

4 April 2024

Grafton Hospital Acquisition Site: Civil Engineering Report Health Infrastructure report;

For: **Health Infrastructure**

Site Address: **184 Arthur Street, Grafton NSW 2460**

Document reference number: **23-0693_RPT_0002**

document control;

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1. Introduction

Acor Consultants has been engaged by Health Infrastructure to prepare a Civil Engineering Design report to accompany the Development Application (DA) to be submitted to Clarence Valley Council (CVC), for the proposed redevelopment of the Grafton Hospital Acquisition site (The Site), located at Grafton NSW 2460.

1.1. Site Locality

The Site lies with Grafton, under the Clarence Valley Council (CVC) Local Government Area (LGA).

The property is bound by Arthur Street to the northeast and Queen Street to the southeast.

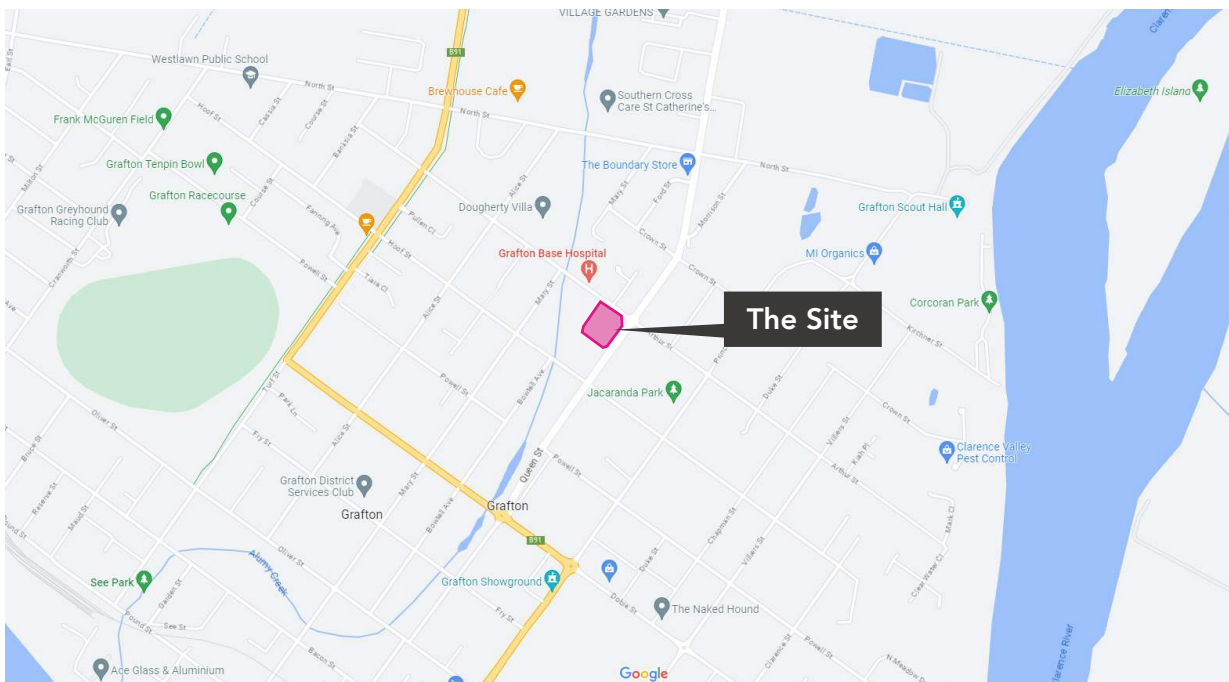


Figure 1 - Site Location (Source: Google Maps)

1.2. Preparation of this Plan

This plan was prepared by Shana Cai and reviewed by Stephen Naughton. Details of their qualifications are provided below:

Albert Lee

BE (Hons)/ B Com, GradIEAust

Stephen Naughton

CPEng NER RPEQ MIEAust NSW Design Practitioner NSW Registered Engineer

2. Site

2.1. Background and Development Proposal

The site forms part of Clarence Correctional Centre, a correctional facility located at 170 Hoof Street, Grafton NSW 2460. The subject site is Lot 2 of DP1276261 and has a site area of approximately 8,700m². The proposal involves the acquisition and redevelopment of the northeast corner of the correctional facility, which is identified as a heritage site.



Figure 2 - Site Locality Plan (Source: Nearmap)

The redevelopment proposal involves reconfiguration of the subject site into an ancillary support site for the Grafton Base Hospital facility. The architectural general arrangement plan is illustrated in Figure 3.



2.2. Existing Land Use

Health Infrastructure, Grafton Hospital Acquisition Site: Civil Engineering Report, 4 April 2024 3

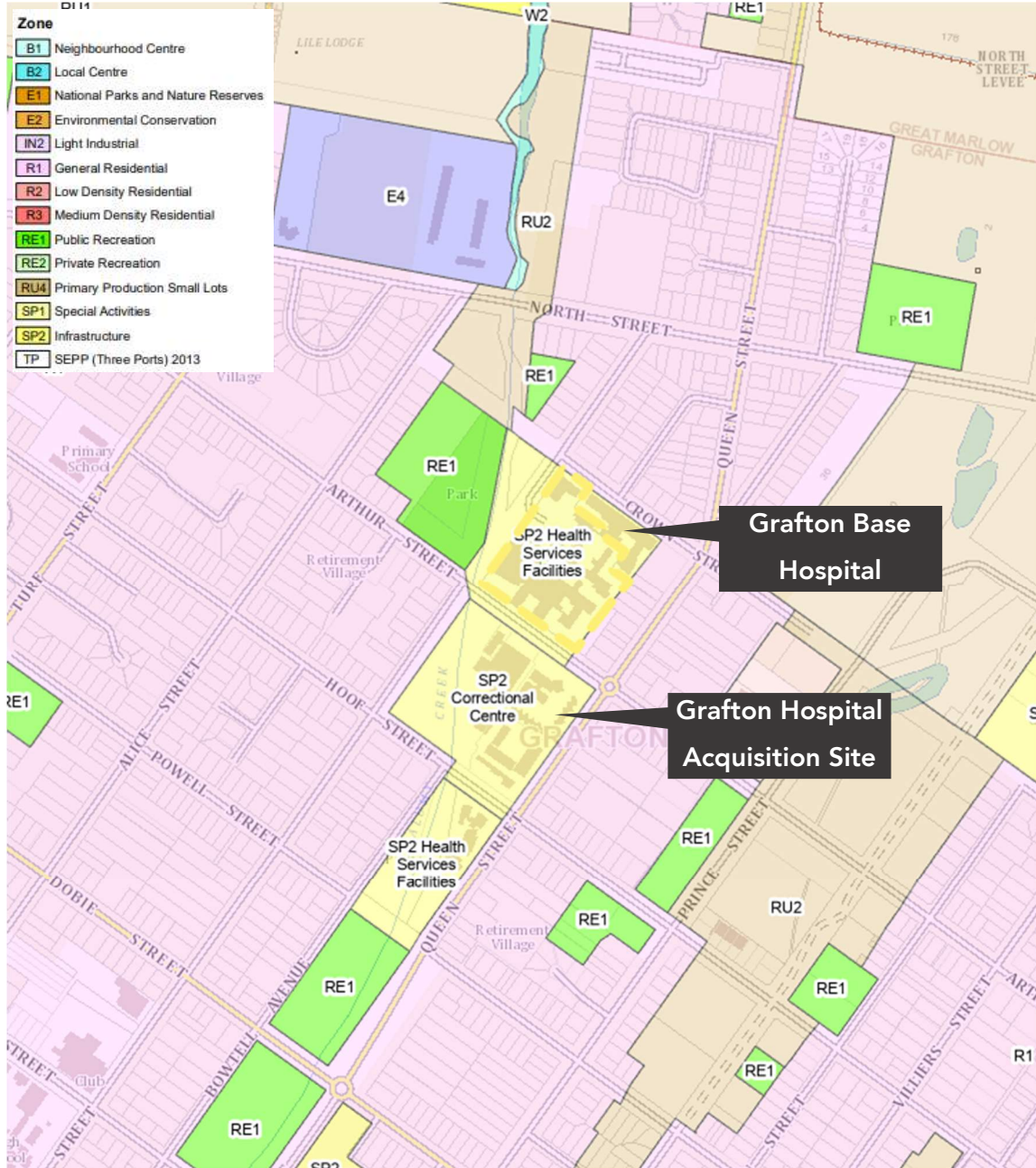


Figure 4 - Land Use Map (Source: NSW ePlanning Spatial Viewer)

3. Flooding, Stormwater Quality and Quantity Management

3.1. Flooding

The stormwater quality and quantity management plan is included in this report as Appendix 1.

3.1.1. Clarence Valley Development Control Plan (DCP) 2011

Part D of the Clarence Valley Development Control Plan (DCP) 2011 outlines Floodplain Management Controls for the Local Government Area (LGA).

Development Controls (i.e. performance criteria and prescriptive controls) are in place to ensure the above objectives are met for all development types located within the LGA that are located within the floodplain.

The section of the Development Control Plan that is applicable to the site (which is Land Use SP2 – Special Use 2, refer Section 2 above) is “Development Control Plan – Development In Environmental Protection, Recreation and Special Use Zones 2011”.

The development will not be used for critical hospital use (as it will be used only for ancillary business services) and can therefore be classified as Concessional Development in accordance with Schedule D2, as it meets the requirements of:

“(b) (iii) A change of use which does not increase flood risk having regard to property damage and personal safety”.

Schedule D3 of the DCP has requirements for floor and pad levels for Concessional Development as follows:

“Unless otherwise specified all floor levels to be now lower than the 5 year flood level plus freeboard unless justified by site specific assessment” and;

“ Floor levels to be no lower than the design floor level”.

The design floor level is defined as:

“the minimum floor level that applies to the development. If the development is concessional development, this level is determined based on what land use category would apply if it was not categorised as Concessional Development”

The change of use is consistent with a Business Land Use (non-critical facility), and as such is subject to those requirements (as noted above).

The Business Land Use requirements that are applicable are as follows:

- “Commercial and Industrial Floor and Pad Levels – Primary habitable floor levels to be no lower than the 100 year flood level plus freeboard. The primary habitable floor levels for infill

development in Grafton, South Grafton and the Heber Street Catchment may be reduced to no lower than 6.4, 7.1 and 8.0m AHD respectively”.

For the proposed development, the floor levels are set at RL 7.1 – as the proposed development is for change of use of existing buildings. As such, the building floor levels can’t be adjusted. The existing floor levels comply with the requirement of being above RL6.4m AHD (requirement for Grafton infill development). In fact, the floor level exceeds this requirement by 700mm.

This meets the DCP requirement for Concessional Development which states the “Floor levels to be no lower than the design floor level” which is RL 6.4m.

CLARENCE VALLEY COUNCIL

BUSINESS ZONES DCP 2011



PART D FLOODPLAIN MANAGEMENT CONTROLS

SCHEDULE D4 LOWER CLARENCE RIVER FLOODPLAIN, YAMBA FLOODPLAIN & OTHER FLOODPLAINS Prescriptive Controls (Refer to clause D3.2)

	Floodplain Management Area							
	General Floodplain				Floodway			
	Critical Uses & Facilities	Sensitive Uses & Facilities	Commercial & Industrial	Concessional Development	Critical Uses & facilities	Sensitive Uses & Facilities	Commercial & Industrial	Concessional Development
Planning Consideration								
Floor & Pad Levels		1,5	1,2	1,3				1,3
Building Components		1	1	1				1
Structural Soundness		1	2	2				1
Flood Effects		2	2	2				
Evacuation		1,2 or 3,5	1,3 or 3,6	1,3 or 2,3 or 3,4,6				1
Management & Design		1,2,3,4	1,2,3,4	1,2				1,2

COLOUR LEGEND: Controls specifically applicable to this DCP Unsuitable Land Use

Figure 5 – Extract from CVC Business DCP 2020

3.1.2. Clarence Valley Local Environmental Plan (LEP) 2011

As shown in the Flood Planning Map extracted from the Clarence Valley Local Environmental Plan (LEP) 2011 (map identification reference 1730_COM_CL1_007H_0140_20150326), the Correctional Centre site lies fully within the FPA.

