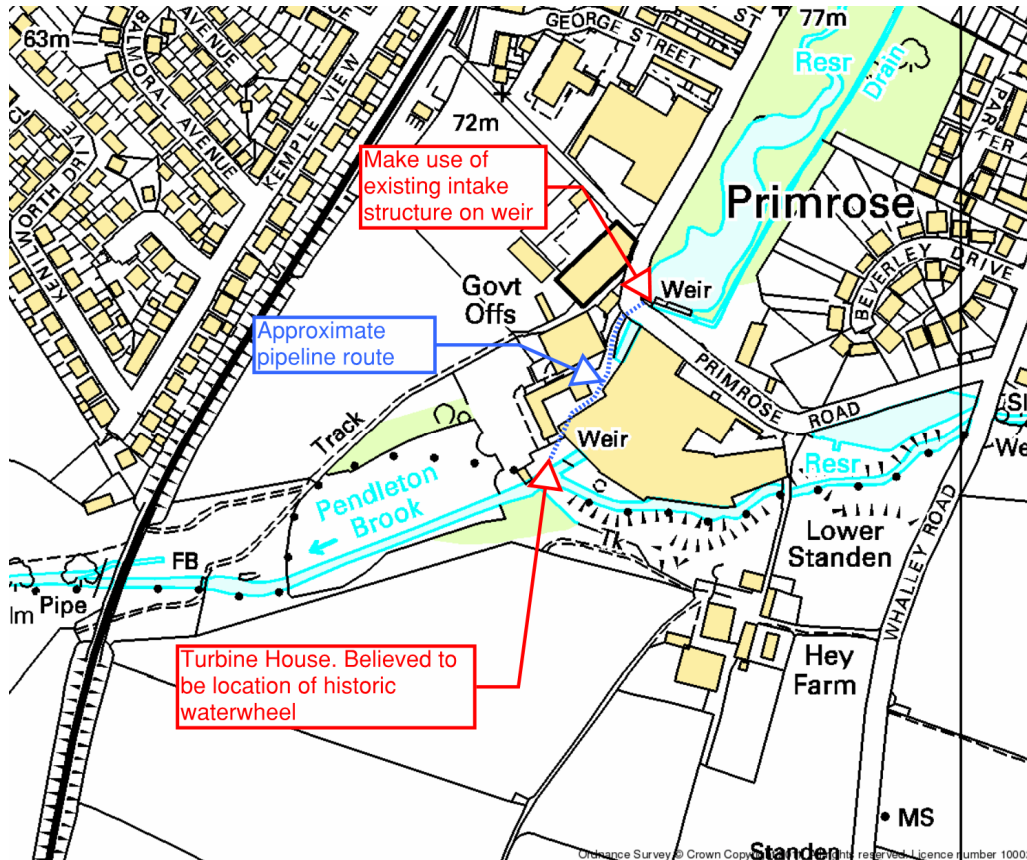


Site 9: Primrose Mill, Clitheroe

Site Assessment

Figure 1 Map showing general layout



Primrose Mill is a former water powered cotton spinning mill built in 1787. It later became a print works, paper works and lifting equipment manufacturer. The mill site has been extensively redeveloped and now provides a private residence, and a mix of technology and industrial business occupancy.

The millpond lies to the North East on Mearley Brook and is not in the ownership of site however, the owners of the site have water abstraction rights. The weir and intake appear in good condition and the scope to produce energy at this site is good.

The option shown above involves the construction of a new inlet and screen at the top of the weir and laying of a buried pipeline passing down the driveway to Primrose Lodge. The pipeline would need to pass under the currently unoccupied part of the mill building. A new powerhouse and new turbine would be constructed adjacent to the Pendleton Brook.

A second option worthy of consideration would be to construct a turbine and power house on the weir. However, this may result in increasing flood risk upstream and a flood risk assessment would be required early in the feasibility stage to evaluate the risk.



