Appendix E

ESD report

Settlement City Shopping Centre – Port Macquarie
Environmental Assessment proposed Stage 1

ING REAL ESTATE

Manidis Roberts

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HEGGIES

REPORT 10-4254-R1

Revision 4

Settlement City Shopping Centre
Port Macquarie
Ecologically Sustainable Development Report

PREPARED FOR

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Settlement City Shopping Centre

Port Macquarie

Ecologically Sustainable Development Report

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TABLE OF CONTENTS

1 INTRODUCTION

Heggies Pty Ltd has been engaged ING Real Estate to review the proposed Settlement City shopping centre expansion and partial redevelopment at Port Macquarie, NSW in terms of Ecologically Sustainable Development. Energy efficiency and greenhouse gas reduction strategies for the proposed Retail Stores are explored with reference to Hastings Council Greenhouse Action Strategy. The ESD report also discusses the current climate change polices and threshold for GHG emissions.

1.1 Energy Efficiency, Greenhouse Gas Assessment and Current Climate Change Policies

1.1.1 National Greenhouse and Energy Reporting Act 2007

The *National Greenhouse and Energy Reporting Act 2007* (the NGER Act) is administrated by the Australian Government Department of Climate Change (DCC) and establishes a structure for corporations to report greenhouse gas emissions and energy consumption and production from 1 July 2008 (see also National Greenhouse and Energy Reporting Guidelines, February 2008).

Under the NGER Act, corporations are required to apply for registration with the Greenhouse and Energy Data Officer if their associated greenhouse gas emissions or energy consumption levels are above defined thresholds for a financial reporting year. There are two threshold levels at which corporations are required to report - facility thresholds and corporate group thresholds. The facility thresholds apply to an individual operation while corporate thresholds are applicable to controlling corporations.

The NGER requires an assessment of Scope 1 and Scope 2 greenhouse gas (GHG) emissions, defined as follows:

- Scope 1 emissions result from activities under a company's control or from sources which they own (eg on-site generation of electricity, on-site transportation emissions); and
- Scope 2 emissions relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations.

More information on the Scope 1 and Scope 2 greenhouse emissions is detailed in Appendix A.

Heggies recommends conducting a detailed energy assessment of the proposed facility when the design is progressed to determine the legislating requirement.

1.1.2 Energy Savings Action Plans (NSW)

The NSW water and energy savings initiatives were introduced by the NSW Government in May 2005. They are administered by the Department of Energy, Utilities and Sustainability (DEUS) and include a requirement for certain businesses, government agencies and local councils to prepare Energy Savings Action Plans. Plans must be prepared in accordance with the Guidelines for Energy Saving Action Plans, available from Department of Energy, Utilities and Sustainability (DEUS).

In accordance with NSW government (Department of Energy, Utilities and Sustainability) requirements, **Energy Savings Action Plans** must be completed by NSW businesses with sites using more than 10 GWh of electricity a year. A summary of the plan is shown in **Table 1**.

Table 1: NSW Energy Saving Action Plan

Program	Energy Savings Action Plans
Who is involved?	Identified NSW high energy use sites
What is involved?	Preparation of plans for all user sites in accordance with the DEUS Guidelines for Energy Savings Action Plans.
Energy use	All stationary energy types.
Baseline requirements	12 months energy data reflecting 'regular and repeatable' use.
Management and technical review requirements	Management review to determine opportunities to improve energy practices within the organisation. The technical review should provide a detailed breakdown of energy use at a site, identify all possible energy savings measures and evaluate those with a practical application.
Identifying and implementing savings	Plans involve identifying cost-effective and potentially cost-effective measures to reduce energy use and achieve savings.
Monitoring, verification and reporting	Annual reporting on implementation and any changes to plan.

Heggies recommends conducting a detailed energy assessment of the proposed facility following 12 months of operations to ensure fulfilment of the legislative requirements of the DEUS Energy Saving Action Plan.

1.1.3 Building Code of Australia 2009– Energy efficiency Section J

The proposed building will be classified as a mixed classification in the following categories:

- Class 6 (Shops, Retails)
- Class 5 (Offices)
- Class 7a (Carpark); Class 7b (Stores)

When applying for a Construction Certificate for a Class 3 to Class 9 building in NSW, The proposed development needs to comply with the BCA 2009 Section J Energy Efficiency.

A full BCA Section J compliance report will be completed during the design development stage of the project.

