

7 PREVIOUS REPORTS

Council provided the following previous reports addressing the river behaviour and flooding issues in or near the catchment.

Floods of February 1971 on the South Coast, by Water Resources Commission, Published Version, 1976. (WRC Report)

The report presents historic meteorological and hydrographic information concerning the February 1971 floods impacting a wide range of sites along the South Coast of NSW, including the Bega LGA.

Major towns included in the report included Nowra, Milton, Batemans Bay, Moruya, Bega, Eden and Mallacoota. The principal rivers along the coastal strip from north to south included Shoalhaven River, Clyde River, Moruya River, Tuross River, Bega River, the Towamba River, and Genoa River.

The report provided:

- Synoptic Weather Charts dated from 28th January to 12th February
- Locations of daily rainfall and pluviograph stations
- Isohyetal maps spanning several days
- Cumulative Mass Curves plotted as graphs
- Locations of stream gauges with daily read staff and automatic recorders
- Gauged streamflow records

As the reported pluviograph data was not tabulated it could not be extracted from the report for comparison with the data obtained from BoM.

Continuous stream gauge records were also presented, with recorded water levels and hydrographs. All figures provided in the WRC report were in imperial units. This data was obtained for the current study from the New South Wales Office of Water (NOW) electronic database rather than reproduced from the WRC report graphs. Also the streamflow records from NOW's Pinneena DVD are likely to be a better representation of large events due to the longer duration of records and more accurate rating curves.

Above average rainfall was noted to occur during the two months preceding the heavy rains of late January to early February causing saturated catchments conducive to flooding and increased runoff.

Early January 1971 conditions were quoted as fairly dry until the later part of the month of January. Complex low pressure systems predominated with unstable meteorological conditions and the heaviest falls in the last three days of January (before the flood of February 1971).

The report noted ongoing historic flooding in the Bega River Valley with the first records dating back to 1851.

Flood Inundation Map - Bega and Brogo Rivers at Bega, by Water Resources Commission, 1979

This plan presents:

