FINAL LOWER MACLEAY RIVER FLOOD STUDY

SUPPORTING INFORMATION

PREAMBLE / BACKGROUND

Catchment Description

The Lower Macleay River floodplain covers an area of approximately 500km^2 downstream of Kempsey. The dominant water courses within the floodplain are the Macleay River, Macleay Arm, Clybucca Creek/Collombatti Creek, Kinchela Creek, Belmore River and Christmas Creek. The general topography of the floodplain includes well defined natural riverbank levees up to 7m AHD along the rivers and creeks formed by deposition of alluvial sediments over the course of numerous historic floods. The terrain grades down to low-lying areas typically less than 1m AHD, and down to 0m AHD. The Macleay River currently discharges to the ocean at South West Rocks via a fully trained river entrance. Historically the river discharged to the ocean at Grassy Head, approximately 10km to the north, until the 1893 flood broke out and formed a new entrance at the existing location. During flood events floodwaters may discharge to the ocean via secondary outlets including Korogoro Creek and Rowes Cut at Hat Head, Killick Creek and Ryan's Cut at Crescent Head, and South West Rocks Creek at South West Rocks.

Land use in the Lower Macleay is predominantly rural and agricultural. Within the rural landscape are areas of forest, wetlands and other environmentally significant lands. There are a number of small urban centres and villages, including Smithtown, Gladstone, Frederickton, Kinchela, Jerseyville, Fishermans Reach, Stuarts Point. South West Rocks, Crescent Head and Hat Head.

The upstream catchment covers an area of approximately 11,500km^2, stretching up to the Northern Tablelands region to townships including Armidale, Guyra and Walcha. Catchment elevations range from near sea level at Kempsey to over 1,000m AHD on the Northern Tablelands. The catchment is of a fan-shaped form, where the central catchment area is fed by a sprawling network of tributaries. The shape and generally steep terrain of the catchment tends to concentrate flood runoff from the upstream sub-catchments, influencing flood behaviour and producing floods with typically rapid rates of rise in the lower valley.

History of Flooding

Significant floods occurred in the valley in 1838, 1893, 1949, 1950, 1963, 2001, 2009, 2011 and 2013. A major flood mitigation scheme was implemented from 1955 to the mid-1970s consisting of numerous flood gates, drainage channels and levees to help protect townships of Kempsey, Frederickton, Smithtown/Gladstone, and Hat Head, the agricultural area, and to provide flood warning and improved drainage. Recent infrastructure works in the floodplain include the Pacific Highway Kempsey Bypass, which crosses the river and floodplain via a 3.2km bridge to the east of Kempsey. The works completed also include an upgrade to the Frederickton levee.

The largest flood on record is the 1949 event (1 in 90 – 1.1% Annual Exceedance Probability (AEP)) followed by the 1950 event (1 in 80 - 1.25% AEP). The 1949 flood reached 8.52m AHD at Kempsey Traffic Bridge resulting in the loss of six (6) lives and more than 7,000 head of stock and 600 buildings damaged or destroyed. However, the AEP estimates are at Kempsey and it is believed that peak flood levels in the Lower floodplain downstream of Smithtown/Gladstone where higher in the 1950 event likely to be a result of comparatively higher ocean levels to those during the 1949 event.

The March 2001 flood event is the largest flood event in the valley in recent years and was the largest to occur since the 1963 event. Over 1,000 residents were evacuated by air from the

floodplain urban centres. This flood event was estimated at 1 in 13 – 8% AEP. Significant flooding also recently occurred during February 2013, which was a 1 in 7 – 14% AEP event.

Following the 1949 and 1950 floods, there was significant community reaction which demanded action to mitigate the impacts of flooding on the Lower Macleay Floodplain. This led to the formation of the Macleay Valley Flood Mitigation Committee which formulated a basis of the flood problem and developed options for the Lower Macleay Flood Mitigation Scheme, a series of works to address flooding problems. Works on the Scheme commenced in 1955 and were progressively implemented until the mid-1970's that included the construction of 47 flood-gated structures (of various sizes), 116km of drainage channels and 180km of levee.

During riverine floods, the performance of the flood mitigation scheme in the lower floodplain is estimated as being:

1) Protection of the Frederickton township up to the 1% AEP flood event
2) Protection of Hat Head village up to the 5% AEP flood event
3) Protection of Smithtown and Gladstone townships in the order of a 20% AEP flood event
4) Protection for the lower Macleay agricultural area from a 40% AEP flood event

