Naturally Driven

Draft Rehabilitation Plan

2020

Clongawny Bog

This rehabilitation plan is developed under Condition 10 of IPC Licence Ref. 500 (April 2017). It outlines measures that will provide for stabilisation of the bog area upon cessation of peat production and decommissioning of the site. ***Rehabilitation*** *generally comprises natural colonisation with or without targeted management.*

Bord na Móna propose to develop a wind farm (Derrinlough Wind Farm) on part of Clongawny Bog. The proposed wind farm also includes parts of the adjacent Drinagh Bog. This proposed development has now been integrated with this rehabilitation plan. The rehabilitation plan outlines how the site will be rehabilitated along with the construction and operation of the proposed Wind Farm.

The general after-use strategy of Bord na Móna is outlined in the Bord na Móna Strategic Framework for Future-Use of Cutaway Bogs 2011. Any consideration of future after-uses for Clongawny Bog such as amenity, developments or mixed uses will be conducted following the relevant planning guidelines and consultation with relevant authorities and will be considered within the framework of this rehabilitation plan.

Rehabilitation of industrial peatlands is a key objective of the Bord na Móna Biodiversity Action Plan 2016-2021. This action plan outlines the main objectives and actions around biodiversity on Bord na Móna lands.

Draft Rehabilitation Plan			
Bog Name:	**Clongawny**	**Area (ha):**	1,028 ha
Works Name:	Boora	**County:**	Offaly
Author(s):	BnM Ecology Team	**Survey/ Monitoring Date(s):**	29/30 September & 1 September 2009 4/06/2010, 11/11/2013, 20,21/05/2014, *A range of additional ecological surveys were carried out 2018-2019 to inform the EIAR for the proposed Derrinlough Wind Farm. These surveys have also informed this rehabilitation plan.*
Maps:	Habitats Map, Potential Future Habitats Map, Landuse Map		
Review status: Updated January 2020			

Background

Bord na Móna operates under IPC Licence issued and administered by the EPA to extract peat within the Boora bog group (Ref. 500 SB). As part of Condition 10.2 of this license, a rehabilitation plan must be prepared for permanent rehabilitation of the boglands within the licensed area. Clongawny bog is part of the Boora bog group.

This plan is a specific rehabilitation plan for Clongawny bog and outlines:

- criteria which define the successful rehabilitation,
- consultation to date with interested parties,
- main issues for rehabilitation,
- proposed rehabilitation programme,
- proposed timeframe to implement this programme, and,
- associated aftercare, maintenance and monitoring.

Bord na Móna have proposed to develop a Wind Farm (Derrinlough Wind Farm) on part of Clongawny Bog. The proposed wind farm also includes part of the adjacent Drinagh Bog. Further details and the EIAR of this proposed development can be obtained at www.derrinloughwindfarmplanning.ie. This proposed development has now been integrated with the rehabilitation plan. The rehabilitation plan outlines how the site will be rehabilitated along with the construction and operation of the proposed Wind Farm.

The basis for the proposed approaches and implementation is the experience gained in 40 years of research on the after-use development and rehabilitation of the Bord na Móna cutaway bogs and decades of proven practice implementing cutaway peatland rehabilitation across the company's landholding.

Scope

The scope of the rehabilitation plan seeks to address issues of concern as identified by Bord na Móna and the consultees. The key issues identified are:

- Categorisation of the habitats developing on Clongawny Bog (outlined in Appendix I)
- Environmental stabilisation of the former peat production areas
- Maintenance of drainage and silt control through the site
- Remediation of water courses (internal) where necessary *(decommissioning)*
- The timeframe for bog rehabilitation/restoration
- The impact of the proposed Derrinlough Wind Farm development on the site and rehabilitation plan
- The Boora Bog Group comprises former raised bogs where most of the peat has been excavated to the deeper fen peat layers. Several portions of bogs have had a shorter industrial production history and remain in the deeper acidic peat layers.
- In general, there is no potential for extensive raised bog restoration in the short-term in areas where there has been extensive peat extraction or removal. This is because the majority of the peat mass has been removed, significantly changing key environmental factors such as hydrology and water chemistry acidity. Even if

suitable, wet hydrological conditions can be re-established, milled peat cutaway tends to have a more alkaline water chemistry, due to the remnant fen peat layers being exposed and the influence of the underlying glacial geology (dominated by Limestone). Typical raised bog *Sphagnum* mosses and other bog species do not thrive with this alkaline water chemistry.

- Rehabilitation of the former industrial peat production sites will lead to the development of a mosaic of cutaway habitats (in association with other land-uses), largely comprising mosaics of wetland, heath, grassland, scrub and Birch woodland. In some cases, there may be potential to develop embryonic peat-forming communities where deeper residual peat, or acidic peat is present.

List of consultees to date

- Open consultation with range of stakeholders at annual Biodiversity Action Plan review days 2010-2018;
- Consultation with Birdwatch Ireland regarding wetland birds and Clongawny Lake.
- Ongoing consultation with Offaly Outdoor Education Centre about a recent proposal to use part of the site for amenity and education.
- Discussions with Forest Service in relation to Native Woodland Scheme area 2017/2018.

Site description

Clongawny Bog is located south of Cloghan in west Co. Offaly. It is part of the wider Boora Bog Group. Drinagh Bog is located to the east and there is also a rail connection to the Derrinlough Peat Briquette Factory. Clongawny Bog has supplied the briquette factory for many years. This bog was in industrial peat extraction in 2019 but now industrial peat extraction has ceased over the whole of the site. Some peat stocks are still present.

Clongawny Bog has a heterogeneous topography with a mosaic of ridges, mounds and basins. Some of the higher ground was developed as conifer forestry in the past. The forestry on the site is managed by Coillte with both commercial production of timber and biodiversity as the main management objectives. The bog is primarily divided into several sections by the blocks of forestry located towards the centre of the site and by a railway that crosses the site in a NW-SE orientation. The site contains several mineral islands (areas of glacial material that were never covered with peat) and had developed as native Oak-Ash-Hazel woodland or were used as farmland in the past. These relic woodlands are still present and add significantly to the overall biodiversity value of the site. Several areas of the site have been rehabilitated in the past including Clongawny Lake, which was created in 2000. Areas of cutaway have emerged over the years and are developing a typical heterogeneous mosaic of pioneer cutaway habitats that reflect underlying environmental factors. Birch and Willow scrub is prominent in the drier areas along with pioneer fen containing Soft Rush and Common Bog Cotton. Pockets of wetlands are developing across the site where drainage has been impeded. Indicators of rich fen are also present, which add to the overall biodiversity value of the site.

Northern Section

This is the largest section and takes in all of the site north of the railway from the eastern to the western side, including a small area of recently active production on the east side. The majority of this area (north-west of the lake and north of the railway) has been classified as production related cutaway. The largest habitat in the Northern section is bare peat (BP).

A large block of forestry is situated to the south of this section and is composed primarily of Sitka Spruce and some Lodgepole Pine. One native woodland (dominated by Ash) on a mineral mound is also located in this section (west side), while another mineral island on the east side contains some maturing scrub with dense Hazel and Blackthorn. The central section is an area of production-related cutaway that is re-vegetating and contains Poor fen pioneer communities.

South-west section

This section is found in the SW part of the site and is found south of the railway. It contains a small native woodland on a mineral island named Maddens Derries. A small area of newly planted Oak woodland (a Bord na Móna Native Woodland Scheme) is located to the north side of this area. This section of new woodland is clearly visible by the high fence around its perimeter. Maddens Derries is the central part of a long ridge on which is developing

open birch scrub (oBir) and dry heath (dHeath). The area to the south of this ridge is primarily recently active peat production with very little vegetation cover and minor amounts of Poor fen communities.

South-eastern section

This large area (south of the railway and east of the mineral ridge that extends into the site from the southern side) contains a large area of recently active peat production with bare peat with very little vegetation cover (west side). The eastern side contains a relatively large lake (classified as an Acid (Oligotrophic) lake) that has developed on a natural basin between forestry planted on higher ground and the main road. This area is classified as a Biodiversity Area (on the land-use map) and is surrounded by pioneer dry heath and some emergent Birch scrub, which are colonising the bare peat. To the south east (south of the railway) an area of dry heath (dHeath) was developing on an old section of cutaway. This area was rehabilitated in 2018 with an intensive drain-blocking programme to re-wet the peat.

This section also contains a small area of diverse wetland located to the north-west (between the mineral ridge of Clongawny More Townland and the conifer plantation). This area is classified as production-related cutover and is used for access between the various sections of the site, although most of the area has been re-vegetated for some time with communities well-established. This area also contains several indicators of Rich fen development including a small area being vegetated by *Schoenus nigricans*, the presence of Brown Mosses and the presence of an iron flush.

South-west 'Island'

This small isolated area to the south-west of the main site is located adjacent to the Cloghan to Five Roads Cross road (R438). It contains a mosaic of cutover bog (PB4), scrub (WS1) and a minor amount of raised bog (PB1). It has never been in industrial peat production and has been leased to Coillte (although no forestry has been planted on it). This area is not included within the proposed Derrinlough Wind Farm site boundary.

See Appendix I for more detail on site, habitats and local features.

Current peat production programme, land-use and proposed developments

- **Bord na Móna railway.** An active rail line is still operational between Clongawny and other sites in the Boora Group. Decommissioning of this infrastructure is dependent on the general cessation of industrial peat production for supply of peat to various customers including West Offaly Power and Derrinlough Briquette Factory.
- **Coillte Forestry.** Several conifer plantations were established on this site in the 1980's by Coillte, with the forestry being leased by Coillte. Stands of mainly Lodgepole Pine and Sitka Spruce were planted on the site. Mixed broadleaves with Oak and Birch were also planted on part of the plantation. No management practices such as thinning or weed control has been carried out on the site since planting took place.
- **Derrinlough Wind Farm**: A planning application has been submitted for the development of a wind farm (Derrinlough Wind Farm), consisting of 21 wind turbines, a 110kv substation, two met masts and all associated infrastructure. Details of this planning application is available at www.derrinloughwindfarmplanning.ie. Within Clongawny, a total of 11 turbines are proposed as part of the Derrinlough Wind Farm along with temporary construction compounds, a met mast, internal site roads and amenity pathways,two permanent underpasses in the townland of Derrinlough, one beneath the N62 and one beneath an existing railway line and ancillary works.
- The remaining cutaway and future cutaway of the site will be left relatively undisturbed by this proposed development. This draft rehabilitation plan will be applicable to those areas and has also been considered in the context of the design, layout and construction of the proposed wind farm infrastructure.
- An amenity plan was also provided as part of the proposed Derrinlough Wind Farm planning application. This will consist of pathways (walking/cycling) through the site..

Current environmental conditions

The different cutaway habitats developing across the site reflects the underlying and varying environmental conditions. Environmental factors such as hydrology, residual peat depths and topography all have a significant influence on the future development of cutaway habitats and proposed rehabilitation. Hydrology tends to have the most significant influence on the development of future cutaway habitats. All sites have hydrological gradients from wet to dry habitats. Shallow residual peat usually means there are stronger fen influences on the pioneer cutaway development as fen peat is the residual peat type and ground-water has a stronger influence. At some sites deeper residual peat has the potential to develop embryonic *Sphagnum*-rich peat-forming communities. Exposed sub-soils may also influence future habitat development and rehabilitation. Exposed lacustrine deposits (shell-marl) tend to exert a strong alkaline influence on the development of various wetland and wet peatland cutaway habitats. It will not be possible to apply any one particular rehabilitation approach to the entire area, as there is such a broad range of environmental conditions on site.

- **Hydrology**: Clongawny Bog is largely gravity-drained, although one pump is still present in the north-east corner of the site. This water pump was used to keep part of the site relatively dry to allow industrial peat production during the summer. Pumping will continue during the decommissioning and rehabilitation period, and during the construction and operation of the Wind Farm. It is expected that pumping will reduce and be rationalised during this period. The objective of hydrological management during the Wind Farm operation will be to manage water levels across the site to keep the cutaway wet (soggy conditions) and protect Wind Farm infrastructure, so that excessive surface water across the site is reduced. A flood risk assessment of the site was prepared and submitted (Appendix 9.1 of the EIAR) to accompany the Derrinlough Wind Farm planning application. A further flood risk assessment will also be prepared to determine any hydrological impacts on the site and adjoining lands from hydrological management and changes to pumping on site.
- **Topography**: Clongawny Bog has a heterogeneous topography with a mosaic of ridges, mounds and sub-basins. This topography affects drainage of the sites and basins trapped between ridges/mounds can hold water.
- **Residual peat types and depths**: Much of Clongawny Bog is now cutaway and the majority of the original raised bog has now been removed. In some places there are exposed sub-soils. In general there is between 0.5-1.5 of residual fen or minerotrophic peat. This will have a significant influence on the development of future pioneer habitats. There are also some isolated pockets with residual peat of deeper than 2 m towards the SE part of the site. This may have the potential to develop embryonic *Sphagnum*-rich peat-forming communities when re-wetted.
- **Sub-soils:** Ongoing industrial peat extraction has exposed glacial deposits in the form of ridges and mounds that previously lay under the peat, across the site. These glacial deposits are made up of limestone-derived mixed till and gravels. These exposed sub-soils have the capacity to significantly influence habitats developing on them due to their higher alkalinity or calcareous influence. Already pioneer calcareous grassland is already developing and other more mature sections have developed woodland with Ash and Hazel (WN2). Several of these glacial mounds were 'islands' or Derries and were never covered in peat. They developed native Oak-Ash-Hazel woodland.

Other considerations

- **Amenity development**: There is a some local community interest in developing recreational use in the area, with a local outdoor education centre keen to used part of the Lake and neighbouring wetland edges for a bog-snorkelling trail.
- **Private sod industrial peat production**: There are pockets of domestic turf cutting towards the northern and western perimeters of the site.
- **Infrastructure**: A phone mast is located on the site.
- **Native Woodland Scheme**: A native woodland scheme plantation has been established on a section of cutaway.

Key biodiversity features of interest

- Clongawny Lake: One of the main features of interest is the creation of an area of open water located at the west of the site. This lake was created over ten years ago during the first phase of rehabilitation and attracts waders and wildfowl. The site also has note-worthy relatively acidic water chemistry, which has

influenced the re-colonisation of *Sphagnum* moss species in drains connected to the lake (the majority of Boora lakes are mesotrophic or developing marl lakes). Bird counts from the site (Biosphere Environmental Services, 2018) indicate that the lake is not used by water bird species to the same extent as other recently created lakes and/or wetland habitats in the Boora region and this low usage has also been linked to the more acidic water chemistry in the lake (Lally H., IPC 2008 paper).

- The site was being used by an estimated six pairs of breeding Lapwing (Red-listed species) during summer 2018. These breeding waders were mainly found in the central part of the site associated with wetlands. One Woodcock territory was also identified in 2018, towards the western side of the site.
- The lake has been used since it flooded in c.2000 by a breeding colony (of varying size) of Black-headed Gulls (red-listed species). The colony size peaked at c.30 pairs of Black-headed Gulls during 2017, although it is not considered likely that these birds bred successfully (refer to Chapter 7: Ornithology of the EIAR for Derrinlough Wind Farm). Three pairs were present at the lake in 2018 and two pairs were present in 2019.
- Pioneer Rich Fen area: One wetland area in particular, towards the centre of the site, contains several indicators of Rich Fen (PF1) habitat and is of particular biodiversity interest. This area has significant potential to develop habitats with important nature conservation interest and potential to qualify as EU habitats Directive Annex I habitats (PF1) in the future. (Codes refer to Heritage Council habitat classification system, Fossitt 2000 (See Appendix I)).
- Marsh Fritillary Butterfly: This species was recorded in the potential rich fen area in June 2010 and adjacent to a number of tracks and boundary habitats in 2018, when 24 larval webs were located. A follow-up survey in 2019 recorded 80 larval webs at a number of locations within Clongawny Bog. It is listed on Annex II of the EU Habitats Directive and is a species of significant conservation importance. Dingy Skipper butterfly is widely distributed through the site on gravelly mounds. This butterfly species has a restricted distribution in Ireland.
- Native Woodlands: The site also contains four relatively small areas of native woodlands (180yrs +) with mature Oak, Ash and Hazel and Bluebell ground cover, which developed on glacial 'islands' that were never covered with peat. The site also contains some conifer plantation, some of which has failed and is beginning to develop native scrub.
- The site is used occasionally by Whooper Swan, Hen Harrier, Merlin and Peregrine in the winter (refer to Chapter 7: Ornithology of the EIAR for Derrinlough Wind Farm).

Current ecological rating (A-E; *following from NRA Guidelines*)

A large part of the site can be rated as having a **low local ecological value (E)** as it was in milled peat production up until 2019. Areas of cutaway have a higher ecological value **(D)**. The breeding assemblage of waders and Black-headed Gulls is significant. The area of undeveloped raised bog also has a higher local ecological value **(D)**, although its restoration prospects are poor.

The presence of Marsh Fritillary Butterfly, this species is listed on Annex II of the EU Habitats Directive and is a species of significant conservation importance **(A).** The native (Oak and Ash) woodlands have a high ecological rating as a habitat of national importance **(C).**

Overall, the site would be considered to be of Local (Higher) Significance.

Criteria defining successful rehabilitation

- The main criteria are stabilisation of the former industrial peat production area and mitigation of potential silt run-off.
- Bord na Móna are proposing to construct a wind farm on site. This has the potential to have a significant impact on the overall cutaway environment. The construction and operation of this wind farm will be integrated into this rehabilitation plan. It is planned to reduce and minimise the impacts of the wind farm infrastructure on the surrounding cutaway. Drainage and pumping can be managed in such a way as to minimise the hydrological zone of influence of this activity. Cutaway rewetting will be carried out and the site managed in such a way that it maximises the target hydrological conditions (water levels at the peat

surface - soggy ground conditions) that are the most appropriate to provide the optimum conditions for the restoration of carbon sink function.

