Darfield Community Association

Darfield Weir Detailed Design

Weir Hydraulic Assessment

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September 2008

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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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1 Introduction

1.1 Background

The project involves the construction of a rock ramp structure at Darfield Weir on the River Dearne at Darfield, South Yorkshire, to provide fish and canoe passage over the weir. The rock ramp works will be part of a wider re-generation scheme for the Dearne Valley, which includes the provision of a car park and an adjacent canoe launching/recovery facility downstream of the weir, close to Doncaster Road bridge and the provision of permanent fishing platforms and links to local footpaths along the river.

The rock ramp will incorporate a row of heavy boulders at the toe and a number of herringbone blockstone rows aligned in the manner of groynes across the river to encourage water retention and positioned to present a gently curving plan shape. The blockstone groynes are to be stabilised and retained by dowels bars fixed to the downstream apron supporting a low height hardwood timber sill. The river bed between the groynes is to be filled with graded armour stone.

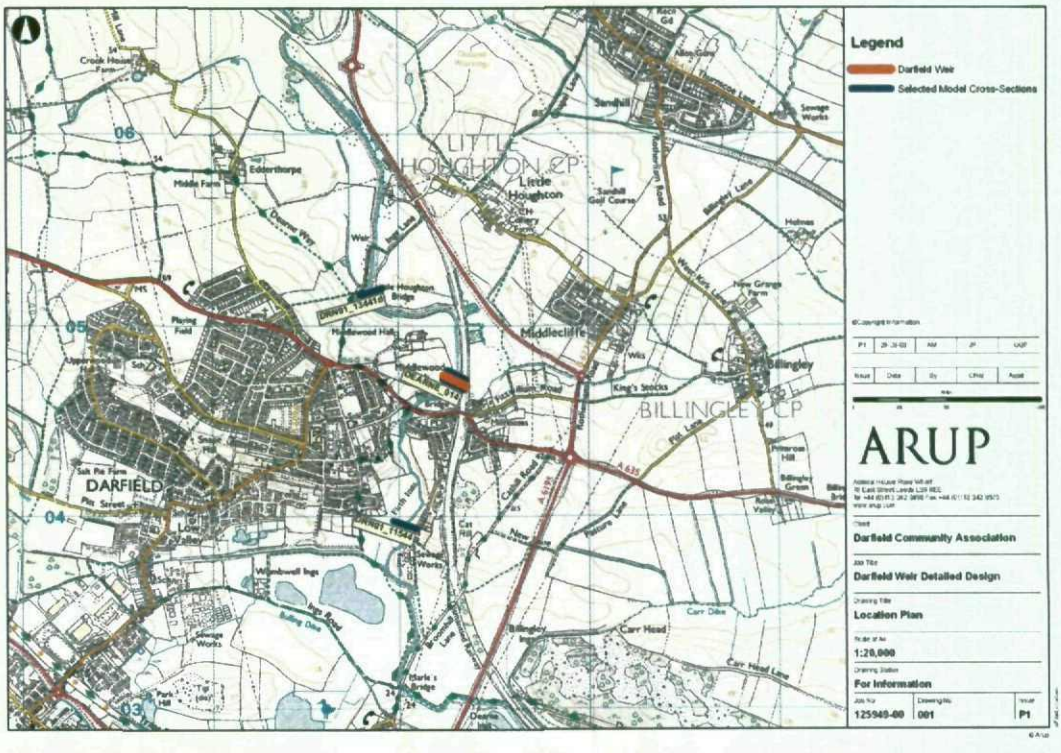
Darfield Weir is, according to the Environment Agency Flood Maps, in an area that has a significant chance of flooding, with the probability each year being greater than 1.3% (1 in 75). The area suffered serious flooding as recently as the summer of 2007.

This report considers the effect on water levels and the risk of flooding at the site after construction of a rock ramp.

1.2 Location

The plan below (Figure 1) shows Darfield weir and also the location of the cross-sections referred to in Table 1.

Figure 1 Darfield weir location plan.



1.3 Purpose of Assessment

Properties within the community of Darfield have been acknowledged as at risk of flooding from the River Dearne. A hydraulic assessment of proposed weir alterations was identified as a key requirement of the detailed design stage of the study. This note seeks to summarise the hydraulic assessment undertaken, the key aims of which were:

- Assess the impact of the proposed weir on water levels in the up and downstream vicinity of the weir;
- Evaluate the impact of the weir on local water velocities.

