

## Milestone 2 – FMM descriptions

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## 3. Ireland

### 3.1. Background and forest history

Following periods of heavy reforestation and deforestation from the 1600s to 1900s, forest cover in Ireland was about 1% in the early 1900s. To develop a forest industry in Ireland, the government started a large afforestation project mainly using the fast-growing exotic softwoods Sitka spruce (*Picea sitchensis* (Bong.) Carr.) and lodgepole pine (*Pinus contorta* Douglas). The main purpose of these forests was to produce timber for domestic use. Since the early 1980s, government afforestation has declined and focus has shifted to encourage private landowners to afforest their agricultural land in exchange for economic incentives.

The total area of the Republic of Ireland is 6 975 000 ha. In 2012, about 10.5% (732 000 ha) of this was covered with forests and the goal is to bring the forest cover to 17% by 2030. The average standing volume is  $140\text{m}^3\text{ha}^{-1}$  and the yield capacity (Sitka spruce)  $20.4\text{m}^3\text{ha}^{-1}\text{yr}^{-1}$ .

Introduced tree species dominate forestry in Ireland. The most important economically is Sitka spruce with more than 50% of the standing volume. Second is lodgepole pine, at 10% of Ireland's forest cover. There are also other tree species in Ireland. These species and their proportions are presented in Table 11.

Today, ecological and social benefits of forests are recognised in certification and legislation. This is reflected in more awareness about sensitive species habitats, increased environmental consideration during forest operations and species diversification towards more native and broadleaf forest. Since much of Irish forest area comprise fast growing softwoods, managed for a timber oriented forestry sector, spruce and pine clearcutting remain the dominant forest management models in Ireland. The long tradition of agricultural production and revenue generation through land-use management means that the exotic softwood's good production capability is a good fit for Ireland's heritage and is unlikely to change.

#### 3.1.1. Ownership

The biggest owner of forest land in Ireland is Coillte. It is a semi-state company. Coillte own 53% of the forest area in Ireland while the remaining 47% is privately owned.

#### 3.1.2. Nature Conservation and Biodiversity Protection non-forested land

Nature conservation and biodiversity protection in Irish forestry often incorporates areas that are not forested, this is due to Ireland historically being heavily deforested and only gaining a significant forest area in recent years. Most historically forested areas have been converted into agricultural land and much of the current forested area was historically blanket peat. Thus, a wider nature conservation approach is often taken in Irish forestry to include non-forested adjacent land that has high biodiversity values (e.g. open bog habitat, rivers and lakes).

### 3.2. The case study area

The CSA is 12 511 ha forest. The forest is dominated by wet sites with a productivity between 8-14  $\text{m}^3 \text{ha}^{-1} \text{yr}^{-1}$ . The CSA, like much of western Ireland, is dominated by blanket peat which limits the productivity of species and potential for many FMMs that could be implemented in the CSA. The eastern side of the country is more fertile and hence has more productive forests, in many cases with similar species choice. There is more interest in restoring bogs today than there was in the past and to date, some bog restoration has taken place in western Ireland.

Table 9. The forest land in the CSA expressed as forest area proportion (%) within productivity and moisture classes.

Productivity/ moisture	Productivity, yield class ( $\text{m}^3\text{ha}^{-1}\text{y}^{-1}$ )	Dry %	Mesic %	Moist %	Wet %
High	>14	1.3	1.8	0.2	11.0
Medium	8-14	3.0	3.3	0.1	71.8
Low	<8	0.3	0.5	0.1	6.6

Using data from the INTEGRAL project and reading Coillte forest management plans, an estimate is that ca 1,700 ha, (13.3 %) of the total 12,735 ha forest is made up of nature conservation and biodiversity protection non-forested land. Since this area is non-forested it was not included when calculating the coverage of the actual FMM, thus the 100% Coverage of CSA forestland in question 4 is calculated from the 86.7% of the “forest estate” that is actually forested.

