2 PROJECT DESCRIPTION

2.1 Introduction

2.1.1 This section presents a summary of the adopted alignment and preferred construction methodology for the Project as well provides details of the alternative options considered, and the constraints and considerations assessed in adopting the preferred scheme and construction method.

2.2 Purpose and Objective of the Project

2.2.1 TKO-LT Tunnel (which is the Project being considered in this EIA Report), together with the proposed Trunk Road T2 (T2) in Kai Tak Development (KTD) and Central Kowloon Route (CKR), will form Route 6 in the strategic trunk road network (**Figure 2.1**).

2.2.2 As part of Route 6 and together with Cross Bay Link (CBL), the objective of the TKO-LT Tunnel is to provide an east-west highway link between Kowloon and Tseung Kwan O (TKO) areas.

2.2.3 In 2002, Civil Engineering and Development Department (CEDD) commissioned an integrated planning and engineering study under Agreement No. CE 87/2001 (CE), Further Development of Tseung Kwan O – Feasibility Study (TKO Study), to formulate a comprehensive plan for the further development of Tseung Kwan O (TKO). The TKO Study recommended that TKO be developed further to house a total population of 450,000.

2.2.4 In March 2009, CEDD appointed AECOM Asia Co. Ltd. (AACL) to carry out a detailed investigation study under Agreement No. CE 42/2008 (CE), Tseung Kwan O – Lam Tin Tunnel and Associated Works – Investigation (the Assignment).

2.3 Project Components

2.3.1 The Project consists of six main sections:

1. Roads P2/D4 Junction – this section comprises the footbridge connecting Park Central and Area 74S DO site (namely Northern Footbridge), and the walkway linking it to the grade separated cycle-track cum footpath connecting G/IC site at TKO Area 72, G/IC site at TKO Area 67 and Area 74S DO site (namely Southern Footbridge) at Roads P2/D4 Junction.

2. Landscape Deck at Road P2 – this section comprises a depressed road section of Road P2 with landscape deck at the eastern side of Ocean Shores was proposed to be designed as DO site.

3. Tseung Kwan O Section (including TKO Interchange) – this section includes a straight alignment with approximately 3ha of reclamation in Junk Bay for construction of depressed Road P2 and associated connection roads.

4. Lam Tin Hill Section – this section comprises the main tunnels and the branch tunnel about 90m and 67m below Kwong Ching House respectively.

5. Lam Tin Interchange – this section includes the link road connections between TKO-LT Tunnel/T2, EHC and Cha Kwo Ling Road.

6. Cha Kwo Ling Village Section – this section comprises the tunnel alignment pass through the middle of Cha Kwo Ling Village.

2.4 Need for the Project

2.4.1 At present, the existing TKO Tunnel is the main connection between TKO and the urban areas of Kowloon and Hong Kong. However, it has nearly reached its capacity limit due to further development of TKO. Thus, the existing TKO Tunnel will hardly meet the anticipated future demand in terms of capacity, convenience and level of comfort. The proposed new TKO-LT Tunnel together with CBL will alleviate the frequent traffic congestion and meet the long-term traffic demand between TKO and the external areas.

2.4.2 Traffic congestions have already occurred during peak hours at TKO Tunnel. Its volume/capacity (v/c) ratio is around 1.14. According to the traffic impact assessment carried out under Agreement No. CE 42/2008 (CE) Tseung Kwan O – Lam Tin Tunnel and Associated Works – Investigation, it is envisaged that the congestion during peak hours at TKO Tunnel would worsen, with the v/c ratio and queue length (measured from toll plaza) of Kowloon-bound traffic during peak hours reaching 1.38 and 2.9 km respectively. The above data indicates that the traffic volume of the existing TKO Tunnel will continue to increase and its capacity would not be able to cope with the estimated traffic volume in year 2021. The anticipated v/c ratio at TKO Tunnel is summarized in **Table 2.1**.

Table 2.1 volume/ capacity (v/c) ratio at existing TKO Tunnel

Year	Anticipated v/c ratios at TKO Tunnel during peak hours	
	Without TKO-LT Tunnel	With TKO-LT Tunnel
2016	1.16	—
2021	1.38	0.86
2026	1.38	0.88

Notes: volume/ capacity (v/c) ratio is an indication of the traffic conditions of roads during peak hours. A v/c ratio equals to or less than 1.0 is considered acceptable. A v/c ratio between 1.0 and 1.2 indicates a manageable degree of congestion. A v/c ratio above 1.2 indicates more serious congestion.

2.4.3 The legislative Council, Sai Kung District Council and the local community have been urging for early construction of TKO-LT Tunnel together with CBL such that these new roads will provide the much needed additional transport capacity to meet the anticipated future demand.

Scenario without the Project

2.4.4 According to the traffic impact assessment for future year carried out by the Project, capacity problem is anticipated to be experienced at the following key road links/junctions:

- Kwun Tong Bypass (near Hoi Bun Road)
- Tseung Kwan O Tunnel
- Clear Water Bay Road (near Ying Yip Road)
- Eastern Harbour Crossing
- Hang Hau Road
- Ying Yip Road
- Po Lam Road (East of Sau Mau Ping Road)
- Ramp connecting Kwun Tong Bypass and Kai Fuk Road
- Kai Cheung Road / Wang Chiu Road
- Sheung Yee Road / Wang Chiu Road
- Kwun Tong Road/Hoi Yuen Road/Hip Wo Street Roundabout
- Cha Kwo Ling Road/Wai Yip Street Junction
- Lei Yue Mun Road / Tseung Kwan O Road

- Lei Yue Mun Road/Kai Tin Road Roundabout
- Cha Kwo Ling Road/Ko Fai Road Junction
- Po Lam Road North/Po Hong Road Junction
- Po Lam Road North/Tsui Lam Road Junction
- Po Lam Road North/Lam Shing Road Junction
- Ying Yip Road/Po Ning Road/Sheung Ning Road Roundabout
- Clear Water Bay Road/Hang Hau Road/Yip Yip Road Roundabout
- Wan Po Road /Po Yap Road / Chiu Shun Road
- Po Yap Road /Tong Yin Street / *(Future Road L671)*
- Po Yap Road /Tong Chun Street / *(Future Road L661)*
- Wan Po Road/Pak Shing Kok Access Junction
- Wan Po Road / LOHAS Park Road
- Wan Po Road / Shek Kok Road

2.4.5 Based on the results of traffic impact assessment, the existing road network in Kowloon East and Tseung Kwan O area will experience serious congestion if an alternative external road link is not provided to meet the population growth and the continuing commercial and industrial development in the TKO area.

Scenario with the Project

2.4.6 Upon the completion of TKO-LT Tunnel, capacity problem on traffic flow in the following locations will be eased or even resolved:

- Tseung Kwan O Tunnel
- Clear Water Bay Road (near Ying Yip Road)
- Hang Hau Road
- Po Lam Road (East of Sau Mau Ping Road)
- Kai Cheung Road / Wang Chiu Road
- Kwun Tong Road/Hoi Yuen Road/Hip Wo Street Roundabout
- Lei Yue Mun Road / Tseung Kwan O Road
- Po Lam Road North/Po Hong Road Junction
- Po Lam Road North/Tsui Lam Road Junction
- Po Lam Road North/Lam Shing Road Junction
- Ying Yip Road/Po Ning Road/Sheung Ning Road Roundabout
- Clear Water Bay Road/Hang Hau Road/Yip Yip Road Roundabout
- Wan Po Road /Po Yap Road / Chiu Shun Road
- Wan Po Road/Pak Shing Kok Access Junction
- Wan Po Road / Lohas Park Road
- Wan Po Road / Shek Kok Road

2.4.7 The effects of TKO-LT Tunnel on journey times and queue lengths have also been examined and the results are summarised in **Table 2.2** and **Table 2.3.** It is concluded from the results of the study that the presence of TKO-LT Tunnel will significantly improve traffic conditions by reducing both journey times and queue lengths.

Table 2.2 Improvements to Journey Time by TKO-LT Tunnel

From	To	Journey Time	
		2011 - Existing Route	2021 - Using TKO-LT Tunnel (and Route 6)
Junction of Yau Tong Road/ Cha Kwo Ling Road	End of CKR at Yau Ma Tei	22 mins.(1)	8 mins.(2)
Junction of Po Yap Road /Po	EHC	12 mins.(3)	3 mins.(4)

Shun Road			
Junction of Po Yap Road /Po Shun Road	End of CKR at Yau Ma Tei	30 mins.(5)	12 mins.(6)
Junction of Wan Po Road /Wan O Road	End of CKR at Yau Ma Tei	35 mins.(7)	15 mins.(8)

Notes: (1) Journey route: Cha Kwo Ling Road, Wai Yip Street, Kwun Tong Bypass, Kai Fuk Road, Kai Tak Tunnel, East Kowloon Corridor, Chatham Road North and Gascoigne Road.
(2) Journey route: Cha Kwo Ling Road, Cha Kwo Ling Roundabout, Trunk Road T2 and CKR.
(3) Journey route: Po Shun Road, Tseung Kwan O Tunnel, Tseung Kwan O Road and Lei Yue Mun Road.
(4) Journey route: Road P2, Tseung Kwan O – Lam Tin Tunnel
(5) Journey route: Po Shun Road, Tseung Kwan O Tunnel, Tseung Kwan O Road, Kwun Tong Bypass, Kai Fuk Road, Kai Tak Tunnel, East Kowloon Corridor, Chatham Road North and Gascoigne Road.
(6) Journey route: Road P2, Tseung Kwan O – Lam Tin Tunnel, Trunk Road T2 and CKR.
(7) Journey route: Wan O Road, Tseung Kwan O Tunnel, Tseung Kwan O Road, Kwun Tong Bypass, Kai Fuk Road, Kai Tak Road, East Kowloon Corridor, Chatham Road North and Gascoigne Road.
(8) Journey route: Cross Bay Link, Tseung Kwan O – Lam Tin Tunnel, Trunk Road T2 and CKR.

Table 2.3 Improvements to Queue Length by TKO-LT Tunnel

Location	Queue Length from Toll Plaza		
	2011 - Existing Road Network	2018 - Without TKO-LT Tunnel (and Route 6)	2018 - With TKO-LT Tunnel (and Route 6)
TKO Tunnel (Westbound)	2km	2.9km	0.05km

2.4.8 According to the traffic improvement proposals under this TKO – LT Tunnel and associated works, all the existing public transport facilities including bus, GMB, RMB, taxi and ferry will be retained. As such, there will not be any adverse impact on these provisions. On the contrary, this project will provide new roads and junction improvements thereby resulting in improvements to the existing public transport network.

2.5 Benefit of the Project

2.5.1 Traffic congestion is now common on many of the existing east-west surface routes such as Boundary Street, Prince Edward Road, Kwun Tong Bypass, TKO Tunnel. A new east-west traffic route is required to bypass theses areas which accommodated a large portion of residential premises and connect West Kowloon directly with Kowloon Bay, Yau Tong and Tseung Kwan O and thereby relieving the traffic congestion on these roads. Upon completion of Route 6, an alternative east-west traffic route across Kowloon will be provided to cope with new developments on its western and eastern sides. The new road network will relieve the existing heavily trafficked road network in central and eastern Kowloon areas and hence reduce journey time and numbers for vehicles across these areas and the associated environmental impact particular air quality and noise impact generated from vehicles.

2.5.2 With the presence of TKO-LT Tunnel and associated works, some of the traffic will be attracted to use TKO-LT tunnel. Traffic loading on Kwun Tong Bypass, Lei Yue Mun Road, TKO Tunnel Road and Wan Po Road will be reduced and the environmental impact due to traffic at these locations will also be reduced.

2.5.3 In addition, with the spare capacity of TKO Road resulting from the commissioning of TKO-LT Tunnel, TKO Road can cope with the future developments in Kwun Tong district, including the proposed housing development in the vicinity of Anderson Road.

2.5.4 After commissioning TKO-LT Tunnel and CBL, heavy trucks heading to TKO Area 137 from TKO Tunnel and Wan Po Road's section between TKO Tunnel and Lohas Park which

is adjacent to the densely populated area in TKO(S) will be diverted to TKO-LT Tunnel and CBL instead. Hence, the environmental impact created from the heavy trucks to TKO(S) shall be reduced.

2.6 Scope of the Project

2.6.1 The outlined scope of the Project under this Assignment is to provide a highway connecting TKO at Po Shun Road in the east and Trunk Road T2 in the west with the associated interchange. The project layout plan is shown in **Figure 2.2**. It comprises the following:

(a) a dual two-lane highway approximately 4.8 km long. About 2.6 km of the highway is in the form of tunnel;

(b) slip roads, depressed roads, viaducts, TKO Interchange, ventilation building, tunnel portal facilities and around 3 ha reclamation on TKO side;

(c) slip roads, branch Tunnels, viaducts, Lam Tin Interchange, tunnel portal facilities, ventilation and administration buildings; and

(d) the associated building, civil, structural, marine, electrical and mechanical, traffic control and surveillance system (TCSS), landscaping, and environmental protection and mitigation works.

2.6.2 **Figure 2.2** shows the Location, boundary and general layout of the Project. The tunnel facilities layouts of the TKO-LT tunnel are shown on **Appendix 2.7**.

2.7 Consideration of Alternative Options

General

2.7.1 The design of the Project has undergone a detailed evaluation of different alignments and form of structures to arrive at the optimum planning, engineering and environmental solutions which fit together in a coherent manner. The following sections summarises the evaluation criteria and the consideration of various alternative options.

Criteria for Options Development

2.7.2 To assess the suitability of the alternative options for TKO-LT Tunnel, a range of environmental, engineering, planning and general community disruption considerations were developed for the decision making process. **Table 2.4** presents the evaluation criteria and associated key issues and constraints for the options selection process.

