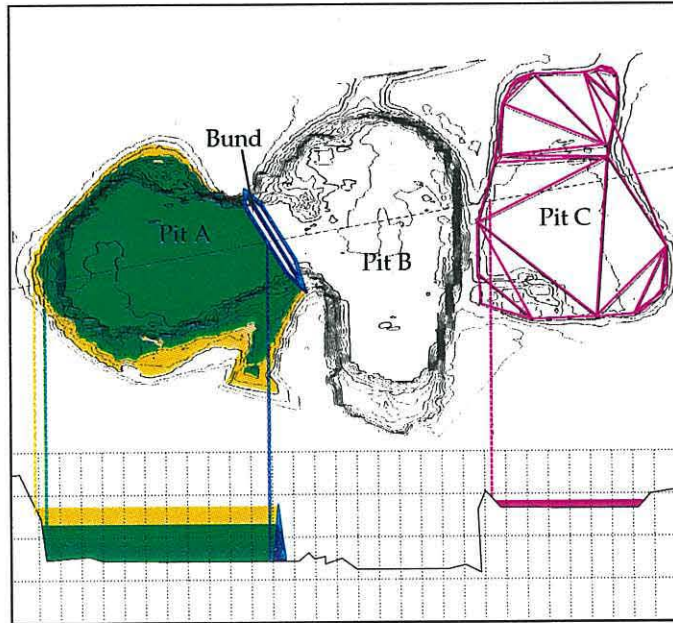


Civil Engineering Department



Environmental Impact Assessment Study for Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit

3 March 1997

EIA-106/1a

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Civil Engineering Department

Environmental Impact Assessment
Study for the Disposal of
Contaminated Mud in the East Sha
Chau Marine Borrow Pit

3 March 1997

Reference C1501

For and on behalf of ERM-Hong Kong, Ltd

Approved by: S.M. Laister

Signed: [Signature]

Position: Deputy Managing Director

Date: 3rd March 1997

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This Operations Manual describes the environmentally important aspects of utilising the exhausted marine borrow pits at East Sha Chau (CMP IV A, B and C) for the disposal of contaminated dredged materials. The Manual is intended to provide guidance in such matters as programming, civil works (eg bund construction, capping) and the procedures which can be adopted for the placement and capping of contaminated materials where they have implications for the mitigation of environmental impacts. The EM&A requirements are described in the EM&A Manual which is issued as a separate document. Both the Operations Manual and the EM&A Manual are prepared in accordance with the Study Brief for Agreement CE 81/95. This manual is intended to be a convenient compilation of largely engineering-related matters which have direct environmental implications, but the overall control of the operation will be subject to the EM&A Manual which takes precedence over the Operations Manual.

This manual does not constitute an engineering specification for utilisation of the pits, particularly with respect to programming or methods of material placement. The programming will be entirely dependent on the actual rates of delivery of contaminated mud, subject to maximum acceptable rates which have been identified in the EIA. There are several possible methods of construction of bunds and of the cap which would be equally acceptable in terms of environmental effects. The actual methods which are used will depend on a variety of factors including the sources and types of materials which are available, the manner in which they are transported to the site, the availability of plant and ancillary equipment, and commercial considerations at the time.

2 GENERAL DESCRIPTION OF PIT UTILISATION

2.1 SUMMARY HISTORY

Until 1995, when the land formation for the new airport was completed, the eastern part of the gazetted East Sha Chau Area, where the natural seabed level was approximately -6 to -8 mPD, had been extensively worked for sand to form three contiguous pits (A, B, and C) (see *Figure 2.1a*). To facilitate access by trailer dredgers to the pits, a northern access channel extending from the Urmston Road/Tuen Mun channel into Pit B had been dredged to approximately -12 mPD. A second access channel had been dredged in a southerly direction towards the airport site from the point where Pits A and B meet.

Dredging operations in Pit B ceased in February 1995. On completion of sand extraction, Pits A and B had been dredged to a level of approximately -30 to -31 mPD and Pit C had been dredged to about -44 mPD. Pit C was then partially backfilled with approximately 17 Mm³ of mud dredged from the airport site and with mud overburden removed from the adjacent Brothers MBA. Backfilling operations in Pit C ceased in May 1995, at which time the pit had been backfilled to a level of approximately -14 mPD. The three borrow pits have been identified as having the potential to receive more than 30 Mm³ of contaminated sediment, and have been designated CMP IV.