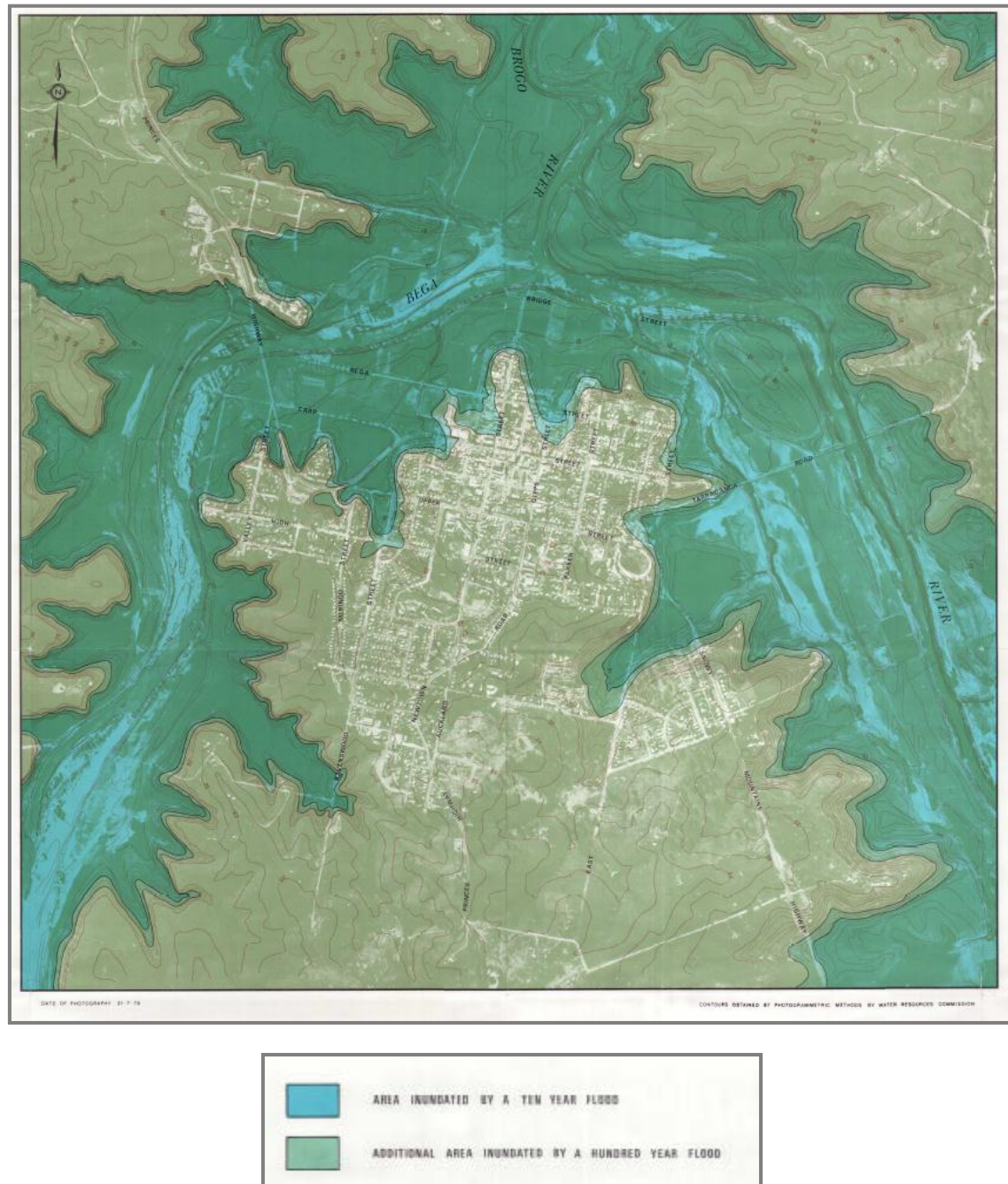
- a flood extent map with design events for a 10 year ARI (Average Recurrence Interval) and 100 year ARI event in and around the town of Bega,
- a table of the monthly distribution of floods at the North Bega Gauge dating back to 1841
- a flood frequency curve and table at the North Bega Gauge using gauged heights and
- flood photos (February 1898, February 1971, August 1974)

Some of the flood heights used in the flood frequency analysis were estimated using data from various historical sources.

It was noted that after the 1851 flood, the town was moved from a low lying area of Brogo River to the site it occupies today.

An extract of the 10 year ARI, and 100 year ARI flood extents from this plan is presented below.

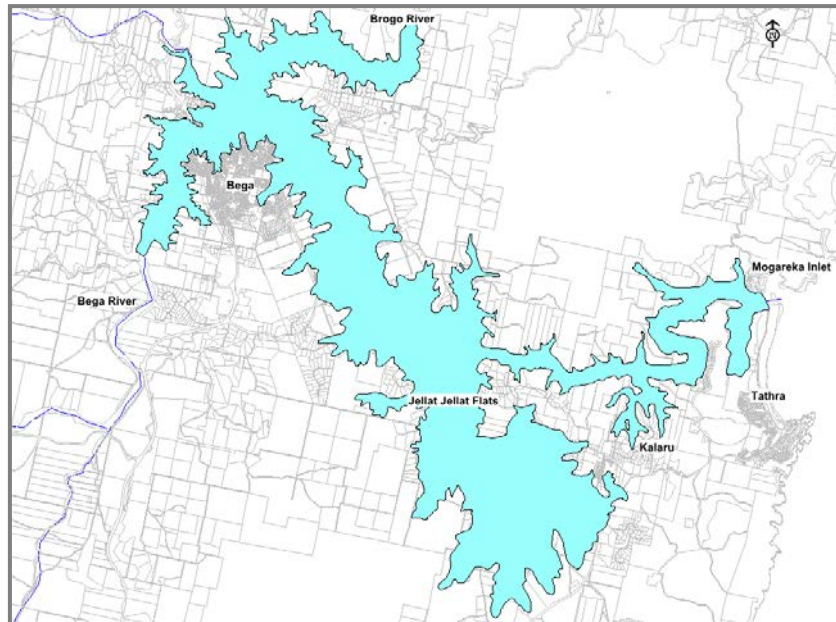
Figure 7.1: Flood Extent Map by WRC, 1979



Flood Inundation Map - Bega and Brogo Rivers at Bega, from Council GIS, 2012

A copy of a flood extent map was provided by Council electronically in GIS format. This extends from upstream of Bega to the Mogareeka Inlet. It is part of the scope of the current study to derive revised flood maps for a range of different sized flood events.

