CHAPTER 5: Construction Method Statement

General Description

It is proposed to construct and operate a small-scale hydroelectric scheme on the Allt Garaidh Ghualaich burn on hillside to the south west of Loch Garry, near Invergarry.

The scheme will consist of an intake weir built on the main burn, and second intake on the tributary, Allt Lon Glas Bheinn. Water will be carried from these intakes to the powerhouse through approximately 4.7km of buried pipeline.

The plant will be run-of-river status (i.e. will not involve storage) and the electricity generated will be exported to the nearby grid.

The construction of a run-of-river hydroelectric generating scheme comprises the following, but not necessarily sequential, stages:

- Construction of site compounds, lay-down areas and other initial preparatory works;
- Delivery of equipment on to site;
- Initial construction works - Permanent and temporary forest roads, bridges etc.;
- Main construction works - Intake weirs, pipeline, turbine house and tailrace; and
- Reinstatement.

The construction period is expected to last approximately 18 months, although much of the main construction works will be achieved in a shorter period of about 12-14 months.

This is possible by progressing key stages concurrently, which not only achieves cost-effective construction but also minimises disturbance-type environmental impacts and interruptions to activities on the site. However, it is likely that periods of poor weather, such as heavy snowfall or periods of high rainfall, will lead to temporary cessation of some aspects of construction, such as pipe laying and pouring concrete. Heavy rain would also interrupt intake weir construction.

The Construction Method Statement (CMS), with the description of works for the main elements is presented below and follows up the recommendations of separate reports carried out by independent professional consultants expert in Archaeology, Fisheries, Habitat (Flora), Protected Mammals and Birds; as well as expert assessments on Access & Traffic, Landscape & Visual Hydrology, Morphology and Noise.

There may be some changes to the method described as the project proceeds and as more knowledge of ground conditions is gained. However, the final detailed design is not expected to differ significantly from that described and any differences are not expected to have a material impact on the findings of this ES In addition, the detailed design and the construction contract will ensure that the mitigation measures identified in this ES, or measures achieving equivalent performance, are incorporated into the detailed design, construction and operation of the scheme.

This CMS looks at the construction of the forest roads, the pipelines, the intake weirs, the powerhouses and temporary construction areas. It considers how the construction of these may be made with as little disturbance to the environment as possible.

Contents

5.1 Construction Elements

Table 5.1 Summary description of construction elements

Element	Description	Drawing No.
Access	Via the A87, 5km of single track public road, and approx. 10km of existing forestry commission roads.	• P730-1 10100
Forest Roads	Around 4.2km of new forest road will be constructed to run from the end of the existing forestry commission road, around 500m above the powerhouse location, to the two intake locations.	• P730-1 10101
Pipeline	HPPE pipe will be used for the low-pressure section near the intakes and GRP pipe will be used for the remainder of the pipelines.	• P730-1 10101
Construction Areas	Temporary construction compounds will be formed at the intake and powerhouse locations.	• P730-1 10103
Pipe Lay Down Areas	Temporary pipe lay down areas will be formed at the powerhouse and the pipe junction.	• P730-1 10103
Quarries	Processed crushed rock will be obtained from the new quarry sites or the existing Forestry Commission quarry.	• P730-1 10106
Bridges & Stream Crossings	One bridge is required on the project. Stream crossings will be managed in accordance with SEPA's "Controlled Activity Regulations"	• P101 60003
Intakes	Intakes GG1 and GG2 will both be concrete weirs, spanning across the width of the burn, and featuring Alpine wash over type screens.	• P730-1 20104 • P730-1 20204
Powerhouse	The powerhouse will be located approximately 50m from an existing forestry commission road. It will comprise a typical agricultural style building, with vertical timber cladding on the walls, with profiled metal sheeting on the roof.	• P730-1 40101 • P730-1 40102 • P730-1 40104
Grid Connection	This will be via a new 33kV overhead line that will connect the powerhouse to the existing overhead line.	

5.2 Common Working Methods

5.2.1 Prior to Construction Works

- Site management to contain working areas and access routes.
- Land made available demarked by temporary fence at commencement and fence retained until completion or such time as stock may be allowed access whereupon the fence will be removed.
- Prior to the commencement of any works, carry out long section survey of all the watercourses and natural drainage, leaving marking on the temporary fencing where such drainage enters and leaves the construction corridor so that during restoration, such natural drainage may be re-instated.

5.2.2 Sediment Control measures

- Carry out works to natural drainage across the site, diverting or directing the watercourses so as to avoid erosion and outwash of disturbed soils.
- Silt traps will be placed at all possible outfalls to prevent silt from flushing across any peat surface

- Control and prevention of silt run-off and construction pollution into adjacent water courses by means of cut-off drains, silt traps and attenuation ponds, all to be removed and restored at completion.

5.2.3 Stripping and storing materials

- Careful side stripping of top peat from all areas to be disturbed. Depth of strip to be at least 250mm but to be determined on site depending on ground conditions. Peat and turf to be lifted and stored in one operation where possible and retained as intact turfs where feasible.
- Do not mix sub-soil with top-soil or peat.
- Use defined peat storage areas to avoid mixing of materials and double handling where possible, with peat stored 'vegetation or turf side up' to avoid desiccation.
- Substrate and turves will be stored separately for each habitat, particularly for flush, peat and woodland habitat.
- All material dug from the pipeline trench will be returned in the order of excavation so that all mineral soil dug out from the pipeline trench will be returned to the bottom of the trench.
- When returning excavated materials to the trench, provide an adequate layer of top-soil or peat for replaced turf species to root.

