14 SUMMARY OF ENVIRONMENTAL OUTCOMES

14.1 Population and Environmental Sensitive Areas Protected

For the scenario without CKR and other parts of Route 6 in place, the traffic conditions in Central Kowloon will continue to deteriorate with an increasing number of roads operating beyond their capacities, thus affecting the connectivity of key developments in Kowloon. The study shows that the journey time between West Kowloon and Kai Tak is predicted to increase from 20 minutes at present to 30 - 35 minutes in 2021. Moreover, the number of signal-controlled junctions along the major east-west corridors that will be overloaded at the peak hours (i.e. those with reserve capacity of 0% or less) will increase in 2021 (to 14 from the present of 6), indicating possibility of severe congestion. Projected queue lengths at critical east-west road links will also increase up to about 80%, i.e. 200 m or above. This traffic congestion will also cause deterioration of air quality and noise environment in the vicinity.

As described in Section 1, CKR, together with the other components of Route 6, will serve as a vital strategic link bypassing the existing east-west road networks, including Boundary Street, Prince Edward Road, Argyle Street, Waterloo Road etc. The CKR would therefore relieve the worsening traffic conditions across central and eastern Kowloon and provide much-needed capacity for accommodating the east-west traffic movements generated by new developments in Kowloon. By relieving traffic congestion, most of the queue length at the critical east-west road links would be reduced and more manageable, with queues being dischargeable more readily.

As these areas have accommodated a large portion of residential premises, the proposed CKR would also bring improvements in air quality, noise environment from existing road networks, on-road safety and the overall quality of the ambient environment.

The proposed CKR would also bring considerable social and economic benefits. With CKR, the journey time between West Kowloon and Kai Tak would take around 5 minutes from portal to portal, representing a significant reduction of almost 70 – 80% journey time compared to that of 20 minutes at present and 30-35 minutes in 2021 during peak hours. The benefits not only include the more direct and quicker journeys for travellers commuting between east and west of Kowloon, but the traffic within Central Kowloon would also enjoy smoother movement and therefore reduced travel time, as traffic diverts from congested routes such as Argyle Street, Prince Edward Road and Jordan Road onto the new CKR corridor.

In fact, the benefits of the reduction in journey time in the above key east-west traffic corridors could also be represented in terms of the increase in average traffic speeds. For example, in 2021, the introduction of CKR would allow the average traffic speed on some of these key east-west traffic corridors to increase

by up to 15kph during the peak hour. Since some of these key east-west corridors are experiencing serious traffic congestion during peak hour already and would probably be even more severe by 2021. The introduction of CKR would allow the increase in average traffic speed of up to 70%, which represent a rather high percentage of increase. Since vehicular emission would decrease as the average traffic speed increases, the introduction of CKR would cause a decrease of emission from vehicles travelling on these key east-west corridors. This decrease in vehicular emission would definitely provide positive impacts on the large number of residential buildings along these key east-west corridors, and also provide a contribution in achieving a better air quality in the region. An estimation has been made on the generation of nitrogen oxides, respirable suspended particulates, carbon dioxide along these key east-west traffic corridors (see http://www.ckr-hyd.hk/pdf/044-02_English(Combined).pdf).

14.2 Approaches Adopted to Avoid Environmental Impacts

Avoidance of environmental impacts has been one of the key considerations throughout the entire project development and design. Given the highly urbanised nature of the areas in the vicinity, there are a large number of residential premises distributed within the study area. In addition, the environs are also characterised with a number of quality public parks which are important social assets. Some important built heritages have also been identified. Hence, the following approaches have been adopted to avoid environmental impacts:

- Optimal use of tunnel instead of viaducts to avoid construction phase impacts (see **Section 14.2.1**);
- Avoidance of public open space / parks (see **Section 14.2.2**);
- Avoidance of physical encroachment on Yau Ma Tei Police Station Old Wing (See **Section 14.2.3**);

14.2.1 Optimal Use of Tunnels Instead of Viaducts to Avoid Operational Phase Impacts

The neighbouring environment of CKR is characterised with a large number of sensitive receivers such as residential premises and schools. Development of a strategic highway could typically take a form of either viaduct or tunnel. However, having a viaduct through such a highly developed area would inevitably generate more conflicts with the receivers. Hence, approximately 80% of the alignment between Yau Ma Tei and Kai Tak has adopted the form of tunnel instead of viaducts, at-graded road or depressed road (see **Section 3**).

As compared to a viaduct form, this would help minimising the potential nuisance such as airborne noise, landscape and visual impacts etc. during the operational phase. For some of the at-grade sections with higher traffic flow, suitable noise mitigation measures such as low noise road surfacing materials, noise barriers, semi-enclosures and full enclosures have been recommended as appropriate to minimize the potential airborne noise impact on the nearby sensitive receivers.

14.2.2 Avoidance of Public Open Space / Parks

Since the majority of the CKR alignment will be an underground tunnel, this will largely avoid the need of using public open space as temporary at-grade construction sites. These include parks such as King's Park Rise Garden, King's Park Rest Garden, King's Park Recreation Ground, Ho Man Tin Park, Ho Man Tin High Level Service Reservoir Playground, Kau Pui Lung Road Playground, Ma Tau Wai Service Reservoir Playground and To Kwan Wan Recreation Ground along the alignment. Large amount of trees within these parks will also be retained. As a result, the local residents will not be deprived of the recreational, leisure opportunities brought about by these amenity facilities.

