# Forestry and Freshwater Pearl Mussel Requirements

# Site Assessment and Mitigation Measures

Forest Service
Department of Agriculture, Fisheries and Food

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# 1. INTRODUCTION

## 1.1 OVERVIEW

Ireland is committed to the principles of Sustainable Forest Management (SFM). As the national regulatory body for forestry, the Forest Service of the Department of Agriculture, Fisheries and Food implements SFM through its environmental guidelines, the *Code of Best Forest Practice – Ireland* and its inspection and monitoring procedures. To further develop its commitment to environmental protection, the Forest Service has developed this document through public consultation, in order to assist in the protection and conservation of the Freshwater Pearl Mussel (FPM) and its habitat. The measures outlined in the *Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures* (hereinafter called the *Requirements*) complement existing Forest Service Guidelines and other measures which contribute to the protection and enhancement of water quality, the conservation of flora and fauna, the sequestration of carbon and the prevention of climate change.

The freshwater pearl mussel (*Margaritifera margaritifera and Margaritifera durrovensis*) is protected under the Habitats Directive (92/43/EEC) and the Wildlife Acts (1976, amended 2000). Based on the most recent assessment Ireland has 46% of the EU FPM individuals. This species is currently in decline throughout the island of Ireland and the rest of Europe. Both sedimentation and nutrient enrichment from a variety of land uses and other activities have contributed significantly to this decline.

The *Requirements* will apply to all potentially impacting forest operations within the catchments of FPM populations in rivers designated candidate Special Areas of Conservation (cSACs) for the species, as listed in Appendix 1. This list will be reviewed on an annual basis by the National Parks and Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government in consultation with the Forest Service. The *Requirements* describe a range of measures intended to reduce potential negative impacts on the species arising from forest operations and supplement all other Forest Service Guidelines and regulations.

A considerable proportion of the forested areas in the designated FPM catchments were planted in the 1960s and 1970s and the soil types are generally unstable at medium to high elevations and the risk of windthrow is high. Consequently sensitive management is required in these areas to minimise the potential impact on FPM. Therefore, the indefinite deferral of harvesting operations is not a sustainable option as windthrow potentially carries a greater risk of sedimentation and nutrient enrichment than harvesting where appropriate mitigation measures are implemented.

Measures are necessary to mitigate potential sediment and nutrient losses to FPM cSAC rivers. Forest operations such as afforestation, harvesting and road construction are a potential source of sediment and nutrients (particularly phosphorus) to rivers. The *Requirements* aim to characterise forest sites, with the objectives of:

(i) identifying areas that have a high risk of sediment and/or nutrient loss;
(ii) assessing the likelihood that such sediment and/or nutrients will reach the FPM;

(iii) specifying appropriate mitigation measures to prevent/reduce such losses.

Understanding the sources and pathways of sediment and nutrients loss from the site to the aquatic zone is critical to the achievement of these objectives. This understanding will be enhanced through research and monitoring of both the effectiveness of the *Requirements* and water quality. The resulting information will then be used to review the *Requirements*.

Where a site assessment (Appendix 2) is required or requested by the Minister for Agriculture, Fisheries and Food this assessment will form part of the application for prior approval or Felling Licence. It is the responsibility of the landowner or the applicant to present this assessment to the Forest Service with the application for approval or licence.

The mitigation measures recommended in the *Requirements* will have to be tailored to specific site needs, based on site assessments. It is the responsibility of forest owners to identify and apply those measures that are appropriate to their particular site. The mitigation measures identified by the forest owner will be considered by the Forest Service and mitigation measures deemed appropriate by the it will become conditions of the approval/licence. In publishing the *Requirements*, the Forest Service recognises and is fully supportive of a catchment-based approach to the protection of FPM under the Water Framework Directive and Habitats Directive. These approaches will address all potential impacting activities in FPM catchments.

## 1.2 SCOPE OF THE *REQUIREMENTS*

The *Requirements* have been developed using available scientific knowledge about the species, its requirements and potential impacts from forestry operations. The *Requirements* are intended to minimise current impacts and seek to prevent any future detrimental impacts on FPM from forests and associated activities. However, there are knowledge gaps. Consequently, monitoring and research are essential in order to establish the effectiveness of the measures detailed below. Therefore, the *Requirements* will be reviewed based on their effectiveness following implementation, on monitoring results (chemical and biological) and on new research findings including the results of the Owenriff Working Group[1].

In the *Requirements* Chapter 2 provides background information including details on the life cycle of FPM. Chapter 3 outlines where the *Requirements* apply and appropriate mitigation measures.

There are 25 river systems designated as cSAC for the FPM (Appendix 1). While the cSAC boundary is often confined to the waterbody or its immediate environs, activities occurring elsewhere within the catchments of these river systems and

[1] The Owenriff Working Group was established in August 2004 with the aim of determining best practice in relation to forest management in the Owenriff Catchment, Co. Galway, for the conservation of FPM. The working group includes representatives from the Forest Service, NPWS, Coillte, the Environmental Protection Agency (EPA), Western Regional Fisheries Board, Galway County Council and the Western River Basin District Project.

upstream of the FPM population can impact on the FPM, even if the activities are taking place outside the cSAC boundary.

A catchment can be simply defined as the area from which a river or lake derives its water, i.e. the land area drained by the river system. The FPM catchment is the section of the catchment that contributes water to the FPM population. Existing Forest Service procedures already include the referral of any sites within 3km upstream of a pNHA, NHA, cSAC, SPA or National Park to the NPWS for consultation. While the Forest Service Guidelines apply in all circumstances, the more specific mitigation measures detailed in these *Requirements* will be mandatory in specific locations and circumstances in the FPM catchments. Within these catchments particular emphasis is placed upon the area that lies within 6km hydrological distance of an identified FPM population. Maps of the areas covered by the *Requirements* will be available through the Forest Service Forest Industry Mapping System (FIMS).

The hydrological distance is measured along the path water takes from the site through the drains and streams to the nearest downstream FPM population. The distance of 6km was derived from:

(a) the likelihood of P reduction from dilution from other streams downstream of the source, allowing for the re-suspension of P to be retained in the stream benthos
(b) the distance over which the effects of sediment trap overflow have been observed
(c) uncertainty with regard to P dynamics in Irish FPM streams (i.e. lack of site-specific data)
(d) the low threshold of sensitivity of juvenile FPM to phosphorus concentrations
(e) the requirement that there must be no reasonable scientific doubt regarding the absence of significant adverse effects.

It was also selected to best represent the balance of views of the three chambers (economic, social and environmental) of Sustainable Forest Management. It will be subject to review based on the monitoring results.

# 2: BACKGROUND INFORMATION

## 2.1 SITE CONDITIONS

The information in this section is based on the 'source-pathway-receptor' model used in the Water Framework Directive. It deals first with the sources of sediment and nutrients, then describes the pathways by which sediment and nutrients reach the aquatic zone, and finally details the sensitivity of the FPM to sedimentation and nutrient enrichment.

In assessing the risk of sedimentation and/or nutrient enrichment from a site, it is important to know the sources of nutrients and the soil type, and to understand the pathway by which water carrying sediment and nutrients moves into the aquatic zone.

### 2.1.1 Sources of nutrients

Research has shown that on some sites, peaty soils in particular, significant amounts of nutrients can be lost to ditches and small streams during various stages of the forest cycle. The three main sources of nutrients are:

- Fertiliser.
- Decaying organic matter.
- Sedimentation.

#### 2.1.1.1 Fertiliser

During the initial afforestation stage, fertiliser may be applied to the crop. Where required ground rock phosphate is applied between April and August, with the maximum rate of application dependent on the site type. No fertiliser is applied on enclosed and recently farmed land. Where required 250 kg/ha is applied on enclosed and not recently worked land and 350 kg/ha on unenclosed land. Further details are available in the *Forestry Schemes Manual* and other publications. Fertiliser may also be applied during the life cycle of the crop, where foliar analysis indicates that there is a nutrient deficiency. The use of aerial fertilisation is limited, requires prior approval and is regulated by licence from the Minister of Agriculture, Fisheries and Food. Second rotation crops are generally not fertilised unless foliar analysis indicates a nutrient deficiency.

