

STRICTLY CONFIDENTIAL

Impact of Singapore Land Reclamations

Report of the Group of Independent Experts (GOE)

in the matter of

ITLOS Order of 8 October, 2003

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Executive Summary

General

The Group of Independent Experts (GOE), established in response to the ITLOS order of 8 October 2003, interacted with the Malaysian and Singaporean delegations and with the appointed technical consultant, the Danish Hydraulics Institute (DHI) on a continuous basis as the work progressed. This report summarises the study and assesses the significance of the various impacts evaluated by DHI.

The impacts were categorized as negligible, slight (impact is seen to be present, but is not detectable), minor (impact is detectable), moderate (has environmental impact) and major. No major impacts were identified.

Almost all impacts were the result of hydrodynamic changes (i.e. changes in the current patterns and wave action) caused by the reclamations, which in turn caused impact on navigation, sediment transport and morphology, and fishing. Thus, if the hydrodynamic changes are reduced, most impacts will also be reduced or disappear.

The most important hydrodynamic change is an increase in the current velocities in Calder Harbour. These increased current velocities can be reduced by widening the crucial Calder Harbour cross sections that restrict the flow. Widening the Calder Harbour channel also decreases the flow resistance through the channel, thereby encouraging greater flow through the Calder Harbour channel. This, in turn, results in some decrease in the current velocities through Kuala Johor.

The GOE recommends that the procedure for widening the Calder Harbour channel should consist of two aspects simultaneously:

- a. taking a “*bite*”, dredged to – 12m, out of the proposed reclamation area (PT Case 2) to open up the crucial cross section at PULAREK;
- b. extending the reclamation with a “*nose*” in a less crucial flow area to counteract the loss of reclaimed area by the bite.

The GOE recommends that the maximum velocities in the Calder Harbour channel at the critical PULAREK cross section be reduced to within 10% of the pre-reclamation maximum values (10% is the margin of error identified by DHI).

A second consideration relates to the large scale eddies generated in the vicinity of Changi by flow separating off the “Changi Finger” (a thin peninsula extending from the mainland of Singapore, along Kuala Johor). Although the impacts of these eddies on navigation were found not to cause significant safety issues in the short term due to low traffic density and the compulsory presence of pilots on board of vessels transiting this fairway, the GOE is nevertheless of the opinion that a reduction of the strength or complete elimination of these eddies will increase the safety of passage of vessels through this channel. Since the present

configuration can be considered as a construction phase of the Changi reclamation, the GOE recommends the streamlining of the Changi Finger as part of the ongoing works in the area.

Conclusions

Based on the available data and the DHI report, the GOE draws the following conclusions:

1. The reclamations at Tuas View and Pulau Tekong have resulted in a number of impacts identified in the DHI study.
2. No major impacts were identified.
3. Seventeen impacts were judged to be in the Minor to Moderate categories.
4. Of these, fourteen impacts are directly related to changes in current velocities near the reclamations. These can be mitigated by reducing the current velocities.
5. Erosion is expected at the PULAREK and Belungkor jetties. It is accepted by the GOE that some erosion had occurred at these jetties prior to reclamation. This can be mitigated by properly designed and built scour protection.
6. The sheetpile perimeter wall in Pulau Tekong (PT Case 1) has increased the wave action in Calder Harbour. Replacing the sheetpile as soon as practicable by the final perimeter berm will reduce the wave reflection significantly.

Recommendations

The GOE recommends:

1. That the maximum velocities in the Calder Harbour Channel at the critical PULAREK cross section be reduced to within 10% of the pre-reclamation maximum values.
2. That Singapore's final design of the shoreline of Area D will include a *bite*, dredged to – 12m, to open up the Calder Harbour channel and a *nose* to compensate for the reclamation area lost by the bite.
3. That the Changi Finger be streamlined as part of the ongoing works in the area.
4. That the sheetpile silt curtain of Area D (PT – Case 1) be replaced by the final revetment protection (PT – Case 2) as soon as practicable.
5. That scour protection be applied to PULAREK and Belungkor jetties.
6. That fishermen be compensated for any losses as a result of the works.
7. That limited research and workshops on gill netting be conducted to improve the procedures currently adopted by the fishermen.

1. Introduction

The official title of the action concerning this report is: *Case Concerning Land Reclamation by Singapore in and around the Straits of Johor (Malaysia v. Singapore)*. On 4 July 2003, Malaysia submitted a statement of claim to Singapore. On 5 September 2003, Malaysia applied for the prescription of provisional measures under Article 290, Paragraph 5, of the United Nations Convention of the Law of the Sea. Malaysia and Singapore appeared before the International Tribunal of the Law of the Sea (ITLOS) on 25, 26 and 27 September, 2003.

ITLOS issued an order dated 8 October, 2003. Part of this order prescribes:

Malaysia and Singapore shall cooperate and shall, for this purpose, enter into consultations forthwith in order to:

- (a) establish promptly a group of independent experts with the mandate:
 - (i) to conduct a study, on terms of reference to be agreed by Malaysia and Singapore, to determine, within a period not exceeding one year from the date of this Order, the effects of Singapore's land reclamation and to propose, as appropriate, measures to deal with any adverse effects of such land reclamation;
 - (ii) to prepare, as soon as possible, an interim report on the subject of infilling works in Area D at Pulau Tekong;

The members of the Group of Independent¹ Experts (GOE) were appointed in January, 2004. They are: Prof. K d'Angremond, Prof. R.A. Falconer, Prof. C.A. Fleming and Prof. J.W. Kamphuis. At that time the GOE was advised that the Danish Hydraulics Institute (DHI) had been selected by Malaysia and Singapore to undertake the detailed technical studies. This work consisted of collecting all available data, performing a limited field measurement campaign to collect any missing data, carrying out extensive numerical (computer) modelling, preparing a final report and in this report determining the impacts on the surrounding waters that are directly attributable to the Singapore reclamations.

DHI reported its results to the GOE and the governments at regular intervals and the GOE interacted on a continual basis with the Malaysian and Singaporean delegations and with DHI to review and update the study as the work progressed. Eventually a final report was submitted by DHI and the GOE proceeded to summarise the study and to assess the significance of the various impacts identified by DHI. The summary of the impacts may be found in Attachment 1.

The GOE submitted the required interim report on the subject of infilling works in Area D at Pulau Tekong entitled *Works in Area D at Pulau Tekong, Singapore – Interim Report by Group of Experts (GOE)* on 5 August, 2004. The report is included as Attachment 2.

The GOE met on the following occasions:

Feb 10 – 13, 2004 – Singapore
April 22-29, 2004 - Johor Bahru
May 7 – 10, 2004 – Singapore
Jun 7, 2004 – London

¹ Two members of the GOE were chosen by Malaysia and two by Singapore.

July 8, 9, 2004 – Copenhagen
Aug 5, 6, 2004 – Zevenhoven (Netherlands)
Aug 18, 19, 2004 – Swindon (UK)
Sep 2-4, 2004 – Putrajaya
Sep 25 – 29, 2004 - Estremoz (Portugal)
Oct 17 – 19, 2004 - Cardiff

The London, Zevenhoven, Swindon, Portugal and Cardiff meetings were held with only the GOE present. The other meetings included extensive Malaysian and Singapore delegations, with DHI being in attendance when needed. The minutes of all GOE meetings are attached in Attachment 3.

The GOE records its sincere thanks to all parties involved in this process, where the aim has been to assess the impact of Singapore's reclamations on the complex interactive water body in and around the Straits of Johor. The professional attitude and open-minded approach by all aided greatly in the completion of the GOE's work and in the production of this report.

2. Description of the Basic Processes

2.1 General Description

For ease of reference, Figures 1 to 6 show the physical layouts of the area and the two reclamation sites. Figure 2 shows Tuas View prior to reclamation (referred to as TVE Case 0) and Figure 3 shows the same area after reclamation of the Tuas View Extension is completed (TVE Case 1). Figure 4 shows Pulau Tekong prior to reclamation (referred to as PT Case 0). Figure 5 shows the existing layout at Pulau Tekong (PT Case 1) with a temporary sheetpile silt curtain around Area D. Figure 6 shows the outline of the final design for the reclamation at Pulau Tekong (referred to as PT Case 2) with a perimeter revetment around Area D.

From the information provided and particularly from the report entitled "Detailed Studies on Tuas View Extension and Pulau Tekong Land Reclamation", prepared by DHI, the GOE finds the following:

A number of impacts have been found. Most of the impacts have resulted from the Pulau Tekong reclamation, but there are also impacts from the Tuas View Extension. Almost all impacts result from hydrodynamic changes (i.e. changes in the current patterns and wave action) caused by the reclamations. The following three changes were found to be the most important. All of these are in the Pulau Tekong area and listed in order of importance.

1. An increase in current velocities in the Calder Harbour channel (East of Pulau Tekong). The major effects from this increase are changes in erosion and sedimentation patterns, changes in navigation conditions and changes in fishing conditions.
2. An increase in large-scale² eddy activity in Kuala Johor in the vicinity of Changi, resulting in stronger current components across the channel. This change affects the conditions for navigation through the area.

² These eddies are of a size comparable to the width of the channel.

3. An increase in current velocities in Kuala Johor (West of Pulau Tekong). This change affects navigation through the area.
4. A decrease in the duration of slack water in the vicinity of Pulau Ubin. Slack water, as cited in the DHI report, is the time when the current velocity is less than 0.25 m/s. This affects the planning and execution of large towing operations through that section.

Because the processes in this tidal estuary system are complex, it was necessary to use sophisticated numerical models to determine the changes resulting from the physical modifications to the estuary introduced by the reclamations. However, for a general understanding of the major consequences, the basic process and the implications for flow in the Calder Harbour and Kuala Johor channels can be simplified as outlined in the following sections.

2.2 Basic Principle

The basic principle will be discussed in connection with the Pulau Tekong reclamation, where the most important changes have taken place (Items 1 to 4 above), recognizing that the same principle applies for the Tuas View Extension.

The reclamations at Pulau Tekong have resulted in a local narrowing of the Calder Harbour and Kuala Johor channels, as may be seen from comparing Figure 4 with Figures 5 and 6. Observations and the model results by DHI showed that the reclamations had very little influence on the water levels and on the quantities of water flowing into and out of the estuary at any cross-section during a tidal cycle.

To pass the same amount of water through a narrower channel requires increased current velocities. The increased current velocities in Kuala Johor and Calder Harbour are therefore mainly a direct result of the decreases in the cross-sectional area of the channels in the vicinity of the Pulau Tekong reclamation, particularly near Area D (shown in Figure 5).

2.3 Current Velocities in Calder Harbour (Item 1)

The increased current velocities in Calder Harbour can be remedied by widening the crucial cross sections that restrict the flow. A re-location of the eastern shore of the Pulau Tekong Area D can widen certain crucial Calder Harbour channel sections and decrease current velocities in these cross sections. Widening Calder Harbour sections will also decrease the flow resistance through that channel. This will encourage more water to flow through Calder Harbour, which in turn will result in some decrease in the flow through Kuala Johor, and hence in decreased current velocities in this channel (Item 3).

Since the dynamic processes in this area are actually much more complex than outlined in the above basic principle, the actual design of the eastern Pulau Tekong shoreline will be an optimization process, requiring many model runs to find an optimum solution. To provide some guidelines to such optimisation, the GOE has asked DHI to study the PT Case 4 and Case 5 scenarios.

PT Case 5 is shown in Figure 7. It involves a re-alignment of the eastern shore of the expanded island by taking a “*bite*” out of the linear shoreline of the proposed reclamation area (PT Case 2) at a crucial flow section, while at the same time extending the reclamation with a “*nose*” in a less crucial area to compensate for area lost in the bite. The GOE notes that the addition of such a nose has no negative impact on the currents in either the Kuala Johor or Calder Harbour channels. It is therefore an effective way of compensating for the land area lost through creation of the bite.

The *bite* has two functions:

1. It leads to a widening of the Calder Harbour channel, reducing the local velocities across the channel (and secondarily reducing the velocities in Kuala Johor).
2. It streamlines the Calder Harbour channel, resulting in a smoother through flow.

The *nose* also performs two functions:

1. It streamlines the flows into and out of the Calder Harbour and Kuala Johor channels.
2. It expands the reclaimed area to compensate for area lost in the bite.

The GOE proposes that the *bite* be specifically located to produce the greatest reduction in current velocities in the crucial cross section at PULAREK (shown in Figure 7).



Figure 1 General Map of Area [Reproduced from the DHI Reports]

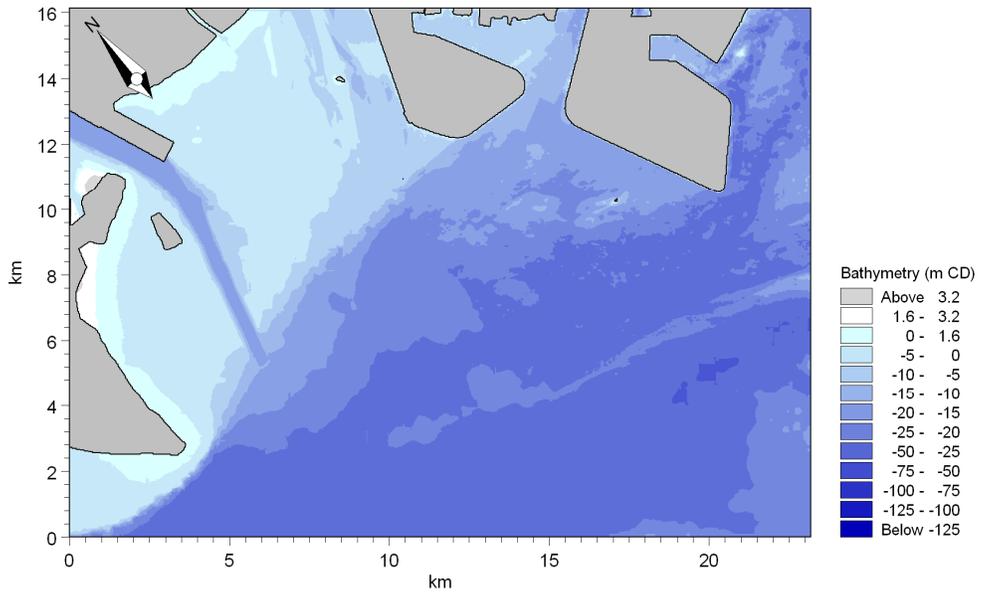


Figure 2 Tuas View prior to Reclamation (TVE Case 0)
[Reproduced from the DHI Reports]

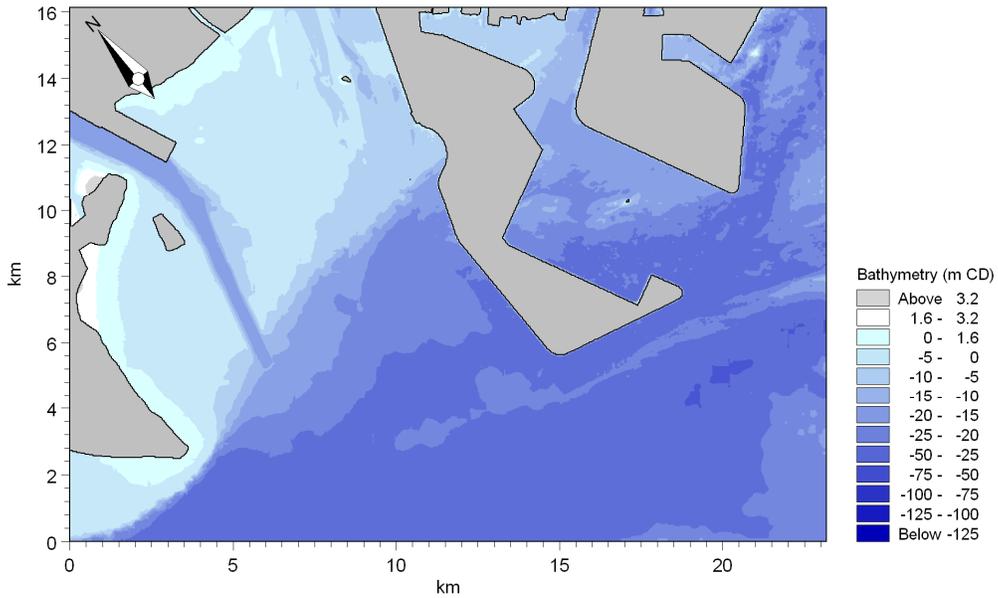


Figure 3 Tuas View – Reclamation Complete (TVE Case 1)
[Reproduced from the DHI Reports]

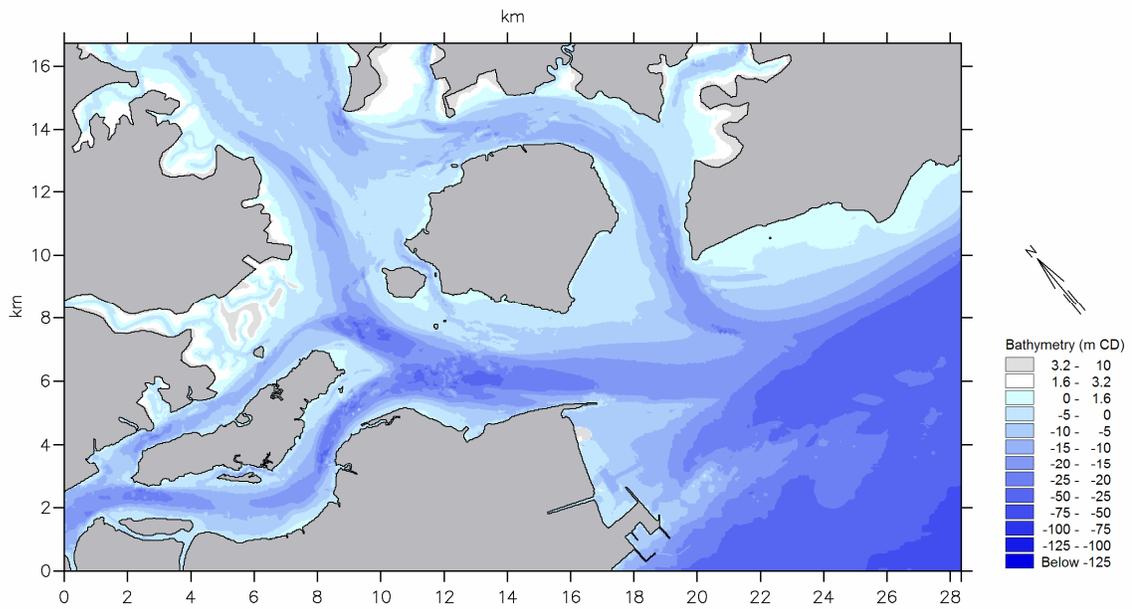


Figure 4 Pulau Tekong Prior to Reclamation (PT Case 0)
[Reproduced from the DHI Reports]

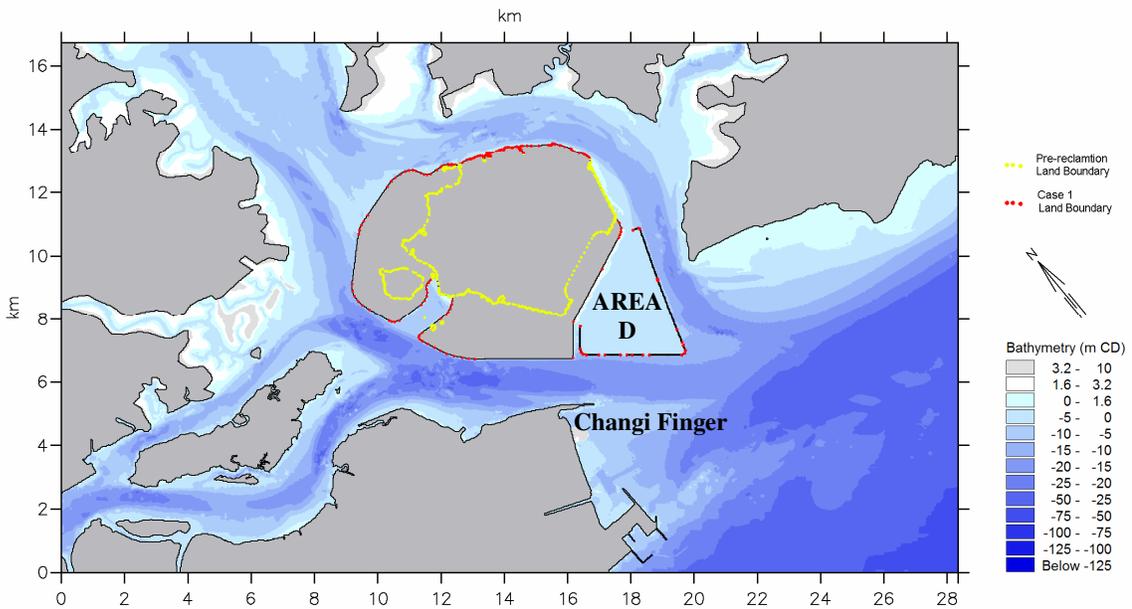


Figure 5 Pulau Tekong with Sheetpile Silt Curtain around Area D (PT Case 1)
[Derived from the DHI Reports]

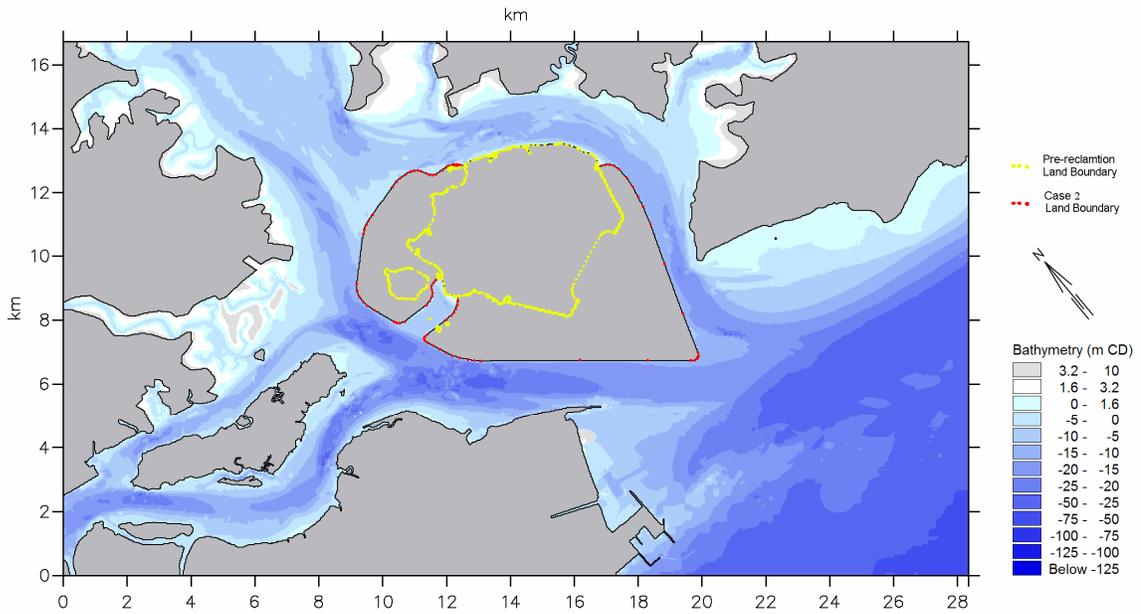


Figure 6 Pulau Tekong with final revetment around Area D (PT Case 2)
[Reproduced from the DHI Reports]

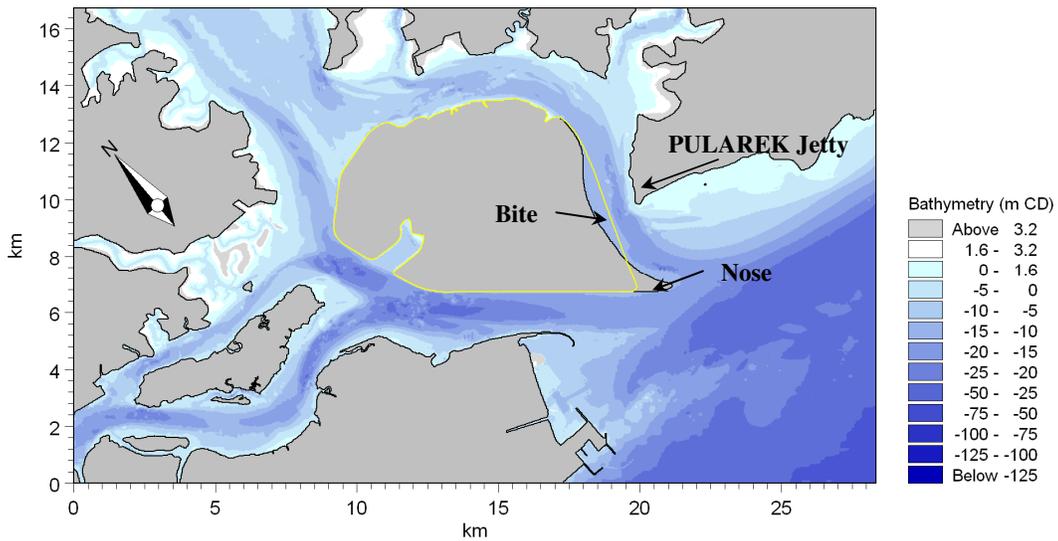


Figure 7 Sensitivity Test showing both “bite” and “nose” (PT Case 5)
[Derived from the DHI Reports]

It is difficult to define absolute criteria for maximum current velocities that are defensible on the basis of technical reasoning only. The DHI study produced no substantive, scientifically based criteria such as, for example, velocity limits to prevent bottom erosion³. Non-technical criteria, on the other hand could range from “no impact” (for example, no change in current velocities is permitted) to subjective criteria, such as, “Any state has a right to use its territory as long as it does not create unacceptable conditions for its neighbours”.

