

## 16. CONCLUSION AND RECOMMENDATIONS

### 16.1 Introduction

16.1.1 The surface runoff falling within the northern catchments of Hong Kong Island are being intercepted by a series of existing drainage culverts running through the urban areas that ultimately discharge into Victoria Harbour. The system is already overloaded and flooding can occur in extreme conditions. However, much of the catchment<sup>1</sup> is outside the urban area and the objective of the drainage improvement scheme studied here is to intercept surface water before it enters the urban area and direct it to an outfall on the west-side of Hong Kong Island. This will reduce the flows in the lower catchment and reduce flooding frequency in the urban area.

16.1.2 DSD (Drainage Services Department) commissioned the Northern Hong Kong Island Drainage Master Plan (DMP) Study in 1996 to assess the existing drainage systems. The Study area covers about 30 km<sup>2</sup>, comprising 16 districts from Kennedy Town in the West to Siu Sai Wan in the East, with a population in excess of one million (Figure 16.1). Many of the existing drainage systems in the lower catchment are situated in major residential and commercial districts, warranting a high standard of flood protection to mitigate against major financial losses and disruption to the public. To avoid flooding and meet the increasing expectations for higher flood protection standards in the northern Hong Kong Island, this Designated Project (DP) was recommended to collect storm runoff in the upper reaches of the catchment and to divert this flow away from developed area, where underground and above ground infrastructure abound.

16.1.3 The EIA report has provided an assessment of the potential environmental impacts associated with the construction and operation of the Project. Study has been undertaken in accordance with EIAO-TM and the Study Brief. The Implementation Schedules of the recommendations are present in Appendix J to this report. The principal findings of this Report are summarised in the following sections.

### 16.2 Water Quality

#### *Construction Phase*

16.2.1 During the construction phase, it was determined that minor and short term impacts to water quality could arise directly from land-based construction works. These works relate to excavation of drainage tunnel and construction of intake structures, construction of the stilling basin at the Western Portal, the construction of a temporary pier at the Western Portal and the placement of rock armour units on the existing seabed. No direct construction runoff is expected. Impact may result from the surface runoff and sewage from on-site construction workers. The impacts could be controlled to comply with WPCO standards by implementing the recommended mitigation measures which would provide a series of good site management options to minimise the impact of stormwater runoff. For the construction of stilling basin, temporary pier and armor rock panel at the outfall of the Western Portal, adverse impact on water quality after implementation of preventive measures is not expected.

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<sup>1</sup> The catchment is enclosed by the ridgelines running between Jardines Lookout in the east through Mount Butler, Mount Cameron, Mount Gough and the Peak.

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**Operation Phase**

- 16.2.2 An assessment of water quality impact due to the operation of the Project was made using the Delft3D-Flow and Delft3D-PART models. With these quantitative modelling tools, impacts were assessed for different rainstorm and tide level scenarios during the wet season. Discharge at the western portal outfall will only occur during rainstorm events. The modelling results indicate that the predicted concentrations of SS, *E. coli* and fresh water salinity would satisfy the Water Quality Objectives (WQOs)/ambient water quality for 1 in 2 and 1 in 50 years rain storm events for all identified ecological sensitive sites (corals) and fish culture zones.
- 16.2.3 The sediment plume during the operation phase is very narrow and localized along the western coast of Hong Kong Island. A short term operation impact due to SS will be expected to the nearby seawater intakes only. Notwithstanding the above, short term operation impacts due to the SS is predicated at the planned WSD's Cyberport seawater intakes. The planned seawater pumping station could incorporate sensors or other appropriate equipment to detect the SS level and increase its storage capacity to cater for situation when the seawater pump is shut down during SS exceedance. Other seawater intake operators have also been consulted on the potential transient impact to their facilities. No adverse comments were received. To alleviate the impact at sources, bar racks at the entrance of the intake structure and sand trap at the bottom of the intake shaft would be installed to collect debris, boulders and coarse sand. The sand trap will be operating at its maximum efficiency during the low flow condition. Cleaning operation will be carried out in the watercourses above the intakes and within the tunnel system before the onset of every wet season to remove leaves and floating debris. The calculated maximum concentrations of *E. coli* and fresh water salinity are well within the range of natural fluctuation levels in the assessment area. No impacts are anticipated at all identified coral sites and fish culture sites. For the impacts from sediment plume, consequently impacts to the corals along East Lamma Channel are not predicted to occur.
- 16.3 **Noise**
- 16.3.1 Representative noise sensitive receivers (NSRs) (Airborne and Structural borne) were identified. Construction noise impacts from the construction activities including the operation of TBM were identified as key environmental issues for this Project. The potential noise impact arising from the Project have been assessed and evaluated.
- 16.3.2 During the construction phase, the unmitigated airborne noise level at most of the NSRs would experience noise level exceeding noise criteria stated in the EIAO-TM. To alleviate the noise impact, noise mitigation measures including the adoption of good site practices, quieter equipment and restriction on the number of equipment operating as well as other possible mitigation measures including erecting of semi or full noise screening structure around work sites, pre-splitting and followed by chemical blasting instead of mechanical blasting method are recommended. The impacts of structural borne noise due to the operation of tunnel boring machine and drilling/blasting activities for the construction of drainage tunnel/adits have been examined. Mitigation measures are required at for tunnel construction near Western Portal and Eastern Portal and the adit construction with vertical shaft W3 by restricting the operation hours of the TBM or blasting activities at those identified NSRs.
- 16.3.3 With the recommended mitigation measures, the mitigated noise levels at identified NSRs would comply with the daytime construction noise standard as set out in the

