File Note

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Project title	Gasworks Weir Fish Pass	Job number	273427
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Prepared by	Holly Webster	Date	31 July 2020
Subject	Fish pass design updates		

1 Introduction

Ove Arup & Partners Limited (Arup) has been commissioned by Natural Resources Wales (NRW) to support the development of a fish/eel pass within an existing weir ('Gas Works weir') on the River Ebbw.

The weir is an approximately 1m high and located on the Ebbw Fach river a tributary of the River Usk in Wales. The weir poses and obstruction to migratory fish and prevents access to circa 3km of potential spawning ground for salmon. The proposals aim to meet current fish pass standards with a focus on salmonids. Arup were appointed to update the consents and finalise the construction work information from a 2014 design by Halcrow. This note details design changes to the 2014 design.

Figure 1: Gasworks weir during site visit

2 Weir and site

The site is located to the South of Abertillery on the Ebbw Fach grid reference SO 21736 03745. The river flows through a 7m channel with vertical masonry walls. The weir is 1m high, approximately 7m long stone pitched formed of two gradients, steeper upstream as shown in figure 1, followed by a less steep longer section as shown in figure 2.

Constraints:

- A low footbridge above the weir which is no longer in use but may act to help prop the walls on either bank
- Upstream of the weir on the left-hand bank is a surface water outfall.
- Downstream of the weir there is a concrete plinth ~2m wide which runs along the left-hand side (see figure 2)
- The vertical masonry walls are approximately 3m above the level of the water on the downstream side of the weir.

Figure 2: Lower part of the weir including concrete plinth running along the left-hand bank

3 Halcrow Proposals

Halcrow's design in 2014 as detailed in their application for Fish Pass Approval and drawings was for a single channel containing a 1200mm wide Larinier pass and 70mm wide section with eel bristles installed (See Figure 2). The pass was to have two gradients to match the weir profile, reduce the demolition required, and allow the pass to be fixed directly onto the weir in places (see figure 3). Downstream of the pass were two pre-barrages composed of blockstone to create pools on the approach to the pass.

