Appendix 5

Water Pipeline Report – Darling Irrigation

(Total No. of pages including blank pages = 44)

Note 1: Reference to costing has been blacked out to maintain Commercial-in-Confidence information.

Note 2: Since completion of this report, the alignment of the pipeline has been modified slightly. This does not alter the analysis or conclusions presented in this report.

This page has intentionally been left blank

DARLING irrigation
making every drop count

Dubbo Zirconia Project Concept Plan

Pressurised Supply Pipeline and River Pump Station

Prepared by Sam Maroulis

for Australian Zirconia Ltd

January 2013

Table of Contents

Objectives 2
Pump Station 3
Option 1 and 2: 22 hour pumping day – low and high head 8
Option 3 and 4: 9 hour Pumping Day (Off peak pumping only) – low and high head 10
Pipeline 12
Option 1 and 2: Pipeline - 22 hour Pumping Window – low & high head 13
Option 3 and 4 Pipeline - 9 hour Pumping Window – low and high head 15
Economic Analysis 17
Summary of infrastructure costs 17
Economic Analysis using Mine Tariffs 18
Economic Analysis using Commercial Tarrifs 19
Summary 20
Appendix A: Macquarie River Profile Survey 22
Appendix B: Diagram of a Wet Well configuration 24
Appendix C: MWH Consultants Report Pump Design 25
Appendix D: Batescrew Pump and Valve specifications 28
Appendix E: Fish Screening and Diversion Infrastructure 31
Appendix F: Proposed Water Pipeline Route 34
Appendix G: Pipeline Design Data to determine head 36
Appendix H: Australian Standard, AS/NZ 2566.2:2002 Buried Flexible Pipelines – Installation 40
Appendix I: Pipe Laying Profile 41

Objectives

The objective of this report is the concept design of a pipeline and pump station from 'Mia Mia' on the Macquarie River to the Dubbo Zirconia Project site at Toongi, supplying 5000Ml/pa. This report includes;

- an hydraulic analysis
- recommendation on pipe material, size, class
- annual overview of energy and maintenance costs of the pipeline and pumping system
- preliminary landholder consultation to identify potential concerns/landholder desires
- sizing of pump motor to check adequacy of existing transformer
- incorporation of adequate contingency in case of pump failure
- consideration of noise levels from the pump station in relation to nearby residents
- best practice intake structures including fish protection.

This report will **not** include

- documents ready for tender
- installation specifications
- provision for regulatory approvals for the construction of the pipeline and pump station.

Pump Station

A meeting with Matt Clatworthy on 13th November 2012 was used to determine land holder concerns and priorities and discuss potential pump site locations. This meeting ascertained the current position of the pump site is the most suitable from a river profile perspective and a power supply perspective as;

- the river silts up regularly or is shallow either side of the existing site
- the power supply comes from a spur line to this site
- access is good both in normal times and during times of high river levels.

Matt was very specific in his wish to minimise the visual and noise impact of the pump station. Matt and his family use the area immediately downstream of the pump site for social functions, including weddings as it has great aesthetic appeal. Matt and his wife are considering developing this area further for functions and events. With respect to the pipe route he expressed concern over the access across any easement. His wishes were for continued farming access across the pipe route and minimal disruption to his current farming and grazing activities.

Matt also pointed out the level of the Dec 2010 floods. This level was related back to a river height and used to then plot the 1:100 river height.

A survey of the river profile was carried out at the existing river pump site at "Mia Mia" to the centre of the river channel. This is attached in Appendix A.

Alex Ryan (Australian Zirconia Ltd) provided detailed energy plan and costs, and requested analysis be done on a solution that included only off peak power consumption. In addition to this two other options were analysed, described under the 22 hour pumping window as 'Low Head Option' and 'High Head Option'. The purpose of this is to quantify the sensitivity of energy pricing as it relates to total operating head in a pump station compared to capital cost of a system.

In all analysis, a **20 year project lifespan** was assumed.

River Pump Selection

The 4 main pump types considered, included;

1. ISO Centrifugal Pumps
2. Turbine / Axial flow pumps vertical and angle configurations
3. Multistage Submersible Pumps
4. Multistage Sump Pumps

Design criteria for pump type selection;

1. Efficient duty point for required application
2. Solution with high degree of reliability and a strong contingency in the case of equipment failure
3. Ease of maintenance and efficient ongoing operating costs
4. Environmentally sound design specification of pump station including protection for fish / aquatic life
5. Minimal sound and visual emissions for local landholders and recreational river users
6. Cost effective design solution

Contingency for Water Flow

The incorporation of a standby pump is the greatest form of contingency for the security of flow. In each option there is a single standby pump considered. In options one and two, this standby pump is capable of delivering the full duty; there is also an additional 2 hours per day pump time contingency in options one and two. The standby pump in options three and four is capable of delivering only half the flow. However, there is 14 hours per day pump time contingency to compensate for this.

A **vertically mounted axial flow pump** best satisfies the above criteria as;

- fitted with Johnson screens it is the most appropriate solution for minimising disturbance to aquatic biodiversity.
- this solution will minimise the visual impact of the pump site
- the motors can be installed above 1:100 year flood height
- the motors can be housed inside a small enclosure which can be clad to minimise any acoustic emissions.
- no infrastructure will be visible in the water or up the river bank.

For conceptual purposes, Batescrew pumps were considered, although there are various brands suitable for this application.

A cross section of the river was surveyed by boat and staff. The results of this are contained in Appendix A. The current water level was expressed in terms of RL. A low water level was determined using historical data from the nearest weir, and comparing to the current water levels. The lowest water level recorded in the past 20 years was 1.5m below the reading on the day of the river survey. This was deemed sufficiently accurate for the purpose of the concept plan. There is 4.0m of elevation from the start of the pipeline to the end point at the processing plant. Therefore the total head on the pump is made up of elevation from 'normal' water level 272m to processing plant 286m, plus friction losses in pipe system. Any pump system must be designed to cater for low water level, an additional 1.5m in elevation lift.

Johnson Screens will screen inlet water into the wet well installation. The wet well would be fed by a horizontal suction line minimum diameter 600mm. The wet well would be a nominal diameter of 800mm -1200mm to facilitate ease of pump removal. The wet end of the pump is a 362mm diameter in this case.

The top of the discharge head of the pump would be mounted at 1:100 year flood height and the motor mounted on top of this. The top of the wet well and motor would be enclosed in a small building, insulated for heat and acoustic protection. This shed would also contain the variable speed motor controller. The motors can be completely independent or programmed to alternate start. The diagram in Appendix 2 illustrates a typical well installation of this nature.

For the purpose of this report the standby pumpset is a replica of the duty pumpset with a single shedded enclosure and separate wells. It may prove more cost effective to install the duty pump and standby pump together in a single larger well.

NOTE1 The nature of the site is that there are a number of large trees in the vicinity of the pump station installation, on and near the river bank. The depth of cut to install a wet well is approaching 9.0m and therefore benching and shoring will be required. It may prove more practical to bore the suction line from the well into the river to eliminate the requirement for a large excavation, in this case the wet well may need to be large enough to contain a boring machine.*

Two flow rates were analysed for this report. The first is 174l/s, this will deliver 5000Ml pa based on a 22 hour pumping day and 365 days per year.
The second of 425l/s represents pumping time aligned with off peak power usage only or a 9 hour pumping window at 365 days per year.

