EFFECTIVE FLOOD WARNING THE AUSTRALIAN WAY

THE WINSTON CHURCHILL TRAVELLING FELLOWSHIP

Visit to Australia & New Zealand

23rd October - 27th November 1994

Lindsay Pickles - National Rivers Authority

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INTRODUCTION

During his life, Sir Winston Churchill often expressed the idea that men and women from all walks of life should be encouraged to travel and learn about the life and work of people in foreign lands. He believed that the experience gained during their travels would enable them to make a valuable contribution to Britain.

When he died on 24 January 1965, trusts were established in the Commonwealth and the United States of America and a fund raising appeal was launched. People from all walks of life who wished to express their gratitude for Churchill's inspiration and leadership helped fund the fellowships, of which there have been around 2500.

In August 1992, the Bureau of Meteorology and Australia's Emergency Management Institute, the umbrella body of the State Emergency Services, began to study ways of improving the effectiveness of warnings. They concluded that there were four stages in the dissemination of a warning and published "Guidelines for Effective Warnings". The four stages this publication looked at were:

- Understanding
- Belief
- Receipt
- Action

In November 1994, I was awarded a Churchill Fellowship to visit Australia to find out whether the guidelines had been successful, what feedback there had been on their use and whether they had been applied in New Zealand. The study aimed to establish whether the way the Australians' used the media in flood warnings could be applicable to the UK.

In England, the Flood Warnings Procedures Group, which consists of representatives of Local Authorities, the NRA and the Police and is chaired by the Ministry of Agriculture, Fisheries and Food (MAFF), agreed to consider the Australian Guidelines to draft propossals for using the media in the dissemination of flood warnings. Initially the proposals were tried using a table top exercise involving the media over the summer of 1994 with real time trials taking place in two NRA regions over the winter season.

Dissemination of flood warning is only part of emergency management and cannot usefully be considered in isolation. This report looks at emergency management in the context of floodplain management, comparing practices in the Antipodes to those in England and Wales. The manner in which flood warning and emergency response is carried out in Australia and New Zealand is compared with the approach taken in England and Wales. Within this context, the four stages of flood warning are studied and recommendations made for incorporating some of their practises into emergency management here.

EMERGENCY MANAGEMENT

Emergency management is not only about managing the emergencies, it is also about preventing them and mitigating the effects. For flooding, this includes development control measures, constructing flood embankments and improving community awareness. Emergency planning is the key to effective management and planning the initiation, flow and receipt of an effective message is particularly important.

Flood Emergency Management can be broken down into four distinct phases:

Mitigation: measures to reduce the likelihood of flooding by controlling development in inappropriate areas and building embankments and other structural flood defences.

Preparedness: measures to make sure the community is aware of the probability of flooding and knows what to do in the event of it happening. Within this phase lies the production and interpretation of technical data and the dissemination or communication of warnings.

Response: measures to undertake immediate local action to cope with the flood, to rescue victims and initiate self help.

Recovery: measures to assist the affected community to get back to normal. This is a long phase which includes rehabilitation, restoration and assembling records.

If emergency services are properly prepared to respond and want to assist or evacuate people who are about to be flooded but these people do not believe they need help, they may refuse with damaging results. As in England, no one authority in Australia is responsible for Emergency Response and co-operation between departments is vital. The institutional approach to emergency management in each country is described below.

Australia

In Australia, flood prediction services for floods with lead times greater than six hours are provided by the Bureau of Meteorology. The State Emergency Services (SES), together with Local Government, interpret the warning and provide assistance to the local community.

The SES is a volunteer body which grew out of the Civil Defence role. It exists at Federal State, Regional and Local level and it is at the Local level that the most of the action takes place and the volunteers are trained to respond. Floods are not the only emergencies to which the SES respond. They assist the Police in traffic accidents, and search and rescue as well as providing assistance to the community in storm and cyclone.

The structure of SES differs from State to State depending on the Acts which set it up, and on the type of emergencies which are most prevalent. However, the concepts are the same, to assist vulnerable communities when things go wrong

Local Authorities hold the key to effective emergency response. Often the SES local controller is employed by the council. It may be a full time role as in Brisbane where 10,000 people live on the floodplain or part time when an employee takes the SES controller role when an emergency is in the offing.

