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Red John Pumped Storage Hydro Scheme

Volume 2, Chapter 9: Flood Risk and Water Resources

ILI (Highlands PSH) Ltd.

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Quality information

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Revision History

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9 Flood Risk and Water Resources

9.1 Introduction

9.1.1 This chapter of the EIA Report provides an assessment of the potential effect on flood risk and water resources from the Development. This chapter is informed by the following appendices contained within Volume 5 of the EIA Report:

- Appendix 9.1: Flood Risk Assessment (referred to hereafter as the FRA) (Volume 5) and Confidential Annex 9.1.1: Breach Assessment (Volume 6); and
- Appendix 9.2: Water Resource Assessment.

9.1.2 Details of water quality, hydromorpholgy and hydrogeology are covered in Chapter 10: Water Environment.

9.1.3 Chapter 2: Project and Site Description provides a detailed description of the works required to implement the Development.

9.1.4 Consultation has been undertaken with SEPA, Scottish Canals, THC, Scottish Water (SW) and SSE.

9.2 Legislation, Policy and Guidance

Legislation

9.2.1 A number of specific regulations have been enacted to implement the statutory European and national legislation into UK law - these regulations include:

- EU Directive 2000/60/EC (Water Framework Directive (WFD)), transposed into the Water Environment and Water Services Act (Scotland) 2003 ('the WEWS Act');
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) in respect of discharges to surface or groundwater ('the CAR Regulations');
- Flood Risk Management (Scotland) Act 2009 and the Flood Risk Management (Flood Protection Schemes, Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Regulations 2010 ('the Flood Risk Management Act'); and
- Reservoirs (Scotland) Act 2011.

9.2.2 This legislation aims to protect and enhance the status of aquatic ecosystems, prevent further deterioration of such ecosystems, promote sustainable use of available water resources, and contribute to the mitigation of floods and droughts.

National Policy and Guidance

9.2.3 Planning Advice Notes (PANs) provide national guidance on various topics and the SEPA has produced a range of guidance documents covering a range of environmental issues. Those documents relevant to the water environment are listed below:

- Scottish Planning Policy (SPP) 2014 (Ref 1)
- PAN 51 - Planning, Environmental Protection and Regulation (Revised 2006) (Ref 2);
- PAN 61 - Planning and Sustainable Urban Drainage Systems (2001) (Ref 3);
- PAN 79 - Water and Drainage (2006) (Ref 4);

- PAN 1/2013 - Environmental Impact Assessment (Ref 5);
- SEPA Interim Position Statement on Planning and Flooding; (2009) (Ref 6)
- SEPA Engineering activities in the water environment: Good practice guide – River Crossings (Ref 7); and
- SEPA Technical Flood Risk Guidance for Stakeholders (Version 10, 2018) (Ref 16);

Local Development Plan (Regional Policy)

9.2.4 The Highland Wide Local Development Plan (Ref 24) was adopted in April 2012. This set out THC stance on what development should take place within the area and its policy preferences. Site specific proposals are included and the purpose of the plan is to guide development and any changes in land use in a manner that will serve the public interest.

Policy 64 Flood Risk

9.2.5 Development proposals should avoid areas susceptible to flooding and promote sustainable flood management.

9.2.6 Development proposals within or bordering medium to high flood risk areas will need to demonstrate compliance with SPP through the submission of suitable information which may take the form of a FRA.

9.2.7 Development proposals outside indicative medium to high flood risk areas may be acceptable. However, where:

- Better local flood risk information is available and suggests a higher risk;
- A sensitive land use (as specified in the risk framework of SPP) is proposed, and / or;
- The development borders the coast and therefore may be at risk from climate change; a FRA or other suitable information which demonstrates compliance with SPP will be required.

9.2.8 Developments may also be possible where they are in accord with the flood prevention or management measures as specified within a local (development) plan allocation or a development brief. Any developments, particularly those on the floodplain, should not compromise the objectives of the WFD.

9.2.9 Where flood management measures are required, natural methods such as restoration of floodplains, wetlands and water bodies should be incorporated, or adequate justification should be provided as to why they are impracticable.

Policy 66 Surface Water Drainage

9.2.10 All proposed development must be drained by Sustainable Drainage Systems (SUDS) designed in accordance with The SUDS Manual (CIRIA C697) and, where appropriate, the Sewers for Scotland Manual 2nd Edition. Planning applications should be submitted with information in accordance with Planning Advice Note 69: Planning and Building Standards Advice on Flooding paragraphs 23 and 24. Each drainage scheme design must be accompanied by particulars of proposals for ensuring long-term maintenance of the scheme.

Supplementary guidance The Flood Risk and Drainage Impact

9.2.11 Within the Supplementary guidance The Flood Risk and Drainage Impact it states in section 5.4 that it should also demonstrate that the development will not increase the risk of flooding elsewhere.

9.3 Methods

Summary of Consultation

9.3.1 A Scoping Report (Appendix 4.2, Volume 5) was issued for comment in September 2017 and comments relevant to flood risk and water resources are summarised in Table 9.1 below and specific responses provided. Comments relevant to the Water Environment are summarised in Chapter 10. The full Scoping Opinion is included in Appendix 4.3 (Volume 5)

