History – Extract of Project Plan (GG)

Council resolved on 26 July 2011 (MIN 11.707f) to establish the Nowra Pool Advisory Committee (NPAC) whose purpose "shall be to advise Council on possible upgrade options for the Nowra Pool and adjoining area." The NPAC's purpose and composition was confirmed again by Council on 25 September 2012 (Minute12.1094.7.K).

On 24th November 2011 a report was presented to the NPAC informing of maintenance and renewal strategies, the report (D11/293850) attempted to detail upgrade options and implications including asset management, financial and environmental considerations. Subsequently reported to the December 2011 ordinary meeting, council adopted resolution (MIN 11.1324) recommending that staff report on methods to bring forward funding for replacement of the pool shell and associated reticulation systems including provision of heat pumps and solar heating with a view to staged implementation, the first stage consisting of the above scope of works.

Strategic Planning & Infrastructure Group (SPIG) prepared a report (D12/51510) to the NPAC in March 2012 which recommended;

- *An engineering consultant specialising in pool construction and upgrading be engaged to provide detailed estimates of cost for Stage 1 works and other shell replacement options;*
- *Council include sufficient funds in the 2012/2013 Operational Plan for the engineering consultancy; and*
- *Council brings forward essential replacement of the 50m Nowra pool shell and associated reticulation systems into the 2013/2014 Operational Plan, using loan funds.*

The March 2012 ordinary meeting of council received this report and although the recommendation was slightly altered so too was the adopted resolution (MIN12.232) which consisted;

a) Engage a consultant that is well versed in creating a precinct with water parks and play equipment who specialises in pool construction and upgrading to provide concept design of the Nowra Pool precinct and detailed estimates of cost for Stage 1 works and other shell replacement options, including heat pumps and potential provision for light weight cover;

b) Include sufficient funds in the 2012/2013 Operational Plan for the consultancy; and

c) Bring forward essential replacement of the Nowra pool shell, being a 55m, 10 lane with boom, and associated reticulation systems into the 2013/2014 Operational Plan, using loan funds.

d) Allocate the balance of Nowra Pool precinct vote (job number 81768) to commence the concept design process in the 2011/12 financial year, this to exclude the estimated required revote, to meet Council's ground water quality testing program (as required by the Office of Environment & Heritage)

Earth2Water Pty Ltd (E2W) was engaged by Shoalhaven City Council (SCC) to undertake a Stage 3 water quality investigation (WQI3) at Nowra Swimming Pool, Scenic Drive, Nowra, NSW (site). The purpose of the WQI3 was to supplement water monitoring previously conducted by E2W (WQI, dated 7 March 2011 and 2WQI, dated 20 May 2011) and to address requirements outlined by Department of Environment, Climate Change and Water (DECCW).

At the ordinary council meeting of May 2012, a motion was moved and carried (MIN12.489c) that Stage 1 of the rebuild of the Nowra Olympic pool plus surrounding areas and aquatic and regional playground be funded in the 2012/13 Budget with a change in the funding arrangements with $4 million being reallocated from the North Nowra Link Road Reserve and $1 million in loan funding.

Actioning resolution (MIN12.232) SPIG commenced the process of quotation by a competitive means for the specialist Nowra Pool Precinct Design consultant. The scope consisted of master plan preparation for the Nowra Pool Site, and provision of preliminary construction specification for replacement of the main pool and project costing. Complete Urban Pty Ltd was awarded the contract early July 2012 and they produced a Project Plan (D12/206567) in early August 2012. A Site Analysis Report (D12/214548) was received late September 2012. This report confirmed the obvious in regards to condition of the existing facilities, however gave greater consideration to the whole of site, its opportunities and constraints, the results of a stakeholder workshop and most importantly a summary of key requirements. As part of this process a preliminary site survey and geotechnical investigation (D12/183635) were undertaken and a flood certificate (D12/212393) obtained from council. The flood certificate determined that the site is below the flood planning level and therefore subject to flood related development controls; they are listed within the flood certificate.

Complete Urban finalised an Options Report (D12/268671) in November 2012, it contained two options for consideration by council. Both options include the pool facilities primarily as described as Stage 1 works, however the options are distinctly different from the requirements of the current project brief (D12/306005) in terms of Swimming Pool length (50m or 51.5m respectively), the option to include a boom to split the pool and widths based on 8 or 10 lanes (20.6m or 25.0m respectively). They also include replacement of the toddler's pool with a splash pad, refurbished amenities and combined plant and entry building comprising cafe, first aid, office, store and multipurpose room to replace swim club. Additionally it assessed pool heating options in terms of capital costs and annual operations and provided cost estimates for Options 1 and 2. Comparing the two options, option 1 bears the closest resemblance to the current brief due to the fact that it shares the same location albeit a slightly wider footprint.

Council resolved at its meeting of 25 September 2012 (MIN11.1088F) to request a status report on planning the replacement and enhancement of facilities in the Nowra pool precinct.

Council resolved at its meeting on 26 October 2012 (Minute 12.1133) that:"the status report on the Nowra pool precinct be received for information." The report to the NPAC on 12th November 2012 (D12/273615) included a presentation by the consultants on their concept designs. The report recommended that;

a) *The following works be the subject of detailed design and construction in the 2012/13 and 2013/14 financial years:*

i) an eight lane pool (50m x 21.6m) to replace the existing 50m pool;

ii) a water activities playground be constructed as an extension to the existing wading pool; and

iii) the existing amenities building be refurbished and include expanded canteen facilities.

b) *The estimated project cost of $5,500,000 (including design, project management and contingency costs) be funded from the remaining 2012/13 budget (Job Number 81762) of $4,847,000 and from a 2013/14 budget allocation of $653,000.*

The motion carried at that meeting and subsequently adopted by Council at its meeting on 23 November 2012 (Minute 12.1308) concluded that;

a) *Council defer pool replacement but provide new reticulation system for existing wading pool;*

b) *Council call for Design and Construction Tenders for a new 9 lane pool (in the current location) including new reticulation for toddlers pool and heat pump technology (solar/gas/electric);*

c) *Council further investigate the location and installation of a splash pool at the earliest convenience and cost this separately to other works.*

The contract with Complete Urban was terminated after this meeting; which resulted in the following tasks originally included within Complete Urban scope of works, not being completed.

- *Draft preliminary design package (Master Plan, Performance Specification for D&C)*

- *Submit Final preliminary design package (Master Plan, Performance* Specification for D&C)

The project scope of works has been based on the interpretation of resolution (MIN12.1308) as it supersedes other resolutions (MIN11.1324, MIN12.232 and MIN12.489c) on this matter. Although the scope of works has been varied in accordance with MIN12.1308, the budget allocation had been fixed at $8 million by MIN12.489c. Consequently, there existed an anomaly between the revised scope of works and the currently voted budget.

To correct this situation a status report (D13/46085) was prepared for the 28th March 2013 NPAC, the status report aimed to clarify the scope of works and estimated costs for the Nowra Pool Upgrade as well as anticipating impacts on services during the construction phase. The motion carried at that meeting and subsequently adopted by Council at its meeting on 23rd April 2013 (MIN13.401) concluded that;

a) *The following be included in the scope of works for the Nowra pool upgrade:*

- *Replacement of existing 7 lane pool with a 9 lane (23m wide 50m long) pool, in the same location and with the same orientation, of reinforced concrete and tiled construction;*
- *Pool profile with 1.85m at 'deep' end and 1.35m at 'shallow' end that meets the FINA standards for national swimming competitions and national water polo;*
- *A 'wet deck' gutter system to 50m pool;*
- *Provision of a new reticulation system to the 50m pool which will also service the existing waterslide pool in accordance with Public Health Act provisions;*
- *Provision of a new reticulation system for the existing wading pool which will also be suitable for a future 'splash pool/pad' water play area in accordance with Public Health Act provisions;*
- *Construction of a 3m clear width coloured concrete concourse around the 50m pool;*
- *Construction of a new plant building to house pumping, filtration, heat pumps, chemical dosing, and control equipment with separate reticulation systems for the new 50m pool/existing waterslide pool and the wading pool;*
- *Provision of Evacuated Tube solar heating;*
- *New heat pumps to be connected to the reticulation systems;*
- *Upgrade electricity supply to the site, with Power Factor Correction;*
- *Fixed starting blocks at both ends of the pool;*
- *New pool 'fit out' including lane ropes, pool blankets, hoist for the disabled, water polo equipment and goals, pool vacuum etc;*
- *Removal of existing shade structures at ends of existing pool and their reinstatement after the pool is replaced;*

b) *The funds currently voted to this project of $7,853,705 be reduced by $1,853,705 to $6,000,000.*

Information current as at 30th April 2013

UNITED BY OUR DIFFERENCE WSP

NOWRA SWIMMING POOL CENTRE HEATING DESIGN OPTION REPORT

Scenic Drive, Nowra

9/10/2013

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3	Revision 4	Revision 5	Revision 6
Remarks	Draft	Draft	Final	Revised with client comments	Revised with client comments	Revised with client comments	
Date	23/8/13	05/9/13	06/9/13	27/9/2013	04/10/2013	9/10/2013	
Prepared by	RKF	RKF	RKF	RKF	RKF	RKF	
Signature							
Checked by	DJK	JO	JO	JO	JO	JO	
Signature							
Authorised by	GW	JO	JO	JO	JO	JO	
Signature							
Project number	SYD1319000	SYD1319000	SYD1319000	SYD1319000	SYD1319000	SYD1319000	
Report number							
File reference							

NOWRA SWIMMING POOL CENTRE HEATING DESIGN OPTION REPORT

9/10/2013

Client

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Executive Summary

Shoalhaven City Council are looking to refurbish the Nowra Swimming Centre, with the aim of providing a facility that can operate throughout the year. In order to achieve all year round operation, the existing facilities need to be upgraded to provide additional heating during the more temperate and cooler months.

WSP has been engaged as the sub consultants to Geoff Ninnes Fong & Partners Pty Ltd to investigate a number of heating solutions, and to review current and future electrical requirements for the upgrade of the Nowra Swimming Pool Centre. The heating and electrical upgrade works will form part of the Nowra Pool Centres overall upgrade works which are being undertaken by Shoalhaven City Council.

This report outlines four system opportunities as follows:

- Photovoltaic panels feeding an electric heat pump
- Evacuated tube hot water system with electric heat pumps
- Evacuated tube hot water system with gas fired hot water units
- Evacuated tube hot water system with gas fired hot water units and a cogeneration plant

We recommend that Council replace their existing solar hot water absorbers with new more efficient evacuated tubes solar absorber technology as the existing system requires replacement. In terms of the supplementary heating option, as result of this investigation, we recommend that Council contact the utility providers to confirm the new electricity and gas tariffs for the site based on the projected increase in consumption. Based on a gas utility rate of $19.69/GJ and electricity of $10.31/MWh the heat pump system offers the lowest life cycle cost over a 25year period.

However if the electricity price remains at $10.31/MWh and the gas rate could be negotiated to below $15/GJ the gas fired hot water heater system would provide the lowest life cycle cost over a 25year period.

From a greenhouse gas emissions perspective, the gas fired hot water heaters provide 31% less greenhouse gas emissions than the heat pumps systems. And with a cogeneration system a further reduction of 5% is achieved. This option also provides the lowest upfront cost.

And as such if the driver for Council is to achieve the lowest greenhouse gas emissions, we would recommend that the gas fired hot water heating system be taken up with space for the installation of a cogeneration system in the future. And if the driver for Council is achieving the lowest life cycle cost, we recommend that the heat pump option is taken up.

Regardless of which option is pursued, we recommend that a Building Management System (BMS) be included in the upgrades to assist in the control, monitoring and optimisation of the hot water unit system. In addition all options will require input from hydraulic, civil, structural and acoustic consultants to progress the design of a new plant room, gas infrastructure and all other works associated with the upgrade.

1 Introduction

Shoalhaven City Council are looking to refurbish the Nowra Swminning Centre, with the aim of providing a faciltiy that can operate throughout the year. In order to achieve all year round operation, the existing facilties need to be upgraded to provide additional heating during the more temperate and cooler months.

As part of Shoalhaven City Councils proposed refurbishment of the Nowra Swimming Centre, WSP has been engaged as the subconsultants to Geoff Ninnes Fong & Partners Pty Ltd to review the heating options and to provide a review of current and future electrical loads requirements to the site.

This involves:-

- Replacing the pool solar hot water heating system
- Installing additional heating for the pool to operate all year round
- Consider renewable technology opportunities with respect to the heating options.

2 Basis of Report

The report is based on

- a site visit undertaken on the 6th of August 2013
- Existing site information provided by Shoalhaven City Council
- Bomaderry Aquatic centre utility bills provided by the Council
- Research into PV, Solar Absorber, cogeneration systems, pool heating systems
- Product information
- WSP's own experience with pool heating systems

3 Limitations

This report has been prepared for the Shoalhaven City Council. WSP cannot accept any responsibility for any use of or reliance on the contents of this report by any third party. The advice contained herein is limited to the information available at the time this report was prepared.

The following have been identified as the limitations to this report.

- Details of the existing plant and systems were not available. As some name plates were damaged, plant rating were not able to be identified.
- Access to the solar absorbers was not available during the site inspection
- The applicable utility rates for the increased gas and electricity consumption of the site have been estimated. The electricity rates are based on the Bomaderry Aquatic Centre rates and the gas is based on the City Administration Building rates.

4 Existing System

Nowra Swimming Centre is located on Scenic Drive in Nowra on the southern bank of the Shoalhaven River. The swimming centre currently consists of a:

- 50m olympic sized outdoor swimming pool (9 lanes wide)
- 15m outdoor toddler pool
- waterslide
- single storey amenities block
- club house
- plant room and outdoor plant area

The centre currently operates for six months of the year between October to March.

Figure 1 Site Map of Nowra Swimming Centre

4.1 Pool Heating

Currently the existing pool is heated using solar absorbers located on the amenities and club house roofs. There is no additional heating provided to the pool and as a result, pool temperatures can vary according to outside temperatures and the heating available to the solar absorbers.

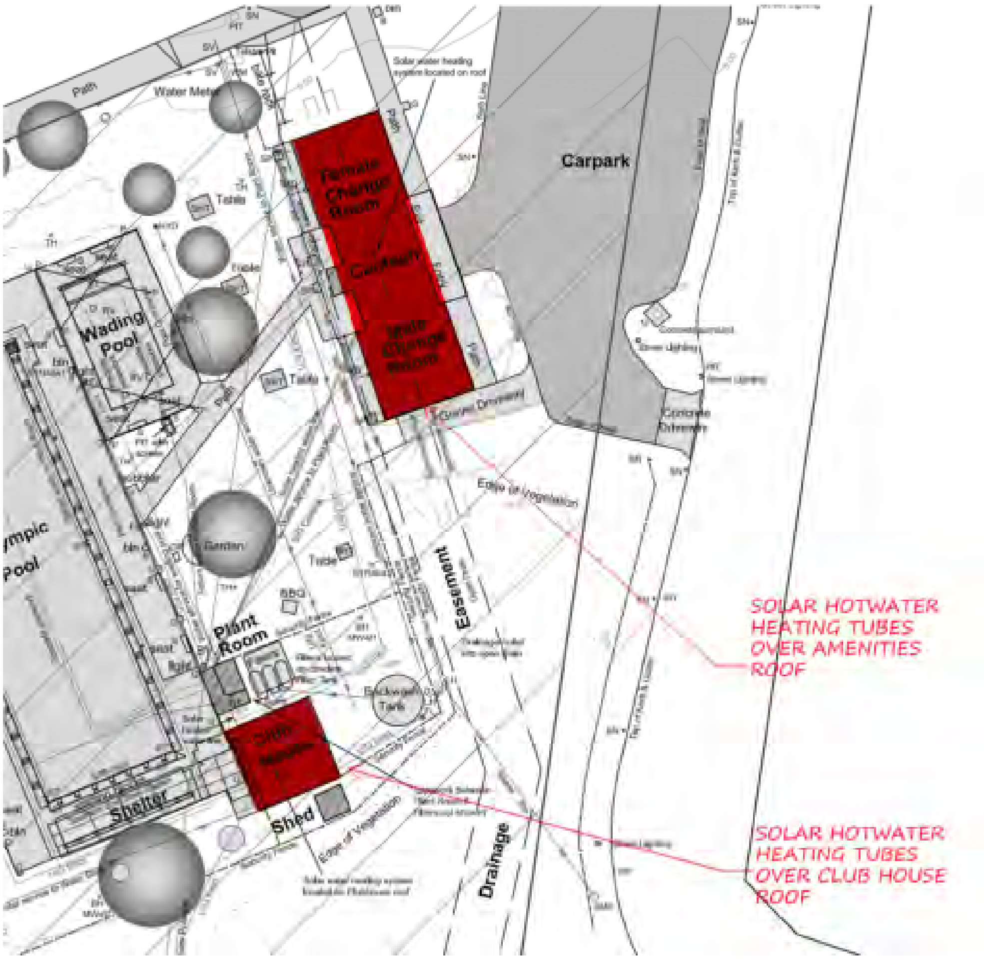

Figure 2 Existing Solar Absorber Locations

We were not able to visually inspect the absorbers as they were not accessible at the time of the site visit. However solar absorbers typically have an economic life expectancy of 20years when regularly maintained. Council staff advised that they are in poor condition and as such we have been asked to include their replacement in this scope of works.

