Delivery under the flood risk management framework

Flood risk management guideline FG01

Department of Planning and Environment

NSW GOVERNMENT

Cover photo: Hunter Valley Flood Mitigation Scheme. John Spencer/DPE

Published by:

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ISBN 978-1-922767-35-6
EHG 2023/0228
June 2023

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1. Introduction

Councils are primarily responsible for managing flood risk in their local government areas (LGAs). The Environment and Heritage Group of the Department of Planning and Environment (DPE) and NSW State Emergency Service (NSW SES) can provide technical advice and support for some council flood risk management (FRM) activities. The NSW Government may provide additional support to local government or undertake extra FRM responsibilities in areas it identifies as a high priority.

Councils can also seek financial support for eligible activities under the NSW Floodplain Management Program (the program) and other relevant programs to support their FRM activities. Decisions to fund projects under the program consider statewide priorities and the business case made by council in the project application.

This guideline provides support to councils in their management of flood risk to their communities consistent with the *NSW Flood prone land policy* (the policy) and principles for FRM outlined in the *Flood risk management manual* (the manual; DPE 2023).

Effective management of flood risk requires a strategic approach. The most effective means for councils to achieve this is to undertake FRM through the FRM framework and process outlined in the manual. This includes a range of related activities beyond the FRM process and involves consideration of flood risk in broader decision-making.

This guideline also provides advice on how councils can deliver activities under the FRM framework including:

- undertaking and documenting strategic FRM activities (see Section 2 of this guideline and Table 2 of the manual). A sample template for councils to consider in documenting strategic activities is provided in Appendix A
- undertaking FRM activities outside the FRM process (see Section 3 of this guideline and Table 3 of the manual)
- undertaking additional activities that need to consider flood risk and the outcomes of the FRM process (see Section 4 of this guideline and Table 4 of the manual)
- developing FRM plans through the FRM process (see Section 5 of this guideline and the manual). Balanced FRM plans are fit for purpose for the community and location. They consider the varying flood constraints and address the existing, future and continuing flood risk to different elements (e.g. people and the built environment) with the aim of limiting residual risks to the community
- implementing FRM plans under the FRM framework (see Section 6 of this guideline and the manual). This generally involves upfront and ongoing efforts and needs to link into broader council forward planning processes.

1.1 Relationship to the manual and guidelines

This guideline builds on the advice provided in the manual. It supports councils in their role in delivery of the policy through the FRM process outlined in the manual. *Administrative arrangements: flood risk management guideline AG01* (FRM guideline AG01) identifies the range of other FRM guidelines and tools and state agencies that are referred to in this guideline. Links to FRM guidelines and relevant websites can be found in the 'More information' section below.

More information on terms used in this guideline is available in the manual and FRM guideline AG01.

1.2 Audience

This guideline is written to support local council staff, state agencies and their consultants in understanding and managing flood risk to local communities.

2. Strategic flood risk management

This section provides advice to support councils managing flood risk effectively through the FRM framework by completing recommended strategic FRM activities outlined in the manual. This may involve:

- establishing local governance arrangements (Section 2.1)
- setting FRM direction (Section 2.2)
- understanding the existing FRM status of council (Section 2.3)
- developing and implementing forward plans (Section 2.4)
- monitoring, reviewing and reporting on FRM (Section 2.5)
- managing flood risk across the LGA (Section 2.6).

It is recommended that councils share information on their strategic FRM activities with DPE Environment and Heritage Group. This can assist state agencies to fulfil their FRM responsibilities (outlined in the manual). These include understanding councils' needs for technical support and financial assistance for eligible FRM activities into the future.

2.1 Flood risk management governance arrangements

A key step in strategic FRM is establishing effective FRM governance arrangements. These arrangements are important for council to fulfil its FRM responsibilities and effectively consider flooding in other core council activities. They need to support effective links between those responsible for delivering the FRM process (Section 5) and those who may make decisions on priorities, implement decisions, manage FRM measures, or who need to consider flood risk in decisions. This requires links to the relevant decision-making committee of the elected council and across council staff, state agencies and the community.

Strategic FRM activities are recommended to be overseen by the council.

The responsibility for coordination of FRM within the council structure should be clearly assigned and resourced. This role should have clear links to other areas of council that have responsibilities for delivering aspects that influence flood risk to the community under the FRM framework. The council has access to external support for this role through the assistance from DPE Environment and Heritage Group and the NSW SES. Council staff would coordinate and oversee, document, monitor, review and report on FRM activities including:

- setting FRM directions as discussed in this section. This involves developing an understanding of FRM status and establishing forward plans for FRM activities
- undertaking core FRM activities outside the FRM process (see Section 3)
- considering the best available flood information and outcomes of FRM planning in decisions relating to broader core activities of council, as discussed in Section 4
- developing FRM plans under the FRM process as discussed in Section 5. This includes establishing and managing FRM committees and technical working groups (TWGs) to support all stages of the FRM process. This includes joint committees with other councils in the same catchment as needed (see Section 5.1.1)
- implementing FRM plans as discussed in Section 6 of this guideline.

Figure 1 provides an example of FRM governance arrangements and links to facilitate effective FRM in an LGA and support cooperation between councils that share a catchment.

Effective internal links between those responsible for delivering the FRM process and those who may make decisions are important. These decisions may be for prioritisation, implementation and management of FRM measures, or by those who need to consider flood risk in decisions. Such links aim to ensure flood risk can be readily considered in the broader decisions of council and in advice from councils to the community and government. The recommended types of internal and external links and their benefits are identified in Sections 2.1.1 and 2.1.2, respectively.

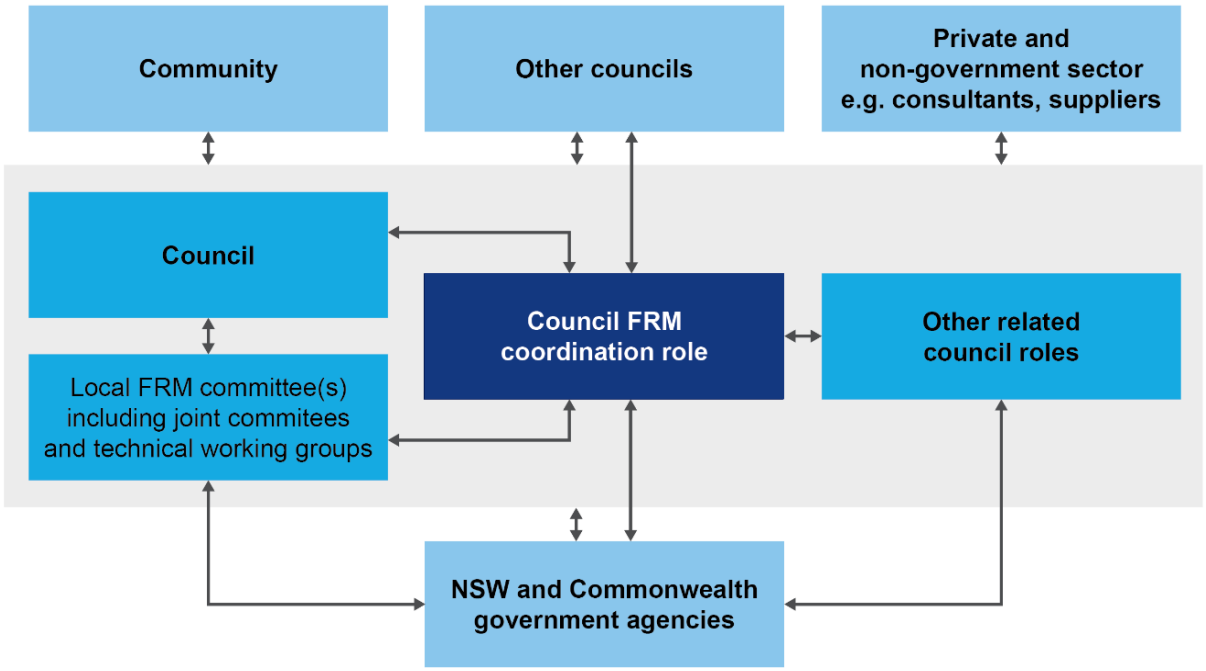

Figure 1 **Example of local flood risk management governance links**

2.1.1 Internal links and their benefits

Internal linkages include those between:

- staff responsible for coordinating FRM in council
- the council or a delegated decision-making committee of council
- FRM committees that support the development of FRM plans
- the FRM committee and any TWG established to support and guide the FRM committee
- all areas of council that need to consider flooding in their decision-making or may undertake FRM actions.

Effective internal linkages assist to:

- provide clarity on reporting to the council on FRM matters
- indicate responsibility for developing FRM plans and in implementing the outcomes of FRM plans through the work of the responsible council business units
- support forward planning for FRM projects
- facilitate management of information systems to support access to flood information
- support flood-informed decisions on infrastructure, emergency management (EM) and land-use planning
- facilitate continued operation and management of FRM assets

- facilitate broad input into the scope of FRM projects so they deliver outcomes suitable for the needs of council and the community
- support completion of priority FRM studies and plans and FRM measures
- support community flood education and awareness activities
- support the capture of lessons learnt from floods through post-event data collection
- support monitoring and reviewing of flood information and FRM to assess its adequacy and use these results in developing forward planning for future FRM activities
- develop and maintain skills and resources to support the development of FRM activities.

2.1.2 External links and their benefits

External links include those to:

- NSW and Australian government agencies that may play a role in FRM and therefore support council's FRM or related activities. This includes agencies that may be members of the FRM committee or a TWG that supports the FRM committee
- the community, to facilitate consultation and 2-way information flow in FRM planning
- other local councils that share catchments, to facilitate cooperative efforts on FRM across the catchment. This may be facilitated by joint FRM committees
- NSW and Australian government and industry stakeholders (e.g. infrastructure providers and insurers) that may need to consider flood risk in their decision-making.

Effective external linkages can facilitate FRM in the LGA by:

- providing access to financial assistance and specific technical support for FRM and flood EM response, recovery and rebuilding
- supporting the 2-way sharing of information on flooding and FRM assets. This can facilitate improved understanding and awareness of flooding and support decisions that are informed by a knowledge of flooding both within and external to government
- supporting coordination and cooperation of the interface between council and NSW Government flood investigations, including rural floodplain management studies developed by the NSW Government in the Murray–Darling Basin and any other studies undertaken or led by NSW Government
- supporting delivery of studies and FRM outcomes from the FRM process through relevant agencies and outsourced delivery mechanisms
- linking to key stakeholders who may influence the management of flood risk to the community
- other councils that share the same catchment whose understanding and management of flood risk may influence flood risk in the LGA.

2.2 Flood risk management direction

FRM direction can be set by council by establishing a local vision, objectives and principles for FRM. These should be established considering the policy objectives, and the vision and principles outlined in the manual, in the context of the local flood situation.

This direction setting provides a basis for comparing the outcomes of FRM activities and activities that consider flood risk relative to the intended direction. Where they are not consistent, it may identify the need to review these activities to better align outcomes.

2.3 Flood risk management status

Understanding the FRM status in the LGA can inform forward planning for FRM activities (discussed in Section 2.4). An example is provided in Appendix A.

It is recommended that councils develop and maintain an understanding of the current status of FRM in their LGA, including:

- identifying current FRM governance arrangements as discussed in Section 2.1
- developing an LGA flood summary informed by flood studies, FRM studies and plans, council's implementation of FRM plan recommendations and other relevant information. This could identify:
  - current knowledge and history of flooding, including an outline of the best available flood information for the LGA, its sources and whether it covers FRM measures already implemented to alter flood behaviour
  - current knowledge on the scale of flood impacts and risk to the community
  - knowledge of FRM measures and their benefits to the community, including:
    - FRM measures already implemented and their benefits
    - FRM measures recommended in FRM plans but yet to be implemented, and the tasks required to implement and maintain these measures
  - information and tools being used to support community flood awareness and consideration of flood risk in broader decisions, as discussed in Section 3.1
- understanding the current condition of key FRM assets, such as levees, flood warning systems and basins and the work needed to maintain these measures
- understanding gaps in knowledge of flooding, flood impacts and flood risk and any studies underway to address these gaps. This can include information to support FRM, EM, infrastructure planning and land-use planning
- accessibility of FRM information within and external to council
- synergies with other LGAs that present an opportunity to work collaboratively in understanding and managing flood risk.

It is recommended that the FRM status be reviewed and updated (as necessary) at least annually. It may be updated more regularly as new information becomes available (from studies and flood events) and FRM actions are implemented.

