Cyfoeth Naturiol Cymru
Natural Resources Wales

Guidance Note

Hydropower Guidance Note: HGN 8 Fish Passage

This guidance note is not intended as a statement of law. It should be read in combination with, and in the context of, the relevant enactments and EU obligations. Nothing in this guidance is intended to give Natural Resources Wales (NRW) power to do anything that it would not otherwise have power to do, or exercise any of its functions in a manner contrary to the provisions of any enactment or any EU obligation. In the event of any conflict between this guidance and enactments or EU obligations the latter takes precedence.

This Guidance Note has been prepared by Natural Resources Wales (NRW) to provide applicants for impounding and abstraction licences for hydropower schemes with information on fish passage. Its contents may be updated periodically and developers should ensure they read the most recent version.

When do you need to install a fish pass?

In Wales a fish pass, or some other solution to maintain fish migration, is often required. This requirement will cover all species of fish and applies to both upstream and downstream migration. We advise applicants to consult us early in the design process about the need for a fish pass. If there is a need, we advise developers to submit and discuss their ideas at the concept stage. This avoids the risk of wasting time and money on detailed proposals which may prove unsatisfactory. Where a technical fish passage solution is needed, developers should anticipate securing the services of a consultant specialising in fish passage.

A new hydropower scheme should avoid making it more difficult for fish to move up or downstream where practicable. Schemes should be located and designed very carefully to avoid interfering with fish movement. It is important to appreciate that even the best designed and operated fish pass may not fully mitigate the impacts of an impounding structure on fish movement. Where a fish pass is required it is usual practice for the licence to contain conditions requiring regular maintenance to ensure optimal efficiency. In

some cases we may require the building of an additional pass while maintaining passage through an existing pass.

In assessing the need for a fish pass and its design we will take account of all relevant information including the overall scheme design, the environmental legislation relevant at the site and the species of fish present.

Both in considering whether fish passes are required under the Salmon and Freshwater Fisheries Act 1975, and in determining abstraction and impoundment licences under the Water Resources Act 1991 we also have a duty to meet the requirements of the Water Framework Directive (WFD), This can include resolving failures to meet the objectives of the WFD due to obstructions to fish passage.

We may require a developer to fund fish passage improvements as part of a scheme where improved fish passage is needed to meet the objectives of the WFD, even though the introduction of the hydropower scheme may not make fish passage worse and no species specific legislation applies.

For example, we may require a fish pass where there is currently a total obstruction to fish passage and even though a hydropower scheme may not make the situation worse, a scheme provides an opportunity to make it better. We will consider, where appropriate, the costs and benefits in making any decisions on schemes.

Flows and fish passage

As well as creating (or making more permanent) physical obstructions to fish migration, hydropower schemes have the potential to affect local fish movements by causing changes to the distribution of water flows at the site. Scheme proposals should be designed to manage flows to ensure that they support the fish passage requirements at the site. For example site-specific flows should not attract migrating fish away from the entrance to a fish pass or a principal migration route.

Where a depleted reach is created by a hydropower scheme, care should be taken so that the ‘return flow’ does not attract fish away from the main channel. In addition, where fish passage is identified as needing protection, flows in the depleted reach will need to be sufficient to support fish populations and allow natural fish movement.

To work effectively and efficiently a fish pass must have sufficient flow passing through it and have sufficient hydrodynamic attraction properties for fish to find it and be encouraged to enter it. Attraction to a fish pass can be promoted by a combination of stimuli including: location, the flow of water relative to other local flows and the velocity of water leaving the pass. The 'residual flow' calculation in your application will need, where appropriate, to include the flow required to service an appropriate 'upstream fish pass and/or downstream fish bywash'.

Upstream fish passage

Where there is existing provision for fish passage, approved or otherwise, a hydropower development should maintain the efficiency of fish passage through the site. When existing fish passes are to be used, but are known to be inefficient and are likely to be made worse by the diversion of water, we are likely to require developers to take opportunities to improve fish passage.

For any scheme developed on a river that is frequented by migratory salmonids and/or eels, section 9 of SAFFA provides powers to require an applicant to include an appropriate fish pass in the scheme

We are identifying existing barriers where fish passage needs improvement to achieve WFD objectives and/or improve eel stocks under eel management plans. We will take this information into account when determining abstraction and impounding licence applications to ensure that improvements to fish passage are consistent with the wider aims for the catchment.

