



# 25-year forecast of softwood timber availability

National Forest Inventory Report

# Summary

The National Forest Inventory provides a record of the size and distribution of forests and woodlands in Great Britain and information on key forest attributes. This information, together with Forestry Commission growth and yield models, is used to forecast softwood and hardwood timber availability. This Report provides a 25-year forecast of softwood timber volume that could potentially be produced from conifers growing in forests and woodlands in the UK. It includes estimates for England, Scotland, Wales and Northern Ireland, broken down by Forestry Commission/Forest Service (FC/FS) and Private sector ownership.

- The forecast of softwood availability for the UK forest estate is an average of 16.5 million m<sup>3</sup> of softwood timber per annum over the 25-year period. For England this is an average of 3.7 million m<sup>3</sup> per annum; for Scotland 10.5 million m<sup>3</sup>; for Wales 1.8 million m<sup>3</sup>; and for Northern Ireland 0.6 million m<sup>3</sup>.
- Softwood availability changes over the period of the forecast; it increases from 14.2 million m<sup>3</sup> per annum in 2012–16 to 18.4 million m<sup>3</sup> per annum in 2027–31.
- The profiles for the FC/FS estate and Private sector estate are different. The FC/FS sees an overall reduction in forecast production while the Private sector sees an increase in potential production.
- The FC estate is projected to generate an average of 5.4 million m<sup>3</sup> per annum for the next 25 years, if existing forest management plans are followed and production is not constrained, as is the published intention in Scotland and Wales. 6.0 million m<sup>3</sup> per annum would be produced in the first five-year period (2012–16) and this will change to an average of 4.8 million m<sup>3</sup> per annum in the final five-year period (2032–36). In addition, production from the FS estate is forecast to average 0.6 million m<sup>3</sup> per annum over the same 25 years.
- The potential production of softwood timber from the Private sector estate is forecast to average of 10.6 million m<sup>3</sup> per annum for the next 25 years, under a management scenario of maximising timber productivity. For England the average is 2.5 million m<sup>3</sup> per annum; for Scotland 7.1 million m<sup>3</sup> per annum; for Wales 0.9 million m<sup>3</sup> per annum; and for Northern Ireland 0.032 million m<sup>3</sup> per annum. Potential production amounts to 7.6 million m<sup>3</sup> per annum in the first five-year period, peaking at 12.7 million m<sup>3</sup> in the period 2027–31.
- The actual levels of timber that will be produced will vary from the results reported here as production depends on the harvesting choices made by forest and woodland owners. A range of scenarios has been used in this forecast for the Private sector to explore how such choices impact on the amount and timing of production.

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## Introduction

National forest inventories are carried out by the Forestry Commission to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands in Great Britain (GB). This information is essential for developing and monitoring policies and guidance to support sustainable forest management.

The current National Forest Inventory, which began in 2009 (the first cycle is due for completion in 2015), is a multi-purpose operation that has involved the production of a forest and woodland map for GB and a continuing programme of field surveys of the mapped forest and woodland areas.

Information and data collected by the National Forest Inventory will be used for a number of purposes, including estimates and 25-year forecasts of forest metrics such as:

- Standing volume
- Timber availability
- Tree growth and increment
- Carbon stocks
- Biomass

Estimates of aspects of the biodiversity and social value of forests and woodlands will also be provided by the Inventory.

**Timber** is defined in this report as the volume of stemwood to 7 cm top diameter in m<sup>3</sup> overbark standing (obs), including stump (above ground) and usable branchwood (of minimum 3 m in length and 7 cm top diameter).

This Inventory Report sets out the results of the 25-year forecast of softwood availability for all forests and woodlands in the UK. For the public sector this is the Forestry Commission in Great Britain (GB) and the Forest Service, an agency within the Department of Agriculture and Rural Development in Northern Ireland (NI). For the Private sector this is all other woodland ownerships. A forecast of hardwood availability will be published in 2013. Further information on this and other National Forest Inventory outputs is available from [www.forestry.gov.uk/inventory](http://www.forestry.gov.uk/inventory).

## Forecast of softwood availability

The last forecast of softwood availability in the UK was published in 2006 (*United Kingdom: new forecast of softwood availability*). This new report, in addition to providing the latest overall forecasts, gives a breakdown of forecast volume by size class and by country. Other reports give further breakdowns, including by National Forest Inventory region.

The basis for the forecast of softwood availability for Great Britain is the National Forest Inventory assessment of Standing timber volume, which was published in 2012 (*Standing timber volume for coniferous trees in Britain*). The forecast of softwood availability for Northern Ireland is derived from other sources.

## How forecasts are derived

Forecasts of softwood availability are derived by assessing:

- Woodland area.
- Woodland characteristics (e.g. age, species) within this area.
- How quickly the trees are growing (yield class).
- When the trees will be harvested.

The forecast of softwood availability for the UK is composed of four separate forecasts: a forecast for the Forestry Commission (FC) estate in GB; a forecast for the Private sector estate in GB; a forecast for the Forest Service (FS) estate in Northern Ireland; and a forecast for the Private sector estate in Northern Ireland. The forecasts have been derived separately for the FC/FS estate and for the Private sector estate. They are based upon the same principles but use different data sources.

For the FC estate, information on woodland area and woodland characteristics has been extracted from the Forestry Commission's long-established Sub-compartment database. For the Private sector estate, the estimates were derived from results obtained to date from the National Forest Inventory. The same principles were used in the Northern Ireland forecast but the data source was the Northern Ireland inventory database.

*The National forest inventory forecasts methodology overview* and the technical documentation on *Felling and removals forecasts* give more information on the approaches used to derive the forecasts (see [www.forestry.gov.uk/inventory](http://www.forestry.gov.uk/inventory)).

## Sub-compartment database

The Sub-compartment database is a record of all land managed by the Forestry Commission. Each stand of trees is represented spatially, together with information on individual stand characteristics (for example species, planting year, spacing and yield class) which is periodically updated. As new surveys of stands are conducted (e.g. for operational purposes), survey results are also recorded against the stands. In addition, the database contains details of how the stands are to be managed – in particular, the planned frequency and type of thinning operations and a 'due date' for felling.

## National Forest Inventory

The National Forest Inventory is composed of two elements: a woodland map and a field survey. The woodland map covers all forests and woodlands over 0.5 hectares with a minimum of 20% canopy cover (or the potential to achieve it), including new planting, clearfelled sites and restocked sites. It is based upon 25 cm resolution colour aerial photography for England and Scotland and 40 cm resolution aerial photography for Wales. The map was validated and updated using satellite imagery (available up to 2009), which gave an independent crosscheck of woodland present. Satellite imagery was also used to identify areas of recently felled forests and woodland. Particular attention was paid to identifying areas of woodland loss verified as being due to the establishment of windfarms or the restoration of habitats.

Field survey work is then used to refine the map-based estimates of woodland and clearfelled areas and to measure detailed aspects of the forest. Field surveys were carried out between 2009 and 2012 to estimate standing volume (and other forest metrics). This involved the ground surveying of one-hectare sample squares that were partially or entirely covered by forest, including clearfelled areas, according to the woodland map. Further details of the mapping work and the derivation of forested areas can be found in the 2010 Woodland Area reports at [www.forestry.gov.uk/inventory](http://www.forestry.gov.uk/inventory).

## Estimates for the Forestry Commission estate

Information from the Sub-compartment database was used to estimate standing volume at the reference date of 31 March 2011 on a stand-by-stand basis. For each stand, if an operational survey had been carried out close to the reference date, information from that survey was used to

estimate standing volume. Otherwise, an estimate was made of the state of the stand, normally involving the application of standard Forestry Commission growth and yield models that take into account the past management of the stand. This data formed the basis of the volume forecasts.

Forestry Commission growth and yield models were then used to 'grow' the stands, based upon the Inventory data and yield class estimates. The stands were grown taking account of harvesting events that either thinned or felled a stand over the forecast period, producing the standing volume, increment and production volumes projected by the forecasts. The timing and scale of thinning and felling events was taken from Forestry Commission forest management plans, which set prescriptions for harvesting across productive forest area on the FC estate. This was then aggregated to produce the estimated total production across a defined geographic area for particular types of stand (classified, for example, by species, age or size class). The production forecast is an output of this stand modelling process.

Because the resulting estimates are based on a full record of data from the Sub-compartment database, there is no sampling error involved in the estimation process, therefore no sampling standard error is calculated. However, the nature of the estimation process within each individual stand does introduce estimation error, with variable contributions from stand to stand, due to the type, age and accuracy of the information held in the Sub-compartment database. These estimation errors have not been quantified in this report.

## Estimates for the Private sector estate

Forests on the National Forest Inventory woodland map were first separated into FC estate and Private sector estate holdings using Forestry Commission spatial records of management boundaries. Estimates of softwood availability on the Private sector estate used a woodland area obtained from the map updated to 31 March 2011 (published in May 2012). This map contained a larger area (around 2.2 million hectares) of Private sector woodland than has been estimated by previous forest inventories. A full account of the National Forest Inventory mapping exercise can be found in the *National forest inventory forecasts methodology overview*. The mapped woodland area results can be found in the National Forest Inventory woodland area statistics for Great Britain, England, Scotland and Wales, available from [www.forestry.gov.uk/inventory](http://www.forestry.gov.uk/inventory).

