Appendix B

Hydrodynamic Modelling Clarifications

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Contact P. D. Treloar

Cardno
Shaping the Future

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URS Australia Pty Ltd
Level 4, 407 Pacific Highway
ARTARMON NSW 2064

Attention: Mr Chris Fay – Associate Environmental Planner

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9, The Forum
203 Pacific Highway
St Leonards New South Wales 2065
PO Box 19
St Leonards New South Wales 1590
Australia

Telephone: 02 9496 7700
Facsimile: 02 9439 5170
International: +61 2 9496 7700

Web: www.cardno.com.au

Dear Sir,

APPENDIX B, HYDRODYNAMIC MODELLING CLARIFICATIONS

Preamble

This memo has been prepared by Cardno to assist URS and addresses some matters that have been raised in relation to the investigations undertaken to support the preparation of the Environmental Impact Statement (EIS) prepared for the Caltex port and berthing facility upgrade project. The general points of clarification are as follows.

Modelling Summary

The conservatism included in the modelling, and the depositional modelling in particular

The model used to assess the hydrodynamic, transport-dispersion and deposition impacts resulting from the proposed works was undertaken to be realistic. This was because the model had been calibrated and validated against real world data. Hence the wave and current modelling predications are considered realistic. However, the higher wave height cases would be slightly conservative because wave transfer coefficients (offshore to onshore) were based on an offshore wave height of 1.5 m. In a major storm, inshore wave heights would be reduced further than modelled due to higher bed friction and wave breaking related to the higher offshore waves. Note: The accuracy of the model is different from the conservative approach taken to using the model to predict dispersion and deposition.

Figures 9.2 to 9.4 in Technical Appendix C of the EIS show that changes to wave heights are very small relative to the wave heights themselves. These changes are contained within the groyne-field protected region of Silver Beach. The changes in currents are also not identifiable (effectively no change). This is because the overall dredging work is relatively small compared with previous dredging works in Botany Bay– covering a large area, and therefore causing small bottom level changes. The seabed level is already established and the proposal is to spot dredge to return the pre-established levels, with the exception of a small increase in overall depth at the fixed berths. Hence the effects on waves and currents must be very small. Design wave heights (Hs) near the seaward ends of the groynes are in the order of 1.8 m (Cardno, 2013) and a 0.1% change in wave height is negligible (≈2 mm).

An estimate of the likely deposition and extent resulting from the works accounting for the fact that the deposition would include dredging northwards of the locations used to calculate your current plot

Because the dredge plume modelling was undertaken close to the Kurnell Wharf, the pattern of deposition depth (see Figure 6.33 of Technical Appendix C) is biased towards the south of the dredge footprint. This approach was adopted because any plume effects would be more important close to the seagrass areas, aquaculture site and headland of Kamay Botany Bay National Park, which are all located in the southern part of the Bay. In fact, much of the dredging would take place further to the north than modelled and shown in Figure 6.2 of Technical Appendix C. Therefore, Figure 6.33 of Technical Appendix C (which is the same figure as Figure 10-3 of the EIS) overestimates the maximum depth of siltation.

Table 4-1 of the EIS shows that about 42% of the sediments would be dredged from the turning circle and approaches area (Area 1), and the sub-berth area (Area 2). The plot included in the EIS shows the deposition that would occur as a result of dredging the approaches and turning circle in two fixed locations (as the process is influenced by overflow dredging). The result would be a peak sedimentation depth of approximately 35 mm. In reality the dredger would move out of these two locations further north to cover the footprint shown on Figure 4-1 of the EIS. It was not possible to model the effects of this due to the limitations of the method used to calculate deposition. It can be estimated, however, that the effect of dredging the whole footprint would create a maximum peak deposition of less than 20 mm. This is based on a volumetric calculation of the dredged sediment over the given area. The most significant change to that shown in Figure 10-2 of the EIS would be to the south of the dredge footprint where the depth of deposition would decrease by 15 mm.

It is also worth noting that the development of the 'mound' of fines through dredging would occur over a period of approximately six-months. Hence the rate of deposition would only add an imperceptible depth each day, somewhere in the region of 0.1 mm.