5.2.4 Turf Management

- Stripped turves should be stored at the edges of the construction corridor 'vegetation or turf side up' with adequate growing conditions e.g. water, light & temperature.
- Generally, turves will be placed 'turf side up' wherever possible. However, where space is restricted within the construction corridor, it may be necessary to stack the turves, up to a maximum thickness of two turves.
- Avoid storing turves on good quality heath/blanket bog.
- Turves should be re-used in areas with similar vegetation and hydrology.
- Restoration of stripped turves should be replaced consecutive to road formation or backfilling of the pipeline to avoid prolonged storage of stripped materials and allow assimilation of the road to commence as soon as possible.
- The heath/bog turves should be replaced no later than 2-3 weeks after the initial cut. However, if this is not possible and heath/bog vegetated turves are to be stored for longer than 2-3 weeks, they should not be stacked. Providing there are adequate growing conditions, turves can be stored for up to 2 months during March/September (growing season).
- Grassland turves can be stored for a maximum period of 2 months.
- The scheme avoids flushes and Groundwater Dependent Terrestrial Ecosystems (GWDTE) where possible. However where turves will be stripped from GWDTEs, they should be replaced as soon as possible, ideally on the same day (please refer to Section 5.7).
- The geomorphology of some features, particularly flush and soak-way habitats, must be correctly re-established to ensure that the original hydrology is maintained.
- Turf transfer should not be undertaken in periods of hot and dry conditions or sub-zero conditions to avoid desiccation or frost damage.

- Monitor turves and water during dry spells to ensure that they remain viable and do not desiccate.

5.3 Pipeline

5.3.1 Description of Works

Approximately 4.7km of buried pipeline will be installed between the intakes and the powerhouse. The pipeline will be a combination of approximately 1.7km of Glass-Reinforced Plastic (GRP) and 3km of High Performance Polyethylene (HPPE). This reflects the fact that pressure increases as the pipe drops down the hill making it necessary to use GRP for the high pressure section.

A pipeline trench will be dug in order to bury the pipeline and the stripping and storing of materials will conform to the method outlined in Section 5.2. All the pipes will be delivered to the laydown area. The pipe-laying contractor will be responsible for moving the pipes from these areas to the pipeline route and for laying out the pipe ready for jointing / fusion welding. It is expected that the pipe can be moved from the delivery point to appropriate points along the pipe route with a tractor and trailer or similar.

5.3.2 HPPE Pipeline

The lengths of HPPE (13m) pipe will be welded together on site directly beside the pipeline route. When the pipeline has been prepared, a long section of trench is excavated, generally 50m-150m.The excavation of the trench, pipeline installation, backfilling of the pipeline and reinstatement will be a continuous process. The various steps in this process are outlined in Drawing No. P101 60001.

5.3.3 GRP Pipeline

The separate 6m pipe segments and the necessary back filling material will firstly be laid out along the working section of the pipeline corridor. Installation of GRP requires that the pipe is laid on a prepared bed of graded material (40mm) and that it is supported and protected around its circumference by graded material not greater than 20mm.

This makes certain requirements on the project design:

- Trial pits must be dug along the pipeline route to confirm depth of peat, soil and rock.
- Suitable material to grade must be available either from the excavation of the pipeline itself or from the excavation of the powerhouse.
- The access road must be close to the pipe route so that pipes can be handled and graded material delivered to the pipe trench.
- Deep peat should be avoided.
- The route selected should minimise the need for rock excavation.

The various steps in this process including reinstatement are outlined in Drawing No. P101 60002. In summary, turf should be stripped off and kept separately so that it is not covered over and can continue to grow. Peat should be kept separately from mineral subsoil. The pipe will be bedded and surrounded by graded material and the trench will be filled in and compacted with mineral subsoil. The stripped area will be re-covered with peat and turf; boulders will be left strewn on the surface. The end result should fit into the landscape and should not be harrowed or reseeded but left rough to allow the original vegetation to re-establish itself.

5.3.4 Pipeline Corridors

- The construction corridor for the HPPE pipeline will be kept to the minimum possible and is not expected to exceed a width of 20m (Drawing No. P101 60001).
- The construction corridor for the GRP pipeline will be kept to the minimum possible and is not expected to exceed a width of 30m (Drawing No. P101 60002).
- On side slopes it is necessary to reduce the width of the corridor in order to minimise the amount of digging into the slope. On slopes with a steep cross fall the corridor is not expected to exceed 10m (Drawing No. P101 60006).

5.3.5 Air Release Valves

Chambers are required to house the air release valves. These will consist of a flanged tee section of pipe to allow the connection of the air valve, and a simple chamber, constructed using pre-cast concrete rings with a pre-cast concrete lid providing manhole access and ventilation. While small in size (400mm high), these may be disguised by the judicious use of rocks during the reinstatement of the pipeline route.

5.3.6 Pipe cover

The depth of the pipe trench will be dependent on the size of the pipe being installed. When backfilling the pipeline, the depth of the pipeline cover will depend on further topographic survey and detailed design, but will not be less than 1m.

5.3.7 Pipeline within riparian buffer

The pipe is positioned according to the hydraulics of the scheme and the pipe level must not exceed the intake crest level. Moreover, a minimum gradient is required on the pipe in order for the scheme to perform correctly. The preference is to take the pipe away from the burn as quickly as possible, not only to minimise in-river working, but also to protect the pipe from the river during flood events. The limitation to this is that the ground level can rise significantly as the bank moves away from the river, requiring deeper and deeper excavation in order to keep the pipe at the correct level. Hence, there may be sections, generally close to the intake, where the pipeline will encroach on the 10m riparian buffer to the watercourse. The pollution control measures outlined in Section 5.3.8 (below) are generally employed as best practice construction measures throughout pipeline installation. However, it will be particularly important to enforce these measures when working within the riparian buffer zone.

