University of Sydney, LEES1

ESD Services Design Report

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Project	University of Sydney, LEES1 Project
Description	Design report for ESD Services
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Contents

1. Executive Summary

This report has been prepared by JHA Consulting Engineers to identify and summarise the proposed Ecologically Sustainable Development (ESD) initiatives which have been incorporated into the design of the proposed LEES1 development at the University of Sydney.

This report demonstrates compliance with the Secretary's Environmental Assessment Requirements (SEARS) which apply to the project and has been prepared to accompany a State Significant Development Application to the NSW Department of Planning and Environment. This report should be read in conjunction with the Architectural design drawings and other consultant design reports submitted as part of the application.

The report identifies how the principles of Ecologically Sustainable Development (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and ongoing operation phases of the development.

The project is being assessed against the University of Sydney Sustainability Framework rating scheme and is on track to achieve a Silver rating. This report outlines the sustainable design features from the following framework categories which have been incorporated to achieve the rating:

- Leadership and Communication
- Resource Efficiency
- Healthy Environment
- Materials
- Climate Change, Landscape and Infrastructure
- Sustainable Transport

2. Introduction

2.1 PROJECT DESCRIPTION

The University of Sydney is developing a new campus gateway at the City Road entrance to the Camperdown Campus (Eastern Avenue). The gateway will be defined by two new buildings, F23 to the west and an eastern building to be identified as LEES1. There will be public domain works linking the two.

The LEES1 building will collocate teaching, research and faculty accommodation from other locations, as part of the co-location of staff that will contribute to teaching and research across the Life, Earth and Environmental Sciences (LEES). Most of the staff will be members of a new School of Life and Environmental Sciences (SOLES), which will commence operation on 1 January 2016.

LEES1 will provide the critical accommodation required to achieve the full LEES vision and the early establishment of the SOLES by making possible decant options from current infrastructure. Importantly, the future stages of LEES2 at the Ross St entrance to the campus and LEES3 on the Gunn building site, will progressively allow for the rationalisation from 26 buildings (with LEES1), 15 buildings (with LEES2) and 5 buildings (with LEES3). The scope of the LEES1 project has been designed to enable the decanting of existing out-dated and long-term, poorly located facilities elsewhere on the Camperdown campus.

This brief describes the engineering services requirements for the **LEES1 building project**. Planning for LEES2 and LEES3 is imminent.

The project will provide approximately 10,000 m^2 of new research and teaching space including:

- PC2 capable research laboratories and associated support and dry workspaces (office and desk).
- Loading dock, storerooms, waste rooms, decontamination area, dirty and clean preparation areas and other auxiliary research spaces.
- NMR spectroscopy and crystallography.
- PC2 capable teaching laboratories and associated preparation and ancillary areas.
- Student commons.
- Enabling of appropriate interconnection with the podium levels of the F07 Carslaw building to create movement between the two buildings and maximise the ability to share common spaces and facilities.

The key project objectives are:

- Create sufficient capacity in the LEES1 building to enable decanting of the G08 Molecular Bioscience building in the immediate term.
- In conjunction with the proposed F23 administration building, create an appropriately iconic and landmark entry point into the Camperdown campus.
- Deliver a building, sufficiently flexible, that in the medium to long term will be able to accommodate a range of science-based users.

In addition to the key objectives, the project will, as far as possible, achieve the following secondary objectives:

- Enable decanting of the existing Macleay building to the extent possible within the constraints of the site and project budget.
- Screening of the existing Carslaw façade from City Road.

The design objectives for the building are to:

- Encourage cross and inter-disciplinary interaction;
- Ensure the building is recognised as world’s best practice in teaching, laboratory and workplace design;
- Put “science on display”
- Provide a sense of place and arrival at the main entry to the campus;

- Create a landmark and terminus at the southern end of eastern avenue that responds to the heritage context;
- Be inspiring, creative, healthy, comfortable and engaging;
- Create a sense of place and identity;
- Respond to the Eastern avenue, City road, St Andrews College and Victoria park frontages;
- Demonstrate the integration of the external spaces and landscaping with the internal spaces;
- Promote community and collaboration;
- Provide a variety of space to enable and support the different mode(s) of teaching, learning and workplace;
- Consider future flexibility of use;
- Create an environment that makes people feel empowered, important, and excited to Be in; and
- Provide a sustainable, long term design solution.

In preparing this ESD summary report JHA has remained cognizant of the following key design factors:

- The design life of the services elements (excluding consumables) need to be a minimum of 20 years where possible and practical.
- All equipment and componentry selected need to be reliable, from a reputable manufacturer / supplier who has a proven history for ongoing service in Australia, and should be selected in recognition of any College preferences.
- The design needs to be robust and reflect the target of keeping single points of failure to an absolute minimum.
- The engineering design solutions will have aesthetic appeal and strong architectural focus that is consistent with the College and Architect's vision for the building.
- Where not cost prohibitive, levels of redundancy and back-up should be implemented.
- The design solution should be sustainably responsible and use low energy systems and equipment (while being cognizant of life cycle costs and capital cost implications).
- The design solution should be flexible and easily adaptable to accommodate changes in use and expansion (while being mindful of capital cost implications).
- The design solution should integrate into the infrastructure and systems.
- Safety in design considerations.

2.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

This report acknowledges the SEARS prepared by the Secretary which notes the following in Section 6 of the document:

6. Ecologically Sustainable Development (ESD)

1. *Detail how the 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 and ongoing operation phases of the development.*
2. *Demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice.*
3. *Include a description of the measures that would be implemented to minimise consumption of resources, water (including water sensitive urban design) and energy.*

Items 1, 2 and 3 of the SEARS requirements are addressed in sections 3, 4 & 5 of this report respectively.

3. Principles of Ecologically Sustainable Development

The principles of Ecologically Sustainable Development as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 have been incorporated into the design and ongoing operation phases of the development as follows:

3.1 THE PRECAUTIONARY PRINCIPLE

Namely, that if 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. In the application of the precautionary principle, public and private decisions should be guided by:

- *(i) Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and;*
- *(ii) An assessment of the risk-weighted consequences of various options.*

Project response:

This development is being designed in accordance with the University of Sydney's Sustainability Framework which is a holistic rating scheme looking at a wide range of environmental, social and operational values. This framework will ensure that the development minimises the impact on the environment whilst also contributing to improvements through education of environmental issues with the students housed within it.

3.2 INTER-GENERATIONAL EQUITY

Namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations

Project response:

This development will not cause any significant impact on the health, diversity and productivity of the environment and will provide a benefit in the form of a state of the art teaching and research laboratory facility for the life, environment and earth sciences.

3.3 CONSERVATION OF BIOLOGICAL DIVERSITY AND ECOLOGICAL INTEGRITY

Namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration

Project response:

This development is proposed on vacant area of land adjacent a main road, in an urban environment at the front entrance to the University Campus. It currently consists of a grassed area and a row of established mature fig trees lining City Road. These fig trees are to remain as part of the development and will not be harmed. The design of the new building will be aesthetically pleasing and will provide a new and attractive gateway to the campus from the City Road entrance. This is a substantial improvement to the amenity and appearance of the site, and with minimal biological and ecological impact other than the loss of a small area of grass.

3.4 IMPROVED VALUATION, PRICING AND INCENTIVE MECHANISMS

Namely, that environmental factors should be included in the valuation of assets and services, such as:

- *(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
- *(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
- *(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those*

best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

Project response:

The design of this development has employed lifecycle costing to determine the optimum strategy with regards to major items of plant, with decisions being made based on whole of life costs rather than capital expenditure only.

4. University of Sydney Sustainability Framework

4.1 UNIVERSITY OF SYDNEY SUSTAINABLE DESIGN FRAMEWORK

The University of Sydney Sustainable Design Framework is a holistic rating scheme with many similarities to the widely adopted industry standard Green Star rating scheme, but tailored specifically to suit the requirements of new University developments.
The aim of the framework is to encourage a balanced approach to designing new university projects; to be resource efficient, cost-effective in construction and operation, and deliver enhanced sustainability benefits with respect to impact on the environment, the health and well-being of students, staff and visitors whilst providing the best possible facilities for a constructive learning experience.

The framework assesses the sustainability initiatives of each project against criteria in the following categories:

- Leadership and Communication
- Resource Efficiency
- Healthy Environment
- Materials
- Climate Change, Landscape and Infrastructure
- Sustainable Transport

The project team has a developed a schematic design which is capable of achieving a Silver rating under this framework. The project team believes this target provides a cost-effective building solution with high quality sustainability outcomes, resulting in value for money for the University of Sydney.

This report has been structured to summarise the sustainability initiatives selected for LEES1 in each of the framework categories and outline how they have been implemented. A list of all the framework initiatives targeted is also included in Appendix A.

5. Sustainable Design Initiatives

The sustainable design initiatives which have been incorporated into the design and operation of the proposed development are outlined below grouped by the relevant categories of the University of Sydney Sustainability Framework.

5.1 LEADERSHIP AND COMMUNICATION

The LEES1 project is committed to achieving sustainability outcomes in the design and construction phases, as well as in operation using the following initiatives:

5.1.1 ESD PROFESSIONAL

All members of the design team are experienced in delivering sustainable outcomes for engineering services packages and the design process shall be overseen by a Green Star Accredited Professional to provide advice on achieving the sustainability targets of the project.

5.1.2 LIFECYCLE COST EVALUATION

A Whole of Life/Life Cycle Cost analysis has been undertaken to confirm the costs of plant, materials, construction, operation and maintenance of the HVAC systems for the proposed building design. This is provided in Appendix B.

5.1.3 COMMISSIONING AND BUILDING TUNING

Comprehensive commissioning procedures shall ensure the building is operating efficiently in accordance with the design intent and carried out in line with the University's design guideline.

5.1.4 ENVIRONMENTAL MANAGEMENT PLAN

During construction an environmental management plan will be implemented to address environmental, worker health and safety and community risks.

5.1.5 SITE WASTE MANAGEMENT PLAN

During the construction phase of the project at least 85% of building demolition and construction waste shall be recycled, an indoor air quality management plan will be implemented to ensure improved indoor air quality for construction workers and an environmental plan shall manage environmental, occupational health and safety and community risks.

5.1.6 INDOOR AIR QUALITY MANAGEMENT PLAN

During construction the head contractor will implement an IAQ management plan to address air quality issues.

5.1.7 BUILDING USERS GUIDE

All relevant information about the design and correct operation of the building's environmental features will be transferred to the occupants via the Building Users' Guide.

5.1.8 PUBLIC INFORMATION DISPLAY

A public information display will be provided in the foyer to communicate ESD initiatives incorporated into the building and to report on building performance.

5.2 RESOURCE EFFICIENCY

To improve resource efficiency, the LEES1 building shall incorporate passive design and energy efficiency measures, reduce water consumption compared to a typical building and provide suitable waste management infrastructure to maximise recycling and resource recovery.

PASSIVE DESIGN AND ENERGY EFFICIENCY

5.2.1 PASSIVE DESIGN PRINCIPLES

A façade design review was previously undertaken during the schematic design phase. Although the building form has changed, the recommendations of the façade review still ring true for the present design. This includes double glazing to the southern facade to minimise heat loss in winter months and high performance glazing with vertical fins to both the western and eastern facades to minimise solar gain. The revised building has limited northern glazing and is shaded by the existing Carslaw building.

