

14. TAI LONG WAN OFFSHORE ISLAND LANDFILL

14.1 Basic Information

Project Title

14.1.1 Tai Long Wan Offshore Island Landfill (TLWOIL) – marine site M.9.

Nature of Project

14.1.2 The Project would form a new marine based waste disposal site in waters located within Tai Long Wan Offshore (*Figure 14.1*).

14.1.3 The TLWOIL would require the construction of an artificial island of approximately 875ha 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. The Tai Long Wan Offshore waste disposal facility would be constructed as a “stand alone” facility, procured through competitive tendering. Construction works would be as described in Part A; Section 3.2.

Location and Scale of Project

14.1.4 The TLWOIL is located approximately 8km to the east of Tai Long Wan. Approximately 380Mcum of fill material will be required to construct the artificial island, with a final site formation level to around +6mPD. The capacity of the landfill site would be in the order of 140Mcum.

14.1.5 Seabed levels in this area vary from 20 to 35m below Chart Datum. There would be a requirement to dredge some 15Mcum of marine muds in the construction of the seawall.

History of Site

14.1.6 The TLWOIL is located within open marine waters and is to be formed entirely as part of this project. There has been no previous development activity within the site area.

Number and Types of Designated Projects Covered

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

14.2 Outline of Planning and Implementation Programme

14.2.1 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 14.2*. Assuming landfill operations start in 2022, the TLWOIL would be full during the period 2040 to 2050, depending upon the rate of waste arisings and the number of other landfills operating concurrently.

14.2.2 The site is not currently 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.

14.2.3 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.

14.2.4 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 marine park and marine conservation areas in the coastal areas of Port Shelter.

14.3 Possible Impacts on the Environment

14.3.1 Possible impacts on the environment during the construction, operation and aftercare phases of the TLWOIL are outlined below. *Figure 14.1* provides details of identified sensitive receivers. The individual assessments are summarised in *Tables 14.1 and 14.2*.

Air Quality

- 14.3.2 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.
- 14.3.3 No Air Sensitive Receivers (ASRs) are found within a 500m radius from the boundary of this site: the closest one being Sai Kung East Country Park which is located some 7km east of the site boundary. Thus, no significant air quality impacts associated with reclamation, operation and construction of the landfill facility within the site are anticipated.
- 14.3.4 The site lies in an open marine area, with no known developments (existing or planned) within 5km from the site boundary. The build-up of air pollutants is not anticipated.
- 14.3.5 Marine vessels will be used for delivering waste to the site. The amount of air pollutants emitted from the territory-wide waste delivery to the site will be less compared to a land based site that relies on road transport. However, 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 490km. Given the distance to be travelled, the regional air quality impacts may be moderate.

Noise

- 14.3.6 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.
- 14.3.7 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.
- 14.3.8 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.
- 14.3.9 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 landfilling operations.
- 14.3.10 The site can only be accessed by marine traffic during both operation and construction phase. Noise from land based waste delivery vehicles is not a concern for this site.

Water Quality

Baseline Conditions at the Site

- 14.3.11 The site is located at the eastern-most waters of Hong Kong at the mouth of Mirs Bay, and falls within the Mirs Bay Water Control Zone. It is sited in the exposed waters approximately 6km east of the Sai Kung Peninsula, and to the south of the Dapeng Bandao (within Mainland waters). The current in the vicinity of the artificial island site is weak during both the dry and wet seasons, with a flow of < 0.5m/s. The strongest current in the area is the dry season flood tide from the northeast.
- 14.3.12 EPD routine marine water and sediment quality monitoring is undertaken at stations MM15 and MS15 some 2km southwest of the island site. The monitoring data obtained from these two stations indicates that the marine water quality is good, with full compliance with the WQOs for dissolved oxygen (DO), total inorganic nitrogen (TIN), un-ionised ammonia and *E-Coli* for the past three years.¹ Likewise, the marine sediment in the area is of good quality, with no exceedance to the Lower Chemical Exceedance Level. The sediment is thus suitable for open sea disposal and the potential for impacts associated with contaminated muds is considered limited.

Key Issues and Sensitive Receivers

- 14.3.13 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).
- 14.3.14 A number of Water Sensitive Receivers (WSRs) are present in the vicinity of the site. These include:
- Secondary contact recreation subzone along the eastern coastline of the Sai Kung Peninsula from Sha Tau Kok to Tung Lung Chau including the coastline of Bluff Island, Fu Tau Fan Chau Wang Chau and Basalt Island;
 - Gazetted beaches at Clear Water Bay; and
 - Ungazetted beaches at Tai Long Wan.
- 14.3.15 In addition, there are a range of aquatic and inter-tidal ecological receivers in the vicinity of the site that would 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:
- SSSIs at Tai Long Wan, Bluff Island / Basalt Island, and the Ninepin Group;
 - Proposed Sheltered Island Marine Park / Reserve;
 - Potential Marine Park / Reserve at Bluff Island and North & South Ninepin;
 - Potential Marine Park / Reserve at Long Ke Wan and Pak Lap Wan;
 - Potential Marine Park / Reserve at Tai Long Wan;
 - Coral and Green Turtle habitats near Ninepin Group, Basalt Island, Ching Chau and Tung Lung Chau; and
 - Fish culture zones at Tap Mun and Kau Lau Wan.