4.2 Electrical & Gas Supplies to Site

There are two electrical supplies to the site with dedicated utility meters, one supply feeds the water slide electrical main switchboard which is rated at 100amps, the other feeds the swim centre electrical main switchboard which is rated at 80amps. The following information was ascertained by a non-intrusive survey of the site:

- The water slide main switchboard currently serves the two existing waterslide pumps.
- The swim centre switchboard supplies the swim centres' lighting, general power and filtration equipment.

Please refer to figure 3 below for further clarification.

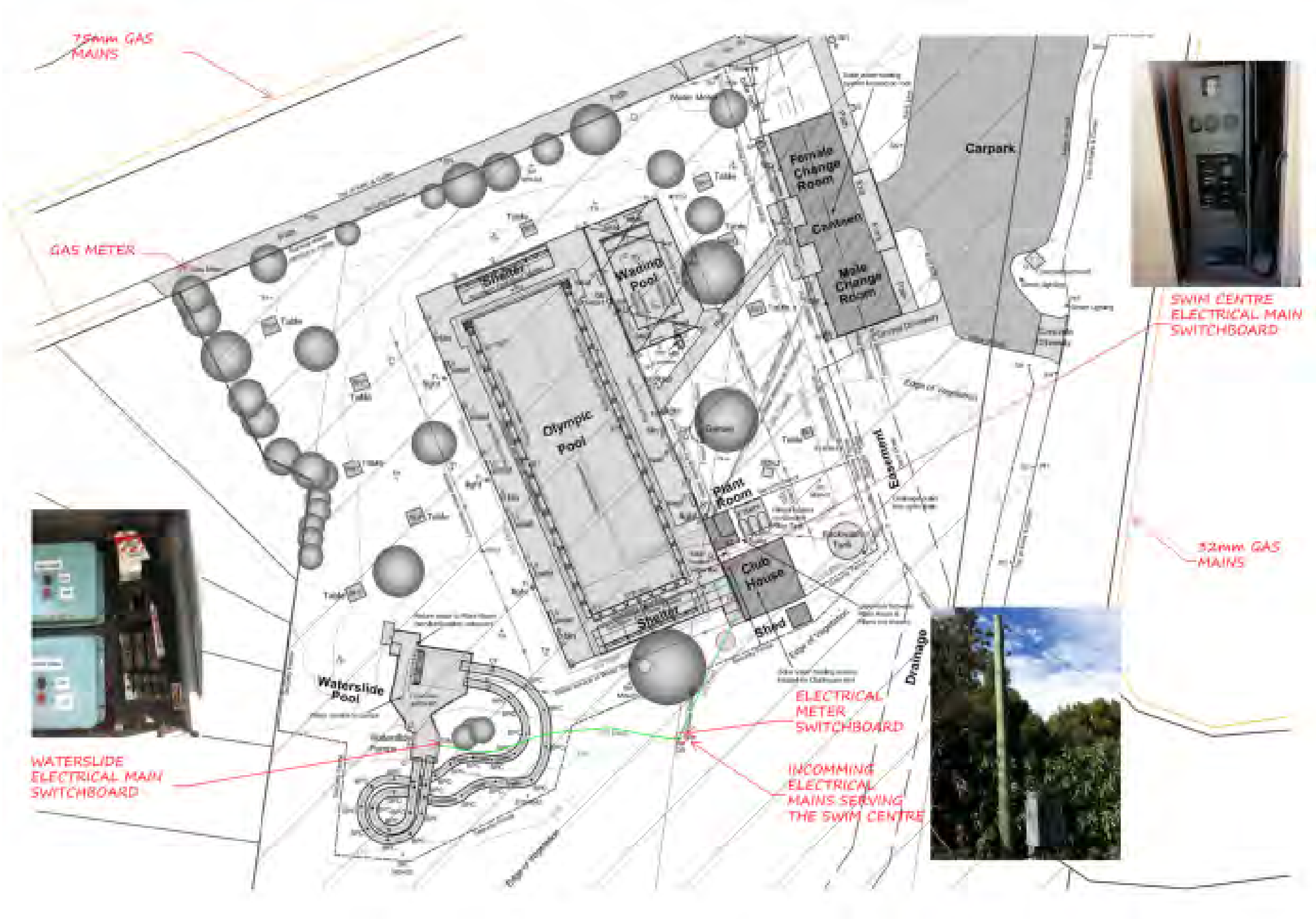

Figure 3 Existing Electrical and Gas Infrastructure Layout

There is no gas supplied directly to the site. However there are two gas mains that run along Scenic drive. One main located to the north of the site is 75mm and the other located to the east of the site is 32mm . There is a gas meter located near the 75mm gas mains near the North West corner of the site.

5 Design Options

We understand that Council are looking to heat the olympic and toddler pools. Although Council are not looking to heat the water slide as part of the upgrades we have allowed for the heat loss in the system sizing. There are four options considered within this report to heat the pools.

- Evacuated tube hot water system with electric heat pumps
- Photovoltaic panels feeding an electric heat pump
- Evacuated tube hot water system with gas fired hot water units
- Evacuated tube hot water system with gas fired hot water units and a cogeneration plant

Regardless of which option is pursued, we recommend that a Building Management System (BMS) be included in the upgrades to assist in the control, monitoring and optimisation of the hot water unit system. In addition all options will require input from hydraulic, civil, structural and acoustic consultants to progress the design of a new plant room, gas infrastructure and all other works associated with the upgrade.

6 Design Standards

Any new works shall be designed in accordance with the current BCA and Australian Standards in particular:

Public Health Act 2010 and Public Health Regulation 2012

AS/NZS 1668.1:1998	Fire and smoke control in multi-compartment buildings
AS/NZS 1668.2:1991	Mechanical ventilation for acceptable indoor-air quality
AS/NZS 3666	Air-handling and water systems of buildings - Microbial control
AS 1926.3-2010	Swimming pool safety - Water recirculation systems
HB 241-2002	Water Management for Public Swimming Pools and Spas
AS/NZS 3500.1:2003	Plumbing and drainage - Water services
AS/NZS 3500.4:2003	Plumbing and drainage - Heated water services
AS3518.1 and 2	ABS
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 3500 (Set):2003	Plumbing and drainage Set
AS 5200.000-2006	Technical specification for plumbing and drainage products - Procedures for certification of plumbing and drainage products
AS 1074:1989	Conduits and Fittings
AS 1284.1:2004	Electricity Metering
AS/NZ 2293.1 – 2005 and NCC2013 clause E4.5, E4.6, E4.8	Exit Signs
AS/NZ 2213.1 – 2005 and NCC 2013 clause E4.2, E4.4	Emergency Lighting
AS/NZS 3000:2007/Amdt 2:2012	Wiring Rules
AS/NZS 3080:2003	Telecommunications Installations
AS/NZS 3008.1.1:2009/Amdt 1:2011	Electrical Installations Selection of Cables
AS/NZS 3439.2:2002	Low Voltage Switchgear and Control Gear
AS 60044.1:2007	Instrument Transformers

AS/NZS 3136:2001	Approval and test specification - Electrical equipment for spa and swimming pools
AS 60529-2004	Degrees of protection provided by enclosures (IP Code)
AS/NZS 60335.2.60:2006	Household and similar electrical appliances - Safety - Particular requirements for whirlpool baths and whirlpool spas(IEC 60335-2-60 Ed 3.1, MOD)
AS/NZS 3112:2011	Approval and test specification - Plugs and socket-outlets
AS/NZS 3191:2008	Electric flexible cords
AS/NZS 60227.5:2003	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Flexible cables (cords)
AS/NZS 61558.2.6:2009	Safety of power transformers, power supplies, reactors and similar products for supply voltages up to 1 100 V - Particular requirements for safety isolating transformers and power supply units incorporating safety isolating transformers (IEC 61558-2-6 Ed 2, MOD)
AS/NZS 3136:2001	Approval and test specification - Electrical equipment for spa and swimming pools
AS/NZS 3100:2009	Approval and test specification - General requirements for electrical equipment
AS 3634-1989	Solar heating systems for swimming pools
AS 2369.1-1990	Materials for solar collectors for swimming pool heating - Rubber materials
AS 2369.2-1993	Materials for solar collectors for swimming pool heating - Flexible or plasticized polyvinyl chloride
AS/NZS 2535.1:2007	Test methods for solar collectors - Thermal performance of glazed liquid heating collectors including pressure drop (ISO 9806-1:1994, MOD)
AS 2560.2.5-2007	Sports lighting - Specific applications - Swimming pools
AS 4282-1997	Control of the obtrusive effects of outdoor lighting
AS/NZS 60598.2.5:2002	Luminaires - Particular requirements - Floodlights (IEC 60598.2.5:1998, MOD)
AS/NZS 60598.2.18:1998	Luminaires - Particular requirements - Luminaires for swimming pools and similar applications
AS 3979-2006	Hydrotherapy pools
AS 1926.3-2010	Swimming pool safety - Water recirculation systems
AS/NZS 60335.1:2011	Household and similar electrical appliances - Safety - General requirements (IEC 60335-1 Ed 5, MOD)
AS/NZS 60335.2.41:2004	Household and similar electrical appliances - Safety - - Particular requirements for pumps
AS 5102.1-2009	Performance of household electrical appliances - Swimming pool pump-units - Energy consumption and performance
AS 5102.2-2009	Performance of household electrical appliances - Swimming pool pump-units - Energy labelling and minimum energy performance standard requirements
AS 5601-2004	Gas Installations
AS/NZS 2293.2	Emergency Evacuation Lighting for Buildings – Inspection and Maintenance
AS/NZS 1680.1	Interior and Workplace Lighting – General Principles and Recommendations
AS/NZS 1677.1 & 2	Refrigerating systems

AS/NZS 4692	Electric water heaters
AS/NZS 5125.1:2010	Heat pump water heaters – performance assessment
AS/NZS 4234:2008	Heated water systems - calculation of energy consumption

With reference to relevant section and parts of the BCA the table below provides a brief summary of the services that will form part of the installation. Reference should be made to the relevant sections of this document.

BCA Reference	Description of Services Items Included
F4.5	Mechanical ventilation or air-conditioning systems complying with AS 1668.2: 1991
J5	Air-Conditioning and Ventilation Systems

In addition the following guides have been used in the pool heating design.

- Swimming Pool Water Treatment and Quality Standards for Pools and Spas published by the Pool Water Treatment Advisory Group
- NSW Ministry of Health Public Swimming Pool and Spa Pool Advisory Document dated December 2012.

7 Design Conditions

The following design conditions have been used in our analysis of the pool heating systems.

Table 1 Design Criteria

Item		Unit	Value	Reference
Olympic Pool	Water set point	°C	28 Max	Swimming Pool Water Treatment and Quality Standards for Pools and Spas
	Dimensions	mm	50 x 23 x (1.35 to 1.85)	
	Area	M^2	1,150	
	Volume	M^3	1,941	
	Turnover Period	Hrs	■ 3.5	
	Turnover Rate	M^3/hr	■ 555	
	Bather Load	No.	329	
Toddler Pool	Water set point	°C	32	Swimming Pool Water Treatment and Quality Standards for Pools and Spas
	Dimensions	mm	15 x 7.5 x (0.3 to 0.5) depth	
	Area	M^2	113	
	Volume	M^3	45	
	Turnover Period	Hrs	■ 0.5	
	Turnover Rate	M^3/hr	■ 102	
	Bather Load	No.	■ 51	
Water Slide	Area	M^2	43	
	Volume	M^3	43	
	Bather Load	No.	25	
Outdoor Air Ambient Temperature		°C	7	BOM

NB:- Heat loss has been considered in the system sizing calculations

7.1 Evacuated tubes hot water system

The solar absorbers combine the most efficient techniques for capturing the sun's heat with modern hydraulic systems to produce cost effective hot water and reduce the need for gas or electricity to heat water for pools.

Evacuated tube solar absorbers comprise a series of vacuum-sealed glass tubes, each with its own absorber plate fused to a heat pipe. Solar energy from the sun is collected by each heat pipe and, from there, transferred to a fluid within the heat pipe circuit (typically glycol). As the fluid heats up, heat can then be transferred to another medium, such as a swimming pool via heat exchanger

However, as the amount of heating available from the solar absorbers varies according to external conditions, it is usually combined with either a gas boosted hot water unit or electric heat pump to provide additional heat to maintain the required pool water temperature; these options are explored further within this report.

WSP propose to replace the existing solar absorbers on the amenities and club house roof with more efficient evacuated tube solar absorbers. The evacuated tube solar absorber shall be connected to a heat exchanger which provides storage for the hot water and separates the solar absorber hot water circuit from the pool water heating circuit. The solar absorbers would contribute 11% of the heating demand/load for the pool during peak periods. We anticipate a cost savings of $9,032 per year which would result in a simple payback of 17 years.

Hot water generated by the solar absorbers would be used to pre-heat water in the hot water vessel. From here it would be distributed around the heating system in which the heat would be topped up by heat pumps or gas fired hot water units.

Table 2 Evacuated Tube Size

Item	Unit	Value
Available Area	m^2	380
No. of Panels	No.	55
Peak Heat Capacity	kW	120
Estimated Order of Cost	$	$150K*
Weight	Kg/m2	30
Pumping Energy Costs		$1,500
Lead Time		3 months
Economic Life Expectancy	years	20
Estimated Annual Heat Supplied to the Pool	MJ	711,213
Estimated Annual Cost Savings	$	$9,032
Simple Payback	Years	17

*The estimated order of costs is for the evacuated tube system only. The above information and advice has been provided by Supreme Heating http://www.supremeheating.com.au/. We recommend that installation of the solar evacuated tube absorbers as a replacement to the existing solar absorbers. The supplementary heating options are explored in the following sections.

7.2 Photovoltaic panels feeding an electric heat pump

We have investigated utilising photovoltaic panels to provide electricity to the heat pump however there is an efficiency loss in converting solar to electricity and then to heat water when compared to an evacuated absorber that directly uses heat to heat water through a heat exchanger. Preliminary calculations identified this to be unviable and as such this option has not been explored further in this report.

7.3 Electric Heat Pump System

As there is no existing gas connection available on site, we would typically expect a heat pump to be the most suitable option to heat the pool, as it avoids the cost of a new gas main. However as the pool is currently only heated by solar absorbers, the sites electrical supply would need to be upgraded to accommodate the additional electrical demand required by the heat pumps.

Although these systems use one third the energy of an electrical heating element hot water heater, they can be expensive to run and have high carbon emission outputs. In comparison with other opportunities outlined in this report, the Heat Pumps also have a lower life expectancy of 15 years when compared to gas fired hot water units' 20years.