The long-term effects (i.e. re-suspension) and how this would affect the modelled results

The dredge footprint is a depositional area, confirmed by the fact that sediments have built up in this location over the past 40 years. The sediments would only be re-suspended in severe storms. Adopting design wave parameters available from Caltex (2013) and applying them in the LITPACK coastal processes modelling system, it can be demonstrated that the fine, deposited bottom sediments would be re-mobilised in a 1-year Average Return Interval (ARI) storm event. Some of that re-suspended sediment would be as suspended load that could be transported out of the dredged area. This process would redistribute the deposited fine sediments, reducing their overall depth by spreading it more widely over the Bay, thereby reducing the height of the depositional mound slightly, but causing no more suspended sediment in the Bay than occurs naturally now during a storm event.

The implications of using an open bucket method of dredging (accounting for the fact that a silt boom will be placed around the dredger head mid-depth in the water column to surface).

If an open bucket were used on the backhoe dredge, additional fine sediment would be placed into suspension throughout the water column as the bucket was being raised. The amount of sediment released would depend on the rate at which the bucket was raised through the water column. With the inclusion of a silt boom, the generated suspended sediment would be retained locally. Most of the fines would settle on the seabed within a period of 12 hours or less.

Submissions Questions

The following is a list of submissions questions raised by Government agencies (highlighted in **bold**). There is a degree of consistency between the comments that warrant a combined response. URS/Cardno responses follow. URS' element of the response is provided in italics.

Of most concern is the extent of dredging, and any resultant impacts upon the marine environment as a direct result of dredging or from altered hydrodynamic processes within Botany Bay.

Response: *Section 8.6.1 of the EIS considers the impact of the proposed works on the long-term hydrodynamic processes in Botany Bay. The conclusions of that assessment state that:*

- *'there would be no change to local wind-wave conditions';*

- *predicted changes in wave-height and wave-direction (resulting from the altered swell) would be minor only (in the order of mm) occurring 'on Silver Beach and within the groyne field, where changes in (significant) wave heights would be +/-0.05% compared against existing conditions';*

- *there would be 'minor changes (ranging from -0.4% to +0.4%) to the significant wave height along Silver Beach [and]... no changes at the [airport] runways, in Port Botany, or at the main recreational fishing sites to the north'; and*

- *Less than 0.1 degree of direction change in the longshore transport processes, which would be contained within the Silver Beach groyne field.*

The model used to predict these changes has been validated against data collected in Botany Bay.

The conclusion is that 'the results of the modelling demonstrate that the effects of the proposed dredging works on the hydrodynamics and coastal processes within Botany Bay would be, at most, minor (adverse) and would not require the development of specific mitigation measures'.

Although the planned area of dredging is significant, the volume is small when compared with the 7.5 million m^3 extracted for the Port Botany Expansion project for example. The changes in depth are relatively small and diffuse; hence there would be no focussed changes in wave parameters and direction changes would not be consistent within the groyne compartments. Moreover, Figures 9-2 to 9-4 of the EIS demonstrate that any small changes are all located in the Silver Beach groynes area, which is inherently protected.

The extent of change in wave heights is in the order of millimetres, and the changes in wave direction are no bigger than about 3.5° at the eastern of Silver Beach, leading to a narrowing/widening in the order of 2 to 3 m within groyne compartments. At the western end of Silver Beach the changes will be smaller, in the order of 0.5 m, not identifiable in surveys. Wave direction changes on Towra Beach would be in the order of less than 0.1°, generally at the limit of the accuracy of the modelling.

The dredging has the potential to alter the hydrodynamic processes which operate within Botany Bay. Given the extent of dredging proposed, the significant environmental receptors located in the vicinity of the proposal, and the major changes to the bay as a result of other major projects undertaken within the bay, there is potential for significant cumulative adverse environmental impact such as altered wave dynamics and wave patterns, scour and erosion, sediment transport, water quality and water circulation, amongst others.

Response: Caltex recognises the potential for the works to impact on the hydrodynamic processes of the Bay as discussed above.

