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HAVE WE FORGOTTEN ABOUT FLOODING ON THE GEORGES RIVER?

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ABSTRACT

Flooding on the Georges River was once the subject of intense scrutiny. Much money was invested on flood mitigation works that partially address the flood problems. Is there now a growing risk that the remaining flood problems will be forgotten?

The Georges River is one of the most populated urban catchments in Australia, with over 1 million people living in the catchment. Floods that occurred in 1986 and 1988 heightened community concerns regarding flooding. However, as the time since the last significant flood increases, the community's awareness of the flood risks is diminishing. The floods in the 1980's were also relatively small events. Floods that occurred in the late 1800's were much more severe, in some places one building storey above the 1986 or 1988 flood levels. Will the community and authorities be prepared when the next large flood occurs?

Flooding was extensively studied in the 1970's and 1980's. This culminated in the construction of a physical model that provided design flood levels between East Hills and Liverpool. The model was kept for several years, but was demolished due to storage limitations at the laboratory where it had been constructed. For many years there was no overall model available to review design flood profiles or to test development options. A numerical model of the Georges River was recently established by Bewsher Consulting to address these issues.

This paper highlights a number of issues for the Georges River, including:

< Community awareness and education of flooding;

< An overview of flood mitigation works undertaken within the catchment;

< The impact and planning considerations for the probable maximum flood, which can be up to 5m higher than the 100 year flood; and

< The challenges ahead for those concerned with management of the floodplain and catchment.

The potential damage bill from major flooding on the Georges River is enormous (over $300M in a 100 year flood) and ranks as one of the most severely flood prone valleys in the State. Concerted action by all levels of government are necessary to ensure that the Georges River receives the attention and funding necessary to minimise its very significant flood risks.

1. INTRODUCTION

Like most river systems in New South Wales, the Georges River has more than its share of flooding problems. At times it has been the subject of perhaps more flooding investigations than any other area in Australia. It is also a wonderful showcase of different types of floodplain management measures that have been undertaken by different Councils in an attempt to reduce flooding problems.

So who could possibly forget about flooding on the Georges River?

The Community ? The last significant floods occurred in 1986 and 1988. As time goes by memories are starting to fade. But these were only small floods. No one remembers the big flood that occurred in 1873, which was more than 3m higher than the 1986 or 1988 floods (at Liverpool weir).

Local Government ? There are examples of development in the catchment that may not be considered appropriate under present day practice. There are times when flooding issues appear to have been given a low priority, or possibly overlooked. The significance of the probable maximum flood, which can be up to 5m higher than the 100 year flood, may also have been overlooked.

The Commonwealth Government ? The Commonwealth Government became partners with the State and Local Government in implementing major flood mitigation projects along the Georges River. However, Commonwealth funding on the Georges River was removed several years ago, despite some projects being only partially completed. More recently, filling of federally owned land has been carried out within the floodplain, apparently without an assessment of its impact on flooding.

This paper aims to act as a reminder to the flooding problems experienced on the Georges River and to highlight some of the challenges ahead for those responsible for its management.

Photo 1
1986 Flood on the Georges River

2. THE GEORGES RIVER CATCHMENT

The Georges River is located in and to the south-west of Sydney, as shown on Figure 1. The river itself is about 100km long. From its headwaters near Appin, the river flows north towards Liverpool, through the Chipping Norton Lakes Scheme, and then east through Bankstown to Botany Bay.

The river has a number of major tributaries, including:

< Bunburry Curran Creek;

< Cabramatta Creek;