2.4 Flood risk management forward planning

Information on the status of FRM, along with knowledge on future community directions and forward infrastructure plans, can help inform decisions on priorities for:

- improving FRM governance arrangements
- improving the adequacy and accessibility of flood information
- asset management and operation of FRM measures (e.g. levees, flood warning systems and basins)
- development of new or review of existing FRM measures, FRM plans and associated studies
- implementation of FRM measures from different FRM plans on a priority basis across the LGA. This should be done considering the priorities identified in plans, the relative ease of implementation, the ability to incorporate these into broader work (e.g. update of a development control plan [DCP]), the relative benefits and costs of measures in different FRM plans, and the accessibility of financial assistance for implementation of major works.

It is recommended the FRM forward plan be reviewed and updated annually. It may be updated more regularly when FRM actions are undertaken or when the implementation of new FRM actions is recommended in FRM plans or other relevant sources.

The priorities identified can inform forward planning for FRM activities and broader council planning and budgeting through the local government integrated planning and reporting (IP&R) framework.

2.5 Monitoring, reviewing and reporting on flood risk management activities

Council should monitor and review its flood information, LGA flood summary, FRM status and forward plans at least annually. Updates should consider projects completed, new projects commenced or planned, new flood information available from studies or flood events, any significant changes in the condition of FRM assets, and any significant changes in the scale or type of development in the floodplain.

Council should make this information available to the NSW Government through the NSW Flood Data Portal to support state agencies in fulfilling their roles in decision-making for FRM and EM activities.

2.6 Managing flood risk across the local government area

Councils are primarily responsible for managing flood risk in their LGA. They do this with the technical and financial support of the NSW Government using the best available information and seek to improve information where needed (see Section 3.1).

The NSW Government has additional responsibilities for rural floodplain management (outside of urban areas) in the Murray–Darling Basin under the *Water Management Act 2000*.

The NSW Government may take on additional responsibilities or provide additional support to local government in areas it identifies as a high priority.

Council studies under the FRM process should consider rural floodplain management studies and plans in the study area, and vice versa. This ensures impacts of any proposed FRM measures are understood and considered, and the FRM recommendations in the plans are compatible.

2.6.1 Managing risk while the FRM process is underway

While the FRM process is underway, councils need to manage the flood risk within the study area. This typically involves the consideration of flood risk in decisions through FRM provisions within a relevant DCP or policy. These requirements may be based on the available information (from existing studies or historic floods) where it is considered by council to be fit for purpose. However, in cases where knowledge of existing flooding is limited or considered inadequate, councils may require proponents to derive the required information for their site as part of a flood impact and risk assessment (FIRA) (see *Flood impact and risk assessment FRM guideline LU01*).

DCPs and policies should be updated as new information becomes available. This will ensure decisions are based on the best available information.

2.6.2 Managing risk before recommended FRM measures are implemented

FRM measures including works recommended in FRM plans should not be factored into decisions until they are implemented and fully operational. For example, development controls should not be amended to cater for works until they are operational and the benefits in relation to reducing flood risk can be realised.

3. Additional core flood risk management activities

Council FRM responsibilities are not limited to the strategic activities identified in Section 2 and the development and implementation of FRM plans (discussed in Sections 5 and 6). Council FRM responsibilities include:

- the best available flood information is identified, maintained and made accessible to support informed decision-making
- information on FRM measures is developed and maintained
- decision-making needs to consider the condition of key FRM assets. This may involve the operation, maintenance and monitoring of these assets
- activities to support community flood awareness
- post-flood data collection and flood behaviour analysis being undertaken as necessary.

These activities are discussed in Sections 3.1 to 3.5.

3.1 Information on flooding

Councils are to use the best available flood information to inform LGA-wide FRM activities and decisions that need to consider flood risk (see Section 4). This should include, where available, information on the full range of flooding with existing FRM measures in place.

Councils are also responsible for sharing flood information to support informed decisions by government, key stakeholders and the community in their LGA. Having access to this information enables key stakeholders and individuals to make informed decisions on managing risks and investing in public and private assets and infrastructure in the floodplain.

To support this, it is recommended council develop, manage and make readily accessible information on flooding and FRM across their LGA. The degree of knowledge required for these activities is to consider the needs of the community and varies with the use of the information (in FRM, EM, land-use and infrastructure planning, and making stakeholders and the community flood aware). It also needs to consider the:

- exposure of the community to flooding
- potential for increases in flood risk due to new development
- potential for change in flood behaviour due to development, changes in the catchment, climate change, and infrastructure and FRM works
- complexity of the flood situation
- information needs of decision-makers, risk managers and the community
- gaps in knowledge of flood risk.

It is important flood information is maintained – and, where necessary, improved – so lessons from previous events, new information from studies, and changes due to implementation of FRM actions can be incorporated in databases and be available for use to manage risk into the future.

Information on the impacts of climate change on flood behaviour and an understanding of the cumulative impacts of development and catchment changes on flood behaviour are also important for management. Undertaking future scenarios in studies (see

Incorporating Australian Rainfall and Runoff into studies FRM guideline FB01) can help understanding of the potential impacts and enable management of the associated risks.

Information also needs to be updated when FRM measures are implemented and fully operational. For example, where a new FRM measure such as a levee or flood warning system is instigated and fully operational, it may change how frequently the community is affected by flooding or how the community needs to respond to flooding, respectively. This change should inform EM planning and community flood awareness activities.

3.2 Information on flood risk management measures

It is important to document FRM measures to:

- understand and maintain knowledge of their intent, design, history and current limitations
- monitor and advise on their condition (see Section 3.3) and whether this may impact their intended FRM function during a flood, which may impact on EM. For example, where the condition of the asset (such as a levee) deteriorates, it may help to identify the need to make changes to EM planning or asset management practices, or consider rehabilitating or upgrading the asset
- identify any recommended improvements or upgrades
- enable consideration of this knowledge in decisions that rely on these measures, such as EM planning.

3.3 Asset management and operation of flood risk management measures

Asset management, including condition assessment and operation of FRM measures, is important to enable these assets to fulfil their FRM function over the long term.

To support the protection afforded by FRM measures, councils should identify them as key community assets and include them in asset management plans prepared through their IP&R framework.

The condition of FRM measures should be monitored, and asset management needs adjusted to address issues as they arise. For example, the condition of FRM measures such as levees and detention basins needs to be monitored, and information maintained on the condition of their key structural and operating components, as they can deteriorate over time.

Where regular condition assessment and monitoring identifies the asset has deteriorated and it may influence risks to the community, advice should be provided to key state government agencies so these changes can be considered in EM planning, FRM and decision-making that considers flooding. It is also likely this would inform council's IP&R reporting and the FRM status and direction as discussed in Section 2.

Where FRM measures need to be operated during a flood event (e.g. closing floodgates on a flood levee), operational plans should also be developed, maintained, tested and exercised regularly.

3.4 Community flood awareness and engagement

A flood aware community is more likely to consider flooding in their decision-making and to respond more effectively to flood warnings and advice about actions in response to a flood threat. Councils should instigate flood awareness activities suited to the needs of their community to maintain this awareness.

Community flood engagement occurs through the FRM process, which can also provide flood information to support future community awareness activities. Councils are recommended to initiate these activities in partnership with the NSW SES on community flood engagement activities.

Working together with the NSW SES is especially important in post-event engagement initiatives. This ensures both parties contribute to and work with the community in the aftermath of a flood event to identify improvements in both FRM and EM planning and engagement in the future.

3.5 Post-flood data collection and behavioural analysis

Collecting information from floods is essential to understanding flood behaviour and the impacts of flooding on the community. It provides important information for future studies and can support the calibration and validation of flood models to provide more confidence in design flood estimates.

Councils are primarily responsible for collecting data on flood behaviour and impacts after a flood to ensure it is available to inform their future FRM activities and decisions that consider flooding. NSW Government agencies may also collect flood data during and post flood events to support an understanding of impacts to the community. This information may assist in an understanding of flood affected areas that warrant collection of more detailed flood data.

In some cases, a post-flood behaviour analysis may be warranted to ensure the flood's behaviour is documented and understood. It is particularly important where a flood larger than previous historic events has occurred, or where observed flood behaviour was different from previous floods or that identified in previous studies. These differences may influence future management.

Table 1 identifies some typical parameters for post-event data collection.

Table 1 Sample post-event data collection

Key data	Typical parameters to collect
Observed flood behaviour at key locations	• Time of observation • Flow direction and velocity • Flood levels at various times including at the flood peak. These should be identified and marked as soon as possible for survey • Rate of rise • Flowpaths • Travel time between key locations, e.g. peak to peak

Impacts to community	• Timing at key locations for:
	  ○ road closures
	  ○ isolation of property
	  ○ inundation of property
	  ○ evacuations

Flood damage	• Property impacts • Infrastructure impacts, e.g. roads, rail • Service impacts, e.g. electricity, water supply, sewer • Environmental impacts, e.g. stream erosion, deposition • Cultural impacts, e.g. cancellation of key community events, impacts on sites of cultural significance
Gauge records	• Water level • Rainfall (pluviograph and manually read data)

4. Additional activities that consider flooding

There are a range of other related activities that councils lead or are involved in that need to consider flooding to support effective management of flood risk to the community, including:

- EM planning for floods
- infrastructure planning
- land-use planning
- rebuilding after a natural disaster
- considering flood risk in other relevant activities.

These activities can use the information, outcomes and outputs of other activities under the FRM framework and process to support FRM to communities. They are discussed below.

4.1 Support for flood emergency management

Effective flood EM planning for communities involves a partnership between the local and state governments. The NSW SES supports councils who in turn support NSW Government-led EM and associated planning by fulfilling their related responsibilities. This includes councils providing flood information to support EM for communities.

EM planning relies on an appreciation of the variability in the EM needs of different parts of the community. This requires an understanding of potential isolation or inundation during floods, and the need for, scale of, and any limitations on, the response when undertaking an EM strategy such as evacuation of a community. One example is when there is limited time for a community response.

Studies under the FRM process can provide information to support effective EM planning for local communities. They should be undertaken in consultation with flood emergency managers to ensure they can effectively input to studies and their needs are considered in recommendations from the process. These needs may include information on:

- flood behaviour and how it varies across the floodplain, over the duration of floods and between floods of different scales and timings and may include a simulation of flood progression to demonstrate the potential impacts on the community
- the key impacts of floods on the community and how these may influence the order and timing of response for different areas within the community
- tipping points at which evacuation routes may be cut and areas isolated and levels at which isolated areas become effectively fully inundated.

Further advice on support for EM is provided in *Support for emergency management planning FRM guideline EM01*.

4.2 Infrastructure planning

Infrastructure planning should consider the:

- impacts infrastructure can have on flood behaviour and risks to the community
- role community infrastructure may be planned to fulfil in response to a flood, for example, a road may be designed to provide for evacuation in addition to its usual function
- vulnerability of infrastructure to flooding and the implications for it fulfilling this role.

The development or upgrade of above-ground infrastructure within and particularly across floodplains and waterways can have a positive or negative impact on flood behaviour, with associated impacts on the community. Infrastructure planning should aim to ensure any adverse impacts on flood behaviour and the community are effectively considered and managed. A FIRA (see FRM guideline LU01) may assist.

Community infrastructure can also have an important role in the lead-up to, during and subsequent community recovery from, floods. It may provide support for flood warning (e.g. water level and rain gauges and communications), or EM for floods (evacuation routes and centres), or some protection of communities from floods (e.g. levees or basins). The effectiveness of this infrastructure in fulfilling these roles can be examined in the FRM process and may lead to recommendations for improvements or upgrades.

The development or upgrade of community infrastructure should also consider whether there is an opportunity for the project to alter flood behaviour or reduce flood risks for the benefit of the community. For example, in upgrading a major transport route is there an opportunity to provide additional waterway capacity and reduce upstream afflux that impacts the community, or to improve flood evacuation capacity from an area where this capacity is limited? Such opportunities need to be balanced with any negative effects to the community.

Community infrastructure can also be vulnerable to floods (e.g. electricity substations, water and wastewater treatment works and pump stations), and there can be interdependencies between different services (e.g. pump stations rely on electricity supply). Sharing flood information (both the existing situation and where available future scenarios [see FRM guideline FB01]) can assist with infrastructure planning, design and management. It can support developing an understanding of vulnerability to flooding and how it may change over the life of the infrastructure.

4.2.1 Rebuilding infrastructure after disasters due to flooding

Rebuilding after a disaster provides the opportunity to make infrastructure and buildings more resilient to flooding. This may make individuals or communities more resilient to future natural disasters.

Rebuilding should consider the advice provided in Section 4.2, as well as changes in knowledge of flood risks and development or design standards since the infrastructure or structures were built.

4.3 Land-use planning

Development and redevelopment in the floodplain can place property and its users at risk. It can also impact on flood behaviour and impacts on the existing community.

