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***For discussion***

# Environmental Assessment Study for Backfilling of Marine Borrow Pits at North of the Brothers

## Purpose

This paper presents the findings of the Environmental Assessment for using the exhausted marine borrow area at North of Brothers as a Type 1 (dedicated) open sea disposal site for the disposal of Category M sediment that has passed biological testing, together with Category L material as a capping layer.

## Sediment Quality and Disposal

2. The New Sediment Classification Framework (NSCF) was promulgated on the 27th April 2000, as detailed in the Works Branch Technical Circular No. 3/2000, and was subsequently superseded by the Environment, Transport and Works Bureau Technical Circular (Works) (ETWB TC (W)) No. 34/2002. Under the NSCF, Lower Chemical Exceedance Levels (LCEL) and Upper Chemical Exceedance Levels (UCEL) are specified for a larger number of potential contaminants than before and biological testing has been introduced. Depending on the concentrations of the contaminants and the results of any biological testing which might be needed as a result of the contaminant concentrations, the material to be dredged will be classified as either Category L, Category M or Category H.

3. Category L material (all contaminants less than their LCEL) is deemed to be suitable for Type 1 open sea disposal sites. Category M material (one or more contaminants greater than the LCEL but less than or equal to the UCEL) which passes biological tests is deemed to be suitable for disposal at Type 1 (dedicated) open sea disposal sites where some monitoring of possible impacts will take place. Category M material which fails the biological tests and Category H material with no contaminants exceeding 10 times the LCEL must be placed in a Type 2 confined marine disposal site. Category H Material with one or more contaminants exceeding 10 times the LCEL must undergo Tier II biological testing and would require to be assigned to a Type 3 special treatment or disposal arrangement if the material failed the biological tests.

4. At present, there are Type 1 open sea disposal sites for Category L material at South Cheung Chau, South Tsing Yi Marine Borrow Area, the East of Ninepins, East Tung Lung Chau and North of Lantau, although the latter site is not currently in use. Type 2 Contaminated Mud Pits at East of Sha Chau (East of Sha Chau CMP) were established some years ago (1992) for the confinement of Category M material which fails the biological tests and Category H material (one or more contaminants greater than the UCEL). However, at present, there are no Type 1 (dedicated) open sea disposal

sites for Category M material which passes the biological tests. This material will need to be disposed at East of Sha Chau CMP and unnecessarily occupy the limited capacity for sediment needing confined marine disposal.

**Project Description**

5. The North of Brothers Marine Borrow Area (NBMBA) was excavated to provide sand fill for the new airport reclamation at Chek Lap Kok. It was dredged to depths up to -35 mPD which is approximately 20m below the surface of the adjacent seabed. The marine borrow area comprises two distinct pits, the west and east pits which as a whole are dumb-bell shaped and aligned lengthways east-west and parallel with the direction of the prevailing flood and ebb tide currents in this area, as shown in Figure 1. It is our policy to backfill exhausted marine borrow pits and to reinstate the seabed. By so doing, long term impacts on tidal flows, wave climate and the marine environment can be avoided.

6. A focussed EIA was conducted in 1998 to examine the environmental impact of proposed sand extraction further west of NBMBA and the disposal of Category L sediment at NBMBA. The NBMBA was last used in 2001/2002 for receiving Category L sediment resulting from the deepening of Pit IVc at the East of Sha Chau CMP, when approximately 9.5$Mm^3$ of material was placed at the western end of the west pit.

7. The NBMBA is currently the only readily available site considered suitable to be designated as a Type 1 – Open Sea Disposal (Dedicated Site) and thus will provide the first such facility in Hong Kong. Backfilling of Category M material passing biological testing will take place until the -29mPD level has been reached, providing a 6m depth layer of material. The Category M material passing biological testing will then be topped by 3m layer of Category L material, between the depths of –29mPD and –26mPD.

**The Environmental Assessment**

Objectives

8. The principal objective of the current study was to carry out an EA of further backfilling the NBMBA, with the assessment considering the NBMBA being operated as either a Type 1 disposal site for Category L material or a Type 1 (dedicated) site for Category M material passing biological testing. As stated above, in order to optimise the use of the pit and provide the only Type 1 (dedicated) site for Category M material passing biological testing, it has been proposed that the pit be used for the disposal of Category M material passing biological testing, with Category L material being used as a capping layer only.

9. In addition to the EA, an Operations Plan for the management of the NBMBA and an Environmental Monitoring and Audit Manual have been prepared.

The Surrounding Environment

10. The NBMBA is located in the North Western Water Control Zone (NW WCZ) which is strongly influenced by the freshwater discharge from the Pearl River Delta (Figure 1), resulting in higher and more variable suspended solids concentrations than compared to other coastal areas in Hong Kong. However, the area still supports a diverse marine ecosystem including fisheries, corals, the Indo-Pacific Humpback Dolphin, Horseshoe Crabs, artificial reefs and a marine park. Also, studies have shown that the benthos in the NW WCZ in the vicinity of the NBMBA is dominated by species which are tolerant to the naturally occurring fluctuations in suspended sediment concentrations.

11. Existing effluent discharges into the receiving waters include the Urmston Road, Pillar Point and Siu Ho Wan outfalls while Castle Peak Power Station, Shui Wing Steel and the Airport at Chek Lap Kok abstract and discharge cooling water. There is an on-going mud disposal operation at the confined disposal area at East of Sha Chau CMP but the North of Lantau open sea disposal area is currently not in use. The coastal waters are also frequented by a wide variety of vessels of different types.

12. Several sediment quality data sets including the EPD sediment quality monitoring data indicate that no significant sediment toxicity is expected in the NW WCZ and the Water Quality Objectives (WQO) for the NW WCZ are being met with the occasional exception of Total Inorganic Nitrogen (TIN), with occasional exceedances of TIN being as a result of the discharges from the Pearl River Delta rather than from local effluent sources.

Approach to the Study

13. Sediment losses to suspension, together with impacts from backfilling vessels at the NBMBA on marine traffic and the future management of the pit were the key issues in the EA. The principal impacts from the operation of the pit were expected to be the direct loss of fine sediment to suspension during backfilling and the possible resuspension of dumped material by wave action during storms. In order to assess these issues and determine the possible ultimate backfilling level, calibrated and verified tidal flow, wave and water quality models were employed. The EA considered a maximum simulated disposal rate of 100,000$m^3$/day at the NBMBA.

14. The EA also considered potential cumulative impacts by simulating concurrent disposal at the East of Sha Chau CMP and the North of Lantau open sea disposal area, both at their respective maximum disposal rates, although, as noted above, the North of Lantau open sea disposal area is currently not in operation.

15. In addition, in order to assess the worst case operational conditions, the models assumed the NBMBA to be at its maximum backfill level, when the near seabed water velocities would be largest and the possibility for any sediment losses would be greatest. Also, it was assumed that disposal operations took place only at the western extent of the west pit on the flood tide and at the eastern extent of the east pit on the ebb tide (see Figure 1), again, a worst case situation with the least potential trapping effect

of the pit.

Findings

*Suspended Sediment Concentrations*

16. The EA determined that suspended solid concentrations would remain below the WQO except in some locations where short term exceedances (less than one hour) might occur. These exceedances, however, were considered to be due to the erosion of slackwater deposits which occurs naturally. Thus, no unacceptable impact on water quality would result from the disposal operations at the assumed maximum disposal rate of 100,000$m^3$/day. While this maximum daily disposal rate is relevant to either Category L or Category M material passing biological testing, as a precautionary measure, a maximum daily limit of 26,700$m^3$, as currently adopted at the East of Sha Chau CMP, is proposed during the disposal of Category M material passing biological testing.

*Deposition*

17. The maximum predicted deposition rate was much less than the rate assumed to be harmful to sensitive marine species such as corals.

*Stability of Dumped Material*

18. The material placed in the NBMBA was found to be stable under the 1:1, 1:10 and 1:100 year storm events and erosion of material placed in the pit is not expected to take place.

*Dissolved Oxygen Concentration, Contaminant Release, Nutrient Release*

19. Assuming sediment placed in the NBMBA is representative of the highest nutrient and oxygen demand sediments identified under EPD's routine sediment sampling programme, no significant impact on water quality would be encountered and no exceedance of the WQO would occur. If Category M material passing biological testing had metal and organic contaminants at the highest permitted concentrations, any impact on dissolved metals in the receiving waters would be negligible compared to available standards for the protection of marine life.

*Marine Traffic*

20. The EA determined that maximum backfill rate assessed of 100,000$m^3$/day of either Category L material or Category M material passing biological testing can be achieved by a mixture of disposal from barges and Trailer Suction Hopper Dredgers (TSHDs) without significant impact on marine traffic. Thus, the proposed maximum daily rate of 26,700$m^3$/day for Category M material passing biological testing can also be achieved using barges or a mixture of barges and TSHDs without significant impact on marine traffic.

21. In addition, information from a recent CED consultancy study which reviewed the contaminated mud disposal strategy, estimated that on average, the volume of Category M material passing biological testing requiring disposal would be 0.16$Mm^3$ per year between the years 2003 to 2007, which is equivalent to an average of 200 to 300 barge loads each year.

22. Also, as part of the management of the disposal operations, a dedicated Web site which will allow Contractors to "post" their intended usage will be set up. All users will be required to register on the dedicated Web site their times of usage and arrange their own disposal operations accordingly, thereby reducing the risks of multiple vessel queuing.

*Capture & Culture Fisheries*

23. The predicted short term elevations in suspended sediment concentrations lie well within the natural variability around Ma Wan, the only marine fish culture zone in the study area, and would not cause exceedance of the WQO at the fish culture zone. No adverse impacts are expected at the fish culture zone or on the capture fishery in the larger study area. This conclusion is also supported by the results of environmental monitoring during the disposal of Category L sediment from the deepening of Pit IVc at the East of Sha Chau CMP.

*Human Health & Ecological Risk Assessment*

24. Detailed human health and ecological risk assessments have been carried out for the disposal operations at the East of Sha Chau CMP in the same water body as the NBMBA. The key ecological receivers (primarily the Indo-Pacific humpback dolphin, horseshoe crabs, corals and fisheries) in the wider vicinity of the NBMBA were assessed in order to ascertain any potential impacts associated with elevations in suspended solids concentrations and to a lesser extent the potential for desorption of contaminants attributable to mud disposal.

25. However, there are few corals of note within the wider study area of the NBMBA (that is, the NW WCZ) and the maximum predicted deposition rates were well below rates that are known from other studies to affect hard corals. In respect of the dolphins or their prey species, as they already live in areas naturally high in suspended solids and there are no risks to these species from the predicted suspended solids concentrations.

26. Bioaccumulation was also not considered to be a significant potential impact based upon field studies at the East of Sha Chau CMP which have not shown any contaminant increases in sediment, water and demersal fauna near the pits compared to those from distant areas and the fact that the Category M material passing biological testing to be backfilled at the NBMBA contains contaminants that are less biologically available.

27. Risk Assessments based upon the comparison of contaminants in fish with the Food Adulteration Regulations have also concluded that there is little risk to both

human and dolphins through the consumption of seafood from the ESC area. Based on these risk assessments and the results of the current environmental assessment, it is clear that the backfilling works would not pose a significant risk to human health or the local marine ecosystem.

28. In addition, as mentioned in Paragraph 3.2, the NBMBA has been used in recent years for the disposal of Category L sediment from the deepening of Pit IVc at the East of Sha Chau CMP, with disposal rates as high as 100,000$m^3$/day. Environmental Monitoring carried out during the backfilling work did not detect any significant or adverse impact, adding additional confidence to the conclusions drawn from the current study.

Mitigation Measures

29. The Operations Plan has specified that disposal can only take place at the western extent of the pits on the ebb tide and at the eastern extent on the flood tide. This measure will optimise the trapping efficiency of the pits and, therefore, minimise sediment loss to surrounding waters. In addition, as the pit will be operated as a multi-user facility, both east and west pits have been further divided into smaller target disposal zones (see Figure 1), which will also facilitate the even filing of the pit.

30. In order to further minimise any risk that sediment might be lost from the disposal operations, the Operations Plan requires that TSHDs, if used, would only dispose material down their suction arm, that the arm is located within 2m of the seabed, directed downwards, that the discharging rate should be less than 6000$m^3$/hour and has a discharging velocity of less than 1.5m/s., whichever is the lower.

31. Category M material to be placed in a Type 1 (dedicated) site will have passed biological tests using several different marine test species stipulated in ETWB TC (W) No 34/2002 and this material is not expected to exhibit any toxicity in the marine environment or result in contaminants being introduced into the marine food chain. Nevertheless, additional mitigation measures are recommended, including the requirement that the upper backfill level of Category M material passing biological testing should remain 3m below the maximum backfill level and that a 3m layer of Category L material is used to cap the pit.

32. During and after the backfilling at the NBMBA environmental monitoring and auditing will be undertaken, in addition to baseline monitoring prior to the pit operation. This will include monitoring of both the biological and physical environment. Biological monitoring will comprise benthic fauna analysis and demersal fisheries tissue contamination at six monthly intervals. Analysis and determination of sediment chemistry will be undertaken taken every three months. In addition, a Water Quality monitoring programme will be implemented. Reference to the on-going monitoring works at the East of Sha Chau CMP is also required.

33. The backfilling of the NBMBA at the maximum rates of 100,000$m^3$/day for Category L material and the proposed 26,700$m^3$/day for Category M material passing biological testing has been studied and found to be acceptable. If unacceptable impacts

are detected in the monitoring programme, the maximum disposal rates can be reduced accordingly.

**Advice Sought**

34. Members are invited to provide comments on the assessment made.

**Civil Engineering and Development Department**
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