University of Wollongong

Ecologically Sustainable Development Design Standard
Version 2 – 5 March 2012

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1. ESD OVERVIEW

Ecologically sustainable development (ESD) is the efficient expenditure of resources to ensure that future generations have access to a comparable standard of environment to that which we enjoy today. The University of Wollongong (UOW) has adopted ESD principles and established this ESD standard, which identifies the minimum design characteristics that should be applied to all new construction and refurbishment works.

This ESD standard focuses on the design phase. The objective is to nominate sustainable design characteristics and technology to ensure a minimum standard outcome. Assessment of the ESD outcome for the new development will be performed utilising the Green Star rating suite, with ongoing monitoring performed using the National Australian Built Environment Rating Scheme (NABERS) tools.

2. INTRODUCTION

This standard provides guidance to the designer on the design characteristics and/or technology to be utilised in the development to achieve a minimum standard outcome. The minimum standard outcome may be specified at a higher level, dependent upon the project.

Where the designer specifies electrical, mechanical, hydraulic or other building elements covered by a separate UOW design standard, then the designer should also refer to the related design standard to ensure that all performance requirements are satisfied.

For each project it is incumbent upon the designer to ensure that the design satisfies site specific operational, logistical and performance requirements incorporating end-user requirements, and that there is not a significant functional or performance trade off (eg. A light fitting may offer lower energy consumption, but may not satisfy minimum illumination requirements for security surveillance or general work requirements).

In determining the most appropriate design for a development, the designer should consider the long-term implications on operations and maintenance. Cost benefit analyses should be performed with consideration of the life cycle cost over the life of the building (typically 40 years), not just initial capital cost.

3. BUILDING LOCATION

The Building Location design considerations include the location of the new building, changes to the land that are made to accommodate the building, orientation of the building and design of the building with regard to the surrounding environment and adjacent structures.

3.1 Design Process

UOW will identify the location(s) and size of the new building. The designer should assess the Building Location design considerations in accordance with this design standard, and submit the findings to UOW for evaluation in conjunction with the functional and cost requirements for the project.

3.2 Design Standard References

The Building Location design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-011 - Building Elements Design Standard; and

b. FMD-MAI-STA-020 - Landscaping Design Standard.

3.3 Standards, Codes & Benchmarks

Table 3.3-1 contains a list of standards, codes and benchmarks relating to the Building Location design considerations.

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current

Table 3.3-1 - Standards, Codes & Benchmarks

3.4 Design Considerations

The Building Location design considerations have been categorised in accordance with the following:

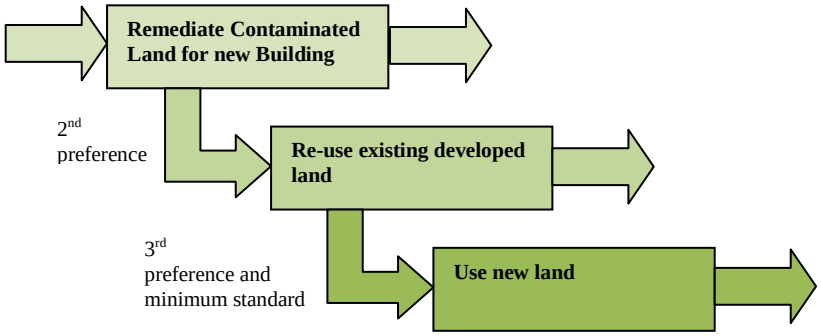
a. Land Impact; and

b. Integration with Existing Environment.

3.4.1 Land Impact

Where options exist for the location of a new building (within the constraints of UOW's geographical, functional and cost requirements), then preference should be given to constructing the building in a location that improves the existing condition of the land. Should this option not be available, then the next preference is to minimise impact on the environment by reusing existing developed land for construction.

Following is the recommended decision hierarchy for the land impact design consideration:



In all three situations (ie. Use of remediated land, re-use of existing developed land or use of new land), UOW should aim to improve the ecological value of the site. In the context of UOW's existing campuses, this would involve the provision of native gardens and minimisation of the impermeable hardstand areas around the building.

Where topsoil is excavated for a project, it should be retained on site with the aim of retaining 95% by volume.

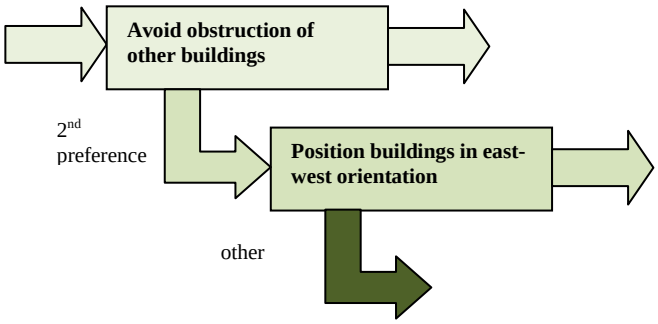
3.4.2 Integration with Existing Environment

The building should be positioned to minimise obstruction of the existing views and daylight of adjacent buildings, ensure that the new building has ample views of open space and daylight and to minimise passive solar heat gain.

Where buildings are adjacent and resulting in shadowing, the preference should be to position the buildings in an east-west orientation, such that northerly sun is not obstructed, however low-angle eastern or western sunlight will be minimised. Consideration should also be given to minimising heat radiated to/from adjacent buildings.

A route should be provided for pedestrians to travel to and from the building and integrated with the existing pedestrian routes. The pedestrian route will be developed in conjunction with a site specific transport assessment and sustainable transport initiatives.

Following is the design hierarchy for the building obstruction design considerations:



3.5 UOW Preferred Design Matrix

Table 3.5-1 contains a design matrix with UOW's preferred design decisions.

Item	Category	1st Preference	2nd Preference	3rd Preference
Building Location				
1	Land Impact	Remediate Contaminated Land for new Building	Re-use existing developed land	Use new land
2	Land Impact	Provide native garden (>40% of site area)	Provide native garden	
3	Land Impact	Retain topsoil on site	Utilise topsoil for other UOW sites	-
4	Integration with Existing Environment	**Mandatory:** Provide a pedestrian route to/from the building		
5	Integration with Existing Environment	Avoid obstruction of other buildings	Position buildings in east-west orientation	-

Table 3.5-1 - UOW Preferred Design Matrix

4. BUILDING FABRIC

4.1 Design Process

The Building Fabric design considerations should be utilised by the designer during the design of the building floor layout, structure and shell elements. As the choice of materials will be influenced by availability and cost, it is recommended that these items be confirmed as part of the process to ensure that options presented to UOW are viable.

4.2 Design Standard References

The Building Fabric design considerations should be read in conjunction with the following UOW Design Standard:

a. FMD-MAI-STA-011 - Building Elements Design Standard.

4.3 Standards, Codes & Benchmarks

Table 4.3-1 contains a list of standards, codes and benchmarks relating to the Building Fabric design considerations.

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current
4	AS/NZS 4859.1 - Materials for the Thermal Insulation of Buildings	Standards Australia	Current

Table 4.3-1 - Standards, Codes & Benchmarks

4.4 Design Considerations

The Building Fabric design considerations have been categorised as follows:

a. Building Form; and

b. Construction Elements.

4.4.1 Building Form

The size and shape of the building significantly influence the functionality, aesthetics and cost of the building. The designer must provide a design that balances each of the influencing factors within the constraints of the design requirements.

Increases to the height of a building significantly increase cost, as additional building services are required (eg. the need for sprinklers and stair pressurisation are related to the height and number of floors in a building). Increases to the floor plate of a building, however, will increase the site area required, may increase the difficulty in providing services throughout the building and may decrease the views and natural light on each floor.

Generally, at this stage of the project, the designer will have been presented with the following constraints:

a. Budget;

b. Location;

c. Purpose of the Building; and

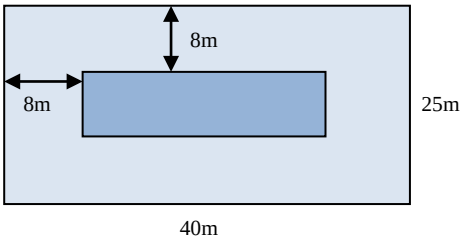
d. Usable floor area.

From these constraints, the designer should then determine the site area allocation for building footprint, roads and hardstand and native landscaped areas. The height of the building will correspondingly be determined by the site area allocation and the number of floors necessary to achieve UOW's targeted usable floor area.

The height determined should be compared against local planning requirements and a cost estimate for a building of this size compared against UOW's budget. Where the height exceeds regulatory or cost constraints, then the designer may reduce the site area allocated to native gardens.

Following determination of the floor plate size, the shape of the floors should then be designed. The shape will determine the length of the perimeter of the building, which correspondingly affects the building cost and availability of natural lighting and external views. The designer should aim to have a minimum of 60% of the floor area within 8m of a window.

Figure 4.4-1 provides an example 1,000m^2 floor plate that will comply with the minimum 60% requirement:



Example 1:

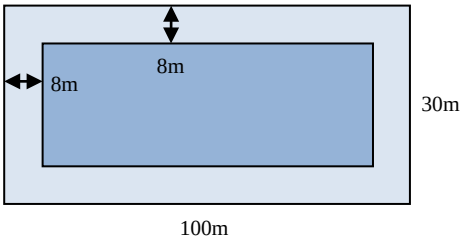
1,000m^2 floor plate with dimensions 25 x 40
Assume windows to all elevations

Area not within 8m of window = 9 x 24 = 216m^2

Therefore > 78% of floor will be within 8m of window.

