the River Restoration Centre

Working to restore and enhance our rivers

Delivering River Restoration: Recipes for Success

13TH ANNUAL NETWORK CONFERENCE

Restoring Europe's Rivers

Byron's Pool nature-like fish pass, highlighting the need for a 'hands on' approach

Project funded by

Cambridgeshire Horizons – driving forward sustainable communities

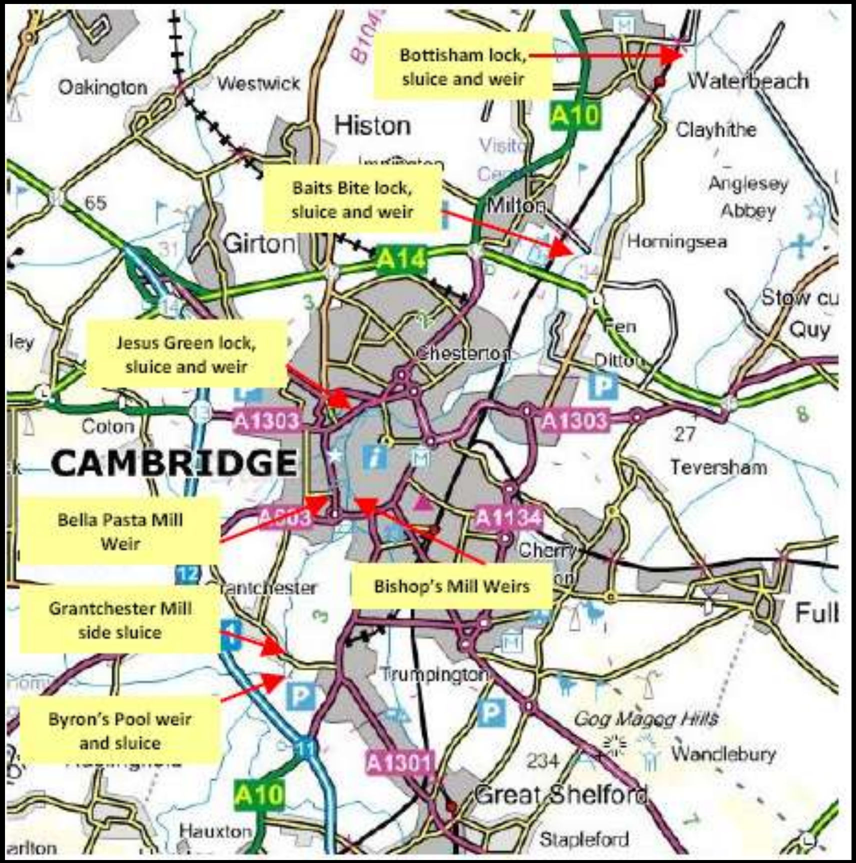
Environment Agency

Cambridge City Council

Ellis Selway MIEEM

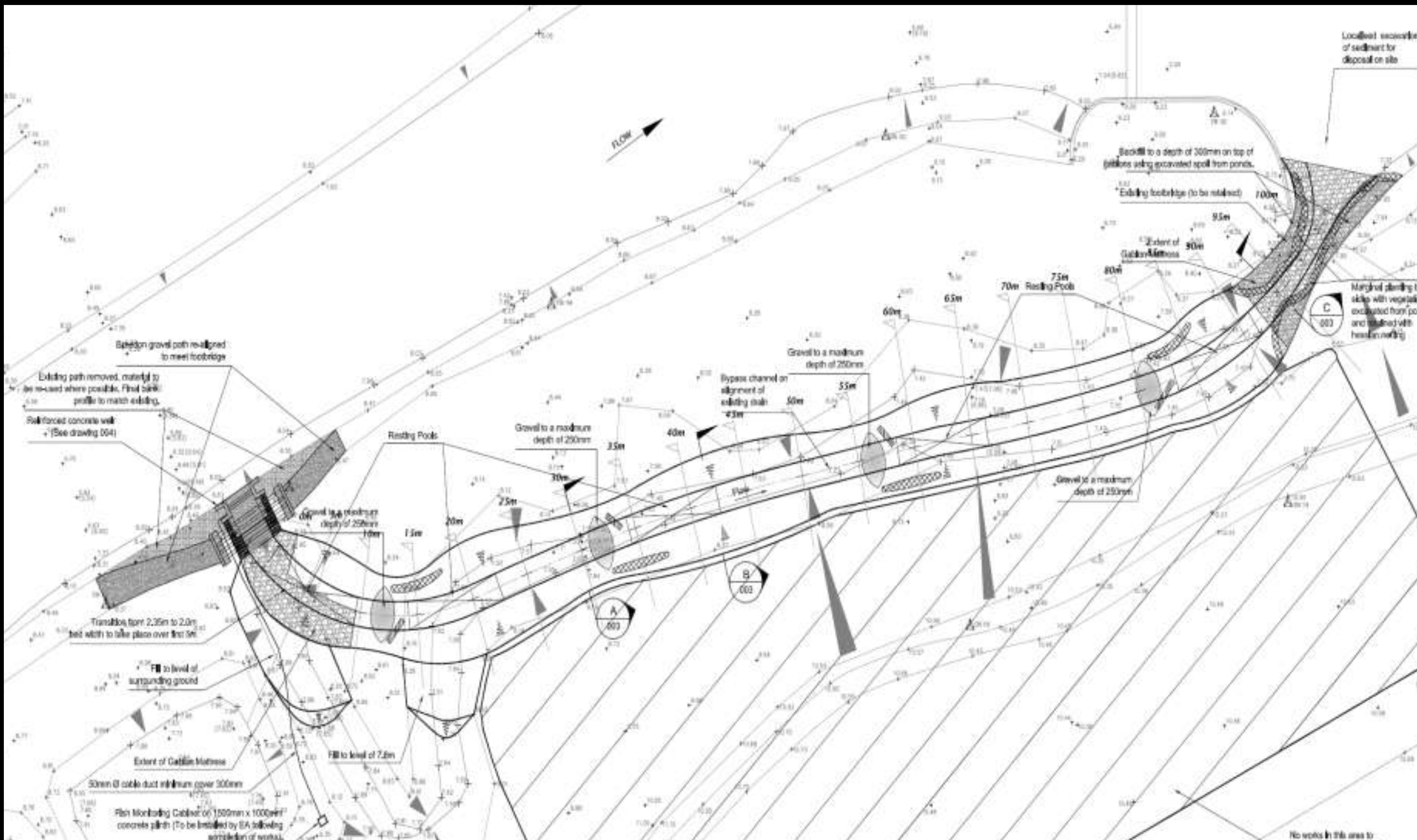
Bodhi Ecology

Anthropogenic in-channel structures

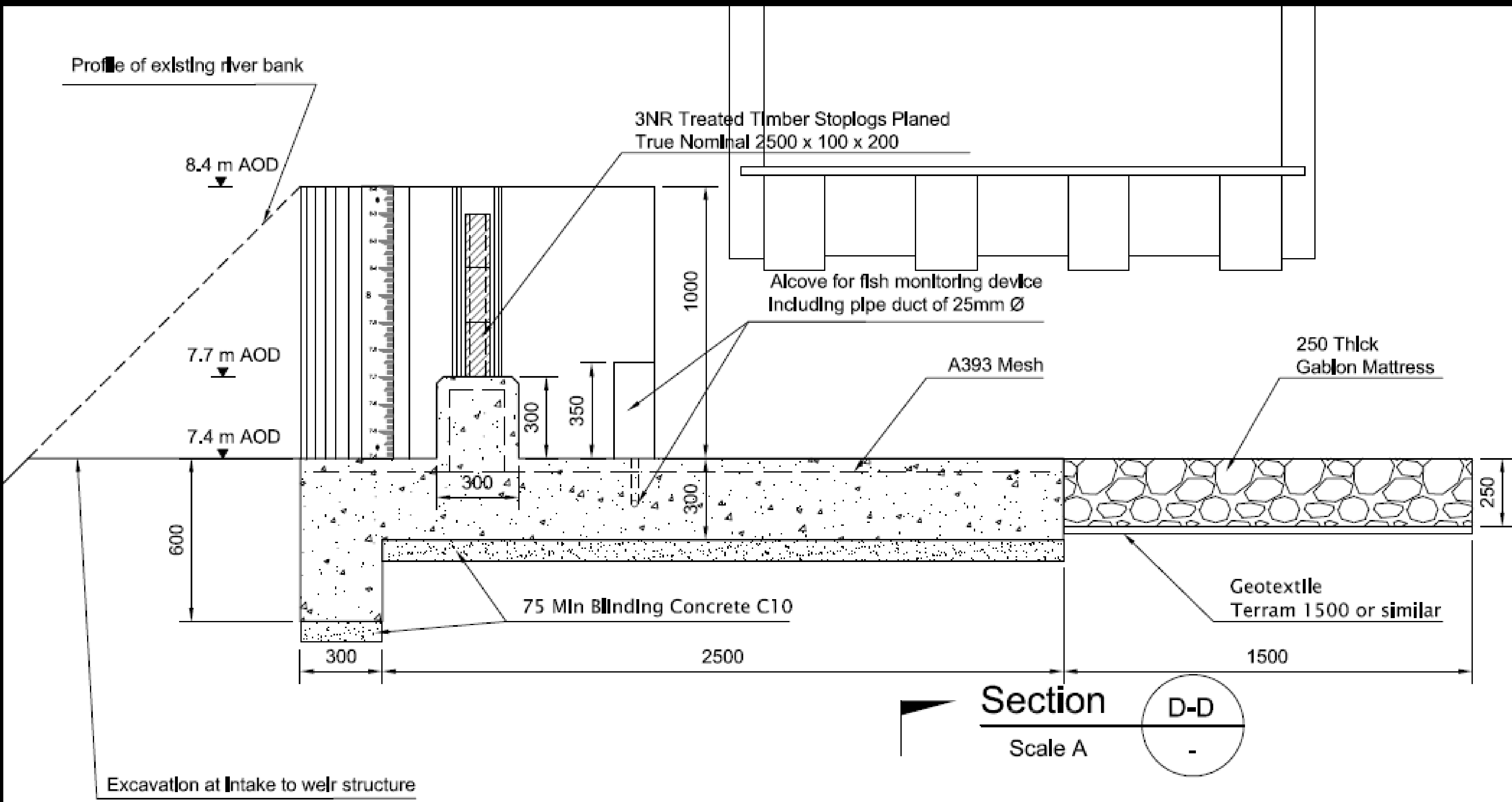


The problem- a complete barrier!

The solution- bypass channel



Small side weir- flow control and maintenance



Construction starts-at last!

Problem- No hard bed level

Construction modifications

Solution-Import additional gravel

Operational modifications

Problem-Excessive water velocity

Operational Modifications

Solution- turreted stop log and additional riffle

Operational Modifications

Solution- Perturbation boulders

Did it work?

