The University of Sydney

AIN – PHYSICS BUILDING

ESD REPORT – Part 4 Submission

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1 Executive Summary

This report has been prepared by Steensen Varming for the University of Sydney (UoS) Australian Institute of Nanoscience (AIN) – Physics Building at Development Application Stage. The purpose of this report is to demonstrate that the proposed design for the AIN Physics Building addresses the Director General's Requirements (DGR) in regards to Ecological Sustainability.

The AIN facility is proposed to be located within the Camperdown Campus behind the existing Physics building (A28). The AIN facility is expected to be a high-class science facility within the University campus comprising of specialist laboratories, teaching and learning spaces, offices, and other support spaces.

This report will form part of the Part 4 submission for the proposed Australian Institute of AIN Physics Building (Application number: SSD 5087-2011 Date: 01.02.2012).

2 Director General Requirements

The Director General Requirements (DGRs) for SSD 5087-2011 Date: 01.02.2012, consist of the following requirements for Ecologically Sustainable Design (ESD).

DGR Requirement	ESD Design Response
Item 1 *Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design, construction and ongoing operation phases of the development.*	*The ESD strategies described in sections (3.1 – 3.8) of this report provide details on how this DGR has been addressed in the proposed design.* *The Environmental Impact Statement, prepared by University of Sydney provides further details in response to this DGR.*
Demonstrate the targets and commitments of ESD.	*Described in Section 4.1 of this report.*
In relation to ESD principles, demonstrate how the following will be incorporated into the detailed design of the building:	
Item 2 *(A) The Green Building Council Australia, Green Star – Education v1 rating tool should be used as a minimum on the planning of the development.*	*A project-specific sustainability framework has been developed for the AIN facility, to provide ESD guidance to the design team.* *The relevant content of the Green Star Education V1 tool has been included in the Sustainability Framework. Refer to Appendix A for an example credit and structure of the framework.* *Refer to Section 4 for more details.*
Item 3 *(B) If co-generation, greywater recycling, stormwater or rainwater harvesting is proposed, the requirements of any required licences from the Office of Environment and Heritage (OEH) and/or I-PART should be addressed.*	• *Co-generation and grey water recycling are not included in the proposed design for the AIN Physics Building.* • *Rainwater Harvesting is included in the proposed design. Hydraulic services Consultant ARUP have confirmed that there are no requirements for licences associated with rainwater harvesting/re-use.* *We have reviewed the licensing requirements stated in the "Guide to Licensing", provided under the Protection of the Environment Operations Act 1997 (POEO Act). The scheduled activities proposed for AIN are not listed in this guide. In our opinion, the proposed development does not require and licence under the POEO Act.*
Item 4 *(C) If co-generation is proposed, details in relation to air quality.*	*Provision for future connection of a district tri-generation system is currently being investigated by the University of Sydney. A campus-wide shared system might be implemented in future.*
Item 5 *(D) If rainwater re-use if proposed, provide details on the proposed end uses and consideration of any associated health risks. The requirements of any licensing requirements under section 68 licences under the Local Government Act 1993 should be addressed.*	*Rainwater Harvesting is proposed for the AIN Physics Building. The Hydraulics Services Consultants ARUP have confirmed that rainwater collection and re-use is planned for the development with a single end use of cooling tower make-up supply. The re-use system will consist of filtration and chemical disinfection/pH correction prior to entering the cooling tower circuit in accordance with AS.3500 and manufacturers guidelines. No health risks are associated with this. No licences are associated with this. Section 68 licences under the Local Government Act 1993 does not reference rainwater re-use.*
Item 6 (E) *City of Sydney Council's Sustainable Sydney 2030 plan.*	*The UoS Sustainability Framework was developed on the basis of a number of external drivers, which included the Sustainability Sydney 2030 plan.* *Refer to Section 4.1 for more details regarding the University of Sydney Sustainability Framework.*

3 Item 1Response

The following sections of this report (3.1 – 3.8) are in response to DGR Item 1. The following sections provide details of how the key ESD initiatives are incorporated in the proposed AIN building. The ESD initiatives detailed in this report present the decisions and outcomes from meetings and workshops with the design team.

3.1 Basis of Design

The ESD initiatives demonstrate the environmental aspirations of the University, and align with the core functional requirements and the projects budget. The design team recognises that the University aspires to achieve environmental, social, and economic sustainability in the design of the proposed AIN building, via best practice measures in green building and low energy technology.

The AIN is considered to be a high-class science facility within the University campus, with research laboratories comprising specialist functional and environmental requirements.

Due to the nature of the research activities to be conducted in the AIN building, certain spaces require stringent environmental control. Energy and water demands might be comparatively high (as compared to a typical educational building). The higher demand is due to close control air conditioning, tight air filtration, pressurisation regimes and energy intensive equipment.

Managing the energy loads of these environmentally sensitive spaces through passive design is limited, due to their high sensitivity. The attention has been focused towards energy efficient mechanical systems and air distribution strategies for the laboratory spaces. Developing an equipment procurement guide has also been suggested to the University, as it will ensure purchase of high-efficiency equipment with lower energy consumption (i.e. equipment that can operate in standby/low energy mode).

Other spaces such as the offices and student hub will not require the same environmental control as required in the laboratories. Opportunities to integrate passive strategies such as daylight harvesting and mixed mode ventilation have been considered and detailed in this report. Mixed mode ventilation and daylight harvesting contributes to energy reductions and provides better indoor environment quality.

