

Water Resources Permitting  
Natural Resources Wales  
Tŷ Cambria  
29 Newport Road  
Cardiff  
CF24 0TP

Packsaddle  
Wrexham Road  
Rhostyllen  
Wrexham  
Clwyd  
LL14 4EH

xx May 2019

Dear Liz,

**Application Numbers PAN-4127 & 28**  
**Afon Cownwy & Marchnant Impoundments**

Thank you for your letter dated 29 March 2019 relating to our Impoundment Licence application numbers PAN-4127 & 28. Using your notation and headings, please find below our responses.

These responses should be read with the updated versions of the detailed design geometry drawings and Basis of Hydraulic Design Reports that are attached to this letter.

**Marchnant Impoundment**

**Hydrology:**

We note your concerns regarding the risk of blockage of the 75mm diameter circular orifice. We have updated our detailed design with a larger diameter pipe (150mm dia.) and this will have a 75mm diameter orifice plate at the inlet. In addition, we have added a coarse bar screen with bars at 40mm vertical centres. The coarse bar screen will be maintained, if required, by raking clear from the footbridge located directly above.

We acknowledge the comments regarding the report and the inconsistencies within. The report has been updated since the original submission and we have added the additional requirements, as requested.

**Sediment plan/channel restoration:**

We are aware of the concerns raised relating to the geomorphological risks and the impact of the works within this reach.

The construction of the new channel will be undertaken offline with the river flows continuing through the tunnel to Lake Vyrnwy. The scope of works includes the creation of a new watercourse channel downstream of the new channel. This will extend to the nearest incoming tributary approximately 80m downstream of the weir.

Silt management including silt fencing and sedimats will be installed downstream of the works during construction and for an agreed period following completion of the main works.

Please note that we have now conducted a preliminary contamination assessment and this has identified ochreous sediment and sheen in the area downstream of the weir. No potential sources of contamination were identified within 700 metres upstream of the site. The creation of a new channel will direct the flows and so mitigate the risk of any organic materials / sediments being transported downstream.

It is proposed to phase the introduction of the flows and we will monitor the downstream channel as part of the commissioning phase. The silt fencing and sedimats will be maintained during the initial turning of flows and will only be removed when it is acceptable to do so. In addition we will introduce a monitoring regime by our Operations Team to attend site and inspect the channel downstream and this will be mandated specifically before, during after storm events.

A Geomorphological walkover survey to be undertaken 12 months after construction to identify any issues related with erosion of land, geomorphological instability or flooding of properties. Sediment translocation or other mitigation measure may be required but it is not possible to confirm scope until walkover survey undertaken.

A two-stage cross-section and extent of the new channel are shown on the updated Detailed Design Drawings.

#### Fisheries:

Since submission of our report "Afon Cownwy and River Marchnant low flow alleviation schemes: Consideration of requirement for fish screening" we have continued to explore the option of behavioural screens only. The advised cost of installing behavioural screens at both sites is now understood to add over £100k to the project costs, which is not affordable. With a completed design and contractors pricing of construction, the full costs of the proposed modifications understood and to insist on either redesign to include physical screens or guidance systems will risk not being able to go ahead with the work. As set out in the report, the project has been developed in agreement with NRW / EA without previous inclusion of any fish screen or guidance system.

For the downstream fish passage, the new weir will divert flows to the existing river. To date we have included feedback from NRW within the detailed design. At no time has a by-wash been mentioned in any discussion with NRW. Furthermore, NRW's pre-application response letter dated 27/06/2018 states that the downstream fish passage can be achieved by the inclusion of a plunge pool, which has been incorporated in our design. We are sure that you will appreciate that the change to a by-wash channel at this stage of the Project would result in an increase in the costs and would have a significant delay to the construction such that the works would not be delivered by the Regulatory milestone date.

With regards to the depth of water in the downstream channel, the upstand height has been increased to 300mm (from 250mm) thus providing a minimum depth of water of 300mm. Please refer to the Detailed Design Drawings for further details.

For the rip rap waterway the depth of the "low flows" channel (Detail 2 in DRG 002) has now been increased to 300mm (from 250mm) and been made of grouted rip rap to contain the flow discharges within the "low flows" channel. The connection between the downstream passage and the "low flows" channel rip-rap is made through a notch in the upstand weir. The width of this notch was defined in order to ensure a 300mm water depth for the Q99 flow.

We will ensure that all surfaces associated with downstream passage will be chamfered (rounded).

## Cownwy Impoundment

### Hydrology

We acknowledge the comments regarding the report and the discrepancies / inconsistencies within. The report has been updated since the original submission and we have added the additional requirements, as requested.

For the orifice diameter the 2 nr 90mm diameter orifices will be cut on the penstock slide with the centres at 0.71m below the river / tunnel weir crest level. Please refer to the updated Detailed Design Drawings for details and the Report for the justification of the solution chosen.

With regards to the orifices and the risk of blocking, twin orifices will be cut on the penstock slide. This penstock will be used to flush debris that accumulates upstream of the tunnel weir. To minimise the risk of the orifices becoming blocked, a new removable screen upstream of the 400mm x 400mm opening will be added to our works.

For the flow gauging station we were proposing to derive the rating curves considering the “as-built” information. The rating curves based on the detailed design geometry and BS ISO 3846:2008 have now been included in the appendix of the hydraulic report. These rating curves will be used for the new flow measurement device to be installed and so will be available on “Day 1”.

With regards to the challenge around the weirs being smaller in height, the weirs crest level were defined at the highest possible level such that the maintained the beginning of operation of the main spillway weir at 8.7 m<sup>3</sup>/s, as existing. We acknowledge that lower crest levels for the split weirs could avoid drowning the flow measurement weir. However, it would mean that the tunnel weir would be drowned with lower flows by the tailwater levels imposed by the tunnel capacity, thus reducing the discharges to the tunnel and affecting the driver of 75:25 split criteria. A key requirement of the works for STW and United Utilities is to maximise abstracted flows to the existing maximum capacity of the tunnel, subject to Q99 and 25% / 75% split requirements.

Referring to section 3.6 of the hydraulic report and the options to measure flows, we confirm the following relating to the discounting of Option 2 – Raising the current weir to operate in free flow conditions. A flow measurement weir at a higher level to ensure the flow control at that location would impose higher pond levels leading to the operation of the main weir spillway with flows smaller than the mentioned 8.7 m<sup>3</sup>/s and, with that, less water would be diverted to the tunnel. Such an option would not be in line with the “maximisation” criterion mentioned above and so this option was discounted.

For the comments relating to the options do not include measuring the flow through the two orifices, the discharges through the orifices have been considered in the design (refer to table 3-2 of the report). The two orifice discharges are incorporated in the rating curves now included in the appendix of the Report.

The design of the new slit weirs has been completed in accordance with the relevant British Standards and to ensure the 25 / 75 flow split with the flow measurement accuracy of +/- 8%.

The physical measurement will be taken from the existing depth monitor, or an equivalent replacement device installed at a suitable agreed location as part of the work on site.

We are sure that you will appreciate that considering an alternative flow measurement method now at this stage of the Project would result in an increase in the costs and would have an impact upon the programme for the works.

## Geomorphology/Biodiversity

Noted with no issues reported.

## Fisheries

Since submission of our report “Afon Cownwy and River Marchnant low flow alleviation schemes: Consideration of requirement for fish screening” we have continued to explore the option of behavioural screens only. The advised cost of installing behavioural screens at both sites is now understood to add over £100k to the project costs, which is not affordable. With a completed design and contractors pricing of construction, the full costs of the proposed modifications understood and to insist on either redesign to include physical screens or guidance systems will risk not being able to go ahead with the work. As set out in the report, the project has been developed in agreement with NRW / EA without previous inclusion of any fish screen or guidance system.

To clarify which comments/improvements have been incorporated in the design, this is in reference to measures now included in the design to retain a height of water in each step (upstands) and a depth of water for fish to land in downstream of the 25% weir. These were not included in the original information submitted for the impoundment licence.

The current design shows the Q99 release at this 25% weir, and the concerns are noted with regards to the dry reach of river this will create. Due to the location of the scour valve on the impoundment structure, allowing for the associated construction access from the opposite side this would add over £90k to the project costs, which is not affordable. We are still exploring options around softer measures to provide Q99 release at the scour valve (e.g. holding the valve open a prescribed amount and locking off), but cannot confirm this is achievable so wish for the impoundment licence to be considered in the context of the current design.

For the comments relating to the Q99 orifice and the risk of blockage, twin orifices will be cut on the penstock slide. This penstock will be used to flush debris that accumulates upstream of the tunnel weir. To minimise the risk of the orifices becoming blocked, a new removable screen upstream of the 400mm x 400mm opening will be added to our works. Due to the restricted channel width, a notch solution could more easily become clogged by floating debris. Furthermore, the discharges through a notch ( $f(H^{1.5})$ ) would be more sensitive to head variations than the discharges through an orifice ( $f(H^{0.5})$ ) which would increase the deviations from the 25 / 75 flow split criteria.

The weirs were designed to conform to BS ISO 3846:2008, Hydrometry – Open channel flow measurement using rectangular broad-crested weirs. The weir length cannot be shorter than 750mm because large discharges (and heads) would lead to unstable water levels. The weir length was increased from 750mm to 1000mm to operate with  $h_1/L$  ratio below the maximum of 1.6 recommended by this BS for the entire range of discharges. Furthermore, a longer throat length allows the weir operation below the modular limit for larger flows.

We will ensure that all surfaces associated with downstream passage will be chamfered (rounded).

For the point raised on the downstream fish passage, we confirm:

- a. The upstands are now 350mm in height. Please see updated 'Cownwy Detailed Design Drawings' attached for further details.
- b. The 350mm high upstand will ensure minimum water depths deeper than 300mm for flows higher than the Q99.
- c. The downstream pools have been extended down to the end of the masonry lining (refer to fig. 3-5 of the updated Report and to the updated Detailed Design drawings).
- d. Water levels for the Q99 are represented in Section BB of the updated Report.
- e. Please refer to Fig. 3.5 of the updated Report. Section BB has been extended down to the end of the masonry lining.
- f. The width of the notch has been defined in order to ensure minimum water depths of 300mm deep for the Q99 flow.
- g. The inclusion of a by-wash has not been mentioned in any discussions to date with NRW. The pre-application response letter dated 27/06/2018 states that downstream fish passage can be achieved by the inclusion of a plunge pool, which we have incorporated in our design.  
Furthermore, the existing masonry structure at Cownwy has existing steps that are more compatible with a plunge pool solution.
- h. We will ensure that all surfaces associated with downstream passage will be chamfered (rounded).

We trust that we have sufficiently answered the comments raised in your correspondence and will allow us to move forward to determination of our Impoundment Licence applications.

Yours Sincerely

**Adam Walker, Project Manager for Hafren Dyfrdwy**