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INQUIRY INTO FLOODPLAIN HARVESTING

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DPIE cease to flow analysis of the Barwon–Darling River: assessment and questions

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Summary

DPIE published an analysis of historical flow data and claimed the Barwon–Darling River has ceased to flow frequently during dry periods, particularly before and during the Federation Drought (1895–1902) and that cease to flow events since the mid-1990s are thus not unusual. They conclude that a constantly flowing river 'is not natural' and use this narrative to support a policy position of providing minimal connectivity for the river. The observed daily flow data for the gauges that DPIE used and their analysis methods were requested by the Connectivity Stakeholder Reference Group but were not made available. DPIE assumed cease to flow events for periods where data is missing from the record of observed daily flows, which is misleading. I used additional lines of evidence (rainfall data and historical monthly flow data published by the Water Conservation and Irrigation Commission) and found the number of days of cease to flow events from 1886–1902 was markedly over-estimated by DPIE and that many events were in fact periods of low flow. It is incorrect to assert that recent cease to flow events on the Barwon–Darling are 'not unusual'.

Background

The following assessment is of the data released by DPIE between the first and second meetings of the Connectivity Stakeholder Reference Group (25 August and 7 October, 2021). The data ('the Barwon Darling River observed and modelled cease to flow 2021 dataset) included information on flow for the gauges d/s Walgett (422001; gauge commenced 01-01-1886), Brewarrina (422002; commenced 17-04-1892), Bourke Town (425003; commenced 01-02-1895), Wilcannia (425008; commenced 27-10-1886), Menindee Weir 32 (425012; commenced 19-02-1958, but the Darling at Menindee Town gauge [425001] commenced on 01-01-1881) and Burtundy (425007; commenced 25-03-1940, but the Darling at Pooncarie gauge [425005] commenced on 01-03-1885).

The data was used to support the claim that the Barwon–Darling has ceased to flow frequently during dry periods, particularly during the Federation Drought (1895–1903): 'the observed cease-to-flow conditions since the 1990s have been severe, but not unusual when compared to the early 1900s' and therefore 'we can't guarantee a constantly flowing river – it is not natural' (DPIE 2021a, p. 7).

The data released by DPIE did not include observed daily flow data for any of the gauges, only periods of cease to flow events and notes on probable events inferred from missing data. It appears no supporting documentation was released that gave details of the methods used in the modelling.

DPIE claim their analysis was based on 'newly found historic data' and that the data 'may be of lower quality than the historic data published on the WaterNSW website' (DPIE 2021b). Starting dates of the observed gauge data, which are not continuous records, are: d/s Walgett (422001) from 29-07-1885, Brewarrina (422002) from 14-11-1896, Bourke Town (425003) from sporadic historical data of large flow events from 04-05-1832 to 02-01-1892 and daily records thereafter; Wilcannia (425008) from 12-02-1914, Menindee at Weir 32 from 18-11-1914, with one record from 01-07-1880 (425012) and Burtundy (425007) from 27-12-1912.

In the absence of the release of the observed daily flow data by DPIE, I found data for the Brewarrina Gauge from 17/04/1892 in PINNEENA (DIPNR 2004), a database of historical water

data collected by NSW government agencies that preceded the WaterNSW real time water monitoring database. Judging by the gaps in the record, this appears to be the same data as used in the DPIE analysis and that on the WaterNSW database. For other gauges I used monthly data from the Water Conservation and Irrigation Commission (1956).

Assessment of the observed cease to flow data by DPIE

There are large amounts of missing data from the Barwon d/s Walgett (422001) and Brewarrina (422002) gauges. For example, for Brewarrina, it is claimed by DPIE there were 103 days of cease to flow (CTF) in 1897, but there are 79 days of missing data; for 1899, 145 days CTF, but 124 days missing; for 1901, 137 days CTF, 108 days missing and 1902, 331 days CTF and 165 days missing.

Attempt to fill these gaps were made by DPIE inferring CTF events using flow data from upstream and downstream gauges. For these periods of missing data, In the Excel spreadsheet on notes for the Brewarrina gauge observed data for cease to flow periods there are many references to 'natural looking CTF event; aligns with US [upstream] gauge'; the upstream gauge being Walgett.

Findings

Between the Walgett and Brewarrina gauges, the Macquarie River enters the Barwon. Prior to any dams or weirs, the Macquarie River ceased to flow only very rarely and for short periods (Mallen-Cooper 2020). While there is no publicly-available daily gauge data for the Macquarie River from the period of the Federation Drought, there are some monthly summaries (Water Conservation and Irrigation Commission, 1956). In 1902, during the Federation Drought, the Darling stopped flowing for 11 months at Menindee, but the Macquarie River remained flowing the entire time.