The passive strategies that have been incorporated in the proposed design will result in:
- Reduced carbon emissions and environmental impact
- Improved Indoor Environmental Quality
- Reduced operating costs
- Reduced consumption of potable water
- Cost effectiveness over life cycles
- Efficient material usage
- Waste Reduction

3.2 Environmental Strategy

The design philosophy is to incorporate both appropriate and sensible initiatives for the project that align with and support the functional and operational requirements for a highly serviced laboratory building of this nature.

In order to reduce the energy load, the Architectural design has incorporated passive design measures where appropriate to minimise energy consumption associated with air conditioning, lighting etc. Due to the specialised nature and core functional requirements of the building some passive design opportunities relating, primarily to physiological issues and reducing energy consumption, have been identified as not appropriate.

The ESD initiatives considered appropriate for the project are based on international best practice benchmarks and guidelines. A key priority for the building is to implement sound energy saving initiatives. With respect to the energy component, our design intent has been to adopt the Energy Hierarchy methodology.

3.3 Energy Hierarchy

The “energy hierarchy” links closely to the proposed key ESD initiatives and defines an integrated approach to the management of energy demand and supply. The energy hierarchy has reduction of energy use as its first priority, and then seeks to meet the remaining energy demand by means of renewable or other harmless means.

The following energy hierarchy has been adopted.

STEP 1 Minimise with high efficiency envelope

STEP 2 System Efficiencies

STEP 3 On site generation

STEP 4 Reduce by offsets

STEP 5 Additional building or network features

Figure: Energy Hierarchy Approach

3.4 Key Environmental Sustainable Design Opportunities

Key ESD strategies that have been incorporated in the proposed design are indicated in the diagram below. Secondary to these is a suite of initiatives captured by the project specific sustainability framework.

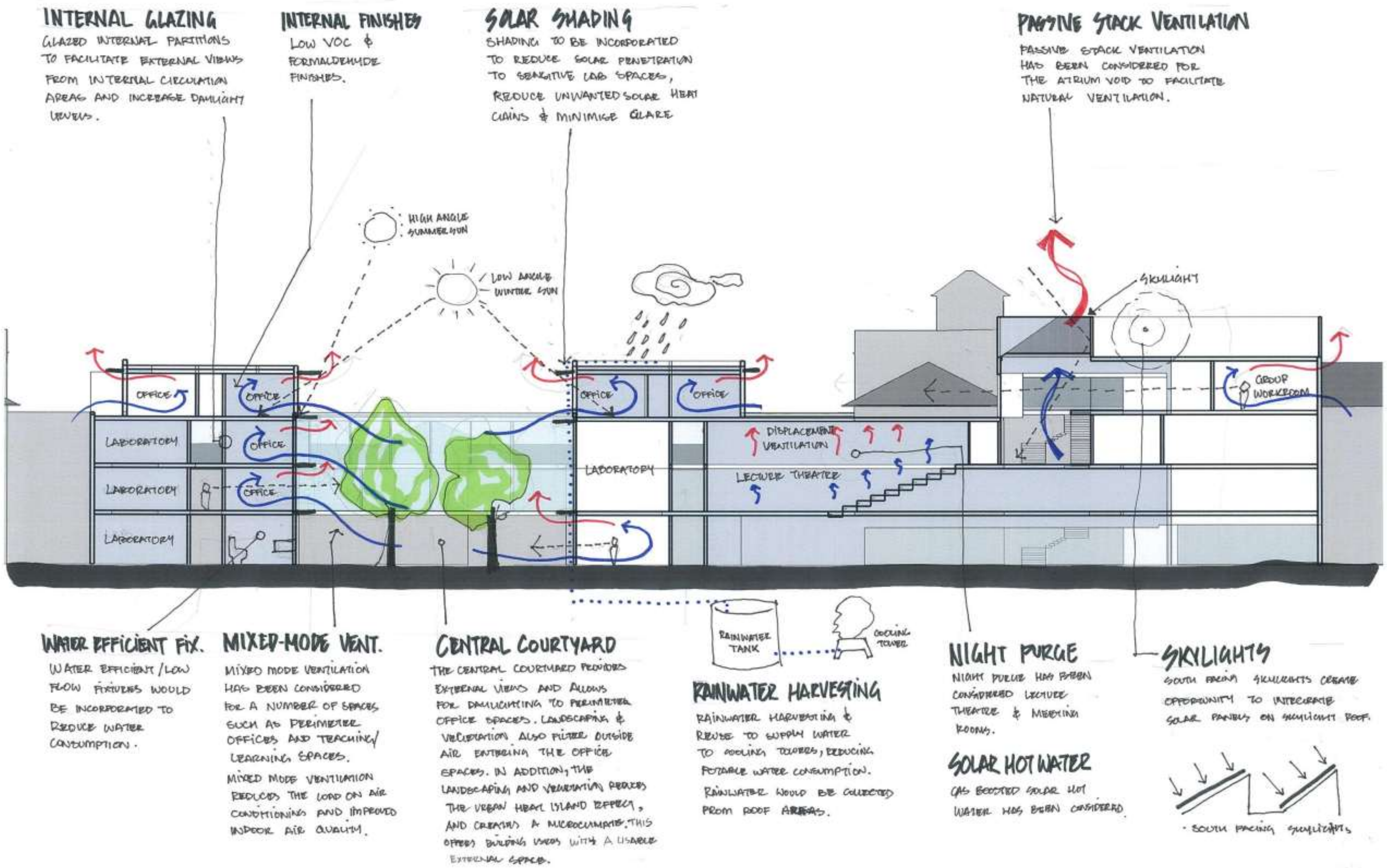

Figure: Section illustrating key Environmental Sustainable Design strategies.

