The Moray Flood Alleviation Group

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ROYAL HASKONING

BURN OF MOSSET FLOOD ALLEVIATION SCHEME

Recommendation Report

Moray Council Environmental Services

April 2004
Final Report
9M8860

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1 INTRODUCTION

The purpose of this report is to recommend a preferred flood alleviation scheme for the Burn of Mosset and Rafford Burn setting out the next steps for progressing the scheme to Flood Prevention Order and construction.

Section 2.0 of this document describes the need within Forres for investment in flood alleviation works. Section 3.0 outlines the scheme development process. Section 4.0 describes the options that have been evaluated in detail and the appraisal findings. Section 5.0 details the preferred option and highlights the key issues and opportunities. The conclusions and next steps are described in Sections 6.0 and 7.0 respectively. Finally the recommendations are described in Section 8.0.

2 STATEMENT OF NEED

2.1 Introduction

Forres is an ancient town located 10 miles west of Elgin in Morayshire. There has been a settlement at Forres since pre-Roman times and the town was granted a charter as a Royal Burgh in 1150. Forres currently has approximately 9,000 inhabitants. The Burn of Mosset, including the Rafford Burn, drains an area of 49km^2 upstream of Forres before flowing through the centre of the town towards Findhorn Bay.

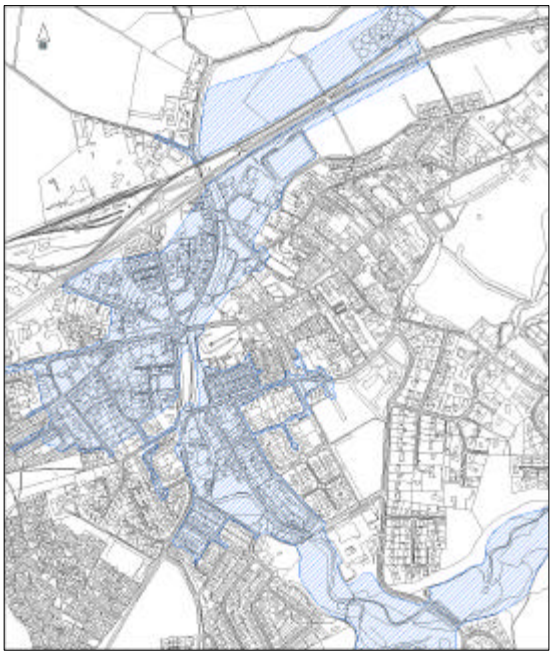
Forres has a long history of flooding from the Burn of Mosset and five flood events have occurred in the past 50 years. Rafford has a history of flooding from the Rafford Burn most notably in 1995, 1997 and 2000.

Recognising the urgent need for flood alleviation the Moray Council's Chief Executive, reporting at a meeting of the Moray Council on 21st June 2000, stated that "Flooding is a very complex issue and the Council is committed to making long term improvements to the rivers and watercourses within Moray". The following sub-sections clearly demonstrate the need for flood alleviation in Forres.

2.2 Recent Flood History

Forres suffered severe flooding in 1997 with smaller events occurring in 2000 and 2002. The 1997, 2000 and 2002 events have been estimated to have return periods of 1 in 50, 1 in 5 and less than 1 in 5 years respectively.

Flooding in Forres from the Burn of Mosset is a natural phenomenon. Base flow in the Burn of Mosset through Forres is less than 1m^3/s. The flow during the 1997 event has been estimated at 48m^3/s. During this event approximately 430 residential and 27 commercial properties were inundated and the A96 trunk road and the Inverness to Aberdeen railway line were both temporarily closed. The map opposite shows the extent of flooding in Forres in 1997.



1997 Burn of Mosset flood extent

The photos below show flooding in Forres:

Fleurs Road July 1997

Burn of Mosset November 2002

Furthermore, the Rafford Burn, a tributary of the Burn of Mosset has a history of flooding Rafford most notably in 1995, 1997 and 2000. The photos below show flooding in Rafford in 1997.

Residential flooding

Rafford Old Road

2.3 Existing Flood Risk

The existing standard of defence in Forres from the Burn of Mosset is very low, less than 1 in 5 years. The existing channel capacity through the town is 10m^3/s compared to the 1 in 5 and 1 in 100 year return period flows of 21m^3/s and 60m^3/s respectively.

This low standard of defence is supported by the observed flood frequency in Forres with three events having occurred since 1997. Table 1 shows the number of residential and commercial properties at flood risk in Forres from the Burn of Mosset. Nearly 1 in 5 houses in Forres are at flood risk from the Burn of Mosset at the 1 in 100 year return period.

