Hydrology of the Crimple Valley Catchment Area

The following is a brief outline of scientific, procedural, and economic concerns relevant to the hydrology and flood resilience of the Crimple Valley. These considerations, which are expanded in more detail in our full report, support the case that this sensitive hydrological catchment basin should remain in its current, largely rural, condition.

The Crimple catchment area (Figure 1) includes the housing and employment draft site allocations PN17, PN18, PN19 and PN20 of the Harrogate Borough Council (HBC) Local Plan, and other major building proposals such as those for the Dunlopillo-Buttersyke Bar section of Green Belt.

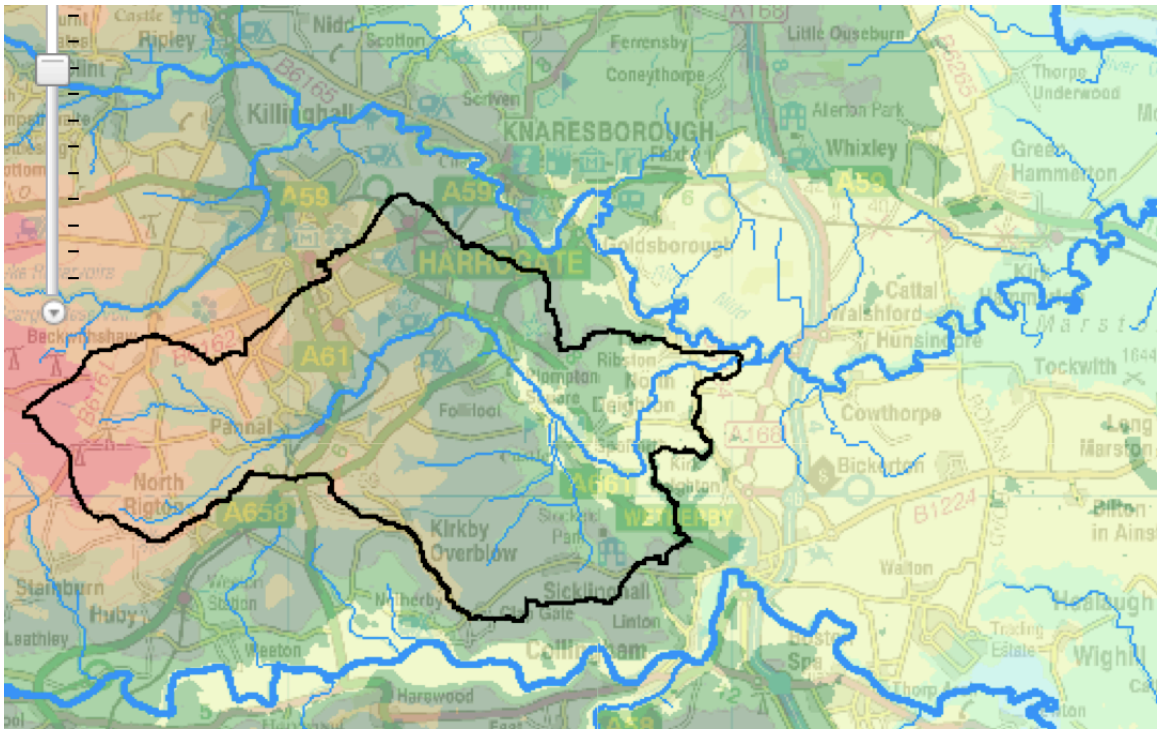

Figure 1. The Crimple catchment area (black outline) superimposed on an OS map with colour-shaded topology. Parts of the Rivers Nidd and Wharfe are also shown, respectively to the north and south of the Crimple. Data from the National River Flow Archive, Centre for Ecology and Hydrology, Natural Environment Research Council.

The reasons listed below overwhelmingly indicate that the entire catchment basin should be excluded from the HBC Local Plan and from any HBC Planning considerations for major building development. These are topics which the HBC site selection procedures and Built and Natural Environment Site Assessments (BNESA, 2017) assessments have not yet considered with sufficient diligence. Indeed, the HBC proposals for the Pannal sites could be construed as failing to meet Planning soundness criteria for (a) hydrological aspects of environmental sustainability and (b) consistency with current national policy as it relates to flood resilience and flood management plans.

These concerns fall into four main topics:

1. The hydrological problems and flood risk of the Crimple basin are substantially greater than has been considered in HBC's Planning exercises. This is supported by well-established sound scientific records and other independent evidence, all readily and publically available.

2. The conventional Environment Agency (EA) Flood Risk Zone assessments, at least for the Crimple Valley, no longer provide an adequate basis for the allocation and assessment of priorities among potential sites for major building developments. The need for additional considerations, even at an early stage of Planning, is unequivocally clear from more recent major HM Government national policy documents and EA publications on Flood Resilience.

3. The remaining rural land of the Crimple Valley provides an essential component of the buffer zones that mitigate the flow of storm water into the exceptionally flood-prone Nidd and Ouse basins. Undeveloped rural buffer zones are especially critical in catchments with the hillslope and flash flood hydrological characteristics of the Crimple basin.

4. The cost and scale of effective flood resilience engineering has been very substantially underestimated. This general issue has been thoroughly documented in the recent HM Government Flood Resilience Review and in EA publications and project reports. Effective mitigation for the Crimple Valley and elsewhere would require expensive civil engineering projects ("Integrated Catchment Management") over unacceptably large land areas. The smaller SUDS (SUstainable Drainage Systems) schemes currently under consideration have very limited efficacy under flash storm conditions.

