

PSRP-7 LEVEE UPGRADE DETAILED DESIGN & COMMUNITY CONSULTATION

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Recommendation

That Council:

- a proceed with construction of the Main City levee to provide a 1 in 100 year level of protection, making allowance for the possibility that the North Wagga levees may also be constructed to provide a 1 in 100 year level of protection**
- b incorporate an investigation into providing a 1 in 100 year level of protection for North Wagga into the upcoming review of the Wagga Wagga Floodplain Risk Management Study and Plan**

Executive Summary

In May 2013, Council resolved to proceed with the detailed design of the Main City and North Wagga levees and to investigate various options available for flood mitigation in North Wagga.

NSW Public Works (PWD) were engaged by Council to undertake the detailed design, investigate options for North Wagga and undertake an economic appraisal for each of the various options for North Wagga and the project as a whole. The outcome of the economic analyses favours the upgrade of the North Wagga levees to a 1 in 100 year level of protection.

Extensive community consultation was undertaken during the detailed design process. This included six (6) community meetings, individual meetings with landholders directly impacted by the proposed levee upgrade, online surveys and the preparation and distribution of fact sheets on various aspects of the project. The feedback received from the community indicated strong support for the upgrade of the North Wagga levee system to a 1 in 100 year level of protection.

On the basis of the economic appraisal and community consultation, it is recommended that Council upgrade the North Wagga levee system to provide a 1 in 100 year level of protection.

There are a number of issues with this proposal that will have to be addressed to ensure that it has the support of the Office of Environment and Heritage (OEH) and is eligible for funding under the NSW Government Floodplain Management Program.

Report

At the Ordinary Council Meeting of 27 May 2013, Council passed the following resolution (13/132).

That Council:

- a proceed with the planned detailed design phase for the upgrade of the Main City levee*

- b proceed with the planned detailed design phase for the upgrade of the North Wagga levee*
- c receive a further report for consideration post completion of the detailed design phase before committing to funding the construction of the upgrade of the main city levee*
- d receive a further report on other options for providing flood protection for North Wagga residents and commercial operators in response to feedback from the community including:*
 - i raising the North Wagga levee to a 1 in 20 year level of protection*
 - ii raising the North Wagga levee higher than a 1 in 20 year level of protection*
 - iii removing the existing North Wagga levees*
 - iv relocation of the village from the floodplain*
 - v raising residences in North Wagga*
 - vi voluntary purchase for properties in North Wagga*
 - vii raising houses in Mill and East Street that are protected by North Wagga levee two*
 - viii maintain the levees at their current level of protection and take no further action*
- e receive a further report outlining other general flood related topics raised by the community through FloodFutures and recommendations on how Council should proceed to address these*
- f continue to seek commitments from the State and Federal Governments*

Council engaged the services of NSW Public Works (PWD) to undertake the detailed design for the Main City and North Wagga levees. The brief provided to PWD was to design the levee upgrade to provide a 1 in 100 year level of protection for the Main City and 1 in 20 year level of protection for North Wagga. In addition to the detailed design, PWD were to undertake a study into the available options for North Wagga. They were also required to undertake an economic analysis for the upgrade of the levee systems and to investigate third party impacts.

Detailed Design

PWD are nearing completion of the detailed design for the upgrade of the Main City and North Wagga levees to provide 1 in 100 and 1 in 20 year levels of protection respectively. The upgrade of the Main City levee results in a change to sheet piling in some sections due to a lack of space in some of the more developed parts of the city. The proposed sheet pile levee is approximately 1.8km in length in three (3) sections between the Sturt Highway and Fitzmaurice Street. The remaining sections of levee will use the same constructions methods that have been used previously, with earthen embankments increasing in height and width, and concrete retaining walls

increasing in height. The North Wagga levees remain predominately as is, with the earthen embankments increasing in height and footprint.

The Main City levee will feature two (2) spillways, one downstream in the vicinity of Flowerdale Lagoon, the other upstream in the vicinity of Koorringal Road. It is necessary to have two (2) spillways to ensure controlled inundation prior to levee failure due to the length of the Main City levee. The North Wagga levee will have a single spillway located downstream at Hopkirk Street.

North Wagga Options

PWD investigated the North Wagga options detailed in the May 2013 Council resolution. The details are provided in the North Wagga Levee Options and Third Party Impacts report (attached). The following sections provide a summary of each of these options.

Raise the North Wagga levee to a 1 in 20 year level of protection

This option is the basis for the detailed design undertaken by PWD and is consistent with the Wagga Wagga Floodplain Risk Management Plan. The estimated cost of construction for this option is \$4.80M, consisting of \$3.35M for the upgrade of the North Wagga levee and \$1.45M for the upgrade of levee two (the smaller levee that protects residences in East Street and Mill Street). The average annual damages (AAD) for this option are \$689K.

Raise the North Wagga levee higher than a 1 in 20 year level of protection

The assessment of this option is based on increasing the height of the North Wagga levee system to provide a 1 in 100 year level of protection. The estimated cost of this option is \$6.81M, comprising \$4.13M for the upgrade of the North Wagga levee, \$1.62M for the upgrade of levee two, and \$1.06M increase in the cost to upgrade the Main City levee. If the North Wagga levees are upgraded to provide a 1 in 100 year level of protection, it will be necessary to increase the design height of the Main City by 100-200mm for 5.1km immediately adjacent to and upstream of North Wagga.

This increase is required because of afflux in floodwaters in larger flood events caused by the restriction in the floodplain attributable to the North Wagga levees (that are overtopped and provide less restriction if designed to provide a lower level of protection). This effect is illustrated in Figure 5 of the North Wagga Levee Options report. The AAD decrease markedly for this option to \$149K. A potential negative aspect for this option is the visual impact of a 1 in 100 year levee and its effect on the amenity of North Wagga.

Remove the existing North Wagga levees

The cost estimate for this option is \$395K, made up of \$320K to remove and dispose of the North Wagga levee and \$75K to remove and dispose of levee two. The AAD increase to \$1.515M for this option.

Relocation of the village from the floodplain

This option was based on the relocation of the entire village to a new, flood free location. An estimate was prepared for the construction of a new subdivision, similar in size and character to North Wagga. The cost of development alone was estimated to be in the order of \$90M. This estimate did not include the cost of land or the cost to relocate buildings that could reasonably be relocated and demolish and replace those that could not. The AAD for this option reduces to zero, however, this is outweighed by the expense involved.

Raising residences in North Wagga

The assessment of this option was based on an estimated cost to raise buildings that may be raised and the estimated cost to demolish and build at a higher level those that cannot. A cursory inspection was undertaken of residential and non-residential structures in North Wagga. This inspection suggested that of the 169 dwellings, it may be possible to raise 113. The remaining 56 would have to be demolished and rebuilt at a higher level if all of North Wagga was to be raised above floodwaters. Similarly, of the nineteen (19) non-residential buildings, seven (7) may be able to be raised, while the other twelve (12) would require demolition and rebuilding above the nominated flood level.

The estimated cost to either raise or demolish and rebuild all buildings is \$22M. This figure is made up of \$6M to raise the 120 buildings that may be able to be raised and \$16M to demolish the 68 that cannot. AAD have not been calculated for this option for a number of reasons. No design flood height has been set to raise buildings above and an amount of damage will occur regardless of the level that buildings are raised to.

Voluntary purchase for properties in North Wagga

A high level estimate of \$37.2M was prepared for the voluntary purchase of all properties in North Wagga. This estimate does not include the demolition of structures on acquired land. If this option was pursued, and all properties are able to be acquired, AAD would decrease to zero. The cost associated with this option is prohibitive compared to some of the other options, at least in the short to intermediate term.

Raising houses in Mill and East Street that are protected by North Wagga levee two

The estimated cost to raise the houses protected by levee two in East Street and Mill Street is \$1.65M. There are 21 dwellings in total. It is likely that seventeen (17) can be raised at an estimated cost of \$850K. Four (4) probably cannot and would have to be demolished and rebuilt at a higher level at an estimated cost of \$800K. AAD have not been calculated for this option as it is not inclusive of all properties protected by the North Wagga levee system.

It is interesting to note that the estimated cost to raise the dwellings in East Street and Mill Street is of a similar magnitude to the cost to upgrade levee two (\$1.45M for 1 in 20 year level of protection and \$1.62M for 1 in 100 year level of protection). It is quite possible that a better outcome may be achieved by a combination of the removal of levee two, house raising and/or voluntary acquisition of properties in Mill Street and East Street.

In addition to addressing the impacts of flooding in East Street and Mill Street, this may also result in a decrease in third party impacts (compared to other options). Further modelling would have to be undertaken to confirm the change in flood behaviour associated with the removal of levee two. Extensive consultation and negotiation will be required with the landholders protected by levee two if this option is to be considered further.

Maintain the levees at their current level of protection and take no further action

There is no capital cost associated with this option. The AAD for the North Wagga levees at their current level are \$1.204M.

The following table provides a summary of the options considered.

Option	Capital Cost	AAD	Present Value of Total Cost at 4% Discount Rate
North Wagga levees at 1 in 20 year level of protection	\$4,800,000	\$689,000	\$13,744,935
North Wagga levees at 1 in 100 year level of protection	\$6,810,000	\$149,000	\$8,329,220
Remove North Wagga levees	\$395,000	\$1.515M	\$20,709,697
Relocation of the village from the floodplain	\$93,500,000	\$0	\$93,500,000
Raising residences in North Wagga	\$22,000,000	Not assessed	\$22,147,499
Voluntary purchase of properties	\$37,200,000	Not assessed	\$37,200,000
Raising houses in Mill Street and East Street	\$1,650,000	Not assessed	\$1,797,499
Current level of protection	\$0	\$1.204M	\$16,291,985

Third Party Impacts

An analysis of the third party impacts associated with each of the North Wagga options was also undertaken. There were 233 residential properties identified on the Murrumbidgee River floodplain at Wagga Wagga located outside of the Main City and North Wagga levees. The AAD for these properties with the North Wagga levee system at its current level is estimated to be \$726K. If the North Wagga levees were removed the AAD will decrease slightly to \$716K. The upgrade of the North Wagga levee system to a 1 in 20 year level of protection will result in an increase in AAD of \$4K to \$730K. Providing a 1 in 100 year level of protection for North Wagga will result in an increase in AAD to \$732K.

Option	Inside North Wagga levee system AAD	Outside North Wagga levee system AAD
Current level of protection	\$1,204K	\$726K
Remove North Wagga levees	\$1,515K	\$716K
North Wagga levees at 1 in 20 year level of protection	\$689K	\$730K
North Wagga levees at 1 in 100 year level of protection	\$149K	\$732K

The increase in AAD for properties in the floodplain outside of the levee system is far outweighed by the decrease in AAD for properties protected by the North Wagga levee system for both options to increase the level of protection provided by the North Wagga levees. Similarly, the decrease in AAD for properties outside of the North Wagga levee system is very small in comparison to the increase in AAD for properties currently inside the North Wagga levee system if the North Wagga levees are removed.

