# ARTIFICIAL REEF DEPLOYMENT IN OUTER LONG HARBOUR AND EAST TAP MUN

## Project Profile

February 2000
Agriculture, Fisheries and Conservation Department

### Content

**Content** (conti.)

## *1. Introduction*

At the meeting on 8 December 1995, the Finance Committee approved the implementation of an artificial reef (AR) project to promote bio-diversity of the marine environment in the waters of Hong Kong and rehabilitate and enhance fisheries resources. Funding of HK$100 million for the AR project was approved (ref. FCR(95-96)87). The project is being implemented in two phases. The first phase involves the deployment of ARs in existing marine parks. The second phase will involve the deployment of ARs outside existing marine parks.

In Phase 1, redundant vessels, tyres, quarry rock and concrete modules are deployed as ARs in Hoi Ha Wan and Yan Chau Tong Marine Parks. Twenty boats, 216 tyre modules, 131 concrete modules and eight quarry rock ARs have been deployed. Phase 1 was completed in September 1999. The initial results are very encouraging. Juveniles of many high-value reef fish, including breams, snappers and grunts have already begun to establish impressive populations around the ARs. In addition, sizeable grouper and snapper adults have also taken up residence on several ARs. Over 110 fish species have so far been recorded on the deployed ARs.

To implement Phase 2 of the AR programme, the Artificial Reef Deployment Study was commissioned to identify suitable sites for deployment outside marine parks and to recommend AR site management plans. Five AR deployment sites were recommended at the West Sokos/Shek Kwu Chau, East Po Toi, Ninepin, Outer Port Shelter, and East Tap Mun. An extensive consultation on the recommendations of the Artificial Reef Deployment Study was conducted between July and September 1999. In response to comments received during the consultation Agriculture, Fisheries and Conservation Department is proceeding with AR deployment proposals in Outer Port Shelter and East Tap Mun and will withhold the proposals for West Sokos/Shek Kwu Chau, East Po Toi and Ninepin.

This Project Profile describes the AR deployment proposal for the Outer Long Harbour and East Tap Mun.

## *2. Basic Information*

### *2.1 Project Title*

Artificial Reef Deployment in Outer Long Harbour and East Tap Mun.

### *2.2 Purpose and Nature of the Project*

The project proposes to construct and deploy artificial reefs with the following main objectives:

1. To create habitats for hard bottom assemblages and provide protection for adult and juvenile fish resources.

2. To enhance the marine resources of the site and contribute to a Hong Kong wide enhancement of marine resources.

### *2.3 Name of the Project Proponent*

Artificial Reefs Division, Agriculture, Fisheries and Conservation Department, Government of the Hong Kong Special Administrative Region.

### *2.4 Location and Scale of Project*

The proposed area in which the artificial reefs (ARs) will be deployed is located at Outer Long Harbour and East Tap Mun. Excluding the fish culture zones, the artificial reef deployment area is approximately 1,558.0ha in size. The location of the proposed AR deployment area is shown in *Figure 2.4a.*

The proposed deployment area will be comprised of nine AR complexes. Locations of these complexes are detailed in *Figure 2.4b*. Each square-shaped complex, measuring 400m x 400m, will contain five AR groups, four located at the corners and one at the centre. Each corner group will be formed from prefabricated AR units that collectively occupy an area of 250$m^2$ on the seabed. The centre group will be made from a single quarry rock pile with basal diameter of 30m. Total footprint area of the ARs to be deployed under this project is approximately 15,400$m^2$.

### *2.5 Number and Type of Designated Projects*

The proposed project will involve works of more than 1ha in size and the boundaries of some proposed AR complexes are less than 500m from boundaries of existing fish culture zones and country parks and is thus classified as a Designated Project under Schedule 2 Part I C.2(a) (v) and (ix) of the Environmental Impact Assessment Ordinance.

### *2.6 Names and Telephone Numbers of Contact Persons*

Senior Fisheries Officer, AFCD

## *2.7 Sources of Funding and Support*

The project is funded solely by the Agriculture, Fisheries and Conservation Department, Government of the Hong Kong Special Administrative Region.

## *3. Planning and Implementation Programme*

### *3.1 Planning and Implementation*

The whole project is planned and implemented by Agriculture, Fisheries and Conservation Department. Acquisition of construction material, fabrication and deployment of AR will be carried out by a contractor to be appointed by AFCD.

### *3.2 Project Implementation*

The project is scheduled for gazettal under Section 5 of the Foreshore and Seabed (Reclamations) Ordinance in April 2000, authorization under Section 8 of the Ordinance is expected in December 2000. Contract for the works will commence in April 2001 and complete in 18 to 24 months time. The project implementation schedule is given in *Table 3.2*.

