Stonehaven Flood Protection Scheme

Hydrology and Hydraulic Modelling
Addendum A to Revision A

December 2015

Aberdeenshire Council

Mott MacDonald

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Contents

1. Introduction

1.1 Purpose of this report

This is an addendum to the Hydrology and Hydraulic Modelling report issued in June 2015 (Report reference 345087_015_ A), and should be read in conjunction with this report.

This addendum presents the additional modelling undertaken as a result of discussions that arose following publication of the scheme. It considers the hydraulic effect of widening of rock armour channel at outlet and straightening up the river outlet downstream of Beach Bridge.

2. Additional Hydraulic Modelling

2.1 Alteration of rock armour at the Carron Water channel outlet

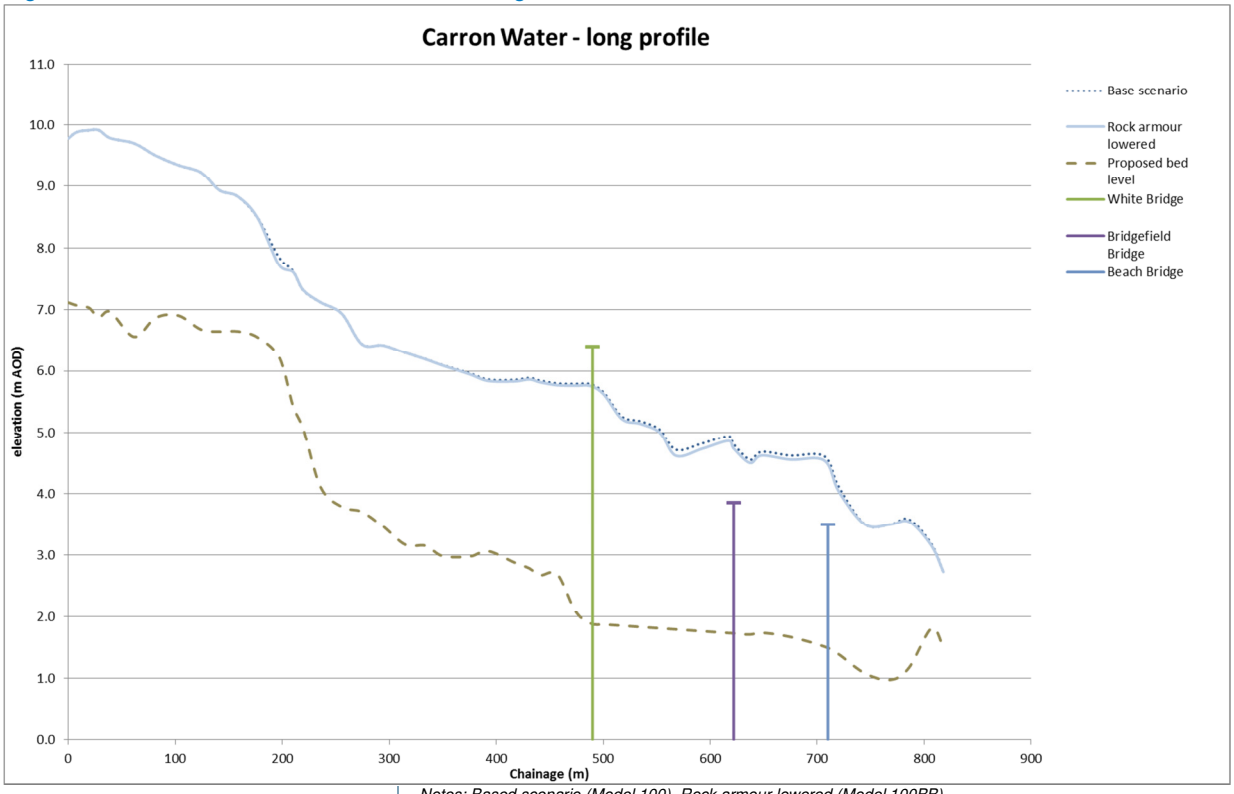
The alteration of the outlet channel at the Carron Water was investigated, firstly by lowering a section of rock armour and secondly by widening the rock armour channel by 2m, 5m and 10m.

