Forestry Division Statement to the Forestry Appeal Committee

FAC Reference	033/2021
File Reference	TFL00472320
Scheme	Felling
Species proposed	See felling application on file
Area	19.96

Summary of application:

Date Submitted	24/02/2020
Date Application Advertised	30/03/2020
Referrals to referral bodies	CoCo 20/03/2020 NPWS 20/03/2020
Response from referral bodies	NPWS 06/05/2020
Date Referred to Inspector	20/03/2020
Desk Assessment/Desk & Field Assessment	Desk only
Submissions Received	None
Appropriate Assessment Screening	Yes
Recommendation from Inspector	Approve
Decision	Approve
Date Decision Issued	13/01/2021
Date Decision Advertised	15/01/2021

Administrative Comments:

The decision was issued in accordance with our procedures, S.I. 191/2017 and the 2014 Forestry Act.

The Department is satisfied that all criteria outlined in its standards and procedures policy have been adhered to in making a decision on the application. Please see the statement from the Inspectorate

Name: Colm Doran Grade: HEO Date: 28/01/2022

Grounds of appeal

Irish Forestry Unit Trust wish to appeal a number of conditions on the Tree Felling Licence approved by the DAFM on the 13/01/2021. There are several areas we wish to appeal in relation to:

- Prohibition of windrowing on site.
- Reforestation — establishment of grass in water setbacks.
- Replanting is to be conducted within 12 months of felling.
- Aquatic/Water setbacks.

Reasoning:

1. Silt, Sediment and Nutrients— There is to be no windrowing on site."

We assume the condition prohibiting windrowing is a misunderstanding of forestry terminology by the ecologist engaged to carry out the Appropriate Assessment Determination. We assume that what is meant here is that there is to be no mounding on site.

For the most part mounding will not be required on this property however mounding will need to be undertaken where ground conditions dictate, We have requested further clarification on this matter several times with no response from multiple department officials, Communication from DAFM has been non-existent. regret to say that I feel that this particular point is wasteful of the FAC's valuable time. This matter and following matters could have been cleared up via email, but due to lack of response, we feel there is no alternative but to lodge an appeal.

We cannot replant the site without gathering brash into windrows, It is impossible to plant down through timber extraction lines. At a minimum, we need to hire a machine to tighten up the lop and top on those lines and gather in other material in order to pit plant. Windrowing causes minimal if any ground disturbance and we cannot understand the reasoning behind prohibiting this practice.

2: Reforestation — "7. Grass vegetation to be established within all water setbacks within 12 months of felling. This is best achieved by broadcasting a 50:SO mix of Yorkshire Fog (Holcus lanatus) and common bent grass (Agrostis capillaris) at a rate of 36 kg/ha immediately after felling CDriscoll et al. 2014).

Setbacks once cleared of trees will naturally repopulate with vegetation. Spreading of grass seed seems both economically and environmentally inefficient. We have never encountered such a practice in the past. We would also question if this is an environmentally safe practice. As we see it, there is a chance that purchased seed may contain some stock of invasive material. We feel that this condition is excessive and unnecessary.

In addition to the above. The spreading of grass on ground following the removal of a conifer forest is a complete waste of time and money. In our experience, these areas will naturally regenerate with vegetation which will come up from beneath the leaf litter once conifers have removed. The ground will have a generous covering of needles and organic matter accumulated over the last 30 years. Grass seed will not germinate on this surface. In order for the grass to germinate the ground will have to receive some level of cultivation for the seed to make contact with the earth. Any level of cultivation or ground disturbance within the aquatic zone would be a

breach of the conditions of the license as outlined in the AAD - "6. Regarding aquatic zones, ensure banks remain undisturbed".

3: Replanting Is to be conducted within 12 months of felling.

The appropriate assessment determination requires that Coupes are to be replanted within 12 months of felling. This is in direct dispute to Page 8 schedule 3 of the Felling licence which states the following and allows a two-year period:

"Under the authority conferred by this licence, the licensee must carry out replanting as outlined in Table 2, within a period of two years following each felling operation.