Studies under the FRM process can provide information to support the development and implementation of strategic land-use planning for communities. This can include information on how flood behaviour, risk and flood related constraints may vary across the floodplain and into the future (considering climate change and the cumulative impacts of development), see future scenarios section in FRM guideline FB01. Plans developed under the FRM process may also include recommendations to improve consideration of flooding in land-use planning. These recommendations may include advice on matters such as the application of flood related controls in local environmental plans (LEPs) and DCPs that are compatible with the flood behaviour, constraints and risk. Advice on consideration of flood risk in land-use planning is provided in FRM guideline FB01.

4.3.1 Areas where rebuilding needs careful consideration

The FRM process can identify areas where there are extremely dangerous flood conditions and where there is very limited time to effectively warn and evacuate people to safety. These are situations where there can be a significant risk to life for occupants of houses and their potential rescuers.

The FRM process can also involve the assessment of options to reduce these risks through improvements in flood warning, EM arrangements and infrastructure, land-use planning and other FRM measures. Where there are no practical, feasible or effective measures to reduce the risks to the occupants of these houses and their potential rescuers, the FRM process should consider the suitability of the location for rebuilding. In some cases, this may result in a recommendation in an FRM plan for voluntary purchase of existing houses to remove the risk to life. Voluntary purchase may also have the benefit of removing the damage to the property, but this is not its primary intent. If houses in these locations are significantly damaged or destroyed in floods, part of the reconstruction effort should encourage consideration of the:

- potential to rebuild on the site to meet existing development conditions that may effectively reduce the risks to life
- potential to rebuild elsewhere on the site where risks to life may be lower and more manageable
- voluntary purchase of properties to prevent rebuilding in the same location where either of the above options cannot effectively address these risks.

Further advice on considerations for rebuilding after flooding are outlined in FRM guideline FB01.

4.4 Other activities that may influence flood risk

Other activities in floodplains and waterways can impact on flood behaviour. These include activities aimed at enhancing riparian, floodplain and catchment vegetation, or the installation of above ground pipelines or structures, such as those aimed at managing stormwater quality or supporting the capture and use of water.

These impacts need to be understood and managed in the planning of these projects, which may require some form of FIRA (see FRM guideline LU01). Further advice on different management measures and considerations for their use are provided in *Flood risk management measures FRM guideline MM01*.

5. Flood risk management process

The policy and manual use a broad risk management hierarchy of avoidance, minimisation and mitigation to support community flood resilience. To achieve this they support the need to undertake FRM under the manual, including developing FRM plans under the FRM process as discussed below, and implementing these plans as discussed in Section 6.

This section provides advice on the key tasks under the FRM process outlined in the manual to aid councils, with support from NSW Government, to fulfill their FRM responsibilities under the policy and manual. Importantly, section 733 of the *Local Government Act 1993* provides that councils have acted in good faith if they have acted substantially in accordance with the principles contained in the manual.

The FRM process provides the basis for understanding and making informed decisions on managing flood risk in a study area. It is a staged process for the development of an FRM plan. These stages may include the establishment of an FRM committee, data collection, a flood study, FRM study and FRM plan, as discussed in Sections 5.1 and 5.2.

Development of FRM plans is flexible to suit the needs of council, the study area and the flood situation. It is generally grouped into 2 projects:

- data collection and the flood study
- the FRM study and plan as discussed in Section 5.1.4.

The FRM process supports plan implementation (discussed in Section 6) and other activities to support FRM to communities, as discussed in Sections 1 to 4 of this guideline and in the manual. In doing so, it supports effective FRM outcomes for the community and government and improved community flood resilience.

The development of FRM plans is a council responsibility. These plans focus on managing flood risk to urban communities in inland areas and to communities in coastal areas. In rural areas of the Murray–Darling Basin the NSW Government may prepare floodplain management plans under the Water Management Act, however, these plans have a different focus, intent and scale to FRM plans prepared by councils. The NSW Government may also take on a greater role in FRM in areas it considers high priority.

Table 2 identifies some of the key tasks under the FRM process and the flexibility in their delivery in different stages. It also refers to the relevant FRM guidelines and tools that support the different stages of project delivery. These guidelines and tools are identified in FRM guideline AG01.

Table 2 Staging of key tasks in flood risk management plan development

Key tasks	Section	Other relevant guidance *	FRM process	Flood study	FRM study	FRM plan	Typical hold points
Preliminary activities	**5.1**	**FG01**					
FRM committee	5.1.1	FG01, FG02	P	M	M	M	
Setting FRM objectives for the study area	5.1.2	FG01	A	A	A	A	
Defining the study area	5.1.3	FG01	P	M	M	M	
Staging	5.1.4	FG01	A	A	A	A	
Scoping	5.1.5	FG01	A	A	A	A	
Applying for financial assistance	5.1.6	FG01	P	S	S	S	
Procurement	5.1.7	FG01	P	S	S	S	
Project tasks	**5.2**						
Project initiation	5.2.1	FG01, FG02	P	S	S	S	
Data collection	5.2.2	FG01	A	A	M	M	T
Community consultation	5.2.3	FG01		A	A	A	
Understanding flood behaviour	5.2.4	FG01, FB01, FB02, FB03, FB04, FB05, MM01, MR01, BT01		P	S		
Hydrological and hydraulic model development		FG01, FB01, FB04, BT01		P	S		
Model calibration and validation		FG01, FB01, BT01		P	S		T
Design flood behaviour		FG01, FB01, FB04, BT01		P	S		
Examining floodplain, catchment and climate changes		FG01, FB01, MM01, BT01		P	S		
Examining existing FRM measures		FG01, FB01, MM01, BT01		P	S		

Key tasks	Section	Other relevant guidance *	FRM process	Flood study	FRM study	FRM plan	Typical hold points
Examining flood behaviour on potential FRM measures		FG01, FB01, MM01, BT01			P		
Understanding model limitations & uncertainty in flood behaviour		FG01, FB01, BT01		P	S		
Reporting on modelling		FG01, FB01, BT01		P	S		T
Understanding the consequences of flooding for the community	5.2.5	FG01, FB01		A	A		
Understanding flood risk to the community	5.2.6	FG01, FB01		A	A		
Acceptability of risk	5.2.7	FG01, FB01		A	A		
Managing flood risk to the community	5.2.8	FG01, FB01, MM01		P	S		
Managing flood risks to the existing community		FG01, FB01, MM01		P	S		
Managing flood risks to the growing community		FG01, FB01, MM01		P	S		
EM planning to limit continuing risk		FG01, FB01, MM01, EM01		P	S		
Assessing and prioritising management options	5.2.9	FG01, FB01, MM01, MT01			P	P	T
Material to support ongoing community education and awareness	5.2.10	FG01, FB02, MM01	A	A	A	A	
Reporting and data handover	5.2.11	FG01, FB01, FB02, FB03, EM01, MR01, BT01		A	A	A	
Adoption of FRM studies and plans	5.2.12	FG01		A	A	A	
Review of FRM studies and plans	5.2.13	FG01	P	M	M	M	

Notes:

P = primary state; S = secondary stage; A = across multiple stages; M = may occur across multiple stages.

T = typical hold points. Typical hold points are when the process is halted until after the TWG and/or FRM committee has reviewed and agreed to the assessment outcome of the subject task.

Notes (cont):

* FRM guidelines and tools are as follows – links to current versions of these are provided in FRM guideline AG01 (see 'More information' section below):

BT01	Brief development tool
EM01	Support for emergency management planning: flood risk management guideline EM01
FG01	Delivery under the flood risk management framework: flood risk management guideline FG01
FG02	FRM committee handbook – unpublished handbook provided to committee members
FB01	Understanding and managing flood risk: flood risk management guideline FB01
FB02	Flood function: flood risk management guideline FB02
FB03	Flood hazard: flood risk management guideline FB03
FB04	Floodplain risk management guideline: incorporating 2016 Australian Rainfall and Runoff into studies
FB05	Floodplain risk management guideline: modelling the interaction of catchment flooding and oceanic inundation in coastal waterways
MM01	Flood risk management measures: flood risk management guideline MM01
MR01	Flood risk management guideline: modelling reports and supporting information (including model files) for review

5.1 Preliminary activities

Prior to commencement of the development of studies or plans under the FRM process, a series of preliminary activities should be undertaken. All projects under the FRM process should consider these activities to ensure the administrative, governance, financial and budgetary aspects of projects are clearly established. This is particularly important for projects within catchments that cross LGA boundaries. These projects will require additional consultation and management protocols to support the development of a fit-for-purpose FRM plan that suits the needs of all communities covered by the plan.

5.1.1 FRM committee and technical working group

An FRM committee should be established to oversee the FRM process in a study area, as an advisory committee to the council. A TWG of council and state agency staff may be established to assist the FRM committee with support from the consultant as needed. The FRM committee and TWG are best formed at the start of the FRM process as this allows members to contribute more effectively to the full range of activities outlined in Table 2.

Where councils share a catchment, consideration should be given to having a joint FRM committee that includes all relevant councils. This can support joint FRM efforts that may provide economies of scale and collaborative efforts between councils. This is particularly important where FRM or changes to development in one LGA will impact on flood risk or EM in another LGA.

Implementation of the findings of joint studies will generally fall back to the individual councils, however, a joint committee (or other arrangements) may continue as needed to support continued communication and coordination of implementation of any joint measures and measures that may influence flood risk beyond an individual LGA.

5.1.2 Establishing FRM process objectives for a study area

The objectives for the FRM process should be set considering the outcomes and outputs required to support delivery under the FRM framework and the current FRM status in the study area (as discussed in Section 2.3). These objectives should be reviewed, and more specific objectives set, at each stage of the FRM process.

5.1.3 Defining the study area

FRM forward planning (see Section 2.4) may identify areas where a better understanding of flood behaviour and risk or where further consideration of FRM options is required. Once the general area for investigations is determined, the study area can be identified. This informs the scope and scale of the modelling required to meet the project output and outcomes.

Some issues to consider in defining the study area include:

- the key factors that influence flood behaviour and inform decisions
- what is known about the flood problem, including information from any previous studies and historic events
- what flood problem the study is aiming to address, including whether flooding is in urban or rural areas, whether the source of flooding is riverine and/or overland flooding, and whether it is likely to be influenced by flooding from an adjoining catchment, downstream waterway, the ocean, or the waterway entrance from the ocean

- what FRM measures have been implemented in response to flooding and any understanding of their impacts on flood behaviour
- what additional FRM measures have been identified and need consideration in investigations
- hydraulic controls (such as bridges, culverts, raised infrastructure across the floodplain and berms at the outlets of waterways to the ocean) that may influence flood behaviour within, upstream or downstream of the location of interest
- known flood-dependent ecosystems that may need to be considered
- known cultural aspects that may need consideration
- expectations for growth of the community and where this is likely to occur (future development scenarios) (see FRM guideline FB01)
- the potential for climate change impacts resulting in sea level rise and/or changes in flood-producing rainfall events influencing flood behaviour in the study area (future climate scenarios) (see FRM guideline FB01)
- the practical scale and scope of the study to produce the level of detailed information required for management. For example, local modelling and management can focus on where most flood risks exist in a town. Broadscale modelling covering large-scale rural areas may not be able to provide sufficient detail to manage flood risk in a town
- the practicality of examining several catchments or locations together and whether this provides economies of scale, whilst not losing a focus on local consultation and management
- whether LGAs in the same catchment may benefit from cooperation in undertaking the study. Joint efforts may provide economies of scale and are particularly important where changes to development or FRM in one LGA will impact on flood risk or EM in another.

To provide a detailed understanding of flooding behaviour for the study area, hydraulic models need to extend upstream and downstream of the study area. Hydrological models need to capture the whole catchment to the downstream end of the hydraulic models and incorporate any key features that will significantly alter catchment flows, for example, flood detention basins. Therefore, modelled areas are generally different from the study area, however, it needs to be remembered that these models are only aimed at reliably identifying flood behaviour to inform decision-making within the study area. Use of models or their results beyond the study area may require the models to be refined or extended.

Models are also developed for a specific purpose, for example, understanding flood behaviour for a community and supporting consideration of FRM measures and future scenarios. Their fitness for purpose to examine flooding within the study area at a different scale or for a different purpose needs to be carefully considered before their use.

In addition, in some cases the scale of an FRM study may be different from a flood study. The flood study can be broad, covering a number of communities in the same catchment, whereas an FRM study and plan may be narrower to focus on FRM for a particular community.

