25-year forecast of softwood timber availability (2016)

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 United Kingdom assuming certain harvesting scenarios are followed. It includes estimates for England, Scotland, Wales and Northern Ireland, broken down by Forestry Commission/Natural Resources Wales/Forest Service (FC/NRW/FS)[*] and Private sector ownership. The findings of the report are summarised in **Figure 1**.

Figure 1 25-year forecast of softwood timber availability for FC/NRW/FS and Private sector estates in the UK
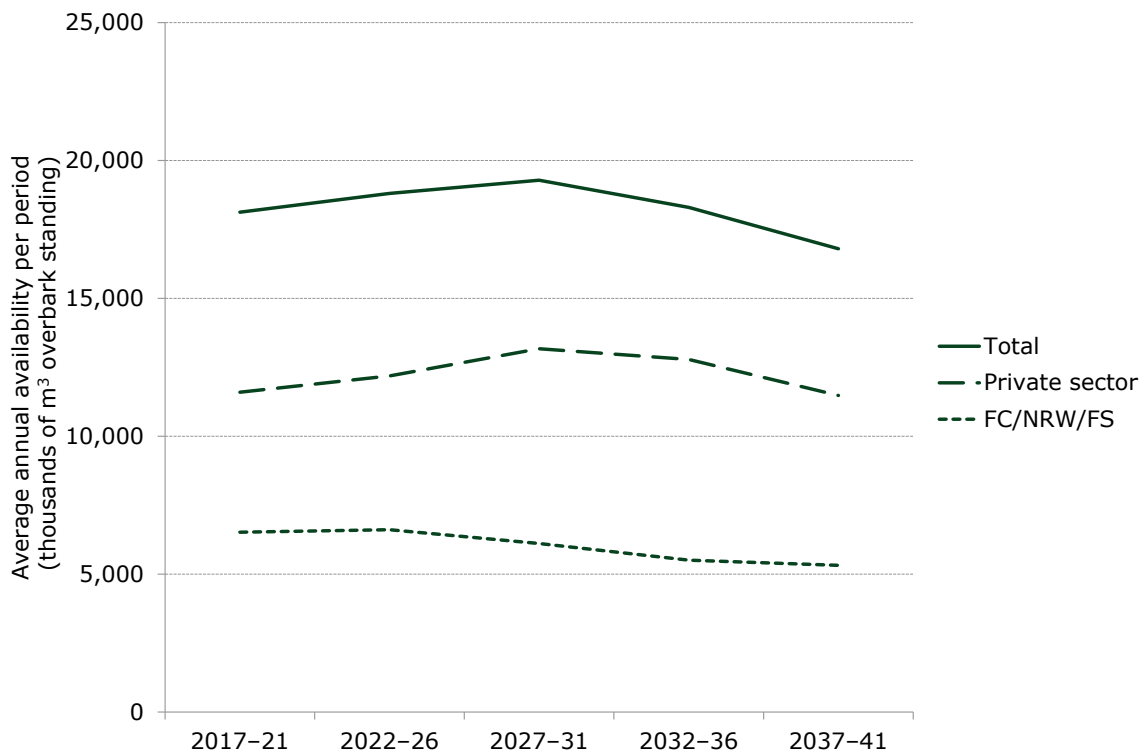
This report supersedes the previous *25-year forecast of softwood timber availability* published in 2012. Some comparison is made between the two reports. Reference is also made to the *50-year forecast of softwood timber availability* (2014) report.

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[*] (Collectively referred to as the public sector in this report)

NFI Interim Report

Key findings:

- The forecast of softwood availability for the UK forest estate is an average of 18.3 million m^3 of softwood timber per annum over the 25-year period. The forecast for England is an average of 4.1 million m^3 per annum; for Scotland 11.9 million m^3; for Wales 1.8 million m^3; and for Northern Ireland 0.5 million m^3.
- Softwood availability changes over the period of the forecast; it increases from 18.1 million m^3 per annum in 2017–21 to 19.3 million m^3 per annum in 2027–31 before reducing to 16.8 million m^3 per annum in 2037–41.
- The profiles for the FC/NRW/FS estate and Private sector estate are different. Over the forecast period, the FC/NRW/FS estate shows an overall reduction in forecast availability while the Private sector estate shows an overall increase. The Private sector increase runs for the first half of the forecast period and is followed by a decline in the second half of the period, with annual availability in the last period (2037–41) returning to a level similar to the 2017–21 period.
- The FC/NRW estate is projected to generate an average of 5.5 million m^3 per annum for the next 25 years, if existing forest management plans are followed and production is not constrained. In the first five-year period (2017–21) 6.0 million m^3 per annum would be potentially available and this will reduce to an average of 4.8 million m^3 per annum in the final five-year period (2037–41). In addition, availability from the FS estate is forecast to average 0.5 million m^3 per annum over the same 25 years. However, it should be noted that the published intention in Scotland is to constrain production and this will reduce availability overall.
- The potential availability of softwood timber from the Private sector estate for the UK is forecast to average 12.2 million m^3 per annum for the next 25 years. This assumes a management scenario of maximising timber productivity. The forecast for England is an average is 2.9 million m^3 per annum; for Scotland 8.4 million m^3 per annum; for Wales 0.9 million m^3 per annum; and for Northern Ireland 0.034 million m^3 per annum. Potential availability amounts to 11.6 million m^3 per annum in the first five-year period, with maximum annual availability of 13.2 million m^3 per annum occurring in the period 2027–31.

The Private sector forecast in this report represents potential availability of softwood timber under the assumption of harvesting to maximise timber production. 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 and owners are unlikely to consistently choose to maximise production over the forecast period.

Contents

NFI Interim Report

Figures

Tables

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 (NFI), which began in 2010, is a multipurpose operation that has involved the production of a forest and woodland map for Britain and a continuing programme of field surveys (the first cycle of field surveys completed in late 2015) of the mapped forest and woodland areas.

Information and data collected by the National Forest Inventory is being 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 NFI.

This report sets out the results of the 25-year forecast of softwood availability for all forests and woodlands in the United Kingdom (UK). For the public sector in the United Kingdom this comprises the Forestry Commission in England and Scotland, Natural Resources Wales and the Forest Service of Northern Ireland, an agency within the Department of Agriculture and Rural Development (DARD) in Northern Ireland. The Private sector covers all other woodland ownerships in the UK.

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

It should be noted that this report assesses the potential amount of timber that could arise from British forests, and any references to volume, production or availability must be taken in that context.

A forecast of hardwood availability was published in 2014. Further information on this and other NFI outputs is available from the NFI web pages.

Forecast of softwood availability

This report provides the latest overall softwood timber availability forecasts, giving a breakdown of forecast volume by size class and by country.

The forecasts of softwood availability for Britain are based on the FC/NRW's Sub-compartment database for public sector woodland and on the National Forest Inventory assessment of the current state of woodland in the Private sector. Recent estimates of standing timber volume and other attributes of coniferous stands in Britain can be found in the published NFI report *Standing timber volume for coniferous trees in Britain* (2012) which was updated in 2013. The forecast of softwood availability for Northern Ireland is derived from other sources.

The previous 25-year forecast of softwood availability in the UK was published in the NFI report entitled *25-year forecast of softwood timber availability* (2012).

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 derived separately: a forecast for the Forestry Commission/Natural Resources Wales estate (referred to as the FC/NRW estate) in Britain (that part of the NRW estate which was formerly Forestry Commission Wales retains a common methodology with England and Scotland); a forecast for the Private sector estate in Britain; a forecast for the Forest Service (FS) estate in Northern Ireland; and a forecast for the Private sector estate in Northern Ireland. The forecasts are based upon the same principles but use different data sources.

For the FC/NRW 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 in Britain, the estimates were derived from results obtained to date from the National Forest Inventory. The same principles were used in the Northern Ireland forecast with the data source for the FS estate being the

Northern Ireland inventory database. For the Private sector in Northern Ireland the forecast was derived from historical establishment and management grant data and the Northern Ireland woodland map.

The *National Forest Inventory forecasts methodology overview* (2012) and the technical documentation on *Felling and removals forecasts* (2012) give more information on the approaches used to derive the forecasts (see the NFI web pages).

Sub-compartment database

The Sub-compartment database is a record of all land managed by the Forestry Commission and Natural Resources Wales. Each stand of trees is represented spatially, together with information on individual stand characteristics (e.g. 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 planned to be managed – in particular, the planned frequency and type of thinning and a date for felling. These prescriptions are recorded in the FC/NRW forest design plans. Forest design plans are prepared and maintained by FC/NRW staff throughout Britain. These plans form the basis of the harvesting regimes used to derive the estimates for the FC/NRW forecasts.

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 of over 0.5 hectare with a width of 20 metres and a minimum of 20% canopy cover (or the potential to achieve it), including new planting, clearfelled sites and restocked sites. It is based upon interpretation of 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 2014), 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 wind farms or the restoration of habitats.

Field survey work was then used to refine the map-based estimates of woodland and clearfelled areas and to measure detailed aspects of the forest. Field surveys carried out between 2010 and 2013 were used to estimate standing volume (and other forest metrics). This involved the ground surveying of 1 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 in the NFI web pages.

Estimates for the FC/NRW estate

Information from the Sub-compartment database was used to estimate standing volume and other attributes of stands at the reference date of 31 March 2015 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 the state of the stand at the reference date. 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. These data formed the basis of the volume forecasts.

Forestry Commission growth and yield models were then used to 'grow' the stands, based upon 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 FC/NRW forest management plans, which set prescriptions for harvesting across productive forest area on the FC/NRW 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 stands were then restocked according to country-level prescriptions (details on restocking can be found in the section on assumptions used in the forecast). The FC/NRW 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 in Britain

Forests on the National Forest Inventory woodland map were first separated into FC/NRW estate and Private sector estate holdings using Forestry Commission spatial records of management boundaries as at 31 March 2015. Estimates of softwood availability on the Private sector estate used a woodland area obtained from the map

updated to 31 March 2014 (published in May 2015). This map contained a slightly larger area (around 2.3 million hectares) of Private sector woodland than was used in the 2012 forecast. 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.