### *3.3 Design of the Prefabricated Artificial Reef Units*

Final design of the prefabricated artificial reef units to be located at the corners of the AR complexes is not yet fixed but will have the following functional requirements:

1. The artificial reef unit shall be optimally designed to enhance marine resources present in the deployment area. AR deployed will provide an appropriate combination of large void space, high surface area to volume ratio and high numbers of refugia;

2. The prefabricated artificial reef unit shall be united with no loose parts;

3. The artificial reef unit, or part of it, shall be as high as possible while satisfying the minimum depth clearance specified for its particular deployment location;

4. The artificial reef unit shall be massive; sufficient to withstand storms, current surges or trawl net towed by 1,000Kw trawlers without lateral displacement;

5. The artificial reef unit shall be made of materials that are non-polluting and durable, and constructed to ensure they remain intact for at least 20 years submerged in a marine environment;

6. The artificial reef unit shall be designed for minimal bearing pressure on the seabed to minimize sinking in soft mud; and

7. The surface of the artificial reef unit shall have a rough texture to enhance marine growth.

***Table 3.2: Project Implementation Schedule***

| | 99 | | 2000 | | | | | | | | | | | | 2001 | | | | | | | | | | | | 2002 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O |
| AR deployment gazette preparation under FSO | * | * | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Public consultation | | | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Permission to apply directly for an Environmental Permit | | | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gazette AR deployment area under FSO | | | | | | * | * | * | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Resolving objections | | | | | | | | * | * | * | * | * | * | | | | | | | | | | | | | | | | | | | | | | |
| Authorization of AR deployment under FSO | | | | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | | | | |
| AR deployment contract preparation | | | | | | * | * | * | * | * | * | * | * | * | | | | | | | | | | | | | | | | | | | | | |
| Application for an Environmental Permit | | | | | | | | | | | | | | * | * | | | | | | | | | | | | | | | | | | | | |
| Tender procedures | | | | | | | | | | | | | | | * | * | * | | | | | | | | | | | | | | | | | | |
| Contract commencement & deployment of AR | | | | | | | | | | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |

*3.4 Quarry Rock Artificial Reef*

Natural quarry rocks will be used in the formation of the central artificial reefs (in each AR complex). 90% of the rock used will be over 70kg (i.e., equivalent to approximately 30 cm x 30 cm x 30 cm in size) with maximum size not exceeding 325kg. No small rocks or "end-of-the-load" materials will be used in the building of the sea-mounts.

*3.5 Artificial Reef Deployment*

The AR units will be fabricated offsite and transported to the deployment sites by barges. A derrick will be used to lower the AR units onto the seabed in a control manner and then released. Quarry rocks will be acquired offsite and deployed using a mechanical grab. The grab load will be released on or close to (1m) the sea bottom. Differential Global Positioning System (dGPS) will be used to ensure accurate deployment of the ARs to within 5m from positions specified in the contract.

All ARs will be deployed at least 200m away from the shoreline (high water mark) and will be deployed in a depth ranging from 10 to 21m below chart datum (*Table 3.5*). Minimum water clearance, from top of deployed reef to sea surface, will be at least 9m C.D. except in close inshore areas (TM8) where a clearance of at least 5m C.D. will be maintained.

***Table 3.5 Water depths at the proposed deployment locations and maximum height of AR to be deployed***

| AR Complex* | Depth range before AR deployment (m) | Maximum height of AR to be deployed (m) |
|---|---|---|
| TM1 | 14-15 | 5-6 |
| TM2 | 13-15 | 4-6 |
| TM3 | 15-16 | 6-7 |
| TM4 | 17-19 | 8-10 |
| TM5 | 20-21 | 11-12 |
| TM6 | 17-20 | 8-11 |
| TM7 | 20-21 | 11-12 |
| TM8 | 9-16 | 4-11 |
| TM9 | 14-16 | 5-7 |

Note: * Please refer to *Figure 2.4b* for location of the AR complex

*3.6 Work Site*

No work site will be provided for the storage of raw materials and fabrication of the ARs under this project. The appointed contractor will have to have its own work site and if located in Hong Kong will be subjected to the requirements of the ordinances and regulations of the Hong Kong SAR.

## *4. Surrounding Environment and Baseline Information*

### *4.1 Geophysical Environment*

Information supplied by the Fill Management Committee of CED details the physical nature of the sediments in the proposed deployment area. From a series of boreholes taken during 1989 information was obtained on the sediment texture and particle size distribution. The records provided by CED detailed the top 30m of sediment. The table below presents the top 6m of sediment as depths greater than this are unlikely to have any impact on the stability of the ARs (*Table 4.1*). The information indicates that unlike many areas in Hong Kong much of the sediments at East Tap Mun contain a high sand content.

