Project Telford Level 2 SFRAs **Date** May 2008
Note Hydrological methodology **Ref** WBTWCS
Author Rebecca Bailey

1 *Introduction*

1.1 This technical note focuses on the hydrological approach taken for the Level 2 SFRA assessment of the following watercourses:

Watercourse*	Upstream Extent (OS NGR)	Downstream extent (OS NGR)
Wall Brook (also cited as Donnington Watercourse)	371210 314040	370000 315690
Wesley Brook Tributary	370361 308299	371940 306050
Hurley Tributary	363740 311880	363810 314270
Crow Brook	368590 311510	367940 314880
Mad Brook	370020 307020	371410 303830
Hurley and Ketley Brook	365752 310831	365090 315160

*It was not always possible to determine the local name for the watercourse. The names referred to here are in agreement with the proposal document.

2 *Objectives*

2.1 To derive flood hydrographs for the following return periods for use in the 2D hydraulic models:

- 20 (5% AEP)
- 100 (1%AEP)
- 100 plus climate change (1%AEP plus 20% increase in flows)
- 1000 (0.1% AEP)

3 *Choice of Methodology*

3.1 The Flood Estimation Handbook (FEH) is the current industry standard for flood estimation in the UK. There are two principle methodologies available in the FEH; the Statistical Method and the Revitalised Flood Hydrograph (ReFH) model, which has recently replaced the Rainfall-Runoff model for most applications.

3.2 The chosen methodology for the hydrological modelling is the FEH Rainfall-Runoff model, for the following reasons:

- The majority of the catchments within the study area are heavily urbanised ($URBEXT_{2000}$ 0.15 <0.600) and therefore the FEH guidance advises against the use of the ReFH approach.
- The catchments are ungauged and too small (<10km²) for statistical method. It is unlikely that a suitable pooled group of stations could be found.
- All the catchments are within the limitations of this method.
- This approach is favoured when catchments are disparate.

4 The Rainfall Runoff Model

4.1 The Rainfall-Runoff method uses a unit hydrograph and losses model to transform a design rainfall event into runoff from the catchment. Where possible, estimates of time-to-peak (Tp), baseflow and standard percentage runoff (SPR) should be based on gauged data rather than catchment descriptors. No suitable gauged data was available for any of the catchments therefore estimates are based on catchment descriptors alone.

5 Design rainfall

5.1 Design rainfall was derived using the FEH. The design storms for each study area were determined by analysis of the whole catchment. The duration which theoretically produces the highest peak flow from the catchment was used in each case. The storm area was set as equal to the whole catchment area and the rainfall parameters were consistent between each subcatchment.

6 Climate change

6.1 Climate change was modelled by increasing the 100 year flows by 20%.

7 Surface water

7.1 A broad scale assessment has been made to judge whether the surface water network imports flows from outside the natural topographic catchment. This is based on the assumption that for up to a 5% AEP (1 in 20 year) event, surface runoff will follow the artificial drainage network and therefore may be exported/imported outside of the topographic catchment boundary. For events greater that the 5% (1 in 20 year) AEP event, the drainage network would become surcharged and surface runoff would follow the natural topography.

7.2 GIS layers of the surface water network, along with the locations of surface water outfalls, were made available by Severn Trent Water. This enabled the estimate of areas outside the topographic catchment which are served by a network of drains which would bring water into the subject catchment. Estimation of flows for these contributing areas was achieved by increasing the catchment area used for the estimation of 5% (1 in 20 year) AEP flows to include the extra contributing areas. This would have most significance for the lowest return period of interest (1 in 20 year, or 5%AEP event).