5.1.4 Staging of the FRM process in a study area

The development of an FRM plan is generally undertaken in 2 discrete projects: the flood study (including data collection), and the FRM study and plan. These are generally separated because the flood study may:

- provide information to inform the management of flood risk so that flood risk can be considered in broader decisions while the FRM study and plan are being developed
- identify that existing FRM measures and practices are generally adequate in managing flood risk and an FRM study and plan may only need to be of limited scope. Alternatively, the flood study may identify that certain existing measures and practices are not adequate to address the flood risk and the FRM study and plan requires a more targeted scope
- provide additional data, such as additional survey or a larger study area, to better inform the scope of the FRM study and plan
- provide information on flood behaviour, impacts and risks and opportunities for management (including some advice on potential FRM options that may be worth consideration) to assist in scoping the FRM study and plan.

Separation between the stages can clearly delineate to the community the distinction between developing an understanding of flooding and examining and deciding on FRM measures.

Where a decision is made to include all stages in a single project it is necessary to provide a clear delineation between stages, for example, separate consultation is undertaken, and individual reports are prepared for the flood study, the FRM study and the FRM plan. The projects should also include clear hold points between each stage to limit the consultant progressing to the next stage until agreed. Typical hold points are shown in Table 2.

5.1.5 Scoping of the FRM process and individual stages

The scoping of the FRM process and stages should commence before applying for funding. It is an important step in ensuring that projects are tailored to provide maximum value and deliver the outcomes and outputs needed to support a range of activities under the FRM framework. Scoping also supports estimation of the potential project cost to support funding applications.

Studies undertaken at various stages of this process vary significantly in their scope and FRM considerations. Project specification can be influenced and should consider:

- the objectives of the process and study
- the information available about the community, catchment, flood behaviour, the environment, climate change and future development
- what studies have been undertaken, and what management measures and practices have either been considered or implemented
- the complexity of the flood problem
- what is known about the exposure and vulnerability of the community to flooding and how this varies
- the susceptibility of the location to climate change impacts on flood behaviour, such as sea level rise, as this can impact on the modelling approach
- the information needs of different end users
- the resources needed to find, collate and assess the existing information, identify knowledge gaps and make recommendations on addressing gaps
- the floods that need to be examined. Both historic events and design events needed to inform decisions on the full range of flood behaviour
- the fitness for purpose of any existing and available tools, such as previously developed hydrologic and hydraulic models of flood behaviour and flood damage models

- the types of FRM options that are likely to be considered to manage flood risk as these can impact on the selection and configuration of study scope and cost
- strategies that council generally uses to consult the community
- the accuracy needed for data, for example, specifications should ensure the survey data meet an appropriate degree of accuracy in height and location (coordinates) required for FRM purposes
- the requirements of funding applications and associated business cases for implementation of FRM measures under relevant programs
- the licensing and handover requirements of project reports, outputs, datasets and models.

The NSW Government provides the manual and associated toolkit, including *Brief development tool BT01*, outlined in FRM guideline AG01 to support specification of projects. This tool can be used by council staff in consultation with staff from DPE Environment and Heritage Group to assist in scoping projects under the FRM process outlined in the manual.

5.1.6 Applying for financial assistance

Council can apply for financial assistance for eligible FRM projects under the FRM framework through the program or other relevant programs. Funding applications should be made in accordance with the requirements of the specific funding program.

5.1.7 Procurement

The scope of works, proposal and the associated contract provide a basis for engagement of a consultant. Where funding is provided through the program or any other relevant government program, the contract documentation is to incorporate any specific requirements of relevant grant conditions, such as accessibility to information and related intellectual property clauses, and the requirement to maintain FRM measures. DPE Environment and Heritage Group provides support to council throughout the project from scoping through to delivery.

Advice on the requirements for projects funded by the NSW Floodplain Management Program is available on the DPE Environment and Heritage Group website.

5.2 Project tasks

This section discusses key tasks undertaken in projects under the FRM process once a consultant is engaged. The typical minimum scope and requirements of the different stages of the FRM process are discussed in the manual, however, the stages of projects can be flexible in consideration of the circumstances, as discussed in Section 5.1.4 of this guideline.

5.2.1 Project initiation

At the start of a contract there is generally a project inception meeting. This meeting would typically include a discussion with the TWG and may involve meeting with the FRM committee.

This inception meeting will discuss issues such as the scope of work, how the project will proceed, involvement of the FRM committee and TWG, key aspects of the project and associated milestones. It provides an opportunity to clarify aspects of the project, to share data, and provide advice on potential sources of information.

5.2.2 Data collection and review

Data collection is rarely undertaken as a separate element of the FRM process, however, in some circumstances such as when a flood event occurs, post-event data collection may be conducted where council or DPE Environment and Heritage Group deem this necessary.

Data collection generally occurs in each stage of the process, with most of it undertaken in conjunction with the flood study to assist understanding of flood behaviour.

Once data is collected it needs to be reviewed to assess its adequacy and limitations, and its use identified so it can be used within its utility to inform work within the scope of the project. The intellectual property of the data should be understood and documented as part of data collection.

Data collected and generated in projects should be appropriately licensed to facilitate availability (whilst allowing effective data management), and should support efficient completion of future stages under the FRM process or implementation tasks that may involve a different consultant.

5.2.3 Community and stakeholder communication and consultation

Successful FRM for communities requires effective and efficient communication and consultation with the community and internal and external stakeholders at all stages of the FRM process. It supports the acceptance and use of flood information and the development, acceptance and smooth implementation of effective FRM measures.

The local community, including those who are flood affected, has a key role to play in the development of flood studies, FRM studies and plans and implementation of FRM plans. Clear and concise communication and effective consultation with the community and stakeholders from the start of the FRM process can encourage participation, keep them informed and let them contribute at key stages of the process and projects. This can facilitate the community and stakeholders to:

- be informed and gain an understanding of the FRM process, the studies being undertaken, the study goals, timing and progress and how floods and flood impacts will be managed until studies are completed
- provide information on their experience and knowledge of flood behaviour and impacts in the area
- provide advice on whether the flood behaviour modelled in studies is reflective of their observations or experiences
- become more aware of flooding and its impacts on and risks to the community in their areas of interest
- understand where to find information on flooding and how to respond to a flood threat in their local area
- understand what they can do to reduce their flood risk
- be in a better position to consider flood risk in their decisions
- have their say on proposed FRM measures
- gain advice on the outcome of the study or process
- gain an understanding of steps that may follow the completion of the process.

An ongoing community awareness strategy tailored to suit the local community may be developed and implemented as part of FRM projects.

The TWG, FRM committee and, where relevant, the council or its nominated decision-making committee, should review and agree to draft reports, presentations and consultation materials before they are presented to the community.

The results of community consultation should be incorporated into reports so they can be considered by the FRM committee in finalising studies and plans and the council can consider this community input in decision-making.

All study reports and recommendations in plans should have been through public exhibition and community engagement. Comments should also be sought from key stakeholders and relevant agencies. Feedback should be considered prior to completion of final reports and their adoption by council.

5.2.4 Understanding and reviewing flood behaviour

Understanding and reviewing flood behaviour provides the basis for making informed decisions on FRM and for the provision of information to support consideration of flooding in FRM, EM, and land-use planning. The FRM process supports these outcomes.

Understanding flood behaviour starts with reviewing information on historic floods and previous studies in light of how the floodplain and waterway structures may have changed over time and what FRM measures may have subsequently been implemented.

This can provide the basis for examining the full range of floods that impact the study area and understanding the existing risks to the community, including:

- how effective new or upgraded FRM measures may be at addressing flood risks to the community
- how existing flood behaviour may change into the future with climate change and considering the cumulative impacts of development (see FRM guideline FB01), and whether this impacts on potential FRM measures.

A review of flood behaviour may occur as needed. This may include:

- when FRM measures are being further investigated, designed or implemented to ensure the benefit to the community predicted in earlier investigations can be achieved in implementation
- after a significant flood occurs where observed flood behaviour is different to previous events or what was predicted in earlier studies
- when design standards change or when there is a significant change in the available information since the completion of the last study.

In each case, the decision to review flood behaviour should consider whether this change will impact on the suitability of the current flood information to support decisions and activities under the FRM framework.

Hydrologic and hydraulic model development

Hydrologic and hydraulic models are an integral part of developing an understanding of flood behaviour as they provide the basis for examining:

- flood flows and volumes (e.g. hydrological modelling approaches such as flood frequency analysis [FFA] and run-off routing)
- how floodwaters flow through the landscape of the floodplain hydraulic models (e.g. one-dimensional [1D], 2-dimensional [2D] or a combination of both [1D–2D]). They provide information such as flood levels, depths, velocities and timing for various events.

Models are tools that should be calibrated and validated using historic flood and catchment information and then used to simulate the full range of design flood behaviour. These support decision-making by:

- extrapolating and interpolating knowledge of flood behaviour to examine the full range of floods and how these events may vary over time
- examining the variation in flood behaviour across the floodplain
- examining the variation in flood behaviour with changes in natural hydraulic controls, such as entrance conditions in coastal waterways or receiving water levels, such as ocean levels
- examining flood behaviour at different points in history, under current conditions (with existing FRM measures in place) and in future scenarios (e.g. changes to catchment and floodplain conditions with community growth, through development and associated infrastructure, and with climate change, see FRM guideline FB01). This can provide information on flood behaviour and risks and how these may vary across the floodplain and between events of different scales and how this may change over time. It can also provide information on the effectiveness of existing FRM measures now and into the future
- examining a range of potential FRM options that may manage flood risk by altering flood behaviour
- providing information to support decisions to manage flood risk for the community and key stakeholders, EM and land-use planning for community growth.

The modelling software chosen for a study depends on a range of factors including the:

- suitability of any available models and their ability to represent the catchment and floodplain features
- availability of topographic, bathymetric and historic flood information
- complexity of the flood situation
- scale and topography of the catchment and floodplain, and key features of interest
- existing FRM measures in place and FRM options likely to be examined
- exposure of the community to flooding and the potential for community growth
- information needs of different end users, for example, emergency managers require specific information to inform EM planning (see FRM guideline EM01)
- the availability of existing fit-for-purpose models for the study area
- budget and time constraints
- its use within industry. This provides the ability to competitively tender further work.

Model calibration and validation

Calibration against an historic event and validation against other historic events is a key step in ensuring models are fit for purpose for interpolation, and for extrapolation to examine the full range of flood events.

Models should be set up to represent the catchment and floodplain conditions, including the scale of vegetation, development, and waterway conditions and structures at the time of the calibration events. Model parameters should be adjusted to obtain an appropriate fit between modelled and actual flood behaviour for the event. The model should then be adjusted to suit conditions at the time of validation events and the appropriateness of calibration parameters tested by examining how reasonably modelled runs compare with the actual flood behaviour in these events. This may result

in some iteration of model parameters to develop parameters that are fit for purpose and will support effective consideration of the full range of flood behaviour.

Model calibration and validation provides an ideal point at which to engage the community and key stakeholders to get confirmation that modelling is providing a reasonable representation of observed flood behaviour for more recent historic events. This enables early detection of any significant deviation from observed behaviour, refinement of the model to suit, and can support community confidence in the model.

A short model calibration and validation report identifying aspects such as proposed design parameters, model fitness with historic events and key modelling methodology is generally prepared to document this work. This is provided with relevant data as required by the project specification to support consideration of adequacy for presentation to the FRM committee and community by the TWG. It should be updated considering the comments of the TWG and council agreement sought and gained for community consultation.

After consultation, the report should be updated considering comments from stakeholders and the community and the final model calibration and validation and associated data provided to the TWG for review. It is important that model calibration and validation is reviewed and agreed to by the TWG and FRM committee before undertaking design flood estimation. This is a key hold point in the study process.

Design flood behaviour

Once it is agreed that the calibrated and validated model provides a reasonable representation of historic floods and is a fit-for-purpose tool for interpolation and extrapolation of flood events, the model can be modified to match existing conditions in the catchment and floodplain. Modelling the full range of design floods can then be completed and reviewed to provide an understanding of the full range of and natural variability of existing flood behaviour.

Design flood estimation needs to consider factors that can influence floods including:

- ocean entrance condition, sea levels and ocean conditions, in the lower sections of coastal waterways. Ocean conditions may be influenced by the same storm event that causes catchment flooding. FRM guideline FB05 provides advice on assessing the coincident behaviour of coastal inundation and catchment flooding.
- flooding from other waterways that may influence flooding in the waterway being examined.