Free passage- connecting isolated and fragmented aquatic systems

Creating valuable habitats- lost on our regulated rivers

Thank you

bodhiecology@btinternet.com

Bodhi Ecology

Presentation Supplementary notes
RRC Conference, Nottingham 19th & 20th April 2012

A CASE STUDY ON THE DESIGN, CONSTRUCTION AND EFFECTIVENESS OF A NEW NATURE-LIKE FISH PASS AT BYRON'S POOL ON THE RIVER CAM, HIGHLIGHTING THE NEED FOR A 'HANDS ON' APPROACH

ELLIS J. SELWAY
Ecologist – Bodhi Ecology
bodhiecology@btinternet.com

Abstract

Riverine fish depend highly upon the physical characteristics of their habitat, utilising different niches during their life cycle for growth, survival and reproduction. Anthropogenic in-channel structures such as weirs can impede these movements, contributing to the decline of fish populations. Fortunately, as a result of legislative and climate change targets, the restoration of riverine habitats has gained momentum in recent years and fish passes of varying design, including ecologically minded nature-like passes, are widely accepted as a method of helping to restore connectivity. Despite this there only a few nature-like fish passes in the UK and limited information available on their effectiveness.

An ambitious project, spanning 5 years from concept to construction, the Byron's Pool nature-like fish pass was installed on the River Cam to bypass a fixed crest weir and sluice representing a complete barrier to fish migration. Specialist contractors were appointed to engineer the design and construct the pass, with construction carried out between 16th December 2010 and 30th March 2011. Several modifications to the design, needed to make the pass fully operational, were carried out both during construction and immediately after the opening of the pass. These included the import of additional gravels, retention of a turreted stop log and installation of additional rocks and boulders.

The effectiveness of the pass was measured using a combination of visual surveys, electrofishing and use of remote video cameras. Environmental conditions were also measured to indicate if these were within the range of physical and biological parameters required by fish.

The pass has proven to be effective and valuable lessons have been learned about the importance of a 'hands on' approach, using manual alterations and adaptations to enhance an otherwise formulaic process.

Keywords: Anthropogenic in-channel structures; Complete barrier; Migration; Fish pass; Effectiveness; Electrofishing; Remote video cameras.

Bodhi Ecology

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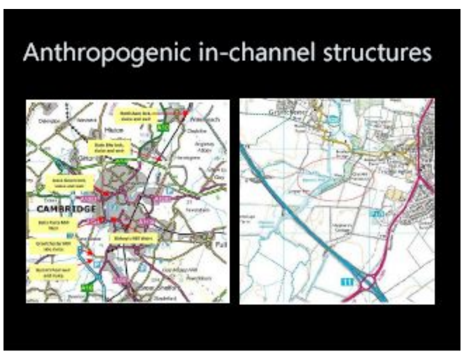
This presentation explains how a **'hands on' approach** was needed to **resolve problems which arose during construction and initial operation of the pass.** It also includes a summary of the findings of my MSc research project which included **an assessment of its effectiveness within the first 3 months of operation.**



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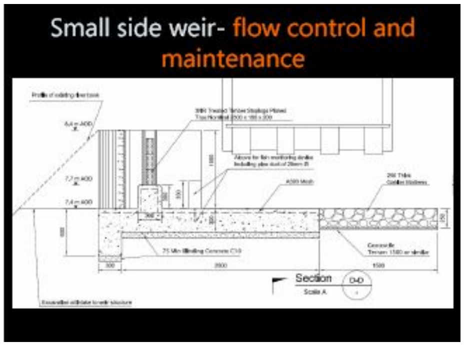

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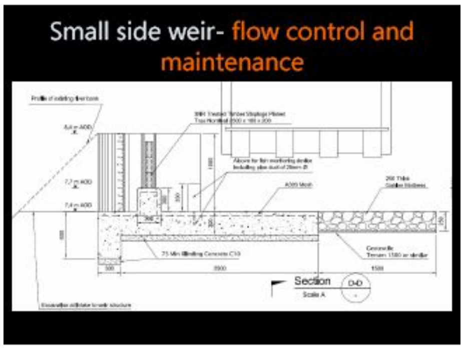

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Solution-To form the channel to the dimensions as designed an additional mixed fill of claybound rejects, ranging from 20-100mm, and graded gravel 10-20mm was imported. This material was also used to infill areas which had become unstable during the removal of silts from the main channel. This provided the opportunity for shallow gravel margins alongside the main channel diversifying the habitat.