While the GOE acknowledges that no one substantive, scientifically justifiable velocity criterion exists, it is nevertheless convinced that if current velocities are reduced as much as is practically possible in critical cross-sections, then essentially the impacts (which depend on these current velocities) will be reduced or eliminated.

To define “practically possible”, the GOE has pursued the following approach. The basic criterion developed by the GOE is to reduce the maximum velocities⁴ in the Calder Harbour channel at the critical PULAREK cross section to the pre-reclamation values. However, DHI has indicated that the uncertainty in the current velocities predicted by its models is of the order of 10%. Hence, the GOE recommends that the maximum velocities in the Calder Harbour channel at the critical PULAREK cross section be reduced to within 10% of the pre-reclamation maximum values.

Singapore’s re-design of the shape of the reclamation to meet the above recommendation is necessarily a separate and complicated study that requires time and expertise. The GOE has proposed the sensitivity tests (PT Cases 4 and 5) to help in this process by increasing the basic understanding of the flow processes in Calder Harbour, focusing specifically on the reduction of current velocities in the PULAREK section. After the results for PT Cases 4 and 5 were received, the GOE was satisfied that these tests indicated the directions to pursue. As a result, the GOE recommends that the methodology used in PT Cases 4 and 5 constitute the basis for an overall framework for a possible solution to current velocities and their secondary impacts in Calder Harbour. The GOE recommends that the final design of the shoreline of Area D will include a *bite* to open up the Calder Harbour Channel and a *nose* to compensate for reclamation area lost by the bite. The GOE notes that in Case 5, the bite was dredged to -12 m and also recommends this obvious secondary method of reducing current velocities.

In PT Case 4 the maximum distance of the bite, inland from the original reclamation boundary in PT Case 2, was 365 m at 2.7 km north of the southern point of PT Case 2. In PT Case 5, the bite was 570 m maximum at 3.6 km north of the point. In both cases the nose was 650 m long. The GOE emphasizes that PT Cases 4 and 5 are sensitivity tests only. They are not a final design aimed at defining the optimum location or size of the bite. Also, no attempt was made to relate the area of the nose to the area of the bite.

2.4 Large Scale Eddies (Item 2)

There are some large scale eddies in the vicinity of Changi that are generated by the flow separating off the “Changi Finger” (a thin peninsula extending from the mainland of

³ The GOE does not consider the attempt to relate fish net behaviour to current velocities, based on one trial test as a valid criterion.

⁴ Maximum velocities occur at ebb tide. The maximum velocity was defined by the GOE as the maximum velocity averaged between 200 m and 1400 m from the Malaysian shore.

Singapore, along Kuala Johor, indicated in Figure 5). These eddies result in increased current velocities across the channel, which affect navigation through the area. Although the impacts of these eddies on navigation were not found to cause unsafe conditions in the short term due to the low traffic density in the channel and the compulsory presence of pilots on board of vessels transiting this fairway, the GOE is nevertheless of the opinion that a reduction in the strength or complete elimination of the eddies will increase the safety of passage of vessels through this channel.

The strength of these eddies can be reduced by changing the channel cross-section, which can be done by modifying either side of the channel. However, since the eddy is mainly generated by the shape of the Changi Finger, its redesign to produce a more streamlined transition for the flow into and out of Kuala Johor would decrease the eddy activity in the most effective way. Sensitivity tests carried out by DHI and reported in an addendum to their Final Report confirm that by using appropriate curvature the eddy can be almost eliminated.

Since the present configuration can be considered as a construction phase of the Changi reclamation, the GOE recommends the streamlining of the Changi Finger as part of the ongoing works in the area.

This action will require a number of numerical model simulations to optimize this new shape of Changi Finger. To understand the influence of changing the geometry of the Changi Finger, the GOE proposed Case 6 as a final sensitivity test. In Case 5, the finger was streamlined and in Case 6, the Changi Finger shape was replaced at its original shape.

2.5 Decrease of Slack Water Tidal Window near Pulau Ubin (Item 4)

The slack water tidal window (defined throughout this study as the duration of flow velocities smaller than 0.25 m/s) has decreased near Pulau Ubin essentially because the current velocities in the area have increased. A second reason is perhaps that the large scale eddies off Changi restrict the overall flow, (both for ebb and flood flows) through the Kuala Johor channel. It is difficult to develop changes to the flow that specifically target the duration of the slack water window, however, the increase of the flow area in Calder Harbour, and the possible redesign of the Changi Finger proposed above, will both contribute to increasing this slack water duration.

A reduction in the slack water times requires more careful planning of the movement of large vessels, in particular vessels under tow, but it does not affect the accessibility of facilities in the Port of Johor. No dangerous situations occurred during the tows and all the manoeuvres indicated safe and controlled manoeuvres.

3. Impacts

The overall purpose of this joint study has been to define the impacts resulting directly from the reclamation activities at Tuas View and Pulau Tekong. This definition process involves:

1. Identifying all of the possible impacts of the reclamation works,

2. Determining the magnitudes of the impacts, and
3. Determining the significance of the impacts.

Task 1: The possible impacts to be studied were identified at the beginning of the work in the Terms of Reference of the GOE and DHI. These instructions are summarized in Attachment 4.

Task 2: DHI was primarily responsible for this second task. Chapter 3 (pp 14 to 23) of its summary report *Detailed Studies on Tuas View Extension and Pulau Tekong Land Reclamation - Volume 1: Executive Summary and Conclusions* lists the magnitudes of the various impacts identified in Step 1. The GOE notes that the term “no impact” can be misinterpreted. For its own report the GOE therefore prefers “negligible impact”, using the following revised definition:

Negligible impact: Changes identified are so small that they can not be classified from the model studies, or the identified changes fall within clearly defined tolerance limits such that the effect has negligible consequence to the environment

Task 3: The GOE’s responsibility was to interact with DHI on the second task and then to determine the significance of each of the impacts (Task 3). The GOE has identified 57 separate issues from the instructions of Task 1 and each of these issues is addressed individually in the detailed impact evaluation sheets of Attachment 1.

A majority of the impacts are classified by the GOE as having “negligible” or “slight” impact. The impacts judged to be “minor” and “moderate by the GOE are summarized in the Table 1.

Table 1
Summary of Most Important Impacts

Definitions of Impact:				
	Detectable	Impact on Environment	Secondary Impacts, on ecosystem, etc.	
Negligible	No, below tolerance limits	Negligible		
Sight	No, but direction is detectable	Below detection limits		
Minor	Yes	Detectable		
Moderate	Yes	Direct impact	May have	
Summary of Minor and Moderate Impacts				
Item	Concern	Location	Impact	Measures
1.9	Hydrodynamics	Calder Harbour	Increased current velocities, result in secondary impacts	Reduce velocities by increasing channel conveyance
1.11	Hydrodynamics	Kuala Johor	Large scale eddies	Streamline Changi Finger.
1.13	Hydrodynamics	P. Ubin - P. Tekong	Decrease in slack water window	As for 1.9 and 1.11
1.14	Hydrodynamics	General Comments	Oil spills spread more	Reduce velocities by increasing channel conveyance
			Sea level rise and climate change not considered	
2.4	Navigation	Kuala Johor	Cross-channel currents generated by eddy	Streamline Changi Finger
2.7	Navigation	JRPGA	Minor impact on anchored vessels	None
2.9	Navigation	Langsat	Minor impact on mooring line tensions	None
2.10	Navigation	Berthing at PULAREK	Minor impact	Reduce velocities by increasing channel conveyance
2.12	Navigation	PULAREK Jetty	Scour at jetty	Apply scour protection
2.13	Navigation	Belungkor Jetty	Scour at jetty	Apply scour protection
3.1	Morphology	Calder Harbour	C&R: Shoreline erosion by currents unresolved because of models used;	Reduce velocities by increasing channel conveyance
			C&R: Wave erosion not resolved by models used	Replace sheetpile as soon as practicable by revetment.
3.2	Morphology	Nenas Channel	Increased sedimentation	Continue maintenance dredging
3.3	Morphology	Kuala Johor	Erosion near Changi	Streamline Changi Finger
6.3	Ecology	Seagrass, TVE side	Possible decrease, but not appropriately de-linked from PTP construction	No appropriate measures
6.11	Ecology	Shrimp, TVE side	Unknown	Inconclusive
6.12	Ecology	Shrimp, PT side	Unknown	Inconclusive
6.14	Ecology	Fishing, PT side	Calder Harbour: Increase in fuel costs; difficulties with gill netting (based on only one study)	Reduce current velocities, compensate fishermen for losses as a result of the work, re-design gill netting operations.

4. Conclusions

The GOE draws the following conclusions:

1. The reclamations at Tuas View and Pulau Tekong have resulted in a number of impacts identified in the DHI study.
2. No major impacts were identified.
3. Seventeen impacts were judged to be in the Minor to Moderate categories.
4. Of these, fourteen impacts are directly related to changes in local current velocities near the reclamations. These impacts can be mitigated by reducing the local current velocities.
5. Erosion is expected at the PULAREK and Belungkor jetties. It is accepted by the GOE that some erosion had occurred at these jetties prior to reclamation. This can be mitigated by properly designed and built scour protection.
6. The sheetpile perimeter wall in PT - Case 1 has increased the wave action in Calder Harbour. Replacing the sheetpile wall as soon as practicable by the final perimeter berm will reduce the wave reflection significantly.

5. Recommendations

The GOE recommends:

1. That the maximum velocities in the Calder Harbour channel at the critical PULAREK cross section be reduced to within 10% of the pre-reclamation maximum values.
2. That Singapore's final design of the shoreline of Area D will include a *bite*, dredged to – 12m, to open up the Calder Harbour channel and a *nose* to compensate for the reclamation area lost by the bite.
3. That the Changi Finger be streamlined as part of the ongoing works in the area.
4. That the sheetpile silt curtain of Area D (PT – Case 1) be replaced by the final revetment protection (PT – Case 2) as soon as practicable.
5. That scour protection be applied to the PULAREK and Belunkor jetties.
6. That fishermen be compensated for any losses as a result of the works.
7. That limited research and workshops on gill netting be conducted to improve the procedures currently in place.

Attachment 1

Impact Tables

Attachment 1 Impact Tables

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2.15	Navigation	General Remarks				

1 - 0. Introduction

In this Appendix, the GOE specifically addresses the items listed in the Terms of Reference of the Consultant. Since this list was attached to the TOR for the GOE, it forms part of the GOE's TOR.

To avoid misunderstandings, the GOE has used the same terminology as DHI to classify the significance of any impact with one exception. The GOE has changed the qualification "no impact" to "negligible impact" as the GOE feels that the word "no" has a meaning, which is too absolute.

Negligible impact: Changes identified are so small that they cannot be classified from the model studies, or the identified changes fall within clearly defined tolerance limits such that the effect has negligible consequence to the environment.

Slight impact: Changes are identified by the models, which are sufficiently clear that they can be classified as either positive or negative. However, the impact in real terms is so small that it is unlikely that it can be detected or measured in the field. The resulting consequence to the environment of a slight impact is most likely below detection limits.

Minor impact: Changes are identified by the numerical models at a magnitude where it is expected that the change and consequent environmental impact can be detected and/or measured in the field.

Moderate impact: Changes and impacts are identified at a level, which can be anticipated to have a direct consequence and may have secondary consequences through ecosystem processes or other linkages not addressed as part of the present study.

Major impact: Changes and resultant impacts are identified at a level that will have serious direct and indirect environmental consequences that will extend the impact out of the immediate area of effect. Major impacts are normally viewed as indicating that a development project has impacts on the overall environmental sustainability of the area.

The GOE notes that there are slight differences in some numerical values quoted in Volume I and in the respective underlying reports (Volumes II – IX). The GOE has generally considered the values from the main reports rather than from the summary report, and the GOE has used the higher numbers of a range.

The items have been grouped in the same way as they were grouped in the TOR. When necessary, the sheets addressing a particular group of items are preceded by a general introduction and followed by general remarks.

1 - 1. Hydrodynamics

The section on Hydrodynamics addresses changes in the hydrodynamic boundary conditions as a result of the reclamation projects in areas that were specifically mentioned in the Terms of Reference.

Water levels, current velocities and wave conditions are considered to be the main hydrodynamic parameters that are discussed in this section. Secondary effects resulting from or caused by changes in the hydrodynamic conditions are addressed in subsequent sections. Where applicable, reference is made to such sections.

In general, it can be concluded from the studies by DHI that the hydrodynamic changes due to TVE are relatively small. The changes induced by the reclamation of P. Tekong are mainly changes in current velocities in the channels around the island. The changes due to Case 2 are generally larger than those due to the Case 1 configuration. Velocities at some distance (about 2km) from the island remain largely unaffected. Water levels remain largely unaffected as well. Wave conditions will become more severe in Case 1 due to reflection of waves by the sheet pile wall. In Case 2, the wave climate becomes milder again, because of the lower reflection of the revetment and sheltering by the reclamation.

The GOE notes that the technical issues that it has to address according to Annex 2 of its TOR cover a broad range of issues. The first issue to be addressed (i.e. Hydrodynamics) has not been found to have a primary effect in this study (e.g. flooding). This issue does, however, manifest itself through the other issues to be addressed by the GOE. It is therefore not relevant to classify the hydrodynamic changes according to the scale of impacts as these may relate differently to the various issues. Only where hydrodynamic changes are so small that they have no impact on any of the other issues has a classification been given to the “significance of impact”.

No: 1.1
Name of Issue: Hydrodynamics / Tanjung Piai
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact See relevant Sections

Available information and data

DHI reports 2003 and 2004

Summary of Consultant's studies

Volumes I, p 16, 34 and III, p 276

Knowledge after considering the studies

Wind wave action decreased due to sheltering by the TVE reclamation (magnitude depends on baseline);

Ship wake increased due to increased traffic to PTP.

Maximum water levels increased up to 0.02 m

Technical common ground determined by the GOE

This is not an issue with respect to the effect of the reclamation works by Singapore.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.2

Name of Issue: Hydrodynamics / Sungai Pulai Estuary

Area of interest: Tuas View Extension

Is the issue relevant? Yes

Significance of impact Negligible

Available information and data

DHI reports 2003 and 2004

Summary of Consultant's studies

Volumes I, p 17, 62 and III p 276, 277

Knowledge after considering the studies

No changes are expected in water levels or currents

Technical common ground determined by the GOE

The GOE see no problems

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.3
Name of Issue: Hydrodynamics / Pulau Merambong
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact See relevant Sections

Available information and data

DHI reports 2003 and 2004

Summary of Consultant's studies

Volume I, p 17, 68

Knowledge after considering the studies

Slight increase in velocity, slight increase in salinity, reduced sedimentation; reduced suspended sediment concentration and increased chlorophyll-a content. These somewhat compensate for each other so that only negligible change in light penetration is expected.

Technical common ground determined by the GOE

The GOE agreed there will only be a slight impact.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.4
Name of Issue: Hydrodynamics / Tg. Kupai and Gelang Patah
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I and III, p 177 -192

Knowledge after considering the studies

There is little indication that suggests any change in the hydrodynamics that is significant at this northerly reach of the W. Johor Straits.

Technical common ground determined by the GOE

The GOE agreed there is negligible impact

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.5
Name of Issue: Hydrodynamics / Entrance W. Johor Straits
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact See relevant Sections

Available information and data

As per DHI report

Summary of Consultant's studies

Volume III, p 177 -192

Knowledge after considering the studies

The studies indicate mixed effects, i.e. an increase in current velocities during ebb tides and a decrease during flood tides. The differences become smaller closer to the second link. Cross currents decrease.

Technical common ground determined by the GOE

No significant issue with respect to the reclamation works

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.6
Name of Issue: Hydrodynamics / Approach to PTP
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact See relevant Sections (3.5)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 16, 29 and III p 177 -192

Knowledge after considering the studies

The velocity changes are small (<0.2 m/s) and the cross currents decrease.

Technical common ground determined by the GOE

Not a significant issue with respect to the reclamation works.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 1.7

Name of Issue: Hydrodynamics / Other locations: PTP anchorage

Area of interest: Tuas View Extension

Is the issue relevant? Yes

Significance of impact See relevant Sections (3.6)

Available information and data

As per DHI reports 2003 and 2004

Summary of Consultant's studies

Volumes I, p 16, 29 and III 177 -192

Knowledge after considering the studies

Velocity changes are small and, in general, a reduction is found. Therefore, no effects on mooring forces are foreseen. The effect on morphology is addressed separately in Section 3. 6.

Technical common ground determined by the GOE

As far as direct effects are concerned, there is a slight beneficial impact. As indicated above, the indirect effects (morphology) will be addressed separately in section 3.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary (for sediment transport see Section 3.6)

No: 1.8

Name of Issue: Hydrodynamics / Sungai Johor, Upper reaches to the mouth of Sg. Johor.

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact See relevant Sections

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 33-37 and III, p 205-207

Knowledge after considering the studies

Maximum and minimum water levels will be decreased by 0.04 m, while the tidal range remains unchanged. There is little indication that suggests change in flood currents that is significant. For ebb tides, there is a small reduction in velocities (< 0.2 m/s)

Technical common ground determined by the GOE

The impact of the reclamation works in the upper reaches of Sg. Johor is not significant

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary to address hydrodynamics in this area.

No: 1.9

Name of Issue: Hydrodynamics / Mouth of Sg. Johor to Tg. Pengelih (Calder Harbour)

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact See relevant Sections (3.1)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20, 33-37 and III, p 205-207, IV p 112-116

Knowledge after considering the studies

The studies indicate an increase in current velocities in the channel, both for ebb and flood conditions. The GOE has presented the data given by DHI in Table format in a more visual way in Figure 1-1 attached to this report.

The studies indicate that wave action in the vicinity of PULAREK is increased for Case 1 due to reflection by the sheet pile wall. The waves are mainly locally generated wind waves. Consequently, the absolute value of the wave heights depends on an assumed relation between the local wind and the records of the more remote wind gauge at Changi Airport. For Case 2, wave heights will reduce to values slightly below the original ones, because of the sheltering effect of the reclamation on the waves and because of a reduction of the reflection.

The wake waves do not change as a result of the reclamation works, except that the wake is reflected off the sheetpile wall in Case 1 and to a lesser extent from the perimeter revetment in Case 2.

Technical common ground determined by the GOE

The GOE agreed earlier on the calibration of the hydrodynamic model, and thus on the changes in current velocities predicted by DHI.

Remaining unresolved issues and concerns

Secondary and tertiary effects. (These will be addressed in the subsequent sections 2, 3, 4 and 5).

Two members of the GOE question if the wave action in the region is properly addressed by the studies carried out to-date. The other members are of the opinion that the wave heights in the area are very small and hence that correct or more complete modelling will only adjust already very small values.

Following receipt of the preliminary draft final report, the GOE had concerns about the model used for the wave studies. In the report it was cited that the studies were undertaken using MIKE 21 SW, a finite volume unstructured mesh solution. This model appears to be different from the original approach proposed by the consultants and no information is available on the validation and prior use of this model.

Similar questions have arisen amongst the GOE regarding the minimum grid size used in the wave model; in the original report, this was 100m for the regional model, whereas the final

model study was undertaken at a 200m minimum grid size. The additional information provided by DHI in its Draft Final Report does not completely satisfy the GOE. Two of the members of the GOE therefore have reservations as to the accuracy of the wave models in the present application.

Suggested remedial measures

Increase in channel conveyance (channel width) to reduce the current velocities.

As far as waves are concerned, the GOE agrees that replacement of the temporary sheet pile wall of Case 1 by the permanent revetment of Case 2 will minimise the issue of increased wave action. The GOE advises therefore that this replacement should be implemented as early as practically possible. The GOE cannot propose any method to reduce reflection from the current temporary works.

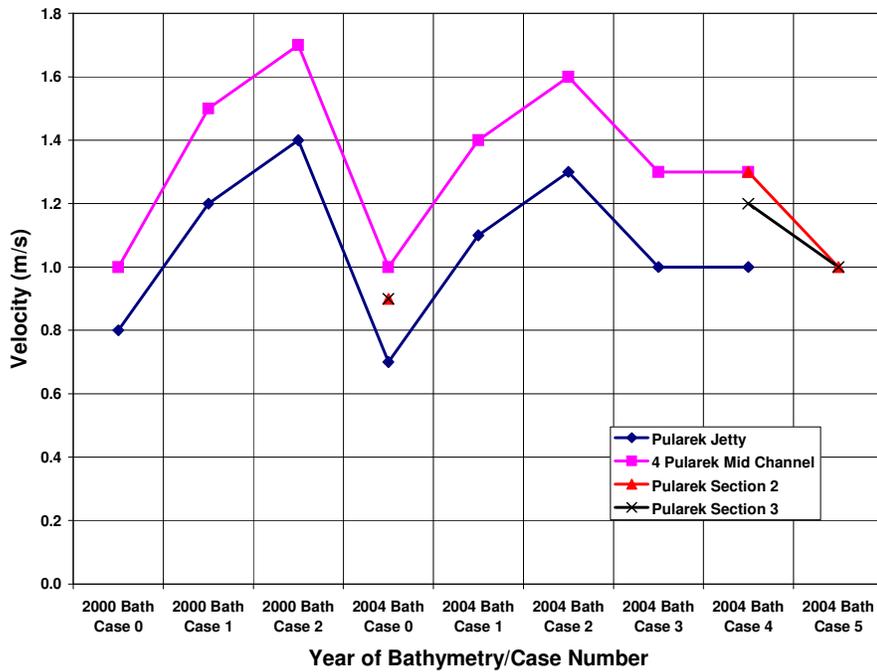
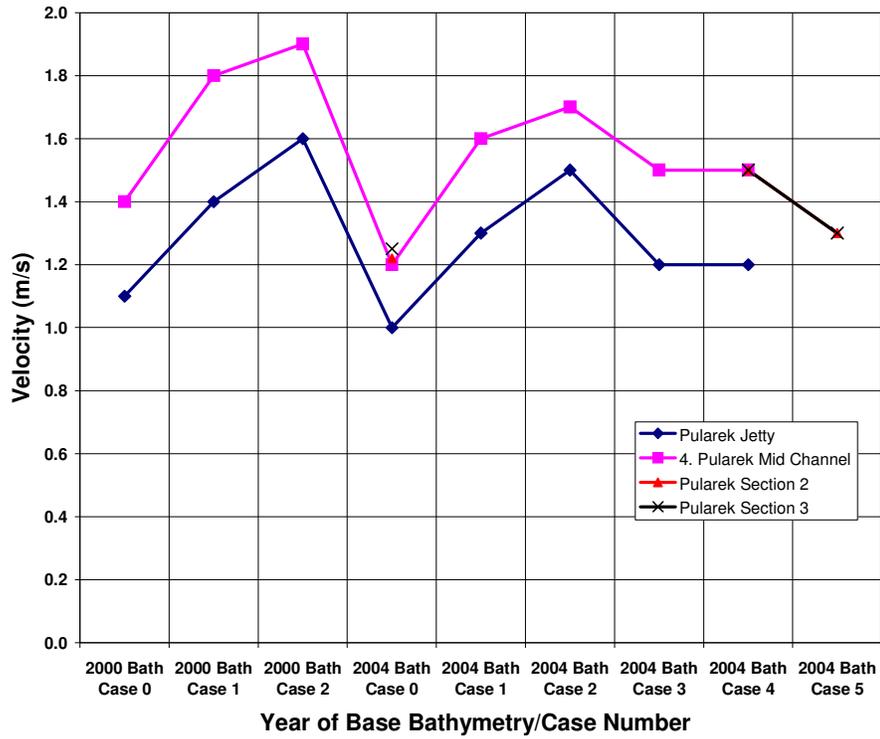


Figure 1.1 – Maximum Current Velocities at PULAREK Ebb (top), Flood (bottom)

No: 1.10
Name of Issue: Hydrodynamics / Nenas Channel
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact See relevant Sections (3.2)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I and III, p 269

Knowledge after considering the studies

There is little indication that suggests any changes in the hydrodynamics that are significant in this channel.

