Report

Tarrone Power Station

Moyne Planning Scheme: Amendment C47

Supplementary Assessment of Hydrology, Water Supply, Wastewater and Stormwater

25 JANUARY 2011

Prepared for

AGL Energy Limited

Level 22, 101 Miller Street
North Sydney
NSW 2065

43283491

URS

Project Manager:

……………………………
Andrea McKintosh
Environmental Planner

Principal-In-Charge:

……………………………
Sean Myers
Senior Principal
Environment and Planning

Author:

……………………………
Tim Routley
Senior Principal Chemical Engineer

Reviewer:

……………………………
David Fuller
Senior Principal Water and Catchments

URS Australia Pty Ltd

Level 6, 1 Southbank Boulevard
Southbank VIC 3006
Australia
T: 61 3 8699 7500
F: 61 3 8699 7550

Date:	**25 January 2011**
Reference:	43283491/43283491/4
Status:	Final

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Introduction

This report has been prepared in response to a request for additional information regarding:

- wetland hydrology;
- water supply and wastewater management; and
- stormwater management,

associated with the proposed Tarrone Power Station development. The report contains separate sections on each of these above issues.

This report is largely based information that has already been presented in the EPA Works Approval Application (WAA) and the Environment Effects Statement (EES) referral to the Minister, although some supplementary information has been included. This submission indicates where additional or updated information is provided.

We have been specifically requested to address in this submission a number of key points as follows:

- the impact of proposed power station bunding on the hydrology of the wetland and whether it would affect inflows into the catchment;
- provide a contour plan of the site;
- an explanation of how stormwater is to be managed;
- the implications of the alternative water supply options; and
- the likely water quality (salt & mineral content) and the expected behaviour of the evaporation pond, sediment basin and retarding basin (in particular frequency of water in pond).

Overview of Water Management

Tarrone Power Station Configuration

AGL is proposing to develop the Tarrone power station in two phases. The first stage is expected to involve the installation of:

- two or three E class gas turbines; or
- two F class gas turbines.

The timing and choice of turbine combination for the second stage of the project is yet to be determined. Completion of the second stage will result in a final facility configuration of:

- four (4) E class gas turbines, or
- three (3) F class gas turbines.

The power station development, configuration and specific gas turbine selected affects the water demand for the site and the two facility configuration options have been considered with respect to the preparation of the site water balance. In turn, the water supply source affects pre-treatment requirements. The water system has been designed to a conceptual level only at this stage and a range of conservative assumptions have been made to ensure that the information presented for the approvals process addresses the potential impacts associated with the full envelope of possible facility arrangements.

An overall facility water management schematic (including stormwater), reproduced from the WAA application, is provided in **Appendix A**.

Water Supply

It is anticipated that the proposed Tarrone power station will require approximately 10 - 15 ML of water per year. During operation water will be used on site for:

- process water;
- maintenance of equipment;
- fire services;
- domestic use; and
- landscaping.

The water quality required to meet these demands, particularly the first two, is effectively a high quality (ie low Total Dissolved Solids [TDS] concentration or ‘salinity’) potable/Class A water. The pretreatment requirements, if any, to achieve this water quality depends on the quality of the water supply and the specific water quality specification for the gas turbine inlet air cooling, which is manufacturer specific.

Three options for the provision of water supply are being investigated, including:

- groundwater extraction;
- transport of water by licensed carrier and water tanker to site; and
- use of recycled water piped to site.

Wastewater

Sewage will be stored on-site and then transferred and treated off-site. Portable toilets will be transferred to the site for periods of major maintenance.

2 Overview of Water Management

The volume of wastewater that would be generated by the peaking power station will vary depending upon the plant runtime. The main sources of wastewater will be the blowdown from the turbine air inlet cooling system and any wastewater arising from water pretreatment processes eg a groundwater desalination plant. The wastewater is proposed to be stored in an on-site evaporation pond, suitably lined to prevent adverse impacts on surface water and underlying soil and groundwater.

Stormwater

Ultimately, the site resides within the catchment of the Moyne River. Existing onsite drainage consists of sub-catchments that feed into open drains. Water drains from the north and north-east towards the south-west, and is collected in an open drain, that flows from the north-west corner of the site to the south and exiting the site in a culvert (2 x 600 RCP) under Riordans Road. This drain also collects water from the catchments to the north of the site. An additional drain exists in the south-east corner of the site directing water from east to west, to the same culvert under Riordans Road. Runoff from the site beyond Riordans Road is expected to flow towards the Moyne River most likely via the ephemeral stream Back Creek, passing about 1.1 km to the east of the site. Back Creek flows south into the Moyne River at a point about 7.5 km to the south of the site. Other than in significant storm events, it is unlikely that stormwater runoff from the site would reach this receiving water, and would normally be lost by infiltration and evaporation.

To the extent practicable, the proposed stormwater management regime for the Tarrone Power Station will be designed to maintain the existing stormwater flow regime on the site, whilst managing potential impacts on stormwater discharge quality. Once the power station is developed, the site runoff will consist of:

- Runoff from areas with low or no potential to impact on stormwater quality are expected to pass through a retarding basin prior to offsite discharge;
- Runoff from hardstand areas are expected to be discharged to a sedimentation pond prior to offsite discharge;
- Turbines, transformers and chemical storages will be bunded and stormwater will only be discharged to the sedimentation pond if confirmed to be un-impacted (i.e. oil free), otherwise the water will be educted out of the bund and disposed of offsite to an appropriately licensed facility as prescribed waste; and
- Some building roof water that may be collected for use on site.

The catchment runoff will be diverted around the site using perimeter swale drains and directed into the existing drain. Swale drains are proposed as they provide treatment for runoff.

The site is located in the Murray and Western Plains Segment of the *State Environment Protection Policy (Waters of Victoria)* [SEPP(WoV)]. The protected beneficial uses of waters in the Murray and Western Plains Segment are nominated in the SEPP(WoV). The corresponding water quality objectives and indicators nominated in the SEPP(WoV) for “ lowlands of the Glenelg & Hopkins catchments, & Portland, Corangamite and Millicent Coast Basins” are the applicable quality criteria for the receiving environment.

Wetland

A wetland has been identified on the site that has potential habitat value, which was addressed in the EES referral.