There are some differences in dominant soil type in the CSA compared to the rest of Ireland. CSA Connacht, like much of western Ireland, is dominated by blanket peat which could potentially limit the productivity of species and FMMs that could be implemented in the CSA. The eastern side of the country is more fertile and hence has more productive forests, in many cases with similar species choice. There is more interest in restoring bogs today than there was in the past and to date, some bog restoration has taken place in Western Ireland, see below for FMM description. Thus there could be fewer conifer clearcutting stands in the future if it is more favourable to let them develop into biodiversity habitats after clearcutting rather than planting exotic conifers again.

#### 3.2.1. Land area and forest cover

The forest cover of the CSA is similar to Ireland, around 10%. Also in standing volume and ownership structure the CSA is similar to Ireland, Table 10.

Table 10. Total land area, forest area, standing volumes, productivity and ownership in the CSA (Barony of Moycullen), County Galway and Ireland. Source: Forest Service (2013). National Forest Inventory – Republic of Ireland.

	Barony of Moycullen	County Galway	Republic of Ireland
<b>Total Area (ha)</b>	<b>77 528</b>	<b>612 430</b>	<b>6 976 110</b>
Forest Area (ha) <sup>1</sup>	12 511	59 410	731 650
Forest cover (%) <sup>1</sup>	16.1	9.7	10.5
Average Volume (m <sup>3</sup> ha <sup>-1</sup> ) <sup>1</sup>	<i>No information exists at present, likely similar to County Galway</i>	135	140
Average Yield Class (m <sup>3</sup> ha <sup>-1</sup> yr <sup>-1</sup> ) <sup>1</sup>	12	16.3	20.4
Forest Ownership (%) <sup>1</sup>			
Public (Coillte)	81.1	65.1	53.2
Private (Grant aided)	14.2	26.2	34
Private Other	4.7	8.7	12.8

### 3.2.2. Tree species

Introduced tree species dominate forestry in Ireland and in the CSA. Most important is Sitka spruce which makes up more than 50% of the standing volume. Second is lodgepole pine making up 10% of forest cover in Ireland and 21 % in the CSA. There are also a number of other tree species and are presented in Table 11.

Table 11. Tree species, proportion of total forest area. Forest Service (2013). National Forest Inventory – Republic of Ireland – Results.

	Barony of Moycullen	County Galway	Republic of Ireland
Species (Latin name)	Proportion (% total area)	Proportion (% total area)	Proportion (% total area)
Sitka spruce ( <i>Picea sitchensis</i> )	50.1	55.5	52.5
Pines, mainly lodgepole pine ( <i>Pinus contorta</i> ), excl. Scots pine ( <i>Pinus sylvestris</i> L.)	37.4	20.9	9.7
Short lived broadleaves: Birch, Alder, Salix and poplar, ( <i>Betula spp</i> , <i>Alnus spp</i> , <i>Salix spp</i> , <i>Populus spp</i> etc.)	6.1	15.7	15.5
Long lived broadleaves Oak Beech, Ash, Maple species ( <i>Quercus spp</i> , <i>Fagus sylvatica</i> L., <i>Fraxinus excelsior</i> L., <i>Acer spp</i> etc.)	1.1	6.1	10.3
Norway spruce ( <i>Picea abies</i> )	0.5	2.9	4.1
Larch, ( <i>Larix spp.</i> )	2.7	2.2	4.4
Scots pine ( <i>Pinus sylvestris</i> L.)	0.3	1.5	1.3

Other conifers: Oregon pine ( <i>Pseudotsuga menziesii</i> ), English yew ( <i>Taxus baccata</i> ), Fir ( <i>Abies spp</i> ) and more	1.8	0.1	2.2
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### 3.3. FMMs in Ireland and in the Irish CSA

Irish forestry dominates by silvicultural systems or models characterized by clear-felling. Approximately 85% of forest land is managed with CF systems. For nature conservation and biodiversity protection other management systems are used. This “FMM” won’t be described below because it is not forested, but it is important to meet nature conservation and biodiversity goals in Irish forestry.

When much of Ireland’s current forest area was afforested since the year 1900, the main goal was to produce timber and there was little consideration of how different species would perform on different sites and how species selection would influence non-timber benefits, i.e. biodiversity, water quality, recreation, tourism, etc.