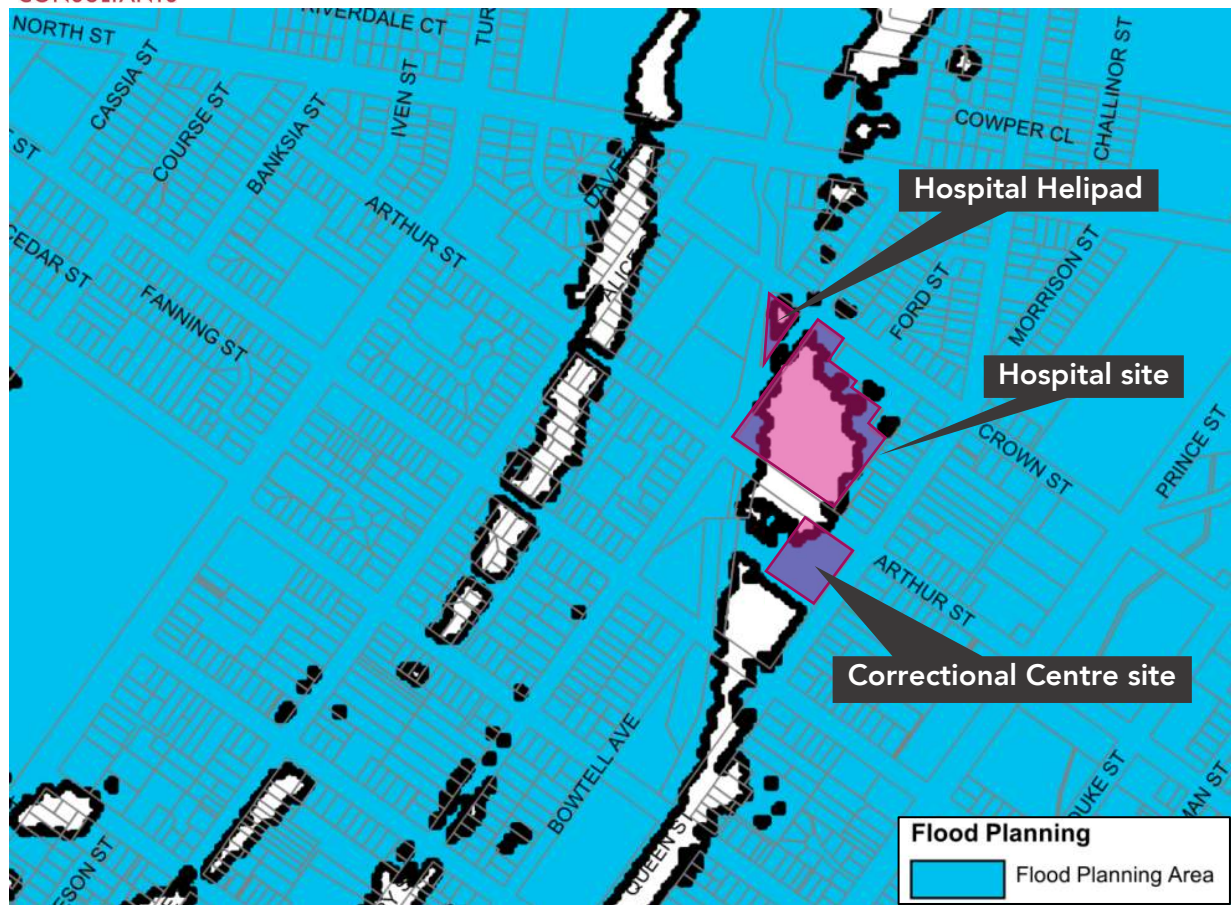


Figure 6 – Flood Planning Map (Source: NSW Legislation)

The Flood Risk Management Manual 2023 (Department of Planning & Environment, NSW) defines FPA as the area of land below the Flood Planning Level (FPL) and thus subject to flood related development controls. The manual also defines FPL as a combination of flood levels derived from historical flood events or floods of specific Annual Exceedance Probability (AEP) events and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans.

3.1.3. Grafton and Lower Clarence Floodplain Risk Management Plan (BC, 2007)

The Grafton and Lower Clarence Floodplain Risk Management Plan (V2 prepared by Bewsher Consulting Pty Ltd June 2007, reference J1276) assessed the flood risk within the Grafton and Lower Clarence Valley floodplain, utilising flood results obtained by the Lower Clarence Flood Study Review prepared by WBM in 2004.

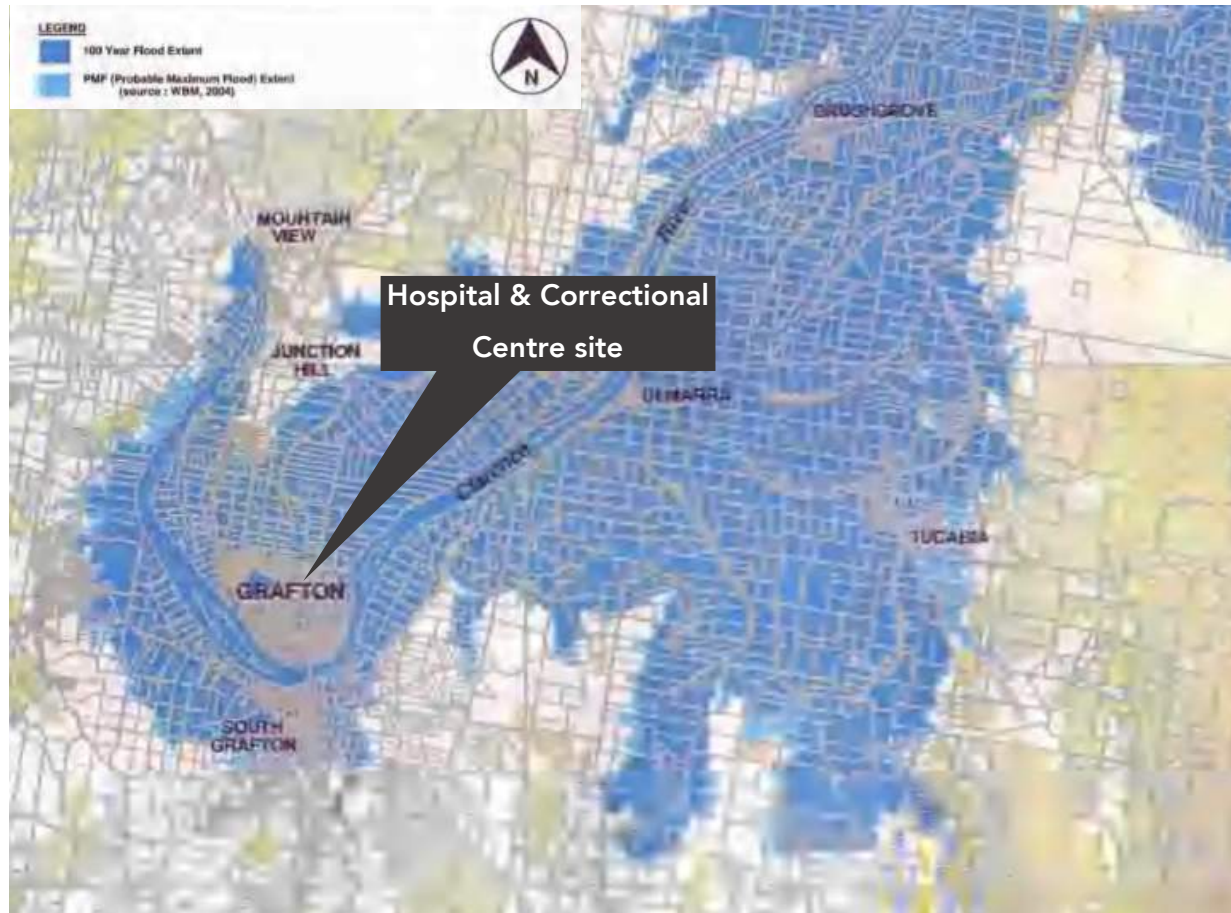


Figure 7 – 100 Year Flood Extent & PMF Floods (BC, 2007)

Whilst there are no contours in the above Figure, tabulated figures for peak design flood levels (PMF) are at RL9.76m Australian Height Datum (AHD) for Grafton (Prince St Gauge) and RL9.00 for Grafton (inside levee). The subject sites are located in Grafton (inside the levee and therefore the FPL of RL9.00m AHD would apply for the PMF event.

For other less rare flood events, the peak design flood levels for Grafton (inside levee) are RL6.80m AHD for the 500 year ARI flood event, RL4.90 – 6.03m AHD for the 100 year ARI flood event and no flooding for the 20 year and 5 year ARI flood events.

3.1.4. Lower Clarence Flood Model Update 2013 (BMT WBM, 2013)

The Lower Clarence Flood Model Update 2013 (Rev 2 prepared by BMT WBM September 2013, reference R.B19054.001.02) was prepared for CVC and was to update the previous 2004 Study via an upgraded computer model.

The Flood Planning Level Modelling Results for North Street (Alumy Creek) Grafton is RL6.5m AHD for the 1% AEP and RL8.9m AHD for the PMF flood event (extracted from Table 7-2 in the Model Update report).

