

DOCUMENT CONTROL

Document Name	UWA Design and Construction Standards: Sustainability - K
Document Status	Final version
Version No.	2.0
Date of Issue	1 st June 2020
Endorsement Body	To be determined
Owner	Director, Campus Management
Author(s)	The Standards have been developed by Campus Management with the assistance of UWA staff, external consultants, contractors and colleagues from other education institutions.
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1 Introduction

1.1 PURPOSE

The UWA Design and Construction Standards (the *Standards*) outline UWA's expectations for its built forms in order to achieve consistency in the quality of the design and construction of those built forms. They are aligned with the UWA's *Campus Plan 2010* planning principles and UWA's requisites for aesthetic appeal, maintainability and environmental sustainability, while ensuring that there is sufficient scope for innovation and technological advancements to be explored within each project.

The Standards are intended for use by any parties who may be involved in the planning, design and construction of UWA facilities. This includes external consultants and contractors, UWA planners, designers and project managers as well as faculty and office staff who may be involved in the planning, design, maintenance or refurbishment of facilities. These Standards also provide facility managers, maintenance contractors and other service providers with an understanding of UWA services in order to assist in the maintenance and operation of facilities.

1.2 SERVICES

The UWA Design and Construction Standards for **Sustainability** (this document) are a part of UWA Design and Construction Standards set of documents (the Standards). The Standards are divided into the following service documents for ease of use, but must be considered in its entirety, regardless of specific discipline or responsibilities:

- A Building and Architecture
- B Mechanical Services
- C Electrical Services
- D Communication Services
- E Hydraulic Services
- F Security Services
- G Fire Services and Fire Safety Engineering
- H Structural Works
- I Civil Works
- J Irrigation Services
- K Sustainability (this document)**
- L Vertical Transport

1.3 RELATED DOCUMENTS

1.3.1 University Documents

The Standards are to be read in conjunction with the following relevant University documents:

- UWA General Preliminaries Document
- UWA Specification for As-Constructed Documentation
- Relevant UWA planning and policy documents such as the *UWA Campus Plan*, *UWA Masterplan*, *Landscape Vision* and *Integrated Infrastructure Strategy*, *University Policy on Alterations to University Buildings*, etc.
- Relevant UWA operational and maintenance documents such as preferred vendors lists, room data sheets, operational and maintenance manuals, etc.
- Other documents as referenced within the *UWA Design and Construction Standards*.

1.3.2 Relevant Legislation

The planning, design and construction of each UWA facility must fully comply with current relevant legislation, including but not limited to:

- Relevant Australian or Australian / New Zealand Standards (AS/NZS),
- National Construction Code (NCC),
- Occupational Safety and Health (OSH) legislation,
- Disability Discrimination Act (DDA),
- Accessibility Aspiration Design Factors, and
- Local council and authority requirements.

1.3.3 Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications and data sheets to ensure product performance over its intended life and so as not to invalidate any warranties.

1.3.4 Project Specific Documentation

Requirements specific to a particular project, campus or other variable, will be covered by project specific documentation, such as client briefs, specifications and drawings. These Standards will supplement any such project specific documentation.

The Standards do not take precedence over any contract document, although they will typically be cross-referenced in such documentation.

Campus Management administer the online contractor safety induction. Upon completion the contractor will be issued with a UWA Contractors Safety Induction Card which they are required to carry at all times when working for the University.

Extracts from the Standards may be incorporated in specifications, however it must remain the consultant's and contractor's responsibility to fully investigate the needs of the University and produce designs and documents that are entirely 'fit for purpose' and which meet the 'intent' of the project brief.

1.4 DISCREPANCIES

The Standards outline the University's generic requirements above and beyond the above mentioned legislation. Where the Standards outline a higher standard than within the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards and project specific documentation, these discrepancies should be highlighted in writing to the Associate Director Capital Works, Campus Management.

1.5 DEPARTURES

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms. However, consultants and contractors are expected to propose 'best practice / state of the art' construction techniques, and introduce technological changes that support pragmatic, innovative design.

In recognition of this, any departures from relevant legislation, or the Standards, if allowed, must be confirmed in writing by the Associate Director Capital Works, Campus Management.

Any departures made without such written confirmation shall be rectified at no cost to UWA.

1.6 PROFESSIONAL SERVICES

For all works, it is expected that suitably qualified and experienced professionals are engaged to interpret and apply these Standards to UWA projects. Works cannot be carried out by unqualified and unlicensed consultants or contractors.

1.7 STRUCTURE OF DOCUMENT

This document is structured into 4 parts:

- Part 1** Introduction (this Section)
- Part 2** General Requirements – outlines the general requirements or design philosophies adopted at UWA
- Part 3** Checklist for project team – checklist of items for consideration at various stages of a project
- Part 4** Specifications (if applicable) – materials specifications and/or preferred lists for materials, processes or equipment used by UWA.

