Appendix D
Integrated Water Management Strategy

MARULAN GAS TURBINE FACILITIES

SUBMISSIONS RESPONSE & PREFERRED PROJECT REPORT

VOLUME 2 | APPENDICES | May 2009

CLIENTS | PEOPLE | PERFORMANCE

Energy Australia and Delta Electricity

Power Station near Marulan

Integrated Water Management Strategy Report

February 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

1.1 General

EnergyAustralia (EA) and Delta Electricity (Delta) have proposed the development of two gas-fired power stations (‘the facilities’) and associated infrastructure near Marulan, NSW. The proposed power facility is located on land adjacent to an existing TransGrid substation as shown in Figure 1**.**

The facility will be developed in stages, which nominally comprise the following:

Stage 1:

- **Stage 1a** - the EA peaking facility to commence construction in early 2009 and be operational in 2010; and
- **Stage 1b** - the Delta Stage 1 peaking facility to be constructed and operational by mid 2013.

Stage 2:

- the Delta Power station shifts from a peaking to a base load facility. To be operational by 2014.

GHD has previously investigated the water requirements for the two proposed power stations and identified the potential for various bulk water sources to meet these requirements (vis GHD, *“Energy Australia, Power Station Near Marulan – Water Impacts”*, May 2008). This report identified that there are a number of potential sources available to meet the overall water needs and, for completeness, these sources are recapped in Section 4.

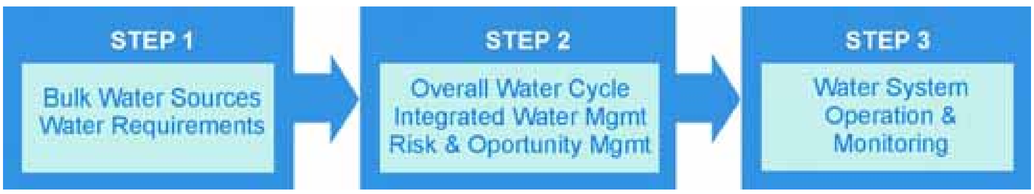
1.2 Objective

The objective of this report is to:

- *determine viable options for an Integrated Water Management Program to meet the water requirements for the proposed gas-fired power stations and associated infrastructure near Marulan*.

1.3 Scope

This report is to fulfil the requirements of *Step 2,* one of three steps outlined in GHD’s original Proposal of Services 14th March 2007, vis:



In meeting the objective of this Step 2 investigation, GHD identified the following scope of work:

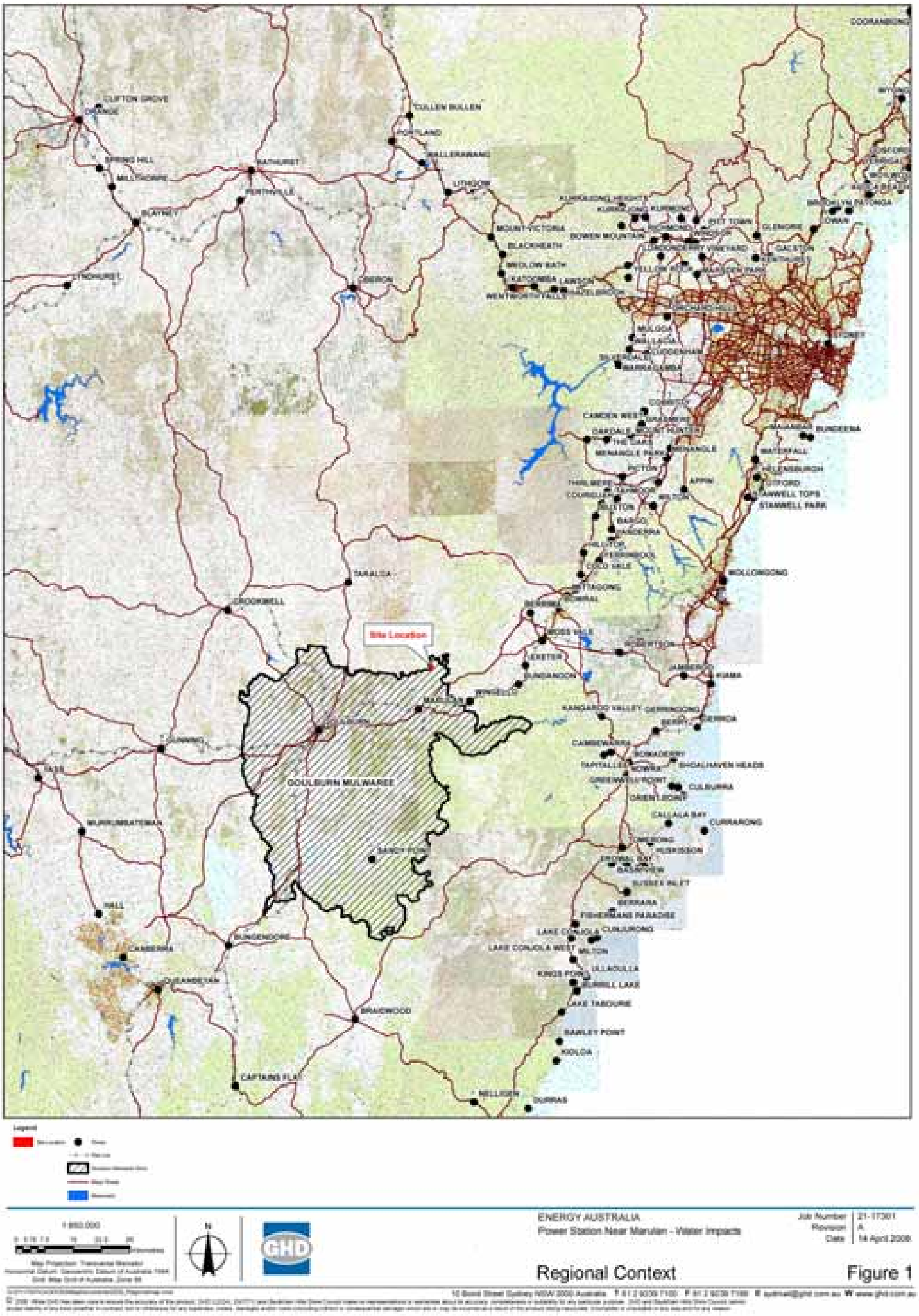
- Develop Integrated Water Management Options short list based on works completed to date (that is, by matching the water requirements with the identified viable bulk water sources).
- Develop a water balance for the **integrated water management (IWM) options**. This will be modelled using GHD's IWM Toolkit.
- IWM options development to Concept Stage based on the outputs of the water balance.
- GHD will identify a range of opportunities and constraints (risks) associated with each IWM Option.
- Undertake further negotiations and liaison with the water supply authorities where required.
- Reporting- GHD will compile a report which details the findings of the tasks completed for the project.

Commercial information (including indicative capital and operation/maintenance and net present value (NPV) of each of the options) relating to the selection of a preferred option has been considered in another report.

This report contains the following sections:

- Section 1 – An introduction to the report.
- Section 2 – Background to the report including site description and previous reports.
- Section 3 – An overview of the various water demands of the two facilities and the timing of these demands.
- Section 4 – An overview of options previously identified to service the water demands. The section identifies the viable options (for differing water demands) to meet the water demands identified in Section 3.
- Section 5 – Develops the options for each of the water demand types into water servicing strategies, which can then be assessed within the integrated water model.
- Section 6 – Provides an overview of the model used to assess each of the water servicing strategies and the results of the modelling (in terms of how successfully the water sources can meet the water demands over the life of the project).
- Section 7 – Assesses the water servicing strategies against criteria.
- Section 8 – Provides the summary and conclusions for the project.

Figure 1 Regional Context



2. Background

2.1 Site Location and Description

The proposed (Marulan) site is located off Canyonleigh Road, Brayton, approximately 12 km northeast of the village of Marulan. The project site is located 20 km from the Marulan Highway turnoff and 10 km from the Canyonleigh-Brayton Road turnoff as shown in Figure 2. The Wollondilly River flows to the west of the site (see Figure 3).

The site is located within the Upper Lachlan Shire Council Local Government Area (LGA) as shown in Figure 1.

2.2 Other Reports

As noted, GHD has previously prepared a report, *"EnergyAustralia, Power Station Near Marulan – Water Impacts",* May 2008. This report included initial investigations of the water requirements for the two proposed power stations, and identified the potential for various bulk water sources to meet these requirements. The report found that there are a number of potential sources available to meet the overall water needs. The identified options and their potential to meet the water demands of the facility are discussed further in Section 4.

Other reports of note include the Goulburn Mulwaree Council, *"Marulan Township Development, Sewerage Master Plan",* GHD, August 2005, which outlines expected flows for the Marulan township in line with proposed developments. Goulburn Mulwaree Council has advised that this report has been superseded and more relevant documents are currently being prepared, however these documents were not available during this study and hence the available Sewerage Master Plan has been referenced within this study, as appropriate.

Figure 2 Site Location Map

Figure 3 Natural Drainage and River Systems

3. Development Water Demands

3.1 Timing

EnergyAustralia (EA) and Delta Electricity (Delta) have proposed to build power station plants in a staged operation. While timelines have not been finalised, EA nominally propose to construct an open cycle peaking plant (gas fired power station) with construction commencing in 2009 and operations commencing in mid 2010.

Delta proposes to initially construct a peaking plant (Stage 1b) commencing in 2011. Depending on electricity demands, this facility may then be converted to a base load facility, with operations (as a base load facility) commencing around 2014.

A nominal timeline for the staged development of the facility is provided in Figure 4.

Thus the main activities for consideration in determining the water demands are as follows:

- EA Peaking facility construction;
- EA Peaking facility operation (ongoing);
- Delta Peaking facility construction;
- Delta Peaking facility operation (ongoing);
- Delta Baseload facility construction; and
- Delta Baseload facility operation (ongoing).

3.2 Water Demands

Water demands for each of the stages of operation were outlined in the earlier GHD report (GHD, 2008) and are summarised again here for completeness. There are a number of differing types of water demanded by the facilities with these being referred to as:

- Potable water which is necessary for domestic type uses (admin building, showering, drinking etc.);
- Demineralised water which is a high quality water required as part of the power station process; and
- Process water which has generally been referred to here as Non-Potable water. This water is required for various uses within the power stations and during construction. While a certain water quality will need to be achieved prior to use in the process, the uses do not preclude the use of a non-potable water source.

Nominal Timeline for Power Stations Construction and Commencement of Operations

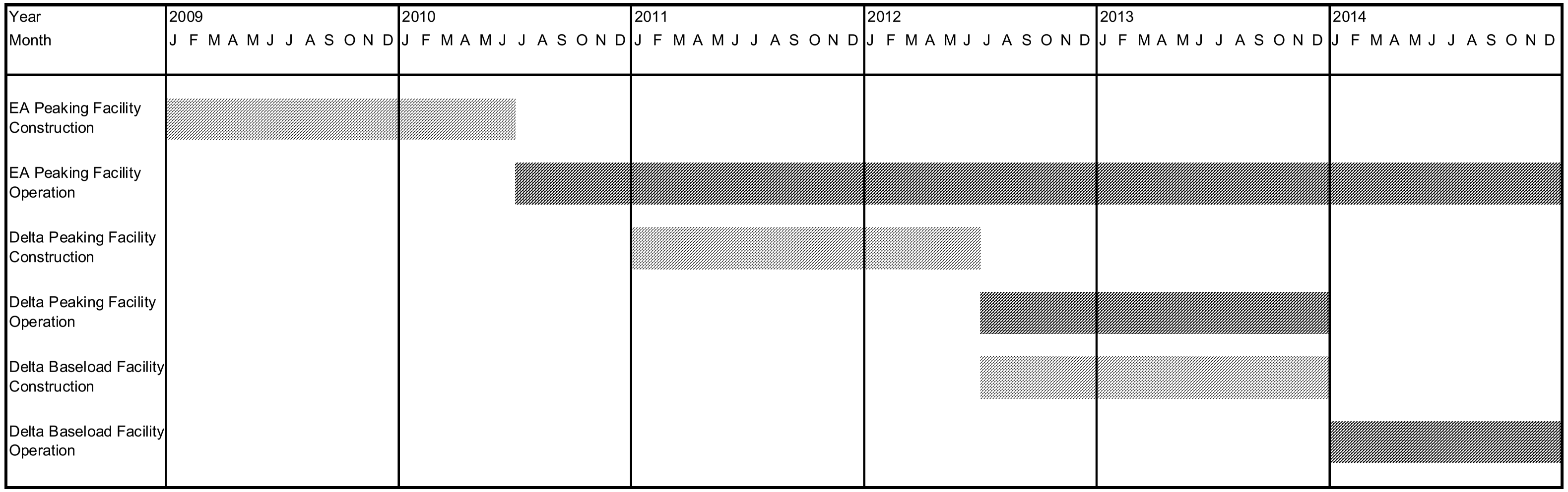


Figure 4 Nominal Timeline for Water Demands For Energy Australia (EA) and Delta Electricity (Delta)

The water demands for each of the water types (potable, demineralised and non-potable) by the stages of construction and operation are summarised as follows:

EA Construction - Referred to as *Preliminary Stage*

- Potable – Assumed negligible (Can be provided by small trucked supplies).
- Demineralised – Nil.
- Non-potable – 11.6 ML/a (based on 7 kL/day plus a further 100 kL/day during summer months (Dec – Feb)).

EA Operation (Peaking Facility) - Referred to as *Stage 1a*

- Potable – 0.04 ML/a.
- Demineralised – 0.0012 ML/a.
- Non-potable – 12.0 ML/a.

Delta Construction (Peaking Facility)

- Potable – Assumed negligible (can be provided by small trucked supplies).
- Demineralised – Nil.
- Non-potable – 11.6 ML/a (based on 7 kL/day plus a further 100 kL/day during summer months (Dec – Feb)).

Delta Operation (Peaking Facility) - Referred to as *Stage 1b*

- Potable – 0.2 ML/a.
- Demineralised – 0.2 ML/a.
- Non-potable – 3.2 ML/a.

Delta Construction (Baseload Facility)

- Potable – Assumed negligible.
- Demineralised – Nil.
- Non-potable – 11.6 ML/a (based on 7 kL/day plus a further 100 kL/day during summer months (Dec – Feb)).

EA and Delta Peaking Facilities operational, Delta baseload facility being constructed - Referred to as *Interim Period*

- Potable – 0.24 ML/a (As for EA and Delta Stage 1a and 1b).
- Demineralised – 0.2012 ML/a (As for EA and Delta Stage 1a and 1b).
- Non-potable – 26.8 ML/a (As for EA and Delta Stage 1a and 1b plus construction).