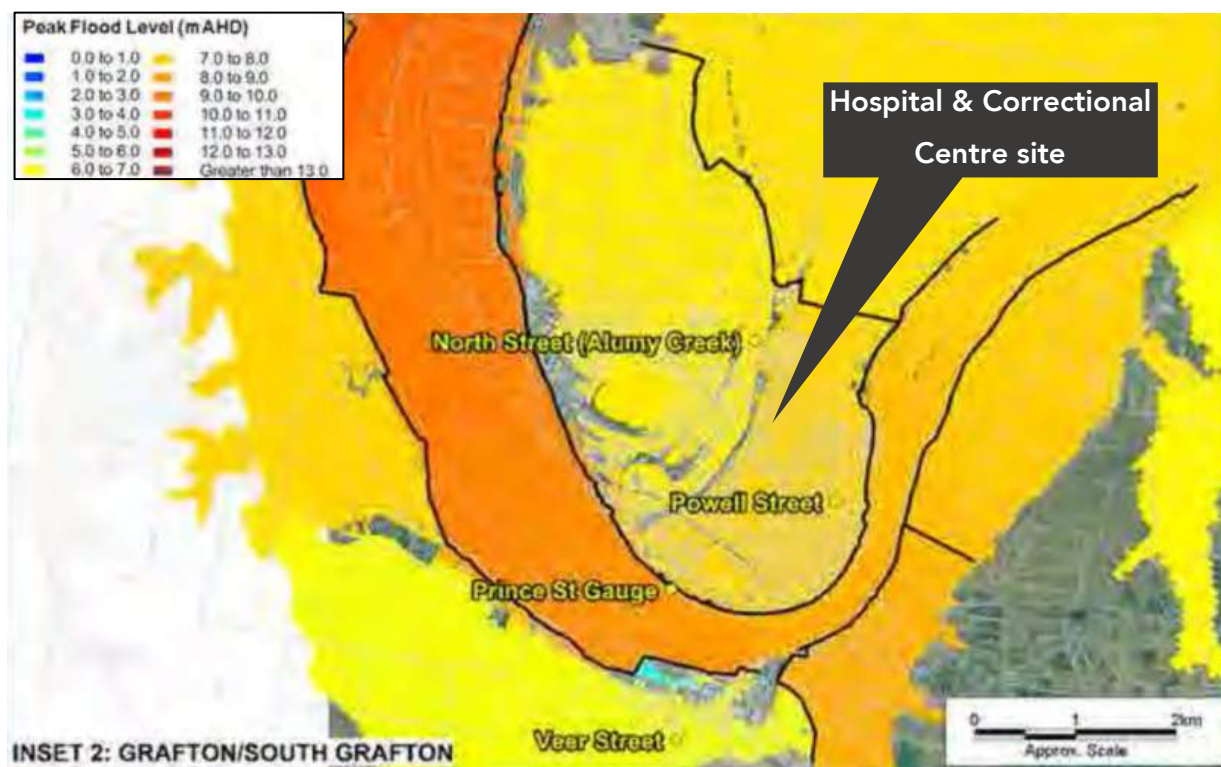


Figure 8 – 1% AEP Design Event Peak Flood Level (Figure 4-8 Rev A, BMT WBC, 2013)

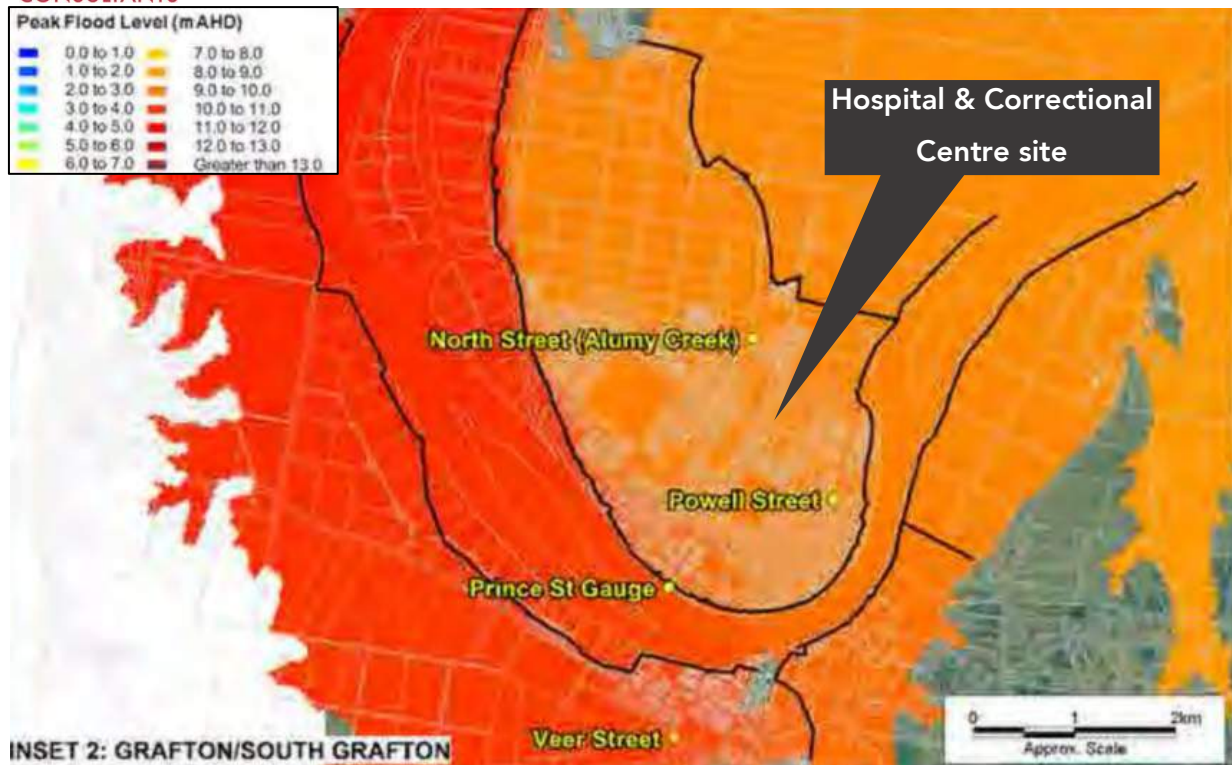


Figure 9 – PMF Design Event Peak Flood Level (Figure 4-9 Rev A, BMT WBC, 2013)

There are no flood contours provided in the above map, however the colour on the map at the Hospital and Correctional centre site indicate an approximate flood level of RL7.0m AHD in the 1% AEP flood event and RL9.0m AHD in the PMF event.

Climate change assessment has also been conducted in the Model Update report, which included three scenarios:

1. Scenario 1: 1% Annual Exceedance Probability (AEP) event: 10% rainfall intensity increase + no sea level rise
2. Scenario 2: 1% AEP event: 10% rainfall intensity increase + 0.4m sea level rise
3. Scenario 3: 1% AEP event: 10% rainfall intensity increase + 0.9m sea level rise

The first two scenarios anticipate approximately 0.4m rise in peak flood level at the Grafton levees for the 1% AEP flood event, and the third scenario anticipates an approximate 0.5m rise.

The Acquisition site is flood affected, with the existing 1% AEP flood level approximately RL 7.08.

The existing flood map shows water within the site in the 1% AEP event, however it is understood that the initial regional flood model did not include the prison walls.



Figure 10 - 1 in 100 year flood event map (Source: CVC Intramaps)

3.1.1. Lower Clarence Flood Model Update 2022 (BMT, 2022)

Updated modelling has been completed by BMT that has not been formally adopted by CVC. The TUFLOW flood model has been provided, and this has been interrogated to determine Flood levels (based on the updated model) for the subject site.

The 1% AEP flood levels are generally consistent with the 2013 flood model – there are some minor differences however they are not significant.

The PMF level has increased significantly to approximately RL 13.18 for the Hospital and subject site.

3.1.2. Flood Model Update 2023 (BMT, 2023)

Updated modelling has been completed by BMT (utilising the 2013 Model, as CVC had not formally adopted the 2022 model update at time of instruction) that included that included the prison walls. The results are included as Figure 11, with the area that was flooded and is now dry (ie not flooded) shown as green. As such, the site is not currently affected by the 1% AEP flood event.

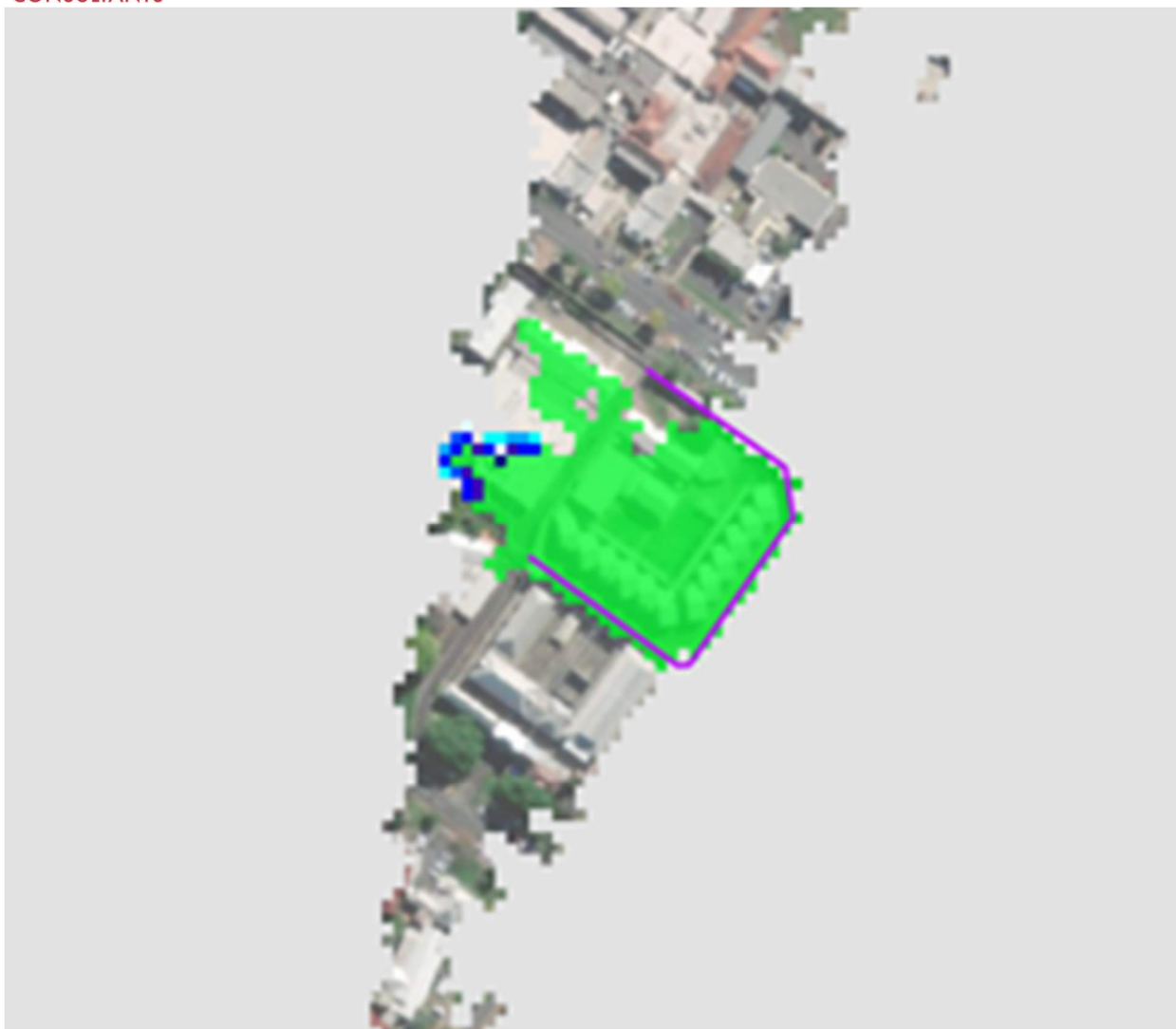


Figure 11 – Updated 1% AEP Flood Mapping (Source: BMT)

Updated modelling has been completed by BMT (refer Appendix B), which includes Climate Change analysis. The Acquisition site is not flood affected in the 1% AEP (including Climate Change) event and does not result in adverse impact (that is, there is no increase in flood level due to the proposed flood protection for the Acquisition Site).

Refer Figure 11 and the BMT report attached as Appendix B.

3.1.3. Flood Protection

The protection of the Acquisition site, which will be utilised for ancillary Hospital purposes (eg administration) will be consistent with the requirements of CVC DCP and LEP for Business Zones use. This requires a minimum floor level can be reduced for Business infill development in Grafton to RL



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6.4m). The level of protection proposed meets this requirement, and the existing floor levels exceed the minimum floor level required for infill development.

Should a flood event greater than the 1% AEP event occur, it would not result in any impact in events up to and including the 1% AEP flood event, as the site is not affected by those events.

CVC DCP requires that building components below the primary habitable floor level are to be flood compatible. Clarence Valley Council Business Zones DCP allows for the habitable floor level for infill development in Grafton to be taken as RL 6.4m. The existing floor levels of the buildings within the proposed development site are at RL 7.1m and therefore the buildings do not need to comply with this requirement.