2.2 PIT UTILISATION SEQUENCE

It is intended that the Pits will be backfilled in sequence: A, B and C. The general sequence of pit utilisation and associated construction works is based on that set out in Annex 1 of the Study Brief. The main stages of the utilisation sequence are described below and are schematically illustrated in *Figure 2.2a*.

The stages described here are merely an example of the possible sequence of events which can be developed from the notional scheme described in the Brief. The key elements of the scheme, from an environmental perspective, are that Pit A will be filled with contaminated mud to a maximum level of -14 mPD following the construction of a bund to separate Pits A and B. When Pit A has been filled and disposal moves to Pit B, an initial cap will be formed over the contaminated sediment in Pit A. Pit B will also be filled to -14 mPD before capping. The mud required to form the caps to Pits A and B will be sourced from Pit C. Additional disposal capacity could be formed in Pit C, if required, by raising the level of the Pit A and B caps to the level of the original seabed.

2.2.1 Stage 1 - Preparatory works and backfilling of Pit A

Preparatory works will be undertaken prior to the placement of contaminated muds in Pit A (ie a bund to separate Pit A from Pit B and the blocking of the southern access channel to prevent migration of contaminated material). These tasks may be undertaken simultaneously. The bund will be constructed using approximately 260,000 m³ of rock fill or construction waste up to a level of at least -11 mPD. The bund need not be raised to its full height before placement of contaminated mud can commence; it need only be maintained at a level of 3 metres or more higher than the level of contaminated mud. A section of the southern access channel to Pit A will be filled with approximately 250,000 m³ of mud to a level of -6 mPD using clean grab-dredged mud.

On completion of the preparatory works, approximately 6.94 Mm³ of contaminated mud will be placed up to a level of -14 mPD in Pit A. On completion of backfilling, the contaminated mud will be initially capped to a level of -11 mPD. The mud for the cap will be obtained from Pit C which as a result will be deepened to approximately -16 mPD.

2.2.2 *Stage 2 -Preparatory Works and Backfilling of Pit B*

The northern access channel (to Pit B) will be backfilled with clean grab-dredged mud to a level of -11 mPD, (permitting continued access by loaded trailer dredgers), and a bund will be formed to raise the divide between Pits B and C from the present -13 mPD to -11 mPD. These works must be completed before Pit B has been filled to a level of -16mPD.

Pit B will be filled with approximately 12.73 Mm³ of contaminated mud up to a level of -14 mPD. Pit B will then be initially capped to a level of -11 mPD. Mud will be dredged from Pit C to provide this capping material, further reducing the level of Pit C to approximately -19 mPD. The maximum permitted daily disposal rates are 16,800 m³ for barges and 16,000 m³ for trailers.

2.2.3 *Stage 3 - Completion of Backfilling to Pits A and B, Backfilling of Access Channels*

Assuming that Pit B is capped with mud taken directly from Pit C, it will not be possible to dispose of contaminated mud for a period of approximately 6 months, since removal of mud from Pit C will be underway.

This stage will involve backfilling of the northern access channel (to -8 mPD) with clean grab-dredged material and raising the level of the rock fill (or construction waste) bund between Pits B and C to -8 mPD will be completed. Raising of the bund will require approximately 12,000 m³ of fill material.

To avoid a hiatus in disposal capacity, dredging of additional mud from Pit C may be undertaken at an earlier date, possibly in order to complete the capping of Pit A to original seabed level. Approximately 7.8 Mm³ of mud would need to be dredged from Pit C to reduce its level to approximately -30 mPD.

2.2.4 *Stage 4 - Backfilling and Capping of Pit C*

Approximately 12.13 Mm³ of contaminated mud will be placed in Pit C, filling it to a level of -14 mPD.

On completion of contaminated mud placement in Pit C, it would be capped using clean material as in Pits A and B.

2.2.5 *Stage 5 - Further Backfilling*

This stage of the proposed scheme involves backfilling Pit C's access channel to -9 mPD using clean grab-dredged mud and completion of the capping of Pit C to -9 mPD with approximately 1.5 Mm³ of clean mud from an external source.