5.3.8 Pollution Control for Pipeline Works

The following mitigation is employed as best practice construction measures:

- SEPA Guidelines on pollution control should be followed.
- Work in dry areas by diverting/pumping the water body around the working area or alternatively by forming temporary culverts through the working area, after obtaining agreement from SEPA.
- Intercept surface run-off from undisturbed areas surrounding a site (e.g. by using cut-off trenches) and divert this around the works.
- The period of time that the stockpiles and ground are exposed will be kept to a minimum where possible and ideally the pipeline will be reinstated as soon as possible.
- Install silt traps at the toe of a slope where pipeline excavation or road construction crosses existing drainage. This will reduce silt transportation and to filter out suspended solids in the water caused by excavation works.

- Excavated materials will be kept well away from watercourses.
- Excavated rock, mineral soil and peat should be kept separate.
- Where pipe trenches are excavated in close proximity to the burn, storage of the materials can be on the topside on the trench, to prevent and excavated material falling into the watercourse.
- No plant or wheel washing will be carried out within 10m of the burn but at designated areas of hard standing.
- Fuel will be stored in steel bunded tanks away from any watercourse at designated construction compounds
- Pollution spill kits will be on site and any soils contaminated with fuel or oil will be removed to a suitable landfill site. All site staff will be trained in the use of spill kits.
- Chemicals and oils to be kept in a locked steel container away from any watercourse at designated construction compounds.
- Settlement ponds can be created as a control measure at the outfall of road culverts to allow suspended sediments to settle before entering a watercourse.
- Temporary, erosion proof, outfalls should be utilised where necessary.
- Ensure that developers, Contractors and others involved in earthworks which could pollute the water environment are aware of their statutory responsibly not to cause water pollution or damage habitats. All such persons should be aware, and should make their employees aware, of the likely causes and consequences of environmental pollution and should be familiar with any control measures and emergency procedures to be deployed.

5.4 Forest Roads

Reference is made to the booklet "*Constructed tracks in the Scottish Uplands*," published by SNH on which this method statement is based.

Access to the Powerhouse and Intakes are required for the following reasons:

- Transport of plant, machinery and materials during construction
- Construction of the Pipeline
- Permanent access to the Powerhouse for maintenance.

5.4.1 Specification of new forest roads

The proposed new forest road to the intakes and the powerhouse will have a finished width of approximately 3.5m. These will require a crushed stone surface fill which will be formed from stone obtained from the new quarries. The depth of the running road surface is anticipated to be approximately 100mm-150mm in accordance with the SNH guidance on constructed tracks in the Scottish Uplands. The material size is normally 20-40mm, although this may be dependent on gradient of the road and the traction required for construction vehicles. Intercepting ditches and cut-off drains will be established on the topside of the roads; this will not serve to transfer water horizontally for long distances or to concentrate run-off where it did not exist before.

5.4.2 Upgrades to Existing Access

The 500m of existing Forestry Commission road that currently extends past the powerhouse is currently around 2m width, and will require widening to 3.5m. This will involve the normal procedure of stripping top peats and topsoil until solid substrate in unearthed and stockpiling in linear strips at the edge of the corridor. The road will be finished using stone from the new quarries. Any existing potholes or bumps will be levelled.

5.5 Method of Road Construction

5.5.1 Normal Road Excavation

Road construction will involve the normal procedure of stripping top peats and topsoil until solid substrate in unearthed and stockpiling in linear strips at the edge of the corridor (please refer to Section 5.2).

Best practice guidelines will be followed for the restoration of the margins of the forest roads and extending over the disturbed area of the pipeline. The general principles will apply:

- In most cases and where a cross slope is not steep, the corridor width will be kept to the minimum. Where roads are to be cut into steep cross slopes or widening at corners is required, consideration will be given to widening the construction corridor to avoid side slopes that are too steep to allow soiling and re-establishment of vegetation and to allow integration of slopes into the adjoining landform.
- Where roads will be permanent, restoration of the edges will be carried out progressively as part of the construction; this will consist of ensuring that excavated mineral soil is buried on top of mineral soil and covered over with vegetative/organic soil and covered with turf. The bulk of the restoration of verges and cuts should be undertaken consecutive to the initial road formation to avoid prolonged storage of stripped materials and allow assimilation of the road to commence as soon as possible.
- Where permanent roads are to be narrowed post construction, the downhill side of the road surface will be broken up to relieve compaction and top soil / top peat material stockpiled adjacent to the roads will be used to narrow the road to the agreed width. Soil will be placed to a rough uneven profile. For less steep sections of the roads, a thin covering of soil will be placed on the centre of the road to encourage the quick establishment of a central vegetated strip.
- Temporary roads will be removed by breaking up the hard core of the road to relieve compaction and replacing the excavated topsoil and turves stockpiled adjacent to the road and pipeline. Temporary culverts will be removed and intercepting ditches will be filled in to restore the natural ground profile and maintain the original ground hydrology.
- Where rock is exposed, every effort is to be made to break up the profile; to round off the top edge; to create ledges and gullies where soil can be placed.
- Monitoring and management over a three-year post construction period to ensure establishment takes place with remedial work carried out if required.

5.6 Peat Management & Moorland Restoration

The key to successful restoration lies in managing the disturbance, so that it lasts for as short a period as possible, and planning the timing of the disturbance to offer the best conditions to do the work.

5.6.1 Guiding principles for restoration

Best practice guidelines will be followed in the restoration of the temporary construction impacts. The general principles include:

- Rapid, progressive restoration as the project proceeds, wherever possible, to reduce the duration of visual impact and to reduce the risk of loss, damage and desiccation to stockpiled top peat and turfs.
- Careful reinstatement of undulating / rough landform over construction corridor using re-spread till, rock and deep peat prior to final shaping with top peat and including forming watercourses to natural irregular alignment to match existing character and integration of the construction site into the adjoining rough and uneven moorland.
- Use of low ground pressure machinery and avoidance of over compaction and blade grading in placement of peat. Top peat will, in preference, be placed by digger bucket, loosely graded with bucket teeth and left rough and undulating. Where intact turfs are being placed these will be lifted in as large a unit as feasible and placed right side up, lightly compacted and all roots buried.
- Where surrounding landscape has numerous boulders on the surface, consideration will be given to retaining irregular groups of rock in random distribution.
- Removal of temporary culverts over water courses at completion and reinstatement of hydrology at completion.
- Utilising the existing top peat and turf as the principle material for reinstatement by careful placement of turfs with roots well buried and creating a matrix of cover over the site if there is a shortage of suitable turf material.
- Give consideration to the continuation of stock exclusion / additional stock management to reduce deer and sheep grazing within the establishment period.
- Monitoring and management over a three-year post construction period to ensure establishment takes place with remedial work carried out if required.