The likelihood of inflows to the Barwon from the Macquarie can also be assessed using historical rainfall data. In March, April and August 1901 and in August, November and December 1902, historical rainfall maps show there was significant rainfall in the Macquarie Catchment (BoM 2021). Weather station data from BoM shows annual rainfall in 1901 for Dubbo (Mentone) was 584 mm and for 1902 345 mm, including 63 mm in August and 96 mm in December. At Quambone, there was 380 mm of rainfall in 1901, including 105 mm in April and 40 mm in June, though only 224 mm in total in 1902, but with 95 mm in November. At Warren, there was 333 mm in 1901, with 83 mm in March, 61 mm in April and 49 mm in October. In 1902 there was 440 mm; 87 mm in April, 61.5 mm in May, 61 mm in July and 69 mm in September.

Given the high rainfall periods in the Macquarie catchment mentioned above it is likely there were significant inflows from the Macquarie to the Barwon during the Federation Drought and in 1901-02 in particular. Indeed, there is a spike in daily flows at Brewarrina from July 1901 to January 1902. Thus it is misleading to assume cease to flow events for periods where data is missing from the Brewarrina gauge.

References in the notes for the Walgett gauge (42201) observed data for cease to flow periods indicate there were 74 days CTF in 1887, but 70 days of missing data; 264 days of CTF in 1888, but the DPIE notes state 'probable missing CTF period' (i.e. no data); for 1899, 77 days CTF, but at least 42 days missing; for 1902, 270 days CTF and but 'probably missed CTF period' from 22-03-1902 to 16-12-1902 (i.e. over 9 months of missing data).

For 1902, with 270 days of CTF inferred by DPIE, historical rainfall maps show there was major rainfall in the northern tributaries of the Barwon–Darling: in the Border Rivers, Namoi and Gwydir catchments in October and November 1901 and August and October-December 1902. Wee Waa on the Namoi received 557 mm of rainfall in 1901, with 105 mm in March, 71 mm in

May and 82 mm in August, and 107 mm in August 1902. Collarenebri, on the Barwon upstream of Walgett, received 111 mm in March 1901, 52 mm in May and 61 mm in November, as well as 59 mm in August 1902. These major rainfall events likely translated into significant runoff and inflows to the Barwon–Darling. These inflows are evident from the spike in flows in 1901 shown in Figure 1a.

As in the case of the Brewarrina gauge, it is misleading to assume cease to flow events for periods where data is missing from the Walgett gauge. Further, the periods of cease to flow assessed by DPIE for the Walgett gauge do not match up with the monthly flows in Figure 1a. Many of the events counted as cease to flow clearly coincide with periods when the river was flowing.

Between 1896–1902 I found only two prolonged periods of cease to flow (Figure 1): in 1888-89 (8 months at Walgett and Wilcannia and 10 months at Menindee) and 1902 (8 months at Walgett and 11 months at Wilcannia and Menindee). These figures compare with recent periods of 23 months (March 2006 to January 2008), 27 months (May 2014 to July 2016) and 25 months (January 2018 to February 2020) at Menindee.

Conclusions

There have been clear and major declines in mean annual discharge on the Barwon–Darling in the period following water resource development in the 1960s, and particularly since 2009, compared with the period prior to development, as well as a marked increase in cease to flow events (AAS 2019, pp. 25, 26; Figs. 10 and 12 therein).

The data presented by DPIE that purports to show 'the observed cease-to-flow conditions since the 1990s have been severe, but not unusual when compared to the early 1900s' has over-estimated the number of days of cease to flow events per year prior to and during the Federation Drought at the Walgett and Brewarrina gauges. This over-estimation is because: 1) decisions were made to count low flows as cease-to-flow events (though there is no information available on what low flow threshold was used for this); 2) periods where data was absent were counted as cease to flow events if they coincided with daily gauge data of zero flows; 3) inflows from major tributaries of the Barwon–Darling were not taken into account, including the Condamine–Balonne which contributed an average of 552 GL per year as end-of system flows to the Barwon–Darling before water resources were developed for irrigation; over twice current outflows (CSIRO 2008, p. 59); 4) there was no attempt to ground-truth their inferences of the number and duration of cease to flow events for which data was lacking by considering likely inflows from localised high rainfall events in tributary catchments using publicly-available historical rainfall data or from other lines of evidence (e.g. historical records such as newspaper reports); 5) DPIE appear not to have cross-referenced their assessment of the number and duration of cease to flow events with other publicly-available gauge data (e.g. monthly data published by the Water Conservation and Irrigation Commission 1956) and from additional gauges with long periods of historical record in tributary catchments.