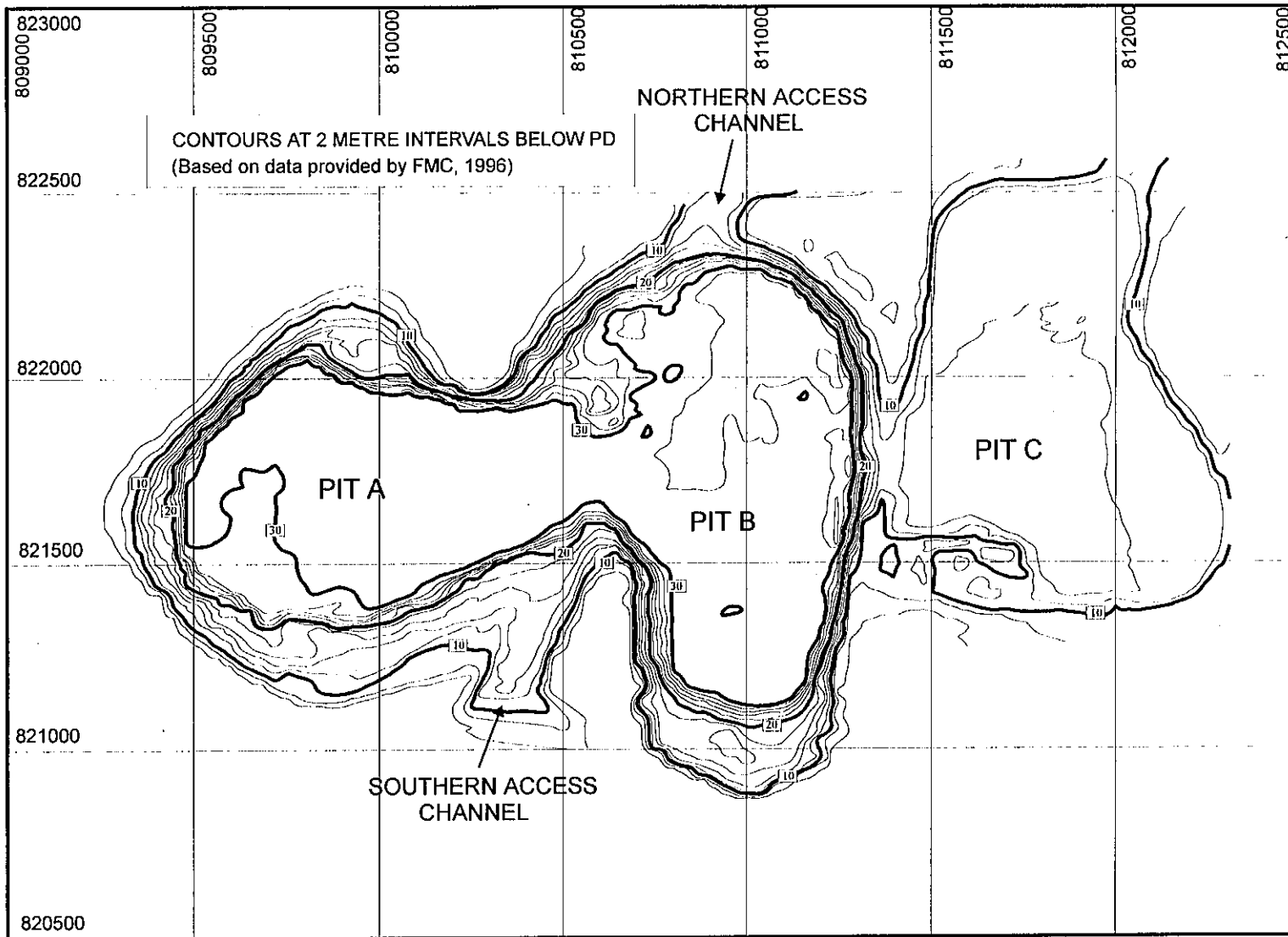
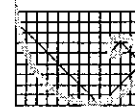


