EARBA STORAGE

A GILKES ENERGY COMPANY

Earba Pumped Storage Hydro Scheme

EIA Report

Chapter 6: Hydrology and Water Management

February 2024

Quality Information

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Revision History

Revision	Revision Date	Details	Authorised
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Contents

6. Hydrology and Water Management

Executive Summary

The Proposed Development involves the construction and operation of a new Pumped Storage Hydro (PSH) scheme with an installed capacity of up to 1,800 Megawatts (MW), utilising the existing Loch Leamhain as the upper storage reservoir and the existing Loch Earba reservoir as the lower reservoir. To create the energy storage capacity, Loch Leamhain would be raised by approximately 75m from its existing 635 m AOD elevation to approximately 710m AOD. In order to form suitable storage in the lower reservoir Loch Earba would be raised by approximately 25 m from its existing average level of 350 m AOD to approximately 376m AOD.

Details of The Proposed Development including plans and detailed drawings are included in the Figures appended to **Chapter 2: The Proposed Development**

The reservoir water level in Loch Earba is currently controlled by two dams, one at the link between Earba east and west and one at the loch outflow at the head of the Allt Labhrach. All water in Loch Earba, excluding spill, is currently reserved for hydro operations.

Two new dams would be required to raise Loch Earba and these would be built at the northern and southern ends of the loch and named Shios and Shuas respectively. The Proposed Development would introduce compensation flow from the foot of the Shios Dam into the Allt Labhrach. Currently no compensation flow is provided into the Allt Labhrach. The proposed compensation flow would be agreed with SEPA as part of the CAR licence. During the initial period of construction, before filling, the construction works at the proposed Shios dam would maintain the natural outflow from Loch Earba into the Allt Labhrach. This flow would then be abstracted for hydro power at the existing generating station until the filling process starts.

At the upper reservoir only one dam would be required on Loch Leamhain. The Proposed Development would release compensation flow from the foot of the Leamhain Dam which is the natural outlet of Loch Leamhain. The flow would be regulated to replicate the natural conditions in the burn using a flow range to be agreed with SEPA as part of the CAR licence. During construction of the Leamhain dam the natural outflow from Loch Leamhain into the Allt Loch a'Bhealaich Leamhain would also be maintained.

The Proposed Development requires the diversion of the burns that flow into the south of Loch Earba so that these watercourses are diverted around the proposed Shuas dam and into the Earba reservoir. At each abstraction point on the proposed diversion there would be provision to allow a continuous compensation flow of Q95 to continue along the original burn to maintain the downstream reaches. These compensation flows would be agreed with SEPA as part of the CAR licence.

Water from the Earba catchment area will be required to fill the lower reservoir prior to operation, which will take a number of years. A hydrological model has been prepared to simulate filling the lower Loch Earba reservoir according to a range of inflows and outflows. It is estimated that filling Loch Earba reservoir would take 2 to 5 years of flow capture. This filling would temporarily impact the downstream hydroelectric schemes at Ardverikie and Lochaber. Discussion with the operators of these hydro-electric schemes is underway.

The Proposed Development would only operate between agreed minimum and maximum levels at both the upper and lower reservoirs. A stop generating level is proposed at Loch Earba to protect against overspill into the Allt Labhrach. A stop pumping level is proposed at Loch Leamhain to protect against overspill into the Allt Loch a'Bhealaich Leamhain.

A stop pumping level is also proposed to prevent pumping operations in Loch Earba during extreme low loch events and to protect against the reduction of the buffer storage provided for the existing hydro and for compensation flow.

In a full duration cycle, with pumping of the full storage volume at maximum rate, the Earba reservoir level would fall from the Top Water Level (TWL) to Bottom Water Level (BWL) in 30 hours. This would draw down at approximately 0.6m per hour. In a long duration full storage generating cycle the Earba reservoir would rise from the BWL to TWL in 22 hrs at a rate of 0.8m per hour.

Considering the same long duration cycle scenarios as outlined above at the Loch Leamhain reservoir would mean that the level rises from the BWL to the TWL in 30 hours at a rate of approximately 2.4m per hour in a full pumping cycle. In a long duration full volume generating cycle the Leamhain reservoir would fall from BWL to TWL in 22 hrs at an average rate of approximately 3m per hour.

6.1 Introduction

6.1.1 The Proposed Development comprises a pumped storage hydroelectric scheme to transfer water between Loch Earba (lower reservoir) and Loch Leamhain (upper reservoir). This Chapter presents a summary of the baseline hydrological conditions and a review of the water management strategy for The Proposed Development. Details of The Proposed Development including plans and detailed drawings are included in the Figures appended to **Chapter 2: The Proposed Development**, and an assessment of potential effects on the water environment (hydrology and hydrogeology) are described in **Chapter 12: Geology Soils and Water**.

