



PARKES SHIRE COUNCIL

BOGAN GATE

FLOOD RISK MANAGEMENT STUDY AND PLAN

OCTOBER 2025

VOLUME 1 – REPORT

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Further Information

For further information about the copyright in this document, please contact:

Parkes Shire Council

2 Cecile Street, Parkes

council@parkes.nsw.gov.au

+61 2 6862 3946

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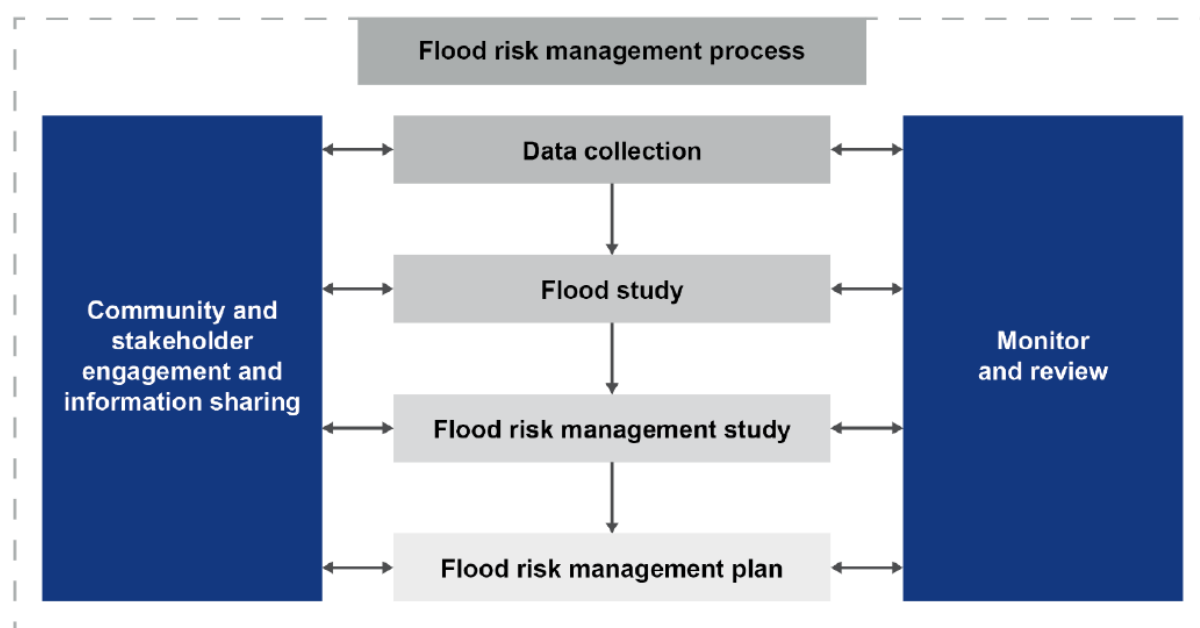
FOREWORD

NSW Government's Flood Policy

The NSW Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the Policy, the management of flood liable land remains the responsibility of local government. The State subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist councils in the discharge of their flood risk management responsibilities.

The Policy provides for technical and financial support by the Government through the flood risk management process shown below.



Presentation of Study Results

The results of the recently completed *Bogan Gate Flood Study* (Lyll & Associates, 2024) have been used as the basis for preparing the *Bogan Gate Flood Risk Management Study and Plan*. The *Bogan Gate Flood Risk Management Study and Plan* have been prepared under the guidance of the Flood Risk Management Committee comprising representatives from Parkes Shire Council, the NSW Department of Climate Change, Energy, the Environment and Water, the NSW State Emergency Service and community representatives.

ACKNOWLEDGEMENT

Parkes Shire Council has prepared this document with financial assistance from the NSW Government through its Floodplain Management Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Climate Change, Energy, the Environment and Water.

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- 2.3 Indicative Extent and Depths of Inundation – 1% AEP (3 Sheets)
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ABBREVIATIONS

AEP	Annual Exceedance Probability (%)
AHD	Australian Height Datum
ARI	Average Recurrence Interval (years)
ARR 2019	Australian Rainfall and Runoff (2019 Edition)
BoM	Bureau of Meteorology
Council	Parkes Shire Council
DECC	Department of Environment and Climate Change
DCCEEW	Department of Climate Change, Energy, the Environment and Water
FRMM	Flood Risk Management Manual, 2023
FRMC	Flood Risk Management Committee
FPL	Flood Planning Level
FPA	Flood Planning Area
FRMS	Flood Risk Management Study
FRMP	Flood Risk Management Plan
FRMS&P	Flood Risk Management Study and Plan
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging (survey)
MHFL	Minimum Habitable Floor Level
NSWG	New South Wales Government
NSW SES	New South Wales State Emergency Service
PMF	Probable Maximum Flood
TCM	Total Catchment Management
TWG	Technical Working Group
VP	Voluntary Purchase

SUMMARY

S1 Study Objectives

Parkes Shire Council (**Council**) commissioned the preparation of a *Flood Risk Management Study and Plan* for the village of Bogan Gate (**Bogan Gate FRMS&P**). The overall objectives of the *Bogan Gate Flood Risk Management Study (Bogan Gate FRMS)* were to assess the impacts of flooding, review existing Council policies as they relate to development of land in flood liable areas, consider measures for the management of flood affected land and to develop the *Bogan Gate Flood Risk Management Plan (Bogan Gate FRMP)* which:

- i) Proposes modifications to existing Council policies to ensure that the development of flood affected land is undertaken so as to be compatible with the flood hazard and risk.
- ii) Sets out the recommended program of works and measures which are aimed at reducing over time, the social, environmental and economic impacts of flooding.
- iii) Provides a program for implementation of the proposed works and measures.

The study area for the *Bogan Gate FRMS&P* applies to areas within the village and its immediate environs that are affected by the following two types of flooding:

- **Main Stream Flooding** which occurs when floodwater surcharges the inbank area of Gunningbland Creek, Blowclear Creek, Botfields Creek and their tributaries. Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses.

Figure 1.1 bound in **Volume 2** of this report is a location plan, while **Figure 2.1** shows the extent of both the Blowclear and Gunningbland Creek catchments as far downstream as where the main arm of the latter crosses the Orange Broken Hill Railway Line. **Figure 2.2** (2 sheets) shows the key features of the existing stormwater drainage system in the vicinity of the urbanised parts of Bogan Gate, as well as the extent of the “Village Centre”, the southern and northern portions of which are principally zoned *RU5-Village* and *R5-Large Lot Residential*, respectively.

S2 Study Activities

The activities undertaken in this present study included:

1. Review of available data and the undertaking of a consultation program to ensure that the Bogan Gate community were informed of the objectives, progress and outcomes over the course of the study (**Chapter 1** and **Appendix A**).
2. Review of historic flooding at Bogan Gate, as well as flooding patterns that are presented in the *Bogan Gate Flood Study* for flood events up to the Probable Maximum Flood (**PMF**). (**Chapter 2** and **Appendix B**).
3. Review of the economic impacts of flooding that are presented in the *Bogan Gate Flood Study*, including the numbers of affected properties and estimation of flood damages (**Chapter 2**).
4. Review of current flood related planning controls for Bogan Gate and their compatibility with flooding conditions (**Chapter 2**).

5. Strategic review of potential flood risk management measures aimed at reducing flood damages and recommended inclusions/updates to both the *Parkes Local Environmental Plan 2012 (Parkes LEP 2012)* and the *Parkes Shire Development Control Plan 2021 (Parkes Shire DCP 2021)* (**Chapter 3** and **Appendix C**).
6. Ranking of works and measures using a multi-objective scoring system which took into account economic, financial, environmental and planning considerations (**Chapter 4**).
7. Preparation of the *Bogan Gate FRMP* (**Chapter 5**).

S3 Summary of Flood Impacts

While the inbank area of Gunningbland Creek and its major tributaries where they run in a westerly direction to the north of Village Centre is of limited capacity, thereby resulting in the relatively frequent inundation of the adjacent road network, only the central portion of the Village Centre is impacted by Main Stream Flooding. Further to this, floodwater originating from Gunningbland Creek generally only inundates land within the Village Centre that is presently undeveloped for all floods with Annual Exceedance Probabilities (**AEPs**) up to 0.2% (1 in 500).

While parts of the Village Centre are affected by Major Overland Flow, the resulting depths of inundation are relatively shallow for all storms up to 0.2% (1 in 500) AEP in intensity.

Figure 2.3 (3 sheets) of the *Bogan Gate FRMS* report shows the indicate extent and depth of inundation at Bogan Gate for a design flood with an AEP of 1% (1 in 100), while **Figure 2.4** (3 sheets) shows similar information for the Probable Maximum Flood (**PMF**). **Appendix B** of the *Bogan Gate FRMS* report show similar information for floods with AEPs of 20% (1 in 5), 10% (1 in 10), 5% (1 in 20), 2% (1 in 50), 0.5% (1 in 200) and 0.2% (1 in 500).

The *Bogan Gate Flood Study* found that while no buildings in the Village Centre would be inundated above-floor level in a 1% AEP flood event, flood damages of about \$0.03 Million would still be incurred during a flood of this magnitude. During a PMF event, 24 dwellings and one public building would experience above-floor inundation, resulting in flood damages totalling about \$5.39 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is effectively zero at Bogan Gate, while for all floods up to the PMF it is only about \$0.1 Million.

S4 Flood Risk and Development Controls

An approach which uses the concepts of *flood hazard* and *hydraulic categorisation*, and is aimed at imposing a graded set of controls over development according to the flood risk has been recommended for incorporation into *Parkes Shire DCP 2021*. The delineation of flood planning constraint categories is based on the proximity to flow paths, depths and velocities of flow, the rate of rise of floodwaters and ease of evacuation from the floodplain in the event of a flood emergency.

Figure C1.1 in **Appendix C** of this report is an extract from the *Flood Planning Map* relating to the study area. The extent of the Flood Planning Area (**FPA**) (the area subject to flood related development controls) has been defined as follows:

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area that lies at or below by the 1% AEP plus 0.5 m freeboard.
- In areas subject to Major Overland Flow, the FPA is defined as areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

Figure C1.1 in **Appendix C** shows the extent of the **Special Flood Considerations Zone**, it being the area of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is H3 or greater and therefore where flood related development controls would apply to future development should Council decide to adopt the optional clause 5.22 in *Parkes LEP 2012*.

Figure C1.2 in **Appendix C** is an extract of the *Flood Planning Constraint Category Map* for the study area which shows the subdivision of the floodplain into four categories which have been used as the basis for developing the graded set of planning controls.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard.¹

S5 The Flood Risk Management Plan

Chapter 5 of this report presents the *Bogan Gate FRMP*, with the recommended works and measures summarised in **Table S1** at the end of this Summary. The recommended works and measures have been given a provisional priority ranking, confirmed by the Flood Risk Management Committee (**FRMC**), according to a range of criteria, details of which are set out in **Section 4** of this report.

The *Bogan Gate FRMP* comprises three “non-structural” management measures which could be implemented by Council and NSW State Emergency Service (**NSW SES**) using existing data and without requiring Government funding. The measures are as follows:

- **Measure 1** – Council to consider the inclusion of the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, noting that it would apply to land that lies between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations.
- **Measure 2** - The application of a graded set of planning controls for future development that recognise the location of the development within the floodplain; to be applied through the update of *Parkes Shire DCP 2021*. Suggested wording for inclusion in *Parkes Shire DCP 2021* is set out in Appendix C of this report.
- **Measure 3** - Improvements in the NSW SES emergency planning, including use of the flood related information contained in this study to update the *Parkes Shire Local Flood Plan* (NSW SES, 2024). Information in this report which would be of assistance to NSW SES includes data on the nature and extent of flooding, details of which could be used to update Volume 2 of the *Parkes Shire Local Flood Plan*.

¹ Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

- **Measure 4** - Council should take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk. This could be achieved through the preparation of a *Flood Information Brochure* which could be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with rate notices.

In addition to the above measures, *Bogan Gate FRMP* includes the investigation, design and implementation of an integrated severe weather/thunderstorm and flood warning system for Bogan Gate, noting that this would require Government Funding (**Measures 5 and 6**). As water levels in the various watercourses that run to the north of Bogan Gate rise relatively quickly in response to intense rainfall (commonly referred to as “flash flooding”), there is merit in implementing an effective location-based messaging system which warns both residents and business owners of the potential for flood producing rain to result in the closure of the road network surrounding the village.

Bogan Gate FRMP includes the investigation and possible implementation by the relevant road and railway authorities of the following flood modification measures:

- The possible raising of Henry Parkes Way at the location of several low-level causeways that are located between Parkes and Bogan Gate (**Measures 7 and 8**).
- The possible upgrade of existing transverse drainage that is located along Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate in combination with any third-party related flood mitigation measures (**Measures 9 and 10**). **Figure 3.6** (3 sheets) is an example of the scale of the impact that the implementation of such works could have on flood behaviour on the broader Gunningbland Creek floodplain west of Bogan Gate for design floods with AEPs of 20%, 5% and 1%.

Based on the outcomes of the community consultation process it was concluded that there is merit in developing and implementing a vegetation management plan for Gunningbland Creek at Bogan Gate, especially in relation to the clearing of vegetation/debris at the Henry Parkes Way and Orange-Broken Hill Railway bridge crossings of the watercourse (Estimated Cost - \$0.25 Million) (**Measure 11**).

S6 Timing and Funding of Bogan Gate FRMP Measures

The total estimated cost to implement the measures set out in the *Bogan Gate FRMP* is **\$0.60 Million**, exclusive of both local and statement government agency costs. The timing of the measures will depend on Council's overall budgetary commitments and the availability of both Local, State and Commonwealth Government funds.

Assistance for funding qualifying projects included in the *Bogan Gate FRMP* may be available upon application under Commonwealth and State funded floodplain management programs, currently administered by the NSW Department of Climate Change, Energy, the Environment and Water.

S7 Council Action Plan

1. Council to consider updating *Parkes LEP 2012* to include the NSW Government's *Special Flood Considerations* clause 5.22 (**Measure 1** of *Bogan Gate FRMP*).
2. Council to update *Parkes Shire DCP 2021* to incorporate the suggested form of wording set out in **Appendix C** of this report (**Measure 2** of *Bogan Gate FRMP*).

3. NSW SES to update the *Parkes Shire Local Flood Plan* using information on flooding patterns, peak flood levels, times of rise of floodwaters and flood prone areas identified in this report (**Measure 3** of *Bogan Gate FRMP*).
4. Council to inform residents of the flood risk, based on the information presented in *Bogan Gate FRMS* (e.g. displays of flood mapping at Council offices, preparation of *Flood Information Brochure* for distribution with rate notices, etc) (**Measure 4** of *Bogan Gate FRMP*).
5. Council to commission the investigation and design of a severe weather/thunderstorm and flood warning system for Bogan Gate, followed by its implementation (**Measures 5 and 6** of *Bogan Gate FRMP*).
6. Transport for NSW to commission an investigation into the feasibility of raising the existing causeways that are located along Henry Parkes Way where it runs between Parkes and Bogan Gate and subject to its findings, implement the necessary upgrade requirements (**Measures 7 and 8** of *Bogan Gate FRMP*).
7. The relevant rail authority in consultation with Transport for NSW to commission a joint investigation into the feasibility of upgrading the existing transverse drainage that is located along Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate and subject to its findings, implement the necessary upgrade/flood mitigation requirements (**Measures 9 and 10** of *Bogan Gate FRMP*).
8. Council to develop and implement a *Vegetation Management Plan* for Gunningbland Creek at Bogan Gate (**Measure 11** of *Bogan Gate FRMP*).

TABLE S1
RECOMMENDED MEASURES FOR INCLUSION IN BOGAN GATE FLOOD RISK MANAGEMENT PLAN

Measure	Required Funding	Features of the Measure	Priority
1. Update of <i>Parkes LEP 2012</i>	Council staff costs	➤ Council to consider including the optional <i>special flood considerations</i> clause 5.22 in <i>Parkes LEP 2012</i>. The optional clause applies to land that lies between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. ➤ While the inclusion of the optional <i>special flood considerations</i> clause 5.22 in <i>Parkes LEP 2012</i> would have limited impact on future development within Bogan Gate, it may have relevance to other urban centres in the LGA such as at Parkes. For this reason, the flood mapping and recommended set of flood related development controls that form part of the present study assume that Council includes the optional clause in <i>Parkes LEP 2012</i>. This approach ensures consistency with other study areas where the adoption of the optional clause has more relevance.	Medium Priority: this measure is designed to mitigate the flood risk to future sensitive and hazardous type development and has a medium priority. It does not require Government funding.
2. Incorporate recommended approach to managing future development on flood prone land in <i>Parkes Shire DCP 2021</i> .	Council staff costs	➤ Graded set of flood controls based on the type of development and their location within the floodplain, defined as land inundated by the PMF. ➤ Floodplain divided into four zones based on the assessed flood hazard and hydraulic categorisation. ➤ The minimum floor levels for all land use types is the level of the 1% AEP flood event plus 0.5 m freeboard in the case of areas affected by Main Stream Flooding and plus 0.3 m freeboard in areas affected by Major Overland Flow. ➤ Additional controls applied to development that is located on land which lies above the Flood Planning Level.	High Priority: this measure is designed to mitigate the flood risk to future development and has a high priority for inclusion in <i>Bogan Gate FRMP</i> . It does not require Government funding.
3. Ensure flood data in <i>Bogan Gate FRMS</i> are available to the NSW SES for improvement of flood emergency planning.	NSW SES costs	➤ NSW SES should update the <i>Parkes Shire Local Flood Plan</i> using information on flooding patterns, times of rise of floodwaters and flood prone areas identified in this report.	High Priority: this measure would improve emergency response procedures and has a high priority. It does not require Government funding.
4. Implement flood awareness and education program	Council staff costs	➤ Council to inform residents of the flood risk, based on the information presented in <i>Bogan Gate FRMS</i>. (e.g. displays of flood mapping at Council offices, preparation of <i>Flood Information Brochure</i> for distribution with rate notices, etc).	Medium Priority: this measure would improve the flood awareness of the community and has a medium priority given the relatively minor impact flooding has on existing development in the village. It does not require Government funding.
5. Investigate and design an integrated severe weather/thunderstorm and flood warning system for Bogan Gate	\$0.05 Million	➤ Liaison with the Bureau of Meteorology and NSW SES to determine the most appropriate set of measures which would provide the maximum warning time of impending severe weather or thunderstorms, as well as actual rising water levels in Gunningbland Creek to the north of the village.	High Priority: this measure would improve the reaction time of the community to potential and actual flooding in parts of Bogan Gate and its surrounding road network.
6. Implement integrated severe weather/thunderstorm and flood warning system for Bogan Gate	\$0.30 Million	➤ Implementation of an integrated severe weather/thunderstorm and flood warning system, which may as a minimum comprise the following: ➤ A telemetered water level at the location of The Bogan Way bridge crossing of Gunningbland Creek which has pre-determined alert levels. ➤ Upgrade of the daily read <i>Bogan Gate Post Office</i> (GS50004) and <i>Trundle (Long Street)</i> (GS 50036) rain gauges to telemetered rain gauges, noting that these gauges, in combination with BoMs <i>Goonumbla (Coradgery)</i> (GS 50016) Flood Warning Network rain gauge (refer Figure 2.1 for location) would provide real time data on the likely intensity and depth of rain falling in the Gunningbland Creek catchment upstream of Bogan Gate. ➤ A location-based text messaging service that alerts subscribers to: a) the issuing of a Severe Weather or Thunderstorm Warning from BoM; and b) the exceedance of the aforementioned pre-determined alert levels on the Gunningbland Creek water level recorder.	

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TABLE S1 (Cont'd)
RECOMMENDED MEASURES FOR INCLUSION IN BOGAN GATE FLOOD RISK MANAGEMENT PLAN

Measure	Required Funding	Features of the Measure	Priority
7. Commission feasibility study into the raising Henry Parkes Way at the location of several low-level crossing that are located along the road between Parkes and Bogan Gate.	Transport for NSW costs	➤ The development of detailed hydrologic and hydraulic models of the catchments which drain to the existing transverse drainage that are located along Henry Parkes Way where it runs between Parkes and Bogan Gate. ➤ The assessment of the level of flood immunity that could be achieved by the raising of Henry Parkes Way, including an assessment of the associated third-party related impacts. ➤ Liaison with Council and affected land holders. ➤ Preparation of preliminary cost estimates of the works required to achieve varying degrees of flood immunity. ➤ Recommend a preferred approach to improving the hydrologic standard of Henry Parkes Way where it runs between Parkes and Bogan Gate.	Medium Priority: this measure would significantly improve the hydrologic standard of Henry Parkes Way where it runs between Parkes and Bogan Gate
8. Design and implement the required upgrade requirements identified by the abovementioned feasibility study.		➤ Subject to the findings of the abovementioned feasibility study, prepare detailed designs of the necessary upgrade requirements ➤ Construct the necessary upgrade requirements.	
9. Commission feasibility study into the upgrade of the existing transverse drainage that is located along Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate.	Relevant Rail Authority and Transport for NSW costs	➤ The assessment of the transverse drainage upgrade and third-party impact related flood mitigation requirements using the flood models that were developed as part of the <i>Bogan Gate Flood Study</i>. ➤ Liaison with Council and affected land holders. ➤ Preparation of preliminary cost estimates of the preferred set of works.	Medium Priority: this measure would: a) reduce the cost of flood damages that are experienced to rail infrastructure as a result of floods on Gunningbland Creek; b) reduce the time that the Orange-Broken Hill Railway is closed for freight and passenger movements during and immediately after major flood events; c) reduce the flood damages within the rural properties that are located both to the north and south of the road and rail corridors, noting that the almost instantaneous failure of the rail embankment during floods can result in damaging flooding being experienced on the downstream side of the railway line; and d) reduce the risk to life of both people and livestock.
10. Design and implement the required upgrade and third-party impact related flood mitigation requirements identified by the abovementioned feasibility study.		➤ Subject to the findings of the abovementioned feasibility study, prepare detailed designs of the preferred transverse drainage upgrade and third-party impact related flood mitigation requirements ➤ Construct the necessary upgrade and flood mitigation requirements.	
11. Develop and implement a <i>Vegetation Management Plan</i> for Gunningbland Creek at Bogan Gate	\$0.25 Million	➤ The <i>Vegetation Management Plan</i> will identify the areas along Gunningbland Creek that require regular maintenance. It will also describe the scope of any rehabilitation works that would be required following the completion of any inbank works. ➤ The required funding would permit the development of the <i>Vegetation Management Plan</i>, the removal of dense vegetation/debris from the inbank area of the watercourse and the implementation of a regular maintenance program over a five-year period.	Medium Priority: this measure would reduce the risk of a blockage being experienced at the major road/rail crossings.
TOTAL	\$0.60 Million		

1 INTRODUCTION

1.1 Study Background

Parkes Shire Council (**Council**) commissioned the preparation of a flood risk management study and plan for the village of Bogan Gate in accordance with the New South Wales Government's *Flood Prone Land Policy* (**Bogan Gate FRMS&P**). **Figure 1.1** shows that the village is located about 42 km to the west of Parkes and lies with the Gunningbland Creek catchment.