Design flood estimation for the full range of flood behaviour also needs to consider and provide information on the key factors that influence FRM. These may include understanding:

- existing FRM measures and their limitations and effectiveness in managing flooding within the community
- the current flood situation with existing FRM measures in place
- which flood drivers may be most important for a location (i.e. peak flood flows, flood volume, ocean impacts, hydrologic or hydraulic controls)
- the likelihood of flooding in different areas of the floodplain
- where the flood functions of flow conveyance in floodways (and local flowpaths in local overland flooding) and flood storage occur in the floodplain in different events (see FRM guideline FB02)
- the variation in flood hazard (see FRM guideline FB03) in different areas of the floodplain and in different events

- the variation in isolation and inundation of different areas of the floodplain from points of community safety. These may be determined using the flood emergency response classification of communities (FERCCs) outlined in FRM guideline EM01
- the variation in time for the community to respond to flooding. This often relates to the variation in timing of floods to reach key tipping points, often based on flood levels, such as inundation of an evacuation route. This is important where evacuation needs to be completed within a limited timeframe
- how flood behaviour and flood-related constraints vary across the floodplain in design floods of different durations but of the same annual exceedance probability (AEP) and across the full range of floods
- peak flood levels for different floods, as these are often used or considered in setting limits relating to risk avoidance.

This may lead to different key design events being used for different areas of the catchment. This is because key flood parameters, such as the critical storm duration and the drivers for flood behaviour, or key issues for FRM (e.g. the shortest time before key evacuation routes are cut or duration of flooding of an access route rather than the flood that derives the peak flood level for that frequency of event), can be different across the floodplain.

Examining the full range of flood behaviour provides an understanding of the sensitivity of flood behaviour to the scale of event. The sensitivity of models to key parameters and assumptions should be tested to provide an indication of the degree of uncertainty in model results.

Understanding design flood behaviour provides a basis for understanding the likelihood of flooding and informs the understanding of flood risk, see FRM guideline FB01.

Examining floodplain, catchment and climate changes

Design flood behaviour should also consider future scenarios (see FRM guideline FB01) that include changes to the catchment, floodplain and climate to allow for an understanding of the future flood behaviour with changed conditions. This can be used to assess changes in the consequences of floods and their likelihood, and the associated risks to the community into the future so these changes can be considered in decision-making.

Examining existing FRM measures

Existing FRM measures, such as levees or basins, that significantly reduce flooding to the community, should be assessed so their value to the community is understood. This may include examining the benefits of the measure, the limitations of these benefits, and the impacts of failure. Modelling the impacts of failure may consider:

- for a levee, either a reasonable breach in the levee or without the levee (which can give an understanding of the extent of inundation for long duration flooding)
- for a basin, modelling should consider a reasonable breach in the basin and a wide range of storm patterns and durations.

This information can support decisions on maintaining and potentially upgrading FRM assets.

Examining flood behaviour under potential FRM measures

Where FRM measures are proposed that will impact on design flood behaviour, these measures should be modelled to examine their impacts and benefits. This provides information to assess their effectiveness based on changes to both the likelihood of flood impacts and the associated consequences to the community.

Examining flood behaviour with potential FRM measures in place should also consider future scenarios (see FRM guideline FB01), so any changes to the effectiveness of FRM measures over time can be understood and:

- these limitations can be considered in decisions
- modifications to FRM measures to adapt to changes in flood behaviour can be modelled
- the ability to adapt can be built into decisions. For example, if a levee needs to be raised in the future to maintain protection, ensure sufficient land is set aside and the design can support future upgrade.

Understanding uncertainty in flood behaviour and model limitations

Robust FRM decisions need to consider uncertainty. The importance of uncertainty to FRM decisions will depend on whether the decision itself:

- is robust, for example, EM planning for the full range of flood risk may be adaptive to change
- involves a tipping point at which a significant change will occur. For example, a tipping point may be the potential for overtopping of a levee once its design flood level (below the crest level) has been reached or the flooding of areas built above the defined flood event (DFE) in a flood rarer than the DFE.

Understanding uncertainty and limitations is inherent in FRM and flood modelling. Calibration and validation of models against flood flows, levels and timing of historic events by experienced modellers can improve confidence in models but does not remove these uncertainties.

Uncertainty can be assessed in models by scenario and sensitivity testing. Evaluating the sensitivity testing results by changing modelling parameters and conditions, such as downstream ocean levels, and the intensity and volume of flood-producing rainfall events, can provide an understanding of the robustness of the predicted flood behaviour. More advice can be found in FRM guideline FB01.

5.2.5 Understanding the consequences of flooding for the community

The consequences of floods vary depending on the exposure and vulnerability of different elements of the community to flooding. The different elements potentially at risk include:

- people
- the economy
- social and cultural aspects
- service continuity
- the natural environment.

The FRM process provides an opportunity to understand, where relevant to FRM decision-making, the consequences for these different elements considering the constraints flooding places on land. Further advice on these aspects is provided in FRM guideline FB01.

5.2.6 Understanding flood risk to the community

Risk is a combination of consequence and the likelihood of the consequence occurring. Consequences vary between floods of different magnitudes, differences in exposure and vulnerability within and between different elements at risk to flooding (see Section

5.2.5), and different flood related constraints. The likelihood of consequences is assessed by looking at floods of different probabilities of occurrence.

Risk assessment should consider the full range of flood behaviour and the consequences to the different elements at risk, where relevant, and consider how risk may change with future scenarios. It should also look at whether risk is distributed across the community or concentrated in specific areas, so management actions can be appropriately tailored to the specific location and community. The other key aspects to consider are uncertainty (Section 5.2.4) and the acceptability of risk (Section 5.2.7).

Further advice on understanding flood risk is provided in the manual and in FRM guideline FB01.

5.2.7 Acceptability of risk

It is important to consider the acceptability of risk as this can influence management.

The level of risk that is acceptable to a community will depend on who is asked, what their experience of floods has been and when they are asked. The acceptability of risk will vary between the different elements at risk (e.g. people relative to the built environment), or with a higher level of consequences (e.g. more damage and risk may only be accepted if it only happens in rarer events).

Further advice on acceptability of flood risk is provided in the manual and FRM guideline FB01.

5.2.8 Managing flood risk

Managing flood risk needs to consider the flood risk to the community and how this varies between events of different scales, in different areas and to the various elements at risk. It also needs to consider uncertainty and how risk may change into the future.

There are a range of FRM measures available to address flood risk as outlined in FRM guideline MM01. Different measures may be suitable to address flood risk to the existing community, to the future community and to further reduce residual risks by managing continuing risks. Different measures may also be needed to manage risks to the different elements (e.g. people relative to the built environment).

The suitability and feasibility of different FRM measures will be specific to the community and their flood and development circumstances. There is no one size fits all solution to managing flood risk.

Implementation of FRM measures identified in an FRM plan is generally decided at an LGA-scale and will generally need to consider relative priorities to FRM measures in other FRM plans and broader council priorities (see Section 6).

Managing existing, future and continuing risk is discussed below. Further advice on managing flood risk is provided in FRM guideline FB01.

Managing risks to the existing community

Where the existing community considers their flood risks are not acceptable, options to manage these risks should be examined. However, the ability to manage risks to the existing community is shaped by the elements at risk, flood behaviour, the community exposure to flooding and the practicality, feasibility and cost effectiveness of measures to address risks.

The ability of FRM measures to reduce existing flood risks to a level the community accepts is often limited. In many cases unacceptable flood risks can be reduced to levels more tolerable to the community using FRM methods that are practical, feasible

and cost-effective. In cases where it is necessary to live with the risks, it is important to consider options to improve management of continuing risk to reduce residual risks.

Recommendations in FRM plans may be to implement FRM measures, however, implementation is generally a staged process as discussed in the manual and Section 6.

Managing risks to a growing community

Managing flood risk to a growing community can limit increases in risks both to new development and its users, and additional risks on the existing community that result from the new development and its users.

The most effective way to address risks from a growing community is to ensure flooding and its potential impacts to and from the proposed development are considered in decision-making. FRM guideline FB01 provides advice on considering flooding in land-use planning, including the development, update and implementation of local strategic planning statements (LSPSs), LEPs and DCPs.

For development proposals, proponents need to consider the flood-related development assessment requirements of the consent authority and relevant planning instruments and policies, including council LEPs and DCPs as outlined in FRM guideline FB01. This may involve the requirement for a FIRA. Advice on FIRAs is provided in FRM guideline LU01.

EM planning

EM is another key element in managing flood risk to the community. It is a primary tool to address continuing flood risk and, through this, to further reduce residual risk to the community. It should be used in partnership with effective FRM and consideration of flooding in land-use planning.

EM relies on understanding where flooding may be an issue, the scale of the potential flood threat and logistics around flood behaviour. This is best understood through EM planning. EM planning is typically undertaken using the best available flood information from sources such as historical events and, in particular, studies under the FRM process.

Studies under the FRM process can provide information to support EM planning as outlined in FRM guideline EM01. These studies may also involve reviewing existing local flood plans, to assess the information on which they are based, and making recommendations for improvement.

5.2.9 Assessing and prioritising FRM options

A balanced FRM plan addresses existing, future and continuing risk to reduce residual risk to a level more acceptable to the community, and in doing so generally involves assessing and prioritising a range of FRM measures. These measures may include FRM measures (such as levees, detention basins, flood warning systems and voluntary purchase or house raising), changes to EM and land-use planning direction, arrangements and advice, and improved availability of flood information.

FRM guideline MM01 provides advice on these measures and their identification, assessment and prioritisation, and on the information required to support efficient funding application under the program.

5.2.10 Material to support ongoing community education and awareness

Information developed during a study (report, spatial information and community consultation materials) can provide the basis for material to support future community flood awareness programs.

Community engagement at a local level is often undertaken by council collaboratively with the NSW SES to provide advice on the flood threat to the community, how this is being managed and how to respond to this threat.

Local flood plans developed by the NSW SES in consultation with council are particularly useful to assist in the development of specific community engagement material. These plans describe flood threat (often based on a combination of information from historic floods and from studies under the FRM process) and key triggers for community action during flooding.

A key element of community awareness is providing advice on flood warnings for the area, their uncertainty and limitations, and how the community should respond. This can help gain community acceptance and understanding of the flood problem and the actions they need to take, often with very limited time to respond to a flood and knowing that access to information may be limited during an event.

5.2.11 Reporting and data handover

All information and deliverables associated with studies funded under the program should also be handed over to council and uploaded to the NSW Flood Data Portal. FRM tool BT01 assists councils with specifying projects and associated reporting, deliverables (including format) and data handover requirements.

Reports provide a key opportunity to communicate the findings of the study to a range of stakeholders. They should outline the work undertaken in the study, the methodology used, the data collected and the findings. They are often developed through various stages of the project.

Draft reports (including interim reports) provide an opportunity for the TWG and FRM committee to review methodology, the report's fitness for purpose (including for consultation) and provide feedback. They can also be used to inform targeted consultation or any subsequent recommendations.

Consultation on the development and findings of studies through the FRM process facilitates the gathering and sharing of information on flood risk between council and the community. It is also a communication tool that can be used to gain feedback on the findings and recommendations of the project.

The structure of reports can vary, however, all reports should include a summary of findings of the project written in plain English, targeted for the community as a non-technical audience. For flood studies and FRM studies and plans under the program, the report should include separate sections suited to the type and scope of the study being undertaken and identified in the project brief. A summary of the typical information to be included in reports and the various stages of development of the information is identified in Table 3.