1.8 DEFINITIONS

For the purpose of this document, the following definitions apply:

- Can:** Implies a capability of possibility and refers to the ability of the user of the document, or to a possibility that is available or might occur.
- May:** Indicates the existence of an option.
- Shall:** Indicates that a statement is mandatory.
- Should:** Indicates a recommendation.

2 General Requirements

2.1 OVERALL PERFORMANCE

UWA's intent for new projects is to be representative of Best Practice sustainable design. As such, all projects shall provide a sustainability report, clearly articulating project performance against the following brief and, where possible, completing a self-assessment against the Green Star tool best suited for the application. The report shall clearly justify the inclusion of sufficient sustainable design initiatives to demonstrate equivalence to a best practice outcome, a minimum of 4 stars.

2.2 ESD PROFESSIONAL

For new buildings or major refurbishment projects, appoint an ESD Consultant to provide the following services:

- *BCA Section J 1 - 3* compliance
- Energy and Thermal Comfort modelling, sufficient to achieve compliance with Section J1 and J2 of the BCA using the JV3 methodology
- Complete, demonstrate and certify compliance with this document or with other documents and guidelines (such as *Green Building Council Australia's Green Star Ratings System*) if these are used.
- Provide advice, support and information related to Sustainability principles, structure, timing and processes
- Provide guidance and support in all stages of the project, including post occupancy evaluation and tuning.
- Refer ESD Scope of Service for the project for further information.

2.3 DESIGN CONSIDERATIONS

2.3.1 Space Planning

Assessment of space requirements and consideration of space planning principles should be undertaken prior to the construction of any new development. Space should be allocated in accordance with *TEFMA Space Planning Guidelines*.

2.3.2 Re-Use of Structure

Wherever possible, existing structures or facades should be re-used or recycled, with appropriate modifications / upgrades to bring façade performance up to compliance with current sustainability codes for glazing, shading and insulation.

2.3.3 Design Intent Report

All Services Consultants shall contribute to the production of a design intent report which includes:

- Description of the basic functions, operations, and maintenance of the nominated building systems (heating, cooling, ventilation, lighting, power distribution, hot water, water reclamation (where included) fire and controls) including a description of their intended operation and maintenance requirements; and a list of what the main components are (including controls), their operation and the importance of their efficient use. The description of use shall also include a description of any water or energy saving features to be commissioned and tuned post occupancy.

The sustainability consultant is responsible for collating all information into a single document which includes the information above, as well as;

- The targets for the project energy and water consumption and energy and water budgets for all nominated building systems.
- Description of how energy, water, and aspects of indoor environment quality are metered and monitored. This includes a meter diagram that illustrates how energy and water budgets are confirmed in operation.

The report is to be issued at all major deliverable stages, from Schematic Design through to Construction completion.

2.3.4 Climate Change Adaptation Planning

The University has undertaken a site wide Climate Change Adaption Plan. The design team shall liaise with Campus Management to obtain the Plan and include the required actions into the design.

2.3.5 Operational Waste

The University has a site wide operational waste management plan. The design team shall liaise with Campus Management to obtain the plan and include the required actions into the design.

2.3.6 Services and Maintainability Review

Ensure that UWA reviews all design documentation for:

- Commissionability
- Controllability
- Maintainability
- Operability
- Safety.

This includes interior fitouts in isolated, or as part of a whole building project. All services shall incorporate review comments into their documentation as required.

A comprehensive services and maintainability review shall be undertaken again with the main contractor once engaged.

2.3.7 Environmental Building Performance

The ESD consultant shall set targets for the expected energy and water performance of the building in conjunction with the University and the design team. These targets should be suitable for comparison with the operational energy and water measurements for the building and so they should be targeted to the metering to be installed in the building. At a minimum, they should include whole building energy and water estimates but may include sub-meter benchmarks if appropriate.

Energy targets as a minimum shall be a 40% improvement on BCA Section J deemed-to-satisfy requirements, and water targets shall be a minimum of 40% improvement on standard practice, as described by the Green Star Potable water calculator.

Façade performance should be 20% improvement over NCC deemed to satisfy requirements.

2.3.8 Metering

Metering schematics and schedules including loads for each meter are to be provided. Meter validation will need to be undertaken prior to handover and included within 'as constructed' documentation.

All energy meters and the monitoring system must be validated in accordance with *Section 8.5 (Non-utility metering system validation)* of the NABERS *Energy & Water for Offices: Rules for Collecting and Using Data*. Meter validation is to include at least four separate readings, to be carried out over no less than 168 hours and with sufficient load on the meter to reduce error to less than 5%.

All water and energy meters must be connected to the Building Management and Control System (BMCS), capable of capturing and processing the data produced by the installed energy and water meters, and accurately and clearly presenting data consumption trends. Consult UWA regarding BMCS points schedule

for all metering and monitoring.

