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Langley Mill fish pass design, River Erewash

Tender Invitation

Background

The River Erewash flows south along the boundary between Derbyshire and Nottinghamshire to join the Trent near Long Eaton. Unusually for a river with an industrial past, the Erewash has only two major barriers to fish migration along its course, one being at Langley Mill weir which is the subject of this scope. Improvements to fish passage are being actively pursued at both sites, with a view to reconnecting habitats for all fish species including the recovering population of Atlantic salmon in the Trent catchment.

Langley Mill weir is located at NGR SK4529247582. The structure provides a head of water which is abstracted by Canal & Rivers Trust to supply the Erewash canal. Water impounded by the weir is diverted into a culvert which has flow control penstocks at either end. At the downstream end of the culvert, the abstracted water flows in an open conduit channel which bifurcates, the left channel confluences with the Nethergreen Brook and feeds water to the canal, whilst the right channel returns surplus water to the River Erewash (over another weir).

Langley Mill weir was the subject of a fish passage options appraisal by the Wild Trout Trust in August 2019 (Appendix), which indicated a rock ramp was the preferred option:

Rock ramp. The 11% plus slope within current footprint of the weir and apron exceeds the usual gradient parameters of 1 – 5% for rock ramps (EA Fish Pass Manual). However, extending a rock ramp structure further downstream would lessen the gradient to within those parameters, especially if lowering the weir crest is possible; this would give scope for creating features (e.g resting pools) that would enable the widest range of fish species and sizes to pass at the widest range of flow conditions. Because of this, this would be the preferred option. The existing CSO and surface water outfalls would have to be taken into account, along with clearance under the aqueduct and whether that increases flood risk

Requirement

1. A critical review of the Wild Trout Trust options appraisal to determine the most appropriate fish passage solution at this site.

2. Flow modelling to:
   - assess the scope (if any) for lowering the weir crest without compromising the abstraction to the canal;
   - maximise the flow of water over the fish pass without compromising the abstraction licence;

- ensure flood risk is not increased and provide the necessary information for an Environment Agency Flood Risk Activity Permit to build the pass.

3. A detailed design for the preferred fish passage option.

The fish pass design is expected to meet the following criteria:

- The design is to provide fish passage for all species of fish, including salmonids, coarse fish and eels.
- The fish pass needs to operate at a wide range of flows, taking account of the abstraction regime at the site and its effects on flow in the main river channel.

The design should build on previous work by the Wild Trout Trust, including detailed site survey to gather enough information for the detailed design to be undertaken.

The quotation should break down of the potential tasks required and associated costs.

The Final Detailed Design Package should include the following components:

- All field survey data and findings including DEM and data points
- Services search results
- Final design drawings and construction plans etc
- Construction methodologies and timelines
- Detailed costings
- Design performance hydrological modelling and flood risk modelling
- Technical Report detailing design iterations and final design.

Timescale

The work package needs to be completed by 31st March 2021.

Please submit all tenders to Tim Jacklin via email tjacklin@wildtrout.org by 25th January 2021. Any queries, please contact Tim Jacklin via email or tel. 07876 525457.

Appendix

Wild Trout Trust Report, August 2019.

Advisory Visit

River Erewash, Fish Passage Appraisal, Langley Mill, Derbyshire

August 2019

Photo 1 Langley Mill weir

1.0 Introduction

This report is the output of a site visit undertaken by Tim Jacklin of the Wild Trout Trust (WTT) and Dr. Ryan Taylor of the Environment Agency (EA) to the River Erewash at Langley Mill, Derbyshire, on 22nd August 2019. Comments in this report are based on observations on the day of the site visit and discussions with Gareth Pedley (WTT), Matt Buck (EA) and Simon Ward (EA). The visit was requested by Ryan Taylor of the Environment Agency to appraise the site for potential fish passage improvements.

