

## **EAST AYRSHIRE COUNCIL**

### **CABINET – 23 JUNE 2010 NEWMILNS FLOOD STUDY**

#### **Report by the Depute Chief Executive/Executive Director of Neighbourhood Services**

## **1. PURPOSE OF REPORT**

1.1 The purpose of the report is to: -

- (a) Advise Cabinet on the findings of the Newmilns Flood Study.
- (b) To recommend that the preferred Option for flood mitigation is the current more frequent inspection and cleaning regime of the existing trash screens and watercourses.

## **2. BACKGROUND**

2.1 The town of Newmilns has suffered from flooding from the Caffle and Back Burns twice in recent years on 18 July 2007 and 14 August 2008 with several properties affected on both occasions. The Caffle and Back Burns run from the north through the town before outfalling into the River Irvine. Both burns are heavily culverted through the town and the capacity of these culverts has been shown to have a significant impact on the flooding that occurred. Large amount of debris resulted in the blocking of trash screens and spilling of water from the channel onto the road network. Refer Appendix 1 for location of Burns and trash screens.

2.2 SEPA reported approximately 30mm of rainfall in 90 minutes over the catchments during the 2007 event which related to a flow return period of approximately 1 in 25 years. 38mm of rainfall in 60 minutes was reported during the 2008 event which related to a flow return period of approximately 1 in 150 years.

2.3 East Ayrshire Council commissioned Halcrow Group Limited (Halcrow) in March 2009 to carry out a flood study of the Caffle and Back Burns in Newmilns. The scope of the study is outlined below:

- Geomorphological assessment of the catchments;
- Hydrological assessment of the Caffle and Back Burn catchments to determine flood flows for the two burns;
- Construction of a hydraulic model of each of the burns using topographical survey data;
- Construction of a hydraulic model of the road network, downstream of the open reaches of the burns to model overland flow;
- Identification of flood mitigation measures;

- Benefit-cost assessment including the calculation of flood damages, costing of flood mitigation options and appraisal of cost benefit-ratios for all feasible options.
- 2.4** In June 2009, the 'UK Climate Impacts Programme' (UKCIP) via 'Department for Environment, Food and Rural Affairs' (Defra) launched its latest set of scenarios that allow users to assess climate change projections probabilistically. Based on the UKCIP09 results for a medium emissions scenario, for the time frame to 2080 the central estimate is an increase in winter precipitation in the Kilmarnock area of 10-20%. This has been translated into a 20% increase in peak flow in order to represent climate change within the hydraulic modelling exercise. This utilises the precautionary principle advocated in Scottish Planning Policy 7, 'Planning and Flooding'. The completed Halcrow report was issued in March 2010.

### **Mitigation Measures Established Post July 2007 Flood Event**

- 2.5** Records show that 23 properties, residential and commercial, were affected by flood waters during the July 2007 flood event.
- 2.6** The inspection and cleaning regime for the trash screens at High Street (Lock-ups), Kilnholm Street (rear of lock-ups), Hillside Place (between Nos. 10 and 12) and Stonygate Road increased to a weekly basis to help reduce the possibility of build up of material (thus preventing free flow into culverts). In times of heavy rain forecasts, additional inspections and cleaning are undertaken prior to the onset.
- 2.7** A length of the masonry wall at Loudoun Street Car Park was removed and replaced with a grill to facilitate easier entry of flood waters to the River Irvine at this point thus reducing flood waters flowing down Loudoun Road.
- 2.8** The masonry walls at entrance to the culvert with respect to the Caffle Burn (Kilnholm Street) were re-built, to a slightly higher level to try and contain as much of the Burn flows within the channel.

### **Mitigation Measures Established Post August 2008 Flood Event**

- 2.9** Records show that 1 residential property was affected by flood waters during the August 2008 flood event and that the flood waters flowing down Loudoun Road were substantially reduced.
- 2.10** On the A71, Main Street, the footway and retaining wall adjacent to the old filling station were lowered to facilitate easier entry of flood waters to the River Irvine at this point thus reducing flood waters flowing down Main Street to Loudoun Road.
- 2.11** Monthly inspections of the Caffle and Back Burns have been instigated to identify any build up of material that may cause problems at the existing trash screens, with appropriate action deemed necessary undertaken.

- 2.12** The measures put in place post August 2008 flood event have not yet been tested to ascertain their effectiveness.

