Fish Passage at Wandle – Thames confluence: Summary, Review and Way Forward.

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Wandle Valley

Introduction

The River Wandle is a tributary of the lower tidal River Thames and provides habitats for native / re-introduced brown trout (*Salmo trutta* L.), rheophilic coarse fish (*e.g.* chub [*Squalius cephalus* L.] and barbel [*Barbus barbus* L.]) and European eel (*Anguilla anguilla* L.). Brown trout and European eel have migratory (between fresh and saline waters) aspects to their life cycles and the lower Thames also contains rheophilic & limnophilc (*e.g.* Common bream [*Abramis brama* L.]) coarse fish and estuarine fish species, which could utilise the lower River Wandle at certain times. Therefore achieving multi-species fish passage between these two environments would bring benefits to the fish communities of both the River Wandle and the Lower Thames. For example, populations of brown trout may be wholly freshwater resident or almost exclusively migratory (known as sea trout), or may exhibit varying proportions of the two life-history strategies, which freely interbreed. Migration to sea maybe risky, but allows the exploitation of resources which are far richer than those available in freshwater habitats which leads to accelerated growth. Returning adults are thus much larger than their freshwater resident brethren and are therefore able to produce more eggs per female. Recent research has demonstrated the importance of a relatively small number of adult female sea trout to freshwater resident brown trout production. Using genetic and stable isotope analysis, over three quarters (>75%) of the juvenile fry in a river were demonstrated to be offspring of migratory maternal fish, despite the freshwater resident fish being far more numerous (>90%). The offspring of migratory fish were found to emerge from the spawning gravels earlier and be larger on emergence than the offspring of freshwater resident brown trout, suggesting that migratory traits provide offspring with an adaptive advantage and greater fitness. Migratory trout were therefore the main drivers of trout reproduction in the river studied (Goodwin *et al*., 2016). Thus allowing migratory pathways for sea trout would bring large benefits to resident brown trout populations in the River Wandle.

EDF weir (*Figure 1*. & *Figure 2*.) and Bell Lane sluice (*Figure 3*.) are parallel structures on bifurcated channels, with near identical crest levels (3.188 mAODN and 3.17 mAODN respectively), that form barriers to multi-species fish passage between the Thames estuary and the lower River Wandle (*Figure 4*.). Both structures are drowned out for a short window of approx. 2-3 hours at high tide during the diel tidal cycle, when tides are above structure crest levels, which occurs on approx. >50% of the monthly tidal cycle. This currently provides uninhibited multi-species fish passage for approx. 40-60 hours a month (approx. 6-8 % of the time), a barrier to all species passage for approx. 660-680 hours a month (approx. 92-94 % of the time), and therefore represents a very significant barrier to fish passage.

Both structures are believed to be owned by London Borough of Wandsworth (Solomon, 2010). These structures impound the River Wandle, back up to the Southside shopping centre culvert, which is the next potential barrier upstream. This impounded section appears very poor ecologically, being heavily silted with concrete banks and bed (presumed as not visible due to siltation in channel), limiting habitats for aquatic biota. Two investigations to addressing fish passage at the site(s) have been carried out; Solomon (2010) and Halcrow (2012).

Aims and Objectives

This document aims to review and summarise the findings of the two previous investigations of the structures, and provide a next-steps way forward to progressing a fish passage solution at the site(s).

Figure 1. EDF Weir viewed from the freshwater side looking downstream into the tidal Thames. The tide is half way up the structure.

Figure 2. EDF Weir viewed from the tidal side looking upstream towards the freshwater side, the tide is at its lowest state.

Figure 3. Bell Lane sluice. Double penstock structure (left) and the Bell Lane creek below the structure, which includes a long concrete apron (right).