Meter trees (electrical, gas and water) shall be produced by the ESD consultant with input from all services. For projects without an ESD consultant, the meter shall be the responsibility of the Mechanical consultant. Refer to UWA regarding meter naming conventions.

Metering shall be provided to all electrical loads over 25kVA and, separately for the following:

- Ventilation plant (board by board)
- Pumping plant
- Heating plant
- Hot water plant
- Vertical transport
- External Lighting
- Internal lighting (board by board)
- Small Power (board by board)
- Chilled water plant (where site wide chilled water connection is not available)

Where a system uses multiple fuel types eg, heating, separate metering shall be provided for both fuels.

2.3.8.1 Energy Metering

Energy sub meters (electricity and natural gas) shall be used to independently measure no more than 25kW. Sub-metering shall also comply with *BCA Section J8* where applicable. Where a single item of equipment exceeds these limits, it should be separately metered from all other items. All energy meters and the monitoring system must be validated in accordance with *Section 8.5 (Non-utility metering system validation)* of the *NABERS Energy & Water for Offices: Rules for Collecting and Using Data*.

Electrical metering and distribution shall be arranged so as to guarantee at least one level of complete master and sub-metering and automatic self-checking.

In addition to the electrical meters noted above, the following energy meters shall be included:

- Chilled water thermal energy meter (where chilled water off a centrally provided service is provided)
- Gas meters, at a minimum for:
 - Heating hot water plant
 - Boilers
 - Whole of site usage

All meters, including water and gas shall be connected to a meter monitoring system. The system will produce alerts if any metering inaccuracy is found. The metering system shall be capable of the following:

- Continuously monitor all meters and is to generate an alarm – including remote notification by email and SMS – whenever an error or inaccuracy is recorded. Initially set error period at 15 minutes, to be adjustable from 1 minute up to 1 hour.
- Inaccuracies are defined as errors in excess of meter tolerances (eg, class 1 meters shall not have errors / inaccuracies of more than 2% due to metering accuracy class)
- Metering system to comply with CIBSE TM39 Building Energy Metering – for all meters – not just electricity meters.
- Monitoring systems are to report the maximum demand as well as consumption and be capable of providing reports on 15 minute, 60 minute, 30 minute, 24 hour, monthly and annual consumption.
- Monitoring system must be capable of providing data retrieval from a central point and include all required reporting mechanisms, as a minimum:
 - All data from all meters
 - Missing data from all meters
 - Recording and displaying data at user adjustable intervals.
 - Initiate an alarm if any energy or water consumption figure increases beyond the target figures. Alarm is to be emailed instantly to Campus Management.
 - Report performance for all end uses, as nominated in the strategy below.
 - Include consumption and demand graphed against time and in tabular form. Including power factor for any energy metering.
 - Provide a monthly report which is automatically emailed to Campus Management.

2.3.8.2 Water Metering

Water sub meters shall be used to independently measure no more than 20% of the total building water use. Where a single end use exceeds this limit and cannot be practically divided into smaller usage loads, it should be separately metered from all other items. All water meters and the monitoring system must be validated in accordance with *Section 8.5 (Non-utility metering system validation)* of the *NABERS Energy & Water for Offices: Rules for Collecting and Using Data*.

2.3.9 Independent Commissioning Agent (ICA)

A commissioning agent, independent of the project design team, shall be employed, at the discretion of the ESD consultant. If required, the ICA shall lead the commissioning and tuning process, with scope defined by the ESD consultant. The ICA shall be appointed by UWA prior to Schematic Design Phase.

2.3.10 Building Commissioning

All services to be commissioned in accordance with *ASHRAE Commissioning Guidelines, AIRAH DA27 and CIBSE Building Commissioning manuals* or an equivalent alternative standard.

In general, the following commissioning requirements will apply to this project:

- Undertake pre-commissioning, commissioning and building tuning in accordance with
 - DA27 Building Commissioning Application Manual,
 - CIBSE Commissioning Code M (and ancillary codes for relevant services)
 - ASHRAE Commissioning Guideline 1:1-2007 (for mechanical only)
- Provide commissioning plan to be included in commissioning tender for each service. The commissioning plan must include:
 - Relevant standard to be commissioned to
 - The objectives or basis of the design
 - The scope of the plan
 - The commissioning team, their responsibilities and interface matrix
 - General sequence of commissioning and commissioning program
 - Requirements for sub-contractor commissioning manuals
 - Proposed commissioning Procedures
 - Witnessing requirements
 - The commissioning activities
 - How each system is intended to operate
 - Acceptable tolerances during commissioning
 - Divisions of responsibilities during commissioning phase (for designers, contractors and interfaces)
 - Pre-commissioning procedures
 - Commissioning Requirements
 - Witnessing Requirements
 - Phased Completion Requirements
 - Post Occupant Checks
 - Training requirements for the Operator
- Provide commissioning report completed in accordance with the plan above
 - Report is to certify that it has been completed in accordance with the above, including being signed by:
 - Designer (mechanical, electrical, hydraulic, fire, security and vertical transport)
 - Head / Main Contractor
 - Commissioning Manager

- Project Manager / Owners Representative
- Demonstrate that the person responsible for commissioning has specific and demonstrable knowledge of the types of systems to be commissioned. Note that a general subcontractor is unlikely to be able to fill this role.