8 Assumptions applicable to each subject reach

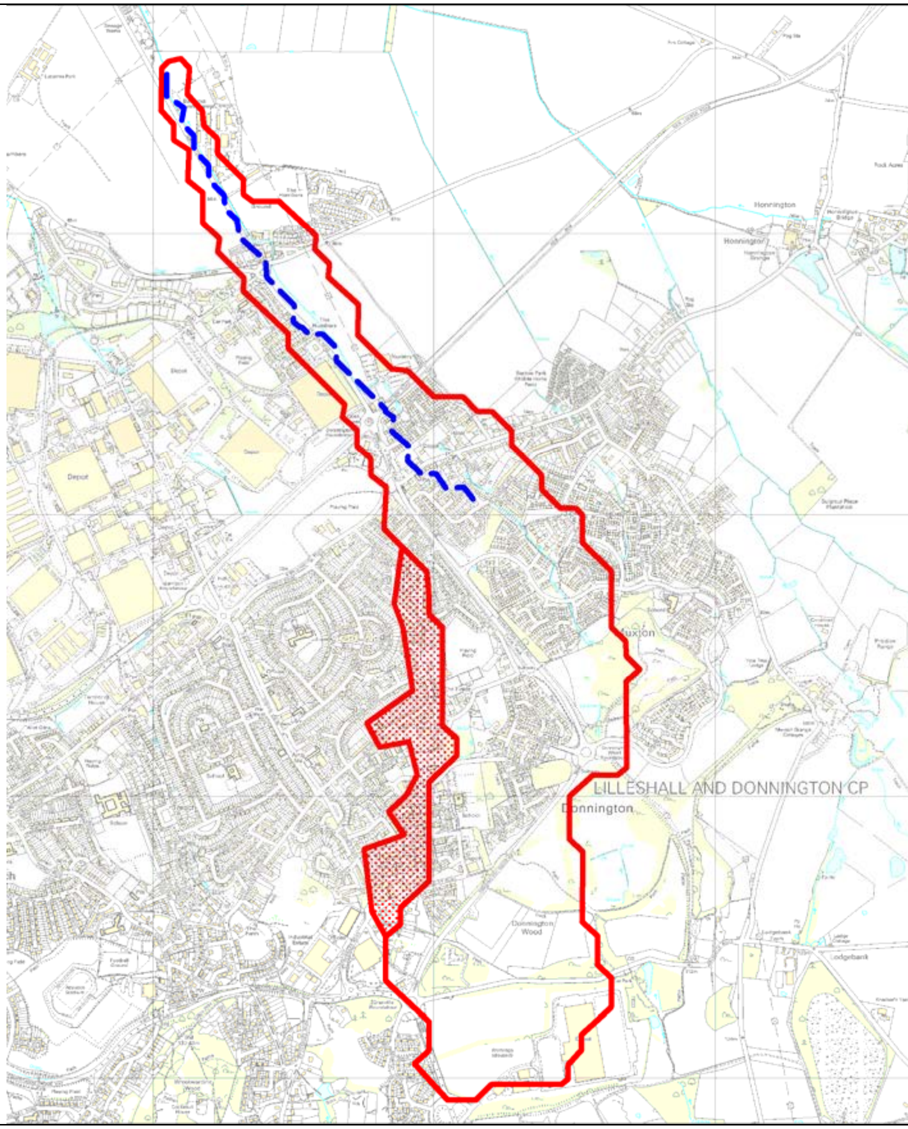
8.1 The following assumptions were made for each subject reach:

- The catchment boundaries as shown on the FEH CD-ROM v2 are correct..
- During a 20 year event or greater, surface runoff follows natural topography.
- All surface water flows converge at the drainage paths as shown on the FEH CD-ROM. Attenuation from structures has only been considered within the modelled extents.

9 Results

9.1 Each subject catchment is summarised below.

Red lines denote the catchment boundary, dotted blue line shows modelled extents and direction of watercourse and hatched red area shows imported runoff areas from drainage network.