FIGURE 2.1a - EXISTING PIT LAYOUT AND BATHYMETRY

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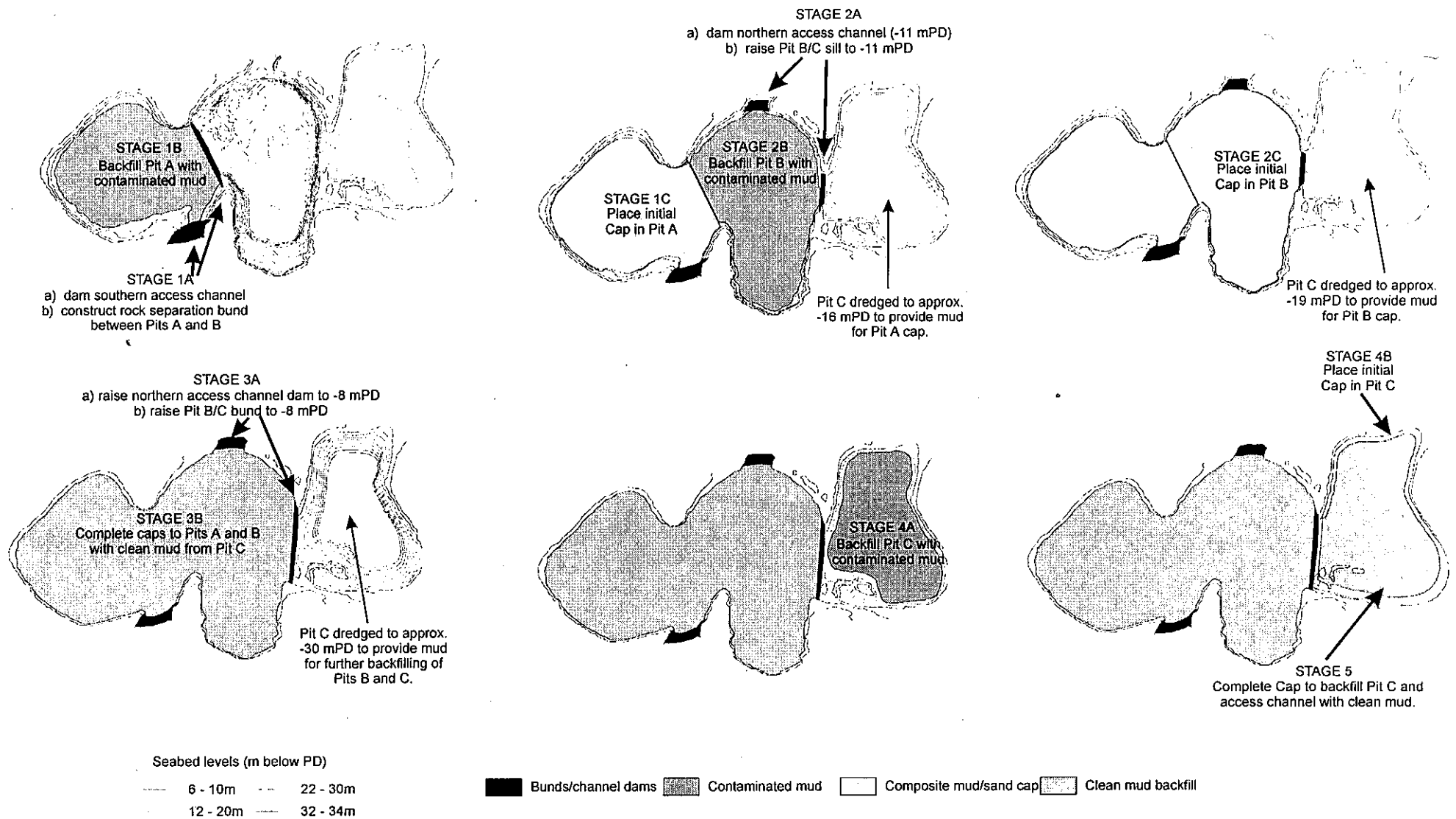


FIGURE 2.2a - PROPOSED DESIGN (BASED ON ANNEX I OF THE STUDY BRIEF)

STAGE 6 NOT SHOWN AS IT IS A LONG TERM ACTIVITY CARRIED OUT AS NECESSARY TO RESTORE THE SEABED

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2.2.6

Stage 6 - Further Capping for Pits A, B and C as Backfill Material Consolidates

In order to ensure restoration of the natural seabed and avoid generating a different wave climate over the CMP IV, it will be necessary to continue to hydraulically place clean mud in Pits A, B and C as previously placed materials consolidate over time.

As a further means of restoring the seabed and enhancing ecological diversity, depending upon ecological considerations at the time, the final layer of backfilling could be topped off with granular or mixed material.

3.1

PERMITTING AND ALLOCATION OF DISPOSAL FACILITIES

Offshore disposal is controlled under the Dumping at Sea Ordinance (1995). Works Branch Technical Circular No 22/92 sets out the procedures to be followed for all works which involve the Marine Disposal of Dredged Mud. All marine disposal is controlled by means of permits issued by the Director of Environmental Protection. The Fill Management Committee is responsible for the management and allocation of disposal facilities. The Technical Circular includes procedures for the notification of disposal requirements, the allocation of disposal sites, determination of sediment quality and application for marine dumping licences, as well as guidelines for the sampling and testing of mud which is to be dredged.

