Construction Methodology

This document provides additional information relating to the construction of a Micro Hydro Scheme on the Nant Ffynnon-wen.

TGVHydro

TGVHydro are a not-for-profit Social Enterprise. The Green Valleys Community Interest Company, a community-owned social enterprise that helps communities across Wales reduce their carbon emissions, solely owns TGVHydro Ltd.

TGVHydro Ltd

CRiC

Beaufort Street

Crickhowell,

Powys

NP8 1BN

Tel: 07969 137719

Email: info@tgvhydro.co.uk

Contents:

1. Purpose of proposed works:

The purpose of the proposed works is to abstract water from the watercourse and use the water to generate green electricity that is first utilised within the Client's property prior to being exported back into the National Grid. Water will flow from the site of two intakes to a shared forebay tank, through a penstock that is buried and in sections surface laid; the accumulated potential energy will be extracted through a Turgo turbine and generator. All water will then be discharged back into the Nant Ffynnon-Wen. An underground cable will be trenched from the turbine house to the Client's existing fuse for domestic use of the electricity within Barn 1, with any excess electricity not used on site to be exported into the National Grid.

2. Abstraction location, abstraction regime, abstraction volumes and power:

Summaries of the flow and volume requirements have been submitted to Natural Resources Wales (NRW) as part of the required abstraction licence.

3. Description of proposed works

The proposed works has 6 main parts: Intake (x2), Forebay tank, Penstock, Turbine House, Discharge and Grid Connection. The proposal for each element, specific biodiversity issues and the proposed construction methodology (aimed at minimising any adverse effects) is described in turn below. There will be no deviations from the proposals outlined in this document unless agreed otherwise in writing.

3.1 Intakes

3.1.1 Main Intake

The NRW Pre-app process has indicated that the intake only needs to be designed as to be passable to fish moving downstream (an upstream fish easement is not required at this location).

The main intake requires the construction of a small dam across the main channel of the Nant Ffynnon-wen. Here, the stream has a shallow bed lined with bedrock and loose stones, has relatively steep sided banks and surrounded by marshy grassland on open moorland. Access to the intake location is moderately good over relatively even and firm ground across the open hill.

The construction of the dam will be undertaken by hand, though materials will be delivered to a designated storage in proximity to the intake site by 4x4 vehicle. There are no trees present around the site of the proposed intake and therefore the construction will only result in localised disturbance to a small area of marshy grassland. There are no moss-covered boulders present within the stream or on the stream banks.

The construction at the main intake site will involve the following stages:

1. Place straw bales in stream downstream of intake working area to minimise transfer of any excess sediment into watercourse.
2. A temporary bypass pipe to take the water past the construction site.
3. A mass concrete slab in the bed of the watercourse upon which a mass concrete weir will be built across the stream.
4. A stainless steel intake tank will be secured to the concrete dam wall. The intake will be screened with perforated steel holes to a maximum diameter of 3mm, the Hands Off Flow (HOF) notch and the split flow of 30% of all water above HOF will remain within the watercourse, ensuring the HOF of Q95 takes precedence over any abstracted water.
5. As there are two intakes for this scheme a separate forebay tank will be required.

6. A 225mm (external) diameter penstock, which will leave the intake structure and will be secured to surface or shallow trenched, where soil depth permits, along an initial 30 metres of the stream bank, where it will connect with the separate forebay tank.

The construction methodology adopts the practice of a temporary piped stream diversion to enable the installation of the intake structure. This approach aims to minimise the disturbance to the existing stream banks, which could also lead to subsequent instability and erosion problems.

Setup

1. All equipment and materials will be brought from the yard in Pant Y Turnor along existing agricultural access tracks to the edge of the open hill land. A designated route will be defined to take a vehicle movements across the open hill on the firmest, driest and even ground, avoiding any notable areas of existing wetter ground.
2. Any materials or equipment that may cause any contamination risk will be kept on a non-permeable sheet raised at the edges to prevent any spillages passing beyond.

