South Australian Murray Darling Basin NRM Board

Coorong Temporary Pumping Review

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August 2009
Ref No 20090924RA1

ADELAIDE
TONKIN CONSULTING
ABN 99 630 962 951
Level 2, 66 Rundle Street
Kent Town SA 5067
T +61 8 8273 3100
F +61 8 8273 3110
adelaide@tonkin.com.au

MOUNT GAMBIER
TONKIN CONSULTING
1 Krummel Street
PO Box 1192
Mount Gambier SA 5290
T +61 8 8723 5002
F +61 8 8723 5004
mtgambier@tonkin.com.au

BERRI
TONKIN CONSULTING
27 Vaughan Terrace
PO Box 2243
Berri SA 5343
T +61 8 8723 5002
F +61 8 8723 5004
berri@tonkin.com.au

DARWIN
TONKIN CONSULTING
Unit 33, 16 Charlton Court
Woolner NT 0820
T +61 8 8981 7155
F +61 8 8981 7455
darwin@tonkin.com.au

PERTH
TONKIN CONSULTING
PO Box 426
Mount Lawley WA 6929
T +61 8 9473 0184
perth@tonkin.com.au

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Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Preliminary Draft for comment	DJR/TG/IF	GCD/JT		31 August 2009

1 Introduction

This report continues and develops further earlier work presented in the Aurecon Australia Pty Ltd Draft Report "Data Collation, Review and Preliminary Hydrodynamic Modelling Coorong Temporary Saline Water Discharge SA Murray Darling Basin NRM Board July 2009 to review and verify the cost estimates associated with pumping saline water from the Southern Coorong across the nearby sand hills into the sea.

The main aims of this report are to:

- Review and independently verify the budget cost estimates provided for the barge mounted pumping options of 150ML/D and 250ML/D for 18-36months and 450LM/D for 3 to 4months for the preferred location and pipe route nominated by the SA MDB NRM Board. We compare these cost outcomes with those provided in Section 4.4 of the Aurecon Report for the nominated pipeline materials.
- Prepare a budget estimate for the ocean outfall option described in the Aurecon Report that is preferred by SA MDB NRM Board.

Make recommendations for an optimized pipeline size, material and pump arrangement for the continuous and intermittent pumping options described above assuming an 18month to three year pumping cycle.

For the purposes of this report it is assumed the pumping exercise once completed may be repeated at some future time.

2 Summary

Outcomes of the work are as follows:

- A review of the Site information described in the earlier project correspondence (Appendix A) suggests that the actual piping route from the Barge to the beach would be approximately 1200m longer than previously indicated. In addition, the change in elevation for pumping may be as high as 27m due to the actual height of the sand dunes along the chosen pipe route. This would need to be confirmed by survey. As a result the total hydraulic head for pumping will be approx. 40-42m depending upon the final pipe route and maximum elevation. This is approx.100% more than the pumping head indicated in Appendix A.
- For cost comparison purposes, it has been assumed the total volume pumped for 150ML/D and 250ML/D would be the same at 137GL. ie. The 250ML/D option operating for 18months.
- The availability of long lead items will affect the overall project timing. At this stage purpose selected pumps and electrical transformers are typically on 12-13 month delivery. While it is conceivable pumping equipment could be hired within this time frame, supply of purpose built transformers would remain on extended delivery.
- For the work done to date the cost per ML pumped is approx. 20% cheaper for the 150ML/D option over a longer pumping period over that for the 250ML/D option based on the assumptions and exclusions noted in Appendix C. This situation may change when operational costs over a longer period are factored in.

3 Pumping Options Considered

3.1 Site

The location of the Site and the basic option considered is based upon the e-mail's of 21 July 2009 and the Sketch shown therein. Refer to Appendix A.

For the purposes of this report the nominated location and an indicative "straight line" route representing the power cable from the land to the Barge, then a nominal pipe route from the Barge to the sea is shown in Appendix B, Sk-01.

