16 Summary of Environmental Outcomes

16.1 Overview

This chapter summarises the overall environmental outcome due to the development of LMC Loop in accordance with Section 3.4.19 of the EIA Study Brief. With the vision to develop the LMC Loop as a hub for cross boundary human resources development within a sustainable Knowledge and Technology Exchange Zone, the Revised PLP and supporting infrastructure have been prepared to achieve economic, social and environmental sustainability. In terms of environmental quality, the Revised PLP would provide an Ecological Area and extensive open space as well as activity/amenity corridor. With the implementation of the proposed environmental measures, adverse environmental impacts arising from the Project are not anticipated.

16.2 Population and Environmental Sensitive Areas Protected

16.2.1 Affected Population (Existing and Planned) along the Project

According to the development parameters, the estimated total number of workers and students for the LMC Loop is approximately 53,000, based on a Gross Floor Area (GFA) and overall plot ratio of 1,200,000m^2 and 1.37 which includes higher education, high-tech R&D facilities, cultural and creative industries and supporting commercial usage at full operation. Higher education would occupy 60% of the total GFA, while the remaining GFA is distributed amongst other land uses including hi-tech R&D facilities, cultural and creative industries, supporting commercial, possible boundary crossing facilities, other government uses and ancillary offices. The provision of open space, amenity area, and an ecological area has been considered in the Revised PLP.

In order to serve the development in LMC Loop, external transport infrastructure to MTR LMC Station, existing San Tin Highway, and future Kwu Tung North NDA were proposed. The alignment will affect to various extents the existing residents in Chau Tau Tsuen, Ha Wan Fisherman San Tsuen, Ha Wan Tsuen, Ma Tso Lung and Pun Uk Tsuen.

To minimize the potential environmental nuisance during construction phase, phasing of construction programme is proposed in order to minimize the nuisance to nearby villages. Good site practices for air quality, noise and water quality were fully considered. In operational phase, central air conditioning system for the first layer of noise sensitive receivers facing internal Road M1 and noise barriers alongside the ECR and WCR were proposed so as to minimise the nuisance. In addition, all buildings with central air conditioning in the development will be equipped with an odour removal system capable of 95% removal efficiency.

16.2.2 Wetlands in Deep Bay

The major environmental sensitive areas near the Project include the wetlands in Deep Bay such as reed marsh inside LMC Loop, Hoo Hok Wai, the Meander, Wetland Conservation and Buffer Areas, LMC Spur Line Mitigation Area, riparian corridor at Ma Tso Lung, Ho Sheung Heung egretry, Mai Po and Futian National Nature Reserve.

A wetland compensation programme will be implemented. The establishment of compensated wetlands will commence during the advance works stage, prior to major construction works. An Ecological Area at the south of LMC Loop adjacent to the Meander, which locates at the major flight lines, will be provided to compensate for the direct loss of reedbeds within LMC Loop. For the direct loss and indirect disturbance outside LMC Loop, off-site compensation will be implemented in San Tin and Hoo Hok Wai.

16.3 Key Assessment Assumptions and Limitation of Assessment Methodologies

In accordance with Clause 3.4.17 of the EIA Study Brief, the key assessment assumptions and limitation of assessment methodologies are presented in **Appendix 16-1**.

16.4 Impacts Summary

In accordance with Clause 3.4.18 of the EIA Study Brief, the impact summary showing the assessment points, results of impact predictions, relevant standards or criteria, extents of exceedances predicted, impact avoidance measures considered, mitigation measures proposed and residual impacts (after mitigation) forms an essential part of the Executive Summary and is presented in **Appendix 16-2**.

16.5 Environmentally Friendly Design and Benefit

16.5.1 Optimum Design for External Connections

16.5.1.1 Western Connection Road

The design of WCR involved the possible utilisation of the existing LMC Road and Ha Wan Tsuen Road, which will have relatively low impact on environment, and comprises few construction issues. Furthermore, as this scheme does not directly pass through the existing villages, land encroachment issue is not expected to be significant.

16.5.1.2 Eastern Connection Road

The design of ECR is intended to minimise the ecological disruptions by designing a section of the carriageway at below-ground level, while eliminating the drawbacks/constraints generated by deep tunnel configurations.

