Proposed Ecologically Sustainable Design Initiatives

Scottish Hospital
Project Application

Lot 2 DP 607572
2 Cooper Street
Paddington, NSW 2021

Prepared For:

On Behalf of:

THE PRESBYTERIAN CHURCH (NSW)
PROPERTY TRUST

Prepared By:

CARDNO ITC PTY LTD
Level 7, 33 York Street
SYDNEY NSW 2000
PHONE +61 2 9495 8100
FAX +61 2 9495 8111

November 2010 **N10926_ESD_R1**

DOCUMENT HISTORY

Issue No.	Revision No.	Date	No of Pages	Comment
1	A	29/09/2010	25	Draft
2	A	06/10/2010	25	Draft
3	A	08/10/2010	25	Final
4	A	10/11/2010	26	Final

REPORT APPROVAL

Approved by: B.Shojaei Date: **10/11/2010**

(Cardno ITC)

Approved by: Date:

(**Cerno Pty Ltd**)

CONTENTS

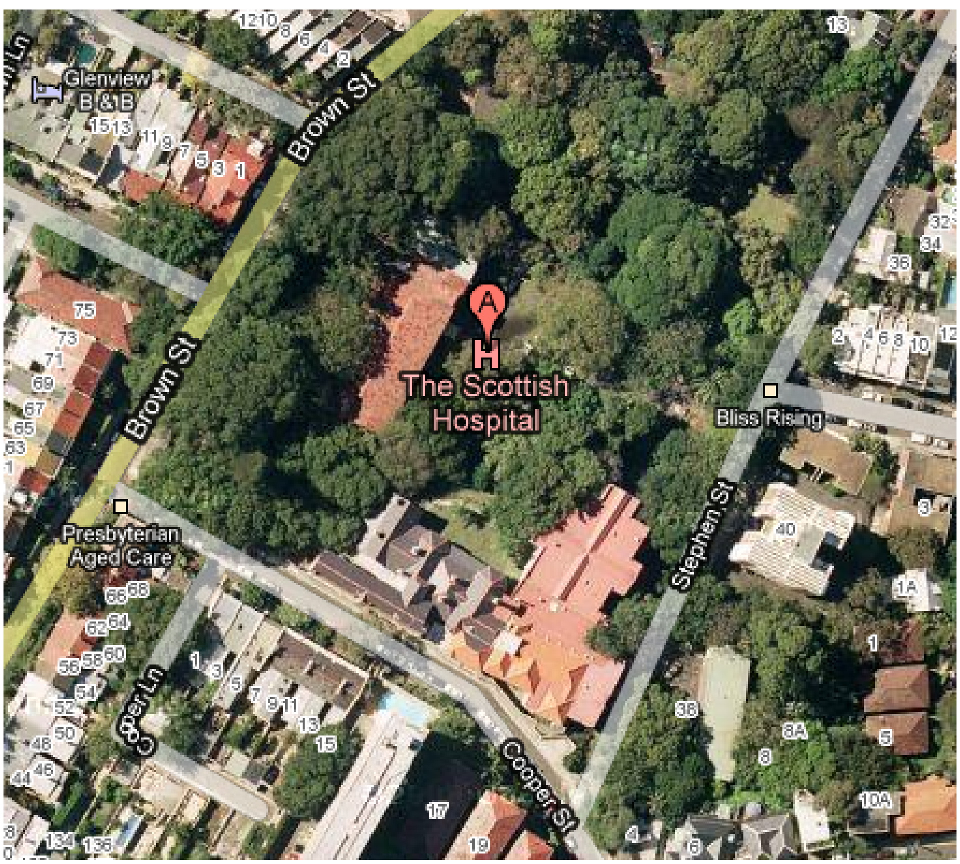
1 INTRODUCTION

Cardno ITC has been engaged to conduct a desktop study to address the Environmentally Sustainable Design (ESD) initiatives for the proposed development at 2 Cooper St, Paddington. The proposed development is a multi-level development consisting of independent living units and aged care facility

This development has been designed and benchmarked against BASIX tool which is a suitably accredited rating scheme that meets industry best practice for residential applications. Please refer to the BASIX Certificate attached for further information (Certificate No. 336367M).

BASIX and ESD guidelines have been used to provide specific benchmarks for this development; however, the project architects, consultants and Cardno ITC, also strived to develop building principles that consistently exceed these minimum benchmarks.

In particular, the units have been designed with the vision to give future residents the very best in terms of passive heating and passive cooling. This, when combined with other energy-efficient strategies (listed later in the report) will lead to low energy demands for the residents and low greenhouse gas emissions for the proposed development. JPR Architects have focused on passive performance as a first priority and have incorporated smart design principles and technologies (such as high performance glazing, generous insulation, sensible shading and well-placed thermal mass).



Location of the proposed aged care facility – 2 Cooper St, Paddington NSW

Natural ventilation and natural lighting have been used wherever possible throughout the whole development. These essential design principles will not only last the life of the building but are low-cost, low maintenance and reliable, especially when compared to other, often prohibitively complex and expensive “bolt-on technologies”. Furthermore, the passive design principles will provide owners with a low-energy, cost-effective and healthy lifestyle.

The building design and ongoing running costs of water and electricity have been considered and integrated at the very early design stages. For example, common area lighting, ventilation, recycled water and lift services should last the design life of the building and offer long term efficiencies and protection from strata levy escalation. A holistic building design has been considered to combine sustainable dwellings with efficient common areas through passive design, energy & water efficiency, renewable energy and rainwater harvesting.