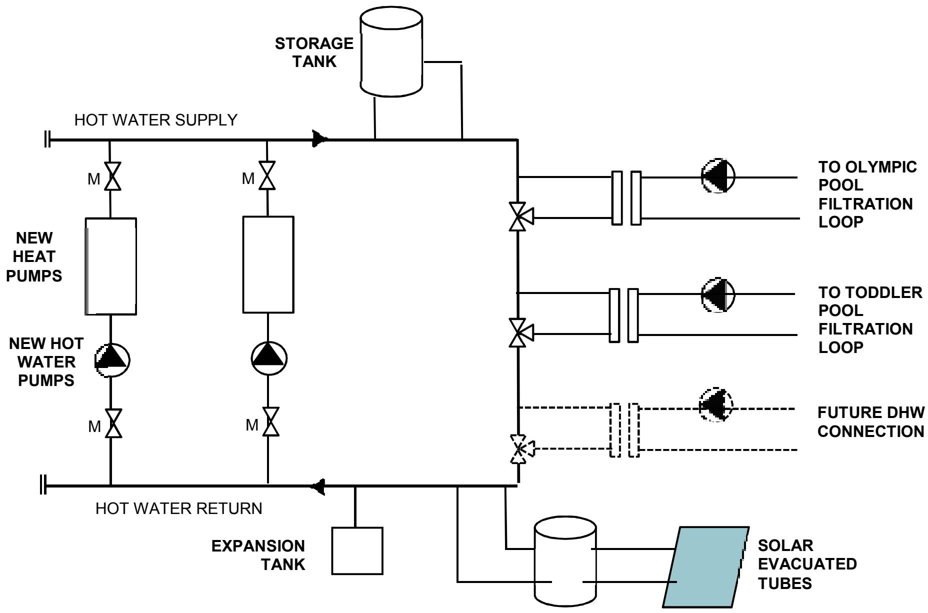

Figure 4 Proposed Heat Pump Schematic

Table 3 Equipment Schedule

Label	HP-1	HP-2
Equipment Type	Heat pump	Heat pump
Heating Capacity Per Unit ($kW_{heating}$)	550	550
Hot Water Temperature (°C)	55/35	55/35
Hot Water Flow (L/s)	6.6	6.6
Electrical input (kWe)	255	255
Sound Power Level 10^{12}W	94	94
Turn down	13%	13%

Table 5 Estimated Capital Cost Breakdown

Item	Breakdown of Capital Costs
Evacuated Tubes	$150K
Mechanical	$650K
Electrical Upgrades	$400K
Gas Reticulation	-
Total	$1,200K

Table 4 System Overview

Item	Unit	Heat Pump
System description		2 x 550kW heat pumps
Weight	Per unit	4.6tonnes
Mechanical Spatial Requirements	m^2	90 (external area) 50 (plantroom)
Electrical Spatial Requirements	m or m^2	5x5.5 Substation Easement
Estimated Electrical Maximum Demand	kVA	1,658
Estimated Gas Maximum Demand	MJ	-
Lead Time		3months
Energy Consumption	MJ	10,683,088
Estimated Annual Greenhouse Gas Emissions	Tonnes	2,611
Estimated Capital Costs	$	$1,050,000
Estimated Annual Energy Cost	$	$294,669
Estimated Annual Maintenance Costs	$	$20,000
Estimated Annual Management Cost	$	-
Replacement Cost	$	$450,000
Life Cycle Costs over 25 Years	$	$13,447,706
Heat Pump Economic Life Expectancy	years	15

Notes

The estimates in table 4 are based on the pool facility operating for 12months.

Figure 5 Proposed Heat Pump Hot Water Heater Spatials

This option would involve multiple heat pumps to allow the system to turn down to supply low load period demands.

The heat pumps would be located in a 90m^2 external enclosure (See Figure 5). Acoustic attenuation would need to be considered to minimise any noise transmission to nearby buildings. A plant room (50m^2) enclosure Due to the increase in electrical demand for the site, the main electrical supply would need to be upgraded to accommodate the electricity demand of the new equipment. This will involve obtaining an increased supply from Endeavour Energy to obtain a permission to connect prior to the practical completion of the site upgrades.

We would recommend that the site be provided with a designated feed from the adjacent street, and supply both the water slide area and the swim centre, from a central location having a designated tariff meter for both developments.

The new electrical supply would entail two new pad mounted substations, and a new main switchboard to be located in the plant room. The estimated maximum demand for this option is 1,658KVA. Each Endeavour Energy padmounted substation and associated cabling to the street will require an easement to be created over the Endeavour Energy assets. The following easements and right of ways are required for the project:

- Substation Easement – 5000mm x 5500mm for two padmount substations
- Cable Easement – 3000mm wide following the cable route from the padmount substations to the incoming cabling at the property boundary
- Vehicle Access – If the padmounted substations are located away from the property boundary within the site a 4500mm wide vehicle access track is required from a publicly accessible road to the padmount substation locations.

The ideal location of the padmounted substations will be at the property boundary nearest to the future plant with the following additional constraints due to site conditions:

- Existing Drainage Easement – Permission will be required from the relevant owner of the easement to bury new electrical cabling underneath this drain.

- Feeder capacity – Capacity of the existing street feeder to supply the additional increase in loads
- Accessibility – Padmount substation accessibility from a Scenic Drive for maintenance of the Endeavour Energy assets

7.4 Gas Boosted Hot Water Heaters

This option involves condensing hot water units. Condensing hot water units are designed to condense water vapour in the flue gas on heat exchanger surfaces to capture latent energy and drain away captured condensation.

Condensing hot water units can operate in non-condensing mode like traditional boilers or in condensing mode. By operating in condensing mode higher efficiencies are gained.

The point at which condensation occurs is the dew point of the products of natural gas combustion which is around 54 to 57°C. Return water temperature needs to be below this temperature for condensation to occur. Based on a temperature difference of 15-20°C the supply water temperature would ideally be below 70°C. This is ideal for pool water heating as the required pool water heating temperatures are generally lower than 35°C. Boilers typically have an economic life expectancy of 20 years, which is longer than heat pumps.

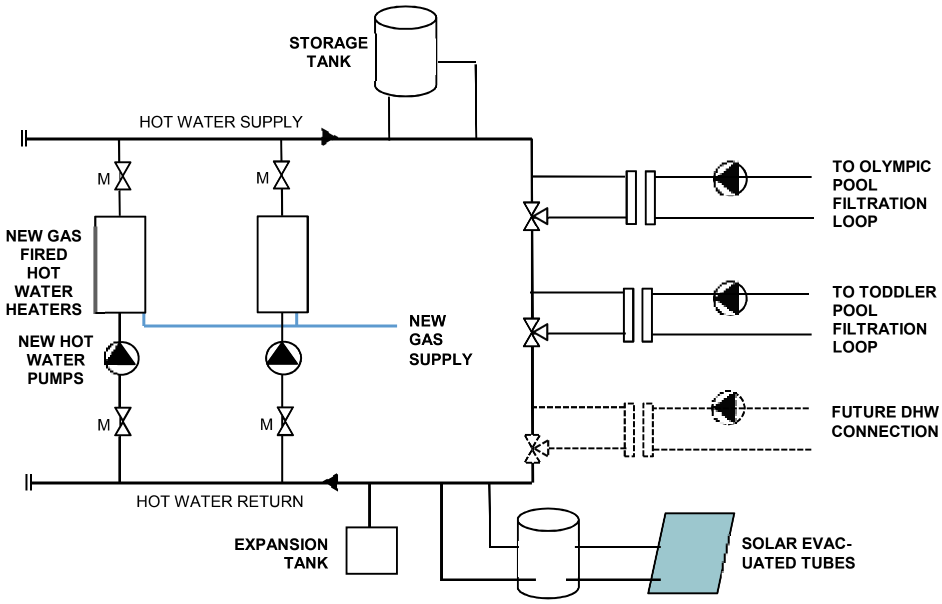

Figure 6 Proposed Gas Fired hot Water Unit Schematic

Table 6 Equipment Schedule

Label	HWU-1	HWU-2
Equipment Type	Hot Water Heaters	Hot Water Heaters
Heating Capacity Per Unit ($kW_{heating}$)	550	550
Hot Water Temperature (°C)	55/35	55/35
Hot Water Flow (L/s)	6.6	6.6
Gas Input (MJ/hr)	1,897	1,897
Pressure (kPa)	2.5-2.7	2.5-2.7
Efficiency	109%*	109%

Table 8 Estimated Capital Cost Breakdown

Item	Breakdown of Capital Costs
Evacuated Tubes	$150K
Mechanical	$300K
Electrical Upgrades	$100K
Gas Reticulation	$80K
Total	$630K

Table 7 System Overview

Item	Unit	Heat Pump
System description		2 x 550kW gas fired hot water heaters
Weight	Per unit	1.27kg
Mechanical Spatial Requirements	m^2	80 (plantroom)
Electrical Spatial Requirements	m or m^2	New service pole on site
Estimated Electrical Maximum Demand	kVA	284
Estimated Gas Maximum Demand	MJ	3,800
Lead Time		3months
Energy Consumption	MJ	20,651,347
Estimated Annual Greenhouse Gas Emissions	Tonnes	1,811
Estimated Capital Costs	$	$630,000
Estimated Annual Energy Cost	$	$370,455
Estimated Annual Maintenance Costs	$	$13,000
Estimated Annual Management Cost	$	-
Replacement Cost	$	-
Life Cycle Costs over 25 Years	$	$14,263,693
Gas Fired Hot Water Heater Economic Life Expectancy	years	20

Notes

The estimates in table 4 are based on the pool facility operating for 12months.

* Based on condensing hot water unit efficiencies which gain additional heat by capturing heat from the exhaust gases.

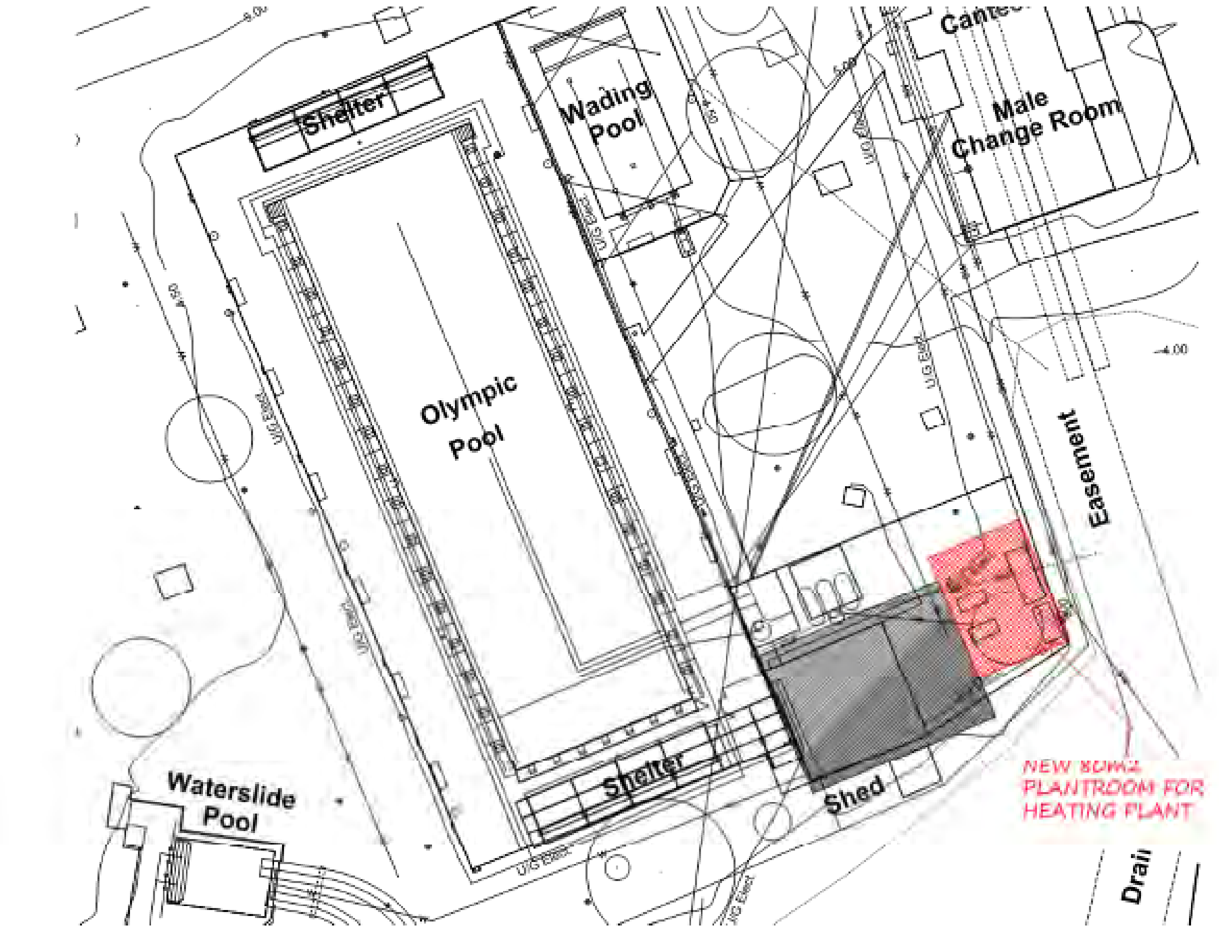

Figure 7 Proposed Gas Fired Hot Water Heater Spatials

This system involves two gas fired hot water heaters to allow the system to turn down to supply low load period demands. The hot water heaters would be located in a 80m^2 ventilated plant room (see Figure 7). The plant room would contain gas fired hot water heaters, storage tank, heat exchangers and circulating pumps.

Consideration must be taken in locating the flues and their associated discharge heights. Hot water Unit exhausts can be combined into a common flue but preferably remain separate.

Although heating system relies on a gas supply, the additional filtration plant and circulating pumps would increase the current electrical demand of the site of 284KVA.

In this option a single pole mounted substation will be required to supply the maximum demand of 284kVA. This involves the extension of the existing 11kV distribution network to the proposed overhead pole transformer, with new service mains to the Nowra Swimming Centre to supply the main switchboard. New poles will be required to support the new substation.

As there is no gas supplied to the site, a new gas main with meter would be required to be supplied to site and reticulated to the pool heating plant room. (See Section 5 for further details)

7.5 Cogeneration with gas fired hot water units

Cogeneration is a common application for Swimming pools due to the continuous demand for pool heating, pump power, and a high demand for domestic hot water. Generally the light and power electricity demand for a swimming pool facility are comparatively small when compared to the heating demands, with electrical loads reducing overnight primarily providing pumping power and minimal heating in meeting the pools set back water temperatures.

A cogeneration system is composed of a gas engine, which is typically a micro-turbine or reciprocating engine, heat exchangers, flues, pumps, pipework and controls.

The gas engine generates electricity and waste heat from natural gas. The waste heat is captured and put through a heat exchanger to provide hot water which can be used to heat domestic water, pool water or air within a facility.

Cogeneration systems become viable when they are able to operate for extended periods of time, provided that the source fuel is inexpensive.

By using the cogeneration system to generate electricity and supplement the use of gas or electricity for heating hot water unit energy can be saved as electricity generated from power stations are inherently inefficient due to transmission losses.

This option proposes the installation of one 27.5kVA micro-turbine CHP arrangement in meeting the sites base load electrical demand and providing usable heat. The unit is intended to meet the sites base load power demand and run continuously throughout the year.

This arrangement would be supplemented with 2 x 550kW high efficiency gas fired hot water heaters. A buffer vessel will provide hot water storage for periods when the hot water demand does not meet the waste heat supplied by the generator. The gas fired hot water units shall be used to top up the heat from the cogeneration plant. The following table list the benefits and disadvantages of cogeneration systems.

The benefits of this type of cogeneration system are:	The disadvantage of this type of cogeneration system are:
• improved operating efficiencies through reduced plant turn down rates • reduced boiler maintenance through limiting cycling and start/stop operation • reduced electrical demand which can provide electricity costs savings • reduction in utility costs and greenhouse gas emission • onsite generation of electricity provide backup when the grid fails	• more complex design resulting in higher capital costs • long paybacks • higher level of maintenance expertise required which is usually provided by suitably qualified company • higher level of management required

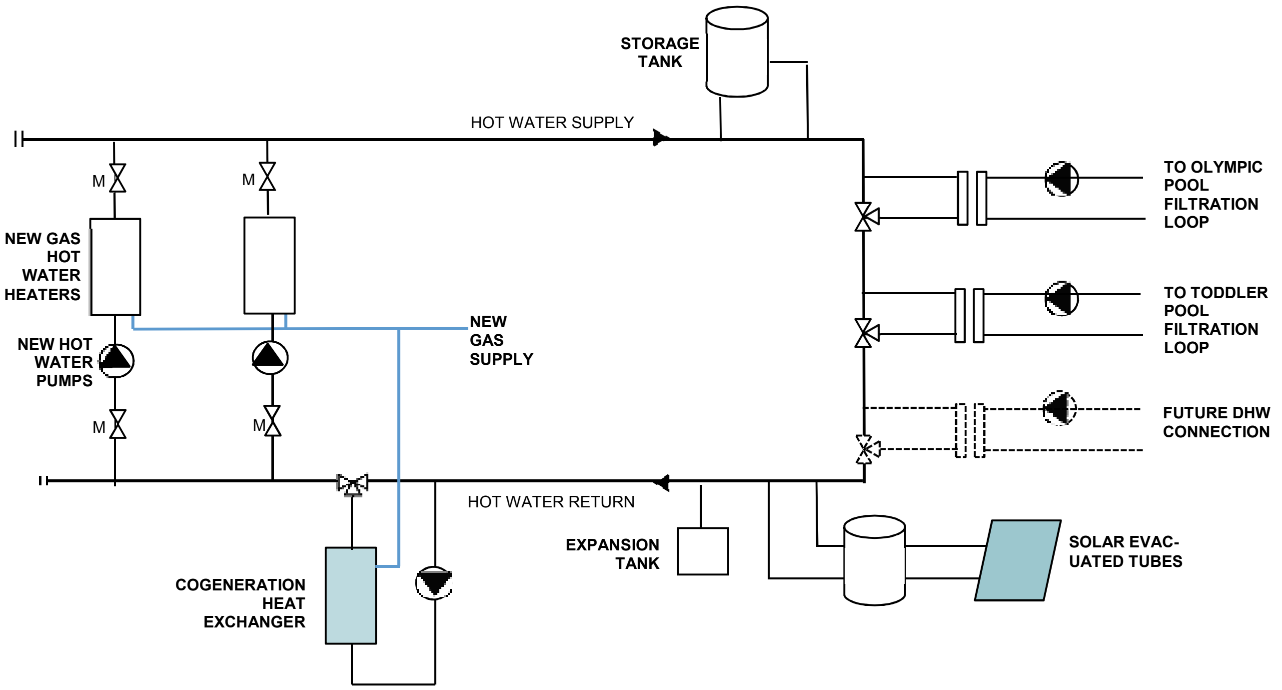

Figure 8 Proposed Cogeneration Schematic

Table 9 Equipment Schedule

Label	HWU-1 & 2	HWU-2
Equipment Type	Hot Water Heaters	Cogeneration heat exchanger
Heating Capacity Per Unit ($kW_{heating}$)	550	120
Hot Water Temperature (°C)	55/35	55/35
Hot Water Flow (L/s)	6.6	1.43
Gas Input (MJ/hr)	1,897	390
Pressure (kPa)	2.5-2.7	35
Efficiency	109%*	N/A

Table 11 Estimated Capital Cost Breakdown

Item	Breakdown of Capital Costs
Evacuated Tubes	$150K
Mechanical	$680K
Electrical Upgrades	$100K
Gas Reticulation	$80K
Total	$1,010K

Table 10 System Overview

Item	Unit	Heat Pump
System description		2 x 550kW gas fired hot water heaters 1 x 27.5 kWe cogen
Weight	Per unit	1.27kg
Mechanical Spatial Requirements	m^2	120 (plantroom)
Electrical Spatial Requirements	m or m^2	New service pole on site
Estimated Electrical Maximum Demand	kVA	199.5
Estimated Gas Maximum Demand	MJ	4,200
Lead Time		6months
Energy Consumption	MJ	21,137,733
Estimated Annual Greenhouse Gas Emissions	Tonnes	1,677
Estimated Capital Costs	$	$1,010,000
Estimated Annual Energy Cost	$	$363,455
Estimated Annual Maintenance Costs	$	$20,500
Estimated Annual Management Cost	$	$10,000
Replacement Cost	$	-
Life Cycle Costs over 25 Years	$	$15,795,200
Gas Fired Hot Water Heater Economic Life Expectancy	years	20
Gas Generator Economic Life Expectancy	years	20

<u>Notes</u>

The estimates in table 4 are based on the pool facility operating for 12months.

