SECTION 34

DOCUMENTATION

Table of Contents

34.0 DOCUMENTATION 4
34.1 DESIGN PROCESS REQUIREMENTS 4
34.1.1 Roles and Responsibilities 4
34.1.2 Interfaces with Other Disciplines 4
34.1.3 Non-Conformance Approvals 4
34.2 GENERAL REQUIREMENTS 5
34.3 REFERENCES 5
34.3.1 Australian Standards: 5
34.3.2 Open Standards: 6
34.3.3 Other Industry Standards, Guidelines, and Conventions: 6
34.3.4 Project Documents: 6
34.3.5 System Documents: 6
34.4 INFORMATION EXCHANGE 6
34.4.1 General 6
34.4.2 Information Requests (Building Records) 7
34.4.3 Site and Infrastructure Records 7
34.4.4 Enlighten 7
34.5 SUBMISSION INSTRUCTIONS 7
34.5.1 General 7
34.5.2 Verification 8
34.5.3 Method of Transmission 8
34.5.4 Letter of Transmittal 8
34.5.5 Project Drawing Register 9
34.5.6 JCU Drawing Register 9
34.6 FILE FORMATS AND NAMING CONVENTIONS 10
34.6.1 General 10
34.6.2 Project Identification Number 10
34.6.3 Discipline Code 10
34.6.4 Drawing file name convention 10
34.6.5 Document File Naming Convention 10
34.6.6 BIM File Naming 11
34.6.7 CAD File Naming 11

34.6.8 Revision Sequencing 11
34.6.9 File Formats 11
34.6.10 Revit (RVT) File Format 12
34.6.11 Industry Foundation Classes (IFC) File Format 12
34.6.12 Portable Document Format (PDF) 12
34.6.13 Design Web Format XPS File (DWFx) 12
34.7 RECORD DOCUMENTS / AS-BUILTS 13
34.7.1 General 13
34.7.2 Record Model 13
34.7.3 Building Record Deliverables 13
34.7.4 Interim BIM Model 14
34.7.5 As-Built Topographic Survey 14
34.8 EMERGENCY EVACUATION DIAGRAMS 14
34.9 OPERATING AND MAINTENANCE MANUALS 15
34.10 BIM STANDARDS 15
34.10.1 General 15
34.10.2 Methodology 16
34.10.3 BIM Use 16
34.10.4 Model Development Methodology 17
34.10.5 Level of Development (LOD) 18
34.10.6 Software 20
34.10.7 Modeling in Revit 20
34.10.8 Model setup and project templates 20
34.10.9 Model naming conventions 21
34.10.10 View naming conventions 21
34.10.11 Object naming conventions 21
34.10.12 Object property/parameter 22
34.10.13 Sheets and Views 22
34.10.14 Model Exchange 23
34.10.15 Model Ownership 23
34.11 CAD STANDARDS 24
34.11.1 General 24
34.11.2 Plan Sets 24
34.11.3 Layer Naming 24
34.11.4 Presentation Styles 25
34.11.5 Drawing Purge 25
34.11.6 Exported Files 25
34.12 GEOGRAPHIC INFORMATION SYSTEM (GIS) 26
34.12.1 General 26

34.12.2 Survey Drawings 26
34.12.3 As Constructed Services Drawings 26
34.12.4 Water and Chilled Water Networks 27
34.12.5 Sewer and Storm Water (Gravity) Networks 27
34.12.6 Electricity Networks 27
34.12.7 Communications Networks 28
34.12.8 Drawing Attributes Blocks 28
34.12.9 Services Drawing Layers 29
34.13 APPENDIX A - DRAWING SUBMISSION CHECKLIST 33
34.14 APPENDIX B - SHEET NUMBERING CONVENTION 34
34.14.1 Discipline Designators 34
34.14.2 Sheet Types 35
34.14.3 Sequence Numbers 35

Version	Date	Authors	Summary of Changes
1	9 April 2013	Multitech for JCU	First Edition
2	30 September 2013	Manager, Infrastructure Services	Revised with JCU comments
2.5	14 August 2014	WA for JCU	
3	19/8/14		Issue to web

34.0 DOCUMENTATION

34.1 DESIGN PROCESS REQUIREMENTS

34.1.1 Roles and Responsibilities

JCU does not wish to be separated from the design process, regardless of whether the project is traditionally delivered, delivered through Managing Contractor, D&C contractor or other.

34.1.1.1 Traditional Delivery

Where traditional delivery is chosen, the framework may be through a Principle Consultant (such as an Architect or Project Manager), or direct to JCU.

The Principal Consultant is to arrange workshops with the JCU Deputy Director – Planning and Development, Manager, Infrastructure Services, Manager, Asset Strategy and Maintenance and other technical staff as directed by these managers from initiation of schematic design.

34.1.1.2 Managing Contractor Framework

Arrange workshops and information issues throughout the design process with the JCU Deputy Director – Planning and Development, Manager, Infrastructure Services, Manager, Asset Strategy and Maintenance and other technical staff as directed by these managers (through the Managing Contractor and JCU's Project Manager).

34.1.1.3 Communication Arrangements

All communication with JCU is to be via the JCU Project Manager. Minutes of any design review meetings etc. are to be provided to all participants via the JCU Project Manager.

34.1.2 Interfaces with Other Disciplines

Ensure that all works necessary for the complete installation and successful operation are advised to other consultants and specified as interface with other engineering disciplines, professions or specialists.

Ensure that information required to accurately design the services is obtained from other consultants as required.

34.1.3 Non-Conformance Approvals

All project team members (for example Consultants, D&C Contractors, Principal Consultants, Internal/External project managers, subcontractors etc.) are responsible for delivering the project in accordance with the project brief, these guidelines, user group information and other contractual documents.

Where there are sound engineering reasons to deviate from these documents, a written non-conformance request is to be submitted to the Deputy Director – Planning and Development via the JCU Project Manager.

This could apply when the project involve aspects, scope, technologies, locations or other applications that are not specifically briefed or covered by the Design Guidelines, the non-conformance request will include clear information on:

- Technical Aspect that is not covered
- A range of options to address the issue
- Time and costs implications for each option

- Effect of the aspect on the design and on other trades
- Effects on users, maintenance, access, life of plant, energy efficiency, cost
- Effects on future re-allocation of the space / system etc.
- Recommended solution to the issue

A Non-Conformance register is to be maintained by the Consultant and the details of each request plus the outcome are to be recorded.

34.2 GENERAL REQUIREMENTS

It is important to document all changes to JCU facilities. JCU uses a variety of systems to track and record building work and other activities. This includes infrastructure, services, operations, maintenance, space programming, and asset and facilities management. Accurate information is critical for effective facilities and asset management.

Building Information Models (BIM) are used to centralise the storage of information relating to buildings. These models are managed by the Design Office.

JCU's Geographical Information System (GIS) is the centre of information relating to site services and infrastructure. The GIS is managed by the Design Office, JCU.