14.2.3 Avoid Physical Encroachment on Yau Ma Tei Police Station Old Wing

All Declared Monuments and graded historical buildings within the boundary of CKR have been identified in an early stage of the preliminary design. The Project has been designed to avoid causing direct physical impacts on these heritage resources.

The cut-and-cover tunnel of CKR will however be inevitably constructed partly underneath the new wing of Yau Ma Tei Police Station, yet both old and new wings of Yau Ma Tei Police Station will be retained. The CKR tunnel will be designed to avoid the old wing building, by maintaining an approximately 2.3 m clearance from CKR tunnel. A grout curtain will be installed in front of the face of Yau Ma Tei Police Station Old Wing to protect the building that may affected by the construction works. It is anticipated that the effect on the building will be controlled below an acceptable level.

14.3 Approaches Adopted to Minimize Environmental Impacts

Other than the approached discussed in **Section 14.2** to avoid environmental impacts on key environmental resources, efforts have also been deployed in the planning and design of CKR to minimize the environmental impacts. These include the following:

- Optimal use of drill-and-blast and drill-and-break tunnelling to minimize construction phase impacts (see **Section 14.3.1**)
- Use of pipepile seawall for temporary reclamation and advisable to conduct some of the dredging works in wet season (if programme allows) to minimize water quality impacts and quantity of dredged contaminated sediments (see **Section 14.3.2**)
- Careful sitting and design of ventilation buildings to minimize air quality impacts and visual impacts (see **Section 14.3.3**)
- Use air purification systems in ventilation buildings to minimize air pollutants emissions (see **Section 14.3.4**)
- Optimal use of green roof to minimize visual impacts and promote sustainability (see **Section 14.3.5**)

- Landscaped decks to minimize nuisance and enhance urban landscape (see **Section 14.3.6**)
- Use of noise barriers, noise enclosures and low noise road surfacing to minimize traffic noise (see **Section 14.3.7**)
- Use of full enclosure at mucking out locations to minimize construction noise and fugitive dust (see **Section 14.3.8**)
- Use of top-down construction method for cut-and-cover tunnel sections to minimize construction noise and fugitive dust (see **Section 14.3.9**)
- Re-provisioned Kowloon City Ferry Pier Public Transport Interchange as a landscape deck to minimize noise and visual impacts and enhance local environment (see **Section 14.3.10**)

14.3.1 Optimal Use of Drill-and-Blast and Drill-and-Break Tunnelling to Minimize Construction Phase Impacts

For the tunnel section, about 60% of the total length (i.e. the section between Yau Ma Tei and Ma Tau Kok where it will run within rock strata) has been designed to adopt either drill-and-blast or drill-and-break tunnelling.

As compared to other tunnelling methods such as cut-and-cover or open cut, this construction methodology would provide more opportunities to optimise the need for temporary at-grade works area within the tunnel section. According to the current design, most of the temporary at-grade works areas would be for the approach roads on the both ends of the tunnel and the locations for the 3 ventilation buildings. This strategy would help minimising the potential impacts such as construction dust, noise and visual impacts on the neighbouring sensitive receivers.

14.3.2 Use of Pipepile Seawall for Temporary Reclamation to Minimize Water Quality Impacts and Quantity of Dredged Contaminated Sediments

Due to the constraints as discussed in **Section 2.4**, there will be a need for an underwater tunnel section of about 370 m long across Kowloon Bay between Ma Tau Kok and Kai Tak. This would require forming a temporary reclamation for the construction of the tunnel structure. This temporary reclamation would eventually be removed after the construction of the tunnel structure. If the conventional fully dredged approach is adopted for the temporary reclamation for this underwater tunnel construction, it would require a dredging of about 357,500 m^3 of sediment which would eventually need to be disposed of.

Depending on the sediment quality, some of these dredged sediment would need to be disposed at the confined marine mud pits in North Lantau. These confined mudpits are however important social resources that need to be conserved as much as practicable. As such, the feasibility of adopting a pipepile seawall approach for the temporary reclamation has been extensively studied and eventually adopted.

According to the latest construction methodology, the temporary reclamation would be constructed by using vertical pipe pile walls. This pipepile seawall

approach would limit the area of sediment dredging/excavating to within the temporary reclamation footprint, and hence minimise the extent of the temporary reclamation. However, some dredging is still required for the fairway of Towngas vessel during the construction stage to ascertain marine safety.

It is estimated that adopting this pipepile seawall approach would reduce the amount of sediment to be dredged / excavated and disposed of significantly by 50% to about 177,000 m^3. This would help minimizing the potential impacts to the confined mud pits and the associated water quality. While the above impact will occur in dry season only, it is considered advisable to conduct some of the dredging works in wet season, if programme allows.