Bypass

1. The stream flow will be diverted to one side of channel via a diversion pipe of approximately 6m length and back into the stream past the intake construction site.
2. The diverted flow will discharge onto a rock slab or straw bale pad, to reduce erosion and bed scour.
3. All components of this bypass structure will be removed once the intake is completed.

Weir

1. The weir foundation slab and wall areas will be dug down by hand to a firm base.
2. Intact turf and soil excavated from the stream banks will be stored separately on the bank upstream of the intake to prevent contamination with other materials.
3. Shuttering will be installed to form the base and will be filled with mass concrete.
4. Shuttering will then be constructed to form the weir wall and filled with mass concrete.
5. Excavated stone will be replaced to the rear and the sides of the intake weir to provide erosion protection.

Intake

The pre-fabricated stainless steel intake box will be bolted to the face of the weir.

Fish easement

1. The intake structure will be designed to allow the safe downstream movement of fish through the intake. Safe downstream movement is to be accommodated through the HOF notch with the addition of a short section of rock ramp easement.

Site reinstatement

1. All construction material and equipment will be removed from site
2. All excavated material, including intact turf, will be formed around the weir walls to minimise any visual impacts
3. If required appropriate seeding will be applied.

3.1.2 Feeding Intake

The NRW Pre-app process has indicated that the intake only needs to be designed as to be passable to fish moving downstream (an upstream fish easement is not required at this location).

The intake requires the placement of pre-fabricated stainless steel sheet to form the weir and direct the flow on an un-named tributary of the Nant Ffynnon-wen. Here, the stream has a shallow bed, with exposed bedrock and loose stones, and relatively steep sided banks surrounded by marshy grassland on open moorland. Access to the intake location is moderately good over relatively even and firm ground across the open hill.

The placement of the weir sheet will be undertaken by hand, though materials will be delivered to a designated storage in proximity to the intake site by 4x4 vehicle. There are no trees present around the site of the proposed intake and therefore the construction will only result in localised disturbance to a very small area of marshy grassland. There are no moss-covered boulders present within the stream or on the stream banks.

The construction at the feeding intake site will involve the following stages:

1. Place straw bales in stream downstream of intake working area to minimise transfer of any excess sediment into watercourse.
2. A temporary bypass pipe to take the water past the construction site.
3. A mass concrete slab in the bed of the watercourse upon which a mass concrete weir will be built across the stream.
4. A stainless steel intake tank will be secured to the concrete dam wall. The intake will be screened with perforated steel holes to a maximum diameter of 3mm, the Hands Off Flow (HOF) notch and the split flow of 30% of all water above HOF will remain within the watercourse, ensuring the HOF of Q95 takes precedence over any abstracted water.
5. As there are two intakes for this scheme a separate forebay tank will be required.
6. A 125mm (external) diameter penstock (feeding pipe), which will leave the intake structure and will be secured to surface or shallow trenched, where soil depth permits, along 270m metres of trenched section, where it will connect with the main intake.

The construction methodology adopts the practice of a temporary piped stream diversion to enable the installation of the intake structure. This approach aims to minimise the disturbance to the existing stream banks, which could also lead to subsequent instability and erosion problems.

Setup

1. All equipment and materials will be brought from the yard in Pant Y Turnor along existing agricultural access tracks to the edge of the open hill land. A designated route will be defined to take a vehicle movements across the open hill on the firmest, driest and even ground, avoiding any notable areas of existing wetter ground.
2. Any materials or equipment that may cause any contamination risk will be kept on a non-permeable sheet raised at the edges to prevent any spillages passing beyond.

Bypass

1. The stream flow will be diverted to one side of channel via a diversion pipe of approximately 6m length and back into the stream past the intake construction site.
2. The diverted flow will discharge onto a rock slab or straw bale pad, to reduce erosion and bed scour.
3. All components of this bypass structure will be removed once the intake is completed.