Wall Brook
(also cited as Donnington Watercourse)

<u>Catchment Descriptors</u>

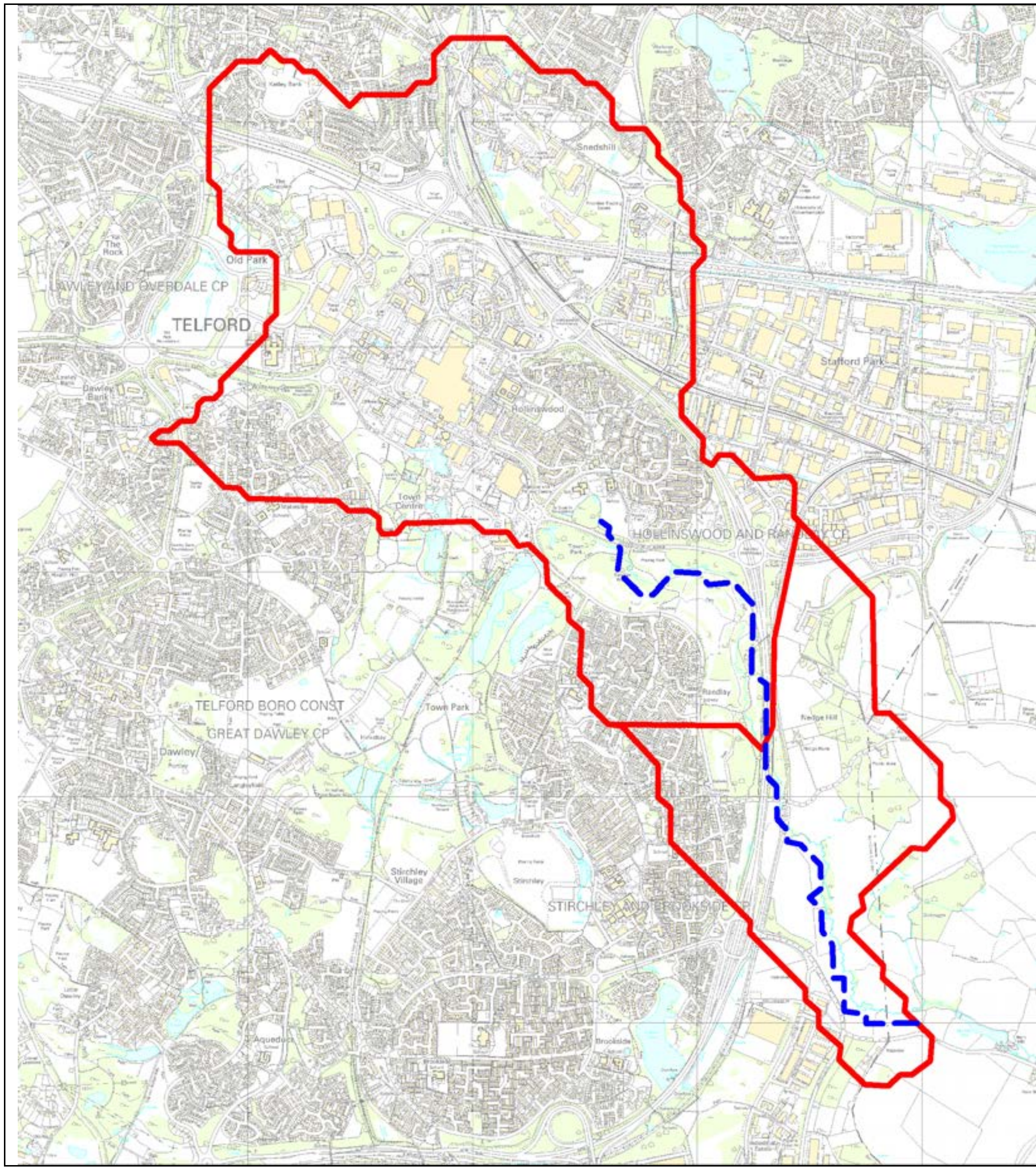
AREA: 1.82 km^2
SARR: 699 mm
URBEXT$_{2008}$: 0.2278
SPRHOST: 38.53 %

Design storm duration: 2.75 hours

<u>Model Inflow boundaries</u>
Lumped catchment approach (1.82km^2) fed into upstream model extent.