Industrial peat extraction continued at Clongawny until 2019. Industrial peat extraction has now ceased. Natural colonisation will form the basis for the environmental stabilisation of the bare peat areas in association with targeted rehabilitation and re-wetting. A significant part of the site has already developed as cutaway and some has quite well-established secondary cutaway peatland habitats already. Comparison of aerial photos taken in 2000 to more recent aerial photo series shows that there have been significant changes in the central cutaway area in the past 20 years, as much of this part of the bog was in full industrial milled peat production in 2000. Some areas still in peat production recently are dominated by bare peat. The bare peat cutaway has varying environmental characteristics including a variable topography.

Re-wetting of the cutaway, where possible, is a general rehabilitation strategy. The main target will be to maintain water-levels close to the peat surface, and to avoid the creation of large-water bodies. Re-wetting and water levels close to the peat surface accelerates the re-vegetation processes, the development of vegetation cover and therefore environmental stabilisation.

There is potential for the creation of wet cutaway habitats at Clongawny Bog but, due to the local topography and largely gravity-drainage system, drain blocks and the introduction of landscape elements (such as berms or bunds) is likely to be required to maximise rehabilitation potential. The main objective of peatland rehabilitation will also be maximise the creation and development of wet soggy conditions (emergent vegetation, water levels at or 0-10 cm above the peat surface). This will require significant water level management across the site.

Development of soggy wetland conditions with water levels at or slightly above the peat surface is likely to lead to the development of poor fen dominated vegetation communities. This also has benefits for carbon fluxes as re-wetting the cutaway helps store residual peat and carbon in place. It also sets the cutaway on a trajectory to eventually become a carbon sink again in the future. Wet cutaway habitats have the potential, in time, to become peat-forming and eventually become carbon sinks again, depending on the balance between local topography, habitat development, vegetation growth, water levels and release of carbon from the remnant peat. More research is required to understand greenhouse gas fluxes and the various path-ways and timeframes for these cutaway areas to become peat-forming carbon sinks.

Sphagnum-rich peat-forming or embryonic raised bog vegetation is generally not expected to develop as a widespread or significant feature of the site in the short-term, as the majority of the site is cutaway (the majority of peat is removed) and has exposed fen peat and underlying calcareous geology and sub-soils. This has changed the environmental conditions of the site significantly. Most raised bog *Sphagnum* spp. (peat-forming vegetation indicator) do not grow where there is such an alkaline influence on the physio-chemical environment. Water-levels would also inhibit the development of this vegetation type in areas that are either too dry (and will develop bog woodland), or areas where there will be deeper permanent water more suitable to development of wetland habitats. However, while *Sphagnum* spp. do not form a significant part of these various communities, other poor fen and wetland bryophytes do thrive in this environment. Cutaway areas can develop an extensive bryophyte layer that, while is not dominated by *Sphagnum* species, will eventually lead to the formation of peat-forming conditions as these pioneer communities mature and ecological succession occurs.

Sphagnum-rich peat-forming or embryonic raised bog vegetation is expected to develop in localised pockets with suitable environmental conditions in the SE of the site. Residual peat depths here are relatively deep and *Sphagnum* mosses are already present where the cutaway is wet. Part of this section was already re-wetted in 2017 with an intensive drain blocking programme.

Drain blocking can be widespread in scale with each field drain being blocked (e.g. Carrickhill in the Littleton Works) or more localised with targeted drain-blocking (e.g. Mountlucas Wind Farm) and both can be very effective. This can be used in conjunction with local topographical features like natural hollows to manage water levels or with other typical features of cutaway peatlands like high peat fields, which act as berms to hold water to some extent. Active management to create low berms to manage water-levels and create shallow wetland habitats dominated by emergent vegetation has also been successfully developed (e.g. Mountlucas Wind Farm, Bruckana Wind Farm, Oweninny, Lough Boora Discovery Park, Ballycon). In conjunction with the wind farm development and associated roads and embankments there will be further opportunities to manage water-levels using the new construction as a partial embankment, where possible. Material (peat and sub-soil) side-casted from the road construction can be used to develop low berms that would then prevent the adjacent cutaway from draining directly into the drains along the roads. This technique has been used at Mountlucas and Bruckana Wind Farm. Overflow pipes will be used to maintain maximum water levels across the cutaway and allow excess surface water to flow into the drainage channels beside the roads and other infrastructure. Managing the cutaway in this way means that the cutaway can stay wet, while excess surface water can drain away through the drainage infrastructure.

It is expected that pumping will be maintained during the decommissioning and rehabilitation phases and during the construction and operation of the Wind Farm. It is expected that pumping will be reduced during the operation of the wind farm. Previously, bogs were pumped to allow industrial peat extraction during the summer, dropping the water levels below the peat surface, and to protect peat stocks during the winter. Now, pumping does not have to drop levels below the peat surface of the cutaway. The field drains will be blocked and water levels will be maintained at or slightly above the peat surface. Pumping during the operation of the wind farm will focus on removing excess surface water that will largely be rain-water. It is not intended to pump any ground-water during the operation of the wind farm. Therefore pumping across the site will help maintain appropriate water levels (soggy conditions) on some cutaway areas outside the wind farm infrastructure and buffer areas (see rehabilitation map). The adjoining cutaway bog around the wind farm infrastructure will be used as temporary storage of water during high levels of rainfall. This will attenuate water flows from the site during winter flood events.

Clongawny Bog has a heterogeneous topography. It is inevitable that some areas will be higher and will always have drier conditions. It is not anticipated to re-wet these areas significantly, but where drains can be blocked they will be blocked. It is expected that these areas will develop as dry bog woodland. These areas include relatively steeply sloped areas along the sides of the gravel hills and ridges, on the mounds of these areas and in areas where the glacial sub-soils have been exposed. Coillte have leased sections of the site and these areas have been planted with conifers, a native woodland scheme has also been established on the site by Bord na Móna. Five areas of mature Oak and Ash woodland are located on mineral soil within the site, these woodlands predate any Bord na Móna operations on the site.

A large area of the site has already been developed for forestry by Coillte. Management within these areas can be considered as ongoing maintenance with routine operations related to timber production and/or development of the conifer plantations as biodiversity areas. Issues of peat stabilisation and potential silt run-off will have to be addressed during forestry operations on the site by Coillte.

It is also inevitable that some areas that are basins will develop deeper water levels and develop wetlands with a mosaic of emergent vegetation (poor fen), Reed-beds and wet woodland. Wetlands like these are already developing on the site and will enhance biodiversity and also enhance mitigation of silt run-off by acting as natural silt traps. Small wetland features will be retained on site as part of the heterogeneous landscape of different habitats. It is not the objective of this rehabilitation plan to create large wetland features dominated by deeper open water that may potentially attract relatively large flocks of wintering waterbirds into the wind farm. Water-levels and re-wetting will be managed to maximise the target conditions of water-levels at or slightly above the bog surface (soggy conditions).

Drain blocking and berm creation has proven to be a very effective tool in re-wetting remnant peat, as well as being generally positive for Greenhouse Gas fluxes from the cutaway (in the long term).No drain-blocking will be carried out drains around the margin of the site. Rehabilitation will be carried out in a manner that does not impact on neighbouring land. It is expected that water will still flow out of the site at the various emission points, through existing silt ponds, which will be maintained until it is deemed that rehabilitation and site stabilisation has been successful.

The EIAR for the proposed Derrinlough Wind Farm development details issues related to peat management during construction. In summary, during construction for access tracks, hardstands and other areas, peat is excavated from the cutaway, moved to the side, graded into berms not more than 1m and allowed to naturally re-vegetate. This has proven successful during construction of Mountlucas Wind Farm. In the event that natural re-vegetation was unsuccessful, then other measures such as re-seeding would be considered. It is not planned at this stage to move significant volumes of peat from one part of the site to another section. As Clongawny Bog is cutaway or is production bog with relatively shallow remnant peat, peat depths with mostly vary between 0-1 m, so the volume of peat to be moved is relatively small compared to an intact peatland.

- Mitigation of silt run-off and remediation of watercourses

Once rehabilitation is completed and the proposed wind farm is constructed, there will be a significant reduction in the potential for silt run-off from the site. Natural colonisation will stabilise the surface peat and proposed rehabilitation measures will also slow the movement of water through the site and enhance settlement of any suspended materials through vegetated areas. This has been a proven technique at the rehabilitated Oweninny Bogs, and provides long-term and sustainable prevention of silt run-off to watercourses. The Oweninny Wind Farm is currently in construction (Phase 1 has been completed) and has been integrated successfully into this cutaway environment, minimising impacts on adjacent cutaway and watercourses on site.

- Maintenance of remnant raised bog areas.

Elsewhere, the small areas of remnant raised bog within the Bord na Móna boundary are generally too small and degraded to warrant significant bog restoration measures and restoration of active raised bog functions. Some patches of marginal raised bog are also being continually cut in some areas for sod-turf under private management. The majority of these areas are likely to slowly dry out and develop Birch woodland eventually, although the time-scale for this natural succession is likely to be relatively long. Some sections may retain typical open raised bog vegetation (degraded bog communities). There is the capacity for some drain blocking in some of the bog remnants that should improve the overall bog remnant condition. These have been identified on the rehabilitation map. These areas will still be a reserve for raised bog species including mosses that may be able to colonise some parts of the cutaway in the future.

Overall, the windfarm and associated infrastructure cover just under 4% of the site, with wetlands accounting for up to 44% of the site into the future. Raised bog habitats should cover 5% of the site with woodland, scrub and pockets of grassland accounting for just over 37% of the site in the future. The forestry accounts for just under 10% of the site.

Derrinlough Wind Farm EIAR mitigation measures that are applicable to Clongawny Bog

Proposed mitigation measures are provided in the Derrinlough Wind Farm EIAR in Chapter 16: Schedule of Mitigation and Monitoring Measures.

Proposed Rehabilitation programme

Completed

- A lake was created along the eastern boundary of the site in 2000 by blocking an outfall and allowing a basin that had formed through peat extraction to fill with water.
- A native woodland scheme has been planted in Clongawny in 2007 comprising Oak (1.2 ha).
- Coillte have planted a significant proportion of the site with conifers (in the 1980s).
- A small area of residual deep peat in the SE part of the site was re-wetted in 2017 with an intensive drain-blocking programme.

Ongoing

- Approximately 25% of the cutaway on the site has already naturally re-vegetated with typical cutaway habitats.

Short-term (2020-) (Pre-Wind Farm construction) (Phase 1)

- Industrial peat extraction in Clongawny has currently ceased. There are still peat stocks on site. Short-term rehabilitation measures will be dependent on the removal of peat stock and the fuel requirements to West Offaly ESB Power Station and Derrinlough Briquette Factory
- Significant bare peat areas through the site and the progress of natural re-colonisation of the cutaway areas will be monitored.
- The most sustainable management option for the recently active production areas within the site is to encourage natural re-colonisation of the site.
- All stock-piles should be removed from the site as part of the winding down of peat production operations. Any remaining or old stockpiles should be levelled as part of the rehabilitation/decommissioning process.
- There will be ongoing monitoring of the site and appropriate rehabilitation planning related to wind-farm planning and construction activities on Clongawny Bog. Opportunities for a Phase 1 re-wetting programme that would not interfere with the construction in the future of the proposed Derrinlough Wind Farm will be explored and implemented, where possible.
- A flood risk assessment will be required for Clongawny Bog to assess the impacts of Phase 1, 2 and 3 rehabilitation measures.
- The impacts of rehabilitation and wind farm construction on the conservation status of species of conservation interest will be monitored.

- While natural colonisation is expected to proceed almost immediately as industrial peat production ceases, there will be a determination of extent of bare peat and selection of best measures to accelerate re-vegetation (if necessary).
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.
- The potential to enhance the woodlands will be re-assessed at this stage.

Wind Farm construction (proposed 2024 - 2026) (Phase 2)

- There will be ongoing monitoring of the site and appropriate rehabilitation planning during the construction phase.
- Side-casted material from the wind farm road and drainage construction will be used to create low berms to help manage water levels and prevent surface water draining directly into the new drains. Pipes to be inserted, where required, to manage water-levels flowing off the cutaway and into the wind farm drainage.
- A widespread drain-blocking programme will implemented across the cutaway, where possible. This will have to be planned in association with the wind farm construction. In general, field drains will be blocked where possible to re-wet cutaway and re-wet to the optimum water-level.
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.

Post wind-farm construction (2026 - 2031) (Phase 3)

- Site conditions and drainage are likely to change somewhat after the construction of the wind farm, so continued assessment could be made of further rehabilitation and maintenance works such as localised drain blocking and berm creation in association with the wind farm infrastructure. Similar rehabilitation works have already been carried out successfully at Mountlucas Wind Farm in Co. Offaly.
- Ongoing monitoring of the hydrology of the site and water levels will be carried out. Further maintenance works and adjustment of water levels may be required to maximise the extent of the target water levels at or slightly above the peat surface.
- It is expected that pumping will be reduced and rationalised during this period. The pumping regime will manage excessive surface water across the entire site while avoiding de-watering of the cutaway areas not in the zone of influence of the wind farm infrastructure.
- There will be continued monitoring of significant bare peat areas within the cutaway after the application of fertiliser. The potential to use a once-off application of fertilisers to accelerate re-vegetation where vegetation is slow to re-colonise on other areas will be assessed. This type of rehabilitation programme has already been successfully trialled at Drumman Bog on bare peat areas.
- Monitor the success of rehabilitation measures.
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.

Long-term (post 2031) (Phase 4)

- This phase will follow on from cessation of industrial peat production in adjacent bogs.
- The proposed wind farm will have a 30 year operational life, so continued assessment of further rehabilitation and maintenance works will be required.
- Monitoring of the site to ensure stabilisation and complete re-vegetation.
- Evaluate success of short-term rehabilitation measures outlined above and enhance where necessary (to be determined by selected short-term management above).

- Targeted active management such as seeding of a nursery crop or use of fertiliser to help promote natural re-colonisation will be carried out, if natural re-colonisation of significant bare peat areas within the recently active production areas has not progressed satisfactorily at this stage.
- The effect of any targeted active management will be monitored and further work determined.
- Decommissioning of silt-ponds will be assessed.
- Assess requirements for decommissioning of pumps and Bord na Móna industrial railway on the site.
- Reporting to the EPA will continue until the IPC License is surrendered.
- There will be some amenity development across the site in association with the construction and operation of the wind farm. Further opportunities to develop amenity infrastructure will be explored and facilitated, where possible,
- Opportunities to integrate other land-uses in to the site will be assessed as required.

Long-term (Post Wind Farm decommissioning)

- At this stage it is expected that the site will have no bare peat cover and that the entire site will be developing a suite of maturing cutaway habitats that reflect the mosaic of environmental conditions. The wind farm infrastructure will have been integrated into the landscape and there are likely to be other land-uses across the site including amenity.
- A flood risk assessment will be carried out for Clongawny Bog to assess the impacts of wind farm decommissioning, potential reduction in pumping and potential changes in water-levels across the site. This assessment will be cognisant of established amenity use or other uses that may have developed over the period.

After-care and maintenance

- There will be annual assessments of the site to determine the progress of the rehabilitation work and requirements for further enhancement measures (depending on outcome of assessments during and after the construction of the wind farm and associated amenity elements).
- Where other uses are proposed for the site, these will be assessed by Bord na Móna in consultation with interested parties. Other after-uses can be proposed for licensed areas and must go through the appropriate assessment and planning procedures.

Potential future natural habitats on the site

This section attempts to predict the development of natural habitats on the site, assuming current land-use and known after-use plans for the cutaway (development, etc.). This prediction is based on research and methods used to predict the natural vegetation of Ireland (Cross, 2006).

- A significant proportion of this site at present is likely to develop dry Birch-dominated woodland (WN7) in the medium to long-term after production. This woodland is likely to be a mosaic containing small patches of more open habitat with scrub (WS1), wet grassland (GS4) and poor fen vegetation (PF2).
- The wooded mineral islands on the site are likely to retain their semi-natural woodland, which has the potential to expand somewhat naturally in the future if the canopy is allowed to mature (such as at Madden's Derries). These woodlands are surrounded by a narrow band of Birch scrub and woodland, some of which has the potential to develop Oak-Ash-Hazel woodland in the future. The small mound containing Hazel scrub also has the potential to develop Ash-dominated woodland (WN2) in the future.
- Other mineral mounds are likely to develop into dry heath (HH1) and calcareous grassland (GS1) depending on the depth of remaining peat over the subsoil (calcareous grassland (GS1) more likely to develop on mounds with exposed sub-soil). These areas also have the potential to develop Hazel scrub and Ash woodland in the long-term (WN2).

- Much of the lower-lying area across the site will develop into a mosaic of pockets of wetland habitats with poor fen (PF2), rich fen (PF1), Reed Swamp (FS1) and wet fen carr woodland (WS1/WN6) interspersed with drier Birch woodland (WN7).
- The residual deep peat located at the SE part of the site has the potential to develop *Sphagnum*-rich embryonic bog vegetation.
- The small wetland area in the centre of the site has the potential to develop into Rich Fen (PF1). The presence of iron flushes close by indicates that springs are present, although this habitat is not likely to be extensive. The majority of this area is likely to develop a mosaic of Wet Willow-Alder-Ash woodland (WN6) (fen carr type woodland) in the long term with open patches containing Poor fen (PF2), Rich fen (PF1), wet grassland (GS4), open water and Reedbeds (FS1).
- The lake has the potential to develop into a natural acid-oligotrophic lake (FL2) typical of lowland bog areas. The lake is likely to be surrounded by some emergent vegetation (Poor fen communities) with the drier sections developing dry heath (HH1) and Birch woodland (WN7).

Budget and costing

- It is anticipated that the majority of the rehabilitation at this site will be through natural re-colonisation. Some preliminary budgeting can be carried out assuming that approximately 44% of the site will be developed as wetlands with a further 5% restored to active raised bog habitats. It is likely that some active management required blocking outfalls to enhance re-wetting will be required on the majority of this area, and the allocated rehabilitation provision will be based on this estimate.

Appendix I. Ecological Report

Ecological Survey Report

Note: This report outlines an ecological survey of the bog. This report should not be taken as a management plan for the site as other land-uses may still be considered. Information within this report may inform the development of other land-uses and identify areas with particular biodiversity value.