Weir

1. The weir foundation slab and wall areas will be dug down by hand to a firm base.
2. Intact turf and soil excavated from the stream banks will be stored separately on the bank upstream of the intake to prevent contamination with other materials.
3. Shuttering will be installed to form the base and will be filled with mass concrete.
4. Shuttering will then be constructed to form the weir wall and filled with mass concrete.
5. Excavated stone will be replaced to the rear and the sides of the intake weir to provide erosion protection.

Intake

The pre-fabricated stainless steel intake box will be bolted to the face of the weir.

Fish easement

1. The intake structure will be designed to allow the safe downstream movement of fish through the intake. Safe downstream movement is to be accommodated through the HOF notch with the addition of a short section of rock ramp easement.

Site reinstatement

1. All construction material and equipment will be removed from site
2. All excavated material, including intact turf, will be formed around the weir walls to minimise any visual impacts

3. If required appropriate seeding will be applied.

3.2 Shared Forebay tank

A shared forebay tank will be constructed to collect water from both the main intake and the feeding intake. Vehicle access to the shared forebay tank location is moderately good over relatively even and firm ground across the open hill.

Mini-excavator will complete the excavation of the forebay tank forebay footing and the remainder of the construction will be completed by hand. Materials will be delivered to a designated storage in proximity to the forebay tank site by 4x4 vehicle or tractor. There are no trees present around the site of the proposed forebay tank, though the construction will only result in the loss of a small area (2m x2m) of acid dry heath.

The construction at the forebay tank will involve the following stages:

1. The machine excavation of the footing to form the base slab on which the forebay tank will be placed.
2. A mass concrete poured into the excavated hollow to form the base slab.
3. Placement and fixing of a plastic tank on the footing slab.
4. One 225mm (external) diameter penstock pipe will connect on the upper side of the forebay tank from the main intake, and a single 225mm (external) diameter penstock will leave the forebay.
5. Excavated material, including intact turf will be formed around the tank.

Setup

1. All equipment and materials will be brought from the yard in the Pant Y Turnor property via existing agricultural access tracks to the edge of the open hill land. A designated route will be defined to take a vehicle movements across the open hill on the firmest, driest and even ground, avoiding any notable areas of existing wetter ground.
2. Any materials or equipment that may cause any contamination risk will be kept on a non-permeable sheet raised at the edges to prevent any spillages passing beyond.

Site reinstatement

1. All construction material and equipment will be removed from site
2. All excavated material, including intact turf, will be formed around the forebay tank to minimise any visual impacts
4. If required appropriate seeding will be applied.

3.3 Penstock

Pipe will be delivered to the yard of the Pant Y Turnor property and transported to the build in sections as required.

225mm Penstock Section: Between Larger Intake & Shared Forebay Tank – Acid Dry Heath (Approx. 30 m)

1. The first 10m of 225mm pipe will be shallow trenched by hand along the right hand stream bank (looking downstream). Beyond the stream bank the additional 20 metres of pipe route will be mechanically trenched across to connect with the shared forebay tank.
2. Place intact turf and topsoil separately from the excavated trench material.
3. Using hand tools and mini-digger part back trench fill with selected material (sub soil and rocks only with no sharp material against the pipe).
4. Place underground services marker tape in trench and backfill to top.
5. Soil and intact turf will be replaced in the correct order to allow effective ground reinstatement and subsequent re-vegetation. Where necessary exposed soil will be re-seeded using a locally appropriate seed-mix.

225mm Penstock Section: Between Feeding intake and Main intake – Acid Grassland (Approx. 270 m)

1. The entire length of the feeding pipe will be trenched through acid grassland, (which in places is damp) to connect to the main intake. Throughout the wetter sections of the trenched route, works will be undertaken by hand.
2. To ensure the trenched feeding pipe does not effect or disturb the sub-surface flow path or disturb the interruption of natural drainage process in the area clay plugs will be secured within the trenched area.
3. Place intact turf and topsoil separately from the excavated trench material.
4. Using hand tools and mini-digger part back trench fill with selected material (sub soil and rocks only with no sharp material against the pipe).
5. Place underground services marker tape in trench and backfill to top.
5. Soil and intact turf will be replaced in the correct order to allow effective ground reinstatement and subsequent re-vegetation. Where necessary exposed soil will be re-seeded using a locally appropriate seed-mix.