6.1.2 This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on Water Resources during construction and operation. This chapter presents a summary of the baseline water management conditions and a review of the water management strategy for the Proposed Development as detailed in **Chapter 2: The Proposed Development**. Where likely significant effects are predicted during construction and operation, appropriate mitigation measures are proposed, and the significant predicted residual effects are assessed. If the project were to be decommissioned, it is anticipated that the potential effects on water management would be equal to the construction impacts. As such, a separate assessment of potential decommissioning effects on water management is not included in this Chapter.

6.1.3 This assessment has been carried out by Gilkes Energy Ltd with hydrological assessment by Mott MacDonald Ltd. A table presenting relevant qualifications and experience of key staff involved in the preparation of this Chapter is included in **Appendix 1.1 – EIA Specialist Team.**

6.2 Scope of Assessment

Study Area

6.2.1 The Study Area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. The Study Area comprises the Proposed Development Site and any upstream & downstream catchment areas.

Consultation Responses

6.2.2 To inform the scope of the assessment for the Proposed Development, consultation was undertaken with statutory and non-statutory bodies. **Table 6.1** below summarises the scoping and consultation responses relevant to the Water Management and provides information on where and/or how points raised have been addressed in this assessment.

6.2.3 Full details of the consultation responses and scoping opinion can be reviewed in **Chapter 4: Assessment Methodology, Scoping and Consultation**, and the associated appendices.

Table 6.1 Consultation Responses

Consultee	Issue Raised	Response/Action Taken
SEPA (SEPA-19) Scoping Response 27 April 2023	Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment. Please also refer to Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.	New watercourse crossings will be designed to convey the 0.5% AEP plus an allowance for climate change. Flood risk associated with the reservoirs will be covered under the Reservoirs (Scotland) Act 2011.
THC (96) Pre-Application Report 8 March 2023	There are a number of watercourses present within, or adjacent to, the application site boundary. This type of development is considered both 'Essential Infrastructure' and 'Water Compatible' under SEPA's 'Flood Risk and Land Use Vulnerability Guidance'. The development can therefore be located in areas at risk of flooding as long as it is designed to remain operational during flood events and does not increase flood risk to others. A Flood Risk Assessment should be submitted to demonstrate that the development will remain operational during flood events and will not increase flood risk elsewhere. SEPA's Technical Flood Risk Guidance for Stakeholders outlines the information required to be submitted as part of a Flood Risk Assessment.	Flood risk during the operational phase of development would be controlled and managed by a separate CAR authorisation which would be agreed with SEPA. The powerhouse structure will be located above the lower reservoir flood level. Flood risk associated with the reservoirs will be covered under the Reservoirs (Scotland) Act 2011.
THC (103) Pre-Application Report 8 March 2023	The proposed hydro scheme will require an authorisation from SEPA under CAR. It is likely that the CAR application will be subject to a derogation (exemption under the Water Framework Directive) assessment and third party consultation which could result in amendments to the scheme. SEPA therefore strongly encourage applicants to twin-track applications for consent under planning and CAR to ensure that CAR requirements can be accommodated more easily when proposals are at their most fluid. Should the applicant choose not to twin-track their applications then the following details must be included in the planning submission to allow us to provide an indication of the potential consentability of the	It is the applicant's intention to twin track the Section 36 & CAR applications.

Consultee	Issue Raised	Response/Action Taken
	proposal under CAR: a) The location and design of the intakes and outfalls and their impact upon the morphology of the water environment; b) Compensation flow; c) Fish passages; d) Other relevant CAR or planning applications or consents for abstractions/hydro schemes; e) Sensitive water uses, water dependent species (including bryophytes) and ecosystems. See Planning guidance on hydropower developments to assist in meeting these information requirements. More detailed guidance on CAR can be found on SEPA's hydropower web page.	
THC (8) Pre-Application Report 8 March 2023	A Flood Risk Assessment should be submitted to demonstrate that the development will remain operational during flood events and will not increase flood risk elsewhere. A Drainage Impact Assessment is also required. Impacts upon Ground Water Dependant Terrestrial Ecosystems will also need to be considered.	Chapter 12: Geology, Soils and Water presents a screening assessment of flood risk sources and principles that would be adopted to control and manage the rate and quality of runoff shed from site during the construction phase of the project. Flood risk during the operational phase of development would be controlled and managed by a separate CAR authorisation which would be agreed with SEPA. An assessment of the potential effects of the Proposed Development on GWDTE will be included in the EIAR at Chapter 8 - Terrestrial Ecology and Chapter 12 - Geology, Soils and Water.

