



CIVIL

Flood Risk Report

For

Moree Hospital Redevelopment

for NSW Health Infrastructure

c/- BESIX Watpac

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Acronyms

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AR&R2019	Australian Rainfall and Runoff 2019
ASB	Acute Services Building
BoM	Bureau of Meteorology
DCP	Development Control Plan
DPE	Department of Planning and Environment
FFL	Finished Floor Level
FPA	Flood Planning Area (Area located below the FPL)
FPL	Flood Planning Level
GF	Ground Floor
LEP	Local Environmental Plan
LGA	Local Government Area
LiDAR	Light Detection and Ranging Terrain Data
m	Measure of length/ height/ distance (metres)
m AHD	Meters above Australian High Datum
m/s	Measure of Velocity (meters per second)
MPSC	Moree Plains Shire Council
NSW	New South Wales
PMF	Probable Maximum Flood
REF	Review of Environmental Factors
REV	Revision
SLR	Sea Level Rise
STH	Silver Thomas Hanley (Project Architect)
SV	Street View
WRM	WRM Water & Environment (MPSC Flood Consultant)

Executive Summary

This flood risk report provides an assessment of the flood risk to the Moree Hospital Redevelopment Project located at 35 Alice Street, Moree. The purpose of this report is to:

- Identify and evaluate flood risk factors that may affect the project site and surrounds and the proposed development for the full range of events (i.e. up to and including the probable maximum flood (PMF) event);
- Assess the impacts of the development, including any changes to flood behaviour and risk, impacts of flooding on the development and its future community and on existing community for the full range of events;
- Provide recommendations for mitigation measures to minimise flood risk;
- Ensure that the development is consistent with NSW Policy in relation to flood impacted development.

NSW Health Infrastructure are proposing to upgrade and extend the existing Hospital facility including the construction of a new Acute Services Building (ASB) and associated site works, including upgraded parking facilities and landscaping.

Flood information presented herein is based on information presented Council's Flood Study (WRM, 2017). Additional flood information has been obtained from the site-specific Flood Information Certificate provided by Moree Shire Council

A review of site flood conditions suggests the site is flood free during a 1% AEP design storm event (commonly referred to as the 100 year event). Flooding across the site is expected to occur during events in excess of a 1% AEP with depths up to approximately 0.5m during a 0.5% AEP (commonly referred to as the 200 year event) and 2.0m during a PMF (i.e. Probable Maximum Flood event).

Flood hazard conditions are relatively low during a 0.5% AEP with up to H2 expected during this event. Hazardous flow behaviour is expected during a PMF design storm event with up to H5 expected across the entire site during this event.

It is noted that PMF is a hypothetical maximum flood event that could occur in a particular area. It is based on the worst-case scenario, assuming the most extreme weather conditions and the highest possible rainfall that could happen in that region. Council's Flood Study (WRM, 2017) suggests the PMF for the region is equivalent to approximately the 1 in 55,000 year event (i.e. 0.0018% AEP) highlighting the low likelihood of the event.

Flood Planning Levels (FPL) in NSW are more realistic estimates of potential flood levels that could occur in a particular area. They are based on historical flood data, hydrological modelling, and other factors such as land use and climate change projections. FPLs are used to guide land-use planning, emergency management, and evacuation plans in flood-prone areas. FPLs are typically lower than PMF and represent the expected range of flood events that could occur in a particular region over time.

FPL is defined under the NSW Floodplain Development Manual (2005) as follows:

"FPLs are the combinations of flood levels (derived from significant historical flood events or floods of specific Annual Exceedance Probability) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the "standard flood event" in the 1986 manual."

The steps needed by way of design and location to enable the infrastructure to withstand flood have been weighed against the need for the infrastructure to serve the community effectively in normal circumstances when there is no flooding.

The Defined Flood Event (DFE) for the purposes of the proposed development is based on the 1% AEP which is generally consistent with the recommendations presented in Moree Plains Shire Council Development Control Plan (DCP). The proposed minimum Finished Floor Level for the new ASB building is sited above the minimum required levels presented in Council's DCP, with a freeboard of approximately 630mm.

The risk assessment presented herein identifies a risk that critical mains and back up services, required to maintain operation of the facility, have the potential to be cut during events in excess of the 1% AEP design storm event. As such, evacuation from the site during this event is recommended with a draft Flood Emergency Plan (FEP) presented herein to enhance site flood preparedness, response and recovery.

It is anticipated the FEP will be further reviewed in consultation with Hunter New England Health and the State Emergency Service prior to occupation of the proposed Acute Services Building.

Introduction

Northrop Consulting Engineers have been engaged by NSW Health Infrastructure (HI), care of Besix Watpac to prepare a Flood Risk Assessment for the proposed redevelopment of the existing Moree Hospital located at 35 Alice Street, herein known as 'the subject site' or 'the site'.

The purpose of this correspondence is to assess the flood risk associated with the proposed development for inclusion into the Review of Environmental Factors (REF).

The Moree Hospital Redevelopment Project involves the upgrade and extension of the existing facility including the construction of a new Acute Services Building (ASB) and associated site works, including upgraded parking facilities and landscaping.

Although the site is not recognised by the Moree Plains Local Environmental Plan (LEP) to be flood prone, consultation with Moree Plains Shire Council suggests the site is located below the Flood Planning Level (i.e. 1% AEP + 500mm) and Probable Maximum Flood (PMF). Similarly, review of the latest Moree and Environs Flood Study/Flood Risk Management Study and Plan (WRM, 2017), in particular Figure 3.4, identifies the site to be located within the Flood Planning Area (FPA).

Flooding at the subject site is derived by the regional Mehi and Gwydir River catchments. Additional information with respect to expected flood behaviour at the site is presented in the Flood Hazard Section of this report below.

Information Sources

The Assessment has been prepared with consideration to the following legislation, guidelines and documents:

- Moree Plains Shire Council (MPSC) Local Environmental Plan (LEP) 2011, in particular Part 5.21 – Flood Planning.
- Moree Plain Shire Council Development Control Plan (DCP) 2013, in particular Chapter 4 – Moree and Environs Floodplain Development and Management.
- Moree and Environs Flood Study / Floodplain Risk management Study and Plan prepared by WRM and dated January 2017.
- NSW Department of Planning and Environment (DPE) Floodplain Development Manual (NSW DPE, 2005)
- NSW DPE Flood Risk Management Manual (NSW DPE, 2023)
- The NSW independent expert inquiry into the preparation for, causes of, response to and recovery from the 2022 catastrophic flood event across the state of NSW (NSW Government, 2022)
- Australian Rainfall and Runoff 2019 (AR&R 2019)
- The NSW Service Level Specification for Flood Forecasting and Warning Services (BoM, 2020)
- Flood Information Certificate provided by Council (included in Appendix B)
- Technical Memorandum – Moree Hospital Redevelopment – Flooding prepared by Northrop Consulting Engineers and dated the 13th of July 2022 (also included in Appendix B).
- Moree Hospital Redevelopment - Initial Flood Advice letter prepared by Northrop Consulting Engineers and dated 20th of August 2023 (included herein as Appendix C)

Methodology

This study has been prepared generally following the below methodology:

- Review of the existing site conditions and proposed development.
- Review of existing flood hazard conditions in the vicinity of the proposed development based on available flood information.
- Review of State and Local requirements including presentation of options to improve community resilience and flood immunity of the facility.
- Summary of adopted flood mitigation and management measures.
- Review flood risk associated with the proposed development.

Flood information presented herein is based on information presented in the Moree and Environs Floodplain Risk Management Study and Plan prepared by WRM and dated January 2017, herein referred to as “*Council’s Flood Study (WRM, 2017)*”. This information was provided by MPSC for the purposes of this assessment.

Additional flood information has been considered herein including information presented in the site-specific Flood Information Certificate provided by MPSC and included herein as Appendix B.

Subject Site and Proposed Development

Subject Site

The subject site is located within the MPSC LGA at 35 Alice Street, Moree otherwise known as Lot 11 DP11113157. The site is bound by Victoria Terrace to the north and east, Alice Street to the south and Whiddon Moree Retirement Village to the west and is susceptible to riverine flooding from Mehi River located approximately 40m to the north of the site.

A review of LiDAR elevation data and site survey suggests the site is relatively flat with a minimum site elevation of approx. 208.5m AHD observed in the south-western corner of the site. Remaining elevations across the site range from approx. 208.75-209.25m AHD.

The characteristics of the subject site are presented in **Photos 1, 2 and 3** while the subject site locality and terrain levels are presented in Figure 2.



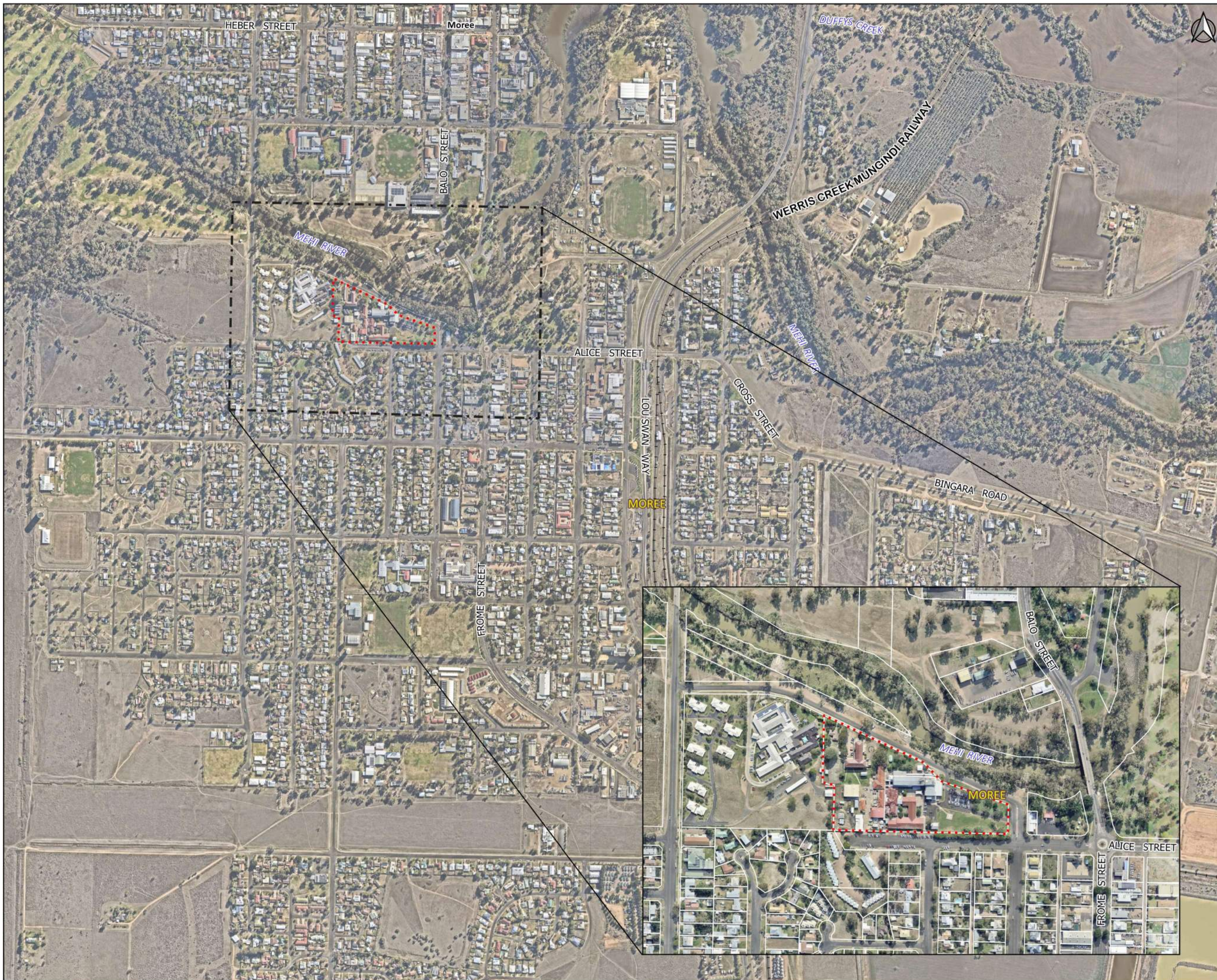
Photo 1 – Looking East towards the site from Cul de Sac in Alice Street (Google SV 2010)



Photo 2 – Looking West towards the site at main site entrance in Victoria Terrace (Google SV 2010)



Photo 3 – Looking South towards the site at main exit in Victoria Terrace (Google SV 2010)



Legend

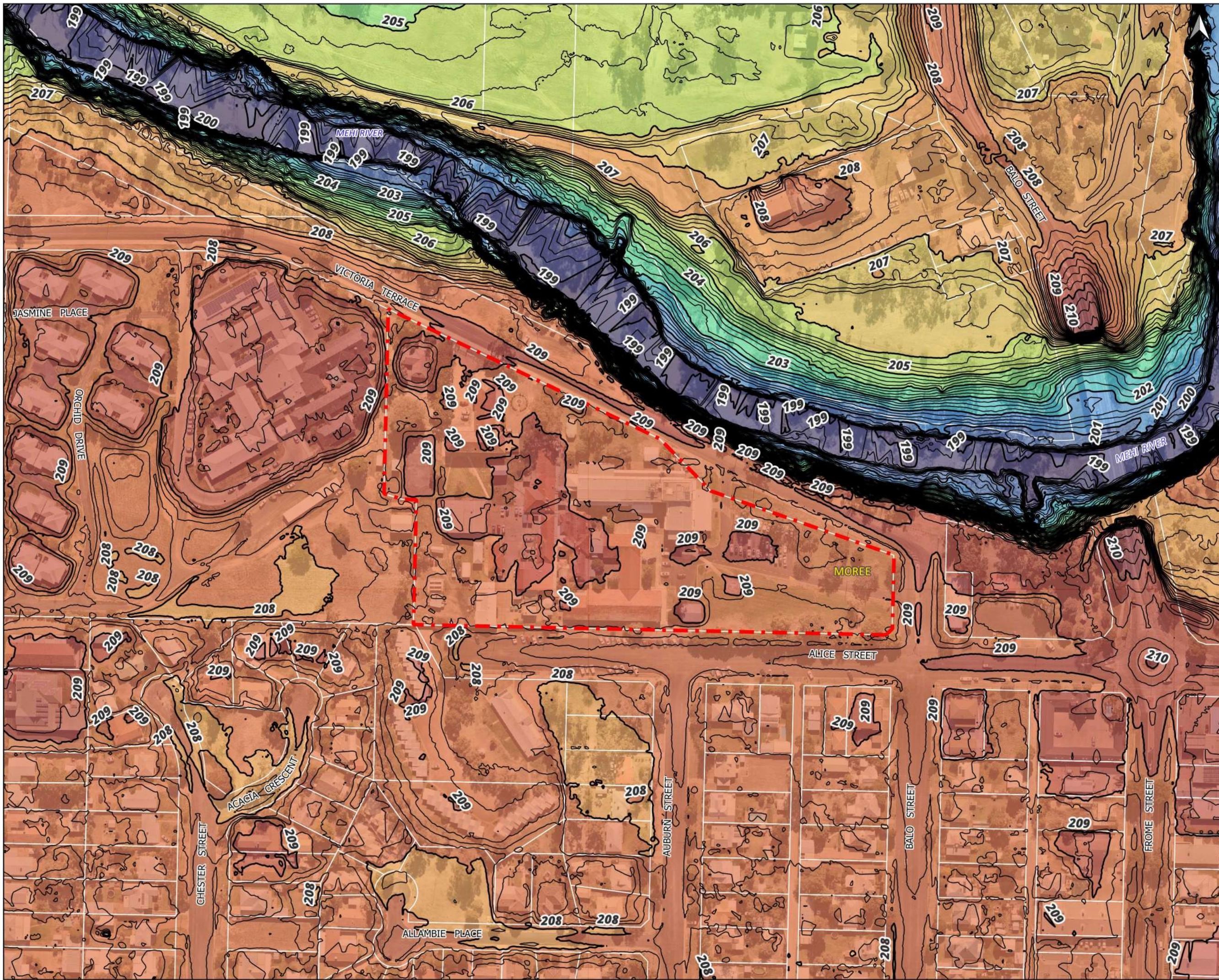
⋯ Subject Site

0 100 200 Metres
1:10,000

Figure 1
Subject Site Locality

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

- Subject Site
- Major Contours (1m)
- Minor Contours (250mm)
- LiDAR Terrain (mAHD)
- <= 197
- 197 - 198
- 198 - 199
- 199 - 200
- 200 - 201
- 201 - 202
- 202 - 203
- 203 - 204
- 204 - 205
- 205 - 206
- 206 - 207
- 207 - 208
- 208 - 209
- 209 - 210
- > 210

0 30 60 Metres
1:2,000

Figure 2
Subject Site
LiDAR (2020) Terrain

Moree Hospital Redevelopment
58 Victoria Terrace, Moree



Proposed Development

The Moree Hospital Redevelopment Project proposes to increase the capacity of the existing Moree District Health Service by extending and retrofitting existing buildings on the site and constructing a new two storey Acute Services Building (ASB) which includes an Emergency Department.

The proposed Acute Services Building has a Ground Floor (GF) Finished Floor Level (FFL) sited at 209.735m AHD which is consistent with the existing hospital FFL. The intent was to maintain connectivity between the existing and proposed facilities. The First Floor FFL is sited 4.5m above the ground floor level with an FFL of 214.235m AHD.

Additional associated site works are also proposed including upgraded parking facilities and landscaping. Proposed site improvements are presented in the below Figure 3.

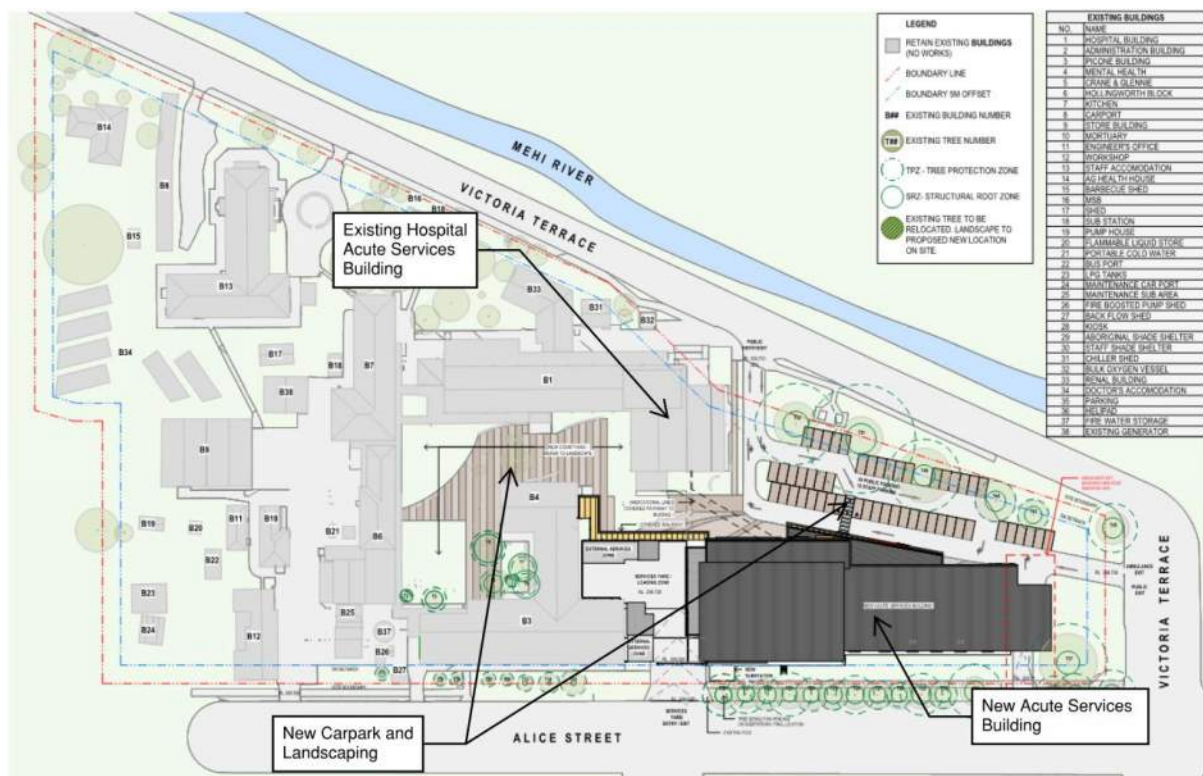


Figure 3 - Proposed Site Plan (STH, REV F - 8/09/2023)

Please refer to the architectural plans prepared by Silver Thomas Hanley (STH) for further details.

Flood Hazard Assessment

As mentioned above, flood information presented herein is based on information presented Council's Flood Study (WRM, 2017). Additional flood information has been obtained from the site-specific Flood Information Certificate provided by Moree Shire Council and included herein as Appendix B.

It is noted that climate change conditions were not directly considered in Council's Flood Study (WRM, 2017) however, the 0.5% AEP (commonly referred to as the 200-year flood event) can be considered herein as a proxy for increased rainfall intensities due to climate change as an alternative. This means that the 0.5% AEP may be considered the 1% AEP (commonly referred to as the 100-year flood event) under future climate conditions. Impacts due to Sea Level Rise (SLR) are not expected to affect the findings of Council's Flood Study (WRM, 2017) as the site is located well above sea level.

It is noted that the design rainfall data used in the preparation of Council's Flood Study (WRM, 2017) is based on Australian Rainfall and Runoff (AR&R) (1987) procedures while the flood hazard conditions presented in the study have considered the more recent revision (i.e. AR&R; 2019).

Presented below is a summary of the expected flood conditions across the site including a summary of the flood behaviour, duration and potential warning time.

Flood Behaviour

The subject site is susceptible to riverine flooding from the Mehi and Gwydir Rivers. The Mehi River is located approximately 40m to the north of the site. The Mehi River flows in a westerly direction, bisecting the township of Moree during frequent and in-frequent events. During major and extreme flood events, the Mehi River is observed to link with the Gwydir River, across Moree Plains, creating an extensive 3-9km wide floodplain.

Initial inundation across the site is expected to occur as the adjacent Mehi River breaks its banks and floodwater continues across the site in a south-westerly direction, towards the intersection of Alice and Auburn Streets.

An additional flow path is also observed passing across the southern boundary of the site, with flows derived by the Mehi River which overtops the Werris Creek Mungindi Railway line approximately 700m west of the site. Flows that overtop the rail corridor are then expected to continue in a westerly direction towards Allambie Place and along Alice Street, adjacent to the southern boundary of the site.

Flood Depth and Elevation

Figures A1 to A3 of Appendix A presents the flood depth and elevation contours at the site and vicinity during the 1% AEP, 0.5% AEP and PMF design storm events. These maps have been prepared using data presented in Council's Flood Study (WRM, 2017).

Review of Figures A1-A3 suggest the site is expected to be flood free during a 1% AEP however, Figure A2 shows the site is expected to become inundated during a 1 in 200 AEP (i.e. 0.5% AEP). Figure A2 suggests flood depths of up to approximately 300-500mm is likely across the site during the 0.5% AEP.

As mentioned above, the 0.5% AEP may be used as a proxy for climate change in lieu of specific climate change modelling presented in the Council's Flood Study (WRM, 2017). Review of the 0.5% AEP results suggest there is the potential that the frequency of inundation across the site may increase, and the site may become inundated under a future climate 1% AEP.

During the PMF, Figure A3 suggests flood depths range up to 2.0m on the subject site. Flooding across Moree is extensive during the PMF design storm event, with flood water expected to extend to approximately Jones Avenue on the southern side of the Mehi River, nearly 1km south of the hospital. This demonstrates a significant flood depth and level of isolation of the site during an extreme flood event.

It is important to recognise that the PMF is an extremely rare event and is defined notionally by Councils Flood Study (WRM, 2017) as the 1 in 55,000 AEP (i.e. 0.0018% AEP) in the region.

Flood Hazard

Flood hazard conditions are based on the latest Australian Rainfall and Runoff (2019) guidelines with a summary of hydraulic behaviour and accessibility during each H1-H6 category presented by the following Figure 4.

Similarly, Figures A4 to A6 of Appendix A presents the flood hazard conditions at the site and vicinity during the 1% AEP, 1 in 200 AEP (i.e. 0.5% AEP) and PMF design storm events.

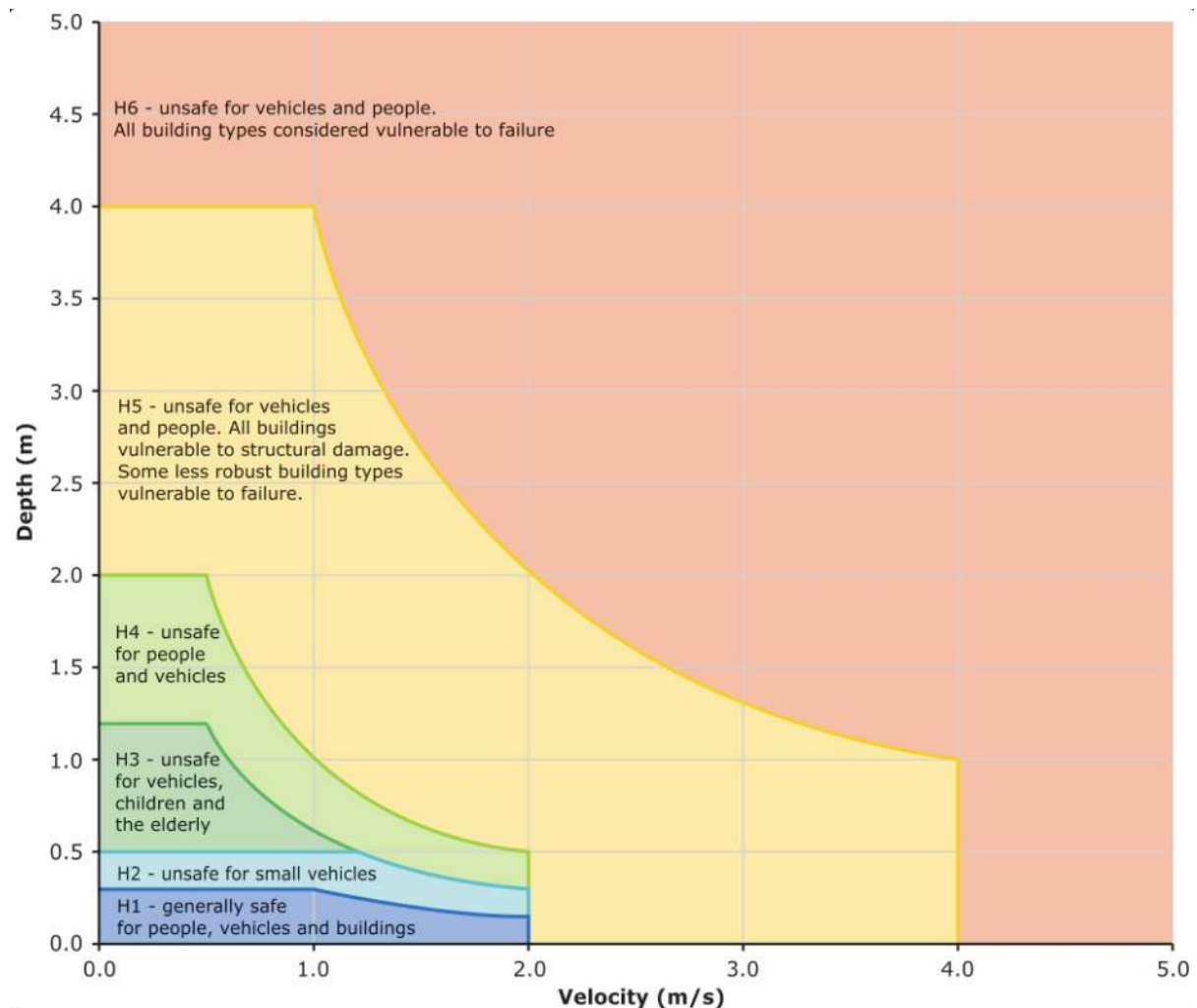


Figure 4 - Australian Rainfall and Runoff (2019) Hazard Categories (ARR 2019)

Flood hazard conditions during the 0.5% AEP are expected to remain relatively low with Figure A5 suggesting up to H2 hazard conditions are expected across the site during this event. This means that the site is expected to remain trafficable for large vehicles, but non-trafficable for small vehicles during this event. It is possible small vehicles may become buoyant during this event presenting a risk to life

and property. Based on the above Figure 4, pedestrians, including children and elderly, are expected to be able to walk across the site (although this is not recommended).

External to the site, evacuation from the facility is expected to become difficult, but not impossible during the 0.5% AEP. Figure A5 of Appendix A suggests nearby roads such as Auburn and Balo Streets are likely compromised during the peak of the 0.5% AEP however, evacuation may still be possible by continuing east along Alice Street and then south up Warialda Street.

Figure A6 of Appendix A suggests H5 flood hazard conditions are expected across the subject site during the peak of the PMF. Similar conditions are observed across a large portion of Moree with H5 hazard conditions extending to Adelaide Street, approximately 600m south of the subject site. Review of the above Figure 4 suggests flood conditions are expected to be unsafe for vehicles and people with all building types vulnerable to structural damage during the PMF. Evacuation from the site during the peak of this event will be extremely difficult and likely only possible by aircraft.

Flood Velocity

Figures A7 to A9 of Appendix A presents the flood velocity at the site and vicinity during the 1% AEP, 0.5% AEP and PMF design storm events.

Figure A8 suggests peak velocities, observed in the eastern portion of the site, are generally less than 2.0m/s during the 0.5% AEP while, velocities elsewhere across the site are expected to be generally less than 0.8m/s.

During the PMF, Figure A9 suggests velocities of up to 2.0m/s are expected across full extent of the site.

Summary of Flood Behaviour

A summary of the expected flood behaviour across the subject site for each return interval is presented in Table 1 below.

Table 1 - Summary of Maximum Site Flood Characteristics

Flood Probability (Return Interval)	Flood Depth (m)	Flood Elevation (m AHD)	Flood Velocity (m/s)	Flood Hazard (ARR 2019)
1% AEP	0.0	209.10*	Not Flooded	Not Flooded
0.5% AEP	0.5	209.30	2.0	H2
PMF	2.0	210.51	2.0	H5

* Flood level Reported in Mehi River adjacent to the site

Flood Duration and Warning Time

Council's Flood Study (WRM, 2017) suggests a critical duration of 48 hours is expected at the site for all return intervals considered. This means that a long duration of immersion at the site is expected (possibly 12 - 48 hours or more), especially during an extreme flood event (i.e. the PMF).

In addition, Council's Flood Study (WRM, 2017) suggests the time it takes for the flood peak to travel from the Chinook gauge (418087) to the Moree gauge (418002), a distance of approximately 12km, is between 7 to 9 hours.

Based on the above information and the extent of flooding expected across the catchment, isolation of the site during a PMF is likely to occur for a prolonged period of time with estimates indicating a duration in excess of 24 hours.

Further to the above, the NSW Service Level Specification for Flood Forecasting and Warning Services (BoM, 2020) suggests a minimum warning time of 12 and 24 hours is expected to be available prior to the peak of a Minor or Major flood event respectively.

Flood Hydraulic Category

Flood hydraulic categories for the site are presented in Figure 3.3 of Council's Flood Study (WRM, 2017), and are reproduced in Figure 5 below. The results presented in Figure 5 below suggests that the subject site is located in Flood Fringe Area. This category is defined by the NSW Flood Risk Management Manual (NSW DPE, 2023) as:

“areas where development will not impact on broad flood behaviour due to alteration of flow conveyance and storage”

Based on the above, it is likely development on the subject site is not expected to significantly affect existing flood behaviour on the subject site and in adjacent properties. Adverse impacts during the 1% AEP are not expected as the site is located outside the extent of this event.

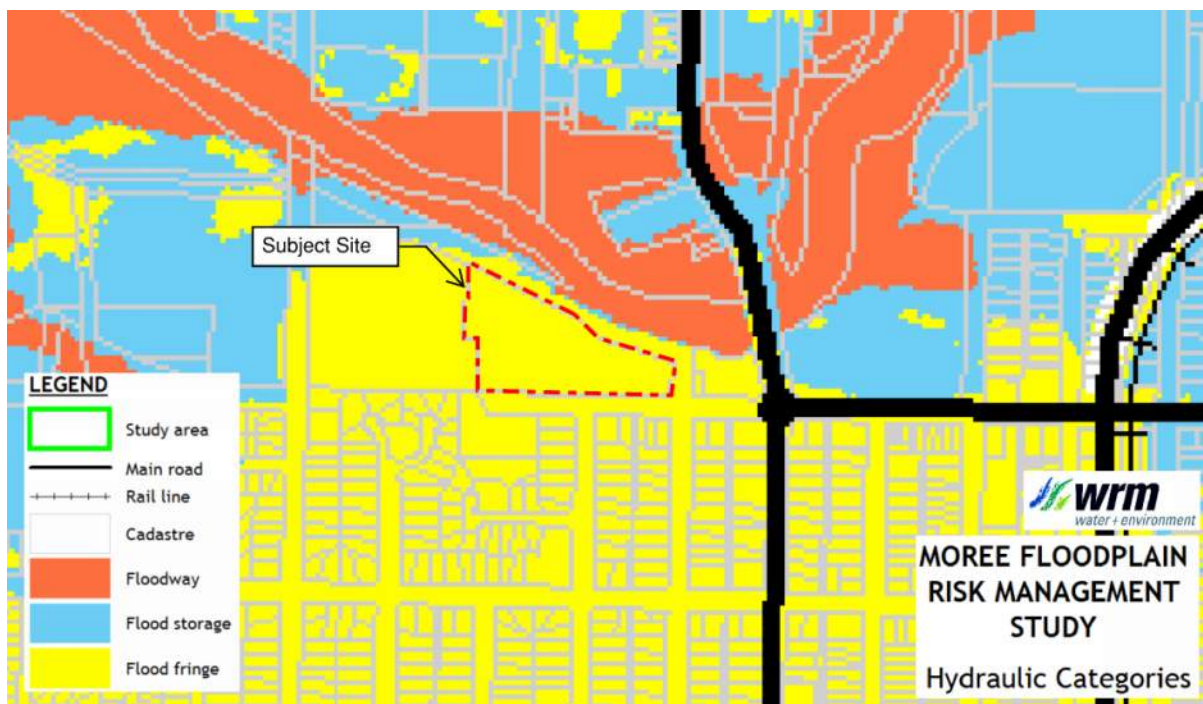


Figure 5 - Site Flood Hydraulic Category (Council's Flood Study; WRM, 2017)

Flood Frequency Hazard

Flood Frequency Hazard is presented in Council's Flood Study (WRM, 2017) and is defined as the Probability of Inundation for an area.

The Flood Frequency Hazard at the subject site is presented in Figure 3.7 of Council's Flood Study (WRM, 2017) and is reproduced overleaf as Figure 6. The below Figure 6 suggests the subject site is located within a F2 Flood Frequency Hazard zone which is defined in Council's Flood Study (WRM, 2017) as a *“Moderate Frequency Hazard”* area.



Figure 6 - Flood Frequency Hazard Categories (Council Flood Study; WRM, 2017; Figure 3.7)

Property Hazard Classification

The Property Hazard Classification highlights the risk to property and infrastructure and is presented in Figure 3.6 of Council's Flood Study (WRM, 2017). Council's Flood Study (WRM, 2017) highlights that structural certification of new buildings is required where the property hazard is within P2 and P3.

The Property Hazard Classification, presented in Council's Flood Study (WRM, 2017), is based on the 1% AEP and as such, the below Figure 7 shows the subject site is located outside the extent of the property hazard classifications.



Figure 7 – Property Hazard Classifications (Council Flood Study; WRM, 2017; Figure 3.7)

Flood Mitigation Measures

Flood Mitigation Measures are typically directed by development controls set out by Local and State Government legislation and guidelines. These have been considered in the development of the Adopted Flood Risk Management Measures presented below.

General commentary and advice with respect to compliance with development controls is presented in this section of the report. More detailed development compliance with specific Local and Regional guidelines is presented for the adopted strategy in the Flood Compliance Section of this report.

Local Government Requirements

Initial advice received from MPSC, suggests the proposed development Finished Floor Level (FFL) be sited at a minimum of the 1% AEP + 500mm or 500mm above adjacent terrain levels.

