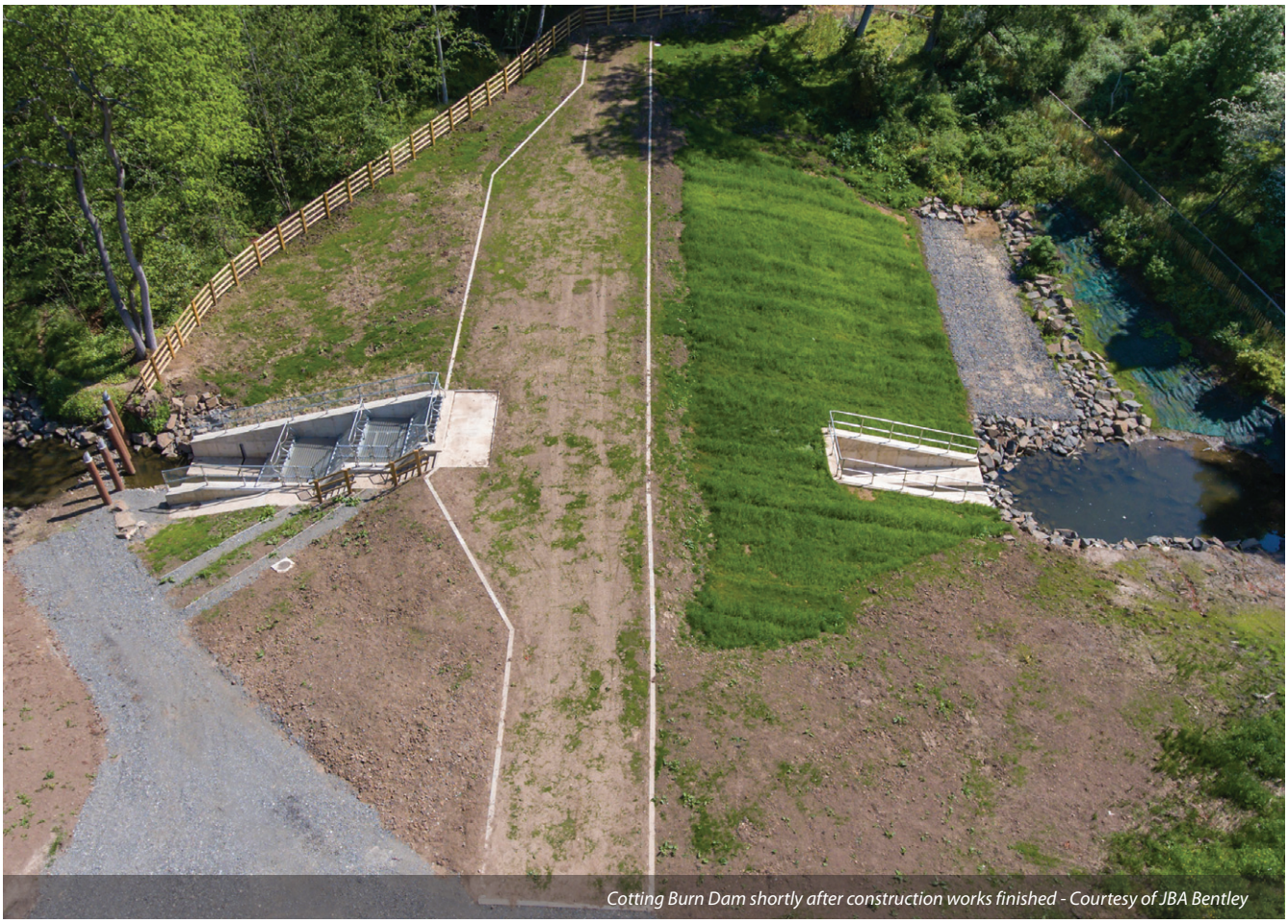
Morpeth Flood Alleviation Scheme Phase 3

Cotting Burn Dam & Lowford tree poles - delivering sustainable flood alleviation in Morpeth through innovation and materials reuse

by Emily Bradley BSc FdSc

Morpeth is an historic market town in Northumberland, situated on the River Wansbeck. It has suffered extensively from flooding, experiencing 22 significant flood events since 1839. In 2008, over 1,000 properties in the town were flooded or affected by flooding. The main source of flooding has been from the River Wansbeck, with Cotting Burn, a tributary to the Wansbeck also causing flooding in parts of the town. The Morpeth Flood Alleviation Scheme has been delivered through the Environment Agency's Water and Environmental Management Framework (WEM) in 3 phases. Phases 1 and 2 saw defences constructed through the town and a large flood storage dam constructed upstream on the River Wansbeck. Phase 3 saw further flood alleviation works on the River Wansbeck in the form of tree poles and a flood storage dam constructed on Cotting Burn with a combined value of £1.7m.