Community Engagement

In March 2015 Council held six community information sessions to outline the detailed designs for upgrades of the Main City and North Wagga Levees, and to deliver a report on alternative flood management options for North Wagga.

Landowners that live in close proximity to the levee were also offered the opportunity to meet with representatives from Council and NSW Public Works to discuss the detailed design. As a result about 18 individual landowners or stakeholders were consulted with.

In addition to this, members of the community were encouraged to provide specific feedback via an online survey or by contacting Council using traditional methods such as letters or telephone.

Members of the general public were also invited to have a look at what the levee upgrades will look like via software made available in the Wagga Wagga City Library, which gave people another avenue to discuss flood related issues with Council staff.

Whilst opportunities for the community to engage were advertised widely to the general public, the large majority of people that attended meetings and/or gave feedback were North Wagga residents.

The feedback received demonstrates majority support for an upgrade of the North Wagga Levee to a 1 in 100 year level of protection.

There is also overwhelming support for an upgrade of the Main City Levee to a 1 in 100 year level of protection.

Community information sessions

These sessions were held over two weeks targeting residents and businesses in Oura, Gumly Gumly, North Wagga, East Wagga, Eunony and the general Local Government Area. As well as providing an avenue to present the latest information, the sessions gave the community an opportunity ask questions, give feedback and discuss flood related issues in general.

A number of methods were used to promote the meetings including:

- the distribution of more than 4000 flyers in a variety of ways to best target different localities
- the placement of advertisements in the Daily Advertiser and The Leader
- stories in Council News
- placement of advertisements in Economic Pulse, Council's newsletter for the local business community

A head count undertaken at each meeting suggests that more than 200 people attended in total. The figures below are based on the attendance sheets. Actual attendance may have been slightly higher, particularly in North Wagga and Gumly Gumly, as not all residents that attended recorded their details.

Meeting	Attendees
Oura	10
Gumly Gumly	17
North Wagga	95
East Wagga	6
Eunony	14
General	28
Total	170

The minutes of these meetings and follow up responses are publicly available on the Flood Futures website.

The key themes of the feedback received at each meeting are summarised below.

Oura

- Scepticism about the accuracy of the modelling
- Concerns that Oura is being forgotten in the conversation about floodplain management, with Council investigating options for North Wagga
- Concerns about the impact that bottlenecks downstream have on the flow of water upstream
- Desire to be kept informed about developments on the floodplain, in particular the Harness Racing Facility

East Wagga

- Strong emphasis on concerns about the combination of riverine and overland flooding, particularly in relation to Marshalls Creek
- Desire for Council to better plan subdivision and industrial development, to minimise the impact on the floodplain and storm water catchments

General

- Questions about timeframes, construction process and funding for the levee upgrade
- Process questions about evacuations and questions for the SES about what impacts different floodplain management options would have on evacuation orders
- Desire for Council to support measures that will make it easier to develop in North Wagga

North Wagga

- An upgrade of the North Wagga Levee system to a 1 in 100 year level of protection will have the most benefit both socially and economically
- Option to relocate the village from the floodplain was widely dismissed
- Desire for a reduction of the amount of vegetation on the floodplain and to relieve bottlenecks downstream, particularly at Malebo Hill
- Concern not enough is being done to ensure that the next time floodwaters overtop the North Wagga Levee that water does not stay inside for as long as it did in the March 2012 flood event
- Concern about the impact of development on the floodplain

Gumly Gumly

- Concern about the impact that raising the Main City and North Wagga Levees will have on floodwaters in Gumly Gumly
- Desire for compensation for properties outside of the levee system if it is upgraded
- Desire to be able to access any assistance that might be available to landholders in North Wagga, such as raising houses

- Concern about the impact of development on the floodplain
- Desire for a reduction of the amount of vegetation on the floodplain and to relieve bottlenecks downstream, particularly at Malebo Hill

Eunony

- Desire for compensation for properties outside of the levee system if it is upgraded
- Concern about the impact of development on the floodplain

Additional feedback

The broader community was encouraged to take the time to think about the information that was presented at the information sessions and provide feedback formally either via an online, survey which was open for six weeks, or by contacting Council.

This opportunity was promoted at each of the six community information sessions, in Council News and in a direct email to 1400 registered Your Say Wagga users.

A total of 283 people provided such feedback either via phone, letter, email, face to face or online.

The feedback was collected under two categories:

- 1) Detailed design for the Main City and North Wagga Levee Upgrades
- 2) Alternative flood management options for North Wagga

Detailed design for the Main City and North Wagga Levee Upgrades

Respondents were encouraged to give feedback on whether or not they supported the Main City Levee Upgrade, suggestions for the detailed design and to discuss floodplain management issues in general.

A total of 45 people contributed to this discussion with 93% of respondents supporting the upgrade of the Main City Levee. The three respondents that did not show support cited concerns about inequity in relation to North Wagga, and did not believe that the Main City Levee should be raised to a 1 in 100 year level of protection unless North Wagga is as well.

The respondents reside in a range of suburbs including Central Wagga and surrounding areas such as Estella, Tatton, Lake Albert, Eunanoreenya and North Wagga. There was little feedback from outlying villages, with only one respondent from Oura.

Of those that support the upgrade, there was a strong emphasis on protecting the city and spending money now to save money later if it is flooded.

Some statements of support include:

"To support the future growth and prosperity of our city"

"We have a 3.7 billion dollar economy. I already lost my house in a flood - I can't afford to lose my job too!"

“To avoid evacuation and higher insurance costs”

“Because if the CBD of Wagga is flooded due to overtopping or outright failure, the city may never fully recover from the devastation caused”

Suggestions for the detailed design were dominated by the useability and aesthetics of the levee aside from its functionality to hold out flood waters.

These include incorporating the Riverside Project and encouraging cafes to develop along it, sealing the bike path, incorporating art and landscaping.

When given the chance to comment on floodplain management in general, the key theme was in relation to tighter measures around development on the floodplain, and a focus on stormwater management.

Alternative flood management options for North Wagga

Respondents were encouraged to identify what they would like to see happen with the North Wagga Levees, which other floodplain management options they believe are appropriate for North Wagga and to discuss floodplain management issues in general.

The majority of respondents reside in North Wagga (72%), however there is strong evidence to suggest that the majority of people that did not identify a suburb also reside in North Wagga. If adjusted to reflect this total estimate this figure demonstrates that 81% of respondents reside in North Wagga.

Five respondents were found to have given feedback on two occasions and the figures have been collated accordingly.

Of the 238 respondents 190 (79%) support and upgrade of the North Wagga Levee to more than a 1 in 100 year level of protection.

Of this 79%, 83% support an upgrade of the levee to a 1 in 100 year level of protection.

This means 61% of all respondents support an upgrade of the levee to a 1 in 100 year level of protection.

Of the 2.1% (5 people) of respondents that would like to see the levee removed, three of them identified as living in North Wagga but outside of the levee system. Two respondents qualified their responses by saying this should only occur after a period of voluntary purchase.

The full breakdown of responses in relation to the levee is as follows:

Option	Number of respondents	Percentage
Upgrade the levee to a 1 in 100 year level of protection	158	66.4%
Raise the North Wagga levee higher than a 1 in 20 year level of protection (non-specific)	25	10.5%
Upgrade the levee to a 1 in 80 year level of protection	1	0.4%
Upgrade the levee to a 1 in 60 year level of protection	1	0.4%
Upgrade the levee to a 1 in 50 year level of protection	3	1.2%
Upgrade the levee to above a 11.5m river level	2	0.8%
Upgrade the levee to a 1 in 20 year level of protection	23	9.7%
Maintain the levees at their current level	18	7.6%
Remove the existing North Wagga levees	5	2.1%
N/A	2	0.8%
Total	238	

Of those that support an upgrade on the levee to a 1 in 100 year level of protection, there was a strong emphasis on protecting the community that many people have lived in for a long time and have grown to be a part of.

Some statements include:

"Have lived in North Wagga for over 30 years - we love it here. Very quiet and close to town. If levee was higher would stop the chance of flooding under most circumstances"

"I would support any measures that will prevent the North Wagga residents once again having to relocate and children having to attend makeshift schools and pre-schools. The emotional toll of the flood is evident when speaking with many residents."

"Raise the levee banks and maybe the insurance companies might bring their premiums down."

When asked about other floodplain management options 77% of respondents either did not answer or specified that no other floodplain management options were required.

Of those that did identify an option there was large support for a house raising scheme, with voluntary purchase identified as the next most popular option.

The full breakdown of responses in relation to non-levee related flood management option is as follows:

Option	Number of respondents	Percentage
No other floodplain management actions are required	70	29.4%
Raise residences in all of North Wagga	22	9.2%
Not house raising	1	0.4%
Raise residences in Mill and East Street only	8	3.4%
Raise residences inside the main North Wagga levee only	6	2.5%
Relocation of the village from the floodplain	4	1.7%
Voluntary purchases for properties in North Wagga	9	3.8%
Raise residences in all of North Wagga AND Voluntary purchases for properties in North Wagga	2	0.8%
Did not answer	116	48.7%
Total	238	

Outside of the options provided, there were also a number of suggestions to clear vegetation on the floodplain, investigate relieving bottlenecks such as Malebo Hill, removing rural levees that do not form a part of the official North Wagga levee system, limit development on the floodplain and better warning systems for evacuations during flood events.

Some statements in relation to non-levee related floodplain management options include:

"Our house is on a concrete slab so is unable to be raised. We love North Wagga so relocation wouldn't work."

"I'm 70 so can't live in a raised house"

"Limit construction on the whole of the floodplain, not just North Wagga, and clear excessive vegetation from the North Wagga flats."

"Equitable treatment of rate payers who are on the floodplain. Compensation for impact from increased levee heights. Planning over time to remove major services and industries off the flood plain - not allow more development on it."

"Widen the gap at Malebo Hill."

The feedback collected at the community information sessions and afterwards demonstrates strong support for an upgrade of the Main City and North Wagga Levees to a 1 in 100 year level of protection. However, North Wagga residents are disproportionately represented in the number of people that responded.

Residents that live on the flood plain outside of the North Wagga levee are primarily concerned about the impact that raising the levees will have on floodwaters.

Residents that are protected by the Main City Levee see the upgrade of the levee as vital for the City, and would like Council to also look at managing the threat of stormwater flooding.