2 Overview of Water Management

The boundaries off the wetland catchment have been identified based on contours. The management strategy for this wetland is, to the extent practicable, to avoid development within the wetland and its catchment. Furthermore, potential preventative measures in the form of bunding will be considered to if necessary divert any site runoff away from the wetland, preserving the natural inflow.

Water Supply and Wastewater Generation and Management

3.1 Water Supply

3.1.1 Water Demands

Overall

It is anticipated that the peaking power station will require approximately 10 - 15 ML of water per year. During operation water will be used on site for:

- process water;
- maintenance of equipment;
- fire services;
- domestic use; and
- landscaping.

Table 3-1 presents the estimated proportion of water use for the major water using equipment or processes for the proposed Tarrone power station. It excludes the additional water demand if groundwater desalination is required, up to approximately 4 ML.

Table 3-1 Proposed Water Uses and Demands

Major water using equipment/processes	Estimated water volume (kL/year)	Estimated % water consumption
Evaporative cooling system	7,300 – 8,300	98.5
Turbine wash water	40	0.5
Fire services	N/A	0
Domestic water usage	80	1
Landscaping	N/A	0
Total	7,420 – 8,420	100

Process Water Requirements

The process water is utilised in the evaporative inlet air coolers as part of the operation of the proposed power station. The estimated requirements for E Class turbine and F Class turbines operating are presented in Table 3-4. Actual water consumption could vary based on actual weather conditions, particularly the temperature and humidity, and the degree to which the coolers are operated when the generators are operated (expected to be predominately in summer).

The process water demand is based on maximising the recycling of water in the coolers. The evaporation rate (and hence the total flow rate) would decrease as relative humidity increases. The blowdown volumes assume water and air are clean and uncontaminated entering the system. The water usage data presented in Table 3-4 are also based on the assumption that the power station is operating during hot, dry periods when water consumption would be highest. However, the evaporative cooler system would not be operated during times of lower ambient temperatures. Therefore, the water usage of the evaporative coolers for three F Class or four E Class gas-turbines, assuming a total evaporative cooler run time of 220 hours in the year is about 7,300 kL/annum and 8,300 kL/annum respectively. If groundwater is the water source, then an additional 3 – 4 ML/annum of water might be required to account for the water losses through pre-treatment processes.

3 Water Supply and Wastewater Generation and Management

The water used for evaporative cooling would typically need to meet the water quality criteria outlined in Table 3-2. The final specification will be nominated by the specific gas turbine supplier.

Table 3-2 Typical Water Quality Criteria for Evaporative Cooling

Designation	Unit	Lower	Upper
Conductivity	µS/cm	50	450
Calcium Hardness (as $CaCO_3$)	ppm	45	170
Chlorides (as Cl)	ppm		<50
Total Alkalinity (as $CaCO_3$)	ppm	45	170
pH	-	7	8.5
Silica (as SiO_2)	ppm		<25
Iron (as Fe)	ppm		<0.2
Oil and grease	ppm		<2
Total dissolved solids	ppm		<550
Suspended solids	ppm		<5

Maintenance of Equipment

A small volume of water will be required for maintenance and cleaning of equipment (including turbine wash water). Up to 40 kL/annum is estimated to be required for this purpose however potable water will not be required.

Fire Services

A water tank will be present on-site to store water for fire fighting purposes. The volume of the tank will be determined as part of the detailed design process and will meet regulatory requirements. The water is not required to be of potable quality however, it would need to be low in suspended solids. The fire water tank may be combined with a raw / process water tank.

Domestic Uses

Water will be required for staff facilities, including drinking water and general amenities. Water for domestic use will be brought to site by tanker or will be collected from the roof of the amenities building and stored in tanks on-site. It is estimated that up to 80 kL/annum will be required for the 5 permanent staff. During minor and major maintenance periods additional domestic water may be required.

Landscaping

To minimise the potential for soil erosion and enhance local ecology, all disturbed areas will be planted at the end of the construction process. In order to minimise water usage, the disturbed areas would be planted with species that are both local to the area and whose water requirements can be supplied by rainfall alone. Some supplementary irrigation water may be required during establishment.

3.1.2 Possible Water Sources

Overview

The three potential options available to AGL for the supply of process water to the proposed Tarrone power station are set out below.

- extracting and treating groundwater;
- road tankering in water (the quality of which will dictate pre-treatment needs); or
- connecting to the Port Fairy recycled water treatment plant which has been proposed as part of the Shaw River power station project (this option will be subject to that project proceeding). The indicated quality of this recycled water[1] is such that it is unlikely to require further treatment at Tarrone Power Station prior to use.

It can be seen that the water source, due to potential pretreatment requirements to meet the water quality requirements for the main demand, gas turbine inlet air cooling, will influence the overall site water demand and the wastewater generation.

Groundwater Supply

The preferred option for water supply is groundwater extraction through the transfer of an existing groundwater licence in accordance with the regulatory and administrative requirements of Southern Rural Water (SRW). The site lies with the Hawkesdale GMA, which currently has exclusion of issuing any new groundwater extraction licences. This is due to the current understanding that the allocation licences for aquifer(s) in the GMA are likely to have reached or exceeded a sustainable volume. As a result, SRW is currently re-assessing the Permissible Consumptive Volume (PCV). Until a decision has been made on the PCV no new Groundwater Extraction Licences (GEL) will be issued by SRW. In order to obtain a licence to extract groundwater for use at the site a permanent transfer from an existing licence would be required. Groundwater extraction is specifically addressed in a separate witness statement by Mr Bryan Chadwick of URS.

The geology beneath the site incorporates the Newer Volcanic Basalt and Port Campbell Limestone, with the basalts believed to be in the order of 40m thick in the local area.

The upper most aquifer is within the Newer Volcanic Basalt, with depth to groundwater reported[2] to be between 10 to 15 m below surface. The yields from the basalt aquifer in the region are highly variable, but it is likely that the facility's water requirements of up to 15 ML/year (max rate of 175kL/day) could be met with extraction from one bore.

The groundwater quality from the basalt aquifer is relatively consistent in the region, but does have some variability both vertically and horizontal.

Table 3-3 presents the likely range of water quality values for a number of parameters that would be expected from the basalt aquifer at the site.