With reference to Sk-01 it is noted that:

1) The assumed distance from the Barge (in a deeper section of water) and the nominated location for the land based equipment (shown as AB on Sk-01) is approximately 1450m. For estimation purposes 10% contingency is added to make provision for actual conditions to give approximately 1600m. This represents the cable length from the Gensets on the shore to the Barge and is consistent with the sketch provided in Appendix A.
2) The straight line distance BC from the Barge to the sea is approximately 2450m. Again for estimation purposes 10% contingency is added to provide some allowance for the actual route and change in elevation to give an overall length of approximately 2700m. This distance is 1200m longer than that shown in the original sketch provided in Appendix A and represents an 80% increase in pipe run length.
3) The nominal pipe route passes across the sand dunes (in plan) for approximately 600m along the line BC. While the actual height of the installed pipeline/s would be determined following a detailed Surveyors survey, indications are that actual current sand dune height could reach as much as 30m. For the purpose of this report it has been assumed the maximum height of the installed pipeline is 25m with a further 2m lift to the pump centreline on the Barge, thus giving 27m maximum change in height for pump selection purposes.

   Importantly, the total pumping head required will be in excess of this figure when hydraulic losses are added for the 2700m of pipeline required. The actual total pumping head required will likely be well in excess of the 20m specified in Appendix A and will have a significant influence on the pumping options available within the required project timeline.

3.2 Pumping Options

Two fundamental pumping régimes have been considered. These are 150ML/Day and 250ML/Day.

A generalised process diagram covering both these options has been developed which describes the pumping and control equipment envisaged at this point. Refer to Appendix B, Sk-02.

Consider the following scenarios.

After 18months (548 days assumed) 137GL would have been pumped at 250ML/D.

Similarly, after 18months 82.2GL would have been pumped at 150ML/D.

Further, it takes approx. 913 days (or 2 ½ years) to pump the same quantity (137GL) at 150ML/D.

Given this cost comparisons have therefore been done on pumping 137GL in total for each scenario (assuming 100% system availability). That is the 250ML/D option operates for 18months, while the 150ML/D operates for 2 ½ years to pump the same volume of water.

For the purposes of this work it has been assumed that neither of these pumping rates produce problems at the pump suction/s due to sand movement and pickup. This should be considered as part of any subsequent detailed design.

The 450ML/D option would require the system to operate for 304days to pump 137GL. Although there would be some economies of scale, this option has not been fully developed as it would be typically twice as expensive as the options described above.

3.3 Process Design

Refer to Sk-02.

The estimate for each flow régime assumes a number of pumps "N" are mounted on a suitably sized Barge to give the require flow. Each pump assembly includes the following equipment:

- Course Suction Strainer – To prevent large items being sucked into the pumps
- Suction line sized to suit the pump .Eccentric reducers would be fitted as necessary.

  Note: It is assumed a stand alone priming unit would be connected to each suction line to ensure the pumps are primed prior to starting.

  Note: Further pumping options would be explored prior to procurement once the geometry of the actual Barge used and associated suction piping geometry and lift are confirmed.
- The pump and motor sets would be mounted upon suitable steelwork skid on the Barge.
- The delivery line for each pump would include a Non Return Valve, Pressure Indicator/transmitter, Flow Switch and Manual Isolation Valve. In addition a smaller bore start up line complete with NRV and actuated valve would be provided. These items provide basic start / stop and control of each pump. Refer to Section 3.4 for the control philosophy envisaged.

It is envisaged the delivery piping would consist of a common large bore header and a number of pipelines running from the Barge to the Outlet structure.

The size and number of pipelines would be optimised as part of a detailed engineering stage. Factors affecting this are:

- The fundamental material selected. At this point it is assumed HDPE conforming to AS4130 would be used.
- The prevailing Site conditions. ie. The need to run the pipeline across the water, then through the sand dunes, then connect to the outlet structure.
- The cost / hydraulic benefit of the different pipe configuration options.
- The requirement that certain sections would need to be removed and stored for future use should the pumping need to be repeated in the future. It is assumed this is the case for all piping except that which can be buried across the sand dunes up to the discharge structure.
- The availability and constructability of the various pipeline pumping options.

At this point it is assumed that flow measurement is not required. This however could be included if required.

3.4 Control Philosophy

It is assumed operation would be as follows:

- Pumps would be able to be started and stopped on the Barge, but also on the land from a control cabinet at the Genset Compound (or other convenient location). Basic monitoring and communications would be provided in both locations.
- Each pump would be primed with a common stand alone priming unit connected to the suction line prior to start.
- A small priming pump would prime the delivery mains, establishing flow prior to start up.
- Start up of each pump via the small bore AV valve, then opening the main AV valve.
- It is envisaged there would be no stand-by capacity (although this could be provided).ie For example 150ML/day would be supplied using 3 x 50ML/Day pumps. Should one fail, capacity is reduced to 100ML/day until the pump with the problem is repaired and brought back on line.
- Critical alarms would be transmitted using an RTU to shore, with an appropriate mobile dial up facility for out of hours monitoring. NB- this could be managed with the out of hours monitoring for the power plant.
- Pumps would shut down in a controlled fashion should there be faults with the power supply or any other critical alarm.

