SPECIFIED BIOMASS HARVESTING

Good Practice Guidance for Energy Assortment Harvesting at Clearfell

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Cover image Specified biomass harvesting of pine residues neatly piled on site after clearfelling, and retained to allow for drying and needle shedding (Worrell Harvesting Ltd).

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About the Authors

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A forestry graduate of University College Dublin and also holding a PhD in forestry from the same institution. Dr Hendrick started his career as a forester with the Forest Service, he switched to the research area in the late 1970s, and then moved to Coillte on its establishment, where he was involved in a number of roles. He joined COFORD, the National Council for Forest Research and Development on its foundation, becoming Director in 2000. From 2010 until his retirement in 2018 he led Forest Sector Development Division within the Department of Agriculture, Food and the Marine, and was responsible for national reporting and accounting on forests and climate change, including bioenergy. He also provided input to national climate change policies and processes as well as international negotiations on forests and climate change, including the role of forest products and energy use of wood. He currently chairs the Wood Fuel Quality Assurance Scheme on behalf of IrBEA

Mr Noel Gavigan

Mr Gavigan holds a Bachelor's Degree in Agricultural Science from University College Dublin, a Graduate Diploma in Management Practice from Dublin Institute of Technology and a Postgraduate Diploma in Environmental Protection from Sligo Institute of Technology. With 10 years' experience in the Agricultural & Horticultural industry and 18 years' experience in renewable energy and the bioeconomy he joined IrBEA in 2010 as Technical Executive. His work includes development of renewable energy, sustainable materials, and environmental protection. He is the auditor of the Wood Fuel Quality Assurance scheme since 2014. He is chair of EcoEd4All, a dedicated group of researchers and environmental professionals developing educational material for all ages from primary school to CPD students.

Mr Kenneth Worrell

Mr Worrell is the founder and Managing Director of Worrell Timber Group (WTG). With over 30 years experience in the forestry sector he has lead Worrell Timber Group to be an industry leader in creating and cultivating innovative practices in the forestry industry, specifically in forest management, harvesting, haulage and chipping. Throughout his forestry career he has amassed significant knowledge and experience by undertaking large scale forestry projects in Ireland, the UK, Germany and France. Working with both private and corporate clients, Mr Worrell has developed a wide range of forestry services to provide a complete forestry services company. The company focuses on maximising forestry owner returns whilst protecting the sustainable long-term future development of the forest resource. Mr Worrell and WTG have developed their own bespoke timber traceability system called “Log-Watch” allowing customers and suppliers real-time notifications and access to timber movements. Pioneering in nature, Mr Worrell has been instrumental in the development of the Specified Biomass Harvesting method of harvesting which has been implemented and perfected by his machine operators during thinning and clearfelling operations. This system provides additional revenue to the forestry owner over an extended period. Recent investment has resulted in the company achieving REDII Certification. This sets the company apart and provides assurance that all activities being carried out to the highest standards and regulations. Mr Worrell is a regular contributor at IrBEA events, Teagasc Timber Talks events, stakeholder group meetings, open days, demonstrations and at bioenergy conferences.

Introduction and definitions

Specified biomass harvesting (SBH) offers a number of advantages, including facilitating forest regeneration, avoidance of windrowing, more efficient subsequent crop management as well as providing a cost-effective biomass fuel.

SBH has significant advantages as a biomass fuel, as greenhouse gas savings on displacement of fossil fuel ensue in many cases in less than one year (Madsen and Bentsen 2018). This is due to avoidance of emissions from decaying residues on site.

Where clearfell logging residues are removed reforestation costs can be lowered. Regeneration is more uniform as brash, logging debris, and potentially soil are not scraped into windrows. Windrowing has been shown to lead to uneven crop growth as trees grow faster closer to the windrows due to higher levels of soil nutrients and better shelter compared to the typically 4-6 intervening rows (Ballard 1978, Hendrick 1979, Zhang et al. 2015).

Windrowing is used to facilitate replanting and initial control of competing vegetation with the aim of reducing initial reforestation planting costs. However, on many sites it can be regarded as a false economy in terms of subsequent crop management and performance. Uneven growth caused by windrowing is likely to lower the value of the crop at final felling due to coarser branching in the trees alongside the windrow. It is well known trees at the edge of plantations are of lower commercial value due to knottiness compared with trees from within the crop.