For the field survey work, initial effort was directed mainly towards Private sector sites that, according to the map, contained areas of coniferous woodland. This resulted in 4036 sample squares being surveyed and the resulting data was used to produce the results in this report. These surveyed

sample squares represent a sub-sample of a planned 15 000 statistically representative squares covering all GB woodland that will be surveyed during this first cycle of the National Forest Inventory survey (due for completion in 2015).

At each sample square, the forest was stratified into different woodland types or stands, where information on species, age, management and a range of other parameters was collected. Typically, sample squares covered parts of two different forest stands, resulting in 8052 stands being assessed. Within each stand, field-based computer systems were used to locate two or three randomly located 100 m<sup>2</sup> (0.01 hectare) circular plots, within which all trees of greater than or equal to 4 cm diameter at breast height (DBH) were mapped, species and age identified, stocking assessed and diameters measured. A total of 228 311 trees were measured. For 59 334 of these trees, additional measurements of tree height and crown dimensions were taken for yield class and other purposes; for 23 714 trees, stem straightness was also assessed. The resulting data were used to estimate the standing volume of the trees and this formed the basis of the volume forecast. All squares were marked on the ground with metal pegs and GPS data of their location were recorded for checking and future measurement. All measurements were subject to office-based checks and 8% were re-measured in the field by an independent quality assurance team to ensure consistency and high standards.

The 2011 Inventory data for the Private sector estate was then run against several harvesting scenarios (including the felling assumptions used for the 2005 Private sector forecast) to understand the impact of different felling ages and thinning rates on future standing volume, increment and production volumes. The scenario approach was necessary to provide a basis for the forecast as there is neither a comprehensive record of felling and thinning plans for the Private sector estate nor a commitment to harvest a given volume.

Out of these scenarios, a single prescriptive and uniform management scenario was chosen to produce the 'headline' forecast. Under this scenario, Private sector forests are managed under a regime designed to maximise productivity (biological potential), within which it is assumed that timber will be harvested in the year of maximum Mean Annual Increment (MAI). It also takes account of wind constraints. This scenario, selected after consultation with Private sector woodland owners and timber processors, aims to maximise timber production in a way that involves relatively straightforward and transparent management prescriptions.

A similar approach was taken for thinning by applying a series of prescriptions set out in Forestry Commission management tables – known as management table thinning – to areas not

at significant risk from windthrow if thinned. In areas considered to be at high risk, determined by a Detailed Aspect Methodology Score (DAMS) of 16 or more, a strategy of no thinning – and felling conditional upon attainment of a terminal height (25 m and higher) – was assumed. Forestry Commission growth and yield models were then used to predict future growth and consequent future standing and harvested volumes.

The harvesting scenarios considered in the forecast are described below. They generate a range of outcomes from maximum possible sustainable potential production to minimum yield, all based upon the biological potential approach (felling to maximum MAI), with each scenario adopting a different approach to thinning and managing wind risk. In addition to these, a further scenario was based upon the 2005 industry-prescribed harvesting approaches.

- **Clearfelling to biological potential.** This assumes choosing a felling age which maximises long-term productivity by clearfelling at year of maximum MAI. Within this overall approach to management, several variants were defined:
  - **Biological potential felling and thinning all.** A scenario which maximises productivity by felling at age of maximum MAI in all stands irrespective of wind risk and to thin all stands to management table thinning, throughout the forecast period (from 2011 onwards).
  - **Modified biological potential, thinning and felling assuming moderate wind risk measures – the ‘headline’ forecast.** This scenario takes account of wind risk, but assumes a relatively risk-tolerant approach in applying wind-risk constraints to harvesting practice. This assumes felling to year of maximum MAI and thinning of all stands to management table in all crops less than DAMS 16, and felling at an assumed terminal height of 25 m (if this is attained before year of maximum MAI) and no thinning for stands at or above DAMS 16.
  - **Modified biological potential, thinning and felling assuming strong wind risk measures.** This scenario also takes account of wind risk, but applies a less risk-tolerant constraint to harvesting practice. This assumes felling to year of maximum MAI and thinning of all stands to management table in all crops less than DAMS 16, and felling at an assumed terminal height of 21 m (if this is attained before year of maximum MAI) and no thinning for stands at or above DAMS 16.
  - **Modified biological potential, assuming thinning based upon observed activity.** This scenario sets year of clearfell at first year of maximum MAI for all mature stands and thinning to management table thinning is only applied in those stands which were observed within the field survey as having been thinned already. No special wind-risk measures are assumed for mature stands. However, for

stands that are too young to have yet been thinned according to management table prescription (taken to be younger than three years after prescribed age of first thin) the scenario assumes management according to the modified biological potential scenario with moderate wind risk measures, described above.

- **Biological potential felling with no thinning.** Felling to maximise productivity by clearfelling at year of maximum MAI and undertaking no thinning.
- **Felling and thinning to the 2005 industry ‘view’.** This scenario uses region-specific sets of harvesting prescriptions based on an industry view of future harvesting practice with regard to age of felling and amount and type of thinning. These were derived in consultation with private sector growers and processors and were the basis of the 2000 and 2005 forecasts.
- **Management felling and thinning plans.** A forecast based upon detailed, stand by stand plans prescribing age of felling and type and intensity of thinning. **This applies to the Forestry Commission only.**
- **No harvesting.** Known as zero intervention, **this** scenario assumes no felling or thinning of any stand.

The impacts of the different harvesting approaches in each of the scenarios are set out in the report *Interpreting National Forest Inventory timber volume forecasts*.

The forecast results for individual surveyed squares were aggregated and scaled up to the areas identified by the woodland map, using standard statistical survey methodology, to produce the estimates in this report. Along with these estimates, associated sampling standard errors have also been calculated and reported, giving a measure of forecast accuracy, conditional upon the underlying assumptions. The sampling standard error will account for random variation arising from the selection of the sample, and random measurement errors, but not from any systematic biases in the field measurements. However, because of the quality assurance process it is thought unlikely that any substantial biases of this nature are present in the survey data.

The sources of error that are not accounted for in the reported standard errors will be those arising from use of empirical models to estimate standing volumes from the recorded survey data and forecasting errors arising from the use of Forestry Commission growth and yield models. Sampling error makes the largest contribution to overall variability in the forecast results and, as a result, the quoted standard errors are expected to be a good representation of the scale of the total error of forecast.

## Assumptions used in the forecast

### Ownership

As forests and woodlands are harvested differently under different ownership types, and a forecast is largely based upon the approach taken to harvesting, assumptions have been made about future forest ownership and thus how stands will be harvested over the forecast period. Changing ownership (past, current and potential) is accounted for by:

- Removing any forest areas already sold by the Forestry Commission from the Sub-compartment database and transferring this area to the Private sector forecast.
- Accounting for any planned land sales by the Forestry Commission (planned disposals are flagged in the Sub-compartment database). These areas will continue to contribute to the Forestry Commission forecast until the date of disposal. After that point areas and volumes are reported separately from the main forecast.

Otherwise the assumption of this forecast is that ownership in the future will remain constant between sectors.

### Restocking

The forecast uses the assumption that, when stands are felled within the forecast period, they are replanted with trees of the same species and yield class (i.e. like-for-like) for both FC/FS and Private sector woodlands. The impact of restocking on production volumes is minimal during the forecast period, as these stands will mostly produce volume after the forecast period. However, a very small volume will arise in relation to some early thinning from stands of higher yield class stands late in the forecast period. These are included in the volumes presented, but they only have material contribution to harvested volumes from the period 2027–2031 and this is small. The like-for-like assumption is only one possible scenario out of many for restocking. Because conifer restocking is currently lower than has been the case in the past, this may over estimate future production. The National Forest Inventory will in future provide a range of modelled restocking scenarios to explore the impacts of such assumptions.

### Currently clearfelled areas

Forest area that is currently clearfelled is not included in these forecasts. For the FC estate, the Sub-compartment database records of clearfelling were used. For the Private sector estate, the area of clearfell was first identified by aerial photography and then updated with satellite imagery. This was used in conjunction with the field survey to estimate stocked area and

area of clearfell. The National Forest Inventory has no information on what has been planted on Private sector sites before harvest and therefore the 'like-for-like' replanting assumption that is applied for the rest of the forecast cannot be applied to these areas. This is a conservative assumption as it is probable that most of this area will be replanted. Not including some level of replanting will create a small underestimate in most results, especially in the later years of the forecast. There will be much less impact on the production forecast than on standing volume, biomass and carbon forecasts, because such stands, if replanted, would only produce volume after the forecast period. Future National Forest Inventory forecasts will provide more options for how this land may be managed.

### 'Overdue timber'

'Overdue timber' is timber contained within stands that are already over the age prescribed for felling according to the management scenario used for a forecast at the start of the forecast period. Application of the rules of the scenario dictates that such stands be immediately felled on day one of the forecast. With this being the case, this prescription is followed in the implementation of the forecast, but the volumes immediately felled by reason of being 'overdue' are reported separately from other harvested volumes – in recognition that this is an artificial and unlikely occurrence.

The fact that, in the Private sector especially, the volume of overdue timber represents a significant amount of total standing volume at the start of the forecast indicates that a portion of the estate is not currently being managed according to the assumed scenario. For 'biological potential' scenarios, this in turn implies that the current practice on at least a portion of the Private sector estate is to leave some stands beyond the age of maximum MAI.