I also placed woody debris and individual angular gabion stones (up to 200mm) randomly in the channel to provide suitable refuge for fish such as Bullhead *Cottus gobio*. Further piles of gravel and gabion stones were left on the bank so that I could tweak the riffles once operational.

With these problems during construction overcome the pass was eventually opened on the 30th March 2011.

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Problem- When the temporary dam and stop logs were removed the flow was highly turbulent swamping the riffles and producing a flow beyond the designed parameters. This was in part due to downstream water levels on the main river being c.200mm lower than average due to exceptionally low rainfall between March and May, the driest 3 month period on record (since 1910), resulted in river flows on the Cam being 42% of the Long Term Average (Environment Agency 2011b).

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Solution- With assistance I placed a combination of gabion rocks and larger 300-450mm perturbation boulders (Heimerl & Wurster 2006) in to the entrance of the pass and the first riffle to baffle the flow, producing areas of slack water for fish to rest in whilst ascending into the pass.

Flow velocity was later measured at a maximum of 1.2m/s, 10cm below water level (water depth c.25cm), well within the recommended maximum velocity parameters of 2m/s for passage of fish (FAO/DVWK 2002).

So with the modifications made did it work…?

Yes but only after these modifications were made. Even operational at historic low flow on the main river the combination of surveys conducted in first 3 months of operation proved that the pass was effective both in terms of the presence of fish within the channel (utilising the habitat) and passage of fish able to migrate upstream beyond the physical barrier.

- visual surveys- minnows negotiating pass/ spawning activity (Minnows, Gudgeon and Chub)
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Key messages:

- **Would it of worked without a hands on approach, NO**

- Even with an engineered design, problems may arise during construction and operation whereby physical alterations maybe needed.

- As a project manager you need to be able to find solutions.

- **In this project this approach made the difference between it being a failure and a success.**

Bodhi Ecology

Extracts from my MSc study* in relation to:

- *specific question asked at conference in relating to Eel passage*
- *Limitations of, and recommendations for, monitoring*
- *Overall conclusions*

*Selway, E., 2011. A case study on the design and construction of a new nature-like fish pass on the River Cam, with an assessment of its effectiveness. Unpublished.

Eel passage

Measured exit water velocity

The water velocity through the slots in the stop log (the fish pass exit) were measured at 1.2m/s. Although these are within acceptable ranges for coarse fish, the water velocity through the stop log slots may exclude passage of elvers (juvenile Eels), as observations by McLeave (1980 cited in Larinier et al. 2002) found that their ability to pass a laminar flow was very limited and that they could only cover a distance of 30cm at a water velocity of 0.5m/s. However, the cumulative impact of barriers to migration further downstream and the relative position of he pass within the catchment mean that the number of elvers reaching Byron's Pool is low (0-1 Ind./100m2) (DEFRA 2010).

The monitoring carried out as part of this study has highlighted the need for some minor modifications to allow free passage for elvers and the need for long-term maintenance of the pass to prevent woody debris (flotsam) potentially blocking the channel.

An elver bristle ramp (with tufts of bristles spaced 7mm apart) (Solomon & Beach 2004) could be retrofitted on one side of the exit pool to allow free passage for elvers.

Limitations of, and recommendations for, monitoring

Due to the fact that the monitoring was carried out immediately after the pass became operational, over a short time period, further monitoring would be beneficial in gauging the long term benefits and effectiveness of the pass.

Conclusions

Overall, the Byron's Pool fish pass has been proven to be effective over the period of time in which this study was conducted.

Passes of this type can contribute to the holistic approach needed to restore the ecological status of our rivers. They provide not only free passage beyond physical structures helping to join isolated and fragmented aquatic systems, but also create valuable habitats, many of which have been lost on our regulated rivers.