14.3.3 Careful Sitting and Design of Ventilation Buildings to Minimize Air Quality Impacts and Visual Impacts

As discussed in **Section 14.1**, the implementation of CKR would relieve the traffic congestion and hence the emission from vehicles. In order to maintain a reasonable air quality inside the tunnel section, a ventilation system would be installed to extract air from the tunnel. The areas and locations of the proposed ventilation buildings have been optimized such that resumption of land can be minimized. Besides, due to the generally higher background air quality condition in west portion, the ventilation building has been cautiously locate at the seafront. This arrangement will maximize the separation and better dispersion of tunnel exhaust so as to reduce the immediate air quality impacts. For example, the nearest residential uses are at Charming Garden and The Coronation which is located at about 300 m away.

The separation of the neighbouring residential premises from the ventilation building at Ho Man Tin is relatively shorter, in the order of 190 – 250 m. In order to strike an appropriate balance between the building height and the visual impacts, the height of the ventilation building in Ho Man Tin has been cautiously optimised as far as practicable. The current design is to limit the height of the Ho Man Tin ventilation building to about 20 m above local ground.

14.3.4 Use Air Purification Systems in Ventilation Buildings to Minimize Air Pollutants Emissions

In addition to the separation of the ventilation buildings from neighbouring buildings, an Air Purification system (APS) will be installed. As discussed in **Section 3.2.9**, the APS for CKR schematically comprises of 2 main processes. The first part involves the use of Electro-static Precipitators (ESP) to remove portion of particulates from the air extracted from the tunnel. After passing through the ESP, the air would be fed into a NO_2 removal system to reduce the NO_2 concentration before it is eventually discharged to the atmosphere.

It should be noted that the tunnel section would occupy about 80% of the entire CKR alignment and the majority of the air within the tunnel would be extracted through the ventilation system. With the APS installed to the ventilation system, at least 80 % of the particulates and NO_2 within the tunnel would be removed. This would provide a positive benefit to the community in the vicinity.

14.3.5 Optimal Use of Green Roof to Minimize Visual Impacts and Promote Sustainability

The use of green roofs has been actively considered in CKR. According to the latest design, green roof would be incorporated in the design of the ventilation buildings and landscaped decks as far as practicable. These green roofs would provide significant environmental benefits to the community and the Project.

In fact, the Government has been promoting greening in buildings to improve the environment. This includes actively implementing rooftop greening where practicable to enhance the cityscape and mitigate the heat island effect in urban areas. The Architectural Services Department completed the "Study of Green Roof Application in Hong Kong" in 2007 which reviewed the latest concepts and design technology of green roof and recommended technical guidelines suitable for application in Hong Kong, covering various aspects including choice of plants, waterproofing layer, thermal insulating layer, drainage layer, planting soil, irrigation as well as maintenance and repair.

According to the "Study of Green Roof Application in Hong Kong" by Architectural Services Department, the application of green roofs has the following potential benefits:

Amenity and Aesthetic Benefits

- It would contribute to aid visual green space continuity throughout urban area.
- Psychological studies have demonstrated the restorative effect of natural scenery holds the viewer's attention, diverts their awareness away from themselves and worrisome thoughts and elicits a meditation-like state. The variety of sounds, smells, colours and movement provided by plants, although not quantifiable, can add significantly to human health and wellness.

Environmental Benefits

- Vegetation has a cooling effect by dissipating some of the city heat through the process of evapo-transpiration. Hence, the use of green roofs has beneficial effects in the reduction of the heat island effect.
- The application of green roofs can reduce the total run-off by absorbing water and returning it to the air, reducing the amount of water available for run-off and spreading the residual run off over a longer period (by storing it for a period before it runs-off, the roof acts as a buffer between the weather and drainage systems).

Sustainability

- Green roofs can contribute to building insulation and energy efficiency. The shading effect of vegetation reduces temperatures of buildings partly through shading and partly through evapo-transpiration. The insulation benefits of green roofs can reduce solar heat gain during the day and provide savings in regular building maintenance cost and contribute to saving more energy (and hence more sustainable).

- Studies have demonstrated that green roofs, when properly constructed, can extend the life of a roof. Degradation by ultraviolet light and the constant expansion and contraction caused by daily extremes of temperature are the prime cause of the disintegration, cracking, delamination and splitting of roofing materials. Green roofs insulate the materials from ultraviolet light and reduce the thermal extremes, thus prolonging roof life.

14.3.6 Landscaped Decks to Minimize Nuisance and Enhance Urban Landscape

Landscaped decks will be provided at the portals of both west and east portions and the re-provisioned Kowloon City Ferry Pier PTI. These three landscaped decks are designed to beautify the portal ends of CKR and the re-provisioned Kowloon City Ferry Pier PTI and mitigate noise impacts of the Project and provide appropriate degree of public access. These above-road level deckings would provide a platform for green treatment which serves as an additional aesthetic resource to improve the scenic quality within the urban setting of the districts.

Depending on the detailed design, part of the landscaped decks will also function as an outdoor open-air public space, providing leisure opportunities and resources for local community. The decks will also potentially serve as open space corridor to facilitate leisure pedestrian walkway connection from the neighbourhood to the existing and/or future provision of local/district open space.

