2A GREGORY PLACE, HARRIS PARK

Energy Efficiency & Ecologically Sustainable Design Report

Prepared for:

2A Gregory Place Pty Ltd
2A Gregory Place,
Harris Park 2150 NSW

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with 2A Gregory Place Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30838-R01-v1.0	14 June 2022	Mark Hobday	Neihad Al-Khalidy	Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Pty Ltd (SLR) has been engaged by 2A Gregory Place Pty Ltd to provide a qualitative Ecologically Sustainable Design (ESD) assessment, including energy efficiency, for the proposed development at 2A Gregory Place, Harris Park.

This assessment is submitted to the Department of Planning, Industry and Environment (DPIE) in support of a State Significant Development Application (SSDA-31179510) for a Concept proposal for an affordable housing and build-to-rent development comprising of approximately 483 dwellings within three free standing four to eight storey buildings.

The ESD has been prepared in accordance with the following State Significant Development – Secretary's Environmental Assessment Requirements (SEARs):

- Identify how ESD principles (as defined in section 193 of the EP&A Regulation) are incorporated in the design and ongoing operation of the development.
- Demonstrate how the development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.
- Demonstrate how the development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.

The proposed development is located near mass transit (rail and strategic bus corridors). Parramatta Station which services multiple train lines is within 850m walking distance of the proposed development. The proposed development will encourage occupants and users of the development to use public transportation and minimise automobile use.

Overall, positive Ecologically Sustainable Design (ESD) and energy efficiency features are currently in place in several design areas, incorporating the following:

- The proposed development will incorporate passive and active energy saving measures such as operable windows to enhance natural ventilation through serviced apartments, where appropriate;
    - 65.1% of the proposed residential units will be naturally cross ventilated.
- The form dictated by the site has been designed to maximise the solar access of residential units;
    - 70.7% of the living rooms and private open spaces of the proposed apartments will receive a minimum of 2 hours direct sunlight between 8.30 am and 3.30 pm at mid-winter.
- Incorporation of thermal mass.
    - Concrete slab construction is proposed for all floors throughout the development - concrete has amongst the highest thermal mass capacity of a range of common building products. External walls, structural internal walls and slabs of the proposed development should be predominantly high thermal mass materials.

It is recommended that with the inclusion of the below systems the development will exceed the Water and Basix Energy requirements for Climate Zone 56:

- LED energy efficient lighting for all residential units;

EXECUTIVE SUMMARY

- Heat pump hot water for residential apartments;
- Efficient individual reverse cycle 1-phase air-conditioning system (zoned) of 4-star energy rating for all apartments.
- The installation of a solar PV system;
    - A 500 kW PV solar system is recommended to significantly minimises greenhouse gas emission reflecting the goal to achieve net zero emissions.
    - A 500 kW PV solar system will offset approximately 693.5 MWh/year of energy usage.
    - The estimated greenhouse gas CO2 emission saving is approximately 586,670 kgCO2/annum
- Minimum 4.5-star energy efficient refrigerators;
- All residential shower heads are 4-Star (>4.5 but ≤6 Litres per minute);
- All residential toilet flushing systems are 4-star;
- All residential Kitchen taps are 6-star;
- All residential bathroom's taps are 6-star;
- Dishwashers and clothes washers to have a minimum 2.5-star water efficiency rating; and
- Provision of 20,000 L rainwater tank for irrigation;

The following recommendations have been made to improve upon the existing key sustainability elements of the proposed development:

- Water efficient bathroom and kitchen fittings;
    - All common area toilet flushing systems are at least 4-star
    - All common area taps are at least 5-star
- Light efficiency measures in the carpark using motion sensors;
- Low levels of volatile organic compounds (VOC) paints and floor coverings and low formaldehyde wood products where possible; and
- Car spaces for small or low emission cars.
- The provision of bicycle storage spaces within the development, although not a requirement of BASIX, will ensure the development become a more sustainable development in a holistic sense. Bicycle parking is provided at rates meeting the requirements of Parramatta DCP 2011;
- Landscaped areas are within the residential development throughout the designated communal areas. Proposed planting provides added cooling during the summer months through the leaf transpiration process and is also useful for wind amelioration;
- Plant species within the development would be predominantly indigenous species that can tolerate low water to reduce maintenance requirements;

Recommendations regarding the mechanical ventilation system, domestic hot water, other appliances, operational waste, etc, have also been made within the body of the report.

EXECUTIVE SUMMARY

These features will help to achieve significant reductions in the energy and water required by the development both in building and operation, as well as ensuring that the residential units are more pleasant spaces to reside.

It is recommended that ESD initiatives continue to be developed and implemented throughout the course of the project.

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

1 Introduction

SLR Consulting Pty Ltd (SLR) has been engaged by 2A Gregory Place Pty Ltd to provide a qualitative Ecologically Sustainable Design (ESD) assessment, including energy efficiency, for the proposed mixed-use development at 2A Gregory Place, Harris Park.

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The initiatives suggested throughout this report have been included as opportunities for the project team to adopt ESD initiatives that provide both a direct and indirect benefit to the proposed development.

1.1 Objectives

The principal objective of this Sustainability Management Plan is to identify all potential energy savings that may be realised during the operational phase of the Project, including a description of likely energy consumption levels and options for alternative energy sources such as solar power in accordance with the SEARs requirements.

The specific objectives of this plan are as follows:

- To encourage energy use minimisation through the implementation of energy efficiency measures.
- To promote improved environmental outcomes through energy management.
- To ensure the appropriate management of high energy consumption aspects of the Project.
- To identify energy savings procedures for overall cost reduction, greenhouse gas emission reduction and effective energy management.
- To assist in ensuring that any environmental impacts during the operational life of the development comply with development consent conditions and other relevant regulatory authorities.
- To ensure the long term sustainability of resource use through more efficient and cost effective energy use practices for the life of the development.

1.3 Site Description

The development site is situated at Gregory Place, Harris Park which is within the City of Parramatta Council. The proposed development is 8 storeys residential development including communal open space with residential apartments above. Parking is to be provided at basement 1, 2 and 3. It is bounded by mixed urban development. The site location and surrounds are shown in **Figure 1** below.

