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Historical rainfall patterns

Blue Mountains - Nepean - Hawkesbury region

Warragamba Dam Raising Project (SSI-8441)
Response to the EIS

Submission to the NSW Department of
Planning, Industry and Environment

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DECLARATION

Submission to the NSW Department of Planning, Industry and Environment regarding the Warragamba Dam Raising Project (Application No. SSI-8441).

This submission objects to the proposal for the reasons set out in the following pages.

I have made no reportable political donations during the previous two years.

I accept all of the Department's submissions disclaimer and declaration requirements, as set out at: https://www.planningportal.nsw.gov.au/major-projects/help/disclaimer-and-declaration

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1

Introduction

As part of the justification for raising the Warragamba Dam wall the Environmental Impact Statement (EIS) argues that this project will mitigate flooding on the floodplains downstream from the Dam. An important part of the rationale for this argument is that climate change will induce long-term changes in rainfall patterns which may increase the flood risk on the plains. The EIS states:

> Nearly all major floods in the Hawkesbury-Nepean are caused by an east coast low, an intense low-pressure weather system that can occur on average several times each year off the eastern coast of Australia. It is likely that climate change would cause the overall frequency of this weather system to change, which may increase rainfall variability and intensity across the Hawkesbury Nepean catchment, and cause changes to flood regimes and dam operational protocols.[1]

The EIS then outlines four future scenarios relevant to the flood risk. All these scenarios assume only an *increase* in rainfall: 4.9, 9.1, 13.9 and 18.6 percent increases (depending on assumptions about emissions).[2] The EIS does not consider any scenarios where rainfall may *decline*.

Using these scenarios the EIS draws the following conclusions regarding the Dam wall:

> The increase in rainfall due to climate change would result in an increase in downstream flooding with the existing dam and a deterioration in Project flood mitigation capacity. For example, if rainfall increased by 9.1 percent, the current 1 in 100 chance in a year flood level at Penrith would change to a 1 in 65 chance in a year event. With

1. SMEC (2021a), *Warragamba Wall Raising: Environmental Impact Statement*, Chapter 15: Flooding and Hydrology, 10 September 2021, Prepared for WaterNSW, p. 121.
2. Ibid., p. 121.

> the Project the current 1 in 100 chance in a year flood level would be experienced in a 1 in 508 chance in a year event, which would decrease to a 1 in 302 chance in a year event. This demonstrates the increased flood risk and the deterioration in Project flood mitigation capacity due to climate change. If rainfall were to increase by 9.1 percent, the Project FMZ would need to be raised by three metres by 2090 to have about the same flood mitigation capacity as the Project FMZ under existing rainfall conditions. To be resilient to the future impacts of climate change and maintain the downstream benefits, the Project includes an additional three metres in the abutment height.

Clearly, the EIS conclusions appear to hinge on the link between climate change and increases in rainfall. However, an important question is ignored in the EIS, namely, how accurate are these assumptions about rainfall patterns for the Blue Mountains-Nepean-Hawkesbury region? This region is the relevant one for consideration in this submission, and for ease of expression I refer to 'local region' in the following pages.

While the links between rainfall and flooding are obvious, disentangling all of the other factors which contribute to the severity of any particular flood is complex. As the EIS notes, the following factors all play a role:

- rainfall intensity and frequency: the number of times, during a specified period of years, that rainfall of a certain magnitude or greater occurs;
- spatial pattern of rainfall: where in the catchment rain falls;
- temporal pattern of rainfall: when, in the event, rain falls;
- initial loss: rain 'lost' at the beginning of an event through infiltration into the soil;
- pre-burst rainfall: rain that occurs before the most intense storm burst;
- dam drawdown: the level of Warragamba Dam before the start of an event;
- relative timings of dam inflows: when water flows from rivers and streams to the dam;
- tides: tidal influences in the Hawkesbury River.[3]

3. SMEC 2021a, p. 14.

Despite this complexity, the EIS argues—as noted above—that the rainfall predictions in their modelling are highly relevant to the view that raising the dam wall will mitigate the flood risk on the plains. In the case of my submission, I acknowledge this complexity and do not draw any inferences about patterns in rainfall data and the severity of flooding except to acknowledge that a link does exist. Instead, I offer an appraisal of the EIS assumptions about rainfall patterns. My comments are based on the published literature from experts in the field, and on a closer examination of the historical rainfall records for the local region over the last century. I conclude that the evidence regarding rainfall patterns for the local region is the *opposite* to that suggested in the EIS. I further conclude that the EIS is deficient in not considering any scenarios in which the volume of rainfall declines, or in which extreme rainfall events lessen over time.

2

Climate change and rainfall patterns

There is little doubt that climate change has brought about major changes in weather patterns in Australia. One of the most dramatic aspects of climate change has been increases in temperature extremes. As a recent CSIRO report notes:

> Very warm months … have increased five-fold in the past 15 years. The frequency of very cool months has declined by around a third over the same period … changes include recent, significant increases in the frequency of high-temperature extremes and decreases in the frequency of low temperature extremes.[1]

However, the connection between climate change and rainfall appears much less clearcut. Drawing conclusions is made difficult because the 'intrinsic rainfall variability on year to year and decade to decade timescales is large'.[2] Nevertheless, the broad pattern in rainfall is a declining trend for southern Australia in the cooler months of the year, particularly in the south-western parts of the continent. In the case of south-eastern Australia declines in rainfall have been evident through the whole of the 20th century, and have become more evident in recent decades. Since the mid-1990s 'southern drying trends' of around 10-20 percent reduction in rainfall have been evident in the south-east.[3] There are a number of factors driving these trends, in particular the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD).[4]

Nevertheless, there is little doubt that global warming has a definitive impact on rainfall. As the CSIRO report authors observe:

1. Karl Braganza et al. (2015), 'Chapter 4: Understanding Recent Australian Climate', in: *Climate Change in Australia: Projections for Australia's NRM Regions, Technical Report*, ed. by Penny Whetton, Canberra: CSIRO, p. 43.
2. Ibid., p. 43.
3. Ibid., p. 44.
4. Ibid., p. 45.

> As the atmosphere warms, its capacity to hold moisture increases, enhancing the potential for extreme rainfall events and the risk of flooding and erosion events. However, changes in the atmospheric circulation patterns that trigger heavy rainfall events could also change, thereby either enhancing or partially offsetting this effect. Studies of the observed record of extreme rainfall in Australia show some evidence of an increase in rainfall extremes.[5]

It is statements such as these which appear to have influenced the EIS authors to conclude that they need only consider *increases* in rainfall (whether that be volume or extremity). However, this statement from the CSIRO report should be interpreted in two ways. First, it provides an explanation of the general principle regarding the connection between global warming and rainfall; and secondly, it offers a summary of rainfall patterns in general. What is does not provide is an indication of what will happen in specific regions, such as the local region (that is, Blue Mountains-Nepean-Hawkesbury). Indeed, in the more detailed chapters of the same report, the CSIRO report authors lay out the variability in these weather patterns and demonstrate that a closer examination of different studies leads to quite different conclusions. These depend on both the geographical areas under consideration and the particular type of rainfall involved.

Thus, there is certainly evidence that the proportion of *heavy rainfall* has been *increasing* in Australia since the 1970s. However, as with rainfall trends in general, there is considerable regional variability. In particular, the east coast region has experienced 'a significant *decrease* in extreme rain events since 1950' (emphasis added).[6] Where climate change fits into this picture is uncertain. It appears that the ENSO is the dominant factor behind changes in rainfall extremes in Australia, but given that global warming influences ENSO itself, disentangling these changes from natural variability is difficult.[7]

Changes in rainfall trends have been linked to Antarctic ozone depletion as well as to global warming. In particular there has been a 'contraction of mid-latitude weather systems toward the pole'.[8] In essence this means that frontal systems, in particular troughs associated with rainfall, have declined in frequency since 1975. This is particularly evident in the dryer conditions experienced in south western Western Australia during the winter months.