Figure 7.2: Flood Extent Map from Council's GIS



Draft Bega River Estuary Sediment Study (BRESS), by Coastal & Marine Geosciences (in association with Environmental Sciences & Engineering), October 1999

Information from the Summary Section of the Draft BRESS document as it relates to the current study are noted below (BRESS, 1999).

- Bathymetric and aerial photography were used to define the history of the floodplain area with the conclusion that no significant change to the estuary has occurred over the past 130 years.
- The most dynamic portion of the estuary is at Mogareeka with the entrance going from fully open to shut over a matter of months in response to flooding from the catchment and ocean waves.
- An inspection of 20 historic aerial photos taken at the entrance (dating back to the 1940's) was undertaken indicating that the entrance has been open for 30% of the time.
- The entrance was quoted as being currently regulated to help alleviate flood impacts.
- Under natural conditions, it was noted that the entrance is likely to have been closed for prolonged periods of time and only opening during large flood events. The closure of the entrance is likely to have resulted in increased flooding of the low lying areas.
- The narrow section at the Gorge (presumably downstream of Jellat Jellat flats) restricts flows causing water to back up onto the floodplain upstream.
- The control at the bridge (Tathra-Bermagui) was noted as being less important except in very large floods.
- An inspection of estuary depths had indicated that scouring during large flood events is sufficient to convey the bed load material through the system and maintain a fairly stable channel geometry.
- The transport potential within the estuary is noted as sufficient to remove material during major flood events.

Bega River Estuary Management Study and Plan by BMT WBM Pty, July 2011

The Bega River Estuary Management Plan provides strategic direction and specific focus for the short and long term sustainable management of the Bega River estuary waterway, its tributaries, its surrounding foreshore lands, and its catchment in so far as catchment activities impact on the condition of the waterway. The Plan is designed to be used as a 'user manual' for undertaking activities and implementing strategies that will result in improved environmental conditions and a better balance between human and ecological demands on the estuary.

The top three priority objectives addressed by the Plan are:

- Maintaining a hydrological regime that maintains estuarine processes, through sufficient freshwater inflows, ocean interactions and backswamp inundation.
- Future development shall be prohibited from areas of unsuitable capability (e.g. steep slopes, highly erosive soils, sensitive adjacent environments, important existing habitats, prominent visual landmarks etc.).
- Enhancement and protection of the vegetation and natural habitats of the estuary, its riparian zone and the broader catchment landscape, including wildlife corridors.

The Bega River Estuary Management Plan covers the tidal section of the Bega River (i.e. the estuary) extending from the river entrance at Mogareeka Inlet to Jellat Jellat and the Penooka Wetlands. As activities beyond the banks of the estuary can have a significant impact on its health, the entire water catchment has also been considered as part of the Plan, depending on the issue.

The introductory sections of the report provided various general information on catchment, river and entrance geomorphology, entrance conditions and management, tidal and fluvial hydrodynamics, sedimentation and erosion that was of a high informative value for the current study.

Bega Street Development Flood Study by Environmental Resources Management Australia, March 2005

The flood study was prepared for Lascorp who were proposing to develop land in Bega Street, Bega. The proposed development was a shopping centre comprising a number of retail stores and speciality shops and an at grade car park facility. The study aimed to address the potential impacts of the development on flood levels in the Bega River.

The hydraulic modelling was carried out in the HEC-RAS model which was calibrated against the, historical 1971 flood levels. The afflux assessment was carried out using roughly estimated 1971 flood event flows of 7700m³/s (in absence of gauged flows and hydrological modelling), with 4000m³/s from the Bega River and 3000m³/s from the Brogo River. The 1971 flood was used as a benchmark, being approximately of a 100 year ARI occurrence, based on an earlier Flood Frequency Analysis by WRC (1979). The estimated pre- and post-development levels at the site were 15.32 and 15.29m AHD respectively while the maximum afflux at the adjacent upstream properties was 20mm. The report acknowledges the limitations of the 1D modelling undertaken for the study.