225mm Penstock Section: Between Shared Forebay Tank and stream crossing – Acid dry head and one base acid rich flush (Approx. 320 m)

1. The 310 metres of pipe route will be mechanically trenched across the acid dry heath, the section of pipe route which proposed to cross the acid base rich flush will be shallow trenched by hand, the trench both approaching and leaving this flush will also

be prepared by hand. Clay plugs will also be used within this area to ensure the subsurface hydrology is not affected.
2. Place intact turf and topsoil separately from the excavated trench material.
3. Using mini-digger, part back trench fill with selected material (sub soil and rocks only with no sharp material against the pipe).
4. Place underground services marker tape in trench and backfill to top.
5. Soil and intact turf will be replaced in the correct order to allow effective ground reinstatement and subsequent re-vegetation. Where necessary exposed soil will be re-seeded using a locally appropriate seed-mix.

225mm Penstock Section: Stream crossing (Approx. 5 m)

From this point the most suitable route for the pipe would be on the right hand bank (looking downstream), therefore a stream crossing has been proposed for the next section of the pipe.

1. The stream flow would be diverted following a bypass arrangement (as described within the intake sections above).
2. The stream bed would be excavated to allow the pipe to sit below the base of the watercourse (and not to create a barrier within the watercourse)
3. Place underground services marker tape within trench
4. Stream bed to be reinstated.

225mm Penstock Section: Scattered semi-natural broadleaved woodland (Approx. 295 m)

Upon exiting the previous section the penstock will revert to being surface laid throughout the next section of its route.

1. Section of pipe will be winched through the semi-natural broadleaved woodland using a powered capstan winch and guided by hand.
2. Care will be taken when winching pipe to avoid scouring of surface materials and damage to upper route systems.
3. The pipe will be laid on the surface through the route – surface laying is preferable to other techniques as it will minimise the impact on this habitat. The topography of the area coupled with the vegetation present on the pipe route slope will allow the pipe to be well screened.
4. The pipe will be secured periodically by pinning, using stainless steel brackets or attaching to timber support posts.
5. The pipe will be secured on soil mounded under the pipe, supporting the pipe as it enters the turbine house.
6. This section of pipeline will have loose materials banks against it to minimise its impact on any existing wildlife corridors and will also have periodic underpasses cut to also reduce its barrier effect.

3.4 Turbine House

There is a need to carefully plan and execute the excavation of the footings for the turbine building to avoid the excess spoil slipping into the stream during and after construction. Restricting the construction times to daylight hours will also be applicable to the installation of the proposed turbine house to avoid potential disturbance to otters that may make use of the only wooded cover in proximity to the development site, though no evidence of otter activity has been recorded.

The turbine house is located adjacent from the stream on the lower part of a gently sloping scattered wooded area. There is no requirement to cut back or remove any of the trees/scrub and the excavation of the turbine house footings will not affect the root zones of the semi-mature trees.

Once construction has been completed areas of bare earth that remain around the turbine house and any areas necessarily tracked over by vehicles will be fully reinstated. The exposed soil will be re-seeded using a locally appropriate seed-mix.

Access to the turbine house will be by foot and vehicle via the gateway off the existing agricultural access track that runs within 5m of the site.

Operation of turbine:
When operating, the turbine mechanism will generate a constant noise, potentially disturbing movements of birds, bats and otter. Enclosing the turbine within a building should eliminate most of this noise and any sound emitting will be masked by the sound of the stream flowing. Potential for disturbance to bats and other wildlife has therefore been avoided.

Construction details:
Excavation will be with machine (mini-digger); construction of building will be by hand. Access for the mini digger is along an existing track.