In the course of the field survey work some 9,594 sample squares were surveyed of which 7,192 were located in Private sector woodland and the resulting data have been used to produce the results in this report. These surveyed sample squares are a sub-sample of a planned 15,000 statistically representative squares covering all woodland in Britain that has been surveyed during the first cycle of the National Forest Inventory field surveys (completed in late 2015).

At each sample square, the area was stratified into forest and non-forest and the forested area was further 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 different forest stands, resulting in 27,490 stands being assessed. Within each stand, field-based computer systems were used to locate two or three randomly located 100 m^2 (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 366,000 trees were measured. For 105,000 of these trees, additional measurements of tree height and crown dimensions were taken for yield class assessment and for other purposes. The resulting data were used to estimate the standing volume of the trees that provided the initial values of timber present in the stand from which forecasts of future timber availability were projected. 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 7% were re-measured in the field by an independent quality assurance team to ensure consistency and high standards of data quality.

The inventory data for the Private sector estate was then run against the headline scenario described in the *50-year forecast of softwood timber availability* (2014). 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);
- to take account of thinning and wind constraints with stands being thinned unless they are assessed with a DAMS (Detailed Aspect Methodology Score) score of 16 or greater in which case they are treated as no thin and a top height at clearfell of 25 m is applied;

- to harvest a proportion of overdue stands (i.e. stands that have exceeded the prescribed age for felling according to the scenario), where overdue stands are handled according to overdue timber allocation option 1 described in Table D2 in the *50-year forecast of softwood timber availability* (2014);
- to restock stands which are currently felled and to restock any stands felled within the forecast period according to the country-level restocking options described in Tables D3 England, D4 Scotland and D5 Wales in the *50-year forecast of softwood timber availability* (2014)[*].

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.

This report concentrates on the headline scenario. Alternative harvesting scenarios and their impact on timber availability are explored in the 2014 publication *50-year forecast of softwood timber availability*.

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. 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.

There are four classes of error or uncertainty that are not accounted for or contained in the quoted sampling standard errors:

1. Errors in standing volume estimates arising from random variation about, and systematic bias in, the empirical models used to estimate standing volumes from mensuration data. It is not thought that this will contribute a large source of additional error.

2. Random variation about, and biases in, the growth and yield models used to project the future growth of stands. It is known that biases exist in these models, some of which have recently been quantified, and both these biases and annual random variation about the growth model projections will contribute accumulating errors in the longer term forecasts such that errors contributed by these sources will eventually become a larger source of error than sampling error.

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[*] In a 25-year time-frame the restocking has only a very limited effect on production in the last period

3. The forecasts are conditional upon future conditions of growth being equal to those experienced in the past. The quoted sampling standard errors do not therefore take account of any major sudden events that significantly impact upon the tree stock, such as meteorological conditions of a type not experienced in the past, or of more gradual deviation from past conditions, such as the possible accumulating impact of climate change. These sources of error will impact more heavily on forecasts further into the future rather than on short-term forecasts.

4. It is important to also note that in the statement above that the forecasts are 'conditional upon the underlying assumptions'. This means in effect that it is assumed that every stand is managed in the future exactly as prescribed by the future management scenario being analysed. In practice there will be considerable uncertainty and variation in the future management of forest stands. This is a major source of future uncertainty and therefore another major source of error in longer term forecasts.

Incorporation of these unaccounted sources of error in future forecasts would require a different forecasting model that is beyond current capacity to implement. The effect would be that the magnitude of standard errors fully accounting for all sources of variation in the forecasts would be close to the sampling standard errors for short-term forecasts, but would then continuously expand for forecasts further into the future. However, the advantage of the semi-deterministic forecasts used in this report are that the comparative effects of alternative management scenarios on future production and state of the woodland resource can be easily identified, even if the forecast values themselves are subject to increasing uncertainty the further they project into the future.

Estimates for the Forest Service estate in Northern Ireland

In Northern Ireland, production forecasting within the DARD Forest Service estate is based on an ongoing programme of forest stand inventory measurement combined with aspects of wider forest management planning requirements. This information, as well as informing softwood availability forecasts, is also required to verify sustainable forest management and is used to form the basis of forestry asset valuations for accounting purposes. The policy for sustainable forest management is delivered as a duty under the Forestry Act (2010) and is assessed for compliance with *The UK Forestry Standard* by independent audit against the UK Woodland Assurance Standard.

During the spring and autumn of 2015, 399 inventory plots were re-measured to assess volume production and yield class.

Estimates for the Private sector estate in Northern Ireland

The Private sector forecast of softwood availability is based upon historical DARD Forest Service establishment and management grant data and on data taken from the Northern Ireland woodland base map which has been compiled using a range of GIS datasets from statutory and non-statutory bodies.

To estimate Private sector softwood availability, management models were developed by DARD Forest Service for conifer stands and components with assumed rotation lengths, thinning interventions and intensities, clearfell recoveries and re-establishment objectives.

Removals from Private sector woodland are monitored in Northern Ireland and reported annually in the Forestry Commission's *Forestry Statistics*.

Assumptions used in the forecast

Ownership

Forests and woodlands are harvested differently under different ownership types. Given that forecasts are largely based on the assumptions made about harvesting prescriptions, the rate of change of ownership is important. In the *25-year forecast of softwood timber availability* (2012) assumptions were made about changes in future forest ownership and thus how stands would be harvested over the forecast period. For simplicity, this current forecast assumes that there will be no future transfer of ownership.

Restocking

The restocking that is applied in this current forecast to both FC/NRW and Private sector woodlands in Britain builds on the approach that was adopted for the *50-year forecast of softwood timber availability* (2014), moving away from the scenario that replaced felled stands with exactly the same crop in the subsequent rotation, and restocking in a way that better reflects current practices. These scenarios were developed in liaison with the Private forest sector. For conifer stands, this includes conifer species diversification and the introduction of 5% open space and 5% broadleaved species. These restocked stands are managed according to a biological potential prescription where in areas considered to be at high risk from wind damage, as determined by a DAMS score of 16 or more, a strategy of no thinning – and felling conditional upon attainment of a top height (25 m and higher) – was assumed. The impact of restocking on production volumes is minimal during the forecast period, as these stands will mostly only produce timber volume after the forecast period. However, a very small volume will arise in relation to some early

thinning from stands of higher yield class late in the forecast period. These are included in the volumes presented, but they only have material contribution to harvested volumes from the period 2037–41 and this is small. This restock scenario is only one possible scenario out of many for restocking and was formulated in liaison with forest industry representatives. The National Forest Inventory has provided a range of modelled restocking and new planting scenarios to explore the impacts of these assumptions in the 50-year forecast report and the report *Evaluation of alternative harvesting and afforestation scenarios on British softwood timber availability* (2015).

Currently clearfelled areas

In the previous 25-year forecast it was assumed that forest area that was already clearfelled as of 31 March 2011 was not included in the forecast. It was acknowledged within the report that not including some level of replanting in these areas would create a small underestimate of future production which in most 25-year forecast results would be marginally evident in the later years of the forecast. The current forecast assumes that all clearfelled areas are restocked, both within FC/NRW and the Private sector, applying the restocking assumptions as described above in the section on restocking.

To estimate area of clearfell for the FC/NRW 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 (**Table 1**) and area of clearfell (**Table 7**).

Overdue timber

Overdue timber is timber contained within stands that, at the start of the forecast period, are already over the age prescribed for felling according to the management scenario used for a forecast. In the *25-year forecast of softwood timber availability* (2012) overdue timber was set aside from the main forecast volume. In the 50-year forecast a separate prescription for overdue timber was developed and implemented and this was run as part of the main scenario. This approach was applied in the 2016 forecast. For example, if the biological potential scenario is used, those stands less than age of maximum MAI will be managed according to that biological potential scenario, but for those stands currently beyond maximum MAI a separate prescription was used. The proposed prescriptions were developed in consultation with the Private sector, allocating around 70% of overdue timber over approximately 20 years. The prescriptions take into account tree species, presence and impact of current tree diseases, age of stand in relation to age of maximum MAI and historical market trends in harvesting. For a full description of the overdue prescription applied see Table D2 in the *50-year forecast of softwood timber availability* (2014).

All areas felled as overdue were restocked in the forecast according to the restock scenario, in common with any other stand felled during the forecast period. This approach will not materially affect the forecast timber volumes as the replacement stands will not mature within the forecast period.

The fact that 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 to either maximum MAI or shorter rotations. This is especially so in the Private sector and 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 differently from the assumed prescription, these, and some other stands that are currently below the age of maximum MAI, are also not likely to be managed to maximum MAI in the future. This forecast assumes they are, but the *Evaluation of alternative harvesting and afforestation scenarios on British softwood timber availability* (2015) report explores the impact of a proportion of all stands, irrespective of current age, becoming overdue.

For more information about the inventory methodology, see the *National Forest Inventory forecasts methodology overview* (2012).

Results

The forecast are projected from the stocked area and standing volume of conifers summarised in **Tables 1** and **2**, respectively.

Table 3 gives the 25-year forecast of softwood timber availability for the UK, GB and each country, broken down by FC/NRW/FS estate and Private sector estate. **Figure 2** illustrates the 25-year forecast broken down by country, ownership and five-year period. **Table 4** gives the forecast of softwood timber availability broken down by country, ownership, size class and five-year period. **Table 5** 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 tables supplied with the *25-year forecast of softwood timber availability* (2012).

The baseline date for these FC and NRW forecasts is 31 March 2015. The forecast starts in 2016, with 2016 defined as starting on 1 April 2015 and ending on 31 March 2016. This convention applies to all forecast years or periods quoted. As the forecast reports on five-year cycles of production, the first single year of 2016 has not been reported resulting in 2017–21 being the first period of production reported on.