¹ EPD, *Marine Water Quality in Hong Kong for 2000*, (EPD 2000)

Reclamation and Site Formation

- 14.3.16 Dredging of some 15Mcum of uncontaminated sediment is proposed for the site development, and there will be reclamation works to create a site footprint of around 875ha. Sediment handling for these activities may give rise to potential water quality impacts from increased suspended solids and reduced dissolved oxygen levels in the water column. Whilst dredging is proposed for this site, EPD data shows that the sediment quality in this area is uncontaminated with no potential for contaminant release.
- 14.3.17 The placement of fill for island construction may lead to localised increases in suspended solids levels. The modelling in the Water Quality and Hydrodynamic Assessment Report indicates that the impacts of island construction on SS are fairly small and at no time do the predicted levels approach or exceed WQO. In addition, the predicted sedimentation rates at the surveyed corals are well below the assessment criterion of 100/m²/day. The highest SS level increase is predicted to occur at SC14 (4.83%) during the Phase 2 construction dry season.

Hydrodynamic and Water Quality Impacts Following Island Formation

- 14.3.18 It is predicted that the island would not cause any significant differences (less than 3%) on accumulated flow through major channels. The presence of the artificial island may cause some localised significant changes in velocity fields in the vicinity. The modelling predicted that the presence of the island would cause an overall increase in average current velocity of 18.89% to the north and an overall reduction in average current velocity of 3.57% to the south-east.
- 14.3.19 In the hydrodynamics and water quality modelling, 34 sensitive receivers that are close to the site were selected for presentation. Of the 34 chosen indicator points, 18 are located in the Mirs Bay WCZ (MP4, FC14, MP1, FC13, GT3, SC10, FC12, SC6, FN1a, MP8, MP8b, MP9, SC8, SC12-14, SC17, SC21), 2 in Tolo Harbour & Channel WCZ (MP2, SC9), 4 in Port Shelter WCZ (MP7, SC16, GB7 and FC6), 8 in Southern WCZ (SC3, 4, 11, 18, NS6, 7, FP6, GT2) and 2 are located within the boundary of Mainland (MF, SB).
- 14.3.20 According to the dry season water quality modelling results, the predicted 90%ile DO at Hong Kong sensitive receivers for depth average and bottom layer ranged from 5.86 to 6.89mg/L which complied with the WQO of ≥ 4 mg/L for depth averaged DO and ≥ 2 mg/L for bottom layer DO. The predicted depth averaged DO levels at the 2 indicator points in Mainland waters (MF and SB) also complied with the Mainland standard of ≥ 5 mg/L.
- 14.3.21 The predicted average salinity levels in the dry season were in the range of 33.88 to 34.00ppt. The predicted levels for operational phase were comparable to baseline scenario with the largest deviation of 0.03%. These differences are minimal in comparison to the WQO of ± 3 ppt for Tolo Harbour and Channel WCZ as well as 10% for all remaining WCZ.
- 14.3.22 The predicted SS levels in the dry season ranged from 0.95 to 4.30mg/L. The largest increase in SS levels caused by the presence of the island would be at MP8b (Water Quality Monitoring Station at Tai Long Wan) with a percentage increase of 11.18%. Recognising that the WQO requires that any waste discharge should not raise the natural ambient level by 30% as well as the Mainland standard that man-made increment should not exceed 100mg/L, these differences are considered acceptable.
- 14.3.23 The predicted *E Coli* levels in the dry season at all of the selected indicator points would be 2 or less count/100mL that are well below the WQO of 610cfu/100mL as well as the Mainland standard of 200count/100mL. Compared to the baseline scenario, no notable changes were observed at any of the indicator points.
- 14.3.24 The predicted average dry season UIA (0.00178-0.00348mg/L) would be quite small in comparison to the WQO of 0.021mg/L and the Mainland standard of 0.02mg/L. The largest increase caused by this site would be at MP8b (Water Monitoring Station at Tai Long Wan) with a value of 5.23%.