Figure 1 Proposed Development Site Location

1.4 Proposed Development Description

SSDA seeks approval for the following mixed-use development:

- Demolition of all existing buildings and structures on the site, site preparation works, excavation and tree removal;
- The construction of a mixed-use development comprising:
  - 483 apartments across (3) buildings "A", "B", "C", between 4-8 storeys in height;
  - 13,210 m^2 of publicly accessible open space on the ground level including a 1530m^2 park, 7737 m^2 of courtyards, passages and accessways, and through site walkways between the buildings and from Gregory place to Parkes Street.
  - There will be roof terraces and green roof links between or above all buildings, with a total of 3133m^2 landscaped area above ground level.

Representative Plans of the Proposed Development

A. Site Plan

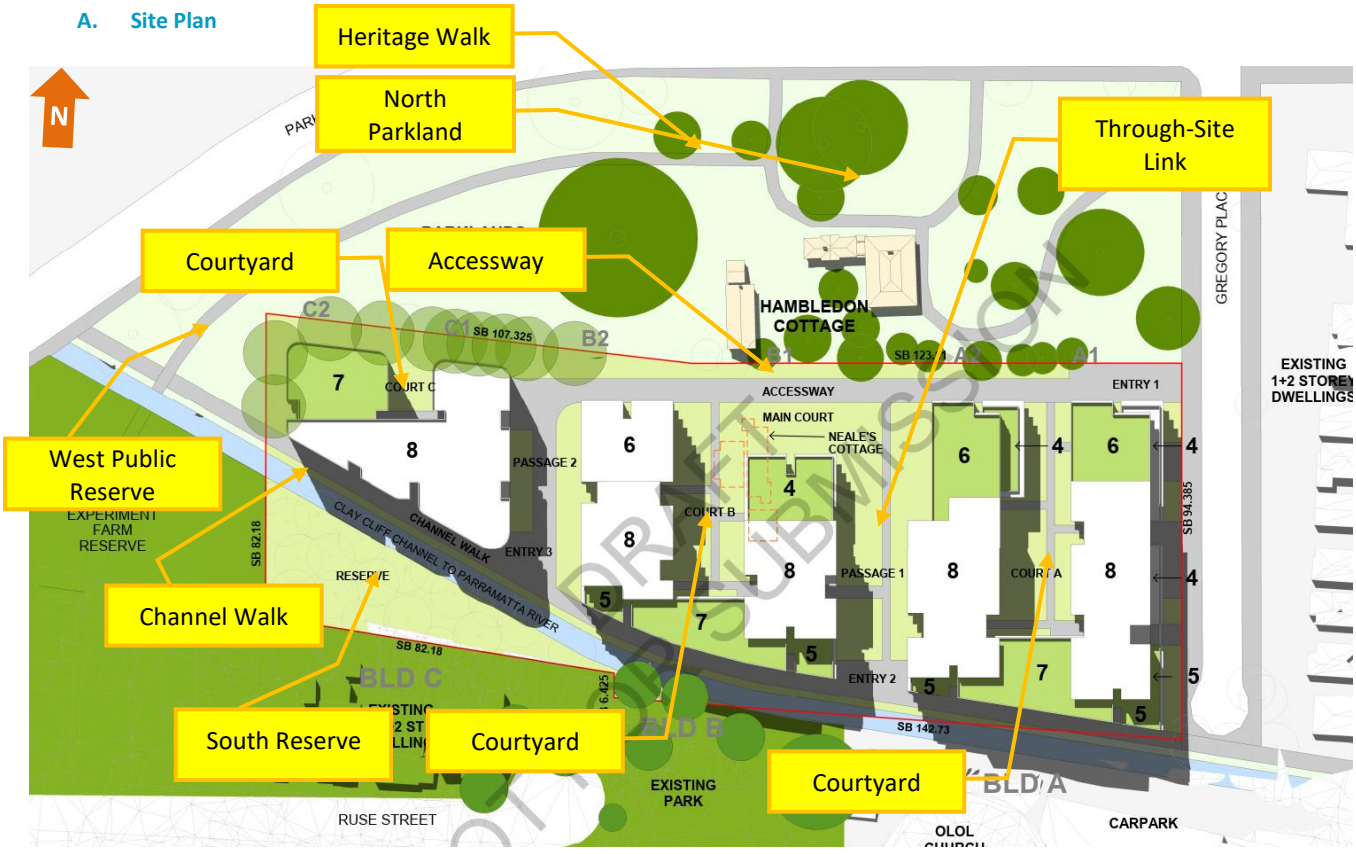


Figure 2 Typical Residential Level

2 Ecologically Sustainable Design

2.1 Definition of Key Concepts

2.1.1 Ecologically Sustainable Development (ESD)

The concept of Ecologically Sustainable Development (ESD) was outlined in "Our Common Future", the report of the 1987 United Nations World Commission on the Environment and Development (the Brundtland Commission). It defined Sustainable Development as

"Development that meets the needs of the present
without compromising the ability of future generation to meet their own needs".

This concept was adopted within Australia in 1990 when the Council of Australian Governments endorsed a National Strategy for Ecologically Sustainable Development. The Commonwealth Government suggested the following definition for ESD in Australia:

"Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased".

Put more simply, ESD is development which aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations. To do this, it is necessary to develop ways of using those environmental resources which form the basis of our economy in a way which maintains and, where possible, improves their range, variety and quality.

The National Strategy for Ecologically Sustainable Development notes that there is no identifiable point where it can be said that ESD has been achieved. The strategy further states that there are two main features which distinguish an ecologically sustainable approach to development:

- We need to consider, in an integrated way, the wider economic, social and environmental implications of our decisions and actions for Australia, the international community and the biosphere; and
- We need to take a long-term rather than short-term view when taking those decisions and actions.

Ultimately ESD should lead to changes in our patterns of resource use, including improvements in the quality of our air, land and water, and in the development of new, environmentally friendly products and processes.

2.1.2 National Strategy for ESD Objectives and Guiding Principles

The National Strategy for ESD sets its core objectives as:

- To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations.
- To provide for equity within and between generations.
- To protect biological diversity and maintain essential ecological processes and life-support systems.

The Guiding Principles of the National Strategy for ESD are documented as:

- Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations.
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The global dimension of environmental impacts of actions and policies should be recognised and considered.
- The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.
- The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.
- Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.
- Decisions and actions should provide for broad community involvement on issues which affect them.

These guiding principles and core objectives need to be considered as a package. No objective or principle should predominate over the others. A balanced approach is required that considers all these objectives and principles to pursue the goal of ESD.

2.2 Specific Requirements for Compliance

Specifications for environmental design measures required for the proposed site are detailed in the following documents:

2.2.1 Mandatory ESD Measures for Consideration

- BASIX Certification for the Residential Component.
- The State Environmental Planning Policy (SEPP) 65 supported by the Apartment Design Guide.
- Part 3 - Parramatta Council Development Control Plan 2011.