5.2.2 IMPROVE BUILDING ENERGY PERFORMANCE BY 20%

JHA has undertaken preliminary dynamic energy modelling of the present design and established the façade specifications to improve building energy performance by 20% compared to the Section J reference building. The dynamic energy model shall be updated with design revisions and used to inform discussions with the project architect to optimise the passive design features of the building for improved energy efficiency.

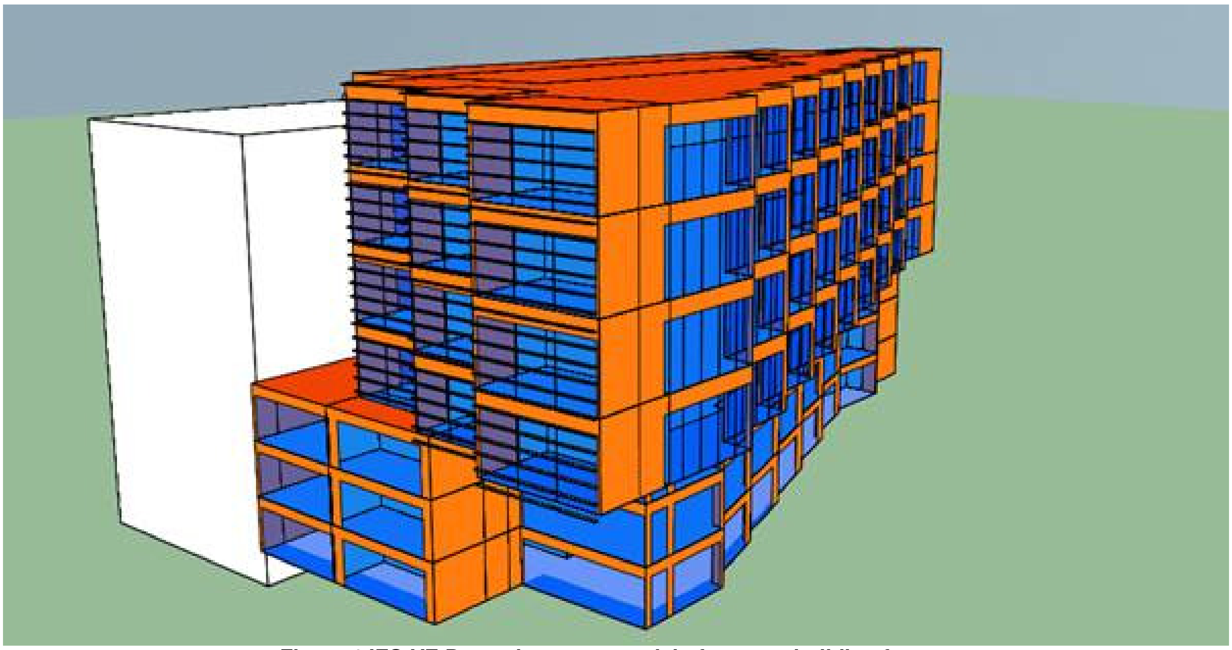

Figure 1 IES-VE Dynamic energy model of present building form

5.2.3 SOLAR PV SYSTEMS

A solar PV system shall be incorporated on the roof to offset electricity consumption of the building. The system shall be designed to maximise electricity generation without exporting power back to the grid, so all solar energy produced on site at LEES1 is consumed by the building. Based on the current building form, there is approximately 1000m² of roof area which under the UoS Framework would require a 75kW Solar PV capacity. Safe access is to be provided to maintain mechanical plant located on the roof, the same access can be used to maintain PV cells.

5.2.4 HOT WATER SYSTEMS

The design team has made provisions for the design and specification of a centralised SHW system with gas or electric boost.
A LCC analysis shall be undertaken for review by the University's independent sustainability consultant.

5.2.5 ENERGY CONSUMING EQUIPMENT

Energy efficient appliances shall be selected to have the highest energy rating available under the Australian Government's Energy Rating scheme to reduce energy consumption and peak power demands in the building.

5.2.6 METERING UTILITY USE

Electricity metering and sub-metering shall be specified in accordance with the University's Electrical, Hydraulic, Mechanical and AUMS Standards to monitor and manage electricity consumption in the building.

5.2.7 LIGHTING SYSTEMS

Lighting systems are to be designed in accordance with the Lighting Design Standard and include efficient fixtures, suitable zoning and intelligent controls to reduce energy consumption.

5.2.8 NO HOT WATER IN PUBLIC RESTROOMS

Supply of hot water to wash basins in public restrooms is to be avoided.

5.2.9 NATURAL VENTILATION

While the project does not exceed the 15% GFA requirement, foyers and student common areas totalling aproximately 6% of GFA shall be fully naturally ventilated with hydronic in slab heating and cooling and large diameter, low speed ceiling fans to provide low energy air circulation and effective cooling.

5.2.10 MIXED MODE VENTILATION

To reduce reliance on mechanical ventilation systems the foyer/common spaces shall be naturally ventilated and conditioned using a hydronic slab heating and cooling system. To reduce peak energy demand, the hydronic system will pre-cool the slab in off-peak periods and use the thermal mass to continue to cool the space throughout the day.

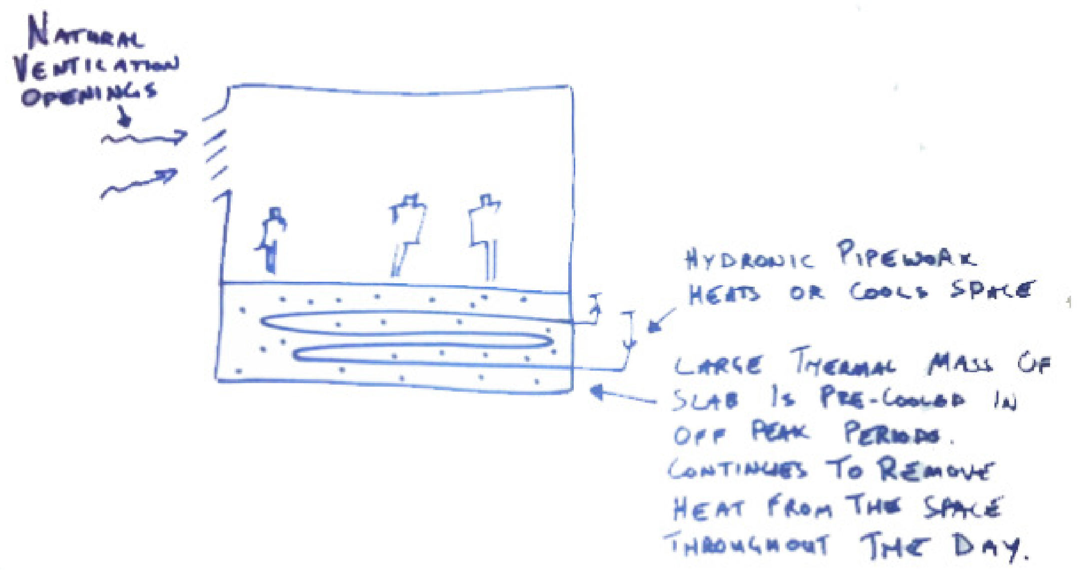

Figure 2 Foyer / common spaces with natural ventilation and hydronic heating and cooling

Perimeter offices and meeting rooms will be provided with operable windows and ceiling fans and air conditioning shall function in a mixed mode ventilation arrangement. Reed switches will detect when the windows are open and deactivate the air conditioning serving that space. In this mode the space will be naturally ventilated reducing the air conditioning energy consumption.

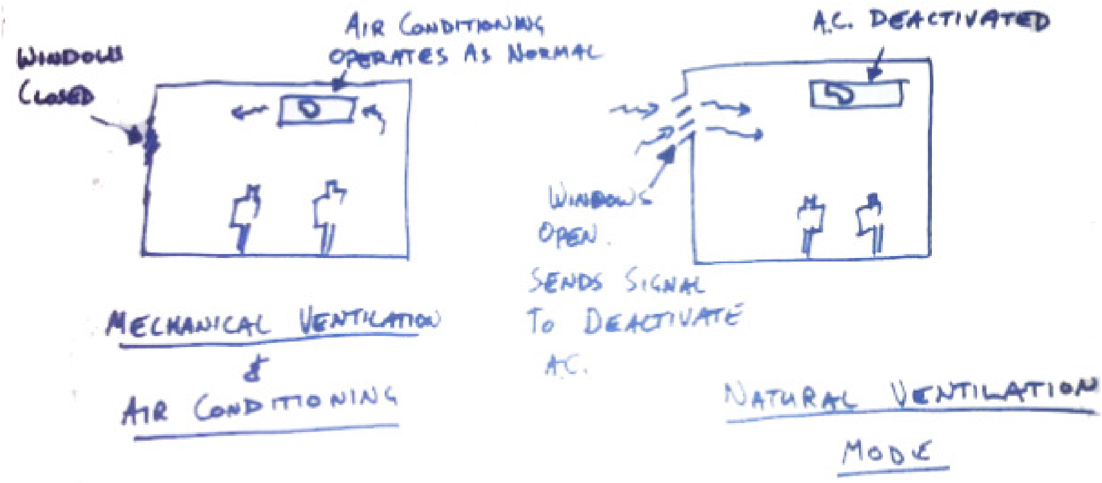

Figure 3 Mixed mode ventilation system in perimeter rooms and offices

5.2.11 PEAK POWER

BMS controls shall incorporate load shedding of the chillers, preconditioning and floating set point control algorithms to reduce peak energy demand. The air conditioning system can precondition the building during off-peak periods and reduce its load or switch off throughout peak energy demand periods and still maintain comfort conditions. Floating set point controls will allow wider temperature set points for the air conditioning system in peak energy periods in appropriate spaces to reduce load on the mechanical plant. Also gas engine driven VRV units have been used to provide cooling for comms rooms.

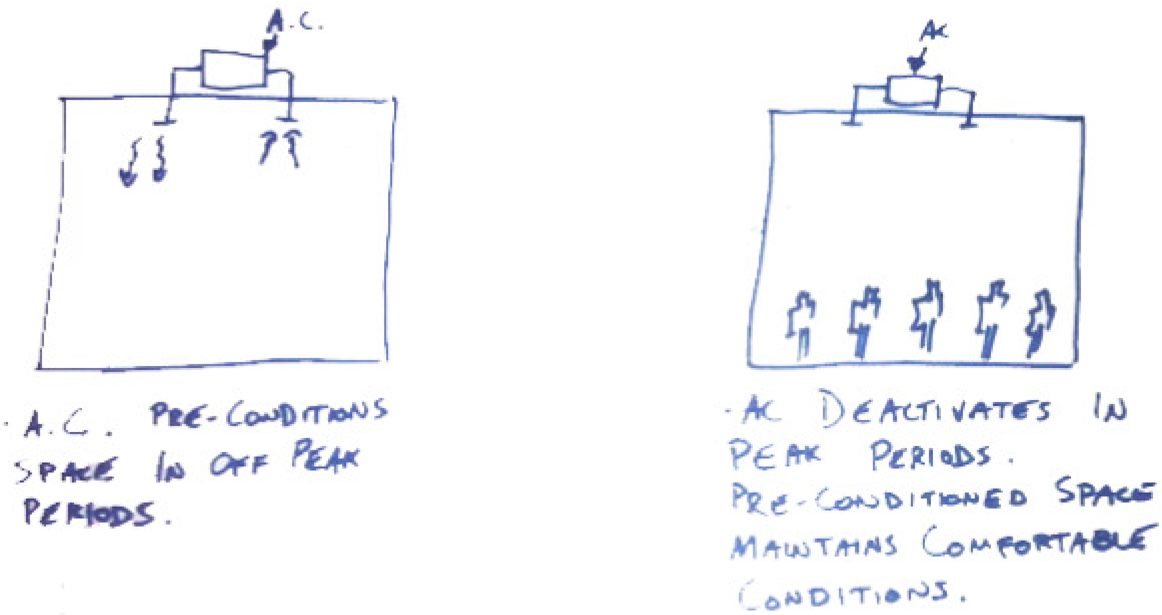

Figure 4 Preconditioning for peak demand reduction

WATER EFFICIENCY

5.2.12 WATER USE

Water consumption shall be reduced by incorporating water efficient fixtures and fittings in accordance with the University Hydraulic Design Standard, minimising water consumption from laboratory equipment and a system for reuse of fire sprinkler system test water. A whole of life/life cycle costing analysis shall been undertaken to assess rainwater harvesting and reuse within the building.

