time effectively mitigate the impact on landscape resources of the area.

The construction of West Rail will also have an impact on topsoil reserves along the route particularly where the construction works will require the removal or temporary relocation of landscape resources i.e. in the Kam Tin valley. The impacts on topsoil removal can be minimised by storage of topsoil according to Government Standards. These comprise storage of topsoil in an area where it will not be disrupted by engineering works, storing heaps at a maximum height of 2 m, carrying out tests on nutrient and organic status, practising weed control, and turning the topsoil heaps to prevent anaerobic conditions occurring. Top soil should also be placed in its final position within 12 months of importation to site.

Impact on Landscape Character

The extensive disruption of the existing landscape pattern and the loss of mature vegetation cause by the construction of the large scale, open Depot site is likely to have a very substantial negative impact on the character of the landscape of the Kam Tin valley just below the Country Park, during construction. Planting of the perimeter embankment slopes will provide a positive woodland feature within the valley which will provided a strong edge to the surrounding landscape pattern, and will be compensation in part for the loss of the existing landscape character, however there will still be a long term moderate negative impact on landscape character in the operational phase.

The disruption cause by the construction of a major linear route through the complex small scale existing landscape pattern between the Depot site and Kam Tin Station and the loss of mature vegetation are likely to have a substantial negative impact on the character of the landscape of the Kam Tin valley during construction. Planting of the embankment slopes will provide a positive large scale woodland feature within the valley which will create an alternative landscape character in compensation for the loss of the existing one, however there will still be a slight negative impact on landscape character in the long term.

Between Kam Tin Station to the Au Tau Interchange, the elevated structures of West Rail will further disrupt the remnants of the traditional agricultural landscape pattern, but will be of a similar size and form to the other transport corridors. Reinstatement of land uses under elevated sections will result in a neutral effect on the landscape character in the operational phase.

Although the form and the scale of the viaduct in the section from Au Tau to Yuen Long is very much larger than that of the traditional landscape pattern, and set at a very elevated position, it will be in the same context as the new road corridors and flood-way works and will be seen in the same landscape setting as current and future development sites. Although the Route would not have a direct effect on the ancestral buildings of historical and cultural interest on the north and south sides of the railway, it is likely to have a significant impact on the quality of their landscape setting, by introducing a overhead engineering structure into a low-lying farm land landscape. Overall, West Rail is considered to have a moderate negative impact on the character of the landscape in this area.

The reinstatement of the land beneath the route and planting around columns positions and in cutting slopes will help to tone down the scale of the structure, and will reduce the impact on the character of the landscape to slight negative level in the long term.

There are two large temporary works areas within the Northern Section and Depot, as shown in *Figure. 7.6c*. The largest area is located east of Au Tau junction adjacent to the Route 3 southbound slip road and crosses underneath the alignment. It is currently used for is used for arable and fish farming and will be used for the storage of materials, plant, temporary accommodation and carparking associated with the construction of the viaduct.

The second temporary works area is north of Au Tau junction within an area of scattered rural dwellings and marginal agricultural land. It will be used for the storage of materials, plant, temporary accommodation etc. associated with the creation of the short section of cutting and the viaduct towards Yuen Long. There will be disruption to scrub vegetation on this site during the construction period.

The construction of the Depot will be carried out from within the footprint of the Depot site. The substantial visual impacts experienced by visually sensitive receivers around the Depot during the construction phase, reflect the nature of the site as a temporary construction area.

7.6.3.1.2 Visual Impact

An assessment of the residual visual impacts during the construction phase is shown in *Table 7.6a, Annex G* and illustrated in *Figures 7.6b* and *c, Annex G.* This assessment assumes that the appropriate mitigation measures identified below have been implemented.

In the IAR, the railway alignment between the West Rail Depot and Kam Tin Station (*Figures 7.6b-e*) included sections of embankment. The ongoing design of West Rail has resulted in these sections of embankment being replaced by viaduct.

When the railway was on embankment, the impacts arising from the visual obstruction and intrusion would be part-mitigated by planting the embankment with trees and shrubs thereby creating a green planted mound; the mitigation would change an initial impact of moderate negative to very slight negative. The replacement of the embankment by viaduct would eliminate the high level of visual obstruction and intrusion created by the embankment and allowed retention of views through the elevated structure. The ground under the viaduct would be reinstated to its previous condition. The visual impact of the structure itself would be part mitigated by careful architectural and engineering detail to all the visible elements.

It has therefore been perceived that substituting the embankment for the viaduct would have a neutral effect on the assessment hence no significant change to the text or tables was carried out other than removal of reference to the embankment within these specific areas.

7.6.3.1.3 Mitigation Measures

Recommended mitigation measures for impacts caused during the construction process 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.

7.6.3.1.4 Residual Impacts

The mitigation measures will, to the maximum extent possible, reduce the potential visual impacts. However the residual impacts will remain substantial but only in the short term during the construction phase. The residual impacts are tabulated in detail in *Table 7.6a, Annex G* and illustrated in *Figures 7.6b* and *c, Annex G.*

The main visual impacts will be experienced by the rural villages adjacent to the railway and the Depot, where the impacts will be significant but temporary during construction. As the distance from the railway increases, the visual impact upon villages and farmland within the Kam Tin valley floor will reduce, although the railway viaducts and the new elevated road will be visible for several hundred metres.

Long distance views of West Rail will be possible from within Tai Lam and Lam Tsuen Country Parks. As these are from generally higher elevations than the views from within the valley floor, the mitigation measures employed during the construction period will tend to be less effective than for views from the valley floor. The visual effect of the construction of the Depot in particular will constitute a substantial change to the character of the Kam Tin valley when viewed from the Tai Lam Country Park. However the fact that views of the Depot will be part of much wider panoramic views to the north, east and west will tend to reduce the significance of the visual impact to an overall moderate impact.

7.6.3.2 Operational Phase

7.6.3.2.1 Landscape Impact

Planting of the embankment slopes around the perimeter of the Depot site will provide a positive large scale woodland feature within the valley which will partly compensate for the loss of the existing landscape character, however there will still be a long term moderate negative impact on landscape character in the operational phase.

Planting of the embankment slopes between the Depot site and Kam Tin Station will provide a positive large scale woodland feature within the valley which will create an alternative landscape character in compensation for the loss of the existing one, however there will still be a long term slight negative impact on landscape character in the operational phase.

Between Kam Tin Station to the Au Tau Interchange, reinstatement of land uses under elevated sections will result in a positive new landscape elements and with those of Route 3 and other infrastructural developments establish a more coherent pattern of vegetation and land use landscape pattern, which is considered to be equal compensation for the loss of existing character. This will effectively mitigate the impact on the landscape character resulting in a neutral effect in the long term.

Between Au Tau to Yuen Long reinstatement of the land beneath the route and planting around columns positions and in cutting slopes will help to tone down the scale of the structure, and will reduce the impact on the character of the landscape to slight negative level in the long term.

7.6.3.2.2 Visual Impact

An assessment of the residual visual impacts during the operational phase is shown in *Table 7.6a, Annex G* and illustrated in *Figures 7.6d-e, Annex G*. This assessment assumes that the appropriate mitigation measures identified below have been implemented.

7.6.3.2.3 Mitigation Measures

The *Landscape Design Strategy Report* has proposed design principles for all landscape and visual aspects of West Rail as a guide to the detailed design by all design consultants. These design principles form the essential basis of the mitigation measures which could be employed to minimise negative impacts and create the potential for positive impacts.

The principle design recommendations that are applicable to the Northern Section and Depot are listed below:

- Create a co-ordinated design of all engineering structures including viaducts for both railway and new roads, bridges catenary support systems, noise barriers, noise enclosures, trackside equipment etc. that adopt a rounded curvilinear form so as to create a modern streamlined image as well as minimising visual impacts;
- Soften and screen engineering structures with planting wherever possible;
- Plant embankments and cuttings of both the railway and the new roads with indigenous vegetation;
- Dense screen planting on both sides of the Depot;
- Lighting within the Depot to be as low as possible, with baffles to reduce overspill, located within the depot and not along the perimeter and only in areas requiring night security;
- Columnar trees to be planted within Depot to screen views into Depot from surrounding elevated land;
- Redirected drainage channels to adopt bio-engineering methods;
- Agricultural land to be reinstated under viaduct wherever practical; and
- Use transparent screens for noise barriers and noise enclosures to permit passenger views out, and also to give the elevated structures a less massive appearance.

7.6.3.2.4 Residual Impacts

The effect of the mitigation measures will be to substantially reduce the potential negative visual impacts. However, some residual negative impacts will remain. These are tabulated in *Table 7.6a, Annex G* and illustrated in *Figures 7.6d* and *e, Annex G.*

The main visually sensitive receivers within the Northern Section and Depot, and the degree of residual visual impact that they will experience during the operation of West Rail are described briefly below.

As in the construction phase, the key impacts will be experienced by the rural villages adjacent to the railway and the Depot, where some negative impacts will still be apparent. *Figure 7.6f* in *Annex G* shows an artist's impression of the Depot from the engineering

Design Consultants. Even with an appropriate sensitive design, the viaduct structures would be visually conspicuous within the rural setting from close distances.

As the distance from the railway increases, the visual impact upon villages and farmland within the Kam Tin valley floor will reduce, although the railway viaducts will be visible for several hundred metres.

7.6.4 Conclusion

West Rail will be carried mainly on embankment and then elevated viaduct structures through this section. It passes over a traditional farmed landscape of the Kam Tin flood plan that is of high scenic quality at the southern end but becomes progressively degraded travelling north by infrastructural development, notably the Route 3 Highway, and container and open storage land uses. Mitigation measures have been recommended to the maximum extent possible 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, however further to the north the extent of natural landscape resources and scenic quality diminishes and viaduct structures 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 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.

Visual impacts during the operational phase will be considerably less, with the implementation of the design principles set out in the Landscape Design Strategy Report are implemented. Nevertheless, there will remain some negative visual impacts that will be felt principally by the rural villages within 200m of the track or Depot.

7.7 Landuse Issues

This section outlines the landuse issues in relation to West Rail from the Kam Tin Valley to Yuen Long. A detailed appraisal of the land use impacts of the railway in this section has been studied by the engineering Design Consultants; the findings of these studies, and recommended mitigation options, have been developed in liaison with the relevant Government departments and affected bodies and have been reported, in detail, elsewhere.

7.7.1 Landuse Context

The Kam Tin Valley is covered by Kam Tin North OZP (No. S/YL-KTN/1) and Kam Tin South OZP (No. S/YL-KTS/1). For the purposes of description, West Rail development in the Kam Tin Valley is divided between the alignment, the proposed Kam Tin Station and the proposed West Rail Depot. A portion of the alignment also extends westwards, towards Yuen Long, and is covered by the Nam Sang Wai OZP (No. S/YL-NSW/1).

7.7.1.1 Alignment

The Kam Tin Valley is a low-lying, semi-rural area of farmland, fish ponds and village development. There are also extensive areas of open storage, informal workshops and factories.

The proposed alignment in this area will encroach on areas of agricultural land currently under cultivation, such as those around Ko Po Tsuen shown as R27 in *Figure 7.6c (Annex G)*. Compensation to local land owners is anticipated.

The railway will affect the access to and from some local communities, severing or disrupting roads, footpaths and footbridges in certain locations, as well as impact on agricultural infrastructure such irrigation facilities. Temporary disruption of utilities may also result from the construction of the railway. The engineering Design Consultants have examined strategies to minimise the impact of West Rail development on existing utilities and infrastructure, and affected infrastructure will be reprovisioned where appropriate.

The proposed rail alignment runs along the western edge of the Lam Tsuen Country Park and Conservation Area, and affects some intrinsic landscape features, several graves and a cemetery. Particular attention should be given to landscaping treatments in order to minimise the impact of the railway on these sensitive areas. Compensation, *fung shui* and/or relocation issues where graves are affected are under liaison.

The proposed rail alignment also affects a number of workshops and temporary structures, especially in the Mo Fan Heung area next to the New Territories Circular Road. Compensation to tenants may be required under the resumption process.

The proposed Kam Tin Station, shown in *Figure 7.6c,* is located on a tract of agricultural land and fish ponds 350 metres south of Kat Hing Wai. Compensation will be provided under the resumption process. No major developments, recreational or community facilities (existing, committed or planned) have been identified within the proposed rail reserve.

The alignment encroaches on a *fung shui* hill north east of the Au Tau Interchange. The *fung shui* significance of the hill is anticipated to be significantly affected. The engineering Design Consultants have conferred with the relevant Government departments and it has been agreed that the use of a cut and cover tunnel through the hill would be a satisfactory solution. Compensation and *fung shui* issues respect to the graves located on the hill are under liaison.

The Pak Oi mortuary in Yuen Long, shown as M12 in *Figure 7.6c*, is affected by the proposed rail alignment and will require reprovisioning. This mortuary is the only such facility in the North West New Territories. Relocation of the mortuary within the hospital grounds is the favoured option.

Positive impacts of West Rail on the Small Traders New Village (R29) are anticipated with the introduction of an upgraded access road. Other planned residential areas exist near the alignment, including an approved CDA and approved private development proposal (A/YL-NSW/15). Screening may be required to minimise any impacts arising from the construction or operation of West Rail in these areas.

7.7.1.2 West Rail Depot

The proposed West Rail Depot site, shown in *Figure 7.6b*, occupies an area of approximately 22 hectares of land in a rural area comprising mainly agricultural land (some of which is Grade A) and fish ponds.

There are several villages to the east and south of the proposed Depot. These are to be protected from any large scale urban encroachment to allow adequate areas for village expansion purposes.

Local access roads between Tin Sam Tsuen and Ma On Kong, and Cheung Po and Tai Tek currently cross the depot site. A road is proposed to run east-west over the depot from Route 3 to Tin Sam Tsuen/Yuen Kong.

7.7.2 Community Context

Likely areas of community concern in the Kam Tin Valley include land and property rights, community facilities, accessibility, cultural values and visual amenity. The development of West Rail will alter the rural character of the Kam Tin Valley, resulting in the loss of valuable areas of farmland and fishponds. Some village houses and land zoned 'V' will be affected by the rail alignment. Compensation for land or houses displaced by West Rail will be required.

The development of Kam Tin Station will have a visual impact on this rural, predominantly low-lying area. Careful architectural design and landscape treatment have been considered by the engineering Design Consultants in order to minimise this impact.

7.7.3 Residual Impacts

The introduction of West Rail is anticipated to catalyse development in the Kam Tin Valley by providing improved accessibility to the metropolitan area. The valley is identified under the TDSR as a strategic growth node capable of accommodating some 36,000 residents. West Rail will facilitate this strategic planning objective. In the interim a restructuring process will occur. A considerable proportion of existing land uses along the alignment will be affected. A degree of access severance will likewise result from the introduction of the railway. This severance will be minimised with the introduction of the east-west road over the depot. In time, and in broad accordance with TDSR intentions, the density and value of development is envisaged to increase in the Kam Tin Valley.

7.7.4 Conclusion

The development of West Rail in the Kam Tin Valley will significantly alter the character of this predominantly rural area. The major land uses affected by the railway include agricultural land and villages. Compensation will therefore be required. Local access roads will also be affected by the alignment, requiring reprovisioning and/or upgrading.

Local communities are likely to raise concerns over disruption to features of *fung shui* significance such as graves, shrines and ponds. Compensation and *fung shui* and/or relocation issues are the subject of ongoing liaison between KCRC and individual landowners and village representatives.

7.8 Archaeological and Cultural Issues

7.8.1 Existing Conditions

The Kam Tin valley, within which the alignment and depot are to be located, has no buildings or structures of known historical interest that are to be directly impacted by the West Rail alignment.

In order that previously unnoted buildings or structures of historical or cultural significance were identified, a survey of buildings to be resumed by West Rail was undertaken. This survey identified a number of features of cultural and historical significance.

The Kwan Tai Shing Kung Temple and associated fung shui grove is situated to the north-east of the village of Cheung Po. The temple was originally a field altar erected in the mid-19th century and, although the precise date of the construction of the temple is uncertain, a couplet engraved on a plaque in the temple may indicate that it was extended to its present form in 1901. The temple has a small, unicameral structure and is built of green brick on a square foundation of irregular stones. A low outer wall which stands opposite the entrance is thought to serve *fung shui* purposes. The roof is tiled and comprises wooden beams supported by gable walls.

In addition to the worship of the Kwan Tai god, ten other gods are served by the temple, all of which are *Land and Water Dragon Gods* for the Cheung Po and Tai Wo villages.

Whilst the building is poorly maintained, and is in need of works to safeguard its future preservation, there is evidence of ongoing religious use of the temple by local villagers.

The Lau's Residence at Tung Shing Lei, east of Yuen Long, is a terrace block of five buildings, the architecture of which displays a blend of traditional Chinese and early 20th century western styles. The earliest building is the Hak Sut Tong which was built as a residence in 1919 by Mr Lau Wai-chau of T'ai Shan County; an ancestral shrine was also placed within the building With the growth in the number of family members, Mr Lau built a new house on land adjacent to the Hak Sut Tong in 1926 and moved himself and immediate family into this new building. The original building then became the ancestral hall, doubling as the Bei Tak (or Peter's) School.

Mr Lau Wai-chau died in 1933 and the land and houses were inherited by his eighth son. Mr Lau's second, third and fourth sons were appointed as executors and were given the responsibility of managing the 'Hak Sut Tong' (the organisation for managing clan property). There have been three generations since the Lau clan first moved into Tung Shing Lei and in 1935, the Lau family added three more houses; a pigsty and a storage room were built near the village entrance a number of years later.

Each of the buildings described above has survived with only minor alterations and all are well maintained. A certain unity of architectural style has been adopted throughout the group of buildings with the bottom portion of the external walls built of granite and the remainder completed in brick. The later houses (dating from 1926 and 1935) are each two-storey structures of linked corner blocks around a central courtyard. They are roofed in red-tile and the year of construction of each can be seen on the lintel of the doors.

In addition to the buildings described above, the Poon Uk Hakka Mansion (which dates from 1932 and is listed as a Grade 1 building by the AMO), and its associated *fung shui* pond and well, lie some distance to the south of the West Rail alignment east of Yuen Long.

Preliminary data gathering has shown that no known archaeological sites will be directly affected by the West Rail alignment; however, a number of areas of high archaeological potential have been identified.

Furthermore, during observations of test pit excavations in the Au Tau/Tung Shing Lei area several pottery sheds dating from the Sung Dynasty (AD960 - 1279) were revealed; in the same area, at a small knoll immediately to the west of the Au Tau interchange, Mr Au Ka-Fat (pers. com. 1997) has revealed evidence of a possible Neolithic site.

7.8.2 Potential Sources of Impact

The Kam Tin valley will potentially be impacted by activities associated with the construction, permanent landtake and operation of West Rail.

Both temporary and permanent landtake may result in damage to, or loss of, archaeological remains and deposits, the removal of historic buildings, standing archaeological monuments or culturally significant features and changes to the setting of buildings and monuments and to the physical coherence of historic landscapes. Subsoil archaeological sites may be affected by:

- Disturbance through excavations at or near the site, topsoil stripping and the passage of heavy machinery on exposed deposits;
- Disturbance by machinery working on the present surface where there are extant earthworks;
- The burial of sites resulting in a limitation on accessibility for future archaeological investigations (including surface survey and remote sensing techniques) and obscuring visible surface evidence; and
- The introduction of archaeological material with spoil from other sites.

In addition, severance and "islanding" may result from permanent landtake required for the West Rail alignment and associated permanent features and from temporary landtake required during construction to accommodate haul roads and construction sites. Areas of historic and cultural interest may be severed, thereby altering or destroying their integrity.

Ground compaction due to construction activities or the weight of permanent embankments may cause damage or distortion to buried archaeological remains, especially in soft alluvial deposits.

Visual and noise intrusion on the setting and amenity of historic and cultural resources may occur where the route passes close to historic buildings, gravesites, archaeological sites and monuments and culturally or historically significant landscape features.

7.8.3 Prediction & Evaluation of Impacts

7.8.3.1 Historic Buildings

The field survey has identified two locations at which buildings or structures of known historical interest may be directly impacted by the West Rail alignment and Depot in the Northern section.

The preliminary lay-out for the West Rail Depot included land currently occupied by the Kwan Tai Shing Kung Temple and its associated *fung shui* grove. Following on-site discussions between the EIA Study Team and the AMO, the engineering Design Consultants were instructed to re-evaluate the design of the Depot to avoid direct impacts to the temple and grove. The final lay out of the Depot avoids direct impacts to the temple or the grove and provides for a buffer zone around the feature to preserve its immediate context.

The wider context within which the temple is currently located has altered considerably in recent years with the construction of Route 3 and the increasing development of village houses in the Kam Tin valley. The construction and operation of West Rail and its associated Depot will further alter the landscape and cultural context within which the temple is located. As such, the indirect impact to the temple is considered moderate to severe; however, with the set-back provided by the current depot layout and the application of appropriate landscape screening, it is considered that the residual indirect impacts may be considered acceptable.

Part of the land upon which the southwestern-most house of the Lau's Residence at Tung Shing Lei, built in 1935, lies within the land gazetted for resumption for West Rail. The associated pigsty and storage buildings, which are of a much later date and are not considered to be of historic interest, also lie within the gazettal area.

The Hak Sut Tong and four houses that make up the Lau's Residence represent well-preserved examples of early 20th century vernacular architecture which blend Chinese and western styles in a startling manner given the rural nature of the Tung Shing Lei area at the time of their construction. It is recommended, therefore, that the group value of the Lau Residence be preserved.

This will involve the avoidance of direct impacts to the house which currently is, in part, within the gazettal area for the railway. It is recommended that this be achieved through the establishment of a buffer zone of at least five metres between the building and the site boundary for the construction worksite.

Although the introduction of the buffer zone will serve to ensure that there are no direct impacts to the Lau residence buildings, their proximity to the West Rail alignment will alter the current landscape context of the buildings and does raise the possibility of there being indirect impacts associated with operational noise and vibration. The assessment of operational noise (see Section 7.3.3) indicates that the noise levels at the Lau's Residence will not exceed the 55 dB(A) criteria set by the EPD; furthermore, the high level of vibration isolation in the permanent way design, which incorporates soft resilient rail baseplates, floating slab track and the use of rubber bridge bearings, will ensure that vibration levels will be imperceptible to residents and will not result in structural damage to the buildings.

The Poon Uk Hakka Mansion (AMO Grade 1) is located to the southwest of Tung Shing Lei, approximately 100 metres to the south of the West Rail alignment. The Mansion will not be subjected to unacceptable direct or indirect impacts due to the construction or operation of the new railway.

7.8.3.2 Archaeological Resources

Preliminary data gathering has shown that no known archaeological sites will be directly affected by the West Rail alignment. However, the modelling of the archaeological potential of the areas through which the West Rail alignment passes is currently underway and will inform the development of the Field Evaluation Programme. The AMO will continue to be consulted regarding the direction and progress of the heritage assessment.

In developing the predictive model of likely impact to archaeological resources, the Study Team has undertaken a number of activities in support of the predictive assessment including the evaluation of information revealed by borehole logs and the planning of a programme of direct observations of geotechnical investigations, particularly the excavation of test pits. For example, during observations of test pit excavations in the Au Tau/Tung Shing Lei area several pottery sheds dating from the Sung Dynasty (AD960 - 1279) were revealed.

Validation of this predictive model of archaeological potential is scheduled to be undertaken in early 1998. This will take the form of a series of Trial Pits and Auger Transects designed to test the accuracy of the maps of archaeological potential prepared on the basis of the Desk Top Study. The findings of the field testing will be formally reported to the AMO.

The completion of these ongoing tasks will enable the final predictive modelling to be completed. The model will then provide a basis for an assessment of the likely impact to archaeology along the alignment of the new railway. This archaeological impact assessment will be based upon the nature and extent of construction activities (*the level of impact*) and the predicted potential (*the predicted value of the resource*) of the area within which the activities are to take place.

The archaeological impact assessment will provide a basis for determining the need for field evaluation in advance of the construction of the new railway which will be advanced through the development (in consultation with the AMO) of a specification and programme for field evaluation (or trial work). This will be reported as Field Evaluation Programme and Protocols which will identify the significant impacts likely to arise during construction and operation and will formulate of a plan for the mitigation of identified impacts.

The first level of field evaluation will comprise non-intrusive surface examination of potentially impacted areas. If identified areas are clear of vegetation then a systematic surface collection will be made by walking parallel lines; if concealed by vegetation then any exposed areas will be searched. Densely vegetated land may be excluded from this stage of field evaluation, due to the time and cost of evaluation, and will be evaluated once Land Acquisition powers have been gained by the KCRC and clearance effected.

The field evaluation programme will identify the areas to be investigated and will produce field evaluation protocols determining the sampling technique (for example, test pit or trench), the sample rationale to be applied (numbers of required test pits; dimensions of pits, sampling grid, etc.) and the site record forms to be used during the field evaluations. The evaluation protocols would be produced with reference to those established in Hong Kong and would be compatible with the best field practice and data capture requirements of the AMO.

Whilst the Field Evaluations fall outside the scope of the EIA Study, they would form part of the ongoing West Rail Project and their commencement would be subject to KCRC gaining powers of access to the identified areas within the study corridor.

The results of the Field Evaluations would form the basis for the development of an archaeological action plan detailing the measures to be adopted to provide appropriate mitigation of the impacts to buried archaeology. Although there are no standard criteria against which to assess the severity of impacts to cultural heritage, the appropriate actions will be defined and recommended based upon the following factors:

- The proportion of the feature affected and whether its key characteristics would be affected by the West Rail works;
- A consideration of the type, survival or condition, fragility or vulnerability, potential and amenity value of the feature affected, and
- Guidelines or criteria on noise, visual intrusion, etc. either in general or site specific terms, provided by other West Rail specialist teams.

The adopted mitigation measures might include the minimisation of ground disturbance in archaeologically sensitive areas, excavation in advance of construction and the provision of a watching brief during construction.

7.8.4 Recommended Mitigation

The mitigation of impacts to revealed archaeological resources will be reported via the field evaluation programme and through ongoing discussions with the AMO's archaeological curators.

The potential direct impacts to the temple and associated *fung shui* grove 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 the 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.

7.9 Ecology

7.9.1 Baseline Conditions

The baseline conditions of the Kam Tin valley area on or along West Rail are described below (include Central Section, Depot and Northern Section), from the northern tunnel portal of the Tai Lam Tunnel (TLT) to the Yuen Long Station. As discussed in *Section 4.10.2.1*, there has been a continuous shifting of baseline condition due to on-going infrastructure developments in the Kam Tin and Au Tau areas including the Route 3 CPS and MDC. This study has established the baseline on the basis of a survey of the current existing conditions and, where appropriate, taking into account future baseline condition through reference to available committed development information included MDC and Route 3 CPS.

7.9.1.1 Flora and Habitats

The hillsides surrounding the Kam Tin valley, except in some ravine sites where shrubs or trees have become established, are grassy in nature and are periodically burnt by hill fire as a result of grave sweeping. Much of the valley floor is flat with an imperceptible northward slope on the gradient of the Kam Tin River. The valley has been intensively developed for agriculture (most are actively farmed with irrigated vegetables and ornamental plant) and light industry, with additional more recent development of various construction projects.

To the west of the proposed West Rail alignment, Route 3 has been constructed. The MDC-NYK project runs to the east of the proposed West Rail alignment (*Figure 7.9a*). The Kam Tin Road Improvement and Kam Tin Bypass projects at Au Tau may commence in the near future. Until summer 1995, when Route 3 construction began, there had been little change in the land use patterns and habitats in Kam Tin valley since the early 1970s. Hong Kong Map Office aerial photographs from the early 1970s were examined and compared to those of 1997. With the exception of the increase in housing construction in the early 1990s, most of the agricultural land was unchanged over the last 25 years. In general, ecological habitats in the Kam Tin valley have a long history of disturbance by agriculture, village development and fire.

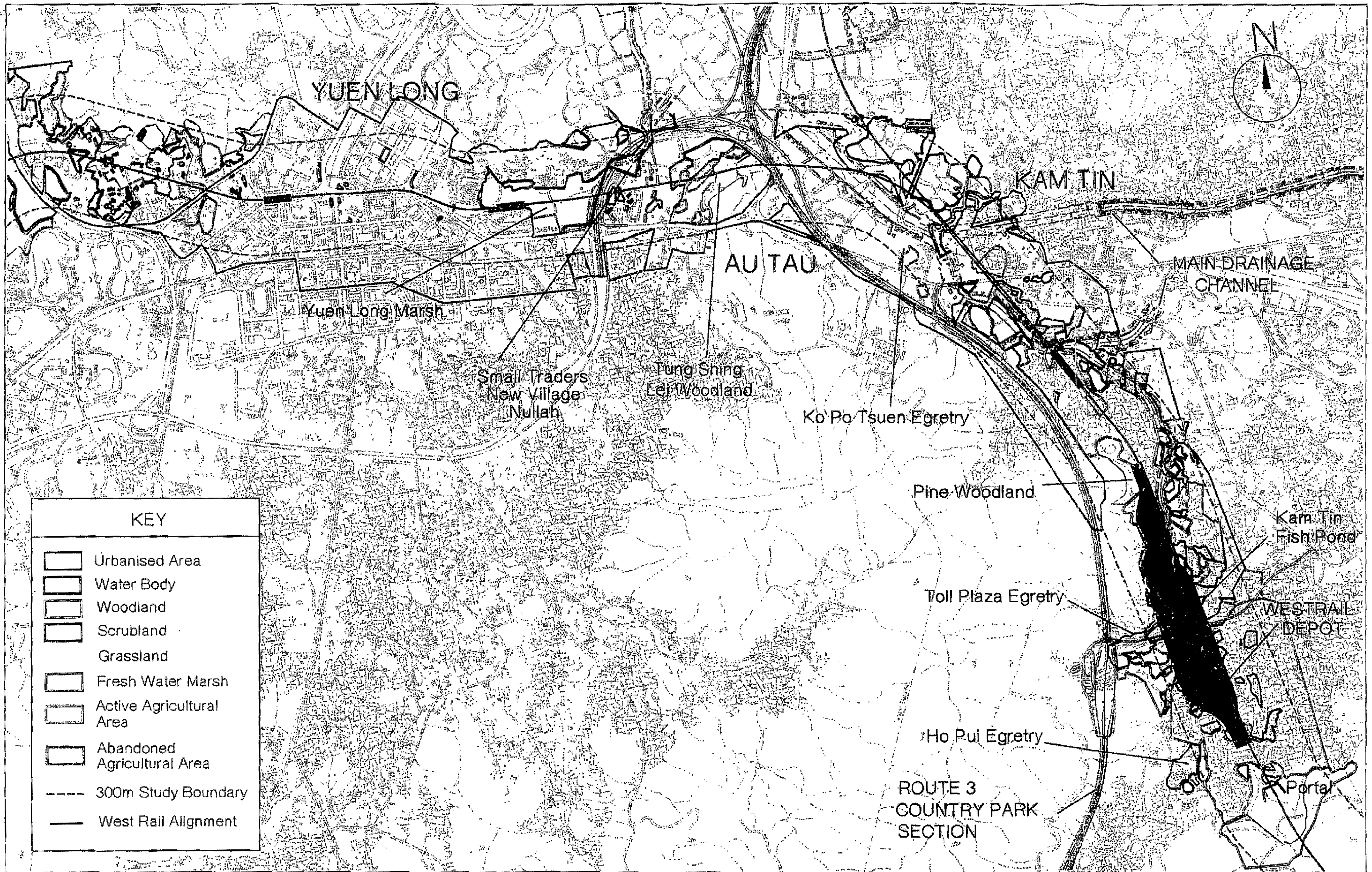
Survey results of the flora studies for West Rail are presented in *Annex H*. Major plant species recorded on the surrounding hillside and in the Kam Tin are listed in *Annex I*. No plant species protected under local regulations were recorded in the study during the survey, and no botanically interesting area was found within the study area. Ecological survey in the study area of Kam Tin Bypass on January 1996 (*Babtie, 1996, Annex J*) showed that plant species recorded were typical of the habitats represented. A protected plant, *Rhododendron simsii*, was reported in Freeman Fox Maunsell (1993a) as occurring south of Ho Pui village in the foothills outside the Tai Lam Country Park, beyond the areas to be affected by West Rail. *R. simsii* was not recorded within the proposed disturbance limits of West Rail during field studies for this project. *R. simsii* is protected under the Forestry Regulations (Section 3), and is the most common and widespread wild rhododendron in Hong Kong.

Habitats found in the Kam Tin valley that would be affected by West Rail include hillside grassland, woodland, agricultural field, wetland including fish ponds, meander of the Kam Tin River and freshwater marshland, as shown in *Figure 7.9a* and discussed below.

Aquatic habitats to be lost along Kam Tin River will be channelised for the MDC-NYK projects in the near future. The MDC-NYK works will convert the existing stream course into a lined, engineered channel. Those works will precede the construction works for West Rail, therefore direct impacts of West Rail on the Kam Tin River would be undetectable and are not addressed further.

7.9.1.1.1 Hill-side Grassland

The north portal area will encroach mainly on the grassland habitat, and the ravine sites where shrubs or trees have become established will be avoided. Dominant grass species recorded included *Arundinella setosa, Eulalia speciosa, Cymbopogon sp. Neyraudia reynaudiana,* and *Ischaemum* spp. A few trees and shrubs, including *Schefflera*



Habitat Map Showing Key Ecological Area in Central and Northern Sections (Updated to Jan 98)

SCALE: 1/20,000

FIGURE 7.9a

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octophylla, Melastoma candidum, and *Litsea rotundifolia* were occasionally found on the grassland habitat. It is believed that this grassland is suffered from periodically burnt by hill fire as a result of grave sweeping, and with limited botanical interest.

7.9.1.1.2 Pine Woodland

The major woodland habitat affected by the Depot is an open pine woodland which is periodically burnt due to grave sweeping. The trunks of dying *Pinus massoniana* dominate the foothill, with densely grown common shrubs and ferns in the understorey, including *Rhodomyrtus tomentosa, Wikstroemia indica, Psychotria rubra, Ficus hirta, Lygodium japonicum* and *Dicranopteris linearis*. A few native tree species such as *Aralia chinensis, Aporusa dioica, Sapium discolor* and *Rhus* spp., together with the fruit trees in abandoned orchards were also found. The potential for succession of these species to replace the canopy, however, was limited by fire and isolation by Route 3 from the uphill area. Further uphill, woody cover decreases rapidly, leaving the higher slopes dominated by grasses and ferns.

7.9.1.1.3 Tung Shing Lei Woodland

At Au Tau most of the habitats have already been disturbed by the construction of the MDC-NYK and Route 3. The major wooded area in this section is at the abandoned Tung Shing Lei village (resumed for Route 3 construction). Large, mature, native trees including *Celtis sinensis* and *Ilex rotunda* were observed. The woodland is typical of villages where isolated native, plantation, and orchard trees grow among the village houses. The trees form a canopy, and the understorey is cleared for village houses, gardens, and pathways. This type of wooded area is poor in diversity and structure although it could develop into woodland of greater ecological value given time, protection from disturbance, and deterioration of the village houses.

7.9.1.1.4 Agricultural Land

Agricultural land is the dominant habitat type in Kam Tin valley, which provides general wildlife habitats for feeding, roosting, nesting or breeding, as discussed under *Section 7.9.1.2*. The crops planted are mainly vegetable and ornamental plants, such as *Rorippa nasturtium - aquaticum* and *Gladiolus gradavensis*. For those abandoned agricultural fields, it is dominated by herbs and grasses such as *Rumex maritimus* and *Paspalum spp.*

7.9.1.1.5 Wetlands

The wetland habitats in the Kam Tin valley comprising fish pond, river meander and marshland provide important feeding, breeding, roosting and nesting habitats for some important wetland-dependant fauna, as discussed in details in *Section 7.9.1.2*. Most of the pond bunds were grassy along the pond with common weedy species such as *Paspalum spp., Bidens pilosa* and *Mikania micrantha*; whereas the dominant vegetation in the marshland are the herbs *Rumex maritimus, Wedelia trilobata,* and the climber *Ipomoea aquatica.*

The main wetland habitat that will be affected by West Rail is fish ponds, totalling approximately 6 ha, as shown in *Figures 7.9b-c*. All of these fish ponds are Grade A and active, except one used for a poly-culture of fish and ducks. As discussed *in Section 4.10.2.2*, fish ponds that were to be reinstated by Route 3 or MDC, but now permanently resumed for West Rail are taken as habitat loss in this assessment. *Figures 7.9b & c* show also the locations of these fish ponds which total approximately 3 ha.

7.9.1.2 Fauna

The following sections of the report describe the wildlife in the Kam Tin valley, based on the surveys undertaken for the present study as well as taking reference from literature.

7.9.1.2.1 Invertebrates

Invertebrates recorded on the study area during the field surveys from April to November 1997 are listed in *Annex M.*

Ninety-five butterfly species were recorded in the Kam Tin valley during the field surveys. This accounts for approximately 40% of the total number of species of butterflies recorded in Hong Kong to date (225 species). According to the indices of local abundance and distribution of Hong Kong butterflies (Walthew, 1997), 20 locally uncommon and 5 rare species were recorded during the surveys. Bascombe (1993) had 12 additional species records in Ho Pui valley, including 4 uncommon, 5 rare and 1 very rare species.

The butterfly species richness in the whole Kam Tin valley is relatively high attributable to the mosaic of riverine, agricultural, woodland, and shrub habitats on the valley floor and on the surrounding hillsides. This observation is made in comparison with Fung Yuen valley (east of Tai Po), which was found to be the most species rich butterfly site in Hong Kong with 128 species recorded (Bascombe (unpubl. data, 1993)).

Dragonfly and damselfly species recorded in upper Kam Tin valley and general area of Kam Tin valley are 20 and listed in *Annex M.* All recorded species are considered to be common, except for *Sinictogomphus clavatus* and *Neurobasis chinensis*. *S. clavatus* prefers still water habitats (Wilson, 1995), but was seen along a small tributary of the Kam Tin River in the study area (*Figure 7.9d*). *Neurobasis chinensis* was recorded along the same tributary on 7 October 1997. The Hong Kong population of *Neurobasis chinensis* has declined in recent years due to destruction of habitat (*ibid*).

