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Assessing Flood Risk and River Modelling
Doulton Brook Development, West Midlands

PLANNING POLICY INTRODUCTION

For any proposed residential development close to a river or watercourse in England, there is a stringent control system implemented through the planning process to set in place the necessary measures to protect new and existing dwellings and manage residual flood risk.

For the Taylor Wimpey Doulton Brook development off Wollaston Road in Stourbridge, the overarching flood risk control was delivered by the Department for Communities and Local Government's 2006 Planning Policy Statement 25: Development and Flood Risk (PPS25) and it's supporting Practice Guide. Underpinning PPS25 was local and regional planning strategies for sustainable development.

KEY STAKEHOLDERS INVOLVED

Established property investment and development company, the Revelan Group, funded and promoted the planning application for Doulton Brook, for which the Flood Risk Assessment was a crucial component.

Leading home builder and developer, Taylor Wimpey, ultimately purchased and developed the site suitable for a sustainable residential development.

While the Local Planning Authority, Dudley Metropolitan Borough Council (DMBC), made the final decision for the Doulton Brook development planning application, statutory flood risk consultee the Environment Agency (EA) and their team of experts were consulted throughout the planning process. The EA also set key technical standards required for the development's Flood Risk Assessment, particularly in respect of the proposed changes to the River Stour that flows through the development site.

ASSESSING THE FLOOD RISK

A Flood Risk Assessment (FRA) is an integral part of development design, which helps promote and deliver sustainable housing and the one undertaken for Doulton Brook was very detailed and included considerable consultation with DMBC and the EA.

While a development FRA is submitted to the LPA as part of the planning application, it is the EA who will appraise its technical content, raise objections where necessary and ultimately approve it when deemed satisfactory in terms of current and residual flood risk management. A FRA must confirm that a development meets contemporary requirements in terms of flood risk management and that flood risk is not increased elsewhere off the site.

As is still the case today, PPS25 required that FRAs must be undertaken by competent people. The PBA team has many years' experience in the assessment of flood risk, hydrology, flood defence and river engineering. The masterplan at the time of the 2011 Doulton Brook development FRA was provided by 4Ward Architects and, in consultation with the EA, River Stour channel realignment expertise was provided by McAuliffe Environmental Ltd.

The restoration and realignment work was an important FRA component, as over 200m of the original River Stour channel was enclosed in a culvert through the site. Opening up or "daylighting" culverted rivers and watercourses (where technically feasible) is supported by both DMBC and the EA.

MODELLING THE RIVER STOUR

For the River Stour work, PBA consulted with the EA from the very beginning of the FRA process and obtained from them a copy of their existing 1 and 2 dimensional (1D & 2D) hydraulic model (using industry standard ISIS-TUFLOW software) and The River Stour Flood Risk Mapping Study Report (April 2010).

Along with a full and detailed topographic survey of the existing site, these components were used to establish what is known as the "baseline hydraulic model" that accurately replicated the pre-development River Stour hydrology and hydraulic conditions. This hydraulic model was subsequently approved by the EA.

Worth noting, there remains an important interaction between the River Stour and the Stourbridge Branch Canal, which exerts a controlling influence on flood hydraulics throughout the river corridor in the vicinity of the development site. This was replicated in the hydraulic model including canal spillway connections into the river, as pictured above.

The baseline hydraulic model also simulated the approximate 225m length of the River Stour that was culverted beneath the original industrial area on the site.

Modelled storm events are better expressed in terms of their annual exceedance probability (AEP). For example: the 1% AEP equates to a storm event that has a 1% chance of occurring in any one year (also referred to as the 1 in 100 year return period).

Consequently, the baseline River Stour model was used to establish the existing 5%, 1% and 0.1% AEP (20, 100 and 100 year) floodplain outlines after a very detailed and complex hydraulic analysis. The simulated floodplain extents were used to evolve the development masterplan and associated civil engineering proposals.

