

## 12. EAST TUNG LUNG ISLAND LANDFILL

### 12.1 Basic Information

#### *Project Title*

12.1.1 East Tung Lung Island Landfill (ETLIL) – marine site M.7.

#### *Nature of Project*

12.1.2 The Project would form a new marine based waste disposal site in waters located to the west of Ninepin Group (*Figure 12.1*).

12.1.3 The ETLIL would involve the construction of an artificial island of approximately 390ha in size. The site would be designated as a public filling area for the receipt of inert C&D material; once the reclamation is completed, the site would be developed as a landfill for subsequent operation for the disposal of waste. Construction works would be as described in Part A; Section 3.2.

#### *Location and Scale of Project*

12.1.4 The ETLIL is located approximately 2.5km to the east of Tung Lung Chau, 2km southeast of the Clear Water Bay Peninsula and some 1km to the west of South Ninepin. Approximately 175Mcum of fill material will be required to construct the artificial island, with a final site formation level to +6mPD. The capacity of the landfill site would be in the order of 65Mcum.

12.1.5 Seabed levels in this area vary from 20 to 30m below Chart Datum. There would be a requirement to dredge some 4Mcum of muds to facilitate seawall construction.

#### *History of Site*

12.1.6 The site is located within open marine waters and would be formed entirely as part of this project. The site location coincides with that of the former East Tung Lung Chau (ETLC) Borrow Area that is currently being used as a marine disposal site for uncontaminated muds. Sand dredging at the ETLC Borrow Area was undertaken between the early and mid-1990s

12.1.7 The general environs are of marine conservation value, and the formation of the Shelter Island Marine Park has been proposed, with its southern boundary some 1.5km to the north.

#### *Number and Types of Designated Projects Covered*

12.1.8 The ETLIL would qualify as a Designated Project under the five categories listed in Part A; Section 2.1.

### 12.2 Outline of Planning and Implementation Programme

12.2.1 An outline for the planning and implementation of this site is summarised in Part A; Section 3.3 and an outline programme is shown in *Figure 12.2*. Assuming landfill operations start in 2018, the ETLIL would be full during the period 2025 to 2030, depending upon the rate of waste arisings and the number of other landfills operating concurrently.

12.2.2 The site is currently not covered by any statutory town plans, as described in Section 3.3, Town Planning Ordinance procedures to cover the site would be required and the reclamation would need to be gazetted under the Foreshore & Sea-bed (Reclamations) Ordinance.

12.2.3 According to the Territorial Development Strategy Review, the area where the site is located is of potentially high recreational value. There are no other identified uses in this area.

12.2.4 The South East New Territories (SENT) Development Strategy Review focused on conserving the natural environment of the sub-region. The SENT Strategy Review proposed areas for inshore water recreation in the coastal area of Port Shelter, around Kau Sai Chau, Sharp Island and Tai Tau Chau, and between Jin Island and Bluff Island to accommodate the increasing demand for marine activities. To conserve the marine ecology of this area and to maintain its natural setting, a potential Marine Park was identified in Port Shelter, and a potential Marine Conservation Area was identified around the coastline of Tai Long Wan/High Island and Kau Shai Chau, Bluff Island, Basalt Island, Town Island, Wang Chau and Sharp Island.

### 12.3 Possible Impacts on the Environment

12.3.1 Possible impacts on the environment during the construction, operation and aftercare phases of the ETLIL are outlined below. *Figure 12.1* provides details of identified sensitive receivers. The individual assessments are summarised in *Tables 12.1 and 12.2*.

#### ***Air Quality***

12.3.2 The reclamation and landfill development has the potential to cause the following air quality impacts:

- Dust (TSP / RSP) and exhaust emissions from on-site plant during construction and operation.
- Gaseous emissions during landfill operation and aftercare arising from non-point source emissions and gas flaring / utilisation (including emissions of methane, carbon dioxide, carbon monoxide, sulphur dioxide, nitrous oxides, etc.).
- Odours arising during the operation of the landfill from waste decomposition and leachate treatment.

12.3.3 No Air Sensitive Receivers (ASRs) are found within a 500m radius from the boundary of this site. The closest ASR is the Clear Water Bay Golf and Country Club that is located 2km to the northwest of the site. The site is located in open marine waters with no topographic features situated between the site and the Clear Water Bay peninsula. Thus, no significant air quality impacts associated with reclamation, operation and construction of the landfill facility within the site are anticipated.

12.3.4 No existing or planned developments that emit similar gaseous emissions are found within 3km from the site boundary. Moreover, there are no existing or planned ASRs in the vicinity of the artificial island. Therefore, cumulative impacts are not anticipated.

12.3.5 Marine vessels will be the mode of transportation for waste delivery to the site. The amount of air pollutants emission from the territory-wide waste delivery to the site will be less compared to a land based site that relies on road transport. The estimated cumulative distance to be travelled from the existing and planned (South East Kowloon RTS to be commissioned in 2012) marine RTSs to the site is approximately 300km. As such, the regional impacts are considered to be neutral to minor.

#### ***Noise***

12.3.6 The reclamation and landfill development has the potential to cause the following noise impacts:

- Construction – from dredging, tipping, piling works and general construction activities;
- Operation – from the use of fixed plant, marine vessels, waste reception area, pumping plant, possible helicopter noise etc.

12.3.7 No noise sensitive receivers are found within a 300m radius from the boundary of this site. Thus, no significant noise impacts associated with reclamation, operation and construction of the landfill facility within the site are anticipated.

- 12.3.8 Although not anticipated at this stage, it is possible that activities could continue beyond normal working hours during the construction and operation phases. This would depend upon working arrangements for fill delivery, day-to-day landfill operations and the overall construction programme. However, as this is an offshore site with no NSRs in the vicinity, the more stringent requirements for noise emissions during the evening and night time periods are not expected to be an issue for this site.
- 12.3.9 Potential operational phase noise impacts would need to be considered in subsequent studies in the event that the island reclamation is used for other land uses (in addition to landfill) or a separate afteruse is developed on top of the landfill following completion of the land filling operations.
- 12.3.10 The site can only be accessed by marine traffic during both operation and construction phase. Noise from land based waste delivery vehicle is not a concern for this site.