1. Place straw bales between proposed excavation location and stream to minimise excess sediment into watercourse
2. Excavate 4m x 4m area to required depth of 200mm using mini-digger
3. Store excess excavated materials away from the streamside of the excavation.
4. Workforce will recover stones from excavation
5. Concrete foundation laid by hand and allowed to set.
6. Concrete and brick plinth for turbine laid in centre of building and allowed to set.
7. Straw bales placed in the watercourse below discharge point to catch sediment entering the water in the final stage of trench digging for the discharge pipe.

8. Trench by hand for exhaust pipe from turbine house to discharge point (this is referenced on the supplied maps). Trenching construction methodology is the same as that described for the laying of the penstock.
9. Lay 300mm discharge pipe in trenched channel
10. Form stone work around outflow using stone recovered from turbine house excavation
11. Fit 10mm screen over discharge pipe (see below)
12. Build turbine house timber frame and shiplap walls.
13. Fit timber roof sections and cover with black corrugated stainless steel sheeting
14 Install door and window
15. Use any excess excavated materials to landscape sympathetically around the turbine house. Where necessary apply a locally appropriate seed-mix to the disturbed ground in the trenched area and any other areas of disturbance.

3.5 Discharge Point

Screening:
There may be the presence of small local fish species and other aquatic fauna in the lower section of Nant Ffynnon-wen so a 10mm screen will be fitted over the discharge pipe exit to prevent fish and other fauna from entering the pipe and accessing the turbine. Scale drawings of the turbine house and discharge point have been supplied with this application.

Construction:
1. A trench will be dug by hand from turbine house to discharge point (this is referenced on the supplied maps). Trenching construction methodology is the same as that described for the laying of the penstock.
2. Stones recovered from the turbine house and trench excavation will be formed around the outlet the provide screening and prevent erosion
3. As required by the NRW (and noted above) a 10mm screen will be fitted over the discharge pipe exit as a precaution to prevent fish from accessing the turbine

3.6 Export and Grid Connection

All mechanical and electrical items (turbine, casing, spear valve, electric control gear, etc.) will be prefabricated and tested off site. Export will be to an existing meter position within Barn 2 of the Pant Y Turnor property. This will allow the property to use electricity. All excess electricity will be exported to the National Grid through the District Network Operator's (DNO) upgraded service cable and transformer.

Export Cable Section: Exiting from turbine house following existing agricultural access track

1. Excavate a trench of at least 610mm deep and store sub soil and spoil down slope of trench.
2. Lay armoured cable within trench.

3. Using digger, part back trench fill with selected material (sub soil and rocks only with no sharp material against the pipe).
4. Place underground services marker tape within trench. Backfill to top placing one additional layer of services marker cable in the trench within 200mm of surface.
5. Replace topsoil and then turf (if any removed).
6. Where necessary apply a locally appropriate seed-mix to the disturbed ground in the trenched area and any other areas of disturbance. (This is likely to be a mix of traditional meadow grass mix of common bent, sweet vernal-grass and either sheep's or red fescue).

Export Cable Section: Improved Grassland Fields (including access track crossing)

1. Using a mini digger strip surface turves and topsoil are removed and stored up slope of trench.
2. Excavate a trench of at least 610mm deep and store sub soil and spoil down slope of trench.
3. Lay armoured cable within trench.
4. Using digger, part back trench fill with selected material (sub soil and rocks only with no sharp material against the pipe).
5. Place underground services marker tape within trench. Backfill to top placing one additional layer of services marker cable in the trench within 200mm of surface.
6. Replace topsoil and then turf.
7. Where necessary apply a locally appropriate seed-mix to the disturbed ground in the trenched area and any other areas of disturbance. (This is likely to be a mix of traditional meadow grass mix of common bent, sweet vernal-grass and either sheep's or red fescue).

