BEFORE THE INDEPENDENT HEARING COMMISSIONERS
FOR GISBORNE DISTRICT COUNCIL

IN THE MATTER: of the Resource Management Act 1991

AND

IN THE MATTER: of an application by Gisborne District Council for resource consent associated with wastewater overflows

---

STATEMENT OF EVIDENCE OF BRIDGET LUCY BOSWORTH – ANALYSIS OF RAINFALL AND OVERFLOW EVENTS

22 June 2021

CooneyLeesMorgan

247 Cameron Road
P O Box 143
TAURANGA
Telephone: (07) 578 2099
Facsimile: (07) 578 1433
Partner: M H Hill
Senior Associate: R C Zame

INTRODUCTION

Qualifications and experience

1. My full name is Bridget Lucy Bosworth. I am employed by Gisborne District Council (**Council**) as a Senior Hydrologist, a position I have held for 4 years.

2. I have the qualifications of MA Hons Geography-Hispanic Studies and MSc Water Resources. I have 19 years' experience as a water resources scientist, analyst and hydrologist.

Code of Conduct

3. My qualifications as an expert are set out above. I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence. Except where I state that I am relying on the evidence of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

SCOPE OF MY EVIDENCE

4. My evidence addresses the following aspects of the application:

   (a) My involvement in the Gisborne Wastewater Overflows Resource Consent Application (**Application**);

   (b) Analysis of rainfall and overflow events in Gisborne city;

   (c) Summary and conclusion.

MY INVOLVEMENT IN THE WASTEWATER OVERFLOW CONSENT PROJECT

5. I became involved in the Project in February 2020, when Wolfgang Kanz (4 Waters Strategy Advisor, Gisborne District Council) asked me to examine the relationship between rainfall events and the opening of the overflow valves in Gisborne city. My aim was to identify whether there was a clear correlation between rainfall duration/intensity and the opening of the valves. This was a high level study and did not involve any hydrological modelling or modelling of the wastewater network.

6. I produced a Memorandum dated 13 May 2020, which was included as Appendix D to the Application.

ANALYSIS OF RAINFALL AND OVERFLOW EVENTS IN GISBORNE CITY

7. I examined 15 rainfall events when the overflow valves were opened and 7 high rainfall events when the valves were not opened, all between April 2014 and February 2020.

8. I analysed rainfall data from 5 rain gauge sites around Gisborne city, which Gisborne District Council (**Council or GDC**) either owns or manages.

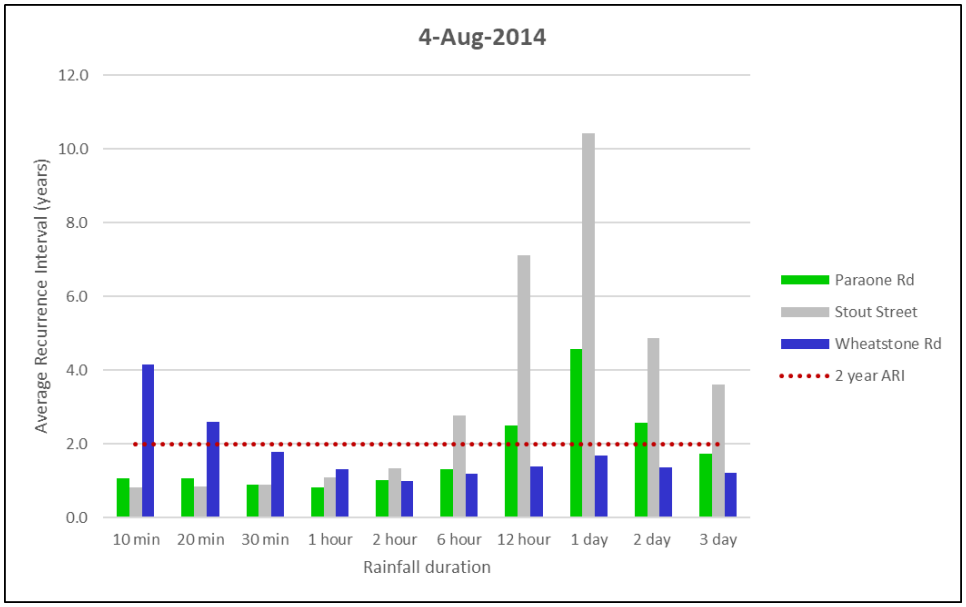
9. I focused on rainfall duration, intensity and Average Recurrence Interval (**ARI**) to see if there was a pattern between the rainfall event and the valves being opened.