Bega Valley Floodplain Management Appraisal Volume 1 Report, by Willing and Partners, Jun 1987

This flood report included hydrologic data, floodmark survey, and land use information. The report also provided a review of flood data, and assessment of flood problems. The inclusions relevant to this Flood Study were:

- Approximate extent of flooding in February 1971 from upstream of Bega to Mogareeka, including Bega, Tarraganda, Jellat Jellat Flats, Kalaru and Tathra along the Bega River, and Brogo River near Bega. These flood extents were based on the DWR Inundation Map 1979.

- A course water surface profile from Bega to Mogareeka Inlet, including the February 1971, February 1919, June 1952, March 1983 events, and estimated water surface profiles for the 10%, 5%, 2% and 1% AEP events. Flood profiles from Bottleneck Reach were extended to Mogareeka.

The report advocates that *“until a Flood Study is undertaken for the Bega Valley, it is considered appropriate that the February 1971 flood be adopted as the flood standard for planning purposes for all areas upstream of Bottleneck Reach”*. The report also notes that floods may rise quickly with limited warning time. Revised levels for both the February 1971 and other historic floods, and a range of design flood events is part of the scope of the current study by SMEC.

Other volumes as part of the Bega Valley Floodplain Management Appraisal report included collated stream gauging data, field survey of floodmarks, the 1:25000 flood atlas, and February 1971 and March 1983 flood levels.

Bega Valley Flood Study Appendix Flood Record Sheets, by Willing and Partners, Jun 1987 (Volume 3 - Appendix B of Bega Valley Floodplain Management Appraisal Report)

This report included numerous flood record sheets with floodmark number, location, date of observation, benchmark details, description of each floodmark and associated date, reliability rating, source where the floodmark was compiled from a report, and a locality sketch. On some occasions the floodmarks were not surveyed to Australian Height Datum and an Assumed Datum (AD) was used.

Tathra Erosion Study, by NSW Public Works, Feb 1980

This study generally relates to erosion at Tathra from Tathra Head to the Bega River entrance. Although the study was related to the Tathra area, it is quoted that the implications from the Tathra Erosion Study could apply to the NSW coast in general. The study highlighted continual beach erosion that could impact on nearby infrastructure and the affected community.