Figure 4.4-1 - Example floor plate dimensions

Figure 4.4-2 provides an example 3,000m^2 floor plate that will comply with the minimum 60% requirement:



Example 2:

3,000m^2 floor plate with dimensions 30 x 100
Assume windows to all elevations

Area not within 8m of window = 14 x 84 = 1,176m^2

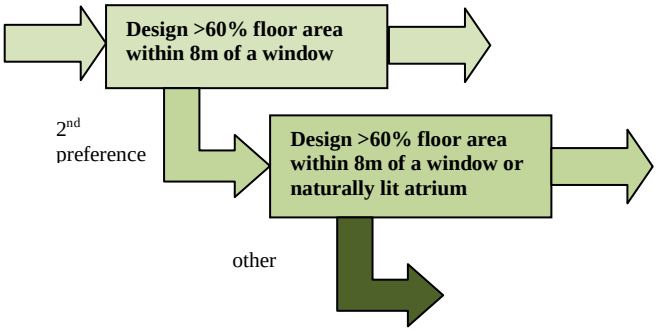
Therefore > 60% of floor will be within 8m of window.

Figure 4.4-2 - Example floor plate dimensions

Should the 60% target for area within 8m of a window not be achievable due to constraints on the size, shape and/or height of the building, then consideration may be given to the inclusion of a naturally illuminated atrium as a secondary preference.

The disadvantages of including the atrium include cost, a reduction in usable floor area and a possible increase in the services requirement (eg. For smoke hazard management)

Following is the design hierarchy for the building shape design considerations:



4.4.2 Construction Elements

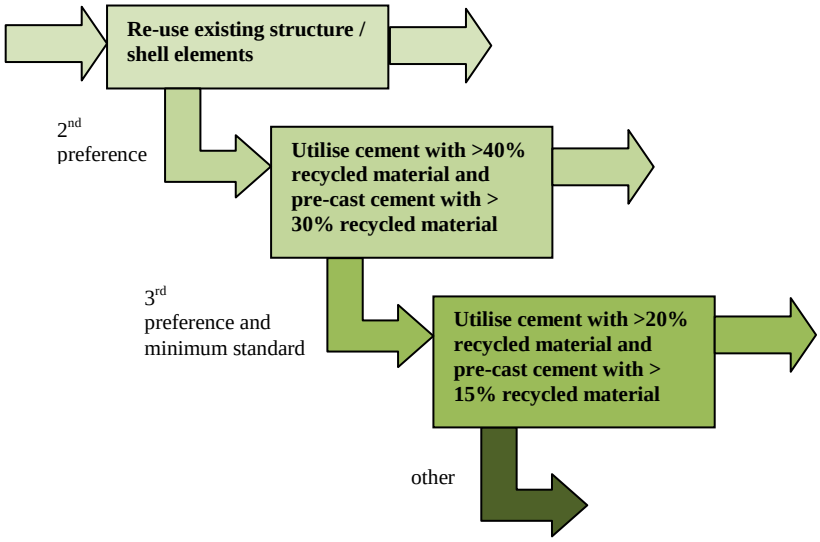
Re-use of Structure & Shell

The re-use of materials during refurbishments is essential to minimising the consumption of new resources and diverting waste product from landfill. Where the opportunity exists to re-use the existing structure and shell, then the designer should target 60% re-use of the existing structure by volume.

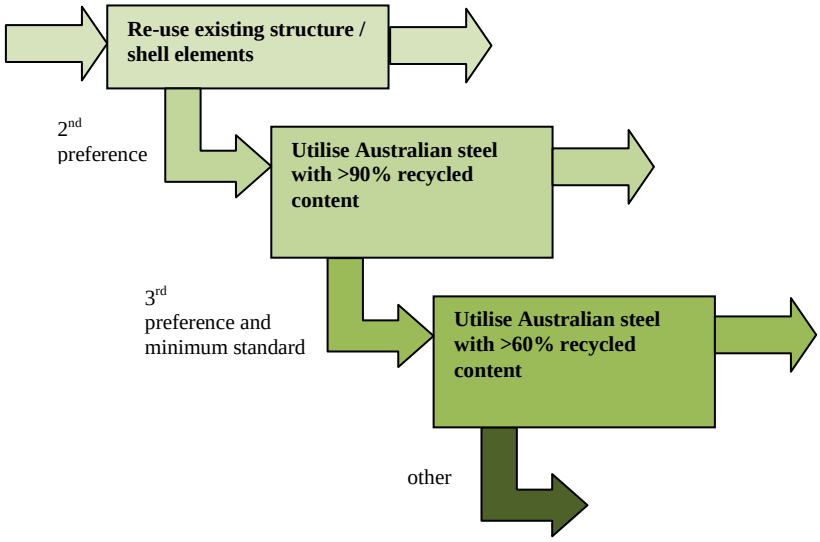
Recycled Content of Concrete & Steel

Where new concrete and steel is used, then the designer should specify that the concrete and steel contain minimum quantities of recycled material.

Following is the design hierarchy for the recycled material in concrete design consideration:

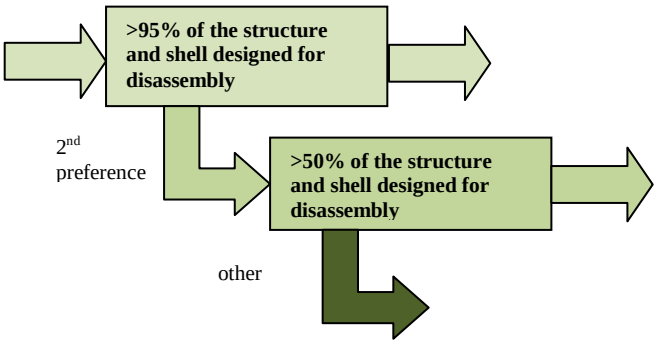


Following is the design hierarchy for the recycled material in steel design consideration:



Steel should meet or exceed its required strength grade, and be permanently marked with this grade. A minimum of 60% of the steel used should be sourced from a contractor accredited by the Environmental Sustainability Charter of the Australian Steel Institute.

Where a new structure and shell is provided, the designer should aim for 95% (by area) of the structure and shell to be designed for disassembly. This will minimise the energy required for demolition at the end of the life cycle of the building,



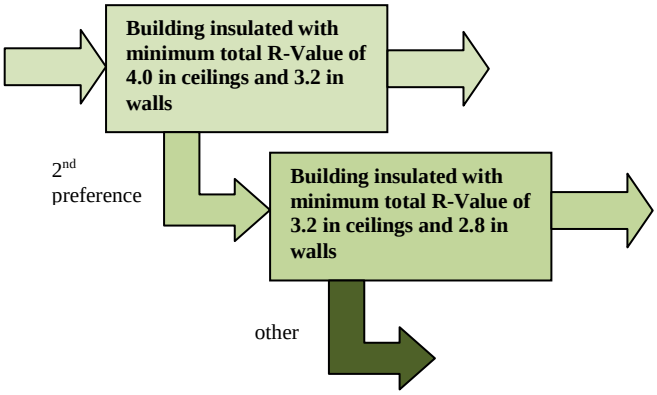
Insulation

Glasswool insulation, containing minimum 70% recycled content, should be installed within the walls and roof void to minimise thermal transferral in all buildings. The insulation should be installed such that it maintains its position and thickness, other than where it is compressed between cladding or by building services.

Wollongong is classified by the Bureau of Meteorology as a climate zone 5 location. The first preference for the designer should be to achieve a minimum total R-Value of 4.0 in ceilings and 3.2 in walls. Should this not be achievable for cost or design reasons, then the second preference is to

achieve a minimum total R-Value of 3.2 in ceilings and 2.8 in walls, which is the minimum permitted for climate zone 5 under the BCA.

The composition and manufacture of insulation material should be free of ozone depleting substances, and satisfy BCA fire indices.

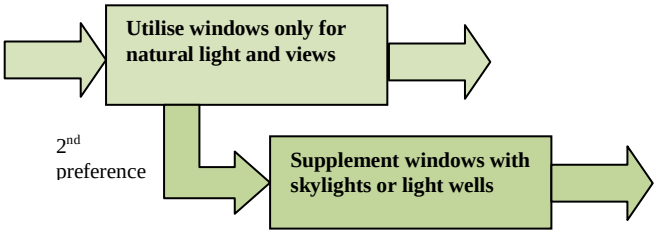


Roof Construction

Where metal roofing is utilised, the roofing should be of steel construction with concealed fixing mechanism that prevents water penetration. The roofing should be pre-fabricated with bonded colour coating with high reflectivity (to minimise solar heat gain) and high emissivity (to facilitate the transmission of heat from within the building to atmosphere).

Roof skylights and light wells may assist the designer to increase the level of natural light throughout the building, however are discouraged due to the increased risk of water penetration, loss of thermal insulation and limited application in multi-storey buildings. The preference should be for a building design that provides natural lighting and views through the windows.

Following is the design hierarchy for the use of roof skylights:



Roof Plant Layout

The layout of roof plant areas (eg. condensing units or cooling towers) should be centralised as much as possible. This will enable the equipment to utilise common service ducts, minimise roof penetrations and maximise the space available for the installation of solar thermal and/or solar photovoltaic systems.

External Shading

External louvres should be installed to minimise the impact of glare on the building occupants. Louvres should be installed on the eastern, western and northern elevations of the building, and provide shade within the building at a distance of approximately 1.5m from the glazing.

Consideration should be given to the method of cleaning of the louvres. The preference is for louvres to be cleaned from ground level, with minimal access equipment.

The designer is discouraged from utilising motorised external louvres. Whilst these systems provide improved glare control, the capital and maintenance costs are considerably higher, and when closed the benefits of natural lighting and external views are lost.

Building Sealing

Perimeter doors and operable windows should be fitted with draft protection devices to minimise infiltration and/or spill air. Testing of the building seals shall be performed to verify that minimal spill air results.