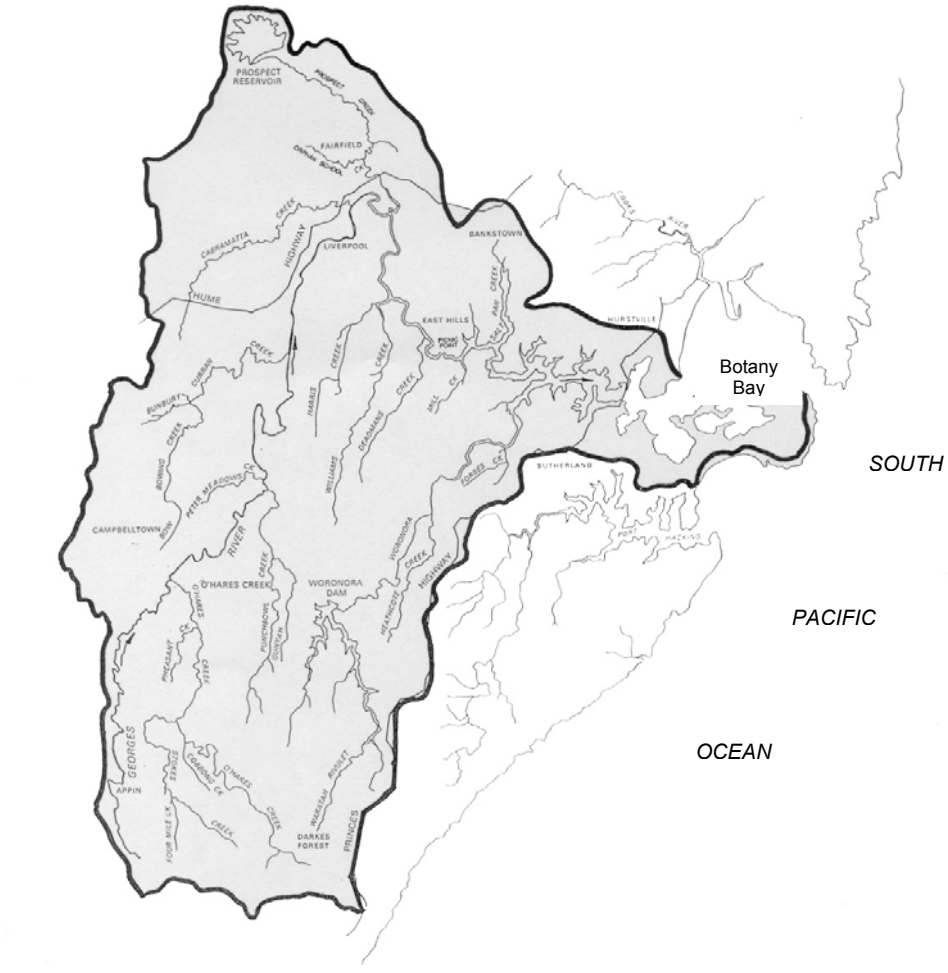
< Prospect Creek;

< Harris and Williams Creeks;

< Salt Pan Creek; and

< Woronora River.

The Georges River has a catchment area of 890km^2. With a population of over 1 million, it is one of the most populated catchments in Australia. Almost 1/3 of Sydney's population is located within the catchment. The catchment also contains significant areas identified for future urban development under the Sydney Region Urban Development Program.



Locality Sketch
Figure 1

The administrative framework for managing the river, floodplain and catchment is complex. There are 12 different government authorities that share the catchment. Each Council has their own planning controls to manage the risk of flooding and to safeguard the environmental qualities of the river. There are a further 9 Government Agencies with an interest in the river or the catchment. Whilst there are many stakeholders with an interest in the Georges River, there is no single authority with vested responsibility for managing the flood risk or the well being of the river for the whole community.

3. FLOOD HISTORY

The Georges River has a long history of flooding. Most flood observations have been recorded at the Liverpool weir, which was constructed in 1836 as a causeway crossing of the river and a source of water for Liverpool. The weir still exists today, with its historical significance recognised by the National Trust and the Australian Heritage Commission.

A histogram of available flood records at the Liverpool weir is represented on Figure 2.