Delta Operation (Baseload Facility) - Referred to as *Stage 2*

- Potable – 0.7 ML/a.

- Demineralised – Produced on-site from service water.
- Non-potable – 63.5 ML/a.

In addition as the power stations commence operation, an initial start up volume is required. The 'start up' demands are required until the plants have reached equilibrium in the process mechanisms and the 'start up' demands will be replaced by 'recovered' (or internally recycled) water sources.

3.3 Summary

An overall summary of the staged water demands is provided in Table 1.

Table 1 Summary of Staged Water Demands

Staging	Units	Preliminary	Stage 1a	Stage 1b (construction)	Interim[3]	Stage 2
Works / Operations			EA peaking facility	EA peaking facility	EA peaking facility DE Peaking Facility	EA peaking facility, Delta base facility
Construction Activities		EA Peaking facility		DE Peaking Facility	Delta base load facility	
Year (Indicative timing only)		early 2009 – mid 2010	mid 2010	2011 – mid 2012	mid 2012 – 2013	2014 – onwards
Potable	ML/a	Assumed minimal	0.04	0.04	0.24	0.74
Demineralised	ML/a		0.0012	0.0012	0.2012	-
Non-Potable	ML/a	11.6[2] (construction activities)	12.0 (+ 7.4 EA startup[1])	12.0 + 11.6[2] (construction)	15.2 + 11.6[2] (construction)	75.5 (+ 53.5 Delta startup[1])
Total Water Demand[1]	ML/a	11.6	12.0	23.6	27.2	76.2

Notes: 1 - Startup volumes not included in total water demand (one off demand only). They will be required at the startup of the EA facility and Delta base load facility only.

2 - The construction demand assumes 7 kL/day plus 100 kL/day for 3 months/yr. Assumed a non-potable demand. Other construction water demands for potable water are assumed minimal

3 – Interim period refers to the period following construction of Stage 1 works and prior to Stage 2 works commencing and when the Delta Base load facility is being constructed.

The above figures were then used to determine a daily flow demand. The daily flow demand gives consideration to the variability in demands of peaking plants (which only operate for some 10% of the year), startup volumes and variations in water demands during construction. A list of assumptions in deriving the daily water demands is provided in Appendix A together with the water balances for the two facilities.

A contingency factor of 10% was added to the demands when undertaking the water balance modelling as described in Section 6. This is to account for system losses or unaccounted for demands).

4. Bulk Water Sources

4.1 Introduction

The GHD (May, 2008) *Water Impacts Report* identified a number of potential water sources to service the various water demands (types and quantity) required by various stages of the plants over construction and operative phases.

As noted, the gas-fired power stations generally require three different types of water sources being:

- Potable Domestic Water;
- Non-Potable Process Water; and
- Demineralised Water.

Water sources were therefore required which could meet the requirements of the water types or be treated to a level where they could meet these requirements.

It should be noted that a portion of the non-potable process water is supplied through an internal loop / recycle, which recovers some of the water from the process to be used again. This process is illustrated in the water balances in Appendix A.

It is noted that the demineralised water required for Stage 1 (incorporating both Stage 1a and 1b) of the power plants is minimal and this water could be supplied by tanker truck deliveries to the site. The demineralised water demands of the baseload facility for Delta (during Stage 2) are much greater, however at this stage the demineralised water would be produced on site (from the non-potable water). The Stage 2 demineralised demands for the EA Facility (which are the same as Stage 1 demands) are assumed to continue to be supplied via truck delivery, as the demands are very low.

As such, only sources of potable and non-potable water will be considered further here. The alternative sources of supply for these water types are outlined briefly below. For further details refer to the GHD report *"EnergyAustralia, Power Station Near Marulan – Water Impacts",* May 2008.

4.2 Potable Water Sources

The potential sources of potable water are summarised below along with a brief assessment of the potential opportunities and constraints.

4.2.1 Goulburn's Water Supply Network

Goulburn's water supply network is primarily from the Rossi Weir, with Pejar and Sooley dams providing water storage. However, Goulburn's water supply network is constrained as a source of potable water supply for the development as it is already a stressed resource and located a considerable distance from the site (that is, 30 kilometres). As such, Goulburn's Water Supply Network was not considered further as a source of potable water for the facilities.

4.2.2 Marulan's Water Supply Network

Marulan's water supply network is sourced from the Wollondilly River. The Goulburn Mulwaree Local Government Area (GMC LGA) has a licence to extract up to 200 ML/year from the Wollondilly River. Currently the licence's spare capacity is 80 ML/year, however due to anticipated future population growth, the final spare capacity is expected to be in the order of 10 ML/year for at least the next 4-5 years.

Marulan's Water Supply Network appears to be able to supply the facilities total potable water supply needs over the course of construction and operation. In addition, Marulan's Water Supply Network is located within close proximity to the site, that is, approximately 12 kilometres southwest of the site.

Furthermore, there may also be potential to source potable water for the 'non-potable' requirements until the existing spare capacity is taken up.

The water must be transported to the site as there is no existing reticulation network in the vicinity of the site. This could be achieved by either tankering or via a pipeline / pumping arrangement. These options are discussed further in Section 5.5.

4.2.3 Goulburn Water Pipeline (Potable / Non-potable water supply)

To transfer water from the Wingecarribee Reservoir to Goulburn as part of the Highlands Source Project, installation of a pipeline is in the planning process. The water will be classified 'raw' water, and would thus require treatment to be of potable quality (although may be suitable for 'non-potable' process requirements).

The pipeline is likely to pass in the vicinity of the power station sites and there is potential for spare capacity to be made available. However access to the water pipeline and any 'spare' water available was not favoured by Goulburn Mulwaree Council due to the advance nature and funding complexity of the project. Thus use of the pipeline was considered a secondary option which would only be investigated further if other options were found to have severe limitations.

4.2.4 Other Comments

Other potable water sources may include those further away such as within the Wingecarribee LGA. Wingecarribee Shire Council have indicated that there may be spare volumes available at its Sutton Forest urban filling station however this requires the transportation of water a significant distance when there are closer sources available (for example, the Marulan WTP). Consequently this option was not investigated further.

The transfer of potable water from its source (for example, Marulan water treatment plant) needs to be confirmed. The water may be tanked or a pipeline / pump station constructed to transfer the water. This is discussed further in Section 5.5.

4.3 Non-Potable Water Sources

The potential sources of non-potable water to service non potable demands are summarised below, along with a brief assessment of the potential opportunities and constraints.

4.3.1 Marulan Sewage Treatment Plant (STP) Effluent

Marulan's sewerage system currently operates as a common effluent drainage scheme (CED) whereby the discharge from individual septic tanks at each property drains to a sewage treatment plant (STP). The STP treats the wastewater and discharges it to an adjacent woodlot for irrigation. The existing STP is currently at or near capacity and augmentation works will be required. These works could coincide with any required upgrades to achieve an appropriate recycled water quality requirement.

GMC have indicated that following future development of Marulan the CED system will be replaced with a conventional sewerage system. Conventional type systems are often considered to have higher flows per person as all household wastes drain to the sewer. This does not necessarily occur in a CED system. Thus flows for the existing system could increase from the 60 ML/a to more than 80 ML/a with the conversion to a conventional system (assuming the wastewater per person increases from 150 L/person/day to around 200L/person/day). GMC have not indicated precisely when the conversion of the sewerage system will occur although Council have initiated planning works for the upgrade of the system. Some preliminary advice (Refer to Appendix B) included indicative timings for a recycled water scheme upgrade to commence in 2013 and which might be expected to coincide with the upgrade of the sewerage system from a CED system to a conventional system,

Following development of Marulan (population growth) and the implementation of the new conventional sewerage system, the existing 60 ML/a of STP effluent will increase to around 3.2 ML/day or 1100 ML/year (Source: GHD, *"Marulan Township Development, Sewerage Master Plan"*, August 2005). It is noted that GMC have indicated that revised estimates are currently being prepared.

The opportunity to utilise the effluent from Marulan STP appears favourable due to its close proximity to the development site (that is, approximately 12 km southwest of the site). Based on the technology adopted, the effluent quality from the existing STP is not expected to be good. The Protection of the Environment Operations (General) Regulation 1998 provides generic emission factors for small STPs in NSW. Thus for the existing Marulan STP (an oxidation / maturation pond type system), the following effluent quality (existing) could be expected at best (noting that given the system is at or above capacity, the effluent quality could potentially be poorer than this):

- Biological Oxygen Demand (BOD) – 30 mg/L;
- Suspended Solids (SS) – 40 mg/L;
- Total Nitrogen (TN) – 40 mg/L;
- Total Phosphorous (TP) – 10 mg/L and
- Oil and grease – 10 mg/L.

4.3.2 Wingecarribee Council Moss Vale Treated Effluent

Wingecarribee Shire Council (WSC) confirmed that it currently treated in the order of 600 ML/year of effluent from its Moss Vale STP and that this volume could be available for reuse.

The Moss Vale Sewerage Treatment Plant (STP) is a secondary treatment plant (IDEA, Intermittently Decanted, Extended Aeration type plant) with dosing for phosphorous removal. The plant is located in Kennedy Close, Moss Vale. The STP accepts predominantly domestic sewage and after treatment the effluent is currently discharged into Whites Creek (a local waterway). The Average Dry Weather Flow (ADWF) is currently some 2.1 ML/day. The current discharge licence limits for the site include a 100 percentile concentration limit for nitrogen of 15 mg/L. This is considered reasonably stringent for a secondary treatment plant and may indicate that extensive further treatment is not required (refer to Section 5 for a brief outline of the impact of nutrients such as nitrogen and phosphorous).

Based on the technology adopted, the effluent quality from the existing STP is expected to be reasonable. As noted above, the Protection of the Environment Operations (General) Regulation 1998 provides generic emission factors for small STP's in NSW. Thus for the existing Moss Vale STP (an Extended aeration plant with chemical P removal), the following effluent quality (existing) could be expected:

- BOD – 15 mg/L;
- SS – 15 mg/L;
- TN – 20 mg/L (although discharge licence is 15 mg/L indicating better quality effluent is being achieved)
- TP – 1 mg/L; and
- Oil and grease – 10 mg/L.

The upgrades to the treatment plant would therefore likely include tertiary filtration (for example, sand filter) and potentially upgraded disinfection (for example, chlorination). It is understood the current method of disinfection is UV, which could have implications in terms of residual disinfection over potentially long detention times within the transfer pipeline. An upgrade of the disinfection system may hence be required.

During more detailed planning, the actual quality of the effluent would need to be reviewed to determine its suitability for use at the power stations. Furthermore, the effluent would need to be transferred some 33 km to the plant. The effluent would be available immediately (although this is dependent on the quality / disinfection requirements. As such, utilising the effluent produced from WSC would be considered further as a source of non-potable water for the development.

4.3.3 Recycled Water from Marulan Industrial Effluent

Marulan's sources of industrial effluent are currently limited to a few highway petrol stations. As such, the flows of water received from industrial sources would likely not be substantial. In addition, the wastewater from these petrol stations is currently discharged to the Marulan STP. As such the Marulan STP would likely be a more reliable and beneficial source of effluent for non-potable source water. Therefore, utilising the effluent from Marulan Industrial Effluent alone would not be considered further as a source of non-potable water for the development.

4.3.4 Groundwater

Groundwater in the GMC area is dominated by the fractured rocks of the Lachlan Fold Belt, which are generally poor aquifers.

While no specific groundwater investigations have been conducted at the site, Environmental Impact Assessments (EIAs) were conducted for a nearby quarry (Gunlake) to show that a registered bore, used for rural purposes, had a low yield rate (2.9L/s) and groundwater that was unsuitable. In addition, a Water Management Strategy (WMS) conducted by PB (2007) indicated that groundwater quality was quite variable with salinity ranging from 400-7500 ppm, however it is expected that the higher salinities would be located in lower lying areas such as the gas fired power plant development site.

As the groundwater in the Marulan area is likely to be of unreliable yield and quality, utilising groundwater as a source of non-potable water for the development would not be considered further.

4.3.5 Wollondilly River Water

The Wollondilly River is located immediately northeast of the development site. The Wollondilly River flows are relatively high compared to the development sites demands. However, there is a risk that the Wollondilly River flows will be estimated as not having any flows somewhere between 0-32% of the time.

Water from the Wollondilly River would only be able to be extracted with an access licence under the Water Act 1912, (although this is progressively moving towards the Water Management Act 2000). Access to water through either the purchase of existing access licenses or a new license, is likely to be difficult or greatly restricted. In addition, the quality of water in the Wollondilly River was examined in the GMC Water Management Strategy (PB, 2007) where it was found that the health of the river is severely compromised and subject to high nutrient loads.

As such, extraction of water from the Wollondilly River will not be considered further as a source of non-potable water for the development due to the water source potentially being quality compromised (requiring treatment), requiring an additional substitutional source of water (when the River does not flow), and potentially being subject to a moratorium on extraction licences.

4.3.6 Stormwater Runoff

GHD conducted stormwater runoff modelling on the proposed development site. The development site is approximately 116 hectares, of which 18.6% is considered to be impermeable handstand and roof area. The preliminary modelling showed that much of the non-potable demand could be satisfied with the capture of stormwater runoff if adequate storage volumes could be provided. The previous modelling indicated that storage volumes in the order of 10 – 20 ML maybe required. Given the large water demands, rainwater from roof buildings (which may, typically, be more readily controlled in terms of water quality) is insufficient as a sole water source. Thus roofwater runoff has been considered together with stormwater runoff from the site only.

Storage volumes of this size would typically require the construction of dams and would occupy a reasonable area of the site. Furthermore, the stored water is then subject to environmental impacts (temperature, flora and fauna etc.), which may influence water quality.

However, given the relative availability of the source, stormwater runoff will be considered further as a source of non-potable water for the development site, dependent on a viable stormwater storage option being available and quality considerations.

4.3.7 Onsite Wastewater Recycling

Wastewater generated from the development site will be generated as a result of domestic and process water. The process water is likely to be of very poor quality and treatment is generally not feasible. In addition, the site is a net water user (losing water to processes), and as such if onsite wastewater recycling was to take place it would require substitution by an additional source of non-potable water.

As such, onsite wastewater recycling will not be considered further as a source of non-potable water for the development as the quality and quantity of effluent supplied would not be sufficient to cater for the site demands.

4.3.8 Other considerations

For potable water, the issue of transport of the water to the site will need to be considered. Water could be delivered via tanker or pipeline / pump station. There are alternative water sources such as that from the Suttons Forest filling point (as mentioned in Section 4.2.4) although these are more remote and require significant transportation distances. Such options would only be considered if the others nominated above were found to be unviable.

All sources of water either captured or treated onsite, will require some degree of storage. In addition, some supplies of water sourced from offsite may require onsite storage. Storage options and comments include the following.