Centralised waste and recycling bin systems shall be provided and a dedicated storage area for the separation and collection of recyclable waste in accordance University Waste Management Design Standard. These measures shall promote and simplify resource recovery and recycling in the LEES1 building;

5.2.13 LABORATORY EQUIPMENT WATER USE

Laboratory equipment water use shall be minimised and water supplies to lab equipment controlled to allow water flow only when equipment is in use.
Lab equipment shall be investigated for recirculating water and savings in cooling and supply flow rates.

5.2.14 PROCESS WATER EFFICIENCY

Process water is not being supplied at present. If supplied it shall be a closed loop recirculating system.

5.2.15 WATER HARVESTING

The UOS water harvesting template is to be completed and investigations shall be carried out to size the rainwater harvesting system correctly and outline monthly water capture, consumption and expenditure rates.

5.2.16 FIRE SYSTEMS

The building contains a fire sprinkler and hydrant system.
A system for capture and reuse of fire system test water shall be provided.

WASTE MANAGEMENT & RESOURCE RECOVERY

5.2.17 CENTRALISED BUILDING WASTE MANAGEMENT SYSTEM

Centralised waste and recycling bin systems shall be provided in accordance University Waste Management Design Standard. These measures shall promote and simplify resource recovery and recycling in the LEES1 building.

5.2.18 WASTE STORAGE

A dedicated storage area for the separation and collection of recyclable waste shall be provided in accordance with the University Waste Management Design Standard. These measures shall promote and simplify resource recovery and recycling in the LEES1 building.

5.3 HEALTHY ENVIRONMENT

The LEES1 design incorporates a range of features to provide a healthy and comforting experience for occupants, delivering the best possible environment in which to work, learn and connect. Careful consideration has been given to light, temperature, air quality and access.

The optimised shading scheme for the LEES1 building facilitates the application of glazing while mitigating extra heat loads and glare and cutting tinting treatment requirements that reduce natural light transmission. These passive design features allow for enriched daylighting and greater access to external views for occupants. Additional daylighting reduces the reliance on artificial light and benefits alertness, mood and productivity. External views provide a connection to nature and the campus environment and also help to create an environment encouraging constructive learning.

5.3.1 ACCESS TO WATER STATIONS

Access to drinking water fountains is provided in student common and eating spaces.

5.3.2 AVOID OVER LIGHTING SPACES

Lighting systems shall be designed to meet the criteria.

5.3.3 DAYLIGHTING

The passive design features of the building allow for sufficient daylighting to meet or exceed the criteria.

5.3.4 EXTERNAL VIEWS

Access to external views in LEES1 shall meet or exceed the criteria.
External views provide a connection to nature and the campus and also help to create an environment encouraging constructive learning.

5.3.5 AVOID GLARE

The optimised shading scheme for the LEES1 building facilitates the application of glazing while mitigating extra heat loads and glare. Operable shading devices shall be incorporated to give occupant control over the lighting environment within the space.

5.3.6 THERMAL COMFORT

The mechanical systems shall achieve the criteria of the credit. Dynamic building simulation shall be used to calculate the thermal comfort for the project.

5.3.7 LOCATION OF STAIRS

The western staircase is positioned at the main public entrances to the building and glazed on the western façade to provide a visual connection and promote an alternative to using lifts.
Signage shall be provided to meet the requirements of the credit.

5.3.8 BUILDING NOISE

The building fabric and services shall be specified to meet or exceed the noise criteria of the credit.

5.3.9 CO^2 MONITORING

CO^2 monitoring and ventilation controls have been incorporated to modulate the ventilation rates of internal spaces to match the occupancy, therefore supplying the optimum quantity of fresh air to maintain air quality and avoid unnecessary loads on air conditioning plant.

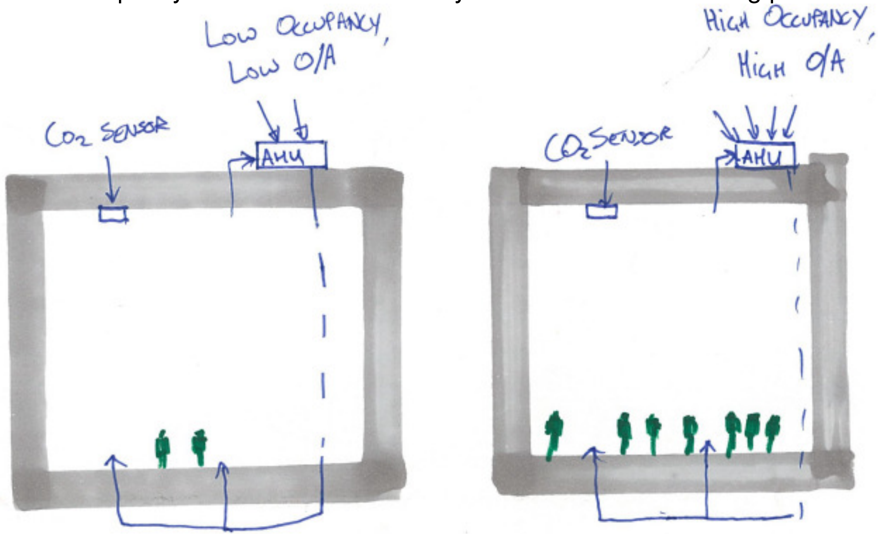

Figure 5 CO_2 monitoring and ventilation control

5.3.10 VOLATILE ORGANIC COMPOUNDS – ADHESIVE & SEALANTS

Adhesive and sealant products shall be selected to contain low or no Volatile Organic Compounds (VOCs) and meet the criteria.

5.3.11 VOLATILE ORGANIC COMPOUNDS – PAINTS & CARPETS

Adhesives, sealants, flooring and paint products shall be selected to contain low or no Volatile Organic Compounds (VOCs) and meet the criteria.

5.3.12 FORMALDEHYDE MINIMISATION

All engineered wood products used in exposed or concealed applications are specified to contain low or no formaldehyde to avoid harmful emissions that can cause illness and discomfort for occupants.

5.3.13 CEILING FANS

Ceiling fans shall be specified for all mixed mode offices and meeting rooms.
Large diameter, low speed ceiling fans have been specified for the foyer and common areas to provide low energy air circulation and effective cooling.

5.4 MATERIALS

5.4.1 LOOSE FURNISHINGS

Loose furnishings within the building shall be selected based on their recycled content, end-of-life recyclability and product stewardship agreements. By selecting loose furnishings which comply with independent environmental certification, for example Ecospecifier or Good Environmental Choice Australia, the project will confidently reduce environmental impacts and waste from furnishings over the life of the building.

5.4.2 SUSTAINABLE TIMBER

Sustainable timber shall be specified for at least half of the timber products used on the project to meet or exceed the criteria

5.4.3 RECYCLED STEEL

60% by mass of all steel shall have a post-consumer recycled content greater than 50% or be reused steel to meet or exceed the criteria

5.4.4 RECYCLED CONCRETE

Recycled concrete shall be specified using recycled aggregate or manufactured sand and reduced quantities of Portland cement to reduce environmental impacts of concrete production and embodied energy.

5.5 CLIMATE CHANGE, LANDSCAPE AND INFRASTRUCTURE

LEES1 has been designed to be sensitive to its current environmental surrounds and adaptable to future proof against changes in campus infrastructure and the effects of climate change.

5.5.1 INFRASTRUCTURE FUTURE PROOFING

The energy and water systems will include provisions for connection to future precinct energy and water distribution systems future proofing the building for potential infrastructure upgrades at the campus.

5.5.2 HIGH ALBEDO ROOF MATERIALS

Materials for the roof and adjacent ground surfaces will be specified with high solar reflectance materials to reduce heat gain in the building and localised heat island effects.

5.5.3 SURFACE HEAT REDUCTION

Materials for ground surfaces been selected with high solar reflectance indexes which meet or exceed the requirements of the credit to reduce heat gain in the building and localised heat island effects.

5.5.4 FLOOD RISK MANAGEMENT

Essential buildings services have been located to avoid inundation from future storm and flood events.

5.6 SUSTAINABLE TRANSPORT

The project promotes and caters for sustainable and alternative transport options by encouraging cycling and public transport and discouraging the use of motor vehicles.

5.6.1 CYCLE PARKING

Bicycle parking shall be provided for staff and students in accordance with the CIP Masterplan and Access Strategy.

5.6.2 CAR PARKING

Car parking is not being provided as part of this development.

