

## 2. PROJECT DESCRIPTION

### 2.1 Introduction

#### 2.1.1 Overview

The MOS Extension alignment runs from Tai Wai in the west, where it will interchange with the KCR East Rail Service, to Lee On in the east (see *Figures 2.1a-c*). The alignment will be on viaduct through the predominantly urban areas of Sha Tin and Ma On Shan, with a section at ground level where it runs along the reserve of the Tate's Cairn Highway median.

The MOS Extension will involve the construction and operation of approximately 11.4 km of railway track, nine stations, a depot at Tai Wai, and two infeed substations. The extension will provide commuters with a direct link from Ma On Shan to the wider East Rail network, greatly improving accessibility to and from the central business areas of Hong Kong for North East New Territories (NENT) commuters.

### 2.2 Consideration of Alternatives

#### 2.2.1 The Development of the MOS Extension Alignment

In December 1994, the assessment and development of the proposed Tai Wai to Ma On Shan Rail Link together with an extension to the KCRC East Rail to East Tsim Sha Tsui, the West Rail and the Tseung Kwan O Extension, were accorded the highest priority by the Hong Kong Government under the Railway Development Strategy.

As a result of the Government's Railway Development Strategy, a feasibility study, which included an Environmental Feasibility Study, was undertaken into the development of an intermediate capacity railway link to Ma On Shan. The feasibility study, made reference to the tentative alignment of the railway reserve as shown on both the Shatin Outline Zoning Plan and the Ma On Shan Outline Zoning Plan.

In response to Government's invitation, KCRC submitted its proposals for the MOS Extension to Government in 1998. The submittal documentation was based upon an above-ground, largely elevated railway which was to be constructed mainly within the established railway reserve; the results of a preliminary environmental review, which established that the new railway would not give rise to insurmountable environmental implications, was also reported upon.

KCRC proposed that the railway should remain within the railway reserve shown on both the Shatin Outline Zoning Plan and the Ma On Shan Outline Zoning Plan. During the development of the current alignment, KCRC have considered a number of design changes, some of which have resulted in minor modifications to the alignment. Discussion regarding these alignment changes is presented below.

### **2.2.2 Modifications Considered During KCRC's Development of the Current Alignment**

The design of the MOS Extension was developed with reference to RDS-1. The broad alignment has been reviewed and the subsequently confirmed within the KCRC proposal. However, the latest technical study has influenced more detailed design elements and, at some locations, the detailed alignment; these changes have arisen due to the decision to construct island platform stations wherever possible, and to use viaducts with a similar cross section to that proposed for West Rail.

It has been found that island platforms are feasible at all stations except Tai Wai, Shek Mun and Sha Tin Tau. However, as the use of island platforms requires that the tracks diverge as they approach the station, the decision to use island platforms, which was made purely on engineering and operational grounds, has resulted in minor changes to the alignment.

The West Rail viaduct structure was developed after extensive investigations into means of reducing the structure-borne noise levels that can be associated with operating railways. Consequently, the decision to use this design for the MOS Extension has been taken principally on environmental grounds.

In addition to the influence of the above two decisions, KCRC have modified their original proposal both as part of the on-going design development process, and in order to overcome various alignment issues. The modifications are as discussed below.

### **2.2.3 Alignment South of Tai Wai**

The alignment to the south of Tai Wai has been developed to facilitate better operating conditions for the MOS Extension, and to accommodate possible future extensions to the rail system. These modifications, which include a change in the vertical alignment of the track and platform at Tai Wai, facilitate better interchange between the MOS Extension and the East Rail Station. The decision to alter the alignment along this section of the route was based purely on engineering and operational grounds.

### **2.2.4 Alignment between Tai Wai and Sha Tin Tau**

KCRC originally proposed that the alignment should follow the southern bank of the Shing Mun River. This alignment dictated that small reverse curves were required and the following problems were envisaged:

- potential for noise from wheel squeal;
- speed restrictions; and
- more frequent maintenance requirements which had night-time noise implications.

In order to avoid the potential noise impacts, and to improve the operating conditions of the MOS Extension, two alternative alignments were considered by KCRC. The first of these comprised a 700-metre radius curve from Tai Wai Station to Sha Tin Tau Station.