What about East Coast Lows (ECLs), the weather systems which the

5. Whetton et al. 2015, p. 118.
6. Braganza et al. 2015, p. 46.
7. Ibid., p. 46.
8. Ibid., p. 46.

EIS links to flooding in the Nepean-Hawkesbury area? The CSIRO report suggests that there is a strong connection between heavy rainfall and East Coast Lows. However, as just noted, their report also concludes that there has been a *decrease* in extreme rain events along the east coast since 1950, and there is also evidence for a 'small decreasing trend in the number of East Coast Lows'.[9] The occurrence of ECLs is complicated by their uniqueness. Whereas the ENSO is a dominant factor behind changes in extreme rainfall (as just noted), this appears not to be the case with ECLs. As a recent Office of Environment and Heritage report noted:

> Climate drivers such as the El Niño/La Nina cycle, which are known to have a major influence for most of eastern Australia, appear to have a very poor correlation with the frequency and intensity of ECLs.[10]

In the EIS the authors acknowledge that the frequency of ECLs may 'remain neutral or show a decline' but they argue that the frequency of more *intense* ECLs will increase:

> The patters of historical ECLs are yet to be fully understood, and as such, there is significant uncertainty in model outputs. However, there is consensus that while the frequency of ECLs may remain neutral or show a decline, the frequency of more intense ECLs events will increase.[11]

The evidence for this claim appears to modelling of weather patterns rather than actual data, with confidence in the assessments based on 'model agreement', that is, the number of models which agree about the direction in change (increasing versus decreasing).[12] It is also unclear where the EIS projection for increasing ECLs comes from. The main reference cited in the EIS, and the one most relevant to the Sydney basin—the 2014 Office of Environment and Heritage *Metropolitan Sydney Climate Change Snapshot*—does not discuss ECLs. A later report (2016) from the same authority—*East Coast Lows Research Program Synthesis for NRM Stakeholders*—discusses ECLs in great detail. The future projections in the report focus on the question of whether ECLs will increase or decrease in frequency and/or intensity, and the main concerns seem to be around coastal erosion and water security. The challenges in modelling ECLs appear formidable. As the OEH report notes:

9. Braganza et al. 2015, p. 49.

10. Office of Environment and Heritage (2016), *Eastern Seaboard Climate Change Initiative: East Coast Lows Research Program Synthesis for NRM Stakeholders*, Adapt NSW, OEH, State of NSW, p. 9.

11. SMEC (2021b), *Warragamba Wall Raising: Environmental Impact Statement*, Appendix G: Climate Change Risk, 10 September 2021, Prepared for WaterNSW, p. 27.

12. Office of Environment and Heritage (2014), *Metropolitan Sydney Climate Change Snapshot*, Adapt NSW, OEH, State of NSW, p. 12.

> There are challenges in modelling the impacts of future changes in the frequency and intensity of ECLs that relate to their small geographical size (compared to global models), relatively short-lived nature, and their multiple origins.[13]

The conclusions which the report draws emphasise uncertainty, particularly around geographical variability:

> Across all ECL types the Project 2 modelling indicates that there will be a decrease in the frequency of winter storms, and a small increase (or no change) in the frequency of summer storms … Without details on which types of ECL these changes relate to it is difficult to draw specific regional conclusions on the likely impact on coastal systems and water security … The ongoing research in this field will be pivotal in addressing these uncertainties.[14]

In summary, there is little doubt that rainfall patterns are linked to climate change, but far less so than for temperature extremes. Furthermore, other factors are important in producing these patterns. What the specialist literature does suggest is that weather patterns have been characterised by declines in both the volume and extremity of rainfall along the East Coast, as well as considerable local geographical variability. When it comes to the East Coast Low weather systems which directly influence heavy rainfall in the local region (that is, the Blue Mountains-Nepean-Hawkesbury), some evidence suggests that these are declining in number, the EIS suggests they may be increasing, while the overall conclusion is that considerable uncertainty characterises this field of research. It is clear from all of the specialist literature that the geographical variability of particular regions in Australia is a fundamental aspect of all projections of rainfall patterns. This variability is something which emerges very clearly from the historical rainfall patterns examined in the next section of this submission.

13. Environment and Heritage 2016, p. 22.
14. Ibid., p. 23.

3

Historical rainfall patterns

Weather stations

In what follows I draw on Bureau of Meteorology (BOM) daily rainfall data for the Blue Mountains-Nepean-Hawkesbury area (the 'local region') covering the last century (or 101 years to be more precise).[1] Some of the stations in these data ceased operation during the time period examined, and some began later in this time period. A small number of stations collected data for the full 101 years.

The analysis below breaks these weather stations into two groups. The first uses all the stations shown in Figure 3.1 and *pools* the data. These data are used to calculate monthly average rainfall during the period 1920 to 2020. This pooling deals with the intermittent nature of the data collection.[2] This analysis focuses on the *volume* of rainfall over the last 101 years.

The second group of stations, shown in Figure 3.2 and Table 3.1, is a small subset of the larger group of stations where there is a continuous record of data collection for the full 101 years. The data from these stations are used to assess the *severity* of rainfall over the last 101 years. Because this analysis is

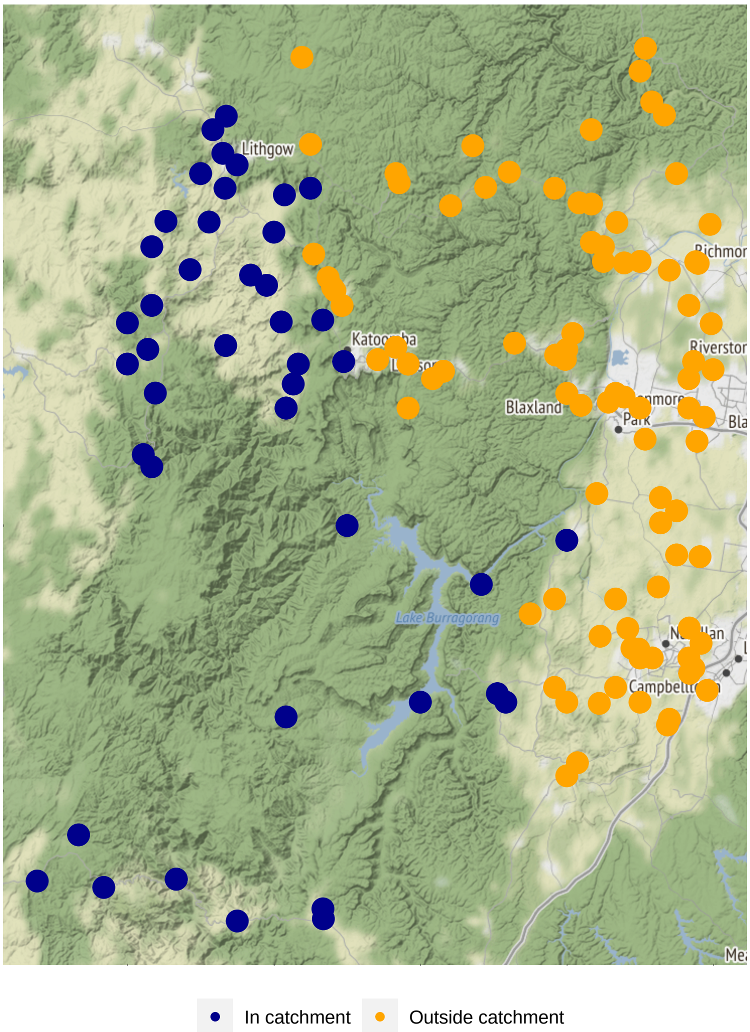
1. The data is sourced from http://www.bom.gov.au/climate/data/stations/. The time frame includes 2020 (hence the 101 years) in order to use the latest data. Data for 2021 is not included, as the year is not yet complete. The analysis in this submission uses the `R` statistical software (R Core Team (2021), *R: A Language and Environment for Statistical Computing*, R Foundation for Statistical Computing, Vienna, Austria, URL: https://www.R-project.org/). The graphs use the `ggplot2` library (Hadley Wickham (2016), *ggplot2: Elegant Graphics for Data Analysis*, Springer-Verlag New York, ISBN: 978-3-319-24277-4, URL: https://ggplot2.tidyverse.org) and the map makes use of Google Maps and the `ggmap` library (David Kahle and Hadley Wickham (2013), 'ggmap: Spatial Visualization with ggplot2', in: *The R Journal* 5. 1, pp. 144–161, URL: https://journal.r-project.org/archive/2013-1/kahle-wickham.pdf).