Bog Name:	***Clongawny More***	**Area (ha):**	1,028ha
Works Name:	Boora	**County:**	Offaly
Recorder(s):	MMC & DF	**Survey Date(s):**	29/30 September & 1 September 2009 4/06/2010, May 2014

Habitats present (in order of dominance)

- Habitats present on the industrial cutaway include: (Codes refer BnM classification of pioneer habitats of production bog. See Appendix II).
- Bare peat (BP), pioneer Poor Fen communities (pJeff, pEang, pTrig, pJbulb) and *Betula pubescens*-dominated scrub (eBir, cBir). There is one large lake along with other fragmented and minor patches of Open water (OW), Reedbeds (pTyp, pPhrag), Dry Heath (dHeath) and dry disturbed/pioneer communities (DisCF, DisWill) around the site. A small wetland area in the centre of the site has developed some Rich fen indicators. (Codes refer to BnM classification of pioneer vegetation of industrial cutaway areas, see appendix II.).
- There is some built land (BL3) with paths accessing works areas and a mobile phone in the SE section. Rail-lines crossing the site can also be classified as BL3. Silt Ponds are located to the NE and SW of the bog. Alongside the silt ponds are linear mounds of excavated material that run parallel to the ponds. This spoil is a mixture of glacial material, limestone and marl.
- Several large area of conifer forestry (WD4) (approximately 92ha in total) have been planted at various locations around the site, on peat and on some of the mineral mounds.
- Oak-Ash-Hazel Woodland (WN2) is present on several small mineral mounds and another mound contains some mature dense Hazel and Blackthorn scrub (WS1). There are small areas of grassland (gCal) associated with this mound, and also with the access routes such as the railways and around the mobile phone mast area.
- Other fringe habitats around the margins of the bog include Scrub (Birch-dominated with some Scots Pine), Birch woodland (WN7) and Cutover Bog (active and abandoned). There are also several drainage ditches around the margins of the site (FW4).

Description of site

Clongawny Bog is located adjacent to the Cloghan to Birr Road. The majority of the site was in industrial peat extraction in 2019 but this has now ceased. The bog is primarily divided into several sections by the blocks of forestry located towards to centre of the site and by a railway that crosses the site in a NW-SE orientation. The forestry on the site is managed by Coillte with both commercial production of timber and biodiversity as the main management objectives. The site has a varied topography with some higher areas, mineral mounds of glacial material and deeper basins.

Northern Section

This is the largest section and takes in all of the site north of the railway from the eastern to the western side, including a small area of recently active production on the east side (east of the railway, Derrinlough). The majority of this area (north-west of the lake and north of the railway) has been classified as production related cutaway. The largest habitat in the N section is bare peat (BP).

A large block of forestry is situated to the south of this section and is composed primarily of Sitka Spruce and some Lodgepole Pine. This section of forestry is of moderate quality and appears to grade from moderate quality on its eastern side to poorer quality on the western side. Some of this forestry has failed and is naturally re-generating

scrub. One native woodland (dominated by Ash) on a mineral mound is also located in this section (west side), while another mineral island on the east side contains some maturing scrub with dense Hazel and Blackthorn.

The central section is an area of production-related cutaway that is re-vegetating and contains Poor fen pioneer communities (pJeff, pEang), emergent Birch scrub (eBir), and a minor amount of dry heath (dHeath). A small patch of raised bog (high bog) (PB1) is located on the northern boundary, while some other boundary habitats include scrub (WS1), conifer plantation (WD4), and dry grassland (GS1, GS2) along with a works area near Derrinlough that is used for storage and refuelling to the east of the site.

South-west section

This section is found in the SW part of the site and is found south of the railway. It contains a small native woodland on a mineral island named Maddens Derries. A small area of newly planted Oak woodland (a Bord na Móna Native Woodland Scheme) is located to the north side of this area. This section of new woodland is clearly visible by the high fence around its perimeter. Maddens Derries is the central part of a long ridge on which is developing open birch scrub (oBir) and dry heath (dHeath). The area to the south of this ridge is primarily recently active peat production with very little vegetation cover and minor amounts of Poor fen communities (pJeff, pEang). A silt pond is located to the west side. There are some remnants of uncut high bog along the eastern and western boundary of this section that can be classified as raised bog (PB1) and are being cut for peat by private individuals along the outer boundary. The eastern boundary also has several plots of land that extend into the mineral ridge of Clongawwny More. Some of these plots contain Birch woodland (WN7), scrub (WS1) and cutover bog (PB4).

South-eastern section

This large area (south of the railway and east of the mineral ridge that extends into the site from the southern side) contains a large area of recently active peat production with bare peat with very little vegetation cover (west side). There is a group of silt ponds (Rip) and some associated Birch scrub (eBir) located at the western side of this section. This area also contains some young pioneer Poor Fen vegetation (mainly pEang and pJeff) spreading from the drains.

The eastern side contains a relatively large lake (classified as an Acid (Oligotrophic) lake) that has developed on a natural basin between forestry planted on higher ground and the main road. This area is classified as a Biodiversity Area (on the land-use map) and is surrounded by dry heath and some emergent Birch scrub, which are colonising the bare peat. This section is notable for the presence of naturally colonising Oak in some of the scrub and also *Sphagnum* moss appearing in some of the drains connected to the lake. The western boundary is defined by several large blocks of conifer forestry. A phone mast is located in one section of plantation, which has been planted on a relatively large mineral island and surrounding shallow peat. This forestry is dominated by Sitka Spruce but it also contains two distinct patches of native old woodland that have developed on mineral mounds and have been left intact. To the south east (south of the railway) an area of dry heath (dHeath) was developing on an old section of cutaway.

This section also contains a small area of diverse wetland located to the north-west (between the mineral ridge of Clongawny More Townland and the conifer plantation). This area is classified as production-related cutover and is used for access between the various sections of the site, although most of the area has been re-vegetated for some time with communities well-established. The railway also runs through this section. The wetland area is mainly at the western side and there are several small areas of open water around which there have developed diverse poor fen communities (pEang, pJeff, pBulb), minor amounts of Reedbeds (pTyph, pPhrag) and emergent Birch scrub (eBir). This area also contains several indicators of Rich fen development including *Cladium mariscus* in the open water, a small area being vegetated by *Schoenus nigricans*, the presence of Brown Mosses and the presence of an iron flush.

South-west 'Island'

This small isolated area to the south-west of the main site is located adjacent to the Cloghan to Five Roads Corss road (R438). It contains a mosaic of cutover bog (PB4), scrub (WS1) and a minor amount of raised bog (PB1). It has never been in industrial peat production and has been leased to Coillte (although no forestry has been planted on it).

Forestry and potential forestry on site

Three main commercial forestry blocks are located on the site. These areas are managed by Coillte and are dominated by *Picea sitchensis.* These plantations have dual purposes with some sections intended for timber production and some sections intended for biodiversity. Some sections have achieved a yield class of 22 which is considered to be of medium quality (depending on planting year) from a timber production point of view but many other sections are of much poorer quality and some sections are failing completely. Low nutrient levels, high water

table, competition from other plants, namely *Calluna vulgaris* and exposure, appear to be taking their toll on these plantations.

A small flush with extensive *Sphagnum* sp. cover was noted close to the edge of the large conifer plantation in the south-east section (northern side, see map). This flush contained extensive cover of *S. capillifolium*, *S. magellanicum*, S. *papillosum* and *Aulacomnium palustre*. Forestry planted in this area had failed. Other species such as *Eriophorum vaginatum*, *Narthecium ossifragum* and *Rhynchospora alba* were present.

An area to the north of the most westerly woodland (Madden's Derries) has been planted with Oak as part of the Native Woodland Scheme. This area was planted in 2008 and is clearly visible with the high deer fencing bounding it. This area consists of *Quercus robur*, *Betula pubescens, Calluna vulgaris, Eriophorum sp.* and *Juncus effusus.* The fungus *Armillaria tabescens* was also noted within this area.

This habitat is found in four separate locations on the site and a boundary wall is still visible in some of the woodlands, indicating they were managed in the past, possibly grazed. These woodlands are dominated by Oak trees that are estimated to be 180+ years old and are quite large (dbh 1.5 m). Many of the trees appear to have been coppiced in the past and as a result are multi-stemmed. Some of these woodlands are bordered with or contained within conifer plantations.

Over-grazing (presumably by deer) is a problem with the result that there is poor diversity in the woods with a poor shrub layer and the woodland is quite open. However, some sections did have numerous *Fraxinus excelsior* (Ash seedlings) so grazing intensity may vary across the site and the poor woodland development may in part be due to the heavy canopy. Species found within the canopy and understorey included *Quercus robur*, *Corylus avellana*, *Sorbus aucuparia*, *Ilex aquifolium*, *Betula pubescens*, *Prunus spinosa*, *Euonymus europaea*, *Hedera helix*, *Sambucus nigra*, *Alnus glutinosa*, *Malus sylvestris*, *Crataegus monogyna* and *Fagus sylvatica*. Several mature *Taxus baccata* were noted in one of the woodlands. Some sections of the canopy were much younger and dominated by *Betula pubescens, Salix cinerea* and/or *Corylus avellana*. The ground cover was generally dominated by *Hedera helix* in the heavily shaded areas, with *Rubus fruticosus* appearing in the more lightly shaded sections. Other species present included *Dryopteris dilatata*, *Dryopteris felix-mas, Arum maculatum, Rubus fruticosus*, *Urtica dioica, Pteridium aquilinum, Lonicera periclymenum, Viola* sp. *Oxalis acetosella* and *Sanicula europaea*. The ground cover of these woodlands was low in diversity but survey during early summer would probably increase the number of species recorded. The ground cover also had extensive moss cover in places as well as one exposed limestone rocks. This was dominated by *Thamnobryum alopecurum*, with *Mnium hornum*, *Hypnum sp.*, *Eurhynchium striatum* and *Thuidium tamariscinum* all present.

One of the woodlands has a canopy dominated by *Fraxinus excelsior* and contained *Sambucus nigra* and *Corylus avellana* with a dense *Rubus fruticosus* and *Pteridium aquilinum* understorey.

The woodland at Maddens Derries is poor in structure, with large gaps in the canopy and dense scrub and thickets of *Rubus fruticosus* and *Pteridium aquilinum* surrounding the mature trees.

One of the small mineral mounds has developed a small area of *Corylus avellana*-dominated scrub. This scrub is quite dense and impenetrable. It is surrounded by a band of dense *Prunus spinosa* and then by a zone of dense *Pteridium aquilinum* and *Rubus fruticosus*. This is a typical example of a succession habitat that will eventually develop Ash woodland (WN2). Several *Fraxinus excelsior* and *Betula pubescens* trees are emerging from the *Corylus avellana* canopy.

There is a minor amount of this habitat on the site and it can be found around the edges of the wooded mineral islands. The canopy is generally dominated by *Betula pubescens*. Other species present include *Sorbus aucuparia*. The ground cover and shrub layers are poorly developed and are dominated by *Rubus fruticosus* thickets. Other species present include *Molinia caerulea*, *Juncus effusus*, *Carex* sp., *Dryopteris dilatata*, *Hedera helix* and *Sambucus nigra*.

Designated areas on site (cSAC, NHA, pNHA, SPA other)

None

Adjacent habitats and land-use

Habitats and land-use around the site include cutover bog with active peat-cutting (PB4), the use of improved grassland (GA1) for grazing livestock and growing fodder, some minor semi-natural habitats such as scrub and remnant patches of raised bog (PB1), some Birch woodland (WN7), commercial forestry (WD4) and the Derrinlough briquette factory to the east of the site.

Watercourses (major water features on/off site)

Several Silt pond areas are present on the site along with some drains along the site boundaries. A deep drain is present in the mid-section of the site while a mostly dry drain was noted to the north of the site.

The eastern side of the site is within the Little River catchment. This river flows north along the eastern side of the site and links to the River Shannon. The western side of the site is drained by several small streams that are linked to the Rapemills River, which also flows to the River Shannon, to the west of the site, and by another small stream to the north of the site that flows directly into the River Shannon.

Fauna biodiversity

Birds

- Several bird species were noted around the site. Wren, Robin and Blackbird use the scrub areas around site, Meadow Pipit (10 - 15) using a variety of habitats on site, Blue Tit was recorded in some of the woodlands, and Snipe (>15) in some of the wetter pioneer Poor fen and wetland areas and in the drains around the site. Wood Pigeon, Magpie, Raven and House Martin occasionally observed over the site. A flock of 22 Curlew were observed on bare peat in the N section while a flock of 40 Lapwing were observed over the S section of the site. A Peregrine Falcon was hunting close to the road on the on the E edge of the bog. Jays were also heard in at least two of the woodlands.
- A group of Mallard (9) were noted in the lake as were one Grey Heron, a single Snipe and two flocks of Lapwing (seven and twelve).

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- 16 Black-headed Gulls using lake (breeding colony)
- 2 Great-crested Grebe
- 1 Ringed Plover (near lake)
- Blackcap (in adjacent Birch woodland)

Mammals

- Signs of Rabbits are widespread and common around the site.
- Signs of Hares also noted.
- Deer tracks were observed throughout the site while evidence of Deer rutting was also observed in some of the woodlands in the form of damaged trees and ground disturbance.
- Pine Marten tracks were observed in numerous locations around the bog.
- Signs of Badger activity in the bog included tracks, scrapes and droppings. Badger activity appeared to be focused on some sections of the woodlands.
- Fox droppings recorded at several locations.
- Evidence of Squirrels (red or grey) was noted in two of the native woodlands.

Other species

- Frogs recorded at several locations on the site.
- Sticklebacks were observed in the lake.
- Painted Lady Butterfly and Tortoiseshell Butterfly were noted in the north of the site while other invertebrate species observed included Grasshopper, Two-spotted Ladybird and numerous Dragonflies.
- Dingy Skipper butterfly was recorded using the site in 2014

4/06/2010

- 4-spotted chaser Dragonfly

- Green-veined White
- Marsh Fritillary Butterfly (8) using dry grassland around the potential rich fen area.

Fungal biodiversity

Leccinum scabrum (Brown Birch Bolete), *Hygrocybe cantharellus* (Goblet Waxcap), *Lactarius vietus* (Grey Milkcap), *Lactarius uvidus*, *Lycoperdon lividum* (Common Puffball), *Armillaria tabescens* (Ringless Honey Fungus) and *Agaricus silvicola* (Wood Mushroom).

HABITAT DESCRIPTIONS

(See Habitat Descriptions Document for detailed description of each vegetation community not described in this section.)

Pioneer Poor Fen communities (pPhrag)

There is a small amount of this habitat present on the site and it is found associated with the developing wetland in the south-west section (south-west of Madden's Derries). Dense stands of *Phragmites australis* are developing in association with *Eriophorum angustifolium*-dominated vegetation (pEang) and a minor amount of *Typha latifolia* in drains with some *Carex rostrata*-dominated vegetation (pRos).

Open Water (OW)

A large area of open water is found within the Biodiversity Area in the east section of the site. This open water area is an acid oligotrophic lake and it is noticeable that there are no emergent Reedbed communities (pTyph and pPhrag) in this lake compared to other recently created lakes. Algae were noted in the lake itself with very little emergent plant species.

The marginal vegetation around the lake is a pioneer community developing on bare peat that included *Campylopus introflexus, Juncus bulbosus, Drosera rotundifolia, Molinia caerulea, Quercus robur, Eriophorum vaginatum, Polytrichum sp., Sorbus aucuparia, Utricularia sp., Alnus glutinosa, Carex echinata, Carex echinata, Betula pubescens, Succisa pratensis, Salix cinerea, Juncus effusus, Carex rostrata* and *Eriophorum angustifolium.* This community was a mosaic of *Campylopus*-dominated vegetation (pCamp) and *Eriophorum angustifolium*-dominated vegetation (pEang). There were some stands of *Eriophorum angustifolium* (pEang) within the water as well as a minor amount of *Carex rostrata* (pRos). Drains connected to the lake contained some *S. cuspidatum* and this species also appeared around the edge of the lake but was poorly developed.

The vegetation of the drier sections around the southern end of the lake was composed of emergent Birch (eBir) and areas of *Calluna vulgaris* dHeath). Birch was more prominent to the west of the lake, while the northern end comprised Sitka Spruce, Heather and bare peat.

The OW habitat immediately to the north of the Native Woodland scheme appears to be subject to seasonal wetting and appeared shallow and mainly consisted of *Juncus bulbosus*-dominated vegetation (pJbulb).

Potential Rich Fen Wetland complex (OW, pClad, pEang, pJeff, eBir, oBir)

This relatively small area is located in the central part of the site adjacent to the south-side of a conifer plantation and the end of the Clongawny More mineral ridge. This area is classified as production-related cutaway but has been out of production for some time and the vegetation communities are well-established. Two access routes cross through the area. This area contains several wetland areas where there is open water and/or a quaking vegetation mat. There is a subtle transition westwards related to the underlying topography from drier communities (eBir and pJeff) to the wetter communities.

The main communities were an *Eriophorum angustifolium*-dominated community and a *C. rostrata*-dominated community with a small amount of emergent *Betula*-dominated scrub. Other species present include *Carex echinata*, *Carex demissa*, *Triglochin palustris*, *Mentha aquatica*, *Molinia caerulea*, *Juncus articulatus*, *Juncus effusus*, *Ranunculus flammula*, *Juncus bulbosus*, *Hydrocotyle vulgaris*, *Salix aurita*, *Osmunda regalis*, *Narthecium ossifragum* and *Myrica gale* (west side). The quaking areas contain *Potamogeton sp., Menyanthes trifoliata* and

Carex rostrata. Mosses include extensive cover of *Calliergonella cuspidata* and *Fissidens* sp.. *Drepanocladus* sp. was also present. The moss layer was extremely well developed on some sections and some hummocks of *Sphagnum* sp. moss were also associated with these wetlands.

The open water contains some stands of *Typha latifolia* (pTyph) as well as several small clumps of *Schoenoplectus lacustris*. *Chara* is prominent in shallow water. One clump of *Cladium mariscus* (a rich fen indicator) was noted in one of the open water areas.

Drier grassland around the fringes of these wetland areas is dominated by *Molinia caerulea* (gMol). An iron flush was noted adjacent to one of the wetland areas and *Schoenus nigricans* appeared in a small drier area adjacent to the open water at the west side of this section (adjacent to the Ash woodland).