NOTE2 The operating head analysed for this report assumes 'normal river levels', which will be the most common scenario. However pump design must incorporate the capacity of the river pump to pump the required flow rate at an additional 1.5m head to account for periods of low level in the river.*

Pump Operating Costs – Mine Tariffs

Item	Energy c/kWh	Market c/kWh	Network c/kWh	Network Demand $/kVA	Fixed $/day
Peak	8.80 (1pm-8pm w/d)		5.1099	5.0811	
Shoulder	8.80 (7am-1pm & 8pm-10pm w/d) (7am-10pm w/e)		3.0344	3.0344	
Off-Peak	5.50 (10pm-7am daily)		2.5360	1.4438	
Total energy		1.5995			[redacted]

Data provided by Alex Ryan (Australian Zirconia Ltd)

Note: Fixed costs including Network demand $/kVA were not considered in economic analysis as they are not variable with energy consumption

Energy supply options

In consultation with Kevin Rugg of *Energy Serve*, the energy supply options for this project are summarised as follows;

1. Construction of a main power line from mine site to Macquarie river, at the expense of Australian Zirconia Ltd. This is included in the capital costs when undertaking the

economic analysis, and estimated at [redacted] In this case the above rates are applicable

2. Draw power from the existing Essential Energy Network to the Macquarie river pump site. This would trigger a new set of tariffs typically as below;

   For the purpose of this report, 'commercial' rates of energy were used.

(reference: NSW Electricity Small Business Essential Energy Standard Published Rates)

   Both options utilising 22 hours pumping are 'probable' without the necessity of a mainline upgrade. It is apparent that rates superior to $0.10/KWh off peak, and $0.19/KWh shoulder and peak are necessary to forgo the pricing advantage of the mine site even with $250,000 added to capital costing to construct a mainline from the mine to the river

3. Upgrade the existing Essential Energy Network to facilitate 9 hour pumping ability. Any costs from Essential Energy are unknown. The tariffs would be as in above option

Budget Costing Pump Station

Major components are priced as of the pricing current at time of writing with allowance made for contractor's margin.

Brands used in budget pricing include;

- Batescrew (14MB turbine pump)
- ABB
- WEG motors
- Iplex Pipelines
- Humes
- Ranbuild

Screens, flanged adaptors, 2 x 1200mm wet well, including support frame at top		
Pump Enclosure A Hebel Panel or Coolroom style cladding of a room with approximate dimensions to cover 2 wet wells next to each other with approximate dimensions 5.0m x 6.0m. Included is an allowance for concreting and foundation slab. The roof is removable to allow a crane easy access to the pumps in order to remove for maintenance purposes.	[redacted]	[redacted]
Installation Installation price includes allowance for coffer dam construction in river, benched and shored excavation for installation of two wet wells, crane hire, 2 X column, pump, motor installation, fabrication work, and rehabilitation of site.	[redacted]	[redacted]

Commissioning Flushing and pressure testing pumps, setting controllers	[redacted]	[redacted]
Contingency Allow 15% contingency for fluctuating pump pricing, variability of earthworks pricing & methodology.	[redacted]	[redacted]
Total (ex GST)	[redacted]	[redacted]

Option 3 and 4: 9 hour Pumping Day (Off peak pumping only) – low and high head

	Low Head Option	High Head Option
	Budget Price (ex GST)	
Pumps Turbine system with pump flow at 425l/s. Low head option duty is 36.6m. This will be achieved with 2 duty pumps and 1 standby pump, 2 stage at 1500rpm, each pump coupled to 150KW WEG motors, system drawing 200KW at full load. High head option with a total head of 54.3m. Installation will be two x 3 stage duty pumps and one standby pump. These pumps will spin at 1500rpm operating at 82% wet end efficiency. Pumps coupled to 2 x 185 KW WEG motors. The pump is a three stage turbine, water lubed, The motors will draw 300KW at full load.	[redacted]	[redacted]
Pump Controller Motor Control will be via a Variable Speed Drive. Three drives will be installed two duty and one standby, offering contingency and security of water. ABB general purpose drives are ideal in those situations where there is a need for simplicity to install, commission and use and where customizing or special product engineering is not required. The drives include several features as standard, such as swinging choke, EMC filter and control panel. These drives are energy efficient and designed to minimise noise emissions in conjunction with the WEG motors	[redacted]	[redacted]
Power supply and Electricals Allowance for 500KVA transformer is required for both these pumping options. Allowance is made for CT metering and switches, and lead in to the pump enclosure. No allowance is made for replacement of power pole No allowance or investigation made for necessity	[redacted]	[redacted]

of mainline upgrade in this case		
Sump and Wet Well Assuming 2 X 600mm suction, Johnson Screens, flanged adaptors, 1200mm wet well, including support frame at top	[redacted]	[redacted]
Pump Enclosure A Hebel Panel or Coolroom style cladding of a room with approximate dimensions to cover 2 wet wells next to each other with approximate dimensions 8.0m x 6.0m. Included an allowance for concreting and foundation slab. The roof is removable to allow a crane easy access to the pumps in order to remove for maintenance purposes.	[redacted]	[redacted]
Installation Installation price includes allowance for coffer dam construction in river, benched and shored excavation for installation of two wet wells, crane hire, 2 X column, pump, motor installation, fabrication work, and rehabilitation of site.	[redacted]	[redacted]
Commissioning Flushing and pressure testing pumps, setting controllers	[redacted]	[redacted]
Contingency Allow 15% contingency for fluctuating pump pricing, variability of earthworks pricing and methodology.	[redacted]	[redacted]
Total (ex GST)	[redacted]	[redacted]

Pipeline

The pipeline route was supplied by Australian Zirconia Ltd and a copy of this route is provided in Appendix F. The route distance is taken as 7500m, with minimal allowance made for pipeline inside the processing plant.

The pipeline would not be laid to grade, but general installation practices compliant with *AS/NZ 2566.2:2002 Buried Flexible Pipelines – Installation* would be adhered to.
For the purpose of this report, HDPE was considered as the material for the pipeline. This material is PE100 AS 4130 standard pipe.

Pipe size selected for this report was analysed for the following criteria;

1. Flow 174l/s (option 1 and 2) Flow 425l/s (option 3 and 4)
2. Friction loss. Not greater than 50% of pipe pressure rating
3. Velocity. Not greater than 2.0m/s
4. Total Pumping Head
5. Operating Costs
6. Net Present Value

NOTE3 The off peak pumping regime is slightly outside the selection criteria 2 and 3. This is not a great concern for the purpose of this concept plan as criteria are accepted to be conservative values.*

The pipeline design would necessarily incorporate air valves and scour valves, the numbers of which would be determined by a detailed site inspection. For the purpose of this report, allowance is made for 5 air valve assemblies and 4 scour valve assemblies. Several isolation valves are also recommended to isolate sections of the pipeline. Pipeline markers would serve as a physical indicator of the actual pipe route as well as highlight positions of all valve assemblies.

Thrust blocks should be constructed at every change in direction of water flow to prevent long term damage from hydraulic hammer and energy surge.

Two underbores are allowed for Bennelong Rd and at Toongi.

All prices are deemed competitive pricing at January 2013, a contingency is recommended to accommodate fluctuations in material and installation pricing.