Implications of Raising the North Wagga Levees to a 1 in 100 year level of protection

There are a number of implications associated with upgrading the North Wagga levee to provide a 1 in 100 year level of protection.

The first major issue that must be resolved is gaining support and approval from OEH to proceed with this proposal. The Wagga Wagga Floodplain Risk Management Plan identifies that the North Wagga levee system should provide protection up to a 1 in 20 year flood event. The NSW Government Floodplain Development Manual provides a process for floodplain risk management. It is a structured process that requires a flood study to be undertaken, followed by a floodplain risk study. A floodplain risk management plan is then developed and implemented. The guidelines for the NSW Government Floodplain Management Program require that the risk management process outlined in the Floodplain Development Manual be followed for a project to be eligible for funding.

As the current Wagga Wagga Floodplain Risk Management Plan identifies a 1 in 20 year level of protection for North Wagga, to proceed with another option may place at jeopardy both current and future funding. This issue may be resolved by amending the Floodplain Risk Management Plan. Council has received funding to review the Wagga Wagga Floodplain Risk Management Study and Plan. Consideration of providing 1 in 100 year level of protection for North Wagga could be incorporated into this review. Many of the process required (flood modelling, impact assessment and community consultation) have been completed as part of the North Wagga options study. These outcomes should be able to be readily consolidated and incorporated into the review with little additional work or cost.

Until such time as the Floodplain Risk Management Plan is updated, it is unlikely that the NSW Government will fund an upgrade of the North Wagga levee system to a 1 in 100 year level of protection. It is also likely that they will not fund the additional increase in height to the Main City levee required to accommodate a future 1 in 100 year North Wagga levee. This may be mitigated by Council funding the cost of increasing the height of the Main City levee by 100-200mm for a length of 5.1km (estimated to be \$1.06M). This can be achieved by identifying separable portions equal to the increase in the construction tender.

The first stages of the upgrade of the Main City are within the section that must be increased in height. It is quite possible that the review of the Floodplain Risk Management Study and Plan may not be completed and adopted prior to the completion of construction of these sections.

In order to accommodate a future 1 in 100 North Wagga levee, it will be necessary to redesign the section of the Main City levee immediately across from and upstream of North Wagga. This exercise must be undertaken now if construction is to commence next financial year. This is not funded under the Floodplain Management Program and will have to be funded wholly by Council. It may be more efficient and cost effective to complete the design for a 1 in 100 year levee for North Wagga now at Council's cost rather than to wait until after the review of the Floodplain Risk Management Study and Plan. If the design of the upgrade to a 1 in 100 level of protection is deferred for too long, many of the preliminary activities will have to be completed again at additional cost.

If the North Wagga levee system is upgraded to provide a 1 in 100 year level of protection, the other mitigation measures identified for North Wagga will not be required and cannot reasonably be supported by Council or the State. It is likely that the provision of 1 in 100 year level of protection will result in pressure to relax or remove the planning restrictions currently imposed on North Wagga. It may be reasonably argued that similar planning controls to those in central Wagga may be applied to North Wagga.

It is quite possible that the proposed upgrade of the North Wagga levees to a 1 in 100 year level of protection may not be supported by the State. This will not be known until that review of the Risk Management Study and Plan has been completed. There are a few reasons why the State may not support the upgrade. It may not be supported by the Office of Water due to the impact on the floodplain. This is considered unlikely given that it can be demonstrated that the impact is relatively minor and localised immediately upstream of Wagga Wagga.

The State Emergency Services (SES) may not support an increase in the level of protection of the North Wagga levee system. Regardless of the level of protection provided, North Wagga will be evacuated in any flood that cuts access roads. There is likely to be an increased level of resistance to evacuation by North Wagga residents if the level of protection is increased. Additionally, if planning restrictions are relaxed or removed, the number of people that must be evacuated from North Wagga is likely to increase. The SES is a key stakeholder in the Floodplain Risk Management Committee. Any proposed change to floodplain risk management should have the support of the SES. The Floodplain Risk Management Plan must be endorsed by the Floodplain Risk Management Committee for it to be adopted by Council.

Budget

The funding for this project is dependent upon successful applications under the NSW Floodplain Management Program. The funding for Council's one third share is dependent upon which scenario in the long term financial plan is adopted.

If Council is to proceed with this project in accordance with the recommendation, it is likely that it will have to fund the additional increase in height for the Main City levee (\$1.06M) and redesign costs for both the North Wagga levees and the upstream section of the Main City levee (estimated to be in the order of \$200K).

Policy

N/A

Impact on Public Utilities

There are many services located in the vicinity of the levee system that will be impacted by the upgrade works. Standard details for the treatment of services have been developed during the detailed design process.

Link to Strategic Plan

1. We are an engaged and involved community

1.1 We are a community that is informed and involved in decisions impacting us

QBL Analysis

	Positive	Negative
Social	Provision of protection against flooding benefits society. The provision of the same level of protection to the residents of North Wagga as the Main City aligns with the principles of social justice.	Upgrading the main city levee and North Wagga levee will result in additional third party impacts outside of the levee system. The increase in costs associated with damages outside of the levee system is outweighed by the decrease inside the levee system resulting in a net benefit to the community. Mitigation measure will be considered for additional impacts outside of the levee system.
Environmental	A Review of Environment Factors (REF) has been undertaken for the upgrade of the levee system. The REF will have to be reviewed and refined prior to construction to accommodate changes in the design.	There will be some environmental disturbance associated with the upgrade of the levee systems.
Economic	The upgrade when complete should result in a decrease in insurance premiums and foster developer confidence.	There will be a financial impact on Council in delivering the upgrade which may be passed on to the community via a Special Rates Variation
Governance	Extensive community consultation has been undertaken in accordance with the project Community Engagement Plan. This has provided the community the opportunity to participate in the Council decision making process.	By recommending an option outside of the Floodplain Risk Management Plan and undertaking investigations outside of the recognised framework, Council has exposed itself to the risk that the upgrade of the levee systems may not be supported by OEH and may not be successful in applications for funding from the State Government.

Risk Management and Work Health and Safety Issues for Council

The main risk associated with this project are the risk that the proposal to upgrade the North Wagga levees to a 1 in 100 year level of protection may not be supported as Council has not strictly followed the flood risk management process detailed in the NSW Government Floodplain Development Manual by deviating from the Floodplain Risk Management plan.

Another risk is the levee system being overtopped prior to the completion of upgrade works. This may be mitigated by expediting construction. There is also a risk that Council may be challenged by impacted third parties, potentially resulting in legal action.

Risks during construction will relating to cost, environmental impacts, WHS and contractor performance will be addressed as part of Project Management and contractor performance management systems for the project.

Internal / External Consultation

Extensive external consultation with immediately impacted residents and the broader community has been undertaken in accordance with a Community Engagement Plan developed specifically for the project.

Consultation has also occurred with the Floodplain Risk Management Advisory Committee, the SES, OEH and across Directorates within Council.

Attachments

1. Levee Upgrade - North Wagga Wagga Options Report and Third Party Impacts



NORTH WAGGA WAGGA LEVEE OPTIONS AND THIRD PARTY IMPACTS

North Wagga Wagga Structural Assessment

Report number H15/01

Date 10th March 2015

A division of the Office of Finance & Services

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NORTH WAGGA WAGGA LEVEE OPTIONS AND THIRD PARTY IMPACTS

North Wagga Wagga Structural Assessment

Report number H15/01

Date 14th June 2015

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North Wagga Wagga Levee Options and Third Party Impacts

Executive Summary

NSW Public Works has been engaged by Wagga Wagga City Council to assess a number of options for North Wagga Wagga levee and assess the Third Party impacts of those options. Third Party Impacts being those impacts occurring outside the North Wagga Wagga levee system.

This assessment was based on a “desktop” review of those options based on information that could be readily obtained from using both electronic and digital mapping systems, a drive-by assessment of the structures in North Wagga Wagga and information from the previous flood modelling studies and assessed damages. There were no detailed building inspections or similar activities involved.

The purpose of this type of assessment is to determine which options may be considered further in more detail and which options are not viable or feasible.

The options assessed are as per Council's Motion. The following table summarises the economic appraisal of all the options and shows that the most cost effective option is to raise the North Wagga Wagga levees to the 1 in 100 year flood level followed by the option of raising it to the 1 in 20 year flood level.

OPTIONS	Estimated capital cost (\$)	Present Value of Total Costs @ Discount Rates		
		7%	4%	10%
Option 1 - 1 in 20 year level of protection	\$4,800,000	\$13,744,935	\$16,568,473	\$11,906,283
Option 2 - 1 in 100 year level of protection	\$6,810,000	\$8,329,220	\$8,266,970	\$8,205,116
Option 3 - Remove the existing levees	\$395,000	\$20,709,697	\$28,107,430	\$16,191,775
Option 4 - Relocation of village	\$93,500,000	\$93,500,000	\$93,500,000	\$93,500,000
Option 5 - Raising houses in North Wagga and Mill and East St [#]	\$22,000,000*	\$22,147,499	\$22,202,212	\$22,115,696
Option 6 - Voluntary purchase of properties [#]	\$37,200,000*	\$37,200,000	\$37,200,000	\$37,200,000
Option 7 - Raising Dwellings in Mill and East St [#]	\$1,650,000	\$1,797,499	\$1,851,212	\$1,764,696
Option 8 - Maintain current (1 in 12 year) level of protection	\$ -	\$16,291,985	\$22,224,820	\$12,668,701

+ - Option 7 is a subset of Option 5 and has been presented for information purpose only.

Middle level capital expenditure estimate; * - Does not include AAD costs

However, it should be noted that the PV of costs for the 1 in 100 year level of protection option has not considered the costs of a number of dis-amenities identified for this option, whereas the option 1 (1 in 20 year level of protection) appears not to have as much of dis-amenities as for option 1.

The Third Party Impacts of these options was also assessed with an analysis of the “worst-case” scenario of having a 1 in 100 year flood event and the North Wagga Wagga levees raised to the 1 in 100 year flood level. The analysis found that there were increases in the flood heights up to 5km upstream of North Wagga Wagga in the floodplain, however this increase was small as follows:

- 0km – 2km between 100mm – 200mm;
- 2km – 3km between 50mm – 100mm;
- 3km – 5km between 20mm – 50mm.

North Wagga Wagga Levee Options and Third Party Impacts

Most of the development affected, which is in East Wagga Wagga, only has a change in depth of 20mm – 50mm, with the majority only having a change around 20mm.

For lesser flood heights (i.e. 1 in 50 year flood events) the effect is less than the above. The analysis found that there were increases in the flood heights up to 4km upstream of North Wagga Wagga in the floodplain, and the increases were less as follows

- 0km – 3km between 50mm – 100mm;
- 3km – 4km between 20mm – 50mm;

Only half of the development in East Wagga Wagga is affected by flooding and those that are affected only have a change in depth of 20mm – 50mm.