Table 1: Number of properties at flood risk

Return Period (years)	Type of property	
	Residential	**Commercial**
5	65	6
10	198	14
25	368	23
50	712	35
100	792	41
200	860	51

As well as residential and commercial properties a number of key assets are at flood risk from the Burn of Mosset. Hydraulic modelling and historic evidence has demonstrated that the A96 trunk road and the Inverness to Aberdeen railway line are likely to flood at the 1 in 10 and 25 year return periods respectively. Disruption and damage to these key transport routes results in economic losses to Forres, Moray and the north east of Scotland. Furthermore, Pilmuir primary school, Forres Academy, the fire station, the sewage works and Benromach Distillery all lie within the 1 in 100 year flood risk area.

For the village of Rafford hydraulic modelling indicates that residential properties are likely to flood at least once on average every 5 years. This finding is supported by the observed flood frequency. Ten properties are believed to be at flood risk in Rafford.

The effect of climate change will exacerbate the future flood risk leading to more frequent flooding in Forres and Rafford.

2.4 Flood Damages

The economic loss to Forres and the north east of Scotland from flooding is considerable. The economic loss caused by the 1997 flood alone has been estimated to exceed £3.7 million. Without investment in flood alleviation the flood damage losses in Forres will exceed £57million over the next 50 years. This estimate is a baseline and does not take account of significant further loses from:

- Road and rail disruption;
- Infrastructure damage;
- Loss of services.

Furthermore, this estimate does not account for deterioration of the existing defences or increasing flood risk due to climate change.

3 SCHEME DEVELOPMENT

The development of a flood alleviation scheme for Forres has been progressed through a process of consultation, investigation and appraisal. The Moray Flood Alleviation Group initially investigated the problem by carrying out a literature and historic review of Forres flooding problem. Consultation with individuals affected by the flooding was undertaken in November 2001 and provided the Group with valuable local knowledge on flood mechanisms and flood risk areas. Further work included extreme flow estimation, climate change analysis, modelling of the watercourses and flood mechanisms, production of flood risk maps, geomorphological studies, preliminary geotechnical investigations and an investigation of environmental opportunities and constraints associated with flood risk management in Forres. These investigations and surveys formed the baseline for the option development and the ongoing appraisal process.

Early in the development of the project, the Group held a Value Management (VM) workshop to generate ideas for solving the flooding problem in Forres. Those who attended the workshop included all five Forres Moray Council Members, representatives of the local community council, representatives from the Moray Council Planning, Estates, Legal and Environment departments, statutory consultees including Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH), as well as members of the Forres flood action group. Options for flood alleviation were discussed and scheme criteria believed to be important to ensure the success of the scheme were identified by the stakeholders at the workshop.

Public and statutory consultation has played an important role in the development of the flood alleviation proposals and will continue to influence the design and construction of the final scheme.

From the wide range of options considered, three options were taken forward and appraised in detail. These three options are outlined in the next section.

4 APPRAISAL OF OPTIONS

A summary of the three options appraised in detail is given below. Each of the options includes channel diversion works at Rafford. All three of the options can achieve a standard of defence of at least 100 years plus climate change.

Option 1: Channel diversion
This option involves diversion of flood flows from the Burn of Mosset to the River Findhorn in combination with the construction of floodwalls and embankments through Forres. Principal works include:

- Construction of a 1.9km long diversion channel;
- Culverting the diversion channel under the A940 road;
- Constructing a cascade into the Findhorn valley;
- 1.6km of floodwalls through Forres (maximum height 1.4m);
- 1.2km of flood embankments (maximum height of 1.5m);
- Removal of weirs and channel reprofiling;
- Floodplain lowering at Burdshaugh, Fleurs Place playing field and downstream of the railway line, and;
- Relocation of services and the remediation of contaminated land.

Option 2: Floodwalls and embankments through Forres
This option involves improving the flood defences through town to convey the flood flow. The principal works include:

- 1.6km of floodwalls (maximum height of 1.7m);
- 1.4km of flood embankments (maximum height of 1.6m);
- Modifications to seven bridges (including the A96 road bridge, the railway bridge, Castle bridge and Orchard road bridge);
- The removal of weirs and channel reprofiling;
- Floodplain lowering at Burdshaugh, Fleurs Place playing field and downstream of the railway line;
- Raising Sanquhar Loch dam embankment, and;
- Relocation of services and the remediation of contaminated land.