In summary, the building designs presented will offer sustainable lifestyles and affordability to the residents as well as high levels of thermal comfort, energy efficiency and water efficiency. It also contains sound and proven sustainable & ecological principles integrated seamlessly into the building design, in part through smart technologies and in part through excellent passive efficiencies.

1.1 Existing Site Description

The proposed development site is located at 2 Cooper St Paddington and is bounded by Cooper Street, Stephen Street, and Brown Street. The site is currently occupied by multiple existing buildings.Proposed Development and Building Layout

Presbyterian Aged Care is proposing to develop the site (The Scottish Hospital) into an independent living and aged care facility consisting of:

- 82 Seniors independent living units
- 100 bed aged care facility
- Basement Car park (2 Levels);
- Retail;
- Buildings varying in height up to 9 levels with a combination of RACF and independent living units;
- Commercial kitchen
- Staff rooms and Staff offices
- Residents Gym.
- Heritage listed building located on Cooper St which is to be converted into a residential flat building

2 OBJECTIVES

Environmental sustainability for the proposed development has been considered in accordance with the following ESD principles:

- Reducing greenhouse gas emissions (energy conservation) through passive building design, efficient services and renewable energy generation;
- Maximising indoor environmental quality (IEQ) factors such as internal air quality, light and comfort, which are key considerations for an independent living and aged care facility;
- Water conservation and management;
- Careful selection of materials to maximise recycled content and reduce environmental impacts;
- Minimising natural resource consumption, waste, pollution and toxicity during the refurbishment and operation of the facility.

It is also recognised that the development of ESD solutions will be an integrated approach with the architecture and the building services.

2.1 Integrated Design Approach

The integrated design process is a process by which all of the design variables that affect one another are considered together and resolved in an optimal fashion. Often referred to as holistic design, it looks at the development as a whole with the emphasis on integrating the different aspects of building's design.

For instance day lighting, natural ventilation and water conservation cut across multiple disciplines. Day lighting in particular affects virtually every design discipline including architecture (building envelope and orientation), mechanical (reduced internal heat loads and modified fabric loads), electrical (lighting design and lighting controls), structural (floor-to-floor heights and external shading) and interiors (interior colours and reflectivity).

Each of these key points are interrelated, a building with good daylight will provide better occupant comfort and well-being as well as reducing energy consumption.

3 ENERGY & EMISSIONS

Greenhouse gas emissions are directly related to energy consumption. In Sydney, for every 1.1kWh of mains electricity consumed, approximately 1kg of CO_2 is released into the atmosphere.

3.1 Integrated Energy Approach

Greenhouse reductions are achieved in a staged approach:

- First, reduction in overall energy consumption through demand reduction and energy efficiency, then;
- Reduction in electricity and gas utility consumption by utilising waste products, rainwater harvesting and renewable energy technologies.

3.2 Energy Efficiency Breakdown

Below is a breakdown of areas within the development and the major contributors to energy consumption within each of the spaces:

AREA	ENERGY CONSUMER
Residences	Lighting
	Refrigeration
	Ventilation and Air-Conditioning
	Domestic Hot Water
	Supplemental System (e.g. television, etc.)
Lobby	Lighting
	Computers and Supplemental Equipment
	Ventilation and Air-Conditioning
Lifts	Lighting
	Lifts
Restaurant	Lighting
	Ventilation and Air-Conditioning
Plaza	Lighting
	Ventilation and Air-Conditioning
	Cooking Processes
	Freezer and Refrigeration
	Hot Water

Pool & Spa	External Lighting
	Heating
	Pumps
Gymnasium	Lighting
	Air-Conditioning
Grounds	External Lighting
Function Spaces	Lighting
	Air-Conditioning
Carpark	Lighting
	Ventilation (if underground)

As noted in the last page the primary energy consumption items are:

1. Lighting;
2. Heating, Ventilation and Air-conditioning;
3. Hot Water.

The integrated response to energy proposed for this project is summarised below:

1. Load Reduction and Passive Design
2. System Efficiency
3. Capture Waste
4. Renewable Energy power generation/ Rainwater harvesting

Energy consumption can be reduced through the efficient design of lighting, air-conditioning and ventilation systems, as well as water heating and other services. This development will consider Green House Gas emission reduction in design and operation, utilising the following initiatives.

Energy Consumer	Load Reduction & Passive Design	System Efficiency	Capture Waste & Utilising Renewable Energy Sources
Lighting	Daylighting to reduce reliance on artificial lighting. Selection of energy efficient lighting	Fluorescent or LED lighting where possible with lighting control systems (timers, daylight dimming, etc) 35 W IRC Halogen Down lights where possible instead of 50W Halogen Down lights.	Photovoltaic (Solar Electricity) panels to be considered to offset some parts of the load.
Heating, Ventilation & Air-Conditioning	Passive design (shading, insulation, glazing type, thermal mass etc)	Mixed mode ventilation systems comprising of energy efficient air-conditioning systems and natural ventilation cooling.	Photovoltaic (Solar Electricity) panels will be considered to partially offset the load.
Hot Water	Instantaneous systems over storage units and gas/solar over electric.	Utilising energy efficient hot water systems as well as low flow fixtures and fittings.	Gas boosted Heat Pumps or Solar panels will provide all hot water.

4 ECOLOGICALLY SUSTAINABLE DEVELOPMENT (ESD) INITIATIVES

4.1 Building Envelope

The role of the building envelope is to block solar gains from penetrating the building fabric in summer while optimising daylight and minimising glare. The appropriate design of openings will also allow an effective functioning of natural ventilation strategies to restore thermal comfort with reduced energy consumption.