3.1.4. Emergency Management & Flood Evacuation

There are existing emergency management strategies in place for the Grafton and South Grafton regions, including the Clarence Valley NSW SES Locality Response Arrangements which forms Volume 3 of the Clarence Valley Local Flood Plan.

The Plan outlines an estimated 'doorknock' time of 9 hours with 35 SES teams (based on an estimate of 3,800 properties at risk within the North Grafton region). On top of the 'doorknock' time, an additional warning lag factor of one hour and a warning acceptance factor of an hour is also considered for SES sequencing of evacuation.

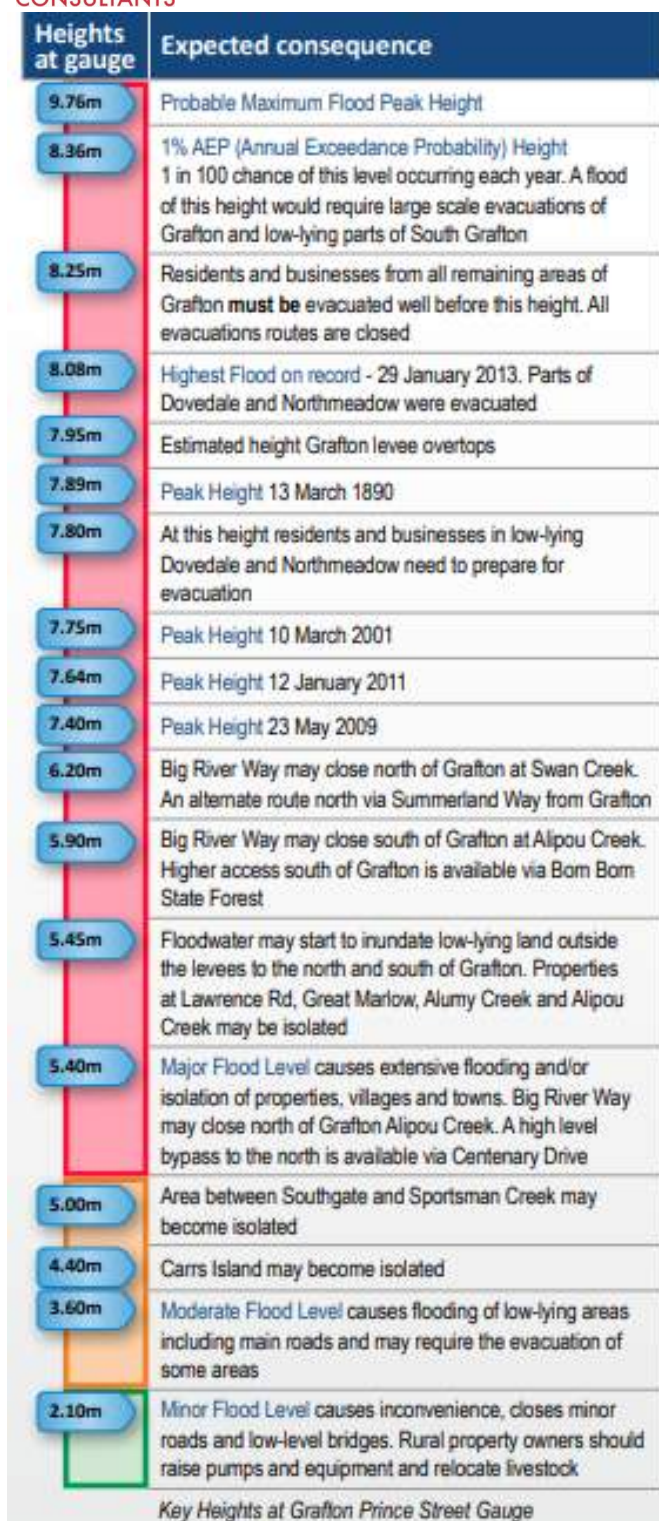


Figure 12 – Expected consequence at differing flood gauge heights (Source: SES Grafton and South Grafton Floodsafe Guide, 2020)

The Clarence Valley Flood Emergency Sub Plan (Vol 1 of the Clarence Valley Local Flood Plan prepared by SES FloodSafe, June 2017) details response operations and measures for all levels of flooding within the CVC LGA.

The subject site is flood affected in the 1% AEP and the PMF event as shown in the Grafton Town Map provided in the Emergency Sub Plan (see Figure 13 below).

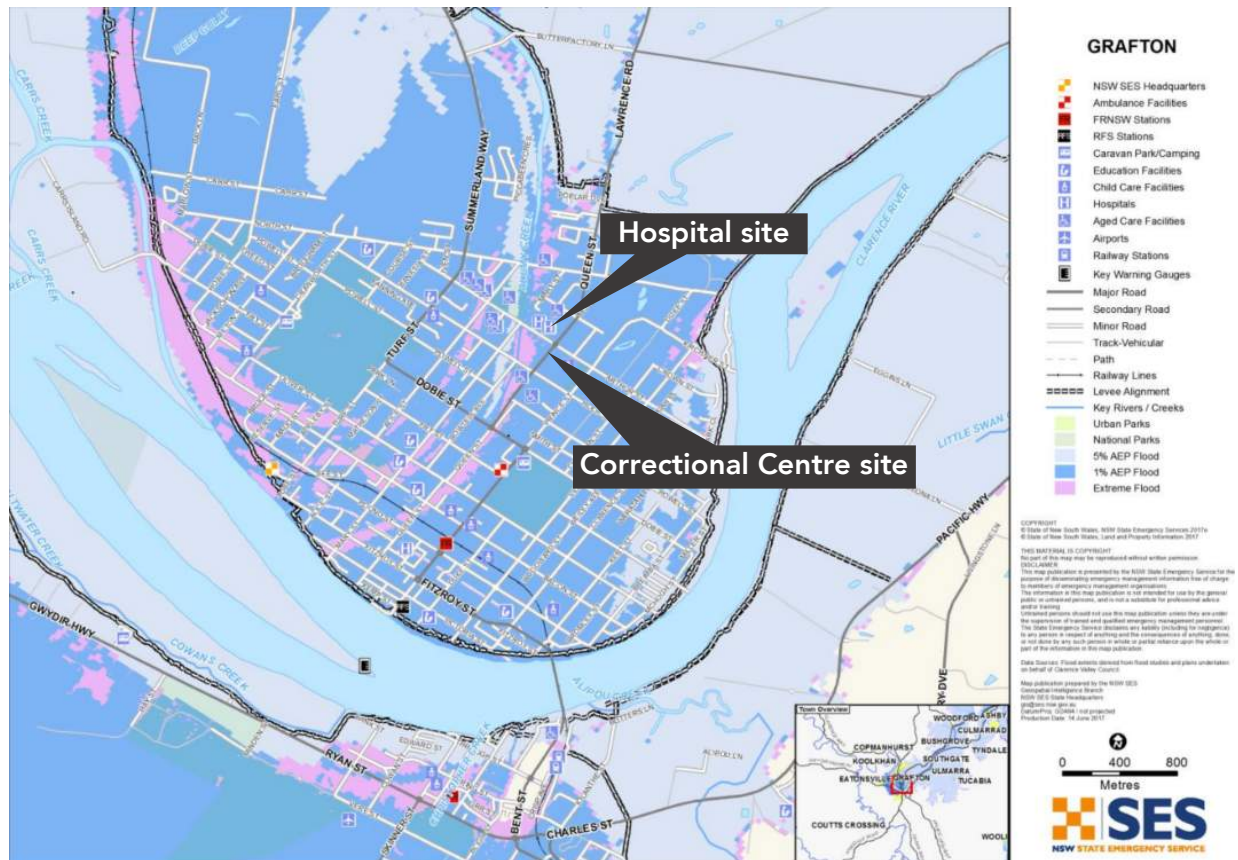


Figure 13 – Grafton Town Map Flood Map (FloodSafe, 2017)

Key warning triggers at the Prince Street gauge are at 2.10m (minor), 3.60m (moderate) and 5.4m (major). Evacuation triggers are in place based on Bureau of Meteorology (BoM) flood height predictions Prince Street gauge for the Grafton area.

The subject sites lie within Sector B in the local flood plan map (see Figure 14 overleaf), where evacuation triggers at a predicted flood height of 8.2m or greater.



Figure 14 – Clarence Valley Local Flood Plan Sub Sectors (SES FloodSafe, 2017)

3.1.5. NSW Government Response to the NSW Independent Flood Inquiry

The NSW Independent Flood Inquiry reported to the NSW Government the causes of, preparedness for, response to and recovery from the February-March 2022 catastrophic flood event which impacted a total of 62 LGAs and caused extensive damage.

Recommendation number 28 relates to Essential Services and Floodplain Infrastructure, which includes the following:

That, to minimise disruption to essential services (power, communications, water, sewerage) and to ensure flood infrastructure is fully serviceable before flooding, Government ensure:

- *essential service infrastructure (communications, water, power and sewerage) is situated as much as possible above the flood planning level. And to minimise disruption to medical services, aged care services and the police, Government ensure hospitals, medical centres, nursing homes, aged care facilities and police stations are situated above the probable maximum flood level*
- *floodplain infrastructure (drains, levees, flood gates) items are all assigned to an appropriate lead agency which has responsibility for ensuring they are fully maintained and functioning especially when floods are likely.*



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The NSW Government's response to the above is supportive in principle, however noted further work required on implementation as per the below:

"NSW Government will ensure future essential services infrastructure development occurs above the flood planning level, where appropriate. Consideration will be given to how to encourage private sector essential infrastructure developers to take the same approach."

3.2. Stormwater Quality

3.2.1. Design Considerations and Criteria

With reference to the CVC Development Control Plan (DCP) Part G Sustainable Water Controls, the table below summarises the default water quality targets.

Table 1 - Table G2 of CVC DCP Default Water Quality Targets

Water Quality Parameter	Default Target
Gross Pollutants (GP)	90% of average annual load retained
Total Phosphorus (TP)	60% of average annual load retained
Total Nitrogen (TN)	45% of average annual load retained
Total Suspended Solids (TSS)	85% of average annual load retained

However, it is noted that proposed Acquisition site development does not involve any increase in impermeable areas or amendment of pavements. Under Table G1 of the DCP, developments with no increase in impermeable surface (post development) are not required to meet water quality targets as outlined in the DCP.