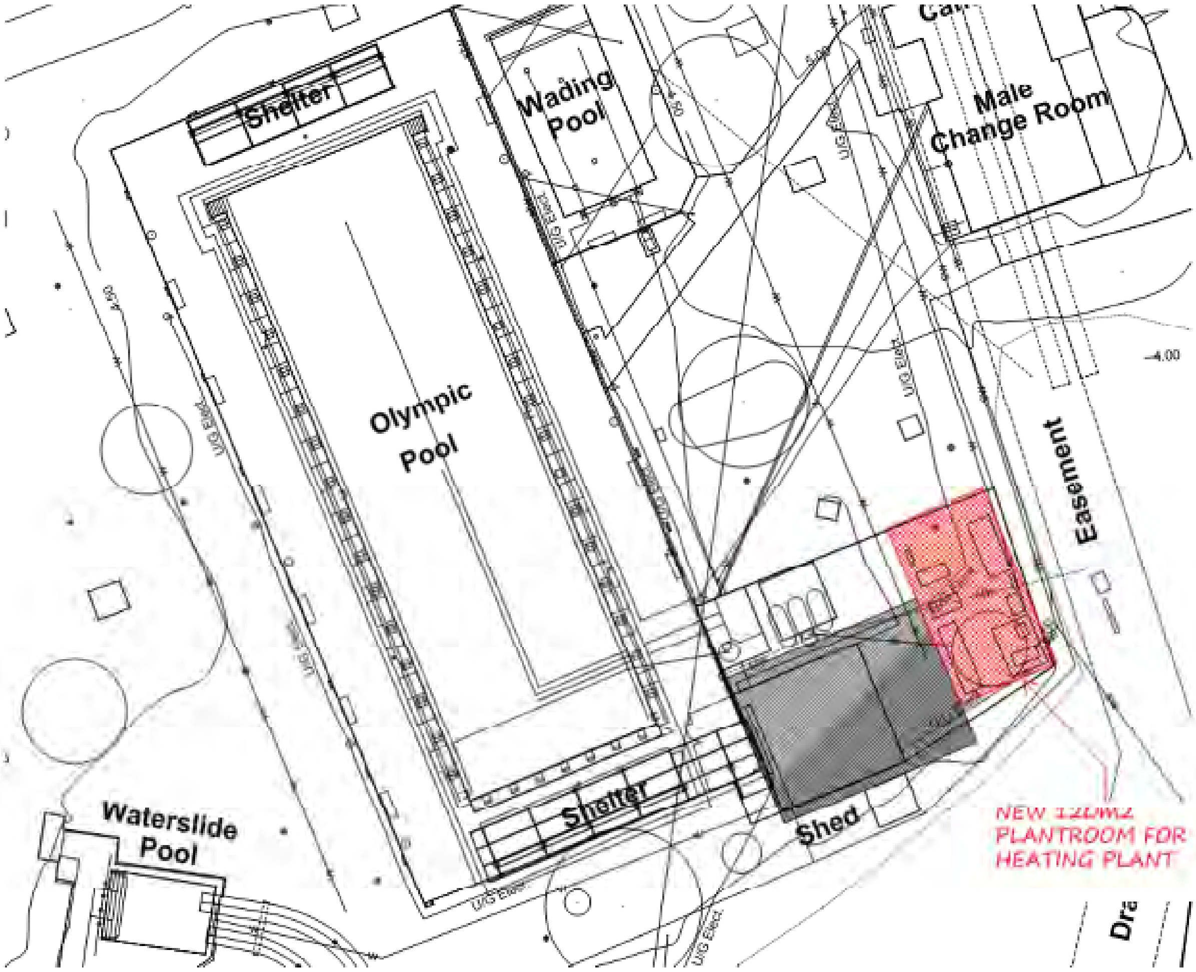

Figure 9 Proposed Gas Fired Hot Water Heater With Cogeneration Spatials

This option involves a new 120m^{2}central plant room (see Figure 9) housing the micro-turbines, gas fired hot water units, buffer vessel, heat exchanger, and associated pumps and pipework. The micro-turbines would be connected in series with the hot water units acting as the lead heat source.

Consideration must be taken in locating the flues and their associated discharge heights, and in the removal of NO_x and CO emissions from the micro turbine exhausts (Normally performed through a catalytic converter but not currently required under NSW regulations).

The micro-turbine would require its own exhaust (NSW Regulations); hot water unit exhausts can be combined into a common flue but would preferably remain separate.

Domestic hot water currently served via electric storage tanks provides hot water to two showers in each change room. All the showers could be provided with heating water from the cogeneration system. However solar hot water collectors would be recommended in providing pre-heating of DHW, supplemented by the central gas fired plant.

In this option a single pole mounted substation will be required to supply the maximum demand of 284kVA (in case the cogeneration unit is not available). This involves the extension of the existing 11kV distribution network to the proposed overhead pole transformer, with new service mains to the Nowra Swimming Centre to supply the main switchboard. New poles will be required to support the new substation.

8 Utility Upgrades

As the upgrades involve additional filtration and heating equipment to serve the pool, all the options outlined in this report trigger an upgrade to the electrical supply to the site. The heat pump option requires a higher electrical supply to the site whilst the gas fired hot water unit option requires a lower electrical supply to the site, along with a new gas supply.

The existing onsite switchboards are past their economic life expectancy of 30years and are in poor condition. There are no labels on the boards making it difficult to determine whether the circuit breakers are currently active and which services they are protecting. In addition we believe the switchboards have not undergone regular testing and maintenance. This would propose a considerable risk to any contractors undertaking remedial works within the switchboards.

The existing switchboards do not comply with the current AS3000 Electrical wiring regulations, major upgrade works or replacement of panels is required to achieve compliance. All existing and new general power circuits shall be protected by RCD's (Residual current devices) as per Australian code requirements. Therefore distribution boards that are proposed to remain shall have the protection devices retro-fitted into the existing distribution boards.

WSP recommend that the site be provided with a designated feed from the adjacent street, and supply both the water slide area and the swim centre, from a central location having a common tariff meter for both developments. Informal advice from Endeavour Energy indicates additional padmounted substations will be required if the heat pump option is elected. A formal application for connection can be submitted with the relevant maximum demand to Endeavour Energy upon confirmation of the design option.

The gas fired hot water heaters and cogeneration system option will require a gas supply from the existing 75mm gas main in Scenic Drive. The gas main is located on the opposite side of Scenic Drive and will require the gas connection to cross the road to the pool site. A gas meter assembly with an enclosure will be installed within the property boundary. The enclosure will be provided to protect the gas meter assembly from unauthorised access. A gas pipeline from the gas meter will be installed within a trench to the pool plant room to supply the gas equipment/appliances. All road surfaces and landscaped areas disturbed to install the new gas service will be returned to match the original condition.

WSP have submitted a gas connection application to Jemena. As a result, ActewAGL have provided a letter of offer for the gas connection, which has been provided in the appendices.

	Units	Existing System (Operating for 12months)	With New Filtration Plant and running for 12 months	Electric Heat Pumps	Gas fired hot Water Heaters	Cogen + Gas fired hot Water Heaters
Estimated Electrical Maximum Demand	KVA	180	269	1,658	284	199.5

9 Capital Costs

Table 12 summarises the capital costs associated with all three options which were explored in detail within this report.

Table 12 Estimated Capital Cost Breakdown

	Heat Pump + Solar Absorbers	Gas Boilers + Solar Absorbers	Cogeneration + Gas Boilers
Evacuated Tubes	$150K	$150K	$150K
Mechanical	$650K	$300K	$680K
Electrical Upgrades	$400K	$100K	$100K
Gas Reticulation	-	$80K	$80K
■ **Total**	$1,200K	$630K	$1,010K

The table shows that the heat pump system and the cogeneration/ hot water system are both over $1mill. The heat pump has a marginally higher capital cost than the cogeneration/ hot water system. This is because of the costs associated with upgrading the electrical supply and the large capital costs of heat pump units.

Heat pumps generally are a viable option for heating when there is simultaneous heating and cooling to enable the chiller to operate in heat recovery mode. In these circumstances there is no cooling provided to the facility and as such it results in a higher premium to install heat pumps to site.

The gas fired hot water heaters include the costs for a new gas supply to the site. However the cost of the gas fired hot water heaters is less than a third of the heat pump and the cost of a new smaller electrical supply and a new gas mains is lower than with the heat pump option.

10 Operational Energy & Costs

Table 13 indicates the overall energy usage for a heat pump system is lower than for a gas fired hot water heater system or a cogeneration system. However the benefits of using gas over electricity is that it is a more greenhouse friendly fuel, resulting in lower greenhouse gas emissions. The gas fired hot water heaters with co-generation has the highest energy usage.

Table 13 Estimated Energy Usage

	Units	Existing System (Operating for 12months)	With New Filtration Plant and running for 12 months	Electric Heat Pumps	Gas fired hot Water Heaters	Cogen + Gas fired hot Water Heaters
Electricity	kWh	324,033	989,533	2,976,524	1,083,723	854,868
Gas	MJ	-	-	-	16,749,944	18,060,208
Total Energy	**MJ**	**1,166,520**	**3,562,319**	**10,683,088**	**20,651,347**	**21,137,733**
Estimated Electrical Maximum Demand	KVA		269	1,658	284	199.5

Notes and Assumptions

- *Internal Lighting is based on 15Watt/m^2*
- *Power (this includes power to filtration plant) is based on 15Watt/m^2*
- *Filtration plant power requirements has been provided by GNFP estimate of 110W running 24/7*
- *Waterslide energy consumption was estimated at 7,693kWh per year based on existing electricity bills which have been extrapolated to show usage throughout the year.*
- *Heating circulation pumps is estimated at 15W*

Table 14 and Figure 10 shows the greenhouse gas emissions for the three options. It shows the existing energy usage and hence greenhouse gas emissions for the filtration equipment is estimated to increase significantly with the addition of more filtration systems and plant and due to extended operation of the facility. The greenhouse gas emissions associated with the filtration plant energy usage is shown in grey. Overall the gas fired hot water heating system produces 31% lower greenhouse emissions than the electric heat pump option. And that a cogeneration system offers a further 5% greenhouse gas reductions than the gas fired hot water heating option, because of its use of waste heat for heating.

Figure 10 Summary of Green House Gas Emissions

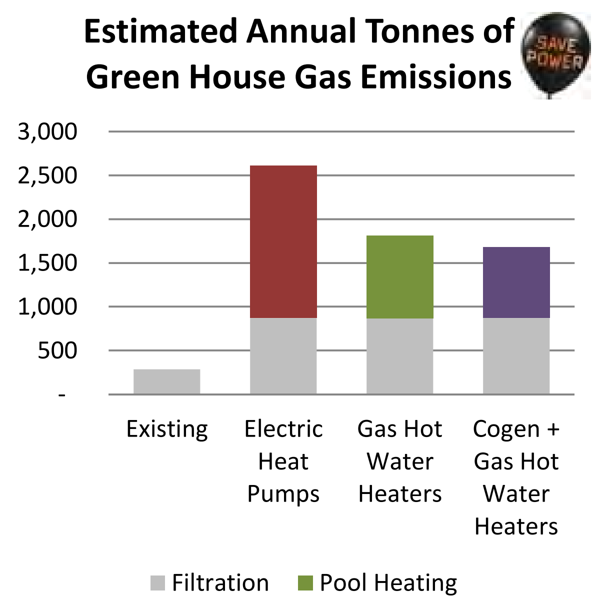

Table 14 Estimated Greenhouse Gas Emissions

Systems	Existing System 12 months Operation	Electric Heat Pumps	Gas Fired hot Water Heaters	Cogen + Gas Fired Hot Water Heaters
Filtration System	285	871	871	871
Pool Heating System		1,741	1,811	806
Total	**285**	**2,611**	**1,811**	**1,677**

Notes

The Sydney greenhouse gas factor of 0.88kg CO2-e/kWh & 0.0512kg CO2-e/MJ was used

Table 15 and Figure 11 summarises the impact on energy costs associated with all three options which were explored in detail within this report. The electricity rates are based on the Bomaderry Aquatic Centre electricity rate of $10.31/MWh. The gas rates are based on the Administration building of $19.69/GJ. The final gas rate will need to be negotiated with by Council with the utility providers as the increase in consumption may provide a more competitive rate.

From an operational cost perspective, gas fired hot water heaters are the more costly option with an approximate annual utility costs of over $370K. A gas fired hot water heater with cogeneration offers a 2% reduction in utility costs than a gas fired hot water heating system without cogeneration. The heat pump system offer 20% less utility costs when compared to the gas fired hot water heaters.

Based on the rate used, the cost of the electric heat pump system is lower than both that of the gas fire hot heaters and the gas fired hot water heaters with cogeneration. The gas fired heaters with cogeneration offers a small electricity cost reduction, through a reduction in electricity demand costs and consumption from the grid.

Figure 11 Summary of Utility Costs

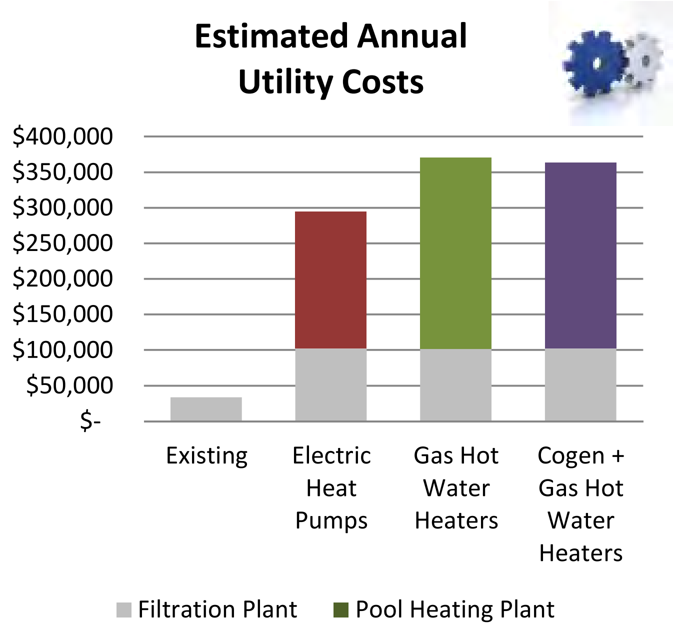

Table 15 Estimated Energy Cost

Systems	Existing System 12 months Operation	Electric Heat Pumps	Gas Fired hot Water Heaters	Cogen + Gas Fired Hot Water Heaters
Filtration System	$33,407	$102,018	$102,018	$102,018
Pool Heating		$192,651	$268,437	$261,436
Total		**$294,669**	**$370,455**	**$363,455**

Notes

Electricity cost Used:- $10.31/MWh & $15/KVA/month based on Bomaderry electricity bills
Gas Cost Used:- $19.69/GJ (City Administration Building rate applied 1,300GJ annual consumption). Bomaderry Aquatic Centre was $21.51/GJ for a 104GJ annual consumption)

11 Life Cycle Cost Analysis

We have undertaken a life cycle cost analysis on the three remaining options. The table below shows capital, energy, maintenance and management costs that are associated for each option. The analysis assumes that electricity and gas prices increase at the same rate.