As Local Authorities provide all services to community; health and welfare, transport, housing and social services, they are in a good position to recognise the distinct needs of different community groups. In Queensland, the SES had a flood liaison room next to the flood control room where representatives from these supporting organisations were on hand to provide assistance quickly when required.

The SES, Local Authorities, Police and Bureau of Meteorology, whose representatives form the Flood Warning Consultative Committee, have a statutory responsibility to draw up Disaster Response Plans for flooding which establish and describe the inter-agency arrangements at a State, Regional and Local levels for the planning and management of flood emergencies.

Representatives of the Bureau, the SES and Local Authorities have drafted a document to assist the production of Flood Emergency Plans. It is called "Flood Warning : An Australian Guide" and sets out best practice for flood warning systems including elements of flood prediction, their interpretation, the design of warning messages and their communication.

Local authorities also have responsibility for the remainder of floodplain policy. They determine planning policy and can prevent inappropriate development. Using funds from State and Federal sources they provide any flood alleviation works required.

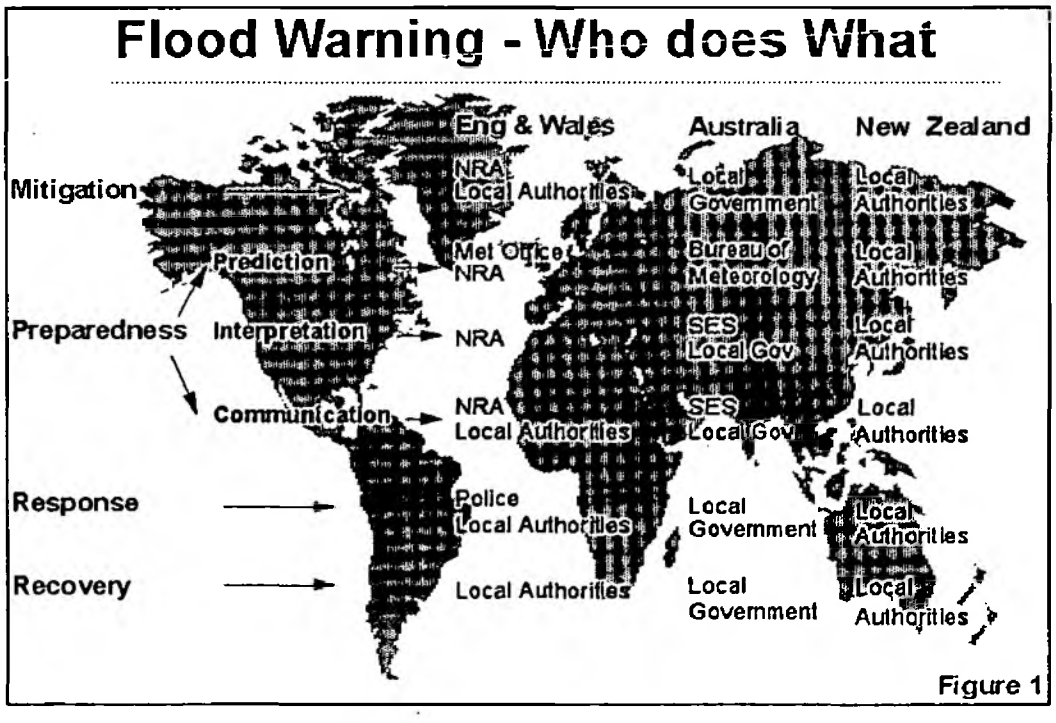

Figure 1 shows which authorities are involved in Emergency Management in England & Wales, Australia and New Zealand.

New Zealand

In New Zealand, it is up to the Regional council, based on catchment boundaries, to issue flood warnings. Regional engineers are responsible for the routine monitoring of river levels, rainfall and marine conditions, flood warnings and emergency action. The Department of Civil Defence, the New Zealand equivalent of the SES, only gets involved in the event of a major emergency or flood. The local authority, at regional and local levels, has responsibility for all aspects of flood defence.

Once a flood reaches the level of a civil defence emergency, it falls under Civil Defence Plans. These contain suitable warning procedures and include the procedure for using radio broadcasts and television announcements. There is a formal document setting out the roles and responsibilities of civil defence response organisations within each region of New Zealand.