#### 2.1.1.2 Decaying organic matter

The brash and dead roots left on site after thinning are also a potential nutrient source but generally the remaining crop takes up these nutrients. During clearfelling there is a higher potential for nutrient loss as there are no living tree roots left to take up the nutrients. Any organic matter (particularly recently dead material such as brash or roots) that is left on site to rot will release phosphorus and nitrogen. The breakdown of brash, roots and other organic matter takes a number of years. Potentially, therefore, a clearfell site may continue to release phosphorus to the aquatic zone for at least three years after clearfelling. The rate of decomposition is influenced by temperature, moisture and humidity. Consequently, phosphorus loss tends to be greatest during the warmer months and may be particularly problematic during a flood event following a prolonged hot and dry period. The potential impact on water quality and the FPM is greatest at this time of the year.

2.1.1.3 Sedimentation

Sediment can carry nutrients either adsorbed or chemically bound to the particles; some of which is bio-available or can become available depending on changes in the chemical environment.

### 2.1.2 Sources of sediment

The main sources of sediment in forest activities are as follows:

- Disruption of the soil surface, causing the subsoil to be exposed to erosion and eventually the transportation of the finer particles by overland flow.
- Weathering of parent material resulting in particle movement by overland flow.
- The transportation of loose or decaying organic particles.

In the *Requirements*, particles from any of these sources are referred to as sediment while in suspension and their accumulation on a streambed is referred to as sedimentation.

### 2.1.3 Soils

For the purposes of the *Requirements*, soils have been divided into three broad categories:

- **Peaty soil:** Any soil with a depth of 30cm or greater of a peat/humus layer. A 30cm depth was selected, as this is the depth of mound and plough drains. Therefore, if the depth of peat is less than 30cm, there is an increased probability that the water will come in contact with mineral soil, thereby reducing the risk of nutrient loss.
- **Mineral:** All non-peaty soils. Mineral soils have a greater capacity than peaty soils to retain nutrients, and generally pose a lower risk of sediment loss.
- **Erodable soils:** Soils that are known to result in sediment release from the site, particularly during and after heavy rainfall. See also Table 3 Assessment of Soil Erodability.

### 2.1.4 Pathways

The main losses of nutrients and sediment are associated with water moving through the site to the aquatic zone. Rainfall falling on the site reaches the aquatic zone through three main pathways:

- **Over surface:** Surface run-off tends to occur more frequently on impermeable soils such as peat or heavy clays or on very thin soils over bedrock or iron pans. It is most evident during heavy rainfall.
- **Through the soil/subsoil:** This pathway is associated with highly permeable soils, e.g. brown earths and brown podsols.
- **Through drains/channels flowing directly from the site to the aquatic zone:** This pathway also includes temporary drains (in which water may not be permanently present) that may only operate during and immediately after rainfall.

The speed of water flow in drains will determine whether the drains can reduce the amount of sediment and/or nutrients being lost to the aquatic zone. If a drain (either permanent or temporary) is devoid of vegetation, water velocity is generally higher. For example, bare peat drains are regularly encountered in blanket bogs. The fastest water velocities generally result in the development of gravel beds in drains. Bare,

eroding drains will rapidly transport nutrients and sediment to the aquatic zone, and should be treated as relevant watercourses (see glossary). Where a drain (whether permanent or temporary) is covered with vegetation and the water flows slowly or ponds, sediment may settle out and phosphorus may be taken up in plant growth. However, such drains are unlikely to operate as effective sediment traps or nutrient sinks during heavy rainfall.

### 2.1.5 Slope

Steeper slopes lead to greater soil erosion and more rapid nutrient loss. Surface runoff is faster on a steep slope, resulting in less contact between water and the soil and vegetation, and less time for sediment to settle out or nutrients to be taken up. For the purpose of the *Requirements*, the slope categories are as follows:

**Table 1. Slope Categories**

| Slope | Slope category |
|---|---|
| Even to 1-in-7 (<15%) | Moderate |
| 1-in-7 to 1-in-3 (15–30%) | Steep |
| 1-in-3 or greater (>30%) | Very steep |

### 2.1.6 Nutrient transportation

Phosphorus loss is generally considered more significant than nitrogen loss, as this is typically the limiting nutrient in Irish aquatic zones. Phosphorus will behave differently in different soil types. Mineral soils will bind phosphorus, particularly if they are strongly acid or if they have a high clay content (sticky soils). Peaty soils have very little capacity to bind phosphorus.

Nutrients in both dissolved and particulate forms move with the water leaving the site, either across the surface, through the soil or through drains. The greatest amount of nutrients is lost during or immediately after heavy rainfall.

The ability of a site to retain nutrients is influenced by soil type (Table 2). Research has shown that, because peaty soils have little or no ability to bind phosphorus, this nutrient can be released from clearfell sites on >30cm peat/humus layer and washed into nearby watercourses. On soils <30cm peat/humus layer, there is often enough contact with mineral soils to bind the phosphorus, thereby reducing the risk of its release into watercourses. There are two high risk categories in terms of phosphorus loss, namely sites with peat greater than 30cm in depth and covering more than 50% of the area and sites with peat greater than 30cm in depth, covering more than 20% of the area and concentrated along the aquatic zone. Drained peat is also highly erodable and can give rise to sedimentation. If there is peat adjacent to the aquatic zone, any brash/roots allowed to break down in this area will release phosphorus directly to the water. Where peat is adjacent to the aquatic zone, the buffer zone will be ineffective in binding the phosphorus to the soil. Buffer zones in such situations will only operate through uptake by vegetation. The greatest risk of phosphorus loss following harvesting is therefore expected to be on deep peat sites. The effects of phosphorus on FPM are mainly indirect and relate to the triggering of algal blooms (Section 2.2.4).

**Table 2. Assessment of Risk of Nutrient Loss**.

| Soil type | Risk |
|---|---|
| Mineral soils | Low |
| Peaty soils | High |

There are two main mechanisms by which the amount of nutrients reaching the aquatic zone can be reduced, providing that the water velocity can be slowed:

- **Adsorption:** If the water is brought in contact with mineral soil, phosphorus may bind to the clay and mineral particles. This requires sufficient contact between the water and the mineral soil. Consequently, binding is most effective if water percolates into mineral soil. Once water begins to flow over the surface, the binding potential is greatly reduced.
- **Uptake:** If the water flows slowly through vegetation plants may take up phosphorus and nitrogen for growth. This occurs most effectively where water runs slowly and percolates into the litter layer or soil of a well-vegetated buffer zone.

### 2.1.7 Sediment transportation

Best forest practice aims at minimising sediment mobilisation. Where soil is disturbed or exposed (i.e. little or no vegetation), there is a risk of soil erosion. Where certain soil types (e.g. peaty soils, sandstone derived soils) and steep slopes occur together, there is a greater risk of soil erosion and subsequent sedimentation. It should also be noted that subsoils may be more prone to erosion than the associated top soil. The erodability of a site may be assessed based on relevant factors (Table 3) such as

- **Parent material:** Parent material comprising non-consolidated material represents a high risk.
- **Soil type:** Soil type is linked to geology. Soils with a high clay content (sticky soils, e.g. gleys) are less likely to erode than those that are friable in nature (e.g. soils derived from Old Red Sandstone).
- **Slope:** Generally the steeper the slope, the greater the likelihood of soil erosion.
- **Climate:** Erosion is linked to climatic severity, which varies with altitude and exposure.

One of the best sources of information is local knowledge and this should be used where possible.

Soil particles move during and immediately after heavy rainfall, with heavier rainfall resulting in the movement of larger soil particles. If rainfall runs off the soil surface or through drains, there is a risk of sedimentation. If the water percolates into the soil, the risk of sedimentation is low. Steep slopes lead to rapid surface run-off and fast flow in drains, and represent the highest risk of sedimentation. Rivers and streams transport sediments downstream as either suspended solids or as part of the bed load.

**Table 3. Assessment of Soil Erodability**.

| Soil type | Slope Class | | |
|---|---|---|---|
| | **Even to 1 in 7 (<15%)** | **1 in 7 to 1 in 3 (15–30%)** | **1 in 3 or greater (>30%)** |
| Less erodable (e.g. gleys) | Low | Low | Medium |
| Erodable (e.g. brown earths) | Medium | High | High |
| Very erodable (e.g. podsols, most peats) | High | High | High |

There are four main mechanisms by which the amount of sediment reaching the aquatic zone can be reduced:

- **Minimisation of soil disturbance:** Reduction of soil disturbance minimises the generation of sediment.
- **Settlement:** where the water ponds or flows slowly, with particles subsequently settling out of suspension.
- **Filtration:** where the water flows slowly through the vegetation and litter layer, e.g. in buffer zones/strips, both act as sieves to filter out particles.
- **Brash mats:** Soil can be protected by the use of brash mats along routes where machinery is obliged to travel.