3.5 Equipment being Re-used

For the purposes of this report it has been assumed:

3.5.1 Barge

- Sections are hired for the duration then decommissioned.

3.5.2 Pumps

Several options are considered:

- Option 1 – Purpose selected pumps are procured and installed, then decommissioned, overhauled, mothballed and stored for future use.

  Note These pumps would be procured based on the process conditions, electrical power constraints and operating conditions. "Premium" brands would be on extended delivery of typically 52-54 weeks (normal sea freight). These pumps offer high reliability, are made from selected corrosion resistant materials and have a design life of 20 years.

  Other "non premium" brands are also available at a cheaper price but with tradeoffs in reliability and design life.

- Option 2 – Suitable Hire pumps are found and used on a one off basis.

  Note This option is problematic in firstly finding appropriate pumps for the required duty and electrical power requirements, being available at the right time, and for the required duration.

There would additionally be a question mark over pumping efficiency and reliability of such pumps, particularly in comparison to those pumps supplied under option 1 above.

If however suitable pumps were found, they offer the advantage of being able to be simply returned to their owner at the conclusion of the pumping period.

- Option 3 – Suitable Hire pumps are found and used on a one off basis for a short time until the purpose selected pumps can be procured and installed.

3.6 Project Timing

One factor that has a major effect upon the costing outcome is the proposed timing from when pumping is to commence. This is important given that the "normal" lead times for certain critical items can be up to 12-13 months delivery.

Procured long lead items include purpose selected pumps and the system transformers.

While it may be possible to use hired pumps (although availability, materials of construction and pump efficiency may be uncertain), procurement of suitable transformers are fundamental to the operation and at this point the critical lead item.

4 Electrical

4.1 General

It has been assumed that the supply would consist of:

- Diesel storage and supply, including offloading capability
- Multiple standalone 415V gensets, synchronised
- Transformer positioned with the gensets to provide 11Kv
- HV cable onto the Barge
- Switchgear and Transformer positioned on the Barge to provide 415V
- Controls on the Barge, remote controls at the Gensets

Details as described below.

4.2 Design Basis

- Pumping requirement 3-5 pumps rated at 400-500kW each.
- Pump motors at 415V
- Generators on land
- Pumps on barge
- Distance 1600 metres
- Auxiliary LV power required at generators and on barge
- Facility has a relatively short life (36 months)
- Relative urgency in implementation of the project

4.3 Generation Facility

- 4 only diesel generators each rated at 1000kVA
- Generation voltage 415V
- Synchronisation at 415 V
- 2 of self bunded fuel tank, each 54,000 litres and associated pumping and pipe work
- LV switchgear supplied with generator
- Step up transformer 2 only 2000kVA, standard distribution type transformer 11000/415V
- HV switchboard Schneider RM6 panel (or similar)
- Comprising 2 off circuit breaker and 2 off isolator as
    - Isolator 1 for HV cable
    - Circuit breaker 1 for transformer 1
    - Isolator 2, for earthing transformer
    - Circuit breaker 2 for transformer 2
- Earthing transformer for HV. (3 off SWER transformers with LV windings connected in delta.
- HV Circuit rating 11000 volts, 209 amps, 3 phase

Note: At this stage the hire only option for the Gensets has been considered.

4.4 HV Cable

- Submerged
- Mining trailing type cable with flexible steel wire armour and waterproof serving
- Conductor Copper 120mm^2 EPR insulated and screened
- Type OLEX 450 with armour and CPE serving to type 412

Alternative
- Float cable on pontoons (as for sand mining)
- Mining trailing type cable with waterproof serving
- Conductor Copper 120mm^2 EPR insulated and screened
- Type OLEX 450 with CPE serving

4.5 Pumping Facility

- Pump controls at LV (415V)
- HV switchboard Schneider RM6
- 2 only transformer 11000/415V
- Comprising 2 off circuit breaker and 2 off isolator as