Table 9.1 Scoping Responses Related to Flood Risk and Water Resources

Consultee	Consultee Comment	Applicants Response
SEPA	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.	Appendix 9.1 (Volume 5) provides the FRA. All guidance has been referred to, as relevant. The applicant has met with SEPA on a number of occasions to discuss the Development, as outlined in Table 4.2 of Chapter 4: Approach to EIA.
Scottish Water	The Development falls partly within the drinking water catchments within which SW abstractions from Loch Duntelchaig, Loch Ashie and Loch Ness are located. SW abstractions are designated as Drinking Water Protected Areas (DWPA) under Article 7 of the Water Framework Directive. Loch Duntelchaig and Loch Ashie supply Inverness Water Treatment Works (WTW), Loch Ness supplies Invermoriston WTW. It is essential that water quality and water quantity in the area are protected. Annex 1 (of the SW response) details a list of precautions and protection measures to be taken within a DWPA and the wider drinking water catchment.	Addressed within Appendix 9.2 (Volume 5). Further consultation was undertaken with SW on the 14 June 2018, who confirmed that pumping arrangement from Loch Ness to provide resilience to Loch Ashie and Loch Duntelchaig public water supply now had the necessary capital spend commitment and therefore SW now regarded Loch Ashie and Loch Duntelchaig as no longer having a water resource issue. The construction and operation of the Development therefore would not change this.
	SW has concerns over the location of the proposed works within Loch Duntelchaig and Loch Ashie and the impact it could have on public drinking water supplies. SW would prefer that the headponds and other associated infrastructure and activities are located out of both Loch Duntelchaig and Loch Ashie drinking water catchments. If it can be demonstrated that this is not practicable, an assessment of impacts on the structural integrity of Loch Duntelchaig and Loch Ashie, their dams, their water quality and quantity and any other associated infrastructure, will require to be undertaken. This should cover the construction, operation and decommissioning stages.	Chapter 3: Design Evolution and Alternatives outlines the design evolution process for the Development, which now avoids the direct use of Loch Duntelchaig. Figure 9.2 (Volume 3) shows the hydrological catchments in relation to the Development. Reservoir Breach Analysis has been undertaken in Confidential Annex 9.1.1 (Volume 6) to assess impact of breach on Loch Duntelchaig and Loch Ashie.

Consultee	Consultee Comment	Applicants Response
Scottish Water (Cont.)	*Summarised comment from SW response* - The impacts need to be discussed with SW and taken into account to determine the risks on these public drinking water supplies. Neither option can be scoped out, as they could have a significant impact on water quality, quantity and infrastructure and this has to be assessed.	Chapter 3: Design Evolution and Alternatives outlines the design evolution process for the Development, which now avoids the direct use of Loch Duntelchaig. Appendix 9.2: Water Resources (Volume 5) provides information on water resources. Further consultation was undertaken with SW on the 14 June 2018, who confirmed that pumping arrangement from Loch Ness to provide resilience to Loch Ashie and Loch Duntelchaig public water supply now had the necessary capital spend commitment and therefore SW now regarded Loch Ashie and Loch Duntelchaig as no longer having a water resource issue. The construction and operation of the Development therefore would not change this.
	There is no transfer from Loch Ness in place at present and no infrastructure to do so. A proposed future scheme takes water from Loch Ness to the water treatment works directly.	Accepted that the transfer is proposed and not current.
	It is stated that Loch Duntelchaig in conjunction with Loch Ashie is the main potable water supply reservoir for Inverness, but does not state that it is a DWPA. It does highlight that the current arrangement is under pressure to meet future demand. It is not stated that any impact on current yield as a result of this proposal will therefore exacerbate this.	Appendix 9.2: Water Resources (Volume 5) provides information on water resources. Further consultation was undertaken with SW on the 14 June 2018, who confirmed that pumping arrangement from Loch Ness to provide resilience to Loch Ashie and Loch Duntelchaig public water supply now had the necessary capital spend commitment and therefore SW now regarded Loch Ashie and Loch Duntelchaig as no longer having a water resource issue. The construction and operation of the Development therefore would not change this.
	This needs to include a study of the impact of dewatering Loch na Curra and Lochan an Eoin Ruadha into Loch Duntelchaig on raising the water levels of Loch Duntelchaig. Please can details be provided of how drainage to Loch Duntelchaig and Loch Ashie from the remaining contributing area downstream of the headponds is to be aligned and managed and any impacts on water quantity and quality be assessed. From Figure 2.3 (Option A), it looks like only a portion of Lochan an Eoin Ruadha is to be included in the headpond.	Chapter 3: Design Evolution and Alternatives outlines the design evolution process for the Development, which now avoids the direct use of Loch Duntelchaig. Option A which involved the use of Loch na Curra and Lochan an Eoin Ruadha was discounted.

Consultee	Consultee Comment	Applicants Response
Scottish Water (Cont.)	This states that an assessment of low flows impact will be carried out and if significant, there will be a review of safe yield of the WTW sources. This should be an assessment of the impact on all flows and an assessment of the impacts on yield is required, regardless of how large or small the impacts on the inflow flow sequence appears to be.	Consultation as above
	This section states that Option B would avoid impacts on Loch Duntelchaig as there would be no loss of catchment area. From the map provided (Figure 2.3), the headpond would encroach into Loch Duntelchaig catchment over a small area. It also says that the headpond area will be isolated from the local catchments, reducing the catchment areas of Lochs Ashie and Duntelchaig and a detailed assessment of the contributing area will be assessed. SW requires details of these contributing areas and how they will be assessed.	Consultation as above
	This notes that in extreme rainfall there could be potential overtopping of the pond embankment and spill arrangements will be provided to Ness catchment. SW requires details of this to ensure that there is no impact on its sources. We would expect flood studies to be completed and reservoir inundation maps prepared to assess the impact of a breach of either option on the downstream environment and to identify if there is potential for a breach scenario to discharge into Loch Duntelchaig/Ashie, artificially raising top water level enough to impact on the dam structures. As the applicant will be aware, a Qualified Civil Engineer (QCE) should be appointed from the DEFRA All Reservoir Panel to sign off the construction of the headpond impoundments.	Reservoir Breach Analysis undertaken in Confidential Annex 9.1.1 (Volume 6) to assess flood risk within the Headpond and impact of breach on Loch Duntelchaig and Loch Ashie.
	Notes that the development has been designed to avoid cross-catchment transfer- can details of this be supplied?	There is no physical connection proposed.
The Highland Council	Policy 63 Water Environment – supports development that does not compromise the objectives of the Water Framework Directive. Assessment of this proposal will include how the proposal relates to the River Basin Management Plan for the Scotland River Basin District and, for this proposal, the North Highland River Basin Management Plan.	Assessment of the impact of the Development carried out in line with THC supplementary guidelines for Flood Risk and Drainage Assessment to the Local Plan.

Consultee	Consultee Comment	Applicants Response
The Highland Council (cont.)	Policy 64 Flood Risk – sets out the Council's expectations in regard to flood risk. This policy is highly likely to be relevant to the proposal. The Council's Flood Team and Scottish Environment Protection Agency responses in this pack provide further information as does the Council's Flood Risk and Drainage Impact Assessment Supplementary Guidance.	Assessment of the impact of the Development carried out in line with THC supplementary guidelines for Flood Risk and Drainage Assessment to the Local Plan.
SSE	No comment made on Scoping Report but contact has been attempted as part of the pre-application process	Contact made, but SSE declined to provide the data requested by the Applicant due to being commercially sensitive.
Scottish Canals (SC)	No comment made on Scoping Report but consultation has been undertaken as part of the pre-application process	A meeting was held with SC on the 27 September 2018 to discuss the potential impact on the canal operation. SC provided details of the required minimum water level in the canal and confirmed that this cannot be compromised through abstraction from Loch Ness, the feed for the canal. Assessment of abstraction of full volume from Loch Ness undertaken.