England & Wales

The National Rivers Authority (NRA) has a general supervisory duty over all matters relating to flood defence, including flood emergencies. However, within this general role, the Meteorological Office, Police and Local Authorities have a part to play in emergency management. The NRA and Local Authorities have powers to improve and maintain defences. Local Authorities are responsible for determining where development can take place. Here, they are advised by the NRA, but with good flood plain management policies, local authorities can play a large part in ensuring that the misery of flooding is kept to a minimum. The NRA has powers to provide flood warning systems so that the public in flood risk areas can be informed of impending flooding. In addition, Local Authorities have the responsibilities for assisting and looking after the communities which they serve. This assistance includes their welfare, the provision of evacuation centres and assistance to property owners in protecting their own houses in times of emergencies.

In England and Wales, county councils are required to plan for emergencies. These include evacuation procedures and offer a wide range of potential emergencies, including the accidental release of chemicals or the contamination of water supplies.

FLOOD WARNING

The preparedness phase of emergency management is all about planning the emergency response and flood warning is an integral part of this. Flood warning incorporates the prediction, interpretation and most importantly, the communication of flood information to those mostly likely to be affected.

The basic aim of Flood Warning is to get a message from the authorities to the community to persuade them to take some sort of action to mitigate against flood damage.

The media is a conduit for that message and its probable involvement is shown in Figure 2. In an emergency, radio or television is well placed to reach a large number of people in a short time. Prior preparation and planning ensures the recipient is ready to receive and understand the message, the channel is geared to send it and the authorities are primed to provide it.

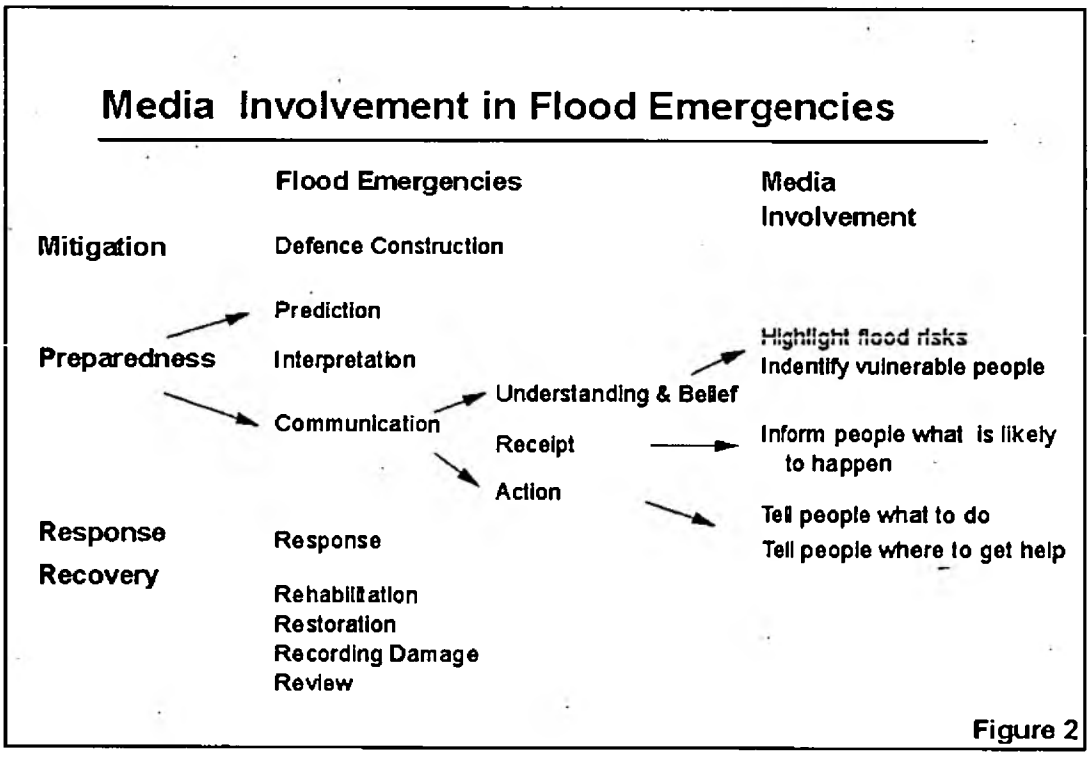

Figure 2

Initially, the community has to be able to understand and believe a flood warning message once it is received. This is best done in the quiet times in between floods. Often the quiet times last so long, the challenge is to retain an interest and understanding.

