Technical Appendix 7.3

Aquatic Ecology Report

SCOTTISHPOWER RENEWABLES

Table of contents

List of Appendices

1 Introduction

1.1 Project Background

1. ScottishPower Renewables (the Applicant) is proposing to construct and operate an extension to the operational Harestanes Windfarm, located 12km north of Dumfries, in Dumfries and Galloway (hereafter 'the Proposed Development'). The Proposed Development comprises an extension of eight turbines with a maximum height to blade tip of 200m and ancillary infrastructure (met masts, cabling, access roads, control building, crane pad locations and borrow pits).

2. The area encompassed by the Application Boundary (hereafter referred to as 'the Site') is located within the southern extent of the Forest of Ae. The Site is an existing commercial forest predominately covered by Sitka spruce *Picea sitchensis* plantation. Several watercourses transverse the Site and discharge into the Water of Ae to the south of the Site, with the largest being Glenkiln Burn near the centre of the Site. The Application Site is shown in **EIA Report Figure 1.2: Application Boundary**.

3. The operational Harestanes Windfarm is located directly north of the Proposed Development within the Forest of Ae and was constructed in 2014.

4. The Environmental Statement (ES) for the operational Harestanes Windfarm was produced in 2004 following surveys completed within 2002 and 2003 (Scottish Power, 2004a and Scottish Power, 2004b).

1.2 Ecological Background

5. No previous ecological surveys have been undertaken in relation to the Proposed Development.

6. The potential for fish species and their habitats to be affected by the Proposed Development mainly occurs during the construction phase of the development.

7. During the construction phase potential impacts include siltation from ground disturbance, accelerated or exacerbated erosion, hydrological changes, pollution, and the blocking or hindering of the upstream/downstream migration of fish.

8. These potential effects could all impact on any surrounding fish by causing direct mortality of juveniles and adults, changes in food availability, avoidance behaviour resulting in unused habitat, blocking of fish migration routes to spawning beds or the damage of instream and riparian habitats

1.3 Scope of Report

9. This appendix presents the methods and results of the aquatic ecology desk study and baseline surveys for the Proposed Development. This report covers the initial aquatic ecology walkover habitat surveys, quantitative electrofishing surveys and subsequent fish habitat surveys.

10. This report does not include ornithological, riparian mammals, bat, badger *Meles meles*, National Vegetation Classification (NVC) or arboreal mammal survey results which are all contained within separate appendices.

11. Photographs of the Site are included in **Appendix A** and relevant legislation is outlined within **Appendix B**.

1.4 Aims

12. The aims of this work were to carry out the following for watercourses that are likely to be affected by the Proposed Development:

- identify watercourses within the Site that have the potential to support fish and are suitable for electrofishing;
- undertake electrofishing surveys in suitable watercourses;
- undertake a Scottish Fisheries Co-ordination Centre (SFCC) fish habitat survey at each electrofishing survey location;
- provide baseline ecological information with reference to whether legally protected and/or notable fish species or habitats are present within each watercourse; and
- provide recommendations for appropriate avoidance, mitigation, compensation and/or ecological enhancement measures.

2 Methods

2.1 Desk Study

13. A desk study was undertaken in April 2020 to review existing ecological baseline information available in the public domain and to obtain information held by relevant third parties.

14. Information on the location of fish records was provided by Forestry and Land Scotland (FLS) and the Annan District Salmon Fisheries Board (ADSFB).

2.2 Walkover Habitat Surveys

15. An initial Aquatic Walkover Habitat Survey was carried out in accordance with SFCC habitat training manual (SFCC, 2007) in order to identify suitable fish habitat and to scope for electric fishing locations throughout the Site. This survey included an assessment of water depth; channel, bank and bed widths; flow, substrate composition; and bank characteristics of all watercourses draining the Site which appear on Ordinance Survey (OS) mapping. The vegetation types present, along with percentage canopy cover and percentage fish cover, were also recorded to assess overall habitat suitability for fish.

16. To date there have been no recent records of freshwater pearl mussel (FWPM) within the Annan catchment. However, during the initial aquatic ecology walkover habitat survey, watercourse suitability in terms of supporting FWPM was also assessed. This included (but was not limited to) a review of the following parameters:

- flow type;
- substrate;
- in-channel vegetation;
- shading; and
- turbidity/levels of suspended sediment.

17. The initial Aquatic Walkover Habitat Survey Area evolved in response to iterations to the Proposed Development during the design stage. The minimum Walkover Survey Area for the walkover habitat surveys was defined as follows and is shown **EIA Report Figure 7.4 Aquatic Ecology Survey Locations and Results.**

- proposed turbine locations and access tracks (new and existing which are proposed to be upgraded) and other infrastructure plus a minimum buffer of 200m upstream and downstream of crossing points; and
- cable route plus a minimum buffer of 100m upstream and downstream of crossing points.

2.3 Electrofishing Surveys

18. Electrofishing is the term applied to a process that establishes an electric field in the water in order to capture fish. When exposed to the field, most fish become oriented toward the anode and as the density of the electric field increases they swim toward it. In close proximity to the anode, they are immobilised.

19. Electrofishing followed a standard electric fishing method and technique following guidelines developed by the SFCC which underpin the National Electrofishing Programme for Scotland (Scottish Government, 2019).

20. Electrofishing was Scoped In for watercourses that were assessed as providing suitable habitat to support salmonids and where there was considered to be a potential for effects arising from the Proposed Development.

21. Electrofishing was carried out with ADSFB and Marine Scotland authorisation by a two-person fishing team who waded each watercourse whilst sampling with an E-Fish 500W Backpack System.

22. Electrofishing survey locations are displayed in **EIA Report Figure 7.4.**

23. Each surveyed section was isolated using stop nets and was fished multiple times until a depletion of fish was noted. On each survey run, the fishing team of two worked in an upstream direction, with one surveyor moving the anode to “draw” fish towards the current. The second surveyor removed immobilised fish from the electrical field with the use of a dipnet.

24. Sampled fish were transferred to an aerated container from which they were identified to species level, measured from the tip of their snout to the end of the middle caudal fin rays (fork length); before being returned safely to the watercourse.