- Offsite storage dams- for example the Tallong Railway dam, which is located closest to the site (some 0-10 kilometres from the site). The dam has a capacity of some 318 ML and is owned by the State Rail Authority. Using dams as a source of water would be considered if short falls were identified in the overall water strategy.

- Onsite aboveground storage is generally suitable for storage sizes less than 1-2 ML. Storage sizes greater than 1-2 ML generally require surface storages.
- Onsite surface storage volumetric capacity depends on the nature of the site. The proposed development size has a relief of some 50m over the site with several drainage lines apparent which could be candidates for onsite storage. The viability and volumetric capacity of these onsite drainage lines would require determining during detailed planning. Numerous farm dams have been successfully located on adjacent properties.

4.4 Summary of Water Supply Options

The following table provides a summary of all the water supply options discussed. Based on the options as described above, the brief descriptions given and discussions provided in the previous GHD report, a comment and rating is provided as to whether they have been considered further as part of a water servicing option.

Table 2 Water Supply Options for Further Consideration

Water Type / Demand	Source Options	Comment	Further consider?
Potable	Goulburn Water Supply Network	Water source is more remote but adequate available within Marulan's supply	No
	Marulan Water Supply Network	Preferred source for potable water supply. Water could be piped or tankered to site. Some 10 ML pa is available over the first 4 years	Yes
Non-potable	Marulan's Sewage Treatment Plant (STP) Effluent	STP is some 12 km from the site. STP upgrade required. Need to transfer to the site. Current volumes available in the order of 0.2 ML/d (approx 73 ML/a)	Yes
	Wingecarribee Council Moss Vale Treated Effluent	Source is some 30 km northeast of the site. Need to transfer to the site. Some 600 ML/a available.	Yes
	Industrial Effluent	Limited industrial effluent and already passes to Marulan STP. Not considered further	No
	Groundwater	Groundwater is likely to be of unreliable yield and quality,	No
	Wollondilly River Water	Likely issues with obtaining extraction license, community acceptability and potential water quality issues	No

Water Type / Demand	Source Options	Comment	Further consider?
	Stormwater Runoff	The amount available for use as a non-potable source is dependent on storage available. Some 110 ML/a (approx.) is available based on a 20 ML storage	Yes
	Onsite wastewater recycling (domestic)	Insufficient domestic wastewater available to meet requirements. Assume this will be treated and disposed onsite or alternatively tankered to Marulan STP.	No
	External sources	Water could be sourced from other sites such as Sutton Forest (potable water) and tankered to the site. Given the higher transport requirements, this is more likely to be a 'back-up' option.	No

In general, and as concluded in the previous GHD report, there are a number of water source options available to meet the water demands outlined in Section 3. For potable water demands, the main option for further consideration is potable water from the Marulan WTP. For non-potable water demands, the water source options for further consideration include Marulan STP effluent, Moss Vale STP effluent and stormwater runoff.

5. Options Development

5.1 General Overview

Based on the water demands (for potable, demineralised and non-potable water as identified in Section 3.3) and the available supply options for each of these demands (as identified in Section 4.4) a range of options, which would form part of an integrated water servicing strategy, have been identified.

The sub options as part of a water servicing strategy (based on water demand type) have been summarised in Table 3.

Table 3 Summary of Servicing Options

	Target Water Supply volumes[1] (ML pa)	**Option PW1**	**Option PW2**	
Potable Water (PW)	0.74	Tank Delivery from Marulan WTP	Pipeline delivery from Marulan WTP	-
		Option DM1		
Demin. Water	0.2012	Truck delivery for EA and demin. Plant for DE.	-	-
		Option NPW1	**Option NPW2**	**Option NPW3**
Non-potable Water	75.5	Supply of R.W from Marulan STP	Supply of R.W from Moss Vale STP	Capture and onsite storage of rainwater. Offsite storage to be considered if not found to be practical during concept design. Top up with potable water.

Notes: 1 Based on ongoing annual operational demand volumes (that is, doesn't allow for short term peaks associated with 'startup' volumes or construction periods)

Any of the above options for each of the water demand types (for example, potable, non-potable) could be adopted in conjunction with the other options (for example, PW1 with DM1 and NPW2) to create a servicing strategy option.

From the above table it is noted that the demineralised water requirements are satisfied by a single option (DM1). The potable water demands will be satisfied through supply from the Marulan WTP and the options outlined are associated with the method of delivery (that is, pipeline or trucking). It is noted that the method of delivery will not affect the water balance. The supply of potable water is considered a sub option to the water servicing strategy as there is adequate supply available. The selection of the potable water option is discussed further in Section 5.5.

Therefore it is noted that the main variations in any water servicing strategy option will be associated with the non-potable water source options (this is also the largest water demand). Thus the water servicing strategies have been differentiated on the basis of their non-potable water source. The options are as follows:

- Option NPW1 – Marulan STP Effluent Option;
- Option NPW2 – Moss Vale STP Effluent Option; and
- Option NPW3 – Stormwater Servicing Option.

For all of the options, it is noted that there may be a need for top-up water if the nominated water sources cannot fulfil the water demands at a given time.

An overview of each of the servicing strategies is provided in the following sections. In order to review the relative merits of each of the options, a basic conceptual outline of each of the options was developed. This is provided in each of the following sections.

5.2 Servicing Strategy Option NPW1 – Marulan STP Effluent

Potable Water - the facilities would be supplied with potable water from Marulan's Water Treatment Plant (WTP). As noted in Section 4.2.2, there is currently some 80 ML/a spare water (compared to the extraction licence) although the likely supply to the power station facilities is some 10 ML/a (over the next 4-5 years) following identified development within the Marulan area. As the target water demand is less than 1 ML/a, it is considered that there should be adequate capacity to reliably meet the long term demand of the facilities.

The two concept arrangements for the potable water supply are outlined in Section 5.5.

Some (excess) potable water may also be available in the short and longer term (from the current 10 ML/a available from Council over the next 4-5 years, and then a decreasing amount as urban development of Marulan is realised) to satisfy the non-potable demands. This is particularly considered to be beneficial where short term shortages of non-potable water occur. This issue is detailed further in the sections outlining the non-potable demands.

Demineralised Water – Demineralised water (some 1,200 litres) for the EA facility would initially be supplied by road transport (for example, 1m^3 (1000L) bulk containers or small tanker deliveries). Similarly the Stage 1b Delta peaking facility would also be supplied by tanker or bulk demineralised water deliveries (an additional 200,000L/a) for a short period. While the volumes are small it is likely that these volumes would need to be sourced from Sydney or a similar major urban centre.

Following commencement of operation of the Stage 2 Delta facility, demineralised water will be generated by the onsite water treatment plant, (which is proposed to be part of the Delta facility) from the non-potable water supply. It is considered a commercial decision as to whether the Delta demineralised water plant could be sized to cater for the ongoing EA demand (rather than continuously trucking in demineralised water). For the ease of consideration (and given that such small volumes are required) it has been assumed that EA will continue to source their demineralised water requirement via road transport.

Non-Potable Water – Non-Potable water will be supplied by effluent from the Marulan STP. At present the STP generates some 60 ML/a but this is expected to increase with future development of the area and a change of sewerage system from a CED type system to a more conventional type of sewerage system (that is, untreated sewage delivered directly to the STP via gravity / rising main type system or similar). Further discussion on the timing and volumes of the increased flows are provided in Section 6.3.2. This option will require the upgrade of the Marulan STP and the transfer of effluent from the STP to the power station facilities via a pipeline arrangement. The Marulan STP will need to be upgraded to produce an effluent quality that is suitable for use at the power station facilities.

However, while the potable and non-potable pipelines, storage and treatment infrastructure are being constructed at Marulan WTP and STP, tanker transport of potable water from Marulan may be required to supply both the potable and to supplement non-potable demands. It should be noted that for the initial two years of development the site requires approximately 7 kL of water per day (this is equivalent to an average of a tanker delivery every 2 days to the site), with higher demands during summer months.

It may be possible to build the Marulan potable and non-potable water supply pipelines from Marulan to the site alongside each other, as they would follow the same route for a large portion of the pipeline length. Alternatively, if potable water is used to supply all water demands (that is, potable and non-potable) in the short term until the upgraded Marulan STP is operational, then a single pipeline could be installed. The pipeline (nominally a 90 mm diameter pipeline) would be used in the short term to supply potable water, which could then be converted for use as a non-potable water pipeline when the Marulan STP is upgraded. Potable water would then be tankered to site.

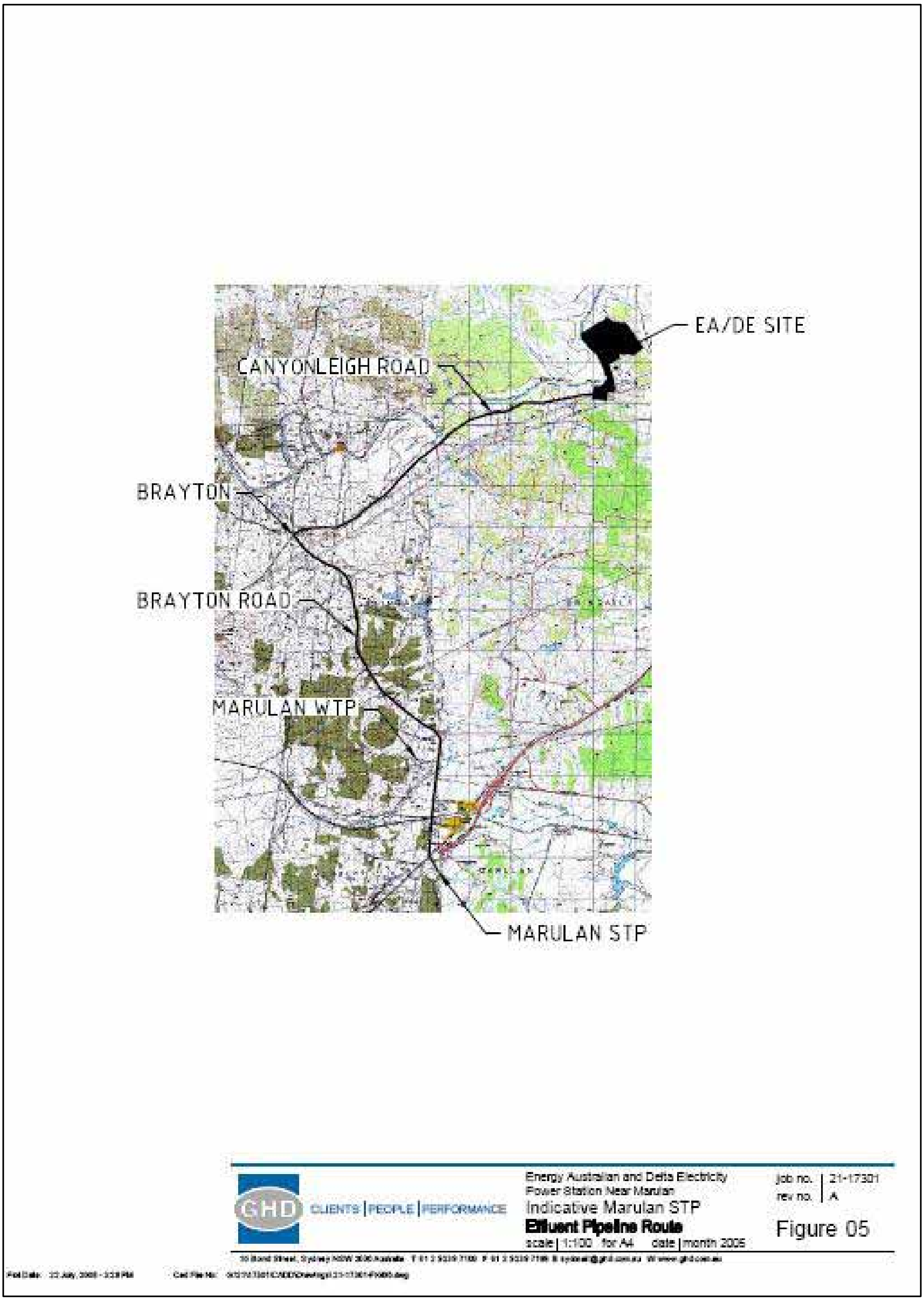
Concept Overview

The Marulan STP flows of 80 ML/a (with conversion to a conventional system but excluding predicted future development) marginally exceed the ongoing, maximum operational, annual demand of the two facilities, which is some 76 ML/a.

Tertiary treated effluent would be pumped from the upgraded Marulan STP to a shared storage tank (some 2 ML) at the power station facility. An indicative pipeline route, as shown in Figure 5, is some 19 km. The pipeline route has been selected so that it will follow a similar path to the potable water pipeline to the extent possible. It is noted that AS/NZS 3500.1:2003 (Plumbing and drainage, Part 1) indicates that in relation to (water and non-drinking water sources) pipelines (from the point of connection to the point of discharge), the non-drinking water services shall not be installed within 300 mm of any parallel drinking water supply for below-ground installations.

Where possible, the alignment of the pipeline route will follow road easements or similar.

Figure 5 Marulan STP Indicative Pipeline Route



5.3 Servicing Strategy Option NPW2 – Moss Vale STP Effluent

Potable Water – As above (vis 5.2).

Demineralised Water – As above (vis 5.2).

Non-Potable Water – Non-Potable water will be supplied by effluent from the Moss Vale STP (within the WSC LGA). This STP generates some 600 ML/a and therefore there is an ample and reliable supply of non-potable water.

The Moss Vale STP currently produces a secondary treated, disinfected effluent that may be suitable for transfer and use within the power stations, as is. However it is considered more likely that tertiary treatment (for example, sand filtration) and higher levels of disinfection would need to be implemented to ensure a higher quality water is delivered to the power stations. It is also noted that nutrient removal (particularly relating to ammonia) may be warranted as this can result in bio-fouling of membranes (as used in the Microfiltration / Reverse Osmosis (MF/RO) treatment process). This would need to be negotiated with WSC but would also be dependent on the selection of the treatment technology (that is, MF/RO plant) adopted at the power station/s.

Other infrastructure would include a transfer pipeline from Moss Vale STP. As for the Marulan STP effluent option, while the STP treatment upgrade, transfer pipeline and storage are being constructed at the Moss Vale STP, it may be necessary to supply both the potable and non-potable demands via tanker transport of potable water from the Marulan WTP.

Concept Overview

The treated effluent would be pumped from the Moss Vale STP to a shared storage tank (100 kL) at the power station facility. The indicative pipeline route as shown in Figure 6 is some 32.5km. Where possible, the alignment of the pipeline will follow road easements or the power transmission line (near power transmission line easement).