### ***Water Quality***

#### ***Baseline Conditions at the Site***

- 12.3.11 The site is located in the Eastern Waters of Hong Kong, between Tung Lung Chau and the Ninepin Group and falls within the Mirs Bay Water Control Zone (WCZ). The generalised current pattern in the area is from west to east / southeast on the ebb tide, with the result that the artificial island site is only very slightly exposed to water quality influence from more westerly waters. On the flood tide the current direction is from the northeast to west / northwest during the dry season, and from the south during the wet season. Apart from the dry season flood tide when the current flows across the site, the current around the site is generally very weak. However, with the weak currents, the arrival of the southwest monsoon (wet season) around late April will have the effect of driving surface waters to the northeast.
- 12.3.12 There are no routine marine water quality / sediment quality monitoring stations located immediately in the proximity of the artificial island site. However, monitoring data from nearby stations in the Mirs Bay WCZ (MM8 to the south and MM14 to the northeast) and Port Shelter WCZ (PS8 and PS11 to the north) provides an indication of water quality in the area. Sediment data is available from the same two monitoring locations in Mirs Bay (MM8 and MS14 respectively) and from the same location as PS8 in Port Shelter (ref. PS6).
- 12.3.13 The quality of the marine waters at these three stations is good, with full compliance with the WQO for dissolved oxygen, total inorganic nitrogen (TIN), un-ionised ammonia and *E. Coli* for each of the past three years.<sup>1</sup> Given the current characteristics for the area the water quality at these three locations will reflect that around the artificial island site. The water at routine monitoring locations west of Tung Lung Chau in the Eastern Buffer WCZ also complied with the WQOs established for dissolved oxygen and TIN for the year 2000.
- 12.3.14 EPD's routine sediment quality data for the afore-mentioned locations shows no breach of the Lower Chemical Exceedance Level for any of the parameters tested. Excavated sediment from dredging activities would thus be suitable for open sea disposal.

#### ***Key Issues and Sensitive Receivers***

- 12.3.15 The project has the potential to cause the following water quality impacts:
- Sediment loss to the water column during dredging / reclamation;
  - Runoff with elevated levels of suspended solids from the site during landfill construction (post-reclamation); and
  - Change in the hydrodynamic regime (i.e., change in flushing capacity and sediment deposition / erosion patterns).

<sup>1</sup> EPD, *Marine Water Quality in Hong Kong for 2000*, (EPD 2000)

12.3.16 A number of Water Sensitive Receivers (WSRs) are present in the vicinity of the site. These include:

- Secondary contact recreation subzone (southeast Hong Kong Island and inland waters between southeast Tung Lung Chau and outer Port Shelter);
- Gazetted beaches at Shek O and Clear Water Bay; and
- Seawater abstraction point at Cape D'Aguilar

12.3.17 In addition, there are a range of aquatic and inter-tidal ecological receivers in the vicinity of the site that may be sensitive to any decline or change in the water quality or sediment deposition / erosion patterns. Impacts upon these are discussed under the "Ecology" and "Fisheries" subsections. The sensitive receivers include:

- Fish Culture Zones at Tung Lung Chau and Po Toi O;
- Cape D'Aguilar Marine Reserve;
- Cape D'Aguilar SSSI;
- Proposed Marine Park / Reserve at Shelter Island; and
- Potential Marine Park / Reserve at Bluff Island and North & South Ninepin;
- Potential Marine Park / Reserve at Long Ke Wan and Pak Lap Wan; and
- Coral / Green Turtle habitat around the Ninepin Group, Po Toi Islands, Sun Kong Island, Tung Lung Chau and Ching Chau.

12.3.18 The study area also coincides with a broad area of activity for the Black Finless Porpoise, *Neophocaena phocaenoides*. From sightings data, one of the core areas for this species is east and northeast of Po Toi between June and November, with very uncommon observations of the species closer to the site area during the year.

#### *Reclamation and Site Formation*

12.3.19 Dredging of some 4Mcum of uncontaminated sediment is proposed for the site development, and there will be reclamation works to create a site footprint of around 390ha. Sediment handling for these activities may give rise to potential water quality impacts from increased suspended solids and reduced dissolved oxygen levels.

12.3.20 The placement of fill for island construction is likely to lead to localised increases in suspended solids levels. The water quality and hydrodynamic modelling indicated that WQO for suspended solids would not be exceeded during the construction of the artificial island but predicted that there would be raised levels of SS at SC5 during Phase 1 construction wet season (17.30%), Phase 2 construction dry and wet seasons (15.34% and 27.80% respectively) and Phase 3 construction wet season (20.88%). Raised levels of SS were also predicted at SC7 (18.19%) during the Phase 2 construction wet season.

12.3.21 During the southwest monsoon there would be a greater potential that the sediment plume would be transported towards the Port Shelter secondary contact recreation subzone and the gazetted beaches at Clear Water Bay, although the water current is generally weak in these waters and is at its strongest from the northeast. This would indicate that the potential for plume dispersal to the north is limited by these forces. Dive surveys during the excavation at the ETLC Borrow Area in 1992 support this scenario, as although the observed extent of the dredging plume was greater during the southwest monsoon (May – June) than the northeast monsoon (March), the area affected was limited to waters immediately around North and South Ninepin islands for both conditions (not reaching as far as East Ninepin islands).<sup>2</sup> The sediment plume caused by dredging for the artificial island dredging is not predicted to have significant effects on WSRs to the north.

<sup>2</sup> Binnie Consulting Ltd (1995). Underwater Dive Surveys - Volume II: Ninepin Monitoring Update, July 1992.