- 14.3.25 The dry season TIN levels ranged from 0.0690 to 0.0958mg/L that is below the WQO of 0.1mg/L for Port Shelter and Southern WCZ and 0.3mg/L for Mirs Bay WCZ as well as the Mainland standard of 0.3mg/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 would be in the range from 0.070 to 0.1537mg/L and exceedances were found at SC3, 4, 11, 16, 18, GB7, FC6, NS6, 7, FP6 and GT2. However, the averaged baseline values (0.1026 to 0.1547mg/L) at these 11 stations also exceeded the WQO. All these stations are located in Port Shelter WCZ and Southern WCZ with an annual mean WQO of 0.1mg/L. The predicted values at the remaining stations complied with their respective WQOs. The maximum percentage increase would be at SC11 (Surveyed Corals at Po Toi Island) with value of 3.3%.
- 14.3.26 According to the wet season water quality modelling results, the predicted 90%ile DO for depth average and bottom layers ranged from 1.70 to 5.33mg/L. In Hong Kong waters, indicator points FC14 (Fish Culture Zone at O Pui Tong), MP1 (Yat Chau Tong Marine Park) and FC13 (Fish Culture Zone at Wong Wan) breached the WQO for DO in Mirs Bay WCZ while MP2 (Hoi Ha Wan Marine Park) and SC9 (Surveyed Corals near Tolo Channel) breached the Channel Subzone of Tolo Harbour WCZ for 90%ile bottom DO. However, the predicted 90%ile DO for the baseline scenario at these 5 points would also be below the WQO. The maximum percentage reduction from baseline levels for these 5 indicator points would be at FC14 (Fish Culture Zone at O Pui Tong) with value of 4.41% or 0.16mg/L. In Mainland waters, the predicted bottom 90%ile DO levels at MF (ranged from 3.63 to 5.00mg/L) and SB (ranged from 1.49 to 4.24mg/L) exceeded the Mainland standard of 5mg/L but, again, the predicted baseline values at these 2 stations also exceeded the Mainland standards. The predicted DO levels at the remaining stations complied with the WQO of ≥ 4 mg/L for depth averaged 90%ile DO and ≥ 2 mg/L for bottom layer 90%ile DO.
- 14.3.27 The predicted average wet season salinity would be in the range of 25.00 to 31.41ppt. It is predicted that the island would cause small impacts to the baseline salinity level at all of the indicator points. The largest predicted deviation would be at SC11 with a value of -1.47% or 0.39ppt. The percentage differences in salinity level caused by the presence of this site would be very small as compared to the WQO that change due to any waste discharge shall not exceed 10% of natural ambient level.
- 14.3.28 The predicted SS levels in the wet season ranged from 1.62 to 4.55mg/L. The largest increase in SS levels caused by the presence of the island was at SC11 of 3.77%. The percentage increases are small, recognising that the WQO requires that any waste discharge should not raise the natural ambient level by 30% as well as the Mainland standard that man-made increment should not exceed 100mg/L.
- 14.3.29 The predicted *E.coli* levels in the wet season at all of the selected indicator points would be 2 or less count/100mL that are very low and well below the WQO of 610cfu/100mL as well as the Mainland standard of 200count/100mL. Comparing to the baseline scenario, no notable changes were observed at any of the indicator points.
- 14.3.30 The predicted average wet season UIA (0.00302 - 0.00497mg/L) were very small as compared to the WQO of 0.021mg/L as well as the Mainland standard of 0.02mg/L.
- 14.3.31 The predicted wet season TIN levels ranged from 0.0678 to 0.2147mg/L. The largest TIN level was predicted at GT2 (Green Turtle site at Po Toi) with value of 0.2147mg/L. Comparing with baseline levels, the percentage changes ranged a between -1.66 to 4.37%, with the largest increase (4.37%) located at FC6 (Fish Culture Zone at Po Toi Island). 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 14.3.25 above. Meanwhile, for Mainland waters, the predicted TIN values (ranged from 0.0623 to 0.802mg/L) at the 2 indicator points, MF and SB, would be well below the relevant standard of 0.3mg/L.

Cumulative Impacts

- 14.3.32 It is understood that a submarine pipeline is to be installed through Mirs Bay to carry LPG from Cheng Tou Jiao (northeast Mirs Bay) to the Lamma Island power station. The pipeline will run nearby to the west of the artificial island site. These works however are due to be complete within two years of commencement (pending) and would not give rise to any potential for cumulative effects.
- 14.3.33 Whilst there are fill management activities in the general Eastern Waters area, there are no activities in the vicinity of the artificial island site. Furthermore, there are unlikely to be any future such activities in the immediate vicinity as previous investigations on behalf of CED have identified the area to be too “sensitive” (i.e., on environmental or other grounds).² The nearest areas of activity are the South of Victor Rock sand borrow area (10km south) and the adjacent East of Ninepin mud disposal area. Given the weak current in the area, there is limited potential for cumulative effects with works at these areas.