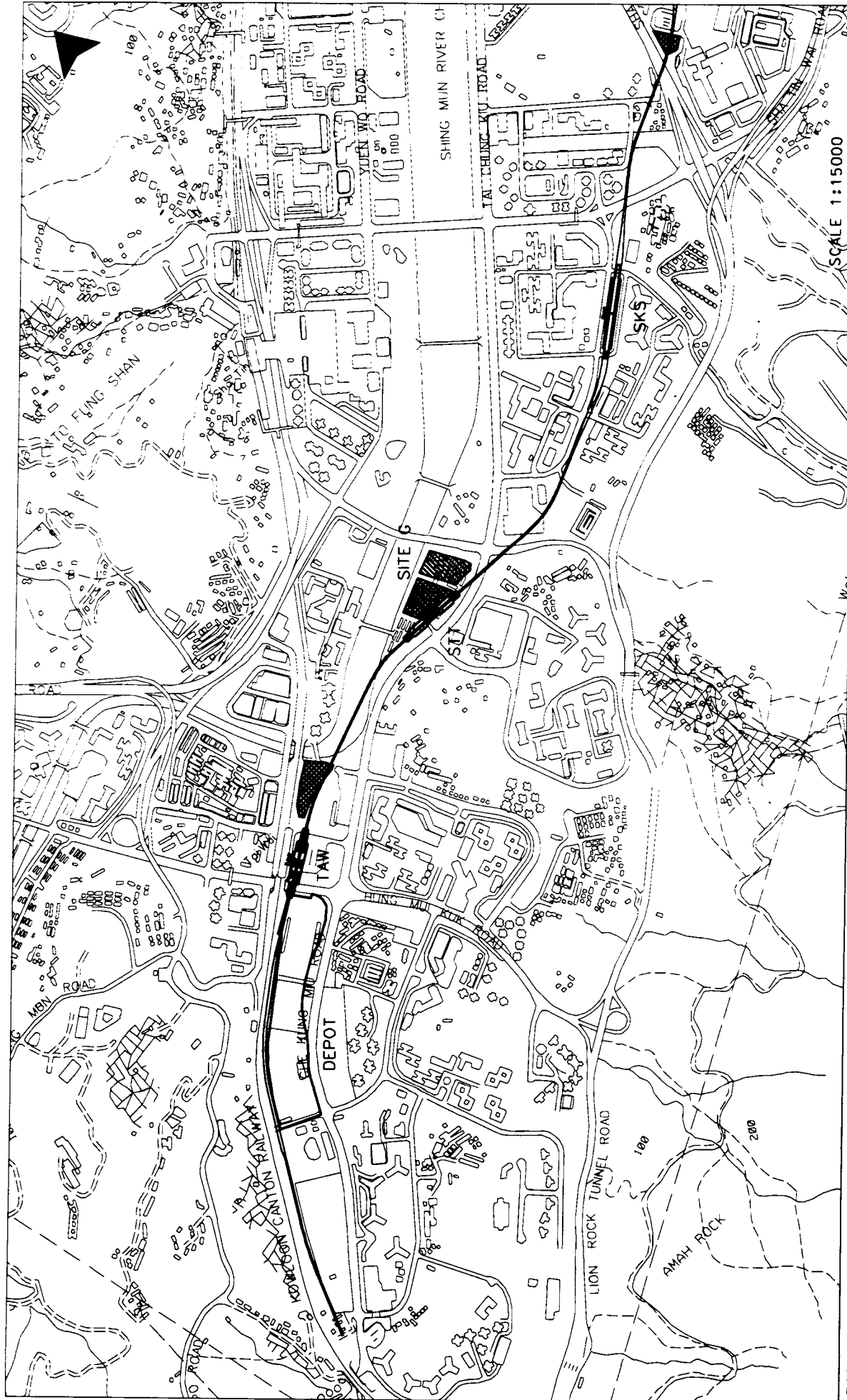


FIGURE 2-10

TAI WAI TO MA ON SHAN ALIGNMENT

- KEY
- - - At grade section of railway
  - Viaduct section of railway
  - ▨ Station
  - ▧ Systems Related Worksites
  - ▩ Construction worksites

SCALE 1:15000



**Environmental  
Resources  
Management**

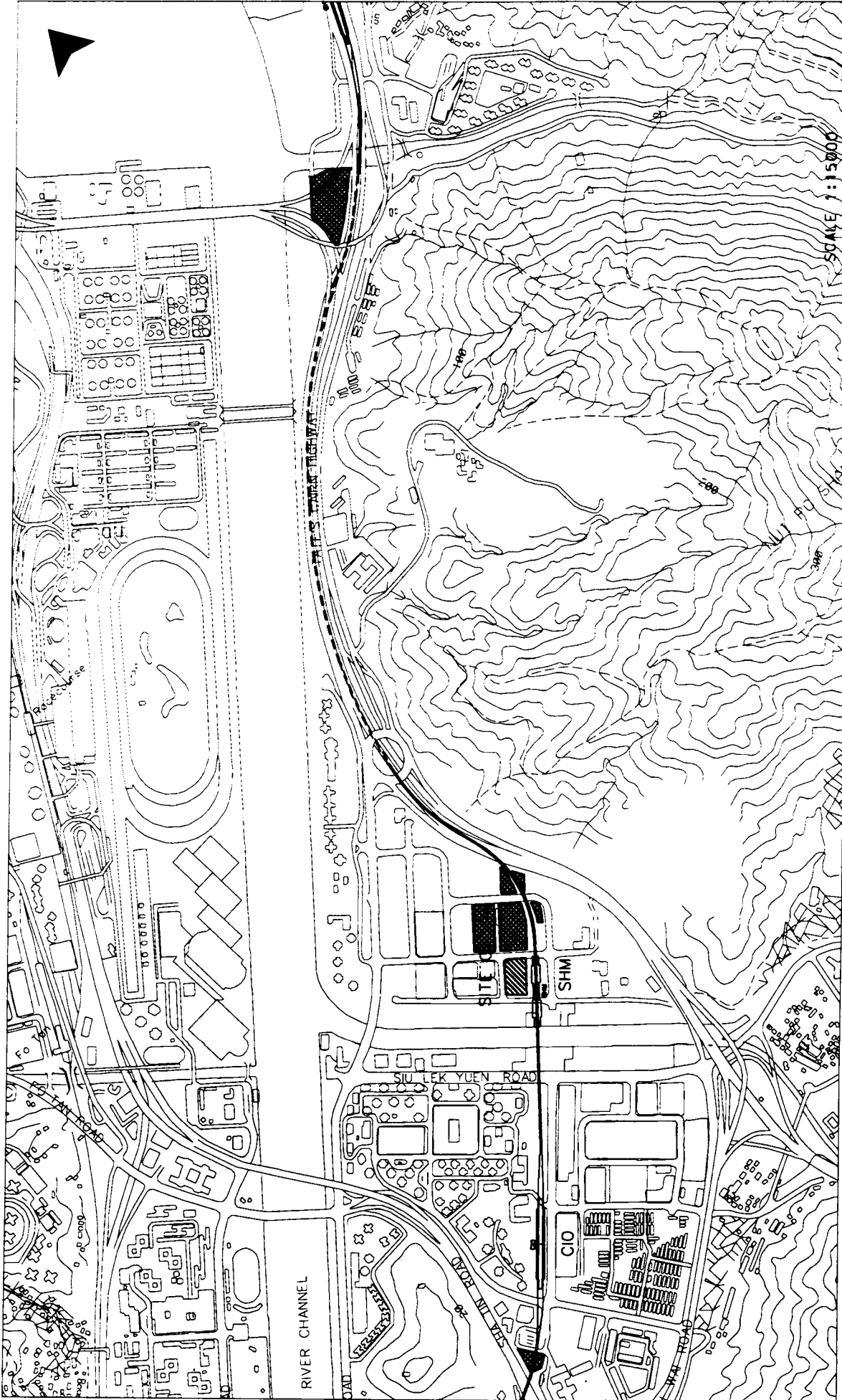
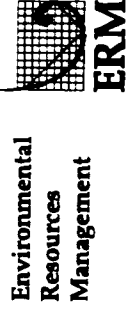