25. Once electrofishing had ceased, a bankside and habitat survey was carried out in accordance with SFCC methods. Each survey included an assessment of water depth; channel, bank and bed widths; flow, substrate composition; and bank characteristics of the watercourse. The vegetation types present, along with percentage canopy cover and percentage fish cover, were also recorded.

26. Measurements of water temperature, conductivity, dissolved oxygen and pH were obtained at each survey location using a calibrated YSI Pro DSS multiparameter meter.

2.4 Data Analysis

27. Fish population estimates were calculated using the “constant p” method (p for probability of capture), which is also known as Zippin’s method (Zippin 1956; Zippin 1958), within “Removal Sampling 2” data analysis software (Seaby and Henderson, 2007).

28. Zippin’s method is considered to give an accurate estimate of fish population size providing the following criteria is met:

- The catching procedure must not lower (or increase) the probability of an animal being caught.
- The population must remain stable during the trapping or catching period; there must not be any significant natality, mortality (other than by the trapping) or migration. The experimental procedure must not disturb the animals so that they flee from the area.
- The population must not be so large that the catching of one member interferes with the catching of another.
- The chance of being caught must be equal for all animals.

29. It should be noted that during electrofishing smaller individuals are more difficult to stun, and that individuals occupying territories under banks or other obstructions may be particularly difficult to catch. It is for this reason that population estimates have been made for each size class of each species as opposed to the fish population as a whole. This ensured that all criteria for applying the Zippin’s method is met.

30. Once fish popualtion estimates were calcualted, the densities of fish per 100/m^2 were calculated and graded. Fish densities were graded using a mulitple run grading sysyem that was established by using ADSFB‘s historical fisheries data set.

31. The grading system is based on the work of Jason Godfrey of Marine Scotland using quintile ranges for numbers of 0+ salmon, 1++ salmon, 0+ brown trout, and 1++ brown trout. This information was used to classify each site on the scale shown in **Table 1** below. The numbers of fish per 100/m^2 generated by this method are shown in **Table 2**.

Minimum density figure quintile ranges	Classification
>80th percentile to max	Excellent
>60th percentile to <80th percentile	Good
>40th percentile to <60th percentile	Fair
>20th percentile to <40th percentile	Poor
>20th percentile to <40th percentile	Very Poor
Zero	Absent

Table 1 – Classification scale of fish density quantile ranges.

Percentile	0+ salmon	1++ salmon	0+ brown trout	1++ brown trout
Minimum	0.75	0.36	0.38	0.36
20th	6.65	2.92	7.53	4.01
40th	19.74	6.66	20.29	8.28
60th	45.23	11.16	41.96	16.09
80th	96.23	19.11	82.08	29.05
Maximum	409.23	118.33	417.72	173.83

Table 2 – Number of fish per m^2 percentiles for 0+ salmon, 1++ salmon, 0+ brown trout, and 1++ brown trout for watercourese within the River Annan catchment.

2.5 Dates of Surveys and Personnel

32. The initial Aquatic Walkover Habitat Surveys were completed by an SFCC habitat walkover trained surveyor between 15 July and 24 July 2020 and further day of walkover habitat surveys were completed on the 14 September along the proposed cable route.

33. Electrofishing surveys and subsequent fish habitat surveys were carried out by a two-person team who hold the relevant SFCC electrofishing accreditations (a principal ecologist who holds the team leader accreditation and a graduate ecologist who holds the operative accreditation).

34. Electrofishing was carried out with Marine Scotland authorisation (who granted a Closed Season and Method Licence, application reference CSM-20-136) and with the consent of ADSFB and the relevant landowner.

35. All electrofishing surveys were completed on 8 September 2020.

2.6 Notes and Limitations

36. Every effort has been made to provide a comprehensive description of the survey area; however, the following specific limitations apply to this assessment:

- Ecological survey data is typically valid for up to three years unless otherwise specified (CIEEM, 2019). The likelihood of surveys needing to be updated increases with time and is greater for mobile species or in circumstances where the habitat or its management has changed significantly since the surveys were undertaken. Factors to be considered include (but are not limited to): whether a site supports, or may support, a mobile species which could have moved on to site, or changed its distribution within a site (CIEEM, 2019).
- Water flows for all electrofishing surveys were above base flow levels. It is therefore it is likely that capture efficiency may be below what would have been obtained under optimum conditions.
- Low water conductivity is likely to result in the reduced electrofishing capture efficiency of small fish (<100mm in length). Therefore, the densities of juvenile fish may be underestimated under such conditions.

3 Results

3.1 Desk Study

37. Data from three electrofishing survey sites in watercourses that were within or as close as possible downstream of the Site were obtained from the Applicant from previous monitoring surveys carried out for the operational Harestanes Windfarm site. Fish densities were graded as either Absent (A), Very Poor (VP), Poor (P), Fair (F), Good (G), and Excellent (E). The details of these surveys are summarised in **Table 3** below.

Site	Year of Survey	Proximity to Site	NGR	Species							
				Salmon fry *Salmo salar*		**Salmon parr**		**Trout fry** *Salmo trutta*		**Trout parr**	
				Density (≈n/100 m^2)	Score *	Density (≈n/100 m^2)	Score	Density (≈n/100 m^2)	Score	Density (≈n/100 m^2)	Score
Glenkiln Burn	2015	Within Site	NY 01025 92315	0	A	0	A	2.58	VP	2.58	VP
Glenkiln Burn	2016	Within Site	NY 01025 92315	0	A	0	A	17.87	F	6.37	P
Garrel Water	2015	0.2km	NY 04400 90100	0	A	0	A	40.15	G	0.680	VP
Garrel Water	2016	0.2km	NY 04400 90100	0	A	0	A	2.549	VP	14.033	F
Deer Burn	2015	Within Site	NY 00800 96600	0	A	0	A	1.09	VP	0	A
Deer Burn	2016	Within Site	NY 00800 96600	0	A	0	A	15.65	P	2.85	VP

*Fish densities were graded as either Absent (A), Very Poor (VP), Poor (P), Fair (F), Good (G), or Excellent (E).