There are a wide variety of physical characteristics of the proposed deployment area ranging from rocky wall and large boulder habitat surrounding the islands to the mud flats in the channels between (BCL 1996).

***Table 4.1 Geophysical Information for Outer Long Harbour and East Tap Mun Artificial Reef Deployment Area***

| **Drillhole No.** | **Sediment Texture at** | | |
|---|---|---|---|
| | **0-2m** | **2-4m** | **4-6m** |
| VD1/2 | Very soft, brownish grey, silty clay with shell fragments | Greyish yellow brown, fine sand with shell fragments flakes | Medium dense, dark yellowish brown fine sand with mica |
| SMMD1/10 | Very soft greenish grey slightly sandy silty clay with some shell fragments | Very soft greenish grey sandy silt/clay to very dense silty/clayey fine fragments. | Very dense greenish grey silty/clayey fine to medium sand with some shell |
| SMMD1/16 | Very soft, greenish grey, slightly sandy to sandy silty clay with some shell fragments | Very soft, greenish grey, slightly sandy to sandy silty clay with some shell fragments | Very soft, greenish grey, sandy silty clay to sandy silt/clay with some shell fragments |

### *4.2 Wave Action*

The area east of Tap Mun is fairly exposed and is susceptible to high wave action and fast currents. The location of the proposed deployment area in east Tap Mun is, therefore, open to the effects of the seasonal northeast monsoon and occasional typhoons *(Table 4.2).*

There are no constrained areas with respect to AR deployment within the area boundary as seabed currents are not excessive and there are no scour holes.

***Table 4.2 Wave Climate of east Tap Mun at Shek Ngau Chau***

| Direction (Degree) | F (m) | d (m) | US ($ms^{-1}$) | UA ($ms^{-1}$) | H (m) | T (s) | L (m) | Sea Bed Velocity max ($ms^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| N | 1,500 | 15 | 30 | 47 | 0.9 | 2.5 | 10 | 0.000 |
| NE | 2,500 | 17 | 35 | 56 | 1.4 | 3.2 | 16 | 0.003 |
| E | 2,000 | 16 | 41 | 68 | 1.5 | 3.1 | 15 | 0.004 |
| SE | 3,000 | 18 | 41 | 68 | 1.9 | 3.6 | 20 | 0.011 |
| S | 450,000 | 20 | 35 | 56 | 6.0 | 11.1 | 146 | 1.744 |
| SW | 9,000 | 15 | 35 | 56 | 2.5 | 4.7 | 34 | 0.127 |
| W | 10,000 | 18 | 31 | 48 | 2.3 | 4.6 | 33 | 0.104 |
| NW | 1,300 | 17 | 21 | 30 | 0.5 | 2.1 | 7 | 0.000 |

Note: F = Fetch Length, d = Water Depth, US = Surface wind speed, UA = Wind-stress factor, H = Wave height, T = Wave Period, L = Wavelength.

## *4.3 Water Quality*

Two EPD water quality sampling stations, MM6 and MM17, are located close to the proposed deployment area. Results from EPD's monitoring programme over the period from 1988 to 1998 (EPD 1989-1999) have shown the following:

1. Sea bottom temperature for the area had an average annual value of 21.4$^{o}$C and a range of 11.0- 28.2$^{o}$C. The surface temperature had an average annual value of 23.3$^{o}$C and a range of 11.5 - 31.2$^{o}$C.

2. Salinity at the sea bottom had an average annual value of 32.9 ppt and a range of 28.5 - 34.6 ppt. Salinity at the surface had an average annual value of 30.9 ppt and a range of 20.2 - 34.4 ppt.

3. Dissolved oxygen at the sea bottom had an average annual value of 81.8% saturation and a range of 2.5 - 198.0% saturation. The surface had an average annual value of 101.4% saturation and a range of 67.2 - 166.0% saturation.

4. Suspended solids had an average annual sample value of 2.6mg.$l^{-1}$ and a range of 0.5 - 24.3 mg.$l^{-1}$.

## *4.4 Hard Surface Assemblages*

Dive surveys by Binnie Consultants Ltd, as part of the Coastal Ecology Studies for the Civil Engineering Department, were carried out to characterise the condition of coral communities around Hong Kong waters. The nearest survey locations to the proposed deployment area were at Shek Ngau Chau (BCL 1996).