The building envelope will be treated with the required levels of thermal insulation to reduce heat gains in hot days and to minimize heat losses in cold days through conduction. This will have significant impact on reducing energy consumption.

The proposed building is intended to be a mixed mode building, being capable of operating on the naturally ventilated mode when outside conditions are favourable which was demonstrated to be for most of the year. The building envelope will be designed to achieve maximum benefits from both operation modes. The glazing performance will be optimised to ensure that thermal comfort is achieved and solar gains are adequate for the efficient operation of the mechanical and the natural ventilation strategy.

Insulation

Insulation reduces the heat transfer between the internal and external conditions. Adequate insulation will be used in the ceilings and walls to reduce the heating and cooling load of the buildings and to reduce the ongoing operational costs. This has a twofold saving through a smaller mechanical system capacity along with operating energy consumption reduction.

To reduce heat losses in cold days, especially at night, the use of blinds will limit the contact between the internal air and the glass, therefore reducing heat losses by conduction.

Glazing and Window Framing

Glazed areas were reduced and adequate performance glass was investigated to reduce excessive heat gains in hot days, increasing periods when natural ventilation will be able to restore thermal comfort, and therefore reducing the frequency of air conditioning use.

Glazing may be described by the following properties:

- Visible Light Transmission (VLT): the percentage of visible light transmitted by the glass.
- Shading Coefficient (SC): the percentage of solar radiation that is transmitted through the glass.
- U-Value: a measure of how much heat is passed through the glass.

The proposed glazing will have a low SC will help to avoid heat gains in the summer, while glazing with a low U-value reduces losses in the winter through the glass. Incorporating effective shading features into the design can avoid the necessity for low shading coefficients in the glass, which usually also decrease the VLT of the glass. To maximise the natural daylight, VLT is selected to be as high as possible where required in the building.

4.2 Indoor Environmental Quality Initiatives

Thermal Comfort

Thermal comfort is a function of the following factors:

- Radiant temperature – the temperature of the surfaces around you, or radiant heat from the sun etc (45% of net comfort effect);
- Air temperature and humidity (35% of net comfort effect);
- Air movement, clothing & activity (20% of net comfort effect).

Thermal comfort can either be provided by passive or mechanical means. Passive means have been optimised before the design of the mechanical systems to reduce operational energy costs, with potential reductions in the Air-conditioning size and ongoing maintenance.

Passive heating and cooling strategies incorporated into the design, which will improve occupant thermal comfort include:

- Roof insulation not only reduce heat gain and loss, but will also moderate radiant temperatures from the walls, floor and ceiling;
- Building facades with high performance glazing and window frames will have a combination of external shading and high-performance glass to reduce heat transfer and radiant temperatures in proximity to the windows;
- Air temperatures through the use of significant ventilation openings within the façade.

Thermal comfort index and PMV (Predicted Mean Vote) shall be considered at the design stage to meet the requirements for each individual building.

Natural Ventilation and Air-Change Effectiveness

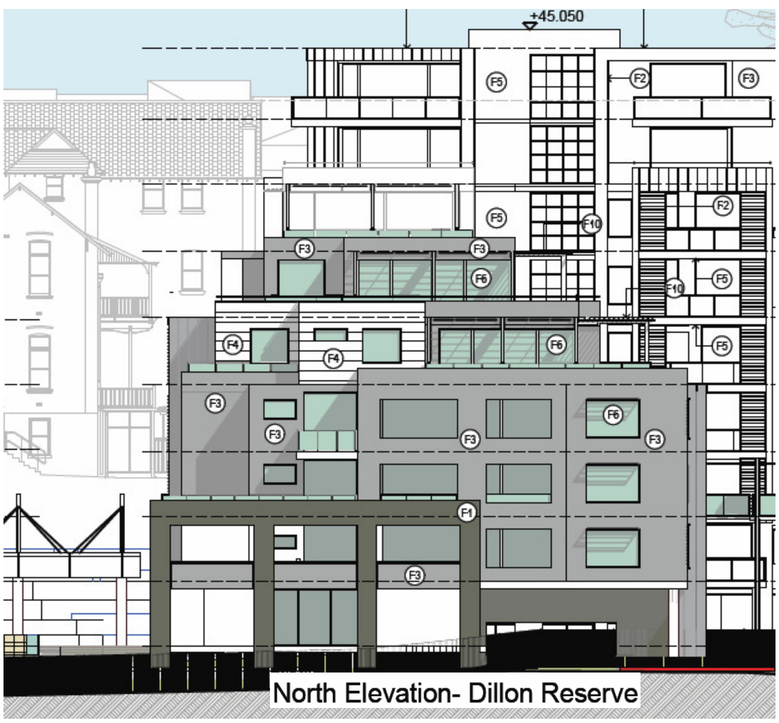
Adequate ventilation is fundamental to the energy and the indoor environmental performance of this development. The cross ventilation system proposed relies on cooled filtered air being provided by surrounding vegetation and landscaping.

The proposed building design reflects this intention by sizing the window openings to allow effective natural ventilation, restoring thermal comfort. The design of the window, when open will allow the introduction and extraction of air through upper and lower openings.

Surrounding vegetation would improve the effect of Natural Ventilation especially during summer months.

Please note that the potential acoustic issues associated with this option would also need to be reviewed with the acoustic consultant.