These conflicting requirements need to be corrected and aligned. An applicant should not have to second guess as to which condition actually applies. Two-year replanting periods have been standard practice across felling licences. We cannot see why this should be reduced to one year.
A much shorter setback distance of 10 to 15 metres will equally protect the watercourse against siltation with the inclusion of sump holes at regular intervals along any such drainage channel. This is in the event that any such channel requires cleaning. Many drains on the site will not and some will only require maintenance where debris has accumulated over the last 30 years or so since the land was planted. The above condition precludes us from undertaking any such maintenance,

(c) Water exclusion zones

1. The TFL states the following "Before operations commence, identify 0 10 m wide exclusion zone along the edge of all aquatic zones, hotspots and water abstraction points, and mark this clearly on a site map and on the ground. Machine traffic and timber stocking are not permitted within these zones "

Within the felling license area the forest road runs directly adjacent to a watercourse. The 10 m exclusion zone for all aquatic zones and the exclusion of machine traffic and timber stacking overlaps the forest road. See attached map that illustrates this. As previously outlined, we looked for clarification from the DAFM Ecology section on this point but received no acknowledgement or reply.

The forest road is in place with a significant period of time. There have been three harvesting operations on this site using this road over the last 15 years. All have been undertaken in line with all relevant Forestry Guidelines and with no negative impact on the watercourse or the wider environment. To insert a condition on this TFL preventing the use of the forest road at this time is arbitrary. This condition has to be removed or modified to allow for the use of the forest road for its intended purpose.

Additional Supporting documentation to be submitted.

We have engaged an Ecologist to undertake a site assessment and compile a report with mitigation measures. This is organised for the week beginning the 15th of February 2021. Our focus for the last number of weeks was on engaging with the DAFM in order to try and sort out these issues through direct engagement within the 28 day period. This has not happened. As a result, the Ecologist's report to back up this Appeal is not included but will be forwarded as soon as its completed.

4. Aquatic/Water setbacks.

(a) Reforestation setbacks
The Reforestation section contains the following condition — "apply a 20m wide uncultivated and unplanted water setback along aquatic zones ...". We maintain that this is excessive and is in contravention to the Interim Standards for Felling and Reforestation. Furthermore, there is a requirement to plant 5 lines of broadleaves outside of the setback which makes a larger unproductive corridor of 60m.

Firstly, this site is moderately/gently sloped on approach to the watercourse, The Interim Standards for Felling and Reforestation(October 2019), sets 10m as the appropriate setback in such a scenario. It is our position that obligating us to increase the aquatic setback area beyond what is appropriate for the site according to the Interim Standards(10-15m) is unacceptable. This condition for the additional setback should be removed.

Secondly, broadleaf planting is encouraged, not required by the Interim Standards in regards to these areas. Section 14.1 on water setbacks states the following in relation to broadleaved planting in relation to water setbacks.

"The establishment of native trees along the edge of the future canopy, either as o separate native woodland plot or as single or small groups of trees, is encouraged"

Therefore, it should be left to the applicants discretion if they see fit to plant broadleaves in such scenarios. We will plant a 5 m wide strip of broadleaves adjoining the aquatic zone setback.

The setback as outlined creates a 40 metre wide unplanted corridor through the site. This creates a significant area of the site that is effectively sterilised and will severely impact on the productive potential of this forest into the future. See Map 1.

As per conditions outlined in this TFL open spaces and broadleaved replanting requirements result in the loss of 55% of the productive area of the site. The required setback as per Interim Standard outlines that a 10 m setback as an appropriate aquatic setback and combined with our proposal to replant a 5 m broadleaved strip will result in a 38% reduction of the productive area. While this is still significant, it adheres to the Interim Standard which are the "universal standards that apply to all felling (thinning and clearfelling}, and reforestation projects on all sites throughout Ireland".

(b) Drainage restrictions

Under mitigation measures the following condition applies — "6. Regarding any existing relevant watercourses (e.g. existing field drain), do not clean any section of such watercourses within 50 m of an aquatic zone, "

Again, we believe a 50metre setback Is excessive. This distance will significantly impede our ability to drain the site, which in turn will have a negative impact on the next forest rotation. A higher water table will leave the next crop significantly more prone to windblow.