6. Appendix A - USYD ESD Framework

THE UNIVERSITY OF SYDNEY

Project Details

Project name:	LEES1
What type of building is your project?	Laboratory Building
What is the ambition level for your project?	Silver - 70%

	Preliminary Design	D & C Stage
Total Points Available	145	145
Current total points targeted	103	0
Remaining points required to achieve ambition level	-2	102

		Points Available	Mandatory Points	Preliminary Design Points Targeted	Design & Construction Points Targeted
1. Leadership and Communication					
1.1	ESD Professional	2	2	2	0
1.2	Life Cycle cost evaluation	3	3	3	0
1.3	Commissioning and Building Tuning	1	1	1	0
1.4	Environmental Management Plan	1	1	1	0
1.5	Site Waste Management Plan	1	1	1	0
1.6	Indoor Air Quality Management Plan	3	3	3	0
1.7	Building Users' Guide	1	1	1	0
1.8	Sheet Metal and Air Conditioning National Contractors Association	2	0	2	0
		14	**12**	**14**	**0**
2. Resource Efficiency					
Passive Design and Energy Efficiency					
2.1	Passive Design Principles	1	1	1	0
2.2	Improve Building Energy Performance by 20%	3	3	3	0
2.3	Solar PV Systems	3	3	3	0
2.4	Hot Water Systems	3	3	3	0
2.5	Energy Consuming Equipment	3	3	2	0
2.6	Metering Utility Use	3	3	3	0
2.7	Lighting Systems	2	2	2	0
2.8	Unoccupied Spaces	0	0	0	0
2.9	No Hot Water in Public Restrooms	1	1	1	0
2.10	Improve Building Energy Performance by 30%	3	0	0	0
2.11	Natural Ventilation	3	0	0	0
2.12	Mixed Mode Ventilation	10	0	10	0
2.13	Peak Power (1)	3	3	3	0
2.14	Peak Power (2)	3	0	0	0
Water Efficiency					
2.15	Water Use	1	1	1	0
2.16	Laboratory equipment water use	3	3	3	0
2.17	Fire Systems	2	2	2	0
2.18	Water Harvesting	3	3	3	0
2.19	Process water efficiency	1	1	1	0
Waste Management & Resource Recovery					
2.20	Centralised Building Waste Management System	1	1	1	0
2.21	Waste Storage	1	1	1	0
		53	**34**	**43**	**0**
3. Healthy Environment					
3.1	Access to water stations	1	1	1	0
3.2	Avoid Over lighting Spaces	3	3	3	0
3.3	Daylighting	2	0	2	0
3.4	External Views	2	0	2	0
3.5	Avoid Glare	2	2	2	0
3.6	Thermal Comfort	2	2	2	0
3.7	Location of Stairs	1	1	1	0
3.8	Building Noise	1	1	1	0
3.9	CO2 Monitoring	3	3	3	0
3.10	Volatile Organic Compounds - Adhesives & Sealants	2	2	2	0
3.11	Volatile Organic Compounds - Paints & Carpets	2	2	2	0
3.12	Formaldehyde Minimisation	2	2	2	0
3.13	Ceiling Fans	2	0	2	0
3.14	Planting selection	1	0	0	0
		26	**19**	**25**	**0**
4. Materials					
4.1	Loose Furnishings	2	2	2	0
4.2	Sustainable Timber (1)	2	2	2	0
4.3	Recycled Steel (1)	3	3	3	0
4.4	Façade Reuse	2	0	0	0
4.5	Structure Reuse	3	0	0	0
4.6	Sustainable Timber (2)	3	0	0	0
4.7	Steel (2)	3	0	0	0
4.8	Recycled Concrete	3	0	3	0
4.9	Regional materials	3	0	0	0
4.10	Joinery	3	0	0	0
4.11	PVC Minimisation	3	0	0	0
4.12	Design for Disassembly	3	0	0	0
		33	**7**	**10**	**0**
5. Climate Change, Landscape & Infrastructure					
5.1	Infrastructure Future proofing	3	3	3	0
5.2	High Albedo Roof Materials	1	1	1	0
5.3	Surface Heat Reduction	1	1	1	0
5.4	Landscape	1	0	0	0
5.5	Flood Risk Management	2	2	2	0
5.6	Stormwater Management	2	0	0	0
5.7	Green Roof / Wall	2	0	0	0
		12	**7**	**7**	**0**
6. Sustainable Transport					
6.1	Cycle Parking	2	2	2	0
6.2	End of Trip Facilities	2	2	0	0
6.3	Car parking	2	0	2	0
6.4	Motor cycle and small car parking	1	0	0	0
		7	**4**	**4**	**0**

The University of Sydney - Sustainability Framework

Project Name: LEES1
Building Type: Laboratory Building
Date : <input submission date>

		Points Available	Mandatory Measure	GATEWAY 1 - 3 (Preliminary Design): Project Team Input – Points Targeted	Preliminary Design Response – Specify how the design intent will achieve the targeted measure	Preliminary submission requirements	GATEWAY 4 (Design & Construction): Project Team Input – Points Targeted	Contractor Design Response – Specify how the project will achieve the targeted measure	Comments from the 80% Construction Documentation workshop	As Built submission requirements – Provide the mentioned As Built documentation to demonstrate how the project complies with the requirements of this measure
1. Leadership and Communication										
1.1	**ESD Professional** Ensure that a principal participant in the design team is suitably trained to provide sustainability advice from the schematic phase through to project implementation (i.e. Green Star Accredited Professional or similar).	2	Yes	2	Project ESD lead is a Green Star Accredited Professional with over 10 years experience in delivering sustainable buidings and infrastructure projects and mechanical design					GSAP Certificate or NABERS Accredited Assessor Certificate or LEED Accredited Professional or Tertiary Education Qualification
1.2	**Life Cycle cost evaluation** Ensure a Whole of Life/Life Cycle Cost (LCC) analysis is used to select between HVAC options and determine the true cost implications of different facade designs. Mechanical plant analysis should be conducted on a 25 year time-frame, and facade designs should be analysed on a 50 year time-frame. This analysis should take into account plant/materials choice, construction costs, ongoing operations and maintenance costs. Financial input data used for analysis, e.g. electricity, gas, inflation and discount rates must be obtained from the CIS Engineering & Sustainability Team. If changes in system design are proposed in the D&C design, the contractor must demonstrate that any substituted system provides better value for money on a life-cycle cost basis.	3	Yes	3	Whole of Life/Lif Cycle Cost analysis included in submission for review.	Life Cycle Costing Spreadsheet UoS Template				Life Cycle Costing Spreadsheet UoS Template As built Mechanical Schedule
1.3	**Commissioning** Incorporate requirements for comprehensive pre-commissioning, commissioning, and quality monitoring for all building services into contracts. All commissioning and building tuning requirements must be is carried out in accordance to the Electrical, Lighting, Hydraulic, Mechanical, AUMS, BMCS Design Standards. Note that there will be an independent commissioning agent, appointed by The University reviewing commissioning practices.	1	Yes	1	Comprehensive commissioning procedure shall be specified for all building services to ensure the building is operating efficiently in accordance with the design intent. REFER TO DOCUMENTS: Electrical services ECI Specification, Hydraulic Services					Extracts from Mechanical, Electrical, Hydraulic, Lifts and Fire Contracts or referenced contract documents that define scope
1.4	**Environmental Management Plan** Develop and implement a project-specific Environmental Management Plan for the construction in accordance with State/Federal government guidelines and standards to address environmental, worker health and safety, and community risks. The main contractor must implement an Environmental Management System certified to the ISO 14001 standard. The above requirements are applicable, as a minimum to all of the below works: * Demolition * Excavation and * Main construction.	1	Yes	1	A project specific environmental management plan shall be developed to manage environmental, occupational health and safety and community risks. The main contractor has maintained an EMS system certified to ISO 14001 since 2006.					Construction EMP NSW EMS checklist with references to project specific EMP
1.5	**Site Waste Management Plan** Develop a Site Waste Management Plan (SWMP) in accordance to the Waste Management Standard. Recycle at least 85% of building demolition and construction waste by weight. The contractor must maintain easily accessible and well-organised records of waste dockets and auditable chain-of-custody documentation and provide the University quarterly waste disposal and recycling reports.	1	Yes	1	During the construction phase of the project a SWMP in accordance with the Waste Management Standard shall be developed to recycle at least 85% of building demolition and construction waste by weight.	Completed UoS Waste Tracking Template				Site Waste Management Plan Completed UoS Waste Tracking Template document summarising % wastes recycled
1.6	**Indoor Air Quality Management Plan** During construction, the Contractor must meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) Indoor Air Quality (IAQ) For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3). The Head Contractor must develop and implement an IAQ management plan for the construction and pre-occupancy phases of the building, in accordance with the UoS Mechanical Standard and the SMACNA Guidelines. The IAQ management plan must address the air quality during construction and include: • HVAC Protection from both dust and odours • Source Control of any materials that contain Volatile Organic Compounds - Construction team must recover, isolate and ventilate containers housing toxic materials • Pathway interruption - clean or occupied areas are to be isolated from areas of work • Housekeeping - cleaning activities must be regularly undertaken to control contaminants, maintenance teams should protect all porous materials from exposure to moisture, vacuum cleaners with high efficiency particulate filters should be used • Scheduling of cleaning prior to occupancy including flush-out activities The IAQ management plan must be submitted to CIS (or the appointed representative) for review and approval, prior to implementation on the project.	3	Yes	3	The head contractor shall develop and implement an IAQ management plan for construction and pre-occupancy phases in accordance with the UoS Mechanical Standard and SMACNA Guidelines.					Construction IAQ Management Plan Filter Media Data Sheets on Mechanical Equipment Photo Log of Construction work demonstrating implementation of measures
1.7	**Building Users' Guide** Provide relevant information about the building's use, functional and environmental aspects, and special features according to the Building Users' Guide template.	1	Yes	1	Relevant information about the design and correct operation of the building's environmental features will be transferred to the occupants via the Building Users' Guide					Building Users Guide to UoS Template document