04/06/2010

This site was also visited during June 2010 and a detailed species list was made. The water level was somewhat lower but there still was extensive standing water (20 cm high) over most of the wetland. Several areas were quaking and there was still some small pools. The vegetation was dominated by *Carex rostrata* with a ground layer of dense *Chara* sp. There were patches dominated by *C. nigra* through the wet area. Loose tussocks of *Carex diandra* were scattered through the wetland, becoming locally frequent. Some of the ground layer was dominated by a dense mat of *Calliergonella cuspidata*. *Betula pubescens*, *Salix cinerea* and *Salix aurita* appeared along the old drains and in drier areas towards the margins, although the majority of the wetland was quite open. The wetland area was surrounded by mainly open scrub.

There were some large hummocks of Bryophytes including *Hylocomium splendens* associated with the scrub. Species more typical of dry communities were found on these hummocks, such as *Molinia caerulea*. Other species recorded in this area included, *Hydrocotyle vulgaris*, *Eriophorum angustifolium*, *Ranunculus flammula*, *Osmunda regalis*, *Mentha aquatica*, *Equisetum fluviatile*, *Cardamine pratensis*, *Juncus articulatus, J. effusus*, *Typha latifolia*, *Menyanthes trifoliata* , *Cladium mariscus* , *Potamogeton* sp., *Hippuris vulgaris*, *C. diandra, C. panicea, C. dioica, C. elata, C. demissa, Pinus contorta*, *Salix repens*, *Potentilla erecta*, *Listera cordata*, *Calluna vulgaris*, *Drosera rotundifolia*, *Kindbergia praelonga*, *Dryopteris carthusiana*, *Succisa pratensis*, *Centaurea nigra Pedicularis sylvatica*, and *Dactylorhiza maculata*. In addition to the one large clump of *Cladium mariscus*, an additional small clump was noted at another location.

The above description indicates that this is a relatively species-rich area and is likely to develop into rich fen in the future (PF1). At present the bryophyte flora may be somewhat less diverse but the site is quite stable at present with 100% vegetation cover in the wetland areas. This area could also be classified as transition mire as it also contains several indicators of this habitat including the quaking sections and the wetland vegetation with frequent *C. diandra. The* domination by *Carex rostrata* probably indicates that the rich fen influence is not extensive at present and that the site is still in a pioneer phase. This is also confirmed by the sparse presence of brown mosses, which were only found in one location.

Marsh Fritillary was recorded within and around the margins of this area, mainly using drier open pioneer grassland dominated by *Molinia caerulea* and *Carex flacca* that was developing on a mound of glacial till along the northern boundary.

***Betula pubescens* scrub (eBir, oBir)**

This habitat is a common one, particularly in the north west of the site. *Betula pubescens* saplings and young trees are generally emerging from Poor fen vegetation dominated by *Juncus effusus*. However, *Betula pubescens* dominated scrub can develop from a range of different communities including dry grassland and disturbed vegetation, the Birch scrub appears to readily emerge from the drains. An area to the east of Madden's Derry is dominated by Open Birch as it runs along a ridge in an east west direction. The majority of eBir and oBir habitats on this site were dry and contained *Salix aurita*, *Tussilago farfara, Agrostis stolonifera, Gallium saxatile, Hieracium pilosella, Chamaerion angustifolium, Calluna vulgaris, Salix cinerea, Viola sp., Campylopus introflexus, Juncus effusus, Rubus fruticosus, Carex flacca, Eriophorum angustifolium, Osmunda regalis, Blechnum spicant* and *Polytrichum formosum.*

This habitat is also prominent along a ridge that is connected to Madden's Derries. This area contains a mosaic of open and emergent *Betula pubescens* scrub that is developing from dry heath dominated by *Calluna vulgaris*. Other species present include *Salix cinerea* and occasional *Sorbus aucuparia* and *Ulex europaeus*. The ground cover contains frequent *Juncus effusus*, *Pteridium aquilinum*, *Chamaerion angustifolium* and *Rubus fruticosus*. Other species present include *Galium saxifrage*, *Molinia caerulea*, *Cirsium* sp., *Hypericum pulchrum*, *Polytrichum*

sp. moss, *Polytrichum formosum*, *Eriophorum angustifolium*, *Dryopteris affinis, D. dilatata, D. felix-mas*, *Salix repens*, *Anthoxanthum odoratum*, *Carex binervis*, *Potentilla erecta*, *Leontodon autumnalis* and *Daucus carota*

Calluna vulgaris-dominated community (dHeath)

Areas of dHeath can be found dotted throughout the site mainly on higher areas of cutover bog (former high fields. *Calluna vulgaris* is the dominant species in this habitat with other minor components comprising of *Juncus effusus*, *Cirsium palustre, C. arvense*, *Agrostis stolonifera*, *Succisa pratensis, Phragmites australis, Chamaerion angustifolium, Polytrichum sp., Betula pubescens, Salix aurita, Ulex europaeus, Rubus fruticosus, Potentilla anglica, Salix repens, Hypochaeris sp.* and *Hypericum sp.*

This habitat is also found in the south-east section of the bog. It is primarily dominated by *Calluna vulgaris* and also contains substantial bare peat and *Campylopus introflexus* cover. Scrub with *Betula pubescens*, *Salix* sp. and *Pinus* sp. is colonising this habitat. Some acidic indicators were noted along the drains through this section such as *Narthecium ossifragum* and *Rhynchospora alba*. *Sphagnum* spp. mosses are appearing in the drains and some sections of drains are infilling where there is water retention (at the bottom of a small basin) with *S. cuspidatum* and *S. magellanicum* prominent. Some *S. capillifolium*. and S. *papillosum* is also appearing along the edges of the drains.

Dry grassland communities (gCal)

A small area of dry grassland habitat is found on the site but is widely distributed. This grassland is found a few locations such as close to the silt ponds, on the verges of some areas of conifer plantation and along the railway. Species composition of this habitat included *Centaurea nigra, Tussilago farfara, Equisetum sp., Agrostis stolonifera, Daucus carota, Centaurium sp, Rubus fruticosus, Hypochaeris radicata, Hydrocotyle vulgaris, Betula pubescens, Anthoxanthum odoratum, Potentilla anglica, Lotus corniculatus, Carex flacca, Dactylorhiza sp., Hypericum pulchrum, Plantago lanceolata, Cirsium arvense, Carex demissa, Mentha sp., Trifolium repens, Molinia caerulea* and *Rumex obtusifolius.*

This type of grassland was also found around one of the mineral islands that contained dense *Corylus avellana* scrub. Additional species present at this location included *Galium verum* and *Arrhenatherum elatius*.

Wet grassland communities (gMol)

A minor amount of wet grassland habitat is found on the site but is widely distributed. This community was also found around the small mineral mound in the centre of the site containing *Corylus avellana*-scrub and is association with railways and the drier sections of the wetland complexes. The vegetation was dominated by *Molinia caerulea* and also contained *Succisa pratensis*, *Carex demissa*, *Rubus fruticosus*, *Potentilla anglica*, *Agrostis stolonifera*, *Hypochaeris radicata*, *Cirsium* spp., *Poa* sp., *Anthoxanthum odoratum*, *Linum catharticum*, *Potentilla erecta*, *Plantago lanceolata*, *Calluna vulgaris* and *Viola* sp.

Dry Disturbed/Pioneer communities (DisCF, DisWill)

Dry disturbed vegetation (DisCF) is found frequently on the small mineral mounds of sub-soil made up of glacial deposits that are found around the production area. It is frequently associated with emergent scrub (eBir) and dry grassland (gCal), which also are found on these mounds. This vegetation is dominated by *Tussilago farfara* and also contains *Rubus fruticosus*, *Molinia caerulea*, *Potentilla anserina*, *Daucus carota*, *Taraxacum* sp., *Agrostis* sp., *Carex flacca*, *Bellis perennis*, *Briza media*, *Equisetum* sp., *Dactylorhiza* sp., *Cirsium arvense*, *Cirsium palustre*, *Salix aurita*, *Leucanthemum vulgare*, *Hypochoeris radicata* and *Centaurium erythraea.*

Production areas (BP)

The majority of this bog was in active production at the time of the survey. There are extensive fields of bare peat around the site that have been recently milled and are divided by drains devoid of vegetation.

Some vegetation is spreading into other fields where there has been less recent activity although vegetation re-colonisation is at various stages. The vegetation is most typically pJeff and it is spreading from the drains into the fields. The drains in these sections are generally completely vegetated and also contain some emergent *Betula pubescens*-dominated scrub (eBir).

There is some encroachment of vegetation from the sides of the drains including pJeff pEang, pTrig, and eBir.

Conifer Plantation (WD4)

Three main commercial forestry blocks are located on the site. These areas are managed by Coillte and are dominated by *Picea sitchensis.* These plantations have dual purposes with some sections intended for timber production and some sections intended for biodiversity. Some sections have achieved a yield class of 22 which is considered to be of medium quality (depending on planting year) from a timber production point of view but many other sections are of much poorer quality and some sections are failing completely. Low nutrient levels, high water levels, competition from other plants, namely *Calluna vulgaris* and exposure, appear to be taking their toll on these plantations.

A small flush with extensive *Sphagnum* sp. cover was noted close to the edge of the large conifer plantation in the south-east section (northern side, see map). This flush contained extensive cover of *S. capillifolium*, *S. magellanicum*, S. *papillosum* and *Aulacomnium palustre*. Forestry planted in this area had failed. Other species such as *Eriophorum vaginatum*, *Narthecium ossifragum* and *Rhynchospora alba* were present.

Riparian zone (Rip)

Two silt ponds are located on the site along with some drains along the boundary. Plant species in these areas includes *Agrostis stolonifera*, *Potamogeton sp*. and *Glyceria fluitians.* The silt ponds appeared to have been recently cleaned out and a drain to the north of the site was in the process of being cleaned during the site visit.

Recently-planted woodland (WS2)

An area to the north of the most westerly woodland (Madden's Derries) has been planted with Oak as part of the Native Woodland Scheme. This area was planted in 2008 and is clearly visible with the high deer fencing bounding it. This area consists of *Quercus robur*, *Betula pubescens, Calluna vulgaris, Eriophorum sp.* and *Juncus effusus.* The fungus *Armillaria tabescens* was also noted within this area.

Oak-Ash-Hazel Woodland (WN2)

This habitat is found in four separate locations on the site and a boundary wall is still visible in some of the woodlands, indicating they were managed in the past, possibly grazed. These woodlands are dominated by Oak trees that are estimated to be 180+ years old and are quite large (dbh 1.5 m). Many of the trees appear to have been coppiced in the past and as a result are multi-stemmed. Some of these woodlands are bordered with or contained within conifer plantations.

Over-grazing (presumably by deer) is a problem with the result that there is poor diversity in the woods with a poor shrub layer and the woodland is quite open. However, some sections did have numerous *Fraxinus excelsior* (Ash seedlings) so grazing intensity may vary across the site and the poor woodland development may in part be due to the heavy canopy. Species found within the canopy and understorey included *Quercus robur*, *Corylus avellana*, *Sorbus aucuparia*, *Ilex aquifolium*, *Betula pubescens*, *Prunus spinosa*, *Euonymus europaea*, *Hedera helix*, *Sambucus nigra*, *Alnus glutinosa*, *Malus sylvestris*, *Crataegus monogyna* and *Fagus sylvatica*. Several mature *Taxus baccata* were noted in one of the woodlands. Some sections of the canopy were much younger and dominated by *Betula pubescens, Salix cinerea* and/or *Corylus avellana*. The ground cover was generally dominated by *Hedera helix* in the heavily shaded areas, with *Rubus fruticosus* appearing in the more lightly shaded sections. Other species present included *Dryopteris dilatata*, *Dryopteris felix-mas, Arum maculatum, Rubus fruticosus*, *Urtica dioica, Pteridium aquilinum, Lonicera periclymenum, Viola* sp. *Oxalis acetosella* and *Sanicula europaea*. The ground cover of these woodlands was low in diversity but survey during early summer would probably increase the number of species recorded. The ground cover also had extensive moss cover in places as well as one exposed limestone rocks. This was dominated by *Thamnobryum alopecurum*, with *Mnium hornum*, *Hypnum sp.*, *Eurhynchium striatum* and *Thuidium tamariscinum* all present.

One of the woodlands has a canopy dominated by *Fraxinus excelsior* and contained *Sambucus nigra* and *Corylus avellana* with a dense *Rubus fruticosus* and *Pteridium aquilinum* understorey.

The woodland at Maddens Derries is poor in structure, with large gaps in the canopy and dense scrub and thickets of *Rubus fruticosus* and *Pteridium aquilinum* surrounding the mature trees.

Hazel scrub (WS1)

One of the small mineral mounds has developed a small area of *Corylus avellana*-dominated scrub. This scrub is quite dense and impenetrable. It is surrounded by a band of dense *Prunus spinosa* and then by a zone of dense *Pteridium aquilinum* and *Rubus fruticosus*. This is a typical example of a succession habitat that will eventually develop Ash woodland (WN2). Several *Fraxinus excelsior* and *Betula pubescens* trees are emerging from the *Corylus avellana* canopy.

Birch woodland (WN7)

There is a minor amount of this habitat one the site and it can be found around the edges of the wooded mineral islands. The canopy is generally dominated by *Betula pubescens*. Other species present include *Sorbus aucuparia*. The ground cover and shrub layers are poorly developed and are dominated by *Rubus fruticosus* thickets. Other species present include *Molinia caerulea*, *Juncus effusus*, *Carex* sp., *Dryopteris dilatata*, *Hedera helix* and *Sambucus nigra*.

Other Habitats (around the fringe of the bog)

Raised Bog (PB1)

Several small remnant patches of this habitat are found around the fringes of the site. The majority of this remnant high bog was drained in the past for industrial peat production, but peat was never harvested. These drains are now filling in. Steep face-banks separate this habitat from the industrial harvested areas of the BnM areas while domestic turf cutting has been taking place on the outer boundaries, some of which would appear to have encroached onto the BnM property. Species present include *Calluna vulgaris*, *Erica tetralix*, *Eriophorum vaginatum*, *E. angustifolium*, *Trichophorum cespitosum*, *Narthecium ossifragum*, *Rhynchospora alba*, *Cladonia portentosa*, *Carex panicea*, *Molinia caerulea*, *Andromeda polifolia*, *Sphagnum capillifolium, S. papillosum* and *S. magellanicum. Sphagnum cuspidatum* was noted in the drains. *Myrica gale* was noted on the high bog at several locations.

Betula pubescens and *Ulex europaeus* are spreading onto these fragments in places and there are patches of scrub (WS1) and Birch woodland (WN7) that have developed on the high bog in places.

The majority of the raised bog would be classified as marginal or face-bank ecotopes and is dominated by *Calluna vulgaris*. A small amount being in better condition could be considered to be sub-marginal with greater *Eriophorum vaginatum* and *Narthecium ossifragum* cover. This habitat as a whole was dry and degraded with evidence that it may once have been burned. No intact pools were present and there were only a few small wet hollows containing *S. cuspidatum*. There are poor restoration prospects for any of these fragments of raised bog but they are good for biodiversity on a local level.

Scrub (WS1)

This habitat appears along the fringes of the production area, mainly along the boundaries. Several different communities are present.

Species present include *Salix cinerea*, *Salix aurita*, *Alnus glutinosa*, *Rubus fruticosus*, *Pteridium aquilinum*, *Crataegus monogyna* and *Betula pubescens*. This habitat forms a mosaic with Dense Bracken (HD1) along parts of the northern boundary.

Cutover Bog (PB4)

This habitat is found around the margins of the site at several locations. Patches of cutover bog within the Bord na Móna site boundary, but managed by private individuals, are begin cut privately for peat and are typical of Turbary with several different individual plots being found in the same unit. Various stages of development are present, from active peat cutting where there is very little vegetation development (dominated by bare peat) and freshly cut turf is being dried, to abandoned sections that are developing *Calluna vulgaris*-dominated vegetation (dHeath), *Juncus effusus*-dominated vegetation (pJeff), dense *Pteridium aquilinum* (dPter) or *Betula pubescens*-dominated scrub (eBir).

Some units of cutover bog have a mosaic of these communities that are related to the time since the different plots were last cut for peat. And the cutover bog forms a mosaic with other habitats in places such as scrub (WS1) and Birch woodland (WN7), particularly on the west side of the Clongawny More mineral ridge (southwest section).

Appendix II. Codes used for habitat classification.