Export Cable Section: Property Connection

1. Once at the property the cable will be trenched across the upper section of the yard to the south east corner of the existing building – Barn 2).
2. The cable will continue to the base of the building and will be secured vertically to the wall.
3. The cable will be drilled through the external wall to connect with the existing DNO equipment.
4. Connect cable with fuse protection into the consumer cable. Export cable to include a lockable isolation switch near to the consumer unit.
6. All electrical items to be tested and certified.
7. Note that the DNO may wish to carry out works on their service cable and transformer. The details of any works they may wish to carry out have not been included here.

4. General Construction Principles

4.1 Access for plant, materials and workforce

Access is required at six locations; intake (x2), shared forebay tank, turbine house, pipe route and export cable route.

Intakes (x2) & Shared Forebay Tank: There is moderately good vehicle and pedestrian access to the intakes and shared forebay tank sites, including transfer of materials to an upper storage area, following an existing agricultural access track and a designated route over the open hill, which seeks to remain on the firmer, drier and more even ground, and thus avoiding any localised wetter areas and features of higher botanical interest.

Turbine House: Site access for the machinery, equipment and materials required for building the turbine house will be along the existing agricultural access track.

Pipe Route: Access between the turbine house and the intake site will be via an existing access track and along a designated route over the open hill. Access for small plant machinery will be required through the upper section of the pipeline route, after the stream crossing, all works will be undertkaned by hand within the broken wooded area (to the turbine house).

Export Cable Route: Good access is available through the existing improved agricultural fields to install the export cable.

Access points from the public highway will be marked with bi-lingual hazard signs.

4.2 Parking and materials storage area

There are no existing storage areas adjacent to the intakes, although the area adjacent to the intakes will be suitable to store equipment and there is also ample storage space available within the yard at Pant Y Turnor. Materials may be delivered on site before they are needed and so will need to be stored. Storage needs to be close to construction site but not create a hazard to pedestrian or vehicle movements. Non-hazardous materials will be stored directly onto the ground. Parking will be available within the yard at Pant Y Turnor.

4.3 Hazardous materials

Hazardous materials will be stored within the yard at Pant Y Turnor until needed. At no point will any hazardous materials be stored directly on the ground.

Cement: Cement will be mixed in a PTO powered mixer running from a tractor. It will be brought to the access point for the intakes and turbine house via tractor and transferred by hand or on small quad and trailer, where ground conditions permit.

Fuel: Fuelling of vehicles and machines will take place in the parking/materials storage areas. The fuelling area will take place on a plastic sheet with sand underneath. Any fuel that is spilt

will either be cleared up from the plastic directly or be absorbed by the sand. If any sand is required to absorb fuel it will be disposed of in the approved manner.
Solvents/adhesives: There are no solvents or adhesives planned to be used in the operations.

4.4 Waste

Non-hazardous waste will be bagged and removed from site. Hazardous wastes will be disposed of in approved manner.

Any waste excavation material or building waste generated in the course of the development must be disposed of satisfactorily and in accordance with section 34 of the Environmental Protection Act 1990 (if controlled waste is to be deposited on the site then either a Waste Management Licence will be required or the applicant will need to register an exemption to licensing with the Environment Agency).

4.5 Workforce

Project manager: A designated project manager will over-see the construction
Assistant Project managers: Assistant Project managers will help the Project Manager and deputise in his absence
Digger driver: Qualified and proficient operator.
Tractor drivers: The tractor drivers are experienced agricultural workers. As such they will be familiar with the terrain, ground conditions and hazards such as the overhead cables. They will be given site orientation, safety briefing and clear instruction
Chainsaw operator: Suitably qualified.
Hydro Installers: The turbine and associated vales/pipework within the turbine house will be installed by suitably qualified and experienced installers under the guidance of the Senior Engineer.
Electrical work: Connection of electrical systems performed by appropriately qualified electrician.
Connection to power grid: Undertaken by Western Power Distribution Ltd.