The *Bogan Gate Flood Risk Management Study* (**Bogan Gate FRMS**) reviewed baseline flooding conditions and the economic impacts of flooding that were assessed as part of the recently completed *Bogan Gate Flood Study* (Lyll & Associates, 2024). It also assessed the feasibility of potential measures which are aimed at reducing the impact of flooding on both existing and future development in the village. This process allowed the formulation of a flood risk management plan for Bogan Gate (**Bogan Gate FRMP**).

The *Bogan Gate FRMS&P* focuses on the village and its immediate environs that are affected by the following two types of flooding:

- **Main Stream Flooding** which occurs when floodwater surcharges the inbank area of Gunningbland Creek, Blowclear Creek, Botfields Creek and their tributaries. Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses.

1.2 Background Information

The following documents were used in the preparation of this report.

- *Bogan Gate Flood Study* (Lyll & Associates, 2024) (**Bogan Gate Flood Study**)
- *Flood Risk Management Manual* (New South Wales Government (**NSWG**), 2023) (**FRMM**)
- *Parkes Local Environmental Plan, 2012* (**Parkes LEP 2012**)
- *Parkes Shire Development Control Plan 2021* (**Parkes Shire DCP 2021**)
- *Parkes Shire Local Flood Plan* (NSW State Emergency Service (**NSW SES**), 2024)

1.3 Overview of Bogan Gate FRMS&P Report

The results of the *Bogan Gate FRMS* and the *Bogan Gate FRMP* are set out in this report. The contents of each Chapter of the report are briefly outlined below:

- **Chapter 2, Baseline Flooding Conditions.** This Chapter includes a description of the existing drainage system at Bogan Gate, as well as the nature of flood behaviour in the study area based on the findings of the *Bogan Gate Flood Study*. The Chapter also summarises the economic impacts of flooding on existing urban development, reviews Council's flood planning controls and management measures, as well as NSW SESs flood emergency planning.

- **Chapter 3, Potential Flood Risk Management Measures.** This Chapter reviews the feasibility of flood risk management measures for their possible inclusion in the *Bogan Gate FRMP*, noting that the measures are investigated at the strategic level of detail.
- **Chapter 4, Selection of Flood Risk Management Measures.** This Chapter assesses the feasibility of potential flood risk management strategies using a multi-objective scoring procedure which was developed in consultation with the Flood Risk Management Committee (**FRMC**) and outlines the preferred strategy.
- **Chapter 5, Bogan Gate Flood Risk Management Plan** presents the *Bogan Gate FRMP* which comprises a number of non-structural measures which are aimed at increasing the flood awareness of the community and ensuring that future development is undertaken in accordance with the local flood risk.
- **Chapter 6** contains a glossary of terms used in the study.
- **Chapter 7** contains a list of References.

Three technical appendices provide further information on the study results:

- **Appendix A – Photographs Showing Historic Flood Behaviour at Bogan Gate** which have been taken from the *Bogan Gate Flood Study*.
- **Appendix B - Figures Showing Design Flood Behaviour at Bogan Gate** which have also been taken from the *Bogan Gate Flood Study*.
- **Appendix C – Suggested Wording for Inclusion in Parkes Shire Development Control Plan** presents guidelines for the control of future urban development in flood prone areas in the village. .

Figures referred to in this document are contained in a companion Volume 2 document that is A3 in size.

1.4 Community Consultation

A *Community Newsletter and Questionnaire* was disseminated to residents and business owners at the commencement of the *Bogan Gate Flood Study* which sort to identify information on historic flooding in the village. Respondents to the *Community Questionnaire* identified a number of notably intense storm events dating back to 1992, the most notable of which occurred on 1-2 March 2012 and 14 November 2022. **Appendix A** of this report contains copies of several photos that show flooding that was experienced in and around the village in November 2005, December 2010, March 2012, June 2016, September 2016, May 2022 and November 2022.

Respondents to the *Community Questionnaire* also highlighted that several holders of *RU1-Primary Production* zoned land that lies on the northern (upstream) side of the Orange-Broken Hill Railway Line to the west of Bogan Gate have petitioned both local and state government representatives over the past 60+ years regarding the impact that the rail embankment has on flood behaviour and seeking improvements to the hydraulic capacity of its transverse drainage.

The draft *Bogan Gate FRMS&P* report was placed on public exhibition for a period of 28 days, during which time Council staff undertook a public information session in the village. Several written submissions were supportive of the study and its findings, as well as the public information session that was conducted by Council staff. Based on comments made in one written response, a recommendation has been incorporated in the *Bogan Gate FRMP* for Council to develop a

Vegetation Management Plan for Gunningbland Creek, especially in relation to the clearing of vegetation/debris at the Henry Parkes Way and Orange-Broken Hill Railway bridge crossings. While another written submission advocated the inclusion of “**Bogan Gate Potential Flood Modification Measure 1**” or “**BG_PFMM1**”) in the *Bogan Gate FRMP*, Council advised that these measures would form part of future stormwater drainage improvements that would be conducted outside of the NSW floodplain management program.

1.5 Flood Frequency and Terminology

In this report, the frequency of floods is referred to in terms of their Annual Exceedance Probability (**AEP**). The frequency of floods may also be referred to in terms of their Average Recurrence Interval (**ARI**). The approximate correspondence between these two systems is:

Annual Exceedance Probability (AEP) (%)	Average Recurrence Interval (ARI) (years)
0.2	500
0.5	200
1	100
2	50
5	20
10	10
20	5

The AEP of a flood represents the percentage chance of its being equalled or exceeded in any one year. Thus a 1% AEP flood, which is equivalent to a 100 year ARI, has a 1% chance of being equalled or exceeded in any one year and would be experienced, on the average, once in 100 years; similarly, a 20 year ARI flood has a 5% chance of exceedance, and so on.

The 1% AEP flood (plus freeboard) is usually used to define the Flood Planning Level (**FPL**) and Flood Planning Area (**FPA**) for the application of flood related controls over residential and commercial/industrial development. While a 1% AEP flood is a major flood event, it does not define the upper limit of possible flooding. Over the course of a human lifetime of, say 70 years, there is a 50 per cent chance that a flood at least as big as a 1% AEP event will be experienced. Accordingly, a knowledge of flooding patterns in the event of larger flood events up to the Probable Maximum Flood (**PMF**), the largest flood that could reasonably be expected to occur, is required for land use and emergency management planning purposes. In the *Bogan Gate Flood Study*, flooding patterns in the study area have been assessed for design floods ranging between 20% AEP event and the PMF.

2 BASELINE FLOODING CONDITIONS

2.1 Physical Setting

The village of Bogan Gate has a population of about 290 and is located about 37 km to the west of Parkes in the Parkes Shire Council LGA. The village is located on Henry Parkes Way at the junction of the Orange-Broken Hill and Tottenham railway lines and comprises a combination of land that is zoned *RU5-Village*, *R5–Large Lot Residential* and *RE1- Public Recreation* (denoted herein as the “Village Centre”). Natural surface levels within the Village Centre vary between a low of about RL 232 m AHD and a high of about RL 241 m AHD.

2.2 Existing Drainage System

The Village Centre lies a short distance to the south of the confluence of Blowclear Creek and Gunningbland Creek, the latter which drains in a westerly direction toward Goobang Creek. **Figure 2.1** shows the extent of both the Blowclear Creek and Gunningbland Creek catchments at their confluence, as well as the additional area that contributes to flow in Gunningbland Creek between its confluence with Blowclear Creek and where it crosses the Orange Broken Hill Railway Line.

Figure 2.1 shows that the headwaters of Gunningbland Creek and Blowclear Creek are each located approximately 25 km to the north-east and north of Bogan Gate, respectively. The inbank area of Gunningbland Creek generally comprises an incised 5-10 m wide by 1.5 m deep channel which has a grade of about 0.1% where it runs between the Village Centre and the location where it crosses beneath Henry Parkes Way, while the inbank area of Blowclear Creek is ill-defined where it runs between Blow Clear Road and its confluence with Gunningbland Creek.

The existing stormwater drainage system in the village (refer **Figure 2.2** (2 sheets) for layout) generally comprises piped and culvert crossings beneath the roads and railway, as well as grass lined table drains that convey overland flow toward the main arm of Gunningbland Creek. **Figure 2.2**, sheet 2 also shows the alignment of a network of rural levees/embankments that have been constructed on the Gunningbland Creek floodplain in the vicinity of the village.

2.3 Flood History

Respondents to the *Community Questionnaire* that was disseminated at the commencement of the *Bogan Gate Flood Study* identified a number of notably intense storm events that have been experienced in the study area, the dates of which are as follows:

- | | |
|-----------------|------------------|
| ➤ January 1992 | ➤ September 2016 |
| ➤ November 2005 | ➤ April 2020 |
| ➤ December 2010 | ➤ January 2021 |
| ➤ March 2012 | ➤ November 2021 |
| ➤ December 2012 | ➤ May 2022 |
| ➤ February 2016 | ➤ November 2022. |

Respondents to the *Community Questionnaire* also provided information on flooding that occurred on a number of these occasions, the most notable of which occurred on 1-2 March 2012 and 14 November 2022 and approximated storms that occur once every 10 years on the average. **Appendix A** of this report contains copies of several photos that show flooding that was experienced in and around the village in November 2005, December 2010, March 2012, June 2016, September 2016, May 2022 and November 2022.

2.4 Design Flood Behaviour

Figures 2.3 and 2.4 (3 sheets each) show the nature of flooding at Bogan Gate for the 1% AEP and PMF events, respectively, while **Figures B1.1 to B1.6** (3 sheets each) of **Appendix B** show similar information for the 20%, 10%, 5%, 2%, 0.5% and 0.2% AEP flood events. These diagrams show the indicative extent and depth of inundation along Gunningbland Creek and its associated tributaries, as well as along the Major Overland Flow paths for the range of design flood events.

Note that as per the requirements of the 2019 edition of *Australian Rainfall and Runoff* (Geoscience Australia, 2019) (**ARR 2019**), the results of the design flood modelling include probability neutral blockage factors that have been applied to existing hydraulic structures, details of which are set out in the *Bogan Gate Flood Study*.

In order to create realistic results which remove most of the anomalies caused by inaccuracies in the LiDAR survey data, a filter was applied to remove depths of inundation over the natural surface less than 0.1 m. This has the effect of removing the very shallow depths which are more prone to be artefacts of the model, but at the same time giving a reasonable representation of the various overland flow paths. The depth grids shown on the figures have also been trimmed to the building polygons, as experience has shown that property owners incorrectly associate depths of above-ground inundation at the location of buildings with depths of above-floor inundation.

Figure 2.5 is a longitudinal section along a 10.5 km length of the Orange-Broken Hill Railway Line and the adjacent Henry Parkes Way where they run between Olive Grove Lane and Overland Road, while **Figure 2.6** shows the time of rise of floodwaters at selected road and rail crossings throughout the study area, noting that time zero on the stage hydrographs represents the onset of flood producing rain (refer **Figures 2.3 and 2.4** for location of each individual stage hydrograph).

The key features of Main Stream Flooding along Gunningbland Creek as identified in the *Bogan Gate Flood Study* are as follows:

- i. Floodwater surcharges both banks of the watercourse during flood events more frequent than 20% AEP along its entire reach.
- ii. Floodwater surcharges the left (southern) bank of the watercourse immediately upstream of The Bogan Way:
 - a. inundates the low lying undeveloped land in the Village Centre that is bounded by Lagoon Street to the west, Marta Lane to the north, Monomie Street to the east and Bogan Street to the south during a 20% AEP event;
 - b. commences to inundate residentially developed allotments in Hutton Street and Lachlan Street in a 10% AEP flood event;
 - c. backs up a grass-lined drain that runs along the Lister Lane paper road reserve as far south as Lachlan Street in a 5% AEP flood event; and
 - d. inundates existing residentially developed allotments that are located to the north of Lachlan Street to a maximum depth of about 0.4 m in a 5% AEP flood event.
- iii. Henry Parkes Way and Orange-Broken Hill Railway embankments are generally elevated about 1 m and 1-1.5 m above adjacent natural surface levels. As a result, floodwater that surcharges the banks of the watercourse downstream of the Tottenham Railway line generally flows in a westerly direction through the rural land that is located on the northern side of Henry Parkes Way where it temporarily ponds on the eastern side of a hillock that is located in the vicinity of Cronin Lane.

- iv. Both the Tottenham and Orange-Broken Hill railway line crossings are overtopped by floodwater generally between 9-12 hours after the onset of flood producing rain, while the road crossings are generally inundated in less than 9 hours.

In regards Main Stream Flooding on the tributary arms of Gunningbland Creek, the *Bogan Gate Flood Study* found that:

- a) the inbank area of Blowclear Creek is not defined to the north of Blowclear Road and as a result, floodwater flows in a southerly direction through rural land where it overtops the road at multiple locations between Five Chain Lane and Mercadool Lane in flood events as frequent as 20% AEP; and
- b) floodwater surcharges the banks of Botfields Creek along its entire reach in flood events more frequent than 20% AEP.

The key features of Major Overland Flow as identified in the *Bogan Gate Flood Study* are as follows:

- i. Major Overland Flow has a negligible impact on the Village Centre.
- ii. As there is no formal kerb and gutter and/or piped drainage system in the Village Centre, stormwater runoff generally ponds in the road reserves for extended periods of time after the cessation of rainfall events.
- iii. The existing grass-lined drain that runs in a northerly direction from the northern end of Lester Lane is of limited capacity and has a minimal grade. It is therefore unable to efficiently drain local stormwater runoff from the portion of the Village Centre that lies to the east of The Bogan Way.

2.5 Existing Flood Mitigation Measures

There are no formal flood mitigation measures present in the village of Bogan Gate.

2.6 Economic Impacts of Flooding

The economic consequences of floods are discussed in **Appendix I** of the *Bogan Gate Flood Study*, which assessed flood damages to residential, commercial/industrial property and public buildings in areas affected by both Main Stream Flooding and Major Overland Flow in the village. The assessment was relied on the procedures set out in *Flood Risk Management Guideline MM01 – Flood Risk Management Measures* (DPE, 2023) and the associated *NSW Flood Risk Management Tool DT01* to estimate both the tangible and intangible damages resulting from flooding at Bogan Gate.

Table 2.1 over the page sets out the number of properties that are flood affected in the Village Centre, as well as the estimated damages which would occur for floods of varying magnitude.

While no buildings in the Village Centre would be inundated above-floor level in a 1% AEP flood event, flood damages of about \$0.03 Million would still be incurred during a flood of this magnitude. During a PMF event, 24 dwellings and one public building would experience above-floor inundation, resulting in flood damages totalling about \$5.39 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is effectively zero, while for all floods up to the PMF it is only about \$0.1 Million.

TABLE 2.1
SUMMARY OF FLOOD DAMAGES

Design Flood Event (% AEP)	Number of Properties						Total Damage (\$ Million)
	Residential		Commercial/ Industrial		Public		
	Flood Affected	Flood Above Floor Level	Flood Affected	Flood Above Floor Level	Flood Affected	Flood Above Floor Level	
20	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0.01
2	5	0	0	0	0	0	0.02
1	6	0	0	0	0	0	0.03
0.5	6	0	0	0	0	0	0.03
0.2	6	1	0	0	0	0	0.05
PMF	38	24	1	1	1	1	5.39

2.7 Impact of Flooding on Vulnerable Development and Critical Infrastructure

Figure 2.7 (3 sheets) shows the location of vulnerable development and critical infrastructure relative to the extent of inundation resulting from the assessed design storm events, while **Table 2.2** over the page sets out the frequency of floods which would impact this type of development/infrastructure.² **Figure 2.6** also provides flood data relating to the frequency, depth and duration of overtopping of the road and rail crossings identified in **Table 2.2** and on **Figure 2.7**.

Community Assets

The electricity substation that is located on the northern side of Henry Parks Way immediately to the east of the Village Centre is subject to relative shallow Major Overland Flow during storms more intense than about 5% AEP, while both telecommunication towers are only impacted by a PMF, and only then by relatively shallow depths.

While the Bogan Gate Memorial Hall that is located at the intersection of Hutton and Lachlan streets is only impacted by the PMF, it would be subject to backwater flooding from Gunningbland Creek to depths approaching 1 m during an extreme flood event.

The Bogan Way heading northern (refer locations H01, H07A, H07B and H09) and Henry Parkes Way, Tubby Lee Road and Leafy tank Road heading west (refer locations H03, H08 and H05A) of the Village Centre are inundated by floodwater during events as frequent as 20% AEP. As shown on **Figure 2.6** (2 sheets), with the exception of The Bogan Way, the affected roads would first become inundated around 9 hours after the onset of flood producing rain and remain inundated for more than 24 hours.

² Critical infrastructure has been split into two categories; community assets and emergency services.

TABLE 2.2
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE LOCATED IN THE STUDY AREA^(1,2)

Type	Development/Structure	Location Identifier ¹	20% AEP	10% AEP	5%AEP	2% AEP	1% AEP	0.50%	0.20%	PMF
Community Assets	Electricity Substation	-	NF	NF	NF	F	F	F	F	F
	Telecommunications Tower	TT1	NF	NF	NF	NF	NF	NF	NF	F
	Telecommunications Tower	TT2	NF	NF	NF	NF	NF	NF	NF	F
	Community Hall (Bogan Gate Memorial Hall)		NF	NF	NF	NF	NF	NF	NF	F
	Major Road Crossing (The Bogan Way)	H01	F	F	F	F	F	F	F	F
	Major Rail Crossing (Tottenham Railway Line)	H02A	NF	NF	F	F	F	F	F	F
	Major Road Crossing (Bogan Gate Tottenham Railway)	H02B	NF	F	F	F	F	F	F	F
	Major Road Crossing (Tubby Lee Road)	H03	F	F	F	F	F	F	F	F
	Major Road Crossing (Henry Parkes Way)	H04A	NF	NF	NF	NF	NF	NF	NF	NF
	Major Rail Crossing (Orange Broken Hill Railway)	H04B	NF	NF	NF	NF	NF	NF	NF	NF
	Major Road Crossing (Henry Parkes Way)	H05A	F	F	F	F	F	F	F	F
	Major Rail Crossing (Orange Broken Hill Railway)	H05B	NF	NF	F	F	F	F	F	F
	Major Rail Crossing (Bogan Gate Tottenham Railway)	H06	NF	NF	NF	F	F	F	F	F
	Major Road Crossing (The Bogan Way)	H07A	F	F	F	F	F	F	F	F
	Major Road Crossing (The Bogan Way/Bogan Gate Tottenham Railway)	H07B	F	F	F	F	F	F	F	F
	Major Road Crossing (Leafy Tank Road)	H08	F	F	F	F	F	F	F	F
	Major Road Crossing (The Bogan Way)	H09	F	F	F	F	F	F	F	F
Emergency Services	Rural Fire Service (Bogan Gate RFB)	RFB1	NF	NF	NF	NF	NF	NF	NF	NF
Vulnerable Development	Educational Facility (Bogan Gate Public School)	-	NF	NF	NF	NF	NF	NF	NF	NF

1. Refer **Figure 2.7** (3 sheets) for location of vulnerable development and critical infrastructure.
2. “NF” = Infrastructure not impacted by flooding.
“F” = Infrastructure impacted by flooding.

Emergency Services

The Bogan Gate Rural Fire Brigade shed is located on the southern side of Station Street within the Village Centre on flood free land.

Vulnerable Development

The Bogan Gate Public School is located at the intersection of Jackson Street and Bogan Street on flood free land.

2.8 Potential Impacts of a Change in Hydraulic Roughness

An analysis was undertaken as part of the *Bogan Gate Flood Study* to assess the sensitivity of flood behaviour to potential changes in hydraulic roughness. **Figure 2.8** shows the impact that a 20% increase in the “best estimate” hydraulic roughness values in the hydraulic model would have on a 1% AEP flood event.

The investigation found that increases in peak 1% AEP flood levels in the areas subject to Main Stream Flooding are generally in the range 20 to 100 mm, with increases of up to 200 mm shown to occur in the vicinity of the Tottenham Railway line crossing of the Gunningbland Creek floodplain. The investigation also found that Increases in peak flood levels in areas subject to Major Overland Flow are generally in the range 10 to 20 mm.

2.9 Potential Impacts of a Partial Blockage of Hydraulic Structures

As mentioned in **Section 2.4** of this report, as per the requirements of ARR 2019, the results of the design flood modelling include probability neutral blockage factors that have been applied to existing hydraulic structures, details of which are set out in the *Bogan Gate Flood Study*. **Figure 2.9** shows that the removal of the probability neutral blockage factors has a negligible effect on flood behaviour at the 1% AEP level of flooding.