<u>Notes</u>

Imported runoff areas shown in hatched red = 0.19km^2



Wesley Brook Tributary

Catchment Descriptors

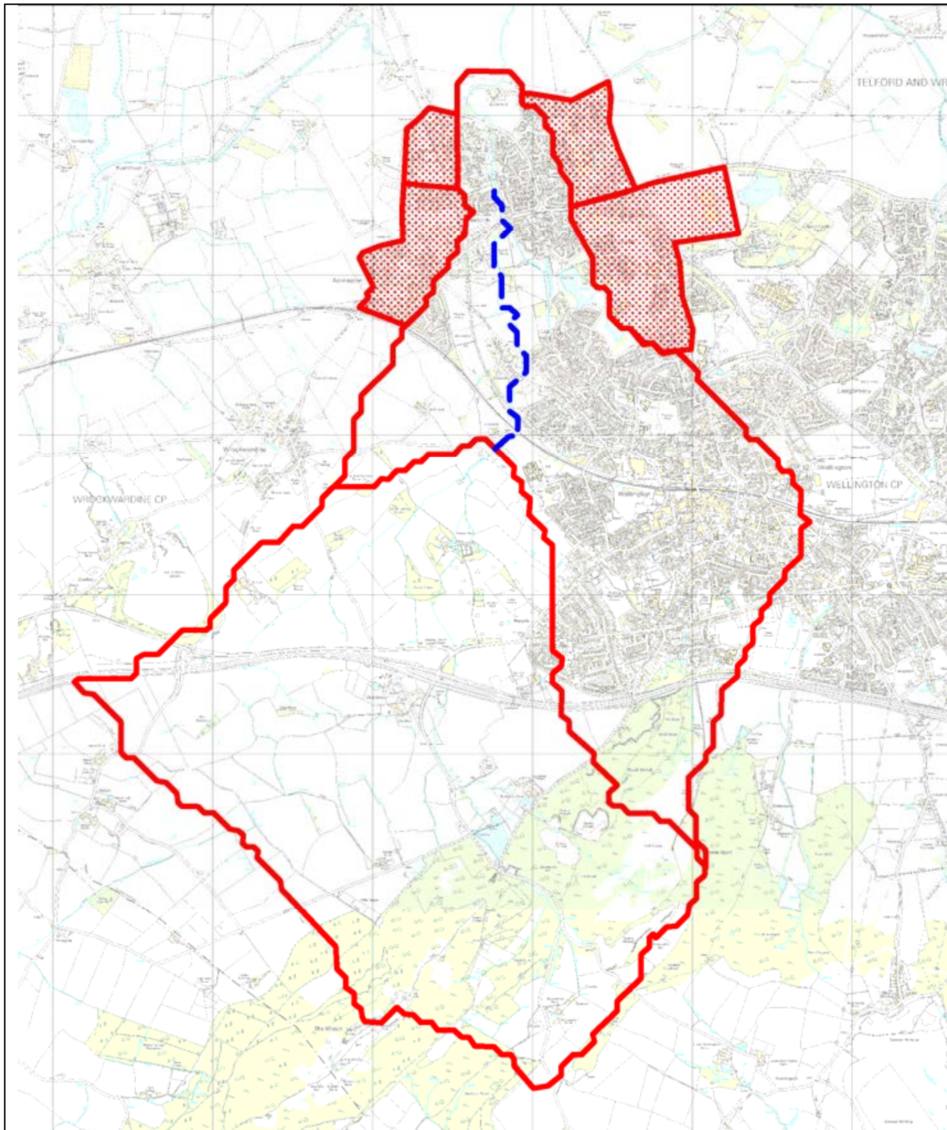
AREA: 6.47 km²
SARR: 733 mm
URBEXT$_{2008}$: 0.4332
SPRHOST: 36.16%

Design storm duration: 1.3 hours

Model Inflow boundaries
Flow hydrographs were derived for the whole catchment and then were distributed though the model.
77% was fed in to the upstream extent to reflect the catchment upstream of the A442 incorporating some of Ketley Bank and Snedshill north of the M54, the town centre and Hollinswood area and the more rural Randlay Wood.
23% was fed in after the A442 representing the remaining catchment through Nedge Hill.