Since such stands are currently being managed in a way contrary to the assumed prescription, these, and some other stands that are currently below the age of maximum MAI, are also not likely to be managed in the assumed way in the future. Reasons for the observed 'delayed felling' leading to the presence of overdue timber at the start of the forecast are not known.

All areas felled as overdue will be restocked in the forecast on a like-for-like basis, as is the case for any other felled stand in the forecast period. In most scenarios, this approach will not materially impact on the forecast timber volumes as the replacement stands will not mature within the forecast period.

For more information about the Inventory methodology, see the *National Forest Inventory forecasts methodology overview*.

# Results

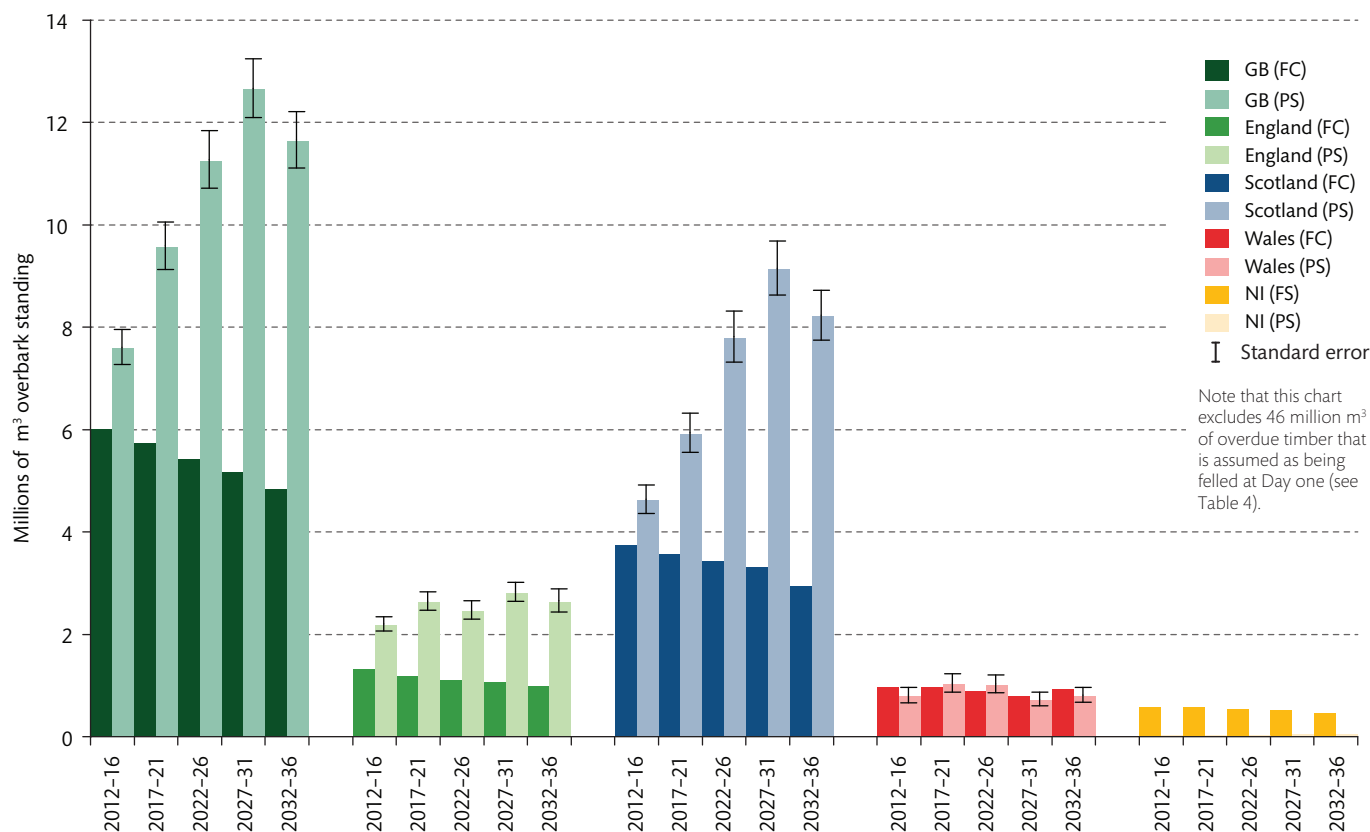
Table 1 gives the 25-year forecast of softwood timber availability for the UK, GB and each country, broken down by FC/FS estate and Private sector estate. Figure 1 illustrates the 25-year forecast broken down by country, ownership and five-year period. Table 2 gives the forecast of softwood timber availability broken down by country, ownership, size class and 5-year period. Table 3 gives a breakdown of the forecast by the percentage of spruce within overall softwood volumes (spruce comprises Sitka spruce and Norway spruce). These tables are comparable to the table supplied with the 2005 forecast.

The baseline date for these forecasts is 31 March 2011. The forecast starts in 2012, with 2012 defined as starting 1 April 2011 and ending 31 March 2012. This convention applies to all forecast years or periods quoted. All values are given in m<sup>3</sup> overbark standing (obs) and, as in previous forecasts, all annual harvested volumes include 'thinning plus felling'. Volumes are presented as average annual harvested volume for each five-year period. The values in the tables have been independently rounded, so may not add to the totals shown. Sampling standard errors (SE) attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

**Table 1** 25-year forecast of softwood timber availability for the FC/FS and Private sector estates in the UK (volume 000 m<sup>3</sup> obs).

Country	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC/FS	Private sector		FC/FS	Private sector		FC/FS	Private sector		FC/FS	Private sector		FC/FS	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
England	1 305	2 184	6	1 183	2 626	7	1 110	2 450	7	1 072	2 804	7	985	2 637	9
Scotland	3 749	4 614	6	3 568	5 917	6	3 417	7 796	6	3 305	9 131	6	2 930	8 213	6
Wales	958	793	19	979	1 025	17	893	1 008	18	795	713	19	927	791	18
<b>GB</b>	<b>6 013</b>	<b>7 591</b>	<b>5</b>	<b>5 730</b>	<b>9 569</b>	<b>5</b>	<b>5 420</b>	<b>11 255</b>	<b>5</b>	<b>5 172</b>	<b>12 648</b>	<b>5</b>	<b>4 841</b>	<b>11 641</b>	<b>5</b>
NI	579	26	-	572	22	-	529	25	-	519	44	-	458	44	-
<b>UK</b>	<b>6 592</b>	<b>7 617</b>	<b>-</b>	<b>6 302</b>	<b>9 591</b>	<b>-</b>	<b>5 949</b>	<b>11 280</b>	<b>-</b>	<b>5 691</b>	<b>12 692</b>	<b>-</b>	<b>5 299</b>	<b>11 685</b>	<b>-</b>

**Figure 1** 25-year forecast of softwood timber availability for the FC/FS and Private sector estates in the UK.



**Table 2** Breakdown of the forecast volume (000 m<sup>3</sup> obs) by country, top diameter class and forecast period.

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector		FC	Public Sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>England</b>															
7-14	301	308	5	215	263	7	179	222	8	152	324	7	145	356	7
14-16	111	120	5	91	113	7	78	98	8	70	103	9	62	113	12
16-18	111	137	6	96	137	7	83	125	8	76	122	9	66	126	13
18-24	304	496	7	281	543	7	256	541	8	239	528	8	207	501	13
24-34	273	638	9	281	824	8	278	817	8	278	868	8	252	798	10
34-44	110	260	10	119	379	9	123	352	10	130	436	9	124	382	10
44-54	53	112	11	56	169	11	59	156	13	62	213	10	61	181	11
54+	41	112	20	44	198	22	54	139	18	66	211	14	66	179	14
<b>Total</b>	<b>1 305</b>	<b>2 184</b>	<b>6</b>	<b>1 183</b>	<b>2 626</b>	<b>7</b>	<b>1 100</b>	<b>2 450</b>	<b>7</b>	<b>1 072</b>	<b>2 804</b>	<b>7</b>	<b>985</b>	<b>2 637</b>	<b>9</b>

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>Scotland</b>															
7-14	909	1 046	4	749	944	5	649	1 061	5	601	1 182	5	505	1 058	5
14-16	392	388	5	345	424	5	309	496	6	285	529	6	241	464	6
16-18	402	403	5	365	495	6	336	614	6	313	661	6	268	573	6
18-24	1 066	1 225	8	1 029	1 633	7	982	2 328	7	957	2 626	6	837	2 277	6
24-34	707	1 076	10	767	1 598	10	779	2 361	8	788	2 881	7	730	2 660	7
34-44	178	299	12	205	509	12	230	619	11	229	832	9	218	784	9
44-54	63	108	16	69	189	15	84	186	18	81	259	12	78	244	13
54+	32	69	22	38	123	22	49	130	35	51	162	18	53	154	22
<b>Total</b>	<b>3 749</b>	<b>4 614</b>	<b>6</b>	<b>3 568</b>	<b>5 917</b>	<b>6</b>	<b>3 417</b>	<b>7 796</b>	<b>6</b>	<b>3 305</b>	<b>9 131</b>	<b>6</b>	<b>2 930</b>	<b>8 213</b>	<b>6</b>