14.3.7 Use of Noise Barriers, Noise Enclosures and Low Noise Road Surfacing to Minimize Traffic Noise

Although CKR will help redistribute traffic of the existing east-west road networks and relieve the traffic congestion across central and eastern Kowloon, the Project would inevitably contribute some road traffic noise impacts that demand mitigation measures.

According to the latest findings, mitigation in form of a combination of noise enclosure, semi-enclosure, cantilever noise barrier and vertical barriers are required at the section of west portion along some slip roads connecting to CKR tunnel, re-provisioned Gascoigne Road Flyover, re-aligned Hoi Wang Road and widened Lai Cheung Road in order to reduce the significant contribution of road traffic noise from CKR. Low noise road surfacing is also recommended along the CKR roads in both west and east portions where necessary.

For the section of elevated roads near Gascoigne Road Flyover (Ferry Street section) in particular, a package of noise mitigation measures including noise enclosure and noise barriers is proposed. This full enclosure and noise barriers will provide beneficial protection to the noise sensitive receivers in the vicinity which have been exposed to higher ambient noise environment caused by existing roads such as Nathan Road, Ferry Street and West Kowloon Highway in West Portion and Kai Fuk Road and other planned roads (D2, D3, and T2) in East Portion. For example, according to the current assessment, the proposed package

of noise mitigation along Ferry Street and GRF would help to reduce the noise impacts on the residential uses along this traffic corridor in the range of 1 – 10 dB(A).

14.3.8 Use of Full Enclosure at Mucking Out Locations to Minimize Construction Noise and Fugitive Dust

According to the current construction methodology, mucking-out points will be located in west, central and east portion as shown in **Figure 3.1.1**, **Figure 3.1.2** and **Figure 3.1.3** respectively. Since the mucking activities will be located in the vicinity of residential premises, noise enclosures would be provided for fully screen off these loading/unloading activities. Appropriate design would also be adopted for any openings such as access, vents etc to ensure the acoustic integrity of the enclosures. By adopting this full noise-enclosure, it would minimize the potential noise and dust impacts generated by the construction activities.

14.3.9 Use of Top-Down Construction Method for Cut-and-Cover Tunnel Sections to Minimize Construction Noise and Fugitive Dust

Section 14.2.1 has clearly elaborated that CKR has prudently adopted tunnel as much as practicable to avoid environmental impacts during both construction and operational phases. As far as the tunnel section is concerned, the majority of about 60% of the tunnel length would adopt drill-and-blast methodology which does not require extensive at-grade work. Only the tunnel sections from Hoi Wang Road to Temple Street (approximately 400 m), at Kowloon City Ferry Pier Public Transport Interchange (approximately 135 m) and at Kai Tak Development Area (within 100 m) (about 15% of the total tunnel length) would inevitably require cut-and-cover construction to allow transition from drill-and-blast tunnel to approach roads or marine tunnel. Since these cut-and-cover sections would require at-grade construction activities such as excavation, diaphragm wall etc, some construction noise and dust nuisance would be inevitable.

In order to minimise these construction nuisance, a top-down approach construction methodology would be adopted for the cut-and-cover section from Hoi Wang Road to Temple Street where existing receivers are located close to the temporary works areas. Following completion of the diaphragm walls, cross walls and the ground will be excavated to the tunnel roof level and the tunnel roof slab constructed. This first stage of excavation and roof slab works will be undertaken beneath temporary decking. This decking provides a platform for pedestrian and road traffic whilst also containing the noise and dust produced by the works being carried out beneath (An attenuation of minimum 20 dB(A) is envisaged for works under the deck). The space above the tunnel top slab will be back-filled with the footpaths and the roads will be reinstated after its completion. The remainder of the tunnel construction will then be continued beneath the tunnel top slab. This approach has the advantage of allowing early reinstatement of the roads and footpaths and therefore reducing the disturbance to the public. Additionally, the roof slab and back-fill will provide a barrier between the construction work of the lower part of the tunnel and roads and footpaths at

ground level (thereby improving the noise and dust barrier temporarily provided by the temporary decking). Conventional 'Bottom-Up' cut-and-cover construction would result in prolonged use of the temporary traffic decking (this would increase the risk of adverse effects of noise and dust at ground level) and would also delay the reinstatement of the ground above the tunnel.

The Kowloon City Ferry Pier Public Transport Interchange also has sensitive receivers in the vicinity. In order to reduce impacts on the environment and existing traffic, temporary decking will be constructed after construction diaphragm wall and initial shallow excavation. The excavation thereafter will be carried out under the temporary decking and removed at certain mucking out point. After the completion of tunnel construction, the ground level will be reinstated. Again, this construction methodology has the advantage of allowing early reinstatement of the roads for the rearrangement of PTI and disturbance to public can therefore be minimised. Further excavation are carried out under the temporary decking away from direct impact on the public and hence provide a shield to reduce the construction noise and fugitive dust.

14.3.10 Re-provisioned Kowloon City Ferry Pier Public Transport Interchange as a Landscape Deck to Minimize Noise and Visual Impacts and Enhance Local Environment

To facilitate the construction of cut-and-cover tunnel section in Ma Tau Kok, temporary re-provisioning of the existing Kowloon City Ferry Pier Public Transport Interchange (PTI), including all bus, green light bus, drop-off area, taxi stand etc, is required. In order to enhance the local urban environment and provide more open space for local residents, an accessible landscaped deck with pedestrian access on the sides are proposed to mitigate the environmental impact. Design details are subject to further study.