It is highlighted that there are otter holts located within the rock armour channel which would make channel modifications more difficult.

Rock armour lowering

An opening in the rock armour was introduced, as displayed in Figure A.1 in Appendix A. The opening had a width of 12m (as the main channel) and a sill level of 3.5mAOD. The results (Figure 2.1) show that lowering the rock armour had little effect on flood water levels.

Figure 2.1: Effect on water levels from lowering rock armour



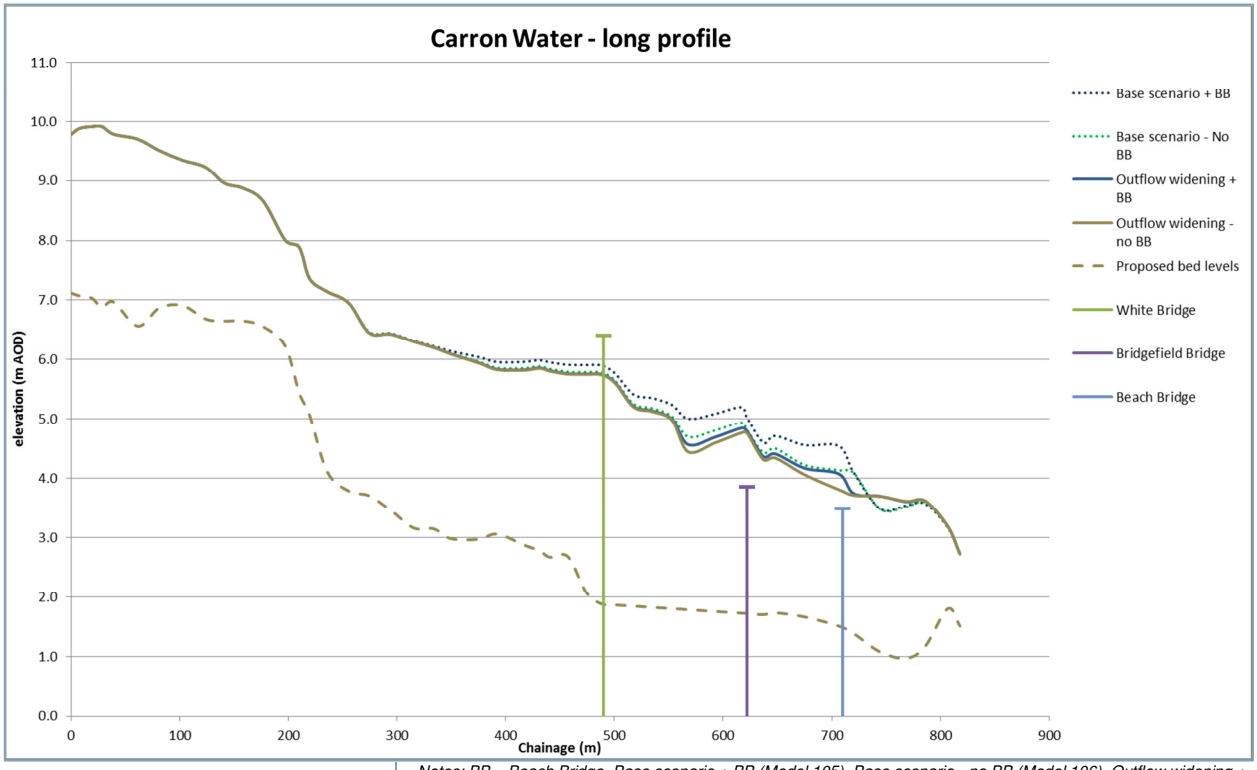
Notes: Based scenario (Model 100), Rock armour lowered (Model 100BB)

Widening by 2m

The channel downstream of Beach Bridge was widened by 2m, and assessed with both Beach Bridge raised and at its existing level as shown in Figure 2.2. The hydraulic modelling indicates that:

1. Widening the channel by 2m while keeping Beach Bridge ("Outflow widening + BB") has a similar effect to raising Beach Bridge without widening ("Base scenario - No BB").
2. If the channel is widened by 2m, the raising of Beach Bridge has little effect on flood water levels.
3. The 2m widening does not reduce flood water levels below the soffit level of the existing Bridgefield Bridge or Beach Bridge, so these bridges remain at risk.