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>Wales</b>															
7-14	195	99	15	196	92	16	169	89	16	130	88	16	153	117	17
14-16	84	43	18	81	41	18	74	42	18	61	34	20	72	51	21
16-18	89	49	18	84	56	19	79	52	19	70	40	22	84	61	22
18-24	258	180	18	249	241	19	233	231	20	219	146	23	281	224	22
24-34	218	218	20	230	372	21	207	329	19	190	209	26	217	217	22
34-44	71	94	31	80	143	23	73	134	25	67	100	27	61	67	25
44-54	28	44	42	34	53	31	32	62	35	30	47	30	28	25	34
54+	15	68	75	24	28	36	26	68	42	27	49	34	30	29	38
<b>Total</b>	<b>958</b>	<b>793</b>	<b>19</b>	<b>979</b>	<b>1 025</b>	<b>17</b>	<b>893</b>	<b>1 008</b>	<b>18</b>	<b>795</b>	<b>713</b>	<b>19</b>	<b>927</b>	<b>791</b>	<b>18</b>

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector		FC	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>Great Britain</b>															
7-14	1 405	1 453	3	1 161	1 298	4	998	1 372	4	882	1 594	4	803	1 532	4
14-16	587	550	4	517	579	4	461	636	5	416	666	5	374	628	5
16-18	603	588	4	546	688	5	498	791	5	458	822	5	419	760	6
18-24	1 629	1 902	6	1 559	2 416	5	1 470	3 100	6	1 415	3 300	5	1 325	3 001	6
24-34	1 198	1 932	7	1 278	2 794	7	1 263	3 508	6	1 256	3 957	6	1 200	3 675	6
34-44	359	653	8	404	1 031	8	426	1 105	8	427	1 367	7	403	1 233	7
44-54	143	264	11	159	412	9	175	404	11	173	520	8	167	450	8
54+	89	248	23	107	349	15	129	338	18	144	422	10	150	362	12
<b>Total</b>	<b>6 013</b>	<b>7 591</b>	<b>5</b>	<b>5 730</b>	<b>9 569</b>	<b>5</b>	<b>5 420</b>	<b>11 255</b>	<b>5</b>	<b>5 172</b>	<b>12 648</b>	<b>5</b>	<b>4 841</b>	<b>11 641</b>	<b>5</b>



**Table 2 (continued)** Breakdown of the forecast volume (000 m<sup>3</sup> obs) by country, top diameter class and forecast period.

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FS		Private sector	FS		Private sector	FS		Private sector	FS		Private sector	FS		Private sector
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>Northern Ireland</b>															
7-14	80	4	-	69	3	-	57	3	-	58	6	-	50	6	-
14-16	48	2	-	40	2	-	35	2	-	36	3	-	30	3	-
16-18	65	3	-	56	2	-	50	2	-	50	4	-	42	4	-
18-24	247	11	-	240	9	-	220	10	-	214	18	-	174	16	-
24-34	121	5	-	147	6	-	151	7	-	143	12	-	142	13	-
34-44	11	1	-	11	0	-	10	1	-	13	1	-	13	1	-
44-54	3	0	-	3	0	-	4	0	-	3	0	-	4	0	-
54+	4	0	-	5	0	-	3	0	-	3	0	-	3	0	-
<b>Total</b>	<b>579</b>	<b>26</b>	<b>-</b>	<b>572</b>	<b>22</b>	<b>-</b>	<b>529</b>	<b>25</b>	<b>-</b>	<b>519</b>	<b>44</b>	<b>-</b>	<b>458</b>	<b>44</b>	<b>-</b>

Top diameter class (cm)	2012-16			2017-21			2022-26			2027-31			2032-36		
	FC/FS		Private sector	FC/FS		Private sector	FC/FS		Private sector	FC/FS		Private sector	FC/FS		Private sector
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %
<b>United Kingdom</b>															
7-14	1 485	1 458	-	1 229	1 302	-	1 055	1 375	-	940	1 600	-	853	1 537	-
14-16	635	553	-	557	580	-	496	638	-	452	669	-	404	631	-
16-18	667	591	-	602	690	-	548	793	-	508	826	-	460	764	-
18-24	1 875	1 913	-	1 799	2 425	-	1 690	3 111	-	1 629	3 318	-	1 499	3 018	-
24-34	1 319	1 937	-	1 426	2 800	-	1 414	3 515	-	1 399	3 969	-	1 342	3 689	-
34-44	370	654	-	415	1 031	-	436	1 106	-	439	1 368	-	416	1 234	-
44-54	146	264	-	162	412	-	179	404	-	177	520	-	170	451	-
54+	93	248	-	112	349	-	132	338	-	147	422	-	153	362	-
<b>Total</b>	<b>6 592</b>	<b>7 617</b>	<b>-</b>	<b>6 302</b>	<b>9 591</b>	<b>-</b>	<b>5 949</b>	<b>11 280</b>	<b>-</b>	<b>5 691</b>	<b>12 692</b>	<b>-</b>	<b>5 299</b>	<b>11 685</b>	<b>-</b>

**Table 3** Breakdown of the forecast volume by per cent spruce.

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)
<b>England</b>										
7-14	56	42	59	39	62	41	68	33	67	31
14-16	66	38	63	40	66	47	72	51	73	44
16-18	66	36	61	41	63	47	69	54	70	49
18-24	61	34	55	40	54	45	59	52	58	52
24-34	40	32	37	40	32	40	36	44	32	43
34-44	25	26	25	37	22	36	25	37	21	33
44-54	21	22	21	34	20	34	23	33	20	28
54+	17	19	19	48	17	37	19	31	19	23
<b>Total</b>	<b>50</b>	<b>32</b>	<b>46</b>	<b>40</b>	<b>44</b>	<b>41</b>	<b>47</b>	<b>42</b>	<b>45</b>	<b>40</b>

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)
<b>Scotland</b>										
7-14	67	72	73	76	72	77	71	67	71	56
14-16	73	72	77	78	76	81	75	79	76	67
16-18	76	71	79	79	78	83	77	81	78	71
18-24	80	70	82	80	81	84	81	83	81	76
24-34	81	67	82	75	82	82	82	83	83	76
34-44	77	55	77	67	79	75	78	77	79	67
44-54	72	45	71	62	75	69	72	68	74	54
54+	64	28	65	54	69	68	65	52	70	44
<b>Total</b>	<b>76</b>	<b>68</b>	<b>79</b>	<b>76</b>	<b>78</b>	<b>81</b>	<b>78</b>	<b>79</b>	<b>79</b>	<b>70</b>

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)
<b>Wales</b>										
7-14	71	58	71	62	71	72	68	55	72	60
14-16	72	58	72	71	74	74	71	70	75	69
16-18	72	58	73	73	75	75	74	73	76	73
18-24	74	56	74	77	75	75	78	72	80	77
24-34	76	48	77	72	74	67	80	65	82	81
34-44	78	43	79	61	75	48	79	51	77	81
44-54	77	44	79	46	75	36	78	38	75	75
54+	71	70	74	57	65	17	65	40	65	70
<b>Total</b>	<b>74</b>	<b>53</b>	<b>75</b>	<b>69</b>	<b>74</b>	<b>62</b>	<b>75</b>	<b>60</b>	<b>77</b>	<b>75</b>

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)	FC (%)	PS (%)
<b>Great Britain</b>										
7-14	65	64	70	68	70	71	70	60	71	51
14-16	72	63	74	70	74	76	74	74	75	63
16-18	74	62	75	71	75	76	76	76	76	67
18-24	76	60	76	71	75	76	77	78	77	72
24-34	71	53	71	65	70	70	72	74	72	69
34-44	61	42	62	55	62	59	62	62	61	57
44-54	54	35	55	48	56	50	55	51	54	45
54+	43	36	48	51	47	45	44	40	46	36
<b>Total</b>	<b>70</b>	<b>56</b>	<b>71</b>	<b>65</b>	<b>71</b>	<b>70</b>	<b>71</b>	<b>70</b>	<b>71</b>	<b>64</b>

**Table 3 (continued)** Breakdown of the forecast volume by per cent spruce.

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FS (%)	PS (%)	FS (%)	PS (%)	FS (%)	PS (%)	FS (%)	PS (%)	FS (%)	PS (%)
<b>Northern Ireland</b>										
7-14	90	90	90	90	90	90	87	87	87	87
14-16	90	90	90	90	90	90	87	87	87	87
16-18	90	90	90	90	90	90	87	87	87	87
18-24	90	90	90	90	90	90	87	87	87	87
24-34	90	90	90	90	90	90	87	87	87	87
34-44	90	90	90	90	90	90	87	87	87	87
44-54	90	90	90	90	90	90	87	87	87	87
54+	90	90	90	90	90	90	87	87	87	87
<b>Total</b>	<b>90</b>	<b>90</b>	<b>90</b>	<b>90</b>	<b>90</b>	<b>90</b>	<b>87</b>	<b>87</b>	<b>87</b>	<b>87</b>

Top diameter class (cm)	2012-16		2017-21		2022-26		2027-31		2032-36	
	FC/FS (%)	PS (%)	FC/FS (%)	PS (%)	FC/FS (%)	PS (%)	FC/FS (%)	PS (%)	FC/FS (%)	PS (%)
<b>United Kingdom</b>										
7-14	67	64	71	68	71	71	71	60	72	51
14-16	73	63	75	70	75	76	75	74	76	63
16-18	76	62	77	71	77	76	77	77	77	67
18-24	77	60	78	71	77	76	78	78	78	72
24-34	73	53	73	65	72	70	73	74	73	69
34-44	62	42	63	55	63	59	63	62	62	57
44-54	55	35	56	48	57	50	56	51	55	45
54+	45	36	50	51	48	45	45	40	47	36
<b>Total</b>	<b>72</b>	<b>56</b>	<b>73</b>	<b>65</b>	<b>72</b>	<b>70</b>	<b>73</b>	<b>70</b>	<b>73</b>	<b>64</b>

Tables 4-6 represent potential volumes, or areas that could produce volume, that have not been included in the previous results. Table 4 gives a breakdown of the amount of 'overdue' timber by ownership and country for GB. Table 5 gives a forecast of potential timber volumes arising from 30 000 ha of land flagged for sale by the Forestry Commission within the Sub-compartment database (as of 31 March 2011). Here the harvesting scenario assumed is one of biological potential. Areas identified as recently clearfelled are not included within the forecasts. For the Forestry Commission, area of clearfell is taken from the Sub-compartment database as of 31 March 2011. For the Private sector, the Inventory fieldwork includes clearfelled areas but the stocked area excludes these, and it is stocked area that is used as the basis for the forecast. The Private sector clearfell area quoted in Table 6 is that taken from the woodland map, which will contain areas recently replanted and not evident in the imagery that the map is derived from.

