

## Best practice flood alleviation schemes

After recent flooding events, ADEPT members have provided examples of best practice in areas where flood alleviation schemes and defence engineering works have proven successful.



Horsbere Flood Alleviation Scheme, Brockworth, Gloucester  
Construction phase photograph

1) Two Gloucestershire flood alleviation schemes, both built in partnership with the Environment Agency and the community since 2007, have been successful in preventing further flooding since construction.

### Horsbere Flood Alleviation Scheme (FAS), Brockworth, Gloucester

This was a joint Environment Agency and GCC funded scheme opened in December 2011. The scheme comprises of a retention area of c. 170,000m<sup>3</sup> capacities to hold back water from the Horsbere Brook upstream of the Longlevens area of the city of Gloucester. The scheme is designed to a 1 in 100 year storm event and will protect up to 350 homes. Many of these homes were severely flooded in 2007 and have not flooded since the scheme was built. Flooding in this area was frequent and potentially severe when the river came out of its banks.

In normal conditions the vast majority of the FAS area is empty of water, but when flows increase above the capacity of the flow control structure, water spills into the flood storage area. It remains there until river flows have reduced.

A control structure located in the brook takes the form of a bridge/culvert over the brook and acts to throttle flow in the river at times of high flow. The retention area comprises over 15 hectares of biodiversity habitat.

### Deerhurst FAS, Gloucester

The village of Deerhurst is a small community comprising of approximately 31 properties on the East side of the River Severn near Tewkesbury. The village has two sites of historic and national interest: one being an Anglo Saxon Church, St. Mary's (670 AD approximately), and the other being Odda's Chapel (1056 AD). A large part of the village and the scheme overlaps the Deerhurst monastic site and multi-period settlement Scheduled Monument (SM).

The village is in the river flood plain and regularly flooded with eighteen properties flooded in July 2007 in addition to both of the village farms. Four of these properties were listed and thirteen of them had water greater than one metre deep throughout the property.

The scheme which was completed in late 2009 cost £0.5m and was supported by the community who provided all of the soil required and £50k in cash. In addition to clay bunds, the scheme incorporated flood gates on the road network and improved warning systems.



Deerhurst flood gate

## Case studies continued

### 2) Pin Mill, Suffolk

Pin Mill is an example of a low cost, community led flood alleviation scheme that worked well in the tidal surge. The design worked way beyond expectations and only one property had a small amount of flooding – compared to 8-9 properties that would have had serious flooding had the scheme not taken place. It has also resulted in the most vulnerable property reducing insurance costs by £1000.

The main flood risk in Pin Mill is tidal, but two parallel running watercourses that collectively join together and discharge into the tidal estuary, also pose a threat during certain circumstances. The Pin Mill Alleviation Scheme was a partnership effort between Suffolk County Council, the Environment Agency and the local community. The responsibility of the operation and maintenance of the completed project was passed to the Parish Council and residents on completion of the project.

The project aimed to improve existing tidal defences, reduce the flood risk to existing properties, provide a scheme that is adoptable for the local residents to take on long term, and to create or enhance biodiversity on site. Ongoing monitoring of the site will be needed to check the condition of the structures and full checks of integrity of the structures will be taken out after extreme events.

Councillor and cabinet member for roads, transport and planning, Guy McGregor, was quoted 'This simple measure will prove tremendously effective in safeguarding people's homes from the devastating impact of flooding. It would not have been possible without the support of the residents' association and parish council. With the help EA support we have also managed to refurbish the tidal defences at the same time'.



Outfall and tide flap to the land drain, next to the old tide flaps of the main streams (Pin Mill)

### 3) Kent based examples - Sandwich and Margate

The Kent case studies have been taken from the December 2013 storm surge events.

#### **Sandwich Town Tidal Defence scheme**

The scheme is being delivered by the EA in partnership with Pfizer and Kent CC. Some areas of Sandwich have a low standard of protection from tidal flooding: a 1 in 20 chance of tidal flooding every year; when complete the £21.7 million scheme will provide a 1 in 200 standard of protection.

The scheme area is divided into 16 reaches along the banks of the River Stour and includes:

- constructing a new tidal flood storage area outside of the town at Broad Salts;
- raising the height of 14km of flood walls and embankments on both banks of the River Stour; building a 1m high flood wall at Sandwich Quay.

On Friday 6 December the biggest tidal surge in 60 years hit the east coast, and the EA teams were in the area to monitor and respond to the surge. Although still in their early stages, the new Sandwich Town Tidal Defence scheme played a major role in saving homes and property. The completed defences all worked as designed and the tidal relief area near the Princes Golf Course took the top off the tidal surge to help protect 219 homes in Sandwich. Kent CC contractors also provided local residents with over 7,000 sandbags, and EA field teams created capacity in the river by running Stonar Cut sluice and put down additional demountable defences on Strand Street which worked in combination with the partially constructed flood alleviation scheme to further reduce the impact of the storm on the town.

