Planning and Environmental Consultants

Response to Further Information Request

Derryclare Wild Western Peatlands Project

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Planning and Environmental Consultants

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1. INTRODUCTION

1.1 Preamble

MKO have been instructed by Coillte Teoranta, (the applicant) to prepare this report in response to the Further Information Request issued by Galway County Council on the 19th of April 2023 under Planning Reference No. 23/60. The further information request is made in relation to the planning application to remove approximately 343 hectares (ha) of coniferous forestry plantation for the purposes of peatland restoration in the townlands of Derryclare and Cloonnacartan in Co. Galway. The full development description as per the public notices, is as follows:

'*Coillte Teoranta (the applicant) seek a ten-year planning permission for development on a site located in the townlands of Derryclare (also known as Doire an Chláir) and Cloonnacartan (also known as Cúil na Ceártan), Co. Galway. The development will consist of the following:*

i. The felling/removal of some 343 hectares of conifer plantation for the purposes of peatland restoration and the establishment of native woodland.
ii. Measures to restore and rehabilitate approximately 281 hectares of Atlantic blanket bog and heathland that is currently planted with lodgepole pine and Sitka spruce forests and managed for commercial forestry.
iii. Conversion of 62 hectares of conifer forestry to native woodland.
iv. Main peatland restoration measures will include tree removal, drain blocking (manual and mechanical) and ground reprofiling.
v. The control of existing invasive species on site and continued control during the restoration works to prevent their spread.
vi. Drain-blocking all existing artificial drainage and artificial land drains currently existing within the peatland restoration areas in order to restore the high water table which is necessary for blanket bog growth
vii. Provision of silt traps at outflows to block the pathway to the Twelve Bens/Garraun Complex Special Area of Conservation.
viii. Deer fencing to protect 62 hectares of proposed native woodland
ix. Provision of a Harvest Management Phasing Plan for the proposed project.
x. Provision of new internal access road extending to 1.58 km
xi. Across the site there will be 4 no. temporary water-crossings constructed in order to facilitate the harvesting of the timber at the site.
xii. Provision of informational signage.
xiii. Resurfacing of up to 8.23 km of existing forestry roads.
xiv. Resurfacing of existing car park to facilitate public access.
xv. Installation of water monitoring stations for real time water monitoring during operations.
xvi. Cutting of roadside trees to improved sightline visibility at site entrance.
xvii. The application is supported by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS).

This report replies on a point-by-point basis to the 5 no. points requesting Further Information as set out in the letter received by the Planning Authority dated 19th April 2023. Please note that the information contained in this response should be read in conjunction with the EIAR as submitted with the planning application.

We wish to highlight that the applicant has engaged with the NPWS, a key stakeholder, with regard to the content of the response to Further Information prior to submitting the response to Galway County Council.

Should you require further clarification on any aspect of this response, please do not hesitate to contact this office.

1.2 Emerging Legislation

The European Union's (EU) ambitious Nature Restoration Law[1] aims to achieve the long-term recovery of ecosystems across the EU. It is estimated that approximately 85% of EU protected habitats are currently in poor condition. The Law aims to reverse this decline by improving the structure and function of ecosystems with the overarching objective of improving resilience and biodiversity. Measures to reverse ecosystem decline include improving habitat connectivity, significantly reducing the use of chemical pesticides and fertilisers and rewetting drained peatlands.

The Law will require the development of national restoration plans and sets out legally binding targets requiring member states to implement restoration measures to cover at least 20% of EU land and sea areas by 2030. There are also specific requirements around the restoration of peatlands with a target to restore 30% of drained peatlands under agricultural use by 2030 and 50% by 2050. With peatlands playing an important role in mitigating the impacts of climate change, the restoration of peatland ecosystems is an essential means of combatting climate change. It is intended these measures will bring the EU's ecosystems back into good condition, thereby enhancing biodiversity and ensuring the continued delivery of key ecosystem services.

In November 2023, the Council presidency and European Parliament representatives reached a provisional political agreement on the proposed rules. This provisional agreement now has to be endorsed and formally adopted by the European Council and the Parliament. In terms of the Parliament, the Law passed the Environment Committee on the 29th of November. The vote of the full Parliament is expected to occur in the first quarter of 2024. If adopted, the Law will be published in the EU Official Journal and enter into force 20 days later.

The objective of the Wild Western Peatlands Project is to restore and rehabilitate approximately 2,100ha of Atlantic blanket bog and wet heath along the western seaboard of Ireland - that is currently planted with poorly performing inappropriate spruce and pine forests - to enhance biodiversity and improve carbon storage in the landscape. The subject site at Derryclare has been chosen as the pilot site for the Wild Western Peatlands project, and further Coillte sites will be selected to make up the 2,100 hectares of the total Wild Western Peatlands project in the coming years. It is considered that the proposed development appropriately aligns with the objectives set out in the Nature Restoration Law, as it will provide for the restoration of approximately 281 hectares of Atlantic blanket bog and heathland.

[1] https://www.rte.ie/news/world/2023/1110/1415887-eu-nature/

2. FURTHER INFORMATION ITEM NO.1

The submitted drawings do not fully and clearly represent the proposed development, please provide the following drawings for the purpose of clarity.

2.1 Part (a)

Site Plan - should clearly demonstrate both the existing and proposed land uses including those within the blue edge boundary- indicating the retained commercial forestry extents, new forestry, wet heath and blanket bog.

2.1.1 Response to Part (a)

An updated drawing of the site plan has been prepared as part of the Further Information response. The restoration plan drawing pack prepared by MKO illustrates both the existing and proposed land uses including those within the blue edge boundary – indicating the retained commercial forestry extents, new forestry, wet heath and blanket bog. Please refer to the submitted drawing pack prepared by MKO for further details. Restoration maps have also been completed to address concerns, please refer to the enclosed Restoration Plan Compartment drawings within the **FI Drawing Booklet** prepared by MKO for further details.

There is no decision support tool currently developed in Ireland to prescribe restoration options on blanket bogs. Developing such a tool can help guide the planner in ensuring the most appropriate restoration option is applied based on the site conditions. A decision support tool was therefore developed using all best available practice guidelines, to produce a decision support tool to help inform management decisions. For the purposes of appropriate assessment, the mitigations applied for all restoration options correspond to the migrations needed for the restoration measure with the highest degree of disturbance and highest level of impact.

The applicant has developed a **Decision Matrix for selecting the Forest to bog restoration option** which is enclosed in Appendix 1. The decision matrix described in this document is a tool that can be used to select the restoration option best suited to the site, based on the site conditions, using the precautionary principle. The decision matrix requires key site data, and it allows the user to prescribe restoration options appropriate for the underlying site conditions. The purpose of the decision matrix is to find the restoration option that will cause the least disturbance and deliver the best restoration results and help guide the site manager in selecting the best restoration option for the site. The decision matrix can also be used to identify what restoration options are not suitable for the site. In all cases, alternative restoration options can be considered up to, but not above the prescribed option. This approach ensures the site is assessed on its ground conditions and provides useful guidance when planning restoration. The decisions are applied using the smallest management unit available, namely the sub-compartment. It should be noted that the decision matrix for selection of restoration options is designed to function as an aid to the restoration practitioner and that final decisions on appropriate restoration options should be made based on best professional judgment and on actual conditions encountered on the ground.

Please refer to the submitted Decision Matrix for selecting the Forest to bog restoration option for further details.

In addition to the restoration plan drawings, the applicant has prepared a Forest to Bog best practice guidance document which is submitted with this response. The guidance document outlines 9 no. steps to be adhered to in all forest to bog operations with step 3 relating to the preparation of a detailed restoration plan for the felled area as part of a site-specific operational plan. The document also includes a detailed literature review.

This guidance document is further discussed under Item 3(d) of this report.

The applicant has additionally prepared a **Derryclare Restoration Plan for Practitioners** enclosed in Appendix 2 which acts as the practitioners quick reference to the Derryclare restoration plan. The plan includes the following:

1. An executive summary for practitioners.
2. A practitioners' management implementation plan (Table 1).
3. Relevant appendices with summaries for the following.
    a. Water monitoring plan.
    b. Invasive species plan.
    c. Grazing management plan (including deer management).
    d. General maintenance plan.
    e. Fire plan.

Please refer to Appendix 2 of this report for further details.

2.2 Part (b)

The sightlines have not been submitted in accordance with the required standard as set out in DM Standard 28 of the Galway County development Plan 2022-2028

2.2.1 Part (i)

i. Please submit a revised site layout plan that indicates visibility of 70m in both directions from the proposed access to the site, from a 2.4m setback from the road edge, and measured along the near road edge, at an object height of between 1.05m from the access to 0.6m at the sightline distance.

2.2.1.1 Response to Part (i)

The sightlines are now submitted as required by DM Standard 28 of the Galway County development Plan 2022-2028. Alan Lipscombe Traffic and Transport Consultants have prepared a response to address the information requested as part of Item No. 1 (b) (i) (ii) and (iii).

The 70m visibility splays taken from a 2.4m setback are shown at the existing access junction on the R344 in the horizontal plane in **Figure FI1.** The figure, together with Plates 1 and 2, show that the only existing obstructions within the visibility splays are shrubs and hedging. We confirm that the hedging will be maintained to 0.6 metres and is located entirely within Coillte's landownership. We confirm that approx. 25m of the northern visibility splay is located outside of Coillte's ownership and consists of a grass verge, which will not result in visibility obstruction.

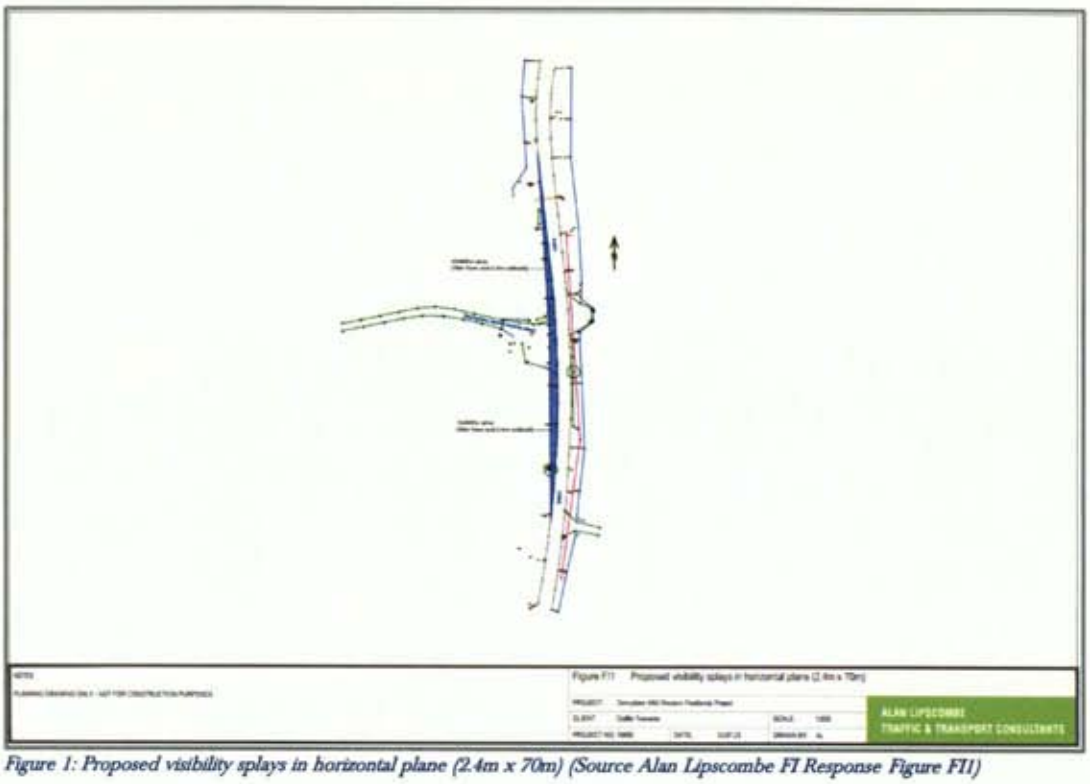


Figure 1: Proposed visibility splays in horizontal plane (2.4m x 70m) (Source Alan Lipscombe FI Response Figure FI1)

The profile of the existing carriageway edge on the R344, together with the visibility splay in a vertical plane are shown to the south and north of the existing access in Figure FI2. The figure shows that once the shrubs and hedging (which are located in Coillte's land ownership) are cleared, as set out above, the required visibility taken from a driver height of 1.05m to an object height of 0.6m is available in both directions.

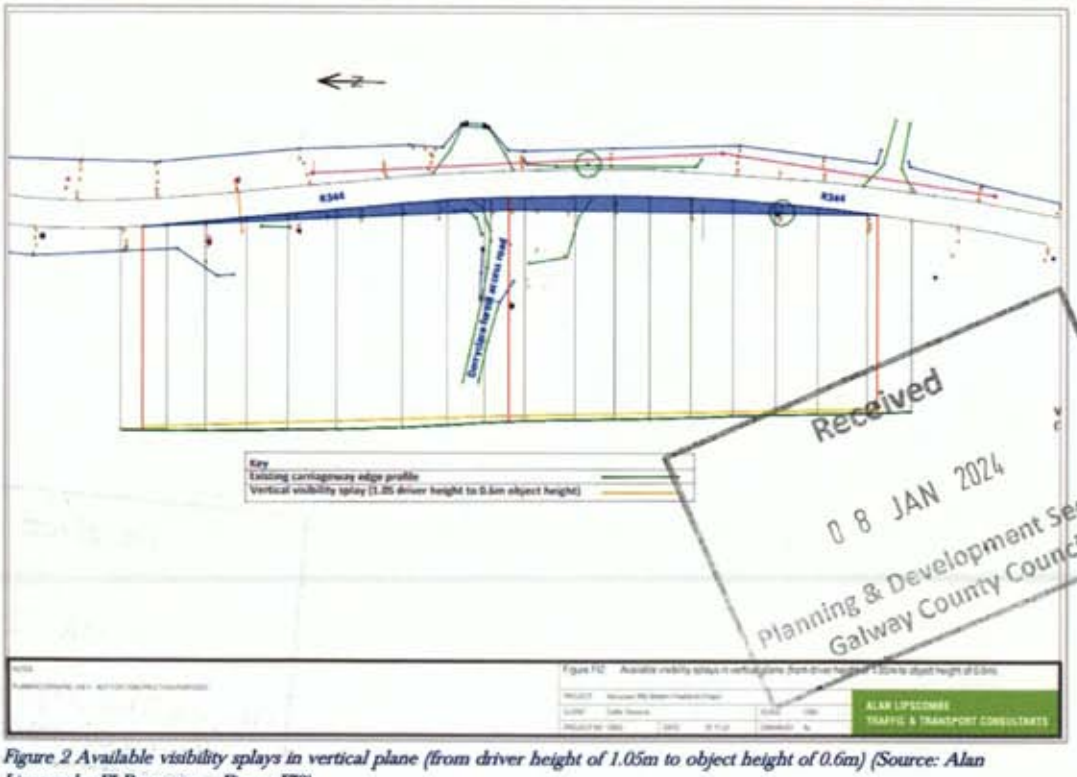


Figure 2 Available visibility splays in vertical plane (from driver height of 1.05m to object height of 0.6m) (Source: Alan Lipscombe FI Response – Figure FI2)

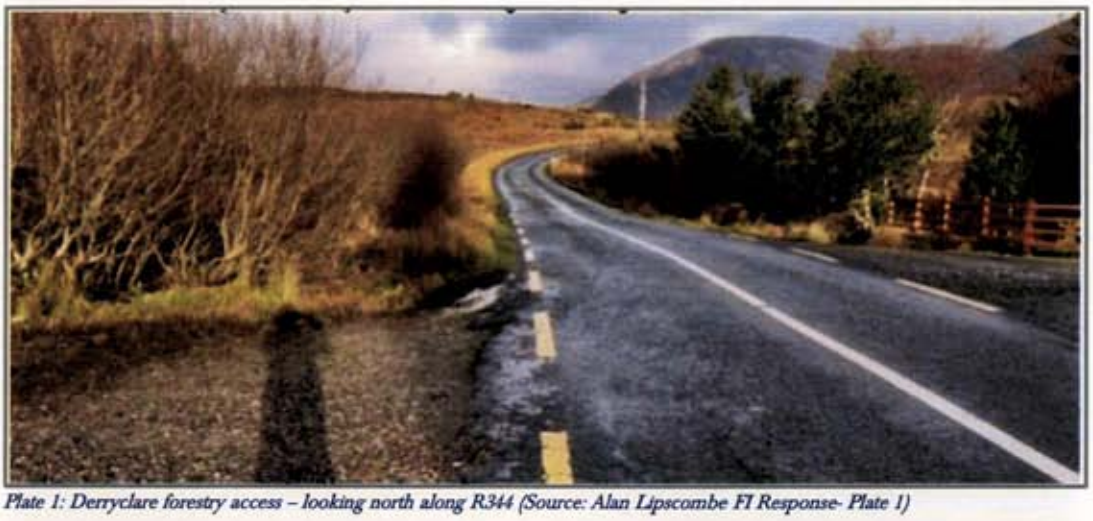


Plate 1: Derryclare forestry access – looking north along R344 (Source: Alan Lipscombe FI Response- Plate 1)

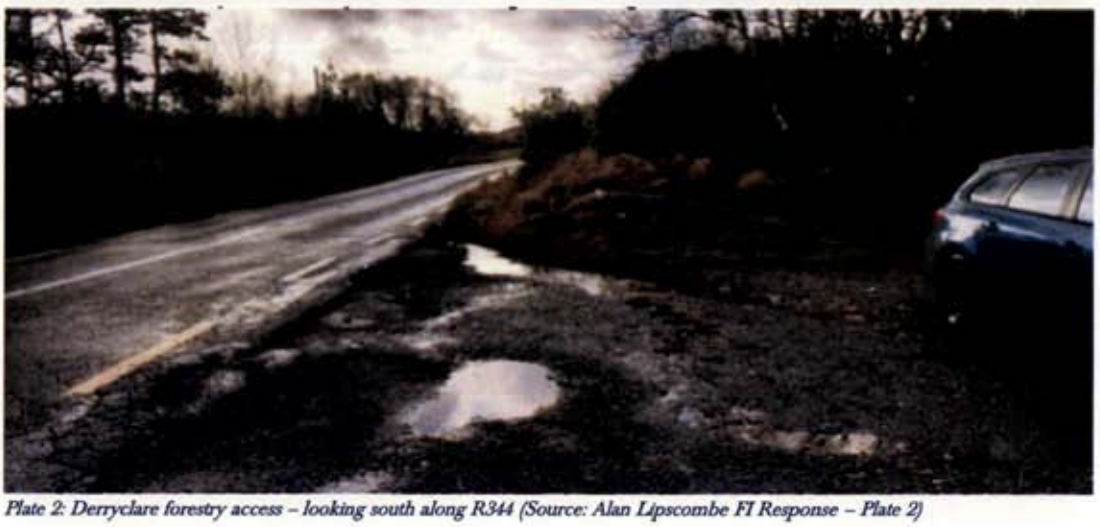


Plate 2: Derryclare forestry access – looking south along R344 (Source: Alan Lipscombe FI Response – Plate 2)

2.2.2 Part (ii)

ii. Where works are required in order to facilitate the provision of adequate sight distances, lands within the sight distance triangles shall be within the control of the applicant and shall be subject of a formal agreement with the adjacent landowner which ensures certainty that the applicant is in a position to comply with the relevant condition and or standard.

2.2.2.1 Response to Part (ii)

As referenced in item (i) above, We confirm that the hedging will be maintained to 0.6 metres and is located entirely within Coillte's landownership. We confirm that approx. 25m of the northern visibility splay is located outside of Coillte's ownership and consists of a grass verge, which will not result in visibility obstruction. All required works are within the applicants landholding and therefore third party consent is not required.

2.2.3 Part (iii)

iii. The full extent of the roadside remedial works, the required consent for same and associated mapping of lands required for the provision and maintenance of sightlines outlined in blue on a site location map and site layout plan is therefore required to be submitted by the applicant.

2.2.3.1 Response to Part (iii)

Please refer to Figure 3 below which indicates the location of the required sightlines in the context of the applicants ownership boundary. As referenced in item (i) above, approx. 25m of the northern visibility splay is located outside of Coillte's ownership and consists of a grass verge, which will not result in visibility obstruction. All required works are within the applicants landholding and therefore third party consent is not required.
Please refer to Figure 3 below which indicates the location of the required sightlines in the context of the applicants ownership boundary. As referenced in item (i) above, approx. 25m of the northern visibility splay is located outside of Coillte's ownership and consists of a grass verge, which will not result in visibility obstruction. All required works are within the applicants landholding and therefore third-party consent is not required.

Figure 3: Sightlines in the context of the Blue Line Boundary (prepared by MKO)

2.3 Part (c)

A drawing demonstrating each harvest block/ unit demonstrating the proposed phasing scheme including the schedule of works for both tree felling, any replanting and proposed restoration works of the project site should be provided.

2.3.1 Response to Part (c)

The phasing scheme was set out in the EIAR which was submitted with the application on 23/02/2023. To account for the Further Information response time, we have rolled the phasing plan forward by 1 calendar year. An updated drawing has been prepared which demonstrates each harvest block / unit in the proposed phasing scheme, including the schedule of works for both tree felling, replanting and proposed restoration works of the project site. Please refer to the submitted Proposed Harvest Phasing Map and Indicative Restoration Phasing Map contained in the **FI Drawing Booklet** prepared by MKO for further details.

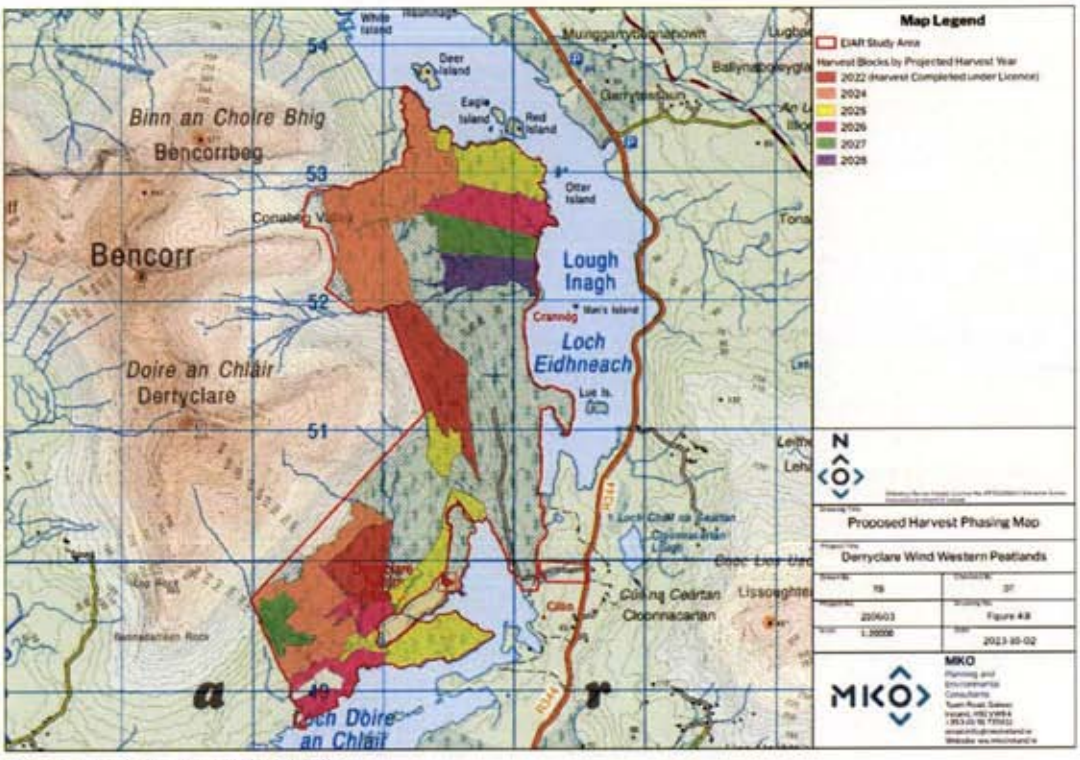


Figure 4: Proposed Harvest Phasing Map

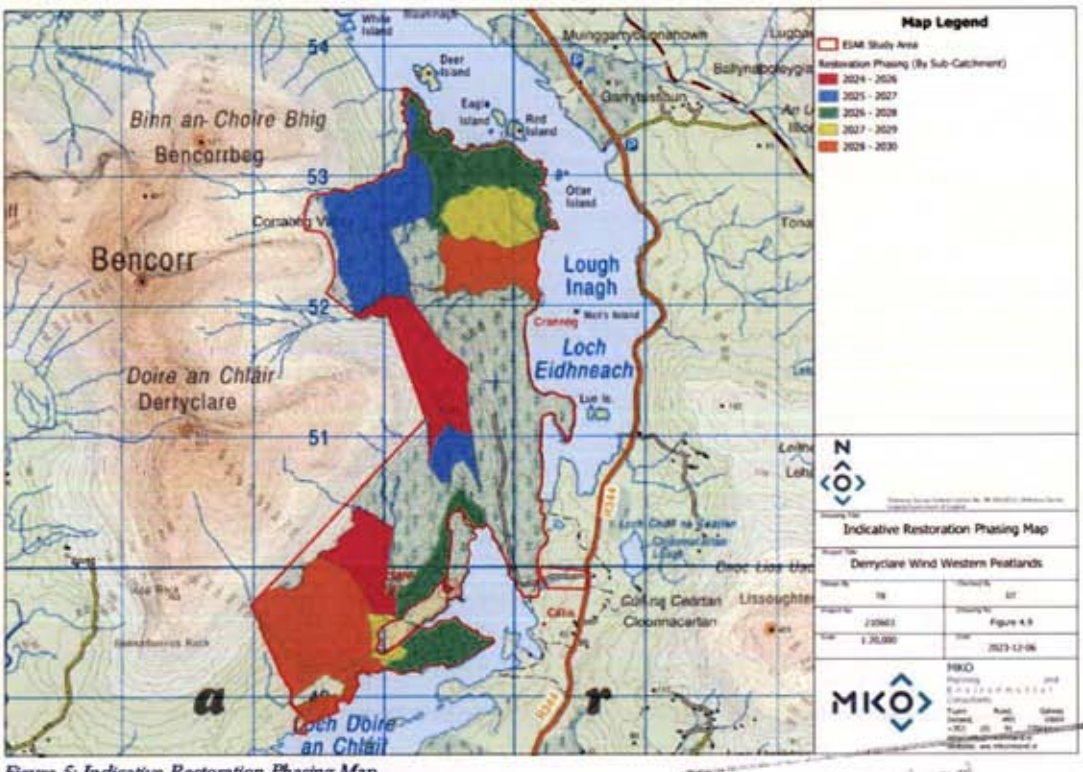


Figure 5: Indicative Restoration Phasing Map

Please refer to the submitted **FI Drawing Booklet** prepared by MKO for further details.

2.4 Part (d)

An individual drawing of each harvest block/sub-unit demonstrating existing/proposed gradient details, peat depths, saturation levels and precise proposed methodology in each of proposed drain blocking, site reprofiling including finished ground levels, involved in the restoration/replanting scheme specific to each sub-unit.

2.4.1 Response to Part (d)

An updated drawing of the harvest block/sub compartment have been updated accordingly and are re-submitted. Please refer to the updated restoration plan drawings within the **FI Drawing Booklet** prepared by MKO for further details.

2.5 Part (e)

Drawings need to clearly demonstrate at an appropriate scale the layout at the entrance to the site including full car park details & location of proposed signage.

2.5.1 Response to Part (e)

The drawings have been updated to clearly demonstrate at an appropriate scale the layout at the entrance to the site including full car park details and location of proposed signage. Please refer to drawing no. 210603 – 14 within the **FI Drawing Booklet** prepared by MKO for further detail.

2.6 Part (f)

Full mapped details of the extent of the 8.23 km of resurfacing of internal roads works proposed and the 1.58km of new internal access road should be provided.

2.6.1 Response to Part (f)

The submitted Site Layout Plan drawing no. 21060304 to 21060309 inclusive as submitted with the planning application provided a road plan of the 8.23 km of resurfacing of internal roads works proposed and the 1.58km of new internal access. Chapter 4 of the submitted Environmental Impact Assessment Report (EIAR) includes the details of the proposed road plan.

Section 4.5.3 of the submitted EIAR states: *"Maximum use has been made of the existing on-site roads in accessing the proposed harvest blocks for timber extraction and bog restoration. All site access roads that are proposed to be used as part of the Proposed Project, both existing and proposed, will be capped with clean stone to minimise the risk of sediment runoff to local water courses. The material required for upgrade and construction of roads within the site will be obtained from local, licenced quarries".*

Section 4.5.3 of the submitted EIAR describes the existing roads "*The existing roadways and tracks through the site will be used to access the proposed timber harvest blocks and restoration areas. It is proposed to use 8.23 kilometres of existing on-site roadways as part of the Proposed Project. While some upgrading of these roadways may be required, it is not anticipated any widening of the roadways will be required. Upgrading of the existing roadways will involve the laying of a new surface dressing on the existing section of roadway only where necessary".*

Section 8.5.2.5 of the submitted EIAR describes that locally sourced stone compatible with the local geology will be used to upgrade the road network "The upgrade of the existing road network will only

be completed where necessary using local stone compatible with onsite geological materials". Please refer to Chapter 4 of the submitted EIAR and drawing no. 21060304 to 21060309 for further details regarding the road map plan.

As referenced in Section 4.5.3 of the EIAR, it is proposed to construct approximately 1.58 kilometres of new roadway as part of the Proposed Project. The routes of the proposed new roads are shown in Figure 4.3. Proposed new access roads will be designed as "Build On-Top Embankment Roads" in accordance with the COFORD (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.

Along the new road there will be 4 no. temporary water-crossings of natural water courses constructed in order to facilitate the harvesting of the timber at the site. Full details of the proposed crossing methods for each watercourse crossing, along with a map of their locations are provided in Appendix 4-1 of the submitted EIAR. Additional temporary water course crossings of forestry drains may also be required to facilitate timber harvesting. These additional crossings will be accomplished using the same methodology described in Section 4.7.9 of the EIAR however, all forest drains within the project site will be permanently blocked as part of the proposed peatland restoration. Temporary Watercourse Crossings will be removed following the completion of the restoration works.

3. FURTHER INFORMATION ITEM NO. 2

The site of the proposed development is located surrounded by The Twelve Bens/Garraun Complex SAC, within c2km from Maumturk Mountains SAC and Connemara Bog Complex SAC and SPA, and within a distance of 15km of 9 no. other designated European site for rare and threatened flora and fauna across the European Union (i.e. Natura 2000 network of sites), which are protected under the EU Habitats Directive (92/43/EEC) & EU Birds Directive (79/409/EEC, as amended by Directive 2009/147/EC) and the European Communities (Natural Habitats) Regulations 1997, as amended by the European Communities (Birds and Natural Habitats) Regulations 2011. The protection of these European sites is further reinforced in the Galway County Development Plan, 2022-2028, which was subject to a Natura Impact Report NIR and includes the following provisions to protect European Sites: Policy Objective NHB 1, Policy Objective NHB 2, Policy Objective NHB 3, Policy Objective NHB 4, Policy Objective WR 1 Water Resources, and DM Standard 50. Based on the information included with the planning application, and the concerns identified by the Planning Authority in relation to the potential direct, indirect and cumulative impacts which include Annex I habitat loss and damage, uncertainties in terms of mitigation measures proposed, deficiencies in the information contained in the NIS concerning potential impacts of the project on Qualifying interests of the European Sites. The planning authority in conjunction with the application of the precautionary principle, consider that adverse effects on the integrity and conservation objectives of the European sites in the vicinity, cannot be ruled out, as a result of the proposed project. Therefore, the Planning Authority requires the applicant to provide and update the submitted NIS accordingly including the following required information:

The issue of mobile species using this 567ha site is not fully addressed in the absence of dedicated surveys. For each field survey undertaken provide: Brief description of methodology/method, Names and qualifications of surveyors, Date(s) of surveys, Study area, Weather conditions at time of survey(s) and time of day (if relevant), Reference to relevant guidance document (where appropriate), Explanation of any departures from recommended guidance. Limitations Note: Where multiple survey visits have been undertaken, dates, times and weather conditions of surveys can be provided in a table in an appendix. Note: Detailed descriptions of survey method can be provided in an appendix.

In response the RFI received from GCC, particularly Item 2, a suite of additional surveys of the Proposed Project site were undertaken by MKO ecologists and Coillte Nature, pertaining to mammals, birds, bats, and watercourses. Targeted surveys of each were undertaken and specific reports for each, detailing methodologies, results, and recommendations, have been included as part of this response to the RFI.

In light of the additional information obtained from these surveys and reports, Chapter 6; Biodiversity of the submitted EIAR was reviewed to determine whether amendments to its conclusions were required. In addition, the additional detail pertaining to the sub-compartment restoration plan, which is provided in this response to the RFI, was also considered.

Taking cognisance of the residual impacts as a result of the Proposed Project, post implementation of the mitigations set out in the respective reports for mammals, birds, bats, and water quality, as well as those already detailed in Section 6.7 of the submitted EIAR, it has been determined that the conclusion of Chapter 6; Biodiversity remains valid and there is no requirement for amendments.

3.1 Part (a)

Full Bird Survey Report, focusing on breeding bird or winter /wetland bird surveys paying particular attention to Merlin, Golden Plover, Common Gull and Cormorant. (Merlin identified as breeding on an island on Lough Inagh) Bird Surveys guidance should be followed – Institute of Ecology and Environmental Management Guidance Document states;

"It is however, an underlying presumption of these guidelines that bird surveys (breeding/non-breeding) should always be scoped in unless robust justification can be provided as to why they are not required. This presumption is due to the wide range of habitats that may be of value to bird species, seasonal variations in habitat use and/or value, the mobility of bird species and the potential sensitivity of bird species to a range of impacts that may result from development projects." Appropriate seasonal bird surveying shall be carried out and submitted.

3.1.1 Response to Part (a)

Pre-commencement surveys will be carried out on site as proposed within the planning application.

Breeding bird surveys were conducted at the proposed development site in breeding season 2023 in response to the RFI from Galway County Council. The survey scope was designed to target merlin, cormorant, common gull and golden plover. Other incidental observations birds of conservation concern observed during these surveys were recorded.

Merlin, cormorant and common gull were recorded at the proposed development site and in the adjacent Lough Inagh and Derryclare Lough during surveys. Through consultation with the National Parks and Wildlife Service during the preparation of the Biodiversity Chapter of the submitted EIAR, it was also confirmed that merlin were nesting in woodland on an island in south Derryclare Lough in the past. Although present in small numbers in Lough Inagh and Derryclare Lough, there was no evidence to suggest that cormorant or common gull are dependent on the area for breeding. Golden plover was not recorded during surveys.

The report concludes that merlin were likely breeding in north Derryclare Lough during breeding season 2023 and have been recorded breeding in other areas of the same lake during previous surveys, and that disturbance of breeding merlin on the north Derryclare Lough islet should be considered during the project works, and appropriate safe working distances applied.

For further details on this please see the **Bird Survey Report** by MKO.

3.2 Part (b)

Bat Survey Report, including the use of transect surveys and static detectors, any required mitigation measures identified for bat species.

3.2.1 Response to Part (b)

A detailed **Bat Survey Report** has been prepared in response to Item 2b of the RFI from Galway County Council (GCC) which is submitted with the RFI response. The report includes the names and qualifications of the surveyors, desktop studies for the Proposed Project site, survey methodologies, results, an impact assessment on bats, and an overall conclusion. Bat surveys were carried out in accordance with Bat Conservation Trust - Bat Surveys for Professional Ecologists – Good Practice Guidelines (3rd edn.).

Bat surveys employed a combination of methods, including desktop study, habitat and landscape assessment, and manual activity surveys. The aim was to assess usage of the site by roosting, foraging and commuting bats to inform the ecological impact assessment. MKO completed dusk bat activity surveys and deployed static bat detectors throughout each season (Spring, Summer and Autumn). Surveys were undertaken by two licenced ecologists during suitable weather for bats.

In total, four species of bat and the Myotis genus were recorded across the proposed development site. No bat roosts were identified, and the site does not support potential for bat roosts. No significant direct or indirect impacts on roosting bat species are anticipated.

A moderate effect is anticipated on woodland-dwellers as a result of the loss of forest habitat, which is mitigated by the phased nature of the felling operations and the retention/re-creation of forest habitat (native scrub woodland) within the Proposed Project site and its surroundings.

Best practice disturbance limitation measures.

- All construction plant and equipment to be used on-site will be modern equipment and will comply with the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1998, and any subsequent amendments.
- Plant machinery will be turned off when not in use. Machines, which are used intermittently, will be shut down during those periods when they are not in use.
- Operating machinery will be restricted to the proposed works site boundary.
- Reduced illumination of the site will be used where possible to prevent disturbance to bats that may potentially occur in the wider area. Where lighting is unavoidable during felling operations, low-intensity lighting and motion sensors will be used to limit illumination.

The report concludes that provided that the Proposed Project is carried out in accordance with the design, best practice and mitigation described in the report, significant effects on bats are not anticipated at the county, national and international scales. For further details please see the **Bat Survey Report** by MKO.

3.3 Part (c)

Aquatic Survey for all water courses within the site, due to the significance of Lough Inagh as an important salmonid lake and the hydrological connections between the site and European Sites

3.3.1 Response to Part (c)

Mayfly Ecology have prepared a **Biological & Chemical Monitoring of Surface Waters** report in response to Item 2(c). The report concludes that the results of the water chemistry and biological sampling paint a complicated picture across both properties, but it is clear there are pressures acting upon these water bodies including but not limited to; flow, pH and excessive metals.

Please refer to the submitted **Biological & Chemical Monitoring of Surface Waters** report enclosed in Appendix 3 for further details.

3.4 Part (d)

Mammal surveys (including any required mitigation during construction and in a post development scenario), including the use of trail cameras

3.4.1 Response to Part (d)

As part of the multidisciplinary surveys conducted by MKO in July, August, and September of 2021 and October and November of 2022, searches for indications of badger, otter, and red squirrel were carried out. This search was conducted in order to determine the presence or absence of these species within Proposed Project site. In response to the RFI, targeted mammal surveys were carried out on the 20th and 21st of July 2023.

Additionally, trail cameras were deployed for a total of 14 days throughout the site. In addition to the above, incidental records of mammal signs were considered during the targeted bird and bat surveys, which were undertaken in response to the RFI. Multiple bird surveys were undertaken in May and July 2023. Bat surveys were undertaken on the 25th of May, 4th of July and 14th of August 2023.

Mammal surveys were carried out in line with NRA (2009) Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes and NRA (2006): Guidelines for the Treatment of Badger Prior to the Construction of National Road Schemes.

No significant mammal activity was recorded within the footprint of the Proposed Project during the multispecies mammal walkover surveys undertaken. However, recordings from the trail cameras deployed throughout the site confirmed that the site is used by a range of mammal species including badger (Meles meles), otter (Lutra lutra), red squirrel (Sciurus vulgaris), fox (Vulpes vulpes), pine marten (Martes martes), and red deer (Cervus elaphus). Although no breeding sites for any species was recorded, taking a precautionary approach, mitigations have been provided, both in this mammal report and in the Biodiversity chapter of the submitted EIAR, to mitigate any potential pathways for effect on these species. Following the implementation of these mitigations, there is no potential for significant impact on any mammal species, as a result of the Proposed Project.

Otter

Best practice disturbance limitation measures.

- All construction plant and equipment to be used on-site will be modern equipment and will comply with the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1998, and any subsequent amendments.
- Plant machinery will be turned off when not in use. Machines, which are used intermittently, will be shut down during those periods when they are not in use.
- Operating machinery will be restricted to the Proposed Project site boundary.
- It is expected that works will occur during normal working hours which will be agreed with the local authority in consultation with the appointed contractor prior to works commencing.
- Light spills during construction works will be minimised where possible thus reducing the effect on areas outside the Proposed Project, and consequently on fauna of conservation.

Red Squirrel

Habitat Loss/ Degradation
Following a precautionary approach, a pre-commencement red squirrel survey for each felling block will be carried in advance of felling, to identify whether any breeding red squirrel or dreys are located within that felling block. Surveys will be carried out as per NRA guidance (NRA, 2009, Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. Dublin: National Roads Authority).

Should active dreys be identified within the felling block to be felled, the following mitigations and best practice procedures will be followed to ensure that no breeding red squirrel sites are impacted:

- Buffer zones of 50 meters will be established around the breeding sites during the breeding seasons (February to September inclusive).

Additionally, the following measures will be followed on a precautionary basis:

- As the proposed felling will result in a temporary reduction of food resources, supplementary feeding of red squirrel will be carried out.

Best practice disturbance limitation measures.
Same as for otter.

Badger and pine marten

Habitat Loss/ Degradation
Following a precautionary approach, a pre-commencement badger and pine marten survey for each felling block will be carried in advance of felling, to identify whether any breeding badger and pine marten, and their associated habitats are located within that felling block. Surveys will be carried out as per NRA guidance (NRA, 2009, Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. Dublin: National Roads Authority, and NRA, 2006, Guidelines for the Treatment of Badger Prior to the Construction of National Road Schemes. National Roads Authority).

Should active breeding sites for either species be identified within the felling block to be felled, the following mitigations and best practice procedures will be followed to ensure that no breeding badger or pine marten sites are impacted:

- Buffer zones of 50 meters will be established around the breeding sites during the breeding seasons.
- These exclusion zones will remain unfelled or will be managed as per guidance set out in the Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (NRA 2006).

Best practice disturbance limitation measures.
Same as for otter.

Please refer to the submitted **Mammal Survey Report** prepared by MKO for further details.

3.5 Part (e)

Full detailed explanation of the recreational use of the existing site and proposed use during operation and post-completion stages, any trails, locations of trails within and adjoining the site, use of fishing facilities at Lough Derryclare and Lough Inagh, this should include any required mitigation measures to protect the proposed bog landscape from humans, animals and any identified protected habitats/ species. (This should also be updated in the EIAR).

3.5.1 Response to Part (e)

The recreational use of the site will not be increased. The proposed development does not set out to increase recreational use of the area in any manner. The surveys completed as part of the initial planning application were based on the existing level of use on the site. The management of recreation use is detailed on the document "Derryclare management and maintenance plan, in section 4.0 under the title "General maintenance plan (including public usage)". In the interest of health and safety, public access to certain forestry blocks will be temporarily restricted during felling operations in keeping with Coillte's open-forest policy.

Please refer to Appendix 4 **Derryclare Management and Maintenance Plan** for further details.

Existing access will be maintained for existing users in line with the Coillte open forest policy.

There are no plans to change the current recreational use of the site. Coillte operate an open forest policy, and this will remain in place for Derryclare. The site is used informally for recreation under Coillte's open forest policy. Currently, there are no waymarked trails within the site, but the forestry tracks are used by walkers, as well as hikers accessing the 12 Bens. However, as set out in section 4.5.4 and 4.5.5 of the EIAR, the existing arrangements will be upgraded, including upgrading the existing car park, providing better threshold signage and maintaining the surface dressing on the existing forest roadways.

Section 4.5.4 of the submitted EIAR states *"It is proposed to upgrade the surface dressing of the existing carpark to provide a level, compacted car park surface. It is not intended to delineate individual car parking spaces. The car park will act as a landing point or trailhead for recreation and amenity users arriving at the site. The car park will provide a safe and easily accessible landing point, allowing visitors to orientate themselves on the site or demount bicycles from cars".*

Section 4.5.5 of the submitted EIAR states *"Entry point signage will be provided, at the main site entrance where recreation users can enter the site. The entry point information boards will provide information about the Wild Western Peatlands project and the peatland restoration process. The signage will also indicate the principles of 'Leave No Trace'. Information in relation to the flora and fauna present at the site and within the local area will also be provided".*

Section 4.5.3.1 of the submitted EIAR states *"Upgrading of the existing roadways will involve the laying of a new surface dressing on the existing section of roadway only where necessary".*

4. FURTHER INFORMATION ITEM NO. 3

Based on the information submitted in the Environmental Impact Assessment Report and as identified in the Environmental Impact Assessment carried out by the Planning Authority, it is considered that the EIAR submitted has not presented a sufficient level of information and assessment in relation to impacts on Population and Human health, Biodiversity (with particular attention to Habitats and Birds Directives), Land, soil, water (in particular the risks of peat instability and impact on water quality), air and climate, Material assets, cultural heritage and the landscape, and the interaction between the above, for the competent authority to make an EIA determination that there is an acceptably low likelihood of environmental effects of a magnitude which would have a significant effect on sensitive environmental receptors as a result of the proposed development and mitigation proposed as part of the submitted EIAR. Therefore, the applicant is requested to address the following deficiencies within the submitted document:

4.1 Part (a)

The Irish Peat Conservation Council (IPCC) raised concerns within their initial scoping response regarding the adequacy of current "best practice approaches" to assessing peat strength and stability, these have been found wanting, owing to numerous landslides across the country. This in combination with the concerns raised by the DHLGH regarding using untrialled and untested methods of peat restoration in an upland area of the west of Ireland; the applicant is requested to provide sufficient supporting evidence demonstrating the trialing and testing of the proposed methods, including the provision of likewise case studies, providing the Local Authority with robust scientific evidence that the proposed methodologies of drain blocking, damning, drain reprofiling, stump flipping, surface smoothing, stump mulching and cross-tracking and do not pose detrimental risks of peat disturbance, peat erosion, peat stability and water quality impacts as a direct result of the development. The supporting evidence should be comprehensive and include the appropriateness of the proposed drain blocking using dams on slopes of greater than 6 degrees, the project proposes these works on slopes of 10 degrees which is contrary to current recommendations and untested in Ireland. Please comprehensively address this concern.