Cotting Burn Dam shortly after construction works finished - Courtesy of JBA Bentley

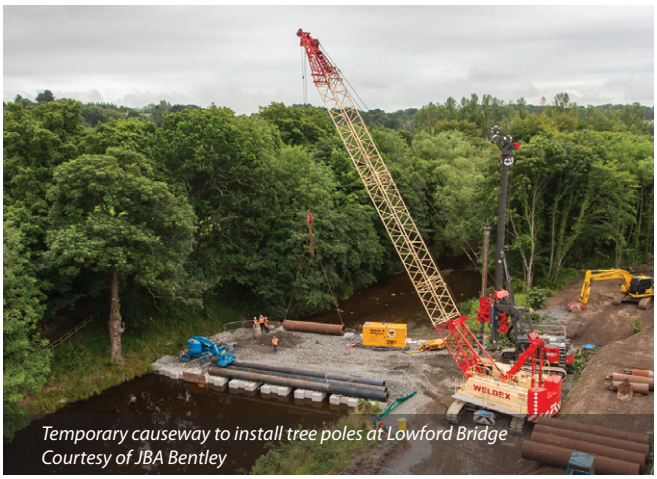
Lowford tree poles

There are several bridges through the centre of Morpeth where large floating debris has become trapped, blocking bridges, reducing conveyance and raising water levels resulting in flooding to the town centre as well as potentially causing structural damage to the bridges. To prevent this debris accumulation, JBA Bentley was tasked to design and build a coarse debris screen across the River Wansbeck, just upstream of Lowford Bridge, to trap large debris. JBA Bentley is a joint venture between JBA Consulting Ltd and JN Bentley Ltd.

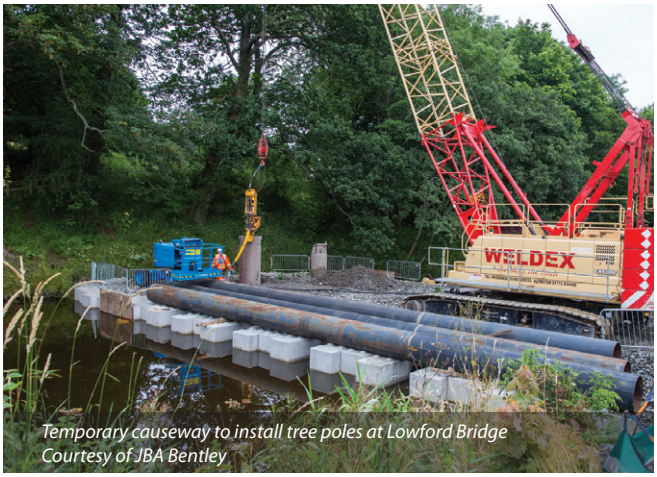
Designed to take debris loading up to the 200-year flood event (0.5% annual exceedance probability) the coarse screen consists of 7 (No.) 711mm Ø CHS tree poles, 17m long. Piling works were undertaken by McGratton Piling Ltd. To ensure the poles were driven straight and on the correct alignment, holes had to be pre-bored with a steel casing inserted to keep the bore open in the soft alluvium material at the surface. Once driven to depth the CHS were backfilled with concrete. The tree poles stand circa 5.5m above bed level.

To enable debris to be safely removed from the screen, an access lay-by was constructed including a ramp down to the bed of the watercourse and a vehicle turning area. Space was tight as the access ramp had to be constructed in a small area of land between the Wansbeck and the B6343, with a significant level change.

To provide enough room for vehicles and achieve accessible gradients, a sheet pile wall was constructed under an Agreement in Principle with Northumberland County Council's Highway Department.



Temporary causeway to install tree poles at Lowford Bridge
Courtesy of JBA Bentley