The Average Annual Damages costs of these Third Party Impacts can be added to the previous costings to provide the Present Value of Total costs associated with each option as below.

OPTIONS	Estimated capital cost (\$)	Present Value of Total Costs @ Discount Rates		
		7%	4%	10%
Option 1 - 1 in 20 year level of protection	\$4,800,000	\$22,803,535	\$29,191,657	\$18,787,931
Option 2 - 1 in 100 year level of protection	\$6,810,000	\$17,412,638	\$20,924,738	\$15,105,617
Option 3 - Remove the existing levees	\$395,000	\$29,594,570	\$40,488,526	\$22,941,446
Option 4 - Relocation of village	\$93,500,000	\$102,508,964	\$106,054,016	\$100,343,940
Option 5 - Raising houses in North Wagga and Mill and East St [#]	\$22,000,000*	\$26,006,463	\$29,605,228	\$23,808,636
Option 6 - Voluntary purchase of properties [#]	\$37,200,000*	\$46,208,964	\$49,754,016	\$44,043,940
Option 7 - Raising Dwellings in Mill and East St [#]	\$1,650,000	\$10,806,463	\$14,405,228	\$8,608,636
Option 8 - Maintain current (1 in 12 year) level of protection	\$ -	\$25,300,949	\$34,778,836	\$19,512,641

The additional Average Annual Damages associated with all these increased flood depths out in the Floodplain do not alter the relativity of the options examined previously.

In view of the above observations, it is recommended that the options 1 and 2 be shortlisted for further detailed evaluation.

North Wagga Wagga Levee Options and Third Party Impacts

North Wagga Wagga Option Assessment

NSW Public Works has been engaged by Wagga Wagga City Council to assess a number of options for North Wagga Wagga.

Options for floodplain management are conventionally grouped into two (2) categories, being non-structural and structural options. Examples in the non-structural category are such measures as town planning, flood warning and flood insurance; while examples in the structural category are flood mitigation dams, levees and channel improvements.

In this section various options that may be relevant to the situation in North Wagga Wagga will be discussed by undertaking a desktop assessment.

The desktop assessment consisted of obtaining the necessary information on house/dwelling numbers, locations, building types etc. etc. using both electronic and digital mapping systems and a drive-by assessment of the structures in North Wagga Wagga. There were no detailed building inspections or similar activities involved.

These options assessed, as specified by Council, are as per Council's Motion:-.

"Receive a further report on other options for providing flood protection for North Wagga residents and commercial operators in response to feedback from the community including:

- i. *raising the North Wagga levee to a 1 in 20 year level of protection*
- ii. *raising the North Wagga levee higher than a 1 in 20 year level of protection*
- iii. *removing the existing North Wagga levees*
- iv. *relocation of the village from the floodplain*
- v. *raising residences in North Wagga*
- vi. *voluntary purchase for properties in North Wagga*
- vii. *raising houses in Mill and East Street that are protected by North Wagga levee two*
- viii. *maintain the levees at their current level of protection and take no further action"*

All assessments below assume that the main Wagga Wagga levee is raised to the 1 in 100 year flood level.

OBJECTIVE

This report summarises the results of cost effectiveness analysis of these alternative options.

The primary objective of this analysis is to evaluate the proposed alternative options and recommend the most cost effective option in terms of the least Net Present Value.

METHODOLOGY

Economic appraisal is a way of systematically analysing all the costs and benefits associated with various management strategies that meet the project objectives to assess their relative desirability.

NSW Treasury Guidelines for Economic Appraisal recommends the following two techniques:

- Cost Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)

CBA is usually adopted where the major costs and benefits of the alternative strategies can be valued in monetary terms.

CEA is adopted when the major costs and/or benefits of a project are not readily measured in monetary terms and the outputs of options are the same or similar.

In the current context, as the alternative options are expected to offer the same (or similar outcomes), CEA has been adopted for the analysis.

North Wagga Wagga Levee Options and Third Party Impacts

i) Raising the North Wagga Levee to a 1 in 20 year level of protection

This option involves assessment of raising the North Wagga levee from the current approximate 1 in 12 year to the 1 in 20 year level of protection.

This option is currently being designed.

The cost estimates are:-

- a) Cost of raising the North Wagga Wagga levee is approximately \$3.35M.
- b) Cost of raising Levee Two is approximately \$1.45M.

These cost estimates are based on extracted quantities from the current design and unit rates from similar previous levee projects in the region.

Average Annual Damages

The estimated average annual cost of flooding in Australia is some \$400 million per year, of which New South Wales incurs some \$140 to \$150 million.

Actual and potential flood damage data can be presented as stage-damage curves for different property types. Such curves relate contents damage to depth of flooding above floor level. These curves are generally derived on the basis of numerous damage studies undertaken throughout Australia.

Average Annual Damages (AAD): Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.

Average Annual Damages can be thought of as a Self-Insurance Policy. That is, it is the amount of money that would have to be set aside each and every year to be drawn upon as needed to pay for flood damages when they occur in the future.

The Average Annual Damages for North Wagga Wagga and Levee Two for this option is \$689,000/year.

PROS	CONS
Provides additional level of protection over current level.	Does not provide full protection against flooding.
Provides the same level of protection that was designed for previously.	

ii) Raising the North Wagga levee higher than a 1 in 20 year level of protection

This option involves assessment of raising the North Wagga levee to the 1 in 100 year level of protection.

The costings for this option allows for additional sheet piling work along Hampden Avenue where space is currently limited and where an earth levee would not be able to be constructed.

The cost estimates are:-

- a) Cost of raising the North Wagga Wagga levee is approximately \$4.13M.
- b) Cost of raising Levee Two is approximately \$1.62M.

These cost estimates are based on extrapolated quantities from option 1 and unit rates from similar previous levee projects in the region.

North Wagga Wagga Levee Options and Third Party Impacts

In addition, this option also impacts on the Main Wagga Wagga levee design as it causes an Aflux in the water levels immediately behind the North Wagga Wagga levee. This Aflux necessitates a height increase of a 5.1km length of the Main Wagga Wagga levee of between 100-200mm.

The additional cost to raise the Main Wagga Wagga levee to accommodate this is as follows:

- Length of levee raised = 5.1 km;
- % of levee sheet pile in current iteration of the detailed design = 52%;
- Assume that this will increase to 75% for roughly 0.15m average raising;
- Total additional sheet pile becomes 5,100m x 0.5m wide @ \$250/m² = \$637,500;
- Concrete volume increase = 50 cub meter = \$100,000;
- Including CPI 10% from concept and 30% contingency gives \$1,054,625

Say \$1.06M.

Therefore the total Capital Cost of this option is \$6.81M.

Average Annual Damages

The Average Annual Damages for North Wagga Wagga and Levee Two is reduced to \$149,000/year.

PROS	CONS
Provides similar level of protection as the Main Levee.	Loss of amenity with the levee being 0.9m – 1.0m higher than it currently is.
Has one of the least Average Annual Damages.	<p>There will be growing pressure to allow the construction of new houses on vacant blocks which will lead to an increase in the number of houses (say 200%) which will:-</p> <ul style="list-style-type: none"> • Create a huge responsibility for rescue organisations when floods larger than the 1 in 100 flood eventuates and there is no high ground to evacuate to; • Lead to more damages costs due to there being more infrastructure.
	Existing road access is currently very congested when there is a flood event and if there were 3 times the volume of traffic it would be unworkable requiring extra costs (e.g. for road widening, more bridging) to improve access.
	Causes the height of the Main Wagga Wagga levee to increase for 5.1km.

iii) Removing the existing North Wagga levees

As a comparison to the other options, the removal of the North Wagga Wagga levee system would involve the removal and disposal offsite of some 50,000m³ of fill from the North Wagga Wagga Levee and some 20,000m³ of fill from Levee Two.

Where to dispose of these quantities of material would be a problem. Options to consider would be to dispose of them back into the Borrow Pit being used for the construction of the Main Levee Bank, at the Tip Site or to be used as needed by residents.

North Wagga Wagga Levee Options and Third Party Impacts

It is unlikely that the material would be needed at once by the Tip but would only be able to be disposed of over many years (minimum 10 – 15 years). A similar time period is envisaged for the disposal of material to resident's as well.

Therefore, for comparison, the costs are prepared on the basis of disposal at the Borrow Pit.

The cost estimates are:-

- a) Removal of North Wagga Wagga levee is approximately \$320K.
- b) Removal of Levee Two is approximately \$75K.

These cost estimates are based on the cartage of material 2-3km from site and using unit rates from similar previous levee projects in the region.

Average Annual Damages

The Average Annual Damages for North Wagga Wagga and Levee Two increase to \$1,515,000/year.

PROS	CONS
Has one of the cheapest capital costs.	Provides no flood protection.
	Has the highest Average Annual Damages.
	Will result in property damage.

Planning

Planning measures which seek to attain Council's objectives are a basic and common-sense option. Techniques such as development controls and land use zoning can be used to positively identify flood hazards, to deter unwise development in flood prone areas and to prevent further obstruction of floodways. As implied by the name, planning measures are most powerful and useful in a situation where they precede development. However, this is not the case for North Wagga Wagga.

In situations like North Wagga Wagga where there is already a large degree of development on the floodplain, town planning measures addressing the flood problem must be realistic and applied with sensitivity. Questions arise as to the rights of landholders, compensation, economic hardship and social disruption. There are many examples where inappropriate, or inappropriately applied, town planning measures have generated considerable opposition from those whom the planners sought to benefit; opposition which lead to the eventual abandonment of the measures.

iv) Relocation of the village from the floodplain

Relocation of the dwellings and other forms of development is a measure that can be implemented through the planning process. This option also has a structural component. In the end it comes down to the physical removal of structures and resiting outside the floodplain (for example "New North Wagga Wagga" suburb).

Except for brick clad buildings and buildings with slab-on-ground, transportation of dwellings to another site can usually be accomplished at moderate cost and minimal disruption. In other cases extensive demolition is usually required. The relocation of steel tanks and silos, and stockpiles of building materials can also be readily achieved.

There are also a number of commercial premises that would not be readily relocatable as follows:-

North Wagga Wagga Levee Options and Third Party Impacts

Table 1 – Number of dwellings

	Number of dwellings probably relocatable	Number of dwellings unlikely to be relocatable	Total
North Wagga Wagga	96	52	148
(Non-residential properties)	7	12	19

In consideration of the social and economic well-being of residents, assessment of this option is on the basis of providing “like-for-like”. That is, on the basis of the equivalent amount of land, infrastructure and amenities as well as keeping the sense of neighbourhood. In effect this option is based on the creation of a new Suburb in Wagga Wagga and relocating

The cost of the infrastructure works (i.e. the new development) is expected to be in the order of \$107/m². The size of the current North Wagga Wagga area (i.e. the area inside the levee bank) is 816,000m² and Mill and East Street Levee is 58,000m².

