

MAITLAND, THE CITY OF LEVEES – DO THEY HELP OR HINDER?

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Abstract

Maitland can rightly be called the City of Levees as without the extensive levee and floodway system, floodwaters would regularly inundate both the residential and commercial areas. Maitland is synonymous with the devastating February 1955 flood on the Hunter River. In that event some levees were overtopped whilst others were not, nonetheless the City was inundated causing loss of life, entire streets of houses washed away, massive flood damages and considerable hardship and worry. The value of the levee system has subsequently been demonstrated by the protection afforded in the 1971, 1977 and more recent June 2007 floods. However in a repeat of the February 1955 flood a similar level of devastation will occur today as it did in 1955, with the potential for loss of life.

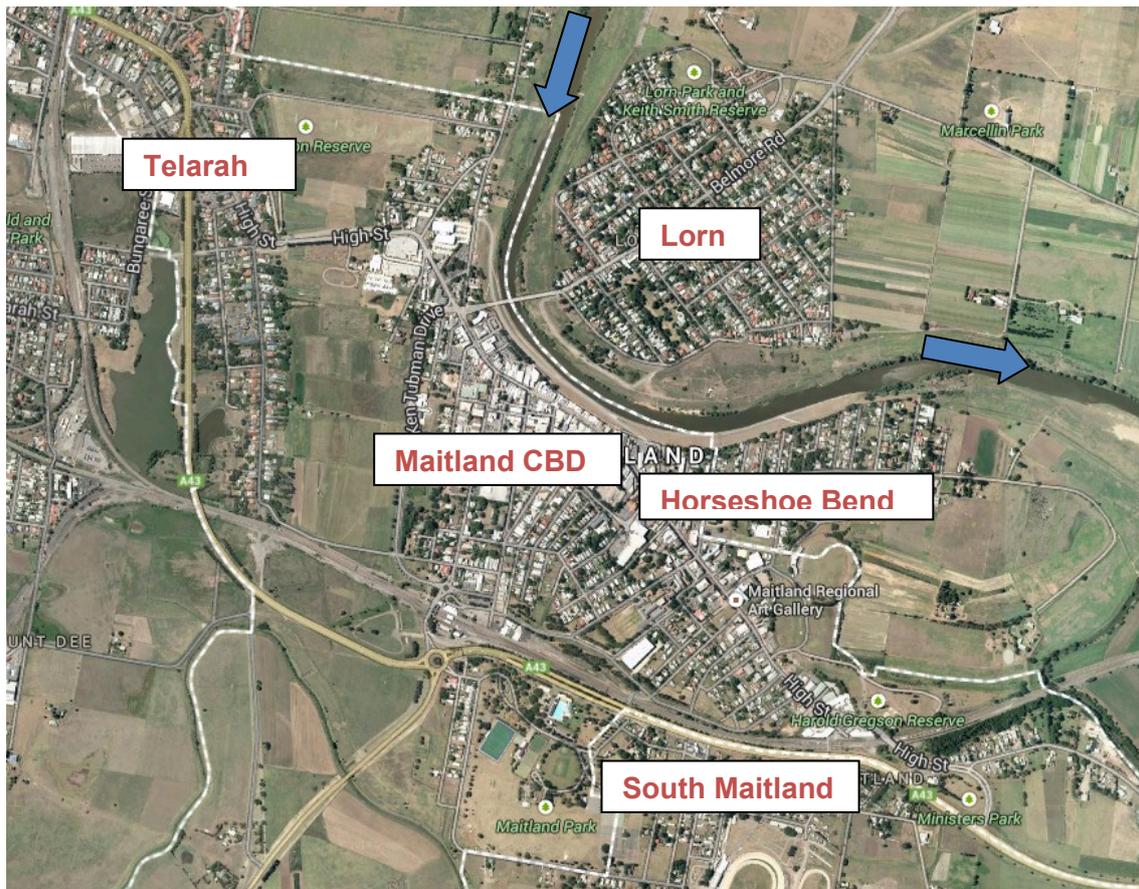
This paper examines the existing flood threat to Maitland, the role of the levee system, and its influence on community perceptions of flood risk. It considers the potential future for Maitland, and assesses what may happen in an event which overtops the levees. Will the City survive such an event or will it be time to relocate? For Maitland to thrive in the future, it must adapt to changing planning requirements and a changing role in the Hunter region. This paper explores whether the levees facilitate this adjustment or constrain it.

