

Technical Appendix 8.5

Aquatic Ecology & Fisheries Survey Report



1. Introduction

1.1 Background

- 1.1.1 Wood Plc have been commissioned by SSE Renewables to undertake aquatic ecology and fisheries surveys in relation the 'Achany Wind Farm Extension ('the Proposed Development')'. These surveys include fisheries habitat, benthic invertebrate fauna and fish fauna.
- 1.1.2 The Project is located on the Glencassley and Glenrossal Estates, approximately 4.5 kilometres (km) north of the village of Rosehall and approximately 11km west-north-west of Lairg within the Highland region of Scotland ('the Site').

1.2 Relevant Legislation and Guidance

Water Framework Directive 2000/60/EC

- 1.2.1 The key purpose of the Water Framework Directive (WFD) is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The framework aims to:
- prevent further deterioration and protect and enhance the status of aquatic ecosystems and, with regards to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
 - enhance protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances, and the cessation of phasing-out discharges, emissions and losses of the priority hazardous substances; and
 - ensure the progressive reduction of pollution of groundwater and prevent its further pollution.
- 1.2.2 Under the WFD member states are required, to achieve "good ecological status" in inland surface waters, transitional waters and coastal waters. Ground waters must also be protected and restored to ensure the quality of dependant surface water and terrestrial ecosystems. The WFD is formally transposed into national legislation through the Water Environment and Water Services (Scotland) Act 2003 (the WEWS Act). Through these regulations the Scottish Environment Protection Agency (SEPA) is empowered to control activities likely to have an impact upon the water environment (i.e. pollution, abstraction, impoundment and engineering). Consequently, SEPA can recommend and enforce regulations upon controlled activities, including the development of monitoring programmes.
- 1.2.3 Classified waterbodies receive legal protection under the Environmental Liability Directive (2004/35/EC), which is transposed into national statute through the Environmental Liability (Scotland) Regulations 2009. This makes it an offence to have an adverse impact on a waterbody that is consistent with deterioration in the water's status or potential under the WFD. The WFD identifies the quality elements relevant for the determination of surface water ecological status. The WFD provides a comprehensive breakdown of quality elements to be assessed in the coastal water environment, which are presented in Table 8.5.1.

Table 8.5.1: Quality Elements for Classification of Surface Water Status

Rivers			
Biological Elements			
<i>Biology</i>	Composition and abundance of other aquatic flora	Composition and abundance of benthic invertebrate fauna	Composition, abundance and age structure of fish fauna
Hydromorphological elements supporting the biological elements			
<i>Hydrological regime</i>	Quantity and dynamics of water flow	Connection to groundwater bodies	
<i>River continuity</i>	River continuity		
<i>Morphological conditions</i>	River depth and width variation	Structure and substrate of the river-bed	Structure of the riparian zone
Chemical and physico-chemical elements supporting the biological elements			
<i>General</i>	Thermal conditions	Oxygenation conditions	Salinity
	Acidification status	Nutrient conditions	
<i>Specific Pollutants</i>	Pollution by all priority substances identified as being discharged into the body of water	Pollution by other substances identified as being discharged in significant quantities into the body of water	

Salmon and Freshwater Fisheries Act 1975 (amended)

- 1.2.4 The Salmon and Freshwater Fisheries Act 1975 makes it an offence to knowingly take, kill or injure, or attempt to take, kill or injure, any Atlantic salmon *Salmo salar*, trout *Salmo trutta* or freshwater fish, which is unclean or immature. The Act also makes it an offence to cause or knowingly permit to flow, or puts or knowingly permits to be put, into any waters containing fish or into any tributaries of waters containing fish, any liquid or solid matter to such an extent as to cause the waters to be poisonous or injurious to fish or the spawning grounds, spawn or food of fish. Defences exist where it can be proved that best practicable means, within a reasonable cost, has been undertaken to prevent such an event.

Atlantic Salmon

- 1.2.5 Atlantic salmon are protected under the Berne Convention (Appendix III), the Conservation (Natural Habitats, &c.) Regulations 1994, the Habitats and Species directive (Annex II and V). The species is also on the long list of globally threatened/declining species ('Biodiversity', UK Steering Group Report, 1995), the UKs list of priority species (UK Biodiversity Action Plan (UKBAP), 2007)), the Scottish Biodiversity List (a species of principal importance for biodiversity conservation in Scotland) and the Species of Conservation Concern List (British species of conservation concern and under at least one international designation).

Trout

- 1.2.6 Neither forms of trout, freshwater resident or sea trout, historically received extensive protection within conservation legislation. Some protection in terms of exploitation controls exist within fisheries legislation and sea trout are further protected within fisheries acts relating to the protection of 'Atlantic salmon'. But both brown trout and sea trout are UKBAP priority fish species.

Freshwater Pearl Mussel

- 1.2.7 Freshwater pearl mussel (FWPM) (*Margaritifera margaritifera*) is protected under the Wildlife and Countryside Act 1981 (as amended) of Great Britain. It is listed on Annexes II and V of the EC Habitats Directive (Council Directive 92/43/EEC) and Appendix III of the of the Bern Convention. It is also on the short list of globally threatened/declining species, from the 1995 Steering Group Report, the Scottish Biodiversity List of species of principal importance for biodiversity conservation, and the UKBAP as a priority species. Recent estimates suggest that Scotland holds a large proportion of the world's known remaining viable populations.

1.3 Survey Sites and Suitability

- 1.3.1 The objectives of the study were to undertake and report baseline fisheries habitat, benthic invertebrate fauna, fish fauna and FWPM at sites within and adjacent to the Proposed Development.
- 1.3.2 A survey of the Site was undertaken on 16-17 September 2020.

Fisheries Habitat Survey and FWPM Habitat Suitability

- 1.3.3 Twenty two (22) sites were initially identified (see **Figure 8.5.1 and 8.5.2**), however fisheries habitat was recorded and FWPM habitat suitability was determined at fifteen (15), due to either the nature of the watercourses (e.g. peat cutting, flush and/or bedrock falls), and/or being out with the wind farm and site access boundaries and land access restrictions at the time of survey.
- 1.3.4 All sites are referenced and named in Table 8.5.2. The catchments, receiving waterbodies and their national grid references (NGRs) are also presented.

Table 8.5.2: Fisheries Habitat Survey and FWPM Habitat Suitability Locations (September 2020)

Survey Reference	Watercourse	Catchments/Receiving Waterbody	National Grid Reference (NGR)	Fisheries Habitat Survey	FWPM Habitat Suitability
A1	Alltan Leacach	River Cassley*	NC 43211 10989	Yes	Yes
A2	Unnamed	Alltan Leacach / River Cassley	NC 43225 10984	Yes	Yes
A3	Allt Bad an t-Sagairt	River Cassley	NC 44221 10209	Yes	Yes
A4	Unnamed	Allt an Rasail / River Cassley	NM 46930 09720	Yes	Yes
A5	Unnamed	Allt an Rasail / River Cassley	NM 46965 09613	Yes	Yes

A6	Unnamed	Allt an Rasail / River Cassley	NC 47203 08865	Yes	Yes
A7	Unnamed	Allt an Rasail / River Cassley	NC 47231 08851	Yes	Yes
A8	Unnamed	Allt an Rasail / River Cassley	NC 47182 08838	No (peat cutting)	No (peat cutting)
A9	Allt an Rasail	River Cassley	NC 47158 08811	Yes	Yes
A10	Unnamed	Allt an Rasail / River Cassley	NC 46366 08096	Yes	Yes
A11	Unnamed	Allt an Rasail / River Cassley	NC 46100 07908	Yes	Yes
A12	Allt an Rasail	River Cassley	NC 45958 07639	Yes	Yes
A13	Unnamed	Allt an Rasail / River Cassley	NC 46240 07043	No (flush)	No (flush)
A14	Allt an Rasail	River Cassley	NC 46220 06596	Yes	Yes
A15	Unnamed	Allt an Rasail / River Cassley	NC 46214 06588	Yes	Yes
A16	Unnamed	Allt an Rasail / River Cassley	NC 46146 06524	Yes	Yes
A17	Allt na Criche	River Cassley	NC 46292 05291	No (bedrock falls)	No (bedrock falls)
A18	Glen Rossal Burn	River Cassley	NC 52940 03580	No (bedrock falls)	No (bedrock falls)
A19	Unnamed	Grudie Burn* / River Shin*	NC 46690 04606	No (access)	No (access)
A20	Allt Sron nan Iarnachan	Allt a Bhadain / River Shin	NC 52940 03580	No (access)	No (access)
A21	Allt a Bhadain	River Shin	NC 49050 05510	Yes	Yes
A22	Allt Doir a Chatha	Allt Mor* / Dornoch Firth / River Oykel SAC**	NC 49620 02860	No (access)	No (access)

* River Cassley, Grudie Burn, Allt Mor and Dornoch Firth are classified waterbodies, with *Good* status. The River Shin is a classified waterbody with *Moderate* status (SEPA 2015)¹. The River Cassley forms a direct part of the River Oykel SAC (UK0030261)². The River Shin flows into the Dornoch Firth/Kyles of Sutherland, River Oykel SAC, then the Dornoch Firth and Morrich More SAC (UK0019806).