5.4 Servicing Strategy Option NPW3 – Stormwater Runoff

Potable Water – See Section 5.2.

Demineralised Water – See Section 5.2.

Non-Potable Water - Servicing Strategy Option NPW 3 involves supplying the development with non-potable water via stormwater harvesting and treatment. It is likely that the relief at the site would be capable of storing large volumes of stormwater. A stormwater storage volume of some 5 ML was allowed for on the site with indicative storage locations as shown in Figure 7. The nominated storage volume was found to be able (within an average rainfall year) to meet the needs of the facility and was found to be able to be comfortably accommodated on site as shown in the Figure. (It is noted that the variability of rainfall events necessitates large storages in order to reduce the deficits which may occur). The stormwater would then require treatment and post-treatment storage prior to being utilised on the site. Deficits in stormwater would nominally be met by substituted potable water via Marulan's Water Supply Network.

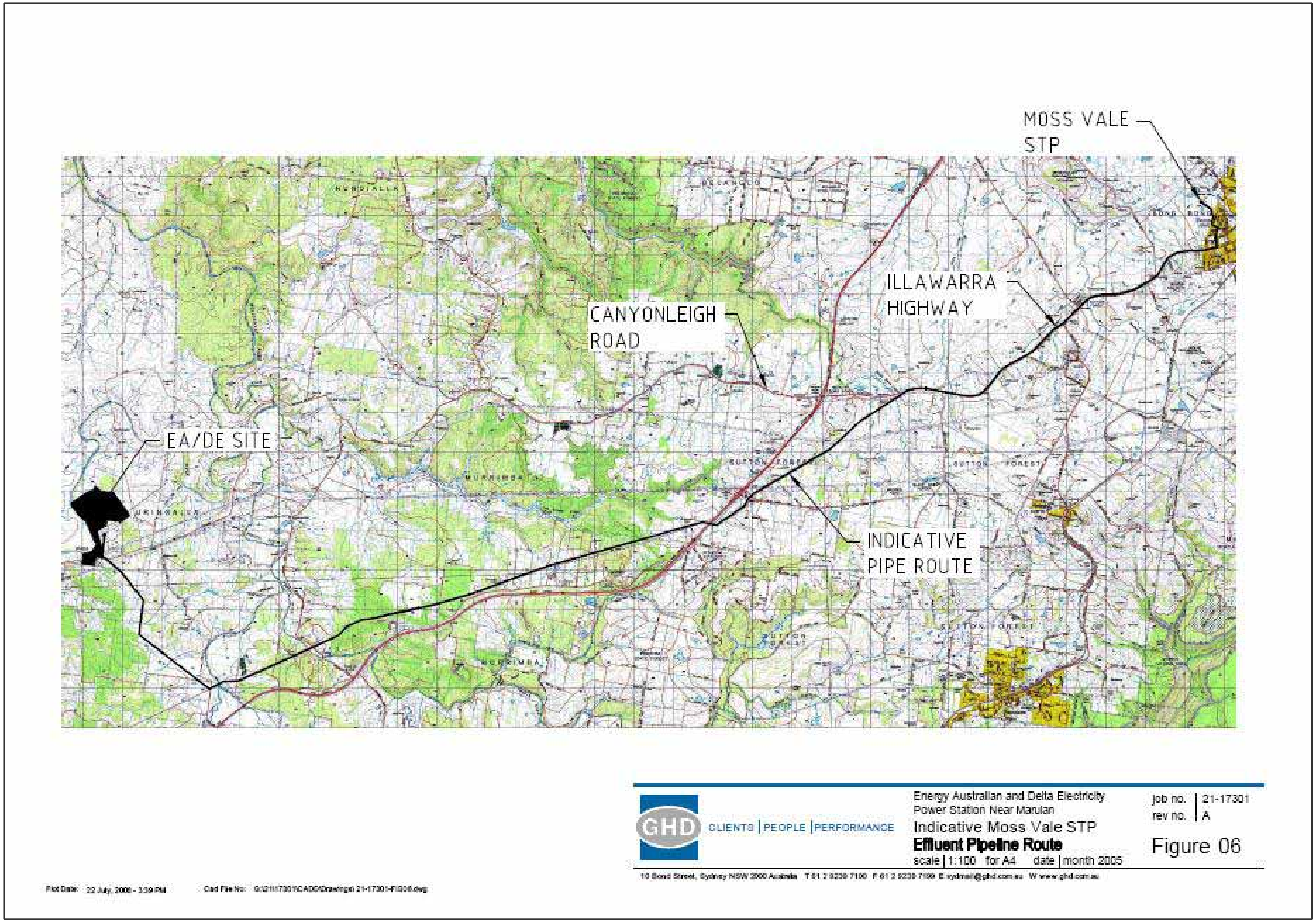


Figure 6 Moss Vale STP Indicative Pipeline Route

Concept Overview

In preparing the water balance model for the stormwater runoff option, consideration was given to the likely areas of runoff capture, likely runoff volumes and location of storages. These are shown in Figure 7.

If a stormwater capture type system were implemented, the following infrastructure could be adopted as a concept overview for the option:

- A first flush type system which would divert the first 15 mm of stormwater;
- Dual storages of 2.5 ML each;
- Swale /drainage channels to divert clean water around the facility and connect to the two storage basins; and
- Stormwater treatment system for runoff from the facility.

The previous GHD report noted that a number of challenges exist in the harvesting of surface runoff including the following.

- o Ensuring the site topography is configured to allow surface runoff to be directed to storage dams- the revised modelling has considered the likely configuration and hence the likely reasonable volumes of stormwater capture.
- o Ensuring runoff water is suitable for reuse- this could be determined when details of the site facilities are well known (for example, confirmed layouts, activities, earthworks etc.). This would involve stormwater quality modelling to determine the extent of treatment required. At this stage, allowance has been made within the scope of the option for a generic stormwater treatment system which may involve a bio-retention system or similar.

5.5 Common to all Options - Potable Water Supply

As previously discussed, potable water from the Marulan WTP can be used to satisfy the potable water demand. There is also likely to be some system capacity to assist in meeting the short term demands (such as during construction) of the facilities. Further the WTP could potentially assist in system top-ups if the non-potable water sources cannot meet the system demands. The long term availability of this water supply (particularly as a top-up for non-potable uses) will be dependent on future development and infrastructure upgrades within the region.

The two concept options for the potable water supply involve either the tankering of water or the construction of a pipeline and pumping facilities. The selection of an option will be influenced by the selection of the non-potable water supply option and hence the required need for potable water top-up. A brief concept overview of the two options is provided in the following section.

Concept Overview – Tankering (Option PW1)

Based on a 15m^3 tanker size for potable water delivery, the total number of truck movements to supply the potable demand only will range from 3 truck movements per year (Stage 1a) through to around 50 truck movements per year (Stage 2). However, it is noted that more frequent deliveries are likely to be required to maintain a 'fresh' potable water supply. An onsite storage would also be required and this would likely be less than 20 kL.

Concept Overview – Pipeline (Option PW2)

The potable water supply would nominally comprise a new pipeline and pump station directly from the WTP to the power station facilities. It is noted that a closer connection point to the existing water reticulation network may be available (subject to confirmation from council regarding capacity) although the difference in pipe lengths is expected to be minimal. Hence the basis for the assessment was via an off-take directly from the Marulan WTP. The pipeline route was assumed to follow the Marulan STP Effluent pipeline as shown in Figure 5. The pipeline diameter was assumed to be 40 mm.

It is noted that while the pipeline from Marulan's WTP to the site is being constructed, it may be necessary to use tankered potable water. The tankered potable water would be required to be stored onsite in a small storage vessel, likely to be less than 20 kL.

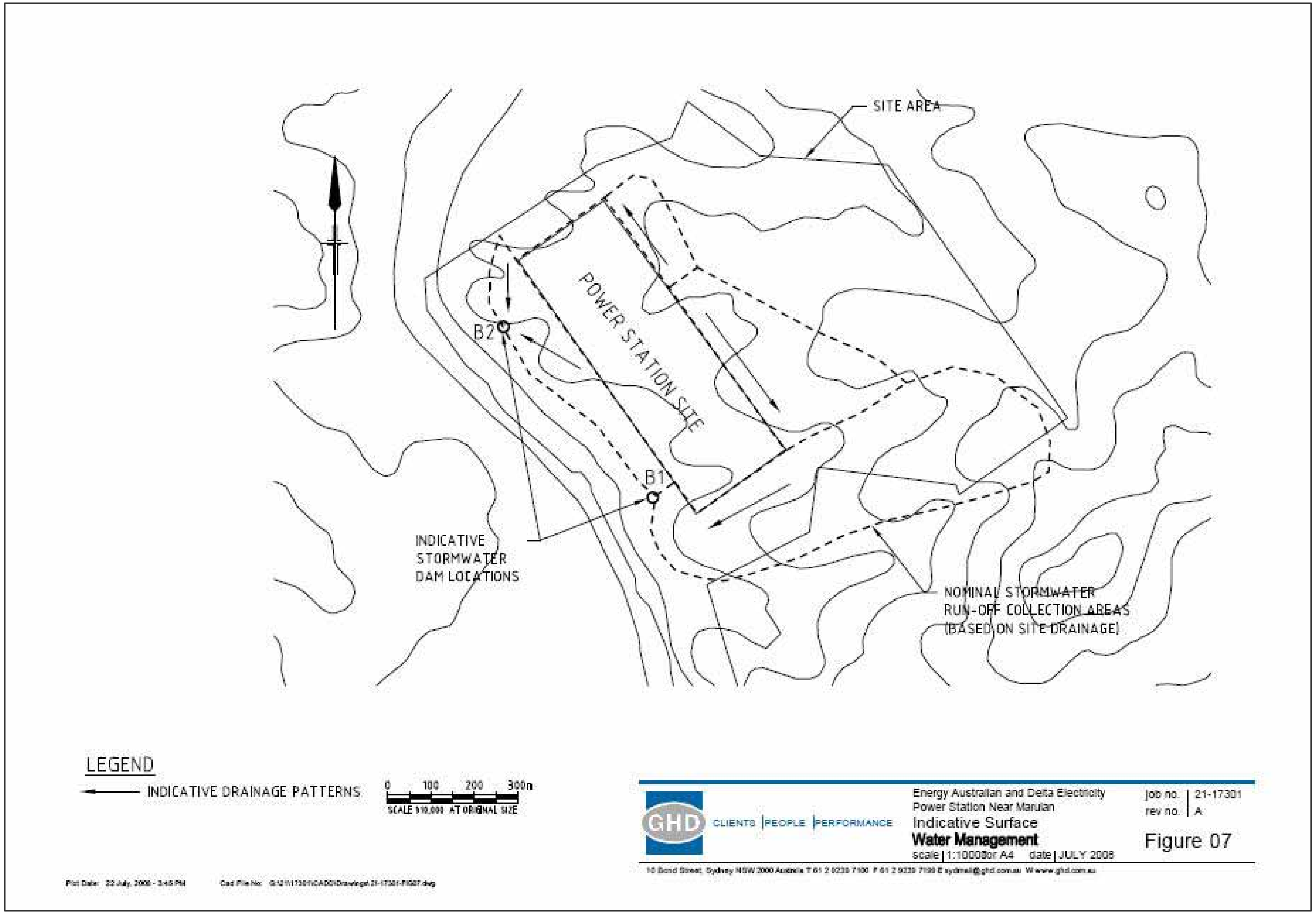


Figure 7 Indicative Stormwater Capture Figure

6. Water Balance Modelling

6.1 Integrated Water Management Toolkit

Water balance modelling was carried out to assess the performance of the short listed options outlined in Section 5. An Integrated Water Management Toolkit (IWM Toolkit), developed by GHD, was used to carry out the water balance modelling. It is useful for evaluating water servicing strategies for various developments as it can consider multiple water sources, water demands and multiple facilities / lots concurrently.

The toolkit uses an intuitive graphical interface to construct alternative water servicing strategies. The model determines time-varying demands and water balances for each time-step for designated elements of the water cycle, which may include: potable water; sewage; recycled water; roof rainwater; stormwater; and groundwater. Calculations carried out within the various Toolkit elements utilise the technical knowledge and industry practice to ensure good accuracy of the results.

In this instance, the water balance was constructed to determine whether the nominated water supply options could satisfy the time varying demands of the power station facilities. In particular it was necessary to determine if there were likely to be any shortfalls (particularly relating to non-potable water supply).

6.2 Input Data - Water Demands

The water demands of the various stages of the development were outlined in Section 3. These were summarised earlier in Table 1.

The data from this table where then used to determine a daily flow demand. The daily flow demand gives consideration to the variability in demands of peaking plants (which only operate for some 10% of the year), startup volumes, and variations in water demands during construction. A list of assumptions in deriving the daily water demands is provided in Appendix A together with the water balances for the facilities.

A contingency factor of 10% was added to the demands when undertaking the modelling to account for system losses or unaccounted for demands.

6.3 Input Data – Water Supply

6.3.1 Marulan Potable

GMC have advised that there is currently about 10 ML/a spare capacity from the Marulan WTP which should be available for around 4 – 5 years and potentially longer. The long term availability of this water supply will be dependent on future development and infrastructure upgrades within the region.

While there would appear to be a reasonable potential for the Marulan WTP to meet the potable water demands there is also likely to be some system capacity to assist in meeting the short term demands such as during construction of the facilities. Further the WTP could potentially assist in system top-ups if the non-potable water sources cannot meet the system demands.

In order to determine the deficits in the non-potable supply, the potable supply was assumed to be unlimited. Comment is provided in the results about the overall potable supply / demand to satisfy both potable demand as well as non-potable demand ‘top-up’.

6.3.2 Marulan STP Effluent

The Marulan STP effluent volumes are currently some 60 ML/a although with the changeover from a CED system to a conventional sewerage system, the effluent volumes will likely increase immediately (refer to Section 4.3.1 for further details). The STP effluent volumes available have been assumed to start at 60 ML/a (2008) and to increase by 10% per year. An initial onsite storage volume of 100 kL was selected in order to maintain security of supply and balance peak flow demands with supply. The appropriateness of this assumption is discussed further in Section 6.4.1. and a final storage volume of 2 ML was selected and allowed for in the Option Development (concept outline).

6.3.3 Moss Vale STP Effluent

The Moss Vale effluent volumes currently significantly exceed the required demands of the power station facility in both the short term and at full development (that is, with the Delta base load facility online). As there are adequate volumes available, a delivery rate of 120 ML/a (that is, approximately 150% of the peak ongoing annual demand) was selected in the model. For Option 1 a storage volume of 100 kL was initially selected.