1.1.4 Port Macquarie - Hastings Council Greenhouse Action Strategy

Port Macquarie Hastings Council joined the *Cities for Climate Protection Program* in October 2001 to strategically identify activities within local Council that are contributing to greenhouse gas emissions and to determine the most appropriate strategic actions to reduce these emissions. Greenhouse gas emissions resulting from the activities of the Council in 1999 produced around 14,000 tonnes of greenhouse gases and cost in excess of $1.35 million for the supply of energy alone. Hastings Council aims to reduce its corporate greenhouse gas emissions from 1999 levels by 20%, by 2010, and stabilise community greenhouse gas emissions at 1996 levels by 2010. These were targets adopted by Council in August 2002.

Council have developed a Greenhouse Action Strategy that provides the direction for implementing effective and practical greenhouse abatement actions in order to achieve these emission reductions. As part of Council's commitment the Greenhouse Action Strategy an Energy/Water Efficient DCP for Non-Residential Buildings is being developed. This DCP will provide a baseline for energy efficiency in new commercial and industrial buildings and establish regulatory and other mechanisms to ensure that new developments maximise resource energy efficiency. The following report draws upon Heggies previous ESD experience with commercial and retail development to provide a review of the proposal and provide conceptual design guidance that reflects Hastings Council's commitment to greenhouse gas abatement.

1.1.5 The Green Building Council of Australia (GBCA) Rating Tools

The Green Building Council of Australia (GBCA) has recently released a new voluntary tool to rate new or redeveloped shopping centres. The tool applies when retail centres with a minimum of 80% of the building's GFA (measured to exclude internal car parks) comprised of BCA Class 6 are eligible for Green Star – Retail Centre. For the purposes of this rating tool, retail centres are considered to be centres that include:

- More than one retail business;
- Common mall area(s);
- Some common/shared plant; and
- Shared building infrastructure amongst tenancies.

The eligibility of the project for green star rating will be examined when the design is progressed.

1.2 Redevelopment Site

The development will be situated on an existing waterfront mixed-use site and will include the construction and refurbishment of:

- Commercial Offices of 2787 m^2.
- New Leisure/Gym/Health Spa of 2300 m^2.
- Multiple smaller retail stores lining the mall passageways.
- Panthers Entertainment club fronting Hastings River (To be redeveloped during stage 2 of the project).
- Cinemas and Bowling of 4942 m^2.
- Specialty Retail of 7148 m^2.

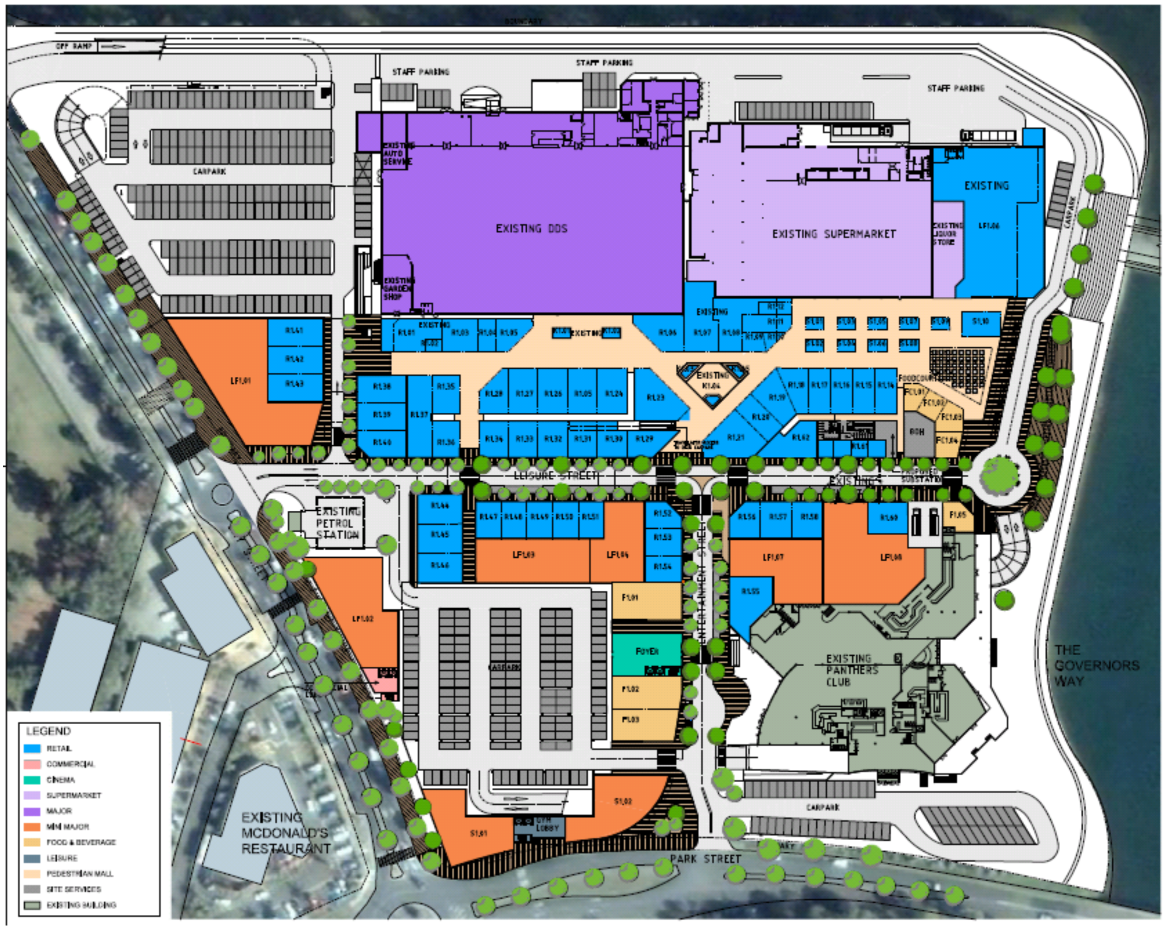
The following buildings will be retained