5.6.2 Peat Management

The Peat Survey Drawing in Appendix J demonstrates that there is little deep peat at the site and hence there is no requirement for floating roads. The analysis in the report shows that all excavated peat can be reused for the reinstatement of road verges.

It is important to note that reinstatement of peat needs to consider the localised hydrology to ensure that the peat will regenerate. With reference to Scottish Renewable's '*Guidance on the assessment of peat volumes, reuse of peat and minimisation of waste',* the following guidelines for the management of peat will be followed:

- Peat re-use will be limited to the areas already disturbed during construction and that peat should not be spread on intact vegetated areas as this will smother vegetation.
- Surplus acrotelmic peat will be reused for road verge reinstatement where possible. The height of the deposited peat should not exceed 1m and the slope angle should not exceed 15° to ensure slope stability. Turves will be placed on top of the peat wherever possible to prevent desiccation. For roads near to watercourses, the peat will only be reused on the topside of roads.
- Should any surplus unconsolidated, saturated peat (catotelmic) arise during excavation, it can be used for the restoration of quarries. Surplus peat may be deposited at a maximum depth of 1m. Peat will only be used for quarry restoration if it can be placed on mineral substrate of a low drainage capacity to prevent degradation and maintain hydrology. Turves will be replaced on top, wherever possible to prevent peat desiccation. Alternatively, reseeding could be done, if appropriate and in consultation with an Ecologist, to help maintain structure.

- Surplus and excavated catotelmic peat will be kept well away from any watercourses.
- Peat may be utilised as backfill material for cable installations, although electrical and thermal design criteria will need to be considered. It is important that only peat uncontaminated with debris is used for this application (i.e. no large stones or tree stumps, etc.).
- Peat should be temporarily stored at areas where the mineral substrate is of a low drainage capacity.

5.7 Groundwater Dependent Terrestrial Ecosystems (GWDTE)

In order to minimise the increased drainage across any wetland habitats created by linear features (pipeline, drains), the following steps will be implemented:

- Where any GWDTE may be intersected by the pipeline or roads, the habitat should be marked to prevent unplanned disturbance and the exact route through the habitat should be clearly defined.
- Approach flushes from either side using boards to protect the vegetation.
- Drains will be avoided as far as possible but, where necessary, will be dug around the contour rather than downslope.
- When laying pipeline, turves will be cut leaving the vegetation intact and replaced as soon as possible, ideally on the same day.
- Vegetation turves will be cut in an irregular pattern to prevent surface lines which may channel flow.
- If construction takes place during dry weather (or in the event of any delays to construction) water the turves to keep them wet.
- Excavate the pipe trench, taking care to store topsoil and sub-soil separately.
- Install the pipeline and, if necessary, place bunds at more regular intervals to prevent the pipeline trench becoming a preferential conduit of water and to maintain groundwater flow through the wetland.
- To prevent the pipeline trench from channelling the water along it, the peat within the trench will be returned to as near natural structure as possible. As much material will be returned to the trench as possible and tamped down very firmly to evict air and close any gaps caused by cutting, without causing compaction.
- Excavated material will be replaced in the order that it was removed.
- Take care to replicate the original soil profile and, in the case of flushes, recreate any slight depression that channelled the flush across the peat.
- Replace the turves, with any flush turves replaced along the original line of the flush.

5.8 Intakes

5.8.1 Description of Works

Each weir will consist of a low concrete structure built across the river as shown in Drawings Nos. *P730-1 20104* and *P730-1 20204*. Each intake will form part of the weir and will be fitted with an Alpine wash-over type screen. Water will pass through the screen and will be collected in a stilling chamber prior to entering the pipeline. The remainder of each weir will be a concrete wall running into the bank.

5.8.2 Method of Construction

The base rock will be exposed and prepared for the foundation slab on which the weir structure is to be built. This preparation will include the removal of any loose material and some rock excavation may be required. This will be achieved by use of an excavator and rock hammer and smaller hand held tools. The base rock will be drilled to allow the slab to be keyed into the rock surface using rock anchors.

Construction of the intake weirs should be carried out during a period of low to moderate flow between 1st June and 30th September and will require the temporary diversion of water. This will involve the construction of a temporary cofferdam across one half of the riverbed using sand bags or material available on site. Part of the weir is built downstream of the cofferdam. The temporary cofferdam is then moved over to the other half of the river. The river then passes through the scour valve that is capable of passing a flow equivalent to Q_{20} and cast into the first half of each of weir while the remaining part is built. This work may last for about three to four weeks.

Concrete will be placed by direct placement, the first pour being for the base slab. The weir wall and the intake part of the structure will then be placed in two lifts to simplify the shuttering requirements.

5.8.3 Fishery Protection

5.8.4 Fishery protection measures for downstream migration

- Design of the screen
- Avoidance of sharp edges in the concrete
- Establishment of a plunge pool below the intake

5.8.5 Fishery protection measures for upstream migration and habitat in the depleted reach

- Compensation flow pipe to deliver a Hands-Off flow of Q95 at all times during operation
- Compensation notch to deliver Q80 when the river upstream of the intake is at Q30

5.8.6 Sediment Management

- A scour valve is in incorporated in to the intake structure, which is designed to flush through sediment that has accumulated behind the intake.
- Stop logs will be located in the plunge pool wall so that material washed out from the scour valve can continue downstream.

