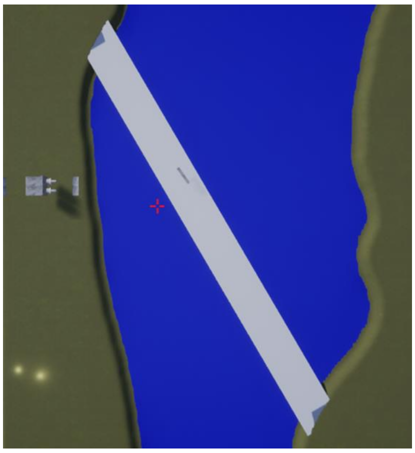
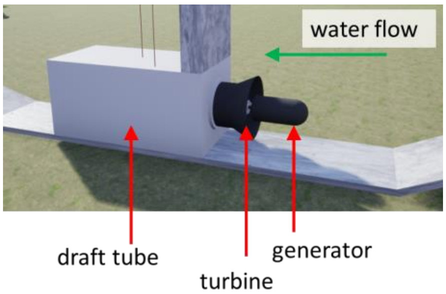
Diglis Weir VOITH Stream Diver

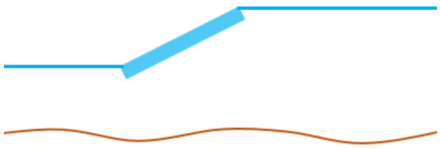


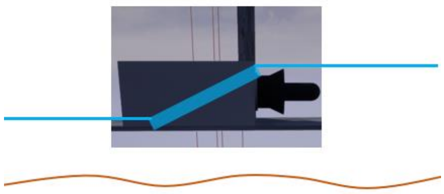
Background. Think ''Hydroelectric Power' and you would correctly imaging a huge power station in the mountains with a high reservoir lake. But these are expensive to build (major civil engineering) and suitable places are limited. They produce enormous amounts of power, Dinorwig (Snowdonia) has 6 300Megawatt turbines.

Now turbine manufacturers are looking at an alternative, 'micro-hydro power' small units which fit on the back of a lorry, produce a few 100 kW of power, and can be retrofitted into rivers and channels. The requirement is that there is a 'head' (water height therefore pressure difference) across the turbine since power is proportional to head x flow. There are several weirs around Worcester, I have chosen Diglis as a case study since there is a minimum head of 2.2m.

The turbine is shown right top, flow enters the right and exits through the 'draft tube' (a very important component of the rig). The diagrams below represent Diglis weir before and after the retro-fitting of the turbine.







Files and Levels.
Level **Diglis** from the **Main menu** then the actor **MAS22_StreamDiver**
Octave Script **Diglis_Data** for you to plot your data. Columns are **head, flow, rpm, power**

Parameters (Independent Variables) available

draft tube length (in metres)
loss coefficient (dimensionless)
head water height difference across turbine (in metres)

Dependent Variables to observe:

HUD: flow, rpm, power
Octave File (as function of time): **flow, rpm, power**

Getting Started

Study 1. This is the important one, we wish to know how the power generated varies with the head over the turbine.

Study 2. Let's investigate the length of the draft tube. If you look at the tube in the level, you will see that it is conical. It's effect is to increase the power generated, i.e., if it were not there, then the turbine would produce less power. Even though it is a simple concrete tube, it is actually expensive to install. So, we need to know how long to make it.

Choose a sensible head and change the length of the draft tube (default 5.3 m), longer and shorter and look at the effect on flow and power.

Study 3. Real river height data has just arrived from the Environmental Agency. An option now exists to use this in the simulation. You will need to adjust **MAS22_System.ini**. Ask for help on how to do this.

Comparison with theory. Theory predicts the following two relationships.

$$flow \propto \sqrt{head}$$

$$power \propto rpm^3$$

You could use your data to check these out. This is not really important compared with the studies suggested above.

Hints for the Roundup.

This investigation is all about installing a small local source of hydro power. So, work out how effective it could be for the local community. How many homes would it power?

Of course you can place more than one device on Diglis weir. Suggest a sensible number and again calculate how many homes it could power.

What could be the environmental / ecological impact of placing turbines on weirs. Do a bit of research on Diglis and other weirs and find out if or how this impact has been mitigated.

Acknowledgement. Thanks to VOITH GmbH & Co. for personal communications and providing data.

VOITH

Domestic electrical energy consumption per household per year (2023) is 2700 kWh, which means an average continuous power draw of 2700/(365*24) = 0.31kW.

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