### *Hydrodynamic and Water Quality Impacts Following Island Formation*

- 12.3.22 The water quality and hydrodynamic modelling indicates that the presence of the island would have a minor impact on the flow through the major channels. The most affected is the Tathong Channel where reductions of accumulated flow of 6.72% and 4.57% were predicted in the dry and wet seasons respectively. The modelling also indicated that changes in the flow velocity fields would be small and localised and that overall increases in current magnitude would also be small (1.72% to 1.92%).
- 12.3.23 In the hydrodynamic and water quality modelling, 39 sensitive receivers that are close to the site were selected for presentation. Of the 39 chosen indicator points, 12 are located in the Port Shelter WCZ (FC6-11, GB7-10, MP7 & SC16), 16 in the Mirs Bay WCZ (FP9, SC5-8, FN1a-d, MP9-11, and SC12-15), 1 in the Eastern Buffer WCZ (FC5) and the remaining 10 in the Southern WCZ (NS6-7, SC3-4, SC11, SC18, MR1, GB6, FP6 & GT2).
- 12.3.24 According to the dry season water quality modelling results, the predicted 90%ile DO for depth average and bottom layer ranged from 6.32 to 7.06mg/L which comply with the WQOs that requires  $\geq 4$ mg/L for depth averaged DO and  $\geq 2$ mg/L for bottom layer DO. Compared to the baseline water quality results, the percentage differences of DO levels were minimal with values ranged from -0.31 to 0.46%.
- 12.3.25 The predicted average dry season salinity ranged from 33.98 to 34.0ppt. Compared with the baseline scenario, the island would cause minimal impacts on salinity levels at all sensitive receivers with maximum percentage differences of 0.03%. The changes in salinity levels were well within the WQO requirement that change due to any waste discharge should not exceed 10% of natural ambient level.
- 12.3.26 The predicted dry season SS levels at the indicator points were in the range of 2.24 to 4.47mg/L. It is predicted that the waste disposal on the site would change the baseline SS levels from -1.95% to 2.54%. The largest percentage increase (2.54%) was predicted at SC7 (Surveyed Corals and Green Turtle site near Ching Chau). Recognising the WQO requirement that the SS levels should not raise the natural ambient level by 30%, all the differences are considered very small.
- 12.3.27 The predicted average dry season *E.coli* concentrations (ranged from 1 to 232count/100mL) were well below the WQO of 610cfu/100mL.
- 12.3.28 The predicted average dry season UIA levels (0.00176 – 0.00348mg/L) at all indicator points were very small as compared to the WQO of 0.021mg/L.
- 12.3.29 The predicted dry season TIN levels for the dry season ranged from 0.0477 to 0.0964mg/L which were below the corresponding WQO for Southern and Port Shelter WCZ (0.1mg/L), for Mirs Bay WCZ (0.3mg/L) and for Eastern Buffer (0.4mg/L). Since the WQO for TIN is an annual mean value, the predicted mean TIN levels for both the dry and wet seasons were averaged to represent the yearly values. The calculated annual mean was the range from 0.068 to 0.156mg/L. Twelve sensitive receivers (FP6, GT2, MR1, SC3, SC4, SC11, SC18, GB6, GB7, FC6, NS6 and NS7), located in Southern and Port Shelter WCZ, exceeded the WQO of 0.1mg/L. However, the averaged baseline values at these indicator points also exceeded the WQO. The largest percentage increase in the annual mean TIN value was found at GB6 (Shek O Beach) with a value of 2.22%.
- 12.3.30 According to the wet season water quality modelling results, the predicted 90%ile DO for depth average ranged from 4.27 to 5.46mg/L. and the values complied with the WQOs of  $\geq 4$ mg/L. The percentage differences ranged from -0.79 to 8.14%.
- 12.3.31 For 90%ile bottom DO, the values ranged from 2.01 to 5.21mg/L which complied with the WQO of  $\geq 2$ mg/L. Compared to the baseline water quality results, increases of bottom DO levels were predicted at most of the indicator points with percentage differences ranging from 1.91% to 35.12%.

- 12.3.32 The predicted average wet season salinity ranged from 24.78 to 30.13ppt. Compared to the baseline water quality results, the percentage differences in salinity caused by the presence of the island ranged from -0% to 2.08% at the selected indicator points which is lower than the WQO requirement that change due to any waste discharge should not exceed 10% of natural ambient level.
- 12.3.33 The predicted wet season SS levels at the indicator points were in the range of 2.28 to 4.65mg/L. Compared to the baseline scenario, a number of indicator points were identified to have a rise in SS levels with increases that ranged from 0.48% to 16.67%. The largest increase (16.67%) of SS levels was predicted at FC11 (Fish Culture Zone at Tai Tau Chau). These values were regarded as small when compared with the WQO requirement that any waste discharge should not raise the natural ambient level by 30%.
- 12.3.34 The predicted average wet season *E.coli* levels caused by the presence of the island ranged from 1 to 130count/100mL, which is well below the WQO of 610cfu/100mL.
- 12.3.35 The predicted average wet season UIA (0.00332 – 0.00632mg/L) at all indicator points were low and well below the WQOs of 0.021mg/L for the annual mean.
- 12.3.36 The predicted TIN concentration for the wet season was in the range from 0.0842 to 0.2182mg/L. Compared with baseline levels, the largest increase (3.12%) was predicted at GB6 (Shek O Beach). Since the WQO for TIN is an annual mean value, the predicted mean TIN levels for both the dry and wet seasons were averaged to represent the annual mean values. The results are discussed in Section 12.3.29 above.

#### *Cumulative Impacts*

- 12.3.37 The exhausted sand borrow pits at East Tung Lung Chau are currently being used for disposal of uncontaminated muds. An EIA Study for backfilling the exhausted sand borrow pits was endorsed by the EPD in 1998 but does not provide a programme for disposal activities. Despite this, it is possible that fill borrow and disposal activities in the general vicinity of the ETLC (including east of the Ninepin) will continue for some years and thus there is potential for cumulative effects.
- 12.3.38 The East of Ninepin open sea mud disposal area is located some 5km east of the artificial island location. As of June 2001 this disposal area was still active, reportedly with a remaining disposal capacity of 9.4Mcum. Although only uncontaminated mud is being disposed of at this site, there may be cumulative impacts on the water quality in term of elevated suspended solid level if this project starts before the end of the service life of the East Ninepin Disposal Area. The extent and magnitude of cumulative impacts would be considered further at the detailed EIA stage of the project when further details of the implementation programme are known.