EIAO-TM. In addition, an EM&A programme would be implemented to monitor the construction noise impact.

- 16.3.4 No exceedance of the noise criteria was predicted except short-term exceedances at some of the several intake shafts. It is expected the residual impacts would be transient and localized. By considering that the construction of the proposed drainage tunnel is unavoidable as it is an integral element of this Project, the short duration of the sensitive receivers experiencing the residual impacts is considered acceptable.

#### 16.4 **Ecology**

##### *Terrestrial*

- 16.4.1 The proposed construction would cause a permanent loss of 0.16 ha of woodland, 0.70 ha of urbanised/disturbed, 0.04 ha of shrubland habitats and 85 m of natural stream. The temporary habitat loss would include 0.53 ha of woodland, 1.56 ha of urbanised/disturbed land, 0.11 ha of shrubland, 91 m of natural stream, and 384 m of nullah.
- 16.4.2 Both the Western Portal and the Eastern Portal would encroach upon urbanised/disturbed habitat but the Eastern Portal would also affect a stand of woodland. Among the 35 intake points, 18 would encroach only one type of land habitat, i.e. urbanised/disturbed habitat. 16 intake points would encroach woodland habitats which however are mainly located along the roads. There are also 2 intake points which would encroach shrubland habitat (including one from the 16 intake points affecting woodland, i.e. this intake point would encroach both shrubland and woodland habitats). Impacts of loss of urbanised/disturbed and shrubland habitat are considered insignificant due to limited ecological values of these habitats. Due to the limited size of woodland to be permanently lost, and the temporary nature of the impact on most of the woodland to be affected, the construction impact on terrestrial habitats is ranked as minor. However, due to the ecological value of woodland habitat, mitigation is required to compensate the impact of woodland loss. Compensatory planting of about 1.5: 1 ratio would be provided.
- 16.4.3 The loss of stream habitat is limited in the present project (91m temporary loss in total and 85m permanent loss in total). The majority of the permanent loss would come from the modification of a section of stream channel immediately upstream to the Eastern Portal. No species of conservation importance/concern was found at the Eastern Portal stream, given its significant proportion in the stream habitat loss, the impact of stream habitat loss is ranked as minor to moderate. Notwithstanding the above, low flow channel is provided at Eastern Portal to provide living space within the modified section of the stream courses for aquatic communities to develop. Step chute in the form of a series of descending water pools is also provided to avoid isolating the aquatic fauna in the channelised section from natural habitats.
- 16.4.4 Other permanently lost sections of streams are scattered among various intake locations and all are close to traffic roads, residential buildings, or existing drainage facilities. Compensation of these scattered stream habitat losses is thus not required.