North Elevation- Dillon Reserve

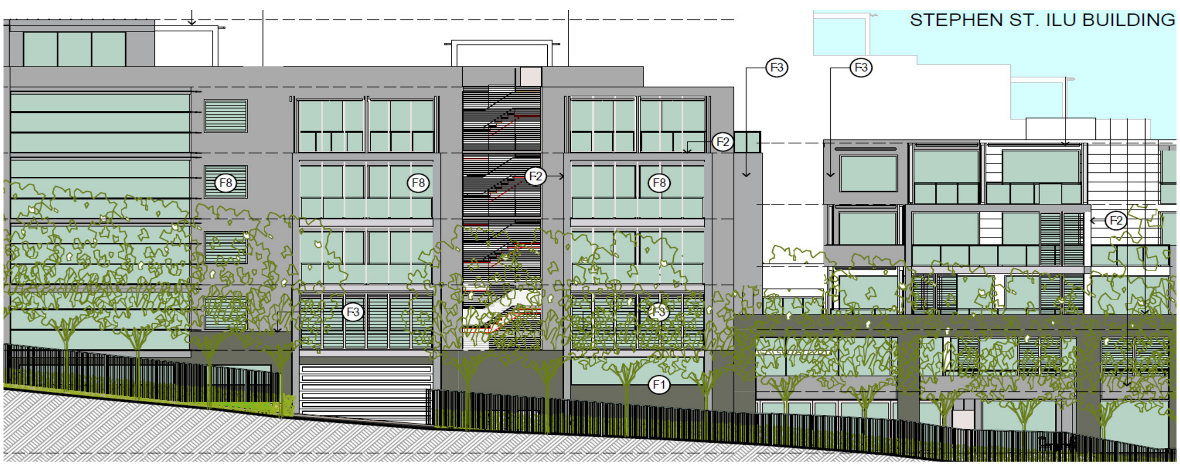

+45.050
North Elevation- Dillon Reserve

Effective Daylighting/ Natural Lighting

Daylighting is the architectural and services design to allow maximum daylight penetration into a building whilst minimizing heat gain and thereby reducing indoor lighting loads.

Daylighting strategies combined with dimmable lighting systems would allow high control of indoor lighting levels whilst minimising power consumption for the buildings.

A high level of architectural input in regards to design, orientation and external shading has been considered to effectively maximise daylighting for the independent living units and aged care facility. Size and location of the existing windows in the heritage building facilitate a high level of daylight harvesting for the buildings, it was not be feasible to add new windows without influencing the heritage nature of this building.



4.3 Materials Initiatives

Environmentally Sensitive Products

To minimise the environmental impact of the buildings, preference will be given to environmentally responsible materials during the selection process, according to the following principles:

- Avoidance of ecologically sensitive products (such as scarce minerals and old-growth forest)
- Selection of materials with a low embodied energy & high recycled content;
- Low toxicity material selection;
- Low impact on the indoor environment;
- Durability, flexibility and recyclability;
- Emissions in manufacture and composition, including greenhouse gases and ozone depleting substances.
- Waste reduction – utilising prefabricated construction will minimise construction work and waste on site.

Ozone Depletion Materials

Selection of insulation will be targeted to minimise both Ozone Depletion Potential (ODP).
The current market has zero ODP insulation on the markets which are highly recommended due to the reduced impact on the environment.

Concrete

Traditional Portland cement production has a considerable embodied energy impact, which will be mitigated by replacing a proportion of cement with an industrial waste product such as fly ash.

Design development will consider the following cement replacement targets, subject to structural considerations:

- Replace 20% of cement with an industrial waste product;
- Use 20% recycled aggregate.

Timber

Where possible, all timber will be supplied from sustainable sources including Forestry Stewardship Council (FCS) certified plantation timbers and recycled products. No timber (either solid or veneer form) will be sourced from rainforests or old-growth forests.

PVC Minimisation

PVC is being phased out in the European Union, as there is widespread evidence to its harmful environmental impact, particularly during disposal or fire. PVC is used in almost all electrical and data cabling and for drainage pipework. Australia does not have any provision for safe recycling or disposal of PVC and it is encouraged that alternatives be considered: Alternatives to PVC products include:

- HDPE and polypropylene pipe work instead of PVC pipe for water supply and drainage systems;
- Linoleum and other natural products instead of vinyl floor coverings;
- Composite materials for electrical cabling.

Finishes

Contamination of indoor air by common indoor pollutants will be reduced in this development by careful material selection, including:

- Use of low-VOC and water-based paints rather than oil-based paints, stains or sealants, reducing indoor air contamination and consequent side-effects including sick-building syndrome and respiratory problems;
- Selection of low-VOC carpets and adhesives;
- Selection of low formaldehyde composite wood products, avoiding the carcinogenic effects of formaldehyde off-gassing;

Volatile Organic Compounds (VOC) & Formaldehyde Minimisation

To ensure long term comfort of occupants, all due care will be taken to minimise VOC and formaldehydes installed within the independent living units and aged care facility.

VOC's are commonly found in carpets, paints, adhesives and sealants uses in construction and extensive exposure to VOC's can cause Sick Building Syndrome effects (eye, nose and skin irritation, headaches lethargy etc).

Formaldehydes are found within composite wood products and extensive exposure can cause irritation to eyes, nose and throat, lead to skin ailments and respiratory system ailments such as asthma.

4.4 Energy Efficiency Initiatives

Efficient Artificial Lighting

An efficient lighting design and control strategy will reduce artificial lighting energy consumption and allow maximum advantage to be taken of natural lighting.

Energy efficiency for the internal lighting throughout the building will be in accordance with AS1680 and BCA Part J.

Exterior lighting design will be in accordance with the Australian Standards and local authority. Pedestrian lighting will be designed with reference to the Woollahra Council’s exterior lighting requirements.