FIGURE 2.1B

TAI WAI TO MA ON SHAN ALIGNMENT

- KEY
- At grade section of railway
  - - - Viaduct section of railway
  - ▭ Station
  - ▨ Systems Related Worksites
  - ▩ Construction worksites

SCALE 1:15000



Environmental  
Resources  
Management

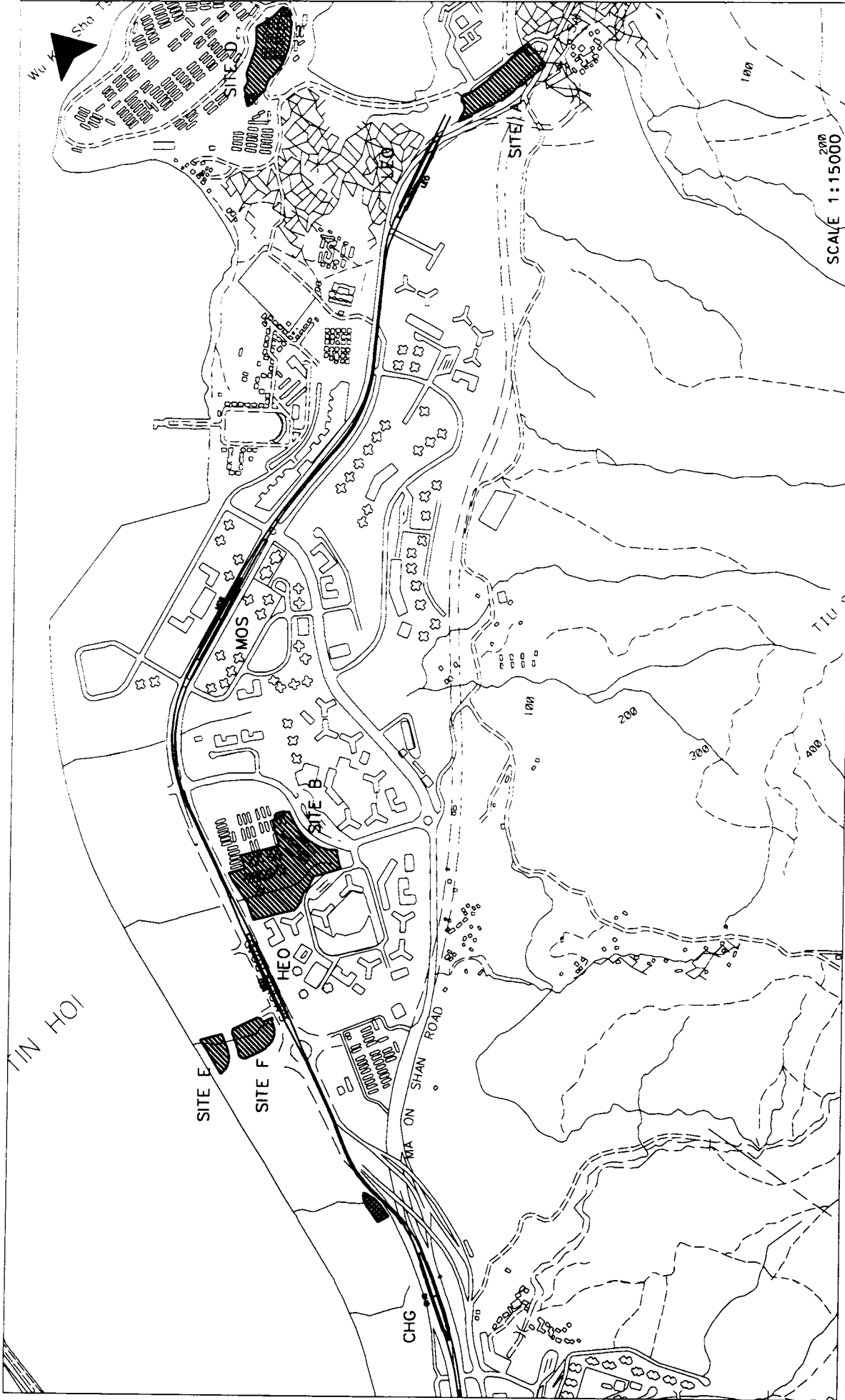


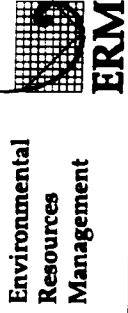
FIGURE 2.1C

TAI WAI TO MA ON SHAN ALIGNMENT

KEY

- - - At grade section of railway
- +—+— Viaduct section of railway
- ▭ Station
- ▨▨▨▨ Systems Related Worksites
- ▩▩▩▩ Construction Worksites

SCALE 1:15000



**Environmental  
Resources  
Management**

However, this alignment took the tracks close to the northern bank of the Shing Mun River, and concerns were expressed over the noise and visual impacts to residential premises of Man Lai Court. This alignment was therefore not considered any further.

The second alternative alignment comprised a 500-metre radius curve commencing from the platform ends of each station with a tangent connecting the two curves. Although this tangent moves the alignment towards residential properties at Man Lai Court, it achieves the required mitigation of the operating constraints outlined above and can be constructed and operated in compliance with the relevant environmental regulations and legislation. In particular, the straighter alignment of this option means that the effectiveness of the noise attenuation system is increased and, with the use of floating slab track, there is actually a reduction in the predicted noise levels at Man Lai Court from maximum noise of 58dB with the alignment on the southern bank of the river, to a maximum noise of 52dB for the alignment through the river. Similarly, there is not predicted to be a change in the resultant visual impacts from the adoption of this alignment. Visual impacts at Man Lai Court during the operational phase are predicted as being 'medium' with either option.

As a consequence of the improved operating conditions that the second alternative alignment presented, and the fact that the alignment could be constructed and operated in compliance with the relevant environmental regulations and legislation, it was resolved that this alignment would be pursued and it is this alternative alignment that has been assessed during the EIA process.