Option 3: Flood storage at Chapelton
This option involves storing flood water upstream of Forres and releasing it at a controlled rate. During a 1 in 100 year flood event the retaining structure would store approximately 3.5 million m^3 of water, inundating an area of approximately 1.4km^2. The retaining structure would be required to comply with the 1975 Reservoirs Act. Principal works include:

- Construction of an 80m long, 5.25m high retaining structure, including control structure and spillway;
- A sediment trap upstream of the retaining structure;
- An earth embankment to maintain access to Sanquhar Mains Farm, and;
- An earth embankment to protect properties along St Leonard's Road.

Performance criteria used to appraise the three options include the following:

- Environmental impact
- Sustainability
- Operation and Maintenance
- Health and Safety

Table 2 ranks the options against each of the performance criteria.

Table 2: Summary of performance criteria

Description	Option 1 Channel Diversion	Option 2 Walls and Embankments	Option 3 Flood Storage
Appraisal Ranking			
Environmental ranking	3	2	1
Sustainability ranking	2	3	1
Operation Ranking	2	1	3
Maintenance Ranking	2	1	3
H & S Ranking	2	3	1

Each option has also been appraised against the whole life costs and scheme risks. *Table 3* summarises the findings of the cost-risk evaluation.

Table 3: Summary of cost – risk evaluation

Description	Option 1 – Channel Diversion	Option 2 – Walls and Embankments	Option 3 – Storage
Cost Risk Summary (£ million)[1]			
Appraisal Best Estimate[1]	14	21	7
Estimated Cost Range[2]	11 - 16	17 - 24	6 – 8

Table Notes:

1. *Appraisal Best Estimate*, this is the total sum of the basic construction cost, the non-construction costs including maintenance and operation, and the risk and design contingency. In treasury terms this cost represents the Base Case which is the best estimate of how much the scheme will cost in economic terms including allowance for risk and optimism.
2. *Estimated Cost Range,* estimated lower and upper limits.

Tables 2 and 3 demonstrate that overall, flood storage is the highest ranking option against the performance criteria and represents the most cost effective solution to managing the flood risk from the Burn of Mosset in Forres.