2.2.2 Voluntary ESD Measures for Consideration

- Green Star Multi-Residential Rating Tool

The City of Parramatta have produced a sustainable design principal, energy efficiency and water conservation document, which covers ESD topics like energy efficiency, passive solar design, thermal mass, water conservation, etc. The document discusses important aspects of building design where there is the potential to increase the energy efficiency of a development during the Concept Design stages of a project by ecologically sustainable means. Note that many of the DCP topics are also addressed by BASIX and the NCC Section J.

3 ESD Initiatives for the Proposed Development

In order to achieve a structured integrated approach to ESD, a series of indicators and strategic goals have been identified at the outset to be communicated to the design team. SLR Consulting's role, as the project's ESD consultant, has been to apply these principles to all aspects of the development ensuring a best possible ESD outcome.

ESD indicators identified for the proposed Concept Plan are:

- Site Layout and Building Design in terms of ESD;
- Energy efficiency;
- Water conservation;
- Transportation;
- Management practices;
- Indoor environment quality;
- Materials;
- Land use and Ecology; and
- Emissions.

The ESD initiatives to be committed for the proposed development will be outlined in the following sections below.

4 Passive Energy Efficiency

Passive energy efficiency refers to the choice of building materials, the placement of external facades and fenestration to effectively utilise solar energy for heating when required, and minimise solar gains when appropriate, thus 'passively' reducing the artificial heating and cooling requirements of the building. While high cooling and heating loads are typical in summer and winter months respectively, a good balance of heating and cooling load reduction techniques is required to produce a development with efficient passive design.

4.1 Site Analysis and Layout

A key ESD objective should be to optimise site conditions and minimise energy consumed for cooling and heating loads through proper selection of building orientation and internal layout. The following points are noted with respect to the sitting of the proposed development.

- As opposed to new developments on the outer fringes of the city which require significant investment in new roads, sewerage, lighting, power, etc, the proposed development site will have immediate access to all of these at very little additional regional infrastructure investment;
- The proposed development provides a large number of units with access to daylighting;
- The proposed development provides good design to promote natural ventilation;
- The proposed development provides a relatively large landscaped area and communal open space, with several smaller communal landscaped spaces also integrated into the proposed development;

4.1.1 Solar Access – Residential Apartments

One of the objectives of energy conservation is to minimise the heating and cooling requirements of buildings. Sunlight should preferably be able to penetrate the building in winter and be excluded from the building in summer. The form dictated by the site has been designed to maximise the solar access of residential units by:

- Maximising solar exposure of every residential apartment. The height and units' layouts will allow excellent solar exposure from north, east and west directions to the majority of the apartments throughout the day, year-round.
- Ensuring that primary facade glazing is attached to all "living zone" rooms for all apartments (i.e. living room, bedrooms etc). With proper attention to design details (e.g. glazing seals), these rooms can act as highly efficient solar collectors especially during winter months.
- Incorporating deep balconies to the east and west to reduce summer thermal loads on the residential units.

The State Environmental Planning Policy (SEPP) 65 supported by the Apartment Design Guide - Part 04 is relevant to the assessment of the daylight access into residential components of the developments in question. The above guide states that:

- Living rooms and private open spaces of at least 70% of apartments in a building receive a minimum of 2 hours direct sunlight between 9 am and 3 pm at mid-winter in the Sydney Metropolitan Area and in the Newcastle and Wollongong local government areas.
- In all other areas, living rooms and private open spaces of at least 70% of the apartments in a building receive a minimum of 3 hours direct sunlight between 9 am and 3 pm at mid-winter.
- A maximum of 15% of apartments in a building receive no direct sunlight between 9 am and 3 pm at mid-winter.

Stanisic Architects has assessed solar access to the site between 8.30 am and 3.30 pm on the winter solstice. The following conclusions have been reached from the solar access study:

- 70.7% of the living rooms and private open spaces of the proposed apartments will receive a minimum of 2 hours direct sunlight between 8.30 am and 3.30 pm at mid-winter. The increase time period is due to the buildings facing directly north and to provide flexibility in design at the detailed design stage.

4.2 Natural Ventilation

In relation to key characteristics of the Sydney Region Wind Climate relevant to the wind impact assessment of the proposed development, we note that Sydney is affected by two primary wind seasons:

- Summer winds occur mainly from the northeast, southeast and south. While northeast winds are the more common prevailing wind direction (occurring typically as offshore land-sea breezes), southeast and south winds generally provide the strongest gusts during summer.
- Winter/Early spring winds occur mainly from the west and the south west quadrant winds (southwest to northwest) provide the strongest winds during winter and in fact for the whole year.

Wind-induced natural ventilation works on the straightforward principle of differential pressure. If a building envelope has multiple openings and there exists a pressure difference between those openings, e.g. the wind pressure at one opening is greater than the pressure at the other openings; airflow will be pushed through the building in the direction positive to negative.

The resulting amount of airflow through the building envelope will be a function of the magnitude of the pressure differential, size of the various building openings and degree of “blockage” in between.

4.2.1 Residential Apartments

The most important role of natural ventilation in the context of the residential apartments is to remove accumulated heat gain during periods of overheating. In this case, ventilation is intended to achieve predicted rates of volumetric air change. Also important during the summer months is the role of ventilation in directly improving the perception of thermal comfort by occupants of a space. This is achieved when moving air aids the evaporation of perspiration by passing over the skin. If there is some air movement, most people will tolerate somewhat higher temperatures.

Heat build-up within apartments through daytime summer temperatures can be quickly purged with the availability of suitable breezes at the site.

The ADG encourages cross ventilation to be assisted by the building design. Building design should enable ventilation to be controlled, where comfort levels are maintained for the occupants during the summer and winter extremes. Locations of windows and openings within the apartment are to be suitably in line where possible with each other on opposite sides of the room. It is recommended that building openings be designed such that cross-ventilation is maximised, to minimise heat gain in summer.

Ventilation of building is achieved by permanent openings, windows, doors or other devices which have an aggregate opening or openable size of not less than 5% of the floor area of the ventilated room. The provision of ceiling fans for use in summer months is also encouraged.