NFI Interim Report

For the Private sector in Britain a baseline of 2013 has been used, which reflects the time period over which the field samples were surveyed. To create an even baseline between public and Private sector data, harvesting management scenarios were applied retrospectively to the data between 2013 and 2016. The opening areas and volumes reported in **Tables 1** and **2** are for 2016, the opening year of the published forecast. In the years between 2013 and 2016 the application of the harvesting management scenario has resulted in an estimated 38.9 million m^3 being removed with a corresponding increment of 38.6 million m^3 resulting in a small reduction in standing volume over these years. However, as the forecast has managed the growing stock from the baseline dates for both FC/NRW and Private sector the figures quoted are only as accurate as the presumption that the scenarios applied reflect actual management.

All volumes are given in cubic metres (m^3) overbark standing (obs) and, as in previous forecasts, all volumes available for harvesting include thinnings and fellings. Volumes are presented as average annual volume for each five-year period. The values in the tables have been independently rounded, so may not add to the totals shown. In some breakdowns of Private sector estimates, the estimates in the body of the table may not sum to the quoted total because each individual value, including the total, has been independently generated by the estimation procedure used for results from the NFI sample survey. Sampling standard errors (SE) attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

Table 1 Stocked area of conifers at 31 March 2016

Country	FC/NRW/FS area (000 ha)	Private sector area (000 ha)	SE%	Total area (000 ha)
England	130.3	179.9	*2*	**310.2**
Scotland	362.7	526.4	*1*	**889.1**
Wales	81.9	47.2	*3*	**129.1**
Great Britain	**575.0**	**753.4**	*1*	**1,328.4**
Northern Ireland	49.5	6.1		**55.6**
United Kingdom	**624.5**	**759.5**		**1,384.0**

NFI Interim Report

Table 2 Standing volume of conifers at 31 March 2016

Country	FC/NRW/FS volume (000 m³ obs)	Private sector volume (000 m³ obs)	SE%	Total volume (000 m³ obs)
England	25,328	60,646	3	**85,974**
Scotland	78,909	152,346	2	**231,255**
Wales	19,345	16,933	6	**36,278**
Great Britain	**123,582**	**229,926**	*1*	353,508
Northern Ireland	12,100	1,372		**13,472**
United Kingdom	**135,682**	**231,298**		**366,980**

Table 3 25-year forecast of softwood availability; average annual volumes within periods

Forecast period	FC/NRW/FS volume (000m³ obs)	Private sector volume (000m³ obs)	SE%	Total volume (000m³ obs)
England				
2017–21	1,263	3,284	5	**4,547**
2022–26	1,200	3,001	5	**4,201**
2027–31	1,169	3,130	5	**4,299**
2032–36	1,018	2,943	6	**3,960**
2037–41	1,006	2,323	6	**3,329**
Scotland				
2017–21	3,744	7,291	5	**11,036**
2022–26	3,796	8,096	5	**11,892**
2027–31	3,627	9,212	5	**12,838**
2032–36	3,183	9,045	5	**12,228**
2037–41	2,966	8,422	5	**11,388**
Wales				
2017–21	1,007	1,002	14	**2,009**
2022–26	1,091	1,064	15	**2,155**
2027–31	839	790	15	**1,629**
2032–36	927	752	15	**1,679**
2037–41	843	700	15	**1,543**
Great Britain				
2017–21	6,014	11,577	4	**17,592**
2022–26	6,087	12,162	4	**18,249**
2027–31	5,635	13,131	4	**18,766**
2032–36	5,128	12,740	4	**17,868**
2037–41	4,815	11,446	4	**16,260**
Northern Ireland				
2017–21	508	22		**530**
2022–26	527	25		**552**
2027–31	474	44		**518**
2032–36	383	45		**428**
2037–41	503	34		**537**
United Kingdom				
2017–21	6,522	11,599		**18,122**
2022–26	6,614	12,187		**18,801**
2027–31	6,109	13,175		**19,284**
2032–36	5,511	12,785		**18,296**
2037–41	5,318	11,480		**16,797**

Figure 2 25-year forecast of softwood timber availability for FC/NRW/FS and Private sector estates in the UK by country

Table 4 Breakdown of the softwood forecast volume (000 m³ obs) by country, top diameter class and forecast period

England

Top diameter class (cm)	2017–21 FC (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 FC (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 FC (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 FC (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 FC (000 m³)	2037–41 Private sector (000 m³)	SE%
7–14	248	261	4	219	225	6	179	202	6	155	194	6	154	254	8
14–16	99	126	5	93	108	7	84	97	6	71	88	7	64	86	11
16–18	102	161	5	96	139	7	92	120	7	79	108	8	70	98	11
18–24	298	671	5	282	624	6	282	559	6	254	519	8	233	420	9
24–34	297	1,062	6	286	1,010	6	291	1,029	6	259	1,005	7	258	722	8
34–44	121	508	7	119	472	6	124	549	7	103	524	7	109	369	7
44–54	57	234	8	56	215	8	57	274	7	46	246	7	51	176	8
54+	42	260	12	49	208	10	61	300	10	51	259	9	66	197	9
Total	**1,263**	**3,284**	**5**	**1,200**	**3,001**	**5**	**1,169**	**3,130**	**5**	**1,018**	**2,943**	**6**	**1,006**	**2,323**	**6**

Scotland

Top diameter class (cm)	2017–21 FC (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 FC (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 FC (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 FC (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 FC (000 m³)	2037–41 Private sector (000 m³)	SE%
7–14	812	1,075	4	718	1,033	4	648	1,078	5	506	1,039	4	555	1,021	5
14–16	372	488	5	343	494	5	312	539	5	251	507	5	239	476	5
16–18	397	561	5	378	616	5	348	667	5	288	629	5	261	557	5
18–24	1,119	1,889	6	1,137	2,363	6	1,087	2,640	6	952	2,523	5	817	2,120	5
24–34	788	1,996	7	888	2,484	7	882	2,936	6	841	2,964	6	763	2,707	6
34–44	184	720	8	230	705	9	236	856	7	230	885	7	222	960	7
44–54	52	287	10	69	228	12	74	285	9	74	283	9	72	332	10
54+	21	274	17	32	173	20	40	210	14	39	215	12	39	250	14
Total	**3,744**	**7,291**	**5**	**3,796**	**8,096**	**5**	**3,627**	**9,212**	**5**	**3,183**	**9,045**	**5**	**2,966**	**8,422**	**5**

Wales

Top diameter class (cm)	2017–21 NRW (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 NRW (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 NRW (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 NRW (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 NRW (000 m³)	2037–41 Private sector (000 m³)	SE%
7–14	180	101	12	173	91	11	128	88	17	131	91	14	155	106	13
14–16	80	45	14	80	41	13	60	44	19	64	46	17	64	42	17
16–18	87	55	15	89	51	14	69	51	19	77	57	17	71	47	19
18–24	265	232	16	286	237	17	226	180	18	279	220	18	237	167	19
24–34	251	344	17	290	379	17	221	232	19	251	227	17	213	175	17
34–44	87	137	19	104	155	22	79	103	20	71	66	16	58	71	25
44–54	35	53	25	42	65	30	34	47	25	29	23	23	23	34	31
54+	23	35	33	27	45	46	23	44	29	25	22	34	21	57	54
Total	**1,007**	**1,002**	**14**	**1,091**	**1,064**	**15**	**839**	**790**	**15**	**927**	**752**	**15**	**843**	**700**	**15**

Great Britain

Top diameter class (cm)	2017–21 FC/NRW (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 FC/NRW (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 FC/NRW (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 FC/NRW (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 FC/NRW (000 m³)	2037–41 Private sector (000 m³)	SE%
7–14	1,239	1,438	3	1,111	1,349	3	955	1,368	4	792	1,324	4	864	1,381	4
14–16	552	659	4	515	644	4	455	680	4	386	641	4	367	604	5
16–18	586	777	4	563	807	4	508	838	4	444	794	4	402	703	5
18–24	1,682	2,792	4	1,705	3,225	5	1,595	3,380	5	1,486	3,261	4	1,287	2,707	5
24–34	1,336	3,402	5	1,464	3,872	5	1,394	4,197	5	1,351	4,196	5	1,234	3,604	5
34–44	392	1,365	5	453	1,331	6	439	1,508	5	404	1,475	5	389	1,400	5
44–54	143	573	6	167	508	7	166	606	6	150	552	6	145	543	7
54+	85	568	10	108	426	11	123	554	8	115	496	7	125	504	10
Total	**6,014**	**11,577**	**4**	**6,087**	**12,162**	**4**	**5,635**	**13,131**	**4**	**5,128**	**12,740**	**4**	**4,815**	**11,446**	**4**

Table 4 (cont'd) Breakdown of the softwood forecast volume (000 m³ obs) by country, top diameter class and forecast period

Top diameter class (cm)	2017–21 FS (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 FS (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 FS (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 FS (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 FS (000 m³)	2037–41 Private sector (000 m³)	SE%
Northern Ireland															
7–14	85	3		66	3		60	6		42	6		49	5	
14–16	49	2		39	2		34	3		24	3		29	2	
16–18	65	2		55	2		48	4		32	4		42	3	
18–24	226	9		220	10		196	17		147	18		200	14	
24–34	68	6		133	7		115	11		117	12		158	9	
34–44	8	1		8	1		10	1		10	1		14	1	
44–54	4	0		4	0		6	0		6	0		9	0	
54+	3	0		3	0		4	0		4	0		3	0	
Total	**508**	**22**		**527**	**25**		**474**	**44**		**383**	**45**		**503**	**34**	