Table 3 Reporting in flood studies and flood risk management studies and plans

Report section	Information	Flood study	FRM study	FRM plan
Preliminaries	Quality assurance and version control Intellectual property statement as per the requirements of the brief	A	A	A
Summary	Outline the purpose of the study as well as its methodology, results and conclusions in plain English	A	A	
	Recommended FRM options for consideration in the FRM plan		P	
	Summary of FRM options and prioritisation including detail in Table 4			P
Introduction	Outline the purpose of the study, the intended end users and the client	A	A	A
Background	Study area – description of the study area, its catchment(s) and the history of flooding in the area Previous studies – a summary of the previous studies completed in the area and their relevance to the current study Discussion of relevant policies, legislation and guidance Flood behaviour – written description of design and historical flood behaviour for a range of events for locations across the study area	A	A	
Available data	Provided and collected – description of all data collected (data and survey) and used for the study and their limitations and final ownership. This includes: • historic data – including summary of historic events and available data • guidelines used • data collection • information from site visit • topographic and aerial survey and imagery • digital elevation model (DEM) development • survey for flood damage assessment	A	A	
Community consultation	Methodology Materials developed Discussion on inclusive consultation undertaken and results for different stages	A	A	A

Report section	Information	Flood study	FRM study	FRM plan
Hydrological analysis	Description of the hydrologic analyses, including any review of existing models and studies, and calibration and validation, and assumed catchment conditions, including: • hydrologic controls in catchment and changes over time • model review to assess fitness for purpose. This includes a model description, and review of model set-up, parameter selection and assumed catchment conditions, leading to any recommended modification or alternative approaches • for new or altered models: model selection, model set-up, model parameter selection • model results – reporting and presentation of results for all design runs including design flood hydrographs at gauges and key locations • compare at-site data to current Bureau of Meteorology intensity–frequency–duration (IFD) data	P	S	
Hydraulic analysis	Description of the hydraulic analyses, including any review of existing models and studies: • identification of hydraulic controls in the floodplain and any key changes over time • model review model review to assess fitness for purpose. This includes a model description, and review of model set-up, parameter selection and assumed catchment conditions, leading to any recommended modification or alternative approaches • for new or altered models: model selection, model set-up, model parameter selection	P	S	
Model calibration and validation	Description of model calibration and validation – presentation of results showing model fit to calibration and validation flood events, if applicable Model parameter selection and assumed catchment conditions Model results – reporting and presentation of results for all design runs including design flood hydrographs at gauges and key locations	M	M	
Model sensitivity	Description of the results of sensitivity analysis and model checks	M	M	
Overall model results	Description of likely model accuracy and limitations such as domain extent compared with suitable study area for result use	M	M	
Consequences of flooding on the community	Identification of existing flood problem areas Flood impacts – a preliminary assessment of flood impacts and risk in the study area Written description (aided by figures if needed) to describe flood levels at which roads are cut and other relevant information Flood damages – assessment and reporting considering advice in FRM guideline MM01	A	A	

Report section	Information	Flood study	FRM study	FRM plan
	Levee failure and overtopping Dam break assessment Impacts of climate change			
Post processing of results	Reporting on and providing the following post-processed model outputs: • flood extents • flood function • flood hazard • FERCCs	A	A	A
Information to inform decisions on activities in the floodplain and managing flood risk	Emergency management requirements (see FRM guideline EM01) Land-use planning (see FRM guideline FB01) Future scenarios (see FRM guideline FB01) Impacts of works on the floodplain	A	A	A
FRM option assessment	Identification and preliminary assessment of options		P	

	Detailed option assessments in separate appendices for:
	• FRM measures including:
	  ○ future steps, and key issues and considerations for implementation
	  ○ specific information on the benefits and limitations of FRM measures
	• EM measures, including related outputs (outlined in FRM guideline EM01), that discusses:
	  ○ the information provided, the basis for development and how it is being delivered
	  ○ key changes to EM with implementation of FRM measures
	  ○ key changes to EM between current and relevant future scenarios
	  ○ advice on the limitations of the local flood plan and the information on which it is based, and any recommendations for update or change
	• land-use planning measures – flood information to support strategic land-use planning that discusses:
	  ○ the information provided, the basis for development and how it is being delivered
	  ○ information for both the current and relevant future scenarios and how this may impact on considering flooding in land-use planning
	  ○ any advice on limitations of council's current land-use planning instruments, policies or practices and any recommendations for change
			P	

Report section	Information	Flood study	FRM study	FRM plan
Peer review	Where required in an appendix	M	M	
Conclusions		A	A	A
Recommendations	For measures including FRM measures such as levees, detention basins or warning systems, these should identify: • budgetary implications for capital expenditure and ongoing monitoring, operation and maintenance • required support, cooperation or leadership from other agencies or councils. Reporting should identify where the relevant agency or council supports implementation • any requirement for external financial support from competitive programs for implementation. The eligibility for funding of the proposed measures under current programs needs to be identified so this can inform decision-making		A	A
	Summary information on each recommended measure including whether: • information is identified in Table 4 • further feasibility or investigation and design is required		A	A
Figures		A	A	A
Acknowledgements		A	A	A
References		A	A	A
Appendices		A	A	A
Data handover	The report is to summarise the intellectual property of all study material (including outputs, models and input data), in consideration of the requirements of the project specification. It is also to document the information handed over as part of the study, including all relevant model files and versions used in the study as outlined in Table 5	A	A	A

Note:

P = primary state; S = secondary stage; A = across multiple stages; M = may occur across multiple stages.

Table 4 Key information to be provided on recommendations in the flood risk management plan

Information	
Overall summary information	
Number of dwellings affected by flooding	Number of dwellings affected above floor level for a range of design events
Percentage of dwellings affected by flooding	Provides an indication of the scale of the problem from a local perspective – expressed as a percentage of dwellings in study area affected by over floor flooding
Occurrence of over floor flooding	Identifies the frequency/regularity of damaging flooding and therefore impact on the community Number of times over floor flooding has been experienced by a significant number of dwellings (considering significant as 25% or more of number of dwellings affected by problem, see above)
Evacuation requirements	Indicates the degree of evacuation problems to which the community is exposed Identify evacuation characteristics, e.g. any issues with getting to evacuation location, time available for evacuation, time for damage reduction, evacuation assistance required (e.g. evacuation route cut early but arrangements in place to facilitate evacuation)
Community involvement	The degree of consultation in project development Most relevant of: • developed by a committee in accordance with the manual • developed with a project steering committee with community membership • input from one or more than one community meeting during the project • no public consultation or input • public comment invited on environmental impact statement or project development application
Information to be provided for each project	
Priority	Identifies the priority order of implementation of each measure
Part of a scheme	Identifies whether the measure is part of a broader scheme
Project cost	Total cost of project or project stage where itemised
Cost–benefit ratio	Identifies the economic efficiency of the project in reducing flood damages Cost–benefit ratio for the project and scheme where relevant
Environmental consideration and enhancement	Considers how the project has dealt with environmental impacts and addressed ecologically sustainable development (ESD) principles and whether it includes environmental enhancement. Highest level of compatibility, for example:

Information	
	• alternative options investigated, environmental consideration • structural solution only • compatible with ESD • incorporates environmental enhancement
Responsibility	Who is responsible for implementation of the project?

Key deliverables

FRM process reports need to be accompanied by a series of spatial and aspatial information on a range of key aspects that support FRM and consideration of flood risk in broader decisions. This information needs to be derived in consideration of the relevant guidance and be available in the required formats and under intellectual property conditions in accordance with the project brief that makes the information accessible.

Once the project is complete, the report and associated data and recommendations should be considered by council and incorporated into the full range of LGA-wide activities (see Sections 2 to 4).

Table 5 Key deliverables for studies under the flood risk management process

Deliverable	Specifics Note: Detailed requirements to be specified in the brief	Notes
Document transmittal checklist	Completed and signed	
Data schedule	A completed electronic list of all data handover and its formats	See Flood Project Handover Template
NSW Flood Database template (completed)		
Data	Study area – spatial layer	Spatial layer of the study area
	Survey data	Raw and processed. Spatial layer of locations
	LiDAR	
	Aerial imagery	Catalogue of imagery
	DEM	
	Flood data	Collected historical information, gauge/rain
	Survey for flood damages assessment	Spatial and/or .csv excel file. Floor, ground levels are to be tabulated with the properties' property number or address, coordinates
	Hydrologic controls	Survey or description
	Hydraulic controls	Survey or description

Deliverable	Specifics Note: Detailed requirements to be specified in the brief	Notes
Hydrologic modelling	Advice on model version used	Include name and version
	Model set-up files	Description and components
	Model input files	All runs or scenarios
	Model output files	
Hydraulic modelling	Advice on model version used	Include name and version
	Model DEM	Consistent with model results
	Model set-up files	Description and components
	Model input files	All runs or scenarios
	Model output files	Native format, ASCII, viewer (e.g. QGIS/waterRIDE)
Flood damages model and assessment	Advice on model version used	Include tool name and version
	Model set-up files	
	Model input files	All runs or scenarios
	Model output files	
Cost–benefit assessment for options	Cost estimates	Spreadsheets
	Average annual damages calculations	
	Net present value calculations	
	Cost–benefit analysis	
Management options assessment	Multi-criteria assessment	
	Environmental assessment	
	Concept design drawings/specifications for recommended works	
Reports	Monthly progress reports	
	Survey brief, where required	
	Calibration and validation report	
	Progress reports	
	Internal peer review report	
	Draft report	
	Final report	
	Figures	
Processed model results Study area-wide	Post processing software	Any software developed or acquired to interface or transfer data between models or to pre/post process including version
	Calibration and validation of model results	To be provided at the calibration milestone and final data handover

Deliverable	Specifics Note: Detailed requirements to be specified in the brief	Notes
	Maximum water level, water depth, velocity	Spatial outputs (e.g. ArcGIS (shapefile) or MapInfo (MID/MIF, etc.) (grid) and figures) including calibration and design
	Flood extents	Spatial layers
	Impacts on flooding of future conditions	
	Flood planning area/levels	
	Flood function maps	
	Assessment of change in flood behaviour or levels as a result of mitigation works	
	FERCCs maps	
	Flood hazard maps	
	Flood impacts – flood damages	
	Assessment of cumulative impacts of changes in the floodplain due to development, filling or infrastructure crossing the floodplain, on flood behaviour	
	Assessment of worst-case flood outcomes due to levee failure	
	Assessment of worst-case flood outcomes due to dam break	
	Mapping to support land-use planning activities	
Model results specific locations	Level, depth, flow velocity, rate of rise, inundation time locations	Graphs (figures) and tables
	Flood profiles/flood depths	Graphs (figures) and tables
	Levels/AEP at which critical access roads/critical infrastructure are affected	Tables and figures
	Levels/AEP at which properties are affected	
	Timing of structures overtopped, including levees and bridges	
	Gauge information (related timing)	
	Gauge height/elevations at which structures are overtopped	
	Link between gauge height and areas inundated	
	Inundation timing of properties/access roads	

Deliverable	Specifics Note: Detailed requirements to be specified in the brief	Notes
Visualisation/ animations	Calibration/validation events for key locations and/or whole study area	Viewer to be provided at the calibration milestone and final data handover
	Design flood events for key locations and/or whole study area	Viewer to be provided with the draft final report for review
	Calibration/validation/design events (key location/whole study area) with management measures	
	Video animation of flood progression	Provide video (e.g. AVI/MP4) for fast responding PMF event

5.2.12 Adoption of studies and plans

It is essential a study or plan developed under the program is adopted by council to:

- support the availability of the related information to the community and other areas of government so it can be considered in decision-making
- alert the community to council's commitment to FRM in the study area and to implementing the recommendations of the associated report
- lead to the inclusion and consideration of information in council's broader priorities and responsibilities for FRM
- lead to the implementation of recommendations. This may involve inclusion of recommendations that cannot be readily implemented into council's forward FRM priorities and its IP&R framework
- support funding applications for implementing FRM measures through the program or other relevant funding programs.

Councils should consider the best available information in decisions. Councils not adopting studies or a plan and not using this information or making it available to others to inform decision-making should consider any resulting legal liabilities.

5.2.13 Review of FRM studies and plans

Management plans are living documents and require continual monitoring, review and update to maintain their currency. The manual provides advice on when reviews may be triggered, scoping of reviews, and implementing any changes resulting from reviews.

5.3 Incorporating completed studies and plans into local government area-wide activities

Councils should ensure the information and outcomes from studies and plans are incorporated into, or considered in, all relevant activities to manage flood risk to the community under the FRM framework, as outlined in the manual and guidelines.

Council should share its available flood information with the NSW Government through the NSW Flood Data Portal so it is available to inform relevant government decisions.

6. Implementation of flood risk management measures identified in flood risk management plans

Flood risk management plans are generally developed under the oversight of an FRM committee.

Rather than covering an entire LGA, they are generally developed for an individual location or floodplain within the LGA or one that spans the border with neighbouring LGAs in the same catchment.

Implementation of plans is generally overseen by council, which can use its governance arrangements under the FRM framework as discussed in Section 2.1 to meets its FRM responsibilities.

Implementation of FRM measures should be undertaken on a prioritised basis that considers a range of factors: the measures' effectiveness, the ability to readily implement them with available resources, and the need for external support (including funding) for implementation.

Where implementation requires substantial investment, decisions to allocate resourcing need to consider priorities in the FRM plan as well as other FRM priorities in the LGA.

6.1 Steps in implementation of flood risk management measures

The steps involved in implementation depend on the project type, who is responsible for implementation, and the support that may be required. Where implementation relies on external responsibilities or technical and financial support this should be identified in the FRM plan and in forward planning.

Implementation steps and stages also vary with the type of project and the detail required to undertake a project to ensure it can be implemented and achieve its FRM goal. Some typical implementation steps and considerations are shown in Figure 2.