Figure 12 Basis Of Life Cycle Costs

	Electric Heat Pumps	Gas Fired hot Water Heaters	Cogen + Gas Fired Hot Water Heaters
Capital Cost			
Annual Energy Costs	$294,669	$370,455	$363,455
Annual Maintenance Cost	$20,000	$13,000	$20,500
Annual Management Costs	-	-	$10,000
Replacement Cost	$450,000	-	-
Total Cost over 25 years	13,447,706	14,263,693	15,795,200

The following assumptions have been used as the basis of the life cycle cost assessment.

- Interest on Capital – 7%
- Utility annual rate of change – 2%
- Gas Cost - $19.7/GJ
- Electricity Cost - $10.3/MWh
- Electricity Demand Cost - $15/KVA/month
- Capacity Charges - 0
- Heat pump replacement cost of $450,000 on the 16th year has included for the replacement of the heat pump which have a life expectancy of 15years.

The outcome of the assessment indicated that the heat pump supplementary heating option provides the lowest costs over a 25 year period, even with heat pump replacement in year 16. The gas fired hot water heaters with cogeneration provides the largest costs over the 25 year period.

It is important to note that this is based on the assumed gas and electricity prices. We have explored the impact of varying gas and electricity prices in the following section of this report.

12 Sensitivity Analysis

Because of the impact of gas prices on the energy costs and hence the life cycle cost, we have undertaken a sensitivity analysis of gas prices.

Figure 13 Sensitivity of Gas Prices

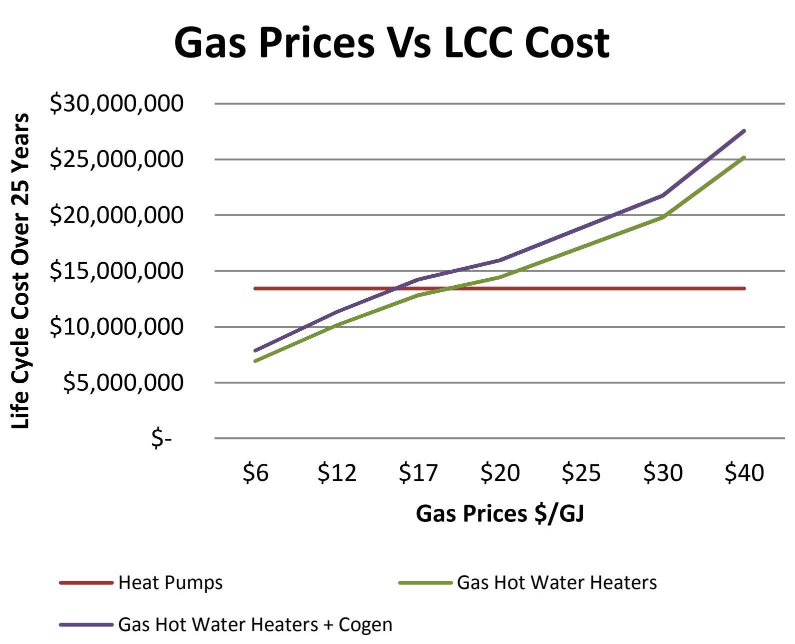

Figure 13 Indicates that if electricity prices were to remain at $10.31/MWh and the gas rate could be negotiated to below $15/GJ the life cycle costs for a gas system would be lower than the heat pump option.

Figure 14 Sensitivity of Electricity Prices

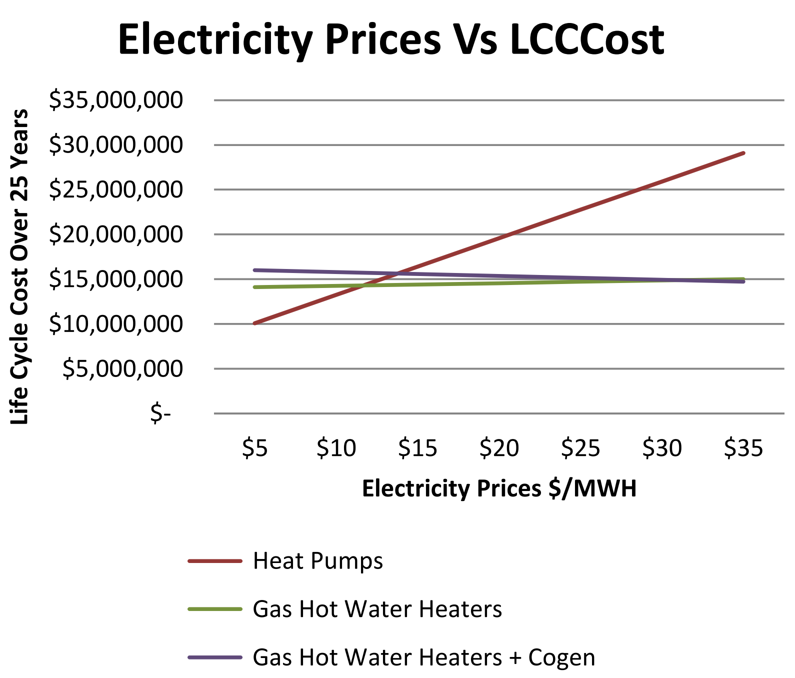

Figure 14 indicates that if the gas prices were to remain at $19.69/GJ and the electricity rate increased to above $14/MWH the life cycle costs for a heat pump option would be more than the gas options.

Further analysis of the impact of reducing the pool water temperatures setpoint are provided in Appendix 1.

13 Recommendation

A comparative summary of the three options has been provided in Appendix 2. We recommend that Council replace their existing solar hot water absorbers with new more efficient evacuated tubes solar absorber technology as the existing system requires replacement. In terms of the supplementary heating option, as result of this investigation, we recommend that Council contact the utility providers to confirm the new electricity and gas tariffs for the site based on the projected increase in consumption. Based on a gas utility rate of $19.69/GJ and electricity of $10.31/MWh the heat pump system offers the lowest life cycle cost over a 25year period.

However if the electricity price remains remain at $10.31/MWh and the gas rate could be negotiated to below $15/GJ the gas fired hot water heater system would provide the lowest life cycle cost over a 25year period.

From a greenhouse gas emissions perspective, the gas fired hot water heaters provide 31% less greenhouse gas emissions than the heat pumps systems. And with a cogeneration system a further reduction of 5% is achieved. This option also provides the lowest upfront cost.

And as such if the driver for Council is to achieve the lowest greenhouse gas emissions, we would recommend that the gas fired hot water heating system be taken up with space for the installation of a cogeneration system in the future. And if the driver for Council is achieving the lowest life cycle cost, we recommend that the heat pump option is taken up.

Regardless of which option is pursued, we recommend that a Building Management System (BMS) be included in the upgrades to assist in the control, monitoring and optimisation of the hot water unit system. In addition all options will require input from hydraulic, civil, structural and acoustic consultants to progress the design of a new plant room, gas infrastructure and all other works associated with the upgrade.

14 Information Required During The Next Phase

During the next phase of design the following information will be required.

- Confirmation of filtration plant electrical loads
- Architectural drawings and sections
- Council agreement of system selection
- Council agreement on utility costs

We will then be able to confirm

- with utility providers the maximum demand required
- confirm spatial and structural requirement of the services with the architect
- provide acoustic performances of plant
- provide schematic design drawings of the systems
- provide a more detailed order of cost estimates in line with the current stage of design

Appendix 1- Impact of changes to temperature setpoint

The following Addendum has been put together at the request of Shoalhaven City Council. The addendum explores the impact of reducing the pool water temperatures setpoint to 25°C all year round and only during winter periods.

The following table indicates the energy; greenhouse gas and cost outcomes based on the original design setpoints outlines in Table 1.

Table 16 Pool water temperature setpoint 28/32°C all year round

Item	Unit	Heat Pump	Gas Fired Hot Water Heaters	Gas Fired Hot Water Heaters and Cogen
Energy Consumption	MJ	10,683,088	20,651,347	21,137,733
Estimated Annual Greenhouse Gas Emissions	Tonnes	2,611	1,811	1,677
Estimated Capital Costs	$	$1,050,000	$630,000	$1,010,000
Estimated Annual Energy Cost	$	$294,669	$370,455	$363,455
Estimated Annual Maintenance Costs	$	$20,000	$13,000	$20,500
Estimated Annual Management Cost	$	-	-	$10,000
Replacement Cost	$	$450,000	-	-
Life Cycle Costs over 25 Years	$	$13,447,706	$14,263,693	$15,795,200

The following table indicates the energy, greenhouse gas and cost outcomes based on the pool temperature setpoint reducing to 25°C all year round.

Table 17 Pool water temperature setpoint 25°C all year round

Item	Unit	Heat Pump	Gas Fired Hot Water Heaters	Gas Fired Hot Water Heaters and Cogen
Energy Consumption	MJ	8,773,014	16,067,389	16,553,775
Estimated Annual Greenhouse Gas Emissions	Tonnes	2,145	1,559	1,425
Estimated Capital Costs	$	$1,050,000	$630,000	$1,010,000
Estimated Annual Energy Cost	$	$239,968	$279,383	$272,383
Estimated Annual Maintenance Costs	$	$20,000	$13,000	$20,500
Estimated Annual Management Cost	$	-	-	$10,000
Replacement Cost	$	$450,000	-	-
Life Cycle Costs over 25 Years	$	11,695,616	11,346,629	12,878,136

The following table indicates the energy, greenhouse gas and cost outcomes based solar absorbers heating the pool during the summer season (November to May) and supplementary heating is only used during the winter season (April to October) to provide pool water temperatures of 25°C.

Table 18 Pool water temperature setpoint 25°C during winter only

Item	Unit	Heat Pump	Gas Fired Hot Water Heaters	Gas Fired Hot Water Heaters and Cogen
Energy Consumption	MJ	8,151,628	14,576,135	15,062,521
Estimated Annual Greenhouse Gas Emissions	Tonnes	1,993	1,477	1,343
Estimated Capital Costs	$	$1,050,000	$630,000	$1,010,000
Estimated Annual Energy Cost	$	$222,173	$249,755	$242,755
Estimated Annual Maintenance Costs	$	$20,000	$13,000	$20,500
Estimated Annual Management Cost	$	-	-	$10,000
Replacement Cost	$	$450,000	-	-
Life Cycle Costs over 25 Years	$	11,125,626	10,397,649	11,929,156

The analysis indicates that if the pool water temperature setpoint was maintained at 25°C all year round, there would reductions in energy usage, greenhouse gas emissions and energy costs which results in life cycle cost reduction of 13% for the heat pump, 20% for the gas fire hot water heaters and 18% for the gas fire hot water heaters with cogeneration.

However if the supplementary heating was used during winter only to maintain the pool water at a setpoint of 25°C provides a further reduction in energy usage, greenhouse gas emissions and energy costs. This reduction reduces the life cycle costs for each opportunity, by 17% for heat pumps, by 27% for the gas fire hot water heaters and 24% for the gas fire hot water heaters with cogeneration.

Appendix 2: Limitations

- The information within this report is confidential and the intellectual property of WSP. The report is for the exclusive use of GNFP & Shoalhaven City Council and will not be issued or copied without the prior consent of GNFP, Shoalhaven City Council or WSP.
- The report's information is a result of the Consultant's observations, based on a visual walk through visit of the general areas and a more detailed review of the main plant room areas together with the overview of available site information. The site observations were limited to typical representative accessible areas only and did not include inaccessible areas such as ceiling voids, riser shafts, internal equipment parts etc.
- WSP takes no responsibility for the accuracy of all the available site information, i.e. availability of drawings and manuals. The Consultants, however, have endeavoured to verify that the available information is a correct indication of the installed services.
- The information provided has been based upon the judgement and experience of the Consultants preparing the report within the limitations of a walk through type visit and general overview of the available information. The recipients of this information are to undertake whatever investigations, verifications or system testing that may be considered necessary to reach an informed decision.
- Comments made are generally reflective of the sufficiency of the services and the standard of design for the quality of the building.
- Warranties and guarantees were not inspected but are assumed to be expired for all original plant.
- The order of costs nominated in this report are estimates only and do not include:-
  - GST/VAT;
  - All associated builders work;
  - Price escalation ;
  - Preliminaries;
  - Professional Fees;
  - Hydraulic, acoustic, structural works
  - Carbon tax dynamics;

Appendix 3: Summary Of Options

Item	Unit	Heat Pump	Gas Fired Hot Water Heaters	Gas Fired Hot Water Heaters and Cogen
System description		2 x 550kW heat pumps	2 x 550kW gas heaters	2 x 550kW gas heaters 1 x 27.5 kWe cogen
Weight	Per unit	4.6tonnes	1.27kg	1.27kg
Mechanical Spatial Requirements	m^2	90 (external area) 50 (plantroom)	80 (plantroom)	120 (plantroom)
Electrical Spatial Requirements	m or m^2	5x5.5 Substation Easement	New service pole on site	New service pole on site
Estimated Electrical Maximum Demand	kVA	1,658	284	199.5
Estimated Gas Maximum Demand	MJ	-	4,000	4,400
Lead Time		3months	3months	6months
Energy Consumption	MJ	10,683,088	20,651,347	21,137,733
Estimated Annual Greenhouse Gas Emissions	Tonnes	2,611	1,811	1,677
Estimated Capital Costs	$	$1,050,000	$630,000	$1,010,000
Estimated Annual Energy Cost	$	$294,669	$370,455	$363,455
Estimated Annual Maintenance Costs	$	$20,000	$13,000	$20,500
Estimated Annual Management Cost	$	-	-	$10,000
Replacement Cost	$	$450,000	-	-
Life Cycle Costs over 25 Years	$	$13,447,706	$14,263,693	$15,795,200
Economic Life Expectancy	years	15	20	20

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NOWRA POOL REPLACEMENT PROJECT
for
SHOALHAVEN CITY COUNCIL

October 2013

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NOWRA POOL REPLACEMENT PROJECT

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NOWRA SWIMMING POOL REPLACEMENT PROJECT

SCOPE OF WORKS SUMMARY

The Nowra Pool Replacement Project comprises the following works, subject to confirmation by the client prior to commencement of detailed design and documentation.

- Removal of the existing 50m pool, balance tank/suction sump, the existing common filtration and water treatment plant and the existing backwash water detention tank;
- Construction of a new FINA-compliant reinforced concrete pool of 50m length, 9 lane 23m width, depth varying from 1.35m at shallow end to 1.85m at deep end, water polo compliant, with new balance tank at deep end, structures to be of formed and poured reinforced concrete construction;
- Provision of new filtration and water treatment plant for the 50m pool in compliance with the "Public Swimming Pool and Spa Pool" Advisory Document, Draft 2, December 2012, published by the NSW Ministry of Health;
- Upgrading of gutters and filtered water return system to wading pool and provision of a new balance tank to enable compliance with the Advisory Document with respect to turnover period and rate;
- Provision of new independent filtration and water treatment plant for the wading pool in compliance with the Advisory Document, this plant to be adequate to be later used for a splash pad replacement for the wading pool should council so decide;
- Provision of disabled access in accordance with the relevant codes and legislated acts;
- Inclusion of the water slide reticulation and filtration and water treatment system with the 50m plant system;
- Provision of pool water heating (refer services engineer's report);
- Provision of new plant room for all pool plant;
- Review of available pool monitoring systems with recommendation;
- Design criteria to include where possible use of optimum plant in terms of energy and other expendables consumption;
- Design criteria to also include consideration where appropriate of Life Cycle Costing analyses in the selection of plant and processes.

DESIGN REFERENCES AND CODES

General

The 50m pool is to comply with the FINA requirements for racing competition and water polo pools.
All pools and the water slide are to comply with the requirements of the NSW Ministry of Health Public Swimming Pool and Spa Pool Advisory Document, Draft 2, December 2012.
All pools are to comply, where appropriate, with the Royal Life Saving Society of Australia Design Guidelines and BCA and DDA Act Access requirements.