10. I obtained the ARI for the rainfall data at each site (for different durations) using the National Institute of Water and Atmospheric Research (**NIWA**)'s web-based programme, known as HIRDS (High Intensity Rainfall Design System (version 4)). Where rainfall at a site did not exactly match the rainfall depth for a given ARI, I used interpolation to estimate the ARI.

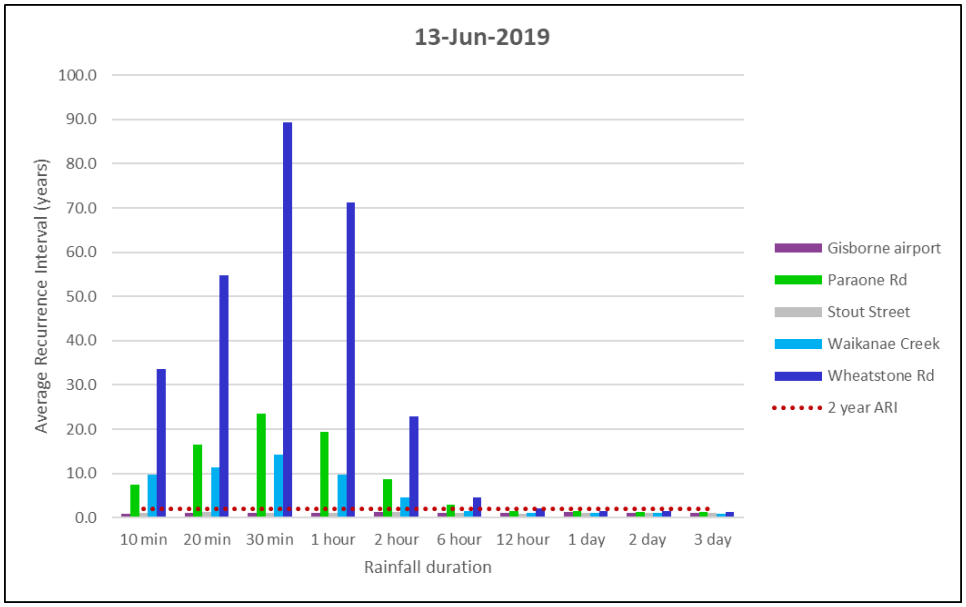
11. I produced graphs for each rainfall event, showing the ARIs for different durations at each site. Each graph has a red dotted line showing the 2 year ARI. A rain event could last for up to 3 days; the ARI for each duration is the ARI associated with the maximum rainfall recorded over that duration (whether that is 10 minutes, 6 hours or 2 days) within that three day period.

12. I have provided graphs of four rainfall events as examples – the first three where the overflow valves were opened (4 August 2014, 13 June 2019 and 7 September 2018) and the fourth graph where they were not opened (16 February 2017). The graphs show how different the rain events are, both in terms of duration and intensity, as well as location.