The main entrances to buildings with an air-conditioned foyer should have an airlock comprising two sets of automatic sliding doors.

External Noise

The designer should consider the location of the building in assessing whether any supplementary acoustic insulation is required. Options for minimising the internal noise level due to external sources include the use of double glazing and installation of acoustic wall panels.

Facade & Glazing

Windows should utilise performance glazing to minimise heat, glare, construction materials and project costs. Where required to address specific issues, such as high external noise levels, double glazing may be considered. The glazing should comply with grade-A safety glass, and offer low reflectivity to minimise reflections affecting adjacent buildings.

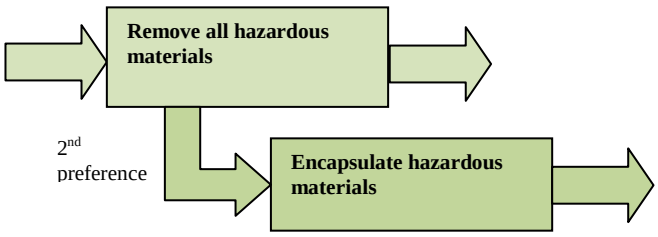
Heat transfer through the facade should be assessed by the designer and not be reliant on tenancy fit-out items for performance. For example, whilst reflective blinds could assist in minimising heat transfer, the facade and glazing shall be designed to satisfy the design criteria on its own.

Hazardous Materials

Where the project involves refurbishment of an existing structure, the designer should specify the removal of all asbestos, replacement of devices

containing poly-chlorinated biphenyls and stripping and reapplication of finishes containing lead.

Where hazardous materials are not able to be completely removed as part of a refurbishment, then the hazardous materials shall be encapsulated.



Existing timber treated with formaldehyde should be reduced, where possible. All new timber should be free of formaldehyde.

A survey of all hazardous materials must be performed on the project site.

4.5 UOW Preferred Design Matrix

Table 4.5-1 contains a design matrix with UOW's preferred design decisions.

Item	Category	1st Preference	2nd Preference	3rd Preference
Building Fabric				
1	Building Form	**Mandatory:** Building must be within local height constraints		
2	Building Form	Design floor plate to be <50% of site area	-	-
3	Building Form	Design >60% floor area within 8m of a window	Design >60% floor area within 8m of a window or naturally lit atrium	-
4	Construction Elements	Incorporate > 60% of existing structure in refurbishment	-	-
5	Construction Elements	Re-use existing structure / shell	Utilise concrete with >60% recycled material; pre-cast concrete with > 40% recycled material and stressed concrete with > 30% recycle material	Utilise concrete with >30% recycled material; pre-cast concrete with > 20% recycled material and stressed concrete with > 15% recycle material
6	Construction Elements	Re-use existing structure / shell	Utilise Australian steel with >90% recycled content	Utilise Australian steel with >60% recycled content
7	Construction Elements	Steel should be permanently marked with its strength grade. A minimum of 60% of steel used should be sourced from accredited provider.	-	-
8	Construction Elements	95% of the building structure and shell to be designed for disassembly	50% of the building structure and shell to be designed for disassembly	-

Item	Category	1st Preference	2nd Preference	3rd Preference
9	Construction Elements	Air-conditioned fully insulated with minimum total R-value of 4.0 for roof and 3.2 for walls	Air-conditioned fully insulated with minimum total R-value of 3.2 for roof and 2.8 for walls	-
10	Construction Elements	Utilise concealed fixing roofing with high reflectivity, high emissivity coating	-	-
11	Construction Elements	Centralise roof plant to maximise space for solar system		
12	Construction Elements	Utilise windows to provide natural light and views and avoid skylights	Supplement windows with skylights or light wells	-
13	Construction Elements	**Mandatory:** Provide fixed external louvres to control glare		
14	Construction Elements	Provide windows with safety rated performance glazing	-	-
15	Construction Elements	Remove all existing asbestos, PCBs and lead-based paint	Encapsulate hazardous materials that are not able to be removed.	-
16	Construction Elements	Existing formaldehyde-treated timber to be reduced. New timber should be formaldehyde free	-	-

Table 4.5-1 - UOW Preferred Design Matrix

5. BUILDING INTERIOR CONSTRUCTION & AMENITY

5.1 Design Process

The Building Interior Construction and Amenity design considerations should be utilised by the designer during the design of the internal floor layout and specifications of wall, floor and ceiling construction types.

Finishes, fixtures and fitments are covered separately in Section 10 - Fit-Out of this Design Standard.

5.2 Design Standard References

The Building Interior Construction and Amenity design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-011 - Building Elements Design Standard; and

b. FMD-MAI-STA-019 - Joinery / Space Allocation.

5.3 Standards, Codes & Benchmarks

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current
4	AS/NZS2107 Acoustics	Standards Australia	Current

Table 5.3-1 - Standards, Codes & Benchmarks

5.4 Design Considerations

5.4.1 Building Amenity

Recycled Waste Storeroom

UOW utilises shared external waste areas. The designer should establish the estimated waste quantity from the new building and identify whether an existing shared waste area is able to accommodate the additional waste disposal requirement.

Where an existing shared waste area is not available, or is of insufficient capacity, then the designer should allocate a new shared external waste location.

The designer should consider the following bin types:

a. Office paper waste for secure destruction;

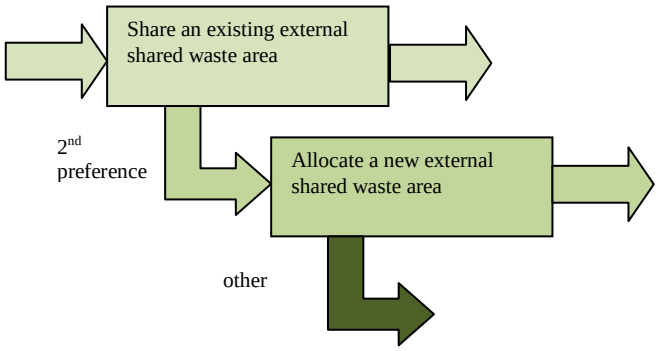
b. Comingled paper and cardboard waste;

c. Comingled recyclables;

d. Organic and paper towel waste; and

e. Separate glass, plastics and metals recycling bins.

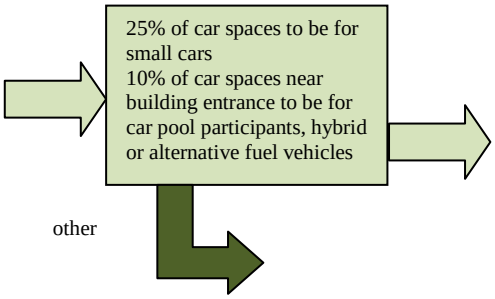
The shared waste area should be accessible by the waste management provider's vehicles and be accessible by cleaning staff travelling to/from the building.



Car Parking

The requirement for car parking will be determined by UOW, depending upon the intended usage of the building. Where car parking is required, the designer should recommend that a minimum 25% of car spaces be dedicated small car spaces, thereby maximising the usage of the space available and encouraging the use of fuel efficient cars.

10% of the car parking spaces closest to the building entrance (with the exception of accessible spaces, as required under the BCA) should be marked as preferential spaces for car pool participants, hybrid or alternative fuel vehicles. The designer is also encouraged to allocate motorcycle spaces at a ratio of 3 motorcycle space per 1 car space.



The need for recharge facilities for electric vehicles should also be assessed.

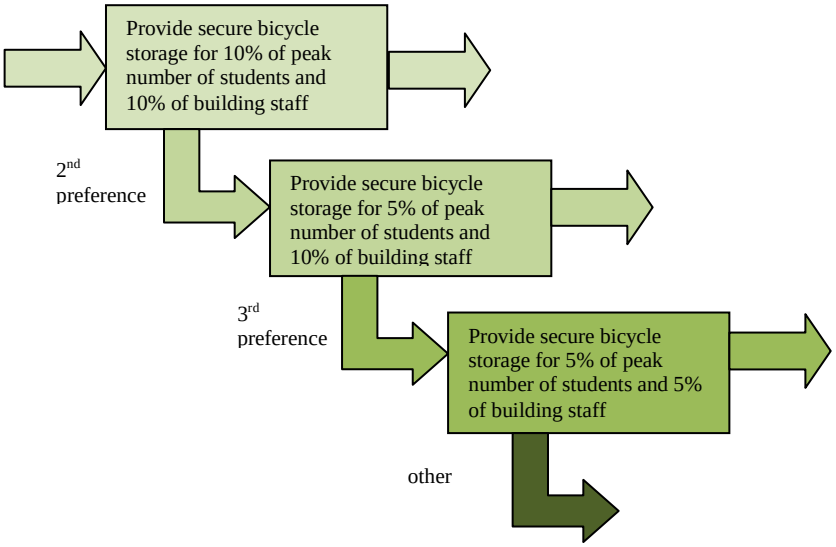
Cyclist Facilities

Secure bicycle storage should be accommodated in the building design to accommodate a minimum 10% of the peak number of students (given 75% occupancy) and 10% of building staff.

Should this quantity not be achievable, the designer's second preference should be to aim for 5% of the peak number of students and 10% of building staff.

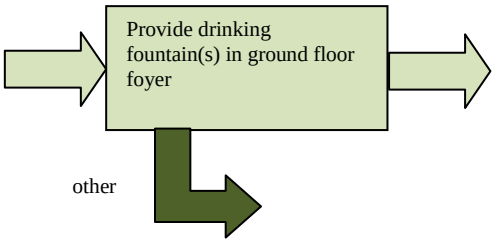
Should this quantity not be achievable, the designer's third preference should be to aim for 5% of the peak number of students and 5% of building staff.