Review of Figure 2 above suggests maximum existing ground levels in the vicinity of the proposed building are in the order of 209m AHD and therefore, the proposed GF FFL of 209.735m AHD is located above this minimum level. Similarly, review of maximum 1% AEP flood levels in the vicinity of the subject site suggests the proposed FFL is also positioned approximately 635mm above the 1% AEP therefore is compliant with Council's requirements.

Further to the above, a review of existing services required to support the proposed development has been analysed by the Technical Memorandum (Northrop, 2023), included herein as Appendix B. The analysis concludes that all supporting Critical Building Services infrastructure within the site is located above, or protected to, a minimum of the 1% AEP design storm event. Please refer to Appendix B for future details.

State Government Requirements

Due to the vulnerable nature of the occupants, and potential reliance on hospitals during disasters, a higher level of flood immunity is often preferred for hospitals when compared to a standard residential or commercial facility. State Guidelines recognise this requirement with the NSW Floodplain Development Manual (2005) stating (pp.K-4):

“Consideration should be given to using the PMF as the Flood Planning Level when siting and developing emergency response facilities such as police stations, hospitals, SES headquarters and critical infrastructure such a major telephone exchanges, if possible”

Similarly, the NSW Government recently commissioned an independent expert inquiry into the preparation for, causes of, response to, and recovery from the 2022 catastrophic flood event across the state of NSW. The inquiry presented several recommendations to improve community resilience and emergency response during flood events. Recommendation 28 states (pp. 37):

“Government ensure hospitals, medical centres, nursing homes, aged care facilities and police stations are situated above the Probable Maximum Flood level”

In addition, the preference for a higher level of protection is recognised by the latest NSW Department of Planning and Environment (DPE) Flood Risk Management Guideline (FB01) (2023) where a preference to locating hospitals outside the extent of the PMF, where possible, is discussed (see page 49 of the Manual).

It is noted these requirements are often much easier to adopt for new hospitals, with significant design and cost implications associated with raising the FPL to the PMF for existing facilities. The latest Flood Risk Management Guideline (FB01) recognises this challenge for existing facilities and provides additional recommendations with respect to development and operational controls.

- Floor levels of emergency medicine areas and patient wards to be sited above an extreme flood level (such as the PMF). This may mean these facilities do not need to be evacuated if services can be maintained.
- The location and protection of backup utility services should be investigated so they can be operational, accessible and available during floods.
- Resupply of essential goods, equipment and materials during floods should be investigated so the facility can continue to operate.
- Adequate room for storage of waste products away from floodwaters should be considered to avoid contamination.
- Design of the site to maximise accessibility of emergency and staff entries into the hospital during floods. This may affect the location and design of the entrance.
- Likelihood of some staff having their homes affected by flooding and their need to look after family members.

These requirements identify both direct and indirect impacts associated with a significant or extreme flood event on the site. The Development Response to each of these items is presented in Table 4.

Mitigation Options

Based on the above, a preference in the State Guidelines towards the use of the PMF for the purposes of the Flood Planning Level is evident. Several potential flood management and mitigation Options were identified during the initial phase of the proposal to raise the Flood Planning Level to the PMF. These are presented in the initial review and advice outlined in the Initial Flood Advice letter (Northrop, 2023) provided in Appendix C and further summarised below. Please refer to the Initial Flood Advice letter (Northrop, 2023) for additional information, if required.

Option 1 – Relocate the Facility

As discussed above, State Guidelines show a preference to locate hospitals outside the extent of the PMF. A study to review alternative locations for the hospital was prepared which identified two alternative locations for the site (REF: Concept Design Report; pp.52).

These two alternative locations were reviewed with respect to the potential exposure of the sites during the PMF. Site 1 was identified to be located outside the mapped PMF flood extent and has the potential to enable greater community resilience and support during a flood emergency.

It is noted that similar operational constraints are expected to exist for this Option when compared to the selected Option (discussed below). Although the direct impact of flooding may be eliminated, indirect impacts to the facility remain. This is due to the extent of flooding throughout the broader township of Moree. Indirect impacts may include:

- Potential loss of centralised services that support the operation of Critical Building Services (i.e. electricity, communications, sewer, water etc.)
- Staffing may become difficult as some staff may have their homes affected by flooding and may be required to look after family members.
- Difficulty with respect to resupply is possible, as roads and access throughout the greater township of Moree is cut.

These are all additional operational constraints that would need to be considered if NSW HI / Besix Watpac were to proceed with this option.

Option 2 – Raise Finished Floor Levels above the PMF

A secondary option was investigated which involved raising the proposed minimum Finished Floor Level for the proposed ASB to a minimum of the PMF.

An initial review of potential constraints for this option was performed with the below items highlighted to require further consideration:

- The proposed FFL would need to be raised a minimum of 780mm to the PMF.
- Connectivity to existing buildings and landscaped levels on the site would need to be investigated. It is likely significant ramping would be required to enable the raised FFL.
- The feasibility to maintain operations of the existing and proposed buildings during a PMF would need to be investigated (noting the site will likely become isolated during a PMF event).
- The capacity of existing services to remain operational during a PMF would need to be reviewed. A review of existing site services has been performed in the Technical Memorandum (Northrop, 2023) which concluded that it is likely these services will be compromised during events greater than the 1% AEP design storm event.

Similar indirect impacts highlighted by Option 1 would also be applicable for this Option.

Option 3 – Maintain proposed levels but protect the facility up to the PMF

This option involves two similar but separate scenarios:

1. Scenario 1 – Full Site Protection: Introduce bunding / flood walls around the boundary of the property and introduce floodgates at site entrances (both vehicular and pedestrian).
2. Scenario 2 – Building Protection: Introduce a flood façade around the vulnerable critical buildings and flood gates at doorway entrances.

This option was intended to enable the lower FFL, generally in accordance with the proposed strategy, however still provides the facility with protection up to the PMF. This strategy would also facilitate lower landscape levels and less ramping when compared to Option 2.

Scenario 1 presents added benefits with the potential to protect the entire site, not just the proposed ASB building, highlighting a significant reduction in flood risk on the subject site when compared to current conditions.

Challenges with respect to isolation of the site, maintaining access into the facility when flood gates were activated and the potential for essential mains services to the facility to be cut during a PMF were identified for this Option.

In addition to the above, similar indirect impacts highlighted by Option 1 would also be applicable for this Option.

Option 4 – Close and Evacuate the Facility prior to major / extreme flood events

This option involved closing the facility prior to a significant or extreme flood event and relocating all staff and patients to an alternative nearby equivalent facility.

Potential constraints and challenges for this option were identified as:

- Loss of operation of the facility following a flood event, potentially for a prolonged period of time
- Increased strain on emergency services / evacuation routes

- The logistics and risk of transporting patients (especially those that require critical care)
- Capacity of nearby facilities to accept additional patients / staff

Option 5 – Protect the Facility to the PMF AND Close and Evacuate the Facility prior to major / extreme flood events.

An additional option was discussed with the design team which involved introducing flood protection measures similar to Option 3 for the proposed development however, also evacuating the facility prior to isolation of the facility (per Option 4).

This option provides a higher level of protection to the facility, to enable the hospital to return to operation as soon as practicable following a significant / extreme flood event, however also recognises the difficulty with respect to maintaining operation of the facility when services and access may be restricted during a significant / extreme flood event.

This option removes some of the challenges with respect to maintaining operation identified for Option 3 however, challenges and risks associated evacuation of the facility, as outlined in Option 4, would remain.

Adopted Flood Risk Management Measures

Following presentation of the Initial Flood Advice (Northrop, 2023) and subsequent liaison with NSW Health Infrastructure and Besix Watpac, we understand the preferred option is to maintain a similar level of flood protection to the proposed facility when compared to the existing facility. This strategy is generally consistent with Council's recommendation for placement of the minimum FFL at or above the 1% AEP + 500mm, or 500mm above existing terrain levels as previously discussed.

It is noted that the NSW Flood Prone Land Policy presents the following objectives with respect to development of flood prone land:

- Using a merit-based approach in preparing and implementing flood risk management (FRM) plans to address riverine and local overland flooding
- Reducing the impact of flooding and flood liability on existing developed areas identified in FRM plans through flood mitigation works and measures including ongoing emergency management (EM) measures, the raising of houses where appropriate and by development controls
- Adopting a merit-based approach for all development decisions in the floodplain, taking into account social, economic and ecological factors, as well as flooding considerations
- Limiting the potential for flood losses in all areas proposed for development or redevelopment by the application of ecologically sensitive planning and development controls.

Although it is recommended NSW Health Infrastructure consider the options presented above, a merit-based approach may be sought for the proposed development in accordance with the objectives set out by the NSW Flood Prone Land Policy.

The existing and proposed facility is considered a Critical Facility in accordance with the NSW Flood Risk Management Manual (NSW DPE, 2023). These facilities are expected to perform key functions for the community during a flood emergency. Section 3.6 of the Flood Risk Management Guideline (FB01) (NSW DPE, 2023) highlights that where the role of a Critical Facility cannot be fulfilled it is important for Emergency Management Planning Authority to identify:

- Alternative arrangements for providing the services to the local community during flood events
- Arrangements for evacuating the facilities, if required

- Efficient arrangements for return to operation after a flood to support recovery and return to business as usual.

It is noted that although the proposed development has been designed generally in accordance with the requirements set out by the Local Government guidelines, it is likely the facility will not be able to operate during events in excess of the 1% AEP design storm event.

A draft operational Flood Emergency Plan (FEP) has been prepared for the proposed development and is included herein as Appendix D. The FEP highlights an alternative arrangement namely evacuation from the site during events in excess of the 1% AEP design storm event.

It is anticipated the draft FEP presented in Appendix D will be further fine-tuned in consultation with the operator (i.e. Hunter New England Health) and the SES and finalised prior to occupation of the new ASB building. The draft version presented in Appendix D conveys the expected strategy to manage the residual risk to life observed on the site during significant or extreme flood events.

The SES have been engaged during the preparation of this report with an attempt to obtain further Flood Intelligence for the region. Unfortunately, the local Flood Intelligence Card was not available for the purposes of the investigation however, the SES have offered to review the proposed Flood Emergency Plan and provide comment as necessary (Refer to Appendix E).

It is recommended the draft FEP be provided to the SES for comment. We will be seeking advice from the SES regarding whether the proposed evacuation strategy is consistent with, and will not impact on, the existing regional emergency management measures in place for the township of Moree.

Flood Risk Assessment

The risk associated with the adoption of the proposed flood mitigation measures has been reviewed with respect to development vulnerability, consequence and risk.

Vulnerability

The vulnerability of Critical Building Services, that are required to maintain operation of the proposed ASB, is discussed in the Technical Memorandum (Northrop, 2023). The findings of the Technical Memorandum (Northrop, 2023) highlight that there is the potential for Critical Building Services to become compromised during flood events in excess of the 1% AEP.

In addition, the proposed Finished Floor Level of the new ASB building is sited at the 1% AEP + 630mm. This level is above the 0.5% AEP however, is located below the PMF. A high-level analysis has been performed to determine, during which predicted AEP the proposed GF FFL of the ASB may become compromised.

The analysis has been prepared via an interpolation (on a log scale) of the flood information available in Council's Flood Study (WRM, 2017). It is noted that for the purposes of the exercise the PMF has been assumed to have a notional AEP of 1 in 55,000 years (i.e. 0.0018% AEP) as outlined by Council's Flood Study (WRM, 2017).

The following Figure 8 presents the results of the analysis with the proposed ASB GF FFL expected to become compromised during a 1 in 1600 AEP (i.e. 0.063% AEP).

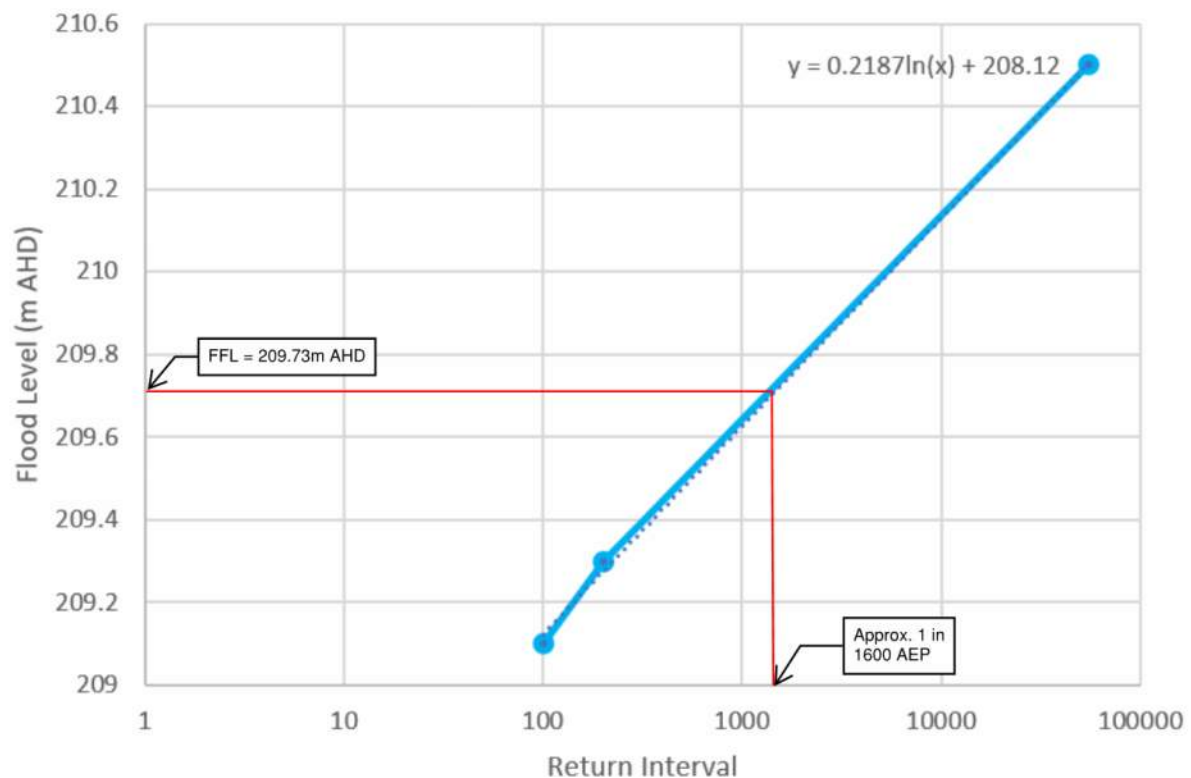


Figure 8 – Estimated Flood Event Affecting the ASB Building

The vulnerability of the remainder of the site is discussed in the flood behaviour section of this report. The findings above suggest the subject site is expected to remain flood free during the 1% AEP, however flood depths of up to approximately 0.5m and 2.0m are likely across the site during the 0.5% AEP and PMF designs storm events respectively.

Although the site is located outside the extent of the 1% AEP, it may be subject to in-direct impacts during this event. This may include loss of critical services (i.e. mains power, sewer, potable water etc.) and increased demand from the community. Review of the vulnerability of services external to the site and a review of operational procedures during increased demand is beyond the scope of this assessment; however, their impacts should not be discounted.

It is noted that the existing site has a back-up generator in the event of loss of mains power to the facility (as outlined in the Technical Memorandum; Northrop, 2022). It is recommended enough fuel be stored on-site to ensure the facility remains operational long enough to enable evacuation or restocking as necessary.

Consequence

As the subject site is not identified as flood prone during a 1% AEP design storm event, the consequences on-site due to flooding are expected to be limited to indirect impacts as mentioned above.

There is the potential for inundation across the site during the 0.5% AEP and as such, it is possible that a number of Critical Building Services, including back up mechanisms for the facility may be cut during this event. Evacuation from the site will be required during a flood event of this magnitude.

Flood hazard conditions are not expected to exceed H2 during this event and therefore standard construction techniques are expected to be capable of withstanding the flood forces. It is noted that the proposed ASB remains above the 0.5% AEP and as such, the over-floor flooding is also not expected to occur during this event. As such, direct damage to the proposed ASB due to flood water during this event is not expected to occur during a 0.5% AEP, however Critical Building Services may inoperable. Following a 0.5% AEP, Critical Building Services and the facilities will need to be dewatered and checked by qualified persons prior to the hospital returning to service.

As the magnitude of flooding increases to a 0.063% AEP, over flood flooding is expected within the ASB. This is likely to cause significant damage to the facility, resulting in an extensive cleanup and restoration following the event. During this event, flood depths across the site range up to approximately 1.23m which will be hazardous for anyone trying to evacuate via vehicles or on foot.

During the PMF, the entire site is expected to be inundated with depths of up to 2.0 meters as shown in Figure A3 of Appendix A. During this event, the GF FFL of the proposed ASB is expected to be under water however, the upper level, sited at an elevation of 214.235m AHD is above the expected maximum flood level.

Flood hazard conditions during the PMF are expected to be high with H5 hazard conditions expected across the site as shown in Figure A9. This flow behaviour is extremely hazardous, and all building types, built using standard construction techniques, are prone to structural failure as outlined in Figure 4.

A review of the structural capacity of the proposed ASB has been performed with the structure expected to be able to withstand flood forces during the PMF. It is possible the building façade and internal elements (i.e. electrical wiring and other materials prone to degradation when wet) may need to be replaced post flood event. The site is also expected to be become fully isolated and surrounded by hazardous flood water, with the only opportunity for evacuation during the peak of this event expected to be via aircraft.

Although the first-floor level may be located above the maximum 0.5% AEP flood level, seeking refuge within the building is not recommended during this or more significant events. This is due to the potential loss of Critical Building Services, the isolation of the site in the event where predicted flood conditions increase during the event. As such, evacuation prior to a 0.5% AEP is strongly recommended.

Risk

As mentioned above, flood risks during events up to and including a 1% AEP design storm event are expected to be relatively low. Flooding across the subject site is not expected to occur during this event. It is during less frequent events such as the 0.5% AEP and the PMF where increased risk is expected.

During the 0.5% AEP, flood depths are expected to reach up to approximately 0.5m on the subject site. These conditions pose a Risk to Life to anyone that may remain on-site particularly for those with limited mobility. Flood water is extremely dangerous and may contain contaminants and debris that can injure pedestrians. The risk to the proposed ASB is expected to be low and likely limited to indirect impacts such as the loss of Critical Building Services. The risk associated with attempting to maintaining operation of the facility (with loss of services) and with limited mobility around the site is expected to be high.

As services to the facility have the potential to be cut, evacuation of the facility is expected to be required prior to a predicted 0.5% AEP. Similar nearby Hunter New England Health facilities are located in Inverell, Narrabri, Glen Innes and Tamworth. Evacuation to these alternative facilities presents its own risk to life with travel time by vehicle to these facilities expected to be in the order of 1-4 hours. This creates a significant risk for patients with life threatening illness / injuries. In addition, it is possible that the local road network may experience higher than usual demand due to evacuation other sectors across the greater Moree Plains. It is possible travel time and evacuation may take longer than expected which should be considered when coordinating the evacuation.

Given the magnitude of the event, it is possible that one of these nearby similar facilities may also be experiencing similar conditions. The Incident Controller will need to discuss the flood conditions with each facility and the SES prior to evacuating the facility. The risk to life due to evacuation of the facility cannot be discounted and will need to be managed carefully by the Incident Controller during the event.

During a PMF design storm event, extreme risk is expected with the potential for building collapse. Refuge within the facility should not be attempted and it is imperative that the site be evacuated prior to the peak of a PMF design storm event. It is possible that the facility could remain inoperable for a prolonged period of time following a PMF, with redesign and reconstruction likely.

Flood Compliance Assessment

State Government Requirements

The proposed development has been assessed based on the State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021 and the NSW Flood Risk Management Manual (DPE, 2023). These items are discussed in more detail below.

SEPP (Transport and Infrastructure) (2021)

The proposed development has been reviewed with respect to the flood related clauses presented in the State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021, in particular Division 1 – Consultation. The following *Table 2* presents the flood related requirements set out in (SEPP) (Transport and Infrastructure) 2021 as well as a response.

Table 2 - SEPP (Transport and Infrastructure) and Compliance

Reference Clause	Requirement	Development Response	Compliant?
2.12.2	A public authority, or a person acting on behalf of a public authority, must not carry out, on flood liable land, development that this Chapter provides may be carried out without consent and that will change flood patterns other than to a minor extent unless the authority or person has		
(a)	Given written notice of the intention to carry out the development (together with a scope of works) to the council for the area in which the land is located.	The REF, including the findings of this report, should be issued to Moree Plains Shire Council during the REF notification period to provide Council the opportunity to respond to the proposal.	Expected to comply through REF submission
(b)	Taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.	Responses from Moree Plains Shire Council should be taken into consideration through the REF process.	Expected to comply through REF submission
2.13.1	A public authority, or a person acting on behalf of a public authority, must not carry out development on flood liable land that may be carried out without development consent under a relevant provision unless the authority or person has		
(a)	Given written notice of the intention to carry out the development (together with a scope of works) to the State Emergency Service, and	The REF, including the findings of this report (and FEP), should be issued to the Local State Emergency Service during the REF notification period to provide the SES an opportunity to respond to the proposal.	Expected to comply through REF submission

Reference Clause	Requirement	Development Response	Compliant?
(b)	Taken into consideration any response to the notice that is received from the State Emergency Service within 21 days after the notice is given.	Responses from the State Emergency Service should be taken into consideration through the REF process.	Expected to comply through REF submission

Flood Risk Management Manual (DPE, 2023)

The Floodplain Development Manual (2005) has recently been updated with the latest Floodplain Risk Management Manual (2023) gazetted in June this year. The proposed development has been assessed using the Objectives of the latest Flood Risk Management Manual (DPE, 2023) as presented in the following Table 3.

Table 3 - Objectives of the Flood Risk Management Manual (DPE, 2023) and Compliance

Objective	Development Response
To reduce the impacts of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.	<p>Although the proposed development is unlikely to reduce public losses resulting from a flood at the site, the development aims to minimise the existing risk on the subject site, where possible. This includes raising the Finished Floor Level to a height that is above the Flood Planning Level and by evacuating and closing the site during predicted major or extreme flood events.</p> <p>Alternative Options to reduce the impact of flooding have been reviewed and negated, as previously discussed.</p> <p>The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing current site flood emergency management procedures.</p>
Archived Through:	
Use a merit-based approach in preparing and implementing flood risk management (FRM) plans to address riverine and local overland flooding.	<p>A merit-based approach sought for the proposed development. The proposal aims to minimise the existing risk on the subject site, where possible. This includes raising the Finished Floor Level to a height that is above the Flood Planning Level and by evacuating and closing the site during predicted major or extreme flood events.</p> <p>Alternative Options to reduce the impact of flooding have been reviewed and negated, as previously discussed.</p> <p>The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing current site flood emergency management procedures.</p>

Objective	Development Response
<p>Reduce the impact of flooding and flood liability on existing developed areas identified in FRM plans through flood mitigation works and measures including ongoing emergency management (EM) measures, the raising of houses where appropriate and by development controls.</p>	<p>The proposal aims to minimise the existing risk by raising the FFL above the Flood Planning Level and by evacuating the site during predicted major or extreme flood events.</p> <p>In addition, the proposed development aims to comply with the requirements set out in the Moree Plains Council Local Environmental Plan (2011) and Development Control Plan (2013) where possible. These requirements and the development response have been assessed in the Local Government requirements section below.</p>
<p>Adopt a merit-based approach for all development decisions in the floodplain, taking into account social, economic and ecological factors, as well as flooding considerations.</p>	<p>A merit-based approach sought for the proposed development. The proposal aims to minimise the existing risk on the subject site, where possible. This includes raising the Finished Floor Level to a height that is above the Flood Planning Level and by evacuating and closing the site during predicted major or extreme flood events.</p> <p>Alternative Options to reduce the impact of flooding have been reviewed and negated, as previously discussed.</p> <p>The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing current site flood emergency management procedures.</p>
<p>Limiting the potential for flood losses in all areas proposed for development or redevelopment by the application of ecologically sensitive planning and development controls.</p>	<p>The proposal aims to minimise the existing risk on the subject site, where possible. This includes raising the Finished Floor Level to a height that is above the Flood Planning Level and by evacuating and closing the site during predicted major or extreme flood events.</p> <p>Alternative Options to reduce the impact of flooding have been reviewed and negated, as previously discussed.</p> <p>The proposed development aims to comply with the requirements set out in the Moree Plains Council Local Environmental Plan (2011) and Development Control Plan (2013) where possible. These requirements and the development response have been assessed in the Local Government requirements section below.</p>

In addition to the Objectives, the proposed development has been reviewed with respect to the aforementioned guidance presented in the supporting guideline – Understanding and Managing Flood Risk (FB01). Section 3.6 of FB01 outlines additional recommendations to assist with managing the flood risk for Community Hospitals. These are summarised in Table 4 overleaf.

Table 4 - Floodplain Development Manual (LU01 - Section 3.6)

Reference	Requirement	Development Response	Compliant?
1	Where the facility cannot be located outside the floodplain, it is best located in areas of limited flood impacts, such as flood planning constraint category (FPCC) 4 or potentially FPCC3	The subject site is expected to be located within Flood Planning Constraint Category 3 (FPCC3) as it is below the Flood Planning Level, but below the PMF and H6 hazard is not expected during the PMF and outside the extent FPCC2.	Yes
2	Floor levels of emergency medicine areas and patient wards above an extreme flood level (such as the PMF) may mean these do not need to be evacuated if services can be maintained.	The proposed development has patient wards and medical storage areas below the PMF.	No (Ground Floor) Yes (Level 1)
3	The location and protection of backup utility services so they can be operational and accessible and are available during floods	A review of existing site critical services infrastructure is presented in Appendix B. The analysis suggests existing critical services have the potential to be compromised in events greater than the 1% AEP design storm event.	Yes (1% AEP) No (For events >1% AEP)
4	Resupply of essential goods, equipment and materials during floods so the facility can continue to operate.	Access and egress to / from the facility is expected to be limited, but possible, during events up to and including the 1% AEP. The site is proposed to be evacuated during events in excess of a 1% AEP so resupply should not be required. Regardless, it recommended enough materials and equipment be stored on-site to enable continued operation during a flood event for at least 72 hours. This should be revised if resupply takes longer.	Yes (1% AEP) No (For events >1% AEP)

Reference	Requirement	Development Response	Compliant?
5	Adequate room for storage of waste products away from floodwaters to avoid contamination	<p>As the subject site is not expected to become inundated during a 1% AEP, adequate storage is expected to be available on-site during this event.</p> <p>The Ground Floor Level of the ASB is expected to become inundated during a 1 in 1600 AEP (refer to below Flood Risk Assessment Section). Storage of waste products to avoid floodwater, once flood water overtops the Ground Floor is not expected to be possible.</p> <p>It is recommended any waste or medical materials that may be sensitive to flood water, or that could contaminate downstream ecosystems be moved to Level 1 of the facility prior to evacuating if time permits.</p>	<p>Yes (1% AEP)</p> <p>No (For events >1% AEP)</p>
6	Design of the site to maximise accessibility of emergency and staff entries into the hospital during floods. This may affect the location and design of the entrance	<p>Access and egress to / from the facility is expected to be limited, but possible, during events up to and including the 1% AEP. The site is proposed to be evacuated during events in excess of a 1% AEP so resupply should not be required.</p>	<p>Yes (1% AEP)</p> <p>No (For events >1% AEP)</p>
7	Likelihood of some staff having their homes affected by flooding and their need to look after family members.	<p>As discussed in the Flood Hazard Assessment Section of this report, a large portion of the Moree township has the potential to become inundated during more frequent events than the 1% AEP. As such, there is the potential for many staff's homes to be affected by flooding prior to evacuation and closer of the facility.</p> <p>Staffing will need to be carefully managed by the operator during a flood event. Alternative arrangements may need to be organised including</p>	<p>Needs to be carefully managed by the operator</p>

Reference	Requirement	Development Response	Compliant?
		accommodation for existing workers, or re-distribution of resources from other nearby similar facilities. It is noted that re-distribution of resources puts more people at risk and in the potential path of the hazard. In the scenario where staffing becomes problematic, the operator should review the impact of closing the facility, prior to the nominated trigger.	

Local Council Requirements

Moree Plains Local Environmental Plan (2011)

The proposed development has been reviewed with respect to the flood related requirements set out in the Moree Plains Local Environmental Plan (LEP), in particular Section 5.21 – Flood Planning. The following Table 5 presents the requirements set out in Section 5.21 as well as a development response to the requirements.

Table 5 - Moree Plain Shire Council Local Environmental Plan and Development Compliance

Reference Clause	Requirement	Development Response	Compliant?
5.21(2)	Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development		
(a)	Is compatible with the flood function and behaviour on the land.	<p>The proposed development has been sited in accordance with advice from Moree Shire Council and remaining DCP items are compliant as outlined in the <i>Table 6</i> of this report.</p> <p>The proposed development is located outside floodway and flood storage flood categorisations and is therefore considered compatible with the flood function of the land.</p> <p>The proposed development is expected to be compliant with this clause.</p>	Yes
(b)	Will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties.	As mentioned above, the subject site is located in Flood Fringe and therefore is not expected to significantly adversely impact existing flood behaviour in accordance with the definition of Flood Fringe.	Yes
(c)	Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood.	<p>A Flood Evacuation Plan has been prepared to assist with evacuation of the facility in the event of a major or significant flood event (refer to Appendix D).</p> <p>Further liaison with the SES is recommended to ensure the proposed strategy is consistent with, and will not impact on, the existing regional emergency management measures already in place for the township of Moree.</p>	Further Liaison with SES Recommended

Reference Clause	Requirement	Development Response	Compliant?
(d)	Incorporates appropriate measures to manage risk to life in the event of a flood.	<p>The proposed development has been sited above the 1% AEP + 500mm. As such, mitigation measures are expected to exceed the requirements set out by Council's Development Control Plan (refer to the below <i>Table 6</i>)</p> <p>In addition, evacuation and closure of the site is recommended during a predicted 1% AEP design storm event. This is due to the potential loss of critical services to the facility and difficulty evacuating during events in excess of the 1% AEP design storm event.</p> <p>Additional mitigation measures have been discussed in the Mitigation Options section of this report.</p>	Yes
(e)	Will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	<p>As significant adverse flood impacts are not expected to be created in adjacent properties (as mentioned above), impacts to riparian vegetation and stability of riverbanks or watercourses is not expected to occur due to the proposed development.</p> <p>It is anticipated an ecologist will provide advice with respect to direct impacts to ecology on the subject site.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
5.21(3)	In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters		
(a)	The impact of the development on projected changes to flood behaviour as a result of climate change.	<p>As mentioned above, the 0.5% AEP can be used as a proxy for climate change. There is the potential for the 0.5% AEP to pass across the site with flood levels up to approximately 209.30 and depths in the order of 500mm.</p> <p>The site is noted as Flood Fringe during more significant events (i.e. during the PMF), and as such a similar classification is expected for the 0.5% AEP.</p> <p>Based on the above, the development is not expected to significantly adversely impact existing flood behaviour in accordance with the definition of Flood Fringe.</p>	Yes
(b)	The intended design and scale of buildings resulting from the development.	<p>As mentioned above, the subject site is located in Flood Fringe and therefore the scale of the development is not expected to significantly adversely impact existing flood behaviour in accordance with the definition of Flood Fringe.</p> <p>Flood mitigation measures are proposed generally in accordance with Council's Development Control Plan. Additional details are presented in <i>Table 6</i> below.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
(c)	Whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood.	<p>A Flood Evacuation Plan has been prepared to assist with evacuation of the facility in the event of a major or significant flood event (refer to Appendix D).</p> <p>Additional mitigation measures are proposed with an aim to minimise the risk to life on the subject site.</p> <p>Further liaison with the SES is recommended to ensure the proposed strategy is consistent with, and will not impact on, the existing regional emergency management measures already in place for the township of Moree</p>	Further Liaison with SES Recommended
(d)	The potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	<p>Flood mitigation measures (i.e. building modifications) have been proposed generally in accordance with Council's Development Control Plan. Additional details are presented in <i>Table 6</i> below.</p> <p>Opportunities to relocate the facility are discussed in the Mitigation Measures Section of this report. The investigation suggests there is limited opportunity to further modify, relocate or remove buildings.</p>	Yes

Moree Plains Development Control Plan (2013)

The proposed development has been reviewed Development Control Plan (DCP) (2013), in particular Chapter 4 – Moree and Environs Floodplain Development and Management. The specific Hospital use is not directly recognised by Council's DCP however, the proposed development has been assessed as "Other Building Developments" as outlined in Table 4.2 of the DCP. Similarly, the site is located within "Flood Fringe" as discussed in the Flood Hazard Assessment section of this report and therefore, the provisions set out in Table 4.2 are applicable for the proposed development.

The following Table 6 demonstrates how the proposed development responds to the requirements set out in Table 4.2 of Council's DCP. In addition, Schedule 1 of Council's DCP identifies additional flood proofing requirements which have also been reviewed in the below Table 6.

It is noted that many of the services outlined in *Table 6* are susceptible to inundation and failure during more significant and extreme flood events. Although they may be sited in accordance with Council's requirements, it is recommended that NSW Health Infrastructure consider a higher level of protection to ensure the hospital can return to operation as soon as practicable following a significant or extreme flood event. This may be reviewed as part of a separate submission and approval as required.