Other benefits of specified biomass harvesting may include:

- Reduced severity of weevil damage
- Improved site access for forest regeneration
- Future management activities including thinning and felling

SBH excludes the harvesting of brash mats, which are branches and tops placed along extraction racks for soil protection during harvesting and forwarding of roundwood and energy assortments, particularly on wet mineral soils (see DAFM Standards for Felling and Reforestation (2019)). Brash mats are not suitable as fuel and should be left on site to decay. The term brash harvesting leads to confusion and is not recommended; SBH is recommended in its place. SBH is a predetermined operation carried out in conjunction with final harvesting, whereby the energy assortment is stacked and left to dry and allow needle and foliage fall to be uniformly distributed over the site, and then harvested separately. Random harvesting of brash after clearfelling raises significant risks in terms of ground damage and contamination of the assortment, making it unsuitable as fuel; it is not a recommended practice.

SBH is defined as:

Planned and specified biomass harvesting (SBH), comprising tops and branches removed during roundwood harvest and piled in situ on the forest floor adjacent to extraction racks, and left for a sufficient time to allow needle and leaf fall before collection. It excludes the material used to make brash mats, or their removal off the site.

Avoiding negative impacts on the environment and site productivity

SBH aims to minimise ground damage, water quality deterioration and also to maintain site productivity through successive rotations, or continuous forest cover in accordance with sustainable forest management principles. It also aims to leave sufficient coarse woody debris and small clumps of advanced regeneration or understorey to facilitate the retention and spread of specialist invertebrate, and other forest biota on the site.

How to alleviate issues of concern by way of avoidance and ameliorative measures;

1. As with all forest harvesting, soil physical damage, erosion and siltation of watercourses can be addressed through good planning and forethought in extraction of SBH after final harvest. The harvest must comply with the DAFM Standards for Felling and Reforestation (2019) and include a harvest plan that sets out the ways the felling and removal of the roundwood, and the SBH will occur.

First of all, the SBH should be felled and piled as part of the final felling operation and placed in linear rows alongside the extraction racks/brash mats used for the removal of roundwood assortments. SBH piles should not be located within the water setback of an aquatic zone or relevant water course (see - Standard for Felling and Reforestation (2019)) so as to avoid any nutrient runoff or risk of soil erosion by working too close to watercourses. Extraction routes should be carefully planned and excessive travel over headlands avoided, permanent watercourses should be identified and protected, and large piles of SBH avoided. Where possible periods of excessive rainfall should be avoided during harvest as outlined in the DAFM Standards for Felling and Reforestation (2019).

Brash matts have been shown to be extremely useful in in protecting vulnerable forest soils from physical damage (Moffat et al 2006). The quantity of brash used depends on the soil type and the need to protect against soil damage such as rutting and displacement that will impact on reforestation.

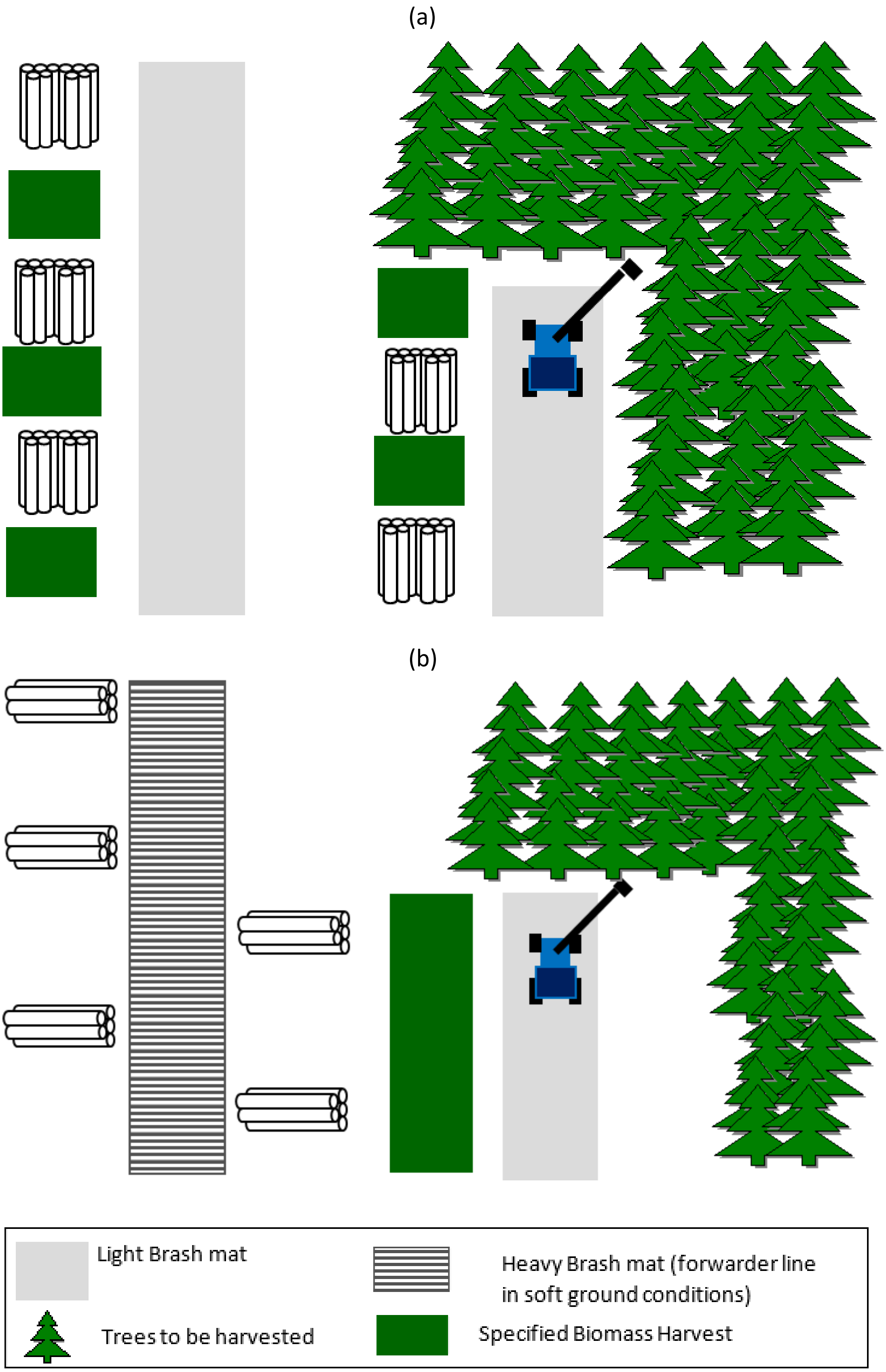
On firmer soils such as brown earths and podzols, a light brash mat is sufficient to protect the soil from damage. On softer soils such as peats and gleys, and on heavily trafficked parts of the site a heavier brash mat will be required.

