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Our Reference: JMCP180

28 August 2008

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Dear Peter

<u>SaldanhaRO Plant Marine Impact Assessment: Response to Reviewer's comments</u>

Given the comments from I&AP's at meetings the CSIR has attended, it welcomes the decision to obtain a formal review of the Specialist Marine Impact Assessment reports despite the fact that this is not a requirement of the Basic Assessment process.

We have read the reviews from the Water Research Laboratory of the University of New South Wales (who we know to have extensive experience in assessing the environmental impacts of RO Plants) and Anchor Environmental Consultants (who have a detailed knowledge of the Saldanha Bay ecosystems). Below we comment in detail on each of the reviewer's comments.

1. Review by the Water Research Laboratory (WRL) of the University of New South Wales

The reviewers correctly comment upon the extensive impact assessment effort undertaken for what is essentially a small RO Plant. However this is to be expected, given the importance of the Saldanha Bay ecosystems. You will recall that initially there was some discussion as to whether a detailed modelling study was indicated and our recommendation that such a study indeed was warranted. We did however *a priori* assume that the impacts would be sufficiently limited not to require a detailed assessment of potential impacts of the RO Plant for all potential future port layouts. Furthermore, it was expected that a detailed three dimensional water quality study (comprising system-wide detailed modelling of phytoplankton and oxygen dynamics, *etc*) would not be warranted given the expected limited scale of impacts.

Intakes
Detailed groundwater studies indeed were undertaken as referred to in CSIR (2007, 2008). The groundwater studies indicated that the beach well intakes were feasible for Site 1 and for Sites 3c and 3d, where borehole intakes are proposed to be located along the causeway.

We agree with the concerns expressed by WRL on the potential impacts of beach wells on groundwater dynamics. On page 115 of CSIR (2007) we also comment on the potential for destabilisation of the adjacent dune systems by beach well extraction systems. The effects on groundwater dynamics are not part of the scope of the Marine Impact Assessment report and thus are not further commented upon here. It should be noted that the preferred option is that of boreholes along the causeway for which such groundwater concerns on dune systems are not an issue.

The reviewers are correct in noting that no detailed near-field modelling has been undertaken in the CSIR studies (CSIR, 2007, 2008) to quantify potential zones of entrainment of intake systems. At the time that the assessment was undertaken many different options were still being considered. As for other instances where the requisite detailed design information was not available or had not been decided upon at the time of assessment, the approach of the CSIR has been to specify performance criteria for the particular sub-system under consideration to ensure compliance with appropriate environmental performance requirements. For the intake we have specified that the intake velocities need to be < 0.15m/s to avoid entrainment effects[1], however we are happy to amend the report to reflect the < 0.1 m/s velocities recommended by the reviewers. We have indicated entrainment impacts for intake pipelines to be medium, if not mitigated. The CSIR has strongly recommended the use of boreholes in the causeway as these will minimise potential environmental impacts universally and specifically minimise entrainment or even eliminate effects.

As it is presently our understanding that boreholes along the causeway are the preferred option, we would *suggest that detailed modelling of entrainment effects from pipelines only be considered should it be intended to construct pipeline intakes*[2].

Discharge Impacts

The reviewers express concern that issues around ***Ferric Hydroxides*** have not been adequately considered. Issues around the use of Ferric Chloride have been discussed in some detail (*e.g.* page 141 in CSIR, 2007). It has been highlighted by the CSIR, depending on monitored impacts, that it may be necessary for some removal of sludge and coagulants from the RO Plant discharge. In the reports the CSIR has dealt with all applied coagulants and backwash material as a bulk discharge. If we understand the reviewer's recommendations correctly, they concur with our assessment that it may be necessary to remove sludge particles (that will include Ferric Hydroxide complexes) from backwashing of RO modules if indicated by the monitoring as proposed by the CSIR (see pages 141 and 175 of CSIR, 2007).

[1] This criterion was set with fish in mind and does not include planktonic organisms, fish eggs and larvae, *etc*

[2] It should be noted that, while spawning activity is important in the bay, we are not sure that the requisite level of knowledge of these activities (*e.g.* distribution of eggs and larvae) is adequate to justify a more detailed assessment (i.e. a detailed entrainment modelling exercise).