Once the baseline hydraulic conditions of the River Stour were established, the development design was introduced into the hydraulic model, then simulated and assessed. This involved modifying the baseline hydraulic model to incorporate the entire development proposals, including adding the new highway bridge, removal of the culvert, restoration of the River Stour corridor and ground raising along the eastern boundary of the site.

As required by PPS25 and contemporary river modelling standards, in addition to the storm events above, the hydraulic analysis at this stage also included for the 1% AEP with an additional 20% added to increase peak flows to replicate estimated climate change effects up to the year 2115. This storm event is of particular interest to the EA and was the benchmark for comparison with the baseline conditions.

The results from our detailed design hydraulic analysis demonstrated that peak water levels along the reach of the River Stour extending upstream of the site were reduced by up to approximately 150mm and 300mm for the 1% AEP plus climate change and 0.1% AEP events respectively. This is because the original culverted section of the River Stour was restricting peak flows and that increased upstream water levels. So by removing the culvert and improving the channel this actually improved flood flows in the River Stour through the development, while not increasing flood risk downstream.

MODELLING THE RIVER STOUR

Freeboard is a commonly used river hydraulic modelling factor of safety usually expressed as a height above a water level for purposes of flood risk management. It is used to compensate for any unknown factors that could contribute to flood heights greater than the height calculated for a selected storm event.

Such factors could include for example, a large tree branch partially obstructing the river channel during a flood event, as pictured above.

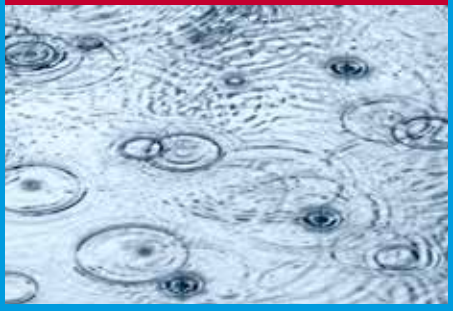
The freeboard between the peak flood level and the top of bank of the restored channel varies along the restored reach. For example, in respect of the 1% AEP plus climate change, the freeboard varies between approximately 1.0m and 2.0m through the development.

Furthermore, a freeboard between peak water levels and top of bank levels is maintained for all events up to and including the 0.1% AEP event.

The EA also set a planning condition that finished floor levels on the Doulton Brook development must be set a minimum of 600mm above the 1% AEP plus climate change flood levels, a height which has been exceeded given the freeboard in the River Stour channel.

THE OUTCOME FOR THE DEVELOPMENT

What this means in actual terms is that during times of storm there will still be significant rises and falls in the water levels along the River Stour through the development site, particularly during very prolonged heavy rainfall.



As an indication, these water level rises are modelled as approximately (the precise levels will vary along the length of the channel through the development) 1.5m for the 5%AEP, 2.0m for the 1% AEP plus climate change and 3.0m for the 0.1% AEP.

However, crucially in terms of residual flood risk, through the development site all of these modelled storm events indicate that the River Stour flows remain "in bank" and do not flood the surrounding area.

After PBA produced an Addendum to Flood Risk Assessment in November 2011, in response to subsequent flood risk matters raised by the EA, the Doulton Brook development FRA was fully approved on 1st February 2012.

In October 2013, PBA was once again appointed to undertake an assessment of the potential flood risk impacts associated with the latest River Stour restoration proposals by McAuliffe Environmental Ltd and design levels proposed by Taylor Wimpey. The design levels proposed along the eastern frontage of the site provided adequate freeboard above the 1% AEP plus climate change flood levels. Furthermore, the river restoration proposals provided an acceptable level of freeboard between the top of bank and the peak flood level.

The key objectives of restoring the River Stour and sustainably developing the site were achieved, while providing acceptable levels of flood protection to the new dwellings and not increasing the site's flood risk.

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Taylor Wimpey

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