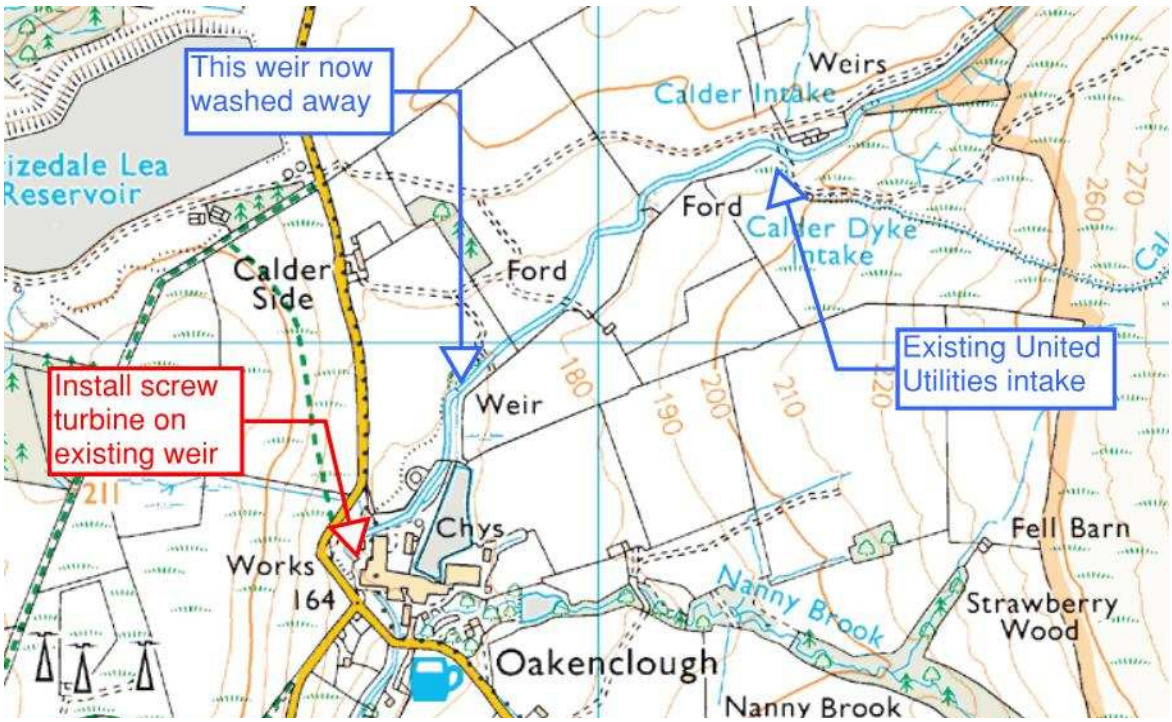
Site 26: Oakenclough Paper Mill

Site Assessment

Figure 1 Map showing general layout



Oakenclough is a late 18th century water mill, now a former paper mill in multiple occupation. The existing buildings are mainly of the late 20th century. The older buildings are below the large pond by the weir and headrace. The site of the waterwheel is still intact, though there is not thought to be any in situ machinery.

There is an existing weir with a significant fall within the Merit Feeds complex, which in itself has good potential for hydro development. It would be suitable for the installation of an Archimedes screw turbine, directly on the weir. The access to the weir is good, and the energy would be useful to the site. However, there is an existing abstraction upstream of the mill at the Calder Intake. This makes the remaining river flow regime unworkable for a hydro scheme. If this abstraction were to become obsolete in the future, this scheme may be worth re-visiting,