2 Hydraulic Modelling

2.1 Scenarios

2.1.1 Baseline

The Section 105 FRM model was trimmed so that a section extending from approximately 900m upstream[1] to 3500m downstream of the weir only was retained. The following amendments were made to this model portion:

- This section contained an inflow from the River Dove and the Wombwell washland. However, due to their location well downstream of the weir, these features were not considered significant for the purposes of assessing weir hydraulics and surrounding flood risk and so were removed from the baseline model.
- A normal depth boundary was applied at the downstream end of the trimmed model.
- A 1% annual exceedance probability (AEP) event peak flow of 75.4 m³/s at Darfield weir was extracted from the Section 105 study results. A Revitalised Flood Hydrograph (ReFH) boundary unit, using catchment descriptors and factored to this peak flow, was used as the upstream inflow.
- Additional survey data of the weir and the river channel immediately up and downstream was obtained. Due to the relatively coarse cross-section resolution of the initial model this was incorporated into the baseline model to provide more thorough representation through the weir area.
- Within the Section 105 model the Darfield weir was originally modelled using a 'General Purpose Weir' unit. In order to more fully reflect the actual weir geometry this was changed to a 'Round Nosed Broad-Crested Weir' unit as this enabled the downstream length of the weir to be included.

2.1.2 Proposed Weir and Rock Ramp

The proposed arrangement of the weir and rock ramp are shown on Figure 2 (125949-001). The existing weir crest and length will be retained at 22.0 mAOD and 11.7 m, respectively. The downstream length of the weir (i.e. the rock ramp section of the proposed weir) will increase from the existing 1.9 m to 16.5 m.

The two trapezoidal chute sections of the rock ramp have not been included within the modelled weir crest. Also, any porosity through the rock ramp aggregate has not taken into account. Both these factors would increase conveyance over the proposed weir and their non-inclusion is deemed a conservative means of assessing hydraulic impact.

2.2 Results

Model results, for the baseline and proposed case, are provided in Table 1.

[1] This extends upstream to a location approximately 230m downstream of the Houghton gauging weir. Potential Darfield weir impacts will not extend upstream beyond this gauging weir.

Table 1. Predicted maximum stage and velocity results for both the baseline and proposed Darfield weir scenarios.

Cross-Section	Location	MAXIMUM STAGE			MAXIMUM VELOCITY		
		Baseline Case (mAOD)	Proposed Case (mAOD)	Difference (m)	Baseline Case (m/s)	Proposed Case (m/s)	Difference (m/s)
DRN01_13441d	900m upstream of Darfield weir	25.46	25.48	0.02	1.20	1.19	-0.01
DEARNE_01	25m upstream of Darfield weir	25.07	25.10	0.03	1.01	0.98	-0.04
DEARNE_05a	Immediately upstream of Darfield weir	25.02	25.05	0.04	1.27	1.25	-0.02
DEARNE_09	Immediately downstream of Darfield weir	24.55	24.55	0.00	1.22	1.22	0.00
DEARNE_014	25m downstream of Darfield weir	24.56	24.56	0.00	1.03	1.03	0.00
DRN01_11544	1000m downstream of Darfield weir	23.61	23.61	0.00	1.09	1.09	0.00

2.3 Discussion

The results in Table 1 show a maximum increase in water level of 0.04 m, which occurs immediately upstream of the weir. Maximum water levels are very slightly increased along the upstream stretch between Darfield and Houghton weirs. However, there are no properties, on either bank, along this section which would be put at a significantly increased risk of flooding by an increase in the 1% AEP event maximum water level from 25.02 mAOD to 25.05 mAOD. There is no change in predicted water level downstream of Darfield weir.