Table 6 - Moree Plains Shire Council Development Control Plan and Development Response

Reference Clause	Requirement	Development Response	Compliant?
New Buildings or Extensions to Existing Buildings (other than minor extensions)	<p>Floor levels are to be not less than 350mm below the flood planning level or the building is to be protected by flood barriers which are not less than 350mm below the flood planning level.</p> <p>Construction below the flood planning level is to be of suitable flood compatible materials as outlined in Schedule 1 or to utilise equivalent alternative methods of flood proofing including techniques to prevent water ingress into building structures.</p>	<p>The proposed ASB has a minimum FFL sited above the Flood Planning Level (i.e. 1% AEP + 500mm).</p>	Yes
Minor Extension (other building)	<p>The floor level of minor extensions is not to be less than the main floor level of the existing structure.</p> <p>Construction below the flood planning level is to be of suitable flood compatible materials as outlined in Schedule 1 or to utilise equivalent alternative methods of flood proofing including techniques to prevent water ingress into building structures.</p>	<p>A minimum FFL of 209.73m AHD has been adopted and is based on the FFL of the existing adjacent Acute Services Building.</p> <p>The proposed FFL is located above the Flood Planning Level (i.e. 1% AEP + 500mm) as discussed above.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
Flood Protection Measures	<p>Mounds are preferred to raised buildings where feasible, particularly in the light industrial and general industrial zones.</p> <p>Mounds should achieve at least 350mm below the flood planning level, but are encouraged to achieve or exceed the flood planning level.</p> <p>Mounding or levees are not to exceed 20% of the land area within the allotment as measured by the surface area of the mound or the top of the levee unless certification has been provided by an appropriately qualified and experienced practicing engineer that the structure would not adversely affect the flow of water or storage of water so as to impact on the locality. In this regard, the cumulative effect of other mounds or levees in the vicinity is to be assessed).</p>	<p>The proposed minimum FFL is located above the Flood Planning Level and therefore, mounds are not necessary to enable protection to the Flood Planning Level.</p> <p>It is recommended NSW Health Infrastructure consider this option if looking to protect the entire site during flood events less frequent than the 1% AEP design storm event. It is possible that this may be reviewed in a separate submission and approval, as required.</p> <p>As presented in the Flood Hazard Assessment section of this report, the subject site is not affected by flooding during the regional Mehi River 1% AEP design storm event. As such, adverse flood impacts are not expected to be created by the proposed development for all events up to and including the 1% AEP design storm event.</p> <p>Similarly, the site is located in a Flood Fringe Area and as discussed above, is by definition not expected to create a significant adverse impact in adjacent properties.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
Storage of Materials Below the Flood Planning Level	<p>The use and storage of hazardous materials is prohibited at levels below the flood planning level in all circumstances.</p> <p>It is necessary to demonstrate that goods and possessions stored at a lower level than the flood planning level can be moved above the flood planning level, by the occupant, within the period of time that a flood warning is issued and inundation of the subject land occurs.</p>	<p>Storage of (potentially hazardous) materials is expected within the building. As discussed above, the minimum FFL of the proposed building is located above the Flood Planning Level and as such, this requirement is expected to be satisfied.</p> <p>It is recommended NSW HI review this requirement for existing infrastructure on the subject site.</p>	Yes
Flood Proofing Materials	<p>Materials used and techniques shall be as listed below. These materials will be used in all situations where the component specified will be below the flood planning level.</p> <p>Refer to Table 4.5 of Council's DCP for further guidance.</p>	<p>Flood Proofing Materials are not expected to be required for the proposed building to comply with this requirement as the proposed minimum FFL is located above the Flood Planning Level.</p> <p>It is recommended NSW Health Infrastructure consider the use of flood proofing materials if looking to return the facility back to operation as soon as practicable post significant / extreme flood event.</p>	Yes
Main Power Supply	<p>Subject to approval of the relevant county council the incoming main commercial power service equipment, including all metering equipment, shall be located above the 1% AEP flood. Means shall be available to easily disconnect the dwelling (or facility) from the main power supply.</p>	<p>The Technical Memorandum (Northrop, 2023) discusses the vulnerability of existing Electrical Services. It is noted these elements are located or protected above the 1% AEP and therefore comply.</p> <p>Similarly, the proposed minimum FFL is located above the Flood Planning Level and therefore proposed electrical elements are expected to comply with this requirement.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
Wiring	<p>All wiring, power outlets, switches, etc. should, to the maximum extent possible, be located above the 1% AEP flood.</p> <p>All electrical wiring installed below the 1% AEP flood should be suitable for continuous submergence in water and should contain no fibrous components. Only submersible type splices should be used below the 1% AEP flood. All conduits located below the 1% AEP flood should be so installed that they will be self draining if subjected to flooding.</p>	<p>The proposed minimum FFL is located above the Flood Planning Level and therefore proposed electrical wiring within the facility is expected to comply with this requirement.</p>	Yes
Equipment	<p>All equipment installed below or partially below the 1% AEP flood should be capable of disconnection by a single plug and socket assembly</p>	<p>The proposed minimum FFL is located above the Flood Planning Level and therefore proposed electrical wiring within the facility is expected to comply with this requirement.</p>	Yes
Reconnection	<p>Should any electrical device and/or part of the wiring be flooded, it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.</p>	<p>Review of services by qualified persons is discussed in the Flood Emergency Plan (FEP). A draft FERP is provided in Appendix D.</p>	Yes
Heating and Air Conditioning Systems	<p>Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the 1% AEP flood. When this is not feasible, every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.</p>	<p>Mechanical Plant within the ASB are proposed to be located in the ground and first floor levels. These FFL's are located above the 1% AEP and therefore are expected to comply with this requirement.</p>	Yes

Reference Clause	Requirement	Development Response	Compliant?
Fuel	Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.	<p>This is expected to be feasible to incorporate into the design and fuel lines should be shut off if evacuating the facility.</p> <p>The requirement to shut off services during evacuation is discussed in the Flood Emergency Plan (FEP).</p> <p>A draft FERP is provided in Appendix D.</p>	Yes
Installation of Fuel Services	The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600mm above the 1% AEP flood.	<p>Mechanical Plant are proposed to be located in the ground and first floor levels of the ASB. The minimum FFL of the facility is located above the 1% AEP + 600mm.</p> <p>There are no proposed fuel storage tanks included as part of the proposed development.</p> <p>It is recommended NSW HI review this requirement for existing infrastructure on the subject site.</p>	Yes
Ducting	<p>All duct work below the 1% AEP flood should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the duct work on a suitable grade.</p> <p>Where duct work must pass through a water-tight wall or floor below the 1% AEP flood, the duct work should be protected by a closure assembly operated from above the 1% AEP flood.</p>	<p>The proposed minimum FFL for the ASB is located above the Flood Planning Level and therefore proposed ducting within the facility is expected to comply with this requirement.</p>	Yes

Council's Flood Study (WRM, 2017)

Section 7.3.3 of Council's Flood Study (WRM, 2017) provides recommendations with respect to updates to Council's current Development Control Plan (2013). The recommended updates and the Development Response is presented in the following Table 7.

Table 7 - Council Flood Study (WRM, 2017) and Development Compliance

Reference	Requirement	Development Response	Compliant?
For New Development within Flood Storage or Flood Fringe Areas			
1	The floor level of all new buildings (residential and commercial) to be above the flood planning level.	The proposed FFL is located above the 1% AEP + 500mm.	Yes
2	Each habitable building must have access to the emergency evacuation centres such that is not inundated by the 5% AEP event and is not inundated by more than 0.3 m for more than 24 for the 1% AEP event	The proposed development is expected to have a flood free rising road evacuation path to the nearby nominated regional evacuation centres (i.e. Moree East Public School or Moree PCYC) during events up to and including the 1% AEP design storm event. Additional information is in the Flood Emergency Plan provided in Appendix D.	Yes
3	Mounds are preferred to raised buildings where feasible. The finished level of the mound should achieve the 1% AEP flood level as a minimum. Mounds and raised buildings may be used in combination to achieve the minimum floor level	A raised FFL is proposed as part of the development. Mounds are not proposed as part of the development, however, may be considered for future proposals to reduce the flood affectation of the site. Mounds have the potential to increase flood behaviour in adjacent properties. Any future proposal should be accompanied by a Flood Impact and Risk assessment (or similar).	Yes

Reference	Requirement	Development Response	Compliant?
4	Mounding or levees are not to exceed 20% of the land area within the allotment as measured by the surface area of the mound or the top of the levee unless certification has been provided by an appropriately qualified and experienced practicing engineer that the structure would not result in a material increase in flood level or hydraulic hazard on upstream, downstream or adjacent properties	Mounding or Levees are not proposed as part of the development	Yes
For Existing Development within Flood Storage or Flood Fringe Areas			
5	The floor level of a minor extension is not to be less than the habitable floor level of the existing structure	The development proposes to tie into the existing FFL of the adjacent existing ASB building.	Yes
6	Construction below the flood planning level is to be of suitable flood compatible materials or to utilise equivalent alternative methods of flood proofing including techniques to prevent water ingress into building structures;	The Ground Floor FFL is located above the 1% AEP + 500mm and therefore, the proposed development is expected to comply with this requirement	Yes
7	The use and storage of hazardous materials is prohibited at levels below the flood planning level in all circumstances.	The Ground Floor FFL is located above the 1% AEP + 500mm and therefore, storage of materials is expected to comply	Yes

Conclusion

A Flood Risk Report has been prepared for the purposes of the Review of Environmental Factors for the proposed redevelopment of Moree Hospital located at 35 Alice Street, Moree.

Flood behaviour outlined by the Review of Moree and Environs Flood Study / Floodplain Risk management Study and Plan (WRM, 2017) has been presented and discussed herein. The flood behaviour at the site suggests there is a risk for Critical Building Services to be compromised during events in excess of the 1% AEP design storm event.

A review of recent Local and State guidelines has been performed with respect to the proposed development. Mitigation measures for the development are proposed that are generally consistent with the recommendations provided by Moree Plains Shire Council and contained within their Development Control Plan.

State guidelines and legislation was also reviewed herein which highlight a preference for consideration in design to the worst case PMF. This was determined to be unsuitable for the proposed development, recognising the development is an extension to the existing facility. It is understood NSW Health Infrastructure preference is to maintain the existing level of flood immunity at the site while, also enhancing existing management measures during events in excess of the 1% AEP. An opportunity exists to enhance the physical immunity of the site during possible future development.

In lieu of enhanced design requirements (with consideration to the PMF), evacuation of the facility has been proposed for events in excess of a 1% AEP design storm event. Preparation of a Flood Emergency Plan, presented herein, is expected to assist NSW Health Infrastructure and Hunter New England Health (the operator) to manage residual risk during these events. The FEP provides recommendations to assist with enhancing flood preparedness, response, and recovery processes during significant and extreme flood events.

Limitation statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by NSW Health Infrastructure. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

Except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

Where this report indicates that information has been provided to Northrop by third parties, Northrop has made no independent verification of this information except as expressly stated in the report. Northrop is not liable for any inaccuracies in or omissions to that information.

The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

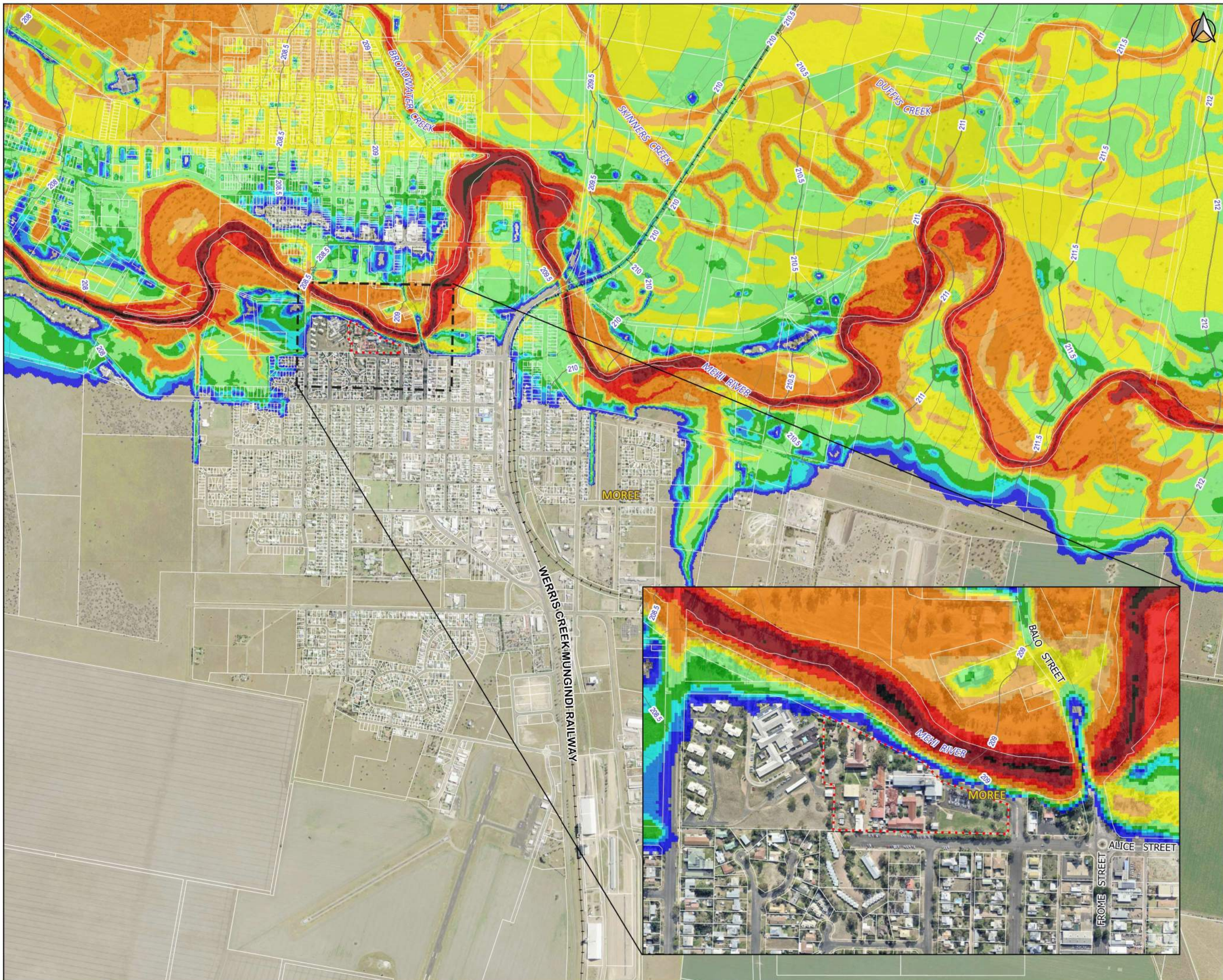
This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required.

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Document Register

Rev	Status	Prepared	Approved	Date
A	Approval	N Parana Manage	L Gitzel	22 September 2023
B	Approval	L Gitzel	L Gitzel	13 November 2023
C	Updated Cover Page	L Gitzel	L Gitzel	14 November 2023
D	Approval	L Gitzel	L Gitzel	1 December 2023
E	Approval	L Gitzel	L Gitzel	7 December 2023

Appendix A – Flood Figures



Legend

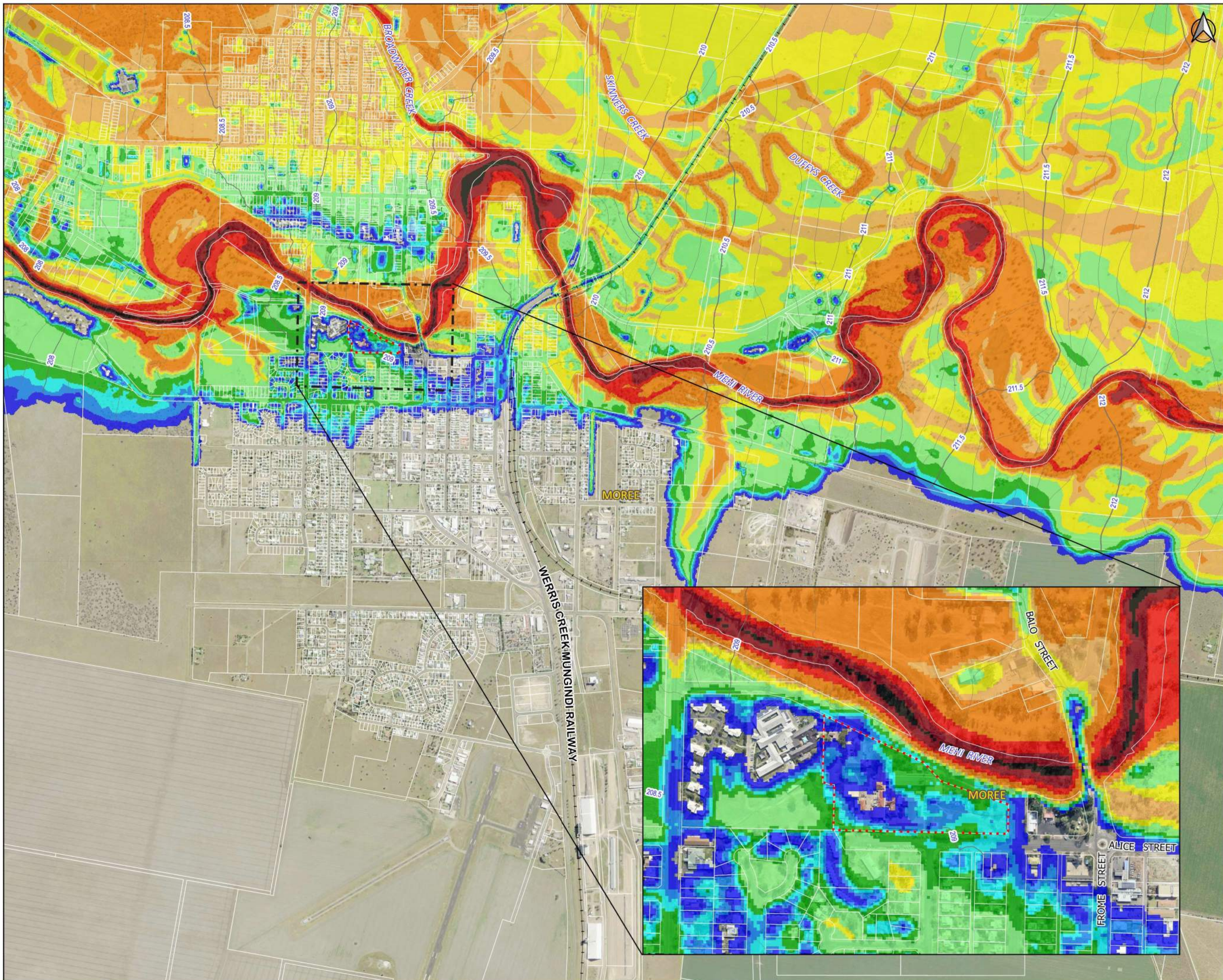
- Subject Site
- Contour (0.5m)
- Contour (0.1m)
- Depth (m)
 - Less than 0.1
 - 0.1 - 0.2
 - 0.2 - 0.3
 - 0.3 - 0.5
 - 0.5 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0 - 5.0
 - 5.0 - 7.5
 - 7.5 - 10.0
 - Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A1
1% AEP Flood Depth and
Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

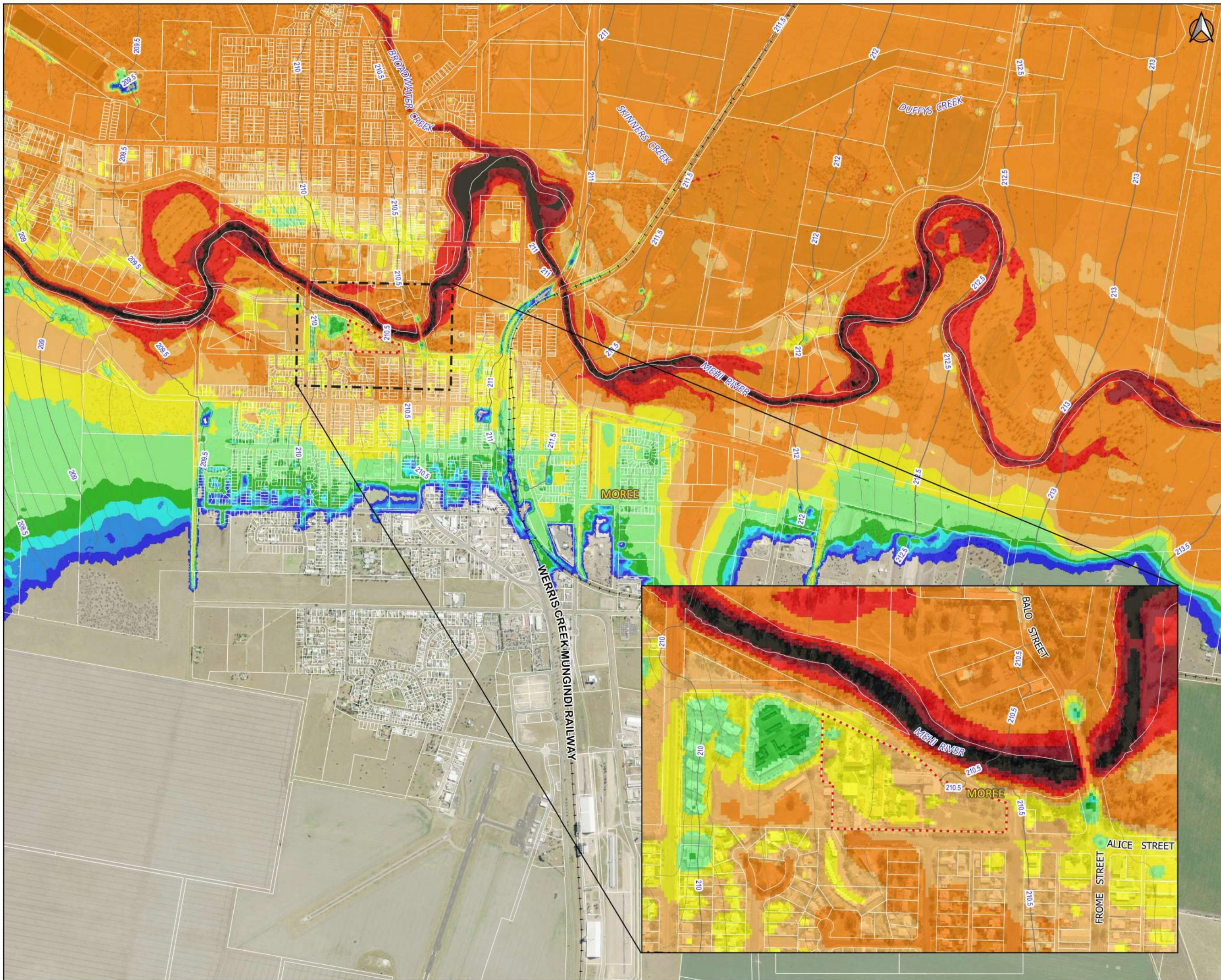
- Subject Site
- Contour (0.5m)
- Contour (0.1m)
- Depth (m)
 - Less than 0.1
 - 0.1 - 0.2
 - 0.2 - 0.3
 - 0.3 - 0.5
 - 0.5 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0 - 5.0
 - 5.0 - 7.5
 - 7.5 - 10.0
 - Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A2
1 in 200 AEP Flood Depth
and Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

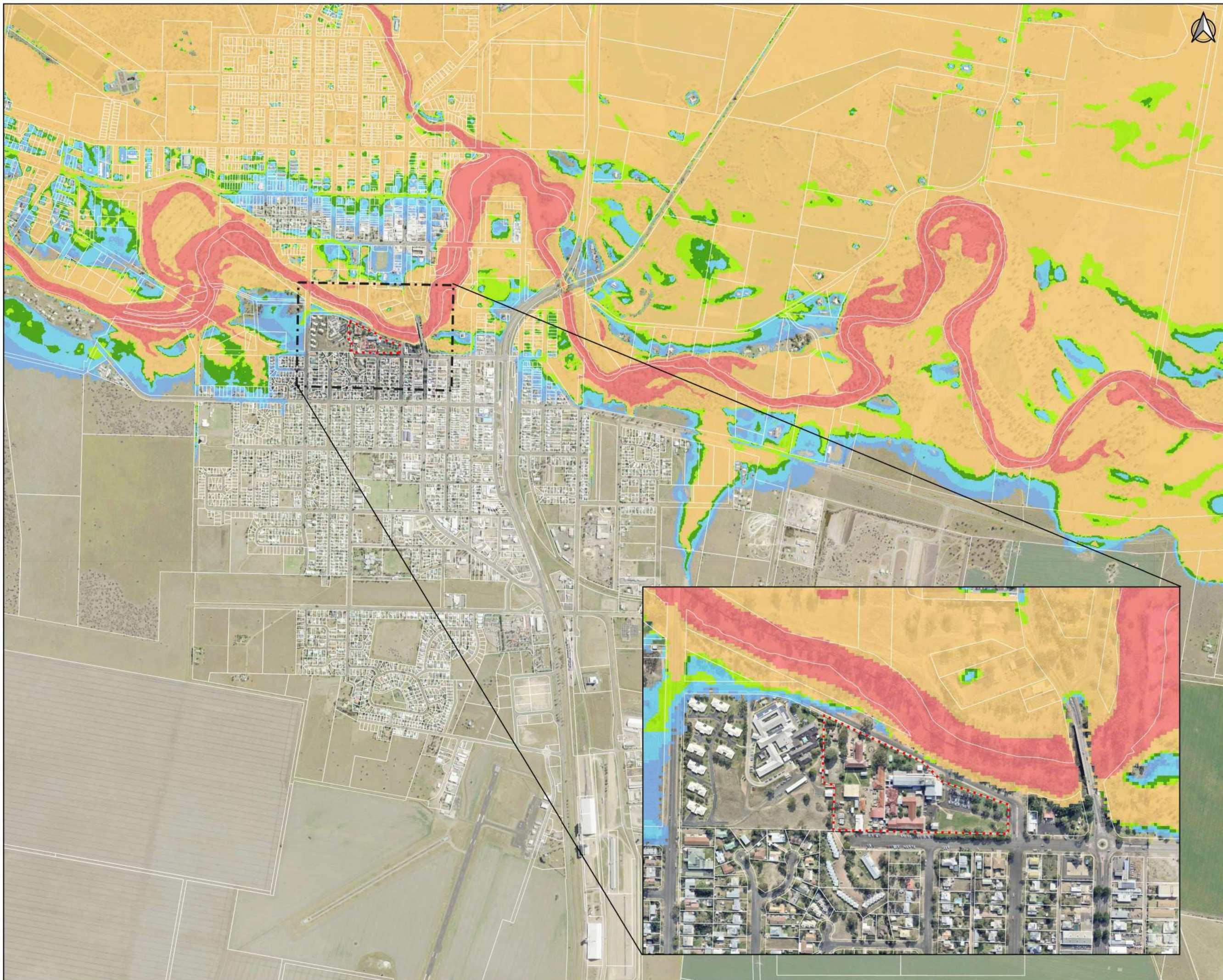
- Subject Site
- Contour (0.5m)
- Contour (0.1m)
- Depth (m)
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 5.0
- 5.0 - 7.5
- 7.5 - 10.0
- Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A3
PMF Flood Depth and
Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

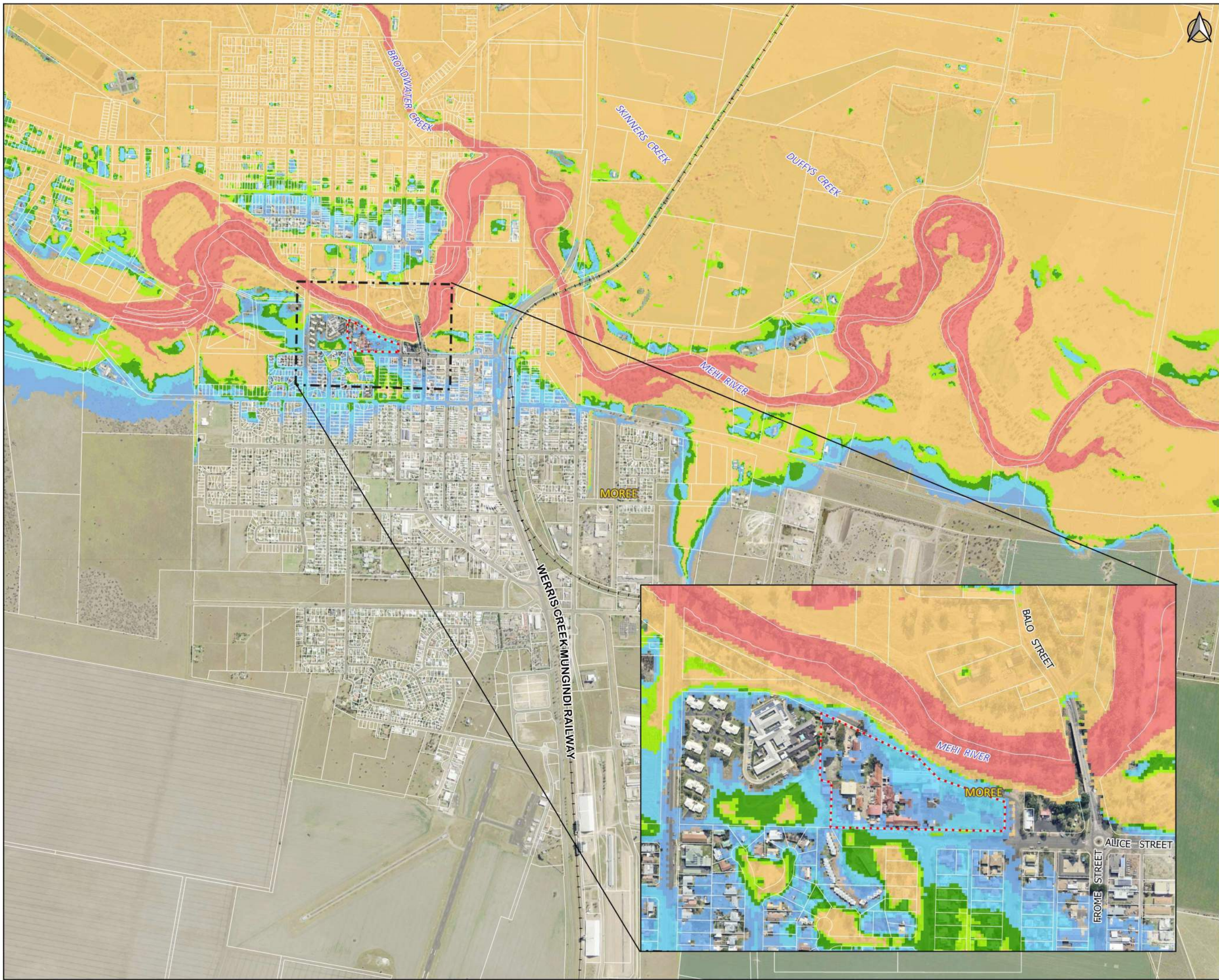
- Subject Site
- ARR 2019 Hazard
- H1
- H2
- H3
- H4
- H5
- H6

0 300 600 Metres
1:19,999.99998

Figure A4
1% AEP Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

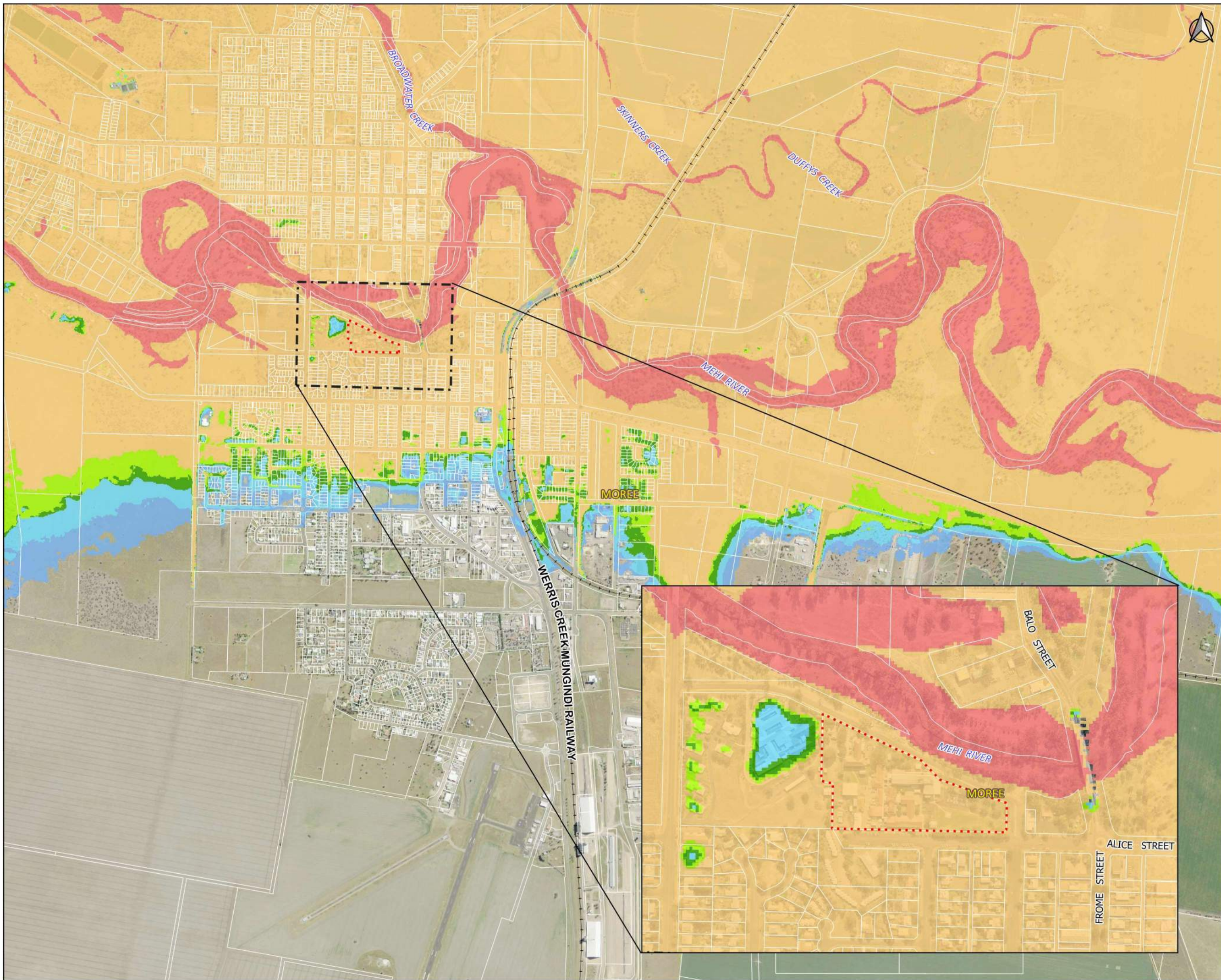
- Subject Site
- ARR 2019 Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

0 300 600 Metres
1:19,999.99998

Figure A5
1 in 200 AEP Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

- Subject Site
- ARR 2019 Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

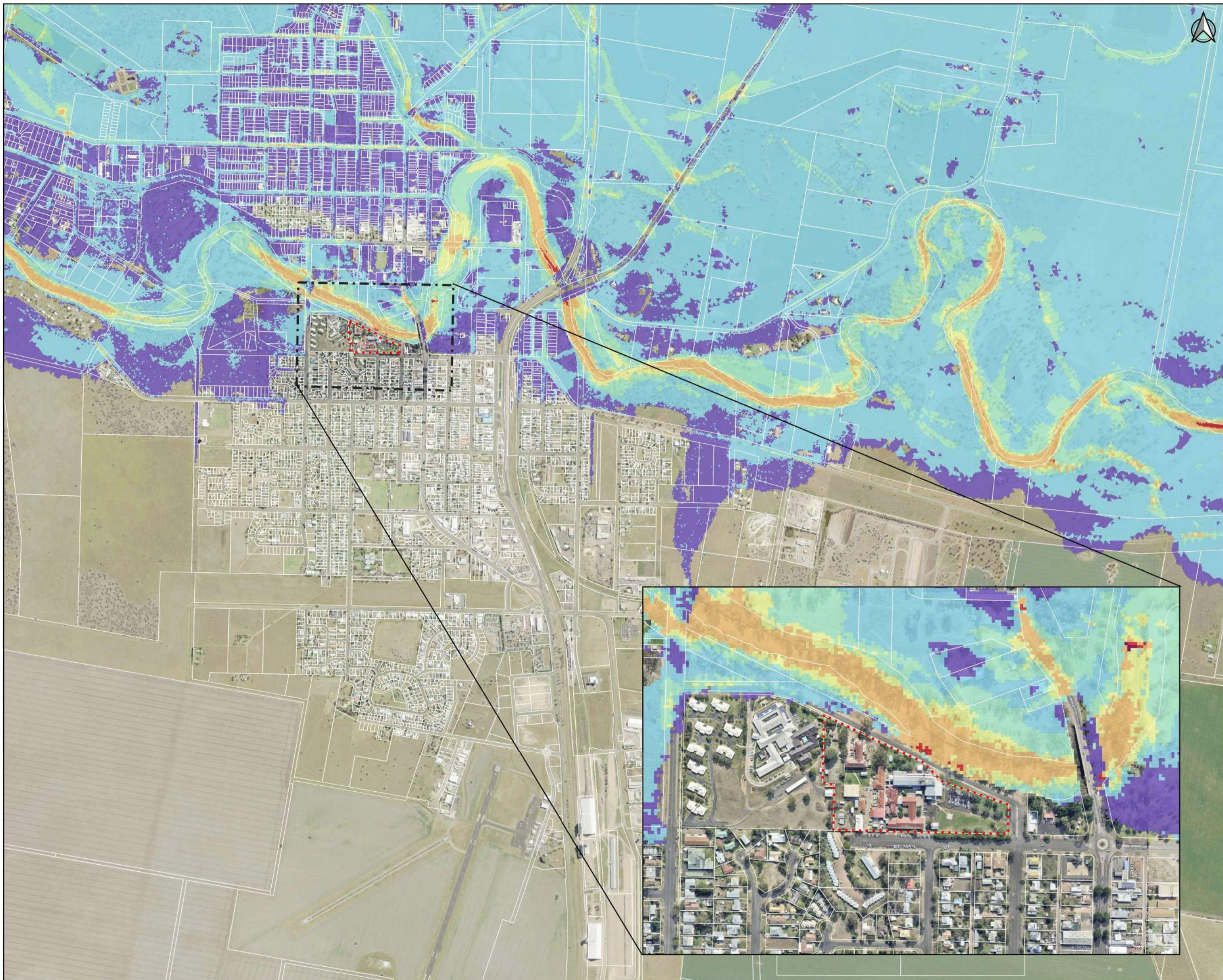
0 300 600 Metres
1:19,999.99998

Figure A6

PMF Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

⋯ Subject Site

Velocity (m/s)