Figure 2.2: Effect on water levels from 2m widening downstream of Beach Bridge

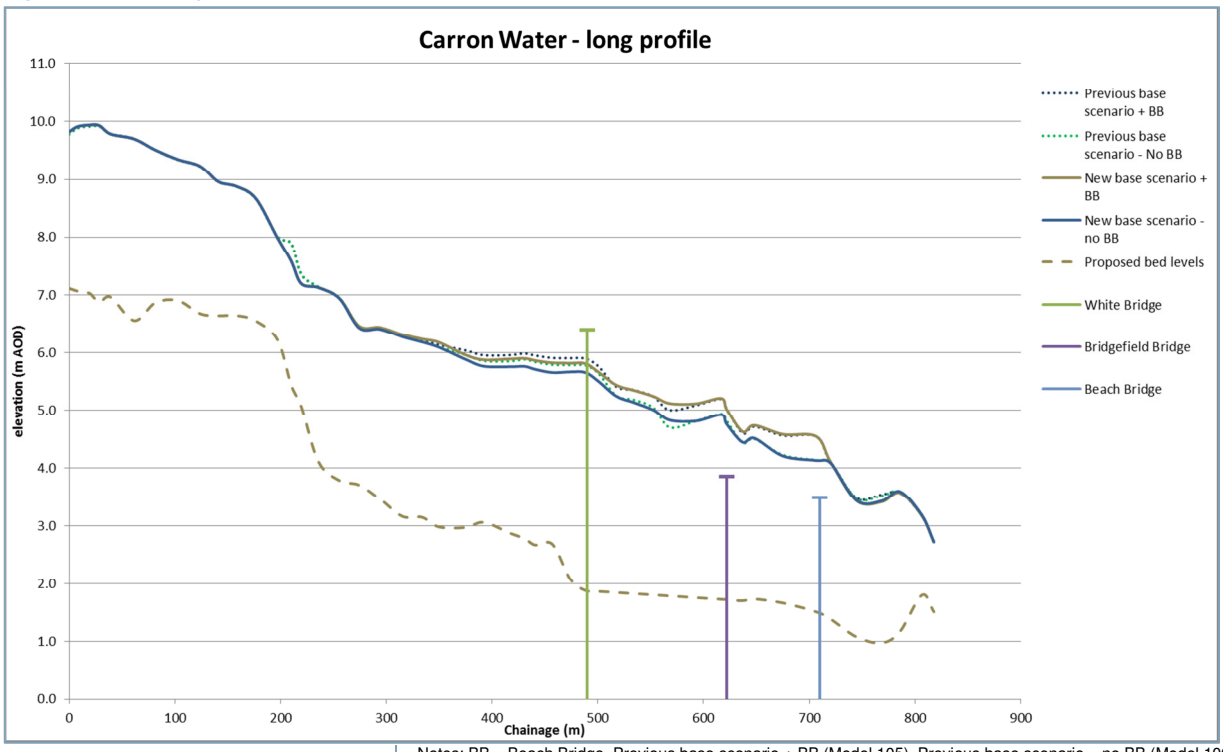


Notes: BB = Beach Bridge, Base scenario + BB (Model 105), Base scenario - no BB (Model 106), Outflow widening + BB (Model 107), Outflow widening - no BB (Model 108)

Update of base scenario

The base scenarios ("Previous base scenario") have been updated with minor adjustments to the hydraulic model to reflect the design development of the scheme, including a slight (<1m) widening of the channel between Bridgefield Bridge and Beach Bridge, and the refinement of the widening works around the existing Green Bridge. The updated base scenario models ("New base scenario") have been used to compare the remaining options assessed downstream of Beach Bridge. A comparison of the changed levels between the base models can be seen in Figure 2.3.