2.10 Potential Impacts of Future Climate Change

DCCEEW currently recommends that the advice set out in Section 3.7.4 of *Floodplain Risk Management Guide - Incorporating 2016 Australian Rainfall and Runoff in studies* (Office of Environment and Heritage (OEH), 2019) be used as the basis for examining climate change in projects undertaken under the State Floodplain Management Program and the FRMM. The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent.³

On current projections the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10 per cent, with the higher value of 30 per cent representing an upper limit which may apply near the end of the century. Under present day climatic conditions, increasing the 1% AEP design rainfall intensities by 10 per cent would produce about a 0.5% AEP flood; and increasing those rainfalls by 30 per cent would produce about a 0.2% AEP event.

³ While ARR 2019 updated the advice in relation to the impact that climate change will have on the BoM, 2016 design rainfall intensities, as well as initial and continuing losses for design flood estimation in late 2024, due to the timing of its release, the advice set out in OEH, 2019 has been adopted for undertaking the present study.

For the purpose of the *Bogan Gate Flood Study*, the impact 10% and 30% increases in design 1% AEP rainfall intensities would have on flood behaviour was assessed by comparing the peak flood levels which were derived from the flood modelling for design events with AEPs of 1%, 0.5% and 0.2%.

Figure 2.10 shows that a 10% increase in 1% AEP rainfall intensities would result in increases in peak flood levels of between 50 and 200 mm along Gunningbland Creek and its tributaries, while depths of Major Overland Flow would generally be increased by between 10 to 50 mm.

Figure 2.11 shows that a 30% increase in 1% AEP rainfall intensities would result in increases in peak flood levels of between 100 and 300 mm along Gunningbland Creek and its tributaries, while depths of Major Overland Flow would generally be increased up to 100 mm.

Figure 2.12 shows that the extent of land that would be inundated by floodwater should 1% AEP rainfall intensities increase by up to 30% is negligible on the northern side of the Orange-Broken Hill Railway due to the relatively steep sided nature of the floodplain in this area, while the extent of land that would be inundated increases on the southern side of the rail corridor due to its relatively flat nature.

2.11 Flood Hazard Vulnerability and Hydraulic Categorisation of the Floodplain

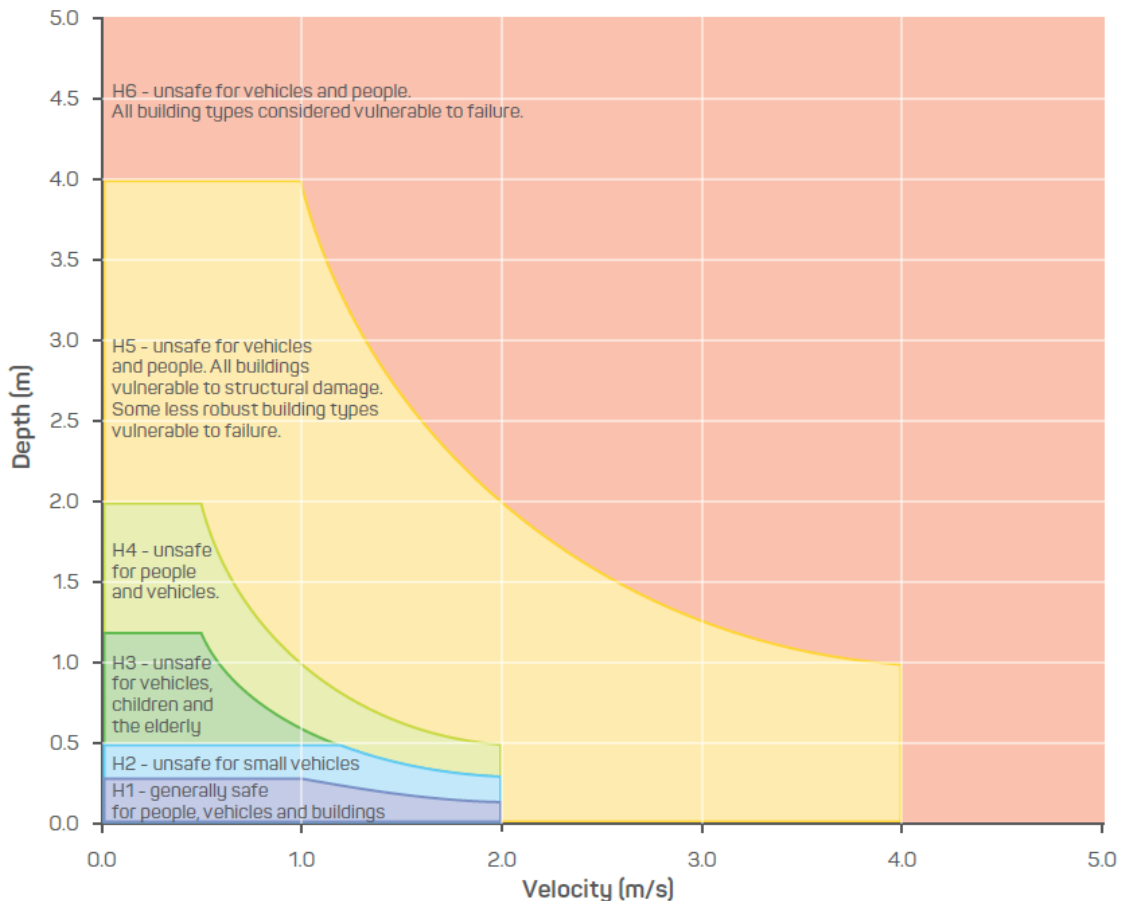
2.11.1 General

According to the FRMM, in order to achieve effective and responsible flood risk management, it is necessary to divide the floodplain into areas that reflect:

1. The impact of flooding on people, as well as existing and future development. To examine this impact it is necessary to divide the floodplain into “*flood hazard vulnerability*” categories, which are provisionally assessed on the basis of the velocity and depth of flow. This task was undertaken as part of the *Bogan Gate Flood Study* where the floodplain was divided into six flood hazard vulnerability zones. **Section 2.11.2** below provides details of the procedure and its outcomes.
2. The impact of future development activity on flood behaviour. Development in active flow paths (i.e. “*floodways*”) has the potential to adversely re-direct flows towards adjacent properties. Examination of this impact requires the division of flood prone land into various “*hydraulic categories*” to assess those parts which are effective for the conveyance of flow, where development may affect local flooding patterns. Hydraulic categorisation of the floodplain was also undertaken as part of the *Bogan Gate Flood Study*. **Section 2.11.3** below summarises the procedure and its outcomes.

2.11.2 Flood Hazard Vulnerability Categorisation

Flood hazard categories may be assigned to flood affected areas in accordance with the definitions contained in ARR 2019. Flood prone areas may be classified into six hazard categories based on the depth of inundation and flow velocity that relate to the vulnerability of the community when interacting with floodwater as shown in the illustration over the page which has been taken from ARR 2019.



Figures 2.13 and 2.14 (3 sheets each) show the *Flood Hazard Vulnerability Classification* based on the procedures set out in ARR 2019 for the 1% AEP and PMF events at Bogan Gate, respectively.

The *Bogan Gate Flood Study* found that the majority of the Village Centre is classified as H1 and H2 in flood events up to 0.2% AEP, with H3 type flooding conditions shown to be present in the low lying land that is located on the northern side of Bogan Street. The *Bogan Gate Flood Study* also found that in flood events up to 0.2% AEP, there are generally no areas classified as H6, while areas classified as H5 are generally limited to the inbank area of Gunningbland Creek, Blowclear Creek and Botfields Creek.

2.11.3 Hydraulic Categorisation of the Floodplain

According to the FRMM, the floodplain may be subdivided into the following three hydraulic categories:

- Floodways;
- Flood storage; and
- Flood fringe.

Floodways are those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with obvious naturally defined channels. Floodways are the areas that, even if only partially blocked, would cause a significant re-distribution of flow, or a significant increase in flood level which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.

Flood storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.

Flood fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

Flood Risk Management Guideline FB02 Floodway Function offers guidance in relation to two alternative procedures for identifying the portion of the floodplain that functions as floodways, flood storage and flood fringe areas.

The indicator technique set out in *Howells et al, 2003* was used as part of the *Bogan Gate Flood Study* to identify the preliminary extent of the floodway based on velocity of flow and depth. Based on the findings of a trial and error process, the following criteria were adopted for identifying those areas which operate as a “floodway” in a 1% AEP event:

- Velocity x Depth greater than 0.25 m²/s **and** Velocity greater than 0.25 m/s; or
- Velocity greater than 1 m/s.

Manual assessment and cleaning of the raw model output data was then undertaken as recommended in *Flood Risk Management Guideline FB02 Floodway Function*.

Flood storage areas were identified as those areas which do not operate as floodways in a 1% AEP event but where the depth of inundation exceeds 300 mm, while the remainder of the flood affected area was classified as flood fringe.

Figures 2.15 to 2.16 (3 sheets each) show the division of the floodplain into floodway, flood storage and flood fringe areas for the 1% AEP and PMF events, respectively.

Sheet 2 of **Figures 2.15 and 2.16** show that the main floodway on Gunningbland Creek generally runs along the northern side of Henry Parkes Way between Tubby Lees Road and Cronin Lane before crossing to the southern side of the Orange-Broken Hill Railway where it rejoins the main arm of the creek. A floodway zone is also shown to be contained within the inbank area along the 5.5 km reach of Gunningbland Creek immediately downstream (south) of the Orange-Broken Hill Railway Line in flood events up to 0.2% AEP.

In addition to the above, a floodway is present in the minor drainage line that runs to the north of Lachlan Street, east of Hutton Street during a 1% AEP flood event, while several streets in the village function as a floodway during a PMF event.

Flood storage areas are confined to the major ponding areas which are located on the upstream side of the road and railway embankments, as well as in the local farm dams that have been constructed to capture surface runoff in different parts of the study area.

2.12 Environmental Considerations

While **Figures 2.17** shows that there is no environmentally zoned land in the immediate vicinity of Bogan Gate, the inbank area of Gunningbland Creek and its major tributaries, as well as their overbank vegetation do have significant environmental value. This is highlighted by identification of areas of significant environmental value on the *Terrestrial Biodiversity* and *Watercourse* maps contained in *Parkes LEP 2012*, extracts of which are shown in the illustrations over the page.



Illustration showing the extent of land identified as "biodiversity" on the "Terrestrial Biodiversity Map" contained in Parkes LEP 2012.



Illustration showing the extent of land identified as "watercourse" on the "Watercourse Map" contained in Parkes LEP 2012.

It is noted that both areas identified as “Biodiversity” and “Watercourse” extend south into the Village Centre generally as far as Bogan Street. It is also noted that area identified as “Watercourse” within the northern portion of the Village Centre does not generally align with the flood affected shown on **Figure 2.3**, sheet 3. Further discussion on the potential impacts that Council must consider when assessing a development application in these two areas is contained in **Section 2.13.2** of this report.

2.13 Council’s Existing Planning Instruments and Policies

2.13.1 General

The *Parkes LEP 2012* is the principal statutory planning document used by Council for controlling development by defining zoning provisions, establishing permissibility of land use and regulating the extent of development in the Parkes Shire Council local government area.

The *Parkes Shire Development Control Plan 2021* (**Parkes Shire DCP 2021**) supplements the *Parkes LEP 2012* by providing general information and detailed guidelines which relate to the decision making process.

2.13.2 Parkes Local Environmental Plan 2012

Figures 2.17 shows the zonings that are incorporated in *Parkes LEP 2012* in the immediate vicinity of Bogan Gate. The southern portion of the Village Centre principally comprises land that is zoned *RU5-Village*, with two small pockets of land that are zoned *RE1-Public Recreation* located with side of Edol Street, while the northern portion is zoned *R5-Large Lot Residential*. The land surrounding the Village Centre is principally zoned *RU1-Primary Production*, with the exception of the rail corridors which are zoned *SP2-Infrastructure* and the large parcel of land which lies immediately to its north which is zoned *RE2-Private Recreation*.

Clause 5.21 of *Parkes LEP 2012* entitled “*Flood planning*” outlines its objectives in regard to development of land that is located within the extent of the FPA. Clause 5.21 was inserted into *Parkes LEP 2012* by the NSW Government on 14 July 2021 and replaced clause 6.6 which was repealed at the time. Unlike the wording in repealed clause 6.6, the FPL is not defined in clause 5.21.

Clause 5.21 states that development consent must not be granted unless the consent authority is satisfied that the development:

- (a) *is compatible with the flood function and behaviour on the land, and*
- (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, and*
- (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, and*
- (d) *incorporates appropriate measures to manage risk to life in the event of a flood, and*
- (e) *will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.*

It also states that 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,*

- (b) the intended design and scale of buildings resulting from the development,*
- (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,*
- (d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.*

While the heading of clause 5.22 entitled “*Special flood considerations*” was inserted in *Parkes LEP 2012* by the NSW Government on 14 July 2021, Council is awaiting the outcomes of the present study prior to making a decision on its possible inclusion. It is noted that the new clause forms part of the updated *NSW Flood Prone Land Package* and has the following objectives:

- in relation to development with particular evacuation or emergency response issues (e.g. schools, group homes, residential care facilities, hospitals, etc.) to enable evacuation of land which lies above the FPL; and
- to protect the operational capacity of emergency response facilities and critical infrastructure during extreme flood events.

The new clause applies to land that lies outside the FPA but within the extent of the PMF.

As mentioned in **Section 2.12**, Council must give consideration to the impact that a proposed development would have on areas identified as “Watercourse” and “Biodiversity”, noting that both these areas affect the northern portion of the Village Centre.

Clause 6.2 of *Parkes LEP 2012* entitled “*Terrestrial biodiversity*” applies to land identified as “Biodiversity” on the *Terrestrial Biodiversity Map*. It states that before determining a development application for development on land to which this clause applies, the consent authority must consider:

- (a) whether the development is likely to have—*
 - (i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and*
 - (ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and*
 - (iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and*
 - (iv) any adverse impact on the habitat elements providing connectivity on the land, and*
- (b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.*

It also states that development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or*
- (b) if that impact cannot be reasonably avoided by adopting feasible alternatives—the development is designed, sited and will be managed to minimise that impact, or*
- (c) if that impact cannot be minimised—the development will be managed to mitigate that impact.*

Clause 6.4 of *Parkes LEP 2012* entitled “*Riparian lands and watercourses*” applies to land identified as “Watercourse” on the *Watercourse Map* and all land that lies within 40 metres of the top of bank of each watercourse identified as “Watercourse” on that map. It states that before determining a development application for development on land to which this clause applies, the consent authority must consider:

- (a) *whether or not the development is likely to have any adverse impact on the following—*
 - (i) *the water quality and flows within the watercourse,*
 - (ii) *aquatic and riparian species, habitats and ecosystems of the watercourse,*
 - (iii) *the stability of the bed and banks of the watercourse,*
 - (iv) *the free passage of fish and other aquatic organisms within or along the watercourse,*
 - (v) *any future rehabilitation of the watercourse and riparian areas, and*
 - (vi) *whether or not the development is likely to increase water extraction from the watercourse, and*
- (b) *any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.*

It also states that development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) *the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or*
- (b) *if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or*
- (c) *if that impact cannot be minimised—the development will be managed to mitigate that impact.*

The above requirements highlight that in addition to flood related constraints, the land which lies to the north of Bogan Street is also potentially constrained by environmental type considerations.

2.13.3 Flood Related Development Controls

Part B2.5 of *Parkes Shire DCP 2021* entitled “*Stormwater Design and Management*” sets out the controls that apply to new residential subdivisions that are proposed within the LGA. The stated objective of the chapter is:

“To ensure stormwater from residential subdivisions is properly drained to a legal point of discharge without causing adverse impacts on public drainage infrastructure, downslope properties or the quality of receiving waters.”

The standards that are to be applied to new subdivision development are as follows:

- a. *All stormwater generated by any subdivision development must be drained to a legal point of discharge.*
- b. *Stormwater drainage systems are designed using the Australian Rainfall and Runoff 2019 major and minor event philosophy, where the minor system shall be capable of carrying the controlling flows from frequent runoff events, while the major system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events.*

- c. Stormwater volumes and characteristics are estimated in accordance with Australian Rainfall and Runoff 2019 by a suitably qualified engineer.
- d. Subdivision development takes into account the stormwater management requirements of the whole site / stormwater drainage system, including stormwater from upslope areas in the catchment that is based on a fully developed scenario.
- e. Existing stormwater management infrastructure abutting the subdivision development, including road drainage and drainage reserves are upgraded / replaced where they do not meet the requirements of the Parkes Shire Council Engineering Design Minimum Standards for Subdivision and Development 2021 and AUS-SPEC #2 Stormwater Drainage.
- f. Subdivisions that are shown as requiring onsite stormwater detention under the Parkes Urban Area Stormwater Management Plan 2019 are designed so that post-development runoff rates from the new subdivision are equal to or less than pre-development runoff rates for the 1% AEP.
- g. Subdivisions are designed to accommodate all stormwater in the 20% AEP via underground drainage infrastructure.
- h. Subdivisions are designed to accommodate all stormwater above the 20% AEP up to the 1% AEP via roads and drainage reserves.
- i. All residential lots in subdivisions must be free of flooding in the 100 ARI.
- j. Subdivisions are provided with all necessary stormwater management infrastructure required to address a) to i) above, and in accordance with Parkes Shire Council Engineering Design Minimum Standards for Subdivision and Development 2021 and AUS-SPEC #2 Stormwater Drainage.
- k. Easements to drain stormwater are provided over all pipelines, pits, overland flow paths and channels (other than natural water courses).
- l. Subdivisions that cannot drain stormwater to a legal point of discharge via gravity must be supported by a site specific stormwater management system that is designed by a suitably qualified engineer.

Part C7.4 of *Parkes Shire DCP 2021* entitled “Fencing” sets out the controls that apply to new fencing that is proposed as ancillary type development. The stated objective of the chapter is:

“To ensure fencing that requires consent does not create adverse impacts on streetscape, residential amenity, public utilities or access.”

The standards that are to be applied to new fencing are as follows:

- a. Fencing must be constructed of masonry, timber or low reflective painted metal materials to manufacturer’s specifications.
- b. Fencing must not incorporate barbed or razor wire in its construction or be electrified or topped with sharp edged materials.
- c. Entrance gates in fencing shall not open outwards onto a public road reserve.
- d. Fencing must be designed so as not to restrict / redirect the flow of any floodwater or overland drainage flow-path within a legal drainage easement.
- e. Fencing complies with the maximum height standards in the following table: [Not reproduced in this report]

It is noticeable that the flood related controls that are set out in *Parkes Shire DCP 2021* only related to new subdivisions and ancillary type development in the form of new fencing, and therefore do not extend to the control of other types of development such as new single dwellings, commercial/industrial buildings and sensitive type development such as aged and child care type facilities. As a result, Council is constrained in its ability to impose suitable controls on new development that is located within the extent of the flood planning area as required by Clause 5.21 of *Parkes LEP 2012*.

2.14 Flood Warning and Flood Preparedness

The NSW SES is nominated as the principal combat and response agency for flood emergencies in NSW. NSW SES is responsible for the issuing of relevant warnings (in collaboration with BoM), as well as ensuring that the community is aware of the flood threat and how to mitigate its impact.

The *Parkes Shire Local Flood Plan* which is dated February 2024 covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures for all levels of flooding within the Parkes Shire LGA. *Parkes Shire Local Flood Plan* is administered by the Parkes Unit Commander who controls flood operations within the Parkes Shire LGA. NSW SES maintains a local headquarters at 1the corner of Clark and Alluvial streets in Parkes.

Volume 1 of *Parkes Shire Local Flood Plan* entitled '*Parkes Shire Flood Emergency Sub Plan*' includes sections on flood preparedness, response and recovery. Volume 1 follows the standard NSW SES template and is divided into the following sections:

- **Chapter 1 - Outline and Scope;** this section of the document introduces the roles and responsibilities for agencies, functional areas and organisations in relation to flooding within the Parkes Shire. It also emphasises the importance of reviewing and maintaining the currency of the *Parkes Shire Local Flood Plan*.
- **Chapter 2 - Overview of NSW Flood Hazard and Risk,** makes reference to Volume 2 of the *Parkes Shire Local Flood Plan* which outlines the existing hazard and flood risk in the Parkes Shire. It also lists the declared dams that are located either in or upstream of the Parkes Shire LGA.
- **Chapter 3 - Preparation;** this section of the document deals with activities required to ensure the *Parkes Shire Local Flood Plan* functions during the occurrence of the flood emergency. It also devotes considerable attention to flood alertness and emergency response.
- **Response;** this section states response operations will commence:
 - a. On receipt of a Bureau Severe Weather Warning or Thunderstorm Warning that includes heavy rain or storm surge; or
 - b. On the receipt of a Bureau Flood Watch or Flood Warning; or
 - c. On receipt warnings for flash flood; or
 - d. On receipt of a dam failure alert; or
 - e. When other evidence leads to an expectation of flooding.

The response strategies to be employed by NSW SES and Council are listed in Chapter 5 of the *Parkes Shire Local Flood Plan* and include information provision and warning, property protection, evacuation, rescue, and resupply.

- **Recovery Operations;** involving measures to ensure the long term welfare for people who have been evacuated, recovery operations to restore services and clean up and de-briefing of emergency management personnel to review the effectiveness of the *Parkes Shire Local Flood Plan*.