Soil erosion can continue to occur as long as there is exposed soil on site. In practice, this means that erosion can occur until the soil has been stabilised by vegetation cover.

### 2.1.8 Site retention capacity

Tree canopy and ground vegetation cover can influence the ability of the forest to retain sediment and nutrients. The canopy intercepts a significant proportion of incoming rainfall, which, consequently, never reaches the ground. Following clearfelling, more water reaches the soil due to the absence of the tree canopy and the lack of absorption by the tree root system. In general, ground vegetation (herbaceous plants and mosses) cover is reduced in closed canopy forests, and when the trees are felled, the likelihood of phosphorus being lost is increased. Ground vegetation can help retain phosphorus on site by taking it up for growth as it is released from the decaying brash and roots. Ground vegetation can also help to remove sediment, by filtering it out of the water and/or by aiding infiltration into the ground. The ability of a site to retain nutrients and sediment can be referred to as the ‘site retention capacity’ or ‘internal buffering’. Vegetated ridelines and natural depressions within the forest can be particularly effective in retaining nutrients and sediment. The effectiveness of such features depends on the amount of run-off intercepted before it reaches the aquatic zone. For example, a vegetated rideline that runs parallel to the aquatic zone will generally intercept a much greater volume of water than one running at a right angle.

## 2.2 FRESHWATER PEARL MUSSEL

### 2.2.1 Taxonomy

There are approximately 20 species of freshwater bivalves in Ireland, including two species of FPM. *Margaritifera margaritifera* is found in rivers with clean, well-oxygenated riverbeds that generally flow over granite or sandstone rock. *Margaritifera durrovensis* is the hard water species of pearl mussel that only occurs in Ireland. It is restricted to one small population in the River Nore.

### 2.2.2 Life cycle

The life cycle of the FPM is a complex and precarious one. The adults are long-lived, with *M. margaritifera* surviving for over 100 years and *M. durrovensis* living to 50-60 years of age. The mussels mature between 7 and 15 years and remain fertile into old age. They can grow up to 14cm in length. The FPM uses its muscular foot to anchor itself to the riverbed. It feeds by sieving food particles from the river water, which is pumped in and out by a pair of siphons.

The sexes are generally separate. The males shed sperm into the water through their exhalent siphons in early summer (June to July). The females inhale the sperm, and fertilisation occurs in brood chambers. The larvae, known as glochidia, develop and are brooded for a number of weeks before being released to the river between July and September. This release is a sudden, highly synchronised event, usually lasting over one or two days. The timing of glochidial release varies among populations and is probably triggered by temperature or other environmental factors. Reports on the number of glochidia released by each female vary, with figures between 0.2 million and 28.4 million cited.

When the glochidia leave the female, they are 0.06-0.07mm long and resemble tiny mussels, with their shells held open. If inhaled by a salmonid fish, the glochidium attaches to the gill filament by snapping shut its shell. Although mostly occurring within a few hours, attachment can occur up to 6 days after release from the female. Typically, 99.9% of the glochidia fail to find a host within 24 hours. The association does not appear to harm the fish and allows young mussels to colonise new areas upstream. The hosts for *Margaritifera* glochidia in Ireland are young native salmonids (first three year classes).

The glochidia remain attached to the host's gills for 9–11 months. They are nourished by the fish and increase to about six times their original length. However, large numbers of glochidia probably fall off and die during the period of attachment (95% loss recorded in a laboratory study). *Margaritifera* glochidia drop off the host fish from May to mid-July and must land in clean gravelly substrates. At this stage, they are only 0.5mm in length. The young mussels bury themselves into the gravel and remain buried for about 5 years, until large enough to withstand the flow of open water. It is likely that as few as 5% of the mussels that fall off fish survive to reach 3-6 years of age.

### 2.2.3 Threats to the FPM

FPM is found naturally only in well-oxygenated rivers with clean gravelly riverbeds. Therefore, a number of activities and factors at catchment level may impact upon the animal itself and/or its habitat, including pollution incidents, agriculture, forestry,

road building, pearl fishing, drainage, river bank and bed erosion and modification, water abstraction, the introduction of exotic species, salmonid stocks, climate change, domestic septic tanks and malpractice in the storage and application of slurries. Many of these activities and their consequent impacts are outside the remit of these *Requirements*.

### 2.2.4 Impacts of sedimentation and nutrient enrichment

While sedimentation can impact on any life stage of the FPM, the first five years, during which the juvenile mussels are buried in the sand and gravel, are by far the most sensitive. During this time, exchange of water between the river and the substrate is essential in order to provide the young mussels with sufficient oxygen and food. Sediment clogs the gaps in the riverbed, which impedes the movement of water. This results in the death of juveniles by oxygen starvation. Plumes of sediment can also cause adults to close up in order to prevent clogging of their gills. Prolonged closure can lead to the death of the adults through oxygen deprivation or starvation. Less extreme conditions can also have adverse impacts, for example, by causing the female to prematurely release the glochidia.

Nutrient enrichment is the increase in the concentration of nutrients such as phosphorus and/or nitrogen in the water. Phosphorus and nitrogen compounds can be directly toxic to FPM. However, nutrient enrichment is most likely to impact on the mussels indirectly through increased growth of algae or macrophytes. Increases in phosphorus and/or nitrogen during the growing season result in filamentous algal growths in rivers. The algae can block water exchange between the river and the river bed substrate, thereby reducing the oxygen concentration in the substrate and leading to juvenile deaths. In the worst case, dense growths of algae can lead to night time oxygen depletion in the water column. If these conditions are sustained, adult deaths occur. This situation is then exacerbated when the algae die and begin to decompose *in situ*, further clogging the substrate and reducing oxygen levels in the water column.

### 2.2.5 Conservation of the FPM

The European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) lists *Margaritifera margaritifera* under Annex II (species of Community interest whose conservation requires the designation of special areas of conservation) and Annex V (species of Community Interest whose taking in the wild and exploitation may be subject to management measures). This Directive was transposed into Irish law by the 1997 Habitats Regulations and its amendment of 2005. The species is also protected under the Convention on the Conservation of European Wildlife and Natural Habitats. It is listed as 'Endangered' on the International Union for Conservation of Nature and Natural Resources (IUCN) Red Data List while *M. durrovensis* is listed as 'Critically Endangered'. In Ireland, *M. margaritifera* is protected under the Wildlife Act 1976 and Wildlife Amendment Act 2000. To date 19 cSACs have been designated for *M. margaritifera* and one for *M. durrovensis*, the only known site in the world (Appendix 1).

Under the Habitats Directive Ireland is required to conserve the populations and habitat of the FPM so that it achieves Favourable Conservation Status i.e. its populations need to be viable and stable or increasing and its range in Ireland needs to be stable. Recent surveys of Ireland's better FPM sites have shown that none of them can be considered in favourable conservation status. In the 2007 national

Conservation Assessment report to the European Commission, required under Article 17 of the Habitats Directive, both FPM species were given the lowest possible rating, "Unfavourable Bad". This assessment is based on 4 criteria namely Range, Population, Area of Suitable Habitat and Future prospects. The last three parameters were assessed as "Unfavourable - Bad" for both species of FPM because there are no viable populations remaining, the habitat is not considered suitable for the recruitment of juveniles and the threats are too great to ensure the long-term survival of the species. This assessment confirms their extremely precarious conservation prospects (further information www.npws.ie).

It is recognised that the maintenance and restoration of fresh water pearl mussels require extremely high water and substrate quality. As a result, Ireland is currently preparing FPM Regulations to give statutory effect to a range of biological and physical targets for FPM cSAC rivers. Biological targets will be set for mussel population structure (e.g. for juvenile recruitment: at least 20% of population ≤65mm in length and at least 5% of population ≤30mm in length; and for adult survival: numbers of dead shells <1% of the population), and cover abundance of filamentous algae and macrophytes (trace/present, ≤4% cover). Targets will also be set for water quality indicators such as diatoms and macroinvertebrates. These will correspond to Water Framework Directive values for "high status" sites, i.e. those rivers that correspond totally or nearly totally to the natural, undisturbed conditions. In addition to these biological elements, it is also proposed to establish operational targets for the degree of siltation of the substratum. It should be further noted that under the Water Framework Directive that the water quality requirements of FPM cSACs must be met by 2015. To achieve this target and meet the requirements of the Habitats Directive for the FPM the Regulations will require the production of FPM catchment management plans, called sub-basin plans, by the end of 2009,for all the sites listed in Appendix 1. These plans will deal with impacts on FPM arising from all landuses and activities in the FPM catchments. In the meantime no deterioration in water quality is allowed under both the Phosphorus Regulations and Water Framework Directive. It is expected that this 'no deterioration' requirement will be further strengthened by forthcoming regulations under the WFD and that interim operational targets will be specified for FPM under the FPM regulations. Adherence to such targets and plans may require significant revisions to this document.