1.8	**Public information display** Provide an energy efficient display in the foyer and similar prominent public area(s) to educate building occupants and communicate building information such as real-time utility (energy, water, gas) consumption, waste management, transport options etc. Displays must be suitably sized for the audience in the space and be connected to data ports and necessary communications equipment to connect to the IT network. The Display and associated IT equipment must at least be on a programmable time clock or be linked to an occupancy control system so it switched off when the building is not in use.	2	No	2	A public information display shall be provided in a prominent public area to promote the energy efficiency of the building and display consumption figures for utilities and communicate alternative transport option around the building.					As built Architectural Plans As built Architectural FFE As built electrical and networking plans
		14		14			0			
2. Resource Efficiency										
Passive Design and Energy Efficiency										
2.1	**Passive Design Principles** Building designs must employ passive design strategies to respond to environmental conditions of the building including orientation, solar access, prevailing winds, seasonal and diurnal temperatures changes. Provide a passive design report demonstrating how passive design elements are maximised by the design to improve indoor environmental quality, thermal comfort and energy efficiency, and to minimise reliance on mechanical cooling and heating whilst preventing noise and pollution sources.	1	Yes	1	LEES1 incorporates passive design principals focused around strategic glazing, a refined shading strategy, orientation and application of thermal mass to minimise the reliance on mechanical air conditioning and deliver a high	Passive design report				Passive design report As built Architectural Site Layout and Shadow diagrams
2.2	**Improve Building Energy Performance by 20%** Complete an energy model using BCA Section J energy modelling Guidelines and the small plug loads template. The report must reasonably estimate predicted energy consumption for each space type within the building and a predicted total annual energy use. Demonstrate that the proposed building will perform: a) at least 20% better than the reference building when the proposed building is modeled with the proposed services; and b) at least 10% better the reference building when the proposed building is modeled with the same services as the reference building. SOFTWARE: Energy simulation software packages such as IES-VE, TAS, Energy Plus must be utilised for creating a representative dynamic Energy Model. The energy simulation software must comply with one of the following Standards: * BESTEST (US NREL, 2005); or * The European Union draft standard EN13791 July 2000; or * Be certified in accordance with ANSI/ASHRAE Standard 140-2001. METHODOLOGY: Energy modelling must be conducted using the JV3 methodology prescribed in the National Construction code 2015. Part load efficiency curves must be applied for modelling mechanical plant operation. The energy report must also address the following: * Thermal bridging - The architectural building design must demonstrate that there are no potential thermal bridging issues. * R values (Building fabric and glazing). R values for building fabric and glazing must be for the full facade or glazing panel and take into account thermal bridging. Centre panel / pane values are not acceptable. U-value and Solar heat gain coefficients must be for the full glazing panel. Centre pane values are not acceptable.	3	Yes	3	JHA has undertaken preliminary dynamic energy modelling of the present design and established the initial façade specifications to improve building energy performance by 20% compared to the relevant Section J reference building. The dynamic energy model shall be updated with design revisions and used to inform discussions with the project architect to optimise the passive design features of the building for improved energy efficiency.	Preliminary energy model report Completed UoS Energy Modeling and Passive Design Template Completed UoS Plug-in loads Template				Energy Modeling Assessment Report Completed UoS Energy Modeling and Passive Design Template Completed UoS Plug-in loads Template
2.3	**Solar PV Systems** Maximise roof design with northeast-northwest orientation to maximise the integration of solar PV technology. The PV system is to be designed so that shading is avoided between the hours of 10am to 3pm throughout the year. The rooftop is to incorporate a PV system of capacity equivalent to 75 Watts per m² of available roof area, or maximised so that the building will not export power. e.g. if there is 1000m² of usable rooftop area 75kW of photovoltaics is to be installed. This capacity must ensure safe access and maintenance of the PV system. Roof-top structures and plant must not be located in areas where that may shade solar PV.	3	Yes	3	A solar PV system shall be investigated to offset electricity consumption of the building. The system shall be designed to maximise electricity generation without exporting power back. REFER TO DOCUMENTS: E500-E505, Electrical Services ECI Specification.	Concept design architectural roof plans, marked up				As built Architectural Drawings Architectural shadow diagrams
2.4	**Hot Water Systems** During Schematic Design, analysis of building hot water demand must be undertaken to determine the most efficient type of solar hot water(SHW) system for the building. It is envisaged that all student accommodation and laboratory buildings would be served by a centralised SHW system with gas/electric boost. Life cycle costing analysis must be conducted using the University's prevailing contracted energy rates. Where the schematic design indicates a SHW hot water is viable, the contractor must develop the design and provide detailed life cycle cost analysis for review by the University's independent project sustainability consultant.	3	Yes	3	The design team has made provisions for the design and specification of a centralised SHW system with gas or electric boost. A LCC analysis shall be undertaken for review by the University's independent sustainability consultant. REFER TO DOCUMENTS: H201-H208, H302, H303, Hydraulic Design Report, Hydraulic Services ECI Specification.	Life cycle costing report. Concept design architectural roof plans, marked up				As built Hydraulic Drawings As built Hydraulic Schedules Hydraulic Calculation Sheet
2.5	**Energy Consuming Equipment** Appliances (clothes dryers, dishwashers. refrigerators, freezers, washing machines, decentralised air conditioning units) are to have the highest energy rating available under the Australian Government's Energy Rating scheme for each standard capacity range of the appliance. Where multiple products are available in the market with the highest energy rating, preference is to be given to locally manufactured products. See compliance template for more detail on appliance capacity ranges. Laboratory equipment: Energy efficiency must a selection criterion for procurement of all laboratory equipment. Guidance can be obtained from the Labs 21 Energy-Efficient Laboratory Equipment guidelines. http://labs21.lbl.gov/wiki/equipment/index.php/Energy_Efficient_Laboratory_Equipment_Wiki	3	Yes	2	Energy efficient appliances shall be selected to have the highest energy rating available under the Australian Government's Energy Rating scheme to reduce energy consumption and peak power demands in the building.					As built Architectural FFE
2.6	**Metering Utility Use** Provide metering and sub-metering in accordance with the University's Electrical, Hydraulic, Mechanical and AUMS Standards.	3	Yes	3	Electricity metering and sub-metering shall be specified in accordance with the University's Electrical, Hydraulic, Mechanical and AUMS Standards to monitor and manage electricity consumption in the building. REFER TO DOCUMENTS: E500-E505, Electrical Services ECI Specification.					Completed UoS Metering and Monitoring Template Document As built Electrical Schematic As built BMS Points Schedule
2.7	**Lighting Systems** Design internal and external lighting systems in accordance to the Lighting Design Standard including energy efficient fittings, zoning, controls and site coordination.	2	Yes	2	Lighting systems shall be designed in accordance with the Lighting Design Standard and include efficient fixtures, suitable zoning and intelligent controls to reduce energy	Completed UoS Lighting Systems Template Document				Completed UoS Lighting Systems Template Document
2.8	**Unoccupied Spaces** Provide a control system to UFA spaces in accordance to the AV, Electrical and Mechanical Design Standards so that AV, lighting and mechanical systems can be shut down both manually and automatically in unoccupied spaces. Note: this excludes labs.	0	No	0	This is not applicable to labs					As built Mechanical Drawings As built Lighting Drawings
2.9	**No Hot Water in Public Restrooms** Eliminate the provision of hot water to wash basins in public restrooms and other facilities as deemed appropriate. Note that the CIS Hydraulic Standard does not permit hot water in certain spaces.	1	Yes	1	Supply of hot water to wash basins in public restrooms shall be eliminated.					As built Hydraulic Drawings As built Hydraulic Schematic
2.10	**Improve Building Energy Performance by 30%** Further to item 2.2, demonstrate that the building will perform an additional 10% better, e.g. a) at least 30% better than the reference building when the proposed building is modeled with the proposed services; and b) at least 20% better the reference building when the proposed building is modeled with the same services as the reference building.	3	No	0		Preliminary energy model report Completed UoS Energy Modeling and Passive Design Template Completed UoS Plug-in loads Template				Energy Modeling Assessment Report Completed UoS Energy Modeling and Passive Design Template UoS Plug-in loads Template Document
2.11	**Natural Ventilation** Naturally ventilate at least 15% of the GFA of the building, excluding car parking spaces.	3	No	0	While the project does not exceed the 15% GFA requirement, foyers and student common areas totalling	Concept design architectural plans, marked up				As built Architectural Plans
2.12	**Mixed Mode Ventilation** Provide BMS controlled mixed mode ventilation to the building, including installing reed switches to operable windows.	10	No	10	Offices and meeting rooms are provided with operable windows and shall function in a mixed mode arrangement.					As built Architectural, Mechanical and BMS Plans
2.13	**Peak Power (1)**									