Statement from Inspectorate.

Assessment Criteria	
Was the AA screening procedure at the time of approval applied? (Y/N)	**Yes**
What version of the AA procedure?	**Nov19 15km**
Standard Operating Procedures applied? (Y/N)	**Yes**

Statement from Inspectorate.

Based on the information supplied by the appellant, do you recommend any change to the original decision?

(Tick as appropriate)

No change	x	Confirm recommendation to grant licence	x	Revise conditions of licence	No	Remit licence for reassessment	No	Revoke licence	No

1: The Ecology Unit has responded to this point raised.

2: The Ecology Unit has responded to this point raised.

3: The Ecology Unit has responded to this point raised.

4: The Ecology Unit has responded to this point raised.

Following the current DAFM AA Screening guidance document I carried out a 15km radius screening on the Natura 2000 sites in the area. I then reviewed the qualifying interests of the Natura 2000 sites in question and by using the latest information available to me some of the Natura 2000 sites were screened out, the remainder have had an appropriate assessment report (AAR) and subsequently an appropriate assessment determination (AAD) was carried out. Following the recommendation from the AAD I have recommended this licence to proceed.

Name: Michael O'Brien

Role: District Inspector

Date: 28/01/2022

Ecology Response

1. **Grounds for appeal – windrowing:**

> 1. **Silt, Sediment and Nutrients – *" There is to be no windrowing on site."***
>
> We assume the condition prohibiting windrowing is a misunderstanding of forestry terminology by the ecologist engaged to carry out the Appropriate Assessment Determination. We assume that what is meant here is that there is to be no mounding on site.
>
> For the most part mounding will not be required on this property however mounding will need to be undertaken where ground conditions dictate. We have requested further clarification on this matter several times with no response from multiple department officials. Communication from DAFM has been non-existent. I regret to say that I feel that this particular point is wasteful of the FAC's valuable time. This matter and following matters could have been cleared up via email, but due to lack of response, we feel there is no alternative but to lodge an appeal.
>
> We cannot replant the site without gathering brash into windrows. It is impossible to plant down through timber extraction lines. At a minimum, we need to hire a machine to tighten up the lop and top on those lines and gather in other material in order to pit plant. Windrowing causes minimal if any ground disturbance and we cannot understand the reasoning behind prohibiting this practice.

Response:

The Owvane (Limerick)_030 river waterbody is downstream of the project and connects the project to the Lower River Shannon SAC. According to the EPA, this river is:

a. Currently at poor ecological status (declined from moderate in the 2010-2015 monitoring period).
b. A Priority Area for Action subcatchment under Ireland's River Basin Management Plan (see https://www.catchments.ie/wp-content/files/areaforactionreports/AFA0151%20Owvane%20AFA%20Report.pdf).
c. Identified as having forestry as a significant pressure to be addressed in order to meet targets under the Water Framework Directive (2000/60/EC) (https://gis.epa.ie/geonetwork/srv/eng/catalog.search#/metadata/072281e4-f695-475b-b7c0-4f97c3284111).

Windrowing has been shown to cause a "substantial increase in total suspended solids and total phosphorus" loss to streams in Ireland (Clarke *et al.,* 2015). However, following review with senior inspectorate on this condition, the wording of this condition was amended to *"At reforestation stage adhere to Section 13, Reforestation of the Interim Standards for Felling & Reforestation. No windrowing within 20 m of aquatic zones or 10 m of relevant watercourses and windrows must run across the slope of the site."* which was done in response to the concerns raised by the appellant, in accordance with Section 17(4) of the Forestry Act 2014 and Section 19 of S.I. No. 191 of 2017 (DAFM letter to applicant dated 11/08/2021) and without impact to the overall conclusion of the AA determination dated 17/12/2020. See iFORIS contacts 11/08/2021.

