

Appendix 12.3

Aquatic Ecology

Transport Scotland

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Table of contents

Chapter	Pages
1. Introduction	1
2. Methodology	1
2.1. The Study Area	1
2.2. Identification of Aquatic Receptors	1
2.3. Data Collation	1
2.4. Proportionality of Survey Effort	3
2.5. River Habitat Survey	3
2.6. Fish Habitat Survey	3
2.7. Aquatic Macroinvertebrate Survey	4
2.8. Aquatic Macrophyte Survey	5
2.9. Waterbody National Pond Survey	5
2.10. Freshwater Pearl Mussel Survey	5
2.11. Fish Survey	6
2.12. Limitations	6
3. Impact Assessment Methodology	7
3.1. Introduction	7
3.2. Nature Conservation Evaluation	7
3.3. Impact Assessment	9
3.4. Mitigation	10
4. Results	11
4.1. Watercourse Screening	11
4.2. River Habitat Survey Summary	12
4.3. Fish Habitat Survey Summary	12
4.4. River Aquatic Macroinvertebrate Survey Summary	13
4.5. Freshwater Pearl Mussel Survey Summary	13
4.6. Waterbody Screening	14
4.7. National Pond Survey Results Summary	14
5. Nature Conservation Evaluation	15
5.1. Introduction	15
5.2. Watercourses	16
5.3. Waterbodies	34
6. Potential Impacts	51
6.1. Aquatic Habitats	51
6.2. Aquatic Species	52
7. Mitigation	54
8. Residual Impacts	62
8.1. Aquatic Habitats	62
8.2. Aquatic Species	67
9. Conclusions	71
Annex A. River Habitat Survey Results	74
A.1. Habitat Modification Score (HMS) and Habitat Modification Class (HMC)	74
A.2. Summary Habitat Modification Results	74
Annex B. Fish Habitat Survey Results	84
Annex C. River Macroinvertebrate Survey Results	95
C.1. Site Physical Variables	96

C.2.	Site Taxa Lists	98
C.3.	Site Biotic Metrics	106
Annex D.	National Pond Survey Results	107
D.1.	Site Physico-chemical Variables	107
D.2.	Site Taxa Lists (Macroinvertebrates)	108
D.3.	Site Taxa Lists (Macrophytes)	120
Annex E.	Freshwater Pearl Mussel Technical Report	122
	CONFIDENTIAL ANNEX	122

Tables

Table 3.1:	Importance Criteria	7
Table 3.2:	Impact Magnitude and Character for Ecological Features	9
Table 5.1:	Watercourse Baseline Ecological Evaluation (from North to South)	17
Table 5.2:	Waterbody Baseline Ecological Valuation (from North to South)	35
Table 7.1:	A9 Standard Mitigation Commitments	55
Table 7.2:	Project Mitigation Commitments	57
Table 8.1:	Aquatic Habitats – Specific Impacts, Mitigation and Residual Impacts – Construction	63
Table 8.2:	Aquatic Species – Specific Impacts, Mitigation and Residual Impacts – Operation	69
Table A.1:	River Habitat Modification Class	74
Table C.1:	Site Physical Variable	96
Table C.2:	Site Taxa Lists	98
Table C.3:	Site Biotic Metrics	106
Table D.1:	Site Physico-chemical Variable	107
Table D.2:	Site Taxa List (Macroinvertebrates)	108
Table D.3:	Site Taxa List (Macrophytes)	120

1. Introduction

- 1.1.1. This appendix provides the details of surveys and desk studies in relation to aquatic ecology undertaken to inform the DMRB Stage 3 Assessment for the Proposed Scheme. The appendix includes a nature conservation evaluation and impact assessment.

2. Methodology

2.1. The Study Area

- 2.1.1. The A9 Environmental Steering Group defined the Proposed Scheme plus 150m as an appropriate extent within which to screen for aquatic receptors potentially affected by the Proposed Scheme¹.

- 2.1.2. In practice, this means waterbodies situated 150m or more from the Proposed Scheme were not considered in the assessment. Nor was any watercourse which does not have direct hydrological connectivity (e.g. tributary connectivity) with a watercourse or waterbody within 150m of the Proposed Scheme.

- 2.1.3. However, the Study Area in relation to aquatic receptors was not restricted to the defined screening area and was extended to 2km from the Proposed Scheme. For example, a river fish monitoring site 1.5km downstream of the Proposed Scheme, on a watercourse falling within 150m of the Proposed Scheme, may be considered relevant as part of the assessment.

- 2.1.4. The Study Area is also not synonymous with the Ecological Zone of Influence (EZOI) which can be specific to individual receptors. For example, a watercourse affected by physical modification within 150m of the Proposed Scheme could affect a migratory fish population beyond the Study Area (through, for example, the severance of spawning habitat located several kilometres upstream of the Proposed Scheme).

2.2. Identification of Aquatic Receptors

- 2.2.1. All watercourses and standing waterbodies within the Study Area were identified from contemporary Ordnance Survey (OS) mapping, and the Centre for Ecology and Hydrology (CEH) Digital River Network (DRN; digitised from 1:50k OS mapping).

- 2.2.2. In addition, watercourses not on the DRN were identified by hydrological walkover surveys undertaken by Atkins Mouchel Joint Venture (AMJV) in August 2015. These were screened according to the criteria defined in Section 2.5 of this appendix, and were excluded from the ecological assessment where identified as minor, mostly ephemeral drainage pathways of negligible ecological importance for aquatic flora and fauna.

2.3. Data Collation

- 2.3.1. Several data sources were used in support of the DMRB Stage 3 Assessment for aquatic ecology receptors. Data sources are detailed below.

Publicly Available Data

- 2.3.2. Several publicly available data sources are directly relevant to aquatic receptors including:
- Scottish Environment Protection Agency (SEPA) Water Framework Directive (WFD) Classification Data and River Basin Management Plan (RBMP) Waterbody Datasheets. The RBMP classifies rivers in terms of their Ecological Status at a 'waterbody' scale. Ecological Status is determined by a number of biological, physico-chemical and hydromorphological elements. Relevant data sources relating to the RBMP include:
 - SEPA River Basin Management Plans Interactive Mapⁱⁱ;
 - SEPA Water Classification Hubⁱⁱⁱ;
 - Scotland's Environment website^{iv};
 - Scottish Natural Heritage (SNH) Interactive Map. The SNH Interactive Map delineates statutory designated sites of importance for nature conservation:
 - SNH Site Link^v; and
 - Ordnance Survey contemporary mapping:
 - Including Where's the Path website^{vi}.

Supplementary Data Requests

- 2.3.3. Several data requests were submitted to regulators, stakeholders and record centres in relation to aquatic ecology. Due to the mobility of many aquatic species (such as migratory salmonids), the data request was extended beyond the Study Area to identify all suitable data that could help inform the assessment of the effects of the Proposed Scheme. This has included the following data requests:
- SEPA river biological monitoring data within 2km of the Proposed Scheme collected since 2010. This included a request for taxa lists and biological metrics associated with aquatic macroinvertebrate, macrophyte and phytobenthos communities, as well as barriers to fish migration. Received (in part) 15th October 2015 and updated 2nd March 2016.
 - Spey Foundation electric fishing data within 2km of the Proposed Scheme collected since 2010. Received 24th May 2016 and checked to confirm no relevant updates in March 2018.
 - Scottish Natural Heritage (SNH) freshwater pearl mussel (*Margaritifera margaritifera*) survey data within 2km of the Proposed Scheme. Received 21st October 2015 and updated 1st June 2016.
 - Cairngorms National Park Authority (CNPA) data including a list of priority species for consideration within the DMRB Stage 3 Assessment process. This list was created using the priority species list within the Cairngorms Local Biodiversity Action Plan (LBAP). The list contained 1200 species and was filtered down by the CNPA to 360 species based on rarity. The CNPA provided records for these species, alongside details of areas with potential to support such species based on a review of the Phase 1 habitat survey results. The records provided were classed as prioritised either "Red"¹ or "Amber"².

¹ Red species/habitats are those of highest priority, where there are records in the corridor and they are species and habitats which are particularly vulnerable and high priority for conservation. This includes, for example, northern damselfly (*Coenagrion hastulatum*).

² Amber species/habitats are still considered high priority, but they are instances where there are no confirmed records but indication of habitat suitability had been provided by an expert in that particular group.

A9 Existing Data Sources

- 2.3.4. Several existing data sources collected in support of the DMRB Stage 2 and 3 Assessment were of direct relevance to aquatic habitats and species including:
- CH2M Hill ecological review of watercourse crossing structures (reviewed May 2016);
 - AMJV Phase 1 Habitat Survey data and protected species data (reviewed May 2016);
 - AMJV Amphibian Habitat Suitability Index data for waterbodies (reviewed January 2017); and
 - AMJV watercourse geomorphological walkover data (reviewed January 2017).

2.4. Proportionality of Survey Effort

- 2.4.1. Surveys were undertaken only in the absence of existing baseline data (or suitable proxies, for example SEPA biological monitoring points), ensuring that survey effort was proportionate to the requirement for robust ecological assessment. Existing baseline data (for example, proxy SEPA monitoring data) were reviewed to identify the validity of its use (spatially and temporally) in place of the requirement for additional scheme specific survey.

2.5. River Habitat Survey

- 2.5.1. Watercourses within the Study Area were identified as requiring River Habitat Survey (RHS^{vii}) where:
- the watercourse is a permanent flowing system with a channel width nominally >1m;
 - the watercourse is to be lost/crossed/diverted or potentially experience a significant change in water quality or quantity; and
 - the watercourse is not obviously canalised or heavily managed.
- 2.5.2. In addition, any river which is a direct tributary of, or falls within, a designated water-dependent site of importance for nature conservation was identified for RHS, regardless of whether it meets the specified criteria.
- 2.5.3. At each watercourse identified as requiring survey, a minimum RHS of 500m was undertaken, centred on the proposed design element (for example, a bridge crossing) i.e. 250m upstream and downstream of the specific design element.
- 2.5.4. In selected instances, for example where all design elements could not be covered within a standard 500m RHS section, this was extended to incorporate additional 500m sections to allow for characterisation of the full extent of habitat that could potentially be affected by the Proposed Scheme.
- 2.5.5. All RHS were undertaken in April and May 2017, by RHS accredited freshwater ecologists³.

2.6. Fish Habitat Survey

- 2.6.1. Where RHS was undertaken, based on the criteria outlined in Section 2.5, it was augmented by a bespoke Fish Habitat Survey (FHS).

³ Environment Agency Accredited RHS Surveyor Numbers: FA001 and FA008

- 2.6.2. The survey comprised a habitat suitability assessment for key fish species (e.g. salmonids and lampreys) and life stages, identifying any key discrete habitat features of specific value (e.g. discrete spawning substrate or deep pools).
- 2.6.3. All FHS were undertaken in conjunction with RHS, during April/May 2017 and April 2018 (Allt nan Ceatharnach survey extension only), by competent freshwater ecologists.
- 2.6.4. The FHS made use of existing approaches for fish habitat classification, e.g. Hendry Cragg-Hine Habitat Classification^{viii}. This approach allows key fisheries habitat features to be identified spatially, if required, in relation to Proposed Scheme design elements. This augments the RHS approach which summarises functional habitats at a survey reach scale.

2.7. Aquatic Macroinvertebrate Survey

- 2.7.1. Where RHS was undertaken, based on the criteria outlined in Section 2.5, it was coupled with a standard River Invertebrate Prediction and Classification Software (RIVPACS) method sampling protocol^{ix} survey for aquatic macroinvertebrates.
- 2.7.2. The recognised survey seasons for RIVPACS macroinvertebrate survey are spring (March-May) and autumn (September-November). All macroinvertebrate survey and identification was undertaken in April 2017 (during the spring sampling season) by competent taxonomists, and quality assured by an independent macroinvertebrate taxonomist.
- 2.7.3. A macroinvertebrate survey was undertaken downstream of the design element (the direction in which most impacts will propagate). Where practical, a survey was also undertaken upstream of the design element, in order to establish a control site for future construction/post-construction monitoring. Additional control site data has also been used to characterise the ecological baseline further for the DMRB Stage 3 Assessment.
- 2.7.4. Species level macroinvertebrate identification was undertaken to allow for the calculation of the Community Conservation Index (CCI)^x which has been used to assess community conservation value for the DMRB Stage 3 Assessment. The CCI provides a measure of overall community conservation value, and highlights specific species of conservation importance based on JNCC threat categories (after Wallace, 1991^{xi}). In addition, species were reviewed against the Scottish Biodiversity List (SBL)^{xii} species lists, the CNPA priority species lists (provided by CNPA), and the latest JNCC species designation records^{xiii}.
- 2.7.5. Where multiple surveys were undertaken (i.e. upstream and downstream of the design element), the taxa list was amalgamated to calculate a reach-based (i.e. multi-site) CCI score.
- 2.7.6. In addition, a number of other standard biotic metrics (Average Score Per Taxon (ASPT)^{xiv}, Proportion of Sediment-sensitive Invertebrates (PSI)^{xv}, and Lotic invertebrate Index for Flow Evaluation (LIFE)^{xvi} were calculated, enabling an assessment of overall habitat quality in relation to water quality, flow character and river bed sediment loading. These metrics were calculated for individual survey sites only, as it is not appropriate to combine multi-site taxa lists for these metrics as has been undertaken for CCI.
- 2.7.7. Environmental variables required to generate RIVPACS community predictions were also collected. This ensures that, should it be required in future, the data collected will support a full site RIVPACS classification.

2.8. Aquatic Macrophyte Survey

- 2.8.1. The aquatic macrophyte assemblages of the upland river systems within the Study Area are bryophyte (moss and liverwort) dominated systems, characterised by low vascular macrophyte abundance and diversity.
- 2.8.2. Aquatic macrophytes were therefore not subject to quantitative survey. Aquatic macrophyte identification and recording was undertaken on an *ad hoc* basis during RHS. This is considered to be an appropriate use of survey effort that enables identification of the macrophyte interest present that could be affected by the Proposed Scheme.
- 2.8.3. The Stage 2 DMRB Assessment proposed that should an exceptional case be identified during the RHS surveys (e.g. high floristic diversity), a macrophyte survey would be undertaken. No watercourse was identified that required further survey.

2.9. Waterbody National Pond Survey

- 2.9.1. Waterbody surveys, where required, were undertaken using the National Pond Survey (NPS^{xvii}) method. Waterbodies within the Study Area were subject to NPS where:
- the waterbody is to be lost by any mechanism (drainage, land take to construction etc.) or may experience a significant change in water quality or quantity as a result of the Proposed Scheme (e.g. severance of feeder surface/groundwater pathways to the waterbody) based on available design information (a precautionary approach was adopted in cases of uncertainty); and
 - the waterbody, based on amphibian Habitat Suitability Index (HSI) survey, supports at least 5% macrophyte coverage, is of moderate or good water quality and is less than 80% shaded.
- 2.9.2. In addition, any waterbody which falls within a designated site of importance for nature conservation was identified for NPS, regardless of whether it meets the specified criteria.
- 2.9.3. CNPA data provided identified “Red” waterbodies based on the screening for potential to support SBL species and CNPA Priority Species, such as northern damselfly (*Coenagrion hastulatum*). These ponds were found to overlap with those already identified as requiring survey based on the screening criteria applied.
- 2.9.4. NPS were undertaken in June 2017. Standard practice for NPS is to undertake three seasonal survey visits. However, a single summer survey visit using the NPS method was utilised for the purpose of the Stage 3 DMRB assessment. Three visits are required for a full NPS in order to collect seasonably variable information such as hydrology and water quality. The single summer visit method undertaken was considered sufficient to:
- characterise the pond;
 - identify species of conservation interest; and
 - determine whether the pond qualifies as Priority Habitat under the SBL^{xii}.

2.10. Freshwater Pearl Mussel Survey

- 2.10.1. Freshwater pearl mussel and its habitat are fully protected by law, under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). The species is also listed under Annex II of the Habitats Directive as a species whose conservation requires the

designation of Special Areas of Conservation (SAC). Survey requirements for this legally protected species were determined in liaison with SNH and through application of the following criteria:

- there is a new or extended road crossing which could impact freshwater pearl mussel, their supporting habitat and/or host species; or
- SNH data/historical information confirms the presence of freshwater pearl mussel in areas impacted by in channel working (e.g. bank protection) or an outfall feature (e.g. Sustainable Urban Drainage Systems (SUDS) ponds discharge); or
- areas with supporting habitat (identified through desk based review of data or by RHS) for freshwater pearl mussel, but where no data is available, are at risk of being impacted by in channel working/outfall features.

2.10.2. Shallow water surveys were undertaken following standard SNH freshwater pearl mussel survey protocol for use in site-specific projects^{xviii}. No deep water surveys were required due to the shallow nature of watercourses within the Study Area.

2.10.3. All surveys were undertaken in April 2017 and April 2018 (Allt nan Ceatharnach survey extension only) by licensed surveyors.

2.11. Fish Survey

2.11.1. No scheme-specific fish survey was undertaken due to:

- the availability of baseline electric fishing data; and
- FHS undertaken as part of baseline DMRB Stage 3 surveys which can relate observed habitat potential to likely species presence.

2.11.2. Alongside consultation with relevant fisheries managers (the Spey Fishery Board (SFB)), and a precautionary approach to species distribution; these data were deemed sufficient to identify species which may be present within the Study Area and inform site-specific design and construction mitigation.

2.12. Limitations

2.12.1. Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. The ecological surveys undertaken to support this assessment have not therefore produced a complete list of plants and animals and the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future. However, the results of these surveys have been reviewed and are considered to be sufficient to undertake this assessment.

2.12.2. The Proposed Scheme has undergone several design iterations alongside the development of the EIA. The latest design iteration resulted in an additional (access road) crossing of the Allt nan Ceatharnach not present in earlier design iterations. Existing field data collected in relation to the Allt nan Ceatharnach A9 crossing was reviewed to confirm its adequacy in characterising the newly affected reach for assessment purposes. The FHS and freshwater pearl mussel survey were extended to this location to inform both the EIA and Habitats Regulations Assessment (HRA) of the River Spey SAC. The existing RHS and macroinvertebrate data were considered to provide suitably proxy for the assessment of the additional Allt nan Ceatharnach crossing and were not extended.

3. Impact Assessment Methodology

3.1. Introduction

3.1.1. Ecological features have been subject to nature conservation evaluation. Impact significance has then been assessed taking into account the nature and magnitude of potential impacts (including duration, extent and reversibility) and their consequent effects on important ecological features. The approach to nature conservation evaluation and impact assessment was agreed across the wider A9 Dualling Programme.

3.2. Nature Conservation Evaluation

3.2.1. The general approach to defining the importance of ecological features follows that of the Chartered Institute of Ecology and Environmental Management (CIEEM, 2016)^{xix}. The approach is also in line with advice given in DMRB Interim Advice Note 130/10 'Ecology and Nature Conservation: Criteria for Impact Assessment'^{xx}.

3.2.2. Ecosystems, habitats and species within the Ecological Zone of Influence (EZol⁴) are assigned levels of importance for nature conservation based on the criteria set out in Table 3.1.

3.2.3. The rarity, ability to resist or recover from environmental change, and uniqueness of an ecological feature, function/role within an ecosystem, and level of legal protection or designation afforded to a given ecological feature are all factors taken into account in determining its importance.

Table 3.1: Importance Criteria

Importance	Criteria
International	<p>Ecosystems and Habitats Ecosystems or habitats essential for the maintenance of:</p> <ul style="list-style-type: none"> internationally designated areas or undesignated areas that meet the criteria for designation; and/or viable populations of species of international conservation concern. <p>Species Species whose presence contributes to:</p> <ul style="list-style-type: none"> the maintenance of qualifying habitats, communities and assemblages that occur within internationally designated sites or within undesignated areas that meet the criteria for such designation.
National	<p>Ecosystems and Habitats Ecosystems or habitats essential for the maintenance of:</p> <ul style="list-style-type: none"> qualifying communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; and/or viable populations of species of national conservation concern. <p>Species</p>

⁴ EZol is an area defined by the assessment in which there may be ecological features subject to impacts and subsequent effects as a result of the Scheme

Importance	Criteria
	<p>Species whose presence contributes to:</p> <ul style="list-style-type: none"> the maintenance of qualifying habitats, communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; or the maintenance and restoration of biodiversity and ecosystems at a national level, as defined in the Scottish Biodiversity Strategy (SBS)^{xxi}.
Regional	<p>Ecosystems and Habitats Ecosystems or habitats essential for the maintenance of:</p> <ul style="list-style-type: none"> communities and assemblages that occur within regionally important sites or localities listed as being of conservation importance in the Highland Biodiversity Action Plan (BAP) or Cairngorms Nature Action Plan (CNAP) (including Local Nature Reserves (LNR)) or within undesignated areas that meet the criteria for such designation; and/or viable populations of species of regional conservation concern. <p>Species Species whose presence contributes to:</p> <ul style="list-style-type: none"> the maintenance and restoration of biodiversity and ecosystems at a regional level, as defined in the Highland BAP or CNPA.
Authority Area	<p>Ecosystems and Habitats Ecosystems or habitats essential for the maintenance of:</p> <ul style="list-style-type: none"> populations of species of conservation concern within the authority area. <p>Species Species whose presence contributes to:</p> <ul style="list-style-type: none"> the maintenance and restoration of biodiversity and ecosystems within a relevant area such as Aviemore in the CNPA.
Local	<p>Ecosystems and Habitats Ecosystems or habitats essential for the maintenance of:</p> <ul style="list-style-type: none"> populations of species of conservation concern within the local area (for example a Local Nature Reserve). <p>Species Species whose presence contributes to:</p> <ul style="list-style-type: none"> the maintenance and restoration of biodiversity and ecosystems at a local level.
Less than Local	<p>Ecosystems and Habitats</p> <ul style="list-style-type: none"> Ecosystems or habitats that do not meet the above criteria, i.e., supporting at least populations of species of conservation concern within the local area. <p>Species</p> <ul style="list-style-type: none"> Features that are considered to be absent or do not meet any of the above criteria.

3.2.4. The valuations applied to aquatic receptors consider the receptor importance in the context of both intrinsic habitat quality and the species it has been identified to support. Had specific notable species, or species protected under specific legislation been identified during the DMRB Stage 3 Assessment, these may have been considered important enough to value in their own right, i.e. separately from the receptor. For example, a viable population of freshwater pearl mussel could be accorded a higher valuation than the watercourse in which it is found. Based on the survey results there was no requirement for species/population valuation as part of the assessment.

3.3. Impact Assessment

3.3.1. For the purposes of this assessment, the impact descriptors in Table 3.2 are taken to summarise the overall characterisation of positive or negative impacts in accordance with CIEEM (2016)^{xix}, including:

- impact extent/scale (e.g. entire habitat loss, partial habitat loss or indication over specific area affected);
- direct or indirect impact (e.g. direct mortality of individuals from vehicle collisions, or indirect mortality of individuals from reduced prey resources due to pollution of watercourses);
- reversibility of impact (reversible or irreversible);
- frequency of impact (single event, recurring or constant);
- duration of impact (short-term, medium-term, long-term or permanent); and
- likelihood of occurrence (certain/near certain, probable, unlikely or extremely unlikely).

3.3.2. The character of impacts was defined using the criteria set out in Table 3.2 as High, Medium, Low or Negligible, following the above impact characterisation approach.

Table 3.2: Impact Magnitude and Character for Ecological Features

Impact Descriptor	Impact Characterisation
High	An impact resulting in a permanent effect on the distribution and/or abundance of a habitat, species assemblage/community or population, in such a way as to alter the integrity of the feature and its conservation status. If negative, this type of effect would reduce the integrity of the feature and its conservation status. If positive, it would result in an improvement to the conservation status of the feature.
Medium	An impact resulting in a long-term but reversible effect on the distribution and/or abundance of a habitat, species assemblage/community or population. If negative, this type of effect would have neutral long-term implications for the integrity of the feature or its conservation status. If positive, it would not alter the long-term conservation status of the feature.
Low	An impact resulting in a short-term reversible effect on the distribution and/or abundance of a habitat, species assemblage/community or population.
Negligible	No discernible impact on the distribution and/or abundance of a habitat, species assemblage/community or population.

Impact Significance

3.3.3. Each feature's importance and the potential impacts upon it have been determined through surveys and consultation, to provide a robust basis for making a professional decision on the appropriate focus of the impact assessment. The assessment is then focused on those impacts that result in potentially significant effects on important ecological features. Habitats, species and species groups that are considered to have a nature conservation value of less than local are not considered important ecological features⁵ in the context of this assessment. Any impact on such a feature as a result of the Proposed Scheme is considered unlikely to have a significant effect on the conservation status of such habitats or species on a local, regional, national or

⁵ An ecological feature is considered important based on many factors including its rarity, diversity, naturalness, context in the wider landscape, size and distribution as set out in A Nature Conservation Review (Ratcliffe, 1977).

international scale. Therefore, features assessed to be of less than local nature conservation value have been scoped out of the ecological impact assessment (EclA).

- 3.3.4. CIEEM (2016)^{xix} notes that impacts that are likely to be relevant in an assessment are those that are predicted to lead to significant effects (negative or positive) on important ecological features. Significant effects are those that undermine the conservation status⁶ of important ecological features. Knowledge and assessment of construction methods and operational activities, together with the ecological knowledge of ecologists with experience of similar large-scale infrastructure projects, has been used to identify the potential impacts of the Proposed Scheme on ecological features.
- 3.3.5. Following the above approach the assessment aims to characterise ecological impacts rather than placing a reliance only on magnitude. The character of an impact is used to inform the determination of whether or not the impact on the feature in question is a significant one.
- 3.3.6. Where impacts on internationally, nationally or regionally important ecological features are characterised as 'Medium' or 'High', they are considered to be potentially significant under the terms of the Environmental Impact Assessment (EIA) Regulations^{xxii}.
- 3.3.7. Impacts characterised as 'Low' on internationally important features, can be determined as potentially significant as can impacts characterised as 'High' on features of Authority Area importance. There may in addition be a number of impacts on a feature that, whilst not of a character to be significant in themselves, may cumulatively result in a significant effect on that feature.
- 3.3.8. Where significant impacts are identified, mitigation will be developed to reduce impacts where feasible and are taken into account in the assessment of residual effects.

3.4. Mitigation

- 3.4.1. The principles of the mitigation hierarchy^{xxiii} have been applied when considering potential impacts and subsequent effects on ecological receptors within the EZoI. The principles of the mitigation hierarchy are that impacts on biodiversity should be subject to the following sequential mitigation actions:
- avoidance;
 - mitigation;
 - compensation; and
 - enhancement.
- 3.4.2. For the purpose of this assessment, mitigation refers to measures that are considered essential to avoid and reduce negative impacts of the Proposed Scheme. Compensation refers to measures taken to make up for the loss of, or permanent damage to, biological resources through the provision of replacement areas. Unless otherwise stated, all compensatory measures are considered to be part of the essential mitigation package.
- 3.4.3. The mitigation measures described within this EclA have been incorporated into the design and construction programme and taken into account in the assessment of residual effects. The mitigation aims to avoid or negate impacts on ecological features in accordance with best practice guidance and UK, Scottish and local government

⁶ Conservation status for habitats is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and function as well as the long-term distribution and abundance of its population within a given geographical area. Conservation status for species is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its population within a given geographical area.

environmental impact, planning and sustainability policies. These mitigation measures include those required to achieve the minimum standard of established good practice together with additional measures to further reduce any negative impacts of the Scheme. The mitigation measures include those required to reduce or avoid the risk of committing legal offences.

- 3.4.4. Mitigation is also designed to produce a net gain for biodiversity where practicable in line with policy and guidelines^{xix}.
- 3.4.5. Mitigation measures set out in this Environmental Statement (ES) will be specified as environmental commitments in the contract documents to ensure implementation by the appointed Contractor.
- 3.4.6. Impacts that are not significant (including those where compliance with regulation is required) would be expected to be avoided or reduced through the application of a Construction Environmental Management Plan (CEMP) and best working practice (e.g. mitigation of potential pollution impacts through adherence to standard best practice and guidelines). Significant ecological impacts are expected to be mitigated through a combination of best practice and typical, proven mitigation methods along with mitigation targeted to specific locations as described in the assessment.

4. Results

4.1. Watercourse Screening

- 4.1.1. A total of 28 watercourses were identified within the Study Area during the desk study. This includes 18 watercourses that are crossed by the existing A9 or will be crossed by the Proposed Scheme and 10 within 150m of the Proposed Scheme that are not crossed.
- 4.1.2. Following the application of the screening criteria as defined in Section 2.5 of this appendix, a total of nine watercourses were identified as requiring further survey to assess their ecological value for the purpose of DMRB Stage 3 Assessment. These watercourses were:
- Bogbain Burn;
 - Allt nan Ceatharnach;
 - River Dulnain;
 - Allt Cnapach;
 - Aviemore Burn;
 - Allt na Criche (Lynwilg);
 - Caochan Ruadh;
 - Allt Chriochaidh; and
 - Allt an Fhearna.
- 4.1.3. The watercourses were subject to RHS, FHS, aquatic macroinvertebrate survey and freshwater pearl mussel survey according to the methods described in Section 2.5 of this appendix.
- 4.1.4. Survey locations for all surveys undertaken are shown in Figures 12.11 and 12.12.

4.2. River Habitat Survey Summary

- 4.2.1. River habitats within the Study Area are characteristic of the upland, historically managed landscape and 'flashy' hydrological regime of the low permeability catchment setting.
- 4.2.2. Common to all survey reaches, RHS recorded low vascular macrophyte abundance and diversity, a bed substrate dominated by gravel, pebble and cobble, and a range of flow types from high energy (e.g. chute flow) to low energy (smooth laminar flow).
- 4.2.3. All rivers surveyed exhibited a degree of historical modification, consistent with the rural (managed) landscape and the presence of existing infrastructure. Dominant bank land use was developed/managed, consisting of coniferous plantation, rough pasture, urban development and mixed woodland.
- 4.2.4. Three rivers within the Study Area - Allt nan Ceatharnach, River Dulnain and Allt na Criche (Lynwilg) - are designated as part of the River Spey Special Area of Conservation (SAC). The River Spey SAC is designated for Habitats Directive Annex II species including freshwater pearl mussel, sea lamprey (*Petromyzon marinus*), Atlantic salmon (*Salmo salar*) and otter (*Lutra lutra*).
- 4.2.5. Three rivers within the Study Area - Caochan Ruadh, Allt Chriochaidh and Allt an Fhearna - fall within the Alvie Site of Special Scientific Interest (SSSI) and have a direct role in supporting wetland site features for which Alvie SSSI is notified.
- 4.2.6. With the exception of Allt Cnapach, Caochan Ruadh and Allt Chriochaidh, all surveyed rivers within the Study Area are also considered likely to meet criteria for the river Priority Habitat definition^{xxiv}, based on the species assemblages which they support (six or more Priority Habitat Criterion B species).
- 4.2.7. Individual site accounts are presented in Section 5, with Habitat Modification Score (HMS) calculations detailed in full in Annex A.

