GUIDELINE 7-2

Technical Flood Risk Management Guideline: Flood emergency response classification of the floodplain

Australian Institute for Disaster Resilience

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The Australian Institute for Disaster Resilience
370 Albert St
East Melbourne Vic 3002
Telephone +61 (0) 3 9419 2388
www.aidr.org.au

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PREFACE

As outlined in Australian Emergency Management Handbook 7 (AEM Handbook 7), *Managing the floodplain: Best practice in flood risk management in Australia* (AEMI 2013), flooding is a natural phenomenon that occurs when water covers land that is usually dry. Floods can create hazardous conditions with exposure of the community to these conditions creating a risk.

This technical guideline is one of a number developed to support AEM Handbook 7. It was developed to provide a basis for understanding the variations in the type of emergency management issues that may be faced in different areas of the floodplain. Together with the technical guideline for flood hazard, this document replaces technical advice on flood hazard quantification provided in Appendix J of SCARM Report 73 (SCARM 2000).

ACKNOWLEDGEMENTS

Development of this guideline was overseen by the National Flood Risk Advisory Group (NFRAG), which is a reference group of the Australian – New Zealand Emergency Management Committee. NFRAG is chaired by Andrew Lea (State Emergency Service, Tasmania).

Duncan McLuckie (New South Wales Office of Environment and Heritage) led the project. Cardno Pty Ltd were commissioned to support development of the guideline.

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1 INTRODUCTION

Floods create hazardous conditions to which people are particularly vulnerable. If floodplains were unoccupied and unused, flooding would not create a risk to the community. It is the human interaction with the floodplain, and the associated exposure to flood hazard, that creates flood risk.

Flooding can isolate parts of the landscape and cut-off evacuation routes to flood-free land. This can restrict access to medical facilities and reduce the ability of emergency services to reach isolated areas (e.g. fire units to respond to a fire threat). Snakes, spiders and other dangerous animals may seek refuge from floodwaters in the isolated area. People may also perceive the need to cross floodwaters to access services, employment or family members. Many flood fatalities result from the interaction of people, often in vehicles, with floodwaters. Any situation that increases people's need to cross floodwaters increases the likelihood of an injury or fatality.

Australian Emergency Management Handbook 7 (AEM Handbook 7), *Managing the floodplain: Best practice in flood risk management in Australia* (AEMI 2013), identifies isolation by floodwaters as an important factor in emergency management planning. It recommends the classification of the floodplain based on flood emergency response categories to inform management decisions. Classification provides the basis for understanding the nature, seriousness and scale of isolation problems, so this can inform decision making by end users, as discussed in Section 1.3.

This technical guideline provides supplementary advice to support AEM Handbook 7. It outlines definitions and approaches to classify the floodplain based upon differences in isolation due to the potential for entrapment of an area by floodwaters, potentially in combination with impassable terrain. It also considers the potential ramifications for an isolated area based upon its potential to be completely submerged in the probable maximum flood (PMF) or a similar extreme flood.

The guideline supports decision making at a precinct or community scale, and for rivers and creeks where flow paths can readily be defined. It is not intended for application in local overland flooding at a smaller scale, or to individual structures.

Existing communities that are vulnerable to relatively frequent flooding may have mitigation strategies, such as a levee, in place or planned. A levee may reduce the frequency at which floods impact upon the community, but the risk of flooding to the community remains. The area behind the levee can also be subject to local ponding due to rain falling within the levee and the limitations on this water getting to the river. A levee would not generally alter the isolation and emergency response issues faced by the community and the emergency response classification would stay the same. However, any levee failure, whether by breach or overtopping, can result in rapid inundation of areas behind the levee, which may require changes to emergency management planning.

Some people in the community may have the (incorrect) perception that a levee has removed, rather than reduced, flood risk, and that it is always safe to remain behind the levee during flood events. This is not the case. Unless the evacuation route from the community is now less vulnerable to flooding, evacuation would need to be completed in the same timeframes it would if the levee did not exist. This can create challenges for emergency management planning and response.

1.1 How to use this guideline

This technical guideline is broken down into four sections:

- Section 1 outlines the guideline
  - Section 1.2 discusses the relationship to AEM Handbook 7 and other guidelines
  - Section 1.3 discusses the end uses that were considered during the development of this guideline
- Section 2 provides definitions and examples for different classification
- Section 3 discusses information to support assessment of isolation
- Section 4 provides a logic diagram on developing categories.

1.2 Relationship to other guidelines and policies

This guideline provides technical advice on the breakdown of the floodplain, depending on the type of emergency management situation faced by communities or precincts. It supports the general guidance in this area provided in AEM Handbook 7. This guideline, along with the technical flood risk management guideline on flood hazard (AEMI 2014), replaces technical advice on flood hazard quantification provided in Appendix J of SCARM Report 73 (SCARM 2000).

This guideline was developed to assist in classification during studies. However, it can also be used to support the retrofit of classifications to existing flood information. It should be read in conjunction with AEM Handbook 7 and other relevant guidance material. Many of the terms used in this guideline are defined in AEM Handbook 7.

This guideline does not provide policy guidance, which depends on the relevant flood risk management policies in place for different jurisdictions. It should not be used to supplant or circumnavigate such policies.

