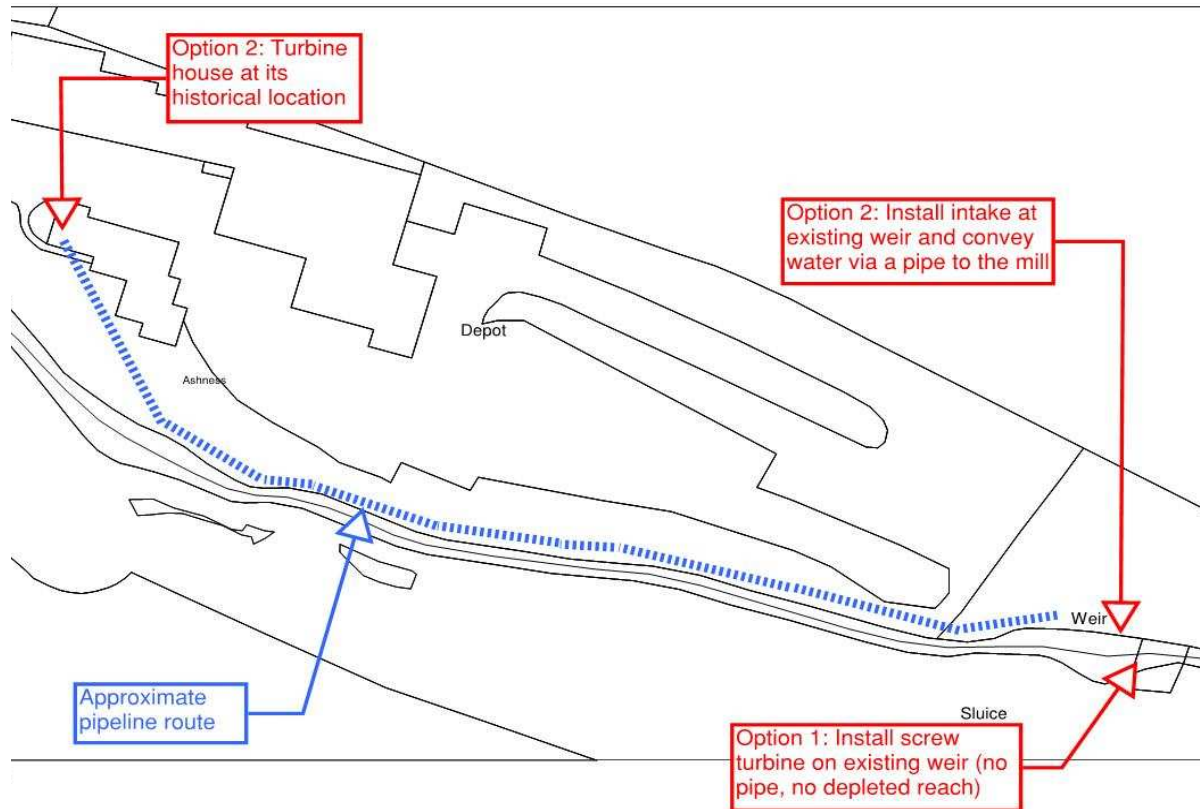


## Site I3: Littlemoor Mill, Dents Yard, Clitheroe

### Site Assessment

Figure 1 Map showing general layout



This mill had a functioning hydro scheme historically and a turbine remains in situ in the main mill building. The weir and sluice gate also remain, but would require some improvements. There are two options for re-instatement of a scheme at this site. The first would involve taking the water out of the stream at the current weir location and running a pressure pipeline down to the mill building and through a turbine before returning the water back to the beck. The old pipeline has collapsed and cannot be re-used. It is likely that a new turbine would need to be installed, although repair of the historic turbine has not been investigated. The second option would involve installing a screw turbine directly onto the existing weir, as investigated in 2009 by Mann Power. This is likely to be the more economic option as it does not require the long length of pipe and associated works. The Mann Power report suggested that a turbine of up to 10kW capacity may be suitable, although this may involve increasing the height of the weir.



