Objection Letter -Dr Munro

I am a statutory consultee, as my property at 13 Cameron is adjacent to the River Carron and around the lowest point in Cameron Street. I was flooded in the 2009 flood, whilst in 2012 my own flood defences succeeded in protecting my property (though my garden, shed and contents suffered damage). I have also been a member of the Stonehaven Flood Action Group since its inception an am currently Deputy Chair of the group.

Whilst I welcome the work done by Aberdeenshire Council in bringing the flood protection scheme to this stage, there are certain aspects which I am concerned about and which I believe must be addressed if Stonehaven is to achieve effective and proportionate flood protection.

Therefore, as an individual, I wish to raise an objection to the proposal which primarily centres on the proposed wall heights between White Bridge and Bridgefield Bridge and the possibility that these could be lower is certain options which have been suggested to the Council concerning the lower stretch of the River Carron were considered and acted upon.

1. *Removal of material and old abutments from beneath Bridgefield Bridge*

The Council has recently indicated verbally that approx. 0.3m of material will probably be removed. However the Mott MacDonald report (Appendix F) pre-dates this decision and although it indicates that re-profiling of the river bed would take place, this is specifically between the bridges and no mention is made or evidence presented in the report to indicate that the effect of removing material from beneath the bridge was modelled.

2. *Modification of rock armour at river mouth*

Mott MacDonald modelled a scenario (Appendix F, Figure 2.7) based on widening the channel by 2 metres which shows a marked reduction in water levels between White Bridge and the Beach Bridge of around 0.3 – 0.5 meters. Despite this the proposals do not consider any widening or modification of the rock armour which could lower the wall heights upstream. Requests that wider / more natural river mouth configurations originally proposed by HR Wallingford in their original design for the rock armour (which the current "S-bend" design doesn't follow). Lowering of the rock armour was modelled (Figure 2.6) but little can be deduced from this since no details were provided as to how long a section was lowered or by how much.

Some modelling was carried out on the S-bend section, to examine the effect of lowering the sewer pipe at the river mouth. This showed only a slight effect, however, it is my understanding that this model did not take into account the fact that the river gradient would change as a result, steepening and increasing flow rates.

3. *Narrowing of the river channel*

The proposals now include a new wall on the south side of the river from White Bridge to Bridgefield Bridge rather than using & reinforcing existing structures where possible. These walls as now proposed are substantially higher – by approx.. 60cm – than those displayed at the public exhibition and would have a severe impact on the visual amenity of this part of Stonehaven. The walls also cause a narrowing of the river at the "pinch point" at Bridgefield Bridge.

Below Bridgefield Bridge the proposals also narrow the channel and there is a further narrowing by the Beach Bridge abutments. This is despite the Mott MacDonald report (Figure 2.4) stating that *narrowing the channel at this point "has the effect of increasing water levels upstream of Bridgefield Bridge". If narrowing the channel raises water levels then surely widening it – including the rock armour – would lower them?*

Response

1. Scope of Evidence

1.1. This is the scope of evidence regarding the objection to Stonehaven Flood Protection Scheme from Mr Munro.

1.2. This evidence will explain the hydrological studies undertaken for the scheme, identifying the magnitudes of the design flows used in the scheme.

1.3. The design flows have been used to derive the heights of the flood walls and this evidence will describe how this has been undertaken and how modifications to the river corridor have been considered to minimise wall heights, such as the lowering under Bridgefield Bridge, including the old supports, as well as the use of self-raising barriers.

1.4. This evidence will explain the impact of waves and why the configuration of the entrance is important to minimise the wave impact and how the configuration of the rock armour has been considered in the design.

2. Hydrological Studies and Design Flows

2.1. The scheme is for alleviating fluvial flooding for Carron Water and Burn of Glaslaw in Stonehaven.

2.2. Scottish Government provides guidance on how to appraise Flood Protection Schemes and allows economically beneficial schemes to be constructed. The 1 in 200 year level of protection has been the desired target as it aligns with current guidance on development within Scottish Planning Policy and would allow for future development within areas protected to the 200 year standard form all flooding.