3.5 Passive Design Initiatives

The following passive design initiatives detailed below responds Item 1 of the DGR.

3.5.1 Daylight Harvesting

Daylight has a major impact on the internal built environment including energy efficiency, increased human performance, workplace productivity, human health and financial return on investment.

Psychologically, daylight and views are much desired. The use of daylight will have a positive influence on the occupants' experience. Having daylight entering a space provides a connection to the outside and is important for giving a context in time and space. This perceptual contact and the dynamic properties of natural light is a key factor of comfort in terms of physiology and psychology.

Though electric light sources have been constructed to closely match the spectrum of daylight, they cannot mimic the variation in light spectrum that occurs with daylight at different times, in different seasons and under different weather conditions.

For the proposed AIN Building, daylight would be the prime source of perimeter lighting during daylit hours. Daylighting methods such as courtyards, skylights and internal voids have been incorporated into the building to harvest usable daylight to interior areas of the building.

The perimeter offices bounding the external courtyard provide daylight and external views for the building occupants. Solar shading would need to be considered for certain orientations to reduce the unwanted solar heat gains and reduce glare.

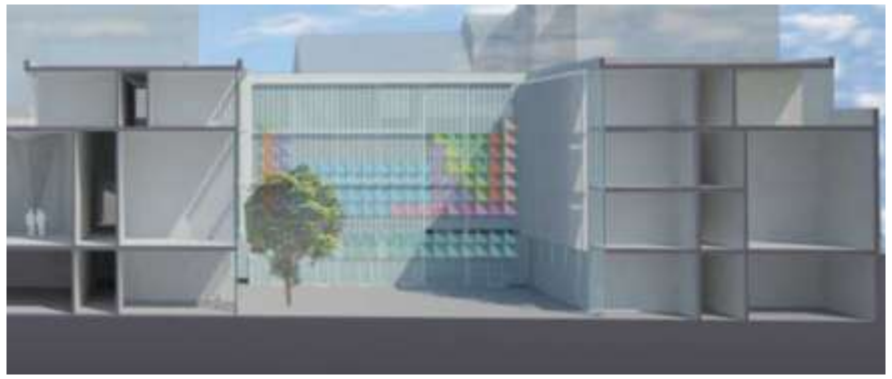

Figure: Perimeter offices bounding the central courtyard. Internal walls/partitions/doors are being considered to facilitate views to the exterior and increase daylight levels to core areas.

Glazed walls/ panels and doors are have also been incorporated in suitable areas, to facilitate views to the outside from the office and circulation areas and increase daylight levels in circulation spaces.

The skylights located above the student hub are arranged with southerly orientation to redirect and diffuse sunlight to the spaces below. High level glazing surrounding the atrium provides daylight and external views to the roof garden for adjoining spaces. The south orientation of the skylights also creates a desirable area to incorporate photovoltaics due to the northern orientation of the skylight roof.

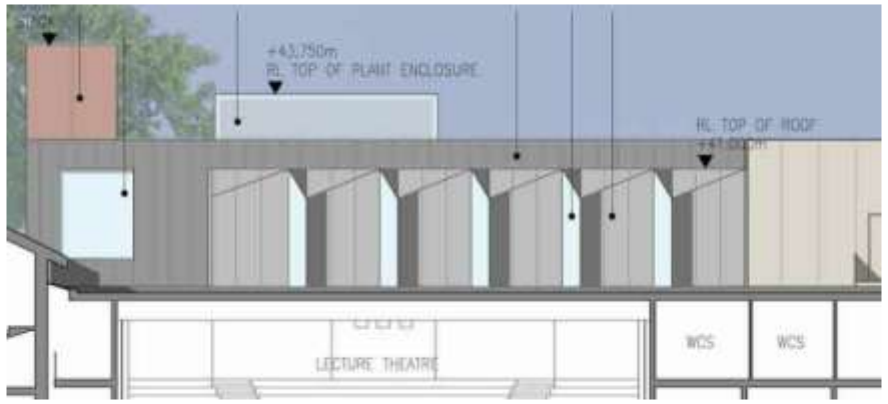

Figure: South facing skylights would harvest diffused daylight.

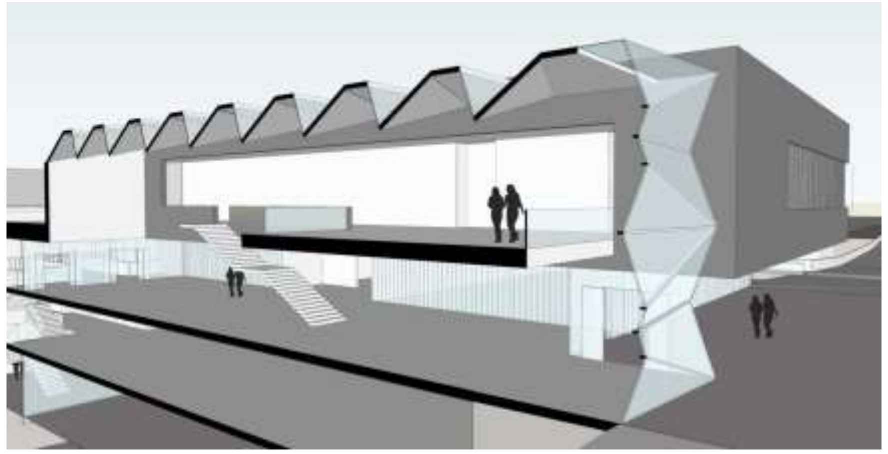

Figure: Skylights and high level external glazing to allow for daylight harvesting and facilitate external views.