4.3. Fish Habitat Survey Summary

- 4.3.1. With the exception of Allt Cnapach, all rivers surveyed provide diverse salmonid fish habitat. Areas of salmonid spawning habitat were also recorded throughout. Features associated with wooded reaches (large woody debris and undercut banks) locally enhance fish habitat.
- 4.3.2. Based on habitats recorded at survey, most rivers within the Study Area are considered likely to support migratory salmonids, as well as resident populations of brown trout (*Salmo trutta*), and potentially small numbers of other lithophilic- gravel spawners such as common minnow (*Phoxinus phoxinus*) and lamprey species. Other eurytopic species (those able to tolerate a wide range of environmental conditions) such as European eel (*Anguilla anguilla*) are likely to be supported by habitats present within the Study Area. Species diversity is likely to be low, as is typical for upland rivers of this type, however abundance of species present may be locally high based on habitat potential. Of note, the River Dulnain and its tributaries are likely to provide a major habitat resource for migratory salmonids within the River Spey SAC.
- 4.3.3. Juvenile salmonids were observed in small numbers throughout most reaches surveyed. In addition, available Spey Foundation electric fishing data from 2010-2015 confirmed the presence of Atlantic salmon and trout fry and parr in varying abundance, as well as European eel in monitoring sites within and adjacent to the Study Area. Adult brook lamprey were also observed during field surveys within the Caochan Ruadh.

- 4.3.4. Several artificial barriers to upstream migration were recorded within the Study Area, some of which are likely to be impassable to migratory species (excluding European eel) during most flow conditions. Of note, artificial bridge inverts and/or culverts associated within the Allt nan Ceatharnach (A9 crossing and Highland Main Line railway bridge), Aviemore Burn (A9 crossing), Allt na Criche (Lynwilg Road crossing) and Allt Chrìochaidh (A9 crossing) act to sever high quality fish habitat upstream of the crossing locations.
- 4.3.5. Individual site accounts are presented in Section 5, with survey results presented in full in Annex B.

4.4. River Aquatic Macroinvertebrate Survey Summary

- 4.4.1. River aquatic macroinvertebrate communities recorded across the Study Area are indicative of high flow velocity, low sedimentation, and low nutrient enrichment (i.e. good water quality).
- 4.4.2. Species richness was high, with over 100 species recorded across all sites, including several species of conservation interest as detailed in the individual site accounts. Individual site species richness was variable, with an average of 40 taxa recorded, ranging from 22 to 53 across the sample sites.
- 4.4.3. Of note, the Regionally Notable⁷ stonefly *Protonemura meyeri*, Notable⁸ caddisfly *Rhyacophila fasciata*, SBL listed species (SBL Watching Brief only⁹; SBL Criterion S1¹⁰) southern iron blue mayfly *Nigrobaetis niger*, and Regionally Notable⁷ water beetle *Oreodytes davisii* were recorded at river sites.
- 4.4.4. Individual site accounts in Section 5, with survey results presented in full in Annex B.

4.5. Freshwater Pearl Mussel Survey Summary

- 4.5.1. No live or dead freshwater pearl mussels were found in any rivers subject to crossing or drainage discharge by the Proposed Scheme. Of the 56 habitat suitability transects undertaken across the rivers surveyed, roughly half (27) were unsuitable, 10 were poor, 13 were moderate and only six were good. A full account of all surveys undertaken is provided in Annex E.
- 4.5.2. The Allt na Criche joins the River Spey approximately 300m downstream of the A9 crossing. The survey here was therefore extended onto the River Spey for approximately 350m downstream of the confluence with the Allt na Criche, where habitat suitability ranged from poor (x2 transects) to moderate (x1 transect). Eight live freshwater pearl mussel adults were recorded within the River Spey.
- 4.5.3. Given the absence of freshwater pearl mussel recorded in rivers being crossed by the Proposed Scheme, and the sub-optimal nature of most habitat recorded, direct impacts on this species within the Study Area have been scoped out of the assessment.
- 4.5.4. Given small numbers of freshwater pearl mussel were recorded on the River Spey (known to support a significant population of freshwater pearl mussel), further consideration has been given to potential indirect impacts on freshwater pearl mussel populations within the wider EZol in the impact assessment. For example, barrier effects

⁷ Species thought to occur in fewer than five localities (regions) across Great Britain.

⁸ Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid.

⁹ 'There is less concern for these habitats and species, which only require monitoring for now'.

¹⁰ 'The species is on the UK BAP list but not considered to be at particular risk in Scotland'.

on migratory salmonids (freshwater pearl mussel host species) have the potential to affect mussel populations outside of the Study Area. Measures will be implemented to avoid and mitigate construction and operational effects that could otherwise impact freshwater pearl mussel populations within the EZol.

4.6. Waterbody Screening

- 4.6.1. A total of 38 waterbodies were identified within the Study Area during the desk study.
- 4.6.2. Following the application of the screening criteria as defined in Section 3 of this appendix, 14 waterbodies were identified as requiring further survey to assess their ecological value for the purpose of DMRB Stage 3 Assessment.
- 4.6.3. The location of these 14 waterbodies (Ponds 8, 14, 16, 18, 19, 21(a, b and c), 28, 30, 31, 37, 43 and 44) are shown in Figure 12.16.
- 4.6.4. With the exception of Ponds 8, 16 and 30 all Ponds were identified as “Red” in the CNPA data provided, based on their *potential* to support priority species, namely amphibians and northern damselfly (see Section 1 for definition of CNPA classifications).
- 4.6.5. Confirmed records of northern damselfly were also provided for Ponds 21 and 30 in the CNPA data.
- 4.6.6. The waterbodies were subject to NPS as described in Section 3 of this appendix.

4.7. National Pond Survey Results Summary

- 4.7.1. Except for three ponds which were slightly alkaline, all pond habitat within the Study Area was slightly to moderately acidic, with relatively high dissolved oxygen levels. This is characteristic of the upland setting, hard geology and prevailing oligotrophic/dystrophic (low nutrient) conditions typical of much of the standing water in the region.
- 4.7.2. Macroinvertebrate taxa richness was exceptionally high with over 150 species recorded, including several species of conservation interest, as detailed in individual site accounts. Site species richness was variable, with an average of 36 taxa recorded, ranging from 16 to 51 across the sample sites.
- 4.7.3. Of note, the SBL species (SBL Conservation Action Needed¹¹; SBL Criterion S3¹²) and Endangered¹³ northern damselfly has been confirmed from historical CNPA records at four ponds within the Study Area. *Coenagrionidae* (narrow-winged damselflies) larvae were also identified to family level through pond surveys undertaken for the Proposed Scheme, but could not be resolved to species level due to the early larval development stage of the specimens. Given northern damselfly is known to be distributed within the survey area, a conservative approach was taken for this species which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.

¹¹ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

¹² Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

¹³ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

- 4.7.4. The SBL species (Watching Brief only¹⁴; SBL Criterion S4¹⁵) and Near Threatened¹⁶ water beetle *Hydrochus brevis*, as well as the Nationally Scarce¹⁷ crane fly *Phalacrocerca replicata* and water boatman *Arctocoris carinata* were also confirmed from pond surveys undertaken.
- 4.7.5. Nineteen truly aquatic macrophytes (obligate hydrophytes) were also recorded across the ponds surveyed. However, none were of notable rarity or specific conservation interest.
- 4.7.6. Loch Puladdern (Pond 43) falls within the Craigellachie SSSI, notified for upland birch woodland and its moth assemblage.
- 4.7.7. Ten of the 14 ponds surveyed are also considered likely to meet criteria for the pond Priority Habitat definition^{xxv} (the exceptions being Ponds 14, 16, 28 and 43), based either on their species assemblage (supporting 50 or more macroinvertebrate species) and/or the assumption that they support northern damselfly.
- 4.7.8. Individual site accounts are presented in Section 5, with raw survey results summarised Annex D.

5. Nature Conservation Evaluation

5.1. Introduction

- 5.1.1. The Allt nan Ceatharnach, River Dulnain, and Allt na Criche (Lynwilg) are designated as part of the River Spey SAC and are therefore of International importance for nature conservation. Pond 21 forms part of the Loch Vaa Special Protection Area (SPA) and is also of International importance for nature conservation.
- 5.1.2. The Caochan Ruadh, Allt Chrioichaidh and Allt an Fhearna fall within the Alvie SSSI and are therefore of National importance for nature conservation.
- 5.1.3. No other watercourses or waterbodies within the Study Area are in themselves designated as non-statutory or statutory sites of nature conservation interest, nor do they fall within any such site. However, watercourses and waterbodies may be also be defined as Priority Habitat under the SBL (and therefore up to National importance for nature conservation) if published criteria are met.
- 5.1.4. The Priority Habitat definitions for rivers^{xxiv} and ponds^{xxv} include several prescriptive criteria by which receptors may qualify. Interpretation is required for one of these criteria in relation to rivers. Headwaters (i.e. a watercourse within 2.5km of its furthest source) qualify only if they have not been 'significantly altered from their natural state'. For the purpose of this assessment headwaters will be considered 'significantly altered from their natural state' if they have a HMS of 3 (Obviously Modified) or more based on RHS results.
- 5.1.5. Watercourses and waterbodies meeting the criteria for inclusion in the assessment of the Proposed Scheme are considered to be at a minimum of Local importance, and up to International importance for nature conservation (i.e. SAC habitat).

¹⁴ 'There is less concern for these habitats and species, which only require monitoring for now'.

¹⁵ The species occurs in less than 6 10km squares of the National Grid in Scotland.

¹⁶ Near Threatened under Red listing based on 2001 IUCN guidelines. Near Threatened- taxa which do not qualify for Lower Risk (conservation dependent), but which are close to qualifying for Vulnerable. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable.


¹⁷ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

- 5.1.6. All watercourses and waterbodies not meeting the criteria for inclusion in the assessment of the Proposed Scheme are assumed to be Less than Local importance for nature conservation.

5.2. Watercourses

- 5.2.1. The results of field survey and the ecological valuation of watercourses within the Study Area is set out in Table 5.1, with watercourse locations shown in Figure 12.12.
- 5.2.2. Results of all surveys undertaken are considered in relation to each watercourse receptor to determine its overall ecological valuation for the purpose of assessment.
- 5.2.3. Original survey data from surveys undertaken in support of the ecological valuations is presented in the corresponding Annex.

Table 5.1: Watercourse Baseline Ecological Evaluation (from North to South)

Watercourse: Bogbain Burn (Ch19000)	Central NGR: NH 87681 24207
 <p>P1010794 – downstream of A9</p>	<p>Baseline Ecological Valuation</p> <p><i>Regional</i> importance for nature conservation. Bogbain Burn provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and ‘Fairly High’ conservation value under the CCI scoring system, including the Regionally Notable¹⁸ stonefly <i>P. meyeri</i>. As well as having intrinsic conservation value, the Bogbain Burn is likely to qualify as SBL Priority Habitat, and serves an important function in terms of flow and sediment delivery to the Allt nan Ceatharnach, which is itself designated as part of the River Spey SAC.</p>
<p>WFD Characterisation</p> <ul style="list-style-type: none"> • Classified WFD Waterbody – No • Proxy SEPA Ecological Monitoring Data Available for Watercourse – No • Receiving Downstream Classified WFD Waterbody – River Dulnain - Allt Ruighe Magaig (WB ID 23112) • Overall Ecological Status of Receiving WFD Waterbody – Good <p>River Habitat Survey (Survey Code WC-032-RH-001)</p> <ul style="list-style-type: none"> • Representative Channel Dimensions: Water Depth: 0.2m, Water Width: 1.6m, Bankfull Width: 2.1m • Habitat Modification Score (HMS): 830 • Habitat Modification Class (HMC): 4 (significantly modified) • Descriptive Summary: A dynamic gravel-bed tributary stream of the Allt nan Ceatharnach flowing through mixed woodland and coniferous plantation. Evidence of significant lateral migration, with berms and terraces recorded. A range of bed substrates (cobble, gravel-pebble, sand and silt), high and low energy flow types, pools, riffles, unvegetated point, side and mid-channel bars, and eroding cliffs provide excellent habitat diversity. High input of large woody debris, constricting flow and promoting habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type. • Constraints: Evidence of historical channel realignment associated with the Highland Main Line railway bridge, particularly downstream of the crossing, contributes to the HMC recorded. Habitat potential is constrained by the presence of the Highland Main Line which intersects and constricts its flow path. Downstream of the railway crossing within the survey reach, the river channel has struggled to recover natural sinuosity following historical realignment and change in land use to plantation woodland. River habitat is of reduced quality as compared with upstream of the crossing. <p>Fish Habitat Survey (Survey Code WC-032-FH-001)</p> <ul style="list-style-type: none"> • Summary: Upstream of the Highland Main Line railway bridge crossing (NH 87858 24216), diverse salmonid fish habitat with fry, parr, pool and glide habitats recorded, as well as sparse optimal¹⁹ spawning habitat. Locally, mixed shade, undercut banks and exposed bankside roots enhance fish habitat quality. Fine sediment deposition was apparent in lower reaches, immediately upstream of the Highland Main Line crossing, which locally enhances habitats available for lamprey species. Downstream of the railway 	

¹⁸ Species thought to occur in fewer than five localities (regions) across Great Britain.

¹⁹ Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2 cm. Water depth in the range 17–76 cm. Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing (after Hendry & Cragg-Hine (1997)).

Watercourse: Bogbain Burn (Ch19000)

Central NGR: NH 87681 24207

bridge there is a distinct change in character to a uniform channel, historically realigned to the railway embankment. Low recovery from historical modification, and decline in fish habitat quality compared with upstream of the crossing. However, substrate and flow conditions continue to provide glide and riffle/run habitat, within the context of a modified channel.

- Fish Data: No existing monitoring data available for Bogbain Burn. Small numbers of juvenile salmonids were observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However, species richness is likely to be low, as is typical for upland rivers of this type.
- Barrier Assessment: Minor natural in-stream barriers were noted, associated with fallen trees (with a maximum head difference of 0.2m) which are unlikely to significantly affect fish movement through the reach surveyed. The Bogbain Burn is not crossed by the A9 and the Highland Main Line railway crossing within the reach surveyed does not present a barrier to fish.

Aquatic Macroinvertebrate Survey (Survey Codes WC-032-AI-001 & WC-032-AI-002)

- The community is species-rich, with 51 taxa recorded over two sample points. Twenty-eight families were represented (the Scottish mean is approximately 25^{xvii}, from a monitoring network comprising over 300 monitoring sites). Of these, 23 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 182 and 186. WHPT ASPT (Family): 7.75 and 8.28. LIFE (Species): 9 and 9.08. PSI (Species): 94 and 94.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and very low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 11.36 and 12.27 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 12.08 - i.e. a community of 'Fairly High' conservation importance. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven predominantly by taxon richness, but also the presence of the Regionally Notable²⁰ stonefly *P. meyeri*.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-032-PM-001)

- No live or dead specimens were recorded. Habitat suitability ranged from moderate (x5 transects) to good (x1 transects) within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Bogbain Burn is not designated as a statutory or non-statutory site of nature conservation importance. It is however a direct tributary of the Allt nan Ceatharnach, part of the River Spey SAC designated for Habitats Directive Annex II species including freshwater pearl mussel, sea lamprey, Atlantic salmon and otter.
- Bogbain Burn is likely to qualify as SBL Priority Habitat due to its species assemblage. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Otter (see ES Appendix 12.10) and soprano pipistrelle *Pipistrellus pygmaeus* (see ES Appendix 12.5) are criterion level B species which have been confirmed as present through A9 surveys. Fish habitat suitability and historical fish records (from the receiving Allt na Ceatharnach) suggest there is a high probability of additional criterion level B species being present, including Atlantic salmon, brown trout, European eel and lamprey species. Bogbain Burn is therefore considered likely to meet the criteria for designation as river Priority Habitat based on its species assemblage.

²⁰ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Allt nan Ceatharnach (Ch17400)

Central NGR: NH 89121 23149



P1010765 - downstream of A9

Baseline Ecological Valuation

International importance for nature conservation. Allt nan Ceatharnach is designated as part of the River Spey SAC. It provides a range of habitats important in supporting SAC qualifying species. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'High' conservation value under the CCI scoring system, including the Regionally Notable²¹ stonefly *P. meyeri* and the SBL species southern iron blue mayfly.

WFD Characterisation

- Classified WFD Waterbody – Yes; River Dulnain - Allt Ruighe Magaig (WB ID 23112)
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Overall Ecological Status of WFD Waterbody – Good

River Habitat Survey (Survey Code WC-033-RH-001)

- Representative Channel Dimensions: Water Depth: 0.2m, Water Width: 4.0m, Bankfull Width: 4.2m
- Habitat Modification Score (HMS): 1625
- Habitat Modification Class (HMC): 5 (severely modified)
- Descriptive Summary: A dynamic gravel-bed tributary stream of the River Dulnain flowing through moorland and coniferous plantation. A range of bed substrates (boulder, cobble, gravel-pebble and sand), high and low energy flow types, pools, riffles and unvegetated side bars provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Two major bridges and evidence of historical channel and bank re-sectioning and reinforcement associated with the Highland Main Line railway bridge and the A9 crossing, contribute to the HMC recorded. Habitat potential is constrained by the presence of the Highland Main Line and A9 crossings which affect river continuity (in terms of flow and sediment transport due to artificial channel and bank reinforcement) and prevent lateral channel migration.

Fish Habitat Survey (Survey Code WC-033-FH-001 and WC-033-FH-002)

- Summary: Optimal salmonid spawning habitat recorded, particularly in lower reaches. Relatively diverse salmonid fish habitat with fry, parr, pool and glide habitats recorded. Locally, undercut banks and exposed bankside roots enhance fish habitat. Sparse suitable habitat identified for lamprey ammocoetes in lower reaches.
- Fish Data: Density electric fishing surveys undertaken between 2011 and 2015 by the Spey Foundation recorded a wide density range of Atlantic salmon fry (34 - 257 per 100m²) and parr (3 - 23 per 100m²) at sites between 130 m and 800 m downstream of the A9 crossing. The Scottish Fisheries Co-ordination Centre (SFCC) classification system Moray Firth Region (SFCC, 2005^{xxvii}), corrected for stream width, classified these sites from 'B - Good' to 'A - Excellent'; the parr classification ranged from 'E - Very Low' to 'B - Good'. Trout fry (8 - 47 per 100m²) and parr (0 - 13 per 100m²) densities ranged from 'B - Good' to 'A - Excellent' for fry, and 'Absent' to 'A - Excellent' for parr. European eel was also recorded (in 2013) approximately 300m downstream of the A9 crossing.
- No Atlantic salmon fry were recorded upstream of the A9 crossing; salmon parr were recorded in low density (1 - 9 parr per 100m²); the SFCC classification for parr ranging from 'E - Very Low' to 'D - Low'.

²¹ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Allt nan Ceatharnach (Ch17400)

Central NGR: NH 89121 23149

The presence of parr and absence of fry is due to mitigation stocking undertaken by the Spey Fishery Board due to the presence of the road and railway migration barriers, consistent with the barrier assessment undertaken during Proposed Scheme surveys. Trout fry (1 - 30 per 100m²) and parr (3 - 12 per 100m²) were also recorded upstream of the A9 crossing; SFCC classifications of 'E- Very Low' to 'B - Good' and 'E - Very Low' to 'C - Moderate' for trout fry and parr respectively. All densities quoted are based on single run (or first run of multiple runs) electrofishing survey- as opposed to catch depletion.

- Small numbers of juvenile salmonids were also observed upstream and downstream of the A9 crossing during freshwater pearl mussel surveys in this reach (see Annex E).
- Barrier Assessment: Artificial in-stream barriers effectively restrict habitat utilisation upstream of the A9 as they are likely to be impassable to most species (excluding eel) during most flow conditions:
 - NH 89112 23125: Engineered bed-check downstream of A9 crossing, constructed from artificial material (rip-rap). May be passable to upstream migration by adult salmonids in some flow conditions, but presents a permanent barrier to localised (upstream) dispersal of juvenile life-stages and other species (excluding eel). Approximately 12m long bed-check, with a 2.5m total head difference.
 - NH 89111 23157: Artificial perched bridge invert under the A9 road crossing, acting to create a shallow flume under the A9 of approximately 40m length, with 0.1m water depth and flow velocities of 1.0-1.5m/s. Likely impassable to upstream movement by all species, excluding eel.
 - NH 89163 23304: Artificial perched bridge invert under Highland Main Line railway bridge, upstream of A9 crossing. Similar hydraulic conditions to the A9 road crossing. Likely impassable to upstream movement by all species, excluding eel.

Aquatic Macroinvertebrate Survey (Survey Codes WC-033-AI-001 & WC-033-AI-002)

- The community is highly species-rich, with 64 taxa recorded over two sample points. Thirty-five families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 28 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 179 and 202. WHPT ASPT (Family): 7.46 and 7.51. LIFE (Species): 8.71 and 8.72. PSI (Species): 94 and 89.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and very low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 10.40 and 15.56 were recorded from respective sites, considered to be communities of 'Fairly High' and 'High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based CCI classification), the score is 16.05 - i.e. a community of 'High' conservation importance. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven predominantly by taxon richness, but also the presence of the Regionally Notable²² stonefly *P. meyeri*.
- Of note, the SBL listed species (SBL Watching Brief only²³; SBL Criterion S1²⁴) southern iron blue mayfly was also recorded.

Freshwater Pearl Mussel Survey (Survey Code WC-033-PM-001 and WC-033-PM-002)

- No live or dead specimens were recorded. Habitat suitability included poor (x1 transect), moderate (x5 transects) and good (x6 transects) within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Allt nan Ceatharnach is designated as part of the River Spey SAC, for Habitats Directive Annex II species including freshwater pearl mussel, sea lampre, Atlantic salmon and otter.
- SSSI river habitat automatically qualifies as SBL Priority Habitat however SAC habitat does not. The Allt nan Ceatharnach is part of the Spey SAC but not the Spey SSSI designation. However, the Allt nan

²² Species thought to occur in fewer than five localities (regions) across Great Britain.

²³ 'There is less concern for these habitats and species, which only require monitoring for now'.

²⁴ 'The species is on the UK BAP list but not considered to be at particular risk in Scotland'.

Watercourse: Allt nan Ceatharnach (Ch17400)

Central NGR: NH 89121 23149

Ceatharnach is likely to qualify as Priority Habitat due to its species assemblage. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Atlantic salmon, brown trout, southern iron blue mayfly, otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5) are criterion level B species and have all been confirmed as present through A9 surveys and historical records. There is also a high probability of additional criterion level B species being present based on habitat suitability, including European eel and lamprey species. The Allt nan Ceatharnach is therefore considered likely to meet the criteria for designation as river Priority Habitat based on its species assemblage.

Watercourse: River Dulnain (Ch16600)

Central NGR: NH 89668 22548



P1010745 – downstream of A9

Baseline Ecological Valuation

International importance for nature conservation. The River Dulnain is designated as part of the River Spey SAC. It provides a range of habitats important in supporting SAC qualifying species. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system.

WFD Characterisation

- Classified WFD Waterbody – Yes; River Dulnain - Allt Ruighe Magaig (WB ID 23112)
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Overall Ecological Status of WFD Waterbody – Good

River Habitat Survey (Survey Code WC-034-RH-001)

- Representative Channel Dimensions: Water Depth: 0.4m, Water Width: 21m, Bankfull Width: 24m
- Habitat Modification Score (HMS): 460
- Habitat Modification Class (HMC): 3 (obviously modified)
- Descriptive Summary: Dynamic gravel-bed major river system through mixed land use (mixed plantation, rough pasture and urban development). A range of bed substrates (bedrock, boulder, cobble, gravel- pebble and sand), high and low energy flow types, pools, unvegetated side bars and eroding cliffs provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: A major bridge (Highland Main Line railway bridge), a minor bridge (A9 road bridge) and evidence of historical bank reinforcement contribute to the HMC recorded, constraining habitat potential by preventing lateral channel migration.

Fish Habitat Survey (Survey Code WC-034-FH-001)

- Summary: Optimal salmonid spawning habitat recorded throughout. High quality, diverse salmonid fish habitat with fry, parr, pool and glide habitats also recorded within the reach. Locally, undercut banks and exposed bankside roots enhance fish habitat availability. Likely to be a critical habitat resource for local fish populations, providing arterial connectivity to a range of smaller tributaries throughout the area- including Allt nan Ceatharnach and the Bogbain Burn). No suitable habitat identified for lamprey ammocoetes.

Watercourse: River Dulnain (Ch16600)

Central NGR: NH 89668 22548

- Fish Data: Timed electric fishing surveys undertaken in 2012 and 2015 by the Spey Foundation recorded relatively low densities of Atlantic salmon fry and parr approximately 550 m downstream of the A9 crossing (13-16 fry and 1-4 parr per 100m²); no trout fry or parr were recorded. Timed site results are expressed as fish numbers per minute captured and classified under a salmon fry index classification developed by the Spey Foundation. As these are primarily salmon fry surveys no timed survey classification system has been developed for parr. These surveys were classed as 'C – Moderate' under the fry classification.
- Small numbers of juvenile salmonids and swim-up fry were observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However, species richness is likely to be low, as is typical for upland rivers of this type.
- Barrier Assessment: No barriers recorded within survey reach. Neither the A9 or Highland Main Line crossing acts as a barrier to fish movement- both are large clear-span structures with footings and piers set on the bank-face.

Aquatic Macroinvertebrate Survey (Survey Codes WC-034-AI-001 & WC-034-AI-002)

- The community is species-rich, with 51 taxa recorded over two sample points. Thirty-one families were represented (the Scottish mean is approximately 25^{xvii}, from a monitoring network comprising over 300 monitoring sites). Of these, 26 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 154 and 204. WHPT ASPT (Family): 8.11 and 7.57. LIFE (Species): 8.7 and 8.5. PSI (Species): 96 and 89.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 10.56 and 14.00 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 11.04 - i.e. a community of 'Fairly High' conservation importance. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven by taxon richness rather than species of specific rarity or conservation importance in the combined taxa list.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-034-PM-001)

- No live or dead specimens were recorded within the River Dulnain. Due to the width of the channel, parallel suitability transects were undertaken aligned to the left and right banks. Habitat suitability ranged from unsuitable (x3 transects) to good (x1 transect) on the left bank surveys, and unsuitable (x3 transects) to moderate (x1 transect) on the right bank transects. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- The River Dulnain is designated as part of the River Spey SAC, for Habitats Directive Annex II species including freshwater pearl mussel, sea lamprey, Atlantic salmon and otter. SSSI river habitat automatically qualifies as SBL Priority Habitat however SAC habitat does not. The River Dulnain is part of the Spey SAC but not the Spey SSSI designation. However, the River Dulnain is likely to qualify as Priority Habitat due to its species assemblage. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Atlantic salmon, otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5) are criterion level B species and have all been confirmed as present through A9 surveys and historical records. There is a high probability of additional criterion level B species being present based on habitat suitability, including brown trout, European eel and lamprey species. The River Dulnain is therefore considered likely to meet the criteria for designation as river Priority Habitat based on its species assemblage.

Watercourse: Allt Cnapach (Ch12200)

Central NGR: NH 91043 18551



P1010725 - upstream of A9

Baseline Ecological Valuation

Local importance for nature conservation. Although Allt Cnapach is unlikely to provide a significant habitat resource for fish, it provides dynamic cascade stream habitat and supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system, including the Regionally Notable²⁵ stonefly *P. meyeri*.

WFD Characterisation

- Classified WFD Waterbody – No
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – Not applicable; Allt Cnapach appears to discharge to (and terminate) in a wetland

River Habitat Survey (Survey Code WC-036-RH-001)

- Representative Channel Dimensions: Water Depth: 0.1m, Water Width: 1.6m, Bankfull Width: 1.8m
- Habitat Modification Score (HMS): 1675
- Habitat Modification Class (HMC): 5 (severely modified)
- Descriptive Summary: Upland minor cascade system with high gradient (10-15%, locally 20% in upper reaches) through mixed woodland (upstream 250m) and rough pasture (downstream 250m) land use. A range of bed substrates (bedrock, boulder, cobble, gravel-pebble, sand and silt), high and low energy flow types provide good habitat diversity in the context of a minor channel. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: A major bridge (Highland Main Line railway bridge), a major weir, and two culverts (one associated with the A9 road crossing) contribute to the HMC recorded, affecting river continuity (flow and sediment transport) and preventing lateral channel migration.

Fish Habitat Survey (Survey Code WC-036-FH-001)

- Summary: Poor quality fish habitat throughout due to high gradients recorded and cascade type habitat.
- Fish Data: No existing monitoring data available for Allt Cnapach.
- Barrier Assessment: Four artificial barriers (including a bridge, weir and two culverts) were recorded but are unlikely to have a material effect on resource use due to poor quality fish habitat recorded throughout.

Aquatic Macroinvertebrate Survey (Survey Codes WC-036-AI-001 and WC-036-AI-002)

- The community is highly species-rich, with 62 taxa recorded over two sample points. Thirty-four families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 27 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.

²⁵ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Allt Cnapach (Ch12200)

Central NGR: NH 91043 18551

- Key community biological metrics for respective sampling sites: WHPT (Family): 175 and 187. WHPT ASPT (Family): 7.62 and 7.48. LIFE (Species): 8.60 and 9.05. PSI (Species): 87 and 78.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and slight channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 10.91 and 10.83 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 11.4 - i.e. a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven predominantly by taxon richness, but also the presence of the Regionally Notable²⁶ stonefly *P. meyeri*.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-036-PM-001)

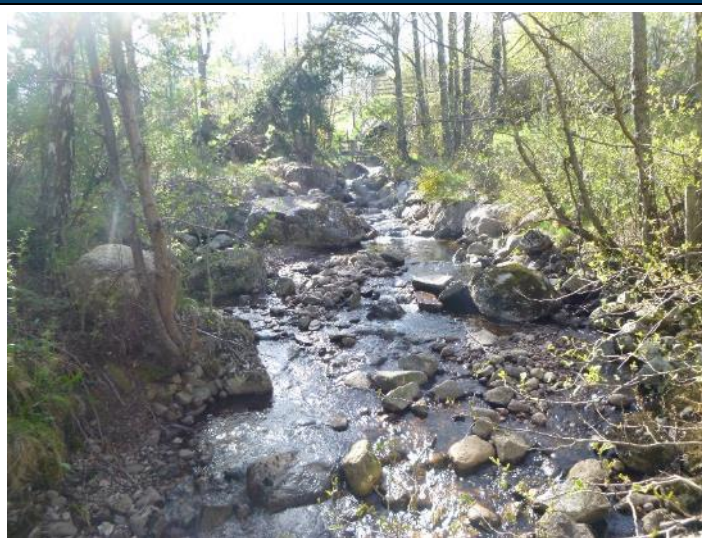
- No live or dead specimens were recorded. Habitat suitability was exclusively classed as unsuitable within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Allt Cnapach is not designated as a statutory or non-statutory site of nature conservation importance.
- Allt Cnapach is a headwater as defined under SBL Priority Habitat definitions. However, it has been 'significantly altered from its natural state', as evidenced by the River Habitat Survey and is therefore not considered to be Priority Habitat under the definition. Although otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5) have been recorded on the watercourse, the Allt Cnapach is not considered to support a significant fish assemblage based on habitat suitability. It is therefore unlikely to qualify as river Priority Habitat.