2.3. The scheme is influenced by Scottish Planning Policy (SPP) (Appendix O: Scottish Planning Policy) which sets out the risk framework for flooding and flood risk to development.

2.4. SPP states “All land is to some degree susceptible to flooding. The likelihood of a site being flooded is measured in terms of probabilities per annum, which range from very low (close to 0% probability) to very high (up to 100% probability).” SPP identifies that land with an annual probability of flooding less than 0.5% is suitable for development, i.e. a low to medium risk area. The proposed flood defences for Carron Water are designed for the 0.5% Annual Probability flood event in line with SPP. The design event is the 0.5 %AP flood (200 year flood) from the River Carron and the Glaslaw Burn. That is an event that could be expected to be met or exceeded 0.5 % of any years.

2.5. The design flood magnitude has a 0.5% chance of being met or exceeded in any year.

2.6. SEPA recommend an allowance for future climate change to be included in a flood protection scheme design. In line with the Government UK Climate predictions (UKCP09) for the Stonehaven area, the design flow includes a 33% increase in flows as described in Appendix B: Option Development and Economic Appraisal.

2.7. The assessment of river flows originating upstream on Carron Water was made using procedures given in the Flood Estimation Handbook (FEH). This handbook is acknowledged as the current best practice guide for hydrological studies in the UK. The assessment is described in Appendix F: Hydrology and Hydraulic Report.

2.8. The Flood Estimation Handbook (FEH) Statistical Method was used for Carron Water with the observed data from the local SEPA river gauging station on the Carron Water upstream of the Red Bridge and Green Bridge. The FEH rainfall runoff method was used for the Burn of Glaslaw, the size of the catchment and lack of a river gauge on the Burn. These methods are used as standard practice and the methodology was agreed with SEPA.

2.9. The design flooding event, combining flow from Carron Water and Burn of Glaslaw, has a flow magnitude of $78m^3/s$ downstream of the confluence. In comparison to the design flood event, flow magnitudes of $31m^3/s$ and $42m^3/s$ were determined for the 2012 and 2009 events, respectively. Flow in River Carron was estimated to be 24 m3/s and 37m3/s for 2012 and 2009 events respectively (based on flows at Carron gauge). Flow in Glaslaw Burn was estimated to in excess of 5.7 m3/s for 2012 event based on anecdotal evidence.

3. Hydraulic Modelling and Wall Heights

3.1. Flood water levels on the Carron Water have been assessed using a computer model. The model was built using TUFLOW hydraulic modelling software, an industry standard program. The model represents the river channel, the adjacent floodplain, and structures, such as bridges and the downstream rock armour. The model was calibrated against the 2012 flood event.

3.2. Overall, the TUFLOW model gives a reasonable representation of flood levels for the range of flood flows used in the design.

3.3. The TUFLOW model allows a range of options to be assessed and compared with the design water levels determined by selecting those works most beneficial in comparison to the physical constraints on site.

3.4. Flood walls are required on both sides of the river between White Bridge and Bridgefield Bridge. Wall heights on the northern side of the river have been mitigated through the use of self-raising barriers allowing those within their gardens to look over the wall into the river.

3.5. On the south side of the river the existing walls are higher than the northern side as shown in Figure 1. The lowest walls are not high enough to provide the necessary flood protection and need to be replaced with higher walls. The strength of the higher part of all the walls is also unknown and is a mismatch of materials, repairs and construction. The new wall will be designed to act as a flood wall and form a consistent finish.

Figure 1

3.6. Along 75m of the 125m length between White Bridge and Bridgefield Bridge the existing wall is high and above head height. The new wall will be a similar height to the existing high walls or will be next to existing buildings. Of the remaining 50m, 25m is proposed to be a self-raising barrier in order to maintain the views of the Category A St James the Great Church, an important historic landmark. The remaining 25m is required to be higher than the existing wall, but will be similar in height to the other walls in the area.

