Ballater & Crathie Community Council (BCCC)
December 2015 Ballater Flood

BCCC has created a sub group known as the Flood Information Group (FIG).

The purpose of the FIG is to produce 3 draft reports on the 2015 flood which seriously impacted Ballater:

Report 1 Causes, mechanism and uncertainties
What happened during the flood based on official reports & residents' experience and what remains uncertain.

Report 2 Social & Economic Damage
Actual damage assessed – as a basis for considering Flood Protection proposals.

Report 3 Flood Protection Actions Taken & Future Proposals
Flood protection work to date & future flood protection proposals/options.

These draft reports will be issued by BCCC in paper and electronic form and will form the basis of a consultation process.

The consultation will enable residents, and all other interested parties to provide feedback on each draft. Consultees are asked to provide comments on each draft in writing to BCCC within [1] month. BCCC will then issue final versions and ultimately one combined Final Report before proceeding further.

These 3 reports should be viewed as a data and information gathering exercise. As such, they will not provide flood protection recommendations.

Flood protection recommendations will be developed after finalising these 3 reports into one final report. [A thorough consultation process will be undertaken before finalising flood protection recommendations.]

BCCC would like to express its thanks to all who have contributed to making these 3 reports possible (by giving their time & providing information, photos and videos) including:

- Ballater Fire and Rescue Staff
- Ballater Police staff
- Ballater Golf Club Staff
- Numerous residents of Ballater
- Aberdeenshire Council, its Flood Team, Ballater Flood Group, & SEPA.

Flood Information Group
December 2015 Ballater Flood
Report 1   Causes, Mechanism & Uncertainties

Abbreviations Use in this Report	
Aberdeenshire Council	AC
Ballater & Crathie Community Council	BCCC
Ballater Flood Group	BFG
Ballater Bridge	The Bridge
Ballater Golf Club	BGC
Balmoral Estate	BE
People of Ballater & surrounding areas	Residents
Red Braes	RB
RPS Consulting Services Ltd	RPS
Scottish Environment Protection Agency	SEPA
Sluievannachie	SL

Summary

Causes:

Weather Conditions

- In the December 2015 flood, the Dee's flow was almost double the previous highest flow recorded. (since the 1970's)
- The Dee's catchment areas had the highest December rainfall on record.
- Additionally, a rapid snow melt, contributed greatly to the Dee's record flow.

Water Flows on the Dee

- The Dee's exceptional flow rate lasted 8 hours:
  - For 8 hours (08.00-16.00), Ballater had flows exceeding anything previously recorded: >770 cuM/sec
  - For 4 hours (10.00-14.00), flow was even higher: >1000cuM/sec.
  - At the peak (about 12.00), maximum flow was around 1250 cuM/sec.
- In this 8-hour period, the Dee burst its banks flooding the village.
- Ballater suffered a short, extreme, violent & extraordinary event.
- Other parts of the Dee Valley suffered, but flooding was most acute in Ballater and at the lower Gairn and Muick.

Mechanisms

- The Dee's much higher flow & the bund breaching meant Ballater suffered more damage than earlier floods.
- Evidence suggests four major Bund breaches: opposite the Red Braes, downstream of this east of the 6th fairway, at the Dooker turn in the Dee & also near the 13th green.
- Red Braes material & trees fell into the Dee. These trees may have helped breach the bund and caused some damming at the Dooker corner.
- Overtopping of the river banks occurred adding further to the flood at SL, at the 6th fairway on BGC, in Ballater (upstream of BRB) and in Ballater (downstream of BRB).

Movement of Flood Water Through the Village

- Based on discussion with residents & evidence, the flood flows through the village have been mapped by flood source.
- This suggests that by tackling any of the flood sources, the area of the village which is flooded can be reduced.
- Lives were at risk from the depth & speed of the water flow, at levels which support services regarded as unsafe to launch boats

Flood / Flow Modelling

- Modelling the flood is vital to establish what happened & action needed.
- In June 17, (18 months after the flood) when RPS began this work - much flood evidence was gone, making their job difficult.
- RPS information gathering from the local community was limited.
  In the opinion of many, the RPS model did not reflect the actual flood in several areas. (see report). As such, the RPS model is open to various serious questions. (see section 4.11)

Ballater Bridge (The Bridge)

- The Bridge has withstood many floods. The 2015 flood was the most severe to date and caused major damage to The Bridge including scouring the river bed and undermining the foundations.
- This damage was despite some flood water bypassing The Bridge through the village.
- The Bridge is a barrier to river flow. Views vary on the effect The Bridge had in raising upstream river levels - between 2 & 100cms. Therefore, it is possible that The Bridge increased 2015 flooding.
- RPS were sufficiently concerned about The Bridge, that they recommended that if a Flood Protection Scheme goes ahead, that The Bridge should be remodelled to re-check it beforehand.

Things we don't know

- RPS considered the major bund breach was near the 13th green. Residents and BFG group agree there was a breach near 13th green but other major breaches occurred opposite and downstream of the Red Braes at the fishing hut, east of the 6th green and at the Dooker turn in the Dee as well as general overtopping at the 6th fairway. The timing and impact of each breach was not observed & cannot be stated with certainty.
- The river course changed dramatically in 2015 – and since. How will the river course in Ballater move naturally in the future? Geomorphological modelling could help provide further information here but may still carry uncertainties
- What further erosion is likely on the Red Braes – or other areas?
- What effect has the 2015 flooding had on the Dee's carrying capacity?
- What effect does The Bridge have on upstream water levels – does this increase flooding?
- In 2015, what volume of water flowed through the village missing The Bridge?
- If the full river volume flowed under The Bridge, would it survive?
- The snow melt was exceptional & key to the scale of the flood. Is this likely to repeat?

Introduction

1.1 Purpose of this FIG Report

This report gathers the information from previous reports and other sources. The aim is to enable **Residents** to gain a clear understanding of the causes and mechanisms of the flooding and the resulting issues.

To ensure this report provides the best possible information and database:

- It relies on vital information provided by **Residents** – in addition to reports, information & explanations from AC, its consultants & other parties.
- It seeks to understand & reconcile contradictions between previous reports & other evidence, to clearly set out the facts.
- It seeks to highlight remaining material uncertainties.
- It was issued in Draft to encourage as much feedback as possible. There was a 3-month consultation, so stakeholder inputs are considered & reflected in the Final Report.

It is the intention of FIG that this report will be followed by two further reports.

Report 2 2015 Flood - Economic Damage
Actual damage will be assessed – to provide input in considering flood protection proposals.

Report 3 Flood Protection Actions Taken & Future Proposals
Flood protection work to date and the current flood protection proposals will be summarised.

These 3 reports will be a package and will form the basis for formulating future flood protection options and recommendations from BCCC for further discussion with Aberdeenshire Council.

The recommendations will be provided in a further draft report which will be available for comment through a similar consultation process.

Once finalised, BCCC intends to present the recommendations to Aberdeenshire Council to seek their support for implementation.

2. Causes of the Flood - Weather Conditions

2.1 Exceptional weather produced record water flows

- **Very Heavy Rainfall:** Due to heavy rainfall pre flood, the ground was saturated.
- **2 storms came in rapid succession in December:** Eva (21/12/2015) & Frank (28/12/2015)
- **Large Snow Melt:** Additionally, there was a temperature inversion (cold weather turned quickly to warm), causing a rapid snow melt and a major additional source of water.
- **Temperature inversion**: event starting at North Pole, strongly linked to climate change.

2.2 River Flows Greatly Exceeded all previous records as a result

Three river catchments contribute to the Dee as it flows through Ballater: the Dee, Muick & Gairn. The flow rates of all three are measured upstream of Ballater by SEPA. The maximum flow rates of the three rivers during the 2015 flood - and prior to this are:

Table 1: Maximum River Flow rates for 2015 Flood & Previously (since 1970's)				
River System	**Maximum flow rates (cubic metres/sec (cuM/sec))**		**Excess 2015 flow rate over previous maximum (cuM/sec)**	
	Pre 2015 Flood	**2015 flood**	**2015 Excess**	**%**
Dee @ Polhollick	558	898	340	60%
Gairn	103	103	0	0%
Muick	130	237	107	82%
Dee @ Ballater	**791**	**1238**	**447**	**56%**
Source: SEPA Gauging Station Data (SEPA records started in the 1970's) & RPS analysis				

So, in Dec 2015, Ballater faced a flooding event 56% bigger than any since records have been kept.

2.3 Why were Dee & Muick flow rates much greater than any previously recorded, but the Gairn similar to the previous maximum?

- Dee (690 sq kms) & Muick (110 sq kms) catchment areas contain large mountainous areas, which had been snow covered. The Gairn does not have a similar snow element in its catchment area (150 sq kms).
- Snow melt is likely to have been a significant element in the excess flow. If this is correct, snow melt accounts for much of the excess flow: 447 (340+107) cubic metres/sec.

2.4 Will Climate Change increase flood risk in the Future?

- Climate change results in higher air temperature & therefore more air moisture. This generally produces higher rainfall – **so more flood risk.**
- **Short/medium term**, climate change means there is a risk of the exceptional events of 2015 recurring - heavier rain plus snow melt.
- **Longer term,** climate change is likely to further increase temperature & reduce snow probability – lower snow melt risk **(less flooding)** but more rainfall **(more flooding).**

Table 2: Ballater flooding Indication & Climate Change Impact (Cubic metres / sec)			
River	**Max flow (cuM/sec)**	**Projected maximum flow & basis (cuM/sec)**	
	During 2015 flood	**Short/Medium Term**	**Long Term**
Dee at Ballater	1247	1550 SEPA suggest 24% increase – higher rainfall	1330 No significant snow: - 220 (table 1) + SEPA 24% increase
Source: SEPA Gauging Station Data, RPS analysis, BCCC calculation			

- Whatever assessment is made of the effects of climate change, the one thing that is clear is that this is subject to considerable uncertainty.