Flow data at the time indicated a Q95 of 0.106 m3/s and Q10 = 1.414 m^3/s

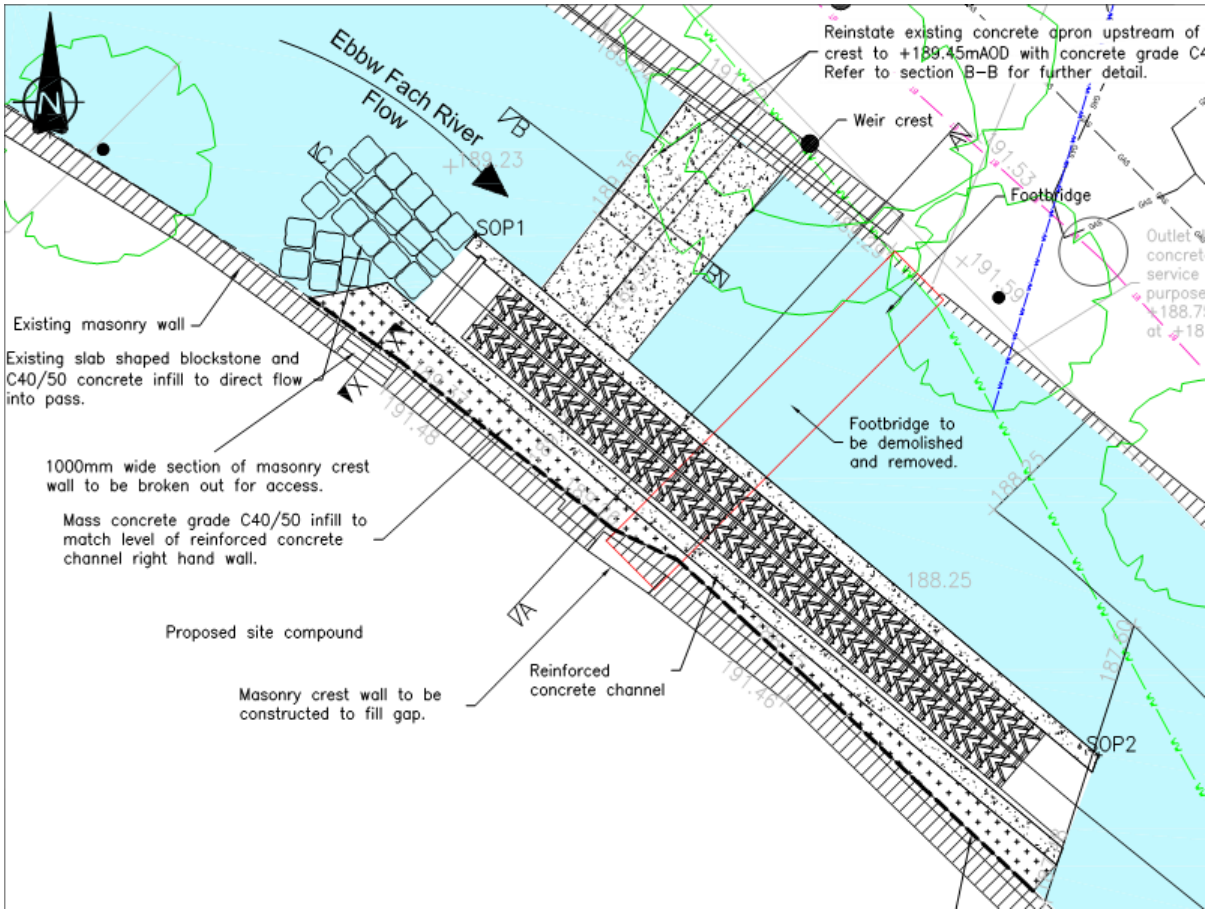

Figure 3: Extract from the Halcrow's general arrangement drawing

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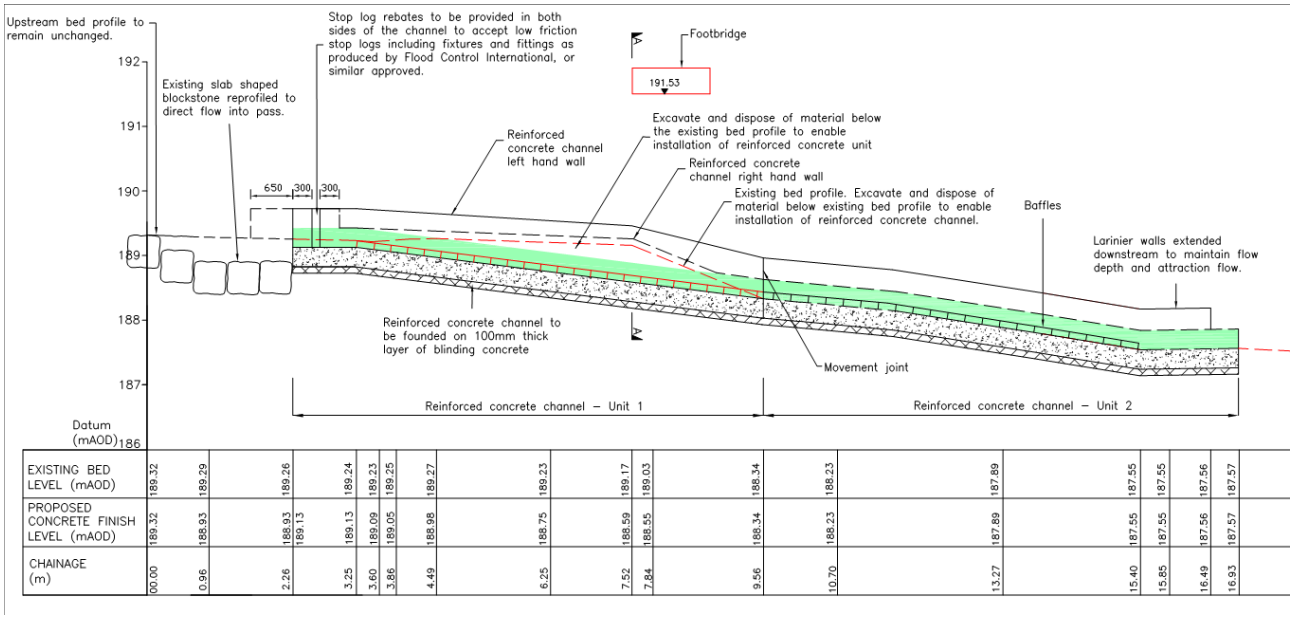

Figure 4: Long Section from Halcrow Proposals

4 Update to meet current fish pass specifications

The pass was reviewed by Arup and our specialist subconsultants Fishtek. The following issues and proposed corrections were identified.

