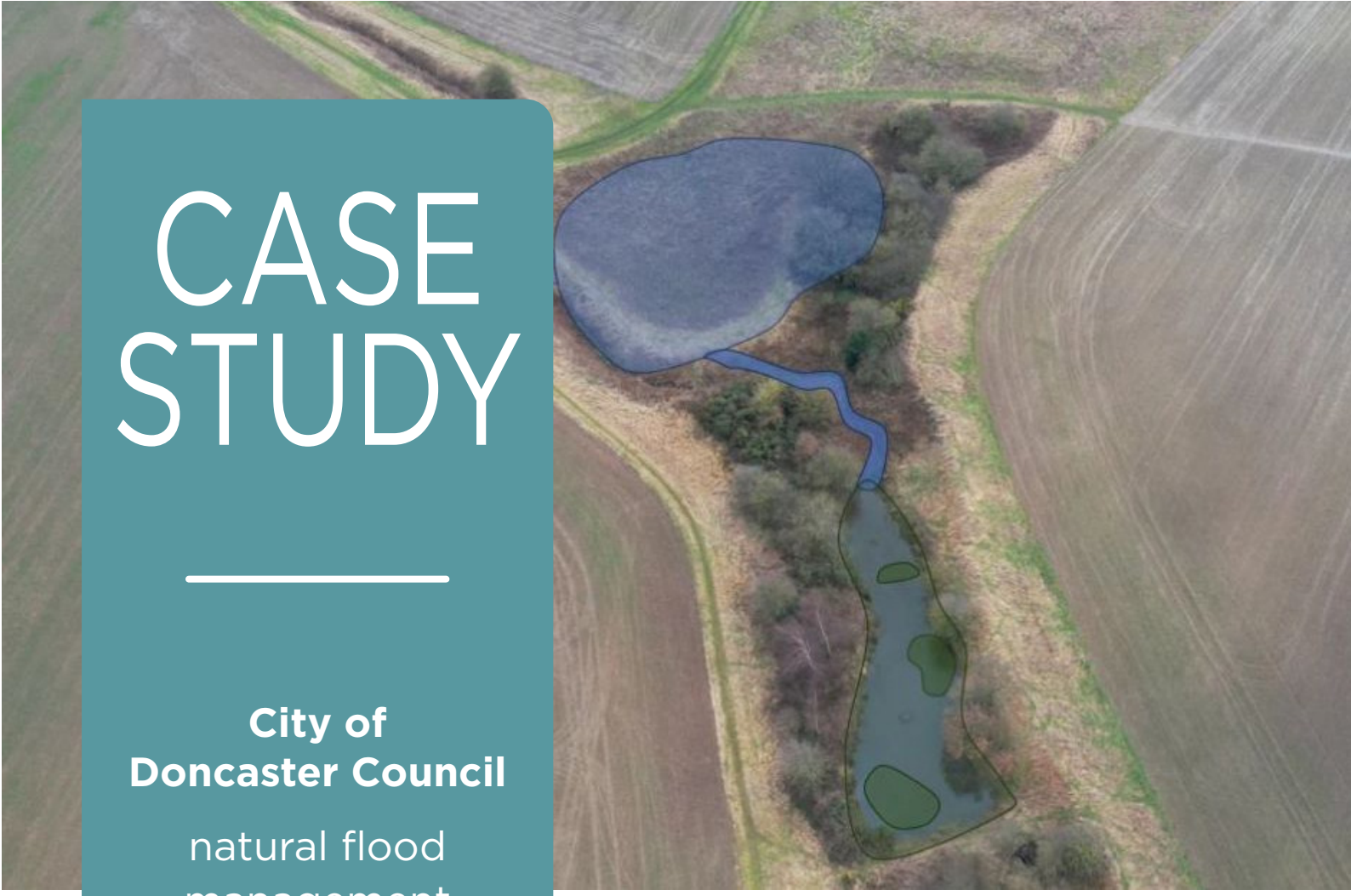

CASE STUDY

City of Doncaster Council

natural flood management

project **summary**

Flooding within the downstream urban areas across the UK is at a record high, causing destruction to homes, schools, businesses and surrounding environments. Backed by government funding, the City of Doncaster Council (CDC) applied for a grant to tackle localised flooding in the area and to create a more climate resilient town. CDC is a strong believer in nature-based solutions including sustainable drainage systems (SuDS) and natural flood management (NFM) and was keen to develop sustainable green solutions in line with council objectives to address the climate and ecological crisis. The £25 million NFM (Natural Flood Management) funds were allocated through SYMCA (South Yorkshire Mayoral Combined Authority) and were adopted by councils and trusts.

The City of Doncaster Council was successful in its application and the development of a flood risk management strategy began. EPG was appointed to provide detailed design and hydraulic calculations for potential NFM (natural flood management) features within the upper and rural parts of the Kearsley Brook catchment.

Flooding occurred in 2019 downstream in the urban area, where Kearsley Brook enters Conisbrough. A feasibility study from JBA had identified several opportunities to implement NFM for flood alleviation. EPG was appointed to undertake detailed modelling of the selected interventions and quantify the flood alleviation potential. The overall objective of the flood alleviation scheme is to lower peak flow rates and volumes at downstream locations, where riverbank overtopping and restrictions, due to structures such as culverts and bridges, result in flooding of urban infrastructure and properties.