Bord na Moṅa habitat classification scheme

	General	Habitat [1]	BnM habitat code	Equivalent Heritage Council codes [2]
Pioneer habitats of industrial cutaway	Peatland	Bare peat (0-50% cover)	BP	ED2
		Embryonic bog community (containing *Sphagnum* and Bog Cotton)	PBa	PB
		Embryonic bog community (Calluno-Sphagnion)	PBb	PB
	Flush and Fen	Pioneer *Campylopus*-dominated community	pCamp	PF2
		Pioneer *Juncus effusus*-dominated community (Soft Rush)	pJeff	PF2
		Pioneer *Eriophorum angustifolium*-dominated community (Bog Cotton)	pEang	PF2
		Pioneer *Juncus bulbosus*-dominated community (Bulbous Rush)	pJbulb	PF2
		Pioneer *Triglochin palustris*-dominated community (Marsh Arrowgrass)	pTrig	PF2
		Pioneer Caricion davallianae-Community with *Cladium* (rich fen)	pCladium	PF1
	Emergent communities	Pioneer *Carex rostrata*-dominated community (Bottle Sedge)	pRos	FS1
		Pioneer *Phragmites australis*-dominated community (Common Reed)	pPhrag	FS1
		Pioneer *Typha latifolia*-dominated community (Reedmace)	pTyp	FS1
		Pioneer *Schoenoplectus lacustris*-dominated community (Bulrush)	pSch	FS1
	Open water	Charaphyte-dominated community	pChar	FL2
		Permanent pools and lakes	OW	FL2
		Temporary open water	tOW	
	Woodland and scrub	Emergent *Betula*/*Salix*-dominated community (A) (Birch/Willow)	eBir	WS1
		Open *Betula*/*Salix*-dominated community (B) (Birch/Willow)	oBir	WS1
		Closed *Betula*/*Salix* scrub community (C) (Birch/Willow)	cBir	WS1
		Ulex europaeus-dominated community (Gorse)	eGor	WS1
		Betula/*Salix*-dominated woodland (Birch/Willow)	BirWD	WN7
	Heathland	Pioneer dry *Calluna vulgaris*-dominated community (Heather)	dHeath	HH1
		Dense *Pteridium aquilinum* (Bracken)	dPter	HD1
	Grassland	Pioneer dry calcareous and neutral grasssland (Centaureo-Cynosuretum)	gCal	GS1
		Dactylis-Anthoxanthum-dominated community (Cocksfoot-Sweet Vernalgrass)	gCo-An	GS2
		Anthoxanthum-Holcus-Equisetum community (Sweet Vernalgrass-Yorkshire Fog-Horsetail)	gAn-H-Eq	GS
		Molinia caerulea-dominated community (dry) (Purple Moorgrass)	gMol	GS4
		Marsh (Meadowsweet and other tall herbs) (Filipendulion ulmariae)	Mar	GM1
	Disturbed	*Tussilago farfara*-dominated community (vegetation > 50%) (Colt's Foot)	DisCF	ED3
		Epilobium-dominated community (vegetation > 50%) (Willowherb spp.)	DisWil	ED3
	General	Riparian areas (streams or drain with associated edge habitats (e.g. FW2/4 + WS1, GS2 etc)	Rip	FW2 +
		Silt Ponds (artificial ponds with associated bank habitats (e.g. FL8 + WS1, GS2, ED2, ED3)	Silt	FL8 +
		Access (tracks or railways with associated edge habitats (e.g. BL3 + gCal, gMol, eGor etc)	Acc	BL3 +
		Works areas (predominately built land but can include landscaped and brownfield habitats (e.g. GA2, WS3, WD4, ED2, ED3)	Works	BL3 +

[1] These are generally pioneer habitats of bare peat and the communities can contain a significant proportion of bare peat. Some habitats are more developed than others. They frequently occur in mosaic with each other.
[2] Not all these communities are equivalent to habitat classes used by The Heritage Council habitat classification scheme (Fossitt 2000) as some are quite rudimentary and undeveloped.

Heritage Council habitat classification scheme (Fossitt 2000)

	General	Habitat	Heritage Council code
Semi-natural and modified habitats	Peatlands	Raised Bog	PB1
		Lowland Blanket bog	PB3
		Cutover Bog	PB4
		Rich fen and flush	PF1
		Poor fen and flush	PF2
		Transition mire and quaking bog	PF3
	Woodland and scrub	Oak-Birch-Holly woodland	WN1
		Oak-Ash-Hazel woodland	WN2
		Wet Pendunulate Oak-Ash woodland	WN4
		Riparian Woodland	WN5
		Wet Willow-Alder-Ash woodland	WN6
		Bog woodland	WN7
		Mixed broad-leaved woodland	WD1
		Mixed broad-leaved/conifer woodland	WD2
		Conifer plantation	WD4
		Scrub (Gorse)	WS1
		Emergent Betula-dominated community	WS1
		Closed Betula scrub community	WS1
		Recently-planted woodland	WS2
		Ornamental scrub	WS3
		Short-rotation coppice	WS4
		Recently-felled woodland	WS5
	Linear woodland	Hedgerow	WL1
		Treeline	WL2
	Grasslands and Marsh	Improved grassland	GA1
		Amenity grassland	GA2
		Dry calcareous and neutral grsld	GS1
		Dry meadows and grassy verges	GS2
		Dry-humid acid grassland	GS3
		Wet grassland	GS4
		Freshwater Marsh	GM1
	Heath and Bracken	Dry Heath	HH1
		Dry calcareous Heath	HH2
		Wet Heath	HH3
		Dense Bracken	HD1
	Disturbed ground	Exposed sand,gravel or till	ED1
		Spoil and bare ground	ED2
		Recolonising bare ground	ED3
		Active quarry	ED4
	Freshwater	Acid Oligotrophic lakes	FL2
		Mesotrophic lakes	FW4
		Artificial ponds (slit ponds)	FL8
		Depositing rivers	FW2
		Canals	FW3
		Drains	FW4
	Cultivated and Built land	Stonewalls and other stonework	BL1
		Earth Banks	BL2
		Buildings and artificial surfaces	BL3
		Arable crops	BC1
		Horticulture	BC2
		Tilled land	BC3

Draft Rehabilitation Plan

2020

Drinagh Bog

This rehabilitation plan is developed under Condition 10 of IPC Licence Ref. 500 (April 2017). It outlines measures that will provide for stabilisation of the bog area upon cessation of peat production and decommissioning of the site. ***Rehabilitation*** *generally comprises natural colonisation with or without targeted management.*

Bord na Móna propose to develop a wind farm (Derrinlough Wind Farm) on part of Drinagh Bog. The proposed wind farm also includes parts of the adjacent Clongawny Bog. This proposed development has now been integrated with this rehabilitation plan. The rehabilitation plan outlines how the site will be rehabilitated along with the construction and operation of the proposed Wind Farm.

The general after-use strategy of Bord na Móna is outlined in the Bord na Móna Strategic Framework for Future-Use of Cutaway Bogs 2011. Any consideration of future after-uses for Drinagh Bog such as amenity, developments or mixed uses will be conducted following the relevant planning guidelines and consultation with relevant authorities and will be considered within the framework of this rehabilitation plan.

Rehabilitation of industrial peatlands is a key objective of the Bord na Móna Biodiversity Action Plan 2016-2021. This action plan outlines the main objectives and actions around biodiversity on Bord na Móna lands.

Draft Rehabilitation Plan			
Bog Name:	**Drinagh**	**Area (ha):**	1389 ha
Works Name:	Boora	**County:**	Offaly
Author(s):	BnM Ecology Team	**Survey/ Monitoring Date(s):**	22-24/09/2009 *A range of additional ecological surveys were carried out 2018-2019 to inform the EIAR for the proposed Derrinlough Wind Farm. These surveys have also informed this rehabilitation plan.* *Other, principally ornithological, surveys were undertaken at part of Drinagh Bog in the period 2010 to 2015.*
Maps:	Habitats Map, Potential Future Habitats Map, Landuse Map		

Review status: Updated January 2020

Background

Bord na Móna operates under IPC Licence issued and administered by the EPA to extract peat within the Boora bog group (Ref. 500 SB). As part of Condition 10.2 of this license, a rehabilitation plan must be prepared for permanent rehabilitation of the boglands within the licensed area. Drinagh bog is part of the Boora bog group.

This plan is a specific rehabilitation plan for Drinagh bog and outlines:

- criteria which define the successful rehabilitation,
- consultation to date with interested parties,
- main issues for rehabilitation,
- proposed rehabilitation programme,
- proposed timeframe to implement this programme, and,
- associated aftercare, maintenance and monitoring.

Bord na Móna have proposed to develop a Wind Farm (Derrinlough Wind Farm) on part of Drinagh Bog. The proposed wind farm also includes part of the adjacent Clongawny Bog. Further details and the EIAR of this proposed development can be obtained at www.derrinloughwindfarmplanning.ie. This proposed development has now been integrated with the rehabilitation plan. The rehabilitation plan outlines how the site will be rehabilitated along with the construction and operation of the proposed Wind Farm.

The basis for the proposed approaches and implementation is the experience gained in 40 years of research on the after-use development and rehabilitation of the Bord na Móna cutaway bogs and decades of proven practice implementing cutaway peatland rehabilitation across the company's landholding.

Scope

The scope of the rehabilitation plan seeks to address issues of concern as identified by Bord na Móna and the consultees. The key issues identified are:

- Categorisation of the habitats developing on Drinagh Bog (outlined in Appendix I)
- Environmental stabilisation of the former peat production areas
- Maintenance of drainage and silt control through the site
- Remediation of water courses (internal) where necessary *(decommissioning)*
- The timeframe for bog rehabilitation/restoration
- The impact of the proposed Derrinlough Wind Farm development on the site and rehabilitation plan
- The Boora Bog Group comprises former raised bogs where most of the peat has been excavated to the deeper fen peat layers. Several portions of bogs have had a shorter industrial production history and remain in the deeper acidic peat layers.

- In general, there is no potential for extensive raised bog restoration in the short-term in areas where there has been extensive peat extraction or removal. This is because the majority of the peat mass has been removed, significantly changing key environmental factors such as hydrology and water chemistry acidity. Even if suitable, wet hydrological conditions can be re-established, milled peat cutaway tends to have a more alkaline water chemistry, due to the remnant fen peat layers being exposed and the influence of the underlying glacial geology (dominated by Limestone). Typical raised bog *Sphagnum* mosses and other bog species do not thrive with this alkaline water chemistry.
- Rehabilitation of the former industrial peat production sites will lead to the development of a mosaic of cutaway habitats (in association with other land-uses), largely comprising mosaics of wetland, heath, grassland, scrub and Birch woodland. In some cases there may be potential to develop embryonic peat-forming communities where deeper residual peat, or acidic peat is present.

List of consultees to date

- Open consultation with range of stakeholders at annual Biodiversity Action Plan review days 2010-2018.
- Regular consultation with BirdWatch Ireland regarding winter waterbird surveys at Drinagh and the breeding wader wetland trial carried out at Drinagh.
- Walk in 03/2016 as part of the 2nd Bord na Mona Biodiversity Action Plan launch.
- This rehabilitation plan remains a draft plan until formal consultation is carried out with relevant stakeholders.

Site description

Drinagh Bog is located to the east of Derrinlough Briquette Factory near Cloghan in West Offaly. It is largely divided into 4 main sections by the topography of the site and a railway on an embankment that crosses from the west to the east side of the site. The western section is separated from the eastern section by a ridge of high ground that partially divides the site (Mannin's Hill) and then by a block of conifer plantation that has been planted on the cutaway bog on this higher ground. This plantation is managed by Coillte (and is known as Drinagh West forest).

North-east section (zoned for biodiversity)

This area is dominated by the large biodiversity area north of the railway that contains a substantial portion of open water. The open water is divided into two main sections by a railway on an embankment. This area is developing into a wetland complex and there is a diverse mosaic of wetland habitats (several Poor fen vegetation communities) developing around the margins of the lakes, particularly along the eastern side. The lakes are shallow and there are frequent patches of emergent Common Reed and Bulrush developing in some sections as well as along the margins with Common Reed. The lakes also contain frequent indicators of the old peat production in this area with long linear islands or ridges of remnant peat vegetated with various communities. Some of the drier sections are developing Birch scrub (emergent, open and closed types). The remainder of the biodiversity area contains emerging Birch scrub and Poor fen vegetation of which Bog Cotton-dominated and Soft Rush dominated communities are the most prominent vegetation types. The wetland complex is enclosed along its northern boundary by a ridge that was developed along a natural stream (now significantly modified with sections piped along its length.

The area north of this ridge is classified as production related cutaway. This area is now quite vegetated with various stages of vegetation colonisation. The production-related area has primarily developed emergent and open Birch scrub with a Soft Rush dominated ground cover. Area of where peat production only recently ceased are much more open and contains more frequent bare peat and much less scrub. There is a small area of cutover bog (inside the BnM boundary) in the north-east corner that is being cut by private individuals and is managed as private land.

South-east section

The south-east section is a core trial area to manage cutaway bog specifically for breeding waders (described in appended report Appendix II). It essentially comprises a mosaic of emerging and open Birch scrub and a Soft Rush-dominated pioneer community. Rehabilitation works commenced in 2010 to clear scrub and create more open water to enhance the site for wader chicks. There is also some bare peat in this area. There is a small area of Birch woodland developed along the west boundary of this area as well as a small area of remnant raised bog (PB1). This patch of high bog has a surprisingly good cover of *Sphagnum* moss in places.

North-west section

This section is mainly classified as a production-related cutaway with a small area of bog that has only recently come out of production (so is therefore devoid of vegetation) located at the northern end. The conifer plantation is located along the east side of this area. The main habitats in the production-related section are emerging birch scrub and a Soft-Rush dominated pioneer Poor Fen community. Other associated habitats include a Bog Cotton-dominated pioneer poor fen community and a minor amount of Common reed stands. Reedmace is also present but is relatively uncommon and confined to drains. There is a very minor area of shallow open water present. This area also contains a series of mineral ridges and mounds where glacial sub-soil is exposed in places. These mounds are quite dry and developing some other habitats such as emerging Birch scrub (eBir), disturbed vegetation dominated by Coltsfoot (DisCF) and some calcareous grassland (gCal), as well as bare sub-soil.

South-west section

Much of this section of the site south of the railway is an area with bare peat that is devoid of vegetation due to recent cessation of peat production activities. Smaller sections classified as production-related are recolonising with mainly emerging and open Birch scrub and Soft Rush-dominated Poor fen vegetation. There are smaller amounts of Bog Cotton-dominated Poor fen vegetation also present associated with the other vegetation communities. Small mineral mounds and ridges are also scattered through this area. These areas are also developing birch scrub and usually have some dry calcareous grassland and disturbed vegetation associated with them. Several mounds also have a small amount of dry heath dominated by Ling Heather (dHeath) developing on them. A small area of Dry Heath is also developing on somewhat higher ground near the eastern boundary of this section. There is also a remnant patch of raised bog (PB1) located along the west boundary (inside the BnM boundary) that is being actively cut from the outside by private individuals. This area is managed as private land. Of note is a drain along this high bog but at the level of the cutaway that is infilled with *Sphagnum* moss.

See Appendix I for more detail on site, habitats and local features.

Peat production programme, land-use and proposed developments

- **Cessation of peat production.** Milled peat production has currently ceased at Drinagh
- **Bord na Móna railway.** An active rail line is still operational between Drinagh and other sites in the Boora Group. Decommissioning of this infrastructure is dependent on the general cessation of industrial peat production for supply of peat to various customers including West Offaly Power and Derrinlough Briquette Factory.
- **Coillte Forestry.** Several conifer plantations were established on this site in the 1980's by Coillte, with the site being leased by Coillte. Stands of mainly Lodgepole Pine and Sitka Spruce were planted on the site.
- **Derrinlough Wind Farm**: A planning application has been submitted for the development of a wind farm (Derrinlough Wind Farm), consisting of 21 wind turbines, a 110kv substation, two met masts and all associated infrastructure. Details of this planning application is available at www.derrinloughwindfarmplanning.ie. Within Drinagh, a total of 10 turbines are proposed as part of the Derrinlough Wind Farm along with a sub-station, temporary construction compounds, a met mast, internal site roads for access and amenity pathways, and ancillary works.
- The remaining cutaway and future cutaway of the site will be left relatively undisturbed by this proposed development. This draft rehabilitation plan will be applicable to those areas and has also been considered in the context of the design, layout and construction of the proposed wind farm infrastructure.

  An amenity plan was also provided as part of the proposed Derrinlough Wind Farm planning application. This will consist of pathways (walking/cycling) through the site.

Current environmental conditions

The different cutaway habitats developing across the site reflects the underlying and varying environmental conditions. Environmental factors such as hydrology, residual peat depths and topography all have a significant influence on the future development of cutaway habitats and proposed rehabilitation. Hydrology tends to have the most significant influence on the development of future cutaway habitats. All sites have hydrological gradients from wet to dry habitats. Shallow residual peat usually means there are stronger fen influences on the pioneer cutaway development as fen peat is the residual peat type and ground-water has a stronger influence. At some sites deeper residual peat has the potential to develop embryonic *Sphagnum*-rich peat-forming communities. Exposed sub-soils may also influence future habitat development and rehabilitation. Exposed lacustrine deposits (shell-marl) tend to exert a strong alkaline influence on the development of various wetland and wet peatland cutaway habitats. It will not be possible to apply any one particular rehabilitation approach to the entire area, as there is such a broad range of environmental conditions on site.

- **Hydrology**: The eastern side of Drinagh is gravity-drained, with existing drains carrying water east towards the Silver River. The western side of Drinagh has two pumps present, with water largely flowing in a westerly directions. In the very south of west Drinagh, a small part of the site drains (using gravity) south towards the Lough Coura complex. Numerous silt ponds exist where water flows out of the bog, and it anticipated that these will be maintained until the site has stabilised (i.e., there are no longer detectable emissions sourced from Drinagh and heading into the relevant catchments. The two water pumps in west Drinagh were used to keep part of the site relatively dry to allow industrial peat production. Pumping will continue during the decommissioning and rehabilitation period, and during the construction and operation of the Wind Farm. It is expected that pumping will reduce and be rationalised during this period. The objective of hydrological management during the Wind Farm operation will be to manage water levels across the site to keep the cutaway wet (soggy conditions) and protect Wind Farm infrastructure, so that excessive surface water across the site is reduced. A flood risk assessment of the site was prepared and submitted (Appendix 9.1 of the EIAR) to accompany the Derrinlough Wind Farm planning application. A further flood risk assessment will also be prepared to determine any hydrological impacts on the site and adjoining lands from hydrological management and changes to pumping on site.
- **Topography**: Drinagh Bog has a heterogeneous topography with a mosaic of ridges, mounds and sub-basins. This topography affects drainage of the sites and basins trapped between ridges/mounds can hold water.
- **Residual peat types and depths**: Much of east Drinagh Bog is now cutaway and the majority of the original raised bog has now been removed. In some places there are exposed sub-soils. In general there is between 0.5-1.5 of residual fen or minerotrophic peat. This will have a significant influence on the development of future pioneer habitats. In east Drinagh there are also some areas with deeper peat where peat production only recently stopped. This may have the potential to develop embryonic *Sphagnum*-rich peat-forming communities when re-wetted.
- **Sub-soils**: Ongoing industrial peat extraction has exposed glacial deposits in the form of ridges and mounds that previously lay under the peat, across the site. These glacial deposits are made up of limestone-derived mixed till and gravels. These exposed sub-soils have the capacity to significantly influence habitats developing on them due to their higher alkalinity or calcareous influence. Already pioneer calcareous grassland is already developing and other more mature sections have developed woodland with Ash and Hazel (WN2).

Other considerations

- **Amenity development**: There is some local community interest in developing recreational use in the area, notably linking up trails with the existing Lough Boora Discovery Park. The wetlands on the site have become of interest to birdwatchers, with several locally scarce species recorded.