- Woolworths Supermarket of 4253 m^2.
- Discount Department Store of 6618 m^2.
- Mini Major of 996 m^2.
- Specialty Retail of 5941 m^2.

The site is presented in **Figure 1**. The site is bounded by Park Street to the east, Bay Street to the south and the Hastings River canal surrounding the western and northern perimeter of the site. Other uses surrounding the site include residential zones to the north and west, a hotel and marina to the east and two schools located to the east.

Port Macquarie offers infrastructure to support growing population levels, with new facilities such as the Base Hospital, two large regional shopping centres (including Settlement City), a number of schools (including St Josephs to the south of the site), TAFE college and a campus of Southern Cross University. As a significant piece of Port Macquarie infrastructure the Settlement City expansion will be important in terms of its overall service provision for Port Macquarie as a whole.

Figure 1 Layout of the Proposed Settlement City Expansion and Partial Redevelopment



1.3 Siting and Overall Concept

The siting of the proposed complex offers distinct advantages including:

- The development of this site will provide centralised retail and entertainment facilities to the expanding Port Macquarie population and will facilitate, in part, the expected strong demand for retail space in Port Macquarie. The Port Macquarie area is expected to achieve strong population growth in the future driven by a combination of the aging population and young families immigrating to the area.
- The development will be situated close to road and bus arterial routes and will have immediate access to existing services infrastructure all at very little additional cost to the town.
- The site is generally flat thereby assisting elderly and disabled access to the site.
- As opposed to new developments on the outer fringes of the town which require greater investment in new roads, sewage, lighting, power, etc, the proposed expansion and partial redevelopment will have immediate access to all of these at very little additional cost to the city. Hence, the redevelopment will impose modest additional energy demands on the city other than the internal building demands of the tenants.

2 SITE ANALYSIS

2.1 Solar Access

One of the objectives of energy conservation is to minimise the heating and cooling requirements of buildings to reduce energy consumed by air conditioning systems. Heating and cooling loads can be minimised and internal thermal comfort optimised by the management of solar access. Sunlight should preferably be able to penetrate the building in winter and be excluded from the building in summer. For many developments containing occupied area with glazing, it is advantageous to utilise appropriately shaded glazing to capture winter sun and exclude afternoon summer sun while optimising outlook.

The form of the new food court has been designed to take full advantage of the views over the Hastings River. The indoor food court is linked to the mall and designed to maximise the solar exposure of the northern facade. This is ideal in terms of energy efficiency as it allows maximum solar radiation receipt to take place, particularly in winter, when the sun's rays are at an acute angle to the north. It will be important on the northern facade to incorporate horizontal shading to glazing to also shield against high altitude summer sun and associated unwanted summer heat.

The proposed leisure/gym/health developments to the north and east of the site will allow solar exposure from these directions throughout the day. Heggies recommends the use of shading initiatives such as horizontal shading devices and louvers to reduce the solar loads on the building in hot summer days.

In the case of the commercial offices where the opportunity to utilise available solar access via glazed building elements is limited, greater attention should therefore be directed at the building construction and mechanical services as described in the following sections.

The building's orientation also provides the opportunity to utilise cross and/or mixed ventilation, which is especially helpful in summer, when cooling north-east breezes generally occur (see **Sections 2.2 & 3.5.1**).

The form of the existing shopping centre dictates that glazing to the smaller retail store glazed shopfronts will be oriented to face toward the north, south and west facing the existing shopping centre. Shopfront glazing will include deep awning cover for rain protection and, as importantly, to provide shading from higher altitude solar heat gain during summer months. Shading to external glazing will be important in the Port Macquarie climate as cooling loads are likely to dominate total air conditioning loads.