Apart from the depressed road/shallow underpass across the Meander and elevated road section across existing streams, the entire route will be at-grade road

and it could prevent disturbance to flight paths of birds. Adequate mammal crossing will be provided along Horn Hill.

The road will pass through the fish ponds as a depressed road and crosses the Meander as a shallow underpass configuration. The underpass section is 200m in length and it avoids the need of a full tunnel design and could also maintain a 2-way single carriageway configuration, which avoids overdesign. Furthermore, as the road level of the underpass level is only -9mPD, the need for a long approach ramp will be eliminated, thus allowing a better interface with the internal road network and public transport services. The depressed road will mean some ecological disturbance during the operational phase, which could be greatly reduced by the use of low level shrubs and trees on both sides to serve as visual barrier to the depressed road. Furthermore, animal overpass above the depressed road would be provided to maintain connectivity for terrestrial mammals.

16.5.1.3 Direct Link to LMC Station

The alignment of the Direct Link have been designed to follow the existing railway reserve of the LMC Spur Line as far as possible to minimise adding ecological impact to the existing fish ponds and to stay away from the existing New Boundary Patrol Road to reduce the security impact.

In the sections crossing the reedbeds within LMC Station, the piers of viaducts will be located at bunds in order to avoid permanent reedbed loss.

From environmental point of view, the Direct Link will connect to the proposed WCR. There will be no additional structures above the Meander and hence reduce the environmental nuisances.

16.5.2 Ecological Area

In LMC Loop, an Ecological Area that includes a large area of reprovisioned reed marsh will be created prior to the commencement of major construction. The provision of a purpose-built area of compensatory reed marsh habitat facilitates more effective ecological enhancement through targeted design and avoidance of the fragmentation and disturbance impacts that might result if it was partially surrounded by development. A buffer distance of 50m between it and the developed area is also recommended. The interface of the buffer and reedbed, as well as the buffer itself, will largely comprise tree species of ecological benefit that will act as a visual buffer against human activity in this zone. The buffer zone provides an excellent opportunity to increase the wildlife value of LMC Loop post-development, via the provision of native tree species and/or established exotics with existing wildlife value. Albeit not considered essential from an ecological point of view, such provision will also compensate for the loss of existing trees in LMC Loop.

16.5.3 Provisions for Re-use of Treated Sewage Effluent

In order to formulate a comprehensive plan for developing a sustainable, environmentally friendly, energy efficient and people oriented community in the LMC Loop, technical guidelines on the green initiatives for the development of the LMC Loop have been proposed.

One of the major green initiatives proposals will be the re-use of Treated Sewage Effluent (TSE) from the on-site STW. The TSE could be used for non-potable water uses such as flushing, make-up water for District Cooling System (DCS) and irrigation in the LMC Loop. It could enhance the efficiency of energy infrastructure of the LMC Loop. Such system would reduce potable water consumption, encourage cost-effective use of TSE and minimise pollution loads to the Deep Bay.

16.5.4 Odour Control Devices for On-site STW

Odour control devices will be installed to reduce the odour emissions from the proposed STW for the LMC Loop. The required odour removal efficiency should be at least 95%. To tackle the cumulative odour impact due to Shenzhen River, the project proponent will undertake to implement bioremediation of 98% odour removal efficiency along a section of Shenzhen River. As a residual mitigation measure, all buildings with central air conditioning in the development will be equipped with an odour removal system capable of 95% removal efficiency. With the odour removal system in place, the odour criterion will be met inside all internal spaces.

16.5.5 Centralized Air Ventilation

In order to tackle the traffic noise impact within the LMC Loop during operational phase, the first layer of noise sensitive receivers building facing Road M1 (i.e. Education and OU R&D/C&C zones) will provide air conditioning with ventilation system.

16.5.6 Building Height Profiles and Amenity/Activity Corridor

An optimum GFA is 1.2Mm^2 and the plot ratio will then be 1.37. The low-rise building will be placed at the south and east of LMC Loop to minimize the impact to flight lines and EA. Tallest building will be located at west and centre of LMC Loop, which is of less ecological sensitivity. The tallest buildings will be approximately 12 storeys (about 54 mPD).

The location of amenity/activity corridor is designed in light of the proposal in Shenzhen. A continued wind corridor from Shenzhen to Hong Kong is also provided.