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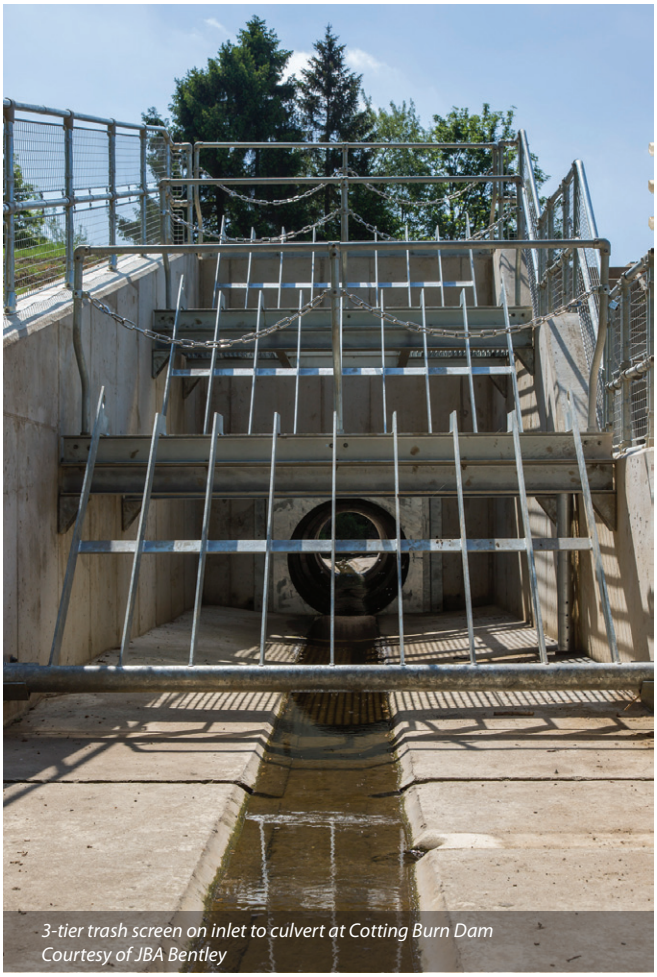

3-tier trash screen on inlet to culvert at Cotting Burn Dam
Courtesy of JBA Bentley

Ecological constraints

Native white clawed crayfish thrive in the River Wansbeck; a protected species under threat from the disease carrying signal crayfish. White clawed crayfish can only be handled under licence and by experienced individuals. Prior to the commencement of any works a fingertip search of the in-channel working area was undertaken and any animals found were relocated a distance upstream of the site. Works could not commence in channel until after 1st July to reduce disturbance to females holding young. The design of the tree poles considered the white clawed crayfish by minimising excavations works and keeping the natural gravel bed undisturbed wherever possible.

Innovation

To minimise disturbance to the river bed during the piling operations, a temporary causeway was constructed across the channel to create a dry working platform. The causeway was constructed from a number of precast concrete blocks which ran parallel with 6 (No.) 600mm Ø HDPE pipes. Clean stone was used as pipe surround and to provide a running surface for machines. The pipes enabled flow to be maintained throughout the works. Once completed some of the concrete blocks were utilised on site and the others were reused on other local sites. This method caused minimum disturbance to the natural channel and made use of reusable materials.

Cotting Burn

Cotting Burn flows from the north towards Morpeth. Upstream it is natural channel until it enters Morpeth where it becomes increasingly culverted. It joins the Wansbeck at the downstream end of the town. Historic flooding from Cotting Burn was caused by culvert surcharge due to blockages within the culvert. Numerous services run through the culvert increasing the potential of snagging debris causing blockages that are difficult to remove.

Earth embankment dam

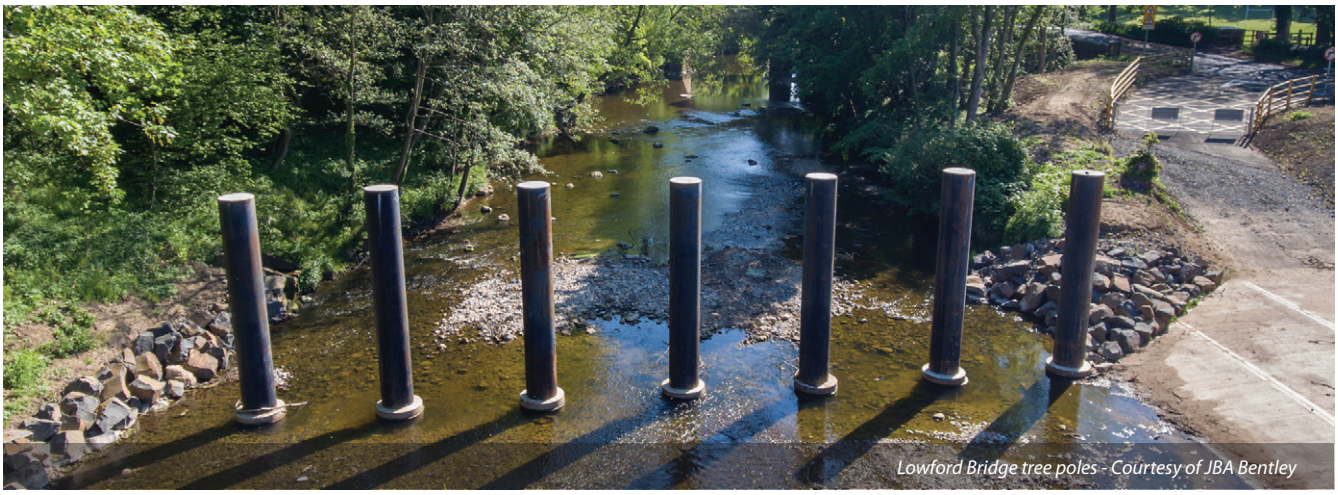
Providing a standard of protection of 1 in 100 years (protection against an event with a 1% annual exceedance probability) Cotting Burn Dam is an online flood storage area. The dam reduces flood risk by two methods; firstly by impounding water, reducing the flood peak during larger storm events and secondly by reducing the risk of blockage of the culvert downstream. 26 properties are directly protected by the scheme.