##### *Marine Ecology*

16.4.5 The construction and operation of the Project would cause subtidal seabed loss and require replacement of artificial intertidal habitat by newly constructed portal. The impact is considered minor as the affected area is small and not colonized by coral. The identified marine benthic communities are also not of conservation concern. The assessment also conclude that the Project will has no significant impacts on Chinese White Dolphin and Finless Porpoise, as their range lies in the west and south of the project area respectively. The impacts to the marine water quality due to change in water quality by the operation discharge are limited. None of the recognized site of marine conservation concern would be affected. A well-planned program of site practices should be able to maintain the impacts to acceptable level.

#### 16.5 **Fisheries**

16.5.1 The construction of the temporary berthing point, permanent outfall and stilling basin will result in some loss of fishing ground (subtidal muddy bottom habitat). However, the size of the loss is small and the fisheries importance of the area is low. This loss is not expected to have a significant negative impact on the capture fisheries. Impacts on fishing ground loss are acceptable.

16.5.2 No residual impacts on the Fish Culture Zones (FCZ) are predicted as there are no overlaps between the area of waters affected during the operation phase and the FCZs.

16.5.3 The water quality assessment results indicate that the operation phase effluent from the drainage tunnel would have only limited and localized impacts on marine water quality. Impacts on fisheries resources are not anticipated.

#### 16.6 **Waste Management**

16.6.1 The construction work will involve site formation and drainage tunnel excavation which will necessitate the removal of spoil. The major source of waste material will be from the tunnelling operation, from which a total of 522,040 m<sup>3</sup> will be excavated. The rate of generation is estimated to be around 500 m<sup>3</sup> per day at each portal. Waste will be removed form the temporary stockpile areas at both Portals, after treatment, and disposed at a designated Government facility. Only small quantities can be used to backfill for this Project.

16.6.2 Other waste generated by construction works would include workforce wastes, maintenance and chemical wastes. Materials which can be reused should be separated from those which require disposal and appropriate facilities provided on site to maintain a clean and tidy site. Recycling should be practiced wherever possible. Provided that the identified waste arising are handled, transported and disposed of using approved methods and that the recommended good site practices are adhered to, adverse environmental impacts would not be expected during construction works.

16.6.3 The recommended mitigation measures should form the basis of the site Waste Management Plan to be developed by the Contractor at the commencement of the construction phase.

#### 16.7 **Air Quality**

- 16.7.1 Potential impacts on air quality during the construction of drainage tunnel were shown to be minimal due to excavated spoil produced from both portals will be transported by enclosed conveyor to a temporary stockpiling area for storage or stored at the barge (or temporary stockpiling area) for Eastern and Western Portals respectively. Stockpiling of excavated spoil will be regularly removed by lorry and barge. For the construction of intakes, most of the excavated spoil will be dropped down to the intake shafts, then collected and transport to either Portals for removal (reverse boring method). No adverse construction dust impact would be expected at all ASRs in the vicinity of the study area.
- 16.7.2 With the implementation of mitigation measures specified in the *Air Pollution Control (Control Dust) Regulation* and inclusion of good site practices, dust nuisance at ASRs is not expected. An EM&A programme for the construction phase will be required to ensure that the dust criteria are satisfied at the ASRs.
- 16.7.3 No unacceptable air quality impact during the operation phase is predicted and expected.
- 16.8 **Cultural Heritage**
- 16.8.1 A comprehensive baseline review and site survey of the Study Area was carried out to determine the presence of historical buildings, potential existence of prehistoric or historic occupation on, or close, to the drainage tunnel alignment.
- 16.8.2 A number of built heritage resources were identified in the Cultural Heritage Review. Most of them are located more than 50m from works areas and no impacts will result. A total of 4 graded historical buildings were found to be located within 50 m of proposed works areas associated with the project.
- 16.8.3 Based on the Literature Review, AMO files have been used as a reference guide for interpretation and analysis of Terrestrial and Marine Archaeology. No known archaeological sites along the proposed alignment or in the vicinity of any of the proposed works areas. For marine archaeology, no known marine archaeological site was found in the offshore areas at Western Portal near Pok Fu Lam.
- 16.8.4 The proposed works will not directly impact any of the buildings. However, indirect impacts may result at Haw Par Mansions, the Wall and Gate of the former Haw Par Mansion Gardens and at the former Explosives Magazine. Recommendations have been made to mitigate these potential impacts including condition survey to the buildings, provision of buffer zone between the buildings and the construction site, erection of protective fencing and screening, and conduction of monitoring during construction works. All mitigation should be undertaken by the project contractors and be in place before works commences.
- 16.8.5 No impacts on historical buildings are predicted during operation phase of the drainage tunnel.
- 16.9 **Landscape and Visual Assessment**