Less than 0.20

0.21 - 0.50

0.51 - 0.80

0.81 - 1.00

1.01 - 2.00

2.01 - 3.00

Greater than 3.00

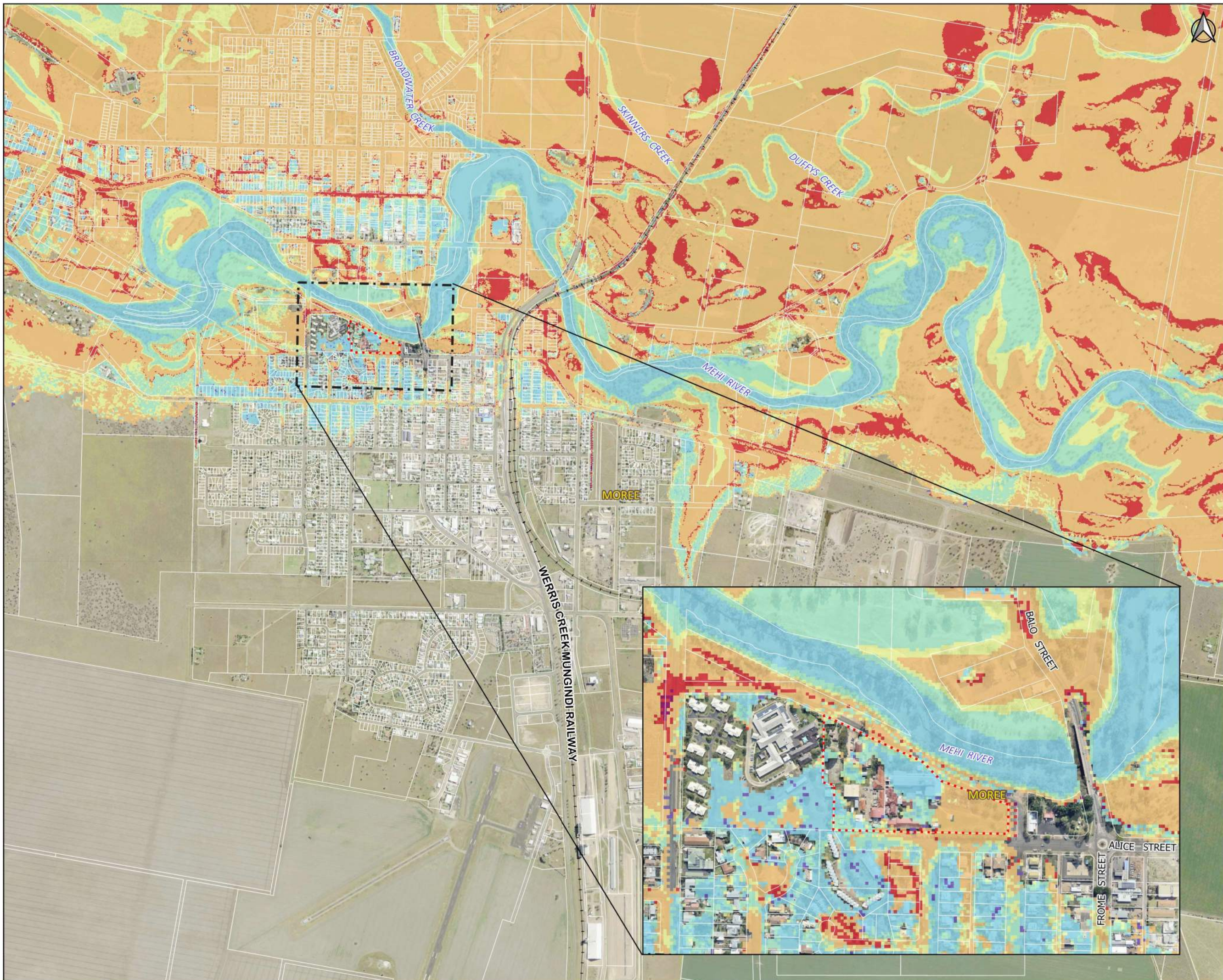
0 300 600 Metres

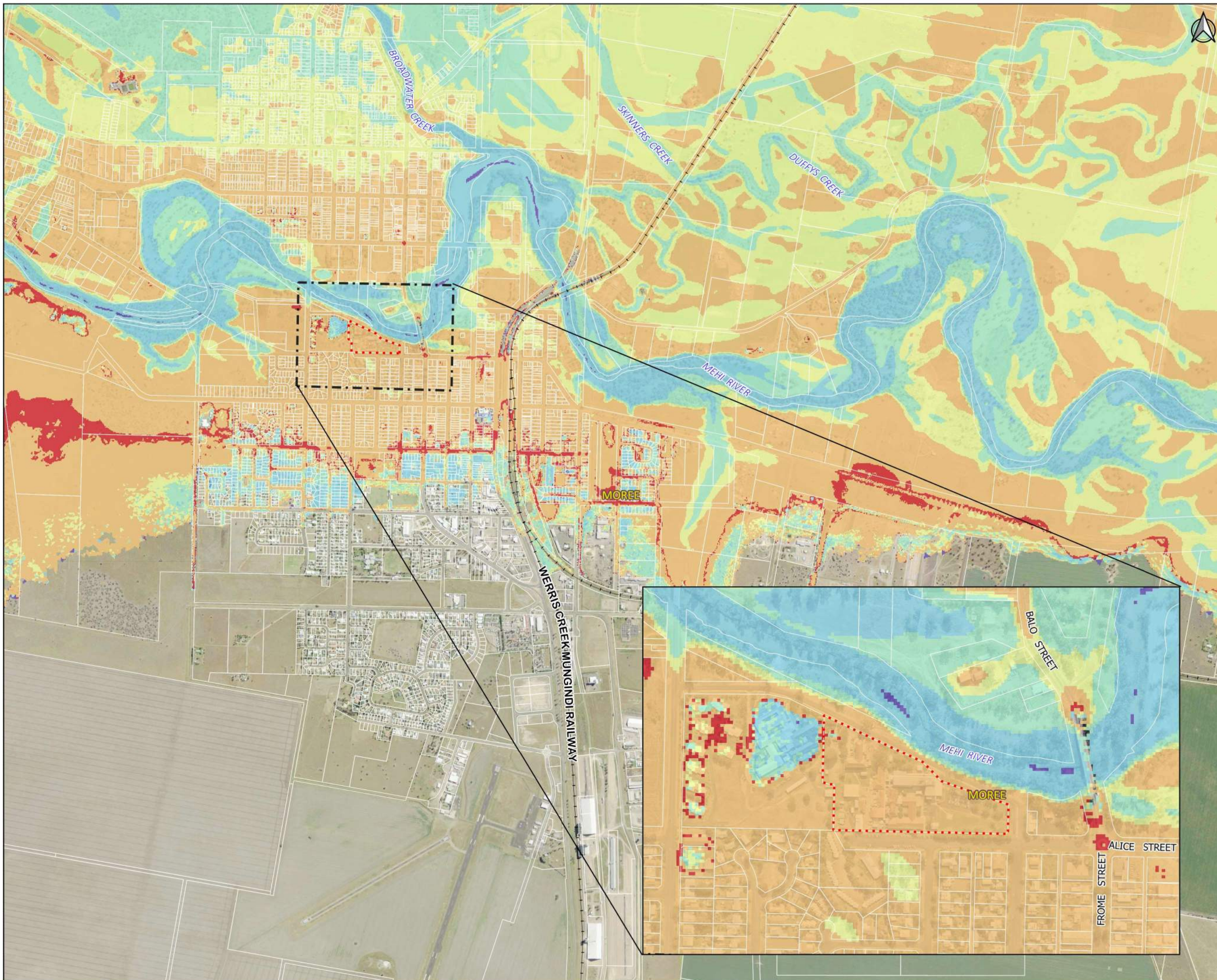
1:20,000

Figure A7
1% AEP Flood Velocity
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree







Legend

Subject Site

Velocity (m/s)

Less than 0.20

0.21 - 0.50

0.51 - 0.80

0.81 - 1.00

1.01 - 2.00

2.01 - 3.00

Greater than 3.00

0 300 600 Metres

1:20,000

Figure A9
PMF Flood Velocity
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree



Appendix B – Technical Memorandum (Northrop, 2022)

13th July 2022

Ref: S220253

Peter Wade
Savills
L25, 1 Farrer Place
Sydney NSW 2000

Dear Peter,

Re: Technical Memorandum – Moree Hospital Redevelopment - Flooding

Northrop Consulting Engineers Pty Ltd (Northrop) have been commissioned to prepare a Technical Memorandum for review by Health Infrastructure NSW for the proposed Moree Hospital Redevelopment following and Expert Review Group Meeting on the 13 April 2022. This Technical Memorandum has been provided to inform Health Infrastructure NSW of Flooding Conditions as advised by Moree Plains Shire Council. It is also provided to inform requirements for Building Finished Floor Levels and Critical Building Services Infrastructure as advised by Council and relevant Service Authorities.

The project team are seeking in-principle acceptance of the adopted design philosophy for the Moree Hospital Redevelopment with respect to Civil and Building Services Infrastructure design. Further details of the design will be provided to Health Infrastructure NSW and the Expert Review Group for review and endorsement as the design is developed.

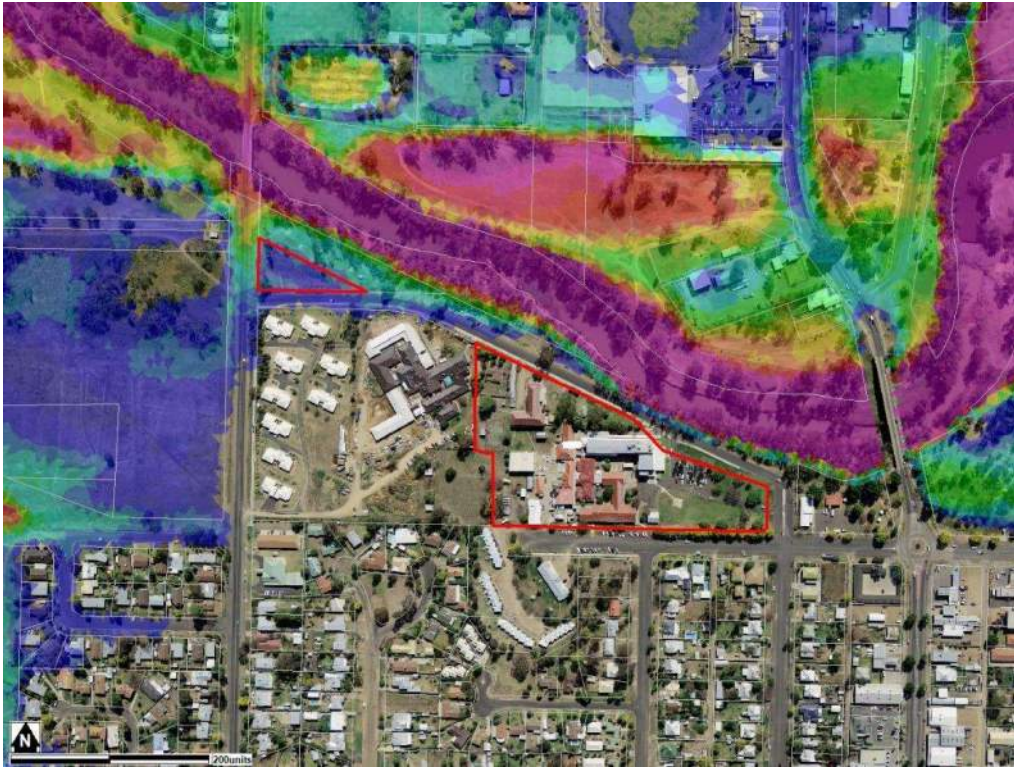
Existing Flooding Conditions

A Flood Certificate obtained from Moree Plains Shire Council specifies Flood Levels for the 1:100-year event and the Probable Maximum Flood (PMF).

Hydraulic Data	100-year ARI Flood	Probable Maximum Flood
Minimum Water Level	208.64	209.99
Maximum Water Level	208.81	210.51
Minimum Water Depth	0.13	0.44
Maximum Water Depth	1.49	2.89
Minimum Water Velocity	0.06	0.06
Maximum Water Velocity	0.83	1.77
Minimum Hazard	H1	H2
Maximum Hazard	H4	H5

Based on discussion with Moree Plains Shire Council, the flood levels are applicable to a portion of land in the northeast corner which is divorced from the main campus and is to remain undeveloped. The flood level provided by Council is not applicable to where the development is occurring.

A Flood Depth image provided in the certificate indicates that the proposed development area is not inundated during the 1:100-year

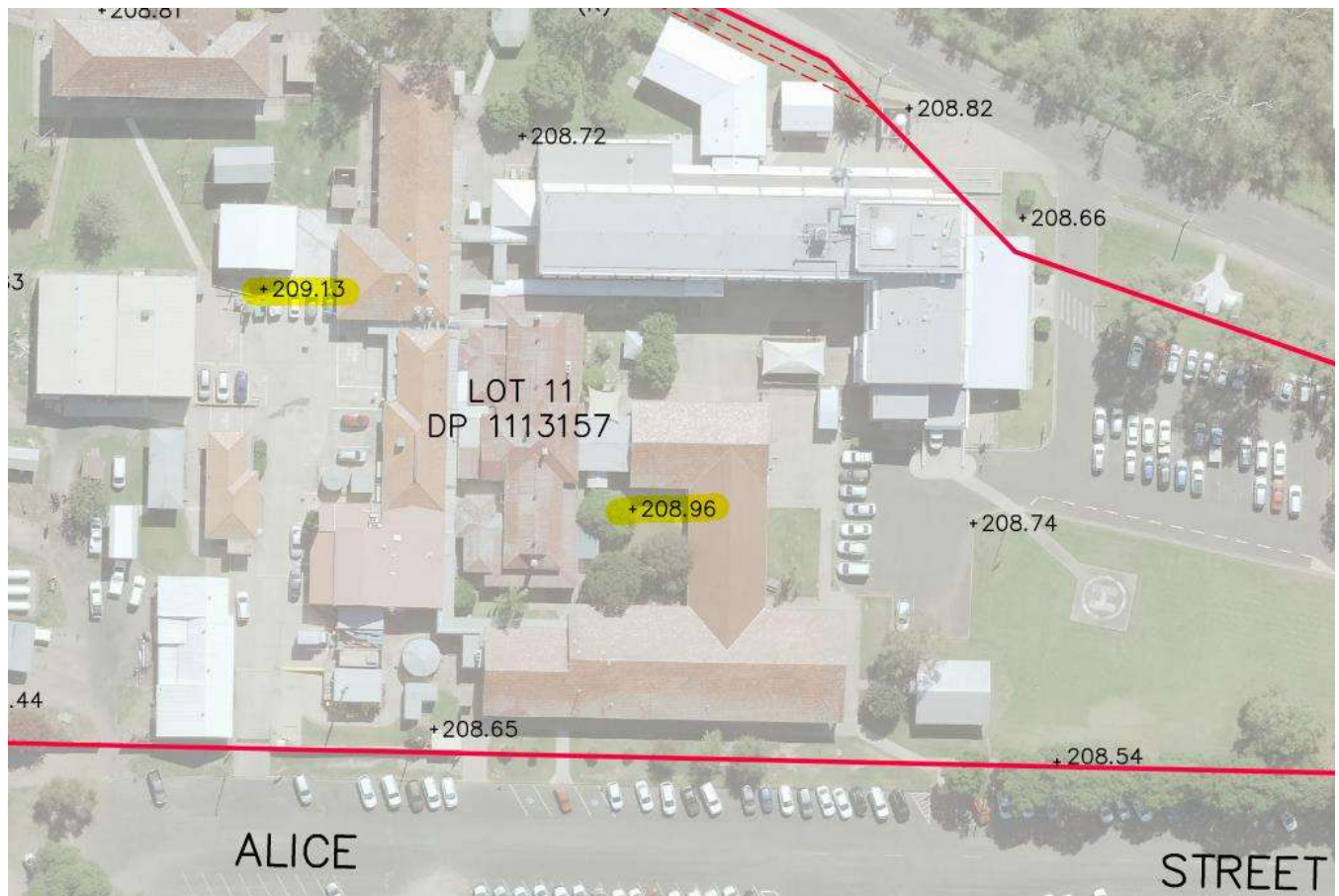


1:100 Year Flood Extent

Building Finished Floor Levels

Based on advice received from Moree Plains Shire Council the site is not inundated with stormwater during the 1:100-year flood event as shown above. Due to the proximity of the Mehi River to the site, Moree Plains Shire Council have advised that the building Finished Floor Level is to be a **minimum of 500mm above the existing ground levels**.

Based on review of survey information prepared by Monteath and Powys, a ground level of RL 208.96m AHD has been recorded in the vicinity of the new building.



Spot Levels over Lot 11 DP 1113157 Prepared by Monteath Powys

With consideration to the advice received from Moree Plains Shire Council, the building FFL should be a minimum of 209.46m AHD (RL 208.96m AHD + 500mm) or above.

Advice received from the project team indicates that the new Building Finished Floor Level is to interface with the existing Community and Outpatient Health Building (Bld 1) which has a finished floor level of 209.80m AHD. This is approximately 840mm above the existing natural ground level identified on the survey which satisfies the requirements of Moree Plains Shire Council.

With respect to the Survey, the constraint associated with the maximum existing ground level is RL209.30m AHD to achieve 500mm from the surrounding Ground Level to the Building Finished Floor Level. More recent survey provided by Monteath, and Powys indicates that levels in the vicinity of the proposed works are all lower than RL209.30m AHD therefore the proposed Building Finished Floor Level set at RL 209.80m AHD satisfies Council's requirement for Freeboard.

Critical Building Services Infrastructure

Electrical Services

In review of the site survey, prepared by Monteath & Powys, as per drawing 220056A_03, dated 12/05/2022, we have observed the following key points of information pertaining to existing electrical services.

- 1% AEP (1:100 Year Flood Level) – 208.81m – Per current advice relating to the surrounding area highlighted above (for flood zone areas)

Item	Measured Relative Level (RL)	Difference to 1% AEP	Comments
Pad-Mount Substation S.84291	209.15	-0.25	Services found to be above the reported 1% AEP.
Site MSB	209.13	-0.27	
MSB-1 (Generator Building)	209.13	-0.27	
Diesel Generator (adjacent to MSB-1)	209.19	-0.21	
MSB-2 (Building 1)	208.73	-0.67	MSB-2 is beneath the reported 1% AEP.

From a compliance perspective, it is realized that the services above are not affected by flooding, as they do not exist within the flood zone depicted above. It is advised to consider, the relocation of existing MSB-2, to be within the Building 1 envelope. Given the existing and proposed buildings with regard to the realized RL level, MSB-2 poses a potential ponding location for heavy rainfall and may be subject to water damage.

NSW Health Document GL2021 Engineering Services Guidelines, under Section 5.6.4, requires all Main Switchboards and Main Distribution Boards to be of at least Form 3b manufacture, and be housed in a separate, accessible room, suitably ventilated and **not subject to flooding**.

AS/NZS 3000:2018, under Section 1.5.14, required that all parts of the electrical installation need be designed to be adequately protected against damage that may be expected from environmental influences during normal operation. This includes damage by water and excessive dampness.

Hydraulic and Fire Services

In review of the site survey, prepared by Monteath & Powys, as per drawing 220056A_03, dated 12/05/2022, we have observed the following key points of information pertaining to existing electrical services.

- Reported 1% AEP (1:100 Year Flood Level) – 208.81m – Per current advice relating to the surrounding area highlighted above (for flood zone areas) as provided by Council is only applicable in the northwest corner which is divorced from the main campus. Development area not shown to be flood affected.

Item	Measured Relative Level (RL)	Difference to 1% AEP (208.81m)	Comments
LPG Storage Vessels	208.57	-0.24	The area is not shown in the flood affected as advised by Council however it is below the reported 1% AEP flood level.
The Main Incoming Services for	208.60	-0.21	
Domestic Cold-Water Tank	209.39	0.58	Services found to be above the reported 1% AEP
Domestic Cold-Water Pump and Softener Room	209.24	0.43	
Fire Tank and Pump Room	208.83	0.02	

The RL of the LPG vessels area is below the reported 1% AEP flood level. The vessels are sitting on a concrete plinth as well as frames which support the vessel above.

From a compliance perspective, it is realized that the services above are not affected by flooding, as they do not exist within the flood zone depicted above. It is advised to consider, the relocation of fire pump and tank as part of the early works.

Mechanical Services & Medical Gasses

- In review of the site survey, prepared by Monteath & Powys, as per drawing 220056A_03, dated 12/05/2022, we have observed the following key points of information pertaining to existing mechanical services central plant & Oxygen Vessel located along site boundary with Victoria Terrace.
- Reported 1% AEP (1:100 Year Flood Level) – 208.81m – Per current advice relating to the surrounding area highlighted above (for flood zone areas)

Item	Measured Relative Level (RL)	Difference to 1% AEP (208.81m)	Comments
VIE Vessel Enclosure	208.84	-0.03	Services found to be above the reported 1% AEP.
Existing Chiller Plantroom	208.99	-0.11	

From a compliance perspective, it is realized that the services above are not affected by flooding, as they do not exist within the flood zone depicted above.

Given the criticality of the VIE oxygen vessel, it is advised to consider the relocation of the enclosure.

We trust this information is satisfactory to review the design approach for the proposed development with respect to flooding and flood levels.

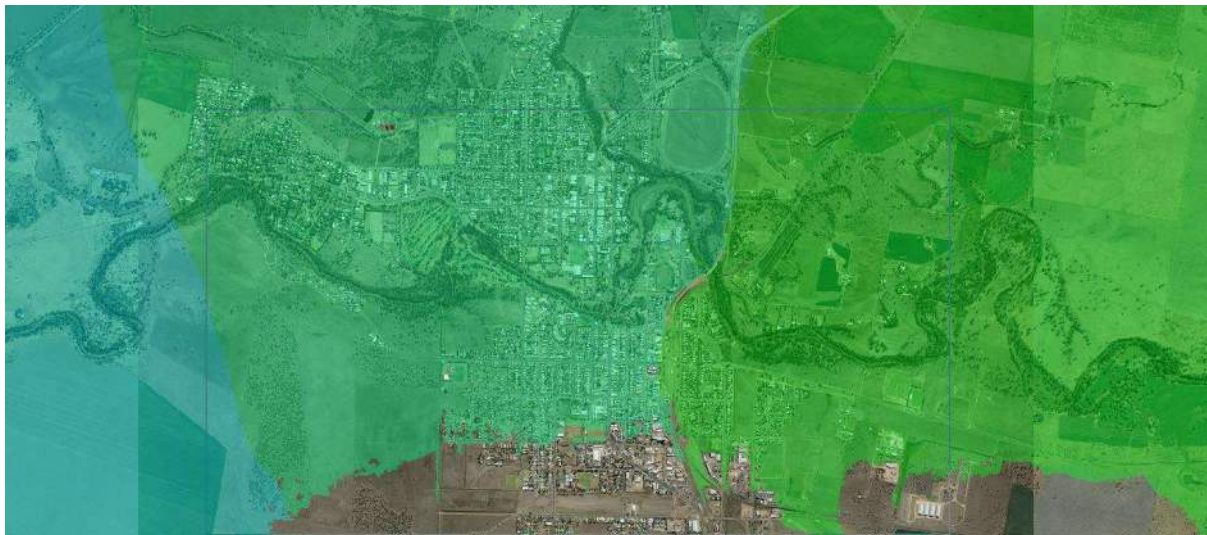
Additional Information

Following a meeting with the ERG Team on the 15th of June 2022, it was requested that additional information be provided to inform the project team on the extent of the Probable Maximum Flood in the vicinity of the proposed development.

This information was sought from Moree Plains Shire Council who have advised on the following flood levels.

Hydraulic Data	100-year ARI Flood	200-year ARI flood (old data)	Probable Maximum Flood
Minimum Water Level	208.64	209.22	209.99
Maximum Water Level	208.81		210.51
Minimum Water Depth	0.13		0.44
Maximum Water Depth	1.49		2.89
Minimum Water Velocity	0.06		0.06
Maximum Water Velocity	0.83		1.77
Minimum Hazard	H1		H2
Maximum Hazard	H4		H5

Moree Plains Shire Council have provided a Flood Map with respect to the 200-year ARI Flood (old data) in the interim to current information being obtained.



Based on review of the Flood Map provided by Moree Plains Shire Council, a significant area of the Moree township is inundated during this event.

With consideration to the Probable Maximum Flood Levels Provided by Moree Plains Shire Council, we would not consider it feasible to elevate the site to the level specified at RL 210.51m AHD.

Attachments

Moree Plains Shire Council – Flood Certificate

Dear Sir/Madam,

The information supplied in this certificate represents the most current flooding information held by Council at the time the certificate was created.

The Flood Planning Level is calculated as a freeboard above the 100 yr ARI Flood. Moree Plains Shire Council has adopted 500mm (0.5m) above the 100 yr ARI Flood as its Flood Planning Level. Please note, if no water level is given for the 100 yr ARI Flood on your property, it still may have an associated Flood Planning Level. Please contact Council to determine your Flood Planning Level.

The following flood information relates to property "Lot: 11 Section: DP: 1113157"

The ground levels for this property ranges from 207.15m to 209.81m AHD

Hydraulic Data	100 year ARI Flood	Probable Maximum Flood
Minimum Water Level	208.64	209.99
Maximum Water Level	208.81	210.51
Minimum Water Depth	0.13	0.44
Maximum Water Depth	1.49	2.89
Minimum Water Velocity	0.06	0.06
Maximum Water Velocity	0.83	1.77
Minimum Hazard	H1	H2
Maximum Hazard	H4	H5

Definitions:

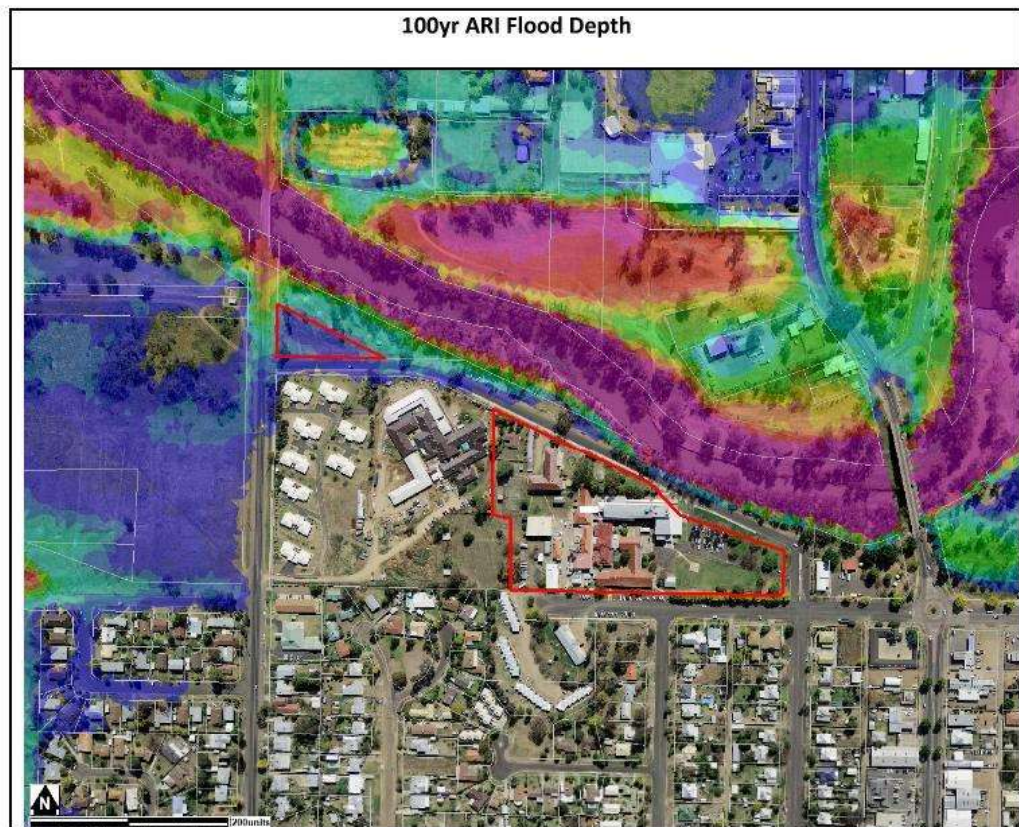
ARI: Average Recurrence Interval (a 100yr ARI has a 1% chance of occurring in any given year)

Level: Elevation of the water surface above Australian Height Datum

Depth: Depth of water above ground level, based on a 20XX ground survey

Velocity: Peak speed of the flood water

Hazard: Potential for floodwaters to affect persons, vehicles, houses and industrial buildings.



The terrain levels provided on this certificate cannot be used for construction purposes. A registered surveyor must be engaged to ensure that all dwellings meet Council's flood planning requirements.

If you have any enquiries regarding this certificate, please contact Council's Planning and Community Development Department on (02) 6757 3222, or at Council@mpsc.nsw.gov.au

James Gilligan

Subject: FW: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

From: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>
Sent: Tuesday, 29 March 2022 1:09 PM
To: Nicole Sutherland <NSutherland@northrop.com.au>
Cc: Syed M. Hasan <S.M.Hasan@mpsc.nsw.gov.au>; Stuart Reynolds <Stuart.Reynolds@mpsc.nsw.gov.au>; Lila-Jane Fisher <Lila.Fisher@mpsc.nsw.gov.au>; Murray Amos <Murray.Amos@mpsc.nsw.gov.au>
Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

G'day Nicole,

Unfortunately, our consultants haven't been able to upload the flood data files onto the NSW Flood Data Portal yet.

However, if you have a look at the report that Rosalie sent through titled Moree FMP Recommendation Investigation, July 30, 2021, in Appendix A it gives the flood level for the 1% AEP Event. As can clearly be seen, there is no water on the hospital lot. So any structure 500mm above natural surface would be above the Flood Planning Level.

I hope this information helps.

Cheers,

Greg Fisher | Project Engineer



Tel: (02) 6757 3426
Email: Greg.Fisher@mpsc.nsw.gov.au
Web: www.mpsc.nsw.gov.au

Level 2, 30 Heber St | Moree NSW 2400 | PO BOX 420

Moree Plains Shire Council's mission is to lead the way in fostering a healthy, positive and well-resourced community.



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From: Nicole Sutherland <NSutherland@northrop.com.au>
Sent: Tuesday, 29 March 2022 12:50 PM
To: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>
Cc: Rory Dale <RDale@northrop.com.au>; Peter Wade <pwade@savills.com.au>; mmcmahon@savills.com.au;
James Gilligan <JGilligan@northrop.com.au>
Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Hi Greg

Just following up on the below. Would the link be available now as we would like to lock in the new building Finished Floor Levels.

Regards

Nicole Sutherland

Associate | Civil Engineer

Northrop Consulting Engineers Pty Ltd

T 02 9241 4188 M 0417 239 925

D 02 9156 3170

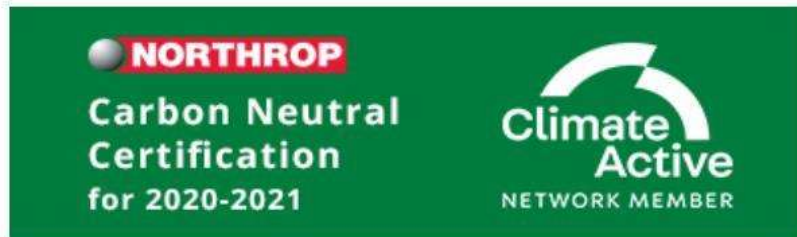
E NSutherland@northrop.com.au

L11, 345 George Street Sydney NSW 2000

www.northrop.com.au



Follow us on



From: Nicole Sutherland

Sent: Friday, 25 March 2022 5:05 PM

To: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>

Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Thanks Greg – appreciate your help

Nicole Sutherland

Associate | Civil Engineer

Northrop Consulting Engineers Pty Ltd

T 02 9241 4188 M 0417 239 925

D 02 9156 3170

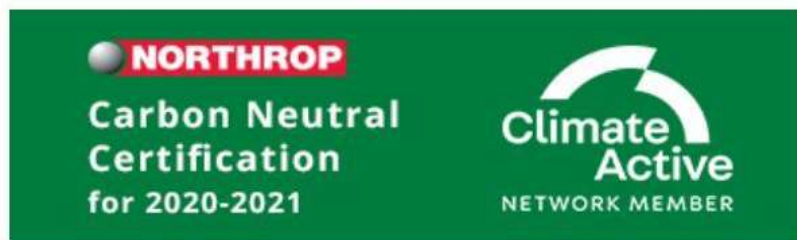
E NSutherland@northrop.com.au

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From: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>

Sent: Friday, 25 March 2022 9:28 AM

To: Nicole Sutherland <NSutherland@northrop.com.au>

Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

G'day Nicole,

I will follow up with our modeller this morning and send you the link as soon as it's in the portal.

Cheers,



Greg Fisher | Project Engineer

Tel: (02) 6757 3426
Email: Greg.Fisher@mpsc.nsw.gov.au
Web: www.mpsc.nsw.gov.au

Level 2, 30 Heber St | Moree NSW 2400 | PO BOX 420

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From: Nicole Sutherland <NSutherland@northrop.com.au>
Sent: Thursday, 24 March 2022 8:26 PM
To: Syed M. Hasan <S.M.Hasan@mpsc.nsw.gov.au>
Cc: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>; Stuart Reynolds <Stuart.Reynolds@mpsc.nsw.gov.au>; Lila-Jane Fisher <Lila.Fisher@mpsc.nsw.gov.au>
Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

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Thanks Syed

Greg – I had a look on the portal however could not find the information. Any chance you could please send me the report/maps or link directly to the specific report that covers the Moree Hospital site?

Appreciate your help.

Regards

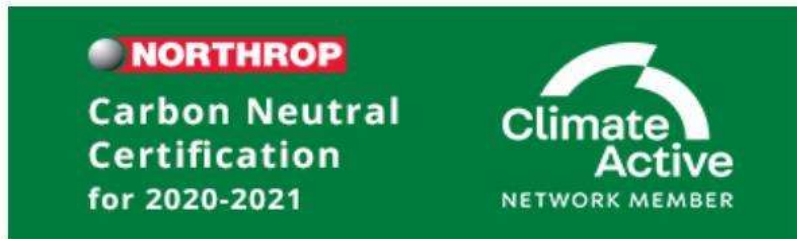
Nicole Sutherland

Associate | Civil Engineer

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From: Syed M. Hasan <S.M.Hasan@mpsc.nsw.gov.au>
Sent: Thursday, 24 March 2022 10:03 AM
To: Nicole Sutherland <NSutherland@northrop.com.au>
Cc: Greg Fisher <Greg.Fisher@mpsc.nsw.gov.au>; Stuart Reynolds <Stuart.Reynolds@mpsc.nsw.gov.au>; Lila-Jane Fisher <Lila.Fisher@mpsc.nsw.gov.au>
Subject: FW: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Hi Nicole,

See attached a flood certificate generated from the Water Ride program. It is important to note that the hospital allotment includes a separate portion of land which is flood liable and skews the way this certificate can be interpreted.

Probably Flood level information will be in the NSW Flood Data portal this afternoon. If you have any question about the NSW Flood data Portal, please contact with Greg Fisher.

Regards

Syed Hasan | Project Engineer



Tel: (02) 6757 3283

Email: s.m.hasan@mpsc.nsw.gov.au

Web: www.mpsc.nsw.gov.au

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From: Shaun Yong <Shaun.Yong@mpsc.nsw.gov.au>
Sent: Monday, 21 March 2022 12:25 PM
To: Murray Amos <Murray.Amos@mpsc.nsw.gov.au>
Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Hi Muz,

Managed to get one done. The only thing is that majority of the site is not impacted by the 1% AEP Flood Event. While the data within the document is for the entire site (11/1113157), the flood data (in particular the 1% AEP) is for the small triangular shaped land north west of the main site.

Do you want me to do some spot height survey for the PMF? I won't be able to get spot height survey for the 1% as we have no data for it.

Cheers.

Kind Regards



Shaun Yong | Land Use Planner

Tel: (02) 6757 3258

Email: shaun.yong@mpsc.nsw.gov.au

Web: www.mpsc.nsw.gov.au

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From: Murray Amos <Murray.Amos@mpsc.nsw.gov.au>

Sent: Monday, 21 March 2022 11:31 AM

To: Shaun Yong <Shaun.Yong@mpsc.nsw.gov.au>

Subject: FW: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Shaun, can you produce a flood information survey on water ride for the hospital site?