Issues Scoped out of Assessment

6.2.4 It is considered that a flood risk assessment is not required, and this document has been scoped out of the Water Management Chapter for the following reasons:

- The new dam structures would be constructed under the Reservoirs (Scotland) Act 2011 and this legislation governs the assessment of the risk of downstream flooding;
- The development site is not at risk of flooding from any external source;
- The development of the site would not lead to increased flood risk elsewhere and given the attenuation in the new reservoirs, may reduce flood risk;
- Safe access and egress to and from the development would be possible during flood events. Access can be taken over the dams and the bridge at Moy channel would be designed to be well above Laggan flood levels (flood level at Moy is controlled by the Laggan dam);
- The development would not prevent safe access to and maintenance of bodies of water and/or flood defence measures; and
- Drainage and run off at water crossings is covered in a separate chapter.

6.3 Legislation and Policy

Legislative Context

6.3.1 The following legislation has been considered in the assessment:

- EU Water Framework Directive (2000/60/EC);
- The Environmental Act 1995;
- Environmental Protection Act 1990;
- Reservoirs (Scotland) Act 2011;
- The Flood Risk Management (Scotland) Act 2009;
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act); and
- The Water Environment (Controlled Activities) (Scotland) Amendment Regulations (CAR) 2013 (CAR);

Policy Context

6.3.2 The following policy has been considered in the assessment:

6.3.3 National Planning Framework 4 (NPF4)[1] adopted by the Scottish Government on 13 February 2023 provides planning guidance and policies regarding sustainable development, tackling climate change and achieving net zero. Policies relevant to this Chapter include:

- Policy 2 (Climate Mitigation and Adaptation); and

[1] Scottish Government (2023) National Planning Framework 4 (NPF4)

- Policy 22 (Flood Risk and Water Management).

6.3.4 In addition, the Highland-wide Local Plan (HwLDP)[2] provides planning guidance on the type and location of the development that can take place in the region. The Local Plan presents development policies of which the following are relevant to this study:

- Policy 63: Water Environment;
- Policy 64: Flood Risk

6.4 Methodology

Desk Study

6.4.1 A review of available flow data and meteorological data applicable to the site has been undertaken. This is summarised in **Appendix 6.1 – Hydrology Study**.

Field Study

6.4.2 Water Flow and Loch level gauging has been undertaken at 4 sites across the Proposed Development site since early 2023.

The data from the field work above is still being collected and, as such, assessments have been made at this time using the desk-based analysis, to derive flow duration curves for points of abstractions. It is planned that once a full record of gauging is complete, it will be submitted to SEPA with a view to confirming or adjusting any provisional CAR licence values.

6.4.3 A geomorphology survey has been undertaken and will form part of the CAR licence submission. This is attached at **Appendix 6.2 – Hydro-morphology**.

6.5 Baseline Conditions

Existing Baseline – Loch Earba

6.5.1 The catchment areas and layout of the existing lochs and proposed reservoirs are shown below in **Plate 1 Catchment and Reservoir Plan.**

[2] The Highland Council (2012) Highland wide Local Development Plan (HwLDP)