Additionally, artificial lighting will be integrated with daylighting to ensure best quality space by artificial lighting supplementing day lighting when required.

Spaces which require a high level of environmental control and are sensitive to daylight (e.g.: TEM Suite) are positioned away from the voids. Shading would also be incorporated to protect direct sun penetration into daylight sensitive laboratory spaces.

3.5.2 Mixed Mode Ventilation

While most of the laboratory spaces in the AIN Physics Building will require close control air conditioning, it has been considered during the concept design, to incorporate mixed mode ventilation for a number of spaces such as offices and circulation spaces. The building floor plate width and atrium void offer obvious opportunities to integrate mixed mode ventilation to reduce demands on air conditioning systems to appropriate areas.

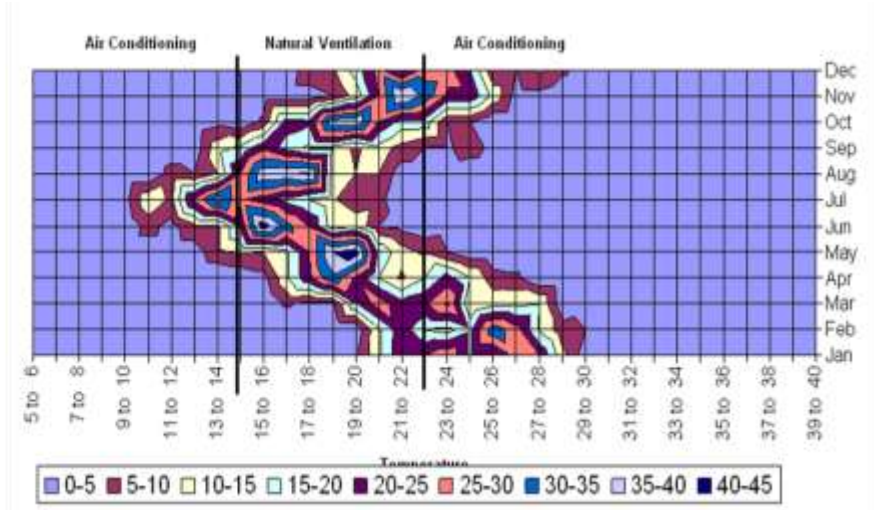

Figure: Temperature Frequency identifying Suitable Natural Ventilation Band

When the ambient temperature is between 15°C and 23°C and ambient humidity below 60%, these are desired parameters for natural ventilation. During these conditions, the windows on the facade will modulate to open position and the air-conditioning is turned-off.

Where ambient conditions are higher or lower than the desired indoor conditions the openings will modulate to the closed position and the building will operate in full air conditioning mode.

By incorporating a mixed-mode system, the building can be "naturally" ventilated effectively removing the building air conditioning load.

Mixed-mode ventilation system has the following benefits and limitations:

Benefits	Limitations
• Reduced energy consumption • Greater provision of outside air • Performance varies with climate • Improved productivity • Connection to outside • Coupled with night purge and thermal mass for improved performance	• Cost • Not suitable for all building / space types • Attention to control and interface with air conditioning system's • High level of user education required • Difficult to achieve in CBD areas (It is possible in buildings with Double Skin Façade) • Local climate – noise, pollution, dust, insect control

The mixed mode approach is considered appropriate for the offices, medium seminar rooms, circulation and breakout spaces, group work rooms and student hub. The mixed mode system will facilitate natural ventilation for certain periods of the year, thereby reducing reliance on air conditioning and leading to savings in energy consumption. This strategy has been developed by ARUP.

The perimeter office configuration provides the offices with an external face to facilitate natural ventilation. Drawing outside air from landscaped areas such as the central courtyard and roof garden would also improve the indoor air quality as plants and vegetation naturally filter air. It is expected that natural ventilation can be used up to 40% of time throughout the year.

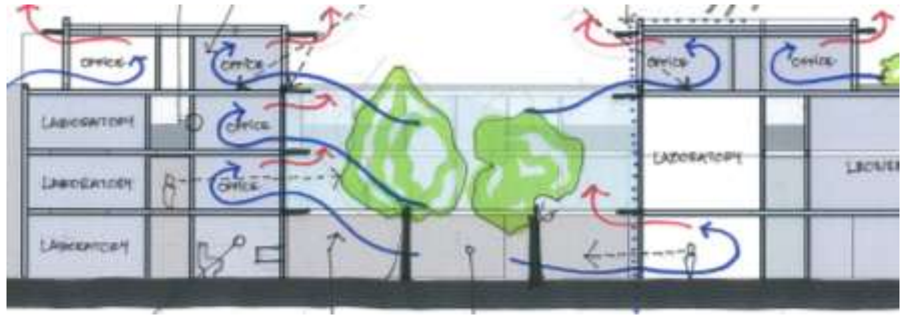

Figure: Mixed mode ventilation has been considered for the perimeter office spaces.