Introduction

The City of Maitland is located on the banks of the Hunter River approximately 35 kilometres north-west of Newcastle at the river's mouth as it enters the Pacific Ocean. The City was founded in around 1820, immediately upstream of a bend in the river and close to the tidal limit. Morpeth, approximately 8 kilometres straight line distance downstream, was the head of navigation for large coastal ships with Maitland at the limit of the shallow draft vessels. Maitland acted as the distribution centre for goods to the prosperous farming lands on the Hunter River floodplain. Up until approximately 1840, Maitland was the second largest town in Australia. However the arrival of the railway in Newcastle in the 1850s, together with larger ships meant the decline of river transport and in the regional importance of the City.

Today, Maitland comprises five main districts, four of which are on the floodplain and each having their own characteristics. Maitland CBD is the original township containing the main shopping centre and business district with some houses. Crossing Belmore Bridge to the east over the Hunter River lies the residential area of Lorn with keenly sought after heritage houses. To the west of the CBD across Long Bridge is Telarah which contains the hospital and residential and commercial areas. However, Telarah is on high ground well above the floodplain. To the immediate south of the CBD lies South Maitland which is a mix of houses and activities associated with the trotting track and the showground. To the south and east is Horseshoe Bend which is predominantly a residential area that developed on low lying lands on the outskirts of the main centre and was severely impacted in the 1955 flood. The term Central Maitland comprises the Maitland CBD, South Maitland and Horseshoe Bend.

Figure 1: Districts of Maitland (courtesy Google Maps)