[1] Wannon Water 2010, *Works Approval Application Port Fairy Recycled Water Treatment Plant (To Supply the Proposed Shaw River Power Station)*, prepared by GHD for Wannon Water

[2] SKM. Preliminary Groundwater Resource Appraisal for the Hawkesdale Groundwater Management Area. 20 December 2007.

3 Water Supply and Wastewater Generation and Management

Table 3-3 Groundwater Quality Parameters

Parameter	Water Quality Values (mg/L)	
	Likely Lower	Likely Upper
Total Dissolved Solids	850	2,000
Chloride as Cl	180	650
Sulphate as SO_4	<20	60
Iron (dissolved)	0.1	5.0
Total Alkalinity as $CaCO_3$	250	500
pH	7.0	7.5
Silica	Unknown	

The capacity for water storage on site will be determined following completion of engineering design and confirmation of which water supply will be used.

Tankered Water

Tankered water is an option. The exact source of this potential supply has not been identified. It would be expected that potable water would be supplied to the site, but use of raw water would be possible. The TDS and quality of tankered water would influence pre-treatment requirements onsite. This could range for similar pre-treatment requirements as for groundwater to no pre-treatment requirement.

Recycled Water

The recycled water under consideration would involve connecting to the Port Fairy recycled water treatment plant which has been proposed as part of the Shaw River power station project. This option will be subject to the Shaw River Power Station project proceeding. The indicated quality of this recycled water[3] is such that it is unlikely to require further treatment at Tarrone Power Station prior to use.

Selection Basis

Three options have been tabled for water supply to the proposed Tarrone power station:

- groundwater extraction;
- transport of water by licensed carrier and water tanker to site; and
- use of recycled water piped to site.

On completion of further investigations into the water quality of the groundwater on-site, a triple bottom line assessment will indicate the best practice water supply.

If water pretreatment is determined to be required, the design will focus on maximising treated water yield and minimising unnecessary wastewater generation.

[3] Wannon Water 2010, *Works Approval Application Port Fairy Recycled Water Treatment Plant (To Supply the Proposed Shaw River Power Station)*, prepared by GHD for Wannon Water

Water harvesting from building rooves to supplement the industrial water supply will be considered as part of the detailed facility design, once the water supply arrangement has determined.

3.2 Inlet Air Cooling Water

The decreased power of gas turbines at high ambient temperatures means that gas turbine performance is at its lowest at the times power is often in greatest demand and most valued (in the local context). Cooling the air entering the turbine by 4 to 10°C on a hot day can increase power output by approximately 1 to 3%. The decreased power resulting from high ambient air temperatures can be mitigated by inlet-air cooling, including evaporative cooling.

Water flows over baffles and air is drawn into the gas turbine inlet through the baffles. The air is cooled by evaporation as it passes over the baffles. Evaporation of the water reduces the temperature and increases the density of the air, allowing the gas turbine to operate at a higher output. After traversing the baffles the remaining water is collected in a sump and then recycled to the top of the baffles. Water is continually added to replace the evaporated water.

As water evaporates there is an increase in the concentration of dissolved salts. To control the salt concentration and to prevent scaling of the system (precipitation of salts), some water is continually bled off or 'blown down' from the sump. The blow down rate is adjusted to keep the concentration of dissolved salts below the threshold for scaling to occur. The blow down water is collected in a pond and left to evaporate.

The water requirements for evaporative cooling of E and F Class generators are presented in Table 3-4. These figures demonstrate the maximum quantities of water required, which would coincide with maximum operating capacity during hot summer weather with low humidity. Actual water consumption would vary based on actual weather conditions.

Table 3-4 Water Demand Requirement for E and F Class Generators

Water Demand Source	Approximate Water Demand Requirement for Operation at Maximum Capacity (kL/hr)[3]			
	Per E Class turbine[1]	Total (4 E Class Turbines)	Per F Class turbine[2]	Total (3 F Class Turbines)
Evaporation	7.5	30	8.8	26.4
Blow down	1.9	7.6	2.2	6.6
Make up	9.4	37.6	11	33
Recirculated	13.1	52.4	15.3	45.9

Notes:
1. Sourced from Leafs Gully water demand requirements
2. Make up volume sourced from GT Pro software package with the remaining water demand amounts calculated as a ratio from the E Class data.
3. The above water consumption only applies at times when evaporative cooling is in operation. The evaporative cooling typically runs during times of high temperature and low humidity.

Evaporative cooling of inlet air to the gas turbine will enable increased power generation output at the proposed Tarrone power station.

3.3 Wastewater

3.3.1 Introduction

The volume of wastewater that would be generated by the peaking power station will vary depending upon the plant runtime. The main wastewater source will be the blowdown from the turbine air inlet cooling system. Wastewater generated at the facility can be divided into:

- Process wastewater – generated through operations associated with electricity generation;
- Maintenance cleaning water; and
- Domestic sewage.

The process wastewater will be directed to the evaporation pond for concentration, and ultimately disposal as a prescribed waste. The maintenance cleaning water will be treated as prescribed waste, removed from site and treated elsewhere. The domestic sewage will be discharged to a septic system or appropriate onsite wastewater collection system (depending on site conditions) for periodic offsite collection and disposal.

3.3.2 Process Wastewater

Process wastewater is generated at the facility by the process of blow down from the evaporative inlet air coolers. The expected maximum volume of wastewater generated is 1.9 kL per hour per E Class turbine or 2.2 kL per hour per F Class turbine.

Water flows over baffles and air is drawn into the gas turbine inlet through the baffles. After traversing the baffles, the remaining water is collected in a sump and then recycled to the top of the baffles. Water is continually added to replace the evaporated water. As water evaporates there is an increase in the concentration of dissolved salts. To control this and to prevent scaling of the system (build-up of salts), some water is continually bled off or ‘blown down’ from the sump. The blow down rate is adjusted to keep the concentration of dissolved salts below the threshold for scaling to occur. The blow down water is collected in a pond and left to evaporate.

The volume of blow down water generated by the evaporative coolers depends on the number of hours the power station is operating, the number of turbines operating, operation of the evaporative cooling (as the turbines can operate effectively without the coolers on) and the ambient temperature and humidity. The annual volume of blow down water is therefore difficult to predict however, an estimate of 1,700 kL/year is estimated, based on 220 hrs turbine operation (all) with evaporative cooling on, to flow to the evaporation pond.