The coral habitat around Shek Ngau Chau, east of Tap Mun, was found to be in slightly poorer condition than other parts of Mirs Bay with hard corals dominating but with less abundance and diversity (BCL 1996). Findings from these surveys also show that there is evidence of adult corals and coral breeding in the proposed deployment area, which has significant implications for the success of the artificial habitat. Any ARs deployed at the area will be sited at a minimum of 200m from the shoreline and away from existing coral reef assemblages and will in no way impact them.

*4.5 Benthic Assemblages*

A comprehensive study of the benthic communities in and around the waters of Tap Mun was undertaken as part of the Benthic Study of Hong Kong waters by Shin and Thompson (1982). This study concluded that the benthic assemblages of the eastern waters, an area inclusive of the proposed deployment area, supported communities that were polychaete dominated (73%), with the most dominant species being Aglaophamus lyrochaeta. Crustaceans were next in order of abundance (10%), followed by other groups (7%), echinoderms (6%) and molluscs (5%). Species diversity was the highest in Hong Kong with a mean number of species of $19m^{-2}$. The mean number of individuals was $88.2m^{-2}$ which is lower than the average for Hong Kong ($101m^{-2}$) and mean biomass for the area was $23g.m^{-2}$, which is low compared to the overall mean biomass for Hong Kong at $35g.m^{-2}$.

*4.6 Fisheries Resources*

Trawls conducted in the northeastern waters of Hong Kong (station T5 - Mirs Bay) recorded average catches comparable to other areas in Hong Kong that were sampled. The catches were composed primarily of the low value rabbitfish *Siganus oramin* ($<\$5kg^{-1}$). The highest catch weight was recorded during October (ERM 1998) *(Table 4.6)*.

***Table 4.6 Fisheries Resources from the Vicinity of the Proposed Site at Outer Long Harbour and East Tap Mun (ERM 1998)***

| **Species** | **% of Catch** | **Mean Weight (g)** |
|---|---|---|
| *Siganus oramin* | 43.2 | 7.00 |
| *Portunus sanguinolentus* | 7.2 | 57.7 |
| *Oratosquilla anomala* | 4.9 | 12.0 |
| *Oratosquilla nepa* | 4.5 | 15.4 |
| *Metapenaeopsis palmensis* | 4.2 | 3.9 |
| *Lagocephalus* lunaris | 3.4 | 34.1 |
| *Sepia sp* | 2.2 | 609 |
| *Polynemus sextarius* | 2.0 | 11.3 |
| *Leiognathus brevirostris* | 1.9 | 10.2 |
| *Caranx kalla* | 1.9 | 3.5 |

*4.7 Fishing Operations*

There are several home ports close to the AR deployment area, the closest being the small-scale ports in Tap Mun, Kau Lau Wan and Sham Wan. From helicopter surveys conducted between June 1996 to May 1997 it has been observed that the most common types of vessels fishing in between Tap Mun and Shek Ngau Chau area include pair and stern trawlers which exploit demersal resources plus heavy concentrations of P4/7 vessels.

The operations responsible for the majority of the catch are pair trawlers and P4 operators. Catch weights reported by the fishermen during the interviews rank very low in comparison with the rest of Hong Kong. Out of the 179 areas in Hong Kong waters where fishermen reported catches only Tap Mun reported high catches ($16^{th}$ out of 179). The other areas near to the deployment area all ranked quite low in terms of adult catch weight, Ocean Point ranked $57^{th}$, Kau Lau Wan ranked $132^{nd}$, Nam She Wan ranked $167^{th}$ and Bate & Fung Head $172^{nd}$. These areas also reported very low catches of fry (ERM 1998).

## *5. Potential Impacts on the Environment*

### *5.1 Potential Benefits in Deploying Artificial Reefs*

The potential benefits of AR deployment in Outer Long Harbour and East Tap Mun include the following:

1. To create habitats for hard bottom assemblages and provide protection for adult and juvenile fish resources.

2. The enhancement of marine resources in the area and a contribution to the enhancement of Hong Kong's marine resources.

### *5.2 Impact on Water Circulation*

The low-density of ARs precludes any impact on the overall wave climate, tidal current and sediment regimes. The volume of reefs placed in each group will make no discernible difference to the flow of water through the area. Locally the ARs may encourage scour and may cause waves to break further offshore than normal. This will only affect the immediate area of the AR.

### *5.3 Impact on Water Quality*

The placement of ARs, using the methods described in *Section 3.5*, is unlikely to cause any significant impact on water quality during deployment. Disturbance of seabed, causing a slight increase in turbidity and suspended solids, will occur during placement of ARs. This, however, will be very localized and restricted to the immediate vicinity of the ARs and very transient in duration. The overall water quality impact is therefore insignificant.