Table 2.4 Evaluation Criteria and Associated Key Issues and Constraints

Criteria	Associated Key Issues and Constraints
Transport and Operation Planning	• **Connectivity at Lam Tin** – options that provide the direct slip road connection between TKO-LT Tunnel, T2, Eastern Harbour Crossing (EHC) and Cha Kwo Ling Road will be considered more desirable. • **Traffic impacts on local road network -** Options that will not overload the local road network due to absence of some slip road connections will be considered more desirable. • **Utilization of existing TKO Tunnel** – options that will deteriorate the

Criteria	Associated Key Issues and Constraints
	utilization of TKO Tunnel after commissioning of TKO-LT Tunnel will be considered less desirable. • **Utilization of new TKO-LT Tunnel and associated slip roads** – Options that will not under-utilize / over-utilize the new TKO-LT Tunnel and associated slip roads will be considered more desirable. • **Tunnel and toll plaza** – options that will not deteriorate the management, operation and maintenance of tunnel and toll plaza will be considered more desirable. Those options that provide adequate merging length before portal are considered more desirable. Options that can provide bus-bus interchange and the associated pedestrian connections at the toll plaza will be considered more desirable. • **Development access** – options that provide connections to TKO Town Centre South and the proposed vehicular road connecting the Junk Bay Chinese Permanent Cemetery will be considered more desirable. • **Travel distance** – options that provide more direct routes will be considered more desirable. • **Alignment design** – options with 'desirable' design standard for both horizontal and vertical alignment design will be considered desirable whilst those options falling below the 'desirable' standards are considered less desirable. Those options only achieving 'absolute' design standard will be considered undesirable whilst those options falling below the 'absolute' design standard are unacceptable. • **Tunnel length** – options with "excessively" long lengths of tunnel will be considered less desirable. • **Weaving arrangement** – options with adequate weaving distances before and after the tunnel respectively will be considered desirable. Those options with weaving distances shorter than the 'minimum' weaving length or weaving section falling within the tunnel will be considered undesirable. As related issue, the directional signage strategy will be considered together the weaving arrangement through the exercise. • **Reclamation for toll plaza** – Options with the least reclamation and disturbance to the marine ecology and fisheries are more desirable.
Engineering Issues	• **Interface with T2** – options that change the T2 alignment, on the other hand, options that affect the traffic management of T2 tunnel, will be considered less desirable. • **Interface with CBL –** options that change the alignment of CBL and hence increase the extent of reclamation required to protect the mainline and slip roads will be considered less desirable. • **Utilities** – options that require diversion of any major utility will be considered less desirable. • **Road safety –** options that create significant increases in traffic impacts in both the operation and construction stages will be considered less desirable. • **Highway infrastructure** – options that cause the greatest permanent

Criteria	Associated Key Issues and Constraints
	impact on existing highway infrastructure will be considered less desirable. • **Geotechnical and Geological conditions** – providing geotechnical and geological risks are assessed as acceptable, the option with less adverse conditions will be considered more desirable. • **Tunnel construction** – options without significant construction risks by using drill and blast or TBM, reasonable construction cost and time will be considered more desirable. • **Viaduct foundation** – options with foundation on difficult ground will be considered less desirable. • **Natural terrain hazards –** options will be assessed based on the presence of significant landslide, debris flow and boulder/rockfall hazards and will be avoided where possible. • **Waterworks Installations –** options that cause the least impact on existing waterworks installations and water mains will be considered more desirable.
Planning and Lands Issues	• **Land resumption (private)** – options with fewer potential land resumption problems (e.g. Cha Kwo Ling Village) will be considered more desirable. • **Land clearance (STT/GLA)** – options with fewer potential land clearance problems will be considered more desirable. • **Government and community facilities** – options that impact on Government and community facilities (e.g. Lam Tin Ambulance Depot) will be considered less desirable. • **East Harbour Crossing** – options that impact on EHC tunnel area and associated facilities will be considered less desirable. • **Committed Development** – options that impact in the committed development (e.g. the Yau Tong Bay comprehensive redevelopment) will be considered less desirable. • **Development Potential of "Residential (Group A) 4" ("R(A)4" Zone at Cha Kwo Ling Village (CKLV) –** options that will have less impact on the development potential of "R(A)4" zone will be more desirable.
Environmental Impacts	• **Marine Ecology** – options involving no / the least reclamation, loss of natural shoreline and causing the least effects on species of conservation interest, such as the Philippine Neon Goby, Grass Puffer fish, coral communities and their habitats and fewer potential impacts to other marine ecological resources will be more desirable. • **Fisheries** – options with the least reclamation and reduced fishing ground loss and causing the least disturbance to fishing operations and fisheries resources will be more desirable. • **Water quality/flows** – options causing the least impact on water quality and hydrodynamics will be more desirable. • **Air and noise** – options with fewer potential noise and air quality impacts during both the construction and operational phases will be more desirable. • **Landfill gas** – options causing the least impact on landfill gas and leachate hazards generated from the Sai Tso Wan landfill will be more desirable. • **Waste management** – options which generate the least amount of disposal materials will be more desirable. • **Landscape and visual** – options which result in the least landscape and visual impacts will be more desirable.

Criteria	Associated Key Issues and Constraints
	• **Archaeology** – options which result in the least terrestrial and marine archaeological impacts will be more desirable. • **Built Heritage –** options that cause the least impact on the built heritages, such as the Tin Hau Temple, Four Hills Public School, Law Mansion in the CKLV area, will be considered more desirable.
Sustainability and Social Impacts	• **Social impact to public and affected individuals** – options with the least or no social impacts during the planning/design, construction and operation stages will be considered more desirable.
Public Perception	• **Previous consultation** – options that will be in conflict with the comments and concerns raised in previous consultations during the feasibility stage of the project will be considered less desirable.
Costs, Implementation and Programme	• **Capital cost** – options that the tunnelling methods and the construction methods relating to massive dredging and reclamation works associated with high cost will be considered less desirable. • **Recurrent consequences** – options that require high annual recurrent costs for repair and maintenance, energy and staff will be considered less desirable. • **Implementation programme –** options that implementation programme will be influenced by the difficulties of the construction method, complexity of the departmental procedures and the diversion of the existing utilities, is considered less desirable.

Continuous Public Involvement

2.7.3 Throughout the formulation of the preferred option, a series of public consultation/engagement activities was held to gather comments and recommendations from public on the Project, including alignment selection, form of construction, land intake, environmental impact, traffic impact and engineering issues, as well as preservation of local culture and heritage, land-use planning and social impact. The activities include meetings, presentations and focus group meetings/forums with key stakeholders such as, local representatives, professional institutions, community groups, conservation/green groups, trade and industrial association related to, public transport, industrial, and various services providers and relevant government departments/ statutory bodies etc. **Table 2.5** summarises the activities during the public consultation process.

Table 2.5 Summary of Public Consultation/Engagement Activities

Date	Consultation/Engagement Activity
Stage 1 Public Engagement	
7 April 2009	Briefing to concerned members of Sai Kung District Council (SKDC)
21 May 2009	Briefing to concerned members of Kwun Tong District Council (KTDC)
6 June 2009	1st stage Focus Group Meeting (FGM) with green groups and professional institutes
11 June 2009	1st stage FGM with AC members, estates and Owners' Committee members in the vicinity of the project in TKO(S)
18 June 2009	1st stage FGM with AC members, estates and Owners' Committee members in the vicinity of the project of Kwun Tong and Lam Tin and Cha Kwo Ling Village (CKLV) representatives
Stage 2 Public Engagement – Kwun Tong Area	
27 May 2010	KTDC T&TC meeting
10 June 2010	Informal meeting with Cha Kwo Ling Village Representatives and the concerned DC member
22 June 2010	Public Engagement Workshop with KT & LT residents' representatives
6 July 2010	KTDC meeting
25 July 2010	Meeting with the residents of Yau Lai Estate including the concerned DC member
27 July 2010	Meeting with Cha Kwo Ling villagers

Date	Consultation/Engagement Activity
20 August 2010	Lam Tin interchange models display at of Yau Lai Estate for the residents (I)
26 September 2010	Lam Tin interchange models display at of Yau Lai Estate for the residents (II)
3 October 2010	Consultation of Lam Tin Hill section
Stage 2 Public Engagement – Tseung Kwan O Area	
11 November 2009	Meeting with Park Central representatives
14 November 2009	Meeting with Ocean Shores representatives
17 November 2009	Meeting with SKDC
3 September 2010	Meeting with representatives from Owners' Committee of Ocean Shores
7 September 2010	SKDC meeting
11 September 2010	Stage 2 Focus Group Meeting with green groups and professional institutes
21 September 2010	Public Engagement Workshop with TKO residents
Stage 3 Public Engagement – Kwun Tong Area	
2 Feb 2012	KTDC meeting
11 Feb 2012	Public Forum for TKO-LT Tunnel
21 Feb 2012	Consultation meeting for Kwong Tin Estate, Hong Pak Court, Hong Nga Court
22 Feb 2012	Consultation meeting for Cha Kwo Ling (CKL) Village
25 Feb 2012	Consultation meeting for Yau Lai Estate
15, 20-22, 27-29 Apr 2012 (three consecutive weekends)	Exhibition at Yau Lai Estate to display the physical model of Lam Tin Interchange
9 May 2012	Lam Tin Area Committee (AC) meeting
25 May 2012	Kwun Tong South (AC) meeting
Stage 3 Public Engagement – Tseung Kwan O Area	
12 Feb 2012	Public Forum for TKO-LT Tunnel and CBL
27 Apr 2012	Consultation meeting with Ocean Shores

2.7.3.1 Key views received during the public consultation/engagement activities are summarized in **Table 2.6**.

Table 2.6 Summary of Public's Views Collected during the Consultation Process

	Major Views/Comments
Stage 1 Public Engagement	• To ensure cost effectiveness and sustainability of the project. • To preserve the existing natural shorelines along the western coast of Junk Bay as far as practicable. • To reduce the scale of reclamation as far as practicable taking into consideration different tolling system and different layout for the toll plaza. • To adopt appropriate noise barriers or mitigation measures addressing the noise generated from the highway. In particular for estates near the portals. • To address the environmental impacts, particularly implications on the marine ecology at Junk Bay.

	Major Views/Comments
	• To preserve the integrity of Cha Kwo Ling Village and minimize construction impact. • To address the traffic problem on local roads during construction of the project. • Welcome the provision of a cycle-track loop in Tseung Kwan O for leisure/transportation usage. Some also opined that if the cycle-track loop could cater for competition to take place, it would be an added-value to the project.
Stage 2 Public Engagement – Kwun Tong Area	• To ensure cost effectiveness and sustainability of the project. • To ensure minimal nuisance to the public during and after construction. • To carry out more informal meetings and/or consultation to the public. • To adopt appropriate noise barriers or mitigation measures addressing the noise generated from the highway. In particular for estates near the portals. • To address the environmental impacts, particularly noise and air pollution and light effect. • To preserve the integrity of Cha Kwo Ling Village and minimize construction impact. • To address the traffic problem on local roads during and after construction of the project. • To concern on redevelopment right for creation of easement at underground stratum of private lots.
Stage 2 Public Engagement – Tseung Kwan O Area	• To ensure cost effectiveness and sustainability of the project. • To reduce the extent of reclamation and preserve the existing natural shoreline • To avoid/minimize nuisance/impact to the public during and after construction. • To carry out more consultation meetings with the public. • To adopt appropriate noise barriers or mitigation measures addressing the noise generated from the highway, in particular for estates near the portals. • To address the environmental impacts, particularly noise and air pollution to Ocean Shores. • To address the traffic problem on local roads during and after construction of the project. • To further improve the slip roads of TKO interchange in order to minimize the noise and visual impacts to nearby residents such as Ocean Shores. • To further study the feasibility of bus-bus interchange at Po Yap Road.
Stage 3 Public Engagement – Kwun Tong and Tseung Kwan O Area	• To implement the project as soon as possible • To minimize the nuisance to the public during and after construction (including tunnelling work under existing building structures).

	Major Views/Comments
	• To implement appropriate mitigation measure to alleviate the environmental impacts included by the project including noise, air quality, light and visual impacts. • To consider if further mitigation measures can be provided at Lam Tin Interchange to further reduce the environmental impacts, particularly noise and air pollution and light effect to Yau Lai Estate. • To preserve CKL Village and avoid/minimize nuisance/impact during construction. • To address the traffic problem on local roads during and after construction of the project. • To try avoiding the tunnel to pass underneath the existing buildings • To enhance greening measures upon the landscape deck near Ocean Shores.

2.7.4 These received views have been taken consideration in the alignment studies. Having received concerns/views/ understanding via the public consultation/engagement, feasible alignment and design options have been developed accordingly. These feasible alignment and design options have been brought forward for discussion with key stakeholders to seek their views on the feasible alignment and design options throughout the consultation process.

2.7.5 Following the Stage 2 public engagement, the recommended scheme was formulated taking into account of the engineering study and comments received from the public engagement. The Recommended scheme was endorsed in December 2010 and presented before the public during the Stage 3 public engagement.

2.7.6 Taking into account of public views collected in the 3 stages of public engagements, environmental factors and engineering considerations, an optimum preliminary design of TKO-LT Tunnel has been developed. Consultation with Sai Kung and Kwun Tong District Council was conducted in January 2013. Both supported TKO-LT Tunnel and CBL and urged for its early implementation.

Review of Previous Options

2.7.7 A review of the previous options for TKO-LT Tunnel in the preceding feasibility study assignments is presented in the following sections.

Feasibility Study on Alternative Alignment for the Western Coast Road

2.7.8 At present, TKO Tunnel is the main external road link between TKO and other areas in the Territory. It will be saturated as a result of the continual development of TKO, and a new external road link is necessary. Under the "Tseung Kwan O Feasibility Study of Opportunities for Further Development" (1990), the need for improved transport infrastructure was identified in the form of a new dual 3-lane highway named the Western Coast Road (WCR), which would link Cha Kwo Ling Road (CKLR) in East Kowloon to Po Shun Road in TKO. A Preliminary Project Feasibility Study for WCR was completed in 1995.

2.7.9 Subsequently, the TKO population growth was revised, and the "Feasibility Study on

Alternative Alignment for the Western Coast Road" (Agreement No. CE 46/96) recommended a new dual 3/4-lane highway linking East Kowloon with TKO via an alignment on reclamation along the coastline in TKO and Lei Yue Mun.

2.7.10 A review was undertaken of the WCR coastal alignment and the refinements were presented in the subsequent "Study on Minimization of the Impacts of Western Coast Road on Lei Yue Mun Village" (Agreement No. NTE 5/99). The coastal alignment option was modified to dual 2-lane configuration together with refinement of arrangements for connections at TKO and Kowloon.

Preliminary Feasibility Study on Tunnel Alignment Option of Tseung Kwan O Western Coast Road

2.7.11 As a result of considerable public opposition to the proposed coastal alignment were received, "Preliminary Feasibility Study on Tunnel Alignment Option of Tseung Kwan O Western Coast Road" (Agreement No. NTE 1/2000) was commissioned in 2000 to examine and develop a viable tunnel option between East Kowloon and TKO.