Central and eastern Ireland has the soil to accommodate a more diverse forest, but in the CSA, the majority of all soil is blanket peat which has limitations for tree species selection. With forest knowledge increasing and policies emerging that aim to protect and enhance biodiversity features, the way forward is to establish native woodland sites, plant lodgepole pine on sites where fertilisation is restricted (Tony Clarke, pers. comm.) and restore some afforested sites back into their previous peatland habitat.

Recent changes in forest policy has resulted in a different value extraction from Irish forestry and thus timber production is no longer the only goal.

Increased emphasis on environmental and ecological factors mean that some sites are no longer considered suitable for certain species. Some of the above-mentioned sites will allow for establishment if fertiliser is applied, but new policies limit the use of fertiliser especially near freshwater pearl mussel (FPM) watersheds. In the future, it may be beneficial to establish some other forest management types on these sites, e.g. low stocking of lodgepole pine or other land-use types e.g. bog restoration.

Afforestation was initially done by the state, who bought marginal land (mainly blanket peat) for afforestation. Since the 1980s, government afforestation has declined and virtually ceased while private land owners (mainly farmers) are incentivised for afforestation grants. Much of private afforestation is carried out on marginal agricultural land which are often more productive than blanket peat.

Three FMMs are used in larger scale in the Irish CSA; 1) Clearfelling Sitka spruce and other conifers (but not lodgepole pine), 2) Clear-felling lodgepole pine 3) Nature conservation and biodiversity protection management (Table 12).

The two clear cutting models are similar. The difference is the tree species and depending on the species they are used on slightly different sites and while it is a choice to thin for other conifers, thinning is not an option for lodgepole pine.

Table 12. The three major forest management models (FMMs) used in the Irish CSA, and in Ireland.

Forest management models (FMM) Domestic name in English	“General characteristic”	Coverage CSA (% forestland)	Coverage Ireland (% forestland)
Clearcutting system – Sitka spruce (mainly) and other conifers	Clearcutting system	55-60	63-66
Clearcutting System – lodgepole pine	Clearcutting system	25-30	20-25
Nature Conservation and Biodiversity Protection	No intervention	10-15	15
Nature Conservation and Biodiversity Protection non-forested land	No intervention	N/A	N/A

### 3.4. Ecosystem services

There is a large difference in the services provided with the three FMMs. Sitka spruce and lodgepole pine are used for timber or pulpwood production while areas managed with models for nature conservation and biodiversity protection are expected to result in a number of other services, see

Table 13.

Table 13. Ecosystem services connected to the four FMMs in the Irish CSA. Ranking of important ESs within each FMM. No ranking between FMM.

Forest manage model (FMM)	Clear-cutting system Sitka spruce and other coniferous	Clear-cutting system lodgepole pine	Nature conservation and Biodiversity protection
Timber production	<b>1</b>		
Timber and fibre production		<b>1</b>	
Habitat protection for invertebrates, fungi deer red squirrel, birds, plants etc.			<b>1</b>
Water quality for salmonids, freshwater pearl mussel and other aquatic species			<b>2</b>
Carbon sequestration			<b>3</b>
Recreation and tourism			<b>4</b>
Landscape amenity			<b>5</b>

### 3.5. Alternative FMMs

In the CSA, three models for managing forests are dominating. But there are also other models used in Ireland, clearcutting models with broadleaves, models characterised by continuous forest cover and models for restoration of bogs. These models are described here briefly.

**Continuous cover forestry.** The goal is to create high forest native woodlands that can facilitate a combination of high quality wood production, biodiversity enhancement and reduce the adverse visual impact of clear-cuts in the landscape. Very few sites in the CSA have the soil to facilitate proper implementation of CCF and the current CCF area is very low. Regeneration by planting suitable conifer, broadleaves or a mix of species, full or partial natural regeneration is also acceptable.

**Bog restoration.** Forest land on blanket peat sites that has the potential to develop into good quality bog habitat is not replanted after harvesting. In addition, drains are blocked to facilitate the growth of Sphagnum. Between 2003 and 2020, it is expected that about 3% of the forest in the CSA will be converted into bog and most of this transformation has already occurred. Bog restoration programmes are often renewed and extended so it is possible that more forest will be converted back into bog.