### ***2.2.5 Alignment between Sha Tin Tau and Sha Kok Street***

KCRC have made minor vertical and horizontal alignment modifications to their original proposal within the section from Sha Tin Tau to Sha Kok Street. These have been necessary to accommodate the proposed viaduct structure depth, to ensure the required clearance of the Tsang Tai Uk Recreation Ground. The viaduct structure to be used on the MOS Extension is based on that developed for West Rail. This viaduct design was developed to reduce structure-borne noise levels. The alignment changes between Sha Tin Tau and Sha Kok Street have been necessary in order to permit the use of the West Rail viaduct in this section of the alignment and therefore to achieve the environmental benefits associated with its use.

### ***2.2.6 Alignment between Sha Kok Street and City One***

Within this section, KCRC have designed the alignment to ensure clearance over the CLP Sui Tan substation, and to ensure that the viaduct structures do not obstruct the graves on the hill near Wong Uk Village. With the exception of the heritage issues associated with the protection of the graves, these alignment changes to KCRC's original proposal have been brought about as a result of engineering concerns. It is not considered that these alignment modifications present any significant change in the environmental impacts of the Project.

### **2.2.7 Alignment between Chevalier Garden and Heng On**

KCRC gave consideration to the adoption of either an island platform or side platform alignment at Chevalier Gardens Station. The decision was made to adopt the island platform layout together with a subway connection to an at grade concourse. To facilitate ease of passenger circulation, the side platform design has the concourse at grade and the platforms as low as possible.

To adopt the lower platforms and ensure that the viaduct misses the flyovers between Chevalier Garden and Heng On, it has been necessary to design the alignment such that it curves to the west to avoid the crest of Road P8's northbound flyover. This modification reduces the severity of KCRC's originally proposed alignment (allowing full line speed to be achieved) and enables the viaducts to be lowered, hence reducing their visual impact.

### **2.2.8 Underground Option**

#### **2.2.8.1 Background**

An underground option has been considered by KCRC. For this option, the section along the Tate's Cairn Highway / Ma On Shan Road median would remain at grade since there are currently no sensitive developments along this section. Additionally, since the proposed station at Tai Wai has to have an above ground interchange with the existing East Rail Station, it is likely that this section would also be at-grade.

The underground option could be constructed by either cut and cover construction or by a combination of bored tunnelling and cut and cover construction.

The preliminary investigations have indicated that bored tunnelling may be feasible from the southern part of the Tsang Tai Uk Recreation Ground to Shek Mun, and from Chevalier Gardens to Lee On. However, due to the shallow nature of the alignment following its descent into tunnel south of Sha Tin Tau Station, it was likely that this section may be constructed using a cut and cover technique.

#### **2.2.8.2 Potential Environmental Impacts**

##### *Underground Option - Construction Phase*

By its nature, those sections that are required to be constructed by a cut and cover tunnelling method would, in many locations, be likely to result in adverse environmental impacts. In particular, noise, dust and visual impacts, would be likely during the site clearance, piling / diaphragm walling, excavation and spoil removal and station or tunnel construction works. Cut and cover working would also affect major road junctions and this would result in increased traffic congestion and potential associated air quality impacts.

Whilst the environmental impacts from the bored tunnelling sections would be less severe, impacts would still result from ground treatment works carried out at grade, the removal of tunnelling spoil and the consequential increase in traffic on the local road network. The construction of an underground option would require the removal of approximately 1,350,000m<sup>3</sup> of spoil, which equates to approximately 190,000 2-way lorry trips. In addition, the back-filling requirements would require in the region of a further 67,500 2-way lorry trips. In comparison, the construction of the above ground alignment would require the removal of approximately 70,000m<sup>3</sup> of spoil (from the bored piles and pile cap excavations associated with the viaduct) which equates to 10,000 2-way lorry trips, and back-filling would be undertaken using local stockpiled material. The additional lorry movements associated with the construction of an underground option would have both noise and air quality impacts on the local road networks.

Bored tunnelling works may also result in potential ground-borne noise and vibration impacts.

#### *Above Ground Option - Construction Phase*

In comparison, the adoption of a viaduct construction philosophy that utilises pre-cast elements means that the construction of the proposed above ground option can be undertaken to a shorter construction period without the need to undertake major 'heavy' engineering techniques such as the excavation of large station or tunnel boxes for the cut and cover sections. The utilisation of the pre-cast elements enables a major aspect of the engineering works to be undertaken at designated worksites which are less sensitive locations away from key sensitive receivers. Whilst the exact method by which the pre-cast elements will be 'delivered' to the site is unknown it is likely that this will be by road. Due to the size of the pre-cast elements, it is possible that these deliveries may be required to be undertaken at night; which may have potential noise implications. Alternatively, it may be possible for the Contractor to develop a system that transports the units along the alignment using a temporary rail track and special rolling stock mounted with cranes. The exact details of delivering the pre-cast units will be determined at a late date. If road delivery is utilised, there will be environmental impacts associated with the vehicle movements. However, the number and frequency of the movements will be less than that required by the underground option for the removal of spoil, therefore, the environmental implications would be lower. Overall, the environmental implications of constructing the above ground option are predicted to be less severe than an underground option, although, it is inevitable that the construction of an above ground railway within an urban environment will give rise to some noise, air quality and visual impacts.

#### *Underground Option - Operational Phase*

The development of an underground option clearly presents a means of practically eliminating impacts such as noise and visual impacts during the operational lifetime of the Project. Noise and visual impacts would be confined to those associated with the operation of the stations, depot and the ventilation shafts, although impacts from these



sources would be anticipated to be minimal. With the adoption, where necessary, of appropriate mitigation measures, no residual impacts would be anticipated in relation to water quality, waste management, ecology, heritage or land contamination.

#### *Above Ground Option - Operational Phase*

With the adoption of the recommended mitigation measures, an above ground alignment can be operated within the required environmental criteria. However, it is acknowledged that the introduction and operation of an above ground transport infrastructure, such as the MOS Extension, within an urban environment will inevitably give rise to environmental impacts such as noise and visual impact. Whilst these impacts can be mitigated to within the required criteria, they cannot be eliminated. As with the operation of an underground option, with the adoption, where necessary, of appropriate mitigation, no residual impacts would be anticipated in relation to water quality, waste management, ecology, heritage or land contamination.

