# Forres (Burn of Mosset)

## *A sustainable solution to flood control*

Figure 1 above: Spillway and stilling basin.

**As the recent events in Cumbria and elsewhere show, Britain is plagued by flooding. According to the Environment Agency and the Scottish Government, over five million people in Great Britain live and work in properties that are at risk of flooding from rivers or the sea. In the small town of Forres, 10 miles west of Elgin in Moray, Scotland, nearly one in five houses were at flood risk from the Burn of Mosset at the 1-in-100-year return period.**

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**Barbara Hellett** and **David Bone**, Royal Haskoning

Forres has a long history of flooding, having suffered from five flood events in the past 50 years. Flooding causes structural damage as well as social and economic loss – the financial loss caused by the 1997 flood alone was estimated to exceed £3.7 million, and without investment in flood alleviation, the damage in Forres would have exceeded £43m over the next 50 years.

Moray Flood Alleviation was established in 2001 for the purpose of delivering alleviation to a number of communities in Moray, including Forres. As part of the overall £162m project, the Moray Council, in conjunction with Royal Haskoning and Morrison Construction, began work on the Forres (Burn of Mosset) Flood Alleviation Scheme.

### The decision process

It was important to include the community from the beginning, so a workshop was held with community and council members, as well as representatives from the Scottish Environment Protection Agency, Scottish Natural Heritage and Forres Flood Action Group.

A flood storage reservoir, situated on the Burn of Mosset at Chapelton, was identified as the principal component of the preferred solution, as it was the most sustainable and cost-effective structure. This, combined with flood defences through Forres, offers sustainable protection against flooding.

The flood storage solution made good use of the natural landforms, as there was a large upstream basin that drained through a narrow valley. In addition, the main structures could predominantly be constructed out of materials sourced on-site, avoiding significant traffic impacts and associated $CO_2$ emissions.

Preparation work commenced on the scheme in 2002 and construction began in November 2007.

### The solution

It would have been easy to fall into the trap of delivering just a flood alleviation scheme that would solely offer protection from rising waters. The design and construction of Chapelton Dam was influenced by the Reservoirs Act, part of which requires the ability to survive the 1-in-10,000-year flood. However, it was important that the flood defence structure blended with the environment.

The team was tasked to design a structure that integrated the engineering and aesthetic/environmental requirements and subsequently delivered a scheme that is an asset for the community at all times. In many respects, much of the dam and stilling basin is analogous to an iceberg – the majority of the engineering is hidden below ground.

Concrete was a natural choice of material for the control structure, as the structure has a 100-year design life. The concrete had micro-fibres added to reduce bleed rate and for crack control. Also, due to the curved shape of the dam crest, concrete allowed for greater flexibility than steel, as the team was able to create the exact forms and sections in-situ.

The specification for unreinforced concrete was similar to that for the control structure, except that in this case macro-synthetic fibres were incorporated to provide abrasion resistance.

The primary mechanism for discharge from Chapelton Dam is the baffled crump weir. The primary consideration for both Royal Haskoning and the Moray Council was the balance between simplicity and efficiency of use of the available storage. Although a fixed orifice is generally easier and less expensive, the baffled crump weir delivers a relatively uniform discharge over a range of heads. Importantly, the baffled crump weir requires no power or user intervention to operate and allows fish passage.

### 'Green' considerations

Although the site of Chapelton Dam does not have any formal environmental designations, prior to construction works, the valley was a relatively wild and undeveloped

# flood alleviation scheme

**Figures 2 and 3: No-fines concrete elements seen at distance.**

habitat. It is close to Sanquhar Woods, a locally important recreation area used by locals.

Accordingly, Royal Haskoning included additional design innovations that would allow for not only a strongly constructed flood defence system but also one that had pleasing aesthetics and long-term sustainability.

The spillway and stilling basin were designed to have a natural appearance, while still being able to dissipate energy from the overtopping flow occurring during the 1-in-10,000-year flood event. The structure uses a combination of open stone asphalt, no-fines concrete and large rock armour covered with topsoil and grass. The porous nature of the structural elements will allow water to dissipate during wet periods and will also allow the grass to survive prolonged dry periods by allowing moisture to percolate upwards. Although extreme flooding events will lead to overtopping and cause some loss of topsoil, the design will allow for vegetation to grow and the dam to better blend with the natural surroundings.

## The test

The Forres (Burn of Mosset) Flood Alleviation Scheme was opened in August 2009 and was the second scheme to be completed under the Moray Flood Alleviation banner. A week later, the newly opened flood defences were put to the test for the first time when, over a 30-hour period, 93mm of rain fell in the area – the amount of rainfall the region would normally expect to receive over six weeks. The scheme performed well during this unexpectedly early test, successfully protecting more than 350 residential and commercial properties from flooding.

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**Figure 4 below: In-situ topping to the concrete elements.**