Waste Management / Disposal Impacts

- 14.3.34 For construction of the “island” on which the landfill would be located, inert C&D material would be brought in exclusively by marine vessel, from a network of barging points in the SAR. The location of barging points would vary during the filling process, according to the source of materials at any given time.
- 14.3.35 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.
- 14.3.36 Anticipated volumes of materials are as follows:
- Volume of public fill that could be accepted for island construction: 380Mcum
 - Volume of muds be dredged for outer sea wall: 15Mcum
- 14.3.37 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.
- 14.3.38 Waste delivery to the TLWOIL will be by marine vessel, which has lower GHG emission rate (per kg waste handled) than delivery by vehicle road truck. However, the cumulative distance between marine RTSs and the site is around 490km (refer to Preliminary Marine Review (March 2002)), the impacts associated with GHG emissions is considered to be moderate.

Ecology

Baseline Conditions

- 14.3.39 The site is located in offshore waters in Mirs Bay, some 6km due east of Tai Long Wan in the Sai Kung East Country Park. Coastal areas of the Sai Kung West (Extension) Country Park and the Plover Cove (Extension) Country Park are located some 14km and 16km northwest respectively. The Tung Ping Chau Marine Park is located 14km due north, whilst the Hoi Ha Wan Marine Park and the Double Haven Marine Park are located 16km and 21km northwest respectively.

² CED (2001). Map of Marine Fill Resources, Mud Disposal Areas and Major Reclamations. Fill Management Division.

- 14.3.40 It is noted that a Potential Marine Conservation Area for the area has been proposed. The Conservation Area would encompass coastal waters (-10mPD) around the East Sai Kung Peninsula from Tai Long Wan to Bluff Island and Kau Sai Chau in Port Shelter.³
- 14.3.41 Some 8km west of the site is the Tai Long Wan SSSI. Other protected areas in the broader area to the southwest include the Ninepin SSSI (14km), the Bluff / Basalt Island SSSI (14.5km) and the proposed Shelter Island Marine Reserve / Park (16km). Beyond these, the Cape D'Aguilar Marine Reserve and SSSI are 26km southwest of the artificial island site.
- 14.3.42 There have been a number of marine ecology surveys undertaken in the vicinity of the proposed TLWOIL site, including a series of surveys undertaken under the Fill Management Study – Phase IV by CED. Reference is made to these surveys as follows:
- 14.3.43 A number of underwater dive surveys were made in coastal waters between 1991 and 1994. Surveys of the northeast Sai Kung peninsula (8km northwest of the site) reported encrusting hard corals, soft coral and gorgonians. The seaweed *Sargassum* was reportedly abundant at shallow sub-tidal Tai Long Wan beach (8km west) and provided a good habitat for a range of crabs and small fish, whilst barnacles and hard coral was present at the north tip of the Bay (Tai Long Tsui Wan – 6km west). The coral communities at Breaker Reef and Shek Ngau Chau (8km north) supported a highly diverse community of reef fish, hard and soft corals.
- 14.3.44 Victor Rock (8km southeast) is a submerged rocky pinnacle and a recognised as a site of conservation importance by virtue of its diverse communities of hard and soft coral, gorgonians, sponges, holothurians, sea urchins, sea fans and fish species.
- 14.3.45 The surveys concluded that the conservation value of each of these dive sites was “high”. There have been no events in recent times that would have devalued the conservation value of these sites.
- 14.3.46 The same study concluded that the more distant coral communities at the Ninepin Group (14km southwest) and Bluff Island / Basalt Island (14.5km southwest) are also of high conservation value. These sites are characterised by diverse communities of hard and soft coral, gorgonians, sponges, holothurians, sea urchins, sea fans and fish species. It is noted that six major types of corals including all hard (stony) corals are protected in the HKSAR under the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).
- 14.3.47 For benthic community, dive surveys east of the Ninepin Group showed that the seabed was dominated by burrowing spionid polychaetes.⁴ Other abundant groups in the epi-benthic community would be echinoderms and crustaceans, whilst the scavenging gastropod *Nassarius squijorensis* was abundant at seabed areas around Basalt Island. Given the similarity in sediment character and water column depth at these locations and the proposed Tai Long Wan Offshore site, benthic community assemblages at the site are expected to be similar. From dive surveys at Breaker Reef, the benthic community at –15mPD was reported to support soft corals, gorgonians and sea anemones.⁵
- 14.3.48 There have been occasional sightings of the Black Finless Porpoise *Neophocaena phocaenoides* in offshore waters around the artificial island site. Compared with observations of this species in other offshore waters around the HKSAR, it can be concluded that the waters around the site do not form part of the core habitat for the species. The Finless Porpoise is protected under the Wild Animals Protection Ordinance (Cap. 170) and are listed in CITES Appendix I. There is some likelihood that the Green Turtle visits Mirs Bay as it has been observed at a number of locations to the southeast of the area (i.e., Tung Lung Chau, Ching Chau, Ninepin and Po Toi).