The dam is an earth embankment with a 1350mm Ø culvert passing through, conveying Cotting Burn. At the entrance to the culvert is a concrete headwall with a 3-tier trash screen manufactured by JHT Fabrication Ltd. A coarse debris screen was installed just upstream of the culvert to trap larger debris from the wooded upstream catchment. Access has been provided so that the screens can safely be cleared.

Under the ICE's *Floods and Reservoir Safety 4th Edition, 2015*, the dam is classified as Category A, 'where a breach could endanger lives in a community". As a Category A dam, it must be designed to safely convey the probable maximum flood (PMF). To safely pass the PMF the crest is designed to overtop in a centrally aligned spillway arrangement. Any overtopping will be short duration, therefore shear stress turf was used as erosion protection on the downstream slope of the dam. On the downstream toe of the dam, a capture channel was constructed using rock armour and rock mattress to train the flow back into the natural channel during overtopping.

Reusing material

16,000t of imported clay was required to construct the dam. Ground investigations showed there was little suitable material on site for use in the embankment. Exploring alternatives, JBA Bentley identified a local source for the embankment fill: surplus material from the nearby Morpeth bypass highways scheme that met the geotechnical specification. CL:AIRE protocols were followed for



Lowford Bridge tree poles - Courtesy of JBA Bentley

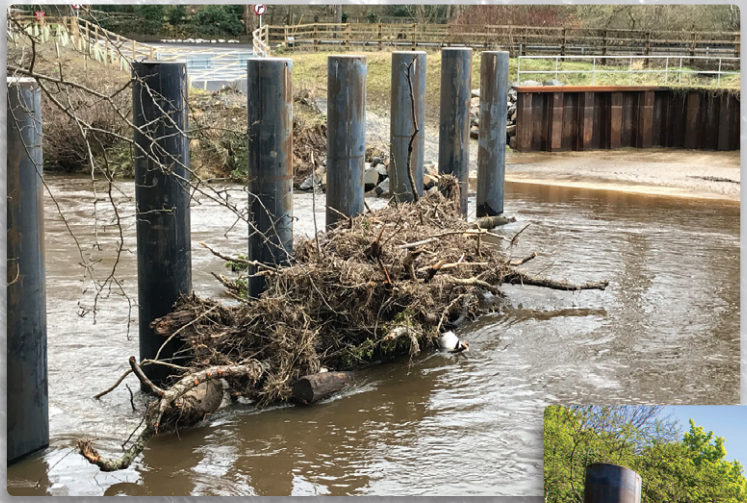
the excavated material, which was located less than one mile from the dam site. Significant cost savings were made by agreeing a commercially attractive price and carbon savings by minimising the haulage distance for the imported material and diverting waste from landfill. The next nearest alternative suitable source material was almost 25 miles from the site; the carbon saving from haulage alone was 71t and the scheme benefited from cost savings of approximately £85,000.

Local Flood Action Group

The dam has been renamed *'The Hargreaves Dam'* in memory of Regional Flood and Coastal Committee (RFCC) Chairman Jon Hargreaves. The Local Flood action group commented:

> *"Residents directly affected are very relieved that the Cotting Burn will no longer be such a threat to them. The late Jon Hargreaves, chair of the Northumbria Regional Flood and Coastal Committee, was admired for his excellent leadership, diligence and personal convictions in getting the dam operational. JBA Bentley built the dam in very difficult conditions and could not have been more helpful. They showed us the work as it progressed and took care to build a dam which will protect Morpeth for centuries into the future. Local people, previously flooded repeatedly, have taken visiting family members to view the dam and are relieved that recent floods have done no damage, thanks to its presence and maintenance to clear debris carried out by local Environment Agency officers."*

The editor and publishers would like to thank Emily Bradley, Engineer with JBA Bentley Ltd, for providing the above article for publication. The author thanks Andrew Gee, Project Manager with the Environment Agency, for his input and the Local Flood Action Group for their comments.



Tree poles in action
Courtesy of JBA Bentley

Tree poles with Lowford Bridge in the background
Courtesy of JBA Bentley