2.3.11 Building Tuning

All service consultants to include a detailed building tuning plan with their tender documentation which includes:

- The requirement for 4 off. quarterly tuning reviews in the 12 month tuning period after practical completion
- Specific tuning issues to be addressed by the contractor at these reviews – these must include all energy efficiency features described in the Design Intent Report (refer above)
- Performance benchmarks for each system that should be used to ensure systems operate efficiently and in accordance with the design.
- Verification that nominated systems are performing to their design potential in full and part load conditions

The ESD Consultant, in conjunction with UWA, is to set target energy and water use for each meter, for each month of the defects liability period. Where usage deviates by more than 10% from prediction, the ESD Consultant and relevant design discipline consultant shall provide an explanation as to why.

The tuning process will be managed and guided by the commissioning agent and tuning team. The contractor is to provide a commitment to be involved with and assist the process.

The mechanical contractor shall configure the BMS to provide the following reports monthly to the ESD consultant and the tenant and any other party identified by the ESD consultant. The reports shall generate automatically each month and be emailed to the ESD consultants nominated email address – adjustable from within the BMS:

2.3.12 Building Users Guide

The ESD consultant shall put together the Building Users Guide, based on the design intent manual. It shall include:

- Develop a building users guide and made available to all relevant stakeholders:
 - Up-to-date, relevant information for the building user in a digital format and made available through any combination of digital signage, interactive information kiosks, induction or training material, website or intranet or mobile application

- Information is to be relevant to building users, ie person responsible for management of the tenanted space
- Information must be able to be updated to ensure it remains relevant to users throughout the life of the building
- Guide to include the following:
 - Description of initiatives designed to enhance energy efficiency and minimise greenhouse gas emissions, and measures that must be taken by users during day-to-day operation to maximise their effectiveness
 - Description of initiatives intended to enhance and minimise water use and the measures that must be taken by users during day-to-day operation to maximise their effectiveness
 - Description of basic function and operation of any nominated building systems building users come in direct contact with
 - List of relevant contacts for maintenance information, operational issues, complaints or other feedback (e.g. relevant facilities management contact details and/or online request/feedback form);
 - Description of alternative transport initiatives promoted within premises (such as bicycle facilities, end of trip facilities, carpooling or car-share), location of a transport plan (if available)
 - Local public transport information, maps and timetables;
 - Description of the operational waste requirements for the building users, including what waste streams can or cannot be collected for recycling at the premises.
 - Information on how to maximise the efficiency potential offered by base building services and nominated systems
 - Information on how to best maximise day lighting, sights and views
 - Information on green make-good requirements for tenants at end-of-life (if available).

The Building Users Guide is to be provided to UWA at least 1 month prior to practical completion.

2.4 CONSTRUCTION MANAGEMENT

2.4.1 Environmental Management Plan

The Contractor must ensure a comprehensive, project-specific Environmental Management Plan (EMP) is in place for construction. The environmental management plan must include the requirements outlined in the *NSW Environmental Management Systems Guidelines* unless an equivalent alternative standard can be identified and approved by the Associate Director Capital Works, Campus Management.

The contractor should have their environmental management system formally certified against AS 14001 or

an equivalent standard.

The contractor shall keep records of site audits, non-conformances and rectification works undertaken over the course of the project.

2.4.2 Construction Pollutants

All ductwork and absorptive materials such as carpets and furniture must be kept covered throughout construction or stored off site to prevent contamination with construction dust and chemicals. This includes the requirement to cap off all ductwork with plastic at the end of each day.

The mechanical contractor and main contractor are to include specific KPI's and procedures around this requirement and shall submit performance reports to UWA no less frequently than monthly during construction.

2.4.3 Reduction of Construction and Demolition Waste

A minimum of 90% by mass of the waste generated during construction and demolition must be diverted from landfill through reuse or recycling. Either a single bin system with off-site sorting or a multiple bin solution can be used.

A summary report outlining the total quantity of construction and demolition waste by mass from site and the proportion of the total that was recycled shall be provided to UWA.

The contractor shall provide their site specific waste management plan, including details and credentials of the relevant waste contractor prior to commencing works on site.

2.4.4 Building Operations and Maintenance Information

Comprehensive Operations and Maintenance information shall be made available to the manager of the facility. It is to include the following:

- Develop a comprehensive Operations and Maintenance manual and made available to the facilities management team which includes:
 - Summary sheet of relevant building service contacts
 - System-level information for all building systems
 - Introduction and scope, including physical and functional descriptions
 - Operating parameters and procedures
 - Preventive maintenance requirements, including procedures and schedules;
 - Corrective maintenance requirements, including repair requirements;
 - Service contacts, and any warranties and certificates.