This unit rate is based on general industry advice for developments within the region.

Therefore, the cost to prepare the new Suburb is:-

Table 2 – Development costs of new suburb

	Area (m ²)	Cost of infrastructure (\$107/m ²)
North Wagga Wagga	816,000	\$87.3M
Mill and East Street Levee	58,000	\$6.2M

This does not include the cost of the purchase of land nor the relocation of all the dwellings and other the facilities (e.g. garages, sheds, gardens, fences, parks, sporting facilities, school etc.) currently in these areas.

Nor does it include the cost of demolition of buildings that cannot be relocated.

Average Annual Damages

The Average Annual Damages would be reduced to \$0/year.

PROS	CONS
	Would be a <u>major</u> disruption.
	Has the dearest capital cost.

v) Raising residences in North Wagga

Raising of the dwellings is a measure that can also be implemented through the planning process. While this option is a structural option it also has a planning component (i.e. any future development to only have raised dwellings).

North Wagga Wagga Levee Options and Third Party Impacts

This option is a flood proofing measure which involves the raising of dwellings so that floor heights are above the flood levels. This would also involve sealing off the ingress of floodwaters through sewers underneath the dwellings and in the streets.

The following assumptions have been made when assessing this option:-

1. Only the houses are raised;
2. There will be no raising of sheds, garages or other structures;
3. There are some houses that cannot be raised (determined from drive-by assessment only i.e. no internal inspections);
4. Cost of all plumbing, sewer etc. to be included;
5. Assume an open steel frame support structure;
6. Assume underneath area not to be enclosed.

For a weatherboard house, an indicative cost may be:-

a. Jacking the house and providing steel frame support	\$30K
b. Plumbing	\$ 3K
c. Electrical	\$ 3K
d. Structural certification	<u>\$ 5K</u>
	\$41K

For a brick house an additional \$10K has been allowed \$51K

However, the costs will vary depending on a number of factors including, but not limited to, the size of the house, the condition of the flooring, complexity of services etc. As well, the volume of work (i.e. raising multiple houses) can influence the above unit costs.

As such, for this desktop assessment, it has been decided to use a range of unit costs as follows:-

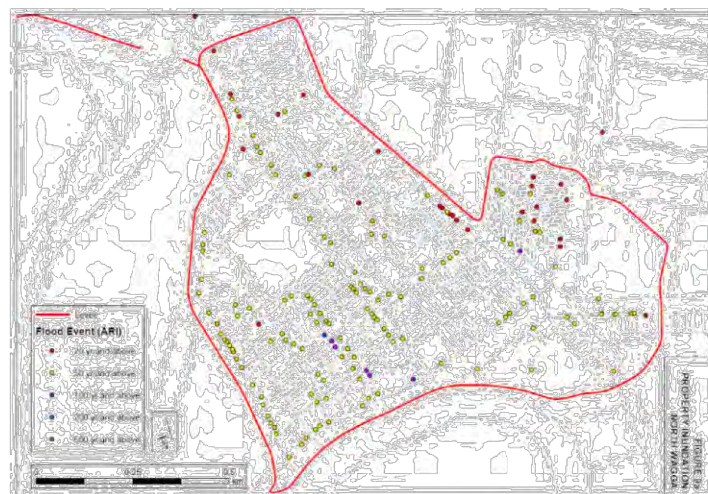
Lower value \$40K

Middle value \$50K

Higher value \$60K

These unit rates are based on general industry advice for raising house within the region.

In the 2009 the Floodplain Management Study (prepared by consultants WMA Water) identified the following properties that would be inundated:-



From "Wagga Wagga Floodplain Management Study" – WMA Water 2009

North Wagga Wagga Levee Options and Third Party Impacts

Table 3 – Number of dwellings

	Number of dwellings probably raised	Number of dwellings unlikely to be raised	Total
North Wagga Wagga	96	52	148
(Non-residential properties)	7	12	19

Table 4 – Cost of raising dwellings that probably can be raised

	Number of dwellings probably raised	Lower value (\$40K/unit)	Middle value (\$50K/unit)	Higher value (\$60K/unit)
North Wagga Wagga	96	\$3,840,000	\$4,800,000	\$5,760,000
(Non-residential properties)	7	\$280,000	\$350,000	\$420,000
Total	103	\$4,120,000	\$5,150,000	\$6,180,000

However, the above costs do NOT include the cost of raising the other dwellings that are considered unlikely to be raised. The dwellings and non-residential premises that cannot be raised are a major disadvantage of this option as they would still incur flood damage.

However, for the purposes of comparison with other options, the cost of construction of a new raised dwelling needs to be allowed. For comparative purposes, assume the cost of a new house ranges from \$150K - \$250K with the cost of non-residential dwellings being double that.

These costs are based on typical costs for various standards of new construction.

Indicative costs are as follows:-

Table 5 – Cost of construction of additional dwellings

	Number of dwellings probably constructed	Lower value (\$150K/unit)	Middle value (\$200K/unit)	Higher value (\$250K/unit)
North Wagga Wagga	52	\$7,800,000	\$10,400,000	\$13,000,000
(Non-residential properties) – assume double the	12	\$3,600,000	\$4,800,000	\$6,000,000
Total	64	\$11,400,000	\$15,200,000	\$19,000,000

North Wagga Wagga Levee Options and Third Party Impacts

For comparison purposes, the total costs are:-

Table 6 – Comparative cost of all dwellings

	Number of dwellings	Lower value	Middle value	Higher value
North Wagga Wagga	148	\$11,640,000	\$15,200,000	\$18,760,000
(Non-residential properties)	19	\$3,880,000	\$5,130,000	\$6,420,000
Total	167	\$15,520,000	\$20,350,000	\$25,180,000

For the Mill and East Street Levee:-

Table 7 – Number of dwellings that probably can be raised

	Number of Houses probably raised	Number of Houses unlikely to be raised	Total
Mill and East Street	17	4	21

Table 8 – Cost of house raising

	Number of dwellings probably raised	Lower value (\$40K/unit)	Middle value (\$50K/unit)	Higher value (\$60K/unit)
Mill and East Street	17	\$680,000	\$850,000	\$1,020,000

For the purposes of comparison with other options, the cost of construction of a new raised dwelling needs to be allowed. For comparative purposes, assume the cost of a new house ranges from \$150K - \$250K with the cost of non-residential dwellings being double that.

These costs are based on typical costs for various standards of new construction.

Indicative costs are as follows:-

Table 9 – Cost of construction of additional dwellings

	Number of dwellings constructed	Lower value (\$150K/unit)	Middle value (\$200K/unit)	Higher value (\$250K/unit)
Mill and East Street	4	\$600,000	\$800,000	\$1,000,000

North Wagga Wagga Levee Options and Third Party Impacts

For comparison purposes only, the total costs are:-

Table 10 – Comparative cost of all dwellings

	Number of dwellings	Lower value	Middle value	Higher value
Mill and East Street	21	\$1,280,000	\$1,650,000	\$2,020,000

The cost for both North Wagga Wagga and the Mill and East Street combined are:-

Table 11 – Comparative cost of all dwellings (North Wagga Wagga and the Mill and East Street combined)

	Number of dwellings	Lower value	Middle value	Higher value
All	188	\$16,800,000	\$22,000,000	\$27,200,000

Average Annual Damages

Average Annual Damages cannot be calculated as it is unknown how many dwellings will be raised, how many home owners will take up the offer for this to be done etc.

PROS	CONS
Dwellings are out of the floodwaters.	Some dwellings cannot be raised.
	Those dwellings that cannot be raised would require the construction of new raised dwellings.
	Damage to other property (i.e. sheds, garages, stables etc. etc.) would still occur.
	Damage to facilities (e.g. water, sewerage, parks and gardens etc.) would still occur.
	More difficult for elderly or disabled people to access dwellings.
	Cost greater than cost of levee raising.

vi) Voluntary purchase for properties in North Wagga

The Voluntary Purchase of properties may be done as follows:-

- If and when a property is put on the market, Council buys the property;
- Council not allow the sale of the property to anyone else;
- Property value determined by independent Valuer;
- No new development to be allowed.

Consideration may also give consideration to imposing a time limit for this scheme (e.g. 15 years).

For the assessment of this option, no attempt was made to obtain actual property values. The cost estimates given below are illustrative only. If it is required to investigate this option further, then more accurate estimates of property values would need to be obtained.

North Wagga Wagga Levee Options and Third Party Impacts

However, as can be seen below, the cost of this option is considered prohibitive.

Table 12 – Comparative cost of voluntary purchasing

	Number of dwellings probably raised	Lower value (\$150K/unit)	Middle value (\$200K/unit)	Higher value (\$250K/unit)
North Wagga Wagga	167	\$25,050,000	\$33,400,000	\$41,750,000
Mill and East Street	19	\$2,850,000	\$3,800,000	\$4,750,000
Total	186	\$27,900,000	\$37,200,000	\$46,500,000

Average Annual Damages

Average Annual Damages cannot be calculated as it is unknown how many dwellings will be purchased, how many home owners will take up the offer for this to be done etc.

PROS	CONS
	<u>Very</u> expensive.
	Damages can occur while waiting for properties to be voluntarily sold.

vii) Raising houses in Mill and East Street that are protected by North Wagga levee two

An option that is to be considered is to raise the houses in Mill and East Street to above the flood level (similar to Option v).

Table 13 – Number of dwellings

	Number of Houses probably raised	Number of Houses unlikely to be raised	Total
Mill and East Street	17	4	21

Table 14 – Cost of house raising

	Number of dwellings probably raised	Lower value (\$40K/unit)	Middle value (\$50K/unit)	Higher value (\$60K/unit)
Mill and East Street	17	\$680,000	\$850,000	\$1,020,000

Like Option v, this does NOT include the cost of raising the other dwellings that are considered unlikely to be raised. The dwellings that cannot be raised are a major disadvantage of this option as they would still incur flood damage.

North Wagga Wagga Levee Options and Third Party Impacts

However, for the purposes of comparison with other options, the cost of construction of a new raised dwelling needs to be allowed. For comparative purposes, assume the cost of a new house ranges from \$150K - \$250K with the cost of non-residential dwellings being double that. Indicative costs are as follows:-

Table 15 – Cost of construction of additional dwellings

	Number of dwellings probably raised	Lower value (\$150K/unit)	Middle value (\$200K/unit)	Higher value (\$250K/unit)
Mill and East Street	4	\$600,000	\$800,000	\$1,000,000

For comparison purposes only, the total costs are:-

Table 16 – Comparative cost of raising all dwellings

	Number of dwellings probably raised	Lower value	Middle value	Higher value
Mill and East Street	21	\$1,280,000	\$1,650,000	\$2,020,000

The pros and cons are the same as for option vi).

viii) Maintain the levees at their current level of protection and take no further action

This is the “status-quo” option.

