Garbhaig Hydro Scheme

Proposed dam raise and catchment extension

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1 Introduction

It is proposed to augment the Garbhaig Hydro Scheme by increasing the reservoir storage (raising the spillway level of the dam) and increasing the catchment area by abstracting water from five intakes on tributaries of the Talladale River to the SE. The reservoir of Loch Garbhaig is situated approximately 2 km South of Loch Maree, near Slattadale in Wester Ross and the development land is predominantly within the extent of Gairloch Estate.

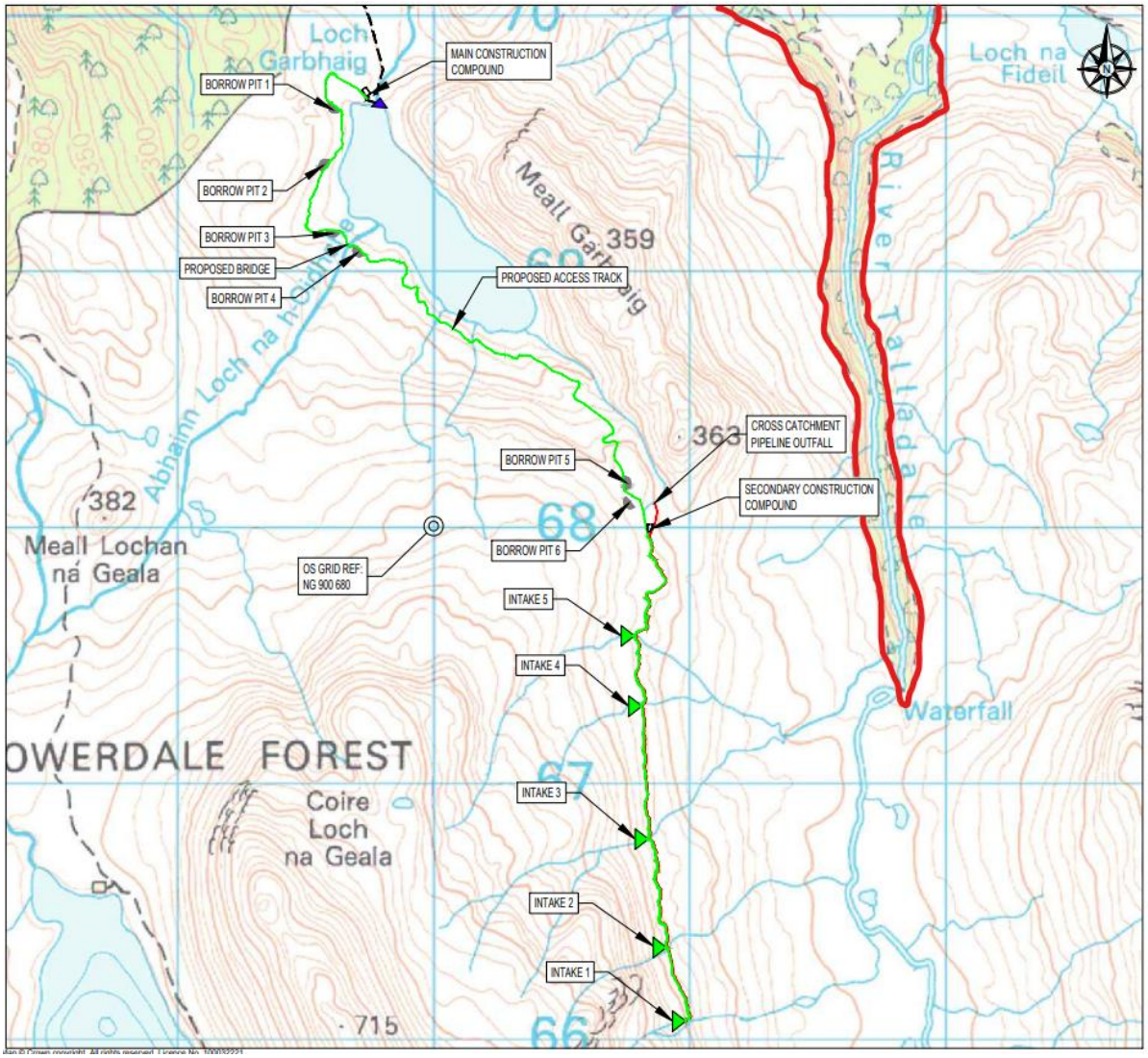

Figure 1 – Showing the proposed scheme elements, from the dam site at the north end of Loch Garbhaig (blue triangle) to the 5 catchment extension intakes to the south (green triangles). The green line indicates the construction track (to be reduced to ATV status). The red line delineates the Talladale Gorge SSSI, also part of the Loch Maree Complex SAC. The whole of the development is within the Wester Ross National Scenic Area (NSA).

The development site falls within the Wester Ross National Scenic Area (NSA) which here is characterised by irregular, rocky moorland, spectacular higher rugged mountains and the lower tree-covered moorland habitat overlooking Loch Maree.