2. As the seminal text in this field points out: 'Where a single station is being analysed it is important that it has a reasonably long record (preferably longer than 30 years) and only a small percentage of missing data. However, for studies that pool data the quality of the data is a bigger issue than record length.' Ball J et al., eds. (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Canberra: Geoscience Australia, p. 79

based on comparisons over time in the number of days in a year when certain amounts of rain fell, a continuous record of data collection is required.

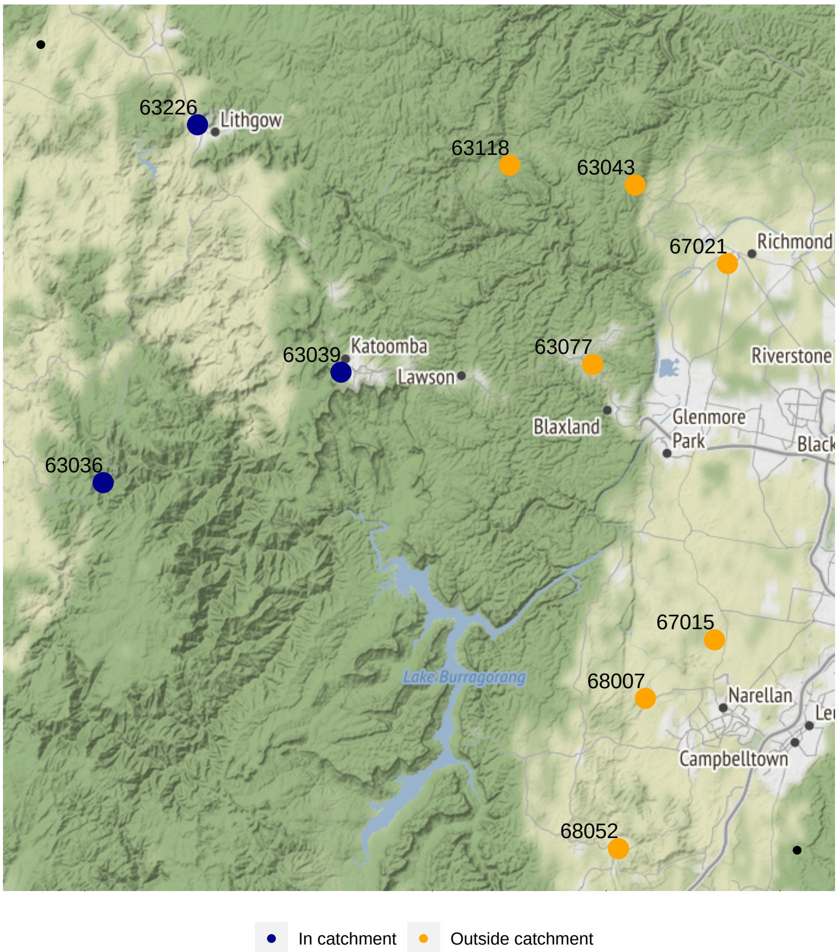
The datasets assembled for this analysis divide the weather stations into those in the catchment area for Warragamba Dam and those outside. This designation is based on the location of the station relative to the creek or river system to which it contributes. For example, stations in Blackheath or Katoomba—depending on their specific location—may contribute to the Coxs River (and hence the catchment) or to the Grose River (and hence outside the catchment).

Figure 3.1: Location of weather stations by catchment / non-catchment designation



Source: Based on latitude and longitude coordinates of BOM weather stations. Designation based on location relative to creek or river systems.

Figure 3.2: Location of weather stations with continuous rainfall records, by catchment / non-catchment designation



Source: Based on latitude and longitude coordinates of BOM weather stations. Designation based on location relative to creek or river systems. Numbers refer to weather station identification. See Table 3.1 for details.

Table 3.1: Details of weather stations with continuous rainfall data 1920 to 2020

Station	*Location*	*Started*	*Catchment*
63036	OBERON (JENOLAN CAVES)	1895	In catchment
63039	KATOOMBA (FARNELLS RD)	1885	In catchment
63043	KURRAJONG HTS (BELLS LINE RD)	1866	Outside catchment
63077	SPRINGWOOD (VALLEY HEIGHTS)	1883	Outside catchment
63118	BILPIN (FERN GROVE)	1892	Outside catchment
63226	LITHGOW (COOERWULL)	1878	In catchment
67015	BRINGELLY (MARYLAND)	1867	Outside catchment
67021	RICHMOND - UWS HAWKESBURY	1881	Outside catchment
68007	CAMDEN (BROWNLOW HILL)	1882	Outside catchment
68052	PICTON COUNCIL DEPOT	1880	Outside catchment

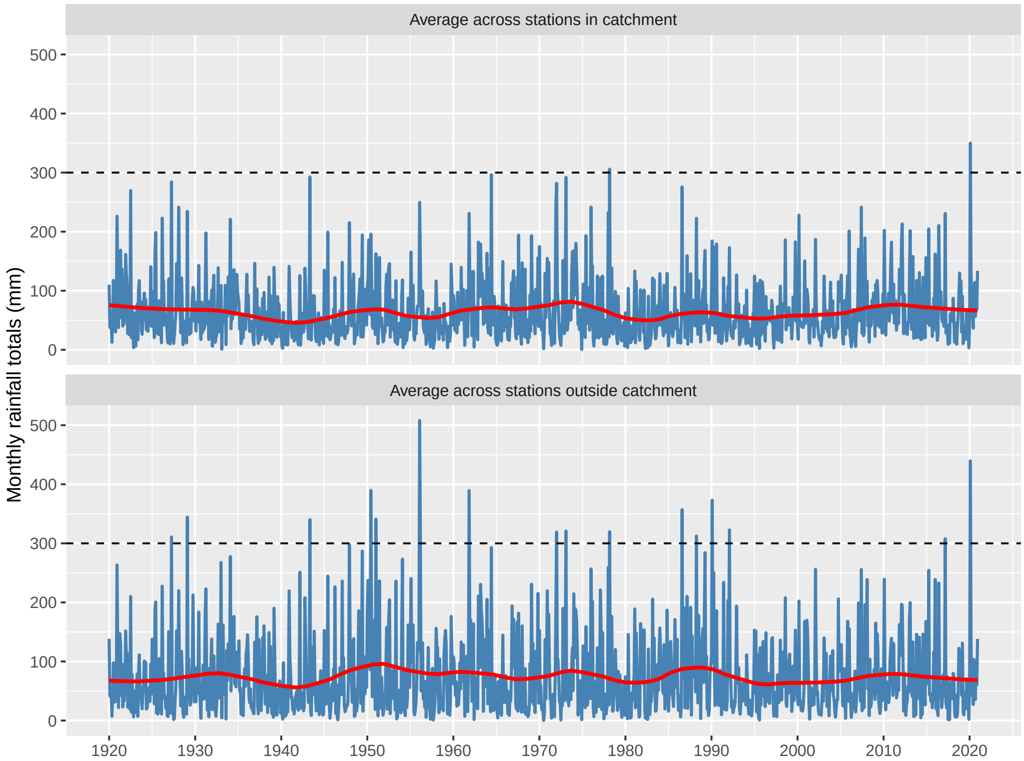
Source: Details from BOM daily rainfall data.

Average monthly totals

The first graph below (Figure 3.3) shows monthly rainfall totals, averaged across the stations in the catchment area and across the stations outside the catchment (using the stations shown in Figure 3.1). A smoothing trend line (in red) is super-imposed on these data and a reference line (at a monthly total of 300 millimetres) is also shown. Three conclusions are evident in these data:

1. there is considerable month-to-month and decade-to-decade variability in rainfall volumes;
2. despite this, the overall long-term trend shows a steady consistency in rainfall volumes; that is, neither a declining nor increasing trend;
3. the stations outside the catchment area have been subject to greater volumes of average rainfall throughout this 101 years; for example, about 8 occasions show monthly totals over 300 millimetres for the stations in the catchment, whereas there are 16 occasions for stations outside the catchment.

Figure 3.3: Monthly rainfall totals, averaged across stations in catchment / non-catchment areas



Source: Calculations based on BOM daily rainfall records.