16.5.7 Green Initiatives

To promote low carbon and green community, a number of green initiatives such as the environmentally friendly transport system, district cooling system and on-site sewage treatment works with effluent recycling for flushing, irrigation and make-up water for DCS were formulated as recommended technical guidelines for future developers' considerations. The implementation of these green initiatives will be subject to separate EIA studies (if identified as DPs) and engineering findings during detailed design stage.

Green initiatives for different themes including urban design and planning, green infrastructure, transport and logistics, energy, water, waste and materials that are applicable at both district and building levels are listed in the **Table 16.1** below.

Table 16.1 Green initiatives at district and building levels

Themes		Green Initiatives
District Level		
Urban Design and Planning		Avoiding urban heat island effect.
		Creating a successful public space network.
		Improving street design and layout.
		Providing comfortable internal conditions.
Green Infrastructure		Integrating green space into urban areas.
		Protecting established wildlife habitats and using green spaces as wildlife habitats.
Transport and Logistics		Making a low-emission and car-free zone.
		Encouraging low carbon vehicle technologies and fuels.
		Promotion of walking and cycling.
Energy		Adopting district cooling system (Fresh Water Cooling Tower System using treated sewage effluent as Heat rejection) subject to further study.
		Selecting low carbon and renewable technologies.
		Improving building energy efficiency.
		Creating opportunities for new patterns of ownership of energy delivery system.
Water		Adopting water recycle strategies - Treated Sewage Effluent (TSE).
		Designing for sustainable water use.
		Integrating sustainable drainage systems into planning and design.
Waste		Formulating waste reduction strategies.
		Devising waste collection strategies.
		Integrating waste infrastructure.
		Exploring community waste management.
Materials		Selecting materials with lowest environmental impacts.
		Selecting materials from local/regional sources.
		Selecting materials from sustainable sources.
		Selecting materials with high recycled content.
Building Level		
Renewable Energy		Solar hot water.
		Photovoltaics (PV).
Building Energy Efficiency	Passive Design	Proper building orientation.
		Daylighting.
		High performance facade. Vertical Shading. High thermal insulation performance glass. Use of automated blinds.
		Optimal window to wall ratio.
		Thermal mass.
		Improved air-tightness.
	Active Design	Energy Efficient Lighting System. High efficiency lighting fixtures. Lighting control.

Themes		Green Initiatives
		Energy efficient ventilation system. Hybrid ventilation. Demand control ventilation.
		Energy efficient air-conditioning system. Heat recovery. Free cooling. Equipment with Variable Speed Drives (VSDs).
		High efficiency lifts and escalators. Variable voltage variable frequency (VVVF) drives. Group selective collective control.
	Behavioural Change	Higher indoor set-point temperature.
		High efficiency electrical appliances.
Water Efficient Fixtures		Low volume/ dual flush water closets.
		Low flow urinal with sensor control.
		Automatic control of taps and toilet flushing faucets with infrared sensors.
		Water Efficient Irrigation System.
Waste Reduction (Operational Phase)		Recycling Bins System (for paper, metals, plastics, fluorescent lamps, glass, toner cartridges, rechargeable battery, scrap electrical and electronic appliances, etc.). Turning food waste into eco-fertilizer.

The greatest environmental benefits will come from the carbon reduction by improvement of Building Energy Efficiency, followed by Energy Infrastructure (District Cooling System) and Renewable Energy (Solar Hot Water System and Photovoltaic). The actual carbon savings achievement by those initiatives related to Building Energy Efficiency and Renewable Energy are subject to the extent of application by the building developers / owners, as well as the environmental awareness of the future occupants.

16.6 Summary of Measures Adopted to Avoid and Minimize Environmental Impacts

The various chapters of this EIA Report have presented key measures to minimise the potential environmental impacts associated with the Project in the planning, design, construction and operational stages. Key measures to minimise the environmental impacts are summarised below.

16.6.1 Consideration of Development Options

More than 90% of the proposed development will involve Higher Education, High-tech R&D and C&C Industries. Compared with other options such as industrial and commercial uses, adverse environmental impact in terms of night time noise, glare and vehicular emission due to night time operations could be avoided.