Figure 2.3: Comparison of base scenarios



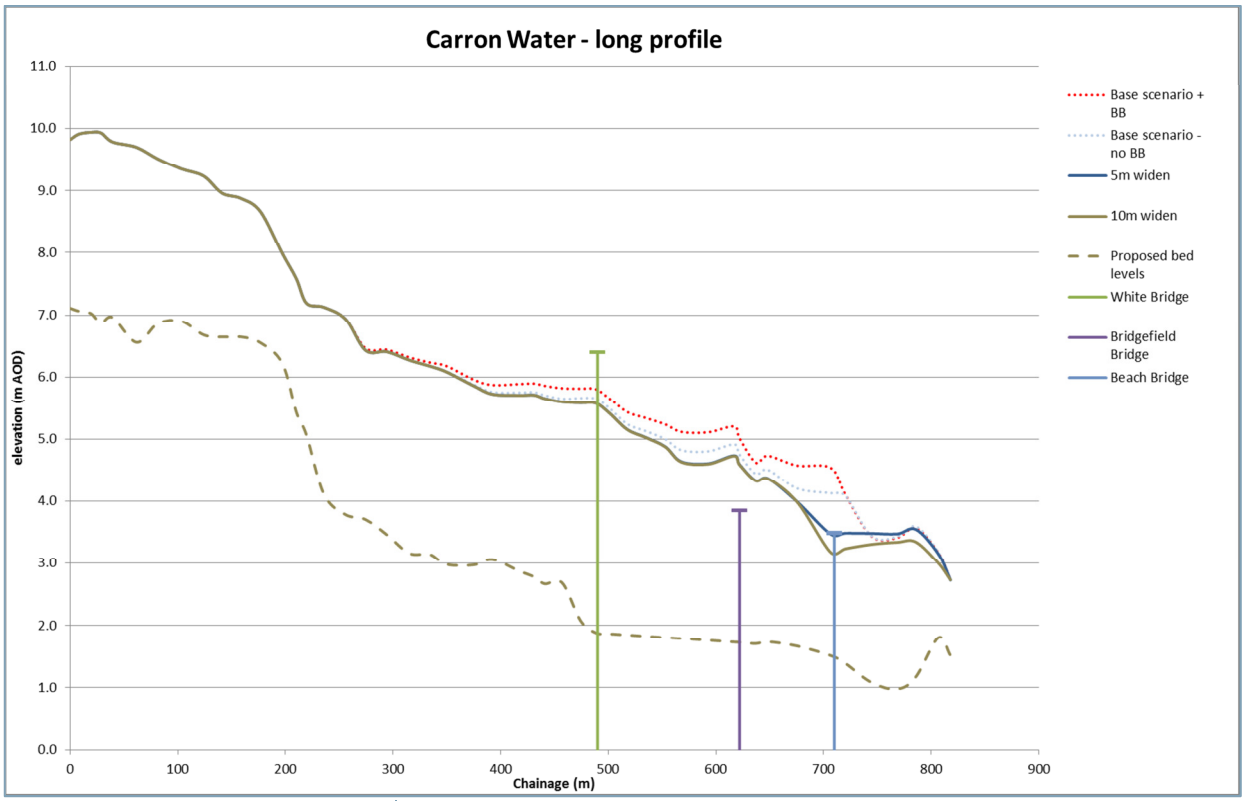
Notes: BB = Beach Bridge, Previous base scenario + BB (Model 105), Previous base scenario – no BB (Model 106), New base scenario + BB (Model 112), New base scenario – no BB (Model 114)

Widening by 5m and 10m

The channel downstream of Beach Bridge was widened by 5m and 10m, and assessed with both Beach Bridge raised and at its existing level as shown in Figure 2.4. The layout of the modelled scenarios are shown in Figure A.3 in Appendix A. The hydraulic modelling indicates that:

1. Widening the channel downstream of Beach Bridge by 5m reduced the flood water levels around the location of the Beach Bridge by up to 0.85m.
2. Modelling of a channel widened to 10m showed no significant further impact on flood water levels when compared to the 5m widening.
3. When compared to the flood water level of the proposed flood protection scheme with Beach Bridge raised ("Base scenario + no BB"), the reduction is limited to near Beach Bridge (0.85m) and Bridgefield Bridge (0.15m), however, when Beach Bridge is not raised ("Base scenario + BB") the reduction is higher and also continues to further upstream of White Bridge.
4. For both the 5m and 10m widening, flood water levels are predicted to be below the soffit level of Beach Bridge, which means that potentially Beach Bridge could be retained in its existing position. However, the difference between the predicted flood water level and the soffit of the bridge would be less than the recommended freeboard value (0.6m).