2.7.12 The above study identified eight "western" tunnel alignment options and five "eastern" tunnel alignment options, as shown in **Figure 2.3**. After a preliminary assessment process, three tunnel alignment options, namely Options 1, 2 and 3, as shown in **Figure 2.4** and summarised below, were selected for more detailed assessment:

- Option 1 comprised a longer northern tunnel that avoided the Yau Tong Bay area and passed under the Eastern Harbour Crossing (EHC) and out to at-grade highway in the old quarry before passing under the site of the former kaolin mine and into cut-and-cover tunnel prior to connecting to T2.
- Option 2 had the same horizontal alignment as Option 1, but did not pass under the EHC. Instead, the tunnel emerged from the hillside onto viaduct that passed over Lei Yue Mun Road (LYMR) and the EHC and down into the old quarry, before passing under the site of the former kaolin mine and into cut-and-cover tunnel prior to connecting to T2.
- Option 3 comprised a shorter southern tunnel that passed in cut-and-cover tunnel through the Yau Tong Bay area north of Lei Yue Mun Village. An at-grade highway then passed around Yau Tong Bay and out over the sea on viaduct before connecting to T2.

2.7.13 The northern alignments of Options 1 and 2 were found to have clear advantages over the southern alignment of Option 3, particularly with respect to land and environmental impacts. Option 1 was duly selected as the preferred tunnel alignment option.

2.7.14 The above study then compared the preferred tunnel alignment option with the original proposed coastal alignment option against various categories of relevant criteria. The tunnel alignment option was found to have advantages over the coastal alignment option on environmental, planning and transport, engineering and programme grounds. The study duly recommended the tunnel alignment option as the preferred scheme for the WCR.

Further Development of Tseung Kwan O – Feasibility Study

2.7.15 In 2002, CEDD commissioned the "TKO Study" to formulate a comprehensive plan for the further development of TKO. In the TKO Study, the long-term transport need of TKO was examined and the need for a new road network comprising WCR, CBL and Road P2 was identified.

2.7.16 Two main alignment options for the WCR were examined under the TKO Study, namely the

"tunnel alignment" and the "coastal alignment". The tunnel alignment option was developed and refined, taking account of the need mainly to:

- provide improved connectivity at both the Kowloon and TKO sides;
- provide direct connections with the EHC;
- provide tunnel facilities (i.e. administration and ventilation buildings, recovery areas, etc);
- provide a toll plaza; and
- minimise construction interfaces with existing and planned infrastructure/ development.

2.7.17 The study identified four possible locations for the toll plaza at the TKO side, as shown in **Figures 2.5 to 2.6**. The public and green groups have requested to preserve the natural shoreline at the Eastern Portal. One option, Scheme 5, as shown in **Figure 2.7** presents the alignment without toll plaza. No reclamation would be required for this option. Therefore, the effect on the ecological and fisheries resources including the natural shoreline and species of conservation interest, such as coral and Philippine Neon Goby, would be minimised. After a preliminary assessment process, two options, namely Schemes 1 and 3 and subsequently renamed as Schemes A and B, as shown in **Figure 2.8** and summarised below, were selected for more detailed assessment:

- Scheme A comprised a toll plaza on proposed reclamation projecting out from the coastline below the original proposed eastern tunnel portal. In order to provide adequate space for the toll plaza, the WCR/CBL/Road P2 interchange was reconfigured as a trumpet interchange and the alignment of Road P2 was shifted eastward to suit the location of the new interchange.
- Scheme B comprised a toll plaza on proposed reclamation running parallel with the coastline. To accommodate this arrangement, the eastern tunnel portal was relocated southwards and the tunnel realigned at the TKO side to suit. This arrangement increased the length of the tunnel, but reduced the size of the WCR/CBL/Road P2 interchange.

2.7.18 Scheme B was found to have advantages over Scheme A, particularly with respect to environmental impacts and engineering and traffic considerations. Scheme B was duly selected as the preferred tunnel alignment.

2.7.19 The coastal alignment was also developed and refined, taking account of the need mainly to:

- update the design based on the latest design standards;
- provide improved connectivity at both the Kowloon and TKO sides;
- provide for a potential toll plaza (although not a tunnel);
- minimise the impacts of the alignment on Lei Yue Mun Village.

2.7.20 The refined coastal alignment, as shown in **Figure 2.9**, ran from T2 and passed south of the EHC and across Yau Tong Bay, through the previously proposed reclamation along the Yau Tong waterfront, before crossing over the entrance to Sam Ka Tsuen Typhoon Shelter on viaduct. It then turned around the hillside at Lei Yu Mun Point and crossed the coastal waters on viaduct before passing onto proposed reclamation along the TKO western shoreline and connecting with CBL and Road P2.

2.7.21 After public consultation and technical evaluation, the tunnel alignment was endorsed. WCR was thus renamed as the "Tseung Kwan O – Lam Tin Tunnel (TKO-LT Tunnel)". Under the TKO Study, the engineering feasibility of TKO-LT Tunnel was established and endorsed.

This scheme is covered by a Schedule 3 EIA Report completed for the TKO Study. It was approved without conditions on 8 December 2005 (Register No.: AEIAR-092/2005).

2.7.22 Under the approved scheme, the Kowloon Section of TKO-LT Tunnel (i.e. the section of trunk road between the western tunnel portal at Lam Tin and T2) passed through a housing development at the former site of the kaolin mine at Cha Kwo Ling. The road formation for the trunk road and local road connections would be completed by the housing development. After passing through the housing development, the trunk road would connect to the proposed T2, which was planned to be on viaduct at that time.

Alternative Arrangements of TKO-LT Tunnel at Kowloon Side

2.7.23 Subsequently under the Kai Tak Planning Review, T2 was revised to take the form of a submarine tunnel.

2.7.24 The housing development at Cha Kwo Ling and its associated local road network were put on hold. To match these changes, CEDD engaged the TKO Study Consultants to carry out additional services in 2006 to study alternative arrangements of TKO-LT Tunnel at the Kowloon side.

2.7.25 According to the recommendations of these additional services, the scheme for the Kowloon Section was revised by adopting a different vertical alignment that descends at a 6% gradient through the existing hillock at Cha Kwo Ling to below sea level at the Cha Kwo Ling Public Cargo Working Area (PCWA) for connection to the T2 immersed tube tunnel. In addition, an interchange in Lam Tin (namely Lam Tin Interchange) was proposed to connect T2 and the Kowloon section of TKO-LT Tunnel to CKLR and the EHC. The revised layout is shown in **Figure 2.10**.

2.7.26 CEDD consulted Kwun Tong District Council (KTDC) and the villagers' organisations of Cha Kwo Ling Village (CKLV) on the TKO-LT Tunnel project in May/June 2007. They raised concerns on the clearance of part of CKLV and urged the road section at CKLV be changed from depressed road to tunnel form to preserve the integrity of the village community. In response to the request, CEDD engaged the TKO Study Consultants to study alternative arrangements at TKO-LT Tunnel Cha Kwo Ling Section to explore alternative conceptual road schemes to minimize the impact on CKLV.

2.7.27 After consideration of various alignment options, the consultants developed an alternative scheme of a tunnel option at CKLV instead of depressed road, and proposed a low level road alignment for TKO-LT Tunnel from ex-EHC casting yard to Black Hill. Under this alternative scheme, some of the slip road connections at Lam Tin Interchange could not be provided due to the limited available space. Two additional branch tunnels are also required for the slip road connections from TKO-LT Tunnel to EHC and T2 to Cha Kwo Ling Road.

2.7.28 The tunnel option is shown in **Figure 2.11**. This alternative tunnel option was supported by KTDC members during the consultation meeting in May 2008. However, some private lot owners of CKLV raised serious concerns on the potential impact of the tunnel option on the redevelopment rights of their existing land lots as the tunnel would pass through the underground strata of their lots. They considered the tunnel option would prevent the provision of deep foundation needed to support possible high rise buildings on their lots upon redevelopment. A villagers' organization also raised the "Fung Shui" issue and requested for reviewing the road alignment.

Alternative Arrangements at Roads P2/D4 Junction

2.7.29 CEDD consulted Sai Kung District Council (SKDC) on the TKO-LT Tunnel project in June

2007. The District Council members raised a numbers of requests including the deletion of the proposed Road D4 flyover and the provision of vehicular roads to Junk Bap Chinese Permanent Cemetery (JBCPC). CEDD engaged the TKO Study Consultants to study alternative arrangements at Roads P2/D4 Junction. The Consultants recommended to replace the D4 flyover by a signal controlled junction with a grade separated cycle track cum footpath crossing across the Roads P2/D4 junction, as shown in **Figure 2.12**. CEDD also agreed to allow flexibility in the layout design of TKO-LT Tunnel such that vehicular connection points could be provided should a vehicular road from JBCPC be proposed in the future. SKDC was consulted again in January 2008 with the above scheme amendments. They welcomed the proposed amendments and fully supported the implementation of the project.

Development of New Alignment Options

2.7.30 After the consultation in Stage 1 public engagement of the Project in 2009, alternative options have been developed and considered for the six major road sections under TKO-LT Tunnel, namely Roads P2/D4 Junction, Landscape Deck at Road P2, TKO Section, Lam Tin Hill Section, Lam Tin Interchange and CKLV Section. The following sections present the consideration of the alternatives for these road sections.

Roads P2/D4 Junction

2.7.31 Under this Project, the merits of and the need for providing the footbridge connecting Park Central and Area 74S DO site (namely Northern Footbridge), and the walkway linking it to the grade separated cycle-track cum footpath connecting G/IC site at TKO Area 72, G/IC site at TKO Area 67 and Area 74S DO site (namely Southern Footbridge) at Roads P2/D4 Junction were assessed.

2.7.32 Six options for the cyclists' crossing facilities across Roads P2/D4 Junction were studied:

- Option 1 – By Zig-Zag Ramps at Cycle Track cum Footbridge
- Option 2 – By Spiral Ramps at Cycle Track cum Footbridge
- Option 3 – By Lifts and Cycle Track cum Footbridge
- Option 4 – Separated Cycle Track
- Option 5 – Subway
- Option 6 – By Lifts and Cycle Track cum Footbridge + Separated Cycle Track

Option 1 – By Zig-Zag Ramps at Cycle Track cum Footbridge

2.7.33 The layout plan and elevation of this Option are shown in **Figure 2.13**. Two proposed Zig-Zag Ramps at 3% gradient are provided at Southern Footbridge for cyclists to cross Road P2.

Option 2 – By Spiral Ramps at Cycle Track cum Footbridge

2.7.34 The layout plan and elevation of this Option are shown in **Figure 2.14**. Two proposed Spiral Ramps with 25m radius are provided at Southern Footbridge for cyclists crossing Road P2.

Option 3 – By Lifts and Cycle Track cum Footbridge

2.7.35 The layout plan of this Option is shown in **Figure 2.15**. Additional lifts will be provided for cyclists crossing Road P2.

Option 4 – By Separated Cycle Track

2.7.36 The layout plan and elevation of this Option are shown in **Figure 2.16**. Under this option, the cycle track will be separated from the Southern Footbridge. A separated cycle track will be provided for the cyclists to cross Road P2 at the cycle track upon Road L673.

Option 5 – Subway

2.7.37 The layout plan and elevation of this Option are shown in **Figure 2.17**. A subway in lieu of footbridge, is considered as an alternative option for crossing facilities. However, the subway is not feasible due to the conflict with the existing box culvert across Road P2.

Option 6 – By Lifts and Cycle Track cum Footbridge + Separated Cycle Track

2.7.38 The layout plan and elevation of this Option are shown in **Figure 2.18**. This option was developed based on the comments received from the Value Management (VM) Workshop held in October 2010 and is a coalescence of Option 3 & 4.

2.7.39 Study on the arrangement on Roads P2/D4 Junction was presented in the Working Paper on Roads P2/D4 Junction. Based on the findings in this Working Paper and the comments received from various Government departments, the following recommendations were proposed:

- The need for the Northern Footbridge is agreed;
- a linkage in the form of elevated walkway between the Northern Footbridge and Southern Footbridge is not required as the bridges can be linked up via the podium of the Area 74S DO Site;
- For cyclists' crossing facilities. Option 6 is recommended as it has the advantages of Option 3 and 4; and
- To facilitate traffic flow from northbound Road P2 to westbound Road D4, it is recommended to adopt signalized junction at Roads D4/L721 Junction.

Landscape Deck at Road P2

2.7.40 Under TKO Study, a depressed road section of Road P2 with landscape deck at the eastern side of Ocean Shores was proposed to be designed as DO site. A landscape deck of 200m long is proposed to cover the depressed road as a noise mitigation measures. The general layout plan of the landscape deck is shown on **Figure 2.19**.

2.7.41 During the meeting held in February 2013 amongst LCSD, HyD and CEDD, LCSD agreed to undertake the maintenance responsibility of the landscaping work on the landscape deck. LCSD advised that the landscape deck to be further designed taking into account of Tiu Keng Leng Park and shall be a passive landscape design. Details of the landscaping design shall be subject to detailed design stage.

Tseung Kwan O Section (including TKO Interchange)

2.7.42 Based on the comments received in Stage 1 Public Engagement, three alternative options had been developed at TKO Section and compared with the Conforming Option:

i. Conforming Option
ii. Alternative Option 1 – S-curve Tunnel with Toll Plaza Island Option
iii. Alternative Option 2 – Straight Tunnel with Toll Plaza Island Option
iv. Alternative Option 3 – Straight Tunnel without Toll Plaza Option

Conforming Option

2.7.43 The general layout plan of the Conforming Option is shown in **Figure 2.20**. The tunnel follows an S-curve alignment. The tunnel section is about 2.2km long at TKO Section. Reclamation is required for toll plaza and connection roads (including Road P2) along the western coast of Junk Bay. The extent of reclamation would be about 12ha.

Alternative Option 1 – S-curve Tunnel with Toll Plaza Island Option

2.7.44 The general layout plan of Alternative Option 1 is shown in **Figure 2.21**. The tunnel follows an S-curve alignment. The toll plaza and associated bus-bus interchange are located on an artificial island off the shoreline and therefore existing natural shorelines along the western coast of Junk Bay would be preserved. The extent of reclamation would be 9.5ha. The risk of hitting adverse ground conditions is considered relatively high. Construction cost of this option is approximately less than the Conforming Option by HK$0.3B.

Alternative Option 2 – Straight Tunnel Option with Toll Plaza Island

2.7.45 The general layout plan of Alternative Option 2 is shown in **Figure 2.22**. Commencing from the tunnel portal in Lam Tin, the tunnel turns gradually from north-eastward to south-eastward and follows a straight alignment. The length of main road would be reduced by about 600m as compared to S-curve. An artificial island and piled deck structure are proposed to accommodate the toll plaza and associated bus-bus interchange. Existing natural shoreline along the western coast of Junk Bay would therefore be preserved. The extent of reclamation would be 9.5ha. The risk of hitting adverse ground conditions is considered relatively lower than that of S-curve. However, the less streamlined configuration of the toll plaza would have serious water quality and marine ecological impacts at Junk Bay. Furthermore, less streamlined configuration of the toll plaza would also create serious visual impact. Construction cost of this option is approximately less than the Conforming Option by HK$1.2B.