At present, the current level of protection of the levee system is approximately 1 in 12 years only. Prior to the 2009 Flood Study, the levee system was considered to offer a 1 in 20 year level of protection.

It is likely development decisions have been made over the years based on their being a 1 in 20 year level of protection and the current 1 in 12 year protection negates those decisions.

There is no cost associated with this option.

Average Annual Damages

The Average Annual Damages are \$1,204,000/year.

North Wagga Wagga Levee Options and Third Party Impacts

SUMMARY

Options	North Wagga Wagga	Levee Two	AAD
<i>i) raising the North Wagga levee to a 1 in 20 year level of protection</i>	\$3.35M	\$1.45M	\$689,000
<i>ii) raising the North Wagga levee higher than a 1 in 20 year level of protection</i>	Raise to 1 in 100 year level of protection \$4.13M + Main Levee works \$1.06M	\$1.62M	\$149,000
<i>iii) removing the existing North Wagga levees</i>	\$320K	\$75K	\$1,515,000
<i>iv) relocation of the village from the floodplain</i>	greater than \$87.3M*	greater than \$6.2M*	\$0
<i>v) raising residences in North Wagga and Mill and East Streets</i>	\$15.5M to \$25.18M	\$1.28M to \$2.02M	-
<i>vi) voluntary purchase for properties in North Wagga</i>	\$25M to \$41.7M	\$2.85M to \$4.75M	-
<i>vii) raising houses in Mill and East Street that are protected by North Wagga levee two</i>	-	\$1.28M to \$2.02M	-
<i>viii) maintain the levees at their current level of protection and take no further action</i>	\$0	\$0	\$1,204,000

North Wagga Wagga Levee Options and Third Party Impacts

Economic Appraisal of Options

Objective

This section summarises the results of cost effectiveness analysis of the alternative options for flood security in the areas protected by the North Wagga Levees. The primary objective of this analysis is to evaluate and recommend the most cost effective option from among the proposed alternative options.

Methodology

Economic appraisal is a way of systematically analysing all the costs and benefits associated with various management strategies that meet the project objectives to assess their relative desirability.

NSW Treasury Guidelines for Economic Appraisal recommends the following two techniques:

- Cost Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)

CBA is usually adopted where the major costs and benefits of the alternative strategies can be valued in monetary terms.

CEA is adopted when the major costs and/or benefits of a project are not readily measured in monetary terms and the outputs of options are same or similar.

In the current context, as the alternative options are expected to offer similar outcomes and not all the major benefits are quantified and valued in monetary terms, CEA has been adopted for the analysis.

Cost Effectiveness Analysis

Following assumptions have been made for the cost effectiveness analysis:

- All estimated capital costs are in current (2014/15) dollars and all the capital expenditure will be incurred by June 2015
- The evaluation period is 30 years
- The useful economic life of the assets constructed under the project is 100 years
- The residual value of the assets at the end of the evaluation period will be at a level pro-rata to the remaining useful economic life
- Maintenance of the levee system is deemed to include the costs of
 - i. Yearly inspections;
 - ii. 5-yearly Audits;
 - iii. 5-yearly crest level surveys

As well as the normal yearly maintenance activities (e.g. tree/shrub removal, erosion repair, pest eradication/repair e.g. rabbit holes, grass mowing, weed eradication etc.).

While a newly constructed levee may not need maintenance, the annual growth of saplings and shrubs means that maintenance needs to commence soon afterwards. As well, if there are levees through high visibility areas (e.g. parks and gardens, town centre) there can be also a cost in maintain them in pristine condition.

As levees age, the deterioration also accelerates thus requiring more maintenance. If maintenance is neglected for a few years, the cost of maintenance actually increases as problems just magnify in size (e.g. removal of a small sapling one year is significantly less than the removal of a tree a few years later).

North Wagga Wagga Levee Options and Third Party Impacts

In addition, there is the cost of maintaining the stormwater structures (i.e. pipes, gate valves and pumps).

Taking all the above into consideration, the average cost can be related to a per metre rate of approximately \$2.00/m/year. For the main Wagga levee this equates to approximately \$18K/year and North Wagga Wagga \$11K/year.

The present values (PV) of the total costs comprising the capital cost, O&M cost and the estimated average annual damage (AAD) cost of options have been determined for a discount rate of 7% p.a. The sensitivities of the PVs of options at higher and lower discount rates of 10% p.a. and 4% p.a. also have been analysed. The results of cost effectiveness analysis are presented in the Table below.

The primary objective of this analysis is to evaluate the proposed alternative options and recommend the most cost effective option in terms of the least Present Value.

OPTIONS	Estimated capital cost (\$)	Present Value of Total Costs @ Discount Rates		
		7%	4%	10%
Option 1 - 1 in 20 year level of protection	\$4,800,000	\$13,744,935	\$16,568,473	\$11,906,283
Option 2 - 1 in 100 year level of protection	\$6,810,000	\$8,329,220	\$8,266,970	\$8,205,116
Option 3 - Remove the existing levees	\$395,000	\$20,709,697	\$28,107,430	\$16,191,775
Option 4 - Relocation of village	\$93,500,000	\$93,500,000	\$93,500,000	\$93,500,000
Option 5 - Raising houses in North Wagga and Mill and East St	\$22,000,000*	\$22,147,499	\$22,202,212	\$22,115,696
Option 6 - Voluntary purchase of properties	\$37,200,000 [#]	\$37,200,000	\$37,200,000	\$37,200,000
Option 7 - Raising Dwellings in Mill and East St	\$1,650,000 [#]	\$1,797,499	\$1,851,212	\$1,764,696
Option 8 - Maintain current (1 in 12 year) level of protection	\$ -	\$16,291,985	\$22,224,820	\$12,668,701

+ - Option 7 is a subset of Option 5 and has been presented for information purpose only.

Middle level capital expenditure estimate; * - Does not include AAD costs

Conclusions and Recommendations

The PVs of costs considered for the analysis present the long term aggregated value of all the current and future costs for each of the alternative options over the next 30 year period in today's dollar values. Hence, the most preferable option will be the one with the least PV of costs and the least preferable option with the highest PVs of costs.

A comparison of the PVs of alternative options for the improving the flood protection level by North Wagga Levees clearly establishes that the options 3, 4 and 6 are least cost effective and would not require any further consideration. It should be noted that option 3 does not offer any flood protection.

Options 5 and option 8 have about the same PV of costs. However, it should be noted that option 5 does not included any costs towards annual damages hence is not preferable.

Option 8 is the 'status quo' option offering no further improvements towards flood protection while incurring damage costs due to flood risks.

North Wagga Wagga Levee Options and Third Party Impacts

Among the remaining options, the North Wagga levy upgrade 'Option 2 – 1 in 100 year level of flood protection' has the lowest PV of total costs at the benchmark discount rate of 7% p.a. The PV of option 2 remains the lowest at both the sensitivity discount rates of 4% p.a. and 10% p.a. Therefore, in terms of cost effectiveness, option 2 is preferable. However, it should be noted that the PV of costs for this option has not considered the costs of a number of dis-amenities identified for this option.

Option 1 – 1 in 20 year level of protection is the second best among the proposed alternative options in terms of cost effectiveness and appears not to have as much of dis-amenities as for option 1.

In view of the above observations, it is recommended that the options 1 and 2 be shortlisted for further detailed evaluation.

North Wagga Wagga Levee Options and Third Party Impacts

Third Party Impact Assessment

NSW Public Works has been engaged by Wagga Wagga City Council to determine what impact the proposed of the levee will have on properties in the floodplain and to propose feasible mitigative measures. The assessment is carried out based on concept and detailed design drawings.

NSW Public Works engaged WMA Water to re-run the hydraulic model to explore the impacts of various alternatives at North Wagga Wagga.

Where a property is impacted, an assessment was made for the change in water depth which is the primary indicator of any additional damages. The assessment then formed part of a database on each structure in relation to its intrinsic characteristics and floodplain changes.

Where the upgrade of the levees will result in an unreasonable impact upon a residential or commercial property, feasible mitigative measures were to be suggested to remove or reduce the risk to an acceptable level. The mitigative measures would be costed appropriately so that Council has a clear understanding of the possible economic and social ramifications.

Third Party Impact Assessment

NSW Public Works through discussions with WMA Water understands the current flood model has been used to assess the following design scenarios:

- 1% AEP flood with current levee conditions;
- 1% AEP flood with Main levee raised to 1%AEP with 0.9m freeboard and North Wagga raised to a 5% AEP with 0.7m freeboard;
- 5% AEP flood with current levee conditions; and
- 5% AEP flood with current Main levee conditions and North Wagga raised to a 5% AEP with freeboard

Two additional model runs were required:

- 1% AEP flood with Main levee raised to 1% AEP with 0.9m freeboard and North Wagga with current conditions; and
- 1% AEP flood with Main levee raised to 1% AEP with 0.9m freeboard and North Wagga levee removed.

Flood Modelling

Flood Modelling has been undertaken for Wagga over a number of years. Firstly by Webb, McKeon & Associates Pty Ltd. in 2004 then WMA Water in 2009 and WMA Water in 2014. This last flood modelling was commissioned to ensure Council had the latest flood modelling information in light of the 2010 and 2012 flood events. Further analysis by WMA Water was also undertaken in January 2015 for the two additional model runs.

The assessment of the North Wagga Wagga Levee Options and the Third Party Impacts are based on these modelling results.

The following graphical information has been extracted from these previous reports for the scenarios shown on the next page.

North Wagga Wagga Levee Options and Third Party Impacts

SCENARIO	FIGURE	MODELLED FLOOD EVENT
1. Leave at existing level.	1	1 in 100 year
2. Remove levee entirely.	1	1 in 100 year
3. Increase levee design height to 1 in 20 year event.	2	1 in 20 year
Change in depth.	3	1 in 20 year
4. Increase levee design height to 1 in 100 year event.	4	1 in 50 year
Change in depth.		
5. Increase levee design height to 1 in 100 year event.	5	1 in 100 year
Change in depth.		