2.2 Wind Impact and Natural Ventilation

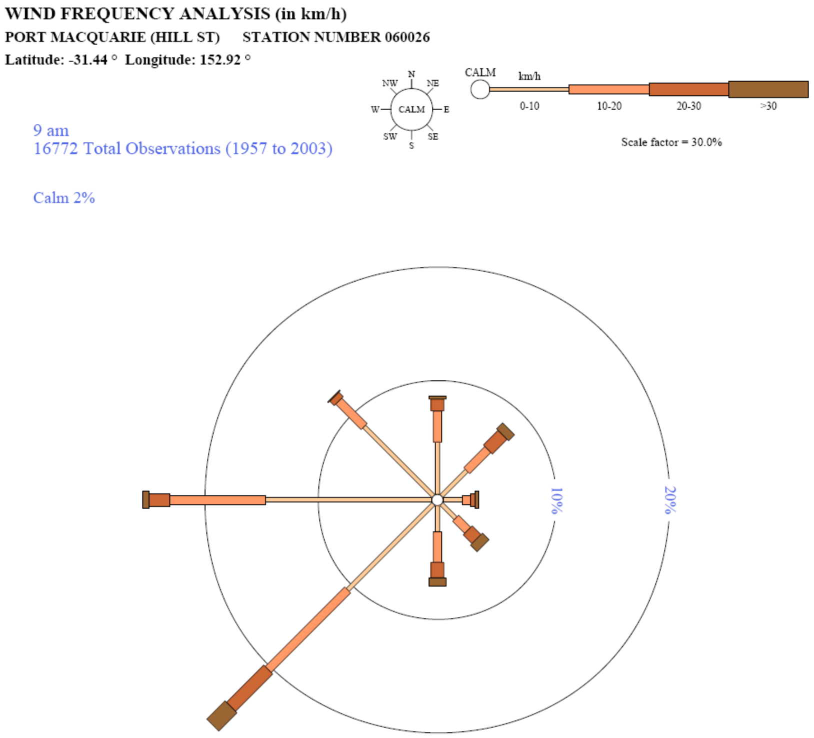
Wind rose data (i.e. wind direction, magnitude and frequency) for Port Macquarie is presented in **Figure 3** below, with cumulative frequencies of various wind velocities plotted against direction.

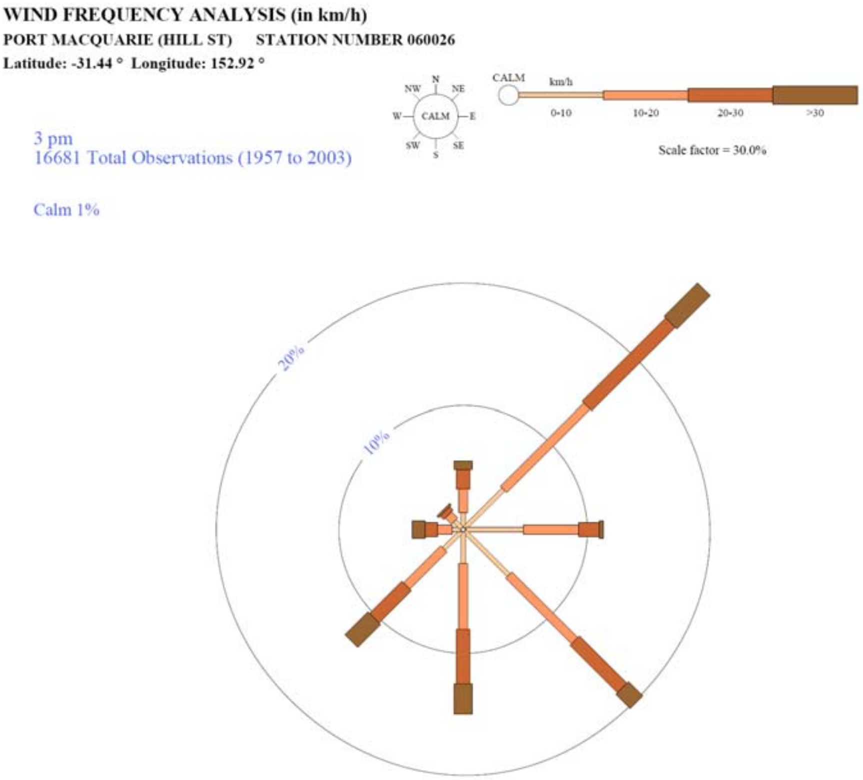
The key characteristics of the Port Macquarie wind climate relevant to the assessment of the development's wind impact and natural ventilation availability are the two distinct primary wind seasons, which occur in summer and winter/early spring.