3.2.2. Treatment Measures

While it is noted that the proposal does not warrant a reduction in pollutants or requiring to meet the water quality targets, measures have been proposed to reduce the pollutants as part of the proposed redevelopment. Proposed WSUD treatment measures nominate for the proposed development include the following:

- Gross pollutant traps (GPTs) – Ocean Protect OceanGuard pit baskets installed at the upstream grated pits

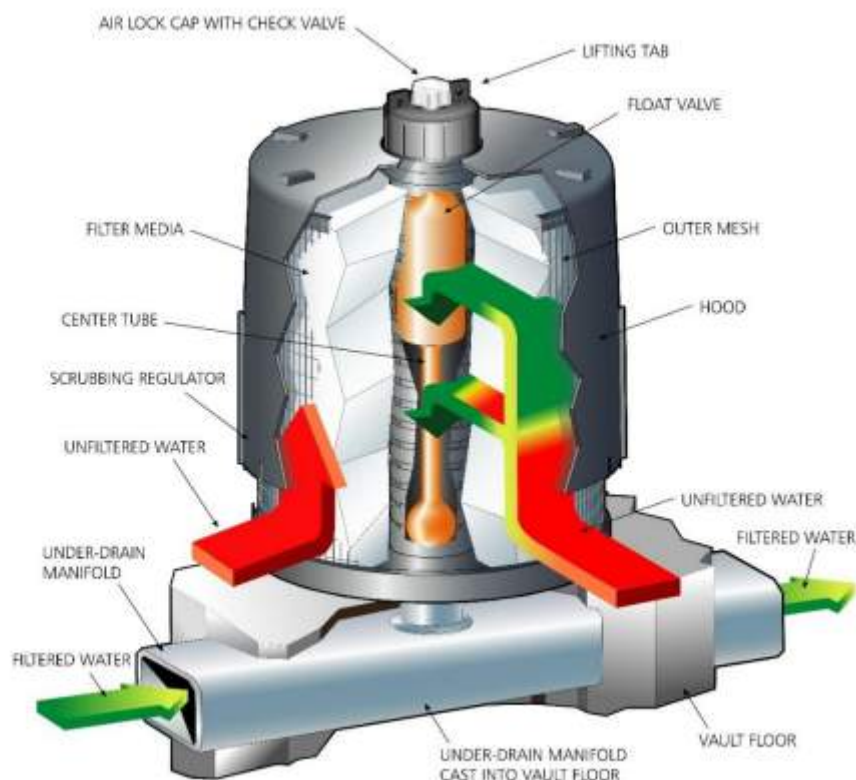


Figure 15 - StormFilter cartridge components (Source: Ocean Protect, 2019)

- Ocean Protect PSorb StormFilter Cartridge within the downstream pits prior to discharge into the Council stormwater drainage system

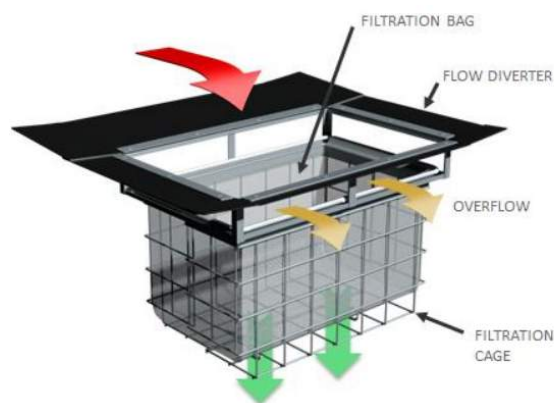


Figure 16 - OceanGuard components (Source: Ocean Protect, 2019)

It is noted that the nominated GPT, Ocean Protect OceanGuard (formerly known as Stormwater360 Enviropod 200 in the previous generation) captures 100% of sediment and debris sized 200micron and larger. There are slots created in the flow diverter for bypassed flows during large storm events where water elevation in the filtration bag can rise. Further, there are slots to allow overflow.

The proposed measures within the Acquisition Site exceed Council requirements.



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3.3. Stormwater Quantity Management

As previously discussed, the development proposal for the Acquisition Site is limited to refurbishment of internal areas of the existing heritage building and does not involve an increase in impervious areas external to the building. As per the Clarence Valley Council Development Control Plan Part G, stormwater runoff volumes and frequency should be reduced or maintained to the pre-development volumes through harvesting, retention, infiltration and detention as appropriate.

As the development does not involve the increase in impervious area, the stormwater runoff peak flow will not increase from the post development figures. In this regard, the existing pits and pipes system in place will be retained and maintain its function post-development. It is noted that water quality treatment measures are proposed to be constructed to reduce pollutants within the stormwater runoff. This involves the reconstruction of the downstream pits to accommodate these water quality treatment measures. The installation of the filter cartridge will provide a level of on-site detention, as there is a weir to facilitate the required water level within the cartridge chamber.

Appendix 1. Civil Engineering Concept Design

NORTHERN NSW LOCAL HEALTH DISTRICT
184 ARTHUR ST, GRAFTON, 2460, NSW
PRELIMINARY

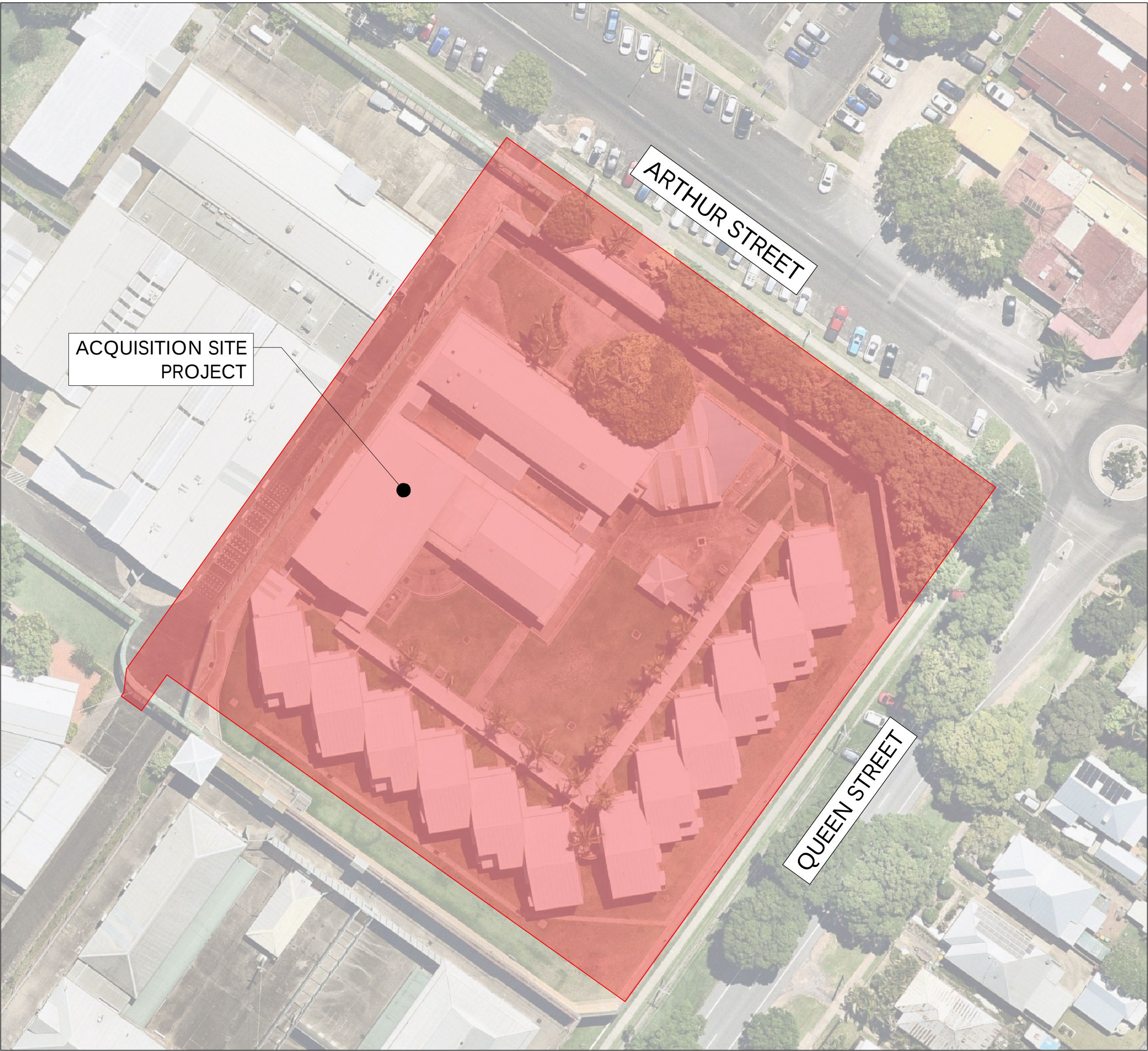
DRAWING LIST

ACQUISITION SITE PROJECT

- CV-DA001
- DRAWING REGISTER & LOCALITY PLAN
- CV-DA101
- SEDIMENT & EROSION CONTROL PLAN
- CV-DA102
- SEDIMENT & EROSION CONTROL DETAILS
- CV-DA301
- STORMWATER MANAGEMENT PLAN
- CV-DA302
- STORMWATER DETAILS

NOTES:

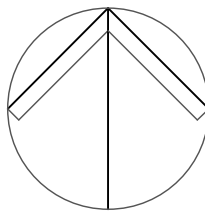
- NO EARTHWORKS.
- EXTERNAL PAVEMENTS TO BE RETAINED (OR REINSTATED WHERE SERVICES WORK NEEDS TO OCCUR).



LOCALITY PLAN
N.T.S

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P2	D.A. ISSUE	15.09.2023	MD	SN
P3	D.A. ISSUE	05.04.2024	AL	SN

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AREA

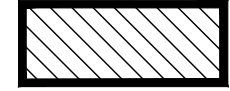
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BLOCK B
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BLOCK C

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BLOCK D

SOIL AND WATER MANAGEMENT LEGEND

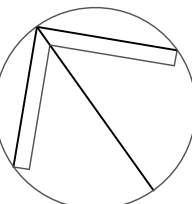
- SEDIMENT FENCE /
HOARDING
-  TEMPORARY SHAKER
RAMP FOR ENTRY/EXIT
-  GEOTEXTILE PIT FILTER /
FILTER SURROUND
INSTALLED ON EXISTING
PIT
-  SANDBAG INLET
SEDIMENT TRAP
-  OVERLAND FLOW
-  SITE ACCESS GATE

SURVEY LEGEND:

- 37.00— CONTOUR (EX.)
- C— TELECOMMUNICATIONS LINE (EX.)
- W— WATERMAIN LINE (EX.)
- G— GAS LINE (EX.)
- S— SEWER LINE (EX.)
- ==— STORMWATER LINE (EX.)
- — — — — PROPERTY BOUNDARY
- 33.45 EX SURFACE LEVEL
-  EX STORMWATER PIT
-  EX GRATED DRAIN
-  EX TREE

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P3	D.A. ISSUE	05.04.2024	AL	SN

NOTES:

- NO EARTHWORKS.
- EXTERNAL PAVEMENTS TO BE RETAINED (OR
REINSTATED WHERE SERVICES WORK NEEDS TO
OCCUR).

5 0 1m at full size 250m

Client
HEALTH INFRASTRUCTURE

Architect
WOODS BAGOT

2/60 Carrington St,
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Project
GRAFTON HOSPITAL ACQUISITION SITE

184 Arthur St,
Northern NSW Local Health District,
NSW 2460



ACOR Consultants Pty Ltd
Suite 2, Level 1, 33 Herbert Street
St Leonards NSW 2065
T +61 2 9438 5098



ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

Drawing Title
SEDIMENT & EROSION CONTROL PLAN

WARNING
NO DRAINAGE WORKS SHALL COMMENCE
UNTIL THE CONTRACTOR CONFIRMS THE
I.L. OF ALL EXISTING DRAINS, AND
CONFIRMS IN WRITING WITH THE
ENGINEERING SUPERVISOR.

ALL EXISTING PROPERTY SERVICES' LOCATIONS AND DEPTHS ARE
APPROXIMATE AND MUST BE VERIFIED ON SITE.
THE CONTRACTOR SHOULD SUPPLY PRECISE LOCATIONS AND
DEPTHS TO THE ENGINEER FOR REVIEW PRIOR TO ANY WORKS
THAT MAY AFFECT THESE SERVICES.

NOTE:
EXISTING UTILITY LOCATIONS ARE INDICATIVE
ONLY. REFER TO SERVICE PROVIDER FOR EXACT
POSITION.