The proposed AIN building also consists of a strategically placed void adjacent the teaching spaces and student hub. The void allows warm stratified air to rise up and be relieved through high level roof openings. With this approach, natural ventilation can be provided without reliance on external wind forces. Thus even during still periods or with slight wind, natural ventilation can be effectively maintained, resulting in improved thermal comfort through better natural ventilation performance.

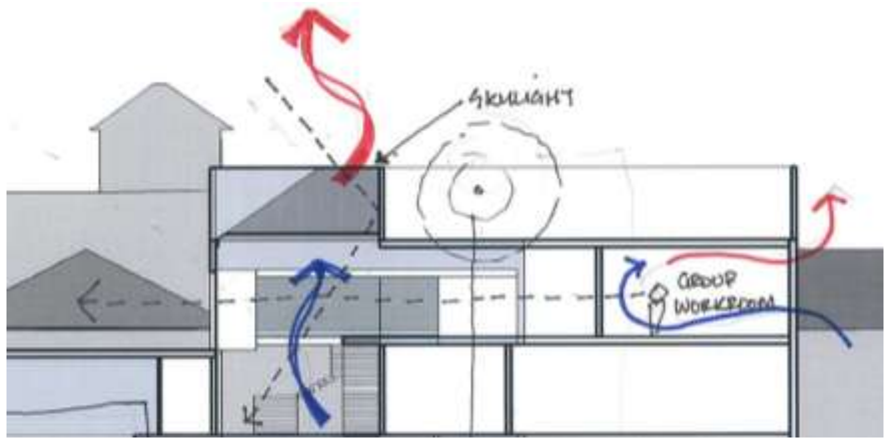

Figure: Passive stack ventilation has been considered for the atrium void adjacent the student hub and teaching/learning areas.

The details of this strategy have been developed further by Architectus and ARUP. The design team has reviewed the operation and maintenance aspects of this system, before taking the final decision.

3.5.3 Night Purge

Night purge can be suitably implemented in institutional buildings which are occupied mostly during the day. During the day, heat is stored in the exposed structure (thermal mass) of the building. Night purging helps to dissipate this heat to the outside.

During the evening, the ventilation openings within the facade modulate to open position to let in cool outside air. The cool outside air enters the office areas, to flush out warm air and cools the building. This brings about substantial reduction in space conditioning loads when the plant starts in the morning.

At night, sensors close the windows when they detect unfavourable outside conditions (like high winds and rain or higher temperatures).

Night purge has been incorporated in several spaces in the AIN building such as the meeting rooms and lecture theatres. Automated openings in the façade are being considered, to facilitate cool night air to enter the building to purge residual heat gains accumulated during the day and recharge the exposed mass. The same openings can be used during the day when ambient temperatures are appropriate for natural ventilation purposes.

Additionally, night purge has also been incorporated for the office spaces. The office spaces are provided with automated openings that are secure and weather protected. The ceilings in these workspaces are of exposed concrete with a diluted silicate paint finish, which has the advantage of providing thermal mass.

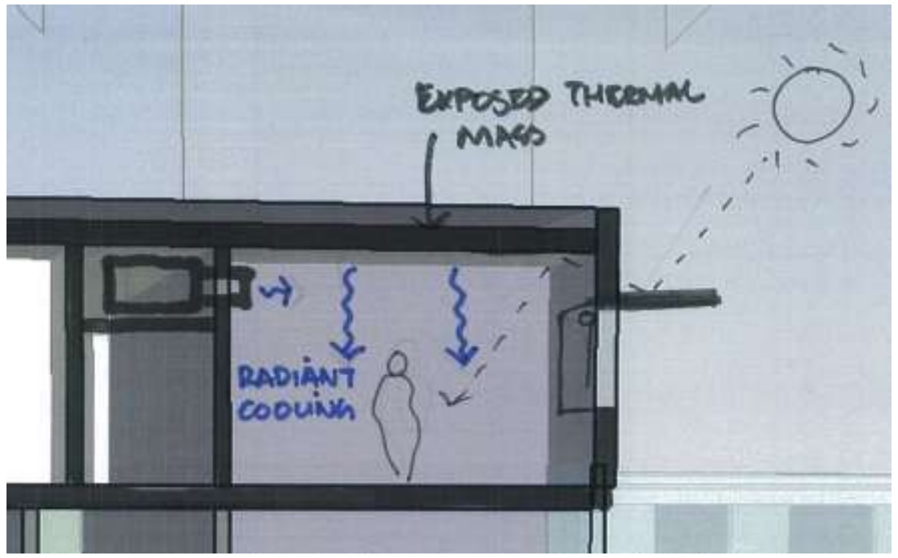

Figure: Night purge could also be incorporated into the office spaces.

3.6 Key Services Strategies

The following services strategies are currently being considered by the Mechanical, Electrical, and hydraulics services consultant. The proposed strategies aim to primarily reduce energy consumption, water consumption and improve indoor environment quality.