3. Water Volumes in the Dee – at Ballater

3.1 How do we know how much water is flowing through Ballater?

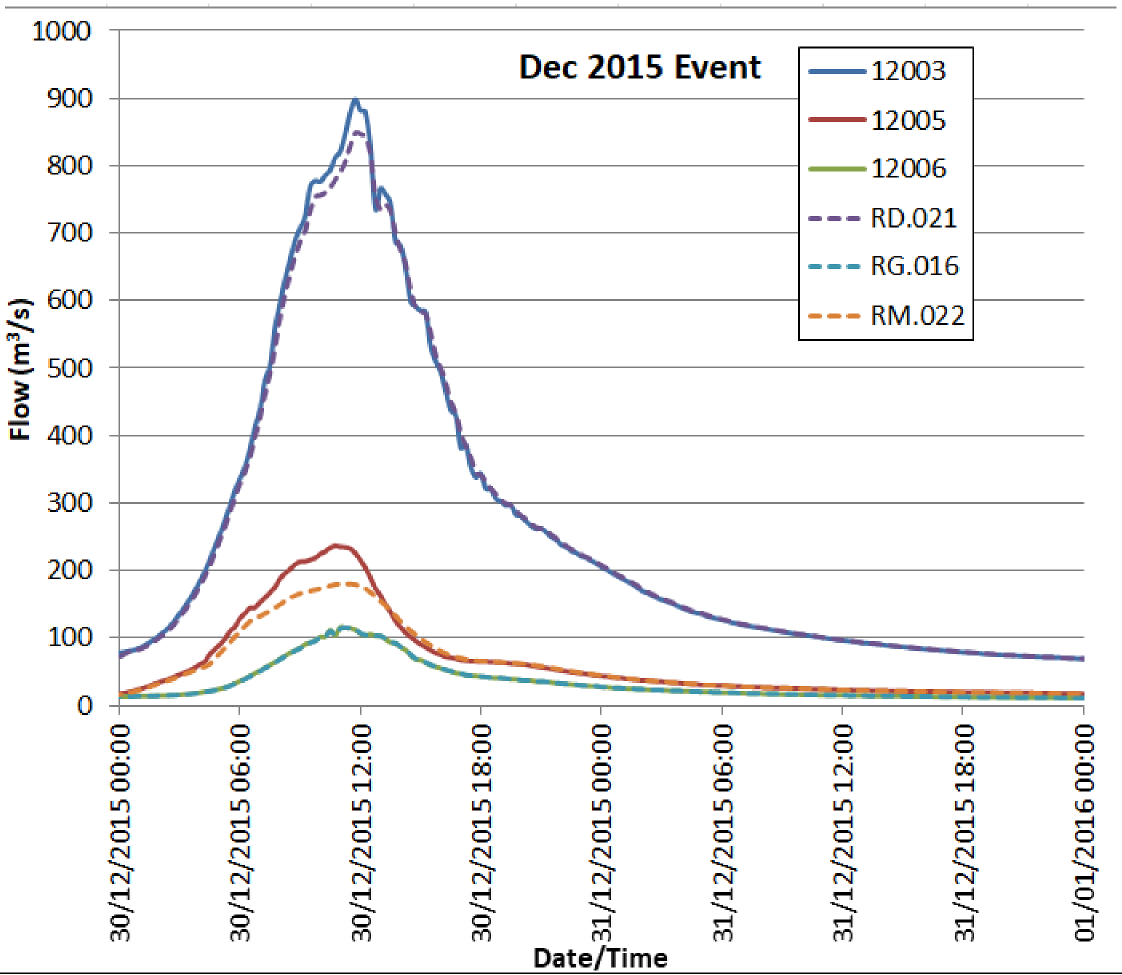
- SEPA have measuring stations on the Dee, Gairn & the Muick upstream of Ballater.
- Station readings are taken every 15 minutes so there is a clear picture of the flows.

- RPS added these flows to get a simulated view of the Dee's flow through Ballater.

3.2 How much water was Flowing through Ballater during the flood?

- Water volumes on the 3 rivers upstream of Ballater are shown in Figure 1 – prepared by RPS. (SEPA stations Polhollick, Muick & Gairn).
- It is clear the flood had a sharp peak lasting a few hours – during which Ballater flooded.
- Previous floods have the same peaking pattern – though with a much lower peak.

Figure 1: SEPA Measuring Stations Flows: Dee, Muick & Gairn (30th Dec 2015)



Source: RPS Hydrology Chapter 2019

- At 08.00, 30th Dec 15, Ballater had flows exceeding anything previously recorded: >770 cuM/sec
- For the next 8 hours (08.00-16.00), Ballater had flows >770cuM/sec
- For 4 hours of the peak (10.00-14.00), flow was >1000cuM/sec.
- At the peak (about 12.00), the maximum flow rate was around 1250cuM/sec.
- Ballater suffered a sharp, extreme and violent event.
- To get a clear sense of the situation at the flood peak, it is important to get evidence (photographs, videos, witness statements, etc). RPS Reports contained no photographs

between 10.00 & 14.00, so it was thought vital that BCCC obtain as much actual evidence as possible.

3.3 How Exceptional was Ballater's 2015 Flow rate

- Since the 1970's, SEPA has recorded river flow rates, so that there is good data for 40 years.
- In this time, there have been several flood events and SEPA recorded the maximum flow rates for each. The most recent, and biggest, are shown in the table below:

Table 3: Flow Rates (cuM/sec) in recent Floods

Date	Max Flow	Comment
30 Dec 2015	1247	Flood mechanism dealt with in Section 4 - breach. Flow rate on a different scale to all previous floods. Damage on a different scale to all previous floods. Damage is dealt with in FIG's Report No 2.
11 Aug 2014	651	Flood mechanism through the golf course, overtopping golf course & caravan park, flooded more than 1993. Flooding on Dee St (as far as Richmond Place). Flood depths up to 0.5 metres. During this event, the River Gairn reached its highest level on record at the Invergairn gauging station Little other damage to the village.
17 Jan 1993	593	Flood mechanism through the golf course, overtopping. Golf course & caravan park flooded. 2 houses in Anderson Rd flooded. Little other damage to the village.
3 Oct 1991	516	
5 Feb 1990	560	

4. Mechanism of 2015 Ballater Flood

As a result of the unprecedented volumes and flow rates described in the preceding section, the risk of the bund alongside the river being breached or overtopped rapidly increased. There are many different breach mechanisms from overtopping and scouring of back slope, failure of front slope, seepage at high water levels and toe erosion.

4.1 Bund along the Dee by the Golf Club

- The North bank of the Dee is protected from flooding by a bund initially constructed between 1994 & 1997 with support from the Foundation for Sports and the Arts. The purpose of the bund was to protect the golf course and consequently the village from flooding by overflow either preventing or reducing the flooding.
- The Bund runs from the east end of the golf course for about 1 mile to near the Sluivannachie picnic site car park. The height varies between 1 & 5 metres above ground level.
- Pre-bund, the golf course acted as a Dee overflow, or flood plain, in particular the Brockie's Pond area flooding every few years.

- Some concern was expressed in the village that by constructing the bund and removing this overflow potential:
  - The village itself might be put at greater risk of flooding.
  - More pressure is put on the high bank at Red Brae potentially contributing to its collapse during high flows with a resulting breach of the bund.
  - By keeping water in the channel, river levels and velocity is likely to be higher than if the river spreads out at high flow, increasing erosion risk on the opposite bank.
- In the 1990's, when the Bund was extended, BE & BGC jointly undertook a series of projects to reduce Red Braes erosion and the risk of flooding the golf course. (see App 1 for details)
- Prior to the December 2015 flood, the bund & flood defences, were in a weak state (see Photo 1) in several places, so their ability to withstand a serious flooding event was not great.
- No dredging in the river had taken place since 1997. The case for and against dredging as a means of flood management is often complex but it may be ineffective at Ballater (in contrast to flat areas such as Somerset) where there is a large flow of bedload sediment as well as water during floods. Dredging can also destabilise banks as the river looks for sediment to carry in place of that which has been removed.

Photo 1: Golf Club Bund on 24th December 2015

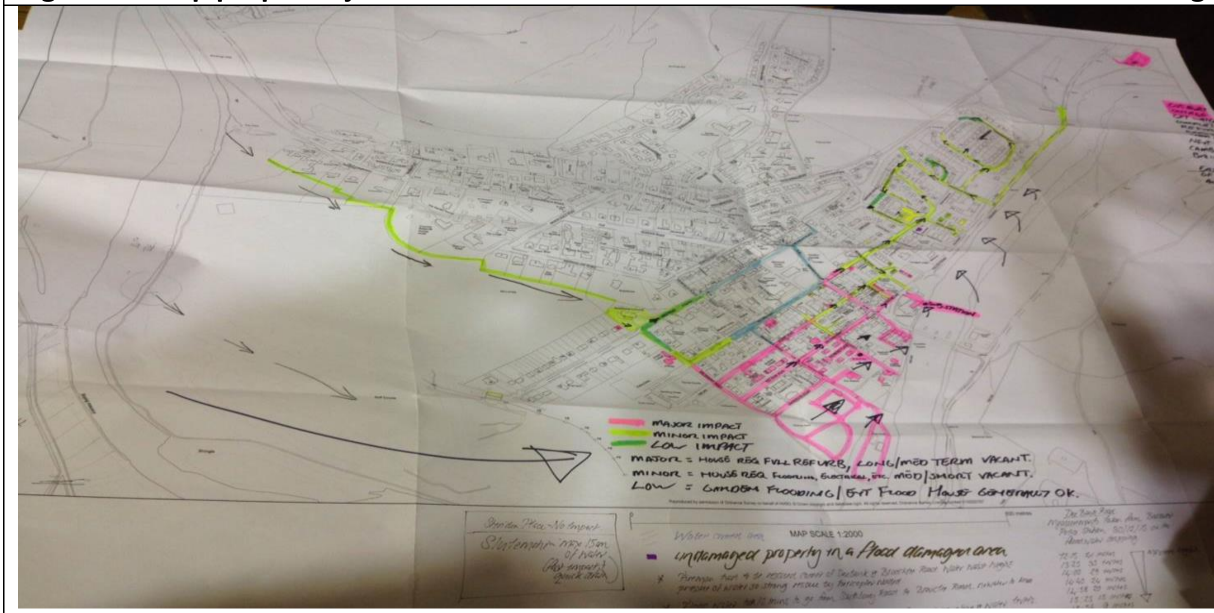
Source: Photograph by Ray Cooper

Figure 2: Google Map showing the various relevant Tees and Greens and the Legacy Channel
Source: Google Maps