The University of Sydney - Sustainability Framework

Project Name: LEES1
Building Type: Laboratory Building
Date : <input submission date>

		Points Available	Mandatory Measure	GATEWAY 1 - 3 (Preliminary Design): Project Team Input – Points Targeted	GATEWAY 1 - 3: Preliminary Design Response Specify how the design intent will achieve the targeted measure	GATEWAY 1 - 3: Preliminary submission requirements	GATEWAY 4 (Design & Construction): Project Team Input – Points Targeted	GATEWAY 4: Contractor Design Response Specify how the project will achieve the targeted measure	GATEWAY 4: Comments from the 80% Construction Documentation workshop	GATEWAY 4: As Built submission requirements Provide the mentioned As Built documentation to demonstrate how the project complies with the requirements of this measure
	Incorporate infrastructure, e.g. thermal storage / pre cooling technologies and load shedding controls to the BMS to reduce peak HVAC energy demand by 5%. PV systems are excluded from this measure. Peak energy demand must be calculated as follows: • Assuming the Building Code of Australia 'Deemed-to-Satisfy' approach for building fabric • In accordance with AS3000 • As the absolute design capacity of the system, after the application of diversity factors • Peak load for mixed-mode ventilated buildings must be calculated assuming mechanically air-conditioned mode is in operation	3	Yes	3	BMS controls shall incorporate load shedding of the chillers, preconditioning and floating set point control algorithms to achieve a 5% reduction in peak energy demand of the HVAC system. .					Short report - Peak HVAC energy demand calculations
2.14	**Peak Power (2)** Further to 2.13 above, reduce peak HVAC energy demand by a further 5%, e.g. total reduction peak HVAC energy by 10%.	3	No	0						Short report - Peak HVAC energy demand calculations
Water Efficiency										
2.15	**Water Use** Provide water efficient sanitary fixtures, tap ware and associated equipment in accordance to the University Hydraulic Design Standard.	1	Yes	1	Water consumption shall be reduced by incorporating water efficient fixtures and fittings in accordance with the	Completed UoS Water Use Template				Completed UoS Water Use Template As built Architectural Schedule
2.16	**Laboratory equipment water use** Minimise laboratory water usage, and maximise opportunities for non-potable water use. **Flow control** All laboratory equipment must incorporate control valves or solenoid valves to allow water to flow only when the unit is being used (unless there is a special requirement for continuous flow of water). **Disinfection and sterilization** Ensure laboratory equipment, e.g. Autoclaves and sterilizers are designed to recirculate water or allow the flow to be turned off when the unit is not in use, or both. • Adjust flow rates to the minimum recommended by the manufacturer, and review and readjust periodically. • Install a small expansion tank instead of using water to cool steam for discharge to the sewer if it does not interfere with the unit's normal operation. • Shut off units that are not in use, or install an automatic shut-off feature if it does not interfere with the unit's normal operation.	3	Yes	3	Laboratory equipment water use shall be minimised and water supplies to lab equipment controlled to allow water flow only when equipment is in use. Lab equipment shall be investigated for recirculating water and savings in cooling and supply flow rates.					
2.17	**Process water efficiency** Provide process water via a closed-loop system designed to provide water at a pre-set temperature to cool the laboratory equipment. Always avoid the use of once-through cooling water for lab equipment.	2	Yes	2	Process water is not being supplied at present. If supplied it shall be a closed loop recirculating system.					
2.18	**Water harvesting** Prepare a monthly water balance report to assess options for rainwater reuse for building. The water balance report must assess the roof collection area, amount of median monthly rain water available, monthly building and garden water demands, life cycle cost savings in avoided water consumption, and the operation and maintenance costs of the water treatment system. Water tanks must be sized appropriately to maximise water collection potential of the building for irrigation, cooling tower use and WCs and urinals. Nominally allow the lesser of either 0.05 cubic meters or 50L storage per 1 m2 of roof area, or 75% of the maximum monthly peak water demand for the building. The water balance report must identify the portion of annual building water consumption that will be met by rainwater reuse. The appropriate system must be installed in accordance with the CIS Hydraulic Standard.	3	Yes	3	The UOS water harvesting template is to be completed and investigations shall be carried out to size the rainwater harvesting system correctly and outline monthly water capture, consumption and expenditure rates.	Completed UoS Water Harvesting Template Water balance report, identify space allowance for tank and size of tank				Completed UoS Water Harvesting Template As built Hydraulic Drawings As built Hydraulic Schematic
2.19	**Fire Systems** Provide a system to capture, store and reuse fire system test water or use a fire protection system that does not expel water for testing.	1	Yes	1	The building contains a fire sprinkler and hydrant system. A system for capture and reuse of fire system test water shall be provided.	Completed UoS Fire Systems Template				Completed UoS Fire Systems Template As built Fire Schematic As built Fire Drawings
Waste Management & Resource Recovery										
2.20	**Centralised Building Waste Management System** Design internal and external centralised waste and recycling bin systems in accordance with the Waste Management Design Standard.	1	Yes	1	Centralised waste and recycling bin systems shall be provided in accordance University Waste Management Design Standard. These measures shall promote and simplify resource recovery and recycling in the LEES1					As built Architectural Drawings As built Landscape Drawings As built Architectural FFE
2.21	**Waste Storage** Provide a dedicated storage area for the separation and collection of recyclable waste in accordance to the Waste Management Design Standard. Laboratory hazardous waste: Storage and handling of hazardous waste from laboratories must be in accordance with the Design Standard http://sydney.edu.au/whs/guidelines/hazardouswaste/	1	Yes	1	A dedicated storage area for the separation and collection of recyclable waste shall be provided in accordance University Waste Management Design Standard. These measures shall promote and simplify resource recovery and recycling in the LEES1 building.	Completed UoS Waste Storage Template				As built Architectural Plans Completed UoS Waste Storage Template
		53		43			0			
3. Healthy Environment										
3.1	**Access to water stations** Provide outdoor filtered water stations, non chilled (with bottle fill facilities) in all new buildings over 2000m2 unless a University filtered water station is in the local vicinity (50m) precinct. Include internal drinking fountains in large student common/seating spaces and eating/dining spaces.	1	Yes	1	Access to drinking water fountains is provided in student common and eating spaces. REFER TO DOCUMENTS: H201-H208, Hydraulic Design Report, Hydraulics Services ECI Specification.					As built Architectural and Landscape Drawings
3.2	**Avoid Over lighting Spaces** Ensure the building lighting design for Fully Enclosed Covered Areas (FECA) provides illuminance of no more than 25% above the minimum maintained illuminance levels in accordance to the Lighting Design Standard. Working plane shall be taken as 720mm above finished floor level (AFFL) unless agreed otherwise with University of Sydney. Fully Enclosed Covered Areas (FECA) is defined by the Tertiary Education and Facilities Management Association (TEFMA) Guidelines.	3	Yes	3	Lighting systems shall be designed to meet the criteria. REFER TO DOCUMENTS: E200-E208, Electrical Services ECI Specification.	Complete UoS Avoid Over Lighting Spaces Template				Complete UoS Avoid Over Lighting Spaces Template and calculations
3.3	**Daylighting** Demonstrate a Daylight Factor (DF) of 2% is achieved at desk-height level (720mm AFFL) under a uniform design sky for at least 30% of the nominated area. Nominated areas are those occupied continually for a period of 4 hours or greater during daylight hours, including offices, learning spaces such as classrooms, computer rooms, library and workshops. Daylighting is desirable to reduce reliance on artificial lighting. Vision glazing does not include windows below 720mm or above 2400mm AFFL.	2	No	2	The passive design features of the building allow for sufficient daylighting to meet or exceed the criteria.	Completed UoS Daylight Template Document				Completed UoS Daylight Template Document Daylight Modeling Assessment Report
3.4	**External Views** Ensure that 40% of the nominated area has a direct line of sight to the outdoors, or into an adequately sized and day lit internal atrium. Views of nature help improve the attention span and wellbeing of occupants by providing daylight, sense of time, weather and distant focal points / connection to campus environment.	2	No	2	Access to external views in LEES1 shall meet or exceed the criteria. External views provide a connection to nature and the campus and also help to create an environment	Completed UoS External Views Template Document				Completed UoS External Views Template Document
3.5	**Avoid Glare** Reduce glare through the use of fixed shading devices, window tinting or operable devices such as shades or blinds to all external or perimeter windows & glazing in accordance with the Architectural Standard. Provide black-out shades as appropriate for spaces with audio-visual requirements. All shading devices must include and incorporate a safe and cost-effective access system for cleaning and maintenance. Where glare reduction is achieved by other than use of operable shading devices, the following assessment is required: • Glare Assessment in accordance with the Daylight Glare Index (DGI) methodology • DGI not exceeding 22 (Acceptable) on the DGI Scale The most cited model for predicting discomfort or reduction in visibility in a day-lit environment is the Daylight Glare Index (DGI). It is calculated from the 'Hopkinson-Cornell large-source glare formula'. It is a function of source size and location, source and background luminance, and direction of view. The probable subjective responses to glare index levels are: * Discomfort Zone Intolerable = DGI 30+ , * Just Intolerable 28, * Uncomfortable 26, * Just Uncomfortable 24 * Comfort Zone Acceptable 22 , * Just Acceptable 20 , * Noticeable 18, * Just Perceptible 16 Modeling of the DGI must be performed in Radiance or equally approved software with high level of detail and accuracy according to relevant guidelines. The calculation basis for estimated DGI values (equation based) given in the below section. The following information and parameters must be utilised for all Glare assessments. * Building Simulation Model - The simulation model must reflect the finalised design and include over-shadowing from adjacent structures (such as adjacent walls, buildings and shading projections) * Geographic Location - • The assessment should be undertaken using Sydney design conditions * Materials Surfaces - The following material reflectance represents typical surface reflectance for materials used in buildings design • Floors: 0.1 , • Internal walls: 0.4 , • Ceilings: 0.7, • Window Framing: 0.7, • Roofs: 0.2 , • Surrounding buildings 0.2-0.3 Where the specified materials used significantly differ from the reflectance values noted above, the actual reflectance properties must be provided (i.e. manufacturer material datasheet). * Glazing Properties - The following Glazing Properties must be used in the glare assessment: • Internal and external reflectance properties (%) and • Visible Light Transmittance (VLT) The glazing used must be consistent with the performance values used in the thermal calculation. * Artificial Lighting - The artificial lighting must be included in the glare assessment. * Design Sky Conditions - The glare study must be assessed for the 21st of June, September and December, with the following sky conditions:	2	Yes	2	The optimised shading scheme for the LEES1 building facilitates the application of glazing while mitigating extra heat loads and glare. Operable shading devices shall be incorporated to give occupant control over the lighting environment within the space.	Completed UoS Avoid Glare Template				Completed UoS Avoid Glare Template For Construction Architectural Elevations For Construction Architectural Section drawings For Construction Architectural Schedule or For Construction Façade Specification Glazing data sheets
3.6	**Thermal Comfort** For Naturally Ventilated and Mechanically Assisted Naturally Ventilated Spaces the Usable Floor Area falls within the Acceptability Limits of ASHRAE Standard 55-2004 are achieved during Standard Operating Hours of Occupancy for 98% of the year for internal temperatures within 80% of Acceptability Limit 1. For Mechanically Air-Conditioned Spaces the Useable Floor Area falls within the Predicted Mean Vote (PMV) levels, calculated in accordance with ISO7730, for Standard Operating Hours of Occupancy for 98% of the year using standard clothing and metabolic rate values for PMV levels between -0.5 and +0.5, inclusive for 95% of the UFA For mixed mode buildings, the above mechanical and natural ventilation thermal comfort criteria must be met for the relevant Useable Floor Areas where the systems are provided. The thermal comfort indices shown below must be used in the thermal comfort assessment: • Air temperature: Must be calculated and fall within 20°C -25°C. • Mean radiant temperature: Must be calculated and fall within 19°C -26°C. • Air velocity: Must be calculated and fall within 0.1 – 0.3 m/s in occupied zones • Humidity: Must be calculated and fall within 40% – 70% • Metabolic Rate/Activity Level: (1.2 – 1.25) • Clothing (clo): Light Business clothes The PMV value must be calculated in a dynamic building simulation software such as IESVE or equivalent for a whole year. The calculation must be based on local weather data from a reliable source, such as an IWEC (International Weather for Energy Simulation) file. A frequency analysis of the PMV levels must be assessed for a period of 30 days within the peak months of January to February. The building model, ventilation/heating/cooling strategy, input data and results/conclusions must be documented and presented to the University. (Usable floor area for the PMV calculation excludes external covered areas, libraries, cafe / canteens or gymnasiums).	2	Yes	2	The mechanical systems shall achieve the criteria of the credit. Dynamic building simulation shall be used to calculate the thermal comfort for the project.					Thermal Comfort Assessment Modeling Report As built Mechanical Drawings As built Architectural Plans
3.7	**Location of Stairs** Provide accessible (available for use by building users and the public) and highly visible stairs in the building as an alternative to vertical transportation by lift. Stairs are to be located within 5m of the primary set of lifts or within 20m of a main entrance. Place highly visible directional signage next to lifts and main entrances to encourage stair use. Signage must be in accordance to the University Signage Standard.	1	Yes	1	The western staircase is positioned at the main public entrances to the building and glazed on the western façade to provide a visual connection and promote an alternative to using lifts. Signage shall be provided to meet the requirements of the					As built Architectural Plans
3.8	**Building Noise** Design the overall building sound levels in line with the lower values specified in the current version of AS/NZS 2107. The noise-level calculations must account for both internal and external noise sources.	1	Yes	1	The building fabric and services shall be specified to meet or exceed the noise criteria of the credit.					Acoustic Assessment Report by Suitably qualified person

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Project Name: LEES1
Building Type: Laboratory Building
Date : <input submission date>

No.	Measure	Points Available	Mandatory Measure	GATEWAY 1 - 3 (Preliminary Design): Project Team Input – Points Targeted	GATEWAY 1 - 3 (Preliminary Design): Preliminary Design Response – Specify how the design intent will achieve the targeted measure	GATEWAY 1 - 3 (Preliminary Design): Preliminary submission requirements	GATEWAY 4 (Design & Construction): Project Team Input – Points Targeted	GATEWAY 4 (Design & Construction): Contractor Design Response – Specify how the project will achieve the targeted measure	GATEWAY 4 (Design & Construction): Comments from the 80% Construction Documentation workshop	GATEWAY 4 (Design & Construction): As Built submission requirements – Provide the mentioned As Built documentation to demonstrate how the project complies with the requirements of this measure
3.9	**CO_2 Monitoring** Provide a carbon dioxide (CO2) monitoring and control system in accordance with the University Mechanical Design Standard.	3	Yes	3	CO2 monitoring and ventilation controls have been incorporated to modulate the ventilation rates of internal spaces to match the occupancy, therefore supplying the					As built Mechanical Layouts As built BMS Points Schedule
3.10	**Volatile Organic Compounds - Adhesives & Sealants** Ensure that adhesives and sealant products (used in the interior of the building, and applied on site, including both exposed and concealed applications) have low Total Volatile Organic Compound levels (TVOCs), maximum limits are defined in the compliance template. Products must be certified to one of the following schemes, as appropriate. Product compliance with the following independent third-party schemes is deemed acceptable: - Ecospecifier - Good Environmental Choice Australia (GECA)	2	Yes	2	Adhesive and sealant products shall be selected to contain low or no Volatile Organic Compounds (VOCs) and meet the criteria	Completed UoS VOC Template				Adhesives and Sealants Construction Schedule listing all products installed Completed UoS VOC Template
3.11	**Volatile Organic Compounds - Paints & Carpets** Ensure that any flooring product have a low Total Volatile Organic Compound levels (TVOCs). Limits are defined in the compliance template. Products must be certified to one of the following schemes, as appropriate. Please see compliance document for more detail on minimum certification levels per scheme. Compliance with the following independent third-party schemes is deemed acceptable: - Ecospecifier - Good Environmental Choice Australia (GECA)	2	Yes	2	Flooring and paint products shall be selected to contain low or no Volatile Organic Compounds (VOCs) and meet the criteria	Completed UoS VOC Template				Paints and Carpets Construction Schedule listing all products installed Completed UoS VOC Template
3.12	**Formaldehyde Minimisation** Ensure that all engineered wood products used in exposed or concealed applications, must either have low formaldehyde emissions or contain no formaldehyde. Engineered wood products are defined as particleboard, plywood, veneer, Medium Density Fiberboard (IVI DF) and decorative overlaid wood panels. Please see compliance document for more detail on minimum certification levels per scheme. Product compliance with the following independent third-party schemes is deemed acceptable: - Ecospecifier - Good Environmental Choice Australia (GECA) - Institute for Market Transformation to Sustainability (MTS) - Australasian Furnishing Research and Development Institute (AFRDI)	2	Yes	2	All engineered wood products used in exposed or concealed applications are specified to contain low or no formaldehyde to avoid harmful emissions that can cause illness and discomfort for occupants.					Composite Timber Schedule listing all products installed