# 3 SITE ASSESSMENT AND OPERATIONAL PROCEDURES

## 3.1 WHERE DO THE *REQUIREMENTS* APPLY?

The *Requirements* supplement all other Forest Service Guidelines and the Code of Best Forest Practice and apply to all potentially impacting forest operations within the catchments of FPM populations in rivers designated cSACs for the species, as listed in Appendix 1. This list may change as new information becomes available as part of an annual national review and is available on the Forest Service FIMS. Table 4 outlines various catchment sensitivities and specifies the correct element of the *Requirements* to be applied in each particular instance.

**Table 4.** Forest Operations (Afforestation, Clearfelling/Reforestation, Roading) Screening Table.

| **Distance from nearest downstream FPM population** (Note 1) | | **Soil** (Note 2) | **Requirements (see * below)** |
|---|---|---|---|
| | | | |
| PART A<br><br>Within 6 km of FPM | Site Adjoins Population | Erodable | FPM Requirements |
| | | Peaty | FPM Requirements |
| | | Mineral | FPM Requirements |
| | | | |
| | Site contains or adjoins an aquatic zone | Erodable | FPM Requirements |
| | | Peaty | FPM Requirements |
| | | Mineral | FPM Requirements |
| | | | |
| | Site does not contain or adjoin an aquatic zone | Erodable | FPM Requirements |
| | | Peaty | FPM Requirements |
| | | Mineral | FS Guidelines* |
| | | | |
| PART B<br><br>Greater than 6 km from FPM | | Erodable | FS Guidelines* |
| | | Peaty | FS Guidelines* |

***FS Guidelines** apply except in the following situations where the Forestry and FPM *Requirements* (Section 3.3 Mitigation) apply

- >10% of catchment (Note 3)
- Afforestation >50ha (Note 4)
- Clearfelling >25ha (Note 4)

**Notes:**

1. **Distance** is measured along the shortest hydrological distance from the nearest point of the site of application to the nearest known FPM population downstream.
2. **Soil:** Soil types are those as defined in this document (e.g. Table 3 Page 11, glossary).
3. **Cumulative Effect:** If the application increases the total cumulative area of an operation in a three year period to more than 10% of the FMP catchment, then FPM *Requirements* apply.
4. **Area of Individual Operation** refers to the area of an individual site (e.g. felling coupe, afforestation site).

## 3.2 SITE ASSESSMENT

If Table 4 identifies that the Forest Service Guidelines are the mitigation measures to be applied then the site assessment form (Appendix 2) need not be completed.

The identification of the correct mitigation measures is an essential element of the *Requirements*. The proper completion of FORM A FPM Site Assessment/Site Description (Appendix 2) will identify the sensitivities on each site. Once the sensitivities and risks associated with the proposed activity have been established the appropriate mitigation measures can be selected and reported on using FORM B FPM Site Assessment Mitigation Measures (Appendix 2). It is the responsibility of the applicant to submit a properly completed assessment with each application. Failing the submission of such an assessment by the applicant, the Forest Service shall inform the applicant of same, and withhold the issue of either approval or licence until such documentation is provided and duly considered by the Forest Service.

## 3.3 MITIGATION

Effective mitigation requires site-specific information and detailed planning. The choice of appropriate mitigation measures rests with a competent person who carries out the site assessment. This assessment will form part of the application for approval or licence. Relevant Forest Service environmental guidelines, the *Forestry Schemes Manual* and the *Code of Best Forest Practice – Ireland* must be adhered to. Possible mitigations and appropriate measures are listed and expanded below.

3.3.1 Area of site
3.3.2 Creation of effective buffer zones/strips
3.3.3 Sediment traps or other sediment control measures
3.3.4 Brash management
3.3.5 Timing of operations
3.3.6 Drainage pattern
3.3.7 Cultivation and planting methods
3.3.8 Fertiliser application
3.3.9 Herbicides and insecticides
3.3.10 Harvesting machinery and equipment selection
3.3.11 New road construction and upgrade
3.3.12 Low Impact Silvicultural Systems (LISS)
3.3.13 Highly sensitive sites options

### 3.3.1 Area of site

#### 3.3.1.1 Afforestation

The current Environmental Impact Assessment (EIA) threshold for afforestation is 50ha, with all afforestation applications assessed under a sub-threshold EIA process. In the case of all areas, the objective should be to maximise the structural diversity through species selection and/or staggering the planting years so that the size of future felling coupes will be minimised.

#### 3.3.1.2 Harvesting area

The availability of nutrients as a result of harvesting is dependent on the extent of the area harvested and the amount of brash produced, so the size of the clearfell area is a key factor in determining the quantity of nutrients released. Reducing the portion of the catchment to be felled at any one time reduces the amount of phosphorus released, by decreasing the amount of decomposing brash and other organic material. The amount of sediment lost is also reduced, as the relative area of exposed soil is smaller. The portion of the catchment to be felled in any one year should be reduced as the sensitivity of the site increases i.e. the higher the number of yes answers in *Section 3.2 Site Assessment*. However, the extent to which the felling area can be practically reduced is influenced by factors including the portion of the catchment planted and the age of the trees. The risk of windblow is a significant consideration as it also represents a threat in terms of sedimentation and nutrient loss. It is important that the benefits gained by a reduction in the proportion of catchment felled are not offset by increased sediment and nutrient losses arising from windblow.

The Forest Service will consider the cumulative effect of all forest operations in the catchment, as individual impacts may be small but the combined impact may be significant. The felling programme in the catchment may comprise one or more coupes. As the difficulty of preventing sediment and nutrient losses tends to increase with increasing coupe size, smaller coupes are preferable. The Forest Service currently limits clearfelling to coupes no greater than 25ha in area. The *Forest Harvesting and the Environment Guidelines* recommend phased felling in a way that minimises cumulative effects and ensures that succeeding rotations do not have the same even-aged structure.

### 3.3.2 Creation of effective buffer zones/strips

Each site must be assessed to determine if an adequate buffer zone/strip exists or is required under *Section 3.2 Site Assessment*. An effective buffer is a buffer zone and/or one or more sequential buffer strips, which, by virtue of its/their topography, impeded drainage and/or density of vegetation cover, has/have a sufficient water retention capacity to filter and retain suspended solids and nutrients in drainage water, so that total suspended solids and nutrient concentrations entering the aquatic zone are minimised. The proposed buffering for each forestry application must be deemed sufficient by the Forest Service prior to approval. The buffer zones and/or strips are eligible as Areas for Biodiversity Enhancement (ABEs) and for grants and premiums as detailed in the *Forestry Schemes Manual*. In some cases, the *Native Woodland Scheme* may be an option, especially sites adjacent to the rivers designated cSACs for the species as listed in Appendix 1.

#### 3.3.2.1 Afforestation/Restock

Where an effective buffer does not exist and is required, a 25m buffer zone should be installed at forest establishment stage. The buffer zone will include five lines of native broadleaves on the section furthest from the aquatic zone, site permitting.

#### 3.3.2.2 Pre-thicket

Pre-thicket describes a plantation that has not closed canopy and as such has a developed ground vegetation. Felling of the trees to increase the buffer zone to 25m at this earlier stage will enhance the ground layer, increase the effectiveness of the

buffer zone and reduce the windthrow risk in comparison to creation of the buffer zone at a later stage.

#### 3.3.2.3 Harvesting

Where effective buffer zones or strips can be installed a number of years prior to harvesting, the amount of nutrients and sediment lost to the aquatic zone during clearfelling will be reduced. Early installation of the buffer zone/strip (Table 5) during the rotation will reduce the risk of windthrow in comparison to later installation. Buffer zones should be installed at the next scheduled thinning or at least three full growing seasons prior to the final felling. In the latter case buffer zones should not be installed where this will result in increased sedimentation of the waterbody as a result of windthrow.