Notes

No imported runoff areas identified; it is possible that some surface runoff from Randlay is exported into Holmer Lake via trunk sewers. The effects of this were not modelled.



Hurley Brook Tributary

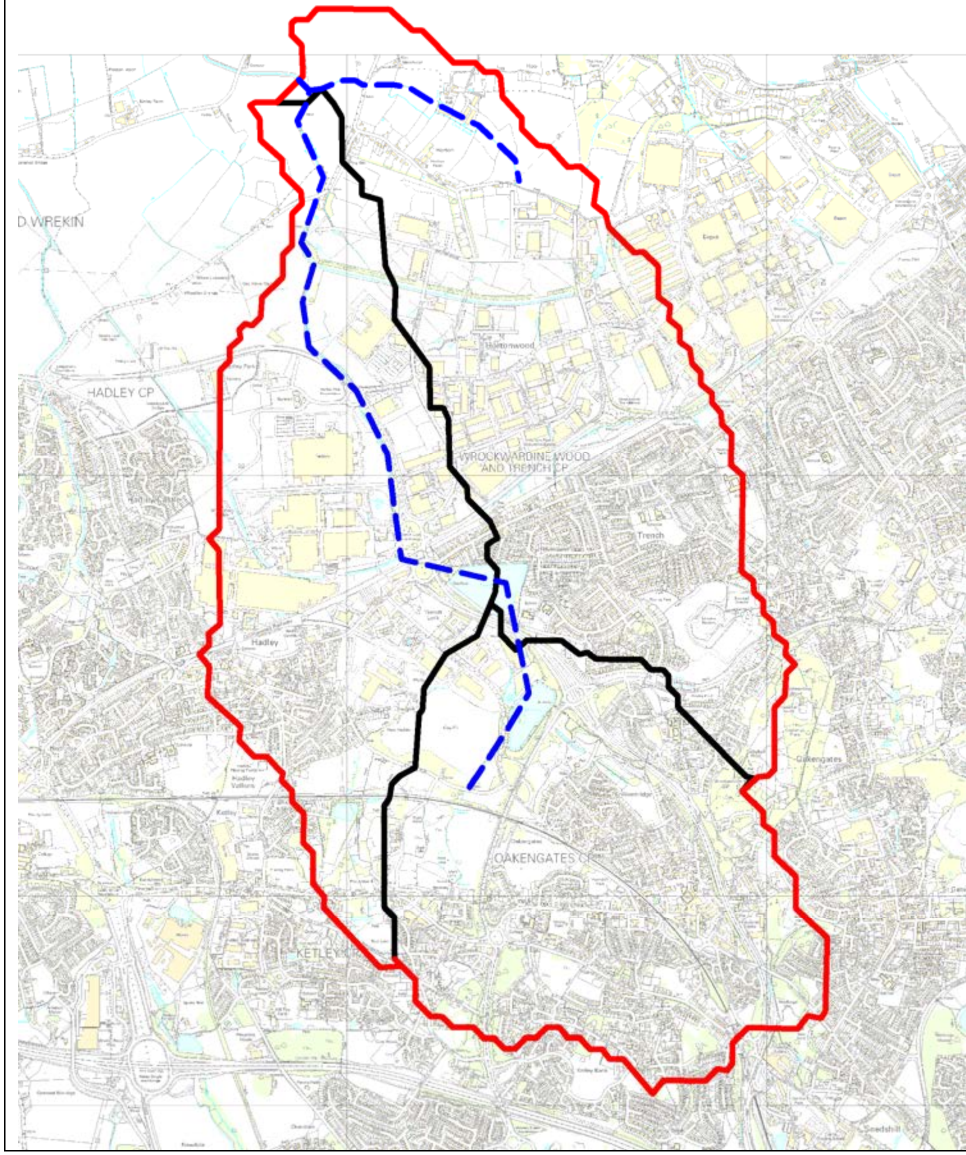
Catchment Descriptors

AREA: 13.71 km^2
SARR: 698 mm
$URBEXT_{2008}$: 0.01482
SPRHOST: 38.75%

Model Inflow boundaries