**Clearcutting system – Broadleaves.** Similar to the two FMMs with conifer – that will be described in below - but with broadleaf tree species like oak, European beech, maple, lime and birch. Major differences to conifer clearcutting systems is generally later first thinning and longer rotation age (rarely clearcutting before the stand is 60 years of age). Since much of the CSA is blanket peat, this FMM is unsuitable as a reforestation option for most of the present day forest. Thus this FMM is more suitable for afforestation and reforestation on private land, which generally has more favourable soils for broadleaf plantations.

### 3.6. The two Clearcutting systems used in the Irish CSA

Today the two clear-cutting models are used on 75-85% of the forest area in the CSA, 30% of the forest area is lodgepole pine dominated stands. In the future, the total area Sitka spruce may be reduced as less fertilizer is now permitted for successful establishment, lodgepole pine will most likely be planted instead. In addition, some areas are likely to be managed as biodiversity conservation areas meaning that the total area managed under the two clear-cutting systems is likely to be reduced in the future.

#### *Edaphic conditions*

The clearcutting models can be used on more or less all sites. At present Sitka spruce is used in the CSA on all these combinations except on dry sites with low production. In the future, many suitable highly productive sites should be regenerated with native woodland species in order to reach national forest policy goals that aim to increase the area forested with native woodland species rather than exotic conifers.

Sitka spruce will produce a higher economic revenue on suitable sites (=high production sites), lodgepole pine should be used on medium and low production sites. Clearcutting (lodgepole pine) today also is used on Moist and Wet sites with higher production.

### *Tree species*

The main tree species managed with the two clearfelling FMMs are Sitka spruce and lodgepole pine but there are a number of other species such as larch and Scots Pine, for more details see Table 11.

The average site should be planted with either Sitka spruce, but Norway spruce, Scots pine, Douglas fir are also options.

Low productive forest sites should be regenerated with lodgepole pine or bog restored and thus no longer be included as forest land.

The stands can be described as monocultures as 90% of the volume should be the principal tree species and 10% in broadleaves (or native conifers if the site isn't suitable for broadleaves).

New planting rules require a mixture of 10-15% broadleaf or conifers other than Sitka spruce and lodgepole pine in both afforestation and reforestation stands. These rules did not exist when most of the forest stands in the CSA were established.

### *Tree species composition*

The clearcutting systems aimed at and result in more or less pure stands (100%) of conifers including lodgepole pine. It is estimated that 80% of the stands in the CSA are monocultures, 15% have an admixture of 5-25% and the remaining 5% of the stands have an admixture of 25-50%. Afforestation and reforestation plantation rules in 2016 require that a minimum of 10% broadleaves are planted in the stand, depending on site suitability native conifers could make up these 10%. Most of the already established forest stands are homogenous as this was not a requirement previously. Most stands will therefore in the future have 5-25% admixture of other species, mainly broadleaves, DAFM (2015).

As lodgepole pine is a low nutrient demander, some Sitka spruce stands in areas where fertiliser use is restricted will be regenerated with lodgepole pine.

### *Rotation periods*

There is no regulation of the rotation period in Ireland. Generally final felling occurs when the most profitable timber assortments can be harvested from the forest (Forest Service 2000).

Optimal rotation periods are around 35-65 years on a financial rotation, which produces the most valuable distribution of timber assortments. Other conifers have slightly longer rotation ages than Sitka spruce on the same site, Coillte (2003).

Sometimes, operational management issues change the optimal financial rotation length, this can mean longer or shorter rotations. This could be for reasons such as access, adjacent forest's suitability for harvesting, wind risk, etc.

Especially for private forest landowners, rotation ages are shorter than the optimal financial rotation as these owners prefer to see the financial values of their forests being realised earlier than the optimal financial rotation.

In addition, forests are sometimes not thinned for various reasons (e.g. wind risk, not economically viable, not informed of its benefits, etc.) which means that rotation lengths are typically shorter.