Fish Migration Barriers (SEPA)

1.3.5 SEPA have reported impassable and passable barriers (natural) on the River Cassley and two (2) of its tributaries that drain the Site (Allt an Rasail and Glen Rossal Burn). SEPA have also reported an

¹ SEPA (2015) <https://www.sepa.org.uk/data-visualisation/water-environment-hub/>

² DEFRA (2021) <https://magic.defra.gov.uk/magicmap.aspx>

impassable barrier (natural) in the lower reaches of the Allt Mor, and impassable (natural and man-made) and passable (man-made) barriers, in the lower reaches of the Grudie Burn.

Benthic Invertebrate and Fish Fauna

1.3.6 Twenty two (22) sites were initially identified (see **Figures 8.5.3 and 8.5.4**), however benthic invertebrate fauna were sampled at fifteen (15) sites, due to the nature of the watercourses (i.e. lack of pool/riffle habitat and flow), or being out with the wind farm and site access boundaries and land access restrictions at the time of survey.

1.3.7 Fish fauna were sampled at nine (9) sites, due to either the nature of the watercourses (e.g. peat cutting, flush, bedrock falls, flow and lack of instream and bankside cover for fish), or being out with the wind farm and site access boundaries and land access restrictions at the time of survey.

Water Quality

1.3.8 Water quality was sampled at sixteen (16) sites, due to the nature of the watercourses, being out with the wind farm and site access boundaries and land access restrictions at the time of survey.

Sampling Suitability

1.3.9 All sites are referenced and named in Table 8.5.3. The sites sampled and those that were not suitable for sampling are presented.

Table 8.5.3: Benthic Invertebrate, Fish Fauna, Water Quality and FWPM Locations (September 2020)

Survey Reference	Watercourse	Benthic Invertebrate Fauna	Fish Fauna	Water Quality	FWPM
A1	Alltan Leacach	Yes	No (not suitable)	Yes	No (not suitable)
A2	Unnamed	Yes	No (not suitable)	Yes	No (not suitable)
A3	Allt Bad an t-Sagairt	Yes	No (not suitable)	Yes	No (not suitable)
A4	Unnamed	Yes	No (not suitable)	Yes	No (not suitable)
A5	Unnamed	Yes	Yes	Yes	No (not suitable)
A6	Unnamed	No (not suitable)	Yes	Yes	No (not suitable)
A7	Unnamed	Yes	Yes	Yes	No (not suitable)
A9	Allt an Rasail	Yes	No (not suitable)	Yes	No (not suitable)
A10	Unnamed	Yes	Yes	Yes	No (not suitable)
A11	Unnamed	Yes	Yes	Yes	No (not suitable)
A12	Allt an Rasail	Yes	Yes	Yes	No (not suitable)
A13	Unnamed	Yes	No (not suitable)		No (not suitable)
A14	Allt an Rasail	No (not suitable)	Yes	Yes	No (not suitable)
A15	Unnamed	No (not suitable)	Yes	Yes	No (not suitable)

A16	Unnamed	Yes	No (not suitable)	Yes	No (not suitable)
A17	Allt na Criche	No (not suitable)	No (not suitable)	Yes	No (not suitable)
A21	Allt a Bhadain	Yes	Yes	Yes	No (not suitable)

1.4 Methods

Sampling Procedures and Guidelines

- 1.4.1 Best practice Scottish Fisheries Co-ordination Centre (SFCC) and Scottish Environment Protection Agency (SEPA), Marine Scotland (MSS) and NatureScot procedures and guidelines were adhered to throughout the survey and sampling programme.

Fisheries Habitat

Fieldwork

- 1.4.2 Observations were made in the context of methods developed by Hendry and Cragg-Hine (1997), and those developed for river / fisheries habitat surveying (EA, 2003 and SFCC, 2007).
- 1.4.3 Predominant habitat was recorded within specific stretches, and the habitat was defined as described in Table 8.5.4. The habitats described are regarded as definable parts of a spectrum of habitats commonly found in watercourses. Where spawning gravels were present and accessible, an assessment of their quality in terms of stability, compaction and siltation was made. In addition, the bankside structure and surrounding land use was also described where appropriate.

Table 8.5.4: Species / Habitat Type and Classification

Species / Habitat Type	Classification
Atlantic salmon (spawning gravel)	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt. Substrate size predominantly pebbles and smaller cobbles depending on fish size.
Trout (spawning gravel)	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt. Substrate size varies from gravels, pebbles and smaller cobbles depending on fish size.
Atlantic salmon (fry habitat)	Shallow (<0.2 m) and fast flowing water indicative of riffles and runs with a substrate dominated by pebbles and smaller cobbles.
Atlantic salmon (parr habitat)	Riffle/run habitat that is generally faster and deeper than fry habitat (0.2 – 0.4 m). Substrate size* from large pebbles/smaller cobbles to boulder.
Atlantic salmon (parr habitat)	Riffle/run habitat that is generally faster and deeper than fry habitat (0.2 – 0.4 m). Substrate size* from large pebbles/smaller cobbles to boulder.
Trout (fry habitat)	Slow to medium flowing shallow water with a substrate dominated by pebbles and smaller cobbles, often concentrated at stream margins.
Trout (parr habitat)	Variety of substrate sizes; undercut banks, tree roots, big rocks; deeper, slower water.
Lamprey spp. (spawning habitat)	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt (but may contain some sand). Substrate size varies from gravels to pebbles.
Lamprey spp. (nursery habitat)	Optimal: Stable fine sediment or sand ≥ 15cm deep with low water velocity and the presence of organic detritus/plant material.

	Sub-optimal: Shallow sediment (<15cm deep), often patchy and interspersed among coarser substrate.
European eel <i>Anguilla anguilla</i> (habitat)	Frequently burrow into mud and utilise cover from larger instream substrate and bankside crevices (e.g. gaps in bank modifications such as walls and log revetments).
Glides	Smooth laminar flow with little surface turbulence. Shallow glide ≤ 0.3m, deep glide > 0.3m.
Pools	No perceptible flow. Shallow pool ≤ 0.3m, deep pool > 0.3m.
Flow constriction	Where flows are accelerated between narrow banksides (usually combined with deep fast flows and bedrock substrates).

* Gravel (2 – 16mm), Pebble (16 – 64mm), Cobble (64 – 256mm), Boulder (>256mm)

** If significant amounts of different habitat types were found to co-exist in the same section, these habitat classifications were adequately described. For example, in the case of salmonids, fry and parr habitat is classified as juvenile habitat.

Where parr habitat is mentioned this refers to habitat that has principally been identified as habitat more suited to parr than fry, however, habitually contains a lower quantity of fry habitat and habitat which is suited to both fry and parr. Salmonid definitions in [Table 8.5.4](#) are adapted from SFCC Habitat Manual (2007) and Hendry & Cragg-Hine (1997). For lamprey spp. these have been adapted from Maitland (2003).

Analysis

- 1.4.4 During the fisheries habitat survey standard SFCC general habitat survey sheets were used, making notes on many different variables including substrate, flow types and cover for fish. From this, further analysis was undertaken and evaluations were made for fish utilisation potential (FUP), and fisheries habitat quality (FHQ) along the watercourse (notably related to providing suitable instream and bankside cover for fish).

Benthic Invertebrate Fauna

Fieldwork

- 1.4.5 Composition and abundance of benthic invertebrate fauna within the Site was assessed using a kick-sampling methodology and following the criteria set out in SEPA procedural guidelines (as described) and British Standard (BS EN 27828:1994).
- 1.4.6 A four-minute combined kick-sweep sample, which included 3 minutes kicking and sweeping, 30 seconds collecting surface activity, and 30 seconds collecting benthic invertebrates adhered to stones, logs etc.;
- 1.4.7 Samples taken using a wire framed mesh net (1.0mm mesh size);
- 1.4.8 Time divided between component habitats and meso-habitats proportionally where possible; and
- 1.4.9 Samples / specimens sorted into different family groups and stored in 90ml containers and fixative (Industrial Methylated Spirit - IMS 99.95%).