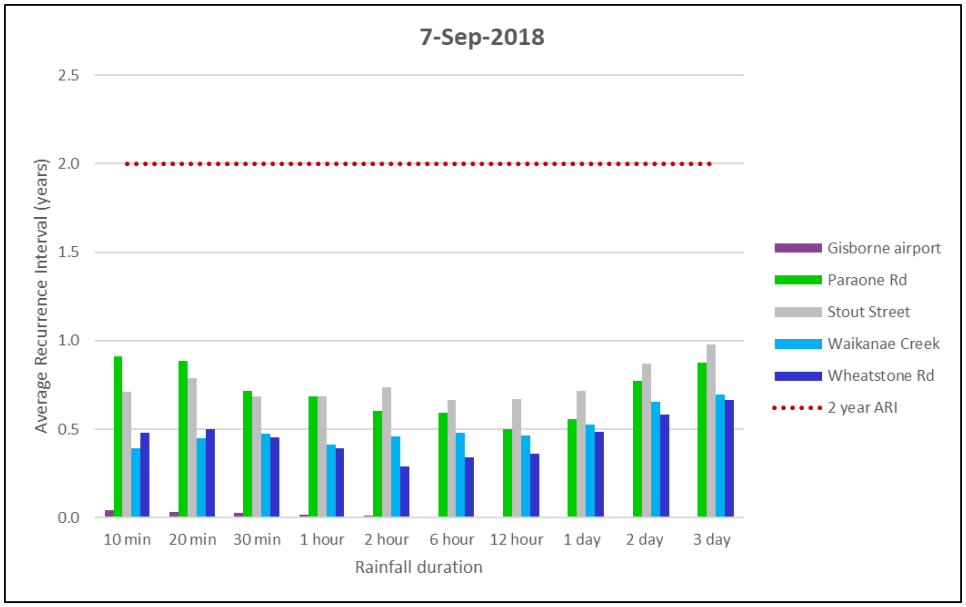
13. The first graph (4 August 2014) shows more intense rainfall of short duration (10 minutes and 20 minutes) at Wheatstone Rd and heavy rainfall of long duration (12 hours to 2 days) at Stout St and Paraone Rd.



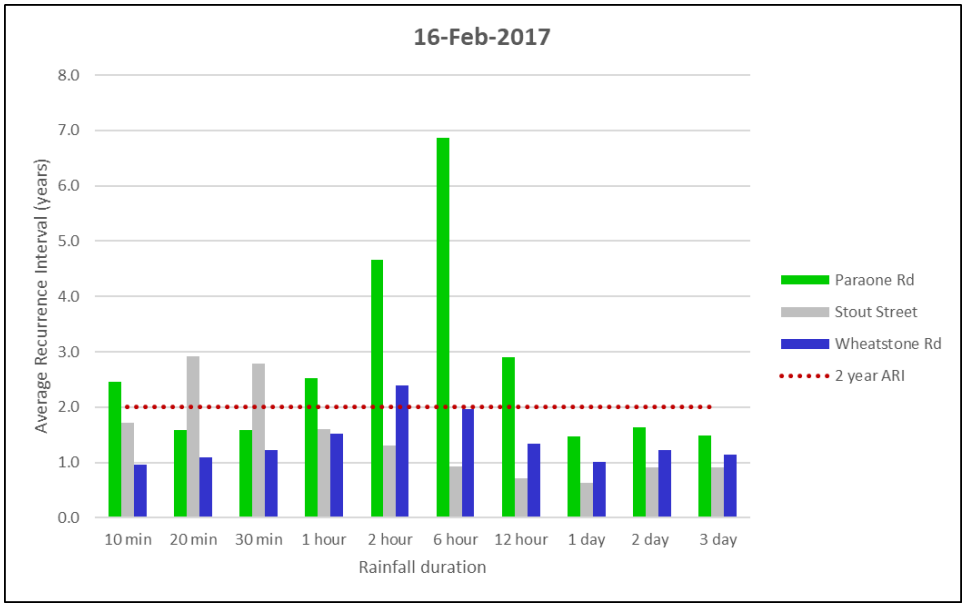
14. The second graph (13 June 2019) shows that the rainfall event was very intense and of relatively short duration. I estimated the highest ARI to be nearly 90 years at Wheatstone Rd for a duration of 30 minutes. The event was relatively localised, with high intensity rainfall recorded at three out of the five sites around Gisborne city.