3.6.1 Mechanical Services

The following mechanical services strategies have been proposed by ARUP to reduce energy consumption associated with the mechanical services and to also improve indoor air quality for a number of spaces;

- *Variable speed drives on pumps and fans;*
- *"Aircuity" type lab air quality sensing for demand control to reduce laboratory airflow rates and hence fan power;*
- *Manifolded laboratory exhaust system to be considered;*
- *Variable flow fume hoods with auto sash closing;*
- *Optimising close-controlled laboratory and clean room air change rates with computational fluid dynamics (CFD) modelling;*
- *Right sizing laboratory plant based on actual equipment and process loads;*
- *Optimising laboratory exhaust airflow rates and associated make-up air conditioning energy;*
- *EC motor fan filter units for clean room re-circulation air, combined with a particle sensing system to reduce airflows wherever possible (including night setback);*
- *Low-pressure drop air distribution system for clean rooms;*
- *High efficiency water-cooled chillers;*
- *Dual temperature chilled water systems for space and process/sensible cooling;*
- *Cooling tower water-side free cooling to be considered;*
- *Mixed mode ventilation in office, meeting and teaching areas;*
- *Outside air economy cycle and night purge for meeting rooms, lecture theatres etc.;*
- *Air-side heat recovery (pre-conditioning of outside air) to be considered for teaching, lecture theatre and laboratory areas;*
- *Automatic shutdown of plant when spaces are unoccupied;*
- *"Smart" sub-metering of building electrical and lighting systems for energy monitoring;*
- *CO_2 and VOC monitoring and control of outside airflow rates in office, meeting and teaching areas;*
- *Low VOC paints, adhesives and sealantsZero ODP refrigerants and insulants;*
- *Refrigerant leak detection system;*
- *Low NO_X emissions from heating plant;*
- *PVC minimalisation.*

3.6.2 Electrical Services

The following electrical services strategies have been proposed by ARUP to reduce energy consumption associated with the electrical services.

- *Long life, low energy lighting to circulation, toilets and external accent lighting*
- *High frequency fluorescent luminaires with high efficiency T5 lamps or LEDs*
- *Fully programmable lighting control system to internal and external lighting*
- *Lighting control 'absence detection' as opposed to 'presence detection'*
- *Daylight dimming to atrium and perimeter lighting*
- *Energy management, monitoring and metering system at the sub distribution level*

3.6.3 Hydraulic Services

The following hydraulic services strategies are currently proposed by ARUP and primarily aim to reduce water consumption.

Conservation measures to be incorporated into the hydraulic services design include:

- *Reducing potable water consumption;*
  - *Reuse of fire test drain water,*
  - *Harvesting rain water for reuse,*
- *Reducing water usage in toilet amenities by providing:*
  - *Low flush WCs*
  - *Low flow urinals;*
- *Reducing water usage in basins, sinks, showers etc by utilising low flow tapware and outlets;*
- *Consideration of Gas boosted solar hot water system*
- *Consideration/review of the viability of using waste heat from chillers (24hr load) to preheat the domestic hot water in lieu of solar pre heat.*
- *Consideration of heatpump hot water units*
- *Maximising runs of flow return loops there-by reducing dead legs, thereby reducing water wasted while awaiting the arrival of hot water.*
- *Variable speed drives on pumps;*
- *Automatic shutdown of plant out of hours and during times of no ocupancy;*
- *"Smart" sub-metering of building;*
- *Low VOC paints, adhesives and sealantsZero ODP insulants;*
- *Low NO_X emissions from water heating plant;*
- *PVC minimisation.*

3.7 Sustainable Materials

3.7.1 General

Consideration has been given to materials having a low embodied energy content, high recycled content and/or highly recyclable.

Material selection is an important aspect of environmental design because building materials consume energy and natural resources during manufacture and transportation to site.

All materials have an associated embodied energy. Embodied energy is the energy consumed by all the processes associated with the making of a product, from the mining and processing of natural resources to manufacturing, transport and product delivery.

Materials with the low embodied energy intensities, such as concrete, bricks and timber, are usually consumed in large quantities. Materials with high energy content such as stainless steel are often used in much smaller amounts. As a result, the greatest amount of embodied energy in a building can be either from low embodied energy materials such as concrete, or high embodied energy materials such as steel.

For the proposed AIN Building, the design team intends to select the best combination of materials based on transportation distances, availability of materials and budget, balanced against known embodied energy content.

The following initiatives have been considered for the AIN building in terms of material selection;

- Use locally sourced materials in order to reduce transportation
- Select low embodied energy materials (which may include materials with a high recycled content)
- Select materials that can be re-used or recycled easily at the end of their lives using existing recycling systems
- Give preference to materials manufactured using renewable energy sources
- Use certified timber
- Use recycled content of concrete.
- Recycled content of steel
- PVC minimisation – The entire services infrastructure should consider alternative materials to PVC. This includes hydraulic, mechanical and electrical systems.
- Use recycled timber or Forest Stewardship Council FSC timber.

Structural integrity must take priority over recycled construction materials to ensure the building is structurally sound.

3.7.2 Materials and Indoor Environment Quality

Materials and finishes containing low VOC and low formaldehyde emissions will be given consideration to improve the indoor environment quality for building occupants and to reduce the health implication caused by VOC's and formaldehyde emissions.

3.7.3 Low VOC Materials

Certain materials emit volatile organic compounds (VOC) and formaldehyde emissions. If building users are exposed to high levels of these emissions; it would result in significant health implications. Low VOC material finishes have been specified for the AIN building, where appropriate, for minimal impact on the health of its occupants.

Volatile organic compounds (VOC) are carbon based compounds and can be found in a range of products. VOC readily evaporate at room temperature and generally have an odour to them.

Materials and finishes that generally contain VOC include:

- Paints.
- Adhesives and Sealants.
- Carpets.
- Reconstituted wood products.
- New furniture.
- Cleaning products.
- Printing materials.
- Office equipment.