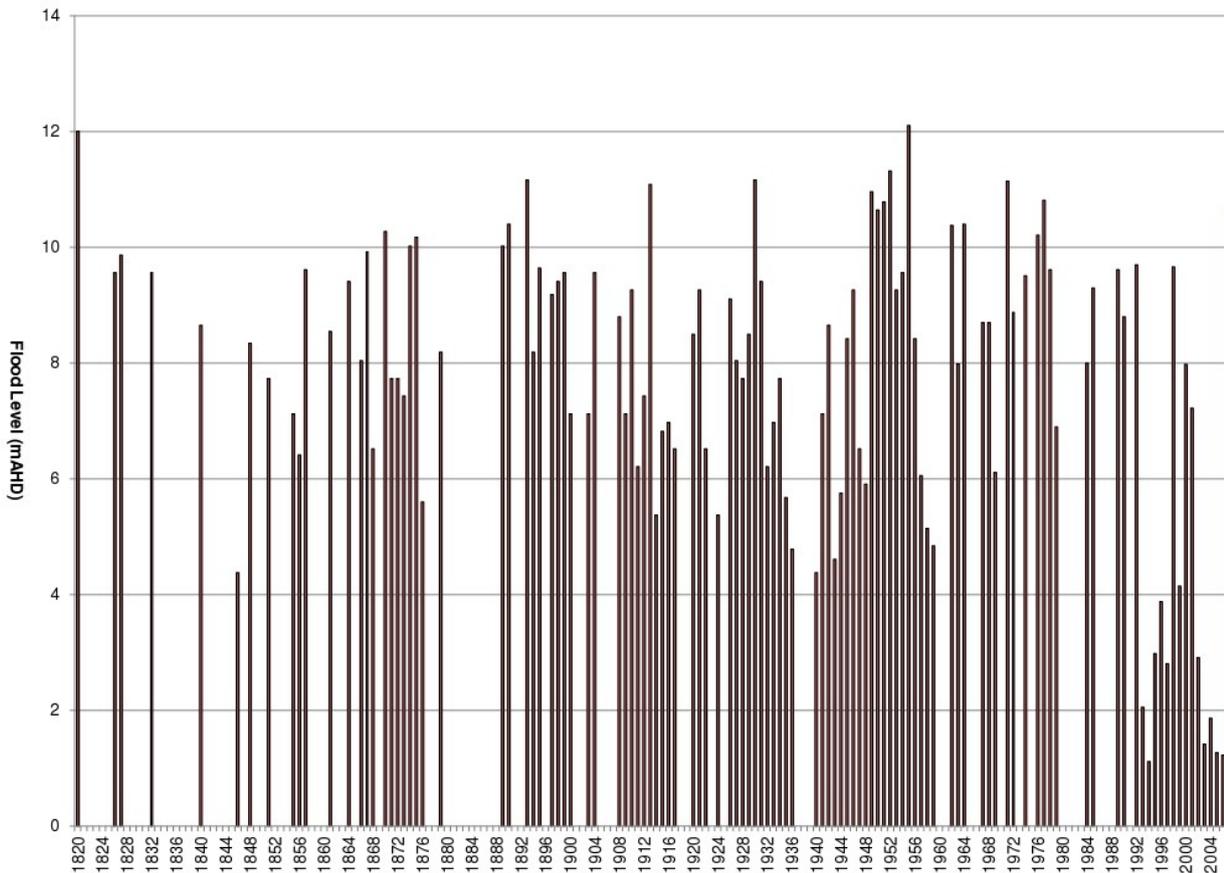


Flood History and the February 1955 Flood

The City of Maitland will always be associated with flooding and in particular the devastating flood of February 1955, though it should be remembered that this flood caused enormous damage all along the Hunter River and its tributaries, from upstream of Muswellbrook to Newcastle. Maitland became the focus of the disaster as desperate measures were taken to assist the stranded population and it received world-wide news coverage. This event is amongst the largest natural disasters to occur in Australia, destroying 59 homes, the evacuation of more than 40,000 people, inundation of over 5000 homes and the loss of 24 lives throughout the region. It was certainly not the first flood experienced in Maitland, as shown by the graph below, but was up to 0.8 metres (at Belmore Bridge) above the most recent large event of the period (in 1952) and overtopped many of the flood defences (refer Figure 2).

The most comprehensive history of flooding at Maitland is contained in the 2008 Hunter - Central Rivers Catchment Management Authority book written by Chas Keys titled *Maitland, City on the Hunter: Fighting floods or living with them?* Much of the background information in this paper was taken from this book. The February 1955 flood resulted in a major re-think of floodplain management and was instigating in the formation of the now State Emergency Services. The enhancement of the flood defences at Maitland was also initiated following this event. Since 1955 Maitland City Council has had planning policies restricting residential development in low lying areas, notably in Horseshoe Bend. As a result of these changed planning philosophies there was a significant reduction in the residential population of Central Maitland (excludes Lorn) from 5,500 in 1955 to less than 2,000 today.