7.9.1.2.2 Reptiles and Amphibians

Reptiles and amphibians were surveyed during spring, summer and autumn field studies for this project. The species recorded during current field surveys and other previous studies (Freeman Fox Maunsell, 1993a; CES, 1995b, Romer, 1979) are listed in *Annex M.*

FISH PONDS IN KAM TIN VALLEY (FROM NORTH PORTAL TO KAM TIN ROAD) TO BE RESUMED BY WEST RAIL

FIGURE 7.9b-1

SCALE: 1/5,000

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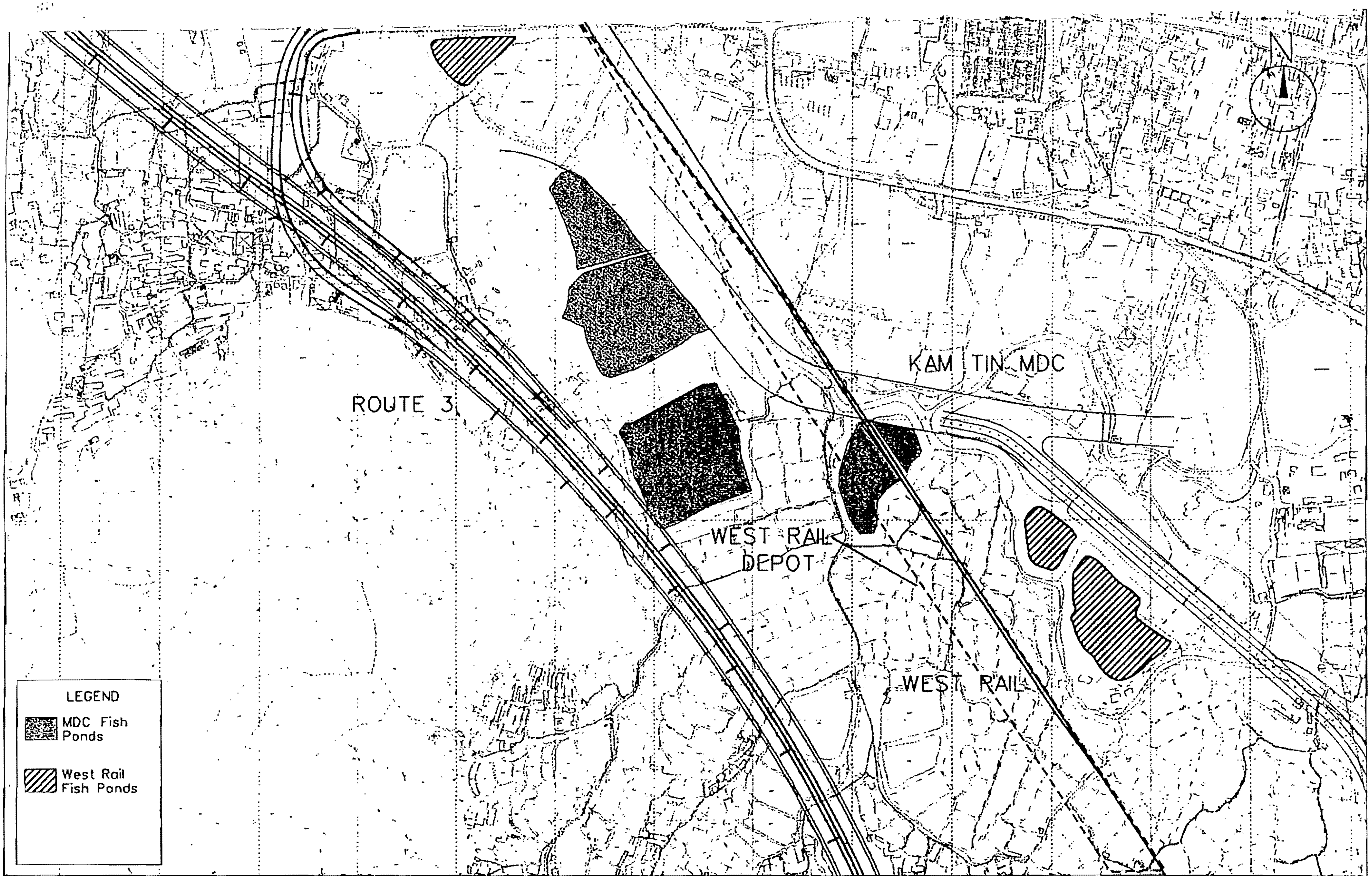

FISH PONDS IN THE KAM TIN VALLEY (FROM NORTH PORTAL TO KAM TIN ROAD) TO BE RESUMED BY WEST RAIL

FIGURE 7.9b-2

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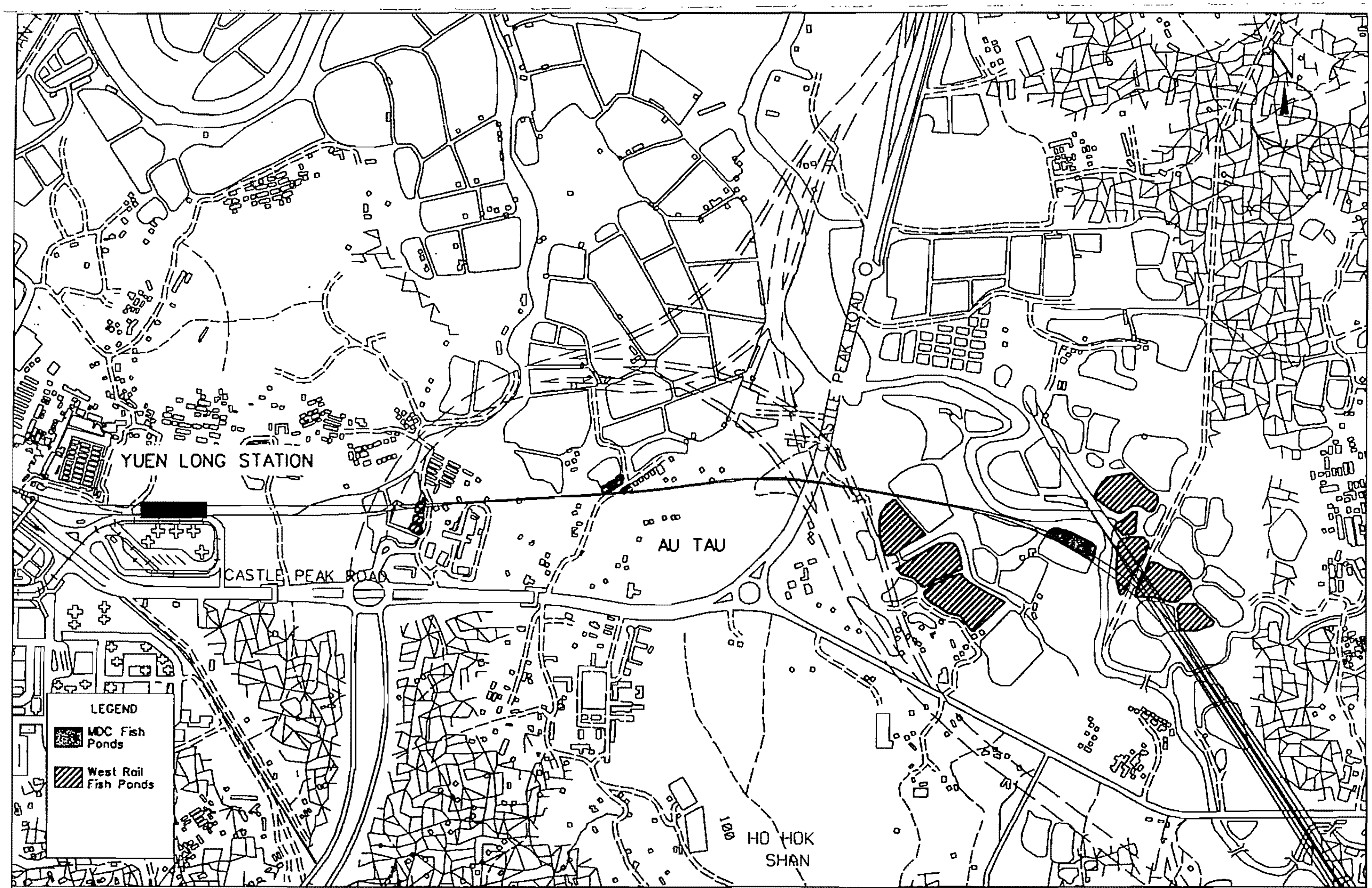

FISH PONDS IN AU TAU AREA TO BE RESUMED BY WEST RAIL

SCALE: 1/12,000

FIGURE 7.9c

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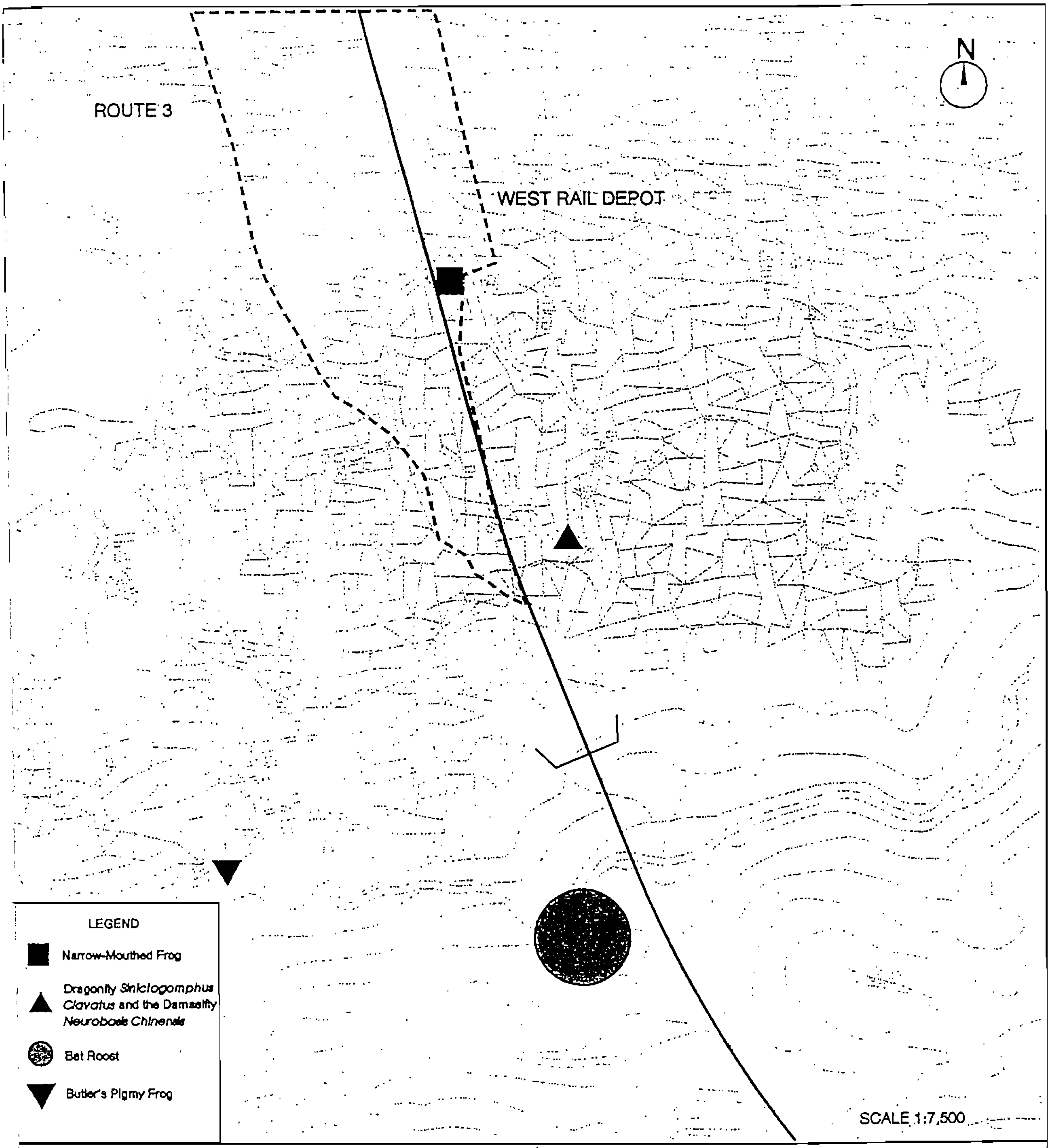

FIGURE 7.9d

INDICATIVE LOCATION OF KEY ECOLOGICAL FEATURES RECORDED IN THIS STUDY

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In total, 10 species of amphibians and 10 species of reptiles were recorded. All recorded amphibians were breeding in wetlands in the study area. Although poor water quality in the Kam Tin River precluded development of a diverse and abundant aquatic fauna, the presence of amphibians and reptiles indicates that the river channel (main stream together with tributaries, channel banks, and associated flora) do support certain wildlife. Therefore, references to the Kam Tin River in this section and hereafter include the entire channel, and are not limited to the stream itself.

Sixteen of the recorded species are relatively common and widespread throughout Hong Kong due to the widespread distribution of similar habitats, such as the Chinese Cobra (*Naja naja*), Changeable Lizard (*Calotes versicolor*), and the Asian Common Toad were found to occupy the lowland habitats throughout the general area of Kam Tin valley. However, two of the recorded species are considered locally uncommon, and one is rare (Michael Lau, pers. comm).

The rare amphibian recorded on site is the Narrow-mouthed Frog *Kalophrynus pleurostigma*, which was recorded during spring and autumn surveys over the general area of Kam Tin valley (*Figure 7.9d*). The Hong Kong sub-species is *K.p. interlineatus*, for which the type locality is Pegu, Burma. The subspecies is distributed in south China and Hainan through Burma to Thailand, Cambodia, and northern Vietnam (Zhao and Adler, 1993). Hong Kong may lie near the northern extent of the species range. Within Hong Kong, the Narrow-mouthed Frog appears to be restricted to lowland habitats, including cultivated fields and grassy areas near streams (Karsen *et al*, 1986), and its distribution depends on the extent and availability of suitable wetland habitat.

Butler's Pigmy Frog *Microhyla butleri* is considered uncommon in Hong Kong. It was recorded in upper Kam Tin River floodplain on 24 September 1997. It is thought to be a forest or forest edge species, but is not well studied (Karsen *et al*, 1986). The regional range of *M. butleri* extends from southern China including Hainan, to Taiwan, and south through Indochina and the Malay peninsula (Zhao and Adler, 1993). The abundance of *M. butleri* throughout its range is unknown but Hong Kong is not at the limit of its geographic range.

The Greater Green Snake *Cyclophiops major* is also considered uncommon in Hong Kong. It occupies wooded habitats and mountainous areas (Karsen *et al*, 1986), but appears also to be largely unknown in terms of ecology. The regional range of *C. major* extends from Vietnam to Hainan and southern China through Taiwan northward to Henan and Gansu Provinces. In Hong Kong *C. major* is not near the periphery of the species' geographic range.

7.9.1.2.3 Mammals

Four mammal species were observed on or near the study area during the 1996/7 surveys for this study. This together with other mammals recorded during previous EIA studies in the Kam Tin valley (Route 3 and Kam Tin Road Widening) are listed in *Annex M*. Totally 15 species were reported in the general area of Kam Tin valley.

During this study, the Javan Mongoose was observed in agricultural habitat near Kam Tin village and rodent burrows were located on fish pond bunds in spring 1997. The Javan Mongoose has apparently undergone range expansion as its population has increased throughout the North West New Territories. It is now reasonably abundant and widespread. This seems particularly true for the Kam Tin valley where the species can be seen in mid-day around sub-urban areas.

Barking Deer and Small Indian Civets may descend from the Tai Lam Country Park for foraging on the Kam Tin River floodplain at night. Pangolin probably occur along the periphery of the floodplain in the non-agricultural habitats below the WSD catchwater. Civets are detected frequently along the WSD catchwater road (WCI, 1996), and they probably also forage nocturnally in agricultural and grassland/shrubland habitats in the study area. Wild Boar also occur throughout the general area, and forage in agricultural habitats in Kam Tin valley.

Nine species of bats were recorded in the study area, 41 percent of the HKSAR total of 22 species, and four of the recorded bat species roost at the site as shown on *Figure 7.9d.* Except the Leschenault's Rousette Bat, which is a frugivore, all others are insectivorous and appeared to feed on aquatic emergent Chironomids above wetlands (Babtie, 1996). Among the bat species recorded, five of the recorded bat species are rare in Hong Kong, and one is uncommon.

Leschenault's Rousette Bat is considered to be of restricted distribution in Hong Kong due to lack of suitable roosting sites (natural or man-made caves) (Ades, 1990). The largest known roost site for *R. leschenaulti* and three other locally rare bat species is approximately 175 m south of the proposed north tunnel portal (*Figure 7.9d*). The roost is one of the largest in Hong Kong, and is used by at least six species of bats.

Fruit bats would be expected to feed on figs and other fruits of the large trees in the Ho Pui area. Such trees were mainly confined to a small riparian stand and a separate stand of village orchard trees in and around Cheung Po village. The riparian trees would be lost due to West Rail construction, but the Cheung Po village trees would not.

All mammals records reported in the general area of Kam Tin valley are native to Hong Kong except Styan's Squirrel, and except Wild Boar, they are all protected under the Wild Animal Protection Ordinance.

Due to the barrier effect of Route 3 construction, mammals other than bats would find it more difficult to reach the Kam Tin River floodplain from the Tai Lam Country Park lands to the west. This could reduce the abundance and diversity of non-volant mammals on the West Rail study area in the future. The barrier effect of Route 3 would be expected to be more pronounced following completion of the roadway when paved surfaces and access controls will be in place.

7.9.1.2.4 Birds

General Bird Survey

Birds species seen on the study area and in the Kam Tin valley are listed in *Annex K*. In total, 113 species were recorded in the Kam Tin valley. This represents 27% of the total number of bird species recorded in Hong Kong. Resident species accounted for 51.3%, and winter visitors for 34.5% of the total number of species. Wetland-dependent species accounted for 35 of 113 species, or 31% of the species total (*Annex K*).

Both uncommon (35 species, 31%) and rare (26 species, 23%) birds were recorded (status designations follow Viney *et al*, 1994). Twenty-two species are both rare or uncommon and wetland dependent (*Annex K*).

Birds which occupy habitats in the Kam Tim valley which are locally and regionally limited in abundance and/or geographic distribution, include the following:

- Black Baza (*Aviceda leuphotes*);
- Bonelli's Eagle (*Hieraaetus fasciatus*);
- Buzzard (*Buteo buteo*);
- Crested Goshawk (*Accipiter trivirgatus*);
- Crested Serpent Eagle (*Spilornis cheela*);
- Kestrel (*Falco tinnunculus*);
- Northern Sparrowhawk (*Accipiter nisus*); and
- Painted Snipe (*Rostratula benghalensis*).

All of the birds of prey, together with the Greater Coucal, Lesser Coucal and Asian Barred Owlet, are listed in Class II of the State Protected Terrestrial Wildlife in China (Hua and Yin 1993). Long-billed Plover, Grey-headed Lapwing and Silky Starling are classified as near-threatened by Collar *et al* (1994), and each of these species was also recorded on the study area.

Painted Snipe is a very localised breeding species in Hong Kong confined to wet agricultural land with associated overgrown marshy areas. The population of the Painted Snipe was considered to be declining in Hong Kong due to losses of wetland habitat (Viney *et al*, 1994).. Since 1993 this species have been recorded regularly only at Kam Tin valley and Long Valley. *Figure 7.9e* shows that the location of the breeding and roosting sites of Painted Snipe in Kam Tin valley. Details of Painted Snipe ecology are presented in *Annex L*.

Except the Painted Snipe, none of the above species would nest in the area proposed for the permanent works of West Rail due to lack of suitable nesting habitat. However, resident and summer visitor species are known to nest in Kam Tin valley or in the surrounding mountainous areas which support woodland habitats (Black Baza, Bonelli's

Eagle, Crested Goshawk, and Crested Serpent Eagle). All of the birds of prey have a wide foraging range and have been reported foraging on or near the study area (CES, 1995a). On the other hand, there were 17 confirmed breeders and 12 possible breeders which occupied the study area during the spring/summer 1997 breeding season and are listed in *Annex K*.

Avifauna Point Count Results

Overall, 62 species were recorded on agricultural habitats in the affected and control zones as defined in *Section 4.10.2.4.2*, representing 15% (62/421) of Hong Kong's avifauna and 55% (62/113) of all species recorded in the Kam Tin Valley (refer to *Annex K* for details). Among the species recorded, 18 species were found foraging on the paddy at Site 1 in January and February. Since many winter visitors and passage migrants are usually silent, bird species diversity may have been underestimated. Analysis shown in *Annex K* indicates that the diversity indices are high relative to other habitats in Hong Kong. The current results demonstrate the significance of Hong Kong's agricultural habitats to avifauna.

Egretry Monitoring

Egretry was selected as a focus group for the Kam Tin Valley as a whole for the following reasons:

- this wildlife group is well-studied in Hong Kong and comprehensive database is available;
- abundance and species composition of nesting herons and egrets are useful bio-indicators of ecosystem condition; and
- 2 of 4 Kam Tin valley egretries have been lost since 1995 to infrastructure and residential developments, and the remaining 2 egretries in Kam Tin valley are under threat from infrastructure and residential developments.

The condition of the egretries found within Kam Tin valley, and the pattern of habitat usage of the ardeids are presented below. Details of the survey result are presented in *Annex K*.

<u>Ho Pui Egretry</u>

The breeding population of ardeids at Ho Pui egretry was first censused in 1991 (Young, 1991), when there were 3 nesting species which totalled at least 83 birds. No data were available for 1993 or 1994, but in 1995 there were four nesting species totalling at least 100 birds (CES, 1995a). The additional nesting species in 1995 was the Night Heron (*Nycticorax nycticorax*). The 1996 count yielded 98 birds in May and 106 birds in June (R3CC, 1996), comparable to numbers in 1995, but only 3 species were recorded. The Night Heron may have nested in 1996 but gone undetected.

FIGURE 7.9e

BREEDING AND ROOSTING SITES OF PAINTED SNIPE AT KAM TIN VALLEY

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Toll Plaza Egretry

The Toll Plaza Egretry was censused in April, May, and June 1997 to identify nesting species and to estimate abundance of nesting pairs. The egretry was first documented in spring 1995, when Little Egrets (4 nests), Cattle Egrets (2 nests), and Chinese Pond Herons (5 nests) occupied the site (CES, 1995a). In 1996 Little Egrets and Cattle Egrets had abandoned the egretry, probably due to the impacts of Route 3 construction. A concrete batching plant was in operation about 5 m from the egretry, and the site offices were located within 70 m of the egretry. In 1996 twelve Chinese Pond Heron nests were active.

Re-use of the egretry in 1996 only by Chinese Pond Herons suggests that Cattle and Little Egrets could not tolerate disturbance levels at the egretry, and abandoned it. These species are typically less tolerant of human disturbance near nest sites than are Chinese Pond Herons.

Ko Po Tsuen Egretry

The Ko Po Tsuen egretry was first recorded in 1994 (K.W. Cheung, AFD, pers. comm.), at which time the nesting community included Little Egrets (5 nests), Cattle Egrets (20 nests) and Chinese Pond Herons (4 nests). However, in 1995 only Chinese Pond Herons remained, and the nest total was 34 (CES, 1995a). In 1996 the egretry had been completely abandoned (R3CC, 1996). The egretry was monitored from April to July 1997 for signs of returning birds but there was no indication that nesting would resume.

Tung Shing Lei Egretry

The Tung Shing Lei egretry was first recorded in 1995 when it supported 34 nesting Chinese Pond Herons in two stands of bamboo at the periphery of fish ponds near Au Tau (CES, 1995a). The egretry has since been destroyed during the construction of the Route 3 interchange in Au Tau. The nesting substrate (bamboo) will be replanted at the periphery of ponds which are to be rebuilt following completion of the Route 3 construction project. Thus, the egretry could be recolonised at a future time. The alignment will pass directly over the former egretry location, and within 50m of the proposed bamboo restoration site.

Pattern of Habitat Usage

The three most abundant ardeid species recorded within the Kam Tin Valley were the Chinese Pond Heron, Cattle Egret and Little Egret, and the Cattle Egret was numerically dominant over the survey period. There were sighting records of other ardeid species including Grey Herons, Great Egret and Night Herons, but these species were not seen nesting.

The survey results shown that 26 sites were used by ardeids in late winter 1996/7 (refer *Figure K2* in *Annex K*). Bird behaviours at these 26 sites were primarily foraging, feeding and roosting. Roosting was concentrated upstream from the egretry at site 5, or at the egretry (site 6). Foraging was more evenly distributed both upstream and downstream from the egretry. This demonstrates that, although the alignment is some 300 to 500 m distant from the Toll Plaza and Ho Pui egretries, and there is seasonal variation in the usage of different habitat, the agricultural and riverine habitats within the alignment plan provide an important foraging ground for the ardeids.

The study also shown that roosting and foraging habitats of the ardeids were both located in Ho Pui valley and they allocated approximately equal time to roosting and foraging in all study periods, except during the nesting season in spring and summer. Tree and pond bunds were found to be the most important roosting habitat for ardeids; whereas paddies, ponds, pond bunds, flooded fields and streams were all used as foraging habitats by the three species in a different pattern.

7.9.2 Prediction of Impact

The main potential source of impact is the loss and fragmentation of habitat due to railway construction which, in conjunction with similar losses as a result of the Route 3, Kam Tin Road widening and MDC projects, is part of a larger cumulative impact. Longer term and indirect impacts on habitat and species may result from increased development pressure on local habitats arising from improved transport links.

Impacts of secondary concern are temporary construction noise and dust, stream sedimentation and/or pollution, and human activity and equipment operation at work sites. These impacts are assessed cumulatively with similar losses resulting from the Route 3 and MDC-NYK projects.

The areas of habitat loss was estimated using the grid count method based on the available land requirement maps and are shown in *Table 7.9a*.

Table 7.9a Estimated Habitat Loss in Kam Tin Valley Due To West Rail (Central Section, Depot and Northern Section)

Habitat	Permanent (ha)	Temporary (ha or m)
Grassland	4.5	0.4
Active Agriculture	58.1	1.4
Abandoned Agriculture	2.0	0
Plantations/woodland	1.3/0.4	0
Shrubland	0.2	0
Fish Pond	6.7	3.5
Fish Pond (MDC-NYK)	3.3	0
Marsh	0.3	0
Kam Tin River Meander	1.8	0.1
Urbanised/Disturbed	19.3	1.2

Note: Estimation based on the gazetted scheme

7.9.3 Evaluation of impacts

7.9.3.1 Habitat

The woodland loss of 0.4 ha at Kam Tin is secondary woodland (open pine woodland). Other losses of trees (1.3 ha) are either roadside plantations or individual orchard trees of little ecological interest. These were not included in the above calculations because the tree species were either exotic or horticultural. Loss of the pine woodland is considered to be a moderate impact. Pine woodlands are relatively common on the hillsides of the New Territories. Major threats to these woodlands include frequent fire disturbance and habitat fragmentation. *Pinus massoniana* is also subject to senility and nematode infestation. This hillside will be bounded by Route 3 on the west side and the proposed rail alignment on the east side. However, with a dense cover of native shrubs and broad-leaved trees in the understorey, the woodland can succeed to broad-leaved secondary forests, and can develop into mature woodland, given time and protection from fire (Thrower, 1984). Loss of woodland habitat would be of greater ecological importance if the surface area of the woodland were large and the density of trees greater. Because the woodland is small (0.4 ha) and sparse, lineside re-planting trees along the railway alignment following construction will be adequate to mitigate the impact of the loss in the long term.

There is a loss of approximately 60 ha of agricultural land to be resumed by West Rail, which provides general habitats for a variety of wildlife such as water birds, song birds and birds of prey, mammals, reptiles, amphibians and invertebrates. This loss comprises approximately 30% of the existing agricultural habitat on the Kam Tin River floodplain (in the valley south of Kam Tin Road and west of Kam Sheung Road). The scale of loss of such habitat type in the Kam Tin valley may be considerable, but similar adjoining and surrounding agricultural land will remain and may provide habitats for the wildlife affected. This remaining agricultural land in the Kam Tin valley would become more important as a wildlife refuge.

The most important losses will be those of the Kam Tin valley wetland habitats comprising stream (1.8 ha), fish pond (10 ha), and freshwater marshland (0.3 ha). As detailed in *Section 7.9.1 Baseline Conditions*, these wetland areas provide valuable wildlife habitats for water birds, song birds and birds of prey, mammals, reptiles and amphibians and invertebrates. The loss of these habitats will constitute a severe impact arising from the project, based on following considerations:

- The habitat is important to some rare or protected species by providing breeding and foraging habitats, such as Painted Snipe, egrets and herons, and the Narrow-mouthed Frog;
- Wetland habitats are declining in the northwestern New Territories due to infrastructure development, conversion from traditional agricultural land uses, and village/residential expansion; and
- The habitat losses will be permanent and irreversible.

As the primary value of these wetland habitats derives from their exploitation by birds and other fauna, the sections below provide more specific discussions on the implications for birds and other fauna. Mitigation for these wetland habitats loss will be required as recommended in *Section 7.9.4*.

7.9.3.2 Birds

7.9.3.2.1 Egretry

The West Rail alignment would pass within 600 m of the Ho Pui egretry, within 100 m of the Toll Plaza egretry, and within 50 m and overhead of the Tung Shing Lei egretry. In the former two cases the alignment would remove agricultural and riverine foraging habitats, and the construction project could disturb nesting. In contrast, at Tung Shing Lei all affected habitats would have been recently created by the Route 3 project. Habitat losses would be minimal because the rail would be elevated through the Tung Shing Lei (Au Tau) area. During the construction phase birds would be expected to avoid the works areas. This could result in reduced nest productivity due to reduction in the total surface area of foraging habitat. Following construction birds would be expected to adapt to both the movements and the noises of the train as they have in other areas where birds occupy rail corridors. Notable among such areas is the KCRC Tai Po Market station and the rail alignment south of Tai Po to Ma Liu Shui. Throughout those areas Little Egrets, Cattle Egrets and Chinese Pond Herons use habitats alongside the rail corridor.

The wetland habitats are important to colonial nesting waterbirds such as herons and egrets. Nesting herons and egrets have been documented feeding to a distance of at least 3 km from the Mai Po egretry (Wong, 1991; Pearson, 1993 [in Young and Cha, 1995]; Young, 1993). Hafner *et al* (1987, in Melville *et al*, 1994) concluded that colony sizes of breeding European ardeids are directly and positively correlated with the area of freshwater habitats within a 10 km radius. When the area of freshwater feeding habitat within 10 km of an egretry dropped below a given threshold, the population of breeding birds was observed to fall precipitously (*ibid*). The apparently greater foraging radius in the European study may reflect habitat differences between Hong Kong and the study area of Hafner *et al* in the Camargue in southern France.

Herons and egrets from the Ho Pui and/or Toll Plaza egretries foraged at sites 4, 7, 10, 11, and 15, and all were within 350m of the proposed rail alignment (*Figure K2, Annex K*). All identified ardeid foraging areas near either the Ho Pui or Toll Plaza egretries were within 1050 m of the proposed rail alignment, and all were within 1 km of either egretry. Thus, based on field observations to date and on current literature, it is predicted that West Rail might adversely affect birds which occupy both the Ho Pui and Toll Plaza egretries due to a reduction in available foraging habitat.

7.9.3.2.2 Painted Snipe

Regarding the Painted Snipe, approximately 15 percent of the preferred roost site (which is also a known nesting location) would be directly affected by construction of West Rail near Kam Tin Road (*Figure 7.9e*). The rail alignment would be some 15 m overhead and supported on columns spaced at approximately 40 m intervals as it crosses the freshwater marsh in that area. The entire works area would be subject to construction disturbance including heavy equipment operation, bored piling, and site de-watering, which may also indirectly affect the remaining roosting site. The result of these impacts, if uncontrolled, could be abandonment of the roost/breeding site. This could result in a decline in production of young, which could lead to a local population decline.

The Painted Snipe is considered to be of conservation importance in Hong Kong, and the potential impacts to its local population would be significant for the following reasons:

- The species is dependent on freshwater marsh habitat which is declining in extent in Hong Kong;
- It occupies an area of freshwater marsh to be disturbed or lost to the West Rail facilities;
- The only other area where Painted Snipe occur in Hong Kong in relatively large numbers (less than 50 birds) is Long Valley which is subject to disturbance caused by Main Drainage Channels for Fanling, Sheung Shui and Hinterland; and
- Continued losses of freshwater marsh habitat in Hong Kong would ultimately lead to loss of the species breeding in Hong Kong.

Operation phase impacts are predicted to be minimal due to the overhead location of the rail.

7.9.3.2.3 Other Bird Species

West Rail is unlikely to cause any significant impact to those bird of prey recorded in Kam Tin Valley such as Bonelli's Eagle and Kestrel, as they usually have a wide foraging range and no nesting activities were recorded within the area to be affected by the West Rail.

Impacts to the bird species identified as breeding within the Study Area are unlikely to be detrimental, as they are mostly common or woodland species with a wide distribution in Hong Kong. Examples of the former are the Crested Bulbul, Magpie Robin and White-breasted Waterhen and the latter are the Asian Barred Owlet.

7.9.3.3 Invertebrate

Two rare and four uncommon species of butterflies were recorded in the study area which is considered rich in species diversity. The proposed West Rail will lead to a reduction of habitats area for the butterfly communities. Since the majority of the habitat mosaic still persist in the Kam Tin Valley, it is unlikely that West Rail will cause significant impact to the butterfly fauna. Dragonflies would be adversely affected by losses of stream channel which they occupied within the proposed works area. Both *Sinictogomphus clavatus* and

Neurobasis chinensis were recorded in the study area, and neither is common in Hong Kong (Wilson, 1995).

7.9.3.4 Reptiles and Amphibians

Of the ten species of reptiles and ten species of amphibians recorded within the study area, one reptile (Greater Green Snake) and one amphibian (Butler's Pigmy Frog) are considered uncommon in Hong Kong. A second amphibian (Narrow-mouthed Frog) is considered rare in Hong Kong. The Narrow-mouthed Frog occupies marsh and abandoned paddy habitats, thus would be affected most by development on the Kam Tin River floodplain. The other two species may be better adapted to woodland edge or woodland habitat, and thus would occupy the edge of the valley. They would, therefore, not be affected to the same extent as the Narrow-mouthed Frog. Although the ecology of the Narrow-mouthed Frog is not well studied in Hong Kong, the species is wetland-dependent, and therefore any habitat loss could reduce the abundance of the species in Hong Kong.

7.9.3.5 Mammals

Loss of riparian trees near Cheung Po village would have minimal effect on bats due to the large areas of dense village woodlands which will remain in the area. The village woodlands support fruit trees which will continue to provide a forage base for bats.

Insectivorous bats forage over freshwater wetlands in Kam Tin valley, including Kam Tin River and associated riparian habitats and fish ponds (G. Ades, Kadoorie Agricultural Research Centre, pers. comm.). Therefore, losses of the lowland freshwater wetlands habitat, which provide insect prey for insectivorous bats, would cause a reduction in available prey, which could lead to reduced production or survival of young and affect bats roosting near the location of the north tunnel portal. This impact is not possible to quantify. However, because availability of roost sites is considered to be a more important determinant of the abundance of local bat populations than is prey availability, the potential impact of lost foraging area is considered to be minor.

West Rail tunnel construction will require blasting, rock drilling, and heavy equipment traffic near the north portal, all of which could affect bats roosting in a cave/tunnel roost approximately 200m south of the tunnel portal (*Figure 7.9e*), particularly the Leschenault's Rousette Bat which is sensitive to disturbance (G. Ades, pers comm). The roost is the largest known in Hong Kong for at least six species of bats. The proposed portal area is partially screened from the roost area by the existing topography, which would remain in place. As the drill and blast operation will follow the existing Government vibration criteria, the potential vibration impact on the bat roost site may not be significant. However, if tunnel blasting or drilling did cause physical damage to the cave, the impact would be significant because it could cause bats to abandon the roost site. This would require mitigation through restoration of the cave, because all bats are protected by the Wild Animals Protection Ordinance.

Impacts on other mammals would include the barrier effect of the rail corridor, although this is considered to be a minimal impact due to the relatively poor terrestrial mammal community in the area.

7.9.3.6 Flora

Loss of flora due to the construction of West Rail is considered to be a minimal botanical impact due to the limited area involved and the widespread distribution of the plant species to be affected (see *Section 4.10.2* of this report for assessment criteria). In terms of flora, the study area is not natural and no rare plants were recorded. If West Rail did not proceed, the area would not have great potential value for flora biodiversity conservation, because the three primary agents of disturbance (urbanisation, farming, and fire) would continue to affect the site.

7.9.4 Recommended Mitigation

The identification, selection and refinement of the West Rail alignment has been a continuous process since the planning of the railway commenced over three years ago. The alignment upon which the EIA study is based is, therefore, the result of a gradual process of evolution, optimisation and assessment. This alignment has been more finely optimised during the period of the initial assessment for operational, safety, environmental and engineering design purposes.

The impact assessment discussed above has been undertaken on the basis of the optimum alignment derived from the selection process; the mitigation measures to minimise potential impacts are identified below.

The assessment of ecological impacts in *Section 7.9.3* 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 to those important marshland, fish pond and abandoned meander habitats lost to the new railway. A key focus for the development of specific ecological objectives for the mitigation measures would be the provision of habitats for the Painted Snipe, herons and egrets, Narrow-mouthed Frogs and dragonflies.

The wetland mitigation through restoration and enhancement will not preclude the provision of habitat to other wetland-dependent wildlife. It may also provide an opportunity to restore critical breeding habitats for bitterns or other species which were formerly breeders in Hong Kong.

Opportunities for extending the existing wetland areas, through utilisation of permanently resumed land within the railway easement corridor has been actively pursued by the Corporation. The length of railway easement corridor between Kam Tin Station and the Au Tau Intersection (refer to *Figure 7.9f*) 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 practiced elsewhere will be adopted for the implementation of the ecological mitigation measures. Therefore these areas will be used during the construction project as works areas, whilst after West Rail construction they will be restored to suitable freshwater wetlands to encourage utilisation by wildlife. The habitat mitigation works should be undertaken as soon as construction works are completed.

Further areas adjacent to the gazetted scheme boundary may be considered for the provision of compensatory habitats, subject to formal agreement of land disposal arrangements following the construction phase. It is envisaged that a further 3.5 ha may be made available through this process.

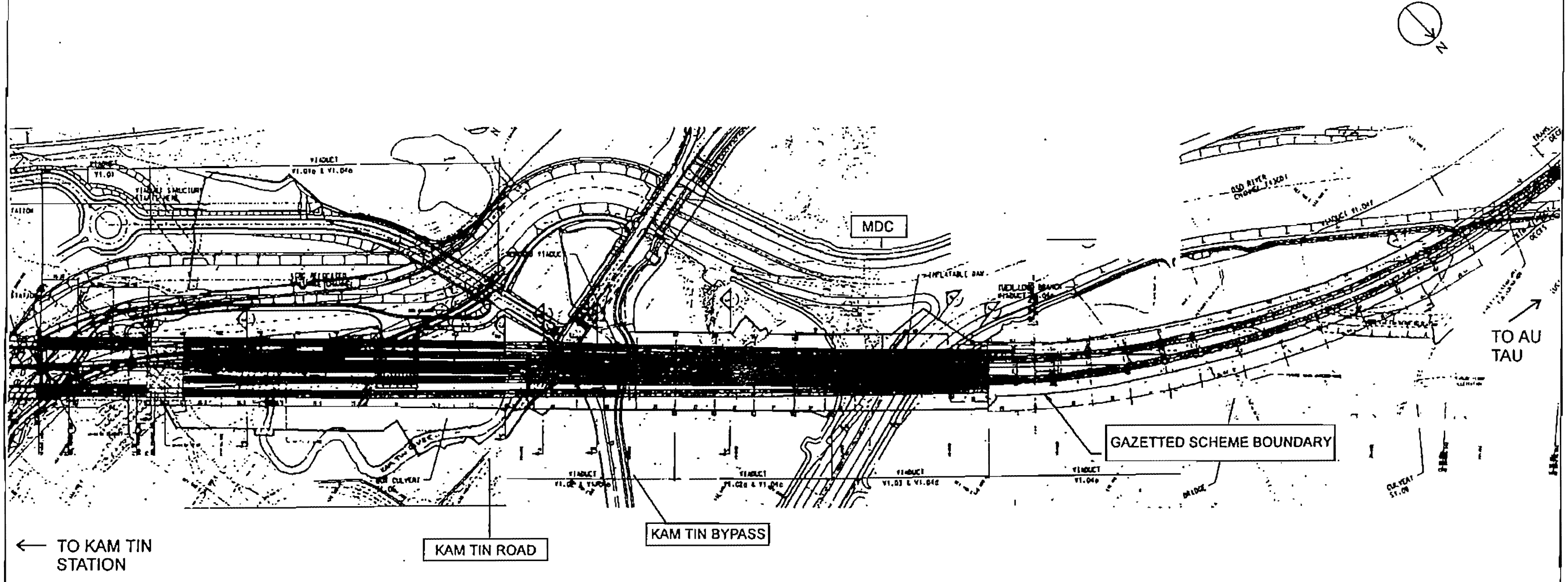
This has maximised the extent to which mitigation of ecological impacts arising from West Rail will be carried out within the railway corridor. Further studies will be undertaken by the Corporation at the Detailed Design stage to develop this into specific wetland habitat restoration or enhancement plans. The outcome of these further studies will be presented in an Habitat Creation and Management Plan which will be submitted to AFD for endorsement. The design principles of the wetland mitigation sites are outlined below.

The ecological objectives of habitat recreation are to mitigate the losses of wetland habitat in the Kam Tin valley, as follows:

- Re-create freshwater wetland habitat;
- Re-provide habitat suitable for dragonflies;
- Re-provide habitat suitable for reptiles and amphibians; and
- Re-provide habitat suitable for wetland-dependent birds.

The wetland habitats to be recreated would be mainly still-water habitats in the form of marsh and pond areas. The design principles for the mitigation sites are presented below and illustrated in *Figure 7.9g*.

- 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;
- 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;



NOT TO SCALE

POTENTIAL RAILWAY VIADUCT FOOTPRINT USED FOR WETLAND MITIGATION

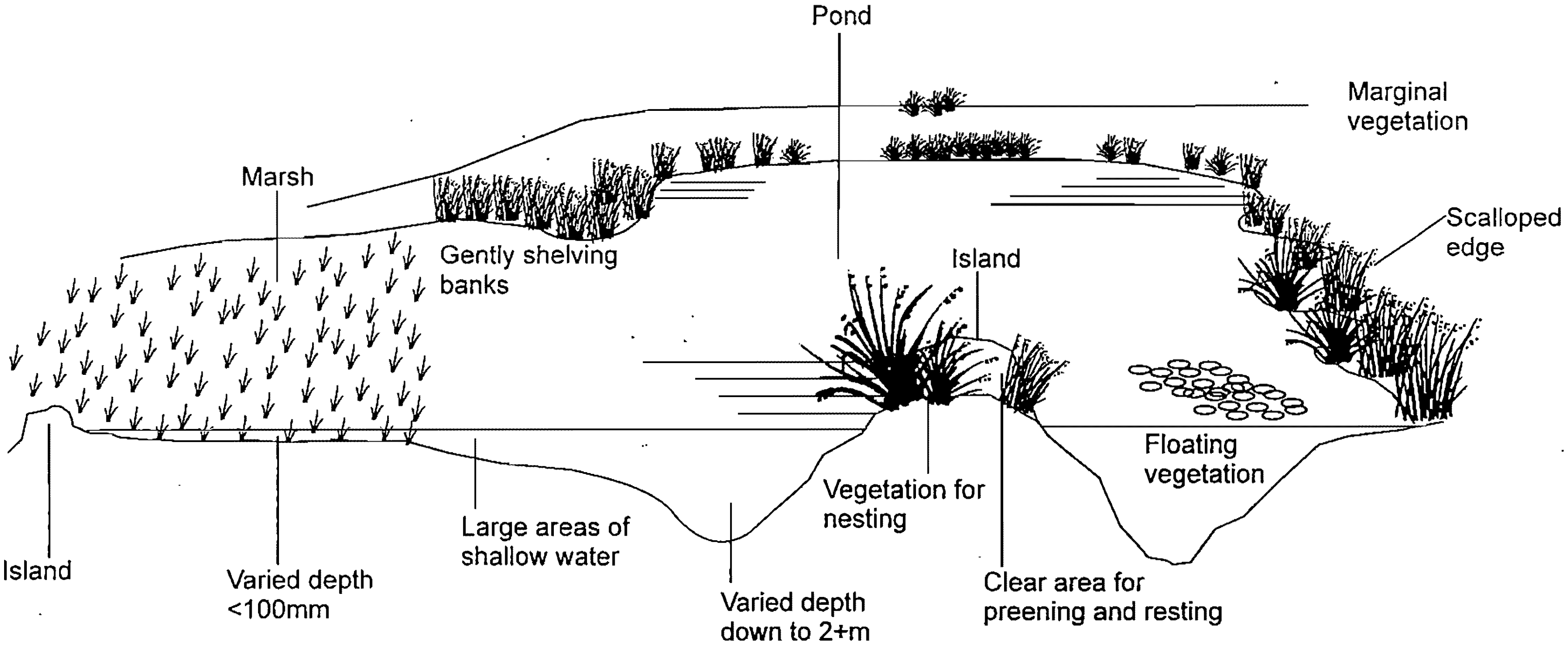
FIGURE 7.9f

Contract/C1588/C1588Z46

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY



NOT TO SCALE

GENERAL DESIGN FEATURES OF FRESHWATER WETLAND

FIGURE 7.9g

Contract/C1588/C1588Z35

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

- 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;
- 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;
- Shallow, sloping pond edges can be extended to create flat marshlands that blend into the ponds;
- 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);
- Marsh vegetation similar to that found at the existing Kam Tin School marsh such as the herbs *Rumex maritimus* and *Wedelia trilobata* should be planted;
- Scattered, small islands (10-15 m^2 in area) rising some 10-20 cm above maximum water levels should be provided in the marshland areas;
- Appropriate soil texture and composition to promote growth of marsh vegetation should be provided.