1.3 End uses considered when forming the guideline

AEM Handbook 7 highlights that understanding flood behaviour is essential for making informed decisions on managing flood risk. This includes comprehending the full range of potential flooding and the interaction of the flood with the landscape, which can isolate areas from flood-free land and result in difficult emergency management situations.

Effective flood risk management can enable a community to become as resilient as practicable to floods through informed prevention activities, and preparation for, response to and recovery from flooding. The completion of studies that improve our knowledge of flood risk can provide the basis for making informed management decisions. Understanding the variation in the emergency response classification of different areas of the floodplain can aid decision making in the following areas:

- Emergency management planning for floods. This guideline provides information for the development of flood emergency management plans by highlighting areas where, given all other issues are the same, evacuation would be more difficult or may need a different management approach.
- Flood risk management. The guideline provides information on the risk to people from isolation. This may be the primary driver for some mitigation measures, such as

improving the flood security or capacity of evacuation routes.

- Strategic and development scale land-use planning. Information on the difficulties of evacuating areas of the floodplain can be an important consideration in setting strategic land-use directions for a community, such as:
  - where not to develop due to impacts on flood risks to existing development or where development is not compatible with the flood hazards and associated risks
  - where development is compatible with the flood hazards and associated risk, what type of development is suited to particular areas. For example, certain developments, such as aged care homes, have residents that are more difficult to evacuate
  - the development conditions necessary to reduce the risks to existing and planned development created by introducing new development into the floodplain.
- Resilience and recovery. Understanding the vulnerability of services to flooding can assist with forward planning to improve the resilience of infrastructure to flood risk so it can increase community resilience.

2 FLOOD EMERGENCY RESPONSE CLASSIFICATIONS

AEM Handbook 7 recommends the classification of the floodplain, by precinct or community, based on flood emergency response categories. These categories consider the full range of flood behaviour and its impacts upon access to communities or precincts in a way that informs emergency response management.

Classification provides the basis for understanding the varying nature, seriousness and scale of isolation problems. Classification can be used with information on the full range of flood risk, local topography and evacuation routes, the rate of rise of floodwaters, the effective warning time and the duration of isolation, to inform a range of management decisions.

Classification is undertaken at three levels. Primarily classification concentrates on whether the area is flooded by the probable maximum flood, or a similar extreme event.

For those areas that are flooded:

- secondary classification examines whether or not a community or precinct area has an exit to community evacuation facilities in a flood-free area outside the broader floodplain during a flood event.
- tertiary classification relates to the potential consequences of flooding on the area and any limitations of available evacuation routes.

For areas that are not flooded, there is no secondary classification, and the tertiary classification relates to whether there are any indirect consequences on the area.

The overall classifications are defined and shown in Table 1, and shown diagrammatically in Figures 1 to 8. Figure 9 is a plan showing the location of some of these categories in an example floodplain. Figure 10 provided a flowchart for determining flood emergency response classifications.

Table 1 **Flood emergency response classifications**

Primary classification	Description	Secondary classification	Description	Tertiary classification	Description	Example figures
Flooded (F)	The area is flooded in the PMF	Isolated (I)	Areas that are isolated from community evacuation facilities (located on flood-free land) by floodwater and/or impassable terrain as waters rise during a flood event up to and including the PMF. These areas are likely to lose electricity, gas, water, sewerage and telecommunications during a flood.	Submerged (FIS)	Where all the land in the isolated area will be fully submerged in a PMF after becoming isolated.	Figure 1 Figure 7 with ring levee Figure 8 with impassable terrain
				Elevated (FIE)	Where there is a substantial amount of land in isolated areas elevated above the PMF.	Figure 2
		Exit Route (E)	Areas that are not isolated in the PMF and have an exit route to community evacuation facilities (located on flood-free land).	Overland Escape (FEO)	Evacuation from the area relies upon overland escape routes that rise out of the floodplain.	Figure 3
				Rising Road (FER)	Evacuation routes from the area follow roads that rise out of the floodplain.	Figure 4, Figure 6 with levee
Not Flooded (N)	The area is not flooded in the PMF			Indirect Consequence (NIC)	Areas that are not flooded but may lose electricity, gas, water, sewerage, telecommunications and transport links due to flooding.	Figure 5
				Flood Free	Areas that are not flood affected and are not affected by indirect consequences of flooding.	

Notes:

1. Classifications are based upon the probable maximum flood (PMF) or a similar extreme flood, if the PMF is not available. Where classifications are being retrofitted to areas covered by existing studies and the PMF or a similar extreme flood is not available, and a decision is made to not estimate or approximate an extreme event, classifications should be clearly indicated as 'Preliminary based upon the largest flood available'.
2. Isolated areas may also be known as:

- flood islands, where areas are isolated solely by flood waters. Where flood islands are completely submerged in the PMF, these may be called low-flood islands. Where flood islands have elevated areas above the PMF, they may be called high-flood islands.
- trapped perimeter areas, where areas are isolated by a combination of floodwaters and impassable terrain. Where trapped perimeter areas are completely submerged in the PMF, these may be called low-trapped perimeter areas. Where trapped perimeter areas have elevated areas above the PMF, they may be called high-trapped perimeter areas.