Technical common ground determined by the GOE

GOE agrees

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary for this specific area.

No: 1.11

Name of Issue: Hydrodynamics / Kuala Johor navigation channel between P. Tekong and Changi

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact See relevant Sections (2.4 and 3.3)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20, 30-34, 39-40 and III, p 222

Knowledge after considering the studies

Velocities in the channel increase, see Figure 1-2. The duration of slack water will decrease. The eddy shedding from Changi finger at flood tide will become more pronounced and will persist during part of the ebb tide. Water levels are slightly lower, while the tidal amplitude remains unchanged. Case 2 leads to slightly higher velocities than Case 1.

Technical common ground determined by the GOE

The GOE agrees on the facts, the main secondary consequences will be discussed in Sections 2 and 3 on navigation and morphology. A discussion about the significance of the effects is deferred to those sections as well.

Remaining unresolved issues and concerns

See later

Suggested remedial measures

As a measure against eddy shedding, streamlining the Changi finger will be effective, as indicated by the addendum report by DHI. Since the present configuration can be considered as a construction phase of the Changi reclamation, such a measure is recommended as a part of the ongoing works in the area.

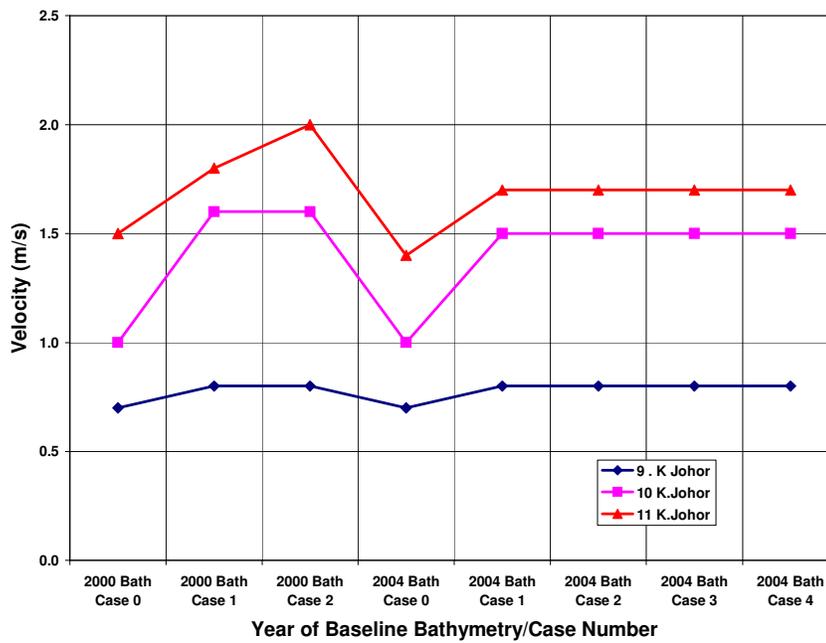
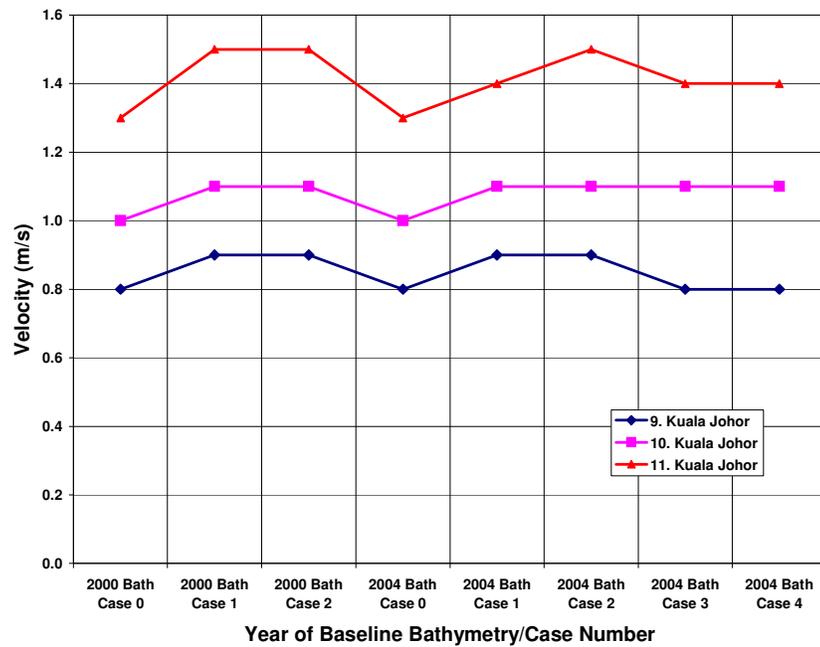


Figure 1.2 – Maximum Current Velocities in Kuala Johor - Ebb (top), Flood (bottom)

No: 1.12
Name of Issue: Hydrodynamics / Pengerang
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact See relevant Sections (2.6 and 3.4)

Available information and data

As per DHI report. A pending issue is the dumping of dredged material.

Summary of Consultant's studies

Volumes I, p 20, 30-34, 39-40 and III, p 205-222

Knowledge after considering the studies

As far as the wave studies are concerned, reference is made to 1.9. Remarks made in that section are considered to be repeated here.

It is noted that velocity changes along this shoreline are very small, except for the area immediately adjacent to Tg. Pengelih. With regard to JPA, the velocities remain largely unchanged to slightly lower, except for the most Western part (the Quarantine Area).

Technical common ground determined by the GOE

GOE agrees

Remaining unresolved issues and concerns

None (Secondary effects are discussed in sections 2.6 and 3.4)

Suggested remedial measures

The GOE recommends that in any reconfiguration of Area D due consideration be given to study the effect of such reconfiguration on the velocities in the Quarantine region of JPA. Another remedial measure would be to reconfigure the geometry of the JPA anchorage by giving up the Quarantine Anchorage and move the anchorage as a whole to the SE.

No: 1.13

Name of Issue: Hydrodynamics / Channel between P. Ubin and P. Tekong

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact See relevant Sections (2.5)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20, 33 and III, p 214, 249, 269, 275

Knowledge after considering the studies

The duration of the slack water period is reduced. This shortens the tidal window available for the towing of large objects between MSE and JRGPA and between sea and the Port of Johor.

Technical common ground determined by the GOE

The GOE agrees on the facts. For the impacts, reference is made to Section 2.5 that specifically addresses navigation.

Remaining unresolved issues and concerns

Effect on large towed objects

Suggested remedial measures

See Section 2

No: 1.14

Name of Issue: Hydrodynamics / General Comments

Area of interest: Pulau Tekong and Tuas View Extension

Grid resolution for final design studies

The GOE recommends that in any further studies related to the final design of the Area D layout, proper attention be paid to the grid resolution in the most sensitive areas of flow separation and eddy shedding.

Increased currents and their effect on oil spills

Although oil spills are not mentioned in the TOR as an issue, the GOE points out that higher current velocities contribute to a faster and probably wider spreading of oil pollution in case of an accidental oil spill.

Sea Level Rise and Climate change

The GOE notes that all studies have been carried out without considering potential effects of sea level rise and climate change. The GOE suggests that the two governments begin to take these into account when designing permanent structures with a very long life time.

Long term predictions

The GOE notes that long term effects related for instance to ecology and morphology have been assessed on the basis of extrapolating a 3-day simulation period of November spring tides. The GOE wishes to highlight at this stage that this approach has limitations, but recognising that the time agreed for the study did not allow for more accurate long-term predictions.

Choice of baseline

In the original TOR the Case 0 condition for TVE was shown to include the pre-2004 configuration of Jurong Island (see Figure 3.2, main report). The initial investigations by DHI, reported in their Progress Report 3 (July 2004), and their subsequent simulations in the Final Report (Vol. III), describe the impact of TVE is assessed relative to the 2004 and 2000 configurations for Jurong Island. In both cases there is a large macro eddy in the lee of TVE and this eddy is stronger for the 2004 baseline configuration. DHI has concluded that this eddy is an important hydrodynamic feature in the direct impact of TVE on the flow and related parameters in the Western Straits of Johor. The GOE notes that a number of large projects have been simultaneously constructed by both countries in recent years, making it difficult to define a baseline that is able to satisfactorily de-link the effects of all these activities from those caused by the construction of TVE. The GOE is satisfied with DHI's use of the 2004 baseline as their Case 0 and its inherent limitations.

1 - 2. Navigation

The navigation studies have been concentrated on the effect of the P. Tekong reclamation works. The GOE has accepted the navigation studies carried out by DHI in 2003 for the TVE area. That study revealed slight positive impacts.

Within the present navigation studies, several issues are addressed:

- Transits of vessels sailing under their own power between the various destinations;
- Transits of large towed objects between the various destinations;
- Berthing and deberthing operations from the various quaywalls and jetties;
- Use of anchorages;
- Structural integrity of jetties;
- Small vessels (this issue is addressed under ecology, fishing).

The studies have been carried out by BMT as sub-contractor to DHI. Use was made of a mathematical simulation model, both in autopilot (fast time) and manual (real time) mode. The impacts identified by DHI/BMT in combination with consultation of PIANC Report PTC II-30 "Approach Channels, a guide for design" brought the GOE to the conclusion that no separate study of marine risk and/or economy were required as part of this study.

No: 2.1
Name of Issue: Ship Traffic and berthing / Approach PTP
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Slight positive

Available information and data

As per DHI reports 2003 and 2004

Summary of Consultant's studies

Volumes I, p 16 and DHI 2003

Knowledge after considering the studies

DHI/BMT indicate that the reduced cross-current in the outer approach was found in earlier studies to result in a slight improvement to navigation conditions.

Earlier studies (DHI 2003) have also assessed the effect of the macro eddy on the current direction in the PTP approach and found no significant impacts on navigation.

No change was found in the currents in the inner approach channel.

Technical common ground determined by the GOE

The GOE concur with the findings of the study.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.2
Name of Issue: Ship Traffic and Berthing / PTP anchorage
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Slight positive

Available information and data

As per DHI reports (2003 and 2004)

Summary of Consultant's studies

Volumes I, p16 and DHI 2003

Knowledge after considering the studies

The macro eddy West of TVE influences the current directions in the PTP anchorage. Earlier studies have assessed the effect of the eddy and found no significant impacts on navigation. Reduction in the current speed in the central sector of the PTP anchorage results in a reduction in anchor loading, resulting in increased safety in most of the anchorage. The increase in the current speed in the extreme southerly sector of the anchorage has no practical consequences for vessels following good anchoring practice. For morphological consequences see Section 3.6

Technical common ground determined by the GOE

The GOE concur with the conclusions of the study.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.3

Name of Issue: Ship Traffic and berthing / Transit Calder Harbour

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 42 and V, part 1. p 135-137, 144-146, 195

Knowledge after considering the studies

There is negligible impact on the safe transit of the design cruise vessel and the design car ferry through Calder harbour to Tg. Belungkor. However, during this transit, the vessels will encounter higher currents.

Technical common ground determined by the GOE

The GOE concur with the conclusion

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.4
 Name of Issue: Ship Traffic and berthing / Transit Kuala Johor
 Area of interest: Pulau Tekong

Is the issue relevant? Yes
 Significance of impact Slight to minor

Available information and data

As per DHI report (inclusive addendum) and PIANC Report PTC II-30 "Approach Channels, a guide for design"

Summary of Consultant's studies

Volumes I, p 20, 42 and V, part 1, p 127-134, 138-140, 144-146, 147-149, 150-152, 161-167, 177-183, 192-194, 195, Addendum report DHI cases 5 and 9

Knowledge after considering the studies

A potential impact due to current instability (eddy formation) in the vicinity of Kuala Johor and Changi finger was noted in the fast time simulation particularly for the 60 000 DWT bulk carrier. The subsequent real time simulation indicated that ship transits were within safe navigational limits, up to MSE, Pasir Gudang and Tg. Langsat.

The higher current velocities require higher engine power and cause more fuel consumption, specifically because larger vessels are required to stem the tide.

The effects are higher for Case 2 than for Case 1.

A sensitivity test carried out by DHI and reported in an addendum to the Final Report confirms that streamlining Changi finger effectively solves the eddy shedding.

Technical common ground determined by the GOE

The GOE concurs that with the present low traffic density the current pattern does not create unsafe conditions. This opinion is related to the compulsory presence of pilots on board of vessels transiting this fairway. The GOE considers the flow pattern does represent an additional hazard in the long term and recommends that in the planning of the works in this region, proper attention be given to optimizing the alignment of the Changi shore to eliminate eddy formation which is considered to be achievable through the sensitivity tests.

Remaining unresolved issues and concerns

Reduction in slack water times was reported by DHI/BMT to have a minor impact on large vessels, in particular vessels under tow. It is reported, however, that this requires more careful planning of the movements but does not affect the accessibility of facilities in the Port of Johor.

Suggested remedial measures

As a measure against eddy shedding, streamlining the Changi finger will be effective. Since the present configuration can be considered as a construction phase of the Changi reclamation, such a measure is recommended as a part of the ongoing works in the area.

No: 2.5
Name of Issue: Ship Traffic and berthing / Transit MSE - JRGPA
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20 and V, part 1, 185- 191, 195

Knowledge after considering the studies

Reduction in slack water times requires more careful planning of the movement of large vessels, in particular vessels under tow, but it does not affect the accessibility of facilities in the Port of Johor. No dangerous situations occurred during the tows and all the manoeuvres indicated a safe and controlled manoeuvre.

The requirement for a better planning stresses the need for availability of reliable data on the tide as the works proceed.

Technical common ground determined by the GOE

The GOE concur with the conclusion with respect to safe navigation.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Keep pilots informed about changes in tidal conditions

No: 2.6
Name of Issue: Ship Traffic and berthing / JPA
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19 and V, part 1, p 93-126, 172-174, 195

Knowledge after considering the studies

The current velocities (and thus the anchor forces) in the Western part of the anchorage will slightly increase. The Western section of the JPA (Quarantine anchorage and to a lesser extent Petroleum Anchorage) has always been and remains unsuitable for large vessels (> 100 000 DWT) owing to space and depth limitations.

Technical common ground determined by the GOE

The GOE concur with the conclusion of the study.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary for Case 2.

The GOE notes that if remedial measures are taken to restrict flow velocities in the PULAREK transect by taking a bite out of Area D, and adding a nose to it, then it would be wise to consider a shift of JPA in easterly direction as part of these measures. The GOE would consider such shift worthwhile in relation to the more important reduction of velocities in the PULAREK transect.

No: 2.7
Name of Issue: Ship Traffic and berthing / JRGPA
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volume V, part 1, p 93-126, 175-176, 195

Knowledge after considering the studies

Ships of the selected size would not normally be anchored in the JRGPA area unless additional precautions were being taken to prevent the ships from swinging out of the defined anchorage in all cases. With additional precautions such as a second anchor, anchor drag would not occur.

Technical common ground determined by the GOE

The GOE agrees with the conclusion

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.8

Name of Issue: Ship Traffic and berthing / Berthing at Pasir Gudang and MSE

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes V, part 1, p 177-194, 195

Knowledge after considering the studies

All simulations were conducted successfully.

Technical common ground determined by the GOE

The GOE agree

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.9
Name of Issue: Ship Traffic and berthing / Berthing Tg. Langsat
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19 and V, part 1, p 86-89, 150-156, 161-167, 195, 287

Knowledge after considering the studies

According to the report of DHI/BMT the increased current velocity does not affect berthing of the 30000 DWT design vessel, though this was not actually simulated. The vessel used in the simulations (60 000 DWT) encountered some minor difficulties, but was too large for the access channel and the jetty. The difficulties that were met were attributed to the larger size of vessel in relation to the depth and width of the dredged approach channel. Mooring line tensions increased for both Case 1 and Case 2.

Technical common ground determined by the GOE

The GOE concur with the conclusion of the study.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 2.10
Name of Issue: Ship Traffic and berthing / Berthing PULAREK
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19, 43 and V, part 1, p 157-160, 195

Knowledge after considering the studies

Level of current awareness and experience required for berthing on ebb tide is increased. The manoeuvre can however be accomplished safely. The berthing manoeuvres at ebb tide are difficult anyway in all Cases, 0, 1 and 2.

Technical common ground determined by the GOE

The GOE agree that mooring on the ebb tide was difficult and has become more difficult.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Reduction of velocities in the PULAREK transect would be effective, but even velocities close to those in Case 0, still result in difficult berthing at ebb tide.

No: 2.11

Name of Issue: Ship Traffic and berthing / Berthing Belungkor

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19, 43 and V, part 1, p 168-171, 195

Knowledge after considering the studies

The increased velocity does not affect berthing.

Technical common ground determined by the GOE

The GOE agree

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary.

No: 2.12
Name of Issue: Ship Traffic and berthing / PULAREK Jetty Structure
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Moderate

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19, 44 and V, part 2, p 40-71, 127

Knowledge after considering the studies

General erosion of residual soft material by currents and prop wash of ships will occur in the jetty area in the order of 0.1 – 0.2 m/year, decreasing with time. Coupled with the higher mooring loads associated with the stronger currents, this may adversely affect the integrity of the structure over a 10 – 15 year time frame. It is noted that insufficient design information was made available to perform a rigorous analysis. This impact is higher for Case 2 than for Case 1.

The pontoons on this jetty were designed to accommodate small craft. It is reported that these pontoons have been damaged by larger vessels than those for which the jetty was originally designed as well as wave and wake action.

Technical common ground determined by the GOE

The GOE is in agreement and recommends the application of a scour protection around the piles. Such scour protection might have been introduced during construction as normal engineering practice, unless scour would have been taken into account in the design. In the absence of detailed design data, it is impossible to judge this point. However, even if scour protection would have been in place from the time of construction, it would now need to be strengthened to cope with the increase in current velocities for Case 1 and subsequently for Case 2.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Application of adequate scour protection. The strength of the scour protection will depend on the actual velocities according to the final lay-out of Area D.

No: 2.13

Name of Issue: Ship Traffic and berthing / Belungkor Jetty Structure

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Minor/moderate

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19, 44 and V, part 2, p 97-126,129

Knowledge after considering the studies

General erosion of residual soft material will occur in the jetty area in the order of 0.1 m/year, decreasing with time. Coupled with the higher mooring loads associated with the stronger currents, this may adversely affect the integrity of the structure over a 10 – 15 year time frame. It is noted that insufficient design information has been made available to perform a rigorous analysis. There is no significant difference between Case 1 and Case 2.

Technical common ground determined by the GOE

The GOE is in agreement and recommends the application of a scour protection around the piles. Such scour protection might have been introduced during construction as normal engineering practice, unless scour would have been taken into account in the design. In the absence of detailed design data, it is impossible to judge this point. However, even if scour protection would have been in place from the time of construction, it would now need to be strengthened to cope with the increase in current velocities for Case 1 and subsequently for Case 2.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Application of adequate scour protection. The strength of the scour protection will depend on the actual velocities according to the final lay-out of Area D.

No: 2.14
Name of Issue: Ship Traffic and berthing / Tg. Langsat Jetty
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 19, 44 and V, part 2, p 73-96, 128

Knowledge after considering the studies

General erosion of residual soft material as a result of increased currents is found to be small in the jetty area (< 0.1 m/year), decreasing with time. Even coupled with the slightly higher mooring loads associated with the stronger currents, no adverse effects on the integrity of the structure are expected. There is no significant difference between Case 1 and Case 2. Erosion that has occurred was due to capital dredging in the access channel.

Technical common ground determined by the GOE

The GOE agree

Remaining unresolved issues and concerns

None related to the reclamation works

Suggested remedial measures

None deemed necessary

No: 2.15
Name of Issue: Ship Traffic and berthing / General Remarks
Area of interest: Pulau Tekong / Tuas View Extension

In spite of repeated indications that the GOE was not satisfied with the quality of the reporting on navigation, no adequate action has been pursued by the consultants. Though the GOE accepts the QA report by Noble & Denton with respect to the methodology and conclusions of the study, the GOE remains of the opinion that the quality of Volume V of the report is less than what could be expected.

1 - 3. Morphology

The Section on morphology addresses the short and long term changes arising from sediment deposition and/or erosion. The main hydrodynamic causes for morphological changes can be attributed to tidal and riverine currents, wave action and wave induced currents and ship propeller wash. Other causes leading to morphological changes can be attributed to riverine and marine inputs and human activity such as dredging.

The GOE emphasises that the accuracy of any morphological study is limited (DHI's estimate of uncertainty is 100%).

The GOE further notes that the DHI reports expect decreasing erosion and sedimentation with time as a result of the increasing resistance against erosion with increasing water depths. This means that some predicted values must be regarded as upper bounds.

For PT, both DHI and the GOE have made a clear distinction between initial morphological adjustments due to the present configuration of the works (Case 1) and the long-term impacts that will occur in the forthcoming years.

No: 3.1
 Name of Issue: Sediment Transport and Morphology / Calder Harbour
 Area of interest: Pulau Tekong

Is the issue relevant? Yes
 Significance of impact Minor to moderate

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20-21, 46-47 and VII, p 72-78, 84-85

Knowledge after considering the studies

The studies conclude that most of the short term changes had occurred by mid 2004, and that additional (long term) erosion will be limited to isolated areas where softer material is present. The studies further indicate some local erosion and sedimentation at the foreshore still take place. More specifically the following points are raised:

- Wave reflection from the sheet pile wall will increase erosion of the shoreline between Tg. Pengelih and PULAREK (Case 1 only)
 - Increased currents in Calder Harbour have resulted in some foreshore erosion, particularly between Tg. Surat and Tg. Belungkor
 - Increased currents in Calder Harbour will lead to continued foreshore erosion between Tg. Surat and Tg. Belungkor and between Sg. Santi and PULAREK. The cause of mangrove fringe erosion, is however associated partly with vessel wake impact, and partly with reflected environmental waves.
 - There will be local spots with increased sedimentation in Sg. Lebam and Sg Santi
 - There will be increased sedimentation in Sg Belungkor.
 - In some stretches (i.e.) immediately N. of Sg Santi, sedimentation will facilitate mangrove expansion
-

Technical common ground determined by the GOE

As far as morphological changes are related to wave conditions, the GOE recommends that the steel sheet pile wall should be replaced by the final revetment boundary at the earliest practical opportunity, although the GOE accepts that this replacement must fit in the over-all construction planning..

Remaining unresolved issues and concerns

Since two members of the GOE have doubts about the completeness of the wave calculations, shore erosion as a result of wave action remains unresolved for the time being. The other two members of the GOE view the impacts of environmental wave action as minor to begin with and therefore are not so concerned about any shortcomings of the analysis. They further doubt

the conclusion in the Final Report of DHI that vessel wake yields only a minor contribution to the erosion.

Suggested remedial measures

Most morphological effects can be reduced considerably by increasing the conveyance of the channel in Calder Harbour with the aim of reducing the peak velocities.

The effects caused by wave action (if any) can be effectively reduced by an early replacement of the sheet pile wall by a sloping revetment.

No: 3.2

Name of Issue: Sediment Transport and Morphology / Nenas Channel

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 21, 50 and VII, p 72, 74

Knowledge after considering the studies

The studies predict an increase in sedimentation in the order of 0.1 to 0.2m per annum.

Technical common ground determined by the GOE

The GOE agrees that there is a potential for increased sedimentation. It recommends regular monitoring to verify the predictions and continuation of maintenance dredging operations as required.

Remaining unresolved issues and concerns

None

Suggested remedial measures

As above

No: 3.3

Name of Issue: Sediment Transport and Morphology / Kuala Johor

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Slight to minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 20, 46-52 and VII, p 60-78

Knowledge after considering the studies

Initial morphological adjustments appear to have stabilized by mid 2004 and the quantity of residual soft material susceptible to erosion is small. Long term erosion and deposition rates are therefore small. Considerable erosion at Changi finger is expected to continue for a few years until harder layers are exposed that prevent further erosion.

Technical common ground determined by the GOE

The GOE agrees on the outcome of the study.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Elimination of the eddy structure off Changi finger would further reduce the erosion potential of the flow.

No: 3.4

Name of Issue: Sediment Transport and Morphology / Coast E. of Pengelih

Area of interest: Pulau Tekong

Is the issue relevant? Yes

Significance of impact Slight

Available information and data

As per DHI report. Other issues are the dumping of dredged material in the vicinity.