Top diameter class (cm)	2017–21 FC/NRW /FS (000 m³)	2017–21 Private sector (000 m³)	SE%	2022–26 FC/NRW /FS (000 m³)	2022–26 Private sector (000 m³)	SE%	2027–31 FC/NRW /FS (000 m³)	2027–31 Private sector (000 m³)	SE%	2032–36 FC/NRW /FS (000 m³)	2032–36 Private sector (000 m³)	SE%	2037–41 FC/NRW /FS (000 m³)	2037–41 Private sector (000 m³)	SE%
United Kingdom															
7–14	1,324	1,441		1,177	1,352		1,015	1,374		834	1,330		913	1,386	
14–16	601	661		554	646		489	683		410	644		396	606	
16–18	651	779		618	809		556	842		476	798		444	706	
18–24	1,908	2,801		1,925	3,235		1,791	3,397		1,633	3,279		1,487	2,721	
24–34	1,404	3,408		1,597	3,879		1,509	4,208		1,468	4,208		1,392	3,613	
34–44	400	1,366		461	1,332		449	1,509		414	1,476		403	1,401	
44–54	147	573		171	508		172	606		156	552		154	543	
54+	88	568		111	426		127	554		119	496		128	504	
Total	**6,522**	**11,599**		**6,614**	**12,187**		**6,109**	**13,175**		**5,511**	**12,785**		**5,318**	**11,480**	

Table 5 Breakdown of the softwood forecast volume by percentage spruce for country, top diameter class and forecast period

England		Top diameter class (cm) 7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	FC (%)	55	62	63	59	44	31	26	21	**50**
	PS (%)	33	33	33	33	33	30	28	28	**32**
2022–26	FC (%)	61	65	64	57	39	28	24	20	**49**
	PS (%)	45	46	45	43	37	31	27	22	**37**
2027–31	FC (%)	65	69	68	62	45	33	29	23	**52**
	PS (%)	43	44	45	42	37	33	30	26	**36**
2032–36	FC (%)	63	66	63	55	40	32	29	22	**48**
	PS (%)	49	52	50	48	42	35	31	20	**40**
2037–41	FC (%)	61	66	63	54	39	32	31	24	**47**
	PS (%)	42	51	50	43	31	25	22	18	**33**

Scotland		Top diameter class (cm) 7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	FC (%)	70	75	77	80	82	80	73	68	**77**
	PS (%)	74	75	75	73	68	59	52	33	**68**
2022–26	FC (%)	72	76	78	81	82	80	75	66	**78**
	PS (%)	77	79	81	82	78	69	60	46	**77**
2027–31	FC (%)	70	75	77	81	82	81	77	70	**78**
	PS (%)	76	80	81	82	80	70	57	36	**78**
2032–36	FC (%)	72	77	79	81	83	81	78	70	**79**
	PS (%)	69	73	74	75	72	62	48	32	**70**
2037–41	FC (%)	75	79	80	82	83	80	76	67	**80**
	PS (%)	63	67	68	71	71	64	51	36	**67**

Table 5 (cont'd) Breakdown of the softwood forecast volume by percentage spruce for country, top diameter class and forecast period

Wales		Top diameter class (cm)								
		7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	NRW (%)	72	74	74	74	75	75	75	71	**74**
	PS (%)	63	67	70	71	65	55	47	49	**64**
2022–26	NRW (%)	70	71	72	73	73	73	73	65	**72**
	PS (%)	71	70	71	71	66	53	42	14	**62**
2027–31	NRW (%)	71	74	75	78	78	76	75	63	**76**
	PS (%)	78	80	79	75	64	50	39	39	**65**
2032–36	NRW (%)	74	78	80	83	83	77	73	59	**80**
	PS (%)	70	77	78	78	75	67	58	48	**73**
2037–41	NRW (%)	68	72	73	77	81	76	73	59	**75**
	PS (%)	58	66	68	70	74	80	84	88	**72**

Great Britain		Top diameter class (cm)								
		7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	FC/NRW (%)	67	72	74	75	72	64	55	46	**71**
	PS (%)	66	66	66	64	57	48	42	31	**58**
2022–26	FC/NRW (%)	70	74	75	75	72	65	57	45	**71**
	PS (%)	71	73	74	73	66	53	44	31	**66**
2027–31	FC/NRW (%)	69	73	75	77	74	67	60	46	**73**
	PS (%)	71	75	76	75	68	55	44	31	**67**
2032–36	FC/NRW (%)	71	75	76	77	74	68	62	46	**73**
	PS (%)	66	70	71	71	65	52	41	26	**63**
2037–41	FC/NRW (%)	71	75	76	76	74	66	59	43	**72**
	PS (%)	59	65	66	67	63	54	44	34	**60**

Northern Ireland		Top diameter class (cm)								
		7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	FS (%)	86	89	90	95	88	67	86	70	**91**
	PS (%)	7	4	5	18	9	1	<1	<1	**12**
2022–26	FS (%)	85	87	89	96	95	73	88	83	**92**
	PS (%)	6	3	4	8	11	1	<1	<1	**12**
2027–31	FS (%)	83	86	87	94	95	79	90	84	**91**
	PS (%)	5	2	3	14	10	1	<1	<1	**9**
2032–36	FS (%)	77	78	85	92	96	86	94	88	**90**
	PS (%)	4	2	3	12	8	1	<1	<1	**8**
2037–41	FS (%)	82	83	86	91	96	89	90	78	**91**
	PS (%)	3	2	2	10	8	1	<1	<1	**7**

United Kingdom		Top diameter class (cm)								
		7–14	14–16	16–18	18–24	24–34	34–44	44–54	54+	Total
2017–21	FC/NRW/FS (%)	69	73	75	78	73	64	56	47	**72**
	PS (%)	66	66	65	63	57	48	42	31	**57**
2022–26	FC/NRW/FS (%)	71	75	76	78	74	65	58	46	**73**
	PS (%)	71	73	74	73	66	53	44	31	**66**
2027–31	FC/NRW/FS (%)	70	74	76	79	75	67	61	47	**74**
	PS (%)	71	75	76	75	68	55	44	31	**67**
2032–36	FC/NRW/FS (%)	71	75	77	78	76	68	63	48	**74**
	PS (%)	66	70	71	71	65	52	41	27	**63**
2037–41	FC/NRW/FS (%)	72	76	77	78	76	67	61	44	**74**
	PS (%)	58	65	66	66	63	54	44	34	**60**

Table 6 gives a breakdown of the amount of overdue timber by ownership and country for Britain arising from the headline harvesting scenario. A proportion of this volume was assumed to have been available for harvesting and has been included in the main forecast of timber availability according to the prescriptions of overdue set out in Table D2 of the *50-year forecast of softwood timber availability* (2014). Volumes of overdue timber were not included in the 2012 forecast.

To bring the base year of the Private sector field data (2013) to the same as that of the public sector data (2015) the headline harvesting scenario of biological potential was applied individually to stands contained in the 2013 data, growing and managing each stand from its assessment date through to 2015. This assumed that a proportion of the overdue timber was harvested in this preliminary period through to the base year of the forecast (2015). This will have adjusted the overdue volume, standing volume and clearfell area at the start of the forecast period.

Table 7 gives estimates of clearfelled areas. For the Forestry Commission, the area of clearfell is taken from the Sub-compartment database as at 31 March 2015. For the Private sector, the NFI fieldwork records clearfelled areas and these areas are combined with the areas of clearfell identified in the NFI map based on satellite imagery to provide the estimates shown in **Table 7**. Currently clearfelled areas are assumed to be restocked within this forecast and contribute marginally to future production. Clearfelled areas were not included in the 2012 forecast.

Table 6 Overdue timber at 31 March 2015 for FC/NRW, 31 March 2013 for PS

All conifers	FC/NRW	Private sector		FC/NRW	Private sector	
	volume (000 m^3 obs)		SE%	area (000 ha)		SE%
England	1,406	19,738	2	3.9	35.6	5
Scotland	887	25,484	8	2.9	45.1	7
Wales	1,122	4,419	17	2.5	6.9	16
Great Britain	**3,394**	**49,641**	**5**	**9.2**	**87.6**	**4**

Table 7 Clearfelled area at 31 March 2015 for FC/NRW, 31 March 2013 for PS

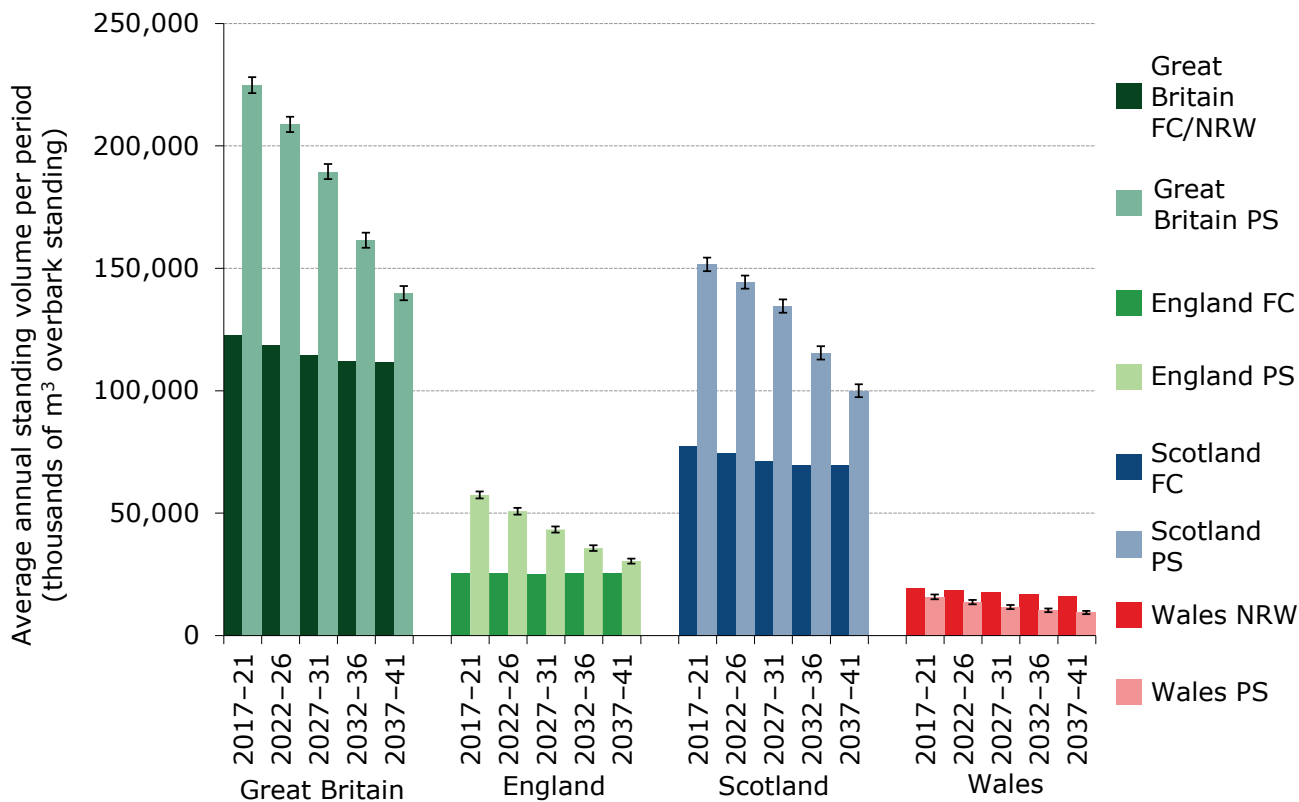| All conifers	FC/NRW	Private sector		Total
	area (000 ha)	area (000 ha)	SE%	area (000 ha)
England	8.8	9.7	10	18.5
Scotland	39.0	41.4	5	80.4
Wales	6.5	3.2	18	9.7
Great Britain	**54.4**	**54.3**	**5**	**108.7**