2. Grounds for appeal – grass seeding:

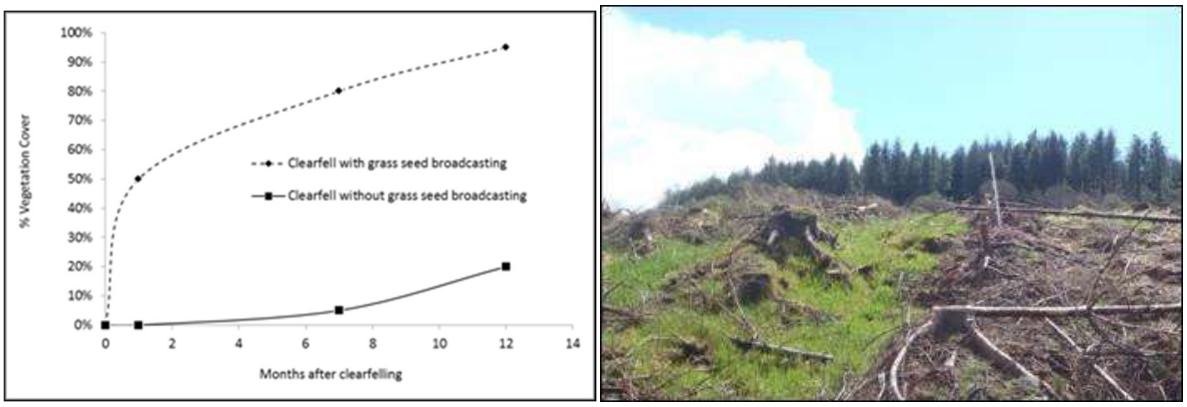
2. Reforestation – "7. Grass vegetation to be established within all water setbacks within 12 months of felling. This is best achieved by broadcasting a 50:50 mix of Yorkshire Fog (Holcus lanatus) and common bent grass (Agrostis capillaris) at a rate of 36 kg/ha immediately after felling (O'Driscoll et al. 2014).

Setbacks once cleared of trees will naturally repopulate with vegetation. Spreading of grass seed seems both economically and environmentally inefficient. We have never encountered such a practice in the past. We would also question if this is an environmentally safe practice. As we see it, there is a chance that purchased seed may contain some stock of invasive material. We feel that this condition is excessive and unnecessary.

In addition to the above. The spreading of grass on ground following the removal of a conifer forest is a complete waste of time and money. In our experience, these areas will naturally regenerate with vegetation which will come up from beneath the leaf litter once conifers have removed. The ground will have a generous covering of needles and organic matter accumulated over the last 30 years. Grass seed will not germinate on this surface. In order for the grass to germinate the ground will have to receive some level of cultivation for the seed to make contact with the earth. Any level of cultivation or ground disturbance within the aquatic zone would be a breach of the conditions of the license as outlined in the AAD - "*6. Regarding aquatic zones, ensure banks remain undisturbed*" .

Response:

Clearfelled coniferous forestry has notoriously depauperate seed banks of ground vegetation (Eyecott *et al.,* 2006). Irish research into broadcasting these particular two grass species (Yorkshire fog and common bent grass) on clearfelled peat sites have shown that they can rapidly improve revegetation and thereby significantly reduce risk of sediment and nutrient loss by c. 58% to 95% (Asam *et al*., 2012; O'Driscoll *et al.*, 2011; 2014, 2021). The KerryLIFE freshwater pearl mussel project have also demonstrated this measures effectiveness for revegetating bare soil after clearfells in sensitive areas:



Vegetation recovery rates following clearfelling with and without grass seed broadcasting in 2017 in Kerry (Yorkshire fog and common bent grass oversown by hand at a rate of 36 kg/ha). The photo shows an area 7 months after clearfelling where the left side of the image was oversown with grass seed and the right side was left as a control (not seeded).

Regarding the concern that it may be environmentally damaging, approximately 140,000 ha of land in Ireland is sown with grass seed every year (primarily *Lolium perrene*) (Humphreys and Casey, 2002). The proposed measure will not significantly add to any environmental risk in this regard. In addition to preventing sediment and nutrient loss, it can facilitate future tree growth by retaining nutrients on site. Rodgers *et al.* (2012) recorded 5.15 kg P/ha lost in the first three years after a clearfell (with the majority being lost in year 2). Teagasc cost fertiliser for reforestation at €190-220/ha (https://www.teagasc.ie/crops/forestry/advice/establishment/reforestation/). Regarding the concern about the need for cultivation, extensive Irish research has shown that oversowing these two native species of grass (without additional cultivation) is extremely effective at revegetating clearfelled peat sites in Ireland and significantly reducing nutrient losses to water (Asam *et al.*, 2012; O'Driscoll *et al.*, 2011; 2014, 2021).