Discussion

The following observations are made:-

1. From Figure 1 - The flood extent and water depth in a 1 in 100 year flood event are the same for both removing the North Wagga Wagga levee completely and leaving it at its current height (i.e. scenarios 1 and 2);
2. From Figure 2 – The flood extent and water depth in a 1 in 20 year flood event is less than that of a 1 in 100 year flood event. Primarily the areas in the south east of Wagga Wagga (along the Sturt Highway) start to become affected;
3. From Figures 3, 4 & 5 – For the scenario that the North Wagga Wagga levee is raised to the 1 in 100 flood level, there is a change in flood levels upstream but very little additional land is inundated.

Cost Effectiveness Analysis

Assessment and conclusion

Figure 5 shows the worst case scenario of the 1 in 100 year flood level with the North Wagga Wagga levee also raised to the 1 in 100 year level.

Floodwaters have to now go around the North Wagga Wagga levee (rather than overtopping it) on the northern and southern sides. This results in there being some 20mm – 100mm of additional depth of water at these locations.

The water also backs up immediately behind the North Wagga Wagga levee resulting in increased water depths for a distance of only some 5km. Beyond this the floodplain widens out and there is no change in the water levels as shown by the areas in grey.

Areas both downstream of North Wagga Wagga levee and greater than 5km upstream means there is NO change in the depth of the floodwaters due to the raising of the North Wagga Wagga levee.

For this approximate 5km section the increased depths are:-

- 0km – 2km between 100mm – 200mm;
- 2km – 3km between 50mm – 100mm;
- 3km – 5km between 20mm – 50mm.

It is also noted that most of the development in East Wagga Wagga only has a change in depth of 20mm – 50mm, with the majority only having a change around 20mm.

North Wagga Wagga Levee Options and Third Party Impacts

For lesser flood heights (i.e. 1 in 50 year flood events) the effect is less than the above. The analysis found that there were increases in the flood heights up to 4km upstream of North Wagga Wagga in the floodplain, and the increases were less as follows

- 0km – 3km between 50mm – 100mm;
- 3km – 4km between 20mm – 50mm;

Only half of the development in East Wagga Wagga is affected by flooding and those that are affected only have a change in depth of 20mm – 50mm.

The additional Average Annual Damages associated with all these increased flood depths are as below.

	AAD (from 14/06/2015 WMA Report)
i. raising the North Wagga levee to a 1 in 20 year level of protection	\$730,000
ii. raising the North Wagga levee higher than a 1 in 20 year level of protection	\$732,000
iii. removing the existing North Wagga levees	\$716,000
iv. relocation of the village from the floodplain	\$726,000
v. raising residences in North Wagga	\$726,000
vi. voluntary purchase for properties in North Wagga	\$726,000
vii. raising houses in Mill and East Street that are protected by North Wagga levee two	\$726,000
viii. maintain the levees at their current level of protection and take no further action"	\$726,000

The present values (PV) of the estimated average annual damage (AAD) cost of these options have been determined for a discount rate of 7% p.a. The sensitivities of the PVs of options at higher and lower discount rates of 10% p.a. and 4% p.a. also have been analysed. The results of cost effectiveness analysis are presented in the Table below.

OPTIONS	Present Value of Damages OUTSIDE levee Costs @ Discount Rates		
	7%	4%	10%
Option 1 - 1 in 20 year level of protection	\$9,058,600	\$12,623,184	\$6,881,648
Option 2 - 1 in 100 year level of protection	\$9,083,418	\$12,657,768	\$6,900,501
Option 3 - Remove the existing levees	\$8,884,873	\$12,381,096	\$6,749,671
Option 4 - Relocation of village	\$9,008,964	\$12,554,016	\$6,843,940
Option 5 - Raising houses in North Wagga and Mill and East St [#]	\$9,008,964	\$12,554,016	\$6,843,940
Option 6 - Voluntary purchase of properties [#]	\$9,008,964	\$12,554,016	\$6,843,940
*Option 7 - Raising Dwellings in Mill and East St [#]	\$9,008,964	\$12,554,016	\$6,843,940
Option 8 - Maintain current (1 in 12 year) level of protection	\$9,008,964	\$12,554,016	\$6,843,940

North Wagga Wagga Levee Options and Third Party Impacts

The above costs can be added to the previous costings to provide the Present Value of Total costs associated with each option as below.

OPTIONS	Estimated capital cost (\$)	Present Value of Total Costs @ Discount Rates		
		7%	4%	10%
Option 1 - 1 in 20 year level of protection	\$4,800,000	\$22,803,535	\$29,191,657	\$18,787,931
Option 2 - 1 in 100 year level of protection	\$6,810,000	\$17,412,638	\$20,924,738	\$15,105,617
Option 3 - Remove the existing levees	\$395,000	\$29,594,570	\$40,488,526	\$22,941,446
Option 4 - Relocation of village	\$93,500,000	\$102,508,964	\$106,054,016	\$100,343,940
Option 5 - Raising houses in North Wagga and Mill and East St [#]	\$22,000,000*	\$26,006,463	\$29,605,228	\$23,808,636
Option 6 - Voluntary purchase of properties [#]	\$37,200,000*	\$46,208,964	\$49,754,016	\$44,043,940
Option 7 - Raising Dwellings in Mill and East St [#]	\$1,650,000	\$10,806,463	\$14,405,228	\$8,608,636
Option 8 - Maintain current (1 in 12 year) level of protection	\$ -	\$25,300,949	\$34,778,836	\$19,512,641

Conclusion

The additional Average Annual Damages associated with all these increased flood depths do not alter the relativity of the options examined previously.

North Wagga Wagga Levee Options and Third Party Impacts

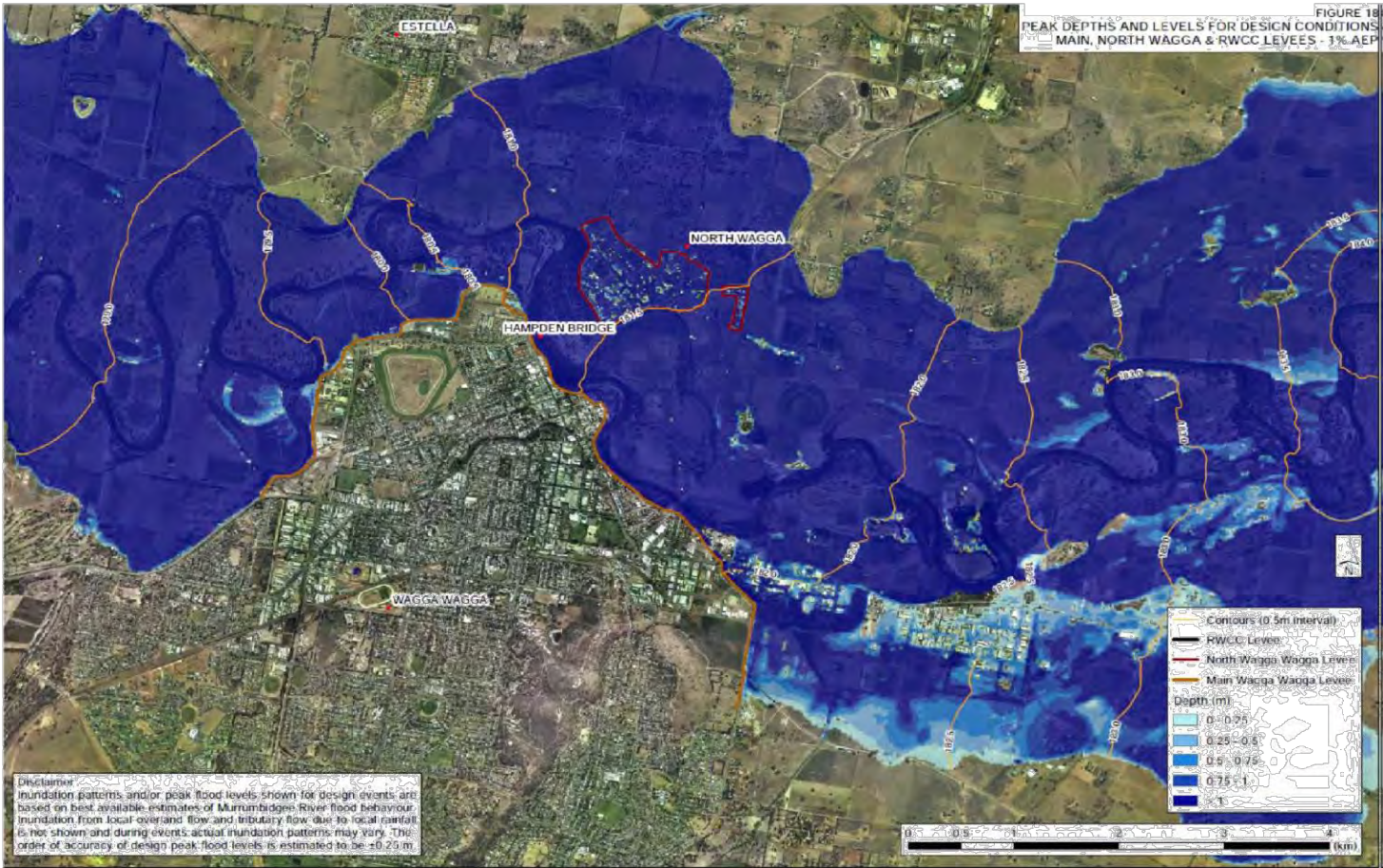


Figure 1 – Current levee level and removal of North Wagga Wagga levee with 1 in 100 year flood extent map

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North Wagga Wagga Levee Options and Third Party Impacts

Figure 2 – 1 in 20 year North Wagga Wagga levee with 1 in 20 year flood extent map

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North Wagga Wagga Levee Options and Third Party Impacts