In winter it is important to close off heated areas that need warming. The opportunity to open and close balcony doors will allow adequate control to moderate the impact of any higher than comfortable winds. It is recommended that the following initiatives also be incorporated to minimise heat leakage from the building:

- Design detailing of the glazing interface to the window framing system and the provision of adequate sealing in accordance with the Building Code of Australia (BCA).
- Doors leading to hallways, stairwells and non-common use areas provided with draught excluders to limit heat losses during winter months.
- Doors located throughout the development in general-use areas, such as access ways to/from the building, fitted with door closers where it is deemed that their opening will have an adverse effect on heat loss during winter.

ADG specifies the following rules of thumb:

- At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed.
- Building depth, which support natural ventilation typically range from 10 to 18 meters.
- Developments, which seek to vary from the minimum standards, must demonstrate how natural ventilation can be satisfactorily achieved, particularly in relation to habitable rooms.

Stanisic Architects has conducted a ventilation study of the proposed Plan to confirm that the site complies with relevant ADG requirements. The following conclusions have been reached from the Ventilation Study:

- 65.1% of the proposed residential units will be naturally cross ventilated across the first nine stories of the development.

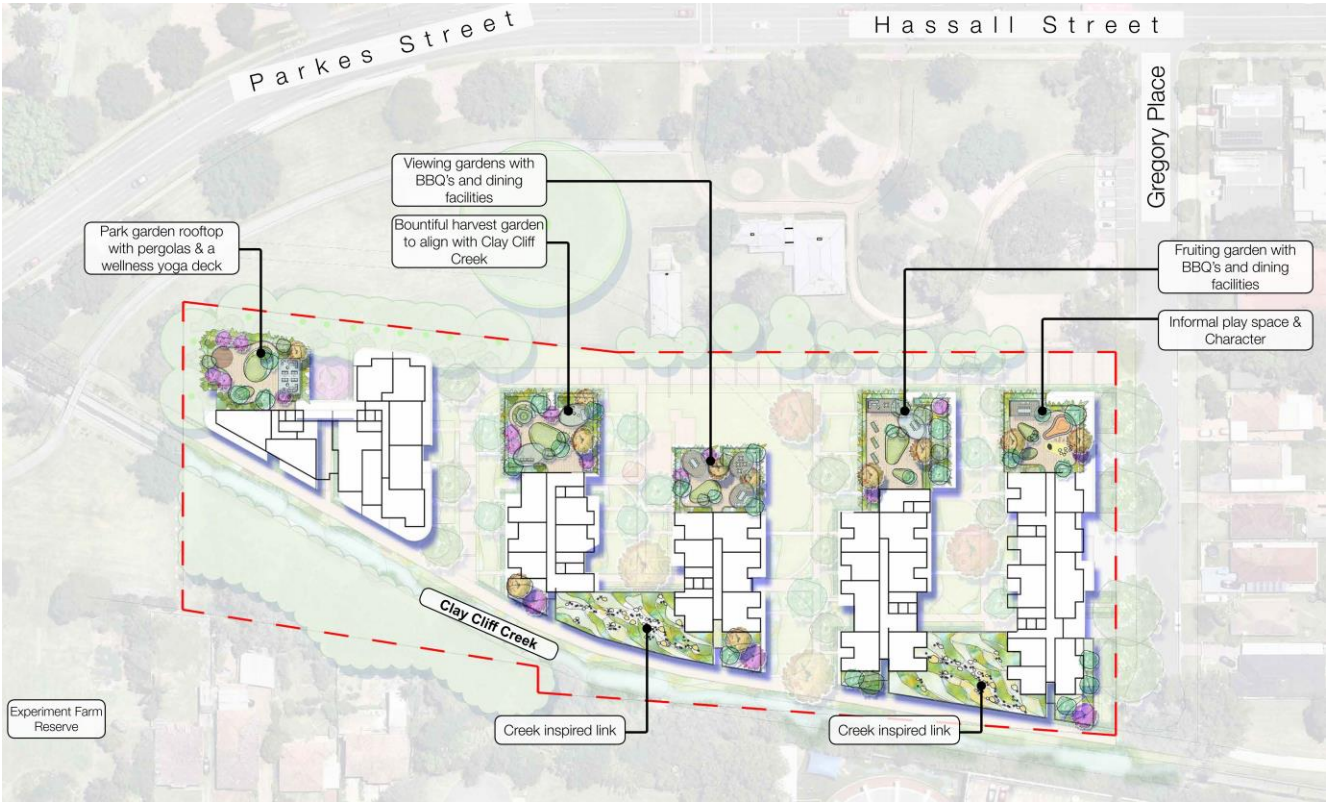
4.3 Landscaping

The following points are noted with respect to the landscaping of the proposed development:

- The proposed landscape plan (refer **Figure 3** – **Figure 6**) shows trees around perimeters as well as throughout the centre communal open spaces on ground level, level 5, level 7 and level 8. The use of trees and perimeter planting for shading is very effective in reducing the reflection of heat and light onto the building from surrounding paved areas. Planting also provides added cooling during the summer months through the leaf transpiration process.
- Most of the trees provided to the perimeter of the site will be evergreen trees, providing year-round wind, heat and solar mitigation.
- There is a combined 16,343 m^2 of vegetation and garden with the below division:
    - 7,737 m^2 of Courtyards, passages and accessways
    - 943 m^2 of Heritage Walkway
    - 1,530 m^2 of Parkland
    - 3,133 m^2 of Landscaped roof areas.

Figure 3 Level 1 Landscaping

Figure 4 Elevated areas Landscaping



4.4 Building Construction

4.4.1 Building Massing

The proposed development will have a compact form requiring less heating and cooling than low-rise buildings that would tend to sprawl out over a site. Apartments will "share" heat with their adjacent neighbours and so gain and lose less heat to the external environment.

4.4.2 Building Materials

4.4.2.1 Walls

It is recommended the proposed buildings consists of either Cavity Brick or Hebel walls. Insulation for the external walls will be assessed in accordance with Basix.

It is recommended Intra-tenancy walls are to be lightweight plasterboard on stud construction or Hebel Power Panel with plasterboard with acoustic insulation where required. This is advantageous from a building life-cycle perspective, as it maximises the adaptive reuse potential when a building reaches the end of its intended use.

4.4.2.2 Roof

It is proposed to use concrete roof with plasterboard ceiling construction for all apartments throughout the building. It is recommended at least R2.5 bulk insulation of the roof and ceiling to reduce the heat gain/loss on the roof level.

4.4.2.3 Glazing

Performance Glazing such as single glaze low-E and double glazed low-E glazing is recommended, this will reduce the solar heat gain mostly on the western and eastern facades where low angle solar rays penetrate beneath shading devices.