### *Size of clearcuts*

Harvested area is regulated in the PEFC Irish Forestry Certification Standards. No clearfell coup size larger than 25 ha and woodland clear felling area must not exceed 25% in 5-year period (Forest Service 2008a, PEFC (Ireland) 2014). The 25 ha limit also applies to all harvest operations (i.e. non-certified forests) that are 6km upstream of FPM populations.

### *Forest regeneration*

Restocking takes place with planted stock typically. Natural regeneration is not typical for the Irish condition.

Some form of site preparation is used on 100% of the regeneration areas. Rather than using the technical definition of soil scarification where mineral soil is disturbed we refer to a wider definition called ground cultivation to include site preparation of deep blanket peat. The practical application is the same – to improve the growing site for seedlings. Mound and mound-and-drain are the most commonly used ground cultivation methods in the CSA. This number (100%) also includes regeneration sites that utilise still functioning ground cultivation method from the previous stand rotation. Replanting direct into clearfelling soil has been dried and resulted in large scale crop failure. (pers. Comm. Tony Clark).

Ground cultivation in Ireland can be divided into three systems:

Soil scarification (with mineral soil disturbance). This method is suitable only for free draining soils in eastern and southern Ireland, is done to a small extent in Ireland and not done at all in the CSA.

Mound-and-drain is the preferred ground cultivation method on wet mineral soils with a peat layer. Drains are dug in 12 m intervals to drain the peatland soils of Western Ireland. The spoils from the drain are laid out in small mounds at 2 m intervals and used as a planting medium for the seedlings.

Mounding only is done as described above but without adding drains. Mounding only is done on thick blanket peat where the old plough ribbon is no longer usable (see below).

Ploughing was the preferred ground cultivation method in the past, especially on sites with thick blanket peat, which is the dominating soil type of the CSA. The plough furrow acted as the drain and the plough ribbon as a planting medium. During reforestation, the plough ribbon from the first rotation is in many cases still present and reused as a planting medium. The impact of the first rotation crop causes the peat to be more friable and more mobile in water; since the risk of water runoff is increased, there is usually no new drainage carried out for reforestation.

Timber producing lodgepole pine is planted at 2500 seedlings/ha and the 1800 seedlings/ha stocking is used for fiber production on sites with a low yield class (Sitka spruce yield class  $\leq 12$ ) Source: Coillte (2003). Sitka spruce is planted at a 2500 seedlings/ha stocking.

### *Browsing and fencing*

There is little browsing threat from game and livestock on Sitka spruce in the CSA. Douglas fir and larches are the most susceptible conifers to browsing, but they only comprise up to 2% of the total forest area, so the annual regeneration area that is in need of fencing is very small.

### ***Introduced species***

Introduced (exotic species) are used to a large extent in Ireland, approx. 85% of the seedlings. Sitka spruce, origin North America, is traditionally the most commonly used species in Irish forestry, NFI (2013). Norway spruce, is used up to 5% of the seedlings. Lodgepole pine, origin North America, is traditionally the second most used species in Irish forestry, NFI (2013).

### ***Genetically improved or modified seedlings***

Many seeds are sourced from stands all over Ireland which have been identified as having superior genetics for providing the objectives of Irish forestry, i.e. good quality timber. For this reason, it is difficult to know the extent to which non-local seed sources are used. All (100%) of seeds/seedlings used are genetically improved (Coford, 2012). Tree breeding still has a lot of potential in increasing favourable tree features and the forest sector hasn't developed to this stage as of yet.

### ***No genetically modified seeds/seedlings are used.***

Hybrids are used very rarely in Irish forestry. A small amount of hybrid larch (*Larix x eurolepis*) is used in Ireland but not in the CSA.

### ***Herbicides and chemicals used***

Herbicides are used where vegetation competition is high; a treated plantation receives 2-3 applications in a rotation age.

Seedlings are coated in insecticides prior to planting and sometimes sprayed in the field to protect against large pine weevil (*Hylobius abietis*).

Trials are being done where a solution with entomopathogenic nematodes are being sprayed on stumps to reduce the number of emerging large pine weevil.

Fungicides are rarely used in Irish forestry, but stumps are painted with urea to prevent future damage from *Heterobasidium annosum* (Fr.) Bref.