Summary of Consultant's studies

Volumes I, p 20, 46-52 and VII p 60-78, 90-93

Knowledge after considering the studies

The DHI modelling does not show a clear link between the reclamation works and the sedimentation along the shore E. of Tg. Pengelih. The model predicts sedimentation for all Cases 0, 1 and 2, but the incremental sedimentation is considered to be less than the limit of model reliability.

The GOE notes further that there is an area with increased sedimentation (0.1 to 0.2 m per year) in the W section of JPA (in particular in the Quarantine area). The actual sedimentation found in JPA as a whole could not be explained by the DHI models.

Technical common ground determined by the GOE

The GOE agrees with the statement of DHI. The GOE further recommends that in case a decision is made to reconfigure the E boundary of Area D consideration is given to deposition in the JPA.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 3.5

Name of Issue: Sediment Transport and Morphology / PTP approach

Area of interest: Tuas View Extension

Is the issue relevant? Yes

Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes VII, p 56

Knowledge after considering the studies

No incremental sedimentation

Technical common ground determined by the GOE

The GOE agrees

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 3.6

Name of Issue: Sediment Transport and Morphology / PTP anchorage

Area of interest: Tuas View Extension

Is the issue relevant? Yes

Significance of impact Slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 16 and VII, p 54-59

Knowledge after considering the studies

There is a shift in the location of sediment deposition resulting in a general decrease in sedimentation in the northern section of between 0.6 and 0.8 m per year and a general increase in the southerly section of between 0.2 and 0.4 m per year. DHI indicates a slight increase in the overall sedimentation in the order of 0.03 m per year of consolidated material.

Technical common ground determined by the GOE

The GOE agrees with the facts.

The GOE concludes that the deposition takes place in an area where the depth is typically over 25m and therefore the deposition is unlikely to cause serious problems.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary but continued monitoring is recommended.

No: 3.7

Name of Issue: Sediment Transport and Morphology / General Remarks

Area of interest: Pulau Tekong / Tuas View Extension

The GOE advises that any undesired morphological developments can be reduced by lowering the peak velocities in the changed situation. This is particularly the case for the channels around PT.

The GOE further notes that there is a continued uncertainty about the source of fine sediment that has settled in JPA, which cannot be explained by the model results. In connection with the same issue, two members of the GOE note that a question regarding dumping of dredged material in the area has not been answered.

1 - 4. Water Quality

This Section addresses changes in a wide range of commonly used physical, chemical and biological indicators for water quality.

A hydrological model study was undertaken to assess the catchment's and industrial effluent inputs, with this study being complemented with field data so far as available. Some of these data were provided by the relevant Government Departments from both countries.

The water quality studies included the following parameters:

- Total suspended solids
- BOD
- Coliform (faecal and total)
- Chlorophyll-a
- Total-N, NO₂ -N NO₃ -N and NH₄ -N
- Total-P, PO₄ -P
- Hg, Zn, Cd, Cr, Pb, Cu, Ni
- Oil and grease

In addition to this a number of in situ measurements were also taken,

- Temperature,
- salinity (conductivity),
- DO,
- Secchi depths
- pH

This comprehensive water quality study was undertaken both for the West and East Johor Straits. In the studies it has been attempted to de-link the impact of TVE and PT from other developments in the region.

No: 4.1
 Name of Issue: Water Quality / W. Straits
 Area of interest: Tuas View Extension

Is the issue relevant? Yes
 Significance of impact Slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 16-17, 53-61 and VIII, p 131-135, 162-179, 259-267, 286-287

Knowledge after considering the studies

All figures quoted below refer to Malaysian waters.

Salinity: the maximum change predicted is 0.2 PSU.

WQ modelling: DHI predicts a slight increase in BOD up to 0.2 mg/l, the dissolved oxygen content (DO) changes vary over the area and show an increase in some places and a decrease in other places ranging from + 0.07 to – 0.2 mg/l in Malaysian waters.

Eutrophication: DHI predicts an increase of up to 0.15 mg/l for total N, an increase of up to 0.04 mg/l for P, an increase of up to 0.08mg/l for inorganic N an increase of up to 0.01mg/l for inorganic P, and an increase of up to 9 µg/l for Chlorophyll-a.

The Secchi depth will decrease within the W. Johor Straits in the order of 0 – 0.2 m (and up to 0.4 m near PTP), and increase in the order of 0 – 0.1 m in the open waters across Tg. Piai and TVE.

Technical common ground determined by the GOE

The changes are considered to have a slight impact.

Remaining unresolved issues and concerns

Two members of the GOE are of the opinion that the de-linking between the effects of TVE and PTP has not been carried out properly.

Suggested remedial measures

None deemed necessary.

No: 4.2
 Name of Issue: Water Quality / E. Straits
 Area of interest: Pulau Tekong

Is the issue relevant? Yes
 Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, 21-22, 53-61 and VIII, p 136-144,180-213, 268-285, 286-287

Knowledge after considering the studies

Salinity: DHI predicts a varying increase in salinity up to 0.5 PSU as a maximum.

WQ modelling: *WQ modelling:* DHI predicts a slight decrease in BOD up to 0.3 mg/l for case 1 and 0.4 mg/l for case 2. The dissolved oxygen content (DO) changes vary over the area and show an increase in some places and a decrease in other places ranging from - 0.1 to + 0.1 mg/l for case 1 and from - 0.1 to + 0.15 for case 2.

Eutrophication: DHI predicts:

a decrease of up to 0.03 mg/l (case 1) and up to 0.04 mg/l (case 2) for total N,

a decrease of up to 0.006 mg/l (both case 1 and case 2) for total P,

a decrease of up to 0.03mg/l (case 1) and 0.04 mg/l (case 2) for inorganic N

a decrease of up to 0.005mg/l (case 1) and 0.006 mg/l (case 2) for inorganic P, and

a decrease of up to 0.9 µg/l (case 1) and 0.5 µg/l (case 2) for Chlorophyll-a, with the exception of the upper part of the Sg. Johor estuary, where there is a slight increase of < 0.02 µg/l (case 1) and 0.05 µg/l (case 2).

Secchi depth value changes range from a decrease of 0.4 m to an increase of up to 0.05 m (case 1) and a decrease of 0.3 m to an increase of 0.3 m (case 2)

Technical common ground determined by the GOE

The GOE agrees on the predictions and considers the changes to be negligible.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary.

1 - 5. Water Levels

The water level variations in the Western and Eastern Straits have been assessed using the hydrodynamic model and the previous studies undertaken by the two Governments.

No: 5.1
Name of Issue: Water Level Changes / W. Straits
Area of interest: Tuas View Extension

Is the issue relevant? No
Significance of impact Negligible

Available information and data

DHI reports (2003 and 2004), DID Report, NUS report(s), Delft Hydraulics Report

Summary of Consultant's studies

Volumes I, p 16, 36

Knowledge after considering the studies

All studies indicate minimal effects of the reclamation works on the water levels.
There will be negligible effects only

Technical common ground determined by the GOE

The GOE is of the opinion that water levels are not an issue, except for a small stretch of coastline between Tg. Piai and the second link. This issue will be discussed separately under the heading Ecology / mangrove.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 5.2
Name of Issue: Water level changes / E. Straits
Area of interest: Pulau Tekong

Is the issue relevant? No
Significance of impact Negligible

Available information and data

DHI reports (2003 and 2004), DID Report, NUS report(s), Delft Hydraulics Report

Summary of Consultant's studies

Volumes I, p 21, 36-37

Knowledge after considering the studies

All studies indicate minimal effects of the reclamation works on the water levels.
There will be negligible effects only

Technical common ground determined by the GOE

The GOE is of the opinion that water levels are not an issue.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

1 - 6. Ecology

The results of the water quality and hydrodynamic model studies were the main input parameters for the ecological impact assessment. Since few site specific data on the tolerance levels of various receptors were available, extensive use has been made of data available in literature.

In the ecological study the impact of the reclamation works on the following parameters were assessed.

- Mangroves
- Sea grass
- Corals
- Mudflats
- Aquaculture
- Fish and shrimps
- Fishing (inclusive small vessels)
- Dugongs

The GOE wishes to emphasize that ecological parameters and secondary effects are variable and prone to uncertainty. Hence all ecological assessment predictions need to be treated with caution.

No: 6.1
Name of Issue: Ecology / Mangroves
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Negligible to slight

Available information and data

As per DHI reports (2003 and 2004)

Summary of Consultant's studies

Volumes I, p 16, 17, 61-63 and IX, p 95-97

Knowledge after considering the studies

DHI predicts:

A slight increase in water levels between Tg. Piai and the second link

A slight change in mean water levels in Sg. Pulai and the W. Johor Straits

A slight increase of salinity levels in Sg. Pulai

Technical common ground determined by the GOE

As the changes are below the tolerance level of mangroves, the GOE agrees that there will be negligible or slight impacts. The GOE takes account of the fact that the rise in the water levels between Tg. Piai and the second link will be largely compensated for by the sheltering effects of TVE.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary.

No: 6.2
Name of Issue: Ecology / Mangroves
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Negligible to slight

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 21, 63-65 and IX, p 97-99

Knowledge after considering the studies

Increased current velocities in Calder Harbour will cause continued erosion of the foreshore. The primary cause of mangrove fringe erosion is however deemed to be associated with vessel wake impact rather than erosion resulting from PT.

For Sg. Belungkor a decrease in current velocity and consequently increased sedimentation up to 0.2 m per year is predicted, which may have longer term consequences to tidal propagation in the mangroves

For the E. Johor Straits a change in mean water levels change is <0.02 m, which is below the tolerance level of mangroves.

For Sg. Santi an increase in salinity of 0.3 PSU is predicted, which is below the tolerance level of mangroves.

Technical common ground determined by the GOE

The GOE is of the opinion that the impacts to be expected can be classified to be between negligible and slightly significant.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary, although a reduction in maximum velocities in Calder harbour will have a positive effect.

No: 6.3
Name of Issue: Ecology / Seagrass
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Slight to moderate

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 17, 65-68 and IX, p 135-138

Knowledge after considering the studies

DHI predicts a potential 7-13% decrease in the seagrass beds off Tg. Kupang as a result of decreased Secchi depths. At the same time, DHI indicates (Vol. I) that it is uncertain that a larger seagrass area would have been sustainable due to the conditions prevailing prior to 2001. Due to the lack of data, this can not be verified.

Technical common ground determined by the GOE

All members of the GOE accept that seagrass beds provide an important nursery ground for marine species.

Remaining unresolved issues and concerns

Two members of the GOE have indicated their reservations about the Secchi depth predictions, and specifically the delinking between the TVE and PTP reclamations in this respect. They further are of the opinion that seagrass as such is not an endangered species, and that the ecological value of the beds must be seen as feeding and nursery grounds for animals. The potential loss of seagrass area as a result of TVE must in their opinion also be viewed against the background of covering large areas of seagrass by the PTP reclamation.

Suggested remedial measures

None deemed appropriate

No: 6.4
Name of Issue: Ecology / Seagrass
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Slight (from positive to negative)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 21, 65-68 and IX, p 139-144

Knowledge after considering the studies

DHI indicates that small positive and small negative changes in the Secchi disc depth are expected at the seagrass beds off Tg. Surat and Tg. Kopok. The predicted changes are within the uncertainty of the assessment and both, positive and negative.

As far as the seagrass bed near Check Jawa (in Singapore waters) is concerned, a decrease of 6% is the predicted short term result. A slightly larger area will be lost from case 0 to case 2.

Technical common ground determined by the GOE

The findings of DHI are so inconclusive that the GOE cannot make a technical quantification of the impact on the seagrass beds off Tg. Surat and Tg. Kopok if any.

Remaining unresolved issues and concerns

Two of the GOE members are not certain that the effect of the construction of the Tg. Langsat complex has been properly de-linked when considering the conditions at the seagrass beds off Tg. Kopok and at Check Jawa.

Two other members of the GOE expressed their concern about the loss of seagrass in the Chek Jawa area.

Suggested remedial measures

None deemed necessary

No: 6.5
Name of Issue: Ecology / Corals
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Slight positive to slight negative

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 17, 68 and IX, 161-162

Knowledge after considering the studies

DHI predicts:

Reduction in salinity of 0.1 to 0.15 PSU

Reduction of suspended sediment concentration of 0.5 to 1.0 mg/l

Reduction of sedimentation of 0 to 0.004 kg/m²/day

Increase in Chlorophyll-a of 2-5 µg/l.

According to DHI's literature review, these changes taken together have no clear effect on the coral community at P. Merambong.

Technical common ground determined by the GOE

The GOE agrees

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 6.6
Name of Issue: Ecology / Corals
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, 22, 68 and IX, p 163

Knowledge after considering the studies

DHI predicts:

No change in salinity

Reduction of suspended sediment concentration of 1 to 5 mg/l

Increase of sedimentation of 0 to 0.012 kg/m²/day

Decrease in Chlorophyll-a of 0 to 0.02 µg/l.

According to DHI's literature review, these changes taken together have a negligible effect on the coral community at Malang Berendam.

DHI further indicates that the revetment along PT may eventually be colonized by coral species.

Technical common ground determined by the GOE

The GOE agrees

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 6.7
Name of Issue: Ecology / mudflats
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Slight positive

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 17, 69-70 and IX, p 185

Knowledge after considering the studies

DHI predicts an increase in foreshore tidal range at the mudflat areas in the order of 0.07 m. This increase in the width of the intertidal mudflat habitat area is regarded as positive. Furthermore, an increase of up to 8 µg/l of Chlorophyll-a in the W. Johor Straits will serve as an additional food supply to the mudflat communities.

Technical common ground determined by the GOE

The GOE concurs with the conclusion that a slight positive impact is predicted.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 6.8
Name of Issue: Ecology / mudflats
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Is the effect significant? Slight to Minor

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 22, 69-70 and IX, p 185-186

Knowledge after considering the studies

DHI predicts that the overlap of mudflat areas is small and any negative impact is within the uncertainties of the assessment. The loss of mudflat area due to the reclamation itself is estimated to be 5% of the total area. This will partly be compensated by development of mudflats N. of PT. Another loss is possible due to erosion along the shoreline as a result of higher velocities.

Technical common ground determined by the GOE

The GOE concurs

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary. Reduction of velocities in Calder Harbour will have a mitigating effect.

No: 6.9
Name of Issue: Ecology / Aquaculture
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 17, 70-72 and IX, p 218-219

Knowledge after considering the studies

DHI predicts:

Reduction in salinity of 0 – 0.2 PSU

Reduction in dissolved oxygen of 0 – 0.5 mg/l

Reduction in suspended sediment concentration of 0 – 5 mg/l

Increase in Chlorophyll-a of 1 – 5 µg/l

in the main aquaculture sites of the W. Johor Straits.

The changes are less than the tolerance levels of the species raised in the area.

Technical common ground determined by the GOE

The GOE deems the impact to be negligible

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 6.10
Name of Issue: Ecology / Aquaculture
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 22, 70-72 and IX, p 219-220

Knowledge after considering the studies

DHI predicts:

Increase in salinity of 0.2 (case 1) – 0.5 (case 2) PSU

Decrease/increase in dissolved oxygen of 0 – 0.05 mg/l

Increase in suspended sediment concentration of 0 – 6 mg/l

Decrease/Increase in Chlorophyll-a of up to 0.5 µg/l
in the main aquaculture sites of the E. Johor Straits.

The changes are less than the tolerance levels of the species raised in the area.

Technical common ground determined by the GOE

The GOE deems the impact to be negligible

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

No: 6.11
Name of Issue: Ecology / Fish and shrimp
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact For shrimp: cannot be determined from the study results
– (see technical common ground below)
For fish: negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 18, 72-73 and IX, p 244-245

Knowledge after considering the studies

DHI predicts a reduction of larvae influx as a result of reduced flushing in the W. Johor Straits. Further studies would be required to quantify the effect on adult shrimp population and the resulting impact on nearshore fishing.

No impact is expected on fishery resources in the W. Johor Straits.

Technical common ground determined by the GOE

The GOE is of the opinion that the modelling approach adopted by DHI for the movement of shrimp larvae is an over-simplification of a complex eco-hydraulic process (or system). The GOE therefore considers it impossible to arrive at a firm conclusion on the impacts of the reclamation works on shrimp, based on the DHI studies.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Inconclusive

No: 6.12
Name of Issue: Ecology / Fish and shrimp
Area of interest: Pulau Tekong

Is the issue relevant? Yes
Significance of impact For shrimp: cannot be determined from the study results
– (see technical common ground below)
For fish: negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 22, 72-73 and IX, p 245

Knowledge after considering the studies

DHI predicts an increase of larvae influx as a result of increased flushing in the E. Johor Straits. Further studies would be required to quantify the effect on adult shrimp population and the resulting impact on nearshore fishing.

No impact on the wild fishery resources is expected.

Technical common ground determined by the GOE

The GOE is of the opinion that the modelling approach adopted by DHI is an over-simplification of a complex eco-hydraulic process (or system). The GOE therefore considers it impossible to arrive at a firm conclusion on the impacts of the reclamation works on fish and shrimp.

Remaining unresolved issues and concerns

None

Suggested remedial measures

Inconclusive

No: 6.13
Name of Issue: Ecology / Fishing
Area of interest: Tuas View Extension

Is the issue relevant? Yes
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 18, 73-74 and IX, p 248

Knowledge after considering the studies

DHI predicts a negligible change or a slight improvement in operating conditions for nearshore fishermen.

Technical common ground determined by the GOE

The GOE agrees

Remaining unresolved issues and concerns

None

Suggested remedial measures

None

No: 6.14
 Name of Issue: Ecology / Fishing
 Area of interest: Pulau Tekong

Is the issue relevant? Yes
 Significance of impact Slight to moderate (with a high degree of uncertainty) Slight (2 GOE members), Moderate (2 GOE members) - with a high degree of uncertainty (agreed by all)

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 22-23, 73-74 and IX, p 248-259

Knowledge after considering the studies

Fuel cost

The increased currents in Calder Harbour will lead to increased fuel costs for nearshore fishermen operating in the area. DHI have estimated the cost per fishing vessel per year.

Gill netting in Calder Harbour

DHI have drawn attention to issues relating to gill net entanglement associated with the higher velocities in Calder Harbour.

Gill netting off Tg. Setapa

Despite fairly extensive investigations, DHI have not been able to establish a clear link between the identified (small) decrease of current velocities off Tg. Setapa and catch potential of nearshore gill net fishing.

Technical common ground determined by the GOE

Gill netting off Tg. Setapa

The GOE concurs with the findings of DHI.

Remaining unresolved issues and concerns

Fuel cost

Two members of the GOE question the basis for the calculation of the increased fuel consumption by local fishermen and felt that the figures quoted were too low.

Gill netting in Calder Harbour

Two members of the GOE are of the opinion that the conclusions drawn by DHI are premature since they are based on a single test only.

Two members of the GOE are of the opinion that the impact is broader with respect to socio-economic aspects and thus more significant than indicated in the DHI report.

Suggested remedial measures

A reduction of the velocities in Calder Harbour by redesigning the E. boundary of Area D would help to reduce the impact.

Fuel Cost

Compensation as deemed appropriate

Gill netting in Calder Harbour

Expert assistance to redesign fishing nets and compensation as deemed appropriate.

Gill netting off Tg. Setapa

None deemed necessary

No: 6.15
Name of Issue: Ecology / Dugong
Area of interest: Tuas View Extension and Pulau Tekong

Is the issue relevant? No
Significance of impact Negligible

Available information and data

As per DHI report

Summary of Consultant's studies

Volumes I, p 23, 74 and IX, p 262-263

Knowledge after considering the studies

As no significant change in seagrass coverage as a result of the works has been identified, it is unlikely that there is any direct impact on food availability for the resident Dugong population (if any).

Technical common ground determined by the GOE

The GOE are of the view that DHI have done the best investigation possible in the time available as to the impacts of the TVE and PT reclamation works. They have established that the impact on seagrasses originating from the reclamation is very small and this is not likely to have any incremental impact on the stress level for the Dugong population (if any). The GOE has no reason to question this conclusion and accepts DHI's assessment.

Remaining unresolved issues and concerns

None

Suggested remedial measures

None deemed necessary

Attachment 2
Interim Report on Area D

Attachment 2 Interim Report on Area D**WORKS IN AREA D AT PULAU TEKONG, SINGAPORE****INTERIM REPORT****By****Group of Experts (GOE)****Introduction**

In the context of the ITLOS Order of 8th October 2003 concerning Singapore's land reclamation in and around the Straits of Johor, the GOE were required to prepare as soon as possible an interim report on the subject of infilling works in Area D at Pulau Tekong, in compliance with paragraph 106, 1(a) (ii) of the Order.

The Interim Report was to state clearly whether the infilling operations in Area D at Pulau Tekong would prejudice Singapore's ability to carry out its commitments under paragraphs 85-87 of the Order of ITLOS, taking into account paragraph 106, 1 (c) of the Order. It is understood by the GOE that this report should not address the issue of whether the boundary of the Area D reclamation should or should not be moved.

In paragraph 87 of the Order Singapore stated that ".....Singapore is pleased to inform the Tribunal that regarding Area D, no irreversible action will be taken by Singapore to construct the stone revetment around Area D pending the completion of the joint study, which should be completed within a year".

In a note prepared for the GOE by the Ministry of National Development, Singapore, entitled 'Note on Infilling Works in Area D at Pulau Tekong, March 2004', Singapore stated the following:

“ In the presentation by Singapore during the 10-13 Feb 04 meeting between Malaysia, Singapore and the GOE, Singapore reiterated that we would not construct the stone revetment around Area D pending the completion of the joint study, which should be completed within a year of the ITLOS Order. The reclamation of the final profile at Area D was planned to be carried out after the OCS is fully utilized in 2006. Singapore also explained that the perimeter sand bund and steel sheet piles for the OCS and the infilling of the OCS with soft dredged material and soft clay would not prejudice Singapore’s ability to implement the commitments referred to in paragraphs 85 to 87 of the ITLOS Order, as the perimeter bund, steel sheet piles and infill material were not at the final Area D reclamation profile position and could be adjusted to accommodate any modifications to the final Area D profile, if such modification is deemed necessary.”

The GOE has now acquired sufficient information to comment on the infilling works in Area D at Pulau Tekong. This has included, in particular, further details of the nature of the material that has been placed during past and current infilling operations.

Description of Site at Area D

The area within the steel sheet pile (see Appendix 1) is described by Singapore as a temporary Offshore Containment Site (OCS) and is receiving ‘soft dredged materials and soft clay from reclamation projects and non-pollutive land based excavated materials generated from Singapore’s construction industry’.

Singapore has explained that the OCS is bounded by a perimeter sand bund with sloping side section, which is built up to 2m below Chart datum (i.e. about 2m below the lowest water level). Steel sheet piles have been installed along the perimeter sand bund as an environmental protection measure to prevent the dispersion of silt into the surrounding waters. The top of the steel sheet piles is 5m above Chart Datum. The steel sheet piles are chosen for their durability and effectiveness as a silt barricade. On the outward-facing slope of the perimeter bund, stones have been placed to form a temporary scour protection for the perimeter bund. Appendix 2 shows the perimeter bund construction sequence.

The temporary sheet pile demarcating the OCS is stated by Singapore to be 150m within the final reclamation profile of Area D. It has been further explained that:

- (i) the perimeter sand bund and sheet piles for the OCS are temporary and do not represent the boundary of the final reclamation profile;
- (ii) the sheet piles will be removed when the OCS is no longer in operation;
- (iii) reclamation will be carried out to the final Area D reclamation profile, as shown in Appendix 3.

Schedule of Infilling Works in Area D

In a presentation to the GOE on 10th to 13th February 2004, and in the presence of delegations of Malaysia and Singapore, a description of the schedule of infilling works in Area D was outlined as illustrated in Appendix 4. This shows the layout and schedule of infilling work of the Area D. Under Phase 1, the grey area has already been filled with dredged material and soft clay up to 2m below Chart Datum. No further infilling of dredged material or soft clay is envisaged in this area. Under phase 2, infilling works are currently in progress in the blue area. Generally, the principle followed is to fill up the inner or northern portion first and then fill downwards to the southern line of the sheet pile wall, so as to safeguard navigational access for the hopper barges. Under Phase 3, infilling in the remaining yellow area is currently scheduled to commence after January 2005. It is envisaged that the capacity of the OCS in Area D will be fully utilized by 2006.