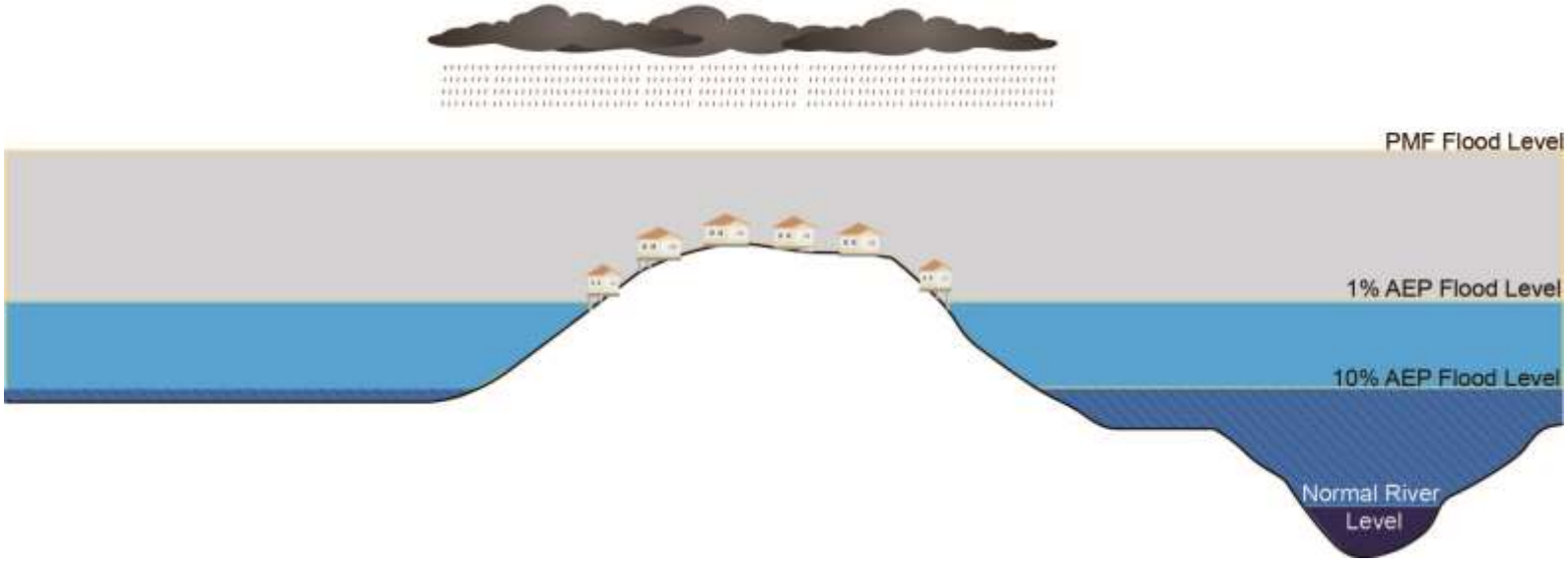

Figure 1 **Example of area that is flood affected, isolated by floodwaters and fully submerged in the PMF. Category FIS.**

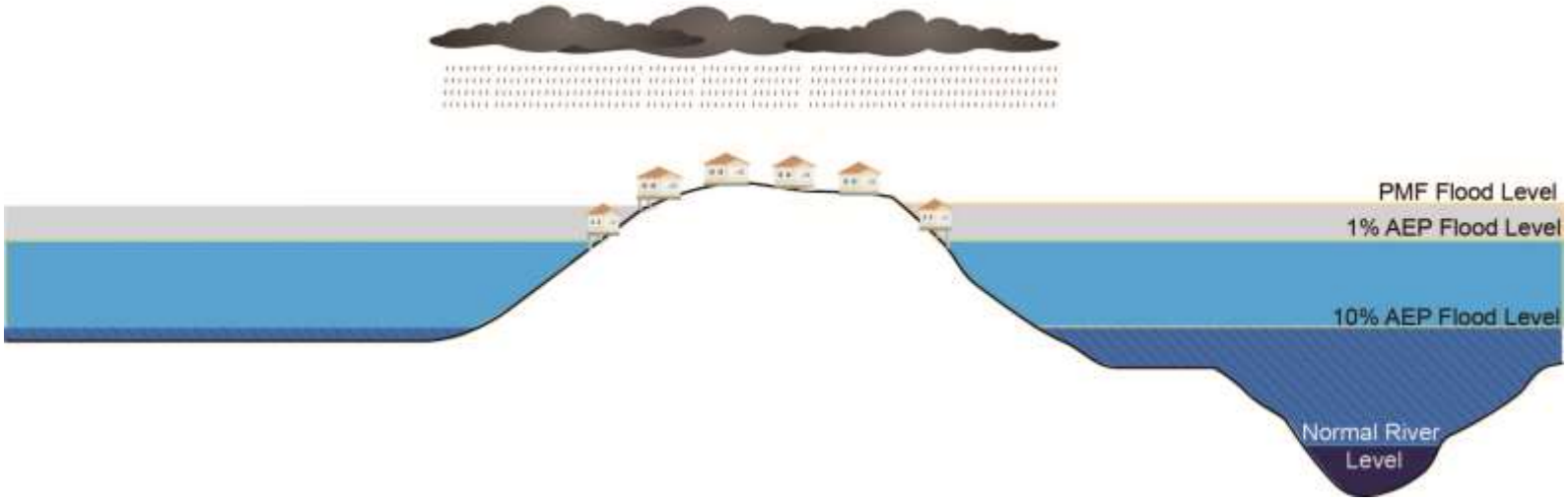

Figure 2 **Example of area that is flood affected, isolated by floodwaters, but has some elevated area above the PMF. Category FIE.**