- Efficient light fittings including T5 fluorescent lamps or compact fluorescent lights (CFLs), incorporating high frequency ballasts;
- Low-power LED lamps will be used in feature lighting and are now available with excellent colour temperature control;
- Daylight dimming of external and streetscape perimeter lighting, as well as internal lighting adjacent to windows;
- Efficiency controls including timers and motions sensors in infrequently used areas;
- Discharge luminaires shall only be utilized in areas requiring area flood lighting.

The electrical services will be designed in accordance with the following design standards and documents:

- Building Code of Australia
- Energy Australia Service and Installation Rules
- AS/NZS 3000 Electrical installations (also known as the Australian/New Zealand Wiring Rules)
- AS/NZS 3008.1 Electrical installations – Selection of cables – Cables for alternating voltages up to and including 0.6/1kV – Typical Australian installation conditions
- AS 1680 Interior Lighting
- AS/NZS 1158 Lighting for roads and public spaces
- AS 4282-1997 Control of the obtrusive effects of outdoor lighting
- AS 1768 Lightning protection
- AS 2053 Conduits and fittings for electrical installations
- AS/NZS 2293.1 Emergency escape lighting and exit signs for buildings – system design, installation, and operation.

External lighting will be in accordance with AS1158 and City of Sydney Council requirements. External lighting will be controlled via photoelectric cells and timers.

Internal lighting will be controlled via a “C-BUS” automated lighting control system or equivalent.

Power Factor Correction

Power factor correction will be provided at the main switch board(s) in accordance with the NSW Installation and Service Rules.

The power factor correction units proposed will correct the power to a factor of 0.98 or better.

Efficient Heating, Ventilation & Air-Conditioning

Heating and cooling of the building can make up a large proportion of the building's energy use throughout the year. This development is primarily a residential building; however as part of this type of development, other areas such as passage ways, common areas and other specialised areas exist. Heating and cooling demands of the buildings vary with each type of area of the building. Different occupancy rates, types of activity and other factor such as equipment loads may affect the necessary levels of heating and cooling.

The different areas of the development have been grouped together into different building types in order to accurately estimate the heating and cooling requirements of the development. The types of areas are as follows:

Residential – include the apartments and living areas,
Circulation – includes all the common corridor type areas,
Common – includes the lounge and other areas common between residents.
Other areas including:

- Offices
- Chaplin
- IR
- Theatre
- Meeting rooms, consulting rooms, cafe,
- Staff room, security, nurse stations, lounges

Heating and cooling energy for the independent living units and aged care facility will be provided by Variable Refrigerant Volume (VRV) air-conditioning systems. The layout of the development will allow for either a localized equipment setup or a central energy plant setup.

Variable Refrigerant Volume air-conditioning systems allow individual and independent heating and cooling control within each apartment or zone. The split unit setup has the evaporator unit located within the ceiling space of each apartment. Each evaporator unit requires a corresponding condensing unit. Refrigerant pipes connect the evaporator to the condenser, which means the condenser must be located close the apartment or zone, usually not more than 30 meters away, that is being conditioned. The condensing unit is air cooled and therefore needs to be positioned to allow for the required amount airflow for optimal operation.

The energy efficiency of VRV systems derives from several factors. The VRV essentially eliminates duct losses, which are often estimated to be 10% to 20% of total airflow in ducted systems. VRV systems typically include two to three compressors, one of which is variable speed, in each condensing unit, enabling wide capacity modulation. This approach yields high part-load efficiency, which translates into high seasonal energy efficiency, because HVAC systems typically spend most of their operating hours in the range of 40% to 80% of maximum capacity.

Manually operable windows will allow bedrooms and living rooms to be naturally ventilated when external temperature conditions are favourable. When outside conditions are not favourable for the natural ventilation mode of operation, the mechanical system shall deliver thermal comfort when spaces are occupied.

Bedrooms will be served by a mixed mode ventilation strategy. Manually openable windows will allow bedrooms to be naturally ventilated when external temperature conditions are favourable.

AC systems will be designed in accordance with the BCA and relevant Australian Standards including but not limited to AS1668.1, AS1668.2, AS 1682 and AS3666.

Car park exhaust and supply will be provided for the basement car parking areas. Outside air make up will be supplied via perforated roller shutters, some external louvers and makeup air systems. The carpark ventilation system will be provided with Variable Speed Drives (VSD) motors and CO sensors as per AS1668.2, BCA requirements to minimise energy use and limit overall system noise levels. Loading dock will be Naturally ventilated.

4.5 Renewable Energy Initiatives

Photovoltaics

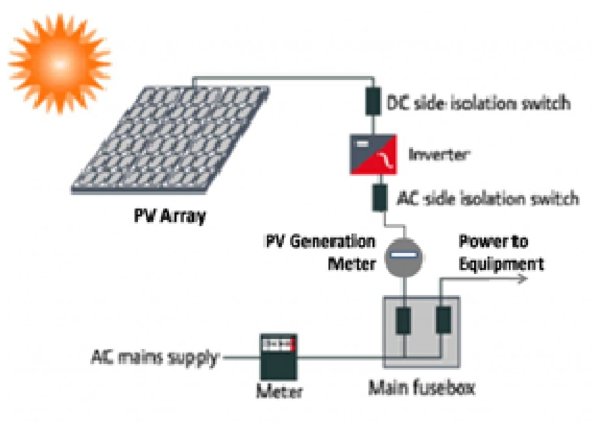
There are many renewable energy sources from which clean energy may be produced and utilised. One of the most cost effective and popular renewable energy technologies for buildings is solar energy and in particular photovoltaic energy (PV), which produces electricity from the sun.

