MURRAY SHIRE COUNCIL

MOAMA FLOODPLAN MANAGEMENT STUDY

Executive Summary

Pursuant to a Flood Study that was completed in 1997, Sinclair Knight Merz were commissioned by Murray Shire to undertake necessary investigations and prepare a Floodplain Management Plan for Moama consistent with New South Wales Flood Policy, and associated recommendations for a Development Control Plan to support the Floodplain Management Plan.

Study area

The study area was confined to New South Wales, although effects of current development on the Victorian side were taken into account because the primary source of flooding is the Murray River which defines the State border. The study area included adjacent rural lands generally confined within the Kanyapella Basin in addition to the urban precincts of the town of Moama.

Moama is situated on the Murray River opposite the city of Echuca, immediately upstream of the confluence with the Campaspe River and approximately 15 river kilometres downstream of the confluence of the Goulburn River. The region supports a growing urban population based on popular tourist and recreational destinations, and a significant agricultural, timber and transport base. The population of the study area is 3 314, mostly based in Moama. Land adjacent to the river has been used extensively for caravan parks and camping grounds with some permanent or semi-permanent structures.

Flora and fauna

Although much of the study area has been cleared for agriculture and urban / industrial or tourism / recreation development, there are areas of State Forests and public reserves. In general

terms, the remnant native vegetation of the area is dominated by *Eucalyptus camaldulensis* (River Red Gum). Red Gum regeneration is related to flood events which provide the necessary conditions for seed to germinate and for the growth of seedlings.

The forests and waterways of the study area provide habitat for a range of fauna species, including large terrestrial mammals such as the Eastern Grey Kangaroo (*Macropus giganteus*); small terrestrial mammals such as the Yellow-Footed Antechinus (*Antechinus flavipes*), the Australian Water Rat (*Hydromys chrysogaster*) and Platypus (*Ornithorhyncus anatinus*); arboreal mammals such as the Brush-Tailed Possum (*Trichosurus vulpecula*), Ring-Tailed Possum (*Pseudocheirus peregrinus*), Sugar Glider (*Petaurus breviceps*) and the Squirrel Glider (*Petaurus norfolcensis*); bats, reptiles, amphibians, birds, fish and crustaceans. More than 200 species of birds have been recorded, of which 75% are known to breed within the region.

Flood hydrology

The approximate catchment areas of the Murray, Goulburn and Campaspe Rivers in the vicinity of the towns are about 40 000, 18 000 and 4 000 km^2, respectively. The flood levels in the study area are caused by the complex interactions of floods in the three rivers. In larger Murray River floods, much of the flow in that river upstream of Barmah is naturally diverted into the Edward River and returns to the Murray downstream at Wakool Junction.

An important factor that determines the flooding pattern in the area is the geomorphology of the floodplain. Both Murray and Goulburn Rivers flow into a very large depression known as the Kanyapella Basin, in the floodplains upstream of Moama and Echuca. The system thus behaves like a large storage basin in the case of large flood events, with two inlets provided by the Murray and Goulburn Rivers and the outlet being the Murray River between Moama and Echuca.

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Major flood level is defined by the Bureau of Meteorology when floods exceed 94.4 m on the Echuca Wharf Gauge. The largest flood since European settlement was in 1870, when the peak was 96.2 m on the gauge. More recently, the largest flood was in 1993 when the peak was 94.80 m.

Flood frequency analysis of the hydrological records for the Murray at Echuca provided estimates of flood peak discharges and river stage for a range of Annual Exceedance Probabilities (AEPs). The 1993 flood was estimated to have an AEP of approximately 5% at the Echuca gauge, meaning that in the long term floods of this magnitude or greater could be expected to occur about once in 20 years on average.

Application and results of hydraulic model

Hydraulic modelling was undertaken using MIKE-11, a one-dimensional numerical modelling system. The model was calibrated primarily using observed data from the 1993 flood, and the model simulation was also validated using data from other historical floods in 1974, 1981 and 1982. This model was then applied with design events for AEP of 10%, 5%, 2%, 1% and 0.5%, and an extreme event nominated as a flood with peak discharge and volume twice that of the flood of AEP 1%. This nominal extreme event was used to consider the implications of a flood large enough to overwhelm any flood mitigation measures (assessment of residual risk). A Probable Maximum Flood was not used, because apart from the usual difficulties of estimating such a flood for a very large catchment, the effect of diversion of Murray River floods into the Edward River and around the study area could not readily be determined.

The model revealed that the 1993 flood levels closely matched the 5% AEP (or 20-year) design flood profile from downstream of the Campaspe confluence, through the bridges and up to the Goulburn River confluence. Upstream of this point, they more closely matched the 2% AEP (or 50-year) design flood profile. In the flood

prone lands in the Bama Forest area and the area on the eastern and western sides of the railway line north of Moama the 1993 flood levels were also closer to the 2% AEP levels. These findings were attributable to the following:

- upstream of Moama / Echuca, the Kanyapella Basin was initially partly full as a result of a lesser flood on the Goulburn River which preceded the main flood by a few weeks;
- downstream of Moama / Echuca, the tributary flood from the Campaspe was relatively low in 1993.