Sent from my Galaxy

----- Original message -----

From: "Syed M. Hasan" <S.M.Hasan@mpsc.nsw.gov.au>

Date: 21/3/22 11:25 am (GMT+10:00)

To: Murray Amos <Murray.Amos@mpsc.nsw.gov.au>

Subject: RE: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding

Hi Murray,

Could you please answer the question of highlighted section of the forwarded email?

Regards
Syed Hasan

From: James Gilligan
Sent: Wednesday, 2 March 2022 10:14 AM
To: Lila.Fisher@mpsc.nsw.gov.au; S.M.Hasan@mpsc.nsw.gov.au
Cc: Aline Carvalhaes <ACarvalhaes@northrop.com.au>
Subject: [220253] Moree Hospital Redevelopment - Stormwater Drainage & Flooding [Filed 02 Mar 2022 10:14]

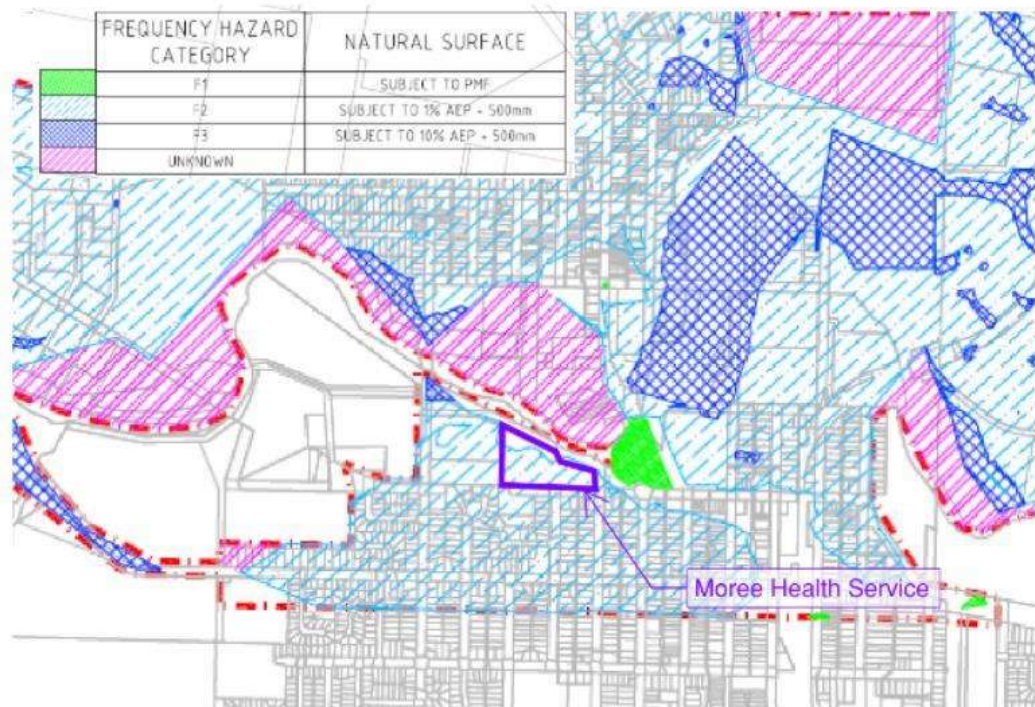
Hi Lila and Hasan

As you are aware, Northrop Consulting Engineers are working with Savills and Health Infrastructure on the Moree Hospital Redevelopment Project.

We are trying to establish the overall stormwater drainage design philosophy for the project and are seeking formal confirmation from Council on the following items.

- General requirements for stormwater drainage – Please confirm design philosophy in the Moree Plains Shire Council Local Government Area for **Minor and Major stormwater drainage infrastructure**. It is understood that the minor system may consider the 1: 20-year (for in-ground pit and pipe network) and major system may consider the 1:100-year storm event (for surface flow paths). Please also confirm maximum ponding depths (assumed 200mm would be acceptable – should it be required at sag pits and the like).
- Requirements for On-site Stormwater Detention to the precinct. Given the location of the development is near to the Mehi River, the provision of OSD may exacerbate local flooding conditions if stormwater is detained however, we will undertake a pre-post assessment of the development based on the net change of impervious area. I understand that this is the adopted philosophy for the Moree Plains Shire Council Local Government Area.
- Requirements for Water Quality Treatment – We understand that there are no specific requirements for water quality treatment of stormwater in the Local Government Area based on previous discussion with Moree Plains Shire Council – other than there being no negative water quality outcomes as noted in the Moree Plains Development Control Plan 2013.
- Flooding Information – Based on previous discussion I understand that model files may be available for the Mehi River which we may be able to obtain. Can you please provide a source link to download this information (if available) or put us in contact with the relevant consultant to obtain this information. We are seeking confirmation of any formal requirements for the proposed development with respect to Flooding. Based on review of the Flood Maps it is understood that the site control is to be 500mm above the 1:100-year Flood Level.

In addition to the above, can you please advise if council can generate a Flood Information Certificate which advises on Flood / Flood Planning Levels for the site – or if this needs to be obtained directly from the model. Based on previous advice received it is understood that a Flood Planning Level of 208.8 (100year) + 500mm freeboard may be considered.



Please feel free to contact me if you would like to discuss the above.

Kind regards,

James Gilligan

Associate | Senior Civil Manager

Northrop Consulting Engineers Pty Ltd

T 02 9241 4188 M 0417 664 577

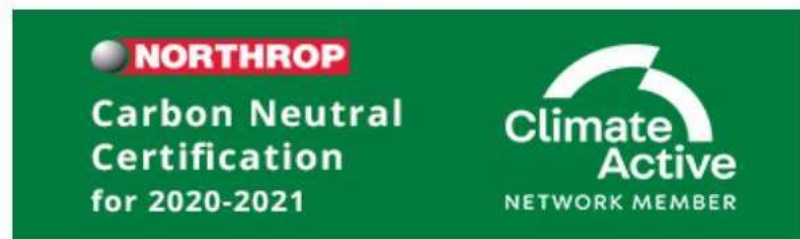
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Moree Plains Shire Council – Flood Certificate

Dear Sir/Madam,

The information supplied in this certificate represents the most current flooding information held by Council at the time the certificate was created.

The Flood Planning Level is calculated as a freeboard above the 100 yr ARI Flood. Moree Plains Shire Council has adopted 500mm (0.5m) above the 100 yr ARI Flood as its Flood Planning Level. Please note, if no water level is given for the 100 yr ARI Flood on your property, it still may have an associated Flood Planning Level. Please contact Council to determine your Flood Planning Level.

The following flood information relates to property "Lot: 11 Section: DP: 1113157"

The ground levels for this property ranges from 207.15m to 209.81m AHD

Hydraulic Data	100 year ARI Flood	200 year ARI flood (old data)	Probable Maximum Flood
Minimum Water Level	208.64	209.22	209.99
Maximum Water Level	208.81		210.51
Minimum Water Depth	0.13		0.44
Maximum Water Depth	1.49		2.89
Minimum Water Velocity	0.06		0.06
Maximum Water Velocity	0.83		1.77
Minimum Hazard	H1		H2
Maximum Hazard	H4		H5

Definitions:

ARI: Average Recurrence Interval (a 100yr ARI has a 1% chance of occurring in any given year)

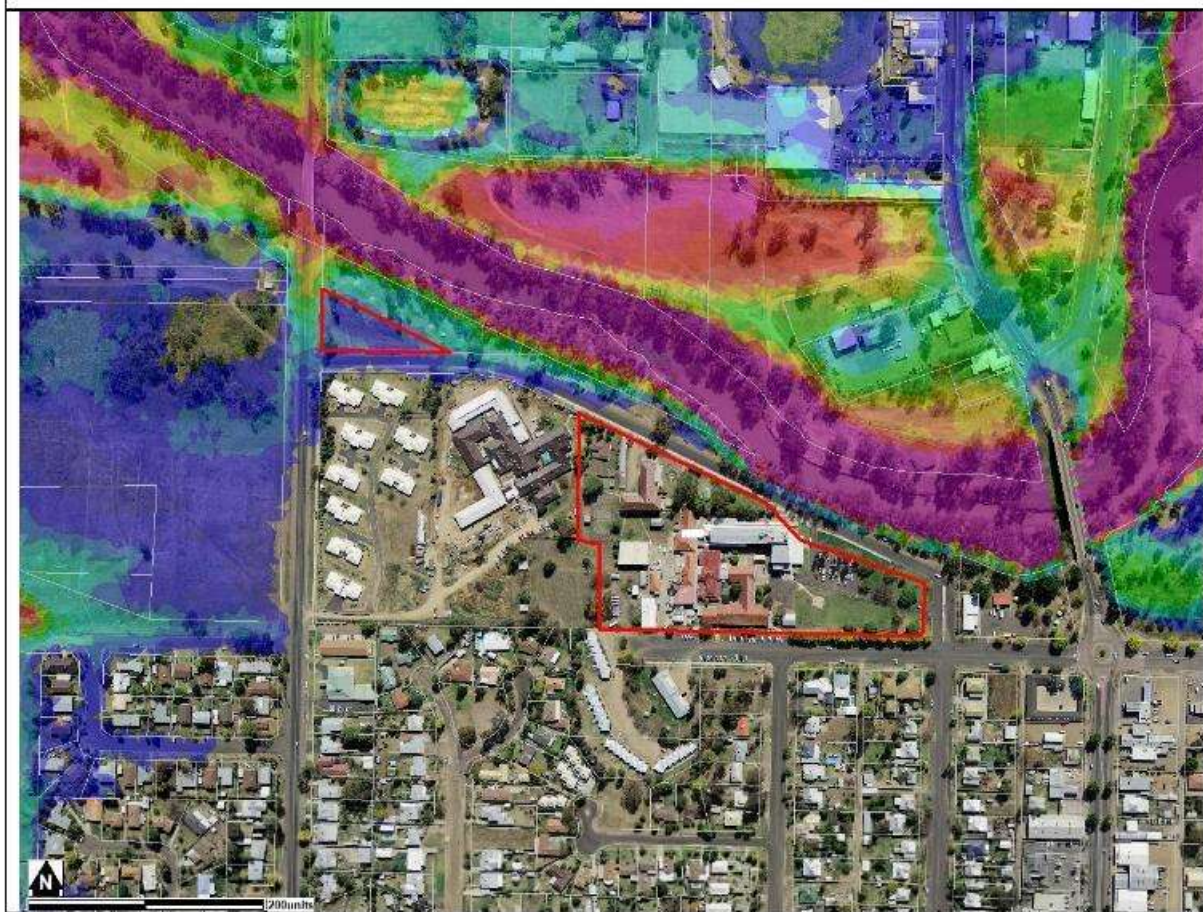
Level: Elevation of the water surface above Australian Height Datum

Depth: Depth of water above ground level, based on a 20XX ground survey

Velocity: Peak speed of the flood water

Hazard: Potential for floodwaters to affect persons, vehicles, houses and industrial buildings.

100yr ARI Flood Depth



PMF (from old study)



The terrain levels provided on this certificate cannot be used for construction purposes. A registered surveyor must be engaged to ensure that all dwellings/buildings meet Council's flood planning requirements.

If you have any enquiries regarding this certificate, please contact Council's Planning and Community Development Department on (02) 6757 3222, or at Council@mpsc.nsw.gov.au

Appendix C – Initial Flood Advice (Northrop, 2023)

20 August 2023

NL231211_B01_[1]

NSW Health Infrastructure
c/- BESIX Watpac
Attention: Sam Taylor
Level 24, 44 Market Street
Sydney NSW 2000

Dear Sam,

Re: Moree Hospital Redevelopment – Initial Flood Advice

Northrop Consulting Engineers have been engaged by NSW Health Infrastructure, care of Besix Watpac, to provide initial advice with respect to potential flood management and mitigation measures for the proposed Moree Hospital Redevelopment.

The advice presented herein is preliminary only and is subject to change following liaison with local agencies responsible for flood emergency management, planning and response. This includes coordination with stakeholders such as NSW Health Infrastructure, Hunter New England Health (as the operator), Moree Shire Council and the State Emergency Service (SES).

Included herein is a summary of the subject site, the proposed development, the existing site flood behaviour, a brief review of State flood related guidelines, and the presentation of four flood management and mitigation measures for the proposed development.

Subject Site

The subject site is located at 35 Alice Street, Moree otherwise known as Lot 11 DP1113157. The site is bound by Victoria Terrace to the north and east, Alice Street to the south and Whiddon Moree Retirement Village to the west.

The subject site is located approximately 40m south of the Mehi River which flows in a westerly direction, bisecting the township of Moree.

The existing site land use is the Moree District Health Service which provides a range of health services including an existing Emergency Department.

Proposed Development

The development proposes to increase the capacity of the existing Moree District Health Service by extending and retrofitting existing buildings on the site and constructing a new two storey ASB building which includes an Emergency Department.

Additional associated site works are also proposed including upgraded parking facilities and landscaping. Please refer to the architectural plans prepared by Silver Thomas Hanley (STH) for further details.

		Date
Prepared by	LG	20/08/2023
Checked by	LG	20/08/2023
Admin	LG	20/08/2023

Flood Behaviour

Figures 1-6 of Attachment 1 presents the flood depth, elevation contours and flood hazard at the site and vicinity during the 1% AEP, 1 in 200 AEP (0.5% AEP) and PMF design storm events. Flood maps have been prepared using Moree Shire Council's "Review of Moree and Environs Flood Study / Floodplain Risk management Study and Plan" prepared by WRM and dated January 2017, herein referred to as "Council's Flood Study (WRM, 2017)".

Review of Figures 1 and 2 suggest the site is expected to be flood free during a 1% AEP however, Figure 3 shows the site is expected to become inundated during a 1 in 200 AEP (i.e. 0.5% AEP). Figure 3 suggests flood depths of up to approximately 400-500mm are likely across the site during the 0.5% AEP.

Flood hazard conditions are based on the latest Australian Rainfall and Runoff guidelines with a summary of hydraulic behaviour and accessibility during each H1-H6 category presented by the inset chart in Figures 2, 4 and 6.

Flood hazard conditions during the 0.5% AEP remain relatively low with Figure 4 suggesting up to H2 hazard conditions are expected across the site during this event. This means that the site is expected to remain trafficable for large vehicles, but non-trafficable for small vehicles during this event. Similarly, pedestrians including children and elderly are expected to be able to walk across the site (although this is not recommended).

External to the site, evacuation from the facility is expected to become difficult, but not impossible during the 0.5% AEP. Figure 4 suggests nearby roads such as Auburn and Ballo Streets are likely compromised during the peak of the 0.5% AEP however, evacuation may still be possible by continuing east along Alice Street and then south up Warialda Street.

During the PMF, Figure 5 suggests flood depths range up to 1.8m on the subject site. Flooding across Moree is extensive during the PMF with flood water expected to extend to approximately Jones Avenue on the southern side of the Mehi River, nearly 1km south of the hospital. This demonstrates a significant flood depth and level of isolation of the site during an extreme flood event.

Figure 6 suggests H5 flood hazard conditions are expected across the subject site during the peak of the PMF. These flood conditions are expected to be unsafe for vehicles and people with all building types vulnerable to structural damage. During major and extreme flood events, the Mehi River (located approx. 40m from the subject site) is observed to link with the Gwydir River, across the Moree Plains, creating an extensive 3-9km wide floodplain. This highlights the magnitude of the hazard and the importance of critical facilities such as the hospital during these events.

Due to the extent of flooding, isolation of the site during a PMF is likely to occur for a prolonged period of time with initial estimates indicating a duration in excess of 6 hours (potentially 24-48hrs). Duration of inundation will be further reviewed during the preparation of the Flood Risk Report.

A summary of the existing site flood behaviour, based on Council's Flood Study (WRM, 2017) is presented in Table 1 overleaf. Note that flood depths are based the results presented by Council's Flood Study (WRM, 2017). Survey levels suggest a minimum site elevation of approx. 208.5m AHD may be observed which highlights the potential for greater flood depths on the site, when compared to Council's Flood Study (WRM, 2017).

Table 1 - Summary of Maximum Site Flood Characteristics

Return Interval	Flood Depth (m)	Flood Elevation (mAHD)	Flood Hazard (ARR 2019)
1% AEP	0.0	209.1*	Not Available
0.5% AEP	0.4	209.3	H2
PMF	1.8	210.5	H5

* Flood level Reported in Mehi River adjacent to the site

State Guidelines / Floodplain Development Manual

Due to the vulnerable nature of the occupants, and reliance on the facility during disasters, a higher level of flood immunity is typically required for hospitals when compared to a standard residential or commercial facility. State Guidelines recognise this requirement with the [NSW Floodplain Development Manual \(2005\)](#) stating (pp.K-4):

“Consideration should be given to using the PMF as the Flood Planning Level when siting and developing emergency response facilities such as police stations, hospitals, SES headquarters and critical infrastructure such a major telephone exchanges, if possible”

Similarly, the NSW Government recently commissioned an [independent expert inquiry into the preparation for, causes of, response to and recovery from the 2022 catastrophic flood event across the state of NSW](#). The inquiry presented several recommendations to improve community resilience and emergency response during flood events. Recommendation 28 states (pp. 37):

“Government ensure hospitals, medical centres, nursing homes, aged care facilities and police stations are situated above the probable maximum flood level”

In addition, the preference for a higher level of protection is recognised by the [latest NSW Department of Planning and Environment \(DPE\) Flood Risk Management Guideline \(FB01\) \(2023\)](#) where a preference to locating hospitals outside the extent of the PMF, where possible, is discussed (see page 49).

The latest Flood Risk Management Guideline (FB01) also recognises the difficulty of relocating existing facilities to a location outside the PMF providing additional guidance with respect to development and operational controls for this scenario discussed and reproduced below (note that additional requirements may also apply):

- Floor levels of emergency medicine areas and patient wards to be sited above an extreme flood level (such as the PMF). This may mean these facilities do not need to be evacuated if services can be maintained.
- The location and protection of backup utility services should be investigated so they can be operational, accessible and available during floods.
- Resupply of essential goods, equipment and materials during floods should be investigated so the facility can continue to operate.
- Adequate room for storage of waste products away from floodwaters should be considered to avoid contamination.
- Design of the site to maximise accessibility of emergency and staff entries into the hospital during floods. This may affect the location and design of the entrance.
- Likelihood of some staff having their homes affected by flooding and their need to look after family members.

These requirements identify both direct and indirect impacts associated with an extreme flood event on the site.

Development Options

A number of potential flood management and mitigation measures have been identified for the proposed facility. These have been placed in order of general consistency with the State Guidelines discussed above (i.e. Option 1 = highest).

Option 1 – Relocate the Facility

Based on a review of the above State Guidelines, there is a strong preference to locate the facility outside the extent of the PMF. A feasibility study to review alternative locations for the hospital has been prepared previously which identified two alternative locations for the site (REF: Concept Design Report; pp.52). These two locations are presented in the below Figure 1.



Figure 1 - Alternative sites (Concept Design Report; pp.52)

These two alternative locations have been reviewed with respect to the potential exposure of these sites during the PMF as presented in Figure 7 of Attachment 1. Figure 7 suggests Site 1 is located outside the mapped PMF flood extent and therefore may enable greater community resilience and support during a flood emergency. Alternative Site 2 has similar and perhaps worse flood conditions (with respect to evacuation) when compared to the existing site and therefore is not recommended.

We understand relocation was not originally preferred by NSW Health Infrastructure given there was already the established campus at the project site. We recommend NSW Health Infrastructure and Besix Watpac revisit the feasibility of relocating the facility now that a greater understanding of the existing flood risk on the subject site and within Site 1 is available.

If considering relocation of the facility, it is recommended relevant stakeholders involved in flood emergency management, planning and response be consulted further. This includes, but is not limited to Hunter New England Health, Moree Shire Council and the State Emergency Service (SES). Advice regarding existing flood emergency management strategies and the location of existing flood emergency shelters would assist to guide the suitability of this strategy.

It is noted that backup of utility services (electrical, potable water, waste etc) and resupply of essential goods and hospital consumables would still need to be considered for this option as it is possible these services may be cut during extreme weather events.

Option 2 – Raise Finished Floor Levels above the PMF

If relocation (i.e. Option 1) is not a feasible option, the latest Flood Risk Management Guideline (FB01) (DPE, 2023) recognises the potential to redevelop the existing site provided the aforementioned development and operational controls are considered.

A summary of potential development and operational controls associated with the proposal is summarised below:

- Raising the Finished Floor Level (FFL) of the proposed facility (or at least the Emergency Department) to a level above the PMF (i.e. min FFL of 210.5m AHD).
- Design provision for the backup of utility services (electrical, potable water, waste, air conditioning / ventilation, etc). Recommended that backup generators / utilities be placed at or protected to a minimum level of the PMF (i.e. 210.5m AHD).
- Noting the potential for prolonged periods of isolation, a review of the feasibility for the facility to remain operable during a PMF event and the feasibility for the resupply of essential goods and hospital consumables (likely prepared by the operator of the facility in consultation with the SES)
- Specialist design of the facility will be required to ensure it can withstand flood forces including debris and impact loading during events up to and including the PMF design storm event.
- Preparation of a Flood Emergency Response Plan to organize flood preparation and response measures for the facility.
- Additional standard development controls are expected to be applicable such as:
 - Construction below the Flood Planning Level (i.e. 1% AEP + 500mm) is to be of suitable flood compatible materials (refer to page 63 of [Moree DCP](#) for material types).
 - Storage of hazardous materials to be placed at or above the Flood Planning Level
 - Electrical wiring connecting to the back up generator to be located above the PMF design storm event.
 - Other electrical wiring not required to maintain operation of the facility during extreme events to be placed or protected up to a minimum of the 1% AEP + 500mm.

It is noted that the proposed development involves retrofitting / extending existing buildings on the site and therefore, raising the FFL may not be a viable solution for all of these facilities. If pursuing this option, it is recommended that the required use and reliance of each of the existing buildings be investigated to confirm whether they provide essential ancillary services for the Emergency Department so that it can remain operable during major or extreme event. If they are required, they should be raised (or protected – per Option 3) to a minimum of the PMF with pedestrian access made available between the facilities at a height above the PMF.

It is anticipated the practicality of this option will require greater analysis from both architectural and civil disciplines to confirm its feasibility. Raising the FFL of the facility to 210.5m AHD will influence access ramps into the facility and site levels. For example, the ground floor level of the new ASB building is currently proposed to be sited at 209.735m AHD. If raising this level to 210.5m AHD, vehicular ramp grades from Alice Street to the Ambulance Drop off zone have the potential to exceed 20% (1:5H).

Similarly, access to the Loading Zone will also be difficult and perhaps impossible. Access to the facility for pedestrians will also mean extended ramps and stairs which is not preferred for the facility given the limited ambulatory capacity of many users. A detailed review of site levels would be required to confirm the feasibility of this option, and it is likely an alternative site layout may need to be investigated to improve ramp grades and access to the facility.

Further to the above, although the facility may remain operable during a PMF, access to the facility from the broader Moree township will be difficult. Access is expected to be impossible by road and will likely require boats and aircraft during the peak of the PMF. Furthermore, positioning the facility within a flood prone area creates additional risk to the community as it may encourage members of the community to enter flood water in order to receive urgent medical treatment.

Option 3 – Maintain proposed levels but protect the facility up to the PMF

This option involves two similar but separate scenarios:

1. Scenario 1 – Full Site Protection: Introduce bunding / flood walls around the boundary of the property and introduce floodgates at site entrances (both vehicular and pedestrian).
2. Scenario 2 – Building Protection: Introduce a flood façade around the vulnerable critical buildings and flood gates at doorway entrances.

This option is intended to enable lower FFLs and landscape levels when compared to Option 2 but still protects the facility from flood water. Similar development and operational controls are expected to be required for this option when compared to those discussed for Option 2 above.

It is important to recognise that flood gates / barriers can be vulnerable to failure if not maintained appropriately. This introduces additional risk, with these measures (and those of Option 2) and are not considered equivalent to moving facility away from the hazard as proposed in Option 1.

Consideration as to how access into the facility can be achieved during the peak of the flood event will also be necessary, particularly for Scenario 2. Access into the facility when flood gates are activated at entrances, and flood water is high and variable may be difficult. Similarly, coincident/cascading hazards such as a fire within the building coupled with a flood event may need to be considered. In this instance, Scenario 1 may be more suitable as occupants may have a space outside the building to evacuate to, in the event of a fire.

Option 4 – Close and Evacuate the Facility prior to major / extreme flood events.

This option involves closing the facility and relocating all staff and patients to an alternative nearby equivalent facility. A lower level of flood protection measures may be applicable if considering this option however, this would need to be weighed against the potential loss of the operation of the facility for a prolonged period of time as repairs are carried out following a significant flood event.

Closure of the facility removes community reliance on the facility during a major or extreme flood event. With this scenario, it is anticipated the facility may need to be closed following notification of a 0.5% AEP or greater flood event. This would mean that patients and staff would need to relocate to an equivalent facility nearby (likely determined by Hunter New England Health / NSW Health Infrastructure).

Closure and evacuation from the facility increases the strain on, most likely, already exhausted resources. The logistics of the evacuation would need to be reviewed with respect to the capacity of nearby facilities to receive evacuees / additional patients, travel time to the alternative facility, available resources to facilitate the move, the available warning time prior to the flood event, and the likely vulnerability / condition of the patients.

Conclusion

A desktop investigation of the subject site with respect to the existing flood behaviour outlined by the Review of Moree and Environs Flood Study / Floodplain Risk management Study and Plan (WRM, 2017) has been presented herein. A preliminary review of recent State legislation has been performed with respect to the proposed hospital.

Four site flood management and mitigation options have been reviewed and discussed with a preferred option (Option 1) recognised.

Should you have any questions or require further information, please do not hesitate to contact the undersigned on (02) 4943 1777.

Yours sincerely,

Prepared by:



Laurence Gitzel

Associate | Flood Engineer

BEng(Env) MProfEng(Env) MIEAust CPEng NER (Civil)

Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by NSW Health Infrastructure. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

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The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation. This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required.

To the extent permitted by law, Northrop expressly excludes any liability for any loss, damage, cost, or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report.

Attachment 1 – Flood Figures

Appendix D – Draft Flood Emergency Response Plan (Northrop, 2023)



CIVIL

Flood Emergency Plan

for

Moree Hospital

for NSW Health Infrastructure

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Report Details

Project: Moree Hospital Development
35 Alice Street, Moree, NSW 2400

Project Ref: NL231211

File Location: Y:\YEAR 2023 Jobs\NL231211 - Moree Hospital Redevelopment\E - Reports\FLOOD\NL231211_Flood_Emergency_Plan_[3].docx

Revision History

Revision	Report Status	Prepared	Reviewed	Issue Date
1	Draft	N Parana Manage	L Gitzel	22/09/2023
2	Draft	L Gitzel	L Gitzel	13/11/2023
3	Draft	L Gitzel	L Gitzel	7/12/2023

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		Date
Prepared by	NM	07/12/2023
Checked by	LG	07/12/2023
Admin	LG	07/12/2023

Flood Response Summary

The following provides a summary of the findings of this Flood Emergency Plan including a summary of the flood behaviour, floor levels with respect to the flood behaviour, the recommended flood response actions, and the recommended off-site flood refuge locations.

Flood Levels

Table 1 - Summary of Maximum Site Flood Characteristics

Flood Probability (Return Interval)	Flood Depth (m)	Flood Elevation (m AHD)	Flood Velocity (m/s)	Flood Hazard (ARR 2019)
1% AEP	0.0	209.1*	Not Flooded	Not Flooded
0.5% AEP	0.5	209.3	2.0	H2
PMF	2.0	210.5	2.0	H5

* Flood level Reported in Mehi River adjacent to the site

Site Plan and Floor Levels

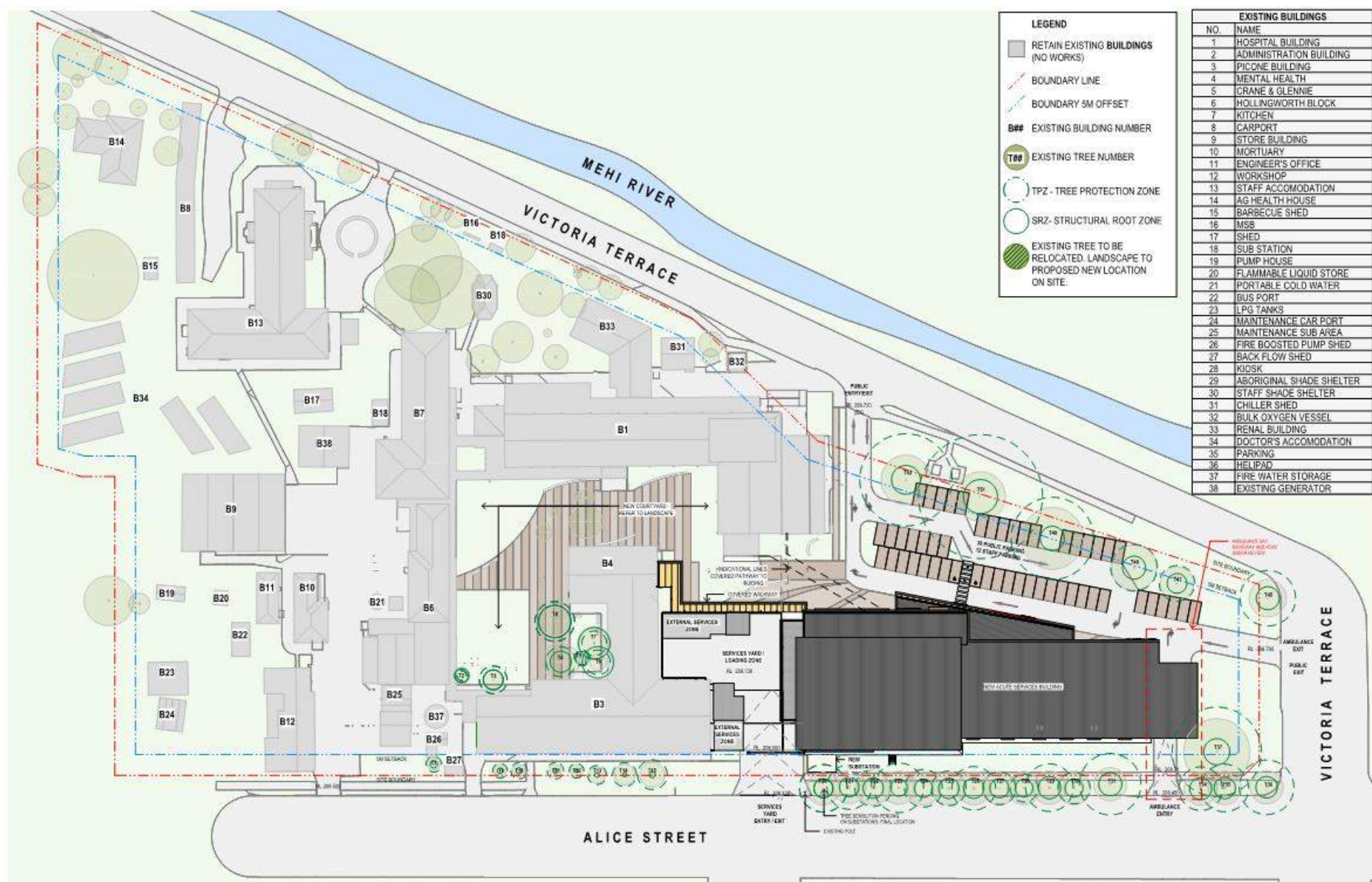


Figure 1 - Site Plan and Building Numbers (STH, REV F - 8/09/2023)

Table 2 - Floor Levels of Habitable Hospital Buildings

Site Location	Level (m AHD)	Relationship to Flood Levels
ASB - Ground Floor Level	209.73	Above 1% AEP, Above 0.5% AEP and Below PMF
ASB - Level 1	214.23	Above PMF
B1 - Ground Floor Level	209.73	Above 1% AEP, Above 0.5% AEP and Below PMF
B3 - Ground Floor Level	209.51	Above 1% AEP, Above 0.5% AEP and Below PMF
B4 - Ground Floor Level	209.53	Above 1% AEP, Above 0.5% AEP and Below PMF
B6 - Ground Floor Level	209.56	Above 1% AEP, Above 0.5% AEP and Below PMF
B7 - Ground Floor Level	209.63	Above 1% AEP, Above 0.5% AEP and Below PMF
B9 - Ground Floor Level	209.20	Above 1% AEP, Below 0.5% AEP and PMF
B10 - Ground Floor Level	209.59	Above 1% AEP, Above 0.5% AEP and Below PMF
B11 - Ground Floor Level	209.58	Above 1% AEP, Above 0.5% AEP and Below PMF
B12 - Ground Floor Level	208.77	Protected from 1% AEP, Below 0.5% AEP and Below PMF
B13 - Ground Floor Level	209.25 - 210.05	Above 1% AEP, Below 0.5% AEP and PMF
B14 - Ground Floor Level	209.60	Above 1% AEP, Above 0.5% AEP and Below PMF
B25 - Ground Floor Level	209.53	Above 1% AEP, Above 0.5% AEP and Below PMF
B33 - Ground Floor Level	209.72	Above 1% AEP, Above 0.5% AEP and Below PMF

Key Personnel*Table 3 – Key Personal Summary*

Person Organisation	Name	Number
Incident Controller		(02) 6757 0009 0428 657 610 (After Hours)
Incident Control Centre (ICC)		
Health Services Functional Area Coordinator		(02) 4921 3000
Moree Hospital Switch		(02) 6757 0000 0428 657 610 (After Hours)
ED Disaster Phone		0436 414 205
SES	-	132 500
Police / Fire / Ambulance	-	000

Flood Response Actions

Table 4 – Flood Response Actions Summary

WHEN	TRIGGER	ACTION	BY WHO
Prior to Flooding	Immediate	Assemble Emergency Kits	Incident Management Team (IMT) / Health Service Manager / Health Liaison Officers (HLO)
	Immediate and Ongoing	Devise emergency shutdown and evacuation procedures including (but not limited to): <ul style="list-style-type: none"> - Assess Road Transport Capabilities - Transport of critical materials and resources (including staff) - Location and storage of hazardous materials - Power down of medical equipment 	Incident Controller/ IMT
	Three monthly	Check Floodsafe Kits	IMT / Health Service Manager
	Twice per year	Coordinate Evacuation Drills	Incident Controller/ IMT
	Immediate and ongoing	Sign up, maintain and review Early Warning Network and Hazard Near Me subscription and warnings	Incident Controller/ IMT
	Daily	Monitor Weather Situation Daily	Incident Controller/ IMT
IMT Assemble	Receive Flood Warning with a Major Flood Classification including a gauge depth at the Moree Gauge of 8.80m .	Assemble IMT and monitor the flood situation for worsening conditions.	Incident Controller / IMT
Site Closure and Evacuation	Receive Flood Warning with a Major Flood Classification including a gauge depth at the Moree Gauge of 11.16m .	Contact and Notify HSFAC (Alert Phase)	Incident Controller
		Assemble IMT	Incident Controller
		Contact Staff / Wards to confirm receipt of evacuation notification. However maintain normal duties until further notice (Standby Phase)	IMT

		Confirmation of Code Brown from Ambulance Control / HSFAC	Incident Controller
		Trigger Code Brown Alert on PA/Hospital notification System notifying staff and patients of impending flood emergency (Response Phase)	Incident Controller/ IMT
		Notify Police / SES of the planned evacuation of the facility.	Incident Controller/ IMT
		Confirm availability of nearby Nominated Evacuation Centres / SES.	Incident Controller/ IMT
		Coordinate Evacuation	Incident Controller/ IMT Staff
		Collect Floodsafe Kits and any additional items.	Incident Controller/ IMT
		Leave signage notifying any responders attending the site that evacuation has been undertaken.	Incident Controller/ IMT
		Evacuate Patients, Staff and Visitors to Nominated Evacuation Centres / alternative facilities and remain until given all clear.	Incident Controller/ Logistic Incident Controller / IMT
Once Risk has Passed / After a Flood	Flood has receded and All Clear issued.	Check all services and structural stability of building/s. Rectify if necessary.	Qualified persons
		Notify HSFAC of Stand down.	Incident Controller/ IMT
		Return to normal operation	All

Route to Off-Site Evacuation Centre/s

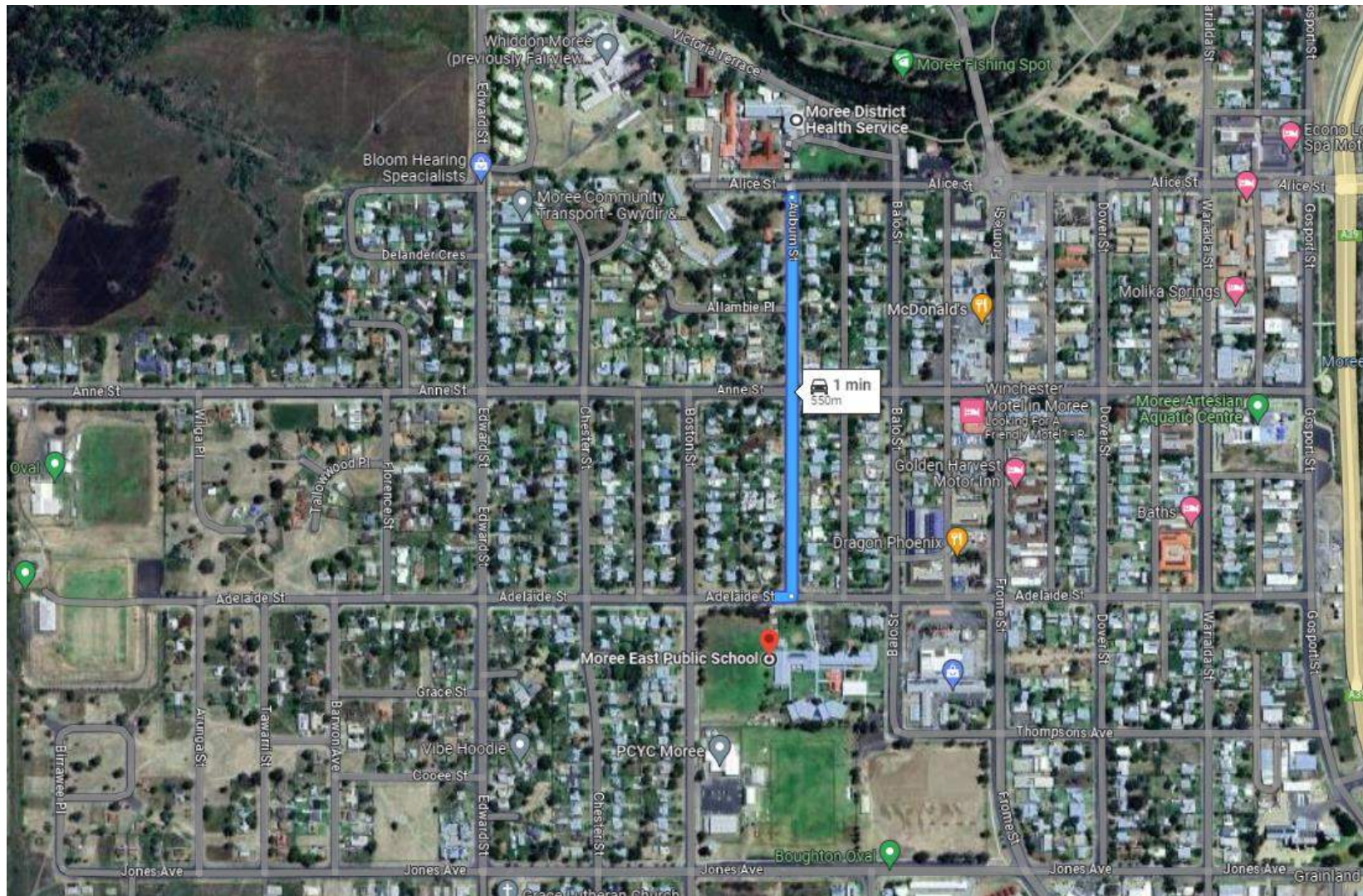


Figure 3 – Evacuation Route to Moree Secondary Collage

Introduction

Northrop Consulting Engineers have been engaged by NSW Health Infrastructure, care of Besix Watpac to prepare a Flood Emergency Plan (FEP) for the Moree District Health Service at 35 Alice Street, Moree (the subject site).