Table 3 - Summary of electrofishing data collected by Annan District Salmon Fisheries Board.

3.2 Initial Aquatic Ecology Habitat Walkover Surveys

38. Fifteen watercourses within the Site were assessed during the initial Aquatic Walkover Habitat Surveys. Five watercourses were identified for electrofishing surveys. These watercourses were assessed as having potential suitability to support populations of juvenile and adult salmonids within the Site and were a representation of the types of watercourse present throughout the Site (**Table 4**).

Site	Description	Substrates	Depth (cm)	Flow Characteristics	Bank Characteristics	Notes
Glenkiln Burn (Central Grid Reference (CGR): NY 01125 92464)	An upland burn (Appendix A: Photograph 1) situated in a deep cut valley with a diverse riparian structure. The watercourse was constant with a series of meanders and a variety of flow and substrate types. Widespread habitat suitability was identified within the watercourse for juvenile and adult salmonids with localised areas available for spawning.	Silt (5%), gravel (5%), pebble (15%), cobble (50%) and boulders (25%). The substrate was stable and uncompacted.	11 to 40	Still margin (10%), shallow glides (60%) and runs (40%)	The banks of the surveyed section were lined with draped vegetation (60%). The banks were also undercut in areas. (15%).	Scoped in for fish survey due to the presence of suitable fish habitat and potential for effects arising from the Proposed Development.
Rough Cleuch (CGR:NY 01003 92457)	Fast flowing upland burn (Appendix A: Photograph 2). The upper reaches of the watercourse flowed through a steep sided ride and at the lower reaches the watercourse converged with Glenkiln burn. Riparian vegetation mainly semi-mature scattered conifers with glades bordered by willow and silver birch.	Silt (10%), sand (5%), gravel (10%), pebble (15%), cobble (40%) and boulders (20%). The substrate was partly compacted and stable.	<10 to 30	Still margin (5%), shallow pools (10%), deep pools (30%), shallow glides (20%), deep glides (5%), runs (10%) and riffles (20%)	The banks of the surveyed section were lined with draped vegetation (45%). The banks were also undercut in areas (40%).	Scoped in for fish survey due to the presence of suitable fish habitat and perceived potential for effects arising from elements of the Proposed Development at the time of survey.
Clachanbirnie Burn (CGR:NY 00458 92163)	Upland burn running through (Appendix A: Photograph 3) a mature forest ride. Generally linear in channel structure with occassional meanders. A perched culvert (8m in length) and a small cascade (1.3m) were recorded downstream of the surveyed area. Substrate conditions were unsuitable for spawning fish due to the partly compacted nature of the surbstrate. However, localised suitable juvenille habitat was present within the watercourse provided by bankside cover and draped vegetation.	Silt (15%), sand (10%), gravel (20%), pebble (10%), cobble (30%) and boulders (15%). The substrate was partly compacted and stable.	<10 to 50	Still margin (5%), shallow pools (10%), shallow glides (40%), runs (20%) and riffles (25%)	The banks of the surveyed section were lined with draped vegetation (35%). The banks were also undercut in areas (20%). Bare soil was also exposed in localised sections (5%)	Scoped in for fish survey due to the presence of suitable habitat and perceived potential for effects arising from elements of the Proposed Development at the time of survey. A perched culvert was present downstream of the scoped area (Appendix A: Photograph 4) which was assessed as a possible barrier to fish movement.
Yellowtree Grain (CGR:NY 03266 92973)	An upland burn (Appendix A: Photograph 5) that passed through an immature conifer plantation. The watercourse had ocassional meanders and was close to the source.The watercourse was characterised by riffles and steep vegetated banksides. There was a perched culvert downstream of the scoped area (8m in length).	Sand (2%), gravel (10%), pebble (40%), cobble (30%) and boulder (18%). The substrate was partly compacted and stable.	<10 to 30	Still margin (5%), shallow pools (15%), deep pools (2%), shallow glides (5%),	The banks of the surveyed section were lined with draped vegetation (40%). The banks were also undercut in areas (15%). Bare soil was also exposed in localised sections (4%).	Scoped in for fish survey due to the presence of suitable habitat and perceived potential for effects arising from elements of the Proposed Development at the time of survey. A perched culvert was present downstream of the scoped area (Appendix A: Photograph 6) which was assessed as a possible barrier to fish movement.
Garrel Water (CGR:NY 03310 92564)	An upland fast flowing burn (Appendix A: Photograph 5) meandering through clear felled woodland. The watercourse was characterised by vegetated banks. Several small waterfalls were recorded in the upper reaches of this watercourse.	Sand (2%), gravel(8%), pebble (35%), cobble (40%), and boulders (15%).The substrate was partly compacted and stable.	<10 to 30	Still margin (1%), shallow glides (45%), runs (25%) and riffles (29%).	The banks of the surveyed section were lined with draped vegetation (20%). The banks were also undercut in areas (16%). Bare soil (6%) and marginal vegetation (10%) in localised sections.	This watercourse was scoped out for fish survey due to steep sided banks that would have made electric fishing unsafe. Addtionally, a series of cascades were present within this watercourse which were assessed as a barrier to fish movement. There is not considered to be potential for effects arising from the Proposed Development due to distance from Proposed Development elements.