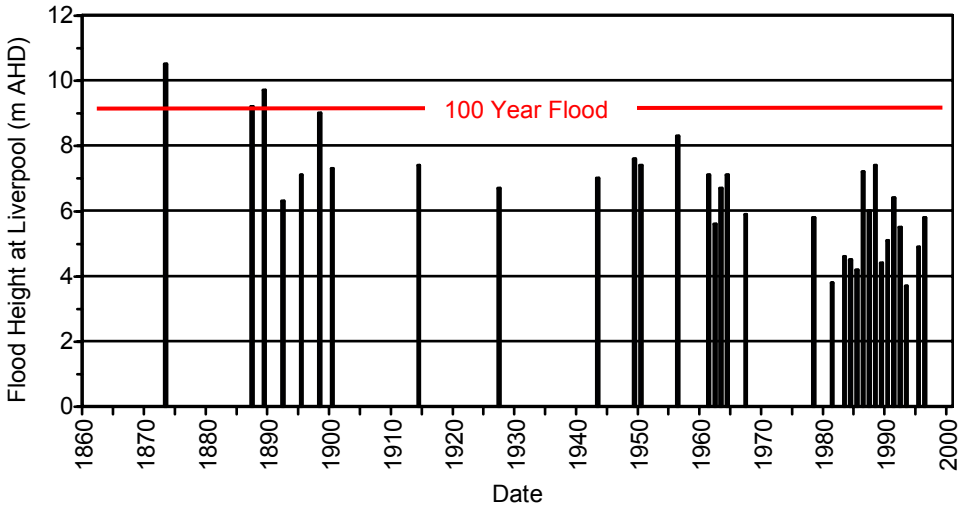


Figure 2
Flood Records at Liverpool

Many people living on the banks of the Georges River will remember the 1986 and 1988 floods. These are the largest floods to have occurred over the last 30 years. Both floods are estimated to be about a 20 year flood. It has been estimated that the 1988 flood inundated over 1,000 residential properties along the Georges River, Prospect Creek and Cabramatta Creek, with an estimated damage of over $40M (2000).

Very few people will remember the 1956 flood, which was the largest flood to have been recorded over the last 100 years. However, this flood is still relatively small compared to other historical floods that have occurred.

No one living remembers the 1873 flood. This is the largest flood to have been recorded along the Georges River. The level at Liverpool was 1m higher than the estimated 100 year flood. Three other large floods, similar to a 100 year flood, are reported to have occurred towards the end of the 19th century.

Thus whilst the Georges River has a long history of flooding, those floods that are remembered by residents are relatively small in comparison to others that are possible, and that have occurred in the past.

4. STUDIES UNDERTAKEN

Flood behaviour on the Georges River has been extensively studied since the mid 1960's. The methods of analysis have varied markedly, including simplified procedures, flood frequency analysis, physical model studies and more recently computer modelling.

4.1 Simplified Procedures

The first major investigation of flooding on the Georges River was undertaken by Harry Scholer in 1966 [Scholer 66]. Flood levels were derived on the assumption that the floodplain between Liverpool and East Hills was comprised of four interconnected ponds. A relationship was derived between water levels in each pond and the flood height at the Liverpool gauge, based on analysis from floods that occurred in 1950, 1956, 1961, 1963 and 1964. A flood prediction model, comprising a number of charts, was proposed for flood warning purposes.

4.2 Flood Frequency Analysis

Further research in the late 1960's was largely based on flood frequency analyses of the historical records at Liverpool. The main investigations were undertaken by Munro, Stewart, and Rowe and Ennis. The results of the different analyses varied significantly. This was largely due to the treatment of some of the earlier, less reliable flood records and the period of analysis.

Flood inundation maps were later derived for the Lower Georges River [Sinclair Knight & Partners, 1978] based on flood frequency analysis at Liverpool and the observed 1956 flood gradient.

4.3 Physical Model Studies

Most of the flood mitigation investigations were carried out by the Public Works Department at their Manly Hydraulics Laboratory, using steady-state physical models. The first investigation was an investigation of flood mitigation options for the Milperra-Moorebank floodway [Public Works Department, 1983], which ultimately led to the adoption of extensive voluntary purchase schemes for both Liverpool and Bankstown Councils. The model was later extended downstream to East Hills for investigations of the proposed M5 motorway crossing. It was later further extended downstream to Picnic Point, to allow investigations of flood mitigation works at East Hills and Carinya Road.

A separate physical model had previously been constructed at the Manly Hydraulics Laboratory in 1979/80 to examine various aspects of the tidal hydraulics of the proposed Chipping Norton Lakes Scheme. In 1982 the model was modified to include overbank flow paths for the purpose of flood investigations for the Lakes Scheme. The model was later extended to incorporate investigations for both Prospect Creek and Rabaul Road.

To consolidate the results from the various model studies, a single physical model, capable of simulating a complete flood hydrograph, was constructed at the University of New South Wales' Water Research Laboratory. The model, which extended between Picnic Point and Liverpool, was used to determine design flood levels for the Georges River. Results from the model are summarised in the 1991 Georges River Flood Study Report [Public Works Department, 1991].