These data also illustrate how assessments of any particular short time frame are sensitive to the window chosen. Depending on when the starting point and end point are selected, one can draw the conclusion that the volume of rainfall has either declined or increased during a particular period.[3]

Heavy and extreme rainfall

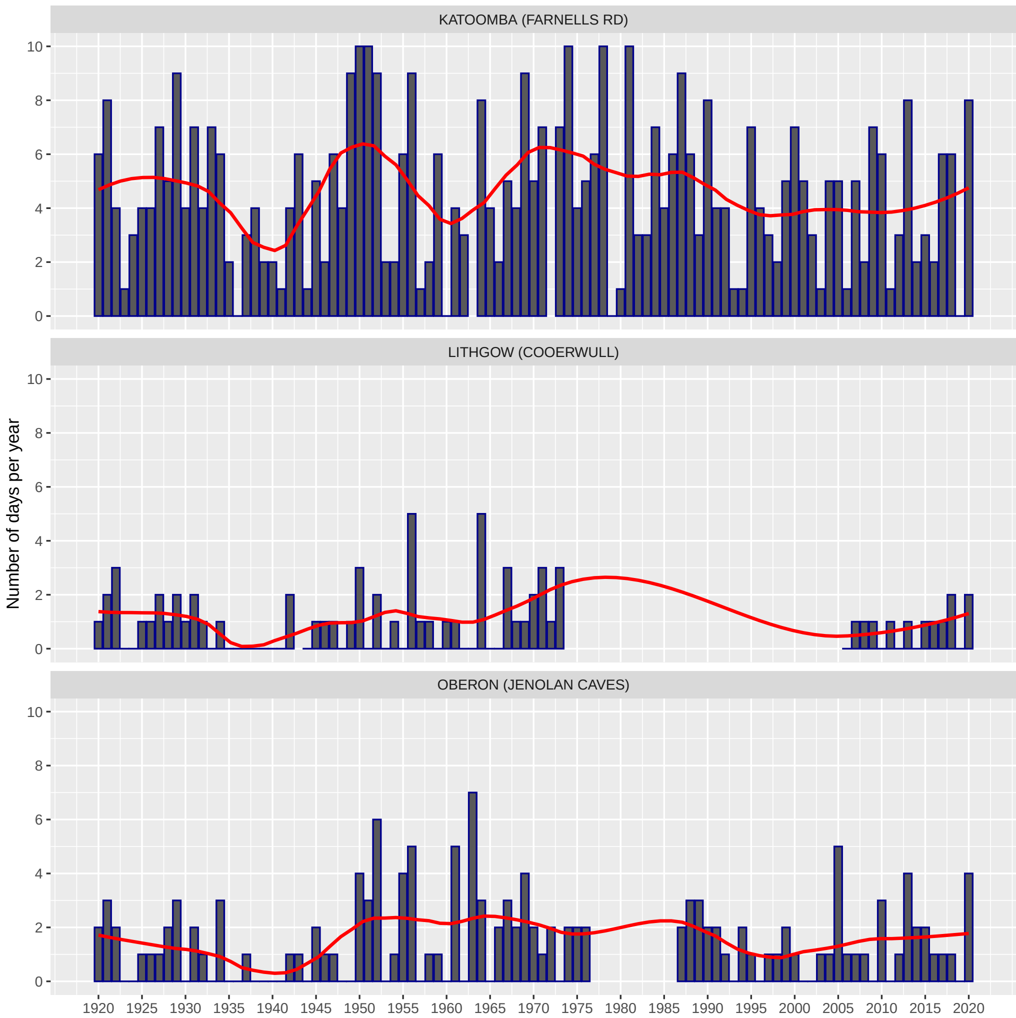
While this submission does not draw any inferences about the relationship between rainfall patterns and the severity of flooding, the literature does suggest that heavy rainfall, rather than average rainfall, is of most concern. To assess historical patterns in heavy and extreme rainfall the smaller subset of weather stations shown in Figure 3.2 are used. Several benchmarks are utilised for this analysis. 'Heavy' rainfall is based on the definition of days when more than 50 millimetres of rain fell in a 24 hour period; 'very heavy' rainfall is based on more than 75 millimetres; and 'extreme' rainfall is based on more

3. Opposite conclusions about trends in rainfall are evident in the EIS discussion of climate change, with differences partly dependent on the time frame chosen.

than 100 millimetres. In some analyses of extreme weather, benchmarks are based on criterion such as the proportion of annual rainfall which falls in a day. However, for analysing long-term patterns, it is more informative to use a fixed criterion (that is, millimetres) rather than benchmarks which might change from year to year, depending on the 'wetness' of those years.

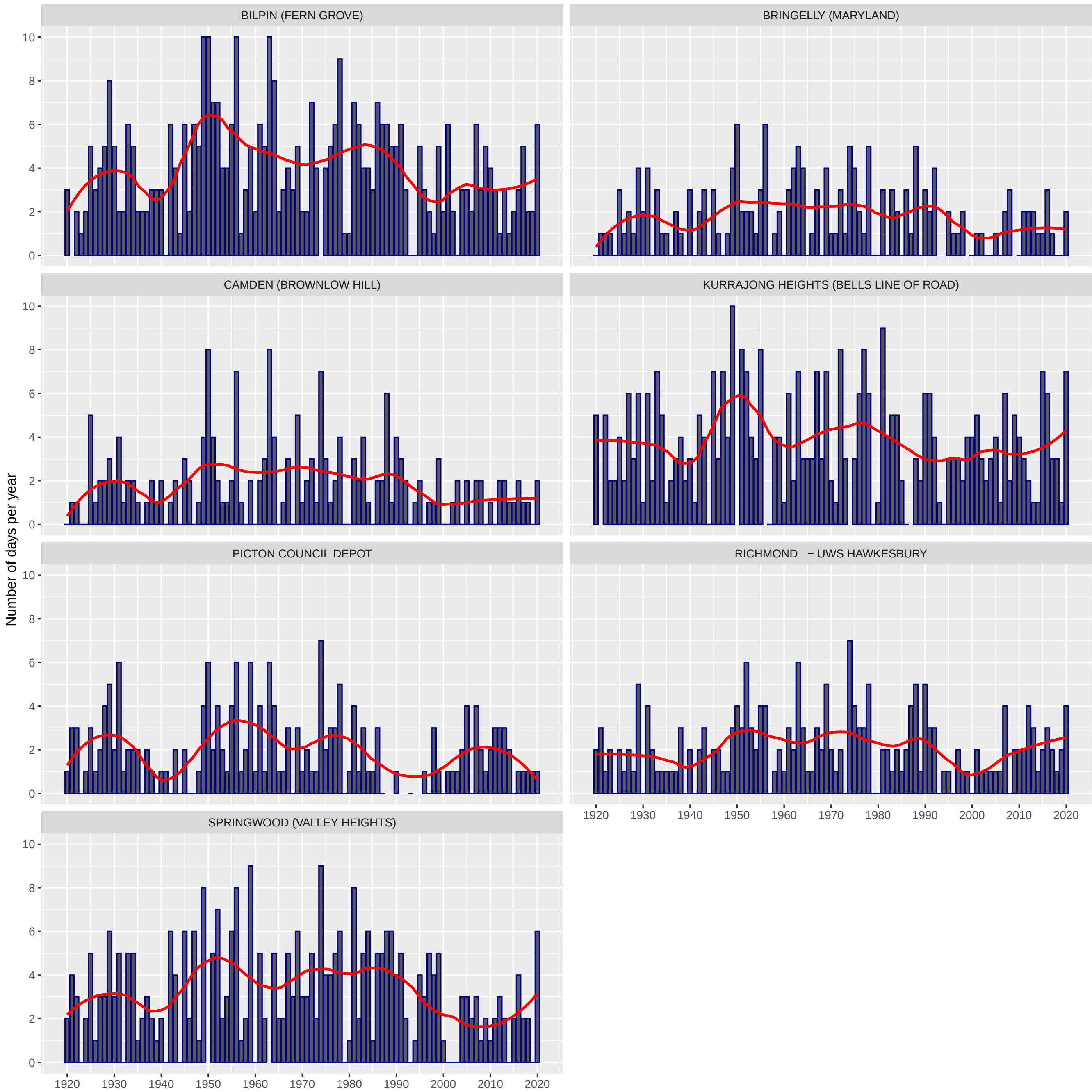
Looking first at 'heavy' rainfall, Figure 3.4 shows the number of days per year when daily rainfall exceeded 50 millimetres at those stations in the catchment area. Figure 3.5 shows the equivalent results for stations outside the catchment. A smoothing trend line (in red) is shown.