Concluding Remarks

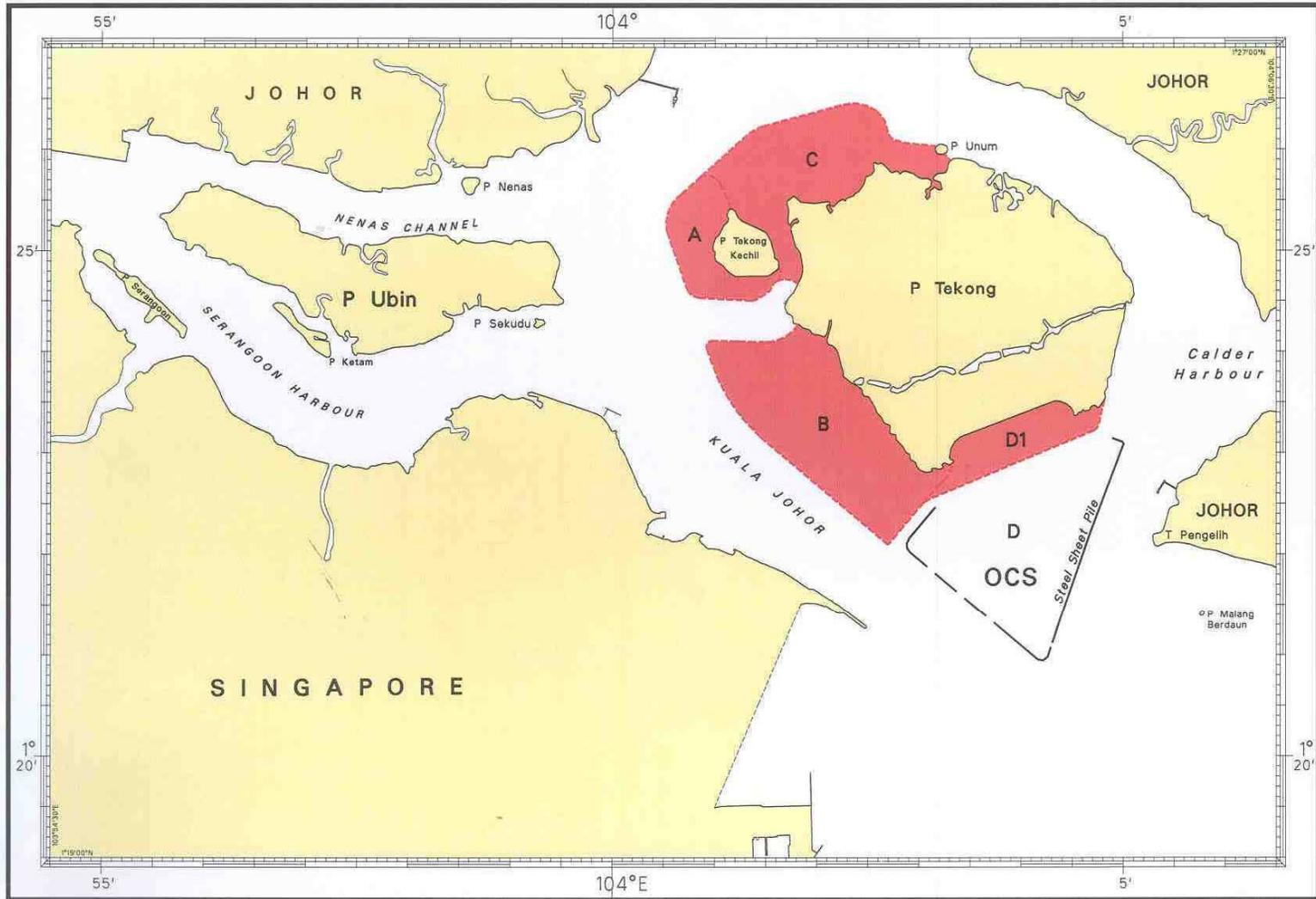
- 1 The GOE are satisfied that any modification to the reclamation north of the termination of the steel sheet pile along the eastern perimeter would not pose any technical or constructional difficulties.
- 2 For the north east section of Area D, where infilling works have been completed up to 2m below CD (see Grey Shaded area in Appendix 4), any modification to the final reclamation profile may require the removal of some infill material, but would be technically and constructionally feasible.
- 3 Similarly, for the western section of Area D, where infilling is in progress (see Blue Shaded area in Appendix 4) the same considerations would apply as in 2 above.

- 4 For the south eastern section of Area D, where infilling is not scheduled to commence until after January 2005 (see Yellow Shaded area in Appendix 4), any modifications to the final reclamation profile would be more straightforward.
- 5 Given the foregoing points 1 to 4, the GOE are therefore satisfied that the construction works undertaken to date by Singapore pose no restrictions on the relocation of the final reclamation profile for Area D if required.

Prof K D'Angremond
Prof R A Falconer
Prof C A Fleming
Prof J W Kamphuis

Dated: 5th August 2004

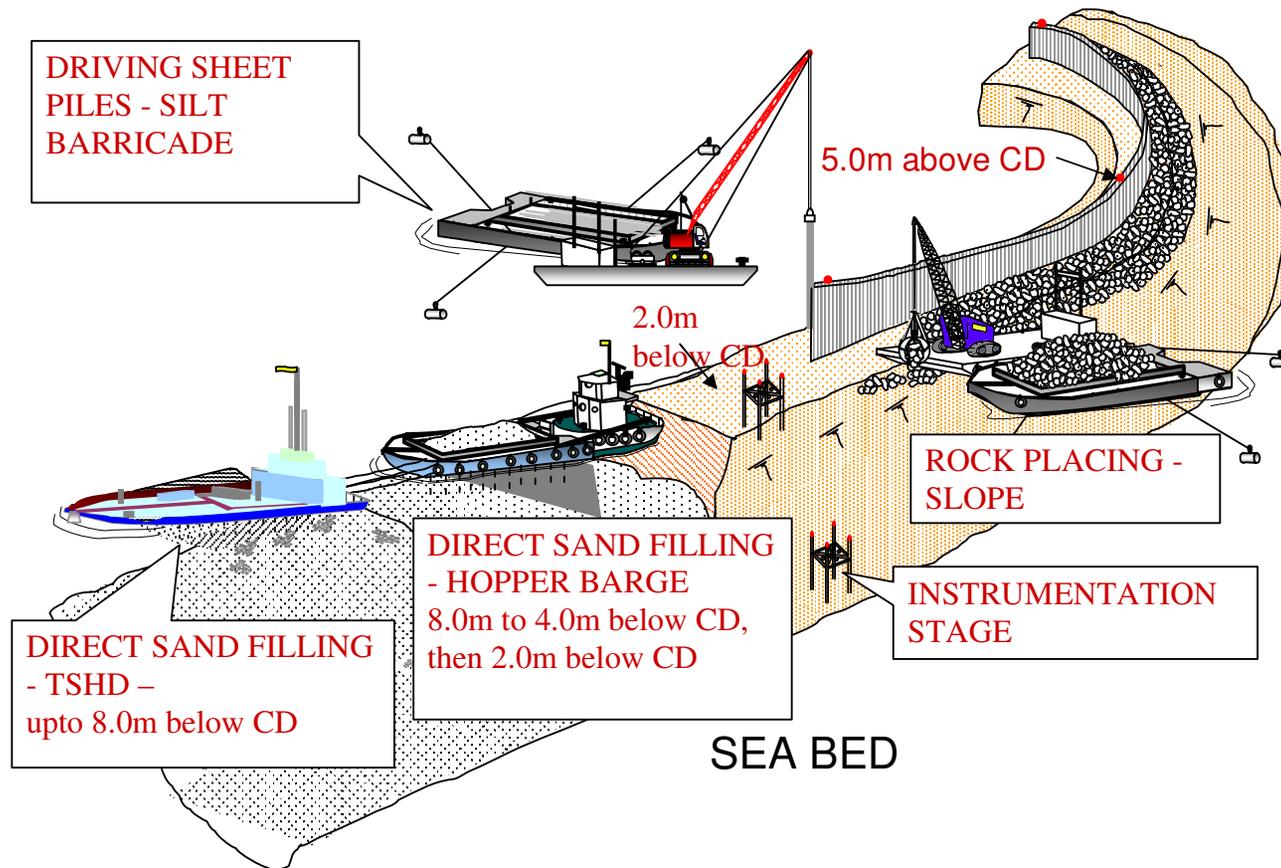
APPENDIX 1 : RECLAMATION PROFILE - INTERIM

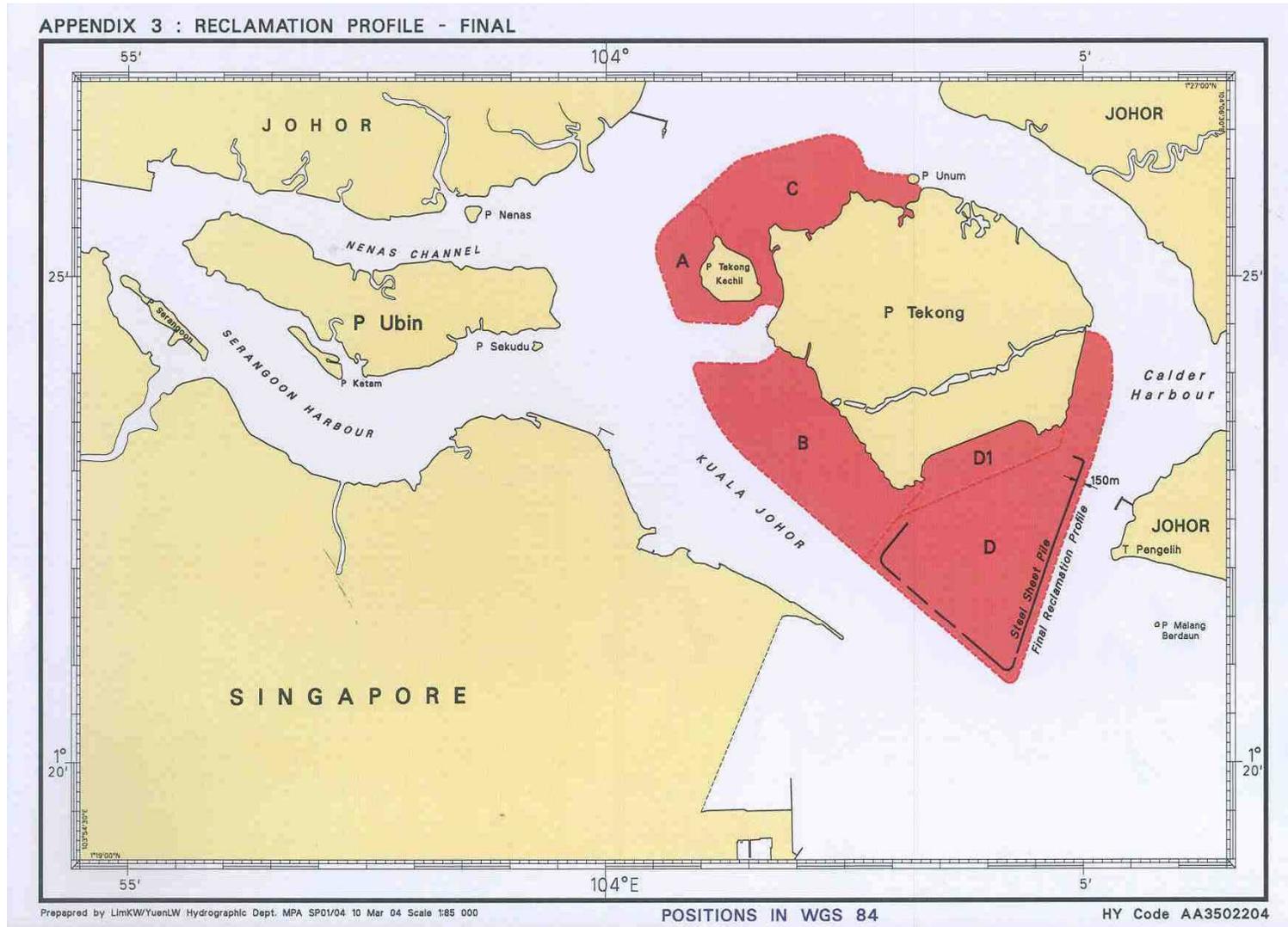


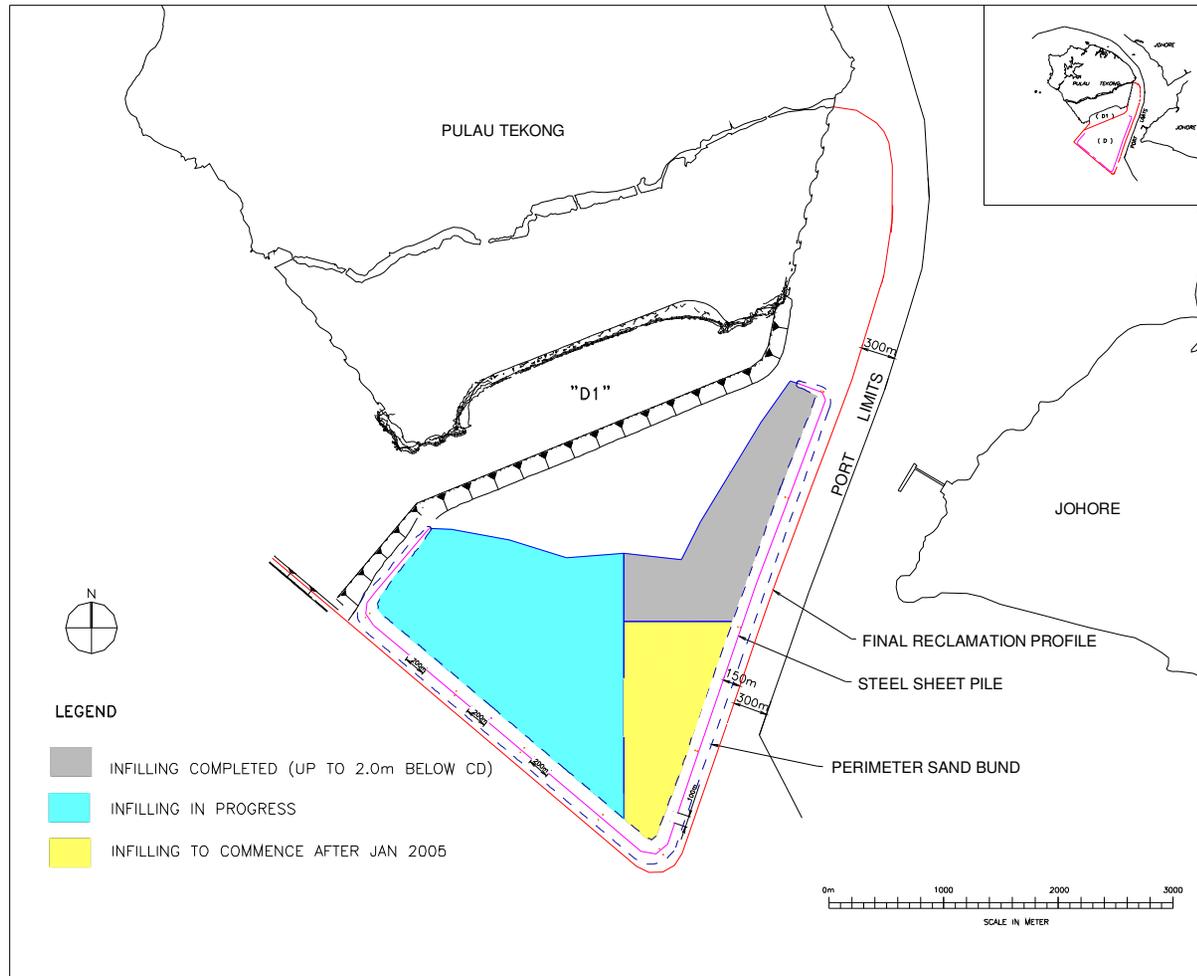
Prepared by LeeNK/YuenLW Hydrographic Dept. MPA SP01/04 10 Mar 04 Scale 1:85 000

POSITIONS IN WGS 84

HY Code AA3502104







Appendix 4 Sequence of Infilling Works

5 November 2004

Attachment 3
Minutes of GOE Meetings

Attachment 3 Minutes of GOE Meetings

Group of Experts Minutes of Meeting 1 (Singapore) February 10 to 13, 2004

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof. Bill Kamphuis

Administrative

Whenever DHI gives information / reports to GOE, the GOE will inform both Governments.

Geometry of P. Tekong

The GOE recommends that test as described in the TOR be performed. These are:

- Case 0: Before start of reclamation,
- Case 1: Existing reclamation outline with sheetpile,
- Case 2: Final designed reclamation outline.

In addition, in order to determine the sensitivities of the *hydro-environmental characteristics* in the region to changes in the geometry of P. Tekong, the GOE recommends the following two tests⁵:

- Case 3 and 4: Two modifications to the geometry of Area D of Case 2.

The actual geometric changes to be tested are to be determined by the GOE in consultation with DHI after preliminary analysis of the results for Case 2. The results of these additional tests will be used to determine the most feasible courses of action, if mitigation measures are needed.

Hydrology and Pollutant Load

GOE recommends that DHI cut back the modelling and data acquisition of hydrology and pollutant loads. Pollutant loads to be input for the main rivers and at all key point sources to be approved by GOE. Hydrology to be the measured flood hydrographs by Malaysia plus any further data required to be approved by the GOE.

Waves

⁵ In an earlier version of this document two other simulation cases were proposed (one with area Y and the other with the original Area C). Singapore questioned the need for these particular simulations, since they were not relevant to the present reclamation geometry, as it relates to the ITLOS order. The GOE agreed to take out these cases.

GOE notes that swell and locally generated wind waves at the sheetpile wall are small and that the sheetpile is temporary. Therefore it finds that the analysis with two models proposed by DHI is excessive. GOE considers it improbable that these small waves will affect either shore erosion of the Malaysian shoreline or manoeuvrability of small craft near PULAREK Jetty. Nevertheless GOE is prepared to support a wave study in order to eliminate any concerns about wave action. GOE suggest that DHI's wave modelling be validated against actual wave measurements at PULAREK and close to the Area D sheetpile wall.

The GOE considers ship-generated waves to be of greater importance here and should be carefully analysed.

Navigation Proposal

The proposal is much too broad and the work proposed in the section on ship navigation and berthing should be significantly reduced. GOE recommends that only fast time simulation of manoeuvrability of generic (large and small) vessels should be used.

Although GOE believes that differences in navigation conditions only exist in the immediate vicinity of P. Tekong, the GOE is prepared to support a fast time simulation study further upstream to Pasir Gudang to eliminate any concerns about effects of the P. Tekong reclamation on navigation.

That would exclude any further work on the Tuas side. GOE notes that vessel-induced drawdown is not mentioned, which is an important ingredient in calculations of forces on moored vessels and of shore erosion. Any economic impact analysis should be clearly focused on sailing times and fuel costs for small boat owners and fishers.

Coastal Structures

GOE recommends that DHI does not carry out an inventory of coastal structures that could be damaged by changed conditions. According to the TOR, section 5.2.3, the two governments have identified the key structures to be studied by DHI.

Sediment Transport

The GOE is satisfied with the proposed level of effort in modelling sediment transport. It is concerned that the proposed Mike 21 MST model does not simulate local mass erosion and requests further clarification on how DHI intends to estimate mass erosion depths.

The GOE also recommends that DHI assess the significance of sediment released from the containment area of P. Tekong, Area D, using available monitoring data.

Water Quality

The GOE is satisfied with the proposed level of effort in water quality modelling.

Ecology

The GOE is satisfied that the proposed ecological approach is in accordance with the TOR. However, the ecological modelling studies should be restricted to those parameters, which are deemed by DHI, in consultation with the GOE, to be quantifiable. In addition the GOE welcomes any evaluations from DHI, which will result in properly founded qualitative inferences. The GOE notes that the proposed Ecolab model has not previously been used in tropical waters and points out that the results will need to be treated with caution.

Water Level Modelling

The GOE sees this as an integral part of the hydrodynamic modelling. The GOE deems it necessary to investigate extreme events for the TVE pre- and post-reclamation cases and for Tekong Case 0 and Case 2 only. The peak discharges for the main rivers will be provided by the Government of Malaysia.

Field Survey

GOE finds that the field survey as cited to be necessary, except for the water level and geodetic measurements for which it would need further justification. The GOE recommends that additional data are required to determine the erodibility of the bottom sediments in the Calder channel region. DHI should take this into account in their revised cost estimates.

General Questions:

The GOE notes that setup costs are included in each subsection of the proposal and this leads to an accumulated setup cost that seems to be excessive.

It is not clear to the GOE what modelling tools the governments of Malaysia and Singapore receive at the end of the day.

The GOE regards the comparisons between the FEM and FDM as an academic exercise that should not be part of the hydrodynamic study. DHI should use whichever model it deems most appropriate.

The GOE wishes DHI to advise in the inception report how they propose to undertake simulations for Case 0 and Case 2 for high and low sediment loads inputs from the rivers.

**Group of Experts
Minutes of Meeting 2 (Johor Bahru)
April 22 to 29, 2004**

The meeting at Johor Bahru was not minuted. The events may be traced from the official record of the meeting (Appendix 1) and the presentation made by the GOE to the general meeting (Appendix 2)

Appendix 1

RECORD OF MEETING BETWEEN SENIOR OFFICIALS FROM MALAYSIA AND SINGAPORE AND THE GROUP OF EXPERTS

CASE CONCERNING LAND RECLAMATION BY SINGAPORE IN AND AROUND THE STRAITS OF JOHOR (MALAYSIA v. SINGAPORE) JOHOR BAHRU, 22 - 25 MARCH 2004

1. The meeting was co-chaired by Puan Hajah Rosnani Ibarahim, the Liaison Officer and Head of Delegation of Malaysia and Mrs. Cheong Koon Hean, the Liaison Officer and Head of Delegation of Singapore. The GOE was led by its Co-Chairs, Professor Kees d'Angremond and Professor Roger Falconer. The Malaysian delegation list is appended as **Annex A** and Singapore's delegation list as **Annex B**. The list of members of the Group of Experts (GOE) and representatives of DHI are appended as **Annex C** and **D** respectively.

2. The meeting discussed matters contained in the Agenda of the meeting which is appended as **Annex E**.

Welcoming Remarks by Co-Chairpersons

3. The Malaysian Co-Chairperson welcomed the delegation of Singapore, the members of the GOE and representatives from DHI. She briefly outlined the programme of the meeting and expressed hope for a successful and fruitful meeting.

4. The Singapore Co-Chairperson thanked the Malaysian Government for convening the meeting. She expressed the hope that the meeting could be concluded within the agreed allotted date.

Briefing on DHI's Volume I : Inception Report, Revision 1

5. Representatives from DHI briefed the meeting on the Inception Report, which it had submitted on 15 March 2004. The briefing note is appended as **Annex F**.

Clarifications and Amendments to DHI's Volume I : Inception Report, Revision 1 by Malaysia, Singapore and the GOE

6. The Governments sought clarifications and amendments to the Inception Report during discussions with DHI. Malaysia's record of the Clarifications and Amendments on DHI's Inception Report is appended at **Annex G**. Singapore's record of the Clarifications and Amendments on DHI's Inception Report is appended at **Annex H**. The GOE presented its comments on the Inception Report as appended in **Annex I**, which both Governments accepted. Copies of **Annexes G, H and I** were provided to DHI for its information and DHI took note of the contents therein.

7. The GOE and DHI held technical discussions on the follow-up work pursuant to the GOE's comments. The outcome of these discussions is appended as **Annex J**. A copy of **Annex J** was provided to DHI for its follow-up work.

8. The Meeting agreed that Singapore would provide information on the pollutant testing of the material placed in Area D to the GOE for the GOE's interim report on the infilling works of Area D, with a copy to Malaysia and DHI.

Contractual Matters

Letter of Appointment to DHI

9. The Meeting requested DHI to submit a revised Inception Report and Financial Proposal by 31 March 2004. DHI should highlight in the documents where changes have been made to DHI's Volume I : Inception Report, Revision 1.

10. The Government would then submit their comments on the revised Inception Report and Financial Proposal to the GOE by 5 April 2004. Copies of their comments would be given to the other Government at the same time.

11. The GOE would consider all comments received and then prepare a set of instructions for DHI. The Governments would like to request the GOE to forward this set of instructions to DHI, with copies to both Governments, by 13 April 2004.

12. The Governments would, by 15 April 2004, issue the Letter of Appointment to DHI on the basis of the revised Inception Report and Financial Proposal, subject to the GOE's set of instructions.

Third Letter of Provisional Appointment to DHI

13. Pending the issue of the Letter of Appointment to DHI, the Governments agreed to issue forthwith a third Letter of Provisional Appointment to DHI to carry out the works set out in **Annex K**.

14. Should the need arise, the Governments may convene a meeting to discuss any outstanding issues with regard to the revised Inception Report.

Outstanding Matters

15. The Meeting agreed that the procedure for the design of mitigation measures will be discussed at the forthcoming meeting scheduled from 8 to 12 May 2004. Both Governments will submit a note on their views to the GOE by 3 May 2004

Other Related Issues

16. The Meeting expressed its appreciation to the Malaysian authorities for arranging site visits for the GOE and delegates. A copy of the presentation materials will be provided to Singapore, the GOE and DHI.