Figure 2.4: Summary of Beach Bridge removal and outlet widening



Notes: BB=Beach Bridge, Base scenario + BB (Model 112), Base scenario – no BB (Model 114), 5m widening (Model 122), 10m widening (Model 123)

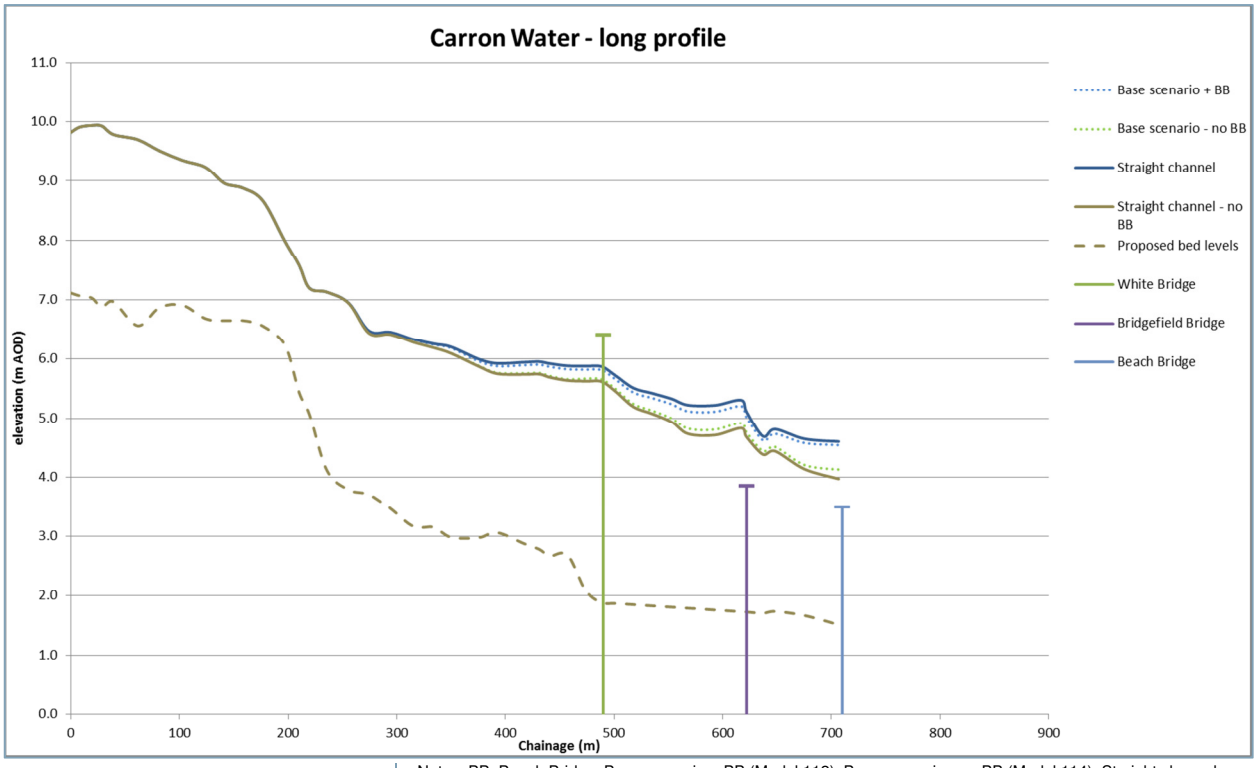
2.2 Straightening up the river outlet

The effect of straightening the outlet to Carron Water downstream of Beach Bridge to the sea has been investigated. Figure A.2 in Appendix A shows the layout of the examined arrangement of the outlet.

The width of the channel was retained in line with the bottom section, i.e. 12m width. The bed level of the straightened channel has set at a peak level of approximately 1.6m AOD, similar to the average level of the bed upstream. The hydraulic modelling results shown in Figure 2.5 indicate that straightening the channel had little effect on flood water levels in the upstream channel.

