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14 Summary of Environmental Outcomes

14.1 General

- 14.1.1.1 This section summarises the overall environmental outcomes due to the construction and operation of the Project in accordance with Section 3.6.1 of the ESB-352/2022. With reference to **Section 1** and **Section 2**, environmental considerations have been the key considerations throughout the Project. Alternative options for designs and construction methodologies have been duly considered in response to the public aspirations collated during the public engagement process in an appropriate manner. Besides, all the options considered have ensured that environmental impacts could be avoided or minimized where practicable and mitigated by implementation of suitable mitigation measures to fulfil all the statutory requirements. The technical assessments conducted (see **Section 3** to **Section 12**) have demonstrated that all the statutory requirements in ESB-352/2022 and EIAO-TM have been complied with.
- 14.1.1.2 The following sections summarise the approaches that have been adopted to either avoid or minimize various environmental impacts throughout the design process, and the associated environmental enhancements.

14.2 Environmentally Friendly Options Considered and Incorporated to Avoid and Minimize Environmental Impact

14.2.1.1 As described in **Section 2.10**, avoidance and minimisation of environmental impacts have been one of the key considerations throughout the entire project development and design. For those impacts that could not be avoided, due considerations have been given to minimize those impacts as much as practicable so that all the residual impacts would comply with the statutory requirements. Given the views and opinions collated from the public engagement process, much emphasis has been given to address environmentally sensitive area such as Tai Lam Country Park, water gathering ground, butterfly overwintering ground at Siu Lang Shui, Fung Shui Woodland in So Kwun Wat, etc. A summary of these avoidance and minimisation approaches is given in **Table 14.1**.

Table 14.1 Key design considerations and the associated environmental benefits

Design Approach	Key Design Considerations	Associated Environmental Benefits
Avoidance of aboveground works within Tai Lam Country Park and water gathering grounds	 Adopt suitable tunnelling method for alignment section across Tai Lam Country Park, such that no aboveground works within Tai Lam Country Park is required Adopt suitable engineering design during drill-and-blast tunnelling to avoid adverse impacts on the water gathering ground 	Avoided direct habitat loss and disturbance within Tai Lam Country Park

Design Approach	Key Design Considerations	Associated Environmental Benefits
Avoidance of direct impact on butterfly overwintering ground at Siu Lang Shui	 Maintain a sufficient separation distance from the butterfly overwintering ground at Siu Lang Shui from the proposed explosive magazine site at Pillar Point Minimize large scale of engineering works (e.g. site formation works) by selecting the proposed explosive magazine site at Pillar Point, which was substantially formed by previous projects 	 Avoided direct impacts on the butterfly overwintering ground Minimised temporary habitat loss through proper site selection
Avoidance of direct impacts to eastern patch of Ching Uk Tsuen Fung Shui Woodland (Fung Shui Woodland at So Kwun Wat)	 Elevate the vertical alignment near the eastern patch of Ching Uk Tsuen Fung Shui Woodland (CUTFSW) at So Kwun Wat to increase the headroom clearance as much as technically feasible Adjust the horizontal alignment to avoid overlapping with the eastern patch of CUTFSW as much as practicable Avoid columns and associated works areas within the CUTFSW Separate the northbound and southbound viaduct structures to provide a 7m separation between the viaduct structures, which would allow a longer duration of direct sunlight reaching the portion of the eastern patch of CUTFSW underneath 	 Avoided direct impacts on the eastern patch of CUTFSW Minimised disturbance to the Fung Shui Woodland
Minimization of disturbance to bat roosts	 Increase separation distances of the tunnel alignment Tai Lam Chung (TLC) Catchwater Tunnel Nos. 5, 6, and 8, which function as bat roosting grounds Adjust tunnel construction methodology (i.e. review explosive charge weight of drill-and-blast method and explore alternative tunnelling methods) in close vicinity of WSD tunnels with bat habitats 	 Avoided direct impacts on bat roosts in TLC Catchwater Tunnel Nos. 5, 6 and 8 Minimised disturbance to bat roosts inside TLC Catchwater Tunnel Nos. 5, 6 and 8
Avoidance of direct impacts on Sites of Archaeological Interest (SAI), Graded Buildings and Potential Marine Archaeology	 Avoid encroachment on SAI and graded buildings Adopt a viaduct for the section running across So Kwun Wat Perowne Barrick SAI and avoid temporary works areas within the SAI Avoid all the anomalies by allowing sufficient setback distance (around 50m) for marine ground investigation 	 Avoided direct impact on SAI and graded buildings Avoided direct impact on anomalies with unknown marine archaeological potential