### **3. HYDRAULIC MODEL DEVELOPMENT**

- 3.1** 'Hydraulic models' were constructed to model flooding from the Back and Caffle Burns. The hydraulic models were run for a range of return period events. The models were run for the 1 in 5, 20, 50, 100 and 200 year return flow period events. The impact of climate change was also considered, as recommended in recent guidance, with an increase in flow of 20%. Due to the significance of culvert blockage on downstream flooding a range of blockage scenarios were also considered: no blockage, 50%, 80% and 100% blockage.

### **4. FINDINGS**

- 4.1** The results indicate that the culverts considered are under capacity for the 200 year return period event, even when no culvert blockage is considered.
- 4.2** Considering the zero blockage scenario on the Caffle Burn, the culvert at Hillside Place is capable of transmitting the flows up to the 50 year return period event with only a very small amount of water predicted to spill during the 50 and 100 year return period events. During the 200 year return period event flows are expected to spill onto Hillside Place and onto Kilnholm Street upstream of the second culvert.

Considering a 50% blockage scenario, flow is predicted to spill first from the Kilnholm Street culvert from the 20 year event. During the 200 year event approximately half of the flow is predicted to spill from upstream of the Hillside Place culvert with a further quarter spilling on the roads from upstream of the Kilnholm Street culvert. When blockage is increased to 80% approximately one quarter of the 200 year flow is predicted to spill at the Hillside Place culvert with a further two quarters predicted to spill at the Kilnholm Street culvert. Spilling is predicted to begin at the Kilnholm Street culvert from the 5 year event.

- 4.3** The Back Burn culvert is under capacity for all return period events modelled from the 5 year return period event. At the inlet the culvert consists of a 450mm diameter concrete pipe the capacity of which is approximately 0.4m<sup>3</sup>/s. During the 100% blockage scenario all flow is assumed to spill from the channel immediately upstream of the culvert inlet. During other scenarios the majority of the flood water also spill upstream of the culvert inlet. Of the flow that enters the culvert it is assumed that half of this then spills out onto the street when the culvert opens up as it passes under the road to the dry ski slope.
- 4.4** The hydraulic modelling also indicated that 75 properties, 43 residential and 32 non-residential, to be at risk from flooding during the 200 year return period event, considering full blockage of the culverts.

## **5. FLOOD ALLEVIATION OPTIONS**

**5.1** A number of flood alleviation options were identified that could reduce the risk of flooding in Newmilns. The following options of flood mitigation were initially identified:

- Design and installation of new trash screens;
- Upstream flood storage areas;
- Flood wall/ embankments;
- Sediment Management;
- Replacement of existing culverts;
- Catchment transfer;
- Overland flow controls.

Further to this, consideration was also given to using these options in combination with each other and the option of leaving the flood protection of properties up to the individual owner to flood proof. Once the feasible options had been identified these were costed and utilised in conjunction with the results of the property damage assessment to provide inputs in the benefit-cost analysis.

### **5.2 Flood walls/ embankments**

Due to the nature of flooding in Newmilns, and that of the catchments of the two burns, the use of flood walls/ embankments was immediately discounted as they are not a suitable option by which to address the required issues. The flood risk to Newmilns is created by overland flow due to under capacity culverts. Therefore the use of flood embankments/walls in the upstream reaches will not provide any reduction in flood risk to properties downstream. Due to the steep, flashy nature of the catchments no flood risk to properties occurs from these open channel sections. This option was therefore not carried forward for assessment within the benefit-cost analysis.

### **5.3 Flood storage areas**

The use of flood storage areas was also discounted on the following grounds:

- Due to the steep topography of both the Back and Caffle Burn catchments a suitable location for a flood storage area (FSA) could not be identified. Additionally the Back Burn disappears underground immediately upstream of the properties on High Street, making the construction of a FSA unviable.
- A FSA on either the Caffle or Back Burn would be located upstream of residential properties (particularly in the case of the Caffle Burn) and therefore the failure of the FSA could have serious consequences.

For these reasons the construction of an upstream flood storage area was not considered as a feasible mitigation option.

**5.4** Initially seven flood prevention options were assessed by the Consultant in terms of their construction feasibility, environmental and health and safety considerations. From these 11 feasible variations to address flood risk within Newmilns were identified. These are listed in the following Table:

<b>Option</b>	<b>Description</b>	<b>Adopted Benefit cost ratio</b>	<b>Benefit cost ratio with no below solum (of properties) damages</b>
<b>Current mitigation measures</b>	Maintenance, clear trash screens, inspect both Burns	<b>0.54</b>	0.00
<b>Option 1</b>	New trash screens on both burns	<b>0.38</b>	0.00
<b>Option 2</b>	Sediment Management on both burns	<b>0.15</b>	0.00
<b>Option 3</b>	Replacement of full length of Back Burn culvert.	<b>0.58</b>	0.06
<b>Option 3a</b>	Replacement of full length of Back Burn culvert <b>AND</b> new trash screens on Caffle Burn.	<b>0.58</b>	0.06
<b>Option 4</b>	Upsizing of 450mm diameter sections of Back Burn culvert.	<b>0.79</b>	0.10
<b>Option 4a</b>	Upsizing of 450mm diameter sections of Back Burn culvert <b>AND</b> new trash screens on Caffle Burn.	<b>0.79</b>	0.10
<b>Option 5</b>	Opening up of Back Burn culvert upstream of ski slope and upsizing of remaining 450mm diameter sections.	<b>0.74</b>	0.09
<b>Option 5a</b>	Opening up of Back Burn culvert upstream of ski slope and upsizing of remaining 450mm diameter sections <b>AND</b> new trash screens on Caffle Burn.	<b>0.74</b>	0.09
<b>Option 6</b>	Catchment transfer on Caffle Burn	<b>0.34</b>	0.02
<b>Option 6a</b>	Catchment transfer on Caffle Burn <b>AND</b> new Trash screens on Back Burn	<b>0.42</b>	0.03
<b>Option 7</b>	Replacement of full length of Back Burn culvert <b>AND</b> catchment transfer on Caffle Burn	<b>0.49</b>	0.04

**5.5** Scheme costs were estimated for the 11 options and costs of additional factors such as design and supervision, maintenance and 'Controlled Activity Regulations' (CAR) licences were also included. A benefit-cost analysis was undertaken to assess the 11 options. Of these, none generated a benefit-cost ratio greater than unity. Of the 11 flood alleviation options considered Options 4 and 4a, partial replacement of the Back Burn culvert (with the addition of new trash screens at the Caffle Burn culverts for Option 4a) offer the highest benefit-cost ratio of 0.79.

It should be noted that a benefit-cost ratio of 0.10 indicates that the cost of implementing the option would be ten times that of the benefits received.

- 5.6 The whole life cost and estimated construction cost plus scheme promotion to implement each of the flood prevention options with optimism bias are summarised in the following Table:

Option	Whole Life Cost including Optimism Bias* <small>*Refer paragraph 5.7 for explanation</small>	Estimated Construction Cost plus Scheme Promotion including Optimism Bias
Current mitigation measures	Annual maintenance cost approx. £11k (Optimism Bias does not apply)	n/a
Option 1	£616k	£320k
Option 2	£1,405k	£443k
Option 3	£3,058k	£2,108k
Option 3a	£3,059k	£2,342k
Option 4	£1,843k	£1,118k
Option 4a	£1,846k	£1,354k
Option 5	£1,982k	£1,232k
Option 5a	£1,986k	£1,468k
Option 6	£1,416k	£808k
Option 6a	£1,194k	£891k
Option 7	£3,858k	£2,915k

- 5.7 There is a widely recognised tendency for appraisers of all kinds of projects to be overly optimistic in their early assessment of project costs, time scales and benefits, when these are compared with final outturn values. This is termed “Optimism Bias”. Under previous Economic Appraisal guidance, Optimism Bias was taken into account in a generalised way. Current Defra guidance now requires an explicit consideration of Optimism Bias through i) the application of suitable uplifts to early best estimates of project costs, and ii) sensitivity analysis of predicted benefits and project time scales.

## 6. CONCLUSIONS

- 6.1 An allocation of £500k for flood prevention has been approved in the Roads and Transportation Capital programme for the financial years 10/11 to 12/13.
- 6.2 The economic assessment has shown that none of options provide a cost benefit ratio greater than 1, i.e. all cost more to implement than the monetary value of the benefits received in terms of reduction in flood risk.
- 6.3 In economic terms the preferred option is either Option 4 or 4a (partial replacement of the Back Burn culvert (with the addition of new trash screens at the Caffle Burn culverts for Option 4a)) as these provide the highest benefit-cost ratio of 0.79. They have estimated present value costs (including optimism bias) of £1.84million and £1.85million for Options 4 and 4a, respectively. **It should be**

**noted that neither of these options fully mitigate all of the flood risk to properties during the 200 year return period event and some properties will still be at risk from both the Caffle and Back Burns.**

- 6.4** Should the Council wish to fully mitigate the flood risk from the 200 year return period event from the Caffle and Back Burns Option 7 is the preferred option. This includes a channel transferring flow from the Caffle Burn to the Huggin' Craig Burn and a full length replacement of the Back Burn culvert. Although it provides a lower cost benefit ratio (0.49) than some of the other options this is the only option that can fully mitigate flood risk from both the Caffle and Back Burns during the 200 year return period event. The estimated cost of this option (including optimism bias) is £3.86million.

