Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Breakfast Point Pty Ltd
c/- TLB Engineers
PO Box 110
CAMMERAY NSW 2062

Project 71235.01
21 Feb 2011
TJW:lll

Attention: Mr Howard Bersten

Email: howard@tlbengineers.com.au

Dear Sirs

Placement of Scour Protection Blanket over Soft Sediments
Inner West Marina, Breakfast Point, Sydney

Further to your enquiry regarding the geotechnical issues associated with the proposed scour protection blanket (SPB) at the Inner West Marina here are my comments on the item numbers in the David Crane & Ass report and other document that you specifically requested:

- Item 5

> 5. Wave climate VOL 6pg 19. The wind waves have been calculated using a 50 year Average Reoccurrence Interval (ARI) as defined by Australian Standard AS 3962 for the design of marinas. This Standard provides no guidance on the design of an ISC. Given the consequences of the failure of the ISC it is considered more appropriate to assess the wave climate using at least a 100 year ARI or even a 200 year ARI would be appropriate (USEPA, 2005). Given the likely extremely low strengths of the sediments the effects of earthquakes causing liquefaction should also be examined (USEPA, 2005). 500 yr or.

There is a very, very low risk of earthquakes causing liquefaction at this site. The sediments have some cohesion, which makes liquefaction less likely than in very loose sands, requiring a very powerful quake. There is also a very low probability of quakes in the Breakfast Point area.

- Item 7

> 7. No discussion is given to the geotechnical nature of the sediments. It is the geotechnical nature of the sediments that will dictate the engineering solutions that are applicable. The contaminated sediment in Kendall Bay is what is described as normally consolidated clay or even underconsolidated clay. Normally consolidated clays are typically very soft. Normally consolidated soils can become underconsolidated by the activity of the benthic organisms and their interaction with the physical environment. Burrowing constructions processes and maintenance and bioirrigation of sediments during feeding and respiration lead to a decrease in strength of the normally consolidated clays because of the presence of voids and gases produced. In simple geotechnical terms, normally consolidated sediments/clays are of very low strength and more often than not cause engineering problems.

Most of this statement is correct however most marine burrowing creatures usually confine their activities to the top 100 – 300 mm. Cardno Ecology Lab have reported that there are very few marine burrowing organisms in the sediment. Consequently there will be no effect from burrowing organisms on the long term behaviour of the sediment and clay below. Notwithstanding this, the sediments will settle locally over time under self weight and the capping layer (basalt rock) will also settle. The geotextile and the basalt will continue to perform their function of reducing water particle movements such that on the underside of the geotextile, the bed sediments will not be disturbed.

- Item 9

9. The proponent concedes (VOL 6 pg 35) the marina development potentially disturbs the contaminated sediments. The report considers this disturbance during constructions, post construction and marina operation. To mitigate the disturbance of the contaminated bed sediments it is proposed to use a geotextile and rock protection blanket. It is stated (VOL 6 pg 36) that the "upper 100 mm of very soft sediment would probably be disturbed" when the geotextile and rock blanket are laid. This estimated of 100mm is based on a report by Douglas Partners (DP). The DP report provides no basis or justification for this "estimate". The "estimate" appears to be based on the fact that the soil behaves as a highly viscous fluid. It is unclear why this would apply to a depth of 100mm only. The bioturbation of organisms will likely penetrate several hundred millimeters below the surface. Vol 3 pg 5, shows that bivalve shells are present below 1.5 metres. As consequence, it could equally be estimated that the disturbance depth will significantly exceed the 100mm. A value of 400 to 500mm is considered more likely.

Tests can be carried out to determine the depth and extent of disturbance and refine placement techniques so that no more than 100 mm is disturbed. It is feasible that refinement of both design and construction procedures could result in almost no disturbance to the sediments.