The upstream boundary represents the catchment to Shawbirch Road, which is predominantly rural, fed into the upstream extent of the model.
The lower boundary represents the remaining, predominantly urban area, fed in at the location of the drain on the right bank.

Notes

Imported runoff area shown in hatched red = 1.42km^2



Crow Brook

<u>Catchment Descriptors</u>

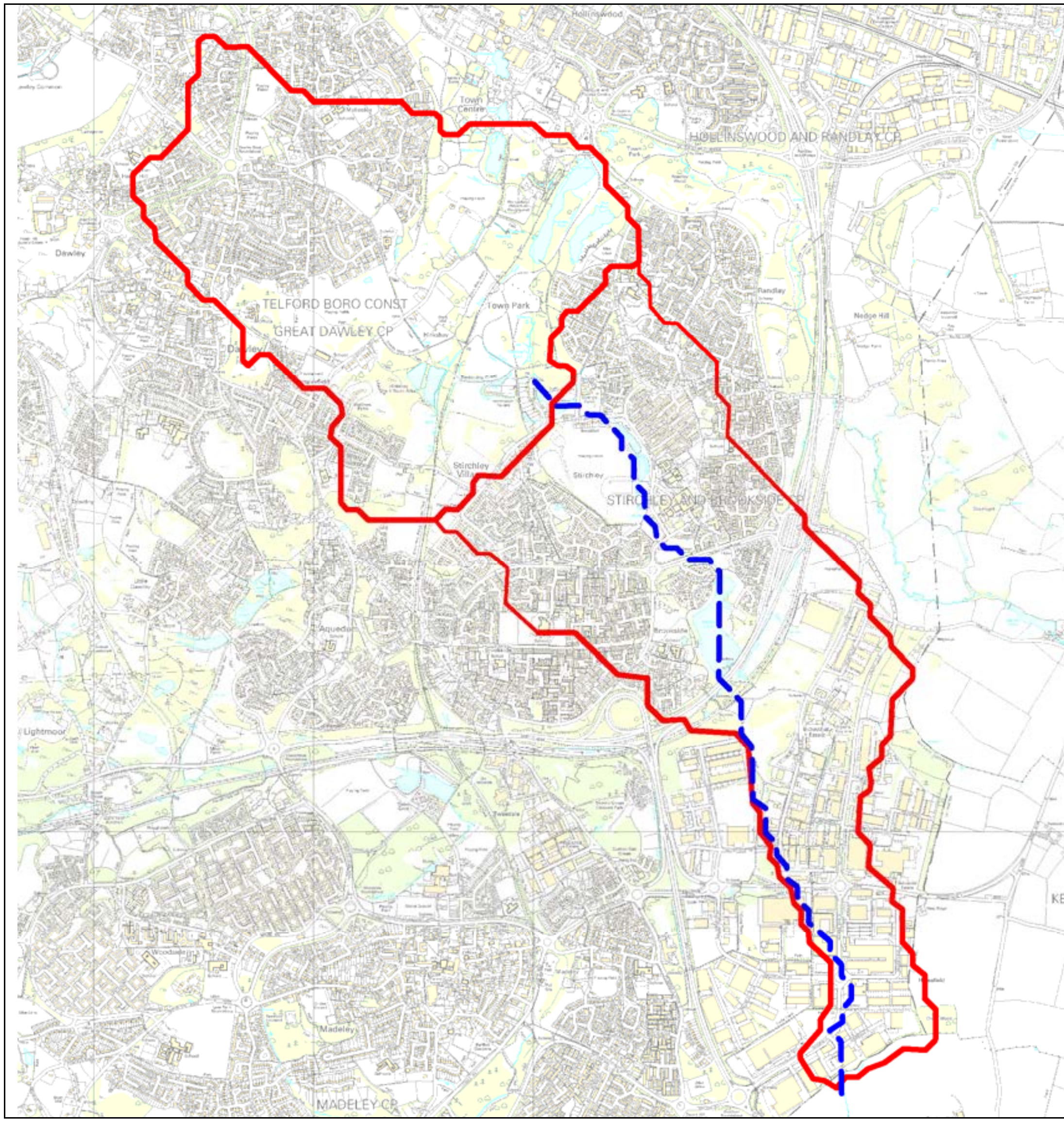
AREA: 10.03 km^2
SARR: 713 mm
$URBEXT_{2008}$: 0.3988
SPRHOST: 38.34%