14.4 Approaches Adopted to Mitigate Environmental Impacts

It can be seen that the design of CKR has adopted the principle to avoid the environmental impacts. Where the impacts could not be avoided, efforts have been deployed to minimize the impacts as much as practicable. Not withstanding this, the EIA has recommended a package of mitigation measures that would be required. The Environmental Mitigation Implementation Schedule in the EM&A Manual has clearly stated the details of such mitigation measures, the timeframe and the implementation agents. Some of the key mitigation measures are discussed below.

14.4.1 Measures Adopted to Mitigate Air Quality Impacts

During construction phase, the extent of temporary works areas that may generate fugitive dust have been reduced to minimize the dust impacts as much as practicable. However, given the relatively short separation with some of the receivers in the urban context, dust suppression measures such as frequent watering would be implemented to minimize the potential construction dust impact and comply with the regulatory requirements.

In addition, other dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation and good site practices would be in place to further minimize construction dust impact. Some examples of these good site practices include:

- Any excavated or stockpile of dusty material should be covered entirely by impervious sheeting or sprayed with water to maintain the entire surface wet and then removed or backfilled or reinstated where practicable within 24 hours of the excavation or unloading;
- Any dusty materials remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads;
- A stockpile of dusty material should not be extend beyond the pedestrian barriers, fencing or traffic cones;
- The load of dusty materials on a vehicle leaving a construction site should be covered entirely by impervious sheeting to ensure that the dusty materials do not leak from the vehicle;
- Where practicable, vehicle washing facilities with high pressure water jet should be provided at every discernible or designated vehicle exit point. The area where vehicle washing takes place and the road section between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;
- When there are open excavation and reinstatement works, hoarding of not less than 2.4m high should be provided as far as practicable along the site boundary with provision for public crossing. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period.
- The portion of any road leading only to construction site that is within 30m of a vehicle entrance or exit should be kept clear of dusty materials;
- Surfaces where any pneumatic or power-driven drilling, cutting, polishing or other mechanical breaking operation takes place should be sprayed with water or a dust suppression chemical continuously;
- Any area that involves demolition activities should be sprayed with water or a dust suppression chemical immediately prior to, during and immediately after the activities so as to maintain the entire surface wet;
- Where a scaffolding is erected around the perimeter of a building under construction, effective dust screens, sheeting or netting should be provided to enclose the scaffolding from the ground floor level of the building, or a canopy should be provided from the first floor level up to the highest level of the scaffolding;
- Any skip hoist for material transport should be totally enclosed by impervious sheeting;
- Every stock of more than 20 bags of cement or dry pulverised fuel ash (PFA) should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides;
- Cement or dry PFA delivered in bulk should be stored in a closed silo fitted with an audible high level alarm which is interlocked with the material filling

line and no overfilling is allowed;

- Loading, unloading, transfer, handling or storage of bulk cement or dry PFA should be carried out in a totally enclosed system or facility, and any vent or exhaust should be fitted with an effective fabric filter or equivalent air pollution control system; and
- Exposed earth should be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shortcrete or other suitable surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.

For the barging facility near Tsing Yi, the following good site practices are required:

- All road surface within the barging facilities will be paved;
- Dust enclosures will be provided for the loading ramp as described in (ii) above;
- Vehicles will be required to pass through designated wheel wash facilities; and
- Continuous water spray at the loading point.

During operational phase, In order to maintain the performance of the APS, air pollutant sensors would be adopted in the TVS/APS to monitor the pollutant concentration levels continuously at the inlet and outlet of the system. The sensor type would be selected by the Contractor based on a performance specification. In addition, a commissioning test shall also be conducted by the Contractor to demonstrate the performance of the proposed APS. Details of the commissioning test shall also be submitted for agreement with relevant authorities.

14.4.2 Measures Adopted to Mitigate Noise Impacts

For construction phase, the extent of temporary works areas where construction plant would be operating has been reduced to minimize the airborne construction noise impacts as much as practicable. However, given the relatively short separation with some of the receivers in the urban context, more mitigation measures would be required. Further measures that had been considered throughout the design process to minimize the construction noise impacts include:

- Use of quiet plant and working methods; and
- Use of temporary noise barriers, and enclosures for relatively static plants etc.

However, construction noise impacts at some receivers that are close to the temporary works areas would still exceed the construction noise criteria but the impacts have been minimized with implementation of all practicable mitigation measures.

For the operational phase, the use of low noise road surfacing, noise barriers and noise enclosures would be required for some of the road sections to mitigate the noise generated by CKR. In addition, acoustic design specification for ventilation buildings has been identified such that the fixed noise source impact can be kept within the acceptable level.

14.4.3 Measures Adopted to Mitigate Water Quality Impacts

Good site practices such as temporary drainage, dike or embankment for flood protection, efficient silt removal facilities, covering exposed areas with tarpaulin, vehicular washing facilities at construction site exits, oil interceptors etc would be implemented to minimize water quality impacts during the construction phase.