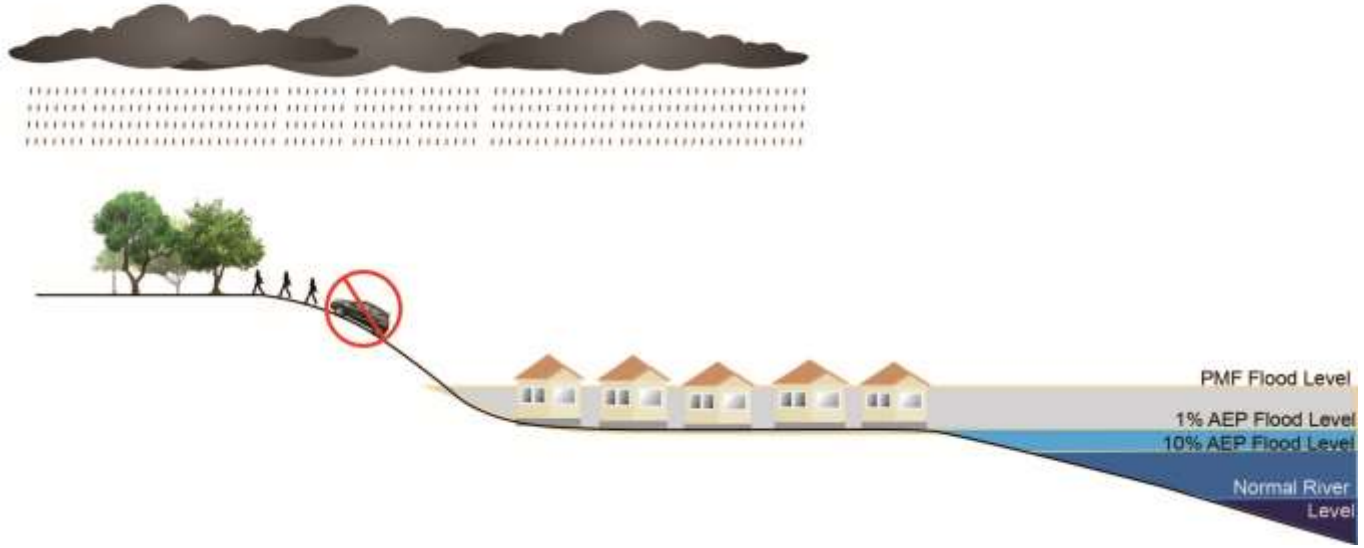

Figure 3 **Example of area that is flood affected and has an exit route that relies on overland escape. Category FEO.**

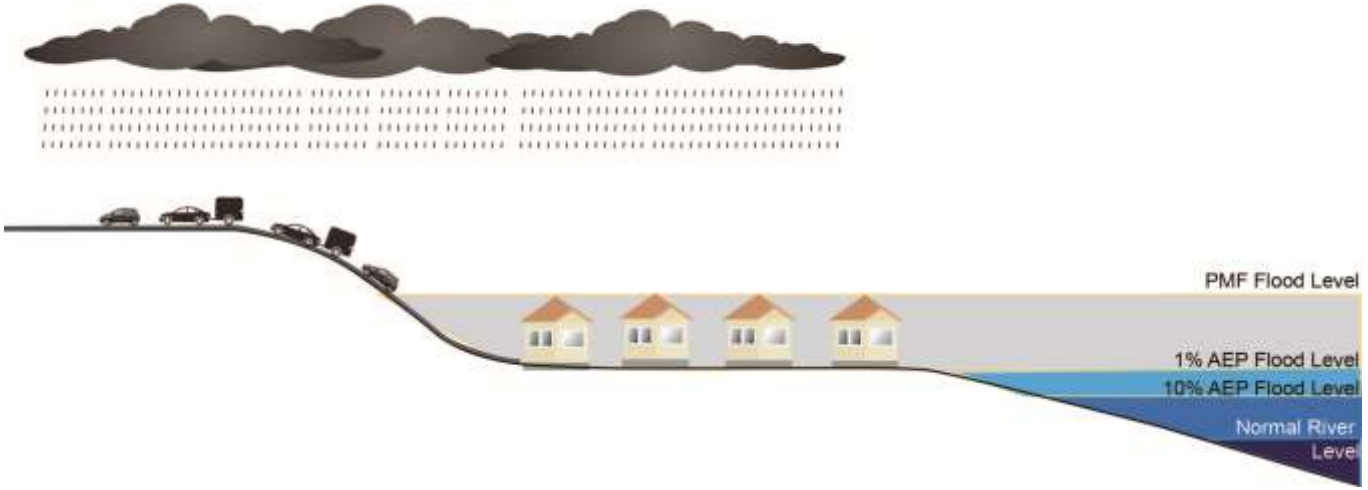

Figure 4 **Example of area that is flood affected and has rising road access to the road network beyond the PMF. Category FER.**