- Up-to-date drawings incorporating at least:
 - Mechanical, electrical and hydraulic drawings and schematics covering all associated nominated building systems
 - Architectural, façade/building envelope drawings
 - Architectural layout of base building
- The following information, to be provided by FCDS
 - Details on targets or design benchmarks for, as a minimum, energy, greenhouse gas emissions, potable water and indoor environment quality including air quality (CO and CO₂) and thermal comfort. These must be SMART (specific, measurable, achievable, relevant and time-bound) goals aimed at assisting the operation team to optimise performance of the building;
 - Details on the metering and sub-metering strategy employed by the building, including any instructions (if sub-metering is provided)
 - Description and location of the sustainable procurement framework (if available)
 - Triggers for updating O&M information must also be detailed such as refurbishment of spaces, recommissioning or replacement of systems, building owner targets or benchmarks change etc
- Provide a Building Log Book to be presented to the building owner prior to Practical Completion that:
 - Be developed in line with CIBSE TM31: Building Log Book Toolkit
 - Cover all building systems as follows:
 - Mechanical systems (such as HVAC and refrigeration systems; mechanically operable systems such as blinds and actuated shading devices)
 - Building Management and Control System (BMCS)
 - Lighting controls
 - Electrical systems (such as electrical generation, electrical supply, distribution systems, security and alarm systems)
 - Hydraulic systems (such as gas and water supply distribution systems, sewage collection and distribution systems, stormwater collection and distribution systems; pumps)
 - Fire protection systems, including pumps and other equipment;
 - Lifts and any other vertical transport devices; and
 - Building envelope, such as facades, roofs and glazing

2.5 INDOOR ENVIRONMENT QUALITY

2.5.1 Entry of Outdoor Pollutants

The outdoor air intakes shall be design to comply with *ASHRAE Standard 62.1* Section 5 to ensure minimum separation distances from pollution sources are maintained. Minimum separation distances and points of discharge for pollutants shall be reflected in the mechanical services drawings.

2.5.2 Elimination of Pollutants

Sources of pollution such as plant rooms, print rooms, kitchens and vehicle exhaust shall be exhausted directly to outside with no recycling of exhaust air to other spaces.

Where none of these facilities are included in the design, this requirement is not applicable.

Exhaust systems shall be shown in mechanical services documentation.

Where printing or photocopiers are provided without an exhaust system they must meet the following emission limits, when tested to one of ECMA-328, RAL-US 122 or GGPS.003. A test certificate must be provided which states the emission limits, issued by a NATA accredited or ISO 17025 accredited laboratories:

Substance	Emission Limit		Emission rate	
	Print Phase (mg/hr)		Ready Phase (mg/hr)	
	Colour Printing Total in ready + print phase	Monochrome printing Total in ready + print phase	Desktop Products	Floor Mounted Equipment
TVOC	18	10	1	2
Benzene	<0.05	<0.05		
Styrene	1.8	1		
Ozone	3.0	1.5		
Dust	4.0	4.0		

2.5.3 Indoor Pollutants - Paints, Adhesives, Sealants and Carpets

All internally applied paints, adhesives, sealants and carpets must not exceed the stipulated 'Benchmark VOC Limits' shown in *Appendix A* of this document.

2.5.4 Indoor Pollutants - Engineered Wood Products

All engineered wood products that are installed internally must be classed as E0 or meet the following limits:

Test Protocol	Emission limit/ Unit of measurements
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11:2005 method 10 for Plywood	< 1.0 mg/L
AS/NZS 1859.1:2004 - Particle Board, with use of testing procedure AS/NZS 4266.16:2004 method 16	< 1.5 mg/L
AS/NZS 1859.2:2004 - MDF, with use of testing procedure AS/NZS 4266.16:2004 method 16	< 1.0 mg/L
JIS A 5908:2003- Particle Board and Plywood, with use of testing procedure JIS A 1460	< 1.0 mg/L
JIS A 5905:2003 - MDF, with use of testing procedure JIS A 1460	< 1.0 mg/L
JIS A1901 (not applicable to Plywood)	< 1.0 mg/L
ASTM D5116	<0.1 (+/- 0.0005) mg/m ² hr (may also be represented as mg/m ² /hr)
ISO 16000 part 9, 10 and 11 (also known as EN 13419)	<0.1 (+/- 0.0005) mg/m ² hr (may also be represented as mg/m ² /hr)
ASTM D6007	0.12mg/m ³ *
ASTM E1333	0.12mg/m ³ **
EN 717-1 (also known as DIN EN 717-1)	0.12 mg/m ³
EN 717-2 (also known as DIN EN 717-2)	3.5 mg/m ² hr (may also be represented as mg/m ² /hr).
*The test report must confirm that the conditions of Table 1 comply for the particular wood product type, the final results must be presented in EN 717-1 equivalent (as presented in the table) using the correlation ratio of 0.98.	
** The final results must be presented in EN 717-1 equivalent (as presented in the table), using the correlation ratio of 0.98.	

