# Appendix D

# Appendix D: Hydraulic Categorisation – Floodway Definition

## Introduction

The Wagga Wagga hydraulic categorisation maps are displayed in Figure 12 and Figure 13 for the 1% and 5% AEP events respectively. The floodway was determined for the 1% AEP event with the methodology then applied to the 5% AEP event.

Hydraulic categorisation is the process by which flood behaviour for a given design event is classified into areas of flood storage, flood fringe and floodway. The NSW Floodplain Development Manual 2005 (Reference 1) provides definitions for all three categories, however these are descriptive definitions and aren't suitable for directly calculating/assessing the categories. The definitions as per Reference 1 are provided below for clarity.

> *Floodway*– areas in the floodplain where significant discharge occurs. Often aligned with natural channels. Floodways are areas that even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
>
> *Flood Storage* – those parts of the floodplain important for the temporary storage of floodwaters during a flood. Extent and behaviour of flood storage areas may vary greatly for different events and so a range should be examined.
>
> *Flood Fringe* – remaining areas of land in the floodplain after flood storage and floodway have been defined. (NSW FDM, 2005)

Two further definitions that are suitable for directly calculating/assessing the floodway extent and that are widely used to describe the characteristics of the floodway are described below:

1. **Comprises 80 to 90 % of the total flow -** The extent which comprises a significant proportion of flow in a flow path (80 to 90% is often used as the portion of flow within the floodway); and
2. **Blockage causes 0.1 m flood impact -** The extent which if partially blocked causes impacts in excess of 0.1 m to occur upstream of the partial blockage.

These two definitions have been used to assist in determining the floodway extent at Wagga Wagga.

Defining the floodway is a critical component of the flood risk management work carried out under the NSW Floodplain risk management program. This relates to the fact that the defined floodway extent will typically not be available for further residential development. As such it is imperative that the floodway definition is appropriate and not conservative.

## Approach

Generally speaking there is no definitive method and defining a floodway is often an iterative process. In the context of 2D and 1D/2D models, the output used in the mapping tends to be in a raster format. A raster presents flood modelling outputs for each grid cell in a gridded format for the given study area. The velocity depth (VD) product for each cell can, and has in previous studies, been used to define the floodway. For example the Howells et al (Howells) method utilises the VD product and the velocity (V) when assessing hydraulic categories.

The proposed method differentiates the floodway from other hydraulic categories by selecting a VD criteria that exceed a specific threshold. Some subjectivity still exists within the methodology and different regions often require different V and VD criteria to produce suitable results. Testing varying V and VD criteria, to some degree, is comparable to a calibration exercise where the VD product to be used as a threshold for defining floodway is modified until such a time as a suitable floodway is obtained.

Given that the VD product can provide a base for defining the floodway extent for raster results, the next issue with floodway definition is defining what the VD product should be "calibrated" to, to achieve a reasonable floodway definition. In other words, what VD product will define a floodway extent which will satisfy the two floodway definitions mentioned above.

## Methodology

In the 2012 paper by Thomas et al., the two previously mentioned floodway definitions were investigated and a correlation was observed between the 80% flow criteria and a 0.1 m afflux.

The proposed method uses various VD and V parameters to estimate the floodway and then verifies results using encroachment analysis similar to that found in Thomas et al. (2012).

In the encroachment analysis all areas not defined as floodway based on the selected VD and V criteria have been totally excluded from the modelling domain and the subsequent impact on flood levels is examined.

It should be noted that this is an iterative process undertaken in the 2D hydraulic model. Various VD and V parameters were examined in combination to find the best definition of the floodway extent. The VD and V parameter combinations listed below define the floodway extent for the Murrumbidgee River as determined by encroachment analysis.

Murrumbidgee River floodway parameters:

a. VD > 0.35 $m^2/s$ and V > 0.35 m/s; or V > 0.35 m/s;
b. VD > 0.25 $m^2/s$ and V > 0.25 m/s; or V > 0.25 m/s;
c. VD > 0.20 $m^2/s$ and V > 0.20 m/s; or V > 0.20 m/s; and
d. VD > 0.15 $m^2/s$ and V > 0.15 m/s; or V > 0.15 m/s;

## Results

Appendix Figure D1 displays the afflux associated with the encroachment analysis. Regions displayed in orange indicate an afflux of approximate 0.1 m. The defined floodway criteria (a., b., c. and d.) listed above were found on encroachment analysis testing to produce an afflux of approximately 0.1 m when used in the specific arrangement presented in Figure D1. This indicates that the selected criteria are suitable for defining the floodway extent. Notably, figure D1 indicates that the b. parameter set (VD > 0.25 $m^2/s$ and V > 0.25 m/s; or V > 0.25 m/s) is suitable for defining the floodway in terms of the afflux it produces for the majority of the floodplain, however the a. parameter set is more suitable in the areas around Oura. Due to complex flood behaviour in the Gumly area associated with the flow breakout near East Wagga, the c. and d. parameter sets were utilised to further modify the afflux caused by encroachment analysis in these regions.

