

Appendix D

Hydrology Review

Ballater Additional Flood Study- Review of February 2021 Event

Hydrology

Background & Methodology

There was an event in February 2021 that significantly impacted Ballater. Aberdeenshire Council requested that RPS look at how this event compared to the previous high event in August 2014.

The information provided by SEPA was as follows:

The following peak flows for the three upstream stations during the event. As they did not peak simultaneously, the combined total at Ballater would be slightly less than just adding the figures together, but it might well have been the highest flow experienced since 2015, possibly equivalent to the flow seen in August 2014 when ex-hurricane Bertha affected the area.

Invergairn peaked at 123.167 m³/s on 21-02-2021 @ 00:00

Polhollick peaked at 444.566 m³/s on 21-02-2021 @ 00:45

Invermuick peaked at 102.535 m³/s on 20-02-2021 @ 23:15

RPS considered the Hydrology Chapter from the RPS Ballater FPS Report (2018) and compared the 21 February 2021 event with the 11 August 2014 event. The 'at site' flood frequency curves developed for the three stations in the previous study were used to estimate the return period of the 21 February 2021 event. The differences between the 2014 and 2021 events were then quantified.

Note that the peak flow events included in this document for the three stations in question were taken from the RPS Ballater FPS Report Hydrology Chapter and only cover up to and including hydrological year 2015. Therefore, we do not consider hydrological years 2016 to 2021.

Analysis

12003 Dee @ Polhollick top five flow events

Hydrological Year	AMAX Date	Flow (m ³ /s)	Return Period (years)
2015	30 Dec 2015	898.051	171 *
2013	11 Aug 2014	558.075	24
1989	05 Feb 1990	484.805	13
1992	17 Jan 1993	482.057	13
2021	21 Feb 2021	444.556	5 to 10 **

* Estimated Return Period greater than record length – use with caution.

** Estimated from at site flood frequency curve. Range given to capture uncertainty and lack of precision in estimation method.

The 21 February 2021 event at Polhollick, station number 12003, had a peak flow of **444.556 m³/s** which is roughly **20% lower** than that recorded on the 11 August 2014 (558.075 m³/s). Comparing to the AMAX series used in the single site analysis for the station and found in RPS Ballater FPS Report Hydrology Chapter pg. 9, the 2021 event ranked fifth largest and had an estimated return period of 5 to 10 years. The return period was estimated using the at site flood frequency curve for the gauging station, Figure 1.6, found on pg. 9 of the RPS Ballater FPS Report Hydrology Chapter.

12006 Gairn @ Invergairn top five flow events

Hydrological Year	AMAX Date	Flow (m ³ /s)	Return Period (years)
2021	21 Feb 2021	123.167	50 to 100 +
2013	11 Aug 2014	103.005	22
2015	30 Dec 2015	102.988	22
1982	13 Oct 82	101.505	20
1994	10 Sep 1995	96.119	15

+ Estimated Return Period greater than record length – use with caution. Estimated from at site flood frequency curve. Range given to capture uncertainty and lack of precision in estimation method.

Our ref: IBE1982

The 21 February 2021 event at Invergairn, station 12006, had a peak flow of **123.167 m³/s** which is roughly **21% greater** than that recorded on the 11 August 2014 (103.005 m³/s). Comparing to the AMAX series used in the single site analysis for the station and found in RPS Ballater FPS Report Hydrology Chapter pg. 12, the 2021 event ranked the largest and had an estimated return period of 50 to 100 years. The return period was estimated using the at site flood frequency curve for the gauging station, Figure 1.8, found on pg. 12 of the RPS Ballater FPS Report Hydrology Chapter.

12005 Muick @ Invermuick top five flow events

Hydrological Year	AMAX Date	Flow (m ³ /s)	Return Period (years)
2015	30 Dec 2015	236.602	171 *
1998	21 Sep 1999	130.128	14
1981	2 Oct 1981	122.322	11
1991	31 Oct 1991	118.016	10
1982	14 Nov 1982	109.146	7

* Estimated Return Period greater than record length – use with caution.

The 21 February 2021 event at Invermuick, station 12005, had a peak flow of **102.535 m³/s** which corresponds to an estimated return period of 5 to 10 years. Comparing to the AMAX series used in the single site analysis for the station and found in RPS Ballater FPS Report Hydrology Chapter pg. 12, the 2021 event does not rank in the top five peak flow events. The return period was estimated using the at site flood frequency curve for the gauging station, Figure 1.8, found on pg. 10 of the RPS Ballater FPS Report Hydrology Chapter.

12005 Muick @ Invermuick Feb 2021 and Aug 2014 event

Hydrological Year	AMAX Date	Flow (m ³ /s)	Return Period (years)
2021	21 Feb 2021	102.535	5 to 10 **
2014	11 Aug 2014	49.423	< 2 **

** Estimated from at site flood frequency curve. Range given to capture uncertainty and lack of precision in estimation method.

The 11 August 2014 event captured at the other two stations as an AMAX event was not captured at 12005 as an AMAX event, however, the peak flow at Invermuick recorded on the 11 August 2014 was 49.423 m³/s at

Our ref: IBE1982

00:00. Therefore, the peak flow recorded on the 21 February 2021 was roughly **107% greater** than that recorded on the 11 August 2014 at Invermuick.

Conclusion

The Dee at Polhollick represents the largest catchment (690 km²) contributing to fluvial flooding at Ballater. The peak flow of the 21 February 2021 event is estimated to have a return period of 5 to 10 years, and has an absolute percentage difference in flow of 20% lower than the 11 August 2014 event. This is significantly smaller than the 11 August 2014 event which is estimated to have had a return period of 24 years.

The Gairn at Invergairn represents the second largest catchment (146 km²) contributing to fluvial flooding at Ballater. The peak flow of the 21 February 2021 is estimated to have a return period of 50 to 100 years and an absolute percentage difference in flow of 21% greater than the 11 August 2014 event. This is significantly larger than the 11 August 2014 event which is estimated to have a return period of 22 years.

The Muick at Invergairn represents the third largest catchment (107 km²) contributing to fluvial flooding at Ballater. The peak flow of the 21 February 2021 is estimated to have a return period of 5 to 10 years and an absolute percentage difference in flow of 107% greater than the 11 August 2014 event. This is significantly larger than the 11 August 2014 event which is estimated to have a return period of less than 2 years.

The difference between the three stations in peak flow recorded and subsequent return period of the events is expected. The response of each catchment to the events on the 21 February 2021 and 11 August 2014 will likely have been driven by rainfall which is localised in nature, i.e. the response of the catchments will depend on where rainfall occurs. This feature is clearly highlighted during the 11 August 2014 event- the event was captured at 12003 and 12006 with extreme peak flows being recorded, whereas at 12005 the 11 August 2014 event was not captured. The varying difference at each of the three stations between the 21 February 2021 and the 11 August 2014 event is thus expected due to the differing catchment response to each unique rainfall event, and it may also be the case that each event was of a duration that was less or more than the critical storm for some of the catchments.