Design Approach	Key Design Considerations	Associated Environmental Benefits
Avoidance of reclamation at To Kau Wan in North Lantau	Remove the original scheme of reclamation at To Kau Wan in North Lantau through optimization of Project alignment and engineering design	Avoided seabed loss at North Lantau, and the associated water quality impacts during the construction stage
Minimization of reclamation and dredging extents for the reclamation	Optimise the extents of reclamation and dredging for the reclamation in Tsing Lung Tau	Minimised construction phase water quality impacts at Tsing Lung Tau
in Tsing Lung Tau		Minimised the amount of sediment to be dredged and disposed
		Minimised the numbers of corals to be directly affected
Confinement of filling works within seawall for the reclamation in Tsing Lung Tau	Commence filling works upon the full completion of the perimeter seawall for the reclamation in Tsing Lung Tau	Minimised the possibility of fill materials and fine suspended solids from being discharged into the open sea in an unacceptable manner
Minimization of slope cutting	Minimise slope cutting through refinement of alignment of the Project	Minimised disruption and impacts to the landscape resources and characters
		Minimised the number of trees to be impacted
		Minimised loss of habitats, especially those of relatively higher ecological value, such as mixed woodland
		Minimised the amount of excavation spoil and construction waste generated

14.3 Estimated Population Protected from Various Environmental Impacts

14.3.1.1 Population and environmental sensitive areas in the vicinity of the Project site have been protected through the avoidance and/or minimisation of environmental impacts from the construction and operation of the Project. Population protected from air quality impacts include air sensitive receivers within 500m from the Project Boundary including residential buildings, commercial buildings, industrial

buildings, educational uses, recreational uses, places of public worship, and government/institutional or community uses. Population protected from noise impacts include noise sensitive receivers within 300m from the Project Boundary including residential buildings, educational uses, places of public worship, and government/institutional or community uses. Population protected from water quality impacts include water sensitive receivers within 500m from the Project Boundary.

14.4 Compensatory Woodland Planting Site

14.4.1.1 The permanent and temporary loss of mixed woodlands of low to medium ecological value due to the Project are about 17.54 ha and 6.54 ha respectively. The habitats to be temporarily affected would be reinstated to condition similar to predisturbed status upon completion of works as far as practicable. To compensate for the unavoidable permanent loss of mixed woodland due to the Project and temporary loss of mixed woodland cannot be reinstated with justification during the detailed design stage, provision of compensatory woodland in a ratio not less than 1:1 in terms of area should be carried out in accordance with the woodland compensation plan and tree compensation plan to be submitted in the detailed design stage. Areas in Tuen Mun West fulfilling the criteria above, are identified as potential compensatory woodland planting sites.

14.5 Environmental Benefits of Environmental Protection Measures Recommended

14.5.1.1 Mitigation measures/ good site practices/ enhancement measures have been recommended to further reduce the environmental impacts due to the construction and operation of the Project. Key recommended mitigation measures/ good site practices/ enhancement measures and their associated benefits are summarised in **Table 14.2** below. Details have been mentioned in technical assessment sections (Section 3 to Section 12).

Table 14.2 Key recommended mitigation measures/ good site practices/ enhancement measures and their associated benefits