Table 8 and Figure 3 show the evolution of standing volume and Table 9 and Figure 4 show the net increment under the headline scenario used to derive the forecast results. Figures 5a and 5b show the relationship between forecast standing volume, increment (i.e. gain in volume over time) and subsequent timber availability over the forecast period. Further elaboration on the extent of clearfell can be obtained from *Preliminary estimates of canopy cover change in British woodlands* (in preparation).

Table 8 25-year forecast of coniferous standing volume; average annual volumes within periods

Forecast period	FC/NRW volume (000m³ obs)	Private sector volume (000m³ obs)	SE%	Total volume (000m³ obs)
England				
2017–21	25,477	57,423	2	**82,899**
2022–26	25,439	50,793	3	**76,232**
2027–31	25,265	43,311	3	**68,575**
2032–36	25,335	35,766	3	**61,101**
2037–41	25,725	30,441	3	**56,165**
Scotland				
2017–21	77,547	151,604	2	**229,151**
2022–26	74,615	144,363	2	**218,978**
2027–31	71,357	134,585	2	**205,942**
2032–36	69,655	115,460	2	**185,115**
2037–41	69,688	99,996	3	**169,684**
Wales				
2017–21	19,577	15,818	6	**35,396**
2022–26	18,531	13,675	7	**32,207**
2027–31	17,956	11,637	7	**29,593**
2032–36	17,112	10,269	7	**27,382**
2037–41	16,182	9,416	7	**25,598**
Great Britain				
2017–21	122,600	224,846	1	**347,446**
2022–26	118,586	208,831	2	**327,417**
2027–31	114,578	189,533	2	**304,111**
2032–36	112,103	161,495	2	**273,598**
2037–41	111,595	139,852	2	**251,447**

Figure 3 25-year forecast of average annual coniferous standing volume
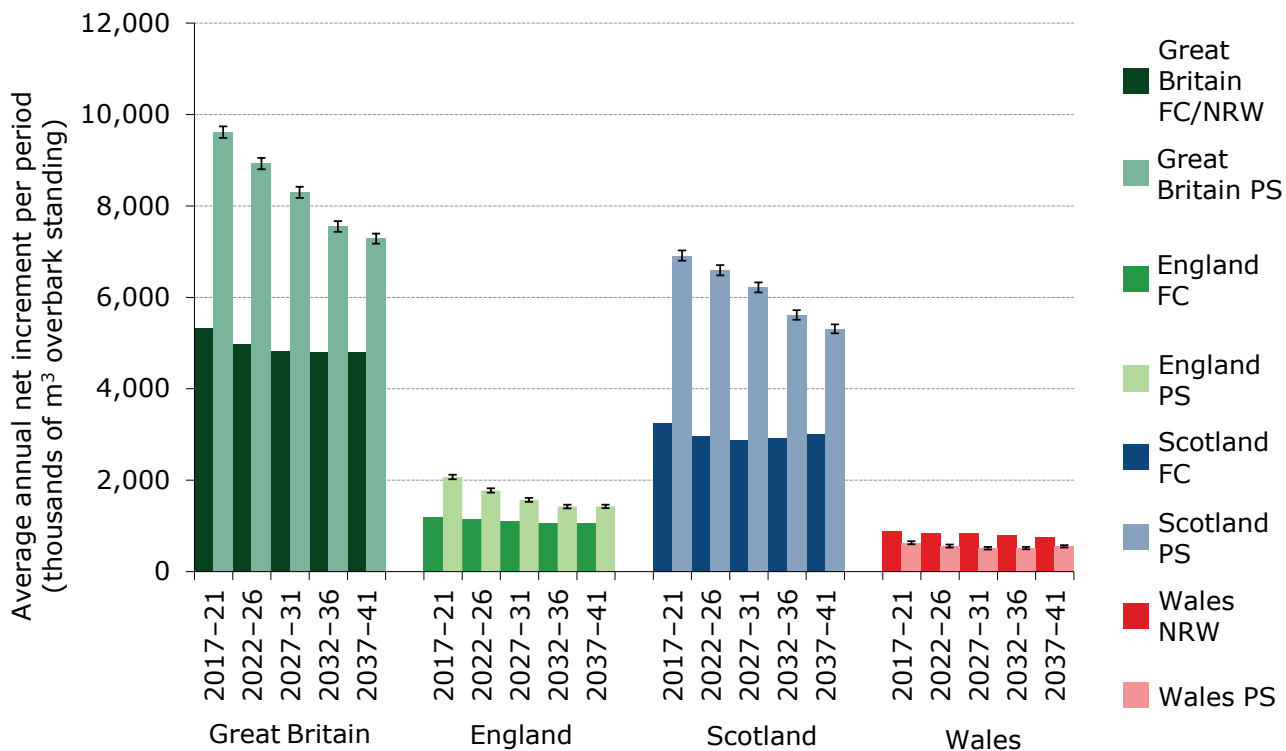
Table 9 25-year forecast of coniferous net increment; average annual volumes within periods

Forecast period	FC/NRW volume (000m³ obs)	Private sector volume (000m³ obs)	SE%	Total volume (000m³ obs)
England				
2017–21	1,187	2,069	2	**3,255**
2022–26	1,157	1,775	3	**2,932**
2027–31	1,104	1,570	3	**2,674**
2032–36	1,065	1,424	3	**2,489**
2037–41	1,055	1,425	3	**2,480**
Scotland				
2017–21	3,250	6,915	2	**10,164**
2022–26	2,970	6,595	2	**9,565**
2027–31	2,888	6,220	2	**9,107**
2032–36	2,927	5,613	2	**8,540**
2037–41	3,001	5,311	2	**8,312**
Wales				
2017–21	893	632	5	**1,525**
2022–26	852	558	6	**1,410**
2027–31	835	511	5	**1,346**
2032–36	806	515	5	**1,321**
2037–41	753	552	5	**1,305**
Great Britain				
2017–21	5,329	9,615	1	**14,944**
2022–26	4,979	8,928	1	**13,907**
2027–31	4,827	8,300	1	**13,127**
2032–36	4,798	7,551	2	**12,349**
2037–41	4,809	7,287	2	**12,096**

