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Afon Claerwen

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1. INTRODUCTION

This report is intended to accompany applications for Planning Permission and Licenses for a proposed hydropower scheme on the Afon Claerwen, downstream of the Claerwen Dam. The river links the Claerwen Reservoir to the Dolymynach Reservoir and the total reach is around 3.5km in length.

Flows in the river are already heavily modified. It is understood that the Afon Arban, which joins the river immediately downstream of the Claerwen Reservoir, provides the base flow in the Afon Claerwen, and this will fluctuate naturally. However, the river is also used to move volumes of water from the Claerwen Reservoir down into the Elan Valley system, and when the dam releases an additional flow of $3.7m^3/s$ is added to the river.

The intention of this scheme is to make use of the flows released from the Claerwen Reservoir, as they pass from the Claerwen Dam to the Dolymynach Reservoir, to generate power. To this end, the hydropower scheme would be designed to make use of the discharges from the dam only, with a maximum capacity for abstraction of $3.7m^3/s$. If the dam was not releasing, all water in the Afon Claerwen would be allowed to pass unhindered down the river, and the hydropower installation would not operate.

Once the dam began releasing, the hydro would activate and abstraction for power generation would begin, with the full release of $3.7m^3/s$ being utilised. This will have the effect of removing the dam release flows only from the depleted reach of the river, and as such arguably the depleted river would enjoy a more natural flow variation, governed only by flows in the Afon Arban.

However despite the central premise to use flows discharged from the Claerwen Dam, the proposed scheme here would to all intents and purposes be formed in exactly the same way as a conventional run-of-river scheme that relied on natural fluctuation in the river flows. NRW have approved and granted an abstraction license for the abstraction with the abstraction limit of $3.7m^3/s$ and they have specified a hands of flow based on the Afon Arban tributary and the license dictates that the project will only abstraction during times of release flows entering the system from the Clearwen Dam.

It is proposed to construct an intake weir approximately 1.5km downstream of the Claerwen Dam, in the location shown in Photograph One. The intake will span the small natural island in the center of the river, and this location particularly lends itself to construction of the intake as it would enable it to be built in two halves, one on either side of the island, whilst flow is diverted to the other side.

PHOTOGRAPH ONE – PROPOSED INTAKE LOCATION

The intake itself would take the form of a low concrete weir wall spanning the two sections of the river. On the downstream face of the weir wall will be an angled Coanda Aquashear Screen. This is a very fine angled bar screen, which prevents debris entering the hydropower system, and also limits the volume of water ingress. Any water over and above the capacity of the screens simply passes over the screens and continues downstream. Below the screen would be a concrete channel, to collect the water and convey it to a chamber on the true right bank. Photograph Two illustrates a typical concrete intake structure with a Coanda Aquashear Screen. The screen spacing will be 2mm.

PHOTOGRAPH TWO – TYPICAL COANDA AQUASHEAR SCREEN & INTAKE

From the intake a pipeline will be laid on the true right bank, following the contours of the river bank above the waterfalls. The associated drawings illustrate the proposed route of the pipe, which will be buried. The pipe will be a syphon for the first section of the pipeline to minimise the depth of dig required in the rock above the waterfalls, as a downhill pipe would need to be buried deeper to function correctly, and would so be more intrusive on the local environment.

Before the ground begins to fall away a syphon chamber is present on the pipeline housing a syhon pump (vacuum pump) and control switchgear. The chamber is a buried concrete chamber 6.6m long by 6.1m wide and 4.5m deep. It is buried about from its top surface and access hatch which is at ground level and will only be visible up close.

The associated drawings illustrate the proposed route of the pipeline, which would be buried throughout. The pipeline runr largely alongside the existing access track, deviating from this line only to avoid steep and rocky ground.

The pipeline itself is of approximately 1800mm internal diameter, and as such represents considerable civil engineering works. Along its length the pipeline will also cross a number of small tributaries of the Afon Claerwen, and will be required to be buried beneath these. To do this, the streams would need to be diverted locally to enable the pipe to be buried, before the stream bed is reinstated over the pipe.

At high and low points in the pipeline an air valve and a water release or washout valve will be required respectively. These will take the appearance of manholes, and once installed and the surroundings reinstated only a manhole cover will be visible up close.