3.7. The level of the top of the wall is as it was reported for the FPO application and public exhibition of the flood protection scheme in 2015. The new wall will form a consistent style for the whole 125m length.

3.8. Bridgefield Bridge is a pinch point in the channel due to its deck level and by the masking of its opening area by gardens upstream as shown in Figure 2.

Figure 2

3.9. The TUFLOW model has been modified to investigate options to remove constraints in order to reduce wall heights. In the section between White Bridge and Bridgefield Bridge the capacity of the channel has been increased by lowering the channel, lowering under

Bridgefield Bridge (by 0.2m, as shown on the application drawings) and by proposing a new culvert (2.5m x 1.5m) under the gardens on the northern bank.

3.10. The modelled options are detailed in Appendix F: Hydrology and Hydraulic Report with Figure 2.3 showing the model with the removal of material under Bridgefield Bridge. 0.2m is the maximum that can be lowered under Bridgefield Bridge to give any long term benefit: a deeper excavation would be lower than the existing bed level downstream and would therefore be likely to fill in again in the future.

3.11. At Bridgefield Bridge the channel widens (to 8.5m) so that the opening area of Bridgefield Bridge is wider than the 6m channel upstream. The new culvert increases the capacity by discharging into the bridge zone which was previously masked by the gardens upstream.

3.12. On the southern upstream side the existing abutment protrudes into the river as shown in Figure 3. The new wall is designed to tie into this protrusion so as not to reduce the opening area of the bridge on the southern side.

Figure 3

3.13. Between Bridgefield Bridge and Beach Bridge the width of the channel is proposed to be reduced. This is proposed to facilitate the construction of the scheme which is constrained between existing walls and buildings. The effect of this change is to increase water levels between White Bridge and Bridgefield Bridge, which were mitigated by the raising of Beach Bridge (Appendix F: Hydrology and Hydraulic Report).

4. Hydraulic Modelling, Rock Armour and Waves

4.1. Widening the rock armour at the outlet was one of many options considered and additional evidence was presented during the period of objection to the scheme (Appendix H: Hydrology and Hydraulic Modelling Addendum A). The report identified that widening the rock armour had a similar effect on flood water levels, in the Arbuthnott Street section, as raising Beach Bridge. The TUFLOW model showed that whilst Beach Bridge could be retained if the channel was widened by 5m or more downstream of Beach Bridge, Aberdeenshire Council chose to raise Beach Bridge instead of widening.

4.2. The predicted 0.5% Annual Probability tidal level is 3.92AoD including an allowance for climate change (Appendix G: River Carron Rock Armour Study). The wall heights on the Carron water must be higher than this, plus an allowance for freeboard.

4.3. Whilst widening the rock armour does lower the water level between Bridgefield Bridge and Beach Bridge, the wall level is retained due to risk of tidal influence.

4.4. The widening options included for the lowering of the SW pipe below the new channel. Figure 2.5 (Appendix H: Hydrology and Hydraulic Modelling Addendum A) shows the bed level considered when straightening the channel and shows that the bed has been lowered at the pipe crossing.

4.5. The topographic survey shows that the crest level of the rock armour is at approximately 3.83mAOD. The peak flood level under Beach Bridge is predicted to be 4.3mAOD with a design level of 4.6mAOD (the level including freeboard). Therefore, during an extreme flood event the water level is much higher than the rock armour and limiting water level increases due to flow.

4.6. The existing rock armour alignment protects against direct waves propagating in the channel by reducing the wave energy. The effect of an open channel can be observed to the north of Carron Water at the mouth of the River Cowie, where larger waves can be observed in the mouth of the channel because there is no rock armour.

4.7. Straightening the channel would expose properties to greater wave heights as the wave energy would not be dissipated by the rock armour. To allow for this the wall heights would need to be higher if the rock armour was removed.