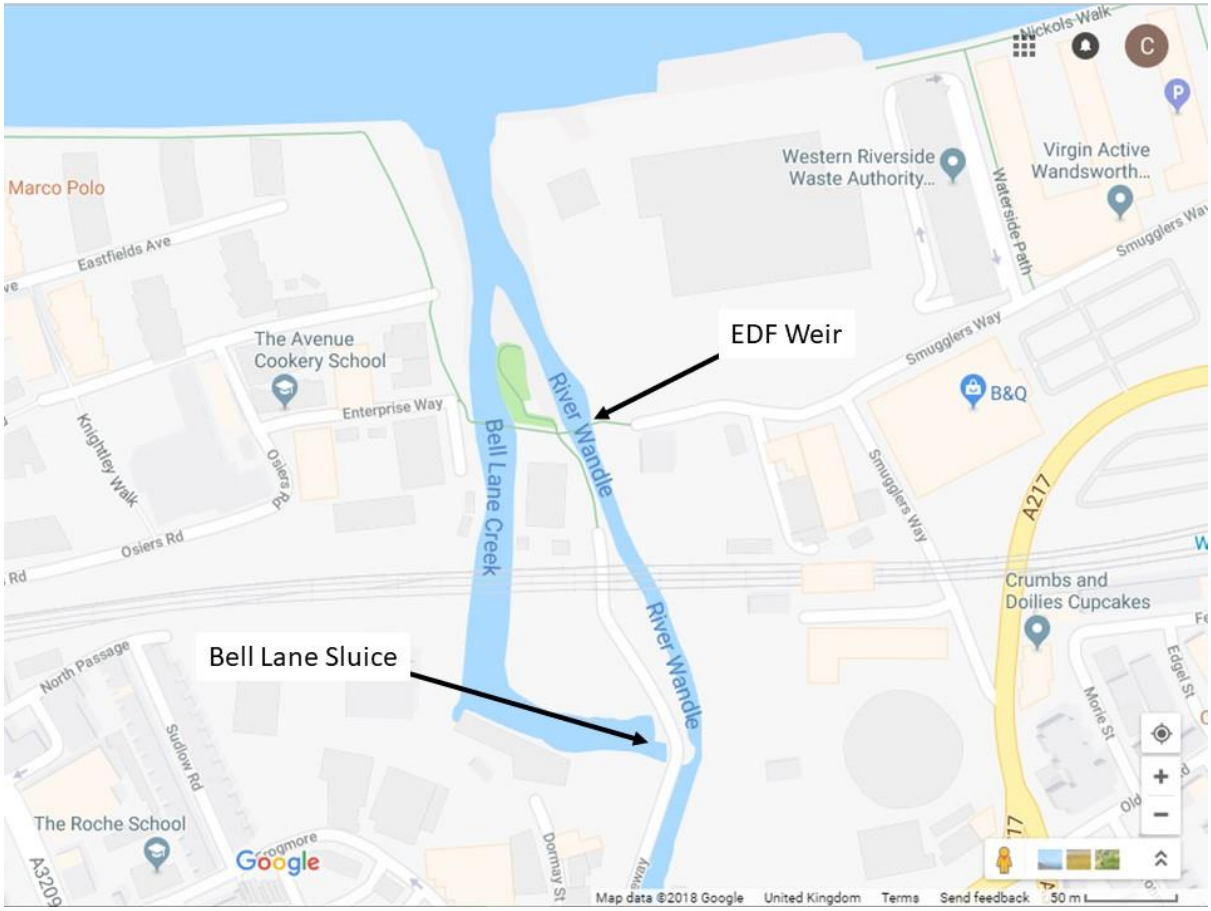

Figure 4. Map of the Lower River Wandle, showing the positions of the 2 structures: EDF weir and Bell Lane Sluice, near Wandsworth, South London. Freshwater flow from the River Wandle is from bottom to top and downstream flow in the tidal Thames is from left to right (source: google/maps).

Summary and review of Solomon (2010)

Solomon (2010) provides a summary of all known structures on the River Wandle. Seven pages are dedicated to EDF weir and Bell Lane sluice, providing descriptions / photographs of the two structures and pass-ability assessment (by expert opinion) for elver, small eel, salmonids (brown/sea trout), rheophilic coarse fish and 'more sedentary' coarse fish (limnophilic).

The structures were deemed passable during high tide windows and impassable when the tide level is below the crests of the structures. Both structures maintain water levels between EDF/Bell Lane and the Southside culvert (approx. 300-480 m upstream) at low tides to maintain habitats and visual amenity value, otherwise the structures serve no specific purpose, however local infrastructure may depend on these raised water levels. Both structures were classified as low priority for remedial action, because both are passable for short windows when they are drowned out by high tides.

Summary and review of Halcrow (2012)

Halcrow (2012) provides:

1. A detailed assessment of the structural dimensions of EDF weir and Bell Lane sluice;

No summary required.

2. An assessment of full weir removal of both structures;

Following an informal visual inspection, full removal of the two weirs was ruled out as not being viable, due to bank stability issues and surrounding infrastructure, at an early stage. Removal of the weirs could cause bed levels to drop by up to 2 m. Given the age of the two weirs (a structure at EDF location dates back to 1610 [Halcrow, 2012]) and the rate of new development in this part of London, local infrastructure (*e.g.* buildings, riverbank walls, railway & A2 bridges etc.) maybe dependent on these raised water levels for their structural integrity and detailed structural survey would be required. EDF weir is also structurally integral to the footbridge that crosses the Wandle at this location. However, the removal or lowering of Bell Lane sluice maybe more straight forward, removal of the penstocks and the quarter circle weir, and investigation by trial opening of the penstocks should be undertaken.