Where a technical fish pass is required, or an existing technical pass requires modification, the design and associated flow requirements need approval by NRW.
Where a fish pass is provided, the licence holder will be required to maintain the pass in an efficient working state.

Design considerations for fish passes in hydropower schemes

The following sections provide examples of the different arrangements of hydropower schemes and fish passes.

Low head scheme, on-weir

Where a fish pass is present, or will be built as part of the scheme, co-locating the fish pass entrance and the discharge from the turbine(s) can help attract fish to the fish pass entrance. Any competing flow away from the fish pass usually reduces the efficiency of the pass and is unlikely to be acceptable.

Where the fish pass entrance and turbine discharge are co-located, an appropriate attraction flow is between 5 and 10 per cent of the maximum turbine flow, dependent on the effectiveness and efficiency of its design. This is subject to factors including the minimum flow required for the pass to attract and convey the species and age-classes of fish at the site.

A fish pass can be made more attractive by providing augmentation and/or auxiliary flows. An augmentation flow is one where flow is added directly to the lower end of the fish pass, so that higher levels of flow leave the fish pass entrance and draw fish into the fish pass. An auxiliary flow is a separate flow which runs alongside the pass and discharges close to its entrance. This can help to attract fish towards the entrance to the fish pass. However, an auxiliary flow can in some cases compete with the fish pass discharge and can be less effective than an augmentation flow if not carefully designed.

The flow through a fish pass may in some cases be considered to be part of the residual flow of the HP and separate from the flow licensed for abstraction and the Hands off Flow. Auxiliary or augmentation flow may also be a constituent of the residual flow or could even be, in some cases, supplied by some or all of the hydropower discharge.

Low-head scheme, leat design

Where the hydropower scheme is to be located within a leat system, a fish pass may need to be located next to the turbine within the leat system and/or on the weir within the main channel of the river, or both.

Consultation with NRW at an early stage will assist in establishing the best fish passage solution where one is needed.

Retention of fish in the main river channel is desirable and the appropriate location for the fish pass should therefore be in the main river channel. This can be achieved with effective flow and screen management. The final design will depend on the requirements of the

species present, the management of flow at the site, and the relevant environmental legislation.

During periods of fish migration, the majority of the flow through the scheme should be in the route of the fish pass to attract the fish. Flow through the site must be managed to ensure effective and efficient fish passage.

Scheme with depleted reach

Where a fish pass is needed for a scheme which causes a depleted reach, it is usually more effective if located at the impounding structure. Sufficient flow should pass through the fish pass and the depleted reach for the efficient passage of the relevant fish species

No fish pass requirement – other future considerations

If a fish pass is not a requirement of a scheme, we may still require you to make allowance for the installation of a fish pass in the future. When this is necessary, you will need to make sure that suitable space for a fish pass is safeguarded and sufficient flow is reserved for its future operation.

Downstream fish passage

Juvenile fish of most species including salmon and sea trout ‘smolts’ and also adult eel migrate downstream from rearing areas. Schemes should be designed in such a way that impounding structures and impounded reaches (weir pools) avoid causing injury to, or delay of fish during these migrations. Adult salmon, sea trout and brown trout migrate downstream after spawning to return to habitats downstream, including the marine environment. Some species of coarse fish, particularly rheophilic species, also migrate downstream after spawning. Adult eel migrate downstream to the sea, where they reproduce. If such fish have to pass over weirs (or other impounding structures) at your proposed scheme, you will need to consider the minimum depth of water passing over the weir and the size of fish that are likely to be passing downstream.

Where the minimum depth of water passing over the impoundment structure is less than the depth at which fish can pass freely, your development will need to make provision for these fish to pass without delay or injury. It is generally acceptable to create a notch, or notches, within the weir crest that will allow fish to pass safely and without delay. Notches will need to be located in appropriate locations and be of an appropriate size.

Where this is not possible and fish cannot be guided to pass via a bypass channel, an appropriate increase in the minimum depth of the water passing over the weir will be needed. Consideration should be given to the timing of downstream migrations and the flow passing over the weir at those times in order to assess the extent of necessary seasonal flow adjustments.