Understanding and Belief

There are various ways to help people at risk of flooding to be more aware:

- Distributing leaflets
- Remembering flood anniversaries
- Providing floor height surveys and flood marks

Flood Risk Leaflets

The State Emergency Services (SES) has produced a leaflet with a magnet attached to keep on the fridge. One is shown in Appendix 1 and has been used to develop a Flood Warning Leaflet for the NRA. These leaflets are available in libraries and at council and SES offices. If a flood risk area is targeted, they can be sent direct to the affected areas.

These could be supplemented by putting a sign in an obvious place, say the electricity meter, giving the floor height. When river heights are given out over the radio, people could be advised to check their floor height to see if it is below or above the warning level.

Anniversary Reports

The media can highlight and raise flood awareness on the anniversary of major floods. These help where flooding has taken place before but it is very difficult to prepare people for very rare events which may not have happened in living memory.

Floodplain boundaries can be advertised by signing floodmarks on lamp posts but only a few councils in Australia do this. In Perth, for example, lamp posts show three levels, the flood which has a 1% chance of occurring in any year, the previous maximum flood level and general floor levels.

The council of Latrobe, Tasmania, a small town subject to flooding on the Mersey river, had carried out floor height surveys and floodplain mapping. The council had used the floor height surveys as public relations exercise, tying in with the ground and aerial surveys. Appendix 2 shows the media release made in connection with the surveys.

Around 300 households were surveyed giving householders the chance to chat and share experiences. These experiences were then used to correlate floodplain surveys. In Latrobe the project team recognised marketing as a necessity. They produced a bulletin for collection from the council offices. Newspapers were approached early with the same story. There were no hidden agendas and trust was important.

The mapping contract had some interesting spin-offs. The prints were used to identify shoals for removal by community volunteers. The maps and aerial photos were also used in a study of stormwater and creek systems for urban and flash flooding and in landscaping the urban creeks to make them more attractive.

Receipt

In Australia, the Bureau of Meteorology had the task of predicting the height of a flood wave and warning the public by radio. This caused one of the greatest communication breakdowns as although the prediction of a flood height was fine for those people aware of rivers, it wasn't for the vast majority of urban floodplain dwellers. The Australian SES recognised the need for interpreting the message to give it some meaning and a lot of their efforts were concentrated here, with variable results as the following examples show.

The Communications Network of the State Emergency Services

Cascade Warnings

In New South Wales, a flood at Moruya was expected and a warning needed to be sent to the Central Business District that river levels of 3.2m were expected. The SES decided to ask the mayor, a trusted authoritative figure, to phone around all affected parties to get people to move stock and evacuate premises. This he did and set in motion a cascade of warnings.

Unfortunately, the message was corrupted and business owners expected water levels in the town to reach 3.2m. This caused great consternation and a lot more effort was expended than necessary.

Television Messages

At Nyngan a flood peaked unexpectedly and the community had to be prepared for evacuation as the ring levee around their town was expected to overtop. Here the media was asked to trail a message across television screens in the middle of a movie. This required the agreement of the television director after hours. Quick co-operation of this sort is assisted by a foundation of mutual understanding and respect laid down during the quiet periods between emergencies.

Coverage

In Tasmania, the Australian Broadcasting Corporation has a network of transmitters and the coverage is quite high. There are commercial radio stations but these tend to be less frequently manned having a syndicate arrangement with the Australian mainland radio. It proved difficult to break into a broadcast in the middle of the night to provide a warning.

Victoria

The north east area of Victoria had been subject to quite severe flooding in October 1993. It was quite clear that as the flood wave moved downstream, so communities in the lower part had far greater opportunity to be prepared and yet this preparedness was more effective in some areas than in others.

The first town to be hit was Benalla where heavy rain fell overnight. Informal warnings didn't seem to work and when people were asked to evacuate, they didn't want to go. When they did want to go, the SES couldn't get to them because of rising flood waters. Evacuation was much more difficult. Here the radio was syndicated with other stations transmitting from Sydney in the middle of the night. Although the message was eventually broadcast, many people didn't hear it as it was late, waking up to find water around their feet.

