Dave started life as an Agricultural Engineer and has 13 years experience in the field of hydrology, erosion and water quality research. Dave has worked for the Queensland Department of Primary Industries and Natural Resources, Mines and Energy over this period. In more recent years Dave has been involved in catchment planning including working with local government looking at floodplain management issues.
A PROCESS FOR ACHIEVING COORDINATED FLOODPLAIN MANAGEMENT IN THE UPPER CONDAMINE FLOODPLAIN, QUEENSLAND

David Waters
Qld Dept of Natural Resources & Mines, Toowoomba, Qld

Background

The upper Condamine floodplain is located in the headwaters of the Murray Darling basin in Queensland (figure 1). The Condamine River is the main drainage line of the catchment flowing north-west from Warwick towards Chinchilla. The project area has a total catchment area of 29,000 km² with a river length of 500km with the floodplain covering an area of 7,500 km².

The catchment includes twelve local government areas. The majority of the shires manage some proportion of both floodplain and upland areas. The area is home to 170,000 people and is an important revenue earner for the region. In 1999, the combined gross value of agricultural production of the twelve local government areas of the floodplain was $838 million, or 13% of Queensland’s gross agricultural production (OESR 2001). Management of flood waters impacts on the economic development, environmental values and social consequences across the region.

Figure 1: The upper Condamine floodplain area
Rapid expansion in irrigation and other infrastructure on the Upper Condamine floodplain has occurred in recent years. This infrastructure can change volume, extent and patterns of drainage of floodwater flows across the floodplain with little cognisance given to the impacts on resource sustainability and water management resulting in increased soil erosion, local flooding and declining water quality.

Several key areas of concern identified by local government and the floodplain community were:

- The influence which the combined effects of all uncoordinated property development to date may have on future flooding
- The potential for the development/growth of structures on the floodplain to adversely impact on existing landowners and their use of the land
- The potential for future investment dollars in the region being lost, either due to the uncertainty in the security of investments or expensive litigation
- That a number of local government bodies who had invoked Section 47 of the local government act (LGA 1936) (which gave some regulatory control over the development of structures) were rescinding their local law due to concerns about potential litigation
- Shire councils within the upper Condamine floodplain have received disaster relief payments in excess of $21 million over the past decade (NR&M 2002). Approximately 75% of this can be attributed to restoration of shire assets as a result of flooding

The piecemeal nature of developments plus the uncertain legislative and regulatory framework and lack of associated standards and tools for evaluation of proposed developments has made administration, assessment and management of development virtually impossible.

Following significant flooding and damage to infrastructure in 1996, a floodplain committee was formed with the support of the floodplain community. The overall aim was to develop a whole of floodplain assessment process, which would enable the local community to sustainably manage future development on the floodplain.

Process

To move towards a whole of floodplain management process, a committee which represented the floodplain community, in collaboration with Natural Resources and Mines (NR&M), successfully applied for Natural Heritage Trust funds which made it possible to achieve the following five steps:

1) Resource Inventory

- **Detailed topographic survey of the floodplain**: High resolution topographic survey data was collected to ensure the data was useful at an individual property scale and detailed enough for future hydraulic modelling purposes. The topographic data also provided an essential base layer of truth, which was needed to define flood pathways when conflicts arose.

The topographic survey was carried out over a three year period at approximately a 100m x 100m interval over 6,400 km² of cropping area on the floodplain. Laser scanning technology was used to capture detailed topographic data along the main river channels.
- **Irrigation infrastructure GIS survey:** This work aimed to collate an accurate digital inventory of all water storages, distribution infrastructure and public infrastructure on the floodplain and also provided a vital base data layer for hydraulic modelling.

2) **Community workshops**

- **Local landholder workshops:** Combining the detailed topographic data layer, infrastructure data and property maps, staff conducted 61 workshops across the floodplain involving 750 participants. The workshops included all landholders in a local area, local government, main roads and Queensland Rail representatives. The workshops aimed to determine historic and current flow patterns, potential solutions and identify problems due to altered flow patterns associated with recent development.

  This local involvement was an important element of the process and resulted in a richer range of options, data and shared ownership of issues and potential solutions.

- **Prioritisation of issues on the floodplain:** An output from the floodplain workshops was that a comprehensive list of prioritised works was compiled in a whole of floodplain context for the first time. Priority setting was based on a number of criteria including the potential impact of the existing modified flow patterns on landowners and infrastructure.

3) **Hydraulic Modelling**

- **Scoping study to assess modelling requirements and future direction:** A scoping study was conducted by WBM Oceanics (WBM 2001) to establish what modelling was required for assessment purposes and the future direction for the overall process (figure 2). The key recommendations from the study were:
  
  - The need for a broad scale two dimensional hydraulic model covering the floodplain
  - Collection of additional cross section data of the main river
  - More detailed hydraulic modelling in a pilot area
  - Formation of a floodplain management board to steer the overall process
  - Development assessment process and develop criteria for assessment

- **Broadscale Floodplain modelling:** Laser scanning technology was used to collect detailed river cross section data for the entire river network prior to modelling being undertaken. This work was jointly funded by NR&M and all local government constituents.

  A broad scale hydraulic model was required to look at the combined impacts of floodplain development from a whole of floodplain scale prior to conducting any detailed modelling of specific areas of the floodplain. Secondly the broad scale modelling provided improved flow boundary conditions for any future detailed modelling.

  One of the major considerations for this work was that the software used for the modelling exercise, must be commercially available to allow landholders and or local government some flexibility when engaging private companies to carry out future modelling investigations.
Consequently, a broad scale two-dimensional MIKE21 hydraulic model was developed for the floodplain (SKM 2003). Hydrologic modelling input for MIKE21 was carried out using runoff routing modelling software URBS (1999). The Bureau of Meteorology (BoM) had previously developed URBS for flood forecasting for the Condamine catchment.