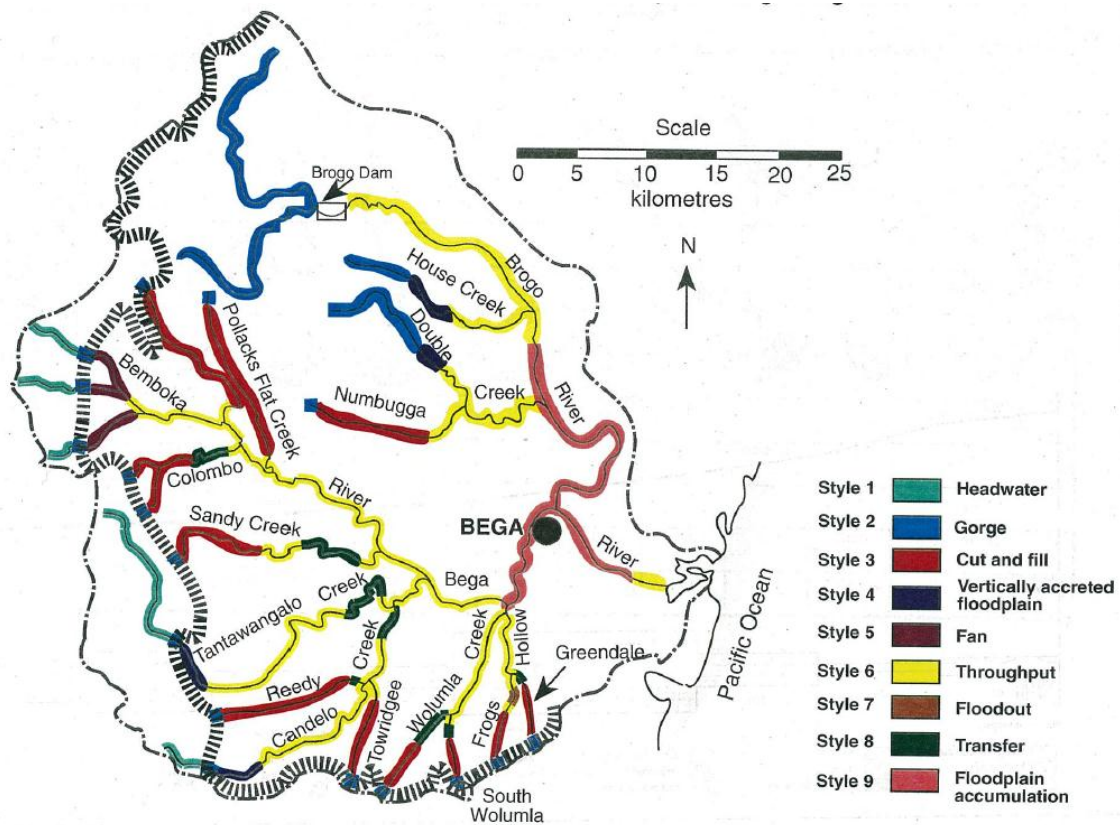
The report mainly relates to the beach erosion with impacts from Bega River. The report states that the Bega River supplies sand to the coast and that the erosion potential could either increase and make things worse, or decrease provided that no major floods occur. Sediment transport calculations, to quantify the fluvial sand movement during floods, were initially to be carried out but were not undertaken due to the absence of flood hydrographs (Public Works, 1980, page 37).

Various processes for the transport of sand near Tathra were identified and included in this assessment. The erosion potential is stated as being dependant on the occurrence or non-occurrence of major flood events, although no quantitative values are stated. The study, however, does not contain significant information on lagoon sandbar behaviour in relation to flooding from the river that would be relevant for this Flood Study.

The Use of River Styles and Their Associated Sediment Storage in the Development of a Catchment-Based River Rehabilitation Strategy for Bega/Brogo Catchment, South Coast, NSW, by Fryirs and Brierley, Jun 1998

Defines river styles in the Bega and Brogo River Catchment including Headwater, Gorge, Cut and Fill, Vertically Accreted Floodplain, Fan, Throughput, Floodouts, Transfer, and Floodplain Accumulation river styles. The floodplain accumulation style is identified along the lowland plain (the focus of this study area).

Figure 7.3: River Styles in Bega and Brogo Catchment (by Fryirs and Brierley, 1998)



(Source: Fryirs and Brierley, Jun 1998)

It is noted that since European settlement “changes to river forms and processes have been dramatic along virtually all river courses beyond the base of the escarpment.” (Fryirs and Brierley, 1998 page v). Part 2 of the report includes patterns of sediment storage along river courses and their relation to bedload transport capacity.

Of relevance to this Flood Study were the results of computations presented in the report. Results included sediment storage and release, associated sedimentation, sediment samples showing grain size distributions particularly in the area in the lowland plain, and the volume of material within the channel. Based on the sediment storage volumetric balance assessment presented in the abovementioned report, 14.165 Mm³ of sediment is being transferred to the lowland plain and 3.716 Mm³ released to the estuary over a period of approximately 150 years, hence 10.449 Mm³ could potentially remain in the lowland plain.

Other relevant computations from the abovementioned report included volumes calculated in the vicinity of several cross sections in the current study area including sections 37, 38, 39, 43. Using these cross-sections the volume of sediment was estimated to a total of 15.7 Mm³ of material in the lowland plain, which provided a more conservative estimate than 10.449 Mm³.

These figures were used in the current study coupled with grain size distributions at each cross-section location to estimate the portion of material to settle over a long term period (150 years). These estimates were considered further in the Section 16 – Sensitivity Analysis.