Where brash mats have become depleted since the roundwood harvest, and as a result soil damage could be expected, the SBH pile should be used to replenish the mat in front of the machine.

Brash mats may vary in use and density. Essentially a brash mat should always be used where soil damage is likely to occur. In practice brash mats will be required in all but the driest conditions on better soils.

A light brash mat is used on dry, well drained soils, considered as something suitable for use in soft ground conditions by the harvester only, or may be considered for forwarding operations where ground conditions are good. A heavy brash is considered as a mat suitable for harvester operations and for forwarding operations in soft ground conditions.

Figure 1: Recommended methods for SBH (Specified Biomass Harvest)



(a) Good ground conditions with optional brash mat depending on ground conditions.

(b) Soft ground conditions with heavy brash mat on every second harvesting line to facilitate extraction vehicles. Note the heavy brash mat is left in situ and is not removed.

Avoiding negative impacts on the environment and site productivity:

2. Excessive removal of needles or foliage at harvest can have negative impacts through reduction in soil fertility and associated site productivity. These impacts first came to attention in the 19th century through the practice in mainland Europe of litter raking (removal) from forests for animal bedding and other uses. It quickly became apparent that forest productivity in terms of timber and fuel production was negatively impacted. As a result, the practice had largely ceased by the beginning of the 20th century (Ondřej et al 2015). The basic proposition is that the removal of nutrients via litter raking greatly exceeds atmospheric nutrient deposition and inputs from mineral weathering. Based on these insights and the literature cited in the introduction, it is essential to retain as much as feasible of the nutrient capital in situ to maintain site productivity.

Good practice proposed is to leave tops and green material on site to allow needles and foliage sufficient time to fall off and return to the litter pool. Most of the tree nutrients are in the foliage and small branches, and their full removal can result in 2-3 times the losses of nitrogen and phosphorus and 1.5 and 2 times for base cations (potassium, calcium, magnesium and sodium) compared with conventional roundwood harvest. (Nisbet 2009). This practice needs special attention on low productivity sites. These can be classified as sites with a preharvest crop of Sitka spruce at yield class of 12 or less, or an equivalent in other species (see Appendix 1). On very poor sites at the lower end of the productivity range it is recommended to leave most of the green material in situ.

In all cases a proportion of the harvesting will be left on site in the brash mats and elsewhere. It is not good practice to remove all the residues as SBH, as this can lead to soil churning and damage – only the preformed SBH piles should be removed.

3. Soil acidification can be induced on poorly buffered soils when excessive amounts of base cations such as potassium, calcium and magnesium are removed in foliage and small branch wood. These sites generally conform with the nutrient poor sites identified in point 2. SBH removal should conform with the guidance in point 2. On very poor shallow soils. SBH removal is best avoided, unless woodash, which is high in pH, can be applied prior to regeneration.