In particular, no industrial use is proposed in the Revised PLP and thus there will be no chimney emissions and impact to residential uses including those nearby villages and hostels with the LMC Loop.

16.6.2 Route Selection of External Connections

Minimising environmental impacts has been one of the key design objectives throughout the planning and design process. Where practicable, protection of environmental sensitive areas has been considered. **Sections 16.2 and 16.5** have described the population and environmental sensitive areas protected, and the environmental friendly design adopted. A summary of these is given below:

- Minimize the WCR footprint by possible utilisation of existing roads such as LMC Road and Ha Wan Tsuen Road (**Section 16.5.1.1**).
- Use of depressed road/shallow underpass across the fishponds and Meander for ECR so as to prevent fragmentation of wetland and disturbance to bird flight paths (**Section 16.5.1.2**).
- Optimize the alignment of the Direct Link to LMC Station to follow the existing railway reserve of the LMC Spur Line to minimise the ecological impact (**Section 16.5.1.3**).

16.6.3 Phasing of Implementation

In order to minimize the environmental nuisance during construction phase, the Project will be implemented in phases. In general, all the construction and operation will be divided into 2 phases. In addition, in order to maintain the ecological values of wetlands, all the ecological compensation such as fishponds provisions and EA establishment will be conducted prior to infrastructures. **Table 16.2** summarises the phasing of implementation.

Table 16.2 Summary of implementation programme

Phasing	Description of Work	Time Line
Advance Works	Fishpond compensation	Late 2013/Early 2014 – 2015
	Land de-contaminations	
	Establishment of Ecological Area (DP1)	
Phase 1 Infrastructures	Site formations works	2015 – 2020
	Land reserve of boundary crossing facilities	
	Western Connection Road including the connections between LMC Road and Fanling/San Tin Highway (DP2)	
	Direct Link to Lok Ma Chau Station (DP3)	
	Drainage System under Internal Transport Networks (DP4)	
	Sewage Treatment Works (DP5)	
	District Cooling System (Western)	
	Bio-remediation	
	Landscaping Works at Open Spaces	
Phase 1 Buildings	Construction and operation of Phase 1 Buildings	Construction: 2016 to 2020 / Operation: 2020
	Construction and operation of fire station cum ambulance depot	
Phase 2 Infrastructures	District Cooling System (Eastern)	2021 - 2027
	Eastern Connection Road (DP6)	

Phasing	Description of Work	Time Line
	Flush Water Service Reservoir (DP7)	
	Landscaping Works at Open Spaces	
Phase 2 Buildings (Full Operation)	Construction and operation of Phase 2 Buildings	Construction: 2024 to 2027 / Operation: 2027

16.6.4 Construction Dust

During construction phase, watering 8 times per day to all exposed area will be implemented. 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 extended 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.

16.6.5 Odour

Odour control devices will be installed to reduce the odour emissions from the proposed STW for the LMC Loop. The required odour removal efficiency should be at least 95% (**Section 15.4.3**).

Bioremediation for odour removal will take place at the Shenzhen River section adjacent to the LMC Loop development. Indicator of odour level, in terms of AVS and Redox, at Shenzhen River will be monitored during operational phase. In case of any non-compliance with the criteria for residual AVS or redox potential in sediment, increase in chemical dosage frequency during

bioremediation works will be undertaken to prevent the recurrence of odour impact from Shenzhen River.

16.6.6 Construction Noise

The following mitigation measures have been considered to tackle the construction noise impact:

- Good site practices to limit noise emissions at the source;
- Use of quiet plant and working methods;
- Use of site hoarding as noise barrier to screen noise at ground level of NSRs;
- Use of temporary noise barriers to screen noise from relatively static PMEs;
- Scheduling of construction works outside school examination periods in critical area;
- Alternative use of plant items within one worksite, wherever practicable;
- Use of temporary noise barriers to screen noise from construction vehicles accessing LMC Loop; and
- Operation of concrete lorry mixer approximately 25m away from the existing NSRs along Lok Ma Chau Road, Ha Wan Tsuen Road and planned NSRs at eco-lodge along Border Road.

16.6.7 Road Traffic Noise

In order to tackle the future road traffic noise impact from the ECR and WCR, the following mitigation measures were proposed:

- Noise barrier; and
- Provision of centralised air conditioning at the first layer of buildings of Road M1.