- Item 10

10. The construction and long term performance of the blanket has clear geotechnical implications, yet no geotechnical in-situ or other factual data has been collected. The lack of factual geotechnical data at this stage is considered to be a serious omission. Because of its underconsolidated nature, the very soft contaminated sediments will experience significant displacement through localized bearing capacity failure when the rocks are placed. This will occur when the armour store is placed on the geotextile and it sinks and in the process move some of the material laterally after which the displaced sediment moves up vertically a short distance from the rock placed. This will result in a wavy surface not a horizontal surface as depicted on Diagram 3 of Figure 8 (Vol 6). The effect is illustrated on Figure A. This waviness could be up to several hundred millimeters USEPA (1998) recommends increasing the blanket thickness by 50% to overcome the uncertainties with this type of construction when carried out under water. Therefore, to obtain an effective rock armour cover of 300mm, a minimum of 450 mm would be required. The proponent has failed to demonstrate that the proposal will not result in significant uncontrolled disturbance of the sediment during rock placement.

I agree in part, but the extent that the sediment surface is displaced will depend on the strength of the sediments around and the shear forces in the sediments that result from the placement of rock. Placement can be very closely managed using for example a controlled feedpipe or diffuser. Consideration should also be given to initially placing a layer of sand over the geotextile before rock fill. Full scale trials would enable a contractor to fine tune his equipment and procedures.

A layer of reclaimed sand was successfully placed over very soft sediments to form a seagrass habitat in a sensitive part of Botany Bay at the Parallel Runway Project at Sydney Airport in 1993.