2.5.5 Views

At least 60% of spaces where occupants are expected to work for extended periods of time must have a clear line of site to a high quality internal or external view. All floor areas within 8m of a compliant view meets this requirement.

2.5.6 Existing Ductwork

All existing ductwork shall be cleaned in accordance with the *AIRAH HVAC Hygiene Best Practice Guidelines* or the *ACR 2006 Assessment, Cleaning and Restoration of HVAC Systems* or an equivalent standard.

2.5.7 Optimal Provision of Outdoor Air

Variable volume outside air systems shall be provided to all regularly occupied spaces where practical. CO₂ sensors shall be included in all regularly occupied spaces with variable volume outside air systems to:

- Reduce the outside air rate to a minimum level when the space is unoccupied
- Increase the outside air rate for all regularly occupied spaces to either 100% above the *AS 1668* minimum requirement or to a level that modelling demonstrates will never exceed 700ppm.

Mechanical documentation shall include CO₂ sensors and describe controls methodology.

Building tuning shall include a review of the operation of the CO₂ monitoring and control system no less frequently than once per quarter.

2.5.8 Internal Noise Levels

Design all regularly occupied spaces to have an internal ambient noise level no more than 5dBA above the 'satisfactory' sound levels provided in the Table 1 of *AS 2107*. The assessment of the space noise levels must include all typical internal and external noise sources in the building with all services operational but with no occupant noise.

2.5.9 Reverberation

Reverberation time in the general learning areas must be below the maximum stated in the 'Recommended Reverberation Time' provided in *Table 1 of AS 2107*.

An acoustic report confirming compliance of the architectural design shall be provided during design phase. Confirmation that acoustic systems were installed as per design or an acoustic testing report shall be provided prior to practical completion.

2.5.10 Acoustic Separation

The sound insulation in general learning areas shall comply with:

- For partition walls: $D_w + L_{Aeq,T} > 75$ and
- For corridor walls: $D_w + L_{Aeq,T} > 70$.

For sole occupancy units, acoustic separation shall meet or exceed the requirements in the *BCA*.

An acoustic report confirming compliance of the architectural design shall be provided during design phase. Confirmation that acoustic systems were installed as per design or an acoustic testing report shall be provided prior to practical completion.

2.5.11 Lighting Comfort

All lights in regularly occupied spaces must have a minimum colour rendering index of 80 unless the space has particular requirements where this is not justified. All lighting shall be flicker free by ensuring:

- Ensure all luminaires installed have a minimum Class A1 and A2 ballast
- High frequency ballasts for all fluorescent lamps
- Electronic ballasts for all High Intensity Discharge lighting.

2.5.12 Lighting Illuminance Levels

Lighting systems must be designed to have maintained illuminance levels that meet the levels recommended in *AS 1680* for the relevant space type.

2.5.13 Localised Lighting Control

All regularly occupied spaces must be provided with lighting controls that allow the occupants to have the ability to adjust the lighting levels to suit the task. This includes the ability turn lights on and off and to adjust the lighting levels. Task lighting should be considered for staff workstations where appropriate.

2.5.14 Daylighting

Daylight modelling shall be performed to demonstrate that the majority of regularly occupied spaces have suitable levels of daylight for their proposed use.

A daylight factor of 2% or a daylight illuminance of at least 160Lux for 80% of the typical occupied daytime hours is to be achieved, where practical.

2.5.15 Daylight Glare Reduction

All windows in regularly occupied spaces must include occupant controllable internal blinds or be adequately shaded to prevent daylight glare issues. Calculations or evidence to be provided to UWA as part of the services and maintenance design review. Where blinds are required for glare control, they shall have a Visible Light Transmittance of no more than 10% and shall be mounted to eliminate direct solar radiation over more than 95% of the glazed area.

2.6 ENERGY

2.6.1 Greenhouse Gas Emissions Reduction

Detailed energy modelling of the building and an options analysis report to outline cost effective greenhouse gas reduction strategies when compared to a 'reference' building shall be produced. The energy modelling must be completed in accordance with the *Green Star Design and As Built* guidelines. The options analysis must include a whole-of-life cost estimate at a minimum of:

- Schematic Design:
 - Multiple glazing / shading / envelope options
 - On site renewable energy options including solar PV, including battery storage
- Design Development:
 - Multiple HVAC system options
 - HVAC control options - e.g., CO₂ control, economy mode, etc.
 - Mixed mode operation
- Options for any other major energy consuming equipment where appropriate.