This plan recommends closure and evacuation of the facility during events in excess of the 1% AEP design storm event. This is recommended due to the potential for Critical Building Services to become flood affected during these events and the difficulty with respect to access and egress for the facility.

It is important to always follow the advice from emergency services during an emergency. If the SES or other emergency services require closure and evacuation of the facility prior to the triggers presented herein, direction received from emergency services takes precedence over any information presented herein. Flood events are dynamic emergencies. It is expected emergency services on the ground at the time of the event will have the most up to date advice.

It is noted that this plan is not intended to replace other emergency plans currently in place at the Hospital. It is intended to supplement current plans and provide greater clarity on potential site conditions and response measures available.

This plan has been prepared for the purposes the Review of Environmental Factors (REF) for the proposed upgraded Acute Services Building. It is intended to be reviewed on a regular basis as updated flood information becomes available and as operational and procedural practices within the hospital are revised.

This plan has been prepared in Draft format and it is expected the plan will be further fine-tuned in consultation with the operator (i.e. Hunter New England Health), the NSW SES, Moree Plains Shire Council, and other emergency response agencies, as appropriate, prior to occupation of the new ASB building.

Subject Site

The subject site is located within the MPSC LGA at 35 Alice Street, Moree otherwise known as Lot 11 DP1113157. The site is bound by Victoria Terrace to the north and east, Alice Street to the south and Whiddon Moree Retirement Village to the west and is susceptible to riverine flooding from Mehi River located approximately 40m to the north of the site.

A review of LiDAR elevation data and site survey suggests the site is relatively flat with a minimum site elevation of approx. 208.5m AHD observed in the south-western corner of the site. Remaining elevations across the site range from approx. 208.75-209.25m AHD.

A subject site locality plan is presented below in Figure 2

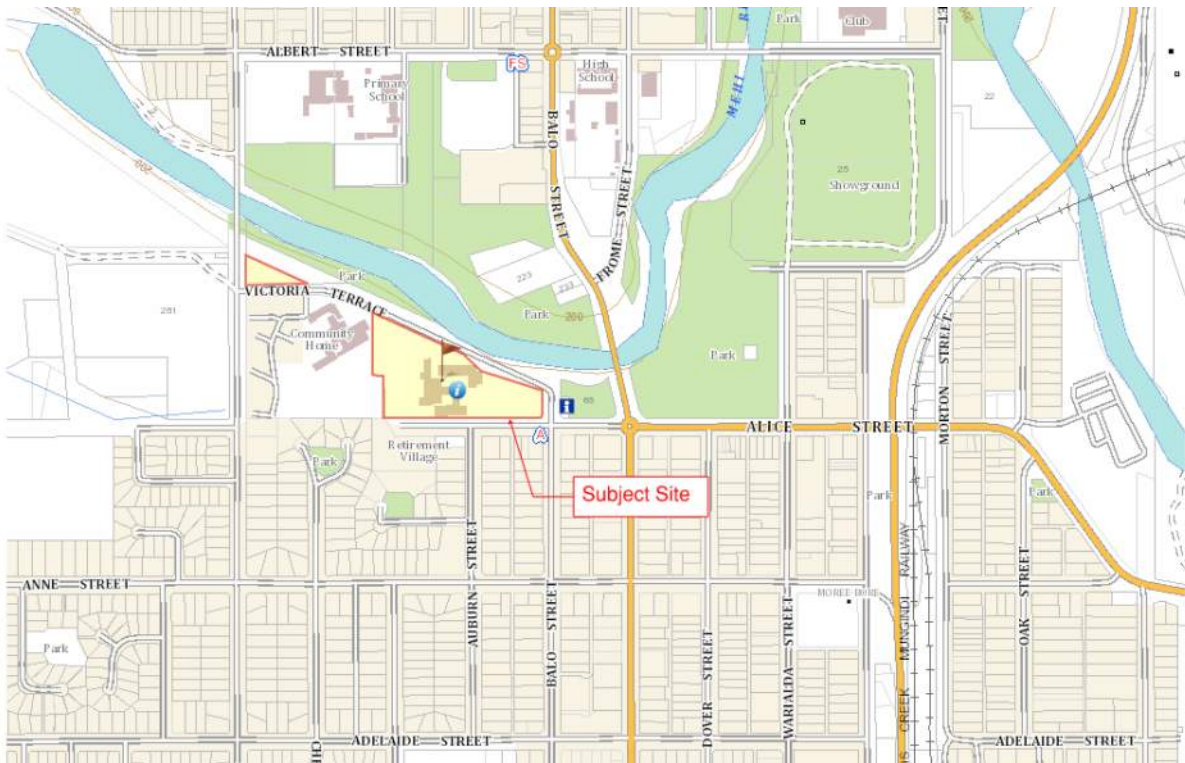


Figure 2 - Locality Plan (obtained from SIX Maps www.maps.six.nsw.gov.au)

This Flood Emergency Plan (FEP) has been prepared to:

- Promote awareness of expected flood behaviour and flood risks associated with the subject site.
- Outline the procedures for managing a flood event.
- Nominate roles and responsibilities when preparing for and responding to a flood emergency.
- Identify measures to monitor weather forecasts and highlight warning systems available.
- Provide education and awareness material for training programs with respect to flooding of the subject site.
- Identify potential evacuation and evasion procedures including evacuation routes and flood refuge opportunities.

Contained herein is a description of the methodology and information used to prepare this report, a summary of the likely flood behaviour, recommendations for flood preparation and recommended response actions during a flood event.

Methodology and Available Data

This plan was prepared based on the flood information presented in the “Moree and Environs Flood Study / Floodplain Risk management Study and Plan” prepared by WRM and dated January 2017, herein referred to as “*Council’s Flood Study (WRM, 2017)*”.

Additional information with respect to the flood behaviour at the subject site, and the site details have been obtained from the following documents:

- Flood Risk Report prepared by Northrop Consulting Engineers, dated the 22nd of September 2023, herein referred to as the “Flood Risk Report (Northrop, 2023)”.
- Architectural Plans prepared by Silver Thomas Hanley (STH) and dated September 2023.

The expected flood behaviour for the subject site is based on the above flood study and site plans and is summarised in the **Flood Behaviour** and **Floor Level** sections of this plan.

A review of the Bureau of Meteorology (BoM), State Emergency Service (SES) guidelines and Moree Plains Shire Local Flood Plan (2012) has been undertaken to report on the likely warning types described in the **Flood and Evacuation Warnings** section of this plan.

A review of the Moree District Hospital Disaster Plan has provided advice with respect to the personnel most likely to be on-site and responsible for flood emergency response. Those expected to be responsible are outlined in the **Flood Response Personnel** section of this plan.

Similarly, a review of the Moree District Hospital Disaster Plan has informed the nominated in the **Assembly Point, Evacuation Routes** section of this plan.

Contact numbers for relevant emergency response agencies and the local evacuation centre/s are noted in the **Emergency Contact** section of this plan.

Finally, a review of the aforementioned flood studies, Moree District Hospital Disaster Plan, Moree Plains Shire Local Flood Plan and Northrop’s Flood Risk Report (2023) have contributed to the recommended preparation and response actions outlined in the **Flood Response Preparation** and **Flood Response Actions** sections of this plan.

Flood Behaviour

Flood Source and Behaviour

The subject site is susceptible to riverine flooding from the Mehi / Gwydir River located approximately 40m to the north of the site. The Mehi River flows in a westerly direction, bisecting the township of Moree during frequent and in-frequent events. During major and extreme flood events, the Mehi River (located approx. 40m from the subject site) is observed to link with the Gwydir River, across Moree Plains, creating an extensive 3-9km wide floodplain.

Inundation across the site is expected to occur initially as the adjacent Mehi River breaks its banks with floodwater continuing across the site in a south-westerly direction and towards the intersection of Alice and Auburn Streets. An additional flow path is also observed passing across the southern boundary of the site, with flows derived by the Mehi River overtopping the Werris Creek Mungindi Railway line approximately 700m west of the site. Flows that overtop the rail corridor are then expected to continue in a westerly direction towards Allambie Place and adjacent to the southern boundary of the site.

Council's Flood Study (WRM, 2017) suggests a critical duration of 48 hours is expected at the site for all return intervals considered. This means that a long duration of immersion at the site is expected (possibly 12 - 48 hours or more), especially during an extreme flood event (i.e. the PMF).

As per Council's Flood Study (WRM, 2017), the time it takes for the flood peak to travel from the Chinook gauge (418087) to the Moree gauge (418002), a distance of approximately 12km, is between 7 to 9 hours and as such, a minimum warning time of 7 hours is expected to be available for the subject site.

It is important to note that the flood events discussed herein are rare and extreme flood events that are not expected to occur every time it rains. The 1% AEP and 0.5% AEP design storm events are commonly referred to as the 100-year and 200-year flood events respectively, while the Probable Maximum Flood (PMF) is defined notionally in Council's Flood Study (WRM, 2017) as the 1 in 55,000-year event (i.e. 0.0018% AEP).

Flood Depth and Elevation

Figures A1 to A3 of Attachment 1 presents the flood depth and elevation contours at the site and vicinity during the 1% AEP, 0.5% AEP PMF design storm events. The maps presented in Attachment 1 have been prepared using the data presented in Council's Flood Study (WRM, 2017).

Review of Figures A1-A3 suggest the site is expected to be flood free during a 1% AEP however, Figure A2 shows the site is expected to become inundated during a 0.5% AEP. Figure A2 suggests flood depths of up to approximately 300-500mm is likely across the site during the 0.5% AEP.

During the PMF, Figure A3 suggests flood depths range up to 2.0m on the subject site. Flooding across Moree is extensive during the PMF with flood water expected to extend to approximately Jones Avenue on the southern side of the Mehi River, nearly 1km south of the hospital. This demonstrates a significant flood depth and level of isolation of the site during an extreme flood event.

Flood Hazard

Flood hazard conditions are based on the latest Australian Rainfall and Runoff (2019) guidelines with a summary of hydraulic behaviour and accessibility during each H1-H6 category presented by the following Figure 2. Similarly, Figures A4 to A6 of Attachment 1 presents the flood hazard conditions at the site and vicinity during the 1% AEP, 1 in 200 AEP (i.e. 0.5% AEP) and PMF design storm events.

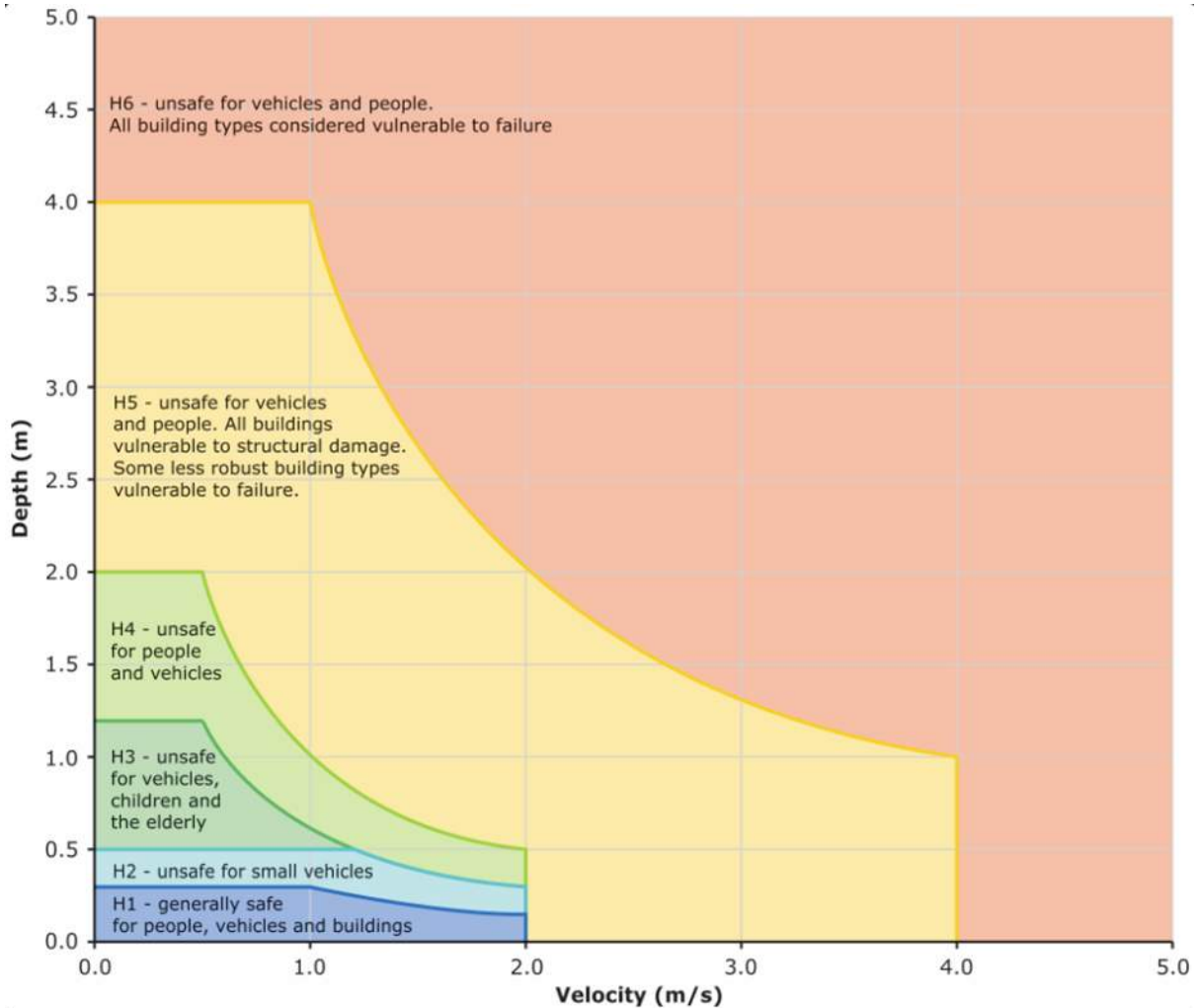


Figure 3 - Australian Rainfall and Runoff (2019) Hazard Categories

Flood hazard conditions during the 0.5% AEP is expected to remain relatively low with Figure A5 suggesting up to H2 hazard conditions are expected across the site during this event. This means that the site is expected to remain trafficable for large vehicles, but non-trafficable for small vehicles during this event. Similarly, pedestrians including children and elderly are expected to be able to walk across the site (although this is not recommended).

External to the site, evacuation from the facility is expected to become difficult, but not impossible during the 0.5% AEP. Figure A5 suggests nearby roads such as Auburn and Ballo Streets are likely compromised during the peak of the 0.5% AEP however, evacuation may still be possible by continuing east along Alice Street and then south up Warialda Street.

Although flood conditions at the site may not be extremely hazardous, during a 0.5% AEP, it is possible Critical Building Services may be cut (including back-up provisions). As such, it is expected that the site will need to be evacuated during a predicted 0.5% AEP design storm event.

Figure A6 suggests H5 flood hazard conditions are expected across the subject site during the peak of the PMF. Similar conditions are observed across a large portion of Moree with H5 hazard conditions extending to Adelaide Street, approximately 600m south of the subject site. Review of the above Figure 2 suggests flood conditions are expected to be unsafe for vehicles and people with all building types vulnerable to structural damage. Evacuation during this event will be extremely difficult and likely only possible by aircraft.

Flood Velocity

Figures A7 to A9 of Attachment 1 presents the flood velocity at the site and vicinity during the 1% AEP, 0.5% AEP and PMF design storm events.

Figure A8 suggests flood velocities are generally less than 2.0m/s during the 0.5% AEP. Peak velocities across the site are observed in the eastern portion of the site with velocities generally less than 0.8m/s expected elsewhere across the site.

During the PMF, Figure A9 of Attachment 1 suggests velocities in the order of 1.0-2.0m/s are expected across full extent of the site.

Summary of Flood Behaviour

A summary of the expected flood behaviour across the subject site for each return interval is presented in Table 1 below.

Table 3 - Summary of Maximum Site Flood Characteristics

Flood Probability (Return Interval)	Flood Depth (m)	Flood Elevation (m AHD)	Flood Velocity (m/s)	Flood Hazard (ARR 2019)
1% AEP	Not Flooded	209.10*	Not Flooded	Not Flooded
0.5% AEP	0.5	209.30	2.0	H2
PMF	2.0	210.51	2.0	H5

* Flood level Reported in Mehi River adjacent to the site

Do not Drive or Walk through Floodwater.

Remember, If It's Flooded, Forget It!

Flood and Evacuation Warnings

A network of rainfall gauge stations is maintained throughout the Moree region. These provide information to the Bureau of Meteorology (BoM) as one source of information informing their flood warning system.

The Bureau should issue one of five types of warnings through local radio, television and through their website <http://www.bom.gov.au>. In addition, the SES may issue a flood bulletin, evacuation warning or evacuation order.

Due to the sensitive nature of this location, it is recommended the Incident Controller and all members of the Incident Management Team (IMT) of the Moree District Hospital register for automatic text and email notifications from the Early Warning Network which filters and passes on BoM warnings.

In addition, the Hazards Near Me App and Bureau of Meteorology Weather App/ Website provides information for current flood behaviour and warnings.

Bureau of Meteorology

Severe Weather Warning

Severe weather warnings are issued by the Bureau for potentially dangerous weather conditions. A description of the threat will be included in the warning along with the time for next issue. It is noted that a severe weather warning does not imply that flooding will eventuate. Warnings have varying lead-times, depending on the weather situation, and can range from just an hour or two up to about 24 hours. These warnings are generally updated every six hours, or as the event dictates.

This type of warning should be accompanied with predicted extreme rainfall depth or predicted river gauge levels, as well as observed values from around the state.

Severe Thunderstorm Warning

A severe thunderstorm warning will be issued if there is strong evidence that a severe thunderstorm will develop, or if a severe thunderstorm is reported. Flash flooding may occur during severe thunderstorms. Warnings are generally updated every three hours or shorter as required.

Flood Alert/ Watch/ Advice

A flood alert / watch / advice is one of the earliest warnings that will be issued by the BoM with advice provided up to four days in advance of the expected onset of flooding (BoM). Although four days warning may be available, they are also occasionally issued during and after the rainfall has occurred, depending on the level of maturity of the flood warning systems and services (BoM).

Generalised Flood Warning

A generalised flood warning is typically more specific than the Flood Alert / Watch / Advice and is issued when flooding is expected to occur in a given area. Three hours warning time is expected from issue of warning to peak flood level as per the "Service Level Specification for Flood Forecasting and Warning Services for New South Wales – Version 3.13" (Bureau of Meteorology, 2020).

Minor/ Moderate / Major Flood Warning

A Minor / Moderate / Major Flood Warning typically provides more information than a generalised flood warning and is issued when flooding is expected to occur in a given area. These warnings are usually accompanied by a flood gauge level and timing for the peak to occur.

Twelve (12) to twenty-four (24) hours warning time is expected from issue of warning to peak flood level as per the "Service Level Specification for Flood Forecasting and Warning Services for New South Wales – Version 3.13" (Bureau of Meteorology, 2020) for the nearby Moree Gauge (418002).

This is expected to be the most likely warning for the site that will provide enough information to trigger response actions on the subject site.

All warnings will be issued through the SES / BOM website, radio and television.

Television:

ABC, Prime, NBN. NRTV.

Radio:

2VM / NowFM (1530AM / 98.3FM), ABC Local (99.1FM), 2NOW / MaxFM (91.3FM), 2TM (1287AM), 2MO (1080AM), 2WEB (585AM) and 2NZ (11188AM).

SES Flood Bulletins

The Northwest SES Division Headquarters distributes SES Flood Bulletins to media outlets and agencies on behalf of all SES units in the region, and other related information (including flood warnings) to the following regional media outlets. The SES Flood Bulletins may contain the following information.

- Current warnings, together with indications of the likely impact of flooding at any predicted heights.
- Current flood heights and flood behaviour.
- Details of conditions and closures of main roads, and
- Advice on safe
- ty matters and means of protecting property.

The NSW SES will issue three levels of warnings.

Advice

The SES will issue flood advice acknowledging that an incident has started and informing people to stay up to date in case the situation changes.

Watch and Act

The SES will issue a Watch and Act warning when flood conditions are changing and the purpose of this warning to prepare for evacuation / isolation or avoid the area that is expected to impact by flooding.

Emergency Warning

The SES will issue an Emergency Warning if evacuation is required. If this occurs **evacuation must be undertaken**. Broadcast will be via radio/ TV, door knock, automated telephone message or SMS.

On-Site Emergency Communication

Emergencies can be declared through the hospital Public Address (PA) system.

As outlined in the Moree District Hospital Disaster Plan (HNELHD, 2022), natural disasters such as flooding are categorised as CODE BROWN – EXTERNAL EMERGENCY and a notification of a Code Brown is received via the communication cascade usually from Ambulance Control or via the HNE LHD HSFAC.

If the facility is to be evacuated, the IMT to generally follow the Order of Evacuation procedure outlined in the Moree District Hospital Disaster Plan (HNELHD, 2022) – Code Orange – Evacuation

In addition, air horns and loudspeakers are to be located within the Flood Emergency Kits or Health Response Team Emergency Equipment Kits on site. If onsite when the alert is issued, the Incident Management Team can use these items to obtain people's attention and direction.

Other Warning Types / Resources

Standard Emergency Warning Signal (SEWS)

This signal may be played over radio and television stations to alert communities to Evacuation Warnings Evacuation Orders or Special Warnings or Dam-Failure Warnings.

Early Warning Network Automated Text and Email Services

It is recommended the Incident Controller and all members of the IMT register for automatic alerts within the Early Warning Network (www.ewn.com.au) which will filter the above BoM warnings and send texts and emails to notify of the situation.

Hazards Near Me NSW

Recently the NSW SES and NSW Public Works have created a new tool called [Hazards Near Me App NSW](#) which is both a webpage and Phone Application. The application filters BoM and RFS warnings relevant to the user and may be used by the Incident Controller and all members of the IMT as an additional resource. The Application is free and allows the user to input a radius of interest for receiving notifications.

Hazard Watch

The NSW SES and Australian Federal Government have prepared the [HazardWatch](#) portal that filters BoM warnings and provides advice on locations and magnitude of predicted hazards. This resource is also free and can be accessed via a smart phone, tablet or laptop.

Flood Response Personnel

Summarised in below Table 4 are the Moree District Hospital personnel, their location and responsibilities in managing the emergency flood response.

The information presented below has been obtained from the Moree District Hospital Disaster Plan (HNELHD, 2022)

Table 4 - Flood Response Personnel and Regional Evacuation Centres

Personnel	Location	Responsibilities
Incident Controller (Health Services Manager or After- Hours Manager)	On site	<ul style="list-style-type: none"> Responsible for overall direction of the incident and is the person in charge. Monitor weather daily for upcoming major or extreme rainfall events. Receive notifications from the Early Warning Network. Monitor Hazards Near Me App including predicted flood levels at the Moree Gauge (418002). Upon receiving of the notification / warning of flooding, confirm the details with the Health Services Functional Area Coordinator (HSFAC) of the Local Health District (LHD) and the notifying organisation the need to activate the disaster plan. Determine the response required (e.g., continue business as usual or initiate Incident Management Team (IMT) notification / preparedness). Nominate members of the IMT in preparation of an emergency. Commence activation of the Incident Control Centre (ICC). Determine staff availability during an emergency. Decide when closure of the facility and evacuation is required. Communicate closure and evacuation to the staff via communication cascade. Liaison with SES or Emergency Services personnel. Refer to the Moree District Hospital Disaster Plan (HNELHD, 2022) for additional responsibilities.

Incident Management Team (IMT) – Operations	On-site	<ul style="list-style-type: none"> • Managing and coordinating the response activities. • Assisting the management team. • Implementing the Action Plan. • Maintain Health Response Team Emergency Equipment Kits. • Receive notifications from the Early Warning Network. • Monitor Hazards Near Me App flood levels at the Moree Gauge. • Refer to the Moree District Hospital Disaster Plan (HNELHD, 2022) for additional responsibilities.
Incident Management Team (IMT) – Planning	On-site	<ul style="list-style-type: none"> • Collection and evaluation of the emergency event. • Development of the Incident Action Plan. • Implementing the Action Plan. • Maintain Health Response Team Emergency Equipment Kits. • Monitor weather daily for upcoming major or extreme rainfall events. • Receive notifications from the Early Warning Network. • Monitor Hazards Near Me App flood levels at the Moree Gauge. • Refer to the Moree District Hospital Disaster Plan (HNELHD, 2022) for additional responsibilities.
Incident Management Team (IMT) – Logistics	On-site	<ul style="list-style-type: none"> • Identify staff under responsibility of logistics; security, patient transport, catering, housekeeping and engineering. • Brief staff on current situation. • Review Traffic Flow Arrangement and maintain clear access for Emergency Services Vehicles. • Assess need for alternative facilities and if necessary, acquire, maintain and secure such facilities. • Assess and provide site support, including water, fuel, equipment maintenance. • Maintain Health Response Team Emergency Equipment Kits.

		<ul style="list-style-type: none"> • Receive notifications from the Early Warning Network. • Monitor Hazards Near Me App flood levels at the Moree Gauge. • Refer to the Moree District Hospital Disaster Plan (HNELHD, 2022) for additional responsibilities.
Staff	On-site	<ul style="list-style-type: none"> • Assist the IMT with coordinating the evacuation / emergency response measures as required. • Maintain normal duties unless instructed otherwise. • Do not ring the switchboard unless for an emergency. • Receive notification of closure or evacuation via the communication cascade. • Remain calm and follow evacuation procedures as required. • Assist IMT with evacuation procedures as required
Moree District Hospital Incident Control Centre	On-Site The Function Room, Moree District Hospital, Victoria Terrace, Moree 2400.	On-site Incident Control Centre as defined by the Moree District Hospital Disaster Plan (HNELHD, 2022)
Moree East Public School	Off-Site Evacuation Centre Cnr of Adelaide Street and Boston Street, Sth Moree	Offsite Regional Evacuation Centre defined in Moree Plains Shire Flood Emergency Sub Plan (SES, 2012). Contact the SES prior to seeking refuge here to ensure it is open.
Moree PCYC	Off-Site Evacuation Centre 360 Boston Street, Sth Moree	Offsite Regional Evacuation Centre defined in Moree Plains Shire Flood Emergency Sub Plan (SES, 2012). Contact the SES prior to seeking refuge here to ensure it is open.

The Incident Controller is expected to be allocated by the operator (Hunter New England Health) and is defined in the Moree District Hospital Disaster Plan (HNELHD, 2022) as the most senior clinical staff member, the Health Service Manager or After-Hours Manager.

The Incident Management Team (IMT) is expected to be personnel nominated as per Moree District Hospital Disaster Plan (HNELHD, 2022) and will support the Incident Controller during a flood event.

The hierarchy of roles for these personal is presented in the Moree District Hospital Disaster Plan (HNELHD, 2022) and reproduced in Figure 6 below.

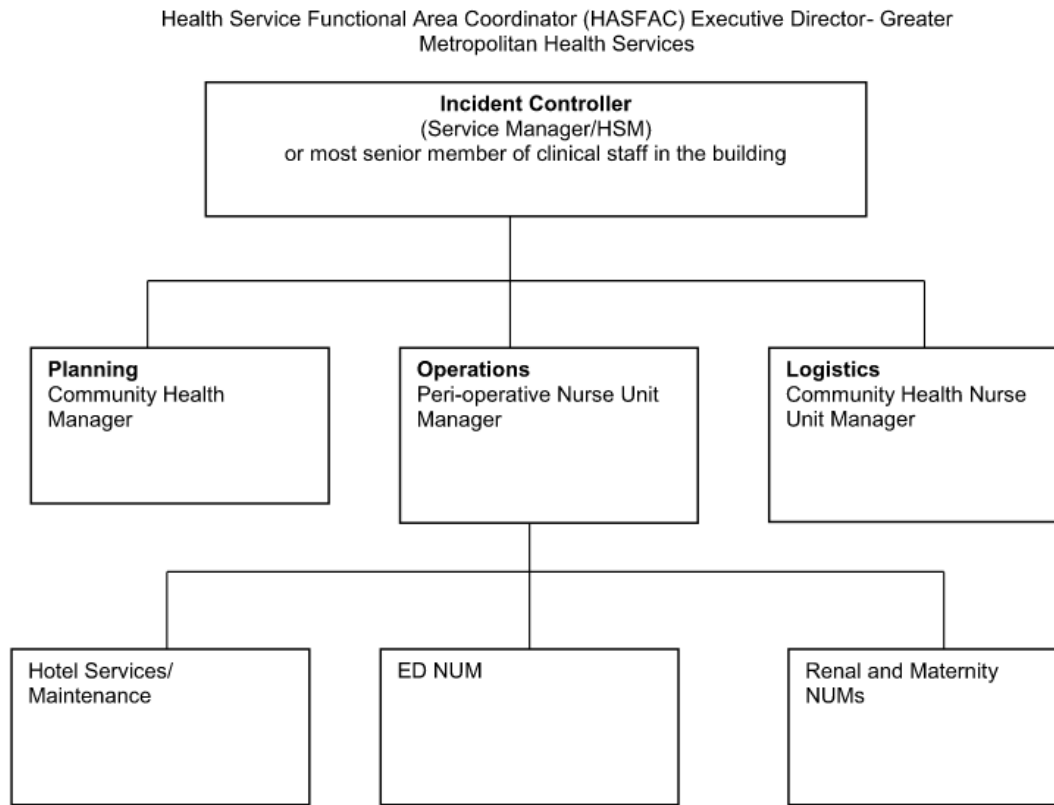


Figure 6 - Flood Response Personnel Hierarchy (Moree District Hospital Disaster Plan; HNELHD, 2022)

Site Floor Levels and Flood Immunity

Floor Levels / Site Levels

The Ground Floor Level of each habitable floor on the site is presented below in Table 8 while each building is presented in the below Figure 4. The relationship of Ground Floor Finished Floor Levels with respect to the 1% AEP, 0.5% AEP and PMF flood levels is also presented in Table 8.