Male and female shower and change facilities with a communal locker facility should also be provided on the ground floor.



Drinking Fountains

Filtered drinking fountains with carafe fillers should be installed to provide students and staff with convenient access to water, and encourage the reuse of plastic water bottles. The designer should include the provision of drinking water fountains with carafe fillers (at full height and an accessible height) in the ground floor foyer area.

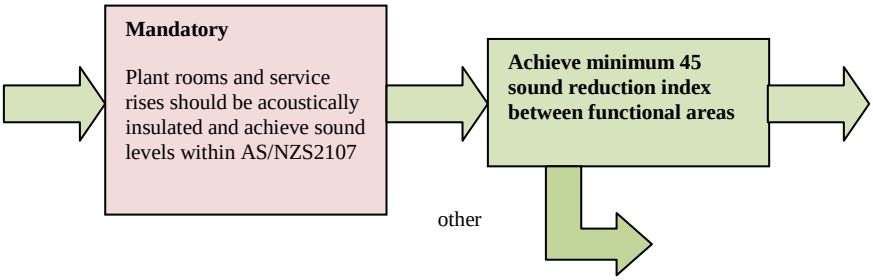


5.4.2 Interior Construction

Internal Noise

Internal partitioning should be designed to achieve a minimum sound reduction index (Rw) of 45 between functional spaces.

Plant rooms and services risers should be acoustically insulated to minimise noise from the building services. Sound levels from plant rooms must satisfy the requirements of AS/NZS2107:2000.



Hazardous Materials

Where the project involves refurbishment of an existing structure, the designer should specify the removal of all asbestos, replacement of devices containing poly-chlorinated biphenyls and stripping and reapplication of finishes containing lead.

Where hazardous materials are not able to be completely removed as part of a refurbishment, then the hazardous materials shall be encapsulated.

The designer shall minimise materials and compounds with high volatile organic compound (VOC) content. New timber construction should be free of formaldehyde. Where existing timber is re-used and contains formaldehyde, the designer will minimise its usage in rooms with continuous occupancy (eg. offices). The designer shall also ensure that any post-formed laminate (eg. Formica or Arborite) only contains water-based poly-vinyl acetate and are low in VOCs.

A survey of all hazardous materials must be performed on the project site.

Access to Equipment

Access must be available to all plant, equipment and field devices requiring ongoing inspection, maintenance and/or testing. This involves:

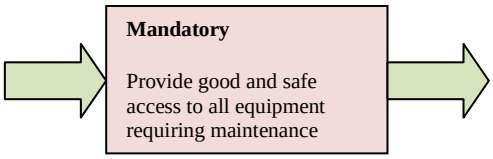
a. Where equipment is located in a plant room, ensuring that there is adequate space around the perimeter of the equipment such that maintenance can be comfortably and safely performed from all sides;

b. Where equipment covers or access panels open or are removed, space is available such that the access panel opens fully or can be removed and placed in a safe location without undue hindrance;

c. Where equipment is located within concealed ceiling space, access is available by lifting of ceiling tiles, or via access panels located to the sides of the equipment. The designer should ensure that maintenance personnel are able to safely reach the parts of the equipment to be

maintained from the access panel location (ie. the access panel must be on the correct side(s) of the equipment).

Examples of the types of equipment that the designer must be careful to ensure access to include fire dampers, fan coil units, concealed space fire detectors and concealed cisterns etc.



5.4.3 Fit-out

Joinery

Where existing joinery cannot be reused, the designer should specify new joinery with a reduced environmental impact. All joinery shall be designed with ergonomics and functionality taken into consideration. The preference is for the joinery to satisfy the following minimum criteria:

a. Modular design, based on standard design dimensions, such that the joinery can be reused in alternate configurations; and

b. A minimum 50% of the joinery (by mass) has been designed for disassembly, such that it can easily be removed and reused.

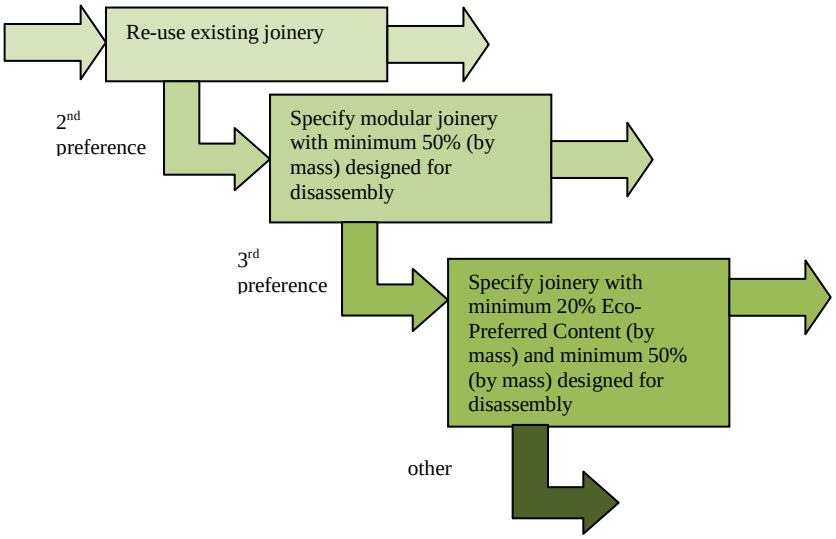
As an alternative, the designer may specify the following:

a. Joinery with a minimum 20% certified "Eco-Preferred Content" (ie. certified by the Green Building Council of Australia) by mass; and

b. A minimum 50% of the joinery (by mass) has been designed for disassembly, such that it can easily be removed and reused.

Modular joinery is considered to be of greater value to UOW compared to joinery simply containing Eco-Preferred Content, as the modular joinery has a greater likelihood of being reused.

The following hierarchy depicts the preference for specification of joinery types.



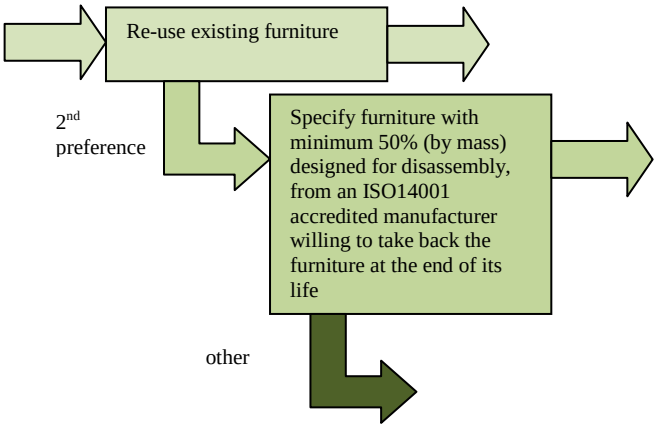
Loose Furniture

Where furniture is not available for reuse, the designer should specify new furniture that satisfies the following minimum criteria:

a. A minimum 50% (by mass) of the furniture must be designed for disassembly;

b. The manufacturer must have an environmental management system accredited to ISO14001 covering waste minimisation, energy, emissions, materials minimisation; and

c. The manufacturer must agree to take back the furniture at the end of its usable life for reuse, recycling or reprocessing.



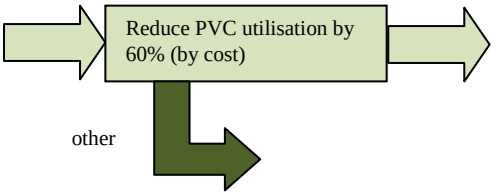
PVC

The designer should reduce the usage of polyvinyl chloride (PVC) by 60% (by cost) of the common uses of PVC. Typical substitutions of material that should be made include:

a. PVC blinds should be substituted with polyester blinds;

b. PVC conduit should be substituted with high density polyethylene (HDPE) conduit; and

c. PVC insulated electrical cables should be substituted with polyethylene insulated electrical cables.



Timber

All new timber should be Forest Stewardship Council (FSC) certified.

5.5 UOW Preferred Design Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Building Interior Construction & Amenity				
1	Building Amenity	Share an existing external shared waste area	Allocate a new external shared waste area	-
2	Building Amenity	25% of car spaces to be for small cars 10% of car spaces near building entrance to be for car pool participants, hybrid or alternative fuel vehicles	-	-
3	Building Amenity	Provide secure bicycle storage for 10% of peak number of students and 10% of building staff	Provide secure bicycle storage for 5% of peak number of students and 10% of building staff	Provide secure bicycle storage for 5% of peak number of students and 5% of building staff

Item	Category	1st Preference	2nd Preference	3rd Preference
4	Building Amenity	Provide drinking water fountains in ground floor foyer		
5	Interior Construction	**Mandatory:** Plant rooms and service rises should be acoustically insulated and achieve sound levels within AS/NZS2107		
6	Interior Construction	Achieve minimum 45 sound reduction index between functional areas	-	-
7	Interior Construction	Remove all existing asbestos, PCBs and lead-based paint	Encapsulate hazardous materials that are not able to be removed.	-
8	Interior Construction	Existing formaldehyde-treated timber to be reduced. New timber should be formaldehyde free	-	-
9	Interior Construction	**Mandatory:** Safe access must be available to all equipment requiring maintenance		
10	Fit-out	Re-use existing joinery	Specify modular joinery with minimum 50% (by mass) designed for disassembly	Specify joinery with minimum 20% Eco-Preferred Content (by mass) and minimum 50% (by mass) designed for disassembly
11	Fit-out	Re-use existing furniture	Specify furniture with minimum 50% (by mass) designed for disassembly, from an ISO14001 accredited manufacturer willing to take back the furniture at the end of its life	-
12	Fit-out	Reduce PVC utilisation by 60% (by cost)	-	-
13	Fit-out	All new timber should be Forest Stewardship Council (FSC) certified	-	-

Table 5.5-1 - UOW Preferred Design Matrix

6. SERVICES - ELECTRICAL

6.1 Design Process

The Services - Electrical design considerations should be utilised by the designer to guide the design of the electrical power supply and distribution throughout the building. The designer should take into consideration the energy efficiency of the electrical services, as well as investigate opportunities to apply demand-side management principles to limit the peak demand.