The glazing requirements for the retail area will be addressed under the NCC section J report.

4.4.2.4 Floor and Thermal Mass

Concrete slab construction is to be used all floors throughout the development in accordance with Basix and NCC section J requirements. Concrete has amongst the highest thermal mass capacity of a range of common building products, as presented in **Table 1**.

Generally, more dense materials have higher mass which has the ability to store heat energy and then release it slowly to the room. This storage effectively smoothest out daily temperature variations within conditioned spaces, with corresponding reductions in both heating and cooling loads.

Table 1 Indicative Thermal Mass Values of Some Common Building and Reference Materials

Material	Thickness (mm)	Thermal Mass ($kJ/m^2.K$)
Dolerite (Rock / Stone)	200	433
10-31 Solid Brick	190	410
Concrete	100	221

Material	Thickness (mm)	Thermal Mass ($kJ/m^2.K$)
Concrete block	90	194
10.01 regular brick	90	151
Clay brick (3.5 kg solid + 0.5 kg mortar)	110	142
Aerated concrete block	100	50
Fibre cement sheet (compressed)	18	32
Wood flooring (hardwood)	19	25
Weatherboard (softwood)	15	16
Fibre cement sheet	6	8
Plasterboard	10	8
Glass	3	6
Expanded polystyrene (EPS-class SL)	50	1.8
Cork	6	1.6
Rockwool (batts)	50	1.5
Fibreglass (batts)	50	0.5
Air	50	0.5

4.4.3 Building Sealing

The purpose of this subsection is to ensure that additional heating and cooling loads will not be introduced through building leakage.

A seal to restrict air infiltration must be fitted to each edge of an external door, operable external window or the like when serving a conditioned space in the proposed residential development. The seal may be a foam or rubber compressible strip, fibrous seal or the like.

The bathroom/toilet and laundry exhaust fans in the proposed development must be fitted with a sealing device such as a self-closing damper or the like.

5 Active Energy Efficiency

Active energy efficiency is achieved by putting in place energy efficient electrical items such as air-conditions systems, artificial lighting to reduce the energy usage of the building.

5.1 Rating System

5.1.1 Residential Component

In NSW, all new residential development proposals are required to achieve a 'PASS' in the Thermal Comfort component of the BASIX rating scheme. When the areas of the apartments are input into BASIX, the maximum heating and cooling loads for the apartment and the overall development will be calculated. Each individual apartment and the overall development are to achieve annual heating and cooling loads of NatHERS climate zone 56 not more than the stated maximum load figures:

- Maximum annual heating load of 45.4 MJ/m^2
- Maximum annual cooling load of 29.5 MJ/m^2

With the recommendations contained within this report we expect the development to exceed the Basix Energy, Thermal Comfort and Water requirements.

5.2 Mechanical Ventilation and Air Conditioning

Where mechanical ventilation is required, the use of energy efficiency measures will be fully explored during detailed design. These measures include linking mechanical ventilation to manual switching where allowable under the NCC and using individual fans rather than a common ducted ventilation system with constant operation. These initiatives will provide significant savings in energy use and associated operational energy costs of the development.

SLR Consulting recommends using minimum 4-star energy efficient Single-phase air conditioning systems for both heating and cooling air conditioning units should be installed to residential apartment.

5.3 Domestic Hot Water

The sole use of electricity as the energy source for conventional electric water heaters is inefficient because electricity is a secondary source, deriving its energy after burning coal. As coal-based systems require expensive handling equipment and specialised pollution control systems, electric solar boosted water systems are used in this development.

In this project, central electric heat pump hot water systems are recommended for water heating within the proposed development.

5.4 Green Power Initiative

It is recommended that a certain percentage (approximately 10%) of "Greenpower" should be made available to residents, providing the opportunity 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 the owner, 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.

The National Greenpower website[1] states that "Australian households generate almost one-fifth of Australia's greenhouse pollution through everyday activities such as transport and household energy use". The average household in Australia emits over seven to eight tonnes of greenhouse pollution each year through energy use alone. This is because most households source their electricity from burning coal and other fossil fuels. By choosing accredited Greenpower, up to 100% of a household's energy usage can be generated from renewable sources.

5.5 Lighting

5.5.1 Natural Lighting

The proposed development maximises the north, east and west facing walls and will be implementing glazing areas to the residential apartment to allow plenty of natural daylight access and therefore minimising the use of artificial lighting.

5.5.2 Artificial Lighting

Household lighting energy use in Australia is increasing due to the construction of larger homes and the installation of more light fittings per home. It is estimated that most homes could readily reduce the amount of energy they use for lighting by 50% or more.

Lighting installations require a design that properly considers the conservation of scarce energy resources. Sustainable lighting design ensures that illuminance is not excessive, that the switching arrangements are such that unnecessary illumination may be turned off and that the illumination is provided in an efficient manner.

There are additional energy losses associated with inefficient lamps and lighting losses associated with luminaries. Consequently, a lighting design which uses the more efficient lamp types and the least number of luminaries for a given design illuminance will be more efficient and usually have a lower capital cost.

It is likely that the lighting to be used within the development will incorporate led lamps and compact fluorescents. It is recommended that the following lighting features be incorporated into the development to minimise energy consumption due to lighting:

- Maximise use of compact fluorescents or LED and minimise or where possible eliminate the use of halogen down lights, as compact fluorescents are much more efficient than halogen lighting.
- Light switches to be located at room exits to encourage switching lights off when leaving a room. Separate switches to be installed for special purpose lighting.
- Artificial lighting to the carpark and common hallways will be controlled by daylight sensors and time clocks, to minimise unnecessary use of artificial lighting.

[1] http://www.greenpower.gov.au

LED lamps are the most energy efficient form of lighting for residential developments. Fluorescent lamps are also very energy efficient form of lighting for hotels. They work by causing a phosphor coating in the inside of a glass tube to glow. Different types of phosphor give different colour light. Although more expensive to buy compared to incandescent bulbs, they are much cheaper to run and can last up to ten thousand hours. With careful design they can replace incandescent and halogen lights in most situations. Fluorescent lamps use only about one quarter of the energy used by incandescent bulbs to provide the same light level. Compact fluorescent lighting connected to daylight and motion sensors are recommended to the common hallways.

SLR recommends a maximum average lighting power density of 10 W/m^2 for the proposed development.