In addition, if pre-treatment of the evaporative cooler water supply is required, which is likely if groundwater is selected as the site water supply (and possible if tankered water is selected), then additional process wastewater streams will potentially be discharged to the evaporation pond.

Pre-treatment may consist of iron removal/multimedia filtration and:

- desalination (reverse osmosis [RO]); or
- electrodialysis reversal [EDR]; or
- ion-exchange [I-X])

with effluent streams comprising filter backwash streams and desalination brines/concentrates/ regeneration streams. An estimated additional input of up to 3,100 kL/a wastewater might be discharged to the evaporation pond in this case (assuming filter backwash comprising 10% of the feed stream flow and EDR desalination concentrate, assuming 80% recovery).

The process wastewater (cooling water blowdown, and should groundwater be used - brine, water treatment cleaning chemical solutions and sludge) will be piped from the plant into an evaporation pond. An evaporation pond water balance for water sourced from groundwater (Option 1) and water trucked/piped (recycled water via Shaw River) into site (Option 2) was undertaken to determine the indicative sizing. The pond was sized on rainfall data from a 90th percentile (wet) year. The assumption was made that a wet year occurs only once every 10 years, and the other 9 years are of average rainfall. Thus the water in the pond at the end of the wet year would be evaporated over the following 9 years of average rainfall. The results are as follows:

Option 1:

- Inflow of 4752 kL/annum (most conservative assumption as described above),
- Pond dimensions of 120 x 120 x 0.5 m, with an additional 1 m freeboard (~ 7.2 ML capacity)

Option 2:

- Inflow of 1664 kL/annum,
- Pond dimensions of 70 x 70 x 0.5 m, with an additional 1 m freeboard (~2.5 ML capacity)

The evaporation pond will not discharge to surface water, and discharge to land and groundwater will be prevented by use of an appropriate liner system.

A tankering option would fall in between these options so has not been specifically addressed, as we have effectively considered the full potential range of process wastewater discharge scenarios

Sewage

A small amount of wastewater will be generated by personnel on-site. This is estimated to be less than 1 tonne per annum (estimates derived from Somerton peaking power station). Sewage from the amenities on-site may be directed to an on-site proprietary wastewater system. Alternatively, a storage and pump system could be used to dispose of domestic wastewater off-site at an appropriately licensed facility.

3.3.3 Evaporation Pond Water Quality

The evaporation pond water quality is a function of the discharge wastewaters volume and quality, the climatic conditions, the pond dimensions, and the evaporation pond wastewater offsite disposal volume and frequency. Indicative wastewater pond influent quality has been predicted for the two options described in Section 3.3.2, which are effectively the ‘worst’ and ‘best’ cases respectively. Indicative process wastewater streams quality and quantity, for streams discharging to the evaporation ponds for the two options are presented in the two tables in **Appendix B** (noting that for the groundwater Option 1 case, the total annual discharge volume presented is less than the nominated case (4752 kL/a), as Reverse Osmosis (RO) desalination has been assumed rather than EDR).

The water balance, assessed in accordance with the assumptions described in Section 3.3.2, suggests that the evaporation pond will generally contain water with high to very high salinity. The pond water will exceed supersaturation (ie salts will be precipitating out of solution) at times, as the ponds are predicted to dry out on occasions. The drying behaviour is very dependant upon the climatic conditions considered on an annualised basis. The pond may be dry for a period of one or two months, usually at the end of summer, between two and seven times in a decade, depending upon the climatic assumptions made.

The water balance modelling also indicated that dissolved solids/salt build up in the pond will be able to be readily controlled with the annual disposal by tanker (as prescribed waste) of a relatively small volume of wastewater in late summer/early autumn, when the volume in the pond is low and TDS concentration is high. This annual removal of evaporation pond wastewater would not be expected to need to commence for some years after commencement of operation.

Stormwater Runoff

4.1 Introduction

The following information is provided in response to queries regarding the potential pre to post development changes in stormwater runoff from the site of a proposed gas turbine power station at Tarrone. The information is based on work completed in support of information presented in the EPA WAA. The information presented herein has been updated slightly from that presented in the WAA to account for updates to the proposed site layout. Specifically some additional hardstand area has been assumed. This marginally changes the sizing of some of the proposed infrastructure, but does not affect either the design philosophy or the expected impacts.

4.2 Stormwater Pre-development

4.2.1 Site Catchments

The power station site receives runoff from a number of catchments as listed below:

- North-West catchment: draining from the north to south; entering the north-west corner of the site.
- North Catchment: draining from the north to south; entering the north of the site.
- North-East Catchment: draining from the north to south; entering the north-east corner of the site.

Pre-development peak inflow estimates to the site for 10 and 100 year ARI (Average Recurrence Interval) storm events were estimated using the Statistical Rational Method recommended in Australian Rainfall and Runoff. These flows are shown in Table 4-1 below:

Table 4-1 Catchment Areas and Design Inflows

Catchment	Area (ha)	Q10 (m^3/s)	Q100 (m^3/s)
North-West	35.6	0.350	0.810
North	5.7	0.083	0.198
North-East	7.6	0.104	0.246

These peak inflows will not be altered by the proposed development but need to be taken into account during design of the site stormwater management system.

The footprint of the proposed power station plant is small and dispersed. Runoff from each of area of plant was considered based upon the footprint of each element and any changes in surface from pre to post development. These areas are numerous and are not reported here. As an example of the size of change in peak runoff, the 10 year ARI peak flow from hardstand areas pre-development is 0.05 m^3s^{-1} compared with a conservative post development peak of 0.42 m^3s^{-1}.

There are also a number of catchments within the site that do not contribute storm runoff to the plant area or receive storm runoff from the proposed area of works. These catchments are not considered further and include:

- Wetland Catchment: Approximately 4.3 hectares, draining from east to west. The catchment is quite small compared with the total surface area of the wetland itself.
- A number of smaller sub-catchments that are outside the footprint of proposed works on site and are not likely to be impacted by the development.

4.2.2 Receiving Waters

Ultimately, the site resides within the catchment of the Moyne River, as verified by the Glenelg Hopkins Catchment Management Authority (CMA) catchment mapping[4]. Runoff from the site beyond Riordans Road is expected to flow towards the Moyne River most likely via the ephemeral stream Back Creek, passing about 1.1 km to the east of the site. Back Creek flows south into the Moyne River at a point about 7.5 km to the south of the site. Other than in significant storm events, it is unlikely that stormwater runoff from the site would reach this receiving water, and would normally be lost by infiltration and evaporation.