5.8.7 Sequence of Operations for Intake Construction

1. Arrive on site and receive site induction.
2. Create appropriate signage.
3. Take receipt of relevant drawings.
4. Carry out a site survey.
5. Mark out “no go” zones.
6. Make temporary water diversion to allow work to continue at the site of the intake structure.
7. Remove overburden to base rock using an excavator.
8. Keep excavated material away from edge of watercourse in separate heaps.
9. Excavate rock to formation level using an excavator and hydraulic rock hammer.

10. Drill base rock and fix steel dowels.
11. Blind formation with concrete.
12. Install steel reinforcement.
13. Install valves and fittings.
14. Construct formwork.
15. Compact concrete using a vibrating poker.
16. Strike formwork once the concrete has been cured.
17. Dress surface of first layer of concrete using a scabbler.
18. Place second lift of concrete and compact.
19. Fix fixtures and fittings.
20. Install Fish Screen.
21. Remove pollution control methods.
22. Tidy site on conclusion.

5.9 Pollution Control for In-River Works

During the intake works the following pollution risks have been identified while redirecting the watercourse:

- Water level rising and overflowing so construction area is inundated.
- Excess silt being washed into the watercourse.
- Oil and fuel entering the watercourse.
- Chemicals entering the watercourse.

At all the stages of construction, the contractor will be contractually bound to follow the relevant pollution prevention guidelines which will include the following mitigation measures:

- SEPA Guidelines on pollution control should be followed.
- Where possible, prior to construction a diversion will be created upstream of the works to channel the water around the working area to prevent it becoming contaminated.
- Where it is not possible to divert the watercourse, the water will be channelled into large diameter pipes and taken directly through the works.
- Geotextile and/or straw bales should be installed in the watercourse before excavation begins.
- The geotextile and straw bales should be replaced before they become ineffective and a supply of these should always be kept on site.
- Excavated material should be kept well away from the watercourse.
- Excavated rock, mineral soil and peat should be kept in separate heaps.
- Pouring of concrete should not take place when heavy rain is imminent.
- Cementous material will not be placed into water.
- Fuel will be stored in steel bunded tanks away from any watercourse.
- Chemicals and oils to be kept in a locked steel container.
- Any static water should be pumped onto the surface not less than 10m away from the watercourse. The pumping of water will prevent stop any suspended solids from entering the watercourse.
- Pollution spill kits will be on site and any soils contaminated with fuel or oil will be removed to a suitable landfill site.
- Straw bales/silt nets shall remain in the water until it runs clean, then the coffer dam can be removed.

- All operatives made aware of the need to prevent the watercourse from being contaminated.
- Regular monitoring of water quality downstream of these should be carried out.

5.10 Powerhouse

5.10.1 Description of Works

The powerhouse, as shown on the drawings in Appendix J, will include the construction of a substantial concrete sub-structure capable of withstanding the thrust of the entire pipeline; the superstructure including lifting facilities for plant maintenance, pigging chamber, tailrace and the connection of the pipeline to the main inlet valve and turbine will be an integral part of this.

The powerhouse will house one turbine, one synchronous generator and control equipment. It will be constructed as portal frame structures on a reinforced concrete floor with timber clad walls and a profiled metal clad roof.

5.10.2 Sequence of Operations for Powerhouse Construction

1. Arrive on site and receive site induction.
2. Create appropriate signage.
3. Take receipt of relevant drawings.
4. Carry out a site survey and mark out “no go” zones
5. Removal and storage of vegetation and topsoil
6. Remove over burden to base rock using an excavator.
7. Move excavated material to contractor’s compound.
8. Excavate rock to formation level.
9. Drill rock head and fix steel dowels.
10. Blind formation with concrete.
11. Install steel reinforcement.
12. Install Earth network
13. Construct formwork.
14. Place concrete.
15. Compact concrete using a vibrating poker.
16. Strike formwork once the concrete has been cured.
17. Where a second lift of concrete is required, place second lift of concrete and compact.
18. Take structure up to foundation level (ready for the Steel Erector sub-contractor, if appropriate).
19. Build superstructure.
20. Carry out ground works including reinstating and landscaping around powerhouse.
21. Remove anti-pollution method.
22. Tidy site on conclusion.

5.10.3 Tailrace

The flow from each turbine will discharge into a tailrace pit, which will return the water via a partially covered open channel directly to the Allt Garaidh Ghualaich. Attention will be given to the design so that water velocities do not lead to any scouring of the river bank or act as an attractant flow for fish. This could include widening and deepening the outfall of the tailrace structure to decelerate flow velocities.

Provision has been made for the exclusion of mammals and any migrating fish. Particular attention will be given to the visual appearance, i.e. by minimising exposed concrete where possible.

5.10.4 Tailrace Construction Sequence

- Construction will adhere to the guidelines for in-river works (Section 5.9)
- Excavation of the tailrace area down to bed rock or solid ground – some bed rock may need to be removed to gain sufficient depth. Existing bed material to be placed to one side for reinstatement
- The floor slab will then be cast in concrete
- Once cured the main outfall structure will be shuttered and cast with reinforced concrete, around the pipe from the turbine
- Wing walls will be completed, tied into the banks
- River bed reinstated to original level
- Bank and bed scour protection (gabions and/or boulders in concrete) will be completed
- Outfall screens fitted

5.10.5 Transformer compound

The transformer and associated switchgear for each powerhouse will be accommodated outside, adjacent to the powerhouse building as shown on Drawing Nos. *P730-1 40101* and *P730-1 40102.* The compound will have a concrete base with bund walls and will be fenced off.