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Project Name: LEES1
Building Type: Laboratory Building
Date : <input submission date>

		Points Available	Mandatory Measure	GATEWAY 1 - 3 (Preliminary Design) Project Team Input Points Targeted	Preliminary Design Response Specify how the design intent will achieve the targeted measure	Preliminary submission requirements	GATEWAY 4 (Design & Construction) Project Team Input Points Targeted	Contractor Design Response Specify how the project will achieve the targeted measure	Comments from the 80% Construction Documentation workshop	As Built submission requirements Provide the mentioned As Built documentation to demonstrate how the project complies with the requirements of this measure
3.13	**Ceiling Fans** Provide ceiling fans for all mixed mode and naturally ventilated areas according to the following schedule: 1. Student Accommodation: One ceiling fan per common living room space and one ceiling fan per bedroom where the fan does not exceed i) 15m2 if it has a blade rotation diameter of not less than 900mm; and ii) 25m2 if it has a blade rotation diameter of not less than 1200mm 2. Office: One ceiling fan per individual enclosed office space or meeting room i) 15m2 if it has a blade rotation diameter of not less than 900mm; and ii) 25m2 if it has a blade rotation diameter of not less than 1200mm 3. Education: One ceiling fans per enclosed spaces where the fan does not exceed i) 15m2 if it has a blade rotation diameter of not less than 900mm; and ii) 25m2 if it has a blade rotation diameter of not less than 1200mm Placement of ceiling fans must be designed to avoid light flicker. Note: the following areas are excluded from this measure - communal and open plan office spaces, circulation spaces and plant rooms and special-use spaces such as laboratories.	2	No	2	Ceiling fans shall be specified for all mixed mode offices and meeting rooms. Large diameter, low speed ceiling fans have been specified for the foyer and common areas to provide low energy air circulation and effective cooling.					For Construction Mechanical Layouts For Construction BMS Points Schedule
3.14	**Planting selection** Incorporate food plants and herbs into the landscape design.	1	No	0						As built landscape plan
		26		25			0			
4. Materials										
4.1	**Loose Furnishings** Specify furnishings with high recycled content, end-of-life local recyclability, product stewardship agreements, warranties greater or equal to ten years. Compliance with the following independent third-party schemes is deemed acceptable: - The current version of Ecospecifier's Green Tag Green Rate Level A, B or C; OR - Australasian Furnishing Research and Development Institute (AFRDI) Green Tick Level C/Silver - Level B or Green Tick Level B/Gold - Level or Green Tick Level A/Platinum - Level A - The current version of Good Environmental Choice Australia GECA 28 - 'Furniture Fittings and Foam' - Level or GECA 28 - 'Furniture and Fittings' - Level B; OR - The current versioin of the Institute for Market Transformation to Sustainability (MTS) Institute for Market Transformation to Sustainability (MTS or SMaRT Sustainable Gold - Level A At least 50% of all furniture items are to be certified to one of the above schemes and the remaining 50% of the items must have at least one (1) environmental credential of: A high recycled content OR End-of-life local recyclability OR product stewardship agreements OR product warranty greater or equal to ten years	2	Yes	2	Loose furnishing shall be selected to meet the criteria. By selecting loose furnishings which comply with independent environmental certification, for example Ecospecifier or Good Environmental Choice Australia, the project will confidently reduce environmental impacts and waste from furnishings over the life of the building.	Completed UoS Loose Furnishings Template				As built Architectural FFE Environmental Manufacturer Data on Furniture Selections Summary Table listing Products and Environmental Claims Completed UoS Loose Furnishings Template
4.2	**Sustainable Timber (1)** Use re-used, post-consumer recycled, or FSC-certified and or PEFC certified timber for at least 50% of all timber products used for concrete formwork, structural, wall linings, flooring and joinery on the project. Supplied timber must be accompanied by chain-of- custody certificate.	2	Yes	2	Sustainable timber shall be specified for at least half of the timber products used on the project to meet or exceed the criteria					Timber Tracking Sheet confirming materials installed
4.3	**Recycled Steel (1)** Ensure that at least 60% of all steel, by mass, has a post-consumer recycled content greater than 50% or is reused.	3	Yes	3	60% by mass of all steel shall have a post-consumer recycled content greater than 50% or be reused steel to mee or exceed the criteria					Statement from Steel Manufacturer Statement from Head Contractor confirming products installed
4.4	**Façade Reuse** Where there is an existing building, reuse the existing façade so that it comprises at least 50% of the new development's façade.	2	No	0		Completed UoS Façade Reuse Template				Completed UoS Façade Reuse Template As built Architectural Elevations
4.5	**Structure Reuse** For redevelopment of existing buildings ensure that, by gross building volume, at least 30% of the building structure is reused.	3	No	0						Volume Calculation Assessment As built Architectural Plans
4.6	**Sustainable Timber (2)** Use re-used, post-consumer recycled, or FSC-certified and or PEFC certified timber for at least 80% of all timber products used for concrete formwork, structural, wall linings, flooring and joinery on the project. Supplied timber must be accompanied by chain-of- custody certificate.	3	No	0						Timber Tracking Sheet confirming materials installed
4.7	**Steel (2)** *When reinforcing steel constitutes more than 50% of the total steel on the project:* - At least 90% of all reinforcing bar and mesh meets or exceeds 500MPa strength grade, and at least 50% of all reinforcing bar and mesh is produced using energy-reducing technologies in its manufacturing (measured by average mass by steel maker annually); AND - At least 90% of all reinforcing steel meets or exceeds 500MPa strength grade, and at least 10% (by mass) of all reinforcing steel is assembled using off site optimal fabrication techniques. *When structural steelwork constitutes more than 50% of the total steel on the project:* - At least 90% of all products must meet or exceed the nominated steel strength grades below: Roof sheeting 550MPa Wall sheeting 550MPa Profiled-steel decking 550MPa Purlins 450MPa Girts 450MPa Light-steel framing systems* 450MPa AND - At least 20% of all products must meet or exceed the nominated steel strength grades below: Hot-rolled structural steels (including plate) (e.g. universal beam and column sections, parallel flange channels, angles) 350MPa Cold-formed sections (including hollow sections) (e.g. square and rectangular hollow sections, circular hollow sections, cold-formed channels and angles) 450MPa Welded sections (e.g. welded beams and columns made from plate) 400MPa AND - At least 50% of the fabricated structural steelwork is supplied by a steel contractor accredited to the Environmental Sustainability Charter of the Australian Steel Institute.	3	No	0						Steel Calculation Sheet Manufacturer Certificates Statement from Steel Manufacturer confirming extent of off-site fabrication and optimisation techniques used
4.8	**Recycled Concrete** Ensure at least 25% of all fine aggregate (sand) and coarse aggregate inputs in the concrete are manufactured sand or other alternative materials (measured by mass across all concrete mixes in the project) This must be achieved *without increasing the volume of Portland cement used by over 5kg/m3* AND The average content of portland cement used in the concrete mix has been reduced by at least 30% compared to a reference case.	3	No	3	The project shall meet or exceed the requirements for recycled concrete.					Concrete Batch Reports and calculations Statement from Concrete Supplier
4.90	**Regional materials** At least 50% of construction and fit-out materials must be manufactured in Australia, using raw materials from Australia.	3	No	0						
4.10	**Joinery** Specify joinery that is either modular and reusable, eco-preferred, or environmentally innovative.	3	No	0		Completed UoS Joinery Template				Environmental Manufacturer Data on Joinery Items Joinery Shop Drawings Statement from Joinery Contractor Completed UoS Joinery Template
4.11	**PVC Minimisation** Replace 30% of PVC products by cost, e.g. pipes, conduits, sheathing and backing of carpet tiles with alternative environmentally preferable alternatives	3	No	0						Data Sheets on Alternative PVC Producers Summary Table listing all non-PVC items and PVC items by cost
4.12	**Design for Disassembly** Design the façade such that minimum 95% can be easily removed from the main structure and disassembled at the end of the products life or building life to allow for future reuse of these materials locally.	3	No	0						Summary Table Calculation Sheet for Façade Systems Disassembly plan covering elements to be recovered and permanent labelling (properties and date of manufacture) of elements to be recovered. As built Architectural Plans As built Architectural Elevations As built Architectural Sections and Detail Drawings
		33		10			0			

The University of Sydney - Sustainability Framework

Project Name: LEES1
Building Type: Laboratory Building
Date : <input submission date>