Option 1 and 2: Pipeline - 22 hour Pumping Window – low & high head

	Low Head Model 450mm HDPE	High Head Model 400mm HDPE
	Budget Price (ex GST)	
Pipe Materials HDPE PE 100 AS/NZS 4130 Class 8 poly pipeline, 20m lengths freighted to specific pipe dumps on project site	[redacted]	[redacted]
Valve assemblies and fittings Includes provision for air valve, scour valve, isolation valves. Allowance for mainline bends, tees, and saddles.	[redacted]	[redacted]
Road crossings, service locations, traffic control Includes provision for sleeving, boring, splicing road crossings to pipeline. Also includes locating services, and traffic control management	[redacted]	[redacted]
Installation This includes provision to lay out pipe in strings, weld pipe. Trench, lay, backfill. This includes thrust blocks and connection to valve assemblies. This also includes provision to connect mainline to pump	[redacted]	[redacted]

Commissioning Includes line filling, line flushing, pressure testing, and physical inspection of pipe route.	[redacted]	[redacted]
Contingency (15%) Allowing for variations in ground conditions and availability of suitable backfill and bedding material and regulatory constraints.	[redacted]	[redacted]
Total (ex GST)	[redacted]	[redacted]

DARLING irrigation
making every drop count

DZP Concept Plan

Option 3 and 4 Pipeline - 9 hour Pumping Window – low and high head

	630mm HDPE	560mm HDPE
	Budget Price (ex GST)	Budget Price (ex GST)
Pipe Materials HDPE PE 100 AS/NZS 4130 Class 8 poly pipeline, 20 m lengths freighted to specific pipe dumps on project site	[redacted]	[redacted]
Valve assemblies and fittings Includes provision for air valve, scour valve, isolation valves. Allowance for mainline bends, tees, and saddles.	[redacted]	[redacted]
Road Crossings, service locations, traffic control Includes provision for sleeving, boring, splicing road crossings to pipeline. Also includes locating services, and traffic control management for road crossings	[redacted]	[redacted]
Installation This includes provision to lay out pipe in strings, weld pipe. Trench, lay, backfill. This includes thrust blocks and connection to valve assemblies. This also includes provision to connect mainline to pump station. No allowance for any connection to processing plant side.	[redacted]	[redacted]
Commissioning Includes line filling, line flushing, pressure testing, and physical inspection of pipe route.	[redacted]	[redacted]

Contingency (15%) Allowing for variations in ground conditions and availability of suitable backfill and bedding material, and regulatory constraints	[redacted]	[redacted]
Total (ex GST)	[redacted]	[redacted]

Economic Analysis

The economic analysis of the 4 options was completed, and then replicated for the 2 types of energy pricing. The first energy pricing is utilising power capacity direct from the mine, with allowance made for $250,000 capital expenditure on the line construction. The second energy pricing is based on 'good commercial' rates at the current site.

Other assumptions used in the economic analysis include;

- Interest rate of 7%
- Average rate of inflation 3%
- Average rate of energy inflation 10%
- Project Lifespan 20 years

NOTE4 Transformer upgrade prices have been allowed for in the project costing, however no line upgrade costs allowed for using 'good commercial' energy rates. In conversation with Kevin Rugg (Energy Serve) we have assumed the line to the existing transformer is adequate to handle an upgrade. This is more probable in the 22 hour pumping regimes due to the lower power requirements.*

Summary of infrastructure costs

	Option 1	Option 2	Option 3	Option 4
Pumping	[redacted]	[redacted]	[redacted]	[redacted]
Pipeline				
Total				

DZP Concept Plan

Economic Analysis using Mine Tariffs

	Option 1	Option 2	Option 3	Option 4
Flow: L/s	[redacted]	[redacted]	[redacted]	[redacted]
Head: m	[redacted]	[redacted]	[redacted]	[redacted]
Water kw	[redacted]	[redacted]	[redacted]	[redacted]
Pump Efficiency	[redacted]	[redacted]	[redacted]	[redacted]
Duty kw	[redacted]	[redacted]	[redacted]	[redacted]
Motor Efficiency	[redacted]	[redacted]	[redacted]	[redacted]
Meter kw	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Off Peak $ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Shoulder $ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Peak: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Peak: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Peak Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Peak $ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Total Enegy Cost	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Motor Power Factor	[redacted]	[redacted]	[redacted]	[redacted]
Kva	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Network Demand $/Kva: Off Peak	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Network Demand $/Kva: Shoulder	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Network Demand $/Kva: Peak	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Total Operating Cost: Energy Provider	[redacted]	[redacted]	[redacted]	[redacted]
Running Cost Nett Present Value Factor *	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Running Cost (Nett Present Value) $	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Capital Cost	[redacted]	[redacted]	[redacted]	[redacted]
Capital Cost Nett Present Value Factor **	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Capital Cost (Nett Present Value) $	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Cost: Nett present value	[redacted]	[redacted]	[redacted]	[redacted]

* Based on Interest rate 7%, inflation 3%, Energy inflation of 10%, Lifespan 20 years
** Based on Interest rate 7%, inflation 3%, Lifespan 20 years

DZP Concept Plan

Economic Analysis using Commercial Tariffs

	Option 1	Option 2	Option 3	Option 4
Flow: L/s	[redacted]	[redacted]	[redacted]	[redacted]
Head: m	[redacted]	[redacted]	[redacted]	[redacted]
Water kw	[redacted]	[redacted]	[redacted]	[redacted]
Pump Efficiency	[redacted]	[redacted]	[redacted]	[redacted]
Duty kw	[redacted]	[redacted]	[redacted]	[redacted]
Motor Efficiency	[redacted]	[redacted]	[redacted]	[redacted]
Meter kw	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Off Peak Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Off Peak $ per year	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Shoulder Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Shoulder $ per year	[redacted]	[redacted]	[redacted]	[redacted]
Peak: cents per kw/h	[redacted]	[redacted]	[redacted]	[redacted]
Peak: $ per hour	[redacted]	[redacted]	[redacted]	[redacted]
Peak Hours per week	[redacted]	[redacted]	[redacted]	[redacted]
Weeks per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Peak $ per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Enegy Cost	[redacted]	[redacted]	[redacted]	[redacted]
Motor Power Factor	[redacted]	[redacted]	[redacted]	[redacted]
Kva	[redacted]	[redacted]	[redacted]	[redacted]
Daily Supply Charge $	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
Network Demand $/Kva: Shoulder	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
Network Demand $/Kva: Peak	[redacted]	[redacted]	[redacted]	[redacted]
$ per year	[redacted]	[redacted]	[redacted]	[redacted]
Total Operating Cost: Energy Provider	[redacted]	[redacted]	[redacted]	[redacted]
Running Cost Nett Present Value Factor *	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Running Cost (Nett Present Value) $	[redacted]	[redacted]	[redacted]	[redacted]
Capital Cost	[redacted]	[redacted]	[redacted]	[redacted]
Capital Cost Nett Present Value Factor **	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Capital Cost (Nett Present Value) $	[redacted]	[redacted]	[redacted]	[redacted]
Total Annual Cost: Nett present value	[redacted]	[redacted]	[redacted]	[redacted]
* Based on Interest rate 7%, inflation 3%, Energy inflation of 10%, Lifespan 20 years				
** Based on Interest rate 7%, inflation 3%, Lifespan 20 years				

5.