Figure 3.4: Number of days of **heavy** rainfall per year, stations in catchment area



Source: Calculations based on BOM daily rainfall data. Heavy rainfall defined as more than 50 millimetres of rain in a 24 hour period.

Figure 3.5: Number of days of **heavy** rainfall per year, stations outside catchment area



Source: Calculations based on BOM daily rainfall data. Heavy rainfall defined as more than 50 millimetres of rain in a 24 hour period.

Several conclusions emerge from these data:

1. heavy rainfall was more common during the 1950s and 1970s than in more recent decades, and this applies to both catchment and non-catchment stations;
2. there is an 'uptick' in heavy rainfall for many of the stations in 2020,

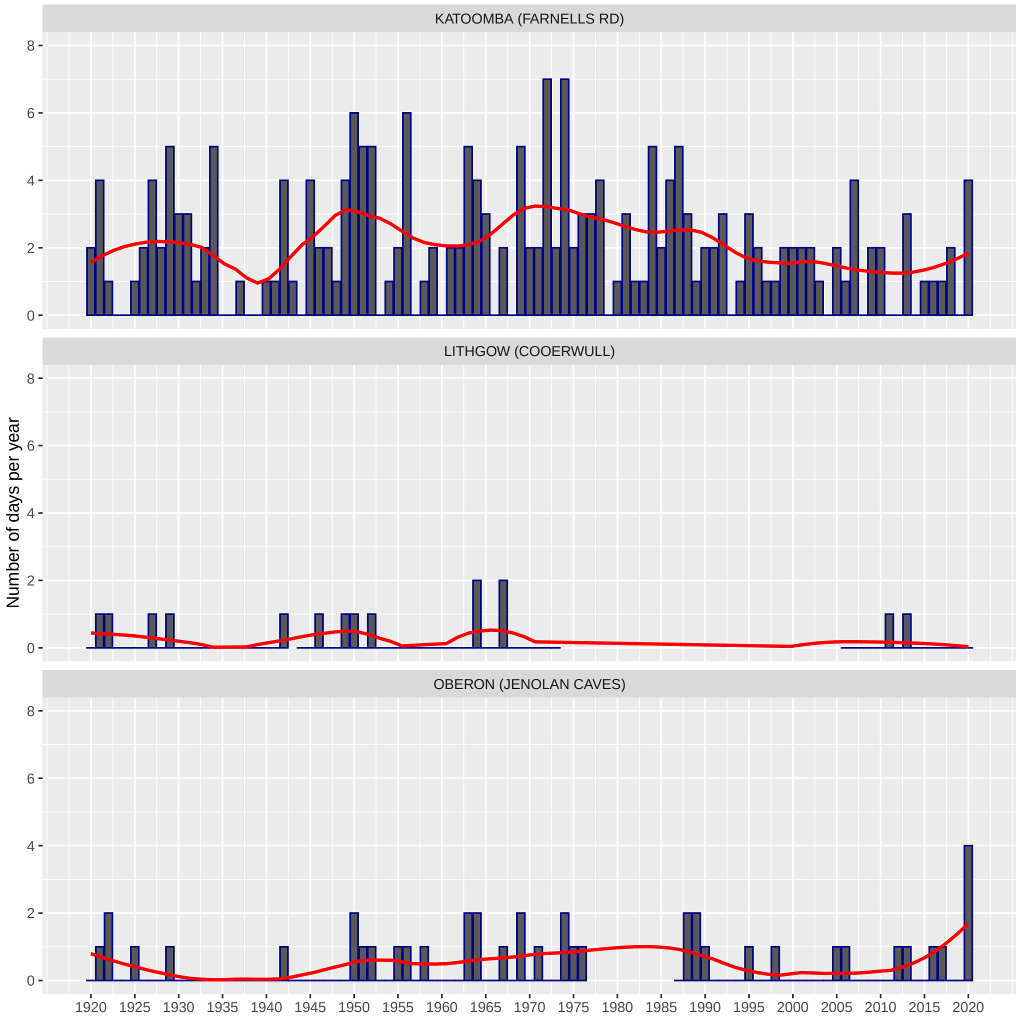
reflecting the substantial falls which broke the long drought;

3. leaving aside this ‘uptick’ the long-term pattern at most of the stations is one of fluctuations, but with a discernible declining trend since the 1980s. This decline is more evident for the stations outside the catchment;
4. geographical variability is quite pronounced: with some locations much ‘wetter’ than others, even where their distance apart is quite modest.

Turning now to ‘very heavy’ rainfall, Figure 3.6 shows the number of days per year when daily rainfall exceeded 75 millimetres at those stations in the catchment area. Figure 3.7 shows the equivalent results for stations outside the catchment. Again, a smoothing trend line is shown.

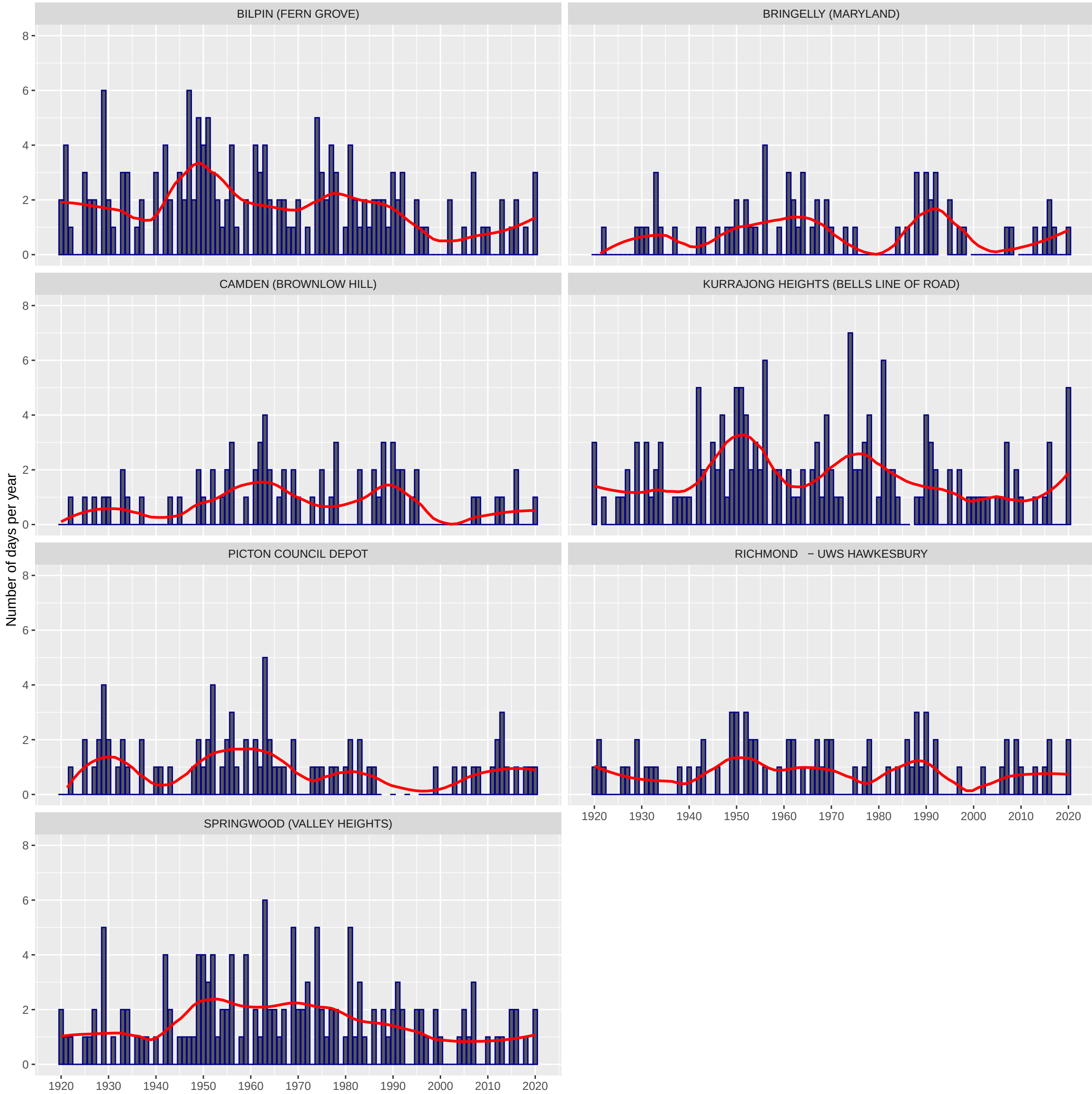
Figure 3.6: Number of days of **very heavy** rainfall per year,

stations in catchment area



Source: Calculations based on BOM daily rainfall data. Very heavy rainfall defined as more than 75 millimetres of rain in a 24 hour period.