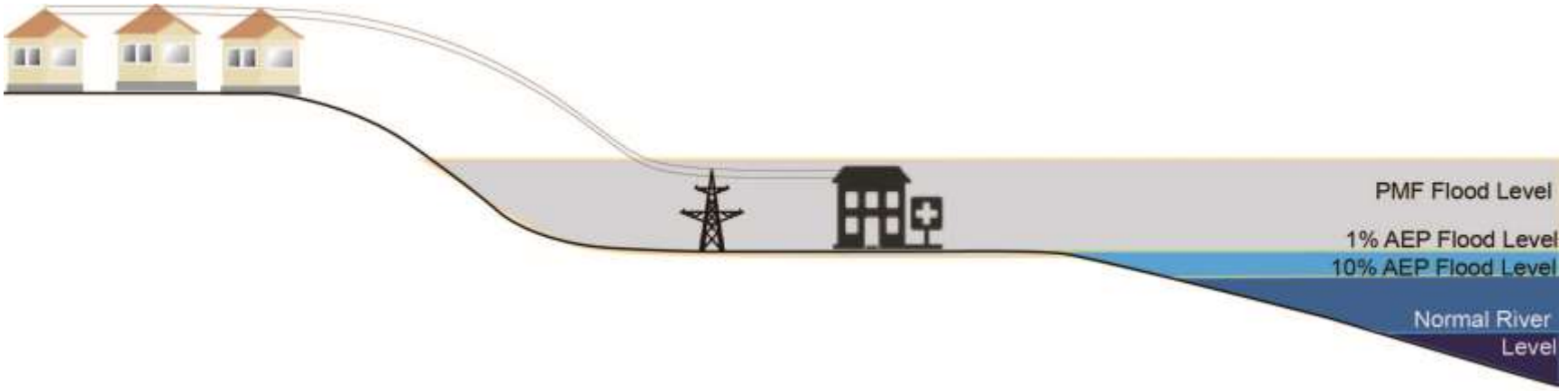

Figure 5 **Example of area that is not flood affected but has indirect consequences; in this case, due to loss of power and hospital facilities. Category NIC.**

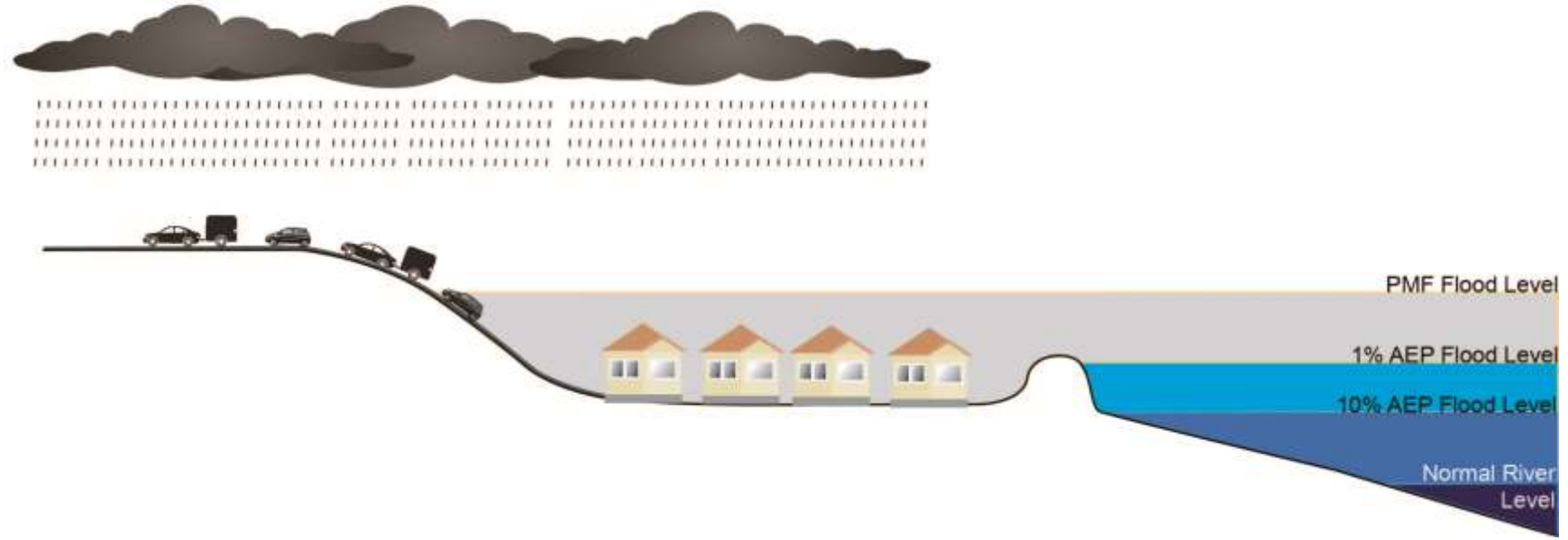

Figure 6 **Example of area protected from the river by a levee designed for the 1% AEP event. In larger floods, including the PMF, the levee will overtop. The area has a rising road access to the road network beyond the PMF. Category FER.**