The site also has close proximity and connectivity with the Talladale Gorge Site of Special Scientific Interest (SSSI) and the Loch Maree SSSI, Special Area of Conservation (SAC), Special Protection Area (SPA), and Ramsar Site. The catchment extension pipeline is, at its closest, 700m from the Talladale Gorge SSSI. This is native pine wood and upland oak woodland hosting a rich variety of woodland bryophyte flora.

2 Background

The original Garbhaig A scheme (1 MW, 1997) was de-commissioned and re-engineered into a 2MW development and renamed as Garbhaig B Hydro scheme in 2016 - this was achieved by increasing the size of the dam and moving the powerhouse, thus increasing the storage and head.

This development proposal is presented in two stages:

- The first is to raise the existing dam 4m higher than its present elevation by lengthening the wing walls and raising the spillway of the original structure, the purpose of the work being to provide additional reservoir storage for the scheme.
- The second is complementary to the dam raising proposal. It involves the construction of five small intakes on the upper tributaries of the River Talladale in order to increase the catchment area available to the hydro scheme. The abstracted water will be conveyed from this catchment by a pipe to Loch Garbhaig (partially via a burn flowing into the loch).

3 Scheme Overview

3.1 Dam Configuration

The works will include the raising of the original concrete spillway structure by 4.0m, as well as extending the embankments lengthways (the left bank by 49m and the right bank by 40m). In total, the length of the dam will increase from 82m to 171m (an increase of 108%).

The new embankment structures will be finished with minimal rock armour at each bank and an earth fill and turf dressing. This will reduce the visual effect of the monolithic cast concrete by breaking up the linear outline, allowing it to effectively blend into the surrounding moorland.

The new dam will raise the top water level (TWL) in the loch by 4.0m, from 227m AOD to 231m AOD, and increase the inundated area by 29.8Ha to 38.3Ha, an increase of 8.5Ha.

The new total volume of reservoir impounded water (at the new TWL of 231mAOD) will be about 2,250,000m³, an increase of about 1,350,000m^3.

3.2 Layout of Intakes

The proposed new intakes at five locations on tributaries of the River Talladale will be small structures designed to blend in to the landscape. The small concrete intake structures, 1.15m high (to screen crest) and approximately 5m in length will be tied into the banks using concrete wing-walls, the majority of which will be hidden by a protective reinstatement cover of natural boulders and local vegetation.

Fish plunge pools will not be required.

Table 1 Showing grid references, chainages and ground level elevations of the 5 intakes and the outfall. The affected reaches are measured to the River Talladale or in the case of tributaries, to the main stem.

ID	NGR	Watercourse	Approximate Elevation of watercourse bed (mAOD)	Chainage between Intake and Outfall (m)	Affected reach of each watercourse (km)
Intake 1	NG 9098 6607	Allt Coire na Ciche	344.5	2290	1.05
Intake 2	NG 9091 6635	Unnamed Burn	335.0	1966	0.86
Intake 3	NG 9084 6678	Allt a' Chaoruinn	326.0	1494	1.49
Intake 4	NG 9081 6730	Unnamed Burn	316.5	955	0.30
Intake 5	NG 9078 6757	Unnamed Burn	313.0	652	0.78
Outfall	NG 9089 6810	Unnamed Burn	298.0	-	0.93
TOTAL					**5.41**

3.3 Layout of Pipeline and Outfall

A buried HPPE pipe approximately 2300m in length will convey the abstracted water from intake to intake and eventually to a small concrete outfall structure at the N end of the pipeline, from where the water will flow into the un-named burn draining into the SE end of Loch Garbhaig. This outfall structure will consist of a small concrete open-walled box “pool”, partially submerged in the conveyance watercourse. Alpine rather than Coanda screens are proposed for the intake abstraction points as they are easier to clean, and their use results in a smaller and more compact intake design. Coanda screens should not be required as fish surveys indicate that it is very unlikely that a population of trout can be supported at the proposed intake locations.

4 Hydrology and Abstraction Rates

The proposed catchment extension intakes will take water from the River Talladale catchment and divert it to the Loch Garbhaig catchment. Hydrology studies have determined that abstraction from the five new intakes (a total of 2.13km^2 of catchment area) will add a maximum abstraction of 347 l/sec via the un-named burn which will convey the abstracted water to Loch Garbhaig.

The abstracted water will flow down a relatively minor watercourse, but it was determined that the channel, an old glacial meltwater overflow route, would be able to handle the increased flow in a sustainable manner. The alternative would be 850m more pipeline being installed down to the loch shore.