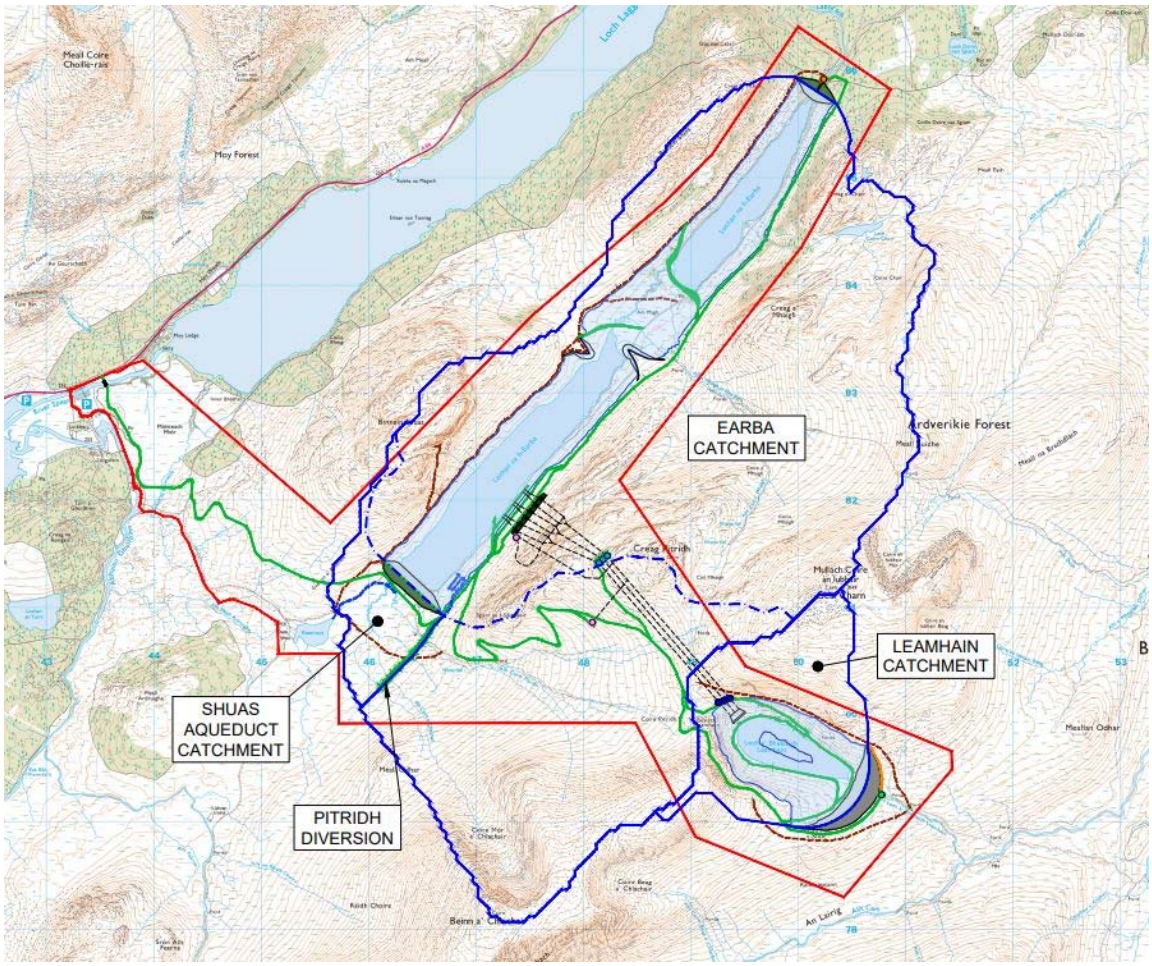

Plate 1: Catchment and Reservoir Plan

6.5.2 Loch Earba is formed by two lochs of the same name, separated by a short reach of channel and floodplain. There is a dam on this channel and this controls the level in the upper loch, providing storage for the existing 1MW Ardverikie hydro electric scheme. There is also a dam on the lower loch, on the natural outlet. This lower dam also includes the hydro intake.

6.5.3 The catchment area of Loch Earba is 26.44km^2. The operation of the existing hydro electric scheme results in the upper Earba loch fluctuating by approximately two metres from a level of 350.57m AOD to 352.6 m AOD. The lower Earba loch fluctuates from a level of 348.19m AOD to 349.19 m AOD (the spill level of the Ardverikie Hydro Dam). During the rare occasions the existing dam at the hydro intake spills the level increases above 349.19m AOD in the lower loch. Likewise, when the dam on the upper loch spills the level will rise above 352.6m AOD.

6.5.4 This gives a total impoundment volume across both lochs of approximately 2.6Mm^3.

6.5.5 The existing hydro-electric scheme abstracts a maximum of 1291 l/s to deliver up to 1MW of electricity.

6.5.6 No compensation flow is passed from Loch Earba into the Allt Labhrach so all water in Loch Earba, excluding spill, is reserved for hydro operations.

Existing Baseline – Loch Leamhain

6.5.7 Loch Leamhain is a hill loch with a natural outlet at the level of 635m AOD. Water flows from this loch in to the Allt Loch a' Bhealaich Leamhain, the Allt Cam and onward to Loch Pattack. There are no existing abstractions from this loch.

6.5.8 The catchment area of Loch Leamhain is 2.57km^2.

6.5.9 It is estimated that the natural fluctuations in Loch Leamhain are approximately 300mm.

Future Baseline

6.5.10 There are no proposals to introduce compensation flow into the Allt Labhrach.

6.5.11 The existing Ardverikie Hydro Scheme could continue to run for many more decades.

6.5.12 Any small-scale conventional hydro utilising the water from either the Allt Coire Pitridh burns or the outflow from Loch Leamhain is considered unviable and there are no plans for any development of this type.

6.5.13 In conclusion, no change to the baseline is proposed or expected.

6.6 Mitigation by Design

Storage Volumes & Stop Levels

6.6.1 The Proposed Development would mean that there are three demands for water from Loch Earba: the supply of water to the pumps to transfer water from Loch Earba to Loch Leamhain; a new compensation flow from Loch Earba to the Allt Labhrach; and maintaining the existing supply of water to the Ardverikie Hydro scheme.

6.6.2 As part of the proposed development two new dams would be constructed at the eastern and western ends of Loch Earba. These are called Shios and Shuas respectively.

6.6.3 These two new dams on Loch Earba would create a reservoir with a top water level (TWL) of 376m AOD which would store a total of approximately 62Mm^3 of water.