The powerhouse will be situated within the pastoral land to the north of Rhiwnant farm, as shown on the associated drawings. It will by necessity be a substantial building, though would be finished in keeping with other agricultural buildings in the area, and the precise finishes are open for discussion within reasonable budgetary constraints. Once the water has passed through the turbine, it would be discharged over a weir outside the powerhouse to an open channel running back into the Afon Claerwen.

Photograph Three shows a typical open channel hydropower powerhouse clad in larch timber, the large color softens within the first two or so years due to exposure to sunlight (UV) the orange becoming more of a silvery grey and becomes sympathetic to the landscape.

PHOTOGRAPH THREE – TYPICAL OUTFALL ARRANGEMENT & POWERHOUSE

The following sections of this report go on to describe the various components of the scheme in more detail, with reference to the planning criteria normally considered by Local Planning Authorities. Where an item normally assessed in the Planning process is not considered relevant, this has been stated.

2. ENVIRONMENTAL SUSTAINABILITY

An environmental assessment has been undertaken by the project developers, the pertinent findings and recommendations of this study would be incorporated into the design drawings for this scheme prior to any construction work commencing.

2.1. Design Principles and Concepts
The setting of the site is generally remote and mountainous, within the Cambrian Mountains. It has however been heavily influenced by man, firstly with mine workings and agriculture, and more recently with the construction of the Elan Valley water supply network. This system of six large dams and connecting pipes was built between 1893 and 1952. The system supplies water to Birmingham 118km away, and is a spectacular example of heavy civil engineering work.

Due to the extent and the nature of the civil engineering works already existing, the perception is that the general concept of the hydropower scheme, as described above, is in keeping with the surrounding environment. Where possible, visible finishes of the structures proposed would also be in keeping with the historical stone faced dams and intake structures.

In order to conserve and enhance biodiversity for the site, all pertinent recommendations arising from the environmental studies completed would be incorporated into the proposed scope of works.

Energy efficiency and carbon reduction are not believed to be strictly applicable in this instance, as the powerhouse building is not intended as a place of work or residence and consequently it does not have to achieve any particular long term efficiency with regard to heat retention, lighting and so forth. Holistically though, the primary aim of the project is to generate clean renewable energy for the National Grid. Consequently, it seems apparent that the project as a whole would have a net benefit for the national energy mix and carbon reduction targets.

The same applies to climate resilience and building standards, which are not directly applicable considerations for the powerhouse or any other aspect of the works, as the building does not need to provide a particular standard for any permanent resident. Again, however, the scheme as a whole would aid the resilience of the nation as a whole to climate change.

To further support the positive impact of this project on the wider environment, where possible sustainably sourced materials would be used in construction. This would extend to recycled aggregates for concretes used, and if at all possible the pipe would ideally have a recycled element to it. This would be dependent on the material used and the supplier, but it seems reasonable to hope that a substantial proportion of the plastics in a GRP pipe would be recycled.

Water supply and waste management are also not considered directly applicable to this project in the permanent case due to there being no permanent potable water supply to the building or any foul drainage or waste arising from the planned operation. A Waste Management Plan would however be produced for the construction phase of the project.

2.2. Demonstration of Appraisal of Physical, Social, Economic and Policy Drivers

The direct impact of this project on physical, social, economic or policy drivers on a local level is perceived as negligible or not relevant, although, the wider purpose of the scheme is believed likely to be in keeping with most government objectives. The reason for this being that in order to comply with a number of objectives relating to renewable energy and carbon emissions, the British Government is committed to developing renewable energy. As this sole objective of this project is to generate renewable energy from an existing water transfer process, it is believed to be closely aligned with current policy.

2.3. Design Development Considering Physical, Social, Economic and Policy Drivers

This scheme proposal has been developed in order to maximise the potential energy generation from the routine dam releases, with as small an impact on the environment as possible. By using a Coanda Aquashear screen the long term maintenance requirements of the scheme would be minimised, and by burying the pipeline along its length the long term visual impact of the works have been limited.

3. MOVEMENT TO, FROM AND WITHIN THE DEVELOPMENT

Access to the site for construction traffic would be along the existing 4 x 4 tracks and the existing public road network up to and over the river crossing immediately upstream of the Dolymynach Reservoir, with all works being accessed from the true right bank of the river. When working on the section of the intake adjacent to the true left bank, materials would be lifted into place over the true right section of the intake.