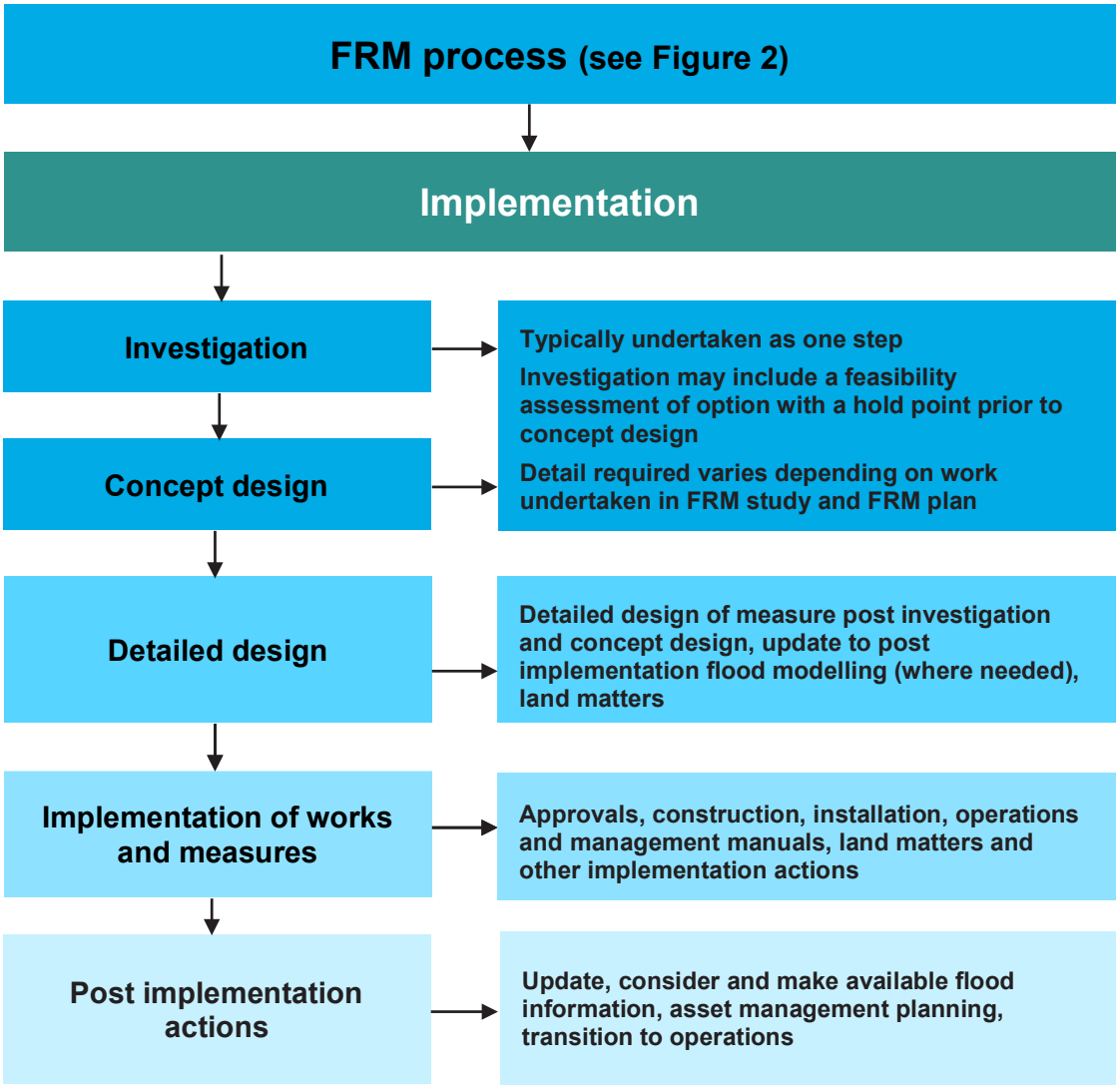

Figure 2 **Typical implementation steps and considerations for flood risk management measures**

The implementation phases need to be fit for purpose to ensure adequate consideration is given to the benefits and potential impacts of each of the types of measures. Each measure will also have a unique set of considerations that influence the likely steps in its implementation.

Details on typical FRM measures and their considerations are provided in FRM guideline MM01. Examples of the typical implementation steps based on different types of measures are identified in Table 6.

Section 6.2 and Table 7 outline ongoing effort after implementation.

Table 6 **Typical flood risk management measures and considerations for implementation**

Typical FRM measures	Key implementation considerations
Flood information	Council is responsible for maintaining flood information and making it available to inform government and community decisions. It should make any new flood information readily available and update relevant consolidated information datasets. Where new information becomes available or new FRM measures (that alter flood behaviour or how the community responds to a flood) are operational, flood information should be updated to reflect this change. This should be accompanied by advice to relevant state agencies and possibly to the community, particularly where it alters the way they respond to a flood threat.
Land-use planning	Council is responsible for local land-use planning and can amend its LSPSs, LEPs or DCPs or supporting information to address recommendations of the FRM plan. Where this change affects property development, related advice to the community that is included with planning certificates under s 10.7 of the Environmental Planning and Assessment Act, should be updated.
Flood EM planning	This is led by the NSW Government. The council should make flood information from flood and FRM studies and plans available through the NSW Flood Data Portal to support the update of local flood plans and inform disaster recovery.
Flood awareness	Councils are jointly responsible for flood awareness in the community with the NSW SES which is responsible for activities to make the community aware of how to respond to a flood threat. They may work together to maintain community flood awareness. Flood awareness activities should be part of all flood and FRM studies and any major mitigation measure that affects flood warnings for the community, significantly alters flood behaviour, or how the community needs to respond to the flood threat.

FRM works projects	FRM studies provide a pre-feasibility assessment of FRM options. In the implementation phase projects generally go through a range of stages prior to construction, and council may seek funding for these stages. Typical stages for different types of projects are:
	• levees and detention basins – feasibility, investigation and design (including approvals operations and maintenance plans, and acquisition of easements or land and review of post-implementation flood modelling), and construction. As these works generally result in changes in flood behaviour and impacts, completion of the works and transition to operations generally leads to:
	  ○ update of flood information and advice of changes to state agencies and the community
	  ○ a review of the local flood planning
	  ○ development of any operations and asset management plans
	  ○ incorporation of assets into planning under the IP&R framework
	• flood warning systems – scoping and investigation including acquiring access, installation. Completion and transition to operations should generally incorporate:
	  ○ a review of flood EM planning
	  ○ advice to the community on any changes in warnings or responding to a flood threat
	  ○ development of any operations and asset management plans and associated maintenance agreements for gauge management
	  ○ incorporation into planning under the IP&R framework.

Typical FRM measures	Key implementation considerations

Voluntary purchase and house raising projects	These projects would generally go through the following implementation steps:
	• confirming the scope of the project, prioritisation between individual properties, and developing an implementation plan. Some key elements for implementation, beyond funding are:
	  ○ voluntary purchase – communication, property valuation, negotiation, purchase, demolition and waste disposal (including consideration of hazardous materials), clearing of the land, and rezoning to open space or another appropriate use compatible with the flood risk or transition to operational land, as agreed with DPE Environment and Heritage Group
	  ○ voluntary house raising – communication, negotiation, support for development application processes and engagement of building contractors, ongoing community flood awareness to identify the need to continue to evacuate in accordance with local flood plans, inclusion and implementation of development control measures to prevent habitable occupation of below raised floor level areas.

6.2 Ongoing effort after implementation

All FRM measures need ongoing resourcing for their update and/or operation and maintenance as outlined in FRM guideline MM01. These efforts vary based on the type of measure. Examples of measures and their typical ongoing effort are provided in Table 7. More detail on specific types of FRM measures is provided in FRM guideline MM01.

Table 7 Ongoing effort for measures after implementation

Measure	Considerations	Who
Flood information	Flood information needs to be kept up-to-date and available. Feedback on the available flood information should be considered in improving the scope, availability and form of this information.	Councils/ NSW Government
	On provision of new information by councils through the NSW Flood Data Portal the NSW Government should update its databases and consider changed information in decisions. This includes considering the need to update local flood plans and intelligence. This may lead to the update of associated advice to the community on responding to a flood threat.	NSW Government
Land-use planning	Monitor the implementation of LSPSs, LEPs and DCPs and seek to improve their effectiveness in managing flood risk through land-use planning and development assessment processes. Councils may maintain a register to document assessment decisions that do not conform to existing DCP requirements and assessment criteria. This may then be used to review these requirements and criteria in upcoming management plan reviews.	Councils
Flood awareness through community engagement	Undertake regular activities to improve community flood awareness. This is encouraged to be undertaken in partnership with the NSW SES. Consideration should be given to monitoring the effectiveness of activities and considering feedback in future activities.	Councils/ NSW Government

Measure	Considerations	Who
Flood mitigation works projects, such as levees, detention basins and flood warning systems	These require ongoing effort, for example: • levees and detention basins – to maintain their desired level of service these may need to be operated and monitored during a flood and their condition maintained, monitored and reported (see Section 3.3). Reporting key changes in condition through the NSW Flood Data Portal enables them to be considered in local flood plans and advice on community response to floods • flood warning systems – operation, asset management including maintenance, calibration, condition monitoring, upgrading and reporting.	Councils with assistance from NSW Government
Property modification measures	These require ongoing effort, for example: • voluntary purchase requires management of land to ensure it is not used for purposes incompatible with the flood function or hazard • voluntary house raising requires monitoring to ensure the benefits of raising are not lost due to sub-floor infill and habitation.	Councils

7. References

DPE (Department of Planning and Environment, NSW) (2023) 'Flood risk management manual: the policy and manual for the management of flood liable land' DPE, Parramatta.

More information

Flood risk management manual, guidelines and tools

See links on the following Department of Planning and Environment (DPE) webpages:

- Flood risk management manual
- Flood risk management guidelines
- 'Administration arrangements: flood risk management guideline AG01'

Other links

- Floodplain Management Program
- NSW Flood Data Portal

Appendix A Sample council flood risk management status template

This appendix provides a sample council may wish to use to document their FRM governance arrangements, FRM roles and responsibilities, and FRM status. Guidance notes are provided in text boxes.

A1. Introduction

The primary objective of the *NSW Flood prone land policy* (the policy) is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

The policy states that flood risk management (FRM) is primarily the responsibility of councils within their local government area (LGA). Councils undertake this role with support from the NSW Government.

The NSW Government recommended that councils use the FRM process and fulfil responsibilities outlined in the *Flood risk management manual (DPE 2023)*, the manual for flood liable land gazetted under section 733 of the *Local Government Act 1993* (the manual) to fulfil their FRM responsibilities under the policy and the manual. Delivery under the FRM framework involves a combination of FRM activities including the development and implementation of FRM plans consistent with the FRM process and the consideration of flood risk in broader decision-making outlined in the manual).

A2. Governance and coordination of flood risk management

The first step in effective management of flood risk across the LGA under the FRM framework is to ensure governance arrangements are in place, providing effective linkages within council and to relevant state agencies and the community. It is recommended these arrangements be documented so they are clear to all.

Good governance arrangements support effective FRM in the LGA, which includes consideration of flooding in decisions, in accordance with the manual. It is recommended a schematic diagram (Figure 3 is an example) and a table (Table 8 is an example) be developed to identify how flood risk is managed in the LGA, the internal linkages within the council that support FRM, and how council links to state agencies and the community.

Council's FRM governance arrangements are shown in Figure 3. This framework reflects that council shares <catchment name> catchment with <council name> Council, and highlights how council will collaborate internally and externally on FRM relevant activities in the catchment that may influence the flood risk to communities.

Table 8 shows how council delivers on its FRM responsibilities.