6.6.4 To provide mitigation such that there is almost always availability of water for the compensation flow and water to run the Ardverikie Hydro this 62Mm^3 includes up to 7Mm^3 of "buffer" storage reserved for the Ardverikie Hydro, compensation flow and a minimum reserve for PSH operation.

6.6.5 It is important to note that this buffer storage may be drawn down over the course of the year through servicing the water demands of the Ardverikie hydro and compensation flow. In very dry conditions, in order to maintain the minimum PSH operational volumes, the flows downstream of Shios Dam would revert to the pass through the natural run off. The recharge of the buffer storage would likely happen during the winter. This is considered to be a conservative buffer that would provide a robust operational regime and protect the operation of the Ardverikie hydro and the provision of continuous compensation flow under normal conditions.

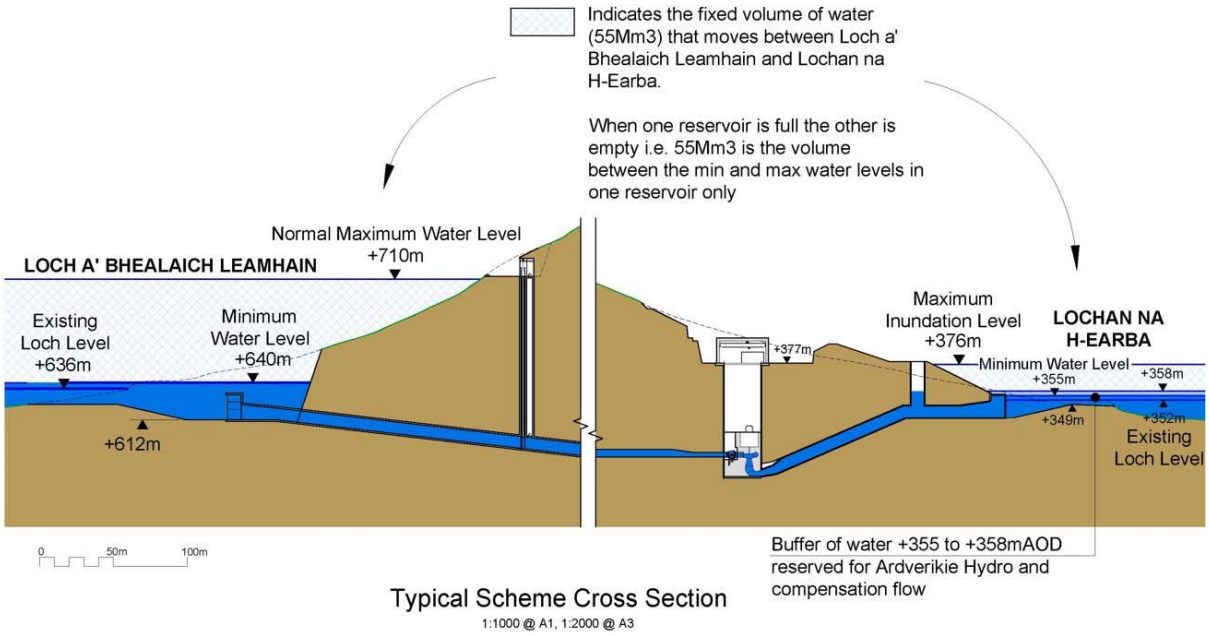

Plate 2: Cross Section through Upper and Lower Reservoirs

6.6.6 Referring to **Plate 2** above, during operation if Loch Earba is at the level 358m AOD and the Leamhain reservoir is full then the full 7Mm^3 buffer storage would be available. Should heavy rain arrive the valve house at Shios dam would open to maintain the 7Mm^3 buffer storage level. This means that Leamhain reservoir could fully discharge for power generation if required. By controlling and releasing water at Shuas dam to match inflows, the risk of curtailment on generation or Shios dam spilling is minimised.

6.6.7 Assuming that the buffer storage has reached the capacity of 7Mm^3 then the stop pumping level of the Proposed Development would be 358m AOD. It is proposed that a stop pumping level of 355m AOD would be implemented for the Earba reservoir when the buffer storage has been reduced to zero. Whilst this means the stop pumping level in Earba will change as the buffer storage varies, the process to control this will be straightforward. By monitoring levels in the upstream and downstream reservoirs the total available volume in each reservoir will be known. If the volume is greater than 55Mm3 then the remainder would be buffer storage and the stop pumping level can be adjusted accordingly. This monitoring process will also ensure that the volume of buffer storage for Ardverikie hydro generation, compensation flow and any evapo-transpiration is maintained and topped up with natural inflow as necessary.

6.6.8 It is proposed that when water levels in the Earba reservoir reach the lower limit of 355m AOD all abstraction for the Ardverikie hydro would stop, this is effectively the proposed ‘hands off level’. This level is approximately 3m higher than the existing TWL so that at all times a continuous body of water remains over the floodplain that separates the two lochs. This would maintain connectivity between the lochs.