6.3.4 Surfacewater runoff

In determining the volumes of surfacewater runoff from the site, an area was first selected as being a likely catchment area for stormwater harvesting. This was based on preliminary site layouts, available topography and drainage lines. An indicative schematic of the area for surfacewater harvesting is shown in Figure 7. It should be noted that this differs to the calculations undertaken in the original GHD (May 2008) report where the entire site was considered to be available for stormwater harvesting.

To determine the likely yield from the site, an EPA_SWMM model was compiled and simulated with daily rainfall obtained from the Bureau of Meteorology from the nearby Goulburn TAFE (Station no. 070263) daily rainfall gauge. The model was simulated for 30 years of rainfall and an average year was selected. The model was then simulated for the average rainfall year (1993) to provide an indication of the likely volumes and variability of volumes on a daily basis. The average year was then applied over the life of the water balance (that is, from 2008 – 2015) using the IWM tool as outlined above.

A stormwater storage volume of some 5 ML was allowed for on the site, with indicative storage locations as shown in Figure 7. The nominated storage volume was found to be able to meet the needs of the facility within an average rainfall year, and was found to be able to be comfortably accommodated on site as shown in this Figure.

Should this option be progressed, it will be necessary to determine more accurate drainage patterns, catchment areas (which will also be dependent on proposed earthworks), as well as consider the reliability of providing adequate volumes given a range of climatic conditions. That is, a climate sensitivity analysis which considers the use of wet, dry and average rainfall years. It is noted that the use of an average rainfall year should be adopted as indicative only as it will not represent the long term variability in rainfall (and hence available water) that could be expected.

6.4 Water Balance Results

Water balance models were constructed for each of the three options. Figure 8 shows the model configuration plot for Option NPW1. It was not considered necessary to include the configuration plots for the other two options as they are reasonably similar in appearance. The results of the water balance for each of the options is provided in the following sub sections.

6.4.1 Option NPW1 - Marulan STP Effluent

As noted, an initial storage volume of some 0.1 ML was selected for the Marulan STP effluent storage at the power station facility. However, given the large peaks associated with start up volumes and summer construction periods, the available storage was considered insufficient to meet the non-potable water demands, and an alternative water source would be required to supplement the STP effluent to the volume of 22 ML over the 2008 – 2015 period. Thus the storage size was increased to some 2 ML and the model rerun.

The results of the Modelling of Option NPW1 with a 2 ML storage over the period 2008 – 2015 are presented graphically in Figure 9. From this Figure it can be noted that although potable top-up of the non-potable supply is required, this is generally limited to a few periods when peaks occur, for example, summer construction periods, start up of facilities, peaking periods.

The total potable water top-up over the nominated period (2008 – 2015) is some 9.2 ML, with a peak period of 3.5 ML/a required in early 2014 in a period coinciding with a requirement for start up volumes for the Delta baseload facility together with a ‘peaking’ period for EA. These volumes may be able to be satisfied with the potable supply as it doesn’t exceed the 10 ML/a nominated as available over the next 4 – 5 years. It is noted that the ongoing (that is, once all facilities are operational) potable water top-up required is still some 1 ML/a but this demand is limited to peaking periods.

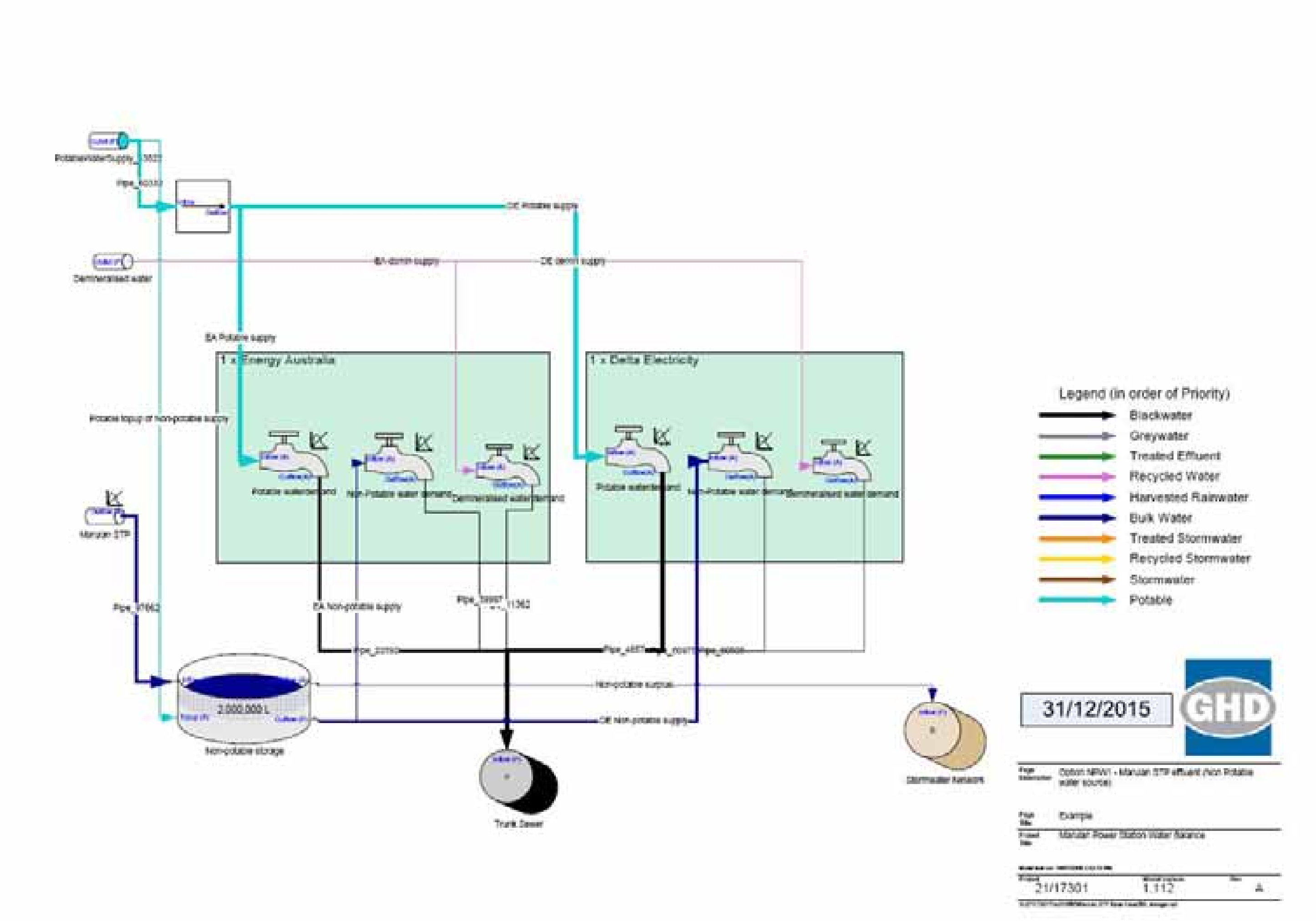


Figure 8 Option NPW1 – Marulan STP Effluent Model Configuration Plot

Alternatively the non-potable top-up may be able to be satisfied by small onsite rainwater harvesting from the roofs of onsite buildings. This would not generate the same volumes identified for Option NPW3 but may be adequate to meet top-up needs (storage would also be required), and the quality could be more readily controlled than for Option NPW3 given that only roofwater would be collected. Determining whether adequate volume was available could be determined in more detailed planning stages.

If the supply from the Marulan STP is found to be greater than that assumed, that is, commencing at 60 ML/a and increasing by 10% p.a., then the nominated storage volume may be able to be reduced significantly and potentially be more comparable to that of Option NPW2.

6.4.2 Option NPW 2 - Moss Vale STP Effluent

The results of the Modelling of Option NPW2 with a 0.1 ML storage over the period 2009 – 2015 are presented graphically in Figure 10. From this Figure it can be noted that although (potable) top-up of the non-potable supply is required, this is generally limited to a few periods when peaks occur, for example, summer construction periods, startup of facilities and peaking periods.

The total potable water top-up over the nominated period (2009 – 2015) is some 2.4 ML with a peak volume of 1.5 ML/a required in early 2014 in a period coinciding with a requirement for startup volumes for the Delta baseload facility together with a 'peaking' period for EA. As for Option 1, these volumes may be able to be satisfied with the potable supply as it doesn't exceed the 10 ML/a nominated as available over the next 4 – 5 years. It is noted that the ongoing (that is, once all facilities are operational) potable water top-up required is still some 0.6 ML/a but this demand is limited to peaking periods.

It is noted that the nominated supply rate, based on a deliverable flowrate of 120 ML/a, is better able to supply the peak demands of the facility and results in a smaller onsite storage being required. Furthermore by slightly increasing either the storage or pump rate of delivery, the top-up of the non-potable system could potentially be avoided completely.

6.4.3 Option NPW3 - Surfacewater runoff

The results of the modelling of Option NPW3 with a 5 ML storage over the period to 2015 are presented graphically in Figure 11. From this Figure it can be noted that potable top-up of the non-potable supply is not required, and that capture of stormwater runoff will satisfy the long term demands of the power station facilities. It should however be noted that the modelling was based on an average rainfall year and applied over the period of consideration. It is likely that over this period rainfall may vary substantially below (and above) the average rainfall conditions and a significant shortfall in non-potable water supply could result. This could be addressed by increasing the storage volumes to allow for greater capture of stormwater over a longer period to buffer low rainfall periods. Again it is noted that there is still some risk associated with this, particularly if prolonged periods of low rainfall occur.

6.5 Overview

The results of the modelling undertaken indicate that the nominated options are likely to be feasible although consideration would need to be given to appropriate sizing of pipework / pumps and storages in determining an optimum configuration for any of the options. For Option NPW1 and NPW2 an allowance does need to be made for top-up of the non-potable supply during peak water usage periods. Given the relatively small volume of top-up required for these options, this demand may be satisfied with potential spare water volumes available at the Marulan WTP, but this would need to be confirmed with council.