4.1.1 Response to Part (a)

Please note that the information contained within the response to Item 3(a) should be read in conjunction with the EIAR as previously submitted with the planning application.

Fehily Timony have prepared a **Technical Note in Response to Further Information Required** enclosed with the FI response with regard to peatland rehabilitation. This note should be read in conjunction with submitted Geotechnical & Peat Stability Assessment as submitted with the planning application.

At the request of the NPWS, Fehily Timony conducted further site reconnaissance to include additional peat probe locations, and design and implementation of a Ground Penetrating Radar (GPR) survey at key profile locations across the site. The results of these surveys were analysed by Fehily Timony and the results are provided in an **Addendum to Geotechnical & Peat Stability Assessment Report** which is submitted with the FI response.

Fehily Timony undertook the peat analyses following the principles outlined in *The Peat Landslide Hazard and Risk Assessment Guide (2nd edition, PLHRAG, 2017)*. Determination of peat depths, strengths and resulting Factor of Safety (FoS) analyses were undertaken in accordance with Eurocode 7 guidance. These are current best practice guidance for assessment of peat strength and stability and have been used on upland peat sites across Ireland.

The methodology adopted for the assessment of peat stability and risk assessment is outlined in Appendix D of the submitted Assessment Report. In this approach, the main factors for assessing peat stability include the following:

- Geomorphological
- Qualitative (judgement)
- Index/Probabilistic (probability)
- Deterministic (factor of safety)

In addition to the above and to ensure a robust assessment, the most conservative material parameters, site conditions and slope analysis method were used to assess the sites' peat strength and stability. These include the use of:

- **Conservative peat strengths** – as discussed in Section 6.1 of the Assessment Report, these values were derived from review of published information on peat strengths, resulting in the most conservative values being used for the stability analyses. Hand Shear Vane measurements within the peat were also undertaken as part of the site reconnaissance for verification purposes. In general, results from HSV testing were in excess of the conservative undrained shear strength values used in the stability analyses.
- **A 100% water level** – For the purposes of the stability analyses it was assumed that groundwater was at the surface. However, a 100% water level is an unlikely scenario due to overriding site conditions including prolonged dry weather conditions, i.e., sloping terrain and the abundance of natural drainage channels (as discussed in Section 4.2 of the Assessment Report).
- **Infinite slope analysis method** – the translational or infinite slope analysis method was adopted to assess the sites slope stability. This method does not consider resisting forces (such as toe loading or buttresses) and is therefore considered to be a conservative method for assessing peat slopes.
- **Surcharge from forestry machinery** – a surcharge of 10kPa was incorporated into the stability analyses to simulate the temporary load created by forestry machinery.

Considering all of the above, it is deemed that the best practice approaches and methodologies used in the Assessment Report erring on the side of caution, are more than adequate to determine the site's peat strength and stability.

Please refer to the **Technical Note in Response to Further Information Required** prepared by Fehily Timony for further details.

Following consultation with MKO and Coillte, a second phase of site reconnaissance was undertaken by FT. The purpose of the site reconnaissance was to further constrain the findings of the Assessment Report. The findings of the Phase 2 Reconnaissance are presented in the **Addendum to Geotechnical & Peat Stability Assessment Report.**

A site walkover was undertaken by FT over four days between 31st October and 3rd November 2023. Weather conditions during the site walkover were cloudy to overcast with periods of heavy rainfall and strong gusts. With respect to site characterisation, the findings from the Phase 2 reconnaissance highlighted no additional factors that could potentially contribute towards instability within the peat deposits. The main findings from the site walkover are summarised as follows:

1. In total, 77 no. additional peat probe locations were visited. The distribution of the combined Phase 1, Phase 2 and RPS probe locations are presented in Drawing No. 001.
2. Peat depths range from 0.0 to 6.3m bgl (PP087) with mean and median depths of 1.0 and 0.60m bgl respectively. The peat depths from both the Phase 1, Phase 2 and RPS surveys are presented in Drawing No. 002. The deepest peat deposits were almost exclusively found in areas of flatter terrain within the north, northeastern and southmost portions of the site.

3. Base of peat was typically recorded as bedrock. However, granular till and scree deposits were also noted. Profiles showing these geological sequences could often be observed in road cuttings and stream sections (Plates 1 and 2). No fine-grained material was encountered.
4. The sites' topography typically displays an angular and hummocky relief, frequently punctuated by bedrock outcrops. This type of morphology is indicative of shallow bedrock.
5. Buoyant peat was recorded at six peat probe locations (PP087, PP088, PP093, PP094, PP095, PP097) where peat depths range from 1.6 (PP095) to 6.3m bgl (PP087).
6. Localised areas of ponded water were recorded. This is not unexpected given the ground conditions and the flat terrain present in localised areas across the site.
7. Slope angles across the site range from 2 to 30 degrees with a mean and median value of 10 and 7 degrees respectively. The slope angle was obtained on site using a handheld Silva Clino Master, which has an accuracy of +/- 0.25 degrees. The slope angle quoted typically reflects the representative slope at each of the peat probe locations.
8. The undrained shear strength of the peat was determined in-situ using a Geonor H-60 Hand-Field Vane Tester. Undrained shear strengths ranged from 5 to 53kPa with a mean and median value of 17 and 15kPa respectively.
9. Other than the historic peat failure identified during the Phase 1 survey at probe location POI008, no other evidence of historic or recent peat instability was recorded.

The findings of the geophysical report are summarised as follows:

- There is a strong correlation between peat depths derived from the GPR survey with those taken during the Phase 1, Phase 2 and RPS peat probe surveys.
- In total, 116 areas of peat were identified, ranging in length from 150m in length) are exclusively found in areas of flatter topography. 41 no. of these areas were described as "pods" having lengths of <20m and often displaying a "bowl" morphology. These "pods" were not assessed for peat thickness and base of peat slope as the risk of instability was deemed to be negligible. The remaining 75 no. areas were assessed for peat thickness and base of peat slope.
- A total of 115 no. peat depths and associated surface and base of peat slope angles were recorded by MGL.
- Peat depths range from 0.8 to 5.0m bgl with an average peat depth of 2.38m bgl
- Peat occurs in isolated areas rather than large laterally continuous deposits.
- In general, the steeper areas of the site show limited extents of peat.
- Base of peat slopes follow the undulating and often rough surface of the underlying geology (typically bedrock).
- Base of peat slope angles broadly correlate with surface slope angles and are on average 2.5 degrees steeper. Localised steeper base of peat slopes are recorded; these predominantly occur over short distances (typically <20m) along the flanks of bedrock ridges. The base of peat slope angles were used in the peat stability assessment analyses for all GPR peat depth locations.

A number of "exclusion zones" are identified in Drawing Numbers 004 and 005 of the Addendum to Geotechnical & Peat Stability Assessment Report (Fehily Timony 2024). Within these exclusion zones the use of heavy machinery for restoration purposes shall be restricted.

4.2 Part (b)

The applicant should have monitored the water quality within and connected to the site in more detail to ascertain baseline quality information to inform both the EIAR and in the assessment of risk in relation to the Appropriate Assessment. Baseline data should be collected over an appropriately representative period, combining both manual and automatic monitoring triggered by flow and submitted in support of the application.

4.2.1 Response to Part (b)

MKO issued a letter to the Environmental Department of Galway County Council. The letter lodged an official request to increase the frequency of chemical sampling in Derryclare Lough, Co. Galway in support and to address Item 3(b) of the request for further information on behalf of the applicant, Coillte Teoranta. The letter was acknowledged on receipt but no response has been received.

There will be 1 year of baseline water sampling in place on site as well as monthly samples taken during the restoration period.

Mayfly Ecology was commissioned by Coillte to undertake a programme of annual biological monitoring (macroinvertebrates – kick sampling) of surface waters at 4 suitable locations in Derryclare and this commenced in June 2023. A programme of monthly grab water sampling for chemical analysis commenced in October 2022 at 5 locations in Derryclare. Water sampling was undertaken by Coillte and laboratory analysis by Fitz Scientific measuring a total of 20 parameters. Mayfly Ecology was also commissioned to analyse the results of the chemical analysis on an ongoing basis.

The **Biological & Chemical Monitoring of Surface Waters** report enclosed in Appendix 2 prepared by Mayfly Ecology for Derryclare, which is submitted with this FI response, summarises the results of the biological and chemical results. In June 2023, biological monitoring occurred at 4 locations on site, and a review occurred of the further 5 locations on site where monthly chemical samples were taken as part of the baseline monitoring.

The report concludes that the results of the water chemistry and biological sampling paint a complicated picture across both properties, but it is clear there are pressures acting upon these water bodies including but not limited to; flow, pH and excessive metals. Two live monitoring stations will be installed for the duration of the project (and 16 pezimeters) to provide continuous monitoring throughout the lifetime of the project.

Please refer to the submitted **Biological & Chemical Monitoring of Surface Waters report** for further details.

4.3 Part (c)

It is noted that the rainfall data utilised to demonstrate the pluvial impact of water drainage across the site relies on data from a monitoring station in Claremorris and data collated from Met Eireann from 1965-1985, where the extents of extreme rainfall as a result of climate change would not have been recorded. This information gap alongside the relatively high levels of existing peat saturation combined with the proposed drain blocking, removal of trees & exposure of bare peat needs to be adequately analysed and studied to determine the risks posed and mitigation required to protect peat stability onsite and avoid any resultant impact on Population and Human health, biodiversity, land, soil and water quality as well as in the adjoining SAC. The applicant is requested to provide site specific standard rainfall data from recent monitoring carried out over an appropriate period across the application site, this should collate alongside the peat depths, saturation levels in corresponding months and results of the FRA. (requested on item d)

4.3.1 Response to Part (c)

Hydro Environmental Services (HES) have provided a response to this item within the submitted **Geological, Hydrological & Hydrogeological Responses to Submissions** document enclosed in Appendix 5. Item 3(c) is responded to as follows:

Rainfall Data

The RFI suggests that the rainfall utilised in the EIAR chapter was from a monitoring station in Claremorris and relied on data collated from Met Eireann from 1965 to 1985. This statement is incorrect.

The data from Claremorris weather station was utilised solely with respect to average potential evapotranspiration. Average potential evapotranspiration data is only available for 14 no. weather stations in the Republic of Ireland. Whilst we acknowledge that this weather station is located ~54km northeast of the project site, it is the closest weather station for which evapotranspiration data is available. As stated in Section 9.3.2, the annual potential evapotranspiration at Claremorris is 408mm/yr. Other weather stations on the Atlantic Coast for which potential evapotranspiration data is available include Belmullet and Shannon Airport, located ~80km northwest and ~100km to the southeast of the project site respectively. The annual potential evapotranspiration at these locations is 527mm/yr and 543mmm/yr. Despite the differences in potential evapotranspiration between these 3 no. rainfall stations, the data from Claremorris is chosen due its proximity to the project site.

With respect to the rainfall data presented in Section 9.3.2 of the EIAR, the rainfall data was sourced from the nearest available rainfall station, *i.e.* Ballynahinch rainfall station, located ~7km to the southwest of the project site. We recognise that Ballynahinch station closed in 1985. However, Met Éireann have modelled the 30-year average rainfall for this station for the period from 1981 to 2010 (www.met.ie). The 30-year annual average rainfall for the period from 1981 to 2010 for Ballynahinch rainfall station was utilised in the assessment of runoff and pluvial effects associated with the Proposed Project.

In addition, Section 9.3.2 of the EIAR presents rainfall return periods for the project site. Rainfall return periods were sourced from Met Éireann (www.met.ie) which uses a depth duration frequency model to estimate point rainfall frequencies for a range of durations for any location in Ireland. Site-specific rainfall return periods specific to the project site are presented in the EIAR.

Nevertheless, we also recognise that the standard average annual rainfall (SAAR) of 1,211mm/yr referenced in the EIAR underestimates the actual rainfall at the project site. Met Éireann now provide a grid of SAAR for the entire country for the period of 1991 to 2020. Based on these site-specific modelled rainfall values, the SAAR at the project site ranges from 2,283 to 2,489mm/year, with an average of 2,429mm/yr.

An updated water balance is provided below, assuming an average annual rainfall of 2,429mm/yr.

$$\text{Effective rainfall (ER)} = \text{SAAR} - \text{AE}$$

$$= 2{,}429\text{mm/yr} - 387\text{mm/yr}$$

$$\text{ER} = 2{,}042\text{mm/yr}$$

Groundwater recharge coefficient estimates from the GSI (www.gsi.ie) vary across the project site from 4% where the project site is overlain by peat to 85% where bedrock outcrop is present. Due to the extensive coverage of blanket peat at the site, the low permeability of the bedrock aquifers and the sloping nature of the topography, a recharge coefficient of 10% is taken for the project site. Based on this coefficient, an estimate of 204.2mm/year average annual recharge is given for the project site. This means that the hydrology of the project site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the project site are estimated to be 204.2mm/yr and 1837.8mm/yr respectively.

SAAR and Implications for Peat Stability Assessment

The rainfall depths referenced in Chapter 9 of the EIAR has no direct implications for the Peat Stability Risk Assessment (PSRA) completed for the Proposed Project. The completed PSRA does not use standard annual average rainfall (SAAR) as an input parameter in the peat stability calculations. The

slope stability calculations are completed assuming a fully saturated peat profile (i.e. the water table is conservatively assumed to be at ground level), and a surcharge of 10kPa (*i.e.* an additional surface load) is applied to each analysis point. This surcharge is equivalent to 1m of stored peat or 1m of water (simulated) above ground level (given the similar density of peat and water). Therefore, the peat stability risk assessment accounts for additional water load (from seasonal and temporal rainfall events) in this manner, and not directly by use of the SAAR rainfall value for the site.

4.4 Part (d)

The application site including post operational needs to be fully assessed against the increased flood risk posed by the change of use of the land, including the changes to the management of the existing water courses and drainage flows within the application site. The FRA should examine the additional loading to the existing surface water features within the site, the ability of each harvest block to accommodate the predicted rainfall, including saturation rates of the peat, the structural capacity of the proposed dams (at the various locations) to accommodate predicted extreme pluvial events, as well as assessing the adequacy of the proposed silt traps and fencing and any additional mitigation measures which may be required.

4.4.1 Response to Part (d)

Hydro Environmental Services (HES) have provided a response to this item within the submitted **Geological, Hydrological & Hydrogeological Responses to Submissions** document enclosed in Appendix 5. Item 3(d) is responded to as follows:

Flood Risk

The purpose of the Proposed Project is to restore and rehabilitate the project site to Atlantic Bog and heathland habitats.

The project site was planted with coniferous forestry plantations in the 1960s. In order to facilitate the forestry operations at this time, the site was drained by inserting forestry drains, typically mound and ribbon drains, into the peat surface at regular intervals. The effect of this "draining" was that the water table in the peat bog was lowered, with water making its way into the forestry drains which in turn discharged into local watercourses and into Lough Inagh and Derryclare Lough. Following the change in land use at Derryclare to forestry, the Derryclare site retained less water than in its original undrained "natural" state. Furthermore, due to the current imposed forestry drainage system the local watercourses (*i.e.* mountain streams) almost certainly respond more rapidly to rainfall events and almost certainly have flashier hydrographs than would normally occurr in its natural state.

With respect to the hydrological and hydrogeological environment, the overall aim of the Proposed Project is to restore the hydrological regime prior to afforestation as much as practicable to its original state. Restoration and rehabilitation will place the existing peatland environments on a path towards naturally functioning peatlands.

Improvements in runoff volumes can be achieved through rehabilitation and restoration. The plans involve the rewetting of the drained peatlands (by increasing the saturation rates of the peat) through restoration works such as drain blocking, surface smoothing and re-profiling. These works will reduce surface water runoff from each harvest block, and on a wider scale increase the water storage capacity of the overall site. This will result in the hydrograph of nearby watercourses being less flashy, with a more gradual response to rainfall events. Therefore, these measures will reduce and delay the hydrograph peak on each of the local watercourses, and also reduce the flood risk downstream of the site.

Furthermore, irrespective of the volumes of runoff from the project site, all runoff from the site enters either Lough Inagh or Derryclare Lough. These are a series of large, interlinked lakes, and they have a

huge ability to buffer rainfall runoff. As a result, the potential for an increase in downstream flood risk as a result of the proposed project is negligible.

Structural Capacity of Dams

As detailed in Chapter 4 of the submitted EIAR, the slopes and sizes of the drains will be the deciding factors in selecting the dam material types and also the spacing of the dams. The selection of dam materials will be based on the existing best practice bog restoration techniques and guidelines. Peat dams will only be used on shallow slopes (<6° gradient), with plastic dams being used on steeper slopes. The spacing of dams will also improve the structural capacity of the dam by decreasing the loading of individual dams. The dam spacing will be between 7.5 m and 20 m on flatter ground, however, the frequency of dams will increase to between 5 m and 7 m on steeper sloping ground.

Best practice for dams is outlined in the submitted Forest to Bog best practice document included in Appendix 6 of this report and will be followed for this project.

The construction of dams and the materials used will be based on best practice bog restoration techniques and guidelines. This includes restricting all dam construction to shallow slopes (<6° gradient). On the steeper gradients other techniques will be used such as complete infilling of drains, reprofiling or windrowing. To ensure the best and most appropriate restoration technique is selected, that best suits the site conditions, a decision support tool was developed (see Appendix 1). This tool sets the operational parameters for each restoration technique using 5 key site factors, namely peat stability factor of safety, slope, peat depth, soil type (blanket bog or heath) and stump size. As slope is a key input, this tool ensures that all dams will be installed in appropriate, specified locations across the site.

Adequacy of Silt Traps and Silt Fencing

As detailed in the EIAR, silt fences and silt traps will be installed at the outfalls of existing drains before the commencement of any works. In areas that are particularly susceptible to erosion (*i.e.* steeper slopes), it may be required to install double or triple silt fences. These measures follow all existing best practices and guidelines in relation to felling and bog restoration and will ensure the protection of downstream surface water quality.

With respect to the adequacy of these features, silt traps and silt fences are widely used during peatland restoration for the prevention of suspended solids entrainment in runoff. Silt traps/fences are incorporated into the Construction Phase for water quality protection only, and they serve no function in long term water attenuation within the Rehabilitation Plan. During the Construction Phase silt traps/fences will be regularly inspected to ensure that they are functional and turbidity will be measured downgradient of the works areas. Necessary repairs and maintenance will be completed when required following inspections. In the event that elevated turbidity concentrations are recorded downstream, all upstream silt traps and silt fences will be inspected and no additional works will be completed until necessary repairs are made and downstream turbidity concentrations return to baseline levels.

Furthermore, the restoration plan also includes an extensive plan to install an intensive network of new protective buffer zones along all watercourses and the lakes (see restoration maps in the enclosed **FI Drawing Booklet**). These buffer zones will vary in width from 30 to 40m and these will be the most effective and permanent silt control measure.

No additional mitigation measures are deemed necessary.

4.5 Part (e)

The inhouse nature of site selection (other stakeholders are not listed) is limited. Justification demonstrating the precautionary approach was applied to site selection criteria in light of the many challenges of the Derryclare site including high status rivers, surrounded by European Sites, important

salmonoid lake, steep topography and extensive variability in peat depth should be adequately demonstrated in the EIAR. Please address this concern also referring to alternative conservation and rewetting solutions including solutions on lower slopes.

4.5.1 Response to Part (e)

The site selection process was described within Section 2 of the submitted Planning Report prepared by MKO. The site selection process was comprehensive and thorough, looking at all of Coillte's sites which were suitable as restoration projects. Appendix 1 of the submitted Planning report Section 2 of the planning report states the following:

"The proposed Derryclare Wild Western Peatland Project is part of Coillte Nature's ongoing Wild Western Peatlands Project. The objective of the Wild Western Peatlands Project is to restore and rehabilitate approximately 2,100ha of Atlantic blanket bog and wet heath along the western seaboard of Ireland - that is currently planted with poorly performing inappropriate spruce and pine forests - to enhance biodiversity and improve carbon storage in the landscape. The area was planted to create rural employment at a time when the importance of peatlands for climate and biodiversity reasons was not well understood. The project presents an opportunity to restore a very rare and unique area of biodiversity".

The key objective of the WWP project is to restore and rehabilitate areas of Atlantic blanket bog and heathland that are currently planted with inappropriate lodgepole pine and Sitka spruce forests. The WWP project is funded by DAFM, as it recognises that some past afforestation on blanket peatlands has been inappropriate and not suitable for forestry. Today, forestry on unenclosed blanket bog is no longer regarded as sustainable and it is also no longer grant aided. Many of the existing forests on blanket bogs that were planted in the past would not be eligible for grant aid today. Many of these plantations are struggling to survive and are now recognised as inappropriate due to the loss of biodiversity, negative impact on water quality, net carbon and methane losses, negative impact on visual landscape and low timber production potential. These forests are both economically and environmentally unsustainable. The benefits of repurposing these forests far outweighs continuing with plantation forests under a clearfell rotation system. These state-owned afforested peatlands are currently the target of a number of important Government action plans, to which this project seeks to respond. The NPWS's Prioritised Action Framework for Ireland 2014-2020 gives an objective to implement "measures to better integrate modified forest landscapes with Natura 2000, with the aim of restoring extent and connectivity of Annex 1 habitats and habitats for species." The National Peatlands Strategy (2018) calls for the present management of state-owned peatland to be "evaluated and alternative management options aimed at increasing the delivery of all the ecosystem services of naturally functioning peatlands" to be considered, with special responsibility for Coillte to continue to "show leadership in responsible management, rehabilitation and restoration of peatlands". Furthermore, the National Biodiversity Action Plan (2017-2021) also calls for "maximised positive outcomes for biodiversity and ecosystem services and restoration of areas impacted by inappropriate forestry".

Central to the Derryclare restoration plan is habitat restoration, where Coillte aim to continue the Forest to Bog restoration started over a decade ago under the EU LIFE programme. Environmental and social concerns are central to the restoration plan, and these have been extensively evaluated by consultant experts to ensure the plan is consistent with enhancing biodiversity, protecting water quality, enhancing the surrounding statutory designated areas, providing a wide range of ecosystem services, creating the conditions to facilitate the return to blanket bog, and ensuring that the visual landscape is improved in line with the iconic nature of the location.

Coillte has identified 30,000 ha of its estate as potentially suitable for Forest to Bog restoration. The initial site selection criteria for the WWP, outlined below, was applied to a range of sites on the Coillte estate. A scoring system (Table 1) was devised that allowed sites to be scored, evaluated, and shortlisted. Following this site selection, 5 sites were shortlisted (Figure 4). Please refer to Appendix 1 of the submitted Planning Report for further detail on the comprehensive process undertaken by Coillte

Teoranta when selecting the most appropriate site for the pilot project. The criteria included the following.

Criteria for Site Selection:

1. The key driver to site selection will be to optimise the biodiversity, water quality and climate mitigation attributes in areas impacted by inappropriate forestry. Priority will be given to sites containing blanket bog and heathland that are considered suitable for restoration on ecological grounds, with the aim of restoring extent and connectivity of Annex 1 habitats. Proximity and hydrological connection to SACs with blanket bog and wet heath habitats is a key attribute. The presence of associated Annex 2 designated floral and faunal species are also important criteria.
2. Blanket bog will be given priority especially sites where there is a significant proportion of deep peat >50cm to increase the delivery of all the ecosystem services of naturally functioning peatlands – rehabilitation and restoration of peatlands.
3. Enhance water quality protection particularly in areas with freshwater pearl mussel (FWPM), salmonid catchments and where forestry is a key pressure in high water quality catchments.
4. Local partnership potential with involvement of statutory and local stakeholders and community is an important factor in site selection.
5. Minimise release of carbon from peat soils and strive to maintain a positive carbon balance. Where the site is not a priority for restoration and is likely to support sufficient tree growth to compensate for greenhouse gas losses from the soil (understood to be YC8 or above for Sitka spruce), they will be retained as resilient environmental mixed woodlands.
6. Sites of low timber production capability, with the majority of conifers growing at yield class 12 or below will be targeted for removal and restored to bog and/or wet heath.
7. Poor landscape design and visual appeal of forest particularly in highly sensitive and scenic landscapes will be a consideration re site selection criteria.

Table 1: The scoring system used to rank sites for bog restoration.

Criteria	Score (1 low; 10 high)
Priority for Annex 1 blanket bog habitat restoration on ecological grounds (within or adjacent to SAC) and associated wet heath, typically <YC10. High proportion of deep peat >50cm depth. Current Bioclass score 1 or 2.	10
Hydrological connection to adjacent SAC with Annex 1 blanket bog and wet heath. Associated Annex 2 floral and faunal species	8
Water quality protection - Highly sensitive water catchment (FWPM Top 8 > FWPM, salmonid catchment, drinking water)	6
Local partnership potential	5
Maintain positive carbon balance (<YC8 SS or YC6 LP). Retaining plantations above YC10 (SS) to maintain positive carbon balance	5
Low timber production capabilities	3

Landscape enhancement in sensitive and scenic landscapes	3
Total score	40

Figure 6: Wild Western Peatlands Project Shortlisted Sites (Source: Stakeholder Information Document)

During the WPP site selection process, five different Coillte sites were shortlisted during the consultation process. Figure 4 shows the shortlisted selected sites. This information is also included in Appendix 1 of the submitted Planning Report. To evaluate the shortlisted sites, further considerations made concerning: a) the proportion of 1st rotation crops (where best practice suggest restoration is more successful on 1st rotation crops, as opposed 2nd rotation crops, b) local sensitivities (Derryclare Nature Reserve was adjacent and provided an opportunity to enhance this reserve) and c) the presence of any significant threats or risks such as invasive species, deer, grazing, legal constraints etc., and d) is the site representative of the Forest to bog sites on the Coillte estate. Following this evaluation, Derryclare was selected.

Peatland restoration is one of the primary nature-based solution to the biodiversity and climate crisis in Ireland, as blanket bogs accumulate and store carbon as well as possessing unique habitats with high biodiversity value. Internationally, the general consensus is that bog restoration should occur where possible. These peatlands also store and filter water, playing a vital role in the management of water

catchments. Careful management of these areas is therefore crucial for climate action. The Wild Western Peatlands Project has been informed by precedent bog restoration projects in Ireland, Northern Ireland and Scotland. In the past decade, Coillte have been to the forefront in bog restoration, having project managed a total of 1,988 ha and 571 ha of blanket and raised bog restoration respectively, under the EU LIFE programme. Coillte is ideally placed and experienced to deliver large Forest to bog restoration projects at scale, in line with governmental policy. Coillte's own policy is to restore 30,000 ha from Forest to bog by 2050. One of the objectives of participating in the EU LIFE projects was to gain experience and develop knowledge to facilitate subsequent restoration projects, all of which have been built into the Derryclare restoration plan. The principles of environmental impact assessment and risk management have been applied in the Derryclare plan and the potential interactions between restoration activities and standard receptors are comprehensively detailed in the EIAR.

If the proposed project were not to proceed, the current land-use, i.e., plantation conifer forestry, at the site will continue. The opportunity to restore and rehabilitate the site to blanket bog and wet heath would be lost, along with the opportunity to better align the landscape of the Proposed Development Site with the surrounding moorland landscape character.

We additionally wish to highlight that consultation was undertaken with external stakeholders including environmental NGOs, regulatory bodies, government agencies, community networks and local businesses. As detailed in Section 3.1 of the Planning Report submitted with the application, an online stakeholder event was held as well as numerous stakeholder site visits.

As mentioned above, Coillte has restored 2,559 ha of peatlands over the last decade and the experience gained and the best practices were included in the "Forest to bog" best practice guidelines developed for this project (see Appendix 6). This detailed report also compiles all know best practices used in Ireland and Scotland to identify the best restoration practices that can be used by practitioners. In developing this report, Coillte linked up with Forest and Land Scotland (FLS) in Scotland to evaluate their advancements made in bog restoration techniques, which they have been using, at scale, for almost a decade. These alternative conservation and rewetting solutions include site reprofiling, cross tracking and stump flipping. The evaluation included joint site visits in Scotland and Ireland and it provided a comprehensive review of the techniques, machine specifications, operational requirements and safeguards needed to adopt these new techniques. Forest and Land Scotland (FLS) together with NatureScot have documented these techniques on their websites for the wider peatland restoration community to view. In Ireland to date, large scale Forest to bog peatland restoration projects typically felled and removed the trees, windrowed the sites, and blocked the drains. Today, these sites have restored with mixed success, some restoring fully and others requiring follow up maintenance to remove reseeding conifers and invasives. In Scotland, the Forest and Land Scotland (FLS) alternative rewetting solutions are seen as an enhancement of known restoration techniques, that provide better and speedier restoration results, by been more successful in raising the water table and making the conditions less favourable for reseeding and invasives, and more favourable for the bogland species to colonise the site. The peatlands in Scotland are similar to Ireland and these promising new techniques should be trailed in Ireland in the Derryclare pilot site.

In developing the Derryclare restoration plan, it was decided to adopt the learnings from Forest and Land Scotland (FLS), and a site visit was held on site with Forest and Land Scotland (FLS) as these alternative conservation and rewetting solutions are new to Ireland, it was important to build in certain safeguards into the plan, especially concerning water quality and peat stability. This involved planning the entire site on the assumption that the most disruptive restoration method would be used across the entire site and proportional mitigations were then prescribed across the entire site. This ensures that all alternative conservation and rewetting solutions would be suitably mitigated. The full range of mitigations are included in the EIAR and CEMP, but they include for example, a detailed hydrological monitoring plan, including live monitoring during operations, applying a peat stability factor of safety, creation of buffer zones along all water courses and lakes of between 30 to 40m, identification of all active drainage from the entire site, and matching the prescribed restoration method to the site conditions.

Matching the prescribed restoration method to the site conditions was an important consideration. This was achieved by developing the "Decision matrix". The decision matrix is a tool that can be used to select the restoration option most suited to the site, based on the site conditions. It also allows you to identify what restoration options are not suitable for the site. The decision matrix requires key site data, and it allows the user to prescribe restoration options appropriate for the underlying site conditions. These site conditions include the peat slide factor of safety, slope, peat depth, soil type (blanket bog or heath) and stump size. The decision matrix is a table that lists all the restoration options (21 permutations) in order of their expected ground disturbance, where option 1 is expected to have the least ground disturbance and option 21 the greatest. The restoration options are also listed in order of their expected speed of restoration, where more intensive restoration methods are assumed to produce speedier restoration (based on the best available literature). The purpose of the decision matrix is to find the restoration option that will cause the least disturbance and deliver the best restoration results and help guide the planner in selecting the best restoration option for the site. It is important to note that there are 21 possible restoration options, except for one option (17), which refers to scrap mounding, where the option is to replant with pioneer native woodland. Options 1 to 15 refer to the restoration options currently used in Ireland, and options 16 to 21 (excluding 17) refer to the Forest and Land Scotland (FLS) conservation and rewetting solutions. This evidence-based approach using site factors ensures that the restoration option selected matches the site conditions. In Derryclare, the decision matrix resulted in approximately 60% of the site been selected for the restoration options currently used in Ireland, and 40% selected for the newer Forest and Land Scotland (FLS) conservation and rewetting solutions (see restoration maps in the Further Information Drawing Booklet).

4.6 Part (f)

The submitted documentation makes no mention of Himalayan Balsalm in the invasive species report, nor are the areas of identified invasive species mapped including bush size and density across the application site, showing their proximity to watercourse and/or potential spreading by the proposed works in each harvest block/sub-unit.

4.6.1 Response to Part (f)

Invasive species can cover a range of plant species, however, in Derryclare, following a detailed ecological assessment (Ecological Report, Hunt, 2021), the main pressure from invasive species was identified to come from rhododendron ponticum. No other invasives (other than conifer reseeding) was observed. Two separate approaches were taken to assess the baseline infestation level, namely:

a. The ecologist walk-over survey, using the DAFOR scale.
b. Detailed sampling survey, using a 10m transect method.

During the ecological assessment of the site, the ecologist conducted a walk-over survey to identify the invasive species present and described the level of infestation, using the standard DAFOR scale (described below). This is a standard approach to assess the level of infestation of invasive species in a forestry setting. This method uses the existing forestry sub compartment boundaries and provides a generic textual description of the level of infestation based on walk over observations. The descriptions are D for Dominant, A for Abundant, F for Frequent, O for Occasional and R for Rare. This data was then used to produce a heat map, which gives a general estimation of the level of infestation over a wide area. This approach provides sufficient data to inform an operational plan to manage invasives. The results are presented in Figure 7 Map 1 below.

The DAFOR scale

PRESENT used where Rhododendron is considered likely to be present but not sufficiently walked to rate following DAFOR as below:

D for Dominant: In practice you will rarely, if ever use this. To score **D**, a species would have to be the most common plant by far, in well over three quarters of the square. It is possible that in a square that is entirely conifer plantation, that Sitka spruce Picea sitchensis might score **D**; or in a square that is almost all occupied by highly improved grassland, perennial rye-grass Lolium perenne might sometimes score **D**, but even these two scenarios are unlikely most of the time. If you are not sure if something should score **D** or **A**, give it **A**.

A for Abundant: Only use **A** if the plant was really very common in many parts of the square. For most species this would mean that there were thousands of individual plants present. In most squares, few species will score as highly as **A** and in quite a few squares there will be no species that score that highly. If you are not sure if something should score **A** or **F**, give it **F**.

F for Frequent: Use **F** if you found the plant in several places in the square and there was usually more than just **A** few individuals in each of these places. You could also use **F** if the plant was only present in one part of the square but was very common in that part, with many individuals and covered **A** substantial area (e.g. between one eight and one quarter of the area of the whole square). If you are not sure if something should score **F** or **O**, give it **O**.

O for Occasional: Use **O** for species that occur in several places in the square, but whose populations are usually not very big. You would also use **O** for species that are very common in one bit of habitat within the square that occupied just a small area (e.g less than one eight of the area of the whole square). You will use **O** for many species in most squares. If you are not sure if something should score **O** or **R**, give it **R**.

R for Rare: Use **R** for any species that occur as a small number of individuals in the square. This small number of individuals may be located in one place in the square, or scattered over several different locations within the square. In many squares **R** is likely to be the score that most species get. If you are not sure if something should score **O** or **R**, give it **R**.

For those of you who are used to using the DAFOR scale, please stick to the basic 5 scores only and avoid entries like **O/F** (occasional to frequent) and particularly please avoid using the prefix 'L' as in **LF** (locally frequent).

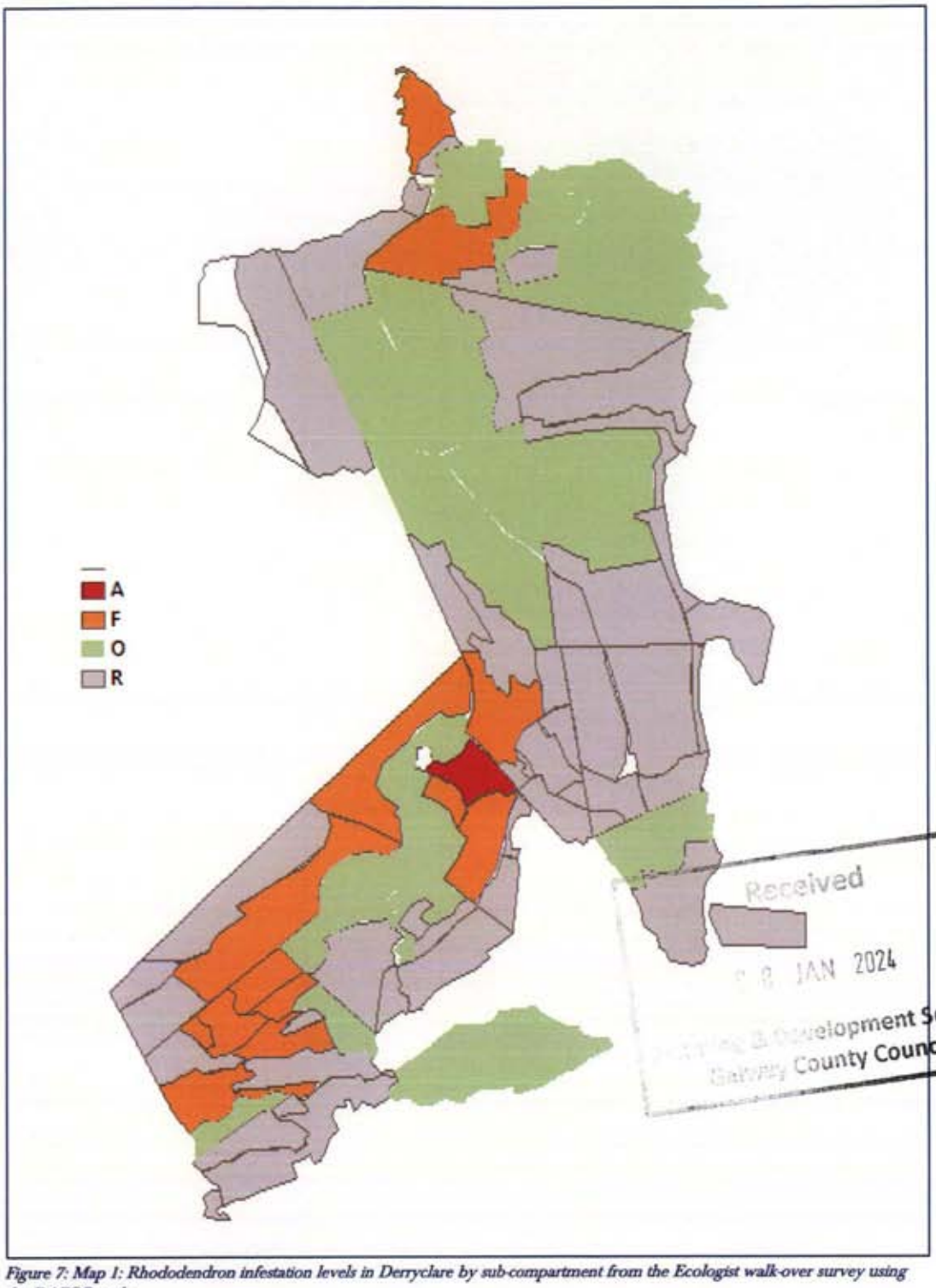


Figure 7: Map 1: Rhododendron infestation levels in Derryclare by sub-compartment from the Ecologist walk-over survey using the DAFOR scale.

However, one limitation of the DAFOR method is that it does not provide the exact locations of the individual rhododendron plants and to provide this, a more detailed survey was undertaken. The intensive methodology used by the NPWS (under the Kerry LIFE project) was initially considered, and it was decided that this approach was too intensive and impractical to adopt in Derryclare. A sampling approach was decided as the best fit for Derryclare, as it addressed the limitations of the DAFOR method, and it was less intensive and more practical to implement than the method used in the Kerry

LIFE project. This sampling approach collected the essential detail required and ensured the process could be easily replicated in future years to monitor progress. As the decision was made for annual interventions on site, during the lifetime of the project, the sampling method was deemed to be the best fit. This sampling method is described here as the '10m transect method'. Please refer to Appendix 6 for observations made when using this sampling method.

The 10m transect method was adopted for Derryclare, to establish a baseline for future monitoring. The 10m transect method is a sampling method that involves a work gang walking a transect of 10m grids throughout the whole property and taking observations at each intersection point on the grid. In Derryclare, 3 people walked through the forest in a line 10m apart from each other. At every 10m intervals the line stopped, and an assessment was made on the level of infestation within a 5m radius from their location. All data was recorded, and geo referenced using GPS Trimble devises, using the ArcGIS Field Maps application. If no rhododendron was present, no data was collected. Where rhododendron was present, a point was recorded with a comment to describe the circumference of the bush(es) sizes (see Table 1). The walk over survey also encountered sub-compartments that were fully infested with rhododendron, and these were noted during the field work and added in as polygons on the baseline map. This field data was then mapped in ArcMap 10.6.1 to form the baseline level of rhododendron infestation in Derryclare (see Map 2).

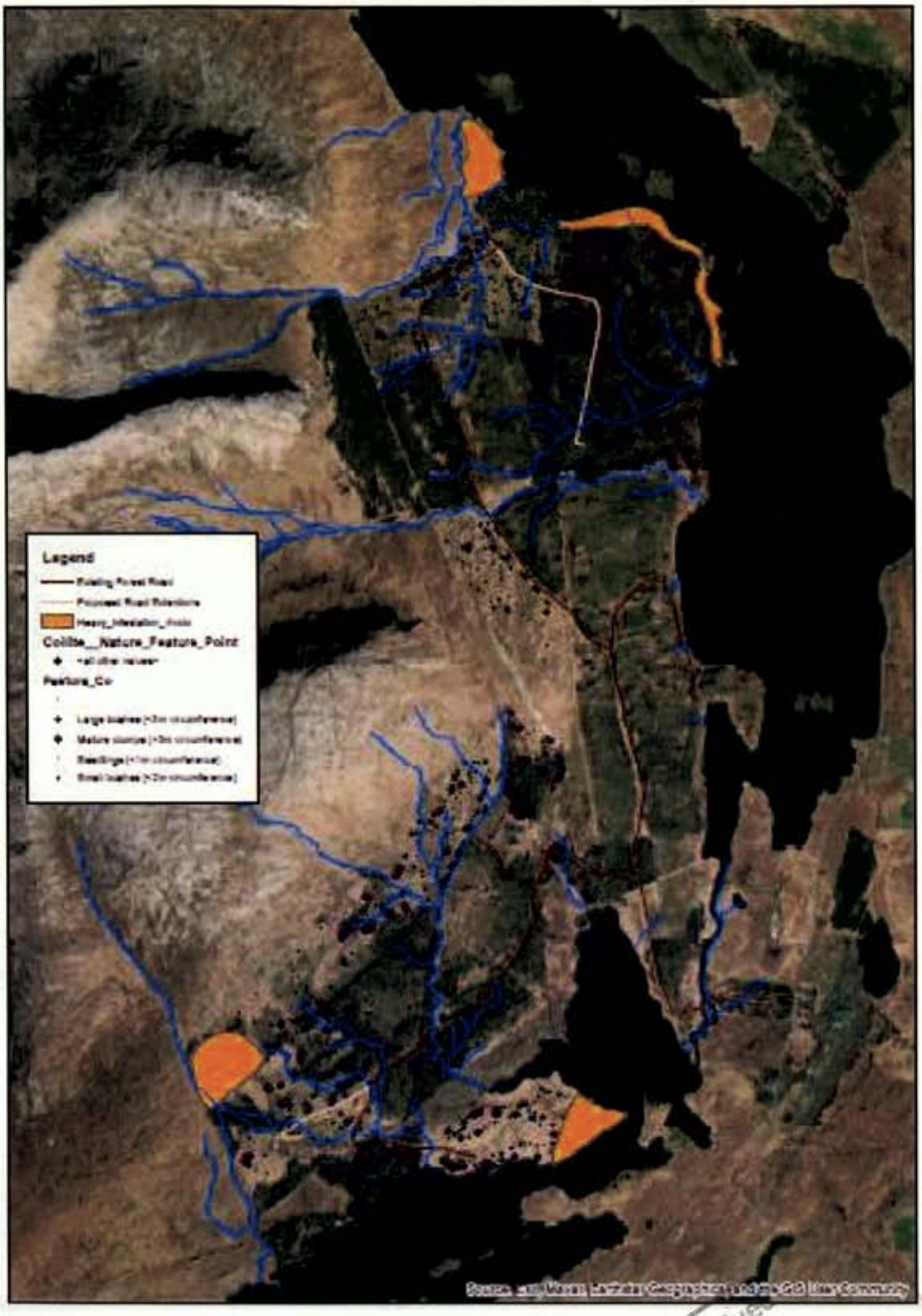
Table 2: Comments used in the ArcGIS Field maps app to describe the infestation.

Description	Explanation	Comment
Rhodo1	Bush size circumference 1m or less	Mostly seedlings (pre flowering)
Rhodo2	Bush size circumference 2m or less	Small bush(es)
Rhodo3	Bush size circumference 3m or less	Larger bush(es)
Rhodo4	Bush size circumference over 3m	Mature clumps

This sampling method has the following main advantages:

- It allows for a relatively quick and accurate field assessment to be made.
- the exact locations within +/- 5m are provided.
- it provides details on the different stages of maturity of the infestation.
- It can provide the exact locations and a more general heat map.

- It is practical and cost effective (3 weeks work for a gang of 3 people to cover 500 ha).
- The data can be used as the basis for an operational work plan.