Desk Study

9.3.2 Data from various sources regarding flooding has been reviewed, including:

- Ordnance Survey (OS) mapping to identify surface water bodies and topography;
- SEPA online Flood Risk Management (FRM) maps;
- River Ness Flood Scheme - Details of Hydraulic Modelling undertaken for Development of Preferred Scheme - The Highland Council / Mott MacDonald October 2011;
- Guidance to risk assessment for reservoir safety management - Volume 2: methodology and supporting information Report - SC090001/R2- Department for Environment, Food and Rural Affairs (Defra);
- Water Control Manual - Caledonian Canal - Version 9.0 - Scottish Canals;
- Flood Risk & Drainage Impact – Supplementary Guidance Jan 2013 – The Highland Council ;
- Dochgarroch Lock water levels - Scottish Canals;
- River Ness flow data - National River Flow Archive;
- Elevation Discharge curve for Loch Dochfour – extract from Loch Dochfour Reservoirs Act Section 10 Inspection 1987;
- Flood Estimation Handbook (FEH) Catchment Data, 2018 (Ref 20).

9.3.3 A desktop study of the hydrological features associated with the Development has been undertaken. The significant water features included in this assessment are therefore assessed to be Loch Ness, Loch Dochfour, Caledonian Canal, Loch Ashie, Loch Duntelchaig and the River Ness; the location of these features are shown in Figure 9.1 (Volume 3).

Flood Risk Assessment

9.3.4 The FRA (Appendix 9.1, Volume 5) outlines the assessment undertaken to evaluate the impact of the Development on flood risk from the construction and operation of the Development. Confidential Annex 9.1.1 (Volume 6) outlines the work undertaken to assess the impact, in the very unlikely event, of a breach of the Headpond Embankment both to the north into Loch Ashie and to the west downslope to Loch Ness during the operational phase.

Water Resource Assessment

9.3.5 The Water Resource Assessment (Appendix 9.2, Volume 5) reviews the current water resource usage and working parameters for the key receptors. It assesses the potential impact on water resources as a result of the Development and addresses appropriate mitigation measures to reduce the impact of the Development including outlining the operational rules.

Assessment Method

9.3.6 The assessment of potential effects on flood risk has been carried out with reference to the guidance and techniques presented within the "*Design Manual for Roads and Bridges*" (DMRB), Volume 11, Section 3, Part 10 "*Road Drainage and the Water Environment*".

9.3.7 The DMRB methodology takes into account the importance or sensitivity of receptors and the magnitude of predicted impacts on flood risk. Importance / sensitivity is based on the

value of the feature or resource, whilst the magnitude of a potential impact is estimated based on the degree of effect and is independent of the importance of the feature.

9.3.8 The assessment of the acceptability of an Embankment breach based on the impact and likelihood of occurrence has been carried out in line with the " *Guidance to risk assessment for reservoir safety management*" - Volume 2: methodology and supporting information "Report - SC090001/R2- (Defra)"

9.3.9 The assessment of the potential effect on water resources has been carried out based on ensuring compliance with the current water management regimes for the key receptors.

9.3.10 The specific generation / pumping operational regime for the Development is not known at this stage as it will be determined by the energy market. The Development has approximately 4,900,000 metres cubed (m^3) of available raw water storage within the Headpond that can be used in a single cycle. It is likely that only a proportion of this will be used per cycle. However, based on a precautionary approach a full cycle has been used for the purpose of the assessment.

Sensitivity or Importance of Receptors

9.3.11 The sensitivity of receptors has been scaled from negligible; to low, medium, high and very high (Table 9.2). Their relation to the SEPA vulnerability guidance are outlined within the table, a full list of receptors can be found within Table 1 of the SEPA report (Ref 29). To ensure the transparency of this assessment, the key indicators used to derive the sensitivity of each receptor are identified in Section 9.4: Baseline Environment.

Table 9.2 Characteristics defining receptor sensitivity

Sensitivity	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance. Most Vulnerable Uses e.g. nurseries
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance. Highly Vulnerable Uses e.g. residential properties
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value or is of regional importance. Least Vulnerable Uses e.g. offices
Low	The receptor is tolerant of change without detriment to its character, is of low environmental value, or of local importance. Essential Infrastructure e.g. essential transport infrastructure
Negligible	The receptor is resistant to change and is of little environmental value. Water Compatible Uses e.g. flood control infrastructure

Magnitude of Effect

9.3.12 The magnitude of the potential effect was evaluated using the criteria outlined in Table 9.3, scaled from high to medium, low and negligible magnitude.

Table 9.3 Characteristics Defining Magnitude of Effect

Magnitude	Characteristics
High	Total loss or major alteration to key elements/features of the baseline conditions such that post development character/composition of baseline condition will be fundamentally changed. Flood Risk – Loss of floodplain or defence protecting more than 100 residential properties from flooding
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition of the baseline condition will be materially changed. Flood Risk – Loss of floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Low	Minor shift away from baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character/composition of the baseline condition will be similar to the pre-development situation. Flood Risk – Loss of floodplain or defence protecting 10 or fewer industrial properties from flooding
Negligible	Very little change from baseline conditions. Change is barely distinguishable, approximating to a 'no change' situation. Flood Risk – Loss of floodplain with limited constraints and a low probability of flooding of residential and industrial properties

Significance of Effect

9.3.13 The significance of a potential effect is derived by considering both the sensitivity of the feature and the magnitude of the effect, using a matrix as illustrated in Table 9.4 below. Professional judgement has been used to apply the criteria to assess receptor importance, and magnitude of effect as each situation is unique.

Table 9.4 Classification of Effects

Magnitude of Effect	Sensitivity				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

9.3.14 Any effect predicted to be Negligible or Minor is considered to be 'Not Significant'. Effects assessed as Moderate or Major are considered to be 'Significant'.