4. CHARACTER

4.1. Scale

The issue of the scale of the project is believed to be applicable only to the intake structures, syphon tank and the powerhouse. The former is governed by the volume of water required to be abstracted, but would be set low within the adjoining banks to minimise the visual impact of the weir on the landscape. Beyond that, the proposed weir would obviously be very small when compared to the existing dams in the Elan Valley system, and as such overshadowed by the scale of the existing structures.

The syphon tank as proposed has been designed to be fully buried in the ground and only the top surface will be at ground level along with the access hatch.

The powerhouse, whilst relatively large, would be of very comparable scale to many agricultural buildings in the area, and from a distance would resemble an ordinary barn used for agricultural purposes. As such, the scale of this powerhouse would be entirely in keeping with other structures in the valley. The closes structures to the powerhouse are the agricultural barns approximately 50m to the south. These barns are significantly larger and help to ensure that the powerhouse appearance is of a relatively small building in its landscape.

4.2. Layout

The layout of the scheme is in essence governed by the topography of the valley, and is heavily influenced by the need to maximise power generation to ensure the scheme is economically viable. Power generation is a function of head or pressure and water flow. In order to maximise power generation, the scheme must balance the available head, or height drop, between the intake and the powerhouse, whilst minimising the length of costly pipework. The majority of the height drop occurs over two sets of waterfalls, one immediately downstream of the proposed intake location, and the other a short distance upstream of the proposed powerhouse location. It follows therefore that the scheme should abstract water above the first set of waterfalls, and return it shortly after the second set. If the intake were moved upstream, the pipe length would increase, increasing cost, but with little height gain. Similarly, if the intake were to be sited below the waterfalls, a significant amount of head would be lost to the scheme and it may not therefore generate enough power to be viable. This is the rationale behind the selection of the intake and powerhouse locations shown on the associated drawings.

The linking of the intake and powerhouse by pipeline is then largely governed by the topography. The pipeline level must remain below the level of the intake in order to ensure water can pass under gravity to the powerhouse except along the area that is a syphon. The syphon is limited to around 6m above the intake level, above this the suction (negative pressure) is such that loss of syphon (loss of prime) is at risk of occurring. Once downstream of the syphon the pipeline must maintain a downwards gradient, whilst avoiding areas of difficult ground.

In this case the pipeline has been routed alongside the existing track where possible, as this track would facilitate access for construction vehicles. Where the pipeline veers from the existing track a new track would be required, which would increase the impact on the local environment.

In designing the scheme, setting the pipe route along the true left bank was considered, but discounted as this side would incur areas of increased dig due to rocky outcrops, and it would also be difficult to build on this bank without causing significant disruption to the public road up to the Claerwen Dam among other difficulties.

The detail of the powerhouse arrangement is set around the proposed turbine, generator and transformer, as the building must be sufficiently large to house this equipment and allow room to remove it for service or replacement. Beyond that the building is intended to be rectangular for economic reasons, but also to closely match its appearance to ordinary agricultural barns. Pipe-work and some concrete structures would be visible, as shown, outside the powerhouse, but these would be below ground level and would not be visible from any distance away. These features are important for the ongoing maintenance of the scheme.

The layout of the intake is governed by its function, which is to gather water. A weir is required in order to ensure a prescribed depth of water, which relates to known flows, is abstracted, and to enable a known flow to pass on over the weir before abstraction begins. Without a level surface like a weir, it is very difficult to measure volumes of water flow and so have any control over the operation of a hydropower scheme to minimise the environmental impact on the derogated reach.

The Coanda Aquashear screen could be replaced with an alternative screen, simple bar screens have been used with success in hydropower for many years, but the advantage of the Coanda Aquashear screen is that it is self cleaning and so requires little maintenance. More conventional bar screens are prone to blockage, and in this instance it would be very difficult to access to clean safely. Often mechanical cleaning devices are used, but these are often visually intrusive and are expensive to maintain. It is also virtually impossible for people or animals to become trapped in or on a Coanda Aquashear screen, as the bar spacing is just 2mm. For this reason they are very safe.

4.3. Appearance

As above, the appearance is largely constrained by the function. Through the design we have however attempted to minimise the visual impact of the scheme, and match it as far as possible with the local surroundings. This relates primarily to the powerhouse, which would be timber clad, to best blend with the surroundings.

The exposed sections of the intake will be smoothly finished concrete, as this provides the most robust finish for a structure in this environment. As previously noted, the appearance is perceived to be largely in keeping with the civil engineering heritage of the valley, though not stone clad like many of the existing dam structures. To add stone cladding to these structures is perceived as being prohibitively expensive and for the weir in particularly; unlikely to be effective in the long term due to the effects of scour.