4.2 Inspection of the Flood Area - at the Time of the Flood

- SEPA provided a photograph (Figure 3) of a map annotated by AC, showing the reported flow mechanisms & identifying the areas affected by flooding.
- The map shows 3 areas of river flooding upstream of the Bridge:
  - Sluievannichie picnic site car park area – some flooding. (top arrow – yellow from Dee)
  - Golf Course around 13th Green – some flooding. (middle dashed arrow)
  - Red Braes (near 12th Green/6th fairway) – major flooding. (larger solid lower arrow)
- The map also shows the Dee overtopping just upstream & downstream of The Bridge.
- Fig 3 also indicates the route of the major flood incursion from the Red Braes, going directly towards the caravan site, which supports the terrible damage inflicted there.
- The map uses colours to reflect the flood's level of impact on the village:
  - Green (low), Yellow (minor) & pink (major).
  - BCCC checked this impact assessment with Residents.
- The 3 flooding mechanisms above are considered in this section, to confirm these.

Figure 3: Map prepared just after the flood to show Ballater flow mechanisms & flooding



Source: RPS Hydraulic Report (page 9) (map provided to RPS by SEPA)

4.3 Sluievannachie (SL) Flooding (top arrow – Figure 3)

- SL is located at the west side of Ballater on the Dee. (see Figure 2)
- SL had flooded in the past (but not recently before 2015).
- In Dec 2015, SL overtopped from about 09.30: the bund remaining intact. (see Photo 2) Water flowed down the yellow route A (Figure 3), coming onto the golf course on 14th Fairway, down 15th fairway (parallel to Abergeldie Rd) & through the Catholic Church grounds and onto Golf Rd. Movement of flood water through the village is dealt with in Section 5.
- SL flooding did not result in deposits of big stones, trees or numerous small stones, indicating the combination of flow rate & water speed was generally not very high, although in places was deeper and caused widespread low level flooding. (Video was taken of SL flood water flows at midday (peak of the flood) confirming this)

Photo 2: Flood Overtopping at Sluievannichie

Source: Photograph by Ian Cameron

4.4 13th Green Area Flooding (middle arrow – Figure 3)

- 13th Green (13G) is located 400m upstream of the start of the Red Braes. (Figure 2)
- 13G has previously flooded (2014) and is a known weak point in the river defences. The river at 13G runs straight and parallel to the bund, not directly applying pressure against it. Flooding has resulted from the Dee overtopping the bund at this point.
- A Legacy channel is shown in Figure 2. (A Legacy Channel is a remnant of an inactive river or stream channel that has been filled or buried by younger sediment.)

- In Dec 2015, 13G overtopped, the bund initially remaining intact. The bund at 13G was then breached along a length of c 35 metres - it is suggested this local breach may have happened here due to bund weakness – e.g. animal burrows etc. Water flowed down the middle arrow route on Figure 3: across the 12th, 11th and 10th Fairways ending in Brockie's Pond – with some flood water also going north to 9th green to join the SL waters.
- 13G flooding resulted in deposits of many big and small stones, indicating the combination of flow rate and water speed was higher – there were no trees indicating trees were not involved in the bund breach. The range of debris may well be from the bund itself, which was formed with river shingle and stones. (course at 13G was photographed after the flood, confirming the type & amount of flood debris & providing reliable evidence of the above)

Photo 3: 13th fairway Debris

Source: Colin Smith (BGC)

4.5 Red Braes (RB) Area Flooding (lowest arrow – Figure 3)

- RB escarpments themselves are on the south and west bank of the river.
- RB are located about 400 metres downstream of 13G. (see Figure 2)
- RB is an escarpment area of soft, sandy terrain & subject to river erosion. There is a view that erosion increased after the BGC bund was built, with a fishing walkway destroyed in 2015. In the 1990's when the BGC bund was built, Balmoral Estate installed rock armour to protect the Red Braes.

- The BGC bund opposite and downstream of the RB had not experienced flooding in recent years & was not a river defence weak point – due to the bund.
- During the 2015 flood between 26,000 and 38,000 cubic metres of the RBs collapsed into the Dee as a result of the elevated water levels (RPS Report). The RB are topped with mature trees, some of which also ended up in the Dee as a result of the collapse.
- The RB reinforcement was not designed for such flows. This appears to have failed & rock armour, boulders etc as well as sand was washed into the river causing a major blockage.
- This is believed to have resulted in:
    - a breach at the fishing hut,
    - a very significant breach 300m downstream of the 6th tee (see Fig 2) as the river bends
    - Significant breaches at the Dooker where the river bend sharply.
    - some small breaches and significant overtopping of the BGC bund opposite the RB at the 6th green and up the 6th fairway,
- The bund was badly breached during the flood event releasing major amounts of water and threatening the village. Photographs of the breaches were taken at the time.
- RB breaches resulted in deposits of large trees, big stones (some >50 kg), & numerous small stones over a distance of 100's metres indicating the combination of flow rate & water speed was very high. (RB breach flood plane was photographed after the flood, confirming the type & amount of debris & providing reliable evidence of the above)
- Trees from the RB became tangled and caught at the Invermuick corner and may have caused some damming and contributed to breaches and overtopping.
- There was significant overtopping at the 6th fairway seriously adding to the volume of flood water.
- The resulting flood water route on Figure 3, down 6th & 4th fairways takes the flood waters directly towards the caravan park - consistent with the heavy damage there.
- The above breach mechanism was also supported by BFG.

4.6 Overtopping in Ballater Upstream of Ballater Bridge (The Bridge)

- Early morning, the river rose rapidly first flooding into Dee Street & the caravan site. Then flood water started to run up Bridge St as the Dee continued to rise.
- There was a sudden, sharp rise in water level at about 9.30am, when the level rose from 20cms to a metre – flow rate also increasing greatly.
- Flood waters in the Dee St area (near the Dee) rose to ground floor window level (1m), with very fast flowing water.
- The dominant water flow direction at this time was from the west, from the golf course – indicating there had been a sudden major breach. It is thought that this was probably caused by the overtopping at the 6th fairway & the breaches in 4.5.
- The Dee at this stage was seriously overtopping in some places, whilst in others, river walls were breached from the landward side by flooding from the golf course & elevated river levels prevented flood water from escaping to the river quickly.
- In the Dee St area, though the river height was above the level of its banks, the main flow was flood water coming from upstream over the BGC rejoining the river, rather than further flood water coming from the river into Ballater.
- This part of the village remained under 1m of very fast flowing water for some hours, and in lower lying areas depths reached 2m.

- Flow rates from flood waters coming across the BGC were increased as this area is at low level so flood water flows sharply down the steep slope on the 3rd fairway towards the caravan site & Dee St.
- Flood water from Dee St also flowed east towards Bridge St, with some water crossing into the east of the village. However, the volume of water bypassing The Bridge is not known. This has been variously estimated at between 5 – 30% of the total river flow – at the peak.

4.7 Overtopping in Ballater Downstream of The Bridge

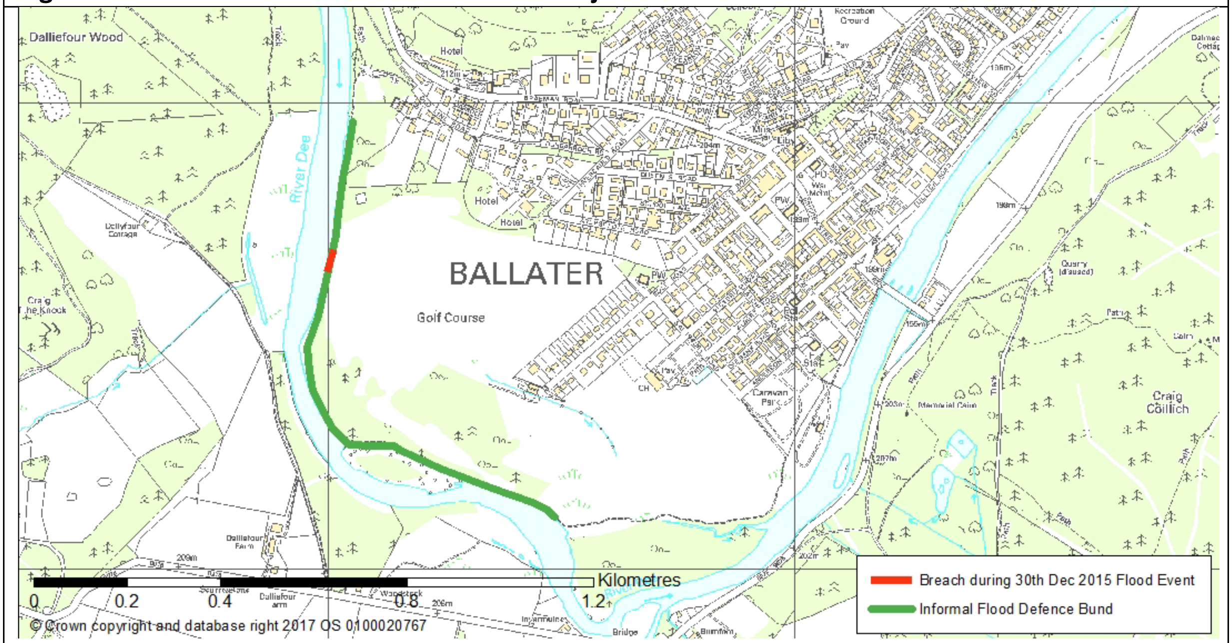
- The area was already flooded with water coming through the village.
- By 10.00 in the morning, river levels continued to rise and overtopped in the Craigview Rd area. This resulted in the dyke on the north side of the A93 collapsing and water spilling over into the rear of Pannanich Rd properties.
- Local overtopping is believed to have continued till early afternoon
- Overtopping contributed to the degree of flooding experienced in the east of the village.