3.7.4 Formaldehyde Emissions

Formaldehyde is generally found in water-based glues used to bond constituent parts of some particle boards and all fibreboards. Formaldehyde turns to a gas state at room temperature and can cause health issues such as irritant eyes, dermatitis and asthma. Low formaldehyde products have been specified by the architects.

The world health organisation has recommended a value of 0.1mg/m3 with a 30-minute averaging time (WHO 2000) as a guideline to prevent sensory irritation to the general public.

3.7.5 Waste

While waste cannot be eliminated, we can reduce its environmental impact by preventing waste wherever possible, and making more sustainable use of the waste that is produced. This is known as the "waste hierarchy": We should aim to reduce, re-use or recycle waste as the preferred options to waste disposal (eg landfill or incineration).

The proposed AIN building will incorporate a central waste storage area to handle the different waste streams generated by the building. The AIN building incorporates a variety of space types and it is expected that there by a number a waste types.

The University of Sydney has identified the following waste types that would need to be addressed for the AIN building:

- General waste.
- Confidential waste.
- Recyclable waste.
- Hazardous waste.
- Chemical waste.
- Compressed Gas cylinder waste.

It is anticipated a waste management plan will be developed by the University of Sydney to deal with the different waste types generated.

In addition to the above, during building construction phase, the following procedures should be considered by the University:

- Encourage recycling of construction and demolition materials and reduce the amount of waste being dispatched to landfill.
- Utilising standard material sizes building fabric and fitting.
- Minimise on-site pollution.

3.7.6 Transport

The proposed AIN building has incorporated design solutions that encourage pedestrian and cycle safety. The following transport initiatives have been considered:

- Pedestrian networks and entrances.
- Bicycle paths racks and enclosures.
- Wide well lit footpaths.
- Incorporating travel information points at entrances and exits.

3.7.7 Building User Guide/ Occupant Training

This "Building Users Guide" provides details of the sustainable features of the building, via simplified description of the building services and systems, in order to assist the occupants in maintaining the environmental performance of the building as envisaged by the design team.

The purpose of the Building User's Guide is to ensure the building occupants maintain the environmental performance as envisaged by the design team. The information in the guide is intended to advise the occupants of the operational procedures they must follow.

Relevant training should also be provided to staff and facility managers to ensure they use features of the building as intended.

4 Item 2 Response

This section of the report is in response to DGR Item 2.

4.1 University Of Sydney Sustainability Framework

The University of Sydney's Campus Infrastructure Services (CIS) have commissioned a Sustainability Framework, known as "Integrating sustainability into capital projects". The University's framework addresses environmental, economic and social sustainability. The aim of the framework is to create a method for managing, communicating and integrating sustainable development across all University projects.

The key objective of the University is to reduce its carbon footprint and to demonstrate its environmental leadership among Australian and international peer research universities. The University seeks to position the AIN-Physics building design and performance within the context of similar laboratory projects.

This framework is intended for use by the members of design teams (planners, architects, urban designers, engineers and construction professionals) who are involved in the projects commissioned by the University.

It has been designed for three distinct project levels, namely – Master plans, Precincts and Buildings. The Building level framework is applicable to the AIN – Physics Building.

The University's ESD Framework consists of the following eight themes:

1. Place making and amenity
2. Intellectual leadership
3. Communication, engagement and community benefit
4. Healthy environment
5. Resource use
6. Climate change impact and design
7. Infrastructure
8. Land use, landscape and biodiversity

Figure: The University of Sydney Sustainability Framework.

The Framework presents the desired environmental outcomes aspired by the University.

For the AIN project, this Framework has been further strengthened by including laboratory-specific initiatives from other rating tools (both local and international).

4.2 Project Specific Sustainability Framework

The University has stated that the preferred approach to sustainable design for the AIN building is through the development of a Project Specific Sustainability Framework, which incorporates the 'University of Sydney Sustainability Framework'. This is to ensure that the proposed AIN building aligns with the core sustainability aspirations of the University.

In addition to the 'University of Sydney Sustainability Framework', additional international environmental rating systems, namely, Green Star, BREEAM, Green Guide for Healthcare (GGHC) and Laboratories for the 21st century (Labs21) have been taken as guidance to set specific ESD benchmarks relevant to the AIN building. The Project Specific Sustainability Framework provides guidance in ESD performance initiatives for the design and construction and is not intended to verify environmental performance of the proposed AIN Building.

The following local and international environmental assessment tools have been analysed to identify the most appropriate ESD initiatives that could be adopted for the proposed AIN Building. Based on these rating tools, a "Project Specific Sustainability Framework" has been developed in order to guide the design process and help achieve a low energy and sustainable building against local and internationally acknowledged rating tool indices.

Figure: The Project Specific Sustainability Framework includes credits from local and international environmental assessment tools.

	Rating Tool	Country of Origin
1	Green Star Education	Australia
2	Green Star Healthcare	"
3	BREEAM Education	UK
4	BREEAM Healthcare	"
5	LEED New Construction	USA
6	Labs 21	"
7	Green Guide for Healthcare	"

A brief summary of each rating tool included in the "Project Specific Sustainability Framework" has been provided below. Refer to Appendix A for an example credit and structure of the Project Specific framework.

4.2.1 Green Star

Green Star is an environmental rating tool developed by the Green Building Council of Australia (GBCA) that has a holistic approach over a wide range of issues that address sustainability, from water to energy, materials to indoor environmental quality and also considers management practices. There are various Green Star rating tools developed to suit a range of different building types. (Office, Educational, Healthcare, Multi-unit residential etc.).