Structures - Swimming Pools and Associated Tanks

Pools and tanks will be designed in accordance with AS 3735, the Australian Standard for the Design of Concrete structures for retaining liquids.
The chemical delivery and storage, controlling and dosing systems are to comply with the relevant SAA Codes and industry standards where these are the defacto standards, in particular but not limited to the handling of hazardous materials.
All electrical works and equipotential bonding are to be designed in compliance with AS NZ 3000.
The pools and tanks are to be designed in accordance with the requirements of the geotechnical reports, with particular reference and compliance with the means of minimisation of differential settlement of the pools and maintenance of the settlement within stringent limits.

Specific Codes

Structural design of pools, tanks and finishes shall comply with the requirements of the following SAA Standards and Codes. Where standards listed are superseded the most current standards are to be used.

- AS3735 2001 Concrete Structures for Retaining LiquidsAS3735 2001
- AS1302 1991* Steel reinforcing bars for concrete
- AS1303 1991 Hard drawn steel reinforcing wire for concrete
- AS1304 1991* Welded wire reinforcing fabric for concrete
- AS1379 1991* The specification and manufacture of concrete
- AS1478 1992 Chemical admixtures for concrete
- AS1527 1974 Two-part polysulphide-based sealing compounds for the building industry
- AS1554 SAA Structural Steel Welding Code
- AS1554.3 1983 Welding of reinforcing steel
- AS2758 1985 Aggregates and rock for engineering purposes
- AS2758.1 1985 Concrete aggregates
- AS3000 1986 SAA Wiring Rules
- AS3600 2001 Concrete Structures with supplements 1 and 2
- AS3610 1990 Formwork for Concrete with supplements 1 and 2
- AS3972 1991 Portland and blended cements
- AS1012 Methods of Testing Concrete
- AS1141 Methods of Sampling and Testing Aggrate
- AS2350 Methods of Testing Portland Cement
- AS3582 Supplementary Cementitious Materials for Use with Blended and Portland Cement
- AS4671 Reinforcing Steel for Concrete
- ASTM-C309 Liquid Membrane Forming Components for Curing Concrete
- ASTM-D1752-67 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- ACI403 Guide for the Use of Epoxy Components with Concrete
- BS3148 Method of Tests for Water for Making Concrete
- BS2571 Specification for Flexible PVC Components
- BS5385 Wall and Floor Tiling

Filtration and water treatment systems

Reticulation, filtration and water treatment systems shall be designed in terms of turnover periods and rates, water treatment and chemistry, to the criteria provided by the NSW Ministry of Health Public Swimming Pool and Spa Pool Advisory Document, Draft 2, December 2012, and the references below as appropriate.

Specific Codes and References

Filtration and water treatment shall be designed in accordance with the following codes and references as appropriate.

- DIN 19 643 Treatment & Disinfection of Swimming Pools
- AS-3979 Swimming Pools
- AS 2436 Guide to noise control on construction, maintenance, & demolition sites
- AS-3000 Wiring Rules
- AS-1939 Protection of Control Boards
- AS-1477 PVC Pipe & Fittings

- AS-2032 Installation of PVC Pipe work
- AS-1318 Colour & Identification
- AS-1345 Identification of Piping, Conduits, & Ducts
- AS 3974 Pipe Supports
- AS 4041 Pressure Piping
- AS-1210 AS Unfired Pressure Vessel Code
- AS-2417 Pump Testing
- AS-2128 Guide to Swimming Pool Safety
- AS-3780 The Storage & Handling of Corrosive Substances
- AS-1319 Safety Signs for Occupational Health
- AS-1216 Hazard Identification & Information Systems
- AS-2865 Safe Working in Confined Spaces
- AS-4267 Water Microbiology

Regulations & Acts:

- Building Code of Australia (BCA)
- NSW Ministry of Health Department Advisory Document Draft 2 December 2012
- Pool Water Treatment Advisory Group (PWTAG) – Plant Sizing
- Royal Life Saving Society of Australia Guidelines
- NOHSC 1995 Plant Design “Making it Safe”
- Current EPA Legislation
- Dangerous Goods Handling and Safe Storage Acts and Guidelines
- Local Water Regulations
- Workplace Health & Safety Act
- Local Electricity Authority.

Design Criteria for Water Quality

The acceptance criteria for the projects PWT requirements shall broadly comprise the following: -

- The selected pool plant shall be capable of operating at a specified *average flow rate* that is defined as being half way between a clean & dirty filter. Refer to Table 1 for proposed plant sizing.
- Turbidity shall not be more than 0.5 units as defined in Section 5.2 of DIN Standard 19643.
- Colour shall not be more than 5 PPM on the Platinum Cobalt Scale.
- pH shall be automatically maintained within the 7.2 to 7.8 range.
- Minimum free chlorine concentration shall not be less than 2.0mg/L
- Total chlorine concentration shall not be more than 10.0 mg/L.
- Maximum Combined Chlorine Level 0.5 mg/L (preferably lower)
- Pool water shall be balanced & manually maintained to provide a Saturation Index (LSI) of + 0.2 to + 0.5.
- Total Alkalinity shall be manually maintained in the order of 80 to 120 mg/L.
- Calcium hardness shall be manually maintained in the order of 80 to 120 mg/L.

An assessment of the proposed mains water supply could affect some of the above chemical parameters, including the chemicals that are required for pH control. It is strongly recommended that the proposed source water be subject to a full spectrum analysis with particular reference to total alkalinity and LSI.

The above quoted turbidity (0.5 NTU) should be considered as being the upper limit when under maximum bather load. Under normal bather load (usually 70% of pool’s full load) the pool’s turbidity should be in the order of 0.2 NTU. Water clarity is a critical factor, whereby pools with poor clarity and high turbidity are more likely to contain higher numbers of micro-organisms. Turbidity can reduce disinfection efficiency and it may shield micro-organisms from disinfection. High water clarity is also a safety consideration in being able to detect submerged bathers in distress.

Most importantly and critically, the bacteriological objectives for the project should be: -

- Heterotrophic Plate Count 100 Colony Forming Units (CFU) per mL
- Thermotolerant Coliform Nil per 100mL
- Pseudomonas Aeruginosa Nil per 100mL

Regular microbiological tests should be conducted on a regular basis. Such tests should be considered as being a valuable management tool that will confirm effectiveness of operating procedures and appropriate plant performance.

DESCRIPTION OF POOLS AND WATER SLIDE

50m pool

The new 50m pool is to be 23m width and depth 1.35m for 12.5m from shallow end, sloped down to 1.85m over 7.5m, and 1.85m for the remaining 30m to the deep end. The pool is to be of wet deck type, fully tiled and with a new balance tank at the deep end. Filtration and water treatment plant is to be fully replaced.

Wading pool

The existing 15m x 7.5m pool is to be altered to include new wet deck gutters, balance tank and filtered water return system. The pool to be fully tiled. A new filtration and water treatment system is to be provided.

Water slides

Two existing water slides of approximately 60m length are to be retained, together with the existing catch pool and plant, the plant to be augmented as required to ensure an adequate system.

Splash pad

A splash pad of 150m^2 area with a number of water features may be commissioned by the Council at some time in the future as a replacement for the wading pool. The filtration and water treatment plant for the wading pool must be designed to be adequate as the base system for the splash pad if later installed.

Backwash water detention tank

The existing above-ground backwash water detention tank is to be replaced with a subterranean formed and poured reinforced concrete detention tank beneath the plant room.

DISABLED ACCESS OPTIONS

Disabled access to the 50m pool can be achieved by one of three methods, namely either construction of a ramp into the pool, installation of a disabled hoist near a shallow end corner on a pool side wall, or construction and installation of an adjustable access platform (also called a lift) at one of the shallow end corners of the pool. The ramp and lift options are shown on the site plan, and the disabled hoist would be located in a similar position to the lift. Vertical lifts or moveable platforms are a much newer concept, and are all to date manufactured, in the Netherlands in the case of the platform reviewed in this study. Possible compliance and performance issues and an acceptable cost need to be resolved to ascertain whether a lift is appropriate.

In terms of acceptability of either the ramp or the hoist, the ramp is generally the preferred option for disabled bathers, the hoist being often regarded as an undignified and unpleasant means of pool entry, particularly in public pools.

GNFP recommends adoption of a ramp if the installation of a platform/lift does not prove to be acceptable.

GENERAL DESCRIPTION OF FILTRATION AND WATER TREATMENT OPTIONS

Filtration

Two types of filtration are acceptable options for this project, namely pressure sand filtration and precoat ultrafine (DE) filtration. These will be considered in greater detail in the body of this report.

Disinfection

Chlorine is the only viable and cost-effective disinfectant for pool water for projects of this size, and the chlorine can be obtained from three different options, two being chemical in nature and the third being a chlorine generation process. The chemical options are sodium hypochlorite solution and granular calcium hypochlorite. The chlorine generation process uses electrochlorination of a brine solution to generate a weak sodium hypochlorite solution as bather demand requires. These options will be discussed later in this report.

pH control

The agents used for pH control generally depend on the disinfectant used. In the case of sodium hypochlorite, pH control can be achieved is achieved by the use of either carbon dioxide gas or acid. The carbon dioxide is usually stored in a Gasmatic cylinder on site. Acid is either stored on site as high concentration liquid sulphuric acid or sodium bisulphate, the latter being mixed in the plant room to provide liquid sulphuric acid. For calcium hypochlorite, pH control is achieved by the use of acid, either dry or as a liquid. Given the particular WHS risks associated with strong acid solutions, GNFP recommends the use of carbon dioxide unless calcium hypochlorite is used. We note that for this project, sodium hypochlorite will be used for all treatment systems.

Advanced oxidation

Where bather loads are high, for instance in heated shallow indoor pools or outdoor pools and splash pads used for young children or in conjunction with slides, advanced oxidation may be necessary as an adjunct to the chemical disinfection. While both UV and ozone systems have been used, the only currently viable system is UV, which will be used if needed and appropriate in this project. Ozone is a significantly more expensive and much less reliable option for larger projects and will not be considered for the Nowra project. It is not likely that a UV system will be included in any of the plant systems to be designed in this project.

FILTRATION SYSTEM REVIEW AND RECOMMENDATIONS

REVIEW OF DIFFERENT FORMS OF FILTRATION

Sand and precoat filtration systems differ markedly in their filtration efficiency, plant size, and washwater consumption. The annual wash water consumption of the three options considered is detailed in the following spreadsheets.

Precoat filtration will also consume some additional pool water due to the need to manage Total Dissolved Solids (TDS). The extent of blow-down for TDS control will vary according to pool usage and the method of disinfection. Blow-down for TDS control is commonly assessed to be 25 to 30 per cent of the washwater consumption required for a granular sand filter plant. Backwash water savings using precoat DE filtration instead of sand filtration, and including TDS control water use, are also shown on the following tables and commonly are in the order of sixty percent of a sand filtration system backwash.

Precoat filtration is an extremely efficient process which will filter finer and provide protection against modern chlorine resistant pathogens, like cryptosporidium and giardia. This latter capability is directly referenced within technical journals and numerous health standards (NSW, ACT and QLD).

Precoat and element filtration will require substantially less washwater consumption, although some periodic dumping of pool water will be required to manage objectionably high TDS levels. Lower washwater consumption has proportional impacts on the size of required balance tanks and the backwash tank. Given that future water costs will inevitably be costed and charged according to its true economic value, low washwater consumption is considered an important and critical attribute.

The perceived disadvantages with precoat filtration are higher capital costs and a more sophisticated filtration process that requires specific annual maintenance of one to two days.

The higher apparent cost of precoat filtration is generally and reasonably justified in terms of reduced mains water consumption, lower waste water disposal cost, reduced heat loss (due to the reduced heated water loss and the required addition of cold mains water), and lower chemical costs (due to lower water loss hence lower chemicals loss, and no need for coagulating chemicals).

PRELIMINARY DESIGN OF FILTRATION SYSTEM OPTIONS

Table 1 - Pool Properties

Pool	Dimensions	Depth	Area (m^2)	Volume (m^3)
50m	50m x 23m	1.35m to 1.85m	1,150	1,941
Wading	15m x 7.5m	0.3m to 0.5m	113	45
Waterslide	8m x 5.4m	1.0m	43	43
Totals			1,306	2,029

Table 2 - Contributary Pool Turnover Characteristics According to NSW MoH Advisory Document

Pool	Bather Load (bathers)	Design Turnover Rate (m^3/hr)	Design Turnover Period (hours)	Required Sand Filter Area (m^2)	Required Precoat Filter Area (m^2)
50m	329	555	3.5	22.2	168
Waterslide	25	43	1.0	1.7	13
Combined 50m and water slide	354	598	3.3	23.9	181
Wading	51	102	0.5	4.1	30

Table 3 - Design Pool Turnover Characteristics Derived from Table 2

Pool	Bather Load (bathers)	Design Turnover Rate (m^3/hr)	Design Turnover Period (hours)	Required Sand Filter Area (m^2)	Required Precoat Filter Area (m^2)
50m pool and waterslide (combined system)	353	600	3.3	24.0	182
Wading	51	102	0.5	4.1	30

Table 4 - Pool Filter Options and Annual Backwash Water plus TDS Control Water Dump Per Annum

Pool	Filters	Backwash water per filter (m^3)	Backwash water per annum (m^3)	Dumped water for TDS control per annum (m^3)	Total water use per annum (TDS plus back-wash) (m^3)
(a) Sand systems			(7 day B/W interval)		
50m + water slide	3-MHS7250	20.3	3,176	NA	3,176
Wading	2-MHS1800	5.1	532	NA	532
Total for sand			**3,708**	**NA**	**3,708**
(b) Precoat DE (Atlas) systems			28 day B/W interval		
i) PCT Series					
50m + waterslide	3-PCT600	10.0	391	881	1,272
Wading	1-PCT300	5.0	65	146	211
Total for PCT precoat series			456	1,027	1,483
ii) NPC Series					
50m + waterslide	2-NPC-066-1032	9.0	235	1,061	1,296
Wading	1-NPC-042-0380	2.6	34	153	187
Total for NPC precoat series			**269**	**1,214**	**1,483**

TABLE 5 - REQUIRED PLANT ROOM AREAS FOR DIFFERENT FILTRATION SYSTEMS

Filter System Type	**Plant Room Area (m^2)**	**Percentage of total pool area (1,306m^2)**
Pressure Sand Filters	**156**	**12**
Precoat (DE) Filters (NPC Series)	**104**	**8**
Additional plant room area for extra plant for possible current or future installation of a splash pad (common to both systems)	**20**	**20**

FILTRATION RECOMMENDATIONS

GNFP recommends that the Atlas NPC series precoat (DE) filters be adopted for the many reasons noted below when considered in comparison with the pressure sand system.

As noted earlier in depth, the many benefits of the precoat systems include:
a) Approximately 60% savings in water consumption, due to reduced backwash frequency, even after allowance is made for water dumping for TDS control;
b) Reduced chemical and heat loss due to the significantly lower total water consumption;
c) Greatly enhanced filtration capability, removing particles down to 1 to 2 microns and pathogens such as cryptosporidia and giardia;
d) Extremely high water clarity due to the very fine filtration capability;
e) Significant reduction in plant room floor area required for the filtration plant;
f) Significant reduction in required volume of both the balance and backwash tanks due to the very much lower water consumption.

In summary, the capital cost difference of a precoat filter system alone is around 10% greater than that of an equivalent sand filter system. The required pump capacity is the same hence no additional power expenditure is incurred in running either system. The minimum (and very conservative) life expectancy of precoat filters is 30^+ years, and of a sand system is around 15 years. The expected water consumption of sand systems is around 3,700m^3 per annum, compared with 1,500m^3 per annum for the equivalent precoat systems. The additional 2,100m^3 of water disposed of by the sand systems contains chemicals and heat energy, both of which are disposed of to waste by the sand system. Precoat systems require approximately 104m^2 of plant room floor area, compared with 156m^2 for equivalent sand systems.

Given the above, it did not seem necessary to carry out a Life Cycle Analysis to justify the recommendation of adoption of precoat systems. The total capital cost of the filtration and water treatment systems (assumed to be precoat systems) is ($1,200,000 + $320,000) = $1,520,000 plus GST, as given in the cost estimates.

REVIEW OF DISINFECTION/CHEMICAL TREATMENT OPTIONS

General

Disinfection of swimming pool water is commonly accomplished by introducing a germ- killing chemical in sufficient strength to almost instantaneously destroy bacteria. Historically chlorine is the most common disinfectant for swimming pools. Chlorine has achieved its most commonly used status because of its low cost, the convenience of on-site storage, and because its excess residual can persist for some time.

The primary goal of disinfection is to provide uniformly distributed disinfection residual of sufficient strength to maintain healthy pool water. The beneficial oxidizing property of the disinfectant will attack many materials, other than bacteria. These materials, if not destroyed by oxidation, would impart undesirable characteristics to the water such as turbidity, colour, and odour. Efficient filtration where solids and bacteria can be physical removed by filtration reduces the need for oxidation.