The River Erewash is a tributary of the River Trent near Long Eaton and flows through an urbanised catchment with an industrial history (collieries, coking plants and textiles). In 1937, J. Inglis Spicer, Clerk & Biologist to the Trent Fishery Board, classified the Erewash from its source to Langley Mill as "animal and plant life totally unable to subsist" and downstream of that point to its confluence with the Trent as "fish life unable to subsist but plant life may appear". Since that time, the decline of heavy industry has resulted in a general improvement in water quality to the point it can sustain fish life. However, the 2016 Water Framework Directive classification for the main stem of the Erewash (comprising three waterbodies) is *Poor* (https://environment.data.gov.uk/catchment-planning/WaterBody/GB104028052740). Several sewage works discharges impact water quality in the Erewash, although upgrades are planned within the next round of water company investment (AMP7, 2020-25).

Unusually for a river with an industrial past, the Erewash has only two major barriers to fish migration along its course, one at the confluence with the Trent and Langley Mill weir which is the subject of this assessment. Improvements to fish passage are being actively pursued at both sites, with a view to reconnecting habitats for all fish species including the recovering population of Atlantic salmon in the Trent catchment.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left-hand bank (LHB) or right-hand bank (RHB) whilst looking downstream. Locations are given as Ordnance Survey ten-figure grid National Grid References (NGR).

2.0 Overview

Langley Mill weir is located at NGR SK4529247582. The structure provides a head of water which supplies the Erewash canal. The history of water supplies

to the local canals is complex, involving three canals (Cromford, Nottingham and Erewash – only the latter is still in use), originally constructed by competing companies and using different water sources. The abstraction is unlicensed and the EA are currently considering the impact upon the River Erewash and the possibility of bringing it under regulatory control via an abstraction licence.

For the purposes of this report, Figure 1 sets out the present flow arrangement. The site underwent major alterations in the 1980s as part of a flood defence scheme carried out by the then Severn Trent Water Authority, which involved changing the course of the River Erewash and building flood banks. Some of the plans from this scheme are presented in Appendix 1.

Water impounded by the weir is diverted into a culvert which has flow control penstocks at either end. At the downstream end of the culvert, the abstracted water flows in an open conduit channel which bifurcates, the left channel confluences with the Nethergreen Brook and feeds water to the canal, whilst the right channel returns surplus water to the River Erewash (over another weir).

Estimates of the flow split between the River Erewash and the canal feeder were made on the day of the site visit by Ryan Taylor based on channel dimensions and flow rates as follows:

- A split of 54% (0.1376 m^3/sec) to 46% (0.117 m^3/sec) of the flow between the river and the canal feeder.

- At the bifurcation of the canal feeder conduit, it was estimated that 72% (0.084 m^3/sec) of the abstracted flow returns to the River Erewash via the right-hand channel and 28% (0.033 m^3/sec) goes to the canal system.

River level on the date of the site visit was slightly above typical low flow (approximately 0.06m above typical low at Sandiacre gauging station). These estimates are broadly in line with records held on file by the EA showing a percentage take (abstraction) of around 40 – 60% in 1990s.