Limitations and assumptions

9.3.15 The FRA (Appendix 9.1, Volume 5) and the water resource review (Appendix 9.2, Volume 5) have been based on available information. With regard to the receptors on the shores of Loch Ness and along the River Ness outlined in the FRA, these have been based on the work undertaken in support of the River Ness flood risk protection scheme (Ref 10).

9.3.16 No long term recorded water levels were available for Loch Ness. Requests were made to SSE for historic water level records. However, SSE have declined to provide the data due to being commercially sensitive. Therefore, long term water levels have therefore been based on generated water levels calculated from River Ness recorded flows and the Ness Weir stage discharge relationship. The calculated water levels have been used to assess the operational impact of abstraction of water from Loch Ness and the discharge of water into Loch Ness during the generation cycle of the Development.

9.3.17 The stage discharge relationship, at the Ness Weir, is based on two years of overlapping water level records at Loch Dochfour and the flow records in the River Ness at Ness-side. The flood flow stage discharge at Ness Weir and the relationship between Loch Ness and Loch Dochfour water level are based on studies undertaken following historic flood events (Ref 30).

9.3.18 The recorded water levels at Loch Dochfour includes levels for the summer of 2018, the lowest water levels in Loch Dochfour and Loch Ness in recent years.

9.3.19 The water resource review has been undertaken based on a daily (24 hour) time step (interval). This is an appropriate time step given the scale of the receiving water body, Loch Ness. The Development has the ability to generate (discharge) for approximately 6.3 hours and pump (abstract) for approximately 7.9 hours. A combined daily cycle (discharge and abstract) would result in a negligible impact on the receiving water body. The assessment has therefore been undertaken based on separate generation and recharge cycle. This allows the full effect of these operations to be assessed.

9.3.20 As explained above, the assessment has been undertaken based on recorded levels and flows in Loch Dochfour and River Ness, respectively. These take account of all current hydro-electric activities within the catchment (therefore including Glen Doe and Foyers) and canal activities. This is therefore regarded as the baseline scenario and therefore no cumulative effect of other similar activities in the catchment is required.

9.3.21 The mitigation proposed through an operational arrangement for the Development is regarded as being of a precautionary nature based on the above limitations.

9.4 Baseline Environment

9.4.1 The baseline flood risk and water resource conditions relevant to the assessment are outlined in the following sections.

9.4.2 The Development Site is situated between the River Ness and River Nairn water catchment areas. The Development is located on Ashie Moor, a ridge of land between Loch Ness to the north-west, Loch Duntelchaig to the south-west, and Loch Ashie to the north-east. Further details of the general hydrological setting are provided in Chapter 10: Water Environment.

Water Resource – Loch Ness, River Ness and Caledonian Canal

9.4.3 Loch Dochfour and Loch Ness are water sources for the northern section of the Caledonian Canal and provide a location for various recreational activities. Details of the operational arrangements of the Caledonian Canal were provided by Scottish Canals.

9.4.4 Loch Ness spans from Fort Augustus to the Bonnar Narrows at Lochend where it becomes Loch Dochfour. At the downstream end of Loch Dochfour, the watercourse splits with the Caledonian Canal continuing east towards Dochgarroch and the River Ness passing over the Ness Weir and flowing parallel to the canal towards Inverness. The weir was constructed during the works to construct the Caledonian Canal and effectively controls the level of Loch Dochfour and subsequently Loch Ness. During low flows the level of Loch Ness and Loch Dochfour are equal, but when discharges from Dochfour over the weir exceed 200 meters cubed per second (m^3/s) the Bonnar Narrows become a control point and the level of Loch Ness rises quicker than Loch Dochfour.

9.4.5 During drought conditions, SSE is required to release water from upstream catchments and reservoirs to provide minimum 'compensation' flows and maintain minimum navigational depths over lock upstream cills. A minimum pass forward flow must be maintained to the River Ness over the Ness Weir and a minimum water level must be maintained at the Ness Weir.

9.4.6 Minimum environmental flows must be maintained in the River Ness at all times. This is achieved through the opening of radial gates on the Ness Weir at the northern end of Loch Dochfour. This is undertaken by SSE based on water levels in the loch.

9.4.7 Based on historic water levels, loch levels in Loch Dochfour have never dropped to a level where Loch Ness inflows have required to be supplemented to maintain the minimum level in Loch Dochfour. Based on recorded flows in the River Ness at Ness-side, the radial gates are operated relatively frequently by SSE to maintain the minimum environmental flow in the River Ness. Conformation of how often the radial gates are operated to maintain the minimum flow in the River Ness was not possible due to the absence of information from SSE, despite requests made by the Applicant.

Direct Flood Risk to the Development Site

9.4.8 SEPA flood maps were accessed from the SEPA website on the 1 October 2018; they indicate that there is no risk of fluvial flooding at the Development Site (Ref 19). However, the SEPA flood maps do not give any indication of flood risk from smaller watercourses; therefore further consideration should be given to the watercourses in close proximity to the Development Site. The smaller watercourses around the Development site are relatively small and are close to their upstream source with relatively small catchments; therefore the flows are not expected to be large under normal flow conditions. The watercourses are likely to have a quick response to rainfall events which may lead to a rapid rise in flow, but the likelihood of this causing flooding on the steeply graded sloped around the site is considered low. The watercourses generally flow away from the Development Site, with little likelihood that any flooding would affect the Development. Based on the above, direct risk of fluvial flooding to the Development is considered low and does not require further consideration.

Fluvial Flooding and Flood Risk from Existing Reservoirs

9.4.9 The shore of Loch Ness is the lowest point of the Development Site at approximately 16 metres Above Ordnance Datum (mAOD). The terrain climbs steeply from the banks of Loch

Ness and then gradually plateaus towards the C1064, which runs south-west to north-east through the Development site, with a high point of 262 mAOD. From the C1064 the land dips down again to the shore of Loch Duntelchaig at approximately 217 mAOD. There are three small peaks at the southern and eastern side of the Development Site, the highest of which is 278 mAOD.

9.4.10 Loch Ness and its upstream catchment feeds flood water into a Potentially Vulnerable Area (PVA) with regard to flood risk – PVA 01/21 Inverness and the Great Glen. Significant flooding has been experienced in Inverness from the River Ness. This has resulted in THC constructing the recently completed River Ness Flood Protection Scheme to protect low lying areas of Inverness from both tidal and fluvial flooding.