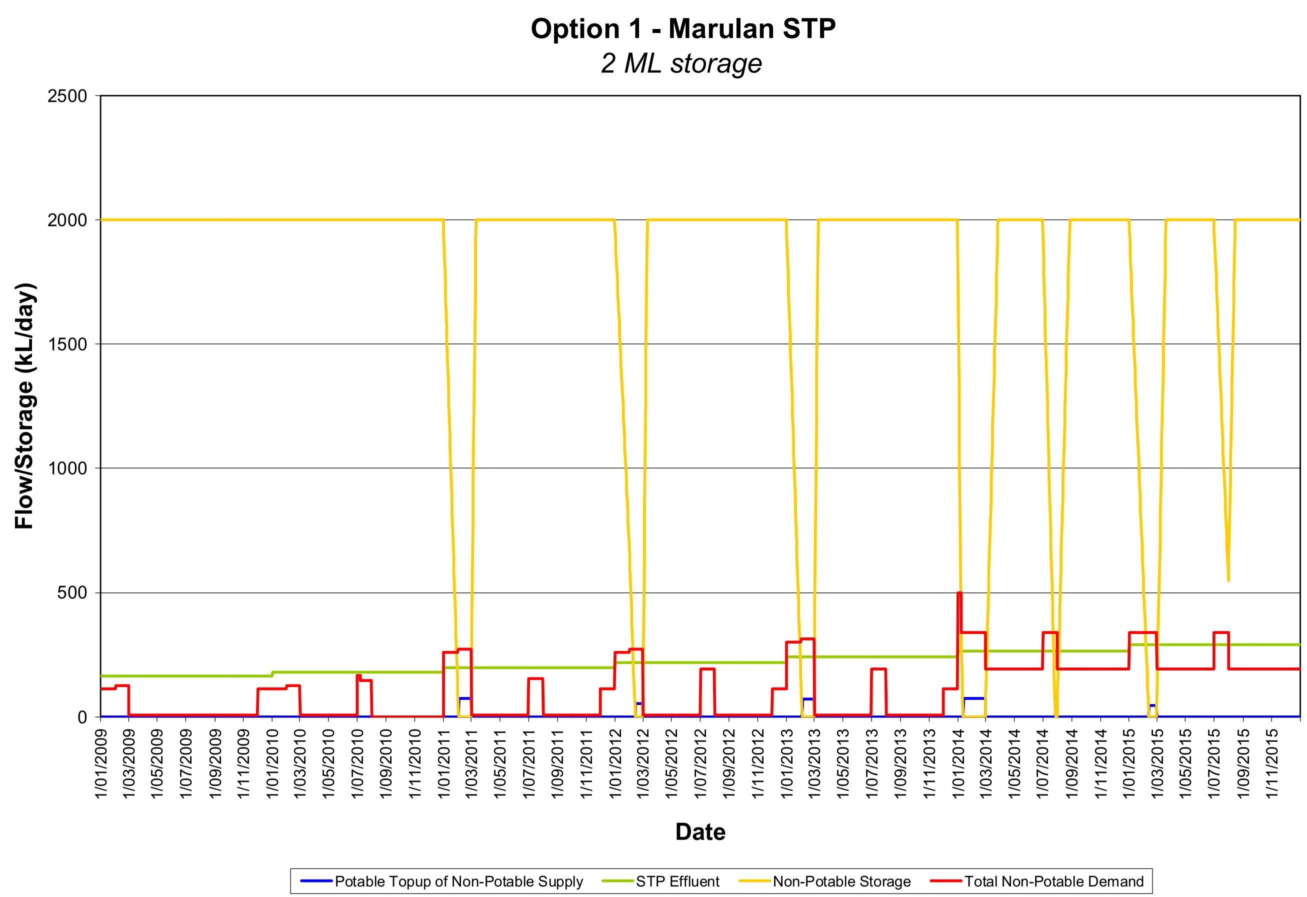


Figure 9 Option NPW1 – Water Balance Results

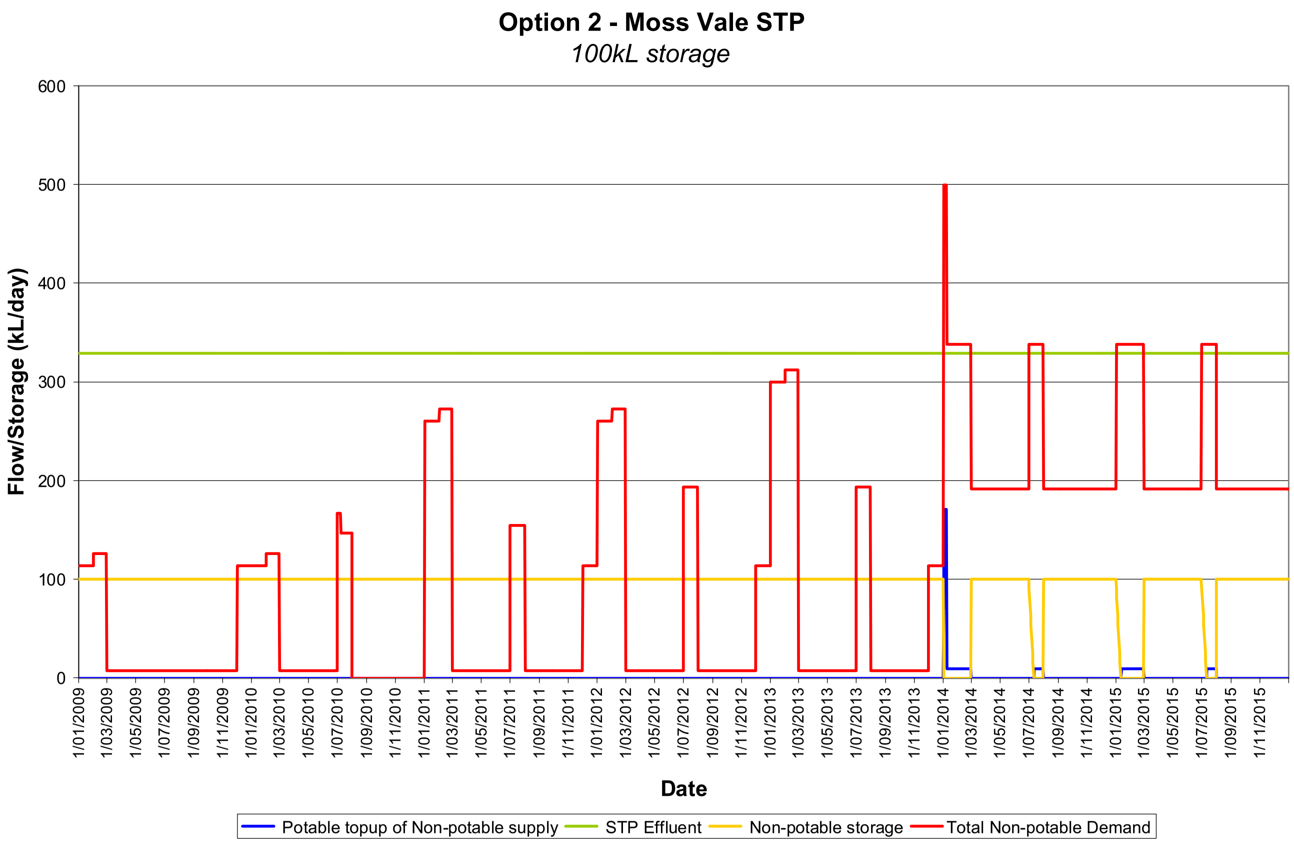


Figure 10 Option NPW2 – Water Balance Results

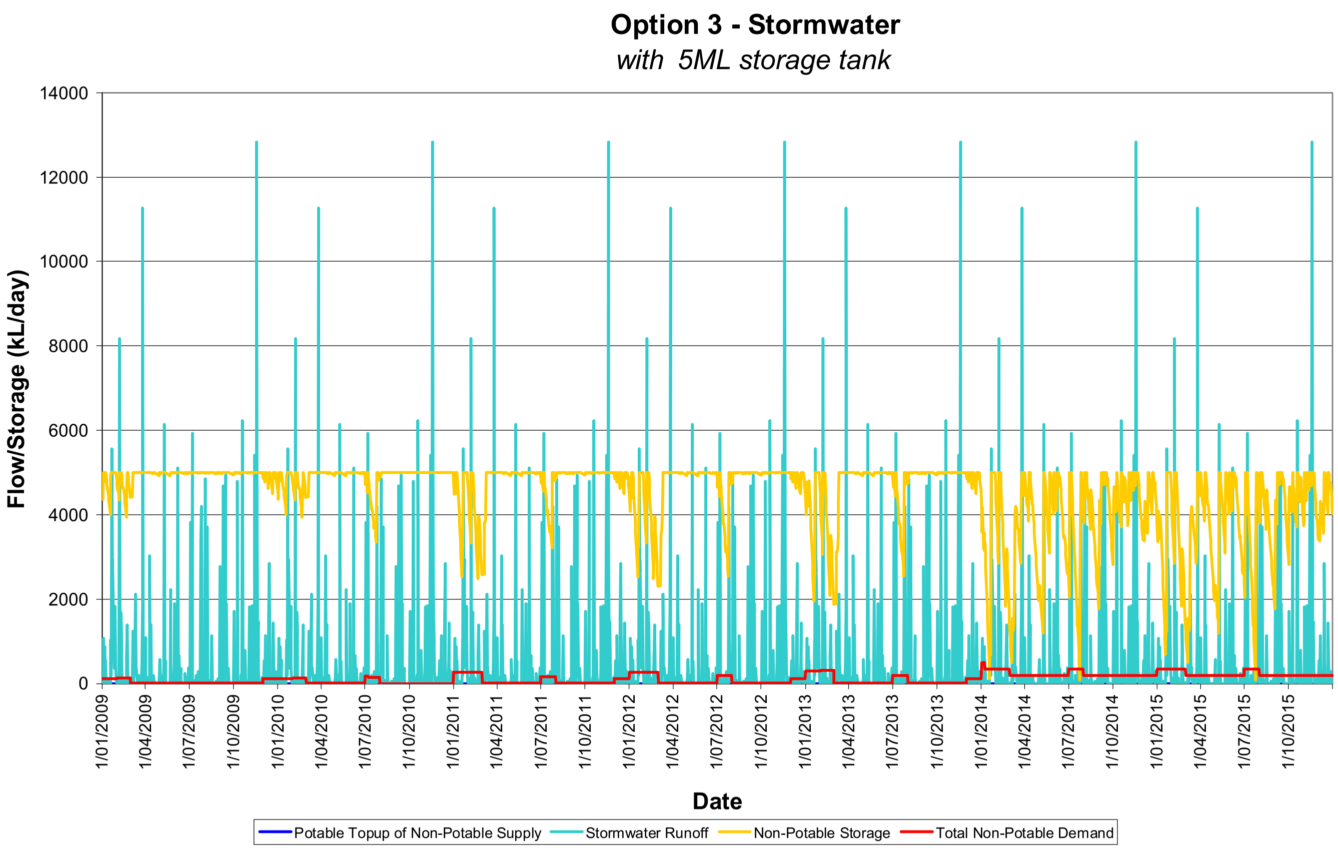


Figure 11 Option NPW3 – Water Balance Results

7. Options Comparison

7.1 Introduction

A number of non-economic factors are considered to be important when considering the relative merits of each of the options. While this list is not exhaustive, it is considered a reasonable scope for comparison of the options. These factors are as follows:

- minimise potable water use;
- efficient use of infrastructure
- flexibility;
- reliability; and
- community acceptability.

It is noted that a formal multi criteria analysis with weighting and scoring of the various options was not included within the scope of this report, and hence the comments provided are considered to be general in nature, only, and do not constitute a ranking of the options.

The following subsections provide a discussion of each of the options against the nominated non-economic factors and provide a general overview of the identified advantages and disadvantages of each of the options. However, GHD were instructed to simply report upon the options and not to show bias to any of the options, as this report may be used in support of the environmental assessment process.

7.2 Option NPW 1 – Marulan STP Effluent

This option minimises the use of potable water as it relies predominantly on a recycled water stream. However as the existing flows from the Marulan STP are insufficient to meet the total future flows and the future flows from the Marulan STP (following predicted development) are not well defined, there is a potential for shortfall of non-potable water supply (some 9.2 ML between 2008 and 2015 based on the assumptions provided in Section 6). This shortfall may potentially be topped up with water from the potable water supply. The unconfirmed future developments leading to increased flows, may also impact on the potential flexibility and reliability of this scheme. For example, if the proposed developments do not occur as predicted then there may be a shortfall in water availability over an extended period which would need to be made up from alternative and external water sources.

Where the Marulan potable water supply cannot be used as a top-up (potentially due to insufficient water being available) then water may need to be sourced from alternatives such as onsite stormwater collection (requiring treatment) or from Wingecarribee Shire Council sources (for example, the potable water supply at Sutton's Forest or trucked water supplies from Moss Vale STP). These risks would have to be fully reviewed and managed if this option were progressed

It is considered that this option may potentially be an efficient use of existing infrastructure. The Marulan STP is currently in need of augmentation / upgrade. Hence any future works on the plant could be undertaken with consideration of the requirements of the EA /DE recycled water requirements. An efficient, focussed upgrade which is beneficial to both Council and EA/Delta could therefore be undertaken. Further, depending on the timing of the developments (both the power station facilities and the Marulan STP upgrade) the construction of a pipeline between Marulan and the power station facilities could initially be used to supply water from the Marulan WTP to satisfy both potable and non-potable demands, and once the STP upgrade is complete, then the pipeline could be converted for use as a non-potable water supply pipeline. At this stage an alternative delivery of potable water would be required. Alternatively, if separate potable water and non-potable water pipelines were installed simultaneously and along the same route (to the extent permissible), then there would be economies of scale in the construction of the pipelines.

The Marulan STP effluent is considered to be an option which would likely be considered favourably by the community and external stakeholders as it involves beneficial reuse of an otherwise waste product. Furthermore the STP is relatively close and would prevent the existing effluent discharge from having negative impacts on receiving lands or waterways.

7.3 Option NPW 2 – Moss Vale STP Effluent

The Moss Vale STP effluent option is very similar to the Marulan STP Effluent option (Option 1) except that it has the advantages of having adequate volumes of effluent already available (that is, there is not the risk that the volumes would not be available). Furthermore the Moss Vale STP effluent is currently of a reasonable standard and hence there would not be the time requirement to upgrade the plant except for that which is required to achieve an appropriate recycled water quality. The main disadvantage of the Moss Vale STP is that it is significantly further away (some 35.3 km total distance) than the Marulan STP and within a different Local Government Area, LGA.

If a transfer system was installed which allowed for higher delivery rates of the STP effluent as adopted in the concept outline (which could be implemented due to the larger volumes available), then the top-up potable water usage will be lower relative to the Marulan STP effluent where available effluent volumes are lower.

7.4 Option NPW 3 – Stormwater

Based on the parameters nominated, the stormwater capture and reuse appears to require the lowest amount of ‘top-up’ of the non-potable water supply system. However, this is on the basis that all rainfall occurs as in an average rainfall year. As there is potential for rainfall to be much lower (or higher) than an average rainfall year, there is considered to be a significant risk that lower volumes will be available and hence significantly greater volumes of top-up water will be required. This risk could be reduced by installing greater storage volumes and / or having greater catchment areas than those nominated although this still may not satisfy the total demands if a sustained dry period (drought) occurs. If this option was pursued it would be considered prudent to consider the likelihood of possible future expansion of the power station facilities and hence the ability of the stormwater system to cater for this (storage, catchment area, rainfall variability).

This option allows for the collection of stormwater runoff into two storage dams based on a preliminary review of likely drainage patterns at the site. The reliance on the natural topography and drainage of the site can reduce the requirement for extensive infrastructure. The stormwater system would require a treatment system although the type of treatment system cannot be accurately determined at this stage until indicative stormwater quality is known. This is dependent on more detailed design of the facility and review of other factors, such as soil types. Any stormwater capture system is at risk of spills or other contamination within the catchment entering the stormwater. While devices can be installed to minimise these risks, the reduction of runoff quality by contamination is still considered to be a significant risk.

It is thought that stormwater capture and reuse would generally be considered favourably by external parties. Consideration would, however, need to be given to the extent to which natural flows are diverted from the receiving waterway (in this case the Wollondilly River), and the impact on those receiving waterways.

Other concerns which were raised in the previous GHD report are reiterated in Section 5.4.

7.5 Summary

Each of the above options are viable in servicing the water needs of the proposed development though each exhibits differing advantages and disadvantages. Following the overall environmental assessment of the proposed development, more detailed investigations and liaison with stakeholders can determine the most *sustainable*, and thus preferred, option. A range of Multi Criteria Assessment and stakeholder consultation processes are available to define and then assess the most sustainable option.

8. Summary and Conclusions

EnergyAustralia (EA) and Delta Electricity (Delta) have proposed the development of two gas-fired power stations ('the facilities') and associated infrastructure near Marulan, NSW.

The objective of this report is to determine *viable options for an* Integrated Water Management Program to meet the water requirements for the proposed gas-fired power stations and associated infrastructure near Marulan.

The water demands for the two facilities were summarised in Table 1

GHD have previously investigated the water requirements for the two proposed power stations and identified the potential for various bulk water sources to meet these requirements (GHD, *"EnergyAustralia, Power Station Near Marulan – Water Impacts"*, May 2008). This report identified that there are a number of potential options available to meet the water demand types. These options were further developed within this report with the summary of available options to satisfy water demand types provided in Table 3.

It was identified that the main variations in any water servicing strategy option (incorporating the sub options for water demands listed in the table above) will be associated with the non-potable water source options, this also being the largest water demand.

The three options (NPW1, NPW2 and NPW3) were then assessed within a water balance. The water balance was constructed to determine whether the nominated water supply options could satisfy the time varying demands of the power station facilities. In particular it was necessary to determine if there were likely to be any shortfalls (particularly relating to the non-potable water supply). The respective models indicate that top-up water is required to satisfy the non-potable demand for two of the options (vis Options NPW1 and NPW2) although the ongoing top-up volumes once both facilities were operational, were likely to be relatively small (0.6 – 1 ML/a). These top-up volumes could potentially be supplied by spare capacity from the Marulan WTP or from a stormwater harvesting system from the site (roof rainwater collection only). While top-up volumes were not found to be required for the third option (vis Option NPW3, the stormwater runoff option), it is noted that the water balance was based on an average rainfall year. Should a prolonged dry period occur then top-up may be required.

Each of the three options represents a *'viable option'* in servicing the water needs of the proposed development though each exhibits differing advantages and disadvantages. Following the overall environmental assessment of the proposed development, more detailed investigations and liaison with stakeholders can determine the most 'sustainable', and thus preferred, option.

Appendix A

Water Demands Assumptions

For Daily Water Balances

Assumptions common to all three Options

- An allowance of 10% of the flows was included when preparing the water balances.
- Potable water demands for both facilities are constant once in operation (as the facilities are staffed all year around).
- Energy Australia Peaking Facility; January, February (summer) and July (winter) were nominated as the months in which the peaking facility would be operational. Thus demands for non-potable and demineralised water would be required during these months. The initial “start up” demand was assumed to occur over a period of 7 days (to account for the initial commissioning period of the plant). Despite the operation of the facility being intermittent only 1 “start-up” volume was allowed for. Therefore it would be necessary to place the start-up volume into suitable storage (and treatment) between operational periods.
- DE Base Load Facility; constant non-potable demand once facility is in operation. The initial start-up demand was assumed to occur over a period of seven (7) days (effectively a startup or commissioning period). This is a one-off event.
- Construction water demand is a base demand of 7 kL/day for both facilities with additional demands in the summer months (Dec – Feb) when 107 kL/day is required (7 kL/day plus 100 kL/day for summer months).