Identification / Analysis

- 1.4.10 Lab-based identification was undertaken by first sieving the sample through a series of fine mesh sieves to remove the fine sediment and mud from the debris, such as twigs and large stones.
- 1.4.11 The sample was then placed onto a white tray and searched at low magnification (5x) to pick out representatives from each family group of aquatic invertebrates recorded.

- 1.4.12 These individuals were then identified to family level, at a high magnification (30-45x) and using applicable identification keys: FBA (2011), Friday (1988), Wallace et al. (1990), Hynes (1977), Elliott et al. (1988); and Edington and Hildrew (1981).
- 1.4.13 Relative abundance of each family group in the total sample was determined, and recorded using the abundance categories, presented in Table 8.5.5. The abundance categories and boundary values are attributed the following and equivalent SEPA classification categories.

Table 8.5.5: Abundance Categories for Aquatic Invertebrates (Equivalent SEPA Classification)

Abundance Category	Equivalent SEPA Classification Categories
1 - 9 individuals	E
10 - 99 individuals	D
100 - 999 individuals	C
1,000 - 9,999 individuals	B
10,000+ individuals	A

Biological Water Quality – Analysis and Classification

- 1.4.14 Two (2) water quality classification tools have been used to assess biological water quality within the sampled watercourses. These include the Biological Monitoring Working Party (BMWP) and Average Score Per Taxon (ASPT).
- 1.4.15 Many factors can attribute to the composition of a benthic invertebrate community, for example disturbance events, hydro-morphology of the watercourse and environmental variables. Therefore, these factors attributing to the benthic invertebrate community composition have also been taken into account when assessing the BMWP and ASPT scores.

BMWP

- 1.4.16 The BMWP score works on the basis of attributing a score to particular benthic invertebrate families according to their pollution tolerance. The species that are least pollution-tolerant are attributed the highest points (e.g. mayfly, stonefly, caddis-fly families) and the lowest points are attributed to those which can tolerate increased organic loads and which tend to be those that habituate organic sediments (e.g. oligochaetes and chironomids) (Moss, 1998). The BMWP is calculated by adding the points for each family group present to give the biotic score, with high scoring sites being indicative of low pollution and low scoring sites being indicative of high pollution. Pristine sites can be recorded in excess of 100, with heavily polluted sites being less than 10 (Moss, 1998).

ASPT

- 1.4.17 Since the BMWP score is particularly sensitive to sampling effort, with higher scores often associated with increased sampling and sorting effort, the ASPT score is also usually determined. The ASPT is derived by dividing the BMWP by the number of family groups present in the sample to derive the total ASPT biotic score and is therefore less sensitive to sampling effort.
- 1.4.18 Table 8.5.6 shows how the BMWP and ASPT scores can be related to the equivalent Water Framework Directive (WFD) (2000/60/EC) status for classification of the benthic invertebrate composition.

Table 8.6.6 BMWP, ASPT and Equivalent WFD Classifications

BMWP	ASPT	Equivalent WFD Status
≥ 85	≥ 6.0	High
≥ 70	≥ 5.0	Good
≥ 50	≥ 4.2	Moderate
≥ 15	≥ 3.0	Poor
< 15	< 3.0	Bad

Fish Fauna

Fieldwork

- 1.4.19 An assessment of species composition, abundance and age class structure of fish fauna was carried out using electrofishing techniques. The methodology followed guidelines developed by the SFCC and captured by the EU LIFE in UK Rivers Project. The methodology also conformed to British Standard guidance (BS EN 14011:2003).
- 1.4.20 The baseline electrofishing surveys were carried out during September 2020. This is within the optimal time of year for survey, as salmonid young of year have emerged from spawning redds, and reached a sufficient size to be captured and identified safely. Water temperatures are also generally within the optimal range for fish capture by electrofishing (10-15 oC).
- 1.4.21 The survey team comprised two experienced surveyors, both certified to SFCC and Environment Agency standards, and with one qualified to SVQ Level III (leading electrofishing operations and undertaking fisheries habitat surveys).
- 1.4.22 The surveys were undertaken using a Smith Root LR24 Backpack Electrofisher, which was battery powered and was set up to drive a single anode. Smooth DC current was utilised, as this is generally accepted as the least damaging to fish during this type of survey.
- 1.4.23 All surveys were carried out in accordance with SFCC guidelines on undertaking and managing electrofishing operations (SFCC, 2007), and under licences that were issued by Marine Scotland (Ref: CSM 20-123 and CSM 20-124).
- 1.4.24 A fully-quantitative sampling methodology was undertaken for all watercourses surveyed. This procedure involves sampling a defined area of watercourse multiple times until fish numbers are depleted. Fully-quantitative sampling is the preferred methodology, as it allows for enumeration of a population, within a given site and provides a reasonably accurate estimate of a given population.

Statistical Analysis and Classification Schemes

Removal Sampling 2

- 1.4.25 Species data collected from fully quantitative survey methods were assessed using a statistical model to identify a population estimate for each watercourse (where data allowed).
- 1.4.26 The statistical model used for relevant population estimation was Removal Sampling 2 (Seaby and Henderson, 2008), and this was linked to the following method:

- 1.4.27 Constant probability of capture - developed by Zippin (1956).
- 1.4.28 This method takes into account the likelihood that the capture of different individuals within a population is constant. The calculation of the estimated population uses the maximum likelihood estimates.

Fish Utilisation Potential (FUP) and Fish Habitat Quality (FHQ)

- 1.4.29 Table 8.5.7 shows the assessment criteria for FUP. This was determined by assessing the probability of fish being present (%) and by presenting rating ranges based on likelihood.

Table 8.5.7 Fish Utilisation Potential (FUP) and Probability

Probability of Fish Present	%	Rating Ranges	
Certain/Near-Certain	95%	Very High	Very High
Probable	50-95%	Very High	High
Unlikely	5-50%	Moderate	Low
Extremely Unlikely	<5%	Very Low	Absent

- 1.4.30 FHQ was determined and rated on the quality of habitat and characteristics to support a fish population, allowing for spawning/reproduction/nursery and providing instream and bankside cover for the fish species/age classes listed in Table 8.5.4 (where applicable).
- 1.4.31 Associated factors for FUP and FHQ included target species/age class, wet width, flow (pool/riffle sequences), water depth (e.g. salmon fry <0.2m, salmon parr 0.2-0.4), substrate (stable gravels, not compacted, free from silt, suitably sized), instream cover, bankside vegetation, associated land-uses and water/sediment chemistry (where applicable/available).

NRA Classification Scheme

- 1.4.32 Fish densities were calculated separately for fry (0+ - young of the year) and parr (1++ - juveniles that have spent at least one Winter in freshwater but have not yet been to sea) and are classified according to the National Rivers Authority (NRA) Classification Scheme (NRA 1994) in Table 8.5.8. This tool grades salmonid density from A to F, where A indicates a very high fish density and F represents an absence of fish.

Table 8.5.8 NRA Fisheries Classification Scheme

Species/Age-class	A	B	C	D	E	F
Trout fry 0+	38	17	8	3	<3	0
Trout parr >0+	21	12	5	2	<2	0
Atlantic salmon fry 0+	86	45	23	9	<9	0
Atlantic salmon parr >0+	19	10	5	3	<3	0
Description	Very High	High	Moderate	Low	Very Low	Absent

- 1.4.33 The figures in the table above are estimates of the number of fish present for each species and age class per 100m² of watercourse. It should also be noted that this scheme was developed for rivers

in England and Wales, therefore it is only being used as a rough guide for relative density and evaluation.

SFCC Classification Scheme

- 1.4.34 The SFCC were asked to develop a national river classification scheme for Scottish rivers, conceived as similar to the NRA Classification Scheme (Godfrey, 2005). Due to the regional relevance of the results, an analysis of the data utilising the SFCC classification system was undertaken and the results compared to those for the NRA procedure.
- 1.4.35 The main difference between the systems is that the SFCC classification is based on single-run electrofishing events rather than fully quantitative sampling. There are numerous classifications for different regions of Scotland based on historical data and the variation in juvenile salmonid densities displayed between these regions.
- 1.4.36 The relevant classification for the Site falls within the North Region and this is presented below in Table 8.5.9.