Date and Venue for the Next Meeting

17. The Meeting agreed to schedule its next meeting from 8 to 12 May 2004 in Singapore. The GOE would revert on its organisational requirements for the meeting. This meeting would discuss, among others, DHI's Note on Ecology Methods (due on 3 May 2004) and Note on Model Set-up (Calibration and Validation Report) (due on 6 May 2004).

Closing Remarks

18. The Malaysian Co-Chairperson thanked her Co-Chair and all participants for their cooperation in making the meeting successful and fruitful.

This Record of Meeting was adopted on 25 March 2004. The Heads of Delegation of Malaysia, Singapore and the GOE approved the Record of Meeting by affixing their signatures to this document.

.....

MDM. HAJAH ROSNANI IBARAHIM
Head of the Malaysian Delegation

.....

MRS. CHEONG KOON HEAN
Head of the Singapore Delegation

.....

PROFESSOR KEES d'ANGREMOND
Co-Chair
Group of Experts

.....

PROFESSOR CHRISTOPHER FLEMING
Member
Group of Experts

25 March 2004

Appendix 2

GOE COMMENTS ON DHI INCEPTION REPORT

GENERAL COMMENTS

- GOE wishes to be complement DHI for timely delivery of Inception Report
- GOE feels that from now on they should be responsible for technically managing project for completion on time and quality standards
- GOE feels that a Project Manager should be appointed from both Governments to deal with contractual matters and liaise with GOE

Chapter 1 - Introduction

- GOE accepts responsibility for determining significance of identified impacts, but this should not preclude DHI from expressing their expert opinion on findings of study

Chapter 2 – Review of Data

- GOE notes extensive absence of various data records etc. and feels it essential that Project Managers ensure that data be made available as matter of urgency
- GOE recommends that firm decision be made urgently on date of May meeting to assess calibration and validation of DHI
- GOE recommends that DHI should submit proposals for measuring critical shear stress in Calder Harbour
- GOE recommends that DHI need to establish bed strata in Calder Harbour

Chapter 3 – Study Approach

- GOE assumes that DHI will use most recent pre-reclamation bathymetry around Pulau Tekong for Case 0 simulations
- GOE concerned that eastern boundary of EJSLM and PT detailed models are too close to study area and DHI should review these boundary locations in consultation with GOE
- GOE wish to clarify that extreme water level predictions excluded from study due to previous studies by both countries not showing any impact due to reclamation
- GOE wish DHI to clarify that MIKE21 does not wave-current interaction predictions
- GOE would ask DHI to provide confirmation that ADCP will segregate incident from reflected waves
- GOE wishes DHI to clarify how they will establish joint probability of current and wave events for extreme conditions – particularly with sheet pile wall changing to revetment
- Pre- and post- reclamation navigable channels and anchorage boundaries will be taken into consideration for manoeuvrability and anchoring studies
- GOE wishes DHI to undertake navigation studies in phased manner as agreed at February meeting between GOE and DHI. Financial proposal must therefore identify cost of individual components
- GOE seeks clarification from DHI of simulation conditions in last paragraph of Section 3.4.7 and Section 3.4.8
- GOE seeks clarification on following manoeuvres cited in Table 3.2:
 - Access and departure to Tg. Belungkor via K. Johor

- Inbound and outbound transit to MSE by full container vessel and full bulk carrier
- GOE recommends use of model for 450k DWT ballast ULCC
- GOE recommends omitting VLCC in ballast to and from MSE
- GOE seeks revised method statement from DHI to address issues relating to indigenous small craft, regional small craft and car ferries
- GOE recommends that if field observations for turbidity in region of area D cause concern about occurrence of sediment plumes from area D then simulations be undertaken to establish plume trajectories
- GOE note that Malaysia does not currently have the extensive pollutant loads requested by DHI for water quality simulations. DHI should work with the relevant Malaysian authorities to acquire as much data as possible and produce the best estimate boundary inputs into Straits of Johor
- GOE expects DHI to try its best to de-link environmental effects of reclamation works from any other anthropogenic inputs in the region
- GOE questions accuracy of Table 3.5 and relevance to current study
- GOE notes model performance criteria cited by DHI and would wish DHI to attempt to meet stricter criteria, such as that used as guidelines by UK Environment Agency (Foundation for Water Research Ref FR0374)

Chapter 5 – Bathymetry and Water Levels

- GOE recommends that measurement of wake waves from passing vessels should not be jeopardized by early communication with vessel crews or vessel operators
- GOE regards heavy metal detection levels in Tables 5.1, 5.2 and marine sediments as high and DHI are requested to review these limits further

THANK YOU

**Group of Experts
Minutes of Meeting 3 (Singapore)
May 7 to 10, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer (Arr. May 8), Prof. Chris Fleming and Prof. Bill Kamphuis

Minutes 3a – Meeting May 7, 2004

Procedural

1. We note that Singapore and Malaysia are at ease with the GOE chairing the meetings that involve GOE.
2. We decide that portions of meetings in which presentations are made by Malaysia will be chaired by Fleming or Falconer and those where Singapore makes a presentation will be chaired by d'Angremond or Kamphuis,
3. No comments were received on the DHI ecology note from either Singapore or Malaysia by 15:00, so we cannot discuss their comments at this time.

Ecology

4. Malaysia thinks there is much more information in the reports they have provided than is used by DHI.
5. Tolerance limits tables need to be used carefully. For example, they do not incorporate cumulative effects and hence background activity may bring a parameter close to its tolerance and the reclamation may just push it over the limit tolerance. Does this constitute significant impact?
6. Malaysia alleges that part of the ecosystem (mud flats) is removed by burial.
7. Is the methodology standard of practice of care? We think it is, within a time frame of less than a decade.
8. DHI needs to determine confidence limits.
9. DHI needs to separate out the effects of the reclamations from all other effects.
10. DHI needs to ask for port construction and maintenance dredge-dump data (such as for PTP and Lansat).
11. DHI states that their proposed study cannot provide quantitative results in many instances. Nevertheless, GOE recommends that the whole program proposed by DHI be accepted. The technical basis for this recommendation is that the data and analysis so purchased will be necessary in any future studies. Unless the present impulse is used to produce the best database possible, any future studies will need to start from a virtually zero information base.

Navigation

12. We need to instruct DHI clearly with respect to navigation.
13. Johor Port Anchorage is considered to be one anchorage now by Malaysia. There is no longer a distinction between the four functions. It is therefore realistic to remove the northwest corner of the anchorage to make more room for navigation into Calder Harbour. Widening the anchorage further to the south or adding to the southeast of the anchorage can easily recover the lost anchorage space.

14. With respect to vessels shortcutting across the present Area D, vessels have always been impeded from sailing through this area before reclamation by keelongs, which were removed shortly before the reclamation works were started.
15. With respect to manoeuvring a tug-assisted tanker, before any simulation takes place, DHI should first determine any change in tidal window, resulting from the reclamation activities. GOE must also verify if BMT can model tug-assisted vessel in fast time mode.
16. A 50,000 tdwt tanker and 60,000 tdwt bulk carrier do not handle much differently at very slow mooring speeds. We should model the worst case of the two – not both.

Mitigative Measures

17. Cases 3 and 4 are sensitivity tests and not mitigative measures. These results will be used in the design mitigation, should any be needed.
18. In its final report, GOE determines significance of any impacts identified by DHI and recommends possible approaches to mitigation if needed.
19. Structural mitigative measures on Singapore's side will be designed by Singapore.
20. Structural mitigative measures on Malaysia's side will be designed by Malaysia, but since Singapore is paying for the mitigations, the designs need to be approved by Singapore.

Minutes 3b – Meeting May 8, 2004

Procedural

21. Delivery of Progress Report No. 2 required on Friday 4th June at the latest to satisfy meeting schedule on Monday 7th June.(p9)

Technical

22. Bathymetry (p10). Clarification required on how all of the different survey charts are cross referenced.
23. Maps look strange with respect to Admiralty Charts regarding the flooded area (above +2). See for example Sungai Sangi on p11.
24. Incorrect title to Table 3.3 on p14.
25. On p19 section 'Salinity and Suspended Solids' statements made regarding temperature and salinity made without reference. Concerns about 3D effects. All such statements with require substantiations.
26. On p30 1st para explanation required as to how the adjustments are made with respect to mean sea level, given to 4 significant figures. Also see tables 4.3 and 4.4.
27. Section 4.4, p32 and Table 4.5. Variation in Manning's number is not consistent with physical sense. Do not agree with statement about 'higher accuracy requirements' requiring an artificial calibration of this factor. Evaluation of k values based on Table 4.5 shows friction **increasing** in the deepest water. Reason seems to be calibration to replicate high land boundary flows and lower mid-channel flows in area of constriction – see figures from p52 onwards.
28. Question the use of Smagorinski formulation (see p32 and p34) which is equivalent to using a constant eddy viscosity and is not likely to properly simulate large scale eddy formations. Our experience is that in these narrow channels, such as Calder Harbour there are gradients in both velocity and depth resulting in gradients in the eddy viscosity – an important mechanism for vorticity generation. We believe that simulations using other

formulations would be more effective and we question why the kappa/epsilon model cannot be used. GOE suggest that a simulation run using kappa/epsilon model to compare to $C_s=0.35$ assumption. GOE are most concerned about properly reproducing eddy formations, particularly to east of Tg. Pengelih and recommend collecting an ADCP transect in that area.

29. P45, Table 6.3 – units column 3 and 5 should be cm/s.
30. P47, Figure 6.6 shows poor correlation at neap tides thought to be on the edge of an eddy. Also current speeds at springs do not correlate with zero values. This reinforces view that this is not a good representation of the eddy and comparison with a different eddy viscosity simulation.
31. P50, Figure 6.11. Scale on x-axis appears to be incorrect. Also why has transect T3 not been used.
32. P52 et seq. Require x-y plot of measured and predicted currents across line of the transect – see Figures 6.12 to 6.16.
33. P59 – Figure 7.3 overestimation of maximum currents not explained.
34. P60 – Figure 7.4 many gross discrepancies in both current magnitude and directions. Also last two sentences of section 7.2 are questionable and there are concerns as to whether there will be any improvement on the basis of the relatively poor correlation shown in Figures 7.5 through to 7.7.
35. Chapter 8 in general is premature as we do have a fully calibrated model. However, there is a need to elaborate on the way in which results of the modelling are to be presented. The concept of showing maxima that are not linked in time is not considered to be useful with respect to appreciating all of the impacts. Furthermore there appear to be considerable inconsistencies between the difference plots presented that need further explanation. It would also be most useful to present the results in animation form showing all time steps through a spring and neap tidal cycle. The GOE request that DHI submit a description of the complete suite of output representations that they intend to use in their final report
36. Chapter 9, p73 states that the required performance criteria have been met or exceeded. The GOE do not think this has been demonstrated in all cases.
37. Appendix B. The legends to the figures are illegible.

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Procedural

38. GOE decides that in the interest of being able to complete the project on time, it cannot be expected to consider further evidence that is not adequately documented.
39. GOE decides to communicate this informally to both sides this evening.
40. GOE requests the information regarding the test results on the material deposited in Area D.
41. In DHI's response to "Instructions to DHI by GOE", dated April 17, 2004, DHI has raised the issue of data outstanding from Malaysia. The GOE requests that this data be provided as soon as possible.

**Group of Experts
Minutes of Meeting 4 (London)
Jun 7, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof. Bill Kamphuis

Procedural

1. It was agreed by the GOE that future meetings where the Governments were present should generally be timetabled to finish at 4:30pm, followed by meetings between the GOE representatives and their respective Governments from 5:00pm to 7:00pm, and with the GOE having a private /working dinner from 7:30pm onwards.
2. It was felt that the arrangements for the last meeting, whereby the GOE members stayed at the same hotel, were efficient and productive. The GOE would therefore wish to continue with this practice.
3. The proposed schedule for the July meeting in Copenhagen is attached in Appendix 1. The GOE understands that the meeting will include the two Government Leaders and 6 additional members from each country.

Mitigating Measures

4. The GOE considered the comments from both Governments with regard to the Draft Recommendations for Mitigating Measures. The version circulated in Appendix H4 of the Record of Discussion of the Third Meeting differs slightly from that agreed by the GOE representatives (Kd'A and RAF) and the Governments on 12th May 2004 and the version agreed on that date is now accepted by the GOE as the final version of Recommendations for Mitigating Measures, see Appendix 2.

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5. The GOE were satisfied that the water levels are generally being well predicted.
6. The GOE is concerned about the level of accuracy of the model in predicting the current speed and direction at several key calibration and verification sites, as shown in Figures 5.10 to 5.25. The GOE appreciates the difficulties in comparing simulated currents with previously measured data, but is not in agreement with DHI's observation on page 41 that "comparisons show a reasonably close match and a satisfactory agreement". The GOE expects these comparisons to be much improved when DHI have had the opportunity of comparing their simulations against their own measured data - to be reported in Progress Report 3.
7. The GOE notes that many of the instructions in Annex F3 to the Record of the Third Meeting have been met; however, the GOE also notes that a number of key issues have not been addressed by DHI. The GOE is concerned that postponing discussions of these items may endanger implementation of corrective measures in the final stages of the study.
8. The GOE is concerned that reference to the next Progress Report, due on 2nd July, only refers to "set-up, calibration and validation of the detailed TVE and PT hydrodynamic

models including preliminary impact assessment results from the detailed hydrodynamic models”. The GOE notes from the Time Schedule and Progress per 3rd June 2004 that the following will have been completed, or near completion, by the date of the next meeting of the GOE on 8th and 9th July 2004:

- a) Navigation simulations
 - b) Morphology simulations
 - c) Wave simulations
 - d) WQ/EU simulations
9. The GOE therefore expects the Progress Report due on 2nd July 2004 to include details on the above topics. The GOE also expects to receive draft Final Reports on:
- a) Field Survey
 - b) Model Set-up and Calibration
 - c) Critical Shear Stress Testing.
10. The GOE assumes that the comparisons between the 25m fine grid predictions (as cited on page 23 of the Inception Report Revision 2) and the ADCP transects in the Calder Harbour region will be completed in time for the Progress Report due on 2nd July 2004, enabling the GOE to have time to consider the configurations for the sensitivity test studies, i.e. Cases 3 and 4.
11. The GOE considered the comments from the Governments of Malaysia and Singapore and these comments are summarised in Appendix 3 (not attached here). The GOE also added some specific comments to this table. The complete list of specific comments is being sent to DHI.

Area D and Related Data

12. The GOE received details of the sampling of Area D from Singapore just prior to their meeting. The GOE notes that the samples provided are within the tolerable limits, but is concerned about the limited data available for Area D. The preliminary view of the GOE is that further in-situ sampling data are desirable and the GOE intends to discuss this further through correspondence. Once the discussions have been finalised the GOE will advise the Governments of their recommendation.
13. The GOE notes that “Malaysia agreed to provide information to DHI [on] capital dredging and spoils disposal”. So far as the GOE is aware, these data have not yet been provided.

Appendix 1

Draft Proposed Timetable for July Meeting in Copenhagen

Wed 7th July:

Afternoon arrival

Evening – separate meeting between GOE representatives and respective governments

Thurs 8th July

09:00 – 10:00 Presentation by DHI to GOE and Government representatives

10:00 – 12:00 Discussion of written comments from both Governments

12:00 – 13:00 Lunch

13:00 – 16:00 Meeting of GOE

16:00 – 17:00 Meeting of GOE and DHI

17:30 – 19:30 Debriefing meeting between GOE representatives and respective governments

20:00 – late Private/Working dinner of GOE

Friday 9th July

09:00 – 11:00 Meeting of GOE and DHI

11:00 – 12:30 Meeting of GOE

12:30 – 13:30 Lunch

13:30 – 14:30 Reporting of GOE to Governments

14:30 – 17:30 Spare time for outstanding matters for consideration by GOE

17:30 – 18:30 Debriefing meeting between GOE representatives and respective Governments – if necessary

19:30 – late Informal Dinner

Saturday 10th July

Departure

Appendix 2

Recommendations for Mitigating Measures

The GOE's responsibility for determining the significance of identified impacts does not preclude the consultant, DHI, from expressing their expert opinion on findings of the study.

In this context DHI have responsibility for providing: detailed descriptions of the impacts of the various reclamation works, and suggestions for methods that might lead to mitigating any adverse effects in consultation with the GOE.

In its final report the GOE will determine the significance of any impacts identified by DHI and the GOE will recommend possible approaches to mitigation if deemed appropriate. Any detailed discussion and study on mitigative measures will only come about after the GOE has reviewed the relevant information and concluded that there has been a significant impact that is attributable to the land reclamation works.

It should be noted that Cases 3 and 4 are sensitivity tests to be carried out as part of DHI's present study and are not mitigative measures. These results may be used to assist in the design of mitigative measures should any be deemed necessary.

Structural mitigative measures on Singapore's side will be designed by Singapore. Malaysia will be informed of and will have the opportunity to give its comments on Singapore's proposals for the design of such measures to the GOE, if it wishes.

Structural mitigative measures on Malaysia's side will be designed by Malaysia. Singapore will be informed of and will have the opportunity to give its comments on Malaysia's proposals for the design of such measures to the GOE, if it wishes.

Any mitigative measures will be reviewed by the GOE for suitability and effectiveness in addressing the impact (including whether they are cost-effective). The measures and the GOE's findings and assessments of these measures will be presented to both governments.

**Group of Experts
Minutes of Meeting 5 (Copenhagen)
Jul 7 to 10, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof. Bill Kamphuis

Procedural

1. It was agreed by the GOE that a standard format will be sent to the delegations of Malaysia and Singapore for their future comments to facilitate the processing.
2. Delegations from Malaysia and Singapore were present in Copenhagen during the meeting of the GOE. Time was set aside for bilateral meetings between the GOE members and the respective delegations. A brief plenary meeting took place, in which the GOE explained the progress and the most important conclusions.

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3. The work of the GOE and of the two government delegations that were present in Singapore took place under extreme pressure of time because the report by DHI was received late.
4. The GOE notes that many of the issues raised in previous meetings have been addressed, be it sometimes only provisionally. However, the GOE also notes that a number of key issues have been deferred by DHI to future reports. The GOE remains concerned that postponing discussions of these items may endanger implementation of corrective measures in the final stages of the study. Instructions given in this respect have not been met by DHI. The GOE stresses once again that DHI should expedite finalizing reports on sections of the work that have been completed.
5. It appears that there is uncertainty between DHI and the two countries about the data requested, the data provided, and the data still missing. DHI agreed to include a full overview of this subject in progress report no. 4.
6. The GOE discussed the calibration and validation of the model in great depth. Although some questions are still to be answered by DHI, the GOE is of the opinion that the present model results can not be improved significantly given the lack of field data and the complexity of the area under consideration.
7. The GOE also had a long discussion with DHI about the wave observations. It was concluded that continuation of the measurements would probably not lead to better results. The envisaged hindcasting proves to be not feasible. Instead, DHI will perform an engineering approach on the basis of the few data collected in June 2004.
8. During the meeting recommendations were made to urgently re-survey Calder Harbour and an area in the mouth of K. Johor. Introduction of better bathymetric data will hopefully improve the quality of the 25m grid model with respect to the eddy SE of Tg. Pengelih. Timely completion of this re-survey is essential for a timely delivery of the hydrodynamic effects of cases 1 and 2.
9. The GOE considered the comments from the Governments of Malaysia and Singapore and discussed these comments along with their own remarks with the staff of DHI. Due to the

earlier mentioned lack of time, the GOE was only able to finalize the list of comments with the response of DHI a week after the end of the meeting. The comments are summarised in Appendix 1, and are being sent to the two governments and DHI.

Area D and Related Data

10. The GOE received data on the cross section of the final profile of Area D, with an indication of the position of the final revetment relative to the international border. With these data, the layout of case 2 is now fixed.
11. DHI indicated that it will provide results on the sediment release from Area D on July 16th. With these data, the GOE will be able to finalize its report on Area D.
12. The GOE took note of an EIA report that indicated the location of a dumping ground for spoil dredged at Tg. Langsat. Still no data are available on the quantities and the nature of the spoil from Tg. Langsat.

August meeting

The GOE decided provisionally to extend its August meeting to take place from 4 to 6 August (inclusive). The location will probably be Copenhagen, in order to discuss model results and subsequent work with DHI staff. Details are to be established on the basis of the updated DHI schedule.

**Group of Experts
Minutes of Meeting 6 (Amsterdam)
Aug 5 and 6, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof Bill Kamphuis (via telephone)

Final Report on Area D

1. The GOE has finalised its report on Area D and Prof Fleming will, on behalf of the GOE, pass the report to the two governments for transmission to ITLOS. If either government wishes to comment on this report to ITLOS then they are reminded that they may do so, as stated in the Terms of Reference.

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2. The GOE are concerned that so many important issues have been delayed to the final report, particularly with regard to navigation, morphology and ecology.
3. The GOE are also concerned about the absence of quantified statements and the lack of confidence limits associated with many of the model predictions in the DHI reports to-date.
4. The GOE have recently received (4th August) a message from DHI indicating that the inclusion of a list of data in Progress Report No. 4 was impossible due to a resource problem within DHI. DHI proposes to include the list in the Field Report; however, they have also confirmed to the GOE that most of the data are now available, including data on Tg. Bin and on dredging and disposal for PTP, Tg. Langsat and Tg. Belungkor.
5. The GOE considered the comments from the Governments of Malaysia and Singapore and discussed these comments along with their own remarks. The integrated comments are summarised in a separate Appendix, and are being sent to DHI for their comments and copied to the two governments.

September Meeting

6. The GOE discussed the programme for the September meeting and have prepared a draft timetable for the meeting – see Appendix 1. It has been assumed by the GOE that this meeting will be held in Putrajaya, but Malaysia is kindly asked to confirm arrangements for this meeting at their earliest convenience.

GOE Final Report

7. The GOE discussed the format of its final report and it was agreed that the report should be concise and clear. With these objectives in mind it was agreed that the report would consist of an Executive Summary and a series of summary sheets, based on the Terms of Reference for the GOE, as received on 17th December 2003. The GOE have finalised the template of their summary sheets and a copy is attached in Appendix 2. A sheet will be completed for each key issue and for both the Pulau Tekong and Tuas View Extension

reclamation works. The key issues to be addressed are as cited in the Terms of Reference and as stated in Paragraphs 2 and 10 of the Statement of Claim of Malaysia.

Tg. Langsat Jetty

8. DHI have advised that the jetty at Tg. Langsat has only been designed for a 30,000 DWT and that the navigable depth is 11.7m. The closest standard vessel in BMT's library is a 17,000 DWT Bulk Carrier with a 9.4m draught. The GOE has agreed to request DHI to carry out Fast Time simulations using the 60,000 DWT Bulk Carrier as originally proposed, but partially laden to keep within the available navigable depth. The GOE believes that comparative pre- and post-reclamation conditions can be analysed in this way. The GOE will check on this option with DHI.

Appendix 1**Draft Timetable for September Meeting in Malaysia****Wed Sep 1:**

Afternoon arrival
Evening – Meeting of GOE

Thu Sep 2:

09:00 – 09:15 Welcoming and opening remarks
09:15 – 10:30 Presentation by DHI on Final Report
10:30 – 11:00 Break
11:00 – 12:30 Question session by both Governments to DHI
12:30 – 14:00 Lunch
14:00 – 17:00 Meeting of GOE
17:00 – 18:00 Meeting of GOE and DHI
18:00 – 19:30 GOE Meeting to complete comments
20:00 – late Private/Working dinner of GOE

Fri Sep 3:

09:00 – 10:00 Meeting of GOE with respective governments
10:00 - 12:00 Meeting of DHI with Governments and GOE – DHI to give preliminary responses to comments (break 10:45 – 11:15)
12:00 – 13:30 Lunch
13:30 – 17:30 Meeting of GOE – DHI to be on stand by
17:30 – 19:30 Debriefing meeting between GOE representatives and respective Governments – if necessary
20:00 – late Dinner

Sat Sep 4:

08:00 – 10:00 Meeting of GOE
10:00 – 12:30 Presentation and discussion by GOE with Governments (break 10:45 – 11:15) – DHI on standby
12:30 – 14:00 Lunch
14:00 – 16:00 Continuation of above meeting - DHI on standby
16:00 – 17:00 Record of meeting and official closure
17:00 Departure of GOE

Appendix 2

GOE Template Form for Final Report1

No:

Name of Issue:

Area of interest: Pulau Tekong / Tuas View Extension

Is the issue relevant? Yes / no

Is the effect significant? Yes / no

Available information and data

Summary of Consultant's studies

Knowledge after considering the studies

Technical common ground determined by the GOE

Remaining unresolved issues and concerns

Suggested remedial measures

Note: This template form has been reduced to one page herein for convenience.