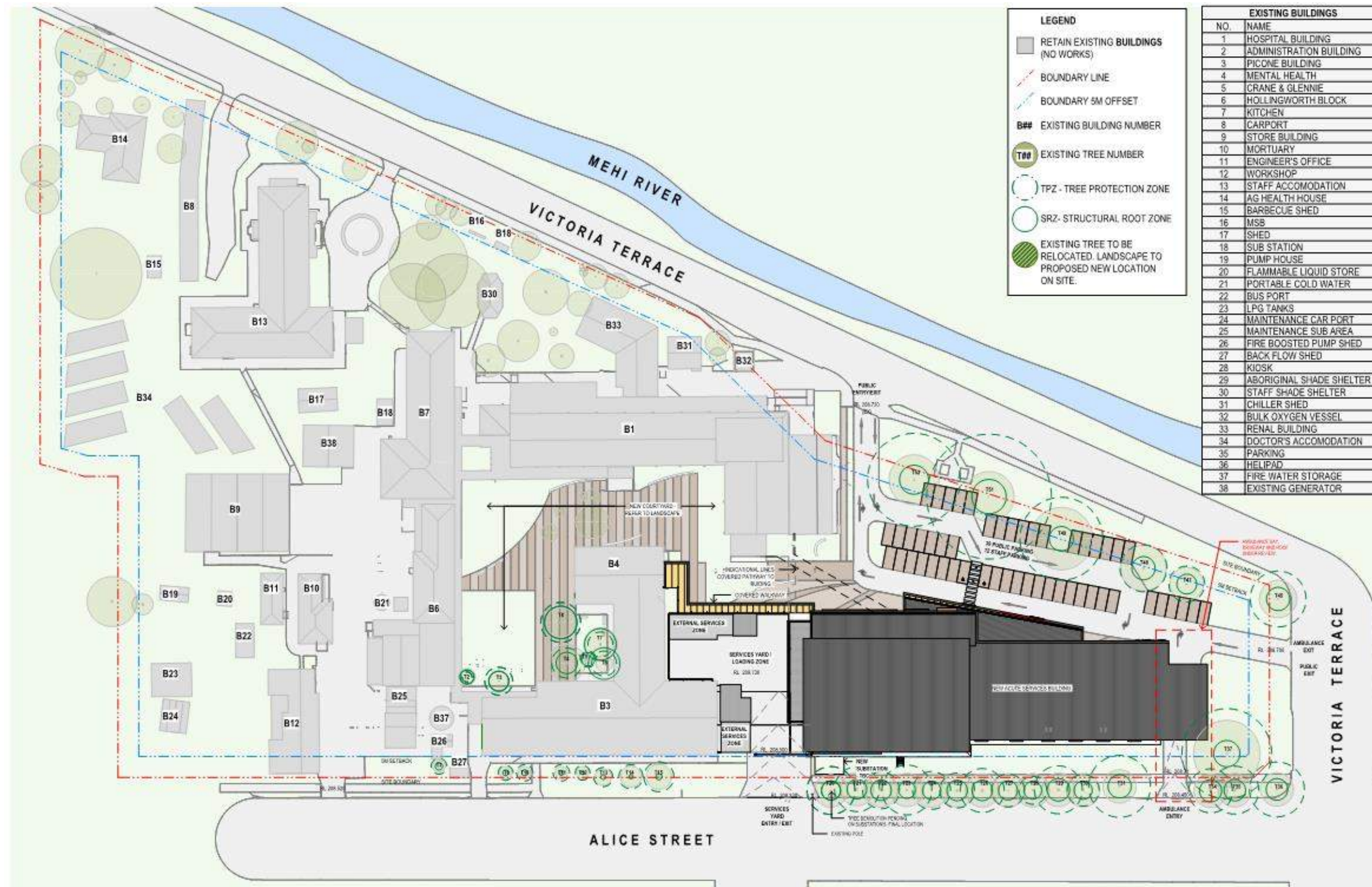


Figure 4 - Site Plan (STH, 2023)

Table 5 - Floor Levels of Habitable Hospital Buildings

Site Location	Level (m AHD)	Relationship to Flood Levels
ASB - Ground Floor Level	209.73	Above 1% AEP, Above 0.5% AEP and Below PMF
ASB - Level 1	213.93	Above PMF
B1 - Ground Floor Level	209.73	Above 1% AEP, Above 0.5% AEP and Below PMF
B3 - Ground Floor Level	209.51	Above 1% AEP, Above 0.5% AEP and Below PMF
B4 - Ground Floor Level	209.53	Above 1% AEP, Above 0.5% AEP and Below PMF
B6 - Ground Floor Level	209.56	Above 1% AEP, Above 0.5% AEP and Below PMF
B7 - Ground Floor Level	209.63	Above 1% AEP, Above 0.5% AEP and Below PMF
B9 - Ground Floor Level	209.20	Above 1% AEP, Below 0.5% AEP and PMF
B10 - Ground Floor Level	209.59	Above 1% AEP, Above 0.5% AEP and Below PMF
B11 - Ground Floor Level	209.58	Above 1% AEP, Above 0.5% AEP and Below PMF
B12 - Ground Floor Level	208.77	Protected from 1% AEP, Below 0.5% AEP and Below PMF
B13 - Ground Floor Level	209.25 - 210.05	Above 1% AEP, Below 0.5% AEP and PMF
B14 - Ground Floor Level	209.60	Above 1% AEP, Above 0.5% AEP and Below PMF
B25 - Ground Floor Level	209.53	Above 1% AEP, Above 0.5% AEP and Below PMF
B33 - Ground Floor Level	209.72	Above 1% AEP, Above 0.5% AEP and Below PMF

Flood Response Actions

Response Actions

In the event where a Major Flood Warning of any level is issued from the Bureau of Meteorology, the Incident Management Team should be assembled to assess the situation and escalate actions as necessary. It is likely increased demand on the facility will be required during this event with a large portion of the Moree Plains expected to become inundated during an event of this magnitude.

If a Major Flood Warning is issued by the Bureau of Meteorology event with flood levels likely to exceed a 1% AEP, it is recommended the facility be closed to eliminate the need for people to be onsite or travelling to or from the site during a flood event. During events in excess of the 1% AEP, there is the potential for Critical Building Services to be compromised (including back-up provisions).

Corresponding gauge levels are presented in the following Table 6. During a 1% AEP flood event, patients and staff currently on site would need to relocate to an equivalent facility nearby (to be determined by the Incident Management Team). All non-essential staff and visitors can either return home (if safe to do so) or proceed to one of the regional evacuation centres outlined in the

Gauge Triggers to Initiate Response Actions

The following Table 7 demonstrates the relationship between the expected Flood warnings (Minor, Moderate and Major), corresponding Moree gauge levels and the expected site response/flood consequence at each respective gauge level.

These have been based on the information presented in the Moree Plains Shire Local Flood Plan (2012) and the Zero Gauge Level at the Moree Gauge of 197.94m AHD (Site No. 418002) (WaterNSW, 2022).

It is noted that the Moree Gauge is located directly upstream of the Dr Geoffrey Hunter Bridge. Flood elevations at this location are similar to expected flood levels at the subject site.

Table 6 - Flood Classifications, Trigger Heights and Flood Level Response/Consequence

Flood Classification	Gauge Depth (m)	Estimated Gauge and Site Flood Level (m AHD)	Flood Response/Consequence
Minor	5.5	203.44	
Moderate	7.6	205.54	
Major	8.8	206.74	IMT to assemble and monitor the situation
Major 1% AEP	11.16	209.10	
Major >1% AEP	>11.16	>209.10	Closure and Evacuation of the Facility
Major 0.5% AEP	11.36	~209.30	
Major 0.063% AEP	11.79	~209.73	ASB Over Floor Flooding Expected
Major PMF (0.0018% AEP)	12.57	~210.51	

Timing

The Bureau of Meteorology Service Level Specification (Version 3.13) suggests a target warning lead time of 24 hours should be available prior to a flood event with the capability to generate a flood depth at the Moree Gauge in excess of 7.0m. This is below a Moderate (7.6m) and Major (8.8m) flood event at the Moree Gauge and is well below the nominated trigger evacuation depth of 11.16m as presented in Table 6 above.

Although prior warning, in the order of 24 hours is expected during an evacuation event, it is important to recognise flood events are dynamic and it is possible less time may be available. Evacuation should commence and be completed as soon as possible following receipt of a Major flood classification with predicted depth at the Moree Gauge in excess of 11.16m.

It is recommended the operator review opportunities to make this as quick and efficient as possible.

Evacuation

Closure of the facility removes community reliance on the facility during a major or extreme flood event. With this scenario, it is anticipated the facility will need to be closed following notification of a flood event in excess of 1% AEP. This would mean that patients and staff would need to relocate to an equivalent facility nearby (likely determined by Hunter New England Health / NSW Health Infrastructure).

The logistics of the evacuation would need to be reviewed with respect to the capacity of nearby facilities to receive evacuees / additional patients, travel time to the alternative facility, available resources to facilitate the move, the available warning time prior to the flood event, and the likely vulnerability / condition of the patients. It is the responsibility of the IMT to manage the situation with assistance from the Health Services Functional Area Coordinator.

It is recommended all non-essential operations in the hospital be cancelled on any day there is a **Flood Warning** with a **Major Flood Classification** including a gauge depth at the Moree Gauge greater than **11.16m**. This is equivalent to a return interval above the 1% AEP (or a 1 in 100yr event) as shown in the above Table 7.

Note that the evacuation triggers proposed are expected to be used as a guide only. In the event where emergency services request the site be evacuated at a lower predicted trigger depth, direction from emergency services takes precedence over the findings of this report.

Evacuation Priorities

It is likely some patients may not be mobile at the time when an emergency is declared. In such an event, the procedure to direct patients to the Evacuation Point should generally follow the Order of Evacuation procedure outlined in the Moree District Hospital Disaster Plan (2022) – Code Orange – Evacuation and reproduced below.

Group One - Ambulant Persons

The first group to be evacuated is ambulant occupants (those who only require a member of staff to direct them to the designated assembly point).

Group Two - Semi-Ambulant Persons

Evacuate semi-ambulant persons next (patients/persons who need some assistance). If a wheelchair is used to evacuate a person to a safe area, it must be returned to the area being evacuated for further use if safe to do so.

Group Three - Non-Ambulant Persons

Evacuate non-ambulant persons using various evacuation techniques – as per WH&S procedures. In the event of a fire, place non ambulant persons on the floor below the smoke line whilst attending to the evacuation of Groups 1 and 2.

Group Four- Aggressive, Violent or Non-Compliant patients

Strategies should be in place to handle aggressive, violent or resistive persons during evacuation.

Ensure all people (patients/staff/visitors) remain within the designated assembly point.

It should be noted that there is a risk that power and essential services to the building may be cut off during a major flood event. This may cause a significant problem if in the middle of a procedure. As such any high-risk patients should be transferred to a nearby hospital prior to the commencement of rainfall. This should be undertaken in accordance with the procedure outlined in the Moree District Hospital Disaster Plan (2022) with the NSW Ambulance Service contacted at the first available opportunity following declaration the emergency.

On-Site Refuge

On-site refuge is not recommended during a flood event.

Although some upper floor levels are above the worst case PMF event there is the potential for structural damage during extreme events.

Closure of the facility is recommended with all staff, patients and any visitors to evacuate the site following receipt of a Major Flood Warning with a quantitative flood depth at the Moree Gauge in excess of 11.16m. This is equivalent to a return interval in excess of the 1% AEP.

If trapped on-site during a flood event, contact the SES immediately on 132 500.

If you are in a life-threatening situation please call Police, Fire or Ambulance on 000.

Evacuation Centres and Routes

Transporting Patients

Following receipt of a Major Flood Warning issued by the Bureau of Meteorology event with flood levels likely to exceed a 1% AEP, the IMT are to liaise with the Health Services Functional Area Coordinator to understand which nearby equivalent facilities remain open and have capability to receive and treat additional patients.

Given the magnitude of the events discussed herein, it is possible other nearby facilities may be experiencing similar flood conditions. Coordination for alternative facilities will need to be managed with the Health Services Functional Area Coordinator.

It is recommended the SES be contacted prior to transporting patients to ensure transport routes to alternative facilities are likely to remain open. This will reduce the risk of emergency services becoming trapped while transporting patients.

Nearby Regional Hospitals managed by Hunter New England Health are summarised below:

- Inverell Hospital
- Narrabri Hospital
- Tamworth Hospital
- Glen Innes
- Armidale

Evacuation Centres

With the closure of the facility, any non-essential staff or visitors who are unable to return home may proceed to the following Regional Evacuation Centres.

- Moree East Public School, Cnr of Adelaide and Boston Streets, Moree.
- Moree Police Community Youth Centre (PCYC) – 360 Boston Street, Moree

The above Evacuation Centres are nominated as Regional Evacuation Shelters for South Moree as outlined in the Moree Plains Shire Local Flood Plan (2012).

Evacuation of non-essential staff or visitors will require coordination by the IMT. It is recommended the SES be contacted prior to proceeding to these facilities to ensure the centres are activated and are accessible. It is recommended those contacting the SES also seek additional advice with respect to the trafficability of nearby roads to ensure a safe route to the evacuation centres is available.

Evacuees seeking refuge in these facilities should take vehicles with them to reduce the potential for property damage due to potential flooding in the lower lying areas of Moree.

Evacuation Route

Once availability and access to the evacuation centres is confirmed, evacuation should be undertaken to the agreed evacuation centre under the control of IMT. A recommended evacuation route is presented in Figure 9 below.

It is imperative that evacuation occur prior to the flood peak. Many roads in the vicinity of the site are expected to be cut by floodwater and evacuation will become increasingly difficult as flood water rises.

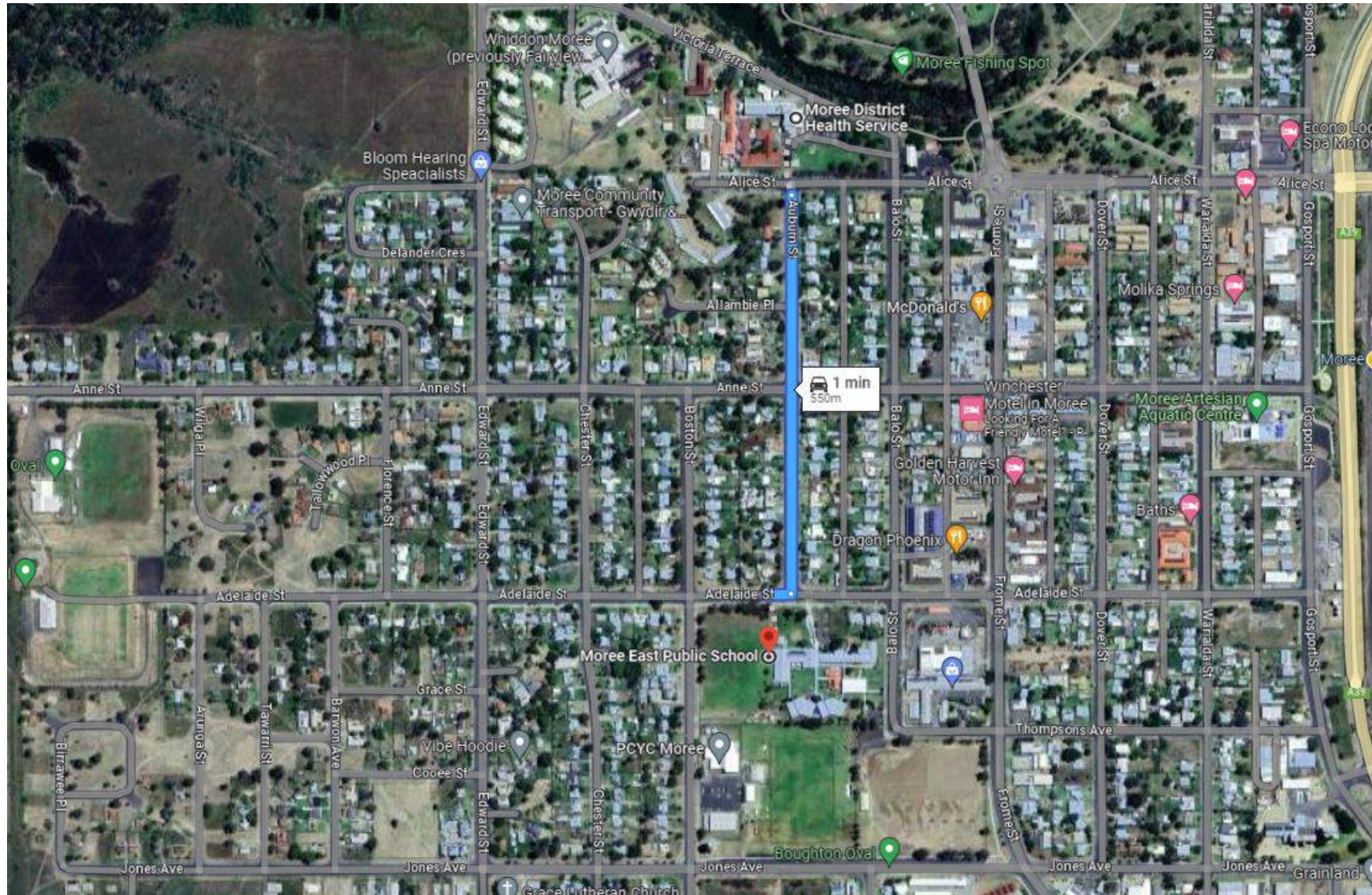


Figure 5 - Evacuation Route to Moree East Public School / PCYC

Emergency Contact

The Incident Controller contact details are (02) 6750 0009 or 0428 657 610 (after hours)

The Hunter New England Local Health District Health Services Functional Area Coordinator can be contacted on (02) 4921 3000.

The Moree Hospital Switch line is (02) 6757 0000 or 0428 576 610 (after hours)

The Emergency Department Disaster Phone is 0438 414 205

For emergency assistance during flood events, please call the **SES** on **132 500**.

If anyone becomes **trapped on-site during a flood event**, it is recommended that they contact the **SES on 132 500** immediately to receive advice.

If you are in a life-threatening situation please call **Police, Fire or Ambulance** on **000**.

Do not Drive or Walk through Floodwater.

Remember, If It's Flooded, Forget It!

Flood Response Preparation

It is the responsibility of the Incident Controller to prepare the facility for a flood event. This will be achieved through; nomination of the Incident Management Team (IMT), induction training, drills, education for staff of the flood risks and behaviour on-site and enabling the preparation and maintenance of a Floodsafe Emergency Kits and Health Response Team Emergency Equipment Kits.

The information presented above is a summary of the flood behaviour and is considered key to understanding the risks associated with flooding. This should be displayed in conjunction with other emergency information (such as fire, etc.) throughout the centre.

Flood Emergency Response Drills

Flood Emergency Response Drills are designed to increase flood awareness within the Facility. These drills should to be undertaken twice per year to familiarise staff within the facility of the procedures when responding to a flood event.

It is also an opportunity to outline expected flood levels and dangers of entering flood water. The following link can be used as a resource for relocating and/or evacuating patients that are mobility impaired: <https://www.ses.nsw.gov.au/floodsafe/what-floodsafe-means-for-you/mobility-impaired/>.

Induction Training

Induction training provides an opportunity educate staff of the expected flood levels and dangers of entering flood water. For new staff, it is expected they will be made familiar with the site flooding conditions and made familiar with the emergency procedures and response during an initial site induction.

Storage of Sensitive Goods

All sensitive goods which are susceptible to damage from flood waters or, if exposed to floodwaters would have significant ramifications to the surrounding area, must be isolated to ensure exposure to flooding does not result in significant property and environmental damage.

Monitoring of Weather Situation

It is the responsibility of the Incident Controller and the IMT to monitor the weather situation of be aware if a warning has been issued. This will be achieved through automatic text messages and emails from the Early Warning Network, and checking Hazards Near Me App and reviewing local radio stations, TV networks and the Bureau of Meteorology website.

TRIGGER FOR MONITORING:

- Continuous – 4pm daily.

BY WHO; Incident Controller and the Incident Management Team (IMT)

Flood Signage

Signage highlighting the subject site is flood prone should be placed throughout common areas across the site. Example Signage has been provided in Attachment 2.

Floodsafe Emergency Kit / Health Response Team Emergency Equipment Kits on site

It is recommended IMT to prepare multiple Floodsafe Emergency Kits / Health Response Team Emergency Equipment Kits on site in the event where evacuation of the site is required.

All designated IMT's are to be familiar with the standards and deployment of the emergency equipment kits. These kits shall be located within the Moree District Hospital Incident Control Centre or with the Health Services Manager.

In addition to the Health Response Team Emergency Equipment Kits, potential items for a flood emergency kit are outlined at: <https://www.ses.nsw.gov.au/floodsafe/prepare-your-home/emergency-kit/>, and reproduced below:

- Drinking water, medicines and non-perishable food items.
- A copy of the facilities emergency management plan.
- Chemical register.
- Air horn and hand-held loudspeaker.
- Portable radios with spare batteries.
- Torches with spare batteries.
- Lanterns with spare batteries.
- Two-way radio with spare batteries.
- A first aid kit.
- Candles and waterproof matches.
- Waterproof bag for valuables.
- A copy of emergency numbers.

When leaving or evacuating add the following items (or otherwise per IMT evac strategies):

- **Register** of Staff, Patients and Visitors on-site.
- **Sign in book** for visitors and contractors.
- **Individual Health Care Plans** including asthma puffers, diabetes medication, epi pens, etc.
- **Drinking water** and **non-perishable food items**.

The contents of the kits and management during a flood event will be the responsibility of the **Incident Controller, IMT, Health Liaison Officers, Health Service Manager and First Aid Officers**.

TRIGGER FOR REVIEW AND EDUCATION:

- Six monthly checking of the emergency kits to ensure all items are in suitable working order.
- Inductions for new staff, highlighting the flood risk associated with the subject site.

BY WHO; Incident Controller, Health Liaison Officers and Health Service Manager.

After a Flood – Stand Down

Once a Final Flood Warning or SES “All Clear” has been received:

- A check of building structural capacity by qualified persons if significant flooding occurred.
- A thorough check of services such as electricity, sewer, water and gas should be undertaken by qualified persons.
- Personal protective equipment should be worn during the clean-up and disinfectant used. Clean up will likely require specialist assistance due to the sensitive nature of the facility.

In consultation with the Incident Controller and the HSFAC stand down will be declared once the facility/service has returned to normal status. The Incident Controller will:

- Notify the IMT and all departments of stand down.
- Implement recovery strategies as required.

TRIGGER FOR RETURN:

- All clear given by SES / HSFAC
- IMT to coordinate inspections for buildings & services to be performed by qualified personnel

BY WHO; SES, IMT, Emergency services, qualified personnel.

Revision of this Flood Evacuation Plan

This plan should be revised if the “Moree and Environs Flood Study / Floodplain Risk management Study and Plan” prepared by WRM and dated January 2017 is revised or if a new Flood Study is prepared for the area.

Similarly, this plan should be revised if the Moree Shire Local Flood Plan (SES, 2012) is updated.

Notwithstanding the above, this plan shall be revised.

- Following a flood event.
- After an operational change.
- Every three years as a minimum.

Revisions should be undertaken by a suitably qualified flood emergency response consultant.

DRAFT

Conclusion

The Hospital is expected to be susceptible to flooding during events in excess of the 1% AEP.

A review of the subject site and anticipated flood behaviour has been reviewed to determine following recommended site flood response emergency response actions:

- The IMT should assemble following receipt of a Flood Warning Major to monitor the flood situation at the subject site
- The facility be closed and evacuated following receipt of a Flood Warning with a Major Flood Classification and gauge depth at the Moree Gauge in excess of 11.16m. This is equivalent to a return interval in excess of the 1% AEP (commonly referred to as a 1 in 100yr event).

Additional preparation, response and recovery procedures are presented herein.

Through adoption of this plan, flood risk on site can be minimised as much as possible. The recommendations contained herein are expected to assist the IMT in managing the risk to life of the patients, staff and visitors during a significant flood event.

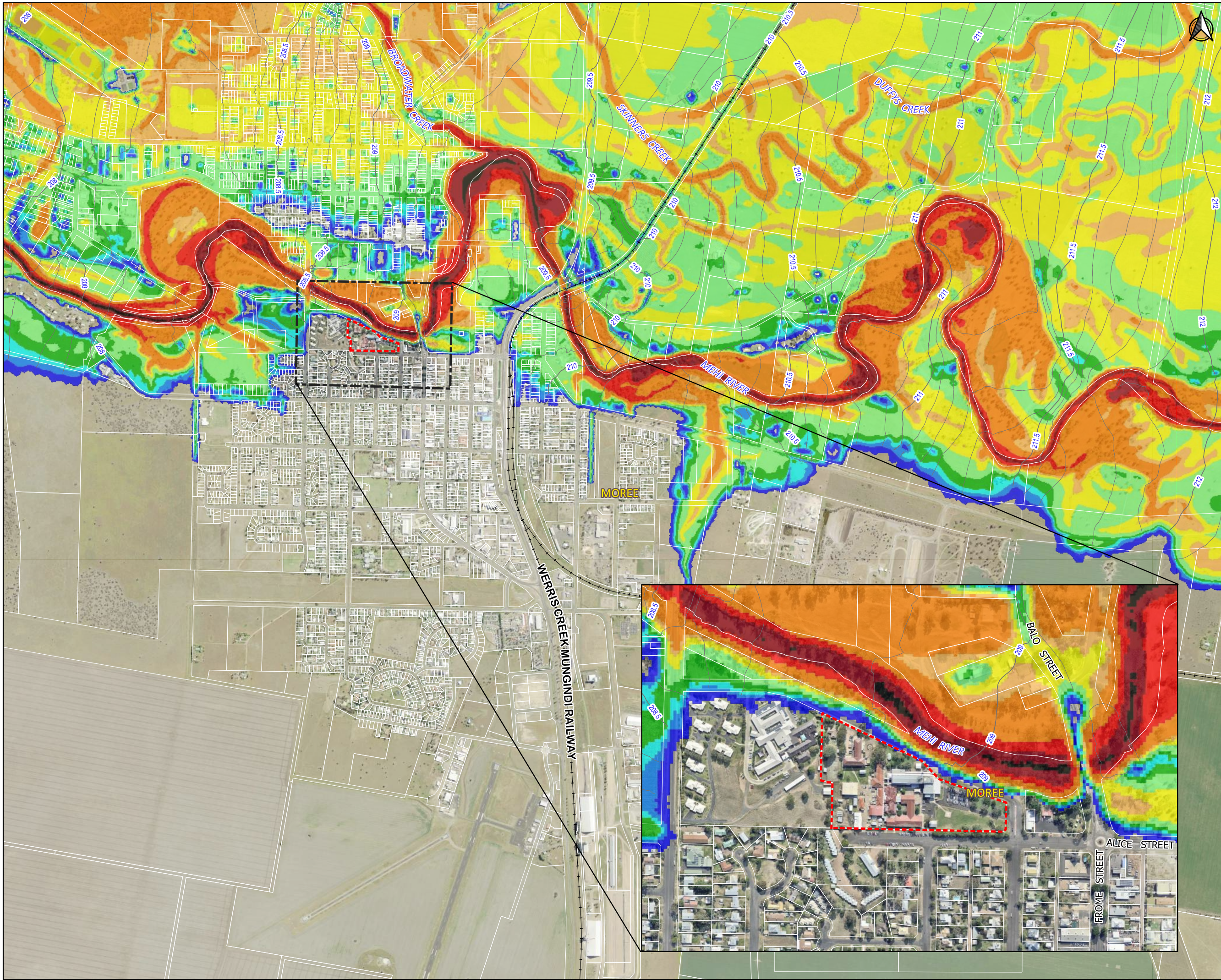
It is important to always follow the advice from emergency services during a flood emergency. If the SES or other emergency services require closure and evacuation of the facility prior to the triggers presented herein, direction received from emergency services takes precedence over information presented herein. Flood events are dynamic emergencies. It is expected emergency services on the ground at the time of the event will have the most up to date advice.

References

- SES (2023) *Flood Disaster Website*
accessed from:
<https://www.ses.nsw.gov.au/disaster-tabs-header/flood/>
September 2023
- SES (2023) *Emergency Business Continuity Plan*
accessed from:
<http://www.sesemergencyplan.com.au/business/index.php>
September 2023
- Bureau of Meteorology (2013) *Service Level Specification for Flood Forecasting and Warning Services for New South Wales – Version 3.13*
accessed from:
http://www.bom.gov.au/nsw/NSW_SLS_Current.pdf
September 2023
- WRM (2017) *Moree and Environs Flood Study / Floodplain Risk management Study and Plan*
- SES (2012) *Moree Plains Shire Local Flood Plan*
- NSW Government (2005) *Floodplain Development Manual* accessed from:
<https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/floodplain-development-manual.pdf> September 2023
- AIDR (2020) *Flood Emergency Response Classification of the Floodplain*
accessed from:
<https://knowledge.aidr.org.au/media/3515/adr-guideline-7-2.pdf> September 2023
- WaterNSW (2023) *Moree Gauge (Site No. 418002) details* accessed from:
[Real-time water data \(waternsw.com.au\)](https://www.waternsw.com.au)

Attachment 1 – Flood Figures

DRAFT



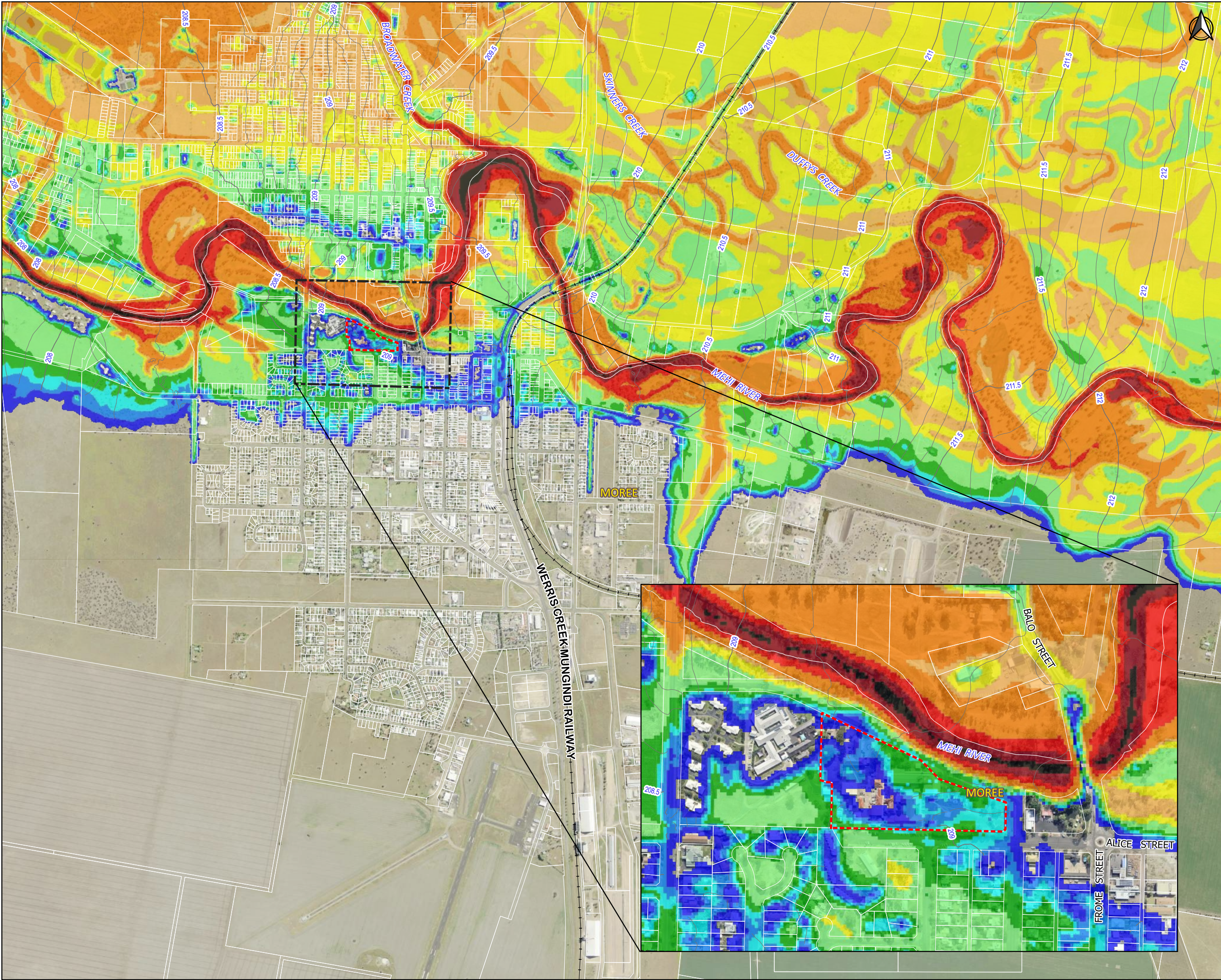
- Legend**
- Subject Site
 - Contour (0.5m)
 - Contour (0.1m)
- Depth (m)
- Less than 0.1
 - 0.1 - 0.2
 - 0.2 - 0.3
 - 0.3 - 0.5
 - 0.5 - 1.0
 - 1.0 - 1.5
 - 1.5 - 2.0
 - 2.0 - 5.0
 - 5.0 - 7.5
 - 7.5 - 10.0
 - Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A1
1% AEP Flood Depth and
Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

Subject Site

Contour (0.5m)

Contour (0.1m)

Depth (m)

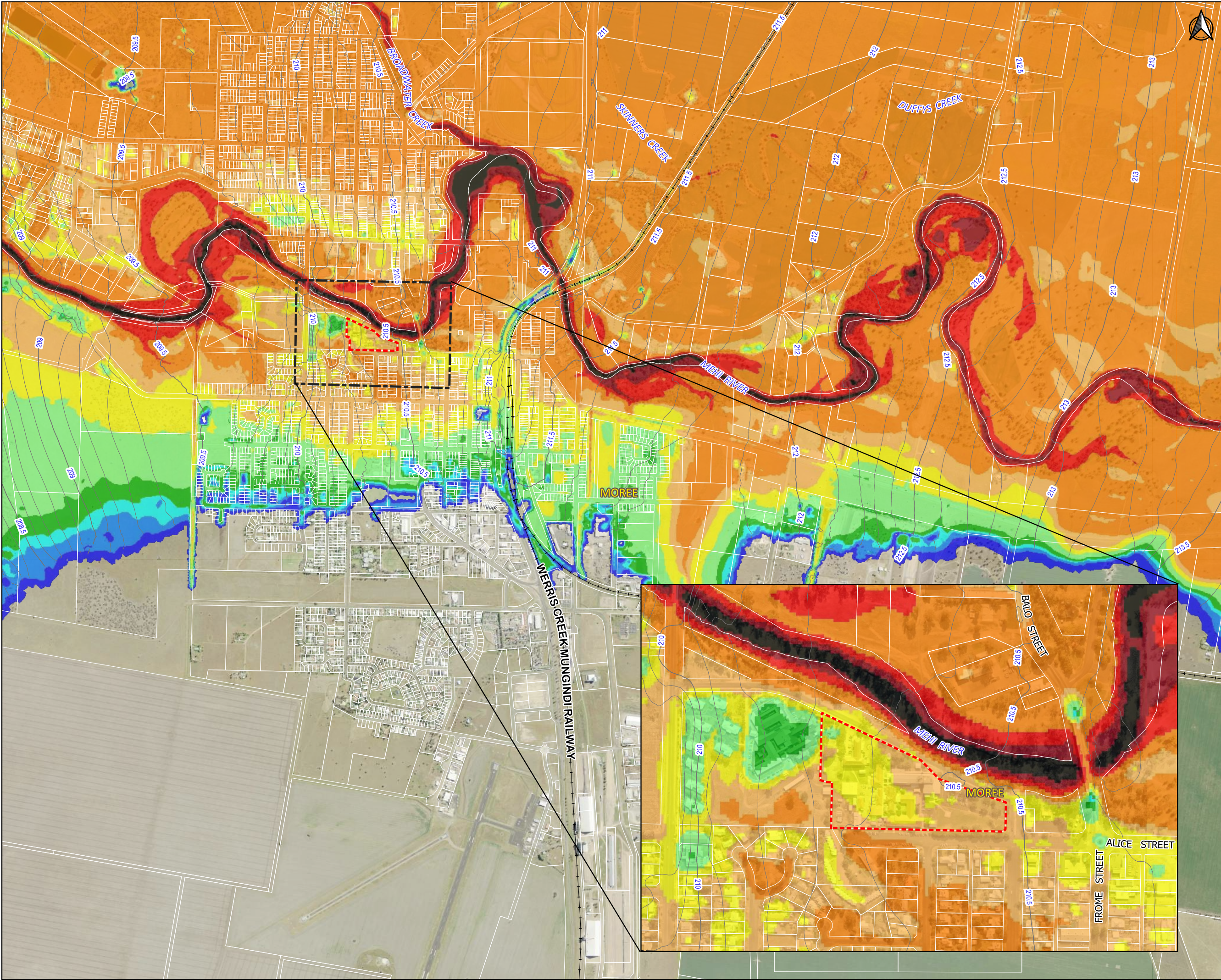
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 5.0
- 5.0 - 7.5
- 7.5 - 10.0
- Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A2
1 in 200 AEP Flood Depth
and Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

- Subject Site
- Contour (0.5m)
- Contour (0.1m)

Depth (m)