Table 8.5.9 SFCC Fisheries Classification Scheme (North Region)

Species/Age-class	A	B	C	D	E	F
Trout fry 0+	98.49	10.07	5.10	4.16	<4.16	0.00
Trout parr >0+	14.73	7.61	4.37	2.72	<2.72	0.00
Atlantic salmon fry 0+	67.36	29.37	14.79	10.70	<10.7	0.00
Atlantic salmon parr >0+	27.66	16.28	9.49	6.36	<6.36	0.00
Description	Very High	High	Moderate	Low	Very Low	Absent

- 1.4.37 The results of the different classification schemes are compared and discussed in Section 1.6 (Evaluation of Results).

FWPMHabitat Classification

- 1.4.38 Habitat was evaluated by taking the criteria in Table 8.6.10 into consideration. For example, good habitat includes many of the optimal habitat characteristics, with little obvious sign of potential harmful influences, such as sedimentation, eutrophication or acidification. Moderate habitat includes some of the optimal habitat characteristics and may show sign of potential harmful influences. Poor habitat includes few of the optimal habitat characteristics and shows sign of potential harmful influences.

Existing FWPM Habitat Suitability and Populations

- 1.4.39 The results of the FWPM habitat evaluations were compared to the habitat suitability assessment and survey of watercourses that were carried out by Cosgrove (2011).

- 1.4.40 They were also compared to Hastie et al (2015), that reported that the River Cassley currently supports a low density FWPM population (code D) with juvenile mussels, indicating recent successful recruitment.
- 1.4.41 Further detail is provided in Technical Appendix 8.1.

Table 8.5.10: Factors for Determining FWPM Habitat Classification (adapted from Skinner *et al.* (2003))

Optimal Habitat Requirements	Potentially Harmful Influences
<ul style="list-style-type: none"> • Water quality - oligotrophic conditions (poor in nutrients), pH 7.5 or less, and with low overall conductivity. • Water depth - 0.1 -2m (optimal 0.3-0.4m). • Water velocity - 0.1- 2ms-1 (optimal 0.25-0.75ms-1), moderate flow preferably with areas of riffle. • Substrate - small sand patches stabilised amongst large stones or boulders. • Bankside cover - shade created by herbaceous vegetation and trees with little or no bank erosion. Shade keeps water temperatures down during the Summer months, inhibits the growth of filamentous algae and is conducive to the presence of host salmonids. • Stable channels - little bed transport except in floods is important. Channel structure should not be altered in any way that will impede water flow, increase flooding, or alter the distribution of substrates. 	<ul style="list-style-type: none"> • River engineering - For hydro-electric schemes, flood protection or fisheries reasons may cause local extinctions. Activities such as dredging and weir construction cause alteration or loss of suitable riverbed substrata. • Sedimentation - Can adversely affect juvenile FWPM and host salmonids which depend on a plentiful supply of oxygen to their habitat. • Eutrophication - Filamentous algal mats, high phytoplankton production and detritus formed by their decay indicate eutrophication conditions that are deleterious to FWPM populations. • Inorganic pollutants - Pyrethroid sheep dip is known to be highly toxic but the direct effect on FWPM is not known. Indirect effects could occur through a reduction in salmonid numbers. • Acidification - Acidification is known to have deleterious effects on juvenile trout and salmon and could therefore have an indirect effect on FWPM. Acidification may also alter juvenile habitat.

1.4.42 The impassable barriers (natural and man-made) noted by SEPA on the River Cassley, Allt an Rasail, Glen Rossal Burn, lower reaches of the Allt Mor and Grudie Burn were also considered as part of the suitability assessment for FWPM.

Water Quality

Fieldwork

1.4.43 Water quality was sampled at sixteen (16) sites in September 2020. These sites are referenced and named in Table 8.5.3 and the water quality results are presented in Table 8.5.14. The water quality parameters were recorded in-situ using a calibrated YSI Professional Plus handheld multi-parameter meter. The variables that were determined included temperature, dissolved oxygen and conductivity.

1.4.44 The water quality meter was calibrated at the start of each working day (using the appropriate calibration/buffer solutions). Calibration records for this were logged within the meter itself.

Survey Limitations

1.4.45 Not all watercourses that drain the wind farm site and site access boundaries were surveyed / sampled. These included A19, A20 and A22, where land access was restricted including a land parcel at Durcha and at Achany Wind Farm.

1.4.46 No other survey limitations. Surveys were planned and administered during stable weather periods and when river levels were in the normal range³.




³ <https://apps.sepa.org.uk/waterlevels>





1.5 Results





Fisheries and FWPM Habitat





1.5.1 Table 8.5.11 identifies each site sampled. It also provides FUP (from Table 8.6.7), FHQ, FWPM ratings, reach descriptions and limiting factors and site identifications/photos.

Table 8.5.11 Fisheries Habitat Assessments

Site Reference	FUP	FHQ	FWPM	Reach Description & Limiting Factors	Site Identification / Photo
A1	Low	Low	Poor	<p>Alltan Leacach - Wet width approx. 1.0-1.5m. Flow consists predominantly of shallow glide, riffle and shallow pool. Flow is moderate. Depth ranging from <10-20cm. Consists of mainly bedrock, boulder and cobble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	
A2	Low	Low	Poor	<p>Unnamed - Wet width approx. 1.0-1.25m. Flow consists predominantly of shallow glide and riffle. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly bedrock, boulder and cobble substrate, which is providing limited instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	
A3	Low	Low	Poor	<p>Allt Bad an t-Sagairt - Wet width approx. 2.0-2.5m. Flow consists predominantly of smooth, shallow pool, shallow glide and riffle. Flow is moderate. Depth ranging from <5-15cm. Consists of mainly bedrock, boulder and cobble substrate, which is providing limited instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	

Site Reference	FUP	FHQ	FWPM	Reach Description & Limiting Factors	Site Identification / Photo
A4	Low	Low	Poor	Unnamed - Wet width approx. 0.75-1.0m. Flow consists predominantly of shallow glide and riffle. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly bedrock and boulder substrate, which is providing limited instream cover. Some bankside cover on both banks provided by undercut banks, draping and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A5	Moderate	Moderate	Poor	Unnamed - Wet width approx. 0.50-0.75m. Flow consists predominantly of riffle and shallow pool. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly bedrock, boulder and cobble substrate, which provides some instream cover. Some bankside cover on both banks provided by undercut banks, draping and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A6	Moderate	Moderate	Poor	Unnamed - Wet width approx. 0.75-1.0m. Flow consists predominantly of riffle and shallow pool. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly boulder and cobble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks, draping and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A7	Moderate	Moderate	Poor	Unnamed - Wet width approx. 1.5-3.0m. Flow consists predominantly of shallow glide, run and riffle. Flow is moderate to fast. Depth ranging from <10-15cm. Consists of mainly bedrock, boulder and cobble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	

Site Reference	FUP	FHQ	FWPM	Reach Description & Limiting Factors	Site Identification / Photo
A9	Moderate	Moderate	Poor	Unnamed - Wet width approx. 1.0-1.5m. Flow consists predominantly of run and riffle. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly cobble and pebble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A10	Moderate	Moderate	Poor	Unnamed - Wet width approx. 0.75-2.5m. Flow consists predominantly of riffle. Flow is moderate. Depth ranging from <5-10cm. Consists of mainly cobble and boulder substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A11	Moderate	Moderate	Poor	Unnamed - Wet width approx. 0.75-1.0m. Flow consists predominantly of run, riffle and shallow pool. Flow is moderate. Depth ranging from <5-15cm. Consists of mainly cobble and pebble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks, draping and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	
A12	Very High	High	Moderate	Allt an Rasail - Wet width approx. 3.0-5.0m. Flow consists predominantly of shallow glide, run and riffle. Flow is moderate to fast. Depth ranging from 10-15cm. Consists of mainly heavy grade bedrock, boulder and cobble substrate, which is providing suitable instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.	