It is noted that there is a Scottish Water pipe running along the coastline in this location with an elevation of approximately 1.8mAOD. The potential effect of the pipe on the flood water levels was assessed in the hydraulic model, which indicated that there will be no significant effect on flood water levels from lowering the pipe.

Figure 2.5: Effect on water levels from straightening the outlet channel



Notes: BB=Beach Bridge, Base scenario + BB (Model 112), Base scenario - no BB (Model 114), Straight channel (Model 120), Straight channel – no BB (Model 121)

Conclusion

The additional hydraulic investigations show that:

1. Straightening the channel downstream of Beach Bridge had no significant impact on flood water levels.
2. Lowering the Scottish Water pipe had no significant effect on predicted flood water levels.
3. 10m of widening downstream of Beach Bridge had no additional significant effects on flood water levels than 5m widening.
4. The effect of widening downstream of Beach Bridge on flood water levels is similar to the effect of raising Beach Bridge on its own. When comparing to when Beach Bridge is raised the difference from widening by 5m is limited to immediately upstream of Beach Bridge (0.85m) and immediately upstream of Bridgefield Bridge (0.15m).

Aberdeenshire Council have chosen to raise Beach Bridge in order to protect the pipe crossing. This addendum shows that widening of the rock armour downstream of Beach Bridge, in addition to raising Beach Beach, only shows localised improvements to flood water levels and so is not considered to provide a significant enough improvement to justify the additional widening works.

As a result of the increase in soffit level of Beach Bridge, the designed water levels between Beach Bridge and White Bridge are between 500mm and 100mm lower (respectively) than indicated on the Flood Protection Order drawings. However, on the left bank looking downstream, the walls have to accommodate the self-raising barrier within them, which has a minimum height of 1.2m. So whilst the raised height of the barrier can be lower, the base height cannot be reduced lower than the proposed 1.2m high.

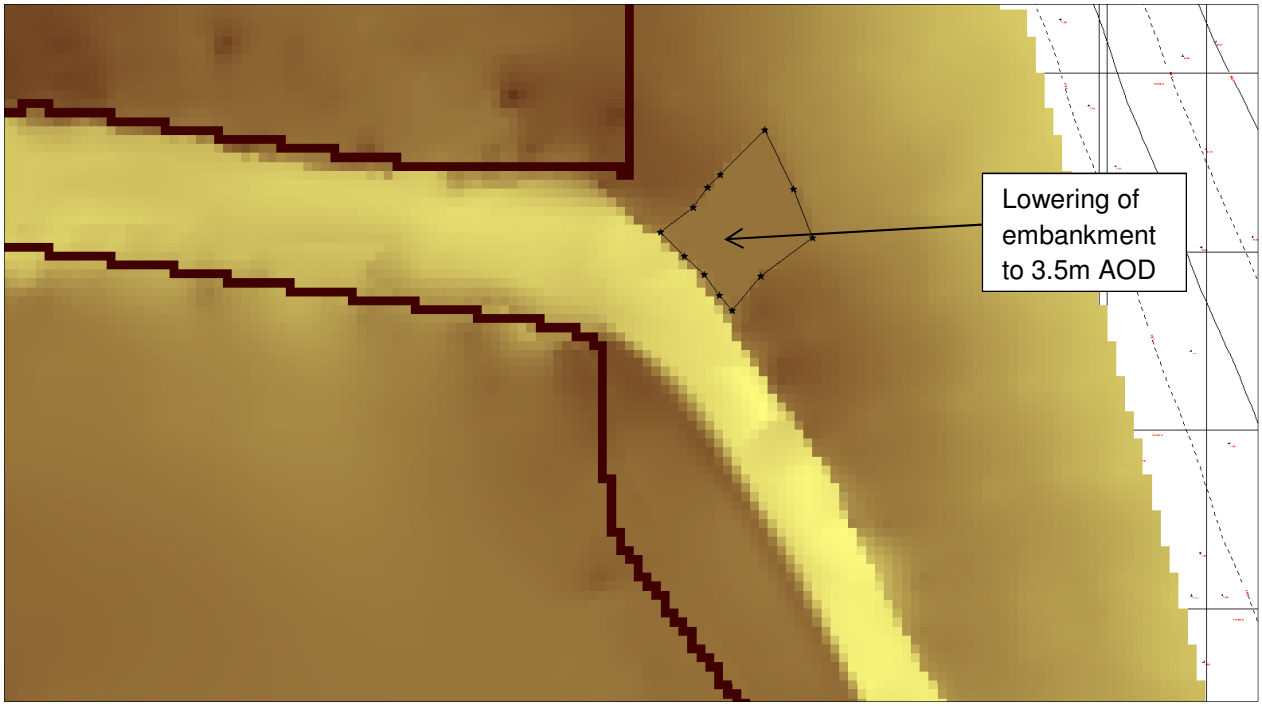
A minimum height for a parapet wall is 1.2m. It is noted that in some places downstream of Bridgefield Bridge the wall height is dictated by this minimum height rather than the flood water level. Therefore there is limited scope in some areas to reduce wall levels to reflect the change in flood water levels resulting from raising Beach Bridge.