Figure 4 25-year forecast of average annual coniferous net increment

Figure 5a 25-year summary of softwood standing volume, increment and availability by country – FC/NRW
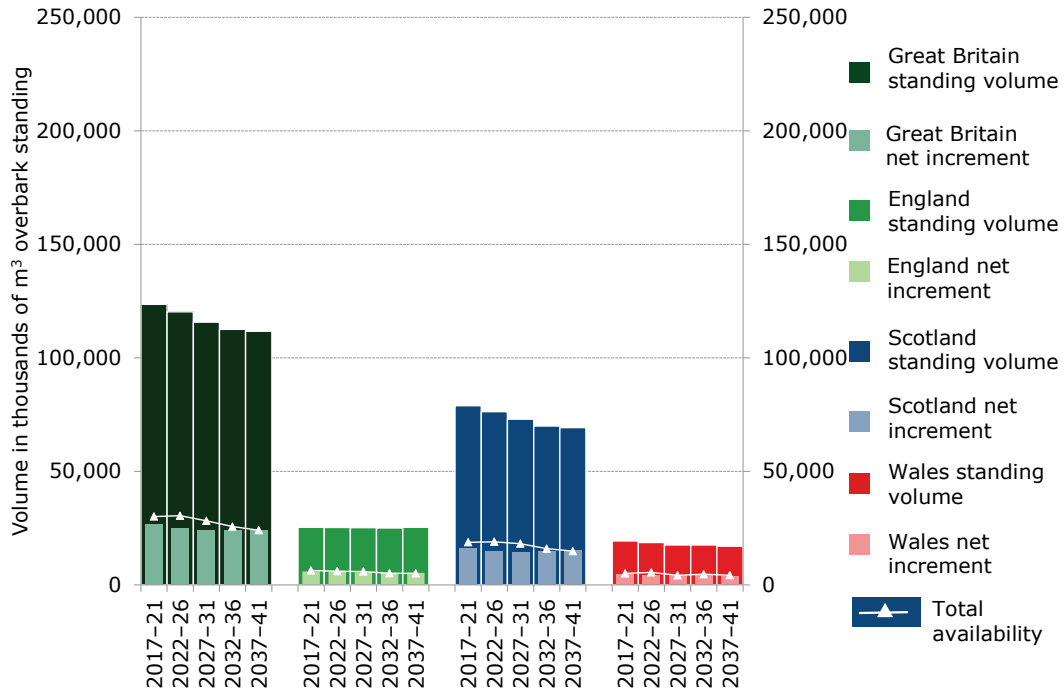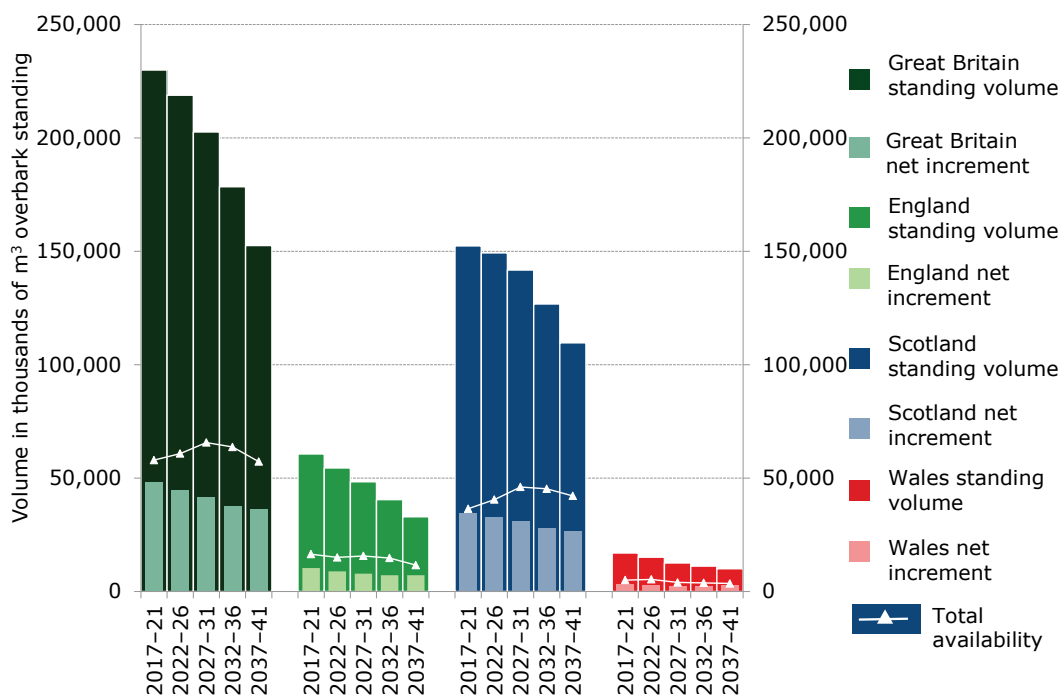

Figure 5b 25-year summary of softwood standing volume, increment and availability by country – Private sector

What the results tell us

The general trend in softwood availability is comparable to that of previous forecasts in that volume levels rise to a maximum and then begin to decline to a level lower than the starting point (**Figure 1**). However, overall available volume has increased due to actual harvesting levels being lower than the biological potential harvesting assumed in previous forecasts. This leads to an accumulation of overdue timber within forests and woodlands. This overdue timber was reported separately to the availability in the previous *25-year forecast of softwood timber availability* (2012) and in this forecast a proportion of the volume has been allocated as available, on the assumption that some will be available for harvest. Between the two forecasts (2012 and 2016) the amount of overdue has increased, again due to harvest levels being lower than the biological potential assumed in the earlier forecasts. Different trends are forecast for the FC/NRW/FS and Private sector estates with the former showing a gradual decline through the period of the current forecast, while the latter rises to a maximum in the middle of the forecast period and subsequently declines. The trend in total availability across both sectors is driven by the trend in Private sector availability.

Overdue timber

There was estimated to be 49.6 million m^3 of overdue timber on the Private sector estate as of 31 March 2013. This estimate was based upon field data of an average collection date of 2013. This is an increase in overdue volume in the Private sector compared to the 2012 assessment of 41.8 million m^3. The increase is due to increment in existing overdue timber combined with more stands reaching and passing maximum MAI without being harvested. To bring the base year of the Private sector field data (2013) to the same as that of the public sector data (2015) the headline harvesting scenario of biological potential was applied individually to stands contained in the 2013 data, growing and managing each stand from its assessment date through to 2015. This assumed that a proportion of the overdue timber was harvested in this preliminary period through to the base year of the forecast (2015). Thus the forecast assumes that a proportion of the overdue volume has already been harvested prior to the first forecast period of 2017–21. The 25-year forecast for the Private sector then continues to assume that a proportion of the remaining overdue volume is harvested over 20 years using the procedure described in the 50-year forecast Table D2 and thus a proportion of the overdue volume is included in the estimates of softwood availability (**Table 3**). These assumptions increase the available volume compared to the 2012 forecast, which reported the then 41.8 million m^3 overdue volume separately. Whether this overdue timber is harvested 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

Restocking of stands during the forecast makes only a very small difference to the estimated timber availability. 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 not to any significant degree. This is illustrated in Figure 10 of the *50-year forecast of softwood timber availability* (2014). The report *Interpreting National Forest Inventory timber volume forecasts* (2012) 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 Britain (at 31 March 2016) is around 354 million m^3. As the harvesting scenarios of this forecast are applied, total standing volume moves to an average annual figure of around 347 million m^3 for the first period of the forecast (2017–21). By the last period of the forecast (2037–41) the average annual standing volume has decreased to 251 million m^3. This reduction arises as forecast removals exceed forecast increment. Average annual net increment is around 14.9 million m^3 for the first period (2017–21) and for the remaining periods ranges between 12.1 and 13.9 million m^3 per annum. The forecast average annual cut for the 25-year forecast period is 17.7 million m^3, and thus it can be concluded that increment is currently forecast to be less than potential harvest within Britain and this is the cause of the reduction. However, this relationship is contingent on the assumed harvesting scenario having been applied. The relationship between the projections of harvest, increment and standing volume is illustrated in **Figures 5a** and **5b**.

There is an increase in the standing volume between the 2012 and 2016 forecasts which reflects net growth in the intervening period. A large determinant in the forecast for total standing volume in Britain is the age class structure of woodlands (**Figure 6**). The development of a planted forest resource within Britain has led to an uneven planting and age profile which, in combination with historical felling and the assumption to fell at the time prescribed in the management scenario applied, is the principal determinant of current and forecast standing volume. This is in contrast with forests of a more evenly distributed age in other countries, 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 forecast is a limited outlook on the evolution of standing volume, confined to the period of the next 25 years, which represents 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.

Figure 6 All conifers – area by age class and ownership for GB
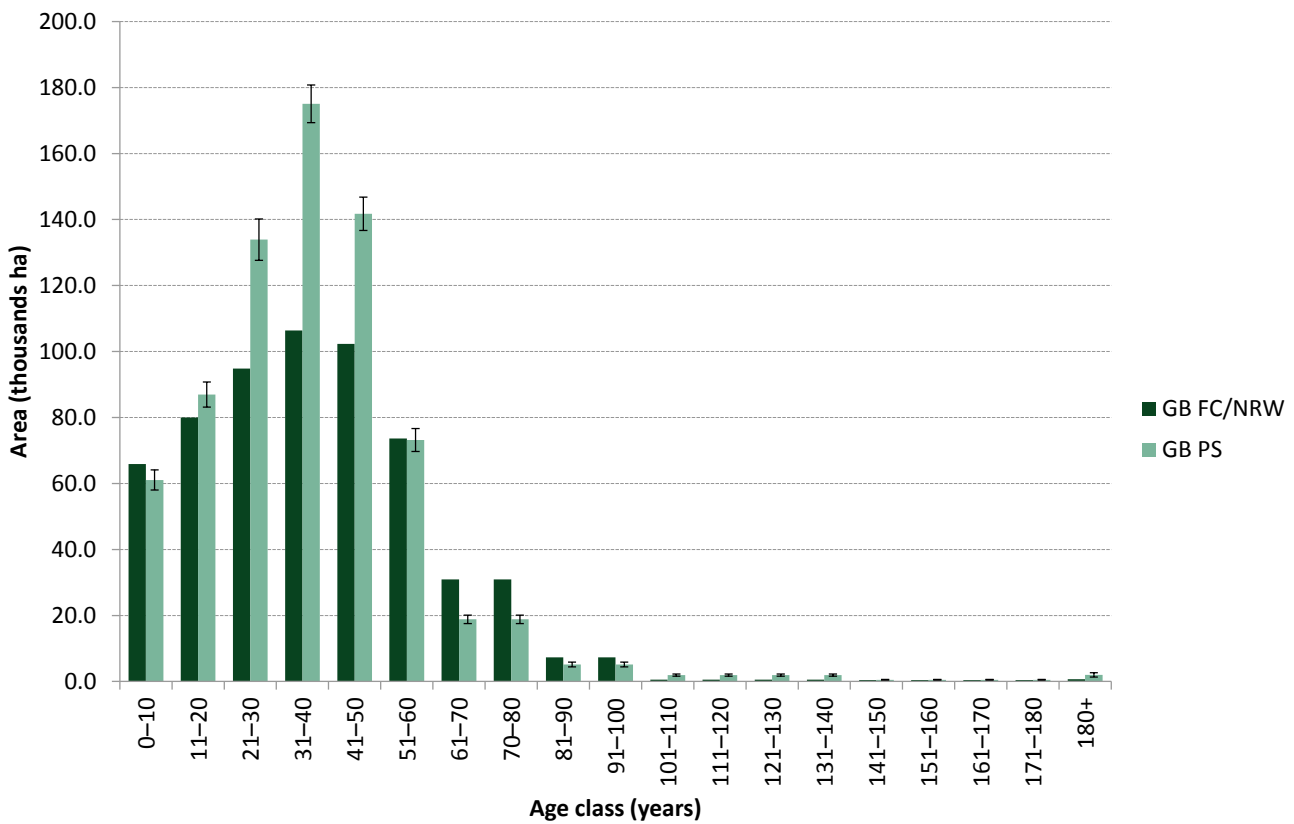
The reports *Standing timber volume for coniferous trees in Britain* (2012), *25-year forecast of standing coniferous volume and increment* (2012) and *Interpreting National Forest Inventory timber volume forecasts* (2012) cover this subject in more detail.

Species and composition of timber available

The proportion of spruce contributing to total timber volume is projected to rise from 63 to 69%, and then to decrease to 65% by the end of the forecast. This is almost unchanged from the 2012 forecast.

NFI Interim Report

The timber size assortments in **Table 5** show a relatively high proportion of larger diameter classes, but this relies on the assumption of owners harvesting and thinning to 'management table'. Other scenarios would produce different assortments and if lower levels of thinning were applied, this would produce a different profile of assortments with more smaller diameter material. The Northern Ireland Private sector data shows a relatively low proportion of spruce.

Impact of future events

The impact of future harvesting events on production levels in the Private sector has been explored through the use of scenarios in previous forecast reports. Clearly if owners choose to fell later or earlier than assumed in the forecast scenario, actual production will vary from that forecast. As owners have a wide range of objectives, it is unlikely that the majority of forests and woodlands will be managed to the headline biological potential scenario assumed 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, as evidenced by the NFI field work. However, there are other drivers contributing to the profile of the forecast, factors which are more fixed than harvesting decisions, such as the age of trees and their rate of growth. These fixed factors are not something that can be changed in the current crop without felling since the age of the trees and rate of growth will tend to determine an underlying profile of actual production. If future harvesting actions reflect in any way the pattern of the maturity of the crop then a profile of production similar to this forecast and its harvesting assumptions, which do reflect the underlying age and growth pattern will evolve. Superimposed upon this underlying pattern of age and rate of growth, actual harvesting activity might be expected to follow a variety of patterns at any one time over the next 25 years, reflecting the different and evolving management objectives of woodland owners. Taking all these factors into account, the timing of actual production is expected to vary from the forecast results, but a level of correlation between actual and forecast can be expected.

In addition to the impact of harvesting decisions, there are other unpredictable external factors that are likely to have an impact on 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 (habitat restoration and built developments) and changes in government policy (affecting for example grants and regulation, land sales and forest management) all have potential future impacts on production levels and timing.

Forecast for the FC/NRW/FS estate

The forecast set out in this report for the FC/NRW/FS estate is broadly comparable to the forecast reported in 2012 both in terms of total production and the shape and timing of the profile of production, which shows a gradual decline in production over the forecast period. This is because they have been derived in a similar way; the Sub-compartment database and Forest Service inventory estimates used in 2012 are consistent with those used in this forecast and felling and thinning rates have not changed significantly.

However, there has been an increase of between 4 and 11% in total volume over the first four periods of this forecast compared with the 2012 forecast. This reflects the evolution of management plans and policy within FC/NRW/FS in the intervening years. Drivers for this change include the accommodation of sanitation felling in response to *Phytophthora ramorum* and Dothistroma needle blight. Another element of change is sustainability policy, where the Forestry Commission is currently retaining more volume for longer periods, which will increase yield per hectare. This is being achieved through implementing longer rotations and a higher proportion of low-impact silvicultural systems.

There are a series of commitments by the FC, NRW and FS to meet most of the forecast volumes within the first five-year period (within a tolerance) and to offer most of the resulting harvested volume to market. However, these commitments vary across the countries (see below). Beyond 2021 the forecast indicates availability only, and although it is based upon existing forest management plans, these will change over time to reflect evolving country policies, such as the strategic production cap set by Forestry Commission Scotland.

- Forestry Commission England is committed to offer to market 1.2 million m^3 per annum (±5%) in the period 2017–21, through new and existing contracts. This offer sits with the caveats that this will be subject to responding to plant health issues and that there is an aim to constrain the total forecast volume by 20 thousand m^3 per annum to accommodate recently emergent environmental considerations. Dothistroma needle blight has the potential to affect the predicted levels of availability from pine in two ways; firstly, with short-term increases in production from sanitation felling and, secondly, there may be longer term impacts in which stands do not achieve the volumes estimated.
- Forestry Commission Scotland is committed to offer at least 3.2 million m^3 per annum (±5%) to market in the period 2017–21, 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.
- Natural Resources Wales is developing its marketing plan for the period 2017–21.

- DARD Forest Service intends to continue to bring timber to market at current levels in the period 2016–20.

When considering the volumes from 2022 onwards, it is worth noting that, historically, actual production for the Forestry Commission has been closely correlated to forecast production as shown in **Figure 7**. If this continues, production from this sector will form a comparatively stable element of the forecast. However, in Scotland plans are being gradually modified to align proposed timber production with the commitment to producing at least 3 million m^3 per annum (± 5%) and, until this exercise is complete (which will take 10 years), the forecast can only indicate availability rather than proposed production.

Figure 7 Actual production of softwood timber volume and forecast of softwood timber availability for GB
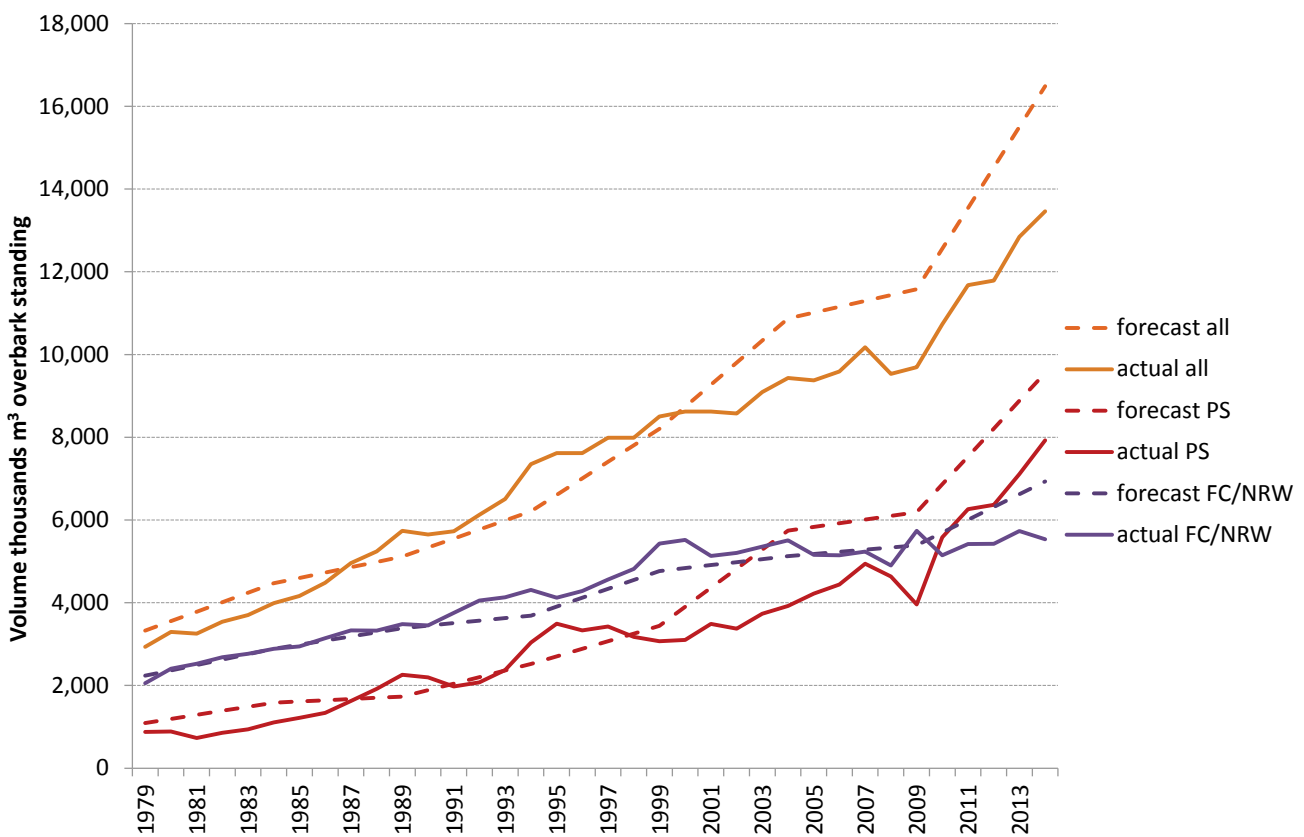
Notes:
- This is produced as a GB chart as the first forecast that covered all parts of the UK was the 2005 forecast *New forecast of softwood availability in the UK* (2006).

- Forecasts for past years have been compiled from a number of previous published softwood forecasts.
- Time series data for wood production and roundwood removals are available from Forestry Commission's *Forestry Statistics*.

Forecast for the Private sector estate

The forecast set out in this report for the Private sector estate is different from the headline forecast reported in the *25-year forecast of softwood timber availability* (2012), with an increase in potential softwood timber availability. The forecasts followed the same basic approach, but the 2012 forecast did not allocate any overdue volume. Assuming that a proportion of this volume is harvested over the period of the forecast has elevated the apparent availability. In addition, the 2016 forecast also includes restocking of areas felled along with those that were already felled at the start of the forecast. As previously mentioned, this restocking makes only a very small additional contribution to the overall availability over the 25-year forecast period.

Analysis of the data has shown that another difference between the two Private sector forecasts was due to actual production during the time between the forecasts being lower than that previously forecast, allowing more overdue timber to build up. A proportion of stands that were available and forecast to be harvested over the intervening five years since the last forecast are still standing and these will contribute to future availability. If stands that have reached maximum MAI or the height prescribed for felling remain unharvested in future, this will lead to a continuing trend of increasing amounts of overdue timber.

Other factors, such as changes made in the continuing development of the forecasting system, account for marginal differences between the forecasts.

Woodland and stocked area

The net change in woodland area between the forecasts is negligible, with a modest planting programme between 2012 and 2016. Stocked area has reduced in the period due to elevated harvesting rates which have exceeded restocking rates of coniferous trees.