4.8 Inspection of the Bund (& flood area) By RPS

RPS were appointed and then "conducted a walkover survey in conjunction with AC on 28th June 2017". This was however some 18 months after the flood. (Hydraulic Analysis Chapter, Page 18)

"The location of the breach in the informal flood defence embankment during the December 2015 flood event was identified by AC" & is indicated in Figure 4 below. The breach location in Figure 4 (Red) identified by AC to RPS is not consistent with the major breach in SEPA's map (Figure 3). Figure 4 shows the breach occurred near 13th Green, which Figure 3 suggests was a lesser breach in comparison to the multiple breaches downstream. (see 4.5)

Figure 4: AC indication to RPS of where the major breach Occurred



Source: RPS Hydraulic Report (P 10)

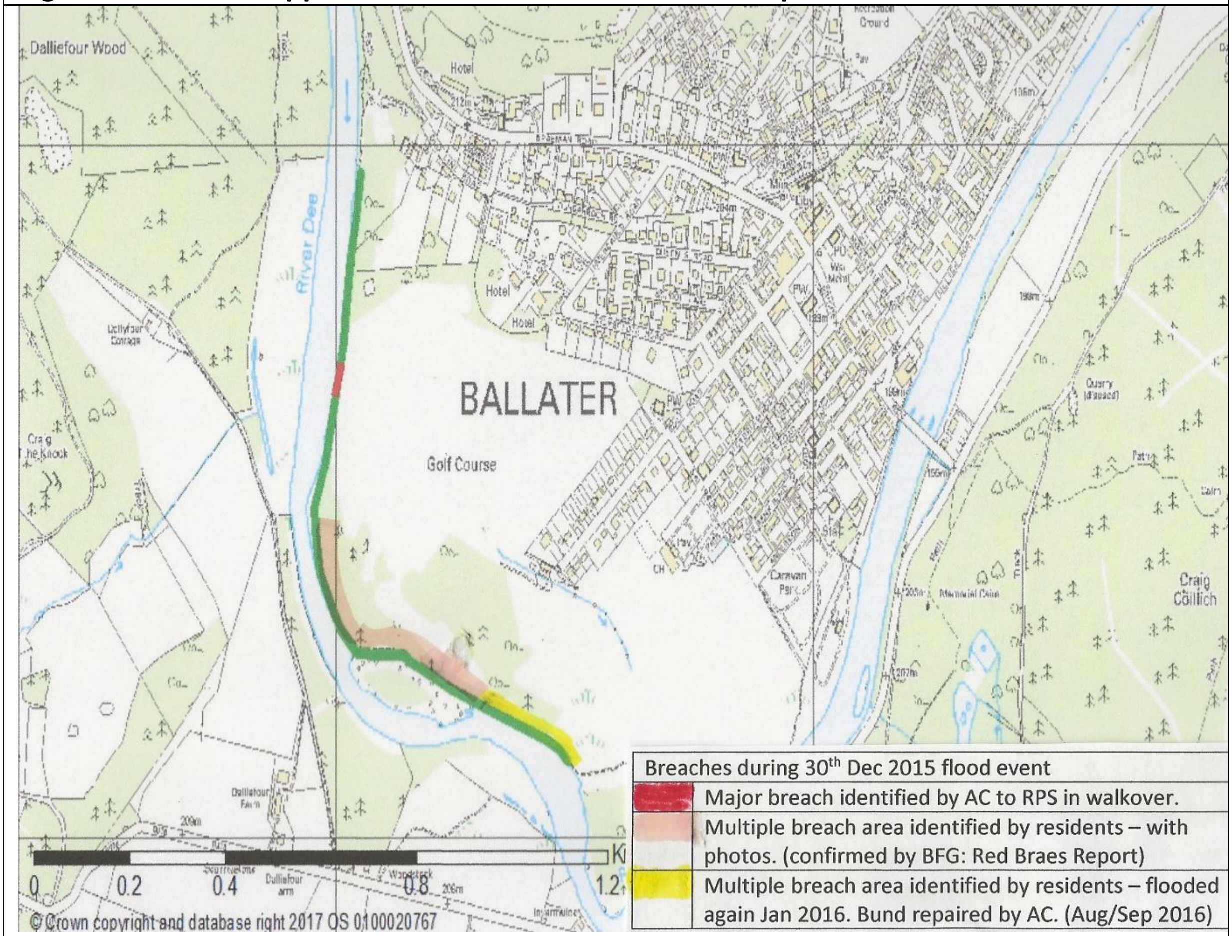
4.9 RPS Evidence Supporting a major Breach Near 13th Green

- RPS were advised by AC as to the location of the major breach.
- Stones and debris had been cleared from the golf course before the RPS walkover on 28th Jun 2017, so RPS observed no physical evidence to confirm the major breach location.
- There are no photographs of the breach area or debris in any of the RPS reports or appendices to support their "Breach near 13th" claim.
- RPS offered no explanation in their main report or appendices of the major breach at this location. Although the breach length was measured and contained within notes taken by AC, other key aspects (breach height, timing and collapse process) of the breach were all "assumed" in the RPS report: "The breach was assumed to occur near instantaneously as the defence level was exceeded, with the crest level reduced to the adjacent ground level. The breach length was defined as approximately 35m as shown in Figure 3.11, in view of information received during the walkover survey and Aberdeenshire Council briefing notes." (RPS Hydraulic Report P41)

4.10 Alternative identification of the Major Breach

- That there was a breach in the area of 13th green, & its scale 35m wide, is agreed by AC, RPS, BFG and others who have studied the flood or observed the resulting damage. All parties also agree this breach was not caused by the collapse of the Red Braes. (Figs. 4 & 5: Red)
- As indicated in 4.5, and confirmed by photographs, there were additional major breaches opposite and south of the Red Braes. These breaches were in total length estimated to be 100-150 metres, & combined with the overtopping (see 4.5), would explain fully the deluge of water which increased water level and flow rate in the village very rapidly. The areas of these breaches are marked in brown & yellow on Figure 5. – though is is not suggested that this was one continuous breach.
- From Figure 5 it is clear that in the yellow area the river is turning and flowing towards the bund. A breach of the bund in this area is therefore likely to be far more damaging as the river is flowing directly into the breach – rather than where the river is flowing parallel to a breach. (e.g. 13th Tee)
- In January 2016, there was a small flood affecting only BGC which resulted from the breached bund in the area marked yellow. (Figure 5) In Aug/Sep 2016, AC took the initiative & repaired a length of about 40metres in the yellow area, to reduce the risk of flooding in this area. The repair was with rock armour and to a height of 1-2 metres.
- The short width of the breach at 13th Green suggests this was not the major breach and the narrow width would not support the rapid increase in flow rate & flood depth.

Figure 5: Breaches opposite & downstream of Red Braes: plus 13th Green



Sources: RPS Reports, Ballater residents, BGC & BFG

4.11 RPS Modelling of the 2015 Flood Event

- The RPS flood model is critical to their assessment of what happened during the flood. To confirm the model is accurate & reliable the flood results (flow speed, depth, etc) were checked against actual measurements. The model must fit with what actually happened
- The 18-month delay in RPS starting meant much "flood evidence" had gone. So, it was harder for RPS to assess what happened. They were more reliant on AC & resident input.
- To check their model, lamp posts etc were marked by AC with tape to indicate high water level: 17 markers are shown on RPS Fig 2.7 (Hydraulic Report). However due to their delayed start, RPS found only 5 markers, and in their view it was not possible to determine the accuracy of the flood markers "in terms of who placed the markers, when this occurred and how representative these were of the actual flood levels which occurred".
- Model result heights varied by up to 30cms from actual readings.
- Local residents confirmed to RPS, the area off Craigview Rd flooded twice, once from through the village & secondly direct from the Dee. RPS model could not reflect this.
- Most crucially, the model was based on a single 35m breach in the bund, whereas the total bund length breached is 100-200m.

- Additionally, the model was not able to effectively reflect the 2014 flood.
- RPS own assessment of their model was “best fit”; not “accurate or good”. (P42 HAC)
- This seriously questions the model’s validity – and some of the “assumptions” made.
- A consequence of this is that the RPS report contains very little discussion of critical flood elements in the village – e.g. the depths of flooding, flood water speeds and duration of flooding at varying village locations are not known.
- Flow rate & depth of flooding in the village is crucial, as this is a threat to life. This is not discussed in any detail in the report. To be fair to RPS it is difficult for them to accurately confirm this information.
- Given this understandable uncertainty due to lack of information, RPS’s assessment of the impact on the village would have benefited from extensive discussion with villagers as to their experience of what happened in the village – during the flood.
- Ultimately, the model assumption of a single small breach rather than the multiple, major breaches observed by residents, BFG & AC (as highlighted in 4.10) means that the model assumptions seem to be flawed and do not reflect what actually happened.