6.6.9 It is proposed that a stop discharge or generating level would be set at a maximum level of 376m AOD in the Earba reservoir.

6.6.10 During generation the upper reservoir will be drawn down therefore it is proposed that a stop generating lower level of 640m AOD would be implemented for the Leamhain reservoir.

6.6.11 During pumping the upper reservoir will rise therefore it is proposed that a stop pumping level would be set at 710m AOD in Leamhain reservoir. The proposed stop pumping and stop generating levels for both reservoirs are provided in **Table 6.2**.

6.6.12 When the system is full with 55Mm^3 PSH storage and 7Mm3 of buffer storage, the reservoirs would be balanced, and both the Leamhain and Earba reservoirs would reach their respective stop generation or stop pumping levels at the same time.

Table 6.2: Reservoir Maximum and Minimum Operating Levels

Location	OS NGR	Stop Generating Level (m AOD)	Stop Pumping Level (m AOD)
Lower Reservoir (Earba)	NN 472 817	376	355 (buffer storage =0m^3) 358 (buffer storage = 7Mm^3)
Upper Reservoir (Leamhain)	NN 494 799	640	710

Proposed Abstraction and Discharge Rates and Volumes

6.6.13 The Proposed Development would both abstract and discharge water between the upper and lower reservoirs dependent upon operating mode. These flow rates are shown in Table 6.3.

Table 6.3: Proposed Abstraction and Discharge Flows

Location	OS NGR	Maximum Discharge (m^3/s)	Maximum Abstraction (m^3/s)
Lower Reservoir (Earba)	NN 472 817	820 (generating)	620 (pumping)
Upper Reservoir (Leamhain)	NN 494 799	620 (pumping)	820 (generating)

Drawdown

6.6.14 The maximum volume of water that would be transferred from the upper to the lower reservoir (or lower to upper) by the operation of The Proposed Development is 55 Mm³.

6.6.15 Based upon an installed generation capacity of up to 1800 MW, it would take approximately 22 hours continuous electricity production at maximum output to transfer 55Mm^3 of water from the upper reservoir to the lower. This represents the fastest maximum single continuous transfer of water which the Proposed Development could physically perform.

6.6.16 When the Proposed Development is generating at 1800MW the rate of rise in the lower reservoir, Loch Earba, would be around 0.8m per hour.

6.6.17 At the upper reservoir, Loch Leamhain, the rate of level fall when the Proposed Development is generating 1800MW would be around 3m per hour.

6.6.18 The pumping operation typically involves a lower flow of water than generation mode. In a full pumping cycle, with 55Mm3 of water moving from lower to upper, the Earba reservoir level would fall from top to bottom in 30 hours.

6.6.19 If the Proposed Development is pumping at maximum capacity this would draw down Earba reservoir at approximately 0.6m per hour. At the same time this pumping operation would increase the Leamhain reservoir at a rate of approximately 2.3m per hour.

6.6.20 Once the Proposed Development is operational, the fluctuations in reservoir levels will be a function of the UK electricity market and this may vary significantly from day to day.

Reservoir Safety

6.6.21 Flood risk associated with the reservoirs will be dealt with in accordance with the Reservoirs (Scotland) Act 2011.

6.6.22 Although both the Shios and Leamhain dams would be designed with a spillway for reservoir safety reasons, the small catchment and the large water abstraction capability make it extremely unlikely that the upper reservoir would reach spillway level. The residual flow regime downstream of the dams would therefore ordinarily be unaffected by spill events from the dam.

6.6.23 The Proposed Development would be designed with fail-safe control systems which would prevent pumping once the upper reservoir is full (the stop pumping level has been reached). These control systems would also prevent generation when the lower reservoir is full. The spillways would therefore be designed to pass the naturally occurring extreme flood event (which would have occurred with or without the Proposed Development being present) required for reservoir safety reasons to ensure the safety of the dam structure.

6.6.24 The Shios spillway would be design for Probable Maximum Flood (PMF) with minimal damage, based on the catchment area characteristics. The design would also assume that the Earba reservoir is full when a PMF occurs, a scenario that is considered unlikely.

6.6.25 The Leamhain dam spillway would be designed for PMF of the smaller Leamhain catchment area and assuming that the Leamhain reservoir is full when a PMF occurs.

Loch Laggan Catchment

6.6.26 The Proposed Development would be operated as a closed system, which means that at all times sufficient water to operate the full cycle of the pumping or generation cycle would be retained within the Earba and Leamhain reservoirs. Once fully operational, run-off from any rainfall within the catchment areas of the two reservoirs would not be stored beyond the buffer volume and would be passed into the downstream catchment.