Photovoltaic (PV) panels are devices that convert sunlight directly into electricity. This electricity can be harnessed and used to power any number of devices. Using grid connection, PV panels can export electricity into the electricity grid. The photovoltaic modules will be mounted on rooftops where they will be out of sight and produce the optimum energy output. The main benefits of PV systems are that there are no moving parts in the system and they therefore need very little maintenance. PV modules also have a very long lifetime with many manufacturers guaranteeing an output of at least 80% of manufactured capacity for 25 years. Another benefit of PV is that it can be installed in various system sizes wherever there is good access to the sun. The modular design of the systems allows retro-fitting of additional panels as required over the life of the building.

Please refer to the appendix A for further information on various available PV technologies.

A typical layout of a PV system is described in the figure below and includes a PV module array, inverter, energy meter and associated safety devices. The grid connected PV system will supply electricity to the grid. The electricity will be metered and sold to the utility company.

Currently in NSW there is a gross feed in tariff, which allows electric to be sold back to the grid at a price three times higher than it is purchased (current price $0.60 per kWh).



A grid connected solar photovoltaic system.

Domestic Hot Water (DHW): Heat Pumps

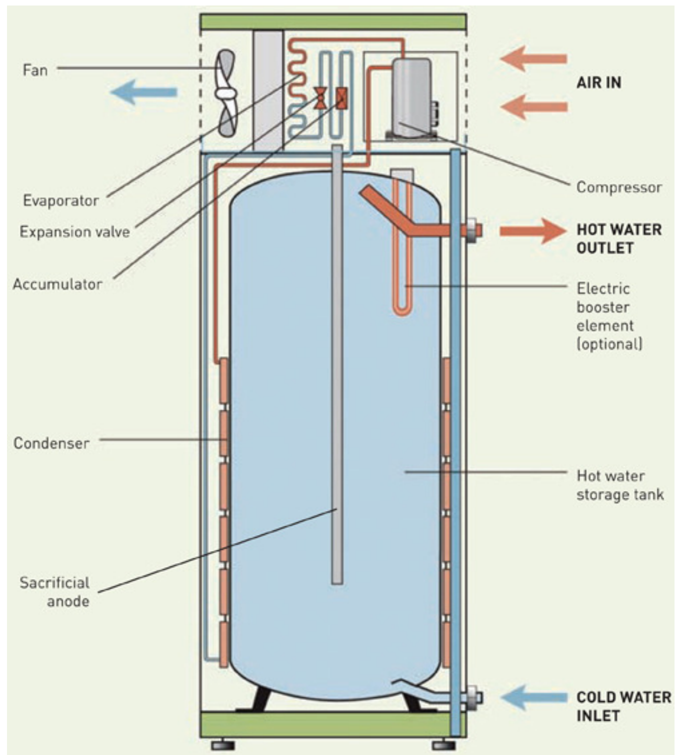
Domestic hot water (DHW) is required for both the residential and common areas of the development. The energy needed to meet DHW demand will be greatly reduced through utilising Heat Pump systems.

A Heat Pump is a planted system whereby heat from the ambient air is absorbed by a refrigerant gas which is then compressed using a small compressor which causes the gas's temperature and pressure to be raised. This results in a higher temperature and pressure for the gas. This temperature increase then transferred through tubes wrapped around the outside of the water storage tank to the water inside the tank.

This is a highly efficient system where Heat Pumps either completely heat or pre-heat the water before it is further heated by a gas fired boiler.

Some of the advantages of Heat Pump systems may include:

- Substantial savings in hot water related expenses over the long term
- A heat pump produces approximately 4 times the amount of renewable energy than electricity required to power the unit.
- A heat pump is effective even in low temperatures. In extreme cold, an electric assist is activated to ensure the water stays at the desired temperature
- It's an environmentally friendly hot water option given the reduction in greenhouse gas emissions through less energy requirements.
- Ease of installation as a solar heat pump uses the same connections as an electric hot water system.
- No roof space or panels needed



Solar booster water heating for pool and spa

Solar hot water generation is arguably the most cost effective form of harnessing solar energy. Hot water for the pool and spa will be generated using one of the commercially available solar collector technologies such as evacuated solar tubes collectors.

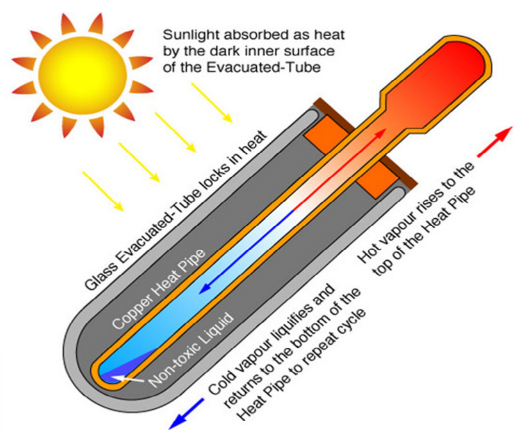
Evacuated tube hot water panels shown in the figure below, are a vacuum technology with low heat losses and good performance at low sun-angles. These are approximately 20-40% more efficient than standard flat-plate solar collectors.