Site Reference	FUP	FHQ	FWPM	Reach Description & Limiting Factors	Site Identification / Photo
A14	Moderate	Moderate	Moderate	<p>Allt an Rasail - Wet width approx. 2.0-2.5m. Flow consists predominantly of shallow glide, run and riffle. Flow is moderate to fast. Depth ranging from 10-15cm. Consists of mainly boulder and cobble substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	
A15	Low	Low	Poor	<p>Unnamed - Wet width approx. 0.5-0.75m. Flow consists predominantly of shallow glide and riffle. Flow is slow. Depth ranging from <5-10cm. Consists of mainly bedrock, boulder and cobble substrate, which is providing limited instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	
A16	Low	Low	Poor	<p>Unnamed - Wet width approx. 0.5-1.0m. Flow consists predominantly of shallow glide and riffle. Flow is slow. Depth ranging from <5-10cm. Consists of mainly cobble and pebble substrate, which is providing limited instream cover. Some bankside cover on both banks provided by emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	
A21	Low	Low	Poor	<p>Allt a Bhadain - Wet width approx. 1.0-3.5m. Flow consists predominantly of smooth, deep pool and shallow glide. Flow is fast to slow (end of culvert into pool upstream end). Depth ranging from 20-50cm. Consists of mainly cobble, pebble, gravel and high organic substrate, which is providing some instream cover. Some bankside cover on both banks provided by undercut banks and emerging vegetation. Associated land use is moorland heath and rough pasture. No canopy cover.</p>	

Benthic Invertebrate Fauna

- 1.5.2 The family groups recorded are presented in Table 8.5.12. Within this table the assessment results for abundance, BMWP, taxon and ASPT have been quantified and detailed.
- 1.5.3 Table 8.5.13 identifies the assessment results using the information given in Table 8.5.12. Within this table the categories and boundary values (from Tables 8.5.5 and 8.5.6) have been used to show how the BMWP and ASPT scores are related to the equivalent Water Framework Directive (WFD) (2000/60/EC) status for classification of benthic invertebrate composition.

Table 8.5.12 Benthic Invertebrate Fauna (Family Groups Recorded September 2020)

Common Name	Family	Revised BMWP Score	SITE												
			A1	A2	A3	A4	A5	A7	A9	A10	A11	A12	A13	A16	A21
Flatworms	Planariidae	4.2									1				
Snails	Lymnaeidae	3													11
Limpets and Mussels	Sphaeriidae	3.6				11	44		2						
Worms	Oligochaeta	3.5		7	2		1	1			1			1	9
Leeches	Glossiphoniidae	3.1			1										
Crustaceans	Gammaridae	4.5				2									
Mayflies	Baetidae	5.3	11	6		8	1	4	4	22		2		4	6
	Leptophlebiidae	8.9								23	2		8	2	48
	EphemereIIDae	7.7			6										
Stoneflies	Taeniopterygidae	10.8	7	1	20	9	5	14	13	10	14	10	7	4	38
	Leuctridae	9.9											1	1	
Damselflies	Coenagriidae	3.5		1											
Dragonflies	Cordulegasteridae	8.6		2										1	1
Beetles	Haliplidae	4													10
	Dytiscidae	4.8		1	1				1					3	9
	Scirtidae	6.5	3		1	25	1			3					
	Elmidae	6.4	1	1	5	72	1	13	7	3	4	1	1	2	42
Alderflies	Sialidae	4.5						2	1						3
Caddisflies	Rhyacophilidae	8.3	3	2	5	7			1		3	2			14
	Polycentropidae	8.6	1	12	7	3	1	17	4	1	6	4		1	7
	Hydropsychidae	6.6	8		4			5	12	2	2	1	6		
	Hydroptilidae	6.7	2		4		1		3		1		1		2
True flies	Tipulidae	5.5	2		6	1						1	1		
	Chironomidae	3.7	14	29	18	12	12	25	11	12	17	41	20	11	146
	Simuliidae	5.8	9	5	3	3	5	1	12	2	5	2	1	6	
Other (Non Scoring Taxa)															
Arachnida	Hydracrina sp.	N/A	1		1								1		4
Crustacea	Ostracoda sp.	N/A		1											
Lepidoptera	Crambidae (Pyrilidae) sp. Larvae	N/A			1					1					
Diptera	Ceratopogonidae sp. larvae	N/A		1							1				4

	Dixidae sp. Larvae	N/A												1	
	Empididae sp. Larvae	N/A				1		1							
	Muscidae sp. Larvae	N/A						2				1			
	Psychodidae sp. Larvae	N/A													1
Abundance			61	67	83	153	72	82	71	78	56	64	46	36	346
BMWP			374.5	355.1	587.5	962.7	322.8	545.6	475.2	545.8	390.6	351.4	294.7	215.5	2038
Taxon (Scoring Taxa)			11	11	13	11	10	9	12	9	11	9	9	11	14
ASPT			34.0	32.3	45.2	87.5	32.3	60.6	39.6	60.6	35.5	39.0	32.7	19.6	145.6

Table 8.5.13 Benthic Invertebrate Fauna Data Analysis (September 2020)

Site Reference	Watercourse	Abundance / SEPA Category	BMWP / Equivalent WFD	ASPT / Equivalent WFD
A1	Alltan Leacach	61 (D)	374.5 (High)	34.0 (High)
A2	Unnamed	67 (D)	355.1 (High)	32.3 (High)
A3	Allt Bad an t-Sagairt	83 (D)	587.5 (High)	45.2 (High)
A4	Unnamed	153 (C)	962.7 (High)	87.5 (High)
A5	Unnamed	72 (D)	322.8 (High)	32.3 (High)
A7	Unnamed	82 (D)	545.6 (High)	60.6 (High)
A9	Allt an Rasail	71 (D)	475.2 (High)	39.6 (High)
A10	Unnamed	78 (D)	545.8 (High)	60.6 (High)
A11	Unnamed	56 (D)	390.6 (High)	35.5 (High)
A12	Allt an Rasail	64 (D)	351.4 (High)	39.0 (High)
A13	Unnamed	46 (D)	294.7 (High)	32.7 (High)
A16	Unnamed	36 (D)	215.5 (High)	19.6 (High)
A21	Allt a Bhadain	346 (C)	2038.0 (High)	145.6 (High)

Fish Fauna

1.5.4 Table 8.5.14 identifies each site sampled, survey technique and sample area, species recorded, composition and abundance and length ranges (mm). It also provides a fully quantitative population estimate, following Zippin (1956) and the NRA and SFCC classifications (from Tables 8.5.8 and 8.5.9).

Table 8.5.14 Composition and Abundance of Fish Fauna (September 2020)

Site Reference	Watercourse	Survey Technique and Sample Area	Species Recorded		Fully-Quantitative Population Estimate (Zippin, 1956)	NRA Classification	SFCC Classification - North Region (Godfrey 2005)
			Composition and Abundance	Length Range (mm)			
A5	Unnamed	Fully Quantitative (~100m ²)	Trout parr: 1	Trout parr: 80	No Depletion (Run 1 Capture)	Very Low	Very Low
A6	Unnamed	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent
A7	Unnamed	Fully Quantitative (~100m ²)	Trout fry: 1	Trout parr: 60	No Depletion (Run 1 Capture)	Very Low	Very Low
A10	Unnamed	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent
A11	Unnamed	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent
A12	Allt an Rasail	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent

Site Reference	Watercourse	Survey Technique and Sample Area	Species Recorded		Fully-Quantitative Population Estimate (Zippin, 1956)	NRA Classification	SFCC Classification - North Region (Godfrey 2005)
			Composition and Abundance	Length Range (mm)			
A14	Allt an Rasail	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent
A15	Unnamed	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent
A21	Allt a Bhadain	Fully Quantitative (~100m ²)	No fish recorded	N/A	N/A	Absent	Absent

Water Quality

1.5.5 Table 8.5.15 identifies each site sampled and the variables recorded to support the baseline fisheries habitat, aquatic invertebrate and fish fauna surveys. No specific water quality classification and/or interpretation will be provided within the current study.

Table 8.5.15 Water Quality Monitoring (September 2020)

Site Reference	Watercourse	Temperature	Dissolved Oxygen	Conductivity
A1	Alltan Leacach	10.8	11.33	36.6
A2	Unnamed	11.6	10.43	37.9
A3	Allt Bad an t-Sagairt	10.8	10.62	36.0
A4	Unnamed	12.0	10.23	33.0
A5	Unnamed	12.0	10.23	33.0
A6	Unnamed	13.0	10.06	36.8
A7	Unnamed	13.2	9.51	42.2
A9	Allt an Rasail	13.2	9.95	39.6
A10	Unnamed	13.2	9.96	39.1
A11	Unnamed	13.6	9.68	39.4
A12	Allt an Rasail	13.7	10.1	40.9
A14	Allt an Rasail	13.5	10.2	41.2
A15	Unnamed	13.6	10.13	41.6
A16	Unnamed	14.2	8.46	41.7
A17	Allt na Criche	13.8	10.25	40.2
A21	Allt a Bhadain	11.8	10.75	65.8



1.6 Evaluation of Results

Fisheries Habitat

- 1.6.1 The results from September 2020 indicated Very High FUP and High FHQ at one site (A12), Moderate FUP and FHQ at seven (7) sites (A5, A6, A7, A9, A10, A11 and A14) and Low FUP and FHQ at seven (7) sites (A1, A2, A3, A4, A15, A16 and A21).
- 1.6.2 Suitability for the target species/age classes (i.e. juvenile salmonids), suitable wet widths (0.5-5.0m), flow (slow, moderate and fast), water depths (<10-50cm), substrate/instream cover (notably bedrock, boulder, cobble, pebble and high organic), bankside vegetation/cover (undercut banks, draping and emerging vegetation), associated land-uses (minimal anthropogenic influence, moorland heath and rough pasture) and water chemistry (all within natural ranges) were all contributing factors in the ratings given for these sites.