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.

Monitoring of the effectiveness of the wetlands as mitigation sites for lost habitats will be undertaken against criteria, operational and to a programme, defined in the Habitat Creation and Management Plan. Insights gained through the ecological monitoring programme will be fed back to the Corporation in the form of management recommendations to further enhance ecological performance of the wetlands. The Corporation will implement the practicable management recommendations following review by AFD.

With regard to the potential impacts on the Painted Snipe habitat, in addition to the habitat creation or enhancement presented above, the following mitigation measures during construction are recommended:

- 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.
- 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.

- 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.
- 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.

The satisfactory mitigation of impacts, associated with the loss of wetland habitats in the Kam Tin valley, will depend upon the successful creation and maintenance of the compensatory habitats identified above and the successful restoration of marshland areas following the completion of construction works. The proposed works to be undertaken in order to achieve these mitigation objectives will be detailed in the Habitat Creation and Management Plan to be prepared by the Corporation and submitted to AFD for endorsement, prior to the onset of construction.

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 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.

Revegetation on the finished cut slope and lineside planting using native species is recommended. Native species suitable for planting on the cut slope include *Gordonia axillaris*, *Rhodomyrtus tomentosa*, *Schima superba* and *Rhaphiolepis indica*.

Areas such as fish ponds that are temporarily disturbed during construction will be reinstated by the Corporation.

7.9.5 Residual Impacts

The combined loss of stream, fish pond, and marshland habitats totals approximately 12 ha; this contrasts with the 8.5 ha of wetland restoration lands to be made available under the West Rail easement in the Kam Tin Station to Au Tau intersection area. As a maximum, there would be a net loss of 3.5 ha. Whilst being smaller, the reprovisioned wetland habitat will partially compensate for its reduced size by being in close ecological linkage and by being managed to clearly defined conservation objectives; as a consequence, the residual impact would be acceptable. Although the habitat losses are set to occur in an area already under considerable pressure due to progressive urbanisation, improved transport access and flood control, the short term habitat losses in the area may be mitigated to the maximum extent possible by the measures proposed above. The extent to which the identified impacts may be mitigated will be dependant upon the successful creation and maintenance of the compensatory habitats.

Secondary impacts will be expected to arise from cumulative changes in the development of the Kam Tin area due to improved transport access and flood control. The impact of most importance would be additional habitat loss due to urbanisation and associated development. Overtime, these impacts are likely to have severe consequences for the ecological resources of the Kam Tin valley, unless measures, similar to those being adopted for West Rail, are implemented by the proponents of future schemes.

7.9.6 Conclusion

The potential ecological impacts associated with West Rail 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. 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 though 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.

7.10 Waste

7.10.1 Potential Sources and Prediction of Impacts

7.10.1.1 Construction Phase

7.10.1.1.1 General

Construction activities to be carried out for the Northern Section of West Rail will result in the generation of a variety of wastes which include:

- Site clearance waste;
- Excess excavated material/spoil;
- General construction waste;
- Demolition waste;
- Chemical waste;

- General refuse; and
- Contaminated mud and sediment.

Environmental issues in connection with the generation, handling and disposal of contaminated muds and sediments are discussed in *Section 7.11*. Assessments of the impacts of the other categories of waste are described below.

7.10.1.1.2 Site Clearance Waste

The elevated sections of the Northern Section of the alignment will minimise the physical impact of the railway at ground level and hence minimal site clearance works will be required. The site clearance works will mainly involve the clearance of vegetation in the areas where the viaduct piers and work areas are to be located.

As Kam Tin Station and the West Rail Depot are to be located in areas currently used by fish ponds and vegetable farms, limited clearance works will be required.

7.10.1.1.3 Excess Excavated Material

The majority of the Northern Section is supported on viaducts and so limited excavation will be required. Excavation will be carried out only for the construction of piles and pile cap foundations for the railway. A short section of cutting through a hill in close proximity to Au Tau burial grounds will be necessary but it will generate minimal quantities of spoil which will be reused as fill for the Depot.

7.10.1.1.4 General Construction Waste

About 56,500 m^2 and 25,000 m^2 of GFA will be constructed at the West Rail Depot and Kam Tin Station respectively. General construction waste generated from these construction works will consist of wood waste from formwork and falsework, material and equipment wrappings and surplus or rejected construction material (mainly concrete).

If general construction wastes are not removed from site regularly, they may hinder construction and present a safety hazard, in addition to causing potential water quality impacts from runoff. The storage and disposal of construction wastes also have the potential to create visual and dust nuisances.

7.10.1.1.5 Demolition Waste

No significant demolition works will be carried out for the construction of the Depot. The alignment of the Northern Section has been refined to avoid encroachment upon existing structures and facilities and the construction of the railway at an elevated configuration has also largely avoided the need for demolition of existing structures.

7.10.1.1.6 Chemical Waste

Substances likely to be generated by construction activities for the Northern Section will, for the most part, arise from the maintenance of equipment. These may include, but may not be limited to, the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils and cleaning fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

Chemical waste may pose serious environmental, health and safety hazards if it is not properly managed. These hazards include:

- Toxic effects to workers;
- Adverse effects on water quality from spills;
- Fire hazards; and
- Disruption of sewage treatment works if chemical waste enters the sewerage system.

7.10.1.1.7 General Refuse

General refuse will be generated from the works sites for the Northern Section and West Rail Depot. The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

7.10.1.2 Operational Phase

7.10.1.2.1 General Refuse

General refuse will arise from the public, station employees and commercial operators within the Kam Tin Station and KCRC staff at West Rail depot. Materials may include food waste, packaging waste, paper, plastic, office wastes, old tins/containers, cleaning materials and miscellaneous other waste produced during daily activities. As discussed for the construction phase, the storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, litter, water quality impacts if waste enters storm water drains, visual impact, and vermin problems if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can lead to similar adverse impacts at those sites.

7.10.1.2.2 Industrial Waste

Industrial waste will arise from maintenance activities of the railway, Kam Tin Station and West Rail Depot. The materials may include scrap materials from rail and carriage maintenance, used fluorescent tubes, cleaning materials and discarded electronic equipment.

7.10.1.2.3 Chemical Waste

Chemical waste will arise from maintenance activities of the railway and station of the Northern Section and West Rail Depot. The waste may include lubricants, oil and paints, acid/alkaline waste, batteries, pesticides, coolants and solvents. As discussed for the construction phase, these chemical wastes may pose significant environmental, health and safety hazards if they are not properly managed.

7.10.2 Evaluation of Impacts

7.10.2.1 Construction Phase

7.10.2.1.1 Site Clearance Waste

As little site clearance works will be required for the construction of the Northern Section and West Rail Depot, it is anticipated that there will be negligible environmental impacts due to the storage, handling, transport and disposal of site clearance waste.

7.10.2.1.2 Excess Excavated Material

Site formation works for the West Rail Depot will generate approximately 866,000 m^3 of excavated material (about half of it is rock and half soil) and require about 1.46 million m^3 of fill to form the Depot to the required levels (see *Table 5.10a, Annex N*). Should the excavated material satisfy the engineering requirements for fill, there will still be a deficit of about 600,000 m^3 of fill. The cut and fill requirements for the Depot are shown *in Figure 7.10a.*

The construction of the Northern Section will generate about 161,000 m^3 of excavated soil and require about 771,000 m^3 of fill for the formation of Kam Tin Station (see *Table 5.10a, Annex N*). Should the excavated material satisfies the engineering requirements for fill, there will still be a deficit of about 610,000 m^3 of fill. The cut and fill requirements for the Northern Section are shown *Figure 7.10b.*

The surplus excavated material from construction of the Central Section could provide part of the fill required. Some of the excess material from the excavation of the TLT may be temporarily stockpiled at the southern part of the West Rail Depot prior to delivery to Kam Tin Station or land formation sites.

It is expected that all the rock excavated from the West Rail Depot could either be reused on site or by the local construction industry. If the soils excavated from the West Rail

Figure 7.10a : Cut and Fill Requirements of West Rail Depot

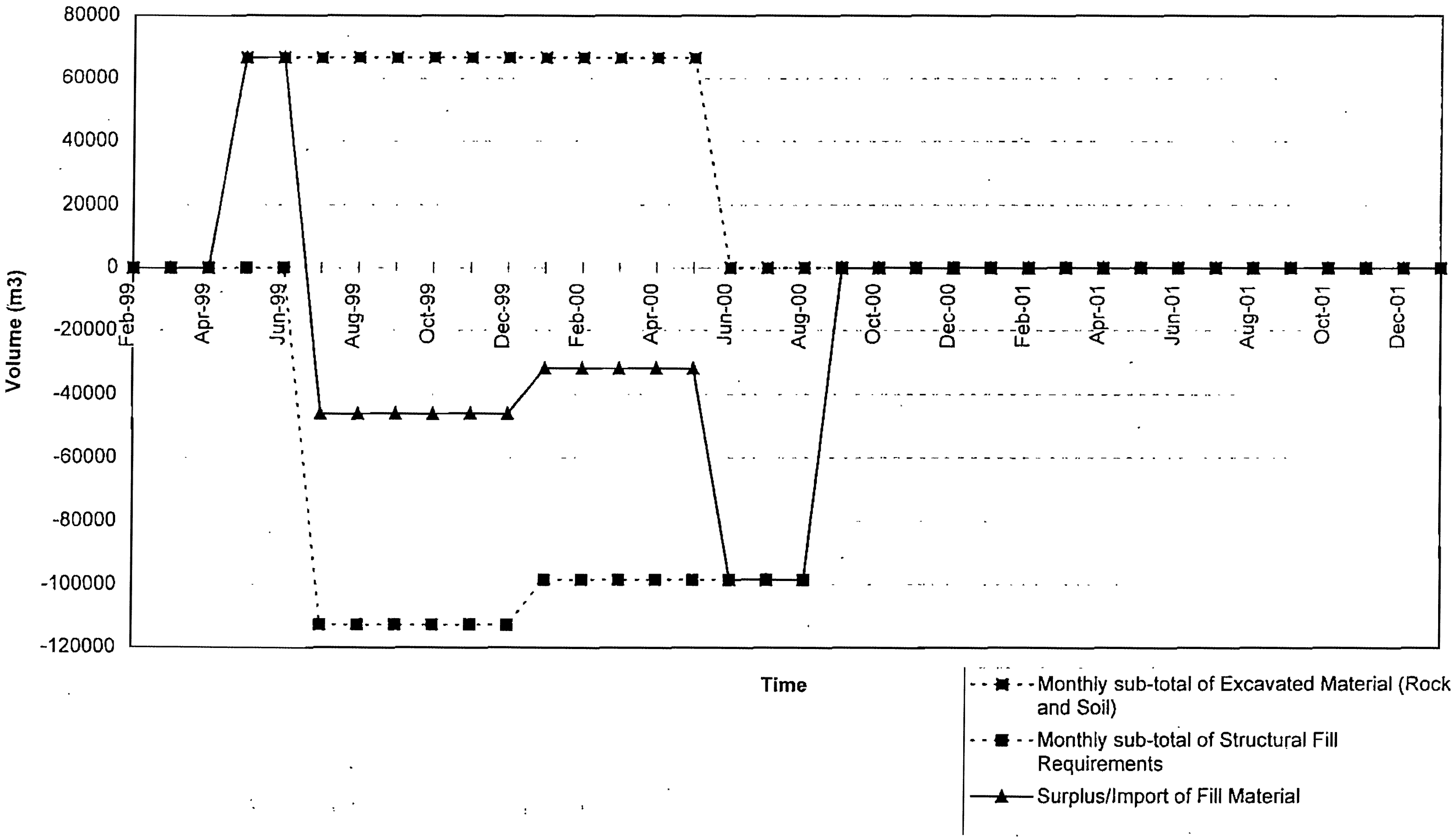
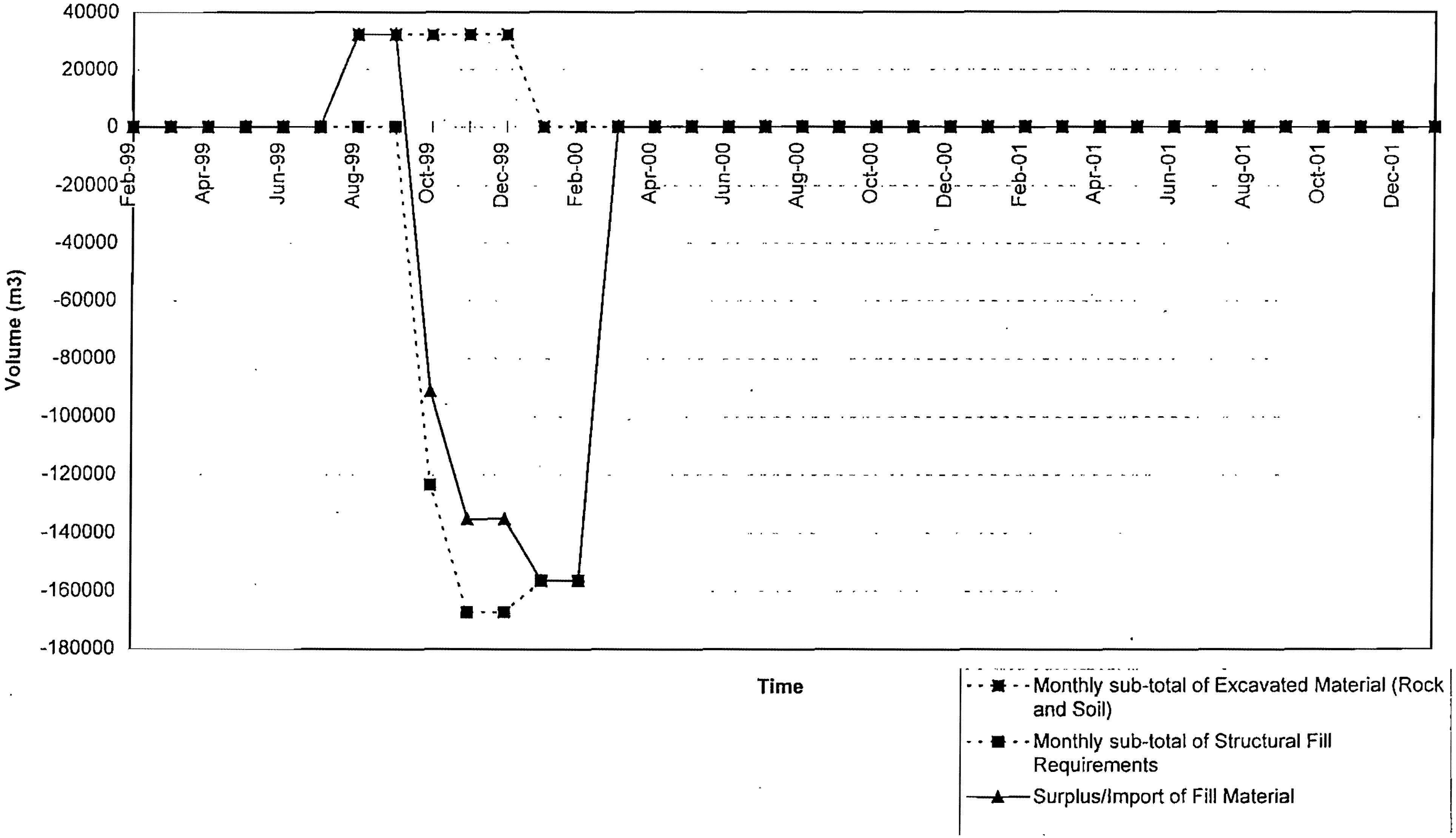


Figure 7.10b : Cut and Fill Requirements of Northern Section



Depot and Kam Tin Station do not have the required engineering properties, up to 593,000 m^3 (432,000 m^3 + 151,000 m^3) of soil will require disposal or reuse off-site. However, it is likely that most of the excavated soil could be reused on site. Assuming 20% of the soils are unsuitable as fill, about 120,000 m^3 (about 440m^3/day, maximum) will need to be disposed of at public filling areas.

With respect to the small quantity of excess excavated soil requiring off-site disposal, it is not anticipated to have a significant impact on the demand for public filling capacity. The disposal of inert excavated material at public filling areas or land formation sites will not have any long term environmental impacts.

The potential air and water impacts from the storage, handling, transport and disposal of excavation materials are covered in *Sections 7.4* and *7.5* respectively.

7.10.2.1.3 General Construction Waste

The storage, handling, transport and disposal of general construction wastes have the potential to create visual, water, dust and associated traffic impacts. About 51,500 m^2 and 40,000 m^2 of GFA will be constructed for the West Rail Depot and Kam Tin Station respectively. Based on a waste generation rate of 0.1m^3/m^2 of GFA to be constructed, a total of approximately 9,150 m^3 of general construction waste will be generated. General construction waste to be generated from other construction activities (such as construction of the railway itself) cannot be determined at this stage.

General construction waste should be removed from site as soon as practicable in order to avoid adverse environmental impacts due to on-site storage of the material.

To conserve the capacities at landfill sites, general construction waste with more than 20% (by volume) inert material should not be disposed of at landfills. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials (concrete, soil, cement/bentonite, etc) at public filling areas and the degradable wastes (wood, paper, plastic, etc) at landfills. The production of general construction wastes should be minimised by the careful control of ordering procedures which can result in surplus materials. The avoidance of over-ordering and the segregation of materials will minimise waste arisings requiring landfill disposal.

Construction and demolition wastes currently form approximately 35% of the annual take-up of the limited landfill void available in Hong Kong, although this proportion has varied widely over recent years. Therefore, it is important to minimise, wherever possible, the amount of wastes which are disposed of by landfill.

7.10.2.1.4 Demolition Waste

As little demolition waste will be generated from the construction of the Northern Section and West Rail Depot, it is anticipated that the environmental impacts will be negligible.

7.10.2.1.5 Chemical Waste

It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the Contractor's on-site maintenance activities and the numbers of plant and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oils and solvent, produced from plant maintenance will be small.

Storage, handling, transport and disposal should be undertaken in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the contractor should be in compliance with all relevant regulations and there will be little environmental impact.

7.10.2.1.6 General Refuse

The number of construction personnel who will work on site has not yet been determined by the engineering Design Consultants. It is anticipated that it will be in the order of 1,100 workers. Estimates of waste arisings based on the anticipated numbers of workers suggest that the amount of general refuse produced at the Northern Section and West Rail Depot will be in the order of 630 kg per day. Provided that the mitigation measures recommended in *Section 5.10* are adopted, the environmental impacts caused by storage, handling, transport and disposal of general refuse are expected to be minimal.

7.10.2.2 Operational Phase

7.10.2.2.1 General Refuse

Based on the operational experience of existing railways, it is expected that the amount of general refuse to be generated during the operation of the Kam Tin Station will be in the order of 500 kg per day. About 180 m^3/month (about 1,000 to 1,200 kg per day) of general refuse is generated at Ho Tung Lau East Rail Depot. It is expected that the operations of the West Rail Depot will generate a similar quantity of general refuse. It is likely that the North West New Territories Transfer Station will be in operation (scheduled for late 1999) before the commissioning of the Kam Tin Station and West Rail Depot. The refuse collected could be delivered to the transfer station or directly to the WENT Landfill. If good practice is adhered to and all feasible avoidance, reuse and recycling opportunities are taken, including minimising over-ordering, there should be minimal impact.

7.10.2.2.2 Industrial Waste

The amount of industrial waste to be generated during the operational phase of the Northern Section cannot be determined at this stage. Metals and discarded electronic equipment have high scrap value and may be sold for recycling. Provided that the scrap materials are collected regularly, it is not expected that storage, handling, transport and disposal of industrial waste will cause any significant environmental impact. Other general industrial waste such as plastic, cloth and paper can be collected together with general refuse and disposed of at licensed waste transfer or disposal facilities.

7.10.2.2.3 Chemical Waste

The amount of chemical waste to be generated during the operational phase of the Northern Section and the West Rail Depot cannot be determined at this stage. Chemical wastes should be stored, handled, transported and disposed of in accordance with the *Chemical Waste Regulations* and *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes*. They should be collected and transported to the CWTF or other licensed facility by a registered waste haulier. Provided that appropriate handling, storage and disposal procedures are followed, no unacceptable impacts associated with the management of chemical waste during the operational phase of the Northern Section and Depot are anticipated.

7.10.3 Recommended Mitigation

7.10.3.1 Introduction

Section 5.10 has recommended the recycling, storage, transportation and disposal measures to avoid or minimise potential adverse impacts associated with waste arising from the construction and operation of the Southern Section under each waste category. The majority of these recommendations are applicable to the Northern Section and Depot. For the construction phase, the contractors should incorporate these recommendations into a comprehensive on-site waste management plan for the construction of the Northern Section and West Rail Depot. Such a management plan should incorporate site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. For the operational phase, it is recommended that KCRC should incorporate the recommendations into a comprehensive waste management plan for the operation of West Rail.

7.10.3.2 Construction Phase

7.10.3.2.1 Excess Excavated Material

The amount of surplus excavated material to be generated from the construction of the Northern Section and West Rail Depot is expected to be small. However, in order to minimise the amount of surplus excavated material to be delivered to public filling areas and optimise the cut and fill balance of West Rail, the priority for off-site disposal of surplus excavated material should be as follows:

- Transport to other sections of West Rail for reuse;
- Transport to other land formation sites in the Tuen Mun and Yuen Long areas for reuse; and

- Transport to public filling areas.

In order to increase the opportunity for reuse of surplus excavated material by other land formation or reclamation projects, it is recommended that the engineering Design Consultants should complete the FMC's Questionnaire on Surplus and Fill Requirements and return it to FMC for inclusion into the Surplus and Fill Requirement Database.

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

7.10.3.2.2 Construction and Demolition Waste

In order to minimise waste arisings and keep environmental impacts within acceptable levels, the mitigation measures described in *Section 5.10* should be adopted.

7.10.3.2.3 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* (*see Section 5.10*).

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

7.10.3.2.4 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.

7.10.3.3 Operational Phase

7.10.3.3.1 General Refuse

General refuse will be generated from the passengers, station employees and commercial operators. General refuse generated on-site should be stored in enclosed bins or compaction units separate from chemical wastes. A reputable waste collector should be employed to remove general refuse and industrial waste from the stations, separately from chemical wastes, on a daily basis to minimise odour, pest and litter impacts.

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.

7.10.3.3.2 Industrial Waste

General industrial waste generated on-site should be stored in enclosed bins separate from chemical wastes and it could be collected together with the general refuse. Scrap metal may be sold for recycling.

7.10.3.3.3 Chemical Waste

Chemical waste that is produced, as defined by Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation, should be handled and disposed of in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (See *Section 5.10*).

7.10.4 Conclusion

The potential impacts of waste arising from the construction and operational phases of the Northern Section and Depot of West Rail have been assessed. Key issues include the need for effective waste management planning during both of these phases, effective management of chemical/industrial and other potentially hazardous wastes, and the strong preference for reuse of clean surplus clean material rather than disposing of it 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.

7.11 Land Contamination

7.11.1 Background

The potential for soil and groundwater contamination exists in some areas along the alignment where current or historic land uses have impacted upon the land. The potential for impacts from land contamination exists primarily where there will be an interface with the underlying soil either during construction or operation of West Rail. The following sections present the findings of the land contamination assessment and includes the analytical results for an indicative sampling programme for pond and river sediments, some of which were suspected to be contaminated with heavy metals.

7.11.1.1 Project Construction

In the Northern Section of West Rail, the main areas where soil may be excavated will be at the Depot and Kam Tin Station. The rail alignment will also comprise embankment and elevated structures which may potentially encounter contaminated soils from excavations for bored piles. The site formation for the Depot and Kam Tin Station will involve excavation and filling of soft sediment or mud at the bottom of existing fish and duck ponds and the Kam Tin River, and then infilling with suitable material. Based on KCRC estimates, site formation works for the West Rail Depot will generate a total of approximately 432,000 m^3 of soft excavated material, and that over 150,000m^3 of mud and sediment may need to be removed as part of the Kam Tin Station and Northern Section development programme. However, there are some concerns that the soft sediment or mud may be contaminated and therefore may need to be removed prior to filling.

Reprovisioning of existing drainage channels for the West Rail Depot will also involve the dredging and disposal of channel sediments. The sediment is likely to be highly organic in nature and may be contaminated with copper and zinc from livestock additives.

7.11.1.2 Current and Historic Land Use

The current and previous landuses of the West Rail Depot and Kam Tin Station are shown in *Tables 7.11a* and *7.11b*.

Table 7.11a Historical Land Use of West Rail Depot

Year	Site usage
1961, 1967	Ponds, cultivation, footpath, residential areas
1983	Ponds, cultivation, footpath, temporary buildings, residential
1997	Ponds, residential, cultivation and agricultural undertakings

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-NE-22b, 22d & 23c; 6-NE-17b, 17c & 17d; 6-NE-18C; 6-NE-23a; and 1:1200 scale reference 109-SW-A, C &D)

Table 7.11b Historical Land Use of Kam Tin Station

Year	Site usage
1980	Ponds, cultivation, footpaths, Kam Tin Road, villages
1997	Ponds, cultivation, footpaths, Kam Tin Road, villages

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-NE-6d; 6-NE-7c; : 6-NE-116: 6-NE-12a, PC &d)

The main concern relates to potential contamination of sediment within the drainage channels scheduled to be reprovisioned, and the fish ponds scheduled in the land take. These soft materials will need to be dredged prior to the development programme.

7.11.1.3 Geology and Hydrogeology

The *Hong Kong Geological Survey (HKGS) Sheet 6* covering Yuen Long indicates that the area of the proposed alignment is composed mainly of the formations described in *Table 7.11c.*

Table 7.11c Geologic Setting - Northern Section

Location	Geologic Setting
West Rail Depot	Holocene alluvium and terraced alluvium, consisting of clay, silt, sand and gravels (well sorted to semi-sorted); Depot footprint may expose Upper Jurassic age coarse ash and crystal tuffs of the Tai Mo Shan Formation, with associated local Pleistocene age debris flow deposits
Kam Tin Station	Holocene alluvium consisting of clay, silt, sand and gravels (well sorted to semi-sorted)

7.11.2 Potential Sources of Impact

Similar potential impacts to those presented in *Sections 5* and *6* are applicable to the Northern Section and West Rail Depot. It is anticipated that a relatively small quantity of excavated material will be generated from the construction of foundations and bored piles for viaducts, some of which will be used in backfilling. This excavated material will probably be acceptable at public dump sites if not reused and should comply with public dumping licence requirements. The other remaining source of impact would be from the excavated soft sediments from the fish ponds and Kam Tin River which may be contaminated.

The prediction, evaluation and recommendation of appropriate mitigation concerning the land contamination impacts in the Northern Section and West Rail Depot are discussed below.

7.11.3 Prediction of Impacts

7.11.3.1 Disposal of Soils

In order to determine the volumes of contaminated material requiring disposal, an indicative sediment sampling programme was conducted in November 1997, as described below, to establish the likelihood of contaminated sediments being encountered during West Rail construction.

A limited sampling programme was conducted to assess various river locations and ponds (duck ponds and fish ponds) to be affected by West Rail for potential contamination. The investigation was intended to provide general indications of sediment contamination, primarily in the Kam Tin Valley in the location of the Depot, and to assess likely requirements for special handling and disposal during the construction phase.

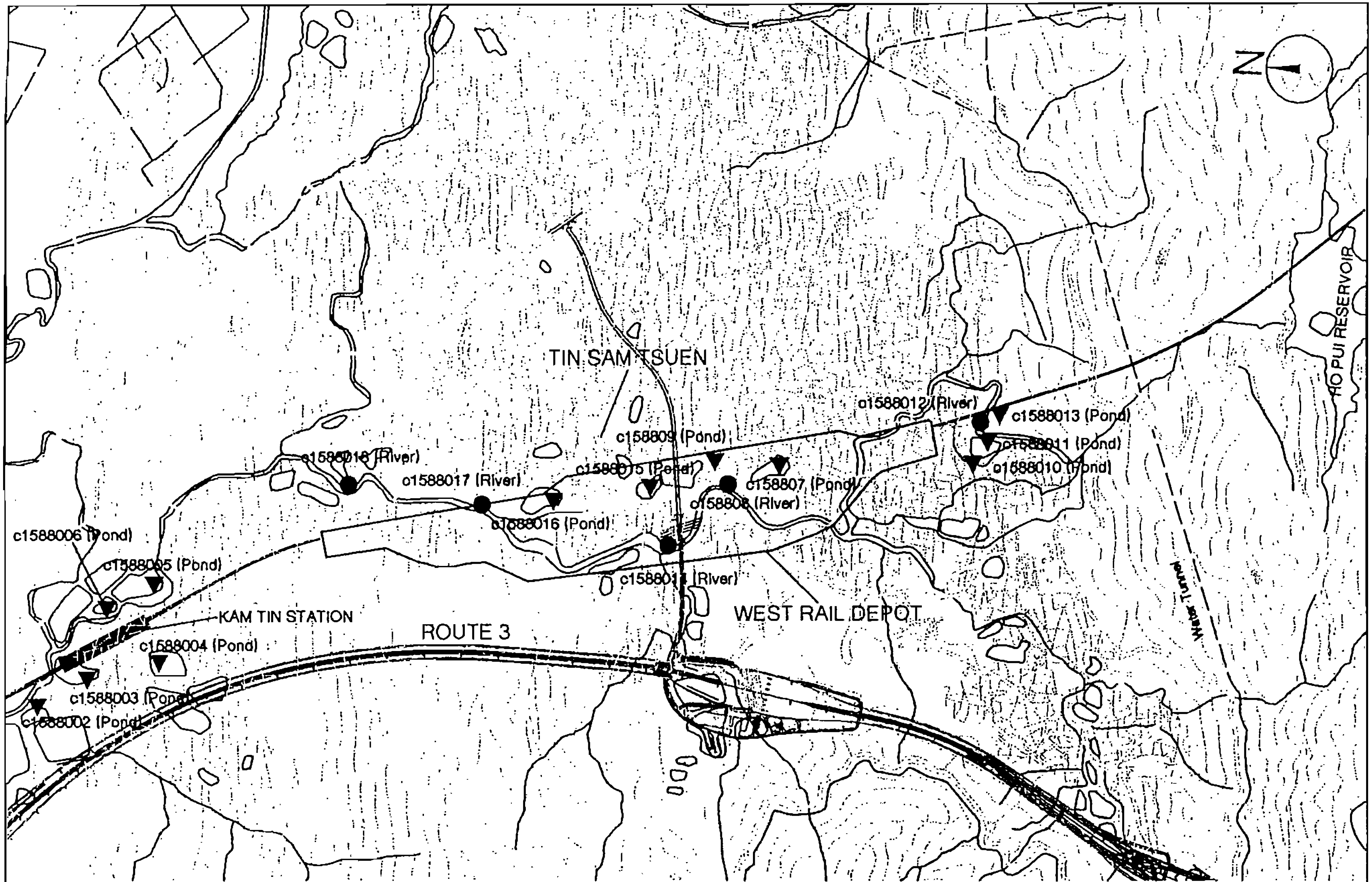
On average, up to four samples were taken from each pond and combined into one composite sample for testing purposes. For one larger pond near the headwaters of the Kam Tin River, eight samples were collected and combined into two composite samples. Where a clearly defined point source was observed in the field, such as a clear influent channel, a sample was taken at these points. Sediments were collected using a small dredge utensil from the shore or a short distance from shore. The locations of pond and river sampling points are shown on *Figures 7.11a and 7.11b.*

All samples were placed in laboratory-supplied sample jars, kept in a cooler with ice, and handled under chain of custody documentation. Analysis of the samples was undertaken by Australian Laboratory Services (ALS) in Hong Kong, and all samples were tested for the seven priority pollutant metals (Hg, Cu, Cr, Pb, Cd, Ni, Zn) to determine the extent of contamination.

The Results of the sediment sample analyses are presented in *Table 7.11d* below.

Table 7.11d Sediment Sample Results, Northern Section

Sample	Type	Cd	Cr	Cu	Ni	Pb	Zn	Hg	Classification
C001	River	0.09	2.9	13.0	0.9	10.4	47	<0.1	Class A
C002	Pond	0.10	5.0	4.8	1.6	41.7	73	<0.1	Class A
C003	Pond	0.07	3.6	7.7	1.2	27.3	40	<0.1	Class A
C004	Pond	0.23	7.9	17.4	3.9	62.7	109	<0.1	Class A
C005	Pond	0.13	4.3	6.0	1.4	32.2	152 (B)	<0.1	Class B
C006	Pond	0.111	5.9	5.1	2.0	49.9	102	<0.1	Class A
C007	Pond	0.04	4.4	2.7	1.0	35.7	48	<0.1	Class A
C008	River	0.71	13.5	62.9 (B)	6.7	28.0	297 ©	<0.1	Class C
C009	Pond	0.15	10.5	18.2	3.5	55.6	144	<0.1	Class A
C010	Pond	0.07	1.3	0.7	0.4	9.2	24	<0.1	Class A
C011	Pond	0.06	1.9	1.8	0.6	11.7	39	<0.1	Class A



● River Sample Location

▼ Pond Sample Location

SEDIMENT SAMPLE LOCATIONS

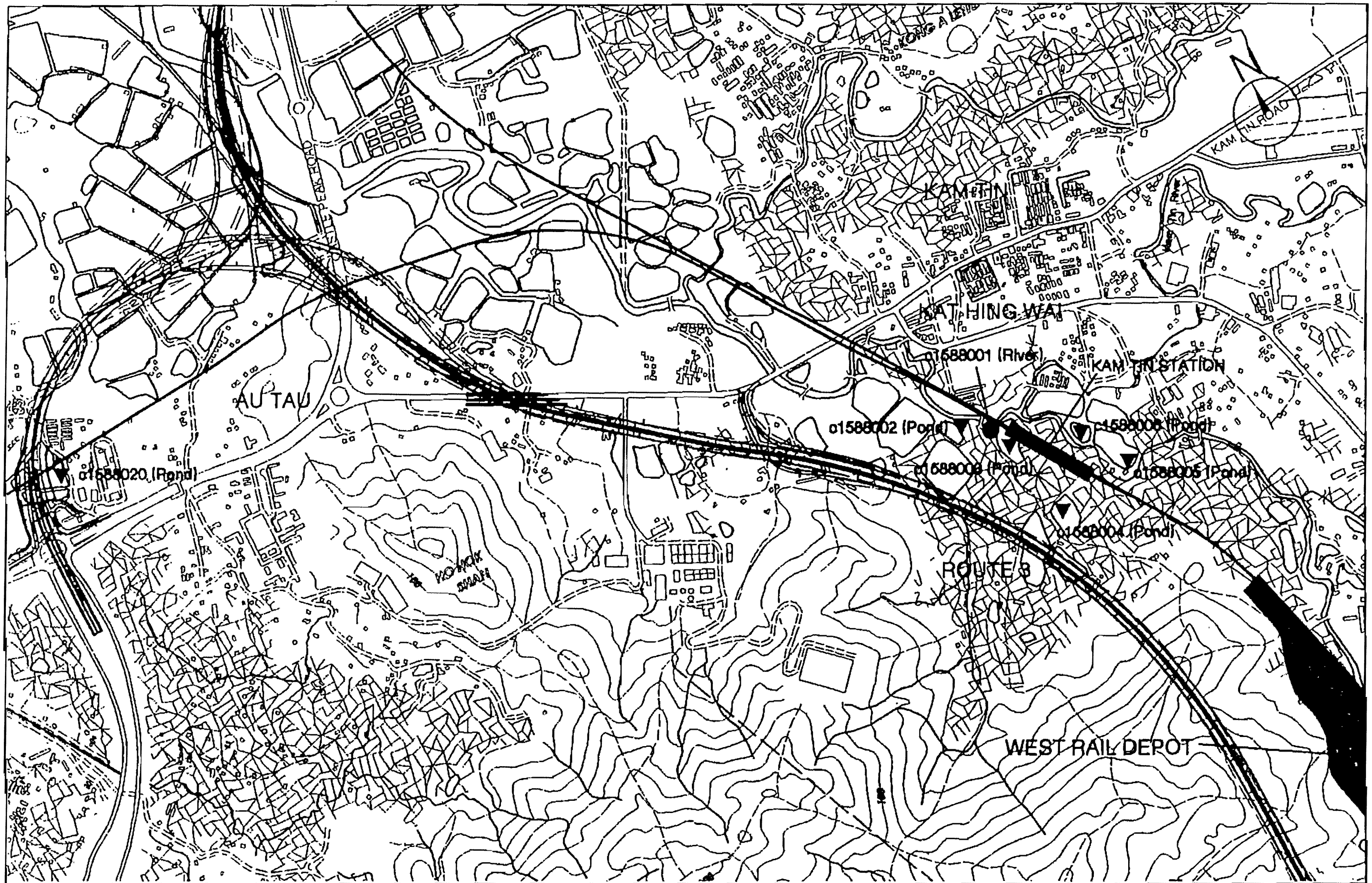
KAM TIN VALLEY

FIGURE 7.11a

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY



● River Sample Location

▼ Pond Sample Location

SEDIMENT SAMPLE LOCATIONS NEAR

KAM TIN

FIGURE 7.11b

ERM

KOWLOON - CANTON

RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

Sample	Type	Cd	Cr	Cu	Ni	Pb	Zn	Hg	Classification
C012	River	<0.04	1.3	0.9	0.4	7.2	20	<0.1	Class A
C013	Pond	0.06	3.2	1.9	0.7	15.6	31	<0.1	Class A
C014	Pond	0.50	2.2	14.3	0.7	13.8	32	<0.1	Class A
C015	Pond	0.36	10.7	33.7	4.6	113	428 ©	0.1	Class C
C016	Pond	0.15	6.8	6.1	2.1	45.6	106	<0.1	Class A
C017	River	0.52	7:6	159 ©	3.6	59.3	384 ©	<0.1	Class C
C018	Pond	0.05	1.6	4.9	0.4	6.5	27	<0.1	Class A
C020	Pond	0.17	10.3	23.9	4.2	26.1	126	<0.1	Class A

Note: mg/kg = milligrams per kilogram

Sample C019 was collected in Western Section. See discussion below.

<0.1 = Below specified level of reporting (LOR).

(B)= Concentration exceeds minimum standard for Class B classification for specified metal.

(C)= Concentration exceeds minimum standard for Class C classification for specified metal.

Preliminary analysis of 19 samples from the Kam Tin River and fish ponds indicates that the majority of the material is Class A. However, three of the samples collected from the footprint of the Depot were determined to be Class C and will require special disposal.

Based on the expected volumes, the likely disposal point for any contaminated material will likely be the WENT landfill site, under the direction of the EPD's Facilities Management Group. Although not officially designated, it is the only landfill site in Hong Kong that is likely to be able to accept small amounts of contaminated sediment. However, if the average daily volume of contaminated mud removed is higher than 1,000 m^3, the alternative of disposal to the East Sha Chau mudpits will need to be considered.

7.11.3.2 Groundwater Disposal

Requirements for disposal of contaminated groundwater are discussed in *Section 5.11.2.3*.

7.11.4 Evaluation of Impacts

Overall, land contamination impacts are not considered to represent a major concern during the construction of the Northern Section and Depot. However, based on the results of the pond and river sediment sampling programme, it is estimated that no more than 30% of this material will be contaminated or unsuitable for reuse, and require special handling and disposal. For the Kam Tin Station the KCRC has estimated that the amount of contaminated mud is 120,000 m^3. From the limited initial sampling programme significant concentrations of heavy metals were detected in only one pond sample (C005) 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 (C015) and two river samples (C008 and C017) 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.