Alternative Option 3 – Straight Tunnel Option without Toll Plaza

2.7.46 The general layout plan of Alternative Option 3 is shown in **Figure 2.23**. Similar to Alternative Option 2, this option follows a straight alignment. Similar to Alternative Option 2, the length of main road would be reduced by about 600m as compared to S-curve. It is proposed that no toll plaza is to be provided under this option. Alternative tolling system is required. The natural shoreline could be preserved. Reclamation size is the smallest amongst all the options (i.e. approximately 3ha). Construction cost of this option is approximately less than the Conforming Option by HK$1.7B.

2.7.47 Evaluation of the 4 options at TKO Bay was presented in the Report on Evaluation of Alignment Options at TKO Section. Amongst the Options, the reclamation area under Alternative Option 3 is the smallest and therefore the environmental impacts anticipated would be minimum. A straight alignment will also offer better driving comfort than the S-curve. Size of the tunnel ventilation facilities is envisaged to be smaller due to the shorter route than S-curve. The risk of hitting adverse ground conditions is considered lower than that of S-curve. Due to the shorter route and smallest reclamation area, the construction cost of the tunnel is the lowest amongst the options. The natural shoreline along the western coast of Junk Bay would also be preserved.

2.7.48 After a comprehensive comparative evaluation of the Conforming Option and the 3 alternative options, Alternative Option 3 was selected as the preferred scheme for the TKO Section in light of the need of least reclamation, provision of shorter route, and the most cost effectiveness and acceptable on environmental grounds. The evaluation results are

summarized in **Table 2.7**.

Table 2.7 Summary of Options Evaluation at Tseung Kwan O Section

Features	Conforming Option	Alternative Option 1	Alternative Option 2	Alternative Option 3
Alignment:	S-curve	S-curve	Straight	Straight
Length of main road:	4.8km	4.8km	Shorter than the Conforming Option by 600m, but longer slip roads connecting Road P2	Shorter than the Conforming Option by 600m
Toll plaza and associated bus-bus interchange be provided?	Yes	Yes	Yes	No, tolling facilities to be further considered.
Reclamation Planning and Land Use:	• About 12ha of reclamation in Junk Bay is required to accommodate the toll plaza, associated facilities and the connection roads. • Length of cycle track starting from the Ocean Shores to the end of CBL (via TKO-LT Tunnel and CBL interchange): 2040m	• About 9.5ha of reclamation in Junk Bay is required to accommodate the toll plaza, associated facilities and the connection roads. • Approximately 13,160m^2 of open space would be reduced as compared with the Conforming Scheme. • Length of cycle track starting from the Ocean Shores to the end of CBL (via TKO-LT Tunnel and CBL interchange): 2020m	• About 9.5ha of reclamation in Junk Bay is required to accommodate the toll plaza, associated facilities and the connection roads. • Approximately 12,421m^2 of open space would be reduced as compared with the Conforming Scheme. • Length of cycle track starting from the Ocean Shores to the end of CBL (via TKO-LT Tunnel and CBL interchange): 1992m	• About 3ha of reclamation in Junk Bay is required for construction of Road P2 and associated connection roads. • Approximately 11,807m^2 of open space would be reduced as compared with the Conforming Scheme. • Length of cycle track starting from the Ocean Shores to the end of CBL (via TKO-LT Tunnel and CBL interchange): 2029m
Natural shoreline be	No	Yes	Yes	Yes

preserved?				
Geotechnical risk in tunnel construction:	High	High	Low	Low
Visual Impact:	Medium	High	Very High	Low
Environmental Impacts:	High marine ecology impact due to reclamation	Medium marine ecology impact due to slightly-reduced reclamation	Serious environmental impacts (particularly water quality & marine ecology) due to the protruding of reclamation into Junk Bay	Lowest environmental impacts due to minimum reclamation required
Construction Cost:	~ HK$80B (baseline)	-HK$0.3B	-HK$1.2B	-HK$1.7B

Lam Tin Hill Section

2.7.49 During the meetings with the residents of Hong Nga Court and the Incorporated Owners of Hong Nga Court in July 2010, it is noted that they strongly object to the alignment passing under the building structures of Hong Nga Court. In addition, a local DC member suggested an alternative alignment at this section.

2.7.50 To address the above concerns, the Original Alignment at Lam Tin Hill Section (**Figure 2.24**) was reviewed and an alternative alignment was proposed, namely Alternative Alignment No. 1 (**Figure 2.25**) in order to minimize the impact to Kwong Ching House. During a meeting with a local DC member, another alternative alignment, namely Alternative Alignment No. 2 (**Figure 2.26**) was also suggested for consideration.

2.7.51 An evaluation of the Original Alignment and the Alternative Alignment No. 1 and No. 2 has been undertaken and the results are presented in the Working Paper on Proposed Alignment at Hong Nga Section. The evaluation results are summarized in **Table 2.8**.

Table 2.8 Summary of Options Evaluation at Lam Tin Hill Section

Features	Original Alignment	Alternative Alignment No. 1	Alternative Alignment 2
Traffic operation:	Desirable	Undesirable	Undesirable
Land impact to private lots:	Small	Medium	Large
Land impact to Kwong Ching House	Medium	Small	No
Construction Cost:	Medium	High	Low

2.7.52 Based on the findings, Alternative Alignment No. 1 is not recommended as the sightline of the tunnels could not comply with the desirable minimum value as stipulated in the TPDM. In comparison, Alternative Alignment No. 2 suggested by the DC member is not recommended as one of the main tunnel and the branch tunnel would pass under Chung Pak House. Under the Original Alignment, the main tunnels and the branch tunnels will be about 90m and 67m below Kwong Ching House respectively within sound rock with Grade III or better. As a result, tunnel construction would unlikely to affect Kwong Ching House. The Original Alignment was therefore recommended.

Lam Tin Interchange

2.7.53 As discussed in **Section 2.2.1**, TKO-LT Tunnel, Trunk Road T2 and CKR will form the proposed Route 6. Lam Tin Interchange will connect with the other strategic trunk roads in the area. The layout and design of the interchange is critical to its functional objective.

2.7.54 Five options with different connectivity were developed for the Lam Tin Interchange and they are shown in **Figures 2.27** to **2.31**, respectively.

2.7.55 As stated that TKO-LT Tunnel, Trunk Road T2 and CKR will form the proposed Route 6. Lam Tin Interchange will connect with the other strategic trunk roads in the Kwun Tong area. The general arrangement of slip road in the interchange is critical to its functional objective. Five options with different connectivity were developed for the Lam Tin Interchange and described as follows:

2.7.56 Option 1 has the simplest layout. However, it cannot provide a direct connection between Trunk Road T2 and EHC and therefore cannot distribute traffic effectively between Routes 2 and 6 in East Kowloon. The layout is indicated in **Figure 2.27**.

2.7.57 Option 2 provides direct connection between TKO-LT Tunnel/T2 and EHC, it impacts significantly on the existing EHC tunnel area and would require new separated satellite toll booths at either side of the existing booths. Traffic exiting EHC to TKO-LT Tunnel/ T2 would have to diverge sharply from traffic exiting EHC to Kwun Tong Bypass before it passes through the toll booths as shown in **Figure 2.28**. Thus, Option 2 is not recommended in view of traffic safety.

2.7.58 Option 3 does not induce any adverse effect on existing EHC tunnel operation, by routing the

link road connections between TKO-LT Tunnel/T2 and EHC, whilst maintaining all desired movements. The layout is indicated in **Figure 2.29**. However, the overall layout of Option 3 is considered relatively complicated and the mostly costly scheme, and there is concern that it could also confuse motorists.

2.7.59 A gyratory system is adopted in Option 4 to reduce the overall length of the slip roads. However, there are too many decisions to be made at the gyratory system and would confuse motorists. The layout is indicated in **Figure 2.30**.

2.7.60 Option 5 is a hybrid of Options 1 and 3, it includes all desired road connections while maintaining a relatively simple layout. It also has the least impacts on EHC. The layout and the slip roads arrangement are shown in **Figure 2.31**. Based on the above evaluation of all options, Option 5 is recommended as the most reasonable scheme.

2.7.61 Based on the above evaluation of the options, Option 5 is recommended to carry forward and form the base for further study. Two options, namely Depressed Road Option and Tunnel Option were developed based on Option 5. Two physical models were created based on Depressed Road Option and Tunnel Option for the 2nd Stage Public Engagement at CKLV Section and Yau Lai Estate.

2.7.62 Evaluation of the Depressed Road Option and Tunnel Option is summarized in **Table 2.9**. The layout plans and photos showing the schematic layout of the Depressed Road Option and Tunnel Option are attached in **Figure 2.32**.

Table 2.9 Summary of Options Evaluation at Lam Tin Interchange Section

Features	Tunnel Option	Depressed Road Option
Volume of excavation materials:	More	Less
Length of slip roads:	Longer	Shorter
Environmental Impacts:	L**ow**er	Higher
Gradient of the main roads:	More gentle	Steeper
Construction cost:	Higher	Lower
Other cons:	No access from CKR to Lam Tin and EHC during night time closure of T2 eastbound tube. Drivers need to use alternative route	Traffic diversion is required on Lei Yue Mun Road during construction

Cha Kwo Ling Village Section

2.7.63 In order to determine the "Recommended Scheme" at CKL for the Project, 4 options were developed. They are:

i. H1a – Depressed Option with tunnel alignment pass through the middle of CKLV as shown in **Figure 2.33**

ii. H1b – Tunnel Option with tunnel alignment pass through the middle of CKLV as shown in **Figure 2.34**

iii. H2a – Depressed Option with tunnel alignment pass through the previous Four Hills Public School as shown in **Figure 2.35**

iv. H2b – Tunnel Option with tunnel alignment pass through the previous Four Hills Public School as shown in **Figure 2.36**

2.7.64 Evaluation of the 4 options was presented in the Report on Evaluation of Alignment Options at CKL. H1a is the least costly option. However, it would have major impact on CKLV, resumption and clearance of private lots and government up to about 500 residents. The depressed road would create relatively higher potential environmental impact to CKLV and Yau Lai Estate due to corresponding Lam Tin Interchange arrangement. H2a is a depressed road scheme and cost approximately HK$1.0B more than H1a. However, it would require permanent change to the seabed profile. Moreover, the alignment will be very close to Tin Hau Temple and have high potential environmental impact to CKLV and Yau Lai Estate due to corresponding Lam Tin Interchange arrangement. The previous Four Hills Public School is required to be demolished to facilitate the tunnel construction. H2b is a tunnel scheme and cost HK$2.1B more than Option H1a. No resumption of private lots is required. However, the tunnel will affect the previous Four Hills Public School. H1b cost approximately HK$1.6B more than H1a. However, clearance to CKLV could be avoided. Environmental impact to CKLV and Yau Lai Estate would be lower than depressed road schemes. However, the underground strata of few private lots above the Option H1b's tunnels will be affected.

2.7.65 The evaluation is summarized in **Table 2.10** as below.

Table 2.10 Summary of Options Evaluation at Cha Kwo Ling Village Section

	Option H1a	**Option H1b**	**Option H2a**	**Option H2b**
Alignment & Characteristics:	Pass through middle of CKLV in the form of depressed road	Similar alignment as Option H1a, but pass through the middle of CKLV in tunnel form	Pass through CKLV at the former Four Hills Public School in the form of depressed road	Similar alignment as Option H2a, but pass through CKLV at the former Four Hills Public School in tunnel form
Construction method:	Cut-and-Cover	Drill-and-Blast+ mechanical breaking	Cut-and-Cover	Cut-and-Cover

	Option H1a	Option H1b	Option H2a	Option H2b
Require resumption of private land or clearance of squatters:	Yes	No	No	No
Impact on land in the vicinity:	CKLV is separated into two parts by depressed road	Creation of easement in underground stratum within tunnel protection area	Less impact on village integrity. The open space near Tin Hau Temple would be temporarily used during construction period	Less impact on village integrity. The open space near Tin Hau Temple would be temporarily used during construction period
How much longer is the main road section compared with option H1a:	-	-	220m	230m
Visual impact on nearby area:	Visual impact on CKLV and Yau Lai Estate is quite significant	Visual impact on CKLV and Yau Lai Estate is less significant than Option H1a	Visual impact on CKLV and Yau Lai Estate is similar to Option H1a	Visual impact on CKLV and Yau Lai Estate is less significant than Option H1a
Is there available access from CKR to Lam Tin and Eastern Harbour Crossing during night time closure of Trunk Road T2 east-bound tube:	Yes	No	Yes	No
Total Construction Cost (incl. TKO-LT Tunnel & Trunk Road T2)	HK$14.0B	HK$13.4B	HK$15.0B	HK$16.1B

2.7.66 As there are merits and drawbacks for each options. All the 4 options were presented to the public for comments, particularly the residents of CKLV during the 2nd Stage of Public Engagement.

Minimisation of Reclamation

2.7.67 Followed a series of public engagement activities conducted in late 2010, majority of the public views supported the Straight Tunnel Option without Toll Plaza. Under this alignment option, the extent of reclamation is largely reduced and the required reclamation is optimized to about 3 ha. The main purpose of the reclamation area is to provide protection to the depressed road P2 which is below sea level, adjacent to the Ocean Shores and landing area for the elevated slip roads connecting the interchange with Cross Bay Link.

Recommended Scheme

2.7.68 Further to views obtained from the 1st Stage and 2nd Stage of the Public Engagement, the Recommended Scheme of the Project is developed.

2.7.69 At Roads P2/D4 Junction, Option 6 (i.e. By Lifts and Cycle Track cum Footbridge + Separated Cycle Track) is the preferred option. As agreed amongst the relevant Government departments, the linkage between the Northern Footbridge and Southern Footbridge is not required.

2.7.70 Further to the 2nd stage of public engagement and the meeting amongst Government departments in February 2013, the landscape deck with length 200m at Road P2 is formed.

2.7.71 In view of geotechnical risks in tunnel construction, environmental impacts (including water quality, marine ecology and visual impacts), cost implication and public preference, Alternative Option 3 (i.e. Straight Tunnel Option without Toll Plaza) is the most preferred option at TKO Section.

2.7.72 Further to the 2nd stage of public engagement, it is noted that the local residents have no objection to the Original Alignment at Lam Tin Hill Section.