6.2 Design Standard References

The Services - Electrical design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-014 - Electrical;

b. FMD-MAI-STA-010 - BMCS; and

c. FMD-MAI-STA-016 - Energy.

6.3 Standards, Codes & Benchmarks

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current
4	AS/NZS3000 - Electrical Installations	Standards Australia	Current
5	AS/NZS1680 - Interior and Workplace Lighting	Standards Australia	Current
6	UOW Energy Policy	UOW Environmental & Sustainability Initiatives Unit	Current

Table 6.3-1 - Standards, Codes & Benchmarks

6.4 Design Considerations

6.4.1 Control Gear & Metering

Substations

Where buildings are located adjacent to each other, the designer should investigate the opportunity to share a common substation. This will minimise costs in constructing chamber or kiosk substations as well as reduce the quantity of materials expended and space used.

Consideration may also be given to co-locating the main switch rooms for both buildings, however separate switchboards and control gear must be maintained to ensure that isolations on either building can be performed independently.

Sub-Metering

Electrical sub-metering should be installed to enable monitoring of the end-use consumption by functional area. This will enable detailed analysis to be performed, thereby allowing UOW to identify areas of inefficiency or further improvement.

The following should be separately metered:

a. General power, lighting and essential services;

b. Central HVAC plant.

Separate sub-metering should be provided for each building zone area and/or tenanted space.

Sub-metered building zone areas should be less than 2,000m^2. Sub-meter data (comprising kW and kVA) should be logged in 15 minute intervals by UOW's Utility Metering and Management System (UMMS), in accordance with the UOW Electrical Design Standard. Data should be exportable from the system in comma separated values (CSV) format, for further analysis.

Where solar photovoltaic systems are installed, the designer should specify a gross interval meter. Where the local distribution network offers a gross feed in tariff, then the meter shall be configured in a gross-metered arrangement (to take advantage of the higher feed in rates), otherwise the meter should be configured to operate in a net-metered arrangement.

Power generated shall be measurable at the inverters of the solar system. Consideration should be given to the provision of a data logger to enable visualisation of the solar PV generation via a web interface.

6.4.2 Energy Efficiency

Lighting

Lighting should be controlled by a BMCS with the capability to control individual lighting zones by time clock, occupancy sensor and/or daylight sensor control. Local controls should also be provided to enable users to manually switch off unused lighting zones.

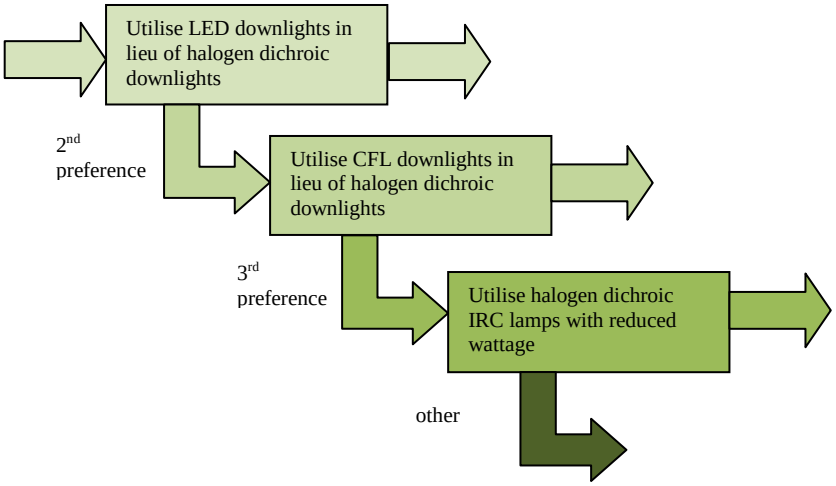
Each lighting zones should be a maximum of 100m^2, with switch plates clearly labelled and located in a readily accessible position (ie. Not secured within a cupboard). The position of switch plates should be at a consistent height and position throughout the building (eg. 1m high, located within the room on the wall furthest from the door hinge)

Task lighting and lighting in function rooms, meeting rooms and breakout areas shall be dimmable. Dimmers should utilise silicon-controlled rectifiers, as opposed to potentiometers, for energy efficiency.

Fluorescent light fittings should have high frequency electronic ballasts to reduce energy consumption

The designer should minimise their usage of halogen dichroic lighting. Where use of halogen dichroic lighting is justified (eg. for display lighting), then the designer should specify that lamps with an infrared coating (IRC) be provided at a lower wattage compared to regular halogen dichroic lamps.

Light emitting diode (LED) and/or compact fluorescent (CFL) downlights should be used to illuminate circulation areas in lieu of halogen dichroic downlights.

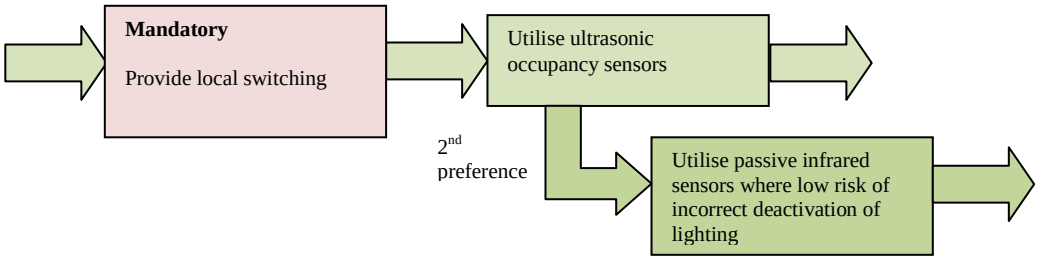


External light fittings should be of high efficiency with a minimum output of 50 lumens / watt. All external light fittings (excluding emergency lighting) should be fitting with daylight sensors and time clock control to prevent unnecessary activation. The designer shall also give consideration to the use of external security light fittings that automatically increase brightness when persons are detected within the vicinity, and dim when no persons are within the area.

The designer should minimise light pollution from external light fittings by ensuring that direct beams are not directed out of the building boundary or at the sky. Where required, a non-transparent shroud should be used to minimise light pollution from fittings.

The design should specify ultrasonic occupancy sensors in areas where there may be minimal movement of the occupants (eg. Seated in an office or meeting room). Where there is reduced likelihood of the occupancy sensor deactivating lighting incorrectly, the designer may specify passive infrared occupancy sensors to minimise cost.

Following is the design hierarchy for the selection of occupancy sensors:



Illuminated Exit Signage

Illuminated exit signage should utilise energy efficient LED lamps or cold cathode fluorescent (CCFL) in lieu of fluorescent lamps. Illuminated exit signage should be wirelessly monitored fittings, compatible with the University's existing monitoring system.

6.4.3 Demand-Side Management

Demand-side management is the smoothing of the electrical demand of the building to minimise the impact of the building on the electricity distribution network during peak demand periods. Demand-side management techniques include energy management (whereby energy is reduced overall), as well as load-shedding, scheduling of equipment operation times and the use of local generation (eg. Solar PV or diesel generator).

The designer should identify equipment that can be scheduled to operate during non-peak periods or deactivated. The following examples should be considered:

a. Distributed air-conditioning equipment (eg. split systems) can be controlled via an optimiser, which deactivates the condensing unit; and

b. Air-conditioning set points can be reset based on the outside air temperature to reduce the loading from the mechanical plant.

6.4.4 Electromagnetic Fields

Electromagnetic fields are created around all electrical equipment, including transformers, wiring, lighting and switchboards. UOW should seek to minimise electromagnetic fields near positions where occupants will be subject to prolonged and excessive exposure.

The designer should establish a maximum exposure limit of 100µT in all areas (in accordance with the Australian Radiation Protection and Nuclear Safety Agency Draft Radiation Protection Standard for Exposure to Electric and Magnetic Fields). A maximum exposure limit of 100nT should be

established in all areas occupied by children under the age of six (ie. childcare centres).

Switchboards and services risers in common areas should be located away from locations where any individual could be continuously exposed.

6.5 UOW Preferred Design Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Services - Electrical				
1	Control Gear & Metering	**Mandatory:** Sub-meters to be installed and logged by smart metering		
2	Control Gear & Metering	Co-locate substations and/or main switch rooms for adjacent buildings		
3	Control Gear & Metering	Install gross interval meter in gross-metered configuration for solar PV systems	Install gross interval meter in net-metered configuration for solar PV systems	Install net interval meter for solar PV system
4	Energy Efficiency	**Mandatory:** Lighting to be controllable by local switching		
5	Energy Efficiency	**Mandatory:** External lighting should have minimum efficiency of 50 lumens/ watt and be controlled with daylight sensors and time clock control.		
6	Energy Efficiency	Utilise LED downlights in lieu of halogen dichroic downlights	Utilise CFL downlights in lieu of halogen dichroic downlights	Utilise halogen dichroic IRC lamps with reduced wattage
7	Energy Efficiency	Utilise ultrasonic occupancy sensors	Utilise passive infrared sensors where low risk of incorrect deactivation of lighting	-
8	Energy Efficiency	Utilise energy efficient LED exit signs	Utilise energy efficient cold cathode fluorescent exit signs	-
9	Energy Efficiency	**Mandatory:** Zero light pollution from direct light permitted.		
10	Demand-side Management	Identify equipment whereby the operation can be scheduled to occur outside of peak periods		
11	Demand-side Management	Identify equipment that is distributed in nature and can be scheduled to operate on a time share basis		
12	Demand-side Management	Identify opportunities for local generation		
13	Electromagnetic Fields	Limit exposure to 50Hz EMF		
14	Electromagnetic Fields	Design switchboards and cabling to be positioned in dedicated services risers and locations		

Table 6.5-1 - UOW Preferred Design Matrix

7. SERVICES - MECHANICAL

7.1 Design Process

The Services - Mechanical design considerations should be utilised by the designer to guide the design of the heating, ventilation, air-conditioning and refrigeration services (HVACR) for the building.