7.11.5 Recommended Mitigation

Mitigation measures outlined in *Section 5.11.5* need to be adopted, where applicable, to minimise environment impacts associated with the development. Results of the sediment sampling and analysis programme indicates that some of the material is seriously contaminated and requires special handling and disposal (Class C). Further sampling and analysis prior to construction will enable volumes of contaminated materials to be more accurately estimated.

7.11.6 Residual Impacts

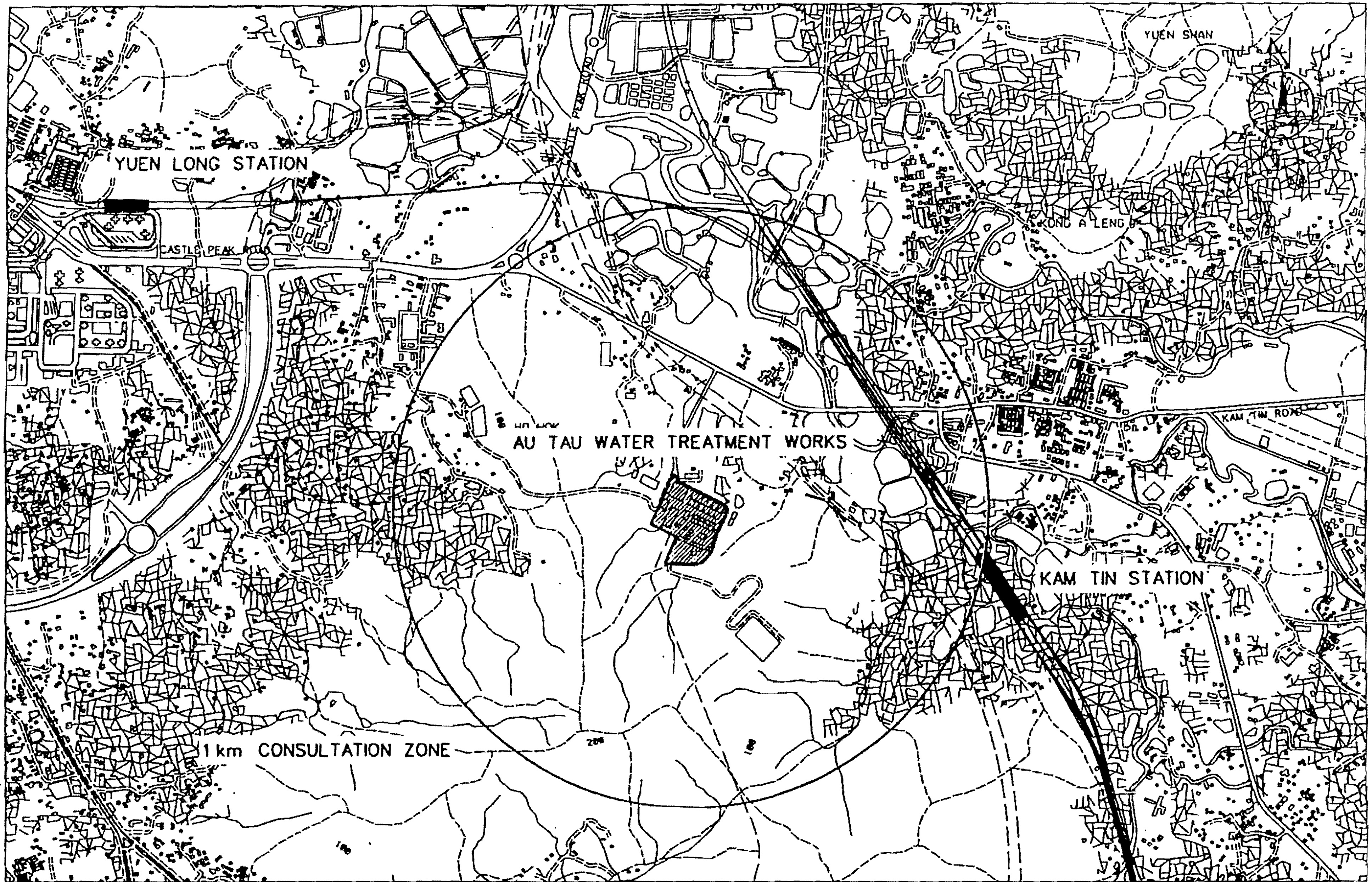
Based on the limited information available at this stage, the potential for major land contamination concerns in the Northern Section and West Rail Depot is not considered significant, provided that the appropriate mitigation measures are adopted.

7.12 Hazards

7.12.1 Background

The proposed alignment of the Northern Section passes within the Consultation Zone (CZ) of the Au Tau Water Treatment Works (WTW), as illustrated in *Figure 7.12a*. Au Tau WTW is located near Yuen Long in the New Territories. As the WTW uses and stores liquefied chlorine in 1 tonne drums it is classified as a Potentially Hazardous Installation (PHI). The basis for Hazard Assessments of developments falling within the CZ of PHIs is provided in *Chapter 11 of the Hong Kong Planning Standards and Guidelines*. A Hazard Assessment study is required to assess the risks to the population associated with the operation of West Rail and compare them with the Government's Risk Guidelines.

This section of the FAR presents a summary of the findings and conclusions of the Draft Au Tau Water Treatment Works Hazard Assessment undertaken by the consultants, which has been prepared as a separate report, and submitted to (and commented upon by) the Fire Services Department, Environmental Protection Department. Planning Department and Water Supplies Department.



LOCATION OF AU TAU WATER TREATMENT WORKS IN RELATION TO WESTRAIL INFRASTRUCTURE

SCALE: 1/18,000

FIGURE 7.12a

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

7.12.2 Objectives and Scope of Work

The objectives of the study were as follows:

- To identify the hazards to the population associated with West Rail operation due to the delivery, storage and handling of chlorine at Au Tau WTW;
- To carry out a Quantitative Risk Assessment (QRA) to evaluate the risks to the population associated with West Rail in both individual and societal terms, the latter presented as an F-N Curve (cumulative frequency vs. number of fatalities);
- To compare individual and societal risks with the Risk Guidelines, making reference to existing risk levels in the CZ of Au Tau WTW; and
- To identify and assess risk mitigation measures to ensure that risk levels are "as low as reasonably practicable" (ALARP) in accordance with the requirements of the Risk Guidelines.

The scope of the Hazard Assessment encompassed the travelling public using West Rail and the population associated with property development at Kam Tin station. Apart from the risk posed by Au Tau WTW itself, it is recognised that the transport of chlorine along public roads to Au Tau (and other) WTWs may pose a significant risk.. Although an assessment of off-site transport risks was outside the scope of this study, these were assessed in detail in the recently-completed Chlorine Transport Risk Study by the EPD.

7.12.3 Conclusions and Recommendations

The Hazard Assessment identified that levels of individual and societal risk at West Rail due to operations at Au Tau WTW comply with the requirements of the Guidelines. Therefore, there is no constraint posed on the alignment of West Rail as a result of its proximity to Au Tau WTW and no mitigation measures need to be considered.

Several recommendations were made to ensure that the risks to the proposed development will be as low as reasonably practicable. Firstly, the off-site Emergency Plan for Au Tau WTW should include arrangements for the external emergency services (in conjunction with KCRC) to stop trains from entering the affected area from either direction in the event of a chlorine release. Secondly, the following principles (which have already adopted in the outline scheme for the development of Kam Tin station) should be carried forward into the detailed design:

- Outdoor recreational facilities should be confined to podium level (18 metres above ground level);
- Ventilation intakes for the station, shops and offices should be located at as high a level as reasonably practicable;
- Residential blocks should be located above the level which could be significantly affected by a major chlorine release at Au Tau WTW (above approximately 20 metres); and

- The station concourse, shops and offices should be substantially enclosed areas.

8. THE WESTERN SECTION

8.1 Introduction

This section provides a brief description of the Western Section of West Rail, and an assessment of the environmental implications of its construction and operation. This assessment is based on the best information available regarding the design and construction of West Rail at the time of the assessment, using the standards, criteria and assessment methods and techniques outlined in *Sections 3* and *4*.

8.2 Alignment Description

The Western Section of the alignment extends generally westward and southward from the Yuen Long station to the proposed Tuen Mun Centre station. The Western Section includes proposed intermediate stations at Long Ping, Tin Shui Wai and Tuen Mun North. The entire 10 km of the Western Section is to be constructed on elevated structure, except for approximately 500 m each of at grade and embankment alignment to be constructed between Tuen Mun North and Tuen Mun Centre stations.

The development of the new railway will require the reprovisioning of the existing Pond Fish Market at Long Ping; the EIA of the reprovisioned market is presented in *Annex O*.

8.2.1 Construction Overview and Programme

Viaduct construction works will predominate on the Western Section. Viaduct construction will initially require bored piling and pilecap/column construction activities and associated plant. Sheetpiling activities will also be required immediately adjacent to roads and the Tuen Mun nullah. A precasting yard and up to three concrete batching plants are likely to be used to supply units for viaduct construction. Precast units will be segmentally launched using a launching truss.

8.3 Noise

This section addresses the noise impacts arising from the construction and operation of the Western Section of West Rail. Potentially affected NSRs are identified, noise impacts are predicted and assessed, and appropriate mitigation measures are formulated, following the methodology outlined in *Section 4*.

8.3.1 Baseline Conditions

8.3.1.1 Yuen Long to Long Ping

The major land uses close to the proposed alignment and Yuen Long station are residential and industrial uses. Low-rise village developments are located to the immediate north of the proposed Yuen Long station. Sun Yuen Long Centre and residential premises along Yuen Long On Lok Road are the closest sensitive receivers likely to be impacted during the construction and operational phases.

The noise climate is dominated by the traffic on Castle Peak Road and the road network in the Yuen Long area. Industrial premises within Yuen Long district and Tung Tau Industrial Area also contribute to the background noise level. Identified noise sensitive receivers (NSRs) are shown in *Figures 12* and *13* of *Annex A*.

8.3.1.2 Long Ping to Tin Shui Wai

Residential buildings and recreational areas are located in the region surrounding the proposed Long Ping station and the West Rail alignment from Long Ping to Tin Shui Wai. Traffic on Tin Fuk Road and Long Ping Road will be the dominant noise source in the area. The existing Light Rail Transit (LRT) railway also contributes to the background noise level.

Residential blocks in Long Ping Estate and Tin Yiu Estate are the nearest NSRs potentially affected during the construction and operational phases. Schools in the vicinity of the proposed alignment may also experience noise impacts from the construction activities, operational trains and fixed plant. *Figures 13* and *14* of *Annex A* present the identified NSRs in this area.

8.3.1.3 Tin Shui Wai to Tuen Mun North

From Tin Shui Wai to Tuen Mun North, major land uses in the vicinity of the proposed alignment and Tin Shui Wai station are residential buildings and village type developments. Background noise levels are mainly from traffic on Ping Ha Road, Castle Peak Road and Tuen Mun Road. Operational noise from the existing LRT line also contributes to the background noise.

The nearest sensitive uses close to the proposed railway which are likely to be affected during the construction and operational phases include Sha Chau Lei Tsuen, Shek Po Tsuen, village and low-rise developments in Tin Sam, Tsing Chuen Wai and Siu Hong Court. NSRs identified in this area are shown in *Figures 14 to 17* of *Annex A*.

8.3.1.4 Tuen Mun North to Tuen Mun Centre

Land uses in the area around the proposed stations in Tuen Mun North and Tuen Mun Centre, and the alignment in between, includes residential buildings, hospital, schools and recreation areas. The nearest residential developments which could be impacted by construction and operation include Brilliant Garden, Affluence Garden and Tai Hing Gardens. Tuen Mun Hospital and the schools in the vicinity of the alignment may also be affected.

The existing noise climate in the area is influenced by traffic noise from Tuen Mun Road, Pui To Road and Tsun Wen Road. The LRT railway also contributes to the background noise level. Identified NSRs in this section are shown in *Figure 18* of *Annex A*.

8.3.2 Construction Phase

8.3.2.1 Potential Sources of Impact

The Western Section starts at Yuen Long station and continues north-west and then south-west through the North West New Territories via Long Ping, Tin Shui Wai and Tuen Mun North stations, terminating at Tuen Mun Centre Station.

Major elements of the Western Section are:

- Stations at Yuen Long, Long Ping, Tin Shui Wai, Tuen Mun North and Tuen Mun Centre;
- Elevated viaduct sections from Yuen Long via Long Ping to Tin Shui Wai;
- Embankment sections between Tin Shui Wai and Tuen Mun North; and
- Elevated viaduct sections between Tuen Mun North and Tuen Mun Centre.

It is identified in the *Draft Technical Report, Construction Plan, Western Section, Halcrow, October 1997* that various worksites will be set up along the alignment. The major worksites are shown in *Figure 14 to 17* of *Annex A* and are listed below:

Kam Tin Station to Tin Ha Road

- Site WSE 7(A) and WSE 6 near Tin Shui Wai station;
- Site WSE 1(C) at Yuen Long station;
- Site WSE3, WSE 3(A), WSE 4, WSE 4(A) near Long Ping station; and
- Site WSE 2, WSE 5(A), 5(B) and 7(C) along the viaducts between Yuen Long and Tin Shui Wai.

Tin Ha Road to Tuen Mun Centre station

- Site WSW 5A, located between Castle Peak Road and Ng Lau Road;
- Site WSW 4 and site WSW 5B near Tuen Mun North station;
- Site WSW 7 and WSW 8 near Tuen Mun Central station;
- Site WSW 2(C) and 2(D) located along the embankment between Tin Shui Wai and Tuen Mun North;
- Work site at Area 35; and
- WSW 1 located along the viaduct between Tin Shui Wai and Tuen Mun Centre.

Sources of impact will include noise generated by construction activities such as site clearance, piling, substructure construction and station construction. It is expected that construction work will generally be restricted to normal daytime working hours.

8.3.2.2 Prediction of Impacts

Details of the likely construction activities and the appropriate construction plant teams have been provided by the engineering Design Consultants. These have enabled an inventory of SWLs to be identified for each component of the various plant teams, from which the total SWL for each plant team has been calculated. Noise levels have been predicted for the station and associated roadwork, and viaduct construction. Construction noise levels have been predicted for each of the main construction activities, using the methodology set out in the *Technical Memorandum on Noise from Construction Work Other than Percussive Piling* (TM2). Noise impacts have been predicted and are shown below in *Tables 8.3a* and *8.3b*. Assumed plant team inventories and detailed calculation are shown in *Annex B*.

Table 8.3a Predicted Noise Levels from Station and Associated Roadwork Construction

Station	Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Const'n	Column Const'n	Station Const'n	Roof Erect'n
Yuen Long	12/13	Sun Yuen Long Centre	86	88	90	89	90	85
	12/9	Ying Lung Wai	77	79	81	80	81	76
	12/15	Shung Tak School	89	91	93	92	93	88
Long Ping	13/60	Luen Fat House	82	84	86	85	86	81
	13/58	Fu Loy Garden	82	84	86	85	86	81
	13/50	Chun Kwong School	86	88	90	89	90	85
Tin Shui Wai	14/5	Tin Yiu Estate	85	87	89	88	89	84
	14/3	Pagoda (Sheung Cheung Wai)	80	82	84	83	84	79
	14/7	QE School	78	80	82	81	82	77
	14/6	Kwok Yat Wai School	91	93	95	94	95	90
Tuen Mun North	17/12	Yan Tze Tin Memorial College	76	78	80	79	80	75
	17/15	WSD Staff Quarters	76	78	80	79	80	75
	17/17	PLK Tin Ka Sing Siu Hong Kindergarten	74	76	78	77	78	73
	17/18	Siu Hong Court	74	76	78	77	78	73
	17/25	Tuen Mun Gov't Primary School	68	70	72	71	72	67

Station	Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Const'n	Column Const'n	Station Const'n	Roof Erect'n
Tuen Mun Centre	18/60	Ho King/Sun King /On Chuen Residential Building	83	85	87	86	87	82
	18/74	Kam Wah Garden	67	69	71	70	71	66

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

Table 8.3b Predicted Noise Levels from Viaduct Construction

Section	Fig/NSR No	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erection
Yuen long to Long Ping	12/16	Nam Pin Wai	82	83	86	85	82
	12/18	Kwan Lok San Tsuen	82	83	86	85	82
	12/29	Rainbow Mansion	86	87	90	89	86
	12/31	Tai Hing Building	75	76	79	78	75
	12/40	Yuen Long Estate	77	78	81	80	77
	12/41	Yuen Long Morning Light School	82	83	86	85	82
Long Ping to Tin Shui Wai	13/60	Luen Fat House	88	89	92	91	88
	13/63	Pok Oi Hospital TPK Memorial College	78	79	82	81	78
	13/65	Temple	78	79	82	81	78
	13/68	Fung Chi Tsuen	88	89	92	91	88
	13/70	Wing Ning Tseun	87	88	91	90	87
	13/72	Ha Mei San Tsuen	87	88	91	90	87
	13/71	Shing Tak School	78	79	82	81	78
	14/5	Tin Yiu Estate	83	84	87	86	83
	14/3	Pagoda (Sheung Cheung Wai)	81	82	85	84	81

Section	Fig/NSR No	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erection
Tin Shui Wai to Tuen Mun North	15/5	Tin Sam Tsuen East Village Houses	84	85	88	87	84
	16/9	Siu Kwong Yuen	84	85	88	87	84
	16/17	Lin Yuen Residential Area	77	78	81	80	77
	16/16	Hing Tak Public School	80	81	84	83	80
	16/24	Bank next to Fu Hong Home for the Aged	86	87	90	89	86
	16/23	Lee Ka Yuen Residential Area	86	87	90	89	86
	17/1	Chik Yuen Garden	76	77	80	79	76
	17/7	Tsing Lun Road Residential Area	83	84	87	86	83
	17/27	Tuen Mun Hospital	76	77	80	79	76
Tuen Mun North to Tuen Mun Centre	18/32	Tuen Mun Hospital Staff Quarters	87	88	91	90	87
	18/33	Affluence Garden	82	83	86	85	82
	18/34	The Church of Christ in China Lee Lai Fun Memorial Prevocational School	75	76	79	78	75
	18/45	Sun Hung Kai Residential Development	79	80	83	82	79

Note: Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

The Man Kei Factory is located away from the construction site and noise levels will be similar to those predicted at Yuen Long Estate. The Pagoda is not classified as a NSR, however, village houses surrounding the Pagoda were assessed. The Fung Chi Tsuen and

Shui Tin Tsuen will be exposed to similar noise impacts as Lun Fat House. Noise impacts at Tin Sam Tsuen and Tin Sam Tsuen East Village Houses will be similar. The Miu Fat Buddhist Monastery is located away from the West Rail alignment and will be exposed to lower noise impacts than the Lee Ka Yuen Residential Area.

8.3.2.3 Evaluation of Impacts

The above predictions indicate that unmitigated construction noise impacts will exceed the criteria at virtually all NSRs during most phases of the construction works, by up to 25 dB(A). A series of construction noise mitigation measures have been developed for this project and their effects on the predicted exceedances are discussed below.

8.3.2.4 Recommended Mitigation

The noise mitigation measures which could be applied to the construction works for the Southern Section have been described in detail in *Section 5.3*. These have been applied to the predictions given in *Tables 8.3a* and 8.3*b* to arrive at the mitigated noise levels for mitigation options M1, M2 and M3. The mitigated noise levels are shown in *Tables 8.3c* and *8.3d* below.

Table 8.3c Mitigated Noise Levels from Station and Associated Roadwork Construction

Station	Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Const'n	Column Const'n	Station Const'n	Roof Erect'n
Yuen Long	12/13	Sun Yuen Long Centre	79/79/74	85/83/81	87/85/81	86/84/78	87/84/81	78/77/75
	12/9	Ying Lung Wai	70/ -/ -	76/74/-	78/76/72	77/75/69	78/75/72	69/ -/ -
	12/15	Shung Tak School	82/82/77	88/86/84	90/88/84	89/87/81	90/87/84	81/80/78
Long Ping	13/60	Luen Fat House	75/ -/ -	81/79/77	83/81/77	82/80/74	83/80/77	74/ -/ -
	13/58	Fu Loy Garden	75/-/-	81/79/77	83/81/77	82/80/74	83/80/77	74/-/-
	13/50	Chun Kwong School	79/79/74	85/83/81	87/85/81	86/84/78	87/84/81	78/77/75
Tin Shui Wai	14/5	Tin Yiu Estate	78/78/73	84/82/80	86/84/80	85/83/77	86/83/80	77/76/74
	14/3	Pagoda (Sheung Cheung Wai)	73/73/ -	79/77/75	81/79/75	80/78/72	81/78/75	72/-/ -
	14/7	QE School	71/71/66	77/75/73	79/77/73	78/76/70	79/76/73	70/-/-
	14/6	Kwok Yat Wai School	84/84/79	90/88/86	92/90/80	91/89/83	92/89/86	83/82/80
Tuen Mun North	17/12	Yau Tze Tin Memorial College	69/-/-	75/73/68	77/75/71	76/74/68	77/74/69	68/-/-
	17/15	WSD Staff Quarters	74/ -/ -	75/-/ -	77/75/-	76/74/ -	77/74/ -	-/ -/ -

Station	Fig/NSR No	NSR Name	Site Clearance	Piling	Pile Cap Const'n	Column Const'n	Station Const'n	Roof Erect'n
	17/17	PLK Kindergarten	67/-/-	73/71/69	75/73/69	74/72/66	75/72/69	66/-/-
	17/18	Siu Hong Court	67/ -/ -	73/-/-	75/-/-	74/-/-	75/-/-	-/ -/ -
	17/25	Tuen Mun Gov't Primary School	-/-/-	-/-/-	69/-/-	68/-/-	69/-/-	-/-/-
Tuen Mun Centre	18/60	Ho King/Sun King /On Chuen Residential Building	76/76/71	82/80/78	84/82/78	83/81/75	84/81/78	75/74/ -

Note: Noise levels are shown for mitigation measures M1/M2/M3

Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are shown in bold (65 dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise

Table 8.3d Mitigated Noise Levels from Viaduct Construction

Section	Fig/NSR No	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erect'n
Yuen Long to Long Ping	12/16	Nam Pin Wai	75/ -/ -	81/80/76	83/81/77	82/80/77	77/77/77
	12/18	Kwan Lok San Tsuen	75/-/-	81/80/76	83/81/77	82/80/77	77/77/77
	12/29	Rainbow Mansion	79/79/74	85/84/76	87/85/78	86/84/81	81/81/81
	12/31	Tai Hing Building	-/ -/ -	74/-/ -	76/74/-	75/-/ -	70/ -/ -
	12/40	Yuen Long Estate	73/ -/ -	76/75/-	78/76/72	77/75/-	72/ -/ -
	12/41	Yuen Long Morning Light School	75/75/70	81/80/72	83/81/74	82/80/77	77/77/77
Long Ping to Tin Shui Wai	13/60	Luen Fat House	81/81/76	87/86/82	89/87/83	88/86/83	83/83/83
	13/63	Pok Hoi Hospital TPK Memorial College	71/71/66	77/76/72	79/77/73	78/76/73	73/73/73
	13/65	Temple	11/-/-	77/76/72	79/77/73	78/76/73	73/-/-
	13/68	Fung Chi Tsuen	81/81/76	87/86/82	89/87/83	88/86/83	83/83/83
	13/70	Wing Ning Tseun	80/80/75	86/85/81	88/86/82	87/85/82	82/82/82
	13/72	Ha Mei San Tsuen	80/80/75	86/85/81	88/86/82	87/85/82	82/82/82
	13/71	Shing Tak School	71/71/66	77/76/72	79/77/73	78/76/73	73/73/73
	14/5	Tin Yiu Estate	76/76/71	82/81/77	84/82/78	83/81/78	78/78/78
	14/3	Pagoda (Sheung Cheung Wai)	74/ -/ -	80/79/75	82/80/76	81/79/76	76/76/76

Section	Fig/NSR No	NSR Name	Site Clearance	Piling	Pilecap Const'n	Column Const'n	Beam Erect'n
Tin Shui Wai to Tuen Mun North	15/5	Tin Sam Tsuen East Village Houses	77/77/72	83/82/78	85/83/79	84/82/79	79/79/79
	16/9	Siu Kwong Yuen	77/77/72	83/82/78	85/83/79	84/82/79	79/79/79
	16/17	Lin Yuen Residential Area	70/ -/ -	76/75/ -	78/76/72	77/75/ -	72/ -/ -
	16/16	Hing Tak Public School	73/73/68	79/78/74	81/79/75	80/78/75	75/75/75
	16/23	Lee Ka Yuen Residential Area	79/79/74	85/84/80	87/85/81	86/84/81	81/81/81
	16/24	Bank next to Fu Hong Home for the Aged	79/79/74	85/84/80	81/85/81	86/84/81	81/81/81
	17/7	Tsing Lun Road Residential Area	76/76/71	82/81/77	84/82/78	83/81/78	78/78/78
	17/1	Chik Yuen Garden	69/ -/ -	75/ -/ -	77/75/ -	76/74/ -	71/ -/ -
	17/27	Tuen Mun Hospital	69/-/-	75/74/66	77/75/68	76/74/71	71/71/71
Tuen Mun North to Tuen Mun Centre	18/32	Tuen Mun Hospital Staff Quarters	80/80/75	86/85/81	88/86/82	87/85/82	82/82/82
	18/33	Affluence Garden	75/ -/ -	81/80/76	83/81/77	82/80/77	77/77/77
	18/34	The Church of Christ in China Lee Lai Fun Memorial Prevocational School	68/1/-	74/73/65	76/74/67	75/73/70	70/-/-
	18/45	Sun Hung Kai Residential Development	72/ -/ -	78/77/73	80/78/74	79/77/74	74/ -/ -

Note: Noise levels are shown for mitigation measures M1/M2/M3

Exceedances of the 75 dB(A) criterion for residential establishments and the 70 dB(A) criterion for educational establishments are s dB(A) during examination periods).

All levels specified are LAeq (30 min) dB unless stated otherwise.

8.3.2.5 Cumulative Noise Impacts

In general, construction works on different sites will not give rise to cumulative impacts due to distance separation and the orientation of individual NSRs. However, there are a few NSRs close to the boundary of station and viaduct construction worksites, Luen Fat House, Tin Yiu Estate and Sheung Cheung Wai, which could be affected by cumulative impacts of noisy activities occurring simultaneously at both sites.

At Luen Fat House, Tin Yiu Estate and Sheung Cheung Wai, cumulative construction noise impact from both Long Ping station and viaduct are expected. The mitigated noise levels from viaduct and station construction are similar and the predicted noise level will be increased up to 3 dB(A), above the predicted level in the tables, if construction works from both sites are running in parallel. The resulting noise levels at Luen Fat House, Tin Yiu Estate and Sheung Cheung Wai would be increased to 84, 82 and 79 dB(A) respectively.

The NSRs at Tin Shui Wai may also be impacted by construction of the development in the area. However, construction works on both sites will not give rise to cumulative impacts due to their distance separation and the orientation of individual NSRs. Moreover, the NSRs are located close to the West Rail worksite with separation of more than 100 m from the Tin Shui Wai development site. It is, therefore, expected that the cumulative noise levels from the West Rail and Tin Shui Wai development, will be similar to the noise level of the West Rail.

8.3.2.6 Residual Impacts

The proposed package of mitigation measures has had limited success in reducing noise levels to within the daytime criteria. There remain many exceedances during viaduct and station construction even with the proposed package of mitigation measures. There are residual exceedances of up to 9 dB(A) above the criterion for residential properties, and 16 dB(A) above the criterion for educational establishments.

Worst case scenarios have been assumed for plant team activities and, if necessary, the predicted noise level could be further reduced by limiting the on-time period or number of items of noisy plant operating at one time. It is suggested that the number of mixer lorries within each work site should be limited to one, with a movable barrier at the loading and unloading area during pilecap and column construction. If the following measures are also applied, it should reduce the noise impacts at all NSRs to within the established criteria, except at two schools which are discussed further below.

Table 8.3e Additional Mitigation Measures

Work Area	Construction Activity	Percentage on time in any 30 minute period	No of Noisy Plant
Yuen Long Station	Piling	80%	-
	Pilecap Const'n	55%	-
	Column Const'n	50%	-
	Station Const'n	35%	-
Long Ping Station	Piling	50%	-
	Pilecap Const'n	55%	-
	Column Const'n	50%	-
	Station Const'n	35%	-
Tin Shui Wai Station	Piling	65%	-
	Pilecap Const'n	70%	-

Work Area	Construction Activity	Percentage on time in any 30 minute period	No of Noisy Plant
	Column Const'n	60%	-
	Station Const'n	50%	-
Tuen Mun North Station	Pilecap Const'n	90%	-
Tuen Mun Centre Station	Piling	50%	-
	Pilecap Const'n	50%	-
	Column Const'n	55%	-
	Station Const'n	50%	-
	Roof Erection	35%	-
Yuen Long to Long Ping	Piling	65%	-
	Pilecap Const'n	45%	-
	Column Const'n	75%	-
	Beam Erection	65%	-
Long Ping to Tin Shui Wai	Site Clearance	70%	-
	Piling	45%	-
	Pilecap Const'n	30%	-
	Column Const'n	30%	-
	Beam Const'n	40%	Stressing rig should not be operated with other PMEs
Tin Shui Wai to Tuen Mun North	Piling	65%	-
	Pilecap Const'n	40%	-
	Column Const'n	30%	-
	Beam Const'n	50%	Stressing rig should not be operated with other PMEs
Tuen Mun North to Tuen Mun Centre	Piling	65%	-
	Pilecap Const'n	40%	-
	Column Const'n	40%	-
Depot Const'n	Beam Const'n	50%	Stressing rig should not be operated with other PMEs

Note: During pilecap and column construction, number of mixer lorries should be limited to one, with movable barrier at the loading and unloading area.

Even with the above mitigation measures, it is expected that up to 10 dB(A) exceedance will still be experienced at some education establishments. It is predicted that the resultant noise levels at the Shung Tak School and Chun Kwong School will be 78 dB(A) and 81 dB(A) respectively, even with these additional mitigation measures.

It is suggested that 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 give an additional mitigation of up to 15 dB(A) to the affected schools to satisfy the noise criterion at the school. A more stringent noise requirement of 65 dB(A) is applicable for educational institutions during examination periods. The provision of secondary glazing and air conditioning should be sufficient to achieve the necessary mitigation. However, it may still be desirable for noisy construction activity to be scheduled outside the examination period.

8.3.2.7 Conclusions

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 more sensitive receivers are still impacted. It is suggested that remaining exceedances of the established criteria are reduced by application of indirect mitigation measures which should result in compliance of construction noise levels.

If the measures recommended above are all implemented, no serious noise impacts are expected from construction of the Western Section.

8.3.3 Operational Phase

8.3.3.1 Fixed Plant Noise

8.3.3.1.1 Potential Sources of Impact

For the purposes of this assessment, it is assumed that ventilation facilities are not required in the Western Section. One traction power feeder station will be provided at Tin Shui Wai. The feeder station will be located within a site at the junction of Long Tin Road/Tin Tze Road and Tin Fuk Road. According to information supplied by KCRC in the *West Rail Operations & Maintenance Plan*, three 132/25 kV transformers will be installed in each feeder station but only two of these will be operational at any one time. The site for this traction power feeder station is to be shared with the LRT. Considerations have been given only to West Rail related operations in this assessment. Allowance has, however, been made for other potential noise sources in the vicinity through the selection of appropriate criteria.

Two substations consisting of one and five transformers will also be required at Tin Shui Wai Station. These will be located to the eastern end and western end of the station, respectively.

8.3.3.1.2 Prediction of Impacts

The noise specifications for each potential source of fixed plant noise have been determined by considering the maximum allowable sound power level for each source to achieve compliance with the HKPSG criteria at the closest NSR, allowing a correction factor for distance, tonality and facade reflection.

The HKPSG suggests that noise criteria for fixed plant should be 5 dB below the appropriate Acceptable Noise Levels (ANL) specified in TM4. This level was therefore taken as the maximum allowable level at the NSR. One NSR, the Housing Authority Development Tin Shui Wai Area 13 phase I, was identified as being likely to be exposed to noise from the Traction Sub-Station at the junction of Long Tin Road/Tin Tze Road and Tin Fuk Road. This NSR was given an Area Sensitivity Rating 'C', therefore the criterion adopted is $L_{Aeq\ (30\ minutes)}$ 55 dB(A). Although the closest NSRs to the two substations are schools, these are not considered as night-time noise sensitive. The NSRs which will limit the maximum SWL of the sub-stations will be the closest residential dwellings which are as follows; HOS development at Tin Shui Wai and Tin Yiu Court which have been assigned an ASR of 'C' and 'B' respectively.

Table 8.3f below presents the maximum allowable sound power level for each of the fixed plant installations which will be required to meet the HKPSG criteria.

Table 8.3f Calculated Maximum Permissible Levels of Fixed Plant Noise

Fixed Plant Noise Source	Nearest Night-time NSR	Area Sensitivity Rating	Night-time Criteria $L_{Aeq\ (30\ minutes)}$ dB	Distance to NSR, m	Maximum Allowable SWL of Source, dB
Feeder Station at the junction of Long Tin Road/Tin Tze Road and Tin Fuk Road	Figure 14 NSR1 Housing Authority Development Tin Shui Wai Area 13 Phase I	B	50	50	89
Substation at the Eastern End of Tin Shui Wai Station	Figure 14 NSR2 Tin Yiu Court	B	50	70	93
Substation at the Western End of Tin Shui Wai Station	Figure 14 NSRC1 HOS Development in Tin Shui Wai	C	55	150	104

Provided that the above allowable sound power levels can be met, no impacts are likely.

8.3.3.1.3 Recommended Mitigation

Noise from the traction sub-stations can be minimised by providing acoustic enclosures around transformers, particularly any cooling fans and ensuring that all equipment is maintained in good working condition.

8.3.3.1.4 Residual Impacts

Past experience suggests that conventional plant can achieve the noise performance requirements derived above, provided the mitigation measures outlined above are adopted. The plant specifications contained within contractual and procurement documentation shall include explicit reference to these performance criteria.

8.3.3.2 Train Operational Noise

8.3.3.2.1 Introduction

The criteria for the assessment of noise from normal train operations are discussed in *Section 3.2.2*. In using criteria based on the Technical Memorandum (TM), the relevant criterion noise level depends on the time of day and the Area Sensitivity Rating (ASR) of the NSR. For this track section, based on the proposed timetable for years 2006-2011, it is proposed that up to 20 trains per hour would operate in each direction. However, the most critical time period for assessment is the hour 0600-0700, when it is proposed that 15 trains per hour would operate in each direction (ie 30 'train movements'). This period falls within the "night-time" period specified in the TM, and as a consequence has a lower specified noise level criteria.

The criteria which are required to be met in this period are 55 dB(A) $L_{eq,30\text{-}min}$ for areas with a ASR of B and 60 dB(A) $L_{eq,30\text{-}min}$ for ASR C.

An additional criterion is that the maximum level of a train passby should not exceed 85 dB(A). L_{max} levels were also calculated as described in *Section 4.4* and compared with this criterion. However, as demonstrated in the Initial Assessment Report, in all cases the relevant criterion in terms of $L_{eq,30\text{-}min}$ will be the more stringent, such that if this was met, the L_{max} criterion will also be met.

8.3.3.2.2 Prediction of Impacts

In the Western Section, a total of 442 NSRs have been identified as potentially being affected by noise from train operations. A complete listing of modelling locations is given in *Annex D* and these are shown on *Figures D14* to *D18* together with the boundary of West Rail.

A computer model of the track was constructed in order to provide accurate calculation of noise levels at each of these NSRs. The model incorporates the entire length of both the up and down tracks, using co-ordinates of the track centres provided by KCRC at 20 m intervals. From these co-ordinates, the alignments of noise sources representing the inboard and outboard plena and the structure-radiated noise from the viaduct were generated. In addition, barrier alignments were generated at the position of the top of the standard walkway barrier. Horizontal offsets from the track centres and vertical offsets from top of rail which were used in generating these alignments as shown in *Table 8.3g* below.

Table 8.3g Schedule of Offsets from Track Centre used to generate Noise Source and Barrier Alignments

Alignment	Horizontal Offset, m*	Vertical Offset, m
Outboard plenum gap	1.625	0.98
Inboard plenum gap	-1.625	0.98
Viaduct radiated noise	0	-2
Standard barrier, double track	3.35	2.08
Standard barrier, single track	3.15 and -3.15	2.08

*Positive offset refers to the outboard side

For each 20-metre section of each noise source, information supplied by KCRC was used to determine the train speed (which differs for the up and down tracks) and the track curvature, which determines the width of the plenum gap. These values were then used to determine a correction to the basic noise spectrum for that source, as described in *Section 4.4.2.4.1*.

For each NSR, the model calculates the contribution of each section of each noise source to the total L_{eq} noise level, taking account of the noise emission level, distance and, for the plenum gap sources, attenuation due to any barriers which break line-of-sight to the source. Barrier attenuation is calculated using the standard Maekawa point-source formula, with correction for a line source effectively being carried out through the numerical integration which is implicit in the modelling process. Conversion from maximum noise levels to L_{eq} levels is carried out as described in *Section 4.4.2.4.1*. To provide a conservative assessment, attenuation due to atmospheric absorption and the ground effect are neglected.

Finally, total L_{eq} noise levels are calculated by summing the levels from the outboard plenum gap, inboard plenum gap and viaduct radiated noise, and compared with the relevant criterion for each NSR.

Where NSRs represent high-rise buildings, it is not obvious which level will be most affected by noise, since at higher levels the barrier attenuation decreases, but the distance from the source increases. For this reason, where the maximum height of an NSR is greater than 40 m above the ground, calculations were carried out at 20 metre intervals down from the top of the building to determine the most-affected location.

Annex D shows results of the above analysis, incorporating all mitigation measures described in *Section 4.4.2.4.1*, with the edge barriers being the basic barrier at 1.2 m above the walkway on each side of the viaduct.

8.3.3.2.3 Recommended Mitigation

From *Annex D*, there are a total of 33 NSRs at which the calculated L_{eq} noise level exceeds the relevant criterion. These are located at San Sang Tsuen, Yick Yuen Tsuen and exceedances here are due to a combination of high train speed, low criterion levels and the fact that the alignment is relatively low in relation to the surrounding NSRs.

At these NSRs, noise levels can be brought to within the NCO criteria by the use of additional edge barriers on the side of the viaduct or track structure. The additional barriers required, and their heights, are shown in *Table 8.3h.*

Table 8.3h Twelve-car train - Additional Barriers Requirements

Start Chainage	End Chainage	Height Above Basic Level, m	Notes
Up Track Side:			
27660	27840	1.5	
27840	27920	2	
27920	28080	2.5	
28080	28280	1.5	
28440	28540	2	
28540	28580	2.5	
28580	29160	2	
32200	32260	1	Near TMC
32260	32300	2	
32300	32400	3	
Down Track Side:			
23600	23820	1.5	West of LOP
27400	27440	1	
27440	27520	1.5	
27520	27720	1	
27980	28280	2	
28400	28480	1	
28480	28620	2	
28620	28880	1	

Having extensively researched structure-borne and airborne noise control measures, the result of this focussed six month study is the detailed specification of the noise barriers, the Multi-plenum system, resilient baseplates, floating slab track and structural enhancement. As a result, no properties will receive residual impacts from a total estimated number of 65 in the IAR with the barrier specification given in *Table 8.3h* above.

As a result, KCRC will not be required to offer 'at-receiver' mitigation measures.

The above analysis does not take account of noise associated with crossovers. On this section of the line, five locations have been identified where this noise source requires additional amelioration. Due to the potential for airborne noise radiation from these locations, it is generally necessary to fully enclose the track for some distance around them, using absorptive lining in the enclosed section. A lining of 45 mm Pyrok, as recommended for lining of the under-walkway plenum, has been assumed.

Noise levels at the nearest NSR were calculated as described in *Section 4.4.2.4.1,* taking account of train speed and distance. The extent of enclosure required to meet the relevant criterion at this NSR was then calculated. Results are shown in *Table 8.3i* below.

Table 8.3i Enclosures Required for Cross-Overs

Crossover Location	Extent of Enclosure
Approx ch. 25800-25900 (near TIS)	Enclosure not required - 1 m additional barrier height on outboard side, both tracks, 50 m each side of crossover
Approx ch. 26400-26600	To 15 m each side of crossover
Approx ch. 29950-30050	To 40 m each side of crossover
Approx ch. 30100-30200	To 25 m each side of crossover
Approx ch. 31900-32100	To 20 m each side of crossover

8.3.3.2.4 Mitigation Required Immediately On Start-Up

The above mitigation measures are designed to ensure that noise levels are within the relevant criteria at full predicted usage of the rail system - that is, 15 twelve-car train movements in each direction between 6 am - 7 am, which represents the most critical time period. Immediately on opening the systems, it is proposed to use the same timetable as for full operations, but to use only eight-car trains. This has the effect of reducing the L_{eq} noise level by 1.8 dB(A), although maximum noise levels close to the track would be almost unaffected.

The barriers which are required, and their heights for operation of an eight car train, are shown in *Table 8.3j* below.