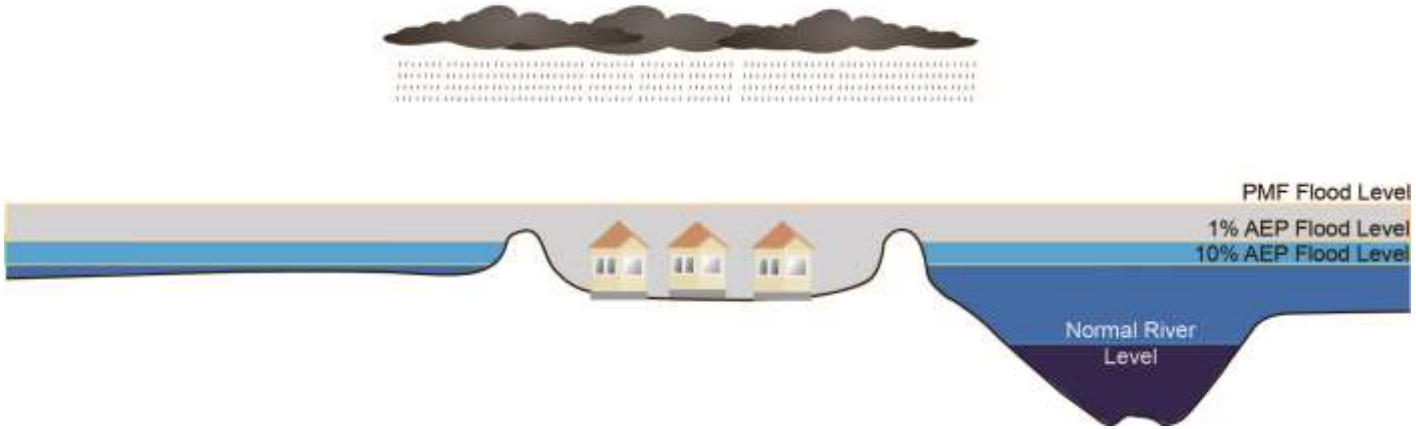

Figure 7 **Example of area protected from the river by a levee designed for the 1% AEP event. In larger floods, including the PMF, the levee will overtop and fully submerge the entire area. access to the Area will be lost before overtopping. Category (FIS).**

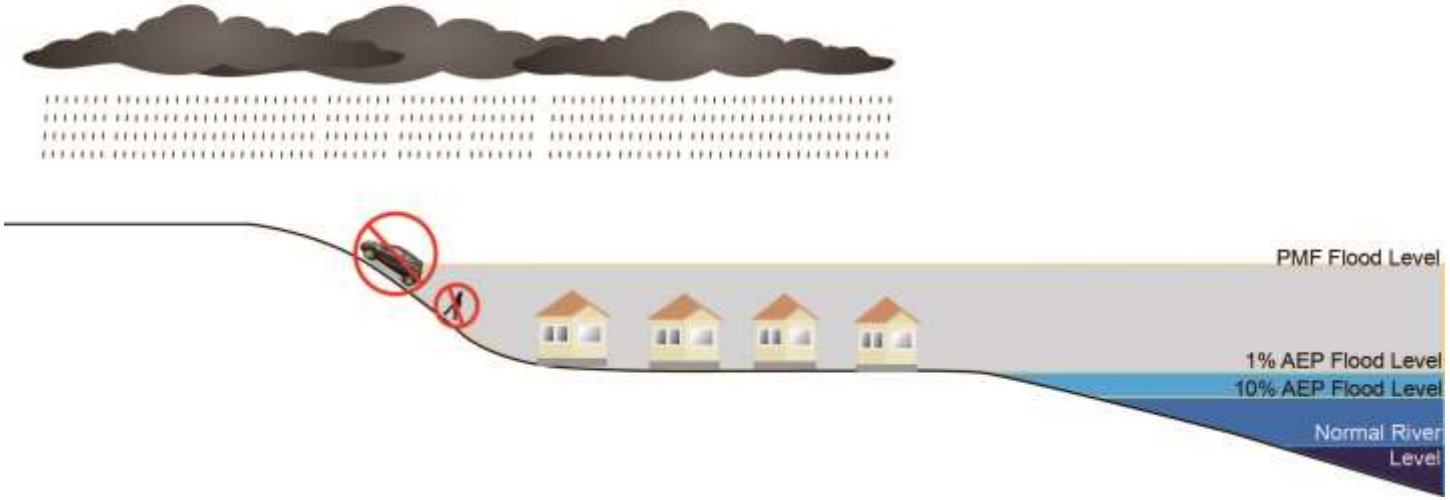

Figure 8 **Example of area that is flood affected, isolated by floodwaters, and has impassable terrain and is fully submerged in the PMF. Category FIS.**