Changes to the built environment and infrastructure directly affect the day-to-day operations of the University. The following list illustrates some of the areas that are affected by building change:

- Emergency evacuation diagrams
- Concept Safety online induction update
- Fire Wardens training
- Room Numbers
- Maintenance records
- Keys and Security
- Labels and signage
- Occupancy (Space & Timetabling)
- Chargeback (Faculty occupied areas, leased spaces)
- Fabric renewal / Maintenance schedule (Asset Management)
- Compliance with standards and codes and regulations
- GIS records
- Student Association activities and records

It is vital that all changes to the built environment are recorded and delivered to the University. To ensure compatibility with JCU's building and infrastructure management systems, Record Documentation shall be delivered as specified in this section.

Note: This section is not a guideline for all project documentation deliverables. This section is focussed specifically on Record Documentation, that is, the As-Constructed or As-Built deliverables.

34.3 REFERENCES

This section is written with reference to the following documents:

34.3.1 Australian Standards:

AS 1100.101-1992 Technical drawing - General principles
AS 1100.201-1992 Technical drawing - Mechanical engineering drawing
AS 1100.301-2008 Technical drawing - Architectural drawing

AS 1100.401-1984 Technical drawing - Engineering survey and engineering survey design drawing
AS/NZS 1100.501:2002 Technical drawing - Structural engineering drawing

34.3.2 Open Standards:

Omniclass

34.3.3 Other Industry Standards, Guidelines, and Conventions:

National Public Works Council – Table of Building Elements (Australian)
AEC (UK) BIM Protocol for Autodesk Revit – V2.0
NATSPEC National BIM Guide
AIA Document E202, Building Information Modeling Protocol Exhibit

34.3.4 Project Documents:

Letter of Transmittal
Project Drawing Register (template)
BIM Management Plan/ BIM Execution Plan
Project File
The Brief
The Contract

34.3.5 System Documents:

JCU Drawing Register
JCU Organisational BIM Management Plan

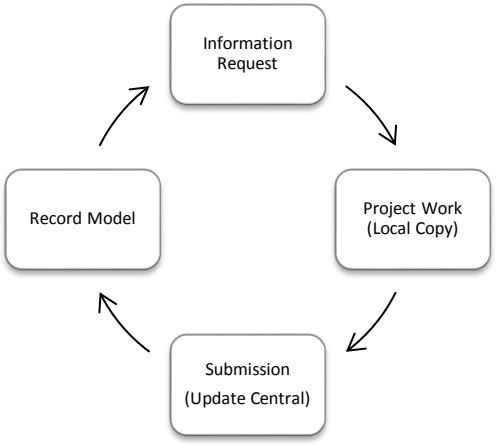
34.4 INFORMATION EXCHANGE

34.4.1 General

This section describes the process of information exchange between the University and *project teams*.

Types of information exchange:

1. requesting building and infrastructure data for *JCU* property (information request)
2. submitting as built documentation to *JCU*



On project completion, final documents (describing as built conditions) are submitted to the Design Office for record keeping and integration with operational systems.

34.4.2 Information Requests (Building Records)

The building records at JCU are used to support planning projects, new building work, upgrades and maintenance to existing facilities. The *project team* may request access to these records.

JCU Building Records are maintained by the Design Office. Official requests for information may be made via the *JCU Project Manager*[1].

JCU encourages the use of "self serve" systems where possible, including the following:

- Enlighten – Web-based GIS

  EDocs – accessible through Enlighten

The url for Enlighten:

https://secure.jcu.edu.au/enlighten3

For access to Enlighten, contact the *JCU Project Manager* to initiate creation of a user account

34.4.3 Site and Infrastructure Records

JCU Site and Infrastructure Records are maintained by the Design Office. Official requests for information may be made via the *JCU Project Manager*[2]. Site and infrastructure details are viewable through Enlighten. Refer Information Requests (Building Records) for access to Enlighten.

34.4.4 Enlighten

Enlighten is the web-based Geographic Information System (GIS) application that enables controlled access to JCU's spatial data. Spatial data includes building footprints, roads, parking lots, paths, creeks, cadastre, and other site features. The system also contains information about underground assets such as communications, water, sewer, storm water, and electricity services.

All Estate Office staff, as well as Information Technology and Resources infrastructure staff, have access to this rich spatial content through Enlighten. Users external to JCU can be trained and issued with accounts to access the system.

Enlighten can be accessed at this URL:

https://secure.jcu.edu.au/enlighten3

34.5 SUBMISSION INSTRUCTIONS

34.5.1 General

All documents, drawings and model submissions shall be in accordance with this section.

The final drawing deliverables for each project is determined at the project level. A list of mandatory requirements is set out in section 34.9.

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[1] Project Managers may use the following email alias to make relevant requests: BuildingRecords@jcu.edu.au

[2] Project Managers may use the following email alias to make relevant requests: GIS@jcu.edu.au

All drawing submissions shall be accompanied with:

- Letter of Transmittal and;
- Project Drawing Register

34.5.2 Verification

All submitted documents shall meet the required standards and integrate successfully into all Estate Office applications (e.g. MEX, BMS, GIS, FM: Systems, etc).

Submitted drawings shall be subject to verification of compliance to this standard. Any drawing or model submission that does not substantially comply will be rejected and appropriate contract action, including withholding of payment, noting on contractor past performance reports, and/or other remedies, may be activated by *JCU*.

The *Project Team* shall not be relieved of responsibility when files are delivered if the files do not meet established requirements or are defective.

Refer to Appendix A for the Drawing Submission Checklist.

34.5.3 Method of Transmission

Files shall be issued to *JCU Building Records* via the *Project Manager*.

Small file sets that are less than 5mb in size may be sent to this email address:
BuildingRecords@jcu.edu.au

Emails with attachments exceeding 5MBb should not be sent this way.

The handling of large file sets (those exceeding 5mb) shall be as agreed by the *project team*. Acceptable methods include:

- Use of large file transfer functions over the internet
- Shared cloud storage space
- CD or DVD
- USB stick (preferred)

Electronic files and media submitted to *JCU* must not contain computer viruses.

File transfers via the internet including cloud storage shall remain secure and confidential.

34.5.4 Letter of Transmittal

The Letter of Transmittal shall contain the following minimum information:

Project Number
Project Title/Description
Contract Number or Reference
Estate Office Project Manager or JCU contact name
Reason for Issue
Date of Issue
Reference to drawing register and attachments
Comments as required

34.5.5 Project Drawing Register

The *Project Drawing Register* contains all finalised versions of models and drawings. It is not a register for tracking revisions throughout the project, but rather a tool to capture the information relating to each model, drawing, and sheet upon handover.

All relevant fields in the register shall be filled where possible.

The *project team* shall supply **a** *Project Drawing Register* listing all finalised documents, including:

- Record Model Revit files
- Record Drawing (As-Constructed) AutoCAD files
- Record Drawing (As-Constructed) PDF files

The *Project Drawing Register* shall match the *JCU* template and shall be supplied in Microsoft Excel file format. Proprietary document transmittals are not acceptable.