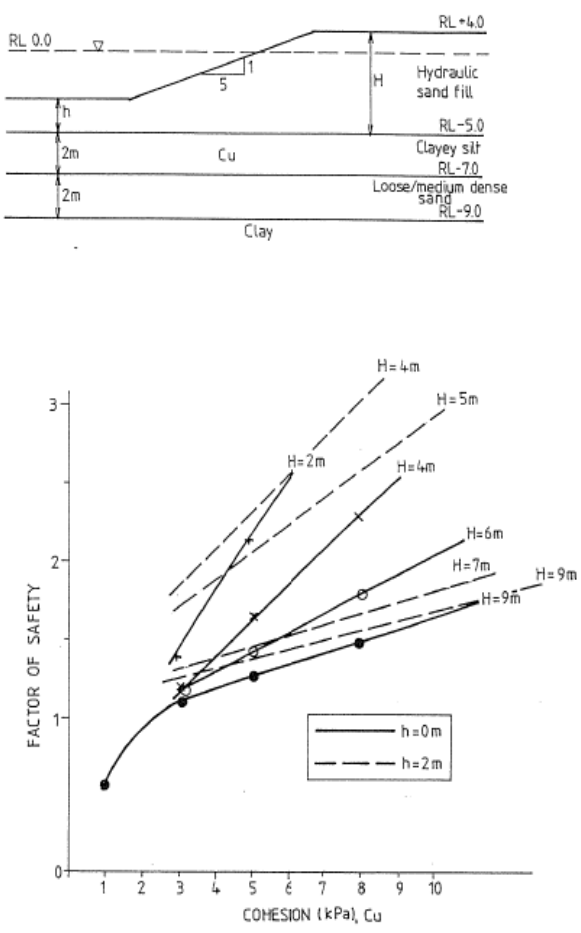


Figure 1: Stability of Reclaimed Sand Slope on Very Soft Sediments

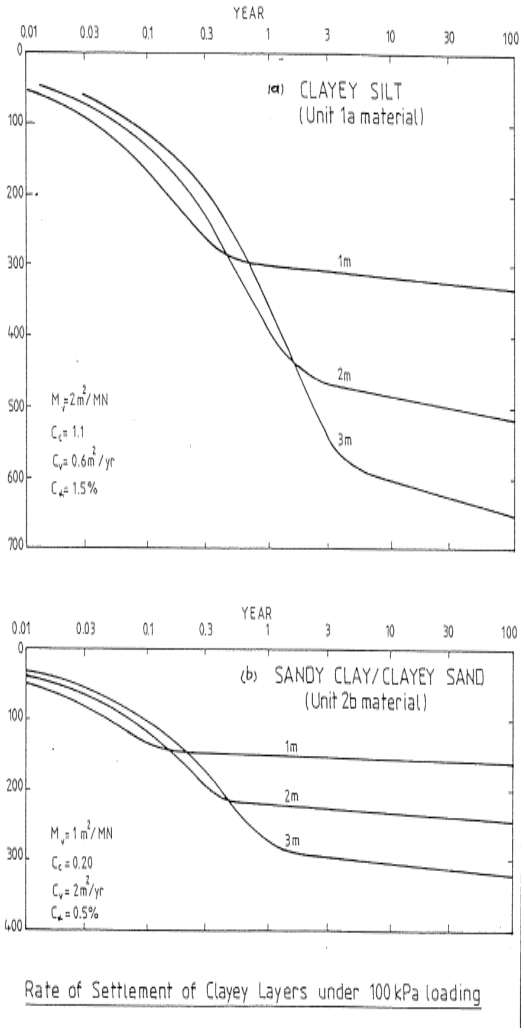


Figure 2: Settlement v Time of Different Thicknesses of Soft Clay under 100kPa

Figure 1 shows the relationship between the factor of safety of a 1V:5H sand slope and undrained shear strength of the sediments for various thicknesses of sand capping. This figure indicates that at the edge of the capping (h = 0m) the undrained strength of the sediments needs to be at least 3 kPa for the edge slope to have a factor of safety of over 1.3 for a capping less than 2 m thick. A minimum capping thickness of 0.5 m was eventually placed initially using a diffuser with no geofabric layer. This was after strength testing in the sediments indicated adequate shear strength and contamination and

other testing of the near surface sediments indicated a reasonable thickness of uncontaminated sediment forming a secondary capping layer.

Figure 2, also from the Parallel Runway Project shows typical settlement versus time flats for 1, 2 and 3 m thickness of clayey silt and sandy clay materials under 100 kPa loading. Settlement under 10 kPa would be one tenth of 100 kPa, and so on. The clayey silt material is probably similar to the sediments at Breakfast Point.

- Item 11

> 11. The proponent may argue that geotextiles are used as a reinforcing member in civil engineering projects to overcome the effects of low strength soils. This is correct, however, when using a geotextile for reinforcing purposes a woven fabric is usually used, not a non woven fabric as proposed at Kendall Bay. Woven fabrics have distinct fibres that act like the steel in reinforcing mesh. Woven fabrics are usually a very poor separator that is why the proponent is using a needle punched spun bound geotextile (Elcomax 1200 R). This type of geotextile has fibres that run in random directions and need to stretch a significant amount to take up load. Therefore they are not suitable to be used as a reinforcing element.

The primary purpose of the geotextile at Breakfast Point is to separate the contaminated sediment from the clean fill. Although a geotextile was not eventually used in the seagrass habitat area at the Sydney Airport Parallel Runway project due to reasons given previously the recommendation made at the time is detailed below:

> If capping is still to be carried out, we suggest placement of a stiff geofabric or grid to form a separation layer between the capping and underlying clays prior to carefully controlled placement of sand. A coarse weave, non buoyant cane or plastic mat or webbing may be suitable in providing lateral stiffness and strength combined with physical separation between the silts and sand capping layer. It would be prudent to monitor the placement and possibly stage the capping to avoid large scale lateral displacements.

- Item 23

> 23. The matter of bathymetry is considered to be important for an ISC (USEPA 2005). It is stated that the flatter the bottom slope the better. This is to reduce the spreading of the capping material during placement. It is also stated that it is difficult to estimate the effects of slope alone, since bottom roughness plays an equally important role in the mechanics of the spreading process. Given the normally and underconsolidated nature of the contaminated sediments, the bottom slope in Kendall Bay is considered to be a very important factor in the selection of the correct method of remediation. Palermo et al (2000) offers some insight into the issue of bottom slope. In this publication the issue of level bottom capping (LBC) is discussed with reference to dredged material capping. This is where dredged contaminated sediments require capping to mitigate the potential for toxicity or bioaccumulation in benthic organisms. These dredged sediments would be very soft similar to those in Kendall Bay. The following is from the **document "... LBC projects ...have been executed at sites with slopes up to 1 to 60 ..."Placement of material on steep bottom slopes (steeper than 1v on 100h) should generally be avoided for a capping project... because of the potential for a slope adjustment ...". Using these criteria it can be concluded that the bottom slope at Kendall Bay is far too steep for the proposed ISC.**

This may be true but requires strength values for the clays and accurate modelling of sub-seabed stratification to analyse reliably. Figure 1 indicates shear strengths required for stability of a sand batter of 1V:5H. The batter of the blanket has a greater impact on the stability of the edge slope of the capping than the bottom slope provided the bottom slope is less than 1V:15H.