Wangaratta

The flood wave then reached Wangaratta, where the level of awareness was believed to be high because a moderate to major flood occurs every few years. However, as the town is protected by the levee system, flood warning focused on the fringe urban community. Although the council was active in sandbagging and closing roads, suggesting that they were aware of the likely extent, people weren't given information about what was happening which caused them concern.

Shepparton

At Shepparton, Bob Cowling of the SES couldn't speak too highly of the local radio and the role they had played in the dissemination of flood warnings. Daily links were set up with the local news to provide information on where the flood waters had reached and what people should do. Bob saw his role and the SES in getting everyone to pull together and work to the plan. The existence of a good emergency plan into which all parties had input assisted greatly.

In Shepparton there was time to see the approaching flood water and helicopters were used to evaluate the impact. The SES kept logs of who had been contacted and when and what warnings had been given out on the radio. This helped to refute any allegation of mismanagement.

Echuca

In Echuca on the Murray River, the flood levees, completed only four months previously, had a chance to prove themselves and the town was relatively unscathed. Pumps to take the stormwater out from inside the town were stretched to capacity during the heavy rainfall which caused the flooding in Benalla. The floodwaters took about 10 days to reach Echuca and the townspeople had sufficient time to close and bolster levee systems using sandbags in low spots.

New Zealand

In New Zealand, warnings are mainly aimed at the recreational public using the river beds, contractors winning gravel and farmers. Many of the warnings are related to farmers because the floodplains are used extensively for sheep and cattle and the farmers require time to move them when necessary.

Action

Receiving a warning is not enough. People also need to know what action they should take. The seeds of understanding planted in the quiet in between floods period will assist but not replace this need for information.

Flood Prediction

In Australia, the Bureau of Metrology has the responsibility for issuing flood forecasts and warnings on a river basin scale. They routinely send warnings through the radio network. An example of a river level prediction is:

"the X river will reach 8.0m at town Y by 6 o'clock this evening."

This gives a prediction and gauge data. It does not give any indication of the likely effect to the community or what people should do. Unless recipients are aware of the river, they will not understand the effect of a 8.0m height prediction.

Interpretation

A bulletin of this type is preferred by the SES:

> "The X-Y road is likely to be closed by mid afternoon and large areas of river flats will be inundated around Y. Travellers should take extra care and use the alternative route via W to X Y & Z and farmers in low lying areas should remove stock"

The interpretation of hydrological flood forecasts to produce this type of bulletin requires a knowledge and understanding of river and floodplain hydraulics. The Australians term this as "Flood Intelligence" which fits in well with the military approach they adopt to emergency response. However, as with all intelligence records, the results are only as good as the input.

In Queensland, the rainfall records volunteers held a competition and the annual prize for the highest rainfall was the Golden Gumboot. There was great upset when a participant was suspected of cheating. A continuous recorder was installed as a check to which the wily operator added the required additional water when checking the rain gauge by hand. Of course this resulted in major peaks of rainfall being recorded at 6 am every morning.

Flood Intelligence

Historical data can be collected and held for future reference using a paper based system. An example of flood intelligence card is given in Appendix 3. It can be augmented by theoretical data from hydraulic models and floodplain maps.

Flood intelligence can also be held and updated using computerised systems. In Canterbury, new Zealand, a Global Positioning System is used to survey floodplains. The height accuracy, once tied to a base station, was believed to be $\pm$ 10mm and it could be used to quickly log details of flooded areas.

The whole of the River Murray has been mapped with results held on three compact discs with a simple version of a Geographic Information System to support their use. The degree of accuracy for any one area is provided by a key where Category 1 flood data is the most reliable, being a combination of historic flood levels, hydrological data, detailed topography and flood photography. Category 4, the least reliable, is a combination of soil maps, geology maps and poor flood and aerial photography.

In North Norfolk, Tasmania, the entire municipality was digitally mapped with flood outlines for the 20, 50 and 100 events as overlays. Paul Winter the Municipal Engineer had persuaded the council to produce maps on a Geographic Information System (GIS) instead of paper maps, as it was significantly cheaper, especially where changes or additions were required. He had carried out floor height surveys to Australian Height Datum related to the river gauge and hoped to automate targeted warnings.

This had already been done in Melbourne where the water company had a very sophisticated arrangement for warning the public. This consisted of flood studies which were presented in maps giving different coloured areas for different flood events. The same colours were represented on a sewer pole on the banks of the Maribynong river and served as a public reminder. The warning system gave a print out of the houses likely to flood and to what depth.