Very High FUP and High FHQ at A12 (Allt an Rasail)

- 1.6.3 This site was given these ratings because of its assessed suitability to support the target species/age classes (notably trout parr). For example, wet width range ranged from (3.0-5.0m), flow is moderate to fast, depth ranged from 10-15cm. The boulder and cobble substrate is providing suitable instream cover and it features undercut banks and emerging vegetation. A limiting factor for this site is the impassable barrier (natural) in the lower reaches.

Moderate FUP and FHQ at seven (7) sites (A5, A6, A7, A9, A10, A11 and A14)

- 1.6.4 These sites were given reduced ratings because of their assessed suitability to support the target species/age classes (notably trout). Overall, these were considered to be small watercourses, at high altitude, with limited flow, depth and heavy grade bedrock/substrates, and unlikely to have fish utilisations, or sustain significant fish populations. Many of these watercourses also had limited accessibility for fish to migrate within the watercourse e.g. spawning and nursery. All of the sites are within the Allt an Rasail catchment, which is limited by the impassable barrier (natural) in the lower reaches.

Low FUP and FHQ at six (6) sites (A1, A2, A3, A4, A15, A16 and A21)

- 1.6.5 These sites were given further reduced ratings because their suitability to support the target species/age classes (notably trout). Overall, these were considered to be minor watercourses, or flushes/peat cuttings, at high altitude, with limited flow, depth and heavy grade bedrock/substrates, and which are unlikely to have fish utilisations, or sustain fish populations. Many of these watercourses also had very limited accessibility for fish to migrate within the watercourse e.g. spawning and nursery. All of the sites are within the Allt an Rasail catchment, which is limited by the impassable barrier (natural) in the lower reaches.

Benthic Invertebrate Fauna

- 1.6.6 The results indicated Low-Moderate abundances (36-346) and SEPA abundance category "D-C" across all sites sampled.
- 1.6.7 The results indicated High BMWP/Equivalent WFD (215.5-2038.0) for all sites sampled. The High BMWP indicates an absence/very little pollution (organic loads) and presence of pollution intolerant species e.g. stoneflies (9.9-10.8), dragonflies (8.6) and caddisflies (6.6-8.6).

- 1.6.8 The results indicated High ASPT/Equivalent WFD (19.6-145.6) for all sites sampled. The High ASPT indicates that even though abundances are low, the average scores per taxon is high, especially with the presence of the pollution in-tolerant species e.g. stoneflies (9.9-10.8), dragonflies (8.6) and caddisflies (6.6-8.6).

Fish Fauna

- 1.6.9 Single trout (parr) were recorded in sites A5 and A7. Both of these watercourses are unnamed and distributed within the Allt an Rasail catchment. The Allt an Rasail catchment is limited by the impassable barrier (natural) in the lower reaches. A7 is immediately connected to Loch an Rasail (perhaps the source of fish within this section is from the loch upstream, as upstream migration is not possible, due to of the impassable barrier (natural) downstream).
- 1.6.10 As per the NRA and SFCC (North Region) classifications both sites have been assessed to be Very Low. This indicates no clear variation between the two classification schemes (understandable based on the single fish captures), small population status, a lack of "parr" habitat, restricted access within the watercourse for spawning and nursery, limited survival within previous years and issues with access from the main river downstream (barrier).
- 1.6.11 No fish were recorded at A6, A10, A11, A12, A14, A15 and A21. This indicates small to zero population status, a lack of habitat for fish fauna, restricted/no access within the watercourse for spawning and nursery, no survival within previous years and issues with access from the main river downstream (barrier).
- 1.6.12 For A12 and A14, this was a surprise, as FUP was Very High and Moderate and FHQ was High and Moderate. Also, benthic invertebrate fauna quality at A12 was High and water quality conditions were in the normal ranges at both sites. Perhaps benthic invertebrate fauna quality is so high, based on the absence of fish, that would be feeding on them. Perhaps the high altitudes and the downstream barrier (natural) are the main determining factors. For A21, this is downstream of the existing Achany Wind Farm access track and the site is influenced by the track culvert, scour pool and high organic/peat deposits on the bed.
- 1.6.13 Due to the low densities of fish recorded at A5 and A7, Zippin (1956) estimates were not viable. The Zippin model requires the population size to be larger to enable a total population estimate to be obtained. If the population size is too small this may not be possible, or an estimate with a large coefficient of variation may be produced.
- 1.6.14 Although the NRA classification is based on rivers in England and Wales the use of quantitative sampling using the depletion method provides a reasonably accurate estimate of a given population. Also, statistical confidence limits for a given population estimate can be derived where the numbers of captured fish are sufficient to produce Zippin estimates (SFCC, 2007). The SFCC single-run classification methodology produces a survey with a lower level of precision than that required to produce a full Environmental Impact Assessment (EIA), where baseline information on fish populations prior to the development will need to be collected. When providing information for EIAs the SFCC recommends that fully-quantitative sampling is performed whenever possible.
- 1.6.15 Wood therefore recommend continuing the use of fully-quantitative sampling and the NRA classification for baseline surveys, ongoing monitoring and full EIAs until such times as an equivalent system exists for Scottish rivers. For the above reasons we have utilised the NRA classifications shown in **Figure 8.5.4**.

FWPM

- 1.6.16 None of the sites identified or sampled were considered to be suitable for FWPM.

- 1.6.17 Sites A12 and A14 (**Figure 8.5.2**) were rated as Moderate because they have some of the optimal habitat characteristics, but overall the suitability is limited by the impassable (natural) barrier identified by SEPA downstream, the shallow water depths, the heavy grade substrates, lack of bankside cover and absence of fish fauna.
- 1.6.18 This also corresponds with the FWPM habitat suitability assessment and survey of watercourses that were carried out by Cosgrove (2011) (Further detail is provided in Technical Appendix 8.1). With some small watercourses appearing to be potentially suitable within the original site boundary, however no evidence of FWPM was found within any watercourses surveyed. The author also reported that all watercourses from the proposed windfarm drain into the River Cassley. The River Cassley is known to hold FWPM and is an important tributary of the River Oykel SAC, which is designated for Atlantic salmon and FWPM.
- 1.6.19 Hastie et al (2015) indicated that the River Cassley currently supports a low density FWPM population (code D) with juvenile mussels, indicating recent successful recruitment. The author reported that although moderately stable, and protected by large boulders, the mussel beds are at risk of being washed out by a major flood event. Also, that the FWPM population is likely to be quite small and scattered, perhaps numbering 1000-2000 mussels at most, overall.

