

MINEHEAD – Hydraulic Assessment Bratton Stream

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Background

The Environment Agency (EA) plans to install a water level gauge on the Bratton Stream and telemetry at Minehead in North Wessex (Fig. 1). This is to be employed as a Flood Warning site, information from which will be used to warn of flooding downstream. Jacobs, as successor to Babbie in the Babbie Brown and Root consortium, was commissioned in May 2005 by the EA to develop a robust hydraulic model for this location to allow development of an accurate and reliable stage-discharge curve at the site. In order to construct the hydraulic model, a channel and topographic survey was carried out.

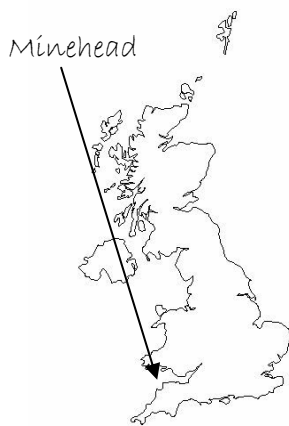


Fig. 1 Location Map

Objectives

The project objectives were to:

- * Produce a topographical site survey
- * Derive the 2, 5, 10, 25, 50, 100 and 200-year return period flows

and water levels at the site using HEC-RAS models.

- * Determine the sensitivity of the predicted water levels to certain hydraulic variables.
- * Present the data, analysis and results in a clear format, including text, tables, drawings etc.

Proposed gauging site

The proposed site lies in parkland just upstream of a small brick arch culvert under a road. The park edge, adjacent to the road is formed by a low landscape bund broken only by the course of the footpath following the watercourse on its left bank.

The watercourse has a good baseflow and the low channel consists of a small cobble bed generally with walled edges approx. 400mm high. Through the park the watercourse is bounded immediately on its right bank by a fence. A grassed floodplain is present on the left bank.

Immediately downstream of the road, the watercourse flows through private land of a residential property and passes over a weir with a drop of approx. 700mm. The weir forms a good downstream boundary for the hydraulic model.

It appears that a combination of the weir and culvert under the road will act as a hydraulic control at low flood flows and that the road itself and the bund on the park boundary will act as the hydraulic control for more extreme floods.

A relatively simple HEC-RAS model, covering all the features given above, is sufficient for this site. This will model approx. 100m of the Bratton Stream watercourse.

At the site detailed for the proposed gauge there are significant tree roots in the channel on the right bank. These could vary in size with time and, in the interests of long term stability of the rating at the site, may need to consider removal of the roots.

Fig. 2 Site location



Hydrology

The Bratton Stream drains eastwards to Minehead and then out towards the north Somerset coast. The catchment covers 7.51km² and is essentially rural. The geology is permeable with a standard percentage runoff estimated using the HOST soils classification of 17.9%.

The Flood Estimation Handbook (FEH) methods were used to estimate the design flows for the un-gauged watercourse. The FEH is the recommended method of flow estimation in the UK. The FEH comprises two methods of flow estimation, the statistical pooling group method and the rainfall-runoff method. The pooling group method was considered the most appropriate method for this study where an estimate of the peak discharge is required. Using donor catchment data from the local gauges of Swill Bridge and Beggearn Huish provided an indication of the flow behaviour of Bratton Stream.

Using this technique, flood flow estimates were derived for 2, 5, 10, 25, 50, 100 and 200-year return periods for the site. To account for future climate change flood flows took into account potential increases of up to 20% in peak flows over the next 50 years (MAFF, 2000); Table 1.

Table 1: Design Flows (cumecs)

R.P. (yr)	Design Flow	Design Flow + 20%
2	1.3	1.6
5	2.0	2.4
10	2.5	3.0
25	3.5	4.2
50	4.5	5.4
100	5.8	7.0
200	7.4	8.9

Survey

The survey was commissioned in July 2005 and included all hydraulic structures on the watercourse. The topographic survey is given in Fig. 3.

Fig. 3 Survey of proposed site



Hydraulic Modelling

The proposed gauge location site has been modelled using the steady-state one-dimensional modelling software HEC-RAS (v. 3.1.3). The model does not take into account floodplain storage effects. The model has been developed assuming that sub-critical flows dominate the watercourse. This is an un-gauged catchment - no data is available to allow calibration or validation of the hydraulic model.

12 channel/floodplain cross-sections were used in the model (Fig. 4). 3 structures were modelled, including the road bridge, footbridge and weir. Values

of channel roughness have been estimated from reference tables and site observations; these are given in Table 2.

Table 2: Roughness Coefficients

River	Channel 'n'	Floodplain 'n'
Bratton Stream	0.02-0.04	0.03-0.07

Discharge coefficients associated with structures have generally been taken as HEC-RAS default values (1.44).

The downstream boundary condition was taken as the normal depth based on the channel slope at this location. The upstream boundary condition was set to critical depth.

The detailed topographic survey at the proposed Minehead gauge site was used to extend the channel/floodplain cross-sections in order to model over-bank flows. Section spacing was approximately 10m. An additional secondary channel was added to accommodate the change in flood flow mechanism at higher return periods (50, 100 and 200-year).

References

MAFF (2000) Flood and Coastal Defence Project Appraisal Guidance, Overview v.1



Fig. 4 Site survey map