What the reviewer's comments indicate is that the removal of the sludge particles (and coagulants) is more likely to be necessary than originally considered, a fact to which the design team needs to be alerted.

The reviewers raise issues around possible generation of large hydroelastic networks which they indicate are common in estuarine environments. This has the potential to result in a decrease in dissolved oxygen (presumably due to the damping of mixing effects), the release of heavy metals and the reduction of light penetration. The preferred discharge location is in approximately 16 to 18 m water depth (allowing a greater degree of initial dilution of the effluent) in close proximity to shipping and associated propeller wash (albeit it intermittent). This limits the possibility of the formation of such large hydroelastic networks referred to by the reviewers. As regards effects such as low oxygen, light penetration, the scavenging potential of ferric hydroxides and its role in increasing phytoplankton blooms, we comment as follows:

- Should hydroelastic networks form and/or should there be deposition of coagulants and backwash material there may be effects on near bottom oxygen concentrations. However the bottom waters at the preferred sites are regularly flushed or partially flushed by upwelling events bringing in cold bottom waters. However, these upwelled waters could themselves be low in dissolved oxygen so it is not clear to what extent this flushing would remove any "oxygen sag" due to the coagulants and backwash material.
- As most of the discharge is indicated to remain in the bottom waters where nutrient concentrations are already high, it is unlikely that algal bloom effects will be of concern.
- As the effluent is predicted largely to remain out of the surface layers at the preferred discharge site, the effects of light limitation also are unlikely to be of concern. However should the coagulants and backwash material accumulate and be stirred up in major storm events, short term turbidity and light effects can be anticipated.

Given the residual uncertainties around these issues the CSIR specialists have indicated that it may be necessary to remove some or all of the coagulants and backwash material from the RO Plant discharge. The extent to which this is necessary will be informed by the monitoring results.

It is possible to simulate in models the deposition, re-suspension and re-distribution of this "sludge", however this would require detailed specification of the exact nature of the sludge quantities and properties, something that may be difficult to specify in detail prior to the commissioning and operation of the RO Plant (*e.g.* we are not sure of the quantity of natural turbidity in the marine environment and consequently the quantity of backwash material that will be generated). What is however certain is that the use of beach wells or boreholes (the preferred option) in the causeway will both limit the quantity of backwash material generated and the coagulant material used.

Toxicity Testing

The WRL reviewers are correct in stating that the exact concentration of constituents will not be known until the plant is operating. The WRL reviewers also indicate that sometimes pilot plants are considered in other countries but that this may not be appropriate in this case due to the limited size of the proposed plant (*i.e*. the proposed RO Plant in Saldanha Bay is roughly the same size as pilot plants elsewhere).

Our experience to date has been that there is no typical "effluent profile" for an RO Plant. This makes it difficult to *a priori* generate an appropriate effluent with which to undertake accurate ***toxicity tests***. The environmental investigations to date have had a significant influence in designing a more benign effluent profile. While some uncertainty remains around synergistic effects of the chemical constituents in the effluent, the monitoring and mitigation measures recommended in the marine specialist impact assessment (CSIR, 2007, 2008) are designed to ensure that all identified contingencies are appropriately managed, *i.e.* the project proponent (through the specified limitations on the effluent profile and required monitoring and associated mitigation activities) is implicitly committed to ensuring that environmental impacts associated with the RO Plant remain acceptable. However, as stated by the reviewers, the CSIR recommendation that dilutions of > 50 be achieved in the near-field, is consistent with the Australian experience that this degree of near field dilution is commensurate with that assumed to be adequate in other investigations. The issues around toxicity are addressed in greater detail in the section responding to the second reviewer (Anchor Environmental Consultants).