2.7.73 In consideration of the opinions received during the 2nd Stage Public Engagement and in order to reduce the impacts to CKLV and Yau Lai Estate, H1b is the best option at CKLV Section.

2.7.74 The Recommended Scheme for the project is the hybrid of Alternative Option 3 at TKO Section, Original Alignment at Lam Tin Hill Section, Lam Tin Interchange Tunnel Option and H1b at CKLV Section. The general layout plan of the Recommended Scheme is shown in **Figure 2.37**.

2.7.75 The major views on the Recommended Scheme during the Stage 3 public engagement are listed as below:

- To ensure minimal nuisance to the public during and after construction (including tunnelling work under existing building structures).
- To implement appropriate mitigation measure to alleviate the environmental impacts included by the project including noise, air quality, light and visual impacts.
- To consider if further mitigation measures can be provided at Lam Tin Interchange to further reduce the environmental impacts, particularly noise and air pollution and light effect to Yau Lai Estate.
- To preserve CKL Village and avoid/minimize nuisance/impact during construction.
- To address the traffic problem on local roads during and after construction of the project.
- To try avoiding the tunnel to pass underneath the existing buildings
- Provide more greening measures upon the landscape deck near Ocean Shore.

Alternative Alignments for Kwun Tong Section

2.7.76 During the 2nd stage PE, comments have been received on considering alternative location of Kwun Tong side (KT) interchange. In view of the received comments, it was considered necessary to conduct a supplementary study on alternative alignments for Kwun Tong Section to address the received comments with the purpose to justify that the Recommended Scheme endorsed in the Project Steering Group in December 2010 is the best option.

2.7.77 Kwun Tong district has been fully occupied by high-rise residential buildings and industrial buildings. In view of the site constraints and the topographic conditions in Kwun Tong district, the desirable location of an alternative interchange shall be an undeveloped government land and near to the major traffic network in Kwun Tong district. As a result, only two suitable locations for the interchange at Kwun Tong side were identified for further study. They are (i) Cha Kwo Ling Public Cargo Working Area (CKLPCWA) and (ii) the Laguna Park with Wai Yip Street Nullah respectively.

2.7.78 Based on the available locations of alternative Kwun Tong side interchange, three Alternative Alignments were developed as shown in **Figure 2.38**. Each of them would have an interchange. For Alternative Alignment 1, the interchange would be located at Laguna Park while for Alternative Alignment 2 and Alternative Alignment 3, the interchanges would be located at the CKLPCWA. All the alignments would connect the Trunk Road T2 at Kwun Tong and connect Road P2 and CBL at Tseung Kwan O respectively.

Alternative Alignment 1

2.7.79 As shown in **Figure 2.38**, the western end of the Alternative Alignment 1 will connect Trunk Road T2 at Kwun Tong. The tunnel will enter underneath the existing Wai Yip Street Nullah and head towards Lei Yue Mun Road and then a horizontal curve would follow towards the Junk Bay. The tunnel would then be in straight form and connect Road P2 and Cross Bay Link at Tseung Kwan at the eastern end. As shown in **Figure 2.39**, **Figure 2.40** and **Figure 2.41**, the administration building of this alignment will be built at Kai Tak while the mid-ventilation building will be built at the CKLPCWA and to be connected the TKO-LT Tunnel by mid-ventilation adit. Two ventilation buildings will be built at the tunnel's eastern and western portals respectively.

2.7.80 Due to the existing foundation of Kwun Tong Bypass and the foundation of Wai Yip Street, the road level of the tunnel right beneath of Wai Yip Street was designed to be at least as deep as -31 mPD in order not to interfere the zone of bulb of pressure of foundation of Wai Yip Street Bridge.

2.7.81 In view of the extremely difficulty in emergency operations and the cost non-effectiveness of slip roads arrangement, this option is considered not viable and not considered for further evaluation.

Alternative Alignment 2

2.7.82 As shown in **Figure 2.38**, the western end of the Alternative Alignment 2 will connect Trunk Road T2 at Kwun Tong. The eastern end of the tunnel will connect Road P2 and Cross Bay Link at Tseung Kwan O. The tunnel will enter the CKLPCWA. As shown in **Figure 2.42**, the administration building of this alignment will be built at Kai Tak interchange of T2 while the mid-ventilation building will be built at the FEHD Transport Section Cha Kwo Ling Vehicle Depot. Two ventilation buildings will be built at the tunnel's eastern and western ends respectively.

2.7.83 An interchange would be formed at CKLPCWA. Two slip roads will be constructed at the CKLPCWA as shown in **Figure 2.43**. Slip Road S1 will provide traffic route from Trunk Road T2 to Wai Yip Street while Slip Road S3 will provide traffic route from Wai Yip Street

to TKO – LT Tunnel EB. Another slip road EHC 1 will be constructed at FEHD Vehicle Depot to provide an indirect linkage from EHC to TKO-LT Tunnel via Cha Kwo Ling Vehicle Depot carriageway to Cha Kwo Ling Road, Wai Yip Street and finally Slip Road S3.

2.7.84 In order to comply with the PHO by avoiding permanent reclamation in the harbour, the Slip Road S1 is designed to be under the seabed level at about -32mPD before entering the existing seawall at CKLPCWA. Under Alternative Alignment 2, EHC2 for traffic from TKO-LT Tunnel eastbound to EHC as provided in the Recommended Scheme could be maintained.

Alternative Alignment 3

2.7.85 As shown in **Figure 2.38**, Alternative Alignment 3 adopts similar alignment of the Western Coast Road under the TKO further study. As shown in **Figure 2.44**, **Figure 2.45** and **Figure 2.46**, the administration building of this alignment will be built at TKO Interchange while the mid-ventilation building will be built at the CKLPCWA and to be connected the TKO-LT Tunnel by mid-ventilation adit. Two ventilation buildings will be built at the tunnel's eastern and western ends respectively.

2.7.86 The western end of the Alternative Alignment 3 will connect Trunk Road T2 at Kwun Tong. The tunnel was designed to continue the alignment of Trunk Road T2 and to go straight under the seabed until it reaches Junk Bay. A horizontal curve was introduced and the tunnel will pass through Lei Yue Mun and reach Junk Bay. The eastern end of the tunnel will finally connect Road P2 and Cross Bay Link at Tseung Kwan O.

2.7.87 The interchanges are proposed at CKLPCWA and at Lei Yue Mun as shown in **Figure 2.44**, **Figure 2.45** and **Figure 2.46**. Slips Road S4 is designed to connect Kwun Tong district from westbound of TKO-LT Tunnel while road users could exit eastbound of T2 to Kwun Tong district by taking Slip Road S1. Details of interchange are shown in **Figure 2.47**, **Figure 2.48** and **Figure 2.49**.

2.7.88 In Alternative Alignment 3, the long slip road in single tube tunnel form is not viable as it is difficult for emergency operation. Alternative interchange at Lei Yue Mun also shows that the slip road arrangement is not viable due to the permanent reclamation inside Victoria Harbour required for the tunnel construction. Alternative Alignment 3 is therefore not viable and not further considered.

Comparison between Recommended Scheme and Alternative Alignment 2

2.7.89 Alternative Alignment 2 is comparatively a non-infeasible alignment amongst the three Alternative Alignments. It would provide three direct Slip Roads and one indirect Slip Road to form an interchange at CKLPCW.

2.7.90 When comparing the Recommended Scheme and Alternative Alignment 2, the traffic performance of Alternative Alignment 2 is unacceptable. In addition, the slip road connectivity and traffic operations of the Alternative Alignment 2 are under performance and much worse than Recommended Scheme.

2.7.91 Under Alternative Alignment 2, environmental impact would be concentrated in the vicinity of Laguna City and therefore affecting more sensitive receivers in Kwun Tong district than the Recommended Scheme.

2.7.92 As a result, the Recommended Scheme is recommended after the evaluation.

2.8 Environmental Friendly Design

2.8.1 In order to preserve the environment in the vicinity of the project, environmental friendly designs are adopted in different locations as far as practical. The environmental friendly designs are summarized in the followings:

Road P2

2.8.2 In order to minimize the visual and noise impact to the nearby residential area, Road P2 will be in the form of depressed road such that the road level will be below ground and sea level.

2.8.3 A 200m long landscape deck will also be provided to cover the depressed road at the road section immediately next to Ocean Shores. The landscape deck connects the amenity areas on both sides of Road P2 and provide a convenient access to the footpath and cycle track along the waterfront.

Tseung Kwan O Section

2.8.4 A "Straight tunnel alignment without toll plaza option" is adopted for TKO Section. A straight tunnel alignment not only attains a good engineering design but also minimize the C&D material when compared with the S-curve tunnel from TKO study.

2.8.5 By omitting the toll plaza, the reclamation extent and the associated environmental impact such as water quality, marine ecology will be minimized.

Lam Tin Interchange

2.8.6 Two options: Tunnel Option and Depressed Road Option were formed under this Project and the Tunnel Option has been adopted. In the Tunnel Option, the main carriageway and most of the slip roads are located below the existing ground level such that the carriageways could be 'hidden" from the nearby residential area as far as possible.

2.8.7 An integrated design with noise shelter comprising a landscape deck and light green-coloured noise enclosures will be provided along the main carriageway as noise and visual impact alleviation measures and flooding preventive measures taking into account of the deep carriageway alignment.

2.8.8 Together with the green terrace roofs upon the tunnel facilities. shrubs and trees will be planted at the landscape deck and the adjacent area to provide a green environment at the interchange.

2.8.9 To further minimize the environmental impact and light nuisance, some part of the slip roads are in tunnel form to alleviate vehicles' visual and noise impact.

Cha Kwo Ling Section

2.8.10 The Tunnel Option as mentioned in paragraph 2.8.6 will avoid clearance of any building structures in Cha Kwo Ling Village (CKLV). The current alignment will avoid running beneath Tin Hau Temple or former Four Hills Public School in the village.

2.8.11 Mechanical breaking method or other non-blasting methods will be deployed for constructing the tunnel at this section such that the potential impacts on the village's residents and building structures in the construction phase will be minimized.

2.9 Construction Methodologies

2.9.1 This section describes the planning of the construction of the project, covering the key aspects including the envisaged methods of tunnel construction, reclamation and other infrastructure, and the sequence of works.

Construction Methods for Tunnels

2.9.2 Based on the available geological profile, it is envisaged that tunnel excavation will be mostly carried out in good quality granite and volcanic rock masses. They are typically excavated by either drill & blast or by tunnel boring machine (TBM). Other forms of excavation such as mechanical and chemical splitting are not cost effective except for either small volume of excavation or at locations where blasting would pose too great nuisance or be hazard. Whilst it is practicable to excavate tunnel by either method, the preferred method can only be determined after study of the constraints on the construction.

Drill & Blast Method

2.9.3 Drill and blast tunnelling is a cyclic operation comprising, the drilling of charge holes for the explosives, blasting of the face, and removal of the spoil either concurrent with, or prior to, the installation of temporary support to the tunnel if required. In addition to the basic components of the tunnelling cycle in poor ground probe and ground treatment hole drilling and grouting are required. Drill and blast excavation is very efficient for tunnels where multiple faces can be excavated simultaneously and there are few restrictions on the delivery, storage and use of explosives.

2.9.4 Typically the excavation phase is completed before the permanent lining is provided to the tunnel. Prior to the provision of the permanent lining temporary support is provided where necessary to secure the opening. The temporary support comprises various elements including, rock bolts/dowels, shotcrete, and steel arches used either singly or in combination depending on the nature of the rock mass.

2.9.5 The permanent lining to the tunnel normally comprises cast mass concrete but could comprise high quality shotcrete, or on occasion precast concrete segments.

2.9.6 When excavating through water bearing ground control of water inflow can only be controlled by methodical injection grouting through overlapping fans of drill holes in advance of the tunnel face. Pre-grouting prior ahead of the face has been proven to be the only effective method of controlling groundwater inflow during excavation. Therefore continuous probing as the face advances is essential to ensure that any water bearing zones or discrete features are located and pre-treated. It must be noted that it is only necessary to control groundwater inflows in situations where

- Groundwater drawdown could induce movement at settlement sensitive structures;
- Inflow could initiate tunnel instability;
- Inflow exceeds pumping capacity and could inundate the tunnel; and
- Water sources (wells/aquifers) could be affected.

2.9.7 In all other situations the standard practice is to seal off groundwater inflow as part of the permanent lining construction activity.

2.9.8 Excavation of tunnels by blasting often gains an advantage by providing short mobilisation times, and allowing the use of multiple excavation headings, as opposed to excavation of

tunnels by TBM. The use of a TBM will typically become more viable as the length of the tunnel increases.

2.9.9 As described above, excavation by blasting is a cyclic sequence, consisting of drilling – blasting – venting – mucking – installing support. The overall duration of the cycle will be largely dependent on the time taken to drill the face, and the time taken to muck out the blasted rock. It is therefore possible to adjust the advance per blast in order to achieve an optimum production rate. Where only one blast a day is possible, it may be best to make greatest advance possible in one blast. Where multiple blasting is possible, it may be best to shorten the round in order to ensure two or even three blasts can be made within the allowable working period.

2.9.10 When blasting in an urban environment, other external factors may affect the blasting method. Of primary concern is the supply of explosive. It is often not possible to store explosives on site in urban areas, and daily delivery from Mines Division is required. This delivery is typically made between 11am and 2pm each day, and the explosives are expected to be used immediately resulting in a single blast each day during the afternoon.

2.9.11 Another influence in urban areas is the presence of nearby sensitive receivers, such as housing, schools or hospitals. These may require that blasting is carried out at certain times of the day. In combination with the daily deliveries, it is very common that blasting is carried out in urban areas during the afternoon rush hour, when other environmental factors help reduce the apparent effects during blasting.

Tunnel Boring Machine (TBM) Method

2.9.12 Section of TBM for tunnel excavation is primarily governed by the geological conditions for the excavation materials to be encountered. The variation of the geological conditions over the entire length of the tunnel will govern design of the TBM and ancillary equipment to be provided. Key issues that need to be considered are listed as follows:

- Permanent support or finishing requirements of the tunnel (e.g. segmental concrete lining, cast in-situ concrete lining or even bare rock) will govern whether the lining is installed either as part of the excavation phase on the TBM, as a consequential activity behind the TBM or after completion of TBM excavation.
- Design issues for temporary works with respect to bolting or anchor diameters and lengths or shotcrete thickness for rock tunnel will also play a major role in ancillary equipment selection and location on the TBM or backup train.
- The anticipated groundwater to be encountered during excavation is a key consideration in selection of TBM type. The allowable amount of groundwater inflow to the excavated tunnel during construction and to the completed tunnel after commissioning would dictate the extent of ground water control of both the TBM design and tunnel lining design.
- The tunnel alignment, including both horizontal and vertical alignment will govern the TBM cutterhead, re-gripping dynamics and muck haulage system. Minimum horizontal and vertical curves are also critical for the design of TBM and may also affect the stroke length and gripper orientation for rock tunnel.