If this option is selected as the preferred option then the minimum following further actions are recommended:

- Detailed hydraulic modelling of the Huggin' Craig burn to determine its capacity to carry additional flood flows without increasing flood risk downstream (this may prove problematic as there already is embankment erosion to the rear of residential properties; this additional flow could exacerbate this with knock on repercussions).
- Topographical and geotechnical survey to determine a proposed location for the transfer channel.
- Hydraulic modelling to determine the proposed design for the transfer channel and abstraction measure.
- A high level environmental appraisal to ensure the transfer channel is environmentally feasible and to ascertain if an Environmental Appraisal or full Environmental Impact Assessment is necessary.
- Topographical and geotechnical survey to determine the design route for the new Back Burn culvert.
- Detailed design of the proposed option following the above initial investigations.
- Further consultation with SEPA to ensure the proposed options are acceptable under 'The Water Framework Directive' and 'Scottish Planning Policy 7'.
- Contract preparation and issue
- Consultation with all landowners, residents and other stakeholders to minimise the impact of the selected scheme on these groups.

This Option may prove problematic with owners of properties adjacent to the Huggin Craig Burn as the current flows within the Burn is causing erosion to the embankments and any additional flows may exacerbate this.

- 6.5** Given the substantial investment needed to implement full flood mitigation from the 1 in 200 year return period event from the Caffle and Back Burns for little cost benefit, recognising blockage to culverts has a serious impact on flood risk, and that the Capital budget allocated is £500k, Option 1 could be considered. This Option considers the design and installation of new trash screens and both the

Caffle and Back Burn culverts in order to reduce the risk of blockage and culvert damage.

The cost, which includes optimism bias, to implement new trash screens is as follows:

Caffle Burn, Screen 1 (Hillside Place)	£146,000
Caffle Burn, Screen 2 (Kilnholm Street)	£90,000
Back Burn (rear 55 High Street)	<u>£84,000</u>
Total	<u>£320,000</u>

It should be noted that the proposed locations for the new trash screens are located on land that is not in Council ownership. The construction of such large trash screens may not be acceptable to the owners of the property.

- 6.6** As outlined in 6.2 to 6.5 above, there is a significant cost to providing mitigation from the 1 in 200 year flood event, and all other Options result in overland flows through Newmilns at lesser flood events. The cost of implementing all Options is greater than the benefits received. The measures implemented, as noted in 2.4 to 2.7, will assist in reducing flood risk.

## **7. LEGAL IMPLICATIONS**

- 7.1** The promotion of any flood mitigation scheme will have to be undertaken through the requirements of the 'Flood Risk Management (Scotland) Act 2009.

## **8. PERSONNEL IMPLICATIONS**

- 8.1** None.

## **9. FINANCIAL IMPLICATIONS**

- 9.1** An allocation of £500k for flood prevention has been approved in the Roads and Transportation Capital programme for the financial years 10/11 to 12/13.

- 9.2** There is currently no central government grant available for the promotion and construction of flood mitigation works. All costs associated with any promotion of flood mitigation works will have to be funded wholly by East Ayrshire Council.

- 9.3** If any Option were to be adopted further detailed works would be necessary prior to design and construction to determine 'buildability', for example as noted in 6.4.

## **10. COMMUNITY PLAN / POLICY IMPLICATIONS**

- 10.1** Any permanent measures implemented will contribute towards protecting and sustaining the environment in which the populace reside thus contributing to .

## **11. RISK MANAGEMENT IMPLICATIONS**

- 11.1** It is not possible to mitigate against all risks of flooding. Option 7 will mitigate against flood risk from the 1 in 200 year return period event.
- 11.2** Blockages to culvert inlets have a serious impact on flood risk. Trash screens can stop debris from entering and then cause blockages within the culvert and/or damage to the culvert. But in trapping debris etc on trash screens, this may result in an increase in water levels and may result in an increase in flood risk.

## **12. RECOMMENDATIONS**

- 12.1** It is recommended that Cabinet;
- (i) note the findings of the Newmilns Flood Study;
  - (ii) agree that the preferred Option for flood mitigation in Newmilns is the 'Current Maintenance Measures' Option, outlined in Table in 5.4, which is the current practice of weekly inspection and cleaning regime of the existing trash screens and monthly inspection of the Caffle and Back Burns.

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**JB/JMcR**  
**17 June 2010**

### **LIST OF BACKGROUND PAPERS**

Newmilns Flood Study

**For further information please contact John McRobert on 01563 576310**

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