<u>Model Inflow boundaries</u>

Three inflow boundaries were derived.
Crow Upper represents the catchment extending out through Oakengates. The surface runoff converges at Middle pool and hence feeds in to the upstream extent of the model.
The Crow East catchment area represents the surface runoff from parts of Wrockwardine Wood and Trench. This inflow feeds in to the model at the upstream extent of the small tributary reach.
The Crow inflow represents runoff from the Hadley area and north of the dismantled railway line through the industrial estate.

<u>Notes</u>

No imported runoff areas were identified.



Mad Brook

<u>Catchment Descriptors</u>

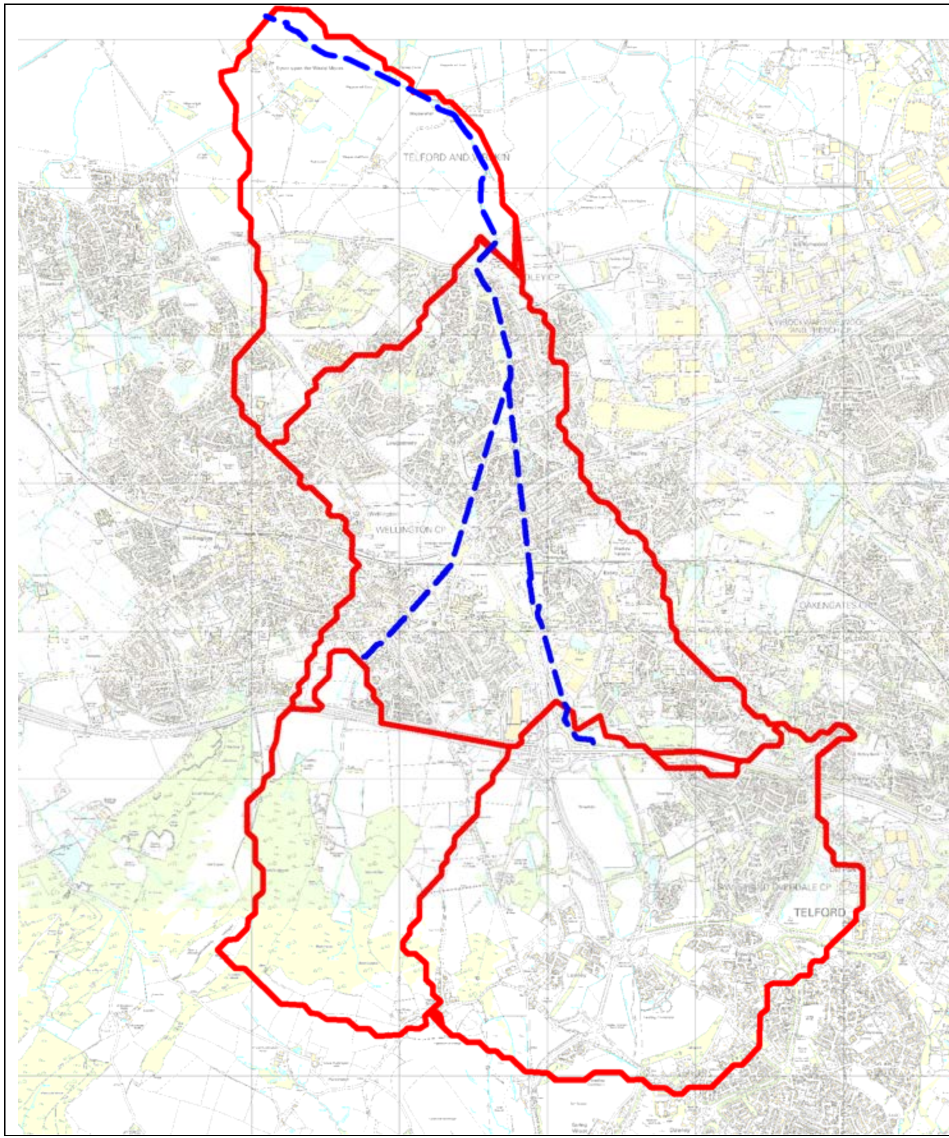
AREA: 5.87 km^2
SARR: 731 mm
URBEXT$_{2008}$: 0.4611
SPRHOST: 36.99%