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
Air Quality	 Adopt dedicated spoil transportation routes away from the identified Air Sensitive Receivers (ASRs) as practicable Install 3-sided screen with top cover and provide 	 Protect ASRs by reducing fugitive dust generation and emissions
	water sprays at the unloading point to barges at the barging facility	• Ensure compliance with the
	Avoid using exempted NRMM as much as practicable and when alternatives are available from the local market at the time of construction	requirements in Annex 4 of the EIAO-TM at the ASRs
	• Site hoardings of not less than 2.4m high should be provided as far as practicable along the site boundary with provision for public crossing.	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	Taller site hoardings may be considered for ASRs in close vicinity to the site boundary, subject to actual site constrains and detailed design. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period	
	Adopt water spraying system for areas with heavy construction activities	
	Connect construction plant and equipment to mains electricity supply, and avoid use of diesel generators and diesel-powered equipment as far as practicable to minimize air quality impact arising from construction machinery	
	Close the impermeable blast covers at tunnel portals prior to blasting works in order to ensure blasting works in a fully enclosed environment	
	Water spray before open blasting and on blasted material prior to transportation	
	Provide vehicle washing facilities at the exit of the barging facility and exit of works sites	
	• The engine of the barge shall be switched-off during berthing as far as practicable. Provision of on-shore power supply shall also be considered wherever possible to minimize air quality impact from the marine vessels, with consideration of actual site constraints or circumstances to be further reviewed during detail design stage	
	• Follow the requirements stipulated in the Best Practicable Means for Cement Works (Concrete Batching Plant) BPM 3/2 (16) to minimise the fugitive emissions arising from the operation of concrete batching plants	
	Provide special mitigation measures for the filling work above mean sea level at the reclamation site in Tsing Lung Tau, including shotcreting, water spraying or covering with impermeable sheet for effective dust control	
	Close liaison between the contractors of other concurrent projects and the Project would be maintained to minimise dusty activities to be conducted concurrently as far as practicable	
	During the subsequent design stage and the operational stage, the ventilation engineer should	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	conduct reviews on the ventilation scheme covering different periods of a day, taking into account the contemporary circumstance such as latest traffic forecast, traffic composition, update on the ambient air quality etc, and then review and update the air quality assessment as necessary to demonstrate full compliance of the AQO. These reviews would allow the designer and operator to optimize the operation of the ventilation system without compromising the compliance of AQO • The planned air sensitive uses within the operation area of the TMB shall be properly designed such that any openings, openable windows, and/or fresh air intakes will be located and avoided from the predicted exceedance zone at 1.5mAG. Further review of the layout and design of operation area will be conducted in Detailed Design Stage to ensure compliance of the AQOs	
Noise	 Follow good site practices to limit construction noise emissions at the sources Use of quality powered mechanical equipments 	Protect NSRs by reducing construction, road
	and quieter construction methods	traffic and fixed noise impacts
	Use of temporary noise barriers and enclosures to screen noise from relatively static PMEs	• Ensure compliance with the respective
	Install acoustic tunnel door or enclosure at the tunnel portal opening for tunnelling activities	road traffic noise requirements at neighbouring NSRs
	Provide at-source road traffic noise mitigation measures (e.g. vertical and cantilevered noise barrier, semi-enclosures and low noise road surfacing)	Ensure compliance with the respective fixed noise requirements at
	Provide mitigation measures for fixed noise sources (e.g. quieter equipment, silencer, barrier and enclosure) with reference to EPD's "Good Practices on Ventilation System Noise Control"	neighbouring NSRs
	Orientate louvres away from adjacent NSRs, preferably onto main roads which are less noise sensitive	
	Select façade for ventilation shafts with adequate sound insulation properties	
Water Quality	Deploy single layer silt curtain during the dredging activities and construction of mud pit	Protect the neighbouring WSRs during construction
	Follow Best Management Practices (BMPs) of mitigation measures in controlling water pollution and good site management as specified in the	and operational phases

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	ProPECC PN 1/94 "Construction Site Drainage" and Environment, Transport and Works Bureau (ETWB) Technical Circular (Works) (TC(W)) No. 5/2005	
	Adopt suitable water control strategies as far as practicable, including probing ahead, pre-grouting and post-grouting, during tunnelling works	
	Control impact on groundwater through adopting toe grouting and installation of recharge well during temporary dewatering for excavation works	
	Provide adequate and sufficient portable chemical toilets for construction workforce and temporary storage tank for collection of wastewater	
	Comply with the Conditions for Working within Water Gathering Grounds	
	Carry out construction works close to inland waters in dry season as far as practicable	
	Conduct watercourse removal and flow diversion in dry season as far as practicable	
	Size all vessels to maintain adequate clearance between vessels and the seabed in all tide levels	
	Control loading of barges and hoppers to prevent splashing of materials into the surrounding water	
	Conduct filling works behind the seawall for the reclamation in Tsing Lung Tau	
	Implement the mitigation measures recommended for control of suspended solids release	
	Install and maintain roadside gullies and oil / grease interceptors for removal of pollutants from storm water as necessary	
	Collect and treat wastewater generated by washing and maintenance activities, and discharge to public sewerage system properly	
Waste Management	Carry out on-site sorting of construction and demolition (C&D) material	• Minimize waste generation
	Make provisions in the contract documents to allow and promote the use of recycled aggregates where appropriate	• Ensure proper handling of chemical waste
	Implement a trip-ticket system for each works contract in accordance with Development Bureau	• Ensure the C&D materials are