Site	Description	Substrates	Depth (cm)	Flow Characteristics	Bank Characteristics	Notes
Killyminshaw Burn (CGR: NY 01528 92851)	Medium flow upland burn running through felled plantation area (Appendix A: Photograph 7). The watercourse cascaded down a hillside before forming a confluence with Glenkiln Burn.	Silt (5%), sand (5%), pebble (20%), cobble (60%), boulder (10%) The substrate was partly compacted and stable.	<10 – to 20	Still margin (10%) shallow pools (30%) and riffle (60%)	The banks of the surveyed sections were bare (60%) with draped vegetation present on banktops (25%).	Scoped out for fish survey due to a series of narrow, vertical cascades (Appendix A: Photograph 8) leading towards Glenkiln burn that were assessed as impassable to fish.
Castletrough Burn (CGR: NY 01074 91880)	Medium flow upland burn running through felled plantation area (Appendix A: Photograph 9). The watercourse cascaded down a hillside before forming a confluence with Glenkiln Burn.	Silt (5%), sand (10%), gravel (15%), pebble (20%), cobble (40%), boulder (10%) The substrate was partly compacted and stable.	<10 – to 20	Still margin (20%) shallow pools (30%) and riffle (60%)	The banks of the surveyed sections were bare (60%) with draped vegetation present on banktops (25%).	Scoped out for fish survey due to a series of narrow, vertical cascades leading towards Glenkiln burn that were assessed as impasable to fish.
Deer Burn (CGR: NY 00819 96590)	An upland burn (Appendix A: Photograph 13) that flowed through mature plantation woodland. The watercourse was crossed by two clear span structures (Appendix A: Photograph 14) at the scoped area; one that supported a forestry track and the other which housed cabling for the existing windfarm.	Sand (5%), gravel (5%), pebble (25%), cobble (55%) and boulder (10%). The substrate was uncompacted and stable.	10 to 20	Still margin (5%), shallow glide (60%), shallow pools (10%) and runs (25%).	The banks of the surveyed section were lined with draped vegetation (10%) The banks were also undercut for the majority of the stretch (70%).	Suitable fish habitat however electrofishing Scoped out at this stage as the only element of the Proposed Development in the vicinty is the proposed cable route which is likely to be attached to an existing clearspan srtucture and not involve intrusive works within the channel or banks. Future fish survey may be required once the exact method and location of cable crossing is determined.
Blenoch Burn (CGR: NY 01071 96177)	An upland burn (Appendix A: Photograh 15) that flowed adjacent to a forestry track and eventually through a pipe-arch culvert before (Appendix A: Photograph 16) converging with Deer burn.	Gravel (5%), pebble (10%), cobble (60%), and boulder (25%). The substrate was partly compacted and stable.	10 to 20	Still margin (5%), shallow glides (15%) and runs (80%).	The banks of the surveyed section were lined with draped vegetation (60%). The bnks were also undercut in areas (15%).	Suitable fish habitat however electrofishing Scoped out at this stage as the only element of the Proposed Development in the vicinty is proposed cable route which is likely to within or or directly adjacent to the existing access track, and not involve intrusive works within the channel or banks. Future fish survey may be required once the exact method of cable crossing is determined.
Cat Cleuch (CGR: NY 02486 92360)	A small and narrow headwater with no visible wetted area (Appendix A: Photograph 17). This watercourse was mainly characterised by overgrown bankside vegetation, poor connectivity and a lack of channel structure. A perched culvert (Appendix A: Photograph 18) was present in the scoped area (spanning c. 10m) where the main forestry track crossed this watercourse.	NA	NA	NA	NA	Scoped out for fish survey due to limited fish habitat suitability and a perched culvert which was assessed as being impassable to fish at the forestry track crossing (Appendix A: Photograph 18)
Black Linn (CGR: NY 02926 90987)	A small headwater (Appendix A: Photograph 19) mainly characterised by overgrown bankside vegetation, poor connectivity and poor substrate heterogeneity. A pipe culvert (Appendix A: Photograph 20) was present in the scoped area (c. 10m in width) where the main forestry track crossed this watercourse.	NA	NA	NA	NA	Scoped out for fish survey due to limited fish habitat suitability.
Tor Linn (CGR: NY 02916 91255)	A small and narrow headwater with no visible wetted area. The headwater was mainly characterised by overgrown bankside vegetation, poor connectivity and	NA	NA	NA	NA	Scoped out for fish survey due to limited fish habitat suitability and a perched culvert which was assessed as being impassable to fish at

Site	Description	Substrates	Depth (cm)	Flow Characteristics	Bank Characteristics	Notes
	a lack of channel structure. A perched culvert (Appendix A: Photograph 21) was present in the scoped area (spanning c. 10m) where the main forestry track crossed this watercourse.					the forestry track crossing (Appendix A: Photograph 21)
Auchencaigroch Burn (CGR: NY 02114 94307)	A modified upland burn that flowed through imature plantation woodland (Appendix A: Photograph 22). The watercourse flowed through a arch-pipe culvert underneath the main forestry track on Site Appendix A: Photograph 23). The watercourse was characterised by modified banksides, in-channel vegetation (Appendxix A: Photograph 24) and a man-made allignment. Downstream of the culvert, the watercourse eventually converged with Glenkiln Burn.	NA	NA	NA	NA	Scoped out due to limited fish habitat suitability.
Auchendowal Sike (CGR: NY 00996 94110)	A small headwater (Appendix A: Photograph 25) mainly characterised by overgrown bankside vegetation and poor connectivity. A narrow pipe culvert (Appendix A: Photograph 26 was present in the scoped area (c. 10m in width) where the main forestry track crossed this watercourse.	NA	NA	NA	NA	Scoped out for fish survey due to limited fish habitat suitability.
Shiel Cleuch (CGR: NY 00964 96560)	Small headwater running underneath and adjacent to main forestry track. The headwater was mainly characterised by overgrown bankside vegetation and poor connectivity (Appendix A: Photograph 27). The watercourse eventually converged with Deer burn downstream of scoped area.	NA	NA	NA	NA	While fish may utilize habitat at the confluence area with Deer burn, the watercourse was scoped out for fish survey due to limited fish habitat suitability and restricted connectivity further upstream of the confluence.

Table 4 – Results of the initial aquatic ecology walkover surveys of watercourses located within the Site of the Proposed Development. Surveys were carried out between 15 July and 24 July 2020.

40. The details of the sections of each watercourse that were identified as being suitable for fish surveys are presented in **Table 5**.