Scope of work for the GOE final report

Based on an electronic version of the various TORs received on 17 December 2003, the GOE will use a standard form for each of the issues in the TOR and summarized herein

The technical issues that are to be addressed by the GOE are as stated in Paragraphs 2 and 10 of the Statement of Claim of Malaysia, dated 4 July 2003, and are grouped into seven main categories to be studied in greater detail by the Consultant, namely:

- i Hydrodynamics
- ii Ship Navigation and Berthing
- iii Sediment Transport and Morphology
- iv Water Quality
- v Water Level Changes
- vi Ecology
- vii Other concerns referred to in the Statement of Claim.

The key issues associated with each of the above categories are described in more detail in paragraphs 5.2.1-5.2.6 of the Terms of Reference of the Consultant (at Annex 1).

The ultimate task of the GOE is to submit a single report, which will include the Consultant's report, to the Governments of Malaysia and Singapore, within one week from the submission of the Final Report by the Consultant. For each of the technical issues identified in Paragraph 4 above, the report will contain the following items:

Assessment of its relevance and significance with respect to the effects of Singapore's land reclamation at Pulau Tekong and Tuas View Extension on Malaysia.

Review of available information and data.

Report on the Consultant's detailed studies and any further studies carried out for the GOE to reach its conclusions, describing the parameters for the studies, who did the studies, modeling methodology, and a listing of additional data acquired for these studies.

Review of the knowledge after considering the studies.

A clear description of technical common ground determined by the GOE.

A clear description of remaining unresolved issues and concerns.

A proposal on the measures to deal with any adverse effects, as appropriate.

The GOE report will be accompanied by an executive summary, specifically written to be understood by readers without a technical background. For each issue, the executive summary will highlight its important aspects, which parts of the issue have been resolved, and what remains unresolved.

Details of the points of concern as in TOR of Consultant:

Malaysia's concerns can be addressed by grouping the joint studies into seven main categories, namely:

- Hydrodynamics;
- Ship Navigation and Berthing;
- Sediment transport and morphology;
- Water quality;
- Water level changes;
- Ecology; and
- Other concerns referred to in the Statement of Claim.

The key issues associated with each of the above categories are described in more detail below.

Hydrodynamics

The Consultant is required to evaluate the hydrodynamic effects of the land reclamation, in particular at but not limited to, the following locations (see Figure 4 for location plan):

Eastern Sector

- Sungai Johor: Upper reaches to the mouth of Sungai Johor;
- Mouth of Sungai Johor to Tanjung Pengelih;
- Nenas Channel;
- Kuala Johor navigation channel between Pulau Tekong and Changi;
- Pengerang; and
- Other locations to be jointly identified by Malaysia and Singapore as proposed by the Consultant and the GOE.

Western Sector

- Tanjung Piai;
- Sungai Pulai estuary;
- Pulau Merambong;
- Tanjung Kupang and Gelang Patah;
- Entrance to West Johor Straits;
- Approach to Port of Tanjung Pelepas; and

- Other locations to be jointly identified by Malaysia and Singapore as proposed by the Consultant and the GOE.

Ship Navigation and Berthing

The Consultant is required to study the impact of the land reclamation on the following navigational activities:

- Vessels passing through or crossing the shipping channels at Calder Harbour;
- Vessels berthing at PULAREK Naval Jetty; and

Maritime traffic movements in the approach navigational channels into the Ports of Pasir Gudang, Johor Bahru and Tanjung Pelepas and facilities as indicated in the red boxes in Figure 5.1 and Figure 5.2, as well as manoeuvrability, berthing and unberthing and traffic safety, if any, at these facilities as compared to the situation before the start of the land reclamation. The approach navigational channels to be studied are as shown in the shaded areas on the maps in Figure 5.1 and Figure 5.2.

The assessment should take into account the changing hydrodynamic conditions.

Sediment transport and morphology

Based on the available information, the study areas consist of tidal and shipping channels, partly bordered on Malaysian and Singapore sides by mangrove coasts and aquaculture facilities. The seabed and coastline is characterised by a mixture of clay, silt and sand, with numerous rocky outcrops.

Prior to the actual studies, assessments should be made to provide an understanding of the TOPT situation for the Pulau Tekong land reclamation and the TOTVE situation for the TVE land reclamation with respect to:

- the stability of the channels and coastline as derived from past and recent hydrographic charts and other relevant data (to be provided by Malaysia & Singapore);
- the best possible representation of the coastline and seabed bottom characteristic and properties, based on seismic data, bore log data and seabed and coastline sediment analysis;
- geological constraints, e.g. rocky outcrops, sub-surface stiff clay or other layers that are susceptible to different rates of erosion; and
- the effects of waves, taking into consideration actual recorded wave measurements in the areas of interest.

The Consultant is required to address the following key issues in the sediment transport and morphology study in all the affected areas. This may include the following activities:

- Establishing the rate of morphological changes along the coasts and on the seabed in the following areas before and after the land reclamation and to identify the key factors influencing the morphological changes:

from Tanjung Pengelih to Kampung Lanjut and Pasir Bunga;
from Tanjung Pengelih to Kampung Jawa;
around Nenas Channel;
around Tanjung Piai, the approach to the Port of Tanjung Pelepas, Sungai Pulai estuary,
Tanjung Kupang and Gelang Patah; and
the entrance to the West Johor Straits and Pulau Merambong.

- Studying whether there are any adverse effects of the land reclamation at Pulau Tekong (including the possible effects of wave and ship wake reflection off the sheet pile at Pulau Tekong Area D (if any)) and at TVE, on the baseline and continuing background pattern of morphological change, with regard to the following:

whether there are any erosion effects in the channel fronting PULAREK Naval jetty and Tanjung Pengelih jetty due to changes in the flow pattern;

whether these hydrodynamic changes or the direct influence of these hydrodynamic changes in the flow pattern will have an adverse effect on the stability of the coastline and the stability of PULAREK Naval Jetty. The study should take into consideration aspects such as the local soil conditions and the jetty structure;

whether there are any siltation effects at Nenas Channel;

d) as far as possible, an assessment of related long-term impacts, such as long-term bed erosion and siltation patterns, long-term shoreline recession, residual currents and shear stresses, river sediment spreading and sediment patterns;

e) the time-scale on which any changes will occur, and whether they will develop into a new equilibrium condition.

Water Quality

The main issues regarding water quality involve changes in parameters such as salinity, salinity gradients, turbidity, suspended solids, dissolved oxygen, heavy metals and nutrient levels in the Johor Straits and the Sungai Johor and Sungai Pulai estuaries and in the surrounding seas and estuaries. In addition, a list of the significant discharges from both Malaysia and Singapore must be agreed on and provided by both parties. Furthermore, the Consultant shall also evaluate the water quality data from the Joint Seawater Monitoring Programme for the Straits of Johor between the National Environment Agency, Singapore (NEA) and the Department of Environment, Malaysia (DOE), under the auspices of the Malaysia-Singapore Joint Committee on the Environment (MSJCE).

In particular, the Consultant is required to address the following key issues in the Water Quality study:

- Establish the water quality of the Straits of Johor prior to the land reclamation by analyzing the data to be provided by both Malaysia and Singapore;

- As far as possible, identify trends over time in the water quality condition from significant discharge points vis-à-vis the effects of the concurrent Pulau Tekong and TVE land reclamation;
- Establish the effects of the Pulau Tekong and TVE land reclamation on parameters such as salinities, salinity gradients, nutrients and dissolved oxygen; and
- Establish the changes in the flushing characteristics of the flow, due to the hydrodynamics of the Pulau Tekong and TVE land reclamation, the resultant effects on the retention of pollutants, and consequently their effects on dissolved oxygen and nutrient levels.

The Consultant, after discussion with the GOE, shall establish a list of possible physical, chemical and biological parameters to be modelled, analysed and monitored.

The Consultant, or its appointed agent, shall carry out benthic measurements to check for particle size distribution, heavy metals and organic pollutants in the benthic environment.

Water Level Changes

One of the effects to be investigated is whether the land reclamation will result in significant changes in water levels and the tidal range in the Johor Straits and in the Sungai Johor and Sungai Pulai estuaries. The following should be studied:

- the magnitude of changes in water level, the phase lag, the tidal range, and tidal prism;
- effects of the water level changes and phase lag on the outflows from the main rivers, such as Sungai Johor and Sungai Tebrau and Sungai Pulai (for various flow conditions including the 100-year flood flow).

Ecology

As far as possible, the Consultant shall assess whether changes in hydrodynamics, water quality and morphology (which are directly attributable to the land reclamation) have secondary effects on the ecology.

The Consultant shall, in its First Progress Report, assess the practicability of studying, in a quantifiable manner and within the timeframe of the studies, whether there are significant impacts on the following environmental receptors which are directly attributable to the land reclamation.

Marine Ecology

Key marine ecological resources and habitats (i.e. benthic habitats, coral deposits, zooplankton, phyto-plankton, algae, sea grasses, fishery, bivalves and dugongs).
Mangrove flora and fauna (herpetofauna, birds, mammals and invertebrates).

- (ii) Fishing Community
Livelihood of fishermen and fishing activities.

For those receptors for which such a study has been assessed to be practicable, the Consultant shall, in the First Progress Report, provide a methodology and cost estimate for conducting such a study. If the methodology and cost are acceptable to the Governments, the Consultant will be instructed to proceed with the study.

**Group of Experts
Minutes of Meeting 1 (Singapore)
August 18 and 19, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof. Bill Kamphuis

1. GOE task Description

The GOE discussed its tasks in the forthcoming weeks, necessary to complete their TOR and determined them to be:

- GOE assesses and approves the work of DHI.
- GOE identifies areas of technical common ground and unresolved issues.
- GOE determines the significance of any impacts discovered in the DHI study.
- GOE proposes general principles and approaches to mitigation.

Detailed design of mitigation measures can only be based on considerable additional work, which must necessarily be performed after the GOE report has been completed. Design of any mitigation measures will be done according to Appendix 2 of the GOE meeting of 4 to 7 June 2004, which was formulated in consultation with both governments.

2. Determination of Sensitivity Tests

On the basis of information provided by DHI to date, GOE confirms that both sensitivity tests should address the P. Tekong Reclamation.

GOE regrets that it has to decide on sensitivity tests without having results for navigation, morphological, water quality and ecological impact assessment studies.

GOE considered a wide range of possible alternative sensitivity tests for the P. Tekong area. Among these were:

- Increasing the depth in Calder Harbour to reduce current velocities.
- Reducing eddy formation by current-deflecting walls.
- Redesigning the Changi Finger to reduce current fluctuations in the Kuala Johor.
- Increasing the depth between P. Ubin and P. Tekong Kechil to influence distribution of flow between the two branches.

GOE recognises that the hydrodynamics around P. Tekong consist of complex interactions between the flows through several inter-connected channels. Any changes to one of the channels will affect the flow through the others. After extensive discussion, GOE considers that the most important apparent potential impacts at this time are related to the hydrodynamics of Calder Harbour and adjacent waters. In that connection, GOE notes that

the east shore of Area D (west shore of Calder Harbour) has not been designed to be hydraulically efficient, resulting in constriction of the Calder Harbour channel and an increase in current velocities in the region. Also GOE notes that the separation of flow into the Calder and Johor channels has not been optimised.

To this end, GOE has defined the following two sensitivity tests.

Case 3

In order to understand the sensitivity of the hydrodynamic characteristics to a change in the shape of the eastern boundary of Area D, GOE proposes to streamline the Calder Harbour flow channel, as indicated in Figure 1.⁶ The change to the Area D geometry needs to be substantial in order to determine the sensitivity of the flow conditions around the whole island to such a change.

Case 4

In order to understand the sensitivity of the hydrodynamic characteristics to a change in the shape of the southerly point of the reclamation, GOE proposes to add a tail to the reclamation in the southwesterly direction, as indicated in Figure 2 to direct the flow from and into the channels on either side of P. Tekong.

GOE stresses that these two sensitivity simulations are scientific in nature. They are performed to add to the understanding of the basic hydrodynamics around the island.

GOE further stresses that if mitigating measures should prove to be necessary in the end, much additional work will be required to investigate potential solutions identified by the GOE. Such additional work would necessarily follow the publication of the GOE final report (see Minute 1).

3. Delivery of Draft Final Report

GOE wants to make firm arrangements with DHI that they receive the draft final report on Aug 30 by 09:00 Malaysia/Singapore time. Later delivery will jeopardise any reasonable review by the GOE within the proposed schedule of the September meetings.

4. Joint Comments - Preliminary Draft Final Report Volume III

GOE collated and discussed the comments received from Malaysia, Singapore and individual GOE members and prepared them for submission to DHI. The document may be found in Appendix 1, which is attached as a separate WORD document.

5. Joint Comments - Draft Progress Report 4

GOE reviewed the DHI responses to this set of joint comments. GOE's final comments are found in Appendix 2.

GOE noted that the responses of DHI had not been sent to the two Governments. These responses are therefore attached as a separate WORD document.

⁶ The shape is related to Case 4.

6. GOE Schedule

GOE considered the possible scenarios for scheduling the remainder of its tasks. In the light of uncertainties in the dates and completeness of the future reports from DHI, GOE proposes that the schedule be kept fluid and be made up as the work progresses. Firmly scheduled so far are a GOE meeting with the two governments and DHI in Kuala Lumpur on Sep 2-4, and the GOE meeting in Portugal on 25-29 September to begin to write its report, based on information received to that date.

A meeting to present the final reports of DHI and GOE will be scheduled on dates that the GOE members will be available.

Figure 1 - Sensitivity Test 1 (Case 3)

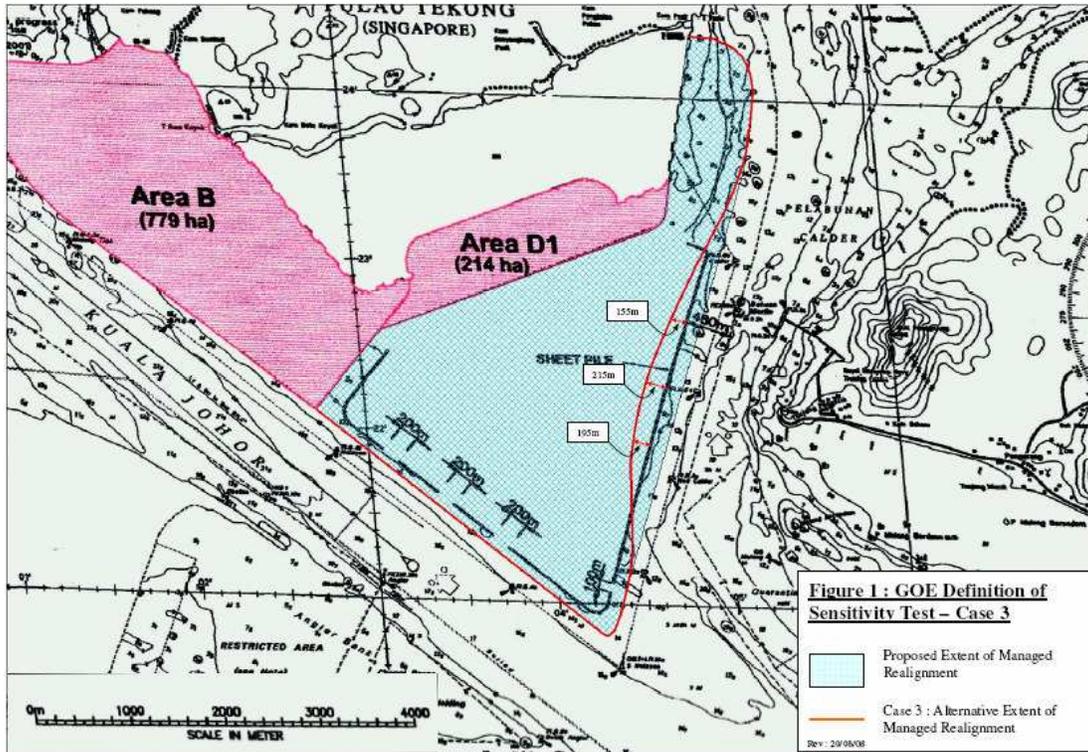
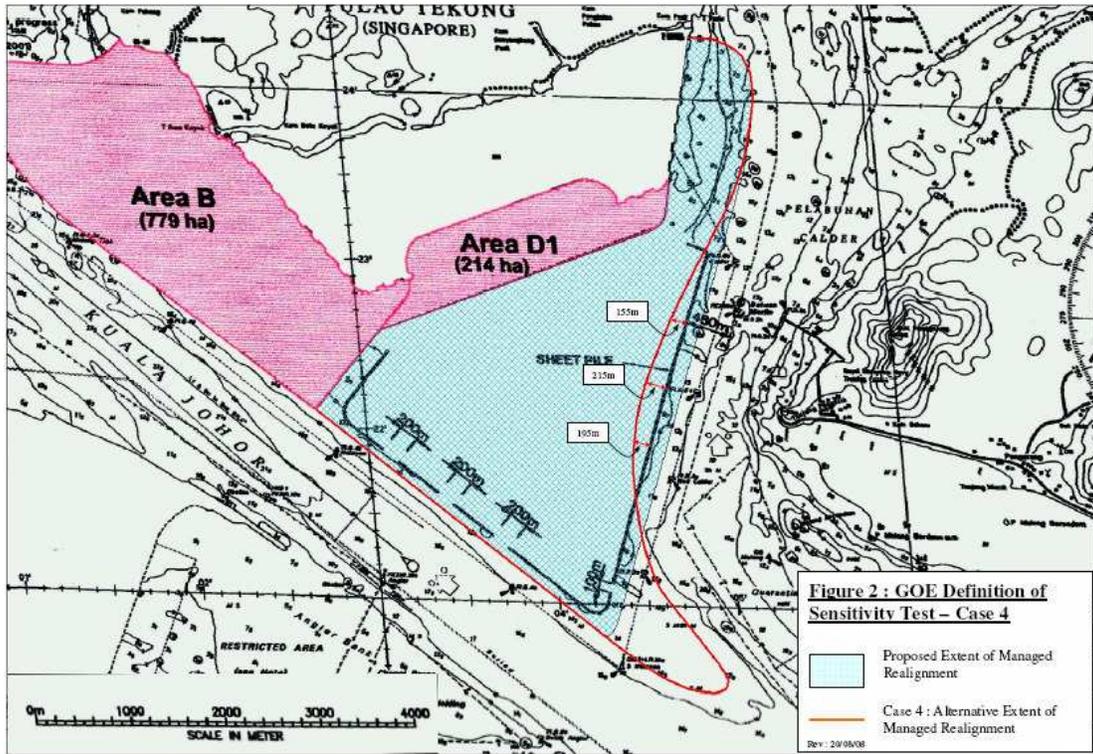


Figure 2 - Sensitivity Test 2 (Case 4)



Appendix 1

GOE Joint Comments on DHI'S Preliminary Final Draft Report

Volume III

Attached as separate WORD document

Appendix 2
GOE Final Comments on DHI'S DRAFT PROGRESS REPORT 4, in
Response to DHI's comments of 17 Aug, 2004

Item	GOE Comment
6	GOE notes it has not received any dredging data and Malaysia is urged to produce these data for GOE.
8	GOE notes that it will be very difficult to make decisions about real time simulations if it does not receive the results of the fast time simulations until Aug 30.
10	GOE notes that the difference between the rating curves has not been resolved that DHI take up discussions with Malaysia on this matter.
12	DHI has only addressed the outliers in the hydrological data and not the remark in general.
18	DHI should address GOE comments 1 and 2
19	Item 1 – Is DHI's experience based on data from the Malaysia/Singapore area. If so, what are the references?
32	Please furnish an answer.
44	GOE want to express that the approach by DHI is only valid if the absolute values of the pollution load are realistic and representative of existing conditions. This also applies to Item 46.
46	Document the confidence band of factor 2; what does factor 2 mean – 0.5x to 2x?
53	Rather than using <ND, GOE suggests to use < x, where x is the numerical value of the actual detection limit, e.g. <0.1 mg/l
57,61, 62,63, 64,65	GOE notes there are inconsistencies between different data sets and some results appear unrealistic such as a higher mercury content higher in the water column (Item 61)
82	DHI to provide governments and GOE with the questionnaires.

Appendix 3
DHI'S DRAFT PROGRESS REPORT 4,
DHI's comments of 17 Aug, 2004

The comments have been attached as a separate WORD document

Group of Experts
Minutes of Meeting 8 (Putrajaya)
Sep 2 to 4, 2004

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof Bill Kamphuis (via telephone)

Meetings of GOE (Sep 1)

1. The first meeting of the GOE was held on the evening of Wednesday 1st September 2004. This was an informal dinner meeting, where the GOE discussed their general impressions of the DHI Draft Final Report. In particular, the GOE expressed their reservations about the Navigation Volume (Vol. 5) and it was felt that a number of key items requested from DHI, following previous GOE meetings, had still not been addressed in the report and that this draft final report (i.e. Vols. 2 to 9) could therefore only be regarded as a first draft at this stage. This opinion was strengthened by the absence of Volume 1, containing conclusions and recommendations.

Meetings of GOE (Sep 2)

2. On the morning of Thursday 2nd September the GOE members met with their respective Government experts. This meeting was followed in the afternoon by a presentation given by DHI to the respective governments and the GOE, with the meeting being chaired by the GOE. The meeting was cordial and at the end of the presentation both governments were invited to ask points of clarification. After the meeting the GOE had an informal dinner meeting.
3. The GOE met informally over dinner and had further discussions on their comments on the first draft of the final report and, in particular, issues relating to navigation.

Meetings of GOE (Sep 3)

4. The GOE met early on Friday 3rd September to prepare their joint key questions for DHI. These general questions are summarised in Appendix 1. The GOE firstly expressed its concerns about a number of issues regarding the Navigation Volume (Vol. 5). The navigation report was regarded as unacceptable and, in particular, the GOE expressed their concerns about compliance with the TOR (Inception Report 2). DHI responded to a number of the GOE's concerns and many of these concerns were seen to be of a reporting nature; DHI stated that these concerns will be addressed in the next draft volume on Navigation. In particular, issues of non-compliance of parts of the TOR were subsequently raised by DHI with BMT and the GOE understands that these concerns are to be addressed as a matter of urgency. It was appreciated by the GOE that in order for them to complete their assessment of the project thoroughly then it was necessary to request an extension of the programme to complete the Joint Study.

5. On the afternoon of Friday 3rd September a meeting was held between DHI, the governments and the GOE, with the meeting again being chaired by the GOE. The meeting focused on the DHI draft final report and DHI's response to the general questions raised previously by the GOE. This presentation was followed by questions invited from both governments to DHI. The meeting was again cordial and fruitful.
6. On the evening of Friday 3rd September the GOE and DHI met informally to explore possible criteria for mitigation, should mitigation be deemed necessary.

Meetings of GOE (Sep 4)

7. The GOE met on Saturday 4th September to discuss the final stages of the programme for completing the project. On the basis of the current status of the draft final report, and the need to complete fully the navigation studies, the GOE decided to recommend to both governments that in order to complete the studies and report fully on the final report the project should be extended by approximately one month. The revised timetable for completion of the project was later presented to both governments and is attached herewith in Appendix 2.
8. This meeting was followed by a meeting held by the GOE and the two government representatives, namely Madam Rosnani and Mrs Cheong, where Mrs Cheong presented satellite photographs acquired by Singapore, illustrating post- and pre-reclamation conditions of the shoreline characteristics, and particularly the bed features, along the shoreline to the South East of Tg. Pengelih. The GOE had previously been taken on a site visit by Malaysia to several sites along this coastline and at two of these sites reference was made to the deposition of mud along the beaches. The satellite images were meant to provide the GOE and Malaysia with additional information that may be relevant to the morphology studies. Information was also provided on the tracking of a trailing suction hopper dredger from Pasir Gudang to the coastline just offshore of the deposits. The GOE were given the opportunity to view the satellite pictures later that afternoon, after which the pictures were provided to DHI for assessment.
9. On the afternoon of 4th September the GOE presented its revised tentative schedule for the governments and the contractor to approve. This was followed by a meeting of the GOE with navigation representatives from both countries to establish the ship simulations to be undertaken in real time by the sub-contractor, namely BMT.
10. The GOE then had a meeting with representatives from DHI and BMT, where the tentative programme was discussed, as well as the procedure for studying the satellite images provided by Singapore. Singapore needed to take the pictures back after the meeting, but they have been handed to DHI for assessment by DHI and further viewing by Malaysia if required. As a result, instructions on the ship simulations to be undertaken were passed to BMT⁷ and DHI was asked to invite representatives from both Governments to participate in the inspection of the satellite images.