There were two limitations with the physical model. Firstly, due to scaling affects, it was not always possible to analyse the impacts of various development scenarios or other changes

to the river or floodplain. Secondly, the model occupied a considerable area, and the expense of keeping the model available indefinitely was not possible. Consequently, the model was dismantled about 7 years ago.

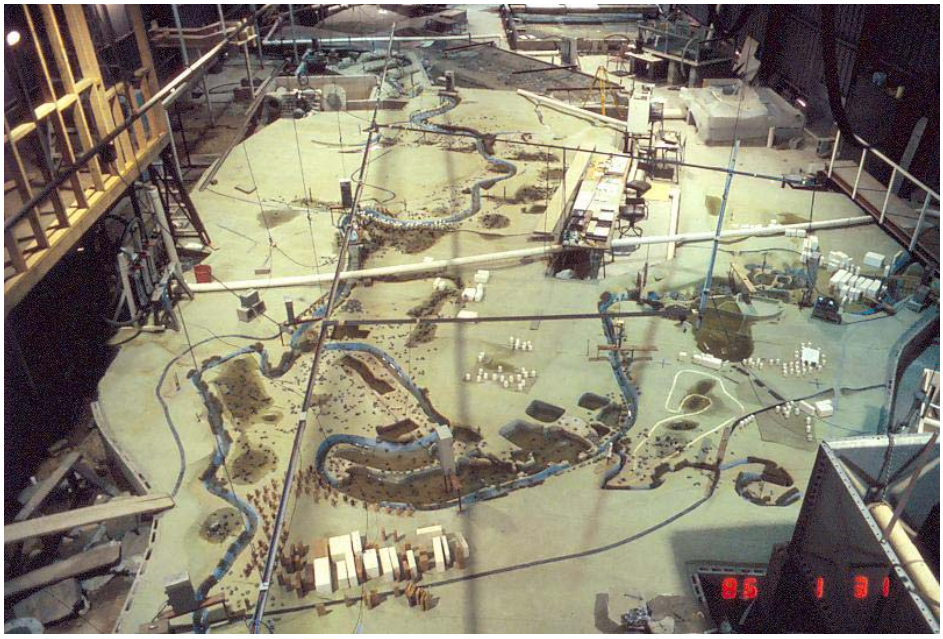


Photo 2
The Georges River Physical Model

4.4 Numerical Model Studies

For some time no model was available to test the impact that works on the floodplain, or other development scenarios, may have on flood behaviour.

Bewsher Consulting recently developed an extensive MIKE-11 hydraulic model of the Georges River [Bewsher Consulting, 1999]. The model was developed for Liverpool Council so that potential flood mitigation works and other development scenarios on the floodplain could be assessed. The model covers a river length of approximately 46km, between Botany Bay and Cambridge Avenue, at the Liverpool/Campbelltown Local Government boundary.

The model amalgamates a number of separate models, including:

- the physical model between Picnic Point and Liverpool [Public Works Department, 1991];
- a MIKE-11 in-bank tidal model downstream of Liverpool [Public Works Department, 1992]; and
- a MIKE-11 flood model upstream of Liverpool [Department of Land and Water Conservation, draft 1998].

The model did not set out to redefine design flood levels where these were already available. Instead the model was calibrated to match the results of past studies. This was achieved using calibration parameters that would normally be expected. In other areas, such as downstream of Picnic Point, design flood levels were derived for the first time.

The current MIKE-11 model provides a tool that allows Liverpool, and other Councils along the Georges River, to assess works and measures that may be considered on or near the floodplain.

5. FLOODPLAIN MANAGEMENT WORKS

There are many examples of floodplain management measures that have been undertaken by various Councils along the Georges River over the last 20 years. Some of the measures provide total protection against the flood risk in the area, whilst other measures provide a partial solution only. Examples of measures that have been adopted along the Georges River are discussed below.

5.1 Voluntary Purchase

The Moorebank-Milperra area is one of the worst floodways in New South Wales. Flood conditions are so severe, that both Liverpool City Council and Bankstown City Council adopted voluntary purchase programs to acquire and demolish buildings located on the floodway. Some 200 houses were identified for voluntary purchase at an original estimate of $20M (1983). The schemes commenced in the early 1980's, with financial assistance provided by the State and Commonwealth Governments. Over half of the houses have since been acquired and removed. Unfortunately Commonwealth assistance for the scheme was withdrawn several years ago, making its completion much more difficult.