Volume 2 of the *Parkes Shire Local Flood Plan* deals with the existing flood hazard and risk in the Parkes Shire LGA. Section 1.6 of Volume 2 states that records show a history of flooding, in what is now the Parkes Shire LGA, at Trundle and Bogan Gate with the most significant in 1930, 1952, 1973, 1976, 1990, 1992, 1998, 2005, 2012 and 2016. It also states that:

- a) in September 2016, a large number of roads were impacted by overland and flash flooding including Narromine-Tullamore Road, Bogan Gate-Trundle Road, Bogan Way, Peak Hill-Tullamore Road, Eugowra Road, Henry Parkes (Orange) Road, Newell Highway and 202 local roads;
- b) in extreme flood events residences at Tichborne (10 kilometres south of Parkes on the Newell Highway (HW17)), Bogan Gate and rural properties west of Tullamore may become flooded.

Section 2.3 of Volume 2 deals with the specific flood threat at both Trundle and Bogan Gate. Information on both villages is set out under the following headings, noting that only information relating to Bogan Gate has been reproduced below:

2.3.1 Community Overview

Bogan Gate is a small rural community with a population of 307. It lies about 36 kilometres west of Parkes and 24 kilometres southeast of Trundle. It is situated adjacent to the main Sydney – Broken Hill railway.

2.3.2 Characteristics of Flooding

Bogan Gate experiences flash flooding from local creeks, including Gunningbland Creek.

2.3.3 Flood Behaviour

[No Bogan Gate specific information provided]

2.3.4 Classification of Floodplain

[No Bogan Gate specific information provided]

2.3.5 Inundation

Bogan Gate residences may become flooded in an extreme event.

2.3.6 Isolation

In Bogan Gate, six properties on and near The Common next to the Gunningbland creek, north of Leafy Tank Road, Footshill Lane and The Bogan Way, were isolated in 1990 with residents requiring emergency accommodation for three days. Isolation generally occurs for one to three days.

Road closures shown in Section 2.6 combined with those in the Bogan River Catchment area can mean that Trundle can be isolated for periods up to one week and Bogan Gate for 24-36 hours.

2.3.7 Flood Mitigation Systems

[No Bogan Gate specific information provided]

2.3.8 Dams

There are no prescribed dams near Trundle or Bogan Gate.

2.3.9 At Risk Facilities

[No Bogan Gate specific information provided]

2.3.10 Other Considerations

[No Bogan Gate specific information provided]

Section 2.6 of Volume 2 deals with road closures within the Parkes Shire LGA. The following road closure information is given in relation to Bogan Gate:

- **Henry Parkes Way (MR61)** - Gunningbland Creek approx. 6 kilometres west of Bogan Gate. Can be cut for up to four days by the Gunningbland Creek - Restricts access between Bogan Gate and Condobolin.
- **Henry Parkes Way (MR61)** - Approx. 3 kilometres East of Bogan Gate. Can be cut for up to four days by the Gunningbland Creek.
- **The Bogan Way (MR350)** - Approx. 1.5 kilometres North of Bogan Gate. Can be cut for up to four days by the Gunningbland Creek. Restricts access between Bogan Gate and Trundle.

Section 2.7 of Volume 2 provides the following summary of isolated communities and properties within the Parkes Shire LGA:

Town / Area (River Basin)	Population/ Dwellings	Flood Affect Classification	Approximate period isolation	Days								NOTES
				1	2	3	4	5	6	7	8	
Trundle	666 persons / 337 dwellings	High Flood island at 1% AEP, Low Flood Island in extreme	6 – 7 days									Resupply by rotary aircraft as roads closed and no suitable airstrip in town vicinity
Bogan Gate	307 persons / 160 dwellings	High Flood Island	1 – 2 days									Resupply by rotary aircraft

Note: Periods of isolation are a guide only. Liaison with the Local Controller and communities/residents involved is essential during periods of potential and actual isolation.

While Annex 2 of Volume 2 lists the facilities at risk of flooding and/or isolation in the Lachlan Valley, there are no listings for Bogan Gate (for example the Bogan Gate Public School is not included in the list).

Volume 3 of the *Parkes Shire Local Flood Plan* deals with NSW SES response arrangements for the Parkes Shire and is set out as follows:

- **Chapter 1: Flood Warning Systems and Arrangements**, which deals with dissemination options for NSW SES flood information and warning products, as well as gauges monitored by NSW SES within the LGA.
- **Chapter 2: SES Locality Response Arrangements**, which deals with NSW SES flood response arrangements by individual sector within the LGA. It is noted that the village of Bogan Gate is not assigned a sector within the *Parkes Shire Local Flood Plan*.
- **Chapter 3: SES Dam Failure Arrangements**, which is not applicable to the Parkes Shire LGA.
- **Chapter 4: SES Caravan Park Arrangements**, which deals with arrangements for the evacuation of flood liable caravan parks within the LGA, as well as specific arrangements for individual parks likely to be affected by flooding. It is noted that no caravan parks are presently located within the village of Bogan Gate.

3 POTENTIAL FLOOD RISK MANAGEMENT MEASURES

3.1 Range of Available Measures

A variety of flood risk management measures can be implemented to reduce flood damages. They may be divided into three categories, as follows:

Flood modification measures change the behaviour of floods in regard to discharges and water surface levels to reduce flood risk. This can be done by the construction of levees, detention basins, channel improvements and upgrades of both transverse and longitudinal drainage systems. Such measures are also known as “structural” options as they involve the construction of engineering works. Vegetation management is also classified as a flood modification measure.

Property modification measures reduce risk to properties through appropriate land use zoning, specifying minimum floor levels for new developments, voluntary purchase of residential property in high hazard areas, or raising existing residences in the less hazardous areas. Such options are largely planning (i.e. “non-structural”) measures, as they are aimed at ensuring that the use of floodplains and the design of buildings are consistent with flood risk. Property modification measures could comprise a mix of structural and non-structural methods of damage minimisation to individual properties.

Response modification measures change the response of flood affected communities to the flood risk by increasing flood awareness, implementation of a flood warning system and the development of an emergency response plan for property evacuation.

3.2 Outline of Chapter

A range of potential flood risk management measures were examined at the strategic level of detail and where appropriate, tested for feasibility on a range of assessment criteria in **Chapter 4**. Following consideration of the results by the FRMC, selected measures were included in the *Bogan Gate FRMP*, details of which are set out in **Chapter 5**.

The potential flood modifications which were assessed as part of this study comprised the minor stormwater drainage improvements, improvements to the hydrologic standard of Henry Parkes Way where it runs between Parkes and Bogan Gate and the removal/reduction in the blocking effects of both Henry Parkes Way and the Orange-Broken Hill Railway embankments, details of which are set out in **Section 3.3** of this Chapter.

The property modification measures considered as part of this study include controls over future development, voluntary purchase of residential properties and house raising (refer **Section 3.4** of this Chapter for details). Response modification measures, such as improvements to the severe weather/flood warning system, emergency planning and responses, and public awareness programs have also been considered, details on which are set out in **Section 3.5** of this Chapter.

3.3 Flood Modification Measures

3.3.1 Stormwater Drainage Improvements

Following discussions with the TWG, it was identified that Major Overland Flow discharging to the Village Centre in its south-east corner has historically caused issues within the local community. An assessment was therefore undertaken whereby a widened/regraded channel was run from the outlet of the existing transverse drainage structure on Station Street, north to the main arm of Gunningbland Creek, in combination with an earth bund which would run along its western side adjacent to the Village Centre (denoted herein as “**Bogan Gate Potential Flood Modification Measure 1**” or “**BG_PFMM1**”).

The left hand side of **Figure 3.1**, sheet 1 shows the layout of the assessed channel and earth bund arrangement, while the right hand side of sheet1 and both sides of sheet 2 show the impact that the implementation of the works would have on floods with AEPs of 20%, 5% and 1%.

While the proposed channel and bund arrangement would prevent nuisance flooding from being experienced in the south-east corner of the Village Centre, the area is not currently subject to damaging type flooding, so the measure would provide limited benefit in terms of reducing flood damages in existing residential development. Based on this finding, the assessed channel and earth bund arrangement has not been included in *Bogan Gate FRMP*.

3.3.2 Road and Rail Transverse Drainage Upgrades

3.3.2.1 Improving Vehicular Access Between Urban Centres

While outside of the study area, Council advised that Henry Parkes Way is cut between Parkes and Bogan Gate at the location of three major creek crossings, whereby the existing causeways are at times inundated to depths exceeding 1 m. The Bogan Way is also inundated by floodwater immediately to the north of the village, thereby preventing vehicular access to the nearby village of Trundle.

It is noted that hospitals are located at both Parkes and Trundle, so access to medical facilities immediately following a flood event would currently be prevented until such time as floodwater in the creek systems which cross both Henry Parkes Way and The Bogan Way recedes.

While the extent to which The Bogan Way is inundated by floodwater from Gunningbland Creek and its major tributaries means that increasing its hydrologic standard would be cost prohibitive, there would be merit in investigating whether it would be feasible to raise Henry Parkes Way at the location of the aforementioned causeways, thereby improving its hydrologic standard and at the same time reducing the flood risk at the designated creek crossings.

Based on the above, the *Bogan Gate FRMP* includes a recommendation for Transport for NSW to undertake an investigation into the feasibility of raising Henry Parks Way to improve its hydrologic standard where it runs between Parkes and Bogan Gate. While subject to the findings of the feasibility study, the *Bogan Gate FRMP* includes the upgrade of Henry Parkes Way to improve its hydrologic standard where it runs between Parkes and Bogan Gate (been denoted herein as “**Bogan Gate Potential Flood Modification Measure 2**” or “**BG_PFMM2**”).

3.3.2.2 Reducing Backwater/Blocking Effects of Road/Rail Embankments

Village Centre

While the Bogan Gate-Tottenham Railway embankment and to a lesser extent The Bogan Way embankment result in elevated water levels being experienced in the northern portion of the Village Centre, there is currently no existing development that experiences above-floor inundation up to the 1% AEP level of flooding as a result of these effects.

Given the significant costs that would be associated with providing sufficient waterway area to remove/reduce these backwater effects, combined with the limited impact that this type of flooding has on existing development at Bogan Gate, the upgrade of the existing road/rail transverse drainage immediately to the north of the village has not been included in *Bogan Gate FRMP*.

Rural Land West of the Village Centre

While not the primary focus of the *Bogan Gate FRMS&P*, several rural landowners have over the past 60+ years petitioned both local and state government representatives regarding improvements to the conveyance capacity of the transverse drainage that is located along the Broken Hill-Orange Railway and Henry Parkes Way where it runs to the west of Bogan Gate.

The Secretary of the Gunningbland Creek Flood Improvement Committee wrote to the Hon Anthony Albanese MP, the then Shadow Minister for Infrastructure in October 2016 following an in-person meeting to discuss flooding in Gunningbland Creek, west of Bogan Gate. The letter states that the railway was raised in the 1950s which resulted in floods occurring within a few years. The letter lists a number of issues in relation to the railway and its impact on flood behaviour, an abbreviated version of which is provided below:

- i. *The height of the railway embankment (up to 1.5 m) creates a levee effect and forces floodwater westward, against the natural flow of the Gunningbland Creek.*
- ii. *Where floodwater from the Gunningbland Creek first hits the Henry Parkes Way and the railway line, the flood mitigation infrastructure is ineffective and the floodwater has to travel 4.9 km before it is able to pass through the railway bridge at Carlachy. As the Carlachy bridge is overwhelmed during a flood, the water has to travel another 4.4 km before it reaches the railway culverts at the Monomie siding, a total of 9.3 km.*
- iii. *Due to the volume of floodwater and the inadequate flood mitigation infrastructure, the railway line, which is required to be open 24 hours, seven days a week, is eventually washed away. This is akin to pulling a plug out of a bath and creates a strong destructive current of water for residents and landowners both north and south of the railway line.*
- iv. *Floods occur on average once every 5-10 years devastating local residents and landowners, and also washing away the railway line*

The letter also lists the following impacts relating to the impact that the railway has on flood behaviour:

- i. *each flood results in loss of livestock, crop destruction, topsoil eroded and washed away, fences continually demolished and in the 2005 and 2012 flood residents upstream experienced inundation inside their homes when levees were breached and carpets and furniture destroyed;*
- ii. *the damage from floods to residents and landowners results in significant repair bills, loss of livelihood and takes a substantial emotional toll on already strained residents and landowners; and*
- iii. *the railway line is washed away and is closed to freight and passenger trains, including the Indian Pacific.*

The letter goes on to state that while residents and landowners on the northern side of the railway line acknowledge that some floodwaters from Gunningbland Creek will have to pass through their properties, in order to mitigate the damage caused by flooding exacerbated by its height, the Gunningbland Creek Flood Improvement Committee recommend that 1 km long viaduct comprising both bridge and culvert structures be installed extending 500 m either side of the existing railway bridge at Carlachy.

As part of the present study, the structure of the TUFLOW hydraulic model was modified by removing both the Henry Parkes Way and Orange-Broken Hill Railway embankments over a 1 km length centred on the existing railway bridge at Carlachy. Natural surface levels were also lowered on the southern (downstream) side of the railway line to remove the blocking effects of an existing

dam that is located on railway land. The scope of the assessed measures has been denoted herein as “**Bogan Gate Potential Flood Modification Measure 3**” or “**BG_PFMM3**”.

Figure 3.2 (3 sheets) shows the impact that the implementation of BG_PFMM3 would have on flood behaviour on the broader Gunningbland Creek floodplain west of Bogan Gate for design floods with AEPs of 20%, 5% and 1%, while **Figures 3.3, 3.4** and **3.5** show the flooding patterns in the vicinity of the existing Carlachy railway bridge under pre- and post-BG_PFMM3 conditions for design floods with AEPs of 20%, 5% and 1%, respectively.

The key findings of the assessment were as follows:

- i. The implementation of BG_PFMM3 would only have a minimum impact in terms of reducing both the extent and depth of inundation on the northern (upstream) side of the road and rail corridors for all floods up to 1% AEP in magnitude.
- ii. The implementation of BG_PFMM3 would result in an increase in both the extent and depth of inundation experienced on rural land that is located to the south (downstream) of the road and railway corridors for all floods up to 1% AEP in magnitude.
- iii. While the section of road and rail embankment which runs to the east of the existing Carlachy railway bridge diverts a portion of the total flow across the Gunningbland Creek floodplain in a westerly direction, the general fall of the floodplain and also its main conveyance path lies to the north of the inbank area of the watercourse, resulting in the majority of the floodwater bypassing the larger waterway area that would be associated with BG_PFMM3. One of the key reasons for this is the presence of relatively higher ground either side of the inbank area of Gunningbland Creek as it approaches the existing road and rail crossings, as indicated by the shallower nature of the floodwater shown on **Figures 3.3, 3.4** and **3.5** in this area.

For example, by inspection of the peak flows set out in **Table 3.1**, the majority of the flow is maintained on the northern side of the road and rail corridors immediately to the west of the assessed works.

TABLE 3.1
COMPARISON OF PEAK FLOWS^(1,2)
(m³/s)

Condition	Northern (Upstream) Side of Road and Rail Corridors			Southern (Downstream) Side of Road and Rail Corridors		
	20% AEP	5% AEP	1% AEP	20% AEP	5% AEP	1% AEP
Present Day	112	248	409	35	63	113
Post-BG_PFMM3	99 [-13]	209 [-39]	338 [-71]	46 [+11]	101 [+38]	188 [+75]
Post-BG_PFMM4	87 [-25]	173 [-75]	252 [-157]	57 [+22]	134 [+71]	274 [+161]

1. The reference point for comparing peak flows is located immediately to the west of the assessed measures.
2. A positive value in [] represents an increase in peak flow attributable to the assessed measure, while conversely a negative value represents a reduction in peak when compared to present day conditions.

Based on the above findings, there is limited merit in providing a 1 km long viaduct type structure centred on the existing Carlachy railway bridge and as a result, BG_PFMM3 has not been included in *Bogan Gate FRMP*.

To highlight the extent to which the Henry Parkes Way and Orange-Broken Hill Railway embankments influence flood behaviour where they run across the full width of the Gunningbland

Creek floodplain, the structure of the TUFLOW hydraulic model was further modified by removing both the road and rail embankments where they run between Olive Grove Lane and Overland Road, a distance of over 10.5 km. The scope of the assessed measures has been denoted herein as **“Bogan Gate Potential Flood Modification Measure 4”** or **“BG_PFMM4”**.

Figure 3.6 (3 sheets) shows the impact that the implementation of BG_PFMM4 would have on flood behaviour on the broader Gunningbland Creek floodplain west of Bogan Gate for design floods with AEPs of 20%, 5% and 1%.

The key findings of the assessment were as follows:

- i. The implementation of BG_PFMM4 would result in a greater reduction in the extent and depth of inundation that would be experienced on the northern (upstream) side of the road and rail corridors when compared to BG_PFMM3 for all floods up to 1% AEP in magnitude.
- ii. The implementation of BG_PFMM4 would result in a greater increase in the extent and depth of inundation that would be experienced on the southern (downstream) side of the road and rail corridors when compared to BG_PFMM3 for all floods up to 1% AEP in magnitude.
- iii. By inspection of the peak flows set out in **Table 3.1**, more than half the total flow which presently discharges in a westerly direction would remain on the northern side of the road and rail corridors immediately to the west of the existing Carlachy railway bridge.

While not assessed as part of the present study, based on the results of the assessment, the greatest reduction in peak flood levels on the northern (upstream) side of the road and rail corridors could possibly be achieved by providing two separate viaduct structures further to the east and west of the existing Carlachy railway bridge, noting that there is existing rail infrastructure in the form of silos and grain storage facilities that are located to the east of the existing crossing which would be adversely impacted by these works.

It is noted that the provision of additional waterway area to the east and west of the existing Carlachy railway bridge in combination with any third-party related flood mitigation measures (e.g. in relation to any affected rail infrastructure) would have the benefit of:

- a) Reducing the cost of flood damages that are experienced to rail infrastructure as a result of floods on Gunningbland Creek.
- b) Reducing the time that the Orange-Broken Hill Railway is closed for freight and passenger movements during and immediately after major flood events.
- c) Reducing the flood damages within the rural properties that are located both to the north and south of the road and rail corridors, noting that the almost instantaneous failure of the rail embankment during floods can result in damaging flooding being experienced on the downstream side of the railway line.
- d) Reducing the risk to life of both people and livestock.

While not the primary focus of the *Bogan Gate FRMS&P*, the present investigation has identified that there is merit in investigating the upgrade requirements of the existing transverse drainage to the east and west of the existing Carlachy railway bridge in combination with any third-party related flood mitigation measures (e.g. in relation to any affected rail infrastructure), noting that the costs associated with such an investigation and any future upgrade of the road and rail infrastructure would need to be covered by other State and/or Federal Government funding programs other than the NSW Government's Floodplain Management Program. The scope of the assessed measures has been denoted herein as **“Bogan Gate Potential Flood Modification Measure 5”** or **“BG_PFMM5”**.

Based on the above, the investigation and possible upgrade of the existing transverse drainage that is located along the Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate in combination with any third-party related flood mitigation measures by the relevant rail authority has been included in *Bogan Gate FRMP*.

3.3.3 Vegetation Management

Based on the outcomes of the community consultation process, it was concluded that there is merit in developing and implementing a vegetation management plan for Gunningbland Creek at Bogan Gate, especially in relation to the clearing of vegetation/debris at the Henry Parkes Way and Orange-Broken Hill Railway bridge crossings of the watercourse. It is therefore recommended that a vegetation management plan be prepared which has the aim of:

- a) seeks to remove any trees that may have collapsed into their inbank area and would then act to exacerbate flooding conditions in existing urban development;
- b) includes regular inspections of major hydraulic structures, as well as following major flood events to ascertain the need for any remedial actions such as removing any vegetation or debris that may impeded or slow the passage of floodwater.

3.4 Property Modification Measures

3.4.1 Controls over Future Development

3.4.1.1 Current Government Policy

The NSW Government has recently implemented reforms of the *NSW Flood Prone Land Package*. As part of the reform, the wording in the flood planning clause of all NSW Councils was updated on 14 July 2021. As part of the reform, Council will need to nominate the FPL or levels that it wishes to define the FPA and make alternative arrangements for making flood planning maps publicly available where previously solely reliant on LEP flood overlay maps. While the reforms also included an optional clause 5.22 titled “*special flood considerations*” which applies to land that lies between the FPA and the extent of the PMF, Council chose not to include it in *Parkes LEP 2012* at the time.

3.4.1.2 Considerations for Setting Freeboard Requirements

Selection of the FPL for an area is an important and fundamental decision as the standard is the reference point for the preparation of flood risk management plans. It is based on the adoption of the peak level reached by a particular flood plus an appropriate allowance for freeboard. It involves balancing social, economic and ecological considerations against the consequences of flooding, with a view to minimising the potential for property damage and the risk to life and limb. If the adopted FPL is too low, new development in areas outside the FPA (particularly where the difference in level is not great) may be inundated relatively frequently and damage to associated public services will be greater. Alternatively, adoption of an excessively high FPL will subject land that is rarely flooded to unwarranted controls. Councils are responsible for determining the appropriate FPLs within their local government area.

Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest and basement entrance levels, etc. As set out in *Flood Risk Management Guideline FB01 – Understanding and Managing Flood Risk* (DPE, 2023), design variables that are typically incorporated in the derivation of freeboard typically comprise the following:

- uncertainties in the design flood level estimates due to the confidence limits associated with the design peak flow estimates, inaccuracies in the LiDAR survey data and possible variations in key parameters such as hydraulic roughness;
- local factors that can result in differences in water levels across the floodplain; and
- increases in peak flood levels due to wave action.

Depending on the design life of a structure, potential increases in peak flood levels associated with future climate change may also need to be taken into consideration when assessing an appropriate freeboard.

Table 3.2 provides a summary of a joint probability analysis which was undertaken to assess the freeboard allowance which should be incorporated in the FPL for areas at Bogan Gate that are affected by Main Stream Flooding, noting the methodology for deriving the various components of the freeboard allowance is based on the approach set out in Public Works, 2010.