Yield class

The yield classes applied in this forecast for the Private sector estate are slightly higher than those applied in the 2012 forecast (an average of 13.8 for all conifers in this forecast, see **Table 10**, compared with 13.2 in the 2012 forecast). The yield classes used in this report and the 2012 report were based on physical measurements which

were taken stand-by-stand, and the differences arise as the 2016 yield classes are based on a larger sample than in the 2012 forecast and are thus more accurate.

The mean yield class for the FC/NRW estate has risen from 12.7 in the 2012 forecast to 13.6 in the 2016 forecast. Both estimates were based on the Sub-compartment database estimates of yield class made at each stand. This change will reflect differential harvesting of lower yield class crops to higher yield class crops raising the mean in combination with recent survey better reflecting actual yield.

Table 10 Coniferous mean yield classes for GB

All conifers	FC/NRW	Private sector
	(m^3 ha^{-1} yr^{-1})	
England	14.5	13.0
Scotland	13.0	13.9
Wales	14.9	14.5
Great Britain	**13.6**	**13.8**

Note:
* The data in this table are for stands aged between 15 and 50 years old.

Harvesting activity

The modified biological potential scenario used in the 2012 forecast represented the volume of timber that would be produced if felling took place in the year of maximum MAI and thinning conformed to management table thinning except in high wind risk areas. The 2016 forecast used the same forecasting approach for most stands but differed in how overdue stands were treated in the forecast. In the 2016 forecast it is assumed that a proportion of overdue stands are harvested over the 20 years following the year when maximum MAI or prescribed top height is reached, while in the 2012 forecast, the overdue volumes were reported as a separate estimate. This is the factor that makes the single biggest difference in the two sets of forecasts, allocating approximately 30 million m^3 of overdue volume over the forecast period as available.

The second largest contribution to increased volume is the expansion of the amount of overdue volume which, due to actual rates of harvesting being lower between 2012 and 2016 than was forecast. This when combined with the increment of the existing overdue volume, results in 7 million m^3 additional overdue volume.

The report *Interpreting National Forest Inventory timber volume forecasts* (2012) discusses how approaches to harvesting influence and constrain the amount of timber that is likely to be harvested in any given period.

Standing volume

The projected estimate of standing volume for the period 2017–21 for the Private sector in Britain shows an increase of over 15% compared to the estimate from the 2012 forecast. This reflects growth in the trees, the treatment of overdue timber and the level of actual harvesting being lower than previously forecast in 2012.

Forecasts for Northern Ireland

Analysis of the data confirms the likelihood that, after 2030, timber availability in Northern Ireland will decline to around 75% of current levels. At the same time, the forests are being increasingly challenged by poor nutrition and disease, so that future forest growth may become harder to predict. An element of this decline can be countered by managing stand rotation lengths and thereby increasing the volume available for harvest from thinning and low-impact silvicultural systems.

DARD Forest Service intends to continue to bring timber to market at current levels in the period 2016–20. This programme provides a manageable income derived from current sales contract values and results in an affordable re-establishment obligation. It requires reasonable infrastructure maintenance to support and generates a competitive level of demand from the all-Ireland wood processing sector.

Targets for timber production figures will be set annually as a consequence of strategic objectives identified in and met through annual business plan targets.

Strategic objectives and future timber marketing are subject to successive government policies, priorities and approvals.

Conclusions

The general trend predicted by this forecast is comparable to that of previous forecasts in that volume levels rise to a peak in 2027–31 and then begin to decline to a level lower than the starting point. The forecast of softwood availability for the UK forest estate is an average of 18.3 million m^3 of softwood timber per annum over the 25-year period. The forecast for England is an average of 4.1 million m^3 per annum; for Scotland 11.9 million m^3; for Wales 1.8 million m^3; and for Northern Ireland 0.5 million m^3. This rise and fall profile 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 England forecast estimates production of softwood timber at a level consistently higher than the 2012 forecast for the 25-year forecast period, with a 7% increase in production over the first 20 years of the forecast. The volume of timber potentially available over the forecast period falls from 1.3 million m^3 in the first period (2017–21) to 1.0 million m^3 in the final period (2037–41). Around 50% of that timber is from spruce.

The Forestry Commission Scotland forecast estimates production of softwood timber at a level consistently higher than the 2012 forecast for the 25-year forecast period, with a 5% increase in production in the first period, and the following three periods showing an average rise of approximately 10%. The volume of timber potentially available over the forecast period falls from 3.8 million m^3 in the first period (2017–21) to 3.0 million m^3 in the final period (2037–41). Around 80% of that timber is from spruce.

Availability for Natural Resources Wales is just over 1 million m^3 for the first two periods of the forecast with an average production of 0.9 million m^3 for the following three periods. Around 75% of that timber is from spruce.

Production from the Northern Ireland Forest Service is approximately 0.5 million m^3 with the exception of the period 2032–36 which shows a decrease to 0.4 million m^3. Around 90% of that timber is from spruce.

For the Private sector, across the UK as a whole, the volume of timber potentially available over the forecast period rises from 11.6 million m^3 in the first period (2017–21) before peaking at 13.2 million m^3 in the third period (2027–31) then falling to 11.5 million m^3 in the final period (2037–41). Around 67% of that timber is from spruce. The peak in production for the Private sector occurs in 2027–31 as it did in the 2012 forecast with a slight increase in volume to 13.2 million m^3; as previously mentioned the first period is significantly higher than in the 2012 forecast due to the assumption of harvesting some of the overdue timber volumes.

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

1. Overdue timber – there was a 19% increase in the amount of overdue timber in the Private sector between the 2012 forecast and this assessment. This arose as actual cut was lower than forecast after 2012.
2. How this overdue timber has been treated within this forecast is different to the 2012 forecast, with the 2016 forecast assuming approximately 70% of overdue timber is available for harvest, while the 2012 forecast did not include production from overdue timber.

Both factors combined elevate forecast timber availability over the 25 years. If actual production continues to fall below availability, this trend will continue, with increasingly large areas and volumes of overdue timber accumulating within the overall forest estate and adding to potential availability.

The actual profile of timber production will be determined by actual harvesting rates. When, and if, timber is harvested will depend on a number of factors that determine the harvesting including the choices made over the coming decades by the Forestry Commission, Natural Resources Wales, the Northern Ireland Forest Service and Private sector woodland owners. For example, owners in the Private sector are unlikely to consistently manage their forests and woodlands to biological potential throughout the 25-year period as is assumed by this forecast. Their choices will respond to changing environmental, economic and policy drivers, underpinned by the principles of biological potential. Therefore actual Private sector production will vary from these estimates to a greater or lesser extent. In England, actual public sector production is less likely than the Private sector forecast to vary significantly from the forecast, as a larger proportion of its woodlands are under longer term policies and plans, and thus will more likely to continue to show a closer relationship between forecast and actual. However, in Scotland plans are being gradually modified to align proposed timber production with the commitment to producing at least 3 million m^3 per annum (± 5%) and, until that exercise is complete, the forecast can only show availability and not proposed production. Even with its systematic policy and planning processes in place, the public sector estate is still subject to the same environmental constraints and changes as the Private sector, and the impacts of these, together with possible changes to strategic policies and economic conditions, may cause harvesting strategies and plans to evolve and change over time.

When drawing conclusions from this report it should also be noted that this is a limited time-frame 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 time-frame were to be presented, a different perspective on potential production would be given.

For example, although availability compared to current production increases across the sector for the next 25 years, there is a trend of reduction in this availability from the period 2027–31 onwards to the end of the forecast in 2037–41. This trend continues beyond the forecast period until 2047–51, when availability is forecast to reach 11.9 million m^3, slightly below the peak of actual production in 2014. This low point precedes a long period of increasing timber availability which is forecast to run for approximately 30 years, resulting in another peak in availability of around 16 million m^3 in the period 2077–2082. These longer term trends are explored in the reports *50-year forecast of softwood timber availability* (2014) and *Evaluation of alternative harvesting and afforestation scenarios on British softwood timber availability* (2015). For example, the

scenarios explore how this dip in availability can be mitigated if modest new planting programmes or extensions to rotation length are followed.

Future work

The forecasts in this report have utilised the information from the 2015 Sub-compartment database, the 2014 woodland map and a sub-sample of the NFI field survey. This sub-sample comprises a total of approximately 10,000 samples of surveyed one hectare squares; future reports will utilise all the 15,000 samples surveyed in the first cycle of the NFI. In addition, forecasts of different restocking scenarios, based on the findings of the NFI second cycle, which will provide actual levels and types of restocking will be available in the coming years. Work is also being undertaken to explore how the underlying growth and yield models used in the forecast may be refreshed to more closely predict future timber yields, especially in improved stock and contemporary silvicultural situations. All such information is an essential part of planning for sustainable forest management.

Glossary

Actual production	Timber reported as having been 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 surveys of harvesting companies and 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 hectare) 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.
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 hectare 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.
Forest Service	An agency within the Department of Agriculture and Rural Development (DARD) in Northern Ireland responsible for the regulation of forestry and the management of state forests in Northern Ireland.
Forestry Commission	The government department responsible for regulating forestry, implementing forestry policy and managing state forests in England and Scotland. 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.
Forestry Commission (FC) estate	Forests, woodlands, open land and other property managed by the Forestry Commission.
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^3 per year or in m^3 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^3 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.
Natural Resources Wales (NRW)	Natural Resources Wales is the largest Welsh Government Sponsored Body - employing 1,900 staff across Wales with a budget of £180 million. NRW was formed in April 2013, largely taking over the functions of the Countryside Council for Wales, Forestry Commission Wales and the Environment Agency in Wales, as well as certain Welsh Government functions.
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, Natural Resources Wales 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 usable 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 trees in woodlands of less than 0.5 hectare. Usually expressed as m^3 overbark standing (m^3 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.

NFI national reports and papers

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 (2012)

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 the NFI web pages.

The National Forest Inventory supports sustainable forest management in Great Britain. For more information see The UK Forestry Standard and its supporting Guidelines.

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