The designer's priority should be to deliver a system that satisfies the statutory requirements with regard to smoke hazard management, provides a consistent thermal comfort level for building occupants and minimises energy consumption.

The designer should also take into consideration the operating noise of the equipment, environmental impact of the refrigerants used and monitoring of CO_2 levels.

7.2 Design Standard References

The Services - Mechanical design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-021 - Mechanical;

b. FMD-MAI-STA-017 - Fire; and

c. FMD-MAI-STA-016 - Energy.

7.3 Standards, Codes & Benchmarks

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current
4	AS/NZS1668 - The Use of Ventilation and Air-Conditioning in Buildings	Standards Australia	Current
5	AS/NZS3666 - Air-handling and Water Systems of Buildings	Standards Australia	Current
6	UOW Energy Policy	UOW Environmental & Sustainability Initiatives Unit	Current

Table 7.3-1 - Standards, Codes & Benchmarks

7.4 Design Considerations

The designer should consider the functional use of the building and determine whether heating, ventilation and air-conditioning (HVAC) services are required. Wherever feasible, natural ventilation should be maximised and mechanical heating and cooling avoided.

Where a building does not initially require HVAC services but may require enhanced space conditions at a future time, then consideration should be given to proving space within plant rooms, access corridors, ceiling spaces etc.

Where a building does require HVAC services, then the designer will develop a profile for the building which correlates demand on a location by location basis against occupancy or time period over which enhanced space conditions are required.

The profile will enable the designer to select the most appropriate system architecture and control strategy.

The following table is a guide to areas requiring HVAC services:

Item	Location	Requirement	Control
1	Classrooms	Not Required	Not Required
2	Laboratories	HVAC	Time/Demand Controlled
3	Offices	HVAC	Time/Demand Controlled
4	Theatres	Local A/C	Manual/Event Initiated
5	Workshops	Not Required	Not Required

For buildings requiring large central plant, considerations should be given to demand-side management. Load shedding strategies should be adopted wherever possible.

Emissions should be minimised and eliminated wherever possible. Provisions should be adopted to prevent refrigerant leakage. Where a leakage does occur the status should be electronically monitored.

7.5 UOW Preferred Design Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Services - Mechanical				
1	Energy Efficiency	**Mandatory:** Central A/C to be controlled through BMS		
2	Energy Efficiency	Local devices to monitor and control individual plant eg VSDs	Plant and equipment to be controlled on a multi zone basis	Areas to be isolated (resulting in reduced demand)
3	Energy Efficiency	Major central plant to be selected for low/medium and high load efficiency eg chillers.	Equipment to be selected for high/low load operation eg high load chiller/low load chiller.	Distributed HVAC system to targe selected areas requiring enhanced space conditons.
4	Demand-side management	Implement load shedding control strategy	Implement time limit controls during peak	Implement manual control procedure
5	Emissions	**Mandatory:** Select low impact refrigerant		
6	Emissions	Select equipment that stores refrigerant in an air tight, reinforced container and a monitoring system is installed.	Select equipment that stores refrigerant in an air tight, reinforced container	
7	Demand-side management	Implement load shedding control strategy	Implement time limit controls during peak	Implement manual control procedure
8	IEQ	Implement natural ventilation	Implement mixed mode ventilation	Implement outside air greater then AS1688.2 requires
9	IEQ	Implement mechanically heated naturally ventilated	PMV are calculated in accordance with ISO 7730	Implement mixed mode operation

Table 7.5-1 - UOW Preferred Design Matrix

8. SERVICES - HYDRAULIC & GAS SERVICES

8.1 Design Process

The Services - Hydraulic and Gas design considerations should be utilised by the designer to guide the design of potable, sewerage, stormwater and gas services within the building. The design considerations should include the overall system design and specification of fixtures and fittings.

Where applicable, the designer should also include a provision for grey water usage.

8.2 Design Standard References

The Services - Hydraulic design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-018 - Hydraulics; and

b. FMD-MAI-STA-017 - Fire.

8.3 Standards, Codes & Benchmarks

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current

Table 8.3-1 - Standards, Codes & Benchmarks

8.4 Design Considerations

Designers will need to consider the water consumption, rejection and losses that result from the design of building services, irrigation systems and laboratory equipment and the selection of specific plant and equipment. All major water consuming functions and/or equipment should be metered to enable UOW to analyse water performance.

Where equipment utilises water as part of a major building service such as a building cooling system or a fire sprinkler system, the plant should be monitored to determine efficiency and whether unexpected losses are occurring.

All gas services should be metered and equipment that utilises gas as a power source for building heating and/or cooling should be monitored so that the efficiency of the equipment can be assessed on a monthly, annual and seasonal basis.

The designer should investigate the opportunity to install a solar thermal system for the heating of hot water. Where available, the preference shall be to utilise solar thermal hot water in lieu of gas heated hot water.

All central plant that utilises gas should be selected for its efficiency under high, medium and low load conditions. Designers should take specific care not to over size or under size the equipment.

Rainwater from the building roof should be captured, filtered and stored at low level externally to the building. The rainwater should then be used for irrigation and topping up of water features.

Provision for grey water pipework shall be made throughout the building. The grey water pipework shall be clearly marked and supplied from the rainwater tanks.

8.5 UOW Preferred Design Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Hydraulic and Gas Services				
1	Occupant Amenity Water	**Mandatory:** Reduce potable water consumption for sanitary use against best practice		
2	Water meters	**Mandatory:** Install water meters for major water uses		
3	Landscape irrigation	Reduce water usage by 30% - 90%	Install a Xerisscape garden	Minimise landscaping to 1% of the area
4	Heat rejection water	Water based heat rejection is not used	Reduce water based heat rejection by 90%	Reduce water based heat rejection by 50%
5	Fire services water	Sprinkler drain points should feed into building rainwater tank	Sprinkler layout should incorporate multiple drain points to minimise wastage	
6	Laboratory water usage	Cooling is achieved through non-potable water means	Reduce water based heat rejection by 90%	
7	Hot water	Utilise solar thermal hot water	Utilise gas hot water	
8	Rain water	Capture rainwater from roof and store at ground level for irrigation and water features		
9	Gas meters	**Mandatory:** Install gas meters for major water uses		
10	Gas monitoring	**Mandatory:** Install monitoring devices to monitor consumption and leakage		
11	Efficiency	**Mandatory:** Major central plant to be selected for low/medium and high load efficiency		

Table 8.5-1 - UOW Preferred Design Matrix

9. ENVIRONS

9.1 Design Process

The Environs design considerations should be utilised by the designer to guide the design of the environment surrounding the building, comprising the landscaping, hardstand, footpaths and irrigation etc.

9.2 Design Standard References

The Environs design considerations should be read in conjunction with the following UOW Design Standards:

a. FMD-MAI-STA-020 - Landscaping.

9.3 Standards, Codes & Benchmarks

Item	Standard / Code / Benchmark	Publisher	Date / Version
1	Green Star - Education	Green Building Council Australia	Current
2	Green Star - Office	Green Building Council Australia	Current
3	Building Code of Australia	Australian Building Codes Board	Current

Table 9.3-1 - Standards, Codes & Benchmarks

9.4 Design Considerations

9.4.1 Footpaths & Hardstand

Footpaths and hardstand should be designed to integrate with UOW's existing pedestrian routes. Any hardstand area immediately surrounding a building should be capable of accommodating vehicles required to maintain the building façade or its plant and equipment e.g. boom lift to clean windows/cladding.

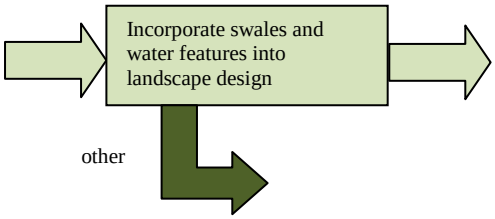
The footpath and hardstand surfaces are also designed to be durable and suitable for accommodating light vehicular traffic by maintenance staff.

The designer should ensure that the footpaths and hardstand are capable of supporting this dual function.

9.4.2 Landscaping

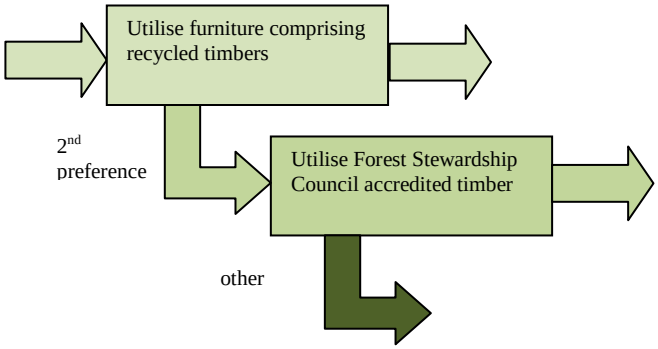
Landscaping should utilise flora native to the location to conserve or restore the ecological value of the site.

The designer should, wherever possible, specify a topology that minimises stormwater runoff from the site. This can be achieved through the construction of swales and/or water features.