In the case of thinning or clearfelling the creation of buffer zones can give rise to short-term increases in nutrients and sediment loss, as well as increasing the risk of windthrow. Therefore, a buffer zone may not be appropriate where there are reasons to suspect that its creation will lead to windthrow or crop destabilisation and consequent elevated losses to the aquatic zone, to the extent that this would negate any potential benefits from the buffer zone. If the assessor determines that the creation of a buffer will not be beneficial, this decision must be fully documented in the application for licence or approval. The background information provided in Section 2.1 will assist in this decision making process. Where the creation of buffer zones is not appropriate other mitigation measures as listed in Section 3.3 may need to be reinforced to reduce nutrient and sediment loss. Also, where appropriate, alternative silvicultural practices should be considered, for example repeated crown thinning during scheduled thinning operations in the buffer zone to open the crown to promote development of ground vegetation layer.

If, following assessment, the creation of a buffer zone/strip is deemed appropriate, the following issues should be considered:

- Create the buffer zone over more than one year if the area involved and/or the potential sediment and nutrient loss is significant.
- Establish buffer zones during dry weather conditions, and not during or after periods of high rainfall.
- Trees may be cleared by mechanical or manual felling. Whole tree extraction or cabling should be considered.
- Fell trees directionally away from the watercourse, if possible.
- Fell stands of larger trees manually (if practical) and debranch in the area furthest away from the aquatic zone.
- Place brash as far away from the aquatic zone as possible. Where possible, avoid placing brash in wet/saturated or wetland areas, especially within the buffer zone.
- The creation of these buffer zones may entail appropriate harvesting machinery entering and working in the buffer zone but planning should aim to minimise machine passes.
- Other options to reduce nutrient and sediment losses may be considered where the use of machinery is not a practical option or where machinery use may result in significant levels of nutrients or sediment entering the watercourse.

The creation of buffer zones (where appropriate) and the overall felling programme in these catchments should be treated on a planned catchment basis. A felling licence is a legal requirement for any felling including the creation of a buffer strip or buffer zone.

**Table 5. Timing of Buffer Zone/Strip Creation**

| **Forest Stage** | **Afforestation /Restocking** | **Pre-thicket** | **Thicket** | **Second & subsequent thinnings** |
|---|---|---|---|---|
| **Timing of buffer creation** | As part of site preparation | As soon as possible* | First thinning** | During thinnings*** or 3 years before final felling |

* Prethicket trees can be cleared manually.
** Thicket stage trees are bigger and need to be harvested by a machine; therefore it is preferable to wait for first thinning stage.
*** Repeated crown thinning during scheduled thinning operations in the buffer zone to open the crown to promote development of ground vegetation

### 3.3.3 Sediment traps or other sediment control measures

Best forest practice aims at minimising sediment mobilisation by reducing soil disturbance through planning, which includes timing of operations and appropriate machinery. Mobilised sediment transportation can be minimised by the use of naturally occurring vegetated overland flow areas and the use of sediment traps. Sediment control measures other than sediment traps will be considered on a site by site basis. Sediment traps should be installed at intervals, ideally as close as possible to the source of the sediment. Each site needs to be assessed regarding sediment management and appropriate plans adopted. Where required, correctly planned, installed and maintained sediment traps/drains for each individual site will help to ensure that water quality is protected. Ongoing monitoring may indicate the need for additional sediment traps and will be noted on the site monitoring form (Appendix 4). Further details on sediment traps may be found in the *Forestry Schemes Manual*, the *Forest Road Manual* and *Forest Drainage Engineering - A Design Manual*. The following is a summary of the use and installation of sediment traps:

- If an existing drain has a preferential flow path (effectively discharging directly into aquatic zone), use sediment traps or drain blocking as appropriate.
- Install sediment traps following the specifications set out in the Forest Service *Forestry and Water Quality Guidelines* and *Forestry Schemes Manual*. Care should be taken during the construction of sediment traps to ensure that it is not the cause of additional sedimentation.
- A series of smaller sediment traps is more effective than a limited number of larger sediment traps. Where required sediment traps must be installed at intervals in the felling coupe and ideally as close as possible to the source of the sediment.
- Steeper sites may require additional sediment traps.
- Additional sediment traps may be required where the buffer is deemed ineffective, for example not vegetated or where the sediment traps are not fully functional.

- In cases of severe storms where windblow occurs all sensitive sites must be assessed for the need for restoration or installation of silt traps.

### 3.3.4 Brash management

The objective of brash management is two-fold, to contribute to the retention of the nutrients on site thus preventing them entering watercourses and to provide access for machinery, specifically harvesters and forwarders, minimising damage to the soil. The decay of brash takes place for some time after harvesting is completed and this process releases nutrients to the environment. These nutrients can be taken up by the soil or plants (standing trees, replanted trees or ground vegetation) either within the forest or in a buffer zone/strip. Nutrients, which are not immobilised, can be washed away by overland flow, usually during the first significant rainfall event after their release.

Retention of the nutrients on site is achieved by the control of water, ensuring that the sediment and nutrients it contains are retained on site and as far away from the watercourse as possible. The preferred methods are as follows:

- Where the brash is not required to form brash mats, it should be allowed to decay evenly distributed over the harvesting site. This allows for a more even distribution of the nutrient release on the site. If windrowing is required it should not be carried out until the needles have been shed.
- Where the brash is required to form brash mats, it is laid out at harvesting stage as a mat to prevent soil disturbance by machine movement. Brash which has not been pushed into the soil may be moved within the site to facilitate the creation of mats in more demanding locations.
- On all sites, planning of the layout of extraction racks must aim to avoid as far as possible areas which if disturbed could become sources of sediment runoff to streams. On highly sensitive sites on-site planning and the harvesting systems used must be such as to ensure run-off is kept to an absolute minimum and that sediment and nutrients do no enter watercourses. This may involve a change of felling system from the more common ‘offset’ method, i.e. felling on one side of the rack only, to the ‘full face’ method, i.e. felling both sides at the same time. Although this is sometimes marginally more costly it ensures much greater availability of brash for brash mats throughout the harvesting operation. Extreme care must be taken to ensure that the brash mats are maintained to the required standard until extraction has been completed.
- It is also preferable that extraction routes, and hence brash mats, should be aligned to the contour where possible. This assists in reducing the rate of water flow towards the receiving waters and consequently assists in onsite sediment entrapment.
- It is particularly desirable that brash mats are as far away from the watercourses as possible.
- In general, the removal of brash mats is not recommended as it is likely to be a source of sedimentation and ineffective in reducing nutrient loss.

### 3.3.5 Timing of operations

Heavy rainfall events can lead to increased soil erosion and/or losses to watercourses, therefore where possible, carry out operations from April to October, as ground

conditions tend to be drier during this period. Use local weather forecasts to minimise mechanical activity during wet conditions. On soils with a high erosion risk and/or low bearing capacity, suspend mechanised operations during and immediately after heavy rainfall.

### 3.3.6 Drainage pattern

The *Forestry Schemes Manual* details the Forest Service requirements regarding drainage, drain types and sediment control and management. Additional information is contained in the *Forest Road Manual* and *Forest Drainage Engineering A Design Manual*. On reforestation sites, the original drainage system should be used, unless that was known to have caused water quality problems. On afforestation sites, adopt a policy of minimum intervention with the least possible drainage and ground disturbance i.e. drains must not be installed unless specifically required for crop establishment. The following principles must apply:

- Drains must not discharge directly into the aquatic zone.
- Drains must stop short of the buffer zone. If an existing drain has a preferential flow path (effectively discharging directly into aquatic zone), use sediment traps or drain blocking as appropriate.
- Block or divert existing drains to create temporary surface ponding or use vegetated overland flow areas, where appropriate following risk assessment.
- Sediment traps must be installed where appropriate.

### 3.3.7 Cultivation and planting methods

Ground cultivation should be minimised at both afforestation and restocking/replanting and pit planting should be carried out where the site permits. Where pit planting is not an option inverted mounding combined with manual planting should be considered.