6.6.27 As a result of the Proposed Development no water would be transferred outside of the overall Laggan Dam Reservoir catchment.

6.6.28 Compensation flow and any spill from Loch Earba would flow into the Allt Labhrach and then into Loch Laggan. The Ardverikie Hydro would continue to discharge directly into Loch Laggan.

6.6.29 Discharges from Loch Leamhain would be designed to replicate the original natural flows to Loch Laggan via the Allt Cam and River Pattack, with a range of operational discharges including occasional freshets to provide the required flow spectrum.

6.7 Potential Significant Effects

6.7.1 This section considers the potential impacts and associated effect significance of the construction, and operation of the Proposed Development based on the typical activities described in Chapter 3: Description of Development and the water management principles outlined earlier in this chapter.

Construction Effects

6.7.2 During construction it would be necessary to fill Loch Earba with sufficient water to able to run the pumping and generation cycles of the Proposed Development. This process would involve the full utilisation of inflows possibly over the entire year, subject to agreement with SEPA as part of the CAR licence ad downstream hydro operators. The filling process would start as soon as possible but would only commence once construction of the lower reservoir dams had progressed significantly.

6.7.3 Depending on rainfall during the filling period the required volume will likely be accumulated over a period of 2 to 5 years assuming that filling occurs year round. This would be slightly longer if a shorter seasonal window were applied.

6.7.4 Please refer to Appendix 6.1 for further details of the estimated filling times demonstrating that the entire year would be required.

6.7.5 This filling process would temporarily reduce the flow of water to the Lochaber and Ardverikie Hydroelectric schemes. Once filling is completed the flows to these two hydro schemes would continue unrestricted.

Operational Effects

6.7.6 It is possible that the Proposed Development would commence part capacity operation prior to the reservoirs containing their final design water volume. In this case the filling process would be completed as soon as possible so that the system is a full capacity. Once the 55Mm^3 of storage has been achieved, compensation flow to the Allt Labhrach and generation flow to the Ardverikie Hydro would commence.

6.7.7 Operation of the Leamhain dam has the potential to impact the downstream water body.

6.7.8 The Pitridh Diversion has the potential to deteriorate the quality of the water body downstream of the intake due to a reduction in flow reaching the lower reaches of this catchment area. Taking water from all the Pitridh catchment burns may impact the area of blanket bog at the south end of Loch Earba. A substantial peatland restoration plan is proposed as part of this scheme and this includes improving the quality of the blanket bog at the south of Loch Earba. Final compensation flows will be agreed with SEPA and in conjunction with the specialist involved in the proposed peatland restoration project.The Pitridh Diversion channel will change the flow of sediments that are moved downstream during spates in the Pitridh burns. This may change the pattern of geomorphological of the burns and present an operation al issue if sediment blocks the proposed channel. A

geomorphology report has considered this in more detail and this report is included in **Appendix 6.2**.

Cumulative Effects

6.7.9 Other than the Proposed Development, there are no other planned abstractions or impoundments within the Loch Laggan catchment.

6.8 Mitigation

Mitigation During Construction

6.8.1 Prior to any filling, an agreement would be reached with Ardverikie Hydro on compensation due to lost generation as a result of the Earba reservoir filling operations.

6.8.2 Prior to any filling of the lower Earba reservoir agreement would be reached with Lochaber Hydro on compensation due to any lost generation as a result of the filling operations.

6.8.3 During construction of the Pitridh diversion water would still pass downstream as compensation flow to maintain the blanket bog below.

6.8.4 During construction of the Leamhain dam the natural flow up to an agreed return period would bypass the works. As the temporary diversion at the Leamhain dam works would be achieved by over pumping, the pumping capacity will likely not match the higher return period flood flows. This means that there will need to be a storm attenuation zone above the proposed temporary drawdown level of Loch Leamhain. This storm attenuation zone will need to be sufficient to store a set volume of storm water until it can be transferred through the pumping system. Furthermore, the pumping methodology will require to be reliable and with built in redundancy such that there is minimal risk of: a) depleting the downstream Allt Loch a Bealaich Leamhain and b) allowing water to build up to unacceptable levels. An outline draft methodology for the Leamhain construction works is contained in **Appendix 2.1 - Leamhain Dam Construction – Draft Pollution Prevention Plan**. The full methodology for the temporary dewatering and flow bypass at Loch Leamhain will form part of the Construction CAR Licence to be agreed with SEPA.

6.8.5 At the Shios dam, until filling can commence, water would be diverted around or through the dam works. This water would be utilised by the Ardverikie Hydro scheme in a reconfigured intake. It is proposed that the levels in Loch Earba are kept low during the construction of the dam foundations, so the existing dams on both the upper and lower Earba lochs would likely be decommissioned but may form part of the temporary works operations during the construction stage.