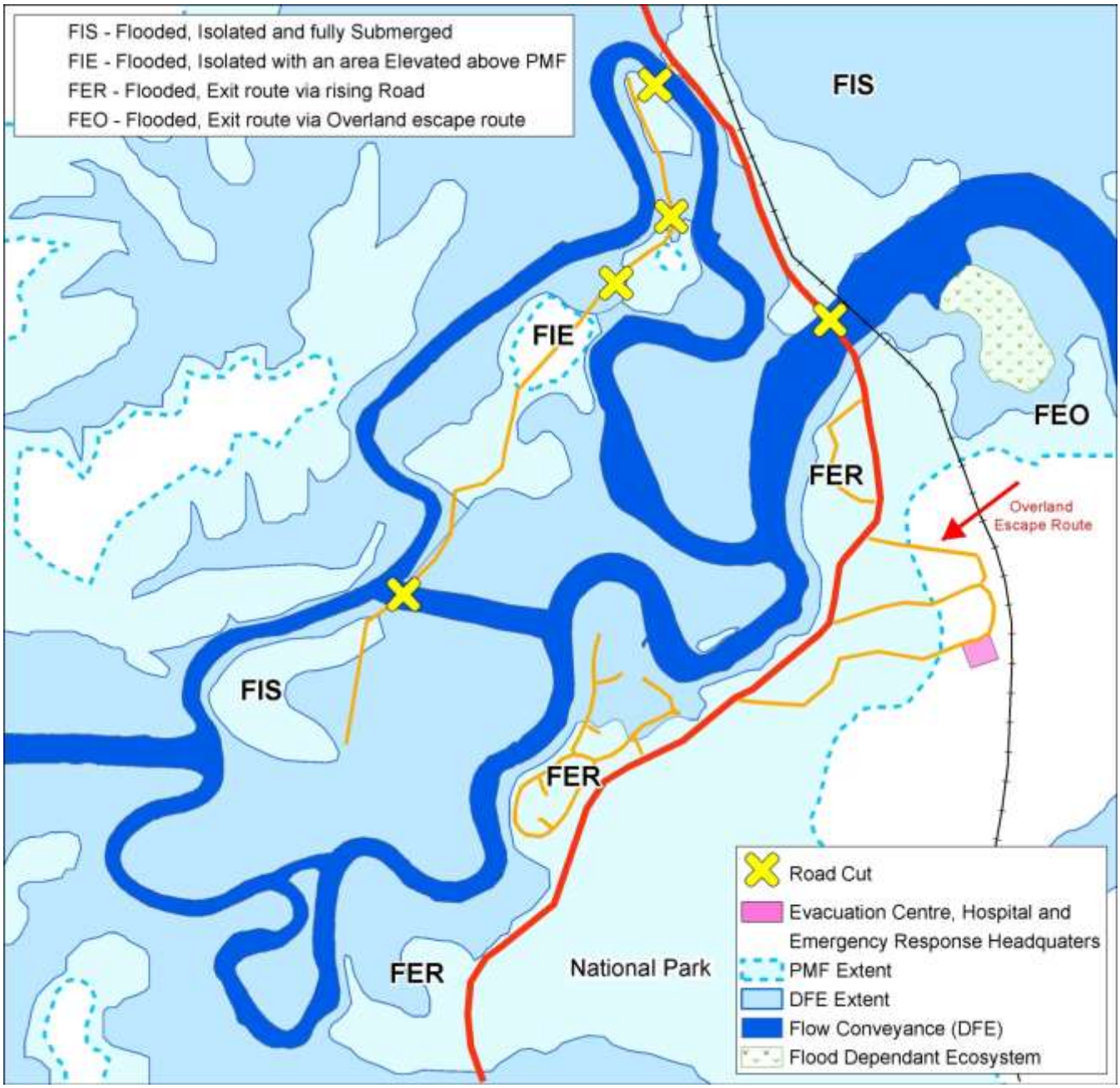

Figure 9 **Map of floodplain showing examples of some classifications**

3 INFORMATION TO SUPPORT ASSESSMENT

Classification requires information describing the spatial extents of flooding for the full range of flood events up to and including the PMF, or a similar extreme flood and how this interacts with the landscape, transport links and key infrastructure facilities.

3.1 Flood investigations consistent with AEM Handbook 7

Flood investigations, such as flood studies and floodplain management studies as described in AEM Handbook 7, provide a basis for developing the required information.

Required information from investigations includes mapping, which should include the following:

- Local topography to sufficient detail across the floodplain. This may be a digital elevation model covering the floodplain.
- Information on cadastre.
- Flood extents for different scales of floods up to and including the PMF, or a similar extreme flood.
- For areas isolated in the PMF or a similar extreme event, information on evacuation routes, whether by road or overland, which may limit the serviceability of the route. This may include whether the route is cut by floodwaters and, if so, where this occurs and the level of the evacuation route at these locations. Information on flood levels for a full range of floods at these locations and corresponding levels at the relevant gauge for flood warnings are also important, and information on the timing of floods are important to inform emergency management planning.
- Whether isolated areas include any elevated areas of land above the PMF, or a similar extreme flood.
- The level of service provided by protection works, such as levees (event works are expected to provide protection for, for example, a design event).
- Information from service providers on the impacts floods would have on their services, where the scope of the classification includes assessment of indirect consequences. This classification can inform strategic planning for services, infrastructure and development and emergency management planning.