Summer winds are primarily from the east quadrant and will tend to produce the following dominant wind flows past the building:

- Milder winds from the east will receive modest blockage upstream of the site at all levels, especially for the over-water oncoming wind directions.
- Stronger southerly winds will receive some moderate blockage from upstream low-rise buildings and the elevated topography of the Port Macquarie town area for winds with a more south-easterly bias.

Figure 2 Prevailing Wind Frequency in Port Macquarie





Winter winds are primarily from west and the south quadrants which will tend to produce the following dominant wind flows past the building:

- Strong west quadrant winds will receive only moderate blockage generated by low-rise buildings and the flat terrain upstream of the site.

It will be critical to provide shelter from cold winter winds for the relevant facades of the building. Proper sealing detailing of facade glazing will be important, especially for west exposed facade areas, to allow solar heat gain during winter months without allowing simultaneous cold air penetration.

At the same time the abundance of cooling seabreezes to the site can be used to remove accumulated heat gains during overheated periods. Also important in warmer climates such as Port Macquarie is the role of ventilation in directly improving the perception of thermal comfort by occupants of a space. This is achieved when, by passing over the skin, moving air aids the evaporation of perspiration. Opportunities to utilise available natural ventilation at the site are explored further in **Section 3.5.1.**

3 BUILDING ENVELOPE AND BUILT FORM

3.1 Insulation

Thermal insulation reduces the amount of heat entering a building in the summer, and conversely leaving the building in winter. This reduces the amount of energy required to heat and cool a building. Any heating inputs, supplied by either through direct solar radiation or a heating device, should be retained within the building as long as possible to lessen the need for further supplementary heating.

Heat will occur by conduction and radiation through walls, ceilings, roof and floors. The amount of heat loss through building elements is a function of the insulation value of that element, the area of that element and the difference between inside and outside temperatures. Accordingly the area and the thermal transmittance are important in considering heat loss. As the roof of the proposed development forms the greatest external surface area this component is integral to the energy efficiency of the development.

For this development recommended indicative insulation requirements are as follows:

- Roof – Ceiling Insulation to R2.5 + foil anti-condensation blanket for metal roof.
- Walls - minimum R value of 1.5.

3.2 Colour

Dark colours absorb heat whilst light colours reflect heat. Light coloured surfaces are recommended internally and externally for this development. It has been determined on this development the advantages of reflecting unwanted heat gain in summer override the advantages of absorbing heat with dark colours in winter.

Light colours can reflect heat around a room in winter whilst simultaneously providing higher levels of natural light within internal areas.

3.3 Thermal Mass

Thermal mass is used to even out daily temperature variations. In a similar fashion to summer heat absorption, on a cold winter's day building thermal mass can 'soak up' the sun's energy during the day, and then release heat back into the building during the night. Generally the more dense the material, the higher the thermal mass, and therefore the more heat energy that can be stored.

Concrete will be used through the development and includes the floor slabs, columns and precast concrete wall panels. A review of material thermal mass values presented in Table 1 reveal that concrete has amongst the highest thermal mass capacity of a range of common building products.

Table 1 Thermal Mass Values for Some Common Building Materials

Material	Material Thickness (mm)	Thermal Mass ($kJ/m^2 K$)
10-31 Solid Brick	190	410
Concrete	100	221
Clay brick (3.5 kg solid + 0.5 kg mortar	110	142
Clay brick (3.0 kg face + 0.5 kg mortar	110	124
Weatherboard (softwood)	15	16
Fibre cement sheet	6	8
Plasterboard	10	8
Glass	3	6
Air	50	0.5

3.4 Glazing

Performance Glazing, as required by the Building Code of Australia (BCA), will reduce the solar heat gain on the proposed redevelopment. A detailed BCA compliance report will be provided during the construction stage of the project.

3.5 Heating/Cooling and Ventilation

Air conditioning system design will vary significantly across the redevelopment within the site to reflect the varied building occupancy requirements.

Independent dedicated packaged systems are most likely to be provided to the smaller retail zones surrounding the mall. Energy efficient models should be encouraged. It is recommended that guidance on appropriate units be provided by the centre operator to any prospective tenants.

The expanded retail facility will most likely incorporate centralised cooling and spatial heating plant. The cooling plant will likely include a centralised chilled water system consisting of chillers and chilled water pumps. The heat rejection system would be provided by rooftop cooling towers. This type of air conditioning system can benefit from the selection of highly efficient staged chillers.