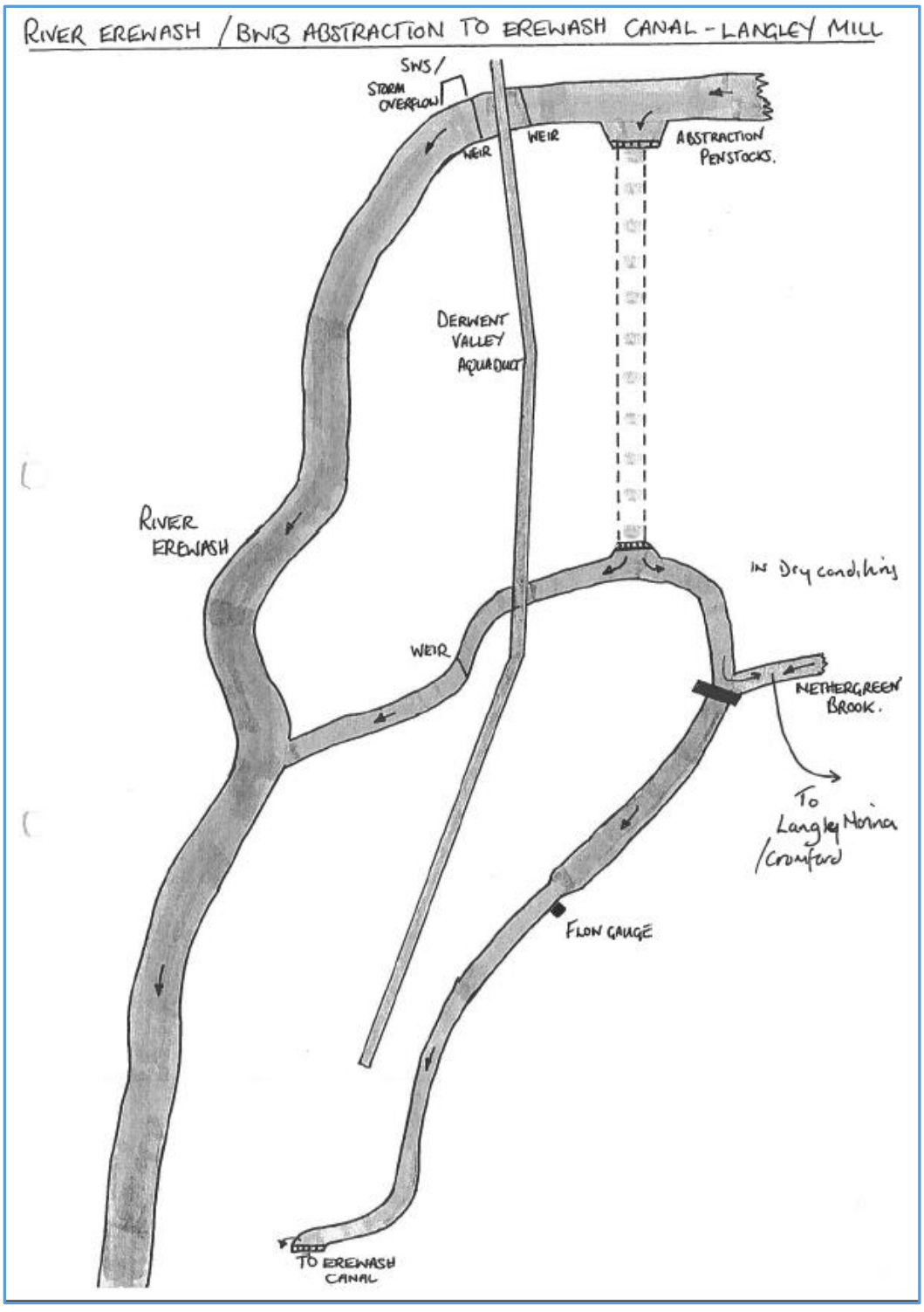

Figure 1 Schematic diagram of canal abstraction at Langley Mill weir (from correspondence supplied by Environment Agency).

3.0 The weir and fish passage

During the site visit, a levels survey of the weir structure (including the 20.7-m long apron) and the riverbed levels upstream and downstream was carried out using a dumpy level. The levels quoted in this report are relative to a temporary benchmark taken on the concrete base of the combined sewer overflow (CSO) at the edge of the brick wall (Photo 2), located at the downstream end of the weir apron.

Photo 2 Temporary benchmark position, NGR SK4528247570, nominal level 3.3m

Figure 2 shows the long section through the weir structure based on the levels taken during the site visit.

The weir structure consists of a crest at the upstream end, 9.5m wide across the channel with a vertical drop of 0.925m onto an extended concrete apron (water level difference also 0.925m). The apron extends approximately 15m downstream at a gradient of 1.2%, then a further 3.6m at 5.3% to a vertical step 0.34m high. The apron continues a further 1.7m downstream of the step, to another vertical step of 0.4m to the downstream riverbed level (water level difference across this downstream step was 0.14m). Water level difference (head loss) across the entire structure was 1.805m over 20.7m (Photo 1).