Aberdeenshire Council have chosen to maintain the design level assuming Beach Bridge is in place which also allows for a contingency with regards to waves in the channel.

Appendices

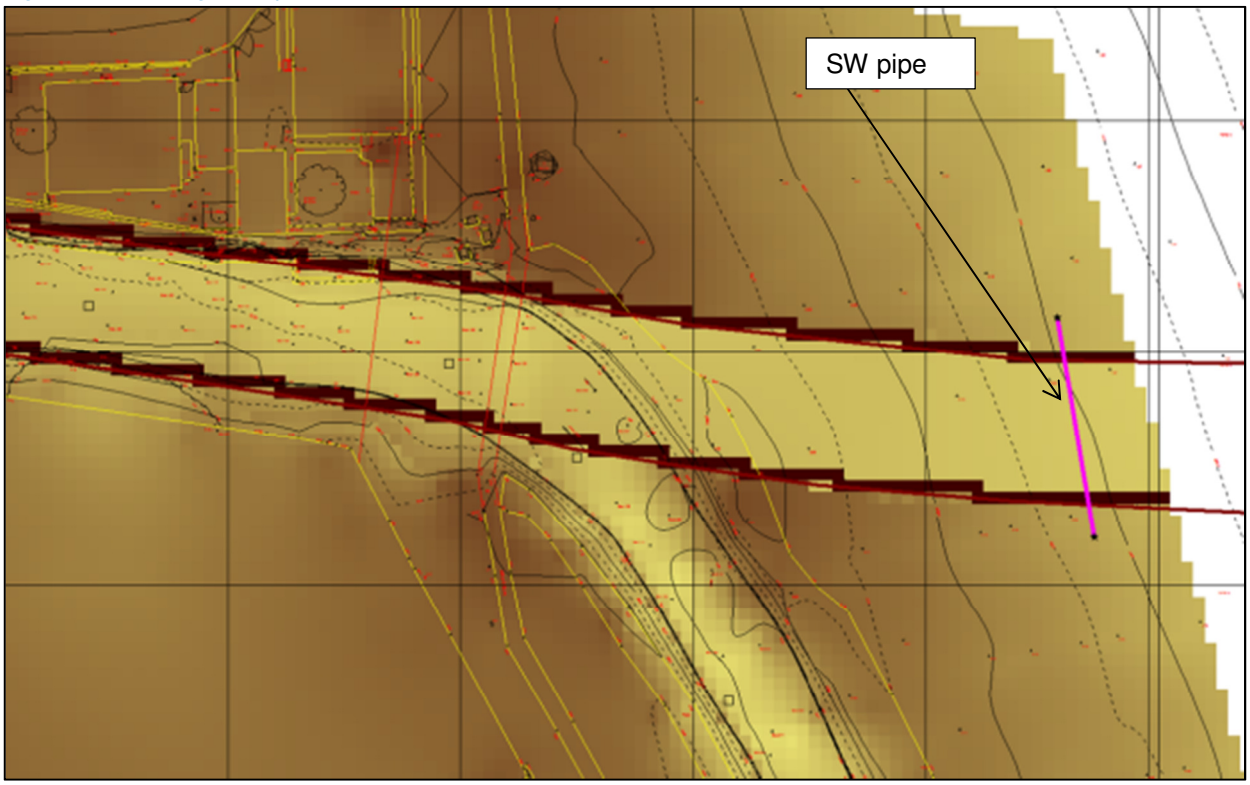
Appendix A. Optioneering

Figure A.1: Lowering the rock armour (Model 100_BB)