The figures in the tables have been independently rounded, so may not add to the totals shown. Sampling standard errors (SE) attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

Figure 2 illustrates the forecast volumes that would arise if the alternative harvesting scenarios (described on page 5) were applied to the Private sector estate. The headline scenario used to generate the results reported here is shown in red.

**Table 4** Overdue timber (volume 000 m<sup>3</sup> obs and area 000 ha).

Country	FC estate	Private sector		FC estate	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE %	000 ha	000 ha	SE %
England	912	18866	7	3.4	38.5	6
Scotland	794	19443	10	2.9	39.8	8
Wales	2 194	3 501	25	5.0	6.0	22
<b>Great Britain</b>	<b>3 900</b>	<b>41 810</b>	<b>6</b>	<b>11.2</b>	<b>84.3</b>	<b>5</b>

**Table 5** Potential timber volumes arising from FC land sales (obs).

Country	2012-16 000 m <sup>3</sup>	2017-21 000 m <sup>3</sup>	2022-26 000 m <sup>3</sup>	2027-31 000 m <sup>3</sup>	2032-36 000 m <sup>3</sup>
England	57	51	47	42	41
Scotland	144	223	273	279	286
Wales	-	-	-	-	-
<b>Great Britain</b>	<b>201</b>	<b>273</b>	<b>320</b>	<b>321</b>	<b>328</b>

**Table 6** Clearfelled land in Great Britain at 31 March 2011.

Country	FC estate	Private sector	Total
	000 ha	000 ha	000 ha
England	8.1	9.0	17.1
Scotland	28.2	43.0	71.2
Wales	4.6	6.1	10.7
<b>Great Britain</b>	<b>40.9</b>	<b>58.2</b>	<b>99.1</b>

**Figure 2** The impact of different harvesting scenarios upon 25-year timber potential for the Private sector (GB).

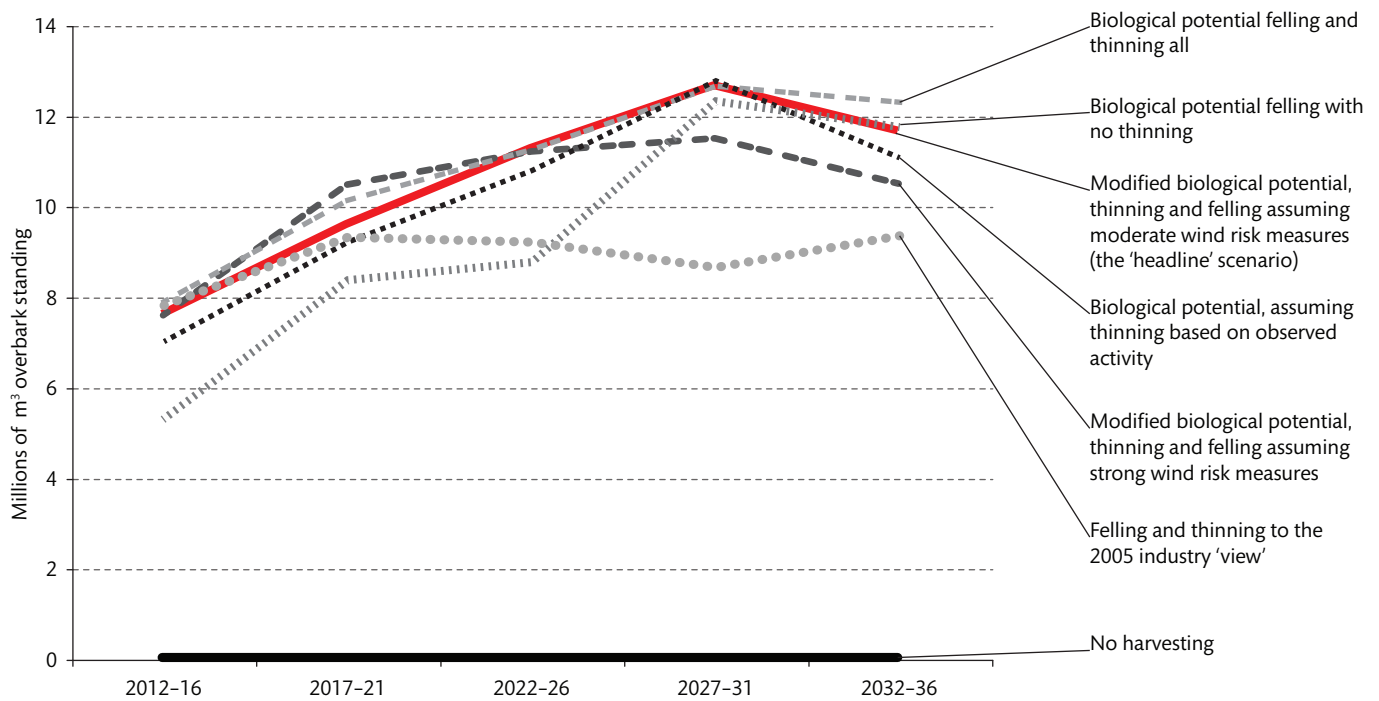


Table 7 and Figure 3 show the evolution of standing volume under the headline scenario used to derive the forecast results. Figure 4 shows the relationship between forecast standing volume, increment (i.e. gain in volume over time) and subsequent timber availability over the forecast period.

**Table 7** 25-year forecast of average annual standing coniferous volume.

Forecast period	FC	Private sector	
	000 m <sup>3</sup>	000 m <sup>3</sup>	SE%
<b>England</b>			
2012-16	23 389	41 626	3
2017-21	22 874	40 094	4
2022-26	22 317	36 386	4
2027-31	21 633	32 183	4
2032-36	21 121	28 276	4
<b>Scotland</b>			
2012-16	73 237	119 210	2
2017-21	69 682	128 866	2
2022-26	66 526	127 120	2
2027-31	62 421	118 654	2
2032-36	58 924	103 304	3
<b>Wales</b>			
2012-16	18 195	14 391	7
2017-21	17 338	12 834	8
2022-26	16 624	10 962	9
2027-31	16 429	8 885	10
2032-36	15 364	7 725	10
<b>Great Britain</b>			
2012-16	114 821	175 227	2
2017-21	109 894	181 794	2
2022-26	105 467	174 468	2
2027-31	100 483	159 722	2
2032-36	95 408	139 305	2

Note: Figures are taken from the National Forest Inventory and therefore are for GB only.

Figure 3 25-year forecast of average annual standing coniferous volume.