Summary

In order to quantify the sensitivity of the capital costs of this project to the operating costs, over the 20 year prescribed lifespan, the net present value financial method was employed. This is a measure of what a set of future payments is worth in current terms, accounting for capital and operating costs.

Four options were modelled,

- Option 1: low head option for a 22 hour pumping window
- Option 2: high head option for a 22 hour pumping window
- Option 3: low head option for a 9 hour 'Off Peak' pumping window
- Option 4: high head option for a 9 hour "Off Peak" pumping window

These four options were then subject to two energy tariff regimes. The first is a set of tariffs aligned with the energy consumption of the mine.

- These are very economical rates
- incur network usage charges.
- additional [redacted] capital expenditure, in order to build a main power line from the mine to the pump site.

The second set of tariffs are standard 'commercial' rates for the pump site.

- estimated off peak rate of $0.10/KWh and a peak rate of $0.19/KWH (based on discussion with Kevin Rugg of Energy Serve and energy retailers).

The report demonstrates that the most efficient option on an annualised Total Net Present Value is the 22 hour pumping window using the mine's energy plan.

It is also noted that the savings in energy rates utilising only off peak power do not outweigh the additional capital cost involved in upgrading the pump and pipeline infrastructure. However spread over 22 hours it is economical to minimise the pumping head. This will be more economical over the 20 year lifespan of the project.

By comparison with for example, the Alkane Tomingley water supply pipeline, the energy costs relative to capital costs are much higher in this proposal, moving a larger volume of water over a shorter distance. In this instance it is important to understand the bearing of the energy inflation rate over a 20 year period. As stated above we have assumed energy prices will rise by an annual average of 10% across the 20 year life of the project. Net present values are very sensitive to this rise in energy pricing above the rate of inflation.

Lastly, it is also noted that if a low head option prevails, there may be scope in the design of the pipeline to reduce the pressure rating of the pipe. The low head 22 hour option has a total

operating head less than 50% of the pressure rating on the pipe. This has the potential to further save capital expenditure.