Potential de-oxygenation of bottom waters

The reviewers are correct in that we did not explicitly consider the effects of additional stratification and the potential effect that this may have on ***de-oxygenation of the near-bottom waters***. There are two effects that mitigate against de-oxygenation of the bottom waters by such stratification effects. First, as stated in the report, for surface water intakes the return flows from the RO Plant are likely to be similar in oxygen content to the surface waters of the bay (i.e. more or less saturated with oxygen). Given the large gradient in oxygen concentration between the surface waters (high) and the near-bottom waters (low) of the bay, it is likely that the discharged brine will have significantly higher oxygen concentrations than the bottom waters in the bay and thus be a possible source of oxygenation of the bottom waters. However, it is less clear how well oxygenated borehole intake waters will be and the extent to which such mitigating effects will be effective. Second, the deeper waters of the bay are "flushed" by the penetration of upwelled waters on an event scale. This would mean that any de-oxygenated bottom waters would be partially flushed with each upwelling cycle (typically occurring about once a week). However, the upwelled waters entering the bay may themselves have a very low oxygen content. The extent to which this flushing would be effective depends on the extent of "residual" stratification introduced into the bottom waters by the discharged brine effluent after initial dilution of the effluent in the near field. The greater this "residual" stratification after initial dilution of the effluent, the greater the likely de-oxygenation of the water and the less the mixing with more highly oxygenated surface waters and/or the upwelled bottom water entering the bay.

The exact effects of potential stratification dynamics on potential de-oxygenation of bottom waters under extended periods of calm conditions can only be accurately quantified if a more sophisticated water quality model is implemented. This would require greater detail on the near-field behaviour of the effluent that in turn is dependant on the detail of the diffuser design. (This would also require more detail on the likely backwash quantities that also could lead to an oxygen demand). Despite the fact that such a sophisticated water quality model has not been implemented, it can be stated that for near-field dilutions of > 50 (resulting in salinity differences of < 1 psu and minimal temperature differences between the dispersed effluents and the ambient waters), this effect is likely to be extremely limited for the volumes of effluent considered here.

The reviewers recommend an approach of using desktop calculations to determine whether there is enough energy to destratify the water column and thus avoid such oxygen "sag" effects. It is possible for such desktop calculations to be undertaken, however it is our belief that such near field effects to a large degree have been incorporated into the far-field modelling that has been undertaken to date. In the far-field modelling undertaken(CSIR, 2008), the effective dilutions indicated in the near field range between approximately 30 and 75 dilutions with a mean dilution of approximately 50 (*e.g*. Figure 3.22a in CSIR (2008)), suggesting that the stratification effects alluded to by the reviewers are to a large degree already included in the simulations. Where such "residual" stratification is likely to occur, the effects of turbulence due to waves, winds and tidal flows in eroding this layer will largely have been incorporated into the far-field model simulations. Preliminary engineering design simulations for the diffuser indicate that initial dilutions of > 50 will be met in the near-field, thus limiting the likelihood a significant stratified layer persisting for any period of time.

Near-field modelling

The CSIR has stated in the Section 4.2 on assumptions and limitations of the study, that ***the near-field was not subject to detailed modelling.*** Implementation of detailed near-field modelling requires a detailed rather than a conceptual design of the discharge structures (*i.e.* alternatives such as an open channel of single/multi-port diffuser outfall) that were not available at the time of the assessment. As it was intended that the study inform which of the discharge locations and structures is environmentally acceptable or preferable, the modelling study was based on broad conceptual discharge designs that parameterised the near-field behaviour of the plume. In this regard, a fairly conservative near-field behaviour was assumed for the various discharges, *i.e.* the brine was assumed to be confined to the near bottom layers whereas in reality this is unlikely to be the case for a well designed diffuser. The approach taken in the study was to assume that the brine was confined to the bottom 0.5 to 0.7 m of the water column for the shallow discharge Sites 1 and 2 (see Table 7.3 in CSIR, 2007). In the deeper sites, Sites 3a, 3b and 3c, the brine was assumed to be confined to the bottom 2 to 3 m of the water column. (As noted above, preliminary engineering design simulations have indicated that such assumed near-field behaviour is reasonable.).

The CSIR believes the approach to be conservative. This is alluded to by the reviewers who suggest that the modelling results for a discharge at Caisson 3 are sufficiently conservative for the advantages of this discharge site to be fully appreciated. This being said, near-field models are not necessarily conservative in that most assume that a dilution of effluent occurs with "clean" ambient waters. In the reality this is unlikely to be the case. For this reason the CSIR focussed on the more conservative approach of using a far-field model (see pg 40 of CSIR, 2007).