Table 2 Showing the abstraction rates at each of the 5 intakes, resulting in a total maximum abstraction of 347 litres per second, and Compensation (Mitigation) Flows (HOF = Hands-off Flow, RF = Residual Flow)

ID	NGR	Watercourse	Maximum Abstraction Rate (m3/s)	Compensation Flows - HOF/RF (litres per sec)
Intake 1	NG 9098 6607	Allt Coire na Ciche	0.095	8/12
Intake 2	NG 9091 6635	Unnamed Burn	0.014	1/2
Intake 3	NG 9084 6678	Allt a' Chaoruinn	0.118	8/11
Intake 4	NG 9081 6730	Unnamed Burn	0.050	3/5
Intake 5	NG 9078 6757	Unnamed Burn	0.070	4/6
TOTAL		**Rate of water return**	**0.347**	

5 Environmental

5.1 Fish habitat

5.1.1 Loch Garbhaig and watercourses ingoing and outgoing

A 2024 study covered Loch Garbhaig itself (plus input burns), including fish habitat survey, electrofishing and eDNA sampling/analysis.

The habitat surveys found very limited accessible or suitable habitat in the small inflowing burns to Loch Garbhaig. The fish surveys found European minnow and very low density of brown trout parr in some of these small burns. No trout fry were found, suggesting there is no or little recruitment of trout in these small tributaries.

Brown trout fry and parr and minnows were found downstream and brown trout only upstream of a series of cascade and waterfall obstacles on the main inflow river: Abhainn Loch na h-Oidhche, suggesting this is the main area of recruitment for brown trout, although the habitat is of relatively high gradient with turbulent water flow so spawning sites are limited to small patches of gravel stored at the edges of the channel or behind large boulders. Upstream of the migration obstacles (NG 89344 68556) there is a larger area of more suitable spawning and nursery habitat for brown trout. No European eel or other fish species were found.

The outflowing Abhainn Garbhaig is not accessible to migratory fish in upstream direction (from Loch Maree) due to natural obstacles or resident trout in a downstream direction (from Loch Garbhaig) due to the existing water intake dam.

5.1.2 River Talladale and input watercourses

A 2025 fish habitat study of the River Talladale and the input tributaries was carried out.

No Freshwater Pearl Mussel or habitat likely to host them were found by this survey.

It is likely that a high waterfall obstacle limits the distribution of migratory fish to the lower River Talladale. Upstream of waterfall obstacles, some habitat is suited to brown trout in the main channel of the River Talladale and its tributaries. The accessibility of suitable habitats in the tributaries is affected by obstacles and the suitability of habitats is limited by the high gradient of fall. In fact, high river channel gradients, obstacles, and lack of suitable habitat mean that it is highly unlikely that a trout population is supported at each intake location.

The proposed abstraction is likely to affect a proportion of the habitat available for fish:

• This survey identified some 1.8 Ha of potentially suitable habitat for brown trout over a river length of 3.8km, (some 77% of the survey area) which may potentially be affected by water abstraction.

• It is estimated that there is a further 4km of the main river and several tributaries that may also be accessible to brown trout in the upper river Talladale that will not be affected by the proposed development.

5.2 Water Environment Mitigations

5.2.1 Compensation Flows

Compensation flows as mitigation for the abstractions will be provided at all 5 of the new intake structures – see Table 2 above. These vary with the upstream flow – the HOF (Hands-off Flow) is always delivered, in this case via an orifice in the front face of the intake within an arrangement of aluminium stoplogs. The RF (Residual Flow) is an mitigation

additional flow which is delivered when the watercourse is running at higher than average flows – this is delivered by a rectangular notch in the top stoplog, set above the intake (screen) crest but below the secondary crest.

The mitigation flows for the new catchment extension intakes vary between 1 litre per second at the smallest watercourse (Intake 2) and 8 litres per second at the two largest watercourses (Intake 1 and 3).

The fish surveys indicate that trout are present in the burns below Intakes 1 and 2, and for this reason a lesser flow will be abstracted at these intakes than is otherwise permissible (1.5 times the mean river flow rather than twice that value).

The compensation flow delivered at the dam will remain unchanged from the present situation at 84 litres per second (see also below)

5.2.2 Sediment Management

The Talladale intake impoundments will form barriers to sediment naturally being washed down the watercourses, which can negatively impact gravel substrates used by fish for feeding and breeding. To mitigate again this impact, there will be a programme of sediment management which will facilitate the movement of sediment across the intake. This will take the form of periodic flushing of the intake pond by removing the aluminium stoplog arrangements and allowing the accumulated sediment to pass downstream.

Fisheries studies have indicated that the watercourses at the intake sites themselves are unlikely to hold populations of fish due to their high gradient or downstream barriers, and for this reason no fish plunge pools are proposed in the intakes design.

5.2.3 Freshet Delivery

A new compensation flow arrangement will be provided at the dam which will deliver the mitigation flow directly from the intake chamber into the upper fish plunge pool. The current ball float mechanism will be replaced with an actuated gate valve operating on water pressure (depth) changes to account for the reservoir's relatively large range in head.

Freshets are a controlled release of water from a dam to manage river flow and support river biodiversity. For providing downstream flow variability the dam currently has no mechanism for releasing freshets other than opening the compensation flow pipe to full bore. An alternative freshet flow delivery arrangement will be provided by including a second pipe next to the new compensation flow pipe, discharging into the upper fish plunge pool.

The frequency, magnitude and duration of freshet flows provided by the new arrangement will be calculated to maintain the current flow variability downstream of the dam.