### 3.3.8 Fertiliser application

The objective of the mitigation measures is that no additional nutrients are released to the receiving aquatic zone. With this in mind fertiliser application must be limited and only applied where the buffer zone/strip has developed a ground vegetation layer. In reforestation sites where fertiliser is required and where the risk of fertiliser runoff is significant, application must be delayed until ground vegetation has developed into an effective buffer. See Section 2.1.1.1 for further information on fertiliser. Phosphate fertiliser for use in forestry is available in two forms – granulated and ground. Granulated P has a more controlled application, will reduce the likelihood of drift and wash off to surface waters. To reduce the impact on aquatic zones the granulated form of P must be used. It should be noted that peaty soils have a very low capacity to bind phosphorus. Procedures in the *Forestry and FPM Requirement - Site Assessment and Mitigation Measures*, the *Forestry and Water Quality Guidelines*, the *Forest Harvesting and the Environment Guidelines,* the *Forestry and Aerial Fertilisation Guidelines* and the *Forestry Schemes Manual* must be strictly followed.

### 3.3.9 Herbicides and insecticides

The application of herbicides and insecticides to forests in Ireland is ground based. Herbicides are used to control weed growth in young plantations but are only required in areas of intensive weed growth. The requirement to use insecticides is currently confined to the control of pine weevil. In this regard, plants are increasingly treated off site. Research is ongoing into the use of alternative biological control agents such

as nematodes. Any chemical to be used in forestry must be on the up to date approved Pesticide Control Service list (www.pcs.agriculture.gov.ie or Pesticide Control Service, Department of Agriculture, Fisheries and Food Laboratories, Backweston Campus, Young's Cross, Celbridge, Co. Kildare) and used in accordance with Forest Service guidelines, in particular the *Forest Protection Guidelines* and the *Guidelines for the Use of Herbicides in Forestry*.

### 3.3.10 Harvesting machinery and equipment selection

The choice of machinery will mainly depend on the harvesting system, the nature of the terrain, environmental considerations, the forest road network and machine availability. The following principles must apply:

- Have a detailed operational site plan, which includes the most suitable route(s) for machine access.
- Only employ competent machine operators.
- Use the least impacting machines and equipment on site to reduce potential negative impacts.
- Ensure adequate run-off control through the use of effective buffers and sediment traps.
- Where the bearing capacity of the soil is low, specify prompt extraction to ensure that fresh brash is available for extraction machinery. In sensitive situations ground pressure may be reduced by the use of partial loads, wider tyres, band tracks and eight wheel forwarders.
- Create and maintain dense, fresh brash mats on all machine routes to avoid soil damage, erosion and sedimentation.
- Supply the junction of extraction paths and landing sites with additional protective brash cover as required.
- Extraction by skidder must only be used where it is the least impacting option.
- Roads must be maintained throughout the harvesting operation to minimise sediment runoff

Machines cross watercourses regularly during harvesting operations and various techniques are used to minimise sediment and nutrient losses. Where suitable bridges are not in place, permanent or temporary structures must be used for crossing drains, relevant watercourses and aquatic zones. Various methods can be deployed depending on width including logs, metal frames and pipes (single or bundles). It is most important that these temporary crossings are removed and the area restored to its original state when all machine operations including restocking are completed. Care should be taken to avoid sediment release with the removal of these structures.

### 3.3.11 New road construction and upgrade

Forest road development, which includes construction, upgrade and repair/maintenance, must follow standard Forest Service Guidelines and the *Forest Road Manual* and must minimise impacts on the aquatic zone. New road construction should have a detailed site survey carried out by an engineering surveyor in advance of any construction work, documenting all watercourses that may be impacted by the operation. Construction should include contingency measures to deal with these watercourses, such as having the correct diameter pipes on site in advance, laying culverts as the work progresses to avoid unnecessary interference with the

watercourse, employment of competent personnel etc. Appropriate mitigation measures for new road construction and upgrade include buffering (3.3.2), drainage and sediment control measures (3.3.3 & 3.3.6) and weather and timing of operations (3.3.5). Special construction works such as bridge building are also subject to appropriate mitigation measures.

### 3.3.12 Low Impact Silvicultural Systems (LISS)

LISS include continuous cover forestry and long term retention. These options have a lower potential for sediment and nutrient loss but they are only suitable for certain sites.

### 3.3.13 Highly sensitive site options

This section only applies to forest establishment areas, where the site sensitivity precludes the success of the other mitigation measures outlined in the *Requirements*. Various options may be examined and considered with the requirement that no additional nutrients or sediment would be released to the receiving aquatic zone.

#### 3.3.13.1 Afforestation

The options for highly sensitive sites include:

- Forest Service schemes such as the Native Woodland Scheme.
- Wider buffer zones (>25m).
- Manual planting.
- No afforestation.

#### 3.3.13.2 Reforestation

The options for highly sensitive sites following clearfelling include:

- Habitat restoration which may include drain blocking.
- Wider buffer zones (>25m).
- Low impact regeneration methods e.g. natural regeneration, no cultivation, low stocking rates, no fertiliser.
- Extension of time frame for replanting obligation to allow determination of extent of natural regeneration.
- Change of tree species for example spruce to pine, to reduce the requirement for fertiliser
- Planting of broadleaves.
- Native Woodland Scheme
- Creation of smaller felling coupe and buffer strips

## 3.4 MONITORING AND RECORDING

### 3.4.1 Operational Site Monitoring

The effectiveness of the *Requirements* will be assessed by monitoring operations on the ground. The objective of the monitoring operations on the ground is to ensure compliance with the *Requirements* and all relevant Forest Service Guidelines and to monitor the effectiveness of the *Requirements*. It is important to carry out the initial visual inspection before work commences to record the baseline conditions against which any change may be compared. The site inspection applies to all potentially impacting forest activities within areas covered by the scope of these *Requirements*.

The operator/supervisor must be familiar with the mitigation measures appropriate to the operation and carry out daily visual inspections using the site monitoring form in Appendix 4 or equivalent documentation. The operator should keep the person in charge informed of emerging or actual problems as work progresses and these should be recorded on the Site Monitoring Form. This will form the basis for timely and appropriate corrective actions. These forms must be signed by the forest owner/agent on a weekly basis, retained as a record by the forest owner and be available for inspection by the Forest Service. Daily monitoring will cease once the operation on the site is completed.

### 3.4.2 Other Monitoring

In addition to the on site monitoring, the effectiveness of the mitigation measures will be supported by a strategic water quality monitoring programme on selected sites implemented by the Forest Service. A strategic biological monitoring programme to be implemented by the National Parks and Wildlife Service will further complement this. Ongoing analyses of the monitoring data will help to fill the existing knowledge gaps and will support the review and update of the *Requirements*.

## 3.5 RESPONSIBILITIES

### 3.5.1 Forest Owners

For any operation it is the responsibility of forest owners to identify and apply those mitigation measures that are appropriate to their particular forest. Forest workers and machine operators must be aware of and understand the operational requirements and relevant mitigation measures and be competent to implement these measures.

All operators must have contact telephone numbers onsite for all relevant agencies (Forest Service, Local Authorities, Regional Fisheries Board and NPWS) in case of accidental damage to aquatic zones, important wildlife habitats etc.

### 3.5.2 Forest Service

The implementation of the *Requirements* will be the responsibility of the Forest Service in accordance with its current procedures through:

- Compliance with the conditions attached to Licences and Approvals issued by the Minister.
- Site inspections by Forest Service staff.
- Compliance with the principles of Sustainable Forest Management
- Financial penalties based on Grants and Premiums.
- Withdrawal of Approvals or revoking of Licences issued.
- Long term water quality monitoring programmes to establish the effectiveness of the *Requirements*.

The Forest Service shall also enforce its Yield Class 14 minimum productivity class for afforestation approvals, while reforestation shall be based on minimum intervention techniques resulting in minimum contributions to the receiving waters. An adaptive management approach shall be employed to ensure best practice is implemented at all times and shall be verified by long term water quality monitoring. Meeting these *Requirements* will complement the principles of SFM and the

Programme of Measures to be implemented under the Water Framework Directive. Compliance will also assist in the overall catchment approach towards the protection of the FPM.

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## 5. GLOSSARY

**Adsorption** is one of the two primary mechanisms by which the amount of nutrients reaching the aquatic zone can be reduced, providing that the water velocity can be slowed. As the water is brought in contact with mineral soil, phosphorus may bind to the clay and mineral particles. This requires sufficient contact between the water and the mineral soil. Consequently, binding is most effective if water percolates into mineral soil. Once water begins to flow over the surface, the binding potential is greatly reduced.

**Aquatic zone** is a permanent or seasonal river, stream or lake shown on an Ordnance Survey 6 inch map

**Bed load** is made up of coarse material that rolls and slides along the riverbed, rather than being suspended in the water column.