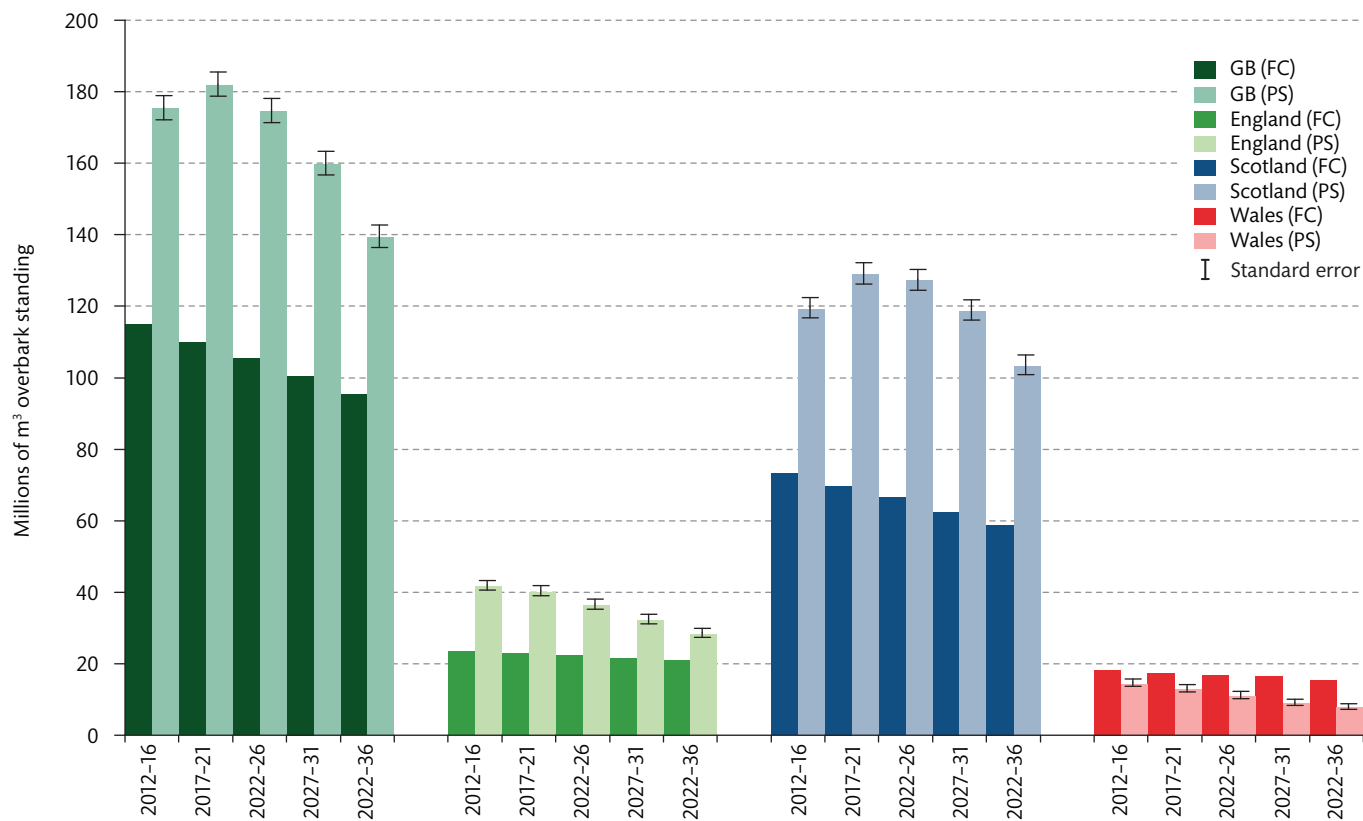
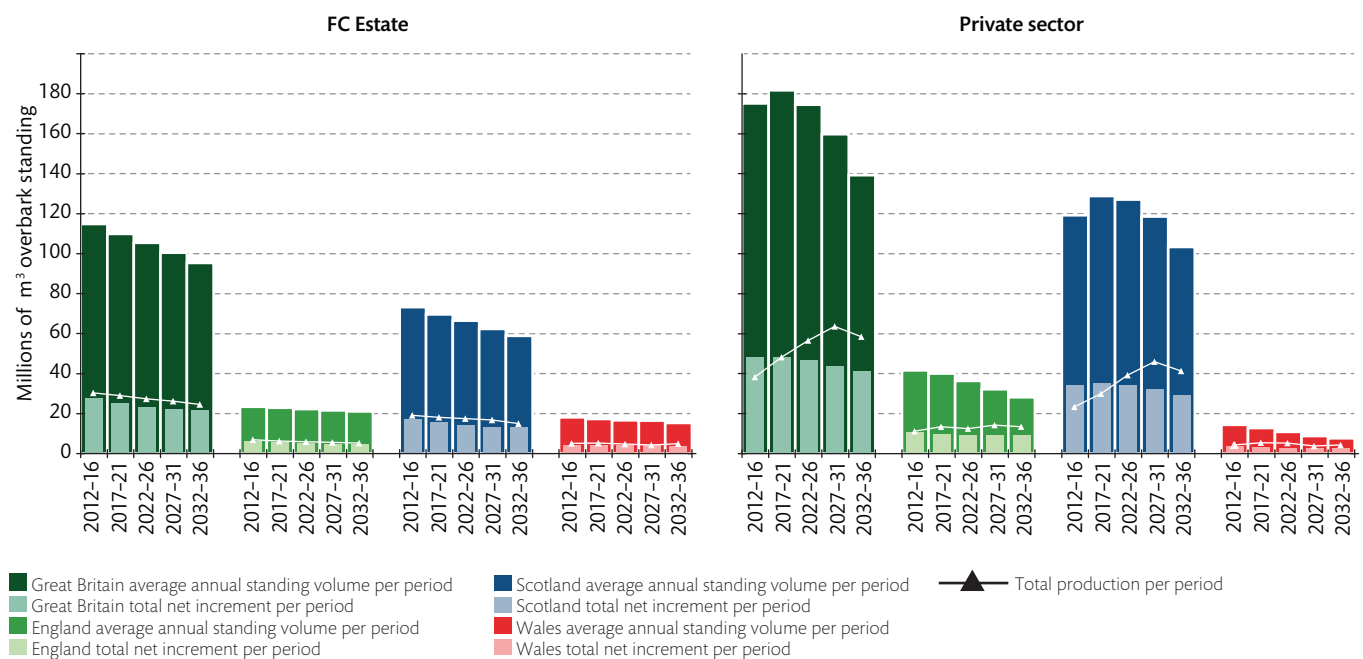


Figure 4 Average annual standing volume and total increment and production per period.



## What the results tell us

The general trend in potential production is comparable to that of previous forecasts in that volume levels rise to a peak and then begin to decline to a level higher than the starting point. However, overall volume has increased with different trends forecast for the FC/FS and Private sector estates.

### Forecast for the FC/FS estate

The forecast set out in this report for the FC/FS estate is broadly comparable to the forecast reported in 2005 – both in terms of total production and the shape and timing of the profile of production. This is because they have been derived in a similar way; the inventory estimates used in 2005 are consistent with those used in this forecast and felling and thinning rates have not changed significantly.

However, there has been a slight decrease of 5% in total volume over the first three periods of the forecast, which results in the peak of production occurring in 2011 as opposed to 2017–21, which was forecast in 2005. A significant element of this shift is the result of land sales, which have reduced overall volumes for the Forestry Commission and increased overall volumes for the Private sector. Another element is forest management policy; the Forestry Commission is currently retaining more volume for longer periods. However, this picture varies between the countries, with decreasing production in England and Scotland and increasing production in Wales.

There are a series of commitments by the FC to meet most of the forecast volumes within the first five-year period (within a tolerance) and to bring most of the resulting harvested volume to market. However, these commitments vary across the countries (see below). Beyond 2016 the forecast indicates intent only, but is based upon existing forest management plans.

- Forestry Commission England is committed to bring to market the forecast volume ( $\pm 5\%$ ) in the period 2012–16, through new and existing contracts.
- Forestry Commission Scotland is committed to bring 3.2 million m<sup>3</sup> per annum ( $\pm 5\%$ ) to market in the period 2012–16, through new and existing contracts. Forestry Commission Scotland's aim is to smooth production in the medium to long term, although management of diseases such as Dothistroma needle blight may result in production increases in the short term.
- Forestry Commission Wales is committed to bring to market at least 80% of forecast volume in the period 2012–16, through new and existing contracts.
- Forest Service intends to continue production at current levels in the period 2012–16.

When considering the volumes from 2016 onwards, it is worth noting that, historically, actual production for the FC has been closely correlated to forecast production. If this continues, the production will form a comparatively 'stable' element of the forecast.

### Forecast for the Private sector estate

The forecast set out in this report for the Private sector estate is different to the forecast reported in 2005, with a significant increase in potential softwood timber availability. The forecasts followed the same basic approach, but the 2011 Inventory provided improved information and data, compared with that used in 2005. Larger areas of forest and woodland, higher growth rates and higher stocking account for the majority of the difference – increasing cumulative volume production in all harvesting scenarios by around 43% (including overdue timber). The new approach to predicting future rates of harvesting by using different scenarios to give a range of potential outcomes (earlier forecasts relied on an 'industry view' for estimating future harvesting activity) accounts for an additional 6% of volume production.

Analysis of the data has shown that the differences between the Private sector forecasts are due to five main factors which are discussed in more detail below:

- Woodland area
- Yield class
- Harvesting activity
- Standing volume
- Overdue timber

### Woodland area

The net area of coniferous trees in this forecast is more than that estimated by the 2005 forecast (around 775 000 hectares compared with 735 000 hectares), even when excluding clearfelling since 2005 (which has been carried out at a rate of around 2–3% per annum). This increase does not mean that more trees have been planted, just that the area was underestimated in 2005. Much of this difference is due to the range of improved processes and techniques used in the latest Inventory, for example – taking physical measurements instead of making estimations of areas such as clearfell. Finally, the Inventory fieldwork identified more minor conifer and broadleaved species in forests and woodlands than previous surveys. While not reducing or increasing woodland area, this improved the allocation of woodland area to individual species and increased the overall area of conifer species.

## Yield class

The yield classes applied in this forecast for the Private sector estate are generally higher than those applied in the 2005 forecast (an average of 13.2 for all conifers compared with 12.7). This is because physical measurements were taken on a stand-by-stand basis to derive the yield classes reported here, while the 2005 forecast used either expert estimates on a regional basis or the yield class distribution found on the FC estate. The yield classes arising from the Inventory and used in this forecast are published in the Statistical analysis report UK 25-year forecast of softwood availability.

## Harvesting activity

The 'biological potential' scenario used in this forecast represents the volume of timber that would be produced if felling took place in the year of maximum MAI and thinning conforms to management table thinning (except in high wind risk areas, as noted previously). In contrast, the 2005 forecast used an 'Industry view' of likely future harvesting activity.