A flood of 0.5% AEP was estimated to have peak stage at the Echuca Wharf of 95.60 m AHD. Since the present planning level was 95.63 m based on previous study, the flood of 0.5% AEP was accepted as the Flood Planning Level for general planning purposes in Moama. Given the slight difference in the two levels quoted above, the old level of 95.63 m AHD was adopted for convenience. This also maintains consistency with a Flood Planning Level used in Victoria for general planning purposes in the city of Echuca.

Flood behaviour and mitigation options

Beyond a given depth of inundation in the Kanyapella Basin north of Moama, floodwaters cross from the east to west of the railway through the Black Bridge. Residential and industrial properties are threatened by these floodwaters, which must drain back to the river through two culverts near the town. One of the options was to block passage of floodwaters through the rail embankment. Although this would improve protection for a part of the township and some rural properties, it would however aggravate flooding in the remainder of the basin, increasing flood depths on numerous rural properties east of the railway and in East Moama. Preservation of the existing flood storage area was considered of paramount concern, and preservation of the existing capacity of the culverts under the railway is a corollary to that.

The other main option considered was to construct a levee which would keep floodwaters west of the railway out of the northern residential and industrial precincts of the town, and also protect more highly developed parts of East Moama. Preservation of the flow-path from the railway culverts back to the river at Chanter Street was essential, and not all allotments in East Moama could be enclosed by the levee. An area is to be zoned as Floodway in order to preserve the flow-path which connects from the Black Bridge and west of the railway embankment to the railway culverts near the township, and then south to the river at Chanter Street in East Moama.

Hydraulic analysis indicated flood levels north of Moama (and west of the railway) could increase by up to 100 mm because of the levee during a flood of 1% AEP. East of the railway and upstream of the Echuca-Moama bridge, flood levels could increase by up to 30 mm in a flood of 5% AEP (less during a flood of 1% AEP).

Features of proposed Floodplain Management Plan

After consideration of planning, social and environmental issues and consultation with the community, a Draft Floodplain Management Plan was prepared. The principal features include:

- A single, continuous town flood protection levee to the standard of the recommended Flood Planning Level for general planning purposes around the north and east sides of the township.
- A floodway with associated culverts under the railway line and around the eastern side of the levee, including expanded culverts under Chanter Street, to improve the flow of water around the town from the northern flood storage area.
- The designation of strategic floodways and the associated removal of physical obstructions to preserve strategic areas of flood flow distribution.
- The designation of high hazard flood storage areas to the north and east of Moama and associated limitations on

rural levees which threaten to reduce flood storage capacity and adversely affect flood heights and surrounding flood behaviour.

- The raising of Old Bama Road in the vicinity of Horseshoe Lagoon Caravan Park, to the level of existing flanking levees, or 5% AEP, whichever is lower, to provide for 5% AEP flood-free access to/from Moama and to avoid the road becoming a channel for flood flows below this level.
- Increasing the height of Chanter Street to provide flood-free access to the eastern area of Moama up to the 5% AEP level.

The principal planning or non-structural features of the Draft Floodplain Management Plan include:

- The identification of key flood zones (floodway and flood storage) and their associated hazard categories for a range of possible flood events.
- The identification of flood planning levels up to and including an extreme flood with the recognition that while such a flood is possible the risk of its occurrence is low. A flood planning level for general planning purposes (identifying what has become known as flood liable land) is also established based on the current application of the 95.63m AHD flood level at the Echuca Wharf Gauge.
- The development of a draft Development Control Plan (DCP) outlining the principles and policies to be applied by Murray Shire Council in the consideration of developments within the designated areas of the floodplain.
- For all approved developments, minimum floor levels for structural design purposes are to be 300 mm above the 1% AEP flood level.

A range of other general recommendations and flood response measures that would also help achieve the Draft Plan objectives include:

- revoking the previous development consent for the Edward Street caravan park;
- establishing flood spillway areas over/across Cobb Hwy for extreme flood events;
- increasing flood awareness (of the full range of flood events, up to and including the extreme flood) of all landholders through general education, signage and issuing of regular flood certificates;
- the voluntary acquisition of properties between Winall and Moama Streets, to remove dwelling entitlements and to rezone to flood compatible land uses such as open space / nature conservation;
- the voluntary acquisition of properties in the Forbes Street area of the main riverside floodway on which structures have been erected;
- imposition of a height restriction on existing rural levees, with levee crests limited to the current height or the 1993 flood level, whichever is the lesser;
- revoking the existing licenses for unconstructed, rural levees – however, consistent with current legislative changes to Part 8 of the NSW Water Act, applicants should have the opportunity to prove (through an hydraulic study) that the proposed work, either in isolation or cumulatively with other similar works, does not have a significant impact.

Many recommendations were also made to ensure compliance with the NSW Environmental Planning and Assessment Regulation (1994). The proposed Floodplain Management Plan was also reviewed in the context of emergency response planning.