A grid resolution of 60m was adopted as the most appropriate to ensure good river definition in the digital terrain model with the 90m grid giving poor definition of the river. A total of 1.9 million computation points were used with a run time of 8 days. The hydraulic model was calibrated against data from the 1976 flood. The model was used to generate predictions for the 20 and 100 year Average Annual Recurrence Interval (ARI).

The model will reside with the floodplain board and is available for use by all the floodplain community with the provision that any new information generated from the model is provided back to the floodplain board to update and refine the model. This arrangement ensures that the model is updated with the best available data.

Figure 2: Schematic of floodplain development assessment process (WBM 2001)
4) Development of Regional floodplain planning framework

- *Runoff and Flow Coordination Framework*: A concurrent project, which built on the outcomes of this work, was conducted by the Department of Local Government and Planning (DLGP 2003). The *Runoff and Flow Coordination Framework for the Condamine Floodplains project* was developed as part of a case study project entitled 'Incorporating Natural Resource Management Initiatives into Local and Regional Planning Instruments'.

The aim of the project was to trial methods for incorporating natural resource management issues into regional planning frameworks in a way that allows them to be more readily translated into local government planning schemes. Since the Upper Condamine floodplain was trying to achieve similar objectives, the flow coordination project was an ideal mechanism to facilitate the inclusion of runoff and flow coordination principles in local government planning schemes.

One of the major outcomes from the project was the development of seven guiding principles (DLGP 2003) relating to future development. These principles are contained in the framework, which provides the ‘rules’ or ‘guidelines’ that will be applied when implementing actions or making decisions affecting runoff and flow coordination on the floodplain.

5) Outcomes

- *Formation of floodplain board*: With a number of the objectives of regional floodplain planning coming together, a review of existing planning assessment methodologies has been conducted. With the full support of all local government representatives, a floodplain board has been proposed. The main function of the board will be to form a basis for an assessment body for future development applications such as levees and infrastructure. The board may be made up of local government, farmers and a state government representative. A technical committee may be established to assess any issues that may arise in relation to hydrology and hydraulic impacts of any development.

- *Targeted on ground works funding*: One of the main outcomes of the upper Condamine floodplain project was a “whole of floodplain” list of prioritised and costed actions that were needed to minimise flood impacts both on a local and regional scale. Because the project was able to demonstrate that on ground actions had been developed in a whole of catchment context, a number of the key recommendations may potentially be funded through the regional body National action plan for salinity and water quality.
Discussion

It is important to remember that floods will reoccur. We can largely predict where they will occur, we cannot however predict when. The process of developing coordinated floodplain management for the upper Condamine floodplain has been highly successful and places the floodplain community in a much better position to plan/prepare for future and the inevitable floods when they occur.

There were a number of important components of the process that were important to the project's success. It was recognised from the start that clear and agreed goals were required between local government, agency staff, landholders and the floodplain community. This provided all parties with some clear direction.

An underlying theme of the project was to ensure that good quality data was collected to allow floodplain planners the opportunity to plan proactively rather than reactively.

The project also concentrated on identifying the cause of the problems faced by the floodplain community not the effects.

Ownership of the problem by all of the floodplain community was imperative. The use of workshops conducted with small groups of landholders and the floodplain community in a local area using high quality data was a key. By ensuring that participants understood the problems and put the local flooding issues in a whole of floodplain context created understanding and ownership of the problem.

By developing a whole of floodplain commercially available hydraulic model to assess future flood impacts, ensured that all the floodplain community could benefit from the modelling outcomes in the short and long term. The second benefit of developing a broad scale model initially, ensured that the best available information could be used to set boundary conditions for flood flows in the development of any future detailed modelling exercises.

Working collaboratively with other organisations such as the DLGP was of mutual benefit to both parties and enabled us to reach our common goal of coordinated regional floodplain planning in the shortest timeframe possible.

To successfully develop such a comprehensive and coordinated floodplain plan requires a significant investment of time and funds. The collection of high quality data, modelling and workshops cost approximately $1 Million with funds contributed by all partners of the floodplain community. However, this figure is a small investment in comparison to the millions of dollars spent every year in the catchment in disaster relief funding for the restoration of assets, which in numerous cases could have been avoided with appropriate broad scale planning.
Conclusions

Developing a coordinated floodplain management plan has:

- Facilitated local governments working together for agreed outcomes and adoption of a single set of rules to assess the combined impact of development
- Given local government much greater certainty in assessment and management of developments locally
- Helped prioritise funding for works in a whole of floodplain context

The process used for the Condamine Floodplain could be adapted to other rural floodplains in Australia. The key elements of the project success were a single clear goal, involvement by all the floodplain community and sound base data. The work has provided a number of valuable insights that can be adopted by local government and natural resource planners to achieve sustainable floodplain assessment. The project can be regarded as a sound example of how investment in natural resource planning has set a foundation for future investment.

Acknowledgements

The author would like to give special mention to the landholders and local government staff on the floodplain who gave a significant amount of time over three years to ensure a workable floodplain management process was achieved.

Thanks must also go to the Natural Heritage Trust for funding a significant proportion of the work and the bureau of meteorology for providing hydrologic data for the modelling exercise.

References


NR&M (2002) Flood plain management as part of the Upper Condamine Catchment-report of the upper Condamine floodplain management project – NHT No. 972976.

OESR (2001), Regional Profiles — Darling Downs, June 2001, Office of Economic and Statistical Research, Queensland Government

BoM (1999) Condamine Balonne Revised URBS model, Bureau of Meteorology, April 1999


MIKE21 user manual, Danish Hydraulic Institute www.dhisoftware.com/mike21