5.2 House Raising

Whilst there has been no formal house raising program along the Georges River, one of the largest house raising programs within the State is being undertaken by Fairfield Council along Prospect Creek, one of the main tributaries to the Georges River.

Over 470 houses have been identified for house raising along Lower Prospect Creek. Some 126 of these houses have been successfully raised, or otherwise treated, at a cost of $5.5M. Many of the remaining houses are brick or brick veneer, which are difficult and costly to raise. Innovative alternatives to the traditional form of house raising have been explored, including the purchase, demolition and resale of vacant land with appropriate covenants. This results in the construction of new, elevated homes at a net cost that is only slightly higher than the cost of raising a timber house.

5.3 Levee Banks

There are several examples of different types of levee banks along the Georges River. A levee in the Kelso Park area was constructed in 1986 to protect 148 homes from floodwaters in the Georges River. Local drainage behind the levee and water quality considerations are significant issues with the levee bank. There has also been considerable pressure for intensification of development within the area “protected” by the levee.

Deflector levees were also constructed further downstream at Carinya Road at about the same time as the Kelso Park levee. The deflector levees provide limited protection to existing dwellings that are located on the banks of the Georges River. They do not stop the inundation of houses, but attempt to slow flood velocities to reduce the risk of major structural damage. Similar deflector levees are currently being constructed at East Hills, which also incorporates provision for improved evacuation.

5.4 Flood Compatible Redevelopment

In other areas along the Georges River, where the risk of flooding is lower or there are no practical flood mitigation measures, specific development controls have been stipulated to reduce the flood risk gradually over time, as redevelopment takes place. An example is

along Henry Lawson Drive in the vicinity of Rabaul Road. The Rabaul Floodway Study [Public Works Department, 1987] recommended that new or redevelopment should be allowed to proceed provided that:

< development is sited as close as possible to higher ground away from the river;

< minimum floor level requirements are satisfied; and

< the passage of floodwaters are not obstructed.

A specific DCP for floodplain development in the Carinya Road area was also developed by Bankstown City Council [Bewsher Consulting, 1997].

5.5 River and other Channel Improvements

Significant changes to the river regime were made as part of the Chipping Norton Lakes Scheme. The Lakes Scheme was part of an overall rehabilitation program following extensive sand extraction from the Georges River at Chipping Norton. The Scheme, which was developed in 1977, resulted in a series of 150ha of lakes connected with the river. Although rehabilitation of the area was the main objective of the scheme, it nevertheless provided a positive flood mitigation benefit to the area.

Other channel improvement works have been confined to the Georges River tributaries. Substantial channel improvement works have recently been undertaken through an industrial area of Bankstown, along a local tributary draining to the Georges River, known as Milperra Drain.

5.6 Upstream Retarding Basins

There is substantial new development occurring in the upper catchment areas, predominantly in the Campbelltown, Liverpool and Fairfield areas. New development usually leads to an increase in impervious catchment area, leading to increased runoff, with the potential to increase downstream flooding. Fairfield, Liverpool and Campbelltown Councils have developed drainage strategies in these new developing areas to ensure that the impacts of increased catchment runoff are mitigated by appropriate compensating measures. The three Councils have adopted schemes with numerous retarding basins that attempt to ensure that post-developed flows do not exceed pre-developed flows.

5.7 Flood Warning

Flood warning has been considered to be one of the main floodplain management measures for the Georges River for many years. In 1966 Harry Scholer developed flood prediction curves to be used by the then NSW Civil Defence Organisation [Scholer, 1966]. Today the Bureau of Meteorology provides a flood warning and flood prediction service for the State Emergency Service and other Authorities.

The Bureau provides flood predictions once the river is expected to exceed minor flood levels at Liverpool. Flood predictions are provided at the Liverpool weir and a number of other downstream gauges. The warning system aims to provide at least 6 hours warning of expected peak flood heights based on actual rainfall, and 12 hours warning based on predicted rainfall.

There is a good network of rainfall and river stations within the catchment. The Public Works and Services' Manly Hydraulics Laboratory also maintains a network of automatic water level recorders downstream of Liverpool. Results from these gauges are posted on the Internet in near-real time during flood events.