Figure 2 The position of the weir, now washed away

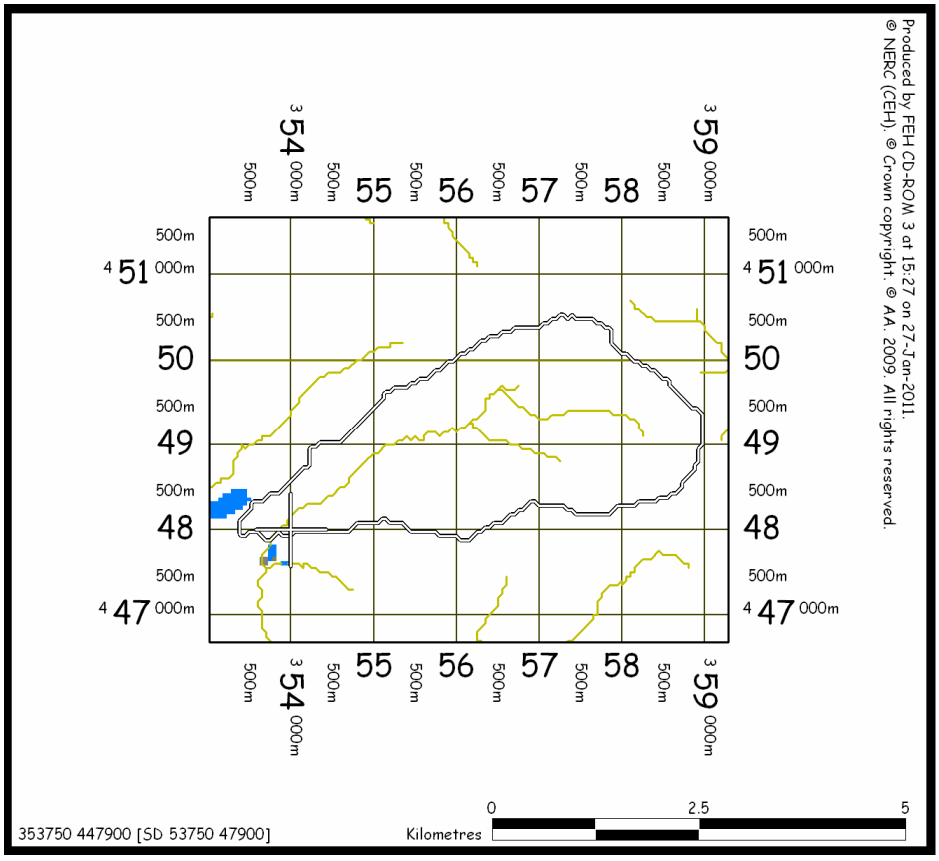
Figure 3 The position of the weir – now washed away

Figure 4 Upstream of the weir from the beginning of the intake

Figure 5 Looking towards the mill along the line of the leat, with the mill pond on the left hand side

Catchment Analysis

Figure 6 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	353780, 447900
Powerhouse Grid Reference	353630, 447660
Catchment Area	8.7 km^2
Annual Rainfall	1572 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_{95}' refers to the flow rate which is exceeded 95% of the year. However, these flow rates represent the unmodified catchment scenario at Oakenclough Mill, and are therefore not accurate representations of the existing scenario.

If the intake were to be abandoned in the future then these figures would represent the potential annual flows.

Table 1 Mean flow rate and flow rate at Q_{95}

Period	Mean Flow Rate [m³/s]	Flow Rate at Q_{95} [m³/s]
Annual	0.316	0.0392
January	0.49	0.0882
February	0.378	0.0682
March	0.404	0.079
April	0.269	0.0534
May	0.191	0.0381
June	0.144	0.0304
July	0.147	0.026
August	0.213	0.0253
September	0.242	0.0346
October	0.352	0.0468
November	0.457	0.0691
December	0.51	0.0905

Table 2 Annual flow duration data

Exceedance Probability	Flow Rate [m³/s]
5	1.08
10	0.741
20	0.451
30	0.313
40	0.229
50	0.174
60	0.133
70	0.102
80	0.076
90	0.051
95	0.039
99	0.026