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	TC(W) No. 6/2010 to ensure that the disposal of C&D materials is properly documented and verified	disposed to designated sites
	• Apply for a designated disposal ground for incorporation into the Contract documents in accordance with Development Bureau TC(W) No. 6/2010 where necessary, if inert C&D materials of the Project are expected to dispose to public fill reception facilities	
	Adopt good waste management and control practices to avoid generation of excessive amount of waste materials	
	Maximize the reuse/recycle of C&D materials as far as practicable	
	Employ waste collectors for disposal of general refuse to prevent potential nuisance caused by mistreating general refuse, such as windblown, vermin, water pollution and visual impact	
	Employ licensed chemical waste collectors for collecting chemical waste	
	Adopt good management practices for handling and disposal of marine sediment at dedicated marine disposal sites	
	Equip GPS or equivalent system at all dump trucks /dump vessels engaged on site for delivery of inert C&D materials from the site to Public Fill Reception Facilities / marine sediment from site to designated dumping site	
	Conduct regular inspection, monitoring, collection and disposal of floating waste by the Contractor	
Land Contamination	Recommend site re-appraisal for the whole project areas to assess the latest site situation prior to the commencement of the construction	Ensure any new changes in operation or land use activities that might cause land contamination issue could be addressed after the agreement of the Land Contamination Review but before commencement of the construction

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
Hazard to Life	Reduce the amount of combustibles in the cabin of truck. The fuel carried in the fuel tank should also be minimized to reduce the duration of any fire	Protect nearby sensitive receivers from adverse impacts due to transportation, overnight storage
	Implement defensive driving attitude and dedicate training programme for both driver and his attendants	and use of explosive for blasting
	Transport the required quantity of explosive for a particular blast	
	Combine explosive deliveries for a given work area as far as practicable	
	Maintain a minimum headway between two consecutive truck convoys of 10 minutes whenever practicable	
	• Implement a better emergency response and training to ensure adequate fire extinguishers are used and attempt is made to evacuate the area of the incident or securing the explosive load if possible	
	Equip bigger capacity AFFF-type extinguishers on all explosive vehicles	
	• Implement good practices as per Practice Note for Authorized Persons and Registered Structural Engineers – Control of Blasting (APP-72), and Mines Division Guidance Note Nos. GN 8 How to Apply for a Mode A Licence for Storage of Schedule 1 Dangerous Goods (Blasting Explosives) and GN 3 Application and Handling of a Conveyance Permit	
	• Formulate a Hazard Management Plan with a view to aligning the understanding of the risk of the three projects (i.e. Route 11 (R11), Tuen Mun Bypass (TMB) and Lam Tei Underground Quarrying (LTUQ)) so that all the working populations at Lam Tei Quarry area, which includes the workforce induced under the construction and operational stage of three projects, could be considered as on-site populations in the QRA for all the three projects. The measures stipulated in the Hazard Management Plan may include, but not limited to, the adjustment of the blasting schedules of the three projects to minimize the potential cumulative impact, provision of common trainings and drills to the workforce of all the three projects, etc. The Hazard Management Plan,	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	which would be agreed among the three projects, would be submitted to EPD for agreement prior to the tender invitation of construction phases of R11, TMB and LTUQ, whichever is earlier.	
Ecology	 Avoid direct impact to recognized sites of conservation importance, important habitats and roosting grounds Avoid reclamation in North Lantau Minimize habitat loss through adopting tunnel design of alignment, refinement of alignment to minimize slope cutting, maximizing haul road extent overlapping with the main alignment as far as possible and minimizing reclamation footprint in Tsing Lung Tau Minimize habitat fragmentation by adopting tunnelling design and maximizing the haul road extent overlapping with the main alignment Minimize risk of direct injury/mortality to species of conservation importance Minimize risk of potential bird collision with noise barriers using tinted materials and superimposing dark patterns or strips on noise barriers Minimize shading impact on the eastern patch of Ching Uk Tsuen Fung Shui Woodland by maximizing the gradient of the alignment to elevate the viaduct and leaving a 7-metre gap between the dual 2-lane carriageway Minimize light glare impact by adjusting artificial lighting away from natural habitats and minimizing unnecessary lighting Minimize water quality impacts by implementing the recommended practices during construction and operational phases under water quality section Minimize indirect disturbance through confining the works within site boundary and adopting other good site practices during construction phase under air quality and noise section Minimize groundwater infiltration by adopting water control strategies in the water quality section 	 Avoid direct impacts on the aboveground habitats in Tai Lam Country Park Avoid direct impacts and minimize indirect impacts during construction phase and operational phase