5.10.6 Pollution Control

At all the stages of powerhouse construction, the contractor will be contractually bound to follow the relevant pollution prevention guidelines which will include the following mitigation measures:

- Regular monitoring of water downstream of the works should be carried out
- Excavated material should be kept well away from the watercourse
- Excavated rock, mineral soil and peat should be kept separate
- Pouring of concrete should not take place when heavy rain is imminent
- Any static water should be pumped on to the surface not less than 10m away from the watercourse
- SEPA Guidelines on pollution control should be followed.

5.11 Grid Connection

The scheme will connect to the National Grid via a new 33kV overhead line that will run from the powerhouse to the existing 33kV overhead line.

5.12 Construction Areas

5.12.1 Locations of Construction Compounds

Construction Areas will generally be located on existing areas of hard standing or naturally flat terrain. Five construction areas are shown on Drawing No. P730-1 10103.

- Construction compounds at each intake, pipe junction and powerhouse
- Pipe laydown area at the powerhouse and pipe junction

5.12.2 Pollution Control

This type of construction involves limited use of hazardous substances; however, activities associated with the transfer or storage of fuel and lubricants have the potential to cause pollution by contamination of the sub soil and by transfer directly into the watercourse. The following mitigation measures should be put in place to ensure that this cannot happen:

- The compound should be sited on a level area.
- The compound should not be directly adjacent to the watercourse.
- Refuelling and the storage oils and other hazardous substances will take place at the construction area next to the Lower Scheme powerhouse. This site adheres to the Best Practice guidance of a minimum 10m buffer from the nearest watercourse.
- There should be no artificial drainage associated with the compound that could lead to accidental spillage (if any) reaching the watercourse.
- All used oil and filters should be removed from the site immediately.
- Any hazardous substances should be kept in a locked container, away from any watercourse.
- Fuel will be stored in steel bunded tanks away from any watercourse.
- In the event of contamination of any part of the compound, the area should be immediately excavated, stored on a chemical resistant material and disposed of by an approved contractor. SEPA should be notified to this.
- All staff should be made aware of their responsibility to protect the environment.
- A copy of SEPA's Pollution Prevention Guidelines – PPG 2, 5, 21 and 26 should be kept on site.
- On completion of construction, the hard standing area will be reduced in size by covering over, reusing firstly the subsoil and then the organic material.

5.13 Water Crossings and Drainage

This section sets out in detail the procedure for in-river works and draws upon both previous site experience and SEPA's *Good Practice Guide for River Crossings*.

As the road and cable traverses the hillside, it is required to cross a number of small streams and ditches. Intercepting ditches and cut off drains will be re-established on the topside of the road; this will not serve to transfer water horizontally for long distances or to concentrate run off where it did not exist before. Where a topside drain or cut through a bank on the top side of the road is made, the peat and turf should be re-used within a few hours to cover over the change in land form.

The type of water crossing employed is dependent on the size of the watercourse, width of the channel and the depth of the river banks. The proposed number, type and locations of watercourse crossings will be dependent on further topographic survey that will be undertaken nearer to the time of construction.

5.13.1 Typical Road Culverts

Where the burns are less than 2m in width, twin-walled plastic culvert pipes are preferred. Culverts will be placed to preserve the continuity of the existing drainage; they should be placed at locations where streams or natural drainage channels cross the road route. They should also be located at regular intervals between these points (Table 5.2).

Table 5.2 Recommended Spacing for Ditch Relief Culverts

Ditch Gradient	Culvert Spacing	
%	Normal Conditions Ground Cross Slope <15%	Very Wet or Steep Conditions Ground Cross Slope >15%
<4	200	100
5	160	80
6	130	65
7	115	55
8	100	45
9	90	40
10	80	35
11	70	30
12	65	25

The existing normal watercourse channel width will be maintained and if multiple barrels are required, channel width will be maintained across all barrels.

Culverts will be placed in deep enough and at an angle so as to avoid scouring at the outfall. The exit points of culverts should not be on to peaty soils in order to avoid scouring and peat erosion. Where possible, the culvert will be laid below bed level to attempt to retain material and replicate a natural bed. The calculated culvert capacity will take this into account, in addition to flow and flood levels (Please refer to Drawing No. P101 60010).

5.13.2 Road Culvert Construction Sequence

- Install silt traps downstream of construction area.
- Place closed pipe culvert barrels of suitable dimensions in the burn.
- Install the hydro pipe across the culverts.
- Construct a stone riprap or a concrete headwall at the inlet and outlets for scour protection. Depending on whether concrete is required, it may not be necessary to divert the watercourse as the flow will be directed straight through the construction area via the culvert.
- The culvert (and hydro) pipes are mounded over with earth or a rock-free compacted fill.
- A surface fill can be laid on the top so that the crossing is suitable for construction vehicles.

5.13.3 Typical pipe crossing below original ground level

The hydro pipe can be buried underneath the burns and the river bed is backfilled and the original channel restored. Depending on the depth of the pipe, it may be necessary to reinforce the channel to prevent erosion (using a gabion or reno mattress for example).

5.13.4 Construction Sequence for Pipe Crossings below Original Ground Level

- Make a small diversion upstream of the construction area and install silt traps downstream of the construction area.
- Pump any excess water into settlement ponds so that the construction area is kept dry.
- Excavate riverbed for pipe trench.

- Bed the hydro pipe in rock-free material and then backfill with river bed material so that the natural channel width and depth are restored.
- It may be necessary to lay a geotextile liner above the pipe bedding material, with a reno/gabion mattress on top, to prevent and erosion of the river bed once reinstated.
- Remove diversion so that the river flow continues down the natural stream channel.

5.13.5 Pollution control

During the in-river works for water crossings, the following pollution risks have been identified while redirecting the watercourse:

- Water level rising and overflowing so construction area is inundated.
- Excess silt being washed into the watercourse.
- Oil and fuel entering the watercourse.
- Chemicals entering the watercourse.