9.4.11 SEPA FRM maps indicate that there a number of properties may be at risk of flooding from Loch Ness in a range of return periods.

9.4.12 Extensive areas of Inverness are at risk from direct inundation from the River Ness during extreme flood events. The recently completed River Ness flood protection scheme has increased the standard of protection to areas downstream of the Ness Bridge to a 1 in 200 year standard. Areas further upstream are however still at risk, including a number of properties.

9.4.13 There are currently ten potential sources of reservoir flood risk in the vicinity of the Development Site, with varying degrees of downstream influence. Full details are included in Appendix 9.1. The risk of existing reservoir flooding to the Development is considered low and acceptable.

Pluvial Flooding

9.4.14 Pluvial flooding is indicated from SEPA FRM maps to occur in low lying areas across the Development Site. Areas of wetland and bog were identified (see Chapter 6: Terrestrial Ecology and Chapter 10: Water Environment for survey and walkover details) and would likely correspond to areas of ponding during high rainfall events. Therefore, pluvial flood risk is included within the assessment.

Flooding from Drainage Networks

9.4.15 There are drainage networks within in the vicinity of the Development. However, these are small localised networks and therefore the flood risk from them is not considered further.

Groundwater Flooding

9.4.16 There are no known records of groundwater flooding and it is unlikely in this location due to the steep slope and freedom of drainage to Loch Ness. Further details of ground water flooding are included in Chapter 10.

Tidal Flood Risk

9.4.17 The local watercourses and water bodies are not tidally influenced, and the Development Site and surrounding area are at an elevation of at between 15-270 AOD. The risk of tidal flooding affecting the Development or of the Development having any influence on tidal flooding is therefore low and does not require further consideration.

Sensitivity of Receptors

9.4.18 To enable a meaningful assessment of environmental impact to be made in accordance with the guidance in DMRB HD45/09, the importance of flood risk receptors must be defined.

9.4.19 Offsite properties, residential and non-residential infrastructure would be vulnerable to any adverse change in flood risk that could be caused by the Development. The implications of this could be financial loss and emotional distress to residents, and disruption to transport and services. SEPA guidance indicates that residential properties are classified as Category 2 – Highly Vulnerable Uses with regard to flood risk. The sensitivity of these receptors, including all property types, in reference to the criteria in this assessment, is therefore categorised as **High**.

9.4.20 Construction and permanent site workers may be sensitive to flood risk at the Development. Use of the site may be restricted during severe weather, reducing the risk to workers. SEPA guidance indicates that the Development site is classified under Category 6 – Water Compatible Uses with regard to flood risk. Due to the balance of vulnerable users and the water compatible land use, the sensitivity of these receptors, in reference to the criteria in this assessment, is assessed to be **Low.**

9.4.21 The location of construction equipment on-site and the use of the Development Site during operation may be necessary but changes to flood risk could cause damage to equipment and pollution incidents. However, equipment located in flood prone areas would be replaceable and is likely to be able to withstand some flooding. The sensitivity of these receptors is therefore assessed to be **Low**.

9.4.22 Loch Ness and the downstream River Ness and Caledonian Canal are sensitive to changes in water levels during prolonged dry periods which could be altered by the Development. The Caledonian Canal is of national importance and therefore its supply of water is essential for its operation. The provision of the environmental minimum flow down the River Ness and the need to maintain a minimum water level within Loch Ness forms part of the operational parameters of the wider catchment as stated in the Caledonian Canal Water Manual, Version 9. The ability to work within and not compromise the ability of others to work within those operational parameters is therefore essential. The sensitivity of these receptors is therefore assessed to be **High**.

Table 9.5 Sensitivity of Flood Risk and Water Resource Receptors

Receptor	Features	Overall Sensitivity
Offsite properties and infrastructure	Health and wellbeing implications of flooding, disruption and financial cost	High
Proposed site users	Health and safety	Medium
Development infrastructure	Financial cost	Low
Loch Ness, River Ness and Caledonian Canal Water Level	Operation of the canal and the wider Ness catchment.	High

Climate Change

9.4.23 According to Defra guidance Table 2 (Ref 27), rainfall intensity is projected to increase by up to 20 % until 2085 due to climate change. Beyond this, it is expected there will be up to 30 % increase in rainfall intensity. The minimum lifetime of the Development is taken as 125 years; the drainage system for the development should be designed to account for at least a 30 % increase in rainfall intensity over its lifetime. However, this should be reviewed after the publication of UKCIP2018, expected release December 2018. The mitigation measures

provided within section 9.7 are based on levels within Loch Ness and therefore the conclusions and proposed mitigation measures are resilient to Climate Change, regardless of the outcome of UKCIP2018.

9.4.24 More recent work undertaken by Centre for Ecology & Hydrology (CEH) for the SEPA to undertake an evaluation of the risk of fluvial flood flow changes across Scotland indicated that for Northern Scotland the increase could be higher (Ref 16). These are summarised in Table 9.6 The FRA (Appendix 9.1, Volume 5). The River Ness Flood Scheme assessment is based on a 20 % increase in peak flows and therefore is in line with both SEPA and DEFRA guidance. The Water Resources Assessment (Appendix 9.2, Volume 5) and the proposed mitigation measures , through operational rules of the Development (when water can be abstracted from Loch Ness and when water can be released into Loch Ness), are based on water level and therefore the mitigation measure is not vulnerable to climate variation. The frequency of when the Development operational rules are applicable will, however, change with climate change. The impact of the Development on wider flood risk and water levels in Loch Ness and Loch Dochfour will not change with the predicted increase in flood flows associated to climate change.

Table 9.6 Likelihood of change in peak flow as a result of Climate Change

River Basin	Time Horizon	Likelihood of change in peak flow (%)	Exceedance Description	Increase in Flood Peak (%) High
Northern Highlands	2080's	10	Very Likely	10
		33	Likely to be exceeded	18
		50	Is as likely as not to be exceeded	23
		67	Unlikely to be exceeded	29
		90	Very unlikely to be exceeded	40

9.5 Assessment of Effects

9.5.1 The following section consider the impact of the construction, operation and decommissioning of the Development on the flood risk and water resources receptors as identified in Table 9.5, as appropriate.

Construction Effects

9.5.2 During construction there is potential increase in flooding due to:

- Increased runoff due to increased area of hardstanding and compacted ground from site clearance, Access Tracks and Compounds;
- Temporary water storage (in attenuation ponds and drainage systems); and
- Increased flows due to dewatering activities.