16.6.8 Water Quality

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. Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94) should be fully implemented.

During the construction of ECR, proper site drainage system with adequate silt removal facilities should be deployed in order to prevent polluted runoff discharged to the Ma Tso Lung Nullah and the Meander. A discharge license should be obtained from EPD prior to any site runoff discharge.

The construction works of underpass construction should be conducted during dry season to prevent excess stormwater runoff to the Meander. Cofferdams or diaphragm walls should be deployed to fully separate the works and the river waters.

16.6.9 Sewerage and Sewage

An on-site STW will be constructed to collect and treat the sewerage from both LMC Loop and the nearby villages. Membrane Bio-reactor will be used for the on-site STW. Off-site compensation at SWHSTW for BOD_5, SS, TKN, NH_3-N and *E. coli* loading will be undertaken to comply with the "no net increase in pollution loading in Deep Bay" policy will be complied.

16.6.10 Waste Management

The amount of C&D material that would need to be transported off site has been minimized as far as practicable in the implementation programme. Opportunity of re-using C&D material has been fully considered and implemented where practicable. Good site practices have been recommended for chemical waste, general refuse and disposal of chemical waste will follow the relevant ordinances.

16.6.11 Land Contamination

The volume of contaminated soil to be treated is tentatively estimated at 57,444m^3 for LMC Loop. The remediation action plan and specification for remediation works is detailed in the endorsed Remediation Action Plan (RAP).

No potentially contaminated site was identified within the contamination assessment area for the associated infrastructure in the adjacent areas in Hong Kong outside the LMC Loop. Re-appraisal on the LMC Loop and the entire contamination assessment area for the associated infrastructure in the adjacent areas in Hong Kong outside Lok Ma Chau Loop would be required to ensure any potential contamination activities from land use changes after the approval of this land contamination assessment study, subject to a proper updating review prior to commencement of the construction works. Where re-appraisal or re-assessment is required, the PP would prepare and submit the Supplementary CAP to EPD prior to the commencement of SI works. Following on from the submission of CAP and completion of SI, the PP would prepare a CAR, a RAP and a RR and submit to EPD for agreement prior to commencement of the works on the development.

16.6.12 Cultural Heritage

No major direct and indirect impact to sites of cultural heritage is anticipated. The only potential impacts from the Project are the indirect visual impact on the built heritage near LMC Loop and Western Connection Road from its surrounding development but it can be mitigated by providing plant screening.

16.6.13 Landscape and Visual

The design of the proposed building structures and road connections networks will incorporate design features as part of visual mitigation measures including integrated design approach, building massing, treatment of built structures,

responsive finishes for the proposed structures, incorporation of the form of greening measures, and innovative architectural design.

The design of noise barrier will reduce the visual effect of the structure through the use of form, materials, textures and colours.

Trees and vegetation will be reinstated below or adjacent to the structures. Planting will be used wherever possible to minimise the apparent height of structures and to soften their appearance in medium and long distance views.

The design of the viaduct will avoid unnecessary visual clutter, this will be achieved through the co-ordination of the various engineering disciplines involved to arrive at innovative design solutions. For example, the location of columns of viaduct should not block any views from VSRs in the proximity and the shape of column should be slimmed down as far as technically feasible to reduce the structural mass at street level, at where space is allowed planting area for shade tolerant tree, shrub and climber species would be provided at the base of the column to soften the vertical emphasis at street level.

16.6.14 Ecology

A wetland compensation programme will be implemented. An Ecological Area will be created to compensate for the direct loss of reedbeds within LMC Loop (**Section 16.4.2**). The fishponds, marshlands, reedbeds and woodland outside LMC Loop will be compensated offsite in San Tin and Hoo Hok Wai.

All the ecological compensation will be established prior to major construction works in order to avoid loss of net ecological value.

16.6.15 Food Safety

A contingency plan was established for food safety implication due to fish consumption from nearby fishponds. An effective communication channel with Food and Environmental Hygiene Department (FEHD) / Centre of Food Safety (CFS) will be set up on food surveillance and food incidents. If pond fish samples do not comply with food safety standards during the food surveillance programme by CFS, fish selling shall be stopped as instructed by CFS.