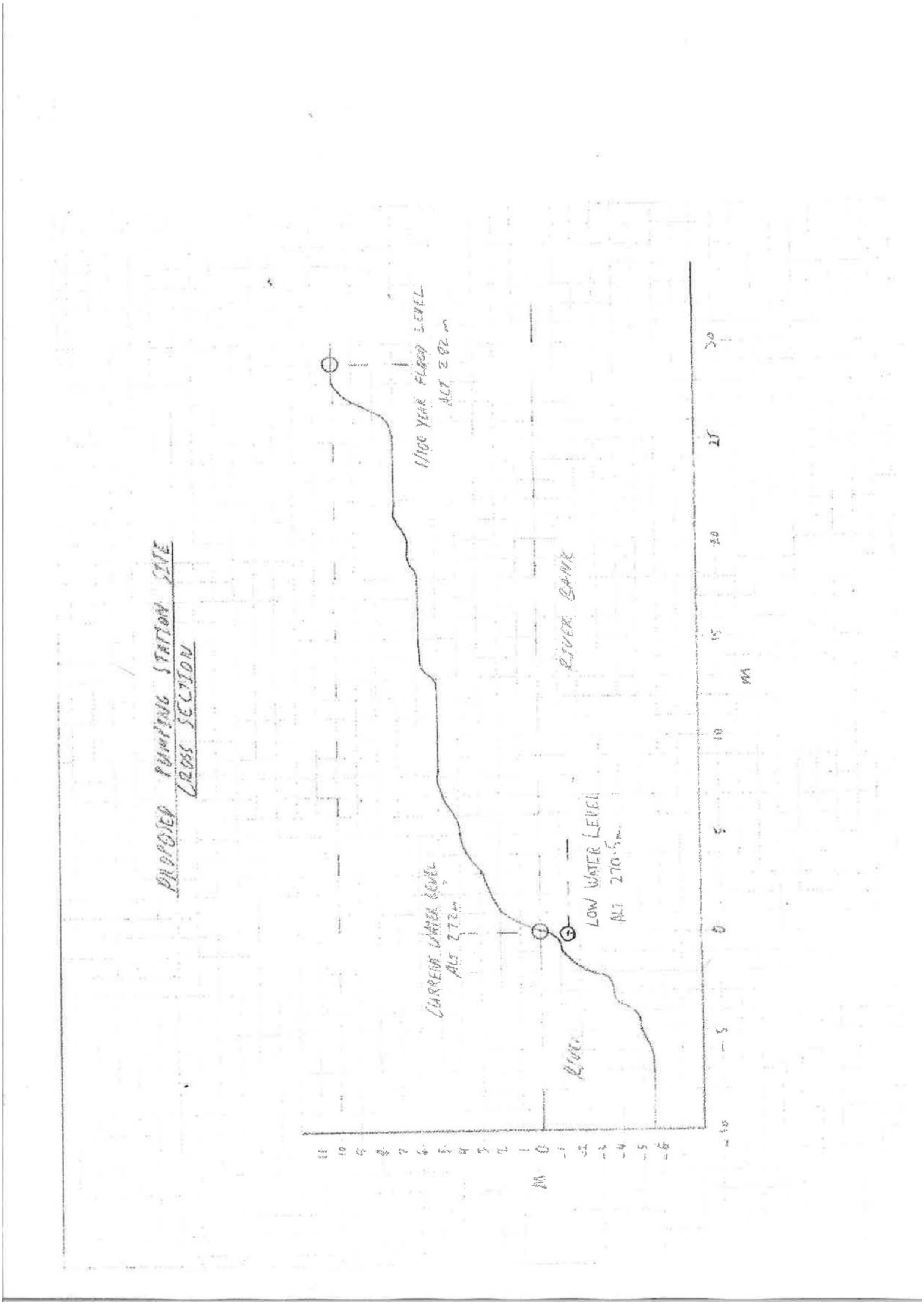
Sam Maroulis

Managing Director

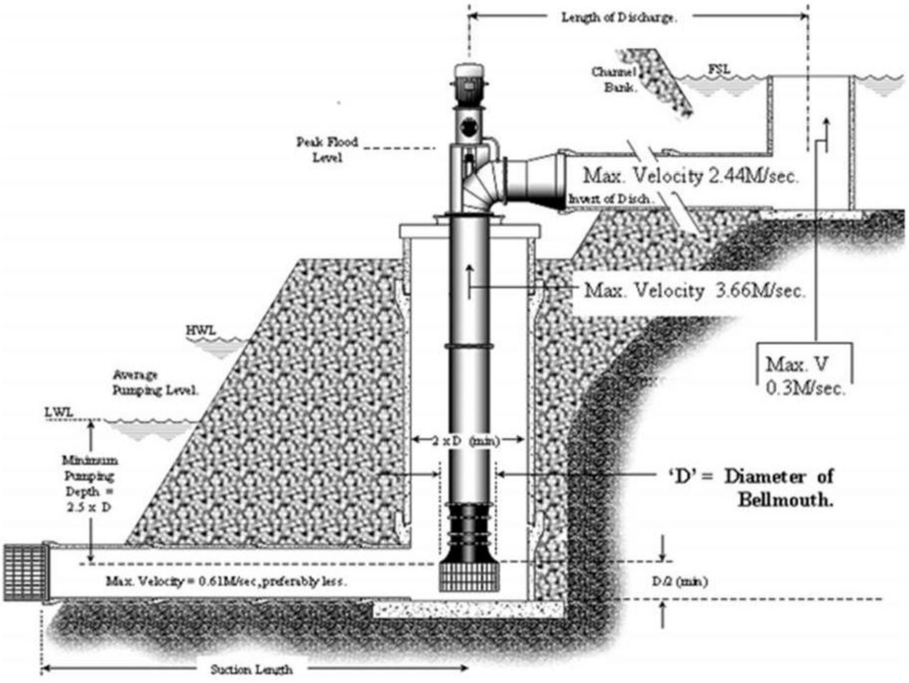
Darling Irrigation

Controlled DRAFT , issued 15th January 2013

Appendix A: Macquarie River Profile Survey


PROPOSED PUMPING STATION SITE
CROSS SECTION
1/100 YEAR FLOOD LEVEL
RIVER BANK
LOW WATER LEVEL
CURRENT WATER LEVEL
RIVER

Appendix B: Diagram of a Typical Wet Well configuration



DARLING irrigation
making every drop count

Appendix C: MWH Consultants Report Pump Design

MWH.
BUILDING A BETTER WORLD

20th December, 2012

Mr. Sam Maroulis
Director, Darling Irrigation Pty Ltd.
113-121 Dandaloo Street
NARROMINE NSW 2821

Dear Sam,

Thank you for coming into our office last Thursday and briefing MWH on the Dubbo Zirconia Project. This letter is a brief summary of the project detail regarding the required water supply, as you described it to us and our preliminary thoughts on how this water supply will be achieved.

Water Supply Requirements:

We understand that the water supply requirements to the proposed mine are as follows:

1. A flow of 5GL pa is to be provided via a new pump station. The pumping regime would be 22 hours per day, 365 days per year.
2. This flow will be sourced from a pre-selected waterhole location on the Macquarie River and discharged into a 50ML buffer storage at the mine site.
3. The proposed pump station site is close to an area of land used by the property owner for recreational activity and as such the pump station will have some environmental sensitivity to the owner, notably noise and aesthetic appearance.
4. The site of the river intake to the pump station will also have environmental sensitivity in respect of aquatic ecology and tree preservation on land.
5. The waterhole at the pump station intake is up to 5m deep and the 1:100 year flood level at the proposed pump station site is approximately 10m above dry weather standing water level in the river (riverbank profile provided).
6. The overall static lift on the pipeline from the top of river bank to the discharge point would be minimal, in the order of around 5m.
7. The pump station would need to be a duplex type, with duty / standby pump arrangement.
8. The length of the proposed rising main is approximately 9km. The preferred rising main material would be PE.
9. The existing power supply / transformer may need to be upgraded to the pump station site.
10. No geotechnical information was available at the time of our briefing.

Based on the above, our initial concepts for water supply to the plant (river intake, pump station, and rising main) are envisaged as follows:

River Intake:

1. In river cofferdam construction
2. Fish / turtle screening (Johnson screens or similar)
3. Intake pipe to pump station – excavation by either open cutting or tunnelling. Footprint for open cut will be substantial due to depth of trenching required and will probably require sheet pile support to reduce extent of excavation. Footprint of disturbance may be restricted by existing mature trees nearby and other environmental considerations. Trenchless construction (boring or tunnelling) could be undertaken from pump wet well back to cofferdam in river. Excavation methodology is subject to geotechnical and environmental investigations, constructability and cost considerations.

DARLING irrigation
making every drop count

Pump Station:

4. Design flowrate: 5GL/a (172L/s).
5. Total dynamic head on pumps: 5m static + 4m/km friction loss = say 41m maximum.
6. Approximate power requirement at pump station : 120kW (each pump, 1 duty / 1 standby).
7. Wet well: say 2400mm to 2700mm dia, concrete pipe wet well depending on detailed hydraulic design / spacing between pumps, etc.
8. Pumps: 2 x vertical turbine in wet well, duty around 172L/s at 41m head.
9. Pump station building to be provided to manage noise and aesthetic issues. Building to contain pumps and electrics, air compressor for screen cleaning, gantry over. Floor of building to be located at 1:100 year flood level. At this location suction pipe from river intake would be approximately 30m long and wet well would be approximately 12m deep. Exterior of building to be sympathetic to local environment.

Rising Main

10. Rising main approximately 9kms long across relatively flat terrain. Rising main to be PE100 material (client preference), around ID400mm (for maximum velocity at duty of around 1.3m/s). Pipe specification nominally PE100 DN450 SDR17 (PN10). Actual strength class subject to detailed design and compliance with AS2566.1 (structural design of buried pipelines).
11. Rising main to discharge into buffer storage at mine site.

Other Considerations

12. For the purpose of gaining the necessary approvals, environmental assessment of the proposal will need to be developed in conjunction with the concept design. The environmental assessment will need to investigate, *inter alia*, local environmental impact at river pump station (in particular aquatic ecology, noise, aesthetics, preservation of mature trees, flood frequency analysis, etc), as well as construction and operational impacts of the whole scheme. Land matters will need to be addressed and formally resolved with all landowners, including easements over property, as agreed. Council will need to approve the proposal and there may also be a number of other key stakeholders who may need to be consulted (such as recreational users of the river, local landcare groups, etc). Once all of the relevant approvals are received in principle, detailed design would then commence.

We trust the above correspondence reflects the proposal outlined to us at our recent meeting and describes some of the engineering detail that will ultimately need to be documented into a detailed design for the scheme. Should you wish to discuss any detail further please contact the undersigned on (02) 9493 9700.

Regards,
Vaughan Pearce

MWH Australia Pty Ltd
Encl.:

Copy to:

Appendix D: Batescrew Pump and Valve specifications

148 L/SEC DUTY @ 62M HEAD (63.1M TDH) SPEED = 1300 RPM

10-Jan-13

BATESCREW PUMPS AND VALVES

14MB

FULL "A" TRIM

IMPELLER SPEED INTERPRETATION SHEETS

IMPELLER 14MB — **PER STAGE** — **PUMP TEST SPEED 1460**

ACTUAL TEST POINTS — **AT TEST 1460** — **FULL TRIM IMPELLER**

FLOW (L/S)	HEAD (M) /STAGE	POWER (KW) / STAGE	EFFICIENCY
10	33	41	8.0
50	26.8	37.3	35.9
75.0	25.6	38.0	50.5
83.0	24.4	38.8	52.2
106.0	23.5	40.3	61.8
121.0	22.9	41.0	67.4
136.0	21.9	41.8	71.5
151.0	21.0	42.9	74.1
166.0	20.4	43.3	78.4
182.0	20.1	44.6	82.1
195.0	19.1	45.5	81.9
205.0	18.5	46.2	82.0
220.0	17.4	47.0	81.4
242.0	16.2	47.7	81.9
257.0	14.6	48.1	78.2
272.0	12.8	48.5	71.8
288.0	11.3	48.5	67.0