England and Wales are well set up with a network of weather radar and rainfall and routing models to assist in the prediction of river heights. The interpretation of those predictions could be improved by using flood intelligence data better.

For flood emergencies, the area likely to be affected can be better defined. Specific flood emergency plans should be drawn up by local authorities in conjunction with the NRA. These would cover not only the prediction and dissemination of the flood warning but the interpretation of likely extent and the response and recovery measures required to assist the community.

Flood Marking on Sewer Pole on the banks of the Maribynong River

The roles of the various authorities could be clarified and set out in the emergency plans so that each party knows, in the heat of the emergency, what is required. These plans would then form the basis for continued flood intelligence to improve the interpretation of the effect of high water levels.

MISINFORMATION

The authorities were often concerned about the public being mis-informed by inaccurate radio and television broadcasts and warnings. They either caused unnecessary distress or at times could be downright dangerous. Often considerable steps were taken to enure the media gave the correct warning or got the right message, adapting working arrangements to suit them.

In Bennalla, community radio worked better than national radio. The disaster response committee in Benalla took great effort in cultivating the media, allocating one person to this role and believes the result was well worth the effort. The person dedicated to looking after the media looked to the experts to provide information and live broadcasts. These were preferred to pre-recorded ones as mis-information could not take place through cutting or splicing.

In Shepparton, a video of National news footage had been compiled to show the good and bad points of media involvement. The footage highlighted some of the mis-information that can be given out. There was some general advice to boil water which should have applied to one town only causing unnecessary worry and concern.

The media also relayed a story about a young man rescued from the roof of his car by helicopter. He was portrayed as a hero. What was not reported was that he had driven his car through three "road closed" signs to get to the point where he had to be rescued.

A MEDIA POINT OF VIEW

I think Naiomi Robson, a well known TV presenter whose family kindly put up with me in Melbourne summed up the difficulty with the media very succinctly.

> "Floods are just not exciting" she said "Basically, most of the pictures you get are of people clearing up dirty houses or children enjoying themselves. And what sort of music can we play? Handels Water Music?"

This sentiment was echoed by David Craven of the SES. He compared the difference in perception between bushfires and floods. In NSW, the fires burnt about 185 homes which were all insured or insurable. The Bush Fire Brigade returned home as heroes with a ticker tape welcome. In the 1993 floods in Victoria, 3000 homes were flooded and livelihoods lost. There was an estimated $500 million to $600 million of uninsured damage but there was relatively little media coverage.

The consensus is that people aren't afraid of flooding, you can get away from a flood. They are afraid of fire. In most instances, floods don't destroy, a fire does. Fire make a frightening sound, water is soothing, generally. A short while after the flood, there is no evidence of water. The minister who came to visit in Victoria saw dirty houses, children having fun and houses intact if a little dirty. There is not a high impact and this is reflected by media coverage. "If only the media could portray the smell" he said.

CONCLUSIONS

Although Flood Patterns in Australia and New Zealand are different, the approach that is taken to planning and preparing for the occasion when an event might take place is similar. The media has a role to play in the communication of all phases of emergency management. The network of local radio stations in England & Wales which already provide a community service with reports of traffic, school closures and planning matters are well placed to be used to issue flood warnings and provide detailed information.

There are useful lessons to be learnt from the fellowship. The culture of planning and assistance in Australia has been retained from the civil defence background and the Flood Warning Manual recently drafted is a good example of this.

The promotion of inter-agency discussions with a view to publishing and using flood emergency management plans at local level is one of the key results of the Churchill Fellowship visit to Australia and New Zealand. These discussions have already started at a National level with the flood warning procedures group chaired by the Ministry of Agriculture, Fisheries and Food (MAFF). However, the debate needs to be carried to a wider audience with the promotion of a programme of discussions and seminars, with the aim of fostering a generally improved understanding of roles and for the need of co-operation.

For impartiality, this should be brokered by an organisation with no direct operational role in the emergency response scenario. A consultant, university faculty or the emergency planning college at Easingwold would all be able to carry out this role.

In England and Wales, the roles of various authorities need to be clarified and set down in emergency plans so that each party knows what is required. Flood emergency plans need to be drawn up in conjunction with local authorities who have the responsibility for looking after the local community in times of upset and natural damage. The role of the NRA in the flood warning process should be part of this local authority plan. The production of an overview manual supported by all parties involved in flood emergencies would assist the production of such plans.