#### *Waste Management / Disposal Impacts*

- 12.3.39 For construction of the artificial island, inert C&D material would be brought in exclusively by marine vessel from a network of barging points in the HKSAR. The location of barging points would vary during the filling process, according to the source of materials at any given time.
- 12.3.40 Whilst various options for construction that avoid dredging have been investigated, it is anticipated that muds would need to be excavated to facilitate construction of the outer seawall prior to public filling. Excavated muds would then be disposed of within the area to be reclaimed with public fill. Following this, the “island” would act as a major recipient of municipal solid waste and other landfilled waste streams.
- 12.3.41 Anticipated volumes of materials are as follows:
- Volume of public fill that could be accepted for island construction: 175Mcum
  - Volume of muds be dredged for outer sea wall: 4Mcum

- 12.3.42 Various potentially polluting materials may be stored, handled and transported to / from the site. Examples include chemicals for waste water/leachate treatment, waste oils, fuel for plant working on the site, etc. These would be managed as described in Section 5.5.
- 12.3.43 Waste delivery to the site will be by marine vessel and therefore the GHG emission per kg waste handled will be smaller compared to road transport (given the capacity for a marine vessel is 100 times more than a truck). The cumulative distance between marine RTSs and the site is around 300km (extracted from the Preliminary Marine Review (March 2002)). In view of these, the GHG impacts are considered to be neutral to minor.

### **Ecology**

#### **Baseline Conditions**

- 12.3.44 The waters around Tung Lung Chau generally mark the limit of influence of the Pearl River flow, and as a result are characterised by high salinity levels (year 2000 mean ~32ppt). These more oceanic conditions and other factors such as the general absence of activities that would otherwise lead to a decline in water quality and low turbidity favour relatively diverse communities, including coral reef ecosystems.
- 12.3.45 An indication of the character of the benthic invertebrate community immediately east of Tung Lung Chau can be obtained from a review of survey data collected using the belt transect method in August 1993. Dive surveys off the east coast of the island reported molluscs to be abundant in the rocky near-shore community, with rock oysters and mussels equally abundant.<sup>3</sup> These are not expected to be present in any great numbers in offshore waters as the substrate is unsuitable (being predominantly silty) and feeding opportunities would be limited. The seabed habitat would likely be dominated by burrowing polychaete worms, with echinoderms and crustaceans also occasionally present. The scavenging gastropod *Nassarius siquijorensis* was recorded further north at Basalt Island, and polychaetes dominated the benthic infauna in the same area<sup>4</sup>.
- 12.3.46 The east coast of Tung Lung Chau was surveyed during the CED's *Underwater Dive Surveys* from which was reported a high abundance and diversity of fish, several species of hard coral, soft coral, sponges and an inter-tidal community supporting barnacles, tunicates, anemones and bryozoans. The conservation value of the two east coast sites surveyed was considered "high".<sup>4</sup> A number of dives undertaken along the west coasts of North and South Ninepin and the south coast of Ching Chau for the same study reported a similarly high quality habitat, particularly for hard corals. The artificial island would be located between Tung Lung Chau, Ching Chau and the Ninepin Group and so any deterioration in water quality or change in hydrodynamics brought about by the island landfill may potentially adversely affect these ecological resources.
- 12.3.47 There are also coral communities further south around Beaufort Island and Sun Kong Island (inc. Fury Rocks) and at the Cape D'Aguiar Marine Reserve. Dive survey reports for several locations report that the conservation value of these site to be "high".
- 12.3.48 From AFCD's public data on the Black Finless Porpoise *Neophocaena phocaenoides* it is known that this species frequents the waters south of the island, with a core area east of Po Toi through summer and autumn. There have also been very occasional sightings of the Finless Porpoise in the immediate vicinity of the island site (one 1km south of Tung Lung Chau and one 1km west of North Ninepin in spring (March – May)). Locally the Finless Porpoise is protected under the Wild Animals Protection Ordinance (Cap. 170) and is a "Grade II National Key Protected Species" in the Mainland. Internationally the Finless Porpoise is listed as "Insufficiently Known" in the IUCN Red Data Book and is listed in CITES Appendix I (i.e. highest protection).

<sup>3</sup> Binnie Consulting Ltd. (1994). Underwater Dive Surveys – Volume II: Marine Ecology of the Ninepins.

<sup>4</sup> Binnie Consulting Ltd. (1994). Underwater Dive Surveys – Volume I.

- 12.3.49 The Green Turtle *Chelonia mydas* has been observed in coastal waters around Tung Lung Chau, Ching Chau, around the Ninepin Group of islands and also further afield in the waters off southwest Po Toi. The Green Turtle has the same protection and conservation status as the Finless Porpoise.

*Direct Habitat Loss*

- 12.3.50 The site footprint covers a surface area of 390ha that corresponds with the minimum area of seabed habitat that would be lost from the works. Associated with this loss there would be smothering and dislocation of benthic species and demersal fishes. As the site is located in waters between 20 and 30m deep there would also be a large loss of water column as a habitat to fisheries and other pelagic species such as the Finless Porpoise and Green Turtle.

*Water Quality / Hydrodynamics*

- 12.3.51 As the baseline water quality conditions in the area are good, the potential for water quality decline is related to increased suspended sediment / sediment deposition and turbidity during dredging and reclamation works, and the associated potential for decreased dissolved oxygen levels.
- 12.3.52 The sub-tidal coral communities that surround the island site at East Tung Lung Chau, Ching Chau and throughout the Ninepin Group are prone to sediment transport and deposition from dredging and reclamation activities – particularly the communities along the west coast of North and South Ninepin islands. It is noted that the precursor to the Coastal Ecology Surveys (i.e., *Underwater Dive Surveys*) commissioned by CED reported significant damage to the coral community on the west coast of North Ninepin following sand dredging at the ETLC Borrow Area. As the artificial island site location more or less overlaps with that of the former ETLC Borrow Area, and as dredging of marine mud will also be required, there is potential for impact on the coral communities at the Ninepin.
- 12.3.53 The results of the water quality and hydrodynamic modelling exercise predict that the spread of sediment from all three works phases would generally be to the southwest, with only a negligible increase in suspended solids levels (~0.3mg/L on average) at coral communities around the Po Toi group of islands. The model did not predict any significant increase in sediment levels on the coral communities around the Ninepin Group of islands to the east or in waters to the north during either the wet or dry seasons.
- 12.3.54 The model output does not indicate that there would be any hydrodynamic change or associated water quality decline during operation of the island landfill.