Comparison of Drill & Blast against TBM Method

2.9.13 The table below summarizes the comparison of drill & blast method against TBM method for construction of TKO-LT Tunnel.

	Drill & Blast Method	**TBM Method**
Cross Section	• Horse shoe shaped tunnel cross section, more efficiency of space. • Less limitation for the ratio of tunnel width and height. • Flexible to change the tunnel section, such as road widening to achieve required sightline at tight curve.	• Circular tunnel cross section, less efficiency of space. • The ratio of tunnel width and height are fixed (limited by diameter of boring). • Adoption of typical size precast segmental lining. Road widening by costly local drill & blast after TBM excavation.
Alignment	• Allow turning radius < 1360m by road widening.	• Post-TBM road widening excavation would be difficult to section with turning radius < 1360m. Typical segmental lining could not be adopted for widened road section. • Bigger TBM is required for the entire tunnel section to avoid road widening.
Construction	• Flexible to change in construction method to tackle the weak zone/fault excavation. • Commence immediately after award of blasting permit. • Vibration caused by blasting on nearby sensitive receivers is major concern. • Monthly excavation rate can be up to 150m month per blast face. • Normally use cast in-situ concrete lining.	• Frequent probing and ground treatment at localised weak zone, such as fault influence zones of poor quality rocks, is required, which is time consuming for the Gripper or Shield TBM. • Normally takes 14 months for TB procurement. • Ground borne noise caused by TBM excavation on nearby sensitive receivers is the major concern. • Monthly excavation progress rate can be up to 400m; however the procurement time will normally outweigh the progress rate for short to medium length tunnel.
Land Requirement	• Neutral in comparing with TBM excavation method as it is normally not possible to establish explosive magazine at Kowloon side.	• Neutral in comparing with drill & blast excavation method.
Excavation Material	• Generate smaller amount of excavated rock than TBM tunnel. • The excavated materials could be recycled for backfilling after cleaning and sorting.	• Generate greater amount of excavated rock than drill & blast tunnel. • The excavated materials could be recycled for backfilling after cleaning and sorting.
Cross Passage	• Cross passage could be easily formed by drill & blast. • Can be excavated soon after tunnel passes, allowing transfer of construction plant between.	• Post-TBM excavation is required and would be difficult to form the cross passage. • Special segmental lining for dismantling or no segment installed at cross passage location.

	Drill & Blast Method	TBM Method
Cost	• The capital cost for TBM and associated plant and equipment is much higher than that required for drill & blast method. Thus, for tunnel in good quality of rock, drill & blast excavation method is considered cheaper than TBM excavation method.	• Consider higher than drill & blast excavation method for tunnelling in good quality of rock.

Construction of Main Tunnel and Branch Tunnel

2.9.14 Due to the hardness of the rock and the size of tunnel, the bored tunnel will be constructed by the Drill and Blast (D&B) method in order to achieve the construction programme within reasonable time and cost. This is commonly used in Hong Kong for the excavation of road tunnels. As for the TBM tunneling method, the following factor considered unfavorable to the road tunnel including:-

- The TBM tunnel will be circular and there will be wastage of excavation and filling for the tunnel invert;
- The TBM tunnel will be formed in single size which is unable to allow for intermediate ventilation jet fan and widening in curved section unless enlarging the entire tunnel size.

2.9.15 Therefore, the drill and blast method is considered to be a more cost effective construction scheme for the tunnel excavation.

2.9.16 A blasting assessment has been carried out to determine the charge weight for blasting as to control the peak particle velocity (PPV) of adjacent features within limit, detail should be refer to Preliminary Blasting Assessment Report.

2.9.17 Geological and hydrogeological assessment has been carried out to investigate the effect on adjacent sensitivity receivers by the tunnel excavation works. The assessment determines the water inflow criteria into tunnel

2.9.18 The envisaged tunnel excavation and support works of the rock tunnel are listed in the sequences below:

- Probe to investigate the water inflow ahead of the tunnel;
- Ground treatment in the form of pre-grouting to control ground water ingress if necessary;
- Excavate the tunnel by drill and blast method;
- Carry out geological mapping and select primary support design in accordance with the pre-determined support requirements based upon the NGI-Q system;
- Install primary rock support using spot dowels, systematic dowels and shotcrete;
- For ground conditions with support category worse than class 6, a site specific design will be carried depending the actual geological and hydro-geological conditions;
- Carry out post excavation grouting if ground water inflow remains above specified limits.

2.9.19 Groundwater inflows around the tunnel construction works will be controlled to limit the ground water drawdown according to the Geotechnical Assessment Report. Pre- and post-grouting will be carried out in accordance with the water inflow criteria.

2.9.20 In the vicinity of the existing sensitive feature or adverse geological condition (e.g. insufficient rock cover), portion of the tunnels will also be constructed by non-blasting (e.g. hydraulic or chemical splitting) or mechanical method (e.g. drill and break) to reduce the impact of blasting to the surrounding features.

2.9.21 For the mixed ground condition, NATM phased tunnel excavation method may be adopted in order to control the ground movement and tunnel stability. And an undrained tunnel permanent lining will be applied to minimize the ground water drawdown.

Construction of Cha Kwo Ling (CKL) Tunnel Section

2.9.22 CKL tunnel section from the western end of Lam Tin Interchange towards west reaching Cha Kwo Ling Village (CKLV) is about 400m.

2.9.23 The soil geology of the Cha Kwo Ling area is predominately Mount Butler Granite (Klb) underlying the reclamation fill along the coastline. Klb Granite mainly comprises equigranular fine and fine-to-medium grained biotite granite. Base on the available GI information, the rock quality is good, with RQD 100 for most of the recovered rock core. The superficial materials mainly comprise a Fill layer of 2 to 3m thick overlaying saprolite of 1 to 9m thick.

2.9.24 As shown in **Figure 2.50**, CKL tunnel section (from the western end of Lam Tin Interchange towards west before reaching CKLV) which is about 130m will be excavated by drill and blast method. The remaining of Cha Kwo Ling tunnel section with 270m will be excavated by mechanical breaking or other non-blasting methods to minimize impact to CKLV. Excavated materials mucked out from the tunnel will be delivered to the tunnel portal and disposal off site via conveyor belt to CKL public cargo area and then to Lam Tei Quarry by sea transport. The expected pull length for one blast per day is about 4m. Taking the excavation area at each tube of about 145m^2, there will about 580m^3 excavated materials (approx. 80 loaded truck trips) to be disposed off each day per tube via sea transport to the following:

- Grade II or above rock to Lam Tei Quarry or Tuen Mun Area 38 Fill Banks
- Grade III or below rock and inert C&D materials to Tseung Kwan O Area 137 Fill Bank

2.9.25 Preliminary blasting assessment have been prepared for ensuring the impacts due to designed charge-weight, in terms of vibration (ppv) and air-over-pressure (AOP), on the CKLV and other stakeholders within the influence zone area are within the acceptable limits. Monitoring plan will be prepared as well for ensure adequate control and monitoring for the concerned stakeholders during blasting.

2.9.26 At the Cha Kwo Ling Public Cargo Working Area, the superficial materials generally comprise a Fill layer of 10 to 20m thick overlaying saprolite of 2 to 5m thick. Locally, occurrences of marine deposits (1to 3m thick) and alluvium (3 to 8m thick) are evident in the available borehole records. In view of the conditions of the existing squatters at CKLV at which the reminder of CKL Section (about 250m) passing underneath up to the interface with landfall section of Trunk Road T2 at the existing Public Cargo Working Area, non-blasting excavation method, e.g. drill & splitting, chemical splitting is recommended though this section of tunnel has been lowered to have sufficient rock cover enabling excavation by drill & blast method. Arrangement for disposal of excavated materials is similar to the above.

2.9.27 In terms of land impact, as there will be no physical impacts on existing private lots, unauthorized dwellings Government STT, GLA and TGLA lots within CKLV during construction and operation stage of the proposed tunnels. The underground strata of these affected lots which lie within the works area defined as the extent of 10m offset from the outer edge of the Tunnel Section will be permanently required to form part of TKO-LT Tunnel. The affected lots include 9 nos. of private lots, 5 nos. of Government STT, 2 nos. of Government GLA, 3 nos. of TGLA and unauthorized dwellings with approximately 150 people.

Construction of Lam Tin Interchange

2.9.28 The proposed location for Lam Tin Interchange is at the southeast side of Cha Kwo Ling Hill, immediately north of EHC toll plaza. It is a man-made three-sided elliptical bowl. The bottom of the bowl comprises a level platform, about 330m long by 165m across, which is currently occupied by Cha Kwo Ling Vehicle Deport at the west end and Cha Kwo Ling Nursery at the east end. The platform level is about +6mPD, which is about the same level as the EHC toll plaza, whereas the steep side-slopes rise to over +70mPD around the perimeter of the bowl.

2.9.29 The site was originally part of a granite quarry, but in late 1980s the original void was enlarged to form the casting basin for the immersed tube tunnels units for the construction of EHC. The side-slopes were cut back and steepened, and the bottom was excavated down to about -5mPD to accommodate the flotation of the precast units.

2.9.30 For the recommended option of Lam Tin Interchange, the mainline will be at the lowest level of about -16mPD, whilst the remaining slip/link roads will be at higher levels. In order to avoid bulk excavation with excessive cutting into the hard granite at the bowl bottom, it is proposed to maintain the platform at about +5mPD with necessary trench excavation for the mainline and slip/link roads with level lower than +6mPD.

2.9.31 Prior to site formation and excavation works, temporary site access connecting CKLR to LTI based on the existing road leading to FEHD area should be firstly formed. This temporary site access will also facilitate construction of Western Portal and Main Tunnel at Lam Tin side. Site formation for the soil ground between +6mPD and -5mPD will be excavated by mechanical means; whilst the rock between -5mPD to -12mPD will be excavated by drill & blast method. Excavated materials will be disposal off site by barges with destinations similar to construction of CKL Section. Stage arrangement for haul roads within the site should be so arranged to suit the site formation works. In view of the close proximity of Yau Lai Estate, northwest corner of the site would be useful for sorting and breaking excavated rock prior to disposal to designated outlets. Temporary noise and air quality mitigation measures would be required for the site formation works, especially via drill & blast method. Preliminary blasting assessment will be prepared for ensuring the impacts due to designed charge-weight, in terms of vibration (ppv) and air-over-pressure (AOP), on Yau Lai Estate, Sai Tso Wan Landfill, EHC, and other stakeholders within the influence zone area within the acceptable limits. Monitoring plan will be prepared as well for ensure adequate control and monitoring for the concerned stakeholders during blasting.

2.9.32 Excavation by drill and blast is a cyclic procedure. This commences with surveying the blast area, drilling the blastholes, placing the steel cages and blast screens, charging the blastholes, placing the surface cover, firing the blast, venting (if required), removing the protective measures, and then mucking out the blasted rock. The cycle is then repeated.

2.9.33 The time required to complete one full cycle will be largely dependent on the size of the blast, as drilling the blastholes and mucking the blasted rock often take up the majority of the time. A typical cycle time of 3 to 4 days for any one location within the site is assumed. It would therefore be necessary to have at least four active blasting locations within the site to allow blasting every day. It may also be possible to blast at more than one location within the site

on any one day, provided sufficient working faces can be created and sufficient protective measures are available. The maximum number of blast locations per day would be determined by the Contractor to suit his method of working.

2.9.34 A four day cycle time would allow survey of the blast area and preparation of the blast design on day one. Drilling would be undertaken on day two, and placing protective measures and blasting on day three. Removal of the protective measures and mucking would be undertaken on day 4. A single blast per day is anticipated.

2.9.35 Drilling would be carried out using standard crawler drill rigs, fitted with dust collection systems and noise mitigation measures. The use of two drill rigs would allow drilling of two blast areas concurrently, thus potentially reducing the overall blast cycle time.

2.9.36 Protective measures are anticipated to consist of a surface cover of gunny sacks, wire mesh and sand bags. Heavy surface protection of wire mesh covered steel cages are anticipated to be required on top of the blast area. Heavy rubber mats would also be placed on top and around the sides of these cages. Wire mesh covered vertical screens are anticipated to be required to surround each blast area. Detailed discussions on anti-flyrock measures will be required by the Contractor with Mines to ensure flyrock occurrences are eliminated.

2.9.37 Moving and placing of the protective measures is anticipated to be carried out using a crawler crane. For surface blasting, every blast may have different depth, width and length, and each blast will require specific blast design and layout of the protective measures. Typical arrangement of the blast design and protective measures must be included in the Contractors Method Statement, with blast specific details provided with each individual blast design submitted to Mines Division.

2.9.38 Upon completion of site formation works, mainline roadworks, slip/link roads, viaduct structure, administration building, environmental mitigation measures will be constructed.

2.9.39 There are 6 slip roads, S1, S2, S3, S4, EHC1 and EHC4 connecting to and from the main tunnel, Eastern Harbour Crossing and local roads in Kwun Tong Areas. First of all, permanent foundation and substructure including all piles, pile caps, pier columns, abutments and bearings will be constructed. After that, scaffold and platform propped on the pier heads will be erected and the deck adjacent to the support will be cast in-situ.

2.9.40 Steel truss with bracket supported on the constructed concrete deck will then be erected. The platform hanger will also be erected by rods from the steel truss. Adjacent deck can then be cast in-situ in span. After concrete strength reach its 7-day value, the platform, hanger rods, steel truss and brackets will be removed.

2.9.41 To cast the next deck segment, repeat the steps in para. 2.9.39 until completion of the whole bridge construction.

Construction of administration building/ ventilation buildings and tunnel associated structures

2.9.42 TKO-LT Tunnel's administration building and the western ventilation building will be situated at the Lam Tin Interchange whereas the eastern ventilation building will be situated at TKO portal.

2.9.43 The Ventilation Buildings and Administration Building will be constructed by typical reinforced concrete construction method which includes i) formwork and falsework erection, ii) rebar fixing, iii) concrete pouring and curing, and iv) formwork striking and back propping.

2.9.44 Superstructures will adopt bottom-up construction. Construct ground floor slabs, beams, columns and walls to the lowest level and process upwards to roof level.