The concerns raised above are particularly important, considering that the DPIE analysis 'is being used in the development of water management policy in the Barwon Darling and Northern Murray Darling Basin' (DPIE 2021b, p. 1).

Cease to flow is a poor metric alone on which to base water management policy. The important issue from an environmental perspective is the loss of low flows and flowing water conditions (Mallen-Cooper and Zampatti 2020). The freshwater biota relies on flows to survive, including baseflows. Without an assessment of the loss of low flows, semi-annual flow pulses and extended periods of baseflow, as indicated in Figure 1, the assessment by DPIE is both incomplete and

misleading. This is because periods of cease to flow may be increased by weirs which capture water from upstream (Mallen-Cooper and Zampatti 2020, p. 225, Figure 6 therein) at the expense of downstream flows. Accordingly, the periods in which the river is not actually flowing have increased markedly in extent and duration. These conditions do not make for a healthy river.

Rather than forming a basis for a common understanding of the historical pattern of cease to flow events in the Barwon–Darling and to provide 'evidence for river connectivity discussions among stakeholders' (DPIE 2021b, p. 1), the DPIE analysis raises more questions than it answers.

Questions for DPIE

- What is the source of the 'newly found historic data' used by DPIE? How was this data processed? What would be a corresponding data quality code for this data?
- Will DPIE release the full set of observed daily flow data for the Barwon–Darling gauges?
- When will supporting documentation be released that gives details of the methods used in the modelling?
- Why is the data on numbers of days of cease to flow per year in the DPIE presentation different from the numbers in the observed data in the Excel spreadsheets?
- Why was the modelled data, and inferences of cease to flow events for missing data in the observed record not ground-truthed against other lines of evidence?
- Will DPIE undertake to revise their analysis in the light of this assessment and include other ecologically important flow metrics?

References

AAS (2019) Investigation of the causes of mass fish kills in the Menindee region NSW over the summer of 2018–2019. Australian Academy of Science, Canberra.

BoM (2021) Recent and historical rainfall maps. Bureau of Meteorology, Canberra. http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=totals&period=daily&region=nat&year=2021&month=10&day=08).

CSIRO (2008) Water availability in the Murray–Darling Basin. CSIRO Water for a Healthy Country National Research Flagship, Canberra.

DPIE (2021a) Analysis to support connectivity discussions. Department of Planning, Industry and Environment, Sydney. Available at: https://www.industry.nsw.gov.au/__data/assets/pdf_file/0009/454059/analysis-to-support-low-flow-connectivity-discussions.pdf [accessed 7 October 2021]

DPIE (2021b) Barwon Darling Cease to Flow Metadata Statement 2021. Department of Planning, Industry and Environment, Sydney. Available at: https://datasets.seed.nsw.gov.au/anzlic_dataset/https-www-industry-nsw-gov-au-water-science-cease-to-flow/resource/75b38fba-c5fb-4aae-9ba7-1d8f73034802 [accessed 7 October 2021]

Mallen Cooper, M. (2020) Comments on the new Macquarie dam at Gin Gin. Healthy Rivers Dubbo. Available at: https://healthyriversdubbo.com/2020/06/30/dr-martin-mallen-cooper-comments-on-the-new-macquarie-dam-at-gin-gin/ [accessed 7 October 2021]

Mallen-Cooper, M. and Zampatti, B. (2020) Restoring the ecological integrity of a dryland river: why low flows in the Barwon– arling must *flow*. *Ecological Management and Restoration* 21, 218–228.

DIPNR (2004) PINEENA 8: New South Wales Surface Water Archive. Department of Infrastructure, Planning and Natural Resources, Sydney. [CD-ROM]

Water Conservation and Irrigation Commission (1956) Surface Water Supply of New South Wales. Stream Flow Records Period to 31st December 1950. Volume 1. Darling River Basin. Government Printer, Sydney.

Figure 1 (a) Monthly flow at the Walgett gauge before and after the Federation Drought (1895-1902), with the periods of cease to flow events (CTF) estimated by DPIE mapped on (pink bars). Flows are on a logarithmic scale (where 1 = no flow) to emphasise that many events counted as CTF were in fact periods of low flow; (b) monthly flow at the Wilcannia gauge; (c) monthly flow at the Menindee gauge. Flow data from Water Conservation and Irrigation Commission 1956, pp. 246–248; 273–275; 283–285)