3. Consideration of relevant fish passage options available;

Consideration was given to providing technical fish passage at the sites, without significant demolition or lowering of the existing structures, which could have brought potential benefits to the upstream reach and the practicalities of implementing the solutions put forward. Two alternatives were investigated:

a) The installation of a fish pass at Bell Lane and the lowering of EDF weir crest to increase the temporal size/length of the current tidal passage window.
b) The installation of a fish pass at EDF weir and the lowering of the Bell Lane sluice crest to increase the temporal size/length of the current tidal passage window.

However, it was concluded that provision of fish passage at both structures would be necessary to meet Water Framework Directive (WFD) requirements. Fish pass type was considered from the following limited number of options: Larinier, Denil, Pool and Weir and Brush-Furnished Fishway. Only Larinier type passes were deemed appropriate for the sites.

4. Outline designs and preliminary costings of the preferred options for Larinier passes on EDF weir and Bell Lane sluice.

Despite the height of both structures, being above the threshold for single flight passes, resting pool provision to create two flight passes were ruled out due to;

a) the potential for such pools to silt up in this estuarine environment;
b) the need for positioning the pass entrance as close to the base of the structure as possible (to increase attractiveness); and
c) space limitations, especially in the culvert at the Bell Lane sluice site.

Therefore the passes worked up to outline design exceeded the maximum length (8-10 m) required for multi-species passage for a Larinier pass. Even at extended lengths, the entrances of the passes at both sites would be perched above water level during lower states of the tide. This could cause negative public perception of the fish passage solutions if implemented in this fashion. This should be a major consideration given the nationwide requirement for fish passage solutions, the high visibility of the sites and the high footfall through this part of central London. Extending the pass to bed level would overcome this perception issue. However, the pass would only meet the max length criteria during part of the tidal cycle, when the rising downstream water level on a flooding tide effectively reduced the pass length to <10 m.

The major oversight of the report is the lack of consideration given to the potential to lower the crest levels of the two structures to facilitate the implementation of a more effective fish passage solution. *i.e.* there may be potential to lower the structures sufficiently to reduce the length of pass required to below the maximum allowable length or potential to implement a solution other than a technical fish pass.

Onsite observations

During a site visit to inform this review, two onsite observations relevant to the provision of fish passage at the sites were noted:

1. The current flow split between the two parallel structures appears to favour greater attraction for upstream migrating fishes at Bell Lane sluice (*Figure 5.*). This may potentially be due to the more upstream positioning of the offtake for the Bell Lane structure and its marginally lower crest level (Approx. 1-2 cm). Under the current flow split, this would increase the passage efficiency of a fish passage solution implemented at the Bell Lane sluice, due to it having a greater attraction flow.

2. Bell Lane creek between Bell Lane sluice and EDF weir (see map in *Figure 4*.) contains good quality gravel substrate, which is a rare resource in the Lower Thames and which may provide valuable spawning habitat for fishes. This would give greater ecological value to implementing a single solution at Bell Lane sluice to maintain the flow over these gravels to keep them clean and provide oxygenated water flow to any fish eggs laid in this location.

Figure 5. The downstream confluence of the bifurcated channels below EDF weir and Bell Lane sluice at low tide. Flow from the EDF structure joins from the right-hand-side and flow from the Bell Lane sluice joins from the left-hand-side. There appears to be a greater proportion of freshwater flow joining from the Bell Lane sluice structure, giving this structure a better attraction flow for migrating fish under the current flow split.

Next Steps - Way Forward – and associated costs

1. Discussions with Environment Agency fisheries staff to determine if effective fish passage to meet WFD requirements could be met by the implementation of an effective fish passage solution (*e.g.* sufficient attraction flow) at just one of the structures.
   Minimal staff time costs (~£500).
2. Trial opening of Bell Lane sluice penstocks to see effect on upstream infrastructure, with input from structural engineer, and benefits to fish passage to inform a full options appraisal.
   Approx. costs £5-10k.
3. Full options appraisal for the site(s), including investigating how much the structures could be lowered to simplify the implementation of a fish passage solution, and the consideration of all available fish passage solutions *i.e.* include tidal tracking flaps, rock ramps etc. not just technical fish passes.
   Approx. costs £10k.
4. Costings and detailed design of preferred option.
   Approx. costs £10-20k.

References

Goodwin, J.C., King, R.A., Jones, J.I., Ibbotson, A. & Stevens, J. (2016) A small number of anadromous females drive reproduction in a brown trout (*Salmo trutta*) population in an English chalk stream. *Freshwater Biology*, doi:10.1111/fwb.12768

Halcrow (2012) *Mole & South London Fish Passage Investigations, Option Appraisal – River Wandle.* Report for Environment Agency, Thames Region. Halcrow Group Ltd., London, pp. 33 plus Appendices A-H.

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