5. Movement of Flood Water through the Village

5.1 Sources of Flood Water and their movement towards the village

Flood water sources were identified in 4.3 – 4.7. Each source is summarised in Table 4 below:

Table 4: Flood Sources & description				
Flood Source	**Ref**	**Description**	**Flow**	**Route to village**
Sluievannachie	4.3	Overtopped bund	Low/medium	North of golf course to Catholic church – Golf Road
13th Green	4.4	35m bund breach	medium	Centre of golf course to old river bed - overflowed down main fairways to the village
Fisherman’s hut & south of Red Braes 200m east of 6th Green & further breach at the Dooker	4.5	Three major bund breaches c.95m and smaller breaches Plus overtopping at 6th fairway	large	South of BGC to old river bed - overflowed down main fairways to caravan park & village.
Upstream of BRB	4.6	Overtopped at Dee Street and Cornellan Square wall breached internally	Low and of limited duration as area flooded by 4.5	Added to problems in Dee St/ Cornellan Square, as the high water level in the Dee was restricting flood water drainage to the Dee.
Downstream of BRB	4.7	Overtopped	Low/medium	From the Dee into Craigview Rd area and into East of the village

5.2 What Levels of Flood Water did Each Source Present to the Village?

Sluievannichie at the Catholic Church

- The flood water emerging from the Catholic Church on to Golf Rd varied according to altitude and whilst it did exceed 2m in some lower lying places was about 30 cms deep in most of Golf Road at the peak of the flood.

13th Green, Fisherman's hut, east of 6th Green, the Dooker & 6th Fairway

- These four flood sources flooded into & over the old river bed and across the length of BGC towards the village.
- Flood waters from across the BGC struck the village from the north end of Salisbury Rd (Victoria Rd junction) to the south end of Salisbury Rd (Anderson Rd junction) & then further south the caravan park.
- The flood water level at BGC Clubhouse reached a maximum level of 30cms. (photos 4 & 5). This suggests the level at the north of Salisbury Rd should be similar.
- Salisbury Rd slopes gently going south towards the Dee. It is suggested the flood depth from BGC gradually increased further south along Salisbury Rd.
- At Anderson /Salisbury Road junction, flood depth maximum was 1 metre.
- The sharpest slope along the side of BGC is at the Caravan Park where the water level was observed to peak at over 1 metre.
- In the lowest lying areas around Dee St water depth exceeded 2m.

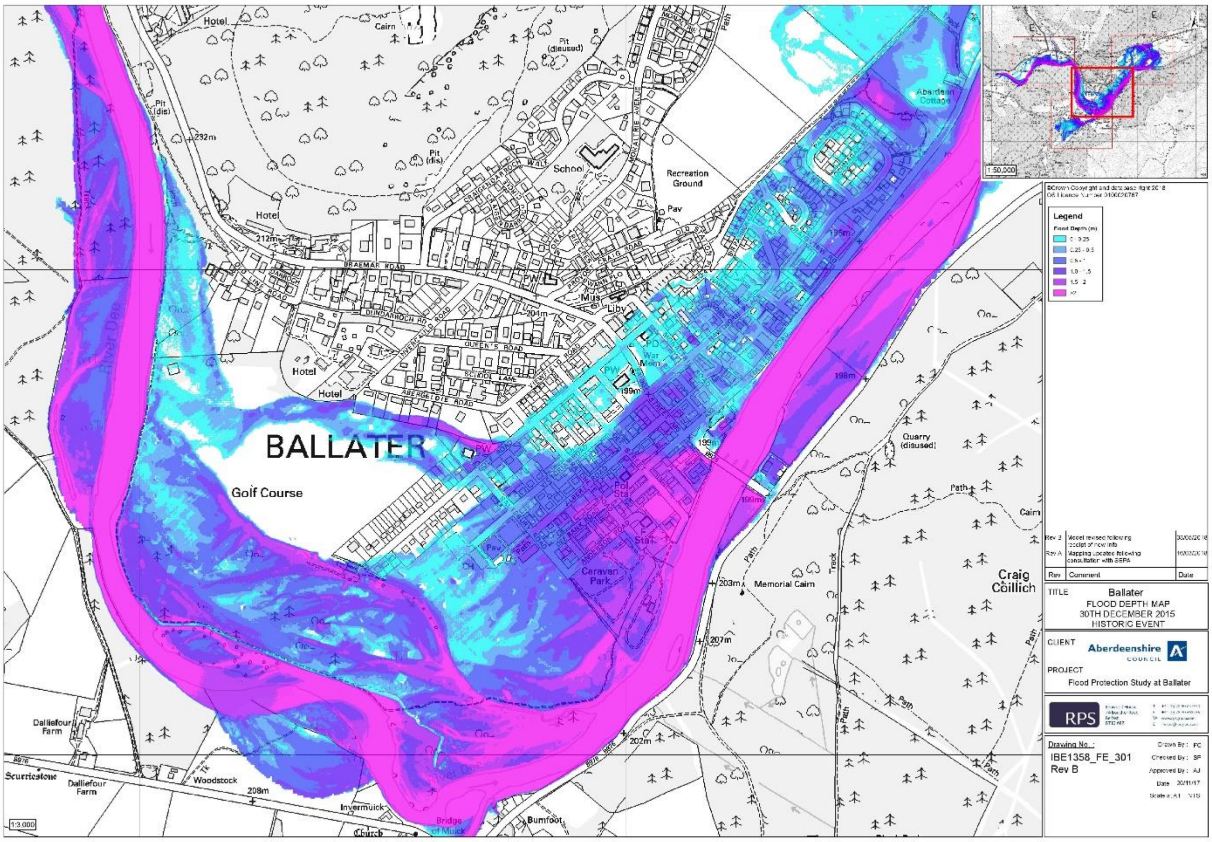
Photo 4: Flood waters reaching the BGC Clubhouse at 10.02 on 30/12/15

Source: Colin Smith (BGC)

Photo 5: BGC Clubhouse Post Flood Damage (flood level about 30cms)

Source: Colin Smith (BGC)

Figure 6: Flood Depth Map 30 December 2015 Historic Event



Source: RPS IBE1358_FE_301 Rev B 20/11/17

Upstream of The Bridge

- In the caravan park & Dee St area, flood water levels exceeded 2metres. Flood water arrived both from the Dee overtopping at Dee St & the BGC, but the force and direction of the flow was from BGC. This flood water was at a similar level to the river water, the body of water becoming one whole. Therefore, the river appears to have overtopped by more than 2 metres in places. (See Figure 6)

Downstream of The Bridge

- Flood water depth depended on local elevation and contours, with water from the Sluievannichie breach & the “Golf Course through the village” affecting different areas – some overtopping of the Dee also adding to the flooding.
- The main source of flood water in the east of the village, was water flowing from the village. The primary route was down Hawthorn Place and when this turns north, the water flowed through the industrial estate and into Pannanich Road, looking for a route to return to The Dee.

- Flood water from Hawthorn Place also entered other roads including Hawthorn Grove, St Patrick Geddes Way and Craigview Road.
- On the south side of Pannanich Road, adjacent to the river (where properties are low lying) flood water did come in from the river side and reached 4 feet, flowing strongly, causing significant damage.
- On the other side of Pannanich Road (which is higher) some properties did not flood.
- The flood water in the east near the river was deep, fast flowing & also significantly polluted with diesel and other chemicals from the village. The situation in this area was also clearly a danger to life and residents took shelter on their upper floors.
- The force of the flood water was sufficient to sweep away fences, oil tanks, plants and gardens and vehicles were also destroyed
- This water drained away by 18.00 on 30th Dec 2015, so that little standing water remained.

5.3 Areas of the Village Flooded by the Different Flood Sources

The multiple flood water sources contributed to the seriousness of flooding in the village by:

- Causing flooding in different areas of the village. (see Table 5 below & Map Figure 6)
- Combining in some areas to cause increased flooding.
- Restricting the drainage of flood waters back to the Dee, causing higher flood levels.

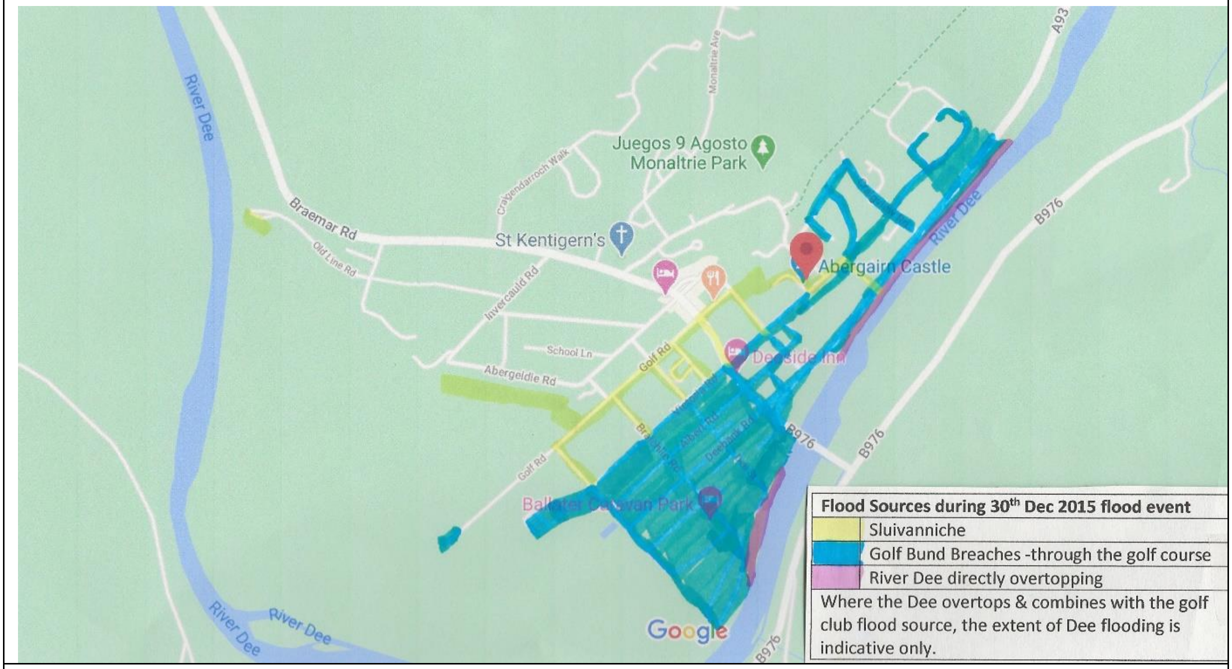
Table 5: Level & area flooded by source - & return route to the Dee