Assumptions for Option 1 - Marulan STP Effluent

- The volumes of effluent available from the Marulan STP were assumed to increase in even increments from the existing 60 ML/a up to 120 ML/a in 2018.
- While the volumes were assumed to be immediately available (that is, as from 2009 when construction operations commence), the requirement to undertake upgrade works at the Marulan STP mean that it is unlikely that appropriate effluent would be available until around early 2011. During this period, the non-potable demands may be met with spare capacity from the Marulan WTP network however this would be determined in negotiations with GMC.
- Storage size – 100 kL initially but based on modelling results this was increased to 2 ML.

Assumptions for Option 2 – Moss Vale STP Effluent

- Assumed a pipeline / pump would be constructed which is capable of supplying some 120 ML/a over the life of the project. This demand would not be required prior to the construction of the Delta facility but would be utilised in the longer term.
- Storage size – 100 kL.
- A daily maximum flow of effluent of 328767 L/day (equivalent to 120 ML/a) from the Moss Vale STP into the non-potable storage tank.

Assumptions for Option 3 – Stormwater

- Stormwater runoff estimated based on an average rainfall year. Some sensitivity analysis would be necessary to determine the impact.
- Storage size adopted was 5 ML.

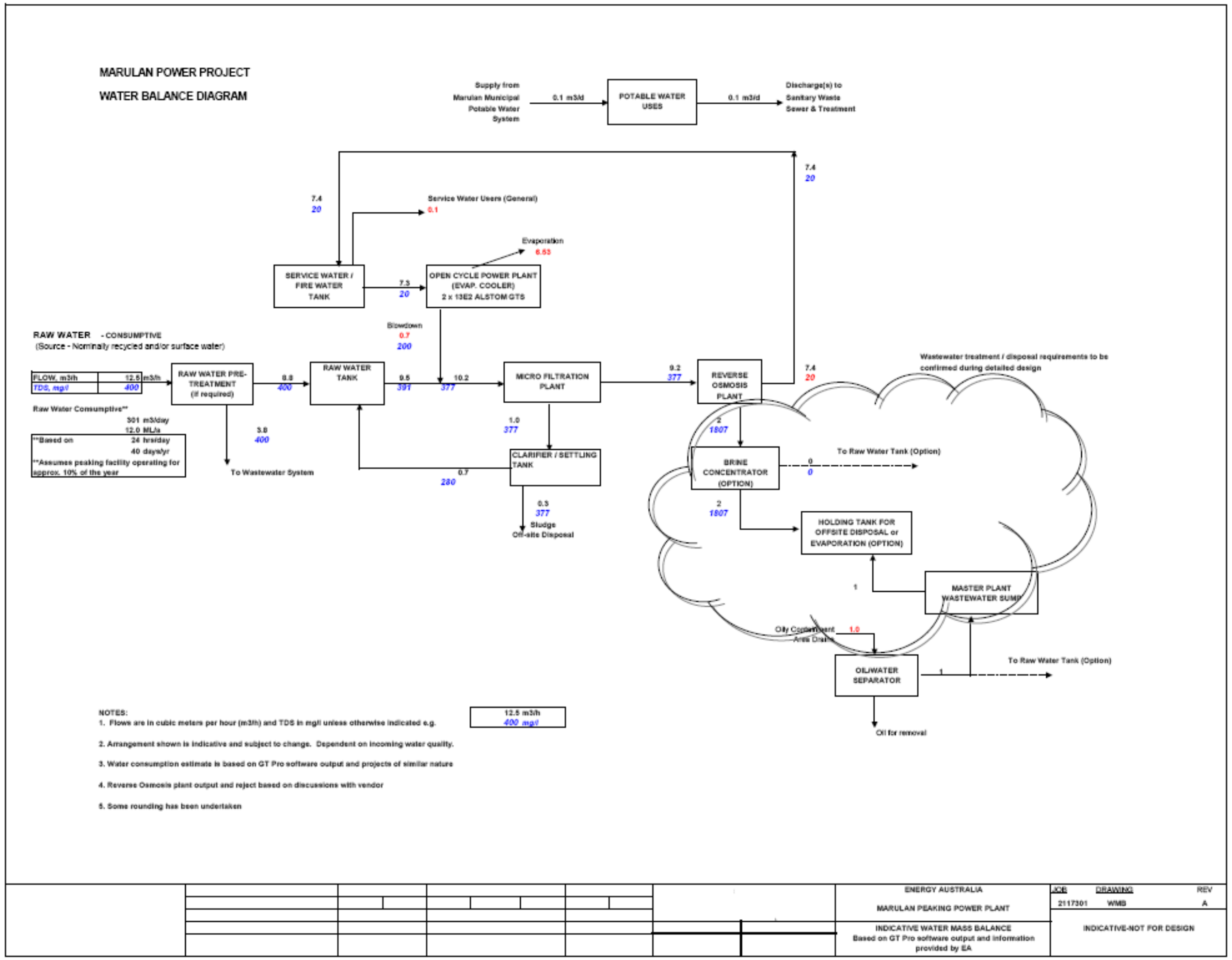


Figure 12 EA Peaking Facility

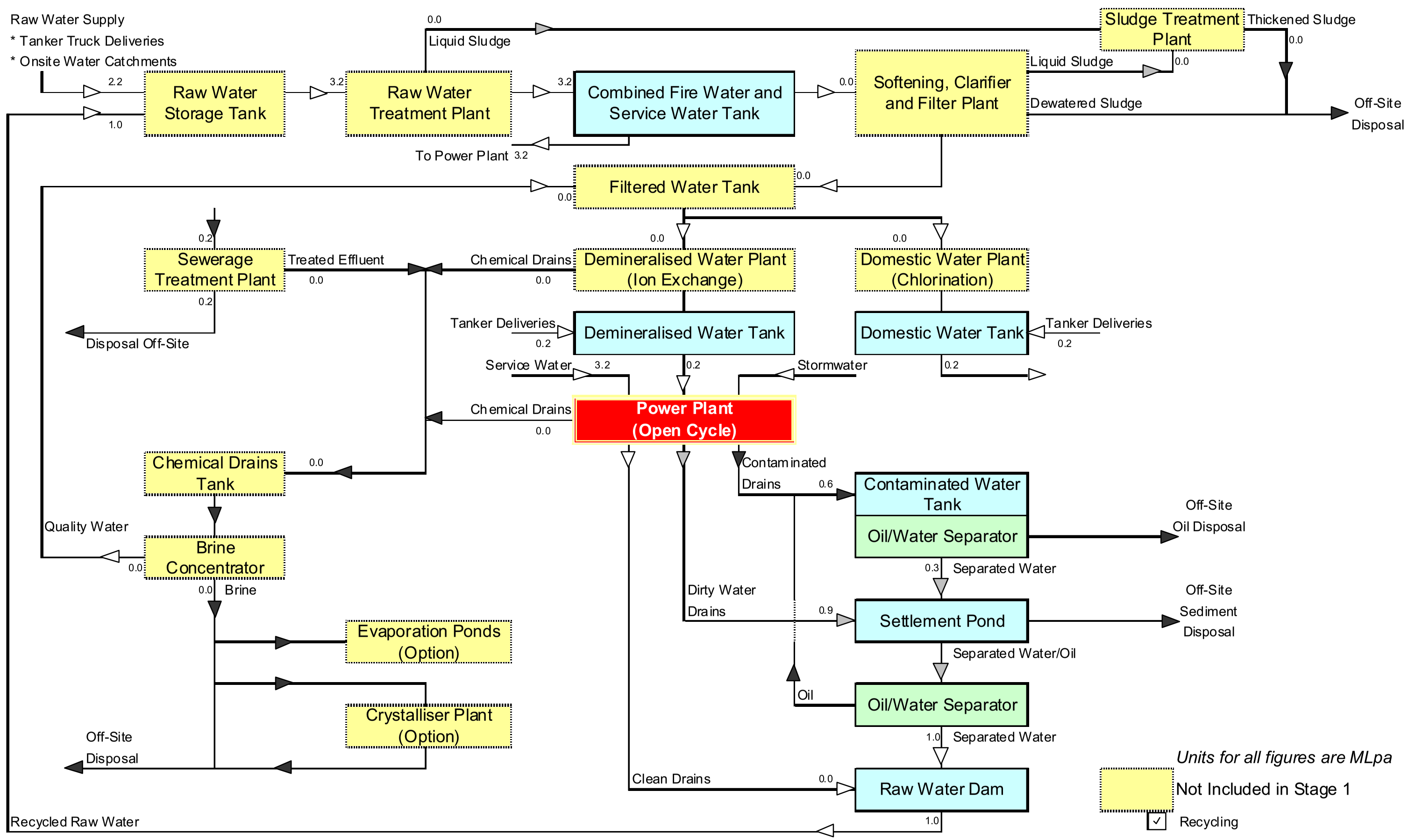


Figure 13 Delta - Open Cycle Water Management with Recycling (Stage 1b)

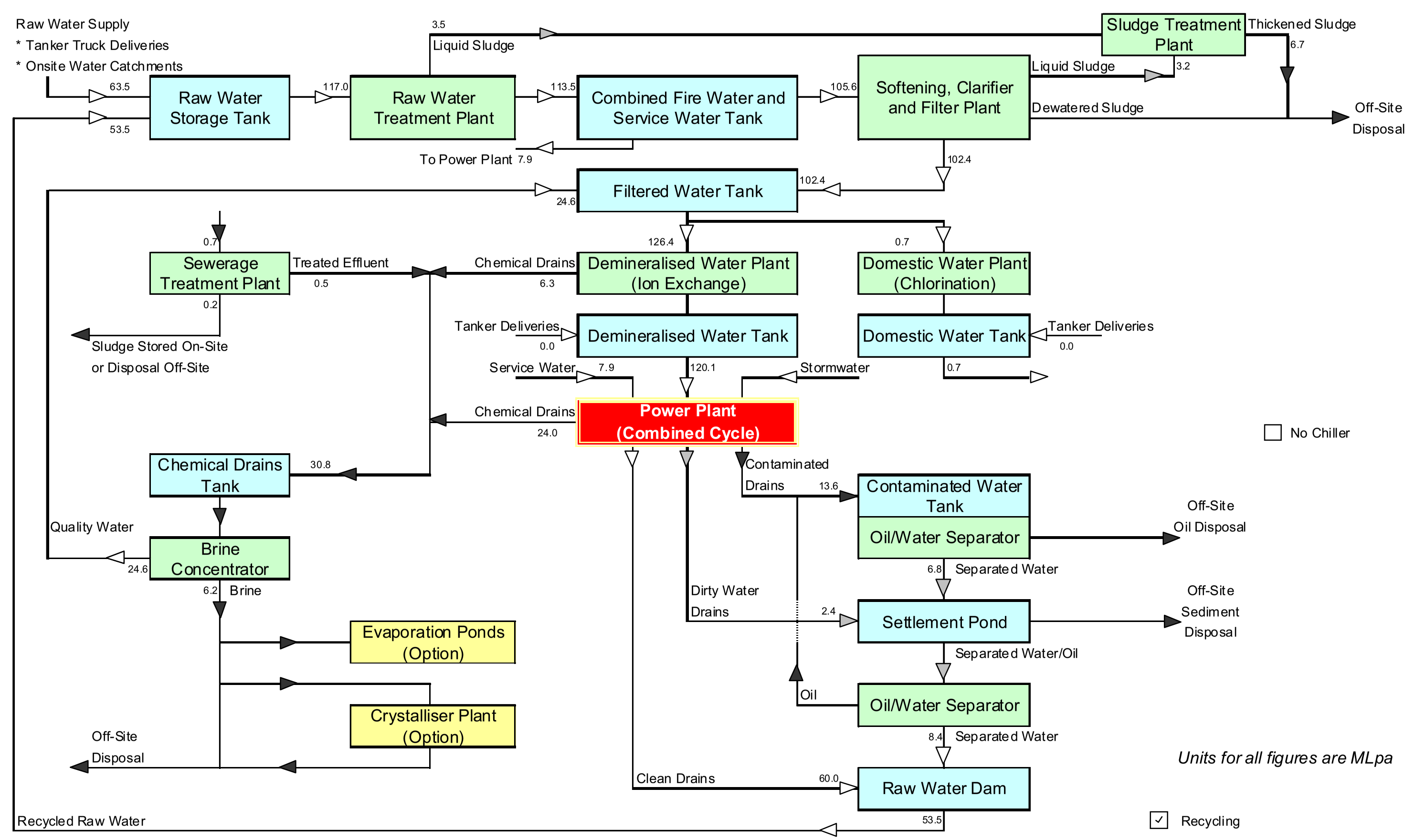


Figure 14 Delta - Stage 2 Combined Cycle Water Management with Recycling

Appendix B

Background on Marulan Water and Sewage Treatment Capacities

*The following are extracts from **"GHD (2008) Energy Australia Power Station Near Marulan-Water Impacts, Sydney May 2008"** being a precursor to this study report and provided as background Marulan water and sewerage systems.*

Marulan Water Supply Network

The development site is located some 12 Km northeast of Marulan. The first potential source of water is the Marulan water supply network. The Goulburn water supply could form a back up although has a considerable distance (cost) disadvantage). As such, Marulan water supply was been investigated below.

Marulan's water supply is sourced from the Wollondilly River, near Brayton, and exhibits the following characteristics.

- Total water usage is approximately 95 ML pa and projected water demand is expected to double, or more, by 2020 depending on levels of water restriction.
- The water source (a pool on the Wollondilly River) is reported to be reliable, although its capacity is unknown and, as such, so is the total amount of water available to the township.
- GMC has a licence to pump some 200 ML pa from the Wollondilly River of which, (Goulburn Mulwaree Council, GMC, have subsequently indicated) some 120 ML is currently extracted per year. However, GMC further advised, that apart from some 10 ML pa, the difference is committed.
- Water is pumped from the Wollondilly River, through a surge vessel and a balance tank (75 KL) and thence, under gravity, it flows some 4.3 Km to a raw water reservoir (35 ML) adjacent to the Water Treatment Plant (WTP).
- The WTP uses a continuous microfiltration membrane, which has a design capacity of some 1.5 ML/day, although peak demand is reported to be 0.64 ML/day.
- The major water users in Marulan are petrol stations and three restaurants.