Table 8.3j Start Up - Location of Additional Barriers

Start Chainage	End Chainage	Height Above Basic Level, m	Notes
Up Track Side:			
27660	27840	1	
27840	27920	1.5	
27920	28000	2	
28000	28280	1.5	
28480	28720	2	
32260	32300	1	Near TMC
32300	32400	2	
Down Track Side:			
27980	28280	1	
28480	28620	1	

The barriers listed in *Table 8.3j* above could, if desired, be increased to the length indicated in *Table 8.3h* when twelve-car trains were brought into service.

Enclosures of approximately the same size as those described in *Table 8.3k* above would still be required to protect adjacent NSRs. Given the difficulties involved in adding additional length to such structures, it would appear more appropriate to construct them to the full required length from the beginning of operations.

8.3.3.2.5 Mitigation for Future NSRs

While the above mitigation measures will ensure that noise levels are within relevant criteria at all existing NSRs, the possibility of future noise-sensitive development close to the track has also been considered. The requirements for noise mitigation for such future development cannot be set out precisely, as they depend on the location of the development, its height and the ASR that would be assigned under the NCO.

To assess the potential for operational noise from the railway to affect possible developments, five locations were selected along the track, representing the range of track speeds and other operational conditions which exist in this section. At each location, noise levels were calculated at hypothetical NSRs with various heights, situated at various distances from the track. These levels were then used to determine the minimum distance from the track at which an NSR could be located in order to comply with criteria of 55 dB(A) L_{eq} (ASR B) and 60 dB(A) L_{eq} (ASR C) for the hour 0600-0700. Calculations were then repeated with additional edge barrier heights of 2 m and 4 m, to determine the effect of these barriers on the minimum allowable distance.Results from this analysis are presented in *Tables 8.3k* and *8.3l*.

Table 8.3k Minimum Distance from nearest Track to New NSR, to meet criterion of 55 dB(A) L_{eq}

Chainage	Description	Building Height, m	Additional Edge Barrier Height, m 0	2	4
32000	N of TMC	10	15	10	10
		50	55	40	35
		90	55	40	35
		130	55	40	35
29500	Viaduct N of TMN	10	12	10	10
		50	120	70	45
		90	120	95	65
		130	120	95	65
25000	Twin Viaduct	10	10	10	10
		50	50	20	15
		90	75	35	15
		130	75	40	15
23000	E of LOP	10	10	10	10
		50	30	10	10
		90	30	10	10
		130	30	10	10

Table 8.3l Minimum distance from nearest track to new NSR to meet criterion of 60 dB(A) L_{eq}

Chainage	Description	Building Height, m	Additional Edge Barrier Height, m 0	2	4
32000	N of TMC	10	10	10	10
		50	10	10	10
		90	10	10	10
		130	10	10	10
29500	Viaduct N of TMN	10	10	10	10
		50	30	25	10
		90	30	25	10
		130	30	25	10
25000	Twin Viaduct	10	10	10	10
		50	20	10	10
		90	20	10	10
		130	20	10	10

Chainage	Description	Building Height, m	Additional Edge Barrier Height, m 0	2	4
23000	E of LOP	10	10	10	10
		50	10	10	10
		90	10	10	10
		130	10	10	10

From *Table 8.31* it is clear that if the ASR for a new development is C, then, in most cases, buildings of any height could be located quite close to the track. With the addition of 4 m edge barriers, buildings of any height could be located up to 10 m from the track at any of the selected locations.

On the other hand, to meet the noise requirements for ASR B, relatively tall buildings may need to be set back up to 120 m from the track. Even with 4 m additional edge barriers, this required setback may be reduced only to 65 m. Low-rise buildings, however, could be located up to 10 m of the track after the provision of 2 m high edge barriers.

The structural design of the viaduct has been specified to accommodate high sided barriers and sections of full enclosure of a limited length up to 230 m. The length of any enclosure required is limited by safety and ventilation requirements.

The Multi-plenum System will always provide greater attenuation than a mitigation solution based solely on noise barriers and, as such, the application of the System will effectively reduce overall barrier heights and consequent visual intrusion. In line with the commitment given to Government by the Corporation, the Multi-plenum System provides the flexibility for future enhancement as edge wall barrier heights can be incrementally extended for increased noise attenuation from 1.2 m upto full enclosure. This will provide Government with greater flexibility in the long term land use planning of the areas through which West Rail passes and will facilitate, as yet uncommitted, development to be considered in much closer proximity to the railway than would otherwise be the case.

8.3.3.2.6 Conclusions

Based on the package of mitigation measures specifically designed for West Rail, there will be no residual exceedances on start up of operations and during full operations in the design year in the western section.

For future development close to West Rail, additional barriers can be applied to minimise as far as practicable the set back. At the indicative locations considered in this assessment for future high rise development, a maximum set back distance of 10 m and 65 m for ASR C and ASR B respectively would be required with a maximum practicable barrier height of 4 m.

The package of mitigation measures incorporating the multi-plenum system and structure borne noise control is considered to represent the maximum practicable level of noise reduction for West Rail.

8.4 Air Quality

8.4.1 Construction Phase

8.4.1.1 Baseline Conditions

8.4.1.1.1 Yuen Long

The land uses in the Yuen Long area are mainly residential, with housing estates including Yuen Long Estate, Long Ping Estate and Shui Pin Wai Estate. The residential areas located to the north of Yuen Long On Lok Road and Ma Wang Road are mainly village houses. According to the *Traffic Census 1996*, the average annual daily traffic flows of major roads in the area are 50,060 vehicles for Yuen Long On Lok Road & Long Yip Street, 16,150 vehicles for Wang Lok Street, and 24,250 vehicles for Wang Tat Road & Ma Wang Road. The vehicular emissions from these roads are the main source of air quality impacts in the study area. Industrial emissions at the Tung Tau Industrial Area will also affect the background air quality.

8.4.1.1.2 Tin Shui Wai

Tin Shui Wai is a newly developed district and many of the housing estates and associated facilities are still under construction. Fugitive dust generated from construction works sites contributes to the background dust levels. Some open space in Tin Shui Wai is currently used for container storage and the main roads of the areas are Tin Ying Road, Ping Ha Road, Tin Fuk Road and Tin Tsz Road. Currently, the vehicular emissions and construction dust are the main sources of air quality impact in the area. The duration of the construction work will be limited and air quality in the Tin Shui Wai area will be dominated by vehicular emissions after the construction works are completed.

8.4.1.1.3 Tin Shui Wai to Tuen Mun

Between Tin Shui Wai and Tuen Mun, the majority of land is used for agriculture, fish ponds and scattered villages. The roads in this area are mainly for local access, namely Ping Ha Road and Shek Po Road. No major air pollutant emissions are identified in the area and the air quality is mainly affected by local access roads.

8.4.1.1.4 Tuen Mun

In the Tuen Mun area, the land uses are a combination of residential, industrial and recreational. Industrial uses in Tuen Mun are concentrated in the Tai Hing area in the northern part of the town. Air quality in the vicinity of the industrial area is dominated by industrial emissions. Tuen Mun Road, Castle Peak Road and Tsing Tin Road are the main roads in the Tuen Mun area. Traffic on these major roads also contributes to the existing background air quality. Given the distance between Tai Hing and the study area, the influence of industrial emissions on the background air quality will be limited. The annual averaged TSP level measured at the Yuen Long air quality monitoring station in 1996 was 100 $\mu g\ m^{-3}$.

8.4.1.2 Potential Sources of Impact

The principal potential source of air quality impacts arising from the construction of the alignment and stations will be fugitive dust. Although powered mechanical equipment, such as air compressors and generators will be used, the number of items required will be limited. Therefore, together with good house-keeping and regular maintenance, the exhaust emissions from these items of plant will be small and not result in adverse impacts.

The Western Section of West Rail will be constructed almost entirely on viaduct with a small at grade and embankment section between Tuen Mun North and Tuen Mun Centre stations. Construction activities for viaduct sections involve excavation during site preparation, construction of foundations by bored piling and construction of the viaduct deck. The main dust source will be from materials hauling and transport from excavation works during site preparation. During the foundation and viaduct deck construction, excavated material from bored piling activities will have a high moisture content and the viaduct deck will be pre-cast. Therefore, dust impacts from materials handling will be limited. It is likely that excavated materials will be taken off site by lorry and hence impacts from haul road dust are anticipated.

The locations of the major worksites for the Western Section are described in *Section 8.3.2.*

Concrete batching plants should they be sited within the construction worksites are potential fugitive dust sources, however, it is uncertain whether this will eventuate as existing infrastructure in the area is good and final siting of these plant may be left up to the contractor. Construction of stations will require excavation which would be likely to cause air quality impacts on the surrounding environment. The volume of material handled, capacity of batching plants for the Western Section and the traffic flows generated for the work sites have been predicted in the *Traffic and Transport Planning Report, Section F - Construction TIA and Traffic Management Plan, Draft Technical Report, Western Section, Halcrow, October 1997* and are summarised in *Table 8.4a.*

Table 8.4a Earth Quantities and Volume of Truck Traffic for the Work Site

Worksite	Duration (days)	Material Export (m³)	Material Import (m³)	Material Handling Rate (m³/day)	Batching Plant Production Rates (m³/day)	Traffic Flow (veh/day) (1)
Yuen Long Station (WSE 1C)	180	-	84,000	467	333	183
Long Ping Station (WSE 3,3A)	240	52,500	-	219	219	88
Tin Shui Wai Station (WSE 6,6A)	240	100,000	-	417	417	168
Tuen Mun North Station (WSW 4)	200	175,000	-	875	500	259
Tuen Mun Centre Station (WSW 7,8)	120	100,000	-	833	625	298
Viaduct Section (WSE 2, 3A)	186	16,000	-	86	86	27
Viaduct Section (WSW 2C, 2D)	186	-	25,000	134	-	14
Viaduct Section (WSW 1, 3 3A , 6)	186	12,000	-	65	-	186

(1) Based on assume working day of 10 hours.

8.4.1.3 Prediction of Impacts

ASRs have been identified according to HKPSG and the APCO guidelines, and are presented in *Annex A*. The predicted cumulative 1-hour and 24-hour TSP levels arising from the construction works of the stations and associated roadworks and viaduct for the Western Section, including materials handling, trucks haulage and batching plant, at the nearby representative ASRs under the worst meteorological conditions are shown in *Table 8.4b*.

The Yau Tze Tin School is located adjacent to Siu Hong Court and air quality impacts will be similar. The Man Kei Factory is located away from the construction sites and will receive lower impacts than Yuen Long Estate.

Table 8.4b Predicted Cumulative 1-hour and 24-hour TSP Levels

Area	Fig/ASR No	ASR Name	1-hour TSP Level	24-hour TSP Level
Yuen Long (YUL)	12/2	Small Traders New Village Public School	489	263
	12/3	Pok Oi Hospital	563	293
	12/6	Small Traders New Village	723	362
	12/9	Ying Lung Wai	930	446
	12/13	Sun Yuen Long Centre	1840	831
	12/15	Shung Tak School	1840	825
	12/16	Nam Pin Wai	1476	678
	12/18	Kwan Lok San Tsuen	982	468
	12/31	Tai Hing Building	866	419
	12/40	Yuen Long Estate	890	432
	12/41	Yuen Long Morninglight School	849	412
	13/58	Fu Loy Garden	699	350
	13/68	Fung Chi Tsuen	758	374
	13/70	Wing Ning Tsuen	495	265
	13/71	Shing Tak School	358	209
	13/72	Ha Mei San Tsuen	1231	571
Tin Shui Wai (TIS)	14/3	Pagoda	932	375
	14/5	Tin Yiu Estate	1117	527
	14/6	TMGH's Kwok Yat Wai Prevocational School	755	375
	14/7	Industrial uses along Hung Tin Road	1222	571
	14/12	Village House to the south of Sha Chau Lei Tsuen	475	256
	15/1	Shek Po Tsuen	585	302
	15/4	Galore Garden	432	238
	15/5	Village Houses to the East of Tin Sum Tsuen	471	255
	15/8	Low-rise residential area, south of Tin Sum Tsuen	619	318
	16/9	Siu Kwong Yuen	954	459
	16/16	Hing Tak Public School	363	210
	16/17	Lin Yuen	856	415

Area	Fig/ASR No	ASR Name	1-hour TSP Level	24-hour TSP Level
	16/22	Miu Fat Buddist Monastery	**763**	**378**
	16/23	Lee Ka Yuen and Residential Use in surrounding area	**1717**	**774**
	16/24	Bank next to Fu Hong Home for the Aged	**2617**	**1157**
Tuen Mun Centre (TMC)	17/1	Chik Yuen Garden	**2455**	**1081**
	17/7	Residential use along Tsing Lun Road	**2381**	**1051**
	17/15	WSD staff Quarters	**829**	**404**
	17/18	Siu Hong Court	**1412**	**651**
	18/32	Tuen Mun Hospital Staff Quarter	**1912**	**861**
	18/33	Affluence Garden	**1514**	**694**
	18/34	The Church of Christ in China Lee Lai Fun Memorial Prevocational School	**805**	**394**
	18/45	Residential development by Sun Hung Kei	**1260**	**583**
	18/60	Ho King Building/Sun King Building/On Chuen Building/Bit Hing Building	**3189**	**1397**
	18/74	Kan Wah Garden	**783**	**385**
	18/76	Tuen Mun Town Park	**1135**	**535**

Exceedance of TSP criteria are shown in bold

Includes background TSP Levels

Units in $\mu g/m^3$

8.4.1.4 Evaluation of Impacts

The predicted 1-hour and 24-hour TSP levels at the representative ASRs along the Western Section are in the range of 358 - 3189 ug m^{-3} and 209 - 1397 ug m^{-3} respectively. The EPD's recommended hourly criteria of 500 $\mu g\ m^{-3}$ and 24-hour AQO of 260 ug m^{-3} are exceeded at most ASRs. Effective mitigation measures should be adopted in order to reduce dust level to within the statutory guidelines.

8.4.1.5 Recommended Mitigation

Mitigation measures for controlling dust from materials handling, excavation and vehicle movements have been described in *Section 5.4.1.5*. With these standard mitigation measures, dust levels arising from construction works of the Western Section can be effectively controlled at most ASRs. The mitigated 1-hour and 24-hour TSP levels are presented in *Table 8.4c*.

Table 8.4c Predicted Mitigated Cumulative 1-hour and 24-hour TSP Levels

Area	Fig/ASR No	ASR Name	1-hour TSP Level	24-hour TSP Level
Yuen Long (YUL)	12/2	Small Traders New Village Public School	260	167
	12/3	Pok Oi Hospital	287	178
	12/6	Small Traders New Village	359	208
	12/9	Ying Lung Wai	383	219
	12/13	Sun Yuen Long Centre	**733**	**366**
	12/15	Shung Tak School	**912**	**438**
	12/16	Nam Pin Wai	**809**	**398**
	12/18	Kwan Lok San Tsuen	**518**	**274**
	12/31	Tai Hing Building	**492**	**263**
	12/40	Yuen Long Estate	480	260
	12/41	Yuen Long Morninglight School	460	250
	13/58	Fu Loy Garden	424	235
	13/68	Fung Chi Tsuen	416	232
	13/70	Wing Ning Tsuen	296	182
	13/71	Shing Tak School	211	147
	13/72	Ha Mei San Tsuen	**593**	**305**
Tin Shui Wai (TIS)	14/3	Pagoda	**553**	**290**
	14/5	Tin Yiu Estate	**543**	**285**
	14/6	TMGH's Kwok Yat Wai Prevocational School	434	240
	14/7	Industrial uses along Hung Tin Road	**602**	**309**
	14/12	Village House to the south of Sha Chau Lei Tsuen	258	166
	15/1	Shek Po Tsuen	304	185
	15/4	Galore Garden	369	212
	15/5	Village Houses to the East of Tin Sum Tsuen	376	215
	15/8	Low-rise residential area, south of Tin Sum Tsuen	351	205
	16/9	Siu Kwong Yuen	**468**	**255**
	16/16	Hing Tak Public School	411	229

Area	Fig/ASR No	ASR Name	1-hour TSP Level	24-hour TSP Level
	16/17	Lin Yuen	432	238
	16/22	Miu Fat Buddist Monastery	360	209
	16/23	Lee Ka Yuen and Residential Use in surrounding area	777	382
	16/24	Bank next to Fu Hong Home for the Aged	**1121**	**529**
Tuen Mun Centre (TMC)	17/1	Chik Yuen Garden	**1047**	**495**
	17/7	Residential use along Tsing Lun Road	**863**	**418**
	17/15	WSD staff Quarters	461	251
	17/18	Siu Hong Court	**777**	**384**
	18/32	Tuen Mun Hospital Staff Quarter	**846**	**413**
	18/33	Affluence Garden	**584**	**303**
	18/34	The Church of Christ in China Lee Lai Fun Memorial Prevocational School	387	220
	18/45	Residential development by Sun Hung Kei	**568**	**295**
	18/60	Ho King Building/Sun King Building/On Chuen Building/Bit Hing Building	**1453**	**664**
	18/74	Kan Wah Garden	285	177
	18/76	Tuen Mun Town Park	423	236

Exceedance of TSP criteria are shown in bold

Includes background TSP Levels

Units in µg/m^3

8.4.1.6 Residual Impacts

As indicated in *Table 8.4c*, with the implementation of the recommended dust control measures, the predicted dust levels criteria will still 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 the predicted mitigated 1-hour and 24-hour TSP levels at the ASRs are shown in *Table 8.4d*. The emission factor for vehicle movement is based on AP-42 and details are presented in *Annex F*.

Table 8.4d Predicted Mitigated Cumulative 1-hour and 24-hour TSP Levels

Area	Fig/ASR No	ASR Name	1-hour TSP Level	24-hour TSP Level	Speed Limit kph
Yuen Long (YUL)	12/13	Sun Yuen Long Centre	446	245	10
	12/15	Shung Tak School	452	247	10
	12/16	Nam Pin Wai	459	249	10
	12/18	Kwan Lok San Tsuen	412	230	15
	12/31	Tai Hing Building	354	206	15
	13/72	Ha Mei San Tsuen	338	199	15
Tin Shui Wai (TIS)	14/3	Pagoda	412	231	15
	14/5	Tin Yiu Estate	355	206	15
	14/7	Industrial uses along Hung Tin Road	382	218	15
	16/9	Siu Kwong Yuen	353	206	15
	16/23	Lee Ka Yuen and Residential Use in surrounding area	430	237	15
	16/24	Bank next to Fu Hong Home for the Aged	325	195	10
Tune Mun Centre (TMC)	17/1	Chik Yuen Garden	315	190	10
	17/7	Residential use along Tsing Lun Road	470	254	15
	17/18	Siu Hong Court	445	245	10
	18/32	Tuen Mun Hospital Staff Quarter	424	235	15
	18/33	Affluence Garden	355	206	15
	18/45	Residential development by Sun Hung Kei	310	188	15
	18/60	Ho King Building/Sun King Building/On Chuen Building/Bit Hing Building	500	259	10

Includes background TSP Levels

Units in µg/m^3

8.4.2 *Operational Phase*

8.4.2.1 Baseline Conditions

The baseline conditions during the operational phase have been discussed in *Section 8.4.1.1*. The background air quality in the developed areas, namely Yuen Long and Tuen Mun is dominated by the vehicular emissions from the nearby roads. The air quality in Tuen Mun is considered to be influenced by industrial emissions such as from the Tung Tau Industrial Area. Tin Shui Wai is also newly developed and a number of other developments are either at the tendering stage or under construction. Fugitive dust generated from construction works site contributes to the background dust levels in Tin Shui Wai in addition to vehicular emissions.

Between Tin Shui Wai and Tuen Mun, the main usage of land is for agriculture, fish ponds and villages. The roads in this area are mainly local access, namely Ping Ha Road and Shek Po Road. No major air pollutant emissions have been identified in the area and air quality is considered to be mainly affected by the local access roads.

8.4.2.2 Potential Sources of Impact

Potential air quality impacts during the normal operation of West Rail will be limited since electric trains will be used and no exhaust gas will be produced. However, low levels of dust may be created by the abrasion and wear of track, electrical pick-up gear and rolling stock during normal operation and from maintenance activities. Dust levels generated from such activities will be low and will have a negligible impact on the ASRs.

The proposed PTIs are enclosed and located further than 20 m from the ASRs. If the air quality controls installed at the interchanges satisfy the requirements outlined in the *Practice Note on Control of Air Pollution in Semi-confined Public Transport Interchanges*, adverse air quality impacts from the transport interchanges are unlikely.

In association with the development of Yuen Long Station and the adjacent Kau Hui Development, Roads L1 and L2 are proposed. Since these roads are located at more than 5 m from the nearest ASRs (namely Nam Ping Wai and the Sun Yuen Long Centre), the HKPSG's buffer distance requirement of 5 m is satisfied and air quality impacts from these roads are unlikely.

8.4.2.3 Recommended Mitigation

Adequate mechanical ventilation should be provided to ensure that the air quality inside PTI meet the standards stated in the Practice Note specified above.

8.4.2.4 Residual Impacts

Air quality impacts during the operational phase of West Rail are not considered to be of concern as limited potential sources have been identified. No residual impacts are anticipated.

8.4.3 Conclusion

The assessment of impacts to air quality from the construction and operation of West Rail within the Western Section has determined that no insurmountable impacts are likely to arise provided that the recommended mitigation measures are implemented.

8.5 Water Quality

This section provides an assessment of the potential water quality impacts, including impacts on river and marine water quality and drainage, associated with both the construction and operational phases of the Western Section. The Western Section rail alignment comprises both elevated and at grade structures, as well as five stations (Yuen Long, Long Ping, Tin Shui Wai, Tuen Mun North and Tuen Mun Central).

Key issues addressed in this section are the generation of construction and operational wastewater which may cause adverse water quality impacts on water sensitive receivers if not properly controlled. Where appropriate, mitigation measures have been described to control potential water quality impacts so that residual (post-mitigation) discharge levels meet the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) standards and EPD's "zero discharge" policy for the Deep Bay catchment.

8.5.1 Construction Phase

8.5.1.1 Water Sensitive Receivers (WSRs)

Potential WSRs likely to be affected by the Western Section construction works comprise:

- Surface waters, including Yuen Long Creek, Tin Shui Wai Nullah and Tuen Mun River;
- Fish/duck ponds near the Yuen Long, Long Ping and Tin Shui Wai Stations;
- The Tuen Mun Typhoon Shelter located downstream of the Tuen Mun River; and
- Gazetted bathing beaches downstream of the Tuen Mun River, in particular Castle Peak Beach,

8.5.1.2 Baseline Conditions

In general, the streams along the alignment are grossly polluted by discharges from livestock farms, unsewered villages and, in some cases, industrial establishments. The existing downstream water quality is generally poor, and construction activities should not cause any further deterioration in baseline conditions.

Site investigations were conducted to check for any recent changes in water quality and any noticeable discharge sources. During site visits, no ground water abstraction points were found within the alignment of West Rail. It is unlikely that any ground water catchment falls within the West Rail study area.

8.5.1.2.1 Yuen Long Creek and Tin Shui Wai Nullah

Yuen Long Creek has a length of 60 km and a catchment area of 26.7 km^2. It begins at Tai Lam Country Park and passes through Yuen Long new town as a 12 km long open nullah before discharging into Inner Deep Bay. The relatively limited dispersive capacity of Inner Deep Bay exacerbates the sedimentation and retention of pollutants at the lower part of the creek during in-coming tides.

Tin Shui Wai nullah is part of the Tin Shui Wai drainage basin that drains into the Inner Deep Bay. The water quality of Tin Shui Wai Nullah varied from "fair" to "bad" in 1995, as reported in the EPD's *River Water Quality in Hong Kong.*

The water quality of Yuen Long Creek and Tin Shui Wai nullah is regularly monitored by EPD's river water monitoring programme. Monitoring stations YL3 and YL4 are located downstream of the tributary of the Yuen Long Creek which will be crossed by the proposed alignment of the Yuen Long and Long Ping sections. Stations TSR1 and TSR2 are relevant to the Tin Shui Wai section. A summary of EPD monitoring data (for 1996) for the closest monitoring stations, YL3, YL4, TSR1 and TSR2 is given in *Table 8.5a.*

Table 8.5a Summary Statistics of 1996 Water Quality of Yuen Long Creek (YL) and Tin Shui Wai Nullah (TSR)

Parameter	YL3	YL4	TSR1	TSR2	WQOs for inland waters of Deep Bay WCZ
DO (% Saturation)	21.95 (3.8-42.0)	35.7 (13.9-57.4)	53.2 (4.4-219.0)	145.7 (49.3-265.4)	n.a.
DO (mg/l)	1.8 (0.3-3.3)	2.8 (1.1-4.4)	4.9 (0.3-15.6)	10.6 (4.0-18.1)	4 mg/l
BOD_5 (mg/l)	155.0 (28.0-340.0)	92.0 (16.0-120.0)	31.0 (8.0-78.0)	7.0 (2.0-62.0)	3 mg/l
COD (mg/l)	107.0 (21.0-530.0)	56.0 (27.0-170.0)	35.0 (18.0-340.0)	15.0 (7.0-49.0)	15 mg/l
Oil and Grease (mg/l)	21.5 (0.6-52.0)	7.0 (0.5-37.0)	1.1 (0.5-92.0)	0.6 (0.5-6.0)	n.a.
SS (mg/l)	145.0 (25.0-400.0)	92.0 (16.0-120.0)	48.0 (10.0-260.0)	31.0 (10.0-140.0)	Annual median 20 mg/l

Parameter	YL3	YL4	TSR1	TSR2	WQOs for inland waters of Deep Bay WCZ
Turbidity (NTU)	80.5	30.0	30.5	28.0	n.a.
	(27.0-200.0)	(18.0-79.0)	(11.0-55.0)	(9.0-120.0)	
Ammoniacal N (mg/l)	23.00	7.85	7.95	0.78	n.a.
	(6.90-54.00)	(3.10-12.00)	(2.70-21.00)	(0.17-29.00)	
Total Kjeldahl N (mg/l)	36.50	11.00	10.50	1.8	n.a.
	(9.90-82.00)	(5.40-24.00)	(5.10-48.00)	(0.8-54.0)	
Total P (mg/l)	9.10	1.65	1.65	0.47	n.a.
	(2.40-18.00)	(1.20-3.60)	(1.10-11.00)	(0.15-5.40)	
pH value	7.2	7.1	7.9	8.4	6.5 - 8.5
	(6.7-7.6)	(6.9-7.4)	(7.4-9.1)	(7.8-9.6)	
Flow (l/s)	428	221	NM	19	n.a.
	(159-1,583)	(143-686)		(3-221)	

Notes:

1. Data presented are annual arithmetic means, except where specified otherwise.
2. Data enclosed in brackets are ranges.
3. NM indicates no measurement taken
4. n.a. = not available

Source: EPD (January 1996 - December 1996)

The water quality of Yuen Long Creek was very bad, reflected in non-compliance with the WQOs throughout 1996, with high annual means of BOD_5 , COD and SS levels, and low DO. There are a number of livestock waste discharges and industrial effluent discharges in the catchment which adversely affect water quality.

The water quality of Tin Shui Wai Nullah also suffers from pollution. A number of livestock waste polluting discharges and industrial effluents are also identified in the catchment.

8.5.1.2.2 Tuen Mun River

The 38 km long Tuen Mun River has a catchment of about 16.5 km^2. The upstream section of the river passes through Lam Tei, San Hing Tsuen and Fu Tei where the Western Section alignment will be parallel to the Tuen Mun River. There are six monitoring stations (TN1-TN6) along the Tuen Mun River monitored by EPD and located close to the alignment of the Western Section. A summary of EPD monitoring data (for 1996) for these six stations is given in *Table 8.5b*..

Table 8.5b Summary Statistics of 1996 Water Quality of Tuen Mun River

Parameter	TN1	TN2	TN3	TN4	TN5	TN6	WQOs for inland waters of Deep Bay WCZ
DO (% Saturation)	26.2	103.8	43.4	48.3	46.6	38.9	n.a.
	(4.0-62.7)	(84.2-153.9)	(11.6-71.1)	(7.7-110.3)	(14.0-81.7)	(8.9-78.2)	
DO (mg/l)	2.1	8.3	3.1	3.8	3.8	3.3	4 mg/l
	(0.3-4.7)	(7.4-11.4)	(0.8-5.1)	(0.6-7.3)	(1.1-5.9)	(0.6-5.8)	
BOD_5 (mg/l)	120	7	5	5	6	4	3 mg/l
	(31-410)	(2-26)	(2-11)	(3-13)	(2-12)	(2-12)	
COD (mg/l)	87	13	103	130	93	216	15 mg/l
	(32-360)	(6-39)	(29-720)	(32-370)	(19-42)	(28-380)	
Oil and Grease (mg/l)	16.0	1.6	0.8	0.5	0.5	0.5	n.a.
	(1.0-57.0)	(0.5-7.6)	(0.5-1.8)	(0.5-1.4)	(0.5-1.2)	(0.5-1.0)	
SS (mg/l)	88	19	6	6	6	5	Annual median
	(30-290)	(2-25)	(3-10)	(4-21)	(4-60)	(4-9)	20 mg/l
Turbidity (NTU)	62.5	11.5	5.3	6.2	6.3	5.0	n.a.
	(13.0-722.0)	(6.0-51.0)	(3.0-11.0)	(1.0-12.0)	(3.0-14.0)	(2.0-13.0)	
Ammoniacal N (mg/l)	7.75	0.76	0.68	0.68	0.58	0.49	n.a.
	(4.30-19.00)	(0.29-2.60)	(0.46-0.73)	(0.39-1.40)	(0.44-0.89)	(0.28-0.92)	
Total Kjeldahl N (mg/l)	12.50	1.35	1.20	1.35	1.20	0.87	n.a.
	(9.50-34.00)	(0.94-1.30)	(0.94-1.30)	(0.75-2.00)	(0.91-1.70)	(0.61-1.40)	
Total P (mg/l)	3.55	0.40	0.23	0.22	0.23	0.19	n.a.
	(1.70-8.80)	(0.15-0.95)	(0.11-0.37)	(0.15-0.60)	(0.08-0.38)	(0.10-0.42)	
pH value	8.3	7.4	7.3	7.5	7.4	7.1	6.5 - 8.5
	(7.1-9.3)	(7.0-8.7)	(6.9-7.6)	(7.2-7.7)	(7.0-7.7)	(6.4-7.9)	
Flow (l/s)	73	29	NM	NM	NM	NM	n.a.
	(31-194)	(7-261)					

Notes:

1. Data presented are annual arithmetic means, except where specified otherwise.

Parameter	TN1	TN2	TN3	TN4	TN5	TN6	WQOs for inland waters of Deep Bay WCZ

2. Data enclosed in brackets are ranges.
3. NM indicates no measurement taken
4. n.a. = not available

Source: EPD (January 1996 - December 1996)

The monitoring data for 1996 showed that the water quality of the lower section (TN3-TN6) of the river was better than the upper sections (TN1-TN2). However, the overall water quality is poor, reflected in non-compliance with the WQOs for DO, BOD_5 and COD, as well as SS on occasions.

At the south of the Western Section, the Tuen Mun North and Tuen Mun Central Stations will be constructed over the existing concrete-lined section of the Tuen Mun River. Construction of columns within the Tuen Mun River to support the rail alignments may be necessary.

Tuen Mun Typhoon Shelter

The water quality of the Tuen Mun Typhoon Shelter is also well documented by EPD's routine marine water monitoring programme (at monitoring stations NT1, and NT3-NT5). A summary of monitoring data for 1995 for relevant stations is given in *Table 8.5c.*

Table 8.5c Summary Statistics of 1995 Water Quality of Tuen Mun Typhoon Shelter

Determinant		NT1	NT3	NT4	NT5
Temperature	Surface	23.9	24.3	23.8	23.7
		(18.1 - 28.5)	(18.0 - 29.3)	(17.9 - 28.7)	(18.0 - 28.4)
	Bottom	27.1	25.9	22.4	23.1
		(27.1 - 27.1)	(25.9 - 25.9)	(17.9 - 26.3)	(17.8 - 27.4)
Salinity (ppt)	Surface	26.5	26.0	26.0	26.4
		(14.6 - 33.5)	(13.5 - 33.4)	(13.4 - 33.6)	(13.7 - 33.8)
	Bottom	19.6	24.9	29.5	28.8
		(19.6 - 19.6)	(24.9 - 24.9)	(24.1 - 33.7)	(23.2 - 33.6)
DO	Surface	68.9	71.1	76.6	79.1
(% Saturation)		(54.4 - 82.2)	(57.0 - 84.6)	(64.1 - 83.8)	(59.6 - 86.9)
	Bottom	83.0	78.1	72.5	77.6
		(83.0 - 83.0)	(78.1 - 78.1)	(58.7 - 81.5)	(62.0 - 90.8)
DO (mg/l)	Surface	5.0	5.1	5.6	5.7
		(4.2 - 6.2)	(4.2 - 6.5)	(5.0 - 6.2)	(4.6 - 6.3)
	Bottom	5.9	5.5	5.3	5.6
		(5.9 - 5.9)	(5.5 - 5.5)	(4.5 - 6.3)	(4.8 - 6.3)

Determinant	NT1	NT3	NT4	NT5
pH	7.9	7.9	8.0	8.0
	(7.7 - 8.0)	(7.7 - 8.2)	(7.8 - 8.2)	(7.9 - 8.3)
SS (mg/l)	14.9	15.0	14.7	10.4
	(11.5 - 27.0)	(7.9 - 24.0)	(7.6 - 34.5)	(5.8 - 18.7)
Turbidity (NTU)	7.2	7.0	11.0	4.7
	(5.1 - 10.6	(5.1 - 9.0)	(2.7 - 38.7)	(2.5 - 6.3)
BOD_5 (mg/l)	0.8	0.7	0.6	0.6
	(0.5 - 1.2)	(0.5 - 1.3)	(0.3 - 0.9)	(0.4 - 1.3)
Ammoniacal N (mg/l)	0.23	0.13	0.09	0.07
	(0.03 - 0.73)	(0.03 - 0.20)	(0.03 - 0.17)	(0.01 - 0.16)
Total Kjeldahl N (mg/l)	0.79	0.66	0.62	0.55
	(0.43 - 1.28)	(0.23 - 1.03)	(0.40 - 1.01)	(0.30 - 0.82)
Total-P (mg/l)	0.15	0.15	0.15	0.13
	(0.06 - 0.36)	(0.08 - 0.35)	(0.07 - 0.33)	(0.08 - 0.32)
E. coli (No/100 ml)	1,617	4,485	1,677	2,060
	(230 - 32,000)	(300 - 28,000)	(280 - 17,000)	(440 - 7,300)

Note:

1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for *E. coli* data which are geometric means.
3. Data enclosed in parentheses are ranges

Source: EPD (1996), Marine Water Quality in Hong Kong for 1995.

The monitoring results indicate that the water quality in the Tuen Mun Typhoon Shelter was generally acceptable with high levels of depth-averaged DO, and low total nitrogen and *E. coli* counts.

Bathing Beaches in Tuen Mun

Water quality of gazetted bathing beaches along the shoreline of Castle Peak Road in Tuen Mun is generally poor. Castle Peak, Kadoorie and New Cafeteria beaches are located closest to the Western Section alignment and their relative distances to the Tuen Mun Central Station are 1.2 km, 1.4 km and 2.2 km respectively. The sources of pollution of the Tuen Mun River, as discussed earlier in this section, are mainly industrial areas, unsewered areas and livestock farms.

North Western WCZ

Water quality of the North Western WCZ is also documented in reports from EPD's marine water quality monitoring programme. Monitoring locations in the vicinity of the works are shown in *Figures 8.5a-c*. A summary of monitoring data for 1996 for stations NM2 and NM3 is given in *Table 8.5d*. North Western waters are well oxygenated in both surface and bottom layers. High *E. coli* counts are reported on occasions, reflecting bacterial loading from the Tuen Mun River.

Table 8.5d Summary Statistics of 1996 Marine Water Quality in North Western Waters.