TABLE 3.2
SUMMARY OF FREEBOARD ANALYSIS
AREAS AFFECTED BY MAIN STREAM FLOODING

Design Variable	Probability of Occurrence/Level of Certainty	Maximum Allowance (m)	Joint Probability Allowance (m)
Wave Action	50%	0.20 ⁽¹⁾	0.10
Uncertainties in Peak 1% AEP Flood Level Estimate			
- LiDAR survey data	100%	0.15	0.15
- Peak flow estimate	50%	0.20 ⁽²⁾	0.10
Future Climate Change	50%	0.20 ⁽²⁾	0.10
	TOTAL		0.45

1. Based on vehicle driven wave action
2. Based on the difference between peak 1% and 0.5% AEP flood levels on Gunningbland Creek at Bogan Gate.

The maximum allowance for uncertainties in the peak 1% AEP flood level estimate is comprised of the following

- inaccuracies in the LiDAR survey data; and
- provision for a 10% increase in the best-estimate peak 1% AEP flow derived by comparison with the increase in peak flood levels associated with a 0.5% AEP flood event.

In regards the potential impacts of future climate change on flood behaviour at Bogan Gate, the *ARR Data Hub* previously gave the following interim climate change factors for Representative Concentration Pathways (**RCPs**) of 4.5 and 8.5 in the years 2050 and 2090:⁴

Year	RCP 4.5	RCP 8.5
2050	6.3%	8.8%
2090	9.2%	20.2%

⁴ While the climate change factors in the *ARR Data Hub* were updated in late 2024, the current study has been prepared in accordance with DCCEEWs current advice in relation to the approach that is to be adopted for assessing the potential impacts on climate change on flood behaviour.

A flood with an AEP of 0.5% is commonly considered to be analogous to a flood that would result from a 10% increase in 1% AEP rainfall intensities. By comparison with the interim climate change factors, the adoption of the 0.5% AEP would provide a reasonable indicator of the potential for future climate change to impact peak 1% AEP flood levels at Bogan Gate.

Based on the joint probability analysis set out in **Table 3.2** the adoption of the traditional value of 0.5 m for setting the FPL in areas affected by Main Stream Flooding would provide a reasonable level of flood protection to future development at Bogan Gate.

While the flood range in the major watercourses which traverse the study area is such that the traditional 0.5 m freeboard is appropriate for setting the FPL, its adoption in areas affected by Major Overland Flow would lead to the FPA extending onto land which would not experience damaging or hazardous flooding during a 1% AEP storm event, even allowing for all the variables which comprise freeboard.

Considerable reduction in the number of properties in Major Overland Flow areas classified as “flood affected” would result by the adoption of a threshold depth of inundation under 1% AEP conditions of 0.1 m as the criterion for defining area which would be subject to the majority of flood related development controls, compared with the traditional approach. Properties with depths of inundation 0.1 m or greater, or in a floodway (i.e. traversed by significant overland flows which may in some cases be less than 0.1 m in depth) would therefore be considered to lie within the FPA. Properties with depths of inundation under 1% AEP non-floodway conditions of less than 0.1 m would be classified as “Local Drainage” and, as such would be subject to controls such as the Building Code of Australia (BCA) requirements, rather than attracting a flood affectation notice. This approach is supported by the FRMM and would not adversely impact on Council’s duty of care in regard to management of flood prone lands. The proposed categorisation of the floodplain, terminology and controls are shown on **Table 3.3**.

TABLE 3.3
PROPOSED CATEGORISATION OF THE FLOODPLAIN

Category	Proposed Terminology used to define inundation in the <i>Bogan Gate FRMS&P</i> report	Are Development Controls Required?	Is Section S10.7 Notification Warranted?
Main Stream Flooding	“Main Stream Flooding”	Yes	Yes
Local Overland Flooding - Local Drainage - Major Drainage	“Local Drainage” “Major Overland Flow”	No (ref. footnote 1). Yes (ref. footnote 2).	No (ref footnote 1) Yes (ref footnote 3)

1. Inundation in Local Drainage areas is accommodated by the minimum floor level requirement of 0.15 m above finished surface level contained in the BCA and does not warrant a flood affectation notice in S10.7 Planning Certificates.
2. These are the deeper flooded areas with higher flow velocities. Development controls are specified in **Appendix C**.
3. Depth and velocity of inundation in Major Overland Flow areas are sufficient to warrant a flood affectation notice in S10.7 Planning Certificates. Inundation is classified as “flooding”.

Figure C1.1 in **Appendix C** is an extract from the *Flood Planning Map* for Bogan Gate. The figure includes areas subject to both Main Stream Flooding and Major Overland Flow. The extent of the FPA (the area subject to flood related development controls) is shown in a solid mauve (Main Stream Flooding) and green (Major Overland Flow) colour in **Figure C1.1**, and has been defined as follows:

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area that lies at or below by the 1% AEP plus 0.5 m freeboard.

- In areas subject to Major Overland Flow, the FPA is defined as areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

Section 3.5.1.4 sets out the recommended approach to managing future development that is located within the extent of the FPA.

3.4.1.3 Special Flood Considerations

As previously mentioned, in July 2021 Council chose not to adopt the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*. The objectives of the optional clause are:

- a) to enable the safe occupation and evacuation of people subject to flooding;
- b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood;
- c) to avoid adverse or cumulative impacts on flood behaviour;
- d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events; and
- e) to avoid adverse effects of hazardous development on the environment during flood events.

The optional clause in its current form applies to:

- a) for sensitive and hazardous development, land between the flood planning area and the probable maximum flood, or as otherwise defined in an adopted flood risk management study and plan that has been prepared in accordance with the Flood Risk Management Manual, and
- b) for development that is not sensitive and hazardous development, land the consent authority considers to be land that, in the event of a flood, may:
 - i. cause a particular risk to life, and
 - ii. require the evacuation of people or other safety considerations.

While the clause applies to all land that lies between the FPA and the extent of the PMF, Council is only required to apply flood affectation notices to S10.7 certificates where it considers flood related controls need to be applied to specific types of development.

By inspection of **Figure 2.14**, sheet 3, there is a significant amount of land within the village that is subject to H1 and H2 type flooding conditions where the flood risk would be so low that it would not be reasonable to apply flood related controls to future development, even were it to be classified as sensitive or hazardous in nature. Based on this finding, there is merit in reducing the extent of land to which the requirements of clause 5.22 apply to only land that is subject to H3 or greater flood hazard vulnerability conditions during a PMF event.

Based on this understanding, **Figure C1.1** shows the extent of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is H3 or greater and therefore where flood related development controls should be applied to future development in accordance with the requirements of clause 5.22 (denoted thereon as the *Special Flood Considerations Zone*).).

Note that prior to making the decision to include the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, it is recommended that Council obtain legal advice to confirm that the above approach of pre-determining the extent of land to which the requirements of the clause apply is legally binding.

3.4.1.4 Proposed Planning Controls for Bogan Gate

While *Parkes DCP 2021* deals with subdivision type development at Bogan Gate, it is limited in its scope and is not consistent with current best flood risk management practice. As a result, it is recommended that Council review and update *Parkes DCP 2021* based on the findings of the present study, as well as the suggested wording that is set out in **Appendix C** of this report.

Schedules 2A and **2B** in **Appendix C** set out the graded set of flood related planning controls which have been developed for areas that are subject to Main Stream Flooding and Major Overland Flow, respectively, while **Figure C1.1** in **Appendix C** shows the areas where the graded set of flood related planning controls set out in **Schedules 2A** and **2B** apply in Bogan Gate.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard.⁵

For areas outside the FPA shown on **Figure C1.1** and assuming Council adopts the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, the MHFL for essential community facilities and utilities which are critical for flood response and recovery, as well as sensitive uses and facilities is the level of the PMF.

Figure C1.2 in **Appendix C** is an extract of the *Flood Planning Constraint Category Map* for the Parkes Shire LGA which respectively show the subdivision of the floodplain at Bogan Gate into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in **Appendix C** of this report.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises areas that lie between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of

⁵ Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on **Figure C1.1**.

The derivation of the four FPCCs firstly involved the derivation of a number of sub-regions which were based on the nature of flooding at Bogan Gate, the sub-categories of which are set out in **Table 3.4**. These sub-regions were then combined, with the resulting extents further refined in order to improve the area over which each FPCC applied.

TABLE 3.4
KEY ELEMENTS COMPRISING FLOOD PLANNING CONSTRAINT CATEGORIES

Flooding	FPCC	Sub-category	Constraint
Main Stream Flooding	1	a	1% AEP Main Stream Flooding Floodway
		b	1% AEP MSF Flood Hazard Vulnerability Classification H6
	2	a	1% AEP MSF Flood Storage
		b	1% AEP MSF Flood Hazard Vulnerability Classification H5
		c	0.2% AEP MSF Flood Hazard Vulnerability Classification H5 and H6
		d	1% AEP Flood Emergency Response Classification (Low Flood Island)
		e	1% AEP Flood Emergency Response Classification (Low Flood Island)
		f	0.2% AEP Main Stream Flooding Floodway
	3	-	Flood Planning Area
	4	-	PMF Flood Hazard Vulnerability Classification H3-H6
Major Overland Flow	1	-	1% AEP Floodway AND Flood Hazard Vulnerability Classification H4 - H6
	2	a	1% AEP Floodway AND Flood Hazard Vulnerability Classification H1 - H3
		b	1% AEP Flood Storage Area
		c	0.2% AEP Flood Hazard Vulnerability Classification H5 and H6
	3	-	Flood Planning Area
	4	-	PMF Flood Hazard Vulnerability Classification H3-H6

3.4.1.5 Revision of Parkes LEP 2012

While Council chose not to adopt the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* in July 2021, there is merit in doing so, if not in direct relation to future development within the Village Centre, then possibly in relation to other urban centres within the LGA.

Special flood considerations

- (1) *The objectives of this clause are as follows—*
 - (a) *to enable the safe occupation and evacuation of people subject to flooding,*
 - (b) *to ensure development on land is compatible with the land's flood behaviour in the event of a flood,*
 - (c) *to avoid adverse or cumulative impacts on flood behaviour,*
 - (d) *to protect the operational capacity of emergency response facilities and critical infrastructure during flood events,*
 - (e) *to avoid adverse effects of hazardous development on the environment during flood events.*
- (2) *This clause applies to—*
 - (a) *for sensitive and hazardous development—land between the flood planning area and the probable maximum flood, and*
 - (b) *for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may—*
 - (i) *cause a particular risk to life, and*
 - (ii) *require the evacuation of people or other safety considerations.*
- (3) *Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—*
 - (a) *will not affect the safe occupation and efficient evacuation of people in the event of a flood, and*
 - (b) *incorporates appropriate measures to manage risk to life in the event of a flood, and*
 - (c) *will not adversely affect the environment in the event of a flood.*
- (4) *A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.*
- (5) *In this clause—*

Considering Flooding in Land Use Planning Guideline—see clause 5.21(5).

flood planning area—see clause 5.21(5).

Flood Risk Management Manual—see clause 5.21(5).

probable maximum flood has the same meaning as it has in the Flood Risk Management Manual.

sensitive and hazardous development means development for the following purposes—

 - (a) *[list land uses]*

Direction— Only the following land uses are permitted to be included in the list—

- (a) boarding houses,
- (b) caravan parks,
- (c) correctional centres,
- (d) early education and care facilities,
- (e) eco-tourist facilities,
- (f) educational establishments,
- (g) emergency services facilities,
- (h) group homes,
- (i) hazardous industries,
- (j) hazardous storage establishments,
- (k) hospitals,
- (l) hostels,
- (m) information and education facilities,
- (n) respite day care centres,
- (o) seniors housing,
- (p) sewerage systems,
- (q) tourist and visitor accommodation,
- (r) water supply systems

The steps involved in Council amending *Parkes LEP 2012* following the finalisation and adoption of *Bogan Gate FRMS&P* are:

1. Council Planning Staff consider the conclusions of *Bogan Gate FRMS&P* and suggested amendments to *Parkes LEP 2012*.
2. Council resolves to amend *Parkes LEP 2012* in accordance with *Bogan Gate FRMS&P*.
3. Council prepares a Planning Proposal in accordance with NSW Planning and Environment Guidelines. Planning Proposal submitted to NSW Planning and Environment in accordance with section 3.33 of the EP&A Act, 1979.
4. Planning Proposal considered by the Department of Planning and determination made in accordance with section 3.34(2) of the EP&A Act, 1979 as follows:
 - (a) whether the matter should proceed (with or without variation),
 - (b) whether the matter should be resubmitted for any reason (including for further studies or other information, or for the revision of the planning proposal),
 - (c) community consultation required before consideration is given to the making of the proposed instrument (the community consultation requirements),
 - (d) any consultation required with State or Commonwealth public authorities that will or may be adversely affected by the proposed instrument,
 - (e) whether a public hearing is to be held into the matter by the Planning Assessment Commission or other specified person or body,
 - (f) the times within which the various stages of the procedure for the making of the proposed instrument are to be completed.
5. Planning Proposal exhibited for public comment.

6. Planning Proposal reviewed following public submissions and submissions from relevant State and Commonwealth authorities.
7. Final Local Environmental Plan with proposed amendments drafted.
8. Amending Local Environmental Plan made by the Minister and gazetted.

3.4.2 Potential Voluntary House Purchase Scheme

Removal of housing from high hazard floodway areas in the floodplain is generally accepted as a cost-effective means of correcting previous decisions to build in such areas. The voluntary purchase of residential property in hazardous areas has been part of the NSW Government's Floodplain Management Program for over 20 years, with the recently released *Guideline for the voluntary purchase scheme* (DCCEEW, 2024a) setting out the key eligibility criteria and funding requirements should a council wish to incorporate such a scheme into one of its flood risk management plans.⁶

Voluntary purchase is a recognised and effective flood risk management measure for existing residential properties in areas where:

- there are highly hazardous flood conditions from riverine or overland flooding and the principal objective is to remove people living in the properties and reduce the risk to life of residents and potential rescuers
- a property is located within a floodway and the removal of a building may be part of a floodway clearance program that aims to reduce significant impacts on flood behaviour elsewhere in the floodplain, by enabling the floodway to more effectively perform its flow conveyance function
- purchase of a property enables other flood mitigation works (such as channel improvements or levee construction) to be implemented because the property will impede construction or may be adversely affected by the works with impacts notable to be offset.

Prior to progressing to the purchase of a property that has been identified as being eligible under the scheme, it would first be necessary to undertake a scoping study, especially if the intention is for a council to apply for NSW Government grant funding. The study would involve discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each.

Following the completion of the scoping study, the subject owner is notified that Council is prepared to purchase the property when the owner is ready to sell. Ultimately, the purchase price of the property is determined by independent valuers and the Valuer General, and by negotiation between Council and the owners, noting that valuations are not reduced due to the flood affected nature of the site.

After purchase, land is subsequently cleared and the site re-developed and re-zoned for public open space or some other flood compatible use. A further criterion applied by State Government agencies in assessing eligibility for funding is that the property must be in a high hazard floodway area, that is, in the path of flowing floodwaters where the depth and velocity at the peak of the flood are such that life could be threatened, damage of property is likely and evacuation difficult.

⁶ State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted. Properties built after this date should have been constructed in accordance with the principles in the manual.

Assessment Outcome

As there are no residential properties located in high hazard floodway areas at Bogan Gate, the inclusion of a voluntary house purchase scheme in *Bogan Gate FRMP* is not an option that is available to Council.

3.4.3 Potential Voluntary House Raising Scheme

Voluntary house raising is recognised as an effective floodplain risk management measure for both riverine and overland flood conditions. It is generally undertaken to:

- a) reduce the frequency of exposure to flood damage of the house and its contents and reduce the frequency of household disruption and associated trauma and anxiety; or
- b) as a compensatory measure where flood mitigation works adversely affect a house, which is generally considered part of the mitigation work rather than a separate VHR scheme.

Voluntary house raising can be an effective strategy for existing properties in low flood hazard areas where mitigation works to reduce flood risk to properties are impractical or uneconomic, noting that it must form part of a broader floodplain risk management strategy for an area rather than as a stand-alone option, as it does not deal with issues such as risk to life. The recently released *Guideline for voluntary house raising schemes* (DCCEEW, 2024b) sets out the key eligibility criteria and funding requirements should a council wish to incorporate such a scheme into one of its flood risk management plans.

State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted, noting that houses built after this date should have been constructed in accordance with the principles in the manual.

Following the adoption of a voluntary house raising scheme as part of a flood risk management plan, the next step is for a council to undertake a scoping study, especially if the intention is to apply for NSW Government grant funding. The study is to include discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each. Following the completion of the scoping study, the subject owner is notified that Council is prepared to cover the cost of raising the existing house to the FPL or higher.

Assessment Outcome

As there are no residential properties at Bogan Gate that are subject to above-floor inundation for all floods up to 1% AEP level of flooding, the inclusion of a voluntary house raising scheme in *Bogan Gate FRMP* is not an option that is available to Council.

3.5 Response Modification Measures

3.5.1 Flood and Severe Weather/Thunderstorm Warning Systems

An effective flood warning system has three key components, i.e. a flood forecasting system, a flood warning broadcast system and a response/evacuation plan. All systems need to be underpinned by an appropriate public flood awareness program.

Presently warnings regarding the potential for flooding to occur at Bogan Gate are limited to BoMs Severe Thunderstorm Warning and Severe Weather Warnings for Flash Flooding alert services which are publicly available via the internet via the following links or on smart phones via free Apps such as Hazards Near Me which is linked to the Australian Warning System:

- <http://www.bom.gov.au/nsw/warnings/>
- <https://hazardwatch.gov.au/>

As the closure of roads due to flooding are of concern to the Bogan Gate community, there is merit in implementing an effective location-based messaging system which warns both residents and business owners of the potential for flood producing rain to be experienced over Bogan Gate, as well as potential road closures due to rising water levels in Gunningbland Creek.

While Council would first need to commission an investigation to assess the feasibility of implementing such a scheme at Bogan Gate, it is envisaged that it would comprise the following as a minimum:

- A telemetered water level at the location of The Bogan Way bridge crossing of Gunningbland Creek which has pre-determined alert levels.
- Upgrade of the daily read *Bogan Gate Post Office* (GS50004) and *Trundle (Long Street)* (GS 50036) rain gauges to telemetered rain gauges, noting that these gauges, in combination with BoMs *Goonumbla (Coradgery)* (GS 50016) Flood Warning Network rain gauge (refer **Figure 2.1** for location) would provide real time data on the likely intensity and depth of rain falling in the Gunningbland Creek catchment upstream of Bogan Gate.
- A location-based text messaging service that alerts subscribers to:
 - a) the issuing of a Severe Weather or Thunderstorm Warning from BoM; and
 - b) the exceedance of the aforementioned pre-determined alert levels on the Gunningbland Creek water level recorder.

While The Bogan Way is also inundated by floodwater that originates from Blowclear and Botfields creeks, the monitoring of water levels in Gunningbland Creek would at the very least provide the Bogan Gate community with a clear indication that elevated water levels are being experienced in the creek systems that lie to the north of the Village Centre and that caution needs to be taken when considering travel arrangements. It would also alert the community, as well as emergency services of the potential for the northern portion of the Village Centre to be inundated by floodwater originating from Gunningbland Creek.

The cost to investigate and design an integrated severe weather/thunderstorm and flood warning system for Bogan Gate is estimated to be about \$50,000, whilst its implementation is estimated to cost about \$300,000.

3.5.2 Improved Emergency Planning and Response

As mentioned in **Section 2.14**, the *Parkes Shire Local Flood Plan* provides detailed information regarding preparedness measures, conduct of response operations and coordination of immediate recovery measures for all levels of flooding.

NSW SES should ensure information contained in this report on the impacts of flooding on urban development, as well as recommendations regarding flood warning and community education are used to update Volume 2 of the *Parkes Shire Local Flood Plan*. Volume 2 should include the following sections:

1 – The Flood Threat includes the following sub-sections:

1.2 Land Forms and River Systems – ref. **Sections 2.1** and **2.2** of this report for information on these topics.

1.5 Characteristics of Flooding – Indicative extents of inundation for the 1% AEP and PMF events and the typical times of rise of floodwaters at key locations on the major watercourses are shown on **Figures 2.3, 2.4** and **2.6**. The location of vulnerable development and critical infrastructure relative to the flood extents is shown on **Figure 2.7**.

1.6 Flood History – Recent flood experience at Bogan Gate is discussed in **Section 2.3** of the report.

1.8 Extreme Flood Events – The PMF was modelled and the indicative extent and depth of inundation presented on **Figure 2.4**.

2 – Effects on the Community

Information on the properties affected by the 1% AEP design flood are included in this report (**Figure 2.3**). As floor level data used in this assessment were estimated from the LiDAR survey and “drive by” survey they are indicative only. While fit for use in estimating the economic impacts of design floods, the data should not be used to provide specific details of the degree of flood affectation of individual properties.

Figure 2.6 shows stage hydrographs at road and rail crossings of various watercourses and drainage lines at Bogan Gate, the locations of which are shown on **Figures 2.3, 2.4** and **2.4** and **2.7**.

Figure 2.7 shows the location of vulnerable development and critical infrastructure at Bogan Gate relative to the flood extents of the 20, 10, 5, 2, 1, 0.5 and 0.2% AEP flood events, as well as the PMF. Refer **Section 2.7** for details of affected infrastructure.

Figures 3.7, 3.8 and **3.9** show the flood emergency response planning classifications for the 5% AEP, 1% AEP and PMF events, respectively, based on the definitions set out in the *Flood Risk Management Guideline EM01 – Support for Emergency Management Planning*.

In regards the above, the Village Centre is generally classified as **Rising Road Access** for all floods up to 1% AEP in magnitude, with the eastern portion gradually changing to a **Low Flood Island** which increasing flood magnitude. The illustrations below are taken from *Flood Risk Management Guideline EM01 – Support for Emergency Management Planning* describing the nature of these two classifications.

