CIVIL ENGINEERING

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

DESIGN STANDARDS

DS-05

Document Register

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1.0	18.10.2021	Project Use		MM
1.1	01.08.2022	Update	B. Taylor	B. Veliscek
2.0	21.07.2023	Annual Review and Update	B. Taylor	B. Veliscek

Contents

Disclaimer
Refer to the Disclaimer within the UQ Design Standards.

Reference Documents
Refer to the UQ Design Standards for the list of documents and associated standards to be referenced for design work.
The designer is to coordinate between disciplines and standards.

01 General Introduction

This technical standard is provided to outline civil engineering design criteria and requirements specific to UQ which meet or exceed the minimum requirements imposed by Australian Standards and Local Authority requirements.

Throughout the Sections of this document, it will be clearly defined when a requirement is mandatory, otherwise any requirement is a 'Guideline' only.

This document does not relieve any person or company commissioned by or contracted to The University of Queensland, (referred to as UQ herewith) or its appointed Design & Construction Managers, from the preparation of comprehensive Specifications for inclusion in Tender or Construction documentation. Such persons or companies should incorporate the requirements contained in the various Sections of this document, as appropriate, in the preparation of those Specifications, but no part of this document should be issued in tender or construction documentation as a substitute for a Specification.

1. Departures from these Technical Standards, or any applicable Australian Standard, if allowed, must be confirmed in writing by the Principal. Any departure made without such confirmation, which is incorporated into the design or construction of a project, shall be rectified at no cost to UQ.

1.1 Abbreviations

1. AEP Annual Exceedance Probability
2. AS Australian Standard
3. BCC Brisbane City Council
4. BPN British Pendulum Number
5. CBR California Bearing Ratio
6. D&C Design & Construct
7. ESA Equivalent Standard Axles
8. FM Facilities Management, Corporate Services
9. NCC National Construction Code Series (incorporating the Building Code of Australia
10. (BCA) and the Plumbing Code of Australia (PCA)
11. PMP Probable Maximum Precipitation
12. SID Safety In Design
13. UQ The University of Queensland (the Principal under all Agreements and Contracts)
14. WHS Work Health and Safety Act and other Legislation Amendment Act 2017
15. WSUD Water Sensitive Urban Design

1.2 Australian Standards

Wherever an Australian Standard (AS) exists which impacts on any matter pertaining to the design, construction, operation or maintenance of a facility, the AS shall set the minimum criteria to be applied to the project. If the Principal requires a higher standard as outlined later in this document or stated in a Project Brief, the Principal's requirement shall take precedence. Assumptions as to acceptable Standards should not be made.

Where an AS is called upon by the NCC or other relevant legislation, the requirements of that AS shall be delivered or exceeded as required by these Guidelines.

1.3 Safety In Design

The consultant must ensure, in carrying out their designs that, so far as is reasonably practicable, the project is designed to be without risks to anyone who constructs, uses, maintains, or future demolishes the proposed works. When undertaking the design, the

consultant must carry out any calculations, analysis, testing or examination that may be necessary to eliminate or minimise risks. The consultant must provide current relevant information on any risks arising from the design to anyone who constructs the proposed works.

Safety is a core value for the University. Safety in this context refers to all aspects of the work including safe design, safe construction, safe operation, safe maintenance and safe demolition. The entire project team have a duty to comply with Section s22 of the Work Health and Safety Act 2011, and amendments to same contained in the Work Health and Safety Act and other Legislation Amendment Act 2017 (WHS).

In doing so, consultants shall ensure, so far as is reasonably practicable, that the design is without risks to health and safety, and that the requirements of the WH+S Act are met. A detailed Safety In Design Report detailing all matters identified and addressed during the design and technical documentation phases shall be provided to the Project Manager/University with the documentation issued for construction purposes.

1. It is expected that the report will address the following, as a minimum:

(a) the purpose for which the structure or plant is being designed

(b) the identification of all design, material, construction, operational and maintenance hazards and assessments of the risks to WH+S associated with these hazards

(c) actions to be taken to remove or mitigate the risk, such as design changes, particular construction methods or procedures, and the like

(d) the results of any testing and analysis

(e) requirements to ensure that the project is so far as is reasonably practicable, without risk when carrying out construction, operation, maintenance and demolition.

1.3.1 Safety In Design Workshops

The Design Consultant Team are responsible for identifying and addressing clearly all work health and safety issues associated with the project. This will be undertaken inherently in all design decisions and should be formally reviewed in a Safety In Design Workshop(s). The workshop(s) can be undertaken either electronically or on site and should be completed by all disciplines.

1.4 Certification Requirements

The consultant is to ensure all project documentation is designed and certified by a Registered Professional Engineer of Queensland with specific experience relating to the appropriate field of expertise.

As Constructed drawings when required by the University or project manager are to be provided with RPEQ certification as required.

Form 15s and 16s when required by the University or project manager are to be provided.

02 Roads, Footpaths and Car Parks

This section sets out the general standards of road and car park design within the UQ's campuses. Works in other areas may be constructed to similar standards where appropriate.

2.1 Standards

The design standards adopted are listed below, and are to be adopted as part of the design documentation where relevant, noting that the governing body/Local Authority will take precedence:

1. AS 1742. Manual of Uniform Traffic Control Devices, Queensland Main Roads Dept. - 1989.
2. AS 1289.5.4.1-2007 Methods of testing soils for engineering purposes
3. Town Plan for the City of Brisbane.
4. Pavement Design: A Guide to the Structural Design of Road Pavements, Austroads
5. Guide to Pavement Technology Part 4k: Selection and Design of Sprayed Seals, 2019. Austroads.
6. Industrial Pavements – Guidelines for Design, Construction and Specification, Cement and Concrete Association of Australia – 1997
7. AS2890.1. Off-Street Parking, Part 1 - Car Parking Facilities
8. AS2890.2. Off-Street Parking, Part 2 - Commercial Vehicle Facilities.
9. MRTS05. Unbound Pavements. Transport and Main Roads Specifications, November 2019.
10. Design Standards for Subdivisional Roadworks - BCC.
11. Design Guidelines for On-site Car Parking Facilities. BCC 1989. (use as reference only)
12. Guide to Road Design Part 3: Geometric Design, Austroads. April 2020.
13. AS1428.1 to 4 Design for access and mobility.
14. Brisbane City Council standard drawings

2.2 Road Classification and Cross-Section

Roads are classified as follows, depending on traffic volume, wheel loads or location on campus. Car parking facilities are to be classified as Minor Roads. It must be noted that a road classification may change as traffic patterns are altered by future building works or other causes.

Table 1 Road Classifications and Design Traffic

Road Classification	BCC City Plan	Design Traffic	Comments
Primary	Neighbourhood Road	9.0 x 10^5 ESA	Major campus traffic flows, heavy traffic
Secondary	Local Road	1.5 x 10^5 ESA	Access between primary roads, buildings, or car parks
Minor	Local Road (cul-de-sac)	4.0 x 10^4 ESA	Access to buildings, car parks and other facilities

Design Note

The pavement designer must note that any road or car park may need to be used as construction access for future building works and in some cases must resist the load of large elevated platform booms required for cleaning high level windows and similar maintenance purposes.

Whilst campus roads would generally correspond to Neighbourhood Roads, it is possible that any road or car park may be required to provide construction access.

Therefore, all roads are to be designed to a Minor road classification as standard and as defined above.

Table 2 below nominates a minimum pavement standard, based on a Minor Road classification as defined by per Table 1 and assumes a design subgrade CBR 3%.

Table 2 Minimum Pavement Standard

Surface	Minimum specification
Wearing Course	30mm AC Seal (Primary 40mm AC seal)
Base course	100mm Class 1 (CBR 80%)
Sub-base Course	100mm Class 2 (CBR 45%)
Working platform OPTIONAL	150mm Class 3 (CBR 15%) OPTIONAL

Design Note

The working platform layer is intended as a subgrade improvement layer. Pavement thickness can be increased, where subgrade test results indicate the use of thicker pavements, ground remediation, poor subgrade strength or areas that will be subject to heavier loadings such as bus standing areas, loading and service or maintenance areas.

2.2 1 Pavement Materials

Pavement materials are to comply with BCC Reference Specifications for Civil Engineering Work – S300 Quarry Products.

2.3 Road Types – St Lucia

This section defines the adopted road types for the University's St Lucia campus.

2.3.1 Principal Roads – St Lucia

1. Blair Drive (BCC)
2. Campbell Road
3. Carmody Road
4. Chancellor Place
5. Coldridge Street (BCC)
6. College Road
7. Hawken Drive
8. Sir Fred Schonell Drive (BCC/UQ)
9. Sir William MacGregor Drive
10. University Drive
11. Upland Road (BCC)

2.3.2 Secondary Roads – St Lucia

Roads primarily intended to provide access between Principal Roads and buildings or car parks. These roads do not normally provide for through traffic.

1. Cooper Road
2. Glasshouse Road
3. Hood Street
4. Jocks Road
5. Keyhole Road
6. Mansfield Place
7. Research Road
8. Rock Street
9. Services Road
10. Slip Road
11. Staff House Road
12. Union Road

2.3.3 Minor Roads – St Lucia

Roads primarily for service access to buildings. There are many such roads on campus, but some examples are:

1. Main Library, off Sir Fred Schonell Drive
2. Electrical Engineering, off College Road
3. Electrical Lane, off Staff House Road
4. Mayne Hall, off Slip Road
5. Microbiology Lane, off Research Road
6. Car parks are to be classified as Minor Roads.

2.4 Road Types – Gatton

This section defines the adopted road types for the University's Gatton campus.

2.4.1 Principal Roads – Gatton

1. Caas Way
2. Galletly Road
3. Hall Road
4. Hay Lane
5. Inner Ring Road
6. Main Drive
7. Old Forest Hill Road
8. Outer Ring Road
9. Services Road

2.4.2 Secondary Roads – Gatton

1. Chapel Hill Road
2. Containment Circle
3. Directors Lane
4. South Ridge Road

2.4.3 Minor Roads – Gatton

All others including car parking areas.

2.5 Road Types – Herston

This section defines the adopted road types for the University's Herston campus.

2.5.1 Principal Roads – Herston

1. Back Road
2. Bowen Bridge Road (BCC)
3. Bramston Terrace (BCC)
4. Butterfield Street (BCC)
5. Central drive
6. Garrick Terrace (BCC)
7. Herston Road (BCC)
8. Research Road
9. Weightman Street (BCC)
10. Western Road
11. Wyndham Street (BCC)

2.5.2 Secondary Roads – Herston

1. Fourth Avenue

2.5.3 Minor Roads – Herston

All others including car parking areas.

2.6 Flexible Asphalt Pavements

1. Subsoil drainage systems shall be provided to protect the pavement subgrade formation, unless the Designer can justify and certify that they are not necessary.
2. As a minimum, the Design Life for all new pavement areas is to be a minimum of 20 years.
3. All secondary and minor roads will have a wearing course consisting of 30mm AC and seal. All primary roads are to have a 40mm AC and seal wearing course.
4. AC Seal must have a prime coat and t ack coat for new construction, and a ta ck coat for re-surfacing. Design and application in accordance with 'Guide to Pavement Technology Part 4k: Selection and Design of Sprayed Seals' by Austroads.

2.7 Rigid Concrete Pavements

Rigid pavements may be designed in accordance with the Cement and Concrete Association of Australia, 1997, "Industrial Pavements – Guidelines for Design, Construction and Specification". Rigid pavements should be considered to be used to provide longevity where it is likely that heavy vehicles will be making tight turns.

2.8 Soaked CBR Tests

Appropriate geotechnical investigations shall be carried out to determine performance criteria of the underlying subgrade material. All geotechnical investigations are to be coordinated with the consultant team, refer to the Structural Engineering Technical Standard for full details.

A 4-Day soaked CBR tests are to be used in all sub-grade testing, in accordance with AS 1289.5.4.1-2007, Methods of testing soils for engineering purposes. It should be noted that a 10-Day soaked CBR test for road areas subject to inundation or more expansive materials may be required. 4 day soaked CBR testing will be provided to the pavement designer for confirmation of the pavement design prior to pavement construction.

Subsoil drainage systems shall be provided where necessary to protect the pavement subgrade formation and at the integration of new and existing pavements, unless the designer can justify and certify that they are not necessary.

2.9 New Road Widths

Where there is no necessity to match existing roads, all new roads should have the following minimum widths between kerbs:

2.11 Ramps and Walkways

All ramps and walkways shall comply with AS 1428.1

Table 3 Road Widths

Services Access Only	Minimum Width
One Way	3.6m
Two Way	4.5m
Roadways	**Minimum Width**
No kerbside parking	6.0m
Parking one side	8.0m
Parking two sides	10.0m

2.10 Footpaths

Footpaths should provide a continuous accessible path of travel to all facilities and should not incorporate barriers such as steps or stairways. All footpaths are to comply with AS 1428.2 and subsequent amendments. Please refer to BCC Standard Drawing BSD-5212.

Tactile Ground indicators should be incorporated as specified in AS1428.4 and subsequent amendments. Polished exposed aggregate shall not be permitted for use in any footpaths.

2.11 Road Layout and Geometry

All roads on UQ campus sites must be provided with kerb and channel unless specific written approval of the University has been provided.

Profiles

Kerb profiles are to be as per standard Brisbane City Council types.

Type E Vertical Face

Type E 'vertical face' barrier kerbs must be used on internal roads unless alternative profiles already in place are to be matched. Layback kerbs will not be used unless specific approval is provided in writing by the Project Manager.

Heavy Duty Kerbs

Heavy-duty kerbs are to be used on the major ring roads and wherever regular bus traffic occurs, i.e. on Principal Roads.

Intersections

(a) Kerb Radii - Dimensions to face of kerb are to be:

Table 4 Kerb Radii

Class	Description	Radius (m)
Minor	Service access	5.0
Secondary	Roads generally	6.0
Principal	Major intersections	10.0

All geometry must allow for 8 tonne truck access to represent service or emergency vehicle access.

(a) Intersections of two Principal Roads are to be channelised to allow two lane exit and entry.

(b) Intersections of a Secondary and a Principal Road should be channelised where site area permits.

(c) Intersections of two Secondary roads, or where one road is a Minor road, should not be channelised.

(d) Where channelisation is to be used, minimum widths of lanes should be:

i. Entry 5.0m

ii. Exit 3.7m

(e) Provide pram ramps at all intersections for persons with disabilities.

Adoption of a low design speed discourages speeding, attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

2.11.1 Design Speed

All road designs are to be compliant to 'Guide to Road Design Part 3: Geometric Design, Austroads. April 2020'. Speed limits on St Lucia Campus is 30kph, however the minimum design velocity for sight distance, curve design etc. is as defined below.

Table 5 Design Speeds

Class	Description	Speed (kph)
Secondary	Roads Generally	60
Principal	Major Roads	80

2.11.2 Grades

1. All pedestrian pavements shall achieve a suitably slip resistant finish and be free of trip hazards along paths of travel. The slip resistance of all horizontal concrete surfaces is to be 'Class V' (minimum 60BPN with a slider 55 pad) as per AS4586.
2. Wherever possible, gradients shall be no steeper than 1 in 40 for concrete or paved surfaces, (1 in 33 for bituminous surfaces), as far as practically possible and no greater than 1 in 14 to suit disabled access.
3. An absolute maximum of 1 in 8 can be considered under special circumstances where particular site difficulties require steeper grades.
4. All access gradings are to be in accordance with AS 1428.2 and the Disability Discrimination Act, 1992.
5. Loading bay and service areas shall have a maximum grade of 1 in 20 in any direction.

2.11.3 Special Vehicles

In each case, the designer must agree on the specific vehicles with the University of Queensland Project Manager. The following are examples for consideration:

1. Emergency and service vehicles - vehicle access must be considered in all building access road design.
2. Vehicle Types
3. QFRS Tender (General Pump).
4. Concrete Trucks.
5. Furniture Vans.
6. Meat Trucks (Vet Science).
7. Council Bus.
8. Mobile cranes.
9. Semi-trailer.
10. Container trucks.
11. Manoeuvre and Clearances - the manoeuvres of these vehicles can be represented by the BCC 8-tonne truck templates, with 500mm extra clearance for buses.

2.11.4 Road Humps

Road humps are to be constructed in accordance with requirements stipulated within AS1742.13 (2009). Furthermore:

1. Road humps may be used as road traffic speed control devices with the written approval of the Project Manager/Engineering Manager.
2. Bitumen humps shall not be used unless there are significant arguments against the use of concrete humps. The hump profile is difficult to achieve in hot rolled bitumen.
3. All road humps shall be painted with reflectorised paint road marking paint including crystal beads.
4. Sign Post Types:
5. Warning signs – at each entry to the property stating that there are humps on the internal roads and that caution must be exercised. This has been done at all entries on the St Lucia campus.
6. Advisory sign – about 10 to 20 metres on each side of the hump, advising of speed hump ahead and indicating safe traverse speed limit. These signs can be W5-10A signs. The warning distance may require adjustment to suit sight distance.
7. Road Markings – advisory road markings to be installed about 10 metres clear of the hump on each side. The road markings consist of the word "HUMP" 200mm wide and 2100mm long. These road markings are OPTIONAL.

2.12 Bicycle Facilities

Investigate the need for bicycle access and bikeways in open space areas and provide where amenable. Provide storage facilities, locker rooms with showers in buildings where possible.

Consider:

1. Bicycle parking in accessible locations that are secure and easy to use,

2. Facilities in accordance with AS 2890.3:2015 Parking facilities Part 3: Bicycle Parking.
3. Consideration should be given to appropriate lighting, shelter, access and destinations and pedestrian movements.
4. Covered parking areas for motorised scooters with recharge points at 600-1100mm above finished ground level.

2.13 Car Parking

a) All parking on site are to be designed and constructed in accordance with the following Australian Standards:

1. AS2890.1. Off-Street Parking, Part 1 - Car Parking Facilities
2. AS2890.2. Off-Street Parking, Part 2 - Commercial Vehicle Facilities.

b) The following car parking types are permitted:

1. Kerbside – Parallel Parking
2. Kerbside – 60º Angle Parking
3. Kerbside – 45º Angle Parking
4. Off-street Surface Car Parking

c) Design Car Size – The University design car is taken as 5.0m x 2.4m

d) Car Park Layout

Table 6 Car Park Layout

Surface Parks	Open	Enclosed	Kerbside Parallel	Parking 60º
Bay width	2.5	2.5	2.2	2.4
Bay length	5.0	5.5	5.6	4.5
Aisle width	6.0	6.0	-	-

Pavement designs are to be completed in accordance with Sections 2.6, 2.7 and 2.8 of this document.

2.14 Roadmarking

2.14.1 Roadmarking Paint

All line marking shall be in accordance with AS1742 ‘Manual of Uniform Traffic Control Devices Part 2’ and all paint shall comply with MRTS45. Paint is to be reflectorized and applied to the manufacturer’s recommendations. Colours to be used are:

1. White general lane and road marking
2. Yellow no standing areas, e.g. kerbs near intersections, loading bays, access bays.

Deleted line marking, including pictograms such as disabled parking bays that are no longer required are to be removed by light grinding to the depth of the paint.

2.14.2 Surface Treatment

1. To ‘old’ concrete AC surfaces and to fresh AC surfaces, apply two (2) coats of paint as defined in Section 2.12.1 above.

2. To fresh concrete surfaces, apply an acid etch (10% hydrochloric), then neutraliser then two (2) coats of paint as defined in Section 2.12.1 above.

3. Marking Types

Table 7 Marking Types

Car Parks	100mm x 300mm long strips at kerbside, with two such strips to form T or L junctions at outer edges of car bays
Lane Marking	100mm wide centrelines, 80mm wide lane lines where additional lanes are to be delineated.
Stop Lines	450mm wide, full lane width
Holding Lines	300mm wide x 600mm long, spaced 600mm

2.15 Traffic Signage

2.15.1 Campus Types

Traffic signs must generally confirm to AS1742 'Manual of Uniform Traffic Control Devices, noting that several common campus signs are not listed in the standard.

2.15.2 Guidelines

AS1742 lists code numbers for many standard signs, together with size codes and guides for the use of signs. Refer to parts 1 to 4 and 5 to 14, Department of Main Roads, Queensland Government.

2.15.3 Sizes

All University signs are "A" size signs unless otherwise approved. Site "B" and "C" are reserved for non-built up areas. A typical sign would be 300mm wide by 450mm high and would have the generic code R5 corresponding to the parking series of the manual.

2.15.4 Paid Parking Signs

Campus signs commonly in use but not included in the Manual are of a regulatory nature for car parks.

03 Earthworks

Appropriate geotechnical investigations shall be carried out to determine performance criteria of the underlying subgrade material, earthworks strategies, pavement designs, temporary and permanent batters and the like in order to assist the civil engineering consultant's design.

All geotechnical investigations are to be coordinated with the consultant team, refer to the Structural Engineering Technical Standards for full details.

Generally, all bulk earthworks are to be designed, documented and certified by a suitably qualified civil engineering consultant. The following aspects are critical in the design and coordination:

1. Protection of existing trees and vegetation.
2. Protection and location of existing infrastructure, services and structures.
3. Erosion and sediment control.
4. Stripping and stock piling of topsoil material.
5. Coordination with the Landscape Architect for all external areas.
6. Coordination with the Structural Engineer for all building related works.

3.1 Supervision

1. All building and pavement related bulk earthworks activities are to be carried out in accordance with Australian Standard AS3798 Guidelines on earthworks for commercial and residential developments. All earthworks shall be carried out in accordance with AS3798 and supervision to Level 1 shall be supplied by the contractor. The contractor shall employ a qualified geotechnical engineer who is a Registered Professional Engineer of Queensland with a minimum $5 million professional indemnity Insurance, to undertake Level 1 supervision of earthworks and whose certification in writing shall include the following:
2. Engineering certification that all general earthworks operations (i.e. Stripping, proof rolling of subgrade, subgrade treatment, trenching, backfill etc.) have been carried out in accordance with earthworks specification.
3. Engineering certification that fill has been placed and compacted to the required minimum density in accordance with the earthworks specification.
4. Engineering certification that any areas of cut have been compacted to the required minimum density in accordance with the earthworks specification.

5. If required, engineering certification that the controlled fill material is suitable to support a conventional slab on ground floor or pavement system or fit for purpose as necessary.
6. Engineering certification that the quality of any imported fill complies with the earthworks specification requirements
7. Engineering certification that the areas of cut have been subject to proof roll and compacted under geotechnical supervision to the same standards as fill areas.

3.2 General Considerations

1. The contractor is to consider the impact of disturbed ground conditions when working in close proximity to existing services and shall employ a suitable methodology to address trench and service stability.
2. Fire Ant control is the responsibility of the Contractor. The Contractor must have appropriate DPI/DNR Certification to deal with Fire Ants. Contractors and Sub Contractors are to notify the Department of Primary Industries within 24 hours if suspected RIFA or ant nests are found as per legislation.

3.3 Disposal of Spoil and Vegetation

3. The Contractor must remove excess spoil from the campus unless noted otherwise in the project Technical Brief, or as directed by the Superintendent.
4. No spoil from excavations shall be placed in bushland or on mulched gardens or lawns.
5. Topsoil should be separated from in situ material and stockpiled for future reuse if approved by the Superintendent.
6. Tree stumps and root boles within the site are to be completely removed and disposed of off campus.
7. Burning of trees and stumps is not permitted.
8. Any rocks in excess of 300 mm diameter must be separated from the spoil and stockpiled in a location nominated by the Superintendent.

3.4 Erosion and Sediment Control

Erosion and sediment controls should be appropriate to the risk posed by the activity for the relevant climatic region e.g. considering the potential soil loss rate, monthly erosivity or average monthly rainfall.

All earthworks activities carried out on-site shall be designed and carried out in a manner which prevents erosion by run-off during and after completion of construction. In particular, runoff must not be allowed to carry silt into adjoining bushland, or receiving waters.

The consultant team during the design process and contractor during construction shall be aware of their responsibilities for protecting the downstream environment and receiving water from pollution and environmental harm, under the Environmental Protection Act, 1994.

1. All Erosion and Sediment Control measures are to be completed in accordance with the Best Practice Erosion and Sediment Control (BESC) documents, by International Erosion Control Association.
2. The Contractor shall…

a) take all necessary precautions to control erosion and downstream sedimentation during all stages of construction including any maintenance or defects period.

b) at all times be responsible for the establishment, management and maintenance of the erosion and sediment control measures.

3. be aware of its duty to notify the local authority and the Environmental Protection Agency (Qld) of a potential or actual incident of environmental harm, under the Environmental Protection Act, 1994.
4. monitor the prevailing weather conditions and protect any

downstream construction and receiving environments.
5. monitor and repair protection measures regularly and after wet periods.

3.5 Tree Protection and Vegetation Removal

1. Vegetation outside of the area of works are not to be tampered with or removed unless specified by the University.
2. Vegetation protection shall be carried out in accordance with an approved Vegetation Management Plan for the project.
3. Prior to clearance works commencing on site, a fauna spotter/catcher shall undertake a survey and species relocation prior to any tree clearing. A joint inspection shall be undertaken to identify selected trees and / or shrubs which are to remain undisturbed. These shall be marked by the principal with coloured tape or similar marks. The contractor shall take care not to damage or remove any of these trees and / shrubs in carrying out the works of the contract.
4. Trees located along the footpath should be, where possible transplanted prior to construction, or replaced in accordance with the vegetation management plan or as directed by the principal.
5. Unless directed by the vegetation management plan or project arborist/ecologist, when working within 4m of trees, rubber or hardwood girdles should be constructed with 1.8m battens closely spaced and arranged vertically from ground level. Girdles must be strapped to trees prior to construction and remain until completion in accordance with AS4970-2009.
6. Where possible, vacuum excavation is to be used, tree roots should be tunnelled under, rather than severed. If roots are severed the damaged area should be treated with a suitable fungicide in accordance with AS4970-2009.
7. Any tree lopping required should be undertaken by a professional arborist.
8. Construction vehicle activity should be limited by fencing of undisturbed areas -refer to Vegetation Management Plan (or EMP)
9. Access should be restricted to pre-existing tracks or the path of least disturbance.
10. The contractor is not to disturb or cut vegetation without the principal approval.
11. The contractor shall employ a professional arborist who shall assist with the work to protect trees

04 Stormwater

4.1 Objective

Unless specifically agreed otherwise by the Project Manager and Consultant Team, the hydraulic consultant is responsible for all drainage within buildings, basements and roofwater drainage, including renovations and refurbishment projects. All drainage in-ground including the collection of downpipes will be the responsibility of the civil engineer where overland flow or surface drainage may be impacted.

The objective of stormwater drainage design is as follows:

1. For all standard design rainfall events, ensure minimal adverse impact to runoff patterns, particularly at critical locations (such as lawful points of discharge and adjacent other facilities)
2. Ensure that flows are not concentrated in such a way as to cause nuisance to surrounding facilities, receiving waters and downstream properties.
3. Guarantee the safety of the public, the University and its facilities and be to the benefit of the receiving environment.

4.1.1 General considerations

1. Appropriate overland flow paths shall be provided to prevent inundation of buildings in extreme events or in cases where the network becomes blocked.
2. Careful coordination with the Landscape Architect for all external areas.
3. Surface stormwater shall be collected via various inlets within the surface such as grated pits, grated trench drains, side-entry pits and channels and conveyed within the underground piped drainage network to the existing trunk drainage systems or to the lawful point of discharge as nominated by the responsible authority.
4. Where the relevant Planning Scheme imposes restrictions on stormwater discharge rates, detention storage shall be provided.
5. Grated pits and trench drains within hard pavements shall be flush with their surroundings and ‘heel safe’ rated in pedestrian areas. All pit covers shall be of strength class suitable to their location and shall consider all loading scenarios including emergency vehicles or heavy cleaning equipment.
6. Water Sensitive Urban Design (WSUD) elements shall be considered and will typically include elements such as stormwater capture and reuse, resilient flora, tree pits, bioretention swales, permeable pavement, bioretention cells and systems capable of capturing gross pollutants and sediment.
7. Provide stormwater pits at changes in direction, grade, junctions and at spacings no more than 60 meters for pipes 225mm in diameter or greater unless pipes are incorporated into a rainwater harvesting system.

8. Provide step irons in pits exceeding 1.2 meters in depth.
9. Consideration shall be made in the stormwater design to exclude garden mulch from entering the drainage system causing blockages and reducing efficiency.

4.2 References and Standards

All work shall meet all the requirements of national and local authorities and shall be in accordance with the following where applicable to the scope of work:

1. State Planning Policy, July 2017.
2. AS 3500 Plumbing and Drainage
3. Queensland Urban Drainage Manual, Fourth Edition. IPWEAQ, 2017. (QUDM)
4. Australian Rainfall and Runoff, A Guide to Flood Estimation. 2019 (AR&R)

4.2.1 Lawful Point of Discharge

All discharge points from developments are required to be a Lawful Point of Discharge, (LPOD). A LPOD shall be determined with the 'lawful point of discharge test', as specified in QUDM Section 3.9.1.

4.2.2 Flooding & Extreme Events

1. All critical infrastructure must be placed above the 1% AEP flood level.
2. All new buildings are to achieve a minimum 500mm freeboard to the 1% AEP flood level.
3. No impact to surrounding environment as a result of net loss of flood storage.
4. Should failure of critical stormwater infrastructure be likely to cause harm, injury or death, (such as an overloaded detention storage device or inundation of a critical overland flow path), the impacts of a PMP event must also be considered in the design.

4.2.3 Overland Flow

Overland flow paths shall be designed for flows corresponding to the frequencies as outlined in Section 4.3.3 below. Overland flow paths shall be designed in all cases to allow for drainage without damage to buildings when all inlet grates are totally blocked.

Suggested depth-velocity products are suggested below for specific cases

1. Vehicle safety

a) Depth*velocity product, ≤0.6m2/s

b) Flow depth ≤300mm

2. Pedestrian safety

a) Depth*velocity product, 0.4m2/s to 0.6m2/s

b) Flow depth ≤300mm

3. Designated swales, overland flow paths

a) Depth-velocity product, 0.4m2/s to 0.6m2/s

b) Flow depth ≤300mm

4.3 Stormwater Quantity

4.3.1 Design Considerations

In all critical locations, hydrological calculations will adopt the latest parameters as stipulated within AR&R 2019. The following design storm frequencies are confirmed:

Table 8 Major Design Storms

Location	Design Event for Piped Flow	Design Event for Overland Flow
*Inner campus areas	2% AEP	1% AEP
Outer areas	5% AEP	2% AEP

*It should be noted that in areas where a designated overland flow path is not achievable, piped drainage is to be designed to have a capacity sufficient enough to cater for a 1% AEP event, with a 50% blockage factor applied to all inlet pits.

Drainage

1. Grading of all hardstand areas shall be graded to provide…

a) adequate and safe runoff of rainwater;

b) no actionable nuisance to surrounding facilities, neighbouring properties or the receiving environment;

c) No erosion effects.

2. The designer is to ensure a suitable blockage is adopted for all inlets to allow for accumulated organic matter, anthropogenic material and hailstones.
3. Overland flow paths and underground piped drainage shall be regarded as a combined system.

Inlets

1. Gully Pits shall be BCC Type 'A' kerb in line gullies (BSD-8052) designed to accept full rainwater flows as above, when 50% blocked.
2. Bar Grates shall be BCC type A frame (BSD-8054).
3. (c) Back Stones - precast backstones shall be extended length wherever possible.
4. Field inlets shall have a minimum size of 600mm x 600mm with full size parallel bar heavy service grates (Web Forge or approved equivalent).
5. A minimum grate size of 450mm x 450mm may be considered in areas with limited catchments and low-risk of blockage.
6. Major Field Inlets shall be as detailed on drawing RS10 and shall be used in areas of critical stormwater drainage where blockages are liable to cause damage to buildings or vehicles. Approval shall be obtained in writing from the Principal prior to their installation.

Access and Maintenance

1. BCC Type manholes or access chambers shall be BCC standard types (refer BCC manual details) and shall match pipe diameters, but shall not be less than 1050 mm internal diameter.
2. Lid - all access holes shall be provided with a heavy service lid, (Web Forge or equal) to allow for future traffic access by service or construction vehicles.
3. Pit lids where in hardstand areas should be infill lid types where necessary, to match the surrounding surface.

Pipes

4. Hydraulic gradelines for all piped drainage design shall be calculated and clearly identified on project drawings.
5. The tidal influence in any drainage pipes to low areas close to the Brisbane River are to be carefully considered, this includes effects of saltwater if applicable.

1. Excavation of trenches and backfilling shall be in accordance with AS3500.
2. The protection and location of new underground drainage infrastructure including excavation and trenching will not undermine existing infrastructure, services, footings or structures.
3. Sub-soil drainage shall be in accordance with AS3500.
4. Underground pipes within trafficable areas shall be reinforced concrete pipes, spigot and socket joints up to 600mm diameter and external bound flush joint for larger pipes, Class 2, 3, 4 and 6 according to traffic loads on Class C bedding.
5. Underground pipes within non-trafficable areas shall by uPVC Class SH up to 150mm diameter. RCP or FRC for 225m diameter or larger.

4.4 Stormwater Quality

4.4.1 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) elements shall be considered and will typically include elements such as stormwater capture and reuse, resilient flora, tree pits, bioretention swales, permeable pavement, bioretention cells and systems capable of capturing gross pollutants and sediment.

All new development work shall meet all the requirements stipulated in the State Planning Policy, July 2017 or its latest version.

Stormwater harvesting and Water Reuse

All new projects shall investigate where feasible, the viability of installing rainwater/stormwater tanks with the intention of reusing stormwater, Fire testing water, air-conditioning condensate etc. for non-potable uses such as irrigation and toilet flushing.

There shall be close collaboration and coordination between the consultants and the University in regard to stormwater reuse. A feasibility and cost report listing storm water re-use opportunities should be provided for review.

05 Infrastructure

Refer to the Hydraulic Design Standard for reference.

5.1 External Services

The project civil engineer is responsible in conjunction with the project team, to co-ordinate all existing services with the proposed works. Confirmation of alignments, grades and depths of cover to all infrastructure impacted by the works are to be appropriately managed to compliant standards for each respective discipline.

Contractors are not to connect of disconnect to any water supply without prior approval from the Associate Director Infrastructure Engineer - Civil. The completion and submission of an inspection test plan before and after project work will also be required.

5.2 Stormwater Drainage

Refer to Chapter 4 and the Hydraulic Design Standard for details.

5.3 Potable Water and Fire

All works to be approved by Local Water Authority (LWA), and Queensland Fire and Emergency Services (QFES) and completed to LWA and QFES standards.

The civil engineer is to provide any required new connections to the Local Water Authority's approval. All new connections are to terminate generally within one metre of the site boundary and be coordinated with the project hydraulic engineer.

All water supply and fire reticulation is to be ductile iron PN35 unless otherwise approved.

5.4 Sewerage Reticulation

All works to be approved by Local Water Authority (LWA) and completed to LWA standards.

Provide a stub connection from the sewer infrastructure at the co-ordinated location with the hydraulic consultant including size and invert. Terminate generally within one meter of the site boundary. Where required, provide a maintenance shaft/manhole at the co-ordinated location with the hydraulic consultant including size and invert.