The following good practice should be applied for the dredging works:

- Install efficient cage-typed silt curtains, i.e. at least 80% SS reduction, at the point of dredging/filling to control the dispersion of SS;
- Water quality monitoring should be implemented to ensure effective control of water pollution and recommend additional mitigation measures required;
- The decent speed of grabs should be controlled to minimize the seabed impact and to reduce the volume of over-dredging; and
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.
- The dredging rates by closed grab dredgers for temporary marine channel outside pipepile wall shall be less than 1,500 m^3/day and 125 m^3/hour (without concurrent dredging with T2 in dry season only) or 750 m^3/day and 62.5 m^3/hour for other conditions respectively.
- Marine dredging works shall be only for the provision marine channel. Sediment removal for construction of underwater tunnel will be conducted within the pipepile wall area for temporary reclamation.
- The workfront of temporary reclamation shall be surrounded by cofferdams and the associated excavation and backfilling works for temporary reclamation shall have no contact with seawater.

The following good practice should be applied for the handling of marine sediment/operation of barging facilities:

- All barges should be fitted with tight bottom seals to prevent leakage of materials during transport;
- Barges or hoppers should not be filled to a level that will cause overflow of materials or polluted water during loading or transportation;
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; and
- Loading of barges and hoppers should be controlled to prevent splashing of material into the surrounding water.
- Mitigation measures for land-based activities should be applied to minimise water quality impacts from site runoff and open stockpile spoils at the proposed barging facilities where appropriate.

For the construction phase, the following measures would be implemented:

- During temporary reclamation, regular litter / rubbish clearance and avoidance of illegal discharges within the embayed marine water should be undertaken.

- Cut-and-cover tunnelling work should be conducted sequentially to limit the amount of construction runoff generated from exposed areas during the wet season as far as practicable.
- During tunneling work, uncontaminated discharge should pass through sedimentation tanks prior to off-site discharge.
- During tunneling work, the wastewater with a high concentration of SS should be treated (e.g. by sedimentation tanks with sufficient retention time) before discharge. Oil interceptors would also be required to remove the oil, lubricants and grease from the wastewater.
- During tunneling work, direct discharge of the bentonite slurry (as a result of D-wall and bored tunnelling construction) is not allowed. It should be reconditioned and reused wherever practicable. Temporary storage locations (typically a properly closed warehouse) should be provided on site for any unused bentonite that needs to be transported away after all the related construction activities are completed.
- For dredging work for the temporary fairway for marine vessels, mitigation measures such as the use of closed grabs and silt curtain have been recommended.
- Use of portable toilet to collect sewage from the workforce.
- Proper handling of chemical waste.

For the operational phase, the following mitigation measures would be implemented:

- Drainage discharge should pass through oil/grit interceptors/chambers to remove oil, grease and sediment before discharging into public storm drainage/ foul sewerage system;
- The silt traps and oil interceptors should be cleaned and maintained regularly; and
- Oily contents of the oil interceptors should be transferred to an appropriate disposal facility, or to be collected for reuse, if possible.

14.4.4 Measures Adopted to Mitigate Impacts on Waste Management

The annual disposal quantities for C&D materials and their disposal methods have been discussed making reference to the C&DMMP which has endorsed by PFC. The amount of C&D material that would need to be transported off site has been minimized as far as practicable in the design. The opportunity for re-using C&D material has been fully considered and implemented where practicable. The Project Proponent will ensure all the mitigation measures mentioned in the C&DMMP will be complied with. Wherever practicable, C&D materials should be segregated from other wastes to avoid contamination and ensure acceptability at public filling areas or reclamation sites. The surplus C&D material would be reused within the site as much as possible. Good site practices have also been recommended for chemical waste, general refuse and disposal of chemical waste will follow the relevant ordinances.

The contaminated sediment will require to be disposed of at confined contaminated mud pits such as East Sha Chau, while the uncontaminated marine and alluvial deposit will require open sea disposal, e.g. in South Cheung Chau, Nine Pin, etc. All issues on management of dredged sediments will be resolved and all relevant arrangements will be endorsed by the relevant authorities including MFC and EPD before the commencement of any dredging works. Exact location of marine disposal of the sediment will be assigned by MFC.

14.4.5 Measures Adopted to Mitigate Impacts on Land Contamination

The assessment of the land contamination has covered all 4 categories of the RBRG land use scenarios in case the excavated contaminated soil was used as public fill for unidentified afteruse. Exceedances of the RBRGs for "Urban Residential" and "Rural Residential" have been detected in the concentrations of Lead and PCBs but not RBRGs for "Public Park" and "Industrial". The remediation action plan and specification for remediation works has been detailed in the Supplementary Remediation Action Plan (RAP).

14.4.6 Measures Adopted to Mitigate Impacts on Hazard

The initially proposed ventilation building near the MTKGW has been removed to eliminate the risk of the draw in of towngas leak from the MTKGW to the CKR tunnel.

The assessment has covered the hazards from transport and use of explosives associated with the tunnel blasting work of the CKR project. The risk is within the acceptable level, thus satisfies the Hong Kong Government risk criteria set out in Annex 4 of the TM-EIAO. Therefore further risk mitigation measures are not required.