Figure 2: Belmore Bridge Flood Record – Annual Peaks



History of Flood Defences

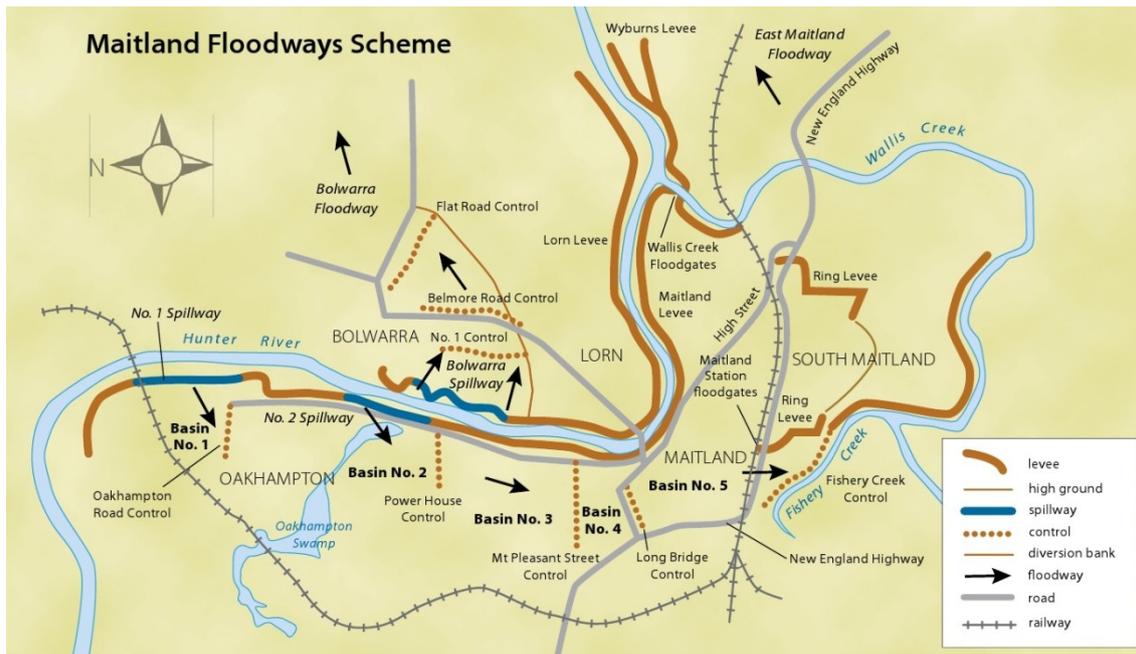
Construction of earthen banks, diversion of local creeks and some form of flood proofing was undertaken when the first floods arrived, soon after the town was settled. Over the years, the defences, particularly the levee banks or “dams” as they were colloquially known, became larger and larger and more extensive. There was no unified approach due to the multiplicity of land owners and there was even competition between the different groups to save their own land from flooding. After a major flood significant damage would be done to the settlements and flood defences, as a result larger more extensive and more elaborate levees would be built. Several reports were written warning of the dangers of the levees creating higher flood levels by confining the flow to a narrow channel, as well as the danger from levee failure.

In the years immediately prior to the February 1955 event, there existed a complex array of uncoordinated levees. The large floods immediately prior to 1955 caused some levee failures but the February 1955 flood produced the most extensive damage and resulted in re-building of the levee system by the Public Works in a coordinated manner.

Current Lower Hunter Valley Flood Mitigation Scheme

The current scheme extends many kilometres downstream from the City of Maitland and includes some 160 kilometres of levees. The scheme protecting the City is shown on Figure 3.

Figure 3: Lower Hunter Valley Flood Mitigation Scheme at Maitland



(image courtesy of Hunter Central Rivers Catchment Management Authority)

Briefly the principle of the scheme at the City of Maitland is to separate the flow into three paths around the two urban areas of Lorn and Central Maitland. The Hunter River carries the low flows but in times of high flow the floodwaters divide. To the west they enter the Oakhampton Floodway, taking a route around the south of Maitland and re-entering the Hunter River downstream of East Maitland. The other flow diversion is at the zig-zag Bolwarra spillway to the north of Lorn, which directs flow eastwards over farm lands.

The scheme largely comprises levee banks around the urban centres but also includes spillways to take the floodwaters into the overbank floodways, control banks to reduce flow velocities, basins to pool floodwaters, a diversion bank around Lorn and flap gated culverts. Flood gates also have to be closed on the railway to prevent inflow behind the levee system.

Performance of the Flood Mitigation Scheme

The scheme was finally completed around 1980, although many parts were in place much earlier. There have been three major floods since 1955 (12m AHD at Belmore Bridge), in January/February 1971 (11.1m AHD), March 1977 (10.8m AHD) and June 2007 (10.7 m AHD). The latter is often referred to as the *Pasha Bulker* storm after the bulk tanker that was beached on the coast at Newcastle and produced major flooding in the Newcastle region.

In the above three recent large events the Oakhampton spillway No 1 was overtopped and flooding occurred around but not in the urban areas of South Maitland. In the 1971 event floodwaters overtopped the Bolwarra spillway but only seeped through the gabions in the other two events. Slight modifications were made to the scheme following the 1971 event to prevent inundation from Hunter River floodwaters back flowing into East Maitland.