Site	Upstream NGR	Downstream NGR	Survey lenth (m)	Width (m)	Area (m^2)
Glenkiln Burn - Upstream	NY 02215 93966	NY 02180 93972	39.00	2.80	109.2
Glenkiln Burn - Downstream	NY 01115 92455	NY 01097 92435	28.00	3.80	106.4
Rough Cleuch	NY 01029 92398	NY 01057 92387	33.00	1.30	42.9
Clachanbirnie Burn	NY 00499 92010	NY 00527 91978	48.00	2.20	105.6
Yellowtree Grain	NY 03222 93410	NY 03224 93373	37.00	1.00	37.0

Table 5 – Details of the sections of each watercourse that were identified during initial aquatic habitat surveys, carried out between 15 and 24 July 2020, as being suitable for electrofishing surveys.

41. No FWPM or their shells were observed during the initial aquatic walkover surveys. The prevailing habitat across the Site was considered sub-optimal in terms of supporting FWPM; particularly in the larger watercourses that drained the Site, namely Glenkiln Burn. While suitable substrates, including localised areas of stabilized gravel, were available, this watercourse appeared subject to fluctuating water levels and velocity, reducing the overall stability of substrates which FWPM require to colonise. There were also low densities of trout (as the host species) within the surveyed areas.

42. In the smaller tributaries and headwaters that were surveyed, habitat requirements for FWPM were not met due to absence of suitable substrates, acidity of watercourse (namely Yellowtree Grain), historic evidence of in-stream disturbance (culverting, bankside modification and alignment) and the absence of salmonids as a host species for FWPM.

3.3 Electrofishing and Fish Habitat Surveys

3.3.1 Glenkiln Burn - Upstream

43. A total of six brown trout, measuring between 67 and 135mm (all 1++ years old), were caught during a three-run electrofishing survey at the Glenkiln Burn - Upstream survey location (**Table 6**).

Species	Run 1	Run 2	Run 3
Brown trout	111, 118, 122	67, 135	128

Table 6 – Lengths of brown trout *Salmo trutta* caught during each sampling run during a three-run electrofishing survey at the Glenkiln Burn – Upstream survey location, carried out on 8 September 2020.

44. The estimated 1++ year old brown trout population of the 109.2m^2 survey area was eight, with lower and upper 95% confidence intervals of six and 14 respectively (**Table 7**). The density of fish was calculated to be equal to or greater than 7.3 individuals per 100m^2 (**Table 7**).

45. The probability of an individual 1++ year old brown trout being caught during each sampling run was 0.41 (**Table 7**) This exceeds 0.40, which represents the sampling efficiency required to give a robust estimate of population size (Stewart *et al*., 2019).

Brown trout (1++)	Value
Estimated population (≈n)	8
Lower 95% confidence interval	6
Lower 95% confidence interval	14
Standard error	3.5
Probability of capture	0.41
Fish density (≈n/100m^2)	≥7.3
Minimum fish density grading	Poor

Table 7 – Brown trout Salmo trutta (1++) population and density estimates for Glenkiln Burn – Upstream, calculated using Zippin's method. The probability of an individual fish being captured during each sampling run, along with the standard error and lower and upper confidence intervals of the population estimate are also displayed.

46. The mean wet width of the watercourse at this location was 2.8m. The mean depth of water was 25cm with a maximum of 45cm.

47. Instream substrate consisted of cobble (50%), boulder (20%), sand (10%), gravel (10%) and pebble (10%). The substrate was free of silt, stable and uncompacted.

48. Flow types present were varied, consisting of shallow glides (35%), runs (35%), riffles (10%), a deep pool (10%) and still margins (10%). The surrounding land use close to the burn was moorland heath surrounded by coniferous forest.

49. Fish habitat was of moderate quality with cover provided by undercut banks (20%), and draped margins (70%).

50. The physico-chemical properties of the water at the Glenkiln Burn - Upstream survey location is displayed in **Table 8.**

Parameter	Value
Temperature (°C)	12.7
Conductivity (µS/cm^{-1})	30
Dissolved oxygen (% saturation)	97.8
Dissolved oxygen (mg/l)	10.38
pH	6.92

Table 8 – The physico-chemical properties of the water sampled at the Glenkiln Burn – Upstream survey location on 8 September 2020

3.3.2 Glenkiln Burn - Downstream

51. A total of seven brown trout, measuring between 96 and 165mm (all 1++ years old), were caught during a four-run electrofishing survey at the Glenkiln Burn - Downstream survey location (**Table 9**).

Species	Run 1	Run 2	Run 3	Run 4
Brown trout	96, 114, 139, 165	154	116, 160	-

Table 9 – Lengths of brown trout *Salmo trutta* caught during each sampling run during an electrofishing survey at the Glenkiln Burn – Downstream survey location, carried out on 8 September 2020.

52. The estimated 1++ year old brown trout population of the 106.4m^2 survey area was eight, with lower and upper 95% confidence intervals of seven and nine respectively (**Table 10**). The density of fish was calculated to be equal to or greater than 7.5 individuals per 100m^2 (**Table 10**).

53. The probability of an individual 1++ year old brown trout being caught during each sampling run was 0.51 (**Table 10**). This exceeds 0.40, which represents the sampling efficiency required to give a robust estimate of population size (Stewart *et al*., 2019).

Brown trout (1++)	Value
Estimated population (≈n)	8
Lower 95% confidence interval	7
Lower 95% confidence interval	9
Standard error	1.0
Probability of capture	0.51
Fish density (≈n/100m^2)	≥7.5
Minimum fish density grading	Poor

Table 10 – Brown trout *Salmo trutta* (1++) population and density estimates for Glenkiln Burn – Downstream, calculated using Zippin's method. The probability of an individual fish being captured during each sampling run, along with the standard error and lower and upper confidence intervals of the population estimate are also displayed.

54. The mean wet width of the watercourse at this location was 3.8m. The mean depth of water was 20cm with a maximum of 30cm.

55. Instream substrate consisted of cobble (35%), boulder (30%), pebble (20%), gravel (10%) and sand (5%). The substrate was free of silt, stable and uncompacted.

56. Flow types present were varied, consisting of runs (70%), riffles (25%), and still margins (5%). The surrounding land use close to the watercourse was moorland heath surrounded by coniferous forest.

57. Fish habitat was of moderate quality with cover provided by undercut banks (40%), draped margins (60%) and rocks (15%).