Following discussion with senior inspectorate on this condition, the condition was amended to *"If not already present, ground vegetation (>90% ground cover) must be established within 20 m of all aquatic zones within 12 months of felling in order to reduce nutrient/sediment loss risk. To do this, a 50:50 mix of Yorkshire Fog (Holcus lanatus) and common bent grass (Agrostis capillaris) should be broadcast at a rate of 36 kg/ha (O'Driscoll et al. 2014) on any bare/un-vegetated ground immediately after harvesting."* This rewording allows for existing and natural establishment of ground vegetation but still requires the grass seeding where that is not occurring within 12 months after felling. This amendment was made in response to the concerns raised by the appellant, in accordance with Section 17(4) of the Forestry Act 2014 and Section 19 of S.I. No. 191 of 2017 (DAFM letter to applicant dated 11/08/2021) and without impacting the overall conclusion of the AA determination dated 17/12/2020. See iFORIS contacts 11/08/2021.

3. Grounds for Appeal – replanting within 12 months.

3. **Replanting is to be conducted within 12 months of felling.**

The appropriate assessment determination requires that Coupes are to be replanted within 12 months of felling. This is in direct dispute to Page 8 schedule 3 of the Felling licence which states the following and allows a two-year period:

"Under the authority conferred by this licence, the licensee must carry out replanting as outlined in Table 2, within a period of two years following each felling operation."

These conflicting requirements need to be corrected and aligned. An applicant should not have to second guess as to which condition actually applies. Two-year replanting periods have been standard practice across felling licences. We cannot see why this should be reduced to one year.

Response:

Page 8 of the licence states *"Where an Alternative Planting Condition is attached to this licence, this condition will be listed in Schedule 2"* and Schedule 2 of the licence goes on to state *"The specific conditions outlined in the attached Appropriate Assessment Determination shall be fully complied with."* However, following discussion with senior inspectorate on this condition, the condition was removed from the licence. This amendment was made in response to the concerns raised by the appellant, in accordance with Section 17(4) of the Forestry Act 2014 and Section 19 of S.I. No. 191 of 2017 (DAFM letter to applicant dated 11/08/2021) and without impacting the overall conclusion of the AA determination dated 17/12/2020. See iFORIS contacts 11/08/2021.

4. Grounds for appeal - water setbacks

4. Aquatic/Water setbacks.

(a) Reforestation setbacks

The Reforestation section contains the following condition – *"apply a 20m wide uncultivated and unplanted water setback along aquatic zones ..."*. We maintain that this is excessive and is in contravention to the Interim Standards for Felling and Reforestation. Furthermore, there is a requirement to plant 5 lines of broadleaves outside of the setback which makes a larger unproductive corridor of 60m.

Firstly, this site is moderately/gently sloped on approach to the watercourse. The Interim Standards for Felling and Reforestation(October 2019), sets 10m as the appropriate setback in such a scenario. It is our position that obligating us to increase the aquatic setback area beyond what is appropriate for the site according to the Interim Standards(10-15m) is unacceptable. This condition for the additional setback should be removed.

Secondly, broadleaf planting is encouraged, not required by the Interim Standards in regards to these areas. Section 14.1 on water setbacks states the following in relation to broadleaved planting in relation to water setbacks.

"The establishment of native trees along the edge of the future canopy, either as a separate native woodland plot or as single or small groups of trees, is encouraged".

Therefore, it should be left to the applicants discretion if they see fit to plant broadleaves in such scenarios. We will plant a 5 m wide strip of broadleaves adjoining the aquatic zone setback.

The setback as outlined creates a 40 metre wide unplanted corridor through the site. This creates a significant area of the site that is effectively sterilised and will severely impact on the productive potential of this forest into the future. See Map 1.