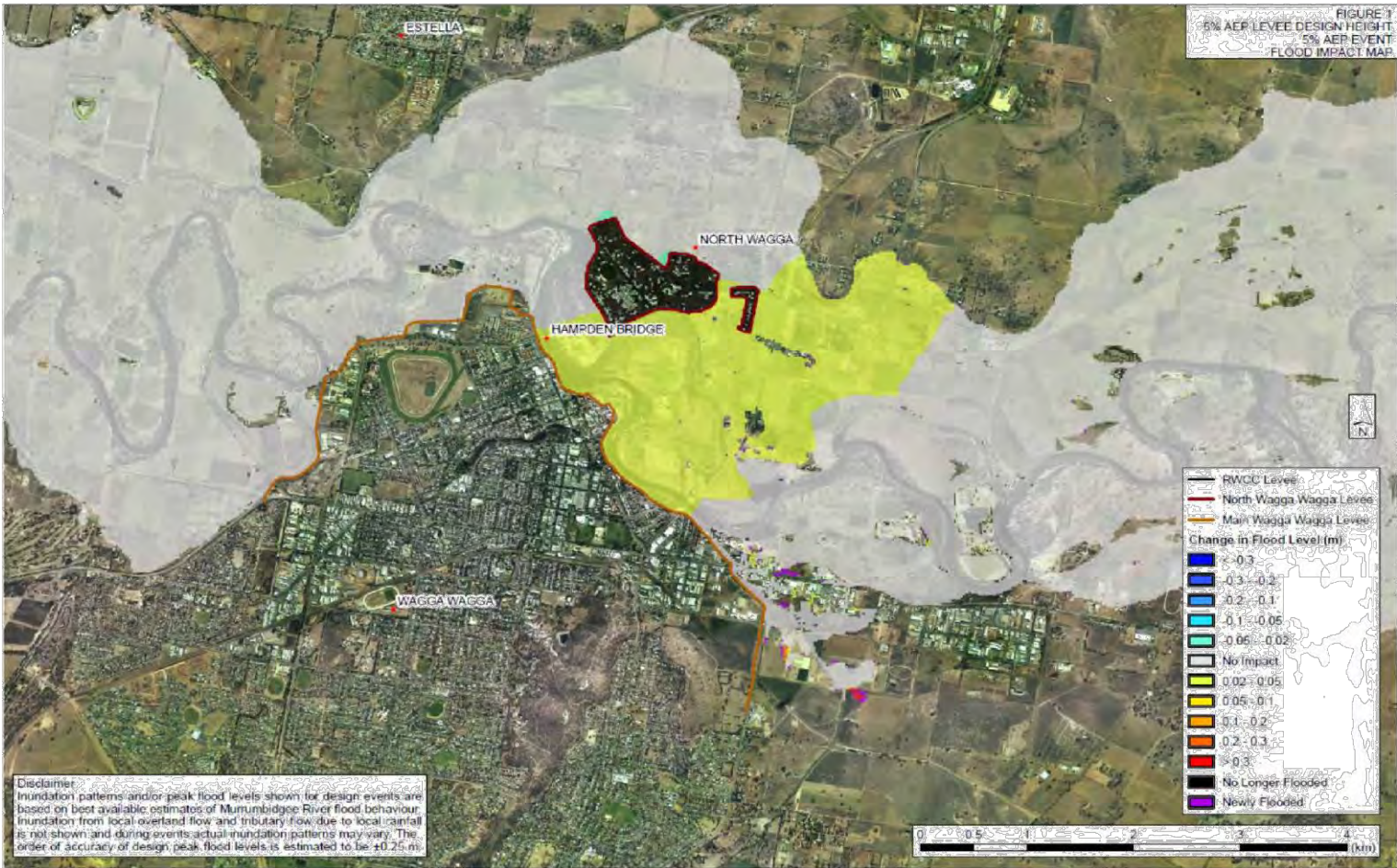


Figure 3 – 1 in 20 year North Wagga Wagga levee with 1 in 20 year flood extent difference map (i.e. showing difference from current condition)

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North Wagga Wagga Levee Options and Third Party Impacts

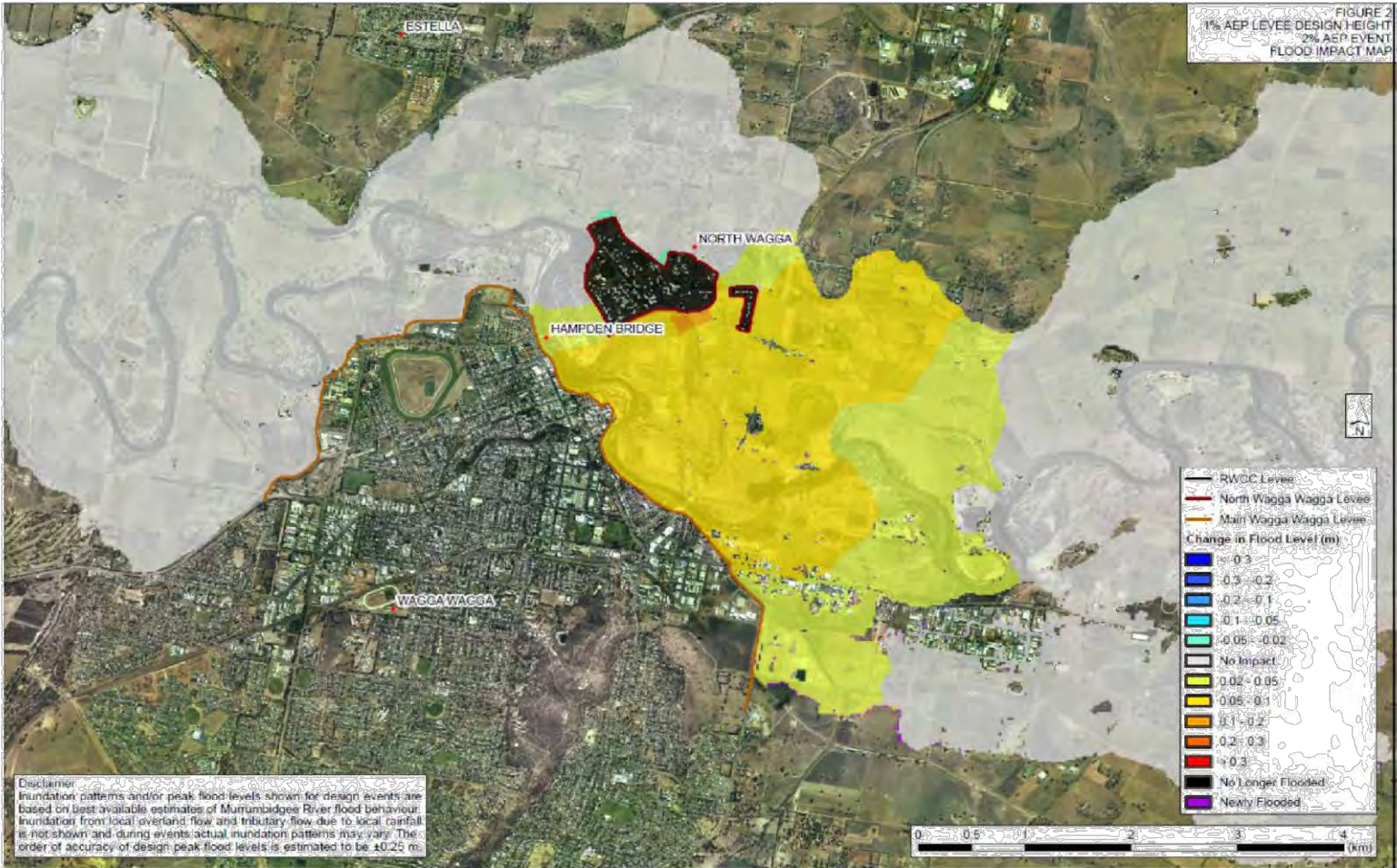
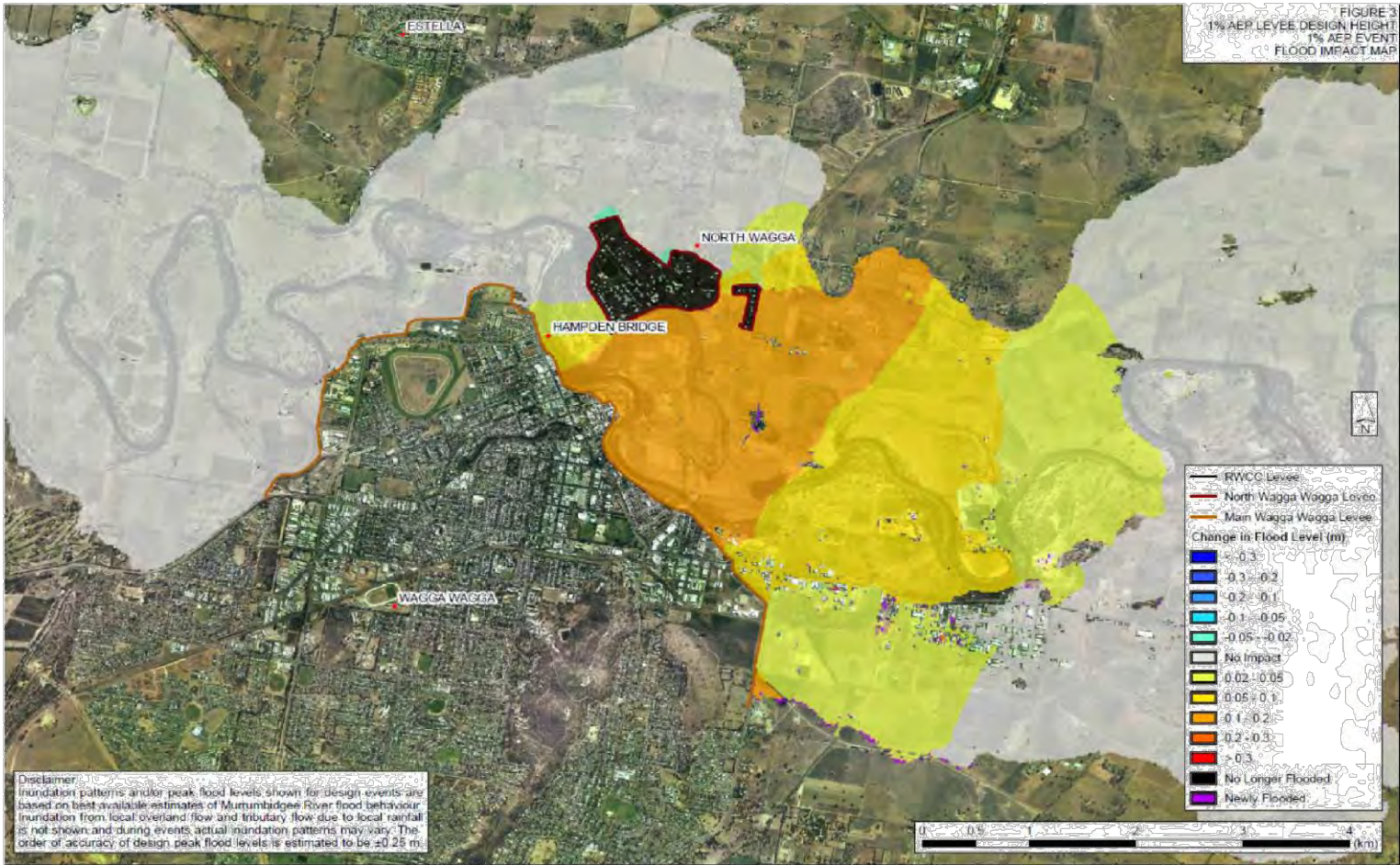


Figure 4 – 1 in 100 year North Wagga Wagga levee with 1 in 50 year flood extent difference map (i.e. showing difference from current condition)
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North Wagga Wagga Levee Options and Third Party Impacts



North Wagga Wagga Levee Options and Third Party Impacts