Figure 3.7: Number of days of **very heavy** rainfall per year, stations outside catchment area

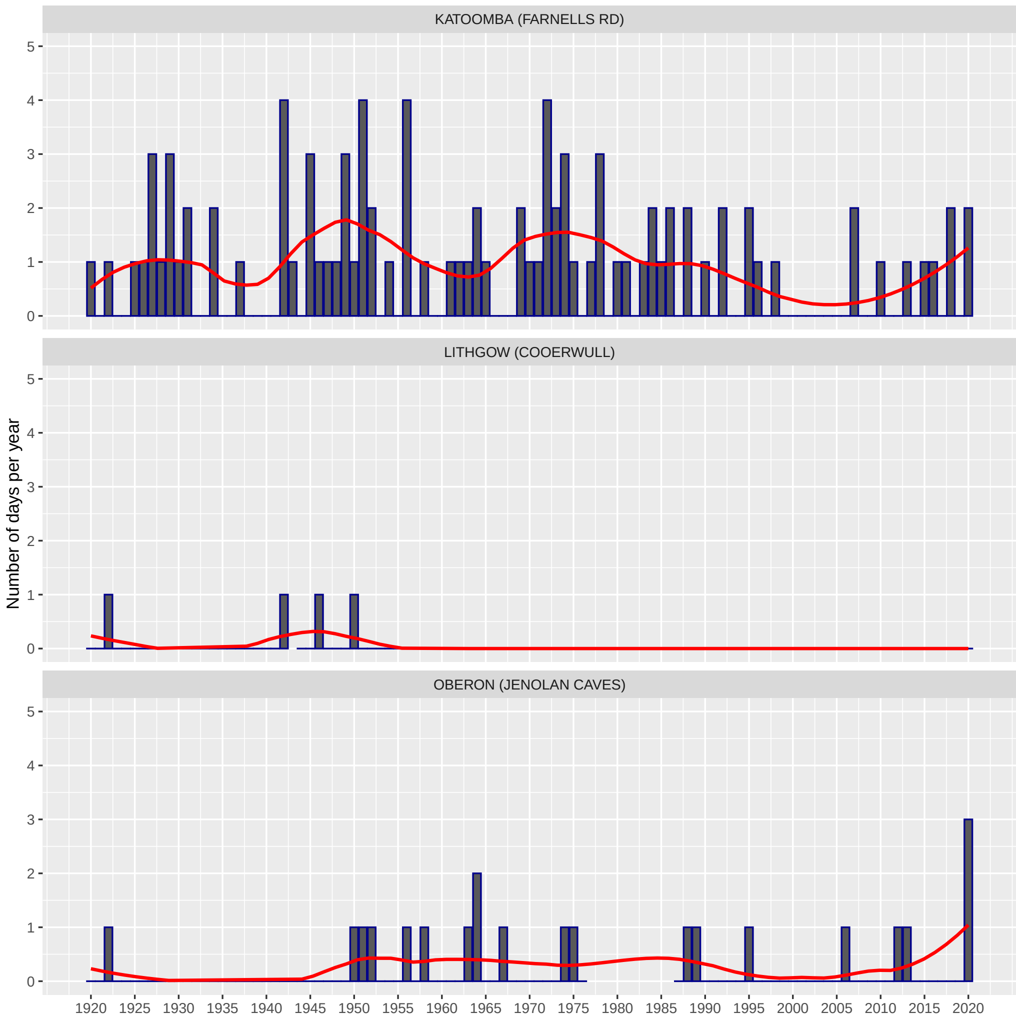


Source: Calculations based on BOM daily rainfall data. Very heavy rainfall defined as more than 75 millimetres of rain in a 24 hour period.

The conclusions which emerge from these data are essentially the same as those for heavy rainfall, though the number of years without any days of very heavy rainfall has increased notably in the catchment stations of Cooerwull and Jenolan Caves. Again, considerable geographical variability is evident in the data.

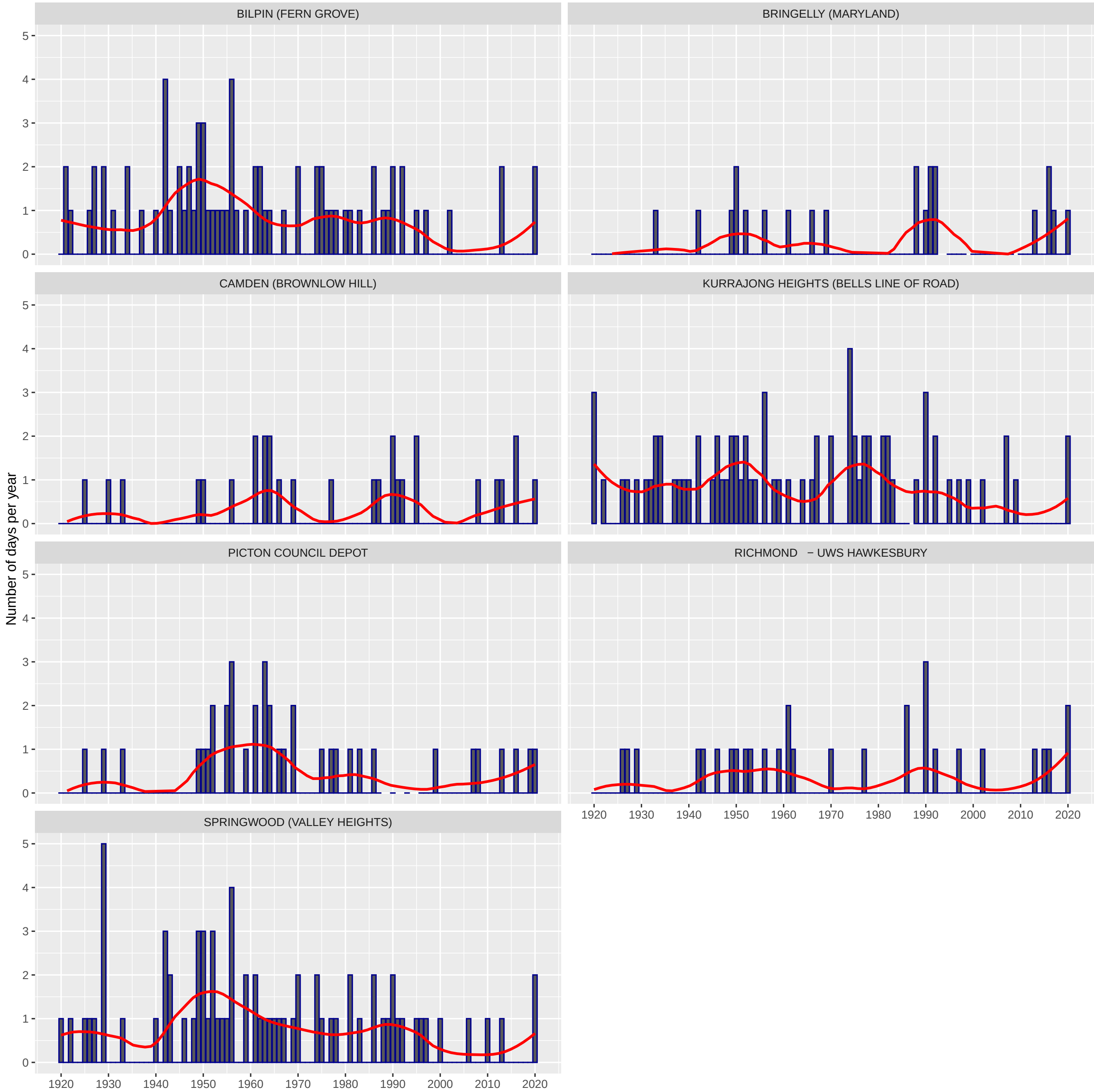
Looking at 'extreme' rainfall, that is, falls above 100 millimetres in a day, Figures 3.8 and 3.9 summarise these results. Again, data from both catchment and non-catchment stations are shown, as is the smoothing trend line.