9.5.3 Temporary hard standing or compacted surfaces, such as those in the Compounds, Access Tracks and as a result of pre-construction site clearance, could result in rapid surface water run-off to local watercourses via the surface water drainage system or increased overland

flow. In line with the receptors identified in Table 9.5, the following effects are assessed below, in the absence of mitigation:

9.5.4 This is considered to be of Low magnitude, and considering the High sensitivity of offsite receptors; this results in a **Moderate adverse** effect.

9.5.5 The Low magnitude effect considered with the Medium sensitivity of proposed on-site users and Low sensitivity of the Development, result in a significance of effect of **Minor** and **Negligible** respectively.

9.5.6 It is anticipated that there will be no adverse effects on water resources during construction to any receptors identified in Table 9.5, or on the operation of the Caledonian Canal from flood risk during the construction phase.

Operational Effects

9.5.7 The operational flood risks associated with the Development are discussed in detail in the FRA report (Appendix 9.1, Volume 5). The following is a summary of the risks identified therein which are:

- Risk of the Development increasing fluvial flood risk from Loch Ness, River Ness and Caledonian Canal due to release of flows;
- Risk of flooding from the Headpond including risk of wave action and risk of overtopping;
- Risk of Embankment breach (Confidential Annex 9.1.1, Volume 6);
- Groundwater flooding of Development components;
- Reduction in water levels in Loch Ness and Loch Dochfour during low flows leading to impact on the ability to maintain navigation within the Caledonian Canal;
- Reduction in water levels in Loch Ness during normal flow conditions;
- Reduction in flows in the River Ness
- Reduction in Loch Ashie catchment resulting in reduced available raw water yield to supply the Inverness Water Treatment Works

Discharge under Normal Operating Conditions

9.5.8 As the Development will include a discharge to Loch Ness under normal operation, it must be operated within parameters that ensure that the Development does not cause an increase in downstream flood risk from the loch itself or the River Ness.

9.5.9 Without mitigation the effect could be of medium magnitude on a medium importance receptor, leading to a potential minor adverse effect. The magnitude would however result in increased flood risk, which would be contrary to the guidance set out by THC in their supplementary guidance The Flood Risk and Drainage Impact (Ref 22) and therefore have been considered further in section 9.7.1.

Risk of Flooding from Headpond

9.5.10 The Development will include the creation of a new Headpond and as the Headpond Embankment impounds a significant volume of water, there is an inherent risk of flooding associated with it. However, the probability of flooding from the Headpond occurring is considered extremely low due to the high standard of design, management, and maintenance required under the Reservoirs Act and provided by any responsible operator.

This is in addition to the mandatory inspections required, as outlined in Table 2.8 of Chapter 2: Project and Site Description

9.5.11 The FRA provides a detailed assessment which has been undertaken to determine the risk associated with the Headpond, and to provide a balanced assessment of the flood risk associated with the Headpond based on a precautionary approach. Significant wave action due to high winds can cause damage to the Embankment, particularly the crest of the Embankment, with potential overtopping if the water level is high enough.

9.5.12 The design freeboard and wave wall within the Headpond mitigates the potential for wave action on the Embankment crest and potential overtopping by waves, by ensuring water levels are below the crest level. Assuming implementation of the above, the potential effect of wave action does not require further consideration.

9.5.13 As detailed in Section 2.4 of Chapter 2: Project and Site Description and shown on Figure 2.6, Figure 2.7 and Figure 2.8 (Volume 3), the normal maximum operating level of the Headpond is 269 m; the overflow weir level is set at 0.5 m above this water level. The crest of the Embankment is set at 3.5 m above the overflow weir. This results in a total freeboard of 4 m above the normal maximum operating level. The evaluation within the FRA shows that the freeboard within the Headpond is sufficient to mitigate the risk of overtopping due to extreme events. The risk of overtopping is therefore considered to be low and the effect is therefore of negligible magnitude.

Breach Analysis and Flood Routing

9.5.14 Although the likelihood of an Embankment breach occurring is extremely low, the consequences, however, are significant. It is therefore necessary to look at the potential flow paths and effects of a breach to determine if the risk is acceptable and to allow adequate emergency planning to be implemented in the future as mitigation in the unlikely event of a breach.

9.5.15 An assessment of the likelihood and consequence of a breach has therefore been undertaken to define the potential areas at risk of flood inundation. The assessment has been undertaken in line with the methodology set out in the Guidance to risk assessment for reservoir safety management – Volume 2: methodology and supporting information Report – SC090001/R2- (Defra). This study is reported fully within the FRA report (Confidential Annex 9.1.1 of Appendix 9.1, Volume 6).

9.5.16 The analysis shows that in the unlikely event of a breach, a substantial area is at risk of inundation. Recognising that the likelihood of a breach event is very low then, in line with the guidance set out in the guide to reservoir risk management, the risk is classed as being broadly acceptable based on the calculated number of fatalities and the estimated probability of failure. This is based on undertaking the rigorous supervision and inspection regime based on the requirements of the Reservoir (Scotland) Act 2011 and that the general condition of the reservoir is classed as condition score 1, very good with no defects, within the guidance to risk assessment for reservoir safety management

9.5.17 The analysis has shown that the Development will not lead to an unacceptable increase in risk due to breach. The effect of the Headpond on flood risk will therefore be negligible based on the very low likelihood of occurrence.

Groundwater Flooding

9.5.18 The analysis within the FRA demonstrates that design will take account of local groundwater flows to: mitigate the risk of raising groundwater levels and flows on-site or elsewhere; take account of groundwater flows into the Headpond; and ensure that groundwater inflow does not pose a risk to users of the below ground areas. Details of the groundwater assessment are included in Chapter 10.

Reduction in water levels in Loch Ness during normal and low water level conditions

9.5.19 Water will be abstracted from Loch Ness to recharge the Headpond. A maximum operating volume of 4,900,000 m^3 of water will be pumped from Loch Ness over a 7.9 hour period. This equates to approximately 87 millimetre (mm) depth over the surface area of Loch Ness.