#### **Margate Flood and Coast Protection Scheme**

The Margate flooding included extreme water levels rather than wave height. The scheme was completed in April 2013 at a total value of £5.3m. Before the scheme was implemented, the water flow path would go straight through the old town area of Margate which can be packed with residential and commercial property.

The scheme was designed to a 1:200 standard allowing for climate change over the 50 year design life, and after the storm occurred in December 2013, the volume of overtopping was insignificant and it was not necessary to close the public highway. No wave overtopping analysis has been done on the event using the old defences as a base model but Kent CC believe it very likely that property level flooding would have occurred had the scheme not been undertaken and completed before this event.

Below is a photo taken after the high tide in the early hours of 6 December, and synopsis explaining the scheme which led to Thanet DC winning the Community Award at the ICE Engineering Excellence Awards last year.



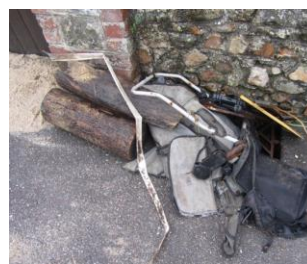
Due to the two low lying areas of Margate that fall within the EA Zone 3 flood risk category, the financial cost of damage to property in the Old Town area, resulting from a major flood event, could be as much as £70m. It is under the East Kent Engineering Services Partnership that Thanet DC approached Canterbury City Council to design and supervise a scheme. Over a 50 year design life, the scheme will aim to reduce the risk of flooding from wave overtopping through four key improvements:

- Strengthening works to the Grade II listed Stone Pier
- Precast concrete stepped revetment
- New and raised seawalls with timber swing floodgates
- Hydraulic powered raising floodgate and wall

The scheme was conceived, designed and supervised by Local Authority engineers acting in partnership across administrative boundaries.



Hydraulic floodgate during installation, Margate



Blockage of culvert resulting in flooding, and debris removed from Culvert, Purzebrook Case Study

#### 4) Devon County Council, working in partnership with the EA, District, Borough and City Councils and South West Water

Following the widespread flooding in 2012 and further incidents in 2013 and 2014, Devon County Council has worked very closely with the second tier authorities to develop and deliver approximately 40 minor improvement schemes totalling almost £400k.

The following case studies have been prepared to highlight some of the excellent works that have been achieved and the different opportunities that have been adopted for funding the schemes.

#### **Aveton Gifford Flood Improvements**

Following the extreme rainfall over much of Devon in 2012, a number of properties in Aveton Gifford were flooded to depths of over 900mm. After being made aware of the extreme impact and frequency of flooding Devon CC commissioned a study confirming that the existing culvert arrangement under the old A379, was prone to blockage causing a backing up of flows resulting in flooding. An initial design to enlarge the existing culvert, reducing the possibility of blockage, was considered and evaluated to ensure that it would not result in an increased flood risk downstream. The project is a great example of collaborative working between key stake holders and the DCC Flood Risk Management unit. Since the January 2014 floods, there has been a noticeable difference as the new culvert has been able to cope with increased quantities of flood water.

#### **Purzebrook Culvert Improvements, Axminster**

A small length of culvert on the Purzebrook has been the site of blockages in each of the flood incidents reported over the past 5 years. After extreme rainfall in 2012, the capacity of the culverted watercourse was exceeded, and the DCC confined space team were called in to clear a large amount of debris. The initial proposed drainage scheme and further investigations into an additional blockage which was also repaired, is a great example of how DCC Flood Risk Management, Highways and all agencies involved were prepared to adopt a pragmatic approach to reach a solution for the benefit of the residents. Since December 2012 flood risk has reduced significantly.

#### **Ludbrook Flood Improvements**

Following extreme rainfall and surface water flooding causing damage to properties and highways, the residents of Ludbrook embarked on a community scheme to prevent further flooding. The scheme design included the installation of a triple flood relief culvert structure to convey floodwater from the upstream of the road to an open lower field downstream. The open rural field would act as additional storage during flood events where water will then be stored in the field until levels drop in the stream and allow the floodwater to be passed back into the stream. Once funding had been secured by the residents at the end of November 2012, construction started and works were completed by January 2013. The works successfully prevented repeated flooding following subsequent events in 2013 following its construction. The project is a great example of collaborative working between the community at Ludbrook and the various teams within DCC.