³ City Planning (2001). Study On South East New Territories Development Strategy Review: Conservation Summary. For PlanD, Govt. of HKSAR.

⁴ ERM-Hong Kong Ltd (1997d) Seabed Ecology Studies: East of Ninepins Final Report, Civil Engineering Department, Hong Kong Government.

⁵ Binnie Consulting Ltd. (1995). 1994 Hypoxia and Mass Mortality Event in Mirs Bay: Final Report. For CED.

Direct Habitat Loss

- 14.3.49 Around 875ha of benthic habitat and some 20-30m of water column over this seabed area will be lost to the island landfill development. Although the area is large, the ecological value of the seabed is not expected to be significant. The loss of water column would be reflected in loss of fisheries habitat. From available data, the area does not appear to be of particular ecological value to either the Finless Porpoise or Green Turtle.

Water Quality / Hydrodynamics

- 14.3.50 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.
- 14.3.51 There are a number of coral communities within a range of 6-8km of the island site that are of high conservation value. These communities are located in all directions to the north, west and south of the site and thus any transport of sediment in these directions will give rise to potential adverse impacts on the coral reef community. If any sediment plume that was to form were transported southeast of the site there may be potential for impacts upon a wide range of sensitive receivers from the mouth of Port Shelter to Po Toi.
- 14.3.52 During the construction phase, the model output shows that suspended sediment levels in the waters around the site may experience a marginal increase in suspended solids levels. Under a worst-case scenario for each of the three construction phases, wet season works display the highest predicted sediment levels. During Phase 1 construction the highest predicted sedimentation rate is 1.2 g/m²/day at the East Ninepin coral community (SC6). Phase 2 construction gives a worst-case scenario of 1.9 g/m²/day at the coral community near Victor Rock (SC14), whilst the worst-case sedimentation rate for Phase 3 construction is 1.4 g/m²/day – also near SC14.
- 14.3.53 The dry season sedimentation rates do not exceed 1.4 g/m²/day (predicted at SC14). In all cases the predicted sedimentation rates are not significant compared with the limit of 100 g/m²/day.
- 14.3.54 It is noted that intrusion of hypoxic water into Mirs Bay in 1994 led to deaths of a large number of marine organisms in the north of the bay, whilst the effects of hypoxia were relatively minor at Breaker Reef. This was attributed to sufficient mixing of the water column around Breaker Reef due to the greater oceanic influence in this area.⁶ Thus, there is some theoretical potential that the site may reduce water column mixing on the leeward side (north and northeast), and thereby generate more favourable conditions for stratification and a decline in water quality.
- 14.3.55 Despite this potential, the model does not predict any significant effect on ecological receivers in the vicinity of the site. The worst-case operational phase increases in suspended sediment being 0.15mg/L near the coral community at Pak Lap Wan (SC13) (southwest of the site) and 0.18mg/L near the coral community at Wong Mau Chau (SC21) (northwest of the site).

Marine Vessel Disturbance

- 14.3.56 From available data, the site area does not appear to be particularly important as a habitat for the Finless Porpoise. However, if marine vessels approach the site via the south of Po Toi group of islands there will be some potential for vessel collision with the Finless Porpoise and possibly the Green Turtle. There would also be greater likelihood for general disturbance from vessel movements through this area (e.g., vessel engine noise and vibration).

⁶ Binnie Consulting Ltd. (1995). 1994 Hypoxia and Mass Mortality Event in Mirs Bay: Final Report. For CED.