4.3 Stormwater Post-development

The proposed Tarrone power station will alter the local runoff of the site. This development will include the introduction of a power station, hardstand areas and associated access roads, all of which can affect the quantity, flow paths and timing of surface runoff during a rainfall event. A 500 / 132kV substation has been approved under the Macarthur Wind Farm planning permit and will be constructed on the site as part of the Macarthur wind farm project.

To minimise potential effects to local hydrology from the development, measures nominated in the WAA application were proposed to minimise impacts. The WAA addressed the expected types of runoff, and aims to ensure that the natural water flows of the region are preserved, and that inflows to the wetland are protected. The major elements of the plan are summarised below:

- Proposed bund with sufficient freeboard to direct potential flood waters from the north of the site in between the turbine area and the transformer/switchyard area.
- Construction of a drain to divert low flows from the existing drain around the turbine area. For storms greater than 100 year ARI, which would cause this drain to overtop, the construction of a floodway is proposed. Both the low flow drain and floodway will discharge into the existing drain south of the turbine area.
- The use of swale drains to divert catchment runoff around the site areas and into the existing drain. Given the small size difference between the 10 and 100 year ARI of the swales, these were proposed to be designed for the 100 year ARI design storm.
- Construction of a retarding basin to receive water from the hardstand areas (conservatively assumed to be paved), located to the south of the site along the existing drain.
- Construction of a sedimentation pond to treat runoff from the process and turbine areas (assumed not roofed or paved), located to the south of the switchyard area. The efficiency of the sedimentation pond will depend primarily on the pollutants and the solids particle sizes.
- Proposed bund between the site and the wetland, to ensure no site runoff enters the wetland.
- Construction of an evaporation pond to receive process wastewater from the plant.

Further details of this plan can be found in the Works Approval Report (URS, 2010).

An increase in runoff is expected from the development and has been estimated using conservative assumptions including paving of hardstand areas and roads. Upon confirmation of the surface type to be adopted, a review of the design should and will be undertaken.

Runoff from hardstand areas will be collected and passed to a retarding basin designed to ensure peak runoff is maintained at pre development levels.

[4] http://www.glenelg-hopkins.vic.gov.au/?id=onlinemapping

Runoff from the power station would be collected and passed to a sedimentation basin that has been sized to retard peak flows at or below pre-development levels and provide ten days residence time to minimise water quality impacts.

4.4 Stormwater Quality Post-Development

A qualitative assessment of the expected water quality for both the proposed retarding basin and sedimentation pond was undertaken and is discussed below.

Retarding Basin

The water quality in the retarding basin is based on the assumption that runoff is likely to contain constituents that are consistent with runoff from a typical road. Based on this, typical TDS (total dissolved solids) concentrations could be within the range of 52 mg/L to 75 mg/L.

The retarding basin has been designed to retard flows yet not retain water for an extended period. Hence, it will remain dry through the majority of its operation and would not be expected to impact significantly on the water quality from that which it receives (there may be some sedimentation, however concentration of dissolved solids due to evaporative effects would not be expected).

Sedimentation Pond

The water quality in the sedimentation pond is based on the assumption that runoff is likely to contain constituents that are consistent with runoff from a typical roof and road that may be included for a development of this type. Based on this, typical TDS (total dissolved solids) concentrations could be within the range of 13 mg/L to 52 mg/L.

Based on the proposed sedimentation pond dimensions, average climatic conditions for the region, and after a typical month, there will be enough runoff generated for the catchment to fill the pond.

The water balance indicates that the sedimentation pond would not be expected to ever dry out. Therefore, a standing water level can be expected for the majority of the pond's operation and significant concentration of dissolved solids due to evaporation would not be expected. Allowing for some evaporation in an exceptionally dry period, the TDS in the pond may approach about 90 mg/L, due to the effects of evaporation, which is low. The sedimentation pond would therefore be expected to remain a high quality permanent water body.

4.5 Implications of Changes to the Proposed Power Station Layout

There have been minor changes and refinements to the indicative site layout proposed since the works approval application was submitted, which addressed stormwater management. We have considered the implications of these, with comments as follows.

- The evaporation pond has been shown in a location further south than initially proposed. During detailed design consideration will be required to ensure correct functioning of the primary drain of the site discharging under Riordans Road.
- The site access road (running along the north of the site boundary) will now be constructed as part of the Macarthur wind farm works.

- The sizing of the retarding basin and sedimentation ponds will need to be reviewed and confirmed during detailed design, based on the final areas and surface types of roadways, bunded areas and hardstands.

The minor layout changes do not affect either the design philosophy or the expected impacts.

4.6 Receiving Environment and Impact on Waterways

The site is located in the Murray and Western Plains Segment of the *State Environment Protection Policy (Waters of Victoria)* [SEPP(WoV)]. The protected beneficial uses of waters in the Murray and Western Plains Segment are nominated in the SEPP(WoV). The corresponding water quality objectives and indicators nominated in the SEPP(WoV) for " lowlands of the Glenelg & Hopkins catchments, & Portland, Corangamite and Millicent Coast Basins" are the applicable quality criteria for the receiving environment.

The proposed best practice stormwater management system nominated for the site, and the significant distance to the identified receiving water (the Moyne River), should result in no impact on the protected beneficial uses of these waters.

Wetland Hydrology

5.1 Introduction

The following information is provided in response to queries regarding the potential pre to post development hydrological changes to a wetland identified at the site of a proposed gas turbine power station at Tarrone. The information is based on work completed in support of a report by URS to AGL in April 2009 titled “Hydrological Investigations of a Wetland at the Tarrone Power Station Site”.

A pre-development site contour plan is presented in **Appendix C**.

5.2 Background and Characteristics of the Wetland

A small shallow wetland area has been identified on the western margin of the proposed Tarrone Power Station development site. This wetland area contains Wavy Swamp Wallaby-grass (*Amphibromus sinuatus)* a vegetation type that is of state conservation significance. The wetland lies within non-native pasture farm land and is directly accessible by cattle and farm vehicles.

It is apparent from site visits that the wetland vegetation is clearly delineated from pasture grasses suggesting an abrupt change in soil characteristics and/or water availability. It is also evident that the wetland is a shallow depression which does not always contain standing water (the site was dry during inspection).