#### **2.2.8.3 Comparison of Above and Underground Schemes**

As is indicated above, from an environmental perspective, there are many advantages to operating an underground railway; particularly the near elimination of noise and visual impacts. These environmental advantages will be experienced by the community for the operating lifetime of the MOS Extension.

The construction of an underground option, and in particular those sections that may be required to be constructed by cut and cover working, has the potential to result in more environmental impacts than the construction of the above ground option. In particular, the construction of an underground option has the potential to give rise to greater noise, dust and visual impacts, and spoil disposal issues. However, these impacts must be considered in the overall context of the Project. In relation to the operating lifetime of the railway, these impacts will only be experienced over a short period of time.

When considered in context it is clear that the construction and operation of an underground option offers long term environmental benefits to the community. However, the selection of either an above ground or underground alternative is based on numerous other considerations, for example, those posed by design, construction, operation, safety and cost. The decision on whether an underground option is feasible needs to consider all of these facets, and to make an overall judgement.

#### **2.2.8.4 Construction Constraints/Considerations**

An overview of the construction issues that require consideration when determining the feasibility of an underground option are summarised in the following paragraphs.

##### *Existing Structures*

From a construction engineering perspective the underground option would present significant conflicts with existing infrastructure and piled foundations. In addition, an underground option would require the relocation or alteration of services including culverts, stormwater drains, electricity cables and gas mains including the strategic gas main near Sha Tin Station. A number of pedestrian subways would also need to be temporarily closed, and under-pinning would be required to the vehicular subway south of Chevalier Garden. In comparison, whilst the proposed above-ground option will have some minor conflicts with existing infrastructure, these interfaces will be minimal and all footbridges and subways could be maintained.

#### *Landtake*

In addition to the potentially higher environmental impacts associated with the additional landtake required for the cut and cover sections, these landtake requirements would also result in conflicts such as the temporary closure of the football ground adjacent to Sha Kok Street and disturbance to the graves and shrine at the Kong Pui Street Rest Garden and Wong Uk Village respectively. The underground option may also require works additional works areas which may require an extension to the currently gazetted boundary.

#### *Construction Safety*

The proposed above-ground option would be undertaken within an existing railway reserve and there would be little effect on adjacent buildings and public thoroughfares. However, protective measures would be required for piling works undertaken at the pier locations, and during the construction of in-situ works and the erection of pre-cast viaduct segments. In comparison, the underground option would require more elaborate protection measures to ensure that adjacent buildings and structures would not be affected by settlement. This would most likely include the need to undertake monitoring, ground treatment and in some instances underpinning at the following locations:

- CLP Sui Tan Sub-station;
- Wong Uk Village;
- Two petrol stations at Kong Pui Street;
- Ma On Shan Road;
- Tate's Cairn Highway; and
- residential blocks between Heng On and Lee On Stations.

#### *Construction Duration*

The construction duration for the underground option would be approximately four years, whereas for the proposed above ground option it would be approximately two.

#### *Construction Costs*

The cost estimates have demonstrated that the construction cost associated with the underground option would be about three times as expensive as the currently proposed above ground option.

### **2.2.8.5 Operational Constraints/Considerations**

An overview of the operational issues that require consideration when determining the feasibility of an underground option are summarised in the following paragraphs.

#### *Operational Safety*

Operational safety considerations need to be taken into account. For the currently proposed above ground option, passengers can evacuate from a train on the viaduct by proceeding along the walkway to the closest station. In addition, emergency vehicles can park underneath the viaduct at the location of the incident in order to enable emergency personnel to quickly and effectively carry out their duties. However, with regard to an incident on the underground railway scheme, passengers would have to be led to safety by the train operator. Essential services staff would only be able to enter the tunnels via the station and the time taken to reach the incident would be longer. There are also additional constraints posed to the essential services staff when dealing with an incident underground in a confined location.

The provision of emergency escape staircases and vent shafts for the underground alignment would also impose additional land take requirements in relation to the underground option.

#### *Energy*

Above ground stations utilise less energy for lighting and ventilation, and use less air conditioning than underground stations. In addition, at least twice as much energy would be required by the underground alternative in order to provide lighting, ventilation and cooling for the tunnels.

#### *Cost*

Energy costs associated with the underground alternative have been found to be twice that of the currently proposed above ground scheme, whereas maintenance costs are about 1.5 times higher due to the greater number of plant items required (for example, for air conditioning units) and the increased staff requirements and their associated costs.

### 2.2.8.6 Evaluation of an Underground Option

With due consideration to all the factors (including those related to environment, design, construction, operating, safety and cost), the above ground option was chosen in preference to the underground scheme.

## 2.3 Do Nothing Scenario

The MOS Extension is proposed in order to improve transport communications for the population of the North East New Territories, and specifically to provide residents of the Ma On Shan and Lee On New Towns with a direct rail link to the wider KCRC (and MTRC) systems, thereby improving accessibility to the central business areas of Hong Kong.

In environmental terms, the projected ridership levels indicate that the proposed railway will carry up to 300,000 passengers a day in 2016. If the MOS Extension were not constructed, the commuters of Ma On Shan, Lee On and other conurbations in the surrounding areas would need to find alternative means of transport. It is most likely that the alternative transport options would comprise car and bus journeys. As a consequence, there would be an increased level of vehicles on the road networks in the surrounding areas which would give rise to increased levels of vehicular air pollutants and noise.

## 2.4 Alignment

The proposed alignment that has been considered within this EIA Report is described in the subsections that follow:

### 2.4.1 *Hin Keng to Tai Wai*

The section from the depot at Hin Keng to Tai Wai Station runs at grade, parallel to the existing KCR East Rail lines which are elevated on an embankment. The distance from the end of the maintenance depot back shunts to Tai Wai station is approximately 1100 m. After passing the depot, the MOS Extension alignment will rise to the same height as the existing East Rail as it continues to approach Tai Wai Station, this will facilitate the transfer of passengers between the two services. Tai Wai Station will have side platforms. The depot is planned for the area to the immediate south-west of Tai Wai Station, currently occupied by the Hong Kong School of Motoring and cycling area. The site is bounded on its southern and western side by Che Kung Miu Road, on its eastern side by Mei Tin Road, and on its northern side by the KCR alignment. In addition, a Public Transport Interchange (PTI) is proposed to the immediate south-east of the Tai Wai Station on the land currently occupied by the existing bus station and Happy Dragon Recreation Park. It is proposed that a new pedestrian subway will be constructed from Tsuen Nam Road to the PTI. In addition, the footbridge ramp of the Che Kung Miu Road roundabout footbridge network will need to be modified to enable the construction of the proposed PTI.