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Bodhi Ecology

Presentation Supplementary notes
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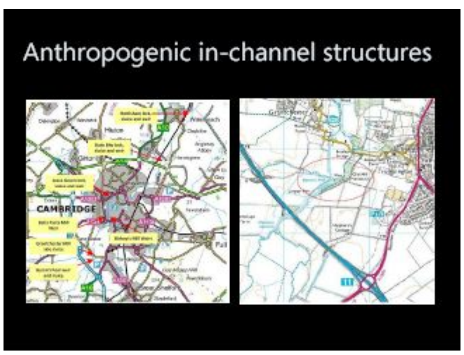

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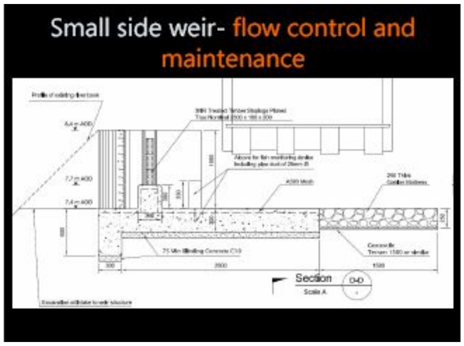

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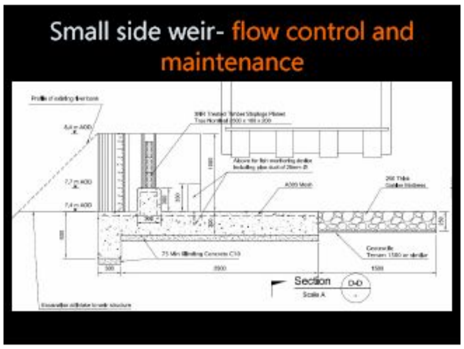

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- **Would it of worked without a hands on approach, NO**
- Even with an engineered design, problems may arise during construction and operation whereby physical alterations maybe needed.
- As a project manager you need to be able to find solutions.
- **In this project this approach made the difference between it being a failure and a success.**

Extracts from my MSc study* in relation to:

- *specific question asked at conference in relating to Eel passage*
- *Limitations of, and recommendations for, monitoring*
- *Overall conclusions*

*Selway, E., 2011. A case study on the design and construction of a new nature-like fish pass on the River Cam, with an assessment of its effectiveness. Unpublished.

Eel passage

Measured exit water velocity

The water velocity through the slots in the stop log (the fish pass exit) were measured at 1.2m/s. Although these are within acceptable ranges for coarse fish, the water velocity through the stop log slots may exclude passage of elvers (juvenile Eels), as observations by McLeave (1980 cited in Larinier et al. 2002) found that their ability to pass a laminar flow was very limited and that they could only cover a distance of 30cm at a water velocity of 0.5m/s. However, the cumulative impact of barriers to migration further downstream and the relative position of he pass within the catchment mean that the number of elvers reaching Byron's Pool is low (0-1 Ind./100m2) (DEFRA 2010).

The monitoring carried out as part of this study has highlighted the need for some minor modifications to allow free passage for elvers and the need for long-term maintenance of the pass to prevent woody debris (flotsam) potentially blocking the channel.

An elver bristle ramp (with tufts of bristles spaced 7mm apart) (Solomon & Beach 2004) could be retrofitted on one side of the exit pool to allow free passage for elvers.

Limitations of, and recommendations for, monitoring

Due to the fact that the monitoring was carried out immediately after the pass became operational, over a short time period, further monitoring would be beneficial in gauging the long term benefits and effectiveness of the pass.

Conclusions

Overall, the Byron's Pool fish pass has been proven to be effective over the period of time in which this study was conducted.

Passes of this type can contribute to the holistic approach needed to restore the ecological status of our rivers. They provide not only free passage beyond physical structures helping to join isolated and fragmented aquatic systems, but also create valuable habitats, many of which have been lost on our regulated rivers.

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