Detailed topographic survey was undertaken to identify the area of *Amphibromus sinuatus* (0.504 ha), the catchment area of the wetland (4.310 ha), local drainage, and the relationship between surface area, volume and depth of water in the wetland. The wetland drains towards the west under Landers Lane where a drainage pipe has been identified in a spoon drain alongside the road. The maximum depth of the wetland is governed by the centre line of Landers Lane since water would spill over the roadway rather than continue to pond back into the proposed development site. The maximum elevation of *Amphibromus sinuatus* (75.99 m AHD) is at the same height as the centre line of Landers Lane.

The wetland has extremely low relief with a typical depth of 10 – 20 mm compared with the land surface immediately adjacent to the road drain to the west. Landers Lane road surface is approximately 300 mm above the lowest point in the wetland. The depth of water in the wetland is therefore estimated to range from 0 mm (dry) to a maximum of ~300 mm.

5.3 Pre-Development Hydrology

Since no local data is available on water levels in the wetland, two hydrological modelling approaches were used to assess pre-development hydrology utilising nearly 40 years of rainfall and evaporation data from the Hamilton Research Station, and stream gauge records in the district. Both approaches were found to provide reasonably consistent results.

Modelling indicates that pre-development wetland water levels are seasonal. The wetland will often be dry in the period January to April. The months of May, June and December are also often dry. Maximum depths will vary significantly from year to year with maximum depths expected in August or September. Flood runoff is likely to occur quickly and typically within one day.

For nearly 65% of the time modelled water levels are at or below 75.8 m AHD suggesting that water drains out of the wetland in the spoon drain adjacent to Landers Lane, or is absent from the site altogether. Fifteen percent of the time the wetland is likely to be “just wet” with water depths of less than 1 cm; 10% of the time water in the wetland will be at or below 296 mm depth and approximately

6% of the time depths of ~300 mm depth of water can be expected. It is noted that lower water levels in the wetland are also likely to be dependent how the pipe drain under Landers Lane functions. This will be largely dependent on the level of vegetation maintenance that occurs in the spoon drain.

It is unlikely that significant contributions to flows into the wetland occur from the remainder of the proposed development site as detailed topographic survey indicates drainage lines that prevent east to west drainage by diverting flows to the south of the development site and under Riordan's Road.

5.4 Post-Development Hydrology

Post-development hydrology was assessed in 2009 under a scenario in which the power station and gas turbines significantly encroached on the North East corner of the wetland catchment. For the purposes of the assessment it was assumed that the area was to be appropriately bunded so that all runoff (from events less than 1:100 AEP[5]) would be diverted away from the wetland. The proposed development was estimated to have reduced the catchment area of the wetland by 24%.

The post-development hydrology of the wetland was modelled using the same models applied to pre-development investigations taking into account the reduction in catchment area. Results showed a small reduction in occurrence of water depths greater than 300 mm (from 6% to 5.3% of the time), little change in the frequency of water levels in the range 1 cm to 296 mm, and an increase in the frequency of days when the wetland has <1cm depth of water from 15% to 19% of the time. No significant change in the timing or seasonality of wetting was identified.

It was concluded that there is unlikely to be a significant change in wetland vegetation due to changes in water levels >1cm depth if up to 24% of the wetland catchment is diverted. However, the sensitivity of *Amphibromus sinuatus* to changes in frequency of water depths <1cm is unknown.

5.5 Implications of Changes to the Proposed Power Station Layout

As discussed previously, some changes in site layout have occurred since the original review of potential hydrological changes to the wetland from the proposed power station development. Reference is made here to:

Ref #1) URS: Site Plan, Figure 3V2.dwg, January 2011.

The changes include:

- Movement of the 4 gas turbine generators to the north and east so that the footprint of this element lies just within the catchment of the wetland (Ref #1)
- If the actual location of the gas turbine generators is as shown in Ref #1 then between 1% and 5% of the wetland catchment would be diverted away from the wetland. This region is particularly flat. Taking into consideration the estimated post-development hydrology describe above, it is unlikely that there would be any significant effect on the frequency of inundation of the wetland area should this area be diverted.
- Introduction of a laydown area to the immediate east of the wetland catchment.
- It is assumed that the laydown area will be designed so that natural drainage of the landscape in this area will continue north to south and that the area will be bunded to avoid runoff to the wetland catchment for events up to 1:100 AEP.

[5] AEP = annual exceedance probability and indicates the likelihood of an event exceeding the estimated event in any given year. That is, there is a 1 in 100 chance that the bunding would be insufficient to divert flows in any given year.

5 Wetland Hydrology

- The siting of a gas receiving facility outside the south eastern corner of the wetland catchment.
- It is assumed that any pipework for this facility will be routed to avoid any sensitive wetland vegetation or any substantive change to the topographic catchment.