Chemical destruction by oxidation plays an important role in the complete filtration and disinfection process. Equally, This not only reduces the reliance upon disinfection, it also improves the efficiency of the disinfection process. Good process design is largely based on using the least harmful chemical in the lowest possible concentration.

Chlorine consumption will generally primarily vary according to variable and unknown bather loads. Other inter-related factors would include:-

i. the efficiency of the selected filtration process;
ii. the operator's good management of the system;
iii. the extent of suspended solids contained within the source water (particularly, any iron, manganese, mineral salts, etc.);
iv. the pool's water temperature;
v. the need for any periodic shock dosing (superchlorination) to address incidents and peak bather loads;
vi. the extent to which ammonia compounds are introduced into the pool by the bathers.

Analysis of the source water is required to determine the presence of any major salts and minerals that could, when oxidized by the chlorination process, result in pool staining problems. Good design should attempt to promote a treatment that is as sympathetic with the raw source water as is possible. Whilst it is comparatively easy to adjust the chemical treatment of soft water to suit the requirements of a disinfectant, it is infinitely more difficult to adjust hard water in the same manner.

Review of the disinfection options

Sodium Hypochlorite Solution

Chemical Detail and Description

- Class 8 Dangerous Goods Package Group 2.
- 10-15% available Cl_2 delivered by road tanker and stored on site within a bunded storage tank.

Advantages

- Simple technology using bulk storage tank and metering pumps.
- Minimal/low maintenance costs.
- Low capital cost.
- Easy superchlorination – simply increase the output of the dose pump.
- Simple operation and maintenance.

Disadvantages

- Chlorine deliveries say once a week.
- Due to its low chlorine concentration, the process requires comparatively large chemical quantities for adequate disinfection.
- When dose pumps are switched off, no backflow or siphon can exist.
- Requires careful handling and highly dangerous if cross-contaminated.
- Very dependent upon pH control, specifically with an acid to counteract the alkalinity of the sterilizer.
- Dependent upon regular deliveries via large road tanker
- Each delivery will require operator attendance and risk management.
- Can decompose quickly in high temperatures.
- Requires spillage containment, delivery access, plant storage space, tank bunding, ventilation of the storage area, DG Licensing, etc.

Dry/Solid Calcium Hypochlorite

Chemical Detail and Description

- Class 5.1 Dangerous Goods - Packaging Group 2
- 70% available Cl_2 in granular form and 65% in tablet form
- Supplied in standard packaged sizes of up to 40kgs.

Advantages

- No bulk deliveries, no bulk storage
- No requirement for spillage containment or Dangerous Goods Licensing
- Reduced WHS and environmental risks.
- More efficient – rapid super chlorination – simply increase the output of the feeder.

Disadvantages

- For large pool applications, granular calcium hypochlorite has a significantly higher cost than liquid sodium hypochlorite.
- Efficiency is very sensitive to hard water issues.
- Compared to a dose pump, chemical feeders are generally more complex and as such are subject to higher maintenance costs due to cleaning issues and blockages.
- Dry chlorine is an imported product, whereby its purchase cost would be subject to potential fluctuations in currency.
- Dust and fumes from the supply container are known irritants, and PPE is essential when opening and or handling the chemical.
- Calcium Hypochlorite will react with organic materials and must be handled with care and used in strict accordance with the Manufacturer's instructions.
- One feeder is generally required for each separate pool FWT system.

Electrochlorination

- Uses electrolysis with either a salt water solution, or in some more recent systems, the TDS (Total Dissolved Solids) already present in mains water, to produce sodium hypochlorite for disinfection.
- The process can vary from a direct supply system which uses salt water or mains water in the pools to a system that creates sodium hypochlorite from a tank containing a brine solution.
- Is a high capital expenditure cost item although proves cost effective when considered using Life Cycle Costing for large pools and large aquatic complexes.
- Requires either twin units or a back-up calcium hypochlorite system, creating a high initial

capital cost expenditure.

- The systems that use the TDS in mains water for chlorine supply are very recent additions to the options and need further intensive study to assess reliability, economy and long term performance.

Electrochlorination could be considered appropriate for the larger pool at the centre, however is not easily responsive to rapid changes in bather load as would be needed for the toddlers pool or a future splash pad. Electrochlorination systems typically have a high system capital cost and reasonably high ongoing power costs. The electrochlorination system is most appropriate and cost-justifiable for aquatic centres with more larger water bodies than at the Nowra centre. It would also not be cost-effective at a centre of Nowra's size to introduce two different systems for chlorine production or provision.

DISINFECTION AND PH CONTROL RECOMMENDATIONS

Subject to the acceptable chemical nature of the source pool water, and given the limited mix of water body types and the long term cost considerations, GNFP recommends adoption of a sodium hypochlorite disinfection system with pH control by carbon dioxide gas. The use of carbon dioxide gas is due in major part to the WHS issues associated with the use of liquid or dry acid. It is highly likely, given the successful use of sodium hypochlorite at the centre for many years, that the source pool water will be acceptable.

COST ESTIMATES FOR THE STRUCTURES, POOLS AND PLANT (All estimates excluding GST)	
New 50m pool and filtration and water treatment plant	**Estimate**
Structure (floor, walls, gutters, hobs, ramp, piers)	$2,570,000
Tiling	$250,000
Balance tank	$200,000
Pool furniture	$50,000
Filtration and water treatment	$1,200,000
Sub-Total	**$4,270,000**
Upgrading to existing wading pool	
Structural alterations (gutters, floor return to pool)	$125,000
Tiling	$30,000
Balance tank	$40,000
Pool furniture	$10,000
Filtration and water treatment (also adequate for future splash pad of 250m^2)	$320,000
Sub-Total	**$525,000**
Demolition Costs for 50m pool and club room	
Sub-Total - Demolition and removal of 50m pool and club room	**$80,000**
Backwash tank	
Sub-Total - New tank structure, disposal pump, reticulation	**$70,000**
Concourse slabs	
Sub-Total - New concourse slabs around 50m pool and wading pool	**$90,000**
New buildings, including new plantrooms and clubroom	
New FWT plant room of 156 sq.m. plus 24 sq. m. for future splash pad plant	$180,000
New club room of approximate area 100 sq. m. as per existing club room	$200,000
New pool water heating plant room of 120 sq. m. area	$120,000
Sub-Total	**$500,000**
Total Estimate for New Pools, Tanks, Filtration and Water treatment Plant, Heating Plant , New Buildings and Relevant Demolition Works	**$5,535,000**

OPTIONAL EXPENDITURE (excluding GST)	
(a) Minor works to water slides	
Upgrading and extension to reticulation pipework	$40,000
Retiling and repair works to catchpool	$25,000
Repair of fibreglass slide runs	$120,000
Total	**$185,000**
(b) Splash pad alternative to upgraded wading pool - additional cost	
Splash pad of 250m^2 in lieu of wading pool - between $750,000 and $800,000	$800,000
Deletion of allowance of $525,000 for wading pool upgrade	-$525,000
Additional demolition cost of $10,000 for removal of existing wading pool	$10,000
Total Additional Cost	**$285,000**
(c) Lift Platform disabled pool access	
VarioPool Lift access platform with allowances for builder's and others' works	$150,000
Deduction for ramp deletion	-$50,000
Total	**$100,000**

NOTES REGARDING THE COST ESTIMATES:

1. **Waterslides**

The waterslides upgrade costs are very preliminary, and have not been confirmed with a water slide manufacturer.

2. **Wading pool/splash pad alternative**

The upgrade estimate for the wading pool is $525,000, including approximately $100,000 additional for a filtration and water treatment system adequate for a future splash pad. The estimate for the basic pool upgrade without the additional plant allowance is hence $425,000. The estimated cost of a new basic wading pool of similar area without enhanced plant capacity is thus in the order of $425,000, and the estimated cost of a new 250 sq. m. splash pad would in the approximate range $750,000 to $800,000. The estimate of cost for the splash pad is very dependent on the number, type and complexity of the water features selected and the suppliers of these elements. The proposed upgrade of the existing wading pool should be reviewed in the light of these figures.

3. **VarioPool Platform Lift Access Facility**

Inclusion of the VarioPool Platform Lift is dependent on the provision of sufficient adequate examples of verifiable proven long-term track records in external pools, particularly in Australia or similar environments, and confirmation of the total overall costs in place.

4. **Contingencies**

Please note that no contingencies have been included in any of the above estimates.

NOWRA SWIMMING POOL REPLACEMENT PROJECT

CONCEPT DESIGN REPORT

POOLS AND TANKS STRUCTURES
FILTRATION AND WATER TREATMENT

APPENDICES

Appendix 1

Olympic Pool Replacement - Pool Plan SP1

Appendix 2

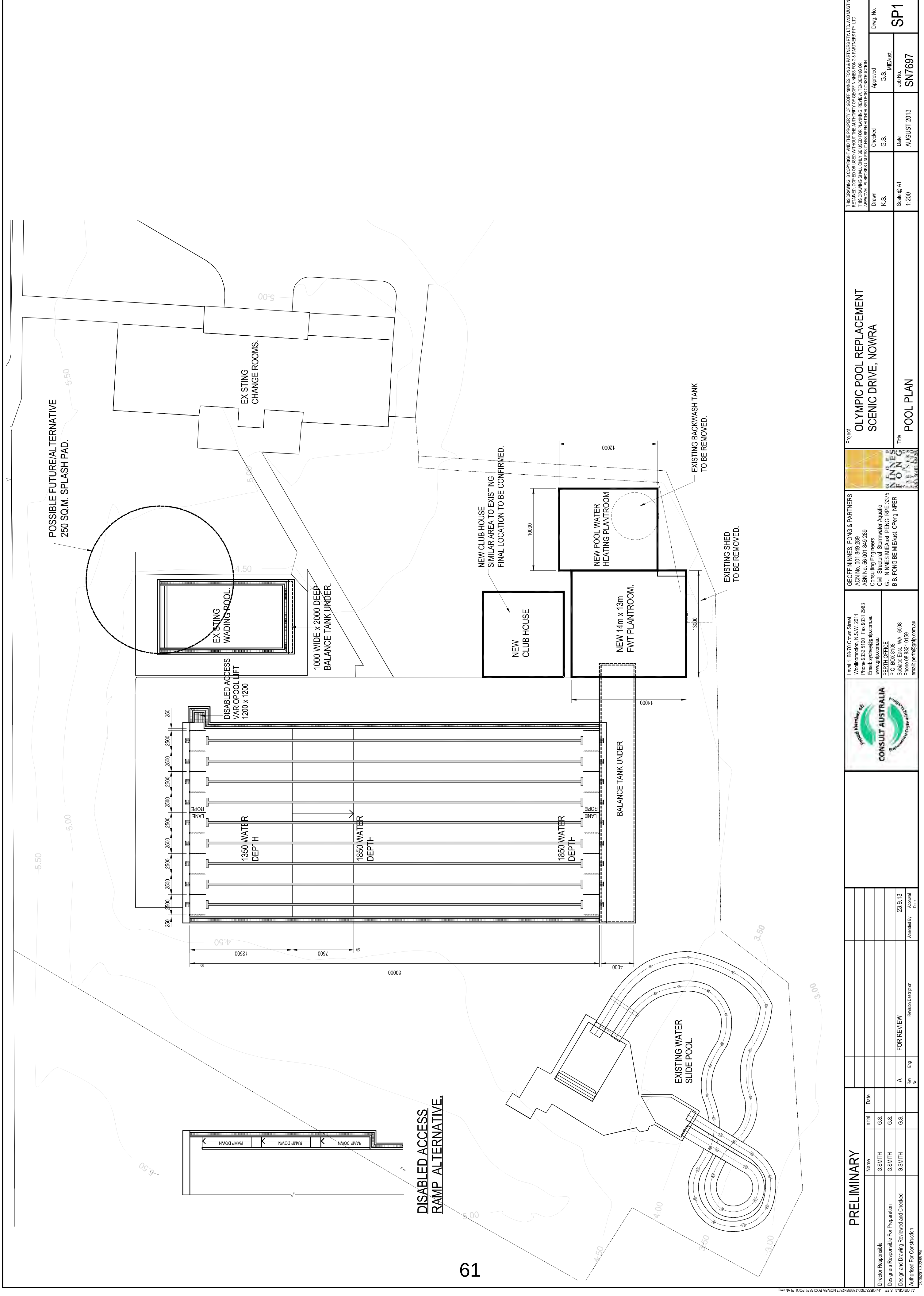
Plan - Granular Sand Filter System
Plan - Precoat Regenerative Filter System

Appendix 3

Nowra Centre - Typical Pwt Plant Process
Schematic With Equipment List And Options