Determinant		North Western WCZ EPD Monitoring Station	
		NM2	NM3
Temperature (^oC)	Surface	23.9	23.7
		(18.1-23.9)	(18.0-28.5)
	Bottom	23.4	22.5
		(17.9-27.8)	(17.7-26.2)
Salinity (ppt)	Surface	26.5	26.4
		(13.4-33.6)	(10.6-33.9)
	Bottom	28.0	30.8
		(18.3-34.0)	(26.9-33.9)
DO (% saturation)	Surface	81.8	81.0
		(64.7-92.2)	(65.7-91.1)
	Bottom	80.0	73.5
		(65.5-86.3)	(53.0-90.0)
DO (mg/l)	Surface	5.9	5.9
		(4.7-6.5)	(5.0-6.6)
	Bottom	5.8	5.3
		(5.0-6.7)	(3.7-6.8)
SS (mg/l)	Surface	6.8	5.8
		(4.6-9.5)	(3.2-9.6)
	Bottom	18.2	10.6
		(5.5-50.0)	(3.8-18.0)
Turbidity (NTU)	Surface	4.8	4.4
		(3.3-6.4)	(1.8-7.2)
pH value		8.1	7.9
		(7.9-8.4)	(7.7-8.4)
BOD_5 (mg/l)		0.63	0.54
		(0.28-1.14)	(0.25-0.87)
Ammoniacal N (mg/l)		0.08	0.08
		(0.03-0.17)	(0.02-0.16)

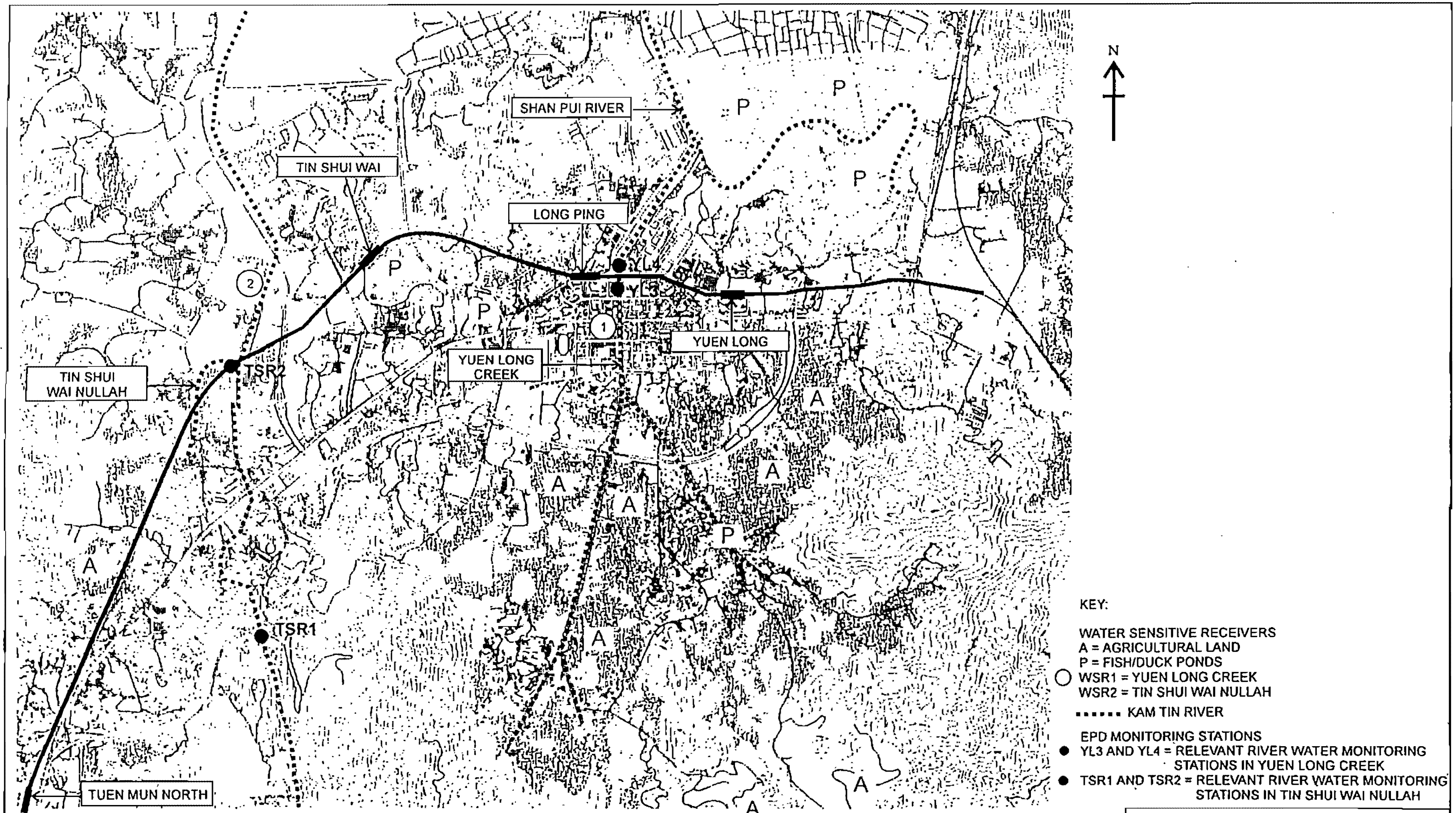


FIGURE 8.5a - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD WATER QUALITY MONITORING STATIONS

NOT TO SCALE

ERM-Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

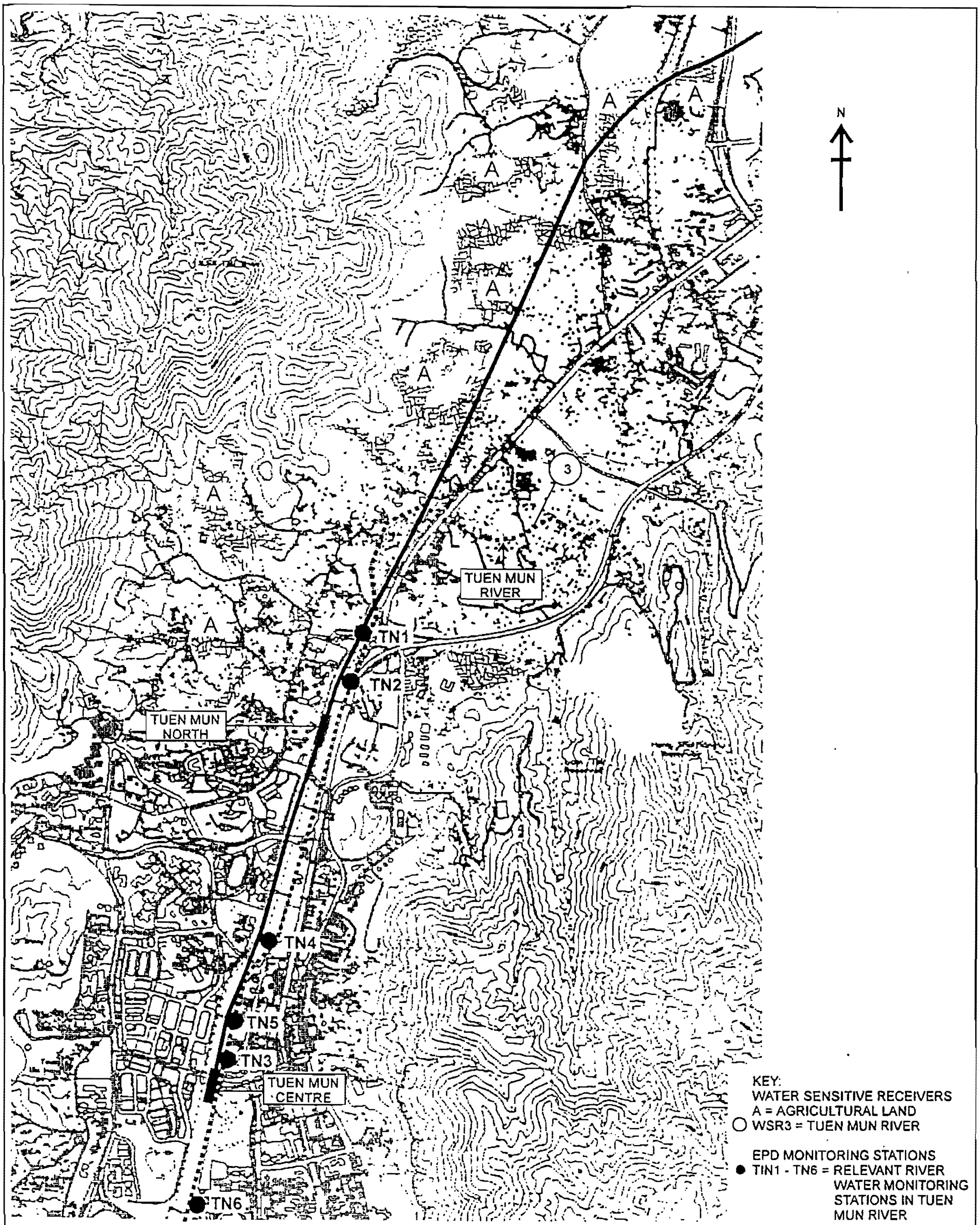


FIGURE 8.5b - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD WATER QUALITY MONITORING STATIONS

NOT TO SCALE

ERM-Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

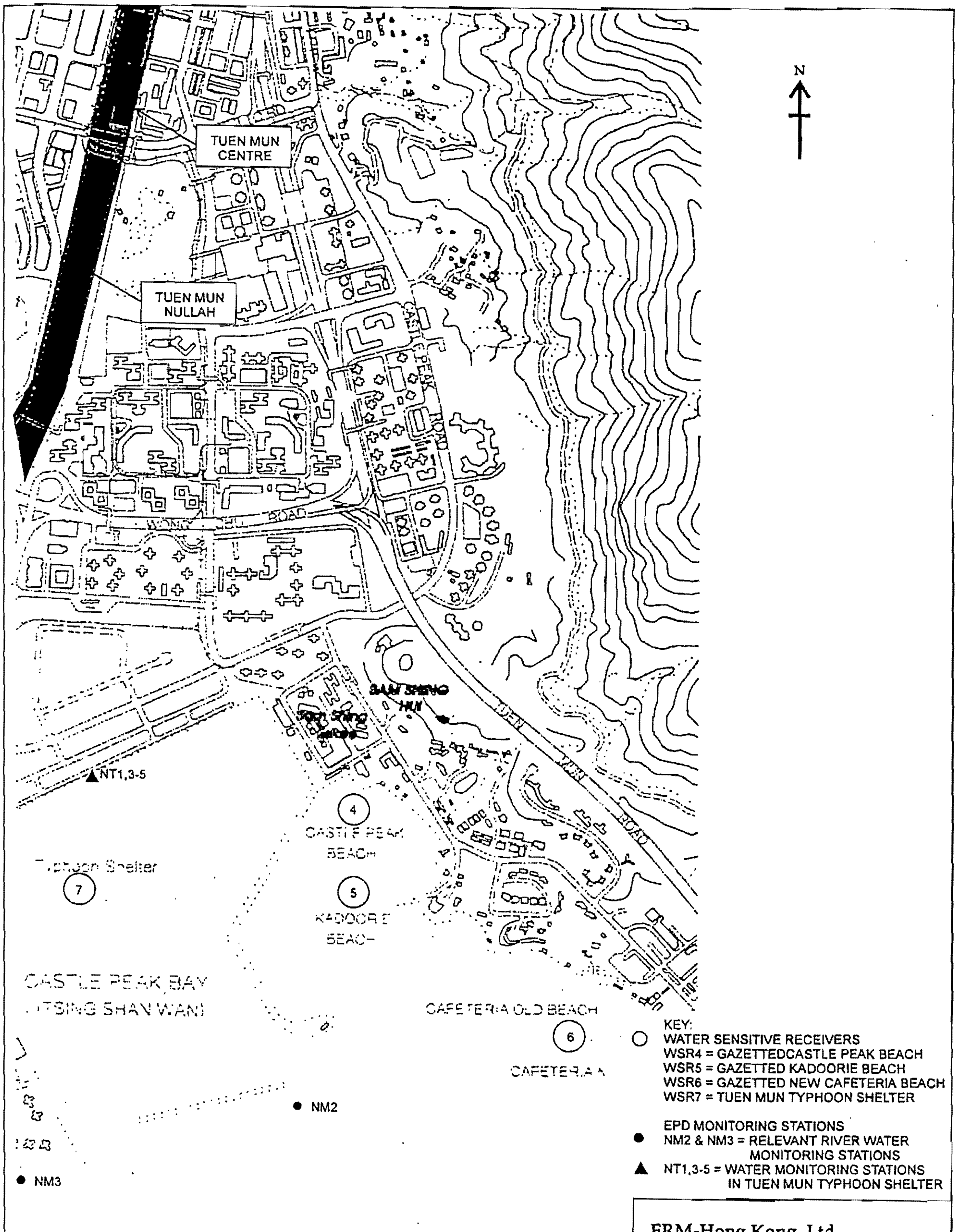


FIGURE 8.5c - LOCATIONS OF WATER SENSITIVE RECEIVERS AND EPD WATER QUALITY MONITORING STATIONS

NOT TO SCALE

ERM-Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

Determinant	North Western WCZ EPD Monitoring Station	
	NM2	NM3
Total Kjeldahl N (mg/l)	0.17	0.15
	(0.10-0.21)	(0.09-0.17)
Total P (mg/l)	0.12	0.12
	(0.06-.026)	(0.06-0.27)
E. coli (no./100 ml)	429	601
	(61-1,250)	(207-2,700)

Note :

1. Except as specified, data presented are depth-average data.
2. Data presented are annual arithmetic means except for E. coli data which are annual geometric means.
3. Data enclosed in brackets are ranges.

Source: EPD (January 1996 - December 1996)

8.5.1.3 Potential Sources of Impact

Construction activities in areas currently occupied by fish/duck ponds and streams may cause disturbance to these water bodies. Potential sources of impacts to water quality from the construction of the Western Section could include the following:

- Construction runoff and drainage;
- Runoff from station construction works;
- Dredging of river/nullahs;
- Runoff from general construction activities and the concrete batching plant; and
- Sewage effluents generated from the construction workforce.

Of particular concern will be the potential flow of construction runoff sediment into fish/duck ponds located in the vicinity of the Tin Shui Wai and Long Ping Stations.

8.5.1.4 Prediction of Impacts

8.5.1.4.1 Construction Runoff and Drainage

Construction Runoff

Runoff from construction sites may contain increased loads of suspended solids (SS) and contaminants. Potential sources of water pollution from site runoff include:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;

- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

Construction runoff and drainage may cause physical, chemical and biological impacts. The possible impacts on the WSRs arising from construction runoff and drainage have been detailed in *Section 5.5* of this report.

Drainage

Major drainage impacts may arise from construction of the alignment within or above the rivers and the nullah. Potential disturbance to the flow of the nullahs and the flooding susceptibility will be discussed below with reference to the following three sub-sections:

- Yuen Long to Tin Shui Wai;
- Tin Shui Wai to Tuen Mun North; and
- Tuen Mun North to Tuen Mun Central.

Yuen Long to Tin Shui Wai

The system of nullahs within Yuen Long is currently undersized for a 50-year design flood, and the centre of Yuen Long has flooded a number of times in recent years. Downstream channelisation improvements in the Tuen Mun Town Centre have improved the drainage conditions. The completion of the Kam Tin channels (43CD) in 1998 will further reduce water levels downstream of Yuen Long. However, these improvements will not increase the level of flood protection from 10-year return period capacity to 50-year. Nevertheless, after the construction of the Yuen Long Bypass Floodway, the capacity will be raise to 200-year (scheduled for completion in 2004) for most sections. Apart from the section where the alignment will be within Yuen Long Town, no temporary construction drainage measures are considered necessary by the engineering Design Consultants[10], although slight modifications of the Yuen Long nullahs will be required for the viaduct support.

For the railway alignment between Long Ping and Tin Shui Wai, the existing hydraulic capacity of the Yuen Long Western nullah is such that it will presently only accept a 100-year return period. The construction of Yuen Long Bypass Floodway and drainage in the vicinity of this section will generally increase this to 200-year return period standards, with a number of minor local bottlenecks. The impact due to construction is considered to be minimal.

The Ping Shan area is generally of low flooding susceptibility as reported by the engineering Design Consultants, so flooding problems are not expected.

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[10] Schematic Design Report, Contract No. TS-200, Western Section, Draft Drainage Impact Assessment, Volume 2

At Nam Ping Wai, the elevated rail structure crosses the flood storage pond for the village flood protection scheme. There will be a small drainage impact due to the location of column supports in the flood storage pond and the resulting reduction in flood storage volume. The engineering Design Consultants have reported the potential reduction in flood storage volume will be very small, such that no mitigation work will be required, although compensation for the loss could be made by minor reworking of the flood pond volume.

Tin Shui Wai to Tuen Mun North

The Tin Shui Wai and Tuen Mun drainage basins have numerous localised flooding problems. A series of new drainage channels and an associated stormwater drainage system to collect the water flow and direct it to the channels are being constructed by the DSD. The drainage impact of the railway alignment between Tin Shui Wai and Tuen Mun North will be an encroachment of the rail elevated structure supports into the concrete-lined section of the Tuen Mun River.

The rail alignment between Tin Shui Wai and Tuen Mun is mainly on viaduct, so that the water courses along this section will not be significantly affected. Runoff along the rail alignment should, however, be collected by drainage channels in order not to impact on downstream WSRs.

It is proposed that, where the rail alignment crosses existing drainage, the drainage will be reprovided under the embankment, with capacity to pass a 200-year return period flood. The elevated alignment for the Yuen Long-Tuen Mun Corridor will cross a number of major watercourses including the Hung Shui Kiu and Ha Tsuen Channels. Modification of existing rivers and nullahs in Ha Tsuen, Hung Shui Kiu channels and Yick Yuen channels with only minor changes in drainage paths will be required. This will only cause a minimal increase in head loss. Rail embankment will have toe channels that will collect all overland flow and divert it to the nearest channel. Provided that the construction site boundary is properly maintained, drainage from the embanked rail structure should cause no significant drainage impact. No temporary construction drainage measures are identified by the engineering Design Consultants. However, any flow from the construction site must pass through settling tanks/ponds before discharging into public drains.

Tuen Mun North to Tuen Mun Central

The Tuen Mun area is of low flooding susceptibility. The Tuen Mun new town has been built to avoid all but the most extreme floods. Hydraulic modelling of the Tuen Mun drainage basin has shown that only limited and localised flooding should occur in the Tuen Mun River. Since there is a limited potential drainage impact from the construction of structure supports for West Rail within the concrete-lined section of the Tuen Mun River, no unacceptable impact is expected.

8.5.1.4.2 Runoff from Station Construction Works

The Yuen Long Station will be elevated above ground (approximately 10m above ground level). Yuen Long Station is located within low-lying areas where flooding events have occurred on an average of every ten years.

The high flooding susceptibility of the Yuen Long Station will be resolved by the implementation of flood mitigation measures, such as the construction of the Yuen Long by-pass floodway. The by-pass floodway is scheduled for completion in 2004, shortly after the completion of the West Rail.

This low-lying area also acts as an undesignated flood storage area for the villages to the north of the Yuen Long Station. Construction of the Yuen Long Station will require partial filling of the flood storage area as an access or works area. The flooding susceptibility of the villages may therefore be temporarily increased during the construction period. Temporary construction drainage will be needed to ensure that the flooding risk to the adjacent villages will not be increased. If the mitigation measures included under Phase I of Kau Hui Development have been completed (programmed to be implemented by 2001), then no major temporary construction drainage will be required.

The Long Ping Station will also be an elevated structure (approximately 8m above the Yuen Long northern by-pass road and the Yuen Long Nullah). The construction of the Long Ping Station will convert a section of open channel to a closed culvert, so that the existing Yuen Long Nullah can run directly under the Long Ping Station.

The Long Ping Station area is presently of high flooding susceptibility. Parts of the Long Ping town centre will flood on average as often as every 10 years. There are also low-lying areas surrounding the town that currently flood even more frequently. This flooding problem however will be resolved by the construction of the Yuen Long bypass floodway which is scheduled for completion in 2004, shortly after the completion of the railway works.

Elevated structural supports for the Long Ping Station should be arranged wherever possible to avoid the Yuen Long Nullah. According to the engineering Design Consultants, temporary works are required. Details of the construction plan and preferred temporary works design will be investigated at a later stage by the engineering Design Consultants.

The Tin Shui Wai Station will be elevated above ground level. The rail alignment is upon elevated structure throughout the station, so that minimal drainage impact is anticipated.

Tuen Mun North Station will encroach onto the linear space along the Tuen Mun River. The station will be built over the open space to minimise the potential impact on the nullah. The platform of the Tuen Mun North Station will be at grade, but over the nullah. The station structures within the main Tuen Mun nullah will be designed to have minimal drainage impact, although the Tuen Mun North Station will convert a section of the open channel to a closed culvert.

Hydraulic drainage modelling has shown that the construction of the Tuen Mun North Station would cause limited flooding in the Tuen Mun town for a 200-year event. All temporary designs will be confirmed by engineering Design Consultants and Contractors.

The Tuen Mun Central Station will be an elevated station (approximately 9m above the surrounding road levels). The station will convert a section of open channel to a closed culvert and thus the potential impact of the station on the flow of the nullah will be reduced by special design of the station structure, which will use continuous longitudinal walls to support the elevated station structure instead of the discrete columns. The station structures within the concrete-lined section of the Tuen Mun River will be designed to have minimal drainage impact. The status of the design of the station is presently under revision and will be issued at a later date and, therefore, no further assessment on drainage can be done at this stage.

8.5.1.4.3 Dredging of River and Nullahs

The construction of the support structures for the viaduct within the existing river or nullahs may require minimal dredging within the water courses in certain areas. Although the dredging area is expected to be small, it will inevitably elevate levels of SS in areas immediately adjacent to the dredging plant (excavator or backhoe). Dredging may also lead to the potential release of heavy metals from the sediments if they are identified to be contaminated.

According to the Schematic Design Report[11], approximately 507,000 m^3 of material will be excavated for five stations (Yuen Long, Long Ping, Tin Shui Wai, Turn Mun North and Tuen Mun Central) and another 43,000 m^3 will be excavated for the pile locations for the viaduct sections.

Mud encountered between Tuen Mun North and Tuen Mun Centre Station is contaminated and the amount of the excavated material would be $135,000m^3$. This requires that an approved sampling and testing program be undertaken and that a Sediment Quality Report be submitted to the EPD, as described in the solid waste section (*Section 8.10*).

8.5.1.4.4 Runoff from General Construction Activities

General construction activities have the potential to cause water pollution from debris and rubbish, such as packaging and used construction materials, which may enter the water column, resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of any receiving water body. Spillages of liquids stored on site, such as oil, diesel and solvents could also result in water quality impacts if they enter surrounding water bodies and soils.

[11] Schematic Design Report, Contract No. TS-200, Western Section, Draft Construction Plan, Volume 10.

The effects on water quality from these construction activities are likely to be minimal provided that site boundaries are well maintained and good construction practices are observed to ensure that litter, fuels and solvents are managed, stored and handled properly.

A concrete batching plant is required for the construction of the Western Section. Surface runoff contaminated by materials in a concrete batching plant would contain high SS concentrations and acidity which could lead to both physical and chemical water quality impacts. Wastewater generated from the washing of mixer trucks should be treated and recycled on site to remove the SS, reduce the acidity and minimise the discharges into stormwater drains.

8.5.1.4.5 Sewage Effluents

Sewage effluents will arise from sanitary facilities provided for the on-site construction workforce for the Western Section, and these have the potential to cause water pollution. Sewage is characterised by high levels of biochemical oxygen demand (BOD), ammonia and *E. coli* counts. This sewage is expected to be connected to the existing sewerage system, since all Western Section stations lie within town centres which are connected to public foul sewerage and treatment systems. However, construction workers are likely to be dispersed along the alignment so that the installation of portable toilets and the proper disposal of sewage may be necessary to ensure that discharge standards are met.

Cumulative Impacts

Possible cumulative construction impacts may arise from increases in sedimentation from the following projects:

- Yuen Long by-pass floodway;
- Tuen Mun Sewerage Master Plan; and
- Yuen Long and Kam Tin Sewerage Master Plan.

Findings from the Drainage Impact Assessment show that there will be no significant change in the runoff quantity and peak flow to the drainage systems and WSRs provided that the site boundary and settling tanks/ponds are properly maintained.

8.5.1.5 Evaluation of Impacts

Although the existing downstream water quality is generally poor, construction activities should not cause any further deterioration in baseline conditions.

The net (unmitigated) water quality impacts on the WSRs include runoff from general construction activities associated with station construction and construction of alignment support structures and the concrete batching plant and crossings over rivers, nullahs and ponds containing elevated concentrations of SS and associated contaminants, as well as construction workforce sewage discharges.

During construction, work will be required both within and on the banks of the concrete-lined section of the Tuen Mun River which is of potential concern to local water quality. If construction activities occur in a natural water body, these activities may lead to scouring and an increase in the suspended solids levels and turbidity of downstream water bodies. Although disturbance to water bodies is likely to be localised and temporary, increases in downstream siltation may occur occasionally and may temporarily affect sensitive uses, such as active fish/duck ponds.

Those parts of the rail alignment with elevated structure supports are being arranged to avoid existing drainage, wherever possible, within the Yuen Long to Tuen Mun section. Although encroachment on the river and nullahs is unavoidable in certain areas, the potential construction impact on them should be restricted to an increase in SS, although mitigation measures will be recommended to reduce this impact to acceptable levels.

Station structural supports are also being arranged, wherever possible, to avoid the nullahs so that hydraulic impacts are reduced. Any change in the alignment of the nullah should be avoided wherever possible. Site-specific mitigation measures are described in *Section 8.5.1.6.1*.

8.5.1.6 Recommended Mitigation

It is important that appropriate measures are implemented to control runoff and drainage to prevent SS loadings from entering the water courses and impacting on downstream WSRs. Proper site management will be essential to minimise surface water runoff, soil erosion and sewage effluents.

Construction site runoff and drainage should be controlled in accordance with the guidelines stipulated in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94). Good housekeeping and stormwater best management practices should be implemented to ensure that runoff from construction areas and any stored excavated material comply with the WPCO and no unacceptable impact on the WSRs arises due to the construction of West Rail. All discharges from the construction site should be controlled to comply with the TM standards and the "zero discharge" policy.

Sedimentation during construction should be avoided through management practices outlined below. Streams should either be enhanced or restored following construction.

8.5.1.6.1 Construction Runoff and Drainage

Construction Runoff

Exposed soil areas should be minimised to reduce the potential for increased siltation, contamination of runoff, and erosion. Runoff-related impacts associated with above ground construction activities can be readily controlled through the use of appropriate mitigation measures, which include:

- The use of sediment traps; and
- The adequate maintenance of drainage systems to prevent flooding and overflow.

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 appropriate watercourses, via a silt retention pond. Permanent drainage channels should incorporate sediment basins or traps and baffles to enhance deposition rates.

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 traps should be regularly cleaned and maintained. 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.

Sand and silt in the wash water from the wheel washing facilities should be settled out and removed before discharging into storm drains. A section of the road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site runoff from entering public road drains.

Oil interceptors should be provided in the drainage system downstream of any oil/fuel pollution sources associated with construction, and regularly emptied 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.

Drainage

Both rail and station structure designs and construction methods have been developed to minimise impacts to the hydraulic capacity of the nullahs. Recommended methods to reduce the potential flooding impact on WSRs include:

- Supporting the elevated rail structures by columns outside the nullah wherever practicable; and
- Realignment of the nullah.

The construction of the elevated rail structure in the Yuen Long area will be a critical part of the Western Section development in terms of the drainage impact of the rail structure. Any temporary works requiring partial blockage of the nullah will need to be constructed during the dry season.

Although other parts of the Western Section are not considered to have a significant impact on drainage, all of the Contractors in the Western Section will be required to ensure that the existing drainage arrangements will not be affected during construction and that any flow from the construction site must pass through settling tanks/ponds before discharging into public drains.

The proposed Yuen Long bypass floodway should mitigate the current problems and raise the flood protection in central Yuen Long to the required 50-year standard. However, even after these works are completed, the existing nullahs will run close to the limit of the channel hydraulic capacity, so that the elevated rail alignment supporting structures should not be placed within the Yuen Long Nullah, where this is avoidable.

8.5.1.6.2 Station Construction

The station structures will be designed to have minimal drainage impact. Any temporary works requiring partial blockage of the nullah will need to be constructed during the dry season. The temporary works will be designed to allow a 1 in 10 year return period event to pass through the nullah during the construction period. At any one time, only one third of the nullahs should be taken for construction. Temporary open storage of excavated materials along the at-grade section (between Tin Shui Wai Station and Tuen Mun North Station) should be covered with tarpaulins or similar materials during rainstorms. Any washout of construction or excavated materials should be diverted to the drainage system via appropriate sediment traps to enhance deposition rates and to remove silt before discharge to the nullahs.

8.5.1.6.3 Dredging of River and Nullahs

43,000 m^3 of material will be excavated for the five viaduct sections. Proper sediment handling and disposal methods should be used to minimise any potential water quality impacts on downstream WSRs, especially if material to be dredged is found to be contaminated in the area between Tuen Man North and Tuen Mun Centre. Details of sediment management are provided in *Section 8.10.*

8.5.1.6.4 General Construction Activities

Debris and rubbish on site should be collected, handled and disposed of properly to avoid entering the water column and cause water quality impacts. The solid waste management requirement on site to prevent such impact is detailed in *Section 8.10* of this report.

All fuel tanks and storage areas should be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank, to prevent spilled fuel oils from reaching the receiving water bodies.

Discharge and surface runoff contaminated by materials from the concrete batching plant 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.

8.5.1.6.5 Sewage Effluent

Construction workforce sewage is expected to be connected to the existing trunk sewer or sewage treatment facilities, although precise information on the size of the on-site workforce is not available at this stage. Construction sewage may need to be handled by portable chemical toilets and sewage holding tanks if the construction workers are likely to be dispersed along the alignment. Appropriate and adequate portable toilets should be provided by a licensed contractor who will be responsible for appropriate disposal and maintenance activities.

8.5.1.7 Residual Impacts

General construction activities associated with Western Section construction could lead to site runoff containing elevated concentrations of SS and associated contaminants. However, water quality impacts will generally be temporary and localised during construction. Therefore, no unacceptable residual water quality and drainage impacts are anticipated from the Western Section construction phase, provided that:

- All of the recommended mitigation measures including appropriate drainage and silty runoff collection facilities are adopted; and
- All construction site discharges comply with the TM.

It is considered that controls on discharges from land based construction activities and proper site management procedures, as discussed above, will minimise residual water quality impacts to acceptable levels.

8.5.2 Operational Phase

8.5.2.1 Baseline Conditions

The list of WSRs for the construction phase is also applicable to the operational phase, although some fish/duck ponds may be filled in for purposes unrelated to West Rail during the construction period.

It is anticipated that surface water quality will be gradually improved through the enforcement of the *Livestock Waste Control Scheme* and the *Water Pollution Control Ordinance* (WPCO), so that there should be some reduction in pollution loading from the surrounding environment.

Pollution loads in the Tuen Mun River will be further reduced after the implementation of the Tuen Mun Sewerage Master Plan, which should be completed by the year 2000. The plan recommends improvements to existing sewerage and the provision of sewerage extensions, and includes:

- Replacements of the inverted siphon at Pui To Road by a pumping system because the inverted siphon was found to be responsible for the direct overflow of sewage into Tuen Mun River;

- Improvement of the performance of the dry weather flow interceptor at Is Hong Road;
- Provision of a new low flow interceptor for wastewater from the squatter area in Tseng Tau Chung Tsuen;
- Extension of existing sewerage to the Tuen Mun and Yuen Long Corridor South areas, and to the eastern area up to Tai Lam Chung;
- Rehabilitation and improvement of existing sewerage, particularly in the industrial area; and
- Provision of public sewerage to about 25 villages.

Several sewerage projects in the area west of Tuen Mun River have been completed. Other sewerage projects aimed at providing sewers to unsewered areas will be implemented progressively. Upon completion of these projects, the water quality of the Tuen Mun River should improve further.

Stage III of the Yuen Long and Kam Tin Sewerage Master Plan (SMP) construction works is scheduled for commencement in 1999. The SMP will discharge sewage collected from the Yuen Long, Kam Tin and Tin Shui Wai areas through the sewerage system to a submarine outfall at Urmston Road and will significantly reduce the pollutant loading to Deep Bay.

8.5.2.2 Potential Sources of Impact

Potential sources of impact on water quality from the operation of the Western Section include:

- Cooling water discharge;
- Runoff from rail track;
- Station runoff; and
- Sewage generation at stations.

8.5.2.3 Prediction of Impacts

8.5.2.3.1 Cooling Water Discharge

No cooling water will arise as air-cooled air conditioning systems will be adopted in all five stations in the Western Section.

8.5.2.3.2 Runoff from Rail Track

Discharges of track runoff may be contaminated with SS (including metals from track grindings and corrosion of rolling stock and other equipment) and oil or grease arising from train or container trucks. With appropriate measures to minimise potential sources of contamination, there should be no difficulty in complying with the TM standards.

8.5.2.3.3 Station Runoff

Rainwater runoff from stations is expected to be "clean" and therefore should have no impact on the WSRs.

8.5.2.3.4 Sewage Generation

Sewage will be generated at all Western Section stations. Uncontrolled discharge of sewage will cause unacceptable water quality impacts on the WSRs. Approximately 123,006 l of sewage will be generated each day, of which 17,946 l is generated by staff, 98,460 l is generated by public and the rest will be wastewater produced by the general water usage. A foul water disposal schematic is used as a collection system and discharged to the existing sewerage system. The Engineering Design Consultants has estimated that, without the station property development, the sewage discharge for each station along the Western Section will be approximately 7 l s^{-1}. The capacity of existing sewer should be adequate to receive the discharge at all stations and this will be confirmed by EPD subsequently.

All Western Section stations are located within the town areas, so that sewage will be collected and disposed to local sewers.

8.5.2.4 Evaluation of Impacts

Net (unmitigated) water quality impacts on the WSRs will arise from discharges from the stations and rail track. The net impacts on water quality from the operation of the Western Section will include rainwater runoff from station areas, and domestic sewage generated from all stations.

8.5.2.5 Recommended Mitigation

The following measures should be adopted, wherever appropriate, for the operation of the Western Section:

- A surface water drainage system should be provided to collect track runoff. Where oils and lubricating fluids could be spilt, the track drainage channels discharge will pass through oil and grit interceptors/chambers to remove oil, grease and sediment before being pumped to the public stormwater drainage system via a rising main;
- Sewage effluents are required to meet the TM standards;
- Silt traps and oil interceptors should be regularly cleaned and maintained in good working order. The efficiency of these installations is dependent on regular cleaning and maintenance; and
- Oily contents of the oil interceptors should be collected for reuse, or transferred to an appropriate disposal facility.

8.5.2.6 Residual Impacts

With the adoption and incorporation of appropriate drainage and effluent collection systems (to be specified by the engineering Design Consultants), minimal residual operational water quality impacts are expected.

8.5.3 Conclusion

This water quality assessment has determined that no insurmountable residual water quality impacts should result from the construction and operation of the Western Section, provided that the mitigation measures described are implemented.

8.6 Landscape and Visual Issues

8.6.1 Existing Landscape Context

8.6.1.1 Landscape Character

From it junction with the Northern Section west of Au Tau, the Western Section of the railway heads through Yuen Long before turning Southwest to Tin Shui Wai and then to the south towards Tuen Mun. The railway passes through five character zones : the three urban settings of Yuen Long, Tin Shui Wai and Tuen Mun, and the two rural areas separating these towns.

Through Yuen Long the route will run on elevated structure above the line of the Yuen Long Nullah, fronted on either side by low and high rise industrial commercial and residential developments. The structures will be seen within a relatively narrow urban corridor of low scenic value dominated by the character of the open concrete-lined nullah and adjacent hard paved road surfaces and will be seen against a building backdrop of the mixed urban land uses of Yuen Long.

Between Yuen Long and Tin Shui Wai the route continues on elevated structure across a large scale lowland landscape of low to medium scenic value where the traditional pattern of the landscape is characterised by the pockets of farmland, the presence of streams and fishponds and the scattered rural settlements, has been infilled with container or open storage land uses.

The route will be elevated on viaduct as it passed Tin Shui Wai and will be seen in the context of the predominantly high rise urban developments to the north of Tin Fuk Road. To the south of the route alignment the landscape is flat, open and less developed than the northern area of Tin Shui Wai although there are a number of major road corridors. Overall the area is considered to be of low to medium scenic value.

From Tin Shui Wai, West Rail continues in a southerly direction on viaduct. The route passes over flat low lying land where the traditional agricultural land use pattern has been largely subsumed by small scale industrial and open storage land uses with extensive village house style residential development. The landscape is generally of low to medium scenic value.

As the route runs south towards the Tuen Mun valley the landscape changes from open low-land industrialised countryside to a more suburban intimate area of low to medium scenic value enclosed by the hills to the east and west of Tuen Mun. West Rail will run on viaduct across Castle Peak Road and the Light Rail Transit and will be visible from the rural villages of the surrounding Countryside.

Tuen Mun is located in the valley between the hills of Castle Peak and Tai Lam Country Park. The route will run on viaduct in a southerly direction to Tuen Mun North Station and will be visible from the community buildings and residential properties in the villages to the north of the station area. From Tuen Mun North Station to Affluence Garden Housing Estate the route will be at grade. It will be seen in the context of the nullah and associated road corridors and against an urban backdrop of low to moderate scenic value consisting largely of high rise commercial and residential land uses. From Affluence Garden to Tuen Mun Centre Station the railway will be on viaduct and will cross the town nullah. It will be clearly visible from the high rise residential and ground level areas within the Tuen Mun River corridor.

8.6.1.2 Visual Envelope

The Western Section is almost entirely on viaduct and will be the most visible section of West Rail. The visual envelope is shown on *Figure 7.6a, Annex G.*

Between Yuen Long and Long Ping Stations the scale of the buildings either side will restrict middle and long distant visibility of the elevated structure resulting in a strictly localised visual impact.

From Long Ping to Tin Shui Wai the rural landscape is flat and open and the visual envelope will be extensive. There will be long distant views of the railway viaduct from the hilltop pagoda within Yuen Long Town Park, from the local rural villages and from the surrounding countryside.

Within Tin Shui Wai the route will be elevated and will be seen in the context of low and high rise urban developments to the north of Tin Fuk Road. To the south of the route the landscape is flat, open and less developed than the northern area of Tin Shui Wai and the visual envelope will be extensive.

Between Tin Shui Wai and Tuen Mun the railway will be on low viaduct. There will be local views from the rural villages and middle and long distant views from the surrounding flat countryside and settlements. The visual envelope will be extensive.

As the railway approaches Tuen Mun, visibility of the elevated structure will be restricted to those developments within the immediate surroundings of the railway and visitors to the Tuen Mun Riverside Park (Area 35).

8.6.1.3 Visually Sensitive Receivers

Visually Sensitive Receivers for the Western Section are listed in *Table 8.6a, Annex G* and shown on *Figures 8.6a-d, Annex G.*

8.6.2 Sources of Impact

Potential sources of landscape and visual impact during the construction and operational phases are identified below.

8.6.2.1 Construction Phase

- Site access and haul routes, including traffic movements.
- Cut and fill, including storage of existing topsoil for reinstatement works.
- Concrete falsework
- Cranes and lifting gear for constructing viaducts.
- Materials stockpiling, construction equipment and plant.
- Utilities, including water, drainage, power and lighting.
- Temporary parking and on site accommodation and working areas.

8.6.2.2 Operational Phase

- Station buildings, EVA's, car parks and service areas.
- Viaducts.
- Noise Barriers.
- Noise Enclosures.
- Embankments.
- Boundary fencing, signage.

8.6.3 Evaluation of Impacts

8.6.3.1 Construction Phase

8.6.3.1.1 Landscape Impact

Impact on Landscape Resources

West Rail will have generally a low level of impact on landscape resources in the urban areas, due to the absence of mature vegetation, landscape features or public amenity.

In the Yuen Long urban area the route will cause disruption to roadside footpaths and some isolated trees and vegetation particularly at Kau Hui village. However, it is likely to have only a very slight negative impact on existing landscape resources. The planting of trees along existing pavements either side of the nullah, in amenity areas and around columns, and improvements to local footpaths will increase the overall level of landscape resources resulting in a slight beneficial impact.

Between Yuen Long and Tin Shui Wai the route is likely to have a slight negative impact on the existing landscape resources through the loss of agricultural land and marginal vegetation for construction space. Reinstatement of the existing land uses under the alignment will reduce the impact to a very slightly negative effect on landscape resources in the long term.

From Tin Shui Wai to the southern end of the Tuen Mun valley the route is likely to have a slight negative impact on the existing landscape resources through the loss of agricultural land local pedestrian accesses, private open space and marginal vegetation for construction space. The reinstatement of the existing land uses under the alignment will result in a very slightly negative impact on landscape resources in the long term.

In the Tuen Mun urban area the construction of West Rail will cause severe temporary disruption to the promenade within Tuen Mun Riverside Park (Area 35), and disturb the use of several footpaths, some roadside trees and vegetation elsewhere in the town along the route. The redesign of the Riverside Park on top of the railway corridor and the planting of trees along existing pavements either side of the nullah, in amenity areas and around columns, and improvements to local footpaths will increase the overall level of landscape resources resulting in a slight beneficial impact on landscape resources during the operational period.

The construction of West Rail will also have an impact on topsoil reserves along the route particularly where the construction works will require the removal or temporary relocation of landscape resources i.e. within the rural areas between Yuen Long, Tin Shui Wai and Tuen Mun. The impacts on topsoil removal can be minimised by storage of topsoil according to Government Standards. These comprise storage of topsoil in an area where it will not be disrupted by engineering works, storing heaps at a maximum height of 2 m, carrying out tests on nutrient and organic status, practising weed control, and turning the topsoil heaps to prevent anaerobic conditions occurring. Top soil should also be placed in its final position within 12 months of importation to site.

Impact on Landscape Character

The introduction of such a large scale structure at an elevated level is likely to cause a distinct change in the character of the streetscape alongside the Yuen Long Corridor. As the quality of the landscape is very low the introduction of construction activity and disruption of local traffic and pedestrians is likely to result in only a slight negative impact on the character of the landscape.

Architectural treatment of the elevated deck and supporting structures, in the Yuen Long section will help give the development a distinct character of its own and give focus to the existing corridor, distracting attention from unsightly elements such as the industrial buildings and the nullah. Planting along existing streets and in association with the structures will also improve the general environment. There is likely to be a slight beneficial impact on the character of the landscape in the operational phase, as a result.

Between Yuen Long and Tin Shui Wai, the linearity of the route, and the elevated nature of the structure will be in stark contrast to the existing landscape character of the open low lying plain. This is likely to result in a moderate negative impact during construction

However, reinstatement of the existing land uses under the alignment between Yuen Long and Tin Shui Wai will reduce the impact on landscape character to slight negative, in the operational phase.

Within Tin Shui Wai the linearity of the route and its elevated nature of the structure will be seen in the context of the predominantly high rise urban developments to the north of Tin Fuk Road sand and open low lying plan to the south. The introduction of the elevated route and associated construction activity is likely to result in a moderate negative impact on the character of the existing landscape during construction. Reinstatement of the existing urban land uses under the alignment at Tin Shui Wai will reduce the impact on landscape character to slight negative, in the operational phase.

The viaduct from Tin Shui Wai to Tuen Mun valley will be in contrast to the small scale pattern of the mixed agricultural / residential / industrial character existing landscape character. The introduction of a large scale, linear element at an elevated level with the associated construction activity is likely to result in a moderate negative impact on the character of the existing landscape during construction. Reinstatement of the existing land uses under the alignment will reduce the impact on landscape character to slight negative, in the operational phase.

Between Tin Shui Wai and Tuen Mun West Rail will be on low viaduct. The nature of the elevated structure will be in contrast to the small scale pattern of the mixed agricultural / residential / industrial character of the existing landscape. The introduction of a large scale, linear element and the associated construction activity, together with the loss of mature vegetation in the rural section south of Tin Shui Wai, is likely to result in a moderate negative impact on the character of the existing landscape during construction. Woodland planting along the embankment will help to screen the railway and provide structure to the local landscape pattern which will result in a slight beneficial impact on landscape, in the operational phase.

Mui Fat Buddhist Monastery, which is a site of historical and cultural interest is located near to the alignment within the suburban area north of Tuen Mun. There will be slight disruption to the area during the construction period resulting in a temporary negative impact on the landscape character surrounding the Monastery. However, the route of West Rail is adjacent to the existing LRT and Castle Peak Road and upon completion of reinstatement work under the viaduct there will only be a slight negative impact on the landscape character of the area in the long term.

The introduction of such a large scale structure at an elevated level is likely to have a distinct change in the character of the streetscape alongside the Tuen Mun nullah corridor.

As the quality of the landscape is low to moderate the introduction of construction activity and disruption of local traffic and pedestrians is likely to result in only a moderate negative impact on the character of the landscape, during construction. Architectural treatment of the elevated deck and supporting structures, will help give the development a distinct character of its own and give more focus to the existing corridor, distracting attention from unsightly elements such as the industrial buildings and the nullah. Planting along existing streets in Tuen Mun and in association with the structures would also improve the general environment and reduce the overall impact of the railway to a slight negative impact in the operational phase.

There will be thirteen temporary construction sites in the Western Section as shown on Figures 8.6a-d, three of the sites are major works areas and nine are minor. One of the major works areas is located immediately adjacent to the Yuen Long station on the northern side in between Tung Tau Tsuen and Sun Yuen Long Plaza near to Kau Tui Village. It will be used during the construction of the Yuen Long station. The area is currently used as open space for residents of Kau Tui Village, although there are no formal recreation facilities in the area. There is no vegetation of ecological significance in this area and as a result it is likely that existing trees will be either relocated elsewhere on the site or felled at the start of the construction period and where possible trees around the perimeter of the temporary works area north of the station will be retained. This will have a substantial negative effect on the landscape character and resources of the immediate area. A new road to Yuen Long Kau Hui and to the proposed station will run in an east-west direction broadly parallel to the temporary works area and it is recommended that screen planting be established along the roadside embankment. This will reduce the negative impact on landscape character and resources to moderate negative during the construction period.

The second major temporary works areas is located north west of Tin Shui Wai station. This site is currently vacant and used as a temporary /informal parking area and would be used for the storage of materials, plant, temporary accommodation and carparking associated with the construction of the adjacent station and viaduct. There are two sites of historical and cultural interest bordering this works area on the southern edge. The works area will not affect vehicular access to these historic sites although the current pedestrians footbridges will be removed during the construction of the station. This will have a slight negative impact on landscape character and resources of the area.