5.6 Appliances

SLR recommends the below measures for energy performance in appliances could include:

- 4-star energy efficient dishwashers;
- 4.5-star energy efficient refrigerators.
- 2.5-star cloth washer;
- 2.5-star energy efficient clothes dryer;

6 Water

Australians use more than one million litres of freshwater per person each year (source: Green Building Council of Australia 2006).

In addition to increased water use efficiency, new developments can reduce potable water demand by residents, tenants and visitors through the provision of an on-site alternative water supply. There are three principle forms of alternative water supply:

- Reticulation of reclaimed water to the site
- Rainwater/storm water storage and reuse
- Grey water storage and reuse.

The above water supply systems can be used for landscape irrigation and fire services, reducing the demand on potable water supply.

6.1 Water Efficiency

The minimum sustainable standard for water efficient water fixtures and fittings is 3A. To achieve greater than the standard level, outlined installation of water efficient fixtures and fittings such as is recommended for the proposed site:

- All residential shower heads are 4-Star (>4.5 but ≤6 Litres per minute)
- All residential toilet flushing systems are 4-star
- All residential Kitchen taps are 6-star
- All residential bathroom's taps are 6-star
- Dishwashers and clothes washers to have a minimum 2.5-star water efficiency rating
- All common area toilet flushing systems are at least 4-star;
- All common area taps are at least 5-star.

Implementation of the above recommendations will assist in reducing the water consumption.

6.2 Landscape Irrigation

Under international best practice guidelines, it is generally recommended that either 90% of the water requirement for landscape irrigation is sourced from on-site rainwater collection or recycled water. Alternatively, best practice would also be achieved with the installation of a water efficient irrigation system comprising subsoil drip systems and automatic timers with rainwater or soil moisture sensor control override.

The landscape design should focus on using native coastal and other drought resistant species that rely primarily on rainwater for their water needs. The following is recommended to be incorporated into the development to minimise water consumption for landscape irrigation.

- Rainwater tanks of 20,000 L for irrigation;
- Native coastal and other drought resistant species that rely primarily on rainwater for their water needs where appropriate and possible;

- Indigenous species are currently proposed to comprise over 30% of the provided landscaping.

7 Transport

When designing a sustainable development, it is important to minimise the use of individual motorised transport where possible and thus enhance energy savings and environmental impact through reduced fossil fuel consumption and improved regional air quality. This can be achieved by encouraging the use of energy efficient public transport that is immediately at hand, reducing car parking facilities, and providing adequate bike storage facilities to minimise the requirement for individual motorised transport. The development includes many walkways and connections between the development and the surrounding parks and streets as shown in **Figure 5** and **Figure 6**. The development and walkways have been integrated into the surrounding areas to create further public areas and walkways around significant public spaces as shown in **Figure 8**. A green travel plan has been included in the submission to outline the sustainable transport strategies the developer is implementing in the design and management of the building which includes strategies to reduce the number of single-occupancy car trips and promote alternative options such as walking and cycling for shorter trips and public transport or carpooling for longer trips.

Figure 5 Open Space and Connections

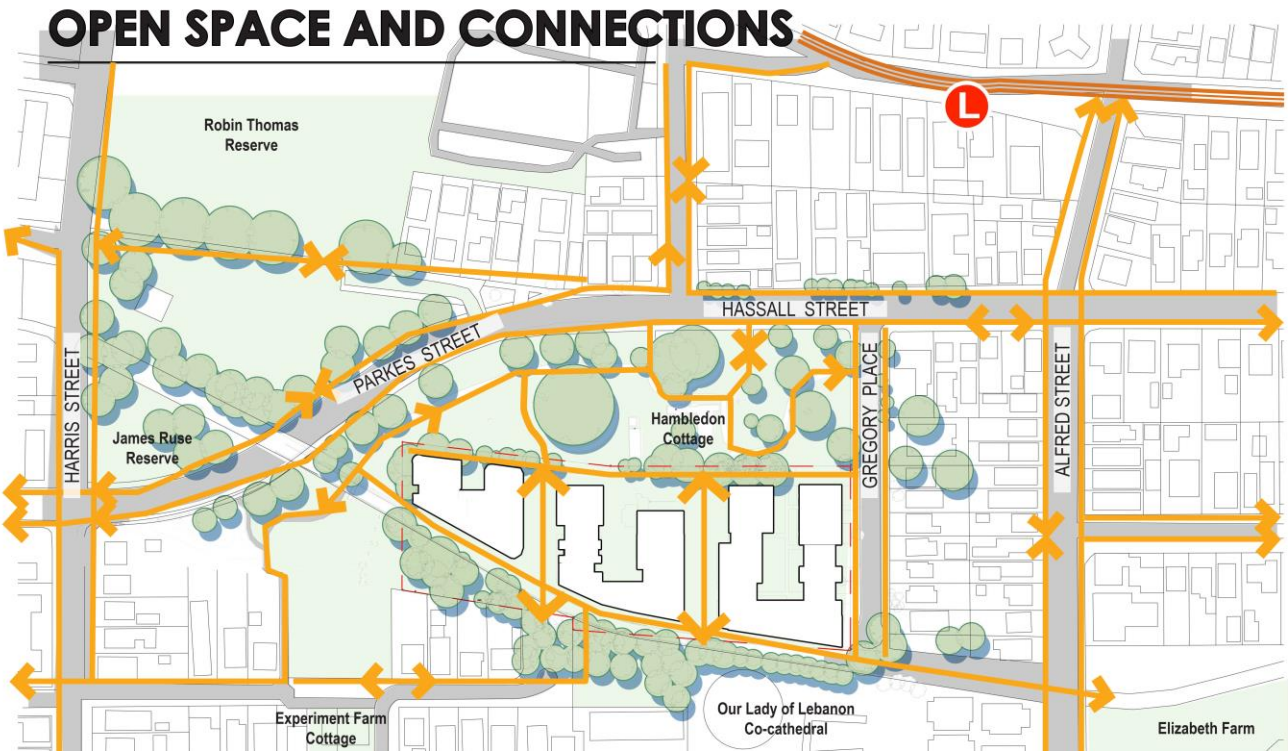
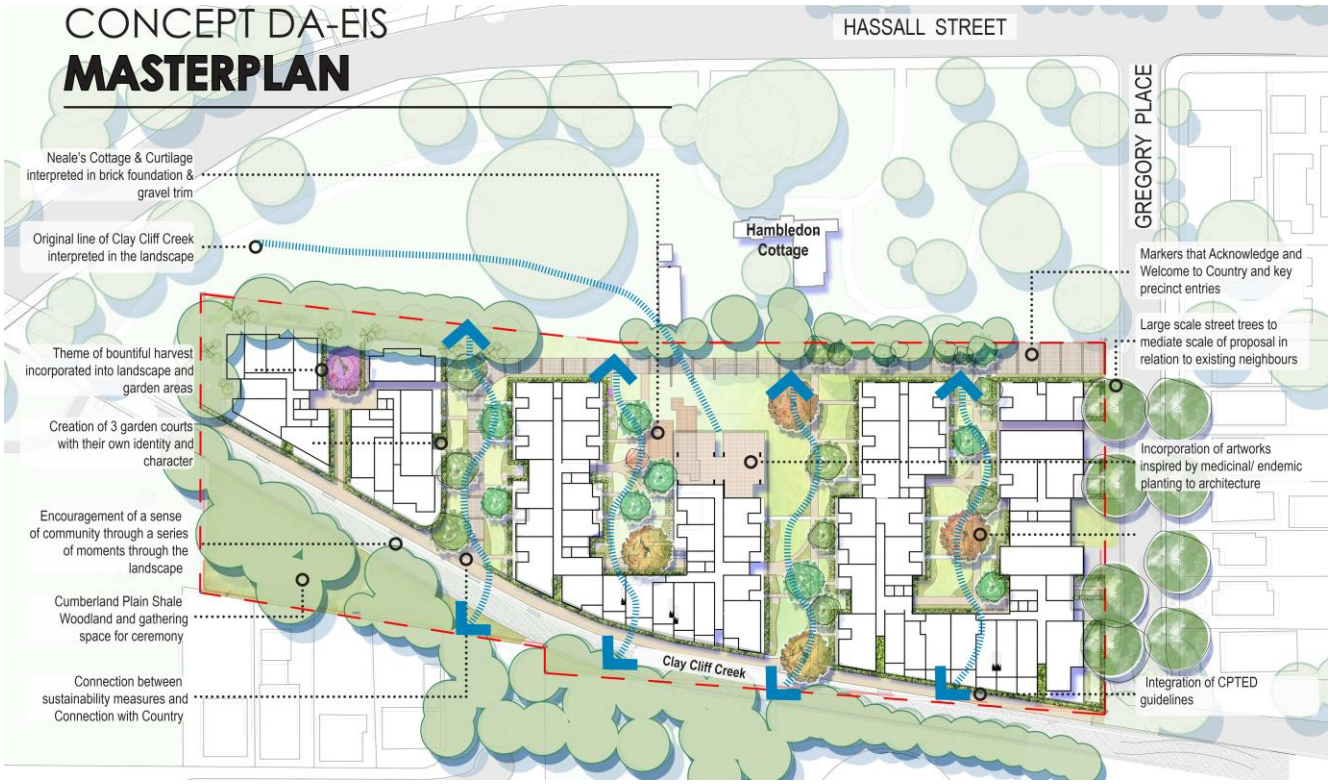