Presently there are screw chillers available in the market with a Coefficient of Performance (COP) as high as 6 and centrifugal chillers with COP's as high as 9. By selecting a more efficient chiller, less energy could be consumed by the cooling plant. Chillers should use non CFC refrigerants.

The centralised heating plant could comprise natural gas boilers. Natural gas fired boilers have significantly lower greenhouse emissions than the equivalent electricity powered boilers.

Generally, it is recommended that all mechanical and electrical equipment within the development is selected bearing in mind the incorporation of energy conservation devices:

- Equipment control systems should be properly calibrated.
- Usage hours should be well defined (ie weekly and day/night occupancy patterns). All heating systems should have sufficient means of control to ensure that areas are only heated when occupied; and areas are only heated to the required temperature.
- Investigate the use of economy cycles. At minimum it is recommended that the throttling range of the dead band be as large as possible, without compromising thermal comfort.
- Energy recovery systems should be considered where appropriate.
- The use of materials such as CFCs should be excluded.

Pipework and ductwork should also be adequately insulated, which represents good energy efficiency practice.

3.5.1 Mixed Mode Operation

For the Port Macquarie climate and humidity levels there is reduced incentive to use air conditioning system in economy cycle mode.

In the case of the indoor food court and mall link, advantage can be taken of favourable ambient conditions through the use of a mixed mode air conditioning system to take advantage of the coastal sea breezes available to the site. In mixed mode ventilation the system operates automatically between natural ventilation and air conditioning depending upon prevailing wind conditions, ambient temperature and internal temperature. In essence, cooler outdoor air with less embodied energy than conditioned air can be used to reduce the demand on the cooling plant.

Natural ventilation is normally driven by differential pressures established between the dominant openings to the relevant space. This will vary according to wind yaw angle relative to the facade, elevation of the unit above ground level, local facade geometry, upstream shielding, turbulence levels, etc.

Mixed mode operation scenarios can be developed utilising numerical techniques such as Computational Fluid Dynamics (CFD) analysis to accurately simulate flow into and out of the proposed spaces.

It is recommended that mixed mode operation initiatives continue to be adopted during the detailed design stage of the project

3.5.2 Geothermal Heat Pumps

Geothermal heat pumps are similar to ordinary heat pumps, but instead of using heat found in outside air, they rely on the stable, even heat of the earth to provide heating, air conditioning and, in most cases, hot water. The principle behind geothermal heat pumps, in the winter, they move the heat from the earth into a system. In the summer, they pull the heat from a system and discharge it into the ground. Therefore, geothermal heat pumps are more sustainable and efficient than conventional heat pumps that use rooftop cooling towers. They can be categorized as having closed or open loops.

For closed loop systems, water or antifreeze solution is circulated through plastic pipes buried beneath the earth's surface. During the winter, the fluid collects heat from the earth and carries it through the system and into the building. During the summer, the system reverses itself to cool the building by extracting heat from the building and placing exchanging it in the ground.

Open loop systems operate on the same principle as closed loop systems and can be installed where an adequate supply of suitable water is available and open discharge is feasible.

At the Settlement City site it is likely a closed loop system would be most appropriate by sinking boreholes directly below the centre.

The cost of a geothermal heat pump is approximately double that of a conventional heat pump system, with the drilling cost additional. Heggies recommend conducting a feasibility study during the detailed design stage prior to the construction certificate application to explore this opportunity further and determine the viability of this option.

3.6 Lighting

Improvements in the energy efficiency of lighting systems can be achieved in various ways:

- Use of the most energy efficient luminaries. The efficiency of available lamps ranges from approximately 10 lumens per watt for a typical incandescent lamp to almost 200 lumens per watt for a high capacity low pressure sodium lamp.
- Installation of an effective lighting control system so that unwanted lighting can be switched off either manually or automatically. A building management system can operate both lighting and air conditioning. Automatic switch controls will be timed for when staff and shoppers are not normally present.
- Integration of electric lighting and daylight utilising daylighting sensors which can automatically adjust illumination to changing natural light conditions. These would be appropriate for the perimeter retail stores.

External lighting used for security purposes in car park areas and building perimeter zones can use high pressure sodium or metal halide fittings and can be turned on by a photo-electric cell and turned off using a time switch or light sensor.

In addition the following general recommendations are made:

- Lighting levels should be established using the guidelines set out in Australian Standard AS 1680.1-1990.
- Internal wall colouring should be made as light as possible to maximise the use of natural daylight.

3.6.1 Construction and Commissioning

To ensure that energy efficient design features are preserved throughout the construction process, the developer will complete all of their work in accordance with their agreed scope of work. The commissioning plan will be designed to meet the requirements of relevant Australian Standards and Codes. This is acceptable due to the scale of the building.