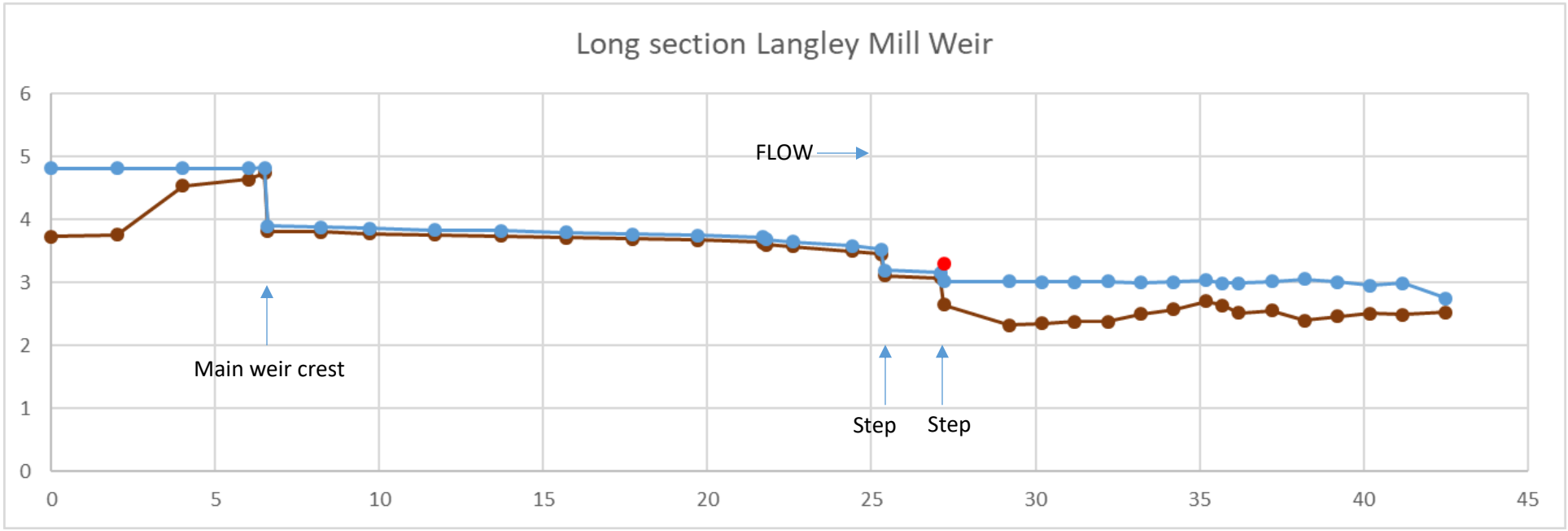

Figure 2 Long-section through weir structure at Langley Mill. All measurements in metres, X-axis = chainage; Y-axis = height. Brown = bed/invert level, blue = water level, red = level of base of CSO outfall.

The difference between the level of the main weir crest and bed level downstream of the entire structure is approximately 2.4m over 20.7m (a gradient of approximately 11.6%).

In its present form, the structure is an impassable barrier to the upstream movement of fish and a significant obstacle to downstream migration. The factors which impede fish passage are:

- The split in flows caused by the abstraction and return of surplus water to the river some distance downstream, creating attraction flows from two potential routes (both currently dead ends) for fish moving upstream. As large a proportion of flow as possible should be retained in the channel where fish passage improvements are made (the main river channel) in order to maximise the chance of fish being attracted to that route.
- The steps at the downstream end of the concrete apron prevent fish from swimming upstream during low flows. At high flows, when the steps may be drowned out, the water velocity over the smooth apron is likely to be too fast for most fish to swim against.
- The height and vertical face of the main weir then prevents fish from swimming upstream (if they managed to traverse the apron) as water depths downstream of the vertical weir face are too shallow to allow those fish species capable of leaping the weir to do so.
- Fish moving downstream could potentially be entrained in the abstraction (presently trash screened with wide bar spacing, approximately 100 mm). As part of the abstraction licencing process, the future recovery of the Erewash as a migratory salmonid spawning river should be recognised, with a potential requirement for 10 - 12.5mm screening for smolts. The proportion and timing of flow abstracted also has a bearing; e.g. reduction/cessation of abstraction during elevated flows and night-time during the spring smolt migration period (April-May).

The following points were noted during the survey:

- The Derwent Valley Aqueduct passes directly over the weir apron (at chainage 13.2m) at a height of 2.6m above the bed level at that point (c.3.75m) and should be considered during the design/construction of any fish passage improvement, along with other services.

- The steps in the concrete apron appear to be constructed from gabion baskets with a concrete skim above (Photo 3). The main weir appears to be constructed of sheet piling with a concrete crest (needs confirmation) and there is considerable undermining of the crest – possibly the reason the concrete apron was installed downstream in the 1980s.