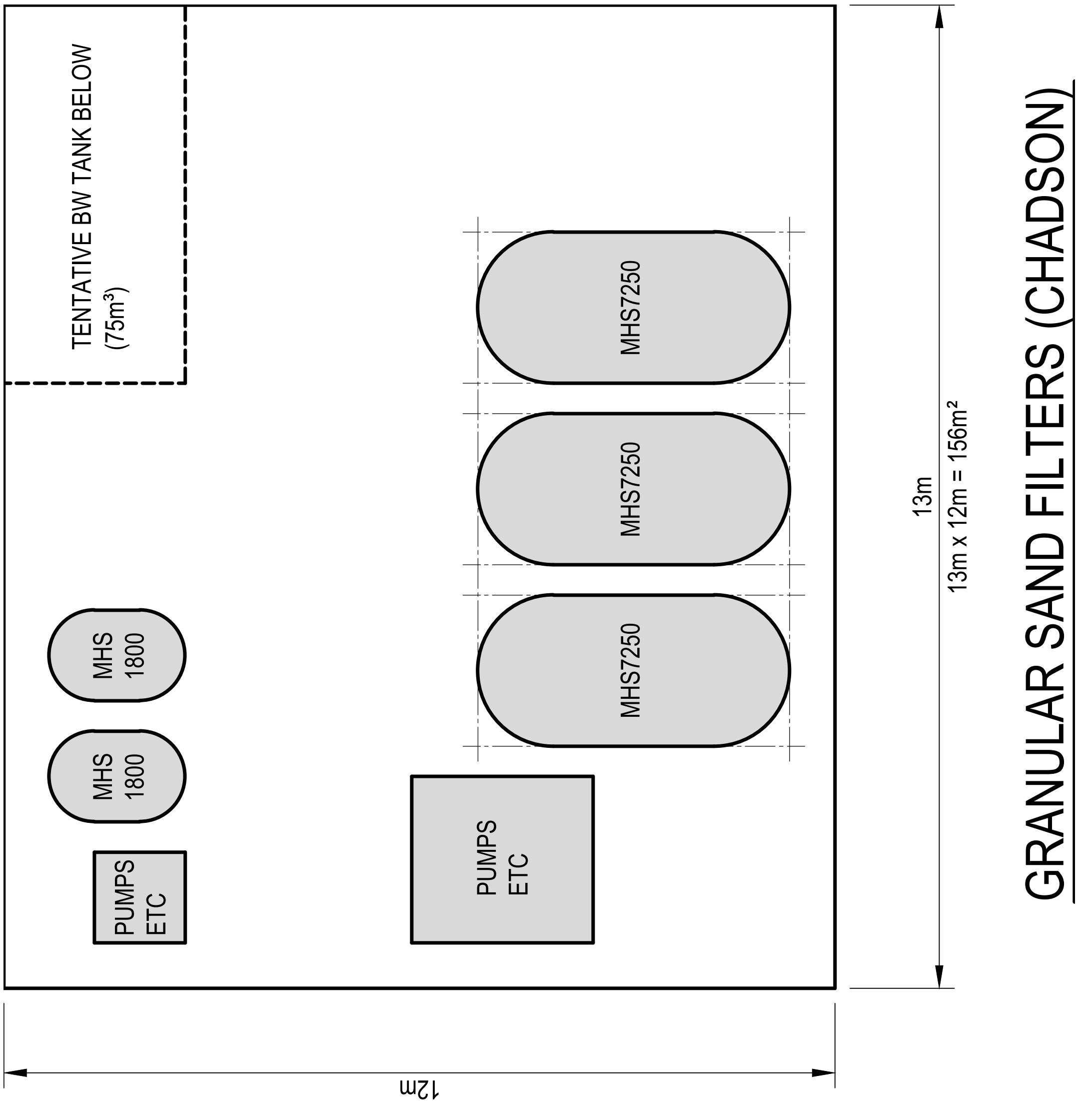
Appendix 1

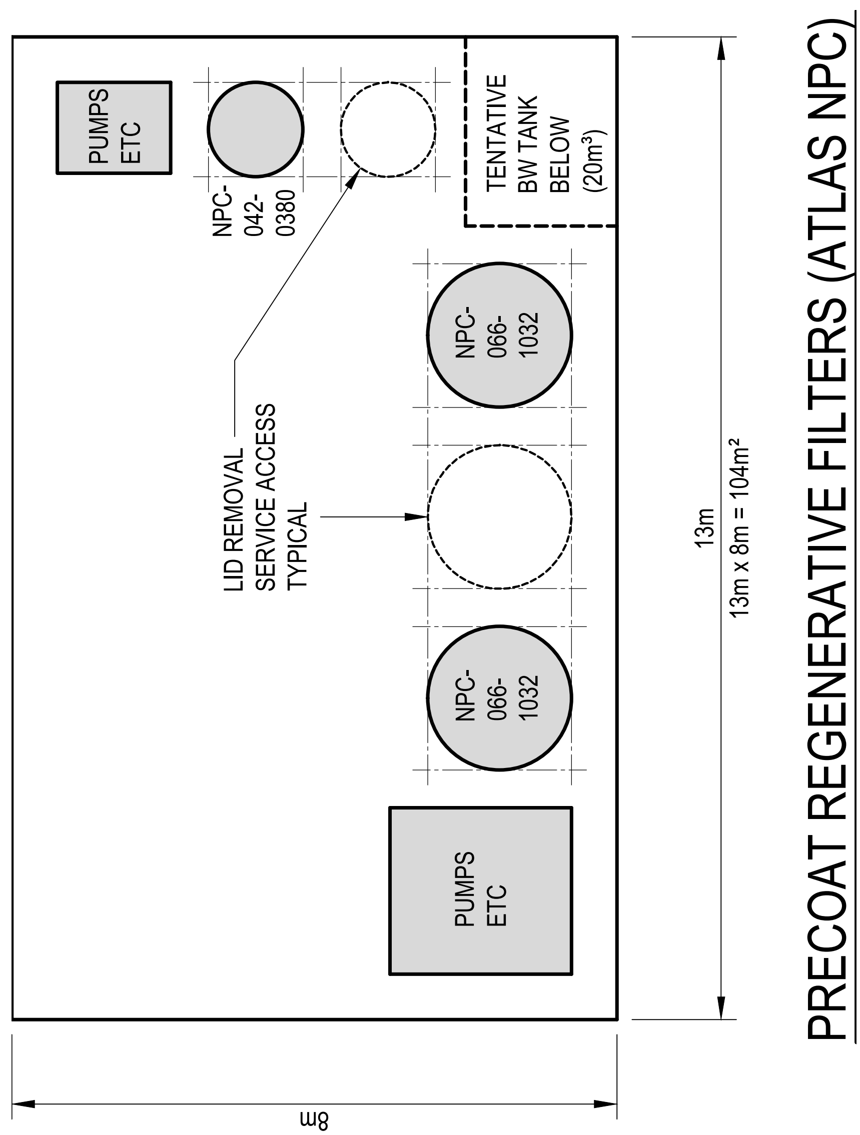
Olympic Pool Replacement - Pool Plan SP1


OLYMPIC POOL REPLACEMENT
SCENIC DRIVE, NOWRA
POOL PLAN
PRELIMINARY
EXISTING CHANGE ROOMS.
POSSIBLE FUTURE/ALTERNATIVE 250 SQ.M. SPLASH PAD.
EXISTING WADING POOL.
1000 WIDE x 2000 DEEP BALANCE TANK UNDER.
DISABLED ACCESS VARIOPOOL LIFT 1200 x 1200
NEW CLUB HOUSE SIMILAR AREA TO EXISTING FINAL LOCATION TO BE CONFIRMED.
NEW CLUB HOUSE
NEW POOL WATER HEATING PLANTROOM
NEW 14m x 13m FWT PLANTROOM.
EXISTING BACKWASH TANK TO BE REMOVED.
EXISTING SHED TO BE REMOVED.
BALANCE TANK UNDER
LANE ROPE
1350 WATER DEPTH
1850 WATER DEPTH
1850 WATER DEPTH
EXISTING WATER SLIDE POOL.
DISABLED ACCESS RAMP ALTERNATIVE.
RAMP DOWN
GEOFF NINNES, FONG & PARTNERS
Consulting Engineers
CONSULT AUSTRALIA
Drawn K.S.
Checked G.S.
Approved G.S.
Scale @ A1 1:200
Date AUGUST 2013
Job No. SN7697
Drwg. No. SP1
A
A FOR REVIEW 23.9.13
Director Responsible G.SMITH G.S.
Designers Responsible For Preparation G.SMITH G.S.
Design and Drawing Reviewed and Checked G.SMITH G.S.
Authorised For Construction

Appendix 2

Plan - Granular Sand Filter System
Plan - Precoat Regenerative Filter System

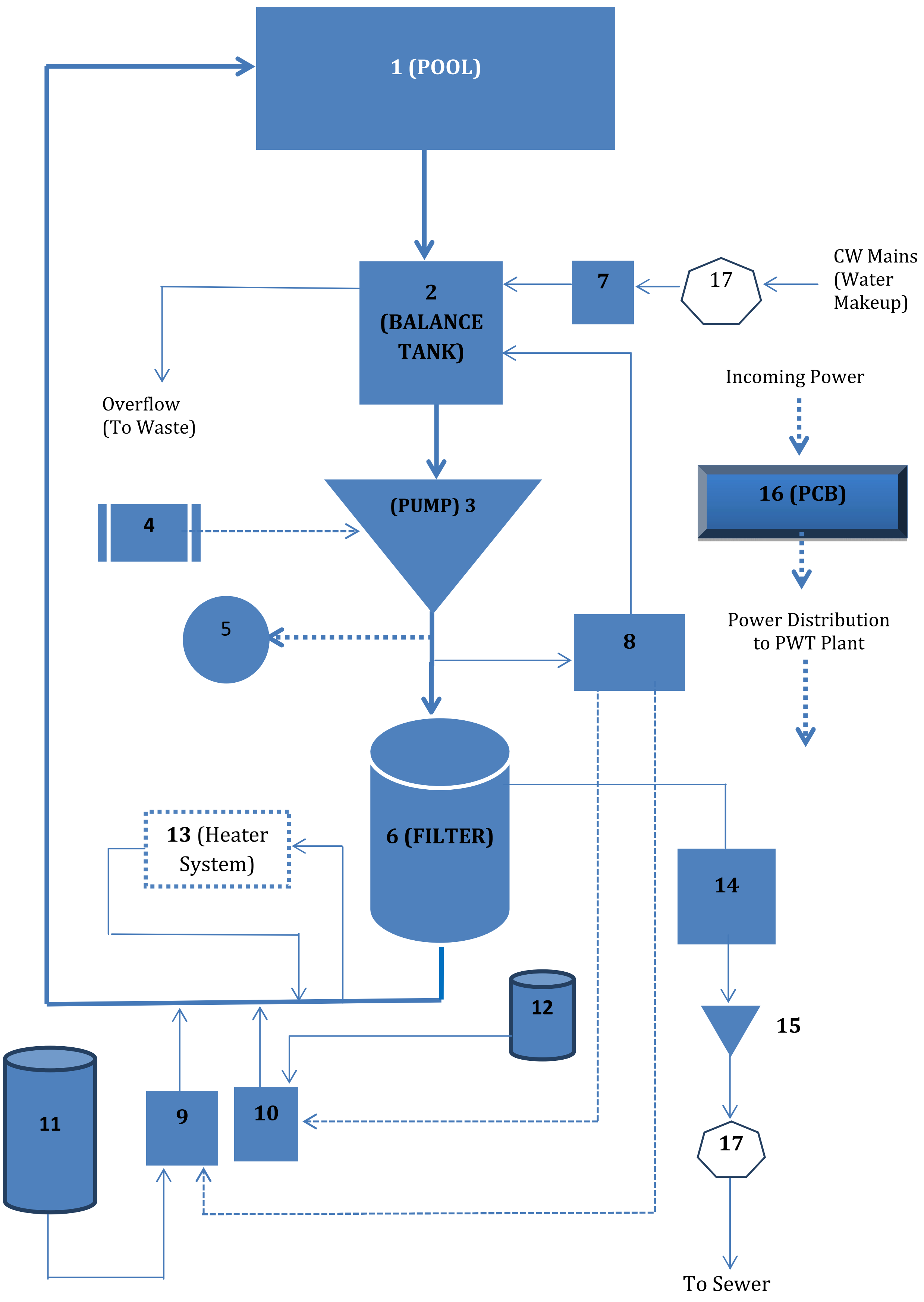

TENTATIVE BW TANK BELOW
(75m³)
MHS7250
MHS7250
MHS7250
MHS
1800
MHS
1800
PUMPS
ETC
PUMPS
ETC
13m
13m x 12m = 156m²
12m
GRANULAR SAND FILTERS (CHADSON)


PUMPS ETC
NPC-042-0380
TENTATIVE BW TANK BELOW (20m³)
NPC-066-1032
LID REMOVAL SERVICE ACCESS TYPICAL
NPC-066-1032
PUMPS ETC
13m
13m x 8m = 104m²
8m
PRECOAT REGENERATIVE FILTERS (ATLAS NPC)

Appendix 3

Nowra Centre - Typical Pwt Plant Process Schematic With Equipment List And Options

TYPICAL PWT PLANT PROCESS SCHEMATIC



NOWRA CENTRE - EQUIPMENT LIST AND OPTIONS

Item	Description	Main 50 (inclusive of Slides)	Existing Wading Pool (or Future Splash Pad Replacement)
	Pool - Volume (m3)	1941	45
1	Pool – Plant Flow (m3/hr)	600 (167 l/sec)	100 (28 l/sec)
2	Balance Tank (working m3)	Varies according to system design & selected filter option	
3	Pumps – No. x Duty	2 x 84 l/sec	a) 1 x 28 l/sec b) 2 x 14 l/sec
	Pump – Selection	2 x ISO 150 x 125-250/250 (18.5Kw)	a) 1 x ISO 125 x 100-250/220 (7.5 Kw) b) 2 x ISO 100 x 65-250/236 (5.5kW)
4	VSD (Recirculating Pump)	Optional – Subject to design (Zenner MSC-3)	
5	Flow Swicth c/w Time Delay	2 x Kelco Engineering	1 x Kelco Engineering
6	Sand Filter Plant – (Δ m2)	21.75 (<28 m3/hr/m2)	3.6 (< 28 m3/hr/m2)
	Sand Filter - Selection	3 x Chadson MHS7250	2 x Chadson MHS1800
	Precoat Min Area – (Δ m2)	180 (< 3.5 m3/hr/m2)	30 (< 3.5 m3/hr/m2)
	Precoat Filter - Selection	a) 2 x Atlas NPC-066-1032 (95.9m2) b) 3 x Atlas PCT600 (60m2)	a) 1 x Atlas NPC -042-0380 (32.06m2) b) 1 x Atlas PCT300 (30m2)
7	Mains Water Make-up	1 x Eureka 65m (2½") dia	1 Eureka – 25mm (1") dia
8	WaterChemistry Controller	Prominent D2C (or DulcoNet)	Prominent D2C
9	Chlorine Pump	PFC	PFC
10	pH Correction System	PFC	PFC
11	Hypo Bulk Storage Tank	5,000 Litre (Combined Use) – Nylex or HazSure®	
12	Gasmatic Drum	BOC - Leased By Council	
13	Pool Heating System	Specified & optioned by Mecahnical Services Consultant	
14	BDT – Sand Filter System	Shared by both systems - 75m3	
	BDT – Sand Filter System	Shared by both systems – 20m3	
15	Waste Water Disposal Pump	Davey - Dynaprime® X201	
16	Pool Control Board (PCB)	Shared By Both Plants (Notional Max – 150 kW) – See Note (i)	
17	Water Meters – Mains	Amiad – 65m (2½") dia	Amiad - 25mm (1") dia
	Water Meter – Wastewater	Amiad – 32mm (1¼") dia	

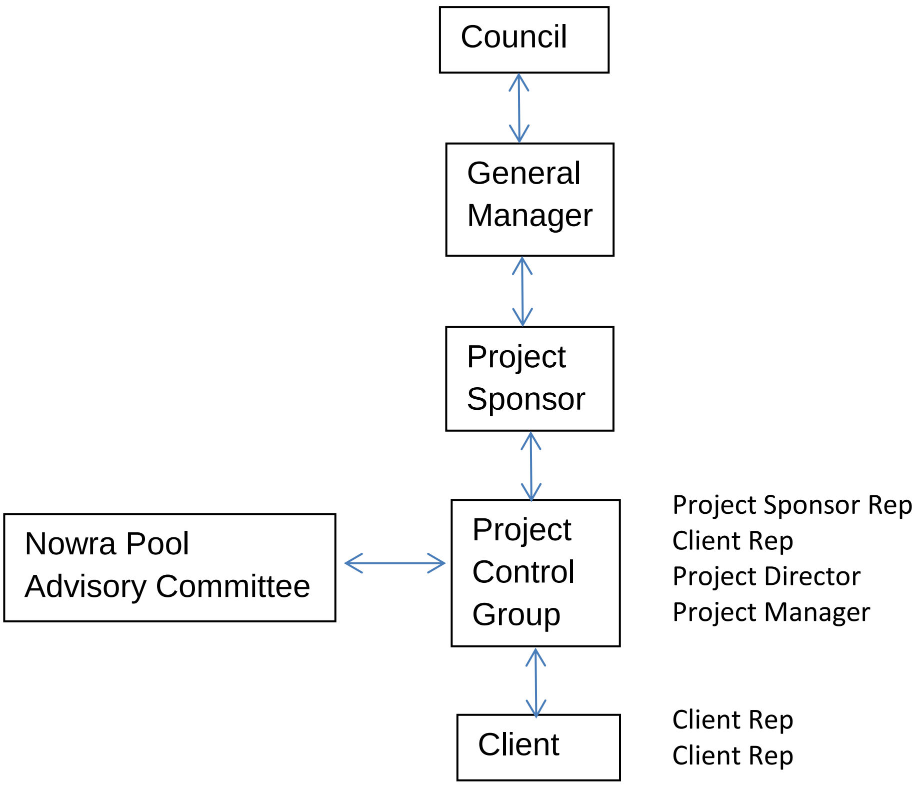
Note (i):

The above electrical load is subject to design development, inclusive of existing slide elevating pumps & provision for splashpad boost pumps, etc.

Nowra Pool - Project Governance

There is a fundamental need to establish a clear project governance framework for the Nowra Pool Project. The history, current status, political interest, community ownership and pressure to deliver on this project makes it imperative to establish clear lines of responsibility, reporting and communication.

The following is being proposed



1. The Project Manager is responsible for the performance of working groups (internal), consultants (external), contractors (external) and facilities works (internal) and reports to the Project Director.
2. The Project Director is responsible for the performance of the Project Manager and reports to the PCG.
3. The Project Sponsor's Representative, is the Chair of the PCG and has overall responsibility for the project, performance of the PCG and reporting to the Project Sponsor.
4. The Representative of each of the groups which comprise the PCG; is responsible for managing their subgroups and representing their interests at the PCG.
5. The Project Sponsor is responsible for reporting to the General Manager and Council.
6. Communication is coordinated through the Project Sponsor/Rep.

PCG Responsibilities

The PCG should:

Oversee the Project

- Develop the project scope; establish the budget and program parameters, and ensure the content of the works to be included meet the Project's performance requirements.
- Establish and manage the User Group.
- Ensure only those functional, cost and program matters contained in the approved brief are implemented and all changes to the brief and budget are sufficiently reported to the Council so as to permit review and approval of such changes.
- Develop and endorse the scope and content of the project brief for all Consultants. Direct and monitor the services, responsibilities and duties of the Consultants throughout all stages of the appointment.

Make Recommendations

- Endorse recommendations on the appointment and engagement of major consultant appointments such as the project manager, principal consultant, architect, engineer, quantity surveyor
- Endorse recommendations for entering contracts with contractors and suppliers.
- Apply / interpret policy, planning objectives and operational recommendations. Where necessary escalate the need for policy interpretation or issue resolution.
- Seek funds for proposals to vary the project.
- Review and endorse project reports submitted by consultants.

Seek Approvals

Seek approval from the Project Sponsor/Council to advance from one phase to the next and confirm the following:

- Funding sources.
- Commitment of funds.
- Change(s) in scope and/or additional expenditure.

Recommend / Endorse Payments

The responsibility of the PCG will be to jointly manage the project on behalf of the Council from inception through to financial completion and post occupancy evaluation.

- Endorse all payments to its Consultants, Contractors and Suppliers.
- Recommend commitment of funds, expenditure of contingency sums and payments.

Although the PCG will have delegated authority for day-to-day management, approval will need to be sought from the Council to:

- Enter into contracts.
- Commit capital funds.
- Change scope of works.
- Increase or vary the budget.