The CSIR also has made the recommendation that a conceptual near-field design be included in the study to confirm that the assumed near-field behaviour and near-field dilutions of > 50 dilutions can be achieved. We thus concur with the reviewer's recommendation regarding near-field design. It is also our understanding that Transnet Capital Projects has accepted this recommendation and modelling of near-field diffuser dynamics is presently underway to ensure that the recommended near-field dilution of > 50 will be achieved.

2. Review by Anchor Consultants

Consideration of alternatives

The reviewer has expressed the opinion that, given the sensitivity of the Saldanha Bay ecosystems and proposed future development pressures, **other alternatives** close to the proposed RO Plant should have been considered in more detail. Such a broader consideration of options was not part of the Terms of Reference for the CSIR specialist marine study and thus were not be considered although these issues are addressed in the overall Basic Assessment Report. It was understood that the screening of broader options would be the responsibility of the project proponent and the EIA practioners undertaking the EIA. However, it should be noted that any additional costs or technical challenges taken on by selecting any of these other options would need to be warranted in terms of the potential impacts of any of the existing options being considered sub-optimal as well as whether potential reduction of impacts achieved by selecting any of these other proposed options would warrant the technical risks and costs of such an option.

Methods, finding and assessment of impacts

The reviewer indicates that he is not satisfied that the synergistic effects of the effluent have been robustly assessed. He supports our recommendation that toxicity testing be undertaken when the RO Plant is commissioned. He however recommends that toxicity testing be undertaken before the design and construction of the plant by using a simulated effluent. Given the challenges in obtaining an emissions inventory for the plant for the assessment and the difficulty in specifying a "typical" RO Plant discharge, it was not possible to undertake such toxicity testing at the time that the marine impact assessment was undertaken. It is acknowledged that such toxicity testing, if possible, would result in a much more robust assessment of potential synergistic effects. Were such toxicity testing undertaken, it would be possible to undertake a re-analysis of existing model results to assess potential toxicity impacts if this were required. We would recommend that if it is possible to develop a sufficiently robust effluent sample that such toxicity texting indeed be undertaken. However it is our understanding that such toxicity testing in most cases is only undertaken after the commissioning of an RO Plant or a pilot RO Plant.

Toxicity Testing

Discussions with Transnet Project has confirmed that it is their intention to proceed with the recommended toxicity testing of simulated effluents concurrent with the final design and construction of the RO Plant. Fairly extensive discussions have been had over the design and execution of such toxicity tests and the need to expedite their execution. The design and/or operation of the RO Plant will need to take due cognisance of the outcomes of the toxicity testing

Transnet Projects have committed to ensuring that the DBNPA concentrations at the diffuser (i.e. point of discharge) remain below 1.15 mg/l. An assumed 33 times dilution of this effluent will ensure that the most conservative water quality guideline identified by the CSIR of 0.035 mg/l is not exceeded beyond this dilution contour. Recent communication from the Transnet Projects engineering design team (email of 12 August 2008) is that for their proposed shock dosing regime, for the present design the maximum DBNPA concentration is likely to be 0.61 mg/l. This provide some leeway for "tweaking" the system to deal with unexpected problems that may cause fouling of the membranes once production starts. This is important because the exact dosing regime will depend on the local conditions that will only be known once operation starts.

The reviewer's concerns around potential mitigation effects are not necessarily valid. Sizing of the brine basin remains a valid option for minimising discharge concentration of biocides. The use of NaOCl remains an option despite issues around potential damage of the RO membranes, however it could prove costly as well as increase the risk of other environmental impacts associated with the use of sodium metabisulphate for de-chlorination. Transnet Capital Projects has indicated a number of mitigation measures (*e.g*. sizing of the brine basin, *etc*). If the concentration of the biocide is too high at the discharge, Transnet Capital Projects have indicated that that the following mitigation is possible:

- The concentration of the brine may be decreased by pumping additional sea water from an additional borehole into the brine sump. This will require additional intake wells and larger brine discharge pumps.
- Chlorine can be used as a biocide but it will need to be neutralised with SMBS to avoid damage to the membranes. This may mean that the brine needs to be re-oxygenated before discharge due to the oxygen scavenging effects of Sodium Metabisulfate.
- The effluent dilution could be increased by installing additional discharge diffusers at other caissons. Sodium Metabisufate can be used to neutralise DBNPA but it will also require reoxygenation of the water.