Invasive species management plan

The baseline data was used to inform and develop the invasive species management plan summarised in Table 3 below. The baseline data collection has shown the level of rhododendron ponticum infestation to be widespread throughout the property, with a mixture of plant sizes and ages. Therefore, the main invasive species threat in Derryclare is from Rhododendron ponticum. There are many papers on rhododendron control (Higgins, (2008) Cross, (1973) Rotherham, (1983). Edwards, (2006)) and it is well understood. Their control is essential and often problematic and successful removal requires continual vigilance and many costly interventions. Regeneration of lodgepole pine seedings is also a known issue with peatland restoration in Ireland and it can be expected in Derryclare. This is typically associated with tree removal of mature crops with heavy cone production on sites that were ploughed. The cones of lodgepole pine and their seed can remain viable for many years, and regeneration on restored sites is most often found where the original plough ribbon is left intact, offering slightly drier conditions that favour seedling regeneration. According to Campbell et al., (2019) conifer regeneration can be dealt with by surface smoothing methods, but otherwise must be removed manually. In Scotland, it was observed that carrying out the restoration work immediately post felling and raising the water table as soon as possible, is an effective way to limit conifer and invasive species regeneration by creating unfavourable conditions for seeding germination. Where seedlings regenerate, the optimum time to remove them is when they are young enough to be pulled up out of the ground or cut with a garden lopper or equivalent. Allowing the seedlings to grow any older will require a chainsaw intervention.

As restoration works proceed and ground disturbance increases, the latent potential for rhododendron infestation and conifer reseeding becomes even more significant. Therefore, owing to the scale of the area involved, an **annual property wide intervention is planned every year**, and this can be very effective as the restoration plan is staggered over several years. The methodology used will be the same one adopted by a recent NPWS study done in the adjoining forest in Kylemore. This approach works well in Connemara and is suited to a restoration programme that allows treated rhododendron plants to remain standing for a few years, before been felled to waste or windrowed. The methodology involves using a chainsaw to nick the stems of mature plants followed immediately with a spot spray of a dilute chemical. Allowing the plant to remain standing, allows the chemical to translocate through the whole plant, resulting is a higher kill rate. Owing to the multiple stems associated with rhododendron, some stems are likely to be missed, so a second, or even third pass is required each year to ensure the plant is fully killed. It is expected that repeating this every year will ensure that when it comes to felling the forest, the understory rhododendron will be dead, and it can be driven over and/or windrowed. This method also 'spot sprays' all the emerging seedlings, especially those in flower. Once the forest is felled and the restoration completed, either spot spraying, or preferably, hand removal of emerging seedlings can be undertaken, to deal with residual rhododendron. The aim is to ensure all restored areas are entirely free from rhododendron and monitoring of these areas will provide a quick visual guide regarding the progress of the rhododendron treatment programme.

It is also noted that the source of seed for rhododendron infestation is off-site on adjacent private property. Treating the rhododendron on private lands is outside the scope of this project. However, this situation will be monitored and if an opportunity arises, co-operation will be offered to assist with rhododendron removal on adjacent private lands. Consequently, within Derryclare property, rhododendron will need to be continuously managed.

Management of conifer reseeding will occur alongside the management plan for rhododendron. In this case each restored site will be monitored for all seedling regeneration and the regeneration removed as part of the annual property wide rhododendron work. Managing it this way will ensure that the issue is addressed each year as reseeded plants are easily managed when small.

The plan to manage Rhododendron ponticum and conifer seedling regeneration in Derryclare involves the following.

1. Establish the baseline level of infestation of rhododendron ponticum.
2. Schedule annual property wide interventions during the lifetime of the project.
3. Monitor progress.
4. Use local community groups for field work.

An overview of the planned treatment schedule for managing rhododendron and conifer reseeding is detailed in Table 3 below.

Table 3: The planned schedule for managing rhododendron in the Derryclare bog restoration programme.

Year	Bog restoration schedule	Rhododendron treatment
0	Secure planning permission and felling licences.	• Property wide treatment of all mature rhododendron plants and seedlings in flower.
1	Year 1 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Monitor emerging seedlings from recently restored areas.
2	Year 2 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower • Pull/threat emerging seedlings from recently felled areas. • Monitor emerging seedlings from recently restored areas.
3	Year 3 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from year 1 & 2 felled areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline.
4 to 7	Year 4 to 7 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas.

		• Monitor emerging seedlings from recently restored
8	Year 8 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline. • Post year 8, monitor site every 3 years and carry out works, if required.

Please see enclosed Appendix 7 **Invasive Species Management Plan Observations** for further details.

4.7 Part (g)

There is an absence of detail in relation to the assessment of potential operational stage impacts from invasive species, re-seeding conifers and grazing animals, public usage and any proposed management to deal with these factors.

4.7.1 Response to Part (g)

The operational detail planned for Derryclare is provided below.

These plans deal with ongoing management and general maintenance issues that will be managed over the entirety of the project implementation stage. This plan covers 5 key areas, namely,

- Invasive species management plan
- Hydrological monitoring
- Grazing management plan (including deer management).
- Fire plan.
- General maintenance plan (including public usage).

Invasive species management plan

Invasive species can cover a range of plant species, however, in Derryclare, following a detailed ecological assessment, the main pressure from invasive species was identified to come from rhododendron ponticum and conifer reseeding with mainly lodgepole pine. Regeneration of lodgepole pine seedings is also a known issue with peatland restoration in Ireland and it must also be managed. The operational plan to deal with invasives involves annual interventions over the lifetime of the project and it is described fully in Section 3.6.1 above.

Hydrological monitoring

There is a detailed and robust hydrological plan that will monitor surface water flow volumes, water table depths and surface water quality monitoring using a variety of techniques, including, automatic sondes, monthly grab sampling, operational water sampling, annual biological monitoring, water level flumes and turbidity monitoring.

Grazing management plan (including deer management)

Grazing pressures from mainly sheep, livestock and deer can lead to dominance by Molinia caerulea and Eriophorum vaginatum (Shaw & Wheeler, 1994) with a decline in Sphagnum species (Lindsay, 2010). The main grazing pressure in Derryclare is from sheep, deer and occasionally cattle. Browsing by hares is also an issue especially regarding woodland development and planned new pioneer woodland establishment. The plan to deal with this is described below.

Fire plan

Fires on blanket bogs tend to burn only the surface vegetation and drier features such as hummocks but leave much of the wet surface relatively intact. After infrequent fire events there is generally sufficient time for the bog surface vegetation to recover, but for more frequent and severe fires (where the fire burns under the surface) it can take more than 50 years for Sphagnum plants to return where burning results in a bare peat surface (Evans & Warburton, 2007). Derryclare is an area historically at risk from wildfires and as a result, this pressure must be managed. The plan to deal with this described below.

General maintenance plan (including public usage)

General maintenance is a catch all that refers to addressing issues as they arise and they can include a wide variety of tasks such as road maintenance, silt trap and dam inspections and repairs, dumping, vandalism, signage erection and repair, and dealing with the public and local requests arising from consultations. For Derryclare the most important general maintenance is expected to be silt trap and dam inspections and maintenance, keeping the main access road in good repair and issues with the public such as recreational usage, dumping and vandalism. The plan to deal with this described below.

Grazing management plan (including deer management)

Summary

The grazing pressure in Derryclare arises from livestock (mostly sheep) and deer. The maintenance plan initially involves the construction of an external sheep fence to ensure that the entire property is fenced off and secured. All livestock will be removed before the fence is completed. An internal deer fence will be erected to fence off the area where pioneer native woodland will be established. Browsing by hares on broadleaves will be monitored and tubes used if browsing is observed. The site will be monitored for trespass and appropriate action taken where required, up to and including impounding. Regular checks will be made to the fence-lines to ensure they remain intact, and any breaches or faults will be repaired as a matter of urgency. Coillte have a process for impounding livestock and this process will be followed if required. Deer culling will not be used in the grazing maintenance plan as Coillte do not own the shooting rights on site. Any deer culling will only occur in agreement with the relevant stakeholders and within the law. To date, there are no immediate plans to carry out any deer culls. However, in the event that it is possible to secure agreement with the adjacent landowners and Sporting rights owner, then culling will occur.

Table 4: The grazing management plan by year during the restoration works.

Years	Restoration plan	Grazing plan
0 (2023)	Secure planning permission and felling licences.	• Complete external sheep fence on external boundary. • Exclude livestock from all site. • Monitor all site for trespass.

1 (2024)	Bog restoration site.	• Check sheep fence line. • Monitor all site for trespass.
2 (2025)	Pioneer native woodland sites.	• Erect deer fence stage 1. • Check sheep fence line. • Monitor all site for trespass and browsing.
3 (2026)	Pioneer native woodland sites.	• Erect deer fence stage 2. • Check sheep fence line. • Monitor all site for trespass and browsing.
4 to 8	Bog restoration sites.	• Check deer fence line. • Check sheep fence line. • Monitor all site for trespass.

General maintenance plan (including public usage)

Summary of the plan

General maintenance is a catch all that refers to addressing outstanding issues, other than invasive species, deer and livestock grazing, and fire, which are all detailed separately. General maintenance on this plan includes a wide variety of tasks such as road maintenance, silt trap and dam inspections and repairs, public usage, dumping, vandalism, erection, and repair of signage, dealing with the public and local requests arising from consultations. For Derryclare the most important general maintenance is expected to be silt trap and dam inspections and maintenance, keeping the main access road in good repair and dealing with issues with the general public such as dumping and vandalism.

General maintenance typically falls under the following headings, public usage/recreation, forest roads, operational maintenance, and anti-social activity. Regarding public usage/recreation, Coillte have an open forest policy which allows permissive access on foot to individual walkers. Across the Coillte estate an estimated 18 million visits to Coillte forests occur every year. This policy will remain in place for Derryclare. Currently, access is obtained by parking at the main entrance and entering the site on foot. This will not change during project duration, though public access to works areas will be restricted during forestry operations in the interests of health and safety. This is inline with current Coillte policy. Public usage will be welcomed and facilitated with better car parking facilities at the main entrance and better signage. The forest roads are essential for site access for both operations and the general public. The forest roads will be maintained during operations. Operational maintenance during the restoration works refers to maintaining the restoration works and ensuring they remain effective. This includes silt traps, constructed dams, leaky dams, silt curtains and sonde telemetry. Other maintenance is associated with anti-social activity, such as dumping and vandalism. General maintenance is expected to be carried out on an ongoing basis to ensure that the main items listed in Table 5 are maintained annually and not allowed to deteriorate.

Table 5: Main items to manage in the general maintenance plan and the required standard

No	Description	Required standard
1	Main forest road.	Maintain good surface dressing, free from potholes.
2	Roadside drains.	Allow to revegetate.
3	Roadside silt traps.	Effective. Water flowing. Not silted up.
4	Roadside dams.	Effective. Water flowing. Not silted up
5	Silt traps in buffer zones.	Effective. Water flowing. Not silted up.
6	Leaky dams in buffer zones.	Effective. Water flowing. Not silted up
7	Dams in buffer zones.	Effective. Water not flowing.
8	Silt traps in restored areas.	Effective. Water flowing. Not silted up.
9	Dams in restored areas.	Effective. Water not flowing.
10	Silt curtains.	Effective and securely in place.
11	Signage.	In good condition, not vandalised.
12	Dumping.	None on site. Remove when observed.
13	Vandalised signage.	Repair when observed.
14	Vandalised forest barriers.	Repair when observed.
15	Access for the public.	Adhere to open forest policy.
16	Restrict public access.	Adhere to Health & safety requirements.
17	Sondes.	Securely in place and operating effectively.

Fire plan

The threat from fires is ongoing on an annual basis in Connemara. For most of the year from June to February the threat is low but from March to May, the threat is high. Between the months of March to May the vegetation is at its driest and most prone to fire. In addition, before it became illegal, the traditional practices of "setting fires" coincides with these months, and unfortunately this practice occurs from time to time. For both of these reasons, the threat of fires needs to be taken seriously in Derryclare and managed.

Fires tend to burn only the surface vegetation and drier features such as hummocks but leave much of the wet surface relatively intact. For infrequent fires there is generally sufficient time for the bog surface vegetation to recover, but for more frequent and severe fires, (where the fire burns under the surface) it can take more than 50 years for Sphagnum plants to return where burning has resulted a bare peat surface (Evans & Warburton, 2007).

Derryclare property lies with the Coillte management area called BAU2. The BAU has a designated fire plan and resources to tackle wildfires at Derryclare if they occur, are part of this fire plan. These

resources include a helicopter call out during the fire season, access to trained fire fighters, established access to local fire brigades, experienced volunteers, and access to the full range of firefighting equipment including fire trailers, beaters, PPE, drones, ATVs, pumps and generators.

Please refer to the **Fire Plan** included within Appendix 3 for further details.

4.8 Part (h)

It is noted the Derryclare Nature Reserve could expand and the native woodland proposed is adjacent to this Nature Reserve. Additional detail on the woodland habitats including potential ancient woodland indicator species and soil descriptions for Areas A to D in the main EIAR would be useful to ascertain the viability of native woodland establishment in the identified plots.

4.8.1 Response to Part (h)

As Derryclare Nature Reserve itself is not part of the Blanket Bog/Wet Heath restoration project and is owned by NPWS, it was not surveyed as part of this project. Therefore, we cannot provide additional detail on the woodland habitats or ancient woodland indicator species. However, NPWS data from the Derryclare Site Synopsis (SITE SYNOPSIS (npws.ie)) and Conservation Objective Series (Conservation Objectives.rdl (npws.ie)) indicate that the woodland is of very high conservation value, possibly of Ancient woodland origin. The following text derived from these two sources are relevant:

The site (The Twelve Bens/Garraun Complex SAC Site Code: 002031) contains several small areas of Sessile Oak (Quercus petraea) woodland, a habitat which is particularly rare in Connemara. The best examples on the site of this habitat are found at Kylemore and on the north shore of Derryclare Lough. Derryclare Wood, a Statutory Nature Reserve, has been particularly well studied. It is composed mostly of Sessile Oak, with some Rowan (Sorbus aucuparia), Downy Birch (Betula pubescens) and occasional Ash (Fraxinus excelsior) forming the canopy layer. There is a well-developed lichen and fungus flora present. The fungal parasite, Hemigrapha astericus, a native of Australia and South America, was first recorded in the northern hemisphere from this wood (SITE SYNOPSIS (npws.ie)).

and

As part of the National Survey of Native Woodlands (NSNW), Derryclare Wood (NSNW site code 1601) was surveyed by Perrin et al. (2008). Derryclare Wood is also a statutory Nature Reserve (Statutory Instrument No. 177 of 1980) and is well-studied. Map 4 shows that woodland area surveyed by the NSNW, including the area classified as 91A0 (9.5ha). The site contains several small areas of Sessile Oak (Quercus petraea) woodland, a habitat which is particularly rare in Connemara....

Includes ancient or long-established woodlands (Perrin and Daly, 2010), archaeological and geological features as well as red data and other rare or localised species. Perrin and Daly (2010) identified Derryclare Wood (NSNW site code 1601) as possible ancient woodland. There is a well developed fungus and lichen flora present (Folan and Mitchell, 1970) Conservation Objectives.rdl (npws.ie)).

With regard to target objective in Conservation Objectives.rdl (npws.ie)) the Area (should remain) stable or increasing. Where topographically possible, "large" woods at least 25ha in size and "small" woods at least 3ha in size.

In this project, areas immediately adjacent to the Nature Reserve were surveyed (Ecological Report, Hunt, 2021). Target habitats include native woodland establishment, mainly pioneer, wet woodland (equivalent to WN7) in areas B, C & D only. It concluded; There is also potential for native woodland creation which will benefit Derryclare Nature Reserve and provide a more extensive and connected area of native woodland cover.

The main constraints re the viability of newly-established woodlands are exposure and grazing pressure, primarily deer and hares. By combining planted saplings with broadcast seeding and willow cuttings, and the use of tree shelters, losses due to these factors will be compensated to ensure an adequate stocking of ca 800 trees/ha. Only mineral soils and shallow peats (< 35cm max) will be targeted for woodland establishment.

In area B: Native woodland is a further target habitat which has been selected for land adjacent to Derryclare Nature Reserve and for lands in between to create a connected woodland area. Gradual conversion to adapted WN7 due to generally waterlogged peat soils, i.e. (natural regeneration/seed broadcasting/limited planting) to native woodland (pioneer birch with holly, rowan; willow and alder in wetter area; some planting of Scots Pine in dry areas). The total area earmarked for pioneer native woodland establishment here is 11.0 ha located to the N/NE of the Nature Reserve.

In area C: Soils within Area C are dominated by peaty podzols along with peats and acid brown earths. Adapted WN7 conversion is proposed due to generally waterlogged peat soils, i.e. (natural regeneration/seed broadcasting/limited planting) to native woodland (pioneer birch with holly, rowan; willow and alder in wetter area; some planting of Scots Pine in dry areas). The total area earmarked for pioneer native woodland establishment here is 30.6 ha located to the W/NW of the Nature Reserve.

In area D: A small area of protective riparian native woodland (downy birch, common alder, grey willow and rowan) is proposed amounting to 20.4 ha on soils comprising saturated shallow peat and gleyed peaty podzols for the peninsulas to the south and east of the Nature Reserve extending into Derryclare Lake. These will primarily target the aquatic/terrestrial zone.

Note: As all management actions in the project area will be taking place within a sensitive aquatic environment (numerous watercourses; sloping ground to protected lakes), measures to minimise sediment run off and nutrient release are required. This will be achieved through pit planting and generous aquatic buffer zone (30 to 40 m width) riparian woodland establishment (planting, seeding and willow cuttings), strategic native willow and alder establishment for bank stabilisation and filtration services, as well as to provide shading habitat along streams/rivers).

5. FURTHER INFORMATION ITEM NO. 4

The applicant is required to provide satisfactory information associated with the proposed development with respect to traffic volumes, traffic routes to and from the site, reference to potential impacts to local and national road network and junctions where a Transport and Traffic Assessment is required as well as a road safety audit. Any advance directional signage required for road safety measures, The absence of ground bearing investigation results to confirm suitability of proposed carrying capacity of internal roadway routes & associated structure analysis whereby extensive works are required in predominantly Peat type soil stratums.

5.1 Part (a)

The applicant is requested to provide clearly identified haul routes proposed to fully assess the public road network being potentially impacted including determination of structure Analysis on the existing roadways to the subject site. All culverts and structures crossed over by HGV's or potential abnormal weight loads should be highlighted in reports which gives details of their structural adequacy

5.1.1 Response to Part (a)

Chapter 13 - Material Assets of the submitted EIAR addresses the likely significant effects of the Proposed Project on transportation infrastructure. This chapter of the EIAR includes details of future traffic volumes and traffic flows for HGVs.

Traffic and Transport Assessment

It is respectfully suggested that that the information presented in Section 13 of the EIAR with respect to traffic volumes, traffic routes, trip generation and the traffic impact on the road network is in accordance with PE-PDV-20045, Transport Assessment Guidelines, TII, May 2014 as stated on Section 13.1.1.2 of the EIAR. These issues are dealt with specifically in the following sections;

- Traffic volumes – A classified turning count survey undertaken at the existing access junction on the R344, together with background traffic forecast for each of the operational years (2023 -2028) is set out in section 13.1.2.3.
- Trip generation and assignment for proposed development – The trip generation for the proposed development is set out for each of these years in Section 13.1.3.1 with the assignment of these trips on routes on the network is discussed in Section 13.1.3.2.
- The traffic impacts of development generated traffic – This is assessed in Section 13.1.5. It was determined that the maximum impact on the R344 would be a +6% increase in terms of PCU. As set out in the EIAR, guidance relating to the requirement to undertake a detailed junction capacity assessment at junctions in the proximity of a proposed development is set out in Document PE-PDV-02045 Traffic and Transport Assessment Guidelines, TII, May 2014. The guidance states that a capacity assessment should be undertaken where the proposed development results in an increase in traffic volumes of 10% or greater, in situations where the network is not currently congested. As the traffic volumes on the R344 are forecast to increase by less than this threshold (maximum +6%) during the proposed development, a detailed capacity assessment was not deemed necessary at the Derryclare Forest Access / R344 junction.
- It is noted that junction improvements, including advanced warning signing is proposed as set out in Section 13.1.4.

Road Safety Audit

The Derryclare forest access on the R344 is an existing junction for which minor improvements, in terms of junction markings and improved visibility splays are proposed. Taking account of this, together with a forecast maximum of 10 HGV movement to and from the proposed development per day. It was considered that a Road Safety Audit would not be required. In the event that an RSA is still requested, the Applicant will commit to completing this request prior to commencement.

Please refer to the **Response to Further Information** prepared by Alan Lipscombe Traffic & Transport Consultants for further details.

5.2 Part (b)

The applicant is requested to provide auto track analysis at the site entrance and within proposed internal layout.

5.2.1 Response to Part (b)

Alan Lipscombe Traffic and Transport Consultants have provided an auto track drawing analysis at the site entrance and within proposed internal layout.

An autotrack assessment for a large articulated HGV (15.4m long x 2.5m wide) exiting the junction is shown in Figure FI3. It is noted that this is an existing access, and these vehicles are currently accommodated at the junction. While based on the forecast traffic volumes it is very unlikely that 2 vehicles will meet at the junction, the figure demonstrates that an HGV accessing the site will be able to wait off the E344 if required.

Please see Figure FI3 within the **Response to Further Information** prepared by Alan Lipscombe Traffic & Transport Consultants for further details.

6. FURTHER INFORMATION ITEM NO. 5

The applicant is requested to address the following gaps of information and inconsistencies within the submitted information:

6.1 Part (a)

The application contains two separate and contradictory methods of construction for the new 1.58km of internal access roads, the EIAR and the Geotechnical and peat stability Assessment, please finalise proposed methodology.

6.1.1 Response to Part (a)

The EIAR submitted as part of the planning application sets out the methods of construction for the new 1.58km internal access roads. Chapter 4 of the EIAR sets out the details of the existing roads on site, and the details of the proposed New Forestry Access Roads. Please refer to Chapter 4 of the submitted EIAR for further details.

All proposed new forestry access roads will be constructed as build on top/ floating roads as described in Chapter 4 of the EIAR. The peat stability assessment report has been updated to reflect this.

6.2 Part (b)

Please provide precise data relating to the excavation of peat from site to facilitate the new internal access road construction and/or peat excavated from re-profiling, the volumes involved, the means of transport and re-use/disposal within the site of elsewhere.

6.2.1 Response to Part (b)

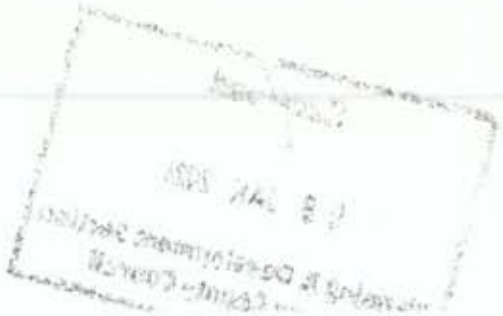
All new internal access roads will be constructed as build-on-top / floating roads as described in Chapter 4 of the EIAR. Therefore, there will be no peat excavated from the site to facilitate road construction. Similarly, there will be no peat excavated for reprofiling. There will be no peat arisings as a result of the proposed project and no necessity to transport or dispose of peat.

6.3 Part (c)

The CEMP should include a section summarising key environmental sensitivities including habitats and water courses as well as all mitigation measures to allow for reporting and monitoring to GCC as a standalone document. This project would require a properly qualified Ecological Clerk of Works, Roles and responsibilities should be clearly defined within the CEMP.

6.3.1 Response to Part (c)

An updated **Construction and Environmental Management Plan (CEMP)** has been prepared by MKO and is submitted with the FI response. All text that has been updated in the CEMP is included in green text. The updated CEMP addresses the inconsistencies identified under item 5(c). It is confirmed that an Ecological Clerk of Works will be appointed on the project and their duties are outlined in Section 4.2 of the submitted CEMP.



APPENDIX 1

DECISION MATRIX FOR SELECTING THE FOREST TO BOG RESTORATION OPTIONS

Decision matrix for selecting the Forest to bog restoration option.

Note:

The purpose of this document is to provide decision support for the practitioner in selecting the suitable restoration options to use on site and identify which restoration are unsuitable, based on the prevailing site conditions. It is to be used in conjunction with detailed walk-over site surveys. It is based on current best practice (2023), and it should be updated going forward to reflect any future changes and improvements in best practice, should they arise.

Author: Dr Dermot Tiernan

Date: 19/9/23

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1.0 How to use the decision support matrix

This document is a guide for practitioners to facilitate planning forest to bog restoration projects. It is intended that it will be used in conjunction with a detailed walkover site survey and to be supplemented by appropriate buffer zone management. This tool identifies the acceptable range of restoration options suitable for a given site, so that the practitioner can match the most appropriate restoration options to the site. It is likely that a range of restoration options will be used on each site, and the decision support tool can be used to set the acceptable range from which these options can be selected. This will ensure that the most appropriate restoration options for each site are selected. It should be noted that this document is a planning tool and the best professional judgement of the restoration practitioner on the site should be followed if conditions dictate that a more conservative restoration option be implemented.

1.1 Overview

There is currently no decision support tool to prescribe restoration options on blanket bogs. Developing such a tool can help guide the planner in ensuring the most appropriate restoration option is applied based on the site conditions. However, for the purposes of appropriate assessment, it is recommended that, following the precautionary principle, the mitigations applied for restoration options correspond to the migrations needed for the restoration measure with the highest degree of disturbance and highest level of impact. A decision support tool (see Table 8) was therefore developed using all best available best practice guidelines to help inform management decisions. Mapping in forestry uses compartments and sub-compartments as standard. A compartment is parcel of land, typically 10 to 30 ha in size, that is demarcated on the ground. Within this compartment are smaller sub-compartments, which divide up the sub-compartment into smaller more uninform homogeneous areas. These sub-compartments can be very useful when planning Forest to bog restoration and prescribing the restoration methods suitable for the site. The decision matrix described here is a tool that can be used to select the restoration option most suited to the site, based on the site conditions. The decision matrix requires key site data, and it allows the user to prescribe restoration options appropriate for the underlying site conditions. These site conditions include the peat slide factor of safety, slope, peat depth, soil type (blanket bog or heath) and stump size. The decision matrix is a table that lists all the restoration options (21 permutations) in order of their expected ground disturbance, where option 1 is expected to have the least ground disturbance and option 21 the greatest. The restoration options are also listed in order of their expected speed of restoration, where more intensive restoration methods are assumed to produce speedier restoration (based on the best available literature). The purpose of the decision matrix is to find the restoration option that will cause the least disturbance and deliver the best restoration results and help guide the planner in selecting the best restoration option for the site. The decision matrix can also be used to identify what restoration options are not suitable for the site. In all cases, alternative restoration options can be considered up to, but not above the prescribed option. For example, if a restoration option of 14 is selected, then all options 1 to 14 can be used but no options above 14 can be used. This approach ensures the site is assessed on its ground conditions and provides useful guidance when planning restoration. It should be noted that the decision matrix tool provides recommendations for restoration options and should be used as a guide for management decisions but is not a replacement for the best professional judgement of the restoration practitioner.

2.0 The Forest to bog restoration options.

The Forest to bog restoration options are numbered from 1 to 21 and they are listed in ascending order of expected ground disturbance and in expected order of the speed of likely restoration post works (see Table 1). Buffer zone management is not listed as a restoration option, as the management of buffer zones is a mandatory requirement for all sites. All Forest to bog restoration begins with the installation of buffer zones, which is carried out in advance of restoration options. Buffer zone management is detailed below in section 2.1.

Table 1: The restoration options listed in order of expected ground disturbance levels and speed of restoration (where 1 is least and 21 is greatest).

Option	21 Restoration options (20 bog restoration, 1 replanting)
1	Fell to waste manually & block interceptor drains
2	Fell to waste manually & fill in interceptor drains
3	Fell to waste manually, block interceptor drains, remove brash from the buffers, windrow
4	Fell to waste manually, fill in interceptor drains, remove brash from the buffers, windrow
5	Fell to waste mechanically & block interceptor drains
6	Fell to waste mechanically & fill in interceptor drains
7	Fell to waste mechanically, block interceptor drains, remove brash from the buffers, windrow
8	Fell to waste mechanically, fill in interceptor drains, remove brash from the buffers, windrow
9	Fell to waste mechanically, block interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator bucket
10	Fell to waste mechanically, fill in interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator bucket
11	Harvest trees & block interceptor drains
12	Harvest trees & fill in interceptor drains
13	Harvest trees, block interceptor drains, remove brash from the buffers, windrow
14	Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow
15	Harvest trees, block interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & bucket
16	Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & bucket
17	**Harvest trees, remove brash from buffers, windrow & scrap mound (replanting option)**
18	Harvest trees, block interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & grind stumps
19	Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & grind stumps
20	Harvest trees, block interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & stump flipping
21	Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & stump flipping

The Forest to bog restoration options can be broken down into the following general categories:

- manual interventions (option 1 to 4).
- felling to waste mechanically (options 5 to 10).
- harvesting trees and windrowing (options 11 to 14).
- harvesting trees, windrowing and surface smoothing (options 15 to 16).
- replanting using scrap mounds (option 17).
- harvesting trees, windrowing and stump grinding/flipping (options 18 to 21).

2.1 Buffer zone management.

Buffer zone management is essential, and they are a central part of the restoration plan. Once the site drainage pattern is mapped, buffers can be put in place along all EPA streams, relevant watercourses, and lakes. The width of the buffer zones will depend on the watercourse and the slope. Recommended buffer widths are given the Table 2 below. Wider buffer zones can be specified where deemed appropriate.

Table 2: Recommended buffer widths for blanket bog restoration.

Watercourse	Gentle slope ($< 6^0$)	Intermediate slope ($6\text{-}11^0$)	Steep slope ($> 11^0$)
EPA streams	20	30	40
Relevant watercourses	10	20	20

Having effective buffer zones installed is the first restoration operation to carry out as it is a key requirement for water quality protection. The function of the buffer zones is to provide protection to the watercourses from subsequent restoration operations. When planning the buffer zones, the goal is to ensure that the buffers are made effective before the restoration activities begin. After tree felling and the removal of brash from the buffer zones, the only operations permitted in the buffer zones are the installation of silt traps and dams on the plough drains, relevant watercourses, interceptor drains and roadside drains. Effective buffer zones will contain a mixture of strategically placed series of silt traps/curtains and dams. Ideally, silt traps should be installed before tree removal begins to afford protection from the harvesting operations. Post felling, a greater number of additional silt traps and dams can be installed (as the site will be more assessable). One these works are completed, the site is left dormant (fallowed) for a period of time, to allow the site to revegetate.

Generally, dams are not effective over slopes of 6 degrees, and it is recommended that larger buffer zones are used on the steeper sites (Table 2). Once the width of the buffer zones is decided, the next step is to walk all the buffer zones and identify which drains within the buffer zone are carrying water. The number of these drains will depend on the original ploughing method. In some cases, the plough drains will not be continued right into the water courses and in these cases, a good buffer may already be in place. However, in the cases where plough drains were continued right into the watercourse, it will be necessary to map all these effective drains that are visibly carrying water. A detailed combined damming and silt trap plan will be required for all these drains, to ensure that the buffer becomes fully effective. If the slope is too steep for effective damming, consider the use of a series of silt traps in combination with methods to slow down the flow rate of the water. Alternatively, install dams further back the drain upstream from the buffer zone, if more suitable locations (slope $< 6^0$) can be found to install the dams and silt traps.

2.2 Fallowing (site revegetation post tree removal).

Fallowing refers to the practice of leaving the site dormant, after the trees are removed, to allow the site to revegetate. (In Derryclare, a sub-catchment approach will be adopted for restoration, so the fallowing period refers to the entire sub-catchment). This practice is a water protection measure to ensure optimum nutrient absorption can occur across the site and especially in the buffer zones. In general, once the timber is removed, works on the buffer zones can be completed, including installation of silt traps, silt curtains and dams. The site is then left dormant (or fallowed), to allow the site and the buffer zones to revegetate. The length of this fallow period will be determined by the effectiveness of the buffer zone and the vegetative cover on site. The effectiveness of the buffer zone, and the length of the fallowing period, will be determined using the on-site water monitoring data, where all water quality values must be within acceptable thresholds. In Derryclare, there is already good existing ground cover under the canopy over most of the site, and recent felled areas within the site have revegetated quickly (usually within a year). It is expected that a fallow period of at least one year will be observed, however, this is conditional on the water quality data downstream from the buffers meeting the acceptable threshold values. Failure to meet the thresholds for the live on-site water quality results, will result in a longer fallow period. When the thresholds for the live on-site water quality results are satisfied, and restoration works begin, all subsequent restoration works will be also subject to meeting the thresholds for the downstream turbidity readings. Failure to meet these turbidity thresholds will result initially in suspension of operations to determine if the issue can be rectified in the short-term. If no satisfactory rectification can be found, the site will have its fallow period extended further, until the threshold values are achieved.

3.0 The decision matrix methodology

The decision support tool developed here uses a 'decision matrix' for recommending the most suitable Forest to bog restoration option. This decision matrix (see Table 8) is a table with all the 21 restoration options listed against the acceptable ranges for each of the key site factors. There are 5 key site factors, namely, a) The peat slide factor of safety, b) Slope, c) Peat depth, d) Soil type (blanket bog or heath) and e) Stump size. This site data was collected for each subcompartment, allowing the user to prescribe a restoration option on a sub compartment level. The decision matrix table allows the user to quickly assess the restoration options based on the key site factors and select the option that has the lowest value. This will ensure that the restoration selected will represent the best acceptable restoration option for the site conditions.

The 5 key site factors are central to what restoration option can be selected and these determine the operational specifications for each restoration option. The decision matrix table allows the user to evaluate these 5 site factors in combination.

What follows is a brief discussion of each of the 5 key site factors, namely,

a) The peat slide factor of safety.

b) Slope.

c) Peat depth.

d) Soil type (blanket bog or heath).

e) Stump size.

3.1 Peat Stability – Factor of Safety (FoS)

Peat stability is a key factor to understand, to ensure that the peat is not prone to peat slides and that areas of high risk are avoided. Quantifying the peat stability risk will also ensure that appropriate low disturbance restoration options are prescribed in the higher risk areas.

A peat stability analysis is undertaken using the "Best Practice Guide for Proposed Electricity Generation Developments (2nd edition, PLHRAG, 2017). The Peat Landslide Hazard and Risk Assessment Guide (PLHRAG)". This is used for windfarm developments, and it is currently the best available assessment available. It calculates a "Factor of Safety", which is a measure of the peat stability on a particular slope under load. For any slope, the degree of stability depends on the balance of forces between the weight of the soil/peat working downslope (destabilising force) and the inherent strength of the peat/soil (shear resistance) to resist the downslope weight. The purpose of the stability analysis was to determine the stability i.e. Factor of Safety (FoS), of the peat slopes. The FoS provides a direct measure of the degree of stability of a peat slope. A FoS of less than 1.0 indicates that a slope is unstable; a FoS of greater than 1.0 indicates a stable slope. An acceptable FoS for slopes is generally taken as a minimum of 1.3. The stability analysis for this project, which analysed the Restoration Harvest Blocks and access roads (new and existing), resulted in FoS above the minimum acceptable value of 1.3 for both the undrained and drained condition, indicating that the site has a satisfactory margin of safety.

In the decision matrix, when the FoS is less than 1.0, only manual restoration options are recommended (restoration option 1). When the FoS is between 1 and 1.3), only mechanised operations excluding reprofiling are recommended (restoration options 1 to 14). When the FoS is greater than 1.3, mechanised operations including reprofiling are recommended (restoration options 1 to 21).

Table 3: Factor of Safety used for the peat slide risk assessment.

Factor of Safetly (FoS)	Stability	Max restoration option	Restoration option
<1.0	Unstable	1	Manual intervention (1)
1 to 1.3	#Marginally Stable	14	Mechanised excluding reprofiling (1 – 14)
>1.3	Acceptable	21	Mechanised including reprofiling (1 – 21)

3.2 Slope

The slope of the site has a large influence on the restoration option to prescribe, and the most appropriate restoration option(s) can only be properly prescribed following a detailed walk-over site survey. The drain blocking technique to use depends largely on the slope. Typically, each site will use a range of drain blocking techniques. Careful consideration is required when deciding the drain blocking technique and this is outlined in detail in Appendix 1 of the 'Forest to bog best practice - Best practice operational guidelines for blanket bog restoration in Ireland'. This sets out the situations required for effective drain blocking that can be considered during the pre-works site walk-over survey.

In the decision matrix, slope is a key consideration. The decision support matrix provides a range of options that can be implemented following the pre-works site walk-over survey, but these should only be evaluated with reference to the best practice guidelines outlined in the 'Forest to bog best practice - Best practice operational guidelines for blanket bog restoration in Ireland'. In general, damming options are effective at slopes of 6 degrees or less and not effective on the steeper slopes. In the decision matrix, when the slope is < 6 degrees, all restoration options can be considered. When the slope is between 6 and 15 degrees, restoration options that slow the rate of flow (such as leaky dams) and filling in the drains can be considered. When the slope is > 15 degrees, the effectiveness of restoration options such as slowing the rate of flow and filling in the drains need to be carefully considered, and only restoration options that can operate within the machine specified safe working limit should be considered. The decision matrix for slope provides a planning guide for what restoration option to use, the specific drain blocking technique(s) to adopt will be refined as part of the pre-works walk-over survey.

Table 4: Slope considerations.

Slope (degrees)	Considerations	Drain blocking techniques	Restoration options
<6	• All drain blocking techniques effective	Block drains *and/or* slow flow rate *and/or* fill in drains *and/or* None	1 - 21
Between 6 and 15	• Damming not effective	Slow flow rate *and/or* fill in drains *and/or* None	2, 4, 6, 8, 10, 12, 14, 17, 19, 21
>15	• Damming not effective • All drain blocking techniques may not be effective • Safe working limits of the machine	Slow flow rate *and/or* fill in drains *and/or* None	2, 4, 6, 8, 10, 12, 14, 17

3.3 Peat depths

Peat depths influence which restoration method is used. Shallower peats are more prone to disturbance, whereas deeper peats are generally more resilient to restoration works. In the decision matrix, when the peat depth is <0.3m, only options 1 to 14 should be considered, and option 17 if the site is designated as suitable for replanting with pioneer native woodland. Where the peat depth is between <0.3m and 0.5m, only options 1 to 14 should be considered. Where the peat depth is between <0.5m and 1.0m, only options 1 to 16 should be considered and where the peat depth is >1.0m, options 1 to 21 (excluding option 17) should be considered.

Table 5: Peat depth influence on restoration options.

Peat depths (m)	Acceptable level of disturbance	Max restoration option
<0.3m	Fell and windrow, replanting	1- 14 (or 17 if replanting)
0.3 to 0.5m	Fell and windrow	1- 14 (or 17 if replanting)
0.5 to 1.0m	Fell and surface smooth	1- 16 (or 17 if replanting)
>1.0m	All 21 options	1- 21 (excl 17)

3.4 Soil type

The soil type here refers to distinguishing between blanket bog and heath soils. Heath soils are shallow and not suitable for the more intense restoration works and generally these areas will be felled and windrowed only. In the decision matrix, when the soil type relates to a blanket bog, all options (except option 17) can be considered. Where the soil type relates to a heath, only options which relate to minimal disturbance should be used, including replanting of pioneer native woodland.

Table 6: Soil type influence on restoration options.

Peat depths (m)	Acceptable level of disturbance	Max restoration option
Blanket bog	All options	1 – 21 (except 17)
Heath	Fell and windrow	1,2,3,4,5,6,7,8,11,12,13,14,17

3.5 Stump size

Stump size is a consideration, mainly for the stump flipping option. Most of the Forest to bog sites will contain poorly growing trees with small stumps. However, large lodgepole pine (south coastal) stumps (> 45cm in diameter) will occasionally occur, and these stumps are not suitable for stump flipping, as they produce deep rooting tap roots. By comparison, large Sitka spruce stumps (> 45cm) can be flipped, as they produce a shallow root plate along the surface. Current stump flipping practice suggests that large stump sizes are an important consideration and that the larger lodgepole pine stumps should not be stump flipped. In Derryclare, the species, age and yield of the crop was used to predict the stump size into 3 main categories (Table 7) and these were used to ensure that no areas with large lodgepole pine (south coastal) stumps can be selected for stump flipping. Assessing the size of the stump is best done once the crop is felled and the stump can be accurately measured. However, a good estimate of stump size can be predicted at the planning stage. In Derryclare, large stump sizes were predicted for Sitka spruce crops (when their age was 60 years plus and their Yield class was 10 or greater) and for lodgepole pine (when their age was 45 years plus and their Yield class was 10 or greater) with all remaining areas assigned a small stump size.

Table 7: The stump size categories used in the decision matrix.

Stump category	Max restoration option
Small	21
Large lodgepole pine (south coastal)	19
Large Sitka spruce	21

3.6 The decision matrix table

The decision matrix table pulls together all the data from the 5 key site factors and presents them as one easy to read table. The purpose of this table is to allow the user to consider all the 5 key factors collectively. This table is the decision matrix for selecting Forest to bog restoration options and this is shown in Table 8.

Instructions for use

Start with the Peat Slide factor of safety and work from left to right. Select the highest number in each category and work across each category. If there is no change in the listed number between categories, retain that number. If the number is not listed in the subsequent category, then you drop to the next available lower number. Once you drop to a lower number you cannot increase it. Once you move through all categories, the number you are left with is the maximum restoration option you can consider. All restoration options lower than this maximum are also acceptable, but no restoration above this maximum is acceptable.

Table 8: The decision matrix for selecting Forest to bog restoration options.

Peat slide factor of safety (FOS)			Slope			Peat depth				Soil type		Stump size		
Low (>1.3)	Med (1-1.3)	High (<1.0)	< 6 degrees	6 to 15 degrees	>15 degrees	<0.3m	0.3 to 0.5m	0.5 to 1.0m	>1m	Blanket bog	Heath	Small	Large LPS	Large SS
1	1	1	1			1	1	1	1	1	1	1	1	1
2	2		2	2	2	2	2	2	2	2	2	2	2	2
3	3		3			3	3	3	3	3	3	3	3	3
4	4		4	4	4	4	4	4	4	4	4	4	4	4
5	5		5			5	5	5	5	5	5	5	5	5
6	6		6	6	6	6	6	6	6	6	6	6	6	6
7	7		7			7	7	7	7	7	7	7	7	7
8	8		8	8	8	8	8	8	8	8	8	8	8	8
9	9		9			9	9	9	9	9		9	9	9
10	10		10	10	10	10	10	10	10	10		10	10	10
11	11		11			11	11	11	11	11	11	11	11	11
12	12		12	12	12	12	12	12	12	12	12	12	12	12
13	13		13			13	13	13	13	13	13	13	13	13
14	14		14	14	14	14	14	14	14	14	14	14	14	14
15			15					15	15	15		15	15	15
16			16					16	16	16		16	16	16
17			17	17	17	17	17	17			17	17	17	17
18			18						18	18		18	18	18
19			19	19					19	19		19	19	19
20			20						20	20		20		20
21			21	21					21	21		21		21

Instructions for use.

Start with the Peat Slide factor of safety and work from left to right. Select the highest number in each category and work across each category. If there is no change in the listed number between categories, retain that number. If the number is not listed in the subsequent category, then you drop to the next available lower number. Once you drop to a lower number you cannot increase it. Once you move through all categories, the number you are left with is the recommended restoration option.

See worked examples below on section 4.0.

4.0 Worked examples.

Below are a few worked examples to demonstrate how the decision matrix may assist in deciding what restoration options, based on the site conditions.

Example 1:

Site conditions	Example	Restoration option
Factor of Safety (FOS)	<1.0	1
Slope	< 6 degrees	1
Peat depth	0.3 to 0.5m	1
Soil type	Blanket bog	1
Stump size	Small	1
Recommended restoration option. Fell to waste manually & block interceptor drains		**1 or less**

Example 2:

Site conditions	Example	Restoration option
Factor of Safety (FOS)	1.0 to 1.3	14
Slope	<6 degrees	14
Peat depth	>1m	14
Soil type	Blanket bog	14
Stump size	Small	14
Recommended restoration option. Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow		**14 or less**

Example 3:

Site conditions	Example	Restoration option
Factor of Safety (FOS)	>1.3	21
Slope	< 6 degrees	21
Peat depth	>1m	21
Soil type	Blanket bog	21
Stump size	Small	21
Recommended restoration option. Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow, surface smooth with excavator & stump flipping		**21**

Example 4:

Site conditions	Example	Restoration option
Factor of Safety (FOS)	>1.3	21
Slope	5 - 15 degrees	21
Peat depth	0.5 – 1m	14 (17 if replanting)
Soil type	Blanket bog	21
Stump size	Small	21
Recommended restoration option. Harvest trees, fill in interceptor drains, remove brash from the buffers, windrow		14

APPENDIX 2

DERRYCLARE RESTORATION PLAN FOR PRACTITIONERS

Derryclare Restoration Plan for practitioners

(summary document for practitioners)

This document is the practitioner's quick reference to the Derryclare restoration plan.

It includes the following:

1. An executive summary for practitioners.
2. A practitioners' management implementation plan (Table 1).
3. Relevant appendices with summaries for the following.
    a. Water monitoring plan.
    b. Invasive species plan.
    c. Grazing management plan (including deer management).
    d. General maintenance plan.
    e. Fire plan.