Depending on the arrangement of your scheme, including any screens, then a by-wash facility may be required.

The channel morphology downstream of structures over which fish pass must not cause injury to migrating fish.

What do you need to do?

You will need to know which fish species are relevant to the location of your scheme and their migratory needs. We encourage you to consult with local NRW fisheries staff to establish what may be needed.
Details on fish pass design are available on the Environment Agency website in the Environment Agency Fish Pass Manual. For small upland schemes you may be advised by NRW that an informal fish passage easement of some description is required.

The manual contains background information on fish passes, the requirements of different species of fish, and gives examples of designs which may be suitable in different circumstances. There is also information on the fish pass approval process, which is the same as that used by Natural Resources Wales.

Eel and elver passage

The Environment Agency Eel Manual, on its website, provides advice for improving passage of eels and elvers: Elver and eel passes - a guide to the design and implementation of passage solutions at weirs, tidal gates and sluices.

Fish passage - Statutory requirements

A range of legislation is associated with the issue of fish passage. The legislation serves two purposes, both identifying those cases where improved fish passage is needed and

providing the legislation to require its inclusion. The following section highlights the relevant legislation and explains how and when they would apply.

Salmon and Freshwater Fisheries Act 1975

The Salmon and Freshwater Fisheries Act 1975 applies to fish passage in waters frequented by salmon and sea trout. Resident brown trout and sea trout are the same species. Where brown trout are present below a permanent natural barrier to upstream migration, they will be considered sea trout unless there is compelling evidence to suggest otherwise.

The Salmon and Freshwater Fisheries Act 1975 provides powers to require that a fish pass be built when:

- a new impoundment is constructed, or
- an impoundment is rebuilt or reinstated over more than half its length, or
- an existing impoundment is raised or otherwise altered, or any other obstruction to the passage of salmon or migratory trout is created, increased or caused.

Where an existing impounding structure is partially passable, removing flow from it to a hydropower scheme will in most circumstances reduce passage efficiency by preventing passage altogether or reducing the window of opportunity for fish to pass. Schemes must be designed to avoid either situation.

Eel (England and Wales) Regulations 2009

To enable the delivery of Eel Management Plans (required under the EU Eel Regulations) the Eel (England and Wales) Regulations 2009 provides NRW with powers to require developers to make provision for the passage of eels through dams and other obstructions. .

Water Framework Directive 2000/60/EC (WFD)

NRW has duty under the Water Environment (Water Framework Directive) Regulations 2003 to exercise its functions so as to secure compliance with the requirements of the WFD and ensure WFD objectives are met. In the context of hydropower, this duty applies

in particular to the licensing of abstractions and impoundments as well as NRW's role as a consultee in the planning process

The duty means that we must exercise our functions to ensure that hydropower schemes do not:

- cause a deterioration in the status of the water body in which the hydropower scheme is situated or associated upstream and downstream water bodies, or
- prevent the future achievement of Water Framework Directive objectives (e.g. Good Ecological Status or Good Ecological Potential)

A fish pass will also be required where a hydropower scheme is built on an existing barrier to fish migration that has been identified as a reason for a water body failing to achieve its WFD objectives. This includes situations where the introduction of the hydropower scheme does not make fish passage worse, but improved fish passage is needed.

Water Resources Act 1991

A hydropower scheme may cause problems for fish passage so that it is harder for the species of fish present to complete their life cycles. Fish passage can be made worse either by an increase in the physical barrier or by changes to the site that results in a delay to migration. This includes impacts of weir pools and depleted reaches of leat and high-head schemes. In these cases a fish pass may be required as a condition of an abstraction licence, impoundment licence, or a flood defence/land drainage consent granted under the Water Resources Act 1991

Section 6(6) of the Environment Act 1995

Natural Resources Wales has a duty to maintain, improve and develop fisheries. Hydropower schemes should not impact fisheries through changes to fish passage. Where the introduction of a hydropower scheme would impact on a fishery through changes to fish passage, a fish pass may be needed to ensure that duty is met.

Protected Areas

There may be other legal obligations where the sites or species affected have nature conservation designations, for example Special Areas of Conservation or Special Protection Areas under the Habitats Directive, Ramsar sites or Sites of Special Scientific Interest. See the Designated Sites Guidance Note for further information