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the **challenges**

NFM techniques mimic natural processes to manage the flow of water within a particular area by using more naturalised features to allow the ground to soak up the rainfall, slow the conveyance flow using natural flow control features known as leaky dams, and hold back water in natural features such as dedicated wet areas and ponding areas. The team at EPG were asked to demonstrate the NFM interventions using suitable detailed hydraulic modelling, to represent the flow characteristics of the watercourse based on runoff generation from the upstream catchment, as well as key 1D structures encountered by Kearsley Brook such as bridges and culvert that impact the flow depth, flow velocity and extent of flooding at the affected properties.

Jacqueline Diaz Nieto, Associate SuDS Engineer, developed an integrated hydraulic model that represented the 2D flows on the surface. This illustrated the flood characteristics that explained the flood flows within the Kearsley Brook catchment.

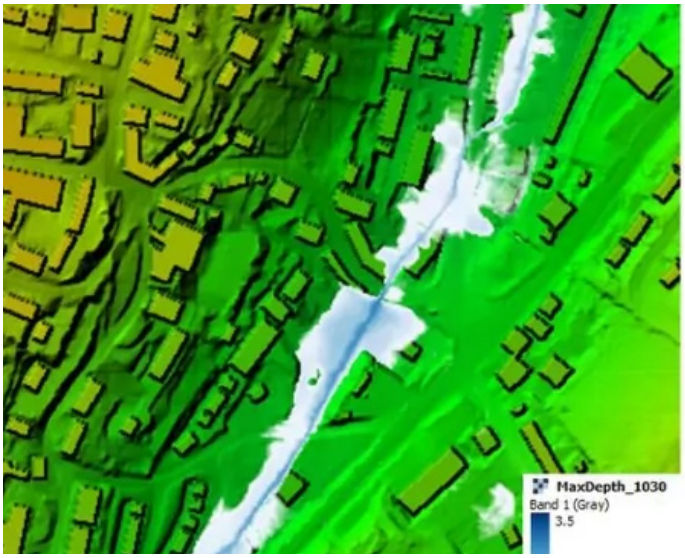
the **solution**

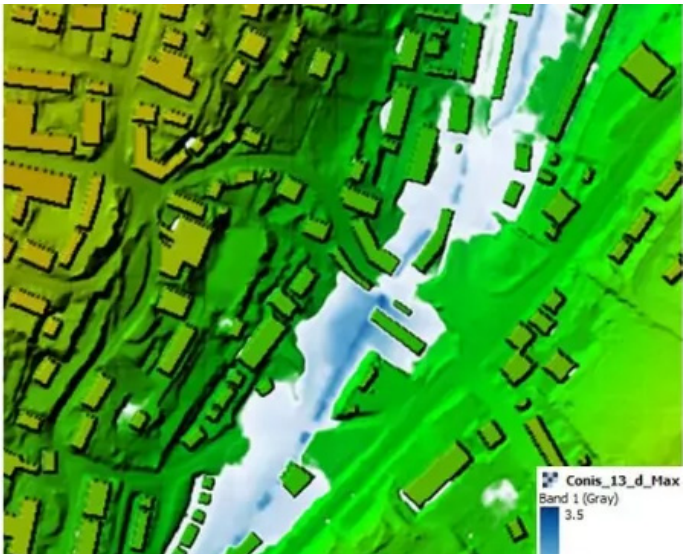
The hydrological analysis incorporated TUFLOW HPC, to develop a direct rainfall model for the entire Kearsley Brook catchment. Rainfall was input as a time series of the 20, 50, 100 and 200-year return period design storm events. The catchment has some areas of ground conditions amenable to infiltration, and this was represented in the model using the Horton method with initial and continuing losses throughout the simulation.

The model demonstrated the movement of surface water within the area and allowed the proposed NFM interventions to be compared against the baseline (pre-interventions) so that the respective flood extents and flood depths could be directly compared. This included:

- The maximum potential upstream catchment area based on topography
- The overland flow depth, flood extent and flow and velocity in the flooding locations

Model outputs were presented as maps showing the extent and depth of flooding on a 1 m grid resolution, and graphical representation of the water levels within the Kearsley Brook channel pre and post NFM interventions.





the **results**

The detailed hydraulic modelling was able to quantify the reduction in flood extent and depth at a property footprint level and attribute this to the reduced peak flow within the Kearsley Brook due to the implementation of NFM features in the upstream catchment.

The proposed NFM designs consist of mainly earthworks to create depressions and bunds to redirect and/or hold back water at various sites within the upstream catchment. Some of the sites selected for NFM interventions comprise of public open space, and the designs have been developed to enhance the amenity and biodiversity value in addition to providing the flood benefits. With river catchment modifications and climate change impacts, downstream urban flooding is becoming more commonplace and widespread. The need to implement flood risk management solutions that also provide wider benefits should always be considered.

Conventional, hard-engineered drainage infrastructure solutions are becoming less appealing as they require extensive capital works and are typically seen as carbon intensive and do not provide wider benefits such as enhancing amenity value and creating habitats to address the ecological crisis.

In the UK, there are now several examples of implementing NFM within the rural upstream catchment in the expectation that the cumulative effective of numerous NFM interventions within the catchment will reduce peak flows in the watercourse downstream. This work clearly demonstrates that NFM interventions to detain runoff in the upstream catchment provides flood alleviation benefits to properties downstream and resilience to changing rainfall patterns.

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