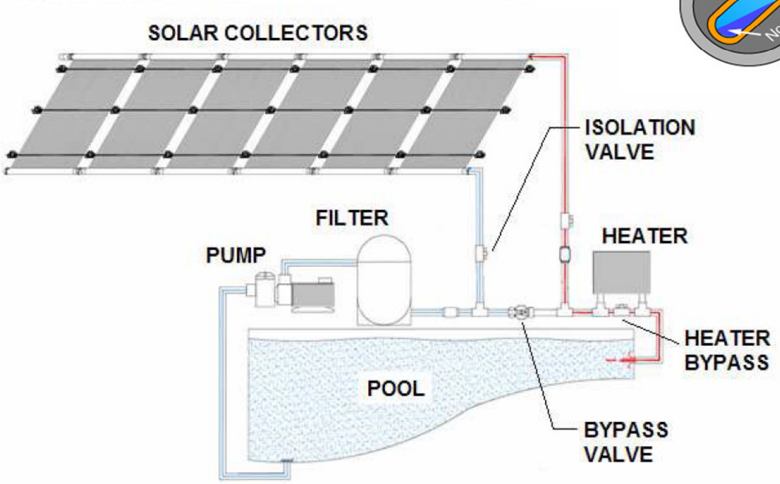
A solar boosted hot water system comprises of three main components; the solar collectors, storage tanks and the water heaters. Water is brought in from the mains into the storage tanks. From there, the water is circulated through the solar collectors and back to the storage tanks. The water is heated as it passes through the solar collectors. The water is continually passed through the solar collectors and back to the storage tank until it reaches the preset temperature. If, for example, during winter, the water is actually losing temperature from being passed through the solar collectors, the control system will stop this circulation occurring.

When there is a demand for hot water, it is taken from the storage tanks. If the water isn't up to the preset temperature, it is first passed through an instantaneous water heater to bring it up to temperature before it is delivered to apartments.

The hot water is then distributed out to the pool and spa via a piping network from the main storage tank. This system will require insulated piping depending on where the central plant would be located.

The advantage of a system such as this is that it allows the pool to be heated by solar energy when the weather conditions allow. Valves, controlled by temperature sensors, determine whether there is any need for the gas fired boiler or heat pump. Given a situation where there is no solar energy that can be used (i.e. winter), the sensors will control the values so the pool water bypasses the solar collectors and goes straight through the boiler.

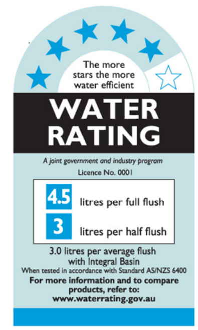




4.6 Water Conservation & Management Initiatives

The reduction in the use of water will be achieved utilising the following measures:

<u>Reduction in water usage</u>



Water usage will be reduced with the installation of low flow equipment such as taps and shower heads. The following measures have been incorporated into the design:

Showerheads: 3 Stars WELS rated;
Toilets: 5 Stars WELS rated;
Kitchen taps: 5 Stars WELS rated;
Bathroom taps: 5 Stars WELS rated;
Water efficient landscape requiring minimum amounts of irrigation;

Dual flush toilets significantly reduce water usage and are already compulsory for all new installations. Appliances such as washing machines will be selected based on their level of water efficiency.

<u>Rain water collection and recycling</u>

Collecting rainwater from roof runoff is a common way to recycle water. In addition to saving drinking water, it allows preparation for times of low rainfall, so gardens will be maintained throughout a year. It also reduces loads on storm water systems because roof runoff is not flushed into the drains. Using rainwater will also reduce water bills.

Rain water will be collected from roof runoff and piped to storage tanks.
With treatment to Class A, recycled water will be used on an unrestricted basis for irrigation and garden watering.

<u>Treatment of collected rain water to Class A</u>

Ultra-violet (UV) treatment is the disinfection process of passing water by a special light source. Immersed in the water in a protective transparent sleeve, the special light source emits UV waves that can inactivate harmful microorganisms. This method of treatment is growing in popularity because it does not require the addition of chemicals.

<u>Treated Stormwater Reuse via Onsite Detention Tank (OSD)</u>

Stormwater reuse can be used for toilet flushing, laundries, water features landscape irrigation, etc. This greatly reduces water consumption for the site.

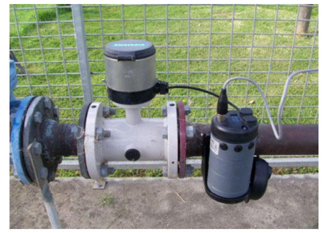
Depending how well this water can be treated, it will also be worth considering reusing this water to supply the pools. This would not present so much of a health issue if the level of treatment can be guaranteed.

<u>Water Loss Reduction</u>

As significant water losses throughout a site can occur due to evaporation from large pool pool covers to reduce night-time losses. We would recommend that this item be considered as part of the final pool solution to minimise water losses.

As heated pools have significantly higher evaporation rates and heat costs associated with them we would recommend against this solution on the basis of the resort ESD target.

Tracking and monitoring (Smart Water Metering)



Smart Water Metering would identify abnormal usage patterns usually associated with leaks, helping to reduce the considerable water lost in this way. In addition, it would allow water efficiency measures to be monitored and tracked for the facilities.

4.7 Environmental Management Initiatives

Energy Sub-Metering

Sub metering to be provided to monitor lighting, mechanical board and general power consumption for the independent living units and aged care facility as well as the Photovoltaic power generation.

Smart metering could be provided for a visual display of the consumption for Electricity, Gas, CO_2 emissions and Water able to be analysed at regular intervals i.e. on a daily / weekly/Monthly /Quarterly and Annual basis.

The visual display will also be able to provide information on the costs associated with this usage, to encourage reduced consumption.

Waste Management System

To encourage and facilitate effective waste management once the development is in operation, sufficient spatial provision will be made to allow for the effective separation of waste from recycling. Dedicated waste recycling rooms allow space for the separation and storage of recyclable waste during the building's operation, allowing for the following waste streams to be separated:

- Glass;
- Cardboard;
- Paper;
- Organics.
- Plastics,
- Metals.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse and composting are examples of waste management options.