4.1 Larinier

- Issue 1: The current design does not operate until flows >Q84. This is not best-practice. The Larinier should function at least at flows as low as Q95.

  Correction 1: We have re-designed to be Larinier 600 mm wide (rather than proposed 1200 mm) and lowered the invert of the upstream baffle to 189.12 m AOD to ensure operation at Q95.

- Issue 2: The Larinier has multiple slope gradients. This is not best-practice and will not be approved by the FPP without sufficient evidence of its functionality.

  Correction 2: We have re-designed the Larinier to be a single slope (15 degrees) with 100 mm baffle height.

- Issue 3: The side walls of the proposed design will allow over-topping at relatively common flows- affecting Larinier performance.

  Correction 3: We have designed the side-walls to be sufficient to contain Q10 water levels plus 100 mm.

- Issue 4: There is no downslope to bed at the upstream end of the Larinier

  Correction 4: We have added a 1-in-2 slope to bed at the upstream end of the Larinier and indicated that this can be the site for mounting a white flashboard for future camera monitoring.

- Issue 5: Lacking details on the position of stop-log slots, camera slots and US and DS water levels

  Correction 5: We have added these details to the design.

4.2 Eel pass

- Issue 1: The 70 mm wide vertical eel passes are prone to blockage and are not best-practice.

  Correction 1. We have designed a new 500 mm wide gravity-fed eel pass which is sited bankside of the Larinier in a reinforced concrete channel. The eel tiles within this concrete channel have a lateral slope that ensures operation over the recommended hydrological flow range of Q99-Q70. The eel pass has a downslope to bed at the upstream and downstream end.

4.3 Pre-barrages

- Issue 1: The notches do not make maximum use of the flow in order to minimise the head-drops.

  Correction 1: The notches have been re-designed (deeper) and re-positioned to reduce head drops between them.

- Issue 2: The pre-barrages appear to not be set flat and do not have an adherent nappe profile.

Correction 2: The pre-barrages have been designed to be flat with adherent nappe profile to promote streaming flow and minimise risk of injury.

4.4 Proposed Design:

The new proposed design is shown below. Additional changes include the use of concrete in the pre-barrages and upstream of the fish pass to enable greater control of the shape and increase durability.