A general trend in Irish forestry is that the number of available chemicals and the quantity at which they are used are being reduced. Source: Dillon & Griffin (2008).

### ***Fertilisation***

The majority of the public afforestation that took place on blanket peat is in need of fertilisation to successfully establish plantations of coniferous including lodgepole pine. One application at establishment is usually sufficient to get the stand started, but a second application might be necessary in some cases. Private afforestation is generally done on more productive sites and is not as dependent on fertilization as the public blanket peat forestry.

### ***Nature protection/consideration***

All afforestation plantations must contain a minimum 10% of broadleaves as Areas of Biodiversity Enhancement (ABE).

When an area is proposed for afforestation, it is necessary to give special regard to nature protection by identifying ABEs and rank them according to environmental sensitivity. ABE must

comprise 15% of the afforested stand (may be reduced to 10% if the stand is smaller than 10 ha). ABEs consist of both open habitat (5-10% of the stand) and retained habitat (5-10% of the stand). Open habitats are setbacks for water (aquatic buffer zone), setbacks around roads and archaeological setbacks. Retained habitats are existing habitats like areas of scrub, non-high forest species, individual high forest species and hedgerows.

Identifying ABEs are crucial to ensuring that proper buffer zones are established around certain environmental features when afforested. However, ABEs can consist of anything from native woodland species acting as an aquatic buffer zone around a FPM watercourse to some birches and alders planted in a spruce stand, far away from any sensitive environmental feature. To some degree, ABEs can thus very similar to the Swedish FMM “Nature conservation with management” since active management is necessary to establish them and to some degree maintain them. This would justify describing them as their own FMM but it is a fairly new concept and a very broad definition.

There is a requirement to have minimum 10% broadleaves or suitable conifers (not Sitka spruce or lodgepole pine) in conifer and 10% suitable conifers (see above) in broadleaf plantations for reforestation. Special reforestation objectives exist to ensure the establishment of native woodland species in aquatic buffers for biodiversity protection, these areas are described as a different FMM.

Additionally, large parts of the CSA’s forests are within or adjacent to proposed Natural Heritage Area (pNHA), Special Areas of Conservation (SAC) or a FPM watershed which restrict possible forestry prescriptions.

### 3.7. Clearcutting system conifers: Sitka spruce

Today the FMM clearfelling conifers/Sitka is used on 50-55% of the area but could be used on 55-60%.

#### *Tree species*

The main tree species managed with the clearfelling model conifers are: Sitka spruce, Norway spruce (*Picea abies* (L.) H. Karst.), Douglas fir, (*Pseudotsuga menziesii* (Mirb.) Franco.), Japanese larch (*Larix Kaempferi* (Lamb.) Carr.), and Scots Pine, (*Pinus sylvestris* L.)

Sitka spruce is used on approximately 90% of all stands in this model and the principal tree species account for approximately 95-100% of the stand volume. The tree species mentioned above are also used but to a lesser extent.

#### *Stand management*

##### **Pre-commercial thinning**

Pre-commercial thinning, PCT, is not used or used only in up to 5% of the established stands in this FMM. Sitka spruce has fast diameter growth in its juvenile stage and opening up the stand too early would promote the growth of undesirable juvenile wood. Due to naturally slow self-pruning it is beneficial to grow young Sitka spruce at a tight spacing.

Productivity in Ireland is generally so high that the first commercial thinning occurs before the stand starts experiencing stunted growth or heavy competition from undesired species. Due to Ire-

lands forest estate recently being established there is little natural regeneration of broadleaf species in most conifer stands that would justify pre-commercial thinning.

### **Commercial thinning**

Thinning is rather uncommon in this FMM, 25-35% of the stands are thinned one or more times during a rotation. Thinning should be done where appropriate, taking risk and demand factors into account. Forests dominated by blanket peat become unstable after commercial thinning which increases the risk of windthrow and there is no recommendation to increase or decrease the proportion of thinning.

### **Pruning**

Pruning is not done, and it is not recommended.

### **Harvest and logging residues**

Harvesting and wood extraction in this FMM is fully mechanized.