Limitations

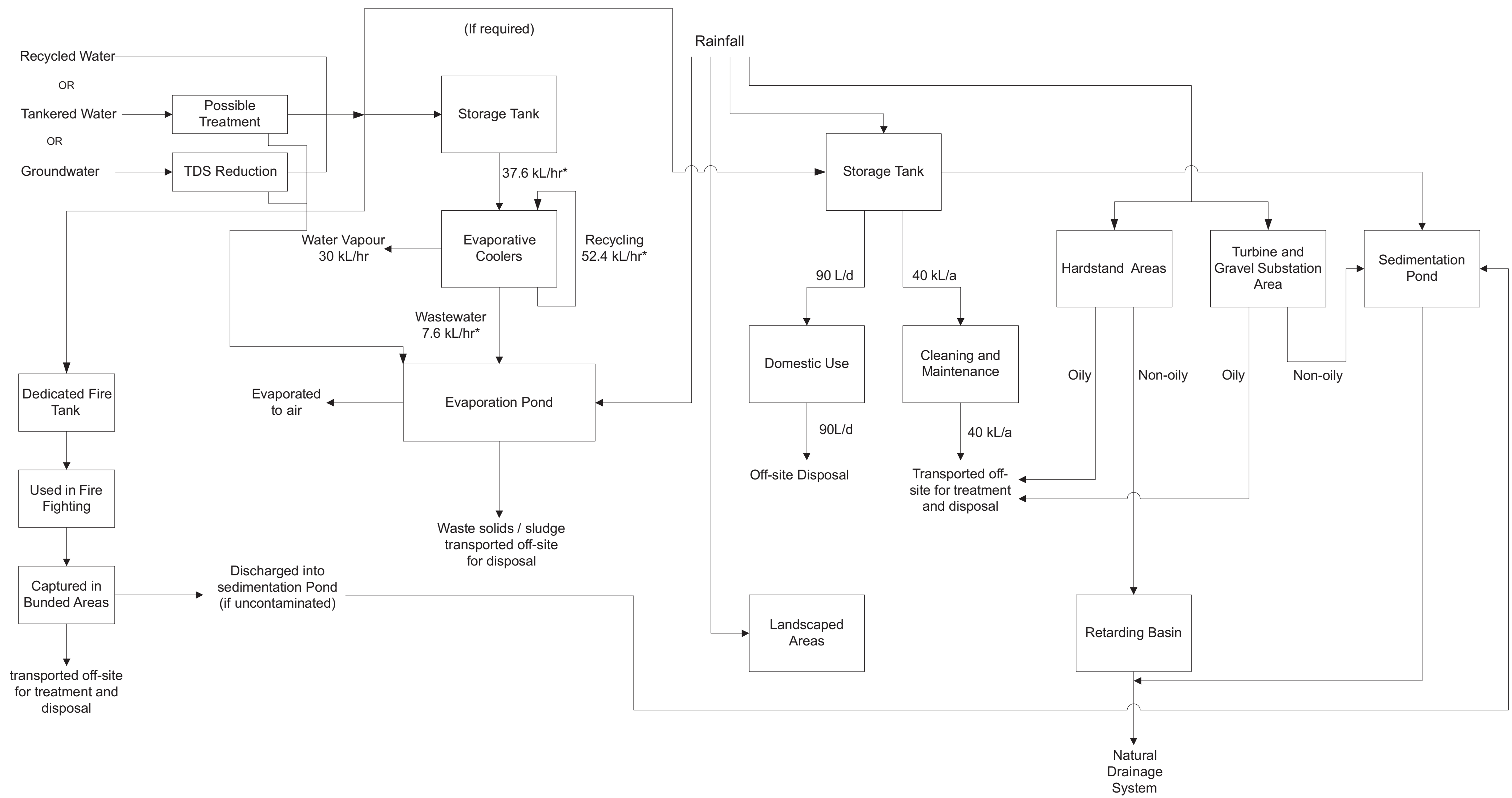
URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of AGL Energy Limited and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 8 December 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 8 December 2010 and 25 January 2011 and is based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Appendix A Water System Schematic



*Indicative flowrates when evaporative cooling operational

Client	Project	Title
AGL ENERGY LIMITED	AGL TARRONE PROPOSED POWER STATION WAA	**WATER CYCLE**

Designed: AR	Checked:	Date: August 2010	File No. Figure 5.cdr	Figure: **5**	Rev. A
Drawn: LLB	Approved:	Status: Final	Job No.: **43283491**		A4

Appendix B Indicative Wastewater Quality

Indicative Evaporation Pond Feed Wastewater Streams Quality - Option 1 - Groundwater Supply Scenario

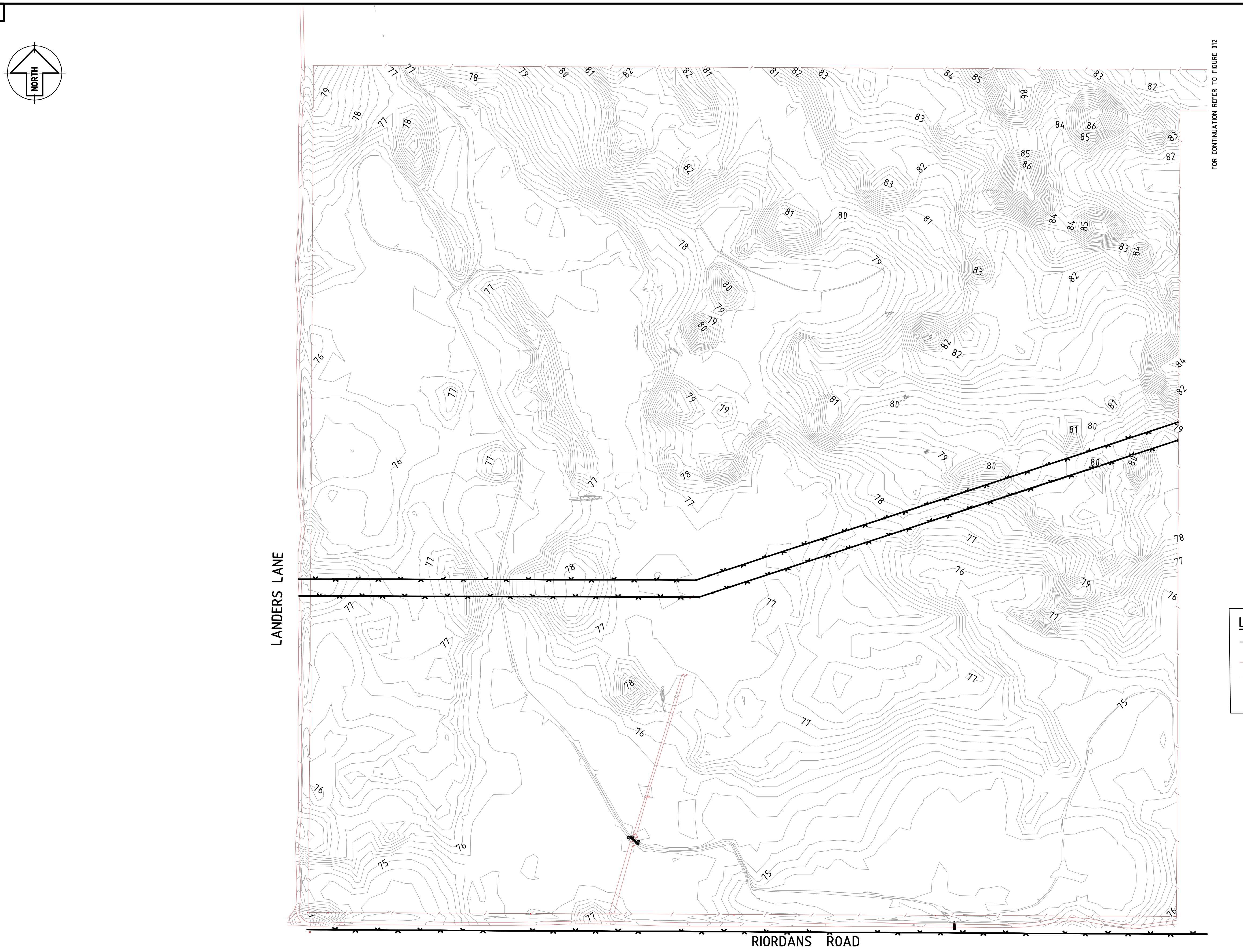
Stream Number			**1**	**2**	**3**	
			Indicative Water Quality			
Stream Description	**Units**	**Groundwater Supply (RO Feed)**	**Multimedia Filter Backwash Stream (Groundwater Pre-treatment)**	**RO Membrane Concentrate (assumed 85% recovery)**	**Inlet Air Cooling Water System Blowdown**	**Evaporation Pond Indicative Average Feed Composition**
Monthly Volume (for 3 months per annum)	**kL**	**2774**	**33.6**	**730**	**554.8**	**1318.4**
Flow Rate	**kL/hr**	**38.00**	**2.10**	**10.00**	**7.60**	**17.63**
Operation	**hrs/month**	**73**	**16**	**73**	**73**	
pH	pH units	7.5	7.5	8.5	8.7	
TDS	mg/L	2000	1800	10000	610	6151
TSS	mg/L	0.5	20	2	0	4
Chloride as Cl	mg/L	650	680	6000	100	3528
Sulphate as SO4	mg/L	60	60	3800	25	2174
Iron (total)	mg/L	5	100	48	1	40
Total Alkalinity	mg/L as CaCO3	500	500	4200	65	2471
Carbonate Alkalinity	mg/L as CaCO3	44	45	350	10	208
Bicarbonate	mg/L as CaCO3	455	450	4100	50	2401
Sodium	mg/L	310	510	3570	151	2151
Calcium	mg/L	140	280	680	280	540
Magnesium	mg/L	0	0	0	0	0

