

## Stage 2 Report, Site 5: Skerton Weir, Lancaster

### Introduction

This study follows on from a pre feasibility report produced by Inter Hydro Technology on behalf of the Forest of Bowland AONB, this is published at [www.forestofbowland.com](http://www.forestofbowland.com). This stage two study has focussed on siting of potential turbines, the impacts of tidal levels on energy output, and a more detailed assessment of power generation and costs.

Skerton Weir is a large weir spanning the River Lune and marks the extent of tidal influence on the river. United Utilities own and maintain the weir and the large central fish pass. The river at the weir is approximately 275 metres wide. The weir is 500m long, including a central fish pass which is 50 metres wide at its downstream end.

### Proposal

Should a scheme at this site be developed, it is proposed that three Archimedean screw turbines be installed on Skerton weir. The turbines would utilise the existing drop over the weir. Depending on where the turbines are situated, a new additional fish pass may be required.

There are two main options for the turbine location: at the western end of the weir (on the Skerton side of the river); or in the middle of the weir, adjacent to the existing fish pass.

#### Installation at the western end of weir

Siltation is known to be a problem in the area proposed for the turbines at the western end of the weir, next to the rowing club. However, any accumulation of silt post-development is likely to be counteracted by the permanent flow to, and from, the turbines. Pre-development, it will be necessary to carry out some silt removal downstream of the weir at the proposed hydro installation (see Environment Agency feedback).

Trees and logs accumulate in the flow at the western end of the weir. Significant screening will therefore be required upstream of the installation to prevent damage to the turbine.

Installation of turbines at this location will require a new fish pass with its entrance immediately adjacent to the turbine outlets. The outlet flow from the turbines will help to attract fish to the fish pass.

The fish passes here may present an opportunity for poaching. It will be important to introduce mitigation to ensure that poachers cannot easily gain access.

#### Installation in the middle of the weir

Putting the turbines in the middle of the weir adjacent to the existing fish pass would counteract the siltation problem, poaching problem and would avoid many of the logs and trees that come downstream. However, installation in the middle of the river is likely to be uneconomic due to increased construction costs. Also it is likely to cause some increase in flood risk, as well as have a greater visual impact. This option is therefore dismissed.



## Power, energy and cost predictions

The effect of the tide on this installation has been investigated by Inter Hydro Technology and by Spaans Babcock (Archimedean screw turbine manufacturer). The method used to make an estimate of power and energy by Inter Hydro Technology is described first:

15 minute interval tide level data was provided by the Environment Agency for St George's Quay in Lancaster. A mean water level at Skerton Weir of 5.6 metres was assumed.

The range of tide levels were ranked and then split into five equal sets, with a maximum, minimum and mean level determined for each of the five sets. These were then compared with the mean weir water level, to determine a range of head values. It was assumed that the water levels at St George's Quay do not represent the downstream water level at the weir. There is a hydraulic gradient from Skerton Weir to St George's Quay. The gradient is unknown, and likely to be variable. It is assumed that a 1 in 1000 gradient exists. The distance along river between Skerton Weir and St George's Quay is 1800 metres. From our range of head values, we have therefore deducted 1.8 metres to give the estimated head difference over the year.

Table 1: Head scenarios, power and energy for 4m<sup>3</sup>/s turbine

	Mean level (m)	Estimated power per turbine (kW)	Estimated energy per turbine (MWh)	20% year (MWh per turbine)	If three turbines (MWh)
Head scenario 1	-0.07	0	0	0	0
Head scenario 2	1.40	35	260	52	156
Head scenario 3	2.04	50	400	80	240
Head scenario 4	2.23	60	450	90	270
Head scenario 5	2.24	60	450	90	270
<b>Total annual energy</b>				<b>312</b>	<b>936</b>

To summarise, according to the Inter Hydro Technology predictions, head scenario 1 will not produce any energy. The weir will be drowned out for approximately 20% of the time. For head scenarios 2-5, our power prediction software indicates the maximum power and annual average energy per turbine, as indicated in the table. This is an estimate of annual energy prediction, taking into account some tidal effects. Our power prediction software uses a crossflow or propeller turbine as an analogue for a screw turbine.