15. The third graph (7 September 2018) shows that the rainfall was not significant (with an ARI of less than 2 years) for all durations and at four sites within the city. Note that the rain gauge at Gisborne Airport was partially blocked, so should be discounted.



16. The fourth graph (16-Feb-2017) shows that three sites recorded an ARI of greater than 2 years for at least one duration. While the maximum ARI in this event was nearly 7 years (for the 6 hour duration), recorded at Paraone Rd, the overflow valves were not opened during this rain event.



17. At one site (Paraone Rd), I also examined whether there was a pattern to rainfall events before the valves were opened, in terms of the length of the rainfall, gaps in the rainfall and maximum hourly rainfall.

18. The second s92 request to Council sought clarification on my statement "that most overflows occur at elevated groundwater levels or where groundwater levels are increasing (rather than decreasing), i.e., when the shallow aquifer is recharging rather

than declining. Rainfall is seasonal and as the autumn and winter progress, there is more rainfall and aquifers are recharging". The s92 request questioned how the Application reconciled this conclusion with the private network being the principal source of the inflow.

19. As noted in the Applicant's further s92 Response dated 21 April 2021[1], my analysis of rainfall and overflow events was undertaken to assess the correlation of heavy rainfall and overflow events. It did not assess the contribution of groundwater flows/infiltration to flows in the piped network – I simply noted that most overflow events occurred at high or increasing groundwater levels. This was not intended to infer that groundwater inflow was a significant source of infiltration.

20. While elevated shallow groundwater levels could potentially be a source of water ingress into the pipes, a high groundwater level does not necessarily mean that groundwater is entering the pipe nor that it is a significant contributor. Most overflows occur during periods of higher rainfall, which is typically during autumn and winter, and this also coincides with the time when the groundwater levels are increasing (rather than declining).

21. I am advised that Council's proposed conditions of consent require a similar hydrological analysis to be conducted on future overflow events and reported annually[2]. I support this approach. While my previous analysis did not show any clear correlation between rainfall intensity/duration and overflow event, further information may lead to a better understanding of the relationship between intense rainfall and overflows and may lead to improved network design or management over time.

SUMMARY AND CONCLUSIONS

22. I undertook a high level analysis of rainfall and overflow events to establish if there was a correlation between rainfall intensity/duration and when the wastewater network overflow valves were opened in Gisborne city. I examined 22 rainfall events, 15 when the valves were opened and 7 high rainfall events when they were not opened. The overflow valves were opened on 9 occasions when the rainfall had an ARI of more than 2 years. There were also 6 occasions when the overflow valves were opened for rainfall events when the ARI was less than 2 years.

[1] At response (d), p5
[2] Mr Mayhew's evidence

23. In my opinion, there is currently no clear indication of the critical rainfall event that leads to the overflow valves needing to be opened. Rain events are complex, in terms of intensity, duration and location. Both short duration/high intensity and long duration/lower intensity events can lead to the requirement to open the valves. However, in contrast, there have also been instances where rainfall has exceeded the 2 year ARI, but the overflow valves have not been opened.

24. In addition, in my opinion, the direct cause of the valves being opened may depend on where and when the rain occurred within the catchment and the travel time of surface runoff to and within the pipe network. I also believe that the overflow valves being opened could also be contributed to by other factors, e.g. a blockage in the system.

25. I examined the timing of the overflow events and the rainfall data from the rain gauge at Paraone Rd. I found that, in general, rainfall lasts for 17 hours before the valves are opened. In addition, there tends to be either no gap or a small gap (i.e. less than one hour) in the rainfall event. In most events when the overflow valves have to be opened, the maximum hourly rainfall exceeds 9 mm. However, the presence of all or some of these factors does not necessarily mean that the overflow valves will be opened.

26. I support the proposed conditions of consent that require a similar hydrological analysis to be conducted on future overflow events and regularly reported.

Bridget Lucy Bosworth

22 June 2021