4.6 Isolator 1 for HV cable

  - Circuit breaker 1 for transformer 1
  - Isolator 2, for auxiliary transformer
  - Circuit breaker 2 for transformer 2
- LV switchboard comprising
  - 2 LV circuit breakers for transformers
  - 3-5 motor starters type DOL
- Auxiliary transformer with HV fuse
- Small power switchboard
- General light and power to barge

4.7 Implementation

- Leased/hired
  - Generators
  - Fuel tanks
  - Fuel system
  - LV cables from generators

- Purchased
  - Transformers
  - LV switchgear
  - Motor starters
  - HV switchgear
  - HV cable (1600 metres)
  - LV cable not part of generators

5 Pumping Equipment

Further to Option 1 of Clause 3.5.2, quotations for purpose selected pumps based on preliminary pumping duties have been provided in Appendix D.

For the 150ML/D option, three 50ML/D pumps are included in the cost estimates. Similarly four 62.5ML/D pumps are included for the 250ML/D option.

It should be noted that these combination of pumps have been nominated to ensure they will operate with a 415V power supply. At this point it is thought 415V transformers and switchgear will be more readily available over other HV options. There is however an associated limitation on pump power, hence pumps in the 50-62.5 ML/D range.

As noted earlier one disadvantage of purpose selected pumps are their extended delivery. Other options are possible with trade-offs in performance, reliability and design life, however this can be clarified once a programme is confirmed in light of the overall project objectives and the confirmed delivery of other long lead items.

Pump duties would be confirmed once the piping route and sizing configuration are locked in.

6 Piping

6.1 Pipe Size

A summary of the likely pipe sizes that could be used for the two pumping regimes is given in Appendix E, Table E1.

While the PN rating would be determined as part of the detailed design, the number of pipes for various likely pipe sizes from the Barge to the sea is estimated in the first instance to ensure fluid velocity is kept within reasonable limits.

Some indicative supply only costs are provided for reference.

Possible pipe combinations are:

150ML/D

1) 3 (three) off x 630mm OD pipes, or
2) 2 (two) off x 800mm OD pipes, and

250ML/D

1) 5 (five) off x 630OD pipes, or
2) 3 (three) off x 800OD pipes, and

Note the outlet geometry shown in Appendix 2, Sk-03 reflects the second option for 250ML/D, but could equally be suited to five smaller pipes if other factors dictated this.

6.2 Construction Related Issues

Assumptions made relating to the piping costing are:

- The larger pipe sizes of 1000mm OD and above are considered unlikely to be used for the pipe from the barge to the sea due to additional difficulty in fabricating, handling and installing them.
- The sections of pipe through the sand hills would, for the most part be installed underground and remain in place after the initial pumping period.
- The sections of pipe from the Barge to the sand hills would need to be removable and re-useable following the first pumping period. It would therefore need to be flanged in manageable lengths. It is assumed these flanges would be installed at 48m centres, ie. 4 x 12m pipe lengths.

7 Outfall Design

7.1 Background

The report produced by Aurecon recommended two general concept designs for the discharge, the first being an outlet at the back of the beach with a scour protection apron, the other being a discharge into the surf zone.

Construction cost estimates of both options were approximated in the report to be $4.5M for the back of beach outlet, and $3.5M - $4.0M for the discharge into the surf zone option. This section of the report will investigate the validity of these cost estimates and also discuss alternative construction options for the proposed back of beach outlet design.

The initial design for the outlet at the back of beach as shown in Appendix C of the report recommends the use of 4x1tonne Rocla A-Jack bundles to form a scour protection apron from the outlet, spanning the beach, and down to a level which has been assumed to be the mean high water level. The design also recommended the use of 8x1 tonne A-Jack bundles strategically placed at the outlet of the pipe to reduce the flow velocity.

The layer of 4x1 tonne A-Jack bundles is to be constructed on top of a 0.8m thick layer of 100-150kg rock, which is to be under-laid by an 800gsm geotextile layer.

7.2 Construction Issues

7.2.1 Site Access

The main issue with construction of this structure is the remote nature of the site and the restricted access currently available. All machinery and materials will need to be transported or travel across the Coorong, at Parnka Point, approximately 16km North of the proposed pipe outlet site nominated by Aurecon. Refer to Figure No.1. This position has been identified as this is the narrowest point of the Coorong with tracks on either side. We expect a barge will be used to carry machinery and material from one side to the other.

Both the existing tracks from the Princes Highway to Parnka Point, and the track from the Southern side of Parnka Point to the beach, are unsuitable for heavy traffic in their current form. Therefore these tracks will need to be upgraded to allow construction to take place.