### **2.4.2 Tai Wai to Sha Tin Tau**

To the east of Tai Wai Station, the alignment will emerge on a viaduct structure, passing over the area currently occupied by the Happy Dragon Recreation Park. The viaduct will continue through the bend of the Shing Mun River to an elevated station located opposite the Chun Shek Estate. The footpath and bicycle track to the south of the Shing Mun River promenade adjacent to Sha Tin Tau Station may require re-alignment to enable the construction of the proposed railway. In addition, it is also proposed that a pedestrian subway and ramp be constructed on the northern side of Sha Tin Tau Station in order to connect with the existing subway under Che Kung Miu Road, thereby providing access from the station to the southern side of Che Kung Miu Road. A number of sites of historic interest at Che Kung and Leu Uk Tsuen, (including the Che Kung Miu Temple) and local residential developments will have a clear view of the alignment. The residential developments include Holford Gardens, Grandway Gardens and Man Lai Court to the north and Tim Sam Village, Carado Gardens, Sun Choi Estate, Lung Hang Estate and Hin Keng Estate to the south.

### **2.4.3 Sha Tin Tau to Sha Kok Street**

The alignment between Sha Tin Tau Station and Sha Kok Street Station runs eastwards on viaduct over Che Kung Miu Road and Lion Rock Tunnel Road, passing adjacent to a wooded mound and a Chinese shrine which are both located at the junction of the two roads. The Che Kung Miu Road/ Lion Rock Tunnel Road junction will require modification to allow the construction of the proposed railway viaduct. From the road junction, the alignment then passes over the Tsang Tai Uk Recreation Ground before running parallel to, and immediately to the south of, Sha Kok Street on its way to Sha Kok Street Station which is located to the west of Shui Chuen Au Street. As Sha Kok Street Station will be an island platform design, the tracks will separate slightly on their approach into the station. Temporary provisioning and permanent modification to the Tsang Tai Uk Recreation Ground will be required. Several large housing estates and three schools are located on either side of Sha Kok Street and these include the Jat Min Chuen residential area, the Pok Hong Estate and the Sha Kok Estate. The construction of the proposed railway viaduct and Sha Kok Street Station will affect the ball courts and lorry parking spaces of Pok Hong Estate along Sha Kok Street. These will both require re-provisioning.

### **2.4.4 Sha Kok Street to City One**

From Sha Kok Street Station, the track reconverge following their separation at the island platform station. The alignment then passes over Shui Chuen Au Street towards Sha Tin Road, with Sha Tin Wai Village to the south. The alignment heads north-east over Sha Tin Road adjacent to a vegetated mound containing graves, rising further as it passes over Wong UK Village, in order to clear the China Light and Power Sui Tan Substation. The alignment then crosses Shatin Road to the north and west of the Prince of Wales Hospital, before passing over a bus terminus (which will require modification for the construction of the railway viaduct) and a small open space located between the bus-terminus and

Ngan Shing Street. City One Station, which is proposed to be of the island platform design, will be located on east of the junction of Ngan Shing Street and Chap Wai Kong Street. The site is located in a long linear reserve set aside for the MOS Extension development immediately to the west and parallel to Chap Wai Kong Street. It is bounded to the north and west by two schools (the Dr. Catherine F. Woo Memorial School and the Lam Kau Mow Secondary School) and residential developments (Yue Tin Court and City One Plaza) and to the south and east by industrial buildings (mostly godowns). The Prince of Wales Hospital is also located to the south-west.

#### **2.4.5 City One to Shek Mun**

A large area of recreational open space, undeveloped land and a nullah is located between City One Station and the Shek Mun Station site. The alignment, still on viaduct, passes across this open space, and over Siu Lek Yuen Road and the nullah before entering an industrial area that is set in a triangle of land located between the nullah, Tate's Cairn Highway and Tai Chung Kiu Road. The alignment then enters the proposed Shek Mun Station which is located parallel to, and immediately to the north-west of, On Ming Street, and above On Muk Street and On Lai Street, the latter of which is likely to be permanently closed. Shek Mun Station will be of a side platform design, and will be located on a site bounded by industrial buildings and land proposed for development.

#### **2.4.6 Shek Mun to Chevalier Garden**

From Shek Mun Station, the alignment swings north over the eastbound lane of the Tate's Cairn Highway, descending to grade in the reserve set aside for the MOS Extension along the centre of the Tate's Cairn Highway and Ma On Shan Road from this point until the track alignment reaches Chevalier Garden Station. The east bound carriage way of Tate's Cairn Highway will need to be lowered to enable the construction of the proposed railway viaduct. From here, the alignment continues at grade, passing under the elevated Shek Mun Interchange roundabout, and along the central reserve of Ma On Shan Road (following the divergence of the Tate's Cairn Highway) until just before the Nullah, where it returns to viaduct for the remainder of the section to Chevalier Garden Station. Chevalier Garden Station will be of an island platform design, and will be located north-east of Hang Shun Street, within the central reserve of the Ma On Shan Road. A pedestrian subway is proposed to provide access to the western and eastern sides of Ma On Shan Road. This section is less heavily developed than those to the west of City One Station but it does pass several residential areas including Garden Vista, Pictorial Gardens and Sha Tin Fishermen's New Village as well as Shatin Hospital. Near Chevalier Garden Station, residential developments (Tai Shui Hang Village and Chevalier Gardens) are located within side-valleys set amongst vegetated hill slopes.