Mitigation During Operation

6.8.6 To mitigate against deterioration of the downstream water bodies in the Allt Coire Pitridh area, compensation flow would be released at each of the intakes on the Pitridh diversion channel.

6.8.7 To mitigate against any deterioration in the Allt Leamhain and areas downstream of Leamhain around the Allt Cam, the full natural flow spectrum would be provided through the Leamhain dam by means of a range of pass through compensation flows including freshets.

6.8.8 Whilst not a mitigation as such, a potential benefit of the project is to introduce a continuous compensation flow into the Allt an Labhrach below Shios Dam. Currently this water course has no compensation flow entering it from the existing Ardverikie hydro scheme.

Table 6.4: Proposed Project Compensation Flows

Catchment	OS NGR	Catchment (km²)	Compensation flow (Litres/second)
Allt an Labhrach	X = 250232.353 Y = 785917.028 NN 50232 85917	24.19	190
Allt Coire Pitridh	X = 246509.538 Y = 780682.682 NN 46510 80683	4.64	36
Allt Coire a' Chlachair	X = 246191.589 Y = 780333.430 NN 46192 80333	0.95	8
Allt Coire a' Chlachair tributary 1	X = 246408.362 Y = 780544.773 NN 46408 80545	0.2	2
Allt Coire a' Chlachair tributary 2	X = 246100.615 Y = 780232.950 NN 46101 80233	0.2	2
Allt Loch a Bhealaich Lemhain	X = 250788.514 Y = 779249.149 NN 50789 79249	2.56	N/A as Natural Flow regime replicated

6.8.9 It should be noted that the Q95 flow that would be passed at each of the Pitridh diversion intakes would collect on the downstream side of Shuas dam. To prevent this water from impounding against the downstream face of the Shuas dam this water would be diverted via the Shuas Aqueduct, as shown on **Figure 2.22 - Shuas Aqueduct - Plan and long section.** This would be a gravity drain / culvert draining to the small reservoir at the head of the Allt Meall Ardruighe. Over-pumping would also be installed as a back up method for ensuring water does not collect on the downstream side of the dam. This pumping method would discharge water to the Earba reservoir. In both cases the water would travel to the river Spean via Loch Laggan.

6.8.10 Taking water from all the Pitridh catchment burns may impact the area of blanket bog at the south end of Loch Earba. A substantial peatland restoration plan is proposed as part of this scheme, and this includes improving the quality of the blanket bog at the south of Loch Earba. Final compensation flows will be agreed with SEPA and in conjunction with specialist involved in the proposed peatland restoration project.

6.8.11 Sediment moved downstream during spates in the Pitridh burns has the potential to accumulate in the proposed diversion channel. A geomorphology report has considered this in more detail and this report is included in Appendix 6.2. A sediment management

plan for the Pitridh diversion channel will be agreed with SEPA as part of the CAR licence application.

6.9 Residual Effects

6.9.1 This section considers the potential residual effects and associated effect significance of the construction and operation of the Proposed Development, following the implementation of mitigation measures.

Construction Residual Effects

6.9.2 Temporary loss of renewable energy (but not revenue) at the Ardverikie and Lochaber hydro schemes during filling the Earba reservoir.

Operational Residual Effects

6.9.3 The introduction of compensation flow into the Allt Labhrach may reduce power from a renewable source at Ardverikie hydro. This may be offset by reduced spill.

Cumulative Residual Effects

6.9.4 No cumulative residual effects were identified.

6.10 Conclusion

6.10.1 The Proposed Development is to build and operate a new PSH with an installed capacity of up to 1800 Megawatt (MW) utilising the existing Loch Earba as the lower storage reservoir and Loch Leamhain as the the upper storage reservoir.

6.10.2 The maximum energy storage of the Proposed Development would be up to almost 40 GWh, which corresponds to a useable water storage volume of 55 Mm^3 (million cubic metres) in the reservoir system.

6.10.3 The Proposed Development would only operate between agreed minimum and maximum levels of Loch Earba and Loch Leamhain

6.10.4 A volume of water, separate to the PSH useable volume, shall be maintained to provide water to the existing Ardverikie Hydro and for compensation flow under normal conditions.

6.10.5 The Proposed Development would release compensation flow at the Shios dam into the Allt Labrach which is the natural outlet of Loch Earba. This would be an enhancement of the water quality status of the Allt Labrach.

6.10.6 The Proposed Development would release compensation flow at the Leamhain dam into the Allt Loch a Bhealaich Leamhain which is the natural outlet of Loch Leamhain. The flow would be regulated to replicate the natural flows in the burn with a water release regime to be agreed as part of the CAR licence.

6.10.7 During construction of the Proposed Development and during the filling process, compensation flow would be maintained at both the Leamhain and Shios dams.