6. HAS THE PROBABLE MAXIMUM FLOOD BEEN FORGOTTEN ?

The topography of the Georges River Valley is fairly unique, in that the lower reaches of the river (from East Hills downstream) is confined to a narrow gorge. This acts as a restriction during large floods, resulting in a wide range in flood levels. It has been estimated that the probable maximum flood will be up to 5m higher than the 100 year flood along a significant portion of the river.

Most Councils along the Georges River have adopted the 100 year flood as their planning level. As a consequence, there is substantial development that is located just above the 100 year flood that will be at risk in larger floods. Little consideration to date appears to have been given to what will happen in the probable maximum flood, or how this risk should be managed.

Very few people within the community have an appreciation of how high flooding can come to on the Georges River. At best, they may remember the 1986 or 1988 floods. But these were small events, no greater than a 20 year flood. Much larger floods (like the 1873 flood, or larger) can and will occur.

With the release of the new Floodplain Management Manual, there is now a greater obligation for Council to consider all floods up to the probable maximum flood.

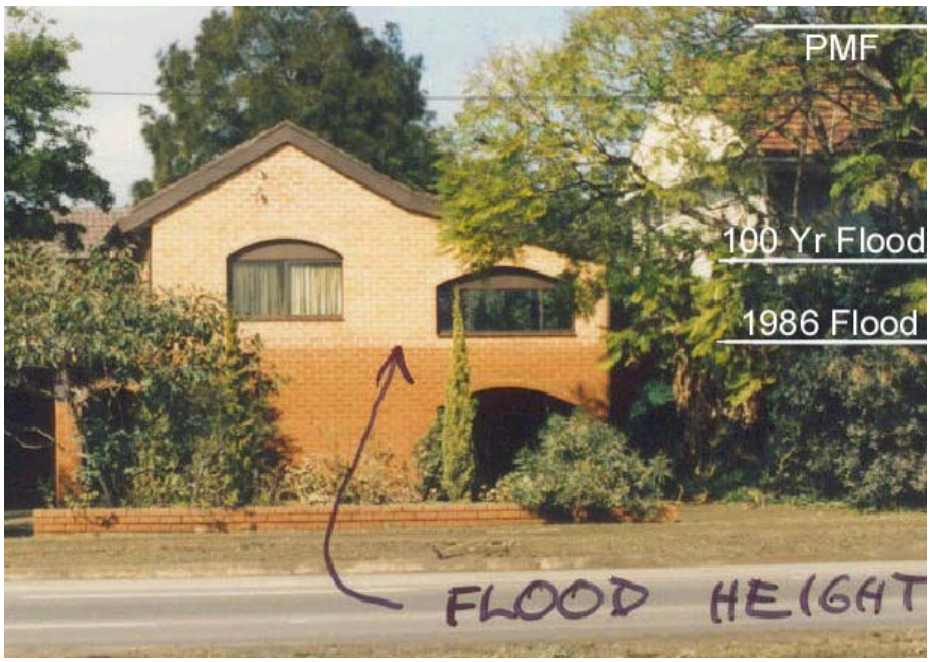


Photo 3
The Range in Flood Levels for many Houses in the Moorebank Area

7. THE CHALLENGES AHEAD

Numerous floodplain management studies have been undertaken on the Georges River over the last 20 years. These studies have been targeted at specific problem areas along the river and lower tributaries. In many instances the recommended measures have been implemented, or are in the process of being implemented.

One of the problems with this approach is that there is no overall plan for the entire floodplain. Areas where site-specific studies have not been undertaken may have been forgotten. Other measures relevant to the whole floodplain and catchment may also have been overlooked. Important considerations that are relevant to the whole area include:

< a review of the cumulative impact that floodplain development and flood mitigation works may have had on the overall flood behaviour in the river.

< management of the flood risk up to the probable maximum flood;

< appropriate and consistent planning controls for new development;

< emergency management procedures;

< public awareness to ensure the community does not forget about flooding; and

< a coordinated and prioritised plan of recommended measures.

A large proportion of the floodplain along the Georges River is located within the Bankstown and Liverpool Council areas. Both Councils will shortly embark on a joint Georges River Floodplain Management Study that should address the above issues.

So what other challenges lie ahead for the Georges River? Perhaps the greatest challenge is to ensure that the community and all concerned with the management of the river and its catchment do not become complacent or forget about the flood risk, particularly as the time since a major flood increases.

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