At all the stages of culvert construction, the contractor will be contractually bound to follow the relevant pollution prevention guidelines which will include the following mitigation measures:

- SEPA Guidelines on pollution control should be followed.
- Road culverts will be made of inert materials.
- If concrete is required, please refer to Section 5.9 Pollution Control for In-River Works
- Sediment traps should be installed on watercourses downstream of the works and regular monitoring of the watercourses should be carried out.
- Excavated material should be kept well away from watercourses.
- Excavated rock, mineral soil and peat should be kept separate.
- Any static water should be pumped on to the surface not less than 10m away from the watercourse.

5.14 Quarries

There is a requirement for some material both for back filling the pipeline trench and the creation and upgrading of forest roads. This will primarily be sourced new quarries identified in Drawing No. P730-1 10106. Material can also be won from small mounds along the pipeline or forest road excavation route or from the existing FCS quarry.

5.14.1 Sequence of Operations for Quarry Extraction

- Mark out extent of proposed area of extraction.
- Ensure buffer strip of not less than 10m between the extent of this and any watercourse.
- Strip off all vegetative and organic material and stack in heaps.
- Clear area sufficient to install screen and allow for area for graded material.
- When all material is used up cover over using previous heaps of vegetative and organic material.
- Reinstatement should seek to blend in with the surrounding environment, the surface being compacted to make it stable but sufficiently rough to promote re-establishment of flora. The end result should be that the reinstated area does not look out of context when compared with the surrounding landscape.
- Rocks may be left protruding.

5.14.2 Pollution Control

- Artificial drainage may be necessary and geotextile and/or straw bales should be installed in such channels before excavation begins.
- Regular monitoring of water quality downstream of these channels should be carried out before they join a watercourse.
- The geotextile and straw bales should be replaced before they become ineffective and a supply of these should always be kept on site.
- Any static water should be pumped onto the surface not less than 10m away from the watercourse.

5.14.3 Quarry Restoration

For reinstating new quarries the following general principles will include:

- If the pit is within glacial till the back wall will, where feasible, be graded back and benched to a slope capable of retaining top peat / top soil. The upper edge will be rounded off and integrated into the surrounding topography. Vegetative peat will be spread over the exposed till to achieve a minimum of 300mm cover. Peat will only be used for quarry restoration if it can be placed on mineral substrate of a low drainage capacity to prevent degradation.
- If the quarry exposes bed rock, every effort is to be made to break up the profile and naturalise the exposed rock face; to round off the top edge; to create ledges and gullies where soil / top peat can be placed.
- On completion the floor of the quarry will be broken up and re-graded to an undulating, rough profile, ramping fill material up against the base of the face of the excavation. Surplus rock material in the vicinity of the quarry will be removed into the quarry. The base of the quarry, and back face where feasible, will be fully covered with reclaimed top peat spread to a minimum of 300mm or to match the top peat depths in the adjacent area.
- As the new quarry may be in use for a number of months, the stripped turves that will be used for restoration may be degraded. Supplementary turves or seeding may be required to successfully restore the vegetation.

5.15 Environmental Protection

Table 5.3 lists the potential environmental hazards and associated mitigation measures specific to the construction phase only. The environmental impacts of the scheme as a whole, including long-term impacts from operation, are considered in Chapter 4 of this ES, and the impacts and mitigation are listed in Table 4.2 at the end of that chapter.

Table 5.3 Summary of Construction Phase Environmental Protection Measures

Best Construction Practice Environmental Protection Measures		
	Hazard	**Mitigation**
1	Silt making the water turbid and causing damage to aquatic plants and fish populations	• Install geotextile material below areas of excavation to filter out suspended solids in the water • Install silt traps and service on a daily basis where siltation is likely to be a problem
2	Cement entering the watercourse	• Pour cement used in the construction of project structures in accordance with SEPA pollution prevention guidelines 5 & 6
3	Spilled / leaked vehicle fuel and hydraulic oil entering	• Store diesel in double skinned, bunded tanks with 110% required capacity away from watercourses

Best Construction Practice Environmental Protection Measures		
	Hazard	**Mitigation**
	watercourses, affecting water quality and fish populations	• Check construction vehicles leaks and supply spillage contingency kits • Adequately maintain vehicles
4	Oil and fuel contaminating soil	• Keep pollution spill kits on site • Move soils contaminated with fuel or oil to a waste site with appropriate licence to accept such special waste by a Registered Waste Carrier • Correct paperwork will be in place • SEPA will be notified of an incident
5	Chemicals entering the watercourse	• Keep chemicals and oils in a locked bunded steel container • Avoid using polluting substances • Advise workers of importance of avoiding spillage
6	Waste water drainage	• No waste water will be generated during operation of the scheme • Any temporary waste generated during construction for welfare facilities (e.g. portaloos) will be removed by a registered waste carrier to a licenced disposal site
7	Protected mammals such as badgers and otters becoming trapped within open pipe runs	• Adopt a cut and fill strategy such that the length of open pipe run is minimised • Install ramps at frequent intervals within open pipe runs at the end of each working day • Cap the open ends of stored and installed pipes to prevent access to animals
9	Trampling and vehicle damage during the construction phase	• Confine the pipeline corridor to a width of 30m • Use vehicles designed to spread load and excavators with wide tracks • Wherever possible route vehicles to avoid flushes, streams and soaks • Ensure that culverts used are made out of a neutral pH material and are large enough to carry heavy flow • Culvert all burns alongside roads to avoid erosion of road sides • Take care to avoid disturbing the soil around the streams enabling the groundwater to seep naturally through the peat • Minimise the number of journeys made across unprotected ground • Mark out areas which should not be touched • Advise all staff as to where important habitats are and provide alternative routes to avoid crossing them
10	Changes to drainage regime during construction	• Avoid drains as far as possible but, where necessary dig around the contour rather than downslope • Do not use drains to transfer large volumes of water laterally • Make culverts from a material with a neutral pH • Ensure that culverts reserve natural drainage continuity • Ensure that culverts do not lead to erosion, scouring or spread of sediment
11	Damage to vegetation and habitat	• Cut turves leaving the vegetation intact and replace as soon as possible • Avoid stacking turves wherever possible. If this is unavoidable, stack at a maximum of two turves thick • Avoid all linear features, for example, pile excavated peat in heaps rather than as a continuous strip-pile • After back filling, spread excess peat thinly over the peat surface • Pile excavated mineral subsoil and return mineral soil • Keep all excavated peat soil separate from mineral soil • Place all excavated mineral soil at bottom of trench • Ensure that turves are irregular in shape and replaced as soon as possible