EPD Technical Circular No. (TC) 1-1-92 (*Classification of Dredged Sediments for Marine Disposal*) defines classes of dredged sediments based on analysis of seven heavy metals.

At present, dredged material which passes the criteria based on the seven metals is classified as suitable for open-sea disposal while material which fails is disposed of at East Sha Chau.

The sediment contamination criteria are presently under review and it is expected that, in addition to the introduction of additional contaminants to the chemical screening for open-sea disposal, the new system will identify criteria for a class of material which cannot be accepted for marine disposal. These revisions are not expected to impact on the manner in which disposal to CMP IV is administered or on any requirements for mitigation measures as CMP IV will only be used for the disposal of material classified as suitable for such disposal. The general permitting procedures and the allocation of responsibility to CED and EPD, respectively, for the administration of disposal resources and the issuing of dumping permits are not expected to change during the lifetime of CMP IV.

3.2

CONTAMINATED MUD PIT MANAGEMENT

The Contaminated Mud Pit Management Scheme, under which the East Sha Chau facility is operated, is administered by the Chief Engineer/Port Works of the CED. After the usual tendering procedures, CED award Pit Capping and Management Contracts to suitably experienced contractors. The Contractor provides an administration pontoon which is anchored close to the active pit and which is used as office accommodation for the CED inspectors. The Contractor undertakes the capping of the pit upon completion of backfilling, in accordance with specified methods previously agreed with CED. The Contractor also provides all necessary ancillary equipment (e.g. boats for personnel transport) and undertakes all engineering surveys required to monitor the backfilling and capping of the pits.

CED also award a contract for the Environmental Monitoring and Audit of all the operations connected with the backfilling and capping of the pit. The EM&A Consultant undertakes the monitoring and audit in accordance with procedures which, previously, have been the subject of agreement between CED and EPD. In the case of CMP IV, the EM&A programme will similarly be subject to agreement by CED and EPD and the procedures are specified in the EM&A Manual produced during this Study.

Therefore, essentially, no changes to the overall administration and management structure are envisaged for CMP IV. The structure is schematically illustrated in *Figure 3.3a*.