4. The importance of retention of wildlife habitat at clearfelling is set out in the DAFM Standards for Felling and Reforestation (2019). This extends to deadwood and branches and small clumps of advance regeneration and understorey where present. These provide habitat for specialist decay organisms and for some bird species and mammals. For deadwood specifically, the recommendation from the Forest Service Biodiversity Guidelines is for the retention of 5 m3/ha on clearfell sites and 2 m3/ha on thinning sites.

The authors' view is that a set of guidelines taking into account the above avoidance and ameliorative measures for SBH can address concerns about biomass harvesting and provide clarity to forest owners, foresters and wood energy companies in relation to where and how the operation should be considered and sustainably undertaken.

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Appendix 1

Equivalent yield class (estimated maximum mean annual volume increment) to Sitka spruce for use in determining sites where SBH is not recommended.

Table Appendix 1.1. Equivalent yield class (estimated maximum mean annual volume increment) to Sitka spruce for conifers.

Sitka spruce	Yield Class $m^3\ ha^{-1}\ a^{-1}$												
	6	8	10	12	14	16	18	20	22	24	26	28	30
	Equivalent yield class												
Corsican pine	4	6	6	8	8	10	10	12	12	14	14	14	14
Douglas fir	6	8	10	10	12	14	16	18	18	20	22	24	24
European larch	4	6	6	6	8	8	8	8	10	10	10	10	10
Grand fir	6	6	8	10	12	14	16	18	20	22	24	26	28
Hybrid larch	4	6	6	8	8	10	10	10	12	12	14	14	14
Japanese larch	4	6	6	8	8	10	10	10	12	12	14	14	14
Lodgepole pine (NC)	6	8	8	10	10	12	12	12	12	14	14	14	14
Lodgepole pine (SC)	6	8	8	10	10	12	12	14	14	16	16	16	16
Noble fir	6	8	10	12	12	14	16	16	18	20	20	22	22
Norway spruce	6	8	10	10	12	14	16	18	20	20	22	24	24
Scots pine	4	6	8	8	10	10	12	12	12	14	14	14	14
Other conifers	6	6	8	10	12	12	14	16	18	20	20	22	22

Table Appendix 1.2. Equivalent yield class (estimated maximum mean annual volume increment) to Sitka spruce for broadleaves.

Sitka spruce	Yield Class $m^3\ ha^{-1}\ a^{-1}$												
	6	8	10	12	14	16	18	20	22	24	26	28	30
	Equivalent yield class												
Alder	4	4	4	6	6	6	8	8	8	8	10	10	10
Ash	4	4	4	4	4	4	6	6	6	6	6	6	6
Beech	4	4	4	4	4	6	6	6	8	8	10	10	10
Birch	4	4	4	4	6	6	6	8	8	8	10	10	10
Oak	4	4	4	4	4	6	6	6	8	8	8	8	8
Sycamore	4	4	4	6	6	8	8	8	10	10	12	12	12
Other broadleaves	4	4	4	6	6	8	8	8	10	10	12	12	12

About the Irish Bioenergy Association (IrBEA)

IrBEA was founded in 1999. Its role is to promote the bioenergy industry and to develop this important sector on the island of Ireland. The diverse membership includes farmers and foresters, fuel suppliers, energy development companies, equipment manufacturers and suppliers, engineers, financiers and tax advisers, legal firms, consultants, planners, research organisations, local authorities, education, and advisory bodies – anyone with an interest in the bioenergy industry. IrBEA is recognised by Government and agencies as the voice of the bioenergy industry. The association's main objectives are to influence policy makers to promote the development of bioenergy, and to promote the interests of members. Improving public awareness, networking, and information sharing, and liaising with similar interest groups are other key areas of work in promoting bioenergy as an environmentally, economically, and socially sustainable energy. Further information on the association is available at www.irbea.org

About the Wood Fuel Quality Assurance Scheme

IrBEA manages and administers the Wood Fuel Quality Assurance (WFQA) Scheme.
The WFQA scheme certifies suppliers of wood fuels including firewood, chip, pellet, and briquette. Certification is to the quality standard I.S. EN ISO 17225 Solid biofuels — Fuel specifications and classes. The standard is used throughout the globe for specification, trade and regulatory purposes in relation to woodfuels. The WFQA is governed by a steering committee made up of representatives of the WFQA membership, IrBEA industry members, DAFM, SEAI and a consumer representative. WFQA members are audited and certified annually on the basis of conformity to EN ISO 17225. Certification with the WFQA satisfies the certification requirements for wood fuels under the Support Scheme for Renewable Heat (SSRH) & the Air Pollution Act 1987 (Solid Fuels) Regulations 2022.
www.wfqa.org/

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