Figure 4: Erosion of Oakhampton Road Control Bank in 1977 (top) and 2007 (bottom)



After each event, rehabilitation works were required on the levees and where controls had been eroded (refer Figure 4). Overall the results from these three floods demonstrate that in small to moderate floods (the 1971 event was only a 5% AEP event at Maitland) the Scheme did an excellent job in mitigating damages to the urban community.

The Lorn and Maitland CBD levees provide protection from Hunter River flooding up to approximately a 1% AEP event or higher, but the levee protecting South Maitland (the “Ring Levee”) is overtopped in approximately a 2% AEP event. Overtopping of the

Ring Levee will mean that Horseshoe Bend and the southern parts of Maitland CBD will also be inundated.

Residents' Perception of Levee Banks and the Protection Afforded

In Maitland there are still some signs 4 meters above the ground showing the height of the 1955 flood on telegraph poles. In the CBD, opposite Council offices, the flood depth was 1.5 metres. Most residents will be aware of the 1955 flood and particularly the June 2007 event but how much importance do they place on flooding? Are residents of Maitland and Lorn fully aware of the protection afforded by the scheme or the implications of failure or overtopping? Are residents aware that larger floods than 1955 will occur? Flooding is not a matter of if but rather when will the next flood occur?

The June 2007 event will have heightened residents' awareness as they stood on the bank watching the floodwaters but due to the mitigation scheme there was little impact on most residents, although many were evacuated as early forecasts were that a peak slightly greater than the 1971 event was expected. Many visitors to Maitland will probably not notice the high banks on the eastern side in the Maitland CBD as these have been successfully blended into the landscape. The South Maitland levee is visually not pronounced and the gates at the railway station will probably not be noticed as a flood protection measure by most.

The most obvious awareness of the levee is in Lorn, and also in Horseshoe Bend, where the earthen banks rise steeply from street level by up to 2.5 m and obstruct views of the river. Driving east from Lorn to Bolwarra also means passing over the raised Lorn diversionary bank and then travelling across the floodplain where there are several indicators which would make even a casual observer aware of the potential for flooding.

The June 2007 event has certainly raised the awareness of residents to flooding but may also have heightened their opinion that the scheme had "solved" flooding and never again will the City of Maitland be inundated. No major levees around Maitland failed in June 2007 but the old adage that "there are only two types of levees, those that have failed or those that will fail," is a reminder of the risks, as residents of New Orleans experienced in August 2005.

Hydraulic modelling indicates that in a repeat of the 1955 event a similar extent of inundation will occur, however the risk to life and damage should be significantly lessened as a result of implementation of an evacuation strategy by the SES. This was undertaken in the 2007 event, though fortunately the estimated peak never eventuated.

Flood Awareness

The increase in flood awareness from the June 2007 event can only be sustained if a continued flood awareness program is undertaken. Fortunately, since 1955 elements of such a program have always been available to residents of Maitland. The most obvious are the various 1955 flood markers placed on telegraph poles. In the past some were removed as they were considered to affect property sales, however in recent times there have been moves to re-establish them and even a suggestion to make some more pronounced.

The City of Maitland has never shied away from its history of flooding and has commemorated the 1955 event on key anniversaries with displays, talks and tours. There was also a 5 year anniversary of the June 2007 event. The local newspaper, The Maitland Mercury has played a key role in this, as have Council, the State Emergency Services (SES), the Hunter Catchment Management Authority (HCMA) and others. In the last 10+ years there has been an increased involvement in flood awareness led by the HCMA and the SES. The elements of the program include:

- research into flood awareness;
- "Walk the Talk" flood tours around Maitland. These have proved to be very popular with residents and visitors;
- employment by the HCMA of a flood and wetland education officer;
- updating and preparation of factsheets on the mitigation scheme, flooding in the Lower Hunter and the June 2007 and February 1955 floods;
- the HCMA and SES having comprehensive and easy to navigate internet sites;
- talks to schools by the HCMA flood and wetland education officer and site visits around Maitland;
- trial evacuations by the SES;
- a DVD of the June 2007 flood;
- preparation of catchment action plans;
- preparation of the book: *Maitland, City on the Hunter: Fighting floods or living with them?*
- preparation of a DVD titled: "Are you Floodsafe"?