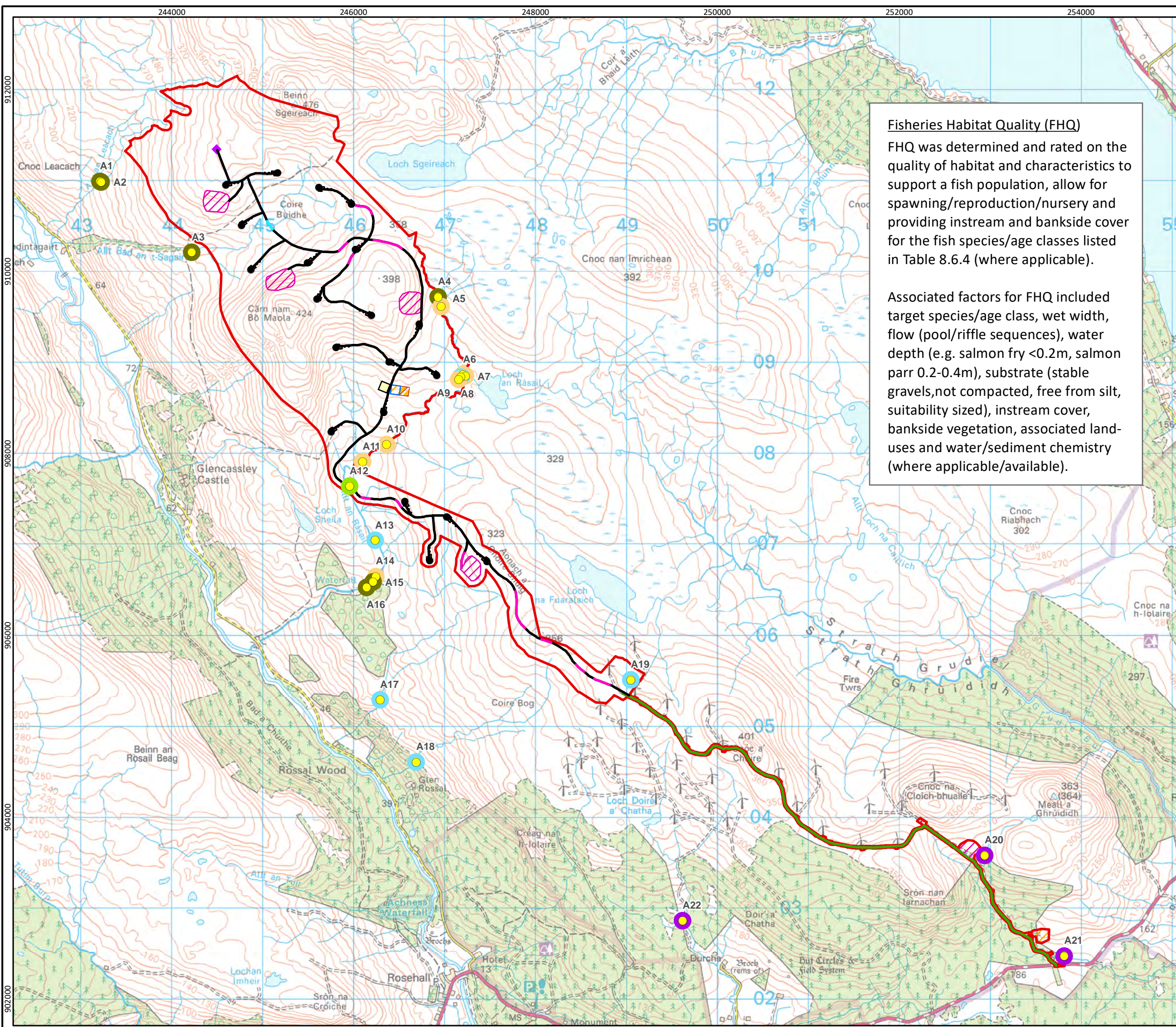
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Fisheries Habitat Quality (FHQ)
 FHQ was determined and rated on the quality of habitat and characteristics to support a fish population, allow for spawning/reproduction/nursery and providing instream and bankside cover for the fish species/age classes listed in Table 8.6.4 (where applicable).

Associated factors for FHQ included target species/age class, wet width, flow (pool/riffle sequences), water depth (e.g. salmon fry <0.2m, salmon parr 0.2-0.4m), substrate (stable gravels, not compacted, free from silt, suitability sized), instream cover, bankside vegetation, associated land-uses and water/sediment chemistry (where applicable/available).

Key

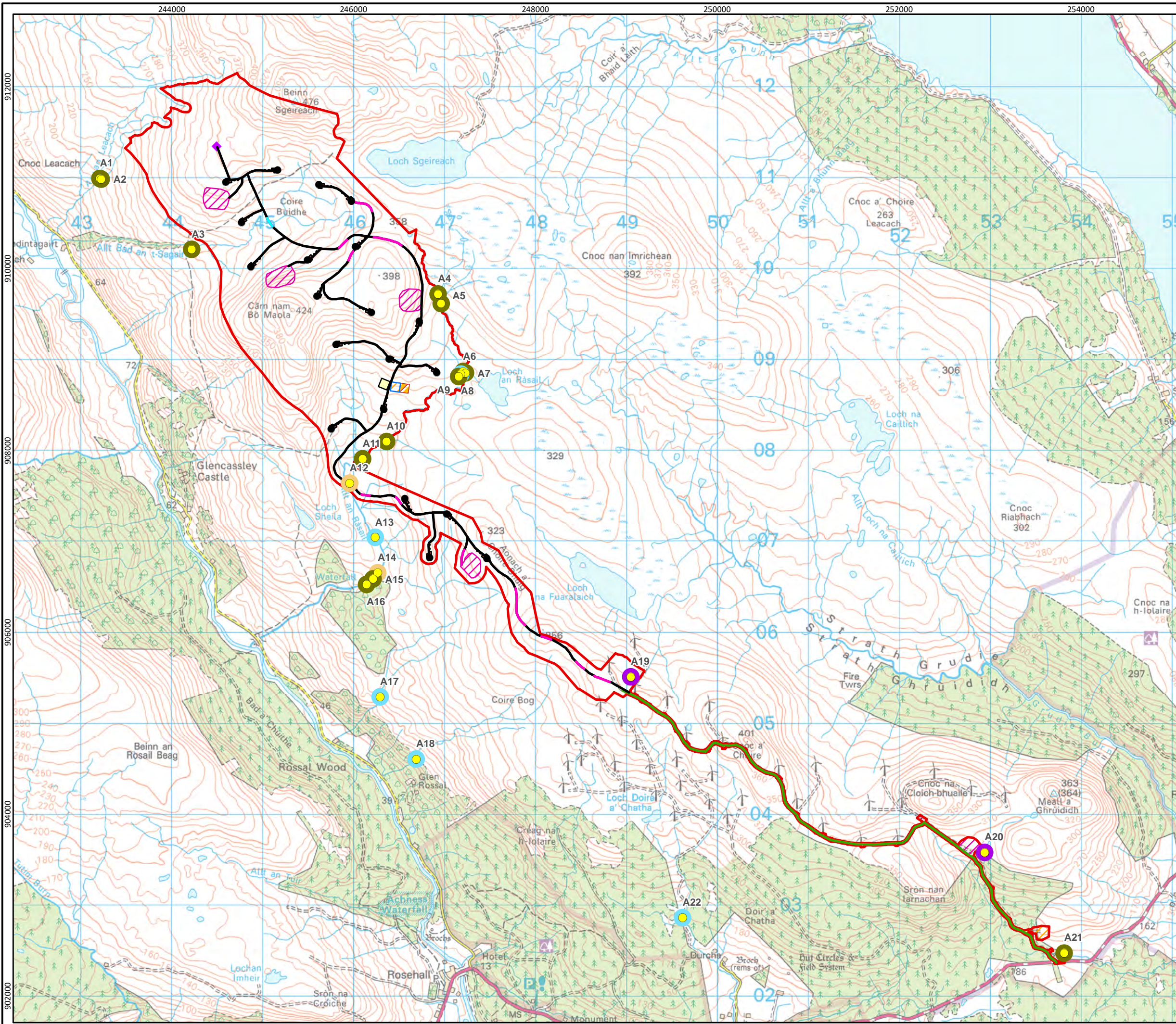
- Site "
- Turbine
- Lidar Location
- Floated Track
- Founded/Cut Track
- Existing Track to be Upgraded
- Borrow 'h
- Hardstanding
- Temporary Construction
- Compound, Security and Storage and Batching Plant
- Extension to Existing Operations Building
- Substation, Welfare Facility and Store
- Temporary Construction
- Compound, Security and Storage
- Survey O

Classification

- Very High
- High
- Moderate
- Low / Moderate
- Low
- Very Low
- No Access
- Not Recorded

Scale 1:40,000 @ A3
 0 1 2 Km

Figure 8.5.1
Baseline Fisheries Habitat & Classification
 Achany Extension Wind Farm
 EIA Report - Technical Appendix 8.5:
 Aquatic Ecology & Fisheries Survey Report



Key

- Site Boundary
- Turbine
- Lidar Location
- Floated Track
- Founded/Cut Track
- Existing Track to be Upgraded
- Borrow Pit
- Hardstanding
- Temporary Construction Compound, Security and Storage and Batching Plant
- Extension to Existing Operations Building
- Substation, Welfare Facility and Store
- Temporary Construction Compound, Security and Storage
- Survey locations