The above solutions are all practical solutions but each will require additional costs and/or additional processes to the plant.

The reviewer is correct in noting that no thresholds were identified in terms of changes in subtidal biota and neither were specific mitigation measures defined that would need to be invoked were such thresholds to be exceeded. In principle such detail would normally be contained in a well-designed Environmental Monitoring Plan. While we believe that it was our brief to assess environmental impacts and provide feasible mitigation measures, the development of detailed thresholds and required responses to the extent suggested by the reviewer we consider to be beyond the brief of a Basic Assessment specialist report, but nevertheless the next logical step in the process. The development of a detailed EMP espousing all possible thresholds and associated detailed monitirong surveys, *etc* will require significant effort. CSIR (2007) contains sufficient information to provide the basis for the development of such a detailed EMP.

In the specialist reports we indicated water quality thresholds of relevance. We indicated areas of potential concern and appropriate mitigation measures. The proposed toxicity testing would provide an overall toxicity threshold that could be incorporated into the monitoring programme (*e.g.* the exact dilutions of the effluent that would be needed to ensure minimal environmental impacts) and will be used to guide the need and extent to which mitigation measures need to be invoked. Furthermore, broad parameters around the survey and monitoring of subtidal benthic communities are given on pg 175 of CSIR (2007). In principle such surveys would be assessing whether there is a statistically significant impact on, for example the abundance, biomass and diversity, compared to a control site.

Transnet Capital Projects has indicated that such detailed environmental management procedures (EMP's) will be developed for both the construction and operational phases of the project and has committed to the full execution of accepted EMP's. The Port of Saldanha Bay has an ISO14001 accredited EMS under which operational working procedures will be developed for the RO Plant that will detail the proposed monitoring programme. Furthermore there has been a commitment by Transnet Project (telecon 24 August 2008) to involve, to the extent appropriate, relevant specialists in the development of these operational working procedures and associated monitoring activities that will include specific thresholds of concern where appropriate and actions that will need to be taken should any of these thresholds be exceeded.

Adressing of I&AP concerns

The reviewer is satisfied that all I&AP comments have been addressed except for the issue of alternatives. The consideration of alternatives other than those provided to the specialist assessment team were excluded from the Terms of Reference for the Marine Impacts Assessment Study.

Consideration of potential future developments

The model results (Appendix C of CSIR, 2007) clearly indicate potential future developments in the bay (Phase 2A and 2B expansion of the iron-ore expansion of export facilities). The concerns around ***pooling of the brine in the proposed new deeply dredged area*** is only likely for discharge Site 3b and possibly Site 3 – Caisson 3 (the preferred site). The brine will indeed be dispersed to a greater or lesser extent by propeller wash in these deeper dredged areas (e.g. presently there exists a scour hole from ship manoeuvring near the Site 3 – Caisson 3 discharge location). The results for option 3a provide some insight into the extent of pooling of effluent that may occur. These results suggest that while it may increase the footprint somewhat at Caisson 3, the approach taken to assessing impacts at the Caisson 3 discharge site are already somewhat conservative. The only manner of quantitatively assessing such a potential impact would be to assess the preferred discharge site under the proposed new dredge channel configurations, however not clear that the results indicate such a study would be warranted, especially as preliminary detailed near-field modelling for the engineering design of the diffuser indicate that > 50 time dilutions can reasonably be expected beyond a nominal 50 m radius of the discharge. Under such circumstances the development of a persistent dense brine layer extending into the proposed new dredge channels is unlikely. Should such a brine layer enter the newly proposed dredge channels, local flushing and mixing effects should limit its persistence to short time periods.

Additional Minor comments

All reported units are now consistent. Other minor corrections have been made.

This letter comprises a formal response to all comments received from the reviewers. I expect that this brings closure/finalisation to this report. Feel free to contact me should you have any queries.

Yours sincerely

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