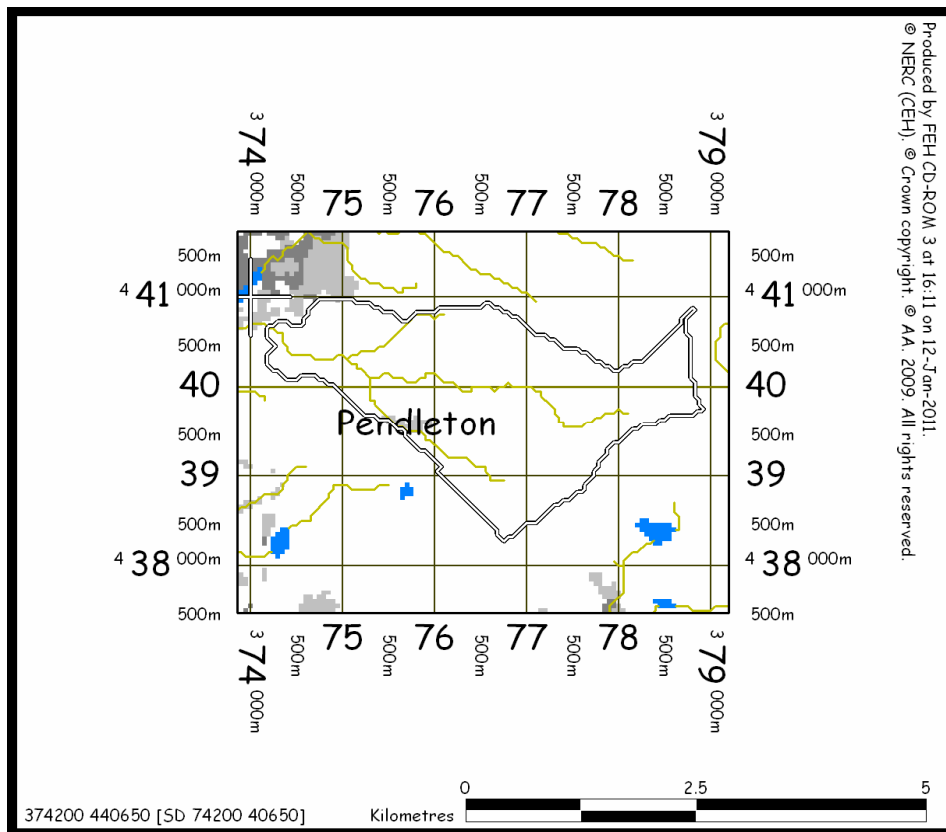
Figure 2 The weir



Figure 3 Top weir from above

## Catchment Analysis

Figure 4 Catchment boundary defined by Flood Estimation Handbook Software



The Flood Estimation Handbook software is used to determine the following catchment descriptors, for the proposed intake location, selected during the site visit.

Intake Grid Reference	374310, 440610
Powerhouse Grid Reference	374200, 440680
Catchment Area	6.4 km <sup>2</sup>
Annual Rainfall	1274 mm

## Annual Flow Statistics

Low Flows software is used to produce a Flow Duration Curve (FDC), which demonstrates how the river flow varies throughout the year. It presents the percentage time of the year each flow rate is exceeded. A particular notation is used to refer to FDC flow rates; e.g. 'Q<sub>95</sub>' refers to the flow rate which is exceeded 95% of the year.

Table 1 Mean flow rate and flow rate at Q<sub>95</sub>

Period	Mean Flow Rate [m <sup>3</sup> /s]	Flow Rate at Q <sub>95</sub> [m <sup>3</sup> /s]
Annual	0.168	0.0192
January	0.285	0.043
February	0.201	0.0321
March	0.208	0.0352
April	0.121	0.0218
May	0.0818	0.0176
June	0.0606	0.0139
July	0.0655	0.0153
August	0.101	0.0164
September	0.135	0.0198
October	0.213	0.0278
November	0.248	0.0327
December	0.292	0.0389

Table 2 Annual flow duration data

Exceedance Probability	Flow Rate [m <sup>3</sup> /s]
5	0.611
10	0.406
20	0.235
30	0.157
40	0.11
50	0.079
60	0.058
70	0.043
80	0.032
90	0.023
95	0.019
99	0.014