It is recommended that design and documentation quality assurance checks and on-site quality assurance be adopted to ensure that energy efficient design features are preserved throughout the construction process. .

4 GREEN POWER INITIATIVE

It is recommended that the option of "Greenpower" should be made available to tenants, providing the opportunity for tenants to contribute to a reduction in total greenhouse gas emissions produced by the proposed Development. Greenpower is produced from environmentally friendly renewable energy sources such as solar, wind, water and biomass.

When a Greenpower product is selected by tenants, the energy supplier commits to buying a certain amount of electricity from approved new renewable energy sources. The financial accounts of Greenpower suppliers are audited independently. This makes a clear distinction between the services provided by standard energy suppliers, and the more sustainable service offered through Greenpower options.

5 WATER EFFICIENCY

It is recommended that the hot water units be rated at least 3.5 stars under the Energy labelling list provided by the Australian Greenhouse Office (AGO) (www.energyrating.com.au).

AAA water efficient fittings should be installed on kitchen and bathroom fittings. These devices will result in a reduction in the use of hot water, thus saving the energy that would be required to heat this additional water capacity. If hot water pipe runs are longer than a few metres, pipes should be adequately insulated.

Dual flush or low volume cisterns and waterless urinals can be incorporated for water use efficiency.

Rainwater Harvesting

The development will have a large roof area well suited to rainwater harvesting applications. Rainwater harvesting can be used for the purposes of irrigation including landscape watering/wash-down needs and toilet flushing.

The use of the rainwater for landscaping will reduce the dependence on potable water whilst at the same time limiting the amount of stormwater from the site. An example a rainwater harvesting system to the new retail/cinemas might incorporate a 10,000L tank for storage, water pump and diversion control as primary components. .

Water efficient landscaping design

Indigenous trees and shrub species that rely on rainwater for their water needs should be used for all landscaping at the development. Timers and soil moisture sensors can be used on all irrigation systems to minimise landscaping water usage.

Hot Water Supply

The domestic type (i.e. excluding HVAC requirements) hot water demands of the redevelopment will be low hence the efficiency of the final system will be important, but not paramount. Hot water systems in approximate order of highest to lowest efficiency are:

- Solar (gas boost).
- Solar (electric boost).
- Electric heat pump.
- Gas storage.
- Gas instantaneous.
- Electric instantaneous.
- Electric storage.

5.1 Water Metering

To help reduce water consumption, accurate information on usage is required at the building management level. Heggies recommend installing water meters for all major water uses in the development.

6 RECYCLED MATERIAL SELECTION, RECYCLABILITY, AND MAINTENANCE

Complete energy efficient design aims to reduce the energy consumed by a building over its entire lifecycle from "cradle to grave". Construction materials and products will be selected, where feasible and reasonable, based on balancing the following criteria:

- Recyclability.
- Sustainable sourcing.
- Low embodied energy.
- Low pollution from manufacturing.
- Low transport costs.
- Minimal environmental impact.
- Durability and minimal maintenance.
- Non-hazardous.
- Eco-labelling and certification.

Embodied energy is the "up front" capital energy investment at the construction stage associated with the building materials and process used in the production of a building. This includes the mining or harvesting of raw materials, processing these materials into housing fabrics, transport for both raw materials and refined products and the preservation of the energy investment through durability.

The building is designed to be durable providing long term-use with the possibility of later adaptive re-use. Materials to be used extensively throughout the development include concrete, steel, glass, aluminium, and carpet. **Table 2** illustrates the long-term renewable and recyclable properties of these materials. Most materials for use on the project can be recycled, including: aluminium (100% recyclable, 95% embodied energy savings), steel (72% embodied energy savings), gypsum plasterboard, timber, concrete**,** some carpets, glass and plastics.

Table 2 Renewable / Recyclable Properties of Some Common Building Materials

Material	Embodied Energy	Durability	Re-useability /Recyclability	Toxicity	Renewable	Polluting
Aluminium	Very high	High	High	Low	No	Moderate
Steel	High	High	High	Generally Low	No	Moderate
Concrete	Moderate	Moderate-high	High potential, depends on market	Low	No	Moderate-low
Wood	Low	Moderate	High	Low	Yes	Low
Glass	Moderate	Moderate	High	Low	No	Low
Carpet	Moderate-high	Low	Moderate, although market very limited	Low	Partially	Moderate-low

6.1 Recycled Content Commitment

6.1.1 Internal Access Roadways and Hard Surfaces

Substitute aggregates are now being used extensively in bitumen mixes for roadway pathway surfaces. For example rubberised asphalt paving using recycled car tyres can be used instead of standard asphalt. Rubberised asphalt can be laid in thinner sections than conventional asphalt and can reduce road noise. Whilst rubberised asphalt is more expensive than conventional asphalt the environmental benefits include reduced scrap tire disposal and displacement of other aggregate materials.