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1400** — DELTA 0.9589041

FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
10	30.3	36.2	8.0
48	24.6	32.9	35.9
72	23.5	33.5	50.5
80	22.4	34.2	52.2
102	21.6	35.5	61.8
116	21.0	36.2	67.4
130	20.2	36.8	71.5
145	19.3	37.8	74.1
159	18.8	38.1	78.4
175	18.5	39.3	82.1
187	17.6	40.1	81.9
197	17.0	40.8	82.0
211	16.0	41.4	81.4
232	14.9	42.1	81.9
246	13.5	42.4	78.2
261	11.8	42.7	71.8
276	10.4	42.7	67.0

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1100** — DELTA 0.7534247

FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
57	14.5	16.3	1.5
63	13.8	16.6	52.2
80	13.3	17.2	61.8
91	13.0	17.5	67.4
102	12.5	17.9	71.5
114	11.9	18.3	74.1
125	11.6	18.5	78.4
137	11.4	19.1	82.1
147	10.8	19.5	81.9
154	10.5	19.8	82.0
166	9.9	20.1	81.4
182	9.2	20.4	81.9
194	8.3	20.6	78.2
205	7.3	20.7	71.8

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1500** — DELTA 1.0273973

	FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
	77	27.0	41.2	50.5
	85	25.7	42.1	52.2
	109	24.8	43.7	61.8
	124	24.1	44.5	67.4
	140	23.2	45.3	71.5
	155	22.2	46.5	74.1
DUTY 1	**171**	**21.6**	**46.9**	**78.4**
	187	21.2	48.4	82.1
	200	20.2	49.3	81.9
	211	19.5	50.1	82.0
	226	18.3	50.9	81.4
	249	17.1	51.8	81.9
	264	15.4	52.2	78.2
	279	13.5	52.6	71.8

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1200** — DELTA 0.8219178

FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
62	17.3	21.1	50.5
68	16.5	21.5	52.2
87	15.9	22.4	61.8
99	15.4	22.8	67.4
112	14.8	23.2	71.5
124	14.2	23.8	74.1
136	13.8	24.0	78.4
150	13.6	24.8	82.1
160	12.9	25.3	81.9
168	12.5	25.7	82.0
181	11.7	26.1	81.4
199	10.9	26.5	81.9
211	9.9	26.7	78.2

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1550** — DELTA 1.0616438

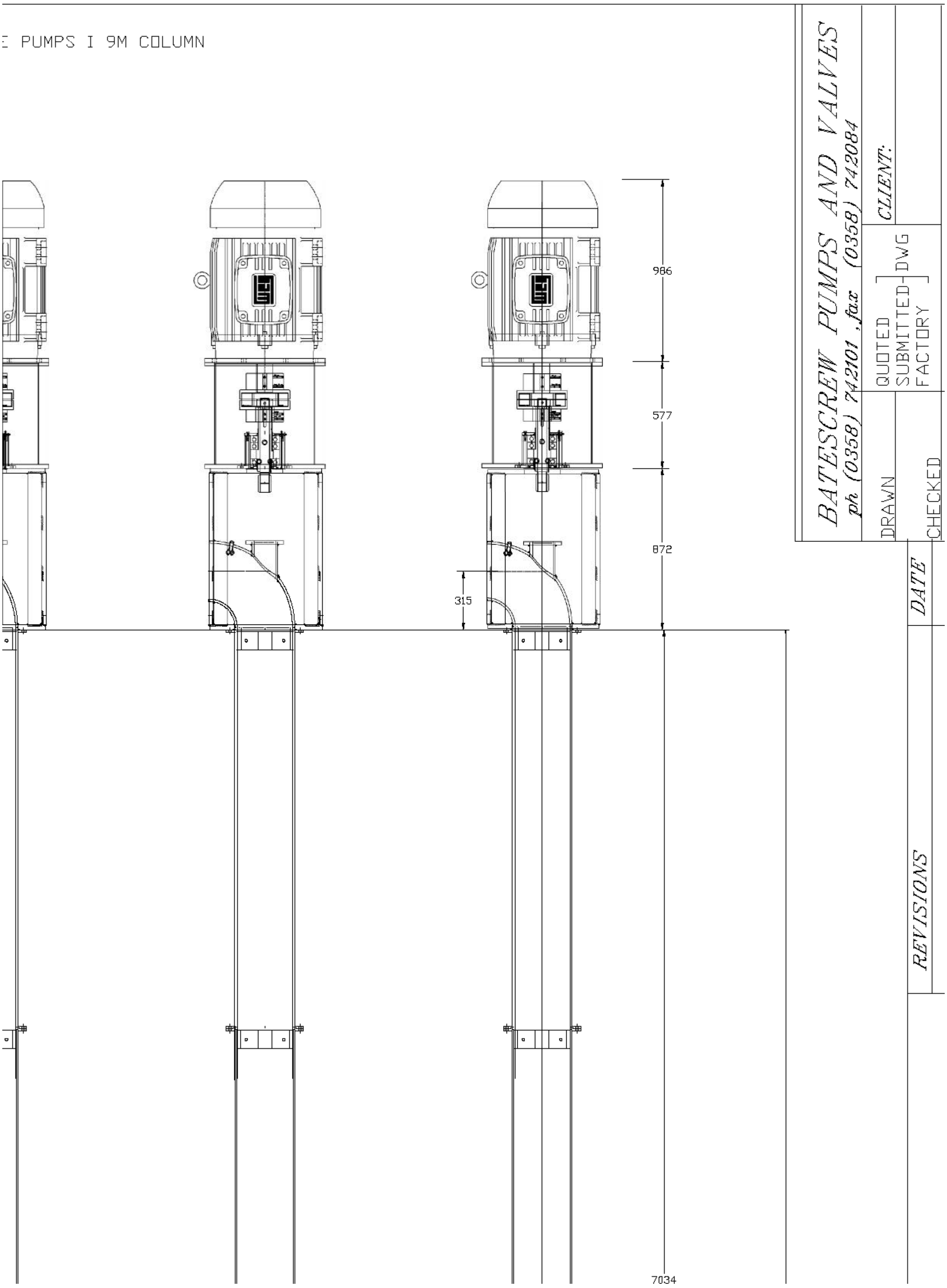
	FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
	80	28.9	45.5	50.5
	88	27.5	46.4	52.2
	113	26.5	48.2	61.8
	128	25.8	49.1	67.4
	144	24.7	50.0	71.5
	160	23.7	51.3	74.1
	176	23.0	51.8	78.4
	193	22.7	53.4	82.1
DUTY 2	**207**	**21.5**	**54.4**	**81.9**
	218	20.9	55.3	82.0
	234	19.6	56.2	81.4
	257	18.2	57.1	81.9
	273	16.5	57.6	78.2

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1300** — DELTA 0.890411

FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
67	20.3	26.8	50.5
74	19.3	27.4	52.2
94	18.6	28.4	61.8
108	18.1	29.0	67.4
121	17.4	29.5	71.5
134	16.7	30.3	74.1
148	16.2	30.5	78.4
162	15.9	31.5	82.1
174	15.1	32.1	81.9
183	14.7	32.6	82.0
196	13.8	33.2	81.4
215	12.8	33.7	81.9

COMPUTER CALCULATED — DESIRED SPEED — INPUT SPEED **1600** — DELTA 1.0958904

FLOW (L/S)	HEAD (M) /STAGE	IMPELLER DRAWN POWER (KW) / STAGE	WET END EFFICIENCY
82	30.7	50.1	50.5
91	29.3	51.0	52.2
116	28.2	53.0	61.8
133	27.5	54.0	67.4
149	26.4	55.0	71.5
165	25.3	56.4	74.1
182	24.5	56.9	78.4
199	24.2	58.7	82.1
214	22.9	59.9	81.9
225	22.2	60.8	82.0
241	20.9	61.8	81.4
265	19.4	62.8	81.9


E PUMPS I 9M COLUMN
986
577
872
315
7034
BATESCREW PUMPS AND VALVES
ph (0358) 742101 ,fax (0358) 742084
CLIENT:
QUOTED
SUBMITTED
FACTORY
DWG
DRAWN
CHECKED
DATE
REVISIONS

Appendix E: Fish Screening and Diversion Infrastructure

INCOMING WATER PROCESSING AND TREATMENT

Water is a vital component in the pulp and paper industry; Johnson Screens® incoming water product line is designed to provide mills with quality process water.