The template is available for download at:
http://www.jcu.edu.au/estateoffice/info/constructionmaintenance/index.htm

Drawing Register Column Headers
File Name
Building Number
Floor Level
Project Number
Project Title
Site Address
Client Name
Consultant Name
Discipline
Drawing Number
Sheet Title
Content
Reason for Issue
Author
Revision Number
Date of Original Issue
Date of last issue
Original Sheet Size
Sheet Sequence Number
Comments/Notes

It is critical that the integrity of the Project Drawing Register is maintained. The information in this table will be migrated to the JCU Drawing Register database (EDocs). The columns and headings shall not be modified in any way.

34.5.6 JCU Drawing Register

The *JCU Drawing Register* is the master record of every drawing relating to all building work for *James Cook University*. This is managed by Design Office staff.

The register contains:

- Record Model Revit files
- Record Drawing (As-Constructed) AutoCAD files

- Record Drawing (As-Constructed) PDF files (individual sheets, not one full set)

The register does not contain:

- Ad-hoc drawings generated from record models
- The incremental developments of drawings that are generated within project phases . (This type of drawing shall be archived electronically within the project file)

Record submissions received shall be verified and migrated directly into the *JCU Drawing Register* by JCU. Record Documents will be linked to the database (EDocs).

34.6 FILE FORMATS AND NAMING CONVENTIONS

34.6.1 General

This section defines the mandatory file naming conventions and acceptable file formats for electronic documents, drawings and models.

34.6.2 Project Identification Number

Each project shall be assigned a unique Project identifier by the JCU Project Manager. At the inception of all projects the *JCU Project Identifier* should be obtained to support the proper naming of model files, content and other support files.

34.6.3 Discipline Code

The discipline prefix shall be the first four letters of the name as per the table below.

Discipline Prefix table	
ARCH	Architect
STRU	Structural
CIVI	Civil
ELEC	Electrical
HYDR	Hydraulic
SURV	Survey
MECH	Mechanical
SPEC	Specification
COOR	Coordination
LAND	Landscaping

34.6.4 Drawing file name convention

Drawings shall be submitted with file names in the following format:

[DISCIPLINE]-[PROJECT NUMBER]-[SHEET NUMBER]-REV-[REVISION NUMBER].XYZ
Example: ARCH-8000-01-REV-01.pdf

34.6.5 Document File Naming Convention

Documents including certificates, reports and other records relating to a building shall adhere to the following file naming convention.

[DISCIPLINE]-[PROJECT NUMBER]-[DOCUMENT NUMBER]-REV-[REVISION NUMBER].XYZ
Example: GEOT-8000-100-REV-A.pdf

Files shall be named to match equivalent native file format versions.

34.6.6 BIM File Naming

The convention for model names shall be as follows:

[DISCIPLINE] – [PROJECT NUMBER] – [BUILDING NUMBER] -REV-[REVISION NUMBER].rvt
Example: ARCH-11111-D4-REV-B.rvt

34.6.7 CAD File Naming

CAD drawing files shall be named in the format below:

[DISCIPLINE]-[PROJECT NUMBER]-[SHEET NUMBER]-REV-[REVISION NUMBER].XYZ
Example: ARCH-8000-01-REV-01.dwg

34.6.8 Revision Sequencing

Pre-tender documents shall use a numeric revision sequence, starting from 0.

Tender and post-tender documents shall use alphabetic revision sequence, starting from A.

34.6.9 File Formats

It is mandatory to adhere to the prescribed file formats. Alternative formats can only be deemed appropriate if the format can be demonstrated to be compatible with existing JCU corporate systems. Acceptance of an alternative format is at the discretion of the Deputy Director – Planning and Development.

Table: Accepted File Formats

Deliverable		File format					
		Revit	Autocad	Word	Excel	PDF	DWFx
Project Drawing Register		☑	☒	☒	☑	☒	
Record Models/As Constructed	Architectural	☑	☒	☒	☒	☑	
	Furniture, Fixtures, & Equipment	☑	☒	☒	☒	☑	
	Structural	☑	☒	☒	☒	☑	
	Civil	☑	☒	☒	☒	☑	
	Electrical	☑	☑	☒	☒	☑	
	Lighting	☑	☑	☒	☒	☑	
	Data and Communications	☑	☑	☒	☒	☑	
	Fire Services	☑	☑	☒	☒	☑	
	Mechanical	☑	☑	☒	☒	☑	
	Hydraulic	☑	☑	☒	☒	☑	
	Finishes Schedule	☑	☒	☒	☑	☑	
Sustainability Report		☑	☒	☑	☑	☑	
Energy Efficiency Report		☑	☒	☑	☑	☑	
Room Data Sheets		☑	☒	☑	☑	☑	

Operation & Maintenance Manual		☒	☒	☑	☒	☑	
Building Design Report		☑	☒	☑	☑	☑	
Safe Design Report		☑	☒	☑	☑	☑	
Design Review	3D	☑	☒	☒	☒	☑	☑
Site Services		☒	☑	☒	☒	☑	☒

34.6.10 Revit (RVT) File Format

The software version for models created and supplied in Autodesk Revit shall be nominated in the *BIM Management Plan*.

Warning!
It is critical that the version of Revit specified in the BIM Management Plan is used to ensure compatibility with all JCU's systems. Confirm with Estate Office prior to commencement.

34.6.11 Industry Foundation Classes (IFC) File Format

Submission of model elements in IFC format is not acceptable to JCU at this time.

Refer to the following link for further information regarding Revit and IFC:

http://www.augi.com/library/myth-buster-revit-ifc

The IFC system is a data representation standard and file format used to define architectural and construction-related CAD graphic data as 3D real-world objects. Its main purpose is to provide architects and engineers with the ability to exchange data between CAD tools, cost estimation systems and other construction-related applications. IFC provides a set of definitions for all object element types encountered in the building industry and a text-based structure for storing those definitions in a data file.

The university supports the concept of Open BIM, however the only compatible format to date that suits current JCU systems is Autodesk Revit file format.

34.6.12 Portable Document Format (PDF)

Documents supplied in PDF format shall conform with the PDF/A standard.

PDF/A is an ISO-standardised version of the Portable Document Format (PDF) specialised for the digital preservation of electronic documents.

Documents shall be formatted such that sections have defined bookmarks.

34.6.13 Design Web Format XPS File (DWFx)

Acceptable file format for design review purposes.

Autodesk Design Review Software is free to download:

http://usa.autodesk.com/design-review/download/

34.7 RECORD DOCUMENTS / AS-BUILTS

34.7.1 General

This section outlines the minimum requirements for Record Documents and Record Models.

For the purpose of this section, the terms building record, record drawing, as-built, and as constructed are synonymous.

34.7.2 Record Model

Unless specified otherwise, the contract conditions shall enforce the delivery of a Record Model for any building work carried out for the University. This applies to new buildings and renovations.

JCU requires Record Models to be Autodesk Revit Building Information Models (BIM).

The Record Model may be considered as a subset of the "As Constructed" documentation for the explicit purpose of facilities management. The Record Model becomes the base information for the ongoing planning, financial management, operation and maintenance of the facility.