9.4.3 Outdoor Furniture

The designer should establish a preference for recycled timber. Where new timber construction is used, the timber should be free of formaldehyde and procured from a Forest Stewardship Council-accredited source. The timber should be of high durability, with protective coatings to minimise environmental deterioration.



Shade cloths should be durable high density poly-ethylene knitted fabrics. PVC materials should not be specified by the designer.

9.5 UOW Preferred Design Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Environs				
1	Footpaths & Hardstand	Minimise footpaths and hardstand	Utilise permeable materials to construct footpaths and hardstand	-
2	Landscaping	Construct swales and/or water features to minimise stormwater runoff	-	-
3	Outdoor Furniture	Utilise furniture comprising recycled timbers	Timber should be Forest Stewardship Council certified	-

Item	Category	1st Preference	2nd Preference	3rd Preference
4	Outdoor Furniture	A minimum of 60% of the steel used should be sourced from a contractor accredited by the Environmental Sustainability Charter of the Australian Steel Institute	-	-

Table 9.5-1 - UOW Preferred Design Matrix

10. MANAGEMENT OF THE ESD PROCESS

A UOW Project Officer will be responsible for the management of the ESD Processes. The Project Officer may engage a specialist ESD Manager. This role will be restricted to working with the outputs produced by the designers to determine whether the desired ESD outcomes will be achieved.

The UOW Project Officer will consider the proposed design from an ESD perspective and model the design to determine whether the outcomes will be achieved using the available assessment tools.

The design process brings together all of the stakeholders that will work on the project. These include UOW, project managers, consultants, builders, representatives from the business area etc. The UOW Project Officer should endeavour to work in a co-operative manner with each of the stakeholders and not adopt a 'policing role".

If this achieved, then all stakeholders will be encouraged to develop solutions that will reduce the environmental impacts of the built asset or infrastructure. Where possible the UOW Project Officer should work with the designers to ensure ESD decisions are made collaboratively and are complementary to the designers design philosophy. Many professional project managers and design engineers refer to this approach as an integrated design strategy.

The UOW Project Officer will generally commence by obtaining agreement from all stakeholders that Green Star will be used as the framework for decision-making processes where possible. This gives a coherent way to think through the design.

In general, the best way to start the process that minimises a building's impact on the environment is to ensure that the design responds to the climate in which it will be built. The ESD opportunities identified during the pre-design and design processes need to be integrated into the detailed design documentation.

The post-design phase is also crucial for the successful completion of the project. Final cross referenced of the documentation should be made against the EDS design standard.

10.1 Management of the Design Processes

The monitoring and design process is outlined in Table 10.1-1

Process	Pre Design	Design	Post Design
1. Project Plan	- Consider appointing an ESD manager - Identify relevant ESD principals - Select Monitoring tools	- Liaise with Design Team - Encourage involvement by Design Team - Demonstrate commitment to Designers	- Ensure EMP complies to ISO14001 and is project specific
2. Building Elements	- Review materials selection	- Model design outputs - Assess toxicity level	- Review final documentation - Apply ESD design standard
3. Services - Electrical	- Review renewable energy options - Establish lighting criteria - Appoint specialist advisor(s) - Review device options	- Model design outputs - Discuss ESD performance with Designer - Prepare ESD design report	- Review final documentation - Apply ESD design standard
4. Services - Mechanical	- Establish air-quality criteria - Consider temperature control options - Document ESD scope - Consider system architecture options	- Model design outputs for each scope item - Model performance of controls - Discuss ESD performance with Designer - Prepare ESD design report	- Review final documentation - Apply ESD design standard
5. Services - Hydraulic	- Review water collection options - Review water treatment options - Review selection of fittings	- Model design outputs for each scope item - Discuss ESD performance with Designer - Prepare ESD design report	- Review final documentation - Apply ESD design standard

Table 10.1-1 - Standards, Codes & Benchmarks

10.2 ESD Process Management Requirements Matrix

Item	Category	1st Preference	2nd Preference	3rd Preference
Management of the ESD Process				
1	Management	Consider the appointment of an ESD Manager		
2	Management	Design documentation must reference the commissioning specification that calls for ASHRAE (or higher) standard.		
3	Management	Design documentation must clearly define the design intent and quality standard for as installed documentation, operations and maintenance manuals, commissioning report and training		
4	Management	Design documentation must clearly define the tuning process for building services, including the procedure, frequency, integration with regular maintenance etc.		
5	Management	Design documentation must contain a maintenance plan which integrates the monitoring of efficient operation with regular maintenance		

Table 10.2-1 - UOW ESD Process Management Requirements Matrix

11. MONITORING & VERIFICATION

To ensure that correct ESD principles have been adopted and that resources are being used efficiently it is important that the design process is monitored so that new construction and refurbishment outcomes can be verified against the design standard.

Where appropriate, verification of the ESD outcome for the new development will be performed utilising the Green Star rating suite, with ongoing monitoring performed using the National Australian Built Environment Rating Scheme (NABERS) tools.

UOW will assign an internal UOW Project Officer or appoint an external ESD Manager prior to the commencement of the design process.

11.1 Monitoring Categories

As outlined above the ESD Manager will use Green Star and NABERS and the primary monitoring and verification tools. Examples of the environment performance categories are outlined in Table 12.1-1

Building Service	Green Star Category	NABERS Category
Building Elements	Building Fabric	
Services - Electrical	Energy	Energy Use
Services - Mechanical	IEQ	Indoor Environment
Services - Hydraulic	Water	Water Use

Table 11.1-1 - Monitoring & Verification Tools

11.2 Monitoring of the Design Processes

At the completion of each process the designer (for that relevant component) will prepare a report to correlate the design against the ESD design standard. The ESD Manager should initially attempt to resolve any ESD issues with the individual designer. Where this is achieved, the ESD Manager will report that the designer has effectively satisfied all ESD design criteria.

The ESD Manager will submit the report to the designer with a copy presented to the UOW Construction Manager. The report will state that the design meets the desired ESD criteria or (where issues could not be resolved with the individual designer) does not meet the desired ESD criteria.

Where the design fails to meet the desired criteria then the ESD Manager will propose a practical solution (where possible) or request the designer review the design and advise of an alternate solution in accordance with the stated ESD principles. If the designer is unable to offer an alternate solution, then the matter will be escalated to the UOW Construction Manager.

11.3 Building User Manual

The designer should specify that a building user manual be provided in conjunction with the operations and maintenance documentation for the building. The building user manual should utilise non-technical prose, and is intended to be accessible by students and staff in the building.

The building user manual should be in a format ready for upload and hosting using UOW's online information portal.

The building user manual shall cover the following topics:

a. Overview of the building;

b. Overview of the ESD considerations incorporated into the building design;

c. Instructions on activating and deactivating lighting, and programming time clocks or other sensors to control the lighting;

d. Instructions on using plumbing fixtures efficiently, including instant hot water heaters; and

e. Instructions on using distributed heating, ventilation and air-conditioning equipment, including adjusting temperature set points and scheduling shutdown.

12. LIFE CYCLE COSTING

The ESD Manager should review the life cycle costing prepared by the designers for the respective building fabric or building service to determine where (if any) additional costs will be incurred by UOW as the result of the implementation of the ESD design standard.

The ESD Manager will assess the costs across the following cost categories:

- Initial cost of materials/equipment
- Construction/Installation costs
- Maintenance costs
- Operating costs including energy, water and gas.

Where there is more than a 1% increase in the cost of one or more of the above categories, the ESD Manager will report the details of the cost impact to the responsible UOW project officer for review.

APPENDIX A - ESD SOLUTION REFERENCE MATRIX

Table A-1 contains an ESD solution reference matrix containing UOW's preferred design criteria. The designer should use the following matrix as a checklist, indicating the preference used in their design or (if applicable) an alternative.

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
Building Location						
1	Land Impact	Green Star	Remediate Contaminated Land for new Building	Re-use existing developed land	Use new land	
2	Land Impact	Green Star	Provide native garden (>40% of site area)	Provide native garden		
3	Land Impact	Green Star	Retain topsoil on site	Utilise topsoil for other UOW sites	-	
4	Integration with Existing Environment	Green Star	**Mandatory:** Provide a pedestrian route to/from the building			
5	Integration with Existing Environment	Asset Technologies Pacific	Avoid obstruction of other buildings	Position buildings in east-west orientation	-	
Building Fabric						
1	Building Form	Legislation	**Mandatory:** Building must be within local height constraints			
2	Building Form	Asset Technologies Pacific	Design floor plate to be <50% of site area	-	-	
3	Building Form	Green Star	Design >60% floor area within 8m of a window	Design >60% floor area within 8m of a window or naturally lit atrium	-	
4	Construction Elements	Green Star	Incorporate > 60% of existing structure in refurbishment	-	-	
5	Construction Elements	Green Star	Re-use existing structure / shell	Utilise concrete with >60% recycled material; pre-cast concrete with > 40% recycled material and stressed concrete with > 30% recycle material	Utilise concrete with >30% recycled material; pre-cast concrete with > 20% recycled material and stressed concrete with > 15% recycle material	
6	Construction Elements	Green Star	Re-use existing structure / shell	Utilise Australian steel with >90% recycled content	Utilise Australian steel with >60% recycled content	