Low flood island. The flood island is lower than the limit of flooding for the event being considered (Figure 8 and Figure 9 show a low flood island in the PMF). During a flood event the area initially becomes isolated by floodwater, terrain, development or infrastructure. If floodwater continues to rise after it is isolated, the land on the island will eventually be completely inundated by floodwaters. Evacuation of the community will be required prior to evacuation routes being closed as people left stranded on the island may drown.

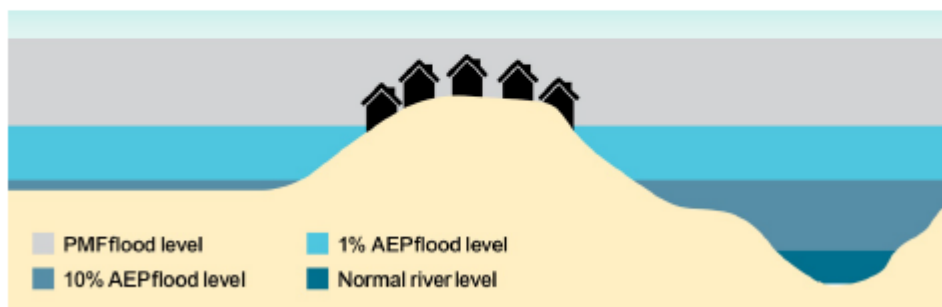


Figure 8 Low flood island

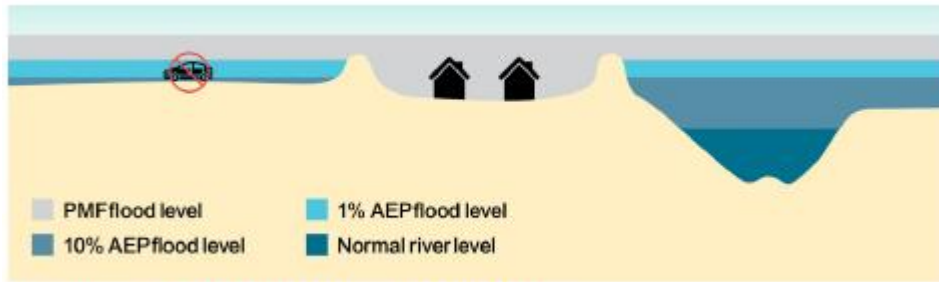


Figure 9 Low flood island created by a ring levee

Areas with rising road access are those areas where access roads rise steadily uphill and away from the rising floodwaters (Figure 12 and Figure 13). The community will not be completely isolated before inundation reaches its maximum extent, even in the PMF. Evacuation can take place by vehicle or on foot along the road as floodwater advances. People should not be trapped unless they delay their evacuation from their homes, for example, people living in 2-storey homes may initially decide to stay but reconsider after water surrounds them.

These communities contain low-lying areas from which people will be progressively evacuated to higher ground as the level of inundation increases. This inundation could be caused either by direct flooding from the river system or by localised flooding from creeks.

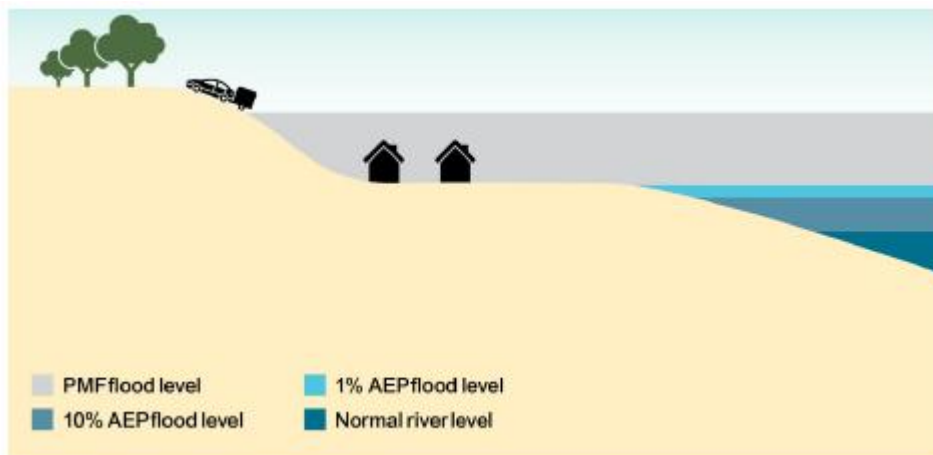


Figure 12 Area with rising road access

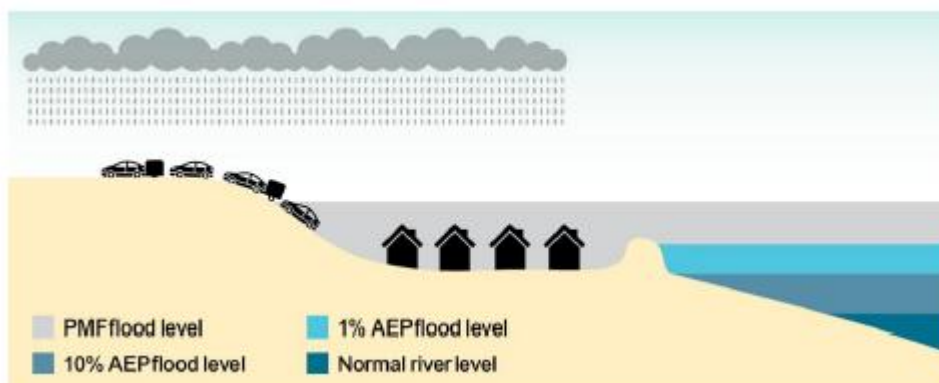


Figure 13 Area protected by a levee with rising road access

3.5.3 Public Awareness Programs

Community awareness and appreciation of the existing flood hazards in the floodplain would promote proper land use and development in flood affected areas. A well-informed community would be more receptive to requirements for flood proofing of buildings and general building and development controls imposed by Council. Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplains of the flood risk.

One aspect of a community's preparedness for flooding is the "flood awareness" of individuals. This includes awareness of the flood threat in their area and how to protect themselves against it. The overall level of flood awareness within the community tends to reduce with time, as memories fade and as residents move into and out of the floodplain. The ability to access free location-based severe weather and thunderstorm warnings via the internet or smart phone via would therefore represent a major opportunity for improving flood warning and preparedness times for people living at Bogan Gate.

Means by which community awareness of flood risks can be maintained or may be increased include:

- displays at Council offices using the information contained in the present study and photographs of historic flooding in the area;
- talks by NSW SES officers with participation by Council and longstanding residents with first-hand experience of flooding in the area; and
- preparation of a Flood Information Brochure which could be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with rate notices.

The community should also be made aware that a flood greater than historic levels or the flood planning level can, and will, occur at some time in the future.

4 SELECTION OF FLOOD RISK MANAGEMENT MEASURES

4.1 Background

The FRMM requires a Council to develop a Flood Risk Management Plan based on balancing the merits of social, environmental and economic considerations which are relevant to the community. This chapter sets out a range of factors which need to be taken into consideration when selecting the mix of works and measures that should be included in *Bogan Gate FRMP*.

Due to differing priorities, individual communities need to establish their own set of considerations in which to assess the merits of different measures. The considerations adopted by a community must, however, recognise the State Government's requirements for flood risk management as set out in FRMM and other relevant policies. A further consideration is that some elements of *Bogan Gate FRMP* may be eligible for subsidy from State and Federal Government sources and the requirements for such funding must, therefore, be taken into account.

Typically, State and Federal Government funding is given on the basis of merit, as judged by a range of criteria:

- The magnitude of damage to property caused by flooding and the effectiveness of the measure in mitigating damage and reducing the flood risk to the community.
- Community involvement in the preparation of the Flood Risk Management Plan and acceptance of the measure.
- The technical feasibility of the measure (relevant to structural works).
- Conformance of the measure with Council's planning objectives.
- Impacts of the measure on the environment.
- The economic justification, as measured by the benefit/cost ratio of the measure.
- The financial feasibility as gauged by Council's ability to meet its commitment to fund its part of the cost.
- The performance of the measure in the event of a flood greater than the design event.
- Conformance of the measure with Government Policies (e.g. FRMM and Catchment Management objectives).

4.2 Ranking of Measures

A suggested approach to assessing the merits of various measures is to use a subjective scoring system. The chief merits of such a system are that it allows comparisons to be made between alternatives using a common "currency". In addition, it makes the assessment of alternatives "transparent" (i.e. all important factors are included in the analysis). The system does not, however, provide an absolute "right" answer as to what should be included in *Bogan Gate FRMP* and what should be left out. Rather, it provides a method by which Council can re-examine the measures and if necessary, debate the relative scoring given to aspects of *Bogan Gate FRMP*.

Each measure is given a score according to how well the measure meets the considerations discussed above. In order to keep the scoring simple, the following system is proposed:

+2	Measure rates very highly
+1	Measure rates well
0	Measure is neutral
- 1	Measure rates poorly
- 2	Measure rates very poorly

The scores are added to get a total for each measure.

Based on considerations outlined in this chapter, **Table 4.1** presents a suggested scoring matrix for the measures reviewed in **Chapter 3**, noting that the green shading indicates that the measure has merit and could be considered for inclusion in *Bogan Gate FRMP*. The scoring has also been used as the basis for prioritising the components of *Bogan Gate FRMP*.

4.3 Summary

Table 4.1 indicates that there are good reasons to consider including the following elements into *Bogan Gate FRMP*:

- Improved planning controls through the development of a flood related development control plan or policy.
- Incorporation of the catchment specific information on flooding impacts contained in this study in NSW SES Response Planning and Flood Awareness documentation for Bogan Gate.
- Improved public awareness of flood risk in the community.
- The investigation, design and implementation of an integrated severe weather/thunderstorm and flood warning system for Bogan Gate.
- The investigation, design and upgrade of one or more existing causeways that are located along Henry Parkes Way where it runs between Parkes and Bogan Gate to improve its hydrologic standard (i.e. the works that have been denoted herein as “**Bogan Gate Potential Flood Modification Measure 2**” or “**BG_PFMM2**”).
- The investigation and possible upgrade of the existing transverse drainage that is located along the Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate in combination with any third-party related flood mitigation measures (i.e. the works that have been denoted herein as “**Bogan Gate Potential Flood Modification Measure 5**” or “**BG_PFMM5**”).
- Development and implementation of a *Vegetation Management Plan* for Gunningbland Creek at Bogan Gate.

TABLE 4.1
ASSESSMENT OF POTENTIAL FLOOD RISK MANAGEMENT MEASURES FOR INCLUSION IN
BOGAN GATE FLOOD RISK MANAGEMENT PLAN

Measure	Impact on Flooding/ Reduction in Flood Risk	Community Acceptance	Technical Feasibility	Planning Objectives	Environ. Impacts	Economic Justification	Financial Feasibility	Extreme Flood	Government Policies and TCM Objectives	Score
Flood Modification										
Implementation of measures comprising BG_PFMM1	+1	+1	+1	+1	0	-1	-1	0	0	+2
Implementation of measures comprising BG_PFMM2	+1	+2	+1	+2	0	+1	-1	0	+2	+8
Implementation of measures comprising BG_PFMM3	+1	+2	+1	0	0	-1	-1	+1	+1	+4
Implementation of measures comprising BG_PFMM4	+2	+2	-1	+1	0	-2	-2	+2	+1	+3
Implementation of measures comprising BG_PFMM5	+2	+2	+1	+1	0	+1	-1	+1	+1	+8
Vegetation Management Plan	+1	+2	+1	+1	+1	+1	+1	0	+1	+9
Property Modification										
Inclusion of <i>Special Flood Considerations</i> clause in <i>Parkes LEP 2012</i>	+1	+2	+2	+1	0	0	0	+2	+2	+10
Controls over Future Development (via update of <i>Parkes Shire DCP 2021</i>)	+2	+2	+2	+2	0	0	0	+1	+2	+12
Voluntary Purchase of Scheme	-2	-2	+2	-2	0	-2	-2	+2	-2	-8
Voluntary House Raising Scheme	-2	-2	+2	-2	0	-2	-2	+2	-2	-8
Response Modification										
Severe Weather/Thunderstorm and Flood Warning System	+1	+2	+2	+1	0	+1	+1	0	+1	+9
Improved Emergency Planning and Response	+2	+1	+2	+2	0	0	0	+2	+2	+11
Public Awareness Programs	+2	+1	+2	+2	0	0	0	+1	+2	+10

5 BOGAN GATE FLOOD RISK MANAGEMENT PLAN

5.1 The Flood Risk Management Process

The *Bogan Gate Flood Risk Management Study* (**Bogan Gate FRMS**) and *Bogan Gate Flood Risk Management Plan* (**Bogan Gate FRMP**) have been prepared as part of a Government program to mitigate the impacts of major floods and reduce the hazards in the floodplain. The *Bogan Gate FRMP* which is set out in this Chapter has been prepared as part of the Flood Risk Management Process in accordance with NSW Government's Flood Prone Land Policy.

The *Bogan Gate FRMS* reviewed baseline flooding conditions and the economic impacts of flooding that were assessed as part of the recently completed *Bogan Gate Flood Study* (Lyll & Associates, 2024). The findings of the *Bogan Gate Flood Study* formed the basis of the preparation of both the *Bogan Gate FRMS* and the *Bogan Gate FRMP*.

5.2 Purpose of the Plan

The overall objectives of the *Bogan Gate FRMS* were to assess the impacts of flooding, review policies and measures for management of flood affected land and to develop *Bogan Gate FRMP* which:

- Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding and establishes a program and funding mechanism for the *Bogan Gate FRMP*.
- Proposes amendments to Parkes Shire Council's (**Council's**) existing policies to ensure that the future development of flood affected land in the study area is undertaken so as to be compatible with the flood hazard and risk.
- Ensures the *Bogan Gate FRMP* is consistent with NSW State Emergency Services (**NSW SESs**) local emergency response planning procedures.
- Ensures that the *Bogan Gate FRMP* has the support of the community.

5.3 The Study Area

The study area for the *Bogan Gate FRMP* principally applies to the urbanised areas at Bogan Gate (denoted herein as the "**Village Centre**"). The study deals with the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of Gunningbland Creek, Blowclear Creek, Botfields Creek and their tributaries. Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses.

Figure 1.1 is a location plan, while **Figure 2.1** shows the extent of both the Gunningbland Creek and Blowclear Creek catchments at their confluence, as well as the additional area that contributes to flow in Gunningbland Creek between its confluence with Blowclear Creek and where it crosses the Orange Broken Hill Railway Line. **Figures 2.2** (3 sheets) shows the key features of the existing stormwater drainage system at Bogan Gate. Also shown on **Figure 2.2** is the extent of the "Village Centre", the southern and northern portions of which are principally zoned *RU5-Village* and *R5-Large Lot Residential*, respectively.

5.4 Community Consultation

The Community Consultation process provided valuable direction over the course of the investigations, bringing together views from key Council staff, other departments and agencies, and importantly, the views of the community gained through:

- The delivery of a *Community Newsletter and Questionnaire* to residents and business owners at the commencement of the *Bogan Gate Flood Study* which sort to identify information on historic flooding in Bogan Gate.
- The public exhibition of the draft *Bogan Gate FRMS* and *Bogan Gate FRMP*.
- Public meetings held by Council representatives.

Meetings were also held with the Flood Risk Management Committee to discuss the findings of *Bogan Gate FRMS* and also the recommended set of measures set out in the *Bogan Gate FRMP*.

Respondents to the *Community Questionnaire* that was disseminated at the commencement of the *Bogan Gate Flood Study* identified a number of notably intense storm events dating back to 1992 and provided flood related information relating to a number of these, the most notable be events that occurred on 1-2 March 2012 and 14 November 2022 and approximated storms that occur once every 10 years on the average. **Appendix A** of the *Bogan Gate FRMS* report contains copies of several photos that show flooding that was experienced in and around the village in November 2005, December 2010, March 2012, June 2016, September 2016, May 2022 and November 2022.

Respondents to the *Community Questionnaire* also highlighted that several holders of *RU1-Primary Production* zoned land that lies on the northern (upstream) side of the Orange-Broken Hill Railway Line to the west of Bogan Gate have petitioned both local and state government representatives over the past 60+ years regarding the impact that the rail embankment has on flood behaviour and seeking improvements to the hydraulic capacity of its transverse drainage.

5.5 Existing Flood Behaviour

While the inbank area of Gunningbland Creek and its major tributaries where they run in a westerly direction to the north of Village Centre is of limited capacity, thereby resulting in the relatively frequent inundation of the adjacent road network, only the central portion of the Village Centre is impacted by Main Stream Flooding. Further to this, floodwater originating from Gunningbland Creek generally only inundates land within the Village Centre that is presently undeveloped for all floods with Annual Exceedance Probabilities (**AEPs**) up to 0.2% (1 in 500).

While parts of the Village Centre are affected by Major Overland Flow, the resulting depths of inundation are relatively shallow for all storms up to 0.2% (1 in 500) AEP in intensity.

Figure 2.3 (3 sheets) of the *Bogan Gate FRMS* report shows the indicate extent and depth of inundation at Bogan Gate for a design flood with an AEP of 1%, while **Figure 2.4** (3 sheets) shows similar information for the Probable Maximum Flood (**PMF**). **Appendix B** of the *Bogan Gate FRMS* report show similar information for floods with AEPs of 20%, 10%, 5%, 2%, 0.5% and 0.2%.

Figure 2.5 of the *Bogan Gate FRMS* report is a longitudinal section along a 10.5 km length of the Orange-Broken Hill Railway Line and the adjacent Henry Parkes Way where they run between Olive Grove Lane and Overland Road, while **Figure 2.6** shows the time of rise of floodwaters at selected road and rail crossings throughout the study area, noting that time zero on the stage hydrographs represents the onset of flood producing rain (refer **Figures 2.3** and **2.4** for location of each individual stage hydrograph).

5.6 Existing Flood Mitigation Measures

There are no formal flood mitigation measures present in the village of Bogan Gate.

5.7 Economic Impacts of Flooding

Table 5.1 shows the number of properties that would be flooded to above-floor level and the damages experienced in residential and commercial/industrial development, as well as public buildings at Bogan Gate.

TABLE 5.1
ECONOMIC IMPACTS OF FLOODING IN VILLAGE CENTRE

Design Flood Event (% AEP)	Properties Flooded Above-Floor Level						Total Flood Damages
	Residential		Commercial/Industrial		Public		
	No.	\$ Million	No.	\$ Million	No.	\$ Million	\$ Million
20%	0	0	0	0	0	0	0
10%	0	0	0	0	0	0	0
5%	0	0.01	0	0	0	0	0.01
2%	0	0.02	0	0	0	0	0.02
1%	0	0.03	0	0	0	0	0.03
0.5%	0	0.03	0	0	0	0	0.03
0.2%	1	0.05	0	0	0	0	0.05
PMF	24	5.21	1	0.1	1	0.08	5.39

While no buildings in the Village Centre would be inundated above-floor level in a 1% AEP flood event, flood damages of about \$0.03 Million would still be incurred during a flood of this magnitude. During a PMF event, 24 dwellings and one public building would experience above-floor inundation, resulting in flood damages totalling about \$5.39 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is effectively zero, while for all floods up to the PMF it is about \$0.1 Million. Therefore, one or more schemes costing up to this latter amount could be economically justified if they eliminated damages in the study area for all possible flood events. While schemes costing more than this value would have a benefit/cost ratio less than 1, they may still be justified according to a multi-objective approach which considers other criteria in addition to economic feasibility.

5.8 Structure of Bogan Gate Flood Risk Management Plan

A summary of *Bogan Gate FRMP* proposed for the study area along with broad funding requirements for the recommended measures are shown in **Table S1** at the commencement of the *Bogan Gate FRMS* report. The measures will over time achieve the objectives of reducing the flood risk to existing and future development for the full range of floods.

Bogan Gate FRMP is based on the following mix of measures which have been given a provisional priority ranking according to a range of economic, social, environmental and other criteria that are set out in **Table 4.1** of the *Bogan Gate FRMS* report:

- **Measure 1** – Consider the inclusion of the optional *special flood considerations* clause 5.22 in the *Parkes LEP 2012*.
- **Measure 2** – Improvements to planning and development controls for future development in flood prone areas via updates of *Parkes Shire DCP 2021*.
- **Measure 3** – Improvements to emergency response planning.
- **Measure 4** – Increase public awareness of the risks of flooding in the community.
- **Measure 5** – Investigation and design of an integrated severe weather/thunderstorm and flood warning system for Bogan Gate.
- **Measure 6** – Implementation of an integrated severe weather/thunderstorm and flood warning system for Bogan Gate.
- **Measure 7** – Investigation into the feasibility of raising sections of Henry Parkes Way where it runs between Parkes and Bogan Gate so as to improve its hydrologic standard (denoted as “**Bogan Gate Potential Flood Modification Measure 2**” or “**BG_PFMM2**” in *Bogan Gate FRMS*).
- **Measure 8** – Depending on the findings of **Measure 7**, the design and implementation of the works associated with BG_PFMM2.
- **Measure 9** – Investigation into the feasibility of possibly upgrading the existing transverse drainage that is located along the Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate in combination with any third-party related flood mitigation measures (denoted as “**Bogan Gate Potential Flood Modification Measure 5**” or “**BG_PFMM5**” in *Bogan Gate FRMS*).
- **Measure 10** – Depending on the findings of **Measure 9**, the design and implementation of the works associated with BG_PFMM5.
- **Measure 11** - Development and implementation of a *Vegetation Management Plan* for Gunningbland Creek at Bogan Gate

5.9 Planning and Development Controls

The results of *Bogan Gate FRMS* indicate that an important measure for Council to adopt in the floodplain would be strong flood risk management planning applied consistently by all of its branches.