2.9.45 Other tunnel associated structures, such as pumping stations, garage and warehouse will be constructed by cast-in-situ method using similar method.

Construction of slopes and retaining walls

2.9.46 Construction of the slopes (including natural terrain mitigation measures) and retaining walls in this project is to a large extent governed by the following constraints/uncertainties:

- Topographical constraint due to sloping ground conditions of the sites;
- Weather condition;
- Possible obstructions to the construction; and
- Geotechnical uncertainties which include ground and groundwater conditions.

2.9.47 Where possible, construction programme should be arranged so that the slopes and retaining walls are constructed under favourable weather condition, preferably in dry season. Temporary drainage system shall be constructed prior to construction.

2.9.48 Obstructions to construction shall be verified and determined on site. Utilities and trees shall be properly treated at the onset of the construction. Natural terrain mitigation measures are normally located at areas with dense vegetation. Minimal disturbance to the environment shall be maintained during the construction.

2.9.49 Where existing structures and sensitive receivers are located in the vicinity of the construction area, temporary safety precaution measures shall be implemented to avoid possible damage. Instrumentation and monitoring works shall be implemented throughout the construction period to monitor the effect of the works. Groundwater monitoring data shall be collected to review the design groundwater level and hence reduce the geotechnical uncertainties where necessary.

2.9.50 Cut slopes and temporary cutting for retaining walls shall be formed by bulk excavation and installed with necessary slope stabilization works including soil nailing. Slope stabilization works shall be installed and stability of the excavation shall be maintained at all stages.

2.9.51 Earth filling including construction of fill slopes and backfilling behind retaining walls shall, in general, be compacted to at least 95% of the maximum dry density. Surface upon which fill is to be placed should be stripped of all trees, loose filling, top soil, boulders, debris of any nature and the like.

2.9.52 L-shaped retaining wall shall not be backfilled until sufficient strength of concrete has been achieved after concreting. Construction of cantilever retaining walls shall be completed prior to excavation in front.

2.9.53 Throughout the construction period, all temporary works should be subjected to regular inspections. Signs of distress in any structure or slope should be recorded and steps taken to alleviate the distress.

Construction of TKO Interchange

2.9.54 The proposed Interchange comprises of 4 slip roads, i.e. S100, S200, S300, S400 and the

Mainline of Cross Bay Link. The Slip road S100 will provide traffic linkage in East-North direction, S200 in West-North direction, S300 in South-West direction and S400 in South-East direction. In order to minimize the land-take and visual impact on the nearby sensitive receivers, e.g. Ocean Shores, small turning radius has been adopted for the slip roads at some locations. In addition, the mainline viaducts will provide linkage between the TKO-LT Tunnel and Cross Bay Link.

Slip Road Viaducts

2.9.55 Due to the curvilinear nature of the 4 slip roads, the proposed typical span is set to 40m for end spans and 45m for intermediate spans and the typical depth of the box section is 2m. The viaducts are designed to be constructed by cast in-situ method and erected by balanced cantilever method.

2.9.56 Typical substructure will be formed by monolithic column to the bridge deck, this will restrict bearing supports at movement joint piers only. The long term maintenance cost of the viaducts can be reduced as bearing inspection and replacement is a difficult task, especially when they are located over water.

Mainline Viaduct Joining Cross Bay Link (CBL)

2.9.57 During the previous meeting with CBL consultants it was agreed that the typical spans for Cross Bay Link would be 75m, and a 3.5m thick box section would be adopted. The mainline viaduct of TKO Interchange will be designed to match with the CBL arrangement as much as possible. The viaducts would be designed as precast segmental construction erected by balanced cantilever method.

2.9.58 The typical CBL viaduct shall comprise of 4 box sections, two for the east & westbound traffic of Cross Bay Link, on the west two additional box sections are required for slip roads S100 & S300, and on the east additional box sections required for slip roads S200 & S400. Since the typical spans for the slip roads are 40m only, the tie-in details between the slip roads and the main viaduct will need special arrangement, especially on the aesthetic treatment. As agreed with CBL consultants, the columns for CBL would be typical V-shaped piers and monolithic connection with the bridge deck.

Foundation and Substructure

2.9.59 The piers are generally supported on piled foundations designed to suit the existing geotechnical conditions. Typically, a group of large diameter bored piles is proposed for each pier. Where a central pier arrangement is not feasible, eccentric piers or portal frames will be adopted. Generally, the piles will be socketted into Grade III or better rock and designed as end bearing piles with capacity contributed from the rock shaft friction and end bearing capacity of the rock socket. An external casing will be adopted for marine piles as permanent casing for casting the piles. For the mainline, the pile caps will be constructed below sea level and above sea bed level in order to be consistence with CBL's. For slip roads' pile caps, the caps will be constructed above sea level. The lateral view of the main bridge piers and slip roads at TKO Section are attached in **Appendix 2.3**.

Reclamation for Road P2

2.9.60 Reclamation is required to provide land for construction of Road P2, Landscape Deck fronting Ocean Shores and at-grade slip roads of TKO Interchange connecting to Road P2. The reclamation area will also cover the proposed footpath, cycle track and associated facilities along Road P2 to both CBL and TKO Town Centre. The reclamation scheme proposed is based on the principle that the extent of reclamation and dredging is kept to

minimum in order to minimize environmental impact. Besides, the proposed diaphragm walls for cut-and-cover tunnel construction for the Landscape Deck should no encroach upon the seawall foundation. Details of the construction method of the depressed road are reflected in paragraph 2.7.74-2.7.81.

2.9.61 According to the Recommended Scheme of TKO Interchange, the proposed reclamation will be in a form of strip to bridge the gap between the vertical seawall fronting Ocean Shores and sloping seawall next to the existing DSD pumping station at the northern part for construction of the proposed Landscape Deck; while the southern edge will be extended with sufficient length to allow the underpass section of Road P2 to climb up and match will corresponding slip roads of the proposed TKO Interchange.

2.9.62 Follow a series of public engagement activities conducted in late 2010, majority of the public views supported the Straight Tunnel Option without Toll Plaza. Under this alignment option, the extent of reclamation is largely reduced and the required reclamation is optimized to about 3 ha. The main purpose of the reclamation area is to provide protection to the depressed road P2 adjacent to the Ocean Shores and landing area for the elevated slip roads connecting the interchange with Cross Bay Link. The general layout of the reclamation is shown in **Figure 2.51**.

2.9.63 The existing seabed level of the proposed reclamation area is generally about -5mPD to –11mPD. The sub-surface profile along the reclamation consists of a layer of marine deposits (0m to 15m thick) overlying a layer of alluvium (0m to 8m thick), which is underlain by the completely decomposed rocks (1m to 8m thick).

2.9.64 Sloping seawalls are proposed to surround and support the reclamation. On one hand, it is proposed for the better dissipation of wave energy and less wave reflection. On the other hand, it is considered more natural and harmony, than the vertical blockwork seawall, with the existing natural shoreline along Chiu Keng Wan.

2.9.65 Steel cellular caisson with stone column is recommended as the non-dredged method for seawall foundation. The cellular caisson can provide immediate shear strength to facilitate early commencement of reclamation behind the seawall. It will be covered by rockfill revetment at the front and armour protection at the top. The permanent sloping seawall will be supported by stone column foundation in the long term by gaining sufficient shear strength during the consolidation process. The left-in-place cellular caisson is assumed to be vanished due to corrosion in the permanent case condition. The cross sections of the reclamation area are shown on **Figures 2.52 to 2.56.**

2.9.66 It is recommended that general fill is used to form the reclamation. As the vertical band drains cannot be installed through the general fill, the vertical band drains must be installed using marine plant before placing general fill. A geotextile separator and a sand layer about 1.5m to 2m thick need to be placed on the seabed before installing the vertical band drains.

2.9.67 Rock fill as foundation core will spread the loading intensity downwards such that the effective maximum pressure at the seawall base level will not be greater than the allowable capacity of the underlying soils. Ground improvement work using stone column is recommended to strengthen the marine deposits remained for non-dredged seawall foundation. Besides, appropriate surface protection layer should be placed to avoid any scour of the foundation.

2.9.68 On-going settlement of the non-dredged reclamation results predominantly from the consolidation of the in-situ marine mud and the soft to firm alluvium. If no ground treatment is employed, the time required to achieve 90% of residual settlement should take many years. To accelerate the rate of settlement, vertical band drains and temporary surcharge technique,

using extra fill material, are normally used.

2.9.69 Band drains should be extended into the underlying firm to stiff alluvial clay or sand layer to achieve anchorage. A geotextile layer should be placed directly over the soft ground followed by a free draining sand layer of 2m to 3m thickness, through which the pore water pressure within the soft stratum will dissipate. Approximately one-fourth of the total thickness of marine deposit and reclamation fill. The consolidation period is normally 1 year. However, the exact level of surcharge and consolidation period shall be determined in detailed design.

2.9.70 Similar to the consolidation using vertical band drains, stone columns will act as drainage paths and dissipate the excess pore pressure. However, the post construction settlement will be slightly larger for stone column since more the initial load will transfer through the columns rather than the soft stratum. Surcharge can be applied to reduce the residual settlement, if necessary. The surcharging period will be similar to that of vertical band drains.

2.9.71 Settlement monitoring using geotechnical instrumentation will be required during the progress of the reclamation in order to establish the settlement profile and to determine when the surcharge can be removed. Instrumentation shall primarily consist of settlement markers, placed at the base of the fill prior to commencement of reclamation, at the top of the fill (or surcharge) and at intermediate levels where required. Other instruments like magnet extensometers and piezometers shall be installed in the marine deposits and underlying strata where such installation would assist in the interpretation of the results from the settlement markers.

2.9.72 The general construction sequences which can be referred to **Figure 2.57**, are summarized as follows:

i. Plant mobilization for the reclamation works

ii. Install stone columns at seawall locations

iii. Install main cell of cellular structure and fill inside the main cell (Refer to **Figure 2.58**)

iv. Repeat (iii) to construct the adjacent main cells of cellular structures

v. Install connecting arcs between main cells and fill inside connecting arcs

vi. Repeat (iii) to (v) above

vii. Install corrosion protection system

viii. Construct sloping berm in front of the cellular structures

ix. Placing geotextile separator and sand drainage blanket if necessary

x. Installing vertical band drains from marine plant at where no stone columns are installed

xi. Filling behind the seawalls for reclamation

xii. Placing surcharge (Refer to **Figure 2.59-2.60**)

xiii. Consolidation period

xiv. Removal of surcharge

2.9.73 To mitigate pollution of water beyond the works area, the following working procedure can be applied.

i. Erect silt curtain to confine the active seawall construction area (Refer to **Figure 2.61**).

ii. Filling for reclamation shall not be carried out unless adequate length of seawall, say 200m, has been completed ahead of the front end of reclamation work, thus the seawall can be used as a barrier.

iii. 2m thick sand blanket to be laid above the marine deposits left in place before commencement of filling for reclamation to eliminate the induced mud wave due to the filling works.

Construction of Depressed Road P2

2.9.74 Cut-and-cover method will be adopted for the construction of depressed P2 road. Excavation and lateral support (ELS) works on the reclaimed land are required for excavation and construction of the underground structure and its foundation. The ELS system typically consists of temporary retaining structures on both sides of the road supported by multi-layers of struts. The maximum excavation depth is approximate 11m for the deepest road level and will be deepened to 18m locally where close to the underground stormwater pumping station.

2.9.75 Temporary open cut is considered as the simplest excavation method provided that the adjacent land is sufficient for slope cutting. However, the Road P2 is located at reclamation area with high groundwater level. The control of water tightness during the excavation will be very difficult for open cut excavation at great depth. It is therefore suggested to limit the depth to about 3m and keep the excavation level above the sea level for the open cut excavation method.

2.9.76 For excavation depth greater than 3m, temporary sheet-pile wall would provide better control of water tightness during the excavation due to its impermeable surface by interlocking of sheetpiles and the embedment depth to create groundwater cut-off below the excavation level. The required embedment depth is greater for excavation at a deeper road level.

2.9.77 Under the current scheme of non-dredged reclamation method, the marine deposit will be left below the proposed depressed road. For greater excavation depth, the required embedment depth will be much longer due to the weak strength of marine deposit in order to maintain the toe stability, and is required to be socketted into rock for most sections. It is anticipated that temporary diaphragm wall is required to resist the large lateral pressure and facilitate the construction of longer embedment depth for road levels at depth more than 6m below ground.

2.9.78 Therefore, the following temporary excavation and lateral support (ELS) schemes are anticipated:

2.9.79 Open cut method to be adopted for sections where road levels at 0-3m below ground;

2.9.80 Sheet-pile wall to be adopted for sections where road levels at 3-6m below ground; and

2.9.81 Diaphragm Wall to be adopted for sections where road levels at depth more than 6m below ground.

2.9.82 U-shaped or box structures of the depressed road can be constructed once the final excavation level is reached. If required for most section, pre-bored H-piles will be installed before

casting the base slab of the U-shaped structure. The partially complete structure can support the temporary retaining walls during the strut removal process. Temporary re-propping against the permanent structure can be provided where necessary until the completion of the depressed road structure.

Construction of cycle track cum footbridge at Roads P2/D4 Junction

2.9.83 After the Value Management Workshop held in October 2009 amongst Government's departments and the comments received for the Working Paper on Roads P2/D4 Junction, it is agreed that a cycle track cum footbridge with 2 lifts on each end to be provided at the P2/D4 Road Junction (Southern Footbridge). A footbridge, namely Northern Footbridge, will also be constructed to connect the sport centre at Area 74S and Park Central.

2.9.84 Cast in-situ method will be adopted for both the Southern Footbridge and Northern Footbridge.

2.9.85 For the Northern Footbridge, all the sub-structures and foundation will first be constructed. Erection of the falsework and formwork for the deck construction starting from Park Central will follow. After concreting of the bridge deck, the falsework and formwork will be dismantled after 7 days of the concreteing and the falsework and formwork for the next deck between the piers will be constructed. The construction sequence will be repeated until all the bridge decks are constructed. Construction of the footbridge's furniture; lift tower and staircases will follow.

2.9.86 Construction of Southern Footbridge is similar to Northern Footbridge except that a main arch for the gateway effect will be constructed prior to the bridge deck construction. For the main arch, the foundation of the arch will first be constructed. Falsework will be constructed to facilitate the erection of the steel members for the main arch. In-situ butt welding will be applied to the steel members to form the main arch. After the main arch is complete, the piers and bridge decks can be constructed which is similar to the Northern Footbridge as mentioned above except that cables between the bridge deck and main arch will be connected during the bridge deck construction.