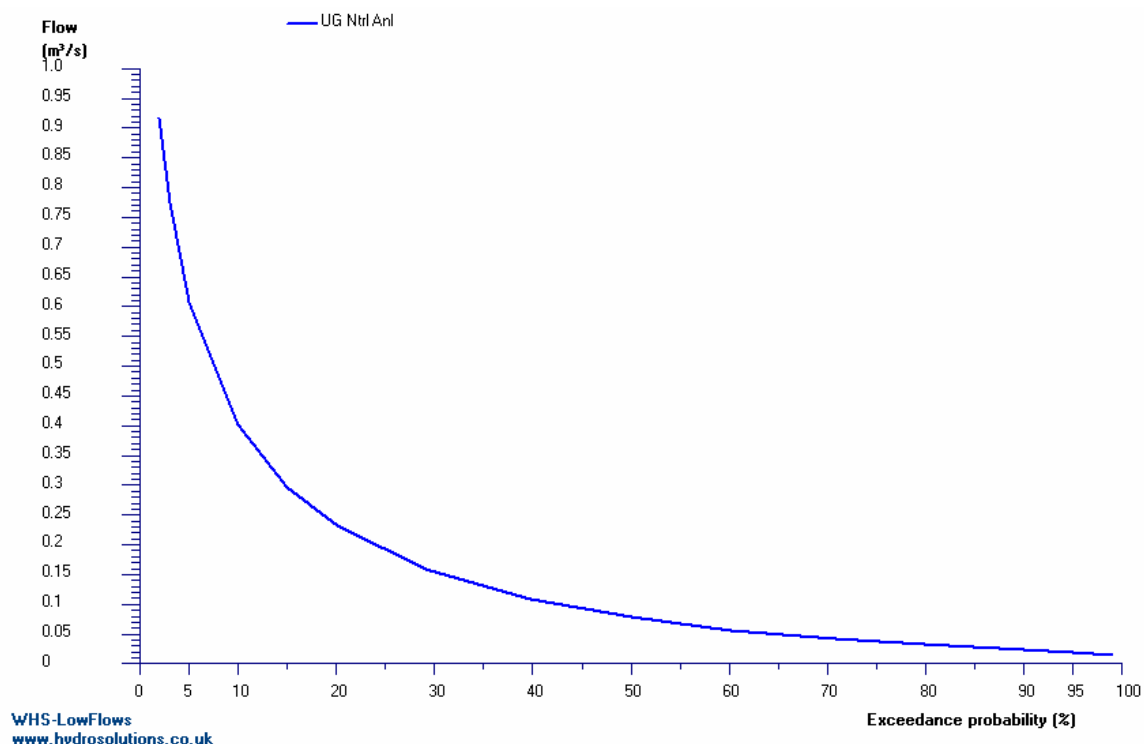


Figure 4 Annual flow duration curve produced using low flows software

## Hydropower Analysis

<b>Site:</b> Littlemoor Mill					
<b>Run Date / Time:</b> 12 January 2011 at 16:22					
<b>Mean Flow:</b> 0.16 m <sup>3</sup> /s			<b>Rated Flow:</b> 0.16 m <sup>3</sup> /s		
<b>Provisional Rated Flow:</b> 0.18 m <sup>3</sup> /s			<b>Gross Hydraulic Head:</b> 4.00 m		
<b>Residual Flow:</b> 0.017 m <sup>3</sup> /s			<b>Nett Hydraulic Head:</b> 3.80 m		
<b>Applicable Turbines</b>	<b>Gross Annual Average Output</b>	<b>Nett Annual Average Output</b>	<b>Maximum Power Output</b>	<b>Rated Capacity</b>	<b>Minimum Operational Flow</b>
<b>Crossflow</b>	19.0	18.8	4.9	4.5	0.041
	<b>MWh</b>	<b>MWh</b>	<b>kW</b>	<b>kW</b>	<b>m<sup>3</sup>/s</b>

Table 3 Hydropower Analysis

Gross Head [m]	4 m
Net Head [m]	3.8 m
Design Flow [m <sup>3</sup> /s]	0.16 m <sup>3</sup> /s
Rated Capacity [kW]	4.5 kW
Average Annual Energy Output [MWh]	19 MWh
Average annual Carbon Dioxide offset	8 tonnes

## Impact Assessment

Littlemoor Mill is not within the Forest of Bowland AONB. It is classified within the Lancashire Landscape Character Assessment as Undulating Lowland Farmland with Settlement and Industry.