*Marine Vessel Disturbance*

- 12.3.55 Whilst there have been sightings of the Finless Porpoise in the vicinity of the site, it seems from data available that the area is not part of the core habitat at any time of year. Depending on the direction of marine traffic to the site during its construction and operation however, there is potential for disturbance of the population in the more frequently used waters around Po Toi. Likewise, vessel movement in the area may affect Green Turtles through increased potential for vessel collision and vessel engine noise / vibration.

*Fisheries*

- 12.3.56 There are spawning grounds and nursery grounds for commercially important fish in the vicinity of the artificial island location. Spawning grounds exist within the Eastern Waters zone that includes Port Shelter and the marine waters east and southward of Tung Lung Chau, Cape D'Aguilar and Po Toi, and at the South East Hong Kong zone that also includes waters around Po Toi.<sup>5</sup> Spawning for most of the commercially valuable fish species is concentrated in the period of June to September.

<sup>5</sup> ERM (1998). Fisheries Resources and Fisheries Operations in Hong Kong Waters. For AFCD, Govt. of HKSAR.



- 12.3.57 Due to the importance of the fishing in the ETLC area, two key initiatives have been proposed for the area. Under the second phase of the AFCD's artificial reefs programme a "no take AR deployment area" was proposed at Outer Port Shelter, whilst a working group on fisheries management proposed the establishment of a Fisheries Protection Area at Port Shelter.<sup>6</sup>
- 12.3.58 Commercially important fish species in the Eastern Waters zone include: *Apogon quadrifasciatus* (broadbanded cardinalfish), *Parapristipoma trilineatum* (chicken grunt), *Sebasticus marmoratus* (scorpionfish), *Trichiurus haumela*, *Upeneus sulphureus* (sulphur goatfish) and *U. tragula* (freckled goatfish). The waters in the Eastern Waters zone have been recommended for protection under the study. Port Shelter, to the north of the artificial island site, is also an important nursery area for *P.trilineatum* as well as fry and juveniles of the high value red pargo *Chrysophrys major* and gold lined seabream *Rhabdosargus sarba*. Commercially valuable species in the South East Hong Kong zone include *Cynoglossus macrolepidotus* (tonguefish) and *Pseudosciaena crocea* (yellow croaker).
- 12.3.59 Siting the artificial island at this location would thus lead to direct loss of an important spawning area for a range of fish species. Impacts on demersal species such as *C.macrolepidotus* would be particularly great, whilst any disturbance of the coral reef ecosystem could affect future spawning of fishes. Sediment plumes may be transported south towards coral reef communities at Po Toi, Beaufort Island and Cape D'Aguilar or north of the Ninepin Group on the southwest monsoon, potentially affecting fisheries resources over a large area.
- 12.3.60 The fish culture zones at Tung Lung Chau and Po Toi O are located approximately 5km to the west and northwest respectively of the artificial island site. Regardless, the model output does not predict any works phase impact upon these fish culture zones.

### ***Cultural Heritage***

- 12.3.61 There is no immediate evidence of archaeological remains in this area. A Custom Station (Declared Monument) was set up at Fat Tong Chau (at the mouth of Tseung Kwan O Bay) during the Song Dynasty (960-1279) to collect taxes from foreign trade ships arriving from South-east Asia. In addition, a fort (Declared Monument) was built in 1717 (Qing Dynasty) on Tung Lung Island located approximately 3km to the west of the site. The Fort was built to control and protect the marine traffic to the mainland, especially from pirates. The fort was abandoned in 1810 when its personnel moved to another fort on the Kowloon Peninsula. The fort is situated on the northeastern side of the island, 35m above the water with cliffs on three sides and commands the approach along the Fat Tong Mun channel.
- 12.3.62 A late Ming Cannon was found during dredging activities at Joss House Bay directly opposite Tung Lung Island in 1956.
- 12.3.63 Recognising the likelihood of archaeological remains in this area and the lack of archaeological data currently available for this site a detailed marine archaeological investigation should be carried out in any future studies.

### ***Landscape and Visual***

- 12.3.64 *Landscape Planning Designations* – This area of landscape is located in an Inshore Protection Area as defined by the TDSR Planning designations and the island would have a substantial impact on the intention of this designation.
- 12.3.65 *Landscape Resources* - The site lies in a marine area, so that the only landscape resource affected will be an area of offshore water. Given the low sensitivity of this resource, there will be no significant impacts on landscape resources.

<sup>6</sup> AFCD (2001). Fisheries. [<http://www.afcd.gov.hk/web/english/fisheries/fish/>].

- 12.3.66 *Landscape Character* - The island landfill site falls within the Eastern Coastal Waters Landscape Character Area. The landscape of this part of Hong Kong is expansive open water adjacent to the Clear Water Bay Peninsula, (*Figures 12.3 and 12.4*). There are no major shipping routes through this area, but a shipping lane is located in the vicinity, and the most notable features are the remote Ninepin Group of islands that is approximately 3km east of the site. The islands are steep-sided, uninhabited and covered only with grass, forming a coastal landscape which is rugged, tranquil and remote.
- 12.3.67 There exists potential for significant impacts on landscape character resulting from construction works that will introduce new artificial elements incompatible with the existing natural and tranquil landscape character. The predicted impact on landscape character during the construction/operation phase of the project will be substantial. At the end of the construction/operation phase, these impacts are likely to be reduced, as the completed island is restored and the landscape mitigation measures are fully implemented. However, the scale of the island is large and the form and the profile of the island and the coastal edge finishing will be rather artificial in nature. The character of the island is therefore incompatible with the existing natural landscape character. As a consequence, the long-term impact on landscape character will be moderate/substantial.
- 12.3.68 VSRs – VSRs affected by the island landfill are identified in *Tables 12.3 and 12.4*. The extent of the project visual envelope is shown in *Figure 12.5* and the key views to the island landfill are shown in *Figure 12.6*.
- 12.3.69 As the potential island landfill site is approximately 5km from the Clear Water Bay Peninsula, VSRs on the Peninsula will be adversely affected by the imposition of the artificial island. VSRs that will be the most affected are very few land based recreational VSRs that use the area for passive and active recreation. However, the magnitude of impact on them will be small. Other distant recreational VSRs will be affected at Shek O, Siu Sai Wan, and Clear Water Bay. Recreational VSRs using the area for marine recreation will experience substantial or moderate impacts due to their proximity to the island, although their numbers are relatively low. Other VSRs, such as travellers on vessels using the shipping route, are often transient. Overall the island will have a moderate impact during the construction/operation phase, reducing to a slight impact during the afteruse phase.