The third major temporary works area is located west of the village of Tin Sam in the rural area north of the Tuen Mun valley. The area is currently used for marginal agriculture and container storage and will be used for general storage of materials, plant, temporary accommodation etc. associated with the construction of the viaduct. There will be disruption to the agricultural land in this area during the construction period resulting in a slight negative change to the surrounding landscape character.

The nine minor sites are located between Yuen Long station and Tuen Mun Central station. Most of the sites are in the urban areas within vacant sites and will be used for the storage of materials, plant, temporary accommodation and carparking associated with the construction of the viaduct. There are no areas of vegetation or landscape features on these sites which could be disrupted during the construction period.

8.6.3.1.2 Visual Impact

An assessment of the residual visual impacts during the construction phase is shown in *Table 8.6a, Annex G* and illustrated in *Figures 8.6a* and *b, Annex G*. This assessment assumes that the appropriate mitigation measures identified below have been implemented.

In the IAR, the railway alignment between Tin Shui Wai and Tuen Mun North Station (*Figures 8.6b,c,f* and *g)* included sections of embankment. The ongoing design of West Rail has resulted in these sections of embankment being replaced by viaduct.

This has required the reassessment of visual impacts. When the railway was on embankment, the impacts arising from the visual obstruction and intrusion would be part-mitigated by planting the embankment with trees and shrubs thereby creating a green planted mound; the mitigation would change an initial impact of moderate negative to very slight negative. The replacement of the embankment by viaduct would eliminate the high level of visual obstruction and intrusion created by the embankment and allowed retention of views through the elevated structure. The ground under the viaduct would be reinstated to its previous condition. The visual impact of the structure itself would be part mitigated by careful architectural and enginnering detail to all the visible elements.

It has therefore been perceived that substituting the embankment for the viaduct would have a neutral effect on the assessment hence no significant change to the text or tables was carried out other than removal of reference to the embankment within these specific areas.

8.6.3.1.3 Mitigation Measures

Recommended mitigation measures for impacts caused during the construction process 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.
- Careful positioning of construction plant.

8.6.3.1.4 Residual Impacts

The effect of the mitigation measures will minimise as far as possible the potential visual impacts. The residual impacts are tabulated in detail in *Table 8.6a, Annex G* and illustrated in *Figures 8.6a* and *b, Annex G.*

The main visual impacts will be experienced by the residents of urban developments and community facilities located immediately adjacent to West Rail where it passes through the Yuen Long, Tin Shui Wai and Tuen Mun.

At Kwan Lok San Tsuen, within the Yuen Long urban area there will be temporarily a very substantial negative visual impact during the construction period due to the proximity of the village to the viaduct (between 50-150m), to Yuen Long Station (300-400m) and to Long Ping Station (300-400m). Impacts on the village will be high particularly during the construction period because of the high degree of visual obstruction of south west views over the nullah, the intrusion to distant views caused by the elevated stations and the proximity of the temporary works area to the south west of Kwan Lok San Tsuen. However, the viaduct track level will be approximately 20m above adjacent ground level (Long Yip Street) and will not obstruct long term ground level views. Sensitive architectural treatment to the concrete pillars of the viaduct and to all visible engineering structures in addition to ground level environmental improvements e.g. street tree planting, will help to reduce the visual impact of the railway in the operational period.

The construction of Yuen Long Station and the adjacent temporary works area will require the removal of a proportion of the trees between Tung Tau Tsuen and Sun Yuen Long Plaza near to Kau Tui Village. There is no vegetation of ecological significance in this area and as a result it is likely that existing trees will be either relocated elsewhere on the site or felled at the start of the construction period. Where possible trees around the perimeter of the temporary works area north of the station will be retained to reduce the visual impact during both the construction and operational periods of the railway. A new road to Yuen Long Kau Hui and to the proposed station will run in an east-west direction broadly parallel to the temporary works area and it is recommended that screen planting be established along the roadside embankment to mitigate the permanent visual impact of the station upon Kau Hui Village.

Long distance views of West Rail will be possible from within Tai Lam Country Park. As these are from generally higher elevations than the views from within the surrounding lowlands, the mitigation measures employed during the construction period will tend to be less effective than for views from the valley floor. However the fact that views of West Rail will be long distance and will be part of much wider panoramic views to the north and west, will reduce the significance of the visual impact on users of the Country Park to almost zero.

In general significant but short term negative impacts will be experienced by some rural villages located adjacent to the viaducts in the countryside between the urban areas during construction. As the distance from the railway increases, the visual impact upon villages and farmland within the low-lying areas will reduce, although the railway viaducts will be visible for several hundred metres.

8.6.3.2 Operational Phase

8.6.3.2.1 Landscape Impact

Impact on Landscape Character

Architectural treatment of the elevated deck and supporting structures, and planting along existing streets and around the structures in the Yuen Long section will increase the level of landscape resources and reduce the overall negative impacts on the landscape character.

Reinstatement of the existing land uses under the alignment between Yuen Long, Tin Shui Wai and the southern end of the Tuen Mun valley will result in a very slight beneficial impact on landscape resources therefore reducing the impact on landscape character to slight negative, in the long term.

Architectural treatment of the elevated deck and supporting structures in the Tuen Mun Section and planting along existing streets in association with the structures and the reprovisioning of public open space near to the alignment to compensate for facilities lost within the Riverside Park (Area 35) will result in a slight beneficial impact on landscape resources, and on the character of the landscape.

8.6.3.2.2 Visual Impact

An assessment of the residual visual impacts during the operational phase is shown in *Table 8.6a, Annex G* and illustrated in *Figure 8.6c-d, Annex G.* This assessment assumes that the appropriate mitigation measures identified below have been implemented.

8.6.3.2.3 Mitigation Measures

The *Landscape Design Strategy Report* has proposed design principles for all landscape and visual aspects of West Rail, as a guide for the detailed design by all engineering Design Consultants. These design principles form the essential basis of the mitigation measures to be employed to minimise negative impacts and create the potential for positive impacts.

The principle design recommendations that are applicable to the Western Section are listed below:

- Create a co-ordinated design of all engineering structures including viaducts, bridges catenary support systems, noise barriers, noise enclosures, trackside equipment etc. that adopt a rounded curvilinear form so as to create a modern streamlined image as well as minimising visual impacts;
- Soften and screen engineering structures with planting wherever possible;

- Plant embankments with indigenous vegetation;
- Redirected drainage channels to adopt bio-engineering methods;
- Agricultural land to be reinstated under viaduct wherever practical;
- Use transparent screens for noise barriers and noise enclosures to permit passenger views out, and also to give the elevated structures a less massive appearance;

Figures 8.6i-k in *Annex G* show examples of railway design at stations.

8.6.3.2.4 Residual Impacts

The effect of the mitigation measures will be to substantially reduce the potential negative visual impacts. However, some residual negative impacts will remain. These are tabulated in detail in *Table 8.6a, Annex G* and illustrated in *Figures 8.6c* and *d, Annex G.*

As in the construction phase, the most significant impacts will be experienced by the residential areas and community facilities such as located immediately adjacent to West Rail where it passes through Yuen Long, Tin Shui Wai and Tuen Mun. This is because even with an appropriate sensitive design, the viaduct structures will be visually intrusive simply as a result of their physical presence. Long distant views will also be available from vantage points and recreational areas outside the spatial scope of the assessment area i.e. the hilltop pagoda in Yuen Long Town Park.

Similarly, there will be residual negative impacts in the rural areas, where even a sensitively designed elevated structure will be intrinsically intrusive. However, as the distance from the railway increases, the visual impact upon villages and farmland will reduce, although the railway viaducts will be visible for several hundred metres.

8.6.4 Conclusion

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 activity will result in a slight negative impacts on these streetscapes, but the innovative quality of the structures with associated planting and street improvements will result in slight beneficial 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 and woodland planting 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 substantial negative visual impacts.

Visual impacts during the operational phase will be considerably less, through the implementation of the design principles set out in the Landscape Design Strategy Report. Nevertheless, there will remain some moderate negative visual impacts that will be felt principally by the residential and community uses immediately adjacent to the elevated structures in the urban areas.

8.7 Landuse Issues

This section outlines the landuse issues in relation to West Rail from Yuen Long to Tuen Mun. A detailed appraisal of the land use impacts of the railway in this section has been studied by the engineering Design Consultants; the findings of these studies, and recommended mitigation options, have been developed in liaison with the relevant Government departments and affected bodies and have been reported, in detail, elsewhere.

8.7.1 Landuse Context

This section outlines, in broad terms, the pattern of land use affected by the development of the Western Section of West Rail.

For the purposes of description the alignment of the Western Section of West Rail is divided into three sections. These are Yuen Long to Tin Shui Wai; Tin Shui Wai to Tuen Mun North; and Tuen Mun North to Tuen Mun Centre. The five stations on the Western Section: Yuen Long, Long Pin, Tin Shui Wai, Tuen Mun North and Tuen Mun Centre are assessed separately.

8.7.1.1 Yuen Long to Tin Shui Wai

The proposed rail alignment, shown in *Figure 8.6a (Annex G),* between Yuen Long and Tin Shui Wai Stations can be divided into two distinct sections, according to their local development character.

- The Urban Section: This section generally follows the alignment previously proposed in the earlier West Rail feasibility studies and will avoid the built-up areas. The alignment is largely confined to the Yuen Long Northern By-pass and to the existing nullah areas. The alignment in this section is considered to have minimal impact in land use terms, having recognised and avoided both existing and planned developments.
- The Rural Section: This section of the alignment runs through an area of low-rise village development, temporary structures and abandoned farmland. The alignment will impact upon two villages, namely Shui Tin Tsuen and Fung

Chi Tsuen (R44 and R45 in *Figure 8.6a* in *Annex G*). Temporary alternative access will be provided to these villages until such time restitution or alternative circulation systems are completed.

8.7.1.2 Tin Shui Wai to Tuen Mun North

This section is located in the Tuen Mun-Yuen Long Corridor, which is semi-urban with mixed land use. The railway alignment will have impact upon a number of land use zonings including village-type housing, open storage, workshops, temporary structures and cultivated and abandoned farmland. Of particular significance are three recognised villages upon which the alignment is anticipated to encroach: Shek Po Tsuen, Tin Sam and Tsing Chuen Wai shown as R/I 4 and R/I 6 in *Figure 8.6b* and R/I 9 in *Figure 8.6c* respectively in *Annex G.*

The general land use planning intention for the area is to regulate informal industrial and storage uses and to encourage residential intensification in certain locations. The development of West Rail in the area does not conflict with this objective, and indeed could in fact provide a catalyst for it.

8.7.1.3 Tuen Mun North to Tuen Mun Centre

This section of the railway, connecting Tuen Mun North and Tuen Mun Centre Stations, is proposed to run along Tuen Mun Nullah. The section comprises a length of approximately 900 metres on the west bank of the nullah and the remaining on viaduct above the nullah. The alignment is anticipated to encroach upon the linear open space and cycle path along the nullah as shown in *Figure 8.6d.* The placement of the railway on a viaduct allows the cycle track connections and the open space to be maintained. The proposed rail alignment by-passes the built-up areas of Tuen Mun New Town.

8.7.1.4 Yuen Long Station

The station site is located on the eastern fringe of Yuen Long New Town. According to the Draft Yuen Long OZP (No. S/YL/2), the site has been zoned for 'Other Specified Uses - Rail Interchange' near the alignment, 'Open Space', 'Village', and 'G/IC' to the north and south. The southern 'G/IC' zone is currently used as a bus station. It is intended that this use be maintained through the construction period and during the operation of West Rail. Some 'G/IC' facilities are anticipated to be affected during construction. The impact however, is expected to be low after reprovisioning.

8.7.1.5 Long Ping Station

The station site is bounded by Wang Yip Street South to the east, Yuen Long On Ning Road to the south, Chun Yi Square to the west and Long Ping Estate to the north. The proposed station site encroaches upon a section of the Yuen Long Northern By-pass, a number of G/IC facilities and the Yuen Long Nullah.

8.7.1.6 Tin Shui Wai Station

The proposed station site is located between Tin Shui Wai New Town and the Ping Shan area. The site encroaches upon sections of Tin Fuk Road and Ping Ha Road, and an area currently occupied by a lorry park to the east of Tin Fuk Road. The proposed station site also covers an area of vacant land and a site designated for a WSD regional maintenance depot. The land resumption for the station is therefore likely to be a complicated process.

8.7.1.7 Tuen Mun North Station

The proposed station site is located on the northern fringe of Tuen Mun New Town immediately to the east of Siu Hong Court. The site encroaches upon a section of Tuen Mun Nullah, Siu Hong LRT stop, the LRT track through Siu Hong Court, and part of a linear public open space used for passive recreation. The station arrangement has been designed in order to ameliorate the impacts on these facilities.

8.7.1.8 Tuen Mun Centre Station

The station site is in the centre of Tuen Mun close to Tuen Mun Town Park, which is shown as OS11 in *Figure 8.6d (Annex G)*. The site encroaches onto an area currently occupied by San Fat Estate (R59), a local playground, a section of Ho Pong Street and a small portion of Tuen Mun Nullah.

San Fat Estate, which currently has a population of around 4,000, is programmed for redevelopment by Housing Department in 2001. Physical and social interfaces may arise between the estate redevelopment and the proposed West Rail station. Consideration has been given to a comprehensive station development which will cover the site currently occupied by San Fat Estate. Housing Department have indicated that any disruption to the estate would require reprovisioning.

8.7.2 Community Issues

This section identifies in the broad community issues arising from the development of the Western Section of the railway. Likely areas of concern to local communities include land and property rights, community facilities, accessibility, historic and cultural values, and visual amenity. These have been studied in detail by the engineering Design Consultants and careful design has been developed to minimise potential impacts.

For the purposes of description, the appraisal of community issues assesses the alignment as a whole and examines the stations separately.

8.7.2.1 Alignment

The alignment will encroach onto a number of private properties including several indigenous villages. Compensation is likely to be required in the resumption process.

Graves and burial grounds in the rural areas, such as the clan graves in Lam Tei, may be affected. This is likely to cause concern to the local community. The relocation of affected graves and shrines as well as financial compensation will be required.

The railway will affect the access to and from some local communities, severing or disrupting roads, footpaths and footbridges in certain locations, as well as impact on agricultural infrastructure such as irrigation facilities. Temporary disruption of utilities may also result from the construction of the railway. The engineering Design Consultants have examined strategies to minimise the impact of West Rail development on existing utilities and infrastructure, and affected infrastructure will be reprovisioned where appropriate.

Potential visual and *fung shui* impact on villages along the alignment, such as Fung Chi Tsuen, Shui Tin Tsuen, Tung Tau Tsuen, Choi Uk Tsuen and Nam Pin Wai is a key issue and the engineering Design Consultants have developed sensitive design measures to minimise the impact.

8.7.2.1.1 Yuen Long Station

A number of well-known temples with historical significance are located in the vicinity of the station site. These temples will not be physically affected by West Rail.

There are a number of established *fung shui* features, such as *fung shui* ponds, in close proximity to the station site. Consultation between the KCRC and local officials has sought to ensure that the station development will be carried out with deference to these features.

The station will be visually noticeable from adjacent developments such as the recognised villages to the north and the Sun Yuen Long Centre. Sensitive design and landscaping has been considered to ameliorate the visual impact of the station.

8.7.2.1.2 Long Ping Station

The proposed station development may disrupt important existing pedestrian/cycle linkages between Long Ping Estate (R43 in *Figure 8.6a*) and the existing town centre to the south. Improved access to existing community services in the south has been considered as part of the station development.

Visual impacts on nearby residential areas, such as Long Ping Estate are anticipated due to the proximity of the station development. Careful architectural design and attractive landscaping treatment have been considered in order to minimise possible adverse visual impact brought about by the station development.

8.7.2.1.3 Tin Shui Wai Station

The proposed station will not result in direct physical impact on any known *fung shui* features. However, the development may be deemed by local community members to cause disruption to features of local significance such as the *fung shui* hill, pagoda. ancestral halls, temples and shrines. Considerations to minimise potential impacts have been made by the engineering Design Consultants, in liaison with local communities, to identify satisfactory arrangements.

The station is likely to have a visual impact on adjacent developments, particularly the villages to the south. Again, sensitive architectural design and landscape have been investigated by the engineering Design Consultants.

8.7.2.1.4 Tuen Mun North Station

The station development will disrupt an amenity area alongside the nullah which is popular amongst local residents. Reprovisioning options have been considered by the engineering Design Consultants.

The station is anticipated to have impact upon the visual amenity of Siu Hong Court (R55 in *Figure 8.6d* in *Annex G)*. Sensitive design has been considered to minimise any negative impact.

8.7.2.1.5 Tuen Mun Centre Station

The proposed station development may encroach onto a primary school (M17 in *Figure 8.6d* in *Annex G*) and a well used playground adjacent to it. The reprovisioning of these facilities is currently under consideration.

8.7.3 Residual Impacts

The development of the Western Section of West Rail is likely to provide a catalyst to development in the North Western New Territories as a whole. This is especially the case along the Tuen Mun-Yuen Long Corridor and in areas around the proposed stations. It is also likely to have a positive impact on property prices and lead to redevelopment of under-utilised land.

West Rail will improve transport linkages to the main metropolitan area and thereby provide greater accessibility to major centres of employment. This is particularly important to Tuen Mun residents. Conversely, with convenient access to Tuen Mun provided by West Rail, opportunities exist for decentralisation of employment in Hong Kong.

8.7.4 Conclusion

The Western Section of West Rail is proposed to pass through the built up areas of Tuen Mun and Yuen Long, as well as the semi-urban Tuen Mun-Yuen Long Corridor. West Rail encroaches on a number of existing land uses including residential and industrial development, infrastructure, villages and community facilities.

As a result of West Rail development, compensation to landowners and tenants will be required in many instances and a number of infrastructure links and facilities will require reprovisioning. Careful consideration has been given to the integration of the alignment and stations into the existing urban environment so as to minimise its visual and physical impact. In addition, there are a number of features of *fung shui* significance along the alignment that must be taken into account to allay community concerns.

8.8 Archaeological and Cultural Issues

8.8.1 Existing Conditions

No buildings or structures of known historical interest are to be directly impacted by the West Rail alignment in the Western Section. However, a number of buildings of historic interest are located within 100 metres of the West Rail alignment comprising:

- The ***Tin Hau Temple at Shui Tin Tsuen*** to the west of the proposed Long Pin Station which is located some 80 metres from the alignment. The temple dates from *c.*1684 and is listed as a Grade 2 building by AMO. A much later but associated former nunnery is located adjacent to the temple.

- The ***Tat Tak Kung Sho*** at Hang Mei Tsuen is listed as a Grade I building and is located to the northeast of the proposed Tin Shui Wai Station, some 80 metres from the alignment.

- The ***Tsui Shing Lau Pagoda*** is located some 40 metres south of Tin Shui Wai Station and is the only historical pagoda still standing in Hong Kong. Local tradition credits Tang Yin-tung, a member of the 7th generation of the Tang clan, as having built the Pagoda in 1486 during the Ming Dynasty. The three storey Pagoda is six-sided and built of grey brick with granite blocks around the entrance doorway; it is said to have been originally seven storeys high. Although To Ti and Kwan Tai are worshipped at Tsui Shing Lau, the Pagoda is said to principally serve a *fung shui* purpose and is associated with a number of *fung shui* elements within the local landscape, including the *fung shui* hill at Hang Mei Tsuen to the east.

In addition, the Miu Fat Buddhist Monastery at Fu Tei is located approximately 100 metres from the proposed West Rail alignment to the north of Tuen Mun North Station.

Preliminary data gathering has shown that no known archaeological sites will be directly affected by the West Rail alignment. The modelling of archaeological potential has, however, identified a number of discreet areas of high archaeological potential.

8.8.2 Potential Sources of Impact

The heritage resources of the Western Section area will potentially be impacted by activities associated with the construction, permanent landtake and operation of West Rail.

Both temporary and permanent landtake may result in damage to, or loss of, archaeological remains and deposits, the removal of historic buildings, standing archaeological monuments or culturally significant features and changes to the setting of buildings and monuments and to the physical coherence of historic landscapes.

Subsoil archaeological sites may be affected by:

- Disturbance through excavations at or near the site, topsoil stripping and the passage of heavy machinery on exposed deposits;
- Disturbance by machinery working on the present surface where there are extant earthworks;
- The burial of sites resulting in a limitation on accessibility for future archaeological investigations (including surface survey and remote sensing techniques) and obscuring visible surface evidence; and
- The introduction of archaeological material with spoil from other sites.

In addition, severance and "islanding" may result from permanent landtake required for the West Rail alignment and associated permanent features and from temporary landtake required during construction to accommodate haul roads and construction sites. Areas of historic and cultural interest may be severed, thereby altering or destroying their integrity.

Ground compaction due to construction activities or the weight of permanent embankments may cause damage or distortion to buried archaeological remains, especially in soft alluvial deposits.

Visual and noise intrusion on the setting and amenity of historic and cultural resources may occur where the route passes close to historic buildings, gravesites, archaeological sites and monuments and culturally or historically significant landscape features.

8.8.3 Prediction & Evaluation of Impacts

8.8.3.1 Historic Buildings

No buildings or structures of known historical interest are to be directly impacted by the West Rail alignment.

The Tin Hau Temple at Shui Tin Tsuen and the Tat Tak Kung Sho at Hang Mei Tsuen are considered sufficiently distant from the alignment (both are located some 80 metres away) to ensure that no indirect impacts are likely to occur. The Tin Hau Temple will be largely screened from the alignment the existing townscape, whilst the landscape context of the Tat Tak Kung Sho is already dominated by the Ping Ha Road to the north. Similarly, the Miu Fat Buddhist Monastery at Lam Tei, which is located to the east of Castle Peak Road some 100 metres from the alignment, is not predicted to experience unacceptable noise impacts.

Concerns have, however, 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. The immediate setting of the pagoda has been severely compromised over recent years by the infilling of the fish ponds which once surrounded the building and their replacement by lorry parking areas and light industrial workshops. The Ping Ha Road and the high rise developments to the north and the school to the west have further altered the wider landscape context. The introduction of the West Rail alignment and associated Station will reinforce the recent developments and, whilst these will be constructed at some considerable elevation, they will be significantly lower than the existing high rise buildings. The visual impact of the Station structure will be mitigated through the adoption of sympathetic external design; discussions with the local village representative have revealed a local preference for a traditional Chinese architectural style to be adopted for the design of Tin Shui Wai Station.

The potential implications associated with the vibration impacts arising during construction and operation have also been identified as causes of concern As a result of the high level of vibration isolation in the permanent way design which incorporates soft resilient rail baseplates and floating slab track, and use of rubber bridge bearings, it is expected that vibration levels will be imperceptible to humans close to the columns supporting the viaduct. Since the most sensitive damage criteria for ancient buildings is above the thresholds of human perception, no structural damage to the Pagoda (located at approximately 40 m from the alignment) as a result of operational vibration will occur.

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 contraction related activities.

8.8.3.2 Archaeological Resources

Preliminary data gathering has shown that no known archaeological sites will be directly affected by the West Rail alignment. The assessment of archaeological potential has, however, identified a number of discreet areas as having a high potential. The evaluation of likely impacts in this area is currently underway and will inform the development of the Field Evaluation Programme. The AMO will continue to be consulted regarding the direction and progress of the heritage assessment.

In developing the predictive model of likely impact to archaeological resources, the Study Team has undertaken a number of activities in support of the predictive assessment including the evaluation of information revealed by borehole logs and the planning of a programme of direct observations of geotechnical investigations, particularly the excavation of test pits.

Habitat Map Showing Key Ecological Area in Western Section (Updated to Jan 98)

SCALE: 1/20,000

FIGURE 8.9a

usr2/ermhk/c1588/ecology

ERM

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Validation of this predictive model of archaeological potential is scheduled to be undertaken in early 1998. This will take the form of a series of Trial Pits and Auger Transects designed to test the accuracy of the maps of archaeological potential prepared on the basis of the Desk Top Study. The findings of the field testing will be formally reported to the AMO.

The completion of these ongoing tasks will enable the final predictive modelling to be completed. The model will then provide a basis for an assessment of the likely impact to archaeology along the alignment of the new railway. This archaeological impact assessment will be based upon the nature and extent of construction activities (*the level of impact*) and the predicted potential (*the predicted value of the resource*) of the area within which the activities are to take place.

The archaeological impact assessment will provide a basis for determining the need for field evaluation in advance of the construction of the new railway which will be advanced through the development (in consultation with the AMO) of a specification and programme for field evaluation (or trial work). This will be reported as Field Evaluation Programme and Protocols which will identify the significant impacts likely to arise during construction and operation and will formulate of a plan for the mitigation of identified impacts.

The first level of field evaluation will comprise non-intrusive surface examination of potentially impacted areas. If identified areas are clear of vegetation then a systematic surface collection will be made by walking parallel lines; if concealed by vegetation then any exposed areas will be searched. Densely vegetated land may be excluded from this stage of field evaluation, due to the time and cost of evaluation, and will be evaluated once Land Acquisition powers have been gained by the KCRC and clearance effected.

The field evaluation programme will identify the areas to be investigated and will produce field evaluation protocols determining the sampling technique (for example, test pit or trench), the sample rationale to be applied (numbers of required test pits; dimensions of pits, sampling grid, etc.) and the site record forms to be used during the field evaluations. The evaluation protocols would be produced with reference to those established in Hong Kong and would be compatible with the best field practice and data capture requirements of AMO.

Whilst the Field Evaluations fall outside the scope of the EIA Study, they would form part of the ongoing West Rail project and their commencement would be subject to the KCRC gaining powers of access to the identified areas within the study corridor.

The results of the Field Evaluations would form the basis for the development of an archaeological action plan detailing the measures to be adopted to provide appropriate mitigation of the impacts to buried archaeology. Although there are no standard criteria against which to assess the severity of impacts to cultural heritage, the appropriate actions will be defined and recommended based upon the following factors:

- The proportion of the feature affected and whether its key characteristics would be affected by the West Rail works;
- A consideration of the type, survival or condition, fragility or vulnerability, potential and amenity value of the feature affected, and
- Guidelines or criteria on noise, visual intrusion, etc. either in general or site specific terms, provided by other West Rail specialist teams.

The adopted mitigation measures might include the minimisation of ground disturbance in archaeologically sensitive areas, excavation in advance of construction and the provision of a watching brief during construction.

8.8.4 Recommended Mitigation

The mitigation of impacts to archaeological resources will be reported via the field evaluation programme and through ongoing discussions with the AMO's archaeological curator.

The indirect visual impacts to the Tsui Shing Lau Pagoda associated with the Tin Shui Wai Station structure will require sensitive mitigation through the adoption of sympathetic external design. It is recommended that due consideration be given to the local preference for a traditional Chinese architectural style to be adopted for the design of Tin Shui Wai Station so as to enable the Station to conform with the existing local environment.

8.9 Ecology

8.9.1 Baseline Conditions

Much of the Western Section lies within a predominantly urbanised area interspersed with small agricultural plots, small fish ponds, isolated marshes, and isolated stands of trees. These habitats are shown in *Figure 8.9a*.

8.9.1.1 Flora and Habitats

8.9.1.1.1 Yuen Long Marsh

Most of the marsh area encroached upon by the proposed alignment is at Yuen Long (the same marsh encroached upon by the Northern Section). As discussed in *Section 7.9.1.1.1*, it is a remnant of the previous Yuen Long Flood Plain, and is now surrounded by village houses and highways. It appeared to be mostly dry at the time of the March 1997 surveys.

8.9.1.1.2 Ping Shan

The Ping Shan woodland is a mixture of exotic plantations, orchards and natural woodland. Village houses and graves are scattered on the hillside. Tree species including *Acacia confuse*, *Delonix regia*, *Dimocarpus longan*, *Clausena lansium*, *Ficus microcarpa* and *Celtis sinensis* dominate the canopy. Grassland habitat occurs on the hilltop near the grave sites. North of Ping Shan is an open area which has been converted into a car park. There has been considerable construction activity associated with a number of projects, including drainage works on Tin Fuk Road during Spring 1997 and housing development at the foothill during Summer 1997. The general levels of disturbance in the area were high, and there was virtually no unaffected habitat.

8.9.1.1.3 Minor Streams

All minor streams in this Section have been or are being channelised. Water quality appeared to be poor, and the water was turbid and malodorous. The streams were of little ecological value in their existing polluted condition, but their water quality is improving due to progressive reductions in pollution loads (EPD, 1996). The extent of improvement will be constrained in part by the small size of the channels, their locations, and their configurations (most were vertical walled).

8.9.1.2 Fauna

The Western Section passes through no habitats which are considered important for the conservation of local or regional fauna biodiversity. All habitats along the alignment have been altered by development of residential areas, transportation infrastructure and flood control facilities. Only common and disturbance-tolerant wildlife was recorded along the alignment.

Reptiles such as the Changeable Lizard (*Calotes versicolor*), amphibians such as Gunther's Frog (*Rana guentheri*), and birds including Bulbuls (*Pycnonotus* spp.), Tree Sparrows (*Passer montanus*), Magpie Robins (*Copsychus saularis*), Black-faced Laughing-thrushes (*Garrulax perspicillatus*), and Japanese White-eyes (*Zosterops japonica*) were recorded along the alignment during spring and summer 1997. These are common and widespread species which are typically associated with village environments in Hong Kong. A single mammal was observed in the Western Section: an adult female House Shrew (*Suncus murinus*). The House Shrew is a common village resident in Hong Kong (Hill and Phillipps, 1981).

8.9.2 Potential Sources of Impact

Direct habitat loss would be expected to be the most serious potential source of impact, but due to the degraded nature of flora and fauna habitats, there are no habitat losses which would be considered severe.

8.9.3 Prediction of Impacts

Table 8.9b presents the expected habitat loss in the Western Section which was estimated using the grid count method and based on the maps given in *Table 8.9a.*

Table 8.9a Land Requirement Maps Used for Calculation of Habitat Loss for the Western Section

DRG #	Scale	DRG #	Scale
GTS200-C-0351	1:2000	GTS200-C-0361	1:2000
GTS200-C-0352	1:2000	GTS200-C-0362	1:2000
GTS200-C-0353	1:2000	GTS200-C-0363	1:2000
GTS200-C-0354	1:2000	GTS200-C-0364	1:2000
GTS200-C-0355	1:2000	GTS200-C-0365	1:2000
GTS200-C-0356	1:2000	GTS200-C-0366	1:2000
GTS200-C-0357	1:2000	GTS200-C-0367	1:2000
GTS200-C-0358	1:2000	GTS200-C-0368	1:2000
GTS200-C-0359	1:2000	GTS200-C-0369	1:2000
GTS200-C-0360	1:2000	GTS200-C-0370	

Table 8.9b Estimated Habitat Loss Caused by the Western Section

Habitat	Permanent (ha)	Temporary (ha)
Grassland	1.98	0
Active Agriculture	6.2	1.68
Abandoned Agriculture	0.5	0
Woodland	1.68	0.98
Shrubland	0	0
Fish Pond	2.02	2.12
Marsh	3.92	0
Urbanised/Disturbed	76.62	17.94

8.9.4 Evaluation of Impacts

Loss of woodland habitat at Ping Shan is considered to be a relatively minor impact. The area of woodland is small, does not support species of conservation interest, and has been degraded by exotic species and climbers.

Channelling of the small streams will be of minor ecological impact. The streams are small, polluted and located in areas where colonisation by animal or plant species of conservation interest would not be expected.

Loss of Yuen Long Marsh is not considered to be of ecological significance. The marsh area is completely surrounded by buildings and pavement. It is small, polluted with solid waste, and subject to intensive traffic and human disturbance. The impact of habitat loss to the rail alignment will be minimal.

No flora or fauna of conservation importance have been identified in the Western Section. The impacts of rail construction and operation are considered, therefore, to be minimal on both a local and a regional scale.

8.9.5 Recommended Mitigation

No mitigation is recommended for the limited impacts of the Western Section.

8.9.6 Residual Impacts

As the evaluation of impacts concluded that the level of ecological impact would be minor, and no mitigation measures are considered necessary, no residual impacts of concern are expected.

8.9.7 Conclusion

Much of the Western Section 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.

8.10 Waste

8.10.1 Potential Sources and Prediction of Impacts

8.10.1.1 Construction Phase

8.10.1.1.1 General

Construction activities to be carried out for the Western Section of West Rail will result in the generation of a variety of wastes which include:

- Site clearance waste;
- Excess excavated material/spoil;
- General construction waste;
- Demolition waste;
- Chemical waste;
- General refuse; and
- Contaminated muds and sediments.

Environmental issues in connection with the generation, handling and disposal of muds and sediments are discussed in *Section 8.11*. The construction of stations and bored piles for the viaducts of the Western Section will generate about 474,000 m^3 of excavated mud (see *Table 5.10a, Annex* N) which needs to be disposed of.

Assessments of the impacts of the other categories of waste are described below.

8.10.1.1.2 Site Clearance Waste

The predominance of elevated sections in the Western Section design will minimise the physical impact of the railway at ground level and hence minimal site clearance work will be required. In sections of embankment, the railway impacts upon a number of footpaths which will be reprovisioned in the form of subways or footbridges. Site clearance works will involve the removal of the existing footpaths and vegetation.

8.10.1.1.3 Excess Excavated Material

The majority of the Western Section will be supported on a viaduct with the remaining lengths being either at grade or on low embankment. Except for the construction of pier foundations, little excavation work will be required.

8.10.1.1.4 General Construction Waste

General construction waste will be generated from the construction of the railway line and stations and will consist of wood waste from formwork and falsework, material and equipment wrappings, and surplus or rejected construction material (mainly concrete).

8.10.1.1.5 Demolition Waste

The alignment of the Western Section has been refined to avoid encroachment upon existing structures and facilities. The alignment of the Tuen Mun Centre Station has been relocated to the Tuen Mun nullah. San Fat Estate which includes 4 blocks of public housing (16 storey and 7 storey buildings), the Ho Fuk Tong Primary School (a 5 storey building) and a market will need to be demolished by mid-2001 for the construction of a bus interchange.

8.10.1.1.6 Chemical Waste

Substances likely to be generated by construction of the Western Section will, for the most part, arise from the maintenance of equipment. These may include, but need not be limited to the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils and cleaning fluids from mechanical machinery; and

- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

Chemical waste may pose serious environmental, health and safety hazards if it is not properly managed. These hazards include:

- Toxic effects to workers;
- Adverse effects on water quality from spills;
- Fire hazards; and
- Disruption of sewage treatment works if the chemical waste enters the sewerage system.

8.10.1.1.7 General Refuse

General refuse will be generated from the works site offices of the Western Section. The storage of general refuse will have the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

8.10.1.2 Operational Phase

8.10.1.2.1 General Refuse

General refuse will arise from the public, station employees and commercial operators within the five stations. Materials may include food waste, wood, plastic, office wastes, old tins/containers, cleaning materials and miscellaneous other waste produced during daily activities. As discussed for the construction phase, the storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently, litter, water quality impacts if waste enters storm water drains, visual impact and vermin problems if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

8.10.1.2.2 Industrial Waste

Industrial waste will be generated from maintenance activities of the railway and the five stations of the Western Section. The materials may include scrap materials from rail and carriage maintenance, used fluorescent tubes, cleaning materials and discarded electronic equipment.

8.10.1.2.3 Chemical Waste

Chemical waste will be generated from maintenance activities of the railway and stations of the Western Section. The waste may include lubricants, paints, used batteries, acids/alkalis, coolants and solvents. As discussed for the construction phase, these chemical wastes may pose significant environmental, health and safety hazards if they are not properly managed.

8.10.2 Evaluation of Impacts

The nature and amount of the waste arising from the construction and operation of the Western Section and the potential environmental impacts which may arise from their handling, storage, transport and disposal are discussed in detail below, under each waste category.

8.10.2.1 Construction Phase

8.10.2.1.1 Site Clearance Waste

As little site clearance works will be required for the construction of the Western Section, it is anticipated that the environmental impacts due to the storage, handling, transport and disposal of site clearance waste will be minimal.

8.10.2.1.2 Excess Excavated Material

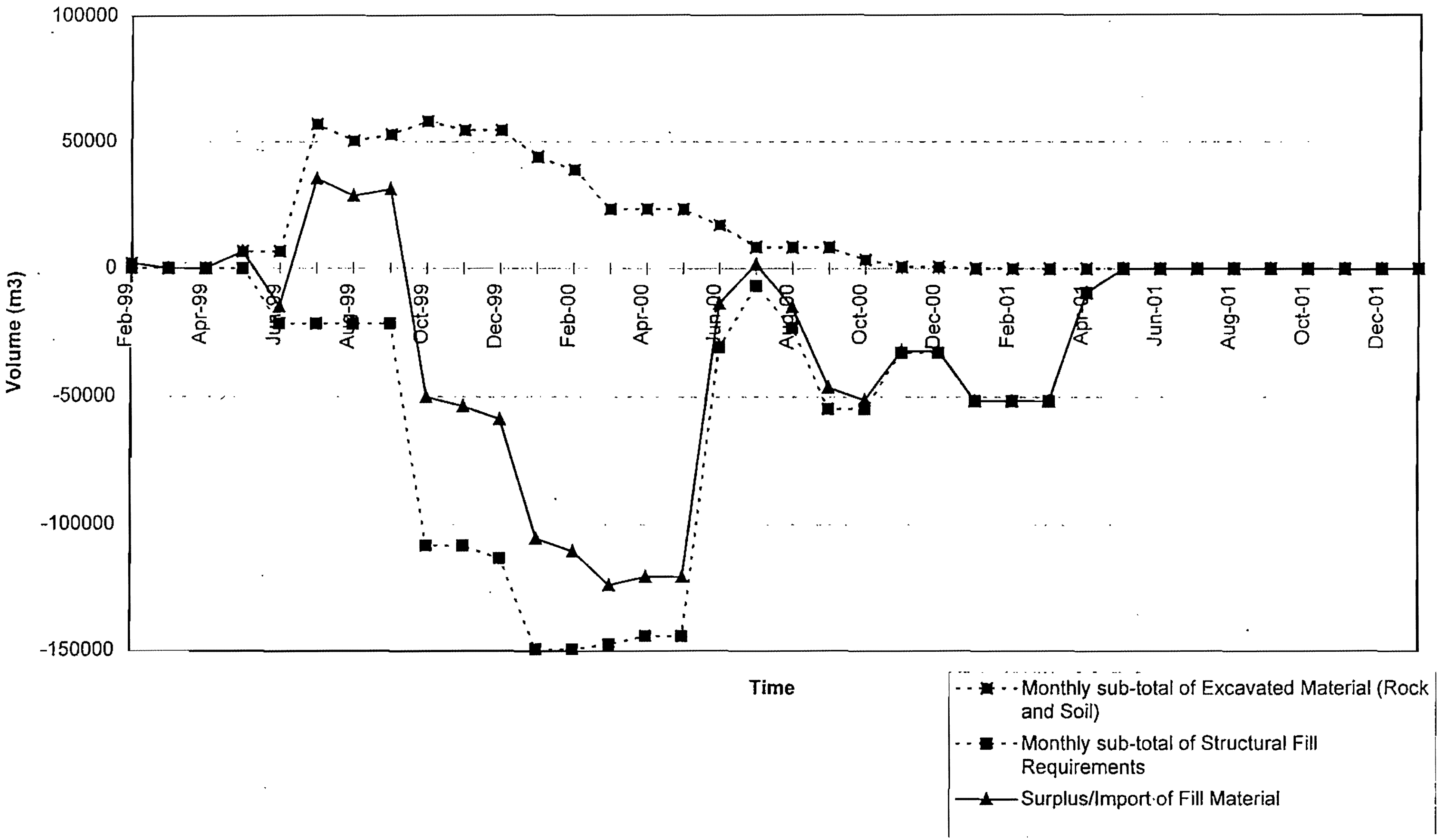
The Construction of the Western Section will generate about 543,000 m^3 (37,000 m^3 of rock and 506,000 m^3 of soil) of excavated material and require 1.55 million m^3 of structural and embankment fill (see *Table 5.10a, Annex N*). Fill material needs to be imported to the site. The cut and fill requirements for the Western Section are presented in *Figure 8.10a*.

It is expected that the small quantity of rock generated could either be reused on site or by the local construction industry. Assuming 20% of the soil excavated are unsuitable as fill, about 101,000 m^3 (350 m^3/day, maximum) will need to be disposed of. The excavated soil should comply with public dumping licence requirements and could therefore be accepted at public filling areas.

With respect to the small quantity of excess excavated material to be required for off-site disposal, it is not anticipated to have a significant impact on the demand for public filling capacity. The disposal of inert excavated material at public filling areas or land formation sites will not have any long term environmental impacts.

The potential air and water impacts from the storage, handling, transport and disposal of excavated material are covered in *Sections 8.4* and *8.5* respectively.

Figure 8.10a : Cut and Fill Requirements of Western Section



8.10.2.1.3 General Construction Waste

The storage, handling, transport and disposal of general construction wastes have the potential to create visual, water, dust and associated traffic impacts. A total of about 152,000 m^2 of GFA will be constructed for the stations in Northern Section. Based on a waste generation rate of 0.1 m^3/m^2 of GFA to be constructed, approximately 15,200m^3 of general construction waste will be generated from the construction of stations. General construction waste arising from other construction works cannot be determined.