If a scheme were pursued here it would be a refurbishment of an historic scheme, or the reinstatement of an alternative hydro power technology at an historic hydro power site. The area of construction is away from any public access, and it is not thought that the development would have any significant visual impact.

## Statutory Requirements

It will be necessary to apply to the Environment Agency for an abstraction licence, and for planning permission for alterations to the weir and the installation of the turbine.

An ecologist will be able to advise on the extent of environmental investigation required at the site.

## Budget Development Cost

The total budget cost for the whole scheme is **£221,000**. It should be noted that the civil works costs can vary considerably as material costs fluctuate. Likewise, mechanical and electrical (M&E) equipment costs vary in accordance with demand. Professional fees should be considered subject to change, as the scope of licensing and planning requirements are not yet defined. Consequently the budget estimate at this stage should be considered accurate to plus or minus 20%. See Table 4.

## Revenue and Simple Payback Period

It is unlikely that a grid connection is going to be economic for this scheme, and more likely that the energy should be used on site.

Under the current government feed-in tariff regulations, hydropower schemes receive a generation tariff according to their rated capacity. Schemes less than 15kW receive 19.9p/kWh. This generation tariff is received regardless of how the electricity is used. The owner has indicated that the electricity would be used on site, thereby offsetting import costs. This increases the value of the generated electricity by the import tariff, which we have assumed is 5p/kWh.

In conclusion, the total value of the generated electricity would be 24.9p/kWh, giving an average annual value of approximately **£4,351**. The simple pay back period according to this budget costing and annual average revenue is **50 years**.

## Conclusion

This is a small scheme with existing infrastructure, and the site owner is in a good position to do the construction themselves. This would reduce the costs considerably and is likely to result in the main cost being the turbine. Ordinarily the simple payback time for this scheme would make development un-economic.

Table 4 Development Budget Cost

**Budget Scheme Cost Estimate**

**Littlemoor Mill, Dents Yard, Clitheroe**

	ITEM	UNIT	QUANTITY	MIN	MAX
<b>Turbine</b>					
	Turbine Quotation	No	1	£70,000.00	£87,500.00
<b>Grid Connection</b>					
	Grid Connection	No	1	£5,000.00	£6,250.00
<b>Civils</b>					
	Concrete Works	m <sup>3</sup>	40	£20,000.00	£25,000.00
	Fish Pass	m <sup>3</sup>	0	£0.00	£0.00
	Metalwork	m	5	£10,000.00	£12,500.00
	Fish Pass Length	m	0	£0.00	£0.00
	Pipe Installation	m			
	Rock	m	0	£0.00	£0.00
	Gravels	m	0	£0.00	£0.00
	Soft	m	0	£0.00	£0.00
	Pipe Materials	No	1		
	Temporary Access	m			
	Rock	m	0	£0.00	£0.00
	Gravels	m	50	£4,000.00	£5,000.00
	Soft	m	0	£0.00	£0.00
	Temporary Access on Good Ground	m	0	£0.00	£0.00
<b>Powerhouse</b>					
	Powerhouse	kW	5	£15,000.00	£18,750.00
<b>Prelims</b>					
	Duration Months		5	£15,000.00	£18,750.00
<b>Sub Total</b>					
	Sub Total			£139,000.00	£173,750.00
<b>Professional Fees</b>					
	Professional Fees			£20,850.00	£34,750.00
<b>Sub Total</b>					
	Sub Total			£159,850.00	£208,500.00
<b>Contingency</b>					
	Contingency			£31,970.00	£41,700.00
<b>GRAND TOTAL</b>				£191,820.00	£250,200.00

## Further Information

This site report is produced by Inter Hydro Technology on behalf of Forest of Bowland AONB, and funded by a partnership including Lancashire County Council, Lancaster & District Local Strategic Partnership, Pendle Borough Council and Ribble Valley Local Strategic Partnership.

This site report should be read in conjunction with the rest of the Forest of Bowland AONB Hydro Feasibility Study which can be downloaded at

<http://www.forestofbowland.com/climatechange#hydro>