Watercourse: Aviemore Burn (Ch7150)

Central NGR: NH 89308 13811



P1010824 – downstream of A9

Baseline Ecological Valuation

Regional importance for nature conservation. Despite being severely modified by road and residential development, Aviemore Burn provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system, including the Regionally Notable²⁶ stonefly *P. meyeri*. As well as having intrinsic conservation value, the Aviemore Burn is likely to qualify as SBL Priority Habitat, and serves an important function in terms of flow and sediment delivery to the River Spey SAC.

WFD Characterisation

- Classified WFD Waterbody – No
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Spey - R. Feshie to R. Nethy (WB ID 23097)
- Overall Ecological Status of Receiving WFD Waterbody – Moderate

²⁶ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Aviemore Burn (Ch7150)

Central NGR: NH 89308 13811

River Habitat Survey (Survey Code WC-044-RH-001)

- Representative Channel Dimensions: Water Depth: 0.15m, Water Width: 4m, Bankfull Width: 4.5m
- Habitat Modification Score (HMS): 1540
- Habitat Modification Class (HMC): 5 (severely modified)
- Descriptive Summary: Severely modified gravel-bed stream system through mixed land use (mixed plantation, urban development and parkland/garden). Despite extensive modifications, a range of bed substrates (boulder, cobble, gravel-pebble, sand and artificial), high and low energy flow types, pools, unvegetated point and side bars and eroding cliffs provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Extensive modifications due to roads and residential development, including three minor bridges, two intermediate bridges, and a culvert (the A9 crossing) contribute to the HMC recorded. Modifications have affected river continuity (flow and sediment transport) and prevent lateral channel migration.

Fish Habitat Survey (Survey Code WC-044-FH-001)

- Summary: Variable fish habitat quality throughout the survey reach. High-gradient cascade type habitats present in upper reaches; fish habitat improves moving downstream of the A9 crossing, particularly downstream of the residential development. Mix of fry, parr, pool and glide habitats, as well as discrete optimal spawning habitat in the lower 100m of the 500m survey reach. Locally, mixed shade, undercut banks and exposed bankside roots enhance fish habitat quality. Despite the significant modifications (including multiple crossings), only a single artificial barrier was recorded (the A9 culvert), as described below.
- Fish Data: Density electric fishing surveys undertaken between 2010 and 2014 by the Spey Foundation, approximately 100m upstream and downstream of the A9 crossing, recorded no Atlantic salmon fry upstream or downstream of the crossing, and very low numbers of parr (1 - 3 per 100m²) downstream crossing only. Relatively low densities of trout fry (1 - 6 per 100m²) and moderate densities of trout parr (4 - 14 per 100m²) were recorded upstream of the A9 crossing. Higher densities of trout fry (9 - 29 per 100m²) and parr (6 - 38 per 100m²) were recorded downstream of the A9 crossing, along with European eel. The Scottish Fisheries Co-ordination Centre (SFCC) classification system Moray Firth Region (SFCC, 2005^{xxvii}), corrected for stream width, classified the trout fry and parr densities upstream of the A9 crossing as 'E – Very Low' to 'A – Excellent' and 'D – Low' to 'A – Excellent' upstream of the A9 crossing. All densities quoted are based on single run (or first run of multiple runs) electrofishing survey- as opposed to catch depletion.
- Small numbers of juvenile salmonids were also observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability. However, species richness is likely to be low, as is typical for upland rivers of this type.
- Barrier Assessment: The A9 crossing acts as an artificial in-stream barrier, effectively restricting habitat utilisation upstream of the A9 as it is likely to be impassable to most species (excluding eel) during most flow conditions:
 - NH 89330 13856. A9 pipe culvert, approximately 2m diameter culvert, with perched culvert outlet (head difference of approximately 0.3m), followed by an additional 0.5m head difference immediately downstream of a placed boulder bed-check. The culvert itself is approximately 15m long with a head difference of 1.2m between the inlet and outlet (approximate 8% gradient). In-combination, the structure and downstream bed-check creates a 2m total head difference and is likely impassable to upstream migration by all species (excluding eel) during most flow conditions.

Aquatic Macroinvertebrate Survey (Survey Codes WC-044-AI-001 & WC-044-AI-002)

- The community is moderately species-rich, but comparatively species-poor compared with other watercourses surveyed as part of this assessment, with 39 taxa recorded over two sample points. Twenty-five families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 22 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.

Watercourse: Aviemore Burn (Ch7150)

Central NGR: NH 89308 13811

- Key community biological metrics for respective sampling sites: WHPT (Family): 118 and 175. WHPT ASPT (Family): 7.89 and 7.65. LIFE (Species): 8.80 and 8.95. PSI (Species): 95 and 89.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 11.92 and 11.39 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 11.75 - i.e. a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven predominantly by taxon richness, but also the presence of the Regionally Notable²⁷ stonefly *P. meyeri*.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-044-PM-001)

- No live or dead specimens were recorded. Habitat suitability ranged from unsuitable (x4 transects) to poor (x2 transects) within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Aviemore Burn is not designated as a statutory or non-statutory site of nature conservation importance. It is a tributary of the River Spey SAC, joining the River Spey approximately 2km downstream of the A9 crossing.
- Aviemore Burn is a headwater as defined under SBL Priority Habitat definitions. However, it has been 'significantly altered from its natural state', as evidenced by the River Habitat Survey and is therefore not considered to be Priority Habitat under the headwater definition. However, it is likely to qualify as Priority Habitat due to its species assemblage. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Atlantic salmon, brown trout, European eel, otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5) have been confirmed through A9 surveys and historical records. There is also high probability of additional criterion level B species, for example lamprey species, being present based on habitat suitability. Aviemore Burn is therefore considered likely to qualify as river Priority Habitat based on its species assemblage.

Watercourse: Allt na Criche (Lynwilg) (Ch3500)

Central NGR: NH 88382 10623



P1010936 – downstream of A9

Baseline Ecological Valuation

International importance for nature conservation. Allt na Criche is designated as part of the River Spey SAC. It provides a range of habitats important in supporting SAC qualifying species. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system, including the Regionally Notable²⁷ stonefly *P. meyeri*.

²⁷ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Allt na Criche (Lynwilg) (Ch3500)

Central NGR: NH 88382 10623

WFD Characterisation

- Classified WFD Waterbody – No
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Spey - R. Feshie to R. Nethy (WB ID 23097)
- Overall Ecological Status of Receiving WFD Waterbody – Moderate

River Habitat Survey (Survey Code WC-049-RH-001)

- Representative Channel Dimensions: Water Depth: 0.15m, Water Width: 4m, Bankfull Width: 4.5m
- Habitat Modification Score (HMS): 1735
- Habitat Modification Class (HMC): 5 (severely modified)
- Descriptive Summary: Dynamic gravel-bed river system through rough pasture and mixed woodland. Evidence of significant lateral migration, with berms and terraces recorded. Despite extensive modifications, a range of bed substrates (boulder, cobble, gravel-pebble, sand, silt and artificial), high and low energy flow types, pools, unvegetated point, side and mid-channel bars and stable/eroding cliffs provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Extensive modifications due to road and rail development, including a culvert, three intermediate bridges, one minor bridge and a major ford contribute to the HMC recorded. Modifications have affected river continuity (flow and sediment transport) and prevent lateral channel migration which is apparent in lower reaches.

Fish Habitat Survey (Survey Code WC-049-FH-001)

- Summary: High quality juvenile fish habitat throughout, with fry, parr, pool and glide habitats recorded. No discrete optimal spawning habitats but widespread opportunistic spawning habitat available. A range of shade and depth conditions locally enhance fish habitat, alongside wooded features, such as undercut banks and extensive exposed bankside roots. Discrete areas of sand/silt and organic detritus recorded, which may be of value for lamprey ammocoetes.
- Fish Data: Density electric fishing surveys undertaken in 2012 and 2015 by the Spey Foundation approximately 600m upstream of the A9 crossing (and 400m upstream of the Lynwilg Road crossing- see Barrier Assessment) recorded trout fry (28 - 47 per 100m²) and parr (10 - 16 per 100m²) but no Atlantic salmon *Salmo salar*. The Scottish Fisheries Co-ordination Centre (SFCC) classification system Moray Firth Region (SFCC, 2005^{xxvii}), corrected for stream width, classified these sites as 'B - Good' and 'C - Moderate' for trout fry and parr respectively. All densities quoted are based on single run (or first run of multiple runs) electrofishing survey- as opposed to catch depletion.
- Small numbers of juvenile salmonids were also observed in the reach beneath the A9 bridge deck during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However, species richness is likely to be low, as is typical for upland rivers of this type.
- Barrier Assessment: Two artificial in-stream barriers were recorded, one of which effectively restricts habitat utilisation upstream of the Lynwilg Road, as described below:
 - NH 88348 10631. Artificial bed at ford comprising concrete and placed stone. Approximately 15m long with a head difference of approximately 1m between downstream and upstream extent (approximate 7% gradient). Downstream extent perched above channel in places (up to 0.4m). High velocity flow approximately 0.05m flow depth at survey. Impassable to upstream migration by all species (excluding eel) at survey. Likely passable to upstream salmonid migration during some flow conditions.
 - NH 88191 10687. Artificial concrete invert at Lynwilg road bridge. Structure perched, with an approximate head difference of 0.7m observed at survey, with a scour pool downstream of structure of approximately 0.6m depth. Artificial invert approximately 15m in length, set on a shallow gradient with high velocity flow, average depth of 0.1m. Bed check comprising boulders located immediately downstream of scour pool, created a second hydraulic head with a head difference of 0.7m across bed check. In combination, the structure is likely to be impassable to upstream movement of all species during most flow conditions (excluding eel).

Aquatic Macroinvertebrate Survey (Survey Codes WC-049-AI-001 & WC-049-AI-002)

Watercourse: Allt na Criche (Lynwilg) (Ch3500)

Central NGR: NH 88382 10623

- The community is moderately species-rich, but comparatively species-poor compared with other watercourses surveyed as part of this assessment, with 40 taxa recorded over two sample points. Twenty-one families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 18 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 140 and 129. WHPT ASPT (Family): 7.80 and 7.58. LIFE (Species): 9.00 and 8.82. PSI (Species): 98 and 90.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 12.22 and 12.14 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 12.5 - i.e. a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven predominantly by taxon richness, but also the presence of the Regionally Notable²⁸ stonefly *P. meyeri*.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-049-PM-001)

- No live or dead specimens were recorded within the Allt na Criche. Habitat suitability ranged from unsuitable (x3 transects) to moderate (x1 transect) within habitat transects undertaken. The Allt na Criche joins the River Spey approximately 300m downstream of the A9 crossing. The survey was therefore extended onto the River Spey for approximately 350m downstream of the confluence with the Allt na Criche, where habitat suitability ranged from poor (x2 transects) to moderate (x1 transect). A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Allt na Criche (Lynwilg) is designated as part of the River Spey SAC, for Habitats Directive Annex II species including freshwater pearl mussel, sea lamprey, Atlantic salmon and otter.
- SSSI river habitat automatically qualifies as SBL Priority Habitat however SAC habitat does not. The Allt na Criche (Lynwilg) is part of the Spey SAC but not the Spey SSSI designation. However, the Allt na Criche is likely to qualify as Priority Habitat due to its species assemblage. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Otter (see ES Appendix 12.10), soprano pipistrelle (see ES Appendix 12.5) and brown trout have been confirmed as present through A9 surveys and historical records. Based on habitat suitability (and records from the receiving River Spey) there is a high probability of additional criterion level B species being present, including Atlantic salmon, European eel and lamprey species. The Allt na Criche is therefore considered likely to qualify as river Priority Habitat, based on its species assemblage.

²⁸ Species thought to occur in fewer than five localities (regions) across Great Britain.

Watercourse: Caochan Ruadh (Ch1700)

Central NGR: NH 86650 10095



P1010910 – downstream of A9

Baseline Ecological Valuation

National importance for nature conservation. Caochan Ruadh falls within the Alvie SSSI and serves an important function in terms of flow and sediment delivery to the wetland features for which Alvie SSSI is designated. It also provides a range of habitats that supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system. Although good quality fish habitat is restricted to downstream of the A9, it has been shown to support brook lamprey that could be genetically isolated.

WFD Characterisation

- Classified WFD Waterbody – No
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – Loch Alvie (WB 100181)
- Overall Ecological Status of Receiving WFD Waterbody – Good

River Habitat Survey (Survey Code WC-052-RH-001)

- Representative Channel Dimensions: Water Depth: 0.15m, Water Width: 1m, Bankfull Width: 2m
- Habitat Modification Score (HMS): 1100
- Habitat Modification Class (HMC): 4 (significantly modified)
- Descriptive Summary: Minor stream system through rough pasture and mixed woodland. A range of bed substrates (boulder, cobble, gravel-pebble, sand, silt and artificial), high and low energy flow types, riffles, pools, unvegetated point and side bars, natural berms and stable/eroding cliffs provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Modifications due to road development and agricultural land use, including a culvert, two minor bridges, and bankside poaching contribute to the HMC recorded. Modifications have affected river continuity (flow and sediment transport) and prevent lateral channel migration.

Fish Habitat Survey (Survey Code WC-052-FH-001)

- Summary: Two reaches of distinct character. The downstream 200m (0-200m) extent comprised diverse fish habitat for a stream of its character (small dimensions and predominant land use), with juvenile salmonid habitat, restricted opportunistic spawning gravels, and fine sediment accumulations adjacent providing excellent lamprey habitat. Fine sediment ingress was noted to be driven, in part, by livestock bank poaching. The upstream 200-500m reach character changes to step-pool, cascade type morphology due to high gradient, resulting in poor fish habitat quality below and upstream of the A9 crossing. The A9 crossing itself presents an artificial barrier as described below.
- Fish Data: FWPM: Adult brook lamprey (*Lampetra planeri*) (approximately 10 no.) were observed throughout the downstream 200m reach of the Caochan Ruadh during habitat surveys (i.e. immediately upstream of Loch Alvie) congregating around spawning gravels. The stream system drains to Loch Alvie, which itself has no obvious major downstream connectivity, suggesting the lamprey population may be genetically isolated. No other monitoring data are available.
- Barrier Assessment: The A9 crossing acts as an artificial in-stream barrier, effectively restricting habitat utilisation upstream of the A9 as it is likely to be impassable to most species (excluding eel) during most flow conditions:

Watercourse: Caochan Ruadh (Ch1700)

Central NGR: NH 86650 10095

- NH 86648 10089. A9 pipe culvert (approximately 25m long, 2m diameter culvert). Outlet perched 0.2m above downstream channel. Downstream channel itself is artificial and reinforced for approximately 15m downstream of the culvert. The artificial bed is also perched by approximately 0.2m at the point at which it connects to the downstream channel. Flow across artificial bed and through A9 culvert is high velocity, but low depth (approximately 0.2m). Structure is likely impassable to upstream movement by all species (excluding eel) during most flow conditions. However, habitat upstream of the structure is generally unsuitable.

Aquatic Macroinvertebrate Survey (Survey Codes WC-052-AI-001 & WC-052-AI-002)

- The community is highly species-rich, with 64 taxa recorded over two sample points. Thirty-four families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 27 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 183 and 204. WHPT ASPT (Family): 7.63 and 7.87. LIFE (Species): 8.83 and 8.58. PSI (Species): 78 and 80.
- Biological metrics are indicative of diverse in-channel habitat, good water quality, high flow velocity conditions and slight channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 9.32 and 15.00 were recorded from respective sites, considered to be communities of 'Moderate' and 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (to produce a reach-based classification), the score is 10.18 - i.e. a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven by taxon richness rather than species of specific rarity or conservation importance in the combined taxa list.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-052-PM-001)

- No live or dead specimens were recorded. Habitat suitability was exclusively classed as unsuitable within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Caochan Ruadh falls within the Alvie SSSI and has a direct role in supporting the wetland site features for which Alvie SSSI is notified.
- Caochan Ruadh is a headwater as defined under Priority Habitat definitions. However, it has been 'significantly altered from its natural state', as evidenced by the River Habitat Survey and is therefore not considered to be Priority Habitat under the headwater definition. Caochan Ruadh itself has not been designated as SSSI river habitat, and therefore does not qualify as Priority Habitat under the definition for rivers. Although brook lamprey, otter (see ES Appendix 12.10), soprano pipistrelle (see ES Appendix 12.5), and reed bunting (*Emberiza schoeniclus*) (within an adjacent wetland; see ES Appendix 12.6) have been confirmed as present, the Caochan Ruadh is a minor watercourse and 'land-locked' in that it drains to Loch Alvie, which itself drains to a bog adjacent to the River Spey with no defined river connectivity. Although migratory fish are likely to be present within the receiving Loch Alvie, regardless of limited downstream connectivity, it is unlikely that habitats within Caochan Ruadh will support significant populations of migratory fish species such as Atlantic salmon or other lamprey species, and therefore the six Criterion level B species required to qualify as river Priority Habitat based on species assemblage.

Watercourse: Allt Chriochaidh (Ch550)

Central NGR: NH 85666 09531



P1010886 - upstream of A9

Baseline Ecological Valuation

National importance for nature conservation. Allt Chriochaidh falls within the Alvie SSSI and serves an important function in terms of flow and sediment delivery to the wetland features for which Alvie SSSI is designated. It also provides a range of habitats that supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'High' conservation value under the CCI scoring system and Regionally Notable²⁹ stonefly *P. meyeri* and the Notable³⁰ caddisfly *R. fasciata*.

WFD Characterisation

- Classified WFD Waterbody – No
- Proxy SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – Loch Alvie (WB 100181)
- Overall Ecological Status of Receiving WFD Waterbody – Good

River Habitat Survey (Survey Code WC-054-RH-001)

- Representative Channel Dimensions: Water Depth: 0.15m, Water Width: 1.4m, Bankfull Width: 2.6m
- Habitat Modification Score (HMS): 885
- Habitat Modification Class (HMC): 4 (significantly modified)
- Descriptive Summary: Minor stream system through mixed woodland. A range of bed substrates (boulder, cobble, gravel-pebble, sand and artificial), high and low energy flow types, pools, unvegetated point and side bars, vegetated and unvegetated mid-channel bars, natural berms and eroding cliffs provide good habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Modifications due to road development, including a culvert, and bank re-sectioning and embankment contribute to the HMC recorded. Modifications have affected river continuity (flow and sediment transport).

Fish Habitat Survey (Survey Code WC-054-FH-001)

- Summary: Two relatively distinct reaches upstream and downstream of the A9. Upstream of the A9, steep gradient (locally >10%) gives rise to cascade type habitat dominated by boulders and cobbles, and low quality fish habitat. Downstream of the A9, gradient reduces, and substrate changes to cobble/pebble dominated, with improved fish habitat including fry and parr habitat. A range of shading conditions and undercut banks/exposed bankside roots locally enhance fish habitat through this reach. Only a single artificial barrier (the A9 crossing) was identified at survey as described below.
- Fish Data: No existing monitoring data.
- Barrier Assessment: The A9 crossing acts as an artificial in-stream barrier, effectively restricting habitat utilisation upstream of the A9 as it is likely to be impassable to most species (excluding eel) during most flow conditions:
 - NH 85669 09528. A9 crossing; box culvert with artificial invert under A9 road with 0.02m flow over 8m wide base. An artificial step cascade immediately upstream of structure comprising 4 steps and a total head difference of 1.4m down to an artificial channel under the A9, which discharges over a perched

²⁹ Species thought to occur in fewer than five localities (regions) across Great Britain.

³⁰ Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid.

Watercourse: Allt Chrìochaidh (Ch550)

Central NGR: NH 85666 09531

outlet downstream of A9 (1.2m head difference between toe of artificial channel reinforcement and downstream).

Aquatic Macroinvertebrate Survey (Survey Codes WC-054-AI-001, WC-054-AI-002 & WC-054-AI-003)

- The community is highly species-rich, with 61 taxa recorded over three sample points. Twenty-nine families were represented (the Scottish mean is approximately 25^{xxvi}, from a monitoring network comprising over 300 monitoring sites). Of these, 26 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling: WHPT (Family): 156, 169 and 217. WHPT ASPT (Family): 8.20, 8.46 and 8.06. LIFE (Species): 9.00, 9.20 and 8.90. PSI (Species): 98, 100 and 94.
- Biological metrics are indicative of diverse in-channel habitat, excellent water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 12.65, 11.94 and 17.37 were recorded from respective sites, considered to be communities of 'Fairly High' and 'High' conservation importance under the system.
- Considering the assemblages across the three sites sampled (to produce a reach-based classification), the score is 18.20 - i.e. a community of 'High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven by taxon richness and the presence of the Regionally Notable³¹ stonefly *P. meyeri* and the Notable³² caddisfly *R. fasciata*.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-054-PM-001)

- No live or dead specimens were recorded. Habitat suitability was exclusively classed as unsuitable within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- Allt Chrìochaidh falls within the Alvie SSSI and has a direct role in supporting the wetland site features for which Alvie SSSI is notified.
- Allt Chrìochaidh itself has not been designated as SSSI river habitat, and therefore does not qualify as Priority Habitat under the definition for rivers. Allt Chrìochaidh is a headwater as defined under Priority Habitat definitions. However, it has been 'significantly altered from its natural state', as evidenced by the River Habitat Survey and is therefore not considered to be Priority Habitat under the headwater definition. Otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5), presence has been confirmed. The Allt Chrìochaidh is essentially 'land-locked' in that it drains to Loch Alvie, which itself drains to a bog adjacent to the River Spey with no defined river connectivity. However migratory fish including Atlantic salmon, brown trout, European eel and brook lamprey have been recorded within the adjacent Allt an Fhearna, and similar habitats are provided within Allt Chrìochaidh. Allt Chrìochaidh is therefore considered likely to qualify as river Priority Habitat, based on its species assemblage.

³¹ Species thought to occur in fewer than five localities (regions) across Great Britain.

³² Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid.

Watercourse: Allt an Fhearna (Ch150)

Central NGR: NH 85789 09377



P1010860 – downstream of A9

Baseline Ecological Valuation

National importance for nature conservation. Allt an Fhearna falls within the Alvie SSSI, and serves an important function in terms of flow and sediment delivery to the wetland features for which Alvie SSSI is designated. It provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. It supports a species-rich macroinvertebrate community indicative of high quality habitat, and 'Fairly High' conservation value under the CCI scoring system and Regionally Notable³³ water beetle *O. davisii* and stonefly *P. meyeri*.

WFD Characterisation

- Classified WFD Waterbody – Yes; Allt na Fearna - u/s Loch Alvie (WB ID 23126)
- Proxy SEPA Monitoring Data Available for Watercourse – No. A Rapid Assessment macroinvertebrate sample was undertaken by SEPA at NH 85311 09130 but no taxonomic data was provided for this location.
- Overall Ecological Status of WFD Waterbody – Good

River Habitat Survey (Survey Code WC-057-RH-002)

- Representative Channel Dimensions: Water Depth: 0.3m, Water Width: 5m, Bankfull Width: 5.5m
- Habitat Modification Score (HMS): 40
- Habitat Modification Class (HMC): 2 (predominantly unmodified)
- Descriptive Summary: Highly dynamic gravel-bed river system through wet plantation woodland. The low modification score relative to other watercourses surveyed is due to the fact the survey of the Allt an Fhearna did not incorporate the A9 crossing; dualling work at the crossing location has already been undertaken as part of the Kincaig to Dalraddy scheme. A range of bed substrates (cobble, gravel-pebble and sand), high and low energy flow types, extensive pools and riffles, unvegetated point, side and mid-channel bars, and eroding/stable cliffs provide excellent habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Only a single area of modified bank profile (re-sectioning) in the upper extent of the survey reach drives the HMC recorded. The Allt an Fhearna at this location would otherwise have been classed as HMC 1 (pristine/semi-natural). Constraints:

Fish Habitat Survey (Survey Codes WC-057-FH-002)

- Summary: High quality fish habitat; habitat types for all salmonid life stages, including optimal spawning habitat, glides, pools and fry and parr represented across the survey reach. A range of shading conditions, undercut banks/exposed bankside roots, and braided channel systems with large woody debris locally enhance fish habitat quality.
- Fish Data: No existing routine monitoring data. However *ad hoc* records from a fish rescue^{xxviii} undertaken by the Spey Foundation during dewatering for the construction of the Allt an Fhearna crossing (A9 Kincaig to Dalraddy scheme) include Atlantic salmon, brown trout, European eel and brook lamprey, underneath and adjacent to the A9 crossing.
- Barrier Assessment: No in-channel barriers identified at survey.

³³ Species thought to occur in fewer than five localities (regions) across Great Britain.

Aquatic Macroinvertebrate Survey (Survey Codes WC-057-AI-001, WC-057-AI-002 & WC-057-AI-003)

- The community is species-rich, with 56 taxa recorded over three sample points. Twenty-one families were represented (the Scottish mean is approximately 25^{xvii}, from a monitoring network comprising over 300 monitoring sites). Of these, 19 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites: WHPT (Family): 175, 161 and 188. WHPT ASPT (Family): 7.96, 7.71 and 8.20. LIFE (Species): 8.71m 8.75 and 8.59. PSI (Species): 89, 93 and 93.
- Biological metrics are indicative of diverse in-channel habitat and good water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 12.29, 12.50 and 12.32 were recorded from respective sites, considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the three sites sampled (to produce a reach-based classification), the score is 12.86 - i.e. a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the reach CCI score is driven by taxon richness and the presence of the Regionally Notable³⁴ water beetle *O. davisii* and stonefly *P. meyeri*. *O. davisii* is also listed as Near Threatened³⁵ based on International Union for Conservation of Nature (IUCN) criteria.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-057-PM-002)

- No live or dead specimens were recorded. Habitat suitability ranged from unsuitable (x3 transects) to poor (x3 transects) within habitat transects undertaken. A full account of the survey is provided in Annex E.

Designated Status and Priority Habitat Assessment

- The Allt an Fhearna falls within the Alvie SSSI and has a direct role in supporting the wetland site features for which Alvie SSSI is notified.
- The Allt an Fhearna itself has not been designated as SSSI river habitat, and therefore does not qualify as SBL Priority Habitat under the definition for rivers. The Priority Habitat definition requires six or more 'criterion level B' species to be present within the river. Otter (see ES Appendix 12.10) and soprano pipistrelle (see ES Appendix 12.5) have been recorded based on A9 surveys. Despite being essentially 'land-locked' in that the Allt an Fhearna drains to Loch Alvie, which itself drains to a bog adjacent to the River Spey with no defined river connectivity, Atlantic salmon, brown trout, European eel and brook lamprey have all been confirmed based on historical records. The Allt an Fhearna is therefore confirmed as river Priority Habitat, based on its species assemblage.

5.3. Waterbodies


- 5.3.1. The ecological valuation of waterbodies within the Study Area is set out in Table 5.2 and shown in Figure 12.16. Results of all NPS surveys undertaken are considered in relation to each waterbody receptor to determine its overall ecological valuation for the purpose of assessment.
- 5.3.2. Original survey data from surveys undertaken in support of the ecological valuations is presented in Annex D.
- 5.3.3. Ponds identified as supporting the SBL species northern damselfly are considered to be of National importance for nature conservation, due to the rarity and highly restricted

³⁴ Species thought to occur in fewer than five localities (regions) across Great Britain.

³⁵ Near Threatened under Red listing based on 2001 IUCN guidelines. A taxon is Near Threatened when it has been evaluated against IUCN criteria but does not qualify for Critically Endangered, Endangered or Vulnerable but is close to qualifying for or is likely to qualify for a threatened category in the near future. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable.

distribution of this species within Scotland. However, there is significant variation in the rarity and distribution of species within the SBL, and this valuation approach is not appropriate for all SBL species. Full justification for each waterbody valuation is provided below.

Table 5.2: Waterbody Baseline Ecological Valuation (from North to South)

Pond Number: P8 (Ch20800)	Central NGR: NH 86141 23803
 <p>P6040390</p>	<p>Baseline Ecological Valuation</p> <p><i>National</i> importance for nature conservation.</p> <p>A semi-permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'Very High' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed³⁶; SBL Criterion S3³⁷) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.</p>
<p>National Pond Survey (Survey Code WB-010-PS-001)</p> <ul style="list-style-type: none"> <li>• Pond Area (winter level): 160m² <li>• Water Area (at survey): 100m² <li>• Summary: Semi-permanent pond within peat bog and heathland land use. Estimated to be approximately 1.25m deep at its deepest point (including up to 0.7m silt). Base composed of 50% peat and 50% clay/silt. No evidence of recent management, with light sheep grazing was noted. No inflows or outflows were identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is acidic, with high dissolved oxygen levels and average dissolved solid levels relative to the ponds surveyed. <li>• Macroinvertebrate Community: The community was moderately species-rich, with 20 taxa recorded. Thirteen families were represented in total, of which 8 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality. <li>• The community BMWP was 73 and BMWP ASPT was 4.87, indicative of moderate water quality, accepting that this metric is more appropriate for the assessment of running water. <li>• The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 28.0 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness and the presence of the Nationally Scarce³⁸ crane fly <i>Phalacrocerca replicata</i>. <li>• The CCI score could potentially be higher; a high abundance of <i>Coenagrionidae</i> were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL Conservation Action Needed³⁶; SBL Criterion S3³⁷), a CNPA Priority Species and Endangered³⁹ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of <i>Coenagrionidae</i> are northern damselfly. 	

³⁶ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

³⁷ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

³⁸ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

³⁹ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P8 (Ch20800)

Central NGR: NH 86141 23803

- **Macrophyte Community:** The community was relatively species-rich for an upland pond of its type, with 11 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including broad-leaved pondweed (*Potamogeton natans*), *Callitriche* sp., greater water-moss (*Fontinalis antipyretica*) and common duckweed (*Lemna minor*).

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- No classification.

Pond Number: P14 (Ch12700)

Central NGR: NH 91161 19053



P6040394

Baseline Ecological Valuation

Authority Area importance for nature conservation.

A permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'High' conservation value under the CCI scoring system and potentially including the Nationally Scarce⁴⁰ water boatman *Sigara striata* and water beetle *Hydraena rufipes*. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-011-PS-001)

- **Pond Area (winter level):** 465m²
- **Water Area (at survey):** 420m²
- **Summary:** Permanent pond within semi-improved grassland and broadleaved woodland. Estimated to be approximately 0.8m deep at its deepest point (including up to 0.6m silt). Base composed of 45% peat, 45% clay/silt and 10% gravel. No evidence of recent management, with very light sheep grazing noted. One inflow and one outflow was identified at survey, and the pond was considered to be hydrologically dependant on input from the inflow, as well as runoff and direct precipitation. Water quality sampling confirms the pond is very slightly acidic, with high dissolved oxygen levels and high dissolved solid levels relative to the ponds surveyed (conductivity was approximately double the mean of all ponds surveyed).
- **Macroinvertebrate Community:** The community was species-rich, with 41 taxa recorded. Twenty-eight families were represented in total, of which 18 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 197 and BMWP ASPT was 6.03, indicative of very good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 15.75 was recorded, which is considered to represent a community of 'High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.