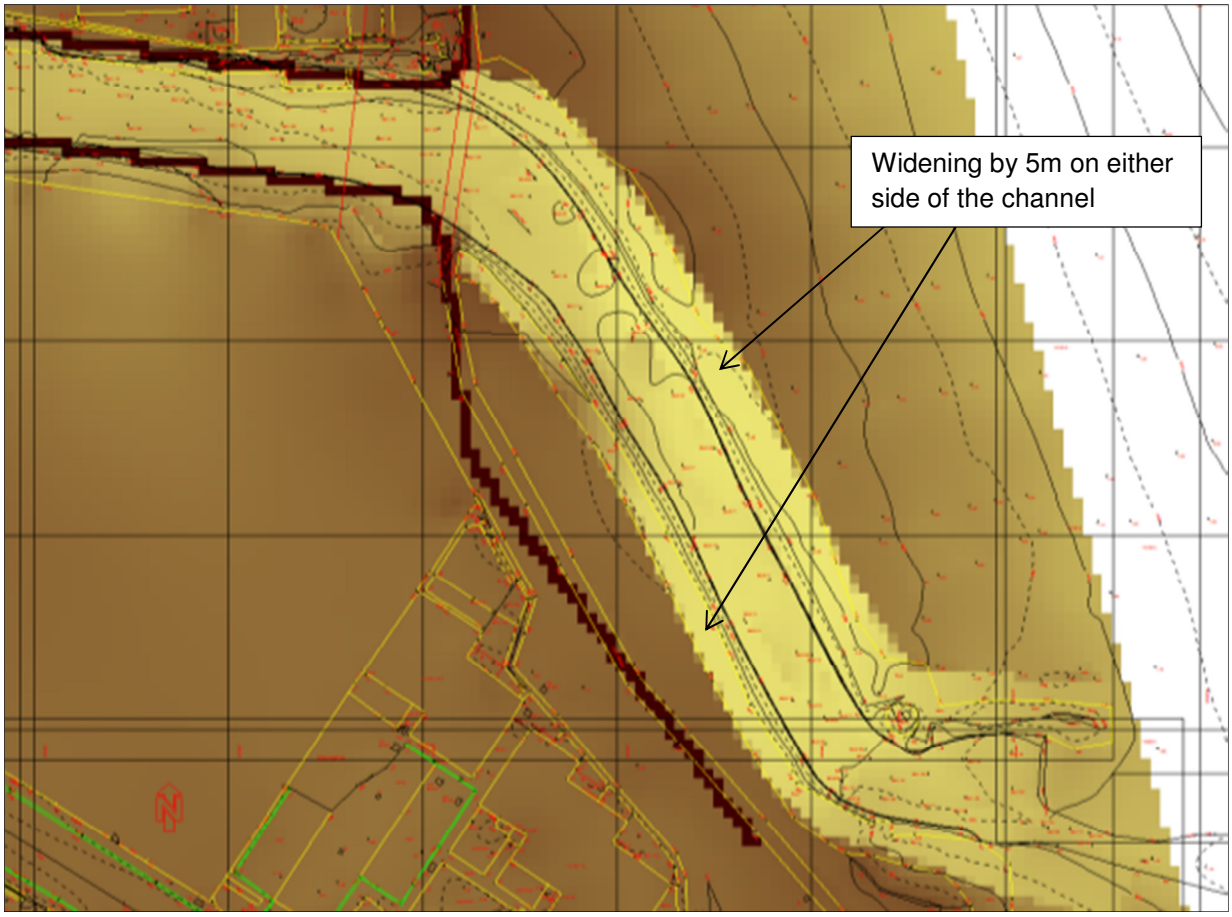
Source: The topographical survey from Aberdeenshire Council

Figure A.2: Straighten up of the outlet of Carron Water



Source: The topographical survey from Aberdeenshire Council

Figure A.3: Widening up of the outlet of Carron Water



Source: The topographical survey from Aberdeenshire Council