In summary as much as reasonably can be undertaken to raise and maintain a high level of awareness has been and will continue to be done. As floods occur and technology changes the elements of the program will be amended as required.

Lorn - How is it protected by Levees?

Lorn was developed in the 1920's as a "garden suburb" with tree lined streets and is predominately made up of highly sought after heritage single storey homes accompanied by boutique shops and eateries. There have been very few new homes built in Lorn in the last 20 years, largely because the existing housing stock is well cared for and there are few vacant lots. The expansion of Lorn is limited entirely by the levee system to the north, south and west. There is an opportunity to extend to the east, into what is mainly turf farms, but this land is at a lower level and thus inundated more frequently.

Whilst the growth of Lorn is therefore entirely restricted by the levee system it is this protection that allows it to survive during floods. Without such a system, parts would have been inundated in June 2007. In February 1955 it is understood that whilst the levees generally performed well there was a breach at Lorn though little detailed information is available on the extent of inundation.

The levees effectively make Lorn an "island" in times of flood. Access to Bolwarra is cut in the 5% AEP and greater events, as it was in 1971 but not in 2007. The only other road route is across Belmore Bridge to Maitland CBD. This access will not be cut until events greater than the 1% AEP but access out of Central Maitland itself is cut in approximately the 5% AEP and greater events.

Maitland CBD, South Maitland and Horseshoe Bend - How are they protected by Levees?

Maitland CBD and Horseshoe Bend are protected from inundation from the Hunter River by the riverbank levee which provides protection to greater than the 1% AEP. However these areas are first inundated from the low lying land in South Maitland adjacent to the Oakhampton Floodway.

The Ring levee provides protection to South Maitland but only to just greater than a 2% AEP event. The Ring levee is less distinct than the riverbank levee and is made up of several components (gates on railway, earthen bank between houses, high ground in Maitland Park, part of the showground and links into Les Darcy Drive). Floodwaters will first enter Maitland over the Ring levee and then will progress northwards invading Horseshoe Bend and ultimately the Maitland CBD. That is unless there is failure of the riverbank levee.

The Future

The growth and makeup of the City of Maitland have changed since 1820 as a result of many factors including: adaptation to floods through the construction of mitigation works, changing transport links and overall changes to lifestyle and the economic makeup of the area. Looking towards the future the City of Maitland must also change and in the process adapt to ensure its survival and well being.

One of the main drivers of change is the need to meet the growth targets contained in the 2006 Lower Hunter Regional Strategy requiring up to 1,300 new homes and 3,200 new jobs in Maitland. Other drivers are that the City has experienced a decline in the competitiveness of businesses, a declining population and prosperity in the city as well as a decay in the historic fabric. How can Maitland respond to the drivers and how is the way forward affected by the existing levees?

Visual and Access Impact of levees

Probably the largest negative response from residents to the construction of a new levee in most areas is the reduction in visual quality and ease of access. Several levees in NSW have been considered but ultimately rejected largely because of these potential impacts. For most residents the view of a river or another water body is the reason they live close to the water. By taking away that view the value of that location is lost. A similar but not quite so important point is the reduction in access resulting from levee construction. Fortunately at Maitland and Lorn these two issues do not appear to be as significant. Houses in Lorn were presumably constructed at a time when there was some form of levee and it would appear that the loss of visual quality has been accepted.

The same would appear to apply at Lorn with access. The road access across the diversionary bank is excellent and whilst access over the levee is more difficult it is possible at some locations. Just downstream of Belmore Bridge on the Lorn side access to the river and views across the river to Maitland CBD are available.

The riverbank levee on the Maitland CBD side has been designed to blend into the adjoining commercial area and is promoted as an area to enjoy the vista across the

river. The Ring levee also blends into the landscape and provides no significant visual or access issue.