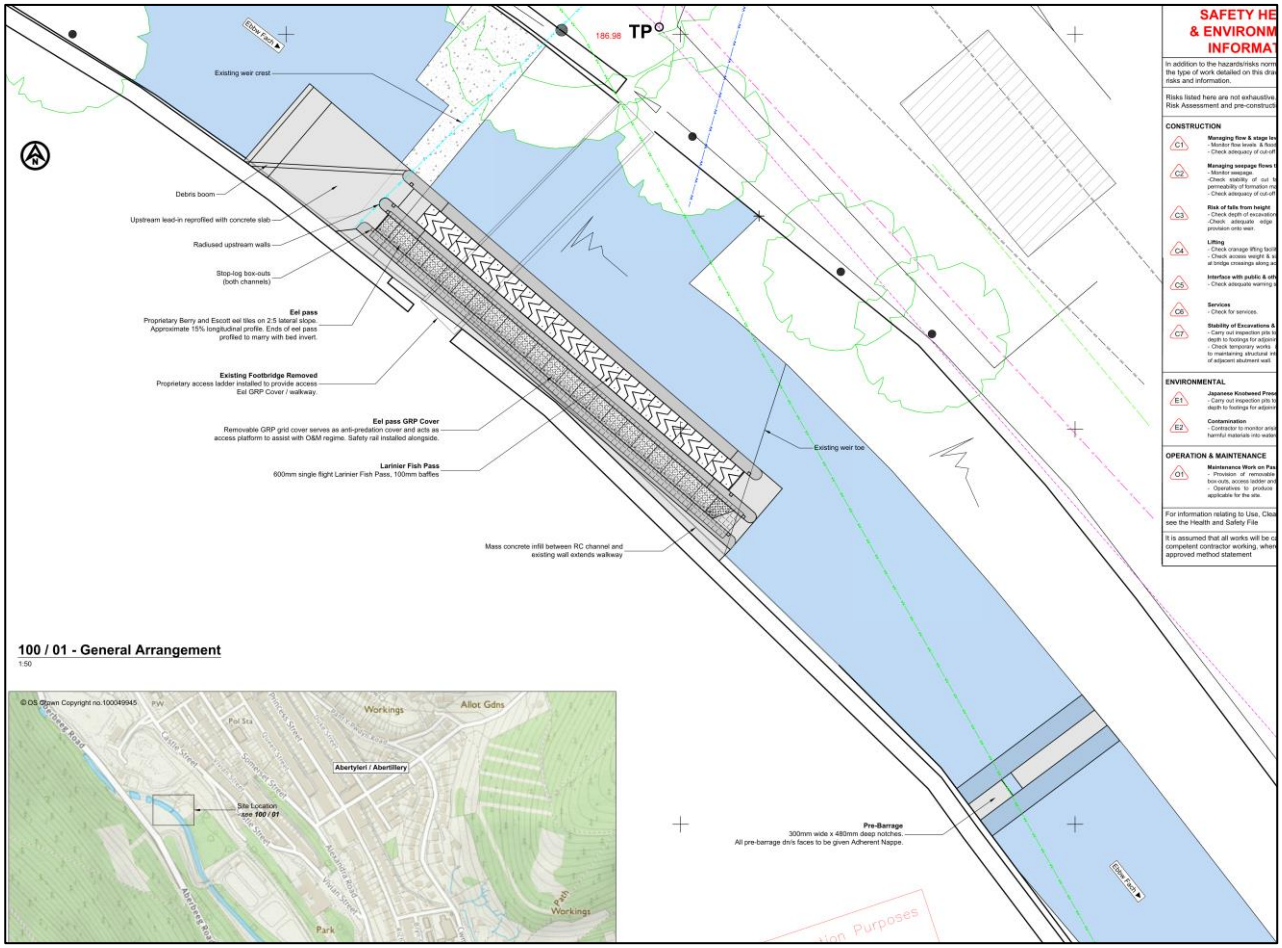

Figure 5: General Arrangement as per FishTek updates

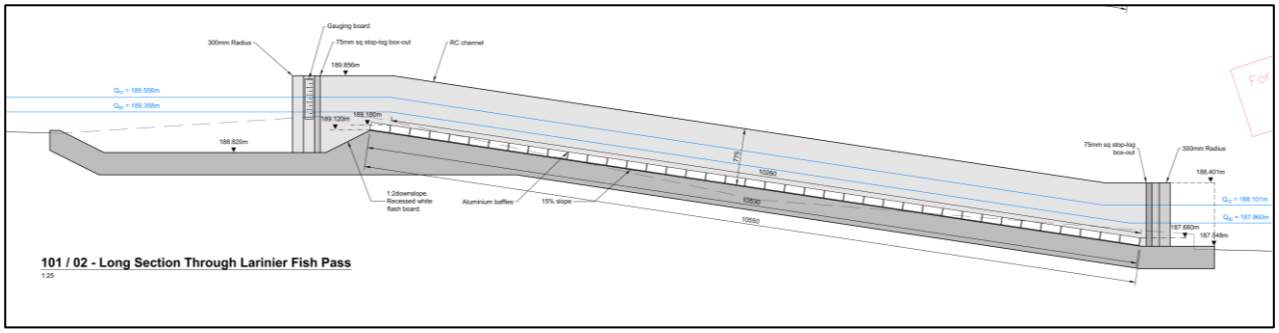

Figure 6: Update long section as per FishTek updates

4.5 Amendments from NRW

The design was subsequently altered to meet the requests of NRW. The amendments are as follows (extract from email 9th March 2020, Michael Clyde, NRW)

- *GRP cover/walkway over the eel pass. Remove this from the design. It will catch debris in flood events causing blockages and potential to get damaged by debris. Not required.*
- *Safety rail alongside GRP cover– remove from design. Potential debris catcher. Not required.*
- *Ladder onto fish pass. Remove from design. Not required. Potential to catch debris and get damaged. Fish pass can be visually inspected from above and if safe, access for maintenance will be via existing ramp access into the river 50m upstream of the weir.*
- *Upstream debris boom. Their use in similar Valleys rivers has created more debris maintenance issues than they alleviate. Remove from design. Not required.*

4.6 Structural and Geotechnical Review

Following the amendments to create a fish pass that would meet current fish pass design guidance based on provided information the pass and pre-barrages were assessed geotechnically and structurally. The reinforcement design cover sheet and concrete specification can be found in the works information. Additionally, standard connections such as movement joints and the interface between the pass and the masonry river walls was specified. Geotechnically the structures were assessed for sliding, topping and bearing failures and found to be safe in all cases.

5 Sewer beneath pass and pre-barrages

Service records for the area identified a 675mm diameter critical Welsh Water sewer running through the pre-barrages. Based on limited information of invert levels the sewer was estimated to be within 0.5m of the riverbed. As Covid-19 prevented survey to confirm the depth and location a methodology was devised to avoid loading of the sewer. This proposed to use compressible filler 30mm thick over a 1m span above the sewer if identified beneath a pre-barrages.

However, in late June a Welsh Water survey crew was able to go to site and confirm that the sewer ran within the concrete plinth along the left-hand bank and hence no filler or other mitigation was required, as follows in below (extract from email 12th June 2020, Holly Smith, DCWW):

As discussed, having now observed the site with our Operations Team it is thought that the sewer most likely runs tight to the northern bank underneath the concrete plinth that can be seen running the length of the river. This assumption is further supported by the presence of the chamber that we saw on this side of the river close to our water treatment works.

From your plans it appears that your work sits outside of this area and therefore will not impact on the sewer. Provided there is no need to disturb or undermine the concrete plinth I would have no objections to your proposals as shown.

As discussed, please bear in mind that because we have not been able to fully verify the assumptions above you must still proceed with caution and contact us if you do come across our apparatus during the course of your works so we can advise you further

The 24 hour contact is 0800 085 3968 – this is more for emergencies or out of hours. Otherwise please contact myself on 07795853667.

6 Update to optimise design to new flow data

In July 2020 NRW identified new flow data indicating that the flow in the river is approximately 60% greater than was used in the previous design. This new information led to the modification of the structures to allow greater flow. (extract from email 14th July 2020, Alex Cowell, NRW):

Flow estimates at this location were requested by Michael Clyde. The flow duration curve statistics (including the key Q95 flow) were provided by Martin Clarke (Hydrology & Water Resources) on the 8th July 2020, to Michael Clyde and Michael Parfitt. This up to date and improved estimate of flow was obtained using a long-term gauging station and local spot gauging's. Q95 is estimated as being 168 l/s at this location.

Given the above information, the design is likely to need adjusting and the weir appropriately lowered at the fish pass entrance. The current intention to lower by 18cm (as stated in form-wra) would only ensure flows <Q99.

The recommend changes are summarised below in the extract from FishTek below (Gary Bilotta, 27th July 2020)

The Q95 flow has increased from 0.106 m3s-1 to 0.168 m3s-1.
The Q10 flow has increased from 1.414 m3s-1 to 2.230 m3s-1.

(1) the whole Larinier design is lowered by 0.15 m.

(2) the whole eel pass design is lowered by 0.10 m.

(3) Pre-barrage 1 (closest to the Larinier toe) is lowered so the crest is at 187.71 m AOD and the notch is widened from 0.3 m to 0.42 m.

(4) Pre-barrage 2 (most downstream pre-barrage) is lowered so the crest is at 187.47 m AOD and the notch is widened from 0.3 m to 0.42 m.

It was noted that the new hydraulic head at the over the Larinier pass and pre-barrage 2 at Q10 flows would make it less suitable for coarse fish to ascend, but still within the acceptable range for salmonids which are the primary focus of this design. These changes were not found to have significant impact on the structural or geotechnical assessments.

DOCUMENT CHECKING (not mandatory for File Note)

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Signature			