Logging residues, e.g. branches >5cm are removed only removed from fertile sites, Yield class  $\geq 18$ . It is financially neutral to carry out this process. The benefits of carrying it out are that there is more biomass supply and replanting is easier (where logging residue isn't extracted, it is windrowed to make planting easier) and the disadvantages are that nutrients are carried off-site and increased risk of rutting and soil compaction.

## **3.8. Clearcutting system: lodgepole pine**

This FMM is in many aspects similar to clearcutting system (conifers). But it has been recognized as an own FMM.

### *Tree species*

Lodgepole pine is now growing on 25-30% of the area in the CSA and all managed with the clear-felling system.

In the future the proportion of lodgepole pine will decrease to 20-25%. Recent changes in forest policy has resulted in a different value extraction from Irish forestry and thus timber production is no longer the only goal.

Despite biodiversity concerns, lodgepole pine is a suitable species on nutrient poor sites and will produce timber and pulpwood even if established with low stocking where clearcutting and reforestation of other more site demanding conifers are not an option because restricted use of fertilisers (Pers. Comm. Tony Clarke, Forest Service (2008b) Forest Service (2015)).

### *Stand management*

#### **Pre-commercial thinning**

Pre-commercial thinning is not done in FMM/lodgepole pine. Productivity in Ireland is generally so high that the first commercial thinning occurs before the stand starts experiencing stunted growth or heavy competition from undesired species. Due to Ireland's forest estate recently being

established, there is little natural regeneration of broadleaf species in most lodgepole pine stands that would justify pre-commercial thinning.

### **Thinning and pruning**

Thinning or pruning are not done in lodgepole pine in the CSA.

### **Harvest**

Harvest is 100% mechanized. Logging residues, e.g. branches >5cm, are in some stands extracted. It is financially neutral to carry out this process. The benefits of carrying it out are that there is more biomass supply and replanting is easier (where logging residue isn't extracted, it is windrowed to make planting easier) and the disadvantages are that nutrients are carried off-site and increased risk of rutting and soil compaction. For this reason, logging residues are only removed from productive sites, i.e. YC(Yield Class)  $\geq 18$ .

### **3.9. FMM for Nature conservation and biodiversity protection**

This FMM don't include any active management. Today approx. 10-15% of the area in the CSA is left for no management for nature conservation and biodiversity protection. The ambition is to leave around 15% of the area. This number is an estimate based on forested area and does not include large open spaces with biodiversity protection, however small open spaces that are integrated in the stand as retained Area for Biodiversity Enhancement (ABE) are included in the number. This 15% area includes water setbacks (aquatic buffers), woody habitat, scrub forest, Native Woodland Site (NWS) Conservation and other forests with biodiversity and conservation designation.

The number is difficult to estimate properly and is based on a national goal for establishing ABEs as a way to diversify the Irish forest industry to accommodate biodiversity and social values along with timber production (which was the main reason for the national afforestation project that started in the 1920s and continues to this day). The forested portion of ABEs and other protected forest areas should comprise 15% of the total forested area in the CSA.

It is important to understand that nature conservation and biodiversity protection in Irish forestry often incorporates areas that are not forested, this is due to Ireland historically being heavily deforested and only gaining a significant forest area in recent years. Most historically forested areas have been converted into agricultural land and much of the current forested area was historically blanket peat. Thus, a wider nature conservation approach is often taken in Irish forestry to include non-forested adjacent land that has high biodiversity values (e.g. open bog habitat and lakes). Policy zones such as Special Areas of Conservation (SAC, designated according to the EU Habitats Directive), Special Protected Areas (SPA, designated according to The EU Birds Directive), National Heritage Areas (NHA, basic Irish statutory designation for wildlife habitat protection) and Proposed National Heritage Area (NHA, non-statutory designation for wildlife habitat protection) are often designated to protect non-forest land. Thus, forests that fall inside a SPA, SAC, NHA or pNHA are often subjected to regulated operation in consultation with a Forest Service official, but timber production can still be the main objective. For example: according to a management plan, large areas of the forest might be in a SAC, but if the SAC is meant to protect an adjacent bog it might only regulate forest operations adjacent to the SAC rather than restrict all forest operations

inside the policy zone. Such a forest would not be included in this FMM but would be described in the conifer FMMs, with regulation of operations done on a case by case basis. Additionally, areas such as open peat land, unplatable land, waterbodies and swamps may be included in a forest management plan as land with a biodiversity or conservation objective, but we try not to include those areas when referring to this FMM. (Forest Service (2015a) Forest Service (2015b) Forest Service (2015c) Forest Service (2016)).