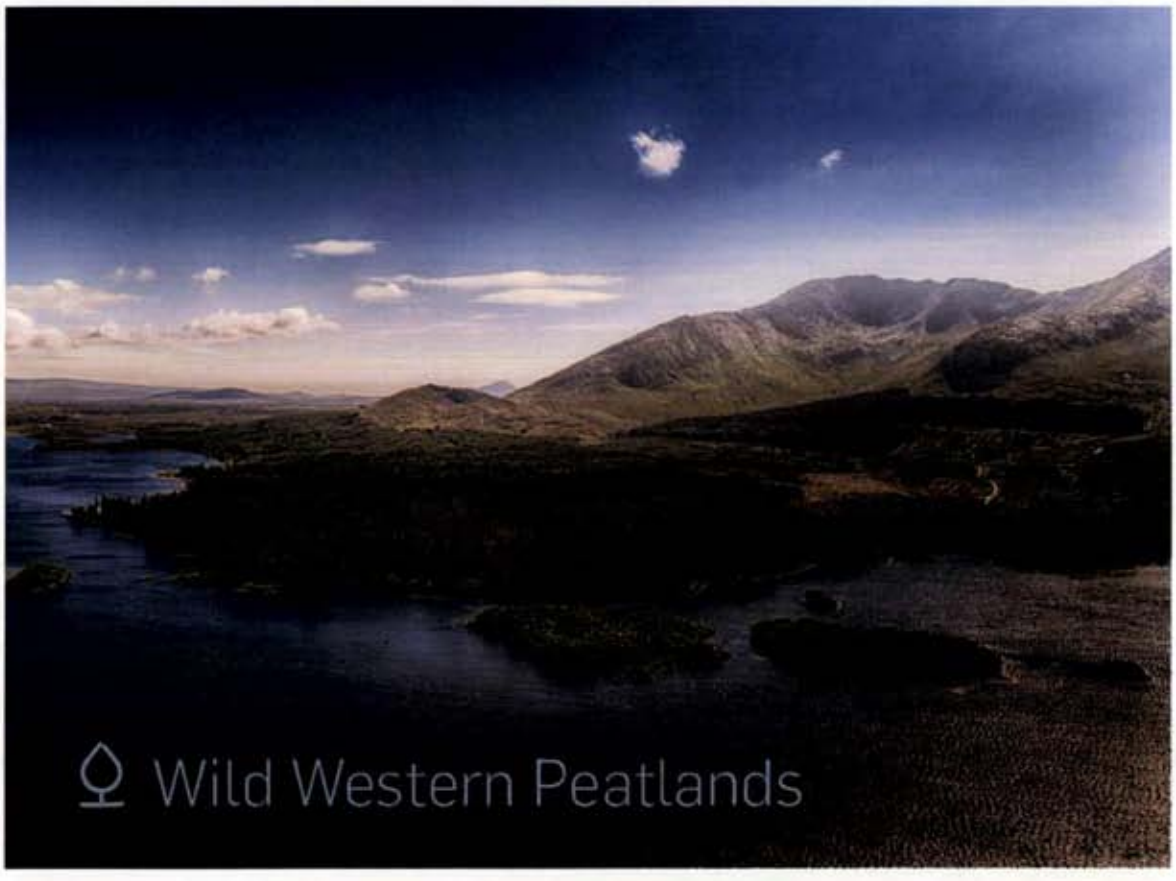


Figure A: Derryclare forest property, Co Galway

Executive summary for practitioners

Forest to bog restoration occurs in two steps, the initial harvesting plan, and the subsequent restoration works. The first step is to create a harvesting plan for the site. This plan removes the existing tree cover, and this is most effective when as much timber as possible is removed from the site. The harvesting plan for Derryclare was prepared by an experienced forester, based on current best forest planning practices. The preferred best practice harvesting method is to harvest as much timber conventionally (harvester and forwarder combination), where this is not possible, felling to waste is the next preferred option, followed by mulching, which is considered the least favorable option. **The basic management unit for the harvesting plan is the harvest block**. The harvest blocks are designed as practical units for harvesting that facilitate; adherence to existing best forestry practice and safety guidelines, ensure felling is staggered in the four water catchments, ensure coupe sizes are practical, so that they can be harvested safely, ensure the shape of coupes are planned to minimise ground disturbance by avoiding unnecessary water crossings, and ensure disturbance is avoided by making full utilisation of the existing road network. All harvest activities will be monitored for water quality, with appropriate mitigations in place.

Buffer zone management is central to Forest to bog restoration. The management of buffer zones starts with harvesting. where in addition to tree removal, it is also possible to initiate restoration works in the buffer zones. Buffer zones widths will be slope dependent and as a precaution all buffer zones will be at least 30m. Before harvesting, work will start on the buffer zones by installing silt traps and dams, where access permits, as a protective measure for the harvesting operations. Once harvesting is complete, the site becomes fully accessible, and this allows works on the buffer zones to be completed, to ensure the buffer zone also becomes effective for the subsequent restoration works. Once harvesting is finished, the brash will be removed from the buffer zones. To minimise ground disturbance, brash removal is best done by the low ground pressure forwarder machine when the brash is 'fresh'. The forwarder is suitable for this operation because it has the required low ground pressure and a bunk to allow the brash to be easily transported using the existing 'fresh' brash mats. Where the trees are felled to waste, brash removal can be done by either the harvester or forwarder. In areas where the trees are mulched, the buffer zones will be felled to waste manually to allow the trees to be moved outside the buffer zone, where the mulching operation will occur.

The second step in Forest to bog restoration concerns the restoration works. The restoration works for Derryclare are based on a variety of technical expert reports, that were combined, to produce a site-specific restoration plan that will involve peatland habitat restoration (281 ha) and the establishment of pioneer native woodland (62 ha). Suitable locations for pioneer native woodland (62 ha) were identified during the planning phase and these locations are concentrated in areas where the peat depth is shallow (< 30cm in depth), adjacent to the adjoining old woodland nature reserve. **The basic management unit of the restoration work is the sub-catchment (or hydrological peatland unit).** The four water catchments in Derryclare were each further subdivided into 38 sub-catchments. Each sub-catchment relates to an individual hydrological peatland unit. The restoration work is based on scheduling these sub-catchments once; a) the trees are removed, b) the buffer zones are in place and are effective and, c) the site is sufficiently vegetated. Once the trees are removed, each sub-catchment will be subjected to a detailed 'walk-over' survey, where the finer detail of the restoration plan can be assessed, to implement best practice, as provided in the "Forest to bog" guidance document. In terms of managing water movements during the restoration works, the recognised best practice is to starts at the highest point in the sub-catchment and proceed to work downslope. All restoration works will be subject to ongoing monitoring, real time turbidity monitoring and a working procedure to halt works if agreed threshold water quality indicators are exceeded. In addition, contractor management will ensure that work stoppages are fully compensated, and that alternative work off-site will be available, during prolonged wet weather, or where work is completely suspended. All site works will be overseen by the appointed clerk of works for the site, to ensure best practice is followed.

Protecting water quality is central to Forest to bog restoration. All operations will be monitored for water quality, with appropriate mitigations in place. Once the timber is removed and the works on the buffer zones completed, the site is left dormant (or fallowed), to allow the site and the buffer zones to vegetate. The length of this fallow period will be determined by the effectiveness of the buffer zone and the vegetative cover on site. The buffer zone protection measures installed for the harvesting operation will be left in situ post harvesting, and while these alone may be effective to allow restoration works to commence immediately, all additional works on the buffer zones works will also occur post harvesting, when they become assessable. Following these works, the site will be allowed to revegetate, as a further water protection measure. The effectiveness of the buffer zone, and the length of the fallowing period, will be determined using the on-site water monitoring data, where all water quality values must be within acceptable thresholds. In Derryclare, there is already good existing ground cover under the canopy over most of the site, and recent felled areas within the site have revegetated quickly (usually within a year). It is expected that a fallow period of at least one year will be observed for all areas, however, this is conditional on the water quality data downstream from the buffers been consistently under the acceptable threshold values. Any failure to meet the thresholds for the live on-site water quality results, will result in a longer fallow period. When the thresholds for the live on-site water quality results are satisfied, and restoration works begin, all subsequent restoration works will be also subject to been consistently under the thresholds for the downstream turbidity and water quality readings. Failure to meet these thresholds will result initially in suspension of operations to determine if the issue

can be rectified in the short-term. If no satisfactory rectification can be found, the site will have its fallow period extended, until the threshold values are achieved. The live water monitoring will ensure that when thresholds are occasionally exceeded, that remedial action will be taken immediately. It is noteworthy, that in forested areas on peatlands, that exceeding of thresholds values occasionally occurs naturally, but in Derryclare the impact is negligible, as all receiving waters drain into both Lough Inagh and Derryclare lake, where the impact is dissipated as result of the natural dilution capacity of the lakes. The use of live water monitoring and the corresponding procedures put in place to deal immediately with above threshold values, will provide appropriate mitigation.

Table 1: Summary table of the practitioner's management implementation plan for Derryclare, describing the main actions and associated mitigations in the CEMP plan.

Practitioners' management implementation plan (summary)			
Main phases	**Main tasks**	**Description of actions**	***CEMP mitigation reference***
1. Planning	• Collect baseline water data. • Prepare planning application.	o Collect chemical and biological baseline water data. o Schedule all field survey works. o Interpret field studies and produce a practical site plan. o Felling planned on a harvest block level and restoration works planned on a sub-catchment/sub-catchment level. o Felling plan adheres to forestry standards and best practice. o CEMP plan and clerk of works in place	*MM1, MM2* *MM3, MM4* *MM7*
2. Install water monitoring stations and property wide water protection measures	• Install water stations. • Appoint environmental manager. • Install turbidity stations. • Install strategic water protection measures.	o Erect 2 permanent water monitoring stations to measure water flow and water quality. o Environmental manager appointed. o Erect live turbidity stations downstream in advance of planned operations. o Strategically install silt traps, silt curtains and dams throughout the site, where possible.	*MM4, MM18* *MM32*
3. Construct road extensions	• Construct the new floating roads. • Maintain the existing road network.	o The "Build On-Top Embankment Roads" to follow the COFORD (2004) standard. Movement monitoring posts will be installed. Strict construction methods to be followed see MM36 in the CEMP. o Where necessary, cap the existing roads with clean stone from local stone quarries. o 4 temporary crossings. o Link operations to prevailing weather conditions. o Link operations to prevailing weather conditions. o Follow refueling procedure. o Erect signage and do not construct access and egress routes. o All machinery will be operated by suitably qualified personnel.	*MM3, MM4* *MM14, MM15* *MM18, MM19* *MM24, MM29* *MM30, MM35* *MM36, MM43* *MM47, MM48* *MM49, MM50* *MM52*
4. Advance preparation of the harvest block (HB).	• Install water protection measures along the HB buffer zones. • Conduct the pre-commencement surveys.	o Manually install silt traps, silt curtains and dams along all the buffers in the HB on advance of harvesting/tree removal as a protective measure for the harvesting operations. o Install continuous turbidity monitoring stations downstream in advance of planned harvesting/tree removal. o Carry out HB pre-commencement Bird (Merlin), mammal (Red squirrel) surveys. o	*MM4, MM18* *MM19, MM24* *MM26, MM32* *MM42, MM44*

Practitioners' management implementation plan (summary)			
Main phases	**Main tasks**	**Description of actions**	**CEMP mitigation reference**
5. Removal of conifer trees	• Carry out harvest operations. • Collect site-specific water samples before, during and after harvesting.	o Carry out plan on a harvest block level as scheduled to Forest Service guidelines and Coillte Health and Safety guidelines. o Site foreman to carry out daily visual inspections. o Collect site-specific water samples before, during and after operations. o Link operations to turbidity thresholds and downstream water quality acceptable thresholds. o Link operations to prevailing weather conditions. o Pay contractor for all downtime. o Link operations to prevailing weather conditions. o Erect signage and do not obstruct access and egress routes. o No refueling, maintenance of machinery or timber stacks within 50m of an aquatic zone or within 20m of any other hydrological feature. o All machinery will be operated by suitably qualified personnel. o Follow refueling procedure. o Adhere to harvest site plan. o Adhere to H&S guidelines.	*MM3, MM4* *MM8, MM9* *MM10, MM11* *MM12, MM13* *MM14, MM15* *MM16, MM17* *MM18, MM19* *MM20, MM21* *MM22, MM23* *MM24, MM25* *MM26, MM27* *MM30, MM32* *MM35, MM37* *MM38, MM39* *MM43, MM47* *MM48, MM49* *MM50, MM52*
6. Initiate buffer zone creation	• Remove brash from buffer zones. • Complete manual works to make the buffer effective.	o Remove brash from all buffer zones at timber removal stage. o Once timer removed and buffers fully accessible, complete the manual installation of silt traps, silt curtains and dams.	*MM13, MM14* *MM16, MM17* *MM18, MM19* *MM21, MM22* *MM23, MM24* *MM26, MM27* *MM30, MM31* *MM32, MM35* *MM39, MM43*
7. Leave site fallow	• Leave site fallow to allow it to revegetate. • Pre-commencement surveys.	o The fallow period applies to the entire sub-catchment/sub-catchment. o Fallow period to be at least 1 year. o Fallow period only complete when the buffer zones is known to be effective. o An effective buffer is when the downstream, monitored water is within the acceptable thresholds, or when the buffer zone works are completed, and the buffer is fully vegetated. o Carry out archeology pre-commencement survey.	*MM4, MM18* *MM19, MM28,* *MM33, MM34,* *MM42,MM44,* *MM45, MM46,* *MM51*

Practitioners' management implementation plan (summary)			
Main phases	**Main tasks**	**Description of actions**	**CEMP mitigation reference**
8 (a). Carry out restoration works – bog restoration.	• Carry out the planned restoration works.	o Carry out restoration on a sub-catchment basis. o Link operations to turbidity thresholds and downstream water quality acceptable thresholds. o Link operations to prevailing weather conditions. o Pay contractor for all downtime. o Follow refueling procedure. o Erect signage and do not construct access and egress routes. o All machinery will be operated by suitably qualified personnel. o Follow refueling procedure. o Adhere to H&S guidelines. o Carry out a walk-over archaeological survey in advance of restoration works.	*MM3, MM4* *MM9, MM10* *MM11, MM12* *MM13, MM14* *MM15, MM18* *MM19, MM21* *MM22, MM24* *MM27, MM30* *MM32, MM33* *MM35, MM40* *MM42, MM43* *MM47, MM48* *MM49, MM50* *MM51 MM52*
8 (b). Carry out restoration works – pioneer native woodland	1. Deer fence the site 2. Cultivate the site 3. Plant the site 1. Site monitoring	o Erect the deer fence. o Cultivate the site. o Plant. o Monitor for survival.	*MM34, MM35* *MM41, MM43* *MM47, MM48* *MM49, MM52*
9 (a). All phases – monitoring	1. Water monitoring 2. Annual invasives control 3. Grazing management plan (including deer management). 4. General maintenance. 5. Fire plan 6. Site monitoring	o Link operations to prevailing weather conditions. o Daily visual checks by site foreman. o Follow water monitoring plan and ensure links in with operations are in place and followed. o Annual monitoring of tree survival rates where native woodland has been planted. o Invasive species monitoring & annual treatment interventions. o Vegetation monitoring plots have been established and will be used to monitor progress of restoration.	*MM3, MM4,* *MM5, MM6,* *MM15, MM18,* *MM26, MM28,* *MM29, MM30,* *MM35, MM42,* *MM44,MM45,* *MM46, MM47,* *MM48,MM49* *MM50, MM51,*

Appendix A: Water monitoring plan (summary)

A hydrological monitoring plan has been proposed for the Derryclare Wild Western Peatlands Project and this is summarised in the tables below.

The overall aim of the monitoring plan is to determine the hydrological success of the restoration project. This will be achieved by monitoring several key hydrological parameters pre- and post-construction.

- The key hydrological parameters generally used to characterise the success of a peatland restoration project are surface water flow volumes and the elevation of the peat water table relative to ground level.
- The plan includes the monitoring of groundwater levels, surface water hydrochemistry and flow volumes at appropriate and accessible monitoring locations within the project site;
- The groundwater level monitoring plan utilises the existing piezometer network at the project site, with groundwater levels being continuously recorded by dataloggers and downloaded at 6-month intervals.
- Surface water hydrochemistry and flow volumes will be recorded at 2 no. locations downstream of the proposed restoration works. It is proposed to complete the monitoring through the use of surface water quality probes and auto-samplers.
- Coillte have committed to completing the proposed hydrological monitoring for a period of 12 months pre-construction and for a period of 3-5 years post-construction.
- The pre-construction monitoring will help establish the baseline hydrological characteristics of the Derryclare Site.
- The operation phase monitoring data will be compared to this baseline data and any deviation from the baseline will be used to determine the overall success of the restoration project.
- In addition, intensive water quality monitoring will be completed throughout the construction phase. This water quality monitoring will concentrate on key parameters including turbidity and phosphorus and will be carried out in accordance with the CEMP.
- All data will be downloaded every 6-months and annual monitoring reports and trend analysis will be shared with all stakeholders and the NPWS.

Monitoring Location	Easting (ITM)	Northing (ITM)	Parameter	Auto/Manual	Monitoring Frequency	Data Download Frequency
Pre-Works Monitoring (Establishing the Baseline)						
SW1	483201	75304	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Phosphorus	Auto – sampler/grab samples	Monthly	N/A
			Flow	Auto – flume/logger	Continuous (15-minute intervals)	Biannual
				Manual – flow meter	Biannual	Biannual
SW2	483019	749322	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Phosphorus	Manual – grab sampling	Monthly	Biannual
			Flow	Auto – flume/logger Manual – flow meter	Continuous (15-minute intervals) Biannual	Biannual
P1 – P5	See Figure B below		21 no. parameters	Manual - grab samples	Monthly	N/A
DB2 – DB4 and DB-6	See Figure B below		Aquatic invertebrate communities	Manual – kick sampling	Annual	N/A
Existing Piezometers	See **Error! Reference source not found.** below		Water level	Auto – logger Manual – dip piezo	Continuous (2-hour intervals) Biannual dips	Biannual

Monitoring Location	Easting (ITM)	Northing (ITM)	Parameter	Auto/Manual	Monitoring Frequency	Data Download Frequency
Construction Phase (During Works)						
SW1	483201	75304	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
				Manual – grab sampling[1]	1 pre-works, on a weekly basis during works Turbidity event – daily samples until turbidity returns to baseline	N/A
			Phosphorus	Manual – grab sampling	Monthly	N/A
				Auto – sampler	1-week	Weekly
				Manual – grab sampling	Monthly	N/A
			Flow	Auto – flume/logger	Continuous (15-minute intervals)	Biannual
				Manual – flow meter	Biannual	Biannual
SW2	483019	749322	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
				Manual – grab sampling	1 pre-works, on a weekly basis during works Turbidity event – daily samples until turbidity returns to baseline	N/A
			Phosphorus	Manual – grab sampling	Monthly	N/A
				Auto – sampler	1-week	Weekly

[1] Construction Phase Only

				Manual – grab sampling	Monthly	N/A
			Flow	Auto – flume/logger Manual – flow meter	Continuous (15-minute intervals) Biannual	Biannual
P1 – P5	See Figure B below		21 no. parameters	Manual - grab samples	Monthly	N/A
DB2 – DB4 and DB-6	See Figure B below		Aquatic invertebrate communities	Manual – kick sampling	Annual	N/A
Additional Auto Sampling Locations	Downstream of works area		Turbidity / Temperature / Conductivity	Auto - probe	Continuous (15-minute intervals)	Weekly
Additional Grab Sample Locations	Downstream of works areas		Range of parameters including turbidity and phosphorus	Manual - grab sampling	1 no. sample before felling 1 no. sample during felling 1 no. sample post felling	N/A
Existing Piezometers	See **Error! Reference source not found.** below		Water level	Auto – logger Manual – dip piezo	Continuous (2-hour intervals) Biannual	Biannual

Monitoring Location	Easting (ITM)	Northing (ITM)	Parameter	Auto/Manual	Monitoring Frequency	Data Download Frequency
Post-Works (Determining the success of the Project)						
SW1	483201	75304	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Phosphorus	Manual – grab sampling	Monthly	N/A
			Flow	Auto –flume/logger	Continuous (15-minute intervals)	Biannual
				Manual – flow meter	Biannual	Biannual
SW2	483019	749322	Temperature	Auto – probe	Continuous (15-minute intervals)	Biannual
			Conductivity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Turbidity	Auto – probe	Continuous (15-minute intervals)	Biannual
			Phosphorus	Manual – grab sampling	Monthly	N/A
			Flow	Auto – flume/logger Manual – flow meter	Continuous (15-minute intervals) Biannual	Biannual
P1 – P5	See Figure B below		21 no. parameters	Manual - grab samples	Monthly	N/A
DB2 – DB4 and DB-6	See Figure B below		Aquatic invertebrate communities	Manual – kick sampling	Annual	N/A
Existing Piezometers	See **Error! Reference source not found.** below		Peat Water level	Auto – datalogger Manual – dip piezo	Continuous (2-hour intervals) Biannual	Biannual

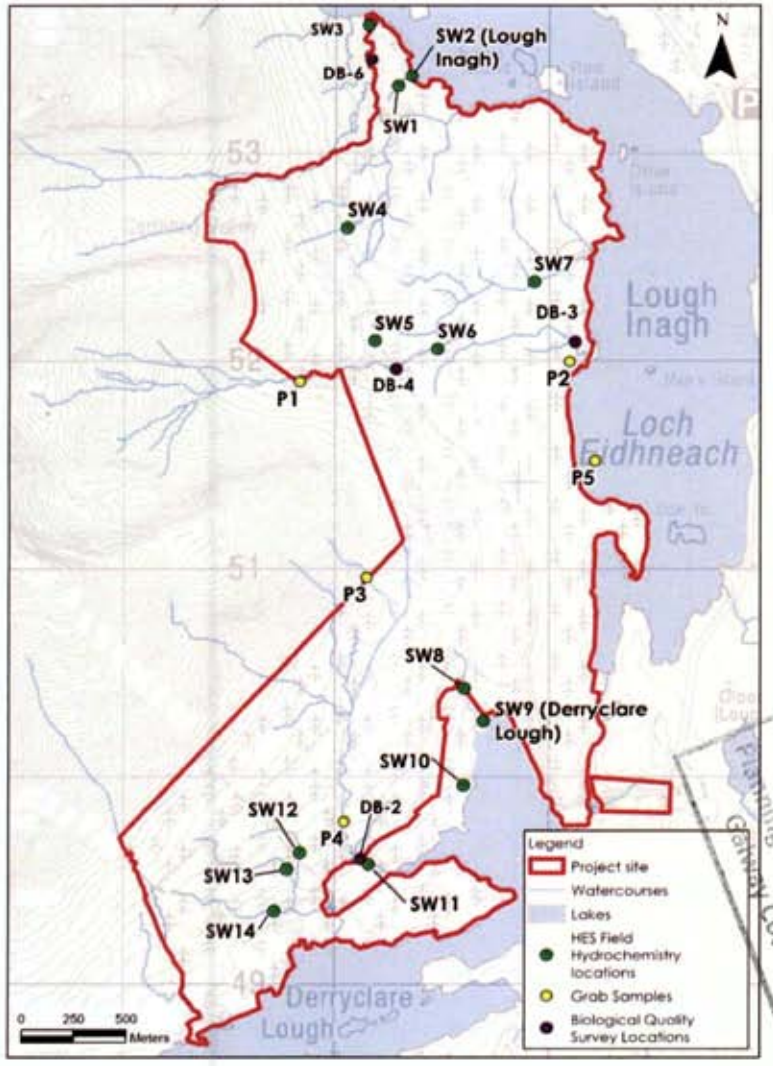


Figure B

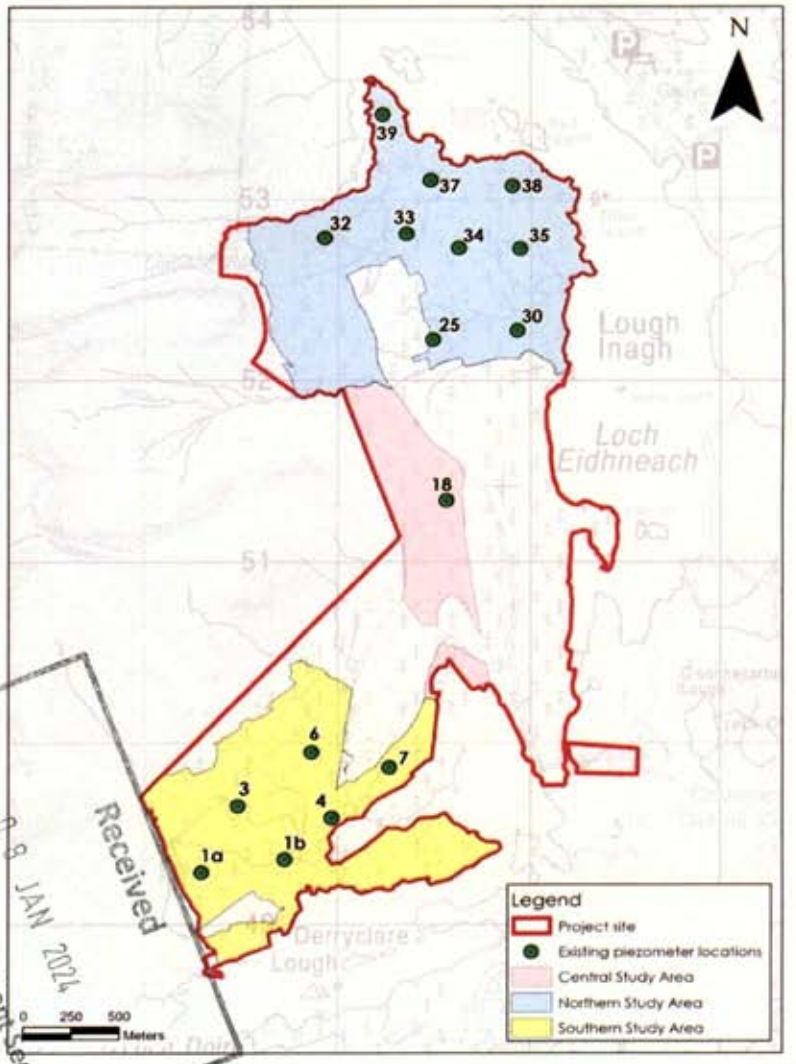


Figure C

Appendix B: Invasive species plan (summary)

Summary of the invasive species management plan

Following an ecological survey, the main invasive species threat in Derryclare was identified as Rhododendron ponticum and conifer reseeding, with no other invasives observed. The control of rhododendron is a priority as it is seen as one of the largest threats to the success of the restoration works. The baseline data has shown that rhododendron is present at a low-level on a property wide basis and it has the potential to become a large high-level infestation, especially once ground disturbance occurs during restoration. Therefore, annual property wide interventions are planned for Derryclare. The treatment will adopt the methodology researched by the NPWS in the adjoining forest property in Kylemore (described below). The treatment has proven itself to be suited to the conditions in Connemara and it is expected to be a good fit for Forest to bog projects. The entire property will be treated annually, so that by the time initial tree removal begins, most of the rhododendron stems will be dead and can be windrowed along with the forest brash. In addition, all newly restored areas will also be included in the annual treatment, so that all new saplings will be treated or removed. As the restoration programme is spread out over 8 years, the expectation is that all restored areas will be free from rhododendron, and this will be used as one measure to monitor the success of the treatment programme. This annual approach, although intensive, is deemed necessary to manage the rhododendron threat in Derryclare. Intermittent surveys will be carried out to monitor progress, including the visual surveys and sampling surveys described below. New survey methods such as drone surveys or remote sensing can also be adopted, if proved successful. These surveys occur when the rhododendron is flowering and can be a cost-effective way to map a site. Conifer reseeding will be manged in two ways, namely by a) creating unfavourable conditions for seeding germination by removing where possible the raised dry plough ridge using surface smoothing, and 2) where seedlings regenerate, these will be removed when they are young enough to be pulled up out of the ground or cut with a garden lopper. In terms of carrying out the site works, it is planned to link in with Forum Connemara, who in co-operation with the NPWS have set up a dedicated local work gang to treat rhododendron in Connemara. This gang has already been employed to carry out the detailed baseline mapping described below. Treatment of rhododendron will be one of the first actions to be scheduled and it will remain a priority throughout the project.

Table 2: The planned schedule for managing rhododendron in the Derryclare bog restoration programme.

Year	Bog restoration schedule	Rhododendron treatment
0	Secure planning permission and felling licences.	• Property wide treatment of all mature rhododendron plants and seedlings in flower.
1	Year 1 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Monitor emerging seedlings from recently restored areas.
2	Year 2 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower • Pull/threat emerging seedlings from recently felled areas. • Monitor emerging seedlings from recently restored areas.
3	Year 3 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from year 1 & 2 felled areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline.
4 to 7	Year 4 to 7 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas. • Monitor emerging seedlings from recently restored areas.
8	Year 8 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline.

Appendix C: Grazing management plan (including deer management) (summary)

Summary

The grazing pressure in Derryclare comes from livestock (mostly sheep) and deer. The maintenance plan initially involves the construction of an external sheep fence to ensure that the entire property is fenced off. All livestock will be removed before the fence is completed. An internal deer fence will be erected to fence off the area where pioneer native woodland will be established. The site will be monitored for trespass and appropriate action taken where required, up to and including impounding. Regular checks will be made to the fence-lines to ensure they remain intact, and any breaches or faults will be repaired as a matter of urgency. Coillte have a process for impounding livestock and this process will be followed if impounding is required. Deer culling will not be used in the grazing maintenance plan as Coillte do not own the shooting rights on site. Any deer culling will only occur in agreement with the relevant stakeholders and within the law. To date, there are no immediate plans to carry out any deer culls.

Table 3: The grazing management plan by year during the restoration works.

Years	Restoration plan	Grazing plan
0 (2023)	Secure planning permission and felling licences.	• Complete external sheep fence on external boundary. • Exclude livestock from all site. • Monitor all site for trespass.
1 (2024)	Bog restoration site.	• Check sheep fence line. • Monitor all site for trespass.
2 (2025)	Pioneer native woodland sites.	• Erect deer fence stage 1. • Check sheep fence line. • Monitor all site for trespass.
3 (2026)	Pioneer native woodland sites.	• Erect deer fence stage 2. • Check sheep fence line. • Monitor all site for trespass.
4 to 8	Bog restoration sites.	• Check deer fence line. • Check sheep fence line. • Monitor all site for trespass.

Appendix D: General maintenance plan (summary)

Summary

General maintenance is a catch all that refers to addressing outstanding issues, other than invasive species, deer and livestock grazing and fire, which are all detailed separately. General maintenance on this plan includes a wide variety of tasks such as road maintenance, silt trap and dam inspections and repairs, public usage, dumping, vandalism, erection, and repair of signage, dealing with the public and local requests arising from consultations. For Derryclare the most important general maintenance is expected to be silt trap and dam inspections and maintenance, keeping the main access road in good repair and dealing with issues with the general public such as dumping and vandalism.

Table 4: Main items to manage in the general maintenance plan and the required standard.

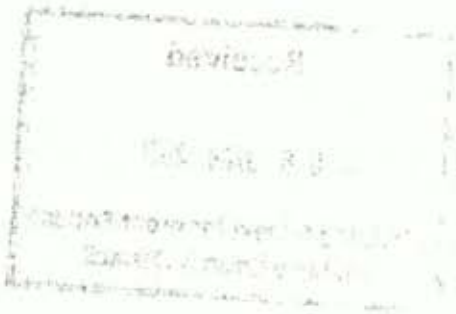
No	Description	Required standard
1	Main forest road.	Maintain good surface dressing, free from potholes.
2	Roadside drains.	Allow to revegetate.
3	Roadside silt traps.	Effective. Water flowing. Not silted up.
4	Roadside dams.	Effective. Water flowing. Not silted up
5	Silt traps in buffer zones.	Effective. Water flowing. Not silted up.
6	Leaky dams in buffer zones.	Effective. Water flowing. Not silted up
7	Dams in buffer zones.	Effective. Water not flowing.
8	Silt traps in restored areas.	Effective. Water flowing. Not silted up.
9	Dams in restored areas.	Effective. Water not flowing.
10	Silt curtains.	Effective and securely in place.
11	Signage.	In good condition, not vandalised.
12	Dumping.	None on site. Remove when observed.
13	Vandalised signage.	Repair when observed.
14	Vandalised forest barriers.	Repair when observed.
15	Access for the public.	Adhere to open forest policy.
16	Restrict public access.	Adhere to Health & safety requirements.
17	Sondes.	Securely in place and operating effectively.

Appendix E: Fire plan (summary)

Summary

The threat from fires is an annual threat in Connemara. For most of the year from June to February the threat is low but for the months from March to May, the threat is high. Between the months of March to May the vegetation is at its driest and most prone to fire. In addition, before it became illegal, the traditional practices of "setting fires" coincides with these months, and unfortunately this practice occurs illegally from time to time. For both of these reasons, the threat of fires needs to be taken seriously in Derryclare and managed. Fires tend to burn only the surface vegetation and drier features such as hummocks but leave much of the wet surface relatively intact. For infrequent fires there is generally sufficient time for the bog surface vegetation to recover, but for more frequent and severe fires, (where the fire burns under the surface) it can take more than 50 years for Sphagnum plants to return when burning has produced a bare peat surface (Evans & Warburton, 2007).

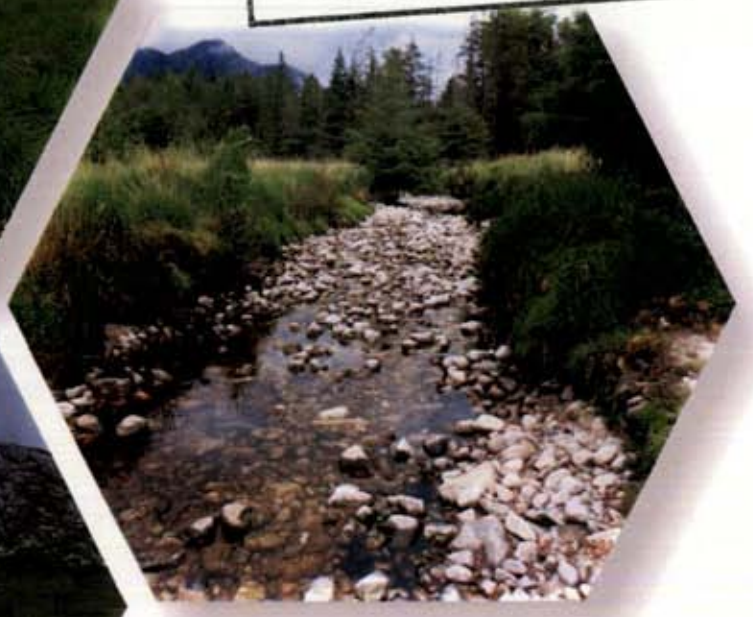
Derryclare property lies with the Coillte management area called BAU2. This BAU has a designated fire plan and resources to tackle wildfires and Derryclare will remain part of this fire plan. These resources include a helicopter call out during the fire season, access to trained fire fighters, established access to local fire brigades, experienced volunteers, and access to the full range of firefighting equipment including fire trailers, beaters, PPE, drones, ATVs, pumps and generators.



APPENDIX 3

BIOLOGICAL & CHEMICAL MONITORING OF SURFACE WATERS REPORT PREPARED BY MAYFLY ECOLOGY

MAYFLY
ECOLOGY



Biological & Chemical Monitoring of Surface Waters

Derryclare & Cappaghoosh

21st July 2023

Draft Version 01

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Acronyms

DB – Derryclare biology
CB – Cappaghoosh biology
EPA – Environmental Protection Agency
EQS – Ecological Quality Standard
LOD – Limit of Detection
QI – Qualifying Interest
Ortho-P – Orthophosphate
OSI – Ordnance Survey Ireland
OSI – Ordnance Survey Ireland
SAC – Special Area of Conservation
SPA – Special Protection Area
WFD – Water Framework Directive

1. INTRODUCTION

1.1. Background

The Wild Western Peatlands is a Coillte Nature project which aims to restore and rehabilitate approximately 2,100 hectares of Atlantic blanket bog and wet heath currently planted with commercial spruce and pine forests. Part of this project involves the regular biological and chemical monitoring of surface waters.

Mayfly Ecology was commissioned by Coillte to undertake a programme of biological monitoring (macroinvertebrates) of surface waters at 11 sites across the Derryclare and Cappaghoosh properties in Co. Galway. The sites had been previously selected by Coillte via desktop analysis and this survey represented the first round of monitoring. Therefore, sites needed to be verified on the ground to assess whether they were suitable for biological monitoring. It is intended that suitable sites will then be surveyed on an annual basis. The first round of biological monitoring for all 11 sites was undertaken by Letizia Cocchiglia of Mayfly Ecology.

A programme of monthly water sampling for chemical analysis commenced in January 2023 at 18 sites across Derryclare and Cappaghoosh properties. Water sampling was undertaken by Coillte and laboratory analysis by Fitz Scientific. Mayfly Ecology was commissioned to analyse the results of the chemical analysis.

This report summarises the results of the June 2023 biological monitoring for the 11 sites and also summarises the first set of results of the monthly chemical analysis for 18 sites. The results will represent a baseline condition prior to any remediation works being carried out for both properties.

1.2. Site Location and Description

The biological and chemical sample sites are split between two properties, Derryclare and Cappaghoosh in Connemara, Co. Galway (**Figure 1-1** & **Figure 1-2**). The sample sites within Derryclare are displayed in **Figure 1-3** and for Cappaghoosh the sites are displayed in **Figure 1-4.** General site details can be found in **Table 1-1** & **Table 1-2** for each property and each is described separately below.

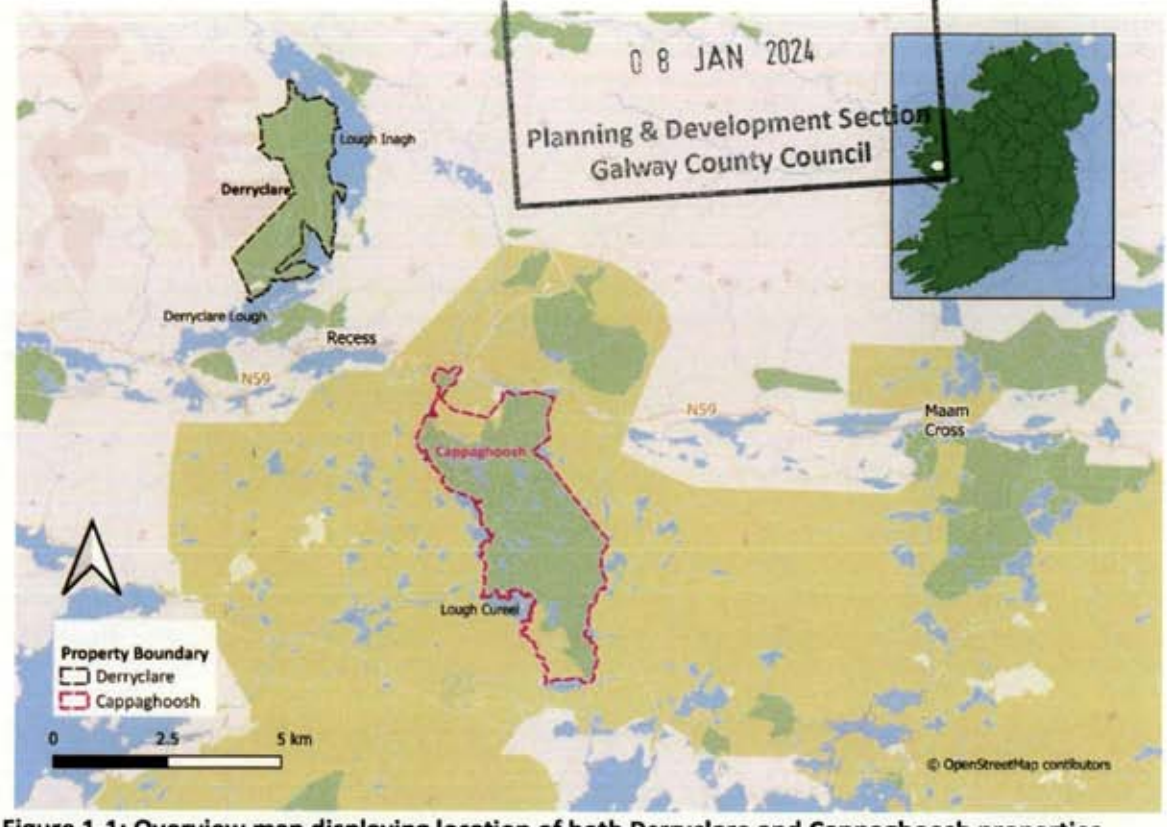

Figure 1-1: Overview map displaying location of both Derryclare and Cappaghoosh properties.

Figure 1-2: Aerial image of the Derryclare and Cappaghoosh properties.

1.2.1. Derryclare

The Derryclare property is located in Connemara near Recess, Co. Galway just north of the N59 Galway to Clifden road. General property co-ordinates are 53.49521, -9.74929. The property is nestled between the Twelve Bens Mountain range to the west and the shorelines of Lough Inagh and Derryclare Lough to the east and south respectively. The Twelve Bens/Garraun Complex Special Area of Conservation (SAC) borders the entire property and includes both aforementioned loughs. Qualifying interest (QI) habitats of this SAC include; Old oak woodland [91A0], Alpine and subalpine heath [4060], Blanket bogs [7130], Rhynchosporion depressions [7150], Rocky slopes [8210,8220], Oligotrophic isoetid lake [3110] and Mixed *Najas flexilis* lake [3130]. QI species include; Freshwater pearl mussel [1029], Atlantic salmon [1106], Otter [1355] and Slender naiad [1833]. Derryclare Nature Reserve is located in the south western section of the property which contains one of the best examples of old oak woodland within the SAC and a successful red squirrel introduction programme was undertaken here in 2005.

Brown trout, sea trout and Atlantic salmon are known to occur in both Inagh and Derryclare loughs. There are historic records (1945) of Arctic charr within Derryclare. More recent records of Artic charr exist in Lough Inagh with anglers reported to be catching the occasional charr up to 2001 (Igoe *et al.*, 2003). The current status of this glacial relict in these lakes is unknown.

Both loughs and the rivers flowing into them are within the Ballynahinch -Ballynahinch Lake freshwater pearl mussel sensitive area. There have been records of this species in this catchment but current status is unknown.

Six sites had been selected via desktop analysis for biological sampling and five sites for water chemistry analysis. Most of the rivers here rise from the steep slopes of the Twelve Bens Mountain range and flow in an easterly / south easterly direction before entering Inagh or Derryclare loughs. These are relatively short rivers under 3km in length. In the upper reaches they are typical fast boulder dominated mountain streams, while the lower reaches are characterised by blanket bog and heath most of which has been afforested. None of these rivers are named on OSI mapping. They are all coded as being part of the Recess_020 waterbody by the EPA.

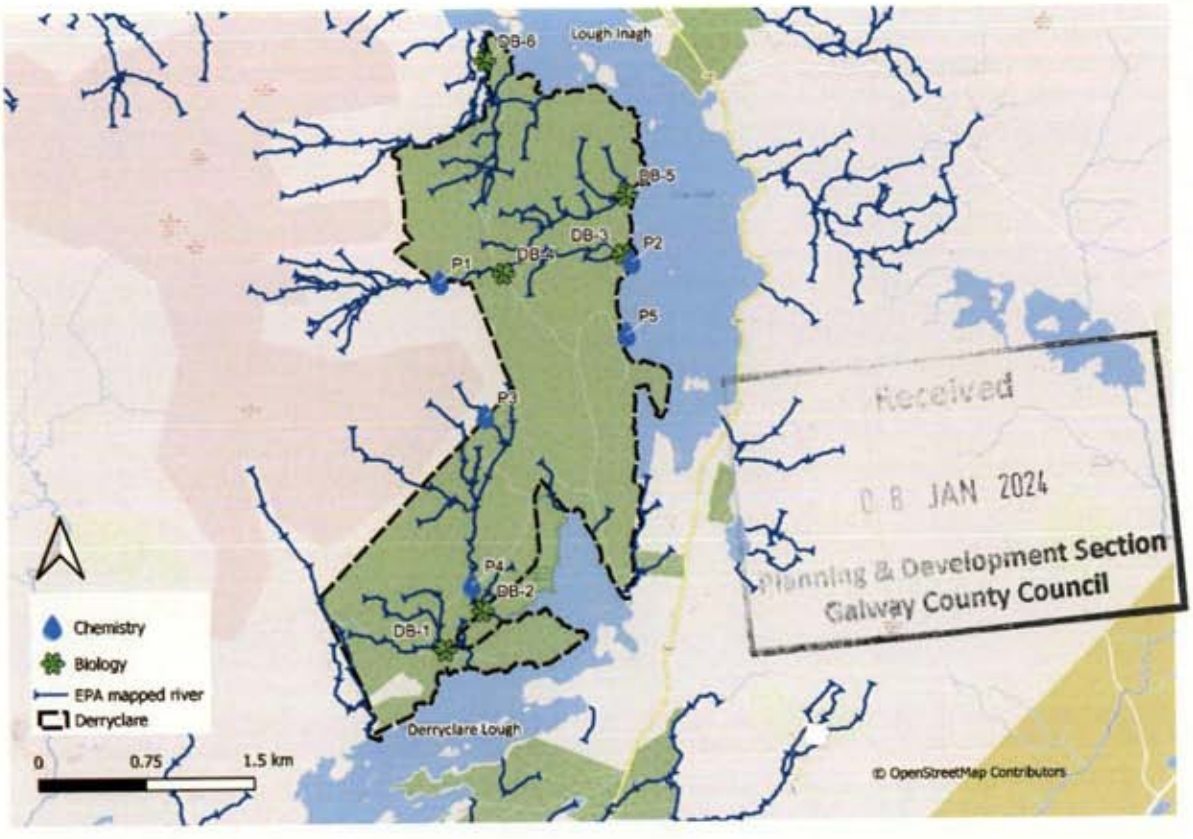

Figure 1-3: Map displaying sample site locations in the Derryclare property.