Fisheries

- 14.3.57 The broader “Eastern Waters” area is of ecological and commercial fisheries importance, although it is the inland waters between Port Shelter, Tung Lung Chau, Cape D’Aguilar and Po Toi that are by far the most productive.⁷ This area has been proposed as a fisheries spawning area. The inland waters are an important spawning ground for a number of commercially species, including *Apogon quadrifasciatus* (broadbanded cardinalfish), *Parapristipoma trilineatum* (chicken grunt), *Sebasticus marmoratus* (scorpionfish), *Trichiurus haumela*, *Upeneus sulphureus* (sulphur goatfish) and *U. tragula* (freckled goatfish). Port Shelter 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*.
- 14.3.58 In the offshore waters that are more characteristic of the artificial island site, there is still fishing activity, albeit less concentrated. The fisheries value of the waters around the site are not known as fishing effort tends to be concentrated in inland waters, although the area is likely to be of importance for natural fisheries recruitment. In support of this statement dive surveys in the area around Breaker Reef (8km north) reported a wide range of reef fish including *P. trilineatum*, tuna and mackerel. At nearby Shek Ngau Mei, “schools of *Chromis*, some wrasse and other small reef fish” were reported.
- 14.3.59 The key concern with respect to fisheries activities is the potential for sediment plume formation and transport from dredging and reclamation activities. The hydrodynamics of the area may carry sediment in almost any direction. Particularly sensitive would be the commercially valuable inshore fisheries around the Sai Kung Peninsula to the west and southwest. Beyond these waters, further inland and / or southwest, there is potential for impact upon an important fisheries spawning zone between the Ninepin Group and Tung Lung Chau that has been proposed for protection.
- 14.3.60 Whilst there are a number of fish culture zones in the broader area, those northeast of the site at Tap Mun and Kau Lau Wan (both 12km away) are the closest. Reference to the generalised water current patterns alone for the area would not suggest that these zones would be affected by any sediment plume from dredging and reclamation activities, although under the combined influence of the southwest monsoon and southeast offshore winds there is some slight potential for impact upon one or both of these zones. It is not considered likely that the other fish culture zones in sheltered areas to the southwest would be affected due to the distance and hydrodynamics.

Cultural Heritage

- 14.3.61 This site is located some distance offshore. There is no immediate evidence of archaeological remains in this area or in the near vicinity. The nearest sites of known archaeological interest are located at the Sai Kung Peninsula. The Ham Tin Archaeological Site is situated at Tai Long Wan, approximately 10km from the site. This Archaeological Site is of high archaeological interest as cultural relics of the late Neolithic and Bronze Age dated between 4,000 to 2,500 years ago have been found.
- 14.3.62 An historic shipwreck was found in the waters now occupied by High Island Reservoir (formerly known as Kwun Mun Channel) in 1974. The shipwreck, dating to late Song-early Ming Dynasties, was found during the construction of the High Island Water Scheme. Together with the shipwreck, some pottery and porcelain shards and glass beads of Indian origin were also recovered.
- 14.3.63 Given the remoteness of this site from known land based sites of cultural heritage interest, the likelihood of archaeological remains in this area appears limited. However, given the lack of archaeological data currently available for this site a detailed marine archaeological investigation should be carried out in any future studies.

⁷ ERM (1998). Fisheries Resources and Fisheries Operations in Hong Kong Waters. For AFCD, Govt. of HKSAR.

Landscape and Visual

- 14.3.64 *Landscape Planning Designations* – This area of landscape is not covered by any planning designations reflecting landscape values and so there will be no impact on these values.
- 14.3.65 *Landscape Resources* - As the site lies in a marine area, there are no impacts on landscape resources.
- 14.3.66 *Landscape Character* - The island landfill lies in the Eastern Coastal Waters LCA. This is an expansive area of open water to the east of Sai Kung Country Park, lying on the edge of the South China Sea. There are no major shipping channels in the vicinity of the site. Approximately 18km to the west of the site, is Tai Long Wan and Sai Kung East Country Park, an area of undeveloped upland countryside characterised by largely natural hillsides, coves and beaches. The offshore landscape of this area is natural, remote and tranquil.
- 14.3.67 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.
- 14.3.68 *VSRs* - VSRs affected by the island landfill are identified in *Tables 14.3 and 14.4* the extent of the project visual envelopes is shown in *Figure 14.5*.
- 14.3.69 As the site is approximately 18km from the Sai Kung Country Park, there are no VSRs close to the site. VSRs significantly affected by the island landfill are limited to recreational VSRs in Sai Kung East Country Park (principally on the Maclehoose Trail, Tai Long Wan, Sai Wan and Ham Tin Wan). Other recreational VSRs will be the visitors to the potential areas for boating, fishing, diving and other water sports activities. Other VSRs, such as travellers on vessels using the shipping route, are few in number and transient.
- 14.3.70 The VSRs will experience works on the landfill (shipping, marine vessels and partially constructed island) as relatively close artificial elements contrasting with the coherent qualities of the existing landscape. However, given the distance between the VSRs and the landfill island, the visual impacts will be generally slight to insubstantial. After the restoration of the landfill island, the visual impact of the island will be reduced further.

Landfill Gas

- 14.3.71 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.
- 14.3.72 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.

14.4 Environmental Protection Measures to be Incorporated into Design and Further Environmental Implications

14.4.1 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 this artificial island site.

Air Quality

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

Noise

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

Water Quality

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

Waste Management / Disposal Impacts

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

Ecology

14.4.6 It is proposed that marine vessel movements to the site are routed to avoid passage through areas of high ecological value, such as the Ninepin Group SSSI and the Finless Porpoise habitat the east of Po Toi.