WARNING
BEWARE OF UNDERGROUND SERVICES

THE LOCATIONS OF UNDERGROUND SERVICES ARE
APPROXIMATE ONLY AND THEIR EXACT POSITION
SHOULD BE PROVEN ON SITE. NO GUARANTEE IS
GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

Drawn	Date	Scale	A1	Q.A. Check	Date
AL	05/04/2024	1:250		SN	05/04/2024
Designed	Project No.	Dwg No.	Issue		
MD	23-0693	DA101	P3		

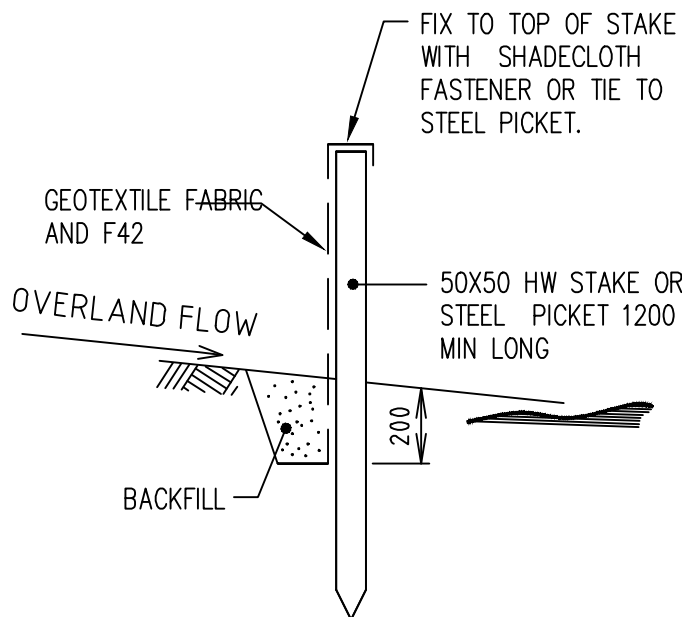
This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by: Approver

Issue	Description	Date	Drawn	Approved
P1	DRAFT D.A.	29.08.2023	MD	SN
P2	D.A. ISSUE	15.09.2023	MD	SN
P3	D.A. ISSUE	05.04.2024	AL	SN

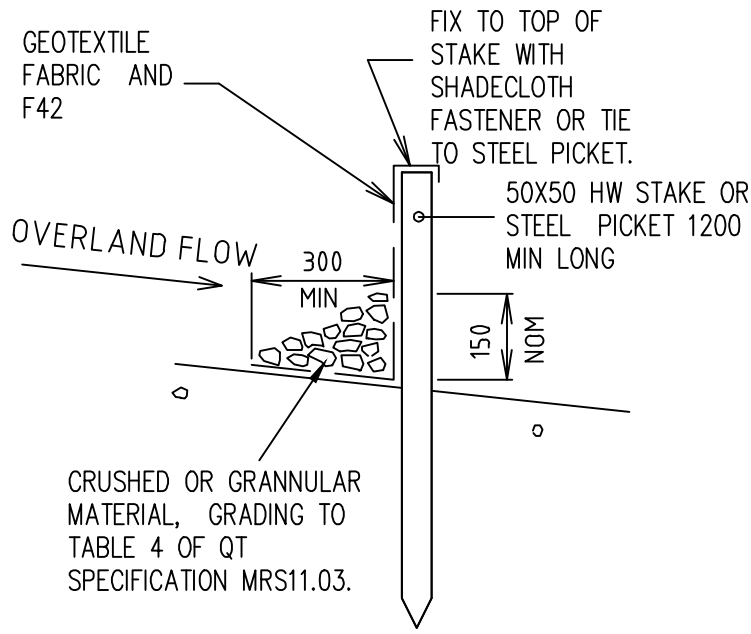
NOTES:

- NO EARTHWORKS.

- EXTERNAL PAVEMENTS TO BE RETAINED (OR REINSTATED WHERE SERVICES WORK NEEDS TO OCCUR).



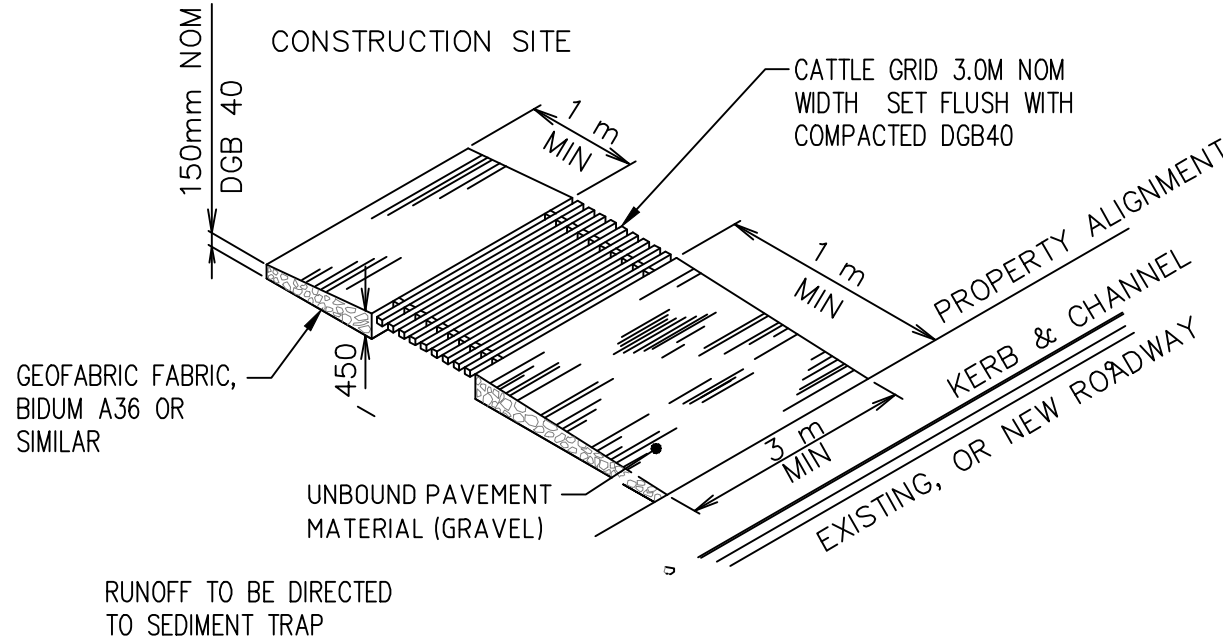
ALTERNATIVE 1



ALTERNATIVE 2

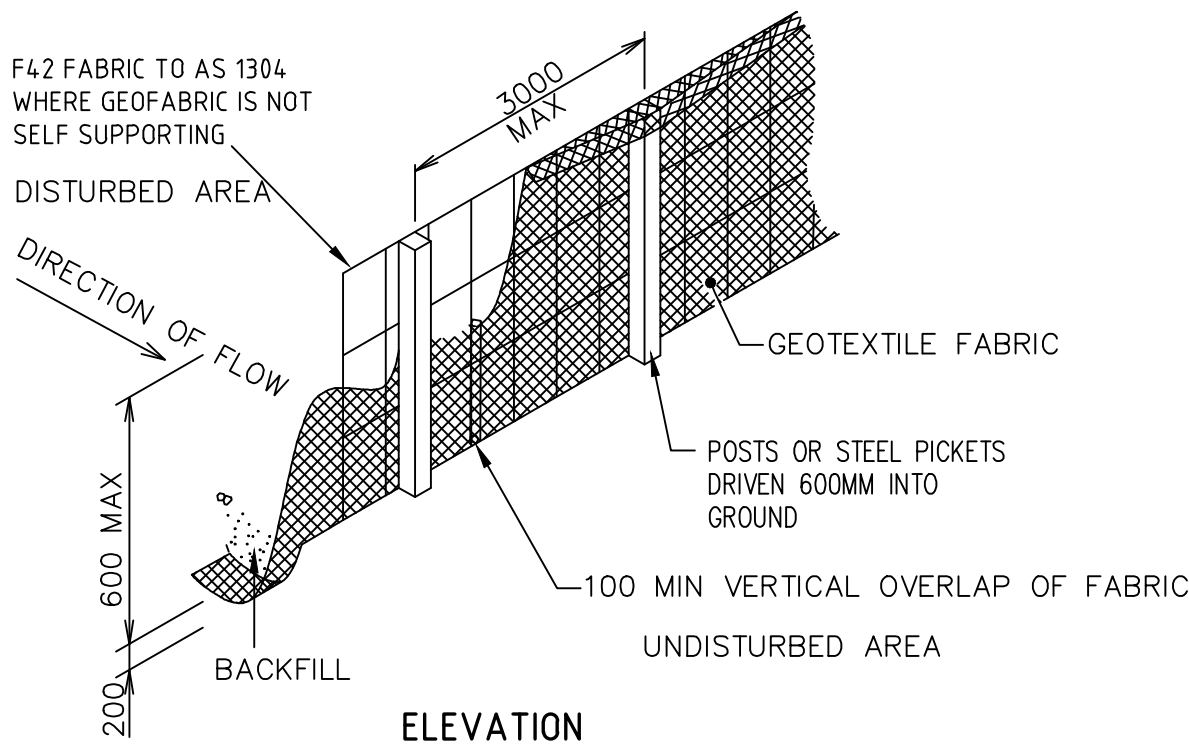
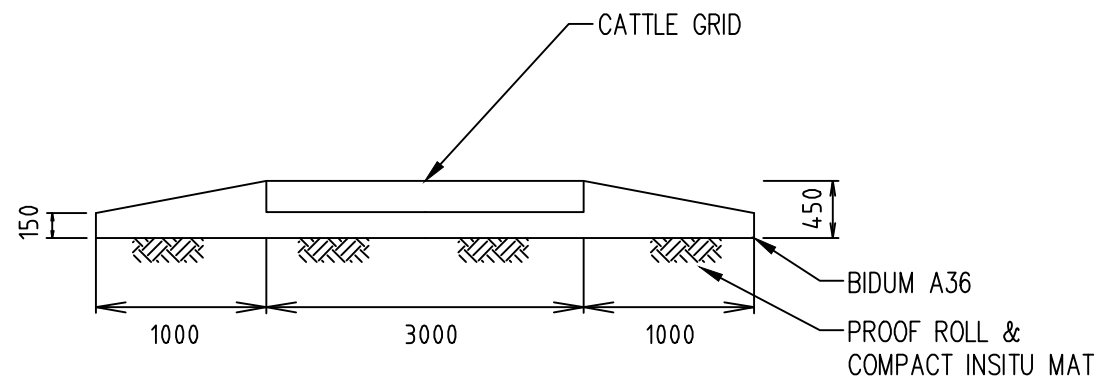
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NOT TO SCALE