5.9.1 Revision of Parkes Local Environmental Plan 2012

Clause 5.21 of *Parkes LEP 2012* entitled “Flood planning” outlines its objectives in regard to development of land which lies within the Flood Planning Area (**FPA**). The wording in the flood planning clause was updated on 14 July 2021 as part of recent reforms that have been implemented by the NSW Government.

While the wording of the *Flood planning* clause was automatically updated on 14 July 2021, Council chose not to include the optional *special flood considerations* clause 5.22 that also formed part of the recent reform package in *Parkes LEP 2012*. The objectives of the optional clause are:

- a) to enable the safe occupation and evacuation of people subject to flooding;
- b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood;
- c) to avoid adverse or cumulative impacts on flood behaviour;
- d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events; and
- e) to avoid adverse effects of hazardous development on the environment during flood events.

The optional clause in its current form applies to:

- a) for sensitive and hazardous development, land between the flood planning area and the probable maximum flood, or as otherwise defined in an adopted flood risk management study and plan that has been prepared in accordance with the Flood Risk Management Manual, and
- b) for development that is not sensitive and hazardous development, land the consent authority considers to be land that, in the event of a flood, may:
 - iii. cause a particular risk to life, and
 - iv. require the evacuation of people or other safety considerations.

While the clause applies to all land that lies between the FPA and the extent of the PMF, Council is only required to apply flood affectation notices to S10.7 certificates where it considers flood related controls need to be applied to specific types of development.

By inspection of **Figure 2.14**, sheet 3, there is a significant amount of land within the village that is subject to H1 and H2 type flooding conditions where the flood risk would be so low that it would not be reasonable to apply flood related controls to future development, even were it to be classified as sensitive or hazardous in nature. Based on this finding, there is merit in reducing the extent of land to which the requirements of clause 5.22 apply to only land that is subject to H3 or greater flood hazard vulnerability conditions during a PMF event.

Based on this understanding, **Figure C1.1** in **Appendix C** shows the extent of the **Special Flood Considerations Zone**, it being the area of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is H3 or greater and therefore where flood related development controls should be applied to future development in accordance with the requirements of clause 5.22.

Based on the findings of the *Bogan Gate FRMS*, it is recommended that Council consider including the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* (**Measure 1**).⁷

5.10 Parkes Shire Development Control Plan 2021

The recommended approach to managing future development in the study area uses the concepts of *flood hazard* and *hydraulic categorisation* to develop controls for future development in flood prone land (**Measure 2**). **Figure C1.1** in **Appendix C** of the *Bogan Gate FRMS* report are extracts from the *Flood Planning Map* relating to the study area. The extent of the FPA has been defined as follows:

⁷ Note that prior to making the decision to include the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, it is recommended that Council obtain legal advice to confirm that the above approach of pre-determining the extent of land to which the requirements of the clause apply is legally binding.

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area inundated by the 1% AEP plus 0.5 m freeboard.
- In areas subject to Major Overland Flow, the FPA is defined as areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

It is proposed that properties that are located either partially or wholly within the extent of the FPA would be subject to S10.7 flood affectation notification and planning controls graded according to flood hazard and hydraulic categorisation. **Schedules 2A and 2B in Appendix C** set out the graded set of flood related planning controls which apply to development in areas that are affected by Main Stream Flooding and Major Overland Flow, respectively. **Figure C1.1** shows the areas where the graded set of flood related planning controls set out in **Schedules 2A and 2B** apply to Bogan Gate.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard.⁸

Figure C1.2 in Appendix C of the *Bogan Gate FRMS* report are extracts of the *Flood Planning Constraint Category Map* relating to the study area. The figures show the subdivision of the floodplain into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises areas that lie between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on **Figure C1.1**.

⁸ Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

5.11 Improvements to Emergency Response Planning and Community Awareness

Two measures are proposed in *Bogan Gate FRMP* to improve emergency response planning and community awareness to the threat posed by flooding.

Measure 3 involves the update by NSW SES of the *Parkes Shire Local Flood Plan* using information on flooding patterns, times of rise of floodwaters and flood prone areas identified in the *Bogan Gate FRMP* report. Figures have been prepared showing indicative extents of flooding, high hazard areas, expected rates of rise of floodwaters in key areas and locations where flooding problems would be expected. **Section 3.5.2** references the locations of key data within the *Bogan Gate FRMS* report.

Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk (included as **Measure 4** of *Bogan Gate FRMP*). Council should also advise residents of the web sites and smart phone Apps that provide real-time Severe Thunderstorm Warning and Severe Weather Warnings for Flash Flooding alerts.

This information could be included in a *Flood Information Brochure* to be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with the rate notices. The community should also be made aware that a flood greater than historic levels or the planning level can, and will, occur at some time in the future. *Bogan Gate FRMP* should be publicised and exhibited at community gathering places to make residents aware of the measures being proposed.

5.12 Implementation of Severe Weather/Thunderstorm and Flood Warning System

Measure 5 comprises the investigation and design of an integrated severe weather/thunderstorm and flood warning system for Bogan Gate, while **Measure 6** involves its implementation. As several roads immediately to the north of Bogan Gate are frequently inundated by floodwater, there is merit in implementing an effective location-based messaging system that warns both residents and business owners of the potential for flood producing rain to be experienced in the upper reaches of the Gunningbland Creek catchment, as well as the potential for road closures to occur due to them being inundated by floodwater. The cost to investigate and design the system is estimated to be about \$50,000, whilst its implementation is estimated to cost about \$300,000.

5.13 Flood Modification Measures

While there was insufficient merit associated with the upgrade of the local stormwater drainage system in the south-east corner of the Village Centre for it to be included in *Bogan Gate FRMP*, the *Bogan Gate FRMS* found that there is merit in Transport for NSW investigating the feasibility of upgrading several existing causeways that are located along Henry Parkes Way where it runs between Parkes and Bogan Gate so as to improve its hydrologic standard (denoted as “**Bogan Gate Potential Flood Modification Measure 2**” or “**BG_PFMM2**” in *Bogan Gate FRMS* and included as **Measure 7** in *Bogan Gate FRMP*). Subject to the findings of the feasibility study, *Bogan Gate FRMP* includes the design and upgrade of Henry Parkes Way at one or more of the existing causeways (**Measure 8**).

The *Bogan Gate FRMS* also found that there is merit in the relevant rail authority investigating the feasibility of possibly upgrading the existing transverse drainage that is located along the Henry Parkes Way and the Orange-Broken Hill Railway west of Bogan Gate in combination with any third-party related flood mitigation measures (denoted as “**Bogan Gate Potential Flood Modification Measure 5**” or “**BG_PFMM5**” in *Bogan Gate FRMS* and included as **Measure 9** in *Bogan Gate FRMP*). Subject to the findings of the feasibility study, *Bogan Gate FRMP* includes the design and upgrade of Henry Parkes Way at one or more of the existing causeways (**Measure 10**).

Based on the outcomes of the community consultation process it was concluded that there is merit in developing and implementing a vegetation management plan for Gunningbland Creek at Bogan Gate, especially in relation to the clearing of vegetation/debris at the Henry Parkes Way and Orange-Broken Hill Railway bridge crossings of the watercourse (**Measure 11**).

5.14 Implementation Program

The steps in progressing the flood risk management process from this point onwards are:

1. Consider public comment, modify the document if and as required, and submit to Council.
2. Council adopts *Bogan Gate FRMP*.
3. Assistance for funding qualifying projects included in *Bogan Gate FRMP* may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Department of Climate Change, Energy, the Environment and Water.
4. As funds become available from Government agencies and/or Council’s own resources, implement the measures in accordance with the established priorities.

Bogan Gate FRMP should be regarded as a dynamic instrument requiring review and modification over time. The catalysts for change could include new flood events and experiences, legislative change, alterations in the availability of funding, reviews of Council’s planning strategies and importantly, the outcome of some of the studies proposed in this report as part of *Bogan Gate FRMP*. In any event, a thorough review every ten years is warranted to ensure the ongoing relevance of *Bogan Gate FRMP*.

6 GLOSSARY OF TERMS

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood (PMF) event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the <i>Flood Planning Map</i> .
Flood Planning Map	The <i>Flood Planning Map</i> shows the extent of land on which flood related development controls apply in a given area, noting that other areas may exist which are not mapped but where flood related development controls apply.
Flood Planning Constraint Category 1 (FPCC 1)	Comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding
Flood Planning Constraint Category 2 (FPCC 2)	Comprises areas which lie below the <i>Flood Planning Level</i> where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
Flood Planning Constraint Category 3 (FPCC 3)	Comprises areas which lie below the <i>Flood Planning Level</i> but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
Flood Planning Constraint Category 4 (FPCC 4)	Comprises areas that lie between the extent of the FPA and the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the <i>Special Flood Considerations Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Level (FPL)	Flood levels selected for planning purposes, as determined by the relevant adopted flood risk management study and plan, or as part of a site specific study In the absence of an adopted flood risk management study and plan for a particular location, the FPL is defined as the peak 1% AEP flood level plus the addition of a 0.5 m freeboard.

TERM	DEFINITION
Flood Prone/Flood Liable Land	Land susceptible to flooding by the PMF. Flood Prone land is synonymous with Flood Liable land.
Floodway	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Flood Storage Area	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the <i>Flood Planning Level</i> is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the <i>Flood Planning Level</i> .
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 0.1 m.
Main Stream Flooding	The covering of normally dry land by water that has escaped or been released from the normal confines of any lake, river, creek or other natural watercourse (whether or not altered or modified) or any reservoir, canal or dam.
Major Overland Flow	Where the depth of overland flow during the 1% AEP storm event is greater than 0.1 m.
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.
Special Flood Considerations Zone	Comprises the area where the flood risk is considered to be high enough to require additional controls to be applied to certain types of development that is located on land which lies outside the FPA. This area is identical to the FPCC4 affected land shown on the <i>Flood Planning Constraint Category Map</i> .

7 REFERENCES

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Howells et al, 2004. ***“Defining the Floodway - Can One Size Fit All?”*** FMA NSW Annual Conference, Coffs Harbour, February 2004.

Lyll & Associates, 2024. ***“Bogan Gate Flood Study”***

NSWG (New South Wales Government), 2023. ***“Flood Risk Management Manual”***

NSW SES (New South Wales State Emergency Service), 2024. ***“Parkes Shire Local Flood Plan”***

PW (Public Works), 2010. ***“Wagga Wagga Levee Upgrade – Flood Freeboard”***

OEH (Office of Environment and Heritage), 2019. ***“Floodplain Risk Management Guide - Incorporating 2016 Australian Rainfall and Runoff in studies”***

APPENDIX A
PHOTOGRAPHS SHOWING OBSERVED FLOOD BEHAVIOUR
AT BOGAN GATE

NOVEMBER 2005



Plate A1.1 – Looking north across flooded rural properties on the northern side of Henry Parkes Way.



Plate A1.2 – Looking north across flooded rural properties on the northern side of Henry Parkes Way.



Plate A1.3 – Looking north across flooded rural properties on the northern side of Henry Parkes Way.



Plate A1.4 – Flooding in the vicinity of the Myalls Homestead.



Plate A1.5 – Flooding in the vicinity of the Myalls Homestead.



Plate A1.6 – Flooding in the vicinity of the Myalls Homestead.

NOVEMBER 2005



Plate A1.7 – Flooding in the vicinity of the Myalls Homestead.



Plate A1.8 – Flooding in the vicinity of the Myalls Homestead).



Plate A1.9 – Flooding in the vicinity of the Myalls Homestead.



Plate A1.10 – Looking north from Henry Parkes Road towards the Bogan Gate Golf Club.



Plate A1.11 – Looking west along Henry Parkes Way.



Plate A1.12 – Looking west along Henry Parkes Way.

NOVEMBER 2005



Plate A1.13 – Looking west along Henry Parkes Way.



Plate A1.14 – Flooding in the vicinity of the intersection of Tubby Lees Road and Henry Parkes Way.

DECEMBER 2010



Plate A2.1 – Flooding in the vicinity of the Bogan Gate Golf Club clubhouse.



Plate A2.2 – Flooding in the vicinity of the Bogan Gate Golf Club.



Plate A2.3 – Flooding in the vicinity of the Bogan Gate Golf Club.



Plate A2.4 – Flooding in the vicinity of the Bogan Gate Golf Club.



Plate A2.5 – Flooding in the vicinity of the Bogan Gate Golf Club.



Plate A2.6 – Flooding in the vicinity of the Bogan Gate Golf Club.

DECEMBER 2010



Plate A2.7 – Flooding in the vicinity of the Bogan Gate Golf Club.



Plate A2.8 – Flooding in the vicinity of the Bogan Gate Golf Club.

MARCH 2012



Plate A3.1 – Flooding in the vicinity of the Neirawang homestead.



Plate A3.2 – Flooding in the vicinity of the Neirawang homestead.



Plate A3.3 – Flooding in the vicinity of the Neirawang homestead.



Plate A3.4 – Flooding in the vicinity of the Neirawang homestead.

JUNE 2016



Plate A4.1 – Flooding in the vicinity of the 8th fairway of the Bogan Gate Golf Club.



Plate A4.2 – Flooding in the vicinity of the old bridge adjacent to the 4th fairway of the Bogan Gate Golf Club.



Plate A4.3 – Flooding in the vicinity of the 8th fairway of the Bogan Gate Golf Club.



Plate A4.4 – Flooding in the vicinity of the 8th fairway of the Bogan Gate Golf Club.



Plate A4.5 – Flooding in the vicinity of the 6th fairway of the Bogan Gate Golf Club.



Plate A4.6 – Flooding in the vicinity of the 6th fairway of the Bogan Gate Golf Club.

SEPTEMBER 2016



Plate A5.1 – Flooding in the vicinity of the 6th fairway of the Bogan Gate Golf Club.

MAY 2022



Plate A6.1 – Flooding in the vicinity of the Neirawang homestead.



Plate A6.2 – Flooding in the vicinity of the Neirawang homestead.



Plate A6.3 – Flooding in the vicinity of the Neirawang homestead.



Plate A6.4 – Flooding in the vicinity of the Neirawang homestead.



Plate A6.5 – Flooding in the vicinity of Cudgelbar Lane.

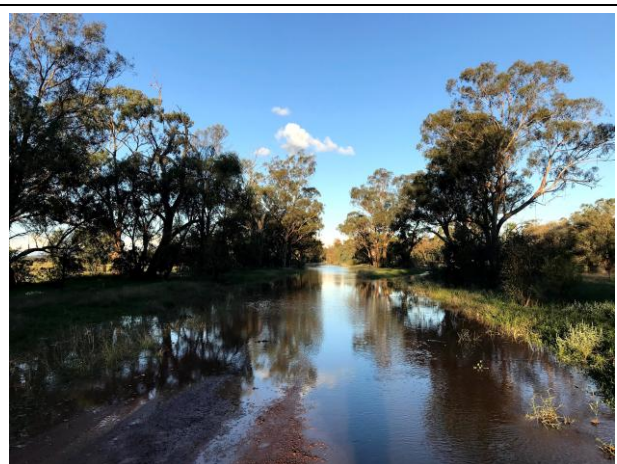


Plate A6.6 – Flooding in the vicinity of Cudgelbar Lane.

MAY 2022



Plate A6.7 – Floodwater inundating the Tubby Lees Road causeway crossing of Gunningbland Creek.



Plate A6.8 – Floodwater inundating the Tubby Lees Road causeway crossing of Gunningbland Creek.



Plate A6.9 – Flooding in the vicinity of Foothills Lane.



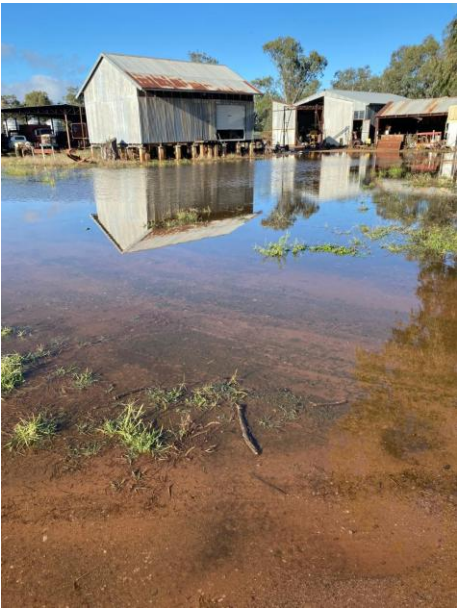
Plate A6.10 – Flooding in the vicinity of Foothills Lane.



Plate A6.11 – Flooding in Foothills Lane.



Plate A6.12 – Flooding in Foothills Lane.

NOVEMBER 2022	
	
Plate A7.1 – The Bogan Way in the vicinity of the Kadina homestead 1	Plate A7.2 – The Bogan Way in the vicinity of the Kadina homestead 1
	
Plate A7.3 – The Bogan Way in the vicinity of the Kadina homestead 1	Plate A7.4 – Flooding in the vicinity of the Myalls homestead.

NOVEMBER 2022



Plate A7.5 – Flooding in the vicinity of the Myalls homestead.



Plate A7.6 – Flooding in the vicinity of the Myalls homestead.



Plate A7.7 – Flooding in the vicinity of the Myalls homestead.



Plate A7.8 – Flooding in the vicinity of the Myalls homestead.

NOVEMBER 2022



Plate A7.9 – Flooding in the vicinity of the Myalls homestead.



Plate A7.10 – Flooding in the vicinity of the Myalls homestead.



Plate A7.11 – Flooding in the vicinity of the Myalls homestead.

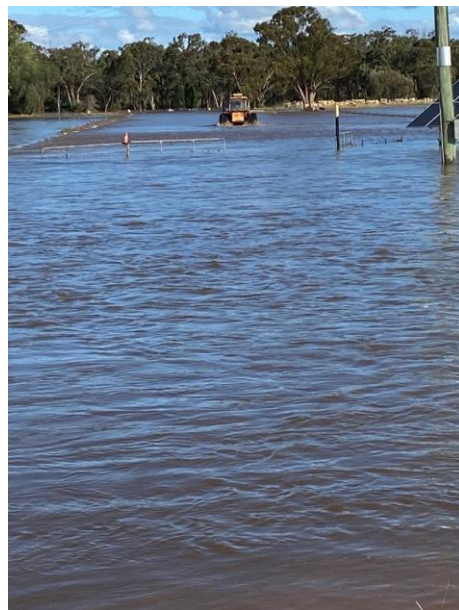


Plate A7.12 – Flooding in the vicinity of the Myalls homestead.

NOVEMBER 2022



Plate A7.13 – Flooding in the vicinity of the Myalls homestead.



Plate A7.14 – Flooding in the vicinity of the Myalls homestead.



Plate A7.15 – Flooding in the vicinity of the Myalls homestead.



Plate A7.16 – Flooding in the vicinity of the Myalls homestead.



Plate A7.17 – Flooding in the vicinity of the Myalls homestead.



Plate A7.18 – Flooding in the vicinity of the Myalls homestead.

NOVEMBER 2022



Plate A7.18 – Floodwater breaching the railway line immediately to the east of Overland Road.



Plate A7.19 – Collapsed section of railway immediately to the east of Overland Road.



Plate A7.20 – Collapsed section of railway immediately to the east of Overland Road.



Plate A7.21 – Collapsed section of railway immediately to the east of Overland Road.4

APPENDIX B

FIGURES SHOWING DESIGN FLOOD BEHAVIOUR AT BOGAN GATE

(BOUND IN VOLUME 2)

APPENDIX C

SUGGESTED WORDING FOR INCLUSION IN PARKES SHIRE DEVELOPMENT CONTROL PLAN

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FIGURES **(BOUND IN VOLUME 2)**

- C1.1 Extract of Parkes Shire Flood Planning Map at Bogan Gate
- C1.2 Extract of Parkes Shire Flood Planning Constraint Category Map at Bogan Gate

C1.1 Introduction

This section of the DCP sets out specific controls to guide development of flood liable land. The approach to managing future development that is subject to flooding supports the findings of a series of location specific flood risk management studies and plans that have been prepared as part of the NSW Government's program to mitigate the impact of major floods and reduce the associated hazards in the floodplain.

C1.2 Objectives in Relation to Flood Risk Management

- a) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.
- b) To increase public awareness of the hazard and extent of land affected by all potential floods, including floods greater than the 1% Annual Exceedance Probability (AEP) flood and to ensure essential services and land uses are planned in recognition of all potential floods.
- c) To inform the community of Council's controls and policy for the use and development of flood prone land.
- d) To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.
- e) To provide detailed controls for the assessment of applications lodged in accordance with the *Environmental Planning and Assessment Act 1979* on land affected by potential floods.
- f) To provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.
- g) To apply a "merit-based approach" to all development decisions which takes account of social, economic and ecological considerations.
- h) To control development and other activity within each of the individual floodplains within the LGA having regard to the characteristics and level of information available for each of the floodplains, in particular the availability of flood risk management studies and plans prepared in accordance with the *Flood Risk Management Manual*, issued by the NSW Government.
- i) To deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles contained in the *Flood Risk Management Manual*.

C1.3 Procedure for Determining What Controls Apply to Proposed Development

The procedure Council will apply for determining the specific controls applying to proposed development in flood liable areas is set out below. Upon enquiry by a prospective applicant, Council will make an initial assessment of the flood affectation and flood levels at the site using the following procedure:

- Assess whether the development is located on flood liable land from the **Flood Planning Map**.
- Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map** (i.e. Main Stream Flooding or Major Overland Flow).
- Identify the category of the development from **Schedule1: Land Use Categories**.

- Determine the appropriate flood level at the site from the results of the location specific flood or flood risk management study.
- Determine which part of the floodplain the development is located in from the **Flood Planning Constraint Category Map**.
- Confirm that the development conforms with the relevant performance criteria, as well as the prescriptive controls set out in either **Schedule 2A** for Main Stream Flooding affected areas and **Schedule 2B** for Major Overland Flow affected areas.

With the benefit of this initial information from Council, the applicant will:

- Prepare the documentation to support the Development Application according to the requirements of **Section C1.9**.