Materials selected for the building of ARs will not leach any harmful substance into the environment causing adverse impact. If boats are used they will be prepared to remove as far as possible any objectionable matters on board, such as oil and grease, following the guidelines described in *Section 6.2*. Impact of any residual oil and grease on water quality will be transient.

If concrete is to be used in the construction of the AR units it may be desirable to incorporate coal ash into the concrete mixture in order to increase strength of the concrete and to reduce the AR units' bearing pressure on the seabed. Results from Japan (Suzuki 1995), Taiwan (Kuo *et al* 1995), USA (Roethel and Oakley 1985), UK (Collins and Jensen 1995), Italy (Relini *et al* 1994), and a case study in Hong Kong (Leung *et al* 1997) have shown that trace metal leaching from coal ash/cement blocks is of little environmental concern because of the formation of a surface salt barrier. Assuming the ratio of PFA in the mixture is similar to that in the reported trials, it is unlikely that trace metal released will cause any impact to the water quality or damage to the flora and fauna of the Outer Long Harbour and East Tap Mun site.

### *5.4 Impact on Noise Quality*

Human settlements at Tap Mun and Kau Lo Wan are over 700m from the closest AR deployment sites at TM1 and TM2, respectively (*Figure 2.4b*). Works at the sites will not involve construction or percussive piling. The only noise generated will be those from a single mechanical derrick or grab used by the barge during deployment of the ARs. Noise

levels during working hours (from 0900hr to 1700hr on any day not being a general holiday) will not exceed the guidelines contained in the Technical Memorandum on "Environment Impact Assessment Process". Impact on noise quality is expected to be minimal during deployment of the ARs.

*5.5 Visual Impact*

No above-water structures will be erected during and after the deployment of ARs. At any given time during deployment, marine plants in the area will include one barge, one tub boat and upto two small shuttle crafts. The contractor is required to conduct deployment and related works during hours between 0900hr and 1700hr on any day not being a general holiday. Deployment will be scheduled to avoid the need to carried out works between 1700hr on Saturday and 0900hr of the following Monday or during public holidays. Unless weather or other conditions cause unavoidable change to this schedule the contractor would remove his vessels and plants from the deployment area at the weekend and public holidays and, where they might cause hazard to the navigation of other users, leave any uncompleted development adequately marked. Visual impact caused by the AR deploment is therefore kept to a minimal.

*5.6 Impact on Utilities*

There is an existing underwater raw water pipeline in Long Harbour running from south of Tap Mun, through Kau Lau Wan Tsui, Wong Mau Kok Tsui, Tung Sam Kei Tsui to Tai Tan (*Figure 2.4b*). Another pipeline is planned and will be laid alongside the existing one across South Channel. The existing and proposed pipelines are 500m from the closest AR complex (TM2) and are unlikely to be affected by the AR deployment using the methods described in *Section 3.5*. The AR project, during and after its implementation, will not in any way affect the construction and inspection of the proposed submarine pipeline or the present and future maintenance of the existing and proposed submarine pipelines.

No other utilities are located in the deployment area.

*5.7 Impact on Marine Traffic and Navigation*

There are no designated major shipping routes through the proposed deployment area. Although container traffic is known to pass to the east and north of the proposed deployment area, the most common vessels using these waters are local fishing vessels or those used solely for recreational purposes. As deployed ARs will have a depth clearance of at least 5m C.D. in close inshore areas (TM8 *Figure 2.4b*) where there are only small craft traffic and at least 9m C.D. in other areas they are unlikely to affect marine traffic activities in the area. As soon as deployment is completed AR depth information will be supplied to Marine Department for updating the relevant chart to aid navigation through the area.

No restrictions on passage and mooring of vessels will be implemented as a result of AR deployment in the proposed area or the area being designated as a Fisheries Protection Area (formerly known as Marine Special Area or MSA) in the future (also see *Section 5.10*).

*5.8 Impact on Benthic Assemblages*

The deployment of an AR could alter a soft bottom assemblage by producing the following alterations in the surrounding substratum:

1. The smothering of a portion of the soft bottom assemblage under the reef base;

2. Modification of the bottom current and, as a consequence, variations in the sediment size-distribution and the sedimentation rate around the reef base;

3. Change of sediment organic content through the metabolic activity of both benthic and nektonic reef assemblages; and,

4. An increase in feeding pressure on the part of the infauna due to both attracted and resident reef fish.

The benthic community in the area is not of particularly high ecological value, being typical of Hong Kong in that it is dominated by polychaetes. Although deployment of ARs may cause the above impacts it is most likely that the overall ecological value of the area (in terms of species richness and abundance) will be enhanced through AR deployment.