				GATEWAY 1 - 3 (Preliminary Design)			GATEWAY 4 (Design & Construction)			
		Points Available	**Mandatory Measure**	**Project Team Input** **Points Targeted**	**Preliminary Design Response** **Specify how the design intent will achieve the targeted measure**	**Preliminary submission requirements**	**Project Team Input** **Points Targeted**	**Contractor Design Response** **Specify how the project will achieve the targeted measure**	**Comments from the 80% Construction Documentation workshop**	**As Built submission requirements** **Provide the mentioned As Built documentation to demonstrate how the project complies with the requirements of this measure**
5. Climate Change, Landscape & Infrastructure										
5.1	**Infrastructure Future proofing** Future proof all infrastructure and plant rooms to allow for readily accessible connection points to future precinct based energy and water distribution systems (e.g.. Hot/chilled water loops, recycled water). This credit is designed to ensure that buildings are able to transition across to centralised utility services.	**3**	**Yes**	**3**	The energy and water systems will include provisions for connection to future precinct energy and water distribution systems future proofing the building for potential infrastructure upgrades at the campus. REFER TO DOCUMENTS: Mechanical Design Report, Mechanical Services Specification.					Services Design Return Brief by Mechanical, ITC, Hydraulic and Electrical Consultants
5.2	**High Albedo Roof Materials** Use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than 78 for low-sloped roofs (less than a 2:12 pitch) or 29 for steep-sloped roofs (greater than a 2:12 pitch) for a minimum of 75% of the total roof surface. SRI guide for roofing materials is as follows: Colorbond Wallaby - 38 Colorbond Gully - 39 Colorbond Cove - 51 Colorbond Dune - 61 Colorbond Paperbark - 68 Colorbond Classic Cream - 82 Colorbond Surfmist - 92 White coated grave on built-up roof - 79 White coating on metal roof - 82 White EPDM -84 White cement tile - 90	**1**	**Yes**	**1**	Materials for the roof have been selected with high solar reflectance indexes which meet or exceed the requirements of the credit to reduce heat gain in the building and localised heat island effects.	Completed UoS High Albedo Materials Template				As built Architectural Finishes Schedule As built Architectural Roof Plan Completed UoS High Albedo Materials Template
5.3	**Surface Heat Reduction** Provide a combination of the following for 90% of the ground materials: - Natural shade is provided by building overhangs or landscaping; OR - Paving materials with a Solar Reflectance Index (SRI) of at least 29; OR - Architectural shade features with a Solar Reflectance Index (SRI) of at least 29; OR - Open-grid pavement system for at least 50% of the hardscape surrounding the building. Open-grid paving is 50% impervious and accommodates vegetation in open cells; SRI guide for paving materials is as follows: New grey concrete - 35 Weathered grey concrete - 19 New white concrete - 86 Weathered white concrete - 45 New Asphalt - 0	**1**	**Yes**	**1**	Materials for ground surfaces been selected with high solar reflectance indexes which meet or exceed the requirements of the credit to reduce heat gain in the building and localised heat island effects.					As built Landscape Drawing(s) As built Landscape Schedule
5.4	**Landscape** Increase the number of trees and flora while recognising the cultural value of the campus landscape. Provide tree at natural ground level, for shade and visual interest, to reduce heat-island effects, where they do not obscure views to facades of important buildings nor visual linkages or solar PV systems. Plant native trees and flora in recreational spaces and in accordance to the Landscape Masterplan and Landscape Design Standard.	**1**	**No**	**0**						As built Landscape Drawing(s) As built Landscape Schedule
5.5	**Flood Risk Management** Protect / locate essential building services equipment such as electrical and mechanical infrastructure to avoid inundation and maintain the lesser of either 500mm free board above the modeled 1 in 100 year flood level, or the PMF level.	**2**	**Yes**	**2**	Essential buildings services have been located to avoid inundation from future storm and flood events in accordance with the criteria of the credit.					
5.6	**Stormwater Management** Ensure the site stormwater management, harvesting system is designed in accordance with the University's Stormwater Masterplan and incorporates water sensitive urban design elements.	**2**	**No**	**0**						
5.7	**Green Roof / Wall** Provide a green roof to at least 50% of the available roof area (excluding areas dedicated to solar PV system) and/or a green wall for at least 20% of the vertical surface area of the building in order to reduce the heat island effect of the project. Use xeriscaping principles to guide the landscape strategy. Where irrigation is required, use non-potable water sources or reduce potable water use by at least 90%.	**2**	**No**	**0**						As built Architectural Roof Plan As built Landscape Drawing(s) As built Landscape Schedule
		12		**7**			**0**			
6. Sustainable Transport										
6.1	**Cycle Parking** Provide bicycle parking racks for staff and students in accordance to the Architectural Design Standard, CIP Masterplan and Access Strategy.	**2**	**Yes**	**2**	Bicycle parking shall be provided for staff and students in accordance with the CIP Masterplan and Access Strategy.	Completed UoS Cycle Parking and End of Trip Facilities Template				Completed UoS Cycle Parking and End of Trip Facilities Template As built Architectural or Landscape Plans
6.2	**End of Trip Facilities** Provide changing / showering facilities and lockers for staff and students in accordance to the Architectural Design Standard, CIP Masterplan and Access Strategy.	**2**	**Yes**	**0**		Completed UoS Cycle Parking and End of Trip Facilities Template				Completed UoS Cycle Parking and End of Trip Facilities Template As built Architectural Plans
6.3	**Car parking** Limit car-parking to no more than the minimum local planning allowances requirements. Ensure car parking requirements are in accordance with the Campus Improvement Plan.	**2**	**No**	**2**	Car parking shall be provided to meet or exceed the requirements of the credit.					As built Architectural Drawings Summary Calculation Sheet
6.4	**Motor cycle and small car parking** Where car parking is to be provided, provide preferential parking to the extent that 20% of non-disabled car spaces are dedicated to motorbikes and 10% to small cars.	**1**	**No**	**0**						As built Architectural Plans
		7		**4**			**0**			

7. Appendix B - Whole of Life / Life Cycle Costs

The estimated whole of life / life cycle costs for major plant and services systems are summarised below.

A number of inputs and assumptions have been made to in order to provide the whole of life cost for various HVAC systems, and includes the following inputs;

Assessment Criteria

- Analysis Period — HVAC 25 years
Facade 50 years
- Discount Rate — 5%
- Inflation Rate — 2%
- Occupancy — Monday – Friday, 8am to 6pm

Associated Costs

- Gas — $0.01/kWh
- Electricity — $0.02/kWh
- Labour Costs — $75/hr
- Maintenance Requirements — AIRAH DA19 HVAC&R-Maintenance

Equipment replacement costs are incorporated into the calculations where equipment lifespan is less than 25 years (as detailed within CIBSE Guide M – Maintenance Engineering and Management).

Where possible, various options have been investigated and a comparison made to highlight the option providing better value for money over the life cycle.

Some commentary is provided within each options table highlighting opportunities that could be considered to further improve the Whole Life Cost of the preferred design solution.

HVAC SYSTEMS – AIR HANDLING PLANT		
	Base	**Option 1**
Description	Combination of centralised Air Handling Units and distributed Fan Coil Units.	Centralised Air Handling Units, Variable Air Volume boxes in-lieu of Fan Coil Units.
Estimated Equipment Cost ($)	480,000	382,000
Annual Gas Consumption (kWh)	-	-
Annual Electrical Consumption (kWh)	339,652	357,500
Maintenance Cost ($/year)	74,280	60,000
Equipment Replacement Cost ($)	330,000 (FCU's)	132,000 (VAV's)
Calculated Costs		
Annual Energy Costs ($)	67,930	71,500
Total Discounted Energy Cost ($)	1,190,970	1,253,240
Total Discounted Maintenance Costs ($)	1,301,970	1,051,670
Whole Life Cost ($)	**2,972,650**	**2,686,910**
Comments	Option 1 has the better WLC outcome. However, the base case option is the preferred design solution. A VAV system serving laboratory areas would require a complex controls strategy which would increase both installation and maintenance costs (note this has not been factored into the calculations). To reduce the WLC of the base case, further consideration could be given to incorporating heat recovery to pre-heat or pre-cool incoming outside air.	

HVAC SYSTEMS – CHILLED WATER SYSTEM		
	Base	**Option 1**
Description	Water cooled chillers and cooling towers.	Air cooled chillers
Estimated Equipment Cost ($)	570,000	640,000
Annual Gas Consumption (kWh)	-	-
Annual Electrical Consumption (kWh)	905,017	230,609
Maintenance Cost ($/year)	8,100	2,100
Equipment Replacement Cost ($)	N/A	N/A
Calculated Costs		
Annual Energy Costs ($)	181,000	230,610
Total Discounted Energy Cost ($)	3,172,5950	4,042,071
Total Discounted Maintenance Costs ($)	141,975	36,810
Whole Life Cost ($)	**3,884,575**	**4,718,880**
Comments	Water cooled chillers and cooling towers, although have a higher maintenance component have a significantly lower WLC due to the higher efficiencies associated with water cooled chillers. Water cooled chillers and cooling towers are the preferred design solution.	

HVAC SYSTEMS – BOILER	
	Base
Description	Gas Fired Boilers
Estimated Equipment Cost ($)	120,000
Annual Gas Consumption (kWh)	879,575
Annual Electrical Consumption (kWh)	-
Maintenance Cost ($/year)	2,400
Equipment Replacement Cost ($)	N/A
Calculated Costs	
Annual Energy Costs ($)	87,960
Total Discounted Energy Cost ($)	1,541,703
Total Discounted Maintenance Costs ($)	42,070
Whole Life Cost ($)	**1,703,770**
Comments	Consideration could be given into providing a different heating solution to reduce the WLC. For example, utilising higher condenser water temperature from the chiller to provide heating, thereby reducing the energy consumption associated with the gas fired boiler.

FACADE - GLAZING		
	Base	**Option 1**
Description	Single Glazing	Double Glazing
Estimated Cost ($)	2,800,000	3,100,000
Annual Gas Consumption (kWh)	256,662	247,401
Annual Electrical Consumption (kWh)	946,843	885,297
Maintenance Cost ($/year)	N/A	N/A
Equipment Replacement Cost ($)	N/A	N/A
Calculated Costs		
Annual Energy Costs ($)	215,035	201,800
Total Discounted Energy Cost ($)	215,000	200,000
Total Discounted Maintenance Costs ($)	N/A	N/A
Whole Life Cost ($)	**8,395,000**	**8,350,000**
Comments	The above energy consumption figures are indicative figures based on the IES modelling carried out and satisfies the 10% improvement over NCC Section J. We have assumed that maintenance and any replacement costs will be the same and therefore have not included with the WLC calculation. WLC is similar for both options with the double glazing option providing a slightly better outcome. Double glazing is required to achieve the 10% improvement over NCC Section J. Therefore, the double glazing option is the preferred design outcome.	

1. Comparison against Industry Benchmark Rating Scheme

1.1 GREEN STAR DESIGN AND AS –BUILT V1.1

This project is being rated under the University of Sydney's proprietary Sustainable Design Framework and therefore is not pursuing a Green Star rating, however the University's framework tool shares many of the same credits with the Green Star Design and As-Built rating tool but tailored specifically towards the needs of the University and their sustainability targets.

For the purposes of comparison the following table has been prepared which outlines where the sustainability initiatives which have been incorporated into this project are recognised by the Green Star Design and As-Built V1.1 tool.

No.	Initiative	Green Star Design and As-Built V1.1	
		Recognised	Credit Reference
5.1.1	ESD Professional	✓	1
5.1.2	Lifecycle Cost Evaluation		
5.1.3	Commissioning and Building Tuning	✓	2
5.1.4	Environmental Management Plan	✓	7
5.1.5	Site Waste Management Plan	✓	22
5.1.6	Indoor Air Quality Management Plan		
5.1.7	Building Users Guide	✓	4
5.1.8	Public Information Display		
5.2.1	Passive Design Principles		
5.2.2	Improve Building Energy Performance by 20%	✓	15
5.2.3	Solar PV Systems		
5.2.4	Hot Water Systems		
5.2.5	Energy Consuming Equipment		
5.2.6	Metering Utility Use		
5.2.7	Lighting Systems	✓	27
5.2.8	No Hot Water in Public Restrooms		
5.2.9	Natural Ventilation	✓	9.22
5.2.10	Mixed Mode Ventilation		
5.2.11	Peak Power	✓	16
5.2.12	Water Use	✓	18
5.2.13	Laboratory Equipment Water Use		
5.2.14	Process Water Efficiency		
5.2.15	Water Harvesting	✓	18
5.2.16	Fire Systems	✓	18
5.2.17	Centralised Building Waste Management Syste	✓	8B.1
5.2.18	Waste Storage	✓	8B.2
5.3.1	Access to Water Stations		
5.3.2	Avoid Over Lighting Spaces	✓	11.1
5.3.3	Daylighting	✓	12.1
5.3.4	External Views	✓	12.2
5.3.5	Avoid Glare	✓	12.0
5.3.6	Thermal Comfort	✓	14
5.3.7	Location of Stairs		
5.3.8	Building Noise	✓	10
5.3.9	CO_2 Monitoring	✓	9.2
5.3.10	VOCs – Adhesives and Sealants	✓	13.1
5.3.11	VOCs – Paints and Carpets	✓	13.1
5.3.12	Formaldehyde Minimisation	✓	13.2
5.3.13	Ceiling Fans		

5.4.1	Loose Furnishings	✓	21
5.4.2	Sustainable Timber	✓	20.2
5.4.3	Recycled Steel	✓	20.1
5.4.4	Recycled Concrete		
5.5.1	Infrastructure Future Proofing		
5.5.2	High Albedo Roof Materials		
5.5.3	Surface Heat Reduction		
5.5.4	Flood Risk Management		
5.6.1	Cycle Parking	✓	17B.4
5.6.2	Car Parking	✓	17B.2