4.4. Landscaping

As far as possible the works would be carried out to minimise the impact on the landscape, with only a narrow corridor being used for much of the work. On completion the ground levels would be returned to the existing levels as far as possible, with topsoil excavated at the outset replaced over disturbed ground. Seeds from local species would then be sown and the banks left to re-vegetate naturally. Typically following work of this nature the ground will recover within a single growing season.

Around the intake of course there would be some permanent alteration to water-levels and the margins of the river. Again these areas would be profiled to blend with the existing levels, seeded, and left to re-vegetate naturally. Again, typically, structures such as these blend well with their surroundings and within a single season the river margins recover to the new levels.

5. FLOOD CONSEQUENCES ASSESSMENT

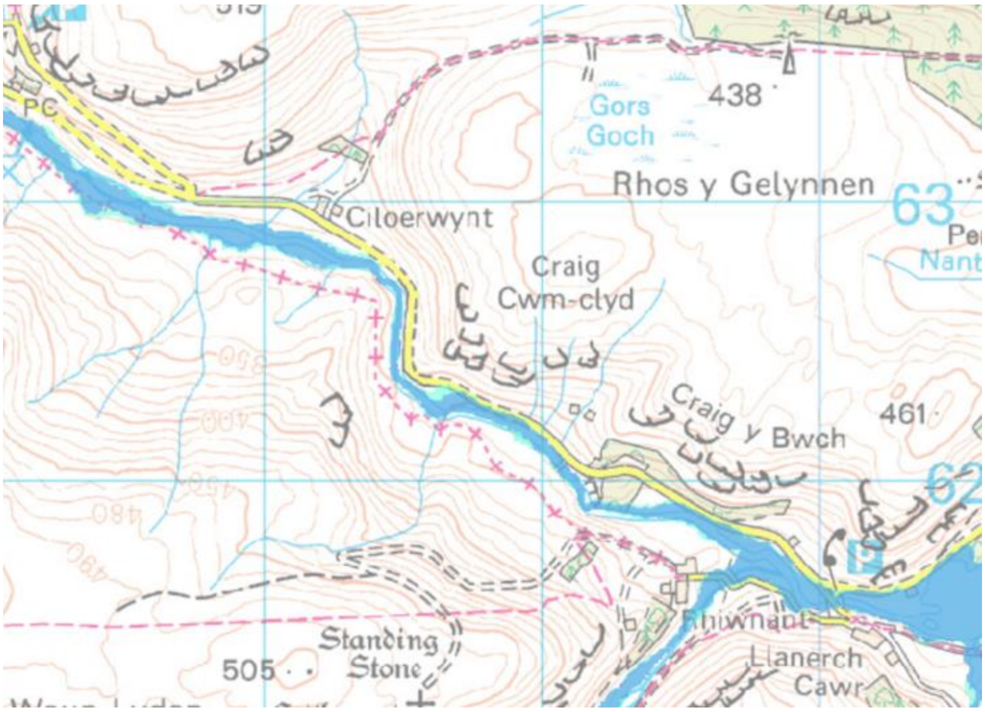

Figure One – NRW Flood Map

Figure One shows the NRW flood risk boundaries for the site, and whilst the intake would obviously be within the boundary of the area "at risk of flooding from rivers", the powerhouse would also be on this boundary. However, it is clear that the extent of the flood boundary is not significantly greater than the ordinary river boundary, suggesting that even flood flows are largely contained within the banks.

This is in part due to the steep gradient of the river at this point and the relatively steep river banks, but also no doubt due to the Claerwen Dam upstream, which will capture and store a large proportion of flood flows in the river.

Given the topography of the site, whilst the proposed weir would impound water upstream and locally raise water levels, the resulting impoundment and any flood flows would still be contained within the river banks. Consequently the proposed weir is not perceived as likely to pose a flood risk to any property or people upstream or downstream.

Similarly, although the powerhouse may impinge on the flood boundary, the river channel at this location and flood plain at this point would operate much as it does at present and the powerhouse would have a negligible impact on available flood plain. Consequently this is also not perceived as likely to pose a flood risk to any property or people upstream or downstream.

The proposed syphon tank would be well above the river flood boundary, and the pipeline, once buried and the ground reinstated with streams crossing above, would have no impact on the flow paths in or around the valley and as such would create no flood risk.