2.10 Construction Programme

2.10.1 The Project construction works are anticipated to commence in early 2016 with completion of the Project by end 2020. A preliminary construction programme for the Project is provided in **Appendix 2.1**. This programme provides the basis for the assessments presented in the EIA Report.

2.11 Concurrent Projects

2.11.1 Concurrent projects in the vicinity of the Project site are identified at the following paragraphs. The status of these concurrent projects is based on the available information at the time of the submission of this Report. It should be noted that the implementation of individual projects would be subject to the on-going review by relevant project proponents.

Trunk Road T2

2.11.2 T2 is a dual two-lane trunk road of about 3.6km, with 2.65km of tunnel. T2, together with the proposed Central Kowloon Route (CKR) and TKO-LTT will form a new strategic highway network, namely, Route 6.

2.11.3 T2 is a separate DP under the EIAO and hence a separate EIA Study will be conducted by the project proponent to address all the impacts (including cumulative impacts) during both the

construction and operational phases.

2.11.4 The T2 project will tie in with the TKO LTT project and according to the most recent information provided by the T2 project team, dredging works will take place from early 2016 to mid 2019. Backfilling works will take place between early 2017 and early 2019. The dredging and filling programme for T2 would coincide with marine works of TKO-LT Tunnel. Cumulative air, noise and water quality impacts are therefore expected to be contributed from T2 during the construction phase of TKO-LT Tunnel and have been addressed in this EIA. During operation phase, cumulative air quality and noise impacts from operation of T2 and associated ventilation building are also anticipated and therefore considered in the assessment in this EIA (Refer to **Sections 3, 4 and 5** for further discussion on air, noise and water quality respectively).

Cross Bay Link (CBL)

2.11.5 CBL is a dual two-lane carriageway of approximately 1.8 km long across the Junk Bay mainly on viaduct, connecting TKO-LT Tunnel to Wan Po Road at the southeastern part of TKO.

2.11.6 CBL is a separate DP under the EIAO and hence a separate EIA Study will be conducted by the project proponent to address all the impacts (including cumulative impacts) during both the construction and operational phases.

2.11.7 According to the information provided by the CBL working team, the construction of the CBL is to be implemented in parallel with the implementation of the TKO-LT Tunnel Project. The Project and CBL is scheduled to be commissioned together with the rest of Route 6 by the end of 2020.

2.11.8 This would overlap with the marine works of TKO-LT Tunnel which are proposed to take place between May 2017 and August 2018. Therefore, potential cumulative water quality and marine ecological impacts during construction phase are anticipated and have been addressed in this EIA (Refer to **Chapter 5** for further discussion on water quality and **Chapter 6** on marine ecology). Construction sites associated with CBL are located within the study area for air quality impact assessment, however, the overlapping activities are marine works which would not generate dusty emissions, cumulative construction air quality impact is not expected. The vehicular emission from CBL has taken into account of in the operational air quality impact assessment (see **Chapter 3** for further discussion on the air quality). CBL construction site is beyond the study area of the TKO-LT Tunnel for noise impact assessment. Cumulative noise impacts from CBL during the construction phase are therefore not anticipated but the operational traffic noise induced from CBL has been considered in the cumulative traffic noise impact assessment during operational phase (see **Chapter 4** for further discussion on noise quality). The detailed programme and lateral view of CBL is attached in **Appendix 2.4**.

Shatin to Central Link (SCL)

2.11.9 The Shatin to Central Link (SCL) will be a through-running line between Tai Wai and the Central Business District of Hong Kong Island. This new strategic railway corridor will increase significantly the cross-harbour and Shatin to Kowloon rail capacities and help redistribute the flows and relieve the other railway lines in Hong Kong and Metro Kowloon.

2.11.10 SCL is a separate DP under the EIAO and hence a separate EIA Study has been undertaken by the respective project proponent to address all the impacts (including cumulative impacts) during both construction and operational phases.

2.11.11 According to information from the project proponent of the SCL, the project commenced in

2012 and all major construction works are anticipated to be completed in 2020.

2.11.12 The dredging work for SCL is scheduled from July 2012 to December 2012 for the Kai Tak Runway barging point and also in 2016 for the submarine railway tunnel from Hung Hom to Admiralty Station. This would overlap with the marine works programme of CBL. Hence, the cumulative water quality impacts during the construction phase of CBL have been considered (see **Chapter 5** for further discussion on water quality). As SCL is not within the study area of TKO-LT Tunnel for air quality and noise impact assessments, no cumulative air quality and noise impacts are anticipated during construction and operational phases.

Kai Tak Development – Road D3A & D4A

2.11.13 Road D3A and D4A are both dual 2-lane district distributor roads, which are 1.4km and 0.1km long respectively, running on the Runway Precinct of Kai Tak Development (KTD). Road D3A is running along the centre of the Runway Precinct and is replacing the original southern section of Road D3 that runs along the waterfront of the Runway Precinct. Road D4 is an extension of Road D4 connecting to the proposed Road D3A. They will serve the Cruise Terminal, the Tourism Node and the development sites in the Runway Precinct.

2.11.14 The construction of these roads will commence in 2014 tentatively and will be completed by 2016, which may not interface with the construction period of TKO-LT Tunnel. In addition, these roads are located out of the study area of TKO-LT Tunnel, therefore, no cumulative environmental impact is anticipated during construction and operational phases of TKO-LT Tunnel.

Kai Tak Development - Cruise Terminal

2.11.15 The development of the Cruise Terminal in Kai Tak is one of the key features in the South East Kowloon Development (SEKD) for formation of a new tourism, sports and recreation centre in the Metro Area.

2.11.16 According to the EIA report on "Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development" (EIA-182/2010), it is planned to implement the cruise terminal in two phases. Dredging work for Phase I Berth (the southern portion) was scheduled between 2011 and 2012, and the tentative programme for Phase II Berth dredging work is planned to be between 2013 and 2014.

2.11.17 No cumulative impact on water quality is anticipated during the construction phase of TKO-LT Tunnel, but impacts, including cumulative impact on hydrodynamic regime during the operational phase, have been considered (see **Chapter 5** for further discussion on water quality).

Tseung Kwan O (TKO) Area 86 Development

2.11.18 TKO Area 86 property development has a site area of about 33 hectares. The development is expected to comprise some 21,500 flats in 50 residential towers and will be home to a population of 58,000 people. It will also provide retail accommodation of about 50,000 m^2 and comprehensive GIC facilities including educational institutes, nurseries, and a community hall, etc.. The total landscaped area in the development site will be about 55,000 m^2, which includes the Central Park of 19,000 m^2.

2.11.19 For Tseung Kwan O (TKO) Area 86 Development, it is out of TKO-LT Tunnel project study area. Therefore, no cumulative impact is anticipated during construction phase.

Submarine Gas Pipelines

2.11.20 An EIA has been conducted for the "Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development" (EIA-182/2010).

2.11.21 According to the EIA report (EIA-182/2010), the construction would commence in January 2012 and be completed in June 2014. Dredging is required for the period from April 2012 to December 2012 and therefore will be completed before the TKO-LT Tunnel works commence. No cumulative construction impact is expected. Cumulative operational impacts from submarine gas pipelines are also not expected.

Hong Kong Offshore Wind Farm in Southeastern Waters

2.11.22 With reference to the Project Profile and the EIA Study Brief (ESB-146/2006), the Project is to construct and operate an offshore wind farm in Southeastern waters of Hong Kong. The project component includes an installation of up to 67 wind turbines, an offshore transformer platform, sub-sea collection and transmission cables, and Research Mast. There will be a landing cable area and proposed cable at the west of Junk Bay connecting the collection cables from the turbines and the CLP existing grid connection network.

2.11.23 According to the latest information provided by CLP, marine works (including dredging, jetting and suction caisson) for the construction of the wind farm would be required for the period from January 2017 to September 2017 which would overlap with marine works programme of TKO-LT Tunnel. Hence, the cumulative water quality impact during construction phase would need to be considered (see **Section 5** for further discussion on water quality).

2.11.24 It is anticipated that the distances from the proposed cable landing area and cable route in Junk Bay to the identified NSRs and ASRs for TKO-LT Tunnel project are larger than the 300m and 500m respectively. Impacts arising from the wind farm construction work in Junk Bay to the NSRs and ASRs for TKO-LT Tunnel are therefore not expected. Hence construction of the wind farm would not have any contribution to the cumulative construction noise and air quality impacts. Cumulative operational impacts from wind farm are also not expected.

Planning review on Development of ex-Cha Kwo Ling Kaolin Mine Site

2.11.25 The planning review on development of Ex-Kaolin Mine Site was commissioned by the Planning Department in July 2011 and is to be read as an update of the previous feasibility study completed in 2003 by the Civil Engineer Department (CED). It sets out to examine the viability of private residential development at the upper platforms of the development site. This study is set against a background of significant policy changes since the previous study in 2003. PlanD's recent public announcement of planning of new developments also includes the Ex-Cha Kwo Ling Kaolin Mine Site (CKLKMS) as one of the designed land resources for private residential development in the near future.

2.11.26 The purpose of this study is to devise a development layout plan that is compatible and cognisant with current and proposed developments in the area.

2.11.27 The layout plan is primarily intended to enhance the manner in which the CKLKMS could be utilised for residential development, the provision of open space, Government, institution or community (GIC) facilities, and pedestrian circulation network. This is to formulate under the umbrella of a comprehensive urban design framework, a landscape framework for private and public spaces and a suggested implementation strategy for the preferred proposal.

2.11.28 The construction programme of this planning review is not available at the time of preparation of this Report. Therefore, no cumulative impact is anticipated during construction phase for TKO-LT Tunnel.

2.11.29 Since this residential development site is located in the vicinity of TKO-LT Tunnel, operational air quality and noise impacts from TKO-LT Tunnel on this development are considered in the assessment (see **Chapter 3** for further discussion on the air quality and **Chapter 4** for further discussion on the noise).

Yau Tong Bay Redevelopment

2.11.30 The proposed YTB redevelopment is located in the southern part of East Kowloon on the waterfront between Kwun Tong and Lei Yue Mun. The Site is surrounded by Cha Kwo Ling Road and Ko Fai Road. The Eastern Cross Harbour Tunnel is located to the north of the redevelopment site and to the south of the redevelopment site lies the Yau Tong Industrial Area.

2.11.31 The overall site area on the waterfront is approximately 10 hectares. The low rise structures which were erected on the site in the past such as shipyards, timber yards and sawmills etc were demolished recently for re-development. There are also an existing ice making and cold storage factory operated by Dairy Farm, a salt water pumping station operated by WSD and a site reserved for CEDD's maintenance depot which is included as part of the redevelopment site.

2.11.32 The proposed redevelopment is characterized by an urban development with 14 residential towers and 4 hotels, together with one G/IC block, clubhouses, retails and internal roads. A minimum 15m wide promenade will also be provided along the sea front for recreational use.

2.11.33 The construction works would commence in early 2013 and to be completed by 2017-2019. It is anticipated that the population in-take year for the proposed redevelopment would begin around year 2017. It is anticipated that only insignificant air quality and noise impacts from superstructure construction works from Yau Tong Bay Redevelopment during overlapping construction period of the Project. Hence, the cumulative air and noise impacts for TKO-LT Tunnel during construction phase are not anticipated.

2.11.34 Since this residential development site is located in the vicinity of TKO-LT Tunnel, operational air quality and noise impacts from TKO-LT Tunnel on this development are considered in the assessment (see **Chapter 3** for further discussion on the air quality and **Chapter 4** for further discussion on the noise).

Proposed Residential Site at Kwun Tong

2.11.35 Three pieces of land in Kwun Tong are suggested to be rezoned as residential lands by Planning Department during Kwun Tong District Council meeting on 8 January 2013. The details information of these three lands including the site at Choi Hing Road, Ngau Tau Kok, the site at Pik Wan Road/ Ko Chiu Road Junction and the site at Lei Yue Mun Path, are shown in **Appendix 2.5**.

2.11.36 These lands are outside the study area of TKO-LT Tunnel. Therefore, no cumulative impact is anticipated during construction and operational phases for TKO-LT Tunnel.

2.11.37 No other concurrent major Government project with programme is indentified at the time of preparation of this Report. The correspondences from Government departments advising their status are attached in **Appendix 2.6**.

2.12 Summary

2.12.1 **Table 2.11** summarises the potential concurrent projects that would contribute to the cumulative environmental impacts during construction and/or operational phase.

Table 2.11 Existing and planned concurrent projects

Project	Construction Programme	Possible Cumulative Impacts		Considered in the TKO-LTT EIA Study	
		Construction Phase	Operational Phase	Construction Phase	Operational Phase
Trunk Road T2	To tie in with TKO LTT, between 2016 and 2020	Air Quality, Noise, Water quality	Air Quality, Noise	Yes	Yes
Cross Bay Link	Commence in early 2016, for completion in late 2020	Water quality Marine ecology	Hydrodynamic and water quality	Yes	Yes
Shatin Central Link (SCL)	Commenced in 2012 for completion in 2020	Nil	Nil	Nil	Nil
KTD – Road D3A & D4A	Commence in 2014, for completion in 2016	Nil	Nil	Nil	Nil
KTD - Cruise Terminal	Commenced in late 2008 for completion in 2014	Nil	Hydrodynamic	Nil	Hydrodynamic
Tseung Kwan O Area 86 Development – 33ha	Commenced in early 2005 for completion in 2020	Nil	Nil	Nil	Nil
Submarine Gas Pipelines	Commenced in 2012 for completion in 2014	Nil	Nil	Nil	NiL
Hong Kong Offshore Wind Farm in Southeastern Waters	Commence in early 2017 for completion in late 2017	Water quality	See Note [1]	Yes	No
Planning review on Development	Programme is not available	Nil	Yes	Nil	Yes (as sensitive receivers in the air

Project	Construction Programme	Possible Cumulative Impacts		Considered in the TKO-LTT EIA Study	
		Construction Phase	Operational Phase	Construction Phase	Operational Phase
of ex-Cha Kwo Ling Kaolin Mine Site					& noise impact assessments)
Yau Tong Bay Redevelopment	Commence in 2013 for completion in 2017-2019	Nil (Insignificant air quality and noise impacts from superstructure construction works)	Yes	Nil	Yes (as sensitive receivers in the air & noise impact assessments)
Proposed Residential Site at Kwun Tong	Programme is not available	Nil	Nil	Nil	Nil

Note:

[1] The wind farm location is outside the boundary of the water quality model. Therefore the change of hydrodynamic regime contributed by the wind farm is not considered in Chapter 5, Water Quality Impact Assessment.