14.4.7 Measures Adopted to Mitigate Impacts on Landscape and Visual

As the majority of the CKR is underground, landscape and visual impacts would be restricted to above ground construction works and operational facilities only. A number of measures are suggested to mitigate the landscape and visual impacts, always considering the principle that the Project should integrate with other key projects in the area, namely the XRL in the West Portion and KTD in the East Portion.

- Detailed Design – Landscape All works shall be carefully designed to minimize impacts on existing landscape resources and visually sensitive receivers, particularly those of high value or high sensitivity. For this purpose, the extent of the works area will be minimised and existing trees within the works area shall be avoided were practicable.
- Detailed Design – Visual Tunnel portals and all structures above ground including noise barriers shall be cautiously designed with colour, texture and tonal quality being compatible to the existing urban context. The 'natural terrain' idea will be applied to the design of ventilation and administration buildings. For noise barriers/ enclosures, the colour of the structural frames

and the frame of the glazing panels shall give a natural look and match with the colour of the adjacent buildings in the area.

- Tree Protection & Preservation: Exiting trees to be retained within the Project Site should be carefully protected during construction. Note no Registered Old and Valuable Trees are located within Works Area and none of the affected trees are LCSD champion Trees or Registered Old and Valuable Trees, neither are they rare or endangered species, but mainly common exotic trees. Tree protection measures will be detailed at the Tree Removal Application stage and plans submitted to the relevant Government Department for approval in due course in accordance with ETWB TC no. 3/2006. Care should be taken to preserve as many trees as possible by avoidance (also see Detailed Design – Landscape).
- Tree Transplantation: For trees unavoidably affected by the Project that have to be removed, where practical transplantation will be chosen as the top priority method of removal. If this is not possible or practical (e.g. the tree is too large or has a low survival rate) compensatory planting will be provided for trees unavoidably felled (See MM10). For trees unavoidably affected by the Project works that are transplanted, transplantation must be carried out in accordance with ETWBTC 2/2004 and 3/2006.
- Compensatory Planting: For trees unavoidably affected by the Project that have to be removed, where practical transplantation will be chosen as the top priority method of removal but if this is not possible or practical (e.g. the tree is too large or has a low survival rate) compensatory planting will be provided for trees unavoidably felled. All felled trees shall be compensated for by planting trees to the satisfaction of relevant Government departments. Required numbers and locations of compensatory trees shall be determined and agreed separately with Government during the Tree Felling Application process under ETWBTC 3/2006. Compensatory tree planting may be incorporated into future landscape decks, public open spaces and along roadside amenity areas affected by the construction works and therefore be part of the wider planting plans.

  Trees affected by the works will be compensated for mainly within the Project Boundary including, but based on an approximate calculation of trees affected by the Project from the 2010 Tree Survey, a worst case scenario suggests it will be necessary to agree additional receptor sites for about 550 compensatory trees.
- Screen planting: Tall screen/buffer trees, shrubs and climbers should be planted, in so far as is possible, to soften and screen proposed structures such as roads and central strip, vertical edges and buildings and to enhance streetscape greening effect where appropriate.. This measure may additionally form part of the compensatory planting and will improve and create a pleasant pedestrian environment.
- Green Roof: Roof greening will be established on ventilation and administration buildings to reduce exposure to untreated concrete surfaces and particularly mitigate visual impact to VSRs at high levels, as further detailed in **Section 14.3.5**.
- Reinstatement: All works areas, excavated areas and disturbed areas for tunnel construction and temporary road diversion or any other proposed works shall be reinstated to former conditions or better, with reasonable landscape

treatment and to the satisfaction of the relevant Government departments. For example, Yau Ma Tei Jade market will be demolished during construction, re-sited to a temporary location and ultimately reinstated back at its original location. (Specific mitigation for disturbance to public open space is detailed separately)

- Reprovising of Public Open Space: All areas of public open space affected by the Project will be re-provisioned either at the same location following the completion of temporary works, or at a separate site as agreed with relevant Government departments and open space shall be re-provisioned in an enhanced manner. For example some of Public Square Street Playground and Temple Street / Kansu Street Temporary Rest Garden will be reprovisioned in-situ, and the Yau Ma Tei Jade market (Jade Hawker Bazaar) will be demolished during construction, re-sited to a temporary location and ultimately reinstated back at its original location. In addition some new open space areas are proposed; the original Yau Ma Tei Specialist Clinic Extension Site and Proposed Yau Mau Tei Landscape Deck are both new public open spaces, such that overall more public open space will be re-provisioned/ reinstated than is taken during construction.
- Landscape enhancement: A comprehensive landscape plan will be implemented to maximize the greening opportunity and create a unique landscape for the project to blend in with its surroundings, including in reprovisioned areas. In particular:
  - landscape enhancement of re-provisioned Kowloon City Ferry Pier Public Transport Interchange (See **Sections 14.3.6 and 14.3.9**);
  - landscape deck on tunnel portals(See **Section 14.3.6**);
  - viaduct planters for trailer planting;
  - vertical greening of piers and walls with climbers or trailer planting;
  - roadside planting i.e. planting along central dividers and on road islands e.g. in the middle of roundabouts. (Roadside planting i.e. at the road edge and not in the central divider or road island, and vertical greening may be considered part of Screen Planting)

In addition a number of general measures regarded as good practise will be implemented and these include: ensuring the construction time frame is kept to a practical minimum; erecting decorative screen hoarding to screen the public from the construction area; controlling lighting during construction and operation; controlling erosion by minimizing the extent of vegetation disturbance on site and providing a protective cover over newly exposed soil; and general good site management such as covering large temporary stockpiles of excavated material with unobtrusive and creating a neat and tidy visual appearance within the construction site.