1.2.2. Cappaghoosh

The Cappaghoosh property is also located near Recess, Connemara in Co. Galway. General coordinates for the property are 53.44478, -9.68832. Cappaghoosh lies directly south-east of Derryclare and south of the N59 Galway to Clifden road. The Connemara Bog Complex SAC borders almost the entire property. This is a large SAC with extensive tracts of blanket bog and many other varied habitats. QI habitats include; Oligotrophic isoetid lake [3110] and Mixed *Najas flexilis* lake [3130], Acid oligotrophic lake [3160], Vegetation of flowing waters [3260], Wet heath [4010], Dry heath [4030], Molinia meadows [6410], Blanket bog [7130], Transition mires [7140], Rhynchosporion depressions [7150], Alkaline fen [7230] and Old oak woodland [91A0]. This is a large SAC stretching to the coastline and also includes some marine QI habitats. QI species includes; Marsh fritillary [1065], Atlantic salmon [1106], Otter [1355] and Slender naiad [1833]. It is also surrounded by the Connemara Bog Complex SPA designated for Cormorant [A017], Merlin [A098], Golden plover [A140] and Common gull [A182].

Little information is known about the fish populations within waterbodies that flow through Cappaghoosh. To the north and outside of the property, Lough Glendollagh is private fishery with Atlantic salmon and brown trout. This lake is downstream of sample sites CB-A and CB-B and it is considered likely salmon and trout would also be present within the river at these sites. There are also historic records (1945) of Arctic charr within this lake but current status is unknown (Igoe *et al.*, 2003).

The rivers within the Cappaghoosh property are not designated as freshwater pearl mussel sensitive areas but the river at site CB-A and CB-B is designated as the Ballynahich- Caher freshwater pearl mussel sensitive area falling into the category: Catchments with other extant populations.

The Cappaghoosh property lies within a relatively flat landscape consisting of mainly blanket bog. It is studded with numerous lakes that are interconnected with small streams and rivers. A large portion of the bog had been afforested with spruce and pine. Some areas of bog remain intact (albeit modified) and in 2007 some bog remediation took place in Cappaghoosh. A programme of tree felling to waste was undertaken with some minimal drain blocking along the north and north east of Lough Curreel.

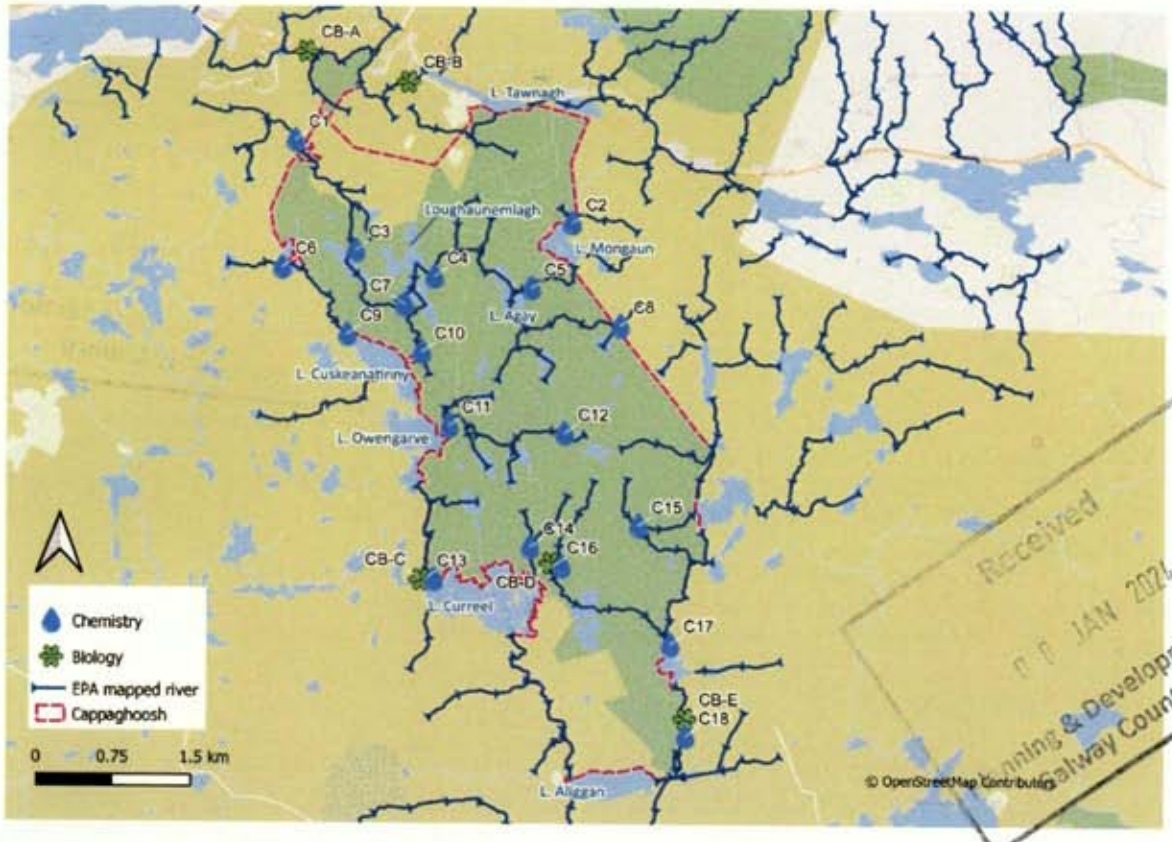

Figure 1-4: Map displaying biological and chemical sample sites in the Cappaghoosh property.

Table 1-1: Site coordinates and codes for biological monitoring points, DB = Derryclare Biology, CB = Cappaghoosh Biology

Site code	Property	Lat	Long	EPA waterbody name	Description (approx. length of main channel)
DB-1	Derryclare	53.48118	-9.76519	Recess_020	Rises within Derryclare property, flows through the nature reserve and discharges to Derryclare Lough (c.1km).
DB-2	Derryclare	53.48367	-9.76132	Recess_020	Rises in foothills of Derryclare Mt. Flows though the nature reserve and discharges to Derryclare Lough (c. 2km).
DB-3	Derryclare	53.50622	-9.74725	Recess_020	Rises between Bencorr and Derryclare Mts and enters Lough Inagh (c. 2.8km).
DB-4	Derryclare	53.50484	-9.75973	Recess_020	Located c.935m u/s of DB-3 in same channel (c. 2.8km).
DB-5	Derryclare	53.50996	-9.74706	Recess_020	Rises within the Derryclare property and discharges to Lough Inagh (c. 1.2km).
DB-6	Derryclare	53.51832	-9.76209	Recess_020	Rises at Bencorrbeg Mt and discharges to Lough Inagh opp. Deer Island. (c. 2.5km).

Site code	Property	Lat	Long	EPA waterbody name	Description (approx. length of main channel)
CB-A	Cappaghoosh	53.46323	-9.71129	Recess_010	Also known as Caher/Owentooey River. This channel section flows from Lough Tawnagh (Park Lough) and discharges to Glendollagh Lough (c. 3.2km).
CB-B	Cappaghoosh	53.46084	-9.6966	Recess_010	1.7km u/s of CB-A in same channel. This site is c. 150m downstream Tawnagh Lough.
CB-C	Cappaghoosh	53.41824	-9.69301	Invermore_020	Also known as Owengarve River. This channel section flows from Owengarve Lough and discharges to Lough Curreel (c. 1km). Site is just u/s L. Curreel
CB-D	Cappaghoosh	53.41996	-9.67442	Invermore_010	Rises from small lough near the centre of Cappaghoosh property and discharges to Lough Duff and then flows into Bunnahask Lough (c. 2.5km).
CB-E	Cappaghoosh	53.40698	-9.65463	Invermore_010	Rises from Bunnahask Lough and discharges to Lough Alligan (c. 930m).

Table 1-2: Site coordinates and codes for water chemistry monitoring points.

Site code	Property	Lat	Long	EPA waterbody name	Description (approx. length of main channel)
P1	Derryclare	53.5042	-9.7665	Recess_020	Located in same channel as biological sample DB-3 & DB-4. Site is c. 490m u/s DB-4
P2	Derryclare	53.50576	-9.74633	Recess_020	Located in same channel as biological sample DB-3 & DB-4. Site is c. 105m DB-3 just before river enters Lough Inagh.
P3	Derryclare	53.49583	-9.76142	Recess_020	Rises in foothills of Derryclare Mt. Site is a small 1st order stream in the upper reaches. P4 sample site is 1.3km d/s in main channel. Biological sample site DB-2 is also in main channel c.1.6km d/s.
P4	Derryclare	53.48528	-9.76255	Recess_020	Rises in foothills of Derryclare Mt. Located 1.3km d/s P3 and 0.3km u/s DB-2.
P5	Derryclare	53.50114	-9.74674	Lough Inagh	Western shoreline of Lough Inagh.
C1	Cappaghoosh	53.45552	-9.71249	Invermore_020	Short river u/s of the north-western boundary of Cappaghoosh property. Sample site just before river enters Loughaunanny (1.1km)
C2	Cappaghoosh	53.44907	-9.67266	Invermore_020	Short river u/s of the north eastern boundary of property. Sample site just before river enters Lough Mongaun (713m)
C3	Cappaghoosh	53.44620	-9.70342	Invermore_020	River within north-western section of property Sample site just u/s Lough Fadda. Channel rises from Loughaunanny.
C4	Cappaghoosh	53.44415	-9.69217	Invermore_020	River within northern section of property. Site is between Loughaunemlagh and Lough Agay.
C5	Cappaghoosh	53.44342	-9.67822	Invermore_020	Site within north-eastern section of property just before outlet to L. Agay.
C6	Cappaghoosh	53.44458	-9.71388	Invermore_020	Short channel just outside and u/s of north—western section property. Sample site just before outfall to Lough Minnaun and d/s of Clogheratinny Lough.

Site code	Property	Lat	Long	EPA waterbody name	Description (approx. length of main channel)
C7	Cappaghoosh	53.44169	-9.69634	Invermore_020	River within north-western section of property. Sample site between Lough Fadda and Loughaunemlagh.
C8	Cappaghoosh	53.44042	-9.66535	Invermore_020	Site just outside eastern boundary and u/s of property. Near source of river which flows toward Lough Agay.
C9	Cappaghoosh	53.43903	-9.70434	Invermore_020	Site on north western boundary of property. Sample site just before L. Cuskeanatinny and d/s L. Minnaun.
C10	Cappaghoosh	53.43770	-9.69373	Invermore_020	Site within western section of property just before L. Cuskeanatinny and d/s Loughaunemlagh
C11	Cappaghoosh	53.43149	-9.68945	Invermore_020	Western boundary of property just before outlet to L. Cuskeanatinny.
C12	Cappaghoosh	53.43112	-9.67291	Invermore_020	Central section of property and same channel as C12 but located in upper reaches of the channel.
C13	Cappaghoosh	53.41827	-9.69246	Invermore_020	South-western boundary of property just before outlet to L. Cureel.
C14	Cappaghoosh	53.42131	-9.67738	Invermore_020	Within southern section of property upstream of L.Cureel.
C15	Cappaghoosh	53.42339	-9.66194	Invermore_010	Within south eastern section of property within short channel flowing toward L. Arusheen
C16	Cappaghoosh	53.41971	-9.67394	Invermore_010	Same monitoring point as biology sample CB-D. Rises from small lough near the centre of Cappaghoosh property and discharges to Lough Duff and then flows into Bunnahask Lough. Site can be dry and in this case the sampler took samples from the drainage ditches perpendicular to the river.
C17	Cappaghoosh	53.41326	-9.65692	Invermore_010	On boundary of southern section of property just before outlet to L. Bunnahask
C18	Cappaghoosh	53.40548	-9.65441	Invermore_020	Rises from Bunnahask Lough and discharges to Lough Alligan (c. 930m).

2. METHODOLOGY

2.1. Desktop Review of Existing Water Quality

A desktop review was completed to gather baseline water quality information. The review included a search of current Water Framework Directive (WFD) status and summary of EPA biological monitoring results (if available).

The characterisation process for the 3rd Cycle River Basin Management Plan has been completed and the report for the relevant catchment was reviewed. The results of this process for the survey site are summarised in the results.

WFD Priority Areas for Action are areas where action will be carried out in the River Basin Management Plan (RBMP). The Areas for Action were selected based on the priorities in the RBMB, the evidence from the WFD characterisation process, and the expertise, data and knowledge of public

body staff with responsibilities for water and the different pressure types. The Local Authority Waters Programme (LAWPRO) conduct assessment work within the Area for Action. EPA mapping tools were used to assess if the relevant water bodies lie within a Priority Area for Action.

The following sources were consulted to conduct the desktop review.

- Environmental Protection Agency (EPA) online mapping tools (https://gis.epa.ie/EPAMaps) and (https://www.catchments.ie/maps/) for waterbody information and mapping;
- Environmental Protection Agency (EPA) catchment characterisation report (EPA 2021) Available online (https://catchments.ie/wp-content/files/catchmentassessments/25B%20Lower%20Shannon%20Catchment%20Summary%20WFD%20Cycle%203.pdf).

The main biological index used by the EPA in determining the quality of Irish rivers is the Q-value. **Table 2-1** below summaries the Q-value index and relationship with water quality. The desktop review included a search of the EPA biological monitoring data results from the closest monitoring station relevant to the proposed development.

Table 2-1: Relationship between the Q-value and water quality (Table adapted from EPA river quality survey reports).

Q-value	Biological Quality[1]	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

2.2. Survey Methodology

Water samples were taken by Coillte once a month from January/February to April 2023 across 18 sites. The methodology for sampling is not described in this document as it was conducted by another party. For the same reasons the methodology for water chemistry analysis is not described but followed standard operating procedures for each parameter. In total 21 parameters are analysed and these are listed below.

Alkalinity (mg/L $CaCO_3$)	Manganese (µg/L)
Aluminium (µg/L)	Nickel (µg/L)
Ammonia (mg/L as N)	Nitrate (mg/L as N)
Calcium (mg/L)	pH (pH Units)
Conductivity (at 20C)	Phosphate-Ortho (mg/L)
Copper (µg/L)	Phosphorus-Total (mg/L as P)
Dissolved Organic Carbon (mg/L)	Potassium (mg/L)
Dissolved oxygen (mg/L)	Sodium (mg/L)
Hardness Total (mg/L $CaCO_3$)	Solids-Total Suspended (mg/L)
Iron (µg/L)	Zinc (µg/L)
Magnesium (mg/L)	

[1] The Q-value has been developed for rivers only. It does not equate to WFD Status however, in Ireland it is often the driving element in status assignment. It is the most common index that is used to calculate Ecological Status for the WFD. The other biological indicator used in rivers is fish and monitored by Inland Fisheries Ireland.

A freshwater ecology survey was undertaken in Derryclare and Cappaghoosh on the 15th-17th June 2023. The following information was collected during the freshwater ecology survey and detailed methodology for each of these surveys is given in the following sections below.

- General habitat survey (includes physical characteristics and riparian zone structure)
- Biological quality survey - Macroinvertebrates
- Aquatic plant observations (macrophyte, macroalgae, bryophytes and liverwort)
- Physiochemical parameters
- Invasive species observations
- Other species/ features of note

2.2.1. General River Habitat Characteristics

At each sampling location the general river habitat characteristics were recorded broadly following those listed within the Environment Agency's *'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual'* (EA, 2003) and *Northern Ireland Environment Agency's 'River Hydromorphology Assessment Technique (RHAT) Training Manual* (NIEA, 2014). Characteristics recorded include the following;

- Substrate type, degree of overlying sediment and note of sediment generated when substrate disturbed.
- Flow conditions and velocity.
- Riparian zone structure which includes a list of the dominant bankside vegetation and degree of shading along the river.
- General hydromorphological characteristics including; river depth, width, bank height, signs of erosion or modification and barriers to connectivity.

2.2.2. Physio-chemical parameters

Hand held probes were used to record physiochemical parameters insitu. Probes used included Oxygaurd Handy Polaris and Hanna Combo which were calibrated before use.

- Dissolved oxygen (% and mg/l).
- pH (pH unit).
- Temperature (°c).
- Conductivity (µS/cm).

2.2.3. Biological Quality Survey - Macroinvertebrates

Macroinvertebrates were collected using a two-minute (or longer may be required in certain substrate conditions) kick sampling method with a standard hand net (1 mm mesh). The survey technique adhered to ISO Standard 10870:2012 and CEN FprEN 16150:2011 for kick sampling and utilised the EPAs standard protocol. Stone washing (1 minute) was also undertaken to ensure collection of species which cling to rock surfaces. The collected sample was tipped into a white tray and macroinvertebrates identified in the field to the lowest taxonomic level possible.

The main biological index used by the EPA in determining the biological quality of Irish rivers is the Q-value. This ranges on a scale from Q1 (Bad biological quality) to Q5 (High biological quality).

The Q-value is based on macroinvertebrate sensitivity to pollution with Group A taxa being the most sensitive and Group E taxa being the most tolerant.

Group A – Sensitive
Group B – Less sensitive
Group C – Tolerant
Group D – Very tolerant
Group E – Most tolerant

Q-values were assigned as per EPA published guidance (McGarrigle *et al.*, 2002; Toner *et al.*, 2005) with the surveyor taking into account river typology, seasonality and habitat conditions as per EPA guidance The information collected during the general river habitat characteristic survey was used to inform Q-value assignment.

The Q-value mainly reflects the effects of organic pollution (i.e., deoxygenation and eutrophication) but where a toxic effect is apparent or suspected the suffix '0' is added to the biotic index (e.g., Q1/0, 2/0 or 3/0). An asterisk after the Q value (e.g., Q3*) indicates heavy siltation of the substratum.

2.2.4. Aquatic plant observations

Any aquatic macrophytes observed were recorded and percentage cover noted. This included submerged/ emergent plants and those growing along the bankside. In addition, the percentage cover of any macroalgae, bryophytes and liverworts were also recorded. Plants and algae were identified to the lowest taxonomic level possible in the field.

2.2.5. Invasive plant species

Any invasive aquatic or riparian plants listed on the Third schedule of the EC (Birds and Natural Habitats) Regulations 2011 (S.I.477/2011) were noted.

2.2.6. Other species / features of note

The presence or signs of Annex I habitat or Annex II species or other protected species if present were noted such as those protected under the Wildlife Act 1976 (as amended), Flora Protection Order 1980 (as amended) or any other species or habitats that are rare.

2.3. Biosecurity

For all freshwater ecological surveys, the surveyor employs strict biosecurity methodology. The surveyor is familiar with invasive plant and animal species that occur in Ireland and before any site is visited a review of any aquatic or terrestrial invasive species records is conducted using the National Biodiversity Data Centres (NBDC) online mapping tool to assist in biosecurity planning. Once on site, should any invasive plant species be present their location is recorded and disturbance of the area avoided.

The surveyor employs the Check – Clean – Dry protocol as recommended by Inland Fisheries Ireland. Before leaving the sampling site all equipment (waders, nets, buckets, trays etc) are checked and any visible debris removed. Equipment is then cleaned using a solution approved for use near water and recommended dosage (Virkon® Aquatic). All equipment is then stored and allowed to dry thoroughly

before reuse. The surveyor holds a second set of gear which is used if sampling more than one catchment in a day.

The surveyor is aware of the current outbreak of crayfish plague (*Aphanomyces astaci*) which is easily spread on contaminated equipment. The latest advice on sampling rivers with known outbreaks will be adhered to. Should there be multiple sites on the same watercourse the surveyor will start in the upper reaches to avoid transmission in an upstream direction. All the equipment will be treated appropriately before re-use, in some cases a second set of clean equipment may be used. Any signs of crayfish plague will be reported immediately to relevant authorities.

3. BIOLOGICAL RESULTS

Section 3.1 discusses the results of the desktop study and known existing biological water quality. **Section 3.2** and **Section 3.3** discusses the results of the biological (macroinvertebrate) monitoring for Derryclare and Caphaghoosh respectively.

An overall summary for each property is given at the start of each section and then each site is discussed individually for more detail. Please see **Appendix A** for summary tables of the general conditions observed at each site as well as a breakdown of the macroinvertebrates identified.

3.1. Existing Biological Water Quality

The biological monitoring sites are located in remote areas which are difficult to access. While the EPA monitor a vast network of rivers in Ireland the majority of the rivers in this project are not monitored individually by the EPA. Instead, rivers which are considered to have similar characteristics are grouped together by the EPA into one waterbody. This means that one waterbody can consist of several individual rivers which are not connected to each other but have similar characteristics. One of the rivers in this waterbody will be monitored and then a status is applied which encompasses all the rivers that fall into that waterbody.

There is an EPA biological monitoring station on the Recess_010 approximately 514m upstream of sample site CB-B and site CB-A is also located on this river. A Q4 was assigned indicating Good biological quality in 2021. However, the overall WFD Status is Moderate due to supporting chemistry conditions and previous moderate biological quality within the monitoring cycle. This river waterbody is At Risk of failing to achieve WFD objectives (2016-2021). The characterisation process for the 3rd Cycle RBMP has been completed for the Galway Bay North catchment by the EPA (EPA, 2021). As part of this process significant pressures are assigned to waterbodies which are At Risk. Significant pressure assigned to the Recess_010 is; Agriculture (chemical pollution as a result of sheep dip).

For the Recess_020 waterbody there are no EPA monitoring points at all. In this case a WFD status is based on modelling and High WFD status (2016-2021) has been assigned. Monitoring sites DB-1 to DB-6 are all located within this waterbody.

For the Invermore_010 there is an EPA biological monitoring station at sample site CB-E upstream of Invermore Lough. A Q3-4 indicating Moderate biological quality was assigned in 2021 and the waterbody has been assigned Moderate WFD Status (2016-2021). The waterbody is At Risk of failing to achieve WFD objectives. The significant pressure assigned to this waterbody is; Forestry (including clear felling and associated drainage). Sample sites CB-D is located upstream of the EPA monitoring point.

Finally, for Invermore_020 there is an EPA biological monitoring station at the outlet of Invermore Lough. Sample point CB-C is on this waterbody but in a separate stream. At the EPA monitoring point a Q3 indicating Poor biological quality was assigned in 2021 and the waterbody has been assigned Poor WFD Status (2016-2021), the river is At Risk of failing to achieve WFD objectives. The significant pressures assigned to this waterbody are; Domestic wastewater, Forestry and Peat extraction & drainage.

Figure 3-1: Modelled WFD Status (2016-2021) for Derryclare.

Figure 3-2: WFD status (2016-2021) and most recent EPA Q-values for Cappaghoosh.

Table 3-1: WFD Status 2016-2021 (*status is based on modelling).

Site code	Property	EPA waterbody name	WFD Code	WFD Status	WFD Risk (3rd Cycle)
DB-1 to DB-6 P1 to P4	Derryclare	Recess_020	IE_WE_31R010500	High*	Not at risk
P5	Derryclare	Lough Inagh	IE_WE_31_232	High	Not at risk
CB-A, CB-B	Cappaghoosh	Recess_010	IE_WE_31R010400	Moderate	At risk
CB-C C1 to C14, C18	Cappaghoosh	Invermore_020	IE_WE_31I010500	Poor	At risk
CB-D, CB-E C15 to C17	Cappaghoosh	Invermore_010	IE_WE_31I010080	Moderate	At risk

Table 3-2: Summary of EPA Q-value results for the last three EPA monitoring cycles.

Water body name	WFD code	EPA station code & name	Closest Sample site	EPA Q-value
Recess_010	IE_WE_31R010400	31R010100 Bunskannive Bridge	CB-A	Q3-4 (2019) Q3-4 (2020) Q4 (2021)
Invermore_010	IE_WE_31I010080	31I010080 0.4km d/s L Bunnahask	CB-E	Q3 (2015) Q3-4 (2018) Q3-4 (2021)

3.2. Derryclare

The results of the biological (macroinvertebrate) monitoring for the six sites in Derryclare are presented in **Table 3-3** below. In summary, sites DB-1 and DB-5 were not suitable to conduct a Q-value assessment. These were very deep rivers (>1m) with peaty substrate and stagnant water. In addition, there was no marginal vegetation to take a sweep sample.

Macroinvertebrate sampling was possible at the remaining sites and Q-value result ranged from High (Q4-5) to Moderate (Q3-4). All the rivers surveyed are part of the Recess_020 waterbody. The EPA have modelled this waterbody as having High WFD Status but it is not monitored directly. The results of this survey indicates that only one of the rivers is achieving High biological quality. This river was only just achieving High quality in the upper reaches but further downstream it declined to Good. A Q3-4 was assigned at one site indicating unsatisfactory condition and a big departure from the expected High biological quality.

Table 3-3: Q-value results for Derryclare site in 2023.

Site code	Q-value (2023)
DB-1	n/a
DB-2	Q3-4 (Moderate)
DB-3	Q4 (Good)
DB-4	Q4-5 (High)
DB-5	n/a
DB-6	Q4 (Good)

3.2.1. Site DB-1

This is small river system which rises within the Derryclare property in a small block of coniferous forestry. As the river flows downstream it enters an area where clear felling has taken place. From Google Earth aerial imagery it appears this was conducted >10 years ago. Habitat has begun to vegetate with regenerating conifers/broadleaves but largely remains open and unshaded along the river. At the sampling point the river here is narrow (0.3m) and very deep (>1m). There was no perceptible flow and water was highly coloured. The river substrate was peaty and it was not possible to enter the water to take a macroinvertebrate sample.

Given the conditions observed this river was unsuitable to take a macroinvertebrate sample and conduct a Q-value assessment. The Q-value was not developed for stagnant peaty rivers and therefore

cannot be applied. There was no marginal aquatic vegetation to even take a sweep sample for macroinvertebrates. The river here is more characteristic of a linear bog pool than a flowing river.

Further downstream the river enters the boundary of the Derryclare Nature Reserve and flows through a section of willow/birch woodland before entering a small lake in the reserve. The river then leaves the lake and flows toward Derryclare Lough. In this section, the river has widened slightly but still very deep with pond like conditions supporting numerous dragonflies and damselflies -brown hawker (*Aeshna grandis*) and large red damselfly (*Ischnura elegans*) were two species identified.

On the day of survey dissolved oxygen was very low (30%, 2.63mg/l) but not unexpected given there is little opportunity for aeration in this stagnant river. Water temperatures were quite high at 23°C and pH was 6 indicating slight acidic conditions.

No aquatic vegetation was observed growing within the river. Water was very dark and deep with no shallow margins making conditions difficult for rooted aquatic species to grow but also survey. Bankside vegetation consisted of lesser spearwort (*Ranunculus flammula*), *Sphagnum* sp., cross-leaved heath (*Erica tetralix*), cuckoo flower (*Cardamine pratensis*), bog cotton (*Eriophorum angustifolium*), rushes (*Juncus* sp., common marsh-bedstraw (*Galium palustre*). Young recolonising conifers and birch were scattered across the clear-felled areas. Beard lichen (*Usnea* sp.) was present on some of the birch and willow trees, this is a lichen that would indicate clean air as it is intolerant of air pollution.

Just upstream of Derryclare Lough a forestry road crosses the river. This bridge spans large boulders placed in the river and it is unclear whether there is a pipe culvert to convey water or if water is dammed by the boulders as vegetation growth was thick here. Flow was stagnant on both sides of the bridge. The bridge is a potential barrier for the movement of aquatic species and it is recommended to investigate this further and assess whether remediation is required.

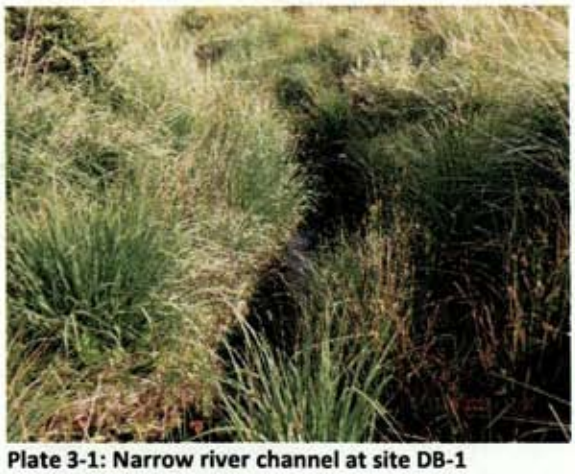

Plate 3-1: Narrow river channel at site DB-1

Plate 3-2: River channel downstream of site DB-1 and the small lake. Here the channel is slightly wider but still deep and stagnant.

3.2.2. Site DB-2

This site is located just on the boundary of the Derryclare Nature Reserve. At the time of survey water levels were very low (0.1m) and the river had a wetted width of 1m but it was clear the bankfull width in higher flows is much wider (2.5m). The flow velocity was slow at the time of survey and moderate water colour.

The river substrate was bedrock and boulder dominated with pockets of smaller substrate and no siltation observed. Owing to the low water the river habitat consisted mainly of glide with no riffles but some pools were present. It is clear that in higher flows this would be a more energetic river with riffles and small cascades down the bedrock.

The river channel appeared natural with no signs of anthropogenic interference at the sample site. Coniferous forestry is present directly upstream with some recent felling activity along the upper reaches of this river (between 2021 -2023 on Google Earth aerial imagery). At the sample site there is an excellent wide broadleaved riparian buffer (>100m). The woodland here is dominated with oak (*Quercus* sp.) but also contains some birch (*Betula* sp.), rowan (*Sorbus aucuparia*), holly (*Ilex aquifolium*), hawthorn (*Crataegus monogyna*) and willow (*Salix* sp.). In more open areas bog/heathland plant species were present such as *Sphagnum* sp., bog asphodel (*Narthecium ossifragum*) tormentil (*Potentilla erecta*) and ling (*Calluna vulgaris*).

The leafy liverwort (*Marsupella* sp.) was the only aquatic plant identified which was growing on the boulders (60% coverage). On the day of survey oxygen and conductivity readings were considered to be within the normal range and as expected for this river. pH was 5.57 indicating acidic conditions.

Upstream of the sample site the river flows under a forestry road via a concrete box culvert. On the day of survey this culvert was perched 0.6m above the river and completely dry. Water was instead flowing under the culvert. These conditions form a barrier for the movement of aquatic species and it is recommended that remediation is investigated.

The macroinvertebrate kick sample indicated a low taxon richness with 13 taxa recorded. Two pollution sensitive taxa (Group A) were present but in low numbers. These were both stoneflies in the Nemouridae family (*Protonemura* sp. and *Amphinemura* sp.). A few *Protonemura* sp. were present and only a single specimen of *Amphinemura* sp. was found. Only one Group B taxon was present which was the mayfly, Leptophlebidae, in small numbers. Most of the sample was made up of pollution tolerant taxa (Group C). Chironomidae and Simuliidae were numerous and the caseless caddisfly Polycentropodidae common. The remaining taxa were present in few numbers. No Group D or E taxa were present.

Although two Group A taxa were found one was in low numbers and the other was a single specimen. Single specimens are not counted toward the Q-value. Only one Group B was present and the sample appeared unbalanced with Chironomidae and Simuliidae being abundant. For these reasons a Q3-4 was assigned indicating Moderate biological quality. It must be noted that this river is dominated with bedrock and boulders, in normal flow conditions finding areas with loose substrate would be tricky but in the very low water levels observed this was even more difficult. It would be interesting to see if the Q-value score improves in higher flows. The low pH recorded on the day of survey indicates acidic conditions and would explain the lack of acid sensitive taxa such as *Baetis rhodani*, Hydrophyscidae.

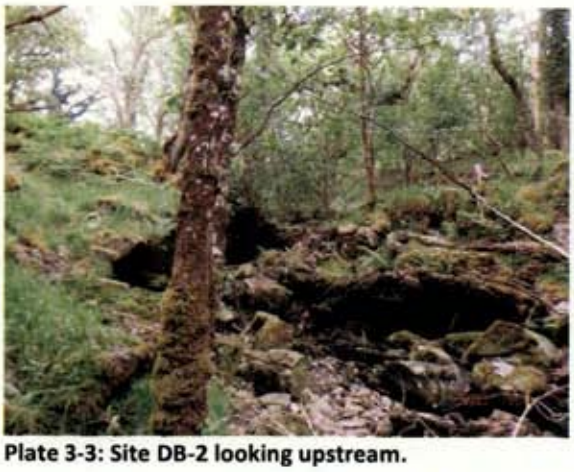

Plate 3-3: Site DB-2 looking upstream.

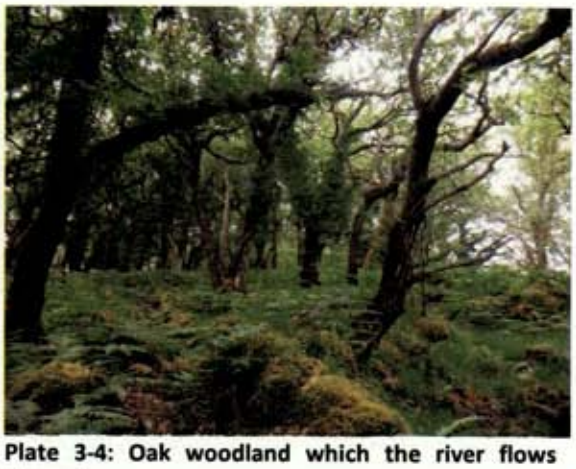

Plate 3-4: Oak woodland which the river flows through.

Plate 3-5: Macroinvertebrate sample taken at site DB-2.

Plate 3-6: Dry box culvert upstream of site DB-2.

3.2.3. Site DB-3

Site DB-3 is located on the same river as site DB-4 in the lower reaches of the river just upstream of Lough Inagh. The middle and lower reaches of this river flow entirely through mature coniferous forestry. Water levels were low at time of survey (0.1m) with short sections almost dry. Wetted width was approximately 2m. River substrate is boulder / cobble dominated with some coarse gravels, sand and no siltation recorded. The river channel itself appeared natural with no anthropogenic interference.

At the time of survey flow velocity was slow and with such low water a relatively uniform glide habitat was present. However, it was clear there would be a well-developed riffle/glide/pool sequence in higher flows. A narrow riparian zone (10m) was present but in some sections this zone was absent with coniferous trees planted to the edge of both banks. Bankside vegetation consisted of regenerating and mature conifers, gorse (*Ulex europaeus*), *Sphagnum* sp., tormentil (*Potentilla erecta*), rushes (*Juncus* sp.), foxglove (*Digitalis purpurea*). The invasive species Rhododendron was also present.

On the day of survey dissolved oxygen levels were low 85.9% and 7.93mg/l which is not surprising given the depth of water. The pH recorded was very low at pH 4.76 indicating acidic conditions.

Aquatic vegetation consisted of the algae; Batrachospermum (<1%) and slimy filamentous green algae (10%).

The macroinvertebrate sample indicated low richness with 12 taxa present. Three pollution sensitive (Group A) taxa were present in the sample. Of these the flattened mayfly, *Electrogena* sp. was common and two stoneflies Chloroperlidae and *Protonemura* sp. were present in few numbers. One less sensitive taxon was common (Group B) and this was the stonefly (*Leuctra* sp.). Simuliidae (Group C) were numerous. The remainder of the sample was made up of pollution tolerant taxa (Group C) in low numbers and one Most tolerant (Group E) again in low numbers.

Interestingly the sample was generally made up of species moderately tolerant - tolerant of acidic conditions and this is reflective of the low pH observed. Three Group A's were present with one of these being common. The sample was slightly unbalanced with numerous Simuliidae and there was quite a bit of filamentous green algae on the substrate. A Q4 indicating Good biological quality was assigned. It would be interesting to see if the Q-value improves with higher water levels.

Plate 3-7: Site DB-3 facing upstream.

Plate 3-8: Site DB-3 facing downstream with L. Inagh just visible in background.

Plate 3-9: Typical substrate at site DB-3.

Plate 3-10: Macroinvertebrate sample taken at site DB-3.

3.2.4. Site DB-4

This site is located 935m upstream of DB-3 in the middle reaches of the river. Here the river has just travelled down the mountains and it is steep, boulder dominated with bedrock outcrops. These characteristics have created a cascade-step-pool habitat. At the time of survey water depth was shallow (0.1m) with moderate flow velocity and a wetted width of 1m. Moderate bank erosion was observed but this was considered to be mainly natural in this energetic stream (in higher flows). Some areas of bank erosion due to sheep/deer access was also visible. No siltation of the substrate was noted.

A narrow riparian buffer was present (10m) but in some sections this zone was absent with coniferous trees planted to the bank edge. Upstream of the bridge on the right bank there is an area which has been clearfelled (sometime between 2017 -2020 from Google Earth imagery). Bankside vegetation consist mainly of conifers but in more open sections and clearfelled areas there is; bell heather (*Erica cinerea*), tormentil (*Potentilla erecta*), rushes (*Juncus* sp.), foxglove (*Digitalis purpurea*), bird's-foot trefoil (*Lotus corniculatus*), meadowsweet (*Filipendula ulmaria*) and regenerating confiers. There were also occasional willow trees (*Salix* sp.).

Slimy filamentous green alga was present instream covering 20% of the substrate and no other aquatic vegetation was visible. Dissolved oxygen conditions were within normal range and pH was much higher (pH 6.25) compared to the downstream site (pH 4.76).

The macroinvertebrate sample indicated a very low diversity with only 9 taxa recorded. Despite this, two pollution sensitive taxa were recorded in good numbers with the flattened mayfly, *Electrogena* sp. were numerous and stonefly *Amphinemura* sp. were common. One less-sensitive taxon was recorded in low numbers which was the stonefly, *Leuctra* sp. The remaining sample was made up of tolerant taxa (Group C) in few numbers with Simuliidae being common. Water was low at the time of survey and substrate was dominated with boulders, these conditions made it difficult to find suitable spots with loose substrate to sample. Although richness was low, two Group A's were in good numbers and taking the low water into account a Q4-5 was assigned. This would indicate High biological quality but it is considered that the site is just on the boundary between Good and High.

Plate 3-11: Site DB-4 facing downstream

Plate 3-12: Bridge at site DB-4 facing upstream.

Plate 3-13: Land use directly upstream of site DB-4

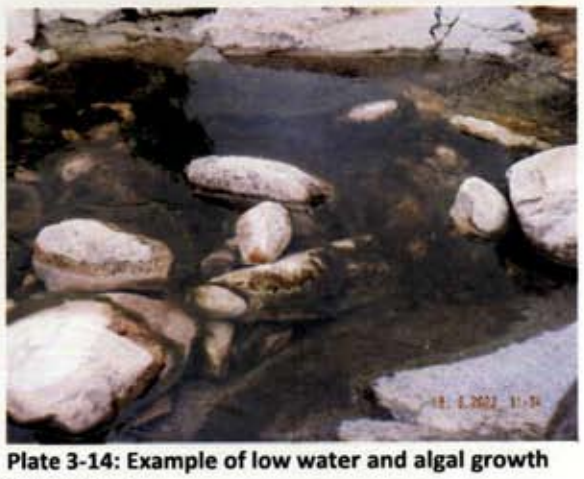

Plate 3-14: Example of low water and algal growth in the river.

3.2.5. Site DB-5

This is a short river system rising within the Derryclare property and flowing entirely through coniferous forestry. The site is located just upstream of the outlet to Lough Inagh. Here the river is narrow (1m), very deep (>1m) with vertical 1m high banks. The water was highly coloured with no perceptible flow and an oily sheen on the surface formed by bacteria. River bed substrate was very peaty and soft. The deep water and soft substrate meant it was not possible to enter the water to take a macroinvertebrate sample.

Given the conditions observed the river was unsuitable to conduct a macroinvertebrate sample and Q-value assessment. The Q-value was not developed for stagnant peaty rivers and therefore cannot be applied. There was no marginal aquatic vegetation to even take a sweep sample for macroinvertebrates.

The river here is located within coniferous forestry with trees planted close to bank edge (within 3m) in some places. This has created a dark habitat shading the river. Bankside habitat consisted mainly of grasses and rushes with some young conifers and the invasive Rhododendron also present. The aquatic plant water lobelia (*Lobelia dortmanna*) was present along the shoreline of the lake. This plant is typical growing in shallow waters of oligotrophic lakes on acid stony substrates.

The river here appears to have been modified into a drainage channel with straightening and deepening. Near the outlet to the lake the river becomes shallower and almost half the channel was covered in slimy filamentous green algae (40%). Dissolved oxygen readings were high (141% 13mg/l) likely due to the excessive algae creating super saturated conditions during the day. pH was low at 5.4 indicating slightly acidic conditions.

Plate 3-15: Straightened channel at site DB-5

Plate 3-16: Stagnant water at site DB-5 with Rhododendron visible in the background.

Plate 3-17: River entering L. Inagh

Plate 3-18: Water lobella in flower along shoreline of L. Inagh

3.2.6. Site DB-6

This river is located just outside the northern boundary of the Derryclare property. At the sample site the river had a wetted and bankfull width of 1.5m with 0.3m high banks. Water was moderately coloured and very shallow on the day of survey (0.07m) but there was still a good riffle/ glide sequence with pools also present.

Moderate bank erosion with undercutting was visible and considered mostly natural however at some locations it was clear erosion was due to sheep/deer access. Along the left bank the river here flows through open expanse of heathland/ blanket bog with bankside vegetation consisting of cross-leaved heath (*Erica tetralix*), bell heather (*Erica cinerea*), *Sphagnum* sp., bog asphodel (*Narthecium ossifragum*), tormentil (*Potentilla erecta*), bog myrtle (*Myrica gale*), bog cotton (*Eriophorum angustifolium*) and rushes (*Juncus* sp.). Habitat is similar on the right bank with an area of clear fell 15-80m back from the bank. It is unclear when this area was felled but it has revegetated with some conifers and broadleaved trees present.

Substrate was cobble dominated with low surface siltation observed (2% silt coverage). A fair bit of slimy green filamentous algae (25%) was observed growing on the cobble substrate. While such a large amount of algae can indicate nutrient enrichment it should be noted that the low flows, cobble substrate and open sunny habitat also create ideal growing conditions for algae at this time of year. The algae Batrachospermum (<1%) and leafy liverwort *Marsupella* sp. were the only other aquatic vegetation present (2%).

The macroinvertebrate sample indicated low taxon richness with 12 taxa present. Three pollution sensitive taxa were present. Of these the stoneflies, *Isoperla grammatica* and *Chloroperlidae* were common and the flatten mayfly *Electrogena* sp. occurred in few numbers. One less sensitive taxon (*Leuctra* sp.) was also common. The remainder of the sample was made up of tolerant taxa (Group C) with numerous Simuliidae present.

With two Group A's common the sample is very close to a Q4-5 (High) however with numerous Simuliidae the sample is a little unbalanced and it is pushed to a Q4 indicating Good biological quality. As with the other rivers in this survey it will be interesting to see whether the Q-value improves in higher flows.

Plate 3-19: Site DB-6 facing upstream with forestry just visible in background.

Plate 3-20: Site DB-6 facing downstream.

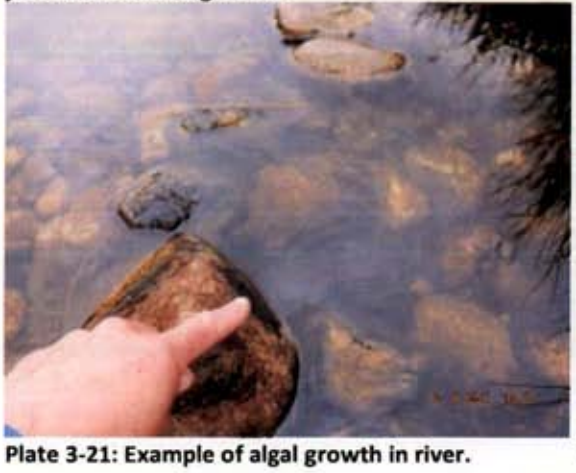

Plate 3-21: Example of algal growth in river.

Plate 3-22: Macroinvertebrate sample taken at site.

3.3. Cappaghoosh

The results of the biological (macroinvertebrate) survey for the six sites in Cappaghoosh are presented in **Table 3-4** below. In summary, sites CB-C and CB-D were not suitable to conduct a Q-value assessment. The first was completely dry on the day of survey and the second site was very slow and deep with pond like conditions.

Of the sites that were surveyed only one achieved satisfactory condition with a Q4 (Good) assigned. This was site CB-A downstream of a small parcel of mature forestry. Further upstream in the same river the conditions degraded to a Q3-4. The lowest biological water quality across both properties was recorded at site CB-E. Here a Q3 was assigned indicating Poor biological quality. This is also an EPA monitoring point and historic results indicate that this river struggles to reach satisfactory condition and has not received a Q4 since 2003.

Table 3-4: Q-value results Cappaghoosh sites in 2023.