Fisheries

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

Cultural Heritage

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

Landscape & Visual

14.4.9 *Mitigation Measures* – Landscape and visual mitigation measures are identified in Part A of the Report and are illustrated in *Figure 14.8*.

14.5 Summary

14.5.1 A summary of the SEA for the TLWOIL is provided in *Tables 14.1 and 14.2*:

Table 14.1: Tai Long Wan Offshore Island Landfill SEA

	Impacts	Score	Commentary
<i>Air Quality Assessment</i>			
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 odours 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 _x , CO, SO ₂ – LFG Flare) taking into account ambient conditions	○	The site is located in open marine waters to the west of Tai Long Wan, 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 490km.
6	Overall Impact	○ / -	Overall air quality impacts are considered to be 'Neutral / Negative – Low' . 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).
<i>Noise Assessment</i>			
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	○	'Neutral' .

	Impacts	Score	Commentary
Water Quality Assessment			
1	Water Course Diversion	○	As a marine site, no water course diversion is required.
2	Potential for sediment contaminant release	○	The sediment in the area has been proved to be uncontaminated as part of EPD's routine monitoring programme. As such, the potential for the release of sediment bound contaminants from the dredging work is considered to be limited.
3	Potential impacts on WSRs	○ / -	Water quality modeling indicates that the construction of the island may cause some increase in SS but that remains below the WQO. It is predicted that both DO and TIN standards in the operational phase would be breached, however, these were both breached in the baseline scenario and the elevations due to the presence of island were not significant, therefore, the island would not be the cause of the exceedances.
4	Potential Impacts on Groundwater	○	As a marine site, there are no groundwater issues.
5	Potential Cumulative Impacts (Potential for concurrent projects to exacerbate preceding impacts)	-	There is a proposal for installing a submarine gas pipeline linking Cheng Tou Jiao in China to the Power Station at Lamma Island. The alignment of the proposed gas pipeline may run in a close proximity to the artificial island site. If the works were to be undertaken concurrently, there would likely be cumulative water quality impacts, in particular localised increased in suspended solids. It is considered that there is potential for fill management marine activities in the area to be concurrent with development of the artificial island site. However, due to the distance involved and the hydrodynamics in the area the potential for cumulative impacts is limited.
6	Overall Impact	-	Dredging and reclamation activities may increase sediment level in the water column. The Sai Kung Peninsula to the west is a very popular beach and coastal recreation area that would be adversely affected by any decline in water quality. There is also limited potential for cumulative effects from fill management works in the waters south of the site. Primarily due to the recreational value of the Tai Long Wan inshore area the overall impact potential is 'Negative – Low' .

	Impacts	Score	Commentary
Waste Management Assessment			
1	Balance of Materials (surplus/deficit of public fill needed for landfill development)	+	The site could accommodate significant amounts of public fill (380Mcum), thus 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	-	Waste will be delivered to the site via marine vessel. The distance travelled from marine RTSS to the site is estimated to be 490km.
3	Overall Waste Impact	0	'Neutral' . Overall the site is considered to have neutral impact due to the balance of the benefit of being able to accommodate C&D surplus materials and the relatively larger amount of GHG emissions for the longer distance travelled.
Ecological Assessment			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	- / - -	There are a number of potential Marine Parks / Reserves along the coast of the Sai Kung peninsula, in addition to the existing Tai Long Wan SSSI. Whilst the numerical model does not predict any significant adverse water quality impact related to island development, there is some potential for localised impacts on ecologically sensitive coral communities in these areas.
2	Affects an important habitat	- / - -	There are coral habitats of high conservation value around the island site. The water column is of fisheries conservation value, and the sub-tidal waters around the Sai Kung East peninsula to a depth of -10mPD have also been proposed as a Marine Conservation Area.
3	Affects a species of conservation importance	- / - -	There have been very occasional observations of the Finless Porpoise in waters around the site, although given the scarcity of these sightings the impact potential is marginal. Several species of hard coral are also of conservation importance.
4	Potential for Cumulative Ecological impacts on sites of recognised value	0 / -	There is slight potential for cumulative effects on water quality in the area from possible future fill management activities at the South of Victor Rock sand borrow area and the East of Ninepin marine disposal area.
5	Overall Ecological Impact	- / - -	The coastal waters around the Sai Kung peninsula are of ecological conservation value. The number of coral reefs makes these waters particularly susceptible to increased sediment levels. Overall, there is potential for a 'Negative – Low / High' impact.