### ***Landfill Gas***

- 12.3.70 There are no sensitive receivers (targets) or pathways within 500m of the site and therefore no potential off-site landfill gas hazard. Landfill gas would have safety implications for those working on the site. In the event that the reclamation on which the landfill would be constructed is also developed for other afteruses, the potential operational phase landfill gas hazards would need to be considered for those developments.
- 12.3.71 Given the remote location of the site and the lack of any sizeable population nearby, the direct off-site use of LFG as an energy source in surrounding communities, is not considered practical. However, it will be used as an on-site energy source.

## **12.4 Environmental Protection Measures to be Incorporated into Design and Further Environmental Implications**

- 12.4.1 Environmental design measures have been identified in Part A (Section 3.8) and generic approaches to mitigating impacts on different environmental parameters are outlined in Part A (Section 5). Whilst the specific requirement for environmental mitigation would be dependent upon the findings of an EIA, the following environmental protection measures are site-specific to East Tung Lung Chau artificial island site.

### ***Air Quality***

- 12.4.2 No specific air quality mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

### **Noise**

- 12.4.3 No specific noise mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

### **Water Quality**

- 12.4.4 Mitigation is likely to be required to prevent impacts during dredging and filling for the artificial island reclamation. Construction procedures, defining the rates and method of dredging and filling taking in to account the hydrodynamics of the surrounding waters and tidal effects (ebb and flood) should be defined in the EIA. If significant impacts are predicted, a silt curtain may be installed around the immediate works area to prevent dispersion of sediments.

### **Waste Management**

- 12.4.5 No specific waste management mitigation measures are recommended at this stage, other than good site practice as described in Part A (Section 5).

### **Ecology**

- 12.4.6 It is proposed that marine vessel movements to the artificial island avoid the waters east of Po Toi due to the importance of the area as a habitat for the Finless Porpoise.

### **Fisheries**

- 12.4.7 There are no particular measures that are proposed for fisheries resource protection.

### **Cultural Heritage**

- 12.4.8 There are no particular measures that are proposed for protection of cultural heritage resources.

### **Landscape & Visual**

- 12.4.9 Landscape and visual mitigation measures are identified in Part A of the Report and are illustrated in *Figure 12.8*.

## 12.5 Summary

12.5.1 A summary of the SEA for the ETLIL is provided in *Tables 12.1 and 12.2*:

**Table 12.1: East Tung Lung Island Landfill SEA**

	Impacts	Score	Commentary
<b><i>Air Quality Assessment</i></b>			
1	Distance to areas of air sensitive land use	○	There are no air sensitive receivers (ASRs) within 500m of the artificial island site.
2	Presence of topographic features which could decrease or exacerbate impacts	○	The site does not lie within any airshed and generally experiences wind. It is unlikely that dust or odour would accumulate around the site.
3	Occurrence of meteorological conditions which could exacerbate impacts	○	Winds blow both towards and away from ASRs. No prevailing wind direction has been identified.
4	Cumulative Impacts of relevant emissions (TSP (construction), NO <sub>x</sub> , CO, SO <sub>2</sub> – LFG Flare) taking into account ambient conditions	○	The site is located in open marine waters to the east of Tung Lung Chau, with no known developments that have relevant emissions within 5km from the site.
5	Total Emissions of Air Pollutants from the territory-wide waste transportation between the RTSS and the site	○ / -	Waste will be delivered to the site by marine vessel and the cumulative distance to be travelled is estimated to be 300km.
6	Overall Impact	○ / -	Overall air quality impacts is considered to be <b>'Neutral / Negative – Low'</b> . This is because local impacts are not anticipated due to the absence of ASRs within 500m from the site but there are potential for regional impacts (from waste delivery).
<b><i>Noise Assessment</i></b>			
1	Distance to areas of noise sensitive land use	○	There are no noise sensitive receivers (NSRs) within 300m of the artificial island site.
2	Topographic Features (Only applicable if there are NSRs within 300m)	○	The site is located within open marine waters with no NSRs located within 300m from the site boundary. Therefore, this criterion is not applicable.
3	Cumulative Impacts of developments within 300m	○	There are no known developments (existing or planned) within 300m of the site.
4	Overall Impact	○	<b>'Neutral'</b>