14.4.8 Measures Adopted to Mitigate Impacts on Cultural Heritage

The findings of the terrestrial archaeology baseline study indicated that the impacted areas are of no or very low archaeological potential. As no adverse impacts are expected to arise from both the construction and operational phase of the Project, no mitigation measures will be required. As a precautionary measure,

the Antiquities and Monuments Office should be informed immediately in case of discovery of antiquities or supposed antiquities during the construction.

The Marine Archaeological Investigation (MAI) was completed in two phases (The first in 2008 and the second in 2012). The Baseline Review established high marine archaeological potential for Kowloon Bay. The 2008 geophysical survey located 8 unknown seabed objects. Diver inspection of them identified them as modern dumped debris. The 2012 geophysical survey located 36 unknown seabed objects. Diver inspection of 28 of them identified them as modern debris with no archaeological value. The eight objects that were not practicable to inspect were deemed to have low archaeological potential due to their location underneath the disused fuel dolphin which is a current work site creating debris.

A watching brief is not required. However, contractor should be alerted during the construction on the possibility of locating archaeological remains, such as cannon and AMO shall be informed immediately in case of discovery of antiquities or supposed antiquities in the subject sites. No additional mitigation is required.

The findings of the Built Heritage Impact Assessment have identified the several buildings and structures which requires mitigation. These include Yau Ma Tei Police Station, Tin Hau Temple, Kowloon Methodist Church, Ma Tau Kok Animal Quarantine Depot, Kowloon City Ferry Pier, Air raid precaution tunnels of the K1 Networks and The Kowloon City Vehicular Ferry Pier.

As the construction works will be in close proximity to the new wing of the Police Station, protective covering should be provided for the buildings in the form of plastic sheeting. Buffer zones should be provided between the construction works and the external walls of the buildings. The buffer zones should be as large as site restrictions allow and be marked out by temporary fencing or hoarding. Additionally, a scheme is under development in order to transfer the existing column loadings to a deeper rock stratum to mitigate the potential for settlement.

The protection measures the old wing of Yau Ma Tei Police Station include the potential to adopt a diaphragm wall construction method which should provide a water sealed wall with minimum water pumping. With a high stiffness wall and adopting lower bearing capacity to minimise chiselling works, settlement due to lateral deflection and vibration can be significantly reduced. Moreover, a grout curtain wall will be provided in front of the affected building. It will absorb the vibration generated during the construction of the tunnel. Recharging system will also be installed as a contingency measure to mitigate the fluctuation of water table.

As the tunnel area to be excavated is in close proximity to the Kowloon City Ferry Pier, it will be necessary to establish the extent of movement which can be tolerated by the building. Options proven to be effective in controlling/limiting ground movements in deep excavation, such as diaphragm walling and contiguous bored piles, will be examined. Special or advanced technology such as preloading of lateral support, use of cross-wall with top-down construction, which can further enhance movement control, will also be studied and specified if found applicable. Further investigation will be conducted into the specific mitigation measures and information will be provided when mitigation has been finalised.

Condition survey and for Tin Hau Temple and the air raid precaution tunnels of the K1 and K1A networks would be undertaken to determine their present

condition and to recommend protective measures to ensure that the structures are not damaged by the construction works.

Tolerance levels for ground-borne vibration have been recommended for some buildings. The vibration monitoring proposal for Yau Ma Tei Police Station, Tin Hau Temple, Kowloon Methodist Church, Ma Tau Kok Animal Quarantine Depot will be submitted to AMO for comment. Vibration monitoring of the structure should be employed during the construction phase to ensure that the level does not exceed the level and as such appropriate vibration monitoring on the building should be complied with as appropriate.

The construction and operation of the tunnel and road network will not cause any insurmountable impacts if the proposed mitigation measures are implemented properly.

14.4.9 Environmental Monitoring and Auditing

In addition to the mitigation measures as described above (see more details in the Environmental Mitigation Implementation Schedule given in the EM&A Manual), a comprehensive environmental monitoring and auditing programme would be implemented to cover various aspects of concern. An independent environmental checker would also be employed to ensure that all the necessary mitigation measures are implemented in a timely and orderly manner.

14.4.10 Overall

Mitigation measures and good site practices to minimize the environmental impacts were recommended throughout the impact assessments of air quality, noise, water quality, waste management, cultural heritage, hazard and landscape and visual. These measures were consolidated in the Implementation Schedule which specifies the responsibility, methodology and timing of implementation, such that effective and appropriate implementation of the measures can be assured.