Photo 3 Gabion construction of steps in weir apron.

- The combined sewer overflow pipe (with flap valve) outfalls to the river on the RHB, immediately downstream of the steps at the downstream end of the concrete apron (Photo 4). The invert level of the concrete base of the outfall is 3.3m.

Photo 4 Combined sewer/surface water outfall

- Downstream of the steps there is a natural river bed; the RHB consists of stone cemented in place, extending to approximate chainage 42.5m where there is a small flapped surface water drain outfall (Photo 5). The LHB was overgrown with brambles at the time of the visit, but is thought to be an earth rather than stone bank. A low berm of sediment consolidated with emergent aquatic vegetation was present against the LHB, narrowing the low-flow channel.

Photo 5 Downstream end of site (chainage 42.5m), end of artificial stone bank on RHB and flapped outfall (red circle).

4.0 Options for fish passage improvement

Weir removal or a nature-like bypass channel would provide the greatest improvement for fish passage but are not viable at this site as the former would remove the head of water required for the abstraction and the latter is not be possible within the existing infrastructure of the site (buildings, flood banks, aqueduct and canal feeder conduit).

The remaining options are various designs of technical fish pass or easement to be constructed within the existing river channel. Whichever option is chosen, the following two points should be considered at the outset:

- The proportion of flow within the river channel should be maximised to protect its ecology and facilitate fish attraction to the fish pass and efficiency of the fish pass. On the day of the site visit, approximately 72% of the water abstracted was being returned to the river (at relatively low flows), indicating that far more water than is necessary for the canal system is being abstracted.

- The potential for lowering the crest height of the weir should be investigated as a first point of action, alongside the review of volume of water abstracted. Any reduction in the height of the weir crest (and hence overall gradient of the structure) would significantly improve the effectiveness of any fish passage improvement that is implemented.

Options:

1. Rock ramp. The 11% plus slope within current footprint of the weir and apron exceeds the usual gradient parameters of 1 – 5% for rock ramps (EA Fish Pass Manual). However, an extending a rock ramp structure further downstream would lessen the gradient to within those parameters, especially if lowering the weir crest is possible; this would give scope for creating features (e.g resting pools) that would enable the widest range of fish species and sizes to pass at the widest range of flow conditions. Because of this, this would be the preferred option. The existing CSO and surface water outfalls would have to be taken into account, along with clearance under the aqueduct and whether that increases flood risk.

2. Technical fish pass. The most applicable solution from within the range of baffled fish pass designs is likely to be a Larinier, bottom-baffle type pass. However, the sheer length and height of the structure would require a multi-flight pass with resting pools, greatly increasing the size and cost. For Larinier passes to achieve maximum efficiency, the baffle size and spacing also has to be matched to the target species, requiring a choice between smaller coarse fish or larger migratory salmonids. They also provide poor passability for eels, lamprey and minor species. Because of the higher cost and more limited range of fish passage opportunity, this would not be a preferred option here.

3. Replace the stepped apron with smooth concrete slope below the weir crest and install low cost baffles (LCB). The existing 1.8m head difference exceeds the recommended maximum values for LCB in the EA Fish Pass Manual (<1m), but the gradient is well below the 25% maximum. It may be possible to create two flights of baffles separated by a resting pool; an eel pass could be installed alongside. Generally this is a less permanent and less beneficial option than creating nature-like features within the existing channel (such as a rock ramp). Anything that roughens and diversifies the present concrete-lined channel more

(e.g. rocks and varied morphology) would be better habitat and have multiple benefits.

4. Pre-barrages to raise downstream water levels in a series of stages. This is not a particularly effective fish passage improvement for smaller fish species, eel or lamprey. However, a pre-barrage/rock ramp hybrid could be considered, effectively creating an engineered pool and riffle system (Effectively a variant of option 1).

5. Lowering of weir crest. As noted above, this should definitely be explored alongside any option. As a bare minimum, a notch could be cut into the crest (being careful not to create velocities outside the ability of the less able species).

5.0 Disclaimer

This report is produced for guidance; no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon guidance made in this report.