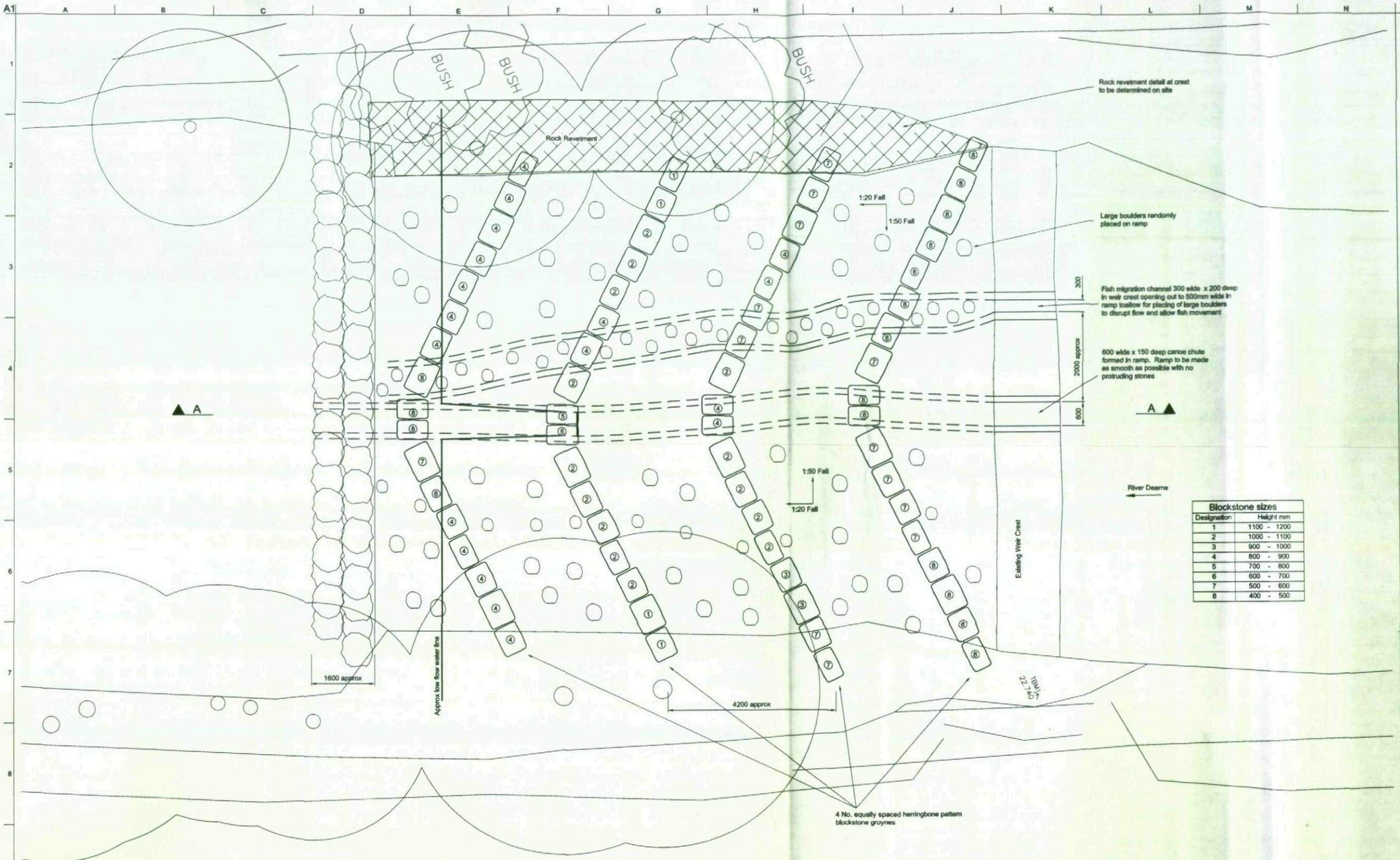
Predicted maximum velocities during the 1% AEP event show a slight decrease upstream of the weir and no change downstream.

3 Conclusion

Hydraulic modelling of the baseline and proposed weir rock ramp scenarios at Darfield weir has shown the impact of the proposals to be relatively minimal. Peak water levels upstream of the weir may be increased very slightly, but these are not likely to place any properties at a significantly increased risk of flooding. Peak water levels downstream of the weir show no change. Predicted maximum velocities show a slight decrease or no change.

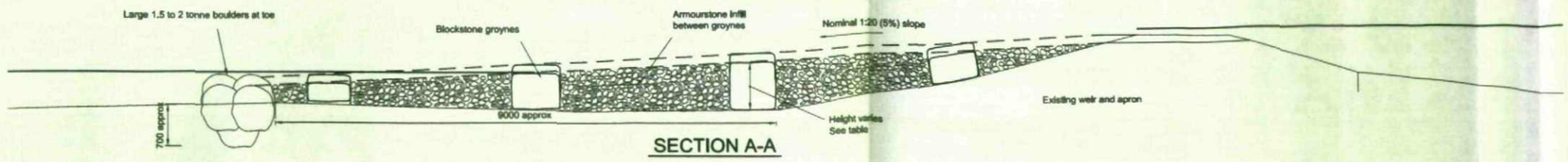
FIGURES

Figure 2 Darfield weir general arrangement.



Blockstone sizes	
Designation	Height mm
1	1100 - 1200
2	1000 - 1100
3	900 - 1000
4	800 - 900
5	700 - 800
6	600 - 700
7	500 - 600
8	400 - 500

PLAN



SECTION A-A

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Job Title

River Dearne, Darfield
Rock Ramp

Drawing Title

General Arrangement

Scale at A1 1:50

Plot ID

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125949	001	T1

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