4.6 Identification of hazards and Health & Safety

Protective equipment: All members of the workforce are required to wear hard hats, HiVis jackets/vests and steel toed safety boots. Other protective equipment will be used for specialist construction tasks as required.
Sloping ground: Much of the construction site is sloping ground. Special care will be taken by the workforce when moving around site and transporting materials by hand. Particularly hazardous areas will be marked with hazard signs.
Power lines: Overhead power cables span a section of the yard at Pant Y Turnor. They are clearly visible and free from tree cover. The requirements of GS6 'Avoidance of Dangers from overhead lines' will be implemented and Western Power notified - We will work to GS6 whenever there are overhead cables – the landowners are allowed to pass underneath as part of their required access but for construction we will notify the DNO who will come to site and

set the safe working parameters for the site. The landowners will be restricted to the same movement while the site is operational.
Stream channel: Ground conditions in the channel are soft and combined with the steep slope form a significant hazard. Hazards will be cleared from the route as much as possible and designed safe routes into the channel will be selected and appropriately marked.
Vehicle movements: Vehicles will often be moving around the construction site. Approved routes will be set and indicated by flags. All workforce employees will be informed of the agreed access routes.
Livestock: Livestock will be removed from the enclosed fields during construction
Incidents: Minor incidents will be recorded and working practices immediately reviewed to determine if risk can be further reduced. Major incidents will result in immediate halting of construction work and a full review of the incident.
COSHH: Any substances that are hazardous to health will be handled with appropriate measures as indicated by the information label.
Condition of work site when not active: Construction will be halted at night and at other times depending on the work program. All excavations will be either filled or clearly marked off if left open. Tools and materials will only be left in the marked storage areas. Hazardous materials will not be left on site. All appropriate warning signs will remain during construction pauses and all workforce safety controls will remain in force. Any open trenches will have planks of wood placed in them to enable species that fall in (e.g. hedgehog) a suitable means to exit.

4.7 Environmental Protection

Fuel: Fuelling of all vehicles, power tools and generator will take place either off site or within the storage/parking area.
Cement: All cement mixing to form concrete will take place in the designated working areas. Cement will be stored off site in a dry location at the Pant Y Turnor yard. Sand/ballast will be stored under plastic sheets in the lower access field.
Water quality: The stream will not be used for cleaning tools or materials. Construction will minimise release of sediment into the river. For mixing cement, water will be drawn from the stream using clean buckets. Hay bales will be placed downstream of the intake working areas and outflow area to filter sediments. They will be removed once construction is completed.
Protection of wildlife: Design and construction has intended to limit disturbance to wildlife. Should protected species be encountered work will cease and advice sought from Natural Resources Wales.
Tree felling: There is no requirement for tree felling for this proposed hydro scheme.

4.8 Timetable

Estimated duration of each task is as follows:
Intake dam (x2): 1-2 months
Pipe route through fields: 6-8 weeks
Construction of turbine house and outflow: 1 month
Export and Grid connection: 4-5 weeks

At some times construction of more than one task will occur together.

4.9 Machinery Description

A 3-5 ton excavator: A mini-digger will be used to excavate the forebay tank, pipe trench, turbine house and export cable trench.
Tractor/trailer: A farm tractor and trailer will be used to transport materials onto and around the construction sites. The tractor will also power a cement mixer via PTO.
4X4/quad bike: Low ground pressure vehicles will be used to again access and transport materials to designated areas of construction activity.
Generator: A small petrol fuelled generator will be used to power 220V hand tools.
Pipe jointing: A combination of butt fusion and electrofusion equipment will be used. Some of the equipment may be mounted on a small tracked machine (similar to 4WD trailer). This equipment will be powered by a small petrol fuelled generator.
Winch: A trailer mounted cable winch will be used to pull lengths of pipe.
Tracked wheelbarrow: Motorised track-dumper wheelbarrow

4.10 Site set up

The construction site will be prepared prior to the arrival of materials and plant. Designated access routes will be identified and demarcated, along with specific site storage areas.

4.11 Signs and markers

Access and safety signs will be placed at access points. Parking and storage areas will be marked by hi-vis tape looped around ground markers. At the start of each day, signs will be checked and replaced if necessary.