Flood Source	Ref	Level & area	Return to Dee
Sluievannachie	4.3	Level: Low depth flooding: typically, usually less than 30cm - but flow continued for many hours. Areas affected: Abergeldie Rd (south gardens), Golf Rd, Netherley Pl, Hawthorn Cres & Pl. These are generally more elevated than those damaged by Red Braes flows.	As these flood areas were to the north of the village, flood water had to drain through the village to the Dee, causing further areas of damage.
13th Green	4.4	Golf Rd west end (south side) had a small flood. Main flood water gathered in old river bed. When it overflowed, flood water moved on a broad front between Victoria Road & the Dee: to & across Bridge St & into the east of the village.	As these areas are in the centre of the village, flood water had to drain through the village to the Dee, causing further areas of damage.
Opposite & south of Red Braes – Fisherman's hut, 6th Green, Dooker & 6th Fairway	4.5	Higher depth (up to and exceeding 1 metre) & very fast flow. These flows were down south side of the golf course with primary impact on the caravan site & south end of Salisbury Rd.	Through caravan park, across Salisbury Rd & through upstream roads, flow also across Bridge St into east of the village.
Upstream of The Bridge	4.6	Raised river levels prevented the flood waters coming from BGC from draining as easily into the	Waters flowed through the village when flooding was elevated & abated back to

		Dee. Damage to walls from BGC waters and upstream overtopping produced elevated flood water levels in the areas near the river.	the Dee when the main storm surge passed
Downstream of The Bridge	4.7	Flood waters were primarily from through the village & flooded to a maximum depth of 4 feet. Some properties in the route of the flood waters did not flood due to their raised elevation.	The flooded areas lie at a lower level than the A93 preventing water returning to the Dee. Water flowed east & north into fields as water levels fell

- The Sluievannichie flood source was an overtopping with flood water usually no more than 30cms as it approached the village at Golf Rd. However, this caused large areas of the village to flood (see Figures 6 and 7). The flooded areas were so large as (1) a steady supply of flood water was channelled into the village, (2) the point of supply of this water was at the upper end of the village and the water had to drain through the village to the Dee & (3) as the upper end of the village is flat, the flood waters were able to travel a long way east (across Bridge St) & damage considerable areas in the east of the village.
- 13th Green & Red Braes flood waters joined as they came across the golf course.
    - **North area of BGC:** Although the flood water height was only 30cms, there was a powerful supply of water & nothing to stop this. Consequently, the flood water damaged most of the lower village between Salisbury Rd & Bridge St. These flood waters crossed Bridge St & did extensive damage in the East of the village, where in some areas flood water could not escape & depths increased to greater levels.
    - **South area of BGC:** This is lower lying, resulting in deeper water, 1metre, and much faster flows, with real and significant danger to life. The southern area consequently suffered the most extensive damage, including destroying all 100 fixed mobile homes at the caravan site and washing large objects & debris though the village damaging walls, property etc. These flood waters crossed Bridge St & did extensive damage in the East of the village.
- Upstream of The Bridge overtopping exacerbated the flooding problem in the lower village. If there had been no flood water coming over the BGC from the sources above and the river had overtopped by 1metre, this would have caused extensive damage to the lower part of the village. The flood waters would have certainly flooded the caravan park, gone a good way up Dee St and into adjacent Road & reached Bridge St. It is less clear whether the static caravans would have been so damaged & washed through the village, causing extensive damage, or directly into the Dee, or that the force of the flood would have been so severe with its real threat to life.

Figure 7: Areas Flooded by Source of Flood Water



Source: RPS Reports, Resident Interviews, videos & photos

6. Impact of Ballater Bridge (The Bridge) on the Flood

6.1 RPS Assessment

Conclusions on The Bridge

RPS Feasibility Report states: 5% of the river volume bypassed The Bridge – based on model results. This figure is open to question (see 4.6) as the accuracy of flow through the village (bypassing The Bridge) proved difficult to model.

A key question raised by the RPS Report is the impact of The Bridge on the flood. RPS said "comments received from local residents suggested the bridge may cause a restriction in flow & it was suggested that an additional arch on the bridge may provide some flood relief." (main Report P36)

RPS conclude the following, based on modelling & expert opinion:

1. **The Bridge could cope with the full 2015 flood** if no flood water had flowed through the village & there would be no material effect on river levels. "the conveyance of any additional flow through the Bridge due to implementation of direct defences is not expected to cause any significant additional increase in discharge or water levels. (as a consequence of increased velocities at the bridge)." (Ballater FP Study, Page 70)
2. **If one of the 4 arches of The Bridge were fully blocked it would have no material effect on upstream water levels**. RPS conclusion from the model: "The largest impact on water levels is seen at the upstream face of the bridge where the water depth increases by 81mm. It made no significant difference to the river levels or flood extents, and had no impact on the number of properties affected. Therefore, the model can be considered to have a low sensitivity to blockage at the Bridge, with a low impact on the number of properties affected." (HAC: P50)

3. **If The Bridge was removed the upstream water level effect would be small** - RPS concluded: "water levels were found to be 340mm lower in the bridge-out scenario."

Figure 8: Cross section of The Bridge showing water level at Peak Flood

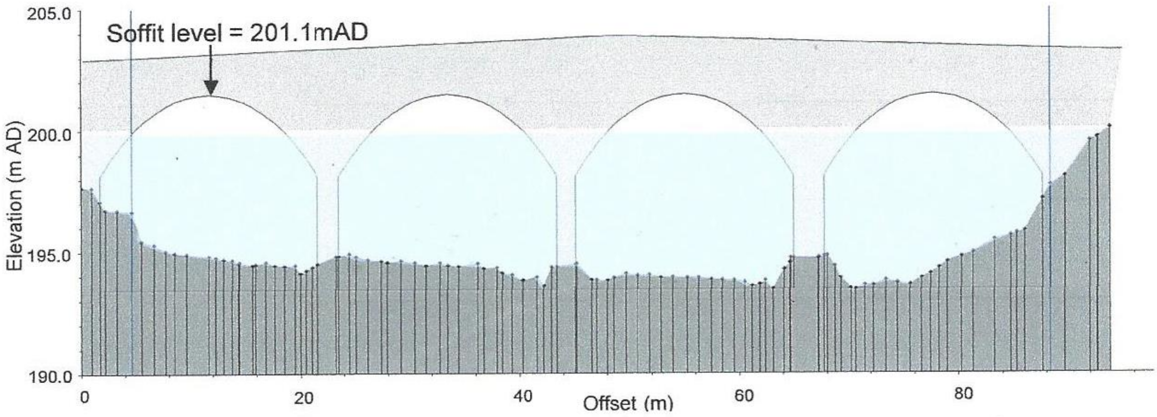



Figure 3.10 - Cross-section showing maximum water level upstream of Royal Bridge Ballater during a 0.5% AEP flood event
Source: RPS Feasibility Report (P38)

However, RPS expressed caution about their conclusions regarding The Bridge, suggesting if flood defences were to be built, bridge modelling should be redone to confirm that the structural integrity of the bridge was not at risk. "should an option which incorporates direct defences be implemented, it is recommended that additional investigation into the potential for scour is undertaken to ensure that the flood alleviation scheme does not compromise the integrity of the bridge."

6.2 Photographic Evidence of The Bridge in Flood

Photo 6: Taken (between 1:42pm & 2:16pm 11/08/14) upstream of The Bridge – river flow during this event was half the level of the 2015 Flood event

Source: RPS Hydraulic Report

Photo 7: Taken (at 10:25am 30th Dec15) from downstream, north side of Dee. River flows increased by 50% from this point. Caravan debris visible upstream on the nearest abutment.

Source: RPS Hydraulic Report

Photo 8: The Bridge at 12.30 30th Dec 2015

Height almost at the arch top (unfortunately, no photo was found)

Photo 9: The Bridge after the Flood showing debris – which would restrict flow

Source: Youtube

Comments on Photographs 6 - 9

Based on the Dee's flow rates (RPS estimates) these 4 photos can be summarised as follows:

Photo	Time/Date	Flow Rate cuM/sec			Water Level at The Bridge	% Dee bypassing The Bridge
		Dee Gross	Thro Village	Net thro bridge		
6	14.00 11//8/14	620	0	620	1 block below start of arch	No water bypassing
7	10.25 30/12/15	1100	60 (5%)	1040	At arch start	Assumes that RPS are correct: 5%
7	10.25 30/12/15	1100	330 (30%)	770	At arch start	Assumes that BFG are correct: 30%
8	12.00	1200	360 (30%)	840	???	Assumes BFG correct
9	Post flood	Shows the debris resulting from the flood. This would have seriously restricted river flow through The Bridge and resulted in higher upstream water levels.				