⁴⁰ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

Pond Number: P14 (Ch12700)

Central NGR: NH 91161 19053

- The CCI score could potentially be higher; the water boatman *S. striata* (if present- specimens could not be resolved beyond *S. dorsalis/striata*) and water beetle *Hydraena rufipes* (if present - specimens could not be resolved beyond *Hydraena riparia/rufipes/britteni*) are Nationally Scarce⁴¹.
- Macrophyte Community: The community was relatively species-rich for an upland pond of its type, with 13 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including broad-leaved pondweed, *Callitriche* sp., greater water-moss and common duckweed.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond does not meet any published criteria for definition as SBL Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P16 (Ch12050)

Central NGR: NH 91191 18381



P6050401

Baseline Ecological Valuation

Local importance for nature conservation. A permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'Moderate' conservation value under the CCI scoring system. The macrophyte community is species-poor, but overall the pond is important for the maintenance of biodiversity at a Local level.

National Pond Survey (Survey Code WB-013-PS-001)

- Pond Area (winter level): 940m²
- Water Area (at survey): 800m²
- Summary: Permanent pond within semi-improved grassland and broadleaved woodland. Estimated to be approximately 0.85m deep at its deepest point (including up to 0.15m silt). Base composed of 90% clay/silt and 10% pebble/rock. No evidence of recent management or grazing noted. One inflow and one outflow was identified at survey, and the pond was considered to be hydrologically dependant on input from the inflow, as well as runoff and direct precipitation. Water quality sampling confirms the pond is neutral, with high dissolved oxygen levels and very low dissolved solid levels relative to the ponds surveyed (conductivity was approximately half the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was moderately species-rich, with 23 taxa recorded. Eighteen families were represented in total, of which 12 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 86 and BMWP ASPT was 5.06, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 10.00 was recorded, which is considered to represent a community of 'Moderate' conservation importance under the system. The CCI score takes account of both taxon richness and the

⁴¹ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

Pond Number: P16 (Ch12050)

Central NGR: NH 91191 18381

relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.

- **Macrophyte Community:** The community was species-poor, with seven marginal species and no truly aquatic species recorded.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond does not meet any published criteria for definition as SBL Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- No classification.

Pond Number: P31 (Ch11850)

Central NGR: NH 90934 18185



P6050402

Baseline Ecological Valuation

National importance for nature conservation.

A permanent pond with moderate water quality and a macroinvertebrate assemblage assessed as 'Fairly High' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁴²; SBL Criterion S3⁴³) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-014-PS-001)

- Pond Area (winter level): 300m²
- Water Area (at survey): 150m²
- **Summary:** Permanent pond within semi-improved grassland and broadleaved woodland. Estimated to be approximately 0.55m deep at its deepest point (including up to 0.15m silt). Base composed of 90% clay/silt and 10% gravel. No evidence of recent management, with light grazing by cattle recorded. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is very slightly acidic, with low dissolved oxygen levels and very low dissolved solid levels relative to the ponds surveyed (conductivity was approximately one third of the mean of all ponds surveyed).
- **Macroinvertebrate Community:** The community was species-rich, with 43 taxa. Twenty-three families were represented in total, of which 15 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 175 and BMWP ASPT was 5.00, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 13.56 was recorded, which is considered to represent a community of 'Fairly High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.

⁴² Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁴³ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

Pond Number: P31 (Ch11850)

Central NGR: NH 90934 18185

- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL Conservation Action Needed⁴⁴; SBL Criterion S3⁴⁵), a CNPA Priority Species and Endangered⁴⁶ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- Macrophyte Community: The community was relatively species-rich for an upland pond of its type, with 11 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including common water-starwort (*Callitriche stagnalis*), bulbous rush (*Juncus bulbosus*), common duckweed, the charophyte *Nitella opaca*, broad-leaved pondweed (*Potamogeton natans*) and unbranched bur-reed (*Sparganium emersum*).

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P19 (Ch11700)

Central NGR: NH 90877 18046



P6050415

Baseline Ecological Valuation

National importance for nature conservation. A semi-permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'High' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁴⁴; SBL Criterion S3⁴⁵) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-015-PS-001)

- Pond Area (winter level): 110m²
- Water Area (at survey): 100m²
- Summary: Semi-permanent pond within semi-improved grassland and broadleaved woodland. Estimated to be approximately 0.5m deep at its deepest point (including up to 0.35m silt). Base composed of 70% clay/silt and 30% pebble/rock. No evidence of recent management or grazing recorded. One outflow was identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is very slightly basic, with high dissolved oxygen levels and very low dissolved solid levels relative to the ponds surveyed (conductivity was approximately one third of the mean of all ponds surveyed).

⁴⁴ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁴⁵ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁴⁶ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P19 (Ch11700)

Central NGR: NH 90877 18046

- **Macroinvertebrate Community:** The community was species-rich, with 47 taxa recorded. Twenty-three families were represented in total, of which 14 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 181 and BMWP ASPT was 5.03, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 15.11 was recorded, which is considered to represent a community of 'High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL Conservation Action Needed⁴⁷; SBL Criterion S3⁴⁸), a CNPA Priority Species and Endangered⁴⁹ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- **Macrophyte Community:** The community was relatively species-rich for an upland pond of its type, with nine marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including water-starwort (*Callitriche* sp.), bulbous rush, and broad-leaved pondweed.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P21a (Ch11400)

Central NGR: NH 91098 17792



P6070451

Baseline Ecological Valuation

International importance for nature conservation.

A semi-permanent pond forming part of the Loch Vaa SPA, with moderate water quality and a macroinvertebrate assemblage assessed as 'Very High' conservation value under the CCI scoring system and assumed to include the SBL species (SBL Conservation Action Needed⁴⁷; SBL Criterion S3⁴⁸) northern damselfly. The pond qualifies as SBL Priority Habitat on the basis of this species, as well as its designation as an SPA and also in terms of species richness (with over 50 aquatic macroinvertebrate taxa recorded).

National Pond Survey (Survey Code WB-016a-PS-001)

⁴⁷ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁴⁸ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁴⁹ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P21a (Ch11400)

Central NGR: NH 91098 17792

- Pond Area (winter level): 2200m²
- Water Area (at survey): 270m²
- Summary: Semi-permanent pond within semi-improved grassland, and mixed woodland. Estimated to be approximately 1.2m deep at its deepest point (including up to 0.9m silt). Base composed of 90% clay/silt and 10% gravel. No evidence of recent management or grazing recorded. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is very slightly acidic, with low dissolved oxygen levels and very high dissolved solid levels relative to the ponds surveyed (conductivity was over double the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 51 taxa recorded. Twenty-eight families were represented in total, of which 21 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 236 and BMWP ASPT was 5.36, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 21.60 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. CNPA historical species records include a record of northern damselfly from the pond in June 2010. Northern damselfly is a SBL species (SBL Conservation Action Needed⁵⁰; SBL Criterion S3⁵¹), a Priority Species for CNPA, and Endangered⁵² under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- Macrophyte Community: The community was relatively species-rich for an upland pond of its type, with 10 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including broad-leaved pondweed and least bur-reed (*Sparganium natans*).

Designated Status and Priority Habitat Assessment

- The pond forms part of the Loch Vaa Special Protection Area (SPA) designated on account of Slavonian grebe *Podiceps auritus*.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of its SPA designation. It would also qualify based on its species-rich macroinvertebrate assemblage (pond Priority Habitat criteria requires 50 or more aquatic macroinvertebrate taxa). The pond would also qualify based on the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

⁵⁰ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁵¹ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁵² Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P21b (Ch11400)

Central NGR: NH 91092 17737



P6070447

Baseline Ecological Valuation

International importance for nature conservation.

A permanent pond forming part of the Loch Vaa SPA, with moderate water quality and a macroinvertebrate assemblage assessed as 'Very High' conservation value under the CCI scoring system and assumed to include the SBL species (SBL Conservation Action Needed⁵³; SBL Criterion S3⁵⁴) northern damselfly. The pond qualifies as SBL Priority Habitat on the basis of this species, as well as its designation as an SPA.

National Pond Survey (Survey Code WB-016b-PS-001)

- Pond Area (winter level): 750m²
- Water Area (at survey): 600m²
- Summary: Permanent pond within semi-improved grassland, and mixed woodland. Estimated to be approximately 0.5m deep at its deepest point (including up to 0.3m silt). Base composed of 100% clay/silt. No evidence of recent management or grazing recorded. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is very slightly acidic, with moderate dissolved oxygen levels and dissolved solid levels relative to the ponds surveyed (conductivity was approximately equal to the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 48 taxa recorded. Twenty-four families were represented in total, of which 20 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 239 and BMWP ASPT was 5.43, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 33.75 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness and the presence of the SBL species (Watching Brief only⁵⁵; SBL Criterion S4⁵⁶) and Near Threatened⁵⁷ water beetle *H. brevis*.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. CNPA historical species records include a record of northern damselfly from the pond in June 2010. Northern damselfly is a SBL species (SBL Conservation Action Needed⁵³; SBL Criterion S3⁵⁴), a Priority Species for CNPA, and Endangered⁵⁸ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.

⁵³ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁵⁴ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁵⁵ 'There is less concern for these habitats and species, which only require monitoring for now'.

⁵⁶ The species occurs in less than 6 10km squares of the National Grid in Scotland.

⁵⁷ Near Threatened under Red listing based on 2001 IUCN guidelines. Near Threatened- taxa which do not qualify for Lower Risk (conservation dependent), but which are close to qualifying for Vulnerable. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable

⁵⁸ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P21b (Ch11400)

Central NGR: NH 91092 17737

- In addition, two damselfly specimens could not be resolved specimens between *Coenagrion puella/pulchellum*, meaning the CCI could potentially be higher than reported. *C. pulchellum* is Near Threatened⁵⁹.
- **Macrophyte Community:** The community was relatively species-poor, with seven marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including bulbous rush, broad-leaved pondweed and unbranched bur-reed.

Designated Status and Priority Habitat Assessment

- The pond forms part of the Loch Vaa Special Protection Area (SPA) designated on account of Slavonian grebe *Podiceps auritus*.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of its SPA designation. The pond would also qualify based on the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P21c (Ch11400)

Central NGR: NH 91167 17782



P6070453

Baseline Ecological Valuation

International importance for nature conservation.

A semi-permanent pond forming part of the Loch Vaa SPA, with moderate water quality and a macroinvertebrate assemblage assessed as 'Very High' conservation value under the CCI scoring system and assumed to include the SBL species (SBL Conservation Action Needed⁶⁰; SBL Criterion S3⁶¹) northern damselfly. The pond qualifies as SBL Priority Habitat on the basis of this species, as well as its designation as an SPA and also in terms of species richness (with over 50 aquatic macroinvertebrate taxa recorded).

National Pond Survey (Survey Code WB-016c-PS-001)

- Pond Area (winter level): 4750m²
- Water Area (at survey): 1500m²
- **Summary:** Semi-permanent pond within semi-improved grassland, and mixed woodland. Estimated to be approximately 1.3m deep at its deepest point (including up to 1.0m silt). Base composed of 95% clay/silt and 5% gravel. No evidence of recent management or grazing recorded. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is very slightly acidic, with low dissolved oxygen levels and moderate dissolved solid levels relative to the ponds surveyed (conductivity was approximately 75% to of all ponds surveyed).

⁵⁹ Near Threatened under Red listing based on 2001 IUCN guidelines. A taxon is Near Threatened when it has been evaluated against IUCN criteria but does not qualify for Critically Endangered, Endangered or Vulnerable but is close to qualifying for or is likely to qualify for a threatened category in the near future. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable.

⁶⁰ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁶¹ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

Pond Number: P21c (Ch11400)

Central NGR: NH 91167 17782

- **Macroinvertebrate Community:** The community was species-rich, with 50 taxa recorded. Twenty-seven families were represented in total, of which 21 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 234 and BMWP ASPT was 5.32, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 29.38 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness and the presence of the SBL species (Watching Brief only⁶²; SBL Criterion S4⁶³) and Near Threatened⁶⁴ water beetle *H. brevis*.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. CNPA historical species records include a record of northern damselfly from the pond in June 2010. Northern damselfly is a SBL species (SBL Conservation Action Needed⁶⁵; SBL Criterion S3⁶⁶), a Priority Species for CNPA, and Endangered⁶⁷ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- **Macrophyte Community:** The community was relatively species-rich for an upland pond of its type, with 10 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including bulbous rush, broad-leaved pondweed and least bur-reed.

Designated Status and Priority Habitat Assessment

- The pond forms part of the Loch Vaa Special Protection Area (SPA) designated on account of Slavonian grebe *Podiceps auritus*.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of its SPA designation. It would also qualify based on its species-rich macroinvertebrate assemblage (pond Priority Habitat criteria requires 50 or more aquatic macroinvertebrate taxa). The pond would also qualify based on the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

⁶² 'There is less concern for these habitats and species, which only require monitoring for now'.

⁶³ The species occurs in less than 6 10km squares of the National Grid in Scotland.

⁶⁴ Near Threatened under Red listing based on 2001 IUCN guidelines. Near Threatened- taxa which do not qualify for Lower Risk (conservation dependent), but which are close to qualifying for Vulnerable. In Britain, this category includes species which occur in 15 or fewer hectads but do not qualify as Critically Endangered, Endangered or Vulnerable

⁶⁵ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁶⁶ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁶⁷ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P28 (Ch9600)

Central NGR: NH 90287 16153



P6050421

Baseline Ecological Valuation

Authority Area importance for nature conservation.

A permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'Moderate' conservation value under the CCI scoring system and including the Nationally Scarce⁶⁸ water boatman *Arctocorisa carinata*.

National Pond Survey (Survey Code WB-021-PS-001)

- Pond Area (winter level): 1600m²
- Water Area (at survey): 1400m²
- Summary: Permanent pond within broadleaved woodland. Estimated to be approximately 0.7m deep at its deepest point (including up to 0.45m silt). Base composed of 100% clay/silt. No evidence of recent management or grazing recorded. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is slightly acidic, with low dissolved oxygen levels and dissolved solid levels relative to the ponds surveyed (conductivity was approximately 70% of the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 39 taxa recorded. Twenty-four families were represented in total, of which 12 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 126 and BMWP ASPT was 4.85, indicative of moderate water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 10.00 was recorded, which is considered to represent a community of 'Moderate' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness and the presence of the Nationally Scarce⁶⁸ water boatman *Arctocorisa carinata*.
- Macrophyte Community: The community was relatively species-rich for an upland pond of its type, with nine marginal and aquatic species recorded in total. The community included 3 truly aquatic constituents (obligate hydrophytes); water-starwort (*Callitriche* sp.), broad-leaved pondweed, and mole pelt algae (*Vaucheria* sp.).

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond does not meet any published criteria for definition as SBL Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

⁶⁸ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

Pond Number: P30 (Ch9000)

Central NGR: NH 90191 15537



P6060427

Baseline Ecological Valuation

National importance for nature conservation.

A permanent pond with moderate water quality and a macroinvertebrate assemblage assessed as 'Moderate' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁶⁹; SBL Criterion S3⁷⁰) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-023-PS-001)

- Pond Area (winter level): 1500m²
- Water Area (at survey): 800m²
- Summary: Permanent pond within broadleaved woodland. Estimated to be approximately 0.85m deep at its deepest point (including up to 0.3m silt). Base composed of 95% clay/silt and 5% pebble/rock. No evidence of recent management but heavy cattle grazing recorded, in addition to duck and wildfowl grazing. No inflows or outflows identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is slightly acidic, with low dissolved oxygen levels and dissolved solid levels relative to the ponds surveyed (conductivity was less than a quarter of the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 32 taxa recorded. Twenty-five families were represented in total, of which 16 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 112 and BMWP ASPT was 5.33, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 26.00 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness and the presence of the Nationally Scarce⁷¹ crane fly *Phalacrocerca replicata*.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. CNPA historical species records include a record of northern damselfly from the pond in June 2010. Northern damselfly is a SBL species (SBL Conservation Action Needed⁶⁹; SBL Criterion S3⁷⁰), a Priority Species for CNPA, and Endangered⁷² under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- Macrophyte Community: The community was relatively species-rich, with nine marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including bulbous rush, broad-leaved pondweed and unbranched bur-reed.

⁶⁹ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁷⁰ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁷¹ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

⁷² Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P30 (Ch9000)

Central NGR: NH 90191 15537

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- No classification.

Pond Number: P18 (Ch8750)

Central NGR: NH 89928 15326



P6060425

Baseline Ecological Valuation

National importance for nature conservation. A permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'High' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁷³; SBL Criterion S3⁷⁴) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis.

National Pond Survey (Survey Code WB-024-PS-001)

- Pond Area (winter level): 500m²
- Water Area (at survey): 500m²
- Summary: Permanent pond within broadleaved woodland and semi-improved grassland. Estimated to be approximately 0.75m deep at its deepest point (including up to 0.3m silt). Base composed of 90% clay/silt and 10% pebble/rock. No evidence of recent management but moderate cattle grazing recorded. One inflow was identified at survey, and the pond was considered to be hydrologically dependant on input from the inflow, as well as runoff and direct precipitation. Water quality sampling confirms the pond is slightly basic, with high dissolved oxygen levels and very high dissolved solid levels relative to the ponds surveyed (conductivity was three times the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 39 taxa recorded. Nineteen families were represented in total, of which 13 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 165 and BMWP ASPT was 5.00, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 17.71 was recorded, which is considered to represent a community of 'High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL

⁷³ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁷⁴ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

Pond Number: P18 (Ch8750)

Central NGR: NH 89928 15326

Conservation Action Needed⁷⁵; SBL Criterion S3⁷⁶), a Priority Species for CNPA, and Endangered⁷⁷ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.

- Macrophyte Community: The community was extremely species-poor, with only a single marginal species recorded.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P37 (Ch8250)

Central NGR: NH 89797 14874



P6060434

Baseline Ecological Valuation

National importance for nature conservation.

A permanent pond with moderate water quality and a macroinvertebrate assemblage assessed as 'Fairly High' conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁷⁵; SBL Criterion S3⁷⁶) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-025-PS-001)

- Pond Area (winter level): 500m²
- Water Area (at survey): 495m²
- Summary: Semi-permanent pond within broadleaved woodland and semi-improved grassland. Estimated to be approximately 0.55m deep at its deepest point (including up to 0.2m silt). Base composed of 40% clay/silt, 40% gravel and 20% pebble/rock. No evidence of recent management but moderate cattle grazing recorded. One outflow was identified at survey, and the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than groundwater. Water quality sampling confirms the pond is slightly acidic, with moderate dissolved oxygen levels and low dissolved solid levels relative to the ponds surveyed (conductivity was approximately 65% of the mean of all ponds surveyed).
- Macroinvertebrate Community: The community was species-rich, with 35 taxa recorded. Twenty-three families were represented in total, of which 18 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 148 and BMWP ASPT was 5.10, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 13.85 was recorded, which is considered to represent a community of 'Fairly

⁷⁵ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁷⁶ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁷⁷ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

Pond Number: P37 (Ch8250)

Central NGR: NH 89797 14874

High' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present. In this case, the CCI score is driven by taxon richness rather than the presence of species of notable rarity.

- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL Conservation Action Needed⁷⁸; SBL Criterion S3⁷⁹), a Priority Species for CNPA, and Endangered⁸⁰ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- **Macrophyte Community:** The community was relatively species-rich, with 10 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including common water starwort, broad-leaved pondweed and common duckweed.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P43 (Ch5400)

Central NGR: NH 89076 12127



P6060439

Baseline Ecological Valuation

Authority Area importance for nature conservation.

Although Loch Puladdern sits within Craigellachie SSSI, the SSSI is notified for upland birch woodland and its moth assemblage, rather than open water habitat meaning the loch is not considered to be of National importance by virtue of occurring within the SSSI. It does however have good water quality, a relatively species-rich macrophyte community, and potentially supports the Nationally Scarce⁸¹ water boatman *S. striata*. It is also a significant open water habitat within the Authority setting.

National Pond Survey (Survey Code WB-027-PS-001)

- Pond Area (winter level): 6000m²
- Water Area (at survey): 6000m²
- **Summary:** Permanent Loch (Loch Puladdern) within broadleaved woodland. Estimated to be over 1.0m deep at its deepest point (including up to 0.2m silt). Base composed of 60% clay/silt and 40% pebble/rock. Evidence of recent management (bank mowing) was recorded, along with suspected duck/wildfowl grazing. Two inflows and one outflow were identified at survey, and the Loch was considered to be hydrologically dependant on input from the inflow, as well as runoff and direct

⁷⁸ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁷⁹ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁸⁰ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

⁸¹ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

Pond Number: P43 (Ch5400)

Central NGR: NH 89076 12127

precipitation. Water quality sampling confirms Loch Puladdern is neutral, with high dissolved oxygen levels and low dissolved solid levels relative to the ponds surveyed (conductivity was approximately one third of the mean of all ponds surveyed).

- Macroinvertebrate Community: The community was species-poor, with 16 taxa recorded. Fourteen families were represented in total, of which 11 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 61 and BMWP ASPT was 4.69, indicative of moderate water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 4.29 was recorded, which is considered to represent a community of 'Low' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present.
- The CCI score could potentially be higher; the water boatman *S. striata* (if present- specimens could not be resolved beyond *S. dorsalis/striata*) is Nationally Scarce⁸².
- Macrophyte Community: The community was relatively species-rich, with 12 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including water starwort (*Callitriche* sp.), shoreweed (*Littorella uniflora*), spiked water-milfoil (*Myriophyllum spicatum*), yellow water-lily (*Nuphar lutea*) and broad-leaved pondweed.

Designated Status and Priority Habitat Assessment

- Loch Puladdern sits within Craigellachie SSSI, notified for upland birch woodland and its moth assemblage.
- As Craigellachie SSSI is not designated based on open water dependant habitats or species. As such Loch Puladdern is not considered to meet published criteria for pond Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

Pond Number: P44 (Ch5400)

Central NGR: NH 89181 12144



P6060444

Baseline Ecological Valuation

National importance for nature conservation. A semi-permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'Moderate conservation value under the CCI scoring system, assumed to include the SBL species (SBL Conservation Action Needed⁸³; SBL Criterion S3⁸⁴) northern damselfly. The pond qualifies as SBL Priority Habitat on this basis. It also supports a relatively species-rich macrophyte community, including several truly aquatic species.

National Pond Survey (Survey Code WB-028-PS-001)

- Pond Area (winter level): 650m²
- Water Area (at survey): 650m²

⁸² Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

⁸³ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁸⁴ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

Pond Number: P44 (Ch5400)

Central NGR: NH 89181 12144

- **Summary:** Semi-permanent pond within improved grassland, parkland and broadleaved woodland. Estimated to be 0.65m deep at its deepest point (including up to 0.2m silt). Base composed of 40% pebble/rock, 40% gravel and 20% clay/silt. Evidence of recent management (bank mowing and emergent vegetation cutting) was recorded, along with grazing by rabbit and wildfowl. One inflow and two outflows (overflows flowing in to a soak away) were identified at survey; however, the pond was considered to be hydrologically dependant on runoff and direct precipitation rather than the inflow or groundwater. Water quality sampling confirms the pond is neutral, with very high dissolved oxygen levels and low dissolved solid levels relative to the ponds surveyed (conductivity was approximately one third of the mean of all ponds surveyed).
- **Macroinvertebrate Community:** The community was relatively species-rich, with 35 taxa recorded. Twenty-four families were represented in total, of which 17 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 149 and BMWP ASPT was 5.32, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 8.53 was recorded, which is considered to represent a community of 'Moderate' conservation importance under the system. The CCI score takes account of both taxon richness and the relative rarity of species present.
- The CCI score could potentially be higher; a low abundance of *Coenagrionidae* were identified to family level but could not be resolved to species level due to the early larval development stage of the specimens. Northern damselfly is known to be distributed within the survey area. It is a SBL species (SBL Conservation Action Needed⁸⁵; SBL Criterion S3⁸⁶), a Priority Species for CNPA, and Endangered⁸⁷ under Red Listing based on 2001 IUCN criteria. A conservative approach has therefore been taken which assumes any unresolved specimens of *Coenagrionidae* are northern damselfly.
- In addition, the water boatman *S. striata* (if present- specimens could not be resolved beyond *S. dorsalis/striata*) is Nationally Scarce⁸⁸ and the CCI could potentially be higher than reported.
- **Macrophyte Community:** The community was relatively species-rich, with 13 marginal and aquatic species recorded in total. The community was dominated by marginal species but truly aquatic constituents (obligate hydrophytes) were also represented including intermediate water starwort (*C. hamulate*), charophyte (*Nitella* sp.), amphibious bistort (*Persicaria amphibia*), and broad-leaved pondweed.

Designated Status and Priority Habitat Assessment

- The pond is not within a designated statutory or non-statutory site of nature conservation importance.
- The pond is considered to meet published criteria for definition as SBL Priority Habitat on account of the conservative assumption that it supports northern damselfly.

CNPA Desk-Based Habitat Classification (see Section 2.3.3 for definition):

- Red.

6. Potential Impacts

6.1. Aquatic Habitats

Construction

- 6.1.1. During construction, river habitats could be affected by:

⁸⁵ Species either undergoing significant decline in Scotland and/or rare or restricted distribution and under threat.

⁸⁶ Species that is rare in the UK and considered to occur in less than 16 10km squares of the National Grid.

⁸⁷ Endangered under Red listing based on 2001 IUCN guidelines. A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.

⁸⁸ Nationally Scarce in Great Britain and estimated to occur within the range of 16 to 100 10km squares of the National Grid.

- placement of new culverts and bridges and/or extension to existing structures resulting in direct habitat loss and reduced habitat availability for aquatic species at the point of construction;
- loss of riparian habitat structure arising from vegetation clearance which may reduce valuable cover and refuge for notable fish populations;
- pollution and sedimentation events (run-off during construction) which may result in habitat degradation, for example smothering of fish habitat (e.g. spawning sites); and
- in channel works such as watercourse diversions and temporary crossings resulting in temporary loss of habitat and/or fragmentation of habitats that affect fish species reaching spawning habitats and/or undertaking daily feeding migrations.

6.1.2. During construction, pond habitats could be affected by:

- direct habitat loss;
- indirect habitat loss as a result of interrupted hydrological support to the pond (e.g. severance of groundwater flow paths or redirection of surface water drainage pathways due to earthworks); and
- pollution and sedimentation events (run-off during construction) resulting in habitat degradation by affecting water quality and/or smothering marginal habitats.

Operation

6.1.3. During operation watercourse and pond habitats could all be affected by the following:

- changes to discharge volume and water quality (i.e. outfalls from new drainage infrastructure); and
- where new and extended culverts are required, watercourse habitat may be affected through changes in hydro-morphological character both upstream and downstream of their location. Associated alterations to sediment delivery rates and changes in flow character have the potential to reduce morphological diversity and reduce habitat complexity.

6.2. Aquatic Species

Construction

6.2.1. Fish populations, including migratory salmonids, lamprey and eel are characteristic of the rivers affected by the Proposed Scheme, and are likely to be present within the construction footprint.

6.2.2. During construction, fish, aquatic macrophyte and aquatic macroinvertebrate communities could be affected by:

- placement of new culverts and bridges and/or extension to existing structures which may result in direct habitat loss and reduced habitat availability for aquatic species at the point of construction;
- loss of riparian habitat structure arising from construction related vegetation clearance which may reduce valuable cover and refuge for notable fish populations;
- acoustic disturbance (e.g. vibration from piling) which may cause physiological damage to fish, deter passage through areas affected and reduce foraging and breeding success;

- visual disturbance (e.g. movement of construction plant and lighting) which may deter passage of fish through areas affected;
- pollution events which may result in species mortality and habitat degradation. Heavy metals that may be mobilised during construction activities (e.g. breakup of existing carriageway) can have detrimental effects on fish such as decreased production, increased susceptibility to disease and increased mortality;
- sedimentation events (run-off during construction) which may smother habitats resulting in the loss/reduction in quality of fisheries spawning sites and in acute cases may result in species mortality (e.g. smothering of eggs/loss of sediment sensitive aquatic macroinvertebrate species);
- in channel works such as watercourse diversions and temporary crossings which may result in temporary loss of habitat of resource value to notable species and/or fragmentation of habitats that affect fish species reaching spawning habitats and/or undertaking daily feeding migrations; and
- de-watering activities that may affect water quality and hydro-morphology which could cause harm to fish species and induce behavioural changes in fisheries populations e.g. disruption to seasonal migration of salmon populations.

6.2.3. During construction, pond species could be affected by the following:

- direct habitat loss to the construction footprint, or indirect habitat loss as a result of interrupted hydrological support to the pond (e.g. severance of groundwater flow paths or redirection of surface water drainage pathways);
- pollution events which may result in species mortality and habitat degradation. Heavy metals that may be mobilised during construction activities (e.g. breakup of existing carriageway) can have detrimental effects on fish such as decreased production, increased susceptibility to disease and increased mortality; and
- sedimentation events (run-off during construction) which may smother habitats resulting in the loss/reduction in quality of fisheries spawning sites and in acute cases may result in species mortality (e.g. smothering of eggs/loss of sediment sensitive aquatic macroinvertebrate species).

Operation

6.2.4. During operation, fish, aquatic macrophyte and aquatic macroinvertebrate communities could all be affected by the following:

- harm to populations/loss of sensitive species reliant on aquatic habitats negatively affected by changes to discharge volume and water quality (i.e. outfalls from new drainage infrastructure), including the potential for reduction in spawning habitat quality and effects on fish recruitment and loss of sensitive aquatic macroinvertebrate species;
- the presence of new and extended structures (culverts and bridges) which may create a barrier to species movement and isolate/fragment existing populations and prevent migratory fish from undertaking spawning and/or feeding migrations affecting recruitment potential;
- if a barrier to fish species is created then recruitment and distribution of freshwater pearl mussel may be constrained as a result of exclusion of larval host (salmonid fish) from key habitats in the catchment. Although no freshwater pearl mussel are present within the site, the potential effects of barriers to migration could elicit impacts within the wider EZoI, i.e. freshwater pearl mussel populations beyond the site extent. Movement of lamprey and eel populations may also be affected as a result of any new barrier; and

- conversely, where watercourse severance is reduced (e.g. through the replacement of existing culverts/structures that are acting as barriers) improved connectivity and fish passage may benefit the fish community and freshwater pearl mussel populations within the EZol.