4.2.2BREEAM

Building Research Establishment Energy Assessment Method (BREEAM) is the UK environmental assessment system. "BREEAM International" is the scheme used to assess buildings located outside the UK. There are standard schemes under BREEAM to rate the following non-domestic building types: Office, Retail, Industrial, Educational and Healthcare. If a building outside the UK cannot be assessed under one of the BREEAM International standard schemes mentioned above it should be assessed using the BREEAM Bespoke International assessment scheme. BREEAM International schemes use local codes, regulations, environmental policies and guidelines.

Under the International Bespoke scheme a project-specific tool would be tailored by BRE to suit the specific functional requirements of the building types. Once the project is registered with BRE, under the guidance of a BREEAM International Assessor, BRE would devise the bespoke rating tool. A local environmental consultant should be employed by the assessor and design team to review the UK compliance requirements and source local alternatives which will be reviewed by the assessor against certain criteria BRE Global set. The CODCD development at the University of Sydney can be assessed under the BREEAM International Bespoke Scheme.

4.2.3LEED

Leadership in Energy and Environmental Design (LEED) rating system can be applied to assess the environmental performance of buildings located anywhere in the world. For countries where a country-specific LEED has been developed, the local codes and guidelines are used. But for countries which have their own Green Building Council's and a country-specific environmental assessment method, LEED credits would use American Standards along with imperial units. This might be a more difficult approach due to the complexity of conversions.

For the proposed CODCD development to be assessed under the LEED system, it would require the "Multiple Buildings and On-campus Building Projects" tool. (Under LEED New Construction and Major Renovations – LEED NC).

4.2.4Scope and Limitations of LEED & BREEAM

Both LEED and BREEAM systems can be used to assess buildings located anywhere in the world. But the client and the design team need to weigh the relevance of each of the schemes to the proposed development. Firstly, it has been noted that LEED gives higher importance to occupant comfort and health, while BREEAM tends to be more focussed on environmental impacts. Secondly, the building regulations in UK are tougher than in US, so BREEAM might seem to be more difficult, but BREEAM Bespoke for international schemes uses local Codes, regulations, environmental policies and guidelines to be more specific to the project location. Under LEED system American Standards need to be used along with Imperial units. This would result in a complex approach to establish compliance.

4.2.5Labs 21 Network

The Labs21 Environmental Performance Criteria (Labs21 EPC) is a rating system to assess the environmental performance of laboratory facilities. Labs21 EPC is the result of two complementary efforts: First is the LEED Green Building Rating System and second is the Laboratories for the 21st century program (Labs21). As compared to LEED system, the Labs21 EPC contains additional credits specific to laboratories.

Labs21 is dedicated to the pursuit of sustainable, high performance, and low-energy laboratories that will:

- Minimize overall environmental impacts.
- Protect occupant safety.
- Optimize whole building efficiency on a life-cycle basis.
- Establish goals, track performance, and share results for continuous improvement.

To demonstrate their commitment to this philosophy, Labs21 Partners commit to the following:

- Adopt voluntary goals.
- Assess opportunities from a "whole buildings" approach.
- Use life-cycle cost analysis as an important decision-making tool.
- Incorporate a comprehensive, whole building commissioning process into new construction and retrofit projects.
- Employ a range of energy and water efficiency strategies.
- Measure energy and water consumption and track emission reductions.
- Evaluate on-site power generation, combined heat and power technologies, and renewable power purchases.
- Build with "green" construction materials.
- Promote energy and water efficiency efforts.
- Expand beyond the laboratory building.

5 Appendix – A

The diagram bellow illustrates the structure of Building Sustainability Framework.

Theme (Place Making and Amenity)

Sub-theme

Place Making & Amenity

1.1	Site design	Cost Impact	Targeted	Implemented (Y/N)	Source	Key Goal	Project Phase	Delivery Risk	Responsibility	Design Response	Design Deliverables	Spatial Applicability High/Medium/Low			
												Laboratories	Worksapces	Teaching and Learning Facilities	Support Spaces
1.1.1	**Orientation** Orient the building to utilise site conditions to optimise the passive design features of its footprint and activate the surrounding public realm.				USYD Framework	Environmental	Design	Low	Architectus	**Date:** **Comments:**	Architects to prepare a Report to demonstrate credit compliance. (Report should contain drawings and description of the passive design features.)	HIGH	HIGH	HIGH	HIGH

Credit Title and criteria

Discipline Responsible for the design.

For comments regarding how the credit criteria will be achieved.

Design Deliverables required to demonstrate compliance.

Applicability of credit to space types. Credits that refer to 'whole of building initiatives' have been rated as 'high' applicability for all space categories. Refer to space type Table categorisation of specific spaces.

Space Types			
Laboratories	**Workspaces**	**Teaching and Learning Facilities**	**Support Spaces**
Clean Room Type A 'Precision Metrology' Type B 'High Performance' Type C 'General Laboratories'	Single Offices Shared Offices Shared Visitor Offices Meeting Rooms Informal Meeting Spaces Utility Hubs/Tea Points/Storage	Lecture Theatres Collaborative Learning Learning Studios Seminar Rooms Teach Laboratories	Café Concierge/Security Desk End of Journey Facilities Loading Dock Loading Dock Storage Roof Space (Teaching and Research) Toilets