- Being certain how much water bypassed The Bridge is critical to assessing the performance of The Bridge during the storm.
- Due to a lack of model validation information & confidence in results it is not clear exactly how much of the river flow bypassed The Bridge.

- If RPS estimate of 5% bypass is correct, The Bridge can deal with a river flow of 1250cuM/sec & the river level will not reach the apex of the arches.
- If BFG estimate of 30% bypass is correct, The Bridge cannot deal with a river flow of 1250cuM/sec & the river level is likely to reach the apex of the arch & put The Bridge at risk.
- The photos suggest the bypass is much greater than 5%, as the 2015 photos show the water level at The Bridge not dissimilar to 2014 flood – even though the peak flow in 2015 was double that of 2014.
- A further serious risk arises as raised water levels increase the risk of obstructions. This is seen in Photo 9, with caravan debris restricting flow & The Bridge capacity.
- In addition to The Bridge being at risk through high river levels, it was also seriously damaged by scouring. As flow increased through The Bridge, debris scoured the river bed undermining The Bridge's foundations.
- **The future of The Bridge as a structure, is at serious risk due to increased flow volumes, elevated water levels, increased obstruction risk & scouring.**
- **There is also a risk that as a result of these factors, The Bridge will cause an obstruction to the river flow and contribute to flooding the village.**

7. Recent Flood Protection Actions: 1950 – 2014 (see Appendix 2 – for details)

- In 1952, Gordon Nicol was asked to research the river erosion at Invermuick by the owner Col Milne, with a view to making recommendations on Flood Protection.
- Gordon Nicol established there had been steady erosion since OS Records began in 1860. The river course had moved, leaving a wide (400ft) river bed with old channels, with the river only occupying an area of 40ft.
- The recommendations included dredging, opening an old river channel, & placing rocks to stabilise Invermuick. This work was halted at the insistence of fishing interests.
- In the 1990's after serious flooding of the BGC & erosion of the Red Braes, BGC & Balmoral Estates (BE) together commissioned research from Strathclyde University to see what flood protection could be done. The river was modelled & several phases of work were done.
- Between 1993-97, the parties undertook dredging of various parts of the Dee, opened up the old river channel by 6th fairway to reduce flow rates at the Red Braes & added groynes to divert water into this channel, added protective rock facing to parts of the Red Braes, added to the size of the BGC bund & extended the bund to cover more of the river bank. (in areas of recent flooding, using pebbles etc extracted from the Dee)
- This work was undertaken gradually in Phases, with the results of each Phase checked prior to proceeding with the next. This parties were satisfied with this gradual, piecemeal approach, which also meant that the scale of costs incurred was manageable.

8. Flood Protection Repairs & Improvements Since 2015

8.1 Flood Protection Repairs Undertaken

- AC has repaired The Bridge more than once. The repairs strengthened The Bridge structure.

- AC and BGC repaired some areas of the BGC bund opposite & downstream of the Red Braes.
- BGC removed stones & boulders from BGC course, moving them to strengthen the Bund.

8.2 If there was a flood similar to 2015 – will the village suffer the same fate?

If things are unchanged, the village will suffer the same. The following changed since 2015:

To increase the scale of the flood:

- Although AC repaired some parts of the BGC bund, there are parts of the bund, weakened in 2015, which were not repaired – leaving remaining breaches & reduced height. **The volume of flood water from across the BGC is likely to be increased.**

To Reduce the Scale of the flood:

- The Red Braes collapse widened the river channel - river capacity is increased & flow rates slowed. The chance of a large Red Braes collapse & risk of bund breaches is reduced.
- Areas of the river bed were scoured by the flood & depth increased: e.g. under BRB. A deeper river increase carrying capacity & reduces flow rates.
- Having said this, recent movements of the river bed are not known.

<u>Overall, there is no reason to think a flood event similar to 2015, would end differently.</u>

This assessment that Ballater remains at risk is supported by recent work done by SEPA in 2020.

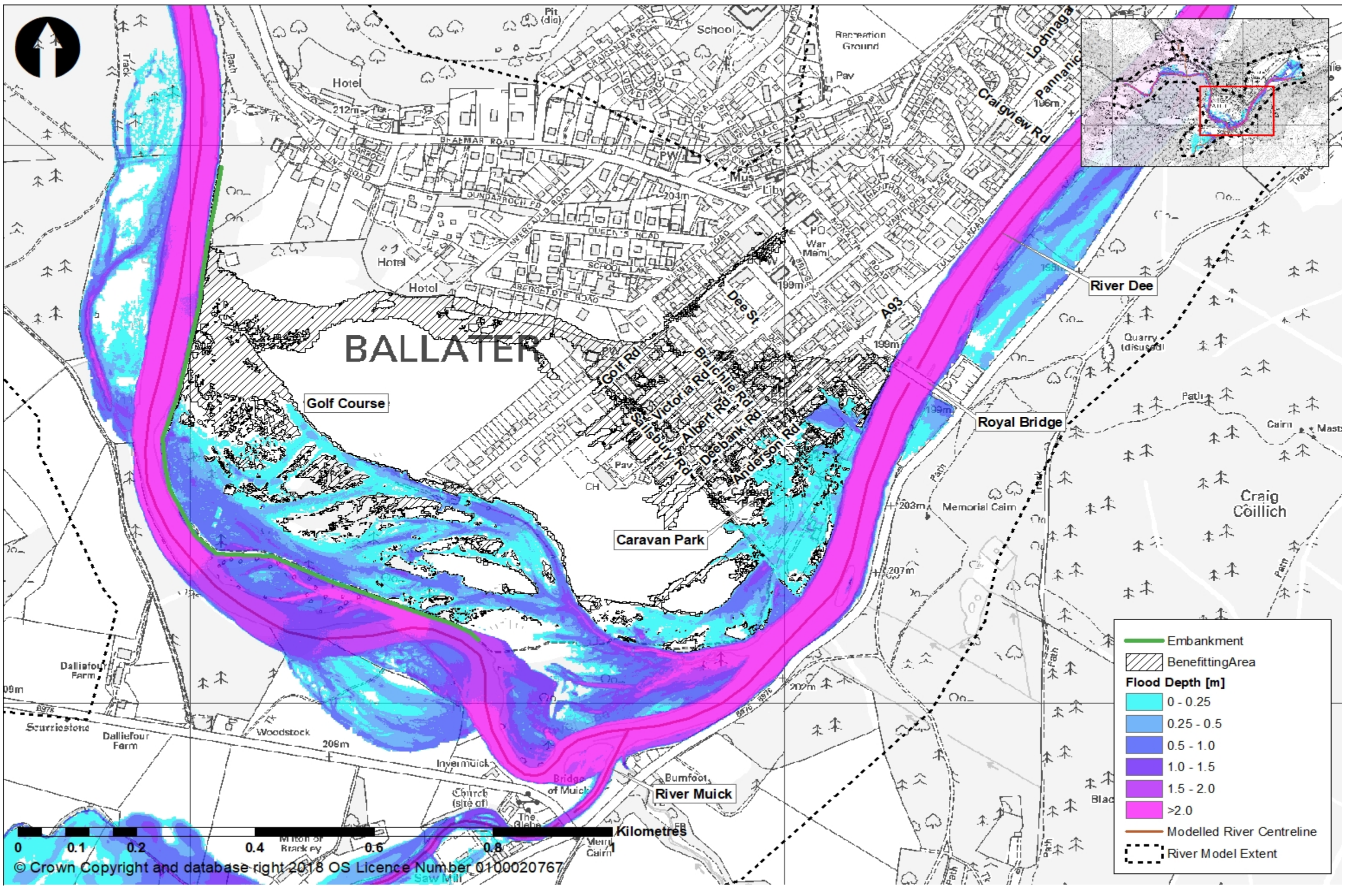
8.3 SEPA 2020 Assessment

Ballater is not at major risk in a smaller 1 in 5 year flooding event

This SEPA map (Figure 9) shows the following

1. the southern parts of Ballater and parts of the lower Muick would flood.
2. Flooding depth would typically be less than 25cms.
3. Golf Rd and northern parts of Ballater would be protected by the bund

Figure 9: Flood Map, showing areas of Ballater and the lower Muick benefitting from the Bund during a one in five year event



Source: Figure 3.19 of RPS Feasibility Report (P.50).