7. Mitigation

- 7.1.1. A list of standard mitigation measures has been developed for all projects within the A9 Dualling Programme; those related to aquatic ecology are detailed below in Table 7.1. In addition to these, scheme specific mitigation measures have also been developed as detailed in Table 7.2. Specific mitigation measures are presented on the Landscape and Ecological Mitigation plan, Figure 13.4. ES Chapter 11 (Road Drainage and the Water Environment) also details extensive committed mitigation measures in respect of control of pollution, sedimentation and hydrological impacts at watercourses and waterbodies.
- 7.1.2. The Proposed Scheme includes embedded mitigation as part of the design such as:
- clear span bridges on Allt nan Ceatharnach, River Dulnain, Allt na Criche (Lynwilg) and Allt Chrìochaidh (in the case of Criche and Chrìochaidh, replacing existing structures which have artificial inverts); and
 - portal-frame culverts at Allt Cnapach, Aviemore Burn, Caochan Ruadh and Allt Chrìochaidh (all currently conveyed under the A9 via piped culverts with artificial inverts) to restore natural channel substrates on these watercourses.
- 7.1.3. This embedded mitigation serves to improve river continuity at five existing watercourse crossings (Table 8.2) by:
- removing artificial in-channel structures (e.g. culvert inverts);
 - restoring natural bed substrates; and
 - improving water depth and flow provision at crossing locations, supporting unimpeded passage for migratory fish.
- 7.1.4. A full list of additional ecological mitigation measures is provided in ES Chapter 12: Ecology and Nature Conservation. Those measures applicable to aquatic ecology have been extracted and reproduced below.

Table 7.1: A9 Standard Mitigation Commitments

Mitigation Item ⁸⁹	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/Objective	Specific Consultation or Approval Required
SMC-E1	Throughout Proposed Scheme	Pre-Construction	Pre-construction surveys will be undertaken to verify and, where required, update the baseline ecological conditions set out in the ES. The scope of the pre-construction surveys will be confirmed with SNH prior to them being undertaken.	To update the baseline ecological conditions set out in the ES.	SNH
SMC-E2	Throughout Proposed Scheme	Pre-Construction	<p>Prior to construction a suitably qualified (or team of suitably qualified) Ecological Clerk of Works (ECoW) will be appointed and will be responsible for implementation of the Ecological Management Plan. The ECoW will:</p> <ul style="list-style-type: none"> • provide ecological advice over the entire construction programme, at all times as required; • undertake or oversee pre-construction surveys for protected species in the areas affected by the Proposed Scheme; and ensure mitigation measures are implemented to avoid and reduce impacts on ecological features; and • monitor the implementation of the mitigation measures during the construction phase to ensure compliance with protected species legislation and commitments within the ES. <p>The ECoW will be a member of CIEEM and will have previous experience in similar ECoW roles. All ECoWs will be approved by Transport Scotland to be appropriately qualified for the role. The ECoW will be appointed in advance of the main construction programme commencing to ensure pre-construction surveys are undertaken and any advance mitigation measures required are implemented.</p>	To ensure the implementation of the Ecological Management Plan.	None required
SMC-E3	At watercourses throughout Proposed Scheme	Construction	Noise and vibration will be reduced by working back from the river bank where possible or working within a dry area to avoid implications to fish, such as behavioural changes e.g. avoidance of areas or physical damage to hearing. In addition,	To protect fish species from noise, vibration and light spill.	None required.

⁸⁹ Only items relevant to aquatic receptors are listed

Mitigation Item ⁸⁹	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/Objective	Specific Consultation or Approval Required
			soft-start techniques will be applied to piling work procedures to enable sensitive species to evacuate the area.		
SMC-E4	At watercourses throughout Proposed Scheme	Construction	Where areas are required to be temporarily dewatered to permit construction activities, fish will be removed by means of electrofishing and relocated prior to dewatering.	To protect fish species during de-watering of watercourse sections and in-stream works.	CAR Licence approved by SEPA
SMC-E5	At watercourses throughout Proposed Scheme	Construction	Water flow/passage will be sufficiently maintained to permit movement of Atlantic salmon, brook lamprey and brown/sea trout past areas of dewatering and/or significant alteration of water movement during any construction works within the watercourses. Suitable temporary channels may be implemented so that movement between areas of habitat can be maintained.	To protect fish species during de-watering of watercourse sections and in-stream works.	CAR Licence approved by SEPA
SMC-E15	Throughout Proposed Scheme	Pre-Construction	The Contractor will describe within the CEMP (Mitigation Item SMC-E1) the strategy to be implemented for the appropriate treatment of invasive, non-native species (INNS). The strategy will set out appropriate construction, handling, treatment and disposal procedures to prevent the spread of INNS in line with recognised best practice.	To prevent the spread of INNS.	None required.
n/a (note)	Throughout Proposed Scheme	Construction	Best practicable means will be employed to avoid the disturbance of sensitive species and habitats with noise, dust and air pollution. The Standard Mitigation Measures as detailed in ES Chapter 11 (Road Drainage and the Water Environment), ES Chapter 13 (Landscape and Visual), ES Chapter 16 (Air Quality) and ES Chapter 17 (Noise and Vibration) will be implemented to protect aquatic and terrestrial habitats and species.	To protect aquatic and terrestrial habitats and species.	n/a

Table 7.2: Project Mitigation Commitments

Mitigation Item ⁹⁰	Approximate Chainage/ Location	Timing of measure	Description	Mitigation Purpose/ Objection	Specific Consultation or Approval Required
P11-E16	Throughout Proposed Scheme	Pre-Construction & Construction	The working area will be kept to the minimum necessary for construction of the project to reduce habitat loss. A Habitat Management Plan will be produced pre-construction and agreed with SNH. This will include specific plans and measures for working on the border of the Craigellachie SSSI/NNR and Alvie SSSI, as well as other sensitive habitats (such as aspen woodland), detailing avoidance, mitigation and rehabilitation measures to further reduce residual impacts.	To protect all habitats, including those located on the boundary of Craigellachie SSSI/NNR and Alvie SSSI.	SNH
P11-E28	Throughout Proposed Scheme	Construction	<p>Culverts placed at Allt Cnapach, Aviemore Burn and Caochan Ruadh will be designed as open structures which act to:</p> <ul style="list-style-type: none"> retain natural bed substrate within the culvert; ensure no deterioration (and aim to improve) existing water depth and flow provision within the culvert for migratory fish; and improve river continuity by replacing existing A9 structures with artificial inverts. <p>The watercourse outlet will be designed to provide appropriate resting pools immediately downstream of the culvert entrance. Marginal/riparian planting will also be implemented to provide cover and mitigate the transition from light to dark at the culvert inlet and outlet. This will ensure fish are not discouraged or prevented from entering or exiting the culvert.</p> <ul style="list-style-type: none"> All culverts, including channel inlet and outlets, will be constructed with reference to SEPA's Good Practice Guides, namely: Engineering in the Water Environment Good Practice Guide: Bank Protection Rivers and Lochs^{xxix}; Engineering in the Water Environment: Good Practice Guide - River Crossing^{xxx}; and 	To maintain aquatic habitats at culverts placed at Allt Cnapach, Aviemore Burn and Caochan Ruadh.	SNH and SEPA

⁹⁰ Only items relevant to aquatic receptors are listed

Mitigation Item ⁹⁰	Approximate Chainage/ Location	Timing of measure	Description	Mitigation Purpose/ Objection	Specific Consultation or Approval Required
			<ul style="list-style-type: none"> Position Statement WAT-PS-06-02 - Culverting of Watercourses – Position Statement and Supporting Guidance^{xxx1}. 		
P11-E29	Throughout Proposed Scheme	Construction	<p>Ponds of Local ecological importance or greater and lost to construction will be replaced as near to their original location as practically possible, or within the nearest suitable habitat, whichever is more ecologically advantageous. This will be undertaken at a ratio of 1 pond loss: 1 pond replacement. SuDS and drainage features shall not act to compensate for the loss of any pond; however, SuDS shall be designed to maximise their biodiversity value, in line with the Construction Industry Research and Information Association (CIRIA) SuDS Manual^{xxxii}. Replacement ponds will be designed following good practice principles as described by SEPA Guidance on good practice in the management and creation of small waterbodies in Scotland^{xxxiii}. An ecological watching brief and fish rescue plan will be instigated in consultation with SNH and SEPA during pond dewatering activities.</p>	To compensate for loss of ponds and maintain/enhance habitats for associated species (including fish and invertebrates).	SNH, CNPA and SEPA
P11-E30	Throughout Proposed Scheme	Construction	<p>A pond at Granish Junction (Pond 18) will be lost as a result of the Proposed Scheme. The new pond will be constructed in an area immediately adjacent to the existing pond (as shown in Landscape and Ecological Mitigation plan, Figure 13.4).</p> <p>A suitability qualified ecologist shall oversee all stages of pond design/creation. The new pond will be designed to occupy a surface area similar in extent to the existing pond being lost, but will include sloping marginal shelves of gradient no greater than 1:8. This will ensure the establishment of an extensive marginal 'drawdown' area.</p> <p>The new pond may be lined to ensure water retention, subject to ground and soil conditions. In the event pond lining is required, a natural bentonite clay product will be used to ensure the sustained hydrological viability of the replacement ponds. The new pond will be 'seeded' with translocated material from their respective pond lost to the Proposed Scheme. This will include the existing marginal seed</p>	To compensate for the loss of Pond 18 and maintain/enhance habitat for northern damselfly.	SNH and SEPA

Mitigation Item ⁹⁰	Approximate Chainage/ Location	Timing of measure	Description	Mitigation Purpose/ Objection	Specific Consultation or Approval Required
			<p>bank/marginal vegetated turf and bare-root plant stock (where available), as well as pond sediment. This will encourage rapid establishment of similar successional characteristics as the pond being lost, and maximise the establishment of northern damselfly <i>Coenagrion hastulatum</i> aquatic larvae, as part of the wider aquatic macroinvertebrate community.</p> <p>The replacement pond shall be constructed no later than March prior to the loss of their adjacent pond to be lost to the Proposed Scheme. Limited translocation of material (as defined above) will be undertaken in March at the time of construction, to include no more than 10% of the pond perimeter. This will reduce disturbance of the existing pond and the macroinvertebrate community. The pond to be lost shall remain in situ until at least August of the same year, allowing for emergence and breeding of adult northern damselfly from the existing pond, maximising the likelihood of oviposition (egg-laying) in the replacement pond. Prior to loss of the existing pond, additional material (as defined above) shall be translocated to the replacement pond, maximising the establishment of the macroinvertebrate community.</p> <p>The replacement pond will otherwise be designed following good practice principles as described by SEPA Guidance on good practice in the management and creation of small waterbodies in Scotland^{xxxiii}. CNPA shall be consulted during the detailed design of the replacement pond</p> <p>An ecological watching brief and fish rescue plan will be instigated in consultation with SNH and SEPA during pond dewatering activities.</p>		
P11-E31	Throughout Proposed Scheme	Construction	<p>Construction works (for example, temporary watercourse diversions and in-channel working) to be undertaken taking into account sensitive ecological seasons (e.g. breeding or migration seasons) and the potential impact that the type of construction work could have on protected species within that season. Prior to construction, consultation will be undertaken with SNH to confirm the programme of construction works.</p>	To protect aquatic species (including salmonids) and bats during construction works affecting watercourses.	SNH, SEPA, and Spey Fishery Board.

Mitigation Item ⁹⁰	Approximate Chainage/ Location	Timing of measure	Description	Mitigation Purpose/ Objection	Specific Consultation or Approval Required
			<p>The key sensitive period for salmonids is mid-October to June, inclusive. However, the most acceptable timing will depend on which sensitive species are present and will be agreed with SEPA, SNH and the Spey Fishery Board. Percussive (hammer) piling will be avoided adjacent to the watercourse in favour of softer alternatives (e.g. silent sheet piling, vibratory sheet piling) where ground conditions allow. Where not possible, soft start piling procedures should be utilised. The soft-start duration should be a period of not less than 20 minutes, and should piling cease for a period greater than 20 minutes, the soft start procedure must be repeated.</p> <p>During any river dewatering and/or in-channel working, an ecological watching brief and fish rescue plan will be instigated in consultation with SNH and SEPA.</p> <p>The key sensitive periods for bats are between May-August (inclusive) when bats form maternity roosts; and between November-February (sometimes extending into October and March dependent on weather conditions) when bats occupy hibernation roosts^{xxxiv}.</p>		
P11-E32	Throughout Proposed Scheme	Construction	Mitigation measures to avoid or reduce potential impacts on surface waters will be employed, including adherence to Guidance for Pollution Prevention (GPP) ^{xxxv} during construction, and appropriate road drainage and runoff treatment.	To protect fauna and habitats from pollution of surface waters during construction.	None
P11-E33	Throughout Proposed Scheme	Construction	Any permanent watercourse diversion works (including realignments at crossings) will incorporate design measures that enhance both in-channel and riparian habitat quality e.g. provision of resting pools/spawning habitats for salmonids. Refer to ES Chapter 11 Road Drainage and Water Environment for key watercourse construction and design mitigation commitments.	To enhance in-channel and riparian habitat at diverted watercourses.	None
P11-E58	International value watercourses (River Dulnain, Allt nan	Construction	No working or artificial lighting within 50m of watercourses during the hours of darkness, taken to be 30 minutes before	To prevent disturbance to otters and fish using	Approval required from the ECoW

Mitigation Item ⁹⁰	Approximate Chainage/ Location	Timing of measure	Description	Mitigation Purpose/ Objection	Specific Consultation or Approval Required
	Ceatharnach, Allt na Criche (Lynwilg))		<p>sunset to 30 minutes after sunrise, unless specifically agreed with SNH.</p> <p>The ECoW will monitor otter activity upstream and downstream of the works using camera traps and may stop site activities at any time should they consider that the works are having an impact on otter activity.</p> <p>When site activities are taking place at more than one International value watercourse at any one time, this will be subject to ECoW approval, to avoid any cumulative impact on otter activity. This includes any works taking place within 50m of the watercourse.</p>	International value watercourses.	
P11-E60	River Dulnain, Allt nan Ceatharnach and Allt na Criche (Lynwilg)	Pre-Construction & Construction	No in-channel works or bank piling activity associated with crossing and outfall construction on the River Dulnain, Allt nan Ceatharnach and Allt na Criche (Lynwilg) shall be undertaken between October- June inclusive.	To avoid key spawning, development and emergence periods for Atlantic salmon and sea lamprey, as well as the smolt run for Atlantic salmon.	None
P11-E61	Allt nan Ceatharnach and Allt na Criche (Lynwilg).	Pre-Construction & Construction	With the exception of temporary dewatering, no working within wetted river channel shall be undertaken on the Allt nan Ceatharnach and Allt na Criche (Lynwilg). No working within the wetted channel shall be undertaken on the River Dulnain.	To avoid acoustic disturbance and water pollution/ sedimentation.	None

8. Residual Impacts

8.1. Aquatic Habitats

Construction

- 8.1.1. With the implementation of the mitigation commitments in Table 7.1 and Table 7.2 (and also in relation to water as detailed in ES Chapter 11 (Road Drainage and the Water Environment), potential impacts described in Section 6 will either not occur, or are likely to be short-term, temporary and not significant and so are not considered further.
- 8.1.2. The exception to this is direct habitat loss, which may be permanent depending on the mechanism of loss, and for which (in terms of river and bankside habitat) there are limited practical mitigation options. These impacts are assessed in Table 8.1 below. Bogbain Burn is not crossed by the Proposed Scheme and no habitat loss is predicted for this watercourse.

Table 8.1: Aquatic Habitats – Specific Impacts, Mitigation and Residual Impacts – Construction

Location	Potential Impact	Characterisation of Impact (Pre-mitigation)	Essential Mitigation	Residual Impact
Watercourse Allt nan Ceatharnach Location: Ch17400, north- west of Carrbridge Value: International	Loss of open channel and bankside habitat through culvert/bridge placement.	Extent: Approximate 22m loss of open channel to A9 1200 Baddengorm Bridge and A9 1200 S side road overbridge. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium	All practical measures have been included in embedded and standard mitigation to avoid impacts on watercourse habitats during construction, reducing the length of culverts required and using bridges and open portal-frame culverts which serve to: <ul style="list-style-type: none"> remove existing artificial in-channel structures (e.g. culvert inverts); restore natural bed substrates; and improve water depth and flow provision at crossing locations, supporting unimpeded passage for migratory fish. Habitat loss is therefore primarily riparian (as a result of abutments) and as a result of the increased extent of habitat physically beneath the road under the Proposed Scheme	Not significant
Watercourse River Dulnain Location: Ch16600, at Carrbridge Value: International		Extent: Approximate 13m loss of open channel to A9 1190 Dulnain Bridge. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium		Not significant
Watercourse Allt Cnapach Location: Ch12200, at Kinveachy Value: Local		Extent: Approximate 10m loss of open channel to A9 1170 C50 Allt Cnapach culvert and A9 1170 C50 S Access Road Culvert. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium		Not significant

Location	Potential Impact	Characterisation of Impact (Pre-mitigation)	Essential Mitigation	Residual Impact
Watercourse Aviemore Burn Location: Ch7150, at Aviemore Value: Regional		Extent: Approximate 10m loss of open channel to A9 1150 C95 Steallan Dubh culvert. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium	(with implications for shading and primary productivity). SMC-E1, SMC-E2, SMC-E3, SMC-E4, SMC-E5 P11-E16 P11-E28 P11-E31	Not significant
Watercourse Allt na Criche (Lynwilg) Location: Ch3500, at Lynwilg Value: International		Extent: Approximate 13m loss of open channel to A9 1130 Criche Bridge. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium	P11-E32 P11-E33 + P11-E58, P11-E60, P11-E61 (International value watercourses only) + Water environment mitigation commitments detailed in ES Chapter 11 (Road Drainage and the Water Environment) with respect to control of construction at watercourses.	Not significant
Watercourse Caochan Ruadh Location: Ch1700, at Ballinluig Value: National		Extent: Approximate 10m loss of open channel to A9 1100 C70 Caochan Ruadh culvert. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium		Not significant
Watercourse Allt Chrioichaidh		Extent: Approximate 17m loss of open channel to A9 1100 Allt Chrioichaidh bridge and SuDS maintenance access bridge A9 1100 S. Effect: Direct negative		Not significant

Location	Potential Impact	Characterisation of Impact (Pre-mitigation)	Essential Mitigation	Residual Impact
Location: Ch550, north-west of Loch Alvie Value: National		Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium		
Watercourse Allt an Fhearna Location: Ch150, west of Loch Alvie Value: National		Extent: Approximate 5m loss of open channel to SuDS maintenance access bridge A9 1090 S. Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: Medium		Not significant
Pond Pond 18 Location: Ch8750, at Granish Value: National	Permanent loss of habitat during construction.	Extent: Total loss of pond Effect: Direct negative Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Impact Descriptor: High	Detailed specific mitigation has been developed to replace this pond. P11-E31 P11-E32 + Water environment mitigation commitments detailed in ES Chapter 11 (Road Drainage and the Water Environment) with respect to control of construction at waterbodies.	Not significant

Operation

- 8.1.3. With the implementation of mitigation commitments in Table 7.1 and Table 7.2 (and also in relation to water as detailed in ES Chapter 11 (Road Drainage and the Water Environment), potential impacts described in Section 6 will not occur.
- 8.1.4. For example, the Proposed Scheme highway drainage design includes a minimum of two water quality treatment levels at each outfall location (see ES Chapter 11 (Road Drainage and the Water Environment)). The existing highway drainage does not include formal treatment or attenuation prior to discharge to watercourses and the Proposed Scheme is therefore likely to improve discharge quality relative to the existing baseline. This analysis has not been fully quantified and is therefore not considered in terms of residual beneficial impacts for aquatic ecology.
- 8.1.5. Operational drainage discharge under the Proposed Scheme has also been shown to be compliant with published water quality thresholds under both the Highways Agency Water Risk Assessment Tool (HAWRAT) in relation to acute and chronic events, and Environmental Quality Standards (EQS) (as defined under the Water Framework Directive) for annual average concentrations of pollutants.
- 8.1.6. Salt thresholds do not exist as part of UK HAWRAT EQS and salt is therefore not included in standard HAWRAT assessment. However, the potential impact of the Proposed Scheme on salt discharge has been assessed against indicative thresholds agreed with SNH (based on Canadian thresholds in the absence of published UK equivalents). With the exception of Allt Cnapach and Loch Puladdern, all receiving watercourses and waterbodies assessed under the Proposed Scheme have been shown to pass the adopted salt thresholds. These analyses are presented in ES Chapter 11 (Road Drainage and the Water Environment).
- 8.1.7. Regarding failures at Allt Cnapach and Loch Puladdern, the road salt assessment does not account for any removal of salt by storage, treatment or attenuation as part of the proposed SuDS and may therefore be considered conservative.
- 8.1.8. Regarding Loch Puladdern specifically, the HAWRAT approach used for the salt assessment was designed to predict impact on receiving rivers and therefore requires a 'flow' volume with which to assess dilution capacity. The assessment of Loch Puladdern is therefore based on an estimated run-off flow volume at a given discharge point (rather than the dilution capacity of the standing waterbody itself) and is extremely conservative. Given Loch Puladdern receives existing highway drainage that is unattenuated and does not include any treatment prior to discharge, it is likely that the introduction of SuDS treatment will be of overall benefit for water quality within Loch Puladdern, as described in ES Chapter 11 (Road Drainage and the Water Environment). No operational impacts are therefore predicted on Loch Puladdern.
- 8.1.9. Allt Cnapach is a minor watercourse, providing low dilution potential. This drives the overall failure against the adopted salt concentration threshold at the assessment point. Given the short-term, infrequent, and reversible nature of the discharge events (which are ameliorated with distance from source) no residual effects on habitats within Allt Cnapach are predicted from salt discharge.

8.2. Aquatic Species

Construction

- 8.2.1. With the implementation of A9 Standard Mitigation Commitments for Water (see ES Chapter 11) and Ecology as outlined in Table 7.1 and Table 7.2, potential impacts described in Section 6 will either not occur, or are likely to be short-term, temporary and not significant. In the case of aquatic species mortality, incidental individual mortality would be negligible at the population level.

Operation

- 8.2.2. With the implementation of A9 Standard Mitigation Commitments for Water (see ES Chapter 11) and Ecology as outlined in Table 7.1 and Table 7.2, the adverse potential impacts described in Section 6 will not occur.
- 8.2.3. For example, the Proposed Scheme highway drainage design includes a minimum of two water quality treatment levels at each outfall location (see ES Chapter 11 (Road Drainage and the Water Environment)). The existing highway drainage does not include formal treatment or attenuation prior to discharge to watercourses and the Proposed Scheme is therefore likely to improve discharge quality relative to the existing baseline.
- 8.2.4. Salt thresholds do not exist as part of UK HAWRAT EQS and salt is therefore not included in standard HAWRAT assessment. However, the potential impact of the Proposed Scheme on salt discharge has been assessed against indicative thresholds agreed with SNH (based on Canadian thresholds in the absence of published UK equivalents). With the exception of Allt Cnapach and Loch Puladdern, all receiving watercourses and waterbodies assessed under the Proposed Scheme have been shown to pass the adopted salt thresholds. These analyses are presented in ES Chapter 11 (Road Drainage and the Water Environment).
- 8.2.5. Regarding failures at Allt Cnapach and Loch Puladdern, the road salt assessment does not account for any removal of salt by storage, treatment or attenuation as part of the proposed SuDS and may therefore be considered conservative.
- 8.2.6. Regarding Loch Puladdern specifically, the HAWRAT approach used for the salt assessment was designed to predict impact on receiving rivers and therefore requires a 'flow' volume with which to assess dilution capacity. The assessment of Loch Puladdern is therefore based on an estimated run-off flow volume at a given discharge point (rather than the dilution capacity of the standing waterbody itself) and is extremely conservative. Given Loch Puladdern receives existing highway drainage that is unattenuated and does not include any treatment prior to discharge, it is likely that the introduction of SuDS treatment will be of overall benefit for water quality within Loch Puladdern, as described in ES Chapter 11 (Road Drainage and the Water Environment). No operational impacts are predicted on resident aquatic species within Loch Puladdern.
- 8.2.7. Allt Cnapach is a minor watercourse, providing low dilution potential. This drives the overall failure against the adopted salt concentration threshold at the assessment point. However, the acute threshold adopted (640 mg Cl/l) is purposefully biased towards protecting highly sensitive species such as freshwater mussel species (noting that freshwater pearl mussel is absent from Allt Cnapach and habitats are unsuitable for freshwater pearl mussel as described in Annex E). The predicted concentration during discharge events at the assessment point is 671 mg Cl/l, a marginal failure against the threshold. The LC₅₀ (the concentration at which 50% of a study population is killed within a given time period) for the majority of species included in the development of the

Canadian standard (including macroinvertebrates and fish), was several orders of magnitude greater (up to 20x) than the threshold adopted.

- 8.2.8. Given the short-term, infrequent, and reversible nature of the discharge events (which are ameliorated with distance from source), the conservative nature of the salt assessment (and threshold adopted), and the absence of highly sensitive species within Allt Cnapach, no residual effects on resident aquatic species are predicted for Allt Cnapach as a result of salt discharge.
- 8.2.9. In relation to habitat connectivity and species permeability, as described in project mitigation P11-E33 (Table 7.2), existing A9 culverts at Allt Cnapach, Aviemore Burn and Caochan Ruadh (all of which include artificial inverts) will be replaced with new open structures. Two existing culverts/bridges with artificial inverts are also being replaced with clear-span bridges (Allt na Criche and Allt Chrioichaidh). At each location, this will act to:
- remove existing artificial in-channel structures (e.g. culvert inverts);
 - restore natural bed substrates; and
 - improve water depth and flow provision at crossing locations, supporting unimpeded passage for migratory fish.
- 8.2.10. Aside from ensuring hydraulic conditions are passable (based on swim capability), culverts can form a barrier to fish movement by eliciting a behavioural response. Fish may be reluctant to swim through culverts, particularly non-migratory species which lack strong behavioural migration cues. It has been suggested that fish find the interior of a culvert less discouraging if natural light is present, but there is little evidence to support this in the UK (CIRIA, 2010)^{xxxvi}. Some evidence suggests that fish may be reluctant to move between discrete light/dark interfaces, i.e. at culvert inlets and outlets. Project mitigation therefore includes riparian and marginal planting at culvert inlets and outlets (P11-E28) to mitigate for this potential through provision of dappled light and shade.
- 8.2.11. In combination, these measures are considered to provide residual beneficial impacts for aquatic species permeability associated with the Proposed Scheme, relative to the existing baseline. These residual impacts are outlined in Table 8.2.

Table 8.2: Aquatic Species – Specific Impacts, Mitigation and Residual Impacts – Operation

Location	Potential Impact	Characterisation of Impact (Pre-mitigation)	Essential Mitigation	Residual Impact
Watercourse Allt Cnapach Location: Ch12200, at Kinveachy Value: Local	Increased species permeability through the A9.	Extent: Removal of artificial culvert invert and naturalisation of river channel underneath replacement A9 1170 C50 Allt Cnapach culvert, improving connectivity to upper catchment. Effect: Direct beneficial Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: High	All practical measures have been included in embedded and standard mitigation to improve habitat connectivity and aquatic species permeability during operation, reducing the length of culverts required and restoring natural bed substrates through the use of open portal-frame culverts. P11-E28 P11-E33	Not Significant (beneficial)
Watercourse Aviemore Burn Location: Ch7150, at Aviemore Value: Regional		Extent: Removal of artificial culvert invert and naturalisation of river channel underneath replacement A9 1150 C95 Steallan Dubh culvert, improving connectivity to upper catchment. Effect: Direct beneficial Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: High		Significant (beneficial)
Watercourse Allt na Criche (Lynwilg) Location: Ch3500, at Lynwilg		Extent: Removal of artificial bridge invert and naturalisation of river channel underneath replacement A9 1130 Criche Bridge, improving connectivity to upper catchment. Effect: Direct beneficial Duration: Long term Frequency and timing: N/A		Significant (beneficial)

Location	Potential Impact	Characterisation of Impact (Pre-mitigation)	Essential Mitigation	Residual Impact
Value: International		Reversibility: Irreversible Likelihood: Certain Impact Descriptor: High		
Watercourse Caochan Ruadh Location: Ch1700, at Ballinluig Value: National		Extent: Removal of artificial culvert invert and naturalisation of river channel underneath replacement A9 1100 C70 Caochan Ruadh culvert, improving connectivity to upper catchment. Effect: Direct beneficial Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: High		Significant (beneficial)
Watercourse Allt Chriochaidh Location: Ch550, north-west of Loch Alvie Value: National		Extent: Removal of artificial culvert invert (including associated cascade) and naturalisation/ improvement of river channel underneath replacement A9 1100 Allt Chriochaidh bridge, improving connectivity to upper catchment. Effect: Direct beneficial Duration: Long term Frequency and timing: N/A Reversibility: Irreversible Likelihood: Certain Impact Descriptor: High		Significant (beneficial)

9. Conclusions

- 9.1.1. In summary, negative residual impacts have been identified only in relation to habitat loss during construction associated with culvert and bridge placement on watercourses affected by the Proposed Scheme, for which there are limited practical mitigation options. This impact arises because of the increased extent of watercourse that will be under culvert or bridge deck, relative to the existing baseline. Watercourses affected by habitat loss at construction include Allt nan Ceatharnach, River Dulnain, Allt Cnapach, Aviemore Burn, Allt na Criche (Lynwilg), Caochan Ruadh, and Allt Chrìochaidh. These residual impacts are not considered to be significant.
- 9.1.2. The Proposed Scheme includes embedded mitigation as part of the design such as the use of clear span bridges on Allt nan Ceatharnach, River Dulnain, Allt na Criche (Lynwilg) and Allt Chrìochaidh (in the case of Criche and Chrìochaidh, replacing existing structures which have artificial inverts). The Proposed Scheme also includes portal-frame culverts at Allt Cnapach, Aviemore Burn and Caochan Ruadh (all currently conveyed under the A9 via piped culverts with artificial inverts), which will restore natural channel substrates on these watercourses. Consequently, significant beneficial residual impacts have been identified in relation to species permeability during operation of the Proposed Scheme.
- 9.1.3. Also of note, the Proposed Scheme highway drainage design includes a minimum of two water quality treatment levels at each outfall location (see ES Chapter 11 (Road Drainage and the Water Environment)). The existing highway drainage does not include formal treatment or attenuation prior to discharge to watercourses and the Proposed Scheme is therefore likely to improve discharge quality relative to the existing baseline. This effect has not been fully quantified (relative to the existing baseline) and is therefore not considered in terms of residual beneficial impacts for aquatic ecology. However, operational drainage discharge under the Proposed Scheme has been shown to be compliant with published water quality thresholds under both the HAWRAT in relation to acute and chronic events, and EQS (as defined under the Water Framework Directive) for annual average concentrations of pollutants. No adverse effects on aquatic ecology in relation to water quality are therefore anticipated.
- 9.1.4. One pond (Pond 18) assessed to be of National value (assumed to support the SBL species Northern damselfly) will be lost to the Proposed Scheme. Detailed mitigation has been developed for provision of a replacement pond prior to the loss of this pond, including relocation of its constituent species, and no residual significant effects are predicted.

ⁱ CFJV/JUK/AMJV (2015) A9 Dualling Programme – South/Central/North. Outline approach to consistency in A9 ecology survey extents.