Great use was made of electronic media to store and display floodplain data. The interpretation of river height predictions relies on such data and if the NRA, in co-operation with Local Authorities, embraces these techniques, they would be better able to provide effective warnings through the media.

FLOOD
ACTION GUIDE

If your area is subject to flooding, the following advice could help save your property or life. Please ensure you and your family read **both** sides of this card.

KNOW YOUR LOCAL FLOOD HISTORY & PLAN

Ask your council or State/Territory Emergency Service:

- ☐ What the terms 'major', 'moderate' and 'minor flooding' mean to your area and at what 'official river height' your home becomes isolated or inundated.
- ☐ Details of local flood plan, whether you may need to evacuate and **how to get to the nearest safe location.**

R E A D Y

EMERGENCY KIT - CHECK LIST

During and after a flood you will need:

- ☐ A portable radio and torch with fresh batteries.
- ☐ Candles and water proof matches.
- ☐ Reasonable stocks of fresh water and tinned food.
- ☐ A first aid kit and basic first aid knowledge.
- ☐ Good supplies of essential medication.
- ☐ Strong shoes and rubber gloves.
- ☐ A water-proof bag for clothing and valuables.
- ☐ Your emergency contact numbers. (Note below)

STATE/TERR EMERGENCY SERVICE	
POLICE, FIRE, AMBULANCE	000
LOCAL COUNCIL	

ACT ON FLOOD WARNINGS

- ☐ Listen to your local radio/TV for further information.
- ☐ Check that your neighbours know of the warning.
- ☐ Stack furniture and possessions above likely flood level, on beds and in roof (**electrical items on top**).
- ☐ Move garbage, chemicals, poisons, to a high, place.
- ☐ Secure objects that could float and cause damage.
- ☐ Protect/relocate valuable stock and equipment.
- ☐ If on the land, move livestock to high ground.
- ☐ Check your car and fill it with fuel.
- ☐ Check emergency kit and fresh water stocks.

S E T

See back of card for: 'Evacuation' & 'During and After' information.

FLOOD ACTION GUIDE

IF YOU NEED TO EVACUATE

You may be advised to evacuate by local authorities, but **if you leave of your own accord, tell police or State/Territory Emergency Service (S/TES) and your neighbours.** Whichever is the case, you should take the following actions:

G O

- ☐ Empty freezers and refrigerators leaving doors open (to avoid floating and subsequent damage).
- ☐ Collect and secure your personal valuables, papers, money, photo albums and family momentos.
- ☐ Turn off electricity, gas and water.
- ☐ Don't forget your emergency kit.

DURING AND AFTER THE FLOOD

If you remain in your home, or when you return, take these precautions:

- ☐ Keep your emergency kit safe and dry.
- ☐ Do not eat food which has been in contact with flood water and even boil all tap water until supplies have been declared safe.
- ☐ Don't use gas or electrical appliances which have been flood-affected, until they have been safety-checked.
- ☐ Beware of snakes and spiders which may move to drier areas in your house.
- ☐ Avoid wading, even in shallow water, as it may be contaminated - if you must enter shallow flood water, wear solid shoes and check depth with a stick.
- ☐ Check with police for safe routes before driving anywhere and don't enter water without checking depth and current.
- ☐ Keep listening to your local radio and TV station and heed all warnings and advice.

Brought to you by your State/Territory Emergency Service.
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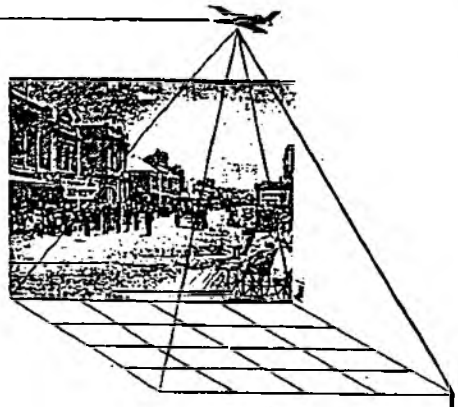
Municipality of Latrobe



"MAPPING THE MERSEY" - LATROBE

INFORMATION BULLETIN NO. 1 MAY 1993

As part of an ongoing mapping and flood mitigation programme, Council has recently embarked on a joint venture with the Bureau of Meteorology (Federal) and the Rivers and Waters Supply Commission (State), to map in detail the Mersey River Basin and the town of Latrobe.