Figure 6 Concept Masterplan



7.1 Provision of Car Parking

Transport emissions are one of the largest contributors of greenhouse gas emissions in Australia. The Green Building Council of Australia (GBCA) encourages the utilisation of alternative and mass transit forms of transport by limiting the availability of private vehicle spaces. Credits are awarded under the GBCA rating tools for car parking at least 25% less than the maximum residential planning allowance.

SLR consulting recommends providing car spaces for low emission or alternative fuel vehicles such as electrical cars.

7.2 Facilitation of Pedestrian and Non-Motorised Transport

When designing a sustainable development, it is important to minimise the use of individual motorised transport where possible and thus enhance energy savings and reduce environmental impact through reduced fossil fuel consumption and improved regional air quality. This can be achieved by encouraging all users of the development to make use of the energy efficient public transport that is immediately at hand.

Bike storage facilities should be installed in the proposed development, which will also help to minimise the requirement for individual motorised transport.

Sufficient recreational opportunities are easily accessible to occupants, eliminating the requirement for long-distance motorised transport for most recreational activities. This would be a positive feature of the development with regards to sustainability as this clearly avoids greenhouse gas emissions that would otherwise have been produced if residents had to travel long distances for recreational activities.

Storage spaces and Bicycle parking for the development are to be provided at rates meeting the requirements of Parramatta DCP 2011.

The provision of bicycle storage spaces within the development, although not a requirement of BASIX, will ensure the development become a more sustainable development in a holistic sense.

7.3 Commuting Using Public Transport

Developments that are within close proximity of good transport nodes with frequent service should be encouraged. The proposed building is located near mass transit and will allow more people to take public transportation to keep their automobiles off the road.

The proposed development is located near mass transit (rail and strategic bus corridors). Parramatta Station which services multiple train lines is within 850m walking distance of the proposed development. The proposed development is also located within the walking catchment to Parramatta Station. The proposed development will encourage occupants and users of the development to use public transportation and minimise automobile use.

The proposed location will allow more people to take public transportation to keep their automobiles off the road.

8 Management

Building management helps to reduce greenhouse gas emissions and energy consumption through adequate commissioning and user guides. It is also to reduce environmental impact during construction activities. The Management category is discussed in the Green Building Council of Australia Multi-Residential Tool V1 which encourages the following practices. Note that the green Star rating tool is not mandatory, and the following initiatives suggested have been included as opportunities for the Project Team to adopt ESD initiatives during the project:

- Having at least one ESD Professional on the design team;
- Improving building services performance and energy efficiency by incorporating comprehensive pre-commissioning, commissioning, and quality monitoring into a project;
- Building tuning period of 12 months. This ensures that the time and cost of building tuning is accounted for during the design phase. A 12-month building tuning period also incorporates quarterly reviews and a final recommissioning;
- Appointing an independent commissioning agent from design to handover to provide advice to the client and design team and to monitor and verify the commissioning of HVAC and building control systems;
- Providing Building User's and Resident user Guides to provide information on the design features and ensure that they are used efficiently; and
- Providing a comprehensive Environmental Management Plan (EMP) for the works in accordance with Section 4 of the NSW Environmental Management System Guidelines (1998).

SLR Consulting recommend incorporating the above initiatives where appropriate and possible.

9 Indoor Environment Air Quality

Achieving enhanced Indoor Environment Quality (IEQ) ensures that the building and building services are designed and managed to benefit the health and well-being of building occupants and visitors.

9.1 Asbestos

It is recommended that Asbestos identification and removal procedures be included in the site Environmental Management Plan (EMP) where required.