Indicative Evaporation Pond Feed Wastewater Streams Quality - Option 2 - Class A Water Supply Scenario

Stream Number			**1**	
			Indicative Water Quality	
Stream Description	**Units**	**Class A Water Feed (Piped Recycle Water)**	**Inlet Air Cooling Water System Blowdown**	**Evaporation Pond Indicative Average Feed Composition**
Monthly Volume (for 3 months per annum)	**kL**	**2774**	**554.8**	**554.8**
Flow Rate	**kL/hr**	**38.00**	**7.60**	**7.60**
Operation time	**hrs/month**	**73**	**73**	
Concetrations				
pH	pH units	7.0		
TDS	mg/L	100	500	500
TSS	mg/L	1	5	5
Chloride as Cl	mg/L	25	125	125
Sulphate as SO4	mg/L	3	15	15
Iron (total)	mg/L	0.1	0.5	1
Total Alkalinity	mg/L as CaCO3	15	75	75
Carbonate Alkalinity	mg/L as CaCO3	1	5	5
Bicarbonate	mg/L as CaCO3	12	60	60
Sodium	mg/L	20	100	100
Calcium	mg/L	0	0	0
Magnesium	mg/L	0.1	0.5	1

Appendix C Site Contour Plan

A1



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- O/H POWER LINES
- FENCE
- 79 REFERENCE TO AHD DATUM
- ROAD OR TRACK

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URS
URS Australia Pty Ltd.
Level 6, 1 Southbank Boulevard,
SOUTHBANK, VIC, 3006, AUSTRALIA
Telephone: (03) 8699 7500
Facsimile: (03) 8699 7550

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Designed	
Drawn	CV
Checked	DF
Approved	DF
Scales	AS SHOWN

Client: **AGL ENERGY LIMITED**

Project Title: TARRONE POWER STATION

Drawing Title: AMENDED SITE SURVEY FOR POWER STATION SITE CONTOURS SHEET 1 OF 2

Status: **FINAL**

Datum: AHD

Date: 12.01.2011

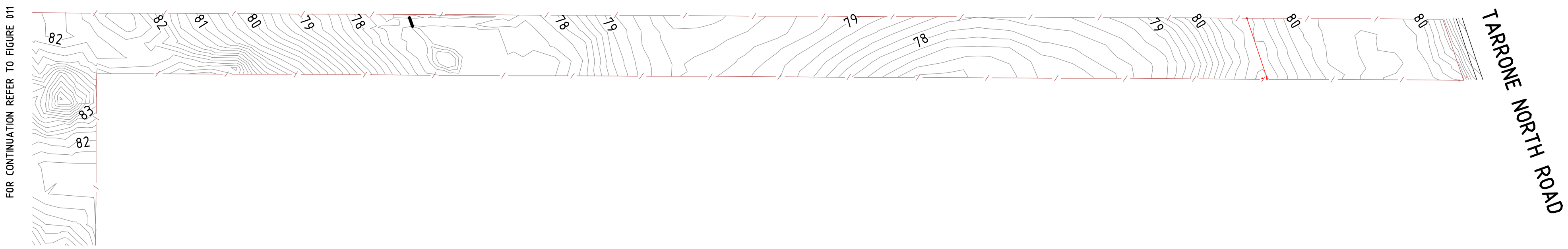
CAD File Number: Site Survey 011

Job Number: 43283491

Drawing Number: **011**

Rev: **A**

A1



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URS Australia Pty Ltd.
Level 6, 1 Southbank Boulevard,
SOUTHBANK, VIC, 3006, AUSTRALIA
Telephone: (03) 8699 7500
Facsimile: (03) 8699 7550

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Drawing Title:	AMENDED SITE SURVEY FOR POWER STATION SITE CONTOURS SHEET 2 OF 2
Status	FINAL
Datum	AHD
Date	12.01.2011
CAD File Number:	Site Survey 011
Job Number:	43283491
Drawing Number:	012
Rev	A

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URS Australia Pty Ltd
Level 6, 1 Southbank Boulevard
Southbank VIC 3006
Australia
T: 61 3 8699 7500
F: 61 3 8699 7550

www.ap.urscorp.com