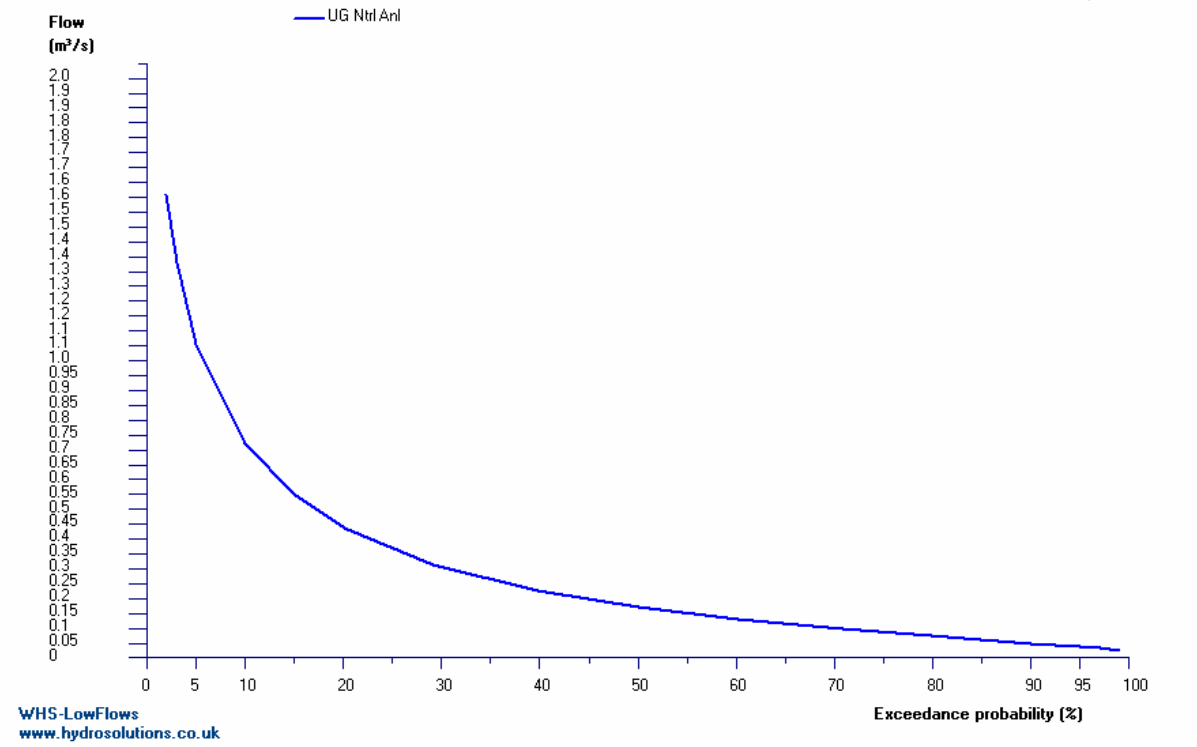


Figure 7 Annual flow duration curve produced using low flows software

Hydropower Analysis

Site: Oakenclough
Run Date / Time: 27 January 2011 at 15:38

Mean Flow: 0.29 m3/s
Provisional Rated Flow: 0.32 m3/s
Residual Flow: 0.033 m3/s

Rated Flow: 0.29 m3/s
Gross Hydraulic Head: 1.80 m
Nett Hydraulic Head: 1.71 m

Applicable Turbines	Gross Annual Average Output	Nett Annual Average Output	Maximum Power Output	Rated Capacity	Minimum Operational Flow
Crossflow	15.5	15.4	3.9	3.6	0.076
	MWh	MWh	kW	kW	m3/s

Table 3 Hydropower Analysis

Gross Head [m]	1.8
Net Head [m]	1.7
Design Flow [m³/s]	0.3 m³/s
Rated Capacity [kW]	3.6 kW
Average Annual Energy Output [MWh]	15MWh
Average annual Carbon Dioxide offset	8 tonnes

The figures in the table above represent the theoretical hydro potential at the site and do not include the influence of the existing abstraction upstream.

Impact Assessment

Oakenclough Paper Mill is within the Forest of Bowland AONB and the landscape has been classified as Moorland Fringe.

There would be significant historical benefits to re-instating a hydro scheme at this industrial mill site. Visual impact would be minimal due to the screening of the existing industrial warehouse units.

It may be worthwhile investigating the installation of a fish pass on the weir alongside a screw turbine.

Statutory Requirements

It would be necessary to apply to the Environment Agency for an abstraction licence and planning permission will be required to install a turbine on the weir.

The site is on the Historic Environment Record and therefore any development would need to be discussed with the county archaeologist.

An ecologist will be able to advise on what degree of environmental assessment is required.

Budget Development Cost

The total budget cost for the whole scheme is **£142,300**. 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%.

Revenue and Simple Payback period

Energy produced at this site would contribute to the requirements of the mill complex. It is not anticipated that a grid connection would be necessary for this scheme; however, it is likely that a grid connection would be inexpensive as there may be an existing high voltage grid on site.

The annual average revenue for this scheme is **£3435.** The simple payback time for this scheme is **40** years.

Conclusion

Unfortunately, despite the existing weir, good grid connection potential and access to this site there is not sufficient water remaining in the beck downstream of the Calder Intake to warrant a hydro scheme.

Table 4 Development Budget Cost

Budget Scheme Cost Estimate
Oakenclough Paper Mill

ITEM	UNIT	QUANTITY	MIN	MAX
Turbine				
Turbine Quotation	No	1	£50,000.00	£62,500.00
Grid Connection				
Grid Connection	No	1	£0.00	£0.00
Civils				
Concrete Works	m^3	10	£5,000.00	£6,250.00
Fish Pass	m^3	5	£2,500.00	£3,125.00
Metalwork	m	2	£4,000.00	£5,000.00
Fish Pass Length	m	2	£4,000.00	£5,000.00
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	£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	4	£15,000.00	£18,750.00
Prelims				
Duration	Months	3	£9,000.00	£11,250.00
Sub Total				
Sub Total			£89,500.00	£111,875.00
Professional Fees				
Professional Fees			£13,425.00	£22,375.00
Sub Total				
Sub Total			£102,925.00	£134,250.00
Contingency				
Contingency			£20,585.00	£26,850.00
GRAND TOTAL			£123,510.00	£161,100.00

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