- 16.9.1 In general, the Project will cause slight to moderate adverse visual impact in the construction phase and negligible to slight adverse visual impact in operation phase before the implementation of mitigation measures.
- 16.9.2 Eastern Tunnel Portal is proposed near the existing carpark to the north of Haw Par Mansion. VSRs identified are motorists and pedestrians along Tai Hang Road and the occupants in the True Light Middle School of Hong Kong. Their sensitivity is medium to low. Western Tunnel Portal is proposed at the south west coastal line of Hong Kong Island. VSRs identified are motorists along Cyberport Road, workers in the Preliminary Treatment Works Complex and travelers in ferry at a distance to the south of site. Their sensitivity is low.
- 16.9.3 There are 35 intake structures proposed along the main drainage tunnel from Tai Hang Road to Pok Fu Lam. The proposed sites for intake structures are mainly located in existing slopes, amenity areas, playgrounds and sitting out areas, alongside existing roads or paths. The existing landscape and visual quality of the proposed sites vary from low to medium. Major VSRs are residential VSRs (high sensitivity) and traveling VSRs (low sensitivity) and a few recreational VSRs (medium to high sensitivity) and institutional VSRs (medium sensitivity).
- 16.9.4 The major source of visual impact is due to the permanent alienation of landscape areas for the provision of intake structures. Since there will be no major above ground structures proposed within boundary of the intake structure, the magnitude of change in visual quality on the existing VSRs is generally considered small.
- 16.9.5 Major source of visual impact during the construction phase of the project are due to the permanent loss of existing vegetation and temporary construction works. During the operation phase of the project, visual impacts are due to the change in existing visual quality (permanent alienation of landscape areas and permanent erection of the above ground structures). After implementation of mitigation measures, the residual visual impacts during the construction and operation phase will be reduced to negligible to slight.
- 16.10 **Hazard to Life**
- 16.10.1 There will be no overnight storage of explosives for this project. Transportation of explosives to site for the construction of adit will be undertaken on a daily basis. The contractor is required to destroy any unused explosives before nightfall. With the implementation of rigorous safety measures for the blasting operation, adverse impact to the nearby sensitive receivers adjacent to the blasting locations will not be expected.
- 16.11 **Environmental Monitoring and Audit (EM&A)**
- 16.11.1 Environmental monitoring and audit requirements for the construction phase are described in terms of the monitoring locations, period of time, frequency and standards against which the monitoring results should be compared to determine compliance. The monitoring programme covers aspects on underground water levels, air, noise and water quality. Site audit would be carried out to check its compliances of the air, noise, water quality, waste management, ecology, fisheries, landscape and visual and cultural heritage mitigation measures during the construction phase. During the initial Operation phase, ground water monitoring will be carried out for a year to confirm the steadiness of the ground water table monitoring in respect of ground water monitoring

is only required. An Implementation Schedule of the relevant mitigation measures for the works is included in the EIA report. Details of the programme are presented in a separate Environmental Monitoring and Audit Manual.

16.11.2 The use of real time reporting of monitoring data on internet website for data record will be used during construction phase which would facilitate the rapid and effective communication with local residents/sensitive receivers nearby to resolve any problems in respect of noise impact to the project.

16.12 **Overall Conclusions**

16.12.1 The EIA has critically assessed the overall acceptability of any environmental impacts likely to arise as a result of the construction and operation of the proposed drainage tunnel. Where necessary and practicable, the EIA has specified the conditions and requirements for the detailed design, construction and operation of the Project in order to mitigate environmental impacts to acceptable levels. The potential environmental impacts would be expected to arise during the construction phase if no mitigation measures are in place.

16.12.2 With the recommended mitigation measures applied, the Project would be environmentally acceptable and no unacceptable residual impacts would be anticipated. The schedule of implementation of the recommended mitigation measures has been provided in Appendix J to this report – Implementation Schedule. Monitoring requirements have also been specified in a separate EM&A Manual to ensure proper implementation of the recommended mitigation measures.