INCOMING WATER

Pulp and paper mills often use water from sources such as rivers and lakes. For this water to be usable in production, it needs to be collected and processed to certain standards.

Johnson Screens offers numerous products for process water:

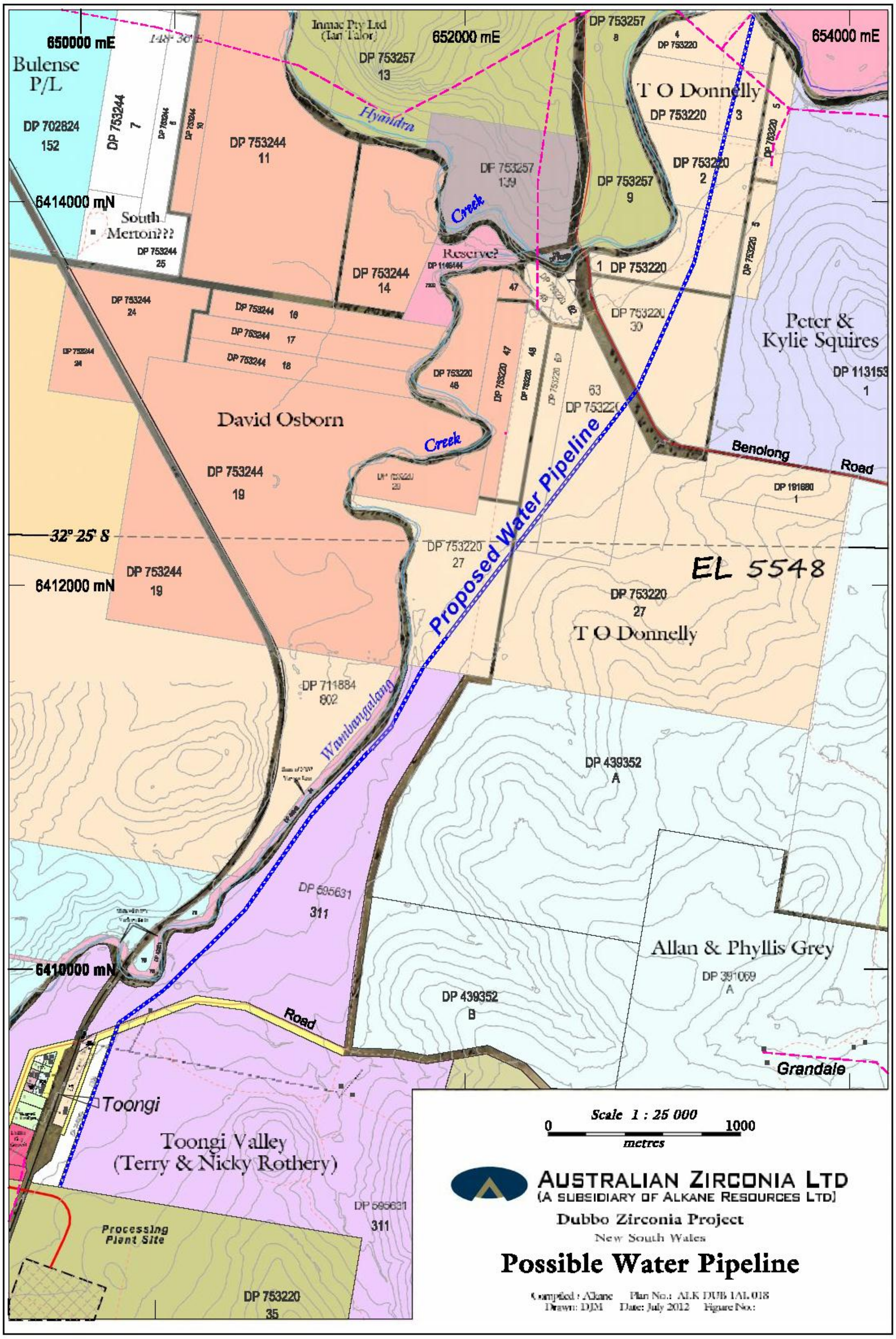
- CoMag® clarification systems
- Fish diversion systems/trash racks
- Hydroburst™ systems
- Passive intake screens
- Reverse osmosis systems
- Triton® underdrain systems

Johnson Screens *passive intake screening systems provide uninterrupted water withdrawal from lakes and rivers.*

Johnson Screens Triton *underdrain systems are available in both stainless steel and PVC; they offer maximum surface area to optimise filtration efficiency.*

Trash racks separate larger unwanted objects out of the water flow in channels.

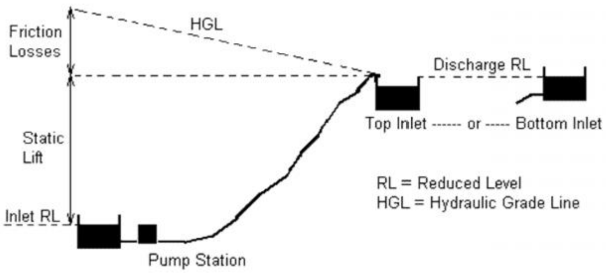
Appendix F: Proposed Water Pipeline Route


650000 mE
652000 mE
654000 mE
6414000 mN
6412000 mN
6410000 mN
32° 25' S
Bulense P/L
DP 702824 152
South Merton???
Inmac Pty Ltd (Ian Talor)
DP 753257 13
Hyandra Creek
DP 753244 11
DP 753257 139
Reserve?
DP 753244 14
T O Donnelly
DP 753220 3
DP 753220 2
DP 753257 9
1 DP 753220
DP 753220 30
Peter & Kylie Squires
David Osborn
DP 753244 19
Creek
Benolong Road
Proposed Water Pipeline
DP 753220 27
EL 5548
T O Donnelly
DP 711884 802
Wambangalang
DP 439352 A
DP 595631 311
Allan & Phyllis Grey
DP 391069 A
DP 439352 B
Road
Grandale
Toongi
Toongi Valley (Terry & Nicky Rothery)
Processing Plant Site
DP 753220 35
Scale 1 : 25 000
0
1000
metres
AUSTRALIAN ZIRCONIA LTD
(A SUBSIDIARY OF ALKANE RESOURCES LTD)
Dubbo Zirconia Project
New South Wales
Possible Water Pipeline
Compiled : Alkane Plan No.: ALK DUB 1AL 018
Drawn: DJM Date: July 2012 Figure No.:

Appendix G: Pipeline Design Data to determine head

ALKANE RESOURCES DUBBO ZIRCONIA PROJECT

13 / 1 / 2013



DATA:

400 mm PE100 AS/NZS 4130 (Poliplex) Class 8
Inlet RL = 272 m Discharge
RL = 286 m Required Flow
Rate = 174 l/s Pipeline
Length = 7500 m
Colebrook White k = 0.010 mm
Kinematic Viscosity = 1.01x10E-6 sq.m/s

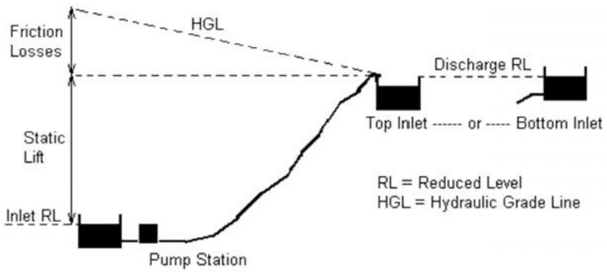
RESULTS:

Friction Losses = 39.90 m
Static Lift = 14.00 m
Velocity = 1.7 m/s
Total Pump Head = 53.9 m

ALKANE RESOURCES DUBBO ZIRCONIA PROJECT

iPLEX Pipelines

13 / 1 / 2013



DATA:

450 mm PE100 AS/NZS 4130 (Poliplex) Class 8
Inlet RL = 272 m Discharge
RL = 286 m Required Flow
Rate = 174 l/s Pipeline
Length = 7500 m
Colebrook White k = 0.010 mm
Kinematic Viscosity = 1.01x10E-6 sq.m/s

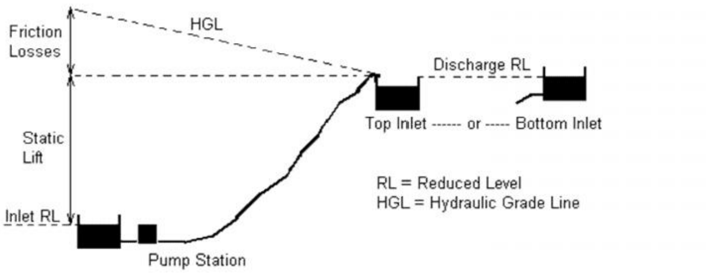
RESULTS:

Friction Losses = 22.43 m
Static Lift = 14.00 m
Velocity = 1.3 m/s
Total Pump Head = 36.4 m

ALKANE RESOURCES DUBBO ZIRCONIA PROJECT

iPLEX Pipelines

13 / 1 / 2013



DATA:

560 mm PE100 AS/NZS 4130 (Poliplex) Class 8
Inlet RL = 272 m Discharge
RL = 286 m Required Flow
Rate = 425 l/s Pipeline
Length = 7500 m
Colebrook White k = 0.010 mm
Kinematic Viscosity = 1.01x10E-6 sq.m/s

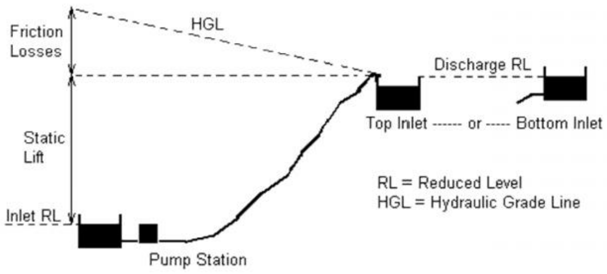
RESULTS:

Friction Losses = 40.31 m
Static Lift = 14.00 m
Velocity = 2.1 m/s
Total Pump Head = 54.3 m

ALKANE RESOURCES DUBBO ZIRCONIA PROJECT

iPLEX Pipelines

14 / 1 / 2013



DATA:

630 mm PE100 AS/NZS 4130 (Poliplex) Class 8
Inlet RL = 272 m Discharge
RL = 286 m Required Flow
Rate = 425 l/s Pipeline
Length = 7500 m
Colebrook White k = 0.010 mm
Kinematic Viscosity = 1.01x10E-6 sq.m/s

RESULTS:

Friction Losses = 22.61 m
Static Lift = 14.00 m
Velocity = 1.7 m/s
Total Pump Head = 36.6 m

Appendix H: Australian Standard, AS/NZ 2566.2:2002 Buried Flexible Pipelines – Installation

TABLE 4.2

MINIMUM EMBEDMENT ZONE DIMENSIONS

millimetres

D_e	Minimum dimension			
	l_b	l_c (see Note 2)	l_o	$B = D_e + 2l_c$
≥75, ≤150	75	100	100	275 – 350
>150, ≤300	100	150	150	450 – 600
>300, ≤450	100	200	150	700 – 850
>450, ≤900	150	300	150	1050 – 1500
>900, ≤1500	150	350	200	1600 – 2200
>1500, ≤4000	150	$0.25D_e$	300	2250 – 6000

NOTES:

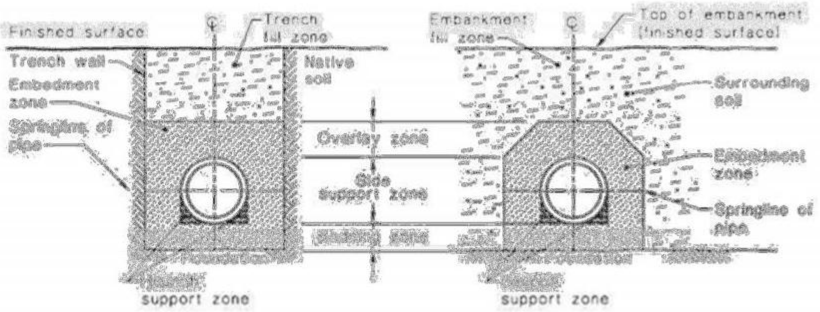
1 The objective is to achieve uniform compaction of the embedment material.

2 The tabulated values may provide insufficient clearances for installation purposes in certain circumstances.

3 The minimum spacing between adjacent parallel pipelines shall be determined from Clause 5.2.6.

4 Refer to Figure 1.2 for definitions of l_b, l_c, l_o.

Appendix I: Pipe Laying Profile



(a) Trench (b) Embankment

FIGURE 1.1 BURIED FLEXIBLE PIPE INSTALLATION—TERMINOLOGY

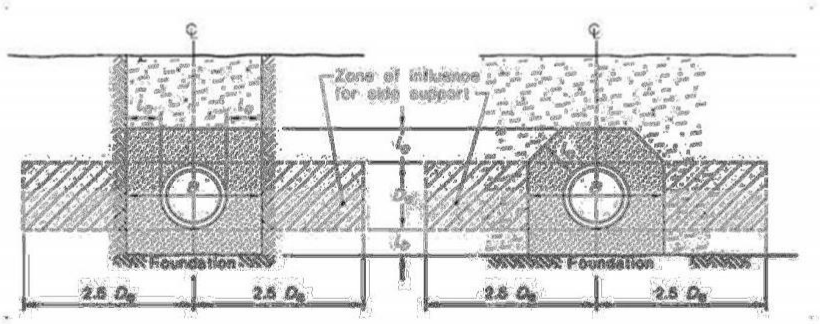


FIGURE 1.2 SIDE SUPPORT AND EMBEDMENT ZONE SYMBOLS

This page has been intentionally left blank