<u>Model Inflow boundaries</u>

Two inflow boundaries were created, one representing the catchment to the upstream extent to the model including parts of Malinslee and Town Park. The other inflow boundary represents the remaining catchment around Stirchley, Brookside and the Industrial Estate. The lower boundary was fed into the model at Holmer Lake and downstream of the A442.

<u>Notes</u>

Imported runoff areas were difficult to determine due to the presence of trunk sewers. However, the flows derived were in agreement with values stated in a report about Holmer Lake.



Hurley and Ketley Brook

Catchment Descriptors

AREA: 17.57 km^2
SARR: 707 mm
URBEXT$_{2008}$: 0.2537
SPRHOST: 38.32%

Model Inflow boundaries

Two catchment areas were identified for the upstream model extents namely 'East' and 'West' representing the more rural southern parts of the catchment. Upper East contributes to Ketley Dingle pool and the tributary feeding in downstream of the pool. Upper West includes some extra area from the upstream side of the railway line. The remaining area was divided into Lower Urban fed in at 3 inflow locations and Lower Rural representing the remaining more rural part of the catchment.

Notes

No imported runoff areas were identified.

Watercourse	Inflow boundary	20 year peak flow (5% AEP) (m^3s^{-1})	100 year peak flow (1% AEP) (m^3s^{-1})	100 year peak flow plus climate change (m^3s^{-1})	1000 year peak flow (0.1% AEP) (m^3s^{-1})
Wall Brook	D1	2.5	4.0	4.8	9.8
	Import	0.3	0.3	0.3	0.3
Wesley	W23	4.2	6.9	8.2	14.8
	W77	14.0	23.0	27.6	49.4
Hurley Trib	HU	6.8	103.	12.4	18.6
	HL	10.7	17.0	20.5	32.7
	Import	2.9	2.9	2.9	2.9
Mad Brook	MU	12.1	19.5	23.4	38.8
	MLH	4.0	6.6	7.9	13.4
	MLL	0.0	6.6	7.9	13.4
Crow Brook	Crow	5.5	8.9	10.7	17.8
	CU20	1.9	3.1	3.7	6.1
	CU80	7.8	12.4	14.9	24.6
	CE	6.8	10.9	13.1	21.8
Hurley and Ketley	UW	2.3	3.8	4.6	7.8
	UE1	8.8	14.1	16.9	28
	UE2	2.6	4.2	5.1	8.4
	L1	2.4	3.9	4.7	7.8
	L2	2.9	4.7	5.6	9.4
	L3	3.3	5.3	6.3	10.5
	LR	2.2	3.6	4.3	7.4

Peak Flows for each watercourse and modelled return period