Key biodiversity features of interest

- The wetlands in the west side of Drinagh have provided substantial interest for both breeding and wintering wetland and waterbirds, and over 100 different bird species have been recorded on the site.
- Breeding waders, which were the focus of a habitat rehabilitation project in 2010 and 2011, peaked in 2012 with 12 pairs of Lapwing, five pairs of Redshank, two pairs of Ringed Plover and one pair of Common Sandpiper, with Snipe also numerous (16 audible birds in 2012). Numbers of breeding waders have since dropped at Drinagh as the open nature of the cutaway habitats have closed over with natural habitat succession, although the wetlands remain an important nesting habitat for wetland birds, including Shoveler, Teal and Water Rail.
- Small patches of remnant high bog are found at several locations around the site. The largest area is in the south-east section (about ~ 5 ha) and is positioned along the western boundary. This bog is in quite good condition and there is a surprisingly high cover of *Sphagnum* moss including *S. capillifolium*, S. *papillosum*, *S. subnitens*, *S. magellanicum* and some and hummocks of *S. imbricatum*. The majority of the bog could be classified as sub-marginal with small patches in the northern section considered as sub-central quality. The cover of *Sphagnum* decreases towards the southern boundary.
- The site is used occasionally by Whooper Swan, Hen Harrier, Merlin and Peregrine in the winter (refer to Chapter 7: Ornithology of the EIAR for Derrinlough Wind Farm)).

Current ecological rating (A-E; *following from NRA Guidelines*)

The majority of the site can be rated as having a **high ecological value (C) (County level).** Bare peat and other intensively managed areas are assessed as having a low local ecological value (although some bare peat areas attract breeding waders).

Overall, the site would be considered to be of County Significance.

Criteria defining successful rehabilitation

- The main criteria are stabilisation of the former industrial peat production area and mitigation of potential silt run-off.
- Bord na Móna are proposing to construct a wind farm on site. This has the potential to have a significant impact on the overall cutaway environment. The construction and operation of this wind farm will be integrated into this rehabilitation plan. It is planned to reduce and minimise the impacts of the wind farm infrastructure on the surrounding cutaway. Drainage and pumping can be managed in such a way as to minimise the hydrological zone of influence of this activity. Cutaway rewetting will be carried out and the site managed in such a way that it maximises the target hydrological conditions (water levels at the peat surface - soggy ground conditions) that are the most appropriate to provide the optimum conditions for the restoration of carbon sink function.

Industrial peat extraction continued at Drinagh until 2019. Industrial peat extraction has now ceased. Natural colonisation will form the basis for the environmental stabilisation of the bare peat areas in association with targeted rehabilitation and re-wetting. A significant part of the site has already developed as cutaway and some has quite well-established secondary cutaway peatland habitats already. Comparison of aerial photos taken in 2000 to more recent aerial photo series shows that there have been significant changes in the central cutaway area in the past 20 years, as much of this part of the bog was in full industrial milled peat production in 2000. Some areas still in peat production recently are dominated by bare peat. The bare peat cutaway has varying environmental characteristics including a variable topography.

Re-wetting of the cutaway, where possible, is a general rehabilitation strategy. The main target will be to maintain water-levels close to the peat surface, and to avoid the creation of large-water bodies. Re-wetting and water levels close to the peat surface accelerates the re-vegetation processes, the development of vegetation cover and therefore environmental stabilisation.

There is potential for the creation of wet cutaway habitats at Drinagh Bog but, due to the local topography and largely gravity-drainage system, drain blocks and the introduction of landscape elements (such as berms or bunds) is likely to be required to maximise rehabilitation potential. The main objective of peatland rehabilitation will also

be maximise the creation and development of wet soggy conditions (emergent vegetation, water levels at or 0-10 cm above the peat surface. This will require significant water level management across the site.

Development of soggy wetland conditions with water levels at or slightly above the peat surface is likely to lead to the development of poor fen dominated vegetation communities. This also has benefits for carbon fluxes as re-wetting the cutaway helps store residual peat and carbon in place. It also sets the cutaway on a trajectory to eventually become a carbon sink again in the future. Wet cutaway habitats have the potential, in time, to become peat-forming and eventually become carbon sinks again, depending on the balance between local topography, habitat development, vegetation growth, water levels and release of carbon from the remnant peat. More research is required to understand greenhouse gas fluxes and the various path-ways and timeframes for these cutaway areas to become peat-forming carbon sinks.

Sphagnum-rich peat-forming or embryonic raised bog vegetation is generally not expected to develop as a widespread or significant feature of the site in the short-term, as the majority of the site is cutaway (the majority of peat is removed) and has exposed fen peat and underlying calcareous geology and sub-soils. This has changed the environmental conditions of the site significantly. Most raised bog *Sphagnum* spp. (peat-forming vegetation indicator) do not grow where there is such an alkaline influence on the physio-chemical environment. Water-levels would also inhibit the development of this vegetation type in areas that are either too dry (and will develop bog woodland), or areas where there will be deeper permanent water more suitable to development of wetland habitats. However, while *Sphagnum* spp. do not form a significant part of these various communities, other poor fen and wetland bryophytes do thrive in this environment. Cutaway areas can develop an extensive bryophyte layer that, while is not dominated by *Sphagnum* species, will eventually lead to the formation of peat-forming conditions as these pioneer communities mature and ecological succession occurs.

Sphagnum-rich peat-forming or embryonic raised bog vegetation is expected to develop in localised pockets with suitable environmental conditions in the SE of the site. Residual peat depths here are relatively deep and *Sphagnum* mosses are already present where the cutaway is wet.

Drain blocking can be widespread in scale with each field drain being blocked (e.g. Carrickhill in the Littleton Works) or more localised with targeted drain-blocking (e.g. Mountlucas Wind Farm) and both can be very effective. This can be used in conjunction with local topographical features like natural hollows to manage water levels or with other typical features of cutaway peatlands like high peat fields, which act as berms to hold water to some extent. Active management to create low berms to manage water-levels and create shallow wetland habitats dominated by emergent vegetation has also been successfully developed (e.g. Mountlucas Wind Farm, Bruckana Wind Farm, Oweninny, Lough Boora Discovery Park, Ballycon). In conjunction with the wind farm development and associated roads and embankments there will be further opportunities to manage water-levels using the new construction as a partial embankment, where possible. Material (peat and sub-soil) side-casted from the road construction can be used to develop low berms that would then prevent the adjacent cutaway from draining directly into the drains along the roads. This technique has been used at Mountlucas and Bruckana Wind Farm. Overflow pipes will be used to maintain maximum water levels across the cutaway and allow excess surface water to flow into the drainage channels beside the roads and other infrastructure. Managing the cutaway in this way means that the cutaway can stay wet, while excess surface water can drain away through the drainage infrastructure.

It is expected that pumping will be maintained during the decommissioning and rehabilitation phases and during the construction and operation of the Wind Farm. It is expected that pumping will be reduced during the operation of the wind farm. Previously, bogs were pumped to allow industrial peat extraction during the summer, dropping the water levels below the peat surface, and to protect peat stocks during the winter. Now, pumping does not have to drop levels below the peat surface of the cutaway. The field drains will be blocked and water levels will be maintained at or slightly above the peat surface. Pumping during the operation of the wind farm will focus on removing excess surface water that will largely be rain-water. It is not intended to pump any ground-water during the operation of the wind farm. Therefore pumping across the site will help maintain appropriate water levels (soggy conditions) on some cutaway areas outside the wind farm infrastructure and buffer areas (see rehabilitation map). The adjoining cutaway bog around the wind farm infrastructure will be used as temporary storage of water during high levels of rainfall. This will attenuate water flows from the site during winter flood events.

Drinagh Bog has a heterogeneous topography. It is inevitable that some areas will be higher and will always have drier conditions. It is not anticipated to re-wet these areas significantly, but where drains can be blocked they will be blocked. It is expected that these areas will develop as dry bog woodland. These areas include relatively steeply sloped areas along the sides of the gravel hills and ridges, on the mounds of these areas and in areas where the glacial sub-soils have been exposed. Coillte have leased sections of the site and these areas have been planted with conifers.

A large area of the site has already been developed for forestry by Coillte. Management within these areas can be considered as ongoing maintenance with routine operations related to timber production and/or development of the conifer plantations as biodiversity areas. Issues of peat stabilisation and potential silt run-off will have to be addressed during forestry operations on the site by Coillte.

It is also inevitable that some areas that are basins will develop deeper water levels and develop wetlands with a mosaic of emergent vegetation (poor fen), Reed-beds and wet woodland. Wetlands like these are already developing on the site and will enhance biodiversity and also enhance mitigation of silt run-off by acting as natural silt traps. Small wetland features will be retained on site as part of the heterogeneous landscape of different habitats. It is not the objective of this rehabilitation plan to create large wetland features dominated by deeper open water that may potentially attract relatively large flocks of wintering waterbirds into the wind farm. Water-levels and re-wetting will be managed to maximise the target conditions of water-levels at or slightly above the bog surface (soggy conditions).

Drain blocking and berm creation has proven to be a very effective tool in re-wetting remnant peat, as well as being generally positive for Greenhouse Gas fluxes from the cutaway (in the long term).No drain-blocking will be carried out drains around the margin of the site. Rehabilitation will be carried out in a manner that does not impact on neighbouring land. It is expected that water will still flow out of the site at the various emission points, through existing silt ponds, which will be maintained until it is deemed that rehabilitation and site stabilisation has been successful.

The EIAR for the proposed Derrinlough Wind Farm development details issues related to peat management during construction. In summary, during construction for access tracks, hardstands and other areas, peat is excavated from the cutaway, moved to the side, graded into berms not more than 1m and allowed to naturally re-vegetate This has proven successful during construction of Mountlucas Wind Farm. In the event that natural re-vegetation was unsuccessful, then other measures such as re-seeding would be considered. It is not planned at this stage to move significant volumes of peat from one part of the site to another section. As Drinagh Bog is cutaway with relatively shallow remnant peat, peat depths with mostly vary between 0-1 m, so the volume of peat to be moved is relatively small compared to an intact peatland.

- Mitigation of silt run-off and remediation of watercourses

Once rehabilitation is completed and the proposed wind farm is constructed, there will be a significant reduction in the potential for silt run-off from the site. Natural colonisation will stabilise the surface peat and proposed rehabilitation measures will also slow the movement of water through the site and enhance settlement of any suspended materials through vegetated areas. This has been a proven technique at the rehabilitated Oweninny Bogs, and provides long-term and sustainable prevention of silt run-off to watercourses. Phase One of the Oweninny Wind Farm is now in operation and has been integrated successfully into this cutaway environment, minimising impacts on adjacent cutaway and watercourses on site.

- Maintenance of remnant raised bog areas.

Elsewhere, the small areas of remnant raised bog within the Bord na Móna boundary are generally too small and degraded to warrant significant bog restoration measures and restoration of active raised bog functions. Some patches of marginal raised bog are also being continually cut in some areas for sod-turf under private management. The majority of these areas are likely to slowly dry out and develop Birch woodland eventually, although the time-scale for this natural succession is likely to be relatively long. Some sections may retain typical open raised bog vegetation (degraded bog communities). There is the capacity for some drain blocking in some of the bog remnants that should improve the overall bog remnant condition. These have been identified on the rehabilitation map. These areas will still be a reserve for raised bog species including mosses that may be able to colonise some parts of the cutaway in the future.

It is anticipated that Derrinlough Windfarm and associated infrastructure footprint will cover just under 4% of the total area of Drinagh Bog Overall. In addition, wetlands should account for up to 46% of the site into the future with a further 1% of the site comprising raised bog remnant habitats. Drier habitat mosaics, including woodland, scrub and drier open areas are likely to account for another 31% of the site. The forestry accounts of 5% of the site, with c.0.5% comprising the works buildings and other land uses.

Derrinlough Wind Farm EIAR mitigation measures that are applicable to Drinagh Bog

Proposed mitigation measures are provided in the Derrinlough Wind Farm EIAR in Chapter 16: Schedule of Mitigation and Monitoring Measures.

Proposed Rehabilitation programme

Completed

- An area of east Drinagh was landscaped and scrub removed as part of a joint Bord na Móna – BirdWatch Ireland project to manage habitats for breeding waders and other wetland birds of conservation concern.

Ongoing

- Approximately 25% of the cutaway on the site has already naturally re-vegetated with typical cutaway habitats.

Short-term (2020-) (Pre-Wind Farm construction) (Phase 1)

- Industrial peat extraction in Drinagh has currently ceased. There are still peat stocks on site. Short-term rehabilitation measures will be dependent on the removal of peat stock and the fuel requirements to West Offaly ESB Power Station and Derrinlough Briquette Factory.
- Significant bare peat areas through the site and the progress of natural re-colonisation of the cutaway areas will be monitored.
- The most sustainable management option for the recently ceased milled production areas within the site is to encourage natural re-colonisation of the site.
- All stock-piles should be removed from the site as part of the winding down of peat production operations. Any remaining or old stockpiles should be levelled as part of the rehabilitation/decommissioning process.
- There will be ongoing monitoring of the site and appropriate rehabilitation planning related to wind-farm planning and construction activities on Drinagh Bog. Opportunities for a Phase 1 re-wetting programme that would not interfere with the construction in the future of the proposed Derrinlough Wind Farm will be explored and implemented, where possible.
- A flood risk assessment will be required for Drinagh Bog to assess the impacts of Phase 1, 2 and 3 rehabilitation measures.
- The impacts of rehabilitation and wind farm construction on the conservation status of species of conservation interest will be monitored.
- While natural colonisation is expected to proceed almost immediately once industrial peat production ceases, there will be a determination of extent of bare peat and selection of best measures to accelerate re-vegetation (if necessary).
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.
- The potential to enhance the woodlands will be re-assessed at this stage.

Wind Farm construction (proposed 2024-2026) (Phase 2)

- There will be ongoing monitoring of the site and appropriate rehabilitation planning during the construction phase.
- Side-casted material from the wind farm road and drainage construction will be used to create low berms to help manage water levels and prevent surface water draining directly into the new drains. Pipes to be inserted, where required, to manage water-levels flowing off the cutaway and into the wind farm drainage.
- A widespread drain-blocking programme will implemented across the cutaway, where possible. This will have to be planned in association with the wind farm construction. In general, field drains will be blocked where possible to re-wet cutaway and re-wet to the optimum water-level.
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.

Post wind-farm construction (2026-2031) (Phase 3)

- Site conditions and drainage are likely to change somewhat after the construction of the wind farm, so continued assessment could be made of further rehabilitation and maintenance works such as localised drain blocking and berm creation in association with the wind farm infrastructure. Similar rehabilitation works have already been carried out successfully at Mountlucas Wind Farm in Co. Offaly.
- Ongoing monitoring of the hydrology of the site and water levels will be carried out. Further maintenance works and adjustment of water levels may be required to maximise the extent of the target water levels at or slightly above the peat surface.
- It is expected that pumping will be reduced and rationalised during this period. The pumping regime will manage excessive surface water across the entire site while avoiding de-watering of the cutaway areas not in the zone of influence of the wind farm infrastructure.
- There will be continued monitoring of significant bare peat areas within the cutaway after the application of fertiliser. The potential to use a once-off application of fertilisers to accelerate re-vegetation where vegetation is slow to re-colonise on other areas will be assessed. This type of rehabilitation programme has already been successfully trialled at Drumman Bog on bare peat areas.
- Monitor the success of rehabilitation measures.
- Silt-ponds will be monitored during this period and there will be continued maintenance and cleaning (if required) to prevent silt run-off from the site during the rehabilitation phase.

Long-term (post 2031-) (Phase 4)

- This phase will follow on from cessation of industrial peat production in adjacent bogs.
- The proposed wind farm will have a 30 year operational life, so continued assessment of further rehabilitation and maintenance works will be required.
- Monitoring of the site to ensure stabilisation and complete re-vegetation.
- Evaluate success of short-term rehabilitation measures outlined above and enhance where necessary (to be determined by selected short-term management above).
- Targeted active management such as seeding of a nursery crop or use of fertiliser to help promote natural re-colonisation will be carried out, if natural re-colonisation of significant bare peat areas within the recently ceased milled peat production areas has not progressed satisfactorily at this stage.
- The effect of any targeted active management will be monitored and further work determined.
- Decommissioning of silt-ponds will be assessed.
- Assess requirements for decommissioning of pumps and Bord na Móna industrial railway on the site.
- Reporting to the EPA will continue until the IPC License is surrendered.
- There will be some amenity development across the site in association with the construction and operation of the wind farm. Further opportunities to develop amenity infrastructure will be explored and facilitated, where possible,
- Opportunities to integrate other land-uses in to the site will be assessed as required.

Long-term (Post Wind Farm decommissioning)

- At this stage it is expected that the site will have no bare peat cover and that the entire site will be developing a suite of maturing cutaway habitats that reflect the mosaic of environmental conditions. The wind farm infrastructure will have been integrated into the landscape and there are likely to be other land-uses across the site including amenity.
- A flood risk assessment will be carried out for Drinagh Bog to assess the impacts of wind farm decommissioning, potential reduction in pumping and potential changes in water-levels across the site.

This assessment will be cognisant of established amenity use or other uses that may have developed over the period.

After-care and maintenance

- There will be annual assessments of the site to determine the progress of the rehabilitation work and requirements for further enhancement measures (depending on outcome of assessments during and after the construction of the wind farm and associated amenity elements).
- Where other uses are proposed for the site, these will be assessed by Bord na Móna in consultation with interested parties. Other after-uses can be proposed for licensed areas and must go through the appropriate assessment and planning procedures.

Potential future natural habitats on the site

This section attempts to predict the development of natural habitats on the site, assuming current land-use and known after-use plans for the cutaway (development, etc.). This prediction is based on research and methods used to predict the natural vegetation of Ireland (Cross, 2006).