Figure 3.8: Number of days of **extreme** rainfall per year, stations in catchment area



Source: Calculations based on BOM daily rainfall data. Extreme rainfall defined as more than 100 millimetres of rain in a 24 hour period.

Figure 3.9: Number of days of **extreme** rainfall per year, stations outside catchment area



Source: Calculations based on BOM daily rainfall data. Extreme rainfall defined as more than 100 millimetres of rain in a 24 hour period.

The conclusions which can be drawn from these data are:

1. extreme rainfall was more common from the 1940s through to the 1970s for Katoomba, and was largely absent for Cooerwull from the 1950s onward. In the case of Jenolan Caves, the 'uptick' in 2020 was notable, but the preceding decades show that extreme rainfall was rare.

In the case of stations outside the catchment, there was variability: many stations saw a declining trend, while for others no pattern was evident.

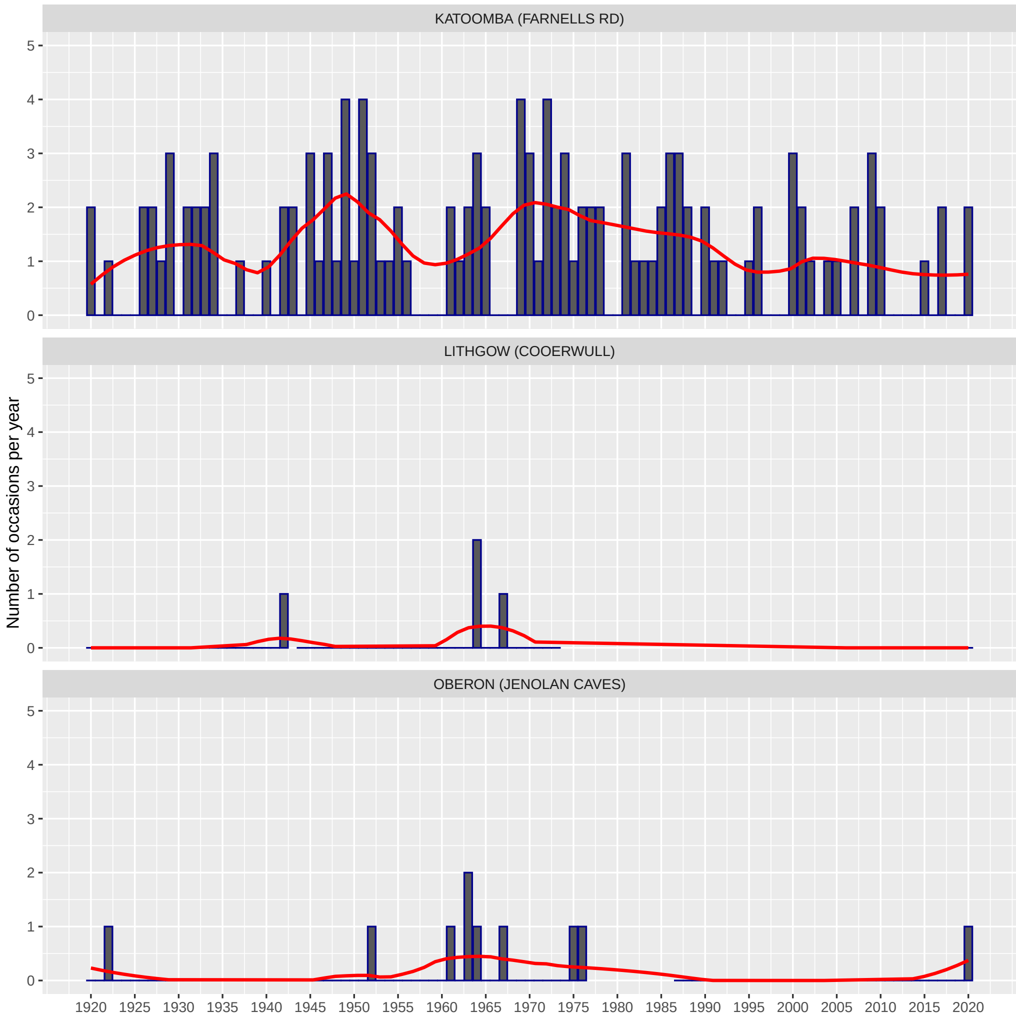
2. for the stations outside the catchment, years without any extreme rainfall appear to be more common in particular decades, reflecting drought years, though considerable geographical variability was also evident.
3. the 'uptick' which was notable in the heavy rainfall data persists with the extreme rainfall, reflecting just how severe the rainfall events of 2020 were.

Extended rainfall

As well as the intensity of heavy rainfall, its continuity is also an important consideration. To assess historical patterns in this regard I now provide data on those years when two successive days had falls of heavy or extreme rainfall.

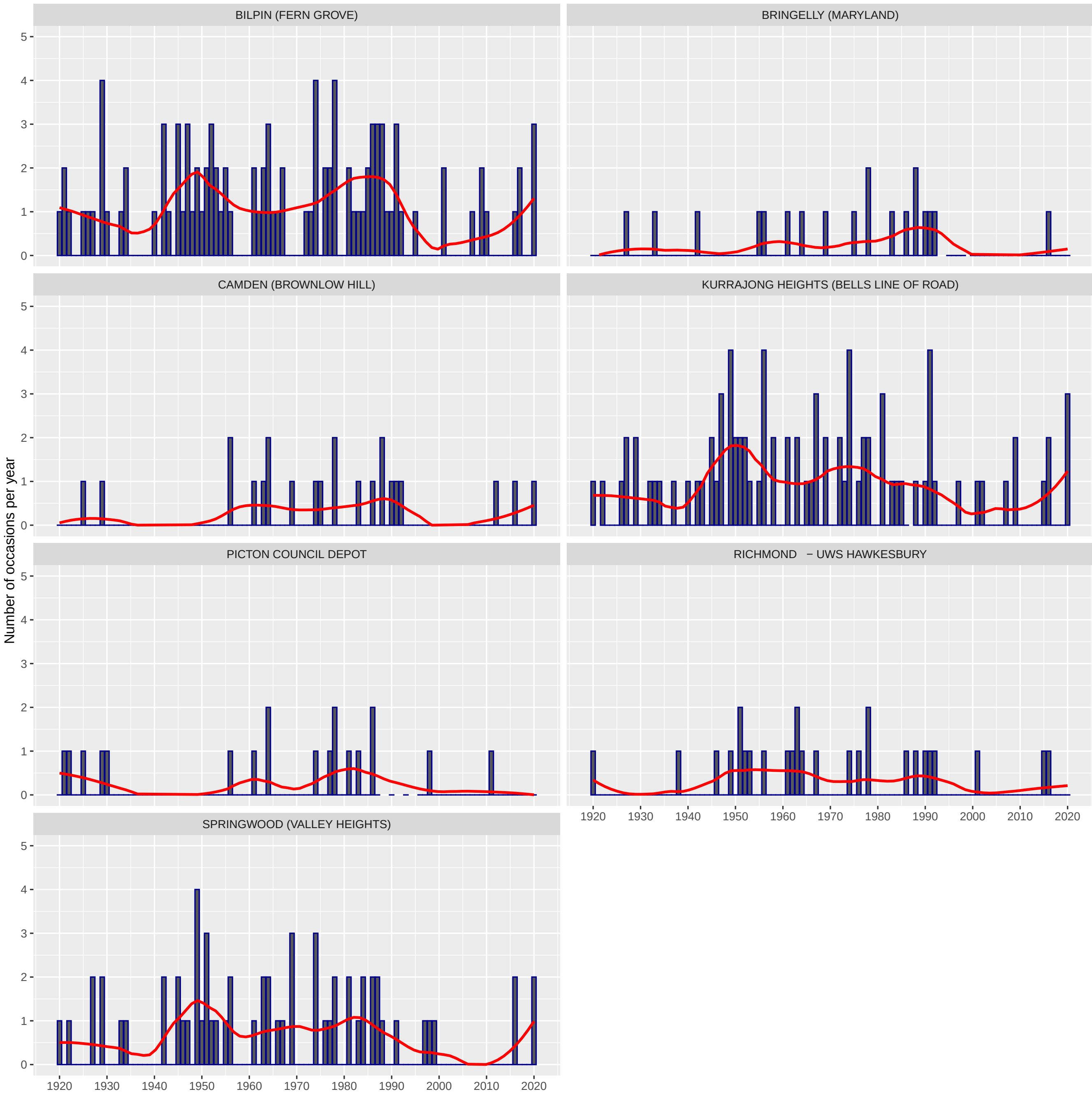
I look first at heavy rainfall, that is, two days in a row with over 50 millimetres of rain on each day. Again, the distinction between catchment and non-catchment stations is shown in Figures 3.10 and 3.11.