The bed of Kendal Bay slopes at shallow angles of 1:25 (V:H) or flatter. Placement of the rock capping layer will need to be controlled so uncontrollable spreading does not occur. Edge batter slope will depend on sediment shear strength with the stable edge batter likely to be closer to 1V:5H than 1V:1.5H.

- Item 31 criticises the conceptual model which is presented in Figure 8 of the submission reproduced as Figure 3 below. Each of the 7 stages is examined.

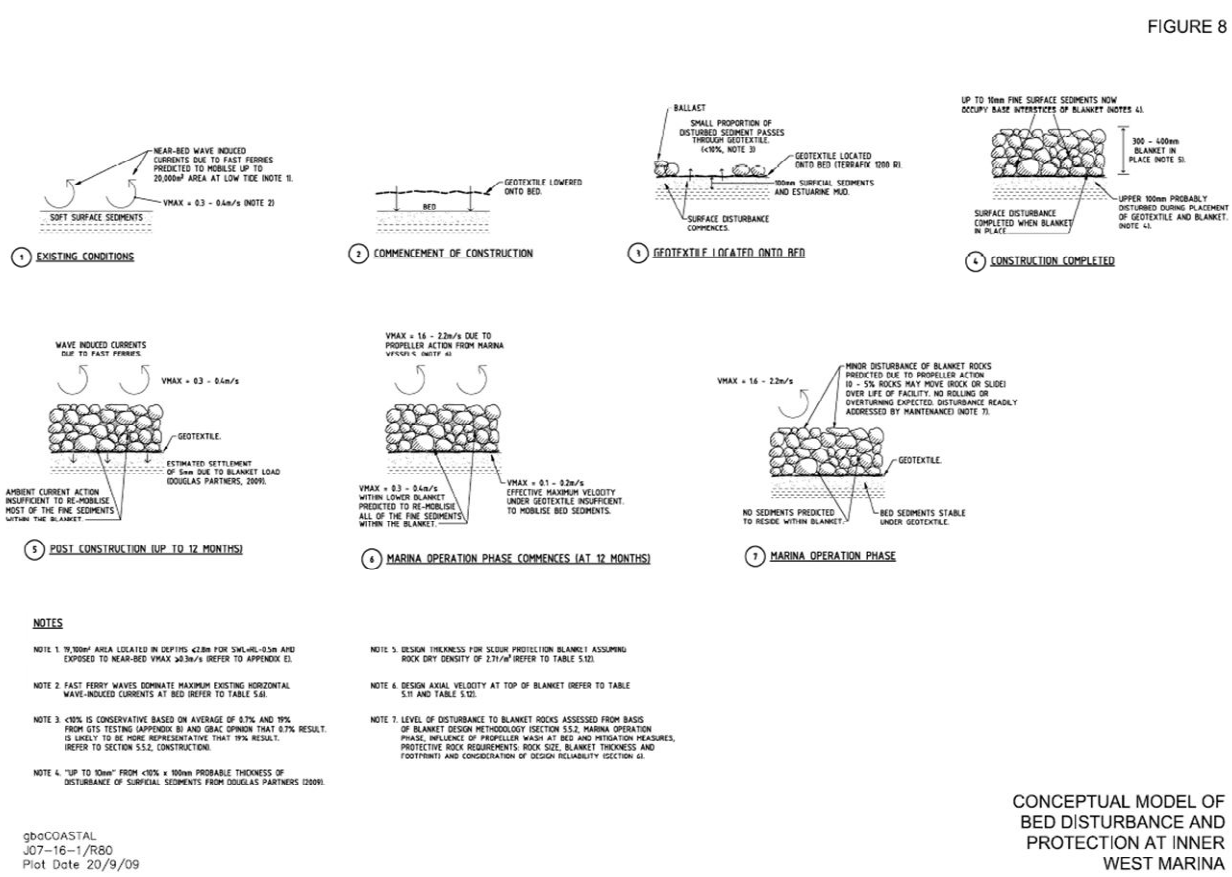


Figure 3: Conceptual Model

31. Conceptual model of Disturbances and Protection. Vol6 pg48 presents this model. The proponent's model and comments are given.