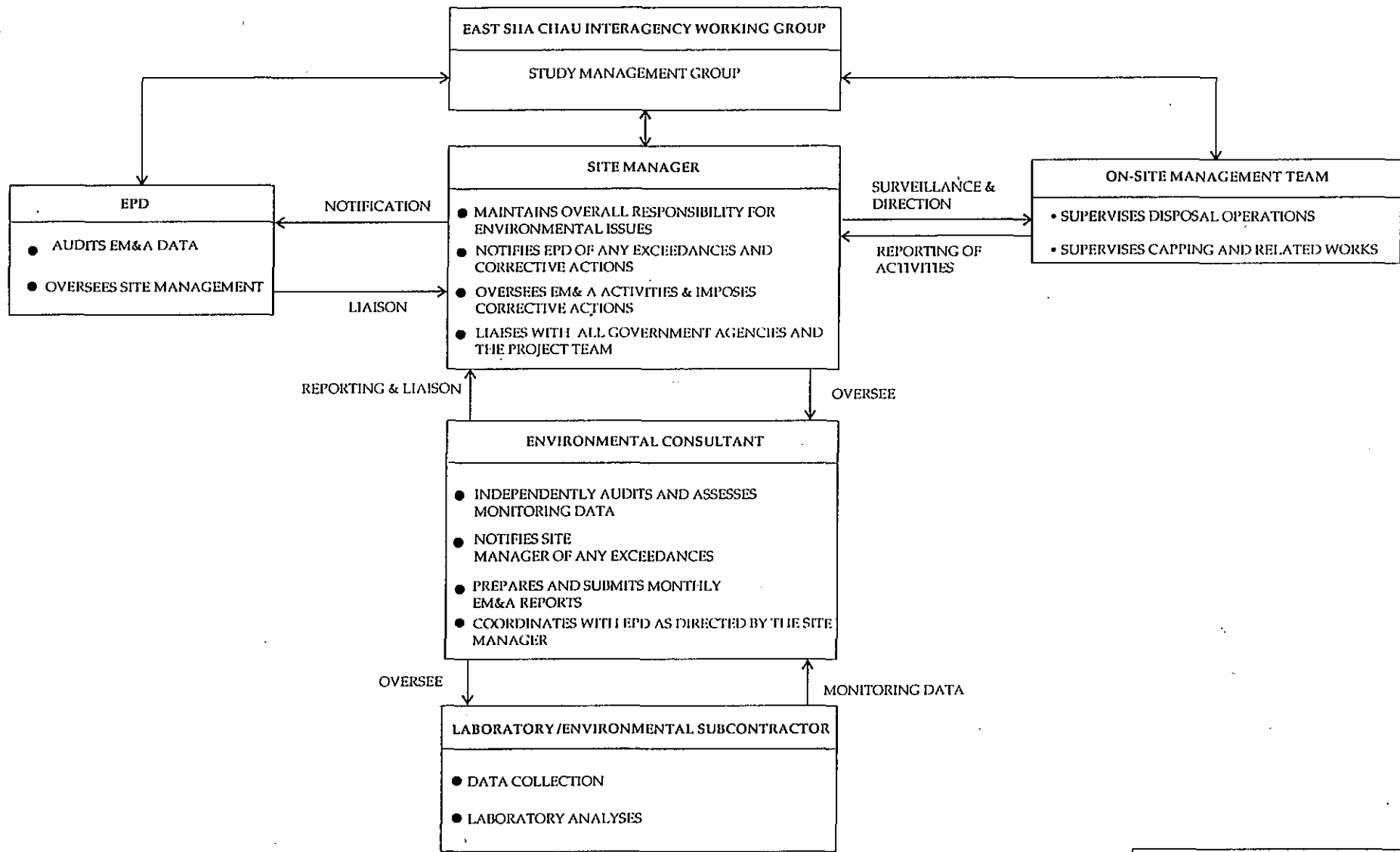


FIGURE 3.3a - OUTLINE OF CMP IV MANAGEMENT AND ADMINISTRATION STRUCTURE

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4 PLACEMENT OF CONTAMINATED MUD

4.1 RATE OF DISPOSAL

FMC estimate that there will be a requirement to dispose, on average, of about 6 Mm³ of contaminated dredged sediment per annum up to the end of the year 2002 after which disposal volumes may decrease. This is equivalent to a daily disposal rate of 16,800 m³ for barges and 16,000 m³ for trailers which, as described in *Section 8.6* of the EIA, is considered to be an acceptable rate which will not give rise to adverse environmental effects. The site will be operated in accordance with present practice and will receive materials on a 24 hour per day, 7 day per week basis except during the Lunar New Year holiday. Oceanic and climatic constraints are discussed in *Section 4.4.3*.

4.2 BACKFILLING LEVEL

The Pits may be filled with contaminated mud to a level no higher than -14 mPD.

4.3 INDICATIVE DISPOSAL VOLUMES

The barge/hopper volumes of contaminated mud which are expected to be accommodated in Pits A and B are 6.94 and 12.73 Mm³ respectively, assuming that mud is placed up to -14 mPD. The volume indicated for Pit A makes allowance for approximately 2.2 Mm³ of clean material which has recently been dredged to form Pit IIIc and was placed in Pit A.

The void volumes and placed hopper volumes for Pit C are given as a range since the volume of contaminated mud which can be placed in Pit C will depend on how much of the existing clean backfill is removed for use elsewhere before placement of contaminated mud commences. Both the low and high volume values assume that approximately 2.6 Mm³ of clean mud will be placed in Pit C during the formation of Pit IIIc. If all of the materials used to backfill the access channels and form the mud caps to Pits IIIc and IIIc and Pits CMP IV A and B are sourced from CMP IV C, a void of approximately 4.05 Mm³ would to be formed allowing approximately 3.89 Mm³ of contaminated mud to be placed. These volumes could be increased significantly if material from Pit C is added to the caps of Pits A and B to raise them to the level of the surrounding seabed. If this were to be done, the potential capacity of Pit C to receive contaminated materials could be increased to about 12.13 Mm³.

The total capacity of all three pits to receive contaminated mud is likely to be between 23.56 and 31.80 Mm³ of contaminated mud (hopper volume) depending on the manner in which they are exploited.

The estimated volumes which can be accommodated in CMP IV are summarised in *Table 4.3a*.