Classification

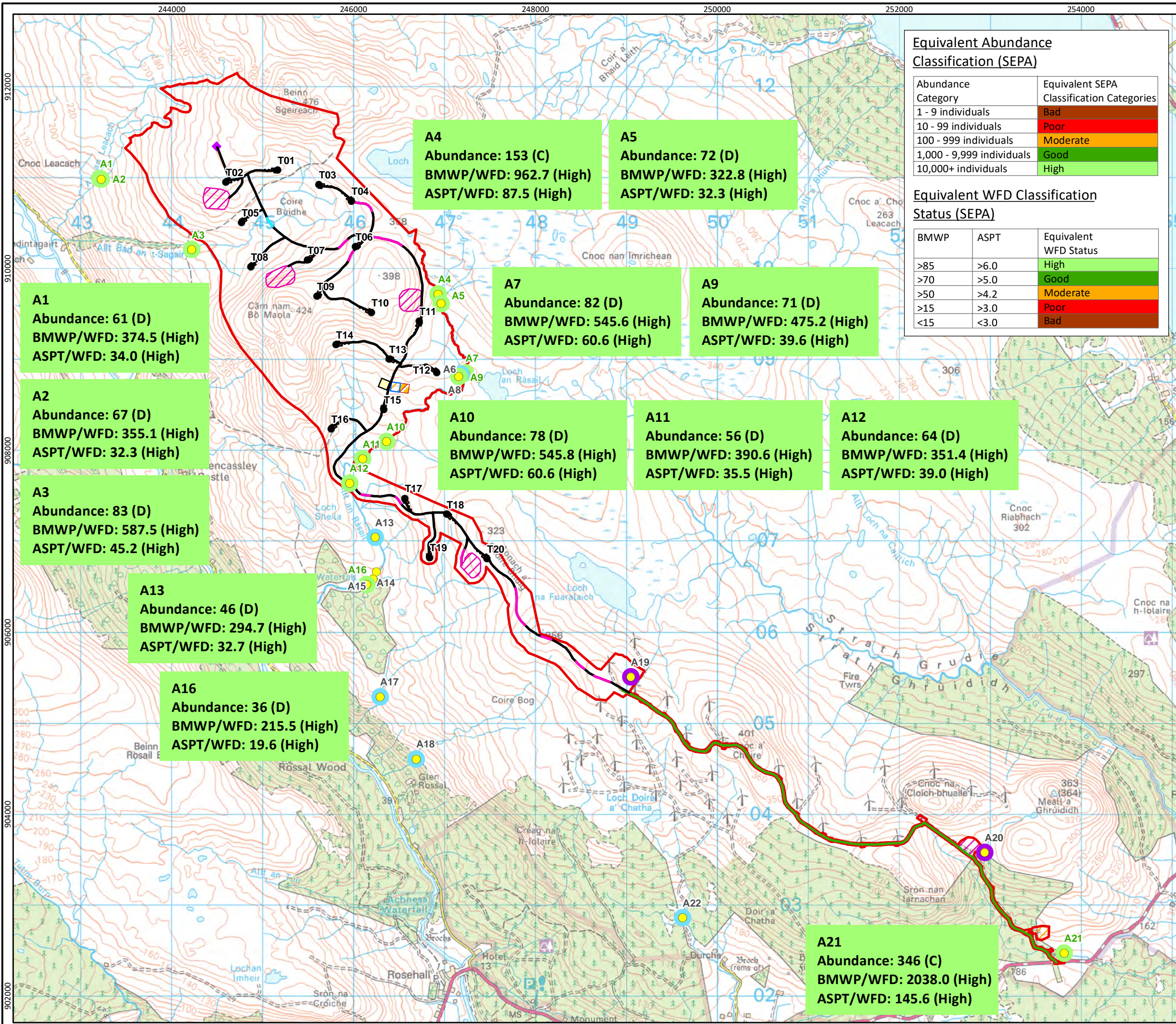
- High
- Good
- Moderate
- Poor
- Bad
- No Access
- Not Recorded

Scale 1:40,000 @ A3

0 1 2 Km

N

Figure 8.5.2
FWPM Habitat Suitability & Ratings
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Equivalent Abundance Classification (SEPA)

Abundance Category	Equivalent SEPA Classification Categories
1 - 9 individuals	Bad
10 - 99 individuals	Poor
100 - 999 individuals	Moderate
1,000 - 9,999 individuals	Good
10,000+ individuals	High

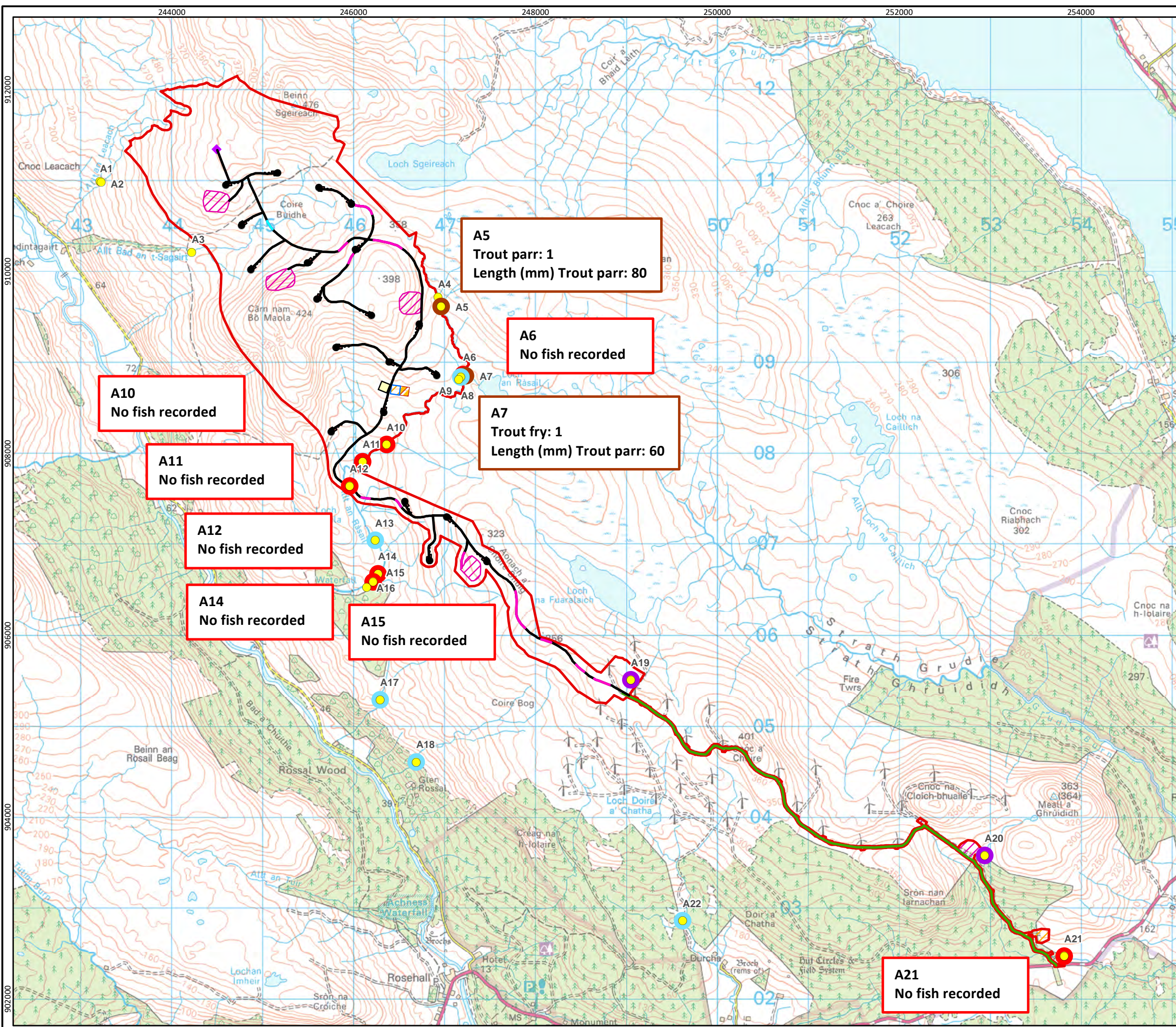
Equivalent WFD Classification Status (SEPA)

BMWP	ASPT	Equivalent WFD Status
>85	>6.0	High
>70	>5.0	Good
>50	>4.2	Moderate
>15	>3.0	Poor
<15	<3.0	Bad

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 - Extension to Existing Operations Building
 - Substation, Welfare Facility and Store
 - Temporary Construction
 - ▨ Compound, Security and Storage
 - Survey Locations
 - Survey Locations with Fisheries
 - No Access
 - Not Recorded
 - A1 Survey Data / Equivalent WFD Status (High)

Scale 1:40,000 @ A3
0 1 2 Km

Figure 8.5.3
Benthic Invertebrate Fauna & Classification
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- Compound, Security and Storage and Batching Plant
- Extension to Existing Operations Building
- Substation, Welfare Facility and Store
- Temporary Construction
- Compound, Security and Storage
- Survey Locations
- No Access
- Not Recorded
- A1 Survey Data / Equivalent WFD Status (High)

NRA Classification

- Very High
- High
- Moderate
- Low
- Very Low
- Absent

Scale 1:40,000 @ A3

0 1 2 Km

N

Figure 8.5.4
Fish Fauna & Classification

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