The *project team* is responsible for the creation, development and supply of a Record Model.

The level of development (LOD) of the Record Model shall be defined in the project specific *BIM Management Plan* (BMP) and form part of the Contract.

Refer to the JCU Organisational *BIM Management Plan* to establish starting point for individual projects.

34.7.3 Building Record Deliverables

The complete list of final drawing deliverables are unique to each project, and shall be defined in the *Contract*. Typically, at each project milestone *James Cook University* requires the delivery of the current model, electronic versions of hardcopy submissions and other files that support the intent of the project.

Mandatory deliverables are listed in the following table.

Deliverable	Responsible Party	Quantity	Format	Due Date
Interim BIM Model – All disciplines as per project plan	Principal Consultant	1 set	.rvt	**3-6 months** prior to Practical Completion
Operations & Maintenance Manuals	Principal Consultant All disciplines	1 set	.pdf/paper	At Practical Completion
Certificate of Classification	Principal Consultant	1 set	.pdf	At Practical Completion
Other certification documents and dossiers (e.g. Hazardous Areas Classification)	Principal Consultant All disciplines	1 set	.pdf	At Practical Completion
As-Built Services	Principal Consultant All disciplines	1 set	.rvt/.dwg/. pdf/paper	At Practical Completion

As-Built Record Model	Principal Consultant All disciplines	1 set	.rvt	30 days from practical completion
As-Built Construction Set	Principal Consultant All disciplines	1 set	.dwg/.pdf/ paper	30 days from practical completion
As-Built Topographic Survey - Building perimeter	Principal Consultant Contractor	1 set	.dwg/.pdf/ paper	30 days from practical completion
Building Compliance Certificate	Principal Consultant Contractor	1 set	.pdf	30 days from practical completion
As-Built Site Services	Principal Consultant All disciplines	1 set	.dwg/.pdf/ paper	At Practical Completion

34.7.4 Interim BIM Model

The Interim BIM Model is used by JCU to coordinate operational systems and programming for readiness prior to practical completion of the building works.

The Interim BIM Model is a current record model (or drawing) complete with room names, room numbers, room areas, floor finishes, and fire and emergency fixtures and equipment indicated.

These are to be submitted 3-6 months prior to practical completion.

34.7.5 As-Built Topographic Survey

A contour and detail survey 50m buffer around building perimeter recording the as-built conditions at completion of all building and landscaping works.

Surveys shall nominate and capture a minimum of one PSM, and include two real world geographical structure reference points with x,y,z coordinates annotated. Reference points shall be external wall corners at diagonal opposite ends of the structure.Refer section Survey Drawings for more details

34.8 EMERGENCY EVACUATION DIAGRAMS

Legislation mandates that all required *Emergency Evacuation Signs* are in place within thirty (30) days from practical completion. The *Interim BIM Model* shall be relied upon to prepare the signs.

James Cook University shall prepare all required emergency evacuation diagrams for the purpose of supplying the wall mounted *Emergency Evacuation Signs*.

A standard view template (Revit) named "Emergency Evacuation" shall be applied to a plan view within the Revit model. This view template is available from the *JCU BIM Template file*.

Where multiple signs are required for each floor level, the dependant view function shall be used.

A standard title block shall be used to create the required sheet for each sign. Standard sheets and symbols are available from the *JCU BIM Resources folder*. Created sheets shall not be deleted.

Where 2D CAD drawings are supplied in lieu of a Record Model, a clean general arrangement plan shall be supplied by the *project team*. This plan shall be free of all annotation with the exception of room tags. A drawing is required for each level of the building. Refer to the *CAD standards* for additional presentation requirements of CAD drawings.

Minimum information required to prepare the Emergency Evacuation Signs:

- Emergency evacuation sign mounting locations
- Main path of egress
- Path of exit
- Emergency evacuation point
- Emergency exit
- Fire hose reel
- Manual call point
- Fire indicator panel
- Warden intercom
- First aid
- Switchboard
- Hydrant
- Fire extinguisher
- Gas isolation
- Zoning

Other building features relating to the fire and emergency design solution

34.9 OPERATING AND MAINTENANCE MANUALS

Details of the requirements for Operations and Maintenance Manuals are given in each section of these Design Guidelines, generally under point XX.3.6.6.

In addition to the O&M Manuals, plant and equipment shall be modelled (BIM) to the Level of Development as specified in the BIM Management Plan. Each item shall include attributes that capture make, model and serial number in the model.

34.10 BIM STANDARDS

34.10.1 General

The focus of this section is to define the required level of BIM development for *JCU*. This section does not cover the implementation of BIM on projects in full detail. The adoption of the NATSPEC National BIM Guide is preferred and, when used in conjunction with this standard, satisfies the requirements to JCU for BIM projects.

34.10.2 Methodology

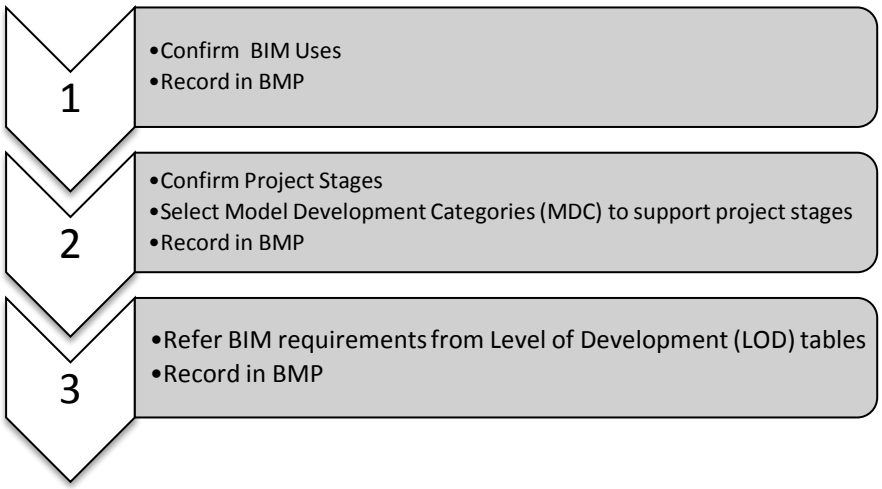
The *project team* shall refer to the *NATSPEC National BIM Guide* and its supporting documents to establish the implementation of BIM on each project.

Hyperlink: http://bim.natspec.org/

A *Project BIM Brief* shall be prepared for each project by Estate Office. This shall form part of the project brief.

A *BIM Management Plan* (BMP), otherwise known as a BIM Execution Plan (BEP) shall be prepared for each project by the project manager. The BMP is a formal document that defines how the project will be executed, monitored and controlled with regards to BIM.

The *JCU Organisational BIM Management Plan* shall be used for guidance when preparing the BMP.



34.10.3 BIM Use

The nominated level of development of BIM shall support the defined uses for it. This means that BIM data shall be prepared 'fit for purpose' taking into account how the BIM is intended to be used. It is key to understand and define what BIM uses apply to the project and further for the operation of the facility.

The current defined BIM Uses for *James Cook University* include:

- Record Models
- Space Management
- Condition Data

Further practical BIM Uses are encouraged and should be well defined within the Project BIM Brief. Typical uses include:

- Asset Management
- Maintenance Scheduling
- Record Modelling
- Space Management / Tracking
- Site Utilisation Planning
- Layout Control & Planning
- Building Systems Analysis

- Energy Analysis
- Lighting Analysis
- Mechanical Analysis
- Sustainability Evaluation
- Disaster Planning
- Existing Conditions Modelling
- Site Analysis
- Design Authoring
- Design Reviews
- Programming
- design review in regard to spatial requirements
- Cost Estimation
- Code Validation
- Engineering Analysis
- 3D Coordination (Design)
- Structural Analysis
- Phase Planning (4D Modelling)
- 3D Coordination (Construction)
- Clash detection

34.10.4 Model Development Methodology

Models may be created and developed over a staged process that is suitable to support the required project outcomes. This methodology shall be defined and recorded in the BMP.

The selected overall model development category may be adjusted to accommodate a specific project or University use.

Four categories of model development are described as follows:

	Model Development Category
I:	This model will support project planning through space and volume illustration, adjacencies, and site positioning.
II:	This model will include a sufficient level of development to support document and system review, clash detection and coordination, and support an as-built format for Owner use after completion. If no Model Development Category (“MDC”) is identified, then MDC II will apply.
III:	This model will include all the benefits and requirements of the early model categories, and will provide sufficient detail to support a detailed model development of systems supporting building occupancy and facility management.
IV:	This model will include the benefits and requirements of the earlier model categories, and support highly detailed logistical, scheduling, and estimating efforts.

34.10.5 Level of Development (LOD)

The level of development for each model component is based on the model content criteria established by *AIA Document E202, Building Information Modeling Protocol Exhibit*.

Hyperlink: http://www.aia.org/contractdocs/training/bim/aias078742

The LOD shall match the minimum required use. Note: the *minimum* LOD is preferred. This shall be outlined in the BIM Management Plan.

The content for each level of development is described as follows:

Levels of development	Authorised Uses
LOD 100 - Conceptual Overall building massing indicative of area, height, volume, location and orientation may be modeled in three dimensions or represented by other data.	Analysis Cost estimating Schedule
LOD 200 – Approximate Geometry Model elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location and orientation. Non-geometric information may also be attached to model elements.	Analysis Cost estimating Schedule
LOD 300 – Precise geometry Model elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model elements.	Construction Analysis Cost estimating Schedule
LOD 400 – Fabrication Model elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location and orientation with complete fabrication, assembly and detailing information. Non-geometric information may also be attached to model elements.	Construction Analysis Cost estimating Schedule
LOD 500 – As built Model elements as constructed assemblies actual and accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model elements.	General Usage

Each of the model categories has an established level of model development for each building system. The level of development for each building system may be adjusted to reflect the University's requirements. This shall be outlined in the BIM Management Plan.

Refer to the following example table showing levels of development for specific building systems. The project LOD shall be defined in the BIM Management Plan.

Building System	Model Category/Level of Development			
	I	II	III	IV
Substructure	0	300	300	400
Structure	100	300	300	400
Enclosure*	100	300	300	400
Interior*	100	300	300	400
Conveying Systems	100	200	300	400
Plumbing	100	200	300	400
Mechanical	100	200	300	400
Fire Protection	0	100	300	400
Electrical	100	200	300	400
Equipment and Furnishings*	100	200	300	400
Special Construction	100	200	300	300
Site work	0	100	100	200
Site Improvements*	100	200	200	300
Site Utilities	100	200	300	300

* Additional LOD descriptions are provided for these building systems.

Several building systems are composed of elements that may require separate levels of component development as described below:

Building System Component	Model Category / Level of Development			
	I	II	III	IV
Enclosure	100	300	300	400
Exterior Walls	100	300	300	400
Exterior Windows	100	200	300	400
Exterior Doors	100	300	300	400
Roof Coverings	100	200	300	400
Roof Openings	100	300	300	400
Interior	100	300	300	400
Interior Partitions	100	300	300	400
Interior Doors	100	300	300	400
Interior Specialties	0	200	300	400
Stair Construction	100	300	300	400
Wall Finishes	0	200	200	300
Ceiling Finishes	0	200	200	300
Windows	100	200	300	400
Floor/Ceiling Construction	100	300	300	400
Equipment and Furnishings	100	200	300	400
Fixed Equipment	100	200	300	400
Moveable Furnishings	100	100	200	300
Special Equipment	100	200	300	400

Fixed Furnishings	100	200	300	400
Site Improvements	100	200	200	300
Roadways	100	200	200	300
Parking	100	200	200	300
Footpaths	100	200	200	300
Landscaping	0	100	100	200
Irrigation	0	100	200	200

The model categories should be reviewed together with the JCU defined requirements, adjusting the specific levels of development for building components to support the end-user requirements. For example: Owner may select an MDC II model for the project, but require detailed equipment data for the mechanical system to support future expansion and systems management. The category II model would remain as stated, with the exception of the mechanical system components which may be set at a higher level of development.

34.10.6 Software

All software used in the development of the BIM shall be defined in the *BIM Management Plan*.

Use	Product	Version
Design Authoring	Autodesk Revit	*TBC*
Design Review	Autodesk Design Review	*TBC*
Model checking	Navisworks, Solibri, other etc.	*TBC*
Cost Estimation	CostX, other	*TBC*

34.10.7 Modeling in Revit

For BIM protocols when modelling in Autodesk Revit refer to:
AEC (UK) BIM PROTOCOL FOR AUTODESK REVIT – V2.0

Where a conflict occurs this standard shall be used.

34.10.8 Model setup and project templates

A blank Revit template consistent with this standard shall be supplied by the Design Office. This template is a resource only, and includes the JCU shared parameters.

JCU_BIM_TEMPLATE-V0.1.RTE

This template includes the following:

Title block 2 Standard versions (long edge and short edge) for each paper size in the A series.	A0 – Long Edge A0 – Short Edge A1 – Long Edge A1 – Short Edge A3 – Long Edge A3 – Short Edge A4 – Long Edge A4 – Short Edge
Text styles	Arial 1.8mm Arial 2.5mm Arial 3.5mm Arial 5.0mm

	Arial 7.0mm
Room Tag	JCU Standard Room Tag
Area schedules	
Shared parameter file	File name here
Common/standard family components	Refer resources.
BIM Bulletin view	
Geo-referenced site plan	Townsville, Cairns, Singapore

Model naming conventions

FILE NAME CONVENTION FOR MODELS	
DISCIPLINE - PROJECT NUMBER – BUILDING NUMBER – REVISION.rvt (example: ARCH-11111-BL001-REV-A.xyz)	
ARCHITECTURAL MODEL	ARCH-
CIVIL MODEL	CIVI-
MECHANICAL MODEL	MECH-
HYDRAULIC MODEL	HYDR-
ELECTRICAL MODEL	ELEC-
STRUCTURAL MODEL	STRUC-
ENERGY MODEL	ENER-
CONSTRUCTION MODEL	CONS-
COORDINATION MODEL	COOR-

34.10.9 View naming conventions

Floor levels shall be named as follows:

LEVEL	NAME
Basement	B1
Ground Floor	00
First Floor	01
Second Floor	02
Third Floor	03
Fourth Floor (and so on)	04
Mezzanine	M1

34.10.10Object naming conventions

Objects within the Model should be named in the following format:

[Object Category]-[Type]-[Subtype]-[Manufacturer]-[Description]-[Grade/LoD]. xyz
The Type, Subtype and Manufacturer fields should be used as needed.

The following is a list of examples:

Window-Double_Hung-Andersen-400Series-Arch_Top-G3.rfa

Plumbing_Fixtures-Sink-Oval-Generic-Under_Counter-G1.rfa

Note – The condition assessment being carried out by OPUS in 2012-2013 has an elemental breakdown based on the National Public Works Council (NPWC) tables.

34.10.11 Object property/parameter

Components shall include the following basic attribute parameters regardless of the graphical development level.

Attribute Table
Description
Manufacturer
Model
Serial Number
Asset tag number
Condition
Installation date
Expiry date
Warranty expiry date
NPWC Code

The use of hyperlinks within object attributes to Operation & Maintenance Manuals, diagram schematics, test reports etc – broken links are not acceptable.

All objects shall be of the correct category, modeled to reflect the actual overall size and volume, and placed in the correct relative position (location and orientation) within the model.

For created content, refer to ANZRS – Revit family creation pack – General compliance checklist C1.
http://www.anzrs.org/blog/

Also, Autodesk family style guide here:

http://usa.autodesk.com/adsk/servlet/index?siteID=123112&id=13080413

34.10.12Sheets and Views

The central BIM shall contain the following sheets and views. Other sheets and views shall be archived with the project files.

Table: Mandatory sheets and views in the BIM (continues next page)

View/Sheet	Content	Responsible Party
BIM Bulletin Board	Drafting view	All editors
View schedule	Schedule of all views within the BIM	
Sheet schedule	Schedule of all sheets within the BIM	
Site plan	Site boundaries	
	True North	
	Project North	
	Principal point of entry	
	Real property data	
Area plans	Gross floor area	
	Interior Gross	
	Room	Estate Office
Area schedules	Gross floor area	
	Interior Gross	

View/Sheet	Content	Responsible Party
	Room	Estate Office
Room schedules	Full building room schedule	
	Level by level filtered schedules	
	Level / Room Number / Department / Room Name / Occupancy / Area / Floor Finish	
Window schedule		
Door schedule		
Plumbing and hydraulic schedule		
Electrical and data schedule		
Mechanical schedule		
Lighting schedule		
Fire/Emergency schedule		
Other equipment schedule		
Floor plan	1:100 scale	
	Room tags, standard	
	North point	
	Building name/number/level	
	Major areas annotated	
Emergency Evacuation plans	Refer separate standard.	Estate Office
	Per level/"You are here"	
Design Criteria	Drafting view	
	Summary of all major design criteria	
	Building Classifications	
	Wind Classifications	
	Hyperlinks to certifications	
	Details of any specific building compliance solutions	
View Templates	Fire & Emergency floor plan	Predefined
	Area floor plan	
	Clean floor plan	
	Architectural floor plan	
	Architectural section	
	Architectural elevation	

34.10.13Model Exchange

The method of model exchange between *project team* members shall be defined in the *BIM Management Plan (BMP)*.

Considerations: Method for hosting, transfer, file security, and access of data between technical disciplines.

34.10.14Model Ownership

All model elements submitted become the property of *James Cook University*.

34.11 CAD STANDARDS

34.11.1 General

In some instances, CAD format may be acceptable in lieu of BIM for particular projects and deliverables. The intent of this section is to standardise the format of drawings and to ensure compatibility with existing University systems.

34.11.2 Plan Sets

Drawing sets shall not be bound within a single file. Each drawing sheet shall be supplied as an individual file with a corresponding file name.

34.11.3 Layer Naming

Generally, the layer naming shall be structured to enable the CAD user easy control for organising and displaying drawing data.

JCU has adopted the method of grouping the drawing objects on layers in the syntax:

DISCIPLINE_VIEW_OBJECT	
Architectural and Structural objects	Syntax: A-WALL All Architectural and Structural objects shall be drawn on layers with prefix "A", followed by the category (eg. "WALL"), with hyphen separators.
Mechanical objects	Syntax: M-DUCT All Mechanical objects shall be drawn on layers with prefix "M", and follow the same syntax as Architectural layer naming
Electrical objects	Syntax: E-SWITCH All Electrical objects shall be drawn on layers with prefix "E", and follow the same syntax as Architectural layer
Hydraulic objects	Syntax: H-DRAINAGE All Hydraulic objects shall be drawn on layers with prefix "H", and follow the same syntax as Architectural layer Some objects should be layered in more detail (not unlike Hatch layers) for controlling display more easily, eg. "H-WATER-COLD", "H-WATER-HOT", "H-WATER-TEPID", etc.
Viewports	All Viewports shall be drawn on layer "Defpoints" (not just a layer which is non-printable or switched off) unless the viewport boundary is intended to be visible, eg. A circular viewport showing a detail
Gridlines	"A-GRIDLINES"

34.11.4 Presentation Styles

Sheet Sizes	Acceptable sheet sizes as follows: A0, A1 and A3 All sheets within a drawing set shall be of the same sheet size.
Titleblock	Shall be standard JCU titleblock available from this link.
Cross Referencing	External references (xref) files must be supplied alongside the main file. Missing or broken links are not acceptable.
Drawing Units	Site survey plans shall be drawn in meters – Refer to the standards for GIS. All other plans shall be drawn 1:1 in millimetres
Drawing Scales	Acceptable drawing scales to Australian Standards
Line styles and line weights	By Layer To Australian Standards
Gridlines	To Australian Standards
Font	To Australian Standards
Font Size	To Australian Standards
Layer Colours	To Australian Standards
Dimensions	Styles to Australian Standards Separate layer Model space
Annotations & keynoting	In model space
Labelling and tagging	Room tags to be placed in model space
Abbreviations	To Australian Standards where available
Symbols	To Australian Standards where available Include legend in model space
Representation of materials and finishes	
Schedules	
Legends	In model space All service lines with unique line types and colours – refer standard block.
Shape files and font files	Must be supplied with the drawing files. Missing file warnings are not acceptable. Autocad file package utility is encouraged for transmission purposes.
Hatching	Do not explode hatching.

34.11.5 Drawing Purge

The “Purge all” function should be used to minimise file sizes are and remove extraneous lines, blocks and other objects.

All content (including blocks, symbols and the like) within the drawing shall be free of copyright and royalty conditions for the immediate and future use by the University.

34.11.6 Exported Files

Exported drawing (.DWG) files shall adhere to the above presentation styles.

34.12 GEOGRAPHIC INFORMATION SYSTEM (GIS)

34.12.1 General

The university's GIS solution is comprised of the following elements:

- Oracle Spatial Relational Database Management System
- AutoCAD Map3D and AutoCAD Civil3D
- Munsys Applications
- Munsys Management Console
- Autodesk Infrastructure Map Server
- Enlighten 3.0

Oracle spatial data is created and edited within an AutoCAD Map3D or Civil3D workspace, facilitated by the Munsys Applications. Munsys Applications have preconfigured business rules that ensure data quality across the whole schema.

Within the drawing workspace, objects are queried from the database and are edited using AutoCAD and/or Munsys Applications tools. New database objects can be created from normal AutoCAD geometry with the functionality to capture attributes during data conversion. Objects attributes (defined in this section) should therefore be attached to the geometry as either:

1. Object Data Tables within an AutoCAD drawing
2. AutoCAD block attributes in a block associated with the geometric objects
3. As spatial object attributes within a spatial (GIS) file, including:
    a. Autodesk SDF file
    b. ESRI SHP file
    c. Mapinfo file

The university will consider alternative file formats, should the above file formats be incompatible with the supplier's system.

Spatial data is styled in Autodesk Infrastructure Map Server, and access control of the data is handled by Enlighten. Enlighten is the end-user interface for viewing, querying, analysing, and printing spatial data.

34.12.2 Survey Drawings

Survey drawings shall be submitted in a format enabling import to the GIS, as follows:

- Drawing units shall be in metres
- Drawings shall be in Map Grid of Australia Zone 55 Projection
- Height shall be in Australian Height Datum (AHD)

34.12.3 As Constructed Services Drawings

Site plans for as-constructed services shall be in the same format as survey drawings for units, projection, and height datum.

Services attributes such as pipe type, material, invert level etc are preferably captured as Object Data Tables, or as geometry attributes in a spatial file. The following tables describe the attributes to be captured.

34.12.4 Water and Chilled Water Networks

The topologies for the water networks should be captured to enable network tracing. This includes pipe locations, sizes, flow direction, and connectivity with valves and junctions (where possible). Chilled Water and Water assets shall be captured and attributes documented using the information structure defined in the following tables.

Points:

NODE_TYPE	NODE_ELEV	NODE_REF	WAT_CATEGORY	COMMENTS	MEX_ID
HYDRANT_SINGLE	25.115	H22	POTABLE		

Note:

Please provide a logical description for NODE_TYPE.

Lines:

PIPE_DIA	PIPE_MATRL	WAT_CATEGORY	COMMENTS
100	**HDPE**	**POTABLE**	

Note:

Pipe material code values are predefined. Values include:

AS Asbestos

FC Fibre Cement

PVC Polyvinyl Chloride

HDPE High Density Polyethylene

STEEL Steel

If these values are not suitable for a feature, please use a logical code.

34.12.5 Sewer and Storm Water (Gravity) Networks

Invert levels for gravity sewer and storm water pipe networks shall be captured within 0.05m tolerance. Sewer and Storm Water assets shall be captured and documented using the information structure defined in the following tables.

Sewer Points:

NODE_TYPE	NODE_DEPTH	NODE_COVELEV	NODE_REF	COMMENTS	SEW_CATEGORY
MANHOLE_PUB	**0.95**	**25.225**			**NORMAL**

Sewer Lines:

PIPE_DIA	PIPE_MATRL	START_INVELEV	END_INVELEV	COMMENTS	SEW_CATEGORY
150	**PVC**	**22.945**	**22.63**		**NORMAL**

Stormwater Points:

NODE_TYPE	NODE_DEPTH	NODE_GL	COMMENTS
WW			

Stormwater Lines:

PIPE_DIA	PIPE_MATRL	START_GL	END_GL	START_IL	END_IL	COMMENTS
375	**CONC**	**22.6**	**22.6**	**21.6**	**21.44**	

34.12.6 Electricity Networks

High Voltage and Low Voltage electricity cables are to be captured and documented using the information structure defined in the following tables.

Electricity Points:

NODE_TYPE	NODE_DESC	NODE_REF	COMMENTS	MEX_REF	CAPACITY
TRANSFORMER	WESTERN COURTS	US45			750

Electricity Lines:

CBL_SIZE	CBL_MATRL	START_TYPE	END_TYPE	COMMENTS	AG_UG
240	Al XLPE	TRANSFORMER	POLE	U9501	UG

34.12.7 Communications Networks

Communications assets shall be captured and documented using the information structure defined in the following tables.

Communications Pits:

COMMENTS	PIT_ID	PIT_MATERIAL
	12	CONC

Communications Conduits:

COMMENTS	CON_DIA	CON_MATERIAL	CON_DESC
	100	PVC	1x100

34.12.8 Drawing Attributes Blocks

If supplying drawings in a spatial file format is not possible, attributes shall be captured using AutoCAD block attributes associated with the geometry. Standard blocks for this purpose are downloadable from the CAD/BIM Resource page. Each spatial layer should have a corresponding attribute block to use, for example, ATT_STORMWATER_PIPE.dwg block should only be used for stormwater pipes. In addition, attribute blocks shall be inserted on the corresponding drawing "NOTE" layer, for example, SEWNOTE for sewer features.

The following example shows an AutoCAD drawing with associated attribute blocks for a sewer gravity pipe. The attribute blocks are snapped to the lines' midpoints.

Attribute blocks for point features, such as manholes, pits, and valves, shall be inserted on top of symbol blocks. This ensures that the point features are visible in the as-constructed drawing when the attributes layer is turned off or frozen.

34.12.9 Services Drawing Layers

Layers shall be organised as:

Name	Description/Use
0	(System layer)
BLOCK	(System layer)
BUILDING	Building outlines
CMSNOTE	Cadastral notes
COMMS_CONDUITS	Communications
COMMS_PITS	
CONTOURS	Topographic contours
DAM	Dams
DELETED	(System layer)
DMSLABEL_CHANNEL	Stormwater drainage
DMSLABEL_CULVERT	
DMSLABEL_PIPE	
EASELINE_	Easements
EASELINE_ELECTRIC	
EASELINE_GENERAL	
EASELINE_LEASE	
EASELINE_RAILWAY	
EASELINE_RESERVE	
EASELINE_ROAD	
EASELINE_SEWER	
EASELINE_STORM	
EASELINE_WATER	
EASELINETXT	
EASEPOLY	
EASEPOLY_ELECTRIC	
EASEPOLY_GENERAL	
EASEPOLY_LEASE	
EASEPOLY_RESERVE	
EASEPOLY_ROAD	
EASEPOLY_SEWER	
EASEPOLY_STORM	
EASEPOLY_WATER	
EASEPOLYTXT	
ELCABLE_	Electrical
ELCABLE_EH_OH	
ELCABLE_EH_UG	
ELCABLE_HV_OH	
ELCABLE_HV_UG	
ELCABLE_LV_OH	
ELCABLE_LV_UG	
ELCABLE_SL_OH	
ELCABLE_SL_UG	
ELDIM	
ELDUCT	
ELNODE	
ELNODE_6.000000	

ELNODE_AIRLINK	
ELNODE_BILLBOARD	
ELNODE_DB	
ELNODE_HV_JUNCTION	
ELNODE_KIOSK	
ELNODE_LV_JUNCTION	
ELNODE_MINI_SUB	
ELNODE_POLE	
ELNODE_PYLON	
ELNODE_SL_JUNCTION	
ELNODE_STANDARD_SUB	
ELNODE_STRLIGHT_POLE	
ELNODE_SWITCH_STATION	
ELNODE_TRANSFORMER	
ELNOTE_DIM	
ELNOTE_TEXT	
ELSERV_SC_OH	
ELSERV_SC_UG	
ELZONE	
FLOODLINE	Flood line
IMG_	Images
MUNICIPALITY	Cadastral
PARCEL	
PARCEL_C	
PARCEL_P	
PATH_AREAS	Path areas
PSM	Permanent Survey Marks
RD_PARKING	Roads
RDAREA	
RDCL	
RDEDGE	
RDINT	
RDNOTE_NOTE_TYPE_TEXT	
RDWALK	
RIVERLINE	Riverlines and polygons
RIVERPOLY	
SEWBASIN	Sanitary and trade waste
SEWDIM	
SEWDIMNOTE	
SEWGLABEL	
SEWGPIPE	
SEWNODE	
SEWNOTE	
SEWRESPIPE	
SEWRLABEL	
SEWRPIPE	
SEWSERV	
SEWSYM	
SEWVLABEL	
SEWVPIPE	

SPORTSFIELDS	Sportsfields
SUBURB	Cadastral
SURVEY_MARKS	Topographic survey marks
SWCATCH	Stormwater
SWCHANNEL	
SWCULVERT	
SWDIM	
SWNODE	
SWNOTE	
SWNOTE_NOTE_TYPE_DIM	
SWNOTE_NOTE_TYPE_TEXT	
SWPIPE	
TOWN_C	Cadastral
TP_LANDUSE_JCUACAD	Town planning, zoning, cadastral
TP_LANDUSE_JCUCOLLEGE	
TP_LANDUSE_JCUDISCCENT	
TP_LANDUSE_JCUDVRES	
TP_LANDUSE_JCUDVSTG1	
TP_LANDUSE_JCUENTPARK	
TP_LANDUSE_JCUNATURE	
TP_LANDUSE_JCUPADDOCK	
TP_LANDUSE_JCUROAD	
TP_LANDUSE_JCUSCHOOL	
TP_LANDUSE_JCUSPORT	
TP_LANDUSE_JCUUVRES	
TP_ZONING_AGRIC	
TP_ZONING_AMUSEMENT	
TP_ZONING_BUS_1	
TP_ZONING_BUS_2	
TP_ZONING_BUS_3	
TP_ZONING_BUS_4	
TP_ZONING_CEMETERY	
TP_ZONING_COMMERCIAL	
TP_ZONING_EDUCATIONAL	
TP_ZONING_EXIST_PUBLIC_ROAD	
TP_ZONING_GOVERNMENT	
TP_ZONING_IND_2	
TP_ZONING_IND_3	
TP_ZONING_INSTITUTIONAL	
TP_ZONING_MUNICIPAL	
TP_ZONING_PARKING	
TP_ZONING_PRIVATE_OPEN_SPACE	
TP_ZONING_PRIVATE_ROAD	
TP_ZONING_PROP_NEW_ROAD	
TP_ZONING_PUBLIC_GARAGE	
TP_ZONING_PUBLIC_OPEN_SPACE	
TP_ZONING_RES_1	
TP_ZONING_RES_2	
TP_ZONING_RES_3	
TP_ZONING_RES_4	

TP_ZONING_SAR	
TP_ZONING_SPECIAL	
TP_ZONING_UNKNOWN	
TREES	Trees
WARD	Cadastral
WATDIM_POTABLE	Water
WATDIMNOTE_POTABLE	
WATLABEL_ABANDON	
WATLABEL_POTABLE	
WATLABEL_RAW	
WATNODE_	
WATNODE_ABANDON	
WATNODE_POTABLE	
WATNODE_RAW	
WATNOTE_POTABLE	
WATPIPE_	
WATPIPE_ABANDON	
WATPIPE_CHILLWR	
WATPIPE_CHILLWS	
WATPIPE_POTABLE	
WATPIPE_RAW	
WATRESPIPE	
WATSERV_	
WATSERV_CHILLWR	
WATSERV_CHILLWS	
WATSERV_POTABLE	
WATSERV_RAW	
WATSYM_POTABLE	
WATZONE_POTABLE	

34.13 APPENDIX A - DRAWING SUBMISSION CHECKLIST

Item	Date Received	Verified against this section
Check project identification number		
Check file naming convention		
Check revision sequencing		
Check file formats		
Letter of transmittal		
Project document register (excel)		
Interim Record Model (BIM)		
Operations & Maintenance Manuals		
Certificate of Classification		
As-Built Services (.dwg)		
As-Built Record Model – Architectural		
As-Built Record Model – Structural		
As-Built Record Model – Mechanical		
As-Built Record Model – Electrical		
As-Built Record Model – Hydraulic		
As-Built Record Model – Topographic (Survey)		
As-Built Construction Drawings (.dwg)		

34.14 APPENDIX B - SHEET NUMBERING CONVENTION

Drawing sheets may be numbered using the following conventions:

[Discipline Designator][Type Designator][Sequence Number]-[Sheet Title]
Example:A101-Site Plan

34.14.1 Discipline Designators

The following table indicates the primary (single) letter designations that may be used.

Designator	Name	Additional Description
	Cover Sheet	
G	General	Sheet list, symbols, code summary, etc.
H	Hazardous Materials	Abatement, handling, etc.
V	Survey / Mapping	
B	Geotechnical	
C	Civil	
L	Landscape	
S	Structural	
A	Architectural	
I	Interiors	
Q	Equipment	
F	Fire Protection	
P	Plumbing	
D	Process	
M	Mechanical	
E	Electrical	
T	Telecommunications	
R	Resource	Existing conditions / buildings
X	Other Disciplines	
Z	Contractor / Shop Drawings	
O	Operations	FM

34.14.2 Sheet Types

The Sheet Types designator takes the drawings of a single discipline and organises them.

Designator	Name
0	General: Symbol legend, abbreviations, general notes
1	Plans
2	Elevations
3	Sections
4	Large Scale Drawings: plans, elevations, sections -- NOT details
5	Details
6	Schedules and Diagrams
7	User Defined
8	User Defined
9	3D drawings: isometric, perspective, photos
10	Space Data

34.14.3 Sequence Numbers

The final component of the sheet number is the two-digit sequence number, which is between 01 and 99. The sequence numbers do not have to be sequential so that space may be left within the set for future additions.