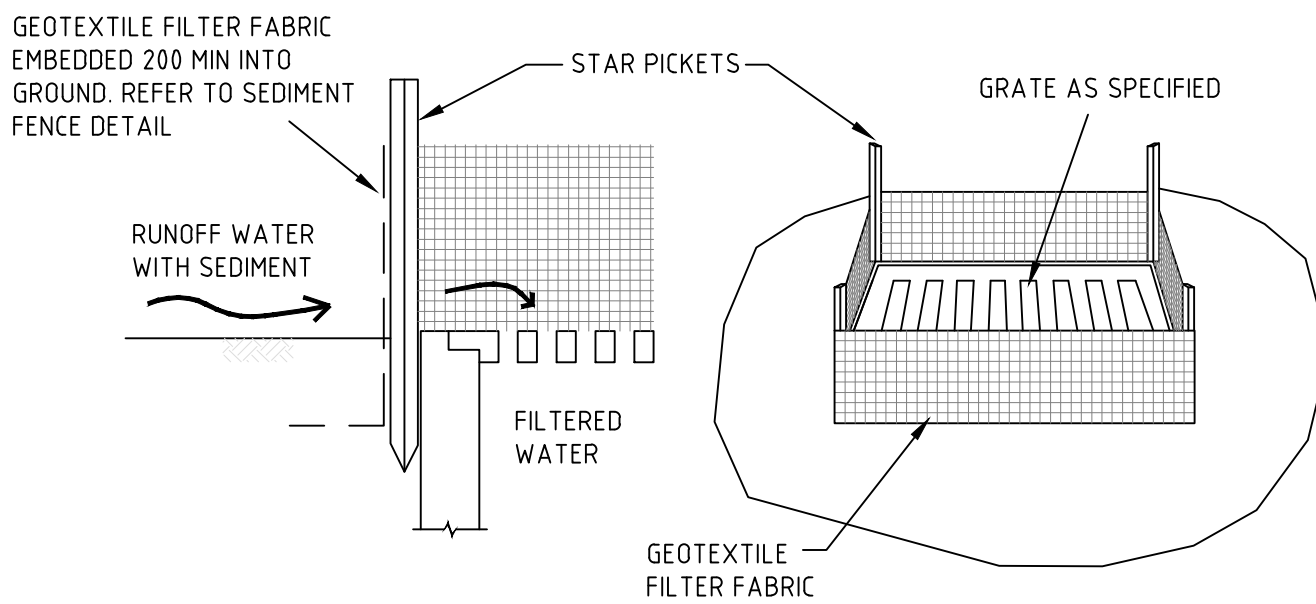
**TEMPORARY CONSTRUCTION VEHICLE
ENTRY/EXIT SHAKER RAMP (TYPICAL)**

NOT TO SCALE



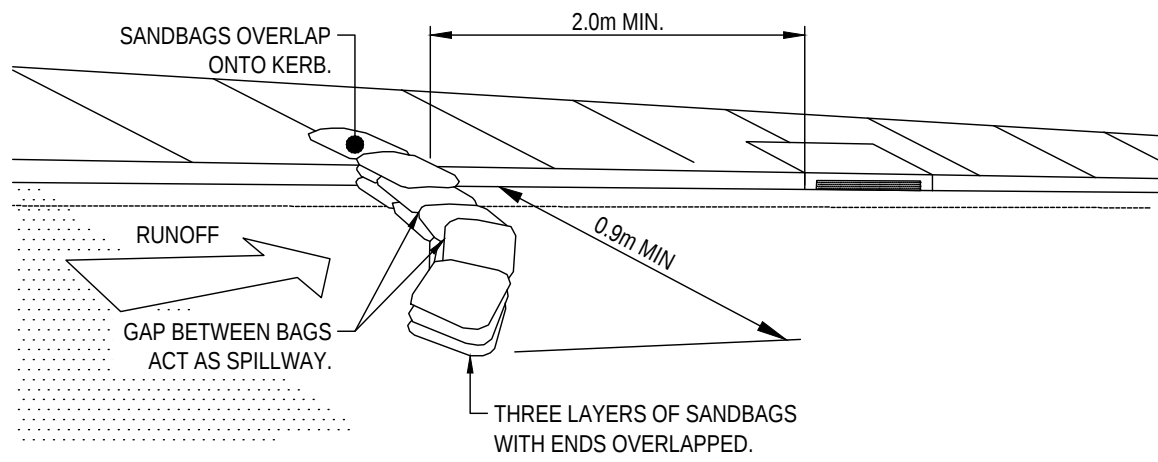
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NOT TO SCALE

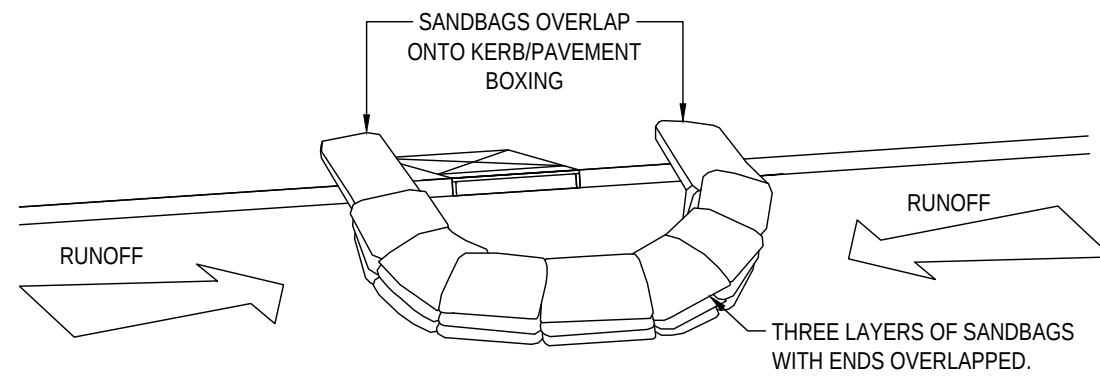


GEOTEXTILE PIT FILTER 1

NOT TO SCALE



SANDBAG SEDIMENT TRAP - AT ON GRADE PIT



SANDBAG SEDIMENT TRAP - AT KERB SAG PIT

SANDBAG SEDIMENT TRAP.

N.T.S.

N.T.S.

Client

HEALTH INFRASTRUCTURE

Architect

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Project

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ENGINEERSMANAGERSINFRASTRUCTURE PLANNERSEVELOPMENT CONSULTANT

Drawing Title
SEDIMENT & EROSION CONTROL DETAILS

Drawn AL	Date 05/04/2024	Scale N.T.S.	A1	Q.A. Check SN	Date 05/04/2024
Designed MD	Project No. 23-0693	Dwg No. DA102	Issue P3		



Appendix 2. BMT Updated Flood Assessment

Our ref: L.002943_001.00_Flood_Impact_Assessment.docx

1 September 2023

ACOR Consultants Pty Ltd
Suite 2, Level 1, 33 Herbert Street
St Leonards NSW 2065
Attention: Gregory Lyell

Dear Gregory

RE: GRAFTON BASE HOSPITAL FLOOD IMPACT ASSESSMENT

Introduction

BMT was commissioned by ACOR to prepare a flood impact assessment to inform the redevelopment of the Grafton Base Hospital. The requested scope included undertaking a flood impact assessment using Clarence Valley Council's (Council) currently adopted flood model (developed by BMT in 2013) and to also simulate a 1 in 2000 AEP flood in Council's updated, but not yet formally adopted, flood model. Our approach and results of the assessment are set out below.

Flood Impact Assessment

The flood impact assessment was undertaken using the current Lower Clarence Adopted Flood Model (referred to herein as the 2013 Flood Model). The assessment is in relation to a proposed wall to be constructed within an acquisition site located in the grounds of the former Grafton Jail. The 2013 flood model is a 2D hydraulic multi-domain TUFLOW model with differing grid resolutions across the model. The former Grafton Jail site is located within the Grafton domain of the model which is set to the highest resolution and uses a 10m grid. This resolution is considered suitable for the assessment.

The existing model did not adequately represent the existing walls of the Grafton Jail. These are solid features and so the model was updated to include these. This updated model was used to simulate the existing case for the following requested design flood events; 1 in 20, 1 in 50 and 1 in 100 AEPs along with a 1 in 100 AEP including an allowance for climate change. The modelled climate change scenario includes a 10% increase in flow and an allowance of 0.9m for sea level rise.

For the developed case the proposed wall was added in as a solid feature. The model was simulated for the same four events used for the existing case.

The results of the flood impact assessment are presented as peak flood level impact maps where a positive value indicates an increase in peak level due to the proposed development. Maps in Annex A show the peak flood level impact maps for the respective design flood events. The maps also show the location of the existing wall and proposed wall.

As can be seen from the maps, no peak flood level impacts are apparent for any of the modelled flood events. The proposed wall remains outside of the flood extent for all modelled events.

1 in 2000 AEP Peak Flood Level

The 1 in 2000 AEP peak flood level is needed to inform the redevelopment of part of the main hospital. BMT was requested to provide the peak flood level for this event using an updated version of the Lower Clarence Flood Model which forms part of the Lower Clarence Flood Model Update 2022 for Clarence Valley Council. This model is referred to herein as the 2022 Flood Model. The model, and associated study, is currently at an advanced draft stage and is not yet adopted by Clarence Valley Council. However, it represents the most up-to-date model available and includes features such as the second Grafton Bridge, updated bathymetry survey and improved details on topographic features such as levees.

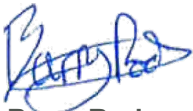
The 1 in 2000 AEP event was not part of the scope of the flood model update and so this event does not exist in the current 2022 Flood Model. Furthermore, the Lower Clarence Flood Model derives its main river inflows from a flood frequency analysis which is not suitable for extrapolation to the 1 in 2000 AEP event. Our approach to derive the 1 in 2000 AEP Clarence River inflow follows that were used for previous assessments, such as the Pacific Highway Upgrade, whereby the ratio of the 1 in 2000 AEP and 1 in 100 AEP design rainfall is used to determine a scaling factor which is then applied to the 1 in 100 AEP inflow. This is considered a pragmatic and valid approach given the general uncertainties of modelling such a large event on a catchment the size of the Clarence River catchment.

A comparison of a long duration¹ design rainfall at Grafton between the 1 in 100 and in 2000 AEPs indicate that a scaling factor of 1.6 is applicable for applying to the 1 in 100 AEP inflows to approximate 1 in 2000 AEP inflows. This scaling factor was applied to the main river inflow and lower floodplain inflows.

The resulting 1 in 2000 AEP flood extent and depths are shown in Annex B. Peak flood levels are indicated at 0.1m intervals. The size of the event results in significant overtopping of the Grafton levee system and inundates the entire town. In the vicinity of the subject site, the 1 in 2000 AEP peak flood level is approximately 8.9 mAHD and is shown to inundate the full site.

Yours Sincerely,

BMT



Barry Rodgers
Principal Scientist

¹ For the purposes of this assessment a 72 hour duration was assumed as this is the duration assumed appropriate for local tributary inflows in the flood study.