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
7	Construction Elements	Green Star	Steel should be permanently marked with its strength grade. A minimum of 60% of steel used should be sourced from accredited provider.	-	-	
8	Construction Elements	Green Star	95% of the building structure and shell to be designed for disassembly	50% of the building structure and shell to be designed for disassembly	-	
9	Construction Elements	Building Code of Australia	Air-conditioned fully insulated with minimum total R-value of 4.0 for roof and 3.2 for walls	Air-conditioned fully insulated with minimum total R-value of 3.2 for roof and 2.8 for walls	-	
10	Construction Elements	Asset Technologies Pacific	Utilise concealed fixing roofing with high reflectivity, high emissivity coating	-	-	
11	Construction Elements	University of Wollongong	Centralise roof plant to maximise space for solar system			
12	Construction Elements	Green Star	Utilise windows to provide natural light and views and avoid skylights	Supplement windows with skylights or light wells	-	
13	Construction Elements	Green Star	**Mandatory:** Provide fixed external louvres to control glare			
14	Construction Elements	Asset Technologies Pacific	Provide windows with safety rated performance glazing	-	-	
15	Construction Elements	Green Star	Remove all existing asbestos, PCBs and lead-based paint	Encapsulate hazardous materials that are not able to be removed.	-	
16	Construction Elements	Green Star	Existing formaldehyde-treated timber to be reduced. New timber should be formaldehyde free	-	-	
Building Interior Construction & Amenity						
1	Building Amenity	University of Wollongong	Share an existing external shared waste area	Allocate a new external shared waste area	-	

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
2	Building Amenity	Green Star	25% of car spaces to be for small cars 10% of car spaces near building entrance to be for car pool participants, hybrid or alternative fuel vehicles	-	-	
3	Building Amenity	Green Star	Provide secure bicycle storage for 10% of peak number of students and 10% of building staff	Provide secure bicycle storage for 5% of peak number of students and 10% of building staff	Provide secure bicycle storage for 5% of peak number of students and 5% of building staff	
4	Building Amenity	Asset Technologies Pacific	Provide drinking water fountains in ground floor foyer			
5	Interior Construction	Building Code of Australia	**Mandatory:** Plant rooms and service rises should be acoustically insulated and achieve sound levels within AS/NZS2107			
6	Interior Construction	Green Star	Achieve minimum 45 sound reduction index between functional areas	-	-	
7	Interior Construction	Green Star	Remove all existing asbestos, PCBs and lead-based paint	Encapsulate hazardous materials that are not able to be removed.	-	
8	Interior Construction	Green Star	Existing formaldehyde-treated timber to be reduced. New timber should be formaldehyde free	-	-	
9	Interior Construction	Building Code of Australia	**Mandatory:** Safe access must be available to all equipment requiring maintenance			
10	Fit-out	Green Star	Re-use existing joinery	Specify modular joinery with minimum 50% (by mass) designed for disassembly	Specify joinery with minimum 20% Eco-Preferred Content (by mass) and minimum 50% (by mass) designed for disassembly	
11	Fit-out	Green Star	Re-use existing furniture	Specify furniture with minimum 50% (by mass) designed for disassembly, from an ISO14001 accredited manufacturer willing to take back the furniture at the end of its life	-	

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
12	Fit-out	Green Star	Reduce PVC utilisation by 60% (by cost)	-	-	
13	Fit-out	Green Star	All new timber should be Forest Stewardship Council (FSC) certified	-	-	
Services - Electrical						
1	Control Gear & Metering	Green Star	**Mandatory:** Sub-meters to be installed and logged by smart metering			
2	Control Gear & Metering	Green Star	Co-locate substations and/or main switch rooms for adjacent buildings			
3	Control Gear & Metering	Asset Technologies Pacific	Install gross interval meter in gross-metered configuration for solar PV systems	Install gross interval meter in net-metered configuration for solar PV systems	Install net interval meter for solar PV system	
4	Energy Efficiency	Green Star	**Mandatory:** Lighting to be controllable by local switching			
5	Energy Efficiency	Green Star	**Mandatory:** External lighting should have minimum efficiency of 50 lumens/ watt and be controlled with daylight sensors and time clock control.			
6	Energy Efficiency	Asset Technologies Pacific	Utilise LED downlights in lieu of halogen dichroic downlights	Utilise CFL downlights in lieu of halogen dichroic downlights	Utilise halogen dichroic IRC lamps with reduced wattage	
7	Energy Efficiency	Asset Technologies Pacific	Utilise ultrasonic occupancy sensors	Utilise passive infrared sensors where low risk of incorrect deactivation of lighting	-	
8	Energy Efficiency	Asset Technologies Pacific	Utilise energy efficient LED exit signs	Utilise energy efficient cold cathode fluorescent exit signs	-	
9	Energy Efficiency	Green Star	**Mandatory:** Zero light pollution from direct light permitted.			
10	Demand-side Management	Green Star	Identify equipment whereby the operation can be scheduled to occur outside of peak periods			
11	Demand-side Management	Green Star	Identify equipment that is distributed in nature and can be scheduled to operate on a time share basis			

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
12	Demand-side Management	Green Star	Identify opportunities for local generation			
13	Electromagnetic Fields	Asset Technologies Pacific	Limit exposure to 50Hz EMF			
14	Electromagnetic Fields	Asset Technologies Pacific	Design switchboards and cabling to be positioned in dedicated services risers and locations			
Services - Mechanical						
1	Energy Efficiency	Green Star	**Mandatory:** Central A/C to be controlled through BMS			
2	Energy Efficiency	Green Star	Local devices to monitor and control individual plant eg VSDs	Plant and equipment to be controlled on a multi zone basis	Areas to be isolated (resulting in reduced demand)	
3	Energy Efficiency	Asset Technologies Pacific	Major central plant to be selected for low/medium and high load efficiency eg chillers.	Equipment to be selected for high/low load operation eg high load chiller/low load chiller.	Distributed HVAC system to targe selected areas requiring enhanced space conditons.	
4	Demand-side management	Asset Technologies Pacific	Implement load shedding control strategy	Implement time limit controls during peak	Implement manual control procedure	
5	Emissions	Green Star	**Mandatory:** Select low impact refrigerant			
6	Emissions	Green Star	Select equipment that stores refrigerant in an air tight, reinforced container and a monitoring system is installed.	Select equipment that stores refrigerant in an air tight, reinforced container		
7	Demand-side management	Asset Technologies Pacific	Implement load shedding control strategy	Implement time limit controls during peak	Implement manual control procedure	
8	IEQ	Green Star	Implement natural ventilation	Implement mixed mode ventilation	Implement outside air greater then AS1688.2 requires	
9	IEQ	Green Star	Implement mechanically heated naturally ventilated	PMV are calculated in accordance with ISO 7730	Implement mixed mode operation	
Hydraulic and Gas Services						
1	Occupant Amenity Water	Green Star	**Mandatory:** Reduce potable water consumption for sanitary use against best practice			
2	Water meters	Green Star	**Mandatory:** Install water meters for major water uses			
3	Landscape irrigation	Green Star	Reduce water usage by 30% -	Install a Xerisscape garden	Minimise landscaping to 1%	

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
			90%		of the area	
4	Heat rejection water	Green Star	Water based heat rejection is not used	Reduce water based heat rejection by 90%	Reduce water based heat rejection by 50%	
5	Fire services water	Green Star	Sprinkler drain points should feed into building rainwater tank	Sprinkler layout should incorporate multiple drain points to minimise wastage		
6	Laboratory water usage	Green Star	Cooling is achieved through non-potable water means	Reduce water based heat rejection by 90%		
7	Hot water	University of Wollongong	Utilise solar thermal hot water	Utilise gas hot water		
8	Rain water	University of Wollongong	Capture rainwater from roof and store at ground level for irrigation and water features			
9	Gas meters	Green Star	**Mandatory:** Install gas meters for major water uses			
10	Gas monitoring	Green Star	**Mandatory:** Install monitoring devices to monitor consumption and leakage			
11	Efficiency	Asset Technologies Pacific	**Mandatory:** Major central plant to be selected for low/medium and high load efficiency			
Environs						
1	Footpaths & Hardstand	Green Star	Minimise footpaths and hardstand	Utilise permeable materials to construct footpaths and hardstand	-	
2	Landscaping	Green Star	Construct swales and/or water features to minimise stormwater runoff	-	-	
3	Outdoor Furniture	Green Star	Utilise furniture comprising recycled timbers	Timber should be Forest Stewardship Council certified	-	
4	Outdoor Furniture	Green Star	A minimum of 60% of the steel used should be sourced from a contractor accredited by the Environmental Sustainability Charter of the Australian Steel Institute	-	-	
Management of the ESD Process						
1	Management	Green Star	Consider the appointment of an ESD Manager			
2	Management	Green Star	Design documentation must reference the commissioning specification that calls for ASHRAE (or			

Item	Category	Design Reference	1st Preference	2nd Preference	3rd Preference	Designer to indicate selection (1st, 2nd, 3rd, other)
			higher) standard.			
3	Management	Green Star	Design documentation must clearly define the design intent and quality standard for as installed documentation, operations and maintenance manuals, commissioning report and training			
4	Management	Green Star	Design documentation must clearly define the tuning process for building services, including the procedure, frequency, integration with regular maintenance etc.			
5	Management	Green Star	Design documentation must contain a maintenance plan which integrates the monitoring of efficient operation with regular maintenance			

Table A-1 - UOW ESD Solution Reference Matrix

APPENDIX B - RECYCLED MATERIALS

Table B-1 contains a list of building elements where the designer should consider using recycled materials.

Item	Category	Building Element	Material
1.	Building Fabric	Structure	Recycled steel, recycled concrete
2.	Building Fabric	Foundation	Recycled steel, recycled concrete
3.	Building Fabric	Door Frames	Recycled aluminium
4.	Building Interior Construction & Amenity	Flooring	Recycled hardwood flooring
5.	Environs	Paths	Recycled steel, recycled concrete
6.	Outdoor Furniture	Benches	Recycled timber
7.	Outdoor Furniture	Waste Bin Enclosures	Recycled timber
8.	Outdoor Furniture	Waste Bins	Recycled plastics