Table 4.3a *Estimated Contaminated Mud Backfill Volumes for CMP IV*

Pit	Cumulative Void Volume (Mm ³)	Placed Hopper Volume (Mm ³)
A	7.22	6.94
B	13.24	12.73
C	4.05 - 12.62	3.89 - 12.13

4.4 *PLACEMENT METHODS AND CONSTRAINTS*

4.4.1 *Method of Placement of Contaminated Material*

The management arrangements for East Sha Chau are defined in the FMC *General Conditions of Allocation, Appendix B - Requirements for Contaminated Mud Pit Management Scheme*. These may be refined from time to time. Full details of proposed changes to the existing procedures are set out in the Operations Manual for Alternative Dumping Procedures submitted to CED, Port Works Division, under Agreements CE 41/95 and 66/95. Those procedures are expected to be implemented in Spring 1997, and the Operations Manual for Alternative Dumping Procedures will be finalized, taking into account any modifications to the procedures following implementation.

The hopper density of trailer dredged material should be similar to that of grab-dredged material and/or material loss rates for trailers should be maintained at or below the modelled loss rate of 5%. It is proposed to assess loss rates for trailers at East Sha Chau through field trials involving *in situ* measurement. If it is determined that loss rates are higher, an alternative method of placement, such as disposal down the trailer arm or other appropriate device, may be required.

4.4.2 *Method of Placement of Capping Materials*

In order to minimise the disturbance to contaminated materials, the materials used for capping must be placed using hydraulic methods. With hydraulic placement, the rate of sediment release can be controlled and sediments are placed more gently on the seabed, thus resulting in less disturbance of previously placed material.

It is recommended that periodic bathymetric monitoring of the completed pit caps, as is carried out at the existing CMPs, should be continued for the purposes of ensuring cap integrity is maintained.

4.4.3 *Oceanic and Climatic Constraints*

The existing procedures for the termination of disposal operations due to oceanic and climatic conditions will continue⁽¹⁾. Under these procedures, operations at the pits cease immediately when the No 3 Typhoon Signal is hoisted by the Royal Observatory or when adverse weather or other conditions are such that the CED Pit Management Team considers that its management duties cannot be discharged properly. No additional oceanic or climatic constraints were identified by the EIA.

⁽¹⁾ Handbook for Management of Contaminated Mud Disposal, Port Works Division, Civil Engineering Department, July 1993.

MITIGATION MEASURES

5.1

GENERAL MEASURES

The following general measures should apply at all times to the backfilling operations:

- dumping should take place in strict compliance with the conditions of the *EPD Marine Dumping Permits* and the *FMC General Conditions of Allocation, Appendix B - Requirements for Contaminated Mud Pit Management Scheme* which are in force at the time;
- all barges and trailers should be fitted with tight seals to their bottom openings in order to prevent leakage of material during transport;
- all barges and trailers should be filled to a level which ensures that material does not spill over during transport to the disposal site and that adequate freeboard is maintained to ensure that the decks are not washed by wave action;
- after discharge, barges and trailers should immediately be closed before moving from the disposal area;
- after discharge, any excess materials should be cleaned from decks and exposed fittings before the vessel is moved from the disposal area;
- the contractor(s) should ensure that the works cause no visible foam, oil, grease, litter or other objectionable matter to be present in the water within and adjacent to the disposal site.

5.2

SPECIFIC MEASURES

The Operations Manual has been formulated in order to minimise the effects on the environment of the East Sha Chau pits and the surrounding area, particularly with respect to loss of sediment to the water column and effects on water quality and the surrounding seabed. The design specifications given in *Section 4* of this Operations Manual also act as mitigation measures which can be adjusted should unacceptable impacts be detected.

Potential adjustments include:

- reduce the maximum daily disposal rate;
- backfill only during more favourable tidal conditions;
- utilize alternative disposal methods (eg, disposal through the trailer arm) to reduce losses.

The timescale of pit utilisation will be dictated by the rate at which contaminated materials are expected to be generated. The following assumptions have been used to derive an indicative programme:

- preparatory works will commence prior to contaminated mud disposal;
- contaminated mud disposal will commence in August 1997; and
- the average rate of delivery of contaminated mud will be of the order of 6 Mm³ year⁻¹ (barge or hopper volume).

The programme is presented in *Figure 6.1a*. The main programme will terminate between late 2002 and late 2003, depending on the amount of material which can be placed in Pit C, with the completion of the initial cap to Pit C. Stage 6, which will comprise the adding of further material to the caps to compensate for consolidation settlement, will continue as a long-term activity dependent on the rate of consolidation and the availability of materials.