	Impacts	Score	Commentary
<b>Water Quality Assessment</b>			
1	Water Course Diversion	○	As a marine site, no watercourse diversions are required.
2	Potential for sediment contaminant release	○	According to EPD's routine sediment quality monitoring data for nearby locations that are representative of the island site, the sediment in the artificial island area is not contaminated. As such, contaminant release is not a key issue.
3	Potential impacts on WSRs	-	<p>Dredging and reclamation activities would result in the dispersal of sediment towards WSRs in the area but no WQO exceedance would be caused in the construction phases.</p> <p>It is predicted that TIN standard in the operational phase would be breached, however, it was also breached in the baseline scenario and the elevation due to the presence of island was not significant, therefore, the island would not be the cause of the exceedance. Therefore, the water quality impact is minor.</p>
4	Potential Impacts on Groundwater	○	Marine site – no groundwater issues.
5	Potential Cumulative Impacts (Potential for concurrent projects to exacerbate preceding impacts)	-	<p>The exhausted sand borrow area at East Tung Lung Chau is currently being used for controlled marine mud disposal. Due to the proximity of the sites it is assumed that this activity would be complete before any works for the artificial island were undertaken.</p> <p>The East Ninepin Marine Disposal Area (open water) to the east of the artificial island site is currently in operation. Subject to operational details for this disposal area there may be potential for concurrent works that may give rise to cumulative impacts from sediment plume formation.</p> <p>The extent and magnitude of cumulative impacts would be considered further at the detailed EIA stage of the project.</p>
6	Overall Impact	-	<p>WSRs in the area that may be impacted are the corals and Green Turtle site at Tung Lung Chau. Impacts on other WSRs are not anticipated due to the hydrodynamics of the area. There is also some potential for cumulative effects from fill management works that have been and are currently active in the area. As the potentially affected WSRs are relatively isolated, the potential for adverse water quality impacts is considered <b>'Negative – Low'</b>.</p>

	Impacts	Score	Commentary
<b>Waste Management Assessment</b>			
1	Balance of Materials (surplus/deficit of public fill needed for landfill development)	+	The site could accommodate major volume of public fill (175Mcum) negating the need to import filling material for site formation. Dredged muds will be incorporated with the fill materials within the island footprint.
2	GHG emissions from mode of transport for delivery of waste to the site from RTSs	0 / -	Waste will be delivered to the site via marine vessel. The distance travelled from marine RTS(s) to the site has been estimated to be 300km.
3	Overall Waste Impact	0	'Neutral'
<b>Ecological Assessment</b>			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	-	The model does not predict that the works phase will give rise to any significant impact upon the Cape D'Aguiar Marine Reserve and SSSI or upon the proposed Shelter Island Marine Park / Reserve to the north. However, the hydrodynamics in the area are complex and although significant impacts are not anticipated, there is still potential that the sediment levels in the vicinity of these receivers may be come elevated.
2	Affects an important habitat	--	<p>The coral reef habitats in the coastal waters at East Tung Lung Chau and possibly to the south around the Po Toi group of islands may be affected by elevated sediment levels.</p> <p>The open waters around the artificial island site are a habitat to fisheries spawning grounds of ecological importance (i.e., many coral reef species). There have also been a number of sightings of the Finless Porpoise to the south and the Green Turtle to the north of the site.</p>
3	Affects a species of conservation importance	- / --	<p>All hard (stony) corals are protected in the HKSAR under the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187). These include many coral species found around the study area. The fish and benthic communities associated with the reefs are also of conservation importance as they are integral to functioning of a healthy reef ecosystem.</p> <p>Beyond the immediate site area, both the Finless Porpoise and the Green Turtle have been observed. Both species are protected under local and international conservation laws: WAPO, Cap. 170 and CITES Appendix I. The Finless Porpoise is also a Grade II protected species in the Mainland. These species migrate over a wide area and would be prone to direct impact from vessel disturbance / collision and from loss of habitat and possibly feeding / breeding grounds.</p>
4	Potential for Cumulative Ecological impacts on sites of recognised value	-	Any concurrent mud disposal activity at the exhausted sand borrow area at East Tung Lung Chau or the East Ninepin Marine Disposal Area may give rise to cumulative impacts on coral communities from sediment plume formation. Likewise with other fill management works that may take place in the area.
5	Overall Ecological Impact	--	Although modelling does not predict significant water quality decline associated with the works, the presence of protected areas of conservation importance, ecologically valuable coral reef habitat and associated species of conservation importance all around the potential site means the overall impact potential is ' <b>Negative – High</b> '.

	Impacts	Score	Commentary
<b>Fisheries Assessment</b>			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	-	The fish culture zones at Tung Lung Chau and Po Toi O and the proposed "Fisheries Protection Area" and "no take artificial reefs deployment area" proposed at Port Shelter are not predicted to be affected by the works.
2	Affects an important mariculture / fisheries resources (including spawning / nursery ground)	- / - -	The island area is within an important spawning ground for a number of commercially valuable fish species. This zone includes waters south and east of the site area and so may be subject to a series of effects. The waters at Port Shelter to the north form an important nursery area and although they would not be directly affected, there is potential for secondary and other effects on fisheries resources.
3	Potential for Cumulative Fisheries Impacts on sites of recognised value	-	As with ecology, there would be potential for adverse cumulative impacts (sediment induced) should concurrent fill management marine works be in progress.
4	Overall Impact	-	The immediate site area is of fisheries significance as a spawning ground, whilst the Port Shelter area to the north is also a nursery ground where fisheries protection measures including a FPA and artificial reef have been proposed. Despite this, the modelling exercise indicates that there is limited potential for adverse impact upon fisheries resources at Port Shelter. Therefore, overall: <b>'Negative – Low'</b> .
<b>Cultural Heritage Assessment</b>			
1	Important cultural (Declared, Deemed or Graded sites) / archaeological sites	○	The nearest designated site is a Declared Monument, (Fort) located on Tung Lung Chau, 3km from the site. The Fort is located high on the island, and would not be affected by the development of ETLIL.
2	Potential for archaeological value	-	The site is located in the vicinity of land based archaeological sites with links to maritime activities. Recognising the lack of archaeological data currently available at the site, it is considered that the likelihood of archaeological remains in this area is reasonable. A detailed marine archaeological investigation should be carried out in any future studies.
3	Potential for Cumulative Heritage Impacts on sites of recognised value	○	The nearest sites of cultural heritage value are land based, (on Tung Lung Chau (3km), therefore they would not be affected by this development. There are no planned or confirmed projects, which may cause cumulative heritage impacts.
4	Overall Impact	-	The potential impacts on cultural heritage are considered to be <b>'Negative – Low'</b> . Whilst there is not direct evidence of cultural heritage remains in the site area, the occurrence of remains on adjacent land increases the potential for marine archaeological finds.