58. The physico-chemical properties of the water at the Glenkiln Burn - Downstream survey location is displayed in **Table 11**.

Parameter	Value
Temperature (°C)	12.6
Conductivity (µS/cm$^{-1)}$	30
Dissolved oxygen (% saturation)	100
Dissolved oxygen (mg/l)	10.78
pH	7.19

Table 11 – The physico-chemical properties of the water sampled at the Glenkiln Burn – Downstream survey location on 8 September 2020.

3.3.3 Rough Cleuch

59. A total of 11 brown trout, measuring between 67 and 135mm were caught during a three-run electrofishing survey (**Table 12**).

60. Four of the fish caught were 0+ years old, measuring between 48 and 54mm, whilst seven were 1++ years old, measuring between 83 and 95mm.

Species	Run 1	Run 2	Run 3
Brown trout	48, 49, 53, 54, 83, 83, 86, 90, 95, 95	95	-

Table 12 - Lengths of brown trout *Salmo trutta* caught during each sampling run during an electrofishing survey at the Rough Cleuch survey location, carried out on 8 September 2020.

61. The estimated 0+ year old brown trout population of the 42.9m^2 survey area was four, with lower and upper 95% confidence intervals also of four (**Table 13**). The density of fish was calculated to be equal to or greater than 9.9 individuals per 100m^2 (**Table 13**).

62. The probability of an individual 0+ year old brown trout being caught during each sampling run was 0.99 (**Table 13**). This exceeds 0.40, which represents the sampling efficiency required to give a robust estimate of population size (Stewart *et al.*, 2019).

Brown trout (0+)	Value
Estimated population (≈n)	4
Lower 95% confidence interval	4
Lower 95% confidence interval	4
Standard error	0.0
Probability of capture	0.99
Fish density (≈n /100m^2)	≥9.9
Minimum fish density grading	Poor

Table 13 – Brown trout *Salmo trutta* (0+) population and density estimates for Rough Cleuch, calculated using Zippin's method. The probability of an individual fish being captured during each sampling run, along with the standard error and lower and upper confidence intervals of the population estimate are also displayed.

63. The estimated 1++ year old brown trout population of the 42.9m^2 survey area was seven, with lower and upper 95% confidence intervals also of seven (**Table 14**). The density of fish was calculated to be equal to or greater than 17.4 individuals per 100m^2 (**Table 14**).

64. The probability of an individual 1++ year old brown trout being caught during each sampling run was 0.87 (**Table 14**). This exceeds 0.40, which represents the sampling efficiency required to give a robust estimate of population size (Stewart *et al.*, 2019).

Brown trout (1++)	Value
Estimated population (≈n)	7
Lower 95% confidence interval	7
Lower 95% confidence interval	7
Standard error	0.1
Probability of capture	0.87
Fish density (≈n /100m^2)	≥17.4
Minimum fish density grading	Good

Table 14 – Brown trout *Salmo trutta* (1++) population and density estimates for Rough Cleuch, calculated using Zippin's method. The probability of an individual fish being captured during each sampling run, along with the standard error and lower and upper confidence intervals of the population estimate are also displayed.

65. The mean wet width of the watercourse at this location was 1.3m. The mean depth of water was 18cm with a maximum of 30cm.

66. Instream substrate consisted of pebble (40%), cobble (30%), gravel (20%), boulder (5%) and sand (5%). The substrate was free of silt, stable and party compacted.

67. Flow types present were varied, consisting of runs (40%), riffles (30%), shallow pools (25%) and still margins (5%). The surrounding land use close to the watercourse was moorland heath surrounded by coniferous forest.

68. Fish habitat was of good quality with cover provided by undercut banks (85%), draped margins (85%), tree roots (5%) and rocks (5%).

69. The physico-chemical properties of the water at the Rough Cleuch survey location are displayed in **Table 15.**

Parameter	Value
Temperature (°C)	10.6
Conductivity (µS/cm^{-1})	75
Dissolved oxygen (% saturation)	100
Dissolved oxygen (mg/l)	11.31
pH	7.86

Table 15 – The physico-chemical properties of the water sampled at the Rough Cleuch survey location on 8 September 2020.

3.3.4 Clachanbirnie Burn

70. No fish were caught during a two-run electrofishing survey of a 105.6m^2 section of Clachanbirnie Burn.

71. The mean wet width watercourse at this location was 2.2m. The mean depth of water was 16cm with a maximum of 30cm.

72. Instream substrate consisted of cobble (40%), boulder (40%), pebble (10%) and gravel (5%). The substrate was free of silt, stable and party compacted.

73. Flow types present were varied, consisting of runs (40%), riffles (30%), a shallow pool (10%), shallow glides (10%), torrent (5%) and still margins (5%). The surrounding land use close to the watercourse was moorland heath surrounded by coniferous forest.

74. Fish habitat was of good quality with cover provided by undercut banks (50%), draped margins (90%) and tree roots (10%).

75. The physico-chemical properties of the water at the Clachanbirnie survey location are displayed in **Table 16**.

Parameter	Value
Temperature (°C)	11.6
Conductivity (µS/cm^{-1})	43
Dissolved oxygen (% saturation)	100
Dissolved oxygen (mg/l)	11.01
pH	7.7

Table 16 – The physico-chemical properties of the water sampled at the Clachanbirnie survey location on 8 September 2020.

3.3.5 Yellowtree Grain Burn

76. No fish were caught during a two-run electrofishing survey of a 37m^2 section of Yellowtree Grain Burn.

77. The mean wet width watercourse at this location was 1.0m. The mean depth of water was 8cm with a maximum of 20cm.

78. Instream substrate consisted of pebble (50%), cobble (30%), gravel (10%), sand (5%) and boulder (5%). The substrate was free of silt, stable and uncompacted.

79. Flows type present were varied, consisting of runs (80%), shallow pools (10%), riffles (5%) and still margins (5%). The surrounding land use close to the watercourse was moorland heath surrounded by coniferous forest.