All buildings must implement any greenhouse gas savings initiatives with a simple payback period of 5 years. Overall designs must achieve a minimum of 40% reduction (including services energy savings) when compared to the 'reference' project with an aspirational target of more than 60% reduction. At completion of Design Development, the ESD consultant shall provide an estimate of building performance reporting against these benchmarks, including an indication of features and expected costs required to improve expected performance to the 60% reduction target,

2.6.2 Advanced Lighting Controls

Advanced lighting controls such as motion sensors and daylight controls shall be utilised to minimise lighting energy, in accordance with *BCA Section J*.

All external lighting must be connected to be BMCS to ensure external lighting is not left on during daylight hours. Daylight sensors to be included.

Refer *UWA Design and Construction Standards – Electrical Services* for further information.

2.6.3 Renewable Energy Sources

For major projects and where practical, renewal energy sources should be considered. Where appropriate, life cycle analysis shall be undertaken and evaluated for the projects.

Where renewable energy sources (for example, solar PV systems) are to be incorporated, all regulatory protocols required shall be incorporated into the project, including all necessary consultation with and obtaining the approval of UWA.

2.7 POTABLE WATER

2.7.1 Potable Water Reduction

All water consuming fixtures and fittings must meet the requirements as per the *UWA Design and Construction Standards – Hydraulic Services*. If there are any variations to the fixtures and fittings, at a minimum, the following water efficiency levels shall be adopted:

- Washroom and kitchen taps less than or equal to 5 star WELS (6L/min)
- Urinals less than or equal to 6 star WELS (1L/flush). Waterless urinals are not to be used for maintenance reasons.
- Toilets dual flush with average less than or equal to 4 star WELS
- Showers less than or equal to 3 star WELS (>7.5L/min <=9L/min).

The design team shall provide a whole-of-life cost assessment of a recycled or rainwater system to reduce total potable water consumption. This analysis shall be presented to UWA for review and incorporation where appropriate.

2.8 EMISSIONS

2.8.1 Stormwater

All stormwater should be infiltrated or reused on site to prevent any stormwater leaving site in a typical year. Where not possible, light liquid and solid arrestors shall be provided to prevent pollution discharge into natural water bodies. Refer *UWA Design and Construction Standards – Hydraulic Services* for further details.

2.8.2 Light Pollution

The external lighting must comply with *AS 4282*.

All external lighting must have a maximum upward light ratio of 5% with calculations and evidence to be provide to UWA at time of services design review.

Up lighting of trees or buildings must be avoided. Where specialty up lighting is required detailed modelling of light spill and aesthetic outcomes shall be provided at design stage. All external lights must be connected to the BMCS to ensure lighting is not left on when not required.

2.9 MATERIALS

2.9.1 Fitout Performance

All interior fitout and finishes must be designed with an expected life of at least 10 years check Arch. The following shall be provided to ensure compliance:

- Interior fitout and finishes schedules (base building supplied)
- Interior architect statement summarising fitout and finishes expected life.

Finishes in high traffic or high wear areas are to be designed to be modular to facilitate repair and replacement as needed.

2.9.2 Portland Cement Reduction

Concrete mixes which reduce Portland cement content as much as possible should be used where practical.

A minimum 40% reduction in Portland cement should be demonstrated as an average across all concrete used in the project.

Generally, this is easy to achieve for some items such as foundations and columns but may be difficult for some pre-cast or post-tension slabs, etc. Refer *UWA Design and Construction Standards – Structural Works* for further details.

2.9.3 PVC

All PVC cables, pipes, flooring and blinds must meet the *Green Building Council Australia's Best Practice Guidelines for PVC*.

2.10 TRANSPORT

Refer *UWA Campus Plan for UWA Integrated Transport Strategy* for transport planning principles and strategies.

Refer *UWA Design and Construction Standards – Building and Architecture* for end-of-trip facilities provisions.

2.11 ECOLOGICAL VALUE

Landscaping should aim to improve the ecological value of the site by increasing the quantity and/or value of the landscaping as a part of the development. If building area increases as a part of the development, this may still be achieved by including higher value landscaping such as native or indigenous planting in place of grass.