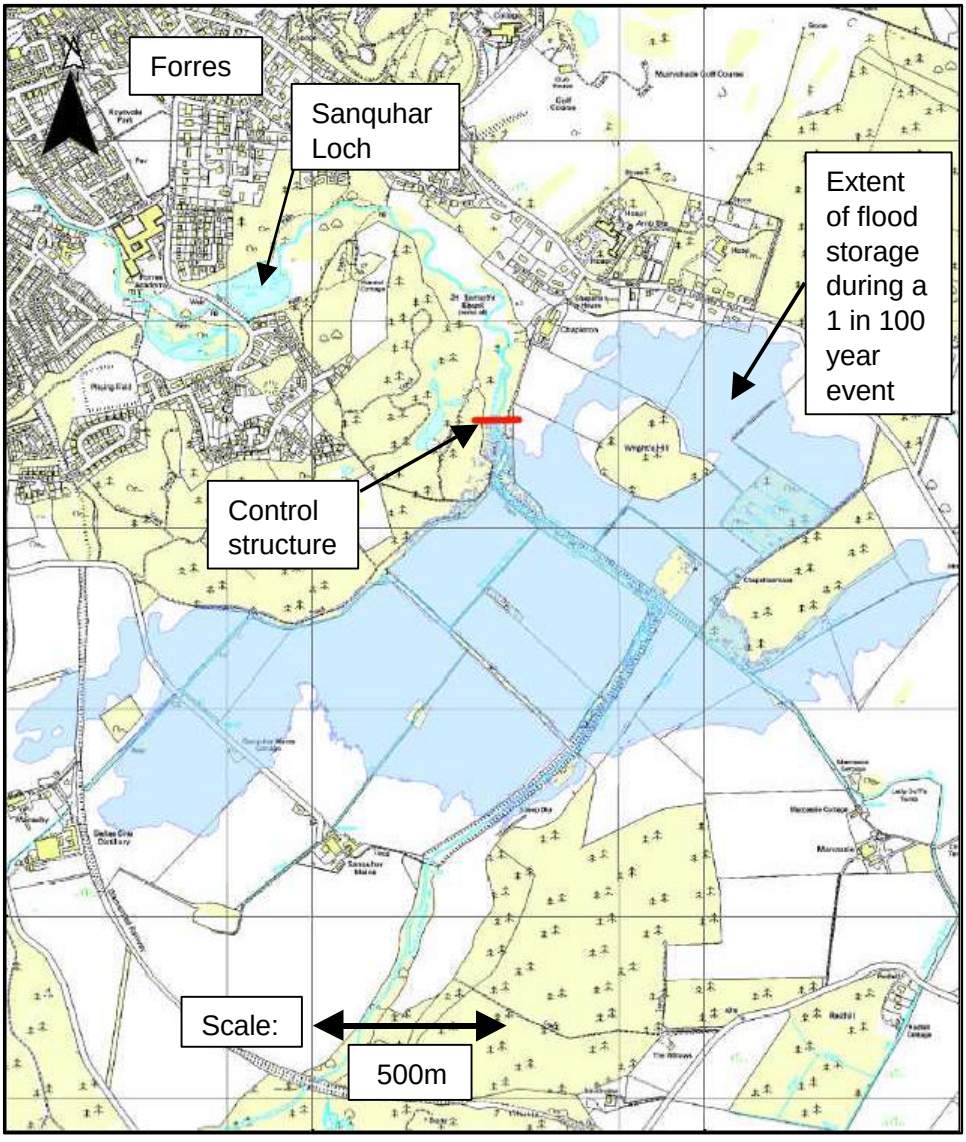
5 PREFERRED OPTION

5.1 Overview

This option involves the temporary storage of nearly 3.5million m^3 of floodwater and the subsequent controlled release of flow through Forres. The proposed flood storage site is located approximately 1.5km upstream of Forres and encompasses an area of 1.3km^2. The storage structure will be an earth embankment dam similar in nature to the Lhanbryde scheme. Flood storage on the Burn of Mosset provides a sustainable method of flood protection for Forres that is relatively self contained and minimises the disruption to Forres. The scheme also provides the opportunity to restore the natural drainage and floodplain through the storage site by removing existing embankments. The scheme will provide Forres with at least a 1 in 100 year standard of protection plus an allowance for climate change.

The preferred option also involves protecting Rafford village by diverting flood water in an open channel parallel with the B9010 road before culverting it under the B9010 and discharging the flow back to the Rafford Burn downstream of the village.

Location and extent of the flood storage scheme



5.2 Summary of the works

The main elements of work consist:

- Construction of an 80m long, 5.25m high earth embankment retaining structure, incorporating a control structure and spillway. The control structure will regulate the flow using penstocks and mechanical equipment;
- Raising a 550m length of Sanquhar Mains Farm access track by up to 3m to maintain access during flood storage;
- Provision of a sediment trap upstream of the control structure;
- Removal of existing banks upstream of the retaining structure to restore the natural drainage and floodplain, and;
- Diversion of the Rafford Burn in an open channel parallel to the B9010 road and culverting it under the road before discharging the flow back to the Burn downstream of the village.

Ancillary works associated with this option include:

- Realignment of Chapelton farm access track;
- Raising or removing one residential property;
- Securing commercial interests within the storage site;
- Protecting properties on St. Leonards road with an earth embankment;
- Realignment of electricity pylons, and;
- Extending a footpath from Sanquhar Loch to Rafford.

5.3 Key Issues

The key issues associated with this option are:

Land management

There is positive support for this scheme from the numerous landowners affected by the works. The long term success of the scheme is however dependant upon the satisfactory negotiation of land management practises within the storage site addressing issues related to access, maintenance, operation and compensation. Legal agreements will need to be formalised with each of the landowners.

Operation and maintenance

The storage scheme will require maintenance and operation under the Reservoirs Act 1975. The nature of the works presents a long term operational responsibility for the Moray Council requiring financial and resource commitment. Preparation of operation and maintenance manuals for the scheme will necessitate further detailed work related to sediment management, safety and security, channel maintenance and the overall design of the control mechanisms.

Planning and development

Consultation with statutory consultees and stakeholders has played an important role in the development and selection of the preferred scheme. The proposal represents a schedule 2 development in relation to the relevant Environmental Impact Assessment (EIA) regulations and as such will require the preparation of an Environmental Statement.

The scheme represents a departure from the development plan as development immediately outside the settlement boundary and as development within the Countryside Around Town (CAT) designation which surrounds Forres. Further

progression of the scheme is necessary to integrate and balance the flood alleviation needs with those of the existing development plan.

In balancing all needs it is essential that both short term and long term consideration is given to flood risk, landuse and the development of Forres, taking account of Scottish Planning Policy on planning and flooding.