	Impacts	Score	Commentary
Fisheries Assessment			
1	Potential for secondary environmental impacts on "Areas of Absolute Exclusion"	○ / -	The nearest fish culture zones are at Tap Mun and Kau Lau Wan – some 12km northwest of the island site. The model does not predict any significant adverse effect upon these sites.
2	Affects an important mariculture / fisheries resources (including spawning / nursery ground)	-	The site is near an important fish spawning area in Eastern Waters, and an important fish nursery area in Port Shelter. However, given the hydrodynamics in the area, there is no more than a limited chance of adverse impact on these areas.
3	Potential for Cumulative Fisheries Impacts on sites of recognised value	○ / -	Given the hydrodynamics and locations of potential concurrent works at South of Victor Rock and East of Ninepin, there is only any slight potential for cumulative effects on fisheries resources.
4	Overall Impact	○ / -	The remote location of the artificial island site relative to areas of fisheries importance means that the hydrodynamics are unlikely to cause adverse impact. However, as there are sensitive areas to the northwest and the southeast there is slight potential, so overall: 'Neutral / Negative – Low' .
Cultural Heritage Assessment			
1	Important cultural (Declared, Deemed or Graded sites) / archaeological sites	○	There are no known sites of cultural heritage significance.
2	Potential for archaeological value	-	The site is remote from land based archaeological sites with links to maritime activities. Notwithstanding the lack of archaeological data currently available at the site, it is considered that the likelihood of archaeological remains in this area is low. A detailed marine archaeological investigation should be carried out in any future studies.
3	Potential for Cumulative Heritage Impacts on sites of recognised value	○	There are no planned or confirmed projects, which may cause cumulative heritage impacts.
4	Overall Impact	○	'Neutral' . The potential impacts on cultural heritage are considered to be negligible. The site is remote from land based archaeological sites with links to maritime activities. A detailed marine archaeological investigation should be carried out in any future studies.

	Impacts	Score	Commentary
Landscape and Visual Impact Assessment			
1	Implications for Landscape Planning and Designations	○	This area of seascape is not covered by any planning designations reflecting landscape/seascape values and so there will be no impact on these values. Overall impacts will therefore be Neutral.
2	Impacts on Landscape Resources	○	As the site lies in a marine area, there are no 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 remote, 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 impacts will be Negative – High.
4	Overall Visual Impacts	-	The number of VSRs affected by the island is very few and most of these are very distant. The most affected VSRs are a limited number of recreational VSRs that use the area for passive and active recreation. Generally therefore, visual impacts will be Negative – Low.
5	Overall Impact	-	Overall, landscape and visual impacts will be 'Negative – Low' for the following reasons: <ul style="list-style-type: none"> • There are no landscape designations covering the disposal site; • No significant landscape resources are affected; • The natural, tranquil and remote landscape character of the Eastern Coastal Waters will be significantly compromised; • There are very low numbers of residential VSRs within the visual envelope of the site and an extremely small number close to it.
Landfill Gas Assessment			
1	Distance between the new / extended landfill and SRs	○	The nearest sensitive receivers are >250m from the site.
2	Number of Receivers within 250m (i.e. the LFG Consultation Zone)	○	There are no sensitive receivers within 250m of the proposed extension.
3	Man Made/Natural Pathways for LFG Migration	○	None.
4	Additional Utilisation of LFG to Reduce Greenhouse Gas Emissions	○	There are no potential users of LFG (other than on-site use)
5	Overall Landfill Gas Impact	○	'Neutral' .

Table 14.2: Summary of Tai Long Wan Offshore Island Landfill SEA

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

Table 14.3 Assessment of Significance of Visual Impacts for Tai Long Wan Offshore 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>Recreational Receivers</i>							
VR70	Tai Wan Beach, Tai Long Wan/Maclehose Trail	10km	Small	Negligible	Medium	Insubstantial	Insubstantial
VR93	Sai Wan	10km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR71	Leung Shuen Wan Chau (High Island)	10km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0.5 – 15km	Very Few	Small	Medium	Moderate to Slight	Insubstantial
<i>Travelling Receivers</i>							
VR49	On Vessels using the Shipping Lanes	13km	Few	Small	Low	Slight	Insubstantial

Table 14.4 Assessment of Significance of Visual Impacts for Tai Long Wan Offshore 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>Recreational Receivers</i>							
VR70	Tai Wan Beach, Tai Long Wan/Maclehose Trail	10km	Small	Negligible	Medium	Insubstantial	Insubstantial
VR93	Sai Wan	10km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR71	Leung Shuen Wan Chau (High Island)	10km	Few	Negligible	Medium	Insubstantial	Insubstantial
VR11	Area for Boating, Fishing, Diving and other Water sports activities	0.5 – 15km	Very Few	Negligible	Medium	Insubstantial	Insubstantial
<i>Travelling Receivers</i>							
VR49	On Vessels using the Shipping Lanes	13km	Few	Negligible	Low	Insubstantial	Insubstantial