Annex A: Peak Flood Level Impact Maps

LEGEND

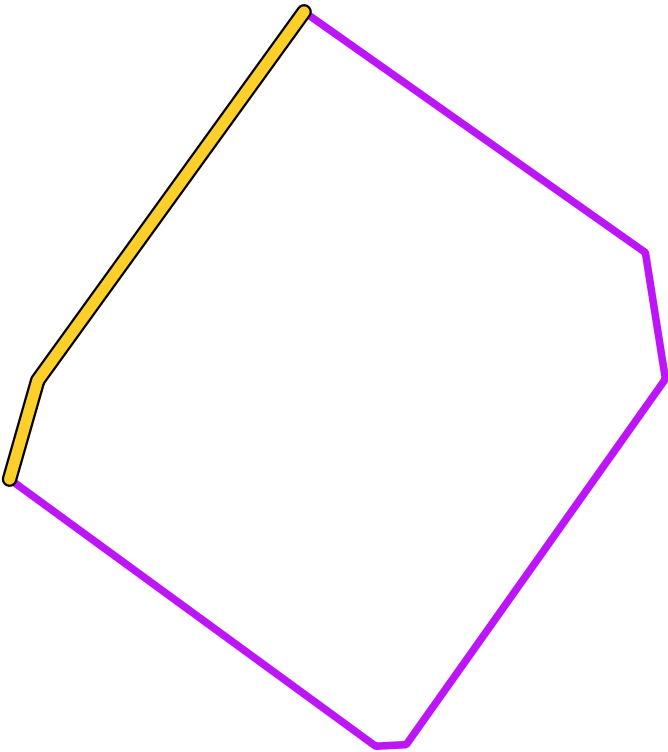
- Proposed Wall
- Existing Wall

Change in Inundation Extent

- Decrease
- Increase

Flood Impact (mm)

- <= -200
- 200 to -100
- 100 to -50
- 50 to -40
- 40 to -30
- 30 to -20
- 20 to -10
- 10 to 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 100
- 100 to 200
- >=200

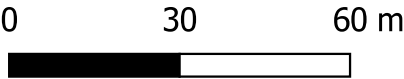


Title:
1 in 20 AEP Peak Flood Level Impact

Figure:
A-1

Rev:
A

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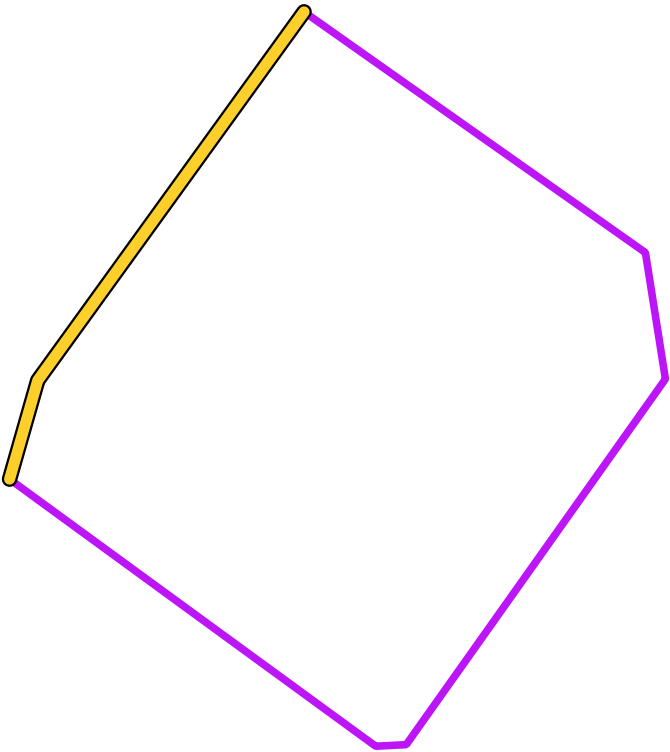
- Proposed Wall
- Existing Wall

Change in Inundation Extent

- Decrease
- Increase

Flood Impact (mm)

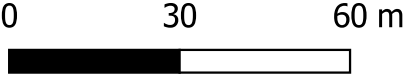
- <= -200
- 200 to -100
- 100 to -50
- 50 to -40
- 40 to -30
- 30 to -20
- 20 to -10
- 10 to 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 100
- 100 to 200
- >=200



Title:
1 in 50 AEP Peak Flood Level Impact

Figure: A-2	Rev: A
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LEGEND

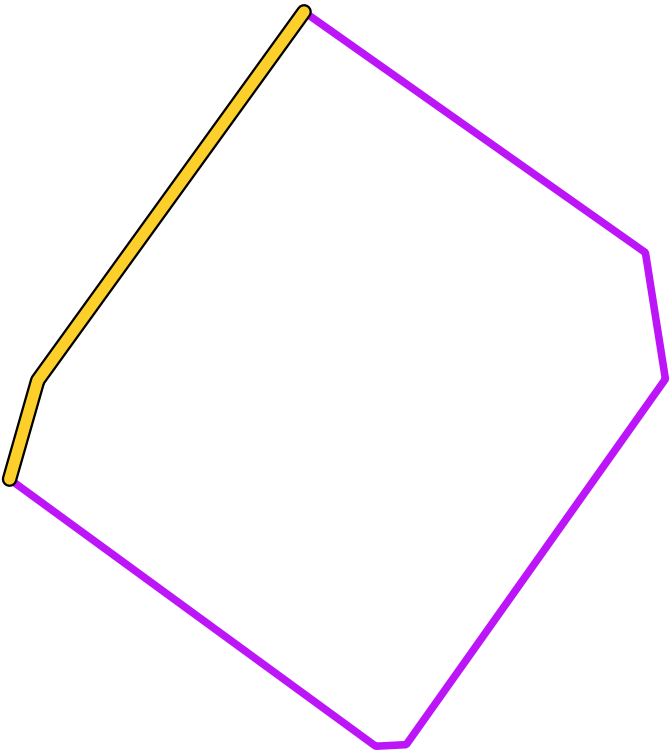
- Proposed Wall
- Existing Wall

Change in Inundation Extent

- Decrease
- Increase

Flood Impact (mm)

- <= -200
- 200 to -100
- 100 to -50
- 50 to -40
- 40 to -30
- 30 to -20
- 20 to -10
- 10 to 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 100
- 100 to 200
- >=200



Title:
1 in 100 AEP Peak Flood Level Impact

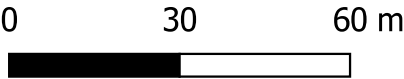
Figure:

A-3

Rev:

A

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LEGEND

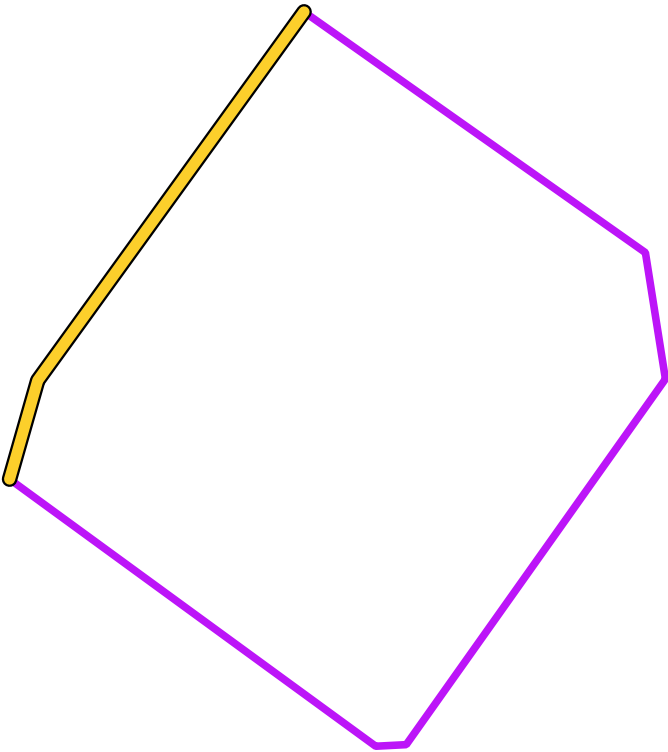
- Proposed Wall
- Existing Wall

Change in Inundation Extent

- Decrease
- Increase

Flood Impact (mm)

- <= -200
- 200 to -100
- 100 to -50
- 50 to -40
- 40 to -30
- 30 to -20
- 20 to -10
- 10 to 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 to 50
- 50 to 100
- 100 to 200
- >=200



Title:
1 in 100 AEP with Climate Change Peak Flood Level Impact

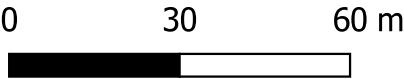
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A-4

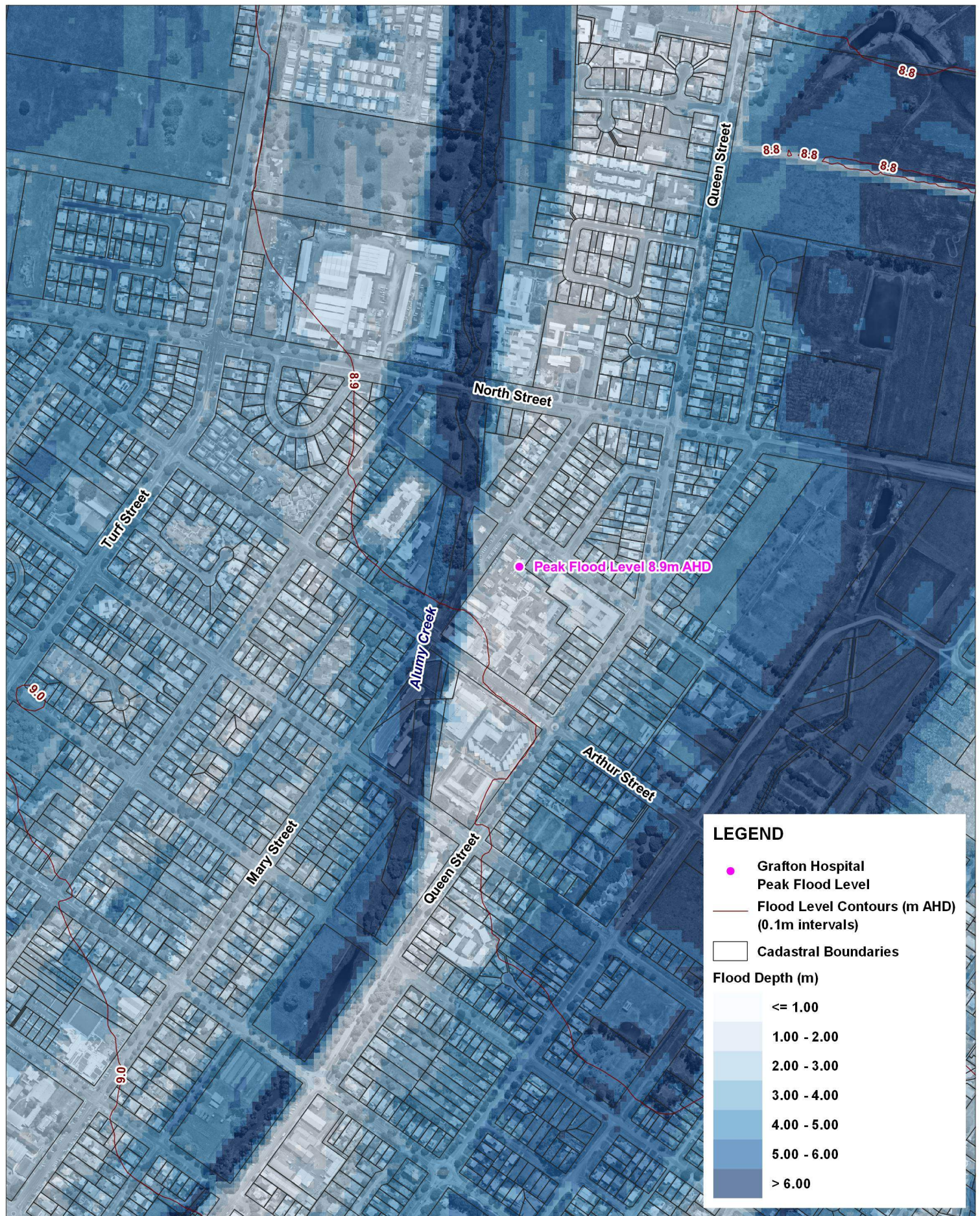
Rev:

A

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Annex B: 1 in 2000 AEP Flood Depths and Levels



Title:
1 in 2000 AEP Peak Flood Depths and Levels

Figure:

B.1

Rev:

A

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0 200 400 m