9.2 Internal Noise Levels

Internal noise levels are a significant factor in determining occupant and customer satisfaction and well-being. The aim of controlling internal noise levels is to encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level. SLR Consulting recommends that all future development in the proposed site meet the recommended criteria and measures provided in accordance with the relevant NCC requirements.

9.3 Carbon Dioxide Monitoring and Control

Elevated carbon dioxide (CO_2) levels are indicative of inadequate ventilation, affecting the quality of air within an enclosed occupied space, and the health of the occupants. CO_2 monitoring systems can detect elevated concentrations of CO_2 and automatically adjust ventilation supply rates before indoor air quality becomes problematic.

SLR Consulting recommends incorporating a CO_2 monitoring system where appropriate to satisfy NCC requirements.

9.4 Paints and Floor Coverings

SLR recommends the use of low levels of volatile organic compounds (VOC) paints and floor coverings and low formaldehyde wood products where possible as per the City of Parramatta DCP 2011 requirements.

10 Operational Waste Management

An operational Waste and Recycling Management Plan is a minimum requirement to meet sustainable building design best practice. The Waste and Recycling Management Plan includes:

- Separate waste and recycling streams;
- Transfer of material to common storage area;
- Communal storage areas;
- Frequency of collection; and
- Signage and educational initiatives for occupants.

A Waste Management Plan is recommended to track all waste going offsite to show that 90% of all construction waste is re-used or recycled.

The proposed development will implement a waste management system that complies with the City of Parramatta's requirement.

11 Renewable Energy Options for the Proposed Development

As the worldwide demand for fuel increases, alternative and renewable energy sources are emerging as economical and sustainable options. Alternative renewable energy sources are becoming more attractive options because of increased global demand for fuels, environmental responsibility, affordability and new local, state and federal government legislations.

The following renewable energy options are available for the Site:

- Solar Energy

11.1 Multi-Residential PV Solar Green Initiatives

SLR has assessed the potential for the installation of a Photo Voltaic (PV) Solar Power System for the Site. It has been determined that more than 500 kW system can be installed on the roofs of the proposed development.

- A 500 kW PV solar system will offset approximately 693.5 MWh/year of energy usage.
- The estimated greenhouse gas CO2 emission saving is approximately 586,670 kgCO2/annum

12 Conclusion

SLR Consulting Pty Ltd (SLR) has been engaged by 2A Gregory Place Pty Ltd to provide a qualitative Ecologically Sustainable Design (ESD) assessment, including energy efficiency, for the proposed development at 2A Gregory Place, Harris Park.

This assessment is submitted to the Department of Planning, Industry and Environment (DPIE) in support of a State Significant Development Application (SSDA-31179510) for a Concept proposal for an affordable housing and build-to-rent development comprising of approximately 483 dwellings within three free standing four to eight storey buildings.

The ESD has been prepared in accordance with the following State Significant Development – Secretary's Environmental Assessment Requirements (SEARs):

- Identify how ESD principles (as defined in section 193 of the EP&A Regulation) are incorporated in the design and ongoing operation of the development.
- Demonstrate how the development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.
- Demonstrate how the development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.

The proposed development is located near mass transit (rail and strategic bus corridors). Parramatta Station which services multiple train lines is within 850m walking distance of the proposed development. The proposed development will encourage occupants and users of the development to use public transportation and minimise automobile use.

Overall, positive Ecologically Sustainable Design (ESD) and energy efficiency features are currently in place in several design areas, incorporating the following:

- The proposed development will incorporate passive and active energy saving measures such as operable windows to enhance natural ventilation through serviced apartments, where appropriate;
    - 65.1% of the proposed residential units will be naturally cross ventilated.
- The form dictated by the site has been designed to maximise the solar access of residential units;
    - 70.7% of the living rooms and private open spaces of the proposed apartments will receive a minimum of 2 hours direct sunlight between 8.30 am and 3.30 pm at mid-winter.
- Incorporation of thermal mass.
    - Concrete slab construction is proposed for all floors throughout the development - concrete has amongst the highest thermal mass capacity of a range of common building products. External walls, structural internal walls and slabs of the proposed development should be predominantly high thermal mass materials.

It is recommended that with the inclusion of the below systems the development will exceed the Water and Basix Energy requirements for Climate Zone 56:

- LED energy efficient lighting for all residential units;
- Heat pump hot water for residential apartments;

- Efficient individual reverse cycle 1-phase air-conditioning system (zoned) of 4-star energy rating for all apartments.
- The installation of a solar PV system;
    - A 500 kW PV solar system is recommended to significantly minimises greenhouse gas emission reflecting the goal to achieve net zero emissions.
    - A 500 kW PV solar system will offset approximately 693.5 MWh/year of energy usage.
    - The estimated greenhouse gas CO2 emission saving is approximately 586,670 kgCO2/annum
- Minimum 4.5-star energy efficient refrigerators;
- All residential shower heads are 4-Star (>4.5 but ≤6 Litres per minute);
- All residential toilet flushing systems are 4-star;
- All residential Kitchen taps are 6-star;
- All residential bathroom's taps are 6-star;
- Dishwashers and clothes washers to have a minimum 2.5-star water efficiency rating; and
- Provision of 20,000 L rainwater tank for irrigation;

The following recommendations have been made to improve upon the existing key sustainability elements of the proposed development:

- Water efficient bathroom and kitchen fittings;
    - All common area toilet flushing systems are at least 4-star
    - All common area taps are at least 5-star
- Light efficiency measures in the carpark using motion sensors;
- Low levels of volatile organic compounds (VOC) paints and floor coverings and low formaldehyde wood products where possible; and
- Car spaces for small or low emission cars.
- The provision of bicycle storage spaces within the development, although not a requirement of BASIX, will ensure the development become a more sustainable development in a holistic sense. Bicycle parking is provided at rates meeting the requirements of Parramatta DCP 2011;
- Landscaped areas are within the residential development throughout the designated communal areas. Proposed planting provides added cooling during the summer months through the leaf transpiration process and is also useful for wind amelioration;
- Plant species within the development would be predominantly indigenous species that can tolerate low water to reduce maintenance requirements;

Recommendations regarding the mechanical ventilation system, domestic hot water, other appliances, operational waste, etc, have also been made within the body of the report.

These features will help to achieve significant reductions in the energy and water required by the development both in building and operation, as well as ensuring that the residential units are more pleasant spaces to reside.

It is recommended that ESD initiatives continue to be developed and implemented throughout the course of the project.

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