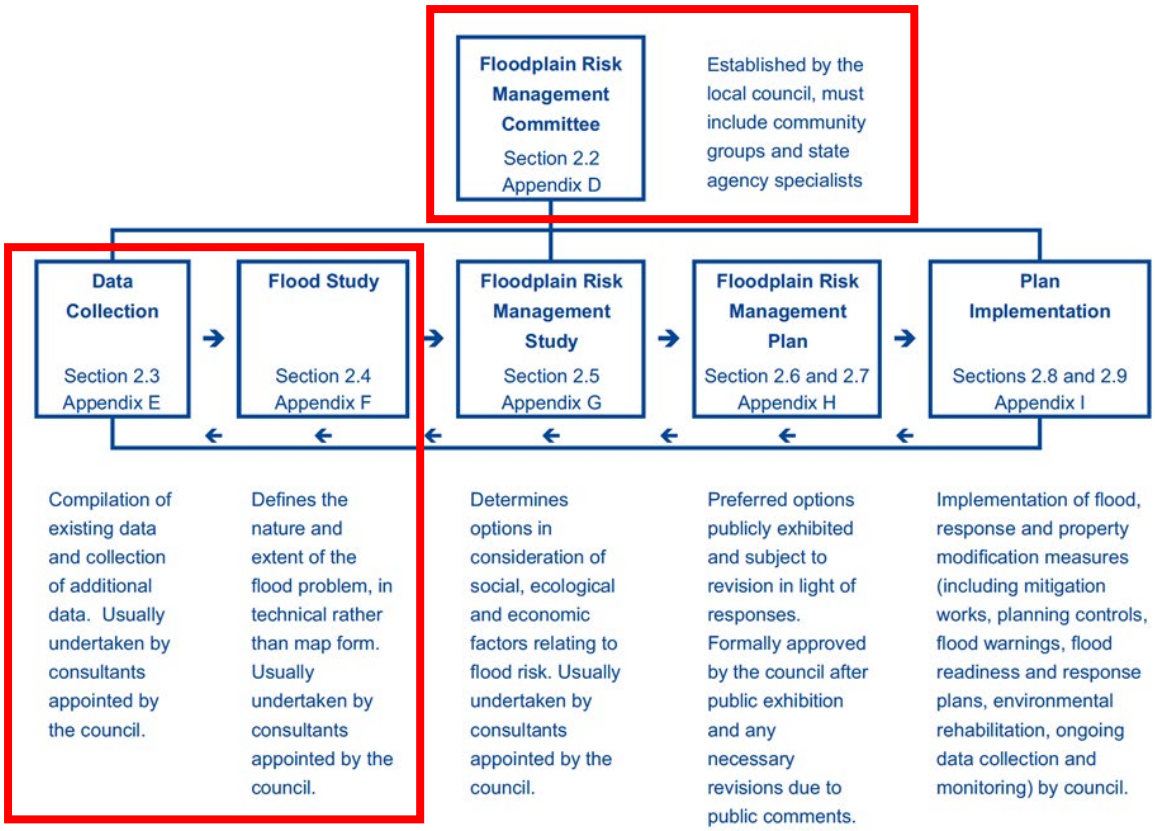
Floodplain Risk Management Process

Previous studies and plans were produced on behalf of Council by NSW Public Works and Webb, McKeown and Associates Pty Ltd between 1985 and 1999. Supplementary Plan Report updates occurred up to 2004 as part of early assessment works associated with the Pacific Highway Upgrade. In 2005 the NSW State Government released the NSW Flood Policy and Floodplain Development Manual to guide Council in preparing and implementing Floodplain Risk Management Plans.

Council with financial and technical assistance from the former NSW Office of Environment and Heritage (OEH) (now Department of Planning, Industry and Environment – DPIE) and in consultation with Council's Strategic and Asset Planning Team, have developed the Final Flood Study for the Lower Macleay River floodplain from Frederickton to South West Rocks to Stuarts Point in the north and Crescent Head in the south.

The Final Flood Study was prepared by Specialist Consultant Engineers (JACOBS) and developed in accordance with the NSW Government's Flood Prone Land Policy and Floodplain Development Manual (2005). The Manual sets out the mandatory processes required for preparing Flood Studies, Floodplain Risk Management Studies and Plans as well as detailing roles and responsibilities for the management of flood prone land.

The following image depicts the overall Floodplain Risk Management Process and tasks undertaken to date (red squares) in developing an ultimate Lower Macleay River Floodplain Risk Management Plan:



The Committee formed includes key representatives from Council, DPIE, NSW State Emergency Service (SES) and four (4) private landowners that have resided within the Lower Macleay River floodplain for many decades.

Community engagement and stakeholder consultation is an important element in flood risk management. The Draft Lower Macleay River Flood Study was placed on public exhibition from the 1st to 28th October 2019.

During the public exhibition period the community was encouraged to review the documents, consider flooding mechanisms affecting the rural and urban areas, and comment on the approaches and methodologies deployed to define the nature and the extent of the flood problem within the Lower Macleay River floodplain from Frederickton (inclusive) and further downstream.

FREQUENTLY ASKED QUESTIONS

The terminology is confusing – what does EY and AEP mean ?

This flood study report discusses flooding events in relation to the probability of a certain magnitude flood event occurring during any given year. The main terms used to describe design flooding are:

- Exceedances per year (EY): the number of times an event is likely to occur or be exceeded within any given year.
- *Annual exceedance probability (AEP):* the probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage.