#### **2.4.7 Chevalier Garden to Heng On**

After Chevalier Garden, the viaduct continues north, rising to cross out of the Ma On Shan highway reserve and into the central reservation of Sai Sha Road from where it continues, north east to Heng On Station, again within the central reserve of Sai Sha

Road. Heng On Station will be located north of the interchange with Hang Fai Street, with a pedestrian subway proposed to provide access to the west and east of Sai Sha Road. Heng On Station will be an island platform station. The residential premises of Vista Paradise and Heng On Estate are located to the north-east and the east of the station respectively. Both residential developments overlook the station, with the Chinese YMCA College and playground located between Heng On Estate and Sai Sha Road. The areas to the west and south of the proposed station are set aside for residential and G/I/C developments.

#### **2.4.8 Heng On to Ma On Shan**

The alignment continues on viaduct, over a pedestrian footbridge located approximately 200 m south of the junction of Sai Sha Road and Hang Hong Street, and continues past a new stadium development before turning east as it approaches the Ma On Shan Town Centre and Ma On Shan Station. The proposed Ma On Shan Station will be located north-east of On Yuen Street within the central reserve of Sai Sha Road, and that was set aside for the MOS Extension project. In order to provide access from the Ma On Shan Station to the western and eastern sides of Sai Sha Road, a pedestrian footbridge is proposed. The construction of the footbridge will require the modification of Sunshine City and Ma On Shan Plaza to enable links with the two developments. Residential developments are located to the north (Tolo Place, Bayshore Towers and Ma On Shan Centre) and south (Sunshine City and Fun Fai Garden) of the station. The residential developments all have podium decks which provide a range of commercial and transportation facilities. Thereafter, the track alignment continues along the MOS Extension reserve in an easterly direction towards Lee On Station.

#### **2.4.9 Ma On Shan to Lee On**

The alignment leaves Ma On Shan Station on viaduct and passes over the existing footbridge linking the Ma On Shan Centre and Fu Fai Garden residential complex, before continuing to head east over On Chiu Street. The alignment then passes on viaduct along the central reserve of Sai Sha Road, through an area of residential properties, including Villa Athena to the north, and Saddle Ridge Gardens together with the Ma On Shan Health Centre to the south. (An emergency footbridge is proposed north of the Saddle Ridge Gardens residential complex, which will enable passengers to disembark to the south of Sai Sha Road in the event of an emergency.) The railway track alignment then continues on viaduct over the junction with Kam Ying Road and along the central reserve as it passes to the north of Lee On Estate and south of Wu Kwai Sha New Village. The alignment then passes over the Lee On Estate access road, into Lee On Station. Lee On Station is the terminal station, however, there will be over-run tracks that terminate beyond the station platform to the north-east of Sai Sha Road. Lee On Station, which is proposed to be of the island platform design, will be situated in a site located to the east of the access road and within a former borrow area comprising a series of flat platforms separated by rock outcrops with the Lee On Residential Development above. A PTI is proposed to be located to the south of Lee On Station.

## 2.5 Construction

### 2.5.1 Contracting Philosophy

The precise details of the proposed construction methodology will be developed during the detailed design stage of the MOS Extension Project. Subsequent to this, the selected Contractor(s) may develop alternative methodologies. Therefore, it is not possible, at present, to present definitive construction details. However, one scenario that has been developed assumes that the MOS Extension will be constructed by means of four major construction contracts. The details of this possible construction methodology are set out below.

Within this scenario, the construction contracts would preliminarily consist of the following:

- (i) TCC200 - This contract would potentially comprise construction of all railway viaduct and stations from the north of Tai Wai Station to a point just south of the Tate's Cairn Highway Crossing. The contract would potentially include 3785 m of viaduct track, together with the construction of four above ground stations : Sha Tin Tau, Sha Kok Street, City One and Shek Mun.
- (ii) TCC300 - This contract would potentially comprise all railway viaduct and at-grade construction, together with stations from a point just south of the Tate's Cairn Highway Crossing to the termination at Lee On Station. The contract would potentially include 2200 m of at-grade track and 4127 m of viaduct track, together with the construction of four above ground stations : Chevalier Garden, Heng On, Ma On Shan and Lee On.
- (iii) TCC400 - This contract would potentially comprise construction of the new Tai Wai Station including viaduct, the adaption of the existing East Rail Station and the construction of a transfer corridor between the two.
- (iv) TCC500 - This contract would potentially comprise construction of the MOS Extension Depot at Tai Wai.

Within this potentially construction methodology, both the southern and northern contracts (TCC200 and TCC300 respectively) would progress from both ends of the viaducts simultaneously, and that the viaduct and elevated Station structures would be constructed using the same match cast segmental construction methodology.

Each contract would require a match casting yard to be set up for the production of the viaduct segments. Additional pre-cast facilities would be likely to be required for the Station pre-cast units and viaduct parapets. The location of the casting yards and the acquisition of any necessary permits or licences associated with their use will be the responsibility of the Contractor.



### **2.5.2 Construction Sequence**

Within this potentially construction methodology the construction sequence would initially involve the construction of the vertical support elements and cross beams. The viaduct structures, which basically consists of 35-40 m span box girders, could be 'delivered' to the various work faces using a system that comprises a temporary rail track and special rolling stock mounted with cranes. However, it should be noted that alternative methods of delivering the pre-cast units may be employed by the Contractor. Once delivered, the pre-cast units would be placed using an erection gantry. The viaducts would continue through the various stations, with the beams between each viaduct column supporting the platform slab and lightweight roof structure where applicable. Once a short section of viaduct is complete, subsequent viaduct girders would be erected on the previously completed vertical support column. As the viaduct erection moves beyond each Station, construction of the Station would commence.

The use, as outlined in this possible construction methodology, of pre-cast segments, beams and slabs would enable the majority of the viaduct sections to be constructed 'in the air' thereby minimising the amount of ground level construction works and consequently the likelihood for disruption to traffic and nuisance to residents.

### **2.5.3 Southern Section Contract (TCC200)**

A works area for the southern section construction contract could be located at Shek Mun on the proposed Station/development site. A lifting point may be located north of Shek Mun Station such that the erection of the viaduct could proceed southwards. At the same time, it would be possible for units to be delivered to the South-West end of the depot area in TCC500 to allow delivery over the completed TCC500 and TCC400 track construction to north of Tai Wai Station.