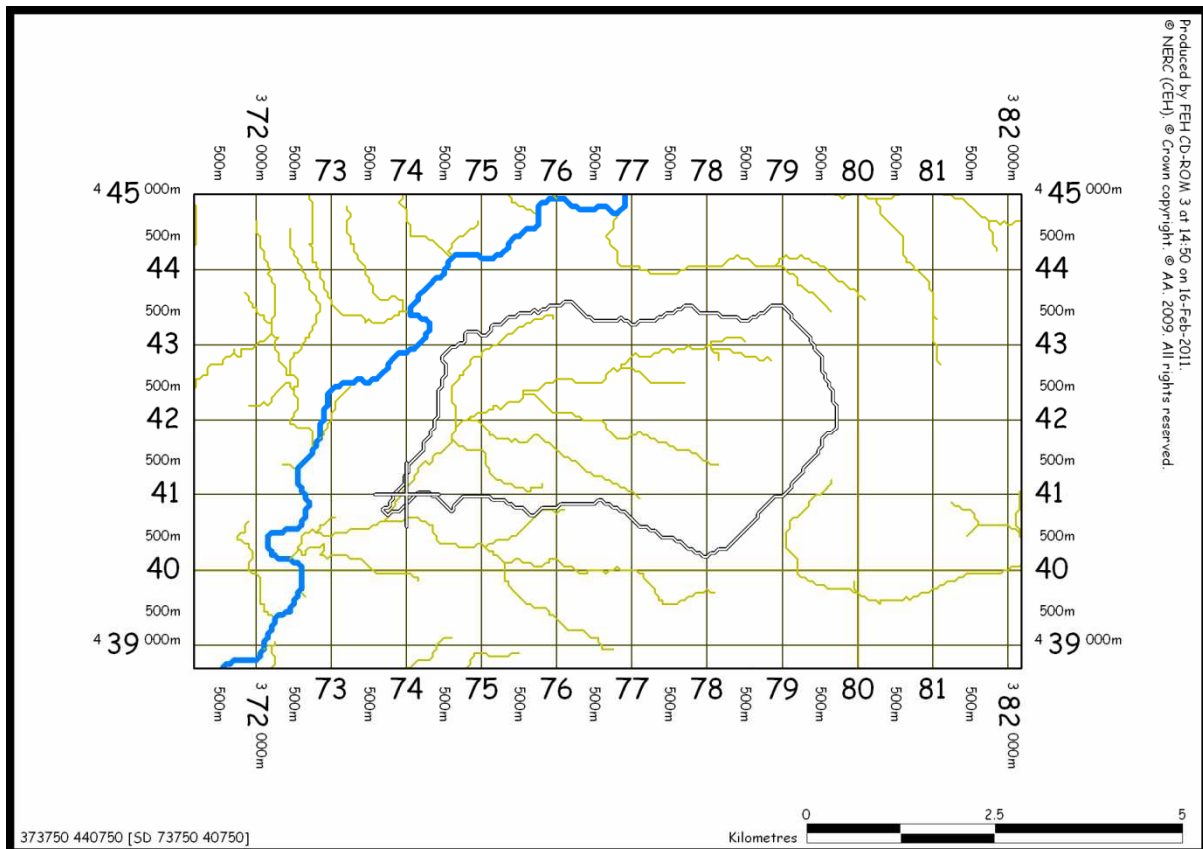
Figure 2 Intake weir from downstream



Figure 3 Existing intake channel above weir

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	373781, 440772
Powerhouse Grid Reference	373697, 440657
Catchment Area	13.58 km ²
Annual Rainfall	1269 mm

NB The site owners have abstraction rights.

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. 'Q₉₅' refers to the flow rate which is exceeded 95% of the year.