Topics 1 and 2 are explained further in the bulleted points below, and all topics are to be fully referenced and expanded in detail in our full report currently under construction.

- The physical hydrology of the Crimple Beck basin has long been studied and the underlying scientific principles are exceptionally well understood. It is the classic example of a catchment area showing subsurface responses to rainfall runoff in the upland hillslopes, overland flows, saturation of the lower sideslopes, and frequent flash floods in the main channel.
- The physical principles underlying the Crimple basin response to rainfall were established in the 1970s through pioneering predictive modelling studies by two of Britain's most accomplished hydrologists, Professor Keith Beven FRS and Professor Mike Kirkby: http://www.tandfonline.com/doi/pdf/10.1080/02626667909491834?needAccess=true&redirect=1 This is one of the most influential publications in the entire field of hydrology with over 5000 citations in the peer-reviewed literature.

- Subsequently, 45 years of daily streamflow records have been recorded by the EA Burn Bridge monitoring station and are publically available from the National River Flow Archive at: http://nrfa.ceh.ac.uk/data/station/meanflow/27051 (the graph shows peaks of multiple flash flood events throughout the 2015/2016 winter and the unprecedented extreme peak flow of late December 2015).
- The Crimple Beck data archives provide local evidence for two trends since the 1990s: (a) extreme flash flood events have intensified, and (b) the winter baseline streamflows (i.e. the seasonal norm that persists between flash floods) have increased, whereas the normally low summer baselines may have somewhat decreased.
- Experiences of Crimple Valley residents, and local historical records, are in accord with this scientific perspective and data: dramatic damaging flash floods, persistently waterlogged lower slopes through the winter months (e.g. on the PN19 site), and streams of runoff water frequently flowing overland in locations where natural drainage and storm drain systems have become overwhelmed (e.g. from the Clark Beck sub-catchment onto the PN17 site).
- To add credibility to the increased probability of flash floods, the same trends seen in the Crimple Beck data are present more strongly in regionally aggregated national data, especially for catchments throughout the North of England, Scotland, and Wales.
- These trends parallel the greater probability of extreme monthly rainfall as conservatively recalculated for the present prevailing atmospheric regimes by Met Office Hadley Centre scientists. A summary of this work is in Annex 2 of the HM Government September 2016 publication – National Flood Resilience Review. (HMG-NFRR): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551137/national-flood-resilience-review.pdf
- This Met Office analysis has been widely supported by risk analysts, including in other branches of Government and in the re-insurance industry. Importantly, it gains credibility by avoiding any alarmist implications and by being based only on the current prevailing meteorological conditions as they affect the UK.
- In a caveat that is relevant to Crimple Valley, the Met Office adds that the probabilities for short intense flash storms or for rainfall extremes in upland or mountainous locations are not included in their model but are likely to be even greater than the increased national or regional monthly extremes they conservatively calculate.
- In contrast, the EA flood risk assignments for the Crimple Valley, notably the Zone 1 areas (less than 0.1% risk per annum), appear to systematically underestimate the flood risk and are inconsistent with the physical and observed reality.
- The concept of a 1:1000 risk is readily understood, and residents have been justifiably skeptical of the EA Zone 1 assignment given to most of the PN19 site; in contrast, in the real world, that particular section of Pannal Meadows was partially inundated by Crimple Beck flash floods during 2000 and 2002 and extensively flooded during June/July 2007, January 2014 and

December 2015. Similar discrepancies apply to the overland flow on the PN17 site higher on the hillslope.

- However, the EA has always acknowledged that many such discrepancies exist in the National Flood Risk Assessment (NaFRA) maps, as has the insurance industry. Accordingly, the EA is currently in the early stages of a multiyear project to update the assessments in more detail ("NaFRA2") and, especially, to incorporate the more complex lessons learned from the extreme floods of 2007, 2014 and 2015.
- The public EA literature on the NaFRA maps has always included many caveats and carries legal disclaimers. Relevant caveats include (a) the relatively low spatial resolution of flood risk models, (b) that the models are based on national or regional parameters and important local factors are often ignored (e.g. often omitting topographic details of smaller flash flood prone catchments as typified by the Crimple), and (c) assessments are only infrequently updated and may become obsolete when conditions change.
- This raises a dilemma for planners as to whether the current NaFRA zones should still be used for planning puposes. How does the Planning process meet its obligations under sections 100 and 101 of NPPF?
- An appropriate current procedure would be to continue to refer to NaFRA Zones, but only in a strictly limited preliminary way as a general approximate indicator of areas of land where flood risk from rivers or sea might exist. Given the many caveats about Zone assignments, planners are obliged to exert careful diligence and actively seek additional pertinent information (e.g. policy documents such as HMG-NFRR, independent pubic documents such as those cited here, and well informed local input) as a basis for recommendations and decisions, even at an early planning stage.
- Consequently, one principal procedural failing of the HBC and BNESA exercise has been to interpret the EA NaFRA flood risk zones too literally, especially during allocation and prioritisation of the sites considered in the HBC LP allocations.

Abbreviations for government documents cited:-

NPPF: HM Government - National Planning Policy Framework. March 2012
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

HMG-NFRR: HM Government – National Flood Resilience Review. September 2016
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551137/national-flood-resilience-review.pdf

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