1	Existing conditions	Near-bed wave-induced currents due to fast ferries disturb large areas within Kendall Bay including the proposed marina footprint area.	The number of ferry journeys does not reduce when the marina is in place, the route taken simply changes. The sediment disturbed is less however, the increased traffic from the marina probably equals the difference. Therefore the same amount of contaminated sediment will still be disturbed, just in a different location.

Water traffic is impossible to reliably predict, however the scour protection blanket will greatly reduce or even possibly eliminate the extent of sediment disturbance from water traffic. So the last statement under 1. is incorrect.

2	Commencement of construction	Geotextile forming part of the blanket is lowered onto the bed.	This will not be straight forward. This geotextile is spun bound and 5.7mm thick. A significant amount of air is trapped within the geotextile which will mean it will want to float. It will not simply fall onto the bed. Current velocities will make handling difficult. There is no evidence presented to show there are no obstructions on the bed and how they will be

Agree placement of other than a coarse open geotextile (a geogrid) will be difficult. Is a geotextile necessary? Other than as a marker layer in which case a geogrid could be suitable. Further contamination testing of the seabed may show that recent sediments on the seabed are not contaminated as it did at Sydney Airport. Consideration could also be given to placing a sand layer over the geotextile or directly over the soft sediments.

			dealt with and the resulting sediment disturbance.
3	Geotextile located onto bed	The geotextile comes to rest on the bed and ballast is placed to temporarily secure the geotextile placement. In the process of coming into contact with the bed and being located to its correct position, disturbance of surface sediments commences. Upper 100 mm of bed sediments probably affected during construction of the blanket *(Douglas Partners, 2009).* Small proportion of the disturbed sediment passes through the geotextile *(<10% of upper 100 mm over the duration of blanket construction)*	Because the sediment is normally consolidated and underconsolidated in nature, the temporary ballast will cause local bearing capacity failures and disruption to the blanket. There has been no justification of the 100mm of disturbance; it is likely to be significantly greater. The hydrodynamic testing shows significantly greater amounts of sediment passes through the geotextile than the assumed 10%. There has been no justification of the 10mm used.

The 100 mm of disturbed sediments is an initial estimate, probably an overestimate. The depth of disturbance could be much less depending on placement technique and sediment shear strength. Placement of the rock fill on top of the geotextile needs to be trialled initially to develop appropriate techniques then monitored during placement over the whole area. The strength of the clays is an important factor affecting the extent of disturbance as is the rock size. It may be necessary to place an initial layer of sand or finer gravel to cushion the placement of the rock layer.

4	Construction completed	300 – 400 mm thick layer of rocks comprising the upper blanket is placed. Disturbance of surface sediments is complete when construction of the blanket is completed. Up to 10 mm of fine surface sediments now occupies the base interstices of the blanket.	Because of the very soft nature of the contaminated sediments, placing the rocks without causing significant localised displacement of the sediment will be very difficult. As a result the effective depth of the blanket in places could be as little as 100mm. See comments in 1 above regarding the sediment in the base of interstices of the blanket.

A sand layer may address this concern if a trial indicates problems with rocks.

5	Post construction (up to 12 months)	Ambient currents, including the controlling wave-induced currents due to fast ferries, are insufficient to remobilise most of the 10 mm of fine sediments within the rock blanket.	Some of the sediments will be remobilised because there will be more than the 100mm present (see comments to 1 above). Because there will not be an effective cover of 300 to 400mm the wave reduced currents will disturb the sediments.

This is speculation and depends on the grading and sizes of the rock and success of placement. If the capping layer is well graded and the sediments relatively undisturbed then currents will not affect the small amount of sediment that is in the seabed.