The difference between ambitions of 15 % of the area and today's 10-15% depends is mainly due to nature protection policies that were not in place when the current forest was established. When an area is proposed for afforestation, it is necessary to give special regard to nature protection by identifying ABEs and rank them according to environmental sensitivity. ABE must comprise 15% of the afforested area (may be reduced to 10% if the site is smaller than 10 ha). ABEs consist of both open habitat (5-10% of the site) and retained habitat (5-10% of the site). Open habitats are setbacks for water (aquatic buffer zone), setbacks around roads, open areas for biodiversity and landscape amenity, and archaeological setbacks. Retained habitats are existing habitats like areas of scrub, non-high forest species, individual high forest species and hedgerows. Identifying ABEs are crucial to ensuring that proper buffer zones are established around certain environmental features when afforestation occurs. However, ABEs can consist of anything from native woodland species (native broadleaves and Scots pine (*Pinus sylvestris* L.)) acting as an aquatic buffer zone around a FPM watercourse to some birches and alders planted in a spruce stand, far away from any sensitive environmental feature. To some degree, ABEs can be very similar to the Swedish FMM "Nature conservation with management" since active management is necessary to establish them and to some degree maintain them. This could justify describing them as their own FMM but it is a fairly new concept and a very broad definition.

When reforestation happens, there is a requirement to have a minimum 10% broadleaf area or diverse conifers (i.e. not Sitka spruce) or lodgepole pine in conifer plantations and 10% suitable conifers (see above) in broadleaf plantations. Special reforestation objectives exist to ensure the establishment of native woodland species in aquatic buffers for biodiversity protection.

Source: Forest Service (2015a) Forest Service (2015b) Forest Service (2015c) Forest Service (2016).

### *Tree species*

Any species could technically be used, but other species than Sitka spruce and lodgepole pine are encouraged.

Acceptable species for NWS establishment are listed below, suitable species for the site depend on the soil type.

*Alnus glutinosa* (L.) Gaertn., *Betula pendula* Roth., *Betula pubescens* Ehrh., *Quercus petraea* L., *Quercus robur* L., *Pinus sylvestris* L., *Populus tremula* L., *Prunus avium* L., *Salix cinerea* L., *Sorbus aucuparia* L., *Taxus baccata* L. and many, bushy small-trees. *Fraxinus excelsior* L. is a NWS species, but the planting of European ash is currently not allowed on new afforestation sites in Ireland due to risk from the ash dieback fungus (*Hymenoscyphus fraxineus*). Forest Service (2015b) Forest Service (2015d).

### *Ecosystem services*



Wood production is not important for this FMM, see also Table 13 above. The ecosystem services are ranked;

1. Habitats protection for invertebrates, fungi, deer, red squirrel, birds, plants etc.
2. Water quality for salmonids, freshwater pearl mussel and other aquatic species
3. Carbon sequestration
4. Recreation and tourism
5. Landscape amenity

### ***Management***

There is normally no or very sparse interventions in this FMM. Planting is often necessary in order to establish the desired native species on site when New Native Woodlands Sites (NWS) are established. Subsequent management may be necessary in order to maintain the desired species composition (e.g. removing shade tolerant conifers from broadleaf plantation). On some sites, small amounts of environmentally sensitive timber extraction is allowed which would make the FMM most similar to D. Selection system.

As described above, nature protection has broad definitions that do not always focus on the protection of the forest but of the surrounding land-uses; also ABEs can vary in their make up so it is difficult to separate groups, hence this is a combined nature conservation and biodiversity protection FMM.

### **3.10. References**

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