⁷ 24 runs to be made in real time with the 60 000 DWT bulk carrier for the case 2 conditions, part to Pasir Gudang, part to Tg. Langsat. The runs to be made by staff of BMT with four pilots (two from each site) to act as pilot during the simulation.

Simulation with the 450 000 DWT tanker as dead ship between the JPGA and MSE as per inception report since the tidal window had reduced

Two demonstration runs at PULAREK by BMY staff

11. The meetings of the GOE concluded late afternoon of 4th September, with the next scheduled meeting being in Portugal from 25th to 29th September 2004.

Appendix 1

General Questions Raised by the GOE with DHI

Nr.	Vol.	Page	Section	Comments	Instructions GOE	Response by DHI
			General	GOE wants a final summary section identifying the key uncertainties in modeling in all appropriate reports.	DHI to Comment	
	I			Missing; GOE expects executive summary (max 9 pages) and precise summary of the work (max 40pages)	DHI to Comment	
	II			No urgent remarks	DHI to Comment	
	III	61	General	We need more clear definitions. Perhaps a table of definitions would be a good idea?	DHI to Comment	
	III	61	6	For example: Define RMS area average – what area? The whole 25 m grid? n grid points in all directions of the point of interest? Example: Define peak spring depth integrated tidal current. Instantaneous, averaged over m time lines on either side of the instantaneous peak?	DHI to Comment	
	III	62	6	Example: Define peak spring flux. Is it instantaneous?, etc., etc	DHI to Comment	
	III	77	1 st bullet	This bullet has always looked like an excuse. It is totally unnecessary. If the stated reasons are correct, then there is an easy way to incorporate this reasoning into the results. We should compare measured values in these graphs with weighted averages of the model values calculated in the vicinity, where the weights are functions of distances of the individual model values from the measured point. If that does not work out, then the excuses in this bullet are incorrect and the discrepancies have other origins than local quirks in bathymetry. Suggest one set of original results to indicate the differences at adjacent points and then present only the averages.	DHI to Comment	
	III	79	Fig 7.14	This demonstrates differences between results from adjacent cells, but also demonstrates that none of the three simulates the phases nor the peaks correctly. So perhaps weighted averages?	DHI to Comment	
	III	80	Fig 7.15	Again, neither is very good. Use weighted averages?	DHI to Comment	
	III	85		Belungkor ebb maxima overestimated both in magnitude and	DHI to Comment	

Nr.	Vol.	Page	Section	Comments	Instructions GOE	Response by DHI
				duration.		
	III	103	8.2.4	Where are the ADCP transects GOE asked for?	DHI to Comment	
	III	138	9.2	Smagorinski should not affect overall currents (as shown). We need to investigate sensitivity of the eddies (e.g. Changi and Calder Harbour exit) to Smagorinski coefficient. That's why we want to see the ADCP transects and some indication of sensitivity of eddy formations to Smagorinski.	DHI to Comment	
	III	147		Conclusions to Ch 9 would be helpful.	DHI to Comment	
	IV	76	12.3 etc	These waves are short and they loose energy against the sheetpile wall since the shape of the sheetpile is of the order of the wave length. The waves are also steep and loose energy on the way through wave breaking (wave-wave interaction). They also occur on high current velocities. None of these is taken into account and hence you should state somewhere that the results will be quite conservative.	DHI to Comment	
	IV		14.1.5	A major cause for uncertainty is surely K_r for the sheetpile. The difference on p 99 between the lines for 1.4 and 1.8 amplification factor for wind (Figs 14.1 and 14.2) is almost the same as between $K_r=0.7$ and 1.0. Combining only these two causes of uncertainty would result in the 1% wave of 0.28 to 0.36 m becoming 0.33 to 0.6 m. That is (approximately) a wave of 0.32 +/- .04 m becomes 0.46 +/- 0.14 m, or an increase of 44%+/-22%. There are other sources of uncertainty. Even though this has little impact on the final results, the limitations of the work should be clearly shown.	DHI to Comment	
	IV			How have you incorporated the wave action from the South China Sea?	DHI to Comment	
	V			GOE cannot accept this report as is. It does not address several key issues in the TOR. Many of the recommendations are not appropriately justified.	DHI to Comment	
	V			How and what was transferred as wave input for the navigation simulations?	DHI to Comment	
	V	29	Last bullet	Does any real ship leave in the "worst current environment"? How realistic are these answers going to be? Should we not involve local pilots and simulate best practice?	DHI to Comment	
	V	71	9.2.1	If there was not a significant effect why does BMT "have an opinion"	DHI to Comment	

Nr.	Vol.	Page	Section	Comments	Instructions GOE	Response by DHI
				that manual real time simulations should be conducted?		
	V	72	9.2.1	Are there problems with the Bulk Carrier? It does not sound like. So why would it be "useful" to do real time simulations?	DHI to Comment	
	V	75	10.2.2	There are no problems with the cruise ship. Obviously a ship with less good maneuverability would have more problems. In view of the above??, we should go and look for poorer vessels and do real time testing?	DHI to Comment	
	V	76	11.1	It is not clear what ship was used. Is it the fully loaded bulk carrier. In that case, this is not what was asked for.	DHI to Comment	
	V	77	11.2	Describe clearly the role of the master mariner in fast time simulations	DHI to Comment	
	VI	46	Fig 11.1	There still seems to be one band of high runoff (from 1201 through Singapore); adjacent areas have of much lower runoff. Is this correct?	DHI to Comment	
	VII	54	7.1	Fig 7.1 does not directly present change resulting from the reclamation. It could be used as an indication of possible change....	DHI to Comment	
	VII	56	Fig 7.1	Fig 7.1 is not only morphological adjustment (as in the title), but rather the difference between 2004 survey and earlier bathymetric information and hydrographic charts. The difference between the accuracy of the depths along the east side and west side of the Calder channel should be clearly highlighted. The fact that subtraction of the west-side bathymetries (Singapore side) gives a good indication of general erosion over the two years between the two surveys and that subtraction of the east side bathymetries does not should be expressed.	DHI to Comment	
	VII	57	Fig 7.3	Correct the time duration for this figure so it matches Fig 7.1. State clearly what is involved here. How does the hard bottom (Fig 4.1) come into play in this diagram? How is erosion limited by the hard layer? Surely Fig 7.3 is only a model result that needs to be related to sediment availability. Relate the erosion here to deposition at JPA. Do you do a sediment balance between erosion and deposition?	DHI to Comment	
	VII	65	Fig 7.9 and 7.11	Nuance the erosion in the "pits". They do not simply erode to -nn m down to the hard layer below the pit, but velocities will decrease so that erosion will eventually balance out. What happens when the "annual" erosion rate hits the hard layer after many years.	DHI to Comment	

APPENDIX 2**Revised Schedule of GOE for Completion of Project**

4 Sep	Decisions on real time simulation Decision on schedule till final report Decision on handling satellite pictures: DHI to report; access for 2 Govts at DHI premises.
10 Sep	DHI submit Volume 1 Draft Final Report
13 Sep	Start Real Time Simulation 2*2 Master Mariners to attend runs, act as pilot, brief and debrief
13 Sep	Governments submit comments on DHI Draft Final Report DHI submit rewritten Vol. 5
14 Sep	Individual GOE members submit comments
16 Sep	JWK collates comments and circulates
17 Sep	KdA makes 2 nd draft of comments GOE may amend instructions for real time simulations
20 Sep	CAF completes and submits integrated list of comments
25 – 29 Sep	GOE writes 1 st version report
1 Oct	DHI submit revised draft Final report
8 Oct	Decision by GOE on cases 5 and 6
17 Oct	Governments submit comments on revised draft
17-19 Oct	GOE meets in Europe
19 Oct	GOE sends comments on revised draft to DHI
25 Oct	DHI submit Final Report
31 Oct	Governments submit comments on Final Report
7, 8 Nov	Time available for Presentation Final Report by GOE. Format to be decided later.

**Group of Experts
Minutes of Meeting 9 (Estremoz, Portugal)
Sep 25 to 29, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof Bill Kamphuis

1. Meeting of GOE (25th Sept)

The GOE met in Estremoz, Portugal, following the International Conference on Coastal Engineering, held in Lisbon. The GOE members travelled from Lisbon to Estremoz on the morning of 25th September and commenced their series of meetings on the afternoon of 25th September. In their first meeting they primarily discussed the comments made by the Government of Malaysia on the GOE's Interim Report to ITLOS regarding Area D and the subsequent letter to the GOE from the Government of Singapore (i.e. Mrs Cheong's letter of ???) on the comments made by the Government of Malaysia. After due consideration of the comments raised by both governments the GOE discussed its previous comments about the limited sampling data in Area D and the subsequent findings of the DHI study, which concluded that there was no significant seepage of material from Area D. The GOE wrote to both governments expressing their views, which are reported for completeness in Appendix 1.

2. Meetings of GOE (26th to 28th Sept)

From Sunday 26th September to Tuesday 28th September the GOE spent its time discussing the findings of the consultant's Draft Final Report and drafting the GOE's report on the consultant's studies. The GOE was generally in agreement and where differences of opinion occurred then both views were included in the draft report.

3. Meeting of GOE (29th Sept)

On Wednesday 29th September the GOE met to discuss the criteria that could be adopted for considering a reconfiguration of Area D. The GOE found it difficult to establish clear scientific criteria to define the basis for any proposed reconfiguration in this complex waterway, but after due consideration the GOE explored ways to achieve a positive and justifiable compromise. The GOE's proposed criteria to be adopted for establishing an optimal configuration of Area D will aim at restoring the original velocities as far as practically possible. The resulting loss of reclaimable land will also be compensated for as far as practically possible as well. The actual recommendation of the GOE still depends on additional information, to be supplied by the Consultant DHI.

The GOE also discussed the issue regarding Cases 5 and 6. It was agreed that Professor d'Angremond would first check as to the contractual conditions regarding these

additional test. If they do form part of the existing contract then the GOE agreed that the following tests would be undertaken:

- Case 5 would investigate further the impact of reconfiguring the Eastern boundary of Area D on the velocities in the Calder Channel. The GOE wish to consider a modification to Case 4, and on the basis of DHI's comments following the predictions obtained from their Case 4 simulations. The GOE will ask DHI to advise on their proposed modification to Case 4 and, subject to the GOE's agreement, this modification will form the basis for the Case 5 simulation.
- Case 6 would investigate the impact of Changi Finger on the complex eddy structure in the Kuala Johor Channel. The GOE are of the opinion that if the Changi Finger is extended and streamlined then this will significantly reduce or remove the predicted eddies in the main channel.

With regard to contractual issues the GOE strongly recommend that the two governments jointly carry out a thorough check of the Inception Report Version 2 to ensure that the Consultant has fulfilled all of their contractual obligations. For example the GOE note that LITPACK modelling has not been carried out by the consultant and there is no justification in their Draft Final Report for the exclusion of this study.

The meetings of the GOE concluded at 2:00 pm on 29th September, with the next scheduled meeting being in Europe, either in the Netherlands or Cardiff, from 17th to 19th October 2004.

APPENDIX 1**GOE Response to Comments of Governments of Malaysia and Singapore on GOE Interim Report of August 2004****The GOE agreed to send the following comments to both Governments:**

The GOE stand by its original view, minuted in its meeting of 7th June 2004, stating that: 'the samples provided are within tolerable limits, but is concerned about the limited data available for Area D. The preliminary view of the GOE is that further in-situ sampling data are desirable and the GOE intends to discuss this through further correspondence'. This statement was subsequently quoted in the GOE Interim Report of August 2004.

Since these original views expressed by the GOE, the consultant (namely DHI) has advised that: 'although periods of slightly elevated concentrations at the boundary (of the sheetpile wall around Area D) do exist, they have no significance for either the ecological processes in the area or for the sedimentation patterns in the area'. In the light of this qualitative assessment of the sediment plume for the offshore containment site at Area D, Pulau Tekong, by the consultant (see Appendix G of Draft Final Report, Vol. VII, Morphological Impact Assessment), the GOE do not currently regard it as necessary to undertake further in-situ sampling data for Area D as a matter of urgency. The GOE are of the opinion that such additional data would not change the findings of the current study.

The GOE recommends that after the current study has been completed the Governments of Malaysia and Singapore – ideally also including Indonesia - set up a Working Group to establish a protocol for the disposal or placement of potentially contaminated dredged and excavated material in the surrounding waters for both – or all three – countries. The GOE would like to draw attention to the existing co-operation in the North Atlantic Region under the London Convention; further details of which can be obtained from the following PIANC Reports:

1. MarCOM Report No. 23 Site Investigations requirements etc.
2. EnviCOM Report No. 05 Environmental Guidelines for disposal facilities for dredged material
3. Unnumbered: Dredged Material Management Guideline
4. ResCom Report No. 13 Dredging of Marinas
5. Handling and treatment of contaminated dredged material from ports and inland waterways (1996)

Full titles of the above reports are available on the PIANC website <http://www.pianc-aipcn.org/>.

**Group of Experts
Minutes of Meeting 10 (Cardiff, Wales)
Sep 17 to 19, 2004**

Present: Prof. Kees d'Angremond, Prof. Roger Falconer, Prof. Chris Fleming and Prof Bill Kamphuis (by telephone and email)

1. The GOE met in Cardiff and started work on Sunday 17th October. In the first instance the GOE reviewed the comments from the governments of Malaysia and Singapore on the Draft Final Report (Version 2) by DHI. The GOE were generally impressed by the comments from both governments and the comments are for DHI to respond to directly. DHI are expected to copy their responses to the members of the GOE.
2. The GOE completed its own comments for DHI. The comments on this occasion were of a more general nature and have been passed to DHI for action before finalising the GOE's Final Report.
3. The GOE spent the remaining two days of the meeting on discussing the issues for their final report and the form of further sensitivity tests, to be undertaken by DHI and relating to possible mitigating measures. The GOE extensively discussed all 65 individual tables in their "Table of Impacts" and debated for each table the individual views on the significance of impact. So far as possible the GOE tried to agree on the significance of the impact, with there being an encouragingly consistent level of agreement on most issues.
4. With regard to the sensitivity tests, two issues were considered: (i) streamlining the reclamation more in the Calder Harbour Channel, with the aim being to reduce the velocities in the area, and (ii) extending and streamlining the Changi finger to provide a smoother flow transition into the Kuala Johor channel, with the aim being to reduce the strength of the complex eddy structure predicted to occur following completion of the reclamation. Following discussion with DHI, the consultant kindly agreed to undertake four further sensitivity tests, two more than contractually agreed. These sensitivity tests all involved modifications to the reclamation in Area D.
5. Finally, the GOE agreed on a schedule of work and a timetable for the completion of its report, due for submission to the governments on 5th November 2004. It was agreed that the final report would be sent from Professor Fleming's office and would include electronic signatures at this stage. A number of hard copies would be sent separately to the two governments

Attachment 4

Task of GOE as outlined in Terms of Reference

Attachment 4 Task of GOE as outlined in Terms of Reference

Scope of work for the GOE final report

This Appendix is based on an electronic version of the various Terms of Reference for the GOE and the Consultant, received on 17 December 2003

Note: this will be checked against the signed hard copy of the document

From the terms of Reference of the GOE

The technical issues that are to be addressed by the GOE are as stated in Paragraphs 2 and 10 of the Statement of Claim of Malaysia, dated 4 July 2003, and are grouped into seven main categories to be studied in greater detail by the Consultant, namely:

- i Hydrodynamics
- ii Ship Navigation and Berthing
- iii Sediment Transport and Morphology
- iv Water Quality
- v Water Level Changes
- vi Ecology
- vii Other concerns referred to in the Statement of Claim.

The key issues associated with each of the above categories are described in more detail in paragraphs in the Terms of Reference of the Consultant.

The ultimate task of the GOE is to submit a single report, which will include the Consultant's report, to the Governments of Malaysia and Singapore, within one week from the submission of the Final Report by the Consultant. For each of the technical issues identified above, the report will contain the following items:

1. Assessment of its relevance and significance with respect to the effects of Singapore's land reclamation at Pulau Tekong and Tuas View Extension on Malaysia.
2. Review of available information and data.
3. Report on the Consultant's detailed studies and any further studies carried out for the GOE to reach its conclusions, describing the parameters for the studies, who did the studies, modeling methodology, and a listing of additional data acquired for these studies.
4. Review of the knowledge after considering the studies.
5. A clear description of technical common ground determined by the GOE.
6. A clear description of remaining unresolved issues and concerns.
7. A proposal on the measures to deal with any adverse effects, as appropriate.

The GOE report will be accompanied by an executive summary, specifically written to be understood by readers without a technical background. For each issue, the executive summary will highlight its important aspects, which parts of the issue have been resolved, and what remains unresolved.

From the terms of Reference of the Consultant

Details of the point of concern as stated in the Terms of Reference of the Consultant are:

Malaysia's concerns can be addressed by grouping the joint studies into seven main categories, namely:

- 1) Hydrodynamics;
 - i) Ship Navigation and Berthing;
- 2) Sediment transport and morphology;
- 3) Water quality;
- 4) Water level changes;
- 5) Ecology; and
- 6) Other concerns referred to in the Statement of Claim.

The key issues associated with each of the above categories are described in more detail below.

1) Hydrodynamics

The Consultant is required to evaluate the hydrodynamic effects of the land reclamation, in particular at but not limited to, the following locations:

- 2) Eastern Sector
 - a) Sungai Johor: Upper reaches to the mouth of Sungai Johor;
 - b) Mouth of Sungai Johor to Tanjung Pengelih;
 - c) Nenas Channel;
 - d) Kuala Johor navigation channel between Pulau Tekong and Changi;
 - e) Pengerang; and
 - f) Other locations to be jointly identified by Malaysia and Singapore as proposed by the Consultant and the GOE.

3) Western Sector

- a) Tanjung Piai;
- b) Sungai Pulai estuary;
- c) Pulau Merambong;
- d) Tanjung Kupang and Gelang Patah;

- e) Entrance to West Johor Straits;
 - f) Approach to Port of Tanjung Pelepas; and
 - g) Other locations to be jointly identified by Malaysia and Singapore as proposed by the Consultant and the GOE.
- 4) Ship Navigation and Berthing
- a) The Consultant is required to study the impact of the land reclamation on the following navigational activities:
 - b) Vessels passing through or crossing the shipping channels at Calder Harbour;
 - c) Vessels berthing at PULAREK Naval Jetty; and
 - d) Maritime traffic movements in the approach navigational channels into the Ports of Pasir Gudang, Johor Bahru and Tanjung Pelepas and facilities as indicated in the red boxes in Figure 5.1 and Figure 5.2, as well as manoeuvrability, berthing and unberthing and traffic safety, if any, at these facilities as compared to the situation before the start of the land reclamation. The approach navigational channels to be studied are as shown in the shaded areas on the maps in Figure 5.1 and Figure 5.2.
 - e) The assessment should take into account the changing hydrodynamic conditions.
- 5) Sediment transport and morphology
- a) Based on the available information, the study areas consist of tidal and shipping channels, partly bordered on Malaysian and Singapore sides by mangrove coasts and aquaculture facilities. The seabed and coastline is characterised by a mixture of clay, silt and sand, with numerous rocky outcrops.
 - b) Prior to the actual studies, assessments should be made to provide an understanding of the T_0^{PT} situation for the Pulau Tekong land reclamation and the T_0^{TVE} situation for the TVE land reclamation with respect to:
 - i) the stability of the channels and coastline as derived from past and recent hydrographic charts and other relevant data (to be provided by Malaysia & Singapore);
 - ii) the best possible representation of the coastline and seabed bottom characteristic and properties, based on seismic data, bore log data and seabed and coastline sediment analysis;
 - iii) geological constraints, e.g. rocky outcrops, sub-surface stiff clay or other layers that are susceptible to different rates of erosion; and
 - iv) the effects of waves, taking into consideration actual recorded wave measurements in the areas of interest.
 - c) The Consultant is required to address the following key issues in the sediment transport and morphology study in all the affected areas. This may include the following activities:
 - i) Establishing the rate of morphological changes along the coasts and on the seabed in the following areas before and after the land reclamation and to identify the key factors influencing the morphological changes:
 - (1) from Tanjung Pengelih to Kampung Lanjut and Pasir Bunga;

- (2) from Tanjung Pengelih to Kampung Jawa;
 - (3) around Nenas Channel;
 - (4) around Tanjung Piai, the approach to the Port of Tanjung Pelepas, Sungai Pulai estuary, Tanjung Kupang and Gelang Patah; and
 - (5) the entrance to the West Johor Straits and Pulau Merambong.
- ii) Studying whether there are any adverse effects of the land reclamation at Pulau Tekong (including the possible effects of wave and ship wake reflection off the sheet pile at Pulau Tekong Area D (if any)) and at TVE, on the baseline and continuing background pattern of morphological change, with regard to the following:
- (1) whether there are any erosion effects in the channel fronting PULAREK Naval jetty and Tanjung Pengelih jetty due to changes in the flow pattern;
 - (2) whether these hydrodynamic changes or the direct influence of these hydrodynamic changes in the flow pattern will have an adverse effect on the stability of the coastline and the stability of PULAREK Naval Jetty. The study should take into consideration aspects such as the local soil conditions and the jetty structure;
 - (3) whether there are any siltation effects at Nenas Channel;
 - (4) as far as possible, an assessment of related long-term impacts, such as long-term bed erosion and siltation patterns, long-term shoreline recession, residual currents and shear stresses, river sediment spreading and sediment patterns;
 - (5) the time-scale on which any changes will occur, and whether they will develop into a new equilibrium condition.
- 6) Water Quality
- a) The main issues regarding water quality involve changes in parameters such as salinity, salinity gradients, turbidity, suspended solids, dissolved oxygen, heavy metals and nutrient levels in the Johor Straits and the Sungai Johor and Sungai Pulai estuaries and in the surrounding seas and estuaries. In addition, a list of the significant discharges from both Malaysia and Singapore must be agreed on and provided by both parties. Furthermore, the Consultant shall also evaluate the water quality data from the Joint Seawater Monitoring Programme for the Straits of Johor between the National Environment Agency, Singapore (NEA) and the Department of Environment, Malaysia (DOE), under the auspices of the Malaysia-Singapore Joint Committee on the Environment (MSJCE).
 - b) In particular, the Consultant is required to address the following key issues in the Water Quality study:
 - i) Establish the water quality of the Straits of Johor prior to the land reclamation by analyzing the data to be provided by both Malaysia and Singapore;
 - ii) As far as possible, identify trends over time in the water quality condition from significant discharge points vis-à-vis the effects of the concurrent Pulau Tekong and TVE land reclamation;

- iii) Establish the effects of the Pulau Tekong and TVE land reclamation on parameters such as salinities, salinity gradients, nutrients and dissolved oxygen; and
- iv) Establish the changes in the flushing characteristics of the flow, due to the hydrodynamics of the Pulau Tekong and TVE land reclamation, the resultant effects on the retention of pollutants, and consequently their effects on dissolved oxygen and nutrient levels.
- c) The Consultant, after discussion with the GOE, shall establish a list of possible physical, chemical and biological parameters to be modelled, analysed and monitored.
- d) The Consultant, or its appointed agent, shall carry out benthic measurements to check for particle size distribution, heavy metals and organic pollutants in the benthic environment.

7) Water Level Changes

- a) One of the effects to be investigated is whether the land reclamation will result in significant changes in water levels and the tidal range in the Johor Straits and in the Sungai Johor and Sungai Pulai estuaries. The following should be studied:
 - i) the magnitude of changes in water level, the phase lag, the tidal range, and tidal prism;
 - ii) effects of the water level changes and phase lag on the outflows from the main rivers, such as Sungai Johor and Sungai Tebrau and Sungai Pulai (for various flow conditions including the 100-year flood flow).

8) Ecology

- a) As far as possible, the Consultant shall assess whether changes in hydrodynamics, water quality and morphology (which are directly attributable to the land reclamation) have secondary effects on the ecology.
- b) The Consultant shall, in its First Progress Report, assess the practicability of studying, in a quantifiable manner and within the timeframe of the studies, whether there are significant impacts on the following environmental receptors which are directly attributable to the land reclamation.
 - i) Marine Ecology
 - (1) Key marine ecological resources and habitats (i.e. benthic habitats, coral deposits, zooplankton, phyto-plankton, algae, sea grasses, fishery, bivalves and dugongs).
 - (2) Mangrove flora and fauna (herpetofauna, birds, mammals and invertebrates).
 - ii) Fishing Community
 - (1) Livelihood of fishermen and fishing activities.
- c) For those receptors for which such a study has been assessed to be practicable, the Consultant shall, in the First Progress Report, provide a methodology and cost estimate for conducting such a study. If the methodology and cost are acceptable to the Governments, the Consultant will be instructed to proceed with the study.