Discussions with GMC ascertained that for the Marulan Water Supply system:

- A surplus water supply is likely to exist over the next ten years until residential and/or industrial development takes up current capacity.
- The surplus water could provide some of the water demands for the facilities for the initial stages, of up to say the 4th year (when power station demand rises (from Stage 1 to Stage 2).

- The potential magnitude of this spare capacity is currently some 80 ML, (vis 200 ML licence capacity minus 120 ML current demand) although with competition to meet Marulan’s growth, it was considered (by GMC) to be more an average of 10 ML pa.
- Seasonal surplus capacity (vis wet periods) may provide further supply and thus alternate storages would need to be provided for the facilities to capture wet weather (or other opportunistic) supply.
- In principle, GMC would be prepared (by establishing an appropriate contract, water fees and upfront contribution) to supply recycled water from an expanded WTP and to take on the role of Water Authority supplying EA and Delta.
- The price for the supply of both potable and recycled water is similar.

As a follow up to the above-mentioned meeting, GMC subsequently provided (see below).

- Water Options for Delta and EnergyAustralia Power Stations near Marulan;
- A Marulan-Year 2018 Design (Preliminary Only); and
- Marulan Estate Preliminary Funding Scenarios

MARULAN’S WATER SUPPLY NETWORK is a promising water supply source, being able to provide 10 ML pa over the first 4 years (Stages 1 for both EA and Delta) of operation. Further supply capacity is available in the Marulan system although this needs to meet residential and industrial growth. At present, this growth is below planned levels and, as such, further supply may well be available over these initial years of construction and operation.

GMC is prepared to function as a Water Authority to supply EA and Delta and were keen to further explore expansion of its current water ands sewage treatment facilities to meet EA and Delta needs.

As noted, Marulan is located some 12 km to the south east of the site and is the closest sewered township. Hence if sewage effluent was to be used as a source of recycled water, this water could potentially (and preferably, due to proximity) be sourced from Marulan.

The Marulan sewerage system is largely a common effluent drainage (CED) scheme which transfers the effluent from individual septic tanks at each property, together with raw sewage from the service centre, to the treatment plant located to the east of the Hume Highway.

The sewerage treatment plant (STP) consists of an oxidation pond (mechanically aerated pond) together with a maturation pond and a wet weather storage dam (some 44 ML). The effluent is disposed of by irrigation on an adjacent woodlot operated by Council.

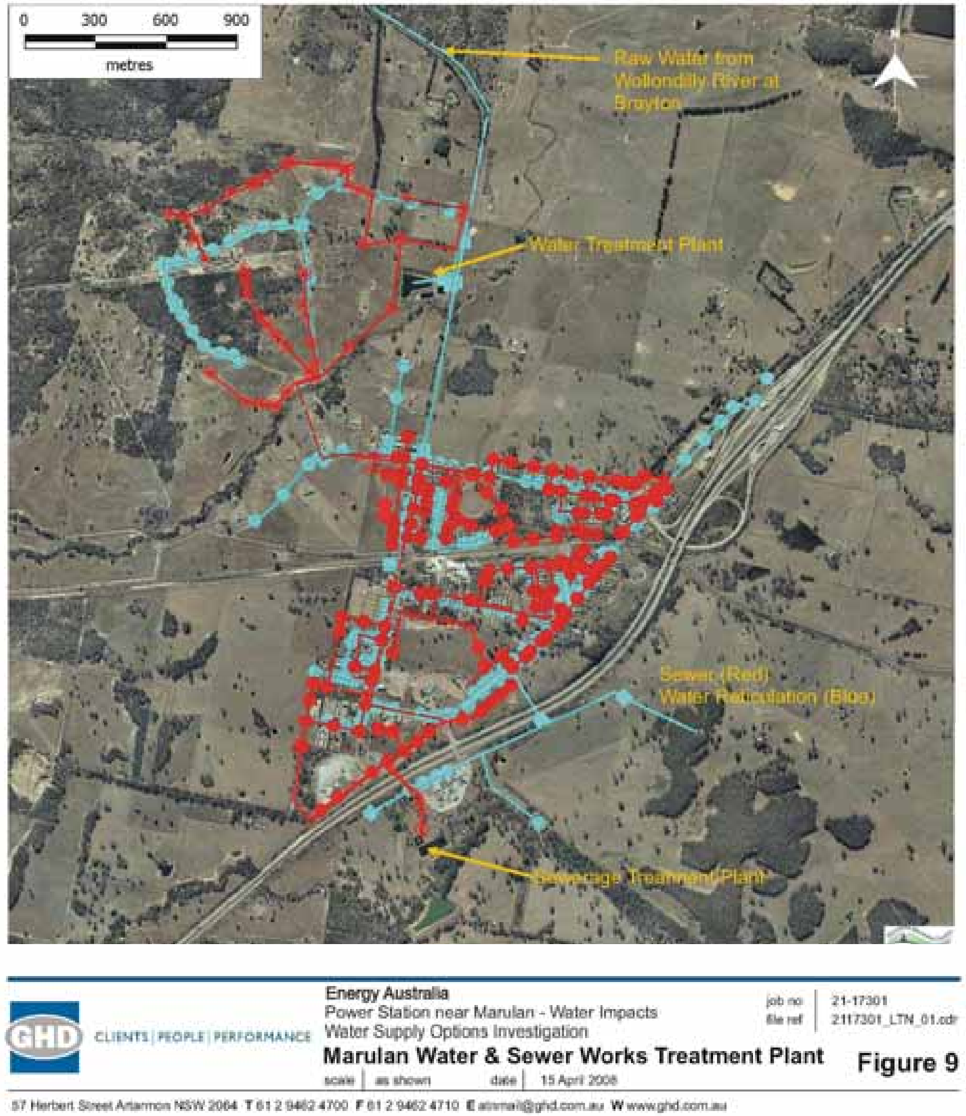
An earlier Study (PB, 2007) indicates that little information is available on current performance of the STP. It was noted that little industry is located in Marulan and the major contributors were the highway service stations, which generate a variable loading during school holiday periods

The PB (2007) information indicates the STP:

- Has a design capacity of 0.2 ML (200 KL) per day; and
- The average dry weather flow and peak flows for the service stations are greater than 228 KL/day.

GHD prepared a Sewerage Master Plan for the Marulan Township Development (August 2005). (Note: GMC advised that this 2005 Sewerage Master Plan has been superceded by subsequent events). This report indicated that at peak periods the ADWF (Average Dry Weather Flow) to the plant was around 228 KL/day, which is approximately equivalent to the plant's capacity. The Sewerage Master Plan also prepared an estimate for the future development of Marulan with the replacement of the common effluent drainage (CED) with a conventional sewerage system. Based on this estimate, the ADWF would increase to around 3,190 KL/d and would require a treatment plant to be constructed based on the activated sludge process (due to space limitations). The report also raised the issue of identifying opportunities for reuse in and around the village as well as reviewing the hydraulic and nutrient capacity of the irrigation soils.

Thus it would appear that there is potential to reuse effluent as a source of water for the proposed development. The existing effluent flow rates (peak ADWF of 228 KL/day) would generate, potentially, 80 ML pa and this supply would grow (slowly) with the expansion of Marulan.



Marulan Sewage Treatment Plant (STP) effluent

Further discussions were held with GMC, which indicated that the actual growth of Marulan was significantly below that originally planned. This has the short term (0-4 years) benefit of additional potable supply (over the 10 ML pa) advised by GMC, although reduced mid to longer term supply due to a lower than planned (some 600 additional residences) generation of sewage for subsequent treatment and recycling.

As noted, the plant requires upgrading to be able to treat the predicted increase in load /population served. Depending on the treatment process selected, further upgrades may also be necessary to make the effluent suitable for process use. This may involve filtration (for example, sand or membrane filtration), additional disinfection and potentially reverse osmosis (if TDS levels are elevated) but would be considered further during more detailed planning.

It is noted that the reuse of effluent by industry (rather than sourcing potable or raw river water source) is considered a more 'sustainable' option by the community.

Discussion with GMC identified that for the Marulan STP:

- Some 60 ML pa would currently be available for treatment and recycling;
- The existing plant requires upgrading; and
- Council is prepared to consider options for the upgrade and recycling as part of a water supply regime for the EA and Delta facilities.

MARULAN SEWAGE TREATMENT WORKS currently has available 60 Ml pa which is currently disposed of via irrigation, although would be available, after recycling and treatment to the required standard for power station use. The STP requires upgrading and Council responded positively to further investigate a scheme to supply treated water to meet the facilities demand

Following a meeting with Mr Greg Finlayson and staff of Goulburn Mulwaree Council in April 2008,a follow up email was provide by Council to GHD outlining some initial *"Water Options for Delta and EnergyAustralia Power Station near Marulan"* which is outlined below.

Water Options for Delta and EnergyAustralia Power Stations near Marulan.

Dear Ian,
Further to our meeting last week, including representatives from Delta and Energy Australia, find below and attached our preliminary responses to your requests regarding water demands for the proposed power stations. The short time prior to your deadline this Friday has not allowed us to be absolute in our advice nor deal with the shape of the water demands. What we can provide is preliminary advice on how annual water demands might be met.

Overall the water demands are not large. We suggest the initial water demands can be met from the existing potable supply. This would be augmented around 2013 with a recycled water scheme, and soon after with an augmentation of the potable supply in Marulan.

The Schematic attached describes the water systems in Marulan as they might be in the year 2018. The key items for our discussion are described. Note that both new reservoirs are above the Betley Park estate, off Brayton Rd. If trucking is considered, this would be the source point, but the specific standpipe location would require consultation with various parties. Deltas connection would be from the recycled water reservoir and Councils preference is for a piped supply to the subject property or suitable tanker fill point to minimise the impacts to the local community. Council will provide either potable or recycled water into this reservoir dependent upon staging and peak demand. Council has concerns about the impacts of the power stations peak water demands on sizing of water infrastructure. It is anticipated that any agreement to supply water to Delta/EA will include a maximum peak instantaneous flow as well as daily and annual volumetric limits. Council will work with Delta/EA and their consultants to determine these limits.

Phase 1.
Construct potable and recycle reservoirs at Betley Park.
Extend potable rising main to reservoir.
Install potable supplementing connection to Recycle res. (item 13)
Power station water supply to be drawn from Recycle Res by pipe or truck.

Phase 2. (approx. 2013) Required for Delta/EA stage 2
Construct Recycle Treatment Plant in conjunction with residential developments and utilizing existing towns wastewater.
Construct recycle rising main.

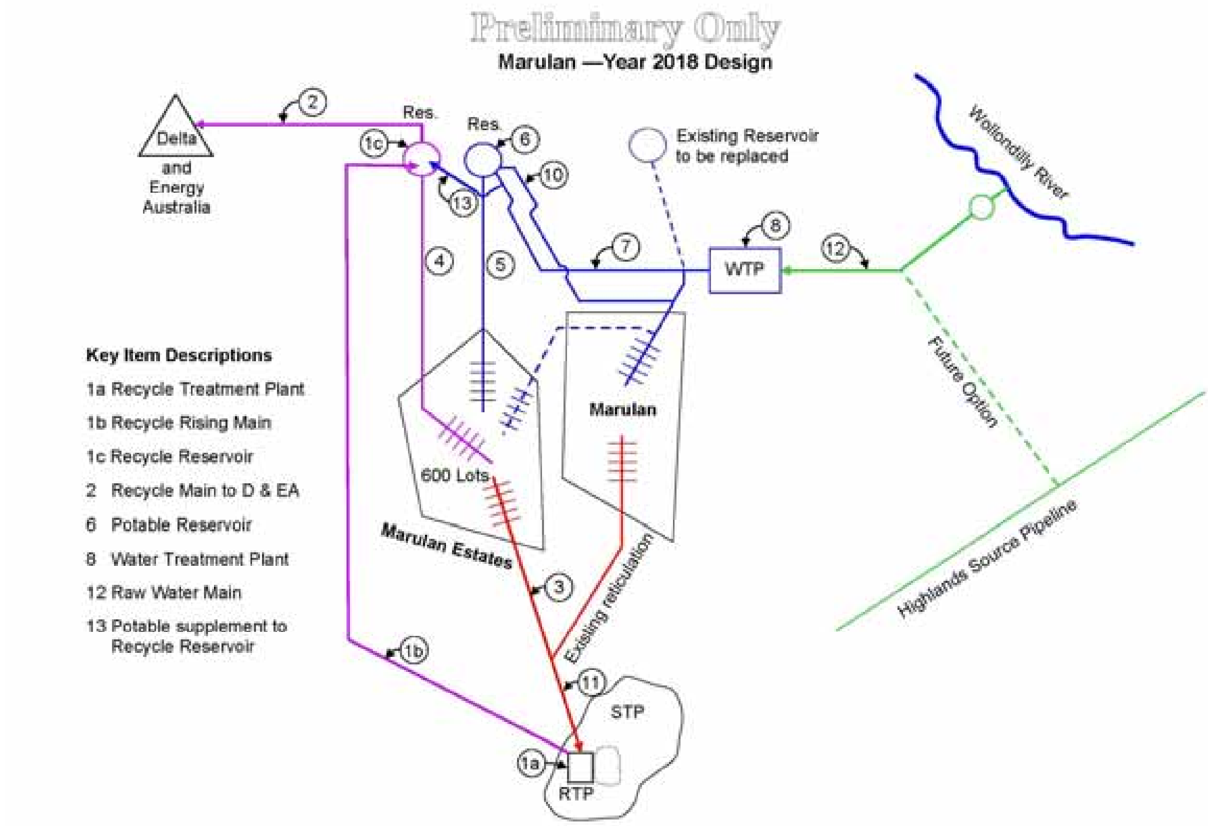
Phase 3. (approx. 2018 depending on housing growth)

Augment potable water source and WTP. An additional 150 ML pa may be required as the ultimate figure. Council will secure this through its IWCM and long term strategy development processes currently in progress.
The timing of WTP augmentation depends on the shape of demand and how the peaks affect daily demands.

Attached is a spreadsheet showing the items described on the schematic and some indicative costs. The cost figures are guesses and you can review these.

Council will require up-front contributions for the recycle works, proportional to demand shares. The potable components may be funded by S64 contributions. The feed main to the power stations would be fully funded by Delta and EA.

GMF 14/4/08


Preliminary Only
Marulan —Year 2018 Design
Delta and Energy Australia
Res.
Res.
Existing Reservoir to be replaced
Wollondilly River
WTP
Future Option
Highlands Source Pipeline
Marulan
600 Lots
Marulan Estates
Existing reticulation
STP
RTP
Key Item Descriptions
1a Recycle Treatment Plant
1b Recycle Rising Main
1c Recycle Reservoir
2 Recycle Main to D & EA
6 Potable Reservoir
8 Water Treatment Plant
12 Raw Water Main
13 Potable supplement to Recycle Reservoir

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