ⁱⁱ Scottish Environment Protection Agency (2017) River Basin Management Plans Interactive Map. Available at <http://gis.sepa.org.uk/rbmp/> (Accessed September 2017)

ⁱⁱⁱ Scottish Environment Protection Agency (2017) Water Classification Hub. <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (Accessed September 2017)

- iv Scotland's Environment (2017) Available at: <http://www.environment.scotland.gov.uk/> (Accessed September 2017)
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- viii Hendry, K., and Cragg-Hine, D. (1997) Restoration of Riverine Salmon Habitats: A Guidance Manual. Fisheries Technical Manual 4. R&D Technical Report W44. Environment Agency, Bristol.
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- xxxii Construction Industry Research and Information Association (2015) SUDS Manual C753.



^{xxxiii} Scottish Environment Protection Agency (2000) Ponds, Pools and Lochans: Guidance on good practice in the management and creation of small waterbodies in Scotland.

^{xxxiv} Collins. J (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

^{xxxv} <http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/> (Accessed 13/04/2016)

^{xxxvi} Construction Industry Research and Information Association (2010) Culvert Design and Operation Guide Report C689.



Annex A. River Habitat Survey Results

A.1. Habitat Modification Score (HMS) and Habitat Modification Class (HMC)

- A.1.1. The Habitat Modification Score (HMS) is an indication of artificial modification to river channel morphology. To calculate the HMS for a site, points are allocated for the presence and extent of artificial features such as culverts and weirs and also modifications caused by the re-profiling and reinforcement of banks. Greater and more severe modifications result in a higher score. The cumulative points total provides the Habitat Modification Score (HMS).
- A.1.2. A Habitat Modification Class (HMC) protocol has been developed which allocates the condition of the channel in a site to one of five modification classes, based on the total score (1 = near-natural; 5 = severely modified) - See Table A.1. Higher HMS scores reflect more artificial intervention and modification of the river channel within a site.

Table A.1: River Habitat Modification Class

Habitat Modification Class	Description	Habitat Modification Score
1	Pristine/semi-natural	0 - 16
2	Predominantly unmodified	17 - 199
3	Obviously modified	200 - 499
4	Significantly modified	500 - 1399
5	Severely modified	1400 +

A.2. Summary Habitat Modification Results

- A.2.1. Survey habitat modification results and overall HMC are presented for each site surveyed within the Study Area.



Bogbain Burn – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-032-RH-001
River Name:	Bogbain Burn
Date:	08/05/2017
Surveyor:	Bonnie Boulton
Accreditation Code:	FA008
Spot Check 1 NGR (Start):	NH 87500 24332
Spot Check 6 NGR:	NH 87722 24239
End NGR:	NH 87956 24206
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System		
A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		0
C	Spot check bank material	100
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		100
I	Spot check bank modification - RS	80
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	400
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		480
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		0
R	Sweep-up artificial features - weirs/dams/sluiques	0
HMS: Weirs/dams/sluiques sub-score		0
S	Sweep-up artificial features - bridges	250
HMS: Bridges sub-score		250
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		830



Photo P1010793



Photo P1010796



Photo P1010800



Photo P1010810



Photo P1010811



Photo P1010813





Allt nan Ceatharnach – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-033-RH-001	
River Name:	Allt nan Ceatharnach	
Date:	05/04/2017	
Surveyor:	Liam Atherton and Naomi Lowden	
Accreditation Code:	FA001	
Spot Check 1 NGR (Start):	NH8915722893	
Spot Check 6 NGR:	NH8910223103	
End NGR:	NH8918123301	
HMS Calculated by:	Naomi Lowden	
RHS Habitat Modification Score & Habitat Modification Class Scoring System		
A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		0
C	Spot check bank material	480
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	400
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		880
I	Spot check bank modification - RS	0
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		0
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	40
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		40
R	Sweep-up artificial features - weirs/dams/sluiques	180
HMS: Weirs/dams/sluiques sub-score		180
S	Sweep-up artificial features - bridges	500
HMS: Bridges sub-score		500
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	25
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		25
Total HMS		1625



Photo P1010765 Downstream of A9



Photo P1010767 Downstream of A9



Photo P1010744 A9 Crossing (Looking Upstream)



Photo P1010799 Under A9



Photo P1010782 Upstream of A9



Photo P1010789 Upstream of A9 (rail crossing)





River Dulnain – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-034-RH-001
River Name:	River Dulnain
Date:	05/04/2017
Surveyor:	Liam atherton and Naomi Lowden
Accreditation Code:	FA001
Spot Check 1 NGR (Start):	NH8966922775
Spot Check 6 NGR:	NH8964522529
End NGR:	NH8941122437
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		0
C	Spot check bank material	40
D	Spot check bank modification - RI	20
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		60
I	Spot check bank modification - RS	0
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		0
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		0
R	Sweep-up artificial features - weirs/dams/sluices	0
HMS: Weirs/dams/sluices sub-score		0
S	Sweep-up artificial features - bridges	350
HMS: Bridges sub-score		350
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	50
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		50
Total HMS		460



Photo P1010743 Downstream of A9



Photo P1010745 Downstream of A9



Photo P1010746 Downstream of A9 (including rail and A9 crossing)



Photo P10107 Downstream of A9



Photo P1010760 Upstream of A9



Photo P1010742 Upstream of A9





Allt Cnapach – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-036-RH-001
River Name:	Allt Cnapach
Date:	04/04/2017
Surveyor:	Liam Atherton and Naomi Lowden
Accreditation Code:	FA001
Spot Check 1 NGR (Start):	NH9083018545
Spot Check 6 NGR:	
End NGR:	
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	330
B	Sweep-up artificial features - Culverts	400
HMS: Culverts sub-score		730
C	Spot check bank material	100
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	200
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		300
I	Spot check bank modification - RS	0
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		0
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		0
R	Sweep-up artificial features - weirs/dams/sluiques	375
HMS: Weirs/dams/sluiques sub-score		375
S	Sweep-up artificial features - bridges	250
HMS: Bridges sub-score		250
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	20
HMS: Poaching sub-score		20
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		1675



Photo P1010715 Upstream of A9



Photo P1010717 Upstream of A9



Photo P1010726 Upstream of A9



Photo P1010729 A9 Crossing (Looking Downstream)



Photo P1010730 Downstream A9 Showing Rail Bridge



Photo P1010733 Downstream of A9





Aviemore Burn – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-044-RH-001
River Name:	Aviemore Burn
Date:	08/05/2017
Surveyor:	Bonnie Boulton
Accreditation Code:	FA008
Spot Check 1 NGR (Start):	NH 89151 13896
Spot Check 6 NGR:	NH 89396 13876
End NGR:	NH 89447 13625
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	350
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		350
C	Spot check bank material	70
D	Spot check bank modification - RI	120
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		190
I	Spot check bank modification - RS	40
J	Sweep-up bank profiles - RS	40
K	Spot check channel modification - RS	200
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		280
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	20
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		20
R	Sweep-up artificial features - weirs/dams/slucices	0
HMS: Weirs/dams/slucices sub-score		0
S	Sweep-up artificial features - bridges	700
HMS: Bridges sub-score		700
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		1540



Photo P1010816 Upstream of A9



Photo P1010818 Upstream of A9



Photo P1010821 Upstream of A9



Photo P1010823 A9 Crossing (Looking Downstream)

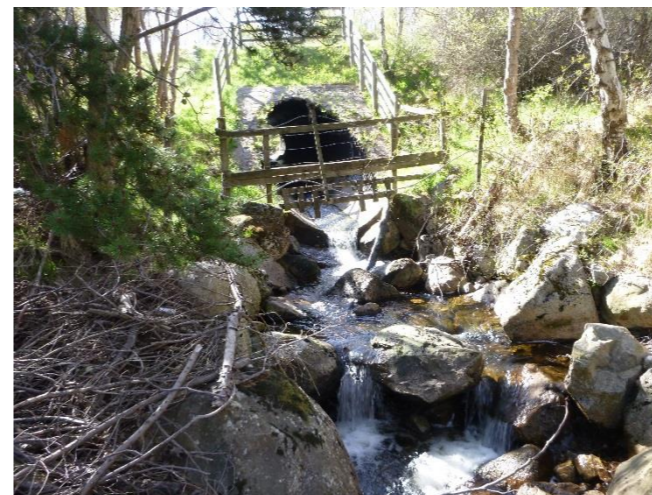


Photo P1010829 A9 Crossing (Looking Upstream)



Photo P1010840 Downstream of A9





Allt na Criche (Lynwilg) – RHS Habitat Modification Scoring and Key Photos

Site Reference:	Wc-049-RH-001
River Name:	Allt na Criche
Date:	10/05/2017
Surveyor:	Bonnie Boulton
Accreditation Code:	FA008
Spot Check 1 NGR (Start):	NH 88465 10423
Spot Check 6 NGR:	NH 88381 10597
End NGR:	NH 88168 10715
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	400
HMS: Culverts sub-score		400
C	Spot check bank material	150
D	Spot check bank modification - RI	40
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	200
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		390
I	Spot check bank modification - RS	0
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		0
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		0
R	Sweep-up artificial features - weirs/dams/sluices	0
HMS: Weirs/dams/sluices sub-score		0
S	Sweep-up artificial features - bridges	700
HMS: Bridges sub-score		700
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	20
HMS: Poaching sub-score		20
V	Sweep-up artificial features - fords	200
HMS: Fords sub-score		200
W	Sweep-up artificial features - outfall	25
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		25
Total HMS		1735



Photo P1010933 Downstream of A9



Photo P1010936 Downstream of A9



Photo P1010939 A9/A95 Crossing (Looking Upstream)



Photo P1010945 Upstream of A9



Photo P1010948 Upstream of A9



Photo P1010957 Upstream of A9 (Lynwilg Road)





Caochan Ruadh – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-052-RH-001
River Name:	Caochan Ruadh
Date:	09/05/2017
Surveyor:	Bonnie Boulton
Accreditation Code:	FA0008
Spot Check 1 NGR (Start):	NH 8664 09942
Spot Check 6 NGR:	NH 86559 10149
End NGR:	NH 86435 10185
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	400
HMS: Culverts sub-score		400
C	Spot check bank material	100
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	200
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		300
I	Spot check bank modification - RS	80
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		80
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	60
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		60
R	Sweep-up artificial features - weirs/dams/sluices	0
HMS: Weirs/dams/sluices sub-score		0
S	Sweep-up artificial features - bridges	200
HMS: Bridges sub-score		200
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	20
HMS: Poaching sub-score		20
V	Sweep-up artificial features - fords	40
HMS: Fords sub-score		40
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		1100



Photo P1010902 Downstream of A9



Photo P1010909 Downstream of A9



Photo P1010912 A9 Crossing (Looking Upstream)



Photo P1010914 A9 Crossing (Looking Downstream)



Photo P1010915 – Upstream of A9



Photo P1010928 – Upstream of A9





Allt Chrioichaidh – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-054-RH-001	
River Name:	Allt Chrioichaidh	
Date:	09/05/2017	
Surveyor:	Bonnie Boulton	
Accreditation Code:	FA008	
Spot Check 1 NGR (Start):	NH 85574 09706	
Spot Check 6 NGR:	NH 85668 09529	
End NGR:	NH 85867 09585	
HMS Calculated by:	Naomi Lowden	
RHS Habitat Modification Score & Habitat Modification Class Scoring System		
A	Spot check channel modification - Culverts	330
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		330
C	Spot check bank material	0
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		0
I	Spot check bank modification - RS	120
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		120
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	60
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		60
R	Sweep-up artificial features - weirs/dams/slucices	375
HMS: Weirs/dams/slucices sub-score		375
S	Sweep-up artificial features - bridges	0
HMS: Bridges sub-score		0
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		885



Photo P1010880 Upstream of A9



Photo P1010881 Upstream of A9



Photo P1010890 Cascade Upstream of A9 Crossing



Photo P1010893 A9 Crossing (Looking Upstream)



Photo P1010895 Downstream A9



Photo P1010900 Downstream A9





Allt an Fhearna – RHS Habitat Modification Scoring and Key Photos

Site Reference:	WC-057-RH-002
River Name:	Allt na Fhearna
Date:	08/05/2017
Surveyor:	Bonnie Boulton
Accreditation Code:	FA008
Spot Check 1 NGR (Start):	NH 85601 09351
Spot Check 6 NGR:	NH 85824 09399
End NGR:	NH 85941 09503
HMS Calculated by:	Naomi Lowden

RHS Habitat Modification Score & Habitat Modification Class Scoring System		
A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	0
HMS: Culverts sub-score		0
C	Spot check bank material	0
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
HMS: Bank & bed reinforcement sub-score		0
I	Spot check bank modification - RS	40
J	Sweep-up bank profiles - RS	0
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
HMS: Bank & bed resectioning sub-score		40
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
HMS: Berms & embankments sub-score		0
R	Sweep-up artificial features - weirs/dams/slucices	0
HMS: Weirs/dams/slucices sub-score		0
S	Sweep-up artificial features - bridges	0
HMS: Bridges sub-score		0
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
HMS: Poaching sub-score		0
V	Sweep-up artificial features - fords	0
HMS: Fords sub-score		0
W	Sweep-up artificial features - outfall	0
X	Sweep-up artificial features - deflectors	0
HMS: Outfall/deflectors sub-score		0
Total HMS		40



Photo P1010853 Downstream of A9



Photo P1010854 Downstream of A9



Photo P1010855 Downstream of A9



Photo P1010854 Downstream of A9



Photo P1010860 Downstream of A9



Photo P1010871 Confluence with Loch Alvie



Annex B. Fish Habitat Survey Results



Bogbain Burn- Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																			
Site reference:	WC-032-FH-001		Surveyor(s):	Liam Atherton																															
River name:	Bogbain Burn		Associated RHS survey ref:	WC-032-RH-001																															
Date:	08/05/2017		Number of photos:	21																															
Time (GMT):	13:00		Photo references:	793 - 813																															
Upstream NGR	NH8750024332		Adverse survey conditions?	No	Yes																														
Downstream NGR:	NH8795624206																																		
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:																																
Site surveyed from:	Left Bank	Channel	Right Bank																																
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">Survey Reach (m)</th> </tr> <tr> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 500</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH8750024332</td> <td>NH8758724300</td> <td>NH8767124241</td> <td>NH8777624222</td> <td>NH8785724221</td> </tr> <tr> <td>Finish NGR</td> <td>NH8758724300</td> <td>NH8767124241</td> <td>NH8777624222</td> <td>NH8785724221</td> <td>NH8795624206</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>								Survey Reach (m)					0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	Start NGR	NH8750024332	NH8758724300	NH8767124241	NH8777624222	NH8785724221	Finish NGR	NH8758724300	NH8767124241	NH8777624222	NH8785724221	NH8795624206	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
	Survey Reach (m)																																		
	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500																														
Start NGR	NH8750024332	NH8758724300	NH8767124241	NH8777624222	NH8785724221																														
Finish NGR	NH8758724300	NH8767124241	NH8777624222	NH8785724221	NH8795624206																														
RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END																														
Fisheries Information																																			
Habitat Type	Description	Species/Life-stage	% by reach																																
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	5	10	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.																												
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	20	15	10	15	15																												
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	5	5	5	0																												
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	60	20	55	30	70																												
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	20	60	20	50	15																												
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	10	5	0																												
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	10	0	0	0	0																												
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	5	15	20	20	0																												
Number within Reach																																			
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	1 (A)	1 (B)	1 (C)	1 (D)	0																												
Comments:																																			
Upstream of the railway bridge crossing (NH 87858 24216), encompassing reaches 0-400m, dynamic gravel-bed river system through broadleaved woodland and coniferous plantation. Evidence of significant lateral migration. High input of large woody debris, constricting flow and promoting habitat diversity. Diverse salmonid fish habitat with fry, parr, pool and glide habitats recorded. Locally, mixed shade, undercut banks and exposed bankside roots enhance fish habitat quality. Fine sediment deposition was apparent in lower reaches, upstream of the railway crossing, which locally enhances habitats available for lamprey species.																																			
Downstream of the railway bridge (encompassing reach 400-500m), distinct change in character to uniform channel, historically realigned to the railway embankment. Low recovery from historical modification, and decline in fish habitat quality compared with upstream of the crossing. However substrate and flow conditions continue to provide glide and riffle/run habitat, within the context of a modified channel.																																			
Barriers																																			
Minor natural in-stream barriers (A-D) were noted, associated with fallen trees (with a maximum head difference of 0.2m) which are unlikely to significantly affect fish movement through the reach surveyed.																																			

Prior to undertaking the survey ensure the following:

You have read the readme for this survey.

You have appropriate permission and it is safe to survey.

You are not lone working.

Your survey team is competent in watercourse habitat recognition.

You have an appropriate risk assessment that fulfils project and client requirements.



Allt nan Ceatharnach – Fish Habitat Surveys (001 and 002)

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA						Prior to undertaking the survey ensure the following:					
Site reference:	WC-033-FH-001			Surveyor(s):	Liam Atherton		You have read the readme for this survey.				
River name:	Allt nan Ceatharnach			Associated RHS survey ref:	WC-033-RH-001		You have appropriate permission and it is safe to survey.				
Date:	05/04/2017			Number of photos:	28		You are not lone working.				
Time (GMT):	13:45			Photo references:	764-790		Your survey team is competent in watercourse habitat recognition.				
Upstream NGR	NH8918123301			Adverse survey conditions?	No	Yes	You have an appropriate risk assessment that fulfils project and client requirements.				
Downstream NGR:	NH8915722893										
Survey direction:	u/s to d/s	d/s to u/s		If yes, state:							
Site surveyed from:	Left Bank	Channel	Right Bank								
				Survey Reach (m)							
				0 - 100	100 - 200	200 - 300	300 - 400	400 - 500			
Start NGR				NH8915722893	NH8913322999	NH8910423062	NH8912323162	NH8915023246			
Finish NGR				NH8913322999	NH8910423062	NH8912323162	NH8915023246	NH8918123301			
RHS corresponding spot check				1>>3	3>>5	5>>7	7>>9	9>>END			
Fisheries Information											
Habitat Type	Description	Species/Life-stage	% by reach								
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.			
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	10	5	5	5	5	5			
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	0	5	0	0	5			
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	70	80	40	30	30	30			
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	10	10	0	0	0	0			
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	0	0	0	0			
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0	0			
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	0	0	0	0	0	0			
			Number within reach								
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	0	2 (A & B)	0	1 (C)				
Comments: Dynamic gravel-bed river system through moorland and coniferous plantation. No optimal salmonid spawning habitat recorded; however opportunistic spawning habitat (appropriate flow and substrate conditions) locally available within fry and parr habitat recorded. Relatively diverse salmonid fish habitat with fry, parr, pool and glide habitats recorded. Locally, undercut banks and exposed bankside roots enhance fish habitat. Artificial in-stream barriers effectively restrict habitat utilisation upstream of the A9, as described below:											
Barriers: - A (P774) NH 89112 23125. Engineered bed check downstream of A9 crossing, constructed from artificial material (rip-rap). May be passable to upstream migration by adult salmonids in some flow conditions, but presents a permanent barrier to localised (upstream) dispersal of juvenile life-stages and other species (excluding eel). Approximately 12m long bed check, with a 2.5m total head difference across the bed check. - B (P777-778) NH 89111 23157. Artificial perched bridge invert under the A9 road crossing, acting to create a shallow flume under the A9 of approximately 40m length, with 0.1m water depth and flow velocities of 1.0-1.5m/s. Likely impassable to upstream movement by all species, excluding eel. - C (P786-788) NH 89163 23304. Artificial perched bridge invert under railway bridge, upstream of A9 crossing. Similar hydraulic conditions to the A9 road crossing. Likely impassable to upstream movement by all species, excluding eel.											



FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA							
Site reference:	WC-033-FH-002		Surveyor(s):	Jon Watt			
River name:	Allt nan Ceatharnach		Associated RHS survey ref:	N/A			
Date:	05/04/2018		Number of photos:	23			
Time (GMT):	11:00		Photo references:	1.1-5.7			
Upstream NGR	NH 89196 22854		Adverse survey conditions?	No	Yes		
Downstream NGR:	NH 89156 22500						
Survey direction:	u/s to d/s	d/s to u/s	Water low to moderate. Clear. 50% overcast clearing to sun in afternoon.				
Site surveyed from:	Left Bank	Channel	Right Bank				
			Survey Reach (m)				
			0 - 100	100 - 200	200 - 300	300 - 400	400 - 500
Start NGR			NH 89156 22500	NH 89093 22571	NH 89098 22646	NH 89158 22692	NH 89164 22778
Finish NGR			NH 89093 22571	NH 89098 22646	NH 89158 22692	NH 89164 22778	NH 89166 22864
RHS corresponding spot check			1>>3	3>>5	5>>7	7>>9	9>>END
Fisheries Information							
Habitat Type	Description	Species/Life-stage	% by reach				
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	1.5	3	2	1.5	2
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	10	20	10	15	15
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	5	0	0	0
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	5	10	5	15	25
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	85	65	85	70	60
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shade provides optimal habitat.	Lamprey ammocoete habitat	0.5	0	0	0	0.5
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	5	0	0	5	4
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	0	0	0	0
General Comments: see below							
Survey reach	Instream	Banks					
0 to 100	Good mixed juvenile salmon habitat throughout section. Width 3 to 5 m. Depth 15 to 50 cm. Substrate dominated by cobble with boulders and pebbles. Flow type mainly riffle and run.	Substantial non-vegetated point and side bars (deposition). Banks fenced from livestock. Some erosion to bank faces outside of bends. Improved grassland both banks with 5 m buffer inside fence.					
100 to 200	Mainly cobble and boulder substrate. Mixed flow types but mainly run and riffle with depths of 10 to 40 cm. One long glide (30 to 50 cm deep) and one deep pool with spawning habitat immediately downstream. Good instream cover for parr and fry.	Much overhead cover from undercuts, particularly in the long glide section. Stable banks fenced off from livestock. Improved grassland both banks with 5 m buffer inside fence.					
200 to 300	Good quality juvenile salmon and trout habitat throughout reach. Stable boulder with some bryophyte cover surrounded by cobble with pockets of sand and gravel. Depth typically 15 to 45 cm. Riffle and run with two short sections of glide.	Downstream end flows under trailing conifer branches for 15 m. Stable banks with around 20% overhead cover from undercuts and draped vegetation. Garden upstream of bridge right bank and woodland left bank.					
300 to 400	Downstream end is very broad (to 10 m) and braided, but stable. Rest is typically 3 to 4 m wet width. Mainly fast flowing run and riffle with stable, coarse substrate. Good quality salmonid habitat.	Stable banks with trees and scrub. Plenty overhead cover. Garden right bank and woodland left. Garden has retained some riparian willow.					
400 to 500	Slightly lower gradient than preceding section. Run/riffle habitat alternates with glide. Coarse substrate throughout so all habitats productive for salmonids.	Low stable banks with riparian trees and scrub. Moderate amount of overhead cover, mainly on outside of bends and in glides where wet-bed width.					
Migration Barrier Notes: No barriers present							

Prior to undertaking the survey ensure the following:

You have appropriate permission and it is safe to survey.
You are not lone working.

Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and



River Dulnain - Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																				
Site reference:	WC-034-FH-001		Surveyor(s):	Liam Atherton																																
River name:	River Dulnain		Associated RHS survey ref:	WC-034-RH-001																																
Date:	05/04/2017		Number of photos:	22																																
Time (GMT):	09:10		Photo references:	742 - 763																																
Upstream NGR	NH8941122437		Adverse survey conditions?	No	Yes																															
Downstream NGR:	NH8966922775																																			
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:																																	
Site surveyed from:	Left Bank	Channel	Right Bank																																	
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="6">Survey Reach (m)</th> </tr> <tr> <th></th> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 500</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH8966922775</td> <td>NH8968422671</td> <td>NH8969322585</td> <td>NH8964522529</td> <td>NH8948822477</td> </tr> <tr> <td>Finish NGR</td> <td>NH8968422671</td> <td>NH8969322585</td> <td>NH8964522529</td> <td>NH8948822477</td> <td>NH8941122437</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>							Survey Reach (m)							0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	Start NGR	NH8966922775	NH8968422671	NH8969322585	NH8964522529	NH8948822477	Finish NGR	NH8968422671	NH8969322585	NH8964522529	NH8948822477	NH8941122437	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
Survey Reach (m)																																				
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RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END																															
Fisheries Information																																				
Habitat Type	Description	Species/Life-stage	% by reach																																	
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	30	5	50	10	10																													
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	30	5	60	20	0																													
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	5	10	10	0																													
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	15	45	10	40	50																													
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	50	40	10	20	40																													
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	0	0	0																													
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0																													
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	0	0	0	0	0																													
Number within reach																																				
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	0	0	0	0																													
Comments: Dynamic gravel-bed river system through mixed land use (broadleaved plantation, rough pasture and suburban/urban development). Optimal salmonid spawning habitat recorded throughout. High quality, diverse salmonid fish habitat with spawning, fry, parr, pool and glide habitats all recorded within the reach. Locally, undercut banks and exposed bankside roots enhance fish habitat availability. Likely to be a critical habitat resource for local fish populations, providing arterial connectivity to a range of smaller tributaries throughout the area.																																				
Barriers None recorded within reach.																																				

Prior to undertaking the survey ensure the following:

You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.

Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.



Allt Cnapach – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																		
Site reference:	WC-036-FH-001		Surveyor(s):	Liam Atherton																														
River name:	Allt Cnapach		Associated RHS survey ref:	WC-036-RH-001																														
Date:	04/04/2017		Number of photos:	28																														
Time (GMT):	14:00		Photo references:	714 - 739																														
Upstream NGR	NH9083018545		Adverse survey conditions?	No	Yes																													
Downstream NGR:	NH9121718418																																	
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:																															
Site surveyed from:	Left Bank	Channel	Right Bank																															
<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">Survey Reach (m)</th> </tr> <tr> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 500</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH9083018545</td> <td>NH9086118528</td> <td>NH9094818537</td> <td>NH9107218511</td> <td>NH9112818483</td> </tr> <tr> <td>Finish NGR</td> <td>NH9086118528</td> <td>NH9094818537</td> <td>NH9107218511</td> <td>NH9112818483</td> <td>NH9121718418</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>							Survey Reach (m)					0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	Start NGR	NH9083018545	NH9086118528	NH9094818537	NH9107218511	NH9112818483	Finish NGR	NH9086118528	NH9094818537	NH9107218511	NH9112818483	NH9121718418	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
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Fisheries Information																																		
Habitat Type	Description	Species/Life-stage	% by reach																															
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.																											
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	0	0	0	0	0																											
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	0	0	0	0																											
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	60	40	40	15	10																											
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	0	0	0	0	0																											
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	0	0	0																											
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0																											
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	10	30	30	10	0																											
Number within reach																																		
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	1 (A)	2 (B & C)	1 (D)	0																											
Comments:																																		
High gradient (10-15%, locally 20% in upper reaches) minor stream system through mixed woodland (upstream 250m) and rough pasture (downstream 250m) land use, with poor quality fish habitat. Dynamic upland cascade system, with a number of artificial instream barriers as described below.																																		
Barriers:																																		
- A (P718-P720) Artificial laid stone forming a weir with a 0.7m head difference and freefall flow over the crest. Likely impassable to upstream migration. Academic given poor habitat suitability.																																		
- B (P727-P728) 0.5m diameter dual pipe culvert (one pipe blocked at survey) under farm access track, with outlet perched 0.1m above stream bed. Unlikely to pose a barrier to fish movement. Academic given poor habitat suitability.																																		
- C (P729) 1.8m diameter pipe culvert under A9, with smooth transition (no perching) at inlet and outlet. Approximate length of 15m, across a head difference of 1.6m (~10% gradient). Unlikely to pose a significant barrier to upstream salmonid migration. Academic given poor habitat suitability.																																		
- D (P731) Artificial bed under clear span railway bridge. Relatively high velocity, shallow flow. Unlikely to pose a significant barrier to upstream salmonid migration. Academic given poor habitat suitability.																																		

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You have an appropriate risk assessment that fulfils project and client requirements.



Aviemore Burn – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA							
Site reference:	WC-044-FH-001		Surveyor(s):	Liam Atherton			
River name:	Aviemore Burn		Associated RHS survey ref:	WC-044-RH-001			
Date:	08/05/2017		Number of photos:	28			
Time (GMT):	16:00		Photo references:	814 - 841			
Upstream NGR	NH8915113896		Adverse survey conditions?	No	Yes		
Downstream NGR:	NH8944713625						
Survey direction:	u/s to d/s	d/s to u/s	If yes, state: Access and visibility restricted by residential land use.				
Site surveyed from:	Left Bank	Channel				Right Bank	
Survey Reach (m)							
		0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	
Start NGR		NH8915113896	NH8922813856	NH8933013858	NH8945013880	NH8948213702	
Finish NGR		NH8922813856	NH8933013858	NH8945013880	NH8948213702	NH8944713625	
RHS corresponding spot check		1>>3	3>>5	5>>7	7>>9	9>>END	
Fisheries Information							
Habitat Type	Description	Species/Life-stage	% by reach				
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat available.	No optimal. Opportunistic spawning habitat available.	No optimal. Opportunistic spawning habitat available.	No optimal. Opportunistic spawning habitat available.	10
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	10	30	0	5	10
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	5	5	5	0
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	20	30	40	40	85
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	5	5	15	40	5
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	0	0	0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	0	0	0	0	0
Number within reach							
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	1 (A)	0	0	0
Comments:							
Heavily modified stream system with low quality fish habitat, as a result of residential land use, localised channel realignment and bank reinforcements. Variable fish habitat quality throughout the survey reach. High-gradient cascade type habitats present in upper reaches; fish habitat improves moving downstream of the A9 crossing, particularly downstream of the residential development. Mix of fry, parr, pool and glide habitats, as well as discrete optimal spawning habitat in the lower 100m of the 500m survey reach. Locally, mixed shade, undercut banks and exposed bankside roots enhance fish habitat quality. Despite the significant modifications (including multiple crossings), only a single artificial barrier was recorded (the A9 culvert), as described below.							
Barriers:							
- A (P829) NH 89330 13856. A9 pipe culvert, approximately 2m diameter culvert, with perched culvert outlet (head difference approximately 0.3m), followed by an additional 0.5m head difference immediately downstream of placed boulder bedcheck. The culvert itself is approximately 15m long with a head difference of 1.2m between the inlet and outlet (approximate 8% gradient). In-combination, the structure and downstream bed-check creates a 2m total head difference and is likely impassable to upstream migration by all species (excluding eel) during most flow conditions							

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Allt na Criche (Lynwilg) – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																		
Site reference:	WC-049-FH-001		Surveyor(s):	Liam Atherton																														
River name:	Allt na Criche (Lynwilg)		Associated RHS survey ref:	WC-049-RH-001																														
Date:	10/05/2017		Number of photos:	33																														
Time (GMT):	08:25		Photo references:	930-962																														
Upstream NGR:	NH8816810715		Adverse survey conditions?	No	Yes																													
Downstream NGR:	NH8846510423																																	
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:																															
Site surveyed from:	Left Bank	Channel	Right Bank																															
<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">Survey Reach (m)</th> </tr> <tr> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 500</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH8846510423</td> <td>NH8846510487</td> <td>NH8841410553</td> <td>NH8837510606</td> <td>NH8825410663</td> </tr> <tr> <td>Finish NGR</td> <td>NH8846510487</td> <td>NH8841410553</td> <td>NH8837510606</td> <td>NH8825410663</td> <td>NH8816810715</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>							Survey Reach (m)					0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	Start NGR	NH8846510423	NH8846510487	NH8841410553	NH8837510606	NH8825410663	Finish NGR	NH8846510487	NH8841410553	NH8837510606	NH8825410663	NH8816810715	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
	Survey Reach (m)																																	
	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500																													
Start NGR	NH8846510423	NH8846510487	NH8841410553	NH8837510606	NH8825410663																													
Finish NGR	NH8846510487	NH8841410553	NH8837510606	NH8825410663	NH8816810715																													
RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END																													
Fisheries Information																																		
Habitat Type	Description	Species/Life-stage	% by reach																															
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm. Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.																											
Gides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	5	0	10	10	5																											
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	10	5	0	5	5																											
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	45	40	60	70	70																											
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	40	50	20	10	10																											
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	5	10	10	5																											
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0																											
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	5	5	0	10	10																											
Number within reach																																		
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	0	1 (A)	0	1 (B)																											
Comments:																																		
Dynamic gravel-bed river system through rough pasture and mixed woodland, with high quality juvenile fish habitat throughout. No discrete optimal spawning habitats but widespread opportunistic spawning habitat (suitable flow and substrate conditions) available. A range of shade and depth conditions locally enhance fish habitat, alongside wooded features, such as undercut banks and extensive exposed bankside roots. Some discrete areas of sand/silt and organic detritus recorded, which may be of value for lamprey species. Two artificial in-stream barriers were recorded, one of which effectively restricts habitat utilisation upstream of the Lynwilg Road, as described below:																																		
Barriers:																																		
-A (P945-947) NH 88348 10631. Artificial bed at ford comprising concrete and placed stone. Approximately 15m long with a head difference of approximately 1m between downstream and upstream extent (approximate 7% gradient). Downstream extent perched above channel in places (up to 0.4m). High velocity flow approximately 0.05m flow depth at survey. Impassable to upstream migration by all species (with the exception of eel) at survey. Likely passable to upstream salmonid migration during some flow conditions.																																		
- B (956-960) NH 88191 10687. Artificial concrete invert at Lynwilg road bridge. Structure perched, with an approximate head difference of 0.7m observed at survey, with a scour pool downstream of structure of approximately 0.6m depth. Artificial invert approximately 15m in length, set on a shallow gradient with high velocity flow, average depth of 0.1m. Bed check comprising boulders located immediately downstream of scour pool, created a second hydraulic head with a head difference of 0.7m across bed check. In combination, the structure is likely to be impassable to upstream movement of all species at most flows (with the exception of eel).																																		