Furthermore the timing of the works will be dependent on seasonal weather conditions.

7.2.2 Materials and Machinery

As well as the Rocla A-Jack units and rock used to form the scour protection apron, a geotextile will be required to line the apron. To construct the structure we have assumed 30 tonne dump trucks will be required to cart all materials to the site and 20 tonne excavators will be required to load the trucks and construct the structure. A dozer and a grader will be used to prepare the access tracks to allow heavy vehicle access to both Parnka Point and the beach.

It is proposed to travel across the Coorong water body via a barge. It is assumed that sufficient water depths exist to enable loaded dump trucks to pass.

7.2.3 Methodology

Before construction can take place the existing tracks will require widening and the installation of a rubble layer will need to be constructed. A five metre wide track will be cleared using a dozer and the rubble will be laid and compacted on this track. A grader will be used between the Princes Highway and Parnka Point to maintain the track condition. A dozer will be used to grade the track across the sand hills on the southern side of the Coorong.

Standard semi tippers will transport the material to the northern side of the Parnka Point where an excavator will place the material onto a waiting 30 tonne dump truck. These will be transported to the southern side of the Coorong on the barge and the trucks will then travel approximately 16km along the beach to the pipe outlet A second 20 tonne excavator will unload and place the material for the structure. It is proposed four 30 tonne dump trucks will run simultaneously along the southern side of the Coorong to maximise the efficiency of the plant and equipment.

Following the construction of the scour protection apron we propose vehicle access across the beach be maintained using precast concrete culverts spanning the width of the apron.

An allowance has also been made to remove the apron structure at the completion of the pumping operation (approximately three years).

Figure No.1 – Proposed Beach Access Route

7.3 Alternative Design Option

Another option for the construction of the scour protection apron is the use of large rock armour instead of the A-Jack bundles. We believe this option may be a more viable option for a number of reasons.

- Rock of reasonable size (up to approximately one tonne) is available for delivery from Kingston SE, whereas the A-Jack units will need to be delivered from Adelaide;
- The placement of A-Jacks requires manual bundling adding to on site construction time, whereas using rock would be significantly shorter.

Considering the relatively short life requirement of the structure, we consider a rock armoured dissipation structure will provide a more cost effective measure of managing erosion of the beach.

7.4 Assumptions

To estimate the cost of construction the following assumptions have been made:-

- A round trip from Parnka Point to the pipe outlet and back, including dumping and loading times, is two hours. This includes barge transport time and travel time based on 35 km/h average speed along the beach;
- Rock material transported from Kingston at $80/tonne;
- A-Jacks units transported from Adelaide at $385/tonne;
- Machinery rates and material costs based on our experience in earthmoving within the region;
- The width of the apron to be constructed is 8.0m;
- The length of the apron to be constructed is 40.0m;
- 600 square metres of geofabric will be required for construction;
- Four concrete culverts will be installed across the apron to allow vehicle access;
- No allowance for any fees or charges associated with approvals;
- No costs associated with detailed design;
- No barge costs as this has been included elsewhere

7.5 Cost Estimate

Refer to Section 8.

8 Costing

Costing of the 150ML/D and 250ML/D options are provided in Appendix C together with a costing breakdown for two construction options for the ocean outfall.

As noted earlier cost comparisons are made on pumping the same total nominal volume of 137GL.

The cost outcomes are of a similar order of magnitude to previous estimates although in some cases pumping durations, methodologies and exclusions vary.

Further work can be done as required in include fuel costs as necessary.

Options to consider procurement of the Gensets can also be undertaken as required.

An alternative proposal for an alternative ocean outfall has been provided. This option appears to be more cost effective than that originally envisaged.

9 Discussion

While it is clear from the work undertaken to date that there is a viable engineering solution for the project, some further clarifications would need to be provided in terms of the special nature of the location that may impact the detailed design, construction methodology and final costing.

These clarifications would include any special environmental and construction constraints, the proposed philosophy of operation and support, timing and longevity.

Appendix A

Previous Correspondence

(Refer to the separate attachment)

Appendix B

Sketches

(Refer to the separate attachment)

Appendix C

Cost Estimates

(Refer to the separate attachment)

Appendix D

Quotations

(Refer to the separate attachment)

Appendix E

Pipe Data

(Refer to the separate attachment)