Environmental Management and Maintenance

Effective environmental and waste management will be implemented throughout the demolition, construction and operational stages of this development.
The aforementioned EMP shall include a Waste Management Plan, specifying recycling targets for demolition and construction waste. It is recommended that construction and demolition contracts stipulate a minimum 80% target for diversion of waste from landfill. This may be achieved through recycling or reuse.

- Identification of appropriate waste sub-contractors for recycling, costs of collection and timing of collection service;
- Participation in waste minimisation training for contractors and sub-contractors;
- Published waste minimisation plan to reduce site waste to landfill;

Provision of separate waste skips for cardboard, timber, metal, soft plastic, polystyrene, insulation, concrete, glass and bricks.

Maintenance staff on site will review documentation at preliminary and final design stages in regards to building services and external building features for access, ongoing maintenance and ongoing cleaning.

5 CONCLUSION

Greenhouse reduction for the building is achieved in an integrated and staged approach:

- Reducing the need for energy and water consumption through building fabric optimisations, passive solar design, demand reduction and energy & water efficiency;
- Optimising electricity, water and gas consumption by utilising waste products, renewable energy resources and rainwater harvesting.

Various passive design solutions and sustainability options for the building fabric were considered including:

- Building Fabric
- Thermal Comfort
- Natural Ventilation and Air-Change Effectiveness
- Effective Daylighting/ Natural Lighting
- Energy Efficiency
- Water Efficiency
- Material Initiatives and Waste Minimisation
- Environmental Management

Energy efficiency for lighting design and control strategies have been considered to reduce artificial lighting energy consumption and allow maximum advantage to be taken of natural lighting.

Variable Refrigerant Volume (VRV) systems will be utilised since they offer a high part-load efficiency, which translates into high seasonal energy efficiency. In comparison, the conventional HVAC systems typically spend most of their operating hours in the range of 40% to 80% of maximum capacity.

The energy needed to meet the domestic hot water demand will be significantly reduced through utilising gas boosted Heat Pump systems.

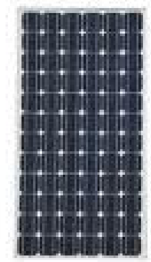
Various environmental management initiatives will be considered including:

- Energy Sub-Metering
- Waste Reduction Management
- Environmental Management
- Learning Resources

Consumption of potable water will be significantly reduced by utilising water efficient fixtures and equipment within the buildings. Collection and treatment of rainwater for the use of irrigation will further reduce the overall water consumption of development.

6 APPENDIX A: PHOTOVOLTAIC PANEL TECHNOLOGIES

Mono-crystalline Solar Modules (Proposed for use in this project)



Mono-crystalline solar modules are the most common example of PV seen around the world. Mono-crystalline solar modules offer the highest commercially available efficiencies (at approximately 17%) meaning that a smaller area of area is required to produce the same amount of electricity. Mono-crystalline solar modules would typically be mounted onto the roof of a building, as they offer little ability to be integrated into a building façade.

Multi-crystalline Solar Modules

Multi crystalline silicon cells are thin wafers of silicon but are cut from multiple crystals grown together in an ingot. They are similar to single crystal cells in life expectancy and fragility. However, they are slightly less efficient than single crystal cells with average efficiencies of around 12% and require more surface area to produce a given amount of electricity. These types of cells are usually square and will have a varied appearance. Multi crystalline cells are cheaper to produce than mono-crystalline cells, due to the simpler manufacturing process.

Amorphous Solar Modules

Amorphous silicon cells are composed of silicon atoms in a thin homogenous layer rather than a crystal structure. Amorphous silicon absorbs light more effectively than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also known as a "thin film" PV technology. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and "fold-away" modules. Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier and therefore cheaper to produce.

Solar Glass / Glass Laminates

Solar glass or glass laminates use the same technology as mono-crystalline solar cells. The solar glass sandwiches the individual photovoltaic cells between two sheets of glass. This allows light to pass through the spaces between the cells. As the gaps between the cells are increased to allow greater light transmission the efficiency of the modules will drop to approximately 12%. The greater use of glass also leads to an increased cost in modules. Solar glass is best used as a component of the building fabric where it will off-set the cost of a building material.

Schott Solar ASI-THRU

The ASI-THRU solar modules released by Schott Solar use a different form of technology to provide an aesthetic façade system. While silicon is still used, it is not grown into a wafer type cell but is essentially sprayed onto a glass material. As glass forms the structural component of the cell, less silicon is available which reduces efficiency to approximately 6%. The cost of the modules is increased due to the glass component, and as more panels are required to generate the same amount of energy, using ASI-THRU will be more costly. However, ASI-THRU solar modules provide a very good façade replacement, as they allow daylight to entered the space and also allow building occupants to enjoy the view. This type of module would only be considered as a component of the building façade where it can offset the cost of a building material.

Dye-Sensitised Solar Cells

Dye-sensitised solar cells are a relatively new class of low-cost PV. Instead of using silicon to convert the sunlight to electricity they use a photo-sensitised titanium dioxide anode to form a photo electrochemical reaction. The dye-sensitised solar cells are a promising form of renewable energy, as they are made of lost-cost materials (the cost of the bulk material is far less than silicon, from which PV cells are usually made) and are easier to manufacture than the standard silicon cells. The efficiency of the dye-sensitised solar cells is less than the silicon options, at 11%, however these efficiencies are generally not available in commercial quantities. Currently the costs are high per unit of output, however this technology can be considered for application in future.