Prior to undertaking the survey ensure the following:

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- You have appropriate permission and it is safe to survey.
- You are not lone working.
- Your survey team is competent in watercourse habitat recognition.
- You have an appropriate risk assessment that fulfills project and client requirements.



Caochan Ruadh – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA					
Site reference:	WC-052-FH-001		Surveyor(s):	Liam Atherton	
River name:	Caochan Ruadh		Associated RHS survey ref:	WC-052-RH-001	
Date:	09/05/2017		Number of photos:	902-928	
Time (GMT):	16:40		Photo references:	27	
Upstream NGR	NH8635810179		Adverse survey conditions?	No	Yes
Downstream NGR:	NH8666409942				
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:		
Site surveyed from:	Left Bank	Channel	Right Bank		

Prior to undertaking the survey ensure the following:

You have read the readme for this survey.

You have appropriate permission and it is safe to survey.

You are not lone working.

Your survey team is competent in watercourse habitat recognition.

You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500
Start NGR	NH8666409942	NH8665610047	NH8662210154	NH8652310144	NH8644810160
Finish NGR	NH8665610047	NH8662210154	NH8652310144	NH8644810160	NH8635810179
RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END

Fisheries Information							
Habitat Type	Description	Species/Life-stage	% by reach				
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.	No optimal. Opportunistic spawning habitat widely available.
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	0	0	0	0	20
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	5	5	0	0	0
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	45	45	10	20	20
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	0	0	0	0	0
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	50	30	0	0	20
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	10	5	5	5	5
			Number within Reach				
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	1 (A)	0	0	0

Comments:
Minor stream system through rough pasture and mixed woodland, with two reaches of distinct character (0-200m and 200-500m). The downstream 200m (0-200m) extent comprised diverse fish habitat for a stream of its character (small dimensions and predominant land use), with juvenile salmonid habitat, restricted spawning gravels, and fine sediment accumulations adjacent providing excellent lamprey habitat. Fine sediment ingress was noted to be driven, in part, by livestock bank poaching. Adult brook lamprey (approximately 10 no.) were observed throughout this 200m reach, congregating around spawning gravels. The stream system drains to Loch Alvie, which itself has no obvious major downstream connectivity, suggesting the lamprey population is genetically isolated. The upstream 200-500m reach character changes to step-pool, cascade type morphology due to high gradient, resulting in poor fish habitat quality below and upstream of the A9 crossing. The A9 crossing itself presents an artificial barrier as described below.

Barriers:
-A (P912-914) NH 86648 10089. A9 pipe culvert (approximately 25m long, 2m diameter culvert). Outlet perched 0.2m above downstream channel. Downstream channel itself is artificial and reinforced for approximately 15m downstream of the culvert. The artificial bed is also perched by approximately 0.2m at the point at which it connects to the downstream channel. Flow across artificial bed and through A9 culvert is high velocity, but low depth (approximately 0.2m). Structure is likely impassable to upstream movement by all species (with the exception of eel) during most flow conditions. However, habitat upstream of the structure is generally unsuitable.



Allt Chrìochaidh – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																			
Site reference:	WC-054-FH-001		Surveyor(s):	Liam Atherton																															
River name:	Allt Chrìochaidh		Associated RHS survey ref:	WC-054-RH-001																															
Date:	09/05/2017		Number of photos:	22																															
Time (GMT):	15:05		Photo references:	880-901																															
Upstream NGR	NH8557409706		Adverse survey conditions?	No	Yes																														
Downstream NGR:	NH8588609597																																		
Survey direction:	u/s to d/s	d/s to u/s	If yes, state:																																
Site surveyed from:	Left Bank	Channel	Right Bank																																
<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">Survey Reach (m)</th> </tr> <tr> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 500</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH8557409706</td> <td>NH8558209672</td> <td>NH8565409546</td> <td>NH8572809494</td> <td>NH8581209539</td> </tr> <tr> <td>Finish NGR</td> <td>NH8558209672</td> <td>NH8565409546</td> <td>NH8572809494</td> <td>NH8581209539</td> <td>NH8588609597</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>								Survey Reach (m)					0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	Start NGR	NH8557409706	NH8558209672	NH8565409546	NH8572809494	NH8581209539	Finish NGR	NH8558209672	NH8565409546	NH8572809494	NH8581209539	NH8588609597	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
	Survey Reach (m)																																		
	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500																														
Start NGR	NH8557409706	NH8558209672	NH8565409546	NH8572809494	NH8581209539																														
Finish NGR	NH8558209672	NH8565409546	NH8572809494	NH8581209539	NH8588609597																														
RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END																														
Fisheries Information																																			
Habitat Type	Description	Species/Life-stage	% by reach																																
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.	No optimal. Opportunistic spawning habitat locally available.																												
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	0	0	0	0	0																												
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	0	5	0	0	0																												
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	30	20	20	60	60																												
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	10	20	20	10	10																												
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	0	0	0	0																												
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0																												
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	0	0	0	0	0																												
Number within Reach																																			
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	1 (A)	1 (B)	1 (C)	0	0																												
Comments:																																			
Minor stream system through rough pasture and plantation woodland, with two relatively distinct reaches upstream (0-200m) and downstream (200-500m) of the A9. Upstream of the A9, steep gradient (locally >10%) gives rise to cascade type habitat dominated by boulders and cobbles, and relatively low quality fish habitat. Downstream of the A9, gradient reduces, and substrate changes to cobble/pebble dominated, and improved fish habitat. A range of shading conditions and undercut banks/exposed bankside roots locally enhance fish habitat through this reach. Only a single artificial barrier (the A9 crossing) was identified at survey as described below.																																			
Barriers:																																			
-A.B (P912-914) Two minor step barriers over boulders due to high gradient within 0-100m reach, cascade habitat.																																			
-C (P890-891) NH 85669 09528. A9 crossing; box culvert with artificial invert under A9 road with 0.02m flow over 8m wide base. An artificial step cascade immediately upstream of structure comprising 4 steps and a total head difference of 1.4m down to an artificial channel under the A9, which discharges over a perched outlet downstream of A9 (1.2m head difference between toe of artificial channel reinforcement and downstream.																																			

Prior to undertaking the survey ensure the following:

You have read the readme for this survey.

You have appropriate permission and it is safe to survey.
You are not lone working.

Your survey team is competent in watercourse habitat recognition.

You have an appropriate risk assessment that fulfils project and client requirements.



Allt an Fhearna – Fish Habitat Survey

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA																																		
Site reference:	WC-057-FH-002		Surveyor(s):	Liam Atherton																														
River name:	Allt na Fhearna		Associated RHS survey ref:	WC-057-RH-002																														
Date:	09/05/2017		Number of photos:	18																														
Time (GMT):	10:35		Photo references:	854-871																														
Upstream NGR	NH8560109351		Adverse survey conditions?	No	Yes																													
Downstream NGR:	NH8594809538																																	
Survey direction:	u/s to d/s	d/s to u/s	If yes, state: Access restrictions due to A9 Kinncraig to Dalraddy construction (upstream), forced survey downstream of works area allowing for only 450m of channel to be surveyed before the confluence with Loch Alvie.																															
Site surveyed from:	Left Bank	Channel	Right Bank																															
<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">Survey Reach (m)</th> </tr> <tr> <th>0 - 100</th> <th>100 - 200</th> <th>200 - 300</th> <th>300 - 400</th> <th>400 - 450</th> </tr> </thead> <tbody> <tr> <td>Start NGR</td> <td>NH8560109351</td> <td>NH8570309347</td> <td>NH8579409379</td> <td>NH8584709457</td> <td>NH8590709517</td> </tr> <tr> <td>Finish NGR</td> <td>NH8570309347</td> <td>NH8579409379</td> <td>NH8584709457</td> <td>NH8590709517</td> <td>NH8594809538</td> </tr> <tr> <td>RHS corresponding spot check</td> <td>1>>3</td> <td>3>>5</td> <td>5>>7</td> <td>7>>9</td> <td>9>>END</td> </tr> </tbody> </table>							Survey Reach (m)					0 - 100	100 - 200	200 - 300	300 - 400	400 - 450	Start NGR	NH8560109351	NH8570309347	NH8579409379	NH8584709457	NH8590709517	Finish NGR	NH8570309347	NH8579409379	NH8584709457	NH8590709517	NH8594809538	RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END
	Survey Reach (m)																																	
	0 - 100	100 - 200	200 - 300	300 - 400	400 - 450																													
Start NGR	NH8560109351	NH8570309347	NH8579409379	NH8584709457	NH8590709517																													
Finish NGR	NH8570309347	NH8579409379	NH8584709457	NH8590709517	NH8594809538																													
RHS corresponding spot check	1>>3	3>>5	5>>7	7>>9	9>>END																													
Fisheries Information																																		
Habitat Type	Description	Species/Life-stage	% by reach																															
Optimal Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm. Water depth in the range 17-76 cm Optimal spawning locations likely to occur where the gradient is 3% or less, at the transitional area between pool and riffle where flow is accelerating and depth is decreasing.	Salmonid recruitment	10	25	25	20	10																											
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding	5	10	25	20	20																											
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge	5	10	15	30	10																											
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning	20	20	30	25	50																											
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat	70	50	30	25	10																											
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat	0	10	0	0	0																											
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge	0	0	0	0	0																											
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat	20	20	20	25	25																											
Number within reach																																		
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental	0	0	0	0	0																											
Comments: Dynamic gravel-bed river system through wet plantation woodland, with high quality fish habitat, and habitat types for all salmonid life stages represented across the survey reach. A range of shading conditions, undercut banks/exposed bankside roots, and braided channel systems with large woody debris locally enhance fish habitat quality.																																		
Barriers: None identified within survey reach.																																		

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Annex C. River Macroinvertebrate Survey Results

C.1. Site Physical Variables

Table C.1: Site Physical Variable

Site	NGR	Easting	Northing	Altitude	GIS altitude	Slope	Velocity	Distance from Source	Mean Wetted width	Mean total width	Mean depth	Boulder Cobble	Pebbles Gravel	Sand	Silt Clay	Cond SPC	Cond C
Bogbain Burn WC-032-AI-001	NH8750424329	287504	824329	319	322	18.18	10-25	3.85	3.37	3.87	12.00	40	60	0	0	99	59
Bogbain Burn WC-032-AI-002	NH8784524187	287845	824187	313	319	18.18	10-25	4.25	1.92	1.92	11.30	35	60	5	0	99	59
Ceatharnach WC-033-AI-001	NH8914023225	289140	823225	292	286	20.83	10-25	6.20	7.70	7.70	8.00	30	65	5	0	144	88
Ceatharnach WC-033-AI-002	NH8915522950	289155	822950	282	279	12.99	10-25	6.50	5.23	5.23	13.33	50	50	0	0	164	99
River Dulnain WC-034-AI-001	NH8958622472	289586	822472	268	267	6.94	10-25	29.50	17.67	18.33	22.00	60	30	10	0	62	34
River Dulnain WC-034-AI-002	NH8968822578	289688	822578	267	265	6.94	10-25	31.00	17.67	20.00	24.00	90	10	0	0	68	38
Allt Cnapach WC-036-AI-001	NH9101018519	291010	818519	258	257	62.50	10-25	1.55	0.72	0.72	6.33	15	85	0	0	74	42
Allt Cnapach WC-036-AI-002	NH9113118470	291131	818470	255	247	31.25	10-25	1.70	1.72	1.72	5.00	25	65	10	0	164	94
Aviemore Burn WC-44-AI-001	NH8928313838	289283	813838	232	235	52.63	10-25	3.20	2.93	3.73	10.67	70	30	0	0	55	34
Aviemore Burn WC-44-AI-002	NH8937513843	289375	813843	226	230	31.25	10-25	3.30	3.93	4.63	11.30	80	20	0	0	57	35

Site	NGR	Easting	Northing	Altitude	GIS altitude	Slope	Velocity	Distance from Source	Mean Wetted width	Mean total width	Mean depth	Boulder Cobble	Pebbles Gravel	Sand	Silt Clay	Cond SPC	Cond C
Allt Na Criche WC-049-AI-001	NH8834210630	288342	810630	221	219	33.33	10-25	4.60	3.07	4.08	12.67	75	20	5	0	61	34
Allt Na Criche WC-049-AI-002	NH8839010572	288390	810572	218	216	33.33	10-25	4.70	4.35	6.10	11.00	60	30	10	0	340	197
Caochan Ruadh WC-052-AI-001	NH8661610131	286616	810131	218	216	60.61	10-25	2.30	2.90	3.90	3.67	50	50	0	0	39	24
Caochan Ruadh WC-052-AI-002	NH8666809979	286668	809979	216	211	100.00	10-25	2.45	1.62	2.20	9.33	20	60	20	0	98	61
Allt Chriochaidh WC-054-AI-001	NH8563909553	285639	809553	235	229	90.91	10-25	2.90	3.13	3.77	10.33	75	20	5	0	30	18
Allt Chriochaidh WC-054-AI-002	NH8572009480	285720	809480	221	218	66.67	10-25	3.00	1.78	7.70	10.00	70	30	0	0	46	27
Allt Chriochaidh WC-054-AI-003	NH8584609546	285846	809546	217	208	66.67	10-25	3.15	2.43	4.27	8.67	65	35	0	0	47	29
Allt Na Fearna WC-057-AI-001	NH8530509132	285305	809132	224	220	14.71	10-25	8.50	5.40	6.27	13.00	55	45	5	0	62	37
Allt Na Fearna WC-057-AI-002	NH8551609292	285516	809292	213	219	14.71	10-25	8.75	7.00	7.53	24.00	55	45	0	0	62	38
Allt Na Fearna WC-057-AI-003	NH8570209360	285702	809360	211	214	14.71	10-25	9.00	7.00	8.33	15.33	40	50	10	0	64	39



C.2. Site Taxa Lists

Table C.2: Site Taxa Lists

Watercourse	Bogbain Burn	Bogbain Burn	Allt nan Ceatharnach	Allt nan Ceatharnach	River Dulnain	River Dulnain	Allt Cnapach	Allt Cnapach	Aviemore Burn	Aviemore Burn
Site Description	WC-032-AI-001	WC-032-AI-002	WC-033-AI-001	WC-033-AI-002	WC-034-AI-001	WC-034-AI-002	WC-036-AI-001	WC-036-AI-002	WC-044-AI-001	WC-044-AI-002
Sample Date	24/04/2017	24/04/2017	24/04/2017	24/04/2017	25/04/2017	25/04/2017	25/04/2017	25/04/2017	27/04/2017	27/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Tricladida</i>			1				1	95		
<i>Polycelis</i> sp.				2			1	64		
<i>Polycelis felina</i>			9	9			2	1496		
<i>Polycelis nigra/tenuis</i>							1	64		
<i>Crenobia alpina</i>										
<i>Nematoda</i>	1	1	1	3						
<i>Radix balthica</i>				1						
<i>Ancylus fluviatilis</i>			1	1		2				
<i>Sphaeriidae</i>										
<i>Pisidium</i> sp.								3		1
<i>Oligochaeta</i>	59	21	7	33			52	111	7	27
<i>Hydracarina</i>	15	2	13	40	6	15	1		1	
<i>Oribatei</i>			1				8			
<i>Ostracoda</i>								9		
<i>Collembola</i>				2						
<i>Baetidae</i>										
<i>Baetis</i> sp.	7						2			
<i>Baetis rhodani</i>	357	251	110	207	196	138	14	59	49	63
<i>Alainites muticus</i>	14	15	19	74	11	22	5	113	1	
<i>Nigrobaetis</i> sp.			11	8		2				
<i>Nigrobaetis niger</i>			5							
<i>Heptageniidae</i>	5					9	18	1		5
<i>Rhithrogena</i> sp.	46	106	150	173	323	3	23	13	59	71
<i>Heptagenia</i> group (incl. <i>Heptagenia</i> , <i>Electrogena</i> & <i>Kageronia</i>)										
<i>Ecdyonurus</i> sp.	1		2	4		18			3	1
<i>Electrogena</i> sp.										
<i>Electrogena lateralis</i>				2					6	3
<i>Ameletus inopinatus</i>		1					1			2
<i>Caenis rivulorum</i>			1		1	1				
<i>Brachyptera risi</i>	40	46		5		2	16	38	185	222





Watercourse	Bogbain Burn	Bogbain Burn	Allt nan Ceatharnach	Allt nan Ceatharnach	River Dulnain	River Dulnain	Allt Cnapach	Allt Cnapach	Aviemore Burn	Aviemore Burn
Site Description	WC-032-AI-001	WC-032-AI-002	WC-033-AI-001	WC-033-AI-002	WC-034-AI-001	WC-034-AI-002	WC-036-AI-001	WC-036-AI-002	WC-044-AI-001	WC-044-AI-002
Sample Date	24/04/2017	24/04/2017	24/04/2017	24/04/2017	25/04/2017	25/04/2017	25/04/2017	25/04/2017	27/04/2017	27/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Nemurella/Nemoura</i>							1			
<i>Protonemura</i> sp.	7	2	1	1						
<i>Protonemura meyeri</i>	5	3		3				1	1	6
<i>Amphinemura</i> sp.	3					1	43			6
<i>Amphinemura sulcicollis</i>	8	23	28	40	8	38	18	143	22	30
<i>Nemurella picteti</i>										
<i>Nemoura</i> sp.										
<i>Nemoura cambrica/erratica</i>								4		
<i>Leuctra</i> sp.	31			10	13	2	12	62	39	8
<i>Leuctra fusca</i>				1						
<i>Leuctra hippopus</i>										
<i>Leuctra inermis</i>	435	310	113	75	44	22	8	26		85
<i>Leuctra nigra</i>							29	20		
<i>Perlodidae</i>										
<i>Perlodes microcephalus</i>	1	2	1	1					2	1
<i>Isoperla</i> sp.										
<i>Isoperla grammatica</i>	24	30	17	30	21	25	25	2		5
<i>Perlidae</i>					1					
<i>Dinocras cephalotes</i>										
<i>Perla bipunctata</i>					4	1				
<i>Chloroperlidae</i>					1			1		
<i>Chloroperla tripunctata</i>	2	2	4	2	11				8	2
<i>Siphonoperla torrentium</i>	5	3	6	13	9	5	46	25	4	9
<i>Oreodytes davisii</i>										
<i>Oreodytes sanmarkii</i>	8	1	54	13	1	5	7			
<i>Ilybius/Agabus</i> sp.										
<i>Hydraena gracilis</i>	24	21	4	3	1				1	1
<i>Odeles marginata</i>	2	5						2		3
<i>Elmis aenea</i>	183	127	175	56	1	9	3	10	2	16
<i>Esolus parallelepipedus</i>				1	2					
<i>Limnius volckmari</i>	23	3	41	16	7	3				3
<i>Oulimnius</i> sp.						2				
<i>Oulimnius tuberculatus</i>						1				





Watercourse	Bogbain Burn	Bogbain Burn	Allt nan Ceatharnach	Allt nan Ceatharnach	River Dulnain	River Dulnain	Allt Cnapach	Allt Cnapach	Aviemore Burn	Aviemore Burn
Site Description	WC-032-AI-001	WC-032-AI-002	WC-033-AI-001	WC-033-AI-002	WC-034-AI-001	WC-034-AI-002	WC-036-AI-001	WC-036-AI-002	WC-044-AI-001	WC-044-AI-002
Sample Date	24/04/2017	24/04/2017	24/04/2017	24/04/2017	25/04/2017	25/04/2017	25/04/2017	25/04/2017	27/04/2017	27/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Curculionidae</i>										
<i>Trichoptera</i>										
<i>Rhyacophila</i> sp.	11	2		4		8	2	1		
<i>Rhyacophila dorsalis</i>	22	21	10	26	4	9	2		5	1
<i>Rhyacophila fasciata</i>										
<i>Glossosoma</i> sp.	7		4	3				2		1
<i>Glossosoma boltoni</i>	1	10	2							
<i>Glossosoma conformis</i>	3	7	9	2	2		3		2	
<i>Agapetus</i> sp.			1	1	1			4		
<i>Agapetus fuscipes</i>							5	22		
<i>Hydroptilidae</i>						31				
<i>Hydroptila</i> sp.				5		443				
<i>Ithytrichia</i> sp.						8				
<i>Philopotamus montanus</i>							6	1		
<i>Psychomyia pusilla</i>						3				
<i>Polycentropodidae</i>				1		11	8	1		
<i>Plectrocnemia</i> sp.	1						2	4		
<i>Plectrocnemia conspersa</i>			1				7	11		7
<i>Plectrocnemia geniculata</i>							3			
<i>Polycentropus</i> sp.						6				
<i>Polycentropus flavomaculatus</i>			1			9				
<i>Hydropsyche</i> sp.				2	1	1				
<i>Hydropsyche instabilis</i>										
<i>Hydropsyche pellucidula</i>					1	1				
<i>Hydropsyche siltalai</i>							1			
<i>Lepidostoma hirtum</i>				2	12	11				
<i>Limnephilidae</i>	4	1	8	15			6	1		2
<i>Drusus annulatus</i>	2		2							
<i>Ecclisopteryx guttulata</i>				1						
<i>Halesus</i> sp.			2				6	3		
<i>Halesus digitatus</i>		1		2			1	5		
<i>Halesus radiatus</i>							2			





Watercourse	Bogbain Burn	Bogbain Burn	Allt nan Ceatharnach	Allt nan Ceatharnach	River Dulnain	River Dulnain	Allt Cnapach	Allt Cnapach	Aviemore Burn	Aviemore Burn
Site Description	WC-032-AI-001	WC-032-AI-002	WC-033-AI-001	WC-033-AI-002	WC-034-AI-001	WC-034-AI-002	WC-036-AI-001	WC-036-AI-002	WC-044-AI-001	WC-044-AI-002
Sample Date	24/04/2017	24/04/2017	24/04/2017	24/04/2017	25/04/2017	25/04/2017	25/04/2017	25/04/2017	27/04/2017	27/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Potamophylax</i> group (incl. <i>Potamophylax</i> sp. & <i>Chaetopteryx villosa</i>)				2						
<i>Potamophylax cingulatus</i>	1	1					3	7		2
<i>Potamophylax latipennis/cingulatus</i>							1			
<i>Potamophylax latipennis</i>										
<i>Chaetopteryx villosa</i>	1		28			1				
<i>Chaetopteryx villosa/Halesus</i> sp.		3						1		
<i>Silo</i> sp.	30	6	10	3						1
<i>Silo pallipes</i>	14	57	9	5				1		1
<i>Beraea maurus</i>										
<i>Sericostoma personatum</i>			1	7				1		
<i>Odontocerum albicorne</i>	1	2								
<i>Athripsodes</i> sp.						1				
<i>Tipula</i> sp.							2	1	1	
Limoniidae								1		
<i>Eloeophila</i> sp.	2	1	2					9		
<i>Hexatoma</i> sp.					11					
<i>Molophilus</i> sp.										
<i>Pedicia</i> sp.	2	2	1				1	1		
<i>Dicranota</i> sp.	11	16	7	10	2	2	19	3	1	7
Psychodidae	2					1		1		1
Ceratopogonidae	1		1			3	7	5		
Simuliidae	68	16	3	5	71	7	4	6	91	131
Chironomidae	399	41	176	375	50	358	73	218	8	21
<i>Atherix ibis</i>						1				
Empididae		1								
Clinocerinae	7	4	6	30	3	7		1		2
<i>Chelifera</i> sp.	2	1	1	1			7			1
Ephydriidae										





Watercourse	Allt na Criche (Lynwilg)	Allt na Criche (Lynwilg)	Caochan Ruadh	Caochan Ruadh	Allt Chriochaidh	Allt Chriochaidh	Allt Chriochaidh	Allt na Fearna	Allt na Fearna	Allt na Fearna
Site Description	WC-049-AI-001	WC-049-AI-002	WC-052-AI-001	WC-052-AI-002	WC-054-AI-001	WC-054-AI-002	WC-054-AI-003	WC-057-AI-001	WC-057-AI-002	WC-057-AI-003
Sample Date	25/04/2017	25/04/2017	25/04/2017	25/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Tricladida</i>			17	22						
<i>Polycelis</i> sp.			13							
<i>Polycelis felina</i>			230	112			1			
<i>Polycelis nigra/tenuis</i>										
<i>Crenobia alpina</i>									1	
Nematoda			2							
<i>Radix balthica</i>										
<i>Ancylus fluviatilis</i>										
Sphaeriidae								1		
<i>Pisidium</i> sp.			1	1						
<i>Oligochaeta</i>		1	29	71			5	11	1	2
<i>Hydracarina</i>	5	6		3	2	1	1	1	3	
Oribatei										
Ostracoda										
<i>Collembola</i>		1								
Baetidae						2				
<i>Baetis</i> sp.				18	2	4				
<i>Baetis rhodani</i>	470	324	195	322	91	109	165	217	292	227
<i>Alainites muticus</i>	27	28	11	18	11	16	4	35	75	24
<i>Nigrobaetis</i> sp.						4		13		19
<i>Nigrobaetis niger</i>										
Heptageniidae	1		24	1			6			
<i>Rhithrogena</i> sp.	11	7	3	8	75	90	135	114	151	76
<i>Heptagenia</i> group (incl. <i>Heptagenia</i> , <i>Electrogena</i> & <i>Kageronia</i>)	2	3		14	16					
<i>Ecdyonurus</i> sp.	1		3	1	2	2		7	3	14
<i>Electrogena</i> sp.		2								
<i>Electrogena lateralis</i>	10	16	67	3	42	40	15			1
<i>Ameletus inopinatus</i>	1	1			7	28	20	4		
<i>Caenis rivulorum</i>										
<i>Brachyptera risi</i>	48	2	1	1	44	53	76		4	9
<i>Nemurella/Nemoura</i>										
<i>Protonemura</i> sp.						2	6			
<i>Protonemura meyeri</i>	2				2	11			2	





Watercourse	Allt na Criche (Lynwilg)	Allt na Criche (Lynwilg)	Caochan Ruadh	Caochan Ruadh	Allt Chriochaidh	Allt Chriochaidh	Allt Chriochaidh	Allt na Fearna	Allt na Fearna	Allt na Fearna
Site Description	WC-049-AI-001	WC-049-AI-002	WC-052-AI-001	WC-052-AI-002	WC-054-AI-001	WC-054-AI-002	WC-054-AI-003	WC-057-AI-001	WC-057-AI-002	WC-057-AI-003
Sample Date	25/04/2017	25/04/2017	25/04/2017	25/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Amphinemura</i> sp.					1				1	
<i>Amphinemura sulcicollis</i>	1	2	11	4	44	40	50	23	44	46
<i>Nemurella picteti</i>				2						
<i>Nemoura</i> sp.				1						
<i>Nemoura cambrica/erratica</i>			2	17			1			
<i>Leuctra</i> sp.		1	20	10	16		2	4	3	
<i>Leuctra fusca</i>										
<i>Leuctra hippopus</i>			24							1
<i>Leuctra inermis</i>	99	33	202	475	28	66	86	20	39	7
<i>Leuctra nigra</i>					1		2			
Perlodidae						1				
<i>Perlodes microcephalus</i>							3			
<i>Isoperla</i> sp.							1			
<i>Isoperla grammatica</i>	1	1	27	29	10	15	18	1	4	2
Perlidae								1		
<i>Dinocras cephalotes</i>								1		3
<i>Perla bipunctata</i>								3	1	4
Chloroperlidae		2		6		1				1
<i>Chloroperla tripunctata</i>	3	2			7	11	34			
<i>Siphonoperla torrentium</i>	21	25	55	118	2	20	20	4	3	2
<i>Oreodytes davisii</i>										1
<i>Oreodytes sanmarkii</i>	1						1	1	1	2
<i>Ilybius/Agabus</i> sp.		1								
<i>Hydraena gracilis</i>	5	1	2	8	1	3	2	3	4	3
<i>Odeles marginata</i>			3	13		4	2			
<i>Elmis aenea</i>	2		5		3	17	17	6	5	6
<i>Esolus parallelepipedus</i>								13	10	7
<i>Limnius volckmari</i>	3		4	7			3	40	34	38
<i>Oulimnius</i> sp.			4	12	1					
<i>Oulimnius tuberculatus</i>			1	10						
Curculionidae			1	1						
Trichoptera							1			
<i>Rhyacophila</i> sp.	1			1	1	2	2		1	1