Table 1 Mean flow rate and flow rate at Q₉₅

Period	Mean Flow Rate [m ³ /s]	Flow Rate at Q ₉₅ [m ³ /s]
Annual	0.351	0.0557
January	0.6	0.111
February	0.451	0.0972
March	0.436	0.089
April	0.298	0.0701
May	0.209	0.058
June	0.158	0.0438
July	0.151	0.047
August	0.216	0.0465
September	0.234	0.0551
October	0.376	0.059
November	0.474	0.0727
December	0.605	0.0919

Table 2 Annual flow duration data

Exceedance Probability	Flow Rate [m ³ /s]
5	1.185
10	0.782
20	0.463
30	0.326
40	0.238
50	0.179
60	0.137
70	0.107
80	0.083
90	0.065
95	0.056
99	0.045

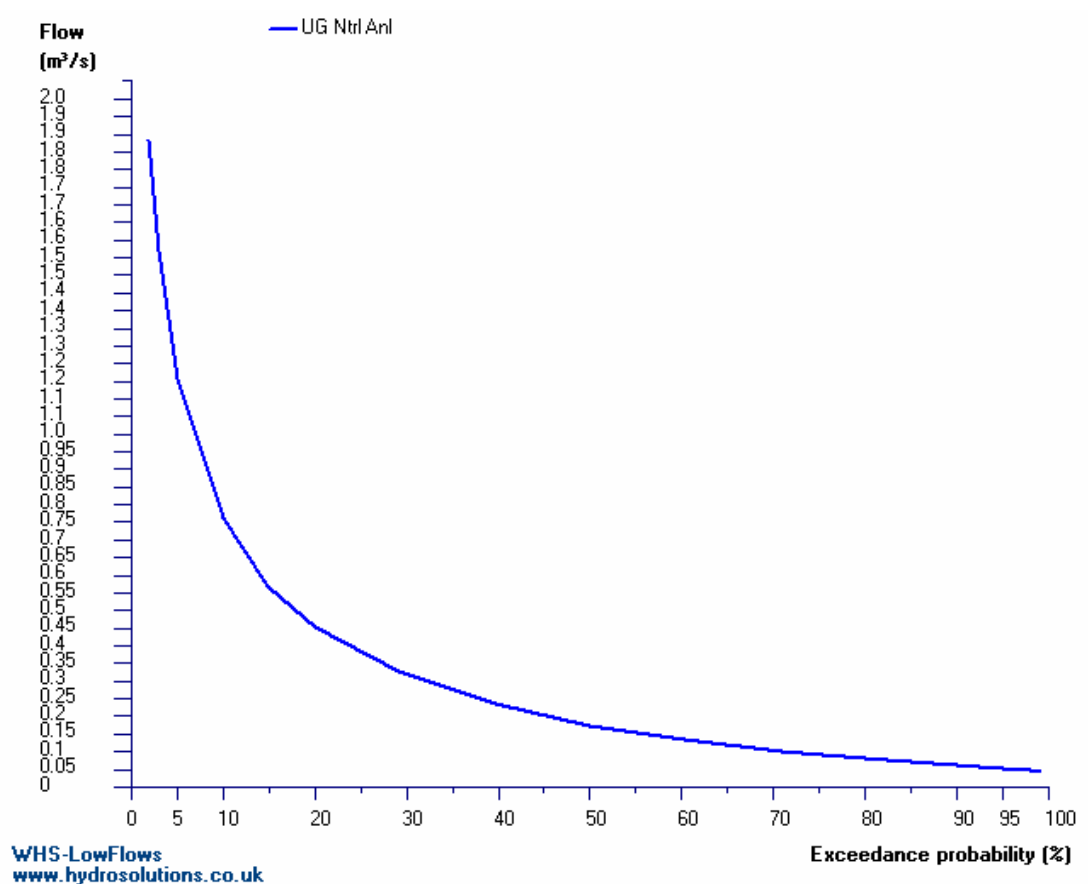


Figure 5 Annual flow duration curve produced using low flows software

Hydropower Analysis

Site: Primrose (Site 9)					
Run Date / Time: 17 February 2011 at 15:33					
	Mean Flow: 0.31 m3/s			Rated Flow: 0.31 m3/s	
	Provisional Rated Flow: 0.34 m3/s			Gross Hydraulic Head: 4.00 m	
	Residual Flow: 0.034 m3/s			Nett Hydraulic Head: 3.80 m	
Applicable Turbines	Gross Annual Average Output	Nett Annual Average Output	Maximum Power Output	Rated Capacity	Minimum Operational Flow
Propellor	28.7	28.4	10.0	9.6	0.23
Crossflow	36.8	36.4	9.1	8.5	0.080