- The large biodiversity area has potential to develop into a wetland complex with a significant area of open water (FL2-3, acid-mesotrophic lake) with fringing Reedbeds and other typical zoned wetland communities including Wet Willow-Alder-Ash woodland (WN6) (fen carr type woodland), wet grassland (GS4) and poor fen (PF2) vegetation. There are already some indicators on site of potential for Rich Fen development (*Schoenus nigricans*) but this is likely to be confined to small pockets affected by ground water.
- The majority of this site at present is likely to develop dry Birch-dominated woodland (WN7) in the medium to long-term after production. This woodland is likely to be a mosaic containing small patches of more open habitat with scrub (WS1), wet grassland (GS4) and poor fen vegetation (PF2), and small wetland complexes with Reedbeds (FS1) and open water (FL2). Small patches on the mineral mounds are likely to develop into dry heath (HH1) and calcareous grassland depending on the depth of remaining peat over the subsoil (calcareous grassland (GS1) more likely to develop on mounds with exposed sub-soil). Some of these areas (GS1) also have the potential to develop Hazel scrub and Ash woodland in the long-term (WN2).
- A large part of the SW section has potential to be developed into a wetland complex of a similar scale to the NE section with appropriate management. There is also potential to develop some smaller bodies of open water in other parts of the site with appropriate management.

Budget and costing

- It is anticipated that the majority of the rehabilitation at this site will be through natural re-colonisation. Some preliminary budgeting can be carried out assuming that up to 47% of the site will be developed as wetlands with some active management required blocking outfalls to enhance re-wetting. The allocated rehabilitation provision will be based on this estimate.

Appendix I. Ecological Report

Ecological Survey Report

Note: This report outlines an ecological survey of the bog. This report should not be taken as a management plan for the site as other land-uses may still be considered. Information within this report may inform the development of other land-uses and identify areas with particular biodiversity value.

Bog Name:	**Drinagh**	**Area (ha):**	1389ha
Works Name:	Boora	**County:**	Offaly
Recorder(s):	MMC & DF	**Survey Date(s):**	22-24/09/2009

Habitats present (in order of dominance)

The most common habitats present on the Drinagh site include:

- Bare peat (BP), pioneer Poor Fen communities (pJeff, pEang, pTrig) and *Betula pubescens*-dominated scrub (eBir, oBir). A wetland complex has developed in the north-east section with a large area of open water and associated marginal and emergent habitats such as Poor fen communities (pRos, PEang), Birch scrub (eBir, oBir) and Tall Reedbed (pPhrag, pThy, pSch). (Codes refer to BnM habitat classification system. See Appendix II).
- A large block of conifer forestry (WD4) has been planted in one section of the bog (Mannins Hill).
- There are fragmented and minor patches of dry grassland (gCal,) and dry disturbed/pioneer communities (DisCF, DisWill) around the site that are associated with the dry mineral mounds. Some dry heath (dHeath) is also developing in one small area.
- The area around Derrinlough Briquette Factory can be mainly classified as built land (BL3). Habitats associated with this area include conifer plantation (WD4), scrub (WS1), disturbed vegetation (ED3), Dense Bracken (HD1), some grassland (GS1/GS2) and silt ponds (FL8). A railway crosses the site and this can also be classed as built along with some works areas with associated infrastructure (BL3). (Codes refer to Heritage Council habitat classification system, Fossitt 2000. See Appendix II).
- Other fringe habitats around the margins of the bog include Scrub (Birch dominated and Gorse dominated), Birch woodland (WN7) and Cutover Bog (active and abandoned).

Description of site

Drinagh Bog is located to the east of Derrinlough Briquette Factory near Clochan. It is largely divided into 4 main sections by the topography of the site and a railway on an embankment that crosses from the west to the east side of the site. The western section is separated from the eastern section by a ridge of high ground that partially divides the site (Mannin's Hill) and then by a block of conifer plantation that has been planted on the cutaway bog on this higher ground. This plantation is managed by Coillte (and is known as Drinagh West forest).

North-east section (Biodiversity Area)

This area is dominated by the large biodiversity area north of the railway that contains a substantial portion of open water. The open water is divided into two main sections by a railway on an embankment. This area is developing into a wetland complex and there is a diverse mosaic of wetland habitats (several Poor fen vegetation communities) developing around the margins of the lakes, particularly along the eastern side. The lakes are shallow and there are frequent patches of emergent Common Reed and Bulrush developing in some sections as well as along the margins with Common Reed. The lakes also contain frequent indicators of the old peat production in this area with long linear islands or ridges of remnant peat vegetated with various communities. Some of the drier sections are developing Birch scrub (emergent, open and closed types). The remainder of the biodiversity area contains emerging Birch scrub and Poor fen vegetation of which Bog Cotton-dominated and Soft Rush dominated communities are the most prominent vegetation types. The wetland complex is enclosed along its northern boundary by a ridge that was developed along a natural stream (now significantly modified with sections piped along its length.

The area north of this ridge is classified as active production or production related cutaway at the time of the survey. This area is primarily bare peat with various stages of vegetation colonisation. The production-related area has primarily developed emergent and open Birch scrub with a Soft Rush dominated ground cover. The recently active production area is much more open and contains more frequent bare peat and much less scrub. There is a small area of cutover bog (inside the BnM boundary) in the north-east corner that is being cut by private individuals and is managed as private land.

South-east section

The south-east section is classified as cutaway on the Land Use Maps 2009. The south east section is primarily a mosaic of emerging and open Birch scrub and a Soft Rush-dominated pioneer community. There is also some bare peat in this area. There is a small area of Birch woodland developed along the west boundary of this area as well as a small area of remnant raised bog (PB1). This patch of high bog has a surprisingly good cover of *Sphagnum* moss in places.

North-west section

This section is mainly classified as a production-related cutaway with a small area of recently active production bog (devoid of vegetation) located at the northern end. The conifer plantation is located along the east side of this area. The main habitats in the production-related section are emerging birch scrub and a Soft-Rush dominated pioneer Poor Fen community. Other associated habitats include a Bog Cotton-dominated pioneer poor fen community and a minor amount of Common reed stands. Reedmace is also present but is relatively uncommon and confined to drains. There is a very minor area of shallow open water present. This area also contains a series of mineral ridges and mounds where glacial sub-soil is exposed in places. These mounds are quite dry and developing some other habitats such as emerging Birch scrub (eBir), disturbed vegetation dominated by Coltsfoot (DisCF) and some calcareous grassland (gCal), as well as bare sub-soil.

South-west section

This section of the site south of the railway is primarily a recently active production area with bare peat that is devoid of vegetation. A smaller block classified as production-related is recolonising with mainly emerging and open Birch scrub and Soft Rush-dominated Poor fen vegetation. There are smaller amounts of Bog Cotton-dominated Poor fen vegetation also present associated with the other vegetation communities. Small mineral mounds and ridges are also scattered through this area. These areas are also developing birch scrub and usually have some dry calcareous grassland and disturbed vegetation associated with them. Several mounds also have a small amount of dry heath dominated by Ling Heather (dHeath) developing on them. A small area of Dry Heath is also developing on somewhat higher ground near the eastern boundary of this section. There is also a remnant patch of raised bog (PB1) located along the west boundary (inside the BnM boundary) that is being actively cut from the outside by private individuals. This area is managed as private land. Of note is a drain along this high bog but at the level of the cutaway that is infilled with *Sphagnum* moss.

Derrinlough works area

This area is associated with the Briquette Factory and is dominated by built habitats (BL3). There is also some mature conifer plantation (WD4) planted around the works area. The section to the east of the works area contains a mosaic of scrub, Bracken, Bramble and disturbed vegetation that has developed on ridges built along silt ponds. The Little River crosses this area and has more diverse emergent and semi-aquatic vegetation, although the channel and riparian zone has been modified in the past.

Designated areas on site (cSAC, NHA, pNHA, SPA other)

The site is adjacent to Lough Coura pNHA (NPWS site code 000909) along part of the south-west boundary and there is very minor overlap (~0.2 ha) between the designated area and the BnM property containing typical fringing scrub habitats that are found around the site). Lough Coura is an old infilled lake containing wet grassland and some rich fen habitat. Some of the old lake and surrounding area has been planted with conifer plantation. Several rare species of conservation importance have been recorded at this site and it is also noted for its archaeological prominence.

Adjacent habitats and land-use

Habitats and land-use around the site include cutover bog with active peat-cutting (PB4) at several locations, the use of improved grassland (GA1) for grazing livestock and growing fodder, remnant patches of raised bog (PB1),

and old cutover bog (PB4) around the margins of the site that have developed a range of habitats including scrub (WS1) and some Birch woodland (WN7).

Watercourses (major water features on/off site)

The drainage system of the west side is linked to a series of silt ponds near the back of the Derrinlough Factory. These silt ponds have some semi-natural features and some aquatic vegetation.

- The Silver River flows along the eastern side of the site. Several streams and drains including the Black Brook in the east side flow into this river, which flows north and is part of the River Brosna catchment. The Black Brook was a natural stream that has had its channel modified in the past and used to drain from the SE corner of the wetland complex. This channel is still present. A second drainage channel drains the northern section of this area. An outflow from the open water complex into a large drain connected to this network is present in the north-east section.
- The Little River flows close to the west side of the site and along the back of the Derrinlough factory. This river drains the Lough Coura complex and flows north linking to the River Brosna. A former stream flowed off the bog into this river near the site of the silt ponds close to the factory. Parts of this channel are still visible.

The OSI second edition 6 inch map indicates several small lakes and pools of open water that were formerly present in the south-east corner of the SW section (Lough Laweclawn).

Fauna biodiversity

Several birds were noted around the site. Snipe were widespread around the site roosting in the wet grassland and scrub (22 sightings around site). Meadow Pipit also widespread around site using cutaway areas and areas with established vegetation cover (9 occurrences). Wren (7 occurrences) and Robin (5 occurrences) noted using patches of scrub around the site. A group of about 30 Redpoll were feeding on Birch scrub in the north-east section of the site. Other species include Blackbird (2), Magpie (1), Rook () (over-flying site), Swallow (5) (over-flying site), Wood pigeon (2), Pheasant (1), Pied Wagtail (1).

Two groups of Mallard were noted on the open water on different days (10 and 7). 1 pair of Mute Swan using open water and a separate family of 1 adult and 3 juveniles also present). A small flock of unidentified waders (possibly Lapwing) were also recorded around a small water body in the west side of the site.

- Signs of Rabbits are widespread and common around the site on many of the mineral islands and one the drier ridges. Signs of Hares widespread around site, especially on younger cutaway with establishing vegetation and some bare peat (3 adults recorded).
- Frequent signs of Deer activity (tracks), mainly single animals, particularly in southern part of the site.
- Pine Marten droppings noted in north-west section and tracks noted in south-east section.
- Signs of Badger activity in the north-east section (woodland adjacent to open water).
- Fox droppings recorded at several locations.
- Pine Marten droppings noted at one location.
- A group of 17 pie-bald ponies including fowls and mature males and females were noted on the site.
- Frogs recorded on the small patch of raised bog and in some Birch woodland around margins of site.
- Sticklebacks (fish) noted in one drain and in some open water (north-west section)
- One Peacock Butterfly noted, associated with Derrinlough works area. Some Dragonfly and Damselfly activity.
- Painted Lady recorded in north-east section.

Fungal biodiversity

Fungal species found on this site included *Russula exalbicans* (Bleached brittle gill), *Lactarius uvidus*, *Lycoperdon perlatum* (Common puffball), *Leccinum scabrum* (Birch bolete), *Boletus badius* (Bay Bolete) *Hygrocybe miniata* (Vermilion waxcap), *Clitocybe ericetorum* (Funnel cap), *Laccaria purpureobadia* and *Clitocybe flaccida* (Tawney funnel cap).

Activities on the site

A small part of the site contains forestry and is managed by Coillte as a commercial plantation.

HABITAT DESCRIPTIONS

(See Habitat Description Document for detailed description of each vegetation community not described in this section.)

Habitats developed on industrial cutaway

Pioneer Poor Fen communities (pJeff)

This pioneer community is generally the most common vegetation community found on the site and is usually associated with emergent *Betula pubescens*-dominated scrub, which is the next stage in the succession of these communities. The vegetation is dominated by *Juncus effusus*. *Phragmites australis* and *Typha latifolia* are sometimes present along the drains within this habitat and occasionally spread out to form small patches of single-species sward or a mixed community with the *Juncus effusus*. Lemna sp. was also noted in a drain at several locations. Other species found in this vegetation type include *Juncus articulatus*, *Centaurea nigra*, *Triglochin palustre*, *Hydrocotyle vulgaris*, *Hypochaeris radicata*, *Tussilago farfara*, *Taraxacum* sp., *Potentilla anserina*, *Dactylis glomerata*, *Agrostis stolonifera*, *Pulicaria dysenterica*, *Eupatorium cannabinum*, *Cirsium palustre*, *C. arvense*, *Osmunda regalis*, *Carex panicea* , *Rumex acetosa*, *Sonchus arvensis*, *Mentha aquatica*, *Hieracium pilosella*, *Cerastium fontanum*, *Daucus carota*, *Carex demissa*, *Molinia caerulea*, This habitat is also regularly associated with other Poor fen communities such as pEang and pTrig, but these usually make up a small proportion of the vegetation cover. Some of this grassland can be quite variable and drier sections are more typical of Disturbed vegetation (DisCF) and can be dominated by *Equisetum* sp.

This habitat is found associated with the maturing woodland near the open water complex in the north-east section. This area is notable for the large hummocks of *Calliergonella cuspidata* that are developing in the grassland and the abundant cover of *Agrostis stolonifera*, which dominates in places.

Pioneer Poor Fen communities (pEang)

This community is widespread throughout the site, although it does not cover as great a proportion of the site as pJeff. It can be found in a variety of situations, mainly in mosaic with pJeff, pTrig and eBir in production-related areas that are rapidly re-vegetating. It can also be found in a variety of conditions including with standing water at the edge of an open water body.

This community is typically found vegetating bare peat and is dominated by *Eriophorum angustifolium*. Other species may include *Mentha aquatica*, *Juncus effusus*, *Juncus articulatus*, *Hypochaeris radicata*, *Rubus fruticosus*, *Lycopus europaeus*, *Triglochin palustre*, *Juncus bulbosus*, *Carex demissa* and *Veronica beccabunga*.

This community is also found around the edge of the open water in mosaic with pRos, pPhrag and pTyph. The vegetation is dominated by *Eriophorum angustifolium* and also contains *Mentha aquatica*, *Molinia caerulea*, *Triglochin palustre, Lythrum salicaria, Hydrocotyle vulgaris, Chamaerion angustifolium, Epilobium hirsutum, Juncus effusus, Typha latifolia, Juncus bulbosus, Galium palustre, Carex nigra*, *Ranunculus flammula, Taraxacum sp., Pulicaria dysenterica*, *Eupatorium cannabinum, Salix aurita, Holcus lanatus* and *Cirsium arvense*. This community can have extensive patches of *Calliergonella cuspidata* moss associated with it, sometimes forming large hummocks in the older more established areas. *Utricularia* sp. is sometimes present in the standing water within this community and other semi-aquatic species typical of aquatic margins such as *Hippuris vulgaris*, *Equisetum fluviatile* and *Typha latifolia* are present.

Pioneer Poor Fen communities (pRos)

This community is mainly found around the margins of the large area of open water in the north-east section, with small patches appearing in other parts of the site, usually associated with wetland areas with open water. It forms a complex mosaic in places with the open water and with other pioneer Poor fen habitats such as pEang and sections are beginning to resemble mature marginal vegetation of lakes (but their diversity is probably still

somewhat lower). There is some typical zonation on plant communities in places around the open water from wet to dry habitats.

This habitat is dominated by *Carex rostrata* in places but can be relatively diverse. Other species present include *Eriophorum angustifolium*, *Carex echinata*, *Hippuris vulgaris* , *Hydrocotyle vulgaris*, *Mentha aquatica*, Utricularia sp., *Typha latifolia*, *Juncus effusus*, *Juncus articulatus*, *Ranunculus flammula* and *Carex demissa.* Some large hummocks of *Calliergonella cuspidata* are developing in this community where it is well-established.

Pioneer Poor Fen communities (pPhrag, pTyph, pSch)

These communities are presently encountered in the open water complex in the north-east section. *Phragmites australis*, *Typha latifolia* and *Schoenoplectus lacustris* can all form dense mono-specific stands around the margins of the open water or in shallow areas where the stands are emergent from the open water. Stands of *Schoenoplectus lacustris* are generally not found in association with the marginal vegetation but rather as small stands of emergent vegetation within the open water. The majority of these stands are relatively small in size at present apart from a large area of Tall Reed swamp dominated by *Typha latifolia* (pTyph) that is located at the south-east corner of the open water complex. This community is somewhat more diverse and open, with patches of open water within it and occasional *Salix* spp. trees developing in it.

Open Water complexes (OW)

A large area of open water is found within the Biodiversity Area in the north-east section of the site. This open water has a complex topography and is found in mosaic with other wetland habitats such as pEang, pRos, pPhrag, pTyph and eBir. Typical emergent species found in the open water near the margins include *Equisetum fluviatile* and *Triglochin palustre.* Patches of *Potamogeton* sp. are frequently found floating in the open water. The open water also contains frequent 'islands' and elongated ridges of remnant peat that are covered with various communities of which pJeff is most frequent.

***Betula pubescens* scrub (eBir, oBir)**

These habitats are the most frequently encountered pioneer habitats at this site. *Betula pubescens* saplings and young trees are generally emerging from Poor fen vegetation dominated by *Juncus effusus*. However, *Betula pubescens* dominated scrub can develop from a range of different communities including dry grassland and disturbed vegetation, which is found on many of the mineral mounds and ridges scattered through the site.. *Salix cinerea* and *Salix aurita* are also frequently present and sometimes become dominant. *Ulex europaeus* is also present on some drier areas on mineral ridges and on shallower peat near the margins of the site.

The underlying or ground vegetation generally reflects the surrounding conditions and pJeff is the most common community that is associated with the *Betula pubescens*-dominated scrub. The ground cover may also be dominated by *Chamaerion angustifolium* or *Agrostis stolonifera* in places. *Salix repens* is also present in places but is never very prominent. The *Betula pubescens*-dominated scrub sometimes develops from a *Calluna vulgaris*-dominated ground cover (dHeath).