9.5.20 Behavioural analysis was undertaken based on normal and low water level in Loch Ness and Loch Dochfour. The analysis showed that water levels will recharge over a period of up to 12 days depending on the inflows into Loch Ness and the volume abstracted. This analysis assumes that the Development does not discharge within this period. This could lead to increased frequency in water levels falling below the Caledonian Canal operational levels and a more frequent need for inflows to be supplemented by SSE inflows from the wider catchment. Water levels in Loch Ness would have fallen below those where supplementary flows would be required based on full abstraction during the low water levels such as those experienced in 2018.

9.5.21 The impacts are short term as Loch Ness will return to baseline through the routing effect of the loch or by the release of water from the Headpond through the generation cycle.

Loch Ashie and Loch Duntelchaig

9.5.22 The Development is mostly located in the Loch Ness catchment but also partially located in the Loch Ashie and the Loch Duntelchaig catchments, as shown in Figure 9.2 (Volume 3). The Headpond is partially located within the Loch Ashie catchment. As a result any rainfall on that part of the catchment will fall into the Headpond, which discharges into Loch Ness. This part of the catchment, approximately 2.5% of the total Loch Ashie Catchment, will therefore be lost. However, the loss of catchment for Loch Duntelchaig is negligible and therefore is not considered further.

9.5.23 Based on behavioural analysis undertaken by Scottish Water as part of the Inverness & Nairn Water Resource Zone (WRZ) hydrology and water resource assessment it concluded that not all available storage in Loch Ashie is utilised. At the point when failure was occurring in Loch Duntelchaig a significant volume of water remained unused in Loch Ashie. All the available storage within Loch Ashie is therefore not currently utilised based on the current operating regime.

9.5.24 To address the shortfall in available yield during drought conditions resilience measures are being considered by Scottish Water to allow raw water to be pumped from Loch Ness to Inverness Water Treatment Works. The pumping arrangement has the capacity to pump the full demand requirement for the works and the supply from the two lochs will no longer be critical during drought conditions.

9.5.25 A review of flood risk based on a breach of the Headpond's northern Embankment into Loch Ashie shows that the loch can contain the flood flows without its dam crest being overtopped. The flood flows can then be conveyed over the Spillway in a controlled manner. The breach of the Headpond northern Embankment would therefore not

compromise the ability to use Loch Ashie as a raw water source for the water treatment works. The pumping station and key infrastructure at the reservoir are set above the reservoir level and would not be at risk of inundation.

Impact on the ability to maintain navigation within the Caledonian Canal

9.5.26 Abstraction of large volume of water from Loch Ness during low water levels would impact on the ability to maintain navigation within the Caledonian Canal and the need for the provision of supplementary inflows from others parts of the catchment. This is regarded as being a Major Impact. Mitigation has been considered in 9.7.4.

Decommissioning Effects

9.5.27 Decommissioning is explained in Section 2.16 of Chapter 2: Project and Site Description. It is assumed that the decommissioning of the Development will require similar activities to construction, potentially with additional crushing of some construction materials and removal of drainage pipework containing residual water and sediment. The attenuated water from the Headpond will be released into Loch Ness in line with normal operation parameters. The decommissioning of the Headpond will require that the works are designed and carried out to the satisfaction of an appropriately qualified reservoir engineer and certified as being discontinued under the Reservoir (Scotland) Act 2011. This will ensure that consideration of the Headpond's ability to both attenuate and convey flood flows in a safe manner are taken into account.

9.5.28 The Headpond is a non-impounding reservoir and therefore loss of storage will not have an impact on flood risk downstream. Compliance with the Reservoirs (Scotland) Act 2011 will ensure that the short term and temporary impacts of the decommissioning of the Development is **Negligible**.

9.6 Cumulative effects

9.6.1 Intra-relationship and inter-relationship cumulative effects have been considered as part of the FRA (Appendix 9.1, Volume 5) and water resource impact assessment (Appendix 9.2, Volume 5), and the results presented below.

Intra-Project Cumulative Effects

9.6.2 Intra-project effects due to component parts of the project being undertaken concurrently have been assessed as part of the assessment above. This assessment has been made on a worst-case precautionary approach, and therefore cumulative intra-project effects will not increase the magnitude or significance of effects on individual receptors.

9.6.3 There is the potential for intra-relationship effects between the assessment of water levels through the flood risk, water resource and the water environment assessments.

9.6.4 The impact of changes in water level as a result of the Development are Negligible both during construction and operation of the Development. The residual effect the Development has on the water environment and shared receptors as a result of these changes is considered to be **Negligible**.

9.6.5 No protected species or important and sensitive ecological receptors have been identified in water bodies across the Site and so these effects are considered to be **Negligible**.

Inter-Project Cumulative Effects

9.6.6 Inter-relationship cumulative effects have been assessed qualitatively where committed development is proposed that could have cumulative effects with water bodies that may be affected by the Development, either during construction or operation phases. However, it is anticipated that providing the same robust and rigorous approach to mitigation is applied to other schemes as this proposal, the potential for significant adverse cumulative effects is low.

9.6.7 The above assessment has taken in to account current operational arrangements for Loch Ness ensuring minimum water levels and hence navigation of the canal and pass forward environmental flows to the River Ness. It is assumed that all other developments will operate within these protocells.

9.6.8 There are other operational hydro power schemes utilising Loch Ness, in addition to the downstream Caledonian Canal. These are historic uses of Loch Ness and therefore form part of the baseline scenario.

9.7 Mitigation and Monitoring

9.7.1 During the construction phase, a Construction Environmental Management Plan (CEMP) will be implemented. Within the CEMP, the contents of an Emergency Response and Flood Risk Management Plan have been outlined (Section 4.4, Appendix 3.1, Volume 5). These measures will be implemented to avoid any adverse effects to the identified receptors.

9.7.2 Any surface water storage and attenuation ponds will be designed appropriately with the locations, type and size confirmed as part of the detailed design (as identified in Section 4 of the FRA, Appendix 9.1, Volume 5). These will be located appropriately and consider any downstream receptors or connectively with other water resources to avoid impacts to shared receptors. A drainage strategy will be prepared providing these details, building on the information requirements outlined in the FRA (Appendix 9.1, Volume 5) and submitted to THC for approval prior to construction.

9.7.3 During operation, increased flood risk as a result of increased flood levels in Loch Ness and downstream flows in the River Ness would be contrary to the guidance set out in the THC supplementary guidance. The detailed flood risk assessment undertaken as part of the River Ness flood protection scheme shows that areas upstream of the area defended by the flood protection scheme are at risk during events in excess of the current 1 in 10 year event. It is therefore proposed that generation is limited to a maximum water level in Loch Ness of 17.6 mAOD, the current day 1 in 10 year flood level.