General construction waste should be removed from site as soon as practicable in order to avoid adverse environmental impacts due to on-site storage of the material.

To conserve the capacities of landfill sites, general construction waste with more than 20% (by volume) inert material should not be disposed of at landfills. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials (concrete, soil, cement/bentonite, etc) at public filling areas and the degradable wastes (wood, paper, plastic, etc) at landfills. The production of general construction wastes should be minimised by careful control of ordering procedures which can result in surplus materials. The avoidance of over-ordering and the segregation of materials will minimise waste arisings requiring landfill disposal. It will also assist in minimising costs should landfill charges be introduced.

Construction and demolition wastes currently form approximately 35% of the annual take-up of the limited landfill void available in Hong Kong, although this proportion has varied widely over recent years. Therefore, it is important to minimise, wherever possible, the amount of waste which must be disposal of by landfill.

8.10.2.1.4 Demolition Waste

The construction of the bus interchange associated with the Tuen Mun Centre Station will involve the demolition of the San Fat Estate. The size and number of flats in San Fat Estate are given in *Table 8.10a.*

Based on a waste generation rate of 0.7 m^3/m^2 of GFA to be demolished, approximately 30,800 m^3 of demolition waste will be generated. The GFA or building plans for Ho Fuk Tong Primary School and the market are not available. Assuming the total GFA of the school is one-third of that of the estate, the estimated quantity of demolition waste to be generated will be about 10,300 m^3. Schools built in 1970s and 1980s may contain asbestos containing materials. It is recommended that an asbestos investigation be carried out prior to the demolition works. Demolition of the market will only generate a small amount of waste. The total quantity of the demolition waste to be generated will therefore be about 40,000m^3. The daily quantity of demolition waste to be disposed of will depend on the demolition programme. It is expected that the buildings could be demolished within 6 months. The daily arisings of demolition waste will therefore be in the order of 230 m^3/day.

Table 8.10a Size and Number of Flats in San Fat Estate

Flat Type	Size (m^2)	Number	Total GFA (m^2)
Large	26.94	358	9,644.5
Medium	22.11	810	17,909.1
Standard	16.91	459	7,761.7
Small	14.03	432	6,061.0
Special B	19.79	14	277.1
Special C	19.05	12	228.6
1 P	8.46	46	389.2
Estate Office	442.6	1	442.6
Shops	52.00	24	1,248.0
Total GFA			43,961.8

It is recommended that the demolition contractor should adopt the selective demolition method so that re-usable material, like wood and metal, can be segregated and recycled, degradable materials can be disposed of at landfills, and inert demolition material can be re-used on site or delivered to public filling area, public filling barging points or land formation sites.

It is understood that the Government plans to establish a public filling barging point (with an anticipated daily throughput of 5,200 m^3 per day) at Tuen Mun Area 38 for bulk transfer of public fill to public filling areas. This barging point may be available during the demolition works. It is recommended that if inert demolition waste is to be delivered to this barging point, the demolition contractor should liaise with the operator of the barging point to discuss the delivery schedule of the material in order not to overload the facility.

The disposal of demolition waste at public filling areas is unlikely to raise any long term concerns because of the inert nature of the waste. The environmental impacts arising from the storage, handling and disposal of demolition waste will therefore be negligible.

8.10.2.1.5 Chemical Waste

It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the contractor's on-site maintenance activities and the numbers of plant and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oils and solvent, produced from plant maintenance will be small. These chemical waste are readily accepted by the CWTF at Tsing Yi.

The storage, handling, transport and disposal of chemical waste should be undertaken in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the environmental impact due to handling and disposal of chemical waste will be minimal.

8.10.2.1.6 General Refuse

The number of construction personnel who will work on the sites has not be determined by the engineering Design Consultants. It is anticipated that it will be in the range of 300 to 500 workers. Estimates of waste arisings based on the anticipated numbers of workers suggest that the rate at which general refuse will be produced at the Western Section will be in the range of 170 to 300 kg per day. Provided that the mitigation measures recommended in *Section 5.10* are adopted, the environmental impacts caused by storage, handling, transport and disposal of general refuse are expected to be minimal.

8.10.2.2 Operational Phase

8.10.2.2.1 General Refuse

The amount of general refuse arising from the operations of the five stations will depend on the number and types of shops at the stations which are not yet been finalised. Based on the operational experience of the existing railway, it is anticipated that in the order of 500 kg per day of general refuse will be generated at each station. If good practice is adhered to and all feasible avoidance, reuse and recycling opportunities are taken, including minimising over ordering, there should be minimal impact.

8.10.2.2.2 Industrial Waste

The amount of industrial waste to be produced during the operational phase of the Western Section cannot be determined at this stage but it is likely to be small. Metals and discarded electronic equipment have high scrap value and may be sold for recycling. Provided the scrap materials are collected regularly, it is not expected that storage, handling, transport and disposal of industrial waste will cause any significant environmental impact. Other general industrial waste such as plastic, cloth and paper can be collected together with the general refuse and disposed of at licensed waste transfer or disposal facilities.

8.10.2.2.3 Chemical Waste

The amount of chemical waste to be produced during the operational phase of the Western Section cannot be determined at this stage but it is likely to be small. Chemical wastes should be stored, handled, transported and disposed of in accordance with the *Chemical Waste Regulations* and *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes.* They should be collected and transported to the CWTF or other licensed facility by a registered waste haulier. Provided that appropriate handling, storage and disposal procedures are followed, no unacceptable impacts associated with the management of chemical waste during the operational phase of the Western Section are anticipated to occur. .

8.10.3 Recommended Mitigation

8.10.3.1 Introduction

Section 5.10.3 has recommended the recycling, storage, transportation and disposal measures to avoid or minimise potential adverse impacts associated with waste arising from the construction and operation of the Southern Section under the headings of each waste type. The majority of these recommendations will also apply to the Western Section. For the construction phase, the Western Section contractor should incorporate these recommendations into a comprehensive on-site waste management plan. Such a management plan should incorporate site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. For the operational phase, it is recommended that the KCRC should incorporate the recommendations into a comprehensive waste management plan for the operation of West Rail.

8.10.3.2 Construction Phase

8.10.3.2.1 Excess Excavated Material

The quantity of surplus excavated material to be generated from construction of the Western Section is expected to be small. However, in order to minimise the amount of surplus excavated material to be delivered to public filling areas and optimise the cut and fill balance of West Rail, the priority for off-site disposal of surplus excavated material should be as follows:

- Transport to other sections of West Rail for reuse;
- Transport to other land formation sites in the Tuen Mun and Yuen Long areas for reuse; and
- Transport to public filling areas.

In order to increase the opportunity for re-use of surplus excavated material by other land formation or reclamation projects, it is recommended that the engineering Design Consultants should complete the FMC's Questionnaire on Surplus and Fill Requirements and return it to FMC for inclusion into the Surplus and Fill Requirement Database.

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.

8.10.3.2.2 Construction and Demolition Waste

In order to minimise waste arisings and keep environmental impacts within acceptable levels, the mitigation measures described in *Section 5.10* should be adopted.

8.10.3.2.3 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.*

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

8.10.3.2.4 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 should be prohibited.

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.

8.10.3.3 Operational Phase

8.10.3.3.1 General Refuse and Industrial Waste

General refuse will be generated from the passengers, station employees and commercial operators. General refuse generated on-site should be stored in enclosed bins or compaction units separate from chemical wastes. The small quantity of industrial waste generated at the stations can be collected together with general refuse. A reputable waste collector should be employed to remove general refuse and industrial waste from the stations, separately from chemical wastes, on a daily basis to minimise odour, pest and litter impacts. Scrap metal may be sold for recycling.

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.

8.10.3.3.2 Chemical Waste

Chemical waste that is produced, as defined by Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation, should be handled and disposed of in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (See *Section 5.10*).

8.10.4 Conclusion

The potential impacts of waste arising from the construction and operational phases of the Western Section of West Rail have been assessed. Key issues include the need for effective waste management planning during both of these phases, effective management of chemical/industrial and other potentially hazardous wastes, and the strong preference for reuse of clean surplus clean material rather than disposing of it 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.

8.11 Land Contamination

8.11.1 Background

The potential for soil and groundwater contamination exists in some areas along the alignment where current or historic land uses have impacted upon the land. The potential for impacts from land contamination exists primarily where there will be an interface with the underlying soil either during construction or operation of West Rail. The following sections present the findings of the land contamination assessment.

8.11.1.1 Project Construction

The Western Section extends for approximately 10 km from Yuen Long Station in the north-east, where it interfaces with the Northern Section of West Rail, to Tuen Mun Centre Station in the south-west. The alignment lies along an essentially urbanised environment, and an elevated viaduct of approximately 6.7 km in length has been proposed. In the central portion between Tin Shui Wai and Tuen Mun North the alignment passes through a largely rural landscape at grade or on low embankment.

The main construction activities involve the five proposed stations (Yuen Long, Long Ping, Tin Shui Wai, Tuen Mun North and Tuen Mun Centre) and small scale excavations required for pier foundations for the elevated structure along the alignment. Little excavation is considered likely within the footprints of the station sites. KCRC estimates that the volume of excavated mud from the stations and viaduct bored piles in the Western Section will be about 236,000 m^3.

8.11.1.2 Current and Historic Land Use

A review of historical maps of the key sites along the route, a selected review of historical aerial photos, and reference to the relevant technical reports produced by the engineering Design Consultants indicate that the majority of the Section is to be developed on land which has primarily been used for urban development, commercial usage, car parking and recreation. The available information does not indicate that there has been any major industrial use of land along the alignment.

A summary of the development of the key sites along the route within the footprint of the development areas where excavation is likely to be undertaken is described in *Tables 8.11a-e.*

Yuen Long Station Area

Table 8.11a Historical Land Use of Yuen Long Station

Year	Site Usage
1959, 1967	Ponds, cultivation, road
1970	Ponds, cultivation, road, nullah, petrol station
1977	Ponds, cultivation, road, nullah, petrol station
1978	Ponds, cultivation, road, nullah, petrol station
1980	Ponds, cultivation, road, nullah, petrol station
1983	Ponds, cultivation, road, nullah
1984	Ponds, cultivation, road, nullah
1988	Pond, cultivation, road, nullah, bus terminus, CIP for LRT transit station, electric sub-station
1989	Marsh, cultivation, road, nullah, bus terminus, WIP for LRT transit station, LRT alignment, basketball court, pumphouse, electric sub-station
1997	Private land and buildings, vacant land, agricultural land, bus terminus, car parking, housing

CIP - Construction in progress, WIP - Works in progress. Note: a tannery was located near to the station footprint between 1977 and 1983.

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-NW-10c and 1:1200 scale, reference 108-NW-B)

The main landuse of concern for the Yuen Long area of the alignment is a petrol station that was formerly located on the southern boundary of the proposed development site until between 1980 and 1983. The site was subsequently developed as a bus terminal and terminus for the Light Rail system. There are no other historic landuses of concern on the proposed Yuen Long Station site.

Long Ping Station Area

Table 8.11b Historical Land Use of Long Ping Station

Year	Site Usage
1970/1969	Nullah, ponds, agriculture, temporary structures, road, residential, school, CIP
1975	Nullah, ponds, reclamation of fish ponds, agriculture, temporary structures, slaughter house, road, residential, school, CIP
1976	Ponds, fish market, slaughter house, road, residential housing
1979	Ponds, fish market, slaughter house, road, latrine, school, **sewage treatment works**
1982	Fish market, slaughter house, road, latrine, school, CIP for residential housing, sewage treatment works
1985	Fish market, road, latrine, CIP for Long Ping Estate, sewage treatment works
1987	Fish market, road, latrine, CIP for Long Ping Estate, bike track, sewage treatment works
1989	Fish market, road, latrine, residential housing, bike track, car park, sewage treatment works, **small car repair shop**
1992	Fish market, road, latrine, residential housing, bike track, nullah, refuse collection points, temporary structures, sewage treatment works
1997	Private land and buildings, housing, fish market, nullah, car repair workshop, car parks, old peoples home, public park, latrine, sewage treatment works, pump house

CIP - Construction in progress. Bold = aerial photo information.

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-NW-9b and 1:200 scale, reference 91-SW-C&D; 108-SW-A)

In terms of potential contaminating landuses, the small scale car repair workshop represents the main concern. Typical contaminants associated with car repair operations include oils, solvents and paints. However, the car repair workshop was identified as being on site for only a short period, and therefore a potential impact on the land is not likely. A small sewage treatment works is located near the centre of the Long Ping Station. This land will be encroached upon by the permanent land take.

In addition, one of the ponds scheduled in the land take was noted to be located adjacent to a truck and trailer storage yard, and the main concern arising relates to the potential contamination of pond sediments as a result of activities in the trailer yard.

Tin Shui Wai Station Area

Table 8.11c Historical Land Use of Tin Shui Wai Station

Year	Site Usage
1977/1978	Marsh, ponds, temporary structures, footbridge
1981	Marsh, ponds, temporary structures, footbridge
1985	Marsh, ponds, temporary structures, footbridge, track
1990	Ponds, temporary structures, footbridge, track, CIP
1993	Ponds, cultivation, temporary structures, footbridge, footpath, bike track, WIP, open storage
1997	Private land and buildings, housing, agriculture, car parking, retail property

CIP - Construction in progress, WIP - Works in progress.
Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-NW-8a, 8b & 8c) from 1993, 1990, 1985, 1981, 1978, and 1977

No major concerns associated with the presence of contaminating activities on the Tin Shui Wai Station site were identified during the current assessment programme.

Tuen Mun North Station Area

Table 8.11d Historical Land Use of Tuen Mun North Station

Year	Site Usage
1955	Road, agriculture
1959	Road, agriculture, temporary structures, well houses
1972/73	Road, agriculture, school, temporary structures
1978	Road, agriculture, construction and reclamation for housing estates
1978/1979	Pond, orchard, cultivation, road, Tuen Mun river channel, school
1981	Pond, orchard, cultivation, road, Tuen Mun river channel, culverts, school, nunnery, open sided structures , CIP,
1984	Orchard, cultivation, road, Tuen Mun river channel, culverts, school, nunnery, latrine, open storage, dumping in progress **(earth for pedestrian bridge)**
1988/1989	Cultivation, road, Tuen Mun river channel, culverts, footbridge, latrine, bus terminus, open storage, burial urns, skating area
1991/1993	Cultivation, road, Tuen Mun river channel, culverts, footbridge, school, refuse collection point, bike track, playground, latrine, bus terminus, open storage, burial urns, skating area, car breakers yard
1997	Private land and buildings, plantation, playground open space, commercial garden, recreational areas, college, bus terminus, electricity substation, car breakers yard

Note - There are three petrol stations located close to/or within the track alignment just to the north of Tuen Mun North Station. Bold = aerial photo information. CIP - Construction in progress.
Hong Kong Ordinance Survey maps (1:1000 scale, ref. 6-NW-21b & 21d & 1:1200 scale, ref.124-NW-A; 107-SW-C)

The main landuse of concern at the Tuen Mun North Station site relates to the presence of a petrol station which is located to the north of the proposed station development area, near the Fung Hong Home for the Aged, and open storage areas north of the site recently observed to be used for car breaking. Potential concerns involve contamination with petroleum hydrocarbons and solvents.

Tuen Mun Centre Station Area

Table 8.11e Historical Land Use of Tuen Mun Centre Station

Year	Site Usage
1962/63	Road, residential, temporary structures, school + electric substation, Tuen Mun River (not channelled), CIP of bridge over river
1970/72	Road, residential, temporary structures, school + electric substation, Tuen Mun River channel, pipeline, open areas
1976	Road, temporary structures, open sided structures, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points
1978	Road, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points
1980	Road, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points
1982	Road, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points
1986	Road, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points, CIP
1993	Road, Tuen Mun river channel, pipeline, residential housing, school + electric substation, playground, refuse collection points, latrine, garden
1997	Commercial property, housing estate and market, primary school, pumping station, park

CIP - Construction in progress.

Hong Kong Ordinance Survey maps (1:1000 scale, reference 6-SW-1c & 6a and 1:1200 scale, reference 123-SE-B7D: and 124 -SW-A7C)

There are no major contaminating land uses on the Tuen Mun Centre Station footprint which represent a major concern.

8.11.1.3 Geology and Hydrogeology

The *Hong Kong Geological Survey* (HKGS) Sheet 6 covering Yuen Long indicates that the area of the proposed station footprints is composed of the mainly surficial deposits listed in *Table 8.11f.*

Table 8.11f Geologic Setting - Western Section

Location	Geologic Setting
Yuen Long Station	Holocene age undivided marine sediments of the Hang Hau Formation (sands and marine muds), overlying Carboniferous Period marble of the Yuen Long Formation.
Long Ping Station	Holocene age undivided marine sediments of the Hang Hau Formation (sands and marine muds), overlying Carboniferous Period marble of the Yuen Long Formation. Locally some Carboniferous Period metasiltstone and phyllite, with metasandstone and debris flow deposits of the Lok Ma Chau Formation is exposed.
Tin Shui Wai Station	Carboniferous Period metasiltstone and phyllite, with metasandstone and debris flow deposits of the Lok Ma Chau Formation.
Tuen Mun North Station	Recent fill and Holocene alluvium. Locally some block bearing tuff and tuffite of Upper Jurassic age is encountered.
Tuen Mun Centre Station	Holocene age undivided marine sediments of the Hang Hau Formation (sands and marine muds).

8.11.2 Potential Sources of Impact

Potential sources of impact relate to the protection of site workers, possible contaminated soil and sediment handling and disposal arrangements, disposal of potentially contaminated groundwater and future impacts for site maintenance and utility workers. These issues are described in more detail in *Section 5.11* and evaluated below.

Similar potential impacts to those presented in *Sections 5* and *6* are applicable to the Western Section. It is anticipated that only a small quantity of excavated muds generated from the construction of foundations and bored piles for viaducts will be contaminated. The rest of the excavated material will probably be acceptable at public dump sites if it is not able to be reused, and should therefore comply with public dumping licence requirements.

The prediction and evaluation of impacts and recommendation of appropriate mitigation measures for the Western Section are discussed below.

8.11.3 Prediction of Impacts

8.11.3.1 Disposal of Soils

Based on the estimated volumes, the likely disposal point for any contaminated material will be the East Sha Chau disposal pits, under the direction of the appropriate authorities.

8.11.3.2 Groundwater Disposal

The issue of disposal of contaminated groundwater is discussed in *Section 5.11.3*.

8.11.4 *Evaluation of Impacts*

There is a small potential for soil and groundwater contamination to have occurred along the Western Section. The main landuses of concern relate to a former petrol filling station within the boundary of the Yuen Long Station site, truck and trailer storage yards and a small car repair workshop on the Long Ping Station site works area, and a petrol station and a car breaker's yard at the Tuen Mun North Station site. None of these land uses are considered to represent a major issue as the sites were redeveloped in the 1980s or later, and are fairly small scale operations. However, further investigations of the two petrol station sites are warranted, in view of the possibility of contamination from leaking underground storage tanks.

As significant volumes of soils which may be contaminated are not anticipated, land contamination impacts are not considered to represent a major concern.

The methodology for sampling of the one pond located along the alignment to the west of Long Ping Station was outlined in *Section 7.11.3*. Results are presented in *Table 8.11g*.

Table 8.11g Sample Results (in mg/kg)

Sample	Type	Cd	Cr	Cu	Ni	Pb	Zn	Hg	Classification
C1588019	Pond	0.26	5.7	22.9	6.7	75.4 ©	206©	0.1	C

Note: mg/kg = milligrams per kilogram

© = Concentration exceeds minimum standard for Class C classification for specified metal.

The sediment sample from this pond was found to be Class C, or seriously contaminated, based on the heavy metal concentrations. Thus some special handling and disposal will be required. The location of this sample is presented in *Figure 8.11a*.

8.11.5 *Recommended Mitigation*

Specific further investigations of the two petrol filling station sites should be undertaken by KCRC prior to construction to determine/confirm whether there is or has been underground storage and whether it is likely that spillage, leakage or other forms of contamination have occurred in the past.

If underground storage is confirmed, preparation of a Contamination Assessment Plan is required. The Assessment Plan should include provision for a visual identification of the presence of any underground tanks.

If site inspections, interviews, reviews of site history, inventory reconciliation or other investigation techniques suggest that contamination is likely, targeted on-site sampling and analysis may be required to define the extent of the problem and develop remediation plans.

More details of the recommended approach to investigation and remediation are provided in *Section 6.11.5*.

Potential impacts associated with the disposal of potentially contaminated soils and groundwater can be mitigated by adopting the measures outlined in *Section 5.11.5*.

8.11.6 Residual Impacts

Based on the limited information available at this stage, the potential for major land contamination concerns along the Western Section of the route is not expected to be significant. Requirements for the disposal of potentially contaminated soils and groundwater from selected ponds will be required, based on a limited sampling plan.

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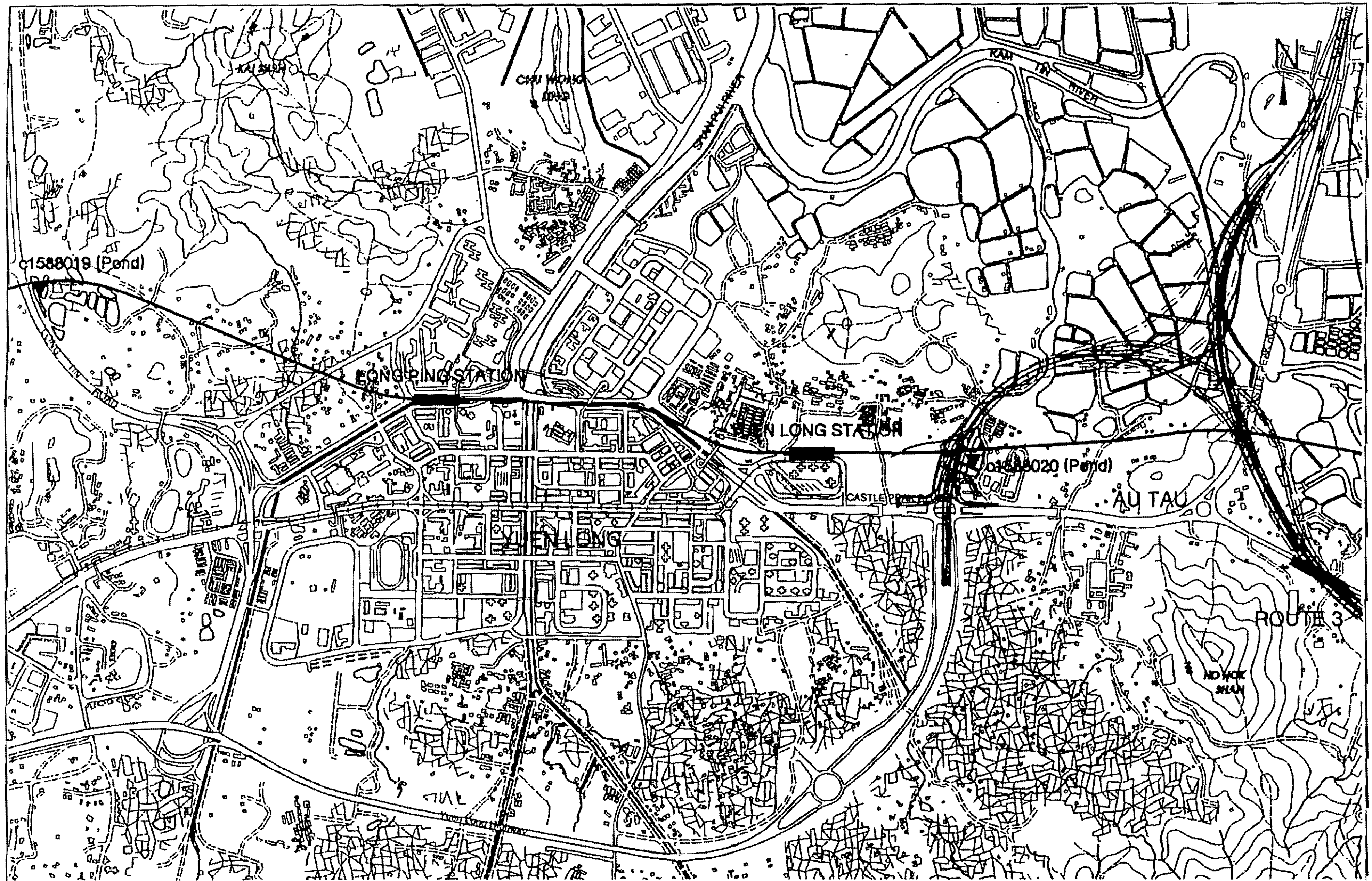

● River Sample Location

▼ Pond Sample Location

SEDIMENT SAMPLE LOCATIONS NEAR YUEN LONG

FIGURE 8.11a

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: TS900 EIA STUDY

9. ENVIRONMENTAL MONITORING AND AUDIT

9.1 General

The West Rail EIA Study has focused on the prediction and mitigation of impacts arising from the construction and operation of the new railway. The primary outputs have been a series of recommendations on the range of measures to be undertaken to eliminate or mitigate predicted impacts to levels that are acceptable to the Hong Kong Government. The findings and recommendations of the Final Assessment Report will constitute a formal commitment on the part of the Corporation to achieve the levels of environmental protection specified and will form the basis on which the Corporation's environmental performance will be judged during later stages of the project.

While the FAR marks the completion of the planning and preliminary design stages of West Rail, the environmental input to subsequent phases of the project will continue in order to ensure that the environmental performance commitments given in the EIA are correctly incorporated through the detailed design phases and tendering, and adequately implemented during the construction and operation of the project.

This process will be managed through the use of a number of contractual, managerial and administrative mechanisms:

- *Development of an EM&A Programme.* The EM&A Programme will provide a description of the organisational arrangements and resources required for the EM&A programme based on the conclusions and recommendations of the West Rail EIA Final Assessment Report. The EM&A Manual, as well as stipulating details of the construction monitoring required and actions to be taken in the event of exceedances of environmental criteria, will also generate a draft Implementation Schedule for the recommended mitigation measures. This Schedule will link the implementation of specified mitigation measures to the specific work activity for which they have been prescribed, thereby ensuring timely implementation;
- *Development of an Environmental Management System (EMS).* At its simplest, the EMS will seek to verify that the performance commitments given in the FAR are being upheld and that no adverse impacts to the environment are being sustained by adjacent sensitive receivers.

  This will be performed primarily by auditing against the Contractor's Environmental Management Plan (EMP) (incorporating the EM&A requirements) which will be incumbent upon the successful tenderer. The regulation of working methods will also be controlled through the inspection of Contractor's Work Method Statements which will be submitted and approved by the Engineer prior to the works being carried out. The Corporation will specify an arrangement whereby Work Method Statements will be scrutinised and signed off by both the Contractor's Environmental Manager and then, by the Corporation's

Environmental Manager before being approved; this will ensure that the environment is consistently and routinely considered in all works processes; and

- *Environmental Liability Scheme.* An environmental liability scheme will be developed and outlined in the West Rail Contractual Documentation which will set out the Contractor's environmental obligations and performance targets.

  The scheme will establish a link between the actual environmental management performance of the Contractor, as judged through construction monitoring and regular audit results, to environmental payments; a similar approach is routinely employed for the monitoring of Contractor's compliance with the requirements of project safety schemes. The mechanism for achieving this is currently under development.

The Environmental Protection Department (EPD) requires the submittal for approval of both the EM&A Manual and the Implementation Schedule, prior to the commencement of construction. At an early meeting of the West Rail Study Management Group, it was agreed that the EM&A Manual would be submitted separately from the FAR document. The EM&A procedures are the concluding deliverables to the EIA process and will be submitted for consideration following the incorporation of comments to the draft FAR report.

The construction EM&A Manual will comprise descriptions of the key elements of the West Rail construction phase EM&A programme including:

- Appropriate background information on the construction and operational phases of West Rail with references to relevant technical reports including the West Rail EIA FAR;
- Organisational arrangements, hierarchy and responsibilities with regard to the management of environmental performance functions during the construction phase to include the EM&A team, the Contractor's team and the Corporation's representatives;
- A broad construction programme indicating those activities for which specific mitigation is required, as recommended in the EIA, and providing a schedule for their timely implementation;
- Descriptions of the parameters to be monitored and criteria through which performance will be assessed including monitoring frequency and methodology, monitoring locations (in the first instance, the location of sensitive receivers as listed in the EIA), monitoring equipment lists, event contingency plans for exceedances of established criteria and schedule of mitigation and best practice methods for minimising adverse environmental impacts;

- Procedures for undertaking on-site environmental performance audits as a means of ensuring compliance with the EMS (and thereby agreed environmental criteria); and
- Reporting procedures.

Prior to the commissioning of the new railway, an Operational EM&A Manual will be prepared, which will detail the ongoing EM&A programme for the operating railway.

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10. SUMMARY AND CONCLUSIONS

In this section an overview of the EIA Study is provided, EIA findings in relation to key issues are presented and summarised and recommendations for further work are discussed.

10.1 Overview of the EIA

10.1.1 Objectives

The objectives of the EIA were to describe the elements of West Rail that were to be assessed, define the standards and criteria which have been applied to the project, explain the assessment methodologies employed by the EIA Study team, identify potential impacts and potentially affected populations and environmental resources, provide a detailed assessment of environmental issues and impacts, make recommendations for their resolution and mitigation, describe residual impacts, and ensure that mitigation measures were integrated within the engineering design process. The assessment work, findings and recommendations described in this FAR meet these objectives.

The scope of the initial assessment reported in the *Initial Assessment Report* (IAR), finalised in August 1997, was defined and, to some extent, limited by the programme for delivery of engineering design information from the engineering Design Consultants. Areas of uncertainty which existed at that stage of the EIA have largely been resolved during the more detailed assessment reported in this FAR, as the results of modelling exercises and surveys have become available, and as more detailed information on construction plans, design features and operational arrangements for West Rail have been provided by or negotiated with the engineering Design Consultants.

10.1.2 Cumulative Impacts and "Cross-Media" Issues

A number of situations that may give rise to cumulative impacts have been considered in the assessment. However, it should be recognised that the potential for cumulative impacts is influenced not only by the coincidence in time and space of particular types of activities, but also by such factors as their relative intensity, nature of impact, diurnal variation, specific location and relative distance from sensitive receivers. In many cases this means that one particular activity or source is dominant in the assessment of cumulative impacts, especially in relation to noise.

For West Rail the following cumulative impact situations have been carefully assessed and, where necessary, appropriate mitigation measures have been formulated:

- Cumulative impacts on water quality associated with both West Rail construction and Kam Tin River works in the Northern Section;

- Cumulative impacts on ecologically important resources in the Central and Northern Sections due to loss of habitat for West Rail, Route 3, Kam Tin River works and other projects; and
- Cumulative noise and dust impacts from the various construction work sites in each Section of West Rail.

The EIA has also examined a number of situations in which there are potential interactions or connections between different segments of the environment or different parts of assessment for this project, including:

- Potential air and water pollution impacts from the storage, handling and reuse of excavated materials;
- The disposal of dredged sediments from marine, freshwater and wetland sites to marine or land-based disposal sites;
- The provision and development of land for off-site mitigation of ecologically important habitat loss;
- The visual impacts of noise mitigation measures; and
- Interactions between the ecological, landscape and historic evaluation of particular sites or features.

These "cross-media" issues have been carefully evaluated in the EIA.

10.2 Key Environmental Issues from the EIA

A number of key impacts and issues were identified in the IAR, either because their nature or scale was significant in itself, their mitigation was proving to be difficult, or a major element of their assessment remained to be completed. The findings of the EIA in relation to these issues are summarised below.

10.2.1 Construction Noise

The initial assessment concluded that a number of unacceptable residual impacts, mainly in the Northern and Western Sections, remained after the usual forms of mitigation had been applied, and that further assessment based on more detailed construction information was required.

The detailed assessment has confirmed the IAR findings, however residual exceedances have been further examined and have been mitigated by outlining, in some cases, extensive reductions in plant on-time and numbers of concurrent plant active on site in order to achieve compliance.

In the Northern and particularly the Western Section, some exceedances at particularly sensitive receivers such as schools, homes for the aged and hospitals remain after the consideration of these further proposals. In these cases, indirect mitigation measures have been recommended to reduce potential impacts to within the established criteria. For schools that have been identified as NSRs in these Sections, it may still be desirable to schedule noisy construction activities outside of examination periods to rigorously ensure that noise impacts are not sustained.

As the project planning and engineering design of the new railway progresses, substantive changes to the construction activities and plant teams assumed in this report may occur. Under such circumstances, it is recommended that the relevent sections of this assessment be updated.

10.2.2 Operational Noise

The initial assessment of operational train noise identified unmitigated noise exceedances at all Noise Sensitive Receivers studied along the route for the design year period of 2006 to 2011. As part of the initial assessment, KCRC committed to adopting a package of mitigation measures which included trackside absorptive barriers supplemented at specific locations by cantilevered noise barriers or full enclosure, where appropriate; an integrated design of structure, resilient track and noise barriers to achieve a maximum level of noise attenuation; specific limits on rolling stock specifications; and a reduction in maximum operating speed. KCRC also committed to providing mitigation measures to the individual affected properties, should it not be possible to meet noise criteria with "at source" mitigation alone.

Following the initial assessment, the package of mitigation measures has been successfully developed and has resulted in the concept design for the Multi-plenum noise attenuation system. This system comprises three components:

- a plenum beneath the train involving the use of vehicle skirts and under car absorption;
- a plenum located beneath a walkway on both sides of the track; and
- edge walls with sound absorption.

The performance of this innovative package effectively reduces the overall height of noise barriers and therefore potential visual intrusion. The Multi-plenum System will always provide greater attenuation than a mitigation solution based solely on noise barriers and, as such, the application of the System will effectively reduce overall barrier heights and consequent visual intrusion. In line with the commitment given to Government by the Corporation, the Multi-plenum System provides the flexibility for future enhancement as edge wall barrier heights can be incrementally extended for increased noise attenuation from 1.2 m upto full enclosure. This will provide Government with greater flexibility in the long term land use planning of the areas through which West Rail passes and will facilitate, as yet uncommitted, development to be considered in much closer proximity to the railway than would otherwise be the case.

Floating slab track and resilient baseplates have been proposed to minimise vibration transmission in the viaduct structure and the structural design of the viaduct has been improved specifically from a noise standpoint. These mitigation measures, in conjunction with the Multi-plenum system, will ensure only three Noise Sensitive Receivers require at-receiver mitigation during the post-2011, full operation of West Rail with 12 car trains and these may be brought into compliance with further structural design optimisation of the viaduct. At the commencement of operations with a six car train, and with an eight car train two year later there will be no residual exceedances.

Short sections of full enclosure are only required where Noise Sensitive Receivers are close to cross-over locations and will not therefore pose safety and ventilation constraints.

The predictions of operational noise impacts for fixed plant and for the West Rail Depot have been made on the basis of information available to date. However, the engineering design and project planning of West Rail will continue; where substantive changes to the currently assumed plant locations or capacity are made, it is recommended that the assessment be updated.

10.2.3 Water Quality

10.2.3.1 Diversions and Realignments

The initial assessment identified the importance of ensuring that the temporary relocation, diversion or realignment of culverts, drains and pipes would be undertaken with minimal additional impact on water sensitive receivers.

The FAR indicates that, provided the recommended mitigation measures are implemented, no unacceptable residual water quality impacts are expected as a result of construction of West Rail. These measures include provision of adequate capacity and maintenance of hydraulic performance in the temporary relocation and diversion of culverts and drains, full reinstatement of these facilities, interception of sediments, and completion of planned sewerage improvement works in advance of West Rail construction.

10.2.3.2 Intersections with Rivers, Nullahs and Ponds

Concerns about the impacts of West Rail construction activities, at those locations at which they will intersect with existing water courses or water bodies, were raised in the IAR. Further investigation and assessment of engineering design and construction proposals has been undertaken to ensure that disturbance to flow, ingress of pollutants, siltation and flooding will be minimised as far as possible.

The detailed assessment has indicated that, for the rail design and construction methods proposed, the scale of dredging and excavation in the vicinity of these water courses and bodies will be minimal, and, provided recommended mitigation measures to control pollution from dredging, excavation, runoff and drainage are implemented, water quality impacts will be temporary and localised.

10.2.3.3 Tsuen Wan Bay Reclamation

Mathematical modelling for the purpose of investigating impacts on flow regimes in the Rambler Channel, and the transport and dispersion of fine sediments away from the site of the reclamation, was in progress at the time of the IAR. A second issue, unknown at the time of the IAR, was the extent of proposed dredging of marine sediments, much of which was expected to be contaminated.

The sediment transport and dispersion modelling has shown that, provided recommended dredging and handling techniques are employed, including silt curtains at dredging sites, no unacceptable impacts will occur at water intakes, beaches or other water sensitive receivers. Similarly, the modelling of tidal flows in the Rambler Channel showed that the Tsuen Wan West reclamation will cause no adverse impact on flow or water quality off-site.

A minimum dredging option will be used for the construction of the reclamation and, although much of the dredged material is expected to be contaminated, no problems are anticipated with dredging, handling or disposal, provided recommended procedures are followed.

10.2.4 Landscape and Visual Issues

The assessment has indicated that significant, temporary visual and landscape impact will occur during the construction phase, primarily in the Southern and Central sections. Mitigation measures such as advanced and screen planting, and decorative hoarding have been recommended to minimise the temporary impacts during the construction phase.

During the operational phase, the impact of the West Rail development is predicted to bring about positive visual impacts in the Southern and Central Sections, in the longer term, by virtue of the screening and landscaping to be placed over the tunnels. In the Northern and Western Sections, some negative visual impacts will be sustained by nearby rural villages, largely as a result of the elevated design, however these will be considerably reduced as the Corporation is committed to the design principles set out in the Landscape Design Strategy Report.

10.2.5 Archaeological and Cultural Resources

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 the 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.

10.2.6 Ecological Resources

The potential ecological impacts associated with West Rail have been assessed, and the available options of impact avoidance and mitigation investigated. The key impact associated with the *c.* 12 ha of wetland habitat loss would be mitigated by the provision of *c.* 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 the Corporation and submitted to AFD for endorsement prior to the onset of construction. Strict control practices are also recommended to minimise the potential disturbance during the construction phase to the Painted Snipe roosting site near Kam Tin Road.

Fragmentation of remaining, undisturbed habitats will result from the development of the transport corridor though 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.

10.3 Further Work Associated with the EIA Process

A number of residual and follow-on assessment tasks have been identified that will require resolution following the completion of the EIA Study. These are itemised below.

- The detailed design contract for the Tsuen Wan Bay Reclamation will include the collection of marine sediment samples in compliance with WBTC 22/92 requirements to determine the degree of heavy metal contamination of the sediment and the need to identify a suitable disposal site for the dredged material. The product of this task will be a Sediment Quality Report to be submitted to the FMC.
- A number of potentially contaminated sites along the West Rail alignment in the Central and Western Sections have been recommended for further investigation prior to commencement of construction. It is considered that, overall, the best method of approaching this issue is to incorporate these requirements into either the Design and Build or construction contracts as appropriate. The investigations can, in this way, be undertaken when access concerns are no longer valid and when the areas to be used for the construction and operation of the railway have been more rigidly defined by the detailed design process.
- A programme of archaeological investigation is to commence with the field testing of the predictive model of archaeological potential, scheduled for early 1998. The findings of the field testing will inform a more extensive field evaluation programme which will be undertaken prior to the onset of construction; further excavation may be scheduled to be undertaken during ground clearance by the Contractor. These field investigations will be undertaken following detailed liaison with the Antiquities and Monuments Office.
- A programme and plan for the creation of wetland habitat for the sites under the West Rail easement and a site adjacent to the TLT tunnel portal at the head of the Kam Tin Valley, in advance of project commencement. These tasks will be presented in a formal Habitat Creation and Management Plan and will be undertaken following close liaison with the Agriculture & Fisheries Department (AFD).
- The Government review of the Gin Drinkers Bay Landfill Gas Hazard Assessment has indicated concern over the proposed location and use of the Temporary Construction Worksite located southwest of Kwai Hei Street at Kwai Chung. The worksite lies within 50 m of the northeast perimeter of the former landfill site near to gas monitoring wells which have shown up to 20% v/v methane concentrations. While the Hazard Assessment report has

presented a comprehensive plan to address potential hazards during construction, it is recommended that a detailed construction risk assessment of the worksite is carried out at a later stage in the design process, but prior to construction, to further address the risks of landfill gas accumulation in temporary structures, storage facilities and the processes and acitivities to be undertaken at the site.

10.4 Conclusion

The FAR provides sufficient evidence that the environmental impacts associated with the construction and operation of West Rail are amenable to mitigation.

The EIA Study has been undertaken at an early stage in the development of the new railway to ensure that environmental considerations have been integrated into the overall railway design. As such, the FAR represents the cornerstone of the environmental management approach to be adopted by the Corporation during the construction and operation of West Rail. The findings and recommendations of the Study will require an ongoing environmental input to the planning of West Rail to ensure required tasks are undertaken and that issues are satisfactorily resolved. The resolution of specific issues will continue to be pursued in discussion with relevant departments and bureaux of Government.