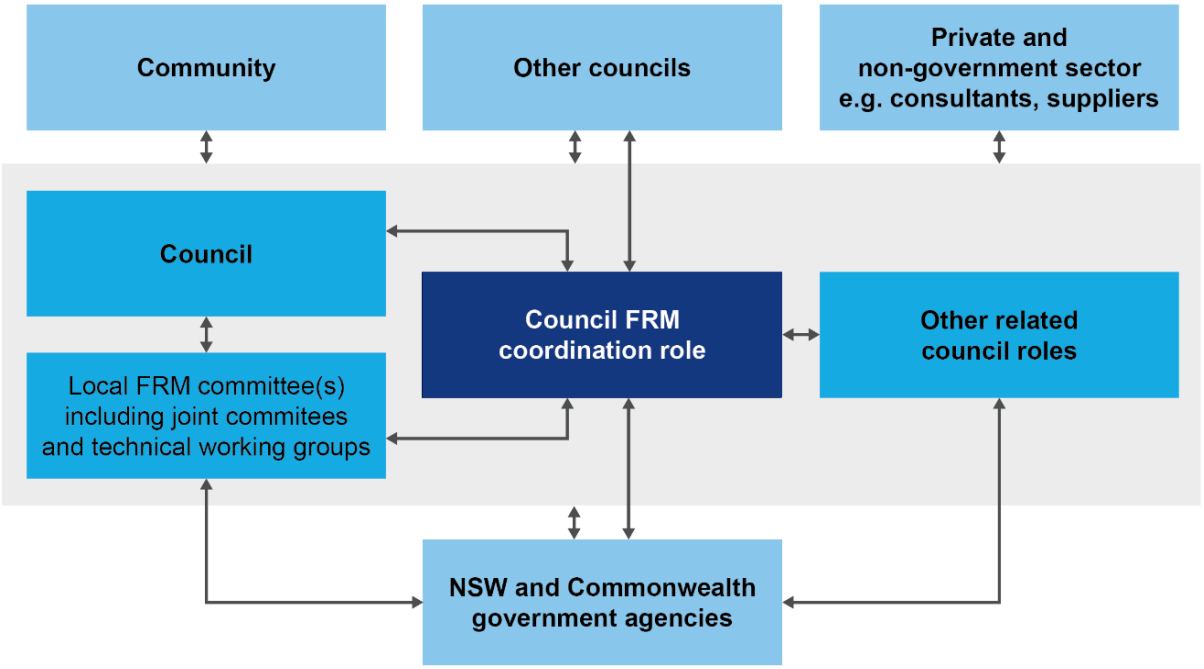

Figure 3 **Local flood risk management governance arrangements (example only)**

Table 8 **Flood risk management roles and responsibilities (examples only)**

Entity	Responsibility	Council reference
Council or delegated committee of council	Support FRM, including plan development, adoption and implementation, and approving budgets and forward plans Encourage consideration of flooding in council decisions, including development and infrastructure decisions Support access to flood information by state agencies, key stakeholders and the community Support flood EM through the local EM committee	Identify council or delegated committee
Council FRM coordination	Develop, monitor, and maintain FRM status and forward plans Coordinate implementation of FRM activities Manage development of studies under the FRM process Report to council on FRM matters Facilitate incorporation of FRM projects into the integrated planning and reporting (IP&R) framework Provide FRM advice Support FRM committees Inform the community and agencies of implementation of FRM works and update flood information Liaise with relevant state agencies on FRM	Identify department/ section/ positions of council responsible for coordinating FRM

Entity	Responsibility	Council reference
	Upload reports and data to the NSW Flood Data Portal Consult with responsible staff at key points of given tasks, e.g. other council roles and committees, FRM committee Review flood impact and risk assessments Identify committees and the area they cover	
FRM committees	Identify TWGs and the area they cover Manage area-specific studies through the FRM process Report to council on key decisions in area-specific FRM studies	Identify local and multi-council FRM committee(s)
Other relevant sections of council with a role in FRM or in considering flooding in decisions		
Design	Consider FRM in design of infrastructure projects Project manage design of FRM works	Identify department/ section/ positions responsible
Construction of FRM works	Project manage construction of FRM works	Identify department/ section/positions responsible
Asset operation and management of FRM works	Operate and maintain FRM assets Inspect FRM assets and any associated reporting	Identify department/ section/positions responsible
Information management	Manage and maintain FRM information Manage accessibility to FRM information within councils and to the community, NSW Government, key stakeholders Provide data broker for flood data requests including those to council through the NSW Flood Data Portal	Identify department/ section/positions responsible
Land-use planning	Ensure FRM is effectively considered in developing and implementing LSPSs, LEPs and DCPs and they consider the best available information Ensure flood impact and risk assessments (FIRAs) to support planning proposals and development effectively consider FRM Ensure FIRA and associated information is available within council so it can be considered in decisions	Identify department/ section/positions responsible
Emergency management	Provide information to support emergency management (EM) Support the development of the local flood plan	Identify department/ section/ positions responsible
Community consultation	Support community consultation on FRM Support community flood awareness initiatives	Identify department/ section/positions responsible

Entity	Responsibility	Council reference
State agencies		
DPE Environment and Heritage Group	Provide council with technical/financial assistance for FRM Membership of the local FRM committee Membership of the TWG	Identify relevant state agency region and contacts
DPE Water	Licence flood control works in designated floodplains in the Murray–Darling Basin Membership of the local FRM committee in some areas of the Murray–Darling Basin	Identify relevant state agency region and contacts
NSW SES	Develop the local flood plan Provide ERM advice Membership of the local FRM committee Membership of the technical subcommittee	Identify relevant state agency region and contacts

A3. Flood risk management status and forward planning

The tables (examples only) in this section outline the current status of FRM activities in a council and indicate areas where activities are planned:

- Table 9 identifies how flood risk is managed in the LGA, the internal linkages within the council that support FRM, and how it links to state agencies and the community
- Table 10 identifies the current FRM status in the LGA
- Table 11 identifies planned future FRM activities
- Table 12 identifies future activities related to implemented FRM measures.

Relevant FRM activities are included in the community strategic plan under the IP&R framework, which is available on the council website.

Table 9 Flood risk management status as at <date> (typical topics and examples)

Activity	Responsibility	Description	Status (examples only)	Current and planned activities (examples)
FRM governance	FRM coordination	Outline governance arrangements to ensure FRM is implemented consistent with the manual	Current governance arrangements outlined in Table 8 and Figure 3	Review governance arrangements and update Table 8 and Figure 3 as needed
FRM knowledge across LGA	FRM coordination	**A consolidated up-to-date LGA-level knowledge of existing flood behaviour is developed**		
		Catalogue of available reports and information	Current information is summarised in <name> and available at <link>	Catalogue updated as studies complete
		Flood mapping	Mapping needs updating for recently completed studies <name> and <name>	Mapping to be updated by <date>
		Outline of current status of FRM at each town/urban area in the LGA	Current FRM status identified in Table 10 (including gaps in FRM implementation)	Status of FRM being reviewed and Table 10 updated
		Gaps in flood information and studies understood and being managed. Future priorities set	Gap analysis undertaken and gaps understood Prioritised plan for future studies and plans (Table 11)	Table 4 updated and FRM strategic plan being developed as part of IP&R framework
		LGA FRM mitigation works status and forward plan	Status of FRM mitigation works understood and forward plan developed to address gaps and maintain, operate and monitor works (Table 12)	Table 5 updated and FRM strategic plan being developed as part of IP&R framework
		LGA-level community flood summary and other resources support community flood awareness activities	LGA-level community summary not developed	Consideration being given to preparing LGA community flood summary by <date>. Examine potential funding options

Activity	Responsibility	Description	Status (examples only)	Current and planned activities (examples)
		Post-event flood data collection	All completed data collection projects included in study catalogue and available to inform decisions	
Availability of FRM information	FRM coordination + information management	**Information is readily available to inform decision-making, availability is understood and contacts for clarifications are clear**		
		Council staff	Intranet site or internal database has mapping that is updated with new studies. Staff are aware of current gaps and know where to get interim information and advice	Maintain up-to-date flood information, reports and mapping as new information becomes available
		State agencies	Study reports, levee inspections and relevant data made available to NSW Government through the Flood Data Portal	Future reports, relevant data and mapping to be uploaded to the Flood Data Portal on completion
		Key stakeholders	Decisions on requests for non-public data made on a request basis	Reports and relevant data uploaded to the Flood Data Portal and current study reports to be made publicly available
		Community	Council flood mapping and current reports available on council's website	Flood mapping and reports being made publicly available through internet site
	FRM coordination	Studies to understand flood behaviour and risk and address knowledge and management gaps	Status of the progress of current studies understood	Program for completion of study
Monitoring FRM implementation	FRM coordination	**Implementation of actions**		
	+ works department	FRM activities to address risk to the existing	Status of current mitigation works implementation understood	Contract being let for flood warning system maintenance

Activity	Responsibility	Description	Status (examples only)	Current and planned activities (examples)
		community from adopted FRM plans	Visual levee inspection in June identified some minor defects	Minor works to address issues included in maintenance schedule
	+ land-use planning department	FRM activities to address risk to future community from adopted FRM plans	LSPS developed that considers flood risk	Update of DCP planned Update of section 10.7 planning certificate notifications based on new studies planned
	+ NSW Government	FRM activities to address residual risk to the community from adopted FRM plans	Low points on evacuations routes surveyed Support update of local flood plan	Provide low point information to NSW Government Work with NSW Government to update local flood plan considering new studies
	+ community consultation, + NSW Govt	Community awareness	Brochures to be updated and for key catchments considering new information Support update of FloodSafe guides	Develop information to assist community in understanding flood risk and make available Provide information to NSW Government to update FloodSafe guides consistent with local flood plan
Community education and awareness	FRM coordination, community consultation, + NSW Government	Ongoing activities to support community flood awareness	Community engagement activities undertaken Flood information made available	Develop communication plan to advise community of changes
FRM forward planning	FRM coordination	**Forward planning of FRM activities**		
		Activities in plans FRM forward plan for studies and FRM actions	Developed (see Tables 10 and 11) and feeds into the IP&R framework	FRM forward plan to be included in the delivery program and operational plan for the IP&R framework
		Implemented works Asset management plan	Table 12 developed and included in asset management planning in the IP&R framework	

Table 10 **Local government area flood risk management status as at <date> – per township or urban area (example only)**

Location	Report	FRM implementation status					
		Date	Actions	Study priority	Status, comments	Total cost $000s	In FRM forward plan
Town A	Historic flood	1955	Information		Available		NA
	Flood study	2015			Complete	90	NA
	FRM study	2018			Complete	150	NA
	FRM plan	2018			Complete	25	NA
			Report and data on Flood Data Portal		Complete		NA
			Updated flood information on web	1	Completed		NA
			Update DCP and mapping	1	Completed		NA
			Flood warning system upgrade	2	Investigation complete, installation underway	30 150	Yes
			Local flood plan update by NSW Government	2	Planned with flood warning system upgrade	In kind	NA
			Levee upgrade	3	Investigation and design (I&D) planned for <date> Construction Update flood info	150 3,000	Yes
			Detention basin	4	I&D planned for <date> Construction Update flood info	100 1,500	Yes
Town B	Historic flood	1974	Information		Available		NA

Location	Report	FRM implementation status					
		Date	Actions	Study priority	Status, comments	Total cost $000s	In FRM forward plan
	Flood study			1	Not started – funding application proposed <date>	150	Yes
	FRM study and plan			2	Not started – awaiting flood study completion	225	No (future)
Village C	Historic flood	1974	Information		Available		NA
	Flood study	2018			Complete	90	NA
			Updated flood information available	1	Underway – completion due <date>		NA
			Local DCP and mapping up-to-date	1	Not started – awaiting mapping update – target <date>		NA
	FRM study				Not started – funding application proposed <date>	150	NA
	FRM plan	2018			Not started – funding application proposed <date>	30	NA

Table 11 **Local government area flood risk management actions forward plan as at <date> (example only)**

Location /source	FRM action	LGA priority	Responsibility	Budget estimate $000		Status	Comments
				Internal	External		
Town A FRM Plan 2018	Flood warning system upgrade	1	Council – FRM coordination			Investigation completed	Implementation underway
	Local flood plan update/ community awareness	2	NSW Government & council			Not started	Do with flood warning system activation
	Levee upgrade	3	Council – FRM coordination	1,050	2,100	Not started	Apply for I&D funding <date>
	Detention basin	4	Council – FRM coordination	30	60	Not started or programmed	Dependent on higher priority actions
Town B LGA FRM status	Flood study (FS)	2	Council – FRM coordination	50	100	Not started	Apply for funding <date>
	FRM study and plan	5	Council – FRM coordination	75	150	Not started	Await FS completion
Village C LGA FRM status	Updated flood information made available	1	Council – info management			Underway	To be on web by <date>
	Local DCP and mapping updated	1	Council – land-use planning			Non started	Awaiting mapping update. Target <date>
	FRM study and plan	2	Council – FRM coordination	60	120	Not started	Apply for funding <date>

Table 12 **Implemented flood risk management works – status and forward plan as at <date> (example only)**

Location	Implemented FRM works status and forward plan	Responsibility	Delivery by	Budget for external costs $000s	Implementation status	Actions/ comments
Town A	Annual maintenance	Council – FRM coordination	Gauge contractor	25	Programmed	Contract let
	System documentation	Council – FRM coordination			Completed	Available through Flood Data Portal
	Owner's manual	Council – FRM coordination			Completed	Available through Flood Data Portal
	Annual maintenance	Council – FRM works	Council		Scheduled	Works programmed
	External visual audit	NSW Government	NSW Government		Completed	<Date> available from Flood Data Portal
	Annual visual inspection	Council – FRM works	Council – FRM works		Completed	Minor deterioration – report on Flood Data Portal
	Asset management	Council – FRM works	Council – FRM works		Ongoing	Maintenance actions updated to address deterioration
	Exercise of levee operation	Council – FRM works	Council – FRM works		Programmed	To be completed