Watercourse	Allt na Criche (Lynwilg)	Allt na Criche (Lynwilg)	Caochan Ruadh	Caochan Ruadh	Allt Chriochaidh	Allt Chriochaidh	Allt Chriochaidh	Allt na Fearna	Allt na Fearna	Allt na Fearna
Site Description	WC-049-AI-001	WC-049-AI-002	WC-052-AI-001	WC-052-AI-002	WC-054-AI-001	WC-054-AI-002	WC-054-AI-003	WC-057-AI-001	WC-057-AI-002	WC-057-AI-003
Sample Date	25/04/2017	25/04/2017	25/04/2017	25/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Rhyacophila dorsalis</i>	3		3		1	1	1			2
<i>Rhyacophila fasciata</i>							1			
<i>Glossosoma</i> sp.	3							1	2	
<i>Glossosoma boltoni</i>		1					2			
<i>Glossosoma conformis</i>	5	10						1	7	6
<i>Agapetus</i> sp.										
<i>Agapetus fuscipes</i>										
<i>Hydroptilidae</i>										
<i>Hydroptila</i> sp.										
<i>Ithytrichia</i> sp.										
<i>Philopotamus montanus</i>				3			1			
<i>Psychomyia pusilla</i>										
<i>Polycentropodidae</i>			1							
<i>Plectrocnemia</i> sp.							2			
<i>Plectrocnemia conspersa</i>			2	1		1				
<i>Plectrocnemia geniculata</i>					1		2			
<i>Polycentropus</i> sp.										
<i>Polycentropus flavomaculatus</i>								1		2
<i>Hydropsyche</i> sp.						1	2	9	2	4
<i>Hydropsyche instabilis</i>				1	3	1	3	13	13	8
<i>Hydropsyche pellucidula</i>								3		
<i>Hydropsyche siltalai</i>			64	40			1			
<i>Lepidostoma hirtum</i>										1
<i>Limnephilidae</i>		1	3	3	2	10	5		1	3
<i>Drusus annulatus</i>										
<i>Ecclisopteryx guttulata</i>	1							1	5	3
<i>Halesus</i> sp.	1		1				2			
<i>Halesus digitatus</i>		2	1	6				1		2
<i>Halesus radiatus</i>			1				2			6
<i>Potamophylax</i> group (incl. <i>Potamophylax</i> sp. & <i>Chaetopteryx villosa</i>)										
<i>Potamophylax cingulatus</i>			1			1	3	1		
<i>Potamophylax latipennis/cingulatus</i>				7						





Watercourse	Allt na Criche (Lynwilg)	Allt na Criche (Lynwilg)	Caochan Ruadh	Caochan Ruadh	Allt Chriochaidh	Allt Chriochaidh	Allt Chriochaidh	Allt na Fearna	Allt na Fearna	Allt na Fearna
Site Description	WC-049-AI-001	WC-049-AI-002	WC-052-AI-001	WC-052-AI-002	WC-054-AI-001	WC-054-AI-002	WC-054-AI-003	WC-057-AI-001	WC-057-AI-002	WC-057-AI-003
Sample Date	25/04/2017	25/04/2017	25/04/2017	25/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017	26/04/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID										
<i>Potamophylax latipennis</i>								1		
<i>Chaetopteryx villosa</i>				1		4				4
<i>Chaetopteryx villosa/Halesus sp.</i>			3	4						
<i>Silo sp.</i>					1	1	1	1		
<i>Silo pallipes</i>				1				1		
<i>Beraea maurus</i>				1						
<i>Sericostoma personatum</i>			2							1
<i>Odontocerum albicorne</i>			11	1			1	1		1
<i>Athripsodes sp.</i>										
<i>Tipula sp.</i>				3						
<i>Limoniidae</i>										
<i>Eloeophila sp.</i>			4	1	2		1	1		
<i>Hexatoma sp.</i>								5	3	3
<i>Molophilus sp.</i>				1						
<i>Pedicia sp.</i>		1	3	5						
<i>Dicranota sp.</i>	9	7	9	40	5	14	10		6	3
<i>Psychodidae</i>										
<i>Ceratopogonidae</i>			1	4			1			
<i>Simuliidae</i>	1237	7		4	152	45	51		4	
<i>Chironomidae</i>	36	194	36	39	18	8	12	12	15	4
<i>Atherix ibis</i>										
<i>Empididae</i>				1						
<i>Clinocerinae</i>	2	3	1	5	1	7	3	4	1	4
<i>Chelifera sp.</i>				1						
<i>Ephydriidae</i>			1							





C.3. Site Biotic Metrics

Table C.3: Site Biotic Metrics

Watercourse	Site ID	Sample Date	Total number of taxa in sample	Total abundance in sample	BMWP Score	ASPT	N-Taxa	LIFE score (family)	LIFE Score (Species)	CCI Score	% Oligo&Chiro	% EPT	PSI Species Score	PSI Family Score	WHPT ASPT	WHPT N Taxa	Reach Metrics			
																	Total Taxa	No. of families	No of Scoring Families	Reach CCI
Bogbain Burn	WC-032-AI-001	24/04/2017	47	1898	135	6.75	20	8.11	9.00	11.36	24.13	57.38	94.25	82.69	7.75	24				
Bogbain Burn	WC-032-AI-002	24/04/2017	40	1168	138	6.90	20	8.16	9.08	12.27	5.31	77.48	94.44	86.27	8.28	22	51	28	23	12.08
Allt nan Ceatharnach	WC-033-AI-001	24/04/2017	47	1060	138	6.57	21	7.90	8.71	10.40	17.26	52.45	93.67	75.00	7.46	24				
Allt nan Ceatharnach	WC-033-AI-002	24/04/2017	51	1331	165	6.60	25	7.63	8.72	15.56	30.65	54.85	88.89	72.73	7.51	27	64	35	28	16.05
River Dulnain	WC-034-AI-001	25/04/2017	30	819	117	6.88	17	8.24	8.70	10.56	6.11	81.07	96.43	87.80	8.11	19				
River Dulnain	WC-034-AI-002	25/04/2017	43	1248	166	7.22	23	7.68	8.50	14.00	28.69	66.67	89.23	77.78	7.57	27	51	31	26	11.04
Allt Cnapach	WC-036-AI-001	25/04/2017	47	508	133	6.65	20	7.63	8.60	10.91	24.61	62.80	87.14	80.43	7.62	23				
Allt Cnapach	WC-036-AI-002	25/04/2017	48	2673	141	6.71	21	7.65	9.05	10.83	12.31	21.44	78.82	72.41	7.48	25	62	34	27	11.4
Aviemore Burn	WC-044-AI-001	27/04/2017	22	498	91	6.50	14	8.31	8.80	11.92	3.01	77.51	95.24	87.88	7.89	15				
Aviemore Burn	WC-044-AI-002	27/04/2017	35	748	133	6.65	20	7.84	8.95	11.39	6.42	71.39	88.89	80.00	7.65	23	39	25	22	11.75
Allt na Criche (Lynwilg)	WC-049-AI-001	25/04/2017	30	2012	112	7.00	16	8.06	9.00	12.22	1.79	35.39	98.18	91.43	7.80	18				
Allt na Criche (Lynwilg)	WC-049-AI-002	25/04/2017	29	685	108	6.75	16	7.79	8.82	12.14	28.47	67.59	90.00	83.87	7.58	17	40	21	18	12.5
Caochan Ruadh	WC-052-AI-001	25/04/2017	46	1105	138	6.57	21	7.68	8.83	9.32	5.88	66.79	78.38	77.08	7.63	24				
Caochan Ruadh	WC-052-AI-002	25/04/2017	53	1482	161	6.71	24	7.77	8.58	15.00	7.42	75.44	80.72	80.70	7.87	26	64	34	27	10.18
Allt Chriochaidh	WC-054-AI-001	26/04/2017	33	595	129	7.17	18	8.06	9.00	12.65	3.03	68.91	98.36	94.74	8.20	19				
Allt Chriochaidh	WC-054-AI-002	26/04/2017	36	636	134	7.05	19	7.83	9.20	11.94	1.26	84.43	100.00	95.24	8.46	20				
Allt Chriochaidh	WC-054-AI-003	26/04/2017	49	786	163	6.79	24	7.78	8.90	17.37	2.16	86.01	94.05	85.19	8.06	27	61	29	26	18.2
Allt an Fhearna	WC-057-AI-001	26/04/2017	39	580	143	6.81	21	7.79	8.71	12.29	3.97	83.10	88.57	78.05	7.96	22				
Allt an Fhearna	WC-057-AI-002	26/04/2017	33	741	123	6.47	19	7.94	8.75	12.50	2.16	88.12	93.22	80.95	7.71	21				
Allt an Fhearna	WC-057-AI-003	26/04/2017	40	553	150	7.14	21	7.85	8.59	12.32	1.08	86.80	92.54	85.37	8.20	23	56	21	19	12.86



Annex D. National Pond Survey Results

D.1. Site Physico-chemical Variables

Table D.1: Site Physico-chemical Variable

Site ID	Specific Conductivity ($\mu\text{s cm}^{-1}$)	Conductivity ($\mu\text{s cm}^{-1}$)	Ph	DO (%)	Do (mg)	Sal (ppm)	Temp ($^{\circ}\text{C}$)
WB-010-PS-001	172.4	140.2	5.09	72.3	7.28	0.08	15.2
WB-011-PS-001	390.4	291.3	6.74	94.6	10.29	0.19	12
WB-013-PS-001	84.6	67.5	7.11	86.7	9.68	0.04	10.8
WB-014-PS-001	64.9	47.5	6.47	55.4	5.99	0.03	11.8
WB-015-PS-001	51.7	38.6	7.23	81.8	8.34	0.02	11.5
WB-016A-PS-001	506	368.9	6.77	66	7.13	0.25	10.7
WB-016B-PS-001	200.4	141.8	6.74	74.2	7.99	0.09	11.8
WB-016C-PS-001	135.9	107.1	5.93	55.4	5.72	0.06	13.9
WB-021-PS-001	121.7	95.2	6.3	40.5	4.17	0.05	13.3
WB-023-PS-001	36.5	27.2	6.29	45.2	5.21	0.02	11.5
WB-024-PS-001	495.7	438.6	7.43	96.2	10.51	0.23	11.2
WB-025-PS-001	116.8	90.7	6.81	67.8	65.2	0.05	13.4
WB-027-PS-001	66.4	50.8	6.98	81.4	8.56	0.03	12.7
WB-028-PS-001	68.1	54.5	6.88	98.2	10.02	0.33	14.6



D.2. Site Taxa Lists (Macroinvertebrates)

Table D.2: Site Taxa List (Macroinvertebrates)

Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Tricladida</i>		1						
<i>Polycelis felina</i>		1						
<i>Polycelis nigra/tenuis</i>		50						
<i>Nematoda</i>					2	2		
<i>Lymnaeidae</i>				1				
<i>Lymnaea</i> group (incl. <i>Lymnaea</i> , <i>Radix</i> , <i>Omphiscola</i> & <i>Stagnicola</i>)			1					
<i>Galba truncatula</i>					1			
<i>Radix balthica</i>		47		310		10		
<i>Gyraulus albus</i>								
<i>Planorbarius corneus</i>						62	7	18
<i>Sphaeriidae</i>						13	1	
<i>Pisidium</i> sp.		564		4	6	46	131	33
<i>Oligochaeta</i>	1	155	12	518	79	76	20	42
<i>Glossiphoniidae</i>								1
<i>Theromyzon tessulatum</i>				2				
<i>Helobdella stagnalis</i>				17		7	7	25
<i>Haemopsis sanguisuga</i>								
<i>Erpobdellidae</i>								1
<i>Erpobdella</i> sp.								
<i>Dina lineata</i>								1
<i>Hydracarina</i>		1		24		7	3	9
<i>Cladocera</i>	3	15		4		2		9
<i>Ostracoda</i>		2						
<i>Copepoda</i>		36			1			
<i>Crangonyx pseudogracilis</i>								
<i>Collembola</i>			2		2			
<i>Baetidae</i>				3				1
<i>Cloeon dipterum</i>				53	1	6		5
<i>Cloeon simile</i>								
<i>Leptophlebiidae</i>		2						1
<i>Leptophlebia</i> sp.								
<i>Leptophlebia marginata</i>								2





Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Paraleptophlebia</i> sp.		71						
<i>Caenis horaria</i>			1				1	41
<i>Caenis luctuosa/macrura</i>								
<i>Nemurella/Nemoura</i>		79			1			
<i>Nemurella picteti</i>		13			2			
<i>Nemoura cambrica/erratica</i>		360						
<i>Nemoura cinerea</i>					3			
<i>Leuctra nigra</i>		1						
Odonata				2				
Coenagrionidae	55			15	8	5	14	17
<i>Pyrrhosoma nymphula</i>	5				1		1	
<i>Ischnura elegans</i>						2		
<i>Coenagrion puella/pulchellum</i>							2	
<i>Lestes</i> sp.						2	23	12
<i>Lestes sponsa</i>				17			12	1
Anisoptera								
Aeshnidae	12					10	1	
<i>Aeshna juncea</i>				1		1		
Libellulidae							5	16
Veliidae		3						2
<i>Velia</i> sp.	1				2			
Gerridae					5	2	1	
<i>Gerris lacustris</i>		1			2			
<i>Gerris odontogaster</i>								
<i>Notonecta</i> sp.			1	4		7	16	9
<i>Notonecta glauca</i>				1				
<i>Notonecta obliqua</i>							1	
Corixidae	17	9		78	75	56	37	61
<i>Callicorixa praeusta</i>								
<i>Callicorixa wollastoni</i>			1					
<i>Corixa</i> sp.					1		2	2
<i>Hesperocorixa</i> sp.				5		1	3	12
<i>Hesperocorixa castanea</i>	1				1	2	15	
<i>Hesperocorixa linnaei</i>							23	
<i>Hesperocorixa sahlbergi</i>			3	1	4	19	5	2





Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Arctocorisa carinata</i>								
<i>Arctocorisa germari</i>						1		
<i>Sigara</i> sp.						14		24
<i>Sigara dorsalis</i>								
<i>Sigara dorsalis/striata</i>		1						
<i>Sigara distincta</i>								
<i>Sigara distincta</i> gp (incl. <i>falleni</i> & <i>fallenoidea</i>)								2
<i>Sigara fossarum</i>								
<i>Sigara fossarum/scotti</i>							2	20
<i>Sigara scotti</i>						2		16
<i>Sigara nigrolineata</i>					26			
<i>Sigara semistriata</i>								2
<i>Sigara</i> sp.								
<i>Paracorixa concinna</i>								
<i>Haliphus</i> sp.				2	1			
<i>Haliphus ruficollis</i> group			1	3		2		
<i>Haliphus fulvus</i>					2			
<i>Haliphus lineatocollis</i>			2	3	3			
<i>Haliphus ruficollis</i>				5	1			
<i>Haliphus sibiricus</i>								
Dytiscidae	1				2	1	4	2
Colymbetinae				7			2	
Hydroporinae	6			3	1	2	2	2
<i>Hygrotus</i> sp.							3	6
<i>Hygrotus inaequalis</i>				4		17	3	13
<i>Hydroporus</i> sp.		10			1			3
<i>Hydroporus angustatus</i>	3							
<i>Hydroporus nigrita</i>								
<i>Hydroporus palustris</i>		3	4	2		4		1
<i>Hydroporus pubescens</i>			1	1	1			
<i>Hydroporus umbrosus</i>								
<i>Nebrioporus assimilis</i>								
<i>Agabus</i> sp.	1	9		8	1		1	
<i>Agabus affinis</i>	1							
<i>Agabus bipustulatus</i>					2			





Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Agabus sturmii</i>								
<i>Ilybius/Agabus</i> sp.					13	4	1	
<i>Ilybius</i> sp.	3				1			
<i>Rhantus</i> sp.						1	15	5
<i>Rhantus exsoletus</i>						1		
<i>Colymbetes</i> sp.								10
<i>Acilius</i> sp.		1		2		5	2	
<i>Acilius sulcatus</i>								
<i>Dytiscus</i> sp.		7		1	4	1	4	
<i>Dytiscus semisulcatus</i>					2			
<i>Gyrinus</i> sp.		2						
Hydrophilidae	3				4			
<i>Hydrochus</i> sp.							11	5
<i>Hydrochus brevis</i>							6	1
<i>Helophorus</i> sp.			1					
<i>Helophorus brevipalpis</i>								
<i>Anacaena globulus</i>						1		
<i>Anacaena limbata</i>								2
<i>Enochrus</i> sp.							1	
<i>Hydraena riparia/rufipes/britteni</i>		1						
Scirtidae								
<i>Dryops</i> sp.								
Curculionidae			1	1				
<i>Sialis lutaria</i>					1			
Trichoptera			1		1			
<i>Agraylea</i> sp.								
<i>Agraylea multipunctata</i>								
Polycentropodidae		1	1	3		4		1
<i>Holocentropus</i> sp.				4		2		4
<i>Holocentropus dubius</i>						2	4	
<i>Holocentropus stagnalis</i>				1		1		
<i>Plectrocnemia</i> sp.						1		
<i>Plectrocnemia conspersa</i>		1						
<i>Plectrocnemia geniculata</i>						1		
Limnephilidae		1	1	13	3	2	6	1





Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Halesus</i> sp.								
<i>Micropterna sequax</i>		1						
<i>Anabolia nervosa</i>								
<i>Limnephilus</i> sp.							2	
<i>Limnephilus lunatus</i>			2	2	21	5	6	7
<i>Limnephilus marmoratus</i>		6						
<i>Limnephilus nigriceps</i>							1	
<i>Limnephilus vittatus</i>		1	2	57	3	1	22	
<i>Beraea pullata</i>		1						
<i>Athripsodes aterrimus</i>								
<i>Mystacides azurea</i>								
<i>Triaenodes bicolor</i>		1				35	71	38
Lepidoptera							1	
Crambidae								
<i>Elophila nymphaeata</i>								
Diptera			1			1		
Tipulidae								
<i>Prionocera</i> sp.						1		
<i>Tipula</i> sp.	1							1
<i>Phalacrocera replicata</i>	2							
Limoniidae			2					
<i>Helius</i> sp.		1						
<i>Pilaria</i> sp.								
Psychodidae			13			2		
Ptychopteridae								
<i>Ptychoptera</i> sp.								
Dixidae					1			
<i>Dixella</i> sp.					2			
<i>Dixella aestivalis</i>					24			
<i>Chaoborus</i> sp.	2	17	3	175	1	111	16	25
Culicidae								
<i>Culiseta</i> sp.		2		1				
Ceratopogonidae	10	5		3	4	18	19	44
Chironomidae	202	166	8	1072	546	1438	755	948
Tabanidae								





Site Description	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species	Species	Species
Taxa ID								
<i>Chelifera</i> sp.		1						
<i>Syrphidae</i>								
<i>Sciomyzidae</i>				1				
<i>Ephydriidae</i>					3			1
<i>Scathophagidae</i>								





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Tricladida</i>						
<i>Polycelis felina</i>						
<i>Polycelis nigra/tenuis</i>						
Nematoda	49	2				
<i>Lymnaeidae</i>						
<i>Lymnaea</i> group (incl. <i>Lymnaea</i> , <i>Radix</i> , <i>Omphiscola</i> & <i>Stagnicola</i>)						
<i>Galba truncatula</i>						1
<i>Radix balthica</i>				22	5	2
<i>Gyraulus albus</i>						3
<i>Planorbarius corneus</i>						
<i>Sphaeriidae</i>						
<i>Pisidium</i> sp.		2				112
<i>Oligochaeta</i>	145	7	24	8	3	43
<i>Glossiphoniidae</i>						
<i>Theromyzon tessulatum</i>						
<i>Helobdella stagnalis</i>	15					2
<i>Haemopsis sanguisuga</i>				3		
<i>Erpobdellidae</i>						
<i>Erpobdella</i> sp.				1		
<i>Dina lineata</i>						
<i>Hydracarina</i>	1	4	3	5		41
<i>Cladocera</i>		3				2
<i>Ostracoda</i>		1				
<i>Copepoda</i>						1
<i>Crangonyx pseudogracilis</i>					2	9
<i>Collembola</i>	1		2		14	1
<i>Baetidae</i>				11		
<i>Cloeon dipterum</i>			4	38		
<i>Cloeon simile</i>						2
<i>Leptophlebiidae</i>						
<i>Leptophlebia</i> sp.						3
<i>Leptophlebia marginata</i>						
<i>Paraleptophlebia</i> sp.						
<i>Caenis horaria</i>						188
<i>Caenis luctuosa/macrura</i>						47





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Nemurella/Nemoura</i>	1			1		
<i>Nemurella picteti</i>						
<i>Nemoura cambrica/erratica</i>						
<i>Nemoura cinerea</i>						
<i>Leuctra nigra</i>						
<i>Odonata</i>						
<i>Coenagrionidae</i>		188	20	1		4
<i>Pyrrhosoma nymphula</i>			3	1		
<i>Ischnura elegans</i>						
<i>Coenagrion puella/pulchellum</i>						
<i>Lestes</i> sp.		2				
<i>Lestes sponsa</i>				46		
<i>Anisoptera</i>			1			
<i>Aeshnidae</i>		12				
<i>Aeshna juncea</i>						
<i>Libellulidae</i>		17		3		
<i>Veliidae</i>						
<i>Velia</i> sp.						
<i>Gerridae</i>		2				
<i>Gerris lacustris</i>			1			1
<i>Gerris odontogaster</i>					1	
<i>Notonecta</i> sp.		5	6	26		
<i>Notonecta glauca</i>						
<i>Notonecta obliqua</i>			1			
<i>Corixidae</i>	24	50	8	38		2
<i>Callicorixa praeusta</i>	2		8			
<i>Callicorixa wollastoni</i>			1			
<i>Corixa</i> sp.			2	21		
<i>Hesperocorixa</i> sp.			3			
<i>Hesperocorixa castanea</i>		9		2		
<i>Hesperocorixa linnaei</i>			4			
<i>Hesperocorixa sahlbergi</i>		1		19		
<i>Arctocorisa carinata</i>	1					
<i>Arctocorisa germari</i>						
<i>Sigara</i> sp.	2		3			





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Sigara dorsalis</i>					1	4
<i>Sigara dorsalis/striata</i>					8	8
<i>Sigara distincta</i>						1
<i>Sigara distincta</i> gp (incl. <i>falleni</i> & <i>fallenoidea</i>)				6		3
<i>Sigara fossarum</i>				2		
<i>Sigara fossarum/scotti</i>				4		
<i>Sigara scotti</i>						
<i>Sigara nigrolineata</i>	1		2			
<i>Sigara semistriata</i>						
<i>Sigara</i> sp.				2		
<i>Paracorixa concinna</i>				2		
<i>Haliphus</i> sp.			14	2		6
<i>Haliphus ruficollis</i> group			9			
<i>Haliphus fulvus</i>						1
<i>Haliphus lineatocollis</i>						
<i>Haliphus ruficollis</i>			2			
<i>Haliphus sibiricus</i>			2			2
Dytiscidae	5			3		
Colymbetinae						
Hydroporinae	9		1			
<i>Hygrotus</i> sp.						
<i>Hygrotus inaequalis</i>						
<i>Hydroporus</i> sp.	6		3			
<i>Hydroporus angustatus</i>						
<i>Hydroporus nigrita</i>					1	
<i>Hydroporus palustris</i>	2		37			
<i>Hydroporus pubescens</i>						
<i>Hydroporus umbrosus</i>		1				
<i>Nebrioporus assimilis</i>			2			
<i>Agabus</i> sp.	7		1			
<i>Agabus affinis</i>						
<i>Agabus bipustulatus</i>	1					
<i>Agabus sturmii</i>	3		1			
<i>Ilybius/Agabus</i> sp.	9	3				
<i>Ilybius</i> sp.		2				





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Rhantus</i> sp.				15		
<i>Rhantus exsoletus</i>						
<i>Colymbetes</i> sp.						
<i>Acilius</i> sp.			1			
<i>Acilius sulcatus</i>			3			
<i>Dytiscus</i> sp.			1			
<i>Dytiscus semisulcatus</i>						
<i>Gyrinus</i> sp.						
Hydrophilidae		2	1			
<i>Hydrochus</i> sp.						
<i>Hydrochus brevis</i>						
<i>Helophorus</i> sp.						
<i>Helophorus brevipalpis</i>					1	
<i>Anacaena globulus</i>	1					
<i>Anacaena limbata</i>						
<i>Enochrus</i> sp.						
<i>Hydraena riparia/rufipes/britteni</i>						
Scirtidae	1	2			1	
<i>Dryops</i> sp.					1	
Curculionidae						
<i>Sialis lutaria</i>	1		4	3		
Trichoptera				2		1
<i>Agraylea</i> sp.						1
<i>Agraylea multipunctata</i>						4
Polycentropodidae		1				
<i>Holocentropus</i> sp.						
<i>Holocentropus dubius</i>		11		1		
<i>Holocentropus stagnalis</i>						
<i>Plectrocnemia</i> sp.						
<i>Plectrocnemia conspersa</i>						
<i>Plectrocnemia geniculata</i>						
Limnephilidae	2					
<i>Halesus</i> sp.					1	
<i>Micropterna sequax</i>						
<i>Anabolia nervosa</i>						2





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Limnephilus</i> sp.						
<i>Limnephilus lunatus</i>	2	1	1	1	1	3
<i>Limnephilus marmoratus</i>						
<i>Limnephilus nigriceps</i>						
<i>Limnephilus vittatus</i>						
<i>Beraea pullata</i>						
<i>Athripsodes aterrimus</i>			4			16
<i>Mystacides azurea</i>						25
<i>Triaenodes bicolor</i>				79		
Lepidoptera			1			
Crambidae				1		
<i>Elophila nymphaeata</i>				1		
Diptera	2				1	1
Tipulidae	7	5				
<i>Prionocera</i> sp.	8					
<i>Tipula</i> sp.						
<i>Phalacrocer</i> replicata		1				
Limoniidae	1					
<i>Helius</i> sp.						
<i>Pilaria</i> sp.	1					
Psychodidae	185					
Ptychopteridae	1					
<i>Ptychoptera</i> sp.	13					
Dixidae						
<i>Dixella</i> sp.		2				
<i>Dixella aestivalis</i>	1	18				
<i>Chaoborus</i> sp.		7		97		
Culicidae		1				
<i>Culiseta</i> sp.		10				
Ceratopogonidae	2	9		20		30
Chironomidae	852	872	10	461	12	77
Tabanidae	1					
<i>Chelifera</i> sp.						
Syrphidae	2					
Sciomyzidae	1					





Site ID	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
Analysis	Species	Species	Species	Species	Species	Species
Taxa ID						
<i>Ephyridae</i>	6		1			
<i>Scathophagidae</i>			1		1	





D.3. Site Taxa Lists (Macrophytes)

Table D.3: Site Taxa List (Macrophytes)

Taxa/Site ID	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
<i>Agrostis stolonifera</i>	✓	✓	✓		✓					✓	✓	✓		
<i>Betula pendula</i>		✓												
<i>Blechnum spicant</i>	✓													
<i>Callitriche hamulata</i>														✓
<i>Callitriche sp.</i>		✓												
<i>Callitriche sp.</i>					✓								✓	
<i>Callitriche stagnalis</i>				✓					✓			✓		
<i>Calluna vulgaris</i>	✓													
<i>Caltha palustris</i>		✓	✓											
<i>Cardamine pratensis</i>		✓	✓	✓	✓							✓	✓	✓
<i>Carex curta</i>	✓	✓				✓		✓		✓		✓		
<i>Carex lasiocarpa</i>						✓		✓						
<i>Carex nigra</i> agg.	✓	✓		✓						✓				✓
<i>Carex rostrata</i>		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓
<i>Cirsium palustre</i>			✓											
<i>Conopodium majus</i>		✓												
<i>Eleocharis palustris</i>					✓		✓	✓				✓	✓	✓
<i>Equisetum fluviatile</i>		✓				✓								
<i>Erica tetralix</i>	✓													
<i>Eriophorum vaginatum</i>	✓													
<i>Filamentous</i>												✓		✓
<i>Filamentous algae</i>	✓													
<i>Filipendula ulmaria</i>			✓										✓	
<i>Fontinalis antipyretica</i>		✓												
<i>Galium palustre</i>					✓									
<i>Galium saxatile</i>	✓													
<i>Glyceria fluitans</i>				✓	✓		✓							
<i>Hydrocotyle vulgaris</i>						✓	✓	✓					✓	
<i>Iris pseudocorus</i>														✓
<i>Juncus articulatus</i>				✓	✓							✓		✓
<i>Juncus bulbosus</i>	✓			✓	✓		✓	✓		✓				
<i>Juncus effusus</i>	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓





Taxa/Site ID	WB-010-PS-001	WB-011-PS-001	WB-013-PS-001	WB-014-PS-001	WB-015-PS-001	WB-016A-PS-001	WB-016B-PS-001	WB-016C-PS-001	WB-021-PS-001	WB-023-PS-001	WB-024-PS-001	WB-025-PS-001	WB-027-PS-001	WB-028-PS-001
Sample Date	05/06/2017	05/06/2017	06/06/2017	06/06/2017	06/06/2017	08/06/2017	08/06/2017	08/06/2017	06/06/2017	07/06/2017	07/06/2017	07/06/2017	07/06/2017	08/06/2017
<i>Lemna minor</i>		✓		✓								✓		
<i>Littorella uniflora</i>													✓	
<i>Marchantia polymorpha</i>									✓					
<i>Mentha aquatica</i>														✓
<i>Menyanthes trifoliata</i>						✓								
<i>Myosotis scorpioides</i>			✓											
<i>Myosotis secunda</i>												✓		
<i>Myriophyllum spicatum</i>													✓	
<i>Nitella</i> sp.														✓
<i>Nitella opaca</i>				✓										
<i>Nuphar lutea</i>													✓	
<i>Persicaria amphibia</i> (<i>P. amphibium</i>)														✓
<i>Petasites hybridus</i>		✓												
<i>Phalaris arundinacea</i>													✓	
<i>Polytrichum commune</i>	✓													
<i>Pontenilla erecta</i>	✓													
<i>Potamogeton natans</i>		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
<i>Potamogeton polygonifolius</i>	✓													
<i>Potentilla palustris</i>						✓				✓				
<i>Ranunculus flammula</i>			✓											
<i>Ranunculus flammula</i>		✓		✓	✓		✓	✓					✓	✓
<i>Salix</i> sp.						✓				✓			✓	
<i>Sparganium emersum</i>				✓			✓			✓				
<i>Sparganium natans</i>						✓								
<i>Sparganium natans</i> (<i>S. minimum</i>)								✓						
<i>Sphagnum</i> sp.	✓													
<i>Sphagnum</i> sp.						✓		✓	✓	✓				
<i>Stellaria holostea</i>		✓												
<i>Stellaria uliginosa</i>					✓									
<i>Vaucheria</i> sp.									✓					



Annex E. Freshwater Pearl Mussel Technical Report

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