The biological potential scenario is one of a number of variants considered in this forecast but all predicted increased volumes when compared with the 2005 forecast. This is because the major part of the increase is due to the higher standing volumes found by the National Forest Inventory and accounts for around a 43% increase upon 2005 volumes, whichever scenario is chosen.

In addition, by choosing this scenario over the 2005 approach the 'upper ceiling' of potential production attainable through harvesting choices is being forecast. This has led to a projected increase in cumulative volume production of around 6% over the 25-year period. This arises because this forecast uses longer rotations and a higher proportion of thinning than those used in the 2005 forecast. If the alternative harvesting scenarios had been used, cumulative volume would have changed by between -1% and 9%.

The 6% increase in cumulative volume production might lead to the conclusion that the approach to harvesting does not greatly influence potential production overall. However, the profile of this production does vary significantly between the two forecasts. For example, when compared with biological potential, the pattern of production for the scenario based on the 2005 Industry view is very different between five-year periods, with a 50% difference in the 2027-31 period. This effect can be seen in Figure 2, where the 2005 scenario produces an additional peak in production within the 25-year period, when compared with scenarios based on biological potential.

A strong component of the second peak in the 2005 scenario is the result of a significant volume of timber from the 2037-2061 period being brought forward into the 2012-2036 period. This occurs because assumed rotations are shorter. This in turn will have an impact on the potential volumes arising in the 2037-2061 period. This happens because even though the cumulative impact of shorter rotations across all stands over the 25 year period is only 6%, the impact on individual stands is much greater. Further work is required to fully substantiate this assertion.

These shorter rotations produce significantly less volume per hectare at time of clearfell and reduce overall standing volume compared with biological potential. The shorter rotation of the 2005 Industry view scenario can 'keep up' in terms of cumulative production, compared to the longer rotations of the biological potential scenario, by bringing volume from the next rotation forward.

Such variation in potential production shows how changes in overall harvesting activity can have a significant impact on the timing and level of volume forecast within periods and reflect the difficulty in accurately predicting actual levels of future harvesting. The Interpreting National Forest Inventory timber volume forecasts report discusses how approaches to harvesting influence and constrain the amount of timber that is likely to be harvested in any given period.

## Standing volume

Previous forecasts for the Private sector estate modelled a stocking and standing volume at time of felling, based upon FC growth and yield models and assuming a certain level of historical thinning (management table thinning) and tree mortality. This forecast is based upon a measured assessment of stocking at time of survey, which gives a more accurate estimate of current standing volume and therefore a more accurate starting point for modelling future stocking and standing volume. This approach has revealed higher current stocking levels than previously modelled and this has led to increases in forecast volume. This higher stocking arises primarily as a result of low levels of thinning in practice and, to some extent, to lower actual mortality rates than the models previously predicted.

## Overdue timber

The 2005 forecast categorised 25.4 million m<sup>3</sup> of timber as 'overdue'. Based on expert opinion, a proportion of this volume (around 53%) was allocated for felling over the 20-year forecast period and this was combined with the five-year average annual volumes. In this forecast this volume is modelled as being felled in the first year of the forecast and

is reported separately. The harvesting scenario used for this forecast highlights around 46 million m<sup>3</sup> of overdue timber within GB. The majority (42 million m<sup>3</sup>) is on the Private sector estate. Whether this timber is 'available' for harvesting or not will depend upon a number of factors, including management objectives and environmental constraints. In practice a wide array of felling and retention practices will apply to these stands, with some being retained and some felled at different points in time in the future.

## Impact of restocking

The 2005 forecast did not include restocking after clearfell for the FC/FS estate, but did for the Private sector estate. In this forecast it is assumed that when trees are felled they are replanted with trees of the same species and yield class (i.e. like-for-like) for both FC/FS and Private sector woodlands. This difference will have marginally depressed volume in the last period (2022-26) of the 2005 forecast compared with this forecast, but not to any notable degree. This is principally because the stands restocked within the 25-year period will not have matured within the forecast period. However for some stands felled in the first period and restocked with high yield class crops, some early thinning volume will begin to arise in the last period, but again not to any significant degree. *Interpreting National Forest Inventory timber volume forecasts* explores the impact of adding restocking to the forecast.

## Impact of harvesting on standing volume

The level and frequency of thinning and felling will have an impact on standing volume and increment over time. If removals exceed increment then standing volumes will be reduced and vice versa. Standing volume for GB (at 31 March 2011) is around 336 million m<sup>3</sup>. As the harvesting scenarios of this forecast are applied, total standing volume moves to an average annual figure of around 290 million m<sup>3</sup> (excluding overdue timber) for the first period of the forecast (2012-16). By the last period of the forecast (2032-36) the average annual standing volume has decreased to 235 million m<sup>3</sup>. This reduction arises as forecast removals exceed forecast increment. Annual net increment is 15.2 million m<sup>3</sup> for the first period (2012-16) and for the remaining periods ranges between 12.5 to 14.7 million m<sup>3</sup> per annum. The forecast average annual cut for the forecast period is 16.0 million m<sup>3</sup>, and as such it can be concluded that increment is currently forecast to be less than potential harvest within GB and this is the cause of the reduction. However this relies on the harvesting assumptions used, which will vary over time.

A large determinant in the forecast for total standing volume in GB is the unusual age class structure. The development of a planted forest resource has led to an uneven planting and age

profile which, in combination with the assumption to fell, is the principal determinant of standing volume. This is in contrast with forests of a more evenly distributed age, which result in a more even development of total standing volume, increment and production through time. Any comparisons of level of cut to increment should account for this. It should also be noted that this is a snapshot of standing volume, taken over 25 years, looking at a fraction of the life cycle of a forest. If a 50 or 100-year window were to be used, a different perspective would be given, in particular estimates of increment and harvesting are likely to be closer to being in balance over longer timescales.

The reports *Standing timber volume for coniferous trees in Britain, 25-Year forecast of standing coniferous volume and increment* and *Interpreting National Forest Inventory timber volume forecasts* cover this subject in more detail.

## Species and composition of volumes

The proportion of spruce contributing to total volume rises from 62% to 69%, and then decreases to 66% by the end of the forecast. This is slightly higher than that suggested by the 2005 forecast, reflecting more accurate inventory data and improved growth models for spruce. The assortments in Table 2 show a relatively high proportion of larger diameter classes – this relies on the assumption of Management table thinning; other scenarios would produce smaller sizes.

## Impact of future events

The impact of future harvesting events on production levels in the Private sector is explored through the use of the scenarios. However, as owners have a wide range of objectives, it is unlikely that the majority of forests and woodlands will be managed to the biological potential scenario used for this forecast. For example, the biological potential forecast relies on the assumption of higher levels of thinning and longer rotations than are typical under current practice. Therefore cumulative volume production is likely to be less if current approaches to harvesting continue. Actual harvesting activity may follow a number of possible patterns and thus actual production will almost certainly vary from the forecast results.

In addition to the impact of harvesting decisions, there are other unpredictable external factors that are likely to have an impact on all production over the period of the forecast. For example, pest and disease outbreaks (current risks include *Dothistroma* needle blight and *Phytophthora*), economic factors, severe weather events (windthrow), changes in land use (wind farms and habitat restoration) and changes in government policy (affecting for example grants and regulation, land sales and forest management) will all have impacts.



# Conclusions

The general trend predicted by this forecast is comparable to that of previous forecasts in that volume levels rise to a peak and then begin to decline to a level higher than the starting point. This is driven by the underlying age class structure of the forests in Britain, which reflects the boost in planting between the post-war period and the late 1980s.

The Forestry Commission forecast predicts production of softwood timber at a level reasonably consistent with previous forecasts, but there is a 5% reduction in production over the first three periods. A significant element of this reduction results from land sales. The volume of timber potentially available over the forecast period falls from 6.6 million m<sup>3</sup> in the first period (2012–16) to 5.3 million m<sup>3</sup> in the final period (2032–36). Around 70% of that timber is spruce.

There is a significant increase in potential production for the Private sector with a 52% increase in cumulative potential production over the 25-year period. The volume of timber potentially available over the forecast period rises from 7.6 million m<sup>3</sup> in the first period (2012–16) to 11.7 million m<sup>3</sup> in the final period (2032–36), peaking at 12.7 million m<sup>3</sup> in the fourth period (2027–31). Around 65% of that timber is spruce.

The increase in volume forecast for the Private sector is due to five main factors:

- Area – there is 8% more woodland in GB than previously reported, which contains an additional 40 000 hectares of conifers on the Private sector estate.
- Yield class – yield class for all conifers on the Private sector estate is higher than previously estimated.
- Harvesting age – this forecast used a biological potential scenario (involving felling stands in the year of maximum MAI) to set felling age for forests on the Private sector estate as opposed to assumptions developed by industry experts about when felling is likely to occur.
- Standing volume – standing volume at the time of clearfell, which is primarily based on direct measurement in this forecast, is higher than in the 2005 forecast, which was solely based on modelled estimates.
- Overdue timber – there have been changes in the definition of overdue timber and how it is treated within this forecast.

When and if timber is harvested will depend on a number of factors, not least of which are the choices made by the Forestry Commission and Private sector forest and woodland owners. There are some constraints on Forestry Commission production in the short term and, for the Private sector, the biological potential scenario is one of many possible scenarios. Owners are unlikely to manage their forests and

woodlands to biological potential throughout the 25-year period and actual production will vary from these estimates.