The model used to predict these changes has considered the influence of a number of recent major projects that have taken place in the Bay, including the Port Botany Expansion work, albeit the long-term effects these projects have now formed part of the 'existing environment' considered and assessed in the model. Previous modelling (Lawson and Treloar (2003)), and the work undertaken for the proposed works, has shown small changes in wave conditions; with no changes in open water currents. Changes in wave heights were in the order of millimetres and current speeds changed only near major structures such as the parallel runway. The dredging proposed by Caltex only requires the need to 'spot dredge' certain location across an established footprint. Locally there would be changes in bathymetry, however across the entire project site there would be unidentifiable macro-scale changes (even accounting for the slight increase in the depth and size of the established berths). In effect, the hydrodynamics of the Bay are not substantially influenced by such a small scale change (demonstrated by the fact that the Caltex proposal is to dredge 153,000 m^3 compared to the 7,500,000 m^3 dredged at Port Botany).

Hence, the assessed impacts examined the 'cumulative effects' on the hydrodynamics of Botany Bay in terms of the above parameters, where the impacts are either **negligible** or **minor** adverse.

This is due primarily to the fact that Caltex is only proposing to dredge a small volume of material (1/50th of that dredged for Port Botany and 1/100th of that dredged for the extension of the Airport Runway) whilst adopting a dredging method that would cause lower intensity effects because the rate of sediment extraction is lower, in terms of sediment disturbance and dispersion, than other alternatives.

Botany Bay has a complex pattern of currents and sand movement. Dredging to allow for the reconfiguration of the Kurnell berthing facility has the potential to have a significant impact on endangered Posidonia australis seagrass communities.

Response: Section 8.6.1 of the EIS considers the effects of the proposed works on the long-term hydrodynamic processes in Botany Bay. The model used to predict these changes has considered the influence of a number of recent major projects that have taken place in the Bay, albeit the long-term effects these projects have now formed part of the 'existing environment' considered and assessed in the model. Hence, the assessed impacts looked at the 'cumulative effects' on the hydrodynamics of Botany Bay in terms of the above parameters, where the impacts are either negligible or minor adverse.

This is due primarily to the fact that Caltex is only proposing to dredge a small volume of material (1/50th of that dredged for Port Botany and 1/100th of that dredged for the extension of the Airport Runway) whilst adopting a dredging method that would cause lower intensity effects because the rate of sediment extraction is lower, in terms of sediment disturbance and dispersion, than other alternatives. Changes in wave heights that might damage sea grass areas are very small – see Appendix H of Technical Appendix C, Locations 5 to 45; would be in the order of millimetres. Hence changes in bottom shear stresses that might damage sea grass roots would be negligible.

The impacts of the current proposal need to be considered in conjunction with other works in the Bay including the Port Botany Terminal 3 expansion and on-going maintenance dredging of shipping channels, to adequately address cumulative impacts of the combined works on the remaining sea grass beds and their dependent ecological communities within Botany Bay

Response: As above (i.e. the modelling has accounted for these projects).

Sydney Ports Corporation Consultation Letter

Caltex has also received a response from Sydney Ports Corporation (SPC) who advises that they have been required to maintain a range of monitoring tasks for several years following completion of their Port Botany Expansion works – from January 2010. The letter is included in **Appendix A, Submissions**.

Response: This requirement was imposed by the NSW DP&I to confirm the results of modelling undertaken for that project. SPC contend that, in the event that some identifiable changes occur following the completion of works proposed by Caltex, it may not be possible to assign levels of responsibility between themselves and Caltex; or indeed other previous works or natural processes. Any changes that might occur in areas other than Foreshore Beach (dot-point 3 in the SPC consultation letter) would be difficult to assign to any particular cause because they would be very small'. This can be concluded through the results of the modelling, the conservatism included in the modelling and the fact that the model already accounts for the changes that have occurred elsewhere in the Bay (including those generated through the Port Botany Expansion).

The tasks required of SPC under Clause B2.40 are being undertaken now. The work undertaken by Cardno for Caltex has shown that some minor shoreline changes would occur on Silver Beach (contained within groyne compartments) and Bonna Point, but would be negligible/not identifiable on Towra Beach. The monitoring work undertaken by SPC in these areas should continue, and because of their long-term involvement, is best undertaken by them.'

Yours faithfully,

P. D. Treloar
Senior Principal, Coastal & Ocean
for **Cardno (NSW/ACT) Pty Ltd**

References

Cardno (2013): Metocean Study for the Caltex Wharf, Kurnell. Report NA49913035/R001_v4) Prepared for Caltex Australia.