Table 3 Hydropower Analysis

Gross Head [m]	4.0 m
Net Head [m]	3.8 m
Design Flow [m ³ /s]	0.31 m ³ /s
Rated Capacity [kW]	9.0kW
Average Annual Energy Output [MWh]	33 MWh
Average annual Carbon Dioxide offset	18 tonnes

Impact Assessment

Primrose Mill is not within the Forest of Bowland AONB, but is classified as being within Undulating Lowland Farmland with Parkland. Primrose Lodge is a Biological Heritage Site.

There is no passage for fish migration beyond the foot of the weir however The Ribble Catchment Conservation Trust would ideally like to remove the weir or at least install a fish pass on the lodge. This could be accommodated as part of a hydro electric scheme, but has not been included in the budget development costs. Advice from the Environment Agency should be sought on appropriate designs and fish species should a fish pass be required.

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

Statutory Requirements

Primrose House is designated as a grade 2 listed building (1972).

Whilst the current owners report to have abstraction rights from the watercourse it will be necessary to apply to the Environment Agency for an abstraction license and for planning permission for alterations to the weir and the installation of pipeline and turbine.

Budget Development Cost

The total budget cost for the whole scheme is **£162,450**. 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%.

Table 4 Budget development costs

Budget Scheme Cost Estimate

Primrose Mill, Clitheroe

	ITEM	UNIT	QUANTITY	MIN	MAX
Turbine					
	Turbine Quotation	No	1	£40,000.00	£50,000.00
Grid Connection					
	Grid Connection	No	1	£5,000.00	£6,250.00
Civils					
	Weir	m ³	3	£1,500.00	£1,875.00
	Fish Pass	m ³	0	£0.00	£0.00
	Weir Screen Length	m	2	£4,000.00	£5,000.00
	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	500	£27,500.00	£34,375.00
	Pipe Materials	No	1	£0.00	£0.00
	Temporary Access	m			
	Rock	m	0	£0.00	£0.00
	Gravels	m	0	£0.00	£0.00
	Soft	m	0	£0.00	£0.00
	Temporary Access on Good Ground	m	0	£0.00	£0.00
Powerhouse					
	Powerhouse	kW	9	£15,000.00	£18,750.00
Prelims					
	Duration	Months	4	£12,000.00	£15,000.00
Sub Total					
	Sub Total			£105,000.00	£131,250.00
Professional Fees					
	Professional Fees			£15,750.00	£26,250.00
Sub Total					
	Sub Total			£120,750.00	£157,500.00
Contingency					
	Contingency			£24,150.00	£31,500.00
GRAND TOTAL				£144,900.00	£189,000.00

Revenue and Simple Payback period

It is unlikely that a grid connection is required for this scheme, and instead the energy could be used on site at the Primrose Mill. The simple payback can therefore be worked out according to the electricity bills saved by the domestic and business usage on site. An estimate of the grid connection cost has been estimated at **£5,000** however, assuming that a Propeller or Crossflow turbine is used.

Under the current government feed-in tariff regulations, hydropower schemes receive a generation tariff according to their rated capacity. Schemes less than or equal to 15 kW receive 19.9p/kWh. This generation tariff is received regardless of how the electricity is used. The current base value of electricity per kilowatt hour on top of this has been assumed as 3p/kWh.

In conclusion, the total value of the generated electricity would be **22.3 p/kWh**, giving an average annual value of approximately **£7,557**. The simple payback, taken as the budget scheme cost divided by the annual value of electricity generated, is **21.5 years**.

Conclusion

There is potential for a small scheme at Primrose Mill, using the existing weir infrastructure albeit with some modification. Ordinarily the simple payback time for this scheme would make development un-economic for commercial export but as a longer term investment to increase self sufficiency to provide power for any further site development the scheme could be viable

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>