Two long span structures are included within this construction contract, the span over the cell box culvert adjacent to the Shing Mun River, and the span over Sha Tin Road. The normal match cast segmental construction sequence is proposed for both these structures.

### **2.5.4 Northern Section Contract (TCC300)**

A possible works area for this construction contract could be at Lee On, which would allow the erection of the main viaduct will proceed south. Within this assumed construction scenario, the timing of the erection of the viaduct from the southern end is likely to be dictated by the construction of the currently proposed three span continuous viaduct structure over the Ma On Shan/Sai Sha Road interchange. As this structure would be likely to be erected using a special construction technique and equipment, this would prevent the use of the standard gantry from being used to construct the viaduct northwards uninterrupted from just south of Chevalier Gardens. An alternative option could comprise completing the short section of viaduct south of the Ma On Shan/Sai Sha Road interchange, including Chevalier Gardens, and then moving the erection gantry north of the Ma On Shan/Sai Sha Road interchange. A lifting gantry would be necessary to lift the

units from a road transporter onto the partly built viaduct just north of the Ma On Shan/Sai Sha Road interchange.

Long span structures would be required adjacent to Lee On Station and across the Tate's Cairn Highway just north of Shek Mun. The viaduct over the Lee On roundabout could be constructed using the normal match cast segmental construction sequence, and a portal frame structure could be constructed over the Tate's Cairn Highway.

### **2.5.5 Depot Contract (TCC500)**

The depot will occupy a site of approximately 600 m by 100 m. The workshop facilities are currently propose to be located at the western end of the site and the stabling area is at the eastern end fronting Mei Tin Road.

The depot will be built beneath the podium of a future development. Ultimately it is proposed that the roof slab will be parking deck for the planned development over the depot.

Within this potentially construction scenario, it is proposed that the depot construction contract would start in the west, due to the additional construction content, and move east. The foundations would consist of bored piles and pile caps with some foundation beams at the perimeter.

### **2.5.6 Tai Wai Station (TCC400)**

The Tai Wai Station will comprise a new side platform Station for the MOS Extension, a major upgrade of the existing Tai Wai East Rail Station and a connecting link between the two. The platform slab will share a common support structure with the railway viaduct, and the Station will be constructed after the viaduct. A particular challenge will be the construction of the podium roof over the whole interchange Station, including the operational East Rail Station.

In order to leave the track clear for viaduct erection by the TCC200 contractor north of Tai Wai Station, this construction scenario assumes that priority on the Tai Wai Station Contract would need to be given to the podium piling adjacent to, and above the new MOS Extension Station, and to the viaduct construction.

### **2.5.7 Construction Worksites**

In order to facilitate the construction of the MOS Extension, a number of 'off-site' worksites have been proposed for the storage, setup, preparation and installation of equipment and systems. The provision of these 'systems related' worksites is considered essential so as not to delay the construction programme.

As the exact construction methodology has still to be defined, it is imperative that scope is maintained for allowing the Contractor to develop more flexible approaches. For example, with the availability of lighter rail mounted vehicles, the opportunity exists to

undertake the track laying construction sequence in different directions from multiple points along the alignment at the same time. This option presents both programme benefits and flexibility over the possible construction methodology outlined in *Section 2.5*, which considered that the works may be undertaken in one direction from two starting points, Tai Wai Depot and Lee On Station. In order to provide Contractors with the opportunity to implement this alternative construction method, it is necessary to provide the systems related worksites shown on *Figures 2.1a-c*, and described below.

*Site A* - This site is located at the eastern end of alignment and it is proposed that it would be used for the purpose of laying track from the Lee On end of the line.

*Site B* - This site, of approximately 22,100m<sup>2</sup>, is located close to Heng On Station. It is proposed that this site would be used for the temporary storage and layout of special trackwork, as well as being a starting point for the track and systems installation works to proceed in both directions. The site would also be used by systems contractors working at Heng On Station.

*Site C* - This site, near Shek Mun Station, would be used for the installation of track and systems between the at-grade section and Sha Tin Tau Station.

*Site D* - Located approximately 1km north-east of Lee On Station, this site will be used for off-site storage.

*Site E* - Located to the south-west of Heng On Station, close to the shore of the Shing Mun River, this site, of approximately 5,000m<sup>2</sup>, would be used for the marine transportation of rails, floating slab and other materials.

*Site F* - Adjacent to the southern end of Heng On Station, this site would be used, in conjunction with Site B, for the installation of track and systems along the down track.

*Site G* - Adjacent to Sha Tin Tau Station, this site of approximately 8,000m<sup>2</sup>, would be the one of the preferred starting points for the cable and track laying from Sha Tin Tau to the Tai Wai Depot.

## 2.6 Operation

It is planned that trains will operate on the MOS Extension alignment from end to end throughout the planned operating hours of 0530 to 0100 hours. As most MOS Extension passengers will interchange with East Rail at Tai Wai, the first southbound train from Lee On and the last northbound train from Tai Wai are planned to connect with the first and last East Rail trains in both directions.

It is envisaged that initially, upon opening, the MOS Extension will operate 4 car trains with a peak service frequency slightly reduced from that proposed for full operation. Peak service frequencies will be achieved by the year 2011. Depending upon patronage, 8 car trains are likely to be used in later years.

The full operating train frequencies for MOS Extension are planned to be:-

- Morning Peak on Weekdays - 2 minutes
- Evening Peak on Weekdays - 4 minutes
- Sundays and Public Holidays and off-peak on Weekdays - 6 minutes.

However, upon opening in 2004, the peak service will 2.5 minutes, although the off-peak frequencies will be as detailed above.

The MOS Extension will be equipped with Automatic Train Operation (ATO) capable of operating up to 30 trains per hour per direction. The design of the ATO system will also allow fall-back to Automatic Train Protection (ATP) mode of operation by manual driving in case of ATO failure.

The MOS Extension Depot at Tai Wai will provide facilities for the maintenance of the MOS Extension and its associated rolling stock. The facilities at the depot will include two running maintenance berths, with one berth having a carriage lifting facility and a small heavy repair workshop. The Depot will, however, be used mainly for stabling and running maintenance due to the small MOS Extension train fleet size.