80. Fish habitat was of moderate quality with cover provided by undercut banks (10%) and draped margins (50%).

81. The physico-chemical properties of the water at the Yellowtree Grain Burn survey location are displayed in **Table 17.**

Parameter	Value
Temperature (°C)	12.6
Conductivity (µS/cm^{-1})	24
Dissolved oxygen (% saturation)	99.5
Dissolved oxygen (mg/l)	10.58
pH	5.3

Table 17 – The physico-chemical properties of the water sampled at the Yellowtree Grain survey location on 8 September 2020.

4 Conclusions

82. Electrofishing surveys found a good density of 1++ year old brown trout were present at Rough Cleuch survey location. A poor density of trout fry (0+ year old fish) were also present at this location.

83. Poor densities of 1++ year old brown trout were found to be present at the Glenkiln Burn – Upstream and Glenkiln Burn – Downstream survey locations.

84. No brown trout fry were caught during electrofishing surveys of Glenkiln Burn. It is possible this is a result the low water conductivity and of small fish not being effectively immobilised.

85. Two of the sections of watercourses surveyed were found to contain no fish, these being Clachanbirnie Burn and Yellowtree Grain Burn.

86. Brown trout are listed on the Scottish Biodiversity List (SBL). The SBL is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. The Nature Conservation (Scotland) Act 2004 places a statutory duty on all public sector bodies in Scotland to further the conservation of biodiversity. Therefore, brown trout are an important ecological consideration in relation to the Proposed Development.

87. In order to help maintain baseline fish populations a fish monitoring programme should be implemented that compares changes in densities pre-construction, during construction and post-windfarm construction with the baseline. These annual surveys should be undertaken between July and October for at least one year after all construction and restoration has been complete. These surveys may also need to include surveying of Deer Burn and Blenoch Burn once further detail on the methods and locations of cabling routes are determined.

88. Conductivity of the water sampled at all survey locations was low (≤75). This indicates the presence of low levels of dissolved minerals, including calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$), and therefore a low pH buffering capacity.

89. Due to the sensitivity of the watercourses to pH changes, tree felling operations associated with the Proposed Development should be kept to a small an area as possible.

90. Felled areas should, where possible, be promptly revegetated following works to minimise the risk of base cations and nutrients leaching from the soil and consequently lowering the pH of nearby watercourses.

91. All crossings of watercourses which contain fish should be designed to ensure the free movement of fish past them. Where watercourses are crossed, clear-span bridges are the preferred solution to minimise ecological effects.

92. Where works take place instream or within the riparian zone it is recommended that such works should be planned to avoid the critical lifecycle stages of brown trout. Spawning and hatching of eggs occurs between October and May. Therefore, works within or close to watercourses containing brown trout should not take place during these months.

93. Construction should comply with the best practice construction methodologies outlined by SEPA in 'Engineering in the Water Environment Good Practice Guide: temporary construction methods' (SEPA, 2009) and in Construction Industry Research and Information Association guidance (CIRIA, 2015).

94. A sediment management and water quality monitoring should be included in the Construction Environmental Management Plan (CEMP) to ensure that pollution, including sediment, does not enter any watercourse, including those that do not contain fish. A plan for appropriate remediation measures to ameliorate any adverse effects should they occur is also recommended.

95. Should any part of a watercourse containing fish need to be impounded during the works, then a fish translocation should be carried out to remove fish from the impoundment. Fish translocation operations will require authorisation from Marine Scotland, ADSFB and the relevant landowner. Therefore, it is recommended that such operations be planned well in advance.

96. Although no aquatic Invasive Non-Native Species (INNS) were observed during surveys the possible presence of such species should not be excluded. Therefore, biosecurity measures should be implemented during the construction phase to prevent the spread of INNS.

97. Biosecurity is defined as a set of precautions that aim to minimise the risk of moving non-native species, parasites and diseases. Measures are likely to include:

- The briefing and training of workers on good biosecurity practices appropriate to their role;
- Equipping workers with the necessary equipment, Personal Protective Equipment (PPE) and substances to implement biosecurity control measures, including effective hygiene and sanitation practices. This will most frequently comprise Virkon S disinfectant tablets, sprayers and brushes to clean and disinfect equipment and PPE prior to leaving site;
- Ensure that that all PPE and survey equipment is clean and dry (and if necessary, disinfected) prior to going to and from site; and,
- Where possible, workers should park vehicles on hard standing areas and check/clean tyres prior to leaving site.

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Appendix A

Site Photographs

1. Electrofishing survey area at the downstream site on Glenkiln Burn

2. Electrofishing survey area at Rough Cleugh

3. Electrofishing survey area at Clachanbirnie Burn

4. Culvert downstream of survey area on Clachanbirnie Burn

5. Electrofishing survey area at Yellowtree Grain

6. Culvert downstream of survey area on Yellowtree Grain

7. Killyminshaw Burn upstream of waterfall

8. Killyminshaw Burn waterfall (impassable) close to the confluence with Glenkiln Burn.

9. Castletrough Burn at confluence with Glenkiln Burn

10. 0+ Trout fry identified In Rough Cleugh

11. 1++Trout parr identified in Glenkiln Burn

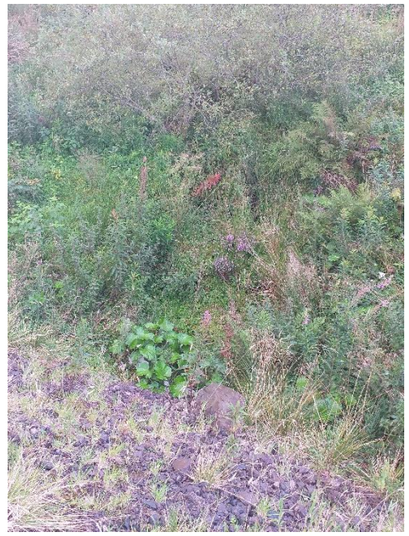
12. Electrofishing survey area at the upstream site on Glenkiln Burn