In summary these two key negative issues associated with levees have been accepted by the community. However if a new levee or higher levee was proposed these issues may reappear.

Impact of Levees increasing Flood Levels

Construction of any levee will increase flood levels in areas not protected by the levee, and this can be relatively easily quantified with the 2-dimensional hydraulic computer models in use today. In the past less consideration was given to this issue, though it was noted in the past at Maitland that by confining the river more and more would raise flood levels. The increase in flood level of the Lower Hunter River Flood Mitigation Scheme has never been accurately quantified but has obviously been accepted by the community in exchange for flood protection.

The hydraulic impacts of construction of a new levee at Maitland would need to be thoroughly assessed and it is likely that some adverse reaction from affected land owners would appear.

Do Levees at Maitland give a False Sense of Security?

This is a question that is impossible to know until the next flood happens. As noted above there has been in the past and there is a high quality flood awareness program that is always under review and being updated. There is not much more that can be done in this regard.

An example of community perceptions underestimating the flood risk is evident from a Maitland Mercury article of 11 January 2011 entitled "*Hands tied needlessly, says would be developer.*" A Horseshoe Bend resident is quoted as follows:

The 1955 flood was an "unnatural disaster" with the opening of the flood gates [of the Glenbawn Dam that was under construction] at the wrong time. There weren't any issues in 2007 and with all the work they've done since '55 the risk is a lot less.

The quote demonstrates a dubious understanding of the 1955 flood event. Glenbawn Dam (in the Upper Hunter catchment near Scone) was under construction at the time, but has an ungated spillway. Even in its completed state it has only a token flood mitigation effect at Maitland. Most current residents of Maitland and Lorn have not experienced inundation of their properties, and impressions of the 1955 flood have naturally faded or warped over time. The desire to discount the risk is strengthened by factors such as relatively cheap land values in some areas.

However it is likely that some residents will not be fully aware of the flood risk and think that the levees completely eliminate the flood risk. Widespread appreciation of the risk is unlikely to increase until severe flooding occurs again. This may mean that residents do not promptly act on the advice of the SES to evacuate.

Should new Levees be constructed, existing Levees raised or Levees removed?

The issue of new levees has been discussed and there are no obvious areas where these works could be undertaken. However it is always possible to raise existing levees and provide greater protection.

Around the urban areas it is unlikely that there would ever be a commitment to remove levees but in rural areas this is an area of discussion. There is a significant cost to public authorities to maintain levees in both rural areas and urban areas and there are many hydraulic, economic, social and environmental reasons for removing levees in rural areas. As yet the way forward is not clear but this is an area that will need to be investigated further.

Future Growth of Maitland – How is this Affected by Levees?

As noted above the 2006 Lower Hunter Regional Strategy requires further housing stock in Maitland. The current levee system at Lorn effectively limits the expansion of the settlement and with nearly all lots occupied there is little potential for growth.

In Central Maitland it is largely the same situation, though there is the opportunity to re-develop existing areas behind the levees to increase the population. This can be achieved by creating “shop top” housing above existing commercial developments or creating new housing stock to replace the existing.

At first glance this strategy appears relatively straight forward but it raises many issues. Should the new houses have raised floors to prevent inundation in a given design flood or should they be at ground level and thus inundated with overtopping of the Ring levee (2% AEP)? Having floors at the lower level will mean inundation in lower than the normally accepted standard for residential housing in NSW of the 1% AEP plus 0.5m freeboard. However if they are to be at the accepted standard this will mean house floors 3 metres to 4 metres above the ground. From a streetscape and access viewpoint this creates significant issues, and this dichotomy is probably the main reason why very few houses have been rebuilt in Central Maitland in the last 30+ years.

There have been many discussions in the past about whether protection by a levee should mean that floor levels can be lowered as a result. The main argument against lowering floor level controls is that a levee is designed to mitigate damages to existing buildings and not promote new development. However at Maitland and Lorn the existing floor level controls assume the presence of levees and indeed the entire Lower Hunter Flood Mitigation Scheme. No attempt has been made to determine flood levels in the absence of the Scheme.