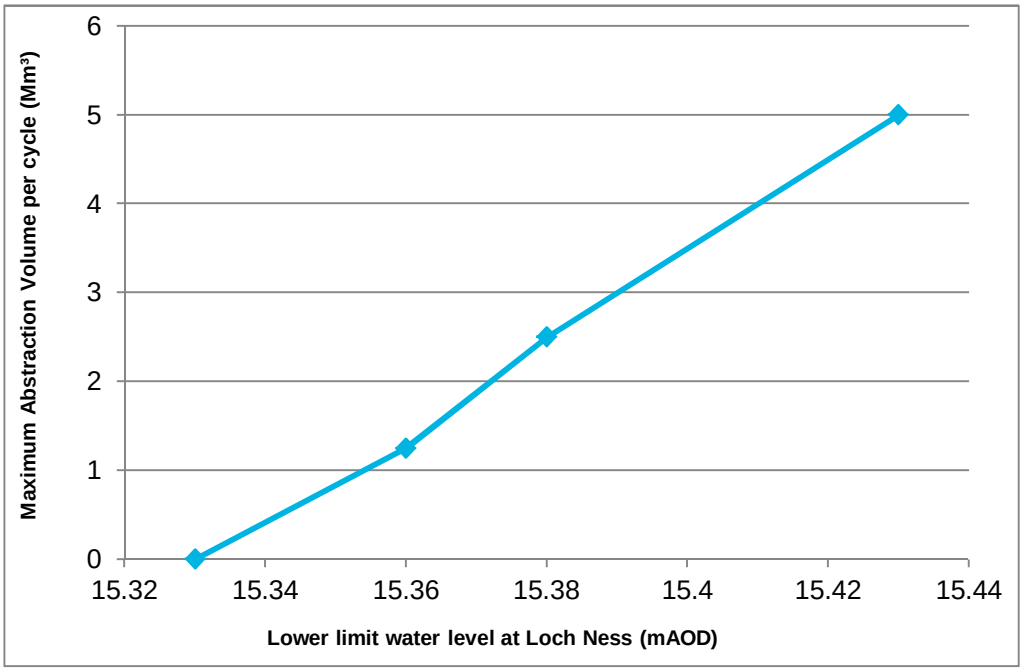
9.7.4 Abstraction of large volumes of water from Loch Ness during periods of low water levels could impact on the ability to maintain navigation within the Caledonian Canal. It would also compel others to supplement inflows from other parts of the catchment into Loch Ness as set out in the Caledonian Canal water manual. This is regarded as being a significant effect to water levels and the operation of the Canal.

9.7.5 It is therefore proposed that abstraction is limited based on a minimum water level in Loch Ness at the commencement of the abstraction cycle, further based on the proposed volume of abstraction. A monitoring arrangement and control procedures will be installed at the Inlet / Outlet structure on Loch Ness to measure water level at Loch Ness and to limit, or stop the abstraction of water if water level in Loch Ness falls below the levels set out in the

operational rules. The proposed operational rules for abstraction from Loch Ness are summarised in Table 9.7.

Table 9.7 Loch Ness abstraction proposed operational rules

Lower limit water level at Loch Ness at the start of the abstraction cycle (mAOD)	Maximum Abstraction Volume per cycle (Mm3)
15.43	5
15.38	2.5
15.36	1.25
15.33	0 (hands-off)



Insert 9.1 Graph of Loch Ness Abstraction Operational Rules

9.7.6 Any operational discharges or abstractions required by the Development will be controlled by the CAR licence, as regulated by SEPA. Therefore the appropriate operational levels for either activity will be agreed and secured via this regulatory regime.

9.7.7 The implementation of the above operation rules will ensure that the abstraction of water from Loch Ness will have negligible impact on available water resources.

9.8 Residual effects

9.8.1 With the implementation of the mitigation measures identified in Section 9.7 the impact of the Development on flood risk and water resources.

Table 9.8 Assessment Summary Table

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Offsite properties - High	Construction - Flooding due to: temporary increases in impermeable area and compacted ground; temporary water storage and increased flow due to dewatering activities.	Low	Implementation of CEMP. Suitable design of surface water drainage (Drainage Strategy)	Negligible	Not Significant
Onsite users - Medium	Construction - Flooding due to: temporary increases in impermeable area and compacted ground; temporary water storage and increased flow due to dewatering activities.	Low	Implementation of CEMP. Suitable design of surface water drainage (Drainage Strategy)	Negligible	Not Significant
Development - Low	Construction - Flooding due to: temporary increases in impermeable area and compacted ground; temporary water storage and increased flow due to dewatering activities.	Low	Implementation of CEMP. Suitable design of surface water drainage (Drainage Strategy)	Negligible	Not Significant
Loch Ness, River Ness and Caledonian Canal Water Level	Operation - discharge to Loch Ness under normal operation	Low	Implementation of operational parameters based on maximum level in Loch Ness for generation	Negligible	Not Significant
Offsite properties - High	Operation - risk of flooding from Headpond	Low	Implementation of operational parameters based on maximum level in Loch Ness for generation	Negligible	Not Significant
Onsite users - Medium	Operation - risk of flooding from Headpond	Negligible		Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Development Infrastructure Low	Operation - risk of flooding from Headpond	Negligible		Negligible	Not Significant
Offsite properties - High	Operation – Embankment breach		Maintenance of Headpond Embankment in line with the requirements as set out the inspections undertaken as part of the Reservoir (Scotland) Act 2011	Negligible	Not Significant
Onsite users - Low	Operation – Embankment breach		Maintenance of Headpond Embankment in line with the requirements as set out the inspections undertaken as part of the Reservoir (Scotland) Act 2011	Negligible	Not Significant
Development Infrastructure - Low	Operation – Embankment breach		Maintenance of Headpond Embankment in line with the requirements as set out the inspections undertaken as part of the Reservoir (Scotland) Act 2011	Negligible	Not Significant
Development - Low	Groundwater flooding	Negligible		Negligible	Not Significant
Loch Ness, River Ness and Caledonian Canal Water Level	Reduction in water levels in Loch Ness during low flows	High	Implementation of operational parameters based on minimum level in Loch Ness for abstraction	Low	Not Significant

9.9 References

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