*5.9 Impact on Corals and Existing Hard Bottom Assemblages*

Dive surveys conducted by AFCD in December 1999 ensured only those areas void of any corals or hard surface assemblages are chosen for placement of ARs. The survey results indicated that the bottom of the proposed AR sites is void of any corals. ARs are also to be sited at least 200m away from any known corals or hard bottom assemblages. There will be no direct habitat loss of corals or hard bottom assemblages. Indirect impacts due to water quality change during deployment are also not expected since potential impact on water quality is unlikely (see *Section 5.3*). After deployment, hard bottom assemblages are expected to benefit from the additional habitat provided by the deployed ARs.

*5.10 Impact on Fishing Operations*

Once ARs have been deployed, the deployment area will become unusable for the few demersal trawlers that use the area. Proposals to manage two thirds of the AR complexes as "no-take" fisheries and the remaining one third (TM1, TM2 and TM8) as fishable, subjected to gear and season restrictions, are being considered. The operations adopted by vessels from nearby ports are mainly small-scale activities (e.g. purse seine, gill net, and hand line) which are likely to benefit from the resource enhancement brought about by the AR deployment and the exclusion of trawling activity despite the establishment of the "no-take" area.

Amendments to the Fisheries Protection Ordinance (Cap. 171) to empower the Director of Agriculture, Fisheries & Conservation to designate the proposed deployment area as Fisheries Protection Areas and to implement the necessary fisheries management measures are being pursued. It is likely that the amendment process will take two years. AR deployment at the proposed area will also take about two years to be completed. AFCD will seek to manage the AR areas through voluntary agreement with fishers prior to the implementation of the legislative amendments, which will include a fishing permit system.

*5.11 Impact on Mariculture Operations*

There are two fish culture zones located within the proposed AR deployment area (*Figure 2.4b*). TM1 is 330m from the northernmost Tap Mun FCZ and TM2 is 550m from the Kau Lau Wan FCZ. Deployment of ARs, using the methods described in *Section 3.5*, at the proposed locations will not have any impact on the mariculture activities in the area in view of the insignificant water quality impact (see *Section 5.3*).

*5.12 Impact on Adjoining Country Parks*

The AR deployment area is fringed by the Sai Kung West Country Park on the west and Sai Kung East Country Park on the south (*Figure 2.4b*). Complexes TM1 and TM2 are within 380m from the Sai Kung West Country Park while TM8 is within 250m from the Sai Kung East Country Park. As the closest ARs to be deployed are some 200m from the boundary of the country parks and submerged in marine environment of over 10m in depth, no adverse impact on the country parks is envisaged during and after deployment of ARs.

*5.13 Impact on Hoi Ha Wan Marine Park*

The Hoi Ha Wan Marine Park is situated more than 600m away from the northwestern corner of AR Complex TM1 (*Figure 2.4b*). Deployment of ARs, using the methods described in *Section 3.5*, in the proposed locations will not have any adverse impact on the water quality in the marine park during and after implementation of the project (see *Section 5.3*).

*5.14 Impact on Recreational Activities*

The Jockey Club Wong Shek Water Sports Centre is located at the southern end of Long Harbour. Recreational activities are mostly confined to Inner Long Harbour and outside the AR deployment area. Following the deployment methods and environmental protection guidelines set out in *Section 3.5* and *Section 6*, resepectively, water quality, noise and visual impacts and potential hazards on the water-based recreational activities will be either kept to a minimal or not be expected during and after implementation of the AR project.

No restrictions on passage and mooring of pleasure crafts will be implemented as a result of AR deployment in the proposed area or the area being designated as a Fisheries Protection Area in the future(also see *Section 5.10*).

*5.15 Impact on Potential Sand Borrow Area*

There are two sand deposits, totalling 80$Mm^3$ of sand reserves, to the east of the deployment area. The closest proposed artificial reef complex (TM9) is about 2km away from the western sand deposit. The deployment of AR in the proposed deployment area should not posed a problem to the extraction of sand should dredging is authorized. On the other hand, if sand dredging were allowed mean suspended sediment concentration would be about 94 $mg.l^{-1}$ in the 1-2km radius from the extraction site. This would have an impact on the AR deployed east of Tap Mun unless dredging is carried out at a low production rate and a low impact method of extraction is used. Impact assessment on the deployed ARs should be carried out if the sand reserves are to be activated.

### *5.16 Other Impacts and Considerations*

No impact on air quality or other considerations, such as hazards, waste, landscape and cultural heritage, can be identified in the implementation of this project.

## *6. Environmental Protection Measures*

### *6.1 Pollution & Litter*

The contractor to be appointed by AFCD shall carry out the work in such a manner as to minimize adverse impacts on the environment during execution of the contract. Standard pollution control clauses will be incorporated in the contract. In particular he shall arrange his method of working to minimize the effects on the environment within the works limits, adjacent areas, on the transport routes and at the loading areas.

The contractor shall take all necessary measures to ensure that:

1. Any land-based residue left shall be removed by the contractor within fourteen days whilst any sea borne refuse caused by the works will be immediately collected;

2. All waste materials, goods and substances resulting from the work undertaken by the contractor are disposed of in an environmentally friendly manner and in line with the requirements of the ordinances and regulations of the Hong Kong SAR;

3. No pollution is caused by the contractor for the purposes of carrying out the contract, either to the land or waters of Hong Kong, as defined under the ordinances and regulations of the Hong Kong SAR;

4. No visible foam, oil, grease, scum, litter or other objectionable matter shall be present on the waters within the deployment sites; and

5. Due care is taken during works to avoid unnecessary disturbance of the seabed or the creation of plumes of muddy water.

### *6.2 Preparation of Boat Prior to Deployment*

If boats are used in the construction of the AR units, the contractor shall be required to undertake various preparatory work to them. The work undertaken shall render such boats suitable for deployment as ARs by removing all items which may otherwise cause litter, pollution and potential hazards and by converting such boats into suitable substrate and shelter for marine life. The contractor shall also be required to ensure that any boat deployed as AR shall not provide unnecessary or undue hazards to divers.

In particular the contractor shall be required to remove all items, materials and substances as follows:

1. All unsecured or partially secured items, materials, stores, substances, coverings such as canvas, floor covers and debris;

2. All covers to portholes, windows (including glass), hatches and doors (including projecting hinges) to maximize numbers of openings between hull and exterior;

3. All entrances, windows, portholes and other holes, whether through the bulkheads, floor, hull or roof, of any boat, having minimum dimensions over

50cm but less than 100cm, such that a diver attempting to pass through such holes could become wedged, will be enlarged, where possible, such that the minimum dimension of the hole is increased to at least 100cm;

4. Any oils including lubricating, fuel and hydraulic oils, from all engines and machinery, hydraulic systems, fuel systems, tanks, containers and any other sources where such engines and fuel tanks are to remain on board;

5. All residual oil, by draining and washing down any oil container, including engines and tanks, with suitable degreasing agent, subsequently flushing with water and draining;

6. Wash down all surfaces of engines and all other areas of grease to remove all excess grease;

7. All air conditioners, refrigeration, and cooling equipment;

8. All insulation material including that from the lining of fish holds and cooling pipes, asbestos covers to exhausts and any metal sheeting from the lining of fish holds;

9. All floatation or buoyancy material, e.g. from buoyancy chambers, etc.;

10. All electronic and life saving equipment and items;

11. All other potentially polluting materials and substances;

12. All such parts of masts and/or superstructures, as necessary, of any boat, which may otherwise be likely to project above the required clearance depth of -5m CD or -9m CD, as the case may be, following deployment as AR; and

13. Any clearly hazardous materials, such as broken glass, exposed sharp nails or other sharp metal pieces shall not be left on board any boat prepared for deployment as an AR.

The contractor shall be required to dispose of all items, materials and substances he has removed from the boats, in an environmentally friendly manner and in line with the requirements of ordinances and regulations of the Hong Kong SAR.

*6.3 Noise and Visual Impacts*

The contractor is only allowed to conduct work related to the deployment of ARs with only one mechanical derrick or grab at any one time. Working hours shall be from 0900hr to 1700hr on any day not being a general holiday. Deployment will be scheduled to avoid the need to carried out works between 1700hr on Saturday and 0900hr of the following Monday or during public holidays. Unless weather or other conditions cause unavoidable change to this schedule the contractor would remove his vessels and plants from the deployment area at the weekend and public holidays and, where they might cause hazard to the navigation of other users, leave any uncompleted development adequately marked.

### *6.4 Deployment Duration*

The contractor shall be required to carry out and complete deployment of the artificial reefs in the shortest possible span of time so as to minimize any adverse impacts caused during deployment.

## *7. Conclusion*

Based on the review of existing ecological, physical and marine traffic information, adverse impacts to the Outer Long Harbour and East Tap Mun area are not predicted due to the deployment of artificial reefs. The potential benefits from the deployment of artificial reefs far outweigh the potential risks or impacts to the environment, facilities and existing activities.

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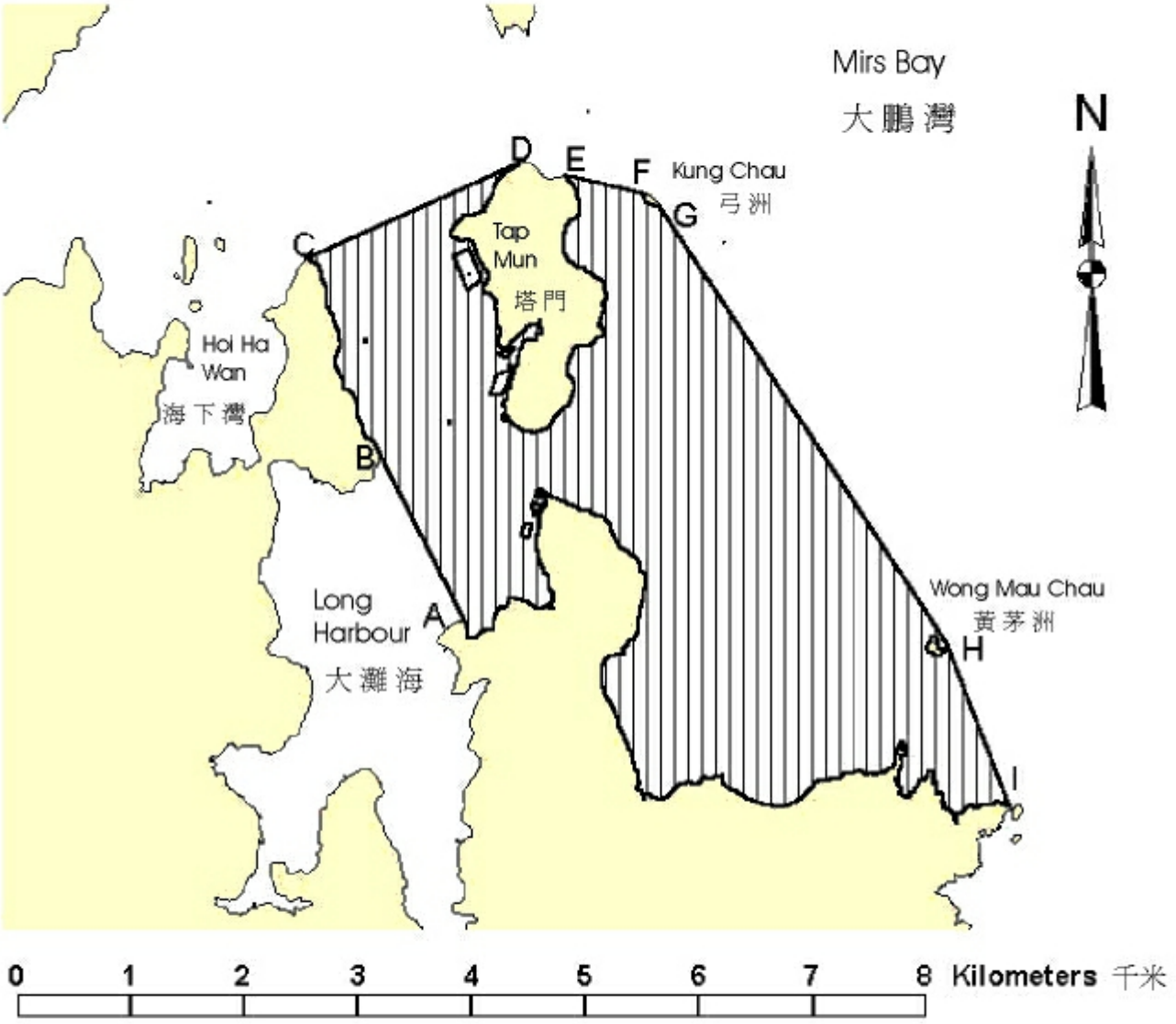
# Proposed Artificial Reef Deployment in Outer Long Harbour and East Tap Mun
# 建議在外大灘海及東塔門水域敷設人工魚礁




EDGED BLACK AREA
1558.0 HA (ABOUT) IN WHICH
15400 SQUARE METRES OF
FORESHORE AND SEA-BED
WILL BE AFFECTED
在以黑色邊線標明約
1558.0公頃範圍內面積
約15 400平方米的前濱
及海床將會受影響

| Point 點 | Hong Kong 1980 Grid 香港1980方格圖 | |
|---|---|---|
| | Northing 北距 | Easting 東距 |
| A | 834554 | 854584 |
| B | 836058 | 853800 |
| C | 837696 | 853180 |
| D | 838534 | 855055 |
| E | 838421 | 855462 |
| F | 838260 | 856172 |
| G | 838171 | 856283 |
| H | 834337 | 858838 |
| I | 832960 | 859378 |

Figure 圖 2.4b

# Proposed Location of AR Complexes in Outer Long Harbour and East Tap Mun Deployment Area

# 建議在外大灘海及東塔門水域敷設的人工魚礁位置