Figure 3.10: Number of occasions of **heavy** rainfall on **two successive days**, per year, stations in catchment area



Source: Calculations based on BOM daily rainfall data. Heavy rainfall defined as more than 50 millimetres of rain in a 24 hour period.

Figure 3.11: Number of occasions of **heavy** rainfall on **two successive days**, per year, stations outside catchment area

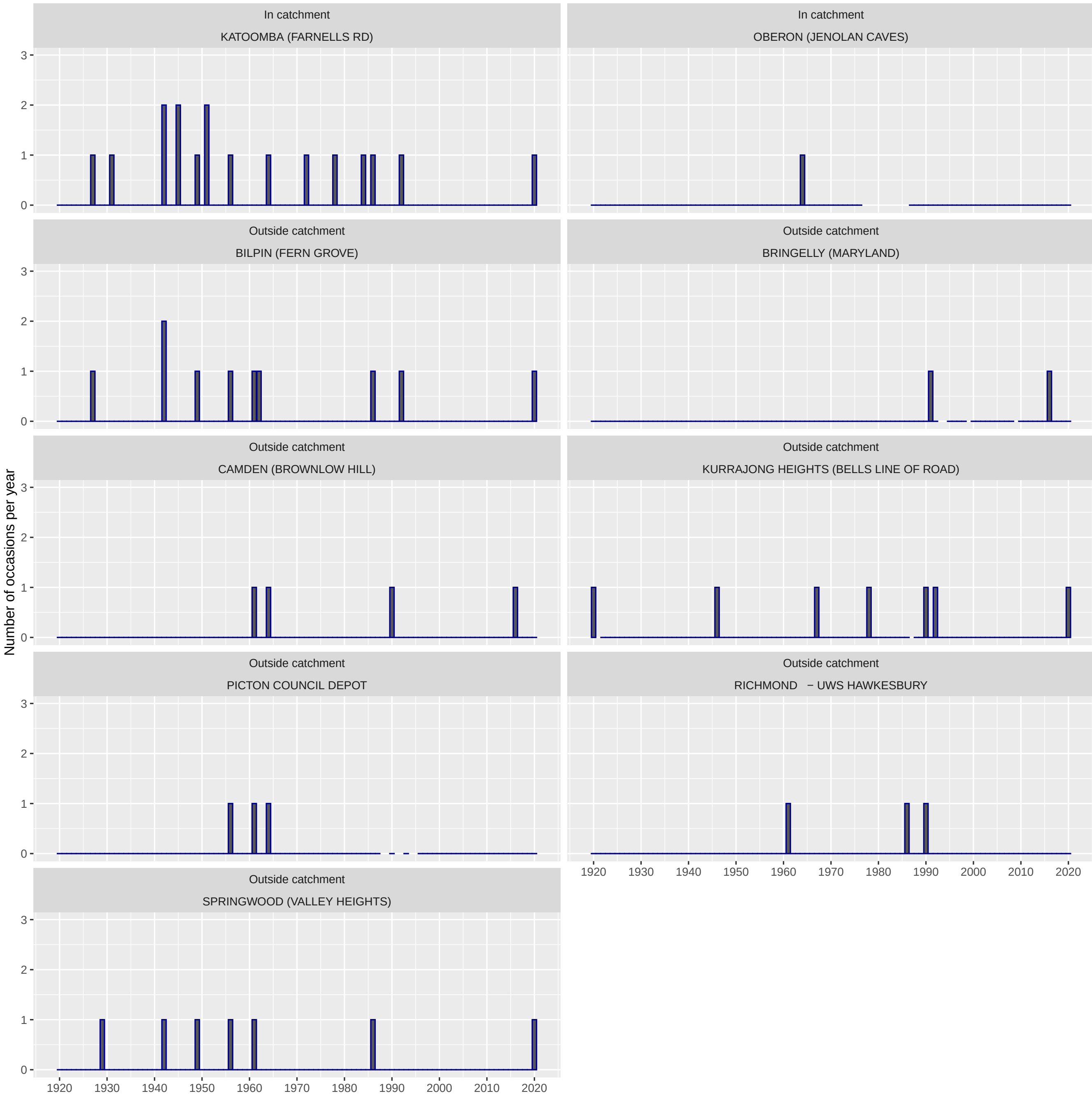


Source: Calculations based on BOM daily rainfall data. Heavy rainfall defined as more than 50 millimetres of rain in a 24 hour period.

These data reinforce the impression which the earlier results suggested: there has been no long-term increase in the severity of rainfall in the region covered by these stations. Indeed, if anything, the prevalence of these 'double days' of heavy rainfall has steadily declined over time, particularly since the 1970s and 1980s.

Finally, I now look at extreme rainfall, that is, two days in a row with over 100 millimetres of rain on each day. This time the results are consolidated in a single figure (Figure 3.12) and there are no trend lines shown. In addition, there are no results at all for Lithgow so this station is omitted from the figure.

Figure 3.12: Number of occasions of **extreme** rainfall on **two successive days**, per year



Source: Calculations based on BOM daily rainfall data. Extreme rainfall defined as more than 100 millimetres of rain in a 24 hour period.

These data provide no evidence of any increasing trend towards more extreme rainfall events. Not only are such events quite rare, but with the exception of 2020, most of these events took place prior to the 1990s. In the case of Katoomba (within the catchment area) these extreme events were far more common in the 1940s and 1950s than for any time since the 1990s (again, with the exception of 2020).

Conclusion

The CSIRO report's assessment that the east coast region of Australia has experienced a significant *decrease* in extreme rain events since 1950 appears to be applicable to the Blue Mountains-Nepean-Hawkesbury region. The detailed assessment of the historical rainfall record outlined above shows unequivocally that there has been no consistent increase in either heavy or extreme rainfall over the last century. Apart from the exceptional rain events of 2020 (and 2021, not shown), the overall pattern has been one of decline. This result has been robust to varying definitions of heavy and extreme rainfall, ranging from falls of 50 millimetres, 75 millimetres and 100 millimetres in a day, including analysis of successive days of heavy and extreme rainfall.

Both the specialist literature and the historical rain data confirm the view that far from expecting more extreme rain events in this region, we are more likely to see a *decline*, albeit with exceptional years which reflect the dramatic temporal and geographical variability inherent in all weather patterns in Australia. The years 2020 and 2021 certainly stand out as exceptional years in this respect, but they should not distract from the long-term trends which emerge from the historical data records.

In conclusion, the logic which the EIS promotes—that climate change equals increased rainfall equals increased flood risk—is not warranted. This chain of reasoning is contested by both a more detailed reading of the specialist literature and by the historical record for the local region. The EIS is *deficient* in its neglect of the possibility of declining rainfall, failing to consider any scenarios except those which assume increased rainfall.

References

Braganza, Karl, Brad Murphy, Bertrand Timbal, Pandora Hope, Andrew Dowdy, Kevin Hennessy, Jonas Bhend, and Dewi Kirono (2015), 'Chapter 4: Understanding Recent Australian Climate', in: *Climate Change in Australia: Projections for Australia's NRM Regions, Technical Report*, ed. by Penny Whetton, Canberra: CSIRO.

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