With an increased population in Central Maitland this means increased population to be rescued in events greater than the 5% AEP. In theory with a co-ordinated and well functioning evacuation strategy residents will have moved from Lorn and Central Maitland, prior to the peak. In practice, despite the best efforts of the SES, Council and others it is likely that some will remain. History has shown that many flood bound and bush fire bound residents are reluctant to move or only make the decision at the last minute when it becomes too late. The strategy has changed for bush fires where it has been made much clearer that there is only a window of opportunity to escape and after

that it is safer to stay. With a bush fire the danger has largely gone once the fire front has passed. However with floods people remain in harm for several hours or even days and efforts are made to rescue them during the event, as happened in 1955 and more recently in Bundaberg in 2013. An increased population to be rescued means additional resources from the SES and other authorities. The question that is always raised is – Should this increased population be permitted as the SES and others already have a significant burden?

In many areas with levees, the residents can relatively easily escape to high ground. However where levees create a flood island, as they do at Central Maitland and Lorn, this is not possible and a situation is created where lives are at risk if the levees are about to be overtopped or fail before overtopping. The most recent example of this was at Bundaberg, Queensland. Major flooding occurred in 2010/2011 but levels were exceeded by the January 2013 flood. Desperate measures were required to evacuate over 1000 people with Black Hawk helicopters employed and residents cutting holes in their roofs to escape as the powerful currents were too strong for flood boats. This is an example where, for whatever reason, residents who were flood aware did not evacuate in time and consequently placed themselves and their rescuers at risk.

The potential for inundation and risk to life is increased significantly if levee failure occurs. Fortunately this is not a common occurrence in NSW as levees are designed to a high standard but even the best built levees can fail, as occurred with dramatic consequences in New Orleans. Levee failure is a real possibility in any flood. This risk of levee failure cannot be accurately established. Earthen banks can fail prior to overtopping due to slumping of the water logged banks or erosion at a weakened point. Some of the levees were constructed prior to 1955 and obviously withstood that event. Presumably post 1955 the rehabilitation works were undertaken in a rigorous manner and levee audits can be undertaken but this can never fully establish the failure potential. This is something that the City of Maitland must live with.

Even in the levees do not fail structurally and let in flood waters there will be a flood greater than 1955 at some time in the future that will overtop the defences and inundate the entire City. Hopefully in such an event all persons will be safe but what should happen to the City thereafter? Should it be rebuilt with the same or greater defences or should its size be decreased? At many flood liable towns in NSW there has been talk of relocating the town after a large flood. Certainly this was discussed many times in Maitland's past but rarely has this actually occurred in NSW. One example is the village of Terara on the banks of the Shoalhaven River following the 1860 and 1870 floods where the settlement was moved to higher ground at Nowra.

At present all escape routes out of Lorn and Maitland are cut at about the 5% AEP flood level. Anyone who has not moved in such an event must then remain in Lorn or Maitland for the duration of the flood. In the smaller floods the risk to life is probably small but if levee overtopping or failure occurs then a situation similar to that at Bundaberg in 2013 will develop. Lives may be lost in such a scenario despite the best efforts of the rescuers. It could be argued that in a perfect world all residents will have been evacuated as a result of high quality and timely flood warnings and the efforts of the SES. Only time will tell what happens at Maitland but history indicates many residents will not evacuate until it is too late.

This situation can be improved upon with construction of a high level evacuation route from the Maitland CBD to high ground at Telarah. Creation of a rising flood access route will mean that residents still have the opportunity to evacuate even after the existing low level routes have been cut and floodwaters are lapping at their door step. There may also be additional transport benefits of such a new route to the Maitland CBD.

Conclusion

Floods have played a significant role in the development of the City of Maitland. The City has responded to the risk by constructing flood defences which largely comprise levees. However these levees also limit the future expansion of the City beyond its present limits, or even within those limits due to streetscape, access and heritage issues. It would appear that most residents accept the disadvantages of levees for the benefit of flood protection but the future growth of Maitland is affected. These issues will require resolute effort from the community over a long time frame to resolve.