A number of cross sections that measure flow in the model are also displayed in Appendix Figure D1. For each cross section the percentage of flow both within and outside of the floodway are displayed. It can be seen that the percentage of flow contained within the encroachment analysis defined floodway ranges from 95% - 98%. As discussed previously, typically the floodway contains 80 to 90% of the total flow.

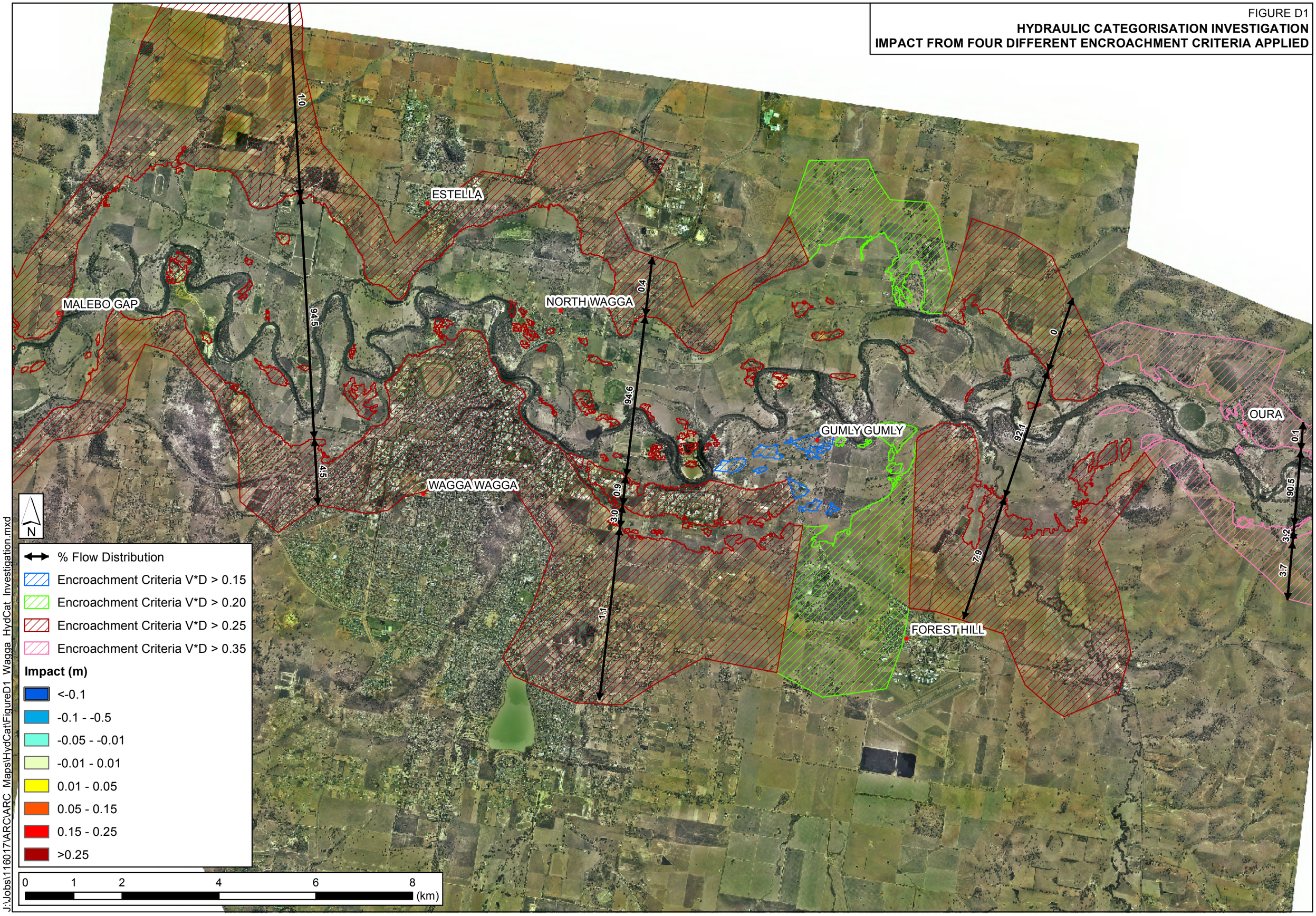
## Conclusions

Defining a floodway is a non-precise process. The goal is to produce floodway extents that match flow behaviour so that the areas which need to be retained for flow are identified whilst other parts of the flood extent can be developed as appropriate. While the allocation of floodway is likely to be a contentious issue that would merit a precise definition, the fact remains that a one size fits all approach still eludes the practitioner.

The method presented defines a reasonable floodway extent using VD and V criteria and then confirms the suitability of the defined floodway extent by using afflux testing. The percentage of flow within the floodway was also investigated and was noted to be greater than 90% which is the upper limit of what is considered typical. Reducing the width of the floodway based on the 80 to 90 % flow criteria is not recommended as the encroachment analysis method produces a more conservative and reasonable floodway extent than using flow distribution.

FIGURE D1

**HYDRAULIC CATEGORISATION INVESTIGATION**
**IMPACT FROM FOUR DIFFERENT ENCROACHMENT CRITERIA APPLIED**

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## APPENDIX D REFERENCES


NSW Government

1. **Floodplain Development Manual**
   2005


## APPENDIX D FIGURES