It is stressed that the programme presented in *Figure 6.1a* is tentative and is based on the assumed 6 Mm³ per year delivery rate of contaminated sediments. Key dates, relative to the commencement and termination of contaminated mud placement in each pit, at which certain operations might commence or be completed, are listed below in time order:

- the construction of the bund separating Pits A and B must be commenced sufficiently early to ensure that the bund is at a level of at least -27 mPD when placement of contaminated mud commences in Pit A; thereafter, construction of the bund must proceed at a rate which ensures that it is at all times at least three metres above backfill level in order to avoid loss of contaminated mud to adjacent Pit B;
- the backfill at the northern end of the southern access channel from Pit A towards the airport site must be in place before the contaminated mud backfill level in Pit A reaches -18 mPD;
- the backfill at the southern end of the access channel leading north from Pit B must be in place before the contaminated mud backfill level in Pit B reaches -17 mPD;
- the divide between Pits B and C must be raised to a level of at least -11 mPD before the contaminated mud backfill level in Pit B reaches -14 mPD;
- if the backfill material is to be sourced from Pit C, the backfilling of the northern and southern access channels (behind the backfilled entrances) must be completed before Pit C is required for disposal of contaminated mud.

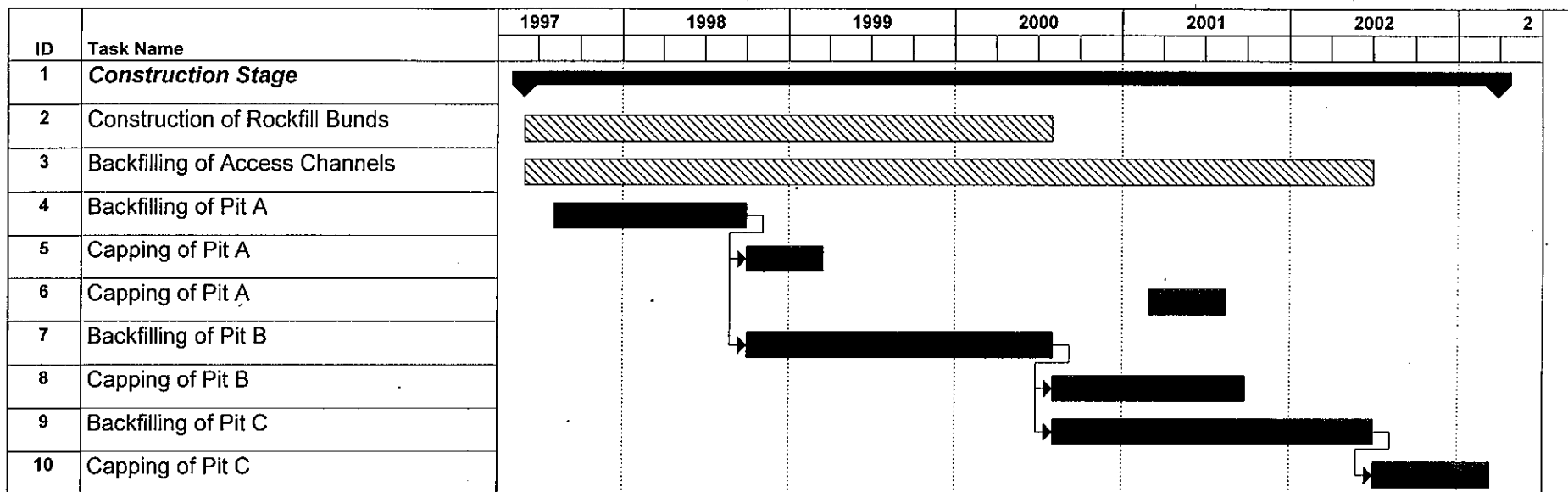


FIGURE 6.1a - INDICATIVE PROGRAMME FOR CMP IV BACKFILLING

The EIA did not identify any constraints to the operations at CMP IV arising from consideration of marine traffic issues. However, prior to the commencement of each new type of operation, or before the issue of tender documents to potential Pit Management and Capping contractors, discussions should be held with Marine Department to identify any new marine traffic constraints which may have arisen following the completion of the EIA. In addition, a Notice to Mariners will need to be issued before any operations commence on site.

All backfilling operations must comply with the *General Allocation Conditions for Marine Disposal Areas and Mud Disposal Sites* and any other conditions required by Marine Department. Fishing vessels will not be permitted to operate in the area during backfilling as it will be a designated Works Area.