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	Minimize site runoff by adopting the best practices detailed in water quality section	
	Reinstate the areas to be temporarily affected to condition similar to pre-disturbed status through replanting as far as practicable	
	Minimize ground-borne vibration disturbance to bat roost through integrated approach (controlling charge weight of blasting and continuous monitoring) and continuous adaptive review	
	• Divert sections of watercourses W4, W22, W23 and W24 to be directly impacted	
	Provide green channel design for watercourses with comparatively higher ecological value and to be directly impacted	
	Compensate the loss of mixed woodland through off-site compensatory woodland planting	
	Conduct detailed vegetation survey prior to construction and submit a detailed transplantation plan in the detailed design stage	
	Preserve, transplant and/or provide compensatory planting of plant species of conservation importance, preferably on-site preservation as far as practicable	
	Conduct pre-construction survey of aquatic and water-dependent fauna species of conservation importance at the watercourses to be directly impacted, including but not limited to Hong Kong Cascade Frog, and submit translocation plan where necessary	
	Conduct detailed pre-construction reconnaissance dive survey along the artificial rocky shore along the Tsing Lung Tau shoreline within the reclamation site of Tsing Lung Tau prior to construction, and review the effectiveness and feasibility of coral translocation	
	Adopt ecological enhancement feature on seawall to enhance the recruitment and colonization of intertidal and subtidal fauna onto the hard substrate surface	
	Regular site inspections to ensure compliance of the recommended mitigation measures	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
Fisheries	Implement the recommended mitigation measures and practices during construction and operational phases under water quality section	Minimize the direct and indirect fisheries impacts during construction and operational phase
Landscape and Visual	Adopt mitigation measures such as tree preservation, tree transplanting, landscape reinstatement, provision of decorative site hoarding, optimization of construction area and lighting control should be adopted during the construction phase	Minimize landscape and visual impacts during construction and operational phases
	Undertake regular site environmental inspections during the construction period to ensure that the mitigation measures recommended in the EIA Report and EM&A Manual are properly implemented by the Contractor	
	• Integrate mitigation measures to be implemented, such as compensatory tree planting, post-planting monitoring, greening works on slopes and associated structures, design of tunnel portals and landscape treatment, design of an elegant bridge structure and approach roads, provision of visually pleasing aesthetic treatment of noise mitigation measures and provision of green roof at buildings as appropriate	
Cultural Heritage	 Conduct field scan, test pits and auger tests at the east of Area A at the lower slopes to the north of Lam Tei Quarry when access is available Suspend the works when antiquities / supposed antiquities, or buildings / structures both at-grade and underground with potential heritage value that would likely be affected by the development are identified during construction works, and the project proponent shall notify AMO immediately for discussion of appropriate mitigation measures to be agreed by AMO before implementation by the project proponent to the satisfaction of AMO 	Verify the presence of any archaeology remains and identify measures if necessary prior to construction
	Any vibration and building movement induced from the construction works should be strictly monitored to ensure no disturbance and physical damages made to the heritage site during the course of works	
	Monitoring proposal for the heritage sites, including checkpoint locations, installation details, response actions for each of the Alert/Alarm/ Action (3As) levels and frequency of	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	monitoring should be submitted for AMO's consideration	
	Conduct a condition survey on Former Perowne Barracks, Gurkha Temple by qualified building surveyor or engineer prior to and after construction phase. The Condition Survey Report shall be submitted to AMO	
	Conduct vibration monitoring for Former Perowne Barracks, Gurkha Temple during construction phase to ensure safe level of vibration will not be exceeded	
	Provide buffer zone of at least 5m to separate the Former Perowne Barracks, Gurkha Temple building from construction works	
	Special attention should be paid to avoid adverse physical impact arising from the construction of the Project to the heritage site. Design proposal, method of works and choice of machinery will be targeted to minimize adverse impacts to the heritage site	
	• Foundation information of the historic structure shall be verified on site if needed, sufficient lateral support should be provided and de-watering (if required) should be carried out with great cautions to control ground movement and change of ground water regime at the heritage site	
	Conduct marine diver survey during the detailed design stage when fencing off of the diving area can be safely implemented but prior to any reclamation works. Should there be any marine archaeological resources identified during the MAI, proper mitigation measures including but not limited to rescue excavation shall be proposed for agreement with AMO before the commencement of reclamation works	
	• The marine ground investigation works (GI) shall be arranged to avoid all the anomalies identified by geophysical survey conducted, by allowing sufficient setback distance (around 50m) from the anomalies. In case of discovery of any antiquities or supposed antiquities in the course of marine GI works, the project proponent is required to inform AMO immediately for discussion of appropriate mitigation measures to be agreed by AMO before implementation by the project proponent to the satisfaction of AMO. Besides, any GI at the anomalies is required to be conducted after	

Aspect	Key Recommended Mitigation Measures/ Good Site Practices/ Enhancement Measures	Associated Environmental Benefits
	confirming their nature by MAI and seeking agreement with AMO	
General	 Implement a comprehensive Environmental Monitoring System throughout the entire construction and the initial operational stages Employ an Environmental Team (ET) and Independent Environmental Checker (IEC) 	Ensure compliance with all statutory requirements and those recommendations in the EIA report