Spaans Babcock completed their own power and energy predictions using the Environment Agency tidal data that we provided to them, as shown below:

Table 2: Power and energy predictions data (Spaans Babcock)

Downstream water level	Head value estimate (m)	Hours occurring	Percentage of time
7.84	0	2.6	21.0
7.09	0.75	1.6	12.9
6.59	1.25	0.8	6.5
6.09	1.75	0.8	6.5
5.60	2.24	5.8	23.1

Their results suggest that the maximum installed power for the turbines is approximately 75kW each. The predicted annual average energy is approximately 700MWh. This would return predicted annual average revenue of £105,000 (assuming 11.5 pence per kilowatt, plus a 3.5 pence export tariff).

The likely partial submergence of the screw turbines and the resulting churning that will occur at high tides has not been tested and so estimates of output have been made.

The budget quote for three screw turbines is £390,000, including transport, lifting, control panel, covers over the screws, gates, hydraulics, bar screen, all mechanical, electrical and hydraulic equipment, installation, supervision, SAT tests and performance testing. The offer excludes: civil work, cable trenching, control and drive train cubicle, high voltage cabling, earthing and grid connection.

## Planner and Environment Agency Feedback

It is recommended that in the event of this scheme being taken further, early dialogue with the planning authorities will be valuable.

### Flood risk

Any alteration to the level on the weir due to an installation is likely to have an effect on the existing Environment Agency flood gauge. It is likely that this gauge will then require re-calibration. It is not clear who would be responsible for this cost. Any applicant will need to commission a study into the effects of the scheme on flows, levels and flood forecasting.

It is understood from the Environment Agency that the installation of three screw turbines on the western end of the weir would **not** increase flood risk upstream. However, due to the fact there is an existing local flood problem, there may be a perceived increase in flood risk by the local residents.

Poaching within a fish pass proximal to the western bank is likely to be a problem. It will have easy access and also good tree cover. It will be important to mitigate this, and set up a long-term management plan to deal with the risk of poaching.

### Consents

A water abstraction license may not be necessary as water is not being removed or diverted from the river. There is an existing impoundment behind the weir, but this may not have an impoundment license. It may therefore be necessary to



apply to the Environment Agency for a license for the existing impoundment. It has not been confirmed who would be responsible for this.

## Fish Passage

It will be necessary to prove that the efficiency of the fish pass is not decreased as a result of the development. Therefore the current efficiency of the fish pass may need to be assessed. If the turbines are installed at the western end of the weir then a complimentary fish pass will be required, in addition to the existing fish pass at the middle of the weir. As this is the first weir on the Lune system, maintaining adequate fish passage is vital. New fish passes will require approval by the National Fish Pass Panel.

## Biodiversity

Any removal of silt may disturb breeding and feeding birds and will need to be carried out with close guidance from an ecologist and with advice from the Environment Agency and Natural England. The mudflats downstream of the weir are covered by a Biodiversity Action Plan and the quality of this habitat needs to be assessed by an ecologist. Management of the removed silt will be required to prevent contamination by any pollutants present in the silt, and also to prevent a radical increase in suspended solids during flows.

The site is upstream of Morecambe Bay SCA/SPA/Ramsar site and the Lune Estuary SSSI. If the works have the potential to affect these sites consultation with Natural England will be needed. The River Lune is designated a Biological Heritage Site for the habitat it provides and the various species it supports. An assessment of how this will be affected by the scheme needs to be undertaken with input from Lancashire County Council. Otters are known to be present on this stretch of the River Lune and so the ecological survey should also assess whether they or their habitat will be affected.

Under the Water Framework Directive Skerton weir marks the boundary between the River Lune Catchment and the Transitional Lune (Estuary) catchment. Both of these are classified as being at Moderate Ecological Status. Any scheme here must not result in deterioration of ecological status.

## Public consultation

Any development at Skerton weir will require thorough public consultation with residents, water sports users, anglers and other users and stakeholders to ensure all viewpoints and issues are considered prior to any further proposals for development.

## Next Steps

The next steps at Skerton weir are to:

- Confirm the head available over the weir
- Gain advice from a fisheries specialist on assessing the efficiency of fish passage
- Install level monitoring equipment to measure the head available over the weir during variable tide levels
- Public consultation and engagement
- Undertake ecological surveys