Ballater Remains at Serious Risk in a more significant Flood Event (repeat of 2015)

This SEPA map (Figure 10) shows the following:

1. Large areas of Ballater & its surroundings would flood – similar to 2015.

2. Flooding depths would be medium for many parts of the village – similar to 2015.

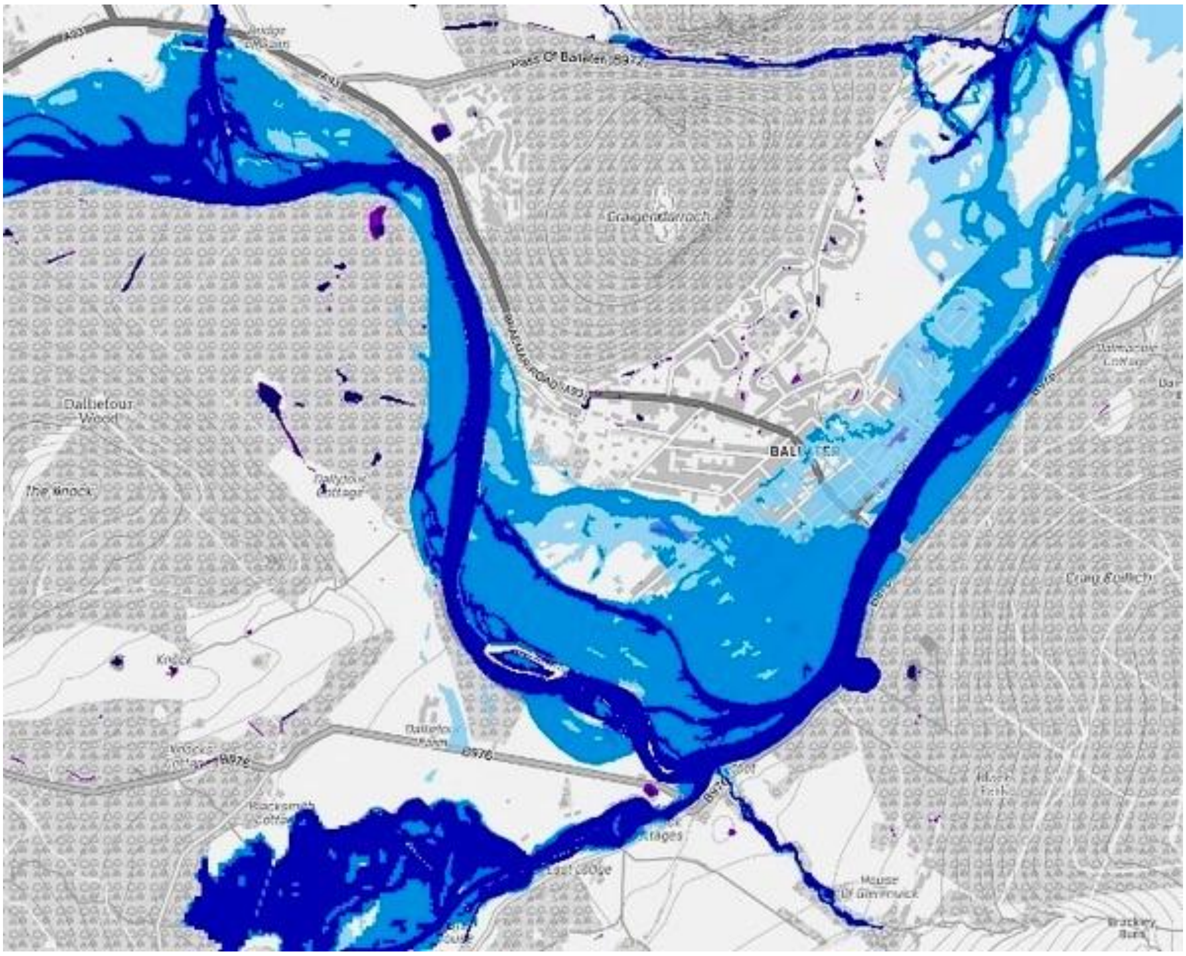
3. As the pattern is similar to 2015, flood water speeds are likely to pose a risk to life – similar to 2015.

This SEPA assessment raises the questions of what can be done to:

(1) prevent the catastrophic & life threatening events of 2015 &

(2) further mitigate the damaging effects of lower level but more frequent flooding in the area.

Figure 10: SEPA Flood Map accessed November 2020, showing areas of Ballater and the lower Muick at high, medium and low risk of flooding



Source: SEPA. Reference should always be made to the SEPA website for the most up to date flood maps.

8.3 Protection Needed

- Village

The primary requirement is to protect life and property – both of which were at risk in 2015. This would require the multiple flood sources to be addressed – or mitigated.

- Caravan Park

The caravan park is a key element in the holiday activity, which is central to the village. Maintaining a thriving caravan park is also central to any flood protection action

- Golf Course

The golf course is a key village social & activity centre & is also vital for the tourist economy. Maintaining an attractive golf course must also be central to a flood protection plan.

Appendix 1: Chronology of Post Flood Events

Date	Activity
Dec 2015	Ballater Flood
Repair & Recovery of Village	
2016-17	Village and its infrastructure repaired
2016	Road damage in the area repaired AC repair section of BGC Bund
Progress Towards Better Flood Protection	
June 2017	AC commissioned RPS to review the flood & make flood protection proposals. AC also commissioned further reports from RPS
Mar 2019	RPS Main Report & recommendations.
Aug 2019	BFG alternative flood protection proposals, as requested by AC
Dec 2019	AC proposed RPS's Option 3A (£31m) for Scottish Government funding
Sep 2020	First BCCC Draft Flood Report
Repair of Flood Defences	
2016	AC repair 2 breaches in BGC Bund
	Army Clearing of Debris from Bridge Arches
2019 & 2020	Repair of the Foundations of Royal Bridge

Appendix 2: History of Flood Protection Work on the Dee at Ballater since 1950

1952 History of the river prepared by Gordon Nicol for John Milne

- Gordon Nicol was asked to research the river erosion at Invermuick by the owner Col Milne, with a view to making recommendations on Flood Protection
- Using the oldest (1866) OS map available & later information, Gordon Nicol confirmed:
  - Dee flowed past the Red Braes in a much easier curve than in 1952.
  - Dee met the Muick about 800ft further downstream than in 1952.
  - At Invermuick, the distance of the river from the road by the Manse and the annual rates of river bank erosion on the south bank at that point were:

Year	Distance	Annual Erosion	Period
1866	230 ft		
1923	180 ft	0.88 feet	57 years
1952	100 ft	2.85 feet	29 years

  - There was clearly a greatly increased rate of bank erosion.
  - At Invermuick, the Dee had established itself near the South bank in a narrow, deep & swift flowing current, increasing erosion & demolishing stones put there by Col Milne.
  - At Invermuick, the old north river bank is 400ft from the present south bank. The river occupies 40 ft of this in normal conditions. The remainder is shingle banks with channels between. These were old river courses at various times since 1866.
  - The present depth of the 40ft wide river bed is much deeper than the old courses to the north, accounting for the much greater erosion.
  - At the southern end of the Red Braes there was also major river encroachment with the distance of the forest "knuckle" and the river being reduced:

Year	Distance	Annual Erosion	Period
1866	520 ft		
1923	340 ft	3.15 feet	57 years
1952	220 ft	4.14 feet	29 years

  - There was clearly an increased rate of bank erosion here but less than Invermuick.
- Gordon Nicol recommended waterflow near the south bank was stilled & reduced. Trees & bolsters (filled with shingle from the old river bed) were to be placed on the south bank to divert part of the river flow north, to re-establish the river in its old channels to the North.
- It is believed dredging commenced to achieve this plan but was stopped by "fishing interests". It is unclear how much was done at Invermuick to implement the scheme.

1993- 97 Balmoral Estates (BE) & BGC reduction of Red Brae Erosion & Course Flooding

- In 1990, BE commissioned British Institute of Hydrology to report on Red Braes erosion. The report recommended granite & rock blocks be placed at the foot of the Red Braes.
- 1n 1993, following 2 early year GC floods, BE & BGC jointly commissioned Prof Fleming (Strathclyde University) to conduct a survey, build a model & make proposals.
- The model and recommendations were completed in Apr 1994.
- His assessment was the river flows directly into the Red Braes causing erosion & is deflected across into the north bank near the 6th tee, flooding in high river levels.
- In 1994 the following was done:

- Excavate the old channel, north of the island, to divert half the river flow to this new channel. This would reduce the river flow on the south bank.
- Groynes built to protect the Red Braes & divert the river flow into the new channel.
- The shingle excavated from the old channel would be used to protects the Red Braes & to extend the BGC Bund. (8000 cuM extracted)

- In 1995, additional work was done:
  - Groynes strengthened and extended.
  - Shingle extracted upstream of Red Braes to prevent "oscillation", which contributed to Red Brae erosion.
  - Shingle used to extend the BGC Bund in the upstream parts of the course.
- In 1996, further work was done to complete the process:
  - Excavate channel & remove shingle from south bank upstream of Red Braes.
  - Place shingle into GC bund at near 6th tee (5 m high), 13th green (1m high) & around the wooded area facing the southern part of the Red Braes.
  - Rock armour with 2 tonne base stones, 2 layers of stone and small boulders and rubble behind was to face the Bund.
  - Repairs to rock facing on the Red Braes, which was showing signs of wear & tear
- In 1997, a final phase of work was done to complete the BGC Bund.
- Cost of 1997 work was borne by BGC – with the costs of all previous work split between BE & BGC. BGC received a donation from the Foundation for Sport and the Arts to assist with this.
- Throughout this work Prof Fleming was clear in stating:
  - Future weather conditions are changing & could result in much greater flood events.
  - River is a living thing, constantly changing – and often unpredictably so.

The following information sources were reviewed in the preparation of this report and where information has been drawn from a source this is indicated in the report.

No	Title	Author	Date	Pages
1	Ballater Feasibility Report (DO3)	RPS	3/2019	177
2	Ballater FPS RP02 Hydraulic (PO1)	RPS	10/2018	59
3	Ballater FPS RP01 Hydrology Chapter (PO1)	RPS	12/2018	61
4	Red Braes Impact on Dec2015 Final	RPS	8/2019	18
5	Ballater Feasibility Report App A Damage Assessment Methodology	RPS	12/2018	17
6	Ballater Feasibility Report App B Classification of Property / Flood Depth	RPS	12/2018	13
7	Ballater Feasibility Report App C Long List of Actions	RPS	12/2018	3
8	Ballater Feasibility Report App D Tabled Model Option Outputs	RPS	12/2018	20
9	Ballater Feasibility Report App E Option Drawings	RPS	12/2018	7
10	Ballater Feasibility Report App F Damage & Defence Cost Assumptions	RPS	12/2018	9
11	Ballater Feasibility Report App G Action Screening Methodology	RPS	12/2018	2
12	BFG Final Report	BFG	??	4
13	Ballater Golf Club Flood Defence Information	BGC	1993-97	200