Recycled materials such as crushed concrete and brick can also be considered as a substitute aggregate and for road base. The cost per ton of this recycled product is typically half of a similar 20mm Blue Steel aggregate.

6.1.2 Concrete Slab Construction

Concrete is composed of three main components, stone (coarse aggregate), sand (fine aggregate) and cement. Recycled masonry and concrete as well as other industrial wastes can be utilised within these components.

The main environmental impacts involved with concrete production are greenhouse gas emissions from cement production and the mining of raw materials. Replacing a proportion of the cement with waste products such as fly ash, slag and silica fume can significantly reduce embodied energy and greenhouse gas emissions.

Coarse aggregate can be replaced with recycled crushed concrete. The simplest approach is to use up to 30 percent recycled aggregate for structural concrete, which has no noticeable difference in workability and strength relative to concrete with natural stone aggregate.

Substitutes for Portland cement include fly ash, ground blast furnace slag and silica fume, which are waste materials from other manufacturing processes. Various blended cements are available, with cement substitution of up to 85 percent. Reducing the amount of Portland cement will result in significant reductions in greenhouse gas emissions.

Heggies recommend consulting with the local supplier and structural engineer to determine the exact product make-up to meet the project demands, with the maximum amount of recycled content as described above, resulting in both cost and embodied energy savings.

6.1.3 Minimisation of Construction Waste

A recycling plan will be developed for construction waste materials. Much of the material generated during construction (excluding packaging and shipping materials) will be recycled, eg: metal (steel & copper), clean dimensional wood & timber off-cuts for reuse, concrete and bricks for crushing, cardboard, glass, asphalt, bricks and beverage containers. Any formwork required for concreting will be recycled and sub-contractors will also be encouraged to make use of recyclable packaging for any materials sent to site.

6.1.4 Non-polluting and non-ozone depleting materials

The developer will minimise, where practicable, the use of PVC, particleboard, laminated wood, plywood and treated timber, and exclude all materials containing CFCs or HCFCs. Wherever possible materials with recycled content and materials listed on the "Ecospecifier" database (http://www.ecospecifier.org) of preferable materials will be used.

7 CONCLUSION

Energy Efficiency and Greenhouse Gas reduction strategies for the proposed Settlement City shopping centre expansion and retail redevelopment at Port Macquarie have been explored with reference to Port Macquarie Hastings Council Greenhouse Action Strategy. The report also discusses the current climate change polices and threshold for Green House Gas (GHG) emissions.

The redevelopment of this site will provide centralised retail and entertainment facilities to the expanding Port Macquarie population. The proposed development will have immediate access to existing infrastructure at very little additional energy cost to the city.

The overall concept of the development as well as specific design features have been investigated to explore opportunities to reduce the energy required by the development, both in building and operation.

Siting issues relating to solar access and natural ventilation have been explored as well as broader ESD principles relating to built form, water efficiency and waste/pollution reduction. It is proposed to explore both passive and active energy saving features such as mixed mode ventilation and geothermal heat pumps during detailed design.

Heggies recommends conducting a detailed energy assessment of the proposed facility when the design is progressed and following 12 months of operations to ensure fulfilment of the legislative requirements of the National Greenhouse and Energy Reporting Act (the NEGR Act) and the DEUS Energy Saving Action Plan.

APPENDIX A: THE GREENHOUSE GAS PROTOCOL INITIATIVE

The Greenhouse Gas Protocol Initiative (hereafter, "the GHG Protocol") is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption. (WBCSD, 2005)

The GHG Protocol comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (this document, which provides a step-by-step guide for companies to use in quantifying and reporting their greenhouse gas emissions).
- *GHG Protocol Project Quantification Standard* (forthcoming; a guide for quantifying reductions from greenhouse gas mitigation projects).

There are three scopes of emissions that are established for greenhouse gas accounting and reporting purposes, defined as follows.

A1.1 Scope 1 Emissions – Direct GHG Emissions

The GHG Protocol defines Scope 1 emissions as those which result from activities under the company's control or from sources which they own. They are principally a result of the following activities:

- generation of electricity, heat or steam. These emissions result from the combustion of fuels in stationary sources, e.g. boilers, furnaces or turbines;
- physical or chemical processing. The majority of these emissions result from the manufacture or processing of chemicals and materials e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing;
- transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars);
- tugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

A1.2 Scope 2 Emissions – Electricity indirect GHG Emissions

Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions.