

**PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL**



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Our Ref: R2019052
Contact: Christopher Hegarty
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Dear Marissa

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**CENTRAL QUEENSLAND UNIVERSITY
BUILDING 81 FLOOD MITIGATION WORKS
TECHNICAL MEMO – Version 2 – 26 Nov 2019**

Background

Cardno was engaged to investigate and provide measures to mitigate flooding around the Community Sports Complex (Building 81) within the CQU site. This was necessary after a storm event on the 4th December 2018 delivered 94mm of rain in approximately 20 Minutes, well in excess of a Q100 Average Recurrence Interval (ARI) storm. The localised flooding around the building was a result of the major storm and 4.8ha catchment runoff flows funnelling and arriving at the door to the building. Figure 1 shows the Community Sports Complex and general location of the proposed drainage works.



Figure 1: Location Plan

Design Assumptions

The design was carried out using the following manuals or guidelines:

- Queensland Urban Drainage Manual (QUDM) Fourth Edition
- Capricorn Municipal Development Guidelines (CMDG) refer to www.cmdg.com.au

Stormwater modelling for pit, pipes and open drains was carried out using 12d software.

The design rainfall assumptions utilised were derived for this site from the Bureau of Meteorology website (Refer Table 1 following).

Intensity-Frequency-Duration Table

Location: 23.375S 150.500E NEAR.. Rockhampton Issued: 26/9/2019

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval

Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	104	135	175	200	234	280	317
6Mins	97.0	126	164	188	219	263	297
10Mins	80.2	104	135	154	180	215	243
20Mins	60.1	77.7	99.8	113	132	157	177
30Mins	49.4	63.8	81.6	92.6	107	128	143
1Hr	33.6	43.4	55.5	63.0	73.0	86.7	97.5
2Hrs	21.8	28.2	36.2	41.2	47.8	56.9	64.1
3Hrs	16.6	21.6	27.8	31.7	37.0	44.1	49.7
6Hrs	10.4	13.6	17.7	20.3	23.7	28.4	32.2
12Hrs	6.54	8.55	11.3	13.0	15.4	18.6	21.1
24Hrs	4.10	5.40	7.29	8.51	10.1	12.4	14.2
48Hrs	2.50	3.33	4.62	5.48	6.61	8.20	9.50
72Hrs	1.81	2.43	3.43	4.10	4.98	6.24	7.27

(Raw data: 44.54, 8.7, 2.47, 83.29, 17.63, 5.9, skew=0.22, F2=4.22, F50=17.69)

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Table 1: Intensity-Frequency-Duration Table

The piped stormwater drainage was designed for Q10 with 0.300m freeboard.

The open drains or swales were designed for Q100 flows including surcharge flows from the underground drainage system. Freeboard for the Q100 was not adopted but manually checked to ensure the hydraulic grade line was below the top of the swale and no overtopping was occurring.

A maximum 1 in 4 open drain batter slope was used. A 1 in 6 slope was used where space permits as they are easier to maintain. Figure 2 shows the typical open drain profile.



Figure 2: Typical Open Drain profile

Design Strategy and Design Outcomes

Remediation of the large catchment was done by way of cut off drains and redirection table drains which results in a reduced catchment of 3500m² in the area of the Building 81 entry. The swales are sized to cut off and redirect overland flows up to Q100. Refer to Figure 3 for an overall layout of the drainage strategy.

The Q100 overland flows are captured in the swale drains with the majority of the catchment directed away from Building 81. The southern end of the catchment is directed to the underground system. Although designed to a Q10 with 0.300 freeboard the pipe network will cater for up to approximately Q50 flows until surcharge will occur from pit 6/1. These bypass and surcharge flows will be directed across Darambal Road to the table drain downstream of the Building 81 entry and access footpath. The location of the bypass flow is labelled on Figure 3. Pit 6/1 has been designed with a domed open grate to accommodate surcharge flows.

The pipe network alignment has been designed to cater for future buildings and green space areas as provided by CQU and allows for future connections of building roof water outlets. The alignment also allows for the future road extension from Darambal Rd to the Bruce Highway.

In the area directly outside Building 81, the designed swale is below the natural surface which is a shallow swale in itself. Therefore the containment of the designed swale within the existing swale batters is not so noticeable but will be effective.

To ensure no future flooding of Building 81 regular maintenance and clearing out of the foot bridge adjacent to the Building 81 entry as well as ensuring any debris or future development would not impede flows within the swale outside Building 81.

Table 2 shows the calculations for outlet scour protection.

Culvert ID	Diameter (mm)	Velocity (m/s)	Flow (m ³ /s)	Calculations			
				Length of Apron (m)	Width of rockpad immediately downstream of culvert outlet (upstream of rockpad) (m)	width at the at downstream end of the rockpad (m)	d50 Rock size (mm)
1	1200	2.3	2.2	9.6	1.5	5.3	300
2	900	2.5	1.3	5.4	1.2	3.4	200
3	900	3	1.5	7.2	1.2	4.1	300

Table 2: Outlet scour protection calculations

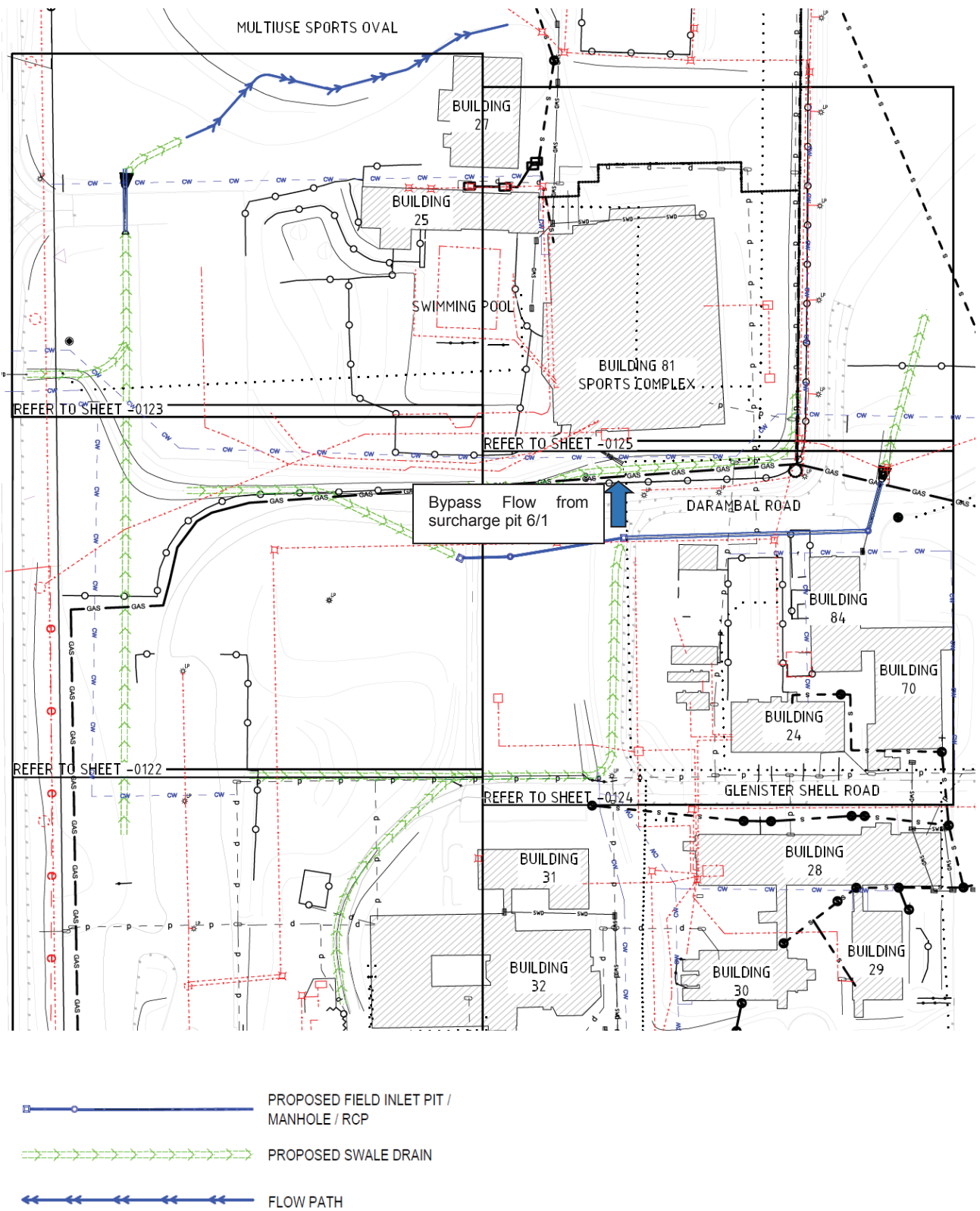


Figure 3: Extract from Cardno Drawing R2019052-CI-0120

Drawings

The following drawings were produced for the project.

SCHEDULE OF DRAWINGS	
DRAWING No.	DESCRIPTION
R2019052-CI-0100	COVER SHEET
R2019052-CI-0101	LOCALITY PLAN, NOTES AND SCHEDULE OF DRAWINGS
R2019052-CI-0102	EXISTING SITE PLAN
R2019052-CI-0103	TYPICAL SECTIONS
R2019052-CI-0104	TYPICAL DETAILS & NOTES
R2019052-CI-0105	CATCHMENT PLAN
R2019052-CI-0106	CALCULATIONS TABLE
R2019052-CI-0120	OVERALL LAYOUT PLAN
R2019052-CI-0121	LAYOUT DETAIL PLAN SHEET 1 OF 5
R2019052-CI-0122	LAYOUT DETAIL PLAN SHEET 2 OF 5
R2019052-CI-0123	LAYOUT DETAIL PLAN SHEET 3 OF 5
R2019052-CI-0124	LAYOUT DETAIL PLAN SHEET 4 OF 5
R2019052-CI-0125	LAYOUT DETAIL PLAN SHEET 5 OF 5
R2019052-CI-0130	FUTURE LAYOUT PLAN
R2019052-CI-0131	FUTURE LAYOUT PLAN DETAIL
R2019052-CI-0140	Q10 LONGITUDINAL SECTION 1 SHEET 1 OF 6
R2019052-CI-0141	Q10 LONGITUDINAL SECTION 2 SHEET 2 OF 6
R2019052-CI-0142	Q10 LONGITUDINAL SECTION 3 SHEET 3 OF 6
R2019052-CI-0143	Q10 LONGITUDINAL SECTION 4 SHEET 4 OF 6
R2019052-CI-0144	Q10 LONGITUDINAL SECTION 5 SHEET 5 OF 6
R2019052-CI-0145	Q10 LONGITUDINAL SECTION 6 SHEET 6 OF 6
R2019052-CI-0150	SEDIMENT AND EROSION CONTROL PLAN
R2019052-CI-0160	SAFETY IN DESIGN

Drawing R2019052-CI-0106 shows further design detail for the pipe and swales designed as part of the project.

External Impacts

This section considers whether there is worsening as a result of the proposed works on all external and downstream properties including any relevant state-controlled road corridors and waterways.

The following assessment is guided by QUDM. The QUDM criteria (Section 3.9) for determining the lawful point of discharge are:

- (i) *Will the proposed development alter the site's stormwater discharge characteristics in a manner that may substantially damage a third party property. If not, then no further steps are required to obtain tenure for a lawful point of discharge (assuming any previous circumstances and changes were lawful).*
- (ii) *If there is a reasonable risk of such damage, then consider if the location of the discharge from the development site under the lawful control of the local government or other statutory authority from whom permission to discharge has been received? This will include a park, watercourse, drainage or road reserve, stormwater registered drainage easement, or land held by local government (including freehold land).*

In considering point (i) QUDM Section 3.6 has regard to four broad categories which will be considered in turn:

- diversion of stormwater

There is diversion of stormwater but this occurs fully within the CQU site and does not affect other land. Stormwater still flows along the same existing flowpaths to exit the site some 500m to the north. The discharge site is to the existing cross drainage at the Department of Transport Bruce Highway road reserve which leads to a gully within the Dreamtime Cultural centre. Refer to Figure 4 following for the discharge point. This is a lawful discharge point and flows at the discharge point will be unaffected.



Figure 4: Queensland Globe – 26 Nov 2019

- concentration of stormwater flows

Stormwater has been concentrated through the use of swales and some underground drainage pipes. However, this concentration is fully within the CQU site. Stormwater still flows along the same existing flowpaths to exit the site some 500m to the north.

- changes in other flow characteristics

There is nil increase in impermeable area as a result of the proposed works. There is expected to be no significant changes in runoff volume resulting. It is possible there may be small

changes in runoff due to changes in times of concentration associated with the new collection system but this is considered negligible.

However, the design does contemplate the future construction of a new road connection at Darumbal Drive to the Bruce Highway and the potential for future buildings on site. Either of these developments would involve increases to impermeable area potentially increasing runoff volumes. A reassessment of site drainage and no worsening would be necessary at that time.

- changes that affect the future use of land

There are no changes that affect future use of land.

In summary, the proposed drainage measures are to mitigate existing flooding impacts within the affected CQU land. These measures do not increase the volume of runoff as there is no development or increases in impermeable area proposed at this time. The drainage measures do divert stormwater and concentrate stormwater within the existing catchment on the CQU property. However these flows are directed to existing drainage features within the land which then discharge lawfully to the Bruce Highway road reserve.

It is concluded that there are no external drainage impacts resulting from the proposed works.

Conclusion and Recommendations

The designed solution will mitigate flooding around the Community Sports Complex (Building 81) within the CQU site.

It is recommended that regular maintenance be carried out to clear the foot bridge adjacent to the building entry and check pipe inlets and outlets are clear of debris.

Yours faithfully



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For Cardno

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