Site code	Q-value (2023)
CB-A	Q4 (Good)
CB-B	Q3-4 (Moderate)
CB-C	n/a
CB-D	n/a
CB-E	Q3 (Poor)

3.3.1. Site CB-A

This site is located on the Recess_010 waterbody also known as the Caher/Owentooey river. The site is directly downstream a small parcel of coniferous forestry. This is a much larger river compared to the Derryclare rivers (7m wetted width) and although water levels were low there was a greater depth (0.3m) than the rivers in Derryclare. Flow velocity was slow to moderate and the river channel appeared natural with meanders and well-developed riffle glide pool sequence. Some bank erosion was evident with sheep accessing the river.

This is a cobble dominated stream with some siltation of the substrate observed (5%) and a moderate plume of silt was generated when the substrate was disturbed indicating siltation within the interstices of the substrate. Along the right bank there is a continuous and wide (50m) riparian treeline consisting of willow (*Salix* sp.) and alder (*Alnus glutinosa*). These trees overhang the bank creating light shading. The left bank is open with heathland species; bog myrtle (*Myrica gale*), rushes (*Juncus* sp.), dog rose (*Rosa canina*), cross-leaved heath (*Erica tetralix*), ling (*Calluna vulgaris*) gorse (*Ulex europaeus*), bog asphodel (*Narthecium ossifragum*) and bog cotton (*Eriophorum angustifolium*) with sheep grazing here.

There was a moderate amount of filamentous green algae covering the substrate within the river (30%). Other aquatic plants identified included; watermilfoil (*Myriophylum* sp.) lesser spearwort (*Ranunculus flammula*), pondweed (*Potamogeton* sp) and water lobelia (*Lobelia dortmanna*) was flowering along the bank edges.

The macroinvertebrate sample indicated moderate taxon richness with 15 taxa present. Two pollution sensitive (Group A) taxa were present with the flattened mayfly (*Heptagenia* sp.) common and the stonefly (*Isoperla grammatica*) occurring in few numbers. Three less sensitive (Group B) taxa were present and all were cased-caddisflies. Tolerant taxa (Group C) made up most of the sample with

Chironomidae being numerous while *Baetis rhodani/atlanticus* was common, Very tolerant (Group D) and Most tolerant taxa (Group E) only occurred in low numbers. As one Group A was common with a number of cased caddis also present a Q4 was assigned indicating Good biological quality.

Plate 3-23: Site CB-A facing upstream.

Plate 3-24: Site CB-A facing downstream with continuous treeline visible along the right bank.

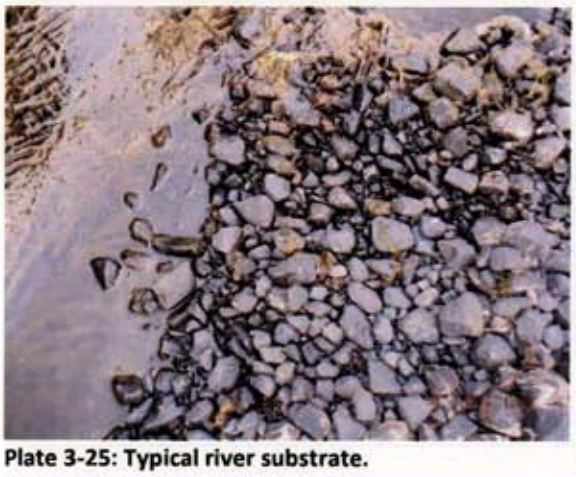

Plate 3-25: Typical river substrate.

Plate 3-26: Alga covering substrate.

3.3.2. Site CB-B

This site is upstream of CB-A and located 150m downstream of Tawnagh Lough. The river here is slow moving with a wetted width of 5m and shallow depth at time of survey (0.2m). Habitat is mostly a slow glide but there is a small amount of riffle where boulders span across the river channel. These boulders appear to be artificially placed as they are spaced at intervals downs the river channel. Moderate bank erosion was evident with sheep accessing the river.

Substrate was cobble/ coarse gravel dominated with bedrock outcrops in sections. Some siltation of the substrate observed (5%) and a moderate plume of silt was generated when the substrate was disturbed indicating siltation within the interstices of the substrate. A limited riparian buffer was present with a narrow 1m willow treeline along the right bank. Along the left bank sheep grazing on the heathland is present up to the bank edge, vegetation here consisted of; rushes (*Juncus* sp.), horsetail (*Equisetum* sp.), *Sphagnum* sp., bog myrtle (*Myrica gale*), tormentil (*Potentilla erecta*), cross-

leaved heath (*Erica tetralix*), forget-me-not (*Myosotis* sp.), bog asphodel (*Narthecium ossifragum*) bog cotton (*Eriophorum angustifolium*) and common marsh-bedstraw (*Galium palustre*).

Dissolved oxygen was low at the time of survey (78.6%, 6.85mg/l). Instream vegetation consisted of a fair amount of filamentous green algae (20%), watermilfoil (*Myriophylum* sp.), lesser spearwort (*Ranunculus flammula*), pondweed (*Potamogeton* sp.), water-starwort (*Callitriche* sp.) and water mint (*Mentha aquatica*).

The macroinvertebrate sample indicated moderate taxon richness with 15 taxa present. Two pollution sensitive (Group A) taxa were present but in very low numbers. Only two specimens of the flattened mayfly (*Heptagenia* sp.) and two of the stonefly (*Isoperla grammatica*) were present. Two less sensitive taxa were present but again in few numbers (*Leuctra* sp. and Sericostomatidae). Pollution tolerant (Group C) taxa made up the majority of the sample with Simuliidae numerous while *Baetis rhodani/atlanticus* and *Seretella ignita* were both common. The very tolerant (Group D) bivalve *Pisidium/Sphaerium* spp was also numerous.

Although two Group A's were present these were in very low numbers. Diversity and abundances appeared unbalanced and a Q3-4 was assigned indicating Moderate biological quality.

Plate 3-27: Site CB-B facing upstream

Plate 3-28: Site CB-B facing downstream.

Plate 3-29:Vegetation with the river.

Plate 3-30: Example of boulder weir across river.

3.3.3. Site CB-C

This site is located on the Owengarve River just before it enters Lough Currell. This is a very isolated and remote site which is difficult to access on foot. The river here is very dark, deep with no flowing water. Aquatic vegetation consisted of both yellow and white water lilly (*Nuphar lutea* and *Nymphaea alba)* and *Sphagnum auriculatum* which was growing in large clumps submerged underwater. The conditions are more like a large bog pool than a river. The river was walked further upstream (c.200m) but conditions were similar.

Given these characteristics a Q-value could not be conducted. Of note was a sea eagle observed perched in the trees on an island within Lough Currell.

Plate 3-31: Site CB-C facing upstream.

3.3.4. Site CB-D

This river is mapped flowing toward Lough Duff. On the day of survey, no discernible river channel was identified. There is a wet flush around a small willow and conifer woodland area but a flowing stream could not be found. There are significant drainage channels around the mapped stream. To the north-east there is narrow drainage channel cut 1m down into the bog and this was almost dry. There is another very wide drainage channel to the south-west of the mapped stream. This is a 6m wide drainage channel with peat excavated to the subsoil and material piled onto the sides forming embankments which are now fully vegetated. This area was also dry with some puddles.

No survey was conducted at this site as no river could be found.

Plate 3-32: Drainage channel to the north-east of the mapped river

Plate 3-33: Drainage channel to the south-west of the mapped river with soil excavated to the bedrock.

3.3.5. Site CB-E

This site is located on a section of river between L. Bunnahask and L. Alligan. At the sample location chosen via desktop analysis it was not possible to conduct a kick sample as the river substrate was dominated with bedrock. The site was moved a little further upstream to where there is also an EPA biological monitoring point.

At the site sampled the river had a 2m wetted width and 0.3m depth. Habitat was glide dominated with some pools and riffles. The substrate is dominated with large boulders, cobbles and coarse gravel. Some siltation was observed (5%) and low-moderate plume of silt was generated when the substrate was disturbed.

Open blanket bog and heathland are present along the left bank with vegetation consisting of, bog myrtle (*Myrica gale*), bog asphodel (*Narthecium ossifragum*), cross-leaved heath (*Erica tetralix*), ling (*Calluna vulgaris*), tormentil (*Potentilla erecta*) and butterfly orchid (*Platanthera sp.*). A narrow band (5m) of this habitat occurs along the right bank and then there is a forestry track and coniferous plantation.

Instream the substrate was almost entirely covered with the filamentous green alga, *Cladophora* sp. with 80% coverage. While such a large proportion of algae can indicate nutrient enrichment it should be noted that the low flows and open sunny habitat also create ideal growing conditions for algae at this time of year and it may be a combination of enrichment and channel conditions that resulted in the excessive algae. The macroalgae *Batrachospermum* sp. was also present in large quantities.

The keeled skimmer dragonfly was observed which is found along wet heathland areas.

The macroinvertebrate sample showed a very low diversity with only seven taxa present. No pollution sensitive (Group A) taxa were present. One less sensitive taxon was present in low numbers and this was the caseless caddis fly, Sericostomatidae. The sample was made up of tolerant taxa (Group C) with numerous Chironomidae Caseless caddisflies and Simuliidae were common. With no Group A taxa, low diversity and excessive algal growth a Q3 was assigned indicating Poor biological quality. The site was last sampled by the EPA in 2021 were a Q3-4 (moderate) was assigned and it appears there has been a decline in this river since. The river here has not achieved a Q4 (Good) since 2003.

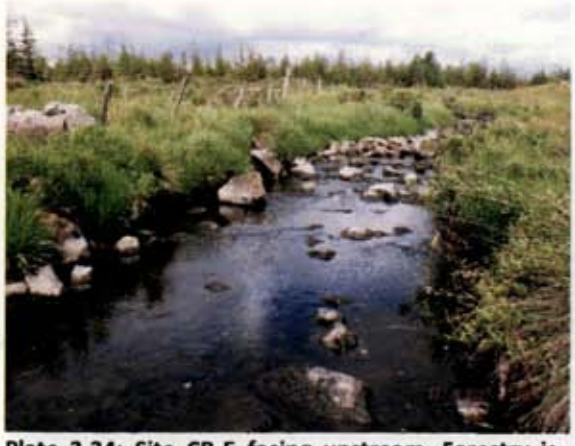

Plate 3-34: Site CB-E facing upstream. Forestry is visible in background.

Plate 3-35: Site CB-E facing downstream.

Plate 3-36: River substrate with excessive algal growth.

Plate 3-37: Macroinvertebrate sample.

4. WATER CHEMSITRY RESULTS

In total 18 sites are sampled across the Derryclare and Cappaghoosh properties monthly. For each water sample 21 chemical parameters are analysed generating a large list of results. This section summarises the results from January to April for Derryclare and February to April for Cappaghoosh.

To help summarise the results succinctly each parameter was assessed against its assigned Ecological Quality Standard (EQS) as set out in the EU Surface Water Regulations (S.I. 77/2009 as amended). These standards are presented in **Table 4-1** below. The majority of these EQS's are based on an annual average over a 12-month period. As only 3-4 months data has been collected the comparison with the EQS serves as an initial guide only. Not all of the parameters analysed have a set EQS.

Significant results which appear to breech the EQS are discussed below. In addition, some sites are located on the same river. These sites are compared with each other and where differences worth highlighting are present they are discussed below. **Appendix B** presents graphs showing the general trend of results for the main parameters discussed.

Please note that dissolved oxygen results are not discussed as this parameter was measured in the laboratory at room temperature and not a reflection of the river conditions at time of survey.

Table 4-1: Summary of parameters analysed at each site and corresponding EQS as per the Surface Water Regulations if one has been set.

Parameter	Surface Water Regs EQS
Alkalinity (mg/L $CaCO_3$)	-
Aluminium (µg/L)	-
Ammonia (mg/L as N)	High status ≤0.040 (mean) / ≤0.090 (95%ile) Good status ≤0.065 (mean) / ≤0.140 (95%ile) (Applies to rivers and lakes)
Calcium (mg/L)	-
Conductivity (at 20°C)	-
Copper (µg/L)	5 - water hardness ≤100mg/L $CaCO^3$ 30 - water hardness ≥100mg/L $CaCO^3$ Annual average EQS - for each representative monitoring point within the waterbody, the arithmetic mean of the concentrations measured over a twelvemonth monitoring period does not exceed the standard. (Applies to rivers and lakes)
Dissolved Organic Carbon (mg/L)	-
Dissolved oxygen (mg/L)	Lower limit 95%ile >80% saturation Upper limit 95%ile <120% saturation (Applied to rivers and lakes)
Hardness Total (mg/L $CaCO_3$)	-
Iron (µg/L)	-
Magnesium (mg/L)	-
Manganese (µg/L)	-
Nickel (µg/L)	20 Expressed as an annual average value. Unless otherwise specified, it applies to the total concentration of all isomers. (Applied to rivers and lakes)
Nitrate (mg/L as N)	-
pH (pH Units)	Soft waters (≤100mg/L $CaCO_3$) >4.5 <9 Hard waters (>100mg/L $CaCO_3$) >6 <9 (Applies to rivers and lakes)
Phosphate-Ortho (mg/L)	High status ≤0.025 (mean) / ≤0.045 (95%ile) Good status ≤0.035 (mean) / ≤0.075 (95%ile) (Applies to rivers only and is for MRP)
Phosphorus-Total (mg/L as P)	High status ≤0.010 (mean) Good status ≤0.025 (mean) (Applies to lakes only and is for MRP)
Potassium (mg/L)	-
Sodium (mg/L)	-
Solids-Total Suspended (mg/L)	No EQS but standard stipulated within the Salmonid regulations is often uses as a standard for suspended solids. ≤25 mg/L (Annual average over 12 months)
Zinc (µg/L)	8 - water hardness annual average ≤10mg/L $CaCO^3$ 50 - water hardness annual average >10 to ≤100mg/L $CaCO^3$ 100 - water hardness annual average >100mg/L $CaCO^3$ (Annual average EQS - for each representative monitoring point within the waterbody, the arithmetic mean of the concentrations measured over 12 month monitoring period does not exceed the standard)

4.1. Derryclare

4.1.1. Sites P1 & P2

Sample site P1 is located on the boundary of the Derryclare property and is just upstream of the forestry. Sample P2 is located downstream in the lower reaches after the river has flowed through the forestry and just before it enters L. Inagh.

The average results across all four months for both sites are presented below in **Table 4-2.** In general, this river has low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating acidic conditions.

Most parameters are similar across both sites but levels of aluminium, iron and manganese are much higher in all months at the downstream site P2 indicating leaching of metals. In addition, dissolved organic carbon is higher at P2 in all months.

Levels of zinc exceed the EQS (8mg/L for waters with annual average hardness ≤10mg/L $CaCO_3$). The spike in zinc levels occurred in February and March. It must be noted that this EQS is based on an annual average of 12 months data and the results are for 4 months of data.

All other parameters which have an EQS set conform to these standards set. Mean ammonia and ortho-P levels indicate High nutrient status at both sites. pH levels indicate acidic conditions at both sites with levels toward the lower end of the EQS boundary. The lowest pH recorded was 4.87 in January and February at site P2.

Table 4-2: Average results (January- April) for paramaters measured at Sites P1 & P2. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	P1	P2
Alkalinity (mg/L $CaCO_3$)	8.00	4.67
Aluminium (µg/L)	54.25	78.50
Ammonia (mg/L as N)	0.02	0.03
Calcium (mg/L)	All samples below LOD <0.6	All samples below LOD <0.6
Conductivity (at 20°C)	38.625	43.3
Copper (µg/L)	All samples below LOD <0.002	All samples below LOD <0.002
Dissolved Organic Carbon (mg/L)	2.98	4.35
Hardness Total (mg/L $CaCO_3$)	8.00	6.25
Iron (µg/L)	25.75	107.25
Magnesium (mg/L)	0.60	0.65
Manganese (µg/L)	2.00	10.75
Nickel (µg/L)	All samples below LOD <1	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51	All samples below LOD <0.51
pH (pH Units)	5.21	4.94
Phosphate-Ortho (mg/L)	0.01	All samples below LOD <0.01
Phosphorus-Total (mg/L as P)	0.015	All samples below LOD <0.03
Potassium (mg/L)	0.30	0.28
Sodium (mg/L)	5.38	6.18
Solids-Total Suspended (mg/L)	All samples below LOD <2*	All samples below LOD <2*
Zinc (µg/L)	9.25	9

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.1.2. Sites P3 & P4

Sample site P3 is located on the boundary of the property. It is in the upper reaches of the waterbody in a small tributary on the slopes of Derryclare mountain and upstream of the forestry. Sample P4 is located downstream in the lower reaches within the forestry.

The average results across all four months for both sites are presented below in **Table 4-3**. In general, this river has low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating acidic conditions.

Most parameters are similar across both sites but levels of aluminium, iron and manganese are again much higher in all months at the downstream site (P4) indicating leaching of metals. In addition, dissolved organic carbon is higher at P5 in all months.

Levels of zinc exceed the EQS (8mg/L for waters with hardness ≤10mg/L $CaCO_3$). The highest spike in zinc levels for both sites occurred in March. It must be noted that this EQS is based on an annual average of 12 months data and the results are for 4 months of data.

All other parameters which have an EQS set conform to these standards. Mean ortho-P levels indicate High status at both sites. Mean ammonia levels indicate High status at P3 and Good status at P4 but its only just missed achieving High. pH levels indicate acidic conditions at both sites with levels just within the lower EQS boundary. The lowest pH recorded was 4.65 in January at site P4.

Table 4-3: Average results (January- April) for paramaters measured at sites P3 & P4. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	P3	P4
Alkalinity (mg/L $CaCO_3$)	8.5	9
Aluminium (µg/L)	42	109.5
Ammonia (mg/L as N)	0.02	0.05
Calcium (mg/L)	All samples below LOD <0.6	0.6
Conductivity (at 20°C)	45.9	52.075
Copper (µg/L)	All samples below LOD <0.002	All samples below LOD <0.002
Dissolved Organic Carbon (mg/L)	3.75	7.8
Hardness Total (mg/L $CaCO_3$)	7.25	7
Iron (µg/L)	22.25	150.25
Magnesium (mg/L)	0.75	0.8
Manganese (µg/L)	2	13.75
Nickel (µg/L)	All samples below LOD <1	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51	All samples below LOD <0.51
pH (pH Units)	4.925	4.8775
Phosphate-Ortho (mg/L)	All samples below LOD <0.01	0.01
Phosphorus-Total (mg/L as P)	All samples below LOD <0.03	0.03
Potassium (mg/L)	0.325	0.55
Sodium (mg/L)	6.475	7.5
Solids-Total Suspended (mg/L)	4*	All samples below LOD <2*
Zinc (µg/L)	8.75	13.25

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.1.3. Sites P5

This site is located within L. Inagh. In general, this lake has low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating slightly acidic conditions.

The average results across all four months for the sites are presented in **Table 4-4** below. Lough Inagh is a naturally oligotrophic (low nutrient) lake and the WFD objective of High status applies for the nutrients; ammonia and total-P. The mean results for ammonia indicate that this High status has been achieved. For total-P the laboratory limit of detection was 0.03mg/l which is above the EQS for both High and Good status. All samples were below the limit of detection and therefore it is not possible to tell which status band the samples fall into.

Table 4-4: Average results (January- April) for paramaters measured at site P5. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	P5
Alkalinity (mg/L $CaCO_3$)	11.5
Aluminium (µg/L)	43.5
Ammonia (mg/L as N)	0.023
Calcium (mg/L)	1.9
Conductivity (at 20°C)	52.43
Copper (µg/L)	All samples below LOD <0.002
Dissolved Organic Carbon (mg/L)	4.15
Hardness Total (mg/L $CaCO_3$)	9.75
Iron (µg/L)	153.5
Magnesium (mg/L)	0.925
Manganese (µg/L)	16.5
Nickel (µg/L)	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51
pH (pH Units)	6.09
Phosphate-Ortho (mg/L)	All samples below LOD <0.01
Phosphorus-Total (mg/L as P)	All samples below LOD <0.03
Potassium (mg/L)	0.35
Sodium (mg/L)	7.23
Solids-Total Suspended (mg/L)	5*
Zinc (µg/L)	19.67

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.2. Cappaghoosh

4.2.1. Sites C2, C8, C5 & C4

The sites are located in the north-eastern section of Cappaghoosh. The rivers flow in an east-west direction through a number of lakes. Sites C8 is located just upstream of the property boundary and upstream of any forestry. It is located on separate river channel to the other sites and flows into L. Agay. This is a first order stream which rises only a short distance upstream. Here the river flows across

open blanket bog / heath and in effect represent conditions before the river flows through afforested areas.

Site C2 is also located on the property boundary the river here rises just upstream and flows mainly across open blanket peat / heathland. A small section borders forestry which from Google Earth imagery was felled sometime between 2009-2012 and replanted. The sample site is located downstream of this forestry. This channel then enters L. Mongaun and flows toward L. Agay. Site C5 is located just upstream of the latter lake. The channel leaves L.Agay and flows toward L. Duff. Site C4 is located upstream of L.Duff.

The average results across all three months for the sites are presented in **Table 4-5** below. In general, these rivers have low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating acidic conditions.

pH ranged from 4.32 to 5.61 with Site C4 having the lowest average pH readings which just breaches the lower EQS boundary. Suspended sediments and DOC levels remained steady and low for the three months.

Levels of metals showed a marked decreases at sites C5 and C4 in April (aluminium, iron, manganese and zinc). On the other hand, aluminium and zinc levels where nearly five times higher than February levels at site C8 in April. In addition, the EQS for copper was below limit of detection for all sites in all months except site C8 in April where the levels breeched EQS

All sites with the exception of C5 breeched the EQS for zinc. This site had a slightly higher hardness value >10mg/l and therefore EQS for zinc is set higher than the other sites.

All other parameters which have an EQS set conform to these standards. Mean ortho-P and ammonia levels indicate High status at all sites.

Table 4-5: Average results (February- April) for paramaters measured at sites C8, C2,C5 & C4. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C8 (u/s forestry)	C2	C5	C4
Alkalinity (mg/L $CaCO_3$)	9	10	8	15
Aluminium (µg/L)	22.33	29	23	41.67
Ammonia (mg/L as N)	0.027	0.023	0.027	0.03
Calcium (mg/L)	2.2	1.033	0.733	1.2
Conductivity (at 20°C)	51.53	54.93	55.73	76.1
Copper (µg/L)	10	All samples below LOD <0.002	All samples below LOD <0.002	All samples below LOD <0.002
Dissolved Organic Carbon (mg/L)	6.767	9.533	7.4	15.033
Hardness Total (mg/L $CaCO_3$)	7.667	9	12	9
Iron (µg/L)	168	583	186.33	243.67
Magnesium (mg/L)	0.9	0.93	0.97	1.23
Manganese (µg/L)	9.67	20.33	12.33	21.33
Nickel (µg/L)	1	All samples below LOD <1	All samples below LOD <1	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51	All samples below LOD <0.51	All samples below LOD <0.51	All samples below LOD <0.51

	C8 (u/s forestry)	C2	C5	C4
pH (pH Units)	4.8	5.3	5.3	4.5
Phosphate-Ortho (mg/L)	All samples below LOD <0.01	0.02	All samples below LOD <0.01	0.01
Phosphorus-Total (mg/L as P)	All samples below LOD <0.03	0.03	All samples below LOD <0.03	0.035
Potassium (mg/L)	0.47	0.37	0.4	0.566666667
Sodium (mg/L)	7.37	8.33	8.4	11.2
Solids-Total Suspended (mg/L)	All samples below LOD <2*	2*	All samples below LOD <2*	All samples below LOD <2*
Zinc (µg/L)	26.33	16	23	9.67

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.2.2. C1, C3, C7 & C10

The sites are located in the north-western section of Cappaghoosh. The rivers flow in a north-south direction through a number of lakes. Site C1 is located just upstream of the property boundary and upstream of any forestry it flows into Loughaunanny then out of this lake and into Cappaghoosh. This is a first order stream which rises only a short distance upstream. Here the river flows across open blanket bog / heath and in effect represents conditions before the river flows through afforested areas.

Site C3 is located further downstream within forestry just before the river enters L. Fadda. The river leaves this lake and then enters Loughaunemlagh, site C7 is just upstream of the inlet to the lake. The river leaves the lake and enters L. Cuskeamatinny and site 10 is located just upstream of the inlet.

The average results across all three months for the sites are presented in **Table 4-6** below. In general, these rivers have low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating acidic conditions.

pH ranged from 4.4 to 6.3 with site C10 having the lowest average pH readings which were very close to breaching the lower EQS boundary. Suspended sediments and DOC levels remained steady and low for the three months.

Metals (iron and manganese) increased in April at site C1 whereas in the other sites these decreased markedly along with aluminium and zinc. Suspended sediments and DOC levels remained steady and low for the three months.

All other parameters which have an EQS set conform to these standards with the exception of zinc at sites C7 and C10. Mean ortho-P and ammonia levels indicate High status at all sites.

Table 4-6: Average results (February- April) for paramaters measured at sites C1, C3,C7 & C10. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C1	C3	C7	C10
Alkalinity (mg/L $CaCO_3$)	8.5	9.67	8.50	10.50
Aluminium (µg/L)	31.67	22.67	16.00	27.00
Ammonia (mg/L as N)	0.027	0.030	0.020	0.035
Calcium (mg/L)	1.733	0.95	0.70	0.78
Conductivity (at 20°C)	57	58.07	65.67	76.60
Copper (µg/L)	All samples below LOD <0.002	All samples below LOD <0.002	All samples below LOD <0.002	All samples below LOD <0.002

	C1	C3	C7	C10
Dissolved Organic Carbon (mg/L)	7.833	7.73	8.37	11.90
Hardness Total (mg/L $CaCO_3$)	12.33	14.67	8.67	9.00
Iron (µg/L)	297.67	175.33	151.00	218.00
Magnesium (mg/L)	1.07	0.97	1.03	1.20
Manganese (µg/L)	23.67	16.67	25.67	37.00
Nickel (µg/L)	All samples below LOD <1	All samples below LOD <1	All samples below LOD <1	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51	All samples below LOD <0.51	All samples below LOD <0.51	All samples below LOD <0.51
pH (pH Units)	5.7	5.1	4.9	4.6
Phosphate-Ortho (mg/L)	0.01	All samples below LOD <0.01	All samples below LOD <0.01	All samples below LOD <0.01
Phosphorus-Total (mg/L as P)	0.03	All samples below LOD <0.03	0.04	0.04
Potassium (mg/L)	0.5	0.43	0.40	0.50
Sodium (mg/L)	8.27	9.00	9.70	11.23
Solids-Total Suspended (mg/L)	All samples below LOD <2*	All samples below LOD <2*	All samples below LOD <2*	All samples below LOD <2*
Zinc (µg/L)	14.67	13.33	9.33	10.67

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.2.3. Sites C6, C9 & C13

The sites are located in the western section of Cappaghoosh. The rivers flow in a north-south direction through a number of lakes. Site C6 is located just upstream of the property boundary, upstream of any forestry and just upstream of L. Minnaun. This is a first order stream which rises only a short distance upstream. Here the river flows across open blanket bog / heath and in effect represents conditions before the river flows through afforested areas.

The river leaves L. Minnaun and follows the western boundary of the property until it enters L. Cuskeamatinny. Site C9 is located at the inlet to this lake. The lake turns into L. Owengarve and the Owengarve River flows out of this toward L. Curreel. Site C13 is just upstream the inlet to L. Curreel.

The average results across all three months for the sites are presented in **Table 4-7** below. In general, these rivers have low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and low pH indicating acidic conditions.

pH ranged from 4.4 to 5.9 with site C13 having the lowest average pH readings which were just in breach of the lower EQS boundary. Suspended sediments and DOC levels remained steady and low for the three months.

Metals (aluminium, iron, manganese and zinc) decreased markedly in April at C9 whereas in the same month metals increased at site C13 with this site recording the highest average levels of all metals with the exception of zinc. Of note at C13 is the average level of copper which was three times higher than the EQS. EQS for zinc was exceeded at all sites.

All other parameters which have an EQS set conform to these standards. Mean ortho-P and ammonia levels indicate High status at all sites. Average levels of ammonia however were just within High EQS boundary.

Table 4-7: Average results (February- April) for paramaters measured at sites C6, C9 & C13. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C6	C9	C13
Alkalinity (mg/L $CaCO_3$)	13	11	9
Aluminium (µg/L)	23.67	18.33	49.00
Ammonia (mg/L as N)	0.023	0.040	0.035
Calcium (mg/L)	0.75	0.75	1.40
Conductivity (at 20°C)	62.2	70.2	78.0
Copper (µg/L)	All samples below LOD <0.002	All samples below LOD <0.002	15.000
Dissolved Organic Carbon (mg/L)	5.733	7.867	10.700
Hardness Total (mg/L $CaCO_3$)	9.00	9.33	9.33
Iron (µg/L)	157.00	114.67	295.67
Magnesium (mg/L)	1.07	1.17	1.27
Manganese (µg/L)	18.00	16.00	51.67
Nickel (µg/L)	All samples below LOD <1	1.00	1.00
Nitrate (mg/L as N)	All samples below LOD <0.51	All samples below LOD <0.51	All samples below LOD <0.51
pH (pH Units)	5.0	5.0	4.5
Phosphate-Ortho (mg/L)	All samples below LOD <0.01	0.010	All samples below LOD <0.01
Phosphorus-Total (mg/L as P)	0.030	All samples below LOD <0.03	All samples below LOD <0.03
Potassium (mg/L)	0.40	0.50	0.50
Sodium (mg/L)	9.47	10.67	11.03
Solids-Total Suspended (mg/L)	All samples below LOD <2*	All samples below LOD <2*	All samples below LOD <2*
Zinc (µg/L)	16.67	18.00	17.00

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.2.4. Sites C15 -C18

The results of these four sites are grouped together as they are all located within the same river system. C15 and C16 are in separate channels in the upper reaches with both rising from the same parcel of forestry. These channels both flow through a medium sized lake and then meet each other just upstream of C17. At C17 forestry borders the right bank and open bog on the left. Immediately downstream of C17 the river enters another lake and C18 is located downstream of this lake with forestry still on the right and bog on the left.

The average results across all three months for the sites are presented in **Table 4-8** below. In general, the rivers have low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and very low pH indicating acidic conditions across all sites.

pH levels were very low across all sites in all months ranging from pH 4.4 to 5.9. Site C15 and C16 had the lowest average pH readings across any of the 18 sites sampled in Cappaghoosh and were both in breach of the lower EQS boundary.

Suspended sediments and DOC levels remained steady and low for the three months. An exception was site C15 in February were suspended solids peak at 18mg/l, although this is below the standard of an annual average ≤25mg/l it is the highest suspended sediment reading across both properties and stands out. Rainfall in February was very low with drier than average conditions and levels returned to undetectable in March and April during high rainfall months. This high reading could potentially be an anomaly or potentially disturbance of the substrate when the sample was taken as water may have been very low in this small first order stream.

Average zinc levels were elevated above the EQS for all sites except C15. Average copper levels were elevated above the EQS for sites C15 and C16. Site C16 had the highest levels of metals compared to the other sites (aluminium, copper, iron and zinc). The sampler noted the river can be dry here and sometimes the water in the drainage ditch is sampled. It is unknown however which months this occurred in.

All other parameters which have an EQS set conform to these standards. Mean ortho-P and ammonia levels indicate High status at all sites.

Table 4-8: Average results (February- April) for paramaters measured at sites C15, C16, C17 & C18. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C15	C16	C17	C18
Alkalinity (mg/L $CaCO_3$)	11.50	6.50	8.50	10.50
Aluminium (µg/L)	77.67	122.67	31.67	34.33
Ammonia (mg/L as N)	0.030	0.023	0.020	0.023
Calcium (mg/L)	1.60	1.80	0.67	0.67
Conductivity (at 20°C)	82.07	77.27	55.57	56.63
Copper (µg/L)	9.00	16.00	Below LOD <2	Below LOD <2
Dissolved Organic Carbon (mg/L)	22.03	15.27	7.07	6.97
Hardness Total (mg/L $CaCO_3$)	12.50	9.67	8.67	8.33
Iron (µg/L)	379.67	507.67	208.00	246.33
Magnesium (mg/L)	1.17	1.20	0.93	0.97
Manganese (µg/L)	1.33	12.67	19.00	25.00
Nickel (µg/L)	1.00	1.00	Below LOD <1	Below LOD <1
Nitrate (mg/L as N)	Below LOD <0.51	Below LOD <0.51	Below LOD <0.51	Below LOD <0.51
pH (pH Units)	4.3	4.4	5.1	5.1
Phosphate-Ortho (mg/L)	0.01	0.01	Below LOD <0.01	Below LOD <0.01
Phosphorus-Total (mg/L as P)	0.04	0.03	Below LOD <0.03	Below LOD <0.03
Potassium (mg/L)	0.23	0.23	0.23	0.37
Sodium (mg/L)	12.40	10.47	8.57	8.53
Solids-Total Suspended (mg/L)	18.00	Below LOD <2*	Below LOD <2*	Below LOD <2*
Zinc (µg/L)	32.00	33.33**	14.00	9.67

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

** Samples exceed EQS in surface water regulations and also standard of 30mg/l (hardness <10mg/l) in the salmonid regulations

4.2.5. C11 & C12

Sites C11 and C12 are located in the centre of the Cappaghoosh property. The river here rises within the forestry and flows in an east-west direction toward L. Owengarve. Site C12 is located in the upper reaches of the channel near the source and site 11 is located just upstream of the inlet to the lough.

The average results across all three months for the sites are presented in **Table 4-9** below. In general, the river has low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and very low pH indicating acidic conditions across both sites.

pH levels were very low across both sites in all months, it ranged from pH 4.2 to 4.6. Both site C11 and C12 were in breach of the lower EQS boundary for pH. Suspended sediments and DOC levels remained steady and low for the three months.

Nutrients were low across both sites with average ammonia and ortho-P falling within the EQS for High Status.

Table 4-9: Average results (February- April) for paramaters measured at sites C11 & C12. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C11	C12
Alkalinity (mg/L $CaCO_3$)	Below LOD <2	12.3
Aluminium (µg/L)	68.33	82.33
Ammonia (mg/L as N)	0.033	0.027
Calcium (mg/L)	1.6	1.63
Conductivity (at 20°C)	85.7	93.6
Copper (µg/L)	13	11
Dissolved Organic Carbon (mg/L)	16.67	19.73
Hardness Total (mg/L $CaCO_3$)	9.33	11
Iron (µg/L)	344	592.7
Magnesium (mg/L)	1.27	1.53
Manganese (µg/L)	16.33	13
Nickel (µg/L)	1	1
Nitrate (mg/L as N)	Below LOD <0.51	Below LOD <0.51
pH (pH Units)	4.4	4.5
Phosphate-Ortho (mg/L)	0.01	0.01
Phosphorus-Total (mg/L as P)	0.03	0.03
Potassium (mg/L)	0.33	0.43
Sodium (mg/L)	11.7	13.97
Solids-Total Suspended (mg/L)	All samples below LOD <2*	5
Zinc (µg/L)	22.67	20

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

4.2.6. C14

This site is located on a small stream in the southern section of the Cappaghoosh property. From satellite imagery the parcel of forestry the river rises from was felled sometime between 2015-2019.

It does not appear to have been replanted but some trees have regenerated. The river then flows into L. Curreel.

The average results across all three months for the sites are presented in **Table 4-10** below. In general, the river has low alkalinity (i.e., low buffering capacity to neutralise acids), very soft water (few dissolved minerals), low nutrients and very low pH indicating acidic conditions across both sites.

pH levels were very low in all months ranging from pH 4.2 to 4.8 with the average just in breach of the lower EQS boundary. Suspended sediments and DOC levels remained steady and low for the three months.

Metals (aluminium, copper, iron, manganese and zinc) all saw a large decrease in April. However, the average levels of zinc were still in breach of the EQS. Nutrients were low across both sites with average ammonia and ortho-P falling within the EQS for High Status.

Table 4-10: Average results (February- April) for paramaters measured at sites C14. Green text indicates initial results are within EQS and red text indicates initial results exceed EQS.

	C14
Alkalinity (mg/L $CaCO_3$)	12.00
Aluminium (µg/L)	45.33
Ammonia (mg/L as N)	0.033
Calcium (mg/L)	1.60
Conductivity (at 20°C)	69.57
Copper (µg/L)	All samples below LOD <2
Dissolved Organic Carbon (mg/L)	16
Hardness Total (mg/L $CaCO_3$)	9.33
Iron (µg/L)	195
Magnesium (mg/L)	1.07
Manganese (µg/L)	4.67
Nickel (µg/L)	All samples below LOD <1
Nitrate (mg/L as N)	All samples below LOD <0.51
pH (pH Units)	4.5
Phosphate-Ortho (mg/L)	0.02
Phosphorus-Total (mg/L as P)	0.06
Potassium (mg/L)	0.27
Sodium (mg/L)	9.47
Solids-Total Suspended (mg/L)	4.00*
Zinc (µg/L)	13.00

*Samples do not exceed 25mg/l which is standard set in the salmonid regulations.

5. SUMMARY

The initial water chemistry results assessed (January/February- April) show that the rivers in both Derryclare and Cappaghoosh are characterised by low alkalinity, low water hardness, low nutrients and low pH.

In terms of pH the results would indicate that these rivers exhibited acidic conditions over prolonged periods with an average of pH 5.2 across all sites in Derryclare and pH 4.8 across all sites in Cappaghoosh. Whether the rivers naturally exhibit this very low pH or if this is due to forestry/peat

drainage is unknown as there is no water chemistry prior to afforestation. Given the quartzite and schist geology the rivers would be considered naturally acidic with very limited buffering capacity associated with this geology. This makes the rivers sensitive to further acidification and both properties are located in areas designated as acid sensitive areas (DAFM, 2015). For these reasons these rivers would lack the capacity to cope with additional acidity and it is likely that land use activities have exacerbated the pH levels resulting in more extreme and prolonged low pH levels. Initial results indicate that average pH exceeded the lower EQS[2] boundary (samples should be > pH 4.5) at a number of sites in Cappaghoosh (C4, C11, C12, C13, C14, C15, C16).

Low pH can impact macroinvertebrate communities and is generally associated with low species diversity (Hildrew *et al.,* 1984; Hildrew & Giller 1994). Low to moderate diversity was observed during the 2023 biological sampling. The low pH values would also limit the salmonid potential within these rivers with an annual average pH <6 considered unsuitable as per the Salmonid Regulations. Sudden decreases of pH can result in gill and skin irritation in salmon and trout. Acid irritates the gills resulting in excessive mucus production and can cause reddened areas on the abdomen.

Acidity levels also influence the solubility of metals in the geology, soils and stream water. One particular metal, aluminium, becomes soluble below pH <5.5 forming monomeric aluminium which is toxic to fish and insects. No EQS has yet been set for monomeric aluminium as it is difficult to predict monomeric levels from total aluminium. Copper and zinc are two metals which also have a toxic effect upon aquatic biota and do have EQSs. All Derryclare sites exceeded the EQS for zinc. In Cappaghoosh 13 out of 18 sites were also above the EQS for zinc. The EQS for copper was also exceeded in 6 out of 18 sites in Cappaghoosh. A large increase in metals occurred in March/April at most sites. February was unseasonably dry and this was followed by a very wet March and April. This wet period may have flushed mobilised metals from the soils into the rivers.

Nutrients were low satisfying the High status EQS for both ammonia and ortho-P in all sites except for one. This exception was site P4 in Derryclare with ammonia indicating Good not High. This waterbody has been modelled at High WFD status and therefore would be expected to achieve High for supporting nutrient conditions.

In terms of the biological samples the results in Derryclare were of interest. The waterbody here has been modelled at High WFD status and again would be expected to achieve High biological quality (Q4-5 or Q5) if sampled. One river did achieve this High biological quality in the upper reaches but then declined to Good further downstream. One river showed a marked departure from High biological quality with a Q3-4 assigned indicating Moderate quality. The results would indicate that this waterbody in Derryclare would struggle to achieve the modelled High WFD status.

In Cappaghoosh, the Q-values varied from Good to Poor. Site CB-E was the most degraded with a Q3 assigned indicating Poor biological quality. This is also an EPA monitoring point and long-term data shows that the site has failed to achieve Q4 (Good) since 2003. Excessive algal growth was observed on the substrate here which could indicate nutrient enrichment issues however the water chemistry results taken close to the biological site indicate low nutrients during winter/early spring (June water chemistry is pending). It may be that the low flows and open sunny habitat created ideal conditions for algal growth combined with limited grazing invertebrates to keep algal growth in check. Oxygen

[2] Please note that majority of EQS set in the Surface Water Regulations are based on an annual average over a 12-month period. As only 3-4 months data has been collected the comparison with the EQS set in the serves as a guide only.

levels were satisfactory on the day of survey. It was unclear on the day what may be the cause of the poor quality but the very low macroinvertebrate diversity may indicate some low-level toxic impact or a hydrological pressure as a result of the low flows.

Finally, it should be noted that during the biological sampling water levels were very low with some rivers almost drying out and this may have impacted the Q-value score. It would be interesting to see if the Q-values improve in higher flows. While these rivers may naturally have low summer flows the impact of drainage and climate change resulting in more frequent and prolonged extreme flows are likely compounding the situation. These rivers flow across open habitats with little to no shading and the water temperatures recorded on the day were quite high. All these factors, including the low pH place additional pressures upon the rivers within Derryclare and Cappaghoosh which may help to explain why some are not achieving High or even Good biological quality.

The results of the water chemistry and biological sampling paint a complicated picture across both properties but it is clear there are pressures acting upon these water bodies including but not limited to; flow, pH and excessive metals.

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Appendix A
Summary of biological field survey results

Table A- 1: Summary of general habitat characteristics for surveys completed in Derryclare 2023.

	Site DB-1	Site DB-2	Site DB-3	Site DB-4	Site DB-5	Site DB-6
Co-ordinates	53.48118, -9.76519	53.48367, -9.76132	53.50622, -9.74725	53.50484, -9.75973	53.50996, -9.74706	53.51832, -9.76209
DO% mg/l	30, 2.63	100.7 , 8.67	85.9, 7.93	99.3, 9.26	141, 13	95, 8.93
Temp °C	23	19.5	19	18	18	18.3
Conductivity uS/cm	95	62	59	55	113	49
pH	6	5.57	4.76	6.25	5.4	5.6
Bank height (m)	0.1	0.5	1	2	1	0.3
Bank wetted width (m)	0.3	2.5	3	1	1	1.5
Average depth (m)	>1	0.1	0.1	0.1	>1	0.07
Water colour	High	Moderate	Low	Moderate	High	Moderate
Bank erosion	None	None	Moderate	Moderate	Moderate	Moderate
Shading	None	Light	Light	Light	Moderate-heavy	None
Substrate (%)	Peat/silt:100	Bedrock Boulder: 35 Cobble: 25 Coarse gravel: 20 Fine gravel: 10 Sand: 8 Silt: 2	Bedrock Boulder: 0 Cobble:25 Coarse gravel: 35 Fine gravel: 20 Sand:15 Silt: 5	Bedrock 15 Boulder: 35 Cobble: 25 Coarse gravel: 15 Fine gravel: 5 Sand: 5 Silt: 0	Peat/silt:100	Bedrock: 0 Boulder: 5 Cobble: 45 Coarse gravel: 28 Fine gravel: 15 Sand: 5 Silt: 2
Surface siltation	Heavy	None	None	None	Heavy	Low
Plume of silt	Heavy	None	None	None	Heavy	None
Substrate comment	Estimation due to coloured water	-	-	-	-	-
River habitat (%)	Stagnant:100	Riffle: 0 Glide: 90 Pool: 10	Riffle: 40 Glide: 60 Pool: 10	Riffle: 40 Glide: 50 Pool: 10	Stagnant: 100	Riffle: 60 Glide: 30 Pool: 10
Flow velocity	Stagnant	Slow	Slow	Moderate	Stagnant	Slow
Landuse	Forestry (mature, clearfelling) mod. blanket bog	Woodland-broadleaved	Forestry-coniferous	Forestry-coniferous	Forestry-coniferous	Blanket bog / Heathland
Filamentous green algae (%)	None	None	10	20	40	25
Note	-Brown hawker -Large red damselfly -Willow warbler -Siskin	-Large red damselfly -Cuckoo	-Red deer	-	-	-Meadow pipit -Skylark -Beautiful demoiselle -Cuckoo

Table A- 2: Summary of general habitat characteristics for surveys completed in Cappaghoosh 2023.

	Site CB-A	Site CB-B	Site CB-C	Site CB-D	Site CB-E
Co-ordinates	53.46323, -9.71129	53.46084, -9.6966	53.41824, -9.69301	53.41996, -9.67442	53.40698, -9.65463
DO (%) (mg/l) **Temp (°C)** **Conductivity (µS/cm)** **pH**	116.4, 10.1 21 89 8.15	78.6, 6.85 21 67 6.4	-	-	96.9, 8.62 20 58 6.48
Bank height (m)	0.5	0.2	1	-	0.7
Bank wetted width (m)	7	5	12	-	2.5
Average depth (m)	0.3	0.2	>0.6	0	0.3
Water colour	Low	Low	High	-	Low
Bank erosion	Light	Moderate	Light	None	Light
Shading	Light	Light	None	None	Light
Substrate (%)	Bedrock: 0 Boulder: 10 Cobble: 35 Coarse gravel: 25 Fine gravel: 20 Sand: 5 Silt: 5	Bedrock: 10 Boulder: 15 Cobble: 30 Coarse gravel: 25 Fine gravel: 13 Sand: 2 Silt: 5	Bedrock: 0 Boulder: 0 Cobble: 0 Coarse gravel: 0 Fine gravel: 15 Sand: 5 Silt/Peat: 80	-	Bedrock: 0 Boulder: 20 Cobble: 25 Coarse gravel: 30 Fine gravel: 15 Sand: 5 Silt: 5
Surface siltation	Low	Low	Heavy	-	Low
Plume of silt	Moderate	Moderate	Heavy	-	Low- moderate
Substrate comment	-	-	Soft and sinking	-	-
River habitat (%)	Riffle: 30 Glide: 50 Pool: 20	Riffle: 5 Glide: 85 Pool: 10	Riffle: 0 Glide: 100 Pool: 0	-	Riffle: 10 Glide: 70 Pool: 20
Flow velocity	Slow- moderate	Slow	Stagnant- slow	-	Moderate
Landuse	Heath Woodland- broadleaved	Heath Lake upstream	Heath	Heath Peat bog (drained)	Heath Peat bog
Filamentous green algae (%)	30	20	-	-	80
Note	-Skylark	-Meadow pipit -Bullfinch -Willow warbler -Skylark	Sea eagle on island in L. Curreel	-	Keeled skimmer dragonfly

Table A- 3: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site DB-2.

Site DB-2 Taxon	Group	Pollution tolerance	Abundance 2023
Protonemura sp.	A	Sensitive	Few
Amphinemura sp.	A	Sensitive	Single
Leptophlebiidae	B	Less sensitive	Few
Polycentropodidae	C	Tolerant	Common
Rhyacophila dorsalis	C	Tolerant	Few
Hydropsychidae	C	Tolerant	Few
Dytiscidae	C	Tolerant	Few
Limnius volckmari	C	Tolerant	Few
Hydraenidae	C	Tolerant	Few
Simuliidae	C	Tolerant	Numerous
Chironomidae	C	Tolerant	Numerous
Lumbricidae	C	Tolerant	Few
Hydracarina sp.	C	Tolerant	Few
Taxon Richness			**12**
Q-value			**Q3-4**

Table A- 4: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site DB-3.

Site DB-3 Taxon	Group	Pollution tolerance	Abundance 2023
Electrogena sp.	A	Sensitive	Common
Chloroperlidae	A	Sensitive	Few
Protonemura sp.	A	Sensitive	Few
Leuctra sp.	B	Less sensitive	Common
Polycentropodidae	C	Tolerant	Few
Hydropsychidae	C	Tolerant	Few
Simuliidae	C	Tolerant	Numerous
Hydracarina sp.	C	Tolerant	Common
Esolus/Oulimnius	C	Tolerant	Few
Tipula sp.	C	Tolerant	Few
Dipertan larva	C	Tolerant	Few
Tubificids	E	Most tolerant	Few
Taxon Richness			**12**
Q-value			**Q4**

Table A- 5: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site DB-4.

Site DB-4 Taxon	Group	Pollution tolerance	Abundance 2023
Electrogena sp.	A	Sensitive	Numerous
Amphinemura sp.	A	Sensitive	Common
Leuctra sp.	B	Less sensitive	Few
Polycentropodidae	C	Tolerant	Few
Hydropsychidae	C	Tolerant	Few
Rhyacophila dorsalis	C	Tolerant	Few
Simuliidae	C	Tolerant	Common
Chironomidae	C	Tolerant	Few
Limnius volckmari	C	Tolerant	Few
Taxon Richness			**9**
Q-value			**Q4-5**

Table A- 6: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site DB-6.

Site DB-6 Taxon	Group	Pollution tolerance	Abundance 2023
Chloroperlidae	A	Sensitive	Common
Isoperla grammatica	A	Sensitive	Common
Electrogena sp.	A	Sensitive	Few
Leuctra sp.	B	Less sensitive	Common
Rhyacophila dorsalis	C	Tolerant	Few
Limnius volckmari	C	Tolerant	Few
Esolus/Oulimnius	C	Tolerant	Few
Chironomidae	C	Tolerant	Few
Simuliidae	C	Tolerant	Numerous
Hydracarina sp.	C	Tolerant	Few
Lumbricidae	D	Very tolerant	Few
Taxon Richness			**11**
Q-value			**Q4**

Table A- 7: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site CB-A.

Site CB-A Taxon	Group	Pollution tolerance	Abundance 2023
Heptagenia sp.	A	Sensitive	Common
Isoperla grammatica	A	Sensitive	Few
Glossosomatidae	B	Less sensitive	Few
Odontoceridae	B	Less sensitive	Few
Lepidostomatidae	B	Less sensitive	Few
Baetis rhodani/atlanticus	C	Tolerant	Common
Esolus/Oulimnius	C	Tolerant	Few
Hydropsychidae	C	Tolerant	Common
Philopotamidae	C	Tolerant	Common
Rhyacophila dorsalis	C	Tolerant	Few
Hydracarina sp.	C	Tolerant	Few
Chironomidae	C	Tolerant	Numerous
Gammarus sp.	C	Tolerant	Few
Sphaerium/Pisidium sp.	D	Very tolerant	Few
Tubificidae	E	Most tolerant	Few
Taxon Richness			**15**
Q-value			**Q4**

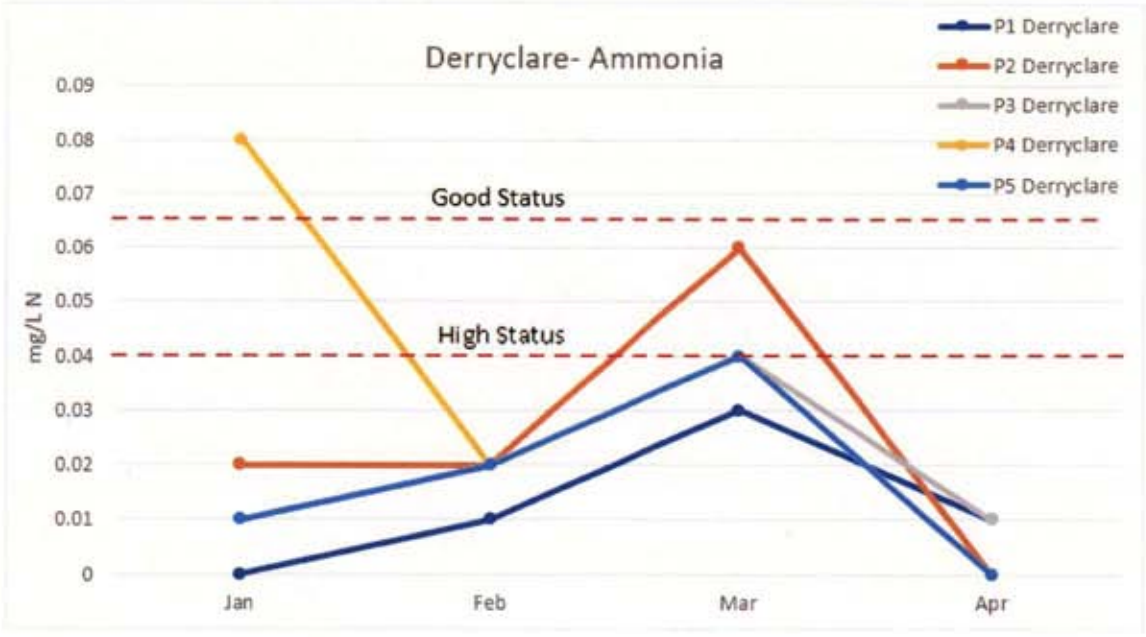
Table A- 8: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site CB-B.

Site CB-B Taxon	Group	Pollution tolerance	Abundance 2023
Heptagenia sp.	A	Sensitive	Few
Isoperla grammatica	A	Sensitive	Few
Leuctra sp.	B	Less sensitive	Few
Sericostoma personatum	B	Less sensitive	Few
Baetis rhodani /atlanticus	C	Tolerant	Common
Serratella ignita	C	Tolerant	Common
Simuliidae	C	Tolerant	Numerous
Hydropsychidae	C	Tolerant	Few
Polycentropodidae	C	Tolerant	Few
Philopotamidae	C	Tolerant	Few
Chironomidae	C	Tolerant	Few
Hydracarina sp.	C	Tolerant	Few
Esolus/Oulimnius	C	Tolerant	Few
Sphaerium/Pisidium sp.	D	Very tolerant	Numerous
Glossiphonia complanata	D	Very tolerant	Few
Taxon Richness			**15**
Q-value			**Q3-4**

Table A- 9: Summary of macroinvertebrate taxa observed and Q-value results in surveys completed to date for site CB-E.

Site CB-E Taxon	Group	Pollution tolerance	Abundance 2023
Lepidostomatidae	B	Less sensitive	Few
Polycentropodidae	C	Tolerant	Few
Hydropsychidae	C	Tolerant	Common
Philopotamidae	C	Tolerant	Common
Chironomidae	C	Tolerant	Numerous
Simuliidae	C	Tolerant	Common
Hydracarina sp.	C	Tolerant	Few
Lumbriculidae	C	Tolerant	Few
Taxon Richness			**7**
Q-value			**Q3**

Appendix B
Graphs of water chemistry results



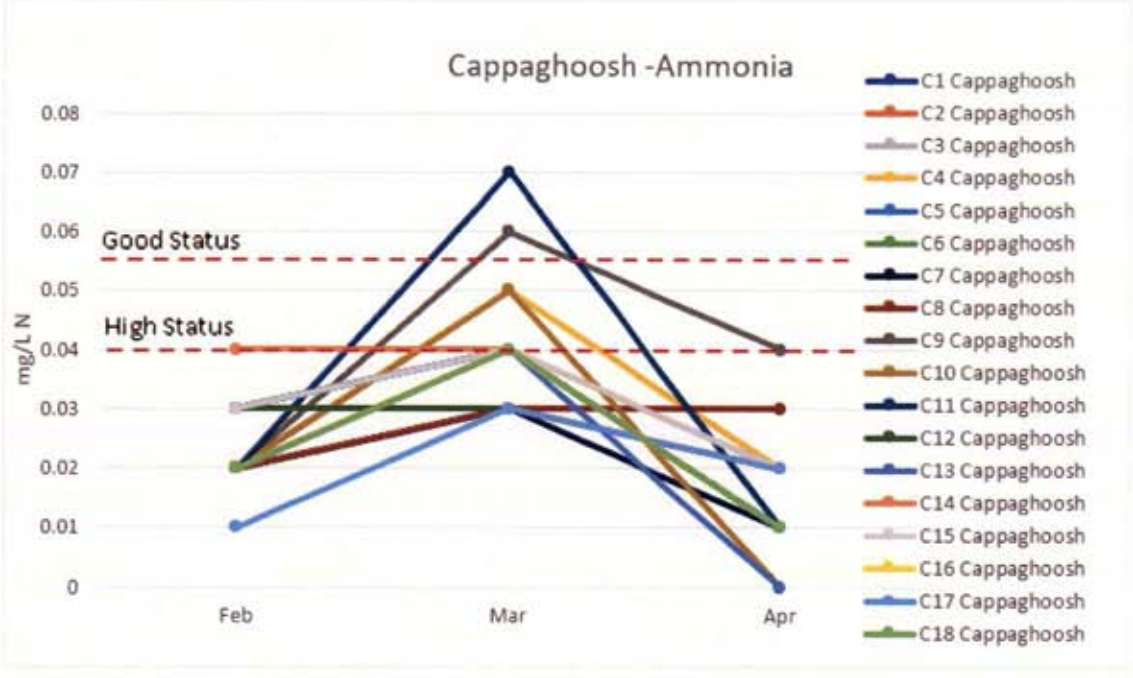
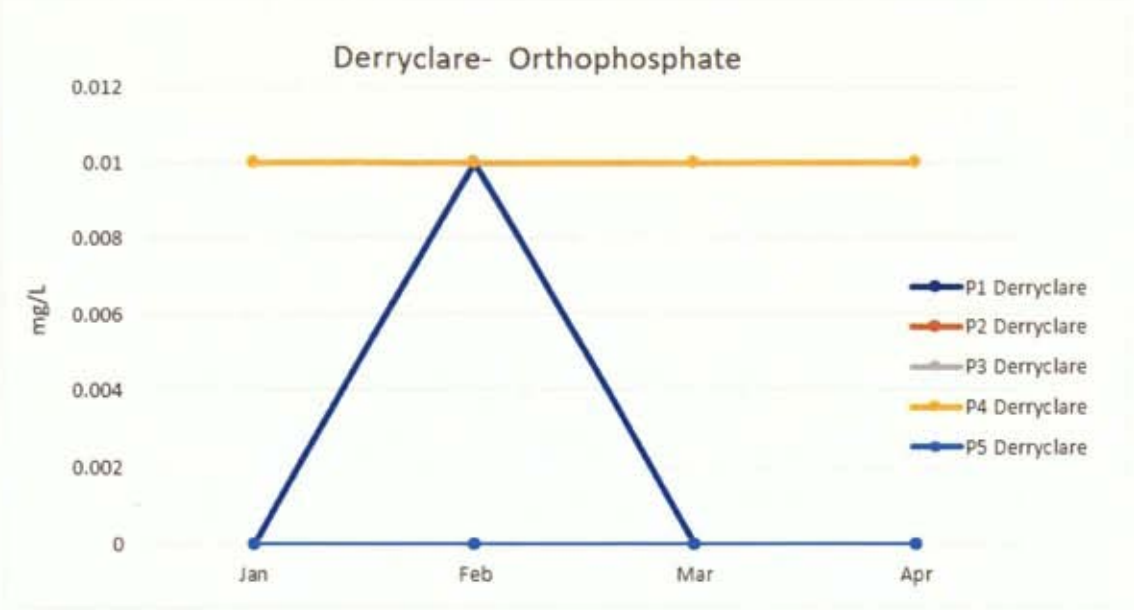


Table B-1: Results for ammonia for the months sampled for both Derryclare and Cappaghoosh properties. The red dashed line indicates the EQS boundary for ammonia as per the surface water regulations. High status ≤0.040 (mean) / ≤0.090 (95%ile). Good status ≤0.065 (mean) / ≤0.140 (95%ile



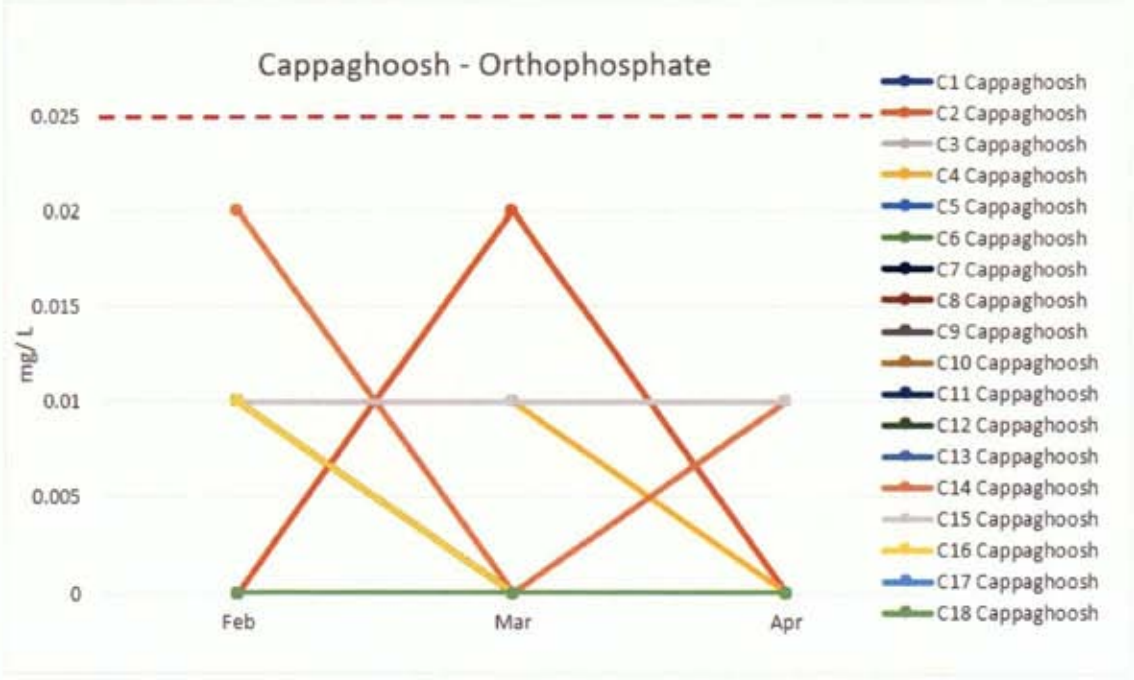
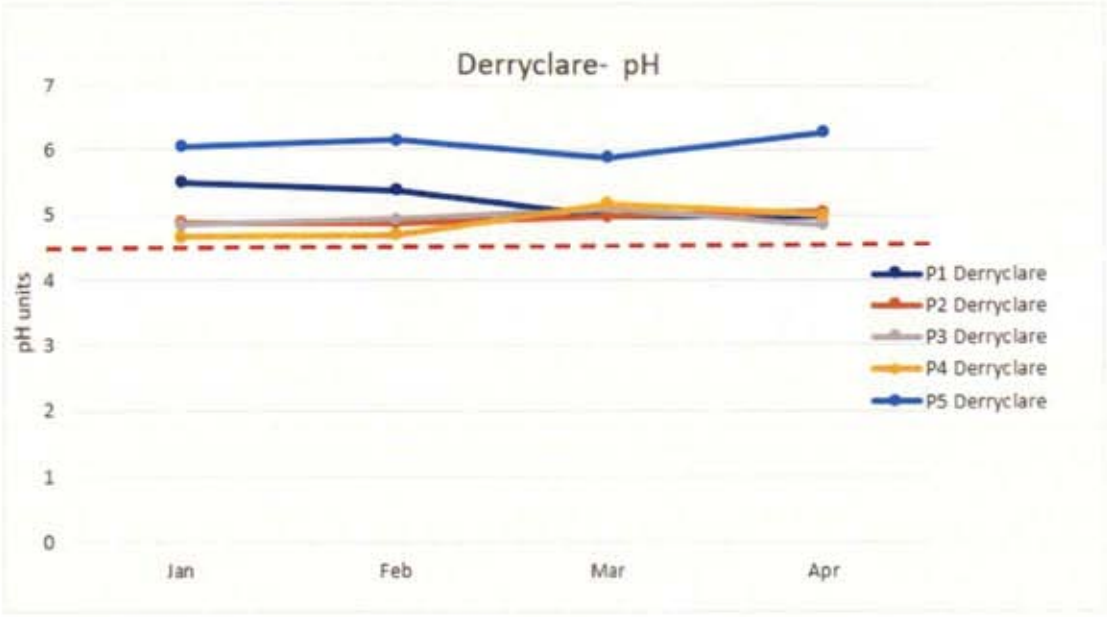


Table B-2: Results for orthophosphate for the months sampled for both Derryclare and Cappaghoosh properties. The red line indicates EQS boundary for phosphate (MRP) as per the Surface Water Regulations. High status ≤0.025 (mean) / ≤0.045 (95%ile). Good status ≤0.035 (mean) / ≤0.075 (95%ile). Orthophosphate is taken as a proxy for MRP.



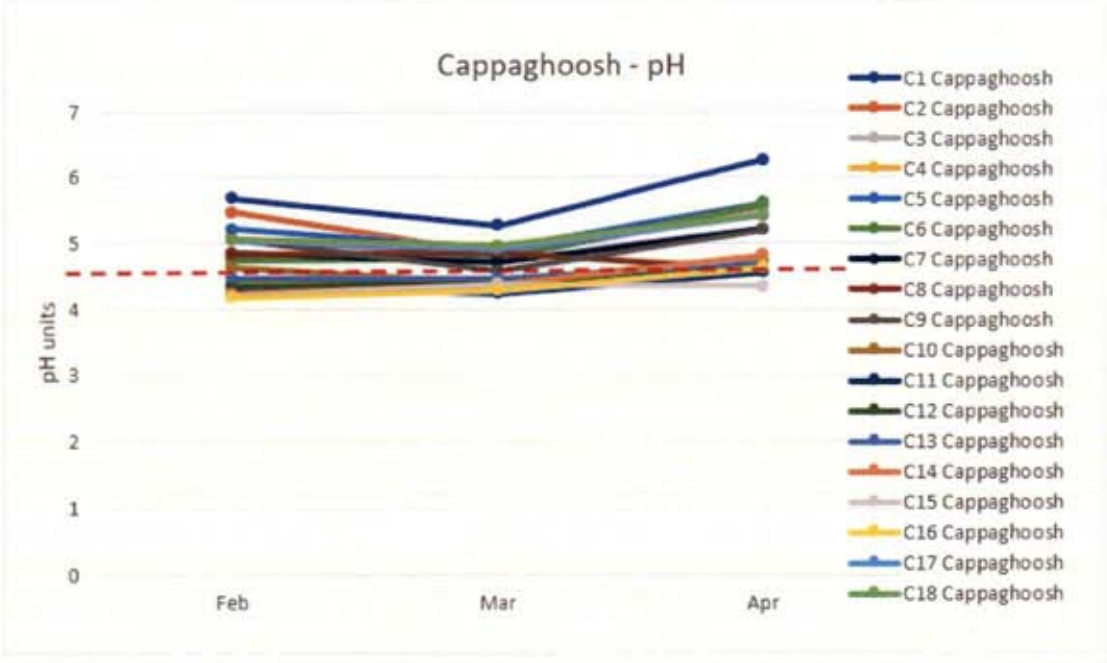


Table B-3: Results for pH for the months sampled for both Derryclare and Cappaghoosh properties. The red dashed line indicates the lower EQS boundary for pH at 4.5 as per the Surface Water Regulations.

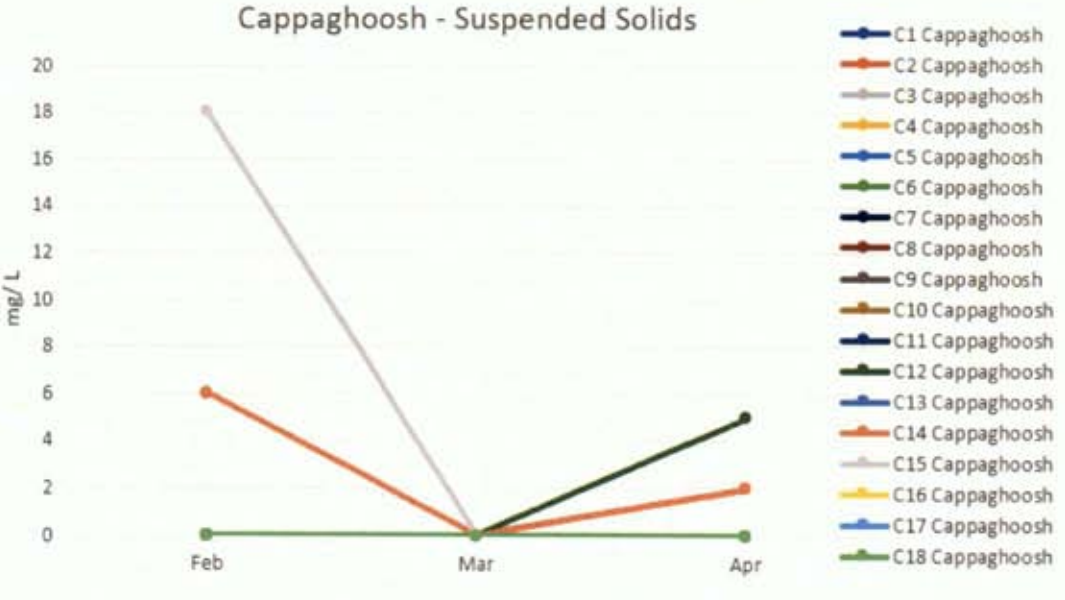
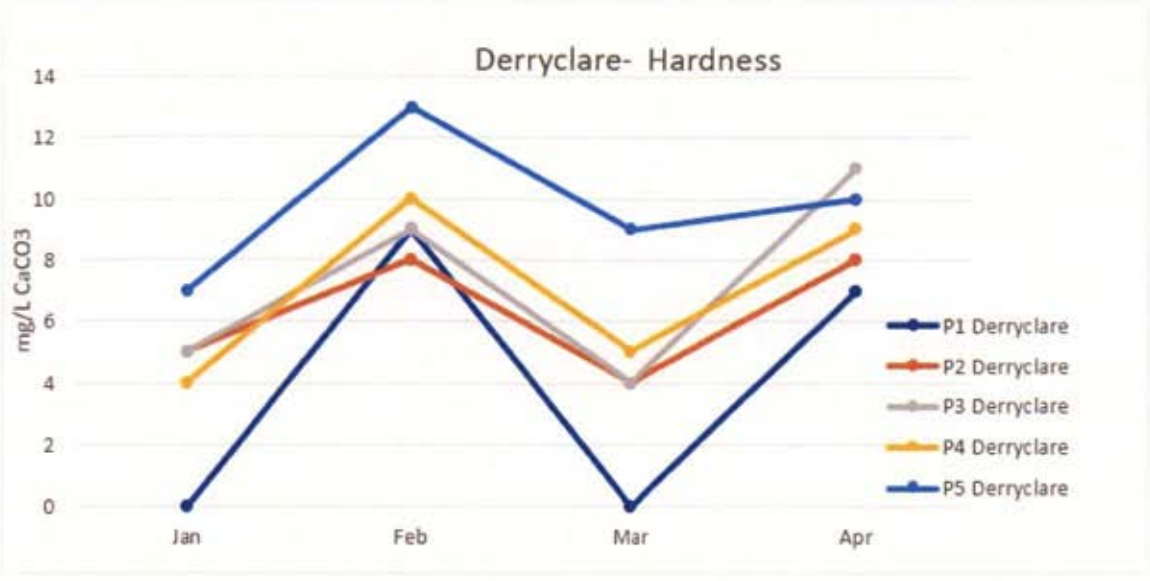


Table B-4: Results for suspended solids for the months sampled for both Derryclare and Cappaghoosh properties. The standard set for suspended solids within the Salmonid Regulations is an annual average of 25mg/L.



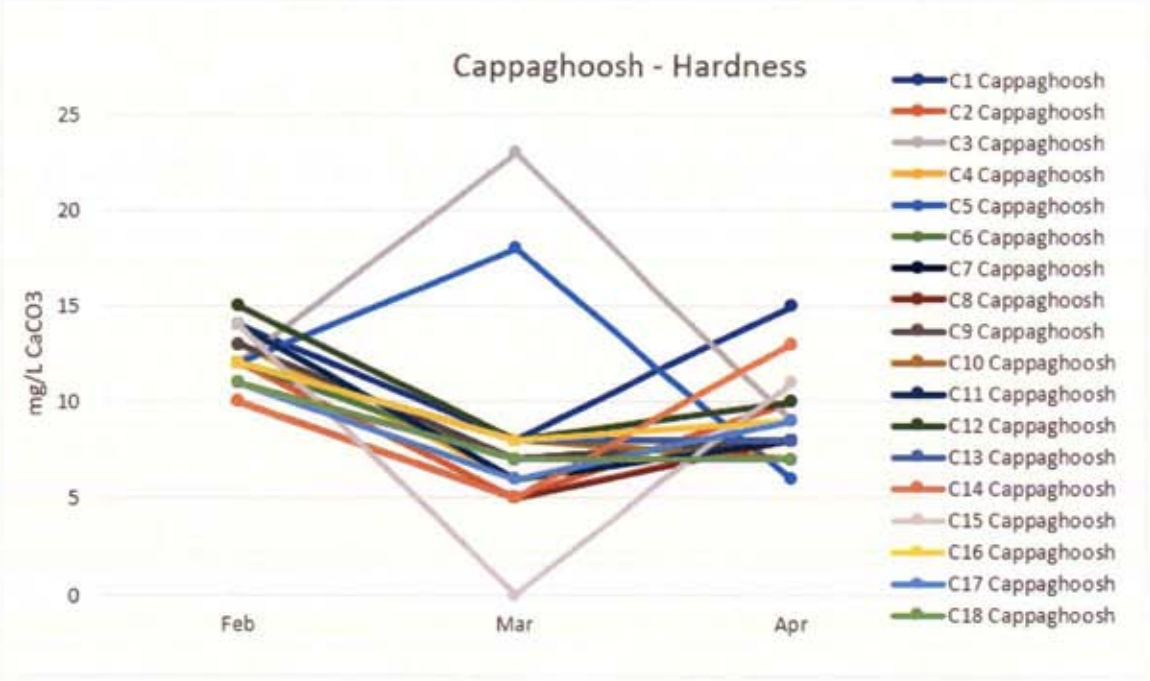
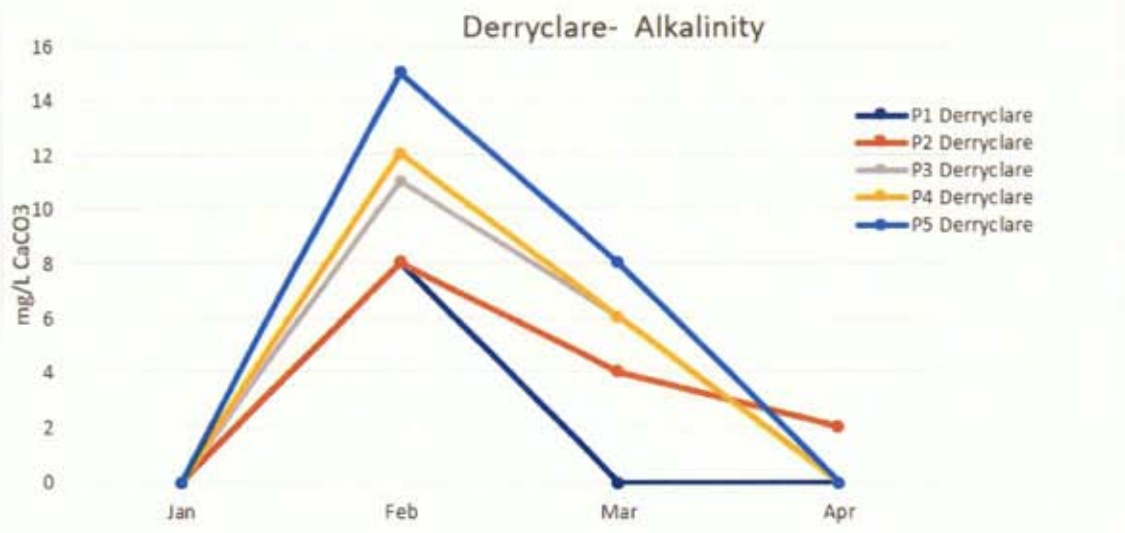


Table B-5: Results for water hardness for the months sampled for both Derryclare and Cappaghoosh properties. No EQS standards are set within the Surface Water Regulations.



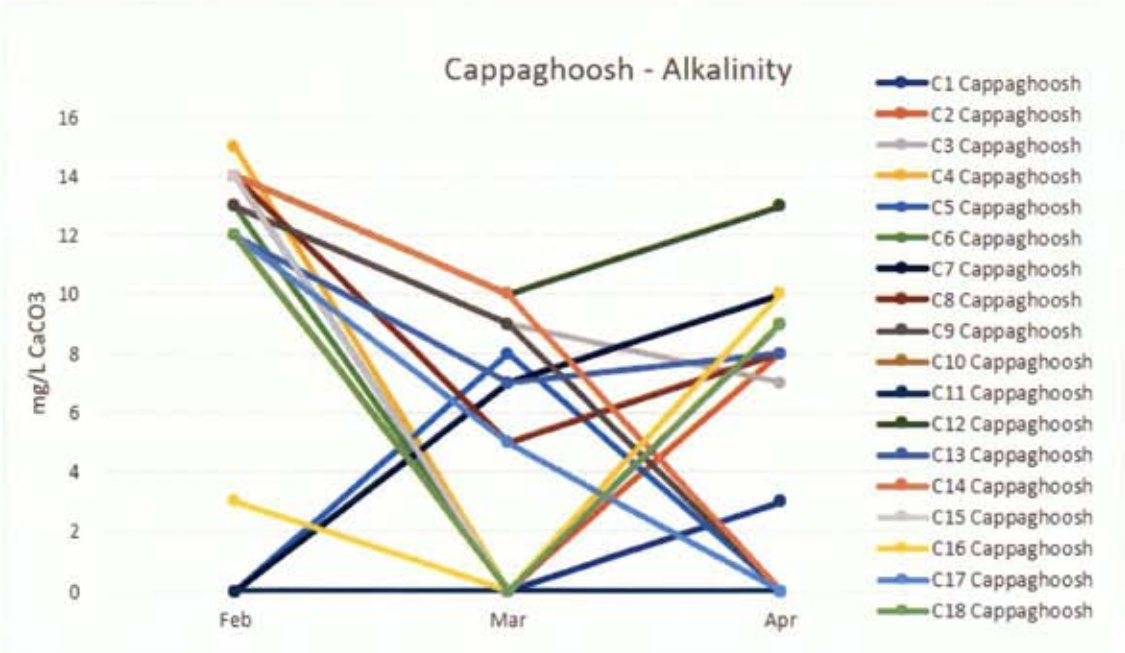
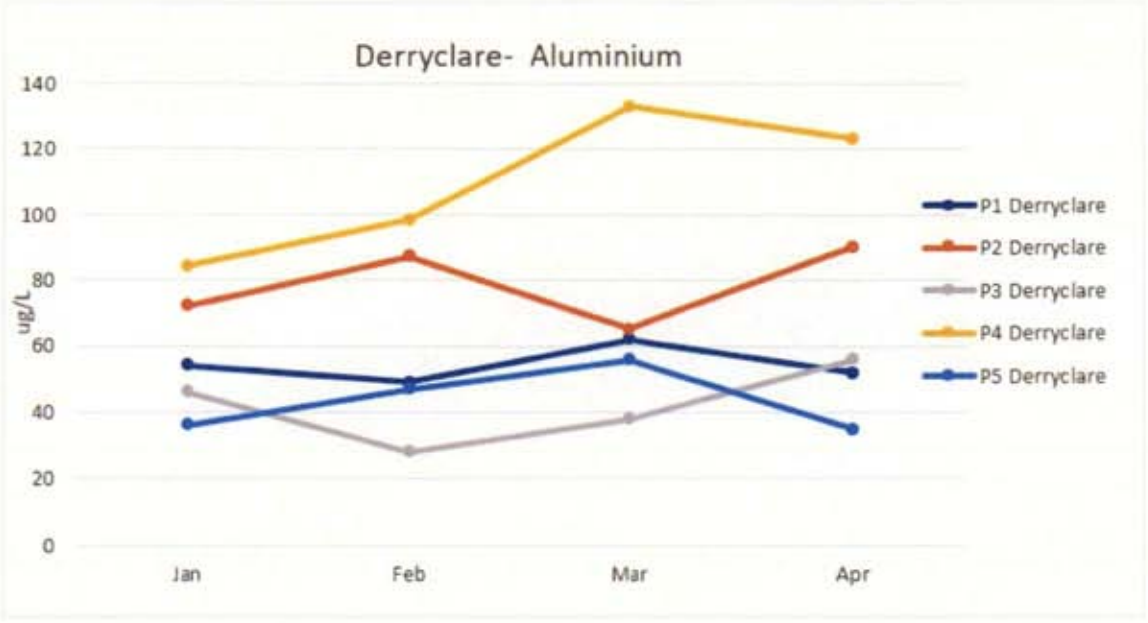


Table B-6: Results for alkalinity for the months sampled for both Derryclare and Cappaghoosh properties. No EQS standards are set within the Surface Water Regulations.



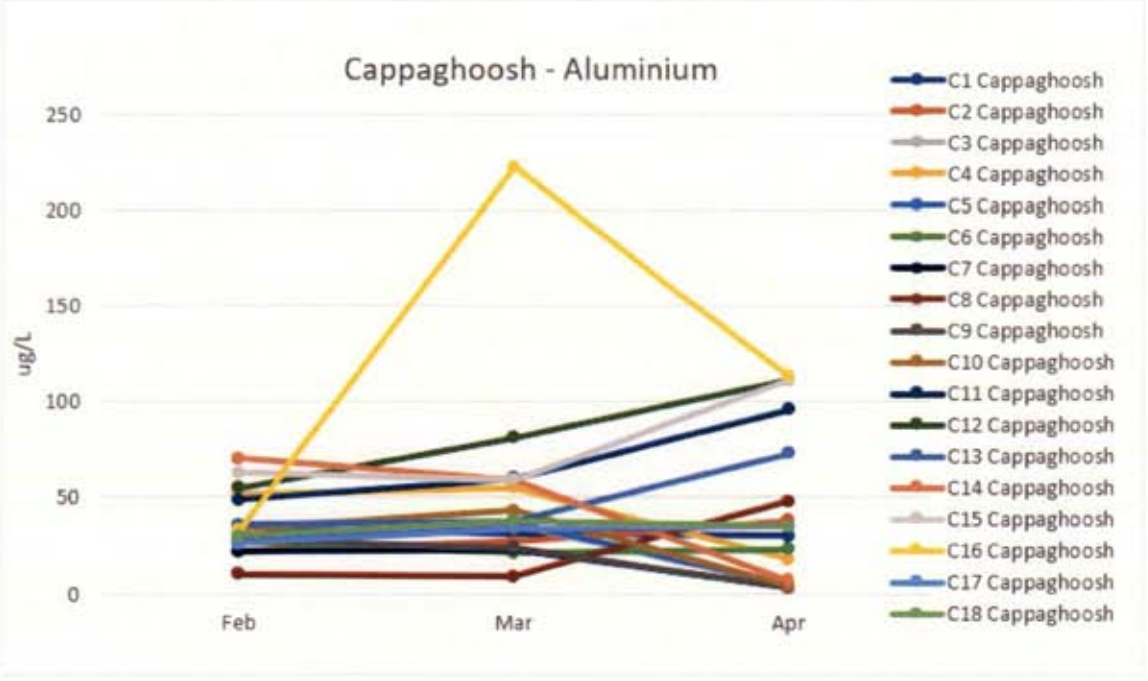
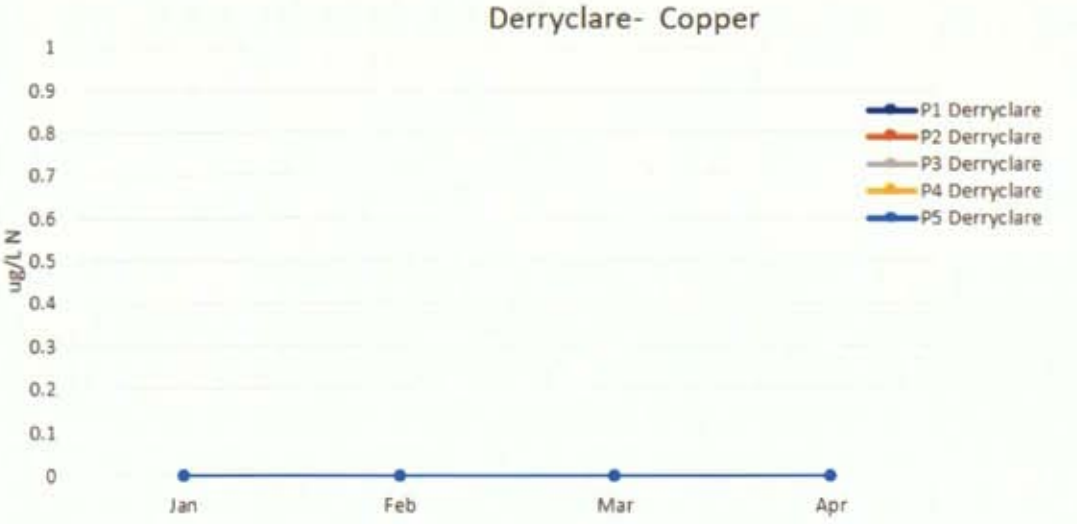


Table B-7: Results for aluminium for the months sampled for both Derryclare and Cappaghoosh properties. No EQS standards are set within the Surface Water Regulations.



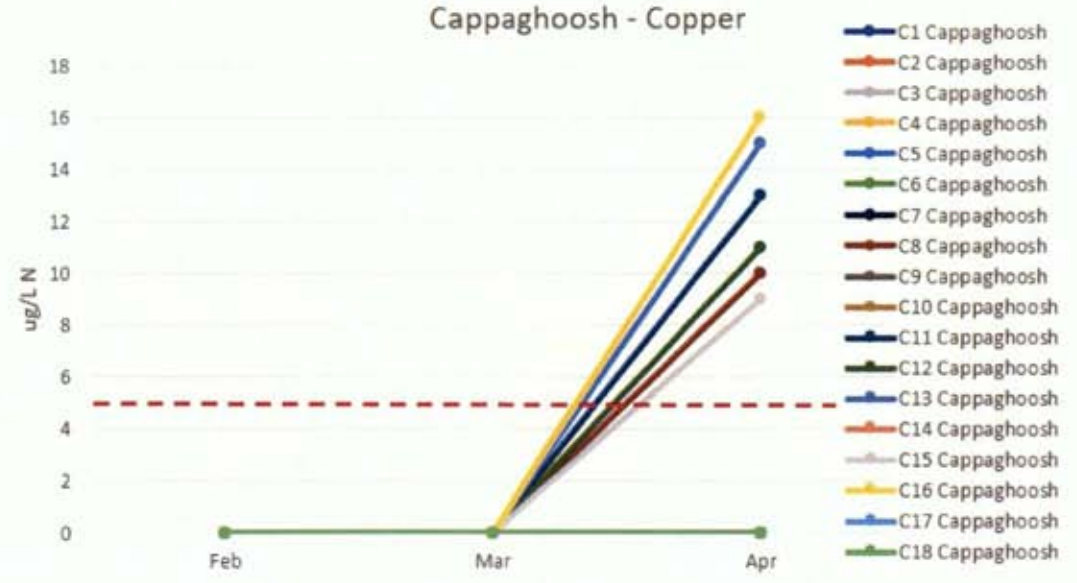
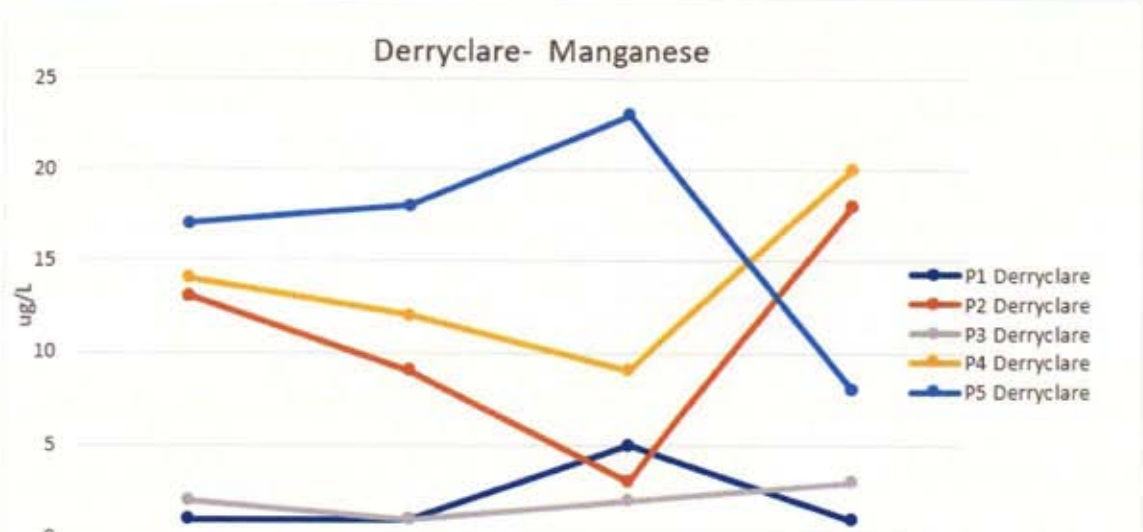


Table B-8: Results for copper for the months sampled for both Derryclare and Cappaghoosh properties. The red dashed line indicated the EQS boundary for copper as per the Surface Water Regulations. This is 5µg/L for water hardness ≤100mg/L $CaCO^3$. All sites fit into this category for average water hardness.



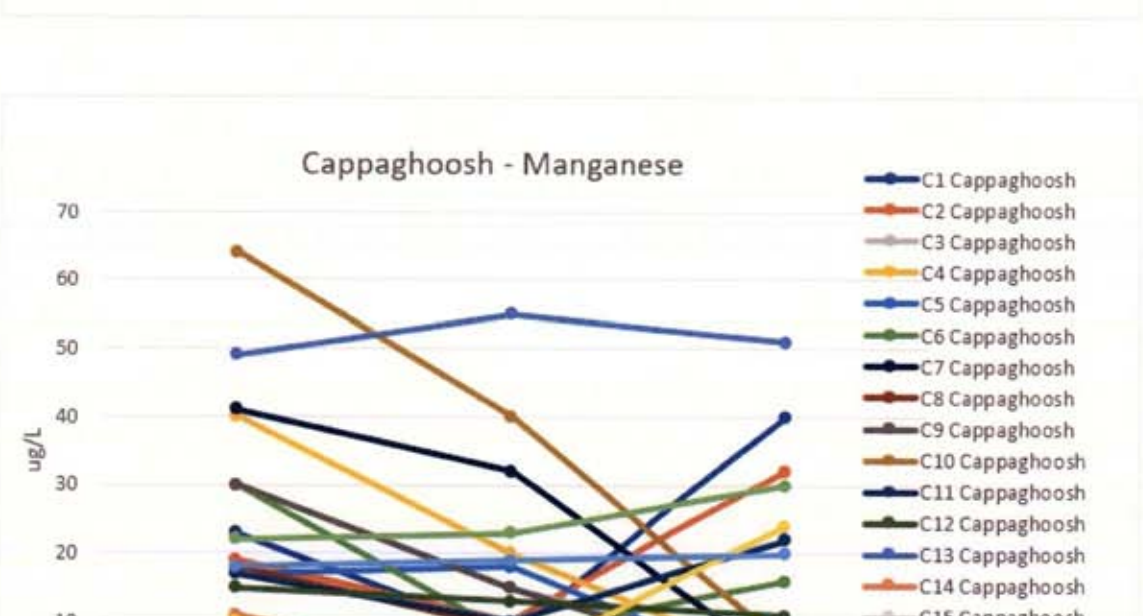
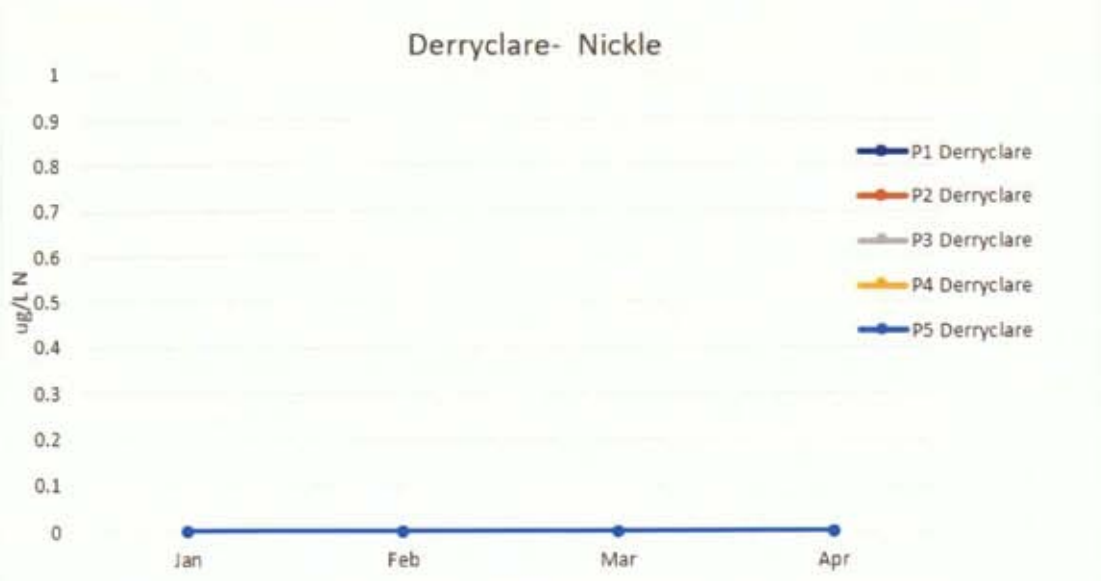


Table B-9: Results for manganese for the months sampled for both Derryclare and Cappaghoosh properties. No EQS standards are set within the Surface Water Regulations.



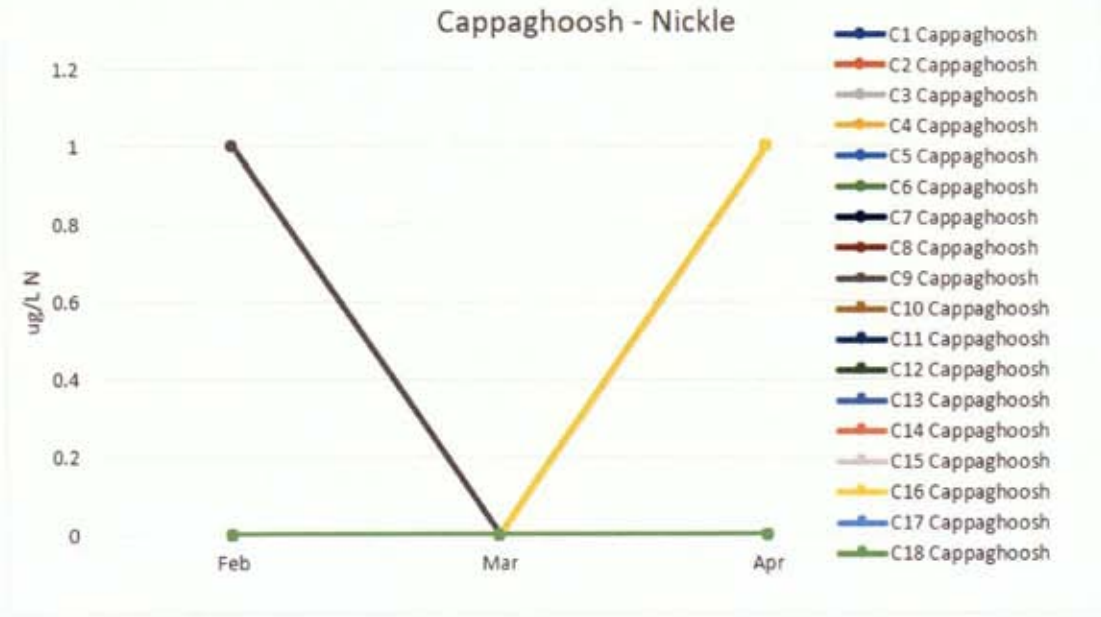
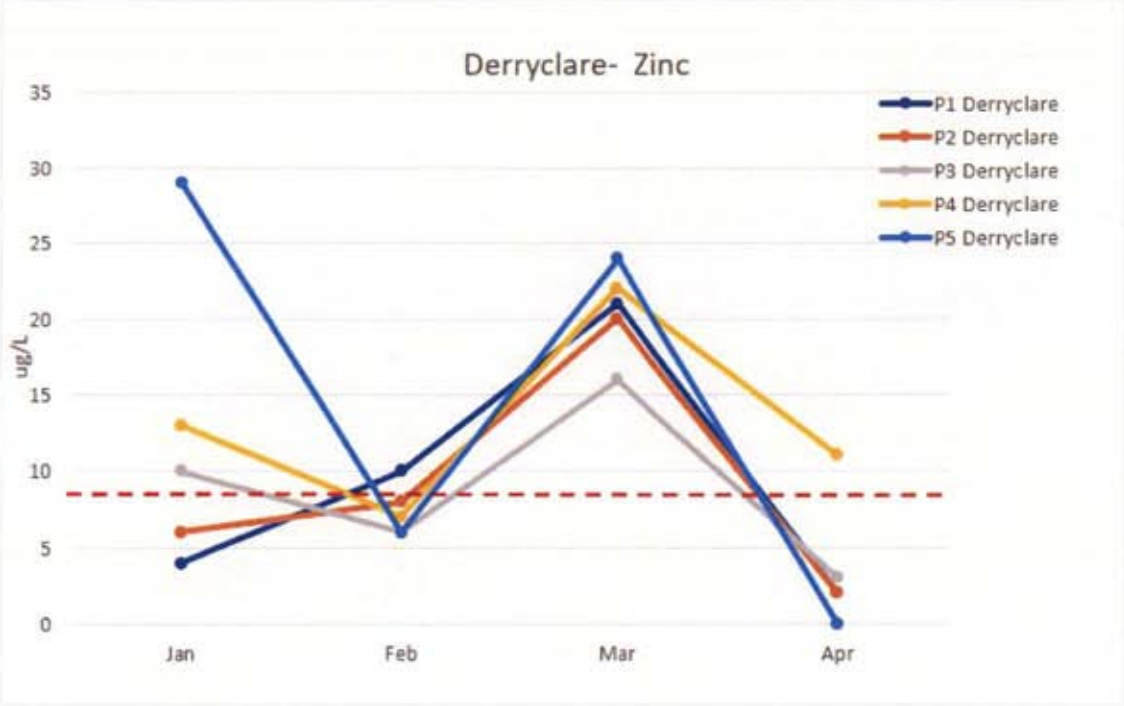


Table B-10: Results for nickel for the months sampled for both Derryclare and Cappaghoosh properties. The EQS boundary for Nickle is 20 µg/L as per the Surface Water Regulations.



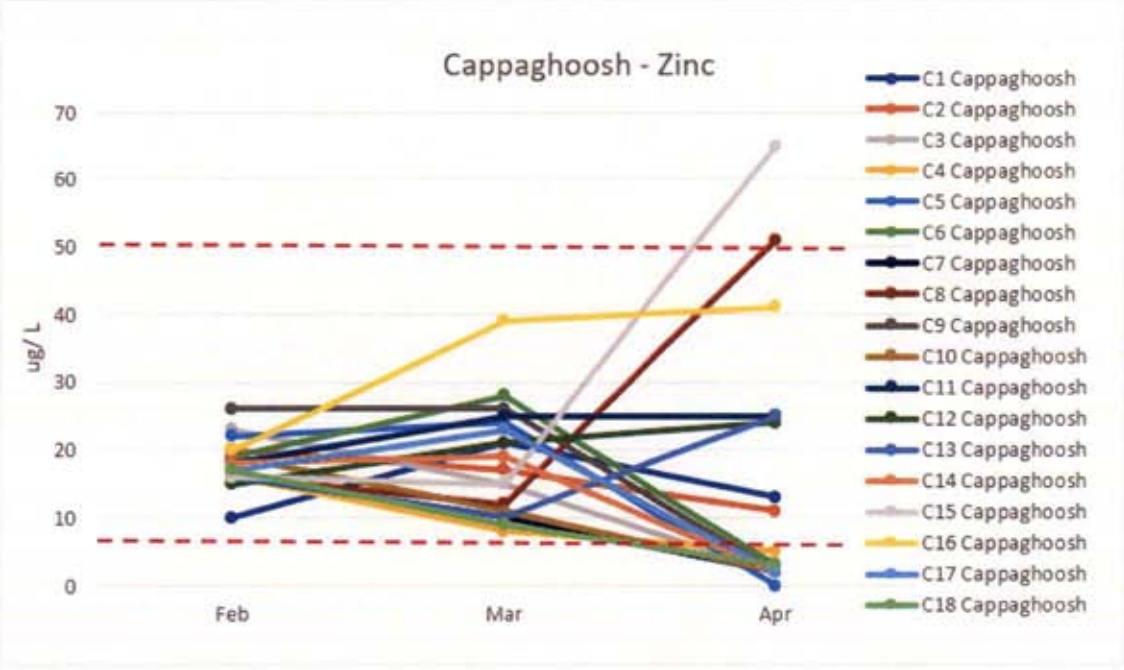


Table B-11: Results for zinc for the months sampled for both Derryclare and Cappaghoosh properties. Red line indicates the EQS boundary for zinc as per the Surface Water Regulations. This is 8ug/L for water hardness with annual average ≤10mg/L $CaCO^3$. 50µg/L for water hardness with annual average >10 to ≤100mg/L $CaCO^3$. Most sites fall into the first category with low average water hardness. Site C1, C3, C5 and C15 fall into the latter category.

APPENDIX 4

DERRYCLARE MANAGEMENT AND MAINTENANCE PLAN INCLUDING FIRE PLAN

Derryclare management and maintenance plans

Date: 06/09/2023

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1.0 Introduction

This report details the Derryclare management and maintenance plans in one document. These plans deal with ongoing management and general maintenance issues that will be managed over the entirety of the project implementation stage. This report covers 5 key areas, namely,

- Invasive species management plan.
- Grazing management plan (including deer management).
- Fire plan.
- General maintenance plan (including public usage).

Invasive species management plan

Invasive species can cover a range of plant species, however, in Derryclare, following a detailed ecological assessment, the main pressure from invasive species was identified to come from rhododendron ponticum and conifer reseeding with mainly lodgepole pine. There are many papers on rhododendron ponticum control (Higgins, (2008) Cross, (1973) Rotherham, (1983). Edwards, (2006)) and it is well understood. Their control is essential and often problematic and success removal requires continual vigilance and many costly interventions. Regeneration of lodgepole pine seedings is also a known issue with peatland restoration in Ireland and it must also be managed. The plan to deal with this described below.

Grazing management plan (including deer management)

Grazing pressures from mainly sheep, livestock and deer can lead to dominance by Molinia caerulea and Eriophorum vaginatum (Shaw & Wheeler, 1994) with a decline in Sphagnum species (Lindsay, 2010). The main grazing pressure in Derryclare is from sheep, deer and occasionally cattle. The plan to deal with this described below.

Fire plan

Fires tend to burn only the surface vegetation and drier features such as hummocks but leave much of the wet surface relatively intact. For infrequent fires there is generally sufficient time for the bog surface vegetation to recover, but for more frequent and severe fires, (where the fire burns under the surface) it can take more than 50 years for Sphagnum plants to return when burning has produced a bare peat surface (Evans & Warburton, 2007). Derryclare is an area historically at risk from wildfires and as a result, this pressure must be managed. The plan to deal with this described below.

General maintenance plan (including public usage)

General maintenance is a catch all that refers to addressing issues as they arise and they can include a wide variety of tasks such as road maintenance, silt trap and dam inspections and repairs, dumping, vandalism, erection, and repair of signage, dealing with the public and local requests arising from consultations. For Derryclare the most important general maintenance is expected to be silt trap and dam inspections and

maintenance, keeping the main access road in good repair and issues with the public such as recreational usage, dumping and vandalism. The plan to deal with this described below.

2.0 Invasive species management plan

2.1 Summary of the invasive species management plan

Following an ecological survey, the main invasive species threat in Derryclare was identified as Rhododendron ponticum and conifer reseeding, with no other invasives observed. The control of rhododendron is a priority as it is seen as one of the largest threats to the success of the restoration works. The baseline data has shown that rhododendron is present at a low-level on a property wide basis and it has the potential to become a large high-level infestation, especially once ground disturbance occurs during restoration. Therefore, annual property wide interventions are planned for Derryclare. The treatment will adopt the methodology researched by the NPWS in the adjoining forest property in Kylemore (described below). The treatment has proven itself to be suited to the conditions in Connemara and it is expected to be a good fit for Forest to bog projects. The entire property will be treated annually, so that by the time initial tree removal begins, most of the rhododendron stems will be dead and can be windrowed along with the forest brash. In addition, all newly restored areas will also be included in the annual treatment, so that all new saplings will be treated or removed. As the restoration programme is spread out over 8 years, the expectation is that all restored areas will be free from rhododendron, and this will be used as one measure to monitor the success of the treatment programme. This annual approach, although intensive, is deemed necessary to manage the rhododendron threat in Derryclare. Intermittent surveys will be carried out to monitor progress, including the visual surveys and sampling surveys described below. New survey methods such as drone surveys or remote sensing can also be adopted, if proved successful. These surveys occur when the rhododendron is flowering and can be a cost-effective way to map a site. Conifer reseeding will be manged in two ways, namely by a) creating unfavourable conditions for seeding germination by removing where possible the raised dry plough ridge using surface smoothing, and 2) where seedlings regenerate, these will be removed when they are young enough to be pulled up out of the ground or cut with a garden lopper. In terms of carrying out the site works, it is planned to link in with Forum Connemara, who in co-operation with the NPWS have set up a dedicated local work gang to treat rhododendron in Connemara. This gang has already been employed to carry out the detailed baseline mapping described below. Treatment of rhododendron will be one of the first actions to be scheduled and it will remain a priority throughout the project.

2.2 Introduction

The main invasive species threat in Derryclare is from Rhododendron ponticum. There are many papers on rhododendron control (Higgins, (2008) Cross, (1973) Rotherham, (1983). Edwards, (2006)) and it is well understood. Their control is essential and often problematic and successful removal requires continual vigilance and many costly interventions. Regeneration of lodgepole pine seedings is also a known issue with peatland restoration in Ireland. This is typically associated with tree removal of mature crops with heavy cone production and sites that were ploughed. The cones of lodgepole pine and their seed can remain viable for many years, and regeneration on restored sites is most often found where the original plough ribbon is left intact, offering slightly drier conditions that favour seedling regeneration. According to Campbell et al., (2019) conifer regeneration can be dealt with by surface smoothing methods, but otherwise must be removed manually. In Scotland, it was observed that carrying out the restoration work immediately post felling and raising the water table as soon as possible, is an effective way to limit conifer and invasive species regeneration by creating unfavourable conditions for seeding germination. Where seedlings regenerate, the optimum time to remove them is when they are young enough to be pulled up out of the ground or cut with a garden lopper. Allowing the seedlings to grow any older will require a chainsaw intervention.

The plan to manage Rhododendron ponticum and conifer seedling regeneration in Derryclare involves the following.

1. Establish the baseline level of infestation of rhododendron ponticum.
2. Schedule annual property wide interventions.
3. Monitor progress.
4. Use local community groups for field work.

2.3 Establish the baseline infestation level.

To assess the invasive species in Derryclare and the level of infestation, two baseline surveys were conducted, namely:

a) The ecologist walk-over survey.
b) Detailed sampling survey using a 10m transect method.

2.3.1 The ecologist walk-over survey.

During the ecological assessment of the site, the ecologist conducted a walk-over survey to identify the invasive species present and describe the level of infestation, using the standard DAFOR scale. The most widely used method for assessing the level of infestation of invasive species in a forestry setting uses the DAFOR method and descriptions. This method uses the existing forestry sub compartment boundaries and provides a generic textual description of the level of infestation based on walk over observations. The descriptions are D for Dominant, A for Abundant, F for Frequent, O for Occasional and R for Rare. This data is then used to produce a heat map, which gives a general estimation of the level of infestation over a wide area. This approach provides sufficient data to inform an operational plan to manage invasives. The results are presented in Map 1 below.

The DAFOR scale

PRESENT used where Rhododendron is considered likely to be present but not sufficiently walked to rate following DAFOR as below:

D for Dominant: In practice you will rarely, if ever use this. To score **D,** a species would have to be the most common plant by far, in well over three quarters of the square. It is possible that in a square that is entirely conifer plantation, that Sitka spruce Picea sitchensis might score **D;** or in a square that is almost all occupied by highly improved grassland, perennial rye-grass Lolium perenne might sometimes score **D,** but even these two scenarios are unlikely most of the time. If you are not sure if something should score **D** or **A,** give it **A.**

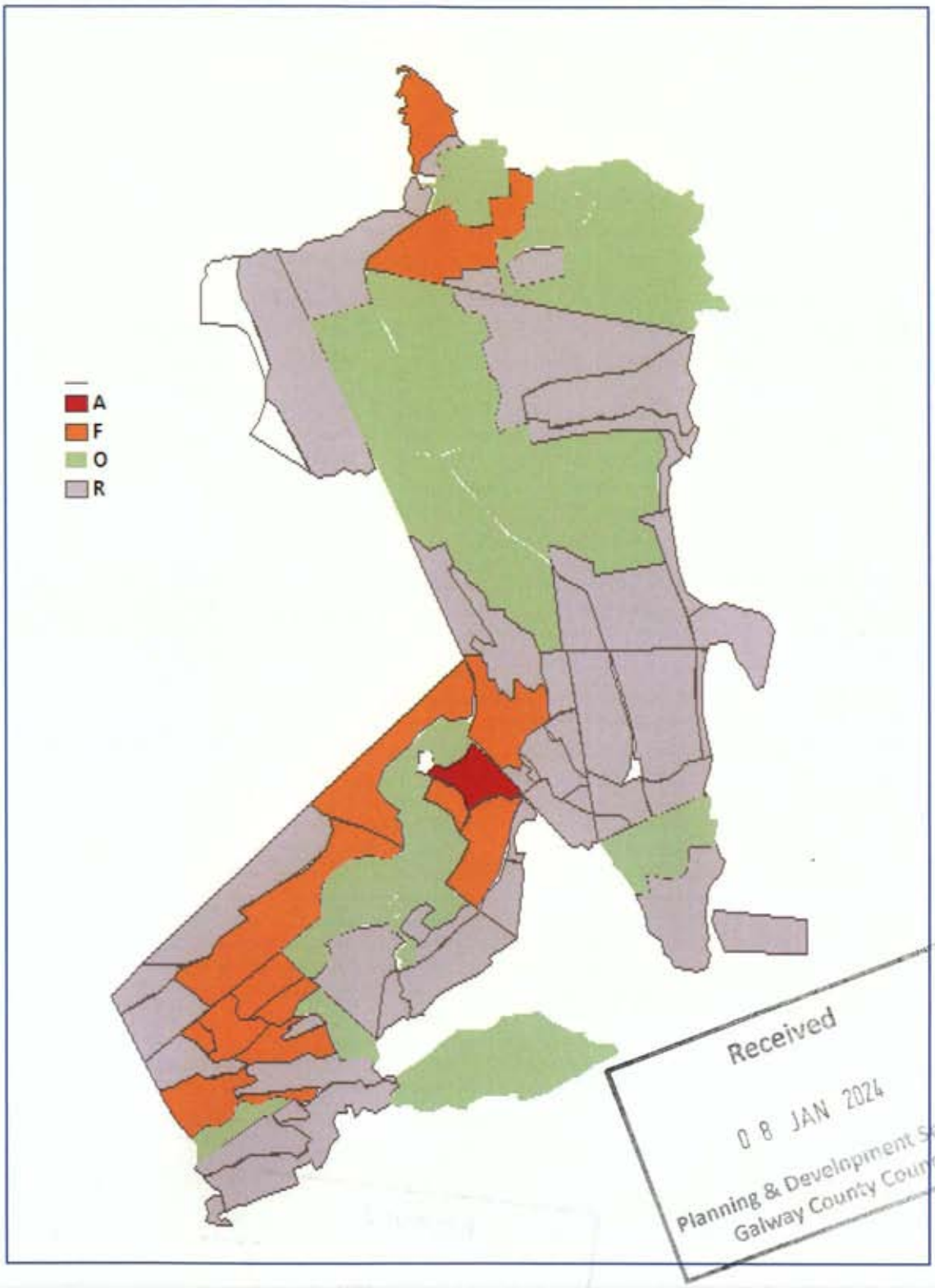
A for Abundant: Only use **A** if the plant was really very common in many parts of the square. For most species this would mean that there were thousands of individual plants present. In most squares, few species will score as highly as **A** and in quite a few squares there will be no species that score that highly. If you are not sure if something should score **A** or **F,** give it **F.**

F for Frequent: Use **F** if you found the plant in several places in the square and there was usually more than just **A** few individuals in each of these places. You could also use **F** if the plant was only present in one part of the square but was very common in that part, with many individuals and covered **A** substantial area (e.g. between one eight and one quarter of the area of the whole square). If you are not sure if something should score **F** or **O,** give it **O.**

O for Occasional: Use **O** for species that occur in several places in the square, but whose populations are usually not very big. You would also use **O** for species that are very common in one bit of habitat within the square that occupied just a small area (e.g less than one eight of the area of the whole square). You will use **O** for many species in most squares. If you are not sure if something should score **O** or **R,** give it **R.**

R for Rare: Use **R** for any species that occur as a small number of individuals in the square. This small number of individuals may be located in one place in the square, or scattered over several different locations within the square. In many squares **R** is likely to be the score that most species get. If you are not sure if something should score **O** or **R,** give it **R.**

For those of you who are used to using the DAFOR scale, please stick to the basic 5 scores only and avoid entries like **O/F** (occasional to frequent) and particularly please avoid using the prefix '**L**' as in **LF** (locally frequent).



Map 1: Rhododendron infestation levels by sub-compartment from the Ecologist site walk-over survey using the *DAFOR* scale.

2.3.2 Detailed sampling survey using a 10m transect method.

One limitation of the DAFOR method is that it does not provide the exact locations of the individual rhododendron plants and to provide this, a more detailed survey was deemed necessary. The intensive methodology used by the NPWS (under the Kerry LIFE project) was initially considered, and it was decided that this approach was too intensive and impractical to adopt in Derryclare. A sampling approach was decided as the best fit for Derryclare, as it addressed the limitation of the DAFOR method, and it was less intensive and more practical than the method used in the Kerry LIFE project. This sampling approach collected the essential detail required and ensured the process could be replicated in future years to monitor progress. This sampling method is called the '10m transect method'. Please refer to Appendix A for observations made when using this sampling method.

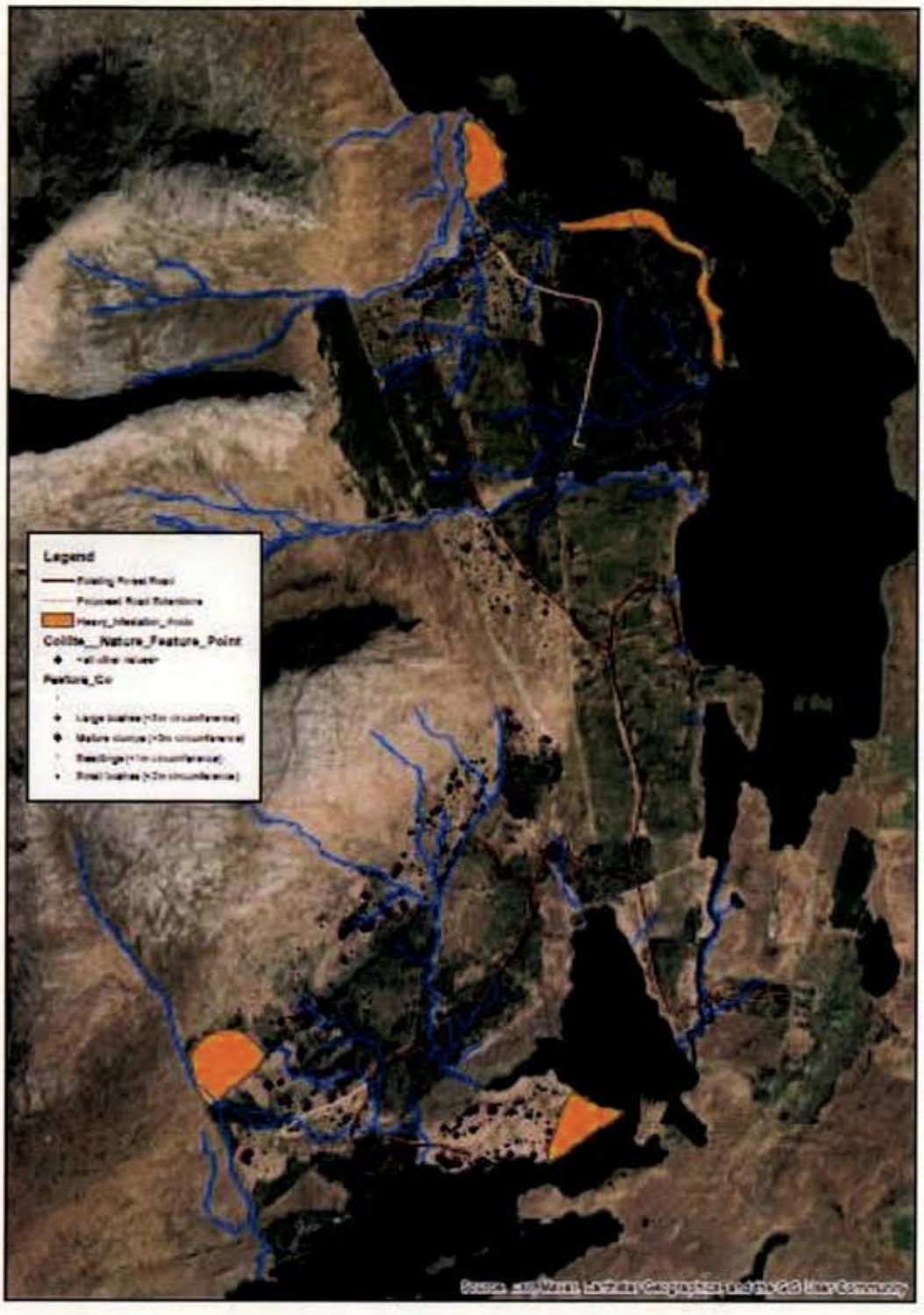
The 10m transect method was adopted for Derryclare, to establish a baseline for future monitoring. The 10m transect method is a sampling method that involves a work gang walking a transect of 10m grids throughout the whole property and taking observations at each intersection point on the grid. In Derryclare, 3 people walked through the forest in a line 10m apart from each other. At every 10m intervals the line stopped, and an assessment was made on the level of infestation within a 5m radius from their location. All data was recorded, and geo referenced using GPS Trimble devises, using the ArcGIS Field Maps application. If no rhododendron was present, no data was collected. If rhododendron was present, a point was recorded with a comment to describe the circumference of the bush(es) sizes (see Table 1). The walk over survey also encountered sub-compartments that were fully infested with rhododendron, and these were noted during the field work and added in as polygons on the baseline map. This field data was then mapped in ArcMap 10.6.1 to form the baseline level of rhododendron infestation in Derryclare (see Map 2).

Table 1: Comments used in the ArcGIS Field maps app to describe the infestation.

Description	Explanation	Comment
Rhodo1	Bush size circumference 1m or less	Mostly seedlings (pre flowering)
Rhodo2	Bush size circumference 2m or less	Small bush(es)
Rhodo3	Bush size circumference 3m or less	Larger bush(es)
Rhodo4	Bush size circumference over 3m	Mature clumps

This sampling method has the following main advantages:

- It allows for a relatively quick and accurate field assessment to be made.
- the exact locations within +/- 5m are provided.
- it provides details on the different stages of maturity of the infestation.
- It can provide the exact locations and a more general heat map.
- It is practical and cost effective (3 weeks work for a gang of 3 people to cover 500 ha).
- The data can be used as the basis for am operational work plan.



Map 2: Rhododendron infestation levels by sub-compartment from the 10m transect method sampling survey.

Observations on mapping rhododendron using the 10m transect method.

Manually mapping invasives is not easy and it is expensive. Knowing the exact locations of individual plants using point features on a map is useful when the infestation is low, but when the infestation level is high, using a polygon feature on a map is more practical. The use of remote sensing and drones should be explored as a reasonable alternative. The heat map approach using the DAFOR method produces good results but cannot provide granular detail. The bespoke 10m sampling transect method described above produces very accurate maps and establishes a detailed baseline, but it is labour intensive. This method took 3 people 10 days to complete, and it covered an area of 350, equating to covering approximately 35 ha per day. While 90% of the area was assessable, certain areas were not assessable for two main reasons. Firstly, in some areas the levels of infestation were too high to physically allow access. In these areas, the perimeter was mapped, and a polygon created to identify these areas as polygons, as opposed a point features. Secondly, in other areas the area was inaccessible due to dense forestry vegetation (such as thicket stage crops or blown areas). In these areas, the perimeter was mapped, and a polygon created to identify that these areas were not part of the survey. The 10m sampling transect method is a very costly and demanding physically. The purpose for which the data will be subsequently used should be ascertained before deciding on using this method. Ultimately, any survey will be used to inform the operational plan to manage the invasives. In the case of Derryclare, the operational plan is to have an annual management intervention across the entire site for 7 to 10 years, as a means of dealing with invasives. In this instance, it is questionable why a detailed survey is needed, other than to provide a detailed baseline. In addition, subsequent site inoculation post ground disturbance from the felling and restoration activities will not be captured in the baseline and these will require supplementary surveys.

Observations on recent advances on mapping rhododendron.

Some initial trials were conducted using LIDAR, RGB and multispectral imagery and different platforms (aircraft and drones) to detect and map the extent of rhododendron cover. Dense canopy cover can prevent detection, and in some instances the differentiation of rhododendron from other young vegetation (particularly Sitka spruce regeneration) is less distinct resulting in false positives. These techniques particularly in areas with forest cover and mixed vegetation are still proving to be challenging and further work is needed to refine the process.

2.4 Schedule annual property wide interventions.

The baseline data collection has shown the level of rhododendron ponticum infestation to be widespread through the property, with a mixture of plant sizes and ages. As restoration works proceed and ground disturbance increases, the latent potential for rhododendron infestation becomes even more significant. Therefore, an annual property wide intervention is needed every year, and this can be very effective as the restoration plan is staggered over several years. The methodology used will be the same one adopted by a recent NPWS study done in the adjoining forest in Kylemore. This approach works well in Connemara and is suited to a restoration programme that allows treated rhododendron plants to be treated and remain standing for a few years, before been removed. The methodology involves using a chainsaw to nick the stems of mature plants followed immediately with a spot spray of a dilute chemical. Allowing the plant to remain standing, allows the chemical to translocate through the whole plant, resulting is a higher kill rate. Owing to the multiple stems associated with rhododendron, some stems are likely to be missed, so a second, or even third pass is required each year to ensure the plant is fully killed. It is expected that repeating this every year will ensure that when it comes to felling the forest, the understory rhododendron will be dead, and it can be driven over and/or windrowed. This method also 'spot sprays' all the emerging seedlings, especially the ones in flower. Once the forest is felled and the restoration completed, either spot spraying, or preferably, hand removal of emerging seedlings can be conducted, to deal with any residual rhododendron. The aim is to ensure all restored areas are fully free from rhododendron and monitoring these areas will provide a quick visual guide the progress of the rhododendron treatment programme.

It is also noted that the source of seed for rhododendron infestation is off-site on private property. Treating the rhododendron on private lands is outside the scope of this project. However, this situation will be monitored and if an opportunity arises, co-operation will be offered to assist with rhododendron removal on these private lands. Consequently, within Derryclare property, rhododendron will need to be continuously managed.

Management of conifer reseeding will occur alongside the management plan for rhododendron. In this case each restored site will be monitored for seedling regeneration and the regeneration removed as part of the annual property wide rhododendron work. Managing it this way will ensure that the issue is addressed each year when the reseeded plants are easily managed.

An overview of the planned treatment schedule for managing rhododendron and conifer reseeding is detailed in Table 2 below.

Table 2: The planned schedule for managing rhododendron in the Derryclare bog restoration programme.

Year	Bog restoration schedule	Rhododendron treatment
0	Secure planning permission and felling licences.	• Property wide treatment of all mature rhododendron plants and seedlings in flower.
1	Year 1 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Monitor emerging seedlings from recently restored areas.
2	Year 2 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower • Pull/threat emerging seedlings from recently felled areas. • Monitor emerging seedlings from recently restored areas.
3	Year 3 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from year 1 & 2 felled areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline.
4 to 7	Year 4 to 7 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas. • Monitor emerging seedlings from recently restored areas.
8	Year 8 felling and restoration works.	• Property wide treatment of all mature rhododendron plants and seedlings in flower. • Pull/threat emerging seedlings from all restored areas. • Monitor emerging seedlings from recently restored areas. • Conduct property wide 10m transect rhododendron survey to monitor progress against baseline.

3.0 Grazing management plan (including deer management)

3.1 Summary

The grazing pressure in Derryclare comes from livestock (mostly sheep) and deer. The maintenance plan initially involves the construction of an external sheep fence to ensure that the entire property is fenced off. All livestock will be removed before the fence is completed. An internal deer fence will be erected to fence off the area where pioneer native woodland will be established. The site will be monitored for trespass and appropriate action taken where required, up to and including impounding. Regular checks will be made to the fence-lines to ensure they remain intact, and any breaches or faults will be repaired as a matter of urgency. Coillte have a process for impounding livestock and this process will be followed if impounding is required. Deer culling will not be used in the grazing maintenance plan as Coillte do not own the shooting rights on site. Any deer culling will only occur in agreement with the relevant stakeholders and within the law. To date, there are no immediate plans to carry out any deer culls.

Table 3: The grazing management plan by year during the restoration works.

Years	Restoration plan	Grazing plan
0 (2023)	Secure planning permission and felling licences.	• Complete external sheep fence on external boundary. • Exclude livestock from all site. • Monitor all site for trespass.
1 (2024)	Bog restoration site.	• Check sheep fence line. • Monitor all site for trespass.
2 (2025)	Pioneer native woodland sites.	• Erect deer fence stage 1. • Check sheep fence line. • Monitor all site for trespass.
3 (2026)	Pioneer native woodland sites.	• Erect deer fence stage 2. • Check sheep fence line. • Monitor all site for trespass.
4 to 8	Bog restoration sites.	• Check deer fence line. • Check sheep fence line. • Monitor all site for trespass.

4.0 General maintenance plan (including public usage)

4.1 Summary of the plan

General maintenance is a catch all that refers to addressing outstanding issues, other than invasive species, deer and livestock grazing and fire, which are all detailed separately. General maintenance on this plan includes a wide variety of tasks such as road maintenance, silt trap and dam inspections and repairs, public usage, dumping, vandalism, erection, and repair of signage, dealing with the public and local requests arising from consultations. For Derryclare the most important general maintenance is expected to be silt trap and dam inspections and maintenance, keeping the main access road in good repair and dealing with issues with the general public such as dumping and vandalism.

General maintenance typically falls under the following headings, public usage/recreation, forest roads, operational maintenance, and anti-social activity. On terms of public usage/recreation, Coillte have an open forest policy which allows permissive access on foot to individual walkers. Across the Coillte estate an estimated 18 million visits to Coillte forests occur every year. This policy will remain in place for Derryclare. Currently, access is obtained by parking at the main entrance and entering the site on foot. This will not change. Public usage will be welcomed and facilitated with better car parking facilities at the main entrance and better signage. The forest roads are essential for site access for both operations and the general public. The forest roads will be maintained during operations. Operational maintenance during the restoration works refers to maintaining the restoration works and ensuring they remain effective. This includes silt traps, constructed dams, leaky dams, silt curtains and sonde telemetry. Other maintenance is associated with anti-social activity, such as dumping and vandalism. General maintenance is expected to be carried out on an ongoing basis to ensure that the main items listed in Table 4 are maintained annually and not allowed to go into disrepair.

Table 4: Main items to manage in the general maintenance plan and the required standard.

No	Description	Required standard
1	Main forest road.	Maintain good surface dressing, free from potholes.
2	Roadside drains.	Allow to revegetate.
3	Roadside silt traps.	Effective. Water flowing. Not silted up.
4	Roadside dams.	Effective. Water flowing. Not silted up
5	Silt traps in buffer zones.	Effective. Water flowing. Not silted up.
6	Leaky dams in buffer zones.	Effective. Water flowing. Not silted up
7	Dams in buffer zones.	Effective. Water not flowing.
8	Silt traps in restored areas.	Effective. Water flowing. Not silted up.
9	Dams in restored areas.	Effective. Water not flowing.
10	Silt curtains.	Effective and securely in place.
11	Signage.	In good condition, not vandalised.
12	Dumping.	None on site. Remove when observed.
13	Vandalised signage.	Repair when observed.
14	Vandalised forest barriers.	Repair when observed.
15	Access for the public.	Adhere to open forest policy.
16	Restrict public access.	Adhere to Health & safety requirements.
17	Sondes.	Securely in place and operating effectively.

5.0 Fire plan

The threat from fires is an annual threat in Connemara. For most of the year from June to February the threat is low but for the months from March to May, the threat is high. Between the months of March to May the vegetation is at its driest and most prone to fire. In addition, before it became illegal, the traditional practices of "setting fires" coincides with these months, and unfortunately this practice occurs illegally from time to time. For both of these reasons, the threat of fires needs to be taken seriously in Derryclare and managed.

Fires tend to burn only the surface vegetation and drier features such as hummocks but leave much of the wet surface relatively intact. For infrequent fires there is generally sufficient time for the bog surface vegetation to recover, but for more frequent and severe fires, (where the fire burns under the surface) it can take more than 50 years for Sphagnum plants to return when burning has produced a bare peat surface (Evans & Warburton, 2007).

Derryclare property lies with the Coillte management area called BAU2. This BAU has a designated fire plan and resources to tackle wildfires and Derryclare will remain part of this fire plan. These resources include a helicopter call out during the fire season, access to trained fire fighters, established access to local fire brigades, experienced volunteers, and access to the full range of firefighting equipment including fire trailers, beaters, PPE, drones, ATVs, pumps and generators.

Fire plan – Derryclare

A: Site Safety Rules

The following rules apply at all times

All firefighting volunteers must ...

- be fully trained (training provided by Coillte).
- wear their PPE at all times.
- check in and out with the attending forest manager.
- never work alone.
- ensure they can be contacted while on site.

Note: Failure to comply with the above site safety rules will result in volunteers been asked to leave the site.

B) Safety During a Fire

A) While fighting a fire:

- Know your limitations. Pace yourself. Do not overdo it.
- Know where you are at all times, and who you are with.
- Know what group you are in and how many people are in that group.
- Do not wander away from the group.
- Ensure that adequate supply of water and food is available.
- Be conscious of escape routes.
- Return to assembly point and sign off with the fire coordinator.

C) During the fire period:

- Have in your car your PPE, fire plan contact numbers, change of clothes and an adequate supply of drinking water.

- Keep mobile phones charged. Let people know where you are working.

- Be familiar with the fire plan, especially the HIRA.

- Know where the beaters are stored. Carry a few in the car during extreme conditions.

- Carry a small amount of extras in the car such as a pruning saw, hack saw, vice grips, buckets, torches etc.

- Get to know the main danger areas and know your way around them.

D) If you hear of a fire:

- Check out the fire as quickly as possible. Get as much information as possible.

- Contact the relevant manager before you attempt to tackle the fire.

- Do not fight the fire on your own.

- False alarms are common. It is better to be safe than sorry.

E) Contact numbers

Not provided HERE due to GDPR reasons

Numbers issued to relevant personnel during the fire season

F) Hazard Identification and Risk Assessment (HIRA)

OPERATION: Forest Fires **LOCATION:** North Mayo **ACTIVITY:** FIRE FIGHTING

No	HAZARDS	CONSEQUENCES	RISK			CONTROLS	PERSON RESPONSIBLE	R
			S	L	N			
1	Terrain Rough ground • Soft areas • Deep drains • Banks/walls/fences	Slip, trips and falls. Minor to serious injury	M	H	1	• Be vigilant • Walk with care • Ensure good footwear • Carry torches at night time • Maintain constant contact with team members	Operator	L
2	Lone Working	Serious Personal Injury	H	H	1	• Never work alone • Stay in close proximity to team • Maintain constant contact with team members • Do not detach from team unless planned	Operator	L
3	Insufficient/Inadequate training	Minor/Serious Injury	H	H	1	• All staff to have completed fire training course • All staff involved in fire drill at start of each year • Adhere to training instructions	Operator	L
4	Petrol Transport and Storage	Explosion/personal injury	H	M	1	• Max of 20 litres in two suitable stopped metal containers marked Petroleum Spirit • Store safe distances from fire	Operator	L
5	Handling foam concentrate	Irritation to skin and eyes	M	H	1	• Wear waterproof gloves S.T.C boots and face shield • Wash out eye immediately in the event of contact	Operator	L
7	Reeling in hose, moving pump unaided	Back injury – serious	H	M	1	• Use purpose built reel • Operator trained in manual handling technique • Moving pump – 2 man job	Operator	L
8	Change in wind direction	Isolation, disorientation and smoke inhalation	M	H	1	• Be vigilant for change in wind direction • Move to avoid smoke • Always work in teams	Operator	L
9	Mechanical Site firefighting with ATV	Serious/fatal injury to operator Serious/fatal injury to persons close by	H	H	1	• Only trained/experienced and competent operators to operate machinery • Observe risk zone • Wear high visibility vest	Operator	L

ASSESSMENT COMPLETED BY _____ SEEN BY _____

DATE _____ DATE _____

G) The penalties for illegal burning

Under section 39 of the Wildlife Act 1976, as amended by the Wildlife (Amendment) Act 2000, a person shall not burn any vegetation growing within one mile of – a wood which is not the property of such person, or other lands restricted by the Wildlife Acts, unless they have provided written notice of their intention to a Garda station in a Garda district in which the land they intend to burn is situated.

Notice of intention to burn must be provided between seven and 35 days prior to the burning.

Failure to provide written notice is an offence carrying penalties,

upon conviction, of;

- **first offence** – fine not exceeding €634.87 or to imprisonment for a term not exceeding three months or to both;

- **second offence** – fine but not exceeding €1,269.74 or to imprisonment for a term not exceeding six months or to both, and third offence – fine not exceeding €1,904.61 or to imprisonment for a term not exceeding twelve months or to both.

H) Reporting fires to the Guards

Important things to know...

1. Campwest do not report fires to the Guards.
2. The guards will only investigate a fire if it is logged on their PULSE system.
3. To log a fire on PULSE all fires within one mile of a forest must be reported to an Garda.

How to report a fire

1. Call the Garda station nearest to the fire.

2. When reporting there are 3 key pieces of information you must provide:

- Report that an offence is occurring (burning within 1 mile of a forest);
- Report the townland the fire is in;
- Report the nearest largest town.

3. When the fire report is completed in the office forward the report and a map of the area to Inspector Joe McKenna.

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APPENDIX 5

GEOLOGICAL, HYDROLOGICAL, & HYDROGEOLOGICAL RESPONSES TO SUBMISSIONS PREPARED BY HES

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GEOLOGICAL, HYDROLOGICAL & HYDROGEOLOGICAL RESPONSES TO SUBMISSIONS IN RELATION TO DERRYCLARE WILD WESTERN PEATLANDS PROJECT, CO. GALWAY – (PLANNING REF: P.23/60)

DRAFT REPORT

Prepared for:
Galway County Council

Prepared by:
Hydro-Environmental Services

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