**Brash mat** is a layer of branches and/or treetops.

**Buffer** or **buffer zone** is an area adjacent to an aquatic zone that is planned and managed specifically for water protection. Typically the buffer zone includes the riparian zone but may also occupy areas beyond the riparian zone. Within the buffer zone, natural ground vegetation is allowed to develop, with additional planting of suitable riparian tree species. For the purpose of these guidelines, the buffer zone will be 25m wide and will support a permanent 5-line belt of native broadleaves on the section furthest from the aquatic zone, where the site is capable of supporting such a crop without the application of fertiliser. Further associated references include 'effective buffer zones' and 'buffer strips':

- **Effective buffer** is a buffer zone and/or one or more sequential buffer strips, which, by virtue of their topography, impeded drainage and/or density of vegetation cover, have sufficient water retention capacity to filter and retain suspended solids and nutrients in drainage water, so that total suspended solid and nutrient concentrations entering the aquatic zone are minimised.
- **Buffer strips** are areas of vegetation that runoff may be discharged through so as to filter out sediment and nutrients. Examples include open vegetated areas or ridelines.

**Capacity** is how much sediment (of all sizes) the stream can transport. Generally, higher volumes of water have a higher capacity.

**Catchment** can be simply defined as the area from which a river or lake derives its water, i.e. the land area drained by the river system.

- The FPM catchment is the section of the catchment that contributes water to the FPM population. The *Requirements* will apply to all potentially impacting forest operations within the catchments of FPM populations in rivers designated candidate Special Areas of Conservation (cSACs) for the species, as listed in Appendix 1. Within these catchments particular emphasis is placed upon the area that lies within 6km hydrological distance of an identified FPM population. Maps of the areas covered by the *Requirements* will be available through the Forest Service FIMS.

**Erodable soils** are soils that are known to result in sediment release from the site, particularly during and after high rainfall events.

**Filtration** is one of the two main mechanisms by which the amount of sediment reaching the aquatic zone can be reduced. Filtration occurs when the water flows slowly through the vegetation and litter layer, with both acting as a sieve to filter out particles.

**FIMS (Forest Industry Mapping System)** FIMS is the Forest Industry Mapping System provided by the Forest Service for use by the forest industry. FIMS provides a facility for Registered Foresters to create and submit maps online for afforestation applications. FIMS makes use of, and works with the Department of Agriculture, Fisheries and Food's spatial database and includes all environmental and spatial data relevant to decisions regarding afforestation. The Registered Foresters can view Department of Agriculture, Fisheries and Food's and Forest Service's spatial datasets, and overlay the boundaries of their plantation using a range of tools for drawing and manipulating spatial data. The plantation boundaries can then be submitted electronically to support their planting approval or grant application.

**Forest Service environmental guidelines** refer to the *Forestry and Water Quality Guidelines*, *Forest Biodiversity Guidelines*, *Forest Harvesting and the Environment Guidelines*, *Forestry and Archaeology Guidelines*, *Forestry and the Landscape Guidelines*, *Forest Protection Guidelines* and *Forestry and Aerial Fertilisation Guidelines*. The procedures outlined in the *Forestry Schemes Manual*, *Code of Best Forest Practice – Ireland* and the *Irish National Forest Standard* must also be adhered to.

**Hydrological distance** is measured along the path water takes from the site through the drains and streams to the nearest FPM population downstream.

**Mounding** is a cultivation method which involves the opening of drains at a specified spacing where the soil extracted from the drain is placed in mounds between the drains to create an appropriate planting medium.

- **Inverted mounding** is a cultivation method where the soil is excavated, inverted and replaced in the original location without the opening of drains.

**Mineral soils** are all soils other than peat. They have a greater capacity than peat soils to retain nutrients and there is generally a lower risk of sediment loss.

**Peaty soil** is defined as any soil with a depth of 30 cm or greater of peat/humus layer over the parent material. The depth of 30cm was chosen because it generally corresponds to the depth of mound drain and plough drains. Consequently if the peat depth is less than 30cm there is a greater possibility of the water coming in contact with mineral soil.

**Relevant watercourse** is defined as one (most often man-made) that is not shown on a 6 inch OS map, and is directly connected to an aquatic zone. It is known locally or has been professionally assessed as having the potential to carry significant amounts of sediment/nutrients, or shows evidence/signs of erosion/deposition. This includes drains or channels flowing directly from the site to the aquatic zone, which may only operate during heavy rainfall.

**Rideline** is a strip of land left unplanted to form a permanent forest internal boundary to facilitate planning, measurement and access. Ridelines may coincide with existing boundaries such as streams and forest roads.

**Riparian** is an area associated with river banks or an area directly adjacent to the

aquatic zone, representing the intermediate between the aquatic and terrestrial environments and having its own distinctive hydrological and ecological characteristics.

**Sediment** is any particle that may be mobilised and will lead to sedimentation of the river/stream bed blocking the interstitial spaces in the gravel bed.

**Settlement** is one of the two main mechanisms by which the amount of sediment reaching the aquatic zone can be reduced. Settlement occurs as the water ponds or flows slowly, with particles subsequently settling out of suspension.

**Suspended solids** include fine-grained clays and sediments and some sand that is transported inside the water column.

**Sustainable forest management (SFM)** is defined as: "The stewardship and use of forest lands in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national and global levels and does not cause damage to other ecosystems." (From the Ministerial Conference on the Protection of Forests in Europe, Helsinki 1993)

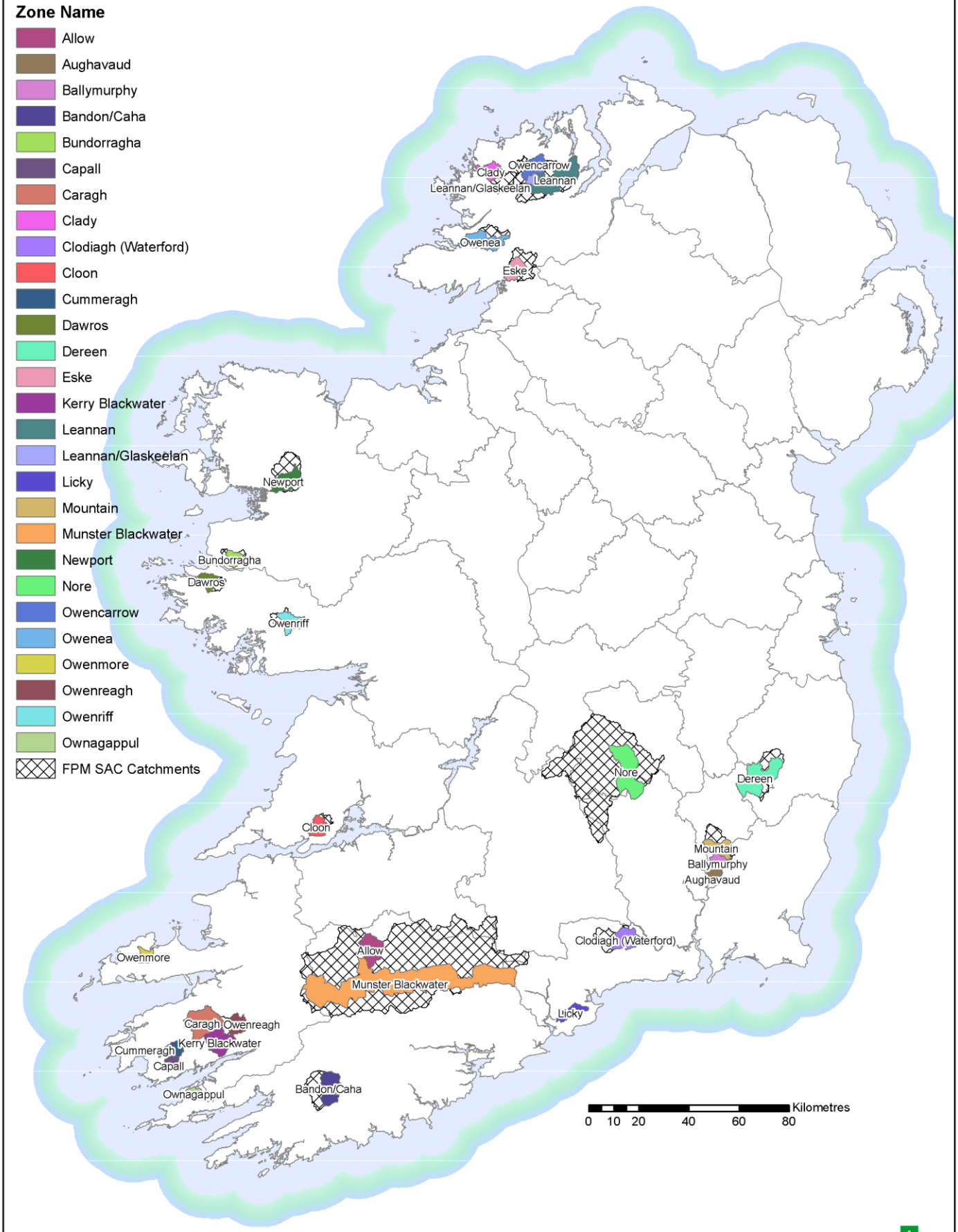
**Uptake** is one of the two primary mechanisms by which the amount of nutrients reaching the aquatic zone can be reduced, providing that the water velocity can be slowed. As the water flows slowly through vegetation, plants may take up phosphorus and nitrogen for growth. This occurs most efficiently where water runs slowly and percolates into the litter layer or soil of a well-vegetated buffer zone.