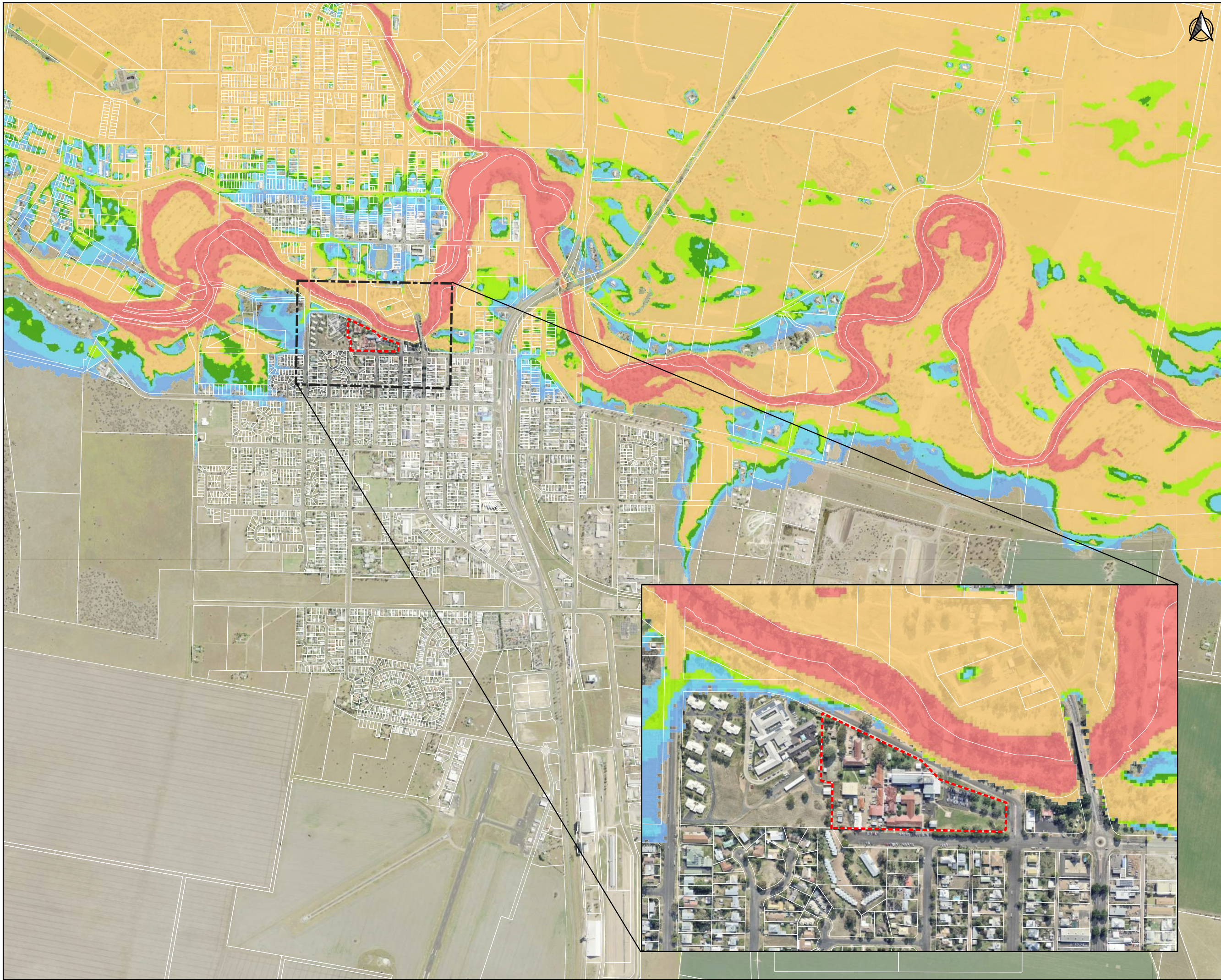
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 5.0
- 5.0 - 7.5
- 7.5 - 10.0
- Greater than 10.0

0 300 600 Metres
1:19,999.99998

Figure A3
PMF Flood Depth and
Elevation
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

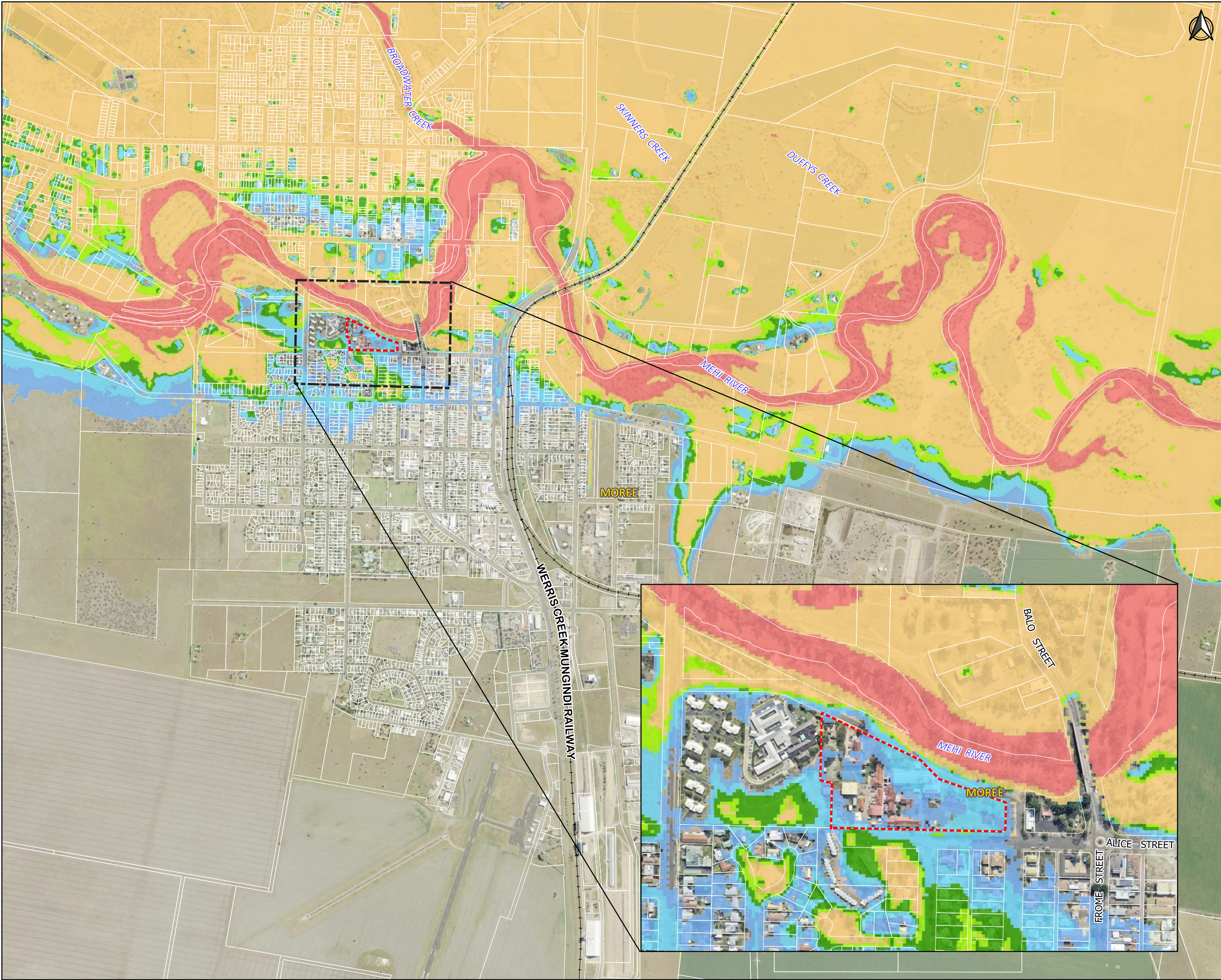
- Subject Site
- ARR 2019 Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

0 300 600 Metres
1:19,999.99998

Figure A4
1% AEP Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

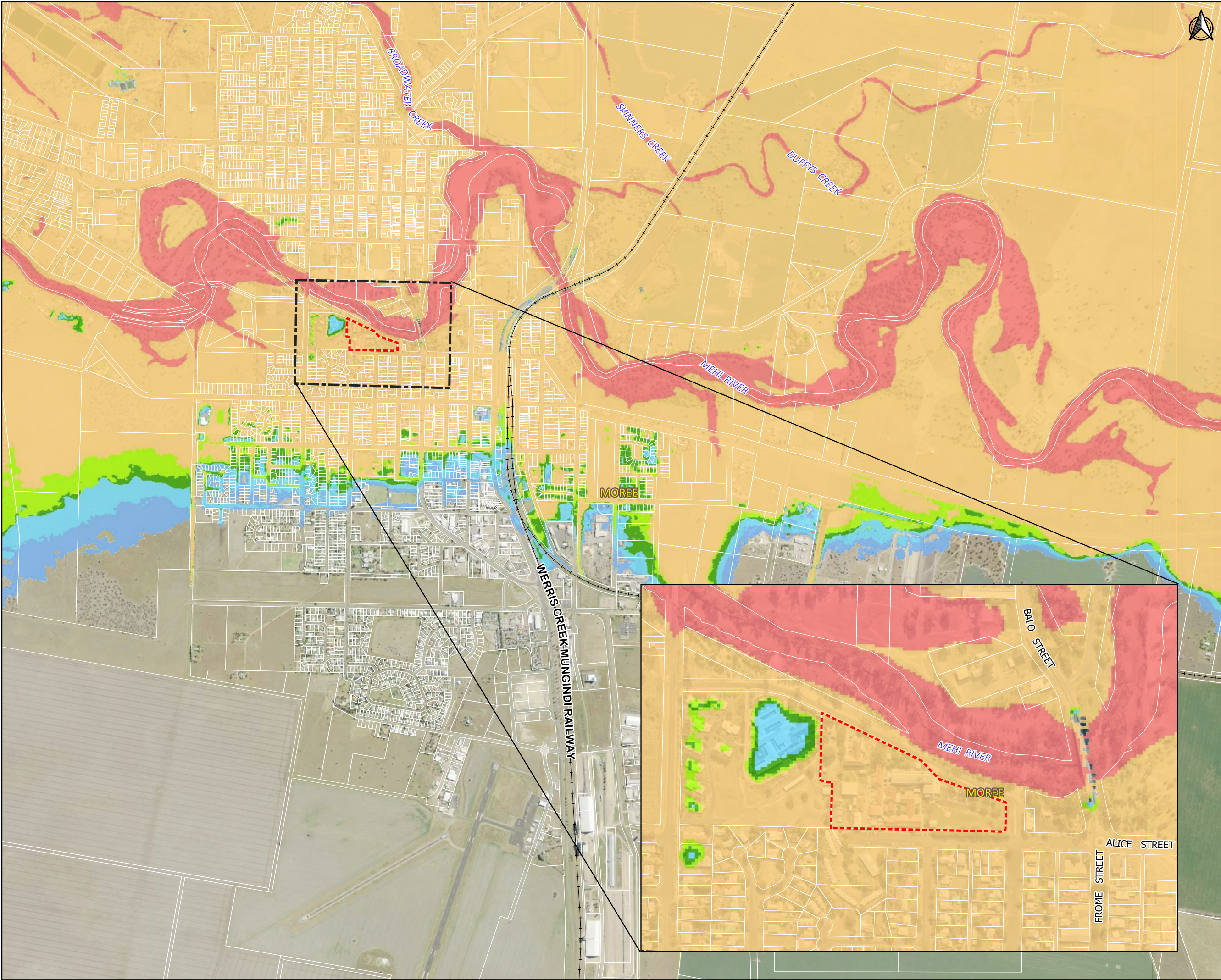
- Subject Site
- ARR 2019 Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

0 300 600 Metres
1:19,999.99998

Figure A5
1 in 200 AEP Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

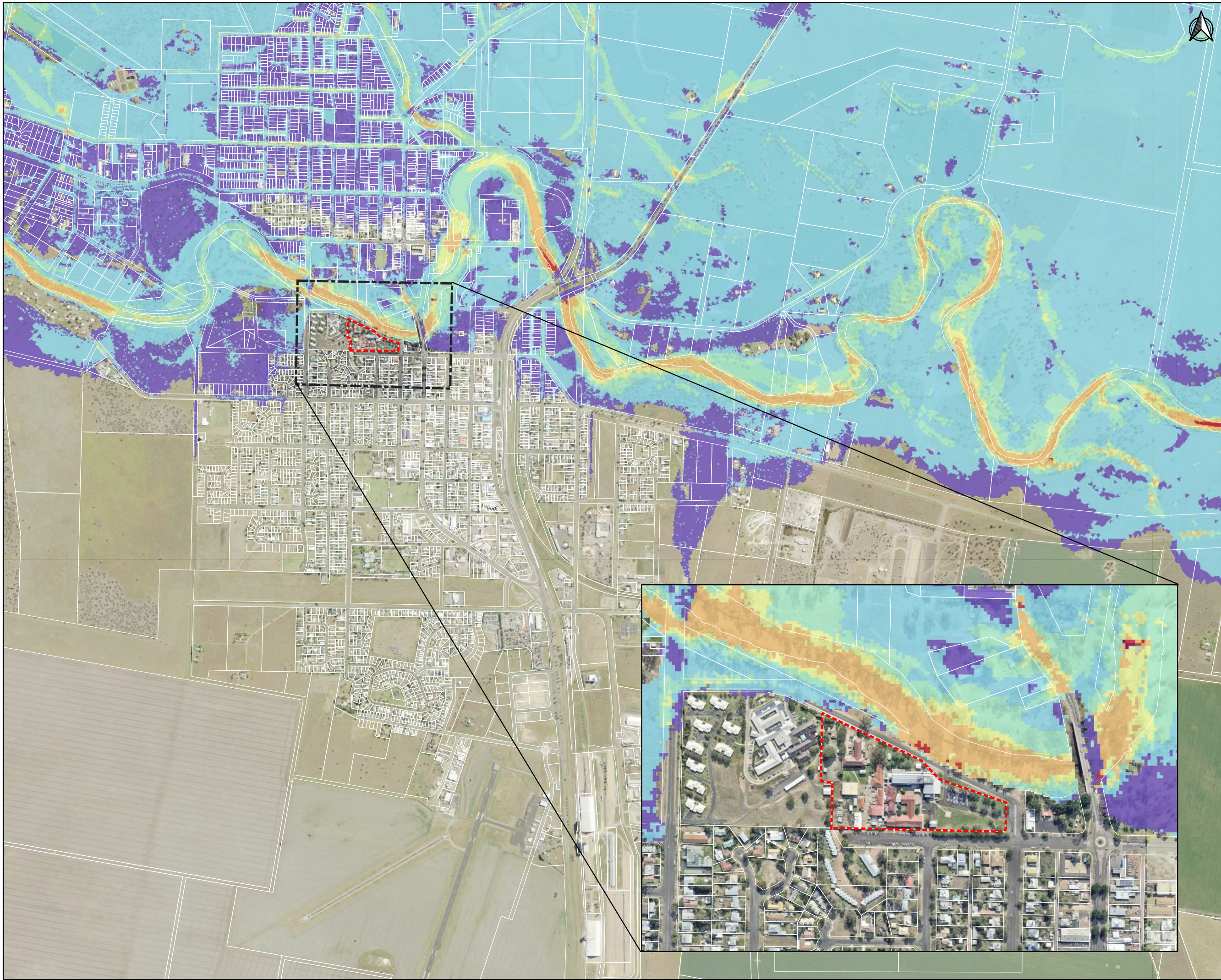
- Subject Site
- ARR 2019 Hazard
 - H1
 - H2
 - H3
 - H4
 - H5
 - H6

0 300 600 Metres
1:19,999.99998

Figure A6
PMF Flood Hazard
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





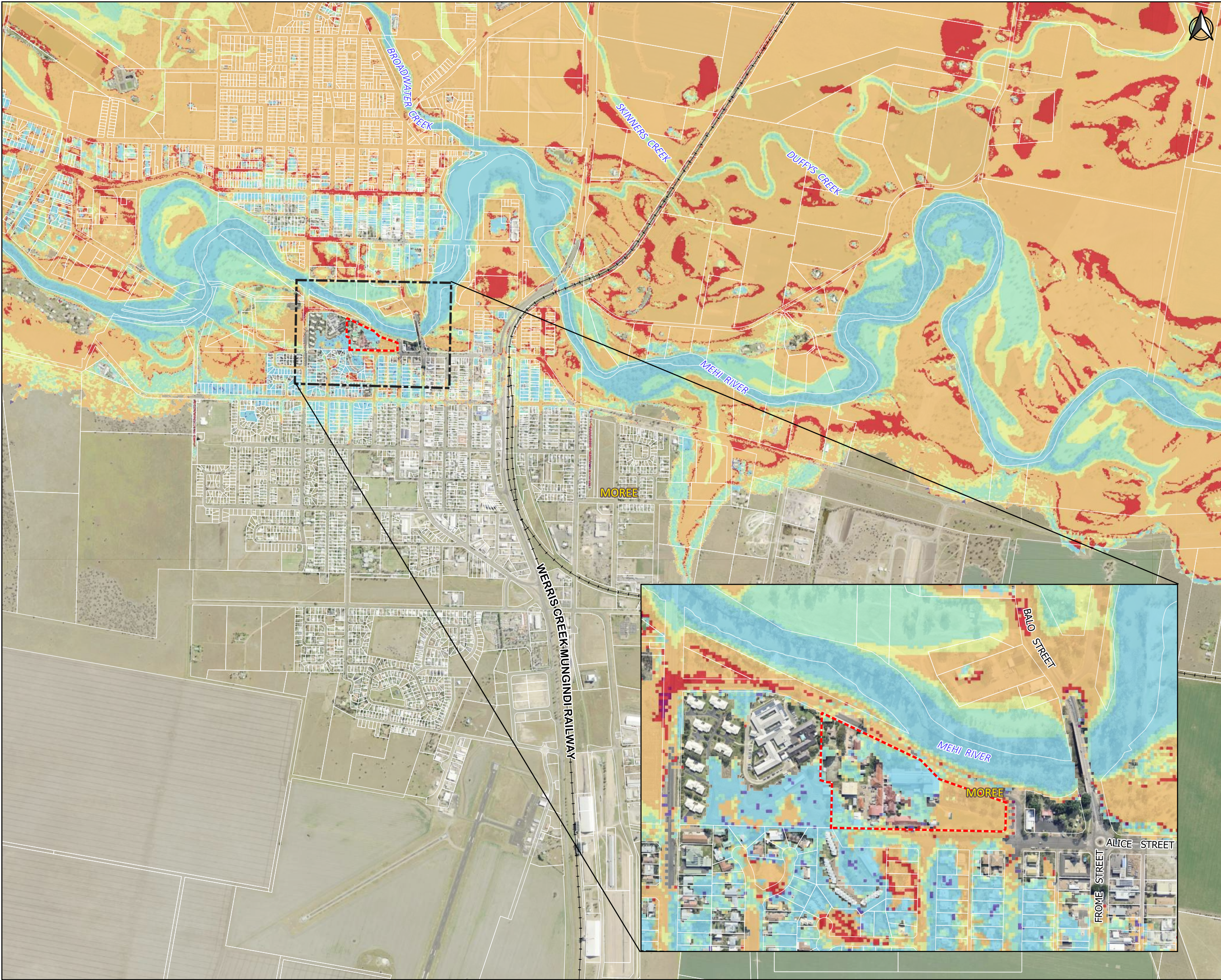
- Legend**
- Subject Site
- Velocity (m/s)
- Less than 0.20
 - 0.21 - 0.50
 - 0.51 - 0.80
 - 0.81- 1.00
 - 1.01 - 2.00
 - 2.01 - 3.00
 - Greater than 3.00

0 300 600 Metres
1:20,000

Figure A7
1% AEP Flood Velocity
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

Subject Site

Velocity (m/s)

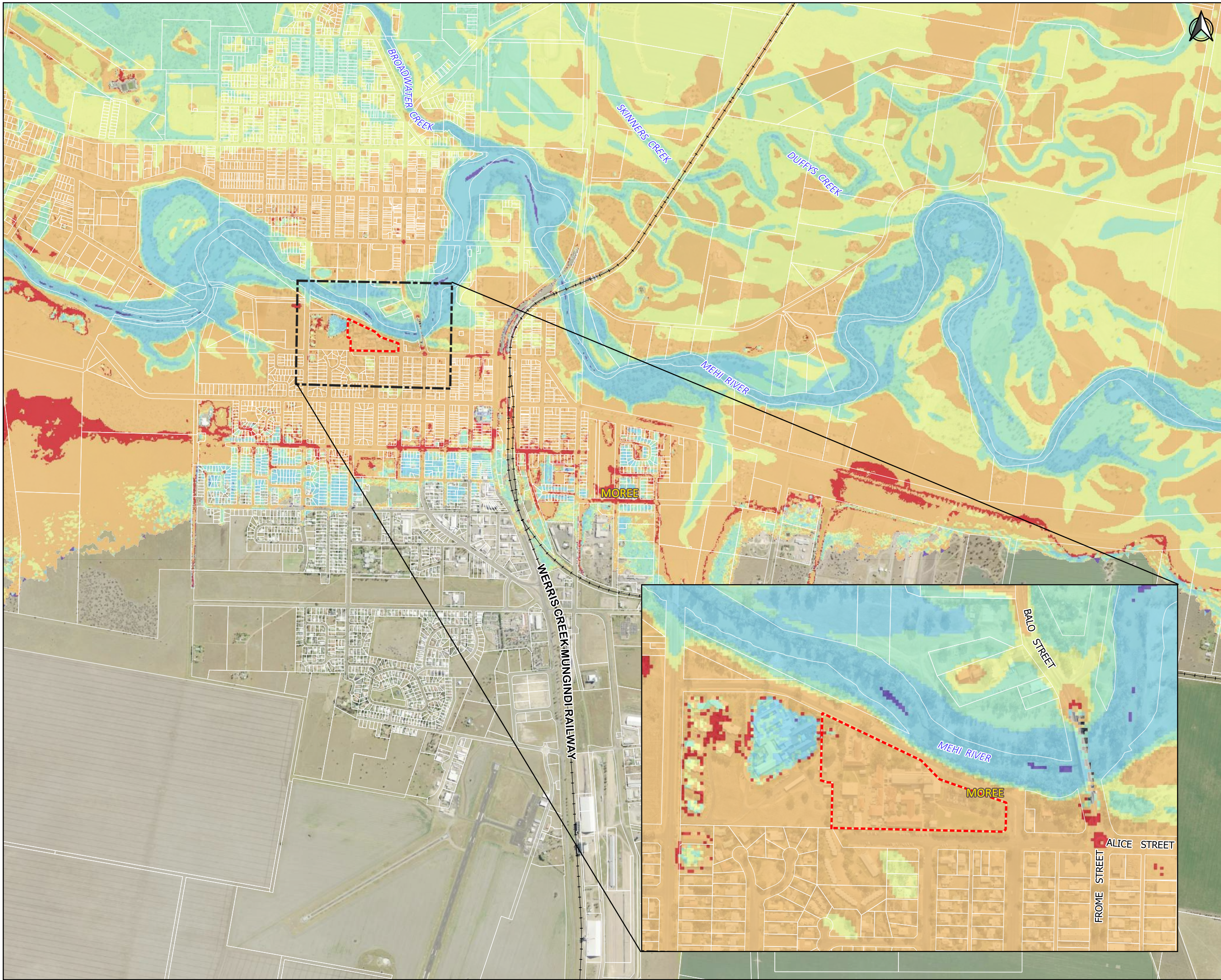
- Less than 0.20
- 0.21 - 0.50
- 0.51 - 0.80
- 0.81 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- Greater than 3.00

0 300 600 Metres
1:20,000

Figure A8
1 in 200 AEP Flood Velocity
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree





Legend

 Subject Site

Velocity (m/s)

Less than 0.20

0.21 - 0.50

0.51 - 0.80

0.81 - 1.00

1.01 - 2.00

2.01 - 3.00

Greater than 3.00

0 300 600 Metres
1:20,000

Figure A9

PMF Flood Velocity
Existing Scenario

Moree Hospital Redevelopment
58 Victoria Terrace, Moree



Attachment 2 – Example Signage

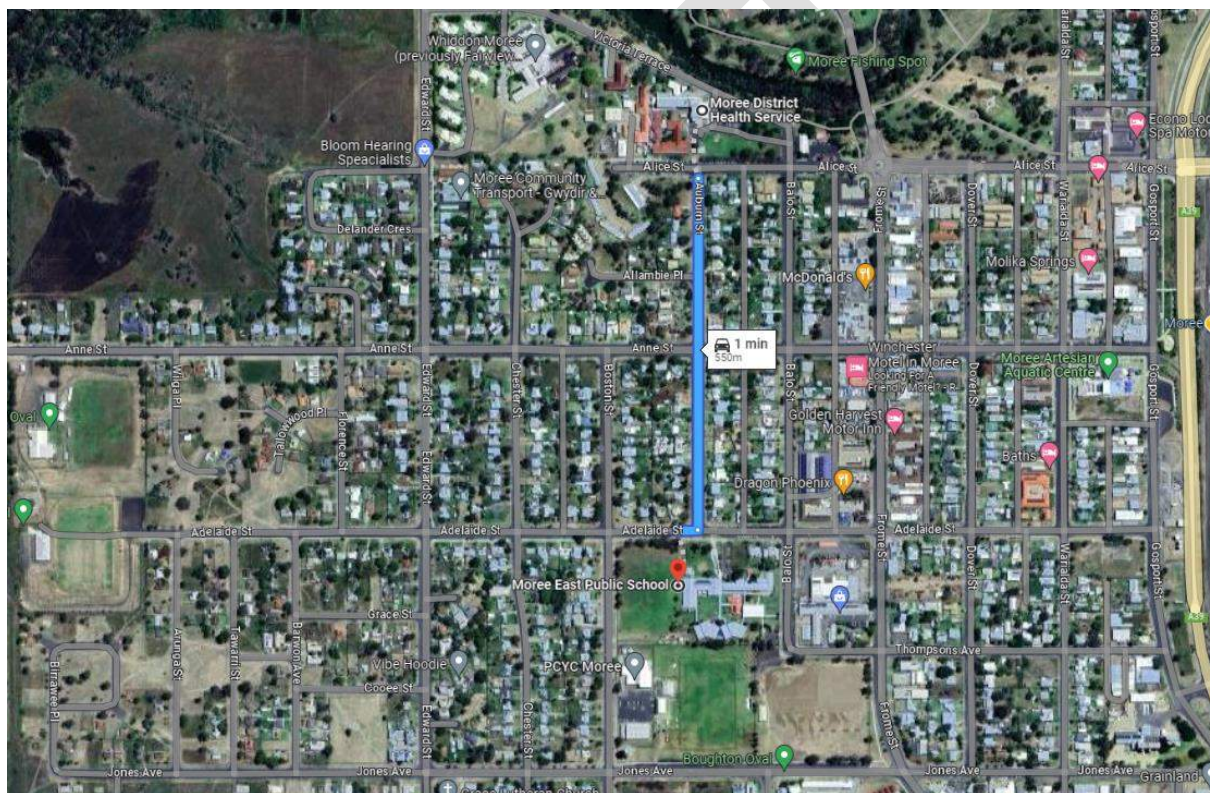
This property is flood prone with predicted depths in adjacent channels of up to 2.0 metres during an extreme flood event.

In the event of a predicted extreme flood event, hospital staff will provide direction. It is possible you will be directed to proceed to the off-site Regional Evacuation Shelter located at

With the closure of the facility, any non-essential staff or visitors who are unable to return home may proceed to the following Regional Evacuation Centres.

1. Moree East Public School, Cnr of Adelaide and Boston Streets, Moree; or
2. Moree Police Community Youth Centre (PCYC) – 360 Boston Street, Moree

If directed, please proceed straight to these facilities and remain until the flood emergency is cancelled. Directions to these facilities is presented below.



For Emergency Assistance during a flood event, contact the SES on 132 500.

If in a life-threatening situation, call 000.

Appendix E – SES Correspondence

Laurence Gitzel

From: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>
Sent: Thursday, 21 September 2023 1:26 PM
To: Laurence Gitzel
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Laurence,

Yes, happy to review the Response Plan and provide comment if necessary.

Kind Regards,

Sonya



Sonya Vickery
Coordinator Planning
NSW State Emergency Service - North Western Zone
P 02 4247 8388 M 0483206864 E sonya.vickery@ses.nsw.gov.au

Tamworth Regional Airport - 2 Packer Street
Westdale NSW 2340, Kamilaroi Nation
PO Box 6020 Westdale NSW 2340
www.ses.nsw.gov.au



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OUR VISION: A TRUSTED VOLUNTEER-BASED EMERGENCY SERVICE, WORKING TOGETHER TO DELIVER EXCELLENCE IN COMMUNITY PREPAREDNESS AND EMERGENCY RESPONSE.

FOR EMERGENCY HELP IN FLOODS, STORMS AND TSUNAMI CALL THE NSW SES ON 132 500

The NSW SES acknowledges the traditional custodians of the lands on which we walk, work and live. We recognise their continuing connection to land, waters and culture and pay respect to Elders, past and present.

This message is intended for the addressee named and may contain confidential information. If you are not the intended recipient, please delete it and notify the sender. Views expressed in this message are those of the individual sender, and are not necessarily the views of the NSW State Emergency Service.

From: Laurence Gitzel <LGitzel@northrop.com.au>
Sent: Wednesday, September 20, 2023 12:18 PM
To: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>
Cc: Tammy Shepley <tammy.shepley@ses.nsw.gov.au>; Daniela Mitreski <daniela.mitreski@ses.nsw.gov.au>
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

EXTERNAL EMAIL: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Thanks Sonya,

As an alternative, would the SES consider reviewing a Draft Operational Flood Emergency Response Plan for the site to ensure the strategy is acceptable from the SES perspective and remains consistent with the SES strategy for the area?

Please don't hesitate to give me call if you would like to discuss.

Cheers,

Laurence Gitzel

Associate | Flood Engineer

My hours are 9am to 5.30pm, Monday to Friday.

Northrop supports working flexibly as it encourages inclusiveness throughout our industry.

Northrop Consulting Engineers

T 02 4943 1777

M 0427 376 919

Level 1, 215 Pacific Highway Charlestown NSW 2290

PO Box 180 Charlestown NSW 2290

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From: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>

Sent: Friday, September 8, 2023 9:54 AM

To: Laurence Gitzel <LGitzel@northrop.com.au>

Cc: Tammy Shepley <tammy.shepley@ses.nsw.gov.au>; Daniela Mitreski <daniela.mitreski@ses.nsw.gov.au>

Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

Hi Laurence,

Unfortunately, I have been advised that it is not possible to share Flood Intelligence data with external parties.

I do know that Moree Council's existing flood study (2017) has been reviewed several times and may provide some insights that could be useful to you. Moreover, I am aware that Council is currently engaging with a consultant to revise the 2017 modelling in light of the recent flood events. It's my understanding that some work has already been undertaken and the consultant is aiming to convert the existing data to new software under the TUFLOW system.

I would recommend that you engage with Council's engineering division and ask if they can assist you. Lila-Jane Fisher at Moree Council is my primary contact there.

Kind Regards,

Sonya



Sonya Vickery

Coordinator Planning

NSW State Emergency Service - North Western Zone

Tamworth Regional Airport - 2 Packer Street
Westdale NSW 2340, Kamilaroi Nation
PO Box 6020 Westdale NSW 2340



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From: Laurence Gitzel <LGitzel@northrop.com.au>
Sent: Thursday, September 7, 2023 9:02 AM
To: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

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Hi Sonya,

No worries. Thanks for letting me know.

Cheers,

Laurence Gitzel

Associate | Flood Engineer

My hours are 9am to 5.30pm, Monday to Friday.

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T 02 4943 1777

M 0427 376 919

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PO Box 180 Charlestown NSW 2290

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From: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>
Sent: Thursday, September 7, 2023 8:48 AM
To: Laurence Gitzel <LGitzel@northrop.com.au>
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

Good morning Laurence

I apologise for not responding sooner. I am making some enquiries in relation to the information we are allowed to release. I am hoping to be able to provide you with something today.

Kind Regards,

Sonya



Sonya Vickery

Coordinator Planning

NSW State Emergency Service - North Western Zone

P 02 4247 8388 M 0483206864 E sonya.vickery@ses.nsw.gov.au

Tamworth Regional Airport - 2 Packer Street
Westdale NSW 2340, Kamilaroi Nation
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From: Laurence Gitzel <LGitzel@northrop.com.au>

Sent: Wednesday, September 6, 2023 2:39 PM

To: NSW SES Risk Reduction <rra@ses.nsw.gov.au>

Cc: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>; Sam Taylor <staylor@besixwatpac.com>

Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

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Thanks Daniela,

Sonya, please refer to the below correspondence. Is this something you can assist us with?

Please don't hesitate to give me a call if you would like to discuss.

Cheers,

Laurence Gitzel

Associate | Flood Engineer

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From: NSW SES Risk Reduction <rra@ses.nsw.gov.au>

Sent: Monday, September 4, 2023 11:33 AM

To: Laurence Gitzel <LGitzel@northrop.com.au>

Cc: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>; Sam Taylor <staylor@besixwatpac.com>; NSW SES Risk Reduction <rra@ses.nsw.gov.au>

Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

Good morning Laurence

Thank you for your email.

The NSW SES North West Zone may be able to assist with local risk and emergency response.

I have Cc Sonya Vickery, Coordinator Planning of North West Zone in email reply.

Thank you.

Kind regards.

Daniela



Daniela Mitreski

Program Support Officer | Emergency Risk Management Branch

NSW State Emergency Service – State Headquarters

E: rra@ses.nsw.gov.au

93-99 Burelli Street Wollongong, NSW 2500

PO Box 6126 Wollongong, NSW 2500

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From: Laurence Gitzel <LGitzel@northrop.com.au>
Sent: Friday, September 1, 2023 5:02 PM
To: NSW SES Risk Reduction <rra@ses.nsw.gov.au>
Cc: Sonya Vickery <sonya.vickery@ses.nsw.gov.au>; Sam Taylor <staylor@besixwatpac.com>
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

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Hi Daniella,

Thanks for providing the below.

Is there any chance the requested information can be provided noting we are working on behalf of the NSW State Government (NSW Health Infrastructure) and are dealing with infrastructure that may be utilised by the SES / Emergency Services during a major / extreme flood event (i.e. a public hospital)?

Happy to receive redacted copies if the concern is with respect to private information.

Happy to discuss over the phone as an alternative. Please don't hesitate to give me a call.

Cheers,

Laurence Gitzel

Associate | Flood Engineer

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From: NSW SES Risk Reduction <rra@ses.nsw.gov.au>
Sent: Tuesday, August 29, 2023 12:50 PM
To: Laurence Gitzel <LGitzel@northrop.com.au>
Cc: NSW SES Risk Reduction <rra@ses.nsw.gov.au>; Sonya Vickery <sonya.vickery@ses.nsw.gov.au>
Subject: RE: Moree Hospital - Flood Risk Management / Emergency Response

Good afternoon Laurence

Thank you for your email enquiry, and proactive interest to improve flood risk management and emergency response.

As per previous advice provided, the NSW SES does not have the resources to provide specific information on individual properties. In addition, your local council is where this information is available if a Floodplain Risk Management Study and Plan has been conducted and these are usually available on the relevant Local Council websites. Each LGA has a Local Environmental Plan (LEP) which identifies the Flood Planning Level for any development in a floodplain. Your local Council will be able to assist you to identify if this property is in flood prone land and within the Flood Planning Level on the LEP.

The NSW SES appreciate residents being proactive about their flood risk. To assist with your investigations into flood risks in a particular area, contact the local council or go to their website as they keep the community informed about flooding.

In relation to managing floodplains the following sites could also be helpful:

- Managing floodplains - [Managing floodplains | NSW Environment and Heritage](#)
- Moree Plains Shire Local Flood Plan - [plan-moree-plains-shire-lfp-dec-2012-endorsed.pdf \(nsw.gov.au\)](#)
- NSW SES - [Home | NSW State Emergency Service](#)
- Flood awareness website <https://www.ses.nsw.gov.au/flood-awareness-nsw>

Thank you.

Kind regards.

Daniela



Daniela Mitreski
Program Support Officer | Emergency Risk Management Branch
NSW State Emergency Service – State Headquarters
E: rra@ses.nsw.gov.au

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From: Laurence Gitzel <LGitzel@northrop.com.au>
Sent: Monday, August 28, 2023 11:00 AM
To: NSW SES Risk Reduction <rra@ses.nsw.gov.au>
Subject: Moree Hospital - Flood Risk Management / Emergency Response

EXTERNAL EMAIL: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi,

We are working with NSW Health Infrastructure and Hunter New England Health to review opportunities to improve flood risk management and flood emergency response for Moree Hospital (35 Alice Street, Moree NSW).

To assist with our investigation, is it possible to obtain the SES Flood Intelligence card and/or any other existing flood emergency preparation and response measures that are currently in place for the Moree region.

More than happy to discuss over the phone if preferred. Please don't hesitate to give me a call.

Cheers,

Laurence Gitzel

Associate | Flood Engineer

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