When drawing conclusions from this report it should also be noted that this is a snapshot of potential production, taken within a 25-year time period, looking at only a fraction of the life cycle of the forests. If a 50 or 100-year forecast were to be used, a different perspective on potential production would be given. For example, during the following 25 years a recovery in production, as young stands regrow, would be evident.

## Future work

This report has built on the woodland area reports published in 2011 and the *Standing timber volume for coniferous trees in Britain* published earlier in 2012. A similar forecast for hardwood timber availability will be published in 2013. Future reports will explore the impacts of potential production on future standing volume and increment and also carbon stocks. In addition, longer-term forecasts and the impacts of different restocking scenarios on the forest resource will be available in the coming years. All such information is an essential part of planning for sustainable forest management across a range of interests, including, for example, biodiversity and climate change in addition to the development of the forest products industry.

# Glossary

- Actual production:** Timber actually felled and removed from the forest. The Forestry Commission keeps records of actual production for its estate, while estimates for the Private sector come from receipts reported by timber processors. These figures are available from Forestry Commission Statistics.
- Age class:** A grouping of trees into specific age ranges for classification purposes.
- Area (forest/woodland):** Forest and woodland area can be defined in net or gross terms. Net area is the land actually covered by trees (in the National Forest Inventory that is to the drip line of the canopy). Gross area includes both the area covered by trees and the open spaces (<0.5 hectares) within (e.g. rides, glades, ponds).
- Biological potential:** A term applied to forecast scenarios with the objective of maximising timber production. It typically involves felling stands in the year of maximum MAI and Management table thinning. It may not take account of factors that constrain thinning and felling (e.g. wind risk or pest attack). The forecast results set out in this report involve constraints on thinning and times of felling to take account of wind risk.
- Broadleaves:** Trees and shrubs that belong to the angiosperm division of the plant kingdom (as distinct from the gymnosperm division that includes conifers). Most in the UK have laminar leaves and are deciduous. Sometimes referred to as 'hardwoods'.
- Clearfelling:** Cutting down of an area of woodland (if it is within a larger area of woodland it is typically a felling greater than 0.25 hectare). Sometimes a scatter or small clumps of trees may be left standing within the felled area.
- Conifers:** Trees and shrubs that belong to the gymnosperm division of the plant kingdom (as distinct from the angiosperm division that includes broadleaves). Conifers mostly have needles or scale-like leaves and are usually evergreen. Sometimes referred to as 'softwoods'.
- Cumulative volume production:** The total volume of timber that is forecast to be produced over the entire forecast period, including any overdue timber.
- DAMS (Detailed Aspect Methodology Score):** A measure of exposure at a particular location. Can be used as a proxy indicator of the risk of catastrophic wind damage to a stand of trees. May be used to influence decisions on thinning and timing of clearfelling where wind is a risk factor.
- DBH (diameter at breast height):** The diameter on the stem of a tree at 'breast height', defined as 1.3 m from ground level.
- Dothistroma needle blight:** A disease of conifers (especially pine) which causes defoliation, losses in yield and, in severe cases, tree death. Also known as Red band needle blight.
- Felling plan:** A spatial and temporal plan of harvesting activities within a forest or woodland.
- Forestry Commission (FC) estate:** Forests, woodlands, open land and other property managed by the Forestry Commission.
- Forest (or woodland):** Land predominately covered in trees (defined as land under stands of trees with a canopy cover of at least 20%, or the ability to achieve this, and with a minimum area of 0.5 ha and minimum width of 20 m), whether in large tracts (generally called forests) or smaller areas known by a variety of terms (including woods, copses, spinneys or shelterbelts).
- Forest management plan:** A holistic spatial and temporal plan stating the objectives of management together with details of forestry proposals over a period of five years and outlining intentions over a minimum total of 10 years. Such plans allow managers to communicate proposals and demonstrate sustainable forest management. They can be used to authorise thinning, felling and other management operations.
- Forestry Commission:** The government department responsible for regulating forestry, implementing forestry policy and managing state forests in GB. Forestry policy is devolved, with the exception of common issues addressed on a GB or UK basis, such as international forestry, plant health and forestry standards.
- Forest Service:** An agency within the Department of Agriculture and Rural Development in Northern Ireland responsible for the regulation of forestry and the management of state forests in Northern Ireland.
- Great Britain (GB):** England, Scotland and Wales.
- Increment:** The increase in volume of a tree or a stand over a year or annualised over a specified period measured either in m<sup>3</sup> per year or in m<sup>3</sup> per hectare per year. See also Mean annual increment (MAI).
- Like-for-like (restocking):** The restocking of areas of felled trees with trees of the same species and yield class.
- Management table thinning:** A sequence of thinnings prescribed by Forestry Commission yield tables over the life of a forest stand. Management table thinning refers to the pattern of thinning recommended in these yield tables. In standard yield tables the thinnings are set to an intensity which aims to maximise diameter increment while also maintaining maximum cumulative volume production.
- Mean annual increment (MAI):** The average rate of volume production up to a given year, expressed in m<sup>3</sup> per hectare per year. In even-aged stands it is calculated by dividing cumulative volume production by age.
- Mensuration:** The study of the measurement of lengths, areas, volumes and related quantities. Forest mensuration is concerned with the measurement of trees, woodlands and forests, including standing and felled timber.
- Overbark:** Used as a qualification when the diameter or volume of wood includes the bark.
- Overdue:** Timber contained in stands that are beyond the felling age prescribed by the harvesting scenario at the start of the forecast.
- Phytophthora:** Fungus-like pathogens that can cause extensive damage and mortality to trees and other plants.
- Private sector estate:** Forests and woodlands in the UK not managed by the Forestry Commission or Forest Service. In the context of the National Forest Inventory, 'Private sector' is used for convenience although it includes land owned or managed by bodies such as local authorities and charities.
- Production forecast:** A forecast of softwood volume production based on a firm plan of harvesting.
- Restocking plan:** A spatial and temporal plan describing how felled areas are to be replanted or regenerated.
- Softwood:** The wood of coniferous trees or the conifers themselves.
- Stand:** A distinct area of woodland, generally composed of a uniform group of trees in terms of species composition and spatial distribution, and age and size class distribution.
- Standard error (SE):** The measure of the margin of error associated with an estimate as a result of sampling from a population

with statistical variability. Larger standard errors indicate less precision in the estimate. Standard errors in this report are quoted in relative terms (i.e. as percentages of the value of the estimate).

**Standing volume:** the live stemwood and useable branchwood of trees (up to 7 cm top diameter). It excludes roots, below ground stump material, small branches, foliage and deadwood. For Private sector woodland only, it also excludes standing volume in trees in woodlands of less than 0.5 hectares. Usually expressed as m<sup>3</sup> overbark standing (m<sup>3</sup> obs).

**Stemwood:** The woody material forming the above ground main growing shoot(s) of a tree or stand of trees. The stem includes all woody volume above ground with a diameter greater than 7 cm overbark. Stemwood includes wood in major branches where there is at least 3 m of 'straight' length to 7 cm top diameter.

**Sustainable forest management:** The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity and vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems.

**Terminal height:** The top height of a stand at which wind damage is expected to reach a level necessitating clearfelling.

**Thinning:** The periodic harvesting of trees in a woodland, involving the removal of some trees for commercial use and the retention of others for future production or long-term retention.

**Thinning plan:** A spatial and temporal plan of harvesting activities within a forest or woodland.

**Top diameter:** The diameter of the smaller (top) end of a length of stemwood, branchwood or log, often used to define different categories of wood products (e.g. sawlogs, roundwood, pulp) and merchantable timber.

**Top height:** The mean total height of the 100 largest dbh trees per hectare.

**UK (United Kingdom):** Great Britain and Northern Ireland.

**Windthrow:** Uprooting of trees by the wind. Windthrow can be endemic – i.e. that caused by frequently recurring peak winds – or catastrophic – an infrequent occurrence associated with exceptionally strong winds where large areas/numbers of trees are blown down.

**Woodland:** *see* Forest

**Yield class (YC):** An index used in the UK of the potential productivity of even-aged stands of trees based on maximum MAI. It reflects the potential productivity of the site for the tree species growing on it.



This Inventory Report is one of a series of publications reporting the outputs of the Forestry Commission National Forest Inventory. It forms part of the 25-year forecast of softwood availability series, which includes the following reports:

- Standing timber volume for coniferous trees in Britain (April 2012)
- 25-year forecast of softwood timber availability (July 2012)
- 25-year forecast of standing coniferous volume and increment
- 25-year forecast of coniferous carbon stocks
- 25-year forecast of coniferous biomass stocks

Supporting technical documentation for these reports is available in:

- National Forest Inventory survey methodology
- National Forest Inventory forecasts methodology overview
- Interpreting National Forest Inventory timber volume forecasts

The woodland map and areas derived from it can be found in:

- National Forest Inventory woodland area statistics (for Great Britain, England, Scotland and Wales).

Full details are available from [www.forestry.gov.uk/inventory](http://www.forestry.gov.uk/inventory).

The National Forest Inventory supports sustainable forest management in Great Britain. For more information see The UK Forestry Standard and its supporting Guidelines, available from [www.forestry.gov.uk/ukfs](http://www.forestry.gov.uk/ukfs).

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