Other species associated with the scrub habitat include *Dryopteris dilatata*, *D. carthusiana, D. felix-mas*, *Equisetum sylvaticum* and *Campylopus introflexus.*

Open *Betula pubescens*-dominated scrub is generally classified where the scrub is somewhat denser and taller, but has still not filled all the gaps and is not developing a woodland canopy.

Closed *Betula pubescens* scrub (cBir)

Closed *Betula pubescens*-dominated scrub is generally classified where the scrub is denser and taller, and has patches that are developing a woodland canopy. This community is generally difficult to access as it is so dense. The species composition is quite similar to the other forms of *Betula pubescens*-dominated scrub described above. It can have some open patches that contain species typically found in pJeff or gCal in drier areas including *Chamaerion angustifolium*, *Tussilago farfara*, and *Rubus fruticosus*.

Birch-Willow woodland (BirWD)

This habitat is found in the north-east section on the small raised area that extends into the open water wetland complex from the railway. This area is a mosaic of developing woodland, patches of younger scrub and open areas containing pJeff. The woodland areas contain frequent *Salix cinerea* in places and this dominates some of the canopy. Some of the woodland is quite dry and the ground cover is dominated by *Rubus fruticosus*. Other species present in the understorey and canopy include *Betula pubescens*, *Ulex europaeus* and *Sorbus aucuparia*.

The ground cover also contains *Eurhynchium praelongum* and *Rhytidiadelphus squarrosus* along with many of the species recorded above in the other scrub habitats and in pJeff.

***Calluna vulgaris*-dominated community (dHeath)**

This community is found in several different locations around the site but it is generally not very extensive in cover. It is associated with drier areas around the margins of the bog. The vegetation is dominated by *Calluna vulgaris* and is not very diverse. Some of the vegetation can be quite open with extensive bare peat cover. Other species associated the older, better developed sections include *Molinia caerulea*, *Anthoxanthum odoratum*, *Betula pubescens*, *Rubus fruticosus*, *Chamaerion angustifolium, Campylopus introflexus*, *Hypnum cupressiforme*, *Potentilla erecta and Erica tetralix.*

This community is associated with emergent *Betula pubescens* and *Ulex europaeus* scrub, and also with Birch woodland on the site. A larger area of this habitat is developing on the east side of the south-west section on a somewhat raised area. This area also contains some occasional young *Pinus contorta* trees as well as *Ulex europaeus* and *Betula pubescens*.

***Ulex europaeus*-dominated community (eGor)**

This scrub community is found in some locations around the site and is mainly associated with some of the drier ridges around the site, particularly the main ridge that divides the north-east section and confines the open the water complex. Overall it forms a relatively minor part of the vegetation in the site. Small amounts of this habitat can be found around the margins of the site associated with drier areas. ‘

This ridge is associated with a drain/stream that flows of the bog in this area. The community is dominated by dense *Ulex europaeus* scrub in places and it can also be associated with dense stands of *Pteridium aquilinum* that also form on these ridges in response to the drier conditions. Other species found in this community includes occasional *Betula pubescens*, *Pinus contorta* and *Salix* spp. trees and saplings.

This community can also be found in associated with small amounts of gCal and disCF, which also develop in these drier areas.

Dry grassland communities (gCal)

This community is most frequently encountered on the drier mineral mounds that are scattered around the site. It is usually associated with dry bare sub soil. This habitat can be found with disturbed vegetation (DisCF) and with emergent *Betula pubescens*-dominated scrub. Some of these mounds that been used to collect Pine debris from the surrounding production area. The grassland is dominated by *Anthoxanthum odoratum*, *Agrostis stolonifera* and *Centaurea nigra,* and it also contains *Carex flacca*, *Filipendula ulmaria*, *Hypochaeris radicata*, *Bellis perennis*, *Dactylis glomerata*, *Cirsium arvense*, *Holcus lanatus*, *Calluna vulgaris*, *Equisetum* sp., *Hypericum pulchrum*, *Cerastium fontanum, Leucanthemum vulgare, Achillea millefolium, Chamaerion angustifolium, Rubus fruticosus, Potentilla erecta, Potentilla anglica, Cirsium arvense* and *Cirsium vulgare. Carlina acaulis* was noted on several mounds.

Wet and dry grassland communities (gMol, gCo-An)

A small amount of diverse grassland of this type is present at the northern end of the north-east section, close to the access point onto the bog. This grassland has developed in an area that has not been disturbed for some time and usually appears near the periphery of the bog. The grassland is dominated by *Molinia caerulea* and also contains frequent *Anthoxanthum odoratum*, *Centaurea nigra*, *Potentilla anserina*, *Agrostis stolonifera*, *Plantago lanceolata* and *Dactylis glomerata.* Other species present include *Rubus fruticosus*, *Lotus corniculatus*, *Calystegia sepium*, *Equisetum* sp., *Arrhenatherum elatius*, *Mentha aquatica*, *Sonchus arvensis*, *Lythrum salicaria*, *Holcus lanatus*, *Carex flacca*, *C. demissa*, *C. nigra*, *Linum catharticum*, *Triglochin palustre*, *Potentilla erecta*, *Calluna vulgaris*, *Rhinanthus minor*, *Hypochaeris radicata*, *Pedicularis sylvatica*, *Hypericum pulchrum*, *Succisa pratensis*, *Lathyrus pratensis*, *Juncus articulatus*, *Trifolium* sp., *Stachys sylvatica*, *Stellaria* sp., *Juncus effusus*, *J. inflexus*, *Dactylorhiza* sp., *Cirsium arvense*, *C. vulgare*, and *Centaurium erythraea.* A small amount of *Betula pubescens*, *Ulex europaeus* and *Salix aurita* is spreading into this grassland type and this community transitions to an emergent *Betula pubescens*-dominated community. There is a subtle change from this community to a more typical mosaic dominated by eBir and pJeff on deeper peat and more low-lying areas.

Some of this grassland is drier and is dominated by *Dactylis glomerata* and *Anthoxanthum odoratum* and is somewhat more tussocky. However, the extent of this vegetation type is quite minor in relation to the site area.

Similar gMol grassland dominated by *Molinia caerulea* (to the community described above) is found in small patches around the margins of the site on drier peat.

Rich fen community

A very small pocket of grassland found along the margins of the north-east section contained some *Schoenus nigricans*, an indicator of developing rich fen. This species was found in a disturbed area in association with *Molinia caerulea*, *Rhinanthus minor*, *Juncus inflexus*, *Carex demissa*, *Equisetum* sp, *Juncus articulatus*, *Centaurea nigra*, *Hypericum pulchrum*, *Sonchus arvensis*, *Mentha aquatica*, *Eriophorum angustifolium*, *Cirsium palustre*, *Carex flacca*, *Galium palustre*, *Calliergonella cuspidata* and *Ajuga reptans*. Some of this vegetation has developed on a spoil heap.

Conifer Plantation (WD4)

This plantation is located in the central part of the site on somewhat higher ground compared the rest of the cutaway. The plantation is managed by Coillte. It is predominantly planted with Sitka Spruce (*Picea sitchensis*) although there is a small amount of Lodgepole Pine (*Pinus contorta*) also planted in several blocks. This plantation is mainly at post-thicket stage with the relatively young trees having closed to forma dense canopy with very little vegetation cover underneath. There are some failed patches with stunted trees that would be considered pre-thicket plantation. These stunted areas are mainly vegetated by *Calluna vulgaris*, which is probably having a negative impact on the nutrient status of the soil and the condition of the trees. Overall, the plantation is in poor condition, although there are some pockets where the Spruce is growing at a fast rate and is in need of thinning.

Dry Disturbed/Pioneer communities (DisCF, DisWill)

Dry disturbed vegetation (DisCF) is found frequently on the small mineral mounds of sub-soil made up of glacial deposits that are found around the production area. It is frequently associated with emergent scrub (eBir) and dry grassland (gCal), which also are found on these mounds. This vegetation is dominated by *Tussilago farfara* and also contains *Rubus fruticosus*, *Molinia caerulea*, *Potentilla anserina*, *Daucus carota*, *Taraxacum* sp., *Agrostis* sp., *Carex flacca*, *Bellis perennis*, *Equisetum* sp., *Dactylorhiza* sp., *Cirsium arvense*, *Cirsium palustre*, *Salix aurita*, *Leucanthemum vulgare*, *Hypochoeris radicata* and *Centaurium erythraea.*

Other Habitats (around the fringe of the bog)

Birch woodland (WN7)

This habitat is located along the western boundary of the south-east section. The woodland is in the initial stages of development and is immature, although it does contain some mature trees. The canopy is dominated by *Betula pubescens* with a minor amount of *Salix cinerea* present. The canopy is about 8 m high and some of the largest trees reach a dbh of 40 cm. The woodland contains shrubby *Betula* of different ages. *Ulex europaeus* is also present in the understorey. The ground cover is relatively dry and dominated by leaf litter, patches of *Rubus fruticosus* and some moss cover. Other species present in the ground layer include *Hypericum humifusum*, *Dryopteris dilatata*, *Ilex aquifolium*, *Juncus effusus*, *Agrostis* sp., *Calluna vulgaris* and *Molinia caerulea.* Moss species present in the ground layer include *Thuidium tamariscinum*, *Polytrichum commune*, *Eurhynchium striatum* and *Hypnum* sp. There are some open patches within the woodland that would be described as scrub and are vegetated with *Ulex europaeus* and *Pteridium aquilinum*. The woodland also contains small stagnant pools of water associated with old drains.

There are signs of Deer-browsing in the woodland.

Raised Bog (PB1)

Small patches of remnant high bog are found at several locations around the site. The largest area is in the south-east section (about ~ 5 ha) and is positioned along the western boundary. This bog is in quite good condition and there is a surprisingly high cover of *Sphagnum* moss including *S. capillifolium*, S. *papillosum*, *S. subnitens*, *S. magellanicum* and some and hummocks of *S. imbricatum*. The majority of the bog could be classified as sub-marginal with small patches in the northern section considered as sub-central quality. The cover of *Sphagnum* decreases towards the southern boundary.

The bog is surrounded by a tall face-bank with dense *Calluna vulgaris* that is almost 3 m high along the east side. A drain in a trench marks the northern boundary while there is some drainage along the southern boundary that is associated with peat cutting on adjacent private land. The vegetation is typically dominated by *Calluna vulgaris* and *Eriophorum vaginatum*. Other species present include *Eriophorum angustifolium*, *Narthecium ossifragum*,

Trichophorum cespitosum, *Drosera rotundifolia*, *Carex panicea* and *Rhynchospora alba*. There is also extensive cover of *Cladonia portentosa*. Other mosses present include *Leucobryum glaucum* and *Hypnum jutlandicum*. There are some typical hummock-hollow complexes but for the most part the surface of the bog is relatively flat with few features. No pools were present and there is no standing water. A very small damp hollow was the only location on the intact bog where *S. cuspidatum* was recorded. Several *Betula pubescens* and *Pinus contorta* are present on the high bog. There was some high *Sphagnum* cover, mainly in hummocks, and there was also some minor lawn development. Some of the larger hummocks do display signs of degradation and drying out in places. An old drain crosses through the centre of the bog (N-S direction) and is infilling with *S. cuspidatum*.

Improved grassland (GA1)

This habitat is found in the south-east section along the western margin. A section of land within the BnM boundary has been improved in the past by private individuals and managed as agricultural grassland. The margins of this area are disturbed and there is some development of patches of *Rubus fruticosus*, *Pteridium aquilinum*, *Urtica dioica* and *Chamaerion angustifolium.* A deep drain separates this area from adjacent habitats on the periphery of the bog.

Cutover Bog (PB4)

This habitat is found around the margins of the site at several locations. Patches of cutover bog within the BnM site boundary, but managed by private individuals, are begin cut privately for peat and are typical of Turbary with several different individual plots being found in the same unit. Various stages of development are present, from active peat cutting where there is very little vegetation development (dominated by bare peat) and freshly cut turf is being dried, to abandoned sections that are developing *Calluna vulgaris*-dominated vegetation (dHeath), *Juncus effusus*-dominated vegetation (pJeff), dense *Pteridium aquilinum* (dPter) or *Betula pubescens*-dominated scrub (eBir). Some units of cutover bog have a mosaic of these communities that are related to the time since the different plots were last cut for peat.

Appendix II. Codes used for habitat classification.

Bord na Moṅa habitat classification scheme

	General	Habitat [1]	BnM habitat code	Equivalent Heritage Council codes [2]
Pioneer habitats of industrial cutaway	Peatland	Bare peat (0-50% cover)	BP	ED2
		Embryonic bog community (containing *Sphagnum* and Bog Cotton)	PBa	PB
		Embryonic bog community (Calluno-Sphagnion)	PBb	PB
	Flush and Fen	Pioneer *Campylopus*-dominated community	pCamp	PF2
		Pioneer *Juncus effusus*-dominated community (Soft Rush)	pJeff	PF2
		Pioneer *Eriophorum angustifolium*-dominated community (Bog Cotton)	pEang	PF2
		Pioneer *Juncus bulbosus*-dominated community (Bulbous Rush)	pJbulb	PF2
		Pioneer *Triglochin palustris*-dominated community (Marsh Arrowgrass)	pTrig	PF2
		Pioneer Caricion davallianae-Community with *Cladium* (rich fen)	pCladium	PF1
	Emergent communities	Pioneer *Carex rostrata*-dominated community (Bottle Sedge)	pRos	FS1
		Pioneer *Phragmites australis*-dominated community (Common Reed)	pPhrag	FS1
		Pioneer *Typha latifolia*-dominated community (Reedmace)	pTyp	FS1
		Pioneer *Schoenoplectus lacustris*-dominated community (Bulrush)	pSch	FS1
	Open water	Charaphyte-dominated community	pChar	FL2
		Permanent pools and lakes	OW	FL2
		Temporary open water	tOW	
	Woodland and scrub	Emergent *Betula*/*Salix*-dominated community (A) (Birch/Willow)	eBir	WS1
		Open *Betula*/*Salix*-dominated community (B) (Birch/Willow)	oBir	WS1
		Closed *Betula*/*Salix* scrub community (C) (Birch/Willow)	cBir	WS1
		Ulex europaeus-dominated community (Gorse)	eGor	WS1
		Betula/*Salix*-dominated woodland (Birch/Willow)	BirWD	WN7
	Heathland	Pioneer dry *Calluna vulgaris*-dominated community (Heather)	dHeath	HH1
		Dense *Pteridium aquilinum* (Bracken)	dPter	HD1
	Grassland	Pioneer dry calcareous and neutral grasssland (Centaureo-Cynosuretum)	gCal	GS1
		Dactylis-Anthoxanthum-dominated community (Cocksfoot-Sweet Vernalgrass)	gCo-An	GS2
		Anthoxanthum-Holcus-Equisetum community (Sweet Vernalgrass-Yorkshire Fog-Horsetail)	gAn-H-Eq	GS
		Molinia caerulea-dominated community (dry) (Purple Moorgrass)	gMol	GS4
		Marsh (Meadowsweet and other tall herbs) (Filipendulion ulmariae)	Mar	GM1
	Disturbed	*Tussilago farfara*-dominated community (vegetation > 50%) (Colt's Foot)	DisCF	ED3
		Epilobium-dominated community (vegetation > 50%) (Willowherb spp.)	DisWil	ED3
	General	Riparian areas (streams or drain with associated edge habitats (e.g. FW2/4 + WS1, GS2 etc)	Rip	FW2 +
		Silt Ponds (artificial ponds with associated bank habitats (e.g. FL8 + WS1, GS2, ED2, ED3)	Silt	FL8 +
		Access (tracks or railways with associated edge habitats (e.g. BL3 + gCal, gMol, eGor etc)	Acc	BL3 +
		Works areas (predominately built land but can include landscaped and brownfield habitats (e.g. GA2, WS3, WD4, ED2, ED3)	Works	BL3 +

[1] These are generally pioneer habitats of bare peat and the communities can contain a significant proportion of bare peat. Some habitats are more developed than others. They frequently occur in mosaic with each other.
[2] Not all these communities are equivalent to habitat classes used by The Heritage Council habitat classification scheme (Fossitt 2000) as some are quite rudimentary and undeveloped.

Heritage Council habitat classification scheme (Fossitt 2000)

	General	Habitat	Heritage Council code
Semi-natural and modified habitats	Peatlands	Raised Bog	PB1
		Lowland Blanket bog	PB3
		Cutover Bog	PB4
		Rich fen and flush	PF1
		Poor fen and flush	PF2
		Transition mire and quaking bog	PF3
	Woodland and scrub	Oak-Birch-Holly woodland	WN1
		Oak-Ash-Hazel woodland	WN2
		Wet Pendunulate Oak-Ash woodland	WN4
		Riparian Woodland	WN5
		Wet Willow-Alder-Ash woodland	WN6
		Bog woodland	WN7
		Mixed broad-leaved woodland	WD1
		Mixed broad-leaved/conifer woodland	WD2
		Conifer plantation	WD4
		Scrub (Gorse)	WS1
		Emergent Betula-dominated community	WS1
		Closed Betula scrub community	WS1
		Recently-planted woodland	WS2
		Ornamental scrub	WS3
		Short-rotation coppice	WS4
		Recently-felled woodland	WS5
	Linear woodland	Hedgerow	WL1
		Treeline	WL2
	Grasslands and Marsh	Improved grassland	GA1
		Amenity grassland	GA2
		Dry calcareous and neutral grsld	GS1
		Dry meadows and grassy verges	GS2
		Dry-humid acid grassland	GS3
		Wet grassland	GS4
		Freshwater Marsh	GM1
	Heath and Bracken	Dry Heath	HH1
		Dry calcareous Heath	HH2
		Wet Heath	HH3
		Dense Bracken	HD1
	Disturbed ground	Exposed sand,gravel or till	ED1
		Spoil and bare ground	ED2
		Recolonising bare ground	ED3
		Active quarry	ED4
	Freshwater	Acid Oligotrophic lakes	FL2
		Mesotrophic lakes	FW4
		Artificial ponds (slit ponds)	FL8
		Depositing rivers	FW2
		Canals	FW3
		Drains	FW4
	Cultivated and Built land	Stonewalls and other stonework	BL1
		Earth Banks	BL2
		Buildings and artificial surfaces	BL3
		Arable crops	BC1
		Horticulture	BC2
		Tilled land	BC3