3 Checklist for Project Team

ACTIVITY	RESPONSIBILITY	STAKEHOLDER(S)	TIMEFRAME
Appoint Sustainability Consultant for projects with a contract value greater than \$2M or where one is deemed necessary	Project Manager	CM (Engineering Services) / CM (Capital Works)	Gate 2 Feasibility
Ensure space planning considerations have been taken into account	Project Manager	CM (Engineering Services) / CM (Capital Works)	Gate 2 Feasibility
Engage other consultants as required (acoustic consultant, operational waste consultant, lighting consultant, emissions consultant, etc.)	Project Manager	CM (Capital Works)	Gate 3 Planning
Complete Design Intent Report	Sustainability / Services Consultants	CM (Engineering Services) / CM (Capital Works)	Gate 3 Planning
Complete Services and Maintainability Review	Services Consultants	CM (Engineering Services) / CM (Building Operations)	Gate 3 Planning
Complete energy and water performance benchmarks	Sustainability Consultant	CM (Engineering Services) / CM (Building Operations)	Gate 3 Planning
Complete metering schedules and BMCS points lists	Services Consultants	CM (Engineering Services) / CM (Building Operations)	Gate 3 Planning
Complete Indoor Pollutants Spreadsheet (Paints, adhesives, sealants, carpets and engineered wood products)	Architect / Services Consultants	CM (Engineering Services)	Gate 3 Planning
Complete greenhouse gas modelling report	Sustainability Consultant	CM (Engineering Services)	Gate 3 Planning
Whole of life analysis for rainwater / recycled water systems	Hydraulic Consultant	CM (Engineering Services)	Gate 3 Planning
Engage Independent Commissioning Agent	Project Manager	CM (Building Operations) / CM (Capital Works)	Gate 3 Planning
Submit Environmental Management Plan	Contractor	CM (Capital Works) / CM (Facilities Operations)	Gate 5 Construction
Submit Waste Management Report	Contractor	CM (Capital Works) / CM (Facilities Operations)	Gate 5 Construction
Building Tuning and Commissioning	Contractor	CM (Building Operations)	Gate 6 Review

Abbreviations

AIRAH	Australian Institute of Refrigeration Air-Conditioning and Heating
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
BCA	Building Code of Australia
CM	Campus Management
CO ₂	Carbon Dioxide
EMP	Environmental Management Plan
FSC	Forest Stewardship Council
GECA	Good Environmental Choice Australia
HVAC	Heating, Ventilation and Air-Conditioning
LED	Light Emitting Diode
NABERS	National Australian Built Environment Rating System
NSW	New South Wales
PEFC	Programme for the Endorsement of Forest Certification
PV	Photovoltaic
PVC	Poly Vinyl Chloride
TEFMA	Tertiary Education Facilities Management Association
UWA	The University of Western Australia
VOC	Volatile Organic Compound

References

- Assessment, Cleaning and Restoration of HVAC Systems (ARC 2006), National Air Duct Cleaners Association.
- DA27 Building Commissioning design application manuals, AIRAH
- HVAC Hygiene Best Practice Guidelines, AIRAH
- AS 1668 The use of air-conditioning and ventilation in buildings
- AS/NZS 1680 Interior Lighting
- AS/NZS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors
- AS 4282 Control of the obtrusive effects of outdoor lighting
- AS 14001 Environmental management systems certification
- Commissioning Guidelines, ASHRAE
- Building Code of Australia
- Green Star Rating System, Green Building Council Australia
- Energy & Water for Offices: Rules for Collecting and Using Data, NABERS
- Environmental Management Systems Guidelines, NSW Environment Protection Authority
- Space Planning Guidelines, Tertiary Education Facilities Management Association
- Campus Plan, University of Western Australia
- Integrated Transport Strategy, University of Western Australia

Appendix A: Summary of Paint, Adhesives and Carpet VOC Limits

Type	Benchmark VOC (g/L)
General purpose adhesives	50
Interior wall and ceiling paint, all sheen levels	16
Trim, varnishes and wood stains	75
Primers, sealers and prep coats	65
One and two pack performance coatings for floors	140
Acoustic sealants, architectural sealant, waterproofing membranes and sealant, fire retardant sealants and adhesives	250
Structural glazing adhesive, wood flooring and laminate adhesives and sealants	100

Compliance Method	Requirement	
Method 1 – Product Certification	The product is certified under a recognised Product Certification Scheme (refer Appendix B)	
Method 2 – Laboratory Testing	The product complies with the Total VOC (TVOC) limits specified in the table below.	
	Test Protocol	Limit
	ASTM D5116 - Total VOC limit	0.5mg/m ² per hour
	ASTM D5116 - 4-PC (4-Phenylcyclohexene)	0.05mg/m ² per hour
	ISO 16000 / EN 13419 - TVOC at three days	0.5mg/m ² per hour
	ISO 10580 / ISO/TC 219 (Document N238) - TVOC at 24 hours	0.5mg/m ² per hour

Appendix B: Sustainability Certification Schemes

Scheme	Reference
GECA	See http://www.geca.org.au/ for a database of compliant products
ECS	See http://www.carpetinstitute.com.au/environmental/ for more details
Green Tag	See http://www.globalgreentag.com/ for more details
SMaRT 4.0 Sustainable	See http://mts.sustainableproducts.com/ for more details
VOC less than 0.5mg/m ² /hr	Check MSDS or supplier datasheet for confirmation of VOC levels.

Change Log

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years. This version differs from the previous version in the following areas:

Section	Title	Description
ALL	ALL	The majority of the sections in this document have been rewritten or updated.