3.2 Retrofitting using existing investigations without PMF or a similar extreme flood

Where studies have already been completed, all the necessary information identified in Section 3.1 may not be available and additional data may need to be sourced. The advice below assumes necessary information on topography, cadastre and transport links is available.

When retrofitting classifications to existing studies where the PMF or a similar extreme flood is not available, the following approaches can be adopted:

- Gain advice from a specialist flood practitioner to approximate an extreme flood and map this to use with other information to establish categories.
- Base classification on the largest flood in the existing information. The limitation of this approach need to be clearly identified – for example, ‘preliminary classification - isolated area with residual land above the 1% AEP [annual exceedance probability] design flood, the largest flood event where information is available’. This approach requires caution, as larger floods may fully submerge the area identified as elevated. Emergency management planning may need to consider the need to evacuate all isolated areas, rather than assume there will be elevated areas above all potential future floods.

4 DETERMINING FLOOD EMERGENCY RESPONSE CLASSIFICATIONS

Figure 10 provides a flowchart to assist in determining the flood emergency response classification of different areas (generally communities or precincts) on the floodplain, based upon the PMF or a similar extreme flood. Where classifications are retrofitted to existing studies, and information on the PMF or a similar extreme flood is not available and not being approximated, the flow chart can be used by reading PMF as 'largest available flood'. Such classifications should be clearly indicated as 'preliminary classification based upon the largest flood available' and used with caution as discussed in Section 3.2.

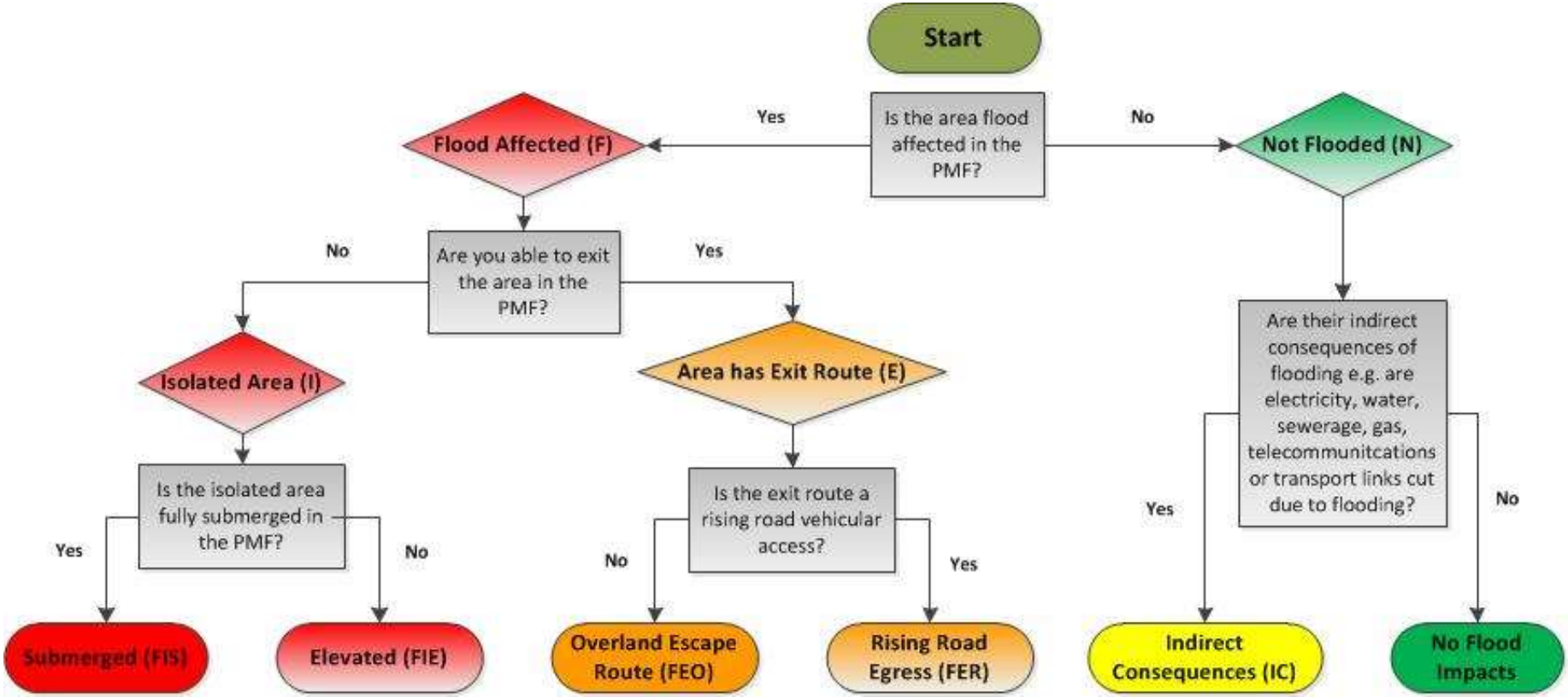

Figure 10 Flow chart for determining flood emergency response classifications

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