Property and Business Interests
The scheme impacts on both residential and commercial interests within the proposed flood storage site. Further consultation and investigations are required to accommodate the needs of affected parties. These investigations include study of the site hydrogeology and options for mitigating the impact on properties in and surrounding the storage area.

Source of fill
The construction of the flood storage structure and other embankments forming part of the scheme requires the provision of a suitable source of fill. Investigations are on-going at this time and as such the cost range for the scheme accommodates different options for the provision of fill. The location and supply of fill material will influence planning, programming and compensation arrangements.

Standard of protection
Storage at Chapelton can reduce the annual probability of flooding in Forres to less than 1% (1:100) from the Burn of Mosset including allowance for climate change. In taking forward the scheme, consideration will be given to further increasing the standard of protection by investigating minor works to the Burn of Mosset through Forres.

5.4 Opportunities

The main opportunities associated with this option are:

Access improvements
There is an opportunity to improve access and footpath networks within the vicinity of the scheme.

Sanquhar Loch
Flood storage at Chapelton offers the opportunity to reduce the sedimentation of Sanquhar Loch increasing its life span as a recreational facility for the community and improving it as a wildlife habitat.

Restoration of the natural channel and habitat creation
Removing existing embankments and restoring the natural channel and floodplain is proposed as part of this scheme to allow the reservoir to drain. This also offers a variety of opportunities for habitat creation or enhancement such as the creation of wet margins, wet woodland, wetland grazing and permanent ponds.

6 CONCLUSIONS

Option 3, Flood storage at Chapelton combined with channel diversion at Rafford, represents the best way forward for the Council for managing the flood risk in Forres and Rafford. The scheme is similar in nature to the Lhanbryde scheme which is due to commence construction in summer 2004.

The scheme provides a standard of protection of at least 1 in 100 years including an allowance for climate change whilst minimising disruption in Forres and protecting the character of the town.

The scheme alleviates flooding from the Burn of Mosset to nearly I in 5 properties in Forres and assets such as the A96, the railway line, the fire station, the sewage works and schools. The scheme investment of £6 – 8 million including future operation and maintenance expenditure is cost effective against the projected benefits of at least £57 million in flood damages over the life time of the scheme.

The scheme has wide support from the public and affected landowners, however land management agreements will need to be resolved. A wide range of stakeholders and landowners will need to contribute to the development and approval of the scheme prior to construction.

The scheme represents a long term operational responsibility for the Moray Council. The scheme also necessitates the integration of flood risk, landuse and development policies to manage the future flood risk within Forres and the surrounding area.

The scheme provides a safe, sustainable solution for managing the flood risk in Forres and Rafford and presents environmental opportunities, including access improvements, siltation management for Sanquhar Loch and habitat creation.

7 NEXT STEPS

The principal next steps are:

- Consult with those directly affected by the proposed scheme including landowners, residents and commercial property owners;
- Consult further with statutory consultees to take forward opportunities and fully establish statutory and regulatory requirements for the design, construction and operation of the scheme;
- Consultation with the Scottish Executive to confirm requirements for the business case submission and obtain feedback on the proposals and funding availability;
- Undertake the further investigations necessary to design and construct the scheme, including: ground investigation, ecological surveys, geomorphological investigation and a study of the hydrogeology within the storage area;
- Take forward the scheme design and preparation of the necessary consents and approvals including the Flood Prevention Order and Planning Application;
- Undertake negotiations with stakeholders and landowners to establish land management agreements for the operation and maintenance of the scheme;
- Compile business case for submission to the Scottish Executive and key statutory consultees;
- Hold a public exhibition in October 2004 to consult on the detailed scheme proposals.

Following recent consultation with the affected landowners and the public there is wide support for the proposed scheme. With continued support and resolution of the key design, construction and operational issues it is expected that the construction of the scheme can commerce as early as Summer 2005 for completion in 2006.

8 RECOMMENDATIONS

It is recommended that:

- Flood storage at Chapelton combined with channel diversion at Rafford is taken forward as the preferred scheme to alleviate and manage the flood risk in Forres and Rafford;
- Consultation on the preferred scheme is undertaken with the following key parties: Scottish Executive, statutory consultees, landowners, residents and commercial property owners to progress investigations and development of the scheme;
- Negotiations with stakeholders and landowners are undertaken to establish land management agreements for the operation and maintenance of the scheme and to acquire land interests as necessary;
- A further public exhibition is held in October 2004 to provide information on the detailed scheme proposals.