A survey plan showing natural surface levels over the site will be required as part of the Development Application documentation. Provision of this plan by the applicant at the initial enquiry stage will assist Council in providing flood related information.

C1.4 Land Use Categories

The policy recognises twelve different types of land use for which a graded set of flood related controls apply. They are included in **Schedule 1: Land Use Categories**.

C1.5 Flood Planning Constraint Categories

For those floodplains where Council has adopted a flood or flood risk management study, the identified flood liable land has been divided into the following four *Flood Planning Constraint Categories* (FPCCs):

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the *Flood Planning Area* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the *Flood Planning Area* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises areas that lie between the extent of the *Flood Planning Area* and the Probable Maximum Flood (PMF) where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on the **Flood Planning Map**.

C1.6 Development Controls

The development controls have been graded relative to the severity and frequency of potential floods, having regard to the FPCCs determined by the relevant Flood Risk Management Study and Plan or, if no such study or plan exists, Council's interim considerations.

The objectives of the development controls are:

- a) To require developments with high sensitivity to flood risk to be designed so that they are subject to minimal risk.
- b) To allow development with a lower sensitivity to the flood hazard to be located within the floodplain, provided the risk of harm and damage to property is minimised.
- c) To minimise the intensification of the high flood risk areas, and if possible, allow for their conversion to natural waterway corridors.
- d) To ensure design and siting controls required to address the flood hazard do not result in unreasonable social, economic or environmental impacts.
- e) To minimise the risk to life by ensuring the provision of reliable access from areas affected by flooding.
- f) To minimise the damage to property arising from flooding.
- g) To ensure the proposed development does not expose existing development to increased risks associated with flooding.

The performance criteria which are to be applied when assessing a proposed development are:

- a) The proposed development should not result in any increase in risk to human life, or in a significant increase in economic or social costs as a result of flooding.
- b) The proposal should only be permitted where effective warning time and reliable access is available to an area free of risk from flooding, consistent with any relevant Flood Plan or flood evacuation strategy.
- c) Development should not increase the potential for damage or risk to other properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.
- d) Procedures would be in place, if necessary, (such as warning systems, signage or evacuation drills) so that people are aware of the need to evacuate and are capable of identifying the appropriate evacuation route.
- e) Development should not result in impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house-raising) or by being incompatible with the streetscape or character of the locality.

The prescriptive controls which apply to development that is proposed on land affected by Main Stream Flooding and Major Overland Flow are set out in **Schedules 2A** and **2B**, respectively.

C1.7 Proposals to Modify Flood Planning Constraint Categories

In certain situations it may be feasible to modify existing flood behaviour through engineering works which in turn would enable the extent of the FPCCs to be modified at a particular location. Proposals to modify an FPCC at a particular location would need to be supported by a detailed flooding investigation, further details of which are set out in **Section C1.9** below. Proposals would also need to demonstrate consistency with the flood related objectives and performance criteria of both the *Parkes Local Environmental Plan 2012* and the DCP.

C1.8 Special Requirements for Fencing

The objectives are:

- a) To ensure that fencing does not result in the obstruction of the free flow of floodwater.
- b) To ensure that fencing does not become unsafe during floods so as to threaten the integrity of structures or the safety of people.
- c) To ensure fencing is to be constructed in a manner which does not increase flood damage or risk on surrounding land.

The performance criteria which are to be applied when assessing proposed fencing are:

- a) Fencing is to be constructed in a manner that does not affect the flow of floodwater so as to detrimentally increase flood affection on surrounding land.
- b) Fencing must be certified by an engineer specialising in hydraulic engineering stating that the proposed fencing would be constructed to withstand the force of floodwater, or collapse in a controlled manner to prevent the impediment of floodwater.

The prescriptive controls which apply to any proposed fencing on land designated FPCC 1 and FPCC 2 are:

- a) An applicant will need to demonstrate that the fence (new or replacement fence) would not create an impediment to the flow of floodwater. Fences must satisfy the following:
 - comprise pool/louvre type fencing or a collapsible hinged type fence structure;
 - be configured so as to allow floodwaters to equalise on both sides of the fence; and
 - be configured so as to minimise entrapment of flood debris.

C1.9 Explanatory Notes on Lodging Applications

The following steps must be followed in the lodgement of a development application:

- a) Check the proposal is permissible in the zoning of the land by reference to any applicable environmental planning instruments.
- b) Consider any other relevant planning controls of Council (e.g. controls in any other relevant part of the DCP).
- c) Check whether the property is located either partially or wholly within the Flood Planning Area or Special Flood Considerations Zone, as defined on the **Flood Planning Map**.
- d) Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map**.
- e) Determine which FPCC applies to the developable portion of the property by reference to the **Flood Planning Constraint Category Map**. Enquire with Council regarding existing flood risk mapping or whether a site-specific assessment may be warranted. A property may be located in more than one FPCC and the assessment must consider the controls that apply in each.
- f) Determine the land use category relevant to the development proposal, by firstly confirming how it is defined by the relevant environmental planning instrument and secondly by ascertaining the land use category from **Schedule 1: Land Use Categories**.
- g) Assess and document how the proposal will achieve the performance criteria for proposed development and associated fencing set out in **Sections C1.6 and C1.8**.

- h) Check if the proposal will satisfy the prescriptive controls for different land use categories in different FPCCs, as specified in either **Schedule 2A** or **Schedule 2B**.
- i) If the proposal does not comply with the prescriptive controls, determine whether the performance criteria are nonetheless achieved.
- j) Illustrations provided in this plan to demonstrate the intent of development controls are diagrammatic only. Proposals should satisfy all relevant controls contained in this plan and associated legislation.
- k) The assistance of Council staff or an experienced engineer or planner may be required at various steps in the process to ensure that the flood risk management related requirements of this Plan are addressed.

Note that compliance with all the requirements of this DCP does not guarantee that an application will be approved.

Information required with an application is as follows:

- a) Applications must include information which addresses all relevant controls.
- b) Applications for alterations and additions (see either **Schedule 2A** or **Schedule 2B**) to an existing dwelling on flood liable land must be accompanied by documentation from a registered surveyor confirming existing floor levels.
- c) Development applications must be accompanied by a survey plan showing:
 - i. The position of the existing building(s) and/or proposed building(s);
 - ii. The existing ground levels to Australian Height Datum around the perimeter of the existing and/or proposed building(s) and contours of the site; and
 - iii. The existing and/or proposed floor levels to Australian Height Datum.
- d) Applications for earthworks, filling of land or subdivision shall be accompanied by a survey plan (with a contour interval of 0.25 m) showing relative levels to Australian Height Datum.
- e) Where an existing catchment based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments an existing suitable flood study may be used if available (e.g. it contains sufficient local detail), or otherwise a flood study prepared in a manner consistent with the latest edition of *Australian Rainfall and Runoff* and the *Flood Risk Management Manual*, will be required and the following information must be submitted in plan form:
 - i. water surface contours;
 - ii. velocity vectors;
 - iii. velocity and depth product contours;
 - iv. delineation of flood risk precincts relevant to individual floodplains; and
 - v. show both existing and proposed flood profiles for the full range of events for total development including all structures and works (such as revegetation/enhancements).

This information is required for both pre-developed and post-developed scenarios.

- f) Where the controls for a particular development proposal require an assessment of structural soundness during potential floods, the following impacts must be addressed:
- i. hydrostatic pressure;
 - ii. hydrodynamic pressure;
 - iii. impact of debris; and
 - iv. buoyancy forces.

Foundations need to be included in the structural analysis.

C1.10 Glossary of Terms

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood (PMF) event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the <i>Flood Planning Map</i> .
Flood Planning Map	The <i>Flood Planning Map</i> shows the extent of land on which flood related development controls apply in a given area, noting that other areas may exist which are not mapped but where flood related development controls apply.
Flood Planning Constraint Category 1 (FPCC 1)	Comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding
Flood Planning Constraint Category 2 (FPCC 2)	Comprises areas which lie below the <i>Flood Planning Level</i> where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
Flood Planning Constraint Category 3 (FPCC 3)	Comprises areas which lie below the <i>Flood Planning Level</i> but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
Flood Planning Constraint Category 4 (FPCC 4)	Comprises areas that lie between the extent of the <i>Flood Planning Area</i> and the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the <i>Special Flood Considerations Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Level (FPL)	Flood levels selected for planning purposes, as determined by the relevant adopted flood risk management study and plan, or as part of a site specific study In the absence of an adopted flood risk management study and plan for a particular location, the FPL is defined as the peak 1% AEP flood level plus the addition of a 0.5 m freeboard.

TERM	DEFINITION
Flood Prone/Flood Liable Land	Land susceptible to flooding by the PMF. Flood Prone land is synonymous with Flood Liable land.
Floodway	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Flood Storage Area	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the <i>Flood Planning Level</i> is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the <i>Flood Planning Level</i> .
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 0.1 m.
Main Stream Flooding	The covering of normally dry land by water that has escaped or been released from the normal confines of any lake, river, creek or other natural watercourse (whether or not altered or modified) or any reservoir, canal or dam.
Major Overland Flow	Where the depth of overland flow during the 1% AEP storm event is greater than 0.1 m.
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain.
Special Flood Considerations Zone	Comprises the area where the flood risk is considered to be high enough to require additional controls to be applied to certain types of development that is located on land which lies outside the FPA. This area is identical to the FPCC4 affected land shown on the <i>Flood Planning Constraint Category Map</i> .

SCHEDULE 1 LAND USE CATEGORIES

Land Use Category	Subdivision	LEP Land Uses
Critical Uses and Facilities	<i>Community facilities which may provide an important contribution to the notification or evacuation of the community during flood events.</i>	Health services facility; Electricity generating works; Emergency services facility.
Sensitive Uses and Facilities	<i>Uses which involve vulnerable members of the community; Uses which may cause pollution of a watercourse or town water supply; Uses, which if affected, would significantly affect the ability of community to return to normal after flood event;</i>	Bio-solids treatment facility; Cemeteries; Child care centre; Correctional centre; Heavy industrial storage establishment; Heavy industries; Highway service centre; Group home; Passenger transport facilities; Respite day care centre; Schools; Seniors housing; Service Stations; Sewage treatment plant; Veterinary hospital; Waste or resource management facility; Water treatment facility.
Subdivision	<i>Subdivision of land which involves the creation of new allotments, with potential for further development;</i>	Camping grounds; Caravan parks; Eco-tourist facilities; Home business/ child care/occupations; Residential accommodation (excluding Group Home and Seniors housing); Tourist and visitor accommodation.
Residential		Attached dwellings Dwelling houses Multi dwelling housing Residential flat buildings Semi-detached dwellings Shop top housing
Commercial and Industrial		Amusement centre; Commercial premises (excluding Market); Crematorium; Depots; Entertainment facility; Freight transport facilities; Function centre; General industries; Industrial retail outlet; Industrial training facility; Light industries; Mortuaries;

		Place of public worship; Public administration building; Recreation facility (indoor & major); Registered club; Research station; Restricted premises; Sex services premises; Storage premises; Transport depots; Truck depots; Warehouse or distribution centre; Wholesale suppliers; Vehicle body repair workshops; Vehicle repair stations;
Recreation and Non-Urban		Agriculture (excluding intensive livestock agriculture); Animal boarding and training establishment; Boat sheds; Charter & tourism boating facilities; Car park; Community facility; Extractive industry; Forestry; Jetties; Market; Open cut mining; Recreation area; Recreation facility (outdoor).
Alterations and additions		i. An addition to existing premises of not more than 10% of the floor area which existed at the date of commencement of this DCP; ii. Rebuilding of a development which substantially reduces the extent of flood effects to the existing development; iii. A change of use which does not increase flood risk having regard to property damage and personal safety; or iv. Subdivision which does not involve the creation of new allotments with potential for further development.

SCHEDULE 2A
PRESCRIPTIVE FLOOD RELATED DEVELOPMENT CONTROLS – MAIN STREAM FLOODING

Planning considerations	Flood Planning Constraint Category 1 (FPCC 1)							Flood Planning Constraint Category 2 (FPCC 2)							Flood Planning Constraint Category 3 (FPCC 3)							Flood Planning Constraint Category 4 (FPCC 4)							
	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	
Minimum Habitable Floor Level						A1	A2 A4				A2	A5	A1	A2 A4				A2	A5	A1	A2 A4	A3	A3						
Building Components						B1	B1				B1	B1	B1	B1				B1	B1	B1	B1	B2	B2						
Structural Soundness						C1	C1				C1	C1	C1	C1				C1	C1	C1	C1	C2	C2						
Flood Affection						D1	D1			D1	D1	D1	D1	D2			D1	D1	D1	D1	D2								
Emergency Response						E4	E2 or E3			E4 E5	E3 E4	E3 E4	E4	E2 or E3			E4 E5	E2 E4	E2 E4	E4	E2 or E3	E2 or E3	E2 E4	E4 E5					
Management and Design						F2 F3	F2 F3			F1	F2	F2 F3 F4	F2 F3	F2 F3			F1	F2	F2 F3 F4	F2	F2 F3	F2 F3	F2 F3 F4	F1					
Stormwater						G2	G2			G1 G2	G1 G2	G1 G2	G2	G2			G1 G2	G1 G2	G1 G2	G2	G2	G1	G1						
Parking and Driveway Access						H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8	H3	H3						

	Not Relevant		Unsuitable Land Use
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SCHEDULE 2B
PRESCRIPTIVE FLOOD RELATED DEVELOPMENT CONTROLS – MAJOR OVERLAND FLOW

Planning considerations	Flood Planning Constraint Category 1 (FPCC 1)							Flood Planning Constraint Category 2 (FPCC 2)							Flood Planning Constraint Category 3 (FPCC 3)							Flood Planning Constraint Category 4 (FPCC 4)						
	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions
Minimum Habitable Floor Level						A1	A2 A4				A2	A5	A1	A2 A4	A3	A3		A2	A5	A1	A2 A4	A3	A3					
Building Components						B1	B1				B1	B1	B1	B1	B2	B2		B1	B1	B1	B1	B2	B2					
Structural Soundness						C1	C1				C1	C1	C1	C1	C2	C2		C1	C1	C1	C1	C2	C2					
Flood Affection						D1	D1			D1	D1	D1	D1	D2														
Emergency Response						E1	E1			E5					E2 or E3	E2 E4	E5					E2 or E3	E2 E4					
Management and Design						F2	F2			F1 F3	F2	F2 F4	F2	F2	F2 F3	F2 F3 F4	F1 F3		F4			F2 F3	F2 F3 F4					
Stormwater						G2				G1	G1	G1	G2		G1	G1	G1	G1	G1	G2		G1	G1					
Parking and Driveway Access						H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8	H1 H3 H5 H6	H1 H3 H5 H6	H1 H3 H5 H6	H1 H3 H5 H6	H1 H3 H5 H6	H2 H4 H6	H6 H	H3	H3					

	Not Relevant		Unsuitable Land Use
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Prescriptive controls for associated planning considerations under each FPCC		
Minimum Habitable Floor Level A1 Habitable floor levels to be set no lower than the 5% AEP flood level plus freeboard ⁽¹⁾ unless justified by site specific assessment. A2 Habitable floor levels to be set no lower than the 1% AEP flood level plus freeboard ⁽¹⁾ . A3 Habitable floor levels to be set no lower than the PMF flood level. A4 Habitable floor levels to be as close to the Minimum Habitable Floor Level as practical and no lower than the existing floor level when undertaking concessional development. A5 Habitable floor levels to be as close to the 1% AEP flood level plus freeboard ⁽¹⁾ as practical, but no lower than the 5% AEP flood level plus freeboard ⁽¹⁾ . In situations where the habitable floor level is set below the 1% AEP flood level plus freeboard ⁽¹⁾ , a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard ⁽¹⁾ .	Building Components & Method B1 All structures to have flood compatible building components below the 1% AEP flood level plus freeboard ⁽¹⁾ (refer Schedules 3A and 3B). B2 All structures to have flood compatible building components below the 1% AEP flood plus freeboard ⁽¹⁾ or the PMF level, whichever is the highest (refer Schedules 3A and 3B).	Structural Soundness C1 Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard ⁽¹⁾ . C2 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard ⁽¹⁾ or a PMF, whichever is the greatest.
Flood Affection D1 Flood Impact and Risk Assessment required to certify that the development will not increase flood affection elsewhere or the flood risk to both occupiers of the proposed development and others. The impact of the development on flooding elsewhere to be considered.	Emergency Response E1 Reliable egress for pedestrians and vehicles required during a 1% AEP flood. E2 Reliable egress for pedestrians and vehicles required during a PMF. E3 Reliable egress for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF level, or a minimum of 20 m ² of the dwelling to be above the PMF level. E4 The development is to be consistent with any relevant flood evacuation strategy or similar plan. E5 Applicant to demonstrate that there is rising road egress/access from all allotments internal to the subdivision to land which lies above the PMF.	Management and Design F1 Applicant to demonstrate that potential development as a consequence of a subdivision or development proposal can be undertaken in accordance with the controls set out in this Development Control Plan. F2 Flood Safe Plan (home or business or farm houses) to address safety and property damage issues (including goods storage and stock management) considering the full range of flood risk. F3 Site Emergency Response Flood Plan required considering the full range of flood risk F4 No external storage of materials below the Minimum Habitable Floor Level which may cause pollution or be potentially hazardous during any flood.
Stormwater G1 Engineers report required to certify that the development will not affect stormwater drainage. G2 The impact of the development on local overland flooding to be considered.	Parking and Driveway Access H1 The minimum surface level of open car parking spaces or carports shall be as high as practical, but no lower than the 5% AEP flood or the level of the crest of the road at the location where the site has access. In the case of garages, minimum surface level shall be as high as practical but no lower than the 5% AEP flood. H2 The minimum surface level of open car parking spaces, carports or garages shall be as high as practical. H3 Garages capable of accommodating more than three motor vehicles on land zoned for urban purposes, or enclosed car parking, must be protected from inundation by floods up to the 1% AEP flood plus freeboard ⁽¹⁾ . H4 The driveway providing access between the road and parking space shall be as high as practical and generally rising in the egress direction. H5 The level of the driveway providing access between the road and parking space shall be no lower than 0.3 m below the 1% AEP flood or such that the depth of inundation during a 1% AEP flood is not greater than either the depth at the road or the depth at the car parking space. A lesser standard may be accepted for single detached dwelling houses where it can be demonstrated that risk to human life would not be compromised. H6 Enclosed car parking and car parking areas accommodating more than three vehicles (other than on Rural zoned land), with a floor level below the 5% AEP flood or more than 0.8 m below the 1% AEP flood level, shall have adequate warning systems, signage and exits. H7 Restraints or vehicle barriers to be provided to prevent floating vehicles leaving the site during a 1% AEP flood. H8 Driveway and parking space levels to be no lower than the design ground/floor levels. Where this is not practical, a lower level may be considered. In these circumstances, the level is to be as high as practical, and, when undertaking concessional development, no lower than existing levels.	

1. Unless stated otherwise in an adopted location specific Flood Risk Management Study and Plan, freeboard is equal to 0.5 m for development being assessed under Schedule 2A and 0.3 m for development being assessed under Schedule 2B.

SCHEDULE 3A
GENERAL BUILDING MATTERS

Electrical and Mechanical Equipment

For dwellings constructed on land to which this policy applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.

Main Power Supply

Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. Means shall be available to easily isolate the dwelling from the main power supply.

Wiring

All wiring, power outlets, switches, etc, should be, to the maximum extent possible, located above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. All electrical wiring installed below this level should be suitable for continuous underwater immersion and should contain no fibrous components. Earth leakage circuit breakers (core balance relays) must be installed. Only submersible type splices should be used below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.

Equipment

All equipment installed below or partially below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B** should be capable of disconnection by a single plug and socket assembly.

Reconnection

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.

Heating and Air Conditioning Systems

Where viable, heating and air conditioning systems should be installed in areas and spaces of the house above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. When this is not feasible, every precaution should be taken to minimise the damage caused by submersion according to the following guidelines:

i) 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.

ii) Installation

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 the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**.

iii) Ducting

All ductwork located below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B** should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a watertight wall or floor below the relevant flood level, a closure assembly operated from above the relevant elevation set out under B1 or B2 of **Schedules 2A** and **2B** should protect the ductwork.

Sewer

All sewer connections to properties in flood prone areas are to be fitted with reflux valves.

SCHEDULE 3B
FLOOD COMPATIBLE MATERIALS

Building Component	Flood Compatible Material	Building Component	Flood Compatible Material
Flooring and Sub Floor Structure	- Concrete slab-on-ground monolith construction. Note: clay filling is not permitted beneath slab-on-ground construction which could be inundated. - Pier and beam construction or - Suspended reinforced concrete slab	Doors	- Solid panel with waterproof adhesives - Flush door with marine ply filled with closed cell foam - Painted material construction - Aluminium or galvanised steel frame
Floor Covering	- Clay tiles - Concrete, precast or in situ - Concrete tiles - Epoxy formed-in-place - Mastic flooring, formed-in-place - Rubber sheets or tiles with chemical set adhesive - Silicone floors formed-in-place - Vinyl sheets or tiles with chemical-set adhesive - Ceramic tiles, fixed with mortar or chemical set adhesive - Asphalt tiles, fixed with water resistant adhesive - Removable rubber-backed carpet	Wall and Ceiling Linings	- Brick, face or glazed - Clay tile glazed in waterproof mortar - Concrete - Concrete block - Steel with waterproof applications - Stone natural solid or veneer, waterproof grout - Glass blocks - Glass - Plastic sheeting or wall with waterproof adhesive
Wall Structure	Solid brickwork, blockwork, reinforced, concrete or mass concrete	Insulation	Foam or closed cell types
Windows	Aluminium frame with stainless steel or brass rollers	Nails, Bolts, Hinges and Fittings	- Galvanised - Removable pin hinges