	Impacts	Score	Commentary
<b>Landscape and Visual Impact Assessment</b>			
1	Implications for Landscape Planning and Designations	--	This area of seascape is located in an Inshore Water Protection Area and will have a substantial impact on the planning intention for this area. Overall impacts will therefore be High.
2	Impacts on Landscape Resources	0	As the site lies in a marine area, there will be no significant impacts on landscape resources. Overall impacts will therefore be Neutral.
3	Impacts on Landscape Character	--	Construction and operation of the island will be incompatible with the open and natural and tranquil landscape qualities of the area. Once completed, the afteruse mitigation will reduce the overall impact of the island a little. However, the landfill will still be incompatible with existing landscape character and resulting overall impacts will be Negative – High.
4	Visual Impacts	- / --	The number of VSRs affected by the site will be relatively low, but those affected have a high visual amenity resulting, from the strong natural character of the area. The most affected VSRs are a number of recreational VSRs that use the area for passive and active recreation. Generally therefore, visual impacts will be Negative – Low/High.
5	Overall Impact	--	Overall, landscape and visual impacts will be <b>'Negative – High'</b> for the following reasons: <ul style="list-style-type: none"> <li>• The Inshore Water Protection Area will be impacted upon.</li> <li>• No significant landscape resources are affected;</li> <li>• The open, natural and isolated landscape character of the Eastern Coastal Waters and the Ninepin will be substantially compromised;</li> <li>• There are low numbers of residential VSRs within the visual envelope of the site and a very small number close to it.</li> </ul>
<b>Landfill Gas Assessment</b>			
1	Distance between the new / extended landfill and SRs	0	The nearest sensitive receivers are >250m from the site.
2	Number of Receivers within 250m (i.e. the LFG Consultation Zone)	0	There are no sensitive receivers within 250m of the site.
3	Man Made Pathways for LFG Migration	0	None.
4	Natural (e.g. Geological) Pathways for LFG Migration	0	None.
5	Additional Utilisation of LFG to Reduce Greenhouse Gas Emissions	0	There are no potential users of LFG (other than on-site use)
6	Overall Landfill Gas Impact	0	<b>'Neutral'</b>



**Table 12.2 Summary of East Tung Lung Island Landfill SEA**

<b>Overall Impacts</b>	<b>Score</b>	<b>Commentary</b>
Overall Air Quality Impact	<b>O / -</b>	Neutral / Negative – Low
Overall Noise Impact	<b>O</b>	Neutral
Overall Water Quality Impact	<b>-</b>	Negative – Low
Overall Waste Management Impact	<b>O</b>	Neutral
Overall Ecological Impact	<b>- -</b>	Negative – High
Overall Fisheries Impact	<b>-</b>	Negative – Low
Overall Cultural Heritage Impact	<b>-</b>	Negative – Low
Overall Landscape & Visual Impact	<b>- -</b>	Negative – High
Overall Landfill Gas Impact	<b>O</b>	Neutral

**Table 12.3 Assessment of Significance of Visual Impacts for East Tung Lung Island Landfill During Construction / Operation Phase  
(Note: All impacts adverse unless otherwise noted)**

Identity No. of VSR	Key Visually Sensitive Receiver (VSR)	Approx Minimum Distance Between VSR and Source(s)	No.s of Receivers (order of magnitude only)	Magnitude of Impact During Construction / Operation (Negligible, Small, Intermediate, Large)	Receptor Sensitivity (Low, Medium, High)	Impact Significance before Mitigation Measures (Insubstantial, Slight, Moderate, Substantial)	Significance of Residual Impacts (Insubstantial, Slight, Moderate, Substantial)
<i>Residential Receivers</i>							
VR92	Siu Sai Wan	8km	Many	Intermediate	High	Moderate to Substantial	Moderate
<i>Recreational Receivers</i>							
VR68	Shek O	9km	Many	Intermediate	Medium	Moderate	Slight
VR69	Clear Water Bay	5km	Many	Large	Medium	Substantial to Moderate	Moderate
VR69a	Clearwater Bay Golf Course	2.7km	Few	Large	Medium	Substantial to Moderate	Moderate to Substantial
VR71	Leung Shuen Wan Chau (High Island)	12km	Very Few	Small	Medium	Moderate to Slight	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0.5 – 10km (Varies)	Few	Intermediate	Medium	Substantial	Substantial to Moderate
<i>Travelling Receivers</i>							
VR49	On Vessels using the Shipping Lanes	0.5 – 10km (Varies)	Very Few	Intermediate	Low	Slight to Moderate	Slight

**Table 12.4 Assessment of Significance of Visual Impacts for East Tung Lung Island Landfill During Afteruse Phase**  
(Note: All impacts adverse unless otherwise noted)

Identity No. of VSR	Key Visually Sensitive Receiver (VSR)	Approx Minimum Distance Between VSR and Source(s)	No.s of Receivers (order of magnitude only)	Magnitude of Impact During Afteruse (Negligible, Small, Intermediate, Large)	Receptor Sensitivity (Low, Medium, High)	Impact Significance before Mitigation Measures (Insubstantial, Slight, Moderate, Substantial)	Significance of Residual Impacts (Insubstantial, Slight, Moderate, Substantial)
<i>Residential Receivers</i>							
VR92	Siu Sai Wan	8km	Many	Intermediate	High	Moderate to Substantial	Slight to Insubstantial
<i>Recreational Receivers</i>							
VR68	Shek O	9km	Many	Intermediate	Medium	Moderate	Slight to Insubstantial
VR69	Clear Water Bay	5km	Many	Large	Medium	Substantial to Moderate	Slight to Insubstantial
VR69a	Clearwater Bay Golf Course	2.7km	Few	Large	Medium	Substantial to Moderate	Moderate to Slight
VR71	Leung Shuen Wan Chau (High Island)	12km	Very Few	Small	Medium	Moderate to Slight	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0.5 – 10km (Varies)	Few	Intermediate	Medium	Substantial to Moderate	Moderate
<i>Travelling Receivers</i>							
VR49	On Vessels using the Shipping Lanes	0.5 – 10km (Varies)	Very Few	Intermediate	Low	Slight to Moderate	Insubstantial