The table below lists the probability terminology used for the 2016 design rainfalls and shows in **bold** the standard EY and AEP values for which design rainfalls are available. Generally, EY

terminology is used for Very Frequent design rainfalls, AEP (%) terminology is used for Frequent and Infrequent design rainfalls, and AEP (1 in x) terminology is used for Rare design rainfalls.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very frequent	**12**			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.50
	1	**63.2**	1.58	1.00
Frequent	0.69	**50.00**	2	1.44
	0.5	39.35	2.54	2.00
	0.22	**20.00**	5	4.48
	0.2	18.13	5.52	5.00
	0.11	**10.00**	10.00	9.49
Infrequent	0.05	**5.00**	20	20.0
	0.02	**2.00**	50	50.0
	0.01	**1.00**	**100**	100
Rare	0.005	0.50	**200**	200
	0.002	0.20	**500**	500
	0.001	0.10	**1000**	1000
	0.0005	0.05	**2000**	2000
Extremely Rare	0.0002	0.02	5000	5000
			↓	
Extreme			PMP	

Note:

- The 50% AEP **does not** correspond to the 2 year Average Recurrence Interval (ARI). Rather it corresponds to the 1.44 ARI.
- The 20% AEP **does not** correspond to the 5 year Average Recurrence Interval (ARI). Rather it corresponds to the 4.48 ARI.

What is "m AHD" ?

Height in metres above the Australian Height Datum. The datum that sets mean sea level as zero elevation. Mean sea level was determined from observations recorded by 30 tide gauges around the coast of the Australian continent for the period 1966–1968. All flood levels reported within the Study are stated to "m AHD".

Why update the old flood planning documents relating to the Lower Macleay ?

Previous studies and plans produced for the Lower Macleay River floodplain were done prior to the adoption of the NSW Flood Policy and Manual 2005 and thus require updating. Additionally, significant computer technology advancements have occurred, tidal and ocean storm surge data has

been revised, and higher resolution base terrain and bathymetry (below water surface) level datasets are now available all of which can be deployed to develop a model to estimate flood behaviour in detail far greater than previously undertaken. For instance, the old model produced data at a scale of kilometres whereas the new model produces data across a 5m grid in urban zones and 20m grid in rural zones.

Will existing levees be raised to provide higher flood level protection ?

The model developed to inform this current Flood Study stage will be utilised in the near future to assess the flood hydraulic performance of various structural mitigation options that will include raising of the existing levees protecting a number of towns and villages, and agricultural lands. The performance assessment will identify the cost feasibility of such options. This work is undertaken during the Floodplain Risk Management Study stage. Council anticipates this next stage will occur during 2020.

Why is flooding in the Lower Macleay River floodplain so severe ?

The catchment upstream of Kempsey is very steep with extensive gorges. The runoff potential is high and all flood flow is funnelled towards Kempsey where upstream near Aldavilla the topography/terrain forms a constriction that concentrates high energy flows. Major overtopping of the riverbank occurs within Kempsey, Hampden Hall, and the Seven Oaks bend distributing enormous flow rates and floodwater volumes to the floodplain. The river entrance channel acts as a hydraulic control and it was found that the dominant source of flooding within the entire lower floodplain is riverine inflows. Tidal ocean storm surge and Maria / Hastings River back-flooding mechanisms were found to be less dominant in producing peak flood levels.

Has Climate Change been considered ?

An assessment of climate change implications was undertaken using the 1% AEP flood event as a baseline. A combination of increased rainfall intensity and sea level rise was considered against future horizons of years 2050 and 2100. The results indicate significant increases in flood level and hazard that needs to be considered during the Floodplain Risk Management Plan stage of which will identify considerations to revise current land-use planning and controls.

Does the current Flood Mitigation Scheme actually work ?

The model developed was utilised as part of the Flood Study scope to assess the performance of the current Lower Macleay Flood Mitigation Scheme. All infrastructure like levees, major gates and control structures, and major cut diversion drains were removed from the model. The results indicated that the infrastructure serves a critical role as intended during frequent minor floods like the 0.2 EY event with less influence on major floods such as the 1% AEP due to submergence effects.

The river appears to be silting up – does this impact on flooding ?

The Maclear River is a highly dynamic system in a state of constant flux – deposition and scour. Extensive changes in land-use from forests to grazing in past decades has degraded riparian zones increasing the sediment load into the river. High siltation levels reduce the capacity of the river channel to convey flood flow direct to the ocean and riverbank overtopping occurs earlier transferring more volume of floodwater to the floodplain. Dredging of critical siltation and deposition zones will be assessed as a management option during the next stage in the process (Floodplain Risk Management Study).

What happens next ?

As shown in the project timeline, Council has scheduled the remaining stages of the Floodplain Risk Management Process assuming State Government funding will be secured during January 2020. At this juncture we are forecasting a Lower Macleay River Floodplain Risk Management Plan to be completed December 2020.