13. Scoped area at Deer Burn

14. Deer burn crossed by two clear span structures

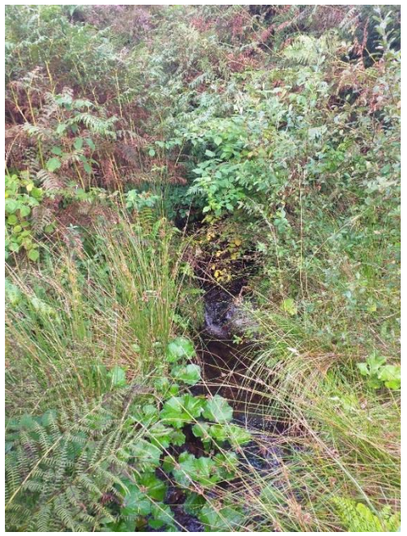
15. Scoped area at Blenoch Burn

16. Pipe-arch culvert with intact instream substrate at Blenoch Burn

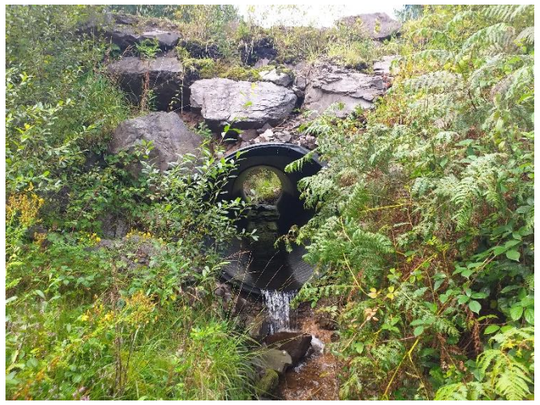


17. Scoped area of Cat Cleugh adjacent to forestry track

18. Small perched culvert spanning the forestry track at Cat Cleugh



19. Scoped area at Black Linn



20. Culvert spanning Black Linn at forestry track

21. Small perched culvert spanning the forestry track at Torr Linn

22. Heavily modified banksides of Auchencaigroch Burn

23. Pipe-arch culvert with intact instream substrate at Auchencaigroch Burn

24. In channel vegetation at Auchencaigroch Burn

25. Scoped area at Auchendowal Sike

26. Pipe culvert under forestry track at Auchendowal Sike

27. Upstream of culvert on Shiel Cleugh

Appendix B

Relevant Legislation and Policy

Water Environment (Controlled Activities) (Scotland) Regulations 2011 (known as the Controlled Activities Regulations or 'CAR')

1. It is an offence to undertake the following activities without obtaining a CAR authorisation from the Scottish Environment Protection Agency:

- Any activity liable to cause pollution of the water environment including discharges of polluting matter and disposal of waste;
- Abstraction of water from the water environment;
- Construction, alteration or operation of impounding works (e.g. dams and weirs) in surface water or wetlands;
- Carrying out building or engineering works in inland water (other than groundwater) or wetlands; or in the vicinity of inland water or wetlands and having or likely to have a significant adverse effect on the water environment;
- Artificial recharge or augmentation of groundwater;
- The direct or indirect discharge, and any activity likely to cause a direct or indirect discharge, into groundwater of any hazardous substance or other pollutant; or
- Any other activity which directly or indirectly has or is likely to have a significant adverse impact on the water environment.

Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003

2. This Act covers regulation of fisheries in Scotland and includes legislation that covers the introduction of polluting effluents, the obstruction of fish passage (screens, dams, weirs, culverts etc) illegal means of fishing, permitted times of legal fishing and fishing licencing (which covers electric fishing). Of relevance to the construction of the Proposed Development are the following provisions:

- Under this act any person who knowingly injures or disturbs salmon spawn or disturbs any spawning bed, bank or shallow in which salmon spawn shall be guilty of an offence
- Any person who obstructs or impedes salmon in their passage to any such bed, bank or shallow shall also be guilty of an offence; and
- Under his act Scottish Ministers may, after consulting such persons they consider appropriate, make regulations with respect to obstructions in rivers to the passage of salmon.

Scottish Planning Policy 2014 (SPP 14)

3. SPP 14[1] sets out national planning policy considerations in relation to Scotland's natural heritage. It summarises the main statutory obligations on the conservation of natural heritage and explains, as part of a wider framework for conservation and development, how natural heritage objectives should be reflected in development plans. SPP 14 describes the role of the planning system in safeguarding sites of national and international importance, provides guidance on the approach to be adopted in relation to local and non-statutory designations and draws attention to the importance of safeguarding and enhancing natural heritage beyond the confines of designated areas.

Scottish Planning Policy on Renewable Energy

4. This planning policy defines factors to be taken into account when considering policies for renewable energy developments or applications for planning permission; includes considerations regarding international and national natural heritage designations and sites out with these.

Dumfries and Galloway Local Development Plan 2

The following Natural Environment Policies are of relevance:

- Policy NE4: Sites of International Importance for Biodiversity.
- Policy NE5: Species of International Importance.
- Policy NE6: Sites of National Importance for Biodiversity and Geodiversity.
- Policy NE7: Forestry and Woodland.
- Policy NE8: Trees and Development.
- Policy NE11: Supporting the Water Environment.

Scottish Biodiversity Strategy (SBS)

5. The SBS was originally published in 2004 ('Scotland's Biodiversity: It's in Your Hands (Scottish Government, 2004); and supplemented by an update in 2013 ('2020 Challenge for Scotland's Biodiversity' (Scottish Government, 2013)). Together the two documents form Scotland's biodiversity strategy in response to the Aichi targets. The aims of the 2020 challenge are to:

- Protect and restore biodiversity on land and in our seas, and to support healthy ecosystems;
- Connect people with the natural world, for their health and well-being, and to involve them more in decision making; and
- Maximise the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth.

6. NatureScot is tasked by the Scottish Government with leading the delivery of 'Scotland's Biodiversity: A Route Map to 2020' and the SBS working groups. Each working group is entrusted with a specific aspect of biodiversity conservation.

Scottish Biodiversity List

7. The SBL is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. By identifying the species and habitats that are of the highest priority for biodiversity conservation, the list helps public bodies carry out their biodiversity duty, including implementation of the SBS.

[1] It is anticipated that SPP 14 will be replaced by National Planning Framework 4 during 2021.

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