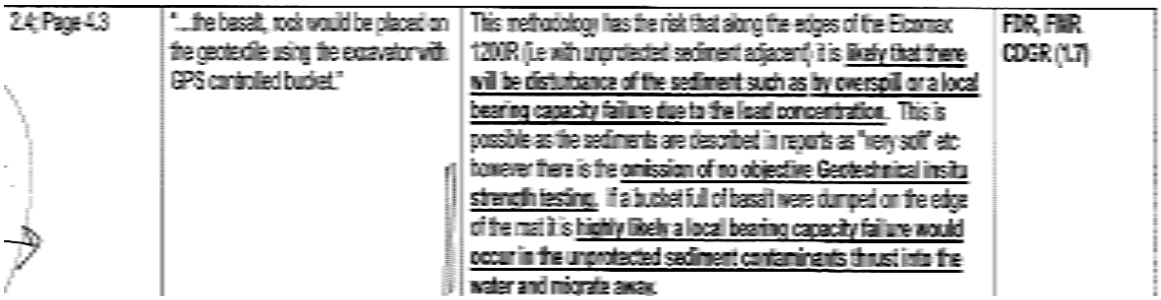
6	Marina operation phase commences (at 12 months)	Once vessels take up their berths within the marina, their propeller action is predicted to remobilise all of the 10 mm of fine sediments located within the rock blanket.	It is agreed that the vessels will remobilise all the sediment located in the rock blanket. Therefore, a significant larger amount of
		This material is suspended into the water column, and dispersed elsewhere within Kendall Bay and beyond, under the action of ambient currents. Tidal flows and wind induced currents would be expected to dominate the dispersion process. The blanket geotextile itself reduces the penetration of ambient currents to the underlying bed sediments such that the velocities under the geotextile are insufficient to mobilize these sediments.	sediment will be redistributed elsewhere in Kendall Bay than calculated by the proponent as explained above. Because the effective thickness of the blanket may sometimes be less than the design thickness the ambient currents in the underlying bed sediments will be sufficient to mobilize the sediments.

Previous comment also applies.

7	Marina operation phase	During operation, minor disturbance of blanket rocks is predicted due to propeller action of vessels located within the marina. Based on the adopted blanket design methods, it is predicted that 0 – 5% of the rocks within the blanket may move over the life of the facility. This disturbance of the blanket rocks is readily addressed by routine maintenance. Any minor mobilisation of the blanket rocks during marina operation and any required maintenance would not be expected to disturb the bed of Kendall Bay under the blanket such that further sediment loss up through the blanket could occur.	Recontamination of the blanket from the far field disturbance has been ignored. Significant amounts of sediment will settle on the blanket which in turn will be remobilised by the vessels using the marina. In turn these will be remobilised to other parts of Kendall Bay. When this continued sediment disturbance is added to the continued disturbance by the fast ferries (and probably increased ferry numbers due to the Sydney Ferries identification of Cabarita wharf demand) and the increased pleasure craft, the total disturbance to sediment will remain unchanged to that which currently occurs.

If the capping is successfully installed so as to prevent disturbance of sediment then this comment does not apply.

- Comment from Mr Rod Jeffries



2.4; Page 4.3	"...the basalt, rock would be placed on the geotextile using the excavator with GPS controlled bucket."	This methodology has the risk that along the edges of the Ecomax 1200R (i.e with unprotected sediment adjacent) it is likely that there will be disturbance of the sediment such as by overspill or a local bearing capacity failure due to the load concentration. This is possible as the sediments are described in reports as "very soft" etc however there is the omission of no objective Geotechnical insitu strength testing. If a bucket full of basalt were dumped on the edge of the mat it is highly likely a local bearing capacity failure would occur in the unprotected sediment contaminants thrust into the water and migrate away.	FDR, FWR CDGR (1.7)

This is correct in the absence of insitu testing there is a risk of bearing capacity failure particularly at the edges. An edge batter of 1V:5H or less is suggested as discussed above.

We trust the above comments are sufficient for your present requirements and are pleased to be of service.

Yours faithfully
Douglas Partners Pty Ltd

Terry Wiesner
Principal