This type of project is also being undertaken by the Municipalities of Northern Midlands, New Norfolk and Huon valley.

The flood plain mapping is an exciting project using coloured aerial photography, field surveying and state of the art computer map production techniques.

In conjunction with the above mapping, Council will also be conducting a floor level survey of buildings in Latrobe.

The combined information will provide Council, State Emergency Service and Police Departments with a factual data base from which to co-ordinate emergency response.

The mapping programme will produce up to date, factual maps and data on:

- **Latrobe's road network**
- **Latrobe's sewerage, stormwater and water reticulation**
- **Land use and vegetation cover**
- **Town planning and engineering**
- **Flood levels for emergency planning**
- **Land tenure**
- **Base information for creek and river beautification projects**
- **River details for Landcare and recreation**

Council will also have information to use on long term flood mitigation and land use strategies for the area.

Its is envisaged the mapping programme will take approximately 6 months with the release of maps, photos and reports by early January 1994.

Throughout the programme Council will keep the community informed on the progress of this major mapping initiative and will culminate with a public meeting upon the release of the final reports.

To assist with the compilation of data, Council are also seeking any relevant information on past flood levels, creek flows or historic photos (copies only). Council would appreciate any submissions.

TABLE I: THE FLOOD INTELLIGENCE CARD FOR WINDSOR, NSW

GAUGE NAME: Windsor Bridge **AWRC NO:** 212903

RIVER: Hawkesbury **LOCATION:** Windsor Bridge

KEY HEIGHTS (metres)

1. **Minor:** 5.8 2. **Moderate:** 7.0 3. **Major:** 12.2
4. **Levee:** N/A

HEIGHT	DATE	REMARKS
5.8 - 12.2		About 30 houses (70 people) and a permanent caravan park (population about 60 families) can be affected between these heights. These are located at Agnes Banks, Cornwallis, Gronos Point, Freemans Reach lowlands, Pitt Town Bottoms and some river bank areas downstream of Pitt Town.
6.0		Gronos Point isolated.
7.0		Water starts crossing bridge deck.
8.0		First evacuation occurs at Cornwallis.
8.2		Decide whether to evacuate Windsor sector if flood predicted to reach Current Planning Level (CPL).
9.6		Decide whether to evacuate Pitt Town sector (34 people) if CPL type flood predicted.
11.0	February 1992	Flood peak.
11.2		Decide whether to evacuate McGraths Hill if flood predicted to exceed 13.0 m.
12.0		Electricity supplies fail progressively up to a height of 20 m. 15-20 houses evacuated in low-lying areas of Riverstone (Blacktown LGA) due to backup flooding in South Creek system.
12.1		Macquarie St cut under railway line.
13.0		Windsor Rd cut at Curtis Rd. This affects evacuation route for McGraths Hill.

HEIGHT	DATE	REMARKS
13.3	August 1990	Flood peak.
13.5		Up to 50 houses evacuated in low lying areas of Riverstone (Blacktown LGA) due to back-up flooding in South Creek system.
13.7		Richmond/Blacktown Rd cut near South Creek.
15.0		Electricity supplies cut progressively to McGraths Hill. George St cut south of Rifle Range Rd.
15.5		Telephone services begin to fail.
16.0		Current Planning Level (CPL) and 1% flood.
		860 houses (2,580 people) to be evacuated from Windsor sector.
		McGraths Hill isolated and almost completely inundated; 520 houses (1,560 people) to be evacuated before this height reached.
		195 people to be evacuated from Wilberforce sector.
17.1		Junction of George St and Richmond/Blacktown Rd cut.
19.1	1867	Flood of record.
		450 people to be evacuated from Wilberforce Sector.
		4,650 people to be evacuated from Windsor Sector.
		450 people to be evacuated from Pitt Town Sector.

Note:

(1) The first reference (5.8 - 12.2 m) provides general information which needs to be given greater specificity (for example, the actual heights within this broad range at which the caravan park and other areas become flood-affected). It is better, however, to have such information on the card in this form than not to have it all.

(2) This example incorporates the three basic kinds of information required: peak and other (1% flood) heights, effects data and decision points.