Best Construction Practice Environmental Protection Measures		
	Hazard	**Mitigation**
		• Return the peat within the trench to as near natural structure as possible • Consolidate mineral soil and peat round pipe to exclude air and avoid water following the pipeline • Restore vegetation cover to as it was before construction
12	Damage/disturbance to fish populations	• Construct intakes (in-river works) 1st June - 30th September
Site-Specific Environmental Protection Measures		
	Hazard	**Mitigation**
13	Destruction of Archaeology	• Site 1 – keep damage to a minimum at the intake; mark out on the ground further downstream and avoid • Site 30 – Avoid the structures and mark out on the ground; the dyke can be cut, but keep damage to a minimum and reinstate after construction
14	Disturbance to Birds	• Brief workforce on sensitive locations • Mark out 'no-go' areas prior to construction works • Pre-construction & pre-felling nest checks • Subject to checks, a timing constraint may be required for a section of the pipeline during April-June for buzzard
15	Protection of Protected Mammals	• Only fell mature trees as a last resort • Check trees for red squirrel dreys and bat roosts prior to felling • If dreys and roosts are found, stop work and obtain a licence from SNH
17	Damage to Sensitive Habitats	• Areas of upland Birchwood and mature wet woodland will be highlighted and avoided during construction, most notably at the powerhouse

5.16 Timetable for Construction Works

Table 5.4 provides an approximate indication of the construction programme and the duration of each construction phase.

Table 5.4 Indicative Programme for Construction Works

	2018											
Month	J	F	M	A	M	J	J	A	S	O	N	D
Duration of Construction Period												
Access Roads & Bridges												
In-river works (intake/tailrace)												
Ecological Timing Constraints												
Pipeline Construction												
Powerhouse Construction												
Restoration/Reinstatement												

5.17 Guidelines and Communications

5.17.1 Guidelines

Throughout the construction phase, the SEPA guidelines "Prevention of Pollution from Civil Engineering Contracts: Special Requirements" and the "Pollution Prevention Guidelines (Relevant PPG's include 2, 5, 11, 21 & 26)" must be followed.

These guidelines will be implemented and issued to the contractors prior to work commencing. In addition, SEPA will be advised of the start of the construction works before works commence and will be asked to advise on a pollution response scheme to be implemented in the event of any incidents.

Reference to and consideration of SNH's "*Constructed Tracks in the Scottish Uplands*" has been made throughout the writing of this Construction Method Statement.

5.17.2 Communications

Close contact will be established and maintained with the contractor, the estate, local farmers and neighbours who will be advised of the time tabling of the different construction elements.

5.17.3 Exceptional Incident Procedure

In the unlikely event that the Environmental Protection Measures (EPMs) should fail and an unforeseen pollution incident should occur, the following procedure is to be followed:

- Discoverer of incident to alert Site Foreman of nature and magnitude of the incident.
- Site Foreman to report incident to SEPA and Water Supply Users immediately in order to inform of potential hazards and to take advice on how to proceed.
- Site Foreman and Team to attempt to prevent situation from getting any worse (i.e. stop pollution source if possible).
- If not possible to stop pollution source, Site Foreman and Team to try to contain situation and minimise damage.
- Work not to be recommenced until pollution incident is resolved and all mitigation measures (EPMs, etc.) have been checked and reinstated.
- Following incident, Foreman to review site EPMs and working practices with SEPA officer to ensure good practice as per WAT-SG-29 Temporary Construction Methods.

5.17.4 Health and Safety

Table 5.5 Potential Hazards and Remedial Measures

	Risk	Mitigation
1	Plant and vehicle movements	Standard construction site practice plus signage and fencing on hazardous areas
2	Injuries from falls and manual handling of equipment and materials	Use of Personal Protective Equipment (PPE), staff awareness program and First Aid provision
3	Adverse weather conditions	All staff will be made aware of the possibility of rapid changes in local weather conditions and will have additional items of warm clothing and wet-weather gear
4	Parasites – ticks and keds	All staff will be made aware of Lyme's disease and primary treatment will be provided on site
5	River flooding	All staff will be made aware of the possibility of river flooding. Construction works in the river during flood season will be avoided.

5.17.5 Operatives on Site and Relative Training

- Supervisors
- Plant Operators
- Steel fixers
- Joiners
- Labourers
- All preferred contractor employees to have completed a CITB safety awareness course. Any plant operators to hold the relevant CITB certificate for that item of plant.

5.17.6 Personal Protective Equipment (PPE)

Hard hats, eye protection, foot protection, protective trousers, gloves and reflective clothing will be worn as a minimum. Hearing protection, masks and wet weather clothing will be available to operatives as necessary.

5.17.7 Plant on Site

- Wide Tracked Excavator
- Rock breaking/trimming tools
- Drilling machine
- Pumps
- Vibrating pokers
- Compressor
- Generators
- Small hand tools
- Wide Tracked Dumper
- Welding machine
- Tipper lorries
- Concrete lorries
- Concrete pumps