## APPENDIX 1: RIVERS DESIGNATED AS cSACs FOR *MARGARITIFERA MARGARITIFERA* AND *M. DURROVENSIS* (SEE ATTACHED CATCHMENT MAP)

| | River Systems containing SACs designated for *Margaritifera* | cSAC Site Code | cSAC Site Name | Rivers (including tributaries) in the SAC containing *Margaritifera* |
|---|---|---|---|---|
| 1 | Bandon | 002171 | Bandon River cSAC | Bandon & Caha |
| 2 | Barrow | 002162 | River Barrow and River Nore cSAC | Aughavaud |
| 3 | Barrow | 002162 | River Barrow and River Nore cSAC | Ballymurphy |
| 4 | Barrow | 002162 | River Barrow and River Nore cSAC | Mountain, Aughnabrisky |
| 5 | Bundorragha | 001932 | Mweelrea/Shreefry/Erriff Complex cSAC | Bundorragha |
| 6 | Caragh | 000365 | Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment cSAC | Caragh, Owenroe, Meelagh, Caraghbeg |
| 7 | Clady | 000140 | Fawnboy Bog/Lough Nacung cSAC | Clady |
| 8 | Corrib | 000297 | Lough Corrib cSAC | Owenriff |
| 9 | Cummeragh | 000365 | Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment cSAC | Capall, Cummeragh |
| 10 | Dawros | 002031 | The Twelve Bens/Garraun Complex cSAC | Dawros |
| 11 | Eske | 000163 | Lough Eske and Ardnamona Wood cSAC | Eske |
| 12 | Kerry Blackwater | 002173 & 000365 | Blackwater River (Kerry) cSAC & Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment cSAC | Blackwater, Kealduff, Derreendarragh |
| 13 | Laune | 000365 | Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment cSAC | Gearhameen & Owenreagh |
| 14 | Leannan | 002047 | Cloghernagore Bog and Glenveagh National Park cSAC | Glaskeelan |
| 15 | Leannan | 002176 | Leannan River cSAC | Leannan |
| 16 | Munster Blackwater | 002170 | Blackwater River (Cork/Waterford) cSAC | Allow |
| 17 | Munster Blackwater | 002170 | Blackwater River (Cork/Waterford) cSAC | Licky |
| 18 | Munster Blackwater | 002170 | Blackwater River (Cork/Waterford) cSAC | Blackwater (main channel) |
| 19 | Newport | 002144 | Newport River cSAC | Newport |
| 20 | Nore | 002162 | River Barrow and River Nore cSAC | Nore |
| 21 | Owencarrow | 002047 | Cloghernagore Bog and Glenveagh National Park cSAC | Owencarrow |
| 22 | Owenea | 000197 | West of Ardara/Maas Road cSAC | Owenea |
| 23 | Owenmore | 000375 | Mount Bandon cSAC | Owenmore |
| 24 | Ownagappul | 001879 | Glanmore Bog cSAC | Ownagappul & Barrees |
| 25 | Shannon Estuary | 002165 | Lower River Shannon cSAC | Cloon |
| 26 | Slaney | 000781 | Slaney River Valley cSAC | Derreen |
| 27 | Suir | 002137 | Lower River Suir cSAC | Clodiagh |

# Fresh Water Pearl Mussel (FPM)

## FPM 6 km Zones and FPM SAC Catchments

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Forest Service

**APPENDIX 2**
**FORM A. FPM SITE ASSESSMENT - SITE DESCRIPTION**

**Forest Service Identification No. _____**

**Name of applicant _____**

**Location:_____**

**Operation:_____**

| | **Question** | **Yes** | **No** | **Comment** |
|---|---|---|---|---|
| 1. | Is the site within the FPM cSAC catchment covered by these *Requirements*? Check current map on FIMS | | | |
| 2 | Hydrological distance from FPM (metres) if known | | | |
| 3 | Is there an effective buffer? **See 3.3.2*** | | | |
| 4. | Slope category. **See Table 1*** | | | |
| 5. | Is there a medium/high risk of soil sedimentation/erosion? **See 2.1.7*** | | | |
| 6. | Is it a peaty soil? **See 2.1.3*** | | | |
| 7. | Is there a high risk of nutrient loss? **See 2.1.6*** | | | |
| 8. | Does the site contain or adjoin an aquatic zone? **See Glossary*** | | | |
| 9. | Does the site contain or adjoin a relevant watercourse? **See Glossary*** | | | |
| 10. | If constructing a road, does the route of the proposed road cross an aquatic zone or a relevant watercourse? **See 3.3.11*** | | | |
| 11. | If harvesting, does the proposed extraction route cross an aquatic zone or a relevant watercourse? **See 3.3.10*** | | | |

* refers to the relevant section in the *Forestry and Freshwater Pearl Mussel Requirements*.

Date of field visit for this Site Assessment:_____

Signed (Competent person) _____

Date _____

Please attach map showing the location of the proposed works.

**FORM B. FPM SITE ASSESSMENT - MITIGATION MEASURES**

*Identify and comment on appropriate mitigation measures and supply additional information as appropriate.*

Forest Service Reference No._____

Location:_____

| Mitigation | Yes | No | N/A | Comment |
|---|---|---|---|---|
| Area of site **(See 3.3.1)** | | | | |
| Creation of effective buffer zones/strips **(See 3.3.2)** | | | | |
| Creation of sediment traps or other sediment control measures **(See 3.3.3)** | | | | |
| Brash management **(See 3.3.4)** | | | | |
| Timing of operations **(See 3.3.5)** | | | | |
| Drainage pattern **(See 3.3.6)** | | | | |
| Cultivation and planting methods **(See 3.3.7)** | | | | |
| Fertiliser application **(See 3.3.8)** | | | | |
| Herbicides and insecticides **(See 3.3.9)** | | | | |
| Harvesting machinery and equipment selection **(See 3.3.10)** | | | | |
| New road construction and upgrade **(See 3.3.11**) | | | | |
| Low Impact Silvicultural Systems (LISS) **(See 3.3.12)** | | | | |
| Highly sensitive sites options **(See 3.3.13)** | | | | |
| Other | | | | |
| Will site mitigation measures outlined above be sufficient to prevent the additional release of:<br>• Nutrients?<br>• Sediment? | | | | |
| Is the forest owner/agent aware of the sensitivities of the site and his/her/their consequent responsibilities? | | | | |

Signed (Competent person) _____

Date _____

**APPENDIX 3. Site Monitoring Form (Visual Inspections).**
Clearfelling, Forest Establishment, Road Development, Thinning.

Date of Commencement of Operations: _____

Comment on water conditions at commencement of operation, if applicable:
_____
_____

Monitoring carried out during week ending: _____

| | | Mon | Tue | Wed | Thur | Fri | Sat | Sun |
|---|---|---|---|---|---|---|---|---|
| 1 | Is the current and forecasted weather suitable? | | | | | | | |
| 2 | Is there surface water runoff to watercourses? | | | | | | | |
| 3 | Is there any increased discolouration in the discharging water? | | | | | | | |
| 4 | Is there any increased silt/sediment in the discharging water? | | | | | | | |

| Day | Comment/Action Taken |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Signed _____ Date _____
Operator

Signed _____ Date _____
Forest owner/agent