As per conditions outlined in this TFL open spaces and broadleaved replanting requirements result in the loss of 55% of the productive area of the site. The required setback as per Interim Standard outlines that a 10 m setback as an appropriate aquatic setback and combined with our proposal to replant a 5 m broadleaved strip will result in a 38% reduction of the productive area. While this is still significant, it adheres to the Interim Standard which are the "universal standards that apply to all felling (thinning and clearfelling), and reforestation projects on all sites throughout Ireland".

(b) Drainage restrictions

Under mitigation measures the following condition applies – *"6. Regarding any existing relevant watercourses (e.g. existing field drain), do not clean any section of such watercourses within 50 m of an aquatic zone."*

Again, we believe a 50-metre setback is excessive. This distance will significantly impede our ability to drain the site, which in turn will have a negative impact on the next forest rotation. A higher water table will leave the next crop significantly more prone to windblow.

A much shorter setback distance of 10 to 15 metres will equally protect the watercourse against siltation with the inclusion of sump holes at regular intervals along any such drainage channel. This is in the event that any such channel requires cleaning. Many drains on the site will not and some will only require maintenance where debris has accumulated over the last 30 years or so since the land was planted. The above condition precludes us from undertaking any such maintenance.

(c) Water exclusion zones

1. The TFL states the following *"Before operations commence, identify a 10 m wide exclusion zone along the edge of all aquatic zones, hotspots and water abstraction points, and mark this clearly on a site map and on the ground. Machine traffic and timber stacking are not permitted within these zones."*

Within the felling license area the forest road runs directly adjacent to a watercourse. The 10 m exclusion zone for all aquatic zones and the exclusion of machine traffic and timber stacking overlaps the forest road. See attached map that illustrates this. As previously outlined, we looked for clarification from the DAFM Ecology section on this point but received no acknowledgement or reply.

The forest road is in place with a significant period of time. There have been three harvesting operations on this site using this road over the last 15 years. All have been undertaken in line with all relevant Forestry Guidelines and with no negative impact on the watercourse or the wider environment. To insert a condition on this TFL preventing the use of the forest road at this time is arbitrary. This condition has to be removed or modified to allow for the use of the forest road for its intended purpose.

Response:

(a) Reforestation setbacks. As mentioned previously, the mitigation measures outlined in the Interim Standards for Felling and Reforestation may be amended following assessment of a project by DAFM. The Interim Standards for Felling and Reforestation do not consider soil type when identifying minimum setback distances. However, the Environmental Requirements for Afforestation (DAFM, 2016) do consider soil type and the 20 m minimum aquatic zone setback for afforestation on peat soils was applied in this instance, given the aquatic environmental sensitivities downstream. Following discussion with senior inspectorate on this condition, the condition wording was changed to: *"20 m setback to be applied to aquatic zones. ADB at reforestation stage to be focused along all riparian zones to ensure areas of long-term retention are created."* This amendment was made in response to the concerns raised by the appellant, in accordance with Section 17(4) of the Forestry Act 2014 and Section 19 of S.I. No. 191 of 2017 (DAFM letter to applicant dated 11/08/2021) and without impacting the overall conclusion of the AA determination dated 17/12/2020. See iFORIS contacts 11/08/2021.

(b) Drainage restrictions. The project screened in for hydrological connectivity to the Lower River Shannon and potential impacts to Otters (a qualifying interest of the SAC) were identified. This condition is a standard condition from the Forestry and Otter Guidelines (DAFF, 2009) and remains unchanged.

(c) Water exclusion zones (and location of the forest road within it): As stated previously, forestry has been identified as a significant pressure on the downstream WFD sub-basin/Area for Action. Forest roads can account for 70% to 80% of sediment loss from forestry (Anderson and Lockaby, 2007). Forwarding on this road presents very high risk of significant silt runoff to the adjacent aquatic zone, particularly if using tracks on forwarders and/or if forwarder turns on the forest road (e.g. to access the temporary bridge mapped as meeting this road on the harvest plan map uploaded to iFORIS on the 25/02/2020). Such forwarding would also not be in line with the minimum requirements in the Interim Standards for Felling and Reforestation (DAFM, 2019) that state on page 7 *"No forwarding or ground haulage operations are to take place on either forest or public road surfaces".* Note that timber stacks can be located on the opposite side of the road from the aquatic zone outside the 10 m exclusion zone although that will be understandably difficult without forwarding along the road. Note also that the 10 m exclusion zone does not apply to temporary crossing points, which by their very nature, can only be accessed by crossing through the exclusion zone using the temporary bridge. This measure remains unchanged.

References

Anderson, C.J. and Lockaby, B.G., 2011. The effectiveness of forestry best management practices for sediment control in the southeastern United States: A literature review. Southern Journal of Applied Forestry, 35(4), pp.170-177.

Asam, Z.U.Z., Kaila, A., Nieminen, M., Sarkkola, S., O'Driscoll, C., O'Connor, M., Sana, A., Rodgers, M. and Xiao, L., 2012. Assessment of phosphorus retention efficiency of blanket peat buffer areas using a laboratory flume approach. *Ecological engineering*.

Clarke, J., Kelly-Quinn, M., Blacklocke, S. and Bruen, M., 2015. The effect of forest windrowing on physico-chemical water quality in Ireland. *Science of the Total Environment*, *514*, pp.155-169.

DAFF. 2009. Forestry and Otter Guidelines. Department of Agriculture, Fisheries and Food, Johnstown Castle Estate, Co. Wexford.

DAFM. 2016. Environmental Requirements for Afforestation, December 2016. Department of Agriculture, Food & the Marine, Johnstown Castle Estate, Co. Wexford.

DAFM. 2019. Standards for Felling & Reforestation (v.Oct2019). Department of Agriculture, Food & the Marine. See Forest Service Circular 14 / 2019, www.agriculture.gov.ie/forestservice/grantsandpremiumschemes2014-2020/schemecirculars/2019circulars/

Eycott, A.E., Watkinson, A.R. and Dolman, P.M., 2006. The soil seedbank of a lowland conifer forest: The impacts of clear-fell management and implications for heathland restoration. *Forest Ecology and Management*, *237*(1-3), pp.280-289.

Humphreys, J. and Casey, I.A., 2002, November. Grassland renovation in Ireland. In *Grassland Resowing and Grass-Arable Rotations. Proceedings of European Grassland Federation International Workshop Agricultural and Environmental Issues, Wageningen (The Netherlands)* (Vol. 18, pp. 79-91).

Nieminen, M., O'Driscoll, C., O'Connor, M., Sarkkola, S., Kaila, A., Sana, A., Rodgers, M., Zhan, X. and Xiao, L., 2014. Export of phosphorus and nitrogen from lodgepole pine (*Pinus contorta*) brash windrows on harvested blanket peat forests. *Ecological engineering*, *64*, pp.161-170.

O'Driscoll, C., Abbas, M., O'Connor, M., Waqas, M., Rehan, M., Nizami, A.S. and Xiao, L., 2021. Mechanism and role of seeded native grasses to immobilize nitrogen on harvested blanket peat forests for protection of water courses. *Environmental Science and Pollution Research*, *28*(19), pp.24756-24770.

O'Driscoll, C., O'Connor, M., de Eyto, E., Poole, R., Rodgers, M., Zhan, X., Nieminen, M. and Xiao, L., 2014. Whole-tree harvesting and grass seeding as potential mitigation methods for phosphorus export in peatland catchments. *Forest Ecology and Management*, *319*, pp.176-185.

O'Driscoll, C., Rodgers, M., O'Connor, M., de Eyto, E., Poole, R. and Xiao, L., 2011. A potential solution to mitigate phosphorus release following clearfelling in peatland forest catchments. *Water, Air, & Soil Pollution*, *221*(1), pp.1-11.

Rodgers, M., Xiao, L., Muller, M., O'Connor, M., de Eyto, E., Poole, R., Robinson